



MODEL CODE OF SAFETY REGULATIONS FOR
INDUSTRIAL ESTABLISHMENTS FOR THE
GUIDANCE OF GOVERNMENTS AND INDUSTRY

AMENDMENTS, 1956

On the initiative of the I.L.O. Textiles Committee and of the Permanent International Committee for Acetylene, Fusion Welding and Allied Industries (C.P.I.), amendments to certain chapters of the Model Code dealing with subjects of interest to these Committees were proposed in 1955 by a panel of experts chosen from among the members of the I.L.O. Correspondence Committee on Occupational Safety and Health.

The Governing Body of the International Labour Office, at its 132nd Session (Geneva, June 1956), authorised the incorporation of these amendments in the Model Code. They will be found printed on the green paper.

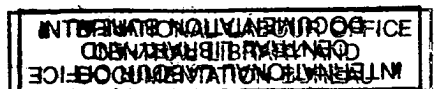
A table of the maximum allowable concentrations of certain dangerous substances recommended in 1956 by the American Conference of Governmental Industrial Hygienists is also reproduced (also on green paper). Like the corresponding table in the first edition of the Model Code (Appendix III), this table is intended to serve only as a guide.

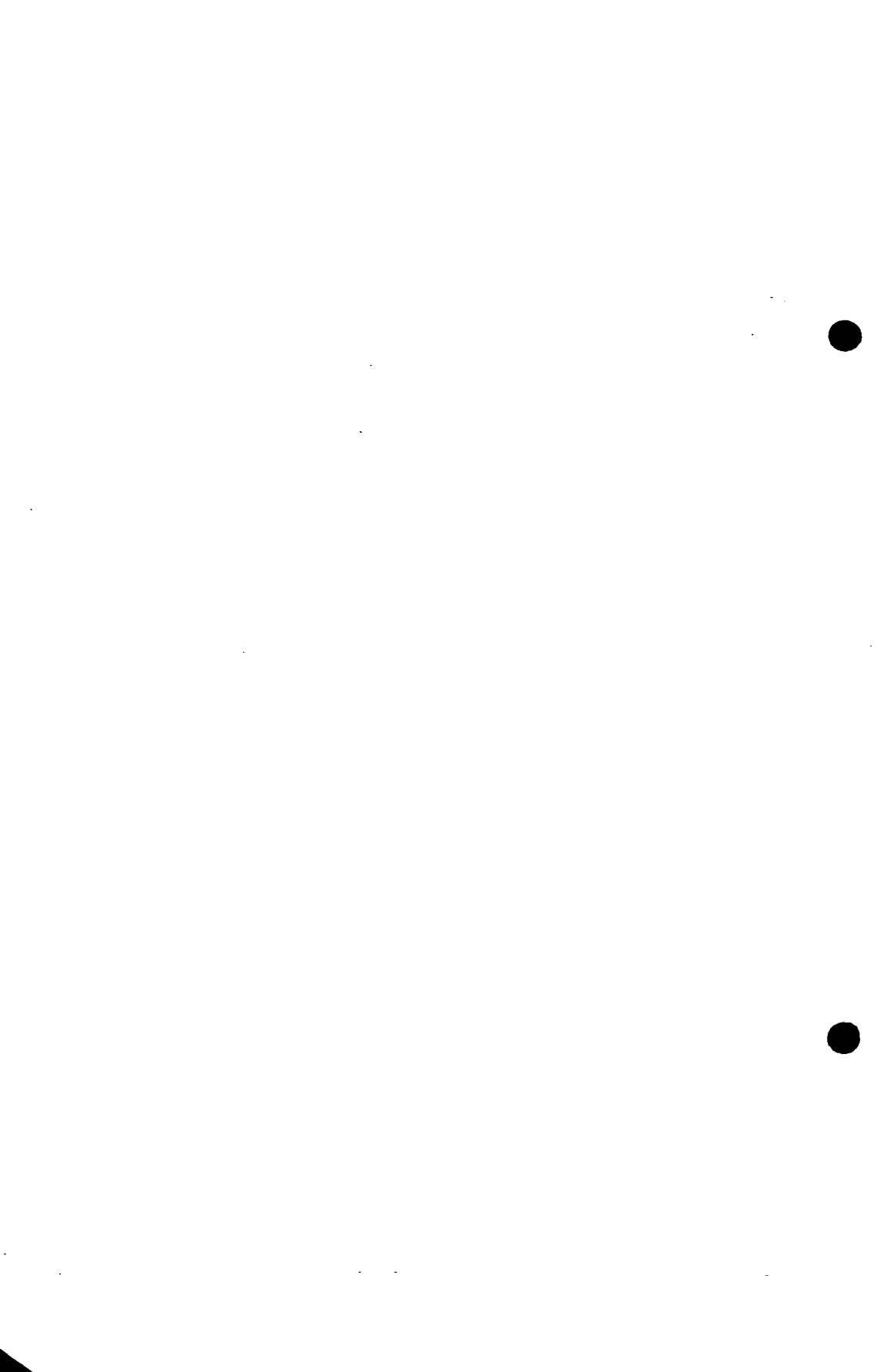
The amendments as printed are intended to be inserted in the code facing the appropriate pages.

As far as possible the amendments have been placed so as to fall opposite the articles affected. Where this has proved impossible (for instance, when new articles have been added and a number of others amended) the amended part has been reprinted in its entirety, and the original pages can, if desired, be replaced by the new ones. Similarly, Appendix III can be replaced by the new pages.

Certain paragraphs of the amended text are preceded by asterisks. This signifies that only the numbering has been modified, the text remaining as in the first edition.

A list of errata in the original edition of the Code is also included.





ERRATA

Page 14.

Regulation 15, paragraph 50. For "used mainly for" read *used exclusively for*; for "automatic control" read "automatic push-button control".

Page 15.

Regulation 15, paragraph 56. For "Off" read "Stop".

Page 20.

Regulation 17. For "during time of use" read "throughout the time when they may be used".

Page 23.

Regulation 24, paragraph 4. For "radiation and excessive temperature due to" read "heat radiation and excessive heat emitted by".

Page 105.

Regulation 100, paragraph 42 (b). For "ductor" read "doctor".

Page 122.

Regulation 101, paragraph 103 (b). For "it encloses" read "they enclose".

Page 123.

Regulation 101, paragraph 107. For "29 to 36" read "59 to 66".

Page 140.

Regulation 105, paragraph 19. At the end of subparagraph (a) add the word "or"; at the end of subparagraph (b) change the word "or" to "and".

Regulation 105, paragraph 21. Delete this paragraph (which is the same as paragraph 18) and renumber the remaining paragraphs of this Regulation accordingly.

Page 422.

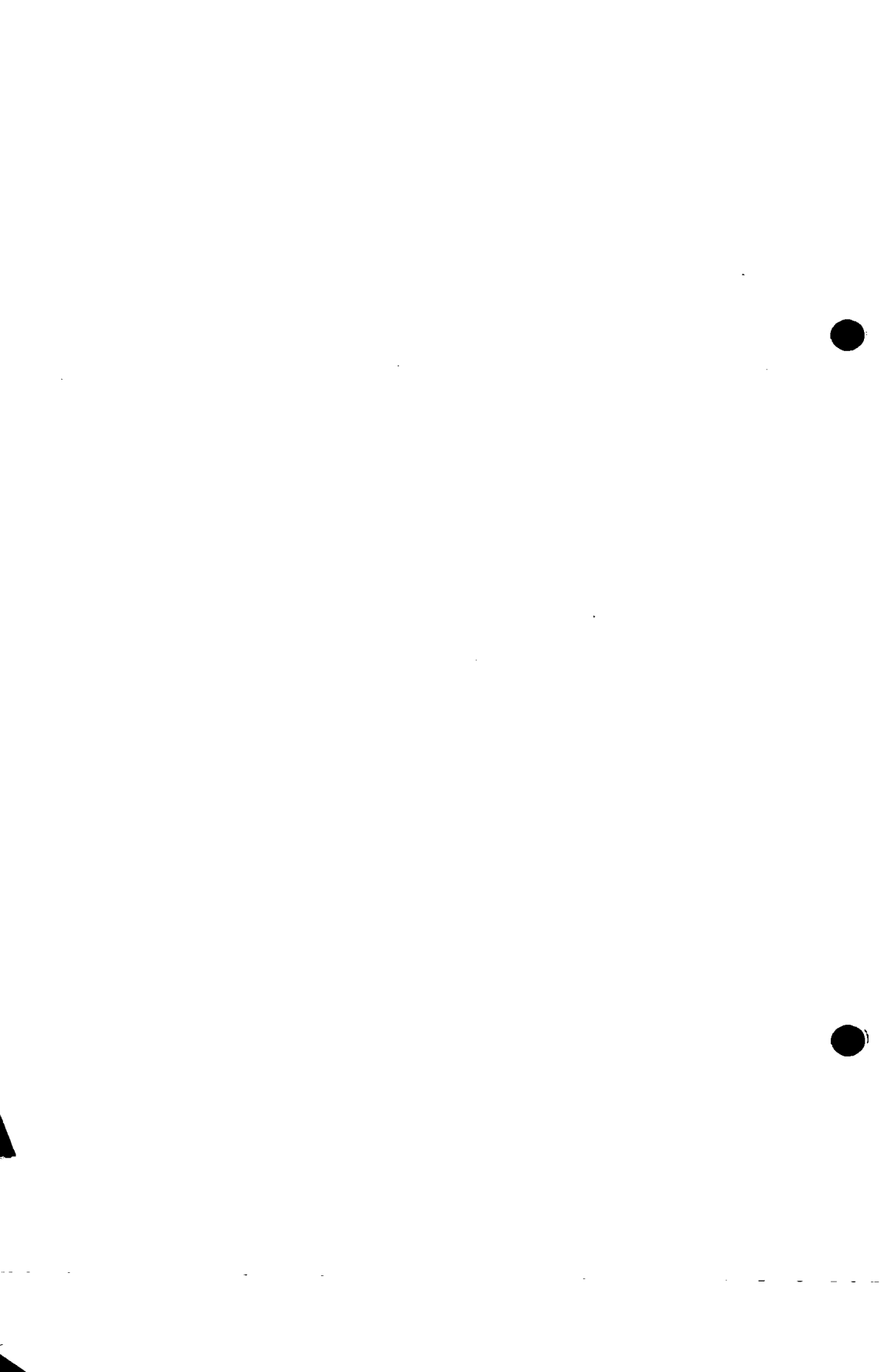
Regulation 217, paragraph 53 (1) (a). For "cloths" read "clothes".

Page 445.

Regulation 228, paragraph 15. For "arc welding, oxy-acetylene welding," read "arc welding and cutting, oxy-acetylene welding and cutting,".

Page 475.

Appendix II, caption of figure 6. For "5 mm." read "1.5 mm.".



INTERNATIONAL LABOUR OFFICE

**MODEL CODE
OF SAFETY REGULATIONS
FOR INDUSTRIAL ESTABLISHMENTS
FOR THE GUIDANCE OF
GOVERNMENTS AND INDUSTRY**

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INTRODUCTION

The *Model Code of Safety Regulations for Industrial Establishments for the Guidance of Governments and Industry*, based on a draft prepared by experts over a period of six years, was approved by a Tripartite Technical Conference held in Geneva in the autumn of 1948 in accordance with a decision of the Governing Body of the International Labour Office.

The Conference examined and approved the Code as a guide, with the exception of certain provisions relating to electrical equipment and toxic substances, and expressed the desire that provisions on dangerous radiations should be added. These three matters were referred by the Governing Body to Committees of Experts which met in the spring of 1949, and the relevant portions of the Code were put into final form by these Committees.

The Tripartite Technical Conference proposed that the text of the Code should be accompanied by an appendix consisting of photographs, drawings and explanations of safety installations, appliances and devices, and that this appendix should be regularly brought up to date. The appendix is in preparation and will be issued later as a separate volume.

In accordance with a decision taken by the Governing Body, the Code is now placed at the disposal of Governments and industries merely for guidance. It is not an instrument involving any binding obligations, and Governments and industries are free to make such use of it as they see fit in framing or in revising their own safety regulations.



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CHAPTER I

GENERAL PROVISIONS

REGULATION 1. PURPOSE AND SCOPE

1. The purpose of this Model Code is to contribute to the elimination of danger to life, and to secure the safety and health of workers in industrial establishments.

2. This Model Code constitutes a guide which Governments and industries shall benefit from to such an extent as they may desire when framing measures for the improvement of safety conditions in industrial establishments.

3. The provisions of this Model Code apply to construction, equipment and working conditions in industrial establishments.

4. With a view to securing some uniformity in basic safety measures, it is desirable that measures based on provisions of this Model Code should, as far as possible, be expressed in the wording of this Model Code.

REGULATION 2. DEFINITIONS

1. In this Code the following terms have the meanings hereby assigned to them:

- (a) the term "competent authority" means a Minister, Government department, or other public authority having powers to issue regulations, orders, decrees or other instructions having the force of law in respect of safety in industrial establishments;
- (b) the term "industrial establishment" means any industrial workplace, permanent or temporary, not being covered by a specific Model Code, including any building or collection of buildings, sheds, structures, yards, or other places where, either permanently or temporarily, one or more persons are employed at manufacturing or processing, including assembling, altering, repairing, finishing, bottling, canning, cleaning, laundering, printing, dyeing, sorting and packing any article or thing, in whole or in part, and also including warehousing, in so far as this is a part of the activity of an industrial establishment;

- (c) the term "employer" means the corporation, firm, partnership, stock association, agent, manager, or other authorised person having control or custody of employment in an industrial establishment or of any employee therein;
- (d) the term "employee" means any person rendering service to an employer for wages, salary, or other reward, and includes any apprentice or learner, whether paid or unpaid;
- (e) the term "safety factor for materials" or "factor of safety for materials" means the ratio between the stress which produces permanent deformation or rupture and the maximum normal working stress.

2. In order to indicate to users of the Code the provisions the application of which is considered of greatest importance, the word "shall" is used. In other cases the word "should" is used.

REGULATION 3. DETERMINATION OF SAFETY FACTORS

The safety factors specified in this Code shall be determined in each country on the basis of such specifications as may have been officially approved respecting the resistance of different materials and substances.

REGULATION 4. OBLIGATIONS OF EMPLOYERS

1. All employers who are legally responsible for the provision and maintenance of workplaces shall ensure that they are so constructed, equipped, arranged, operated and conducted as to afford reasonable and adequate protection to their employees against accident and injury to health.

2. All employers shall—

- (a) take steps to ensure that the workers are properly instructed concerning the hazards of their respective occupations and the precautions necessary to avoid accidents and injury to health; and
- (b) notify newly engaged workers of the hazards to which they might be exposed.

3. (1) Within one week before work is begun in any industrial establishment, the employer shall notify the competent authority of the commencement of the operation of the establishment.

(2) The notification shall contain a description of the work to be carried out in the establishment.

(3) Whenever the type of work carried out is changed the competent authority shall be duly notified of the change.

4. Notices indicating the obligations of the employer and the workers with respect to safety and health conditions shall be posted in workrooms in such a way that all the workers may be informed.

5. Distinctive visual signs shall be provided to indicate all points where danger may be encountered.

REGULATION 5. OBLIGATIONS OF EMPLOYEES

1. Every employee shall co-operate with the employer in carrying out the provisions of this Code.

2. Every employee shall forthwith report to the employer or the foreman any defect that he may discover in the industrial establishment or the appliances used therein.

3. Every employee shall make proper use of all safeguards, safety devices and other appliances furnished in accordance with this Code for his protection or the protection of others, and shall obey all safety instructions made or approved by the competent authority pertaining to his work.

4. No employee shall interfere with, remove, displace, damage or destroy any safety devices or other appliances furnished for his protection or the protection of others, or interfere with any method or process adopted with a view to minimising occupational hazards.

5. All employees shall comply, in regard to their conduct, with the requirements of this Code.

REGULATION 6. OBLIGATIONS OF OTHER PERSONS

1. The contractors, architects or individuals who build or renovate buildings to be used as working places, shall comply with the provisions of this Code.

2. The builders, manufacturers or vendors shall comply with the provisions of this Code concerning the protection of machines, apparatus and vessels, and the packing and marking of flammable, explosive or toxic substances.

CHAPTER II

PREMISES OF INDUSTRIAL ESTABLISHMENTS

Section 1. Buildings, Structures, Workplaces and Yards

REGULATION 7. FACTOR OF STRUCTURAL SAFETY

1. All buildings, permanent or temporary, shall be structurally safe and sound so as to prevent risk of collapse.

2. Roofs shall be of sufficient strength to withstand normal conditions of snow, ice, and wind, and where necessary, to carry suspended loads.

3. Foundations and floors shall be of sufficient strength to sustain safely the loads for which they are designed; and no foundation or floor shall be overloaded.

4. The factor of safety for structural steel with reference to the breaking load should be at least four for static loads and at least six for live or dynamic loads, and shall be correspondingly higher for other materials; provisions shall be made for a greater margin for abnormal situations.

5. In seismic zones, the safety factors shall be modified and adapted to the local conditions, especially as regards buildings, tanks and piping systems, in order to prevent or reduce to a minimum the dangers of collapse, explosion, etc.

REGULATION 8. CONSTRUCTION, ALTERATIONS AND REPAIRS

Plans for proposed new construction and for proposed alterations or substantial repairs of buildings shall be submitted to the competent authority for examination and approval.

REGULATION 9. SPACE REQUIREMENTS

1. Workrooms should be at least 3 m (9 ft. 10 in.) in height from floor to ceiling.

2. The maximum number of persons employed in a workroom should not exceed one person per 11.5 m³ (400 cu. ft.); in calculating the number of m³ (cu. ft.) no deduction should be made for benches or other furniture, machines or material, but height exceeding 3 m (9 ft. 10 in.) should be excluded.

REGULATION 10. CROWDING OF FLOOR SPACE

1. The floor space in any building shall not be crowded with machinery in a manner dangerous to employees, or be overcrowded with materials or products so as to constitute a menace to them.

2. Sufficient space shall be provided around the individual machines or process units to allow for normal operation, adjustments, and ordinary repairs, and for materials supplied, in process, or completed.

REGULATION 11. WALKWAY SURFACES*Stumbling Hazards*

1. The parts of floors over which any person is liable to walk shall be sufficiently even to afford safe walking and safe trucking of materials.

2. Such parts shall be free from holes and splinters, improperly fitted covers for gutters or conduits, and from protruding nails and bolts, projecting valves or pipes, or other projections or obstructions which might create stumbling hazards.

Slipping Hazards

3. Floors, stair-treads and landings shall not be slippery under any normal conditions, or made of any material which will become slippery through wear.

4. Stairways, ramps, elevator platforms and similar places where slipping may be especially hazardous, shall be provided with non-slip walkway surfaces.

REGULATION 12. FLOOR AND WALL OPENINGS*Ladderway Openings*

1. Ladderway floor openings shall be guarded on all exposed sides, except at the entrance to the opening, by permanent railings and toeboards; the passage through the railings shall be provided with a barrier or gate so arranged that a person cannot walk directly into the opening.

Stairway Openings

2. Stairway floor openings shall be guarded on all exposed sides, except at the entrance to the stairway, by permanent railings and toeboards.

3. For infrequently used stairways where traffic across the opening prevents the use of permanent railings, the guard shall consist of a flush-hinged floor-opening cover of adequate strength, equipped with railings attached thereto so as to leave only one side exposed when the cover is open. When the opening is not in use the cover shall be closed or the exposed side guarded.

Hatchway Openings

4. Hatchway, chute, pit, and trap-door floor openings shall be guarded by—

- (a) removable railings with toeboards on not more than two sides and permanent railings with toeboards on all other exposed sides; or
- (b) a flush-hinged cover as specified for stairway floor openings.

Manholes and Other Openings

5. Manhole floor openings shall be guarded by manhole covers of adequate strength, which need not be hinged.

6. Other floor openings into which persons can accidentally walk shall be guarded either by permanent railings and toeboards on all exposed sides or by hinged floor-opening covers of adequate strength.

7. When covers for either type are not in place the openings shall be constantly attended by someone or protected by portable enclosing railings.

8. Floor openings into which persons cannot accidentally walk on account of fixed machinery, equipment or walls shall be guarded by covers securely held in place and leaving no openings more than 2.5 cm (1 in.) in width, or by toeboards on all exposed sides.

Wall Openings

9. All wall openings less than 1 m (40 in.) from the floor, having both a height of at least 75 cm (30 in.) and a width of at least 45 cm (18 in.) from which there is a drop of more than 2 m (6 ft. 6 in.), shall be solidly enclosed or guarded by fixed or rolling barrier rails, picket fences, half doors, or equivalent barriers, capable of withstanding a load of at least 100 kg (220 lb.) applied, in any direction except vertically upward, at any point on the top rail or corresponding member.

10. All other wall openings, irrespective of their width, shall, if their lower edge is either 7.5 cm (3 in.) or less above floor level on the near side or 2 m (6 ft. 6 in.) or more above ground or floor level on the far side, be guarded by—

- (a) a toeboard across the bottom of the opening; or
- (b) an enclosing screen, either solid or of grille or slat work with openings not more than 2.5 cm (1 in.) in width, capable of withstanding a load of at least 50 kg (110 lb.) applied horizontally at any point.

Construction of Railings

11. All railings shall be constructed in a permanent and substantial manner of wood, pipe, structural metal or other material of sufficient strength.

12. Standard railings shall be at least 90 cm (36 in.) from the upper surface of the top rail to floor level.

13. Standard railings shall have posts not more than 2 m (6 ft. 6 in.) apart and an intermediate rail half-way between the top rail and the floor.

14. The dimensions of railings and posts and the anchoring and framing of members shall be such that the completed structure shall be capable of withstanding a load of at least 100 kg (220 lb.) applied in any direction at any point of the top rail.

15. Railings of the following types of construction shall be deemed to satisfy the test requirements laid down in paragraph 14:

- (a) for *wood railings*: top rails and posts of at least 5 by 10 cm (2 by 4 in.) stock, and intermediate rails of at least 5 by 5 cm (2 by 2 in.) or 2.5 by 10 cm (1 by 4 in.) stock; all such railings shall be smooth and free from large or loose knots, protruding nails or bolts, splinters, fins, slivers, or cracks;
- (b) for *pipe railings*: top rails and posts of metal pipe of at least 32 mm ($1\frac{1}{4}$ in.) diameter and intermediate rails of metal pipe of at least 25 mm (1 in.) diameter;
- (c) for *structural metal railings*: top rails and posts of angle iron of at least 38 by 38 by 5 mm ($1\frac{1}{2}$ by $1\frac{1}{2}$ by $\frac{3}{16}$ in.) and intermediate rails of angle iron of at least 32 by 32 by 3 mm ($1\frac{1}{4}$ by $1\frac{1}{4}$ by $\frac{1}{8}$ in.).

16. All railings shall be of sound material free from defects and all sharp corners shall be rounded and smoothed.

Construction of Toeboards

17. Toeboards shall be at least 15 cm (6 in.) in height.

18. Toeboards may be made of wood, iron, steel or other substantial material.

19. Toeboards shall be securely fastened in place, with not more than 6 mm ($\frac{1}{4}$ in.) clearance above floor level.

REGULATION 13. STAIRS

Strength

1. All stairs, platforms, and landings shall be of sufficient strength to sustain safely a live load of not less than 500 kg/m² (100 lb./sq. ft.) with a factor of safety of four.

2. Stairs and platforms made of perforated material shall not contain openings which permit the fall of wrenches and other similar objects; the maximum permissible opening shall not exceed 10 to 12 mm (ca. 7/16 in.).

Width

3. Stairs, except service stairs, *i.e.*, stairs giving access to oiling platforms, etc., should be not less than 1.12 m (44 in.) in width, clear of all obstructions except handrails, and shall in no case be less than 90 cm (36 in.).

Pitch

4. Except for service stairs, the pitch of stairways should be between 30° and 38° from the horizontal, and shall not be less than 20° or more than 45°.

5. Where the slope would be less than 20° a ramp should be installed, and where the slope is more than 45° a fixed ladder should be provided.

Height

6. No stairway shall have a height of more than 3.7 m (12 ft.) between landings, and intermediate landings shall have a dimension of not less than 1.12 m (44 in.), measured in the direction of the run.

Headroom

7. Headroom shall be provided at all points in the stair well. The vertical clearance shall be not less than 2.2 m (7 ft. 6 in.) from the top of the tread on a line with the face of the riser.

Treads and Risers

8. Except for service stairs, the treads, exclusive of nosings or projections, shall be not less than 23 cm (9 in.) in width, and the risers shall be not more than 20 cm (7¾ in.) nor less than 13 cm (5 in.) in height.

9. There shall be no variation in the width of the treads and the height of the risers in any flight; the top and bottom treads of any flight should be clearly distinguishable.

Railings

10. All stairways having four or more risers shall be equipped with stair railings on any open side.

11. Enclosed stairways less than 1.12 m (44 in.) in width shall be equipped with at least one handrail, preferably on the right side descending.

12. Stairways 1.12 m (44 in.) or more in width shall be equipped with one stair railing on each open side and one handrail on each enclosed side.

13. Stairways 2.25 m (88 in.) or more in width shall be equipped in addition with an intermediate hand rail.

14. Stair railings shall be constructed in a permanent and substantial manner of wood, pipe, structural metal or other material of sufficient strength.

15. The height of stair railings, from the upper surface of the top rail to the surface of the tread in line with the face of the riser at the forward edge of the tread, shall be not less than 76 cm (30 in.); if the railing is used as a handrail the height shall not be more than 86 cm (34 in.).

16. Handrails shall be continuous throughout a flight of stairs and at landings and without obstructions (other than those intended to prevent persons from sliding).

17. If of wood, handrails shall be at least 5 by 5 cm (2 by 2 in.) in cross section and, if of metal pipe, at least 4 cm (1½ in.) in diameter.

18. Handrails mounted directly on walls or partitions shall be fixed by means of brackets attached to the lower side of the rails so as not to interfere with the smoothness of the top and side surfaces of the rails.

19. Brackets shall be spaced not more than 2 m (6 ft. 6 in.) apart and shall be of sufficient length to provide a clearance of at least 4 cm (1½ in.) between the rails and the walls or any obstructions on the walls.

20. The height from the upper surface of the handrail to the surface of the tread in line with the face of the riser shall be not more than 86 cm (34 in.) or less than 76 cm (30 in.).

21. The completed structure shall be capable of withstanding a load of at least 100 kg (220 lb.) applied in any direction at any point of the rail.

Service Stairs

22. The clear width of service stairs, such as stairs in engine and boiler rooms, or stairs leading to service platforms around machinery, shall be at least 56 cm (22 in.).

23. The pitch of service stairs shall be not more than 60°, and the width of the treads shall be not less than 15 cm (6 in.).

24. Winding or spiral service stairs should be prohibited.

Window Openings

25. Window openings at stair landings, where the opening is more than 30 cm (12 in.) in width and the sill is less than 90 cm (3 ft.) above the landing, shall be guarded securely by bars, slats, or grille work to prevent persons falling through.

Ramps

26. Ramps used by persons for ascent or descent from one level to another shall be limited to a slope of not more than 1 in 10, and shall conform to all relevant requirements for construction, width, enclosures and railings applying to stairways.

27. Where railings for ramps may be subjected to heavy stresses from trucking or handling materials, additional strength shall be provided by use of heavier stock, closer spacing of posts, bracing or otherwise.

**REGULATION 14. FIXED LADDERS, OVERHEAD WALKS,
RUNWAYS AND PLATFORMS**

Fixed Ladders

1. All metal parts or fittings of ladders shall be made of steel, wrought iron, malleable cast iron or other equivalent material.
2. Fixed ladders shall be so installed that—
 - (a) the distance from the front of the rungs to the nearest fixed object on the climbing side of the ladder is at least 75 cm (30 in.);
 - (b) the distance from the back of the rungs to the nearest fixed object is at least 16.5 cm (6½ in.); and
 - (c) except in the case of ladders equipped with cages, baskets or equivalent devices, there is a clearance of at least 38 cm (15 in.) from the centre line of the ladder on either side across the front of the ladder.
3. If fixed ladders are used to ascend to heights exceeding 9 m (30 ft.)—
 - (a) landing platforms should be provided for each 9 m (30 ft.) or fraction thereof; and
 - (b) the sections of the ladder should be staggered.

Overhead Walks, Runways and Platforms

4. Walks, runways, working platforms, or open-sided floors 2 m (6 ft. 6 in.) or more above floor or ground level, except platforms used for loading and unloading of freight, and small platforms used for motors or similar equipment which do not afford standing space for persons, shall be guarded on all open sides by standard railings and toeboards, complying with the provisions of paragraphs 11 to 19 of Regulation 12.
5. Runways used for filling of tank cars or for oiling may have the railing on one side omitted, if necessary, subject to the hazard of falling being reduced by the use of runways not less than 56 cm (22 in.) in width.
6. All runways or platforms constructed over conveyors or machinery shall be guarded on all open sides by standard railings and toeboards.

REGULATION 15. ELEVATORS AND BUILT-IN HOISTS

General Provisions

1. Every part of the structure, machinery and equipment of elevators shall be—
 - (a) of good design, good mechanical construction, sound material, adequate strength and substance, and free from defect; and
 - (b) kept in good repair and in good working order.

Hoistway Enclosures

2. Hoistways for all elevators shall be substantially enclosed throughout their height, and there shall be no openings except for necessary doors, windows, or skylights.

3. Hoistways for elevators outside buildings shall be substantially enclosed to a height of at least 3 m (10 ft.): Provided that the enclosure shall be continuous to the top of any side on which there is access to the cage.

4. The enclosure shall be either a continuous wall or substantial grille work, metal bars, or wood slats.

5. Openings in fixed enclosures shall not exceed 5 cm (2 in.) in their lesser dimension, and at all places where moving cars, counterweights or sliding doors present a hazard they shall not exceed 12 mm ($\frac{1}{2}$ in.) in their lesser dimension.

6. Elevators operating through hatch covers shall be prohibited in future installations for hatchways with more than two landings. Hatch covers shall be capable of sustaining a load of not less than 15 kg/cm² (220 lb./sq. in.) when closed.

7. When the covers are open and the platform or cage is not at the landing level the opening shall be adequately protected on all sides, either by standard railing or by suitable arrangement of the open hatch covers.

8. All ledges, floor beams, sills, saddles and timbers on landing sides of hoistways that project more than 2.5 cm (1 in.) shall be fitted with smooth, bevelled guards which extend to the hoistway enclosure and are securely attached directly under the projections at an angle which should be 75° from the horizontal and shall in no case be less than 60°.

9. Ropes, wires, or pipes should not be installed in hoistways, except when necessary for the operation of the elevators.

10. Electrical conductors other than trailing cables shall be encased in metal conduits or be armoured cables; all live parts of electrical apparatus in hoistways or on cages shall be suitably enclosed to afford protection against accidental contact.

11. Clearance between the sides of elevator cars and hoistway enclosures shall be not less than 20 mm ($\frac{3}{4}$ in.), and clearance between the cars and their counterweights not less than 25 mm (1 in.).

12. Clearance between the car platforms and the landing thresholds shall be not less than 12 mm ($\frac{1}{2}$ in.) for elevators using steel guide rails or 20 mm ($\frac{3}{4}$ in.) for elevators using wood guide rails; in no case shall such clearance exceed 38 mm (1 $\frac{1}{2}$ in.).

13. Clearance between loading sides of car platforms and the hoistway enclosures shall not exceed 13 cm (5 in.) except when the landing doors are installed wholly within the hoistways, in which case the clearance may be 19 cm (7 $\frac{1}{2}$ in.).

14. Hoistway pits shall be of such depth that, when the car rests on the fully compressed buffers, a clearance of not less than 60 cm (2 ft.) remains between the under side of the car and the bottom of the pit.

15. Hoistway pits shall not be used as thoroughfares and should be enclosed; doors shall be kept locked at all times except for authorised access.

16. Hoistway enclosures shall be of such height that, when the car is at the top landing, there remains above the top of the cage structure a clear height equal to the distance the car travels in one second and in no case less than 60 cm (2 ft.).

17. Floorings of iron, steel, concrete or wood shall be provided at the top of hoistways, either immediately below the sheaves or at the level of the top of the machine beams.

18. The floor shall cover the entire area of the hoistway and shall be capable of sustaining a concentrated load of 150 kg (330 lb.) on any 30 cm² (4 sq. in.) of the structure, but not simultaneously for the entire structure.

19. Where penthouses are provided over elevator shaftways, they shall be substantially constructed and access shall be afforded by means other than through the shaftway.

20. Headroom of not less than 2.15 m (7 ft.) shall be provided in penthouses.

21. Penthouses shall not be used as thoroughfares. Doors shall be kept locked at all times except for authorised access.

Landing Doors and Gates

22. Landing doors for power-driven elevators shall be provided with interlocks to hold the elevator car immovable while any landing door is open, and to make it impossible to open any landing door when the car is more than 7.5 cm (3 in.) away from the landing except with a special emergency key.

23. Landing openings in passenger-elevator hoistway enclosures shall be protected, preferably by sliding doors, combination sliding and swinging doors, or swinging doors.

24. On passenger elevators, vertically sliding or counter-balanced landing doors shall be permitted only if interlocked with elevator-car doors or gates so that—

- (a) these cannot open more than 60 cm (24 in.) until the hoistway door is locked in its fully opened position; and
- (b) the landing door cannot start to close until the car door or gate is closed to within 60 cm (24 in.) of full closure.

25. Landing doors for hydraulic passenger elevators shall be provided with a device which will compensate for the creeping of the car away from the landing caused by leakage in the valve or in the cylinder.

26. Landing openings in freight-elevator hoistway enclosures shall be protected by horizontally or vertically sliding doors, counterbalanced vertically sliding doors, combination sliding and swinging doors, swinging doors, or vertically sliding gates.

27. Landing doors or gates operated by the motion of the cage shall not be permitted.

28. Openings in gates made of grille, lattice or other open-work shall not exceed 5 cm (2 in.) in their lesser dimension.

29. Landing doors for hand-driven freight elevators shall be provided with mechanical locks operated by the cage.

30. All landing doors or gates shall when closed extend the full height from the landing threshold to the top of the landing opening.

Elevator Cars

31. Power-driven elevator cars, except cars operating through hatch covers, shall, save for the openings necessary for entrance and exit or for loading and unloading, be completely enclosed at sides and top.

32. The enclosure, up to a height of not less than 1.22 m (4 ft.) above the car floor, and the roof of the car shall be of wood or metal and shall be of solid and substantial construction.

33. Grille or mesh work construction may be used for car sides above 1.22 m (4 ft.) from the car floor provided that no opening exceeds 13 cm² (2 sq. in.) in area.

34. Entirely enclosed elevator cars shall have emergency exits in the top. The hatch of the emergency exit in the top shall open toward the inside, or better, both toward the inside and the outside.

35. Hand-driven elevator cars, except those operating through hatch covers, shall be enclosed on the top and on the sides not used for entrances.

36. Car tops shall be capable of sustaining safely a load of 100 kg (220 lb.) on any area of 0.1 m² (1 sq. ft.).

37. Power-driven elevator cars shall be provided on all landing sides with doors or gates: Provided that car doors may be dispensed with where the landing openings are fitted with solid doors so arranged that their inner surfaces and the interior of the hoistway form a continuous smooth flush surface, and where the speed of the car does not exceed 1.5 m/sec. (300 ft./min.).

38. (1) On all electrically-operated cars the doors or gates shall be provided with a car-door or gate electric contact which will prevent the operation of the car unless the door or gate is closed.

(2) All the electric contacts of doors shall be of the positive action type (like all electric safety contacts).

39. Elevator cars which are not electrically operated shall be provided with protection equivalent to that required in paragraph 38.

40. Car doors or gates shall not be opened automatically when the car passes a landing.

41. Sliding car doors for power-driven elevators may be—

- (a) solid, with or without glass or grille vision panels; or
- (b) constructed of open grille or bars with openings not more than 12 mm ($\frac{1}{2}$ in.) in width; or
- (c) collapsible, with openings not more than 65 mm ($2\frac{1}{2}$ in.) in width.

42. Elevator car doors or gates shall, when closed, guard the full opening.

43. Elevator cars, except for direct lift plunger elevators, shall be provided with safety gear or catches attached to the car frame; such gear or catches shall be capable of stopping and holding the car with capacity load in cases of predetermined overspeed, free fall, or slackening of cables.

44. Car safety gear shall be operated by speed governors.

45. A pawl and ratchet shall not be considered a sufficient safety device.

46. Elevator cars operated by hand power shall be equipped with hand brakes that operate in either direction of motion of the elevators; when the brake has been applied it shall remain locked in the "On" position until released.

47. The weight balancing the brake band shall be so secured as to prevent it from falling down the hoistway.

48. When travel exceeds two storeys or 10 m (33 ft.) a governor shall be provided for control of speed of the car in its descent.

49. Power-driven elevator cars used for carrying employees or passengers, or for the transportation of freight and an operator shall be constructed, installed, and operated in conformity with all requirements of this Code for passenger elevators.

50. Passenger elevators, that is, those used mainly for passenger transportation, except elevators operated by automatic control, shall be at all times in charge of a regular, trained, and competent operator.

51. Passenger-elevator cars operating at a speed exceeding 45 m (150 ft.) per minute, except automatic-operation or hydraulic type elevators, shall be controlled by electric car switches.

52. Passenger-elevator cars operating at a speed less than 45 m (150 ft.) per minute, except the automatic-operation type, may be operated by electric car switches or by lever, control rope or wheel mechanisms.

53. The installation and use of power manlifts shall be prohibited.

54. Freight-elevator cars may be operated either by automatic or double-button controls, electric car switches, lever or wheel mechanisms, or hand-operated ropes or cables.

55. Handles of car-switch operating devices shall be arranged to return automatically to the "Stop" position and lock there when the hand of the operator is removed.

56. Wheel operating mechanisms shall be marked to indicate the direction of the motion of the car, and an indicating device marked "Up", "Down" and "Off" shall also be provided to show the position of the control valve or switch.

57. Cables and hand ropes shall be provided with securely fastened stop balls, arranged to centre the operating mechanism at the limits of travel of the car.

58. Cables and hand ropes shall be provided with cable or rope locks forming part of the interlocking arrangement, which will prevent the car from being operated from any other floor or landing.

59. All power-driven elevators shall be provided with limit switches to stop the car automatically if it passes the highest or lowest landings; these shall be independent of the operating devices and located on the car, in the hoistway or in the machine room.

60. All electric-elevator cars shall be provided with emergency stop switches, which will cut off the source of power; these shall be independent of the operating devices and located adjacent to them.

61. A manually operated disconnecting switch shall be installed in the main line of electric-elevator machines or motor-generator sets, adjacent to and visible from them.

62. Elevators having winding-drum machines shall be provided with a "slack-cable" device, which will, if the car is obstructed in its descent, automatically cut off the power, apply the brake, and stop the machine.

63. Slack-cable switches shall be so constructed that they will not automatically reset when the slack in the cable is removed.

64. The rated speed of power-driven freight elevators carrying an operator shall not exceed 37.5 m (125 ft.) per minute, except in the case of automatic-operation and continuous-pressure-operation elevators or elevators controlled by a regular operator.

65. The rated speed of electric freight elevators with continuous-pressure operation shall not exceed 45 m (150 ft.) per minute.

66. The rated speed of belt or chain-driven freight elevators shall not exceed 18 m (60 ft.) per minute, and the rated speed of elevators operating through hatchway covers shall not exceed 15 m (50 ft.) per minute.

67. Elevators operated by hand power shall not have a car travel in excess of four storeys or 18 m (60 ft.) in height.

68. Elevator cars shall be adequately lighted at all times when in use.

Guides, Buffers and Counterweights

69. Car and counterweight guide rails of power elevators travelling more than 30 m (100 ft.) and operating at more than 30 m (100 ft.) per minute shall be of steel or other appropriate material: Provided that where the use of steel rails presents an accident hazard, such as in chemical or explosives factories, wood may be used regardless of height or speed.

70. Pits of all power-driven elevator hoistways shall be provided with buffers that will absorb the energy of fully loaded cars when descending at the governor tripping speed.

71. For passenger cars with a car speed not exceeding 60 m (200 ft.) per minute, oil, spring or air buffers may be used; for passenger cars with a speed exceeding 60 m (200 ft.) per minute, oil buffers shall be used.

72. For freight cars with a car speed not exceeding 15 m (50 ft.) per minute, solid buffers may be used; for freight cars with a car speed exceeding 15 m (50 ft.) per minute, spring, air, or oil buffers shall be used.

73. Buffers shall be so installed that there will be a clearance of at least 60 cm (2 ft.) between the lowest point of the car and the bottom of the pit when the buffers are fully compressed, and so located that they strike the centre sill or girder of the elevator car.

74. Counterweight buffers, similar to those required for cars, shall be provided for car and machine counterweights.

75. Car and machine counterweights shall run in guides or substantial boxing, the inner surfaces of which shall be flush.

76. Counterweight runways should be located in the hoistways, with the exposed sides of such runways covered from a height of at least 2.15 m (7 ft.) above the floor of the pit to the bottoms of their own pits.

77. Car or machine counterweights not located in elevator shafts shall be entirely enclosed on all sides.

Suspension Cables

78. At least two hoisting and two counterweight cables shall be provided on all passenger elevators, and should be provided on all power freight elevators that are raised or lowered by cables.

79. The operation of freight elevators having only one hoisting cable shall be prohibited unless the diameter and material of the

cable are adequate to carry safely the maximum load with a factor of safety of not less than 12.

80. The minimum diameter permitted for any type of cable shall be 12 mm ($\frac{1}{2}$ in.).

81. The drum ends of cables shall be securely anchored, preferably by clamps; on the inside of the winding drums, and there shall be at least two turns of the hoisting and counterweight cables on winding drums when either the car or the counterweights are at their limits of travel.

82. All cables shall be provided with means for equalising, and drum type elevators shall be provided with eveners.

Machinery

83. Except in the case of hand-operated elevators, overhead bearings shall be placed on the tops of the beams or on the flooring referred to in paragraph 17 of this Regulation.

84. No elevator machinery, except the idler or deflecting sheaves, shall be hung underneath the supporting beams at the top of the hoistways.

85. No machinery, except the buffers and machinery for hydraulic-plunger elevators, shall be located directly under the elevator hoistway.

86. Set-screw fastenings shall not be used in lieu of keys in the construction and installation of any hoisting machinery.

87. All hoisting machinery shall be provided with adequate guards, conforming to requirements for machine guarding in this Code.

88. Winding drums and leading sheaves shall be of cast iron or steel, and shall be provided with finished U-grooves, not more than 1.6 mm ($\frac{1}{16}$ in.) larger than the cables used.

89. The diameter of drums and sheaves shall be not less than forty times the diameter of the cables.

90. No friction gearing or clutch mechanism shall be used for connecting the drums or the sheaves to the main driving gear of a passenger elevator.

91. The use of belt or chain-driven machines for passenger-elevator cars shall be prohibited in all new installations.

92. Means shall be provided to stop the belts of belt-driven elevators without stopping other machinery driven from the same source of power.

93. Machines for power elevators, other than hydraulic machines, shall be equipped with brakes applied automatically when the operating device is at the "Stop" position.

94. The cables of the operating circuits shall be separated in their full length from other conductors used for emergency calls,

for telephone and lighting circuits, and for the operation of the emergency stop switches mentioned in paragraph 60 of this Regulation.

95. The frames of all electrical machinery or appliances, and the operating cables if insulated from the frame, shall be effectively grounded.

96. All hydraulic-elevator machines, vertical or horizontal, shall be so constructed and so roped that the piston will be stopped before the car can be drawn into the overhead work.

97. Stops on hydraulic machines shall be of ample strength to bring the piston to rest when under full pressure without damage to the cylinder or cylinder head.

98. The travelling sheaves for hydraulic elevators shall be guided with metal guide rails and guide shoes.

99. Cylinders of hydraulic-elevator machines shall be provided with means for releasing air or gas.

100. Elevator pumps, unless equipped with pressure regulators which control the motive power, shall be provided with automatic by-passes.

101. The car platforms of direct-plunger elevators shall be fastened securely to the head of the plunger and, when the plunger consists of more than three sections and the elevator car is equipped with counterweights, shall also be secured to the bottom section of the plunger by a non-corrosible cable inside the plunger.

102. All elevators operated from a pressure tank where the fluid pressure is obtained by directly admitting air or gas to the tank shall comply with all rules covering hydraulic elevators.

103. No hand-operated elevator shall be provided with any equipment or attachments for applying any other power unless such elevator is permanently and completely converted into a power elevator conforming to the requirements of this Code for the type to which it is converted.

Inspection

104. All parts of elevator installations shall be inspected at regular intervals prescribed by national laws or regulations.

Signalling Devices

105. Elevator cars shall be provided with an audible emergency signal that is operative from the car and audible outside, or with a telephone.

Posting of Signs

106. All elevator cars shall have a sign posted conspicuously, which shall show the maximum rated load that can be carried on the elevator.

107. Power elevators that do not conform to all regulations for passenger elevators shall have signs posted at every landing and in the elevator car, prohibiting all persons except the operator from riding therein.

REGULATION 16. YARDS

Surface

1. Plant yards shall be properly drained and graded in order to facilitate safe access to buildings and safe handling of material and equipment.

2. Drain pools and catch basins shall be provided where necessary, and shall be properly covered or enclosed.

3. Ditches, pits, and other hazardous openings shall be provided with substantial covers, enclosed or surrounded by substantial guards.

4. Walkways, roadways, and tracks for plant railways should be carefully laid out in such a manner as to avoid dangerous grade crossings.

Gates

5. Where the premises are surrounded by fencing, separate entrance and exit gates should be provided for pedestrian, vehicular, and railroad traffic.

6. Gates for pedestrian traffic should be located at a safe distance from those for vehicular and railroad traffic, and should be of sufficient width to permit the free passage of employees at rush hours.

Walkways

7. Safe walkways should be constructed along the shortest lines between important points.

8. Walkways should not be located under the eaves of buildings, where they may become slippery.

9. Where it is necessary for pedestrians to cross railroad tracks or vehicular roadways, bridges or underpasses should be provided, and the track or roadway should be fenced so as to prevent direct crossing at such points.

10. Walking along railroad tracks by unauthorized persons should be prohibited.

11. Railings should be installed along walkways on bridges, on steep slopes, at slippery places, and at places where pedestrians are liable to injury from passing vehicles.

Roadways

12. Roadways for automobiles, tractors, or other vehicles should be soundly constructed and surfaced with good wearing material.

13. Roadways should be of adequate width, and where used by two-way power traffic shall be at least twice the width of the widest vehicle normally used, plus 1.25 m (4 ft.); sufficient clearance from overhead structures should be provided.

14. Where the establishment of grade or level crossings cannot be avoided, such crossings should be protected by watchmen, gates, or automatic signals.

15. Substantial railings or walls should be provided along bridges, slopes, and sharp curves.

Parking of Vehicles

16. Where parking space is provided for automobiles of employees, there should be regulations covering use of driveways for entry and exit, speed limits, space allotment, method of parking, etc., and these regulations should be strictly enforced.

Section 2. Lighting

REGULATION 17. GENERAL PROVISIONS

All places where persons work or pass, or may have to work or pass in emergencies, shall be provided during time of use with adequate natural or artificial lighting, or both, suitable for the operations and the special type of work performed. Natural lighting shall be adopted wherever possible.

REGULATION 18. NATURAL LIGHTING

1. Skylights and windows should be located and spaced so that daylight conditions are fairly uniform over the working areas.

2. Where necessary skylights and windows should be provided with devices to avoid glare.

3. A regular system of cleaning skylights and windows should be established to ensure that they are kept clean at all times.

REGULATION 19. ARTIFICIAL LIGHTING

Quality

1. Artificial lighting shall be provided when daylight fails or for areas where the daylight illumination is insufficient.

2. The general lighting should be of a uniform level, widely distributed to avoid harsh shadows or strong contrasts, and free from direct or reflected glare.

3. Where intense local lighting is necessary, it may be obtained by a combination of general lighting and supplementary lighting at the point of work.

4. Supplementary lighting should be specifically designed for the particular visual tasks and so arranged, or provided with shading or diffusing devices, that glare is prevented.

Intensity

5. A minimum of 20 lux (2 ft. candles) should be provided for yard roadways and outside thoroughfares.

6. A minimum of 50 lux (5 ft. candles) should be provided—

- (a) where discrimination of detail is not essential, such as for handling materials of a coarse nature, handling coal or ashes, rough sorting, or grinding of clay products;
- (b) for passageways, corridors and stairways, warehouses, storerooms and stockrooms for rough and bulky materials.

7. A minimum of 100 lux (10 ft. candles) should be provided—

- (a) where slight discrimination of detail is essential, such as for the production of semi-finished iron and steel products; rough assembling; milling of grains; opening, picking, and carding of cotton; or other primary operations in most of the industrial processes; and
- (b) for engine and boiler rooms, passenger and freight elevators, crating and boxing departments, receiving and shipping rooms, storerooms and stockrooms for medium and fine materials, locker rooms, toilets and washrooms.

8. A minimum of 200 lux (20 ft. candles) should be provided where moderate discrimination of detail is essential, such as for medium assembling, rough bench and machine work, rough inspection or testing of products, sewing light-coloured textile or leather products, canning and preserving, meat packing, planing of lumber, veneering and cooperage.

9. A minimum of 300 lux (30 ft. candles) should be provided where close discrimination of detail is essential, such as for medium bench and machine work, medium inspection, fine testing, flour grading, leather finishing and weaving cotton goods or light-coloured woollen goods, or for office desk work with intermittent reading and writing, for filing, and for mail sorting.

10. A minimum of from 500 to 1,000 lux (50 to 100 ft. candles) should be provided where discrimination of fine detail is involved under conditions of a fair degree of contrast for long periods of time, such as for fine assembling, fine bench and machine work, fine inspection, fine polishing and bevelling of glass, fine wood-working, and weaving dark-coloured woollen goods, or for accounting, book-keeping, drafting, stenographic work, typing, or other prolonged close office desk work.

11. A minimum exceeding 1,000 lux (100 ft. candles) should be provided where discrimination of extremely fine detail is involved under conditions of extremely poor contrast for long periods of

time, such as for extra-fine assembling, extra-fine inspection, testing of extra-fine instruments, jewellery and watch manufacturing, grading and sorting tobacco products, make-up and proof-reading in printing plants, and inspecting or sewing dark-coloured cloth products.

12. The provisions of paragraphs 5 to 11 apply to lighting equipments under average operating conditions, not simply when new and clean as first installed. Where conditions are favourable it may be necessary to provide initially at least 25 per cent. more light; in locations where dirt will collect rapidly the initial level should be at least 50 per cent. above the recommended minimum standards.

Emergency Lighting

13. Where large numbers of persons are employed in buildings, emergency lighting systems should be provided in all important stairways, exits from workplaces, and passages to these.

14. All windowless buildings shall be provided with emergency lighting.

15. Emergency systems should be capable of producing and maintaining for at least one hour a minimum intensity of 5 lux (0.5 ft. candle) and should have energy sources independent of the installations for the general lighting systems.

16. Provision shall be made for the automatic lighting of the emergency system upon failure of the general system.

17. Where there is a special fire hazard which may put emergency lighting circuits out of use, indicators equipped with reflectors, luminous paints, or battery-operated lamps, or any similar device protected against fire, shall be installed in convenient places.

Section 3. General Ventilation

REGULATION 20. GENERAL PROVISIONS

Suitable atmospheric conditions shall be maintained in work-rooms, by natural or artificial means, to avoid insufficient air supply, stagnant or vitiated air, harmful draughts, excessive heat or cold, sudden variations in temperature, and where practicable, having regard to the nature of the processes carried on, to avoid excessive humidity or dryness, and objectionable odours.

REGULATION 21. AIR SUPPLY

1. Clean fresh air shall be supplied to enclosed workplaces at an average rate of not less than 30 to 50 m³ (1,000 to 1,750 cu. ft.) an hour per worker, or at such a rate as to effect a complete change

of air a number of times per hour varying from six for sedentary workers to ten for active workers.

2. Where an adequate supply of fresh air cannot be obtained by natural ventilation, or where it is difficult to get the desired amount of air to the centre of the workrooms without creating uncomfortable draughts near the inlets, mechanical ventilation shall be provided.

REGULATION 22. AIR CLEANLINESS

1. All dust, fumes, gases, vapours or mists generated and released in industrial processes shall be removed at their point of origin, so far as possible, and not permitted to permeate the atmosphere of the workrooms.

2. Local heating apparatus, installed in workrooms, shall be so constructed that combustion gases are prevented from entering the atmosphere of the room. The use of open braziers or salamanders shall be prohibited.

REGULATION 23. AIR MOVEMENT

The air movement in enclosed workplaces shall be so arranged that the workers are not subjected to objectionable draughts, and the air velocity should not exceed 15 m (50 ft.) a minute during the heating season or 45 m (150 ft.) a minute during warm sunny weather.

REGULATION 24. TEMPERATURE AND HUMIDITY

1. A temperature suitable for the type of work performed shall be maintained in enclosed workplaces and such temperature shall be increased or decreased and the degree of humidity varied in accordance with the kind of work and the outside temperature and humidity.

2. The competent authority in each country shall fix the ranges of temperature and humidity for the various types of work.

3. In localities subject to high or low seasonal temperatures, the effects of the variations in temperature should be minimised by any appropriate means such as heat insulation of roofs, walls and floors, and, if possible, doors and windows.

4. All employees shall be protected, either by heat insulation of the equipment or by other suitable means, against radiation and excessive temperature due to steam and hot-water pipes or other heated machines or equipment.

5. Stationary or movable screens, preferably of fireproof material, should be provided where necessary, to shield workers from intense heat radiation.

6. Where central heating systems are used, radiators and heating pipes shall be so installed that the workers are not inconvenienced by radiation of heat or by the circulation of hot air.

7. In industries involving exposure of workers to unduly high or unduly low temperatures, passage rooms should be provided so that the workers can gradually cool themselves off to or warm themselves up to the prevailing seasonal temperature before passing into it.

REGULATION 25. PROTECTION FOR OUTSIDE WORKERS

Roof shelters and wind breaks should be provided for yard workers, to protect them from rain and wind.

CHAPTER III

FIRE PREVENTION AND PROTECTION

Section 1. Building Exits

REGULATION 26. DEFINITIONS

In this Code the following terms have the meanings hereby assigned to them:

- (a) the term "wood-frame construction" means a construction in which wooden frame work forms the structural support for enclosure walls, floors, and roofs;
- (b) the term "slow-burning construction" means construction consisting of substantial masonry walls and heavy timber interior;
- (c) the term "fire-resisting construction" means construction in which all walls, partitions, floors, stairs, roofs, window frames and sashes, doors and other interior finish consist of fire-resisting materials; and designed to withstand without collapse the burning of the contents of the building for a specified period of time;
- (d) the term "low-hazard occupancies" means areas occupied for purposes involving the storage or use of materials which ordinarily do not burn rapidly or with excessive smoke, and in which neither poisonous fumes nor explosions are a special risk due to the nature of the contents of the building;
- (e) the term "moderate-hazard occupancies" means areas occupied for purposes involving the storage or use of materials which are liable to burn with moderate rapidity and to give off a considerable volume of smoke, but in which neither poisonous fumes nor explosions are a special risk due to the nature of the contents of the building;
- (f) the term "high-hazard occupancies" means areas occupied for purposes involving the storage or use of materials which are liable to burn with extreme rapidity or in which poisonous fumes are a special risk due to the nature of the contents of the building.
- (g) the term "storey" does not necessarily mean an actual storey, but a height of 5 m (16 ft. 6 in.) for the main storey and a height of 4 m (13 ft. 4 in.) for the upper storeys¹;

¹ Thus, a building 25 m (82 ft.) in height without storeys shall be deemed to be the equivalent of a building comprising a ground floor 5 m (16 ft. 6 in.) in height, and five upper floors, each having a height of 4 m (13 ft. 4 in.).

- (h) the term " passage " means the free space between machines, installations or piles of material. " Free " means the absence of obstacles, namely pillars, transmission equipment, pulleys, piles of material, etc.;
- (i) the term " aisle " means a free space for traffic inside a workplace, the word " free " having the same meaning as in paragraph (h);
- (j) the term " corridor " means a free space for traffic outside workplaces, the word " free " having the same meaning as in paragraph (h);
- (k) the term " exit " means an opening providing a means of egress from a workplace to another part of the building;
- (l) the term " final exit " means an opening affording a safe means of egress into the open air;
- (m) the term " passageway " means any way which may be used by persons, such as a passage, an aisle, a corridor, a stair, an exit or a final exit.

REGULATION 27. HEIGHT AND SEGREGATION OF BUILDINGS

Height

1. The height of factory buildings erected or reconstructed after the effective date of these regulations shall be limited, according to type of construction and occupancy hazard, to the number of storeys, including the ground floor, indicated in the following table.

Type of construction	Occupancy hazard		
	Low	Moderate	High
Wood-frame	3 storeys	2 storeys	1 storey
Slow-burning	7 storeys	6 storeys	4 storeys
Fire-resisting	No limit	No limit	5 storeys

2. Existing buildings may be occupied two storeys higher than the limits specified for new buildings, if provided throughout with approved automatic sprinkler protection.

Segregation

3. All processes involving serious explosion and flash-fire hazards shall be located in segregated buildings, where the equipment shall be so arranged that only a minimum number of employees are exposed to such hazards at any one time.

REGULATION 28. PASSAGES

1. In workplaces, passages between machines, installations or piles of material should be at least 60 cm (24 in.) wide.

[New paragraph 4.]

4. All industrial processes involving serious fire hazards, such as certain preparatory operations in the textile industries, should be located in buildings or workplaces separated from one another by walls of fire-resisting construction.



2. The competent authority may require the passages to be of a considerably greater width, when danger from the machines, dimensions of the pieces worked, or the quantity of waste or installations, or piles of material so require.

REGULATION 29. AISLES AND CORRIDORS

Where immediate access to exits is not afforded, safe and continuous aisles or corridors having an unobstructed width of at least 1.12 m (44 in.) and leading directly to each exit shall be maintained at all times.

REGULATION 30. STAIRWAYS

Construction

1. All new stairs, platforms and landings in buildings four or more storeys in height and all stairs, platforms and landings in new buildings of fire-resisting construction shall be of incombustible material throughout.

Enclosures

2. Except in special cases where open stairways are permitted, all inside stairways, landings, or parts of floors used by persons descending the stairways shall be completely enclosed in fire-resisting stair shafts.

3. Outside stairways shall be shielded against fire, smoke and weather and should be enclosed in fire-resisting towers, with access through outside balconies or vestibules.

Arrangement

4. In buildings of non-fire-resisting construction more than three storeys in height and with roofs having a slope of less than 1 in 4, at least one stairway shall extend through the roof.

5. All stairways shall lead to the street directly or by way of a yard, court, or fire-resisting passageway, the width of which is at least equal to the aggregate of the minimum widths, prescribed in accordance with Regulation 31, of all exits discharging through it.

6. All approaches to stairs which may be used for exit purposes shall be so marked as to make clear the direction of egress to the street.

REGULATION 31. EXITS AND FINAL EXITS

1. Exits should be so installed in number and arrangement that all persons working in the workplaces can leave them immediately and in perfect safety in an emergency. The minimum width of the exits shall be 1.12 m (44 in.).

2. The exits shall be so placed that in order to go from a workplace to a final exit or to a fireproof and smokeproof stairwell or to a door affording passage through a fireproof wall, the distance to be covered shall not exceed—

(a) 15 m (50 ft.) in high-hazard occupancies; and

(b) 30 m (100 ft.) in low- and moderate-hazard occupancies.

3. These distances may be increased or decreased by the competent authority according to whether automatic sprinklers are installed or if the hazards are fairly high.

4. The final exits and the passageways which lead to them shall be 1.12 m (44 in.) wide, when the number of persons employed does not exceed 50. When the number of persons to be evacuated exceeds 50, the number or the dimensions of the final exits and, consequently, the passageways which lead to them, shall be increased, taking into consideration the fact that evacuation in columns is always preferable and that it is desirable that their width should be multiples of the unit of passage comprised between 56 cm (22 in.) and 60 cm (24 in.).

5. Every passageway shall be calculated so that a jam in the traffic cannot, in any case, occur.

REGULATION 32. HORIZONTAL PASSAGeways

1. No stairs or steps shall be used in horizontal passageways.

2. (1) When there is a difference in level between connected floor areas, ramps shall be installed.

(2) Warning notices shall be provided at the beginning of the ramps, especially at the top.

REGULATION 33. DOORS

Fire Doors

1. Stairway enclosures and fire-exit partitions shall be provided with fire doors of the self-closing type, which can be easily opened from either side.

Types

2. Swinging doors shall be used for exits: Provided that horizontal sliding doors may be permitted by the competent authority in cases in which for practical reasons swinging doors are not suitable.

3. Vertical-sliding doors, rolling shutters and revolving doors shall not be permitted.

Arrangement

4. All swinging exit doors, including doors from rooms to corridors and hallways, shall open with the line of travel in leaving the building.



[New text.]

1. All industrial establishments shall be provided with sufficient fire-extinguishing equipment, suitable for the special risks of the establishment, and persons trained to use the equipment correctly shall be present during all normal working periods.

2. Equipment and plant involving a serious fire risk should, if practicable, be so constructed and installed that in case of fire they can be easily isolated, whenever possible by automatic means.

3. Ventilation ducts, pneumatic conveyors and similar equipment involving a serious fire risk should be provided with flame-arresting or automatic fire-extinguishing appliances.

5. Doors from rooms to corridors and hallways shall be so located as not to project into the path of travel at any point during the swing.

6. Doors giving access to stairways shall not open immediately on a flight of stairs, but on a landing the width of which is at least equal to that of the door.

7. Doors from stairways to outside the building shall be so arranged as not to restrict the effective width of the stairs.

8. The distance between street-floor exit doors shall not exceed 45 m (150 ft.) and the minimum width of any such door shall be 1.12 m (44 in.).

9. Exit doors shall be so arranged as to be readily visible, and no obstructions interfering with access or visibility shall be permitted.

10. No door leading into or out of any factory building or floor thereof shall be locked, bolted, or fastened against egress during periods of occupancy.

REGULATION 34. ELEVATORS AND HOISTS

1. While elevators are not recognised as exits, the hoistway enclosures for freight elevators in buildings more than two storeys in height and for all passenger elevators shall be of fire-resisting construction throughout.

2. Elevators shall not be located in a common shaft with a stairway unless such shaft is of the enclosed fire-resisting type.

- REGULATION 35. EXIT SIGNS

Exit doors and passageways shall be plainly marked with illuminated signs indicating the way of egress and so arranged that they will remain lighted even if the current fails.

Section 2. Fire-Fighting Facilities

REGULATION 36. GENERAL PROVISIONS

All industrial establishments shall be provided with sufficient fire-extinguishing equipment, and persons trained to use the equipment correctly shall be present during all normal working periods.

REGULATION 37. WATER SUPPLY

1. An adequate water supply with ample pressure shall be maintained at all times for extinguishing fires in ordinary combustible materials.

2. Where connection with a public water-supply system is not available, a private supply shall be provided from elevated tanks or, by means of pumps, from reservoirs or streams.

3. Fire pumps shall be so located or protected that their operation will not be impaired by a fire in the establishment.

REGULATION 38. HYDRANTS

1. Fire hydrants shall be readily available and so located or protected that they will not be liable to injury from vehicles.

2. During cold weather fire hydrants shall be drained thoroughly after use in order to prevent freezing.

3. Hydrants and supply pipes should be flushed at frequent intervals in order to remove sediment.

REGULATION 39. HOSE

1. All hose couplings for use outside and all hydrant or stand-pipe nipples shall be of the same type as that used by the public fire department which may be called on for aid.

2. Hose for outside or yard protection should be at least 63 mm ($2\frac{1}{2}$ in.) hose with 25 to 32 mm (1 to $1\frac{1}{4}$ in.) nozzles, taking into consideration the pressure of the water.

3. Hose for inside use by building occupants should be at least 38 mm ($1\frac{1}{2}$ in.) hose with 10 or 13 mm ($\frac{3}{8}$ or $\frac{1}{2}$ in.) nozzles, taking into consideration the pressure of the water, unless trained fire-fighting teams are employed.

4. Hose should be thoroughly drained and dried after each use. Rubber-lined hose shall be tested at least once in every 3 months.

REGULATION 40. USE OF WATER

1. Water should not be used, except as a very fine spray, on fires in large quantities of flammable liquids, greases or paints, or fires in flammable organic dusts.

2. Water shall never be used on fires in aluminium or magnesium powder, or in the presence of calcium carbide, or of substances liable to give off flammable or noxious gases, or in fires in which live electrical equipment is involved, except in the form of spray in very fine particles, for low tension equipment.

3. (1) Notices shall be placed at the entrance and inside premises in which any of the substances referred to in paragraph 2 of this Regulation are present and also at the entrance to the establishment.

(2) The presence of such substances shall be notified to those public and private fire brigades of the neighbourhood which might be called upon in the event of fire.

REGULATION 41. SPRINKLERS

1. Where automatic sprinkler systems are used, water-control valves on such systems shall be kept open at all times: Provided that such valves may be closed on the orders of a responsible person.

2. Automatic electrical signalling devices should be provided for warning whenever the normal position of any valve is disturbed.

3. A clear space of at least 60 cm (24 in.) shall be maintained below and on all sides of automatic sprinkler nozzles to ensure effective spray action.

REGULATION 42. PORTABLE EXTINGUISHERS

Installation

1. All industrial establishments, including those where approved automatic-sprinkler protection is provided, shall be equipped for protection against small incipient fires with portable fire-fighting appliances, suitable for the types of fire liable to occur in view of the nature of the process or the contents of the establishment or its divisions.

2. All appliances shall be conveniently and conspicuously located.

Combustible Materials

3. Where fires may occur in combustible materials other than those mentioned in paragraphs 4, 5 and 6 of this Regulation, the portable equipment may consist of fire pails, bucket tanks, pump tanks filled with water, or of soda-acid, anti-freeze, or foam extinguishers, or other equivalent systems.

Flammable Liquids

4. Where fires may occur in flammable liquids, grease, or paint, the portable equipment shall not require the use of water in its ordinary state, but shall consist of foam, carbon tetrachloride, carbon dioxide, dry powder extinguishers, or other equivalent systems.

Electrical Equipment

5. Where fires may occur in which live electrical equipment is involved, the portable equipment shall not consist of soda-acid, foam or water extinguishers (except as spray in very fine particles),

but shall consist of carbon dioxide, dry powder extinguishers or other equivalent equipment. Account shall nevertheless be taken, in a general way, of the tensions involved.

Flammable Metals

6. Where fires may occur in magnesium or aluminium dust or shavings, the use of all liquids, carbon dioxide and foam types of extinguishers shall be prohibited and an ample supply of fine dry sand, stone dust or other inert material shall be kept available for segregating such fires by building dams or dykes around them.

Inspection

7. Portable fire-fighting apparatus shall be inspected at least once a week.

8. Soda-acid and foam extinguishers shall be emptied and recharged annually.

9. Chemical extinguishers shall be refilled immediately after use.

10. The attention of the fire-fighting personnel shall be drawn to the dangers presented by carbon tetrachloride and by methyl bromide in a confined atmosphere, as well as to the chemical reactions which, in certain cases, take place between the extinguisher liquids and the materials used.

Section 3. Alarm Systems and Fire Drills

REGULATION 43. ALARM SYSTEMS

Installation

1. All high-hazard and moderate-hazard occupancies shall be equipped with fire-alarm signal systems having a sufficient number of signals clearly audible to all persons in the building whenever the alarm is sounded in any portion thereof.

Sending Stations

2. A sufficient number of hand-operated sending stations or fire-alarm boxes should be provided on each floor and so located that it is not necessary to travel more than 30 m (100 ft.) to reach a station.

3. Fire-alarm stations should be conspicuous, readily accessible, and in the natural path of escape from fire.

Sounding Devices

4. (1) Alarm-sounding devices shall be distinctive in quality and pitch from all other sounding devices, and shall not be used for any purpose other than that of sounding fire alarms or calling fire drills.

(2) As far as possible, the signal and alarm systems shall be actuated from a source of power independent of that ordinarily used for lighting and for running the machines.

REGULATION 44. FIRE DRILLS

Exit Drills

1. Drills should be held at least once in every three months, to ensure orderly exit from buildings in the event of fire and to prevent panic.

2. Drills should be directed by a supervisory organisation, capable of planning and conducting the drill, composed of a chief, assistants, guards, and others according to the needs of the establishment.

3. Fire-drill plans should be prepared to simulate actual fire conditions.

4. All persons normally employed on the premises should participate in the drills and be trained in the use of portable extinguishers.

Fire-Fighting Drills

5. Where organised fire brigades are maintained, fire-fighting drills should be held at least once a month, preferably without notice.

6. Such drills should closely approximate to actual conditions of fire fighting, including use of equipment.

Fire-Fighting Personnel

7. In establishments not maintaining fire brigades at least some of the regular operating personnel, including all watchmen, should be thoroughly trained in the proper handling of the fire-fighting equipment in the establishment and its use against the types of fire for which it is intended.

8. Employers should inform newly engaged workers of all fire-fighting installations, all the exits and their use in the event of fire.

Section 4. Storage of Explosives and Flammable Substances

REGULATION 45. EXPLOSIVES

Commercial explosives shall be kept or stored in accordance with special regulations to be issued by the competent national authority.

REGULATION 46. FLAMMABLE LIQUIDS

1. Not more than 20 l (5 gals.) of flammable liquids having a flash point (Abel-Pensky test) of less than 21° C. (70° F.) shall be kept or stored in workrooms and only in containers of an approved type.

2. (1) Such liquids may be stored in closed containers and in limited quantities to be specified by the competent authority, in rooms of fire-resisting construction which are situated above ground and isolated from the remainder of the building by fire walls and self-closing fire doors.

(2) These rooms shall not have openings covered with glass or transparent material which would allow the direct rays of the sun to pass.

3. Large quantities of such liquids shall be stored in isolated buildings of fire-resisting construction or in storage tanks, preferably underground and at a distance from any building to be specified by the competent authority and with the working supply furnished to various points in the factory through pipe lines.

4. Effective steps shall be taken to prevent leakage of such liquids into basements, sumps or drains and to confine any escaping liquid within safe limits, and also to avoid the formation of explosive or flammable mixtures of vapour and air, especially during transfer.

REGULATION 47. COMPRESSED GASES

1. Cylinders containing compressed gases may only be stored in the open if they are adequately protected against excessive variation of temperature, direct rays of the sun, accumulations of snow, or continuous dampness.

2. Where such cylinders are stored inside industrial establishments, the storage spaces should be isolated by fire-resisting and heat-resisting walls or partitions.

3. Compressed gases shall never be stored near highly flammable substances.

REGULATION 48. COAL, CELLULOID AND OTHER HIGHLY FLAMMABLE SOLIDS

1. Large quantities of bituminous coal should, in order to minimise the risk of spontaneous combustion, be stored under water or, if stored in the open, should be arranged in a number of separate piles with no point in each pile more than 3 m (10 ft.) from a surface exposed to the air.

2. Pulverised coal with a temperature exceeding 65° C. (150° F.) should be cooled before being placed in storage bins.

3. Bins for the storage of pulverised coal shall be of non-combustible material and so located that radiation from boilers, furnaces, steam pipes, or other sources of heat cannot raise the temperature of the contents to a dangerous degree.

4. Celluloid and other highly flammable solids shall be stored only under conditions to be specified by the competent authority.

REGULATION 49. PACKING MATERIALS

1. (1) Large quantities of excelsior (wood wool), straw, or other packing materials of a flammable nature shall be stored in separate buildings or in incombustible or metal-lined rooms with metal-lined doors.

(2) These rooms shall not have openings covered with glass or transparent material which would allow the direct rays of the sun to pass.

2. Small quantities of such materials shall be stored in metal or metal-lined bins with self-closing covers.

REGULATION 50. SMOKING

Smoking and the lighting or carrying of matches, cigar lighters, or other flame-producing articles or smoking materials shall be prohibited in all places where explosive, highly flammable, or highly combustible materials are stored or handled.

Section 5. Disposal of Waste

REGULATION 51. ACCUMULATION

1. Where industrial waste is not mechanically removed, no waste material of a flammable nature shall be permitted to accumulate on the floors, but shall be removed at least once a day or shift, and more often where possible, and shall be placed in suitable covered metal containers.

2. Separate self-closing metal receptacles shall be provided in workrooms for oil-soaked waste, rags, or other materials subject to spontaneous combustion.

REGULATION 52. DISPOSAL

1. The contents of waste containers shall be burned or entirely removed from the establishment at least once a day, unless baled.

2. (1) Baled waste material of a flammable nature shall be stored in metal-lined rooms with metal-lined doors, or in isolated buildings of fire-resisting construction, from which it shall be removed at least once a month.

(2) This period may be extended if the storerooms are not less than 15 m (50 ft.) from the working premises.

REGULATION 53. BURNING OF WASTE

1. Waste and rubbish should preferably be burned in incinerators.

2. When waste or rubbish is burned under boilers, it shall be burned promptly when received and not permitted to become mixed with the coal supply or the ashes.

3. When waste or rubbish is burned in the open, no fires shall be started within 15 m (50 ft.) of any combustible building or material or within 6 m (20 ft.) of any other structure.

4. Special precautions shall be taken for the protection of all persons employed in burning waste or rubbish.

5. Highly flammable waste shall be destroyed separately.

REGULATION 54. ASHES

1. Permanent non-flammable bins or other safe places shall be provided inside the building for the disposal of ashes, soot and cinders removed from boiler rooms.

2. Accumulations of ashes, soot and cinders in the open air shall be at a distance of at least 15 m (50 ft.) from the buildings.

Section 6. Lightning

REGULATION 55. GENERAL REQUIREMENTS

1. Protection against lightning shall be provided for—

- (a) buildings in which flammable materials are manufactured, used, handled or stored;
- (b) storage tanks containing oils, paints, or other flammable liquids; and
- (c) tall chimneys or stacks.

2. Protection against lightning should be provided, especially in localities where thunderstorms are very frequent or very severe, for—

- (a) grain elevators;
- (b) flour and feed mills;
- (c) isolated buildings where flammable gases, fumes, dust, or lint are present; and
- (d) buildings having elevated features, such as steeples, flag poles, and water tanks.

REGULATION 56. GROUNDING OF STRUCTURES

Buildings, tanks and other structures which are roofed or clad with metal, electrically bonded, but which rest on foundations of non-conducting material, shall be properly grounded.

REGULATION 57. LIGHTNING CONDUCTORS

1. Structures of non-conducting materials, or where the metal covering is not electrically bonded, shall be equipped with air terminals (lightning rods), conductors, and ground connections.

2. Smoke-stacks, ventilators and other projecting metal objects shall be securely bonded to the system.

3. Metallic bodies located inside a building within 1.8 m (6 ft.) of a lightning conductor shall be electrically bonded to it.

4. Metallic bodies of considerable size should be grounded also at their farther extremity inside the building.

5. Metallic bodies with any dimension exceeding 1.8 m (6 ft.) located inside a building at a distance from a lightning conductor exceeding 1.8 m (6 ft.) should be independently grounded.

6. All installations against lightning shall be inspected at least once every six months and repaired if necessary.

REGULATION 58. LIGHTNING ARRESTERS

Lightning arresters shall be provided, except in cases where it has been technically established that their use is not desirable, on all overhead light, power, telephone and radio conductors entering a building.

CHAPTER IV

MACHINE GUARDING

Section 1. General Provisions

REGULATION 59. DEFINITIONS

In this Code the following terms have the meanings hereby assigned to them:

- (a) the term "prime mover" includes steam, gas, oil and air engines and turbines, electric motors, hydraulic turbines waterwheels and windmills;
- (b) the term "mechanical power transmission equipment" includes flywheels on machines other than prime movers and all mechanical means of transmitting power from a prime mover up to but not including the point of operation of power-driven working machines;
- (c) the term "point of operation" means that part of a working machine at which cutting, shaping, forming or any other necessary operation is accomplished, including such other parts as may offer a hazard to the operator in inserting or manipulating stock or material;
- (d) the term "flywheel" in relation to prime movers includes flywheels, balance wheels and pulleys which are mounted on and revolve with the crank shaft of an engine or other shafting of a prime mover;
- (e) the term "standard machinery guards" means guards constructed as specified in Regulations 82 to 89.
- (f) the term "standard railings and toeboards" means railings and toeboards constructed as specified in Regulation 12, paragraphs 11-19.

REGULATION 60. PROVISION OF GUARDS

All moving parts of prime movers, transmission equipment and all dangerous parts of driven machines shall be effectively guarded, unless so constructed or located as to prevent any person or object from coming or being brought into contact with them.

REGULATION 61. BUILT-IN SAFETY

1. When an employer orders machinery, machine parts or other working equipment, he shall specify in his order that such machinery, parts or equipment shall be provided with all the protective devices required by the safety regulations for any dangerous part thereof: Provided that in cases where it is impossible to anticipate the type of protective device required for special operations, such device may be obtained elsewhere.

2. Manufacturers, vendors and hirers of machinery, machine parts or other working equipment shall be responsible for seeing that every article delivered, sold or let on hire by them is provided with all the protective devices as required by paragraph 1 of this Regulation.

3. Employers installing new machinery, machine parts or other working equipment, and persons or firms in charge of the erection or installation of such machinery, parts or equipment shall see that all the machines, parts of machines and other working equipment installed or erected by them are so placed and so guarded as to be in full conformity with the safety regulations.

REGULATION 62. REMOVAL OF GUARDS

1. No person or persons shall remove or make ineffective any safeguard, safety appliance, or safety device guarding a dangerous machine or machine part except when the machine is stopped and for the purpose of immediately repairing or adjusting such machinery, guard, appliance or device.

2. Upon completion of the repairs or adjustments, such guard, appliance or device shall immediately be replaced.

REGULATION 63. DEFECTIVE MACHINERY OR GUARDS

1. Defects or deficiencies in a machine, guard, appliance, or device shall be reported promptly by the operator or any other employee of the establishment.

2. The power shall be turned off, and the controlling device shall be locked or a conspicuous notice shall be placed on the machine, prohibiting its use until the necessary adjustments or repairs have been made and the machine is again in good working condition.

Section 2. Prime Movers**REGULATION 64. FLYWHEELS**

1. Flywheels of prime movers shall be securely guarded.

2. Where barring of a flywheel may be necessary, provision shall be made for this to be done on the periphery of the wheel through a slot in the guard.

3. An adjustable guard should be provided at flywheels of gas or oil engines when necessary for starting the engine or for running adjustments. A slot opening for starting purposes may be permitted.

REGULATION 65. CRANKS AND RODS

Cranks, crossheads, connecting rods and tail rods or extension piston rods shall, unless protected by construction or location, be enclosed with guards of standard construction or guarded with standard railings.

REGULATION 66. SPEED-LIMITING DEVICES

Governors

1. All prime movers, except prime movers not connected by shafting, couplings or gears to a constant load, and reversing engines without flywheels, shall be equipped with effective governors to control automatically the speed of the prime mover under varying loads.

Automatic Stops

2. Governors shall be provided with automatic stopping devices to shut off the driving medium if the governor fails to function.

3. Prime movers not equipped with governor stops shall be provided with independent automatic speed-limiting devices.

Ball Guards

4. Revolving governor balls when so placed as to constitute a source of danger shall be guarded with enclosures of standard construction, extending to the top of the governor balls when at their highest position.

REGULATION 67. EMERGENCY STOPS

Speed-limiting devices, safety stops or emergency shut-off valves shall be provided with remote controls, so that in an emergency the prime mover may be shut down from a safe place.

REGULATION 68. PASSAGEWAYS

If passage over a journal or bearing of a prime mover is necessary, the passageway shall be guarded with standard railings and toeboards.

REGULATION 69. WATERWHEELS AND TURBINES

The head race and tail race of waterwheels and turbines shall, unless protected by location, be securely guarded with standard railings and toeboards.

Section 3. Mechanical Power Transmission Equipment**REGULATION 70. ISOLATED EQUIPMENT**

When shafting, belts and pulleys are located in basements, towers, or rooms used exclusively for power-transmission equipment, the requirements for safeguarding may be waived if—

- (a) the basement, tower or room is kept locked against unauthorised entrance at all times when the machinery is in motion;
- (b) the vertical clearance in passageways between the floor and the ceiling or other overhead objects is not less than 1.7 m (67 in.);
- (c) adequate lighting is provided and the footing is dry, firm and level; and
- (d) the route followed by the oiler is protected in such a manner as to prevent accidents.

REGULATION 71. SHAFTING*Guarding Horizontal Shafting*

1. Without prejudice to the provisions of Regulation 60, all exposed parts of horizontal shafting 2.6 m (8 ft. 6 in.) or less above the floor or working platform, except service runways used only for oiling or running adjustments, shall be guarded with—

- (a) casings enclosing the shafting completely; or
- (b) casings in the form of a trough enclosing either the top and both sides or the bottom and both sides of the shafting, as the location requires; the sides of the casings shall extend a distance below the bottom of the shaft at least equal to the diameter of the shaft and to a point not more than 15 cm (6 in.) above the floor.

2. Guards of horizontal shafting shall conform to the provisions of Regulations 82 to 89; in existing installations standard railings may be permitted if they are placed not less than 30 cm (12 in.) or more than 50 cm (20 in.) from any moving part.

Shafting Over Roadways

3. Transmission shafting extending over roadways shall be protected if it is less than 2 m (6 ft. 6 in.) above the highest point of the load of vehicles passing underneath.

Shafting Under Machines

4. Exposed shafting under bench machines shall be guarded with casings enclosing the shafting completely, or with a trough enclosing the top and sides of the shafting, as the location requires.

5. If the shafting is located near the floor, the sides of the trough shall come within 15 cm (6 in.) of the floor.

6. The sides of the trough shall extend at least 5 cm (2 in.) or a distance equal to the diameter of the shaft, whichever is the greater, below the shaft.

7. Guards shall conform to the provisions of Regulations 82 to 89.

Guarding Vertical or Inclined Shafting

8. Exposed vertical or inclined shafting 2.6 m (8 ft. 6 in.) or less above any floor or working platform other than a service runway shall be enclosed with stationary casings, constructed as specified in Regulations 82 to 89.

Guarding Shaft Ends

9. Projecting shaft ends shall be guarded by non-rotating cups or safety sleeves.

REGULATION 72. COLLARS AND COUPLINGS

Collars

1. Revolving collars shall be cylindrical and without projecting parts.

Couplings

2. Shaft couplings located 2.6 m (8 ft. 6 in.) or less above the level of the floor or working platform shall be securely guarded.

REGULATION 73. SETSCREWS, KEYS AND OTHER PROJECTIONS,
AND KEYWAYS*Setscrews*

1. All setscrews in moving parts, wherever located, shall be made flush, countersunk, or protected with safety sleeves or a stationary enclosure.

Revolving Projections

2. All keys, bolts, grease cups and other projections in revolving parts shall be made flush, or so enclosed as to prevent persons from coming into contact with such projections.

Keyways

3. Unused keyways shall be filled up or enclosed.

REGULATION 74. FRICTION DRIVES

The driving point of all friction drives, when exposed to contact, shall be guarded, and all arm or spoke friction drives or web friction drives with holes in the web shall be entirely enclosed with standard guards.

REGULATION 75. CLUTCHES

1. Clutches, and clutch pulleys with projecting parts, located 2.6 m (8 ft. 6 in.) or less above the floor or working platform, or less than 90 cm (3 ft.) from a hand-oiled bearing, shall be enclosed with standard guards other than "U" type guards constructed as specified in Regulations 82 to 89.

2. The shifting part of jaw clutches shall be attached to the driven shaft, that is to say the shaft that will be idle when the clutch is disengaged.

REGULATION 76. GEARS

1. Exposed power-driven gears shall be guarded in one of the following ways:

- (a) with a complete enclosure;
- (b) if the gear wheels are of the solid disc type, with a band guard covering the face of the gear and having flanges extending inward beyond the root of the teeth on the exposed side or sides.

2. Hand-operated gears shall be guarded in a manner similar to that prescribed for power-driven gears whenever they present a hazard.

REGULATION 77. SPROCKETS AND CHAINS

Power-driven sprocket wheels and chains shall, unless guarded by location, be completely enclosed.

REGULATION 78. PULLEYS

Guarding Requirement

1. Pulleys, any parts of which are located 2.6 m (8 ft. 6 in.) or less above the floor or working platform and exposed to contact, shall be guarded with complete enclosure when the belt or rope is

entirely enclosed, or with partial enclosure extending from the bottom to at least the top of the pulley on all unprotected sides except the tops and bottoms of pulleys carrying vertical or inclined belts or ropes.

2. Guards shall conform to the provisions of Regulations 82 to 89.

3. Pulleys serving as flywheels, on which the point of contact between belt and pulley is more than 2.6 m (8 ft. 6 in.) from the floor or platform, may be guarded with a disc guard covering the spokes.

4. Pulleys more than 15 cm (6 in.) in diameter and located on a line or countershaft 90 cm (3 ft.) or less from a hand-oiled bearing shall be completely guarded on the side nearest the bearing.

Damaged and Idle Pulleys

5. Pulleys with cracks or with pieces broken out of the rim shall not be used.

6. Pulleys which are permanently out of service shall not be allowed to remain on shafting which is in use.

Exposure to Moisture

7. Composition or laminated wood pulleys shall not be installed where they are continuously subjected to the action of moisture.

Exposure to Corrosion

8. Pulleys used where conditions are such as to produce active corrosion should be of corrosion-resisting material.

Crowned Faces

9. Both driving and driven pulleys carrying a non-shifting belt should have crowned faces.

Alignment

10. Pulleys shall be kept in proper alignment to prevent belts from running off.

Belt Stops

11. Unless the distance to the nearest fixed pulley, clutch or hanger exceeds the width of the belt used, a stop shall be provided to prevent the belt from leaving the pulley on the side where insufficient clearance exists.

12. Where there are overhanging pulleys on line or countershafts with no bearing between the pulley and the end of the shaft, a stop or hanger shall be provided.



[New text of paragraph 22: new paragraph 23.]

22. (1) The need for applying dressing to belts or ropes shall be obviated as far as practicable by proper selection, layout and maintenance.

(2) Where dressing is necessary it shall be applied only where the belts or ropes leave the pulleys; the block of dressing should be applied by means of a long or short holder according to the position of the belt.

Inspection of Belts

23. An inspection of belts from end to end should be made periodically.

REGULATION 79. BELT, ROPE AND CHAIN DRIVES

Guarding Requirement

1. Belt, rope or chain drives located 2.6 m (8 ft. 6 in.) or less above the floor or working platform shall be guarded except in the case of—

- (a) belts, ropes or chains the location of which effectively prevents persons or their clothing from coming into contact with them;
- (b) flat belts 25 mm (1 in.) or less in width and round belts 10 mm ($\frac{3}{8}$ in.) or less in diameter.

2. Guards shall conform to the provisions of Regulations 82 to 89.

Horizontal Belts

3. Where the lower run of a horizontal belt is 2.6 m (8 ft. 6 in.) or less above the floor or working platform, the guard shall extend to at least 38 cm (15 in.) above the top run or to a height of 2.6 m (8 ft. 6 in.), whichever is the least, and shall be not less than 1.06 m (42 in.) in height unless the belt is completely enclosed.

4. Horizontal belts 13 cm (5 in.) or more in width and with both runs more than 2.6 m (8 ft. 6 in.) above the floor or platform shall be guarded under their entire length if located over a passageway or a workplace and running at a speed of 9 m/sec. (1,800 ft./min.) or more and the distance between the centres of the pulleys is 3 m (10 ft.) or more.

5. The guards should follow the line of the pulley to the ceiling or be carried to the nearest wall.

6. If the location of the belt makes it impracticable to carry the guard to the ceiling or wall, the guard shall enclose completely the top and bottom runs of the belt and the face of the pulleys.

7. Overhead belt guards shall be at least $1\frac{1}{4}$ times as wide as the belts which they protect up to but not exceeding 15 cm (6 in.) on each side, and shall be adequate in strength to contain the belt in the event of breakage.

8. Where the upper and lower runs of horizontal belts are so located that passage of persons between them would be possible—

- (a) the passage shall be completely barred against use by standard railings or other substantial barriers; or
- (b) there shall be provided over the lower run a solid platform guarded on either side with a solid barrier or with a railing completely filled in with mesh or other filler; and the upper run shall be provided with a guard which will prevent contact with it by either the worker or the objects carried and which is adequate in strength to contain the belt in the event of breakage.

Overhead Rope, Chain and Link Drives

9. Overhead rope drives, and chain or link drives where the chain exceeds 5 cm (2 in.) in width, shall be guarded in the same manner as horizontal overhead belts, except that the guards shall be not less than 15 cm (6 in.) wider than the drive on each side.

10. (1) Rope drives so located that the condition of the rope, particularly the splice, cannot be observed conveniently, shall be equipped with a telltale device, preferably of the electric bell type, which will give warning when the rope begins to fray.

(2) This device shall be guaranteed to function even if it has not been in use for a long time.

Vertical or Inclined Drives

11. Vertical or inclined belt, rope and link drives shall be enclosed to the upper pulley, sheave, or sprocket guard, or to a height of not less than 2.6 m (8 ft. 6 in.) above the floor or platform, or shall be guarded with standard railings.

12. Vertical or inclined belts, ropes and links running over a lower pulley, sheave, or sprocket more than 2.6 m (8 ft. 6 in.) above the floor, shall be guarded at the bottom in the same manner as horizontal overhead belts, if located over a passageway or a workplace and running at a speed of 9 m/sec. (1,800 ft./min.) or more.

Cone Pulley Belts

13. When the nip-points of cone belts and pulleys located more than 1 m (40 in.) above the floor or platform are not adequately guarded by frames of belt shifters, they shall be guarded with a vertical guard, placed in front of the pulley and extending at least to the top of the largest step of the cone.

14. If the cone is located less than 1 m (40 in.) above the floor or platform, the cone pulley and belt shall be guarded to a height of 1 m (40 in.) regardless of whether the belt is shifted by a belt shifter or by hand.

Belt Tighteners

15. Suspended counterbalanced tighteners shall be of substantial construction and securely fastened.

16. Bearings for tighteners shall be securely capped.

17. Means, such as cables or chains fastened to some substantial overhead object, shall be provided to prevent tighteners from falling in case the belt breaks.

18. Suspended counterweights shall, unless guarded by location, be encased.

Use of Belts

19. Endless belts should be used wherever possible; where this is not practicable the belts should be laced with rawhide, leather or other suitable non-metallic lacing.

20. Metal lacing, belt hooks or rivets shall not be used on cone pulley belts that must be shifted by hand, and should not be used on other belts unless absolutely necessary in emergencies.

21. Belts or ropes shall not be replaced on pulleys or taken off pulleys by direct hand method while the pulleys are in motion.

22. The need for applying dressing to belts or ropes should be obviated by proper selection, layout and maintenance; where dressing is necessary it shall be applied only where the belts or ropes leave the pulleys.

REGULATION 80. BEARINGS AND OILING DEVICES

Bearings

1. Bearings shall be kept in alignment and properly adjusted.

Oiling Devices

2. Machinery shall not be oiled by hand when in motion if this would expose the operator to risk of injury.

3. Bearings which cannot be reached directly without risk shall, unless they are of the ball or roller type or of the self-lubricating type or connected with a central oiling system, be provided with extension oil or grease pipes terminating in readily accessible and non-hazardous locations.

4. Overhead line-shaft bearings shall not be oiled by hand while the shafting is in motion, except from service runways or platforms or by means of long-spout force-feed oil cans.

5. Loose pulleys should, unless self-oiling, have devices arranged to permit oiling in any position when the machinery is shut down.

6. Where an excess of oil cannot be avoided, drip cups or drip pans shall be provided. If suspended beneath overhead bearings such cups shall be securely fastened.

REGULATION 81. POWER CONTROL

Control Requirement

1. Every power-driven machine not driven by an individual motor or prime mover shall be equipped with a clutch, a loose pulley or other adequate means of stopping the machine quickly and starting it, which shall be immediately accessible to the operator.

Switches

2. (1) Electric switches shall be of such form and placed in such position as to render it as difficult as possible to actuate them inadvertently by contact with persons or objects.

(2) Electric switches with horizontal levers should not be used. If such switches are used and are placed in such a position that persons or objects can come into accidental contact with the lever, the lever shall be guarded.

Buttons

3. Starting buttons shall—

- (a) be countersunk or otherwise protected against inadvertent contact; and
- (b) not be placed with the head turned upwards unless the head is securely covered.

4. Stopping buttons shall be one or more in number according to the working position of the operator or operators.

5. Starting buttons shall be made of green material and stopping buttons of red material, except as provided in paragraph 8 of this Regulation.

6. (1) Where there is more than one operator to a machine, each operator shall be provided with control buttons for starting and stopping the machine, and the machine shall not operate until all starting buttons are simultaneously depressed. This is especially applicable to such machines as power presses, power brakes, etc.

(2) Adequate steps shall also be taken to ensure that no other person is in the danger zone.

7. Machines driven by two or more motors with separate push button controls shall be equipped with one or more main stopping buttons by means of which the whole machine can be stopped.

8. In the case referred to in paragraph 7 of this Regulation special buttons for individual motors shall not be coloured red.

Brake

9. Heavy machines that continue to run after the power has been cut off shall in addition be provided with an effective brake. Such brake shall be automatic where it is necessary to prevent danger.

Belt Shifters

10. Every pair of fast and loose pulleys shall be equipped with a permanent belt shifter provided with mechanical means to prevent the belt from creeping from the loose to the fast pulley.

11. Mechanical belt shifters shall be equipped with a positive locking device which normally shall be in the "Off" position.

Clutch and Belt-Shifter Handles

12. Every clutch or starting device shall be equipped with a permanent operating handle located outside the guards.

13. Belt-shifter and clutch handles shall be rounded and be located as far as possible from danger of accidental contact while remaining within easy reach of the operator.

14. Belt-shifter handles should not be located directly over any place where persons work or pass.

15. The handles of all clutch and belt shifters of the same type in each shop, except handles with three positions, should move in the same direction to stop the machine, either all right or all left.

Pedals

16. Where a pedal is used to operate a clutch or belt shifter, it shall be so guarded that it cannot be struck accidentally so as to start the machine.

Belt Poles

17. The use of belt poles as substitutes for mechanical shifters should be avoided.

18. Where necessity compels the use of belt poles for shipping of overhead belts, they should be of sufficient size to enable workers to grasp them securely, such as 50 mm (2 in.) in diameter or 38 by 50 mm (1½ by 2 in.) in cross section.

19. Poles should extend from the top of the pulley to within about 60 cm (2 ft.) from the floor.

20. When a belt is being unshipped it should always be thrown off the driving pulley, not the driven pulley.

Belt Perches

21. Where loose pulleys or idlers are not practicable, belt perches in the form of brackets, rollers or other devices shall be used to prevent idle belts from resting on shafts.

22. Perches shall be substantially made and so designed that the shipping of belts to and from them can be safely accomplished.

Emergency Stops

23. In addition to the stopping device at each machine there shall be provided in each room, section or department, emergency stops or switches, properly marked and easily accessible, by which each complete and separate unit of power transmission therein can be quickly stopped.

Warning Signals

24. Unless all machinery can be readily seen from its control station, effective signalling equipment shall be installed and used to give ample warning before starting the machinery.

Section 4. Standard Machinery Guards**REGULATION 82. GUARDS***General Provisions*

1. Guards should be so designed, constructed and used that they will—

- (a) provide positive protection;
- (b) prevent all access to the danger zone during operations;
- (c) cause the operator no discomfort or inconvenience;
- (d) not interfere unnecessarily with production;
- (e) operate automatically or with minimum effort;
- (f) be suitable for the job and the machine;
- (g) preferably constitute a built-in feature;
- (h) provide for machine oiling, inspection, adjustment and repair;
- (i) withstand long use with minimum maintenance;
- (j) resist normal wear and shock;
- (k) be durable, fire- and corrosion-resistant;
- (l) not constitute a hazard by themselves (without splinters, sharp corners, rough edges, or other sources of accidents); and
- (m) protect against unforeseen operational contingencies, not merely against normally expected hazards.

Materials

2. Standard guards or enclosures shall be made—

- (a) of metal castings, or of solid, perforated or expanded metal, or woven wire on a frame of angle iron, iron pipe, or solid rod; or
- (b) of wood, plastic or other material suitable for the purpose for which it is to be applied.

Anchoring

3. All guards shall be securely fastened to the machine or to the floor, wall or ceiling and shall be kept in place whenever the machine is operating.

REGULATION 83. FRAMEWORK*General Provisions*

1. The following are minimum advisory standards for the construction of guards. When existing nationally recognised available standards are more stringent, they should be followed in preference to those given herein.

[Paragraph 1: new text of subparagraph (j).]

- (j) resist normal wear and shock and not easily be rendered inoperative;



Small Guards

2. Minimum dimensions of materials for the framework of metal guards 75 cm (30 in.) or less in height and with a surface area not exceeding 1 m² (10 sq. ft.) shall be 1 cm ($\frac{3}{8}$ in.) for solid rod, 20 by 20 by 3 mm ($\frac{3}{4}$ by $\frac{3}{4}$ by $\frac{1}{8}$ in.) for angle iron.

3. Other construction of equal strength may be substituted for guards of the same areas as mentioned in paragraph 2.

Braced Guards

4. Minimum dimensions of materials for the framework of guards more than 75 cm (30 in.) in height and with a surface area exceeding 1 m² (10 sq. ft.) shall be 25 by 25 by 3 mm (1 by 1 by $\frac{1}{8}$ in.) for angle iron or 20 mm ($\frac{3}{4}$ in.) inside diameter for metal pipe.

5. Other construction of equal strength may be substituted for guards of the same areas as mentioned in paragraph 4.

6. Such guards should be rigidly braced every 90 cm (3 ft.) or fractional part of their height to some fixed part of machinery or building structure.

Unbraced Guards

7. When a guard is fastened to the floor or working platform without any other support or bracing, the framework should be—

- (a) not less than 38 by 38 by 3 mm ($1\frac{1}{2}$ by $1\frac{1}{2}$ by $\frac{1}{8}$ in.) for angle iron;
- (b) 38 mm ($1\frac{1}{2}$ in.) diameter for metal pipe; or
- (c) of other metal construction of equal strength.

8. Rectangular guards should have at least four upright frame members, each of which shall be securely fastened to the floor.

9. Cylindrical guards should have at least three supporting members carried to the floor.

Joints

10. All framework joints should be made equivalent in strength to the materials of the frame.

Horizontal Overhead Belt Guards

11. Framework of guards for horizontal overhead belts, ropes, or chains more than 2.6 m (8 ft. 6 in.) above the floor or platform if of angle iron, should be at least—

- (a) 25 by 25 by 5 mm (1 by 1 by $\frac{3}{16}$ in.) for belts up to 25 cm (10 in.) in width;
- (b) 38 by 38 by 6 mm ($1\frac{1}{2}$ by $1\frac{1}{2}$ by $\frac{1}{4}$ in.) for belts over 25 up to 35 cm (10 to 14 in.) in width;

- (c) 50 by 50 by 8 mm (2 by 2 by $\frac{5}{16}$ in.) for belts over 35 up to 60 cm (14 to 24 in.) in width; and
- (d) 80 by 80 by 10 mm (3 by 3 by $\frac{3}{8}$ in.) for belts over 60 cm (24 in.) in width.

12. Guard supports, if of flat iron, should be of the following dimensions:

- (a) 38 by 6 mm ($1\frac{1}{2}$ by $\frac{1}{4}$ in.) for belts up to 25 cm (10 in.) in width;
- (b) 50 by 8 mm (2 by $\frac{5}{16}$ in.) for belts over 25 up to 35 cm (10 to 14 in.) in width;
- (c) 50 by 10 mm (2 by $\frac{3}{8}$ in.) for belts over 35 up to 60 cm (14 to 24 in.) in width; and
- (d) 65 by 10 mm ($2\frac{1}{2}$ by $\frac{3}{8}$ in.) for belts over 60 cm (24 in.) in width.

13. All guards should be provided with an adequate number of supports and attachments so as to ensure sufficient rigidity and resistance.

REGULATION 84. FILLERS

Minimum Dimensions of Materials

1. Fillers should be made of solid sheet metal not less than 0.8 mm (0.03 in.) in thickness, perforated sheet metal not less than 1 mm (0.04 in.) in thickness, expanded metal not less than 1.25 mm (0.05 in.) in thickness, or woven wire not less than 1.5 mm (0.06 in.) in diameter.

2. Fillers of other material of equal strength for the same areas may be substituted.

Woven Wire

3. Woven wire should be of the type in which the wires are securely fastened at every crosspoint by welding, soldering, or galvanising, except in the case of diamond or square wire mesh made of wire 2 mm (0.08 in.) in diameter, 20 mm ($\frac{3}{4}$ in.) mesh, or heavier.

Fastenings

4. Filler materials should be securely fastened to angle-iron framework with rivets or bolts, by welding, or by weaving through the frames.

5. Wire mesh made of wire 2 mm (0.08 in.) in diameter, 20 mm ($\frac{3}{4}$ in.) mesh, or heavier, may be bent entirely around rod frames.

6. Filler material for pipe frames should be made into panels with rolled edges or bound with sheet metal, and the panels shall be fastened to the frames with steel clips.

Filler Openings

7. Where guards or enclosures are within 10 cm (4 in.) from moving parts of machinery at all points, no mesh or opening should be more than 6 mm ($\frac{1}{4}$ in.) in width.

8. Where the clearance is between 10 cm (4 in.) and 38 cm (15 in.) no mesh or opening should be more than 13 cm² (2 sq. in.) in area.

REGULATION 85. HEIGHT OF GUARDS

Except as provided for specific installations, the minimum height of guards should be 1.8 m (6 ft.) from the floor or platform level.

REGULATION 86. FLOOR CLEARANCE

If practicable without permitting exposure of moving parts, guards should clear the floor by about 15 cm (6 in.), to prevent interference with cleaning around machines.

REGULATION 87. INTERLOCKS

Where practicable, guards on power-driven machines should be interlocked with the machine control so as to prevent operation of the machine unless the guard is in its proper position, or so arranged that it is difficult to operate the machine until the guard is replaced.

REGULATION 88. "U" GUARDS

1. "U" guards should be constructed of materials specified for fillers in Regulation 84.

2. Edges shall be smooth and, if the size of the guard requires, be reinforced by rolling or wiring or by binding with angle or flat metal.

REGULATION 89. WOOD GUARDS*Material*

1. Wood used for guards shall be sound, tough, and free from any loose knots.

Construction

2. Wood guards shall be made of planed lumber not less than 25 mm (1 in.) rough board measure, or of plywood or fabricated products of equal strength, and the edges and corners shall be rounded off.

3. Wood guards shall be securely fastened together with wood screws, hardwood dowel pins, bolts, rivets, or crimped nails, and shall be equal in rigidity to metal guards fulfilling the requirements of Regulations 82, 83 and 84.

Section 5. Machine Guarding, at Point of Operation**REGULATION 90. GENERAL PROVISIONS**

1. As far as practicable, the point of operation of working machines shall be effectively guarded.

2. Particular attention should be paid to old-type machines, which were constructed without adequate provision for protection of the workers.

3. Where practicable, mechanical feeding and ejection devices should be provided.

4. Individual starting and stopping devices shall be provided on every working machine having a cutting, drawing, grinding, pressing, punching, shearing or squeezing action, so as to make it possible for the operator to start or stop the machine without leaving his working position.

5. Enclosure guards, where used, shall conform to the provisions of Regulations 82 to 89: Provided that where visibility of operations is desirable the fillers for the guards covering points of operation may be of clear transparent material where the strength and rigidity of standard fillers is not necessary.

6. Where pedals are used to actuate machines or parts of machines, an automatic locking device shall be attached to the pedal or an inverted U-shape guard shall be fastened to the floor over the treadle, leaving sufficient clearance for the foot of the operator between the treadle and the guard.

**REGULATION 91. ABRASIVE GRINDING, POLISHING
AND BUFFING EQUIPMENT***Definitions*

1. In this Regulation the following terms have the meanings hereby assigned to them:

- (a) the term "abrasive wheel" means a power-driven, rotatable wheel, except a disc wheel as defined in subparagraph (c), composed of abrasive particles held together by artificial or natural mineral or organic bonding and used for grinding purposes;
- (b) the term "cutting wheel" means an organic-bonded abrasive wheel of either solid, steel-centred, or inserted-tooth type, the thickness of which is not more than $\frac{1}{48}$ of its diameter for wheels up to 50 cm (20 in.) in diameter or not more than $\frac{1}{60}$ of this diameter for larger wheels, and which is used for coping, cutting, grooving, jointing or slotting operations;

[New paragraph 7.]

7. The moving parts of protective devices, such as doors, cylinder covers and fly-wheel covers, the weight of which might cause danger to the personnel, shall be balanced so that their movement cannot cause shock or dangerous pressures.



- (c) the term " disc grinder " means a power-driven, rotatable disc faced with bonded abrasives, mounted on either a horizontal or a vertical spindle and used for grinding or polishing metal or other surfaces on the face of the disc;
- (d) the term " grindstone " means a power-driven, rotatable wheel composed of natural or artificial sandstone, including a metal wheel or cylinder fitted with blocks of natural or artificial sandstone, and used for grinding purposes;
- (e) the term " polishing wheel " means a power-driven, rotatable wheel composed in whole or in part of textile fabric, felt, leather, paper, wood or other material, with a glued coating of abrasive particles on the periphery of the wheel, and used for polishing or light grinding of metal or other materials;
- (f) the term " buffing wheel " means a power-driven, rotatable wheel composed of laminated felt or cotton-sheeting discs with mild abrasive compounds applied loosely on the periphery of the wheel, and used for obtaining highly-finished surfaces on metal or other materials;
- (g) the term " belt grinder " means a machine tool equipped with a power-driven flexible, abrasive-coated belt, used for polishing or light grinding of metal or other surfaces;
- (h) the term " sanding machine " means a machine equipped with a power-driven belt, disc or drum covered with sandpaper or other abrasive-coated material, and used for smoothing and polishing wooden surfaces;
- (i) the term " tumbling barrel " means a power-driven, rotatable or reciprocating cylinder, mounted on a frame and used for cleaning and polishing small castings or other parts, etc., by tumbling them against one another with or without added cleaning or abrading materials.

General Provisions

2. (1) Every care shall be taken to position abrasive wheels so as to reduce to a minimum the damage resulting from violently projected fragments of the wheel if the wheel should burst. When the work allows, the direction of rotation of the wheel shall also be determined by the same consideration.

(2) All floor stands for grinding, polishing or buffing equipment shall be rigidly constructed, sufficiently heavy for the wheels, discs, tables, or drums used, and securely mounted on substantial foundations to withstand vibration.

3. Bearing boxes on grinding, polishing or buffing equipment shall be of sufficient length to provide an ample bearing surface, and shall be adjustable for take-up.

4. Bearings on grinding, polishing or buffing equipment shall be kept properly adjusted and well lubricated.

5. Protection for the heads and eyes of workers on or around grinding, polishing or buffing equipment shall be provided, and

used, and the protective devices shall comply with the requirements of Chapter XIV of this Code.

6. Suitable hoods, properly connected to exhaust systems that will effectively remove at their point of origin the dust and dirt particles generated, shall be provided for equipment used in grinding, polishing or buffing operations, except where—

- (a) a liquid is used at the point of grinding, polishing or buffing contact;
- (b) the equipment is used occasionally only for grinding tools used in a shop and such occasional use of the total equipment does not exceed the equivalent of one operator for a period of two hours in every consecutive eight hours.

7. Where suction hoods on grinding, polishing or buffing equipment form all or part of the machine guards, they shall be of sufficient strength to serve effectively the purpose of guards.

8. Suction hoods and exhaust systems shall conform to the provisions of Section 2 of Chapter XIII of this Code.

Protective Devices for Abrasive Wheels

9. Abrasive wheels, except wheels used for internal grinding or wheels 50 mm (2 in.) or less in diameter, shall be provided with the most efficient protection against injury from wheel breakage that the work will permit.

10. Protection hoods shall be used on abrasive wheels wherever possible.

11. Where the employment of hoods on abrasive wheels will interfere with the work, protection flanges shall be provided and where cup, cylinder or sectional ring wheels are used, protection chucks or bands may be substituted.

Protection Hoods

12. Protection hoods for abrasive wheels, which may also serve as exhaust hoods, shall consist of a peripheral band and two side members, securely connected and enclosing the wheel as closely as the work will permit, including spindle ends, nuts, and flange projections.

13. Protection hoods for abrasive wheels shall be so constructed that it is not necessary when changing wheels to detach the peripheral band from the side member which is connected to the machine.

14. Hoods for abrasive wheels over 15 cm (6 in.) in diameter shall be made of cast steel or fabricated from wrought iron, steel castings or structural steel; for wheels 15 cm (6 in.) or less in diameter, use may be made of materials such as malleable iron or aluminium where they are shown to have sufficient toughness for the purpose.

15. Protection hoods for abrasive wheels shall be of sufficient strength to withstand the impact of and retain the pieces of the wheel should it break in operation; steel castings not less than 10 mm ($\frac{3}{8}$ in.) thick or structural steel not less than 5 mm ($\frac{3}{16}$ in.) thick may be considered adequate for hoods housing wheels over 30 cm (12 in.) and not more than 40 cm (16 in.) in diameter and 10 cm (4 in.) in thickness.

16. Protection hoods for cutting wheels more than 30 cm (12 in.) in diameter, 12 mm ($\frac{1}{2}$ in.) or less in thickness, and operated at 70 m/sec. (14,000 ft./min.) or more, shall be fabricated of structural steel ranging from 3 to 6 mm ($\frac{1}{8}$ to $\frac{1}{4}$ in.) in thickness.

17. The distance between new abrasive wheels and the inside of the peripheral bands shall not exceed 38 mm ($1\frac{1}{2}$ in.), and the inside width of the hoods shall not exceed the thickness of the wheels by more than—

(a) 38 mm ($1\frac{1}{2}$ in.) for wheels less than 30 cm (12 in.) in diameter; and

(b) 50 mm (2 in.) for wheels 30 cm (12 in.) or more in diameter.

18. Protection hoods for abrasive wheels shall be so constructed that the peripheral band can be adjusted to the constantly decreasing diameter of the wheel by means of an adjustable tongue, or its equivalent, so that the angular protection specified in paragraphs 19 to 23 of this Regulation will be maintained throughout the working life of the wheel and the maximum distance between the wheel periphery and the tongue or the end of the peripheral band at the top of the opening will at no time exceed 6 mm ($\frac{1}{4}$ in.).

19. On bench and floor stands for abrasive wheels the top of the opening in the hood exposing the face of the wheel shall not be more than 65° above the horizontal plane of the spindle, and the exposure ordinarily shall not exceed 90° but may be increased to 125° where the nature of the work requires contact with the wheel below the horizontal plane of the spindle.

20. In operations where the grinding is done on the tops of abrasive wheels, the opening in the hood shall be as small as possible and shall not exceed 60° .

21. On cylindrical grinding machines the top of the opening in the hood shall not be more than 65° above the horizontal plane of the spindle, and the exposure shall not exceed 180° .

22. On cutting machines, and on surface grinding machines that employ the wheel periphery, the top of the opening in the hood shall not be less than 15° below the horizontal plane of the spindle, and the exposure shall not exceed 150° .

23. On swing-frame and portable grinding machines the top half of the wheels shall be protected at all times, and the exposure shall not exceed 180° .

24. Protection hoods for abrasive wheels shall be so mounted as to maintain proper alignment with the wheels, and the strength of the fastenings shall exceed the strength of the hood.

25. Where coolants are used on abrasive wheels, the hoods should be designed to ensure proper drainage of the coolants.

26. Centreless grinding machines shall be provided with hoods for both grinding and regulating wheels.

Additional Enclosure

27. All cutting machines which are so designed that the material being cut travels under the wheel or the wheel travels above the material permitting a relative horizontal traverse between the wheel and the work of more than 25 cm (10 in.) and which use solid cutting wheels 25 cm (10 in.) or more in diameter, shall be provided, in addition to the protection hood, with an enclosure so arranged that it surrounds the working parts of the machine when it is in operation; such enclosure may consist of a set of heavy screen panels suspended from above and extending from a height of approximately 2.5 m (8 ft.) above the floor to or below the level of the table on which the work is placed.

Flanges

28. Abrasive wheels, unless mounted in chucks, cemented to metal backs, or otherwise securely mounted on spindles, shall be mounted between flanges.

29. Tapered flanges shall be of steel.

30. The two flanges for the same wheel shall be of the same diameter, and the bearing surfaces shall be so designed that, when tightened up, full annular contact with the wheel will be assured.

31. Straight or tapered flanges shall be recessed at least 1.5 mm ($\frac{1}{16}$ in.) on the side next to the wheel, leaving bearing surfaces next to the rim with minimum radial widths ranging from 3 mm ($\frac{1}{8}$ in.) for flanges 25 mm (1 in.) in diameter to 75 mm (3 in.) for flanges 60 cm (24 in.) in diameter, and with maximum widths twice the minimum widths.

32. Straight flanges of the adaptor and sleeve types shall be recessed so that there will be no bearing on the sides of the wheels within 3 mm ($\frac{1}{8}$ in.) of the holes.

33. Where protection hoods are employed, the diameter of straight flanges for straight-sided wheels, with small holes that fit directly on the machine spindles or arbors, shall be not less than one-third the diameter of the wheels.

34. Adaptor flanges for straight-sided wheels with holes larger than the machine spindles or arbors shall be used only in connection with protection hoods, and their diameter shall be not less than—

- (a) 50 mm (2 in.) larger than the hole diameter for wheels up to 60 cm (24 in.) in diameter; or
- (b) 75 mm (3 in.) larger than the hole diameter for wheels over 60 cm (24 in.) in diameter.

35. Sleeve flanges for mounting wheels with holes larger than the machine spindles or arbors on precision grinders shall be used only in connection with protection hoods and their diameter shall be not less than—

- (a) 50 mm (2 in.) larger than the hole diameter for wheels up to 20 cm (8 in.) in diameter; or
- (b) 65 mm (2½ in.) larger than the hole diameter for wheels over 20 cm (8 in.) in diameter.

Protection Flanges

36. Where wheels 16 cm (6 in.) or more in diameter are not provided with protection hoods, chucks, or bands, they shall be mounted between protection flanges, preferably of the tapered type.

37. Protection flanges shall cover all but a rim having a maximum width of—

- (a) 38 mm (1½ in.) on wheels 15 cm (6 in.) in diameter;
- (b) 50 mm (2 in.) on wheels 20 cm (8 in.) in diameter;
- (c) 65 mm (2½ in.) on wheels 25 cm (10 in.) in diameter;
- (d) 75 mm (3 in.) on wheels 30 to 75 cm (12 to 30 in.) in diameter; and
- (e) 100 mm (4 in.) on wheels 90 cm (36 in.) in diameter.

Cup, Cylinder and Sectional-Ring Wheels

38. Cup, cylinder and sectional-ring abrasive wheels shall be—

- (a) protected by hoods; or
- (b) enclosed in protection chucks; or
- (c) surrounded with protection bands.

39. Not more than one fourth of the original height of cup, cylinder or sectional-ring abrasive wheels shall protrude beyond the protection: Provided that—

- (a) where the thickness of the rim of the wheel is less than 50 mm (2 in.), the maximum distance which the wheel may protrude shall not exceed a dimension equal to the thickness of the rim; and
- (b) where the thickness of the rim of the wheel is 50 mm (2 in.) or more, the wheel may protrude not more than 50 mm (2 in.) beyond the protection.

40. Protection hoods used on cup, cylinder and sectional-ring wheels shall conform to the requirements of paragraphs 12 to 26 of this Regulation.

41. Where the chuck which holds a cup, cylinder or sectional-ring wheel is the only protection, it shall be so designed that the jaw will at all times protect the wheel up to the point specified in paragraph 39 of this Regulation.

42. Protection bands for cup, cylinder and sectional-ring wheels shall be made of wrought iron or steel plate, with a minimum thickness of—

- (a) 1.5 mm ($\frac{1}{16}$ in.) for wheels less than 20 cm (8 in.) in diameter;
- (b) 3 mm ($\frac{1}{8}$ in.) for wheels 20 to 60 cm (8 to 24 in.) in diameter; and
- (c) 6 mm ($\frac{1}{4}$ in.) for wheels 60 to 75 cm (24 to 30 in.) in diameter.

43. Protection bands for cup, cylinder and sectional-ring wheels shall be—

- (a) continuous;
- (b) bent to conform as closely to the periphery of the wheel as practicable;
- (c) fastened together so as to leave the inside of the band free from projections; and
- (d) of sufficient width to provide the protection specified in paragraph 39 of this Regulation.

Mounting of Abrasive Wheels

44. Abrasive wheels shall be carefully inspected before mounting to make sure that they have not been injured in transit, storage, or otherwise.

45. In the inspection of abrasive wheels, the wheels should be suspended and tapped gently with a light implement, such as the wooden handle of a screw driver for light wheels, or a wooden mallet for heavy wheels, and if they sound cracked they shall not be used.

46. Washers or flange facings of compressible material shall be fitted between the abrasive wheels and their flanges.

47. The diameter of washers used in mounting abrasive wheels shall not be smaller than the diameter of the flanges, and the thickness shall not exceed 0.65 mm ($\frac{1}{40}$ in.) for blotting paper or 3 mm ($\frac{1}{8}$ in.) for rubber or leather.

48. If flanges with babbitt or lead facings are used, the thickness of the facings shall not exceed 3 mm ($\frac{1}{8}$ in.).

49. All surfaces of abrasive wheels, washers, and flanges in contact with one another shall be free from foreign material.

50. Driving flanges for abrasive wheels shall be keyed, pressed, screwed or shrunk on to the spindles, and the bearing surfaces shall run true and at right angles to the spindles.

51. Abrasive wheels shall neither be forced on the spindles nor be too loose, but shall fit freely, and the soft metal bushings shall not extend beyond the sides of the wheels.

52. Allowance for mounting fit of abrasive wheels shall be made in the wheel holes and not in the wheel mounts.

53. Spindle end nuts shall be tightened only sufficiently to hold the flanges in place against abrasive wheels, as excessive clamping strain is liable to damage the wheels.

54. Where hoods are used on abrasive wheels, care shall be taken to see that the hood is properly replaced after mounting a new wheel.

Spindles

55. (1) Spindles for abrasive wheels shall be made of steel and be of such diameter as to ensure rigidity and freedom from vibration due to flexure.

(2) The minimum diameters of spindles for the various diameters and thickness of abrasive wheels operating at speeds up to 35 m/sec. (7,000 ft./min.) shall be in accordance with the dimensions specified in Tables 1 and 2 of Appendix I of this Code.

56. Heavier spindles shall be used for abrasive wheels operating at speeds exceeding 35 m/sec. (7,000 ft./min.) having regard to the design of the machines, the type of bearings, and the quality of materials and workmanship.

57. An abrasive wheel larger than that specified by the machine manufacturer shall not be used on any machine.

58. Abrasive wheel spindles shall be so threaded that the nuts on both ends will tend to tighten as the spindle revolves.

59. The length of the thread on an abrasive wheel spindle shall be such that, when the wheel is mounted and the spindle nut is tightened against the flange, the full length of the nut bears on the spindle threads.

Work Rests

60. Work rests for abrasive-wheel machines shall be—

- (a) substantially constructed;
- (b) shaped to fit the contour of the wheel; and
- (c) securely fixed in position as close as possible to the wheel, and in no case more than 3 mm ($\frac{1}{8}$ in.) from the wheel.

61. Adjustments of work rests on abrasive-wheel machines shall not be undertaken while the wheels are in motion.

Operating Speed

62. (1) Abrasive wheels shall be tested by the manufacturer at such speeds exceeding the operating speed as are determined by the competent authority.

(2) Tables 3 and 4 in Appendix I to this Code may serve as a guide in determining the speed at which wheels should be operated and tested.

63. (1) An abrasive wheel shall not be operated at a speed in excess of that guaranteed by the manufacturer, which operating speed shall be clearly marked on the wheel.

(2) A wheel on which such speed is not clearly marked by the manufacturer shall not be used.

64. Machine spindle speeds shall be tested and found correct for the size of abrasive wheel to be operated, before the wheel is mounted, and shall not be changed as the wheel is reduced in diameter, except by persons specially assigned for this purpose.

65. Where an adjustable speed motor is used on abrasive-wheel machines, either an interlocking device shall be provided to ensure that the motor cannot be run at a speed excessive for the wheel used, or the control device shall be enclosed in a locked case and the speed changed only by a person authorised to do so.

66. Abrasive wheels used in factories, such as sawmills, where other operations may result in fluctuations of the general power supply which might give rise to overspeeding should be provided with driving power from an independent source that will assure a constant speed.

Operations

67. Work shall not be forced against cold abrasive wheels, as when starting in the morning in cold rooms or on new wheels that have been stored in cold places, but shall be applied gradually, allowing the wheel to warm up so as to avoid the danger of breakage.

68. All abrasive wheels should be run at full operating speed for at least one minute before applying the work, during which period no person shall be permitted to be directly in line with the wheel.

69. Grinding on the flat sides of straight abrasive wheels shall not be permitted, except on wheels designed for side grinding, and care shall be taken to avoid striking the sides of wheels when grinding castings suspended from chain blocks, or during other operations.

70. Abrasive wheels should be tested for balance at least once a week and trued if necessary.

71. Abrasive wheel dressers, except the diamond type, shall be equipped with guards over the tops of the cutters to protect the operators from flying particles.

72. Abrasive wheels used in wet grinding shall never be allowed to stand partly immersed in water, as the water-soaked part may throw the wheel dangerously out of balance.

73. Coolant boxes on wet grinding machines that are not designed so as to provide a constant supply of fresh coolant, shall be thoroughly drained at the end of each day's work and provided with a fresh supply just before starting again.

Disc Grinders for Metal Work

74. Protection hoods for horizontal single-spindle disc grinders shall enclose the whole disc, except for an opening on the grinding side no larger than is required for the work.

75. Protection hoods for horizontal double-spindle disc grinders shall enclose both discs and the grinding chamber, except for openings as small as possible for passing the work through the chamber.

76. Protection hoods for vertical spindle grinders shall cover the top of the disc including the revolving head and as much of the periphery of the disc as the nature of the work will allow.

Grindstones

77. Natural stone wheels should not be used for production purposes where the use of abrasive wheels is practicable.

78. Grindstones should be provided with substantial hoods, in order to minimise the risk of contact with the revolving wheels and the risk of bursting wheels.

79. Grindstones shall be mounted between flanges of generous proportions, which shall be securely fixed to support the stones and connect them rigidly with the arbors.

80. Double thicknesses of leather or rubber should be used for gaskets between the grindstones and each of their flanges, but wooden washers 12 to 25 mm ($\frac{1}{2}$ to 1 in.) in thickness may be substituted.

81. Grindstones shall not be operated at speeds exceeding—

(a) 17.5 m/sec. (3,500 ft./min.) for hard stones; and

(b) 15 m/sec. (3,000 ft./min.) for soft stones.

82. Grindstones shall not be left standing in water as this results in lack of balance.

83. Grindstones should be tested regularly for balance and trued if necessary.

84. Dressing uneven surfaces on revolving grindstones by means of bars, pipes, rods, or strips of metal held against the high spots of the stones should not be permitted.

85. If grindstones are badly worn out of shape, they should be roughly trued by hacking and finished smoothly with wheel dressers.

86. Any dressing of grindstones shall be carried out under efficient exhaust draught to remove the dust.

Polishing and Buffing Wheels

87. Spindles of polishing and buffing wheels shall be so guarded as to prevent contact with them, whether a wheel is mounted on the spindle or not.

88. The diameter of flanges for laminated polishing and buffing wheels ordinarily should be not less than one-third the diameter of the wheels.

89. When applying chromium oxide, iron oxide, lime, tripoli, or other mild abrasives to revolving buffing wheels, the sides of the cakes or sticks should be held lightly against the periphery of the wheels in such manner that they will not be caught on the wheels.

Sanding Machines for Woodworking

90. Belt sanders shall be provided with guards enclosing both pulleys and covering the edges of the unused run of the belts.

91. Disc sanders shall be provided with guards enclosing the revolving discs, except such portion of the working side as may be necessary for the application of the work to be finished.

92. Where tables are used on horizontal-spindle disc sanders—

- (a) all parts below the plane of the table shall be enclosed;
- (b) above the table the peripheries, the backs, and as much as possible of the working faces of the discs shall be enclosed; and
- (c) the spaces between the revolving discs and the edges of the tables shall not be greater than 3 mm ($\frac{1}{8}$ in.).

93. Drum sanders shall be provided with guards enclosing the revolving drums, except such parts above the tables as may be necessary for contact with the work to be finished.

94. Feed rolls on drum sanders shall be provided with semi-cylindrical guards of heavy material, adjustable to the size of stock being finished and firmly secured to the frame of the machine, to prevent the fingers or hands of the operators from coming in contact with the rolls at any point.

95. The delivery side of drum sanders shall be provided with a metal extension of the take-off table, hinged to the frame of the machine so as to prevent the fingers of takers-off from being caught between the stock and the edge of the table when short pieces are being sanded.

96. All types of sanding machines shall be provided with suction hoods properly connected to effective exhaust systems installed in conformity with the provisions of Section 2 of Chapter XIII of this Code.

Tumbling Barrels

97. Horizontal revolving or reciprocating tumbling barrels used for cleaning and polishing shall be enclosed or guarded to sufficient height to prevent any person from coming in contact with the tumblers when they are in motion.

98. Doors or gates to the enclosures shall be so interlocked with the driving machinery of the tumblers that—

- (a) the doors or gates cannot be opened while the tumblers are in motion; and
- (b) the tumblers cannot be started while the doors or gates are open.

99. Tumblers shall be provided with a substantial device, such as a worm gear, rack, barrel, or hand-wheel locking bar, to prevent movement of the drums while being loaded or unloaded.

100. Tumbling barrels shall be—

- (a) dust-tight, and directly connected to efficient exhaust systems for removal of dust; or
- (b) enclosed in dust-tight booths or rooms, connected to efficient exhaust systems.

REGULATION 92. AGITATORS, MIXING MACHINES AND DRUM MIXERS

Definitions

1. In this Regulation the following terms have the meanings hereby assigned to them:

- (a) the term "agitator" means a tank or other container equipped with blades or paddles fixed to revolvable shafts, or other simple mechanical devices, for stirring and mixing liquids with other liquids or with solid substances;
- (b) the term "mixing machine" means a stationary or portable machine equipped with power-driven mixing arms, paddle wheels, or other devices for blending and mixing liquid or solid substances or combinations of these;
- (c) the term "drum mixer" means a power-driven, rotatable, horizontal or vertical cylinder for mixing various substances.

General Provisions

2. Where practicable, all mixing operations involving liberation of dust, fumes, gases, mists or vapours shall be effected in closed apparatus.

Open-Top Agitator and Mixing Tanks

3. When the top of an open agitator tank, beater tank or paddle tank is less than 1 m (40 in.) above the floor or working level, adequate standard railings shall be installed on all open sides.

4. When the top of an open tank is less than 15 cm (6 in.) above the floor level, standard toeboards shall be provided.

Agitating Devices

5. Unless agitating devices are removable or equipped with individual stop controls, they shall be provided with power cut-offs that will prevent the accidental starting of the ploughs, propeller blades or spiral stirrers during cleaning or repair of the containers.

6. Machines with mechanical agitating or stirring devices installed for use with removable bowls shall be provided with interlocks to prevent access to such devices whilst in motion.

Candy Pullers

7. Adequate guards, such as a frame around the base of the machine that will operate a stop switch upon slight pressure, shall be provided for candy pullers to protect workers from contact with the revolving mixing arms which project above the machine.

Dough Mixers in the Food Industry

8. Dough mixers shall be provided with tight-fitting covers of substantial material over the tops of the mixing bowls.

9. Horizontal non-tilting dough mixers provided with fixed covers shall be equipped with valve-controlled feed to and discharge from the mixers.

10. Horizontal non-tilting dough mixers provided with hinged or removable covers shall be equipped with interlocking devices, so arranged that—

- (a) the cover cannot be opened until the blade-driving mechanism has been stopped; and
- (b) the blades cannot be set in motion again until the cover is in place on the mixing bowl.

11. Horizontal tilting-type dough mixers, in which the rotating blades are not used for discharging, shall be provided with interlocking devices or automatic power cut-offs which—

- (a) will disconnect the power from the mixing blades when the bowl starts to tilt; and
- (b) will prevent application of the power again until the bowl has been returned to its operating position.

12. Horizontal tilting-type dough mixers that are cleared by rotating the blades while the bowls are in the tilted or unloading position shall be provided with interlocked covers which will prevent access to the rotating blades while the bowls are in the vertical position but will allow a limited amount of opening of the cover for the discharge of the dough when the bowls are tilted.

13. Cake mixers, cream beaters, marshmallow beaters, chocolate-paste mixers, and other food-industry mixers of the dough-mixer type, which present crushing or shearing hazards between the blades or between the blades and the bowls, shall be equipped with safety devices conforming to the requirements relating to dough mixers in paragraphs 8 to 12 of this Regulation.

Dough-Mixer Types in Other Industries

14. Safety devices, conforming to the provisions for dough-mixers in paragraphs 8 to 12 of this Regulation, shall be provided for mixing machines of the dough-mixer type used in other industries, such as—

- (a) machines for compounding ingredients of lacquers, paints and plastics;
- (b) machines for incorporating raw rubber with sulphur or other fillers;
- (c) machines for mixing asphalt materials in the coating of roofing paper or roofing felt; and
- (d) machines for mixing foundry moulding sand.

15. Where the operations on dough-mixer types of machines in any industry involve the liberation of dust, fumes or gases, the mixers shall be provided with covers.

Sand Mixers

16. Wheel or edge runner mills for mixing foundry moulding sand or similar materials shall be guarded by screen enclosures or by other effective means, such as a properly designed plough guard extending from the centre of the mill to the outer circumference of the path of travel of the wheels to push out of the way any person who happens to be too close to the danger point of the wheels; where the pans of such mills rotate, they shall be guarded by screens extending at least to the height of the edge of the pan.

17. Sand mixers should be self-discharging; if they are not self-discharging, they shall be equipped with discharging gates and workers shall be prohibited from shovelling sand out of the mills during the mixing operation.

18. Sheet-metal cones shall be provided and used for the sampling of sand in sand mixers, and workers shall be prohibited from putting their hands inside the mixers while the blades are in motion.

Pug Mills

19. Pug mills, used for working up ground clay into a homogeneous mass for moulding of brick or pottery, shall be provided with—

- (a) covers projecting at least 10 cm (4 in.) beyond the opening on all sides and placed not more than 20 cm (8 in.) above the machine or floor; or

- (b) substantial gratings, with bars not more than 10 cm (4 in.) apart, covering all openings; or
- (c) hoppers, completely surrounding the opening through which the machine is fed and extending not less than 90 cm (36 in.) above the upper level of the opening.

Beaters

20. Beater engines, such as are used in the pulp and paper industry for hydrating pulp and mixing it with chemicals, or in the chemical industry for pulping cellulose nitrates for use in explosives, lacquers or plastics, shall be provided with covers over the beater rolls, substantial enough to resist the impact of any bars or knives that might be thrown out of the rolls.

21. Wooden paddles, which shall be kept in good condition and free from splinters, shall be used to remove congestions in front of the beater rolls, and the use of valve hooks or pieces of wire or metal for such purpose shall be prohibited.

Paddle Vats and Mixing Drums in the Leather-Producing Industry

22. Paddle vats and revolving horizontal drums, used in the tanning of leather, shall be enclosed or guarded, and provided with interlocks and locking devices conforming to the requirements relating to tumbling barrels of paragraphs 97 to 99 of Regulation 91.

Mixing Drums in Other Industries

23. Enclosures, guards, interlocks and locking devices, conforming to the requirements relating to tumbling barrels of paragraphs 97 to 99 of Regulation 91 shall be provided for revolving, horizontal, mixing drums used in other industries, such as—

- (a) barattes or tumblers for preparing alkali-cellulose xanthate or similar materials;
- (b) paste mixers for preparing lead-oxide paste for storage-battery grids;
- (c) malting drums for mechanical malting of barley in the manufacture of malt liquors;
- (d) ordering or conditioning drums for moistening of tobacco leaves; and
- (e) rotary drum-dyeing machines with perforated, horizontal drums revolving in dye vats or troughs.

REGULATION 93. CASTING, FORGING AND WELDING EQUIPMENT

Definitions

1. In this Regulation the following terms have the meanings hereby assigned to them:

- (a) the term "casting equipment" means equipment used in foundries for shaping metal by pouring or pressing it, while molten, into suitably shaped moulds and permitting it to

- solidify, excluding sand mills (classified under "agitators, mixing machines, and drum mixers"), moulding machines (classified under "presses"), cleaning equipment (classified under "screening and separating machines"), and conveyors (classified separately);
- (b) the term "forging equipment" means equipment used in forge shops for shaping heated or cold metal by hammering or pressing, excluding rolling equipment (classified under "rolls");
 - (c) the term "welding and cutting equipment" means equipment used for heating metallic parts locally to a molten state by means of electrical energy or high-temperature flames, for fusing the parts together with or without pressure, or for cutting metal.

General Provisions

2. Where technically possible, all casting, forging, or welding equipment generating or releasing fumes, gases, smoke or vapours in quantities tending to injure the health of the workers, shall be provided with suction devices, to remove such fumes, gases, smoke, or steam at their point of origin by exhaust hoods and exhaust systems conforming to the requirements of Section 2 of Chapter XIII of this Code.

3. All floors, gangways, aisles and pits in which molten metal is being handled or welding is performed shall be kept free from pools of water and undue dampness.

4. Foundry melting furnaces and forging heating furnaces shall conform to the requirements of Chapter VIII of this Code concerning furnaces.

5. Protection for heads and eyes of employees in casting, forging and welding operations, protective clothing and other personal protective equipment shall be provided, and used, and the protective devices shall comply with the requirements of Chapter XIV of this Code.

Ladles

6. Tilting-type foundry ladles of not more than 900 kg (2,000 lb.) capacity, mounted on stationary supports or trucks or handled by overhead cranes or trolleys and used for the distribution of molten metal, for reservoir or mixing purposes, or for handling of slag, may be of either the hand-shank type or the gear-operated type; when the capacity is 900 kg (2,000 lb.) or more they shall be of the gear-operated type.

7. Hand-shank foundry ladles shall be equipped with manually-operated safety locks.

8. Gear-operated foundry ladles and all mechanically or electrically operated ladles shall be equipped with automatic safety locks or brakes, to prevent overturning and uncontrolled swaying.

9. Gearing of tilting mechanisms on foundry ladles shall be enclosed with standard machinery guards of solid material.

10. Single-shank foundry ladles shall be equipped with metal shields.

11. Bails (or suspensions) and trunnions of bottom-pouring foundry ladles and of all other types that are suspended by bails, shall be examined daily for possible defects or excessive wear.

12. Foundry ladles shall be—

- (a) properly dried, preferably in ovens or outside the foundries, to prevent explosions of molten metal; and
- (b) kept in a dry place when not in use.

Centrifugal Casting Machines

13. Pouring mechanisms and inclined tracks or tilting platforms of horizontal centrifugal machines for casting of pipe or other cylindrical hollow shapes shall be enclosed with standard machinery guards.

Drop Hammers and Forging Hammers — All Types

14. All foot-operated hammers shall be equipped with substantial guards—

- (a) over the tops of the trip pedals; and
- (b) over the extension of the pedals at the rear.

15. All hammers should be provided at the back with suitable guards for stopping pieces of flying scale, arranged to permit easy access to the dies through being—

- (a) pivoted on one side; or
- (b) supported on portable floor standards; or
- (c) suspended from the ceiling.

16. Die keys for hammer heads shall be made of open-hearth material and machined accurately to fit the notches, with the edges tempered and bevelled.

17. Die keys for hammer heads shall not project so as to endanger workers.

18. Before changing dies or making adjustments or repairs on drop hammers or forging hammers, except hammers provided with an automatic locking arrangement for the ram, the ram shall be securely locked by a device strong enough to withstand safely the weight of the ram, plus the maximum steam or air pressure in the case of a steam hammer or air hammer, such as—

- (a) a timber, preferably of hardwood, with a metal ferrule on each end and a handle on the side; or
- (b) a pipe, with a flange at each end; or
- (c) a rail or structural shape, carefully squared at both ends.

19. When hammers are not in use, they should be left with the upper die or the ram resting on the bottom.

20. Compressed air, or preferably suction, should be used instead of scale brushes for removing scale from hammer anvils.

21. Scale brushes, where used, and oil swabs for oiling hammer dies shall be provided with handles of sufficient length to enable the operators to reach the full length of the die or anvil without placing hands or arms between the dies.

Steam and Pneumatic Hammers

22. Admission pipe lines for steam or pneumatic hammers shall be equipped with conveniently located stop valves, which shall be closed and preferably locked during the changing of dies, the carrying out of repairs, and the performance of other work on hammer or dies.

23. Where the steam pressure available for steam hammers is higher than the pressure for which the hammer was designed, a reducing valve or an automatic regulating valve supplemented by a safety valve shall be installed.

24. Steam pipes to hammers shall be—

- (a) placed in floor trenches where practicable, or otherwise protected at points exposed to contact; and
- (b) provided with proper supports to prevent failure, excessive vibration, or expansion.

25. Where cylinders on steam hammers are not equipped with self-draining arrangements, they shall be provided with drain cocks piped to sumps or drain pipes.

Mechanically-Operated Hammers

26. (1) Hammers operated by direct mechanical power shall be provided with means for disconnecting the power, such as—

- (a) a suitable switch where an individual motor drive is used;
- (b) a proper belt shifter where fast and loose pulleys on the counter shaft are used; or
- (c) a clutch on the driving pulley, with the proper means of operation.

(2) Each of these arrangements shall be provided with suitable means for locking or latching the starting devices in the "Off" position.

27. Mechanically-operated hammers with which only one hand is used for holding the material, shall be provided with—

- (a) a safety stop, dog or catch, which will prevent the ram from coming down until such device has been released and is held out of the way by the other hand; or
- (b) a hand lever instead of the pedal for tripping the hammer.

28. Mechanically-operated hammers where neither hand is used for holding the material shall be provided with safety stops or tripping levers, or both, so arranged that the simultaneous use of both hands is required to trip the hammer.

29. Where springs are used for suspending the rams on mechanically-operated hammers, the springs shall be enclosed by standard machinery guards.

Board Drop Hammers

30. Board drop hammers shall be equipped with permanent overhead platforms provided with standard railings and toeboards and with fixed ladders, for use in oiling, adjustment of the rolls and other work.

31. Board drop hammers shall be provided with screen guards above the heads of the workers.

Hydraulic Forging Presses

32. (1) Where the operating valves are not part of or attached to the frames of hydraulic forging presses, the valves shall be so located that the operator will have a clear and unobstructed view of the press when standing in the usual operating position.

(2) Where an arrangement as required in paragraph (1) is not practicable, a mirror affording a full view of the press shall be installed in front of the operator.

Mechanically-Operated Forging Presses

33. Vertical forging presses operated by direct mechanical power should be equipped with automatic or semi-automatic feeding devices where the operations will permit, supplemented by guards, barriers or enclosures in front of the rams.

34. Where manual feeding is necessary, mechanically-operated forging presses shall be provided with suitable gate guards, interlocked enclosure guards or two-handed tripping devices, so designed that it will be impossible for the operators to place or permit their hands to remain in the danger zone after the presses have been tripped.

35. On vertical forging presses the openings between the bottoms of ram enclosures or gate guards and the work or working surfaces shall not exceed 10 mm ($\frac{3}{8}$ in.), and the tops of the enclosure guards shall extend at least as high as the upper limits of the rams.

36. Vertical forging presses shall be equipped with non-repeat devices by which the pedals or operating levers are disconnected after each stroke.

37. Relief springs on cold-heading or similar forging presses shall be enclosed by standard machinery guards.



[New text of paragraphs 44-47.]

Welding Equipment—All Types

44. Welding and cutting operations shall be prohibited in proximity to places where combustible materials are stored, and in proximity to materials and plant where explosive or flammable dusts, gases or vapours are likely to be present or given off, except with special precautions.

45. Arc-welding and cutting operations that are carried out in places where other persons are working or passing shall be enclosed by means of suitable stationary or mobile screens.

46. Walls and screens of both permanent and temporary protective enclosures for arc-welding and cutting operations shall be so painted as to absorb harmful rays and prevent reflection.

47. Suitable incombustible tables, jigs or work-benches shall be provided for support of small or moderate-sized work during welding and cutting operations; such operations should not be undertaken on work resting directly on concrete floors.

Upsetters

38. Upsetters (horizontal bolt and nut forging machines) shall be—

- (a) provided with cover plates over the slides; and
- (b) equipped with a cast-iron safety breaker, inserted between the frame and the fixed gripping die, to relieve any undue strain on the machine by jamming of work between the dies.

Bulldozers

39. Bulldozers (heavy bending machines) shall be provided with guards attached to the moving heads and lapping past the stationary heads.

Die Blocks for Hammers and Forging Presses

40. Forging-die blocks weighing less than 450 kg (1,000 lb.) shall be provided with holes in both ends, for insertion of rods to facilitate lifting and moving the dies.

41. Rod holes in forging-die blocks shall be of such diameter and depth as to permit the insertion of rods strong enough to ensure the safe handling of the dies.

42. Transfer trucks, preferably of the elevating-table type, shall be used for moving forging-die blocks to and from hammers and presses.

Forging Tools

43. For placing or removing material in forging operations suitable tools such as long-handled tongs for feeding of hammers; tongs, pliers, sticks, or picks for feeding of presses; and tongs or steel forks for handling hot metal on the floors, shall be furnished and used.

Welding Equipment — All Types

44. Welding and cutting operations shall be prohibited in areas containing combustible materials or in proximity to explosive or flammable dusts, gases or vapours.

45. Welding and cutting operations that are carried out in places where persons other than the welders are working or passing shall be enclosed by means of suitable, stationary or portable screens at least 2.15 m (7 ft.) in height.

46. Walls and screens of both permanent and temporary enclosures for welding and cutting operations shall be painted with black or dark grey, flat paint to absorb the harmful light rays and prevent reflection.

47. Suitable metal-covered tables, jigs or work-benches shall be provided for support of small or moderate sized work during welding and cutting operations; such operations should not be undertaken on work resting directly on concrete floors.

48. (1) Welding or cutting operations on containers filled with explosive or flammable substances shall be prohibited.

(2) Subject to such conditions as the competent authority may impose, the provisions of subparagraph (1) shall not apply to the following welding operations when carried out by experienced persons:

- (a) the repair by the electric welding process of water-sealed gas-holders;
- (b) the repair in an open situation of gas mains;

where such gas-holders or gas mains contain town gas, coal gas, furnace gas, or similar flammable gas, other than acetylene, at more than atmospheric pressure.

49. Welding or cutting operations on any container that has held explosive or flammable substances shall only be undertaken after—

- (a) the container has been—
 - (i) thoroughly cleansed by steam or other effective means; and
 - (ii) found, by air tests, to be completely free from combustible gases or vapours; or
- (b) the air in the container has been replaced by an inert gas.

Oxy-Acetylene Welding and Cutting Equipment

50. Acetylene cylinders whether filled or empty shall not be stored—

- (a) in rooms where welding or cutting work is being done; or
- (b) in rooms containing oxygen cylinders unless separated from them by a fire-resisting partition.

51. Acetylene cylinders when in use shall be kept in an upright position.

52 (1) Both acetylene and oxygen cylinders when in an upright position shall be held by straps, collars or chains to prevent them from falling over, and such cylinders shall not be dropped or subjected to heavy blows.

(2) The devices for holding the cylinders shall be such that the cylinders can be rapidly removed in case of fire.

53. Specially designed trucks should be used for transporting acetylene and oxygen cylinders in industrial establishments; where an acetylene cylinder and an oxygen cylinder are mounted together on a truck or carrier, a partition of asbestos or other non-combustible material shall be installed between the cylinders, which shall be so placed that the acetylene valve outlet nipple is directed away from the oxygen cylinder.

54. Protection caps on acetylene and oxygen cylinder valves shall be screwed on firmly when the cylinders are being moved or are not in use.

[New text: paragraphs 48-54.]

48. Welding or cutting operations on containers filled with explosive or flammable substances shall be prohibited except in certain particular cases where all appropriate safety precautions have been taken, and subject to any conditions imposed by the competent authority, in particular, for—

- (a) the repair by the electric welding process of water-sealed gasholders, where such gasholders contain town gas, coal gas, furnace gas or similar flammable gas, other than acetylene, at more than the atmospheric pressure;
- (b) urgent repairs in the open air of gas mains; where such gas mains contain town gas, coal gas, furnace gas or similar flammable gas, other than acetylene, at more than atmospheric pressure; and
- (c) such repair of pipes in oil refineries as is essential for safety.

49. Welding or cutting operations on any container that has held explosive or flammable substances or in which flammable gases may have been generated shall only be undertaken after—

- (a) the container has been—
 - (i) thoroughly cleansed by steam or other effective means; and
 - (ii) found by air tests to be completely free from combustible gases or vapours; or
- (b) the air in the container has been replaced by an inert gas.

Gas Welding and Cutting Equipment

50. Except when in use, cylinders containing combustible gases shall not be kept in rooms where welding or cutting work is being done, and oxygen cylinders shall be kept separated from all other cylinders.

51. (1) Acetylene cylinders, when in use, shall be kept in such a position that the head is higher than the base (foot).

(2) Liquefied gas cylinders shall be kept in a vertical or nearly vertical position.

52. (1) Gas cylinders shall not be allowed to fall over and shall not be dropped or subjected to violent shocks.

(2) Cylinders in use shall be held in position by straps, collars or chains to prevent them from falling over.

(3) The devices for holding the cylinders shall be such that the cylinders can be rapidly removed in case of fire.

53. Suitably designed equipment shall be used for transporting gas cylinders in industrial establishments.

54. Protective caps on gas cylinder valves shall be in position when the cylinders are being moved or are not in use.

[New text of paragraphs 55, 58 and 59.]

55. Gas cylinders shall be kept at a safe distance from all operations which produce flames, sparks or molten metal or cause excessive heating of the cylinders.

58. (1) The hose lines for conveying acetylene and oxygen from supply piping or cylinders to burners shall be of different colours.

(2) Screwed couplings on these hoses shall have different threads and shall be plainly marked to avoid interchanging the hose.

59. Welding or cutting burners shall not be hung from regulators or other equipment on the gas cylinders; in the case of a prolonged stoppage of work they shall not be laid down until the gases have been completely shut off.

55. Where portable acetylene and oxygen supply equipment is used, the cylinders shall be kept at a safe distance from all operations which produce flames, sparks or molten metal or result in excessive heating of the cylinders.

56. Oxygen cylinders shall not be handled with oily hands or gloves, and grease or oil shall not be used as a lubricant on the valves, fittings, gauges or the regulating equipment.

57. Acetylene and oxygen pipe lines from generators or manifolds shall be painted with distinctive colours for identification.

58. Hose lines for conveying acetylene or oxygen from supply piping or cylinders to burners shall be of different colours; couplings shall have different threads and should be plainly marked to avoid interchanging the hose.

59. Welding or cutting burners shall not be laid down until the gases have been completely shut off, and shall never be hung from regulators or other equipment so as to come in contact with the gas cylinders.

Arc Welding and Cutting Machines

60. Motor generators, rectifiers, or transformers in arc welding or cutting machines, and all current-carrying parts, shall be protected against accidental contact with uninsulated live parts.

61. Ventilating slots in transformer enclosures shall be so designed that no live part is accessible through any slot.

62. Frames of arc-welding machines shall be effectively grounded.

Hand-Operated Arc Welding Equipment

63. Cable connectors used in arc-welding circuits shall be carefully insulated on the supply side.

64. The outer surface of electrode holders including the jaw so far as possible, shall be fully insulated.

65. Electrode holders should be provided with discs or shields, to protect the hands of the operators from the heat of the arcs.

Resistance Welding Machines

66. In resistance welding machines, all current-carrying parts except the welding contacts shall be completely enclosed.

67. Resistance welding machines shall be equipped with line-disconnecting switches, located at or near the machines.

68. Power lead terminals shall be securely attached with screws and bolts, and plugs shall not be used except for control circuits.

69. Automatic and semi-automatic resistance welding machines shall, where practicable, be equipped with gate guards or two-handed tripping devices, so designed as to prevent the hands of the operator from reaching in the danger zone after the pressure control has been actuated.

REGULATION 94. CRUSHERS, GRINDING MILLS AND PULVERISERS

Definitions

1. In this Regulation the following terms have the meanings hereby assigned to them:

- (a) the term "crusher" means a machine ordinarily used for reducing solid, dry materials of 1.5 m (60 in.) or less diameter by pressure, impact or friction, to sizes ranging from 5 to 15 cm (2 to 6 in.);
- (b) the term "grinding mill" means a machine ordinarily used for reducing materials of 15 cm (6 in.) or less diameter to coarse powder so that approximately 90 per cent. will pass through a 4 mesh/cm (10 mesh/in.) screen, or for grinding of wet materials, but excludes crushing rolls consisting of two or more rolls mounted upon horizontal shafts revolving in opposite directions (classified under "rolls");
- (c) the term "pulveriser" means a machine ordinarily used for reducing coarse powders or materials to a fine state or for fine grinding of wet materials.

General Provisions

2. Where practicable, all crushing, grinding and pulverising operations involving liberation of dust shall be effected in dust-tight equipment, and, if necessary, the plant shall be equipped with an effective exhaust system.

3. Moving parts of crushers, grinding mills and pulverisers constituting a hazard shall be enclosed with standard machinery guards; where enclosures are not practicable, such parts shall be surrounded by standard railings, including toeboards, if the moving parts are less than 15 cm (6 in.) above the floor level.

4. Where practicable, crushers, grinding mills and pulverisers should be provided with mechanical feeding devices.

5. Where manually fed hoppers on crushers, grinding mills or pulverisers are so located that the operators may fall or step into them, the opening shall be covered or surrounded by standard railings and toeboards.

6. Every crusher, grinding mill or pulveriser driven from a common line shaft shall be provided with a positive acting and locking belt shifter or friction clutch, so that the machine—

- (a) can be stopped instantly in an emergency; and
- (b) cannot be started again until the shifter or clutch is released.

7. Grinding chambers and all equipment for grinding or pulverising dry combustible substances within such chambers shall, wherever practicable, be of brass, bronze or other non-sparking material.

8. The grinding and pulverising of materials producing explosive dusts shall be carried out in special equipment and the operations shall be conducted in conformity with the requirements of Regulations 189 and 193.

9. Combustible material delivered to grinding mills or pulverisers shall be passed over self-cleaning magnetic separators of sufficient size to ensure the removal of nails, wires and other ferrous material.

10. Magnetic separators used in connection with grinding or pulverising operations shall be provided with interlocks which will stop the flow of material when the separator fails to function, or with suitable alarm systems which will be automatically actuated in such cases.

11. Where a group of grinding mills or pulverisers handling combustible materials discharges into a common spout or conveyor, each machine should be isolated by individual rotary valves or choke sections in the spout or conveyor.

12. Where no permanently installed travelling or other cranes are available, provision should be made for the installation and use of chain or other hoists of ample lifting capacity in all cases where heavy parts have to be dismantled or replaced on any machine or installation.

Crushers

13. Where material for crushing has not previously been reduced to suitable sizes, the top of the crusher shall be covered with a grid on which the material can be dumped and broken.

14. Crushers shall, where necessary, be provided with a substantial guard which will protect workers from hazards created by flying material.

15. Work above open tops of gyratory crushers shall be performed only by workers provided with, and using, safety belts and life lines attached to substantial anchorages.

16. When it is necessary to punch or push down or rearrange jammed material in gyratory crushers—

- (a) the crusher shall be stopped; and
- (b) long, light rods shall be employed for moving the material.

17. When it is necessary to turn large pieces of material in the feeding hoppers of gyratory crushers by means of power or chain hoists, long and light rods ending in hooks shall be used for pulling the chains under the objects.

Edge Runners, Dry Pans and Wet Pans

18. Edge runners, dry pans and wet pans shall be enclosed with standard machinery guards, so designed that they will prevent workers from being caught by the grinding wheels, scrapers, grinding pans or beds.

19. Workers shall be prohibited from reaching into edge runners, dry pans and wet pans to remove objects or to empty the machines while they are in operation.

20. Accessible discharge openings on edge runners, dry pans and wet pans shall be so designed or guarded that the hands of the workers cannot come into contact with the moving parts of the machines.

Ball, Tube and Compartment Mills

21. Standard machinery guards or standard railings shall be provided on both sides of ball, tube or compartment mills with bottoms less than 2.6 m (8 ft. 6 in.) above the floor level.

22. Passageways under ball, tube or compartment mills shall be provided with standard machinery guards on both sides and on top.

23. Repairing of ball, tube or compartment mills or removal of their doors or manhole covers shall not be undertaken until the power has been shut off and the mill locked against accidental starting.

24. Wedges used for loosening doors on ball mills shall be attached to the covers by means of flexible wire rope or chains, or be held by tongs during the operation, so as to prevent them from flying out and striking the workers.

Paper Pulp Grinders

25. Wood grinders for the production of mechanical paper pulp, when driven by waterwheels, shall be equipped with governors which will limit the speed of the grinding wheels to the speed recommended by the manufacturers.

26. Centre-pocket doors of three and four-pocket pulp grinders shall be provided with pins or counterweights, to prevent the doors from falling on the hands of the workers while filling the pockets.

Other Grinding Mills and Pulverisers

27. Unless mechanical feeding devices are provided, hoppers on bark grinders, cage disintegrators, centrifugal roll mills, colloid mills, cone mills, hammer mills, ice crushers, and ring-roll mills shall be of such size and arrangement that the fingers of the operators cannot come into contact with the moving parts.

28. Manually-fed, power-driven meat or other food grinders of the worm type shall be provided with feed throats, permanently attached to the worm casings, with openings not exceeding 5 cm (2 in.) in diameter at a distance of at least 15 cm (6 in.) above the worm.

Skull Crackers (Drop Balls, Scrap Drops)

29. Skull crackers for breaking castings or scrap shall not be permitted inside factory buildings.

30. Drop pits for skull crackers shall be surrounded on all sides by substantial enclosures of concrete, steel or wood of sufficient height to protect workers in the vicinity or passers-by from injury by flying fragments of metal.

31. Adequate arrangements shall be made so that all operators working skull crackers as well as other employees shall be clear of the breaking area.

REGULATION 95. DRILLING, BORING AND TURNING MACHINES

Definitions

1. In this Regulation the following terms have the meanings hereby assigned to them:

- (a) the term "drilling machine" means a machine tool equipped with a rotatable spindle ordinarily carrying pointed or fluted cutting tools for drilling holes in metal, wood or other substances, but which also may be used with appropriate tools for mortising, counterboring, countersinking, reaming, routing or tapping;
- (b) the term "boring machine" includes machine tools equipped with rotatable spindles carrying internal-cutting boring bars for enlarging and finishing the surfaces of holes in metal, and machines with rotatable spindles carrying boring bits for boring holes in wood or other soft substances;
- (c) the term "turning machine" means a lathe or screw-cutting machine equipped with a spindle for rotating metal or wooden workpieces about a horizontal or vertical axis in turning or facing operations, but which also may be used with appropriate tools for boring, drilling, knurling, metal spinning, or thread cutting.

General Provisions

2. Power gears, spindles, universal joints, and shafting on drilling, boring, and turning machines shall be protected with standard machinery guards.

3. Where cone pulleys and belts are used on drilling, boring and turning machines for changes of speed for spindle and feed motions, the pulleys and belts shall be guarded in accordance with the requirements of paragraphs 13 and 14 of Regulation 79.

4. Where counterweights are used on drilling, boring and turning machines, they shall—

- (a) be rigidly attached to the bars; or
- (b) if suspended by chains or ropes, be enclosed to floor level with standard machinery guards.

5. Workers shall be prohibited from attempting to change or adjust cutting tools or cutting-tool holders on drilling, boring and turning machines until the power has been cut off and the machine is stopped.

Drilling and Boring Machines

6. Chucks used for holding tools in drilling and wood-boring machines shall be of a safety type, without projecting parts.

7. Drills, reamers and taps for metal work or wood-boring bits, when used in single-spindle horizontal drilling and wood-boring machines should, if possible, be enclosed, except at the point of contact, with efficient guards.

8. Drills, reamers and taps for metal work, or wood-boring bits, when used in single-spindle vertical or radial drilling and wood-boring machines should, if possible, be enclosed in efficient guards.

9. Spindle or driving heads on radial drilling machines shall be enclosed.

10. Suitable clamps, jigs or fixtures shall be provided and used for holding work-pieces on vertical drilling-machine tables, so as to prevent the work from turning with the drills.

11. Where the operator is liable to be injured by projecting parts of the work, rotating horizontal tables on vertical metal-boring mills shall be surrounded by standard machinery guards, extending above the top of the work on the tables; the guards may be of two or more sections and hinged to the frames of the machines so as to afford easy access for adjustments or repairs.

12. Riding on work-tables of vertical metal-boring mills while the machines are in operation shall be prohibited, unless the operator has complete control of the machine from his position.

13. Where practicable and necessary, drilling and boring machines should be equipped with suction hoods, properly connected to efficient exhaust systems that will remove dust and fumes at their point of origin; catch boxes for the removal of cuttings should be fitted in the exhaust system.

14. Brushes shall be provided and used for removing drillings from workpieces on drilling and boring machines.

Lathes—Metalworking

15. Lathe dogs on horizontal metalworking lathes shall be provided with countersunk setscrews or so designed that there are no protruding parts.

16. The tops of chucks and face plates on horizontal metalworking lathes should be covered with standard machinery guards which should comprise movable sections.

17. Horizontal metalworking lathes should be provided with automatic brakes, and workers should be prohibited from placing

their hands on lathe chucks for holding workpieces, or on face plates, unless the power has been cut off.

18. Where horizontal metalworking lathes are located near aisles or passageways, or parallel to each other and close together, adjustable screens shall be installed where necessary to prevent flying chips from striking persons passing by or workers on other lathes.

19. Rotating horizontal tables of vertical metalworking lathes shall be guarded in conformity with the requirements relating to drilling and boring-machine tables in paragraph 11 of this Regulation.

20. Turret lathes and other machines in which the rotating stock bar extends beyond the end of the machine, shall be provided with substantially supported, tubular guards covering the projecting stock bar.

21. Automatic metalworking lathes and similar machines shall be equipped with splash guards and pans for catching cutting oil thrown or running from the tools.

Lathes—Woodworking

22. Cutting heads on wood-turning lathes, whether rotating or not, shall be covered as completely as possible by hoods or shields, which should be hinged to the machines so that they can easily be thrown back for making adjustments.

23. Shoe-last and spoke lathes, wood-heel turning machines, and other automatic wood-turning lathes of the rotating knife type shall be equipped with hoods enclosing the cutter blades completely except at the contact points while the stock is being cut.

24. Lathes used for turning long pieces of wood stock held only between the two centres shall be equipped with long curved guards extending over the tops of the lathes, to prevent the workpieces from being thrown out of the machines if they should become loose.

25. Guards covering the workpieces on wood-turning lathes should be constructed of expanded metal or other suitable material which will permit observation of the turning operations.

26. Wood-turning lathes shall be equipped with suction hoods, properly connected to efficient exhaust systems that will remove at their point of origin the chips and dust produced.

27. Where suction hoods on wood-turning lathes form all or part of the guards for the cutting heads, they shall be of sufficient strength to serve effectively the purpose of guards.

REGULATION 96. MILLING MACHINES, PLANERS AND SHAPERS

A. *Metalworking**Definitions*

1. In Part A of this Regulation the following terms have the meanings hereby assigned to them:

- (a) the term "milling machine" means a machine tool, ordinarily used for shaping and dressing external or internal surfaces of metal stock secured to a fixed, sliding or rotating table or held between centres, by means of a multi-toothed cutter mounted on a rotatable, horizontal or vertical spindle, but which may also be used with appropriate tools for boring, drilling or internal slotting;
- (b) the term "planer" means a machine tool used for surfacing and shaping large metal stock, secured to a horizontal table that reciprocates under an adjustable cutting head provided with stationary cutting tools, which usually cut only while the table is moving in one direction;
- (c) the term "shaper" includes slotters and means a machine tool used for surfacing and shaping external or internal metal parts, secured to an adjustable horizontal table, by means of cutting tools with bevelled edges or a series of teeth, clamped to rams that reciprocate horizontally or vertically over the working surfaces, usually cutting only on the power stroke of the ram.

General Provisions

2. Work to be machined in milling machines, planers and shapers shall be clamped securely to the tables or angle plates, or fastened tightly in special holding devices suitable for the operations.

3. Workers shall be prohibited from attempting to change stop dogs or make adjustments to the work or to the cutting tools on milling machines, planers or shapers, until the machines have been stopped.

4. Rotating horizontal tables on vertical milling machines and shapers shall be guarded in conformity with the requirements in paragraph 11 of Regulation 95 relating to drilling and boring machine tables.

Milling Machines

5. The cutter-driving mechanisms and the power-feeding mechanisms for the table movements on milling machines shall be enclosed—

- (a) in the milling machine housings; or
- (b) with standard machinery guards.

6. Milling cutters for external operations, mounted on horizontal arbors or spindles shall be provided with strong guards of suitable material—

- (a) enclosing the cutting surface except the part necessarily exposed for the milling operations and extending on each side of the cutters to the ends of the arbor to the arbor supports; or
- (b) enclosing the cutter completely but opening automatically to a sufficient extent to permit the cut to be made as the work approaches the cutter.

7. Heads on vertical milling machines shall be enclosed.

8. Hand wheels for horizontal or vertical adjustment mechanisms on milling machines shall be—

- (a) mounted on the shafts by means of clutches or ratchet devices so that the wheels do not revolve when the automatic feed is used; or
- (b) provided with removable handles fitted with compression springs so that they will not remain on the wheels unless held in place by the operators.

9. Workers on milling machines shall be prohibited from attempting to remove chips from workpieces near the cutters until the machines have been stopped.

10. Brushes shall be provided and used for removing chips from workpieces on milling machines.

11. Automatic milling machines shall be equipped with splash guards and pans for catching cutting lubricants thrown or running from the tools.

Planers

12. Openings in bed frames on metal planers shall be covered with sheet-metal panels, fastened securely in place.

13. Openings in metal-planer housings less than 2 m (6 ft. 6 in.) above the floor level shall be covered.

14. Exposed reversing dogs on sides of metal planers shall be covered.

15. Metal planers should have at least 60 cm (24 in.) clearance on the sides and ends of travel of the reciprocating tables or the work thereon, which clearance shall be permanently maintained.

16. Where the clearance between the ends of tables on metal planers, or the work thereon, and walls or other fixed objects is less than 60 cm (24 in.), standard guard rails shall be provided across each side of such clearance space.

17. Riding on worktables of metal planers while the machines are in operation shall be prohibited: Provided that such riding may be allowed where the nature of the operations makes it necessary.

Shapers

18. Crank mechanisms, gear drives, hydraulic drives and screw drives for the tool-carrying rams of metal shapers shall be enclosed in housings.

19. Rams on horizontal metal shapers shall be provided with effective guards for the full length of their stroke.

20. Counterweights on vertical metal shapers or slotters shall be attached to the frames of the machines by means of chains.

Broaching Machines

21. Broaching machines shall be enclosed in housings, leaving exposed only the broaching tools and the work-holding fixtures.

22. Broaching machines shall, where necessary, be provided with exhaust systems for the removal of chips, dust and fumes at the bottoms of vertical machines and at one end of horizontal machines.

B. Woodworking

Definitions

23. In Part B of this Regulation the following terms have the meanings hereby assigned to them:

- (a) the term "planer" means a machine for smoothing or surfacing the sides and edges of wooden stock and reducing it to required thickness and width as it is being carried on or over horizontal tables past cutting knives fastened in cutter heads, in rotating cylinders or on rotating spindles mounted on sliding frames; it includes planing machines, jointers, matchers, panel raisers, stickers, tenoners and timber sizers;
- (b) the term "shaper" (spindle moulding machine) means a machine for cutting and shaping the edges of wooden stock pushed against cutting knives which are mounted on one or two revolving vertical spindles projecting above the horizontal tables.

Planers and Shapers — General Provisions

24. Woodworking machines which constitute a hazard because the tools continue to rotate after the power is cut off shall be equipped with effective brakes.

25. Cylinders and spindles which hold woodworking cutting tools shall be equipped, if necessary, with a locking device to prevent them from moving when the cutters are being changed, except in cases where they are effectively held in position by the brakes of the machine.

26. Wood planers and shapers should be provided with suction hoods, properly connected to efficient exhaust systems that will remove at their point of origin the chips, dust, shavings or slivers produced.

27. Suction hoods and exhaust systems shall conform to the requirements of Section 2 of Chapter XIII of this Code.

Planers (Jointers)

28. Overhand planers with horizontal heads shall be equipped with cylindrical cutting heads provided with slots or throats not exceeding 13 mm ($\frac{1}{2}$ in.) in width.

29. Overhand planers with horizontal cutting heads shall be provided with—

- (a) vertically and laterally adjustable substantial covers over the section of the heads in front of the guides, having front edges shaped to allow easy insertion of work passed under them; and
- (b) substantial covers protecting the section of the heads behind the guides, regardless of the position of the latter.

30. On overhand planers table openings shall be as small as possible, and the clearance between the edge of the opening and the cutter edge shall in no case exceed 3 mm ($\frac{1}{8}$ in.).

31. Where cutter knives on overhand planers are exposed beneath the tables, they shall be guarded.

32. Wood planers with vertical heads shall be provided with hoods, which may be exhaust hoods, so arranged as to enclose the whole revolving head except a slot of sufficient width for the application of the material to be planed.

33. Machines equipped with either sectional or solid feed rolls shall be provided with anti-kickback devices placed in front of the feed rolls.

34. Push blocks, fitted with handles and pressure shoulders, shall be provided, and used, when pieces less than 45 cm (18 in.) in length are machined on hand-fed wood planers.

35. Where automatic feeding devices are used on wood planers, the feeding mechanisms shall be guarded by metal shields or hoods leaving only the space required for the insertion of the wood.

Grooving and Tenoning Machines

36. Cutting heads and knives on grooving and tenoning machines shall be protected by hoods securely fastened to the machine and constructed of sheet steel, at least 3 mm ($\frac{1}{8}$ in.) in thickness or other material of equal strength.

37. Feed rolls on grooving and tenoning machines shall be guarded by metal strips or bars fastened to the frames carrying the rolls and so arranged as to remain in adjustment for any thickness of stock.

38. Where the top feed rolls on grooving and tenoning machines are corrugated, the guards shall be extended over the tops of the rolls.

39. Feed chains and sprockets of double-end tenoning machines and of stave croziers shall be completely enclosed, except for the portion of the chain used for conveying the stock.

40. Rear ends of tenoning machine frames, over which the feed conveyors pass, should be extended so that the stock on leaving the machines will be guided to points where it can be safely removed.

Wood Shapers (Spindle Moulding Machines)

41. Cutting knives on wood shapers and similar machines shall be of such design and so locked in position as to prevent them from flying out of the heads.

42. Wood shapers and similar machines, if not automatically fed, shall be provided with guards for the cutters, extending well beyond the sweep of the longest knife and adjustable to the height of the work, such as—

- (a) guards which exert the necessary pressure for holding the workpiece against the table and the guide, and which can be rapidly adjusted according to the nature of the work; or
- (b) other types especially designed for the particular kind of work to be done.

43. Metal guards placed close to the cutters shall be faced with wood.

44. Where workpieces for wood shapers and similar machines are too small to afford a secure handhold at least 30 cm (12 in.) away from the cutters, they shall be clamped securely in jigs or fixtures before being machined except in cases where the machines are guarded in accordance with paragraph 42 (a) of this Regulation.

Combined Machines

45. (1) Combined machines having a number of tools shall be so constructed that only one tool can be used at a time, and it is possible to disengage each tool separately.

(2) Each tool on combined machines shall be provided with the protective devices prescribed for non-combined machines.

REGULATION 97. PACKING AND WRAPPING MACHINES

Definitions

1. In this Regulation the following terms have the meanings hereby assigned to them:

- (a) the term "filling machine" means a machine for filling bottles or other containers with liquids, by gravity or under pressure, for preservation or for transport;
- (b) the term "packing machine" means a machine for filling cans, cartons, sacks or other containers compactly and securely with powdered, solid or semi-liquid materials for preservation or for transport;
- (c) the term "sealing machine" means a machine for covering or closing the filling openings of filled or packed containers;
- (d) the term "wrapping machine" means a machine for covering articles to be packed or for covering filled or packed containers, and for securing the wrappings.

General Provisions

2. All dangerous moving parts of carton, cloth-bag, paper-bag and sack-filling, weighing and sealing machines, and of carton-ing, labelling, tying and wrapping machines, shall be provided with guards that will prevent the fingers or any other part of the body or the clothing of operators from being caught by them.

3. All bevel or other gears on roller conveyors carrying bottles, cans, cartons, glasses, or jars between the various individual machines for packing and wrapping operations, or between successive units in automatic combination machines, shall be covered with standard machinery guards extending under the bottom where the gears mesh.

4. Conveyor systems used for handling containers and materials during packing and wrapping operations shall conform to the requirements of Section 2 of Chapter IX of this Code.

5. Conveyors used for carrying filled bottles, jars, or other glass containers shall be provided with side rails at a suitable distance above the conveying surface, to prevent the containers from tipping over and falling off.

6. Workers shall be prohibited from attempting to clear jams, remove obstructions, or adjust articles on automatic or semi-automatic packing and wrapping machinery without first stopping the machinery.

Bottle-Filling and Bottle- or Jar-Capping Machines

7. Filling stations on pressure bottling machines shall be provided with enclosures extending at the sides and rear from the base of the machine to at least 10 cm (4 in.) above the top of the bottle, and so arranged that each bottle, when being filled, will be similarly covered on the side facing the operator.

8. Enclosure guards on bottling machines shall be of—

- (a) sheet metal not less than 1.25 mm (0.05 in.) in thickness or screen of equal strength when bottling is done under pressures up to 5 kg/cm² (75 lb./sq. in.); and

(b) sheet metal not less than 2.5 mm (0.1 in.) in thickness or screen of equal strength when the pressure exceeds 5 kg/cm² (75 lb./sq. in.).

9. Bottle-corking, bottle-capping and jar-capping machines shall be provided with enclosures conforming to the requirements of paragraphs 7 and 8 of this Regulation.

10. Bottle-corking, bottle-capping and jar-capping machines shall be provided with tables or other devices for supporting the bottles or jars firmly during corking or capping operations.

11. Suitable tongs shall be provided and used for removing fragments of broken bottles or jars from filling and corking or capping machines, and all glass fragments shall be promptly deposited in suitable containers located conveniently for the purpose.

Can-Filling and Can-Closing Machines

12. Automatic or semi-automatic can-filling, can-tipping, can-sealing, and can-seaming machines shall be entirely enclosed, except for openings necessary for the intake and discharge of the containers.

13. Vacuum can-sealing machines should be provided with small windows in the tops of the exhaust chambers for observation of the sealing process while the doors are closed.

14. Where cans are sealed by soldering or by the use of cements, the can-sealing machines or units shall be provided with exhaust devices for the removal of fumes.

15. The use of cement or cement solvents containing benzol or other toxic materials in can-sealing machines shall be prohibited.

16. Steam pipes and heated surfaces of can-filling and can-closing machines shall, so far as practicable, be enclosed in insulating material, and the hot water or steam shall be so disposed of as not to endanger workers.

Sack-Filling Machines

17. Sack-filling machines shall be provided with hinged transparent guards in front of the filling spouts.

Labelling Machines

18. Labelling machines for carbonated beverage bottles shall be provided with enclosures complying with the requirements of paragraphs 7 and 8 of this Regulation.

Wrapping Machines

19. Knives for cutting wrappers from paper rolls in wrapping machines shall be so located and guarded that the hands of the operators cannot come in contact with them while the machines are in operation.



[New text of paragraphs 4 and 5.]

4. (1) Cylinder and beater covers and doors to dust grids on opening, picking (scutching) and carding machines shall be provided with interlocks that will prevent—

- (a) opening of the covers or doors while the cylinders or beaters are in motion; and
- (b) movement of the machines by power while the covers or doors are open.

(2) The bolts and nuts used in the interlocking mechanism shall be of a special type which can be removed only with a master key and not with an ordinary spanner, so as to prevent workmen from tampering with them, or else they shall be riveted.

5. Doors and inspection openings in dust trunks or other delivery ducts following porcupine or similar cylinders on opening, picking (scutching), carding and Garnett machines shall be so placed that the cylinders and fans cannot be reached through them, or other effective measures shall be taken to prevent access to the cylinders and fans while these are in motion.

Nailing Machines

20. Nailing machines for fastening lids on packed wooden cases should be provided with transparent shields or fine-mesh wire guards in front of the machines.

21. When necessary to adjust hammer rods on foot-operated nailing machines or to clear fouled nails, an effective device shall be provided for locking the operating treadle.

REGULATION 98. OPENING, PICKING (SCUTCHING),
CARDING AND COMBING MACHINES

Definitions

1. In this Regulation the term "opening, picking (scutching), carding and combing machines" means machines used principally in the manufacture of textiles and in working upholstery fillings, to loosen and separate animal or vegetable fibrous materials, to remove undesirable matter or to arrange the fibres in a parallel direction into a ribbon-like form for spinning.

General Provisions

2. Cylinders, beaters and similar working parts of opening, picking (scutching), and carding machines shall be—

- (a) enclosed in housings which will prevent the escape of dust as far as practicable;
- (b) where necessary, connected to exhaust systems for the removal of the dust, in accordance with the requirements of Section 2 of Chapter XIII of this Code.

3. All the appliances used in the pneumatic conveyance of textile material to and from opening machines, and for the removal of dust extracted in these machines or from picking (scutching), and carding machines shall be so arranged as to reduce to a minimum the amount of dust or fibre escaping into the atmosphere of any occupied room.

4. Cylinder and beater covers and doors to dust grids on opening, picking (scutching), and carding machines shall be provided with interlocks that will prevent—

- (a) opening of the covers or doors while the cylinders or beaters are in motion; and
- (b) movement of the machines by power while the covers or doors are open.

5. Doors and inspection openings in dust trunks or other delivery ducts following porcupine or similar cylinders on opening, picking (scutching), carding, and Garnett machines shall be so placed that the cylinders cannot be reached through them, or other effective measures shall be taken to prevent access to the cylinders while the latter are in motion.

6. All belts, pulleys, gears, chains, sprocket wheels and other dangerous moving parts on opening, picking (scutching), carding and combing machines shall, unless covered by the machine housings, be enclosed with standard machinery guards.

7. Feed rolls on opening, picking (scutching), combing and Garnett machines, and the licker-in on carding machines and Garnett machines shall be provided with covers or guards, so arranged as to prevent contact with the rolls by the workers while feeding material.

8. Setscrews on all revolving parts of machines shall either be made flush or be countersunk, or be securely fenced, unless in such position as to be equally safe as if they were securely fenced.

Bale Breakers and Openers

9. Bale breakers should be equipped with hopper feed and with suction removal of the cotton to the openers or to the blending bins.

10. Openers should be equipped with suction feed from the bale breakers and with suction removal of the cotton to the picking machines (scutchers).

11. Where lattices or conveyors are used for feeding bale breakers or openers, strong grid guards shall be provided over the lattices or conveyors, extending at least 1.22 m (4 ft.) from the intake of the feed rolls.

Pickers (Scutchers)

12. Breaker pickers should be equipped with suction feed from the openers or from the blending bins.

13. The lap forming rolls on intermediate and finishing pickers (scutchers) shall be provided with guards which—

- (a) move up and down with the weights for the lap rolls; and
- (b) prevent access to the lap rolls for starting new laps when the weights are on.

Carding and Combing Machines

14. The lap or sliver forming rollers on carding, sliver or ribbon lap, and combing machines shall be provided with a guard or cover which shall either—

- (a) prevent access to the intake of the lap roller and fluted roller as long as the weighted rack is down; or
- (b) prevent access to the intake of the lap roller and fluted rollers, and be so locked that the guard or cover cannot be raised until the machine is stopped and the machine cannot be started until the guard or cover is closed.

[New text from paragraph 9 onwards.]

Cleaning Machinery

9. Moving parts of opening, picking (scutching), carding and combing machines shall be cleaned only when power is disconnected and the machine is stopped.

10. Cleaning of stationary parts of opening, picking (scutching), carding and combing machines and of the floor beneath such machines shall be carried out—

- (a) only while the machine is at rest, where there is imminent risk of contact between the person or anything held in the hand and moving parts during cleaning; and
- (b) by means of vacuum devices or brushes when any part is being cleaned while the machine is in motion.

11. Stripping operations shall not be considered as part of cleaning of machines.

Bale Breakers and Openers

*12. Bale breakers should be equipped with hopper feed and with suction removal of the cotton to the openers or to the blending bins.

*13. Openers should be equipped with suction feed from the bale breakers and with suction removal of the cotton to the picking machines (scutchers).

*14. Where lattices or conveyors are used for feeding bale breakers or openers, strong grid guards shall be provided over the lattices or conveyors, extending at least 1.22 m (4 ft.) from the intake of the feed rolls.

[New text.]

Pickers (Scutchers)

*15. Breaker pickers should be equipped with suction feed from the openers or from the blending bins.

16. Where lattices or conveyors are used for feeding breaker pickers, strong grid guards shall be provided on the lattices or conveyors, extending at least 1.22 m (4 ft.) from the intake of the feed rolls.

*17. The lap forming rolls on intermediate and finishing pickers (scutchers) shall be provided with guards which—

- (a) move up and down with the weights for the lap rolls; and
- (b) prevent access to the lap rolls for starting new laps when the weights are on.

Carding and Combing Machines

18. (1) The lap or sliver forming rollers on carding, sliver or ribbon lap, and combing machines shall be provided with a guard or cover which shall either—

- (a) prevent access to the intake of the lap roller and fluted roller as long as the weighted rack is down; or
- (b) prevent access to the intake of the lap roller and fluted rollers, and be so interlocked that the guard or cover cannot be raised until the machine is stopped and the machine cannot be started until the guard or cover is closed.

(2) The licker-in cover shall be screwed down so that it cannot readily be lifted while the machine is in motion.

(3) Covers should be extended as far as is practicable over the doffer.

19. (1) Each cotton card should be equipped with a stripping roll or other means of collecting the strippings as they are combed from the flats.

(2) On operations calling for flat strippings which are allowed to fall on the doffer cover, where such strippings are removed by hand the doffer cover shall be kept closed and securely fastened to prevent it from being opened while the machine is in operation.

Garnett Machines

*20. Open spaces between cylinders and openings in the lower frames of Garnett machines and between the lower frames and the floor shall be covered with standard machinery guards of sheet steel not less than 1 mm (0.04 in.) in thickness, or other material of equal strength.

Cloth Openers

21. A board with a slit in it, to allow the opened cloth to pass out of it, shall be provided, either in front of the beater which opens out cloth, so as to prevent access to the beater, or in front of the scrimp rolls, where the cloth passes over the rolls after leaving the beater, so as to prevent access to the rolls.

Garnett Machines

15. Open spaces between cylinders and openings in the lower frames of Garnett machines and between the lower frames and the floor shall be covered with standard machinery guards of sheet steel not less than 1 mm (0.04 in.) in thickness, or other material of equal strength.

REGULATION 99. PRESSES (METAL AND OTHER SUBSTANCES)

Definitions

1. In this Regulation the following terms have the meanings hereby assigned to them:

- (a) the term "press" means a machine for compressing, cutting, or shaping metallic or non-metallic substances by pressing, drawing, or stamping, excluding hammers, forging presses, bulldozers, and upsetters (classified under "casting, forging, and welding equipment"), shearing machines (classified under "shears"), and cylinder or rotary printing presses equipped with revolving printing or impression cylinders mounted on horizontal shafts (classified under "rolls");
- (b) the term "punch press" means a press equipped with a ram or slide and with dies for the purpose of bending, blanking, coining, curling, cutting, drawing, embossing, extruding, forming, perforating, piercing, punching, redrawing, reaming or trimming materials under great pressure;
- (c) the term "hydraulic press" means a press in which power is transmitted to the ram by hydrostatic pressure;
- (d) the term "platen press" means a printing press in which the paper or other material, supported on flat impression surfaces, is forced against the printing surfaces which are supported on stationary flat beds;
- (e) the term "mould-making machine" means a machine used for ramming moulding sand into foundry moulds by jarring and mechanical pressure or compressed air;
- (f) the term "core-making machine" means a machine stamping sand to form cores for foundry moulds by jarring and mechanical pressure or compressed air.

General Provisions

2. Presses shall be equipped with means for disconnecting all power from the machines and from any pulleys on the machines by—

- (a) devices for locking or latching the switches or starters on individual motor drives in the "Off" position; or
- (b) fast and loose pulleys, with belt shifters which can be locked or latched in the "Off" position; or

- (c) belt perches or idler pulleys, to facilitate throwing belts off and on the drive pulleys; or
- (d) clutches on drive pulleys, with clutch handles which can be locked in the "Off" position.

3. All presses, except hydraulic presses, shall be equipped with effective brakes.

4. Large presses should have some provision for stopping the press instantly at any point of the stroke.

5. Revolving or reciprocating parts on the sides of presses located within 2.6 m (8 ft. 6 in.) of the floor or working level, and not enclosed by the housing of the machine, shall be covered with standard machinery guards.

Punch Presses — Automatic, Semi-Automatic or Mechanical Feed

6. Punch presses equipped with automatic, semi-automatic or mechanical feeding devices such as dial feed, slide feed, hopper feed and automatic roll and strip feed, shall be provided with—

- (a) fixed enclosure of the ram, with the opening between the bottom of the enclosures and the work or the working surface not exceeding 6 mm ($\frac{1}{4}$ in.) and with the top of the enclosure extending at least as high as the upper limit of the ram; or
- (b) limitation of the ram stroke so that the clearance between the ram and the die or stripper does not exceed 6 mm ($\frac{1}{4}$ in.).

7. Ram enclosures on punch presses shall—

- (a) enclose the rear as well as the front and sides of the rams;
- (b) be of solid sheet metal, perforated or expanded metal, strong wires or wire mesh, non-shatterable glass, or transparent plastics; and
- (c) be so constructed as not to cause eye strain to the operator.

8. (1) Openings in ram enclosures or gate guards on punch presses shall in no case be of such size, whatever the distance the guards are from the dies, as would enable any part of the hand to come within the trapping or nipping area.

(2) Subject to this paragraph, safe measurements are included as a guide in Appendix II to this Code.

9. In order to prevent the fingers, hair, or clothing of operators from getting caught, automatic roll feeds on punch presses shall be provided with complete enclosure of the roll gears and rolls except for the feed opening.

Punch Presses — Hand-Fed

10. Hand-fed punch presses shall be provided with—

- (a) fixed enclosure of the rams or limitation of the ram strokes, conforming to the requirements of paragraphs 6, 7 and 8 of this Regulation; or

- (b) an interlocked guard which totally encloses the tools and is provided with a gate which—
- (i) can be opened to give access to the tools only when the ram is at rest;
 - (ii) must be closed before the ram can be set in motion;
 - (iii) shall be interlocked directly with the clutch key or the clutch key extractor;
 - (iv) has an additional and separate device for holding the gate closed when the ram is in motion; and
 - (v) where possible shall be so designed as to prevent an accidental stroke of the ram when the normal operating device is not in the operating position; or
- (c) on presses with a stroke of more than 12.5 cm (5 in.), not including high-speed presses with a variable stroke, an automatic guard which—
- (i) will remove the hand from between the tools with a forward motion;
 - (ii) shall be positively driven so as to operate on any stroke of the press, whether intentional or not; and
 - (iii) shall be so adjusted as to have sufficient movement and to operate early enough in the stroke to prevent the danger of the hand being trapped between the tools.

11. Where necessary special hand tools, such as pushers, pickers, pliers, tweezers, forks, magnets or suction discs, for placing and removing material without placing the hands in the danger zone, shall also be provided and used.

12. Openings in enclosure guards and gate guards on hand-fed punch presses shall conform to the requirements of paragraph 8 of this Regulation.

13. (1) In addition to complying with the provisions of paragraph 10 of this Regulation, large hand-fed punch presses on which two or more operators are employed shall be provided with guards, mechanically linked to the ram, which will effectively prevent the operators and any other employee from remaining within reach of the ram and dies when there is any danger of trapping.

(2) If the competent authority so decides, this paragraph shall not prohibit the use of such presses equipped with two-hand controls for each operator, if all such controls must be actuated simultaneously and maintained in action to operate the press, provided that adequate steps are taken to prevent all persons other than the operators from being within reach of the press when it is in motion.

14. Mechanically operated forward moving guards shall be permitted on hand-fed punch presses only where both sides and the back of the press are fitted with guards.

15. Mechanically operated forward moving guards on hand-fed punch presses shall be so—

- (a) arranged that the operator cannot reach into the danger zone while the press is in motion;
- (b) installed that there is no squeezing point between the guard and any stationary part of the press; and
- (c) covered with leather or rubber on the parts which may strike the hands of the operator so as to soften the blow as much as possible.

16. Hand-fed punch presses equipped with gate guards or forward-moving guards not connected directly to the ram shall be provided with non-repeat devices, by which the pedal or the operating lever is disconnected after each stroke and a positive device is introduced to stop the press.

17. Non-repeat devices on hand-fed punch presses shall not be dependent upon the action of any spring except a compression spring operating in a closely fitting barrel or on a rod and so wound that the space between the coils is less than the diameter of the wire.

18. Non-repeat devices on hand-fed punch presses may be so arranged that they can be rendered inoperative in case continuous production is desired, subject to the press being otherwise safeguarded in accordance with the provisions of paragraphs 10 to 15 of this Regulation.

19. Foot-actuated punch presses shall be provided with substantial guards over the pedals, so constructed that the operator will have a comfortable position for the foot between press operations.

20. Levers on hand-actuated punch presses shall be equipped with spring latches to prevent accidental or premature tripping.

21. Dies for punch presses shall be so designed and constructed as to provide or permit safeguarding conforming to the requirements of paragraphs 6 and 10 of this Regulation.

22. All unnecessary metal on dies for punch presses should be cut away, especially on the fronts and sides, and the fronts should be cut at 45° bevel to reduce hazards.

23. Before setting dies in punch presses, or removing them—

- (a) adequate means shall be provided to prevent dropping of the rams; and
- (b) except on large presses which cannot be turned by hand, the power shall be disconnected and the press turned by hand until proper alignment of the dies is assured.

Hydraulic Punching, Compressing and Expressing Presses

24. Hydraulic presses used for compressing materials or for expressing liquids from them shall, so far as practicable, be guarded



[New text.]

Baling Presses

31. (1) Where the moving platforms of baling presses rise above floor level they shall be provided with smooth aprons to prevent workers from getting caught between the floor and the press platform.

(2) The edges of the pit in which the platform moves shall be chamfered or otherwise guarded so as to prevent a person's foot from being trapped between the edge of the pit and the edge of the platform.

32. Baling presses on which two workers are employed shall not be started up or down by one of the workers without a signal from the other, unless they are started up by a device requiring simultaneous action by both workers.

in accordance with the requirements of paragraphs 6 to 23 of this Regulation.

25. Interlocked enclosing guards for hydraulic presses with downstroking rams shall be provided with means of positively supporting the ram when the guard is open.

26. Where the operating valves are not part of or attached to the frames of hydraulic presses—

- (a) the valves shall be so located that the operator will have a clear and unobstructed view of the press when standing in the usual operating position; and
- (b) where the operation of the press is not plainly visible, a mirror affording a full view of the press shall be installed in front of the operator.

Extruding Presses

27. Horizontal or vertical presses for extruding soft metal, ceramics, graphite, plastics, rubber, macaroni, or other materials through specially formed dies by means of compressed air or hydraulic or steam pressure shall be provided with safety valves on the receiving lines and pressure gauges readily visible from the operating stations.

Macaroni Presses

28. Horizontal or vertical presses for extruding macaroni shall be equipped with two-hand controlling devices for the packers, to prevent the operators from getting hands or fingers caught between the packers and the extrusion cylinders.

29. Short-cut macaroni presses shall be provided with guards in front of the rotating cutting blades.

30. Workers shall be prohibited from attempting to clean macaroni presses without first stopping the machines and disconnecting the power.

Baling Presses

31. Where the moving platforms of baling presses rise above floor level, they shall be provided with smooth aprons to prevent workers from getting caught between the floor and the press platform.

32. Baling presses on which two workers are employed shall never be started up or down by one of the workers without a signal from the other.

Core-Making and Mould-Making Machines

33. Core-making and mould-making machines in foundries shall be provided with two-hand tripping devices, so arranged as to prevent operators from placing their hands in the danger zone while the machine is in operation.

34. Gears, shafts, connecting rods, and other revolving, reciprocating, or oscillating parts on core-making and mould-making machines in foundries shall be properly enclosed.

35. The return side of bucket elevators for delivery of sand to foundry mould-making machines shall be—

- (a) enclosed with standard machinery guards to a height of not less than 2.6 m (8 ft. 6 in.) above the floor or working level; or
- (b) surrounded by standard guard rails placed not less than 38 cm (15 in.) or more than 50 cm (20 in.) from the moving parts.

36. Belts or chains, gears or pinions, heads, and sand elevators on sand slingers in foundries, where not covered by housings, shall be enclosed with standard machinery guards.

37. Locomotive, automotive and tractor types of sand slingers in foundries shall be provided with wheel guards in front of all wheels moving on tracks.

38. Moulding-sand handling equipment in foundries shall, unless the sand contains sufficient moisture to prevent the liberation of dust—

- (a) be enclosed as completely as possible; and
- (b) be provided with exhaust conforming to the relevant requirements of Section 2 of Chapter XIII of this Code.

39. Trunnions on foundry flasks or moulds shall be provided with end flanges with a diameter not less than double the diameter of the trunnions.

40. Foundry flasks or moulds of large dimensions shall be provided with loop handles of wrought iron or steel.

Ceramic Moulding Presses

41. Plungers and dies of moulding machines used in the manufacture of brick, building blocks, drain and sewer pipes, tile and other ceramic products shall so far as practicable be guarded in accordance with the requirements of paragraphs 6 to 23 of this Regulation.

42. Such machines shall be equipped with individual driving mechanisms or with positive acting and locking belt shifters or friction clutches, so that the machine—

- (a) can be stopped instantly in an emergency; and
- (b) cannot be started again until the mechanism is released.

43. Vertically operating arms for lifting trays on brick-moulding presses shall be guarded to prevent risk of injury.

44. Adjustable press plates on brick-moulding presses shall be provided with substantial handles.

45. Workers shall be prohibited from attempting to change or adjust press plates on brick-moulding presses, or moulding

forms in building-block making machines, without first stopping the machines.

46. Exposed gearing on brick or tile presses and on building-block making machines shall be enclosed with standard machinery guards, and the crosshead connecting rods shall be enclosed or covered with solid or wire-mesh guards.

47. Tamping mechanisms on building-block making machines shall be covered with standard machinery guards.

Platen Printing, Creasing and Scoring Presses

48. Platen, or job, printing presses and creasing and scoring presses of the platen type shall, where practicable, be equipped with automatic feeding devices.

49. Where automatic feeding is not practicable, platen printing, creasing or scoring presses shall be provided with automatic safety stops operated either by rods or gates which will prevent the platen from closing if the hand or hands of the operator is between the platen and the bed.

50. Workers on platen presses shall be prohibited from changing formes, making ready, making adjustments to and cleaning or oiling the presses without first disconnecting the power.

Box Enders, Corner Stayers and Edge Attaching Machines

51. Box enders, corner stayers and edge attaching machines, used in the manufacture of cardboard or paper boxes, shall be provided with—

- (a) automatic feeding devices; or
- (b) fixed guards, so arranged that the fingers of the operator cannot come between the head and the anvil; or
- (c) automatic devices that will prevent the application of injurious pressure if the fingers of the operator are between the head and the anvil.

Embossing or Die-Stamping Presses

52. Embossing or die-stamping presses for leather or paper products shall be safeguarded in accordance with the requirements for punch presses of paragraphs 6 to 23 of this Regulation.

Dinking or Clicking Presses

53. Dinking or clicking presses for leather products, textile fabrics or paper products shall be equipped with—

- (a) automatic devices that will prevent the application of injurious pressure if the fingers of the operator are between the head and the cutter; or
- (b) sliding tables which will not require operators to place their hands under the beams; or

- (c) two-hand tripping devices, which will require the removal of both hands of the operator from the danger zone until the beam has reached the bottom of its stroke.

54. Where hand dies are used on dinking or clicking presses, the beam stroke shall be adjusted so that the beam will not come closer than 75 mm (3 in.) above the table.

55. Hand dies for dinking or clicking presses—

- (a) shall be not less than 75 mm (3 in.) in height; and
(b) should be provided with vertical or horizontal handles, placed at least 12 mm ($\frac{1}{2}$ in.) below the tops of the dies.

Garment Presses

56. Garment presses shall be provided with two-hand tripping devices which will require the removal of both hands of the operator from the danger zone until the press has closed.

57. Garment presses should be provided with heat insulating material between the plate on the pressure head and the metal cover above it.

58. Steam supply pipes for garment presses, when exposed to contact, shall be covered with heat insulating material.

REGULATION 100. ROLLS

Definitions

1. In this Regulation the following terms have the meanings hereby assigned to them:

- (a) the term "roll" means a set of two or more cylindrical bodies, placed a small distance apart and rotatable in opposite directions to draw metallic or non-metallic material between them in order to compress or crush or shape it, to make it smooth or glossy, to print on it, or to distribute or to spread a viscous liquid on its surface, and includes a single roll revolving over a moving flat bed and used for similar operations;
- (b) the term "calender" means a machine with smooth rolls used for pressing cloth, leather, molten glass, paper or rubber;
- (c) the term "crushing roll" means a machine ordinarily provided with corrugated or toothed rolls used for crushing brittle materials, dry or wet;
- (d) the term "roller mill" means a machine ordinarily provided with smooth or corrugated rolls, used for grinding or mixing chemicals, enamels and paints, food products, printing inks, rubber, toilet soap and other materials, or for pressing materials together;
- (e) the term "rolling mill" means a machine used for reducing hot or cold metal bars, billets, ingots, plates, rods and slabs to specified profiles or sections or for finishing such materials by passing them through a set or train of driven rolls;

- (f) the term "cylinder press" means a printing press in which the paper or other material is supported on revolving cylinders and forced against printing surfaces supported on reciprocating flat beds;
- (g) the term "rotary press" means a printing press in which the paper or other material, supported on revolving cylinders, is forced against printing surfaces also supported on revolving cylinders.

General Provisions

2. Belts, couplings, flywheels, gears, pinions, pulleys, shafts, sprockets, wobblers and other revolving or reciprocating parts on the sides of the machines, if located within 2.6 m (8 ft. 6 in.) of the floor or working level and not enclosed by the housing of the machines, shall be covered with standard machinery guards.

3. Rolls on machines not specifically mentioned in this Regulation, such as those used for corrugating, crimping, embossing, and graining of, or printing on, metal or leather, paper, plastics, textiles, wood and other non-metallic materials, shall be equipped with—

- (a) a quick power-disconnecting or reversing device within easy reach of either hand or either foot of the operator; and
- (b) a fixed or self-adjusting barrier on the in-running side of the rolls so arranged that the material to be processed can be fed to the rolls without permitting the fingers of the operator to be caught between the rolls or between the guard and the rolls.

4. Workers shall be prohibited from attempting to clean rolls without first—

- (a) stopping the machinery; and
- (b) disconnecting the power, except on large machines which cannot be turned by hand and are equipped with slow-motion power control.

Rolling Mills

5. Floors around rolling mills shall be even and free of any projections, obstructions, open holes or crevices, grease or oil, which could be the cause of slipping or falling.

6. Stairways and overhead walks or subways shall be provided for passage across hot beds, looping floors, repeaters, and roller or transfer tables of rolling mills.

7. Stairways, overhead walks, and platforms in rolling mills shall be guarded on all open sides with standard railings and toeboards.

8. Sides of hot beds, roller tables and other conveyors, and skids of rolling mills shall be provided with adjustable guards.

9. Glass screens shall be provided in front of pulpits for blooming, billet and bar mills.

10. Open spaces between separate sets of finishing rolls or rod mills shall be guarded.

11. Workers stationed inside loops on looping floors for rod mills should be protected by stops or enclosures against possible injury in case the loops are contracted rapidly through sticking in the rolls.

12. Reels on rod mills shall be screened off, to prevent ends of rods from whipping, breaking off, flying, or jumping out of the rolls.

13. Heating furnaces for rolling mills shall conform to the requirements of Regulation 145 of Chapter VIII of this Code.

14. Before changing rolls, making readjustments or starting repairs on rolling mills, all switches or valves controlling machinery shall be locked.

15. Locks on control switches or control valves for rolling-mill machinery shall not be removed until the responsible person has ascertained that all safeguards are in place and all workers and tools are in the clear.

16. Before starting rolling mills for any purpose, engineers or motormen shall give warning by means of audible or visible signals, followed by an interval of not less than 30 seconds, to make sure that everyone is out of danger.

Crushing Rolls and Roller Mills

17. Crushing rolls and roller mills shall be enclosed with standard machinery guards, except over the necessary openings for feeding and discharging the material being processed, which shall be provided with hoppers, chutes or spouts so constructed that the fingers of the operators cannot come in contact with the rolls.

18. Crushing rolls and roller mills where toxic or irritating dusts, fumes or vapours are liberated from the material being processed—

- (a) shall be provided with suction hoods, properly connected to efficient exhaust systems, in accordance with the relevant requirements of Section 2 of Chapter XIII of this Code; and
- (b) should, so far as practicable, be equipped with dust-tight enclosures.

Dough Brakes

19. Dough brakes in bakeries or in cracker (biscuit) factories—

- (a) shall be provided with guards over the tops of the rolls; and
- (b) if not equipped with automatic feeding devices, shall be provided both in front and behind the rolls with grid guards

which, on contact with the hands or arms of the operators, will actuate mechanisms that stop and reverse the motion of the rolls.

Bread-Moulding Machines

20. Bread-moulding machines shall be equipped with hoppers supplied with dough through chutes—

- (a) by gravity feed from overhead proofers; or
- (b) by conveyor belts.

21. Chutes and hoppers on bread-moulding machines shall be provided with electrically or mechanically interlocked covers, so hinged to the chutes or hoppers that the rolls and belts in the machines will stop moving when the covers are opened.

Candy-Rolling Machines

22. Batch rollers for hard candy, sheeters for lozenge dough, sizers for nougat or caramel sheets and other candy-rolling machines shall be provided with hinged guards of sheet metal or wire mesh, rigidly fixed to cover the rollers while the machine is in motion, and so arranged that the fingers or hands of the operators cannot come into contact with the rolls while feeding the machines.

Textile-Wringing Machines

23. Power wringers in laundries or textile establishments shall be equipped with—

- (a) band feed, or with a feed board; and
- (b) a bar or other guard extending across the entire front of the feed or first pressure rolls, so arranged that the striking of the guard by the hand of the operator or other person will stop the machine or instantly relieve roll pressure.

Collar and Cuff-Dampening and Starching Machines

24. Roll-type laundry machines for dampening or starching collars and cuffs shall be equipped with guards so constructed as to prevent the fingers of the operators or other persons from being caught between the rolls and consisting of—

- (a) a cover with a feed slot not exceeding 10 mm ($\frac{3}{8}$ in.) in width; or
- (b) a bar or other guard extending across the entire front of the feed, so arranged that the striking of the guard by the hand of the operator or other person will stop the machine.

Rubber Mills

25. Mills used for breaking down, cracking, grating, mixing, refining, and warming rubber or rubber compounds shall be so installed that, irrespective of the size of the mill, the top of the

front roll is not less than 1.15 m (46 in.) above the floor or working level: Provided that in existing installations where the top of the front roll is below this height a strong rigid distance-bar guard shall be fitted across the front of the machine in such position that the operator cannot reach the nip point of the rolls.

26. Rubber mills shall be equipped with—

- (a) hoppers so constructed or guarded that it will be impossible for the operators to come into contact in any manner with the nip of the rolls; or
- (b) horizontal safety-trip rods or tight wire cables across both front and rear, which will, when pushed or pulled, operate instantly to disconnect the power and apply the brakes, or to reverse the rolls.

27. Safety-trip rods or tight wire cables on rubber mills shall—

- (a) extend across the entire length of the face of the rolls; and
- (b) be located not more than 1.75 m (69 in.) above the floor or working level, with provision for adjustment of 7.5 cm (3 in.) up or down, and from 5 cm (2 in.) to 10 cm (4 in.) from the face of the front roll or the back roll, respectively.

28. Safety-trip stops on rubber mills shall be so adjusted that the mills, when running empty at any speed, will be stopped after tripping within a distance of travel of the front rolls of—

- (a) 25 cm (10 in.) on individually driven mills with the diameter of the front rolls up to and including 42 cm (16½ in.);
- (b) 38 cm (15 in.) on individually driven mills with the diameter of the front rolls over 42 cm (16½ in.) and up to and including 57 cm (22½ in.);
- (c) 45 cm (18 in.) on individually driven mills with the diameter of the front rolls over 57 cm (22½ in.) and up to and including 66 cm (26 in.);
- (d) 45 cm (18 in.) on mills driven in groups of two or more and with the diameter of the front rolls up to and including 42 cm (16½ in.);
- (e) 61 cm (24 in.) on mills driven in groups of two or more and with the diameter of the front rolls over 42 cm (16½ in.) and up to and including 57 cm (22½ in.); or
- (f) 91 cm (36 in.) on mills driven in groups of two or more and with the diameter of the front rolls over 57 cm (22½ in.) and up to and including 66 cm (26 in.).

29. Safety stops on rubber mills shall be tested daily, and accurate measurements of the distance of travel shall be taken not less than once in every month.

Paper-Making Machines

30. Paper-making machines shall be equipped with—

- (a) suitable steps provided with non-slip surfaces, upon which the operators can stand while pulling out broke; and
- (b) gangways alongside the machines, of sufficient width and provided with standard railings and with non-slip surfaces so as to afford safe access to working places.

31. At points where paper has to be fed by hand between a felt passing over a felt roller and a drying cylinder the surface of the felt roller should be not less than 11 cm ($4\frac{1}{2}$ in.) from the surface of the drying cylinder.

32. Where paper passes downwards over a leading roller to the intake of a felt and the first drying cylinder, a guard covering the felt roller as far as possible shall be provided to minimise the risk of being trapped between the felt and the cylinder.

Veneer Glue Spreaders and Wringers

33. Veneer glue spreaders and veneer wringers shall be equipped with—

- (a) guards in front of the rolls, leaving only sufficient space to insert the stock but not enough to permit any portion of a hand to enter the rolls; or
- (b) two-hand tripping devices, so arranged as to prevent placing the hands in the danger zone after the machines have been tripped and while the rolls are still revolving.

Ironing Machines — Flat-Work Type (Calenders)

34. Flat-work ironing machines in laundries or textile establishments shall be equipped with—

- (a) suction hoods, properly connected to exhaust systems for removal of excessive heat and excessive moisture;
- (b) complete enclosure of the pressure rolls, or vertical guards on all sides to a height of not less than 2.15 m (7 ft.), which may form part of the suction hood, to prevent workers from reaching into the rolls; and
- (c) bars, gate guards or other guards extending across the entire front of the feed or first pressure rolls, not more than 10 mm ($\frac{3}{8}$ in.) above the feeding lip and so arranged that the striking of the guard by the hand of the operator or other person will stop the machine in time to prevent the hand being burned on steam-heated metal or being caught in the nip of the front roll.

35. During the reclothing of rolls of flat-work ironing machines, except machines equipped with slow-motion power control, the power shall be disconnected and the machine turned by hand.

Ironing Machines — Body Type

36. Roll-type body, bosom, collar and neckband ironing machines in laundries shall be equipped with—

- (a) guards enclosing the pressure rolls and provided with interlocking devices which will prevent removal of the guards for cleaning or clothing the rolls until after the machine has been stopped; or
- (b) bars, gate guards or other guards extending across the entire front of the feed or first pressure rolls, so arranged that the striking of the guard by the hand of the operator or other person will stop the machine.

Leather Setting-out Machines (Striking-out Machines)

37. Setting-out machines in leather manufacturing shall be equipped with—

- (a) safety-bar trips in front of the tables and just above them, so arranged that any pressure on the bar will disconnect the power and apply the brakes; and
- (b) adjustable wire-mesh guards over the tops of the machines, to prevent operators from removing any pieces of leather caught in the slicker plates until the guard is dropped and covers the moving parts on the front of the machine, which prevents feeding until the guard is raised again.

Leather-Glazing or Rolling Jacks

38. Glazing or rolling jacks in leather manufacturing shall be provided with U-shaped guards of wire mesh or expanded metal enclosing the rapidly moving arms and the attached glass, metal, or rubber rollers or shoes to within 32 mm (1¼ in.) of the machine tables.

Paper-Finishing Calenders

39. Paper calenders and supercalenders shall be provided on all sides and within easy reach of the workers with—

- (a) electrically operated stop buttons; or
- (b) manually operated power-disconnecting devices.

40. Emergency stopping devices on paper calenders and supercalenders shall be tested frequently by making use of them when stopping the machines.

41. Unless smoothly finished, necks of paper calender and supercalender rolls shall be covered by solid enclosures, extending from the frames of the machines to the production surfaces of the rolls.

42. Paper calender stacks shall be equipped with—

- (a) feeder belts for starting paper webs over the top roll into the first nip; and
- (b) a curved steel plate on the in-running side of each pair of rolls, extending the full length of the rolls, with the concave side toward the rolls and the top edge held by spring or gravity pressure against the surface of the top roll of each

pair just above the nip on the out-running side (the so-called ductor feed).

43. Paper supercalenders, unless equipped with ductor feed, shall be provided at all in-running nips with nip guards extending the full length of the rolls.

44. Suitable steps with non-slip surfaces and handbars shall be provided at each paper calender, for use while making adjustments.

45. Specially constructed safety scrapers shall be used for removing blisters, scabs and other foreign material from calender rolls.

46. Workers shall be prohibited from attempting to clear chokes on paper calenders until the machines have been stopped.

Rubber Calenders

47. Where practicable every roll nip on calenders used for frictioning, sheeting, coating and spreading of rubber or rubber compounds shall be efficiently guarded so as to make the nip inaccessible.

48. Such calenders shall also be equipped with—

- (a) horizontal safety-trip rods or tight wire cables across both front and back that will operate instantly when pushed or pulled to disconnect the power and apply the brakes; and
- (b) vertical tight wire cables on each side of the calenders, connected with the tripping mechanism at the top and fastened to the frame within 30 cm (12 in.) of the floor.

49. Horizontal safety-trip rods or tight wire cables on rubber calenders shall—

- (a) extend the full length of the face of the rolls; and
- (b) be located not more than 1.75 m (69 in.) above the floor or working level, with provision for adjustment of 75 mm (3 in.) up or down.

50. Vertical tight wire cables shall be located at a distance of—

- (a) not more than 30 cm (12 in.) from the face of the rolls; and
- (b) not less than 25 mm (1 in.) from the calender frame.

51. Safety stops on rubber calenders, individually or group driven and irrespective of the size of the rolls, shall be so adjusted that calenders with driving rolls travelling at a maximum peripheral speed of 15 m (50 ft.) per minute shall be stopped, after tripping, within a distance of not more than 30 cm (12 in.) measured on the driving roll.

52. The permissible increase in distance of travel for driving rolls on rubber calenders after tripping shall be 15 cm (6 in.) for each additional 7.5 m (25 ft.) per minute of maximum speed, up to 60 m (200 ft.) per minute.

53. Safety stops on rubber calenders shall be tested daily, and accurate measurements of the distance of travel shall be taken not less than once in every month.

54. Where toxic or irritating dusts, fumes or vapours are liberated from material being processed, rubber calenders shall be provided with suction hoods, properly connected to efficient exhaust systems conforming to the relevant requirements of Section 2 of Chapter XIII of this Code.

Cylinder Printing Presses, Creasers and Scorers

55. Openings in the frames of cylinder printing presses near where the operators stand, and the spaces between the segments and the register racks, shall be covered to prevent the feet, legs, or clothing of the workers from being caught in moving parts.

56. Feeder platforms on cylinder presses, and steps leading to the platforms, shall be provided with—

- (a) anti-slip surfaces; and
- (b) standard railings and toeboards.

57. Hand-fed cylinder presses should be provided with—

- (a) seats for press feeders; and
- (b) paper lifts for raising piles of paper to the level of feedboards located more than 1.5 m (5 ft.) above the floor level.

58. Cylinder presses equipped with gas-flame sheet heaters shall be provided with hand clearance holes in the sides of delivery boxes, so that operators will not be burned if caught between the heaters and the edges of the delivery boxes while removing sample sheets.

59. Where gas-flame sheet heaters are used on cylinder presses, they shall be of a type that automatically shuts off the gas when the press stops, except from the pilot light which ignites the gas when the press starts and the jets are automatically opened.

60. Workers on cylinder presses shall be prohibited from changing formes, making ready, making adjustments to and cleaning or oiling the presses without first disconnecting the source of power.

61. Before starting cylinder presses, operators shall make sure that—

- (a) formes are locked securely in position; and
- (b) all tools are removed from the press beds.

62. Creasers, scorers and other printing machines of the cylinder-press type shall conform to the requirements of paragraphs 55 to 61 of this Regulation.

Rotary Printing Presses

63. High-speed rotary printing presses should where possible be provided with—

- (a) a hinged metal guard over the exposed part of each plate cylinder, to prevent injury from contact with the plates on revolving cylinders or from flying pieces of plates in case of breakage; and
- (b) a complete metal enclosure of both sides of each inking mechanism, from the fountain to the plate cylinder, to eliminate accidental contact with the rollers during operation and to prevent the ink mist from polluting the atmosphere around the press: such enclosure guards to be designed for easy accessibility to enclosed parts for adjustments, routine changes, or other work.

64. On rotary presses where it is impracticable to conform to paragraph 63 of this Regulation, plate cylinders and inking mechanisms located at the sides of passages or service footboards between the press units shall be covered with metal guards that—

- (a) will prevent accidental contact of workers with moving parts; and
- (b) are so constructed that the covered parts are easily accessible for adjustments, routine changes, cleaning and repairs.

65. Service walks, service platforms and platform stairs on rotary presses shall be provided with—

- (a) anti-slip surfaces; and
- (b) standard railings on all open sides.

66. Service walks and service platforms on rotary presses shall be provided with toeboards on all open sides and in places where they cross openings in press frames.

67. Rotary presses should be equipped with—

- (a) individual motor drives; and
- (b) push-button control, through stations located conveniently at different parts of the presses.

68. Central push-button control boards for rotary press drives shall be entirely enclosed, to prevent possible short circuits through material accidentally getting into the coils at the back of the boards, which might cause the press to start or reverse.

69. Before rotary presses are revolved for any purpose, the crews shall be warned through effective sound or light signals.

70. Rotary presses shall be equipped with barring hubs, preferably one hub for each unit of a press, so that they can be turned by hand.

71. Where pits are required under rotary presses, they should be not less than 1.22 m (4 ft.) in depth, to facilitate safe access for necessary adjustments, oiling, or repairs.

72. High-speed rotary presses should be equipped with central oiling systems, preferably with oilproof housings.

73. Rotary presses that are not equipped with central oiling systems shall so far as practicable be provided with—

- (a) self-oiling or anti-friction bearings; or
- (b) extension pipes from bearing caps in hazardous locations to easily accessible and safe locations.

74. Frames of rotary presses and ends of plate and impression cylinders should be wiped regularly after each run, to remove superfluous oil that might create slipping hazards.

75. Slitters on rotary presses—

- (a) shall be provided with guards, so enclosing the discs that the hands of the workers cannot come into contact with the cutting edges; and
- (b) should be provided with suction hoods near the cutting slots, for removal of the paper dust created in the slitting operations.

76. All bolts, nuts and screws on high-speed rotary presses should be tested not less than once in every two weeks and tightened if found to be loose.

77. Roll levers on floor decks of rotary presses, when not in actual use for placing of rolls, shall be—

- (a) turned up towards the press frames, to reduce stumbling hazards; and
- (b) left attached to the press frames, if of the removable type.

78. Loose paper shall not be allowed to accumulate on the floors around rotary presses.

79. Where fractional width paper rolls are used on upper decks of rotary presses, such as one, two, or three-page rolls on four-page wide presses, and are hoisted to the roll brackets by means of cable or chain hoists, collars shall be fastened securely on the roll spindles to prevent the spreader hooks from slipping.

80. Flat sheet deliveries on rotary presses shall be provided with hinged open-work metal guards in front of the delivery trays, to prevent workers from getting their arms caught between the stationary crossbar and the moving lateral bar of the delivery mechanism when reaching for sample sheets.

81. Rotogravure presses shall be provided with suction hoods, properly connected to efficient exhaust systems, in accordance with the relevant requirements of Section 2 of Chapter XIII of this Code, for removing any fumes liberated by the solvents in the inks.

REGULATION 101. SAWS (WOODWORKING)

A. General Provisions

Definitions

1. In this Regulation the following terms have the meanings hereby assigned to them:

[New paragraph 82.]

Cloth Printing Machines

82. (1) The spur gears driving the rolls shall be effectively guarded.

(2) At the back of the rolls where an operative attends to remove creases in the cloth passing in, an effective "nip" guard shall be provided along the whole length of rolls so as to prevent the operative's fingers from being caught in the "nip" between the rolls or between the guard and the rolls.



- (a) the term " mill " means any kind of woodworking saw used for reducing logs to rough-edge lumber or timber, and includes the carriage and the driving machinery;
- (b) the term " re-saw mill " means a mill used to rip saw boards, cants, planks, slabs, timbers and other mill products into two or more pieces;
- (c) the term " crosscut saw " means a woodworking saw with teeth shaped and set for sawing across the grain of the wood;
- (d) the term " rip saw " means a woodworking saw with teeth shaped and set for sawing along the grain of the wood.

General Rules

2. Floor openings for conveyors or chutes near woodworking saws shall be effectively protected by standard railings and toe-boards.

3. Saws shall be driven by a prime mover of sufficient power to avoid all risks of jamming or wedging of the wood worked.

4. The speed of cutting shall be suitable for the nature of the work to be done.

5. The teeth of the saws shall be suitable for the nature of the work to be done.

6. Saws shall be maintained in good condition; they shall not have any cracks, shall be perfectly regular and be correctly sharpened and correctly set.

Removal of Waste

7. The floors of rooms or buildings in which woodworking saws are used shall be kept free from wood waste and other obstructions, and where practicable the saws shall be provided with suitable suction hoods, properly connected to efficient exhaust systems conforming to the relevant requirements of Section 2 of Chapter XIII of this Code.

Mill Sawyers' Stands

8. Stands for head sawyers on band mills or circular mills shall be protected by shields not less than 1.2 m (4 ft.) in height, constructed—

- (a) of iron or steel, not less than 6 mm ($\frac{1}{4}$ in.) thick; or
- (b) of planks, 5 cm (2 in.) or more in thickness; or
- (c) of reinforced concrete, 20 cm (8 in.) or more in thickness.

9. Stands for head sawyers on band or circular mills shall be provided with—

- (a) levers, push-buttons, switches, valves or other devices, to enable the sawyer to stop the mill in any emergency without leaving the stand; and

- (b) means for securely locking all the controls in the "Off" position.

Log Carriages for Mills

10. Log carriages or saw carriages for band mills or circular mills shall be—

- (a) of iron or steel, or of heavy timber mortised or dovetailed and through-bolted; and
(b) completely decked over, to prevent workers from stepping through openings in frames.

11. Stands for log setters on band or circular mill log carriages shall be provided with anti-slip surfaces.

12. The clearance between the rear edge of band or circular mill log carriages and the walls or wall timbers shall be not less than 90 cm (36 in.) where used as a passageway and shall in no case be less than 45 cm (18 in.).

13. No roof trusses, timbers or other parts of the building or fixtures shall be located within 2 m (6 ft. 6 in.) above the surface of band or circular mill log carriage decks.

14. Where log decks for band mills or circular mills are equipped with power-operated devices that turn the logs upward and toward the carriage knees, the knees shall be equipped with curved extensions to prevent logs from being thrown over the knees.

15. Sheaves for ropes, cables or chains of band or circular log carriage drives shall be guarded by boxes of heavy timber securely fixed to the floor.

16. Bevel gears and spur gears on band or circular mill log carriages, and belts and friction wheels for driving the carriages, shall be enclosed with substantial guards.

17. Wheels on band or circular mill carriages shall be provided with wheel guards extending to within 6 mm ($\frac{1}{4}$ in.) of the rails.

18. Each end of band or circular mill log carriage runs shall be provided with a substantial buffer stop, preferably equipped with pneumatic or spring bumpers, capable of bringing the carriage to a full stop from its maximum speed without dangerous retardation.

19. Guard rails of 32 mm ($1\frac{1}{4}$ in.) metal pipe or 5 by 10 cm (2 by 4 in.) lumber shall be provided along the sides of band or circular mill log carriage runways at a height level with the top of the setter's platform.

20. Standard guard rails shall be installed, not less than 45 cm (18 in.) from the saw carriage, in front of any door which opens into a passageway in the rear of band or circular mill log carriages.

21. Where steam engines are used exclusively for driving band or circular mill log carriages—

- (a) the main steam pipe shall be equipped, as close to the engine as conditions permit, with a quick-closing valve so weighted or otherwise actuated that it will close automatically when released by the sawyer; and
- (b) a device for releasing the stop valve in the main steam pipe shall be provided within easy reach and control of the sawyer.

Live Rolls and Transfer Tables for Mills

22. Spaces between live rolls for conveying lumber or slabs from band mills or circular mills shall be provided with full covers so supported and secured that they will not be displaced under working conditions, and constructed either of—

- (a) sheet metal, not less than 6 mm ($\frac{1}{4}$ in.) in thickness; or
- (b) planks, not less than 5 cm (2 in.) in thickness.

23. Driving gears or sprockets and chains for live rolls or transfer tables from band mills or circular mills, belts and pulleys and friction discs for driving roll shafts, and driving shafts for live rolls, shall be enclosed on top, bottom and sides with guards of metal or heavy planking provided with doors for access at necessary points.

24. Vertical faces of transfer tables of band mills or circular mills shall be covered in conformity with the provisions of paragraph 22 of this Regulation, unless so located as to be protected by live roll tables or machine frames.

25. Where it is necessary to cross live rolls, conveying tables or transfer tables for band mills or circular mills, stairways and elevated bridges equipped with standard railings and toeboards shall be provided.

26. The use of spiked live rolls for band mills and circular mills should be prohibited.

B. *Band Saws*

Definition

27. In this Regulation the term "band saw" means a machine for sawing timber or lumber, equipped with one or more endless steel bands with a continuous series of notches or teeth on one or both edges and running over a pair of wheels or pulleys that are usually mounted one above the other but are sometimes mounted horizontally.

General Provisions

28. Band wheels on woodworking band saws, and the return portion of the blades between the upper and lower band wheels, shall be enclosed with hinged guards of sheet metal not less than 1 mm (0.04 in.) in thickness or other material of equal strength.

29. Guards for upper band wheels on woodworking band saws shall extend—

- (a) downward below the lower part of the wheel rim; and
- (b) upward, preferably conforming to the shape of the wheel, to afford a clearance at the top of not less than 10 cm (4 in.) from the wheel.

30. Guards for lower band wheels on woodworking band saws, which also shall serve as suction hoods, shall—

- (a) extend to the floor, to prevent anything from getting under the wheel; and
- (b) be properly connected to efficient exhaust systems.

31. The working side of saw blades on woodworking band saws between the guide rolls or gauges and the upper wheel enclosures shall be enclosed, preferably with self-adjusting guards.

32. Woodworking band saws should be provided with automatic tension regulator, to compensate for expansion and contraction and to ensure proper tension during use.

33. Where operators on power-fed woodworking band saws stand within 75 cm (30 in.) of the feed rolls, the rolls shall be provided with semi-cylindrical guards of heavy metal—

- (a) adjustable to the size of the stock being cut; and
- (b) firmly secured to the frames of the machines.

34. Band wheels on woodworking band saws shall not be run at a speed in excess of that which will allow a factor of safety of ten in all parts of the wheel.

35. Saw bands shall be carefully examined for cracks or other defects, when put on or taken off the band wheels.

36. Any woodworking saw band found to have developed a crack shall be removed from service while such defect exists.

37. Workers on woodworking band saws shall be prohibited from attempting to back the work away from the saw in case it binds or pinches, or to remove any part of broken saw blades, without first stopping the machine.

Band Mills

38. Upper band wheels on band mills, and as much of the saws as practicable, shall be completely enclosed.

39. Except for a distance of 25 mm (1 in.) from the front edge, all band wheels on band mills shall have a minimum rim thickness of 16 mm ($\frac{5}{8}$ in.).

40. No band wheel on band mills shall be run at a speed in excess of 45 m/sec. (9,000 ft./min.) unless—

- (a) it has been designed and constructed with a factor of safety of ten for its rated speed;

- (b) it has been properly tested for balance when running at its rated speed; and
- (c) the maximum allowable speed in revolutions per minute has been plainly marked by the manufacturer on the wheel and the frame of the machine.

41. Counterweights on telescopic band mills shall be covered for the full length of travel.

42. All band wheels on band mills shall be inspected not less than once in every month, with all hubs, spokes, rims, bolts and rivets subjected to hammer tests, and any wheel in which a crack is found shall be removed from service.

Band Re-saw Mills

43. (1) Band re-saw mills shall conform to the requirements of paragraphs 38 to 42 of this Regulation, concerning band mills.

(2) Feed rolls on band re-saw mills shall be safeguarded in accordance with the provisions of paragraphs 22 to 26 of this Regulation.

C. Circular Saws

Definitions

44. In this Regulation the following terms have the meanings hereby assigned to them:

- (a) the term "circular saw" means a machine for sawing timber or lumber, equipped with one or more thin steel discs with a continuous series of notches or teeth on their peripheries, ordinarily mounted on horizontal arbors or spindles located—
 - (i) beneath work tables or benches provided with slots through which the upper portion of the blades projects to cut material pressed against the blades; or
 - (ii) above work tables or benches, to the level of which the blades are dropped, when needed, to cut material pressed against the blades; or
 - (iii) in frames suspended from overhead shafting so that they can be swung to cut through material resting on the tables;
- (b) the term "equaliser" means a machine equipped with two circular crosscut saws for cutting barrel staves, bolts, box-boards, vehicle stock and other lumber products to fixed lengths by simultaneously trimming both ends;
- (c) the term "jump or bed trim saw" means a machine used in sawmills for squaring the ends of sawed stock and trimming it to fixed lengths, equipped with two or more circular crosscut saws mounted on sliding collars underneath the tables and raised by means of levers, pedals or compressed air as needed for cutting;

- (d) the term "lath bundle trimmer" means a machine for trimming bundled lath to fixed lengths, equipped with one or two circular crosscut saws and with swinging arms for holding the bundles;
- (e) the term "overhead or drop trimmer" means a machine used in sawmills for squaring the ends of sawed stock and trimming it to fixed lengths, equipped with two or more circular crosscut saws mounted on movable arms suspended from shafts or beams above the cutting points and dropped as needed for cutting;
- (f) the term "slasher" means a machine equipped with two or more circular crosscut saws, mounted on arbors attached to posts suspended from above, arranged in a horizontal line above a table provided with chain feed, and which is used—
- (i) in sawmills for sawing edgings, slabs and other waste lumber into lengths suitable for lath or other by-products; or
 - (ii) in pulp and paper mills for sawing logs into bolts, approximately 30 cm (12 in.) in length, for wood pulp grinders;
- (g) the term "railroad or travelling saw" means a machine equipped with a single circular crosscut saw that moves forward in a stationary table when cutting;
- (h) the term "stove wood saw" means a machine used in sawmills for cutting edgings or slabs to suitable lengths for firewood, equipped with two or more circular crosscut saws mounted on arbors above the saw tables;
- (i) the term "swing or pendulum saw" means a saw frame suspended from a shaft above the work table and equipped with a single circular crosscut saw, which is pulled forward to make cuts, with the extreme lower edge of the saw passing through a special slot in the table or bench top, and automatically retires from the saw cut when released;
- (j) the term "tilted arbor circular crosscut saw" means a table machine equipped with a single circular crosscut saw, mounted on an arbor set at an angle to the plane of the saw table for crosscutting at an angle, bevelling or grooving across the grain of the wood;
- (k) the term "tilting-table circular crosscut saw" means a table machine equipped with a single circular crosscut saw and with a tiltable saw table for crosscutting at an angle, bevelling, or grooving, across the grain of the wood;
- (l) the term "titled arbor circular ripsaw" means a table machine equipped with a single circular ripsaw, mounted on an arbor set at an angle to the plane of the saw table for ripsawing at an angle, bevelling or grooving along the grain of the wood;
- (m) the term "tilting table circular ripsaw" means a table machine equipped with a single circular ripsaw and with a tiltable saw

table for ripping at an angle, bevelling or grooving along the grain of the wood;

- (n) the term "bolter" means a machine equipped with one or more circular ripsaws for ripping short logs, slabs, or edgings, held on a split table or on a travelling carriage, into widths and thicknesses suitable for heading bolts, lath bolts, shingle bolts, stave bolts or other by-products;
- (o) the term "dado head saw" means a machine for cutting grooves or recesses on wooden parts, equipped with two circular grooving saws set close together, with special cutters inserted between them for removing the wood between the saw cuts;
- (p) the term "wobble or drunken saw" means a single circular ripsaw blade of small diameter, mounted at an angle by inserting wedges between the saw disc and the collar;
- (q) the term "edger" means a machine used in sawmills, planing mills and box factories for edging and ripping boards, cants and lumber, equipped with two or more circular ripsaws mounted on a common arbor, with devices for varying the distance between the saws, and usually with power feed;
- (r) the term "heading saw" means a machine equipped with a single circular ripsaw for sawing barrel-head material from heading bolts, placed upright in a pendulum swing carriage, which is pushed towards the saw for cutting;
- (s) the term "knee bolter" means a machine equipped with a single circular ripsaw for squaring up and cutting out defects from shingle bolts standing upright on a small travelling carriage operated by the knee and turned by the hands of the operator to follow the contour of the sap;
- (t) the term "lath bolter" means a machine equipped with one or more circular ripsaws for reducing slashings to lath bolts of suitable width and thickness for the lath mills;
- (u) the term "lath mill" means a machine equipped with a number of evenly spaced small circular ripsaws for sawing lath bolts into lath of specified thickness;
- (v) the term "segment saw" means a machine for sawing veneer sheets from prepared fitches, cutting a sheet at each forward travel of the reciprocating carriage by means of a saw consisting of ten or more circular ripsaw segments of thin section, fastened tightly with countersunk screws to one side of a flange;
- (w) the term "shingle clip saw" means a machine equipped with one or two circular ripsaws for edging and squaring shingles to make them uniform in width;
- (x) the term "horizontal shingle saw" means a machine equipped with one or more circular ripsaws, each reinforced on one side with a flange, mounted on vertical shafts, for cutting shingles from the bottom of shingle bolts, fed over the saws in sliding frames or in rotating compartment frames;

- (y) the term "vertical shingle saw" means a machine equipped with a single circular ripsaw, mounted on a horizontal shaft, for cutting shingles from shingle bolts, fed to the saw in carriages;
- (z) the term "cylinder saw" means a machine for cutting barrel, bucket, keg or tub staves with a single woodworking saw consisting of a cylinder of sufficient length to cut the proper size staves, with the rear end closed and with sawteeth cut in the edge of the front end, against which stave bolts are fed by a carriage travelling on two tracks, one outside and the other inside the cylinder;
- (aa) the term "rock saw" means a small coarse-toothed circular saw, carried on adjustable arms in front of the head saws, for cutting a wide kerf through the bark on top of the log and removing small stones or pebbles, so as to protect the main saw.

General Provisions

45. Woodworking circular saws shall be so installed as to prevent undue movement and excessive vibration.

46. Tables for woodworking circular saws should be not less than 85 cm (34 in.) or more than 90 cm (36 in.) in height.

47. Woodworking circular saws shall, unless otherwise specified, be provided with hood guards, which—

- (a) cover as much as possible the exposed part of the saw at all times, at least to the depth of the teeth, are easily adjustable and extend close to the top of the stock at the cutting edge of the saw;
- (b) are as narrow as possible;
- (c) are adjusted as near as possible to the point of operation;
- (d) have the plane of the saw blade clearly marked on the saw hood;
- (e) are so designed as to protect the operator from accidental contact with the saw and from flying splinters or broken saw teeth; and
- (f) are made of, or lined with, material soft enough to be unlikely to cause tooth breakage by accidental contact with the saw.

48. Parts of woodworking circular saws underneath tables shall be closely covered by guards or by hoods which may serve as exhaust hoods.

49. Spreaders (riving knives), where used on woodworking circular saws, shall—

- (a) be slightly thinner than the saw kerf and slightly thicker than the saw blade;
- (b) be not less than 5 cm (2 in.) in width at the top of the saw table;

- (c) extend to a height above the table from 2 to 5 mm ($3/32$ in. to $3/16$ in.) less than the height of the saw; and
- (d) be securely fastened at the back of the saw and in accurate alignment with the saw, and adjustable so that the clearance between the saw and the spreader above the table is as small as possible and in no case exceeds 3 mm ($1/8$ in.).

50. Spreaders on woodworking circular saws should be curved approximately to the contour of the saws with which they are used.

51. For re-saws with tapered sawblades used in planing mills, straight spreaders thicker than specified in paragraph 49 may be used.

52. The maximum speeds of woodworking circular saws shall not exceed those recommended by the manufacturer of the saw in each particular case.

53. Counterweights used to actuate feeding mechanisms on woodworking circular saws should be enclosed in stationary casings.

54. Workers shall be prohibited from adjusting guards or saw guides on woodworking circular saws while the saw blade is in motion, unless such adjustment can be made without risk of contact with the saw blade.

55. Woodworking circular saws shall be—

- (a) properly maintained, set, and sharpened;
- (b) examined at regular and frequent intervals; and
- (c) replaced or removed for correction if defects are discovered.

56. The practice of drilling holes at the ends of cracks in woodworking circular saws shall be prohibited, and cracked saws shall not be used until they have been satisfactorily repaired.

57. Operators of woodworking circular saws should not stand directly in front of the saws during sawing operations.

58. Woodworking circular saws used for both crosscutting and ripping operations shall be safeguarded in accordance with the requirements of paragraphs 98 to 105 of this Regulation concerning ripsaws.

Circular Mills

59. The saws on single circular mills and the top saws on double circular mills shall be provided with adjustable hood guards.

60. Double circular mills shall be provided with screens of wire mesh or other suitable devices, so placed as to protect the sawyer from flying particles.

61. The horizontal distance from the sides of saws on double circular mills to the nearest post of the frame shall be not less than 25 mm (1 in.) greater than the clear vertical distance between the collars of the top and bottom saws, to eliminate the possibility of slabs falling and jamming between the saw and any obstruction.

62. Circular mills shall be provided with brackets or edging supports between the saws and the sides of the frames.

63. Circular mills shall be provided with guides, which can be adjusted without the use of wrenches or other hand tools.

64. Circular mills shall be equipped with effective spreaders or riving knives.

Circular Re-saw Mills

65. Circular re-saw mills shall conform to the requirements of paragraphs 59 and 62 to 64 of this Regulation, concerning circular mills.

66. The feed rolls shall conform to the requirements of paragraphs 22 to 26 of this Regulation.

Rock Saws

67. Rock saws, where provided, shall be equipped with—
- (a) hoods, which also may serve as exhaust hoods, covering the saw as fully as possible, so as to protect the sawyer from flying sawdust and pebbles; and
 - (b) counterweights, so that the saws will swing up in the clear when not in use.

Circular Crosscut Saws

68. Woodworking circular crosscut saws, except railroad saws and swing saws, shall be provided with spreaders, conforming to the requirements of paragraphs 49 and 50 of this Regulation.

69. Manual-feed woodworking circular crosscut saws should be equipped, wherever practicable, with sliding tables for feeding material, and with means for securely holding pieces to be cut into short sections.

Equalisers

70. Equalising saws shall be covered so far as practicable on the tops and backs and, when mounted on arbors outside the bearings, also on the outer part of each saw to a point below the bottom.

71. Equalisers equipped with carriers shall be provided with springs or weights to keep the carriers away from the saws except when stock is being fed.

Jump or Bed Trim Saws

72. Jump or bed trim saws in sawmills shall be provided with—
- (a) substantial guards of heavy wire mesh or of planking not less than 5 cm (2 in.) in thickness, suspended in front of the saws; and
 - (b) standard machinery guards enclosing the underpart of the saw tables, consisting in part of suitable hinged doors to give access to the enclosed parts for lubrication and adjustments.

73. End saws on jump or bed trim saws in sawmills shall be guarded at the sides and bottom by standard machinery guards of metal or wood, firmly secured to the floors.

74. Jump or bed trim saws in sawmills shall be provided with limit stops to prevent the saws from being raised too high above the tables.

75. Operating pedals for jump or bed trim saws in sawmills shall be covered with suitable and substantial stirrups of metal or wood, securely fastened to the floors.

76. When repairs or adjustments are being made on jump or bed trim saws in sawmills, where operation of the saws is—

- (a) controlled by one or more pedals, safety blocks shall be placed under the pedals; or
- (b) controlled by hand levers, all the levers shall be locked with yokes provided for that purpose.

Lath Bundle Trimmers

77. Single or double lath bundle trimmers shall be guarded on ends and rear with substantial housings of metal or wood.

78. Housings on lath bundle trimmers shall—

- (a) cover the tops of the saws and come down as far as practicable in the front and rear where the cutting is done with the lower part of the saws; and
- (b) come as far as possible towards the tops of the saws at the back and ends where the cutting is done with the upper part of the saws.

Overhead or Drop Trimmers

79. Overhead trim saws in sawmills should be provided with hoods, which may serve as exhaust hoods, over the tops of the saws and carried down as far as will permit the thickest stock to pass through.

80. Overhead trim saws in sawmills, when not equipped with hoods, shall be guarded at both the front and the rear with barricades—

- (a) constructed of planks, 75 mm (3 in.) or more in thickness, bolted to 10 by 10 cm (4 by 4 in.) posts;
- (b) suspended from above by cables or chains or securely fastened to the machine frames; and
- (c) placed not more than 30 cm (12 in.) from the trim tables, except where large timbers require a greater distance.

81. End saws on overhead trim saws in sawmills shall be guarded at the sides with standard machinery guards or by standard railings.

82. Overhead trim saws in sawmills shall be provided at the front of each saw with a bar or rod, which shall be—

- (a) installed not less than 60 cm (24 in.) from the front edge of the saw and not more than 30 cm (12 in.) above the trim table; and
- (b) so connected with the driving mechanism of the conveyor that the striking of the bar or rod will automatically stop the conveyor.

Slashers

83. Slashers in sawmills shall be safeguarded in accordance with the requirements of paragraphs 79 to 82 of this Regulation concerning overhead trim saws.

84. Slashers used in pulp and paper mills shall be safeguarded in accordance with the requirements of paragraph 80 of this Regulation.

85. Saw tables for slashers in pulp and paper mills shall—

- (a) be not less than 1.05 m (42 in.) above the floor or working level; and
- (b) be guarded on all exposed sides with standard hand-rails.

Railroad or Travelling Saws

86. Hood guards on circular crosscut saws that move forward in stationary saw tables when cutting shall—

- (a) be fastened securely to the arbor or to the saw table;
- (b) cover the saw when running idle;
- (c) extend not less than 5 cm (2 in.) in front of the saw teeth when the saw is in its back position; and
- (d) be limited in width so as to give a clearance of 6 mm ($\frac{1}{4}$ in.) on each side of the saw blade.

Stove Wood Saws

87. Circular gang saws used in sawmills for cutting firewood shall be provided with barriers over the saws that—

- (a) come within 15 cm (6 in.) of the saw tables; and
- (b) are not less than 3 mm ($\frac{1}{8}$ in.) in thickness, if of sheet metal; or
- (c) are not less than 4 cm ($1\frac{1}{2}$ in.) in thickness, if of wood.

88. Chain feed tables for stove wood saws shall be of such length that workers placing stock on them cannot reach the saws in straightening stock on the feed chains.

Swing Saws

89. Hood guards on swing saws (pendulum saws) shall extend below the arbors, with the side cover next to the end of the arbor preferably hinged for access to the saw.

90. The lower part of swing saws shall be guarded when the saw is in its back position.

91. Swing saws shall be provided with—

- (a) limit chains or other positive devices which will prevent the front edge of the saw from advancing beyond the front edge of the saw table;
- (b) counterweights or other effective devices which will automatically return the saw so that the front edge of the saw is not less than 25 mm (1 in.) behind the back edge of the saw table when the saw is released by the operator at any point of its travel; and
- (c) latches or other positive means which will prevent the saw from rebounding when swinging back.

92. Counterweights on swing saws shall be prevented from dropping by means of—

- (a) bolts passing through both bars and counterweights; or
- (b) bolts through the extreme ends of the bars; or
- (c) safety chains, secured to the ceilings or other overhead supports.

93. Belts on swing saws shall be enclosed—

- (a) for the entire length on the front toward the operator; and
- (b) to not less than 2.6 m (8 ft. 6 in.) above the floor or working level on the back and on both sides.

Tilted Arbor Circular Crosscut Saws

94. Hood guards and spreaders on circular crosscut saws mounted on tilted arbors shall be so supported that they will at all times be in alignment with the saws.

Tilting Table Circular Crosscut Saws

95. Self-adjusting hood guards on circular crosscut saws equipped with tiltable tables shall be so designed that both sides will rest on the table or on the material being cut.

Circular Ripsaws

96. Woodworking circular ripsaws shall be provided with spreaders, in accordance with the requirements of paragraphs 49 and 50 of this Regulation.

97. During operations on which spreaders cannot be used woodworking circular ripsaws shall be provided with anti-kickback dogs or cams, which shall be—

- (a) of a width at right angles to the saw of not less than 3 mm ($\frac{1}{8}$ in.);
- (b) in contact with the work as it moves under them; and

- (c) so designed that any backward movement of the material being cut will cause them instantly to engage and hold the material securely, regardless of its thickness.

Circular Ripsaws — Manual Feed

98. Woodworking manual-feed circular ripsaws for sawing short stock should be equipped with sliding feed tables provided with clamping devices.

99. Workers on manual-feed circular ripsaws which are not equipped with sliding feed tables shall be provided with, and use, push sticks for pushing pieces of stock through the saw.

Tilted Arbor Circular Ripsaws — Manual Feed

100. Hood guards and spreaders on manual-feed circular ripsaws mounted on tilted arbors shall be so supported that at all times they will be in alignment with the saws.

101. Guides on manual-feed circular ripsaws shall not extend beyond the point at which the cut is made.

Tilting Table Circular Ripsaws — Manual Feed

102. Self-adjusting hood guards on manual-feed circular ripsaws equipped with tiltable tables shall be so designed that both sides will rest on the table or on the material being cut.

Circular Ripsaws — Self-Feed

103. Self-adjusting hood guards on woodworking self-feed circular ripsaws shall—

- (a) extend to a position not more than 12 mm ($\frac{1}{2}$ in.) above a horizontal plane passing through the bottom of the feed rolls; or
- (b) be so constructed that it encloses the saw and the feed mechanism as a single unit.

104. (1) Feed rolls on woodworking self-feed circular ripsaws shall be provided with guards so constructed as to prevent operators or other workers from being caught between the rolls and the material or the chain feed mechanism, whatever size of stock is being cut.

(2) These guards shall be—

- (a) constructed of strong material, preferably metal; and
- (b) firmly secured to the supports of the feed rolls.

105. Chain feeds at the rear of woodworking self-feed circular ripsaws shall be so arranged or guarded that the hands of workers will not be caught between the chain feed and the end of the saw table.

Bolters

106. Saws on heavy bolters for ripping sections of logs into bolts shall be—

- (a) enclosed at the back and sides, to prevent accidental contact;
- (b) guarded over the top with metal or hardwood strips; and
- (c) provided with effective adjustable spreaders.

107. Bolters equipped with short-travel carriages shall conform to the requirements of paragraphs 29 to 36 of this Regulation concerning circular mills.

Dado Head Saws

108. Dado head saws shall be equipped with sliding tables, provided with devices for securely holding small stock.

109. On dado head saws where the grooving is done with the lower part of the saw, all the saw, except the part necessary for the work, shall be covered.

110. On dado head saws where the grooving is done with the upper part of the saw—

- (a) the top part of the saw shall be covered as fully as possible; and
- (b) the part of the saw under the table shall be covered by an enclosure which may serve as an exhaust hood.

Wobble Saws

111. The use of wobble saws shall be prohibited unless the blades are specially designed and mounted for the work.

Edgers

112. (1) Edgers shall be provided with a guard over the sawblades which shall—

- (a) consist of a grid of sufficient strength made of flat or rod iron members placed parallel to the sawblades and not more than 50 mm (2 in.) apart, and over the grid a cover of sheet metal so designed and installed that it prevents kickbacks over the front feed rolls; and
- (b) have both the grid and the metal cover hinged to the machine frame at opposite ends of the machine.

(2) The guard may also be made of angle iron placed over the sawblades at an angle of 90° to the blades and in such a way that it will stop kickbacks but permit cleaning of the sawblades.

113. Where the first pressure rolls or feed rolls on edgers are located within 75 cm (30 in.) of the front of the edgers, guards shall be placed in front of the rolls.

114. Edgers should be equipped with heavy pressure rolls both in the front and at the back of the saws.

115. Unless the feed rolls on edgers are made in independent sections of not more than 15 cm (6 in.) in length, or are so hung as to form a toggle, the edgers shall be provided with—

- (a) finger guards, placed in front of either front or back pressure rolls; or
- (b) dog guards, placed back of the front pressure rolls.

116. Openings in end frames of edgers in sawmills shall be covered with wire mesh or wood guards, hinged or otherwise arranged to permit oiling or inspection.

Heading Saws

117. Heading saws equipped with pendulum swing carriages shall be covered over the back and sides as completely as the operations will permit, and the swing carriages shall be provided with guards on the outside and the back.

Knee Bolters

118. Knee bolters in shingle mills shall be provided with—

- (a) hoods or other guards covering the entire back of the saw;
- (b) guards, suspended rigidly and as low as possible in front of the crown of the saw, to protect operators from flying knots, sawdust, or other debris; and
- (c) limit stops for the carriage, to prevent it from coming back too far and jumping the track.

Lath Bolters and Lath Mills

119. Lath bolters and lath mills equipped with feed rolls shall be provided with—

- (a) adjustable metal or wood covers enclosing the feed rolls, saws, and gearing as a unit; or
- (b) hoods, which also may serve as exhaust hoods, over the saws and extending well down over the front of the feed rolls; and
- (c) standard machinery guards enclosing the gears or the sprockets and chains.

120. Hoods for saws on lath bolters and lath mills shall be of—

- (a) sheet metal, not less than 3 mm ($\frac{1}{8}$ in.) in thickness; or
- (b) wood, not less than 4 cm ($1\frac{1}{2}$ in.) in thickness.

121. Lath bolters and lath mills shall be provided with effective spreaders and anti-kickback devices.

Segment Saws

122. Segment saws shall be carefully examined at frequent intervals to ensure that all segments are fastened securely to the saw discs.

Shingle Clip Saws

123. Shingle clip saws shall be provided with—

- (a) metal guards, not less than 5 cm (2 in.) in width, located not more than 10 cm (4 in.) above the saw, and strong enough to support the weight of the operator should he slip and fall on it; and
- (b) housings of sheet metal or wood which may also serve as exhaust hoods enclosing the bottom part of the saw up as far as possible without interfering with the work of the spring-board.

124. Shingle-clipper springboards shall be equipped underneath the front edge with steel finger guards, not more than 1.5 mm (0.06 in.) or less than 1 mm (0.04 in.) in thickness, 12.5 cm (5 in.) in length, and 3 cm (1¼ in.) in width.

Shingle Saws — Horizontal

125. Horizontal shingle saw machines shall be equipped with guards enclosing the rims of the stationary single-saw frames for one-block or two-block beds or the rotating multiple-block compartment frames.

126. Feed frames on one-block or two-block shingle saw machines shall be provided with safety spalling curves that leave several centimetres (inches) of the curve opening clear of the saw when the sliding carriage is over the blade.

127. Horizontal shingle saw machines shall be so equipped that the machine—

- (a) will stop when the special treadle for operating the jaw of the carriage is tripped; and
- (b) will not start again except by tripping the saw-machine treadle.

Shingle Saws — Vertical

128. The periphery and inside of vertical shingle saws shall be guarded, to intercept flying chips or knots.

129. Guards for the cutting face of vertical shingle saws, when located at the side of the saw—

- (a) shall project 4 cm (1½ in.) past the cutting edge of the saw; and
- (b) shall be not more than 6 mm (¼ in.) from the side of the saw.

Cylinder Saws

130. Cylinder saws for cutting barrel staves shall be provided with enclosures covering the drum and all the saw except the part immediately adjacent to the bolt carriage.

D. *Frame Saws*

Definitions

131. In this Regulations the following terms have the meanings hereby assigned to them:

- (a) the term "frame saw" means a machine for sawing wood equipped with one or more straight blades having a series of notches or teeth on one edge and having a reciprocating movement;
- (b) the term "sash gang mill" means a machine for sawing lumber from small logs or for resawing cants or timbers, single or in heaps, by a number of straight ripsaw blades, ordinarily 95 to 100 cm (38 to 40 in.) in length, stretched vertically in a sash that reciprocates in vertical slides on a heavy frame, with the blades cutting only on the downward stroke.

Frame Saws

132. All dangerous parts of frame saw installations such as frames, cranks, crank pulleys, flywheels, connecting rods, counterweights, feed rolls, driving gears and sprockets and chains shall be securely fenced unless they are adequately protected by location.

133. When inspections are made or when repair or maintenance work such as the inserting, changing or sharpening of a saw blade is carried out on frame saw installations, adequate precautions shall be taken to prevent—

- (a) the inadvertent descent of the frame;
- (b) the fall of elevated pressure rolls; and
- (c) the accidental starting of the machine.

134. Where practicable, adequate precautions should be taken, especially in very cold weather, against the breaking of saw blades.

135. Sawyers' stands and log carriages for frame saw installations shall, where practicable, conform to the requirements of paragraphs 8 to 21 of this Regulation concerning stands and carriages.

136. Power-driven rollers, where used for feeding timbers or logs to frame saws shall be safeguarded in accordance with paragraphs 22 to 26 of this Regulation concerning live rolls.

Sash Gang Mills

137. The vertical guide frames and the driving mechanisms of sash gang mills shall be enclosed in substantial housings.

138. Power-driven carriages, where used for feeding round logs to sash gang mills, shall be provided with—

- (a) devices for holding the logs or heaps of slashed logs firmly while passing through the mills;
- (b) guards or standard railings along exposed sides of the runways; and
- (c) wheel guards in front of the carriage wheels.

139. Power-driven rollers, where used for feeding cants, flitches or single slabbed logs to sash gang mills, shall be safeguarded in accordance with the requirements of paragraphs 22 and 23 of this Regulation concerning live rolls.

E. *Other Saws*

Definitions

140. In this Regulation the following terms have the meanings hereby assigned to them:

- (a) the term "drag saw" means a machine for sawing logs or timbers into shorter lengths with a straight crosscut saw blade, 1.8 m (6 ft.) or more in length and from 25 to 30 cm (10 to 12 in) in width, reciprocated by means of mechanical power.
- (b) the term "chain mortise machine" means a machine for cutting mortises in wooden parts with a number of single saw teeth assembled in the form of an endless chain of roller links, suspended from a power-driven sprocket wheel.

Drag Saws

141. Woodworking drag saws shall be—

- (a) so located that there is not less than 1.2 m (4 ft.) clearance for passage at the ends when the saw is at the extreme limit of its stroke; or
- (b) enclosed with standard railings.

142. Cranks and gears, friction wheels and walking beams on drag saws shall be covered with standard machinery guards.

143. When sawing short ends on drag saws, such as shingle blocks, the ends shall be—

- (a) held in place by long-arm levers; or
- (b) securely dogged to the haulways.

Chain Mortise Machines

144. Chain mortise machines shall be provided with—

- (a) telescoping self-adjustable guards, covering the sprocket wheel and the chain down to the top surface of the material being processed, which will also serve as exhaust hoods to remove the chips; or
- (b) thumb stops at both sides of the chain.

REGULATION 102. SAWS (METAL AND OTHER SUBSTANCES)

Definitions

1. In this Regulation the following terms have the meanings hereby assigned to them:

- (a) the term "band-saw machine" means a machine tool for sawing metal stock to specified length, width, bevel, mitre or curve, or for removing excess metal from castings or stampings, equipped with one or more metal-cutting band saws consisting of endless steel bands with a continuous series of notches or teeth on one or both edges and each band running over a pair of wheels or pulleys that are mounted either one above the other or horizontally;
- (b) the term "circular-saw machine" means a machine tool for sawing metal bars, billets, ingots, pipe, plate, rods, sheets or other metal stock to specified length, width, angle or bevel, equipped with one or more metal-cutting circular saws consisting of thin steel discs with a continuous series of notches or teeth on their peripheries, mounted on horizontal arbors or spindles located above or beneath the sawbeds or saw tables;
- (c) the term "cold-sawing machine" means a circular-saw machine ordinarily used for trimming the ends of cooled pipe or steel billets, held in vice jaws on the sawbeds, by advancing the saws to cut through the stock;
- (d) the term "slitting-saw machine" means a circular-saw machine for cutting narrow slots in metal parts with small circular saws, usually less than 5 mm ($\frac{3}{16}$ in.) thick and ground slightly thinner at the centres for clearance in deep cuts;
- (e) the term "friction-sawing machine" means a machine tool for cutting metal stock to fixed lengths with a large, slightly hollow-ground circular steel disc without teeth, operated at high peripheral speed and melting a path through the metal by the heat of friction as the stock is forced against the disc;
- (f) the term "hack-saw machine" means a machine tool for sawing metal stock, held in vice jaws on the sawbeds or saw tables, with a straight metal-cutting saw blade mounted in a reciprocating horizontal frame, forced through the work by the weight of the frame or by hydraulic or mechanical pressure on the frame, and ordinarily cutting only on the forward stroke;
- (g) the term "hot-sawing machine" means a circular-saw machine, ordinarily arranged as a part of a series and used in iron and steel mills and rolling mills for cropping and cutting uncooled billets, double-length pipe, rails and structural steel to fixed lengths;
- (h) the term "linter" means a machine for removing the very short fibres adhering to cotton seeds after ginning, by means

of a number of small circular saws, carried on a rapidly revolving cylinder, against which the seeds are forced by wire brushes rotating in the opposite direction.

Metal-Cutting Saws — General Provisions

2. Metal-cutting saws used for operations liberating injurious dust or fumes in harmful quantities shall be provided with suction hoods, properly connected to efficient exhaust systems conforming to the relevant requirements of Section 2 of Chapter XIII of this Code.

3. Where coolants are used on metal-cutting saws—

- (a) the saw guards should be designed to afford proper drainage for the coolant; and
- (b) splash guards should be provided.

4. Workers shall be prohibited from attempting to remove pieces of broken saws without first stopping the machines.

Band-Saw Machines

5. Vertical band-saw machines for sawing metal stock or trimming castings shall be provided with—

- (a) self-adjusting enclosure of the upper band wheels and the portion of the blades above the saw tables except the working side of the blades below the guide rolls or the guides; and
- (b) complete enclosure of the lower band wheels and the portion of the blades beneath the tables.

6. Horizontal band-saw machines shall be provided with complete enclosure of both band wheels and of all of the sawblade or sawblades except the portions necessary for the work.

Circular-Saw Machines

7. Cold-sawing machines, slitting-saw machines and other circular-saw machines for cutting cold metal stock shall be provided with hood guards, which shall cover the exposed part of the saw at all times at least to the depth of the teeth, and shall either—

- (a) automatically adjust themselves to the thickness of, and remain in contact with, the material being cut; or
- (b) be fixed or manually adjusted, with the space between the bottom of the guard and the material being cut not exceeding 10 mm ($\frac{3}{8}$ in.) at any time.

8. Parts of saws underneath tables of metal-cutting circular-saw machines shall be covered by enclosures, which may serve as exhaust hoods.

9. Where metal-cutting circular saws are driven by means of sprocket wheels, such wheels shall be covered with standard machinery guards.

10. Small pieces of material or piles of material to be cut on metal-cutting circular-saw machines shall be held securely in clamps or fixtures on the saw tables or carriages.

Friction-Sawing Machines

11. Friction saws for cutting cold metal stock to fixed lengths—
- (a) shall be equipped with sheet-metal hood guards covering as much of the saw as possible, to stop flying sparks, and substantial enough to hold segments of the saw in case of breakage; and
 - (b) should be provided with remote control.

Hack-Saw Machines

12. Tops of reciprocating saw frames on power-driven hack-saw machines should be covered by stationary hoods, extending over the full length of travel.

13. Cranks, gears, pistons, screws, springs and other reciprocating or revolving parts of power-driven hack-saw machines, except the blades, shall be enclosed in housings or covered by standard machinery guards.

14. Metal stock to be cut on power-driven hack-saw machines shall be held securely in vices or clamps on the saw tables.

Hot-Sawing Machines

15. Hot saws for cropping and cutting uncooled metal—
- (a) shall be provided with hood guards of not less than 3 mm ($\frac{1}{8}$ in.) sheet metal over the tops of the saws, to intercept flying sparks; and
 - (b) should be provided with remote control.

Saws for Materials Other than Wood or Metal

16. Band saws or circular saws used for cutting asbestos, mica, stone or other mineral products, bakelite, celluloid or other plastics, bone, horn, or ivory, carbon, felt, leather, paper, cardboard, or other paper products, rubber, or other non-metallic materials except wood, shall be safeguarded in accordance with the requirements of paragraphs 2 to 10 of this Regulation concerning metal-cutting bandsaws or circular saws.

17. Linters shall be equipped with—
- (a) dustproof enclosures of the hoppers or feed ducts and of the saw cylinders and brushes, provided with interlocks that will prevent them from being opened while the saw cylinder is revolving and prevent the saw cylinder from rotating unless the enclosures are in place; and
 - (b) suction removal of the lint after separation.

REGULATION 103. SCREENING AND SEPARATING MACHINES

Definitions

1. In this Regulation the following terms have the meanings hereby assigned to them:

- (a) the term "screening and separating machine" means a machine for mechanically separating liquids from other liquids or from solid substances, or for separating solid substances without the use of cutting or grinding tools or of pressure vessels, but does not include picking, carding and combing machines;
- (b) the term "foundry cleaning equipment" means devices or machines for removing sand and other materials from foundry castings;
- (c) the term "centrifugal machine" means a machine equipped with a drum or basket, fixed to vertical shafts, rotating at high speed and used for separating liquids of different densities (separators), for separating liquids from cotton, wool or other fibrous materials (extractors), or for separating liquids from granular or coarser crystalline substance (driers);
- (d) the term "filter press" means a machine equipped with perforated plates or screens covered with a special filtering medium, ordinarily cloth, and used for separating suspended solid substances from liquids;
- (e) the term "hulling and cleaning machines" means machines of various types for removing husks, pods, shells or other types of outer covering from vegetable products and freeing the remainder from foreign admixtures or dust, or for removing dust from dry textiles or other materials by threshing;
- (f) the term "screening and sifting machine" means a machine equipped with flat surface screens or sieves, with end shaking, reciprocating or vibrating motion, or revolving cylindrical, hexagonal or octagonal reels through which the finer particles of pulverised or granulated substances in a dry condition are passed to separate them from coarser particles;
- (g) the term "washing machine" means a machine used for freeing cloth, wearing apparel and household articles, barrels, bottles and other containers, or other articles, from impurities or certain constituents by application of steam, water or other liquids;
- (h) the term "drying tumbler" means a machine ordinarily consisting of a revolving perforated drum used for drying clothes or other textiles by air or for shaking them out.

Foundry Cleaning Equipment

2. Foundry castings should be removed from the flasks on vibrating gratings in enclosed mechanical mould-shakeouts provided with--

- (a) exhaust for carrying away the dust and fine particles arising from the operations; and
- (b) conveyors or equivalent means for collecting the sand underneath the gratings and returning it to the conditioning stations.

3. Where foundry castings are transported from shakeouts to cleaning rooms by means of overhead equipment—

- (a) the chain slings, wire ropes and hooks used shall be of sufficient strength and securely attached to parts of the castings capable of carrying the loads; and
- (b) the loads shall not be moved over workers below, who, if required to be in the path of travel, shall be given ample warning which will permit them to move to safe locations and avoid possible injury from falling parts or from falling hot sand.

Hand Cleaning

4. Large castings may be cleaned and chipped by hand in the moulding and casting rooms, if the use of compressed air or abrasive blasting is prohibited and suitable protection is furnished to the cleaners and to other workers employed in such rooms by—

- (a) the use of suitable curtains, partitions or screens, to prevent injury from flying chips and particles; and
- (b) exhaust ventilation to prevent any injurious concentration of dust; and
- (c) the use of goggles, respiratory protective equipment and protective clothing, where other methods of control do not afford the required degree of protection.

5. Where finishing rails or benches are used for supporting castings during cleaning and chipping operations, safe clearance shall be provided between the rails or benches and between individual castings.

Tumbling Barrels and Tumbblasts

6. Horizontal revolving and reciprocating tumbling barrels, used in foundries for removing sand and scale from small castings, shall be installed and guarded in conformity with the provisions of paragraphs 97 to 100 of Regulation 91.

Abrasive Blasting Units

7. Cleaning of foundry castings by means of abrasive blasting (sand blasting) shall be—

- (a) undertaken only in cabinets or rooms, completely and tightly enclosed except for air intakes and satisfactorily protected outlets, preferably with part of the enclosures affording visibility of the operations and with—

- (i) automatic equipment; or
 - (ii) the operator located outside and manipulating the tools through openings sealed with flexible washers or sleeves; and
- (b) performed with the use of abrasive, such as steel shot, grit, etc., as a blasting medium, excluding silica sand.

8. (1) Where it is necessary for operators to work inside abrasive-blasting rooms they shall be provided with air-supplied sand-blast helmets, gloves, leggings and necessary special clothing, for protection against dust and flying particles of abrasive or metal.

(2) No part of the protective equipment shall be left inside the blasting chambers.

9. When the air comes from compressors, in the tube supplying the operator there shall be a filter to retain any excess of carbon monoxide originating in the lubricating oil, grease, etc.

Centrifugal Machines — General Provisions

10. Centrifugal extractors, separators, and driers shall be provided with—

- (a) metal lids, not less than 1 mm (0.04 in.) in thickness;
- (b) interlocking devices that will prevent the lids from being opened while the rotating drums or baskets are in motion and prevent the starting of the drums or baskets while the lids are open; and
- (c) rims on the drums or baskets, so designed that the drums or baskets can be safely turned by hand with the lids open.

11. Engines and variable-speed motors driving centrifugal machines shall be provided with effective speed-limit governors.

12. All centrifugal machines shall have effective braking arrangements.

13. Centrifugal machines shall not be operated at a speed in excess of the manufacturer's rating, which should be legibly stamped on the machine at an easily visible place, both on the inside of the basket and on the outside of the machine.

14. Centrifugal machines shall be fluid-tight, except for necessary supply and drain pipes.

Extractors

15. Extractors used in cleaning and dyeing for separating volatile flammable liquids from textile fabrics shall—

- (a) be equipped with lids and drum or basket rims of non-ferrous metal;
- (b) have all metallic parts and pipes effectively grounded;

- (c) be equipped with drain pipes, provided with liquid-seal traps, to underground storage tanks;
- (d) not be connected to any sewer system;
- (e) be drained daily; and
- (f) have bearings designed so as to prevent over-heating.

16. Electrical equipment on extractors for removing volatile flammable liquids shall be of the explosion-proof type.

Filter Presses

17. Filter presses shall be equipped with safety valves for escape of material, to prevent bursting of the presses or the filters in the event of undue pressure being exerted by the pumps.

18. The following provisions shall apply to open-tank filter presses:

- (a) when the top of the tank for the immersion of the filter-cell basket is less than 1 m (40 in.) above the floor or working level, adequate standard railings shall be installed on all open sides; and
- (b) when the top of the tank is less than 15 cm (6 in.) above the floor or working level, standard toeboards shall be provided.

19. Parts of rotary filter presses extending above the containers in which they revolve shall be provided with removable sectional covers, except for a space sufficiently large to discharge the press cakes over an apron at the top of the entrance side of the container.

Hulling and Cleaning Machines — General Provisions

20. Hulling and cleaning machines shall be equipped with standard machinery guards enclosing exposed belts and pulleys, chains and sprockets, gears, or other parts of the driving gear and for the feed conveyors where these are used.

Cacao Bean Cleaners

21. Cacao bean cleaners shall be provided with guards which will prevent the workers from coming into contact with the cracking rolls.

Corn Husking Machines

22. Corn husking machines shall be provided with guards over the husking rolls, if the workers are liable to come into contact with them.

Corn Silking and Cleaning Machines

23. Corn silking and cleaning machines shall, unless effectively covered by housings, be provided with adjustable enclosures for the screen chambers.

Fanning Mills

24. Fanning mills for removing chaff or other foreign materials from grain or vegetables, and other hulling and cleaning machines equipped with air aspiration, shall be enclosed in dustproof housings, except for necessary feed and discharge openings.

Pea Viners and Shellers

25. Pea viners and shellers shall be provided with guards or barricades, to prevent the workers from coming into contact with the revolving cylinders.

Rag-Willow Machines

26. Rag-willow machines (dusters) should be—

- (a) enclosed in dustproof compartments, with means of access to the rags so interlocked that they cannot be opened until the paddles have stopped moving; and
- (b) provided with efficient exhaust for removing from the compartments all the dust liberated during the processing of the rags.

Screening and Sifting Machines — General Provisions

27. Bolting, screening and sifting machines used in the manufacture of cocoa, flour, spices, starch, sugar, pulverised coal and similar substances, shall be equipped with dust-tight housings with hinged or removable doors, so interlocked as to prevent them from being opened while the operations are carried on.

Sand Sifters

28. Sand sifters in foundries shall, unless the sand handled contains sufficient moisture to prevent the liberation of dust, be—

- (a) enclosed as completely as possible; and
- (b) provided with exhaust conforming to the relevant requirements of Section 2 of Chapter XIII of this Code.

29. Rotary sand sifters in foundries shall be guarded by enclosures or with standard railings of angle iron or metal pipe, placed not less than 38 cm (15 in.) or more than 50 cm (20 in.) away from the sifters.

30. Belt shifters and motor-control switches for rotary sand sifters in foundries shall be placed within easy reach of the operators, and so protected that there will be no danger of accidental starting.

31. Portable compressed air-driven vibrating sand sifters in foundries shall be anchored with a rope slightly shorter than the air-supply hose, to prevent breaking of the hose coupling through movements of the machine.

Washing Machines and Drying Tumblers

32. Laundry washing machines and drying tumblers of the double cylinder type shall be equipped with interlocking devices that will prevent—

- (a) the covers or doors on the outer cylinders from being opened while the inner cylinders are in motion; and
- (b) the inner cylinders from being moved when the covers or doors of the outer cylinders are open, except by a hand-operated worm wheel or the operation of an inching device with two-hand control.

33. Laundry washing machines and drying tumblers of the double cylinder type shall be provided with adequate means of holding open the covers or doors of both inner and outer cylinders during charging and discharging operations.

34. Laundry washing machines and drying tumblers of the single cylinder type shall—

- (a) be enclosed or guarded to a sufficient height to prevent workers from coming into contact with the cylinders when they are in motion;
- (b) be equipped with devices which will automatically prevent the cylinders from moving when the covers or doors are open; and
- (c) unless the covers or doors open downward, be provided with adequate means for holding the covers or doors of the cylinder open during charging and discharging operations.

35. Washing machines and drying tumblers for use with volatile flammable liquids shall—

- (a) be provided with pressure-relief doors functioning in case of an explosion inside, and so designed as to open away from the operator and to close automatically after the explosion;
- (b) have all metallic parts and pipes securely grounded;
- (c) be equipped with drain pipes, provided with liquid-seal traps to underground storage or settling tanks;
- (d) not be connected to any sewer system; and
- (e) have electrical equipment of the explosion-proof type.

36. Washing drums or reels for washing hides or skins in leather manufacture, potato washers for removing potato skins in starch manufacture and other processes, scaling reels for removing scales from fish, barking drums for removing bark and dirt from wood for chemical pulp manufacture, and similar machines, shall be safeguarded in accordance with the requirements of paragraph 34 of this Regulation.

37. Bottle-washing machines equipped with live roller conveyors for delivery of unwashed bottles to machine-charging stations, or of washed bottles from the washing machines to the

bottle fillers, shall be provided with guards completely enclosing the bevel gears on the conveyors, unless these are guarded by location.

38. Rotary-brush bottle-washing machines shall be provided with suitable screens at the charging stations to protect workers from flying glass due to bursting bottles.

REGULATION 104. SEWING AND STITCHING MACHINES

Definitions

1. In this Regulation the following terms have the meanings hereby assigned to them:

- (a) the term "sewing machine" means a machine equipped with one or more reciprocating needles carrying flexible thread or filaments, used for uniting or fastening pieces of textiles, leather, paper, straw-braid or other fabrics together by stitches;
- (b) the term "wire-stitching machine" means a machine equipped with one or more reciprocating heads for cutting fine wire, coiled in the machine, into staples, driving them through assembled pieces of leather, paper or other material and clinching the ends on the inside.

Sewing Machines

2. Moving parts of power-driven sewing machines shall be completely enclosed, except those parts necessarily exposed for the sewing.

3. Power-driven sewing machines shall be provided with substantial needle guards, so designed that—

- (a) the fingers of the operators cannot pass under the needles;
- (b) the needles can be threaded conveniently without removing the needle guards; and
- (c) visibility of the sewing operation is afforded.

4. The shafting and driving mechanism of power-driven sewing machines shall be entirely enclosed.

Wire-Stitching Machines

5. Power-driven single or multiple wire-stitching machines shall, unless automatically fed, be equipped with—

- (a) sliding sweep guards that will push the fingers of the operator out of the danger zone; and
- (b) safety locks on the pedal controls, to prevent the machines from being operated while adjustments, cleaning, or repairs are being made.

REGULATION 105. SHEARS, SLICERS AND SLITTERS

Definitions

1. In this Regulation the following terms have the meanings hereby assigned to them:

- (a) the term "shears" or "shearing machine" means a machine ordinarily equipped with straight, bevel-edged blades operating vertically against resisting edges, or with rotary, overlapping cutting wheels, and used for shearing metals or non-metallic substances;
- (b) the term "slicer" or "slicing machine" means a machine ordinarily equipped with band knives or reciprocating knife blades and used for cutting across or slicing non-metallic substances or for splitting them into layers;
- (c) the term "slitter" or "slitting machine" means a machine ordinarily equipped with circular disc-type knives, and used for trimming or cutting into metal or non-metallic substances or for slitting them into narrow strips; for the purpose of this Regulation, this term includes bread or other food slicers equipped with rotary knives or cutting discs;
- (d) the term "rotary cutting machine" means a machine ordinarily equipped with spiral cutting blades or with pairs of revolving cylinders fitted with helicoidal knife blades, and used for shearing cloth or rugs, for clipping fur, and in shaving hides;
- (e) the term "chipping machine" means a machine equipped with heavy, rotating metal discs fitted with bevelled knife blades and used for cutting wood into chips for distillation or for manufacture of chemical pulp.

General Provisions

2. Shears, slicers and slitters shall be equipped with standard machinery guards enclosing exposed belts and pulleys, chains and sprockets, gears and other moving parts of driving mechanisms on the machines.

3. Cleaning of shears, slicers and slitters shall not be attempted without first stopping the machines.

Alligator Shears

4. Alligator shears shall be provided with—

- (a) heavy U-shaped metal band guards rigidly mounted horizontally around the fixed jaws; and
- (b) mechanical feed, where practicable.

5. Alligator shears shall be equipped with means for readily disconnecting the power, and shall not be permitted to run continuously when not in use.

6. Alligator shears shall never be so located as to face passage-ways, aisles or workplaces, and suitable screens should be provided to prevent operators or other workers from being injured by flying particles.

Corner Cutters

7. Corner cutters, used in the manufacture of paper boxes, shall be equipped with—

- (a) right-angle-shaped guards, fastened to the machines in front of the knives and provided with slots or perforations to afford visibility of the operations; or
- (b) other guards equally efficient for the protection of the fingers of the workers.

Dough Dividers

8. Dough dividers shall be provided with safety locks for the controlling devices.

9. Before attempting to clean dough dividers, the machines shall be stopped and the controls locked.

10. Hand-fed dough dividers shall be provided with front guards that will prevent the fingers of workers from being caught between the cutting head and the front of the machines.

11. Dough dividing and weighing machines equipped with automatic feed shall be provided with feed chutes or with hoppers so designed that the hands of the workers cannot come into contact with the moving parts of the machines.

Guillotine Paper Cutters

12. Where practicable, hand and foot power guillotine paper cutters shall be provided with rods or plates, so arranged on the feeding side that the hands of the operators cannot reach the cutting edge of the knife while feeding or holding the paper in place.

13. Power-driven guillotine paper cutters, except continuous feed trimmers, shall be equipped with—

- (a) starting devices which require the simultaneous action of both hands to start the cutting motion and of at least one hand on a control during the complete stroke of the knife; or
- (b) an automatic guard which will remove the hands of the operator from the danger zone at every descent of the blade, used in conjunction with one-hand starting devices which require two distinct movements of the device to start the cutting motion, and so designed as to return positively to the non-starting position after each complete cycle of the knife.

14. Where two or more workers are employed at the same time on the same power-driven guillotine paper cutter equipped with two-hand control, the device shall be so arranged that each

worker shall be required to use both hands simultaneously on the safety trip to start the cutting motion, and at least one hand on a control to complete the cut.

15. Power-driven guillotine paper cutters, other than continuous trimmers, shall be provided, in addition to the brake or other stopping mechanism, with an emergency device which will prevent the machine from operating in the event of failure of the brake when the starting mechanism is in the non-starting position.

16. Guillotine cutters used for cutting material other than paper shall be safeguarded in accordance with the requirements of paragraphs 12 to 15 of this Regulation.

Index Cutters and Vertical Paper Slotters

17. Index cutters, and other machines for cutting strips from the ends of books, and for similar operations, shall be provided with fixed guards, so arranged that the fingers of the operators cannot come between the blades and the tables.

Metal Squaring Shears

18. When knives are being set or other work is being carried out on metal squaring shears, the knife bar shall be securely blocked up.

19. Foot- or power-operated squaring shears for trimming metal plates or sheets, or for cutting them to fixed lengths, shall be provided with—

- (a) a barrier guard at the front of the knife, fastened to the machine frames at both ends with the lower edge not more than 10 mm ($\frac{3}{8}$ in.) above the table and from the knife, and set at such an angle that the line of the cut is plainly visible to the operator;
- (b) a self-adjusting barrier guard with a limit of 10 mm ($\frac{3}{8}$ in.) above the table and from the knife, but which will rise automatically to the thickness of the material to be cut; or
- (c) where metal squaring shears are fed from the back, a suitable guard for the back of the knife.

20. Where two or more workers are employed at the same time on the same metal squaring shears, the operating mechanism shall require each operative's hands to be on the controls before the shears can be tripped.

21. When knives are being set or other work is being carried out on metal squaring shears, the knife bar shall be securely blocked up.

Rubber Choppers

22. Rubber choppers shall be provided with adjustable guards of sheet metal or wire mesh with slots or openings not exceeding 6 mm ($\frac{1}{4}$ in.), extending across both front and rear of

the cutting blade so that it will be impossible for the fingers of the operators to come into contact with the knife while feeding or removing stock.

Veneer Clippers

23. Clippers for trimming veneer sheets shall be provided with—

- (a) automatic feed and conveyors or travelling tables for removing stock when clipped; or
- (b) hinged metal screens or vertical finger guards, both in the front and at the back of the knife, so fixed as to make it impossible for workers to place any portion of a hand under the knife when feeding or removing stock.

Slicing Machines — General Provisions

24. Workers shall be prohibited from attempting to make adjustments on slicing machines until after the machines have been stopped.

Band Knives

25. Band wheels on band knives, and all portions of the blades except the working side between the sliding guide and the table on vertical machines, or between the wheel guards on horizontal machines, shall be completely enclosed with hinged guards of sheet metal not less than 1 mm (0.04 in.) in thickness or of other material of equal strength.

26. Sliding guides on cake cutters, macaroni cutters and other vertical band knives shall be provided with guards that will cover the blades at all times down to the height of the material being cut.

27. Upper feed rolls on leather-splitting band knives and other horizontal band knives shall be provided with metal guards, attached to the apron and extending down to within 6 mm ($\frac{1}{4}$ in.) of the bottom of the roll.

Barking Discs

28. Barking discs for removing bark from pulpwood shall be equipped with—

- (a) housings enclosing the back and periphery of the disc and the front except the operating head;
- (b) suspended guards of expanded metal or wire mesh, with openings not exceeding 6 mm ($\frac{1}{4}$ in.) hung in front of the operating head;
- (c) feed tables provided with automatic turning devices, which will make it unnecessary for workers to hold the wood during operations; and

(d) suitable connections to efficient exhaust systems for removing the bark and shavings.

29. Where barking discs are directly connected to water-wheels or turbines, governors shall be provided to keep the speed of the discs within safe limits.

Bread-Slicing Machines (Reciprocating Type)

30. Power-driven bread-slicing machines shall be provided with guards over the vertically moving knives, to prevent the hands of the workers from being caught at the back of the knife frames between the automatic pushers and the knife edges.

Leather-Splitting Machines

31. Feed rolls on leather-splitting machines with stationary or vibrating knife blades shall be provided with bars or other guards, so arranged that the material can be fed to the knives without permitting the fingers of the workers to be caught between the rolls.

Rubber Band Choppers

32. Cutter heads and knives on rubber band choppers shall be enclosed with guards of sheet metal or wire mesh, with slots or openings not exceeding 6 mm ($\frac{1}{4}$ in.), extending—

- (a) not less than 30 cm (12 in.) below the table on the discharge side;
- (b) not less than 15 cm (6 in.) in front of the cutting head; and
- (c) not more than 75 mm (3 in.) above the table on the feed side.

Slitting Machines — General Provisions

33. Circular disc-type knives on machines for cutting metal and leather, paper, rubber, textiles or other non-metallic substances shall, if within reach of operators standing on the floor or working level, be provided with guards enclosing the knife edges at all times as near as practicable to the surface of the material, and which may either—

- (a) automatically adjust themselves to the thickness of the material; or
- (b) be fixed or manually adjusted so that the space between the bottom of the guard and the material will not exceed 10 mm ($\frac{3}{8}$ in.) at any time.

34. Portions of blades underneath the tables or benches of slitting machines shall be covered by guards.

Bread-Slicing Machines (Rotary Type)

35. Bread-slicing machines with rotary cutting discs or blades shall be provided with guards in the form of tunnels on both the feeding and delivery sides which—

- (a) will prevent access to the discs or blades;
- (b) are so interlocked with the starting mechanism that the tunnels cannot be removed or opened except when the machine is at rest; and
- (c) have the exposed parts of the cutting discs or blades securely guarded.

Candy Cutters and Slitters

36. Caramel and nougat cutters and slitters shall be securely guarded and provided with—

- (a) belt conveyors or travelling tables to carry the material under and away from the knives; or
- (b) slide feeds set at an incline that will permit the material to pass by gravity to the knives on the intake side and away from the knives on the discharge side.

Fruit and Vegetable Slicers

37. Knife sets on peach slicers, sugar beet slicers and similar machines shall be enclosed, except for feed and discharge openings.

Leather Strippers

38. Strippers for trimming tanned hides in leather manufacturing shall be equipped with two-hand operating devices.

Rubber Bevel Cutters

39. Sliding tables on bevel cutters for rubber sheets shall be provided with stops which limit their travel so that the knife discs cannot protrude beyond the edge of the tables.

Multiple-Process Slitters

40. Guards for the cutting discs used on multiple-process machines for cutting off or slitting material shall enclose the discs as completely as practicable.

Rotary-Cutting Machines — General Provisions

41. Rotary-cutting machines for shaving, shearing or shredding of fur, leather, textiles or other materials involving the liberation of dust, fur, lint or other substances, shall be provided with exhaust for removing the substances liberated in the operations.

Fur-Clipping and Fur-Cutting Machines

42. Fur-clipping and fur-cutting machines shall be completely enclosed, except for feed and discharge openings.

Pile Cutters and Cloth Shears

43. Pile cutters and cloth-shearing or carpet-shearing machines shall be provided with covers or guards, so arranged and inter-

locked that the fingers of the workers cannot come into contact with the knife cylinders except when the machine is at rest.

Rag Cutters or Shredders

44. Fly knives, bed knives and the spiked feed drums on rag shredders shall be covered with dust-proof enclosures, provided with hinged or sliding doors or covers for access.

45. Enclosures for rag shredders, which also may serve as exhaust hoods, shall be equipped with interlocking devices, so arranged that the covers cannot be opened while the machines are in motion.

Rotary Paper-Cutting Machines

46. Rotary machines for cutting paper from rolls into sheets of fixed lengths shall be provided on all sides and within easy reach of the workers with—

- (a) push buttons, where electric power is used;
- (b) manually operated quick power-disconnecting devices, where mechanical power is used; and
- (c) adequate braking devices.

47. Rotary paper-cutting machines shall be equipped with a bar or pipe in front of the nip of the spreader or squeeze roll.

48. Platforms on rotary paper-cutting machines shall be provided with standard railings and toeboards.

49. Single-knife rotary paper-cutting machines shall be provided with a guard at the bearing of the knife spindle, to prevent workers from reaching for paper at a point close to the knife.

50. Duplex-knife rotary paper-cutting machines shall be provided with—

- (a) a guard at the bearing of the first knife spindle; and
- (b) a hood for the second knife.

51. Where the rotary cutting knife of a paper-cutting machine is within reach of the workers it shall be effectively guarded.

Leather-Shaving and Skiving Machines

52. Leather-shaving machines shall be equipped with metal hood guards covering all except the necessary working part of the knife cylinder, with the attached grinding wheel; such guards may also serve as exhaust hoods.

53. Feed rolls on leather-shaving machines and skiving machines shall be so guarded that the material will be fed through a slot, or under a fixed rod or strip located directly in front of the nip a. running the full length of the rolls, without permitting the fingers of the workers to be caught between the rolls.

Unhairing and Fleshing Machines

54. Unhairing machines and fleshing machines in leather tanneries shall be equipped with a bar across the front of the machine acting as a rest in case the operator slips.

55. Unhairing and fleshing machines which are operated by pedals and on which two workers are employed, shall be equipped with a lever which will prevent either worker from starting the machine by pressing the pedal until the lever is thrown by the other worker.

56. Unhairing and fleshing machines shall, when equipped with rotating fixed knife cylinders or with knives carried on travelling endless bands, be provided with enclosures of sheet metal or wire mesh with openings not exceeding 12 mm ($\frac{1}{2}$ in.), covering the pinch rolls and the knives except the necessary openings for feeding stock.

57. Unhairing machines equipped with travelling knife cylinders shall be provided with movable wire-mesh gate guards at the front of the machines, so arranged that—

- (a) as the knife cylinder moves downward on the bolster, the gate operates downward and remains clamped to the bolster; and
- (b) as the knife cylinder returns upward, the gate is automatically released and moves upward, permitting the processed hide to be removed and replaced by another.

Disc Chipper Machines and Hog Mills

58. Disc chipper machines and hog mills for cutting wood-pulp stock or wood-distillation stock into chips shall be enclosed in substantial housing provided with feed spouts—

- (a) not less than 90 cm (36 in.) in length; and
- (b) with swinging baffles installed in the mouths, to intercept particles flying back from the knives.

59. Disc chipper machines and hog mills shall be provided with screens of heavy wire mesh above and in front of the spouts, to protect workers and passers-by from flying chips.

REGULATION 106. SPINNING, WEAVING AND KNITTING MACHINES*Definitions*

1. In this Regulation the following terms have the meanings hereby assigned to them:

- (a) the term "spinning machine" means a machine used for drawing and twisting combed or carded slivers, composed of fibres, into threads or yarns, or into cords, lines, ropes or string, and winding the spun filaments into balls, cakes or skeins, or on bobbins or spools, and includes warpers and slashers;

- (b) the term "wire-drawing machine" means a machine used for drawing wires;
- (c) the term "wire-stranding machine" means a machine for twisting wires into strands for wire ropes or cables, and winding them in coils or on reels or spools;
- (d) the term "weaving machine" or "loom" means a machine used for interlacing spun threads or yarns by weaving, to form textile cloth or fabric;
- (e) the term "wire-weaving machine" means a machine used for interlacing wires to form wire cloth, wire fencing, or wire screening;
- (f) the term "knitting machine" means a machine equipped with knitting needles for interlooping threads or yarns so that one loop supports another, to form knitted fabrics, garments or netting.

General Provisions

2. Gears on spinning, weaving and knitting machines shall be covered with standard machinery guards.

3. Wire-mesh guards shall not be used for any parts of cotton spinning machines or for any other textile machinery producing fly, and if used for other machines, shall be placed at a distance of not less than 75 mm (3 in.) from any moving part, and shall be of a mesh not larger than—

- (a) 6 mm ($\frac{1}{4}$ in.) for guards within 10 cm (4 in.) from any such part; or
- (b) 13 cm² (2 sq. in.) in area for guards over 10 cm (4 in.) from any such part.

4. Spinning and weaving machines used for processing asbestos fibres or glass threads shall be provided with efficient exhaust for removal of any dust or fibres liberated complying with the relevant requirements of Section 2 of Chapter XIII of this Code.

5. Moving parts of spinning, weaving and knitting machines shall be cleaned only when the power is disconnected and the machine is stopped.

6. Cleaning of stationary parts of spinning, weaving and knitting machines and of the floor beneath such machines shall be carried out—

- (a) only while the machine is at rest, where there is imminent risk of contact of the person or anything held in the hand with moving parts during cleaning, and
- (b) by means of vacuum devices or by brushes when any part is being cleaned while the machine is in motion.

Textile Drawing Frames

7. Main driving shafts on drawing frames shall be entirely enclosed.

[New text from paragraph 4 onwards.]

4. Starting and stopping devices shall be provided on every slubber, roving frame or other speed frame, so as to make it possible for the operator to start or stop the machine from any working position.

*5. Spinning and weaving machines used for processing asbestos fibres or glass threads shall be provided with efficient exhaust for removal of any dust or fibres liberated complying with the relevant requirements of Section 2 of Chapter XIII of this Code.

*6. Moving parts of spinning, weaving and knitting machines shall be cleaned only when the power is disconnected and the machine is stopped.

*7. Cleaning of stationary parts of spinning, weaving and knitting machines and of the floor beneath such machines shall be carried out—

- (a) only while the machine is at rest, where there is imminent risk of contact of the person or anything held in the hand with moving parts during cleaning, and
- (b) by means of vacuum devices or by brushes when any part is being cleaned while the machine is in motion.

8. Irregularities in the operation of spinning, weaving and knitting machinery should be reported immediately by workers to persons, such as loom-fixers, designated by the management for the purpose, unless the correction of the irregularity is regarded as part of the normal responsibility of the workers.

Textile Drawing Frames

*9. Main driving shafts on drawing frames shall be entirely enclosed.

*10. The roller gearing on drawing frames shall be effectively guarded by a cover which shall be so interlocked that it cannot be raised until the machine is stopped and the machine cannot be started until the cover is closed.

Speed Frames

*11. Headstocks on slubbers and roving frames shall be guarded with metal plates, and any access door shall be so interlocked that the door cannot be opened while the machine is in motion, and the machine cannot be restarted until the door is closed and locked.

*12. Draft-change wheels, back roller and carrier wheels, twist and carrier wheels, bobbin-shaft driving wheels and swing wheels, lifter wheels and bottom cone drum wheels on slubbers and roving frames shall be completely covered.

[New text.]

13. Bobbin skew gears and spindle skew gears on speed frames shall be effectively enclosed in guards of sheet metal.

*14. Lifter rack wheels on slubbers and roving frames shall be provided with guards which will effectively protect the nip both as the rail rises and as it falls.

*15. Every suspended counterweight shall be cast with the eyelet forming part of the weight itself, and, where necessary, the counterweight shall be enclosed.

Spinning Machines

*16. Hinged gear covers, head end panels, sliding panels and doors in guards on spinning machines shall be interlocked with the belt shifters or other driving controls in such a manner as to prevent—

- (a) the cover, panel or door being opened while the mechanism is in motion; and
- (b) the machine being restarted until the cover, panel or door is closed and locked.

*17. Belt shifters for spinning machines shall be provided with locks, which shall be used when the machines are stopped for cleaning, oiling or repair.

Spinning Mules

18. Clearance between the ends of carriage runs on spinning mules and walls, columns, other machines or fixed structures, shall not be less than 45 cm (18 in.), but in new mills the clearance should be greater.

*19. The ends of carriage runs on spinning mules of the type used in the woollen trade shall be guarded by standard railings.

*20. Wheels on spinning-mule carriages shall be provided with substantial wheel guards, extending to within 6 mm ($\frac{1}{4}$ in.) of the rails.

21. (1) So far as practicable, back shaft scrolls, carrier pulleys, draw band pulleys, faller stops, quadrant pinions, rim band tightening pulleys, and backs of headstocks, including rim pulleys and taking-in scrolls on spinning mules, shall be enclosed by standard machinery guards.

(2) The taking-in bevels should be closely guarded by a separate guard even if they are inside the headstock back guard.

(3) The gears driving the fluker rod should be guarded.

22. (1) Working or cleaning between the roller beams and carriages of spinning mules shall be done only when the machine is at rest with the carriage stopped on the outward run and the

8. The roller gearing on drawing frames shall be effectively guarded by a cover which shall be so interlocked that it cannot be raised until the machine is stopped and the machine cannot be started until the cover is closed.

Slubbers and Roving Frames

9. Headstocks on slubbers and roving frames shall be guarded with metal plates, and any access door shall be so interlocked that the door cannot be opened while the machine is in motion, and the machine cannot be restarted until the door is closed and locked.

10. Draft-change wheels, back roller and carrier wheels, twist and carrier wheels, bobbin-shaft driving wheels and swing wheels, lifter wheels and bottom cone drum wheels on slubbers and roving frames shall be completely covered.

11. Bobbin skew gears and spindle skew gears on slubbers and roving frames shall be effectively enclosed in guards of sheet metal.

12. Lifter rack wheels on slubbers and roving frames shall be provided with guards which will effectively protect the nip both as the rail rises and as it falls.

13. Every suspended counterweight shall be cast with the eyelet forming part of the weight itself, and, where necessary, the counterweight shall be enclosed.

Spinning Machines

14. Hinged gear covers, head end panels, sliding panels and doors in guards on spinning machines shall be interlocked with the belt shifters or other driving controls in such a manner as to prevent—

- (a) the cover, panel or door being opened while the mechanism is in motion; and
- (b) the machine being restarted until the cover, panel or door is closed and locked.

15. Belt shifters for spinning machines shall be provided with locks, which shall be used when the machines are stopped for cleaning, oiling or repair.

Spinning Mules

16. Clearance between the ends of carriage runs on spinning mules and walls, columns, other machines or fixed structures, shall be not less than 45 cm (18 in.).

17. The ends of carriage runs on spinning mules of the type used in the woollen trade shall be guarded by standard railings.

18. Wheels on spinning-mule carriages shall be provided with substantial wheel guards, extending to within 6 mm ($\frac{1}{4}$ in.) of the rails.

19. So far as practicable, back shaft scrolls, carrier pulleys, draw band pulleys, faller stops, quadrant pinions, rim band tightening pulleys, and backs of headstocks, including rim pulleys and taking-in scrolls on spinning mules shall be enclosed by standard machinery guards.

20. Working or cleaning between the roller beams and carriages of spinning mules shall be done only when the machine is at rest with the carriage stopped on the outward run and the brake on, and no worker shall go between the roller beam and the carriage until he has received a prearranged signal from the spinner (mule minder).

21. When spinning mules have been stopped they shall not be started again until it is certain that no workers are between the roller beams and the carriages.

Cap, Flyer and Ring-Spinning Frames

22. An effective guard shall be provided for the inrunning nip of double rollers driving the spindles on cap, flyer or ring-spinning frames.

23. Banding on cap, flyer or ring-spinning frames equipped with double rollers shall be prohibited while the machines are running.

Wet-Spinning Frames

24. Wet-spinning frames for flax shall be provided with splash guards.

Warpers

25. Workers on high speed warpers shall be prohibited from picking waste out of mechanical stop motions with the fingers.

Slashers

26. Slashers shall be provided with—

- (a) guards for the open nips of the top squeezing rollers;
- (b) horizontal safety stop bars, located not more than 1.75 m (69 in.) above the floor or working level and connected to the control levers for quickly stopping the machines from any point; and
- (c) lifting levers or other devices for raising the squeeze rolls in the size boxes.

27. Size kettles for slashers shall be provided with temperature-control equipment.

28. Steam supply pipes for machines shall comply with the provisions of paragraph 1 of Regulation 128, and shall be provided with a pressure gauge between the pressure reducing valve and the machine.

[New text.]

brake on, and no worker shall go between the roller beam and the carriage until he has received a prearranged signal from the spinner (mule minder).

(2) Unless the setting-on rod of the mule tends to run to the "off" position, an approved stang lock shall be required.

*23. When spinning mules have been stopped they shall not be started again until it is certain that no workers are between the roller beams and the carriages.

Cap, Flyer and Ring-Spinning Frames

*24. An effective guard shall be provided for the inrunning nip of double rollers driving the spindles on cap, flyer or ring-spinning frames.

*25. Banding on cap, flyer or ring-spinning frames equipped with double rollers shall be prohibited while the machines are running.

26. (1) The draft pinion wheels should have an interlocking cover.

(2) The inner panels at the driving end should be continued to the floor.

Wet-Spinning Frames

*27. Wet-spinning frames for flax shall be provided with splash guards.

Warpers

*28. Workers on high speed warpers shall be prohibited from picking waste out of mechanical stop motions with the fingers.

Slashers

29. (1) Slashers shall be provided with—

- (a) guards for the open nips of the top squeezing rollers;
- (b) horizontal safety stop bars, located not more than 1.75 m (69 in.) above the floor or working level and connected to the control levers for quickly stopping the machines from any point; and
- (c) lifting levers on other devices for raising the squeeze rolls in the size boxes.

(2) The cylinders should be separated by at least 15 cm (6 in.).

*30. Size kettles for slashers shall be provided with temperature-control equipment.

*31. Steam supply pipes for machines shall comply with the provisions of paragraph 1 of Regulation 128, and shall be provided with a pressure gauge between the pressure reducing valve and the machine.

[New text.]

32. If the vessel is not designed to prevent vacuum collapse, it shall be equipped with one or more vacuum relief valves with openings of sufficient size to prevent the collapse of the vessel on the occurrence of a vacuum.

33. The control levers of the slasher should be connected to a treadle or a horizontal bar located not more than 1.75 m (69 in.) above the floor to control the operation from any working position.

34. (1) Slasher kettles and cookers shall be provided with expansion chambers in the covers, or drains, to prevent surging over.

(2) Steam-control valves shall be so located that they can be operated without exposing the worker to moving parts, hot surfaces or steam.

35. The dryer enclosure shall be provided with an exhaust system which will effectively prevent wet air and steam from escaping into the room.

Beam Trucks and Slings

*36. Beam trucks for handling beams on or between warpers, slashers, warp-tying machines and looms shall, where necessary to prevent danger, be provided with lock pins or other devices for holding the beams securely in place during transporting.

*37. Where beams cannot be lifted, carried or lowered manually without undue risk of personal injury, suitable lifting appliances and runways shall be provided for conveyance of the beams.

*38. Slings for lifting beams in and out of looms or other machines shall be so made that the beams cannot slip out of them while suspended.

Fibre-Rope-Laying Machines

*39. Spindles on automatic rope-laying machines shall be covered or enclosed with guards to prevent spools from flying out, so arranged that—

- (a) the guards cannot be opened while the machines are in operation; and
- (b) the machines cannot be started unless the guards are in place.

Wire-Drawing Machines

*40. Blocks on wire-drawing machines shall be equipped with either—

- (a) stopping devices, so arranged that they will automatically shut down the blocks if a worker is caught in the block; or

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- (a) the guards cannot be opened while the machines are in operation; and
- (b) the machines cannot be started unless the guards are in place.

Wire-Drawing Machines

33. Blocks on wire-drawing machines shall be equipped with either—

- (a) stopping devices, so arranged that they will automatically shut down the blocks if a worker is caught in the block; or
- (b) bar guards across the entire length of the operating side of continuous wire-drawing frames or units, so designed that pressure against the bars will instantaneously stop the machine.

34. Driving mechanisms located underneath the benches of wire-drawing machines shall be enclosed, with the guard over the rear of the machines extending upward to not less than 1.15 m (45 in.) above the floor or working level.

35. Wire-drawing machines used for wet drawing shall be equipped with splash guards.

36. Reels on wire-drawing machines shall be equipped with stopping devices, so arranged that they will automatically shut down the blocks—

- (a) if a worker is caught in the wires running from the reels; and
- (b) if the reels are drawn up to the frames.

Wire-Rope Stranding Machines

37. Stranding machines for wire ropes shall be guarded throughout the entire length on both sides with standard machinery guards or standard railings with the controlling devices located outside the guards or railings.

38. Placing of full or empty reels over the strander while it is in motion shall be prohibited.

Weaving Machines (Looms)

39. Where overhead runways for beams are provided, looms should be so installed that there will be a clearance of not less than—

- (a) 30 cm (12 in.) between the flanges of the beams of back-to-back looms; and
- (b) 75 cm (30 in.) between the outer ends of the shuttle boxes in the cross alleys.

40. Where overhead trolleys for the beams are not provided, looms more than 1.8 m (72 in.) in width should be so installed that there will be a clearance of not less than 38 cm (15 in.) between the flanges of the beams of back-to-back looms.

41. Looms shall, where the nature of the work requires, be equipped with shuttle guards on the front of the battens (slays) so arranged as to prevent the shuttles from flying out of the sheds.

42. Shuttle guards on looms shall be inspected regularly to make sure that they have not been bent out of position or otherwise rendered ineffective.

43. Pins and studs in eccentric motions on looms in or along passageways shall be guarded.

44. Except where the hammer head on looms always extends over the breast beam there shall be a space of not less than 18 mm ($\frac{3}{4}$ in.) between the hammer head and the beam.

45. Duck bills on all loose reed looms shall be protected to prevent access from below.

46. The overhead driving shaft over jacquard looms shall be guarded by enclosure.

47. On all looms finger room shall be provided between the setscrews on the heald shaft and the top of the loom.

48. On dobby looms there shall be a space of not less than 25 mm (1 in.) between the connecting rods driving the dobby and the framework of the loom, and a space of not less than 50 mm (2 in.) between the slay and the picking stick.

49. Weight levers on looms shall not be allowed to project in such a way as to obstruct the alley.

50. Looms shall be provided with devices by which each loom fixer (tackler) can prevent the loom from being started while adjustments are being made.

51. Workers on looms shall be prohibited from placing their hands between the battens (slays) and the breast beams while the loom is in operation and from putting their heads in this position to examine cloth from the underside whether the loom is in motion or not.

[New text.]

(b) bar guards across the entire length of the operating side of continuous wire-drawing frames or units, so designed that pressure against the bars will instantaneously stop the machine.

*41. Driving mechanisms located underneath the benches of wire-drawing machines shall be enclosed, with the guard over the rear of the machines extending upward to not less than 1.15 m (45 in.) above the floor or working level.

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*43. Reels on wire-drawing machines shall be equipped with stopping devices, so arranged that they will automatically shut down the blocks—

- (a) if a worker is caught in the wires running from the reels; and
- (b) if the reels are drawn up to the frames.

Wire-Rope-Stranding Machines

*44. Stranding machines for wire ropes shall be guarded throughout the entire length on both sides with standard machinery guards or standard railings with the controlling devices located outside the guards or railings.

*45. Placing of full or empty reels over the strander while it is in motion shall be prohibited.

Weaving Machines (Looms)

46. (1) Where overhead runways for beams are provided looms should be so installed that there will be a clearance of not less than—

- (a) 30 cm (12 in.) between the flanges of the beams of back-to-back looms; and
- (b) 75 cm (30 in.) between the outer ends of the shuttle boxes in cross alleys.

(2) The clearance referred to in (a) should be considerably greater in new sheds or in old sheds which are being modernised.

*47. Where overhead trolleys for the beams are not provided looms more than 1.8 m (72 in.) in width should be so installed that there will be a clearance of not less than 38 cm (15 in.) between the flanges of the beams of back-to-back looms.

*48. Looms shall, where the nature of the work requires, be equipped with shuttle guards on the front of the battens (slays) so arranged as to prevent the shuttles from flying out of the sheds.

*49. Shuttle guards on looms shall be inspected regularly to make sure that they have not been bent out of position or otherwise rendered ineffective.

[New text.]

*50. Pins and studs in eccentric motions on looms in or along passageways shall be guarded.

*51. Except where the hammer head on looms always extends over the breast beam there shall be a space of not less than 18 mm ($\frac{3}{4}$ in.) between the hammer head and the beam.

*52. Duck bills on all loose reed looms shall be protected to prevent access from below.

*53. The overhead driving shaft over jacquard looms shall be guarded by enclosure.

*54. On all looms finger room shall be provided between the setscrews on the heald shaft and the top of the loom.

55. On dobby looms there shall be a space of not less than 25 mm (1 in.) between the connecting rods driving the dobby and the framework of the loom, and a space of not less than 50 mm (2 in.) between the stay and the picking stick.

56. (1) Weight levers on looms shall not be allowed to project in such a way as to obstruct the alley.

(2) Measures shall be taken to prevent weights from falling.

*57. Looms shall be provided with devices by which each loom fixer (tackler) can prevent the loom from being started while adjustments are being made.

*58. Workers on looms shall be prohibited from placing their hands between the battens (slays) and the breast beams while the loom is in operation and from putting their heads in this position to examine cloth from the underside whether the loom is in motion or not.

*59. No shuttle which is capable of being threaded by mouth suction shall be used on looms.

*60. Irregularities in the operation of looms should be reported immediately by workers to loom fixers (tacklers) or other designated persons.

*61. Where more than one worker is employed at the same time on the same loom, such as during cleaning after the warp has run out, changing of warp, or adjustments by loom fixers, one worker shall not start the loom without a signal from the other or others.

62. Flywheels on looms should be of solid construction.

Plaiting Machines

*63. Plaiting machines shall be provided with—

- (a) standard machinery guards covering the bottom shaft gearing;
- (b) screens or plate guards covering the side arms to the full extent of their height and travel; and

[New text.]

- (c) interlocked hinged guards designed to prevent workers from being hurt between the knife and the card bar and so arranged that—
- (i) the guards cannot be raised while the machine is in motion; and
 - (ii) the machine cannot be restarted until the guards are lowered.

Wire-Weaving Machines

64. Looms for weaving wire screening shall be guarded in accordance with the appropriate requirements of paragraphs 46 to 62 of this Regulation, concerning textile looms.

Knitting Machines

*65. Knitting machines shall be provided with guards to protect operators from flying parts of needles.

*66. Workers on net-knitting machines shall be prohibited from attempting to adjust tangled meshes while the machines are in motion.



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Wire Weaving Machines

56. Looms for weaving wire screening shall be guarded in accordance with the appropriate requirements of paragraphs 39 to 54 of this Regulation, concerning textile looms.

Knitting Machines

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58. Workers on net-knitting machines shall be prohibited from attempting to adjust tangled meshes while the machines are in motion.

Section 6. Vats and Tanks

REGULATION 107. VATS AND TANKS

Definitions

1. In this Regulation the term "vat" means a large vessel, such as a tun, cistern, tank or tub used for holding liquors, preparations for dyeing or tanning, stock for papermaking or liquids or semi-liquids intended for other purposes, but does not include pressure vessels and totally enclosed storage tanks.

General Provisions

2. (1) Vats, pans and open tanks containing hot, corrosive, or poisonous liquids shall, when so set that the opening or top is less than 1 m (40 in.) above the floor or working level, be either—

- (a) so raised that the top will be not less than 1 m (40 in.) above the floor or working level; or
- (b) securely covered, except when charging or discharging, with adjustable covers of solid metal, bars, wire mesh or other suitable material; or
- (c) where possible, guarded on all sides by enclosures or by standard railings and, when the top is less than 15 cm (6 in.) above the floor, also by standard toeboards.

(2) The provisions of (a) and (b) of this paragraph shall apply to every vat, pan and open tank irrespective of the nature of the liquids that it may contain.

3. Where vats, pans or open tanks containing hot, corrosive or poisonous liquids adjoin, or the space between them is less than 45 cm (18 in.) in width, or is 45 cm (18 in.) or more in width and not guarded, the passage between them shall be barred.

4. Vats, pans and tanks containing hot, corrosive or poisonous liquids shall be provided with pipes or drains of sufficient capacity to carry off the contents without their being liable to back up on the floors.

5. Above-ground tanks containing hot, corrosive or poisonous liquids should be—

- (a) surrounded with pits, catch basins or depressions of some kind, of sufficient size to hold the entire contents of the tank in case of rupture; and
- (b) provided with overflow pipes leading to tanks or to safe places outside the buildings.

6. Walkways should not cross over open vats, pans, or tanks containing hot, corrosive or poisonous liquids; but where it is necessary to install service walkways for access to agitator drives or valves, or for taking samples, such walkways shall be—

- (a) not less than 45 cm (18 in.) in width;
- (b) provided on both sides with standard railings and toeboards; and
- (c) kept clean and dry at all times.

Dipping Tanks

7. Dipping tanks containing flammable liquids, such as varnishes, enamels or paints, shall be—

- (a) made of metal or other incombustible material;
- (b) securely grounded; and

(c) where practicable, provided with tight-fitting covers, hinged or sliding, which in case of fire will automatically close through the action of a fusible link, and which shall be kept closed when the tanks are not in use.

8. Dipping tanks containing volatile flammable liquids should be as small as the nature of the operations will permit.

Tanning Vats

9. Soaking vats, lime vats and tanning vats used in the leather-producing industry, shall be covered with substantial plank flooring set in recesses so that they are flush with the surrounding floors, to prevent workers from falling into the vats; such covers shall only be removed when necessary in connection with the process.

10. Where rocking vats are employed for tanning, the flooring shall be so arranged that the feet of the workers will not be caught between the rocker arms and the vat planking.

11. Where the tops of lime vats with revolving paddles are less than 1 m (40 in.) above the floor or working level, the vats shall, in addition to being guarded in conformity with the requirements of paragraph 2 of this Regulation, be provided with safety chains, stretched above the surface of the lime solution, to afford a handhold for an immersed person.

12. Bleaching vats with tops less than 1 m (40 in.) above the floor or working level shall be enclosed on all open sides with standard railings, provided with toeboards where the tops are below, or less than 15 cm (6 in.) above, the floors.

13. Bleaching vats should be provided with exhaust for removing any injurious fumes liberated in the processing.

14. Acid supply pipes for bleaching vats should be installed in or below the floors.

Electroplating Tanks, Galvanising Tanks and Pickling Vats

15. Electroplating tanks (including chrome plating and anodising tanks), galvanising tanks and pickling vats from which any injurious fumes are liberated shall be provided with exhaust, preferably of the lateral slot type, along the inside of the tanks or vats above the solutions.

Steaming Vats for Veneer Stock

16. Steaming vats and soaking pits for softening logs and fitches with hot water or steam to prepare them for veneer cutting shall—

(a) extend not less than 1 m (40 in.) above the floor or working level; or

(b) be provided with solid covers.

17. Floors surrounding steaming vats and soaking pits shall be of non-slip construction with a cleated, corrugated or rough abrasive surface that will retain its non-slip characteristics under all conditions of moisture.

18. Large steaming vats and soaking pits for veneer stock, which are divided into sections, shall be provided between the sections with substantial walkways equipped with standard railings and toeboards.

CHAPTER V

ELECTRICAL EQUIPMENT

REGULATION 108. DEFINITIONS

In this Chapter the following terms have the meanings hereby assigned to them:

- (a) "tension" means the difference in electrical potential between any two conductors or between any conductor and ground, expressed in volts;
- (b) an "electric safety switch" means a switch installed in an electric control circuit for the special purpose of preventing accidents and so constructed as to prevent inadvertent opening or closing of the circuit;
- (c) "dust-tight apparatus" means apparatus of such construction that dust will not enter.

REGULATION 109. INSTALLATION

General Provisions

1. All electrical equipment and installations shall be of such construction and so installed and maintained as to prevent danger both from contact with live conductors and from fire.

2. (1) Material for all electrical equipment shall be selected with regard to the working tension, load, and to any special condition of use.

(2) All such equipment should conform to the standards established by the competent authority and should be clearly marked.

3. Only persons qualified as to experience, technical knowledge and other stipulated requirements of the respective competent authorities shall be permitted to install, adjust, examine or repair electrical equipment or circuits.

4. After the installation of new electric systems and after extensive alterations to existing installations an inspection shall be made by a qualified person other than the person or persons engaged in the work, before the new system or new extension is placed in service.

5. The workers who have to operate electrical installations or machinery or who must work in the immediate vicinity of such installations shall be provided by the employer with a booklet containing the principal safety provisions relating to their work.

Isolation and Segregation

6. Where it is impossible or impracticable to enclose electrical circuits or current-carrying parts of electrical equipment operating at 50 volts A.C. or more to ground, accidental contact by persons or objects shall be prevented by installing the circuits or equipment—

- (a) in rooms or enclosures which are accessible to authorised persons only; or
- (b) on balconies, galleries or platforms, so elevated and arranged as to exclude unauthorised persons.

7. (1) Where electric transformers, capacitors or other electrical equipment and conductors are installed on exterior walls of buildings they should be located at a sufficient distance from windows or other wall openings to avoid fire hazards or accidental contact from such windows or openings.

(2) When structural repairs, extensions or paint work must be undertaken, appropriate measures shall be taken for the protection of persons whose work may bring them into the proximity of live equipment.

Working Space

8. Electrical equipment which requires adjustment or examination during operation shall be so installed that readily accessible and adequate working space with sure footing can be provided and maintained at all necessary points.

9. (1) Switchgear and other electrical equipment involving exposed live metal parts operating up to 650 volts (A.C. or D.C.) shall be so installed that there is a clear working space at least 2.15 m (7 ft.) high so as to allow safe access to such current carrying parts as require adjustment or examination during operation.

(2) The width of this working space shall be—

- (a) 75 cm (30 in.) where there are no bare or live parts on one side of the working space;
- (b) 1.35 m (54 in.) where there are bare or live parts on both sides of the working space.

10. Working spaces adjacent to exposed live parts shall not be used as passageways.

Circuits

11. Electric wiring shall be of as simple a layout as possible.

12. (1) All electric conductors shall be properly insulated and securely attached.

(2) Electric conductors shall, as far as practicable, be so arranged that the course of any conductor can be easily traced.

(3) In underground raceways of considerable length, means of egress shall be provided at each end and if necessary at suitable intervals.

Controllers and Resistance Devices

13. Main contractors of electric motor controllers, thermal cut-outs, switches, relays and resistance or impedance devices for equipment located in rooms where flammable gases or substances are manufactured, used or handled, or where combustible dust or flyings are liberated in the operations, should be installed in separate rooms or compartments lined with substantial fire-resisting materials, and auxiliary control push buttons or switches of suitable types placed in convenient locations in the workrooms.

Switchboards

14. (1) Switchboards or fuse distribution boards for A.C. at tensions exceeding 50 volts to ground in which live metal is exposed when arranged for operation shall be installed in rooms specially provided for the purpose and accessible to authorised persons only.

(2) The floors of such rooms shall either be constructed of insulating material or furnished with mats or platform of insulating material.

Electric Motors

15. Electric motors in which sparking or arcing can occur should, where practicable, be installed in specially provided motor rooms, particularly in locations where explosives, flammable gas or flammable flyings exist.

16. Electric motors should not be, and unless of an approved explosion-proof type shall not be, installed beneath floors of workrooms where volatile flammable liquids are used.

17. Electric motors shall be firmly secured to the supports on which they are mounted.

Transformers and Capacitors

18. Where electric transformers, capacitors or other equipment contain oil in excess of 5,000 l (1,320 gals.) per tank, compartment or chamber, the oil-containing equipment shall be—

- (a) situated outside the industrial buildings; or
- (b) so erected over pits, drains or sumps that the whole of the contents of any one of the containers will be quickly drained off.

19. Where there is a risk arising from power capacitors or condensers—

- (a) they shall be so controlled or connected as to prevent danger from residual charges; and
- (b) a notice warning the personnel of the presence of capacitors and indicating the precautions to be taken before touching them shall be posted up near the installation.

20. Where transformers, capacitors or other electrical equipment containing oil are installed inside factory premises, adequate ventilation shall be provided and the walls and doors of the room in which the equipment is installed shall be of fire-proof construction.

21. Air-cooled electric transformers installed inside work-rooms of factories shall be—

- (a) placed not less than 30 cm (12 in.) from combustible materials; or
- (b) separated from combustible materials by barriers of incombustible, heat-insulating material; or
- (c) of a rating not exceeding 650 volts, and completely enclosed except for ventilating openings.

Storage Batteries

22. Non-portable electric storage batteries exceeding 150 volts or a capacity of 15 kWh at an eight-hour rate of discharge shall be located in rooms or compartments suitably constructed for the purpose, with acid-resisting floors and adequate ventilation.

Portable Conductors

23. Portable and pendent conductors shall not be installed or used on circuits operating in excess of 250 volts A.C. to ground, unless they are accessible to qualified persons only.

24. Where portable conductors are required, fixed outlet-sockets shall be installed at a sufficient number of safely accessible points.

Identification

25. Electrical circuits and other electrical equipment shall be identified by labels or other suitable means, to reduce the risk of accidents from mistakes.

REGULATION 110. PROTECTIVE GROUNDING (EARTHING)

Non-Current-Carrying Enclosures or Parts

1. Armouring and sheathing of electric cables, metal conduits and their fittings, metallic safeguards and other non-current-carrying parts of utilisation equipment shall be effectively grounded.

Grounding Conductors

2. (1) Grounding conductors shall be of low resistance and of sufficient capacity to carry safely the heaviest flow of current which may result from a breakdown of the insulation of the equipment to be protected.

(2) Unless the maximum possible ground fault leakage current from the defective circuit or conductor is greater than that required to operate the circuit overload protective devices, suitable ground leakage protective devices shall be provided which, on the occurrence of a ground fault, will disconnect the whole installation or at least the defective circuit.

3. At places where they are likely to be damaged, grounding conductors shall be mechanically protected.

Portable Electrical Equipment

4. Where portable electrical equipment with exposed metal parts is used, the following precautions shall be taken:

- (a) exposed metal frames of equipment operated on A.C. and D.C. systems of supply shall be efficiently grounded: Provided that this requirement shall not apply where the tension does not exceed 50 volts to ground on a D.C. system of supply;
- (b) the tension between any conductor and ground on either A.C. or D.C. systems shall not exceed 250 volts;
- (c) where satisfactory grounding conditions cannot be obtained, a lower voltage shall be used; and
- (d) portable electric equipment shall not be used in flammable surroundings unless of the flame-proof or intrinsically safe type.

Grounding and Disconnection during Repairs

5. (1) Isolating switches shall be provided for disconnecting electrical equipment or conductors from the source of supply when repair or maintenance work has to be done on the equipment or conductors.

(2) When conductors or equipment are so isolated they shall be effectively grounded and, where necessary, short-circuited.

REGULATION 111. GUARDING OF LIVE PARTS

General Provisions

1. Permanent enclosures, covers or other standard machinery guards shall, where practicable, be provided for all current-carrying parts of electric circuits or equipment operating at 50 volts A.C. or more to ground, including parts exposed through windows or wall openings, unless such parts are isolated by location in accordance with the requirements of paragraph 6 of Regulation 109 of this Code.

2. (1) Enclosures, covers and guards for live conductors or equipment shall be so designed that they will prevent danger of electric shock or short circuit.

(2) Safe access to conductors and equipment shall be provided for purposes of adjustment or repair.

3. Enclosures, covers and guards for current-carrying parts of electric circuits or equipment, which may at any time be removed while the parts are live, shall be—

(a) of insulating material; or

(b) so arranged that they cannot readily be brought into contact with the live parts.

4. (1) Where live metal, forming part of electric circuits or equipment such as large switchboards, at a tension exceeding 50 volts A.C. or D.C. to ground, must necessarily be exposed for operation and control purposes, suitable insulating stands shall be provided for the workers.

(2) These shall be of such size and so placed that the workers cannot readily touch any live part without standing on them.

Conductors

5. (1) Crane trolley wires and other conductors which cannot be completely insulated shall be so placed or protected as to prevent accidental contact.

(2) Where the protection afforded to crane trolley wires and other conductors by position or height may be diminished by the stacking or piling of materials, either the stacking or piling shall be prohibited or the conductors shall be guarded at the places where stacking or piling may be expected to occur.

6. Wherever practicable, electric conductors other than those referred to in the preceding paragraph and operating at more than 50 volts A.C. to ground shall be—

(a) insulated by coverings of rubber, cambric, asbestos, paper or other materials suitable for the particular voltage employed and for the prevailing atmospheric conditions (temperature, moisture, etc.); and

(b) enclosed in cable armour, metal conduits or other raceways, to prevent injury or disturbance to the conductors, their insulation, or their support.

Fuses, Circuit Breakers and Switches

7. (1) Electric fuses, circuit breakers and switches shall be enclosed, unless mounted on switchboards or panelboards accessible to authorised persons only.

(2) Electric fuses and circuit breakers shall be of sufficient rupture capacity to avoid danger to life.

8. Electric fuses rated for a capacity of more than 20 ampères on A.C. or D.C. systems operating at more than 110 volts shall be assembled in an enclosure and controlled by a switch or switches so arranged that—

- (a) the enclosure cannot be opened until the switch or switches are in the " Off " position, and
- (b) the cover of the fuse must be closed before the switch can be placed in the " On " position:

Provided that when the construction of the fuses and contacts is such that live metal is not exposed when the cabinet or containers is open, an interlocked switch shall not be required.

9. Electric fuses mounted on switchboards or panelboards shall be of such design that no live part can be touched and shall be so arranged that they—

- (a) are automatically disconnected from all sources of electrical energy before being accessible; or
- (b) can be disconnected by means of a switch; or
- (c) can be handled conveniently by means of suitable insulating tools provided for that purpose.

10. Enclosed electric switches or circuit breakers shall be so constructed that they can be operated from outside the enclosure.

11. Electric switches or circuit breakers controlling circuits or machines on which men have to carry out repairs or perform other work shall be provided with means for locking or visibly securing them in the " Open " or " Off " position.

12. (1) Single-throw and double-throw electric knife switches that open upward shall be provided with stop blocks or latches, to prevent them from closing by gravity.

(2) Single-throw and double-throw electric knife switches which are placed so as to open horizontally shall be installed in such a way as to prevent them from being switched accidentally.

13. (1) Electric safety switches shall give a maximum guarantee of reliability, even after an extended lapse of time.

(2) Such switches shall operate directly, in such a way as not to be dependent on springs when switched off.

14. Handles or levers of electric circuit breakers which may move suddenly in such a way that persons in the vicinity might be injured by being struck by them, shall be guarded.

Control Equipment

15. Electric control equipment operating at 50 volts A.C. or more to ground shall be guarded against accidental contact with live parts by—

- (a) complete fixed enclosures; or

- (b) enclosures provided with securely fastened doors or covers and accessible to authorised persons only; or
- (c) location, in accordance with the requirements of paragraph 6 of Regulation 109 of this Code.

16. Manual electric controllers shall be operable from outside the enclosure containing them, and, to prevent accidental operation during work on the circuit or on the equipment, shall be provided with—

- (a) detachable operating handles; or
- (b) individual covers over the operating handles, with securely locked doors, that can be opened only by the operators; and
- (c) a dead man control (switch in the handle capable of cutting off the power when released).

Switchboards and Panelboards

17. Electric switchboards and panelboards of individual motor controls should be of the "dead-front" type with all live parts enclosed in locked compartments.

18. Electric switchboards and panelboards located in work-rooms or otherwise accessible to plant workers, shall be—

- (a) enclosed in cabinets or by standard machinery guards, in either case provided with doors and locks to exclude unauthorised persons; and
- (b) provided with insulating mats or platforms on surrounding floor spaces.

19. Current-carrying parts of electric switchboards and panelboards, which ordinarily are isolated or guarded but occasionally require adjustments or repairs, shall be so arranged that suitable portable covers or shields can be effectively placed to protect workers from contact with any neighbouring live parts.

20. The general arrangement of main switchboards for tensions not exceeding 650 volts A.C. or D.C. shall be such that—

- (a) all parts which may have to be adjusted or handled are readily accessible;
- (b) the course of every conductor can, where necessary, be readily traced;
- (c) conductors, not arranged for connection to the same system, are kept apart so that they can, where necessary, be readily distinguished;
- (d) all apparatus requiring handling can, so far as is practicable, be operated from the front of the switchboard; and
- (e) all measuring instruments and indicators are, as far as practicable, so placed that they can be observed from the front of the switchboard.

21. Where switchboards are used for the control of tensions exceeding 650 volts on D.C. or A.C. systems—

- (a) the metal cases of all instruments working at high tension shall be either grounded or completely enclosed in insulating casing of adequate thickness; and
- (b) all metal handles and all metal gear for operating switches shall be efficiently grounded.

22. When work has to be done on any high tension switchboard the whole switchboard shall be made dead: Provided that if the switchboard is arranged in separate sections which can be electrically divided and isolated from each other by barriers or screens the relevant section only need be made dead.

Electric Motors

23. Electric motors operating at more than 230 volts A.C. to ground shall, unless—

- (a) isolated by installation in specially provided motor rooms; or
- (b) isolated by elevation not less than 3 m (9 ft. 10 in.) above the floor or working surface; or
- (c) of the enclosed type,

be provided with permanent enclosures or other suitable guards, so arranged as to prevent persons or conducting objects from inadvertently coming or being brought into contact with live parts.

24. Suitable enclosures or guards shall be provided to protect exposed current-carrying parts of electric motors and the insulation of motor leads, where installed directly under equipment outside the bases or columns of the machines, or in other locations where dripping oil, excessive moisture, steam, vapours, or similar injurious agencies exist.

Storage Batteries

25. Where non-portable electric storage batteries are located in rooms used for other purposes also, they shall be provided with—

- (a) enclosures or standard machinery guards; and
- (b) special means to prevent the accumulation of flammable gas.

26. Electric storage battery jars and cells, unless composed of glass, hard rubber or other insulating material, shall be mounted on insulating supports.

Portable Cords and Lamps

27. Where likely to be damaged, portable or flexible electric cords shall be—

- (a) protected by sheathing of tough rubber, if necessary with the additional protection of flexible metallic armour, and

(b) maintained in good condition, particularly as regards insulation, plugs and other connections.

28. All screw-cap type holders of electric lamps shall be so constructed that no live metal parts belonging either to the lamp holder or to the bulb itself are exposed before the bulb is completely unscrewed.

29. Portable electric lamps shall be used only—

- (a) where adequate permanent fixed lighting cannot be provided;
- (b) with sockets or lamp holders of insulating material and suitable lamp guards of sufficient strength, completely insulated from any live part; and
- (c) at the tension considered to be safe in the particular conditions of work.

Hand Tools

30. Pliers, screwdrivers, fuse pullers and similar hand tools used in connection with electric work shall be adequately insulated

31. Handles of oil cans and of wipers, brushes and other cleaning devices used around electrical equipment shall be made of non-conducting materials.

Arc Welding and Cutting Machines

32. Motor generators, rectifiers, or transformers in arc welding or cutting machines, and all current-carrying parts, shall be protected against accidental contact with uninsulated live parts.

33. Ventilating slots in transformer enclosures shall be so designed that no live part is accessible through any slot.

34. (1) Frames or metal casings of arc welding machines and transformers shall be effectively grounded.

(2) Where the connection of one pole of the secondary or welding circuit to the tank of the welding machine or transformer is likely to attract dangerous intensities of stray current the welding circuit shall be grounded only at the point of work.

Hand-Operated Arc Welding Equipment

35. Cable connectors used in arc welding circuits shall be carefully insulated on the supply side.

36. The outer surface of electrode holders, including the jaw so far as possible, shall be fully insulated.

37. Electrode holders should be provided with discs or shields, to protect the hands of the operators from the heat of the arcs.

Resistance Welding Machines

38. In resistance welding machines, all current-carrying parts except the welding contacts shall be completely enclosed.

39. Resistance welding machines shall be equipped with line-disconnecting switches, located at or near the machines.

40. Power lead terminals shall be securely attached with screws and bolts, and plugs shall not be used except for control circuits.

41. Automatic and semi-automatic resistance welding machines shall, where practicable, be equipped with gate guards or two-hand tripping devices, so designed as to prevent the hands of the operator from reaching in the danger zone after the current control has been actuated.

Operations

42. Electric circuits or equipment should always be considered live, unless it is positively known that they are dead.

43. (1) Work on live conductors or equipment shall not be undertaken where the tension exceeds 250 volts A.C. or D.C. to ground.

(2) When work is undertaken at a tension lower than 250 volts A.C. or D.C. to ground precautions against shock or short circuit shall be taken by the use of insulating tools, gloves, mats, screens, or other protective equipment.

(3) Workers engaged in such duties shall be kept under constant technical supervision.

44. When work has to be undertaken on or near live bare conductors, the conductors shall be guarded by permanent or temporary screens or barriers of insulating material so as to prevent accidental short circuit.

REGULATION 112. FIRE-FIGHTING AND PERSONAL PROTECTIVE EQUIPMENT

Fire-Fighting Equipment

1. Portable fire-fighting equipment for use at fires in which live electrical equipment is involved—

- (a) shall consist of extinguishers containing carbon dioxide, dry powder or any non-conducting and non-toxic substance not involving risk to the operator;
- (b) shall be conspicuously marked and conveniently located near the electrical installations; and
- (c) shall not be installed in locations subject to temperatures sufficiently high or low to affect their efficiency.

2. The use of any fire-fighting equipment which is carried in the hand and which emits a continuous jet of water or other conducting liquid shall be prohibited for fires involving live electrical equipment.

Personal Protective Equipment

3. While working on or close to live electric circuits or equipment, workers should—

- (a) wear suitable clothing, free from metal fittings;
- (b) avoid wearing unnecessary metal objects or flammable articles, such as finger rings, key or watch chains, or metal or celluloid cap visors or eye shields;
- (c) be provided with, and use, suitable protective equipment conforming to the relevant requirements of Chapter XIV of this Code; and
- (d) carry tools or metal equipment in such a way as to avoid dropping them.

REGULATION 113. STATIC ELECTRICITY

General Provisions

1. Where necessary to avoid danger under flammable conditions, precautions against incendive sparks resulting from static electricity shall be taken as follows:

- (a) the relative humidity of the air shall be maintained at not less than 50 per cent., preferably with automatic control;
- (b) charges which may accumulate on metal bodies shall be discharged by providing leakage paths to ground either by—
 - (i) direct ground wires or by ground wires in which a value of resistance is included; or
 - (ii) the use of conductive rubber having a volume resistivity of not less than 100,000 ohms.

Shafting, Pulleys and Belts

2. Where dangerous accumulation of static charges may be caused by belt and pulley drives, both shaft and bearing shall be grounded.

3. Where sparking may occur between the belt and pulley in such a way as to cause risk to the workers, the accumulation of static charges shall be reduced by means of metallic combs connected to ground and placed, if necessary on both sides, as close as possible to the belts at the point where they run off the pulleys.

Flammable Liquids and Powdered Materials

4. Where volatile fluids are transferred from storage tanks to tankers or road vehicles, the metalwork of the storage system shall be bonded to the metalwork of the tanker or road vehicle, and also to earth if the vehicle has rubber tyres.

5. (1) Where finely divided powders are transported by pneumatic conveyors with metal sections, these shall be conti-

nuously bonded along the whole path traversed by the flammable powder.

(2) Where finely divided aluminium or magnesium powders are handled, detectors or other suitable instruments shall be provided and used so that any place where accumulation of static charges occurs can be found.

6. Where special risks arise in connection with the handling of sensitive explosives or detonators, "anti-stat" footwear and protective face screens shall be used.

Static Eliminators, Neutralisers or Radioactive Equipment

7. Where the accumulation of static charges may cause danger and the measures indicated in paragraphs 1 to 6 of this Regulation are ineffective or impracticable, static eliminators or neutralisers so designed and installed as effectively to prevent incendive sparking shall be used or other suitable precautions taken.

8. Where radioactive devices are used to eliminate static charges, they shall be so constructed, shielded and located as to prevent injury to the workers by radioactive emission.

Spray Painting

9. In spray painting installations, the metallic objects to be painted or varnished and the metallic parts of spray cabins, booths, containers and exhaust systems shall be grounded.

10. The spraying pistol shall be grounded by means of a metallic wire or by other suitable means.

REGULATION 114. ELECTRICAL EQUIPMENT IN FLAMMABLE OR EXPLOSIVE ATMOSPHERES

General Provisions

1. Electrical apparatus shall be excluded from places where there is constant danger of explosion from flammable gas or vapour mixtures and placed outside the area of risk.

2. In places where there is occasional danger of explosion from flammable gas or vapour mixtures, all electrical apparatus shall be—

- (a) excluded from the area of risk; or
- (b) so constructed as to prevent danger.

3. Such apparatus shall be—

- (a) of explosion-proof (flame-proof) construction; or
- (b) pressurised by being kept constantly under a slight positive pressure of clean air; or
- (c) filled with an inert gas under a slight positive pressure; or

- (d) of intrinsically safe design, the circuit energy being limited to a value incapable of producing an incendive spark; or
- (e) ventilated by forced draught; or
- (f) of any other construction approved by the competent national authority for special cases.

Electric Motors

4. Electric motors located in workrooms where explosives, flammable gas or flammable flyings are encountered, shall be of an approved explosion-proof type.

Explosion-proof (Flame-proof) Apparatus

5. (1) Explosion-proof apparatus shall be of a construction certified by a recognised authority as safe for use in the atmosphere in question.

(2) No alterations which would impair the initial safety of the design shall be made to any explosion-proof apparatus.

6. (1) Electrical conductors for explosion-proof apparatus shall be in solid drawn screwed steel conduit, metal sheathed steel armoured cable, or mineral-insulated metal sheathed cable.

(2) Such conductors shall be connected to the apparatus by fittings which will maintain its explosion-proof character.

Conduit Wiring

7. (1) Where a conduit passes from a safe area to an area of risk, explosion-proof stopper boxes shall be inserted at the point where the conduit enters the area of risk.

(2) Stopper boxes shall also be fitted between the terminal boxes of fittings and between every length of conduit connected to them where the conduit is over 25 mm (1 in.) in diameter, unless the terminal box assembly has been certified by the testing authority independently of external connections.

8. Conduit bends should have a radius of at least three times the conduit diameter.

Armoured Cables

9. Where there is risk of mechanical damage, cables shall be armoured.

10. Where there are long vertical runs of paper insulated cables, special measures shall be taken to prevent the oil or other impregnating liquids from draining away from the cables by gravity.

11. The electrical continuity between the metal casings of explosion-proof apparatus or appliances and the sheathing of the cable shall be ensured by plumbing, soldering or by the use of suitable clamps.

Mineral Insulated Metal Sheathed Cables

12. Certified explosion-proof fittings sealing the cable insulation and preventing the admission of moisture shall be used.

Wiring and Cables

13. The outer non-insulated metal sheathing of cables or wiring shall not be used as an active conductor.

14. Where metal sheathing or metal armouring of cables or wiring is supported by metal parts of the buildings or structures, it shall either be insulated therefrom or securely bonded thereto.

Pressurised Apparatus

15. Pressurised apparatus shall be subjected to a constant positive pressure of clean air or inert gas at all times when the apparatus is electrically energised.

16. Suitable interlocks shall be provided to disconnect the apparatus should the pressure fail.

17. An indicator shall be provided to show that the equipment is actually under pressure.

Intrinsically Safe Apparatus

18. The circuit characteristics shall be tested and approved by a recognised testing authority.

19. Intrinsically safe apparatus and circuits shall not be modified after certification and installation and such circuits shall be electrically isolated from other circuits.

Forced Draught Ventilation

20. Large motors or other apparatuses which are not protected as required by the preceding paragraphs shall be of an enclosed type, such that a large volume of fresh clean air is forced in and released through trunking or pipes to the open air.

Open Air Situations

21. Bare overhead outdoor supply lines shall be terminated outside the danger area and the termination fitted with effective protection against high voltage surges.

22. When metal sheathed and/or armoured cables are used to extend the supply line into the area of risk the sheathing shall be electrically continuous and effectively grounded.

23. All cables, including underground telecommunication cables, shall be buried at a depth of not less than 50 cm (20 in.) so as to afford protection against accidental mechanical damage.

Disconnection

24. All electrical apparatus requiring frequent attention shall be capable of being completely isolated electrically.

25. Where an isolating switch is not immediately adjacent to the apparatus that it controls, measures shall be taken to prevent restoration of electric supply while apparatus is open for work or inspection at a time when there is risk of a flammable atmosphere.

26. Isolating switches shall be labelled to relate them to the apparatus which they control.

Fuses

27. Fuses shall be placed outside the danger area: Provided that where this is not possible, they shall be enclosed in explosion-proof cases which shall not be opened unless the source of supply has been disconnected.

Electrical Equipment — Inspection — Maintenance

28. All electrical equipment, including electric lighting equipment, shall be inspected by a competent and qualified person at intervals not exceeding twelve months and shall be properly maintained.

Artificial Lighting

29. Artificial lighting, unless provided by officially approved electric lighting systems, shall be provided by lamps installed outside the rooms.

Static Electricity

30. All metal walls, roofs, equipment and machinery shall be adequately grounded.

31. Where the nature of the process permits, a humidity of not less than 50 per cent. should be maintained in premises in which flammable liquids are manufactured.

REGULATION 115. ELECTRICAL EQUIPMENT IN PREMISES WHERE THERE IS RISK OF INORGANIC DUST EXPLOSIONS

General Provisions

1. The provisions of this Regulation shall apply to premises where magnesium, aluminium and other inorganic, flammable powders and dusts are manufactured, handled or used.

Electrical Control Equipment

2. Motor starters, lighting switches, all fuses and circuit breakers and similar equipment shall be placed outside the danger area.

3. The actuating devices for remote control contactors for starting or stopping motors shall be of dust-tight construction: Provided that where this type of construction is not practicable explosion-proof enclosures shall be used.

Electric Motors

4. Electric motors shall be of dust-tight construction: Provided that where this type of construction is not practicable explosion-proof enclosures shall be used.

Heating

5. Electric heaters shall conform to the provisions of paragraph 9 of Regulation 187 of this Code.

Ground Leakage Control

6. (1) Protection against overload and short circuit shall be supplemented by an automatic device which will operate on the occurrence of leakage between any live conductor and ground in excess of 10 per cent. of the setting of the over-current protection.

(2) This device shall be capable of disconnecting either the whole installation or that circuit which is defective.

Portable Electric Equipment

7. Portable electric equipment shall not be used in danger areas.

Static Electricity

8. Precautions against static electricity shall be taken in conformity with the requirements of Regulation 113 of this Code.

9. "Anti-stat" footwear shall be worn by all the personnel in establishments in which aluminium or magnesium powder is present.

REGULATION 116. ELECTRICAL EQUIPMENT IN PREMISES WHERE THERE IS RISK OF ORGANIC DUST EXPLOSIONS*General Provisions*

1. The provisions of this Regulation shall apply to premises in which materials such as flour, grain, spice, starch, sugar and cocoa, that produce flammable dusts, are processed, handled and stored.

2. In rooms where materials producing flammable organic dusts are processed, handled or stored—

- (a) electric motors and generators shall be provided with dust-tight enclosures of a type approved by a competent authority or installed in the engine rooms or in separate dust-proof rooms ventilated from a source of clean air;
- (b) if motor control devices are of the remote-control type, the contactors actuating the controls shall be either—
 - (i) of dust-tight construction; or
 - (ii) located in separate dust-tight rooms; and

- (c) all electrical apparatus and equipment shall be of such design that no external part on which dust may settle shall reach a temperature at which the dust is liable to ignite.

Fuses

3. Fuses shall be placed outside the danger area: Provided that where this is not possible, they shall be enclosed in dust-tight cases which cannot be opened unless the source of supply has been disconnected.

Artificial Lighting

4. Artificial lighting required for the interior of bins, conveyors, elevators, hoppers or similar constructions or equipment used in the processing or handling of materials producing flammable organic dust, shall be supplied by electric lamps enclosed in dust-tight globes which shall be—

- (a) properly protected against mechanical damage;
- (b) mounted flush in the walls or roofs of the construction or equipment; and
- (c) controlled by dust-tight switches outside.

REGULATION 117. PORTABLE ELECTRIC TOOLS

1. Where practicable, handles of portable electric tools should be insulated or made of insulating materials.

2. Portable electric tools shall be provided with built-in switches, which are—

- (a) spring-controlled in such a way as to require to be held in the closed position by the operator; and
- (b) so located as to minimise the risk of accidental starting should the tool be laid down.

3. (1) Where portable electric hand tools are used on building sites or similar places out-of-doors and simultaneous defects in the insulation of the tool and the continuity of the ground connection may result in serious or fatal electric shock, the voltage of an A.C. current supply for the hand tool should not exceed 110 volts.

(2) Where a transformer is introduced to reduce mains tension to the value recommended in paragraph 3 (1) of this Regulation, it shall be of the double wound type, the centre point of the secondary or lower voltage winding being tapped and brought out for permanent connection to ground.

(3) Where a reduction of pressure to less than 110 volts A.C. is impracticable, the following alternative precautions should be taken:

- (a) an isolating transformer of equal ratio should be interposed between the main supply and the portable electric hand tools so that the secondary circuit is "ground free"; or

- (b) where the continuous integrity of the ground wire bonding and plug and socket connections is tested by providing a contactor circuit energised from a low voltage transformer or battery, and including the ground wire and connections, the arrangement should be such that a break or interruption in the ground connections will release a contactor controlling the source of electric supply to the hand tool; or
- (c) means of testing the continuous integrity of the ground connections enabling the workers to test the tools themselves at frequent intervals should be provided and be readily accessible.

4. Motors, connecting cords or cables, and terminals for portable electric tools shall be protected in accordance with the requirements of this Chapter respecting fixed installations.

5. (1) Portable electric hand tools shall be connected by socket-outlets and plugs of a pattern which provides an extra pin and contact for the ground wire.

(2) Where heavy values of current are anticipated the socket shall be controlled by a switch incorporated in the same component.

6. Fixed outlet-sockets with pull-out plugs for connecting cords or cables of portable electric tools should be installed conveniently near to the work, so as to avoid the use of long cords.

7. Where possible, connecting cords or cables of portable electric tools should be suspended overhead high enough to permit free passage of persons beneath them.

8. Where portable electric tools are suspended from above, they should be supported by means of springs or counterweighted ropes or chains.

9. Special slings or shoulder straps should be provided for carrying heavy portable electric tools from place to place, but such slings or straps shall not be used to support the tools during operations.

10. Workers using portable electric tools should avoid wearing—

- (a) loose clothing with free ends; and
- (b) gloves other than rubber gloves.

REGULATION 118. ELECTRICAL REPAIRS

1. Except in cases in which it is absolutely necessary, repair work shall not be undertaken on live electric circuits.

2. So long as definite and satisfactory evidence to the contrary has not been obtained, repairmen should assume that all parts of electric circuits are live.

3. Work on live parts of electric circuits shall only be carried out—

- (a) on direct order from a competent, responsible person; and
- (b) under direct and constant supervision by a competent person thoroughly familiar with the installation to be repaired, the work to be carried out and the risk inherent in this work, and capable of taking immediately all necessary steps to prevent accidents or mishaps during the work.

4. Before allowing work to begin on any electric circuit, machinery or installation, the person in charge shall take all necessary steps to ensure that—

- (a) the circuit, machinery or installation in question is reliably disconnected from any source of power;
- (b) the switches or circuit-breakers controlling the circuit, machinery or installation have been securely locked in the " Off " position; and
- (c) such other measures have been taken as may be necessary in each particular case to prevent the current from being switched on again before the work has been completed and the repairmen withdrawn.

5. After repairs, the current shall only be switched on again on the definite order of a competent and authorised person.

6. When repairs have to be carried out on electric circuits, power cables or overhead transmission lines to which current can be supplied from more than one direction, the circuit, cable or line shall be securely disconnected from the power supply on both sides of the place at which the repairs are to be undertaken.

7. Overhead power lines, in addition to being disconnected, shall be reliably grounded, where necessary on both sides of the place at which the repairs are to be made.

8. All repairmen having to climb masts or poles of overhead electric lines shall be provided with and shall use safety belts of an appropriate type and of adequate strength, conforming to the requirements of Regulation 232 of Chapter XIV of this Code.

9. All tools used in electrical repair work, such as pliers, screwdrivers, fuse tongs and the like, shall be—

- (a) strongly insulated; and
- (b) of an appropriate type, suitable for the work.

10. Where necessary, besides using insulated tools, repairmen working on electrical installations shall—

- (a) wear well-made rubber gloves of a type conforming to the requirements of Regulation 233 of Chapter XIV of this Code, and, over these, strong leather gloves without any metal fastenings; and
- (b) use well-insulated working stands in the form of trestles, platforms or mats.

11. Before replacing defective fuses in power circuits, the circuit should be disconnected from the source of power; if this is not possible the worker changing the fuse shall have his face and eyes adequately protected.

12. When manipulating fuses in live power circuits, workers shall—

- (a) use appropriate tools, such as tongs or tweezers, specially provided for the purpose; and
- (b) place themselves on special stands, such as adequately insulated trestles or rubber mats.

13. All electrical repairmen should—

- (a) have adequate training in methods of resuscitation and first aid in case of accident; and
- (b) attend regular resuscitation and first aid exercises under the direction of a fully competent instructor.

14. When electric light or power is used for work in boilers, tanks or other closed vessels—

- (a) the tension of the current shall not exceed—
 - (i) 100 volts for direct current;
 - (ii) 42 volts effective pressure between phases, for three-phase current with the neutral point grounded; and
 - (iii) 24 volts effective pressure, for single-phase current;
 - (b) only strongly insulated cords (flexible conductors) and sockets made of insulating material shall be used;
 - (c) the lamps shall have adequate protection against breakage; and
 - (d) the cords (flexible conductors) shall be so arranged or installed as not to create a tripping hazard.
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CHAPTER VI

HAND TOOLS AND PORTABLE POWER-DRIVEN TOOLS

REGULATION 119. HAND TOOLS

General Provisions

1. Hand tools for factory use shall be of material of good quality and appropriate for the work for which they will be used.
2. Hand tools shall be used only for the specific purposes for which they were designed.
3. Wooden handles of hand tools shall be—
 - (a) best quality straight-grained material;
 - (b) of suitable shape and size; and
 - (c) smooth, without splinters or sharp edges.
4. Where there is any risk of an explosive atmosphere being ignited by sparks, any hand tools used therein shall be of a non-sparking type.
5. Hammers and sledges, cold chisels, cutters, punches and other similar shock tools should be made of carefully selected steel, hard enough to withstand blows without mushrooming extensively but not so hard as to chip or break.
6. Heads of shock tools should be dressed or ground to a suitable radius on the edge as soon as they begin to mushroom or crack.
7. Hand tools should be tempered, dressed and repaired only by properly qualified persons.
8. When not in use, sharp-edged or sharp-pointed hand tools shall be provided with protection for the edges or points.
9. Hand tools shall not be allowed to lie on floors, passageways, stairways, or in other places where persons have to work or pass, or on elevations from which they may fall on persons below.
10. Suitable and conveniently located cabinets, holders or shelves shall be provided at benches or machines for hand tools.
11. Hand tools should be—
 - (a) issued through a tool room, in which they are stored safely on racks or shelves in cabinets or tool boxes;

- (b) inspected periodically by competent persons; and
- (c) replaced or repaired when found defective.

12. Workers should be properly instructed and trained in the safe use of their hand tools.

Axes, Adzes, Cleavers and Hatchets

13. Axes, adzes, cleavers, hatchets and similar non-metal-cutting hand tools shall always be kept sharp.

14. Handles for axes, adzes or hatchets shall be fitted carefully to the heads and kept securely fastened to them.

15. Where it is necessary for workers to carry axes, adzes or hatchets, carrying cases of suitable material should be provided.

Cold Chisels, Chisel Cutters (Chisels with Holders) and Punches

16. Edges of cold chisels and chisel cutters and points of punches shall be—

- (a) of suitable shape for the particular work to be done; and
- (b) kept sharp.

17. Where cold chisels or chisel cutters are used for chipping, removing rivets or similar operations, screens or guards shall be provided and used so as to protect other workers from the effects produced by flying chips.

18. Workers using cold chisels or chisel cutters in operations involving risks of eye injuries shall be provided with, and use, goggles conforming to the requirements of Regulation 228 of Chapter XIV of this Code.

19. Heads of cold chisels, chisel cutters and punches should be kept free from grease and oil.

Crowbars and Pinchbars

20. Points or edges of crowbars or pinchbars shall be kept in good condition, to minimise slipping hazards.

21. When not in use, crowbars or similar tools should be laid flat in safe places on the floor or platform and not leaning against a flat surface.

Files

22. Files shall be provided with substantial metal-ferruled handles or other suitable holders and shall not be used without them.

23. The filing of work which is rotating in a lathe should be avoided, but when it is done the operator shall hold the file in the hand which is farther away from the revolving work.

24. Files shall not be used for prying or as drift pins or hammers, and shall not be struck with hammers.

Hacksaws (Metal)

25. Hacksaw blades shall be—

- (a) stretched tightly in their frames; and
- (b) moved in a straight line with light steady strokes, so as to avoid breaking the blades and possibly injuring the hands.

Hammers and Sledges

26. Handles for hammers and sledges shall be fitted carefully to the heads and kept securely fastened to them.

27. Hammers used for striking tempered or case-hardened steel shall be made of brass, bronze, copper, lead, wood, or other material which does not shatter.

28. Hammers and sledges shall be kept free from oil or grease.

29. Tempered metal hammers and sledges with loose handles or with cracks in the faces due to service shall be removed from service until the defect is corrected.

Hand Knives

30. Handles of hand knives shall be provided with hilt guards of fibre, leather or steel, or with finger rings or loops, to prevent the hand from sliding on to the blade.

31. Points of V-knives, used on trimming operations in rubber manufacture, shall be properly rounded.

32. Carrying pouches or sheaths shall be provided for hand knives, such as those used in canneries, slaughter houses, leather-producing and leather-working factories, or rubber factories.

Hand Saws (Wood)

33. When using hand saws—

- (a) crosscut saws shall be used for cutting across the grain of the wood only; and
- (b) ripsaws shall be used for cutting with the grain of the wood only.

Lifting Jacks

34. Lifting jacks of all types shall be of such construction that the load—

- (a) will remain supported in any position; and
- (b) cannot be lowered inadvertently.

35. When lifting objects with jacks, the jacks shall be—

- (a) set on solid footings;
- (b) centred properly for the lifts; and
- (c) so placed that they can be operated without obstruction.

36. After objects have been lifted to the desired height by means of jacks, substantial blocking with an ample factor of safety shall be placed under the objects before work on them is started or any workers get under the objects.

37. Before the loads are lowered, workers shall make sure that they are in a safe place.

Hand Hooks

38. Hand hooks, and small picks for handling bolts or lumber, shall be kept sharp.

39. Shanks of hand hooks shall be securely fastened in the handles.

Pliers, Wire Cutters and Nippers

40. When cutting wire under tension or spring wire in coils by means of pliers, wire cutters or nippers, at least one end of the wire shall be clamped or held down to prevent it from flying after being cut.

41. Pliers shall not be used as substitutes for wrenches to tighten or loosen nuts.

Scrapers

42. When using scrapers on metal objects, the hands should be—

- (a) free of grease, oil or excess moisture; and
- (b) held high enough from the work to avoid striking them against sharp corners or edges on the objects.

Screwdrivers

43. Edges of screwdrivers shall—

- (a) be properly ground;
- (b) fit the slots of the screws; and
- (c) be free from grease or oil.

44. Screwdrivers shall be provided with substantial and smooth-surfaced handles.

45. When tightening or loosening screws in detached small parts, the work should be held in a vice or against a firm surface that will bear the pressure of the driver.

46. Screwdrivers shall not be used for prising, or as chisels.

47. Screwdrivers with rounded and worn edges, with bent shanks, or with roughened or splintered handles shall be discarded or removed from service until repaired.

Tongs

48. Tongs shall be so shaped that when they are closed sufficient space will be left between the handles to avoid finger pinching.

Wood-Cutting Chisels, Drawknives (Spokeshaves) and Planes

49. Wood-cutting chisels, drawknives and plane blades shall be kept sharp.

50. Wood-cutting chisels shall be provided with—

- (a) substantial handles, metal ferruled or supported in sockets; and
- (b) metal bands around the ends of the handles when hammers or mallets are used for driving them.

51. When drawknives are used for removing bark or for shaping wood stock, the material shall be clamped firmly in a stand or holder.

Wrenches and Spanners

52. Corrugations on the jaws of pipe wrenches shall be kept sharp.

53. When tightening or loosening nuts or bolts with a wrench or spanner—

- (a) a tool of proper size shall be used; and
- (b) the practice of using a piece of wood, a nail or other thin object as a shim with an oversized wrench shall not be permitted.

54. Pipe or other extensions on wrenches or spanners shall not be permitted, unless the tools are designed for use in this manner.

55. Wrenches and spanners shall not be used as hammers.

56. Wrenches with spread, battered or cracked jaws, cracked or broken handles, or other defects, shall be discarded or removed from service until repaired.

REGULATION 120. PORTABLE POWER-DRIVEN TOOLS

General Provisions

1. Portable power-driven tools shall be constructed without projections on any exposed, revolving or reciprocating parts.

2. Workers using portable power-driven tools shall be provided with, and use—

- (a) goggles or shields, where protection from flying particles is required; and
- (b) respirators, helmets or masks, when exposed to harmful amounts of objectionable dust which cannot be removed at the point of origin by local exhaust.

3. Portable power-driven tools should be—

- (a) issued through a tool room or by a competent person, to which or to whom they should be returned when not in use;

- (b) given a visual or external examination when returned to the tool room or to the person by whom they were issued; and
- (c) given a complete inspection, including cleaning and tests, by qualified persons at regular intervals depending on the frequency of use.

4. Defective portable power-driven tools shall be immediately repaired or removed from service.

Portable Electric Tools

5. All portable electric tools shall comply with the provisions of Regulation 117 of Chapter V of this Code.

Abrasive Wheels and Scratch Brushes

6. Abrasive wheels and scratch brushes on portable electric tools shall be safeguarded in accordance with the requirements of Regulation 91.

Circular Knives

7. Circular knives on portable electric tools shall be provided with guards enclosing the knife edges at all times, as near as possible to the surface of the material.

Circular Saws

8. Circular saws on portable electric tools shall be provided with—

- (a) fixed hood guards which cover as much as possible of the blade; and
- (b) adjustable riving knives following the contour of the blade and extending from the underside of the guards to a point 1.5 mm ($\frac{1}{16}$ in.) above the lowest part of the blades in the cutting position.

Drills, Boring Bits, Reamers and Taps

9. Drills, boring bits, reamers and taps on portable electric tools should be provided with telescoping sleeve or coil spring types of guards.

10. Where practicable, as in the case of small work which can be done conveniently on benches, portable electric drilling, boring, reaming or tapping equipment should be supported in bench stands.

Chuck Wrenches

11. Chuck wrenches for portable electric tools—

- (a) shall fit loosely enough to drop out of the sockets when released; and

- (b) shall not be secured to the tools by chains, strings or other attachments.

Portable Pneumatic Tools

12. Operating triggers on portable pneumatic tools shall be—

- (a) so located as to minimise the risk of accidental starting of the machine; and
- (b) arranged to close the air inlet valve automatically when the pressure of the operator's hand is removed.

13. Hose and hose connections used for compressed air supply to portable pneumatic tools shall be—

- (a) designed for the pressure and service to which they will be subjected;
- (b) fastened securely to the permanent pipe outlet; and
- (c) kept out of aisles and passageways, so as to reduce tripping hazards and injury to the hose.

14. Pneumatic hammers shall be—

- (a) so constructed that the pistons will be retained without any risk of their coming out accidentally; and
- (b) provided with springs, safety clips or other devices to reduce the risk of tools shooting out.

15. The practice of shooting working tools out of pneumatic hammers, instead of removing them by hand, shall be prohibited.

16. Before changing working tools on portable pneumatic equipment, or doing work other than the regular operations, the stop valves in the air supply lines shall be closed.

17. When cutting rivets with pneumatic cutters—

- (a) the tools should be provided with small wire baskets to intercept the rivet heads; or
 - (b) the workers should be provided with suitable protection for their heads and eyes.
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CHAPTER VII

BOILERS AND PRESSURE VESSELS

Section 1. Boilers

REGULATION 121. DEFINITIONS

In this Code the following terms have the meanings hereby assigned to them:

- (a) the term "steam boiler" means any enclosed vessel in which for any purpose steam is generated under pressure greater than atmospheric pressure.
- (b) the term "medium- and high-pressure boiler" means a steam boiler on which the maximum allowable working pressure exceeds 1 kg/cm^2 (15 lb./sq. in.).
- (c) the term "low-pressure steam boiler" means a steam boiler used exclusively for operation at pressures not exceeding 1 kg/cm^2 (15 lb./sq. in.).
- (d) the term "hot-water boiler" means a hot-water boiler for operation at pressures not exceeding 10 kg/cm^2 (150 lb./sq. in.) or temperatures not exceeding 120° C. (250° F.).
- (e) the term "working pressure" means gauge pressure or pressure above atmospheric pressure in kg/cm^2 (lb./sq. in.).

REGULATION 122. STEAM BOILERS

Construction

1. Steam boilers, their fittings and attachments shall be—
 - (a) so designed that they will be adaptable to the particular circumstances of their use; and
 - (b) so constructed that they will be of sufficient strength to sustain the internal pressures to which they will be subjected.
2. Steam boilers, their fittings and attachments shall be of appropriate material of good quality, free from injurious defects, and of adequate thickness and weight, conforming to the specifications established by the competent authority.

Markings

3. (1) Every boiler shall have a number plate affixed to it bearing the following data:

- (a) name of the manufacturer;
- (b) number of the boiler;
- (c) year of manufacture; and
- (d) maximum permissible working pressure.

(2) For the purpose of this paragraph, the term "manufacturer" means the manufacturer or the person who is in charge of erecting the boiler and who presents it in working order.

Boiler Records

4. Every boiler, when constructed or sold, shall be accompanied by a certificate showing all the technical specifications used by the manufacturer and containing all the standards, designs and dimensions in accordance with the maker's number plate affixed on the boiler.

5. The certificate referred to in the foregoing paragraph shall also contain the results of all the control tests carried out during the manufacture of the material and the construction of the boiler.

6. The certificate referred to in paragraph 4 shall accompany the boiler during its whole life.

7. Every boiler owner shall keep a boiler maintenance register in which shall be noted under the corresponding dates all tests, internal and external examinations, cleanings and repairs undertaken on the boiler. This register shall be submitted on request to the boiler inspector or other competent authority.

Inspection

8. Steam boilers shall be inspected, internally and externally, by qualified inspectors authorised by the competent authority—

- (a) during construction;
- (b) before being placed in service, after installation;
- (c) before being placed in service, after reconstruction or repairs;
- (d) periodically, while not under pressure, at intervals not exceeding fourteen months; and
- (e) periodically, while under operation, at least once every fourteen months.

9. After due notice of a proposed internal inspection of a steam boiler the owner or user shall have the boiler drained, cooled, opened up and thoroughly cleaned by the appointed time.

10. On internally-fired steam boilers, any grates shall be removed, as well as sufficient brick or other material to facilitate thorough examination of the boiler, furnace or other parts as deemed necessary by the inspector.

11. When steam boilers are subjected to hydrostatic tests, the required test pressure shall not be more than 1.5 times the maximum permissible working pressure and shall conform to the requirements to be determined by the competent authority.

12. (1) During hydrostatic tests of steam boilers, the safety valves shall be removed or the valve discs held down by means of testing clamps and not by screwing down the compression screw upon the spring.

(2) When the hydrostatic test at the pressure specified in paragraph 11 is completed, a further test shall be carried out in order to check the safety valves at normal working pressure.

13. Steam boilers which upon inspection are found unsafe for use, or are not provided with the fittings necessary for safe operation, or have the fittings improperly arranged, shall not be operated until the boilers and their fittings are put into a condition to ensure safety of operation.

14. When at an inspection any deterioration of the boiler is found that would increase the risk of explosion, the permissible working pressure shall be reduced sufficiently to permit safe operation of the boiler; this reduction shall take into account the years of operation of the boiler.

15. Where portable lamps or portable electric tools, other than welding apparatus, are used, the tension shall not exceed 25 volts.

Storage

16. Spaces at tops or sides of boilers shall not be used for storage and shall be kept free of combustible material.

REGULATION 123. MEDIUM- AND HIGH-PRESSURE BOILERS

Boiler Rooms

1. Boilers shall only be installed in places and in a manner approved by the competent authority.

2. Medium- and high-pressure boilers for industrial establishments should be located—

- (a) in detached buildings of fire-resisting construction, used for no other purpose and situated not less than 3 m (10 ft.) distant from buildings not forming part of the establishment; or
- (b) in structures of fire-resisting materials, connected to or in close proximity to other buildings of the establishment.

3. Where there is a risk of fire spreading between a boiler room and an adjoining workroom where explosives or highly flammable materials are manufactured, used, handled or liberated, the separation of the rooms shall be made complete and there shall be no exits or other openings in the walls between the rooms.

4. Boiler rooms, blow-offs, ash pits or alleys, high-pressure steam-line tunnels and other places where there is danger of workers being trapped in confined spaces in the event of explosion within a boiler or rupture of steam lines, shall be provided with two or more adequate exits, which shall be kept clear of obstructions.

5. Railed walks, runways and stairs of iron and steel construction or other fire-resisting materials provided with non-slip surfaces shall be erected for convenient and safe access to overhead valves, water columns, feed water regulators and other fittings on medium- and high-pressure boilers.

6. Runways located on top of or alongside a battery of medium- or high-pressure boilers shall be provided with two or more means of descent as far apart as practicable.

7. Medium- and high-pressure boiler rooms should be of sufficient height to permit installation and operation of all valves and safety appliances, with a minimum clearance of 15 cm (6 in.) above the highest valve or fitting, or stems or levers at their greatest height, and 1.80 m (6 ft.) above the highest runway.

8. Pits in medium- and high-pressure boiler rooms shall be covered or surrounded by standard railings and toeboards.

9. (1) The provisions of paragraphs 1, 2, 3, 4, 5 and 8 of this Regulation shall apply also to sheds of locomotives, locomobiles and steam cranes used within industrial establishments.

(2) The provisions of paragraphs 6 and 7 of this Regulation shall also be applied, as far as possible, to such sheds.

10. Foundations and structures supporting medium- and high-pressure boilers shall be—

- (a) capable of withstanding any strain which may be transferred to them by the maximum weight of the boilers during hydraulic tests and the expansion or contraction of the boilers and their supports; and
- (b) tied together in such a manner as to maintain their proper relation.

11. Where medium- and high-pressure boilers are supported on structural steelwork, the supports shall be so located or insulated that the heat from the furnace cannot impair the strength of the steel.

12. Settings of medium- and high-pressure boilers shall be provided with suitably packed openings or sleeves of sufficient size to permit expansion and contraction of pipes.

13. The bases of vertical boilers should be carefully shimmed with iron or steel shims, properly secured or grouted.

14. Wet-bottom stationary boilers shall have a space of not less than 30 cm (12 in.) between the bottom of the boiler and the floor line, with access for inspection.

Access and Inspection Openings

15. Except for special types of boiler where such openings manifestly are not needed or used, medium- and high-pressure boilers or parts thereof shall be equipped with suitable manhole, handhole or other inspection openings for examination and cleaning.

16. Manhole openings in heads or shells of medium- and high-pressure boilers shall be of sufficient size to allow easy access and egress and shall be in conformity with the minimum dimensions laid down by the competent authority. Suggested minimum sizes are as follows:

- (a) 30×40 cm (12×16 in.) if elliptical; and
- (b) 40 cm (16 in.) in diameter, if circular.

17. Handhole openings in heads or shells of medium- and high-pressure boilers shall be of sufficient size to admit a hand and should not be less than 70×90 mm ($2\frac{3}{4} \times 3\frac{1}{2}$ in.).

18. Threaded openings on medium- and high-pressure boilers, when intended to be used for inspection or washout purposes, shall be not less than 25 mm (1 in.) pipe size.

19. Access doors in the settings of medium- and high-pressure boilers shall be of suitable shape and sufficient size to admit of easy access and egress and should be not less than 30×40 cm (12×16 in.).

20. Firing door openings on medium- and high-pressure boilers which are fed by hand shall be of sufficient size and suitable shape to allow easy and efficient feeding and should, in the boilers of this class in which the minimum furnace dimension is 60 cm (24 in.) or more, be not less than—

- (a) 30×40 cm (12×16 in.) in size, if rectangular or elliptical; or
- (b) 40 cm (16 in.) in diameter, if circular.

21. Firing doors in water-tube boiler settings, and observation doors, when located within 2 m (6 ft. 6 in.) of the floor or working level and normally opened while the boilers are under pressure, shall be of the inward opening type.

22. Medium- and high-pressure boilers burning oil, pulverised fuel, or gas, shall be equipped with one or more explosion doors, located at the highest point of the combustion chamber.

23. Explosion doors on medium- and high-pressure boilers, when located within 2 m (6 ft. 6 in.) of the floor or working level, shall be provided with substantial deflectors to divert any blasts away from the workers.

Safety Valves

24. Each medium- or high-pressure boiler shall be equipped with at least one safety valve—

- (a) placed on or as close as possible to the boiler;
- (b) connected to the boiler independently of any other steam connection; and
- (c) without any valve or obstruction to the flow of steam between the boiler and the safety valve or between the safety valve and the discharge point of any pipe connected to it.

25. The safety valve or valves on medium- or high-pressure boilers shall be of sufficient capacity to discharge all the steam generated by the boiler at maximum load.

26. Seats and discs of safety valves for medium- and high-pressure boilers shall be of suitable corrosion-resisting material, and the seat shall be so secured to the valve body that there is no possibility of the seat lifting.

27. Safety valves for medium- and high-pressure boilers shall be so constructed and maintained—

- (a) that the failure of any part will not obstruct the free and full discharge of steam from the valves;
- (b) that no shocks injurious to the valves or to the boiler are produced by their operation; and
- (c) that the valve can be turned on its seat.

28. Safety valves for medium- and high-pressure boilers shall be—

- (a) capable of being so adjusted and set that they will operate without chattering;
- (b) sealed or otherwise so protected that they cannot be tampered with by unauthorised persons;
- (c) provided with special means for lifting the valve for testing purposes; and
- (d) so arranged that the discharge can be readily heard by the boiler attendant.

29. Safety-valve discharge outlets on medium- and high-pressure boilers shall be so located or piped as to be carried clear from running boards and platforms, preferably not less than 3 m (10 ft.) above the platform around the valve.

30. When discharge pipes are used on safety valves for medium- and high-pressure boilers, they shall be—

- (a) not less in cross-section area than the full area of the valve outlet; and
- (b) fitted with open drains to prevent water lodging in the upper part of the valves or in the pipes.

31. When mufflers are used on safety valves for medium- and high-pressure boilers, they shall—

- (a) have sufficient outlet area to prevent back pressure from interfering with the proper operation and discharge capacity of the valves; and
- (b) be so constructed as to avoid any possibility of restriction of the steam passages due to deposits.

32. Superheaters which are so arranged that they can be isolated from medium- and high-pressure boilers shall be equipped with one or more safety valves, which shall be located near the

outlet: Provided that such valve or valves may be located anywhere in the length of the outlet header when there is a uniform flow of steam through the superheater tubes and header.

33. Economisers used on medium- and high-pressure boilers shall be equipped with at least one safety valve provided with seats and discs of corrosion-resisting material.

Stop Valves

34. Steam discharge outlets on medium- and high-pressure boilers, except safety-valve and superheater connections shall be equipped with stop valves located at an accessible point in the steam delivery line and as near the boiler as practicable.

35. Quick and convenient means of manipulating the principal stop valves on medium- and high-pressure boilers should be provided—

- (a) by extending the valve spindles so that the valve wheels may be operated—
 - (i) from the floors of the boiler room by means of chains, gears or other mechanical devices; or
 - (ii) from outside the boiler rooms in case of emergency; or
- (b) by installing remote-control stations for electrically-operated valves and providing further hand controls in a protected space where they may be operated without danger in case of failure.

36. When two or more medium- and high-pressure boilers are connected to a common steam main, the steam connection from each boiler equipped with a manhole opening shall be fitted with two lockable stop valves having between them an ample free-flow drain, the discharge from which shall be visible to the operator while manipulating the valves.

37. When stop valves on medium- and high-pressure boilers are so located that water can accumulate, ample drains shall be provided.

Water-Column Pipes

38. Pipes connecting water columns to medium- and high-pressure boilers shall be not less than 25 mm (1 in.) pipe size, and as short and direct as possible.

39. On horizontal-return tubular medium- and high-pressure boilers, the steam connections to water columns shall be taken from the top of the shell or the upper part of the head, and the water connections from a point not less than 15 cm (6 in.) below the centre line of the shell.

40. On the firebox types of medium- and high-pressure boiler, the water connections shall be taken from a point not less than 15 cm (6 in.) below the lowest water line or as near thereto as

possible, and in no case less than 45 cm (18 in.) above the mud ring.

41. Where practicable, water connections from medium- and high-pressure boilers to water columns shall be provided with a cross at each right-angle turn, to facilitate cleaning.

42. Water columns on medium- and high-pressure boilers shall be fitted with drain cocks or drain valves with suitable connections to a safe point of disposal.

43. No outlet connections, except for damper regulators, feed water regulators, drains, steam gauges or apparatus of such form as does not permit the escape of an appreciable amount of steam or water therefrom, shall be placed on pipes connecting water columns to medium- and high-pressure boilers.

Steam Gauges

44. Each medium- and high-pressure boiler shall be equipped with a steam pressure gauge, so placed—

- (a) that it will be free from vibration;
- (b) that it can be conveniently adjusted; and
- (c) that it will afford a clear and unobstructed view for the attendant from the usual operating position in front or at the side.

45. Steam gauges for medium- and high-pressure boilers shall be connected to the steam space or to the water column or its steam connection by a siphon tube, which shall be—

- (a) of sufficient capacity to keep the gauge tube filled with water; and
- (b) so arranged that the gauge cannot be shut off from the boiler except—
 - (i) by a cock, placed near the gauge and provided with a tee or lever handle so fitted that it will be parallel to the pipe when the cock is open; or
 - (ii) by a cock or a shut-off valve on boilers carrying a pressure of 35 kg/cm² (500 lb./sq. in.) or over.

46. Steam gauge connections for medium- and high-pressure boilers shall be as short as practicable.

47. Dials of steam gauges for medium- and high-pressure boilers shall—

- (a) be of such size and so marked that the graduations and the pointer can be clearly determined by a person, with normal vision at a distance equal to one and one-half times the width of the boiler front;
- (b) be graduated to not less than one and one-half times the pressure at which the safety valve is set, and preferably to

- approximately double such pressure, with the graduation so arranged that the pointer will be in a nearly vertical position when indicating the normal pressure; and
- (c) have the maximum permissible working pressure indicated in red on the dial.

48. All steam gauges in any medium- or high-pressure boiler room should be of the same type, with similar graduation of face.

49. (1) Each medium- or high-pressure boiler shall be provided with a valved connection for the exclusive purpose of attaching a test gauge.

(2) This should take the form of a three-way cock on the tube carrying the pressure gauge, but in any case shall be attached to the same boiler connection.

Water-Gauge Glasses

50. Each medium- or high-pressure boiler shall be equipped with at least one, but preferably two, water-gauge glasses, which shall be—

- (a) so located or so equipped with approved devices as to be easily read by the attendant;
- (b) fitted at top and bottom with a quick-closing valve, which may be easily closed from the floor in case the glass breaks;
- (c) connected directly to the boiler, or to the water column, by piping of not less than 12 mm ($\frac{1}{2}$ in.) pipe size;
- (d) equipped with a valved drain, piped to a safe point of disposal; and
- (e) provided with a wire-glass or other suitable guard for the protection of workers from flying glass or escaping hot water in case of breakage, so designed that it will not obstruct free observation of the water level.

51. Water-gauge glasses on medium- and high-pressure boilers shall be so placed that when the visible water level is at the lowest reading in the glass, at least sufficient water will remain in the boiler to prevent any danger.

Gauge Cocks

52. (1) Subject to the provisions of the succeeding subparagraphs of this paragraph, each medium- and high-pressure boiler shall be equipped with three or more gauge cocks, located within the range of the visible length of the water glass.

(2) When the boiler is equipped with two water-gauge glasses with independent connections to the boiler and located not less than 70 cm (28 in.) apart on the same horizontal line, gauge cocks shall be optional.

(3) Gauge cocks shall not be required for boilers of the miniature type, but such boilers shall be equipped with at least one try-cock.

(4) For boilers of the locomotive type not over 90 cm (36 in.) in diameter, and for boilers of the firebox and waterleg types with a heating surface not exceeding 5 m² (50 sq. ft.), only two, and not three, gauge cocks shall be required.

53. Gauge cocks located above normal reaching distance from the floor or working level shall be provided with—

- (a) permanently attached rods or chains for operation from the floor; and
- (b) suitable means to prevent water or steam discharging on workers manipulating the rods or chains.

Fusible Plugs

54. Fusible plugs, where used on medium- and high-pressure boilers as additional low-water alarms, shall be renewed at intervals not exceeding twelve months, and casings which have been used shall not be refilled.

55. Fusible plugs should not be used on medium- and high-pressure boilers operating at pressures exceeding 17.5 kg/cm² (250 lb./sq. in.).

56. Fire-actuated fusible plugs, where used on medium- and high-pressure boilers, shall be located at the highest possible point in a part of the boiler subjected to direct furnace heat.

57. Steam-actuated fusible plugs, where used on medium- and high-pressure boilers, shall be so located that they will operate when the water level is at a point where a fire-actuated fusible plug would be located.

Blow-off Equipment

58. Each medium- and high-pressure boiler shall be equipped with at least one blow-off pipe, fitted with a valve or cock in direct connection with the lowest water space, and the boiler shall be so designed and installed that all water can be drained from it

59. Each bottom blow-off pipe on a medium- and high-pressure boiler forming part of a range of boilers having a common blow-off pipe, drain or sump, shall be fitted with—

- (a) two slow-opening valves; or
- (b) one slow-opening valve and one quick-opening valve or cock; or
- (c) a valve operated by a key which can only be removed when the valve is closed, which key shall be the only key available for the blow-off valves of the range of boilers.

60. Valves for bottom blow-off pipes on medium- and high-pressure boilers shall be free from dams or pockets which might collect sediment and restrict the flow.

61. When exposed to direct furnace heat, bottom blow-off pipes on medium- and high-pressure boilers shall be protected by firebrick or other heat-resisting materials, so arranged that the pipes can be readily inspected.

62. Blow-off piping on medium- and high-pressure boilers shall discharge at a point where there is no danger of injury to workers, and shall not be connected to the sewer for the toilet facilities of the factory unless first passed through a blow-off tank.

63. Blow-off tanks, where used, shall be—

- (a) provided with a vent pipe, free from valves and of sufficient size to prevent the accumulation of pressure in the tank; and
- (b) so located that all parts will be accessible for inspection.

Feed-Water Systems

64. Medium- or high-pressure boilers not using condensate feed water, or other waters which are satisfactory, should be supplied with treated or purified water in order to avoid corrosion and the formation of scale.

65. The discharge end of feed pipes for medium- and high-pressure boilers shall be—

- (a) so located that the feed water at no time will be discharged—
 - (i) directly against surfaces exposed to direct radiation of the fires or to gases at high temperatures; or
 - (ii) close to any riveted joints of the furnace sheets or of the shell; and
- (b) if necessary, fitted with a baffle to divert the flow from riveted joints.

66. Feed pipes for medium- and high-pressure boilers shall be provided with a check valve near the boiler, and a valve or cock between the check valve and the boiler.

67. When two or more medium- and high-pressure boilers are fed from a common source, the feed pipe shall also be provided with a valve on the branch to each boiler between the check valve and the source of supply, so as to prevent the water from backing out of one boiler into another.

68. When medium- and high-pressure boilers are equipped with duplicate feed arrangements, each arrangement shall conform to the requirements of paragraphs 64 to 67.

69. Where economisers or other feed-water heating devices are connected directly to medium- and high-pressure boilers without intervening valves, the required feed valves and check valves shall be placed on the inlets of the economisers or water heaters.

70. When feed-water heaters of the open type are used on medium- and high-pressure boilers, an oil separator shall be placed

on the exhaust steam line to remove the oil coming from the engine or pump.

71. (1) Medium- and high-pressure boilers with more than 25 m² (270 sq. ft.) of water-heating surface shall have at least two means of feeding which should be driven by separate sources of power, one of which shall be a pump, inspirator or injector, and each of which shall be capable of feeding at the rate of at least twice the average evaporative capacity of the boiler.

(2) Other boilers shall be provided with means of feeding in accordance with requirements to be laid down by the competent authority.

Economisers

72. Economisers used on medium- and high-pressure boilers shall be provided with—

- (a) thermometers to show the temperature of the water at the inlet and outlet of the economiser;
- (b) tight-closing dampers between the economiser and the boiler; and
- (c) caps or lids in the header opposite the tubes, to facilitate removal of deposits from interior surfaces; and
- (d) a safety valve.

73. Settings of economisers on medium- and high-pressure boilers shall be provided with—

- (a) ventilating doors to facilitate circulation of air in the chamber surrounding the economiser; and
- (b) hinged metal covers, which should serve as explosion doors over the top of the space above the side dampers.

Damper Regulators

74. Where automatic control devices are used on inlet or outlet dampers on medium- and high-pressure boilers, they shall be so installed that failure of or accident to their mechanism will not allow the inlet damper to open or allow the outlet damper to close.

Gas-Fired Boilers

75. (1) Where boilers are gas fired, each burner shall be equipped with—

- (a) a separate quick-operating gas cock;
- (b) an adjustable gas orifice or a removable orifice of a fixed drilling to meet the local condition;
- (c) an adjustable air shutter capable of giving a complete shut-off and so held by a lock washer or screw that accidental shifting of the shutter is impossible;

- (d) a mixing tube not less than six times as long as its minimum diameter; and
- (e) a positive pilot light.

(2) Where possible, an automatic fuel-regulating governor should be fitted, regulated by the steam pressure and so constructed that, in the event of its failure, the steam cannot enter the gas chamber or the supply pipe.

76. Gas-fired boilers should not be located in rooms that are enclosed on all sides; however, if they are so located, these rooms shall be ventilated at all times in order to prevent any accumulation of gas.

Automatic Stokers for Coal-Burning Boilers

77. When automatic stokers are used for feeding coal-burning boilers, all parts of the moving mechanisms where there is danger of contact shall be adequately guarded in accordance with the requirements of Regulations 60 to 89.

Direct-Fired Autoclaves

78. Direct-fired autoclaves should be provided with thermocouple spots, welded to the inside of the autoclave bottom and so arranged that the flame is automatically cut off when the temperature of the contents reaches the safe limit.

REGULATION 124. LOW-PRESSURE STEAM BOILERS AND HOT-WATER BOILERS

Working Pressure and Temperature

1. The maximum allowable working pressure on boilers used exclusively for low-pressure steam heating shall not exceed 1 kg/cm² (15 lb./sq. in.).
2. The maximum allowable working temperature at or near the outlets of hot-water boilers shall not exceed 120° C. (250° F.).
3. Where the pressure on a low-pressure steam boiler or the temperature of a hot-water boiler exceeds that specified in paragraph 1 or 2, as the case may be, the requirements of Regulation 123 shall apply, and cast-iron construction shall be prohibited.

Access and Inspection Openings

4. Steel-plate low-pressure steam boilers shall be provided with suitable manhole openings and handhole or washout openings to permit inspection and facilitate removal of sediment: Provided that manhole openings may be omitted where the size or construction of the boiler is such that entrance is impracticable.

5. Manhole openings and handhole or washout openings in heads or shells of steel-plate low-pressure steam boilers, except

boilers of the locomotive or firebox type when set in brick or otherwise constructed so as to make such openings inaccessible, or boilers used exclusively for hot-water heating and not provided with steam space, shall conform to the requirements of paragraphs 16 to 19 of Regulation 123.

6. Cast-iron low-pressure steam or hot-water boilers shall be provided with suitable washout openings to permit the removal of sediment.

7. Access doors in steel-plate low-pressure steam boiler settings shall be not less than 30 by 40 cm (12 by 16 in.).

Safety Valves

8. (1) Each low-pressure steam boiler shall be equipped with at least one safety valve or other safety device for relieving pressure, approved by the competent authority.

(2) Safety valves shall comply with the requirements of paragraphs 24 to 31 of Regulation 123, and shall be sealed and adjusted to discharge at a pressure not exceeding 1 kg/cm² (15 lb./sq. in.), with the seals so attached that the valve cannot be taken apart without breaking the seal.

Water-Relief Valves

9. Each hot-water boiler shall be equipped with at least one expansion pipe or water-relief valve.

10. Water-relief valves for hot-water boilers shall be set to open at or below the maximum allowable working pressure.

11. Diaphragms, valve seats or discs of rubber or composition liable to fail due to deterioration when subjected to hot water or steam shall not be used on water-relief valves for hot-water boilers.

12. Water-relief valves on hot-water boilers shall be so located and piped that there will be no danger of scalding persons.

Stop Valves

13. Where a stop valve is used in the supply pipe connection of a single low-pressure steam or hot-water boiler, a stop valve shall also be provided in the return pipe connection.

14. Where two or more low-pressure steam or hot-water boilers are connected to a common system, a stop valve shall be provided in each supply and return pipe connection.

Water-Column Pipes

15. Water-column pipes on low-pressure steam or hot-water boilers shall conform to the requirements of paragraphs 38 to 43 of Regulation 123.

Steam Gauges

16. (1) Each low-pressure steam boiler shall be equipped with a steam pressure gauge, conforming in construction and installation to the requirements of paragraphs 44 to 49 of Regulation 123.

(2) The size and graduation of the scale of the gauge shall be such as to be easily read by the boiler attendant.

Pressure or Altitude Gauges

17. Each hot-water boiler shall be provided with a pressure or altitude gauge, connected to the boiler or to its flow connection in such a manner that it cannot be shut off from the boiler except by a cock, placed on the pipe near the gauge and provided with a tee or lever handle so fitted that it will be parallel to the pipe when the cock is open.

18. Scales on dials of pressure or altitude gauges on hot-water boilers shall—

- (a) be graduated to not less than one and one-half times the maximum allowable working pressure of the boiler; and
- (b) have the maximum permissible working pressure indicated in red on the dial.

Pressure Combustion Regulators

19. When pressure combustion regulators are used on low-pressure steam boilers, they shall operate to prevent the steam pressure from rising above 1 kg/cm^2 (15 lb./sq. in.).

Thermometers

20. Each hot-water boiler shall be equipped with a thermometer—

- (a) so located that it is easily readable when observing the water pressure or altitude; and
- (b) so connected that it at all times indicates the temperature of the water in the boiler.

Temperature Combustion Regulators

21. Each hot-water boiler should be equipped with a temperature combustion regulator, which will control the rate of combustion to prevent the temperature of the water from rising above 120° C. (250° F.).

Water-Gauge Glasses

22. Each low-pressure steam boiler shall be equipped with one or more water-gauge glasses—

- (a) with the lower fitting provided with a valve or petcock to facilitate cleaning; and
- (b) otherwise conforming to the requirements of paragraphs 50 and 51 of Regulation 123.

Gauge Cocks

23. Each low-pressure steam boiler shall be provided with two or more gauge cocks—

- (a) located within the range of the visible length of the water-gauge glass; and
- (b) conforming to the requirements of paragraphs 52 and 53 of Regulation 123.

Installation of Pipes

24. Hot-water heating systems shall be so installed that—

- (a) the risk of freezing of the system is reduced to a minimum; and
- (b) the expansion pipe cannot be accidentally shut off.

Blow-off Equipment

25. Each low-pressure steam or hot-water boiler shall be equipped with a bottom blow-off connection conforming to the provisions of paragraphs 58 to 63 of Regulation 123.

Feed Piping

26. Feed or make-up water shall not be discharged directly against any part of a low-pressure steam boiler exposed to the direct radiant heat from the fire.

27. Where feed and make-up water is introduced into hot-water boilers from a steam or water pressure line, the line shall be connected to the piping system and not directly to the boiler.

28. Feed-water shall not be introduced into low-pressure steam or hot-water boilers through the openings used for the water columns, water-gauge glasses or gauge cocks.

Automatic Fuel Cut-off and Water-Feeding Devices

29. Each automatically fired steam or vapour-system boiler should be equipped with an automatic low-water cut-off or water-feeding device, so constructed and located that when the surface of the water falls to the lowest safe water line—

- (a) the water inlet valve cannot feed water into the boiler through the float chamber; and
- (b) the device will automatically—

- (i) cut off the fuel supply; or
- (ii) supply requisite feed water; or
- (iii) simultaneously cut off the fuel supply and supply feed water.

REGULATION 125. OPERATION AND MAINTENANCE OF BOILERS

General Provisions

1. Steam boilers, whether manually or automatically fired, shall be under adequate supervision at all times while they are in service.

2. Workers in charge of operation and maintenance of boilers shall be properly qualified, and shall possess such experience, technical knowledge and other qualifications as may be required by the competent authority.

3. Only maintenance and repair personnel, persons directly connected with the power department and those accompanied by authorised persons shall be admitted to the boiler rooms.

Preparing Boilers for Service

4. Before new or reconditioned boilers are placed into service, they shall be thoroughly examined, internally and externally, so as to make sure that—

- (a) no one is inside;
- (b) the boilers contain no tools or foreign materials;
- (c) all fittings, appliances and connections are in proper working condition;
- (d) all discharge and access openings are closed; and
- (e) the safety valves, steam-gauge connections and water connections to the water columns are open.

5. Before opening intake or feed valves for filling the boilers, a vent valve shall be opened to permit the escape of air during filling.

6. Boilers shall be filled with water up to or above the steaming level before fires are started.

Heating of Boilers

7. Except in cases of emergency, heating of boilers should be started slowly and should not be forced, especially in the case of new boilers or boilers with new brick settings, so as to assure uniform heating of all parts and to avoid expansion strains.

8. Both inlet and outlet dampers on boilers shall be opened before the fires are lighted.

9. Where other boilers are connected to the breeching of the smokestack of a boiler in which a fire is being built, all doors and dampers on any dead boiler shall be closed.

10. Where coal or wood is used as fuel for boilers, flammable oils or other materials which might cause explosions or flare-backs should not be used.

11. Laying of fires ready for lighting in coal or wood-burning boilers out of service or under repair shall be prohibited, so as to avoid possible injury to workers in the event of the fire being started before the boiler is ready.

12. Before lighting a fire in any oil-fired boiler the person lighting the fire should satisfy himself that—

- (a) there is no oil on the floors of the combustion chambers, about the burners or in front of the boilers; and
- (b) the boiler furnaces are well ventilated, so as to expel any possible vapours which might cause explosions.

13. Where oil, gas, waste gases, pulverised coal or wood refuse is used as fuel for boilers—

- (a) outlet dampers should be open wide enough to produce a light draught and to prevent flare-backs; and
- (b) the burners, unless equipped with permanent, automatic igniters, should be lighted by means of hand torches of sufficient length.

14. Where there are more than two burners on oil or gas-fired boilers the centre burners should always be ignited first.

Placing Boilers in Service

15. When the boiler is heated—

- (a) the level of the water in the water-gauge glass should be checked with the gauge cocks;
- (b) the vent valves should be closed after steam has escaped for several minutes;
- (c) the blow-off valve should be examined for leaks; and
- (d) the steam pressure should be raised slowly.

16. When allowing steam to enter cold pipes and connections, the valves should be operated slowly until the parts have been warmed up.

17. When the steam pressure in the boiler approaches the working pressure—

- (a) the safety valve shall be tested by hand;
- (b) drains between the boiler and the main header should be opened and left open until the boiler is cut in; and
- (c) the gate valve between the boiler and the steam main should be opened slowly; where a non-return valve is used, the

valve stem should be opened so as to permit the seat to lift automatically at the required boiler pressure; where a non-return valve is not used the boiler stop valve should be opened very slowly when the pressure in the boiler is approximately equal to the pressure of other boilers on the line.

18. (1) Regular and frequent inspection of valves, cocks, gauges, lines and other parts of boilers, and of their attachments, shall be maintained during operation.

(2) Written records of the results of these inspections shall be kept on suitable forms provided by the occupier of the industrial establishment.

19. Dials and glass covers of steam or altitude gauges and of thermometers shall be kept clean and well lighted.

Firing of Boilers

20. Fires in boilers under operation should be maintained as uniformly as possible.

21. Should a flare-back occur, the fuel supply should be shut off, and the boiler setting shall be completely ventilated before firing is resumed.

22. When feeding coal-burning boilers by hand, boiler attendants should—

- (a) make sure that the damper in the boiler uptake is open before the furnace door is opened for the purpose of throwing fresh fuel on the fire or breaking open a bed of coals; and
- (b) open the furnace door while standing at one side, using the door as protection in case of a flare-back.

23. When hand-firing a heavy charge of green coal, a hot spot should be left in the coal bed, so that the volatile gases will be ignited and burn without creating flare-back hazards.

24. Slice bars shall not be left lying on boiler-room floors or between the boilers when not in use, but shall be placed in racks provided for that purpose and so constructed and located that workers cannot come into contact with the hot parts of the slice bars.

25. Where boilers are equipped with superheaters and are kept in continuous operation, the superheater tubes should be lanced not less than once during each shift.

26. When banking coal fires in boilers—

- (a) the ash-pit doors should be closed tightly;
- (b) the fire doors should be opened slightly to admit a limited quantity of air above the grates; and
- (c) the dampers in the boiler uptakes should be opened just enough for a draught to pass through and enter the stack.

27. Unless the fuel-feed installations on oil or gas-burning boilers are equipped with automatic valves or other devices which

will shut off automatically and completely all oil or gas in case a burner is extinguished—

- (a) the oil or gas burners should be watched sufficiently to ensure that the fuel supply being delivered is actually burning; and
- (b) if a burner snaps out or is accidentally extinguished—
 - (i) the oil or gas supply should be turned off at once; and
 - (ii) the furnace and all fuel passages should be thoroughly ventilated before relighting the fire.

28. When a burner of a pulverised-coal-burning boiler snaps out or is accidentally extinguished, the coal supply should be stopped as quickly as possible and the furnace should be thoroughly ventilated before relighting the fire.

29. When it is necessary to change the firing rate on boilers using oil, gas or pulverised coal—

- (a) the draught should be increased before moving up the fuel supply; and
- (b) the fuel supply should be decreased before lowering the draught.

30. Safety valves on boilers shall be kept free and in working order at all times and shall be tested not less than once in every 24 hours.

Water Level

31. In order to ensure that a proper water level is maintained in boilers during service, boiler attendants shall—

- (a) at the beginning of each shift and several times during the shift—
 - (i) check the water level in the water-gauge glasses with the gauge cocks; and
 - (ii) blow out the water columns and water-gauge glasses to determine that all connections are clear; and
- (b) read the water level at frequent intervals in the water-gauge glasses.

32. Water-gauge glasses on boilers shall be kept clean, but shall not be cleaned while in place, and shall be replaced with clear clean glasses when foreign substances in the tubes make it difficult to determine the water level.

33. After new water-gauge glasses have been installed on boilers to replace glasses that have been broken or removed for cleaning, they should be warmed by passing a little steam through them before water is admitted.

34. When the water in a boiler is not visible in the water-gauge glass and testing of the gauge cocks confirms that the water level is low, all stresses on the boiler shall be reduced without

sudden change, and no attempt shall be made to restore the former water level by increasing the supply of feed to the boiler or to reduce the pressure by opening the safety valve.

Reducing Boiler Pressure

35. In order to reduce boiler pressure safely in case of low water or other emergencies the following procedure should be observed:

- (a) the source of fuel supply should be stopped at once;
- (b) where waste gases are used as fuel, they should be by-passed to the stacks or chimneys;
- (c) all air supply to the boiler should be cut off;
- (d) where coal is used as fuel, dampers and furnace ash-pit doors shall be closed and the fire should be banked; and
- (e) where oil, gas or pulverised coal is used as fuel, dampers and air-control-register shutters should be closed and induced or forced-draught fans should be shut off.

36. After the boiler has cooled down so that little or no pressure shows, the feed valves should be closed gradually, the boiler should be cut out of service and thoroughly examined to determine the cause of the low water and ascertain whether any damage has been caused, and necessary adjustments or repairs shall be made.

Foaming and Priming of Water

37. (1) In the event of foaming or priming of water in boilers—

- (a) the stop valve of the boiler should be closed, the fire checked and the surface blow-off, if any, used; and
- (b) if there is sufficient water in the boiler, the bottom blow-off should be opened for a few moments several times, alternated with feeding in fresh water.

(2) Where all the measures adopted fail to stop foaming or priming, the boiler shall be taken out of service until the condition is corrected.

38. Where signs of oil are found in a boiler, the surface blow-off, if any, should be used and if that fails to correct the condition, the boiler should be closed down as soon as practicable and the interior boiled out with a caustic solution.

Economisers

39. Outlet valves on pipes leading from economisers to boilers should be open at all times, but when they are closed for any reason—

- (a) the flue damper should be closed;
- (b) the economiser should be drained; and

- (c) the bottom blow-off valve should be locked open while the economiser is out of service.

Blowing-down Boilers

40. Blow-off valves on boilers shall be opened completely at least once in every 24 hours, and preferably at least once in every shift.

41. In blowing-down boilers, the blow-off valve should—

- (a) first be opened slowly to about one-half position;
- (b) after approximately 25 mm (1 in.) of water has been blown down, be slowly opened wide to permit escape of scale and sediment; and
- (c) after approximately 10 cm (4 in.) of water has been blown down, be closed slowly and tightly.

42. Where blow-off pipes on boilers are fitted with both a blow-off valve and a quick-opening cock, the cock should be opened first and closed only after the valve has been shut off and securely seated.

43. Boiler attendants shall be prohibited from blowing-down more than one boiler at a time and from leaving the operation until the blow-off valve is closed.

44. When boilers are being blown down and the attendant is unable to see the water-gauge glass, an assistant shall be stationed to observe the water level and give the necessary signals to the attendant.

45. Boilers shall be inspected for leaks and other defects during each shift, and when leaks are discovered near longitudinal seams or drum-head flanges, or when tube failure occurs, the boiler shall be taken out of service at once and the pressure reduced in accordance with the requirements of paragraphs 35 and 36 of this Regulation.

Ash Removal

46. Where coal is used as fuel for boilers, ashes and clinkers shall be removed as necessary and not allowed to accumulate in ash-pits or be piled against boiler fronts.

47. When wetting down hot ashes, workers should stand away from the pile as a precaution against scalding, and shall avoid throwing water from hose on hot castings, pipes or fittings.

48. Where ashes are removed by suction systems, the explosion doors on the storage hoppers shall be kept free and in good condition at all times.

49. Where ashes are removed by steam-jet systems, the installations shall be of a type that, so far as practicable, will prevent the release of dust, and workers should be careful to avoid being scalded by hot water flowing from the gates during removal of the ashes.

50. In the event of blockage of ash sluices, where ashes are fed automatically to clinker grinders and removed by hydraulic systems—

- (a) two workers shall always be assigned to opening the blocked sluice, with one of them standing clear of the job and ready to assist the other in case of accident; and
- (b) a baffle shall be provided to avoid hot ashes dropping from the clinker grinder on the worker slicing out the stoppage.

Cutting Boilers out of Service

51. When boilers are being prepared for cleaning, inspection, repairs or laying up, the boiler pressure should be reduced in accordance with the requirements of paragraphs 35 and 36 of this Regulation, except that on coal-burning boilers—

- (a) doors and openings about furnaces and settings should be kept closed and the fires allowed to burn out completely on the grates;
- (b) fires shall never be hauled except to prevent damage to a boiler or in case of emergency;
- (c) fire doors shall never be opened for hauling fires until the safety valves have been lifted, the stop valves closed and the steam pressure considerably reduced, preferably below 3.5 kg/cm² (50 lb./sq. in.); and
- (d) feeding of fresh water should be continued until the fires are out.

52. When possible, boilers should not be drained until the brickwork and walls are thoroughly cooled; on large boilers eight hours after the steam pressure is down should ordinarily be allowed for cooling.

53. Where it is impracticable to empty boilers at atmospheric pressure, they should be blown down at as low a pressure as is consistent with operating conditions.

54. Boilers should be vented while they are being emptied and the vents left open after draining until the boiler is filled again or is laid up.

55. After boilers have been drained—

- (a) manhole and handhole plates should be removed;
- (b) the boilers should be flushed thoroughly with water from a hose carrying ample pressure so as to remove scale and loose sediment; and
- (c) any remaining water should be wiped up with mops or sponges.

Cleaning and Repairs

56. Repairs shall never be made on boilers or steam lines while they are under pressure, nor shall adjustments, such as

tightening up flanged fittings be made on steam lines while they are under pressure.

57. Before allowing workers to enter boilers for the purpose of cleaning or making repairs, all blow-off, feed-water, main steam-stop and other valves shall be closed, locked and marked with tags or devices indicating that there are workers inside.

58. Where the boiler to be cleaned or repaired is one of a battery of two or more boilers, and any of them are in service, the main steam valve shall be tightly closed and locked.

59. Where blow-off valves of several boilers are connected to the same header, the valves of any boilers in service shall be tightly closed, marked and locked, to prevent opening into the boiler which is to be cleaned or repaired.

60. No worker shall enter a boiler for the purpose of cleaning or making repairs, unless another worker is stationed outside the manhole or other access opening so as to render assistance if needed.

61. (1) Workers shall never be allowed to enter boiler settings or shells until these are sufficiently cool.

(2) Workers, when entering such settings or shells, should take precautions against being burned by flue dust or loose parts that might fall, and against injury from explosions caused by water being thrown on hot flue dust.

62. Before any person enters a boiler setting or shell the setting or shell shall be thoroughly ventilated by fans, blowers or other means, so as to expel any possible combustible or toxic gases or vapours, particularly where kerosene has been used as a scale solvent.

63. During cleaning or repairing of boilers, especially on humid days, ventilation should be provided by running forced-draught fans or induced-draught fans, if available, at very slow speed in order to eliminate the hazard of flue gases from other boilers entering the firebox in which work is being done.

64. All tools and extension lights used by workers in cleaning or repairing boilers shall be in good condition and suitable for the work.

65. The use of portable lights, the bulbs of which are not protected and the cables of which are not heavily insulated in accordance with the provisions of paragraphs 27 to 29 of Regulation 111, shall be forbidden.

66. Blow torches shall never be used inside boilers.

67. Where mechanical tools used in cleaning or repairing boilers are driven by steam or air, the power shall be generated outside the boilers, and all connections shall be inspected at frequent intervals.

68. When tubes or shells of boilers are cleaned by mechanical means, tools should not be operated on one spot for any considerable length of time as this may reduce the strength of the metal.

69. After cleaning operations on a boiler are completed—

- (a) one worker should be detailed to examine the interior to see that no tools or other equipment, especially rags and waste, are left in the boiler; and
- (b) the boiler shall not be closed until it is absolutely certain that all workers are outside and that all equipment has been removed.

Laying-up Boilers

70. After boilers which are to be laid up have been cleaned, repaired and inspected—

- (a) they should be thoroughly dried by means of light wood or paper fires or hot-air stoves, so as to prevent corrosion;
- (b) a quantity of quicklime, approximately 10 kg (20 lb.) per 100 h.p., in earthenware containers should be placed inside each boiler to ensure the absorption of moisture;
- (c) all connections to the boiler should be closed tightly; and
- (d) the manhole covers should be replaced.

71. Where boilers are laid up for a considerable time—

- (a) they should be opened at intervals of two or three months, and the quicklime renewed; or
- (b) all fire surfaces should be thoroughly cleaned with a steam jet, or with a wire brush, and given a protective coating of fish oil or other semi-drying oil so as to prevent external corrosion.

72. Idle boilers should not be left with water in them.

Personal Protective Equipment

73. When exposed to injury hazards which cannot be eliminated otherwise, workers in boiler rooms shall be provided with, and use, personal protective equipment conforming to the requirements of Chapter XIV of this Code.

Section 2. Unfired Pressure Vessels

REGULATION 126. DEFINITIONS

In this Section the following terms have the meanings hereby assigned to them:

- (a) the term "pressure vessel" means a vessel other than a boiler constructed to hold steam, hot water, gas or air under

- pressure, ordinarily obtained from an external source or from the indirect application of heat, excluding metal bottles or cylinders used for transport of gases under pressure;
- (b) the term "steam-heated pressure vessel" means an airtight vessel or an open pan or kettle, which is steam-jacketed, or equipped with steam coils or steam-supply piping and is used in such operations as cooking, distilling, drying, evaporating and hardening;
 - (c) the term "water-pressure tank" means a pressure vessel used for heating water by means of live steam or steam coils, or for the storage of cold water to be dispersed by means of pressure;
 - (d) the term "air-pressure tank" means a pressure vessel used as a primary or secondary tank in connection with ordinary compression cycles, and receiving their air supply direct from the compressors;
 - (e) the term "refrigeration tank" means a pressure vessel used in refrigeration systems, excluding the piping of such systems;
 - (f) the term "working pressure" means gauge pressure or pressure above the atmospheric pressure in kg/cm^2 (lb./sq. in.).

REGULATION 127. GENERAL PROVISIONS

Construction

1. Pressure vessels, their fittings and attachments shall be—
 - (a) so designed as to be suitable for the particular circumstances of their use; and
 - (b) of sufficient strength to sustain the internal pressures to which they will be subjected.
2. The materials used in the construction of pressure vessels should be such as to reduce to a minimum the risk of wastage due to corrosion, erosion or electrolysis in the particular circumstances of the intended use of the vessel.
3. In the design of pressure vessels allowance shall be made in the thickness of the plates for wastage due to corrosion, erosion or electrolysis.

Pressure Vessel Records

4. Every pressure vessel shall be accompanied by a certificate issued by the manufacturer showing the specifications to which the vessel has been constructed and the maximum permissible working pressure of the vessel.
5. Every pressure vessel, when constructed or sold, shall be accompanied by a certificate showing all the technical specifications used by the manufacturer and containing all the standards, designs and dimensions in accordance with the maker's number plate affixed on the vessel.

6. The certificate referred to in the foregoing paragraph shall also contain the results of all the control tests carried out during the manufacture of the material and the construction of the vessel.

7. The certificate referred to in paragraph 5 shall accompany the vessel during its whole life.

8. Every owner of a pressure vessel shall keep a vessel maintenance register in which shall be noted under the corresponding dates all tests, internal and external examinations, cleanings and repairs undertaken on the vessel. This register shall be submitted on request to the inspector of pressure vessels or other competent authority.

Installation

9. Pressure vessels shall be so installed that all parts can be readily inspected.

Access and Inspection Openings

10. (1) Except for those types of pressure vessels where such inspection openings are impracticable, pressure vessels shall be equipped with suitable manhole, handhole or other inspection openings for examination and cleaning of the vessel, unless the vessel is provided with a removable head or cover plate of sufficient size for this purpose.

(2) Vessels over 6 m (20 ft.) in length should have at least two manholes.

11. Manhole openings in heads or shells of pressure vessels shall be of sufficient size to allow easy access and egress and shall be in conformity with the minimum dimensions laid down by the competent authority.

Suggested minimum sizes are as follows:

- (a) 30 × 40 cm (12 × 16 in.) if elliptical; and
- (b) 40 cm (16 in.) in diameter, if circular.

12. Handhole openings in heads or shells of pressure vessels shall be of sufficient size to admit a hand and should not be less than 70 × 90 mm ($2\frac{3}{4}$ × $3\frac{1}{2}$ in.).

13. Threaded openings in pressure vessels, when intended to be used for inspection or cleaning purposes, shall be at least 40 mm ($1\frac{1}{2}$ in.) pipe size.

Safety Appliances

14. Pressure vessels shall be protected by such safety and relief valves or appliances and indicating and controlling devices as will ensure their safe operation, with the appliances so constructed, located and installed that they cannot readily be rendered inoperative.

Safety Valves

15. Safety valves on pressure vessels shall be designed with a substantial lifting device by which the valve disc may be lifted from its seat after the pressure of the vessel has reached 75 per cent. of the pressure at which the valve is set to blow.

16. For pressure vessels in which pressure is not generated but is derived from an outside source, safety valves shall be so connected to the vessels or systems which are to be protected as to prevent a rise in pressure beyond the maximum allowable working pressure in any vessels protected by the valves.

17. For pressure vessels in which pressure may be generated, the safety valves shall be connected—

- (a) directly to the vessels which are to be protected; or
- (b) if the contents of the vessels are likely to clog or cause interference with the operation of directly connected safety valves, to pipe lines leading to the vessels.

18. Safety valves having either the seat or the disc of cast iron shall not be used on pressure vessels.

19. The discharge capacity of safety valves on pressure vessels shall be sufficient for the size of the supply pipes and the pressures at which the vessels are operated.

20. Outlets of safety valves on pressure vessels shall be so located or piped that they will not be hazardous to persons.

21. When two or more safety valves are placed on one connection for a pressure vessel, such connection shall have a cross-sectional area at least equal to the combined areas of the safety valves.

22. When two or more safety valves are fitted on a pressure vessel, all except one of the valves should be set to blow at a pressure slightly above the maximum permissible working pressure.

23. Where safety valves on pressure vessels are exposed to temperatures of 0° C. (32° F.) or less, they shall be provided with drains of an adequate diameter at the lowest point where water can collect.

24. Safety valves on pressure vessels shall be tested not less than once a day, except where the pressure vessels contain flammable gases, in which case the safety valve shall only be tested as frequently as may be necessary to ensure the greatest possible degree of safety.

Rupture Discs

25. Safety rupture discs, where used, shall be of suitable metal which—

- (a) is uniform in thickness;
- (b) is capable of withstanding any chemical action to which it is subjected; and

(c) will undergo as small a change as possible in tensile strength due to changes of temperature.

26. Where safety rupture discs are used for additional protection of pressure vessels, they shall be designed to fail at a pressure above the safety valve setting.

Identification of Control Valves

27. Where a battery of pressure vessels is operated, control valves shall be plainly marked, by numbering or by the use of a distinctive colour system; and, unless the valve is located at the vessel, each vessel shall carry a mark corresponding to that on the valve.

Indicating and Recording Devices

28. Indicating and recording devices on pressure vessels shall be—

- (a) as safe as possible;
- (b) clearly legible;
- (c) so protected as to prevent workers being injured in the event of breakage; and
- (d) properly maintained.

Inspection

29. Pressure vessels shall be inspected, internally and externally, by qualified inspectors authorised by the competent authorities—

- (a) after installation before being placed in service;
- (b) after reconstruction or repairs before being replaced in service; and
- (c) periodically at intervals specified by the competent authority.

30. When at an inspection any deterioration of the pressure vessel is found that would increase the risk of explosion, the permissible safe working pressure shall be reduced sufficiently to permit safe operation of the pressure vessel; this reduction shall take into account the years of operation of the vessel.

31. The maker's certificate and the records of inspections shall be kept available for examination during the life of the vessel.

32. After due notice of a proposed inspection of a pressure vessel, the owner or user shall prepare the vessel at the appointed time by—

- (a) removing the covers from all inspection openings; and
- (b) thoroughly cleaning the vessel to facilitate examination.

33. Inspection of pressure vessels should include—

- (a) hammer tests or calibration of the shells and heads;
- (b) tests for gas leaks; and
- (c) hydrostatic tests when such are considered necessary by the inspector.

34. When pressure vessels are subjected to hydrostatic tests, the required test pressure shall not be more than 1.5 times the maximum permissible working pressure and shall conform to the requirements of the competent authority.

35. Pressure vessels which upon inspection are found unsafe for use, or not provided with the fittings necessary for safe operation, or with the fittings improperly arranged, shall not be operated until the vessels and their fittings are put into a condition to ensure safety of operation.

36. When pressure vessels are repaired, only materials similar to those used in the original construction shall be employed.

REGULATION 128. STEAM-HEATED PRESSURE VESSELS

1. Where steam-heated pressure vessels are operated at a pressure less than that of the main steam supply line, an effective reducing valve followed by a safety valve shall be installed in the line leading from the main line to the vessel, and shall be properly secured against manipulation by unauthorised persons.

2. Reducing and safety valves on steam lines for pressure vessels shall be tested at least once in every 24 hours.

3. Steam supply pipes for steam-heated pressure vessels should be placed in floor trenches, where practicable, or covered with insulating material.

4. Where steam-heated pressure vessels are equipped with mechanical agitators, the agitating devices shall be guarded in accordance with the requirements of paragraphs 5 and 6 of Regulation 92.

REGULATION 129. CLOSED STEAM-HEATED PRESSURE VESSELS

Interlocks

1. Where practicable, closed steam-heated pressure vessels equipped with bayonet-jointed covers should be provided with interlocks or other effective means for preventing—

- (a) the rise of pressure inside the vessel before the cover is in the fully locked position; and
- (b) the release of the cover from the locked position before the pressure inside the vessel has been reduced to atmospheric pressure.

Steam Agitation

2. Where the contents of closed vertical pressure vessels are stirred by means of live steam, the vessels should be provided with heavy coil springs or other suitable shock absorbers under their supports.

Revolving Closed Vessels

3. Pressure gauges and safety valves on revolving cylindrical or spherical steam-heated pressure vessels, such as revolving autoclaves, devulcanisers, rag or straw boilers and rotary driers, shall be located on the steam lines at the trunnions through which steam is admitted to the vessels.

4. Driving mechanisms of revolving steam-heated pressure vessels shall be—

- (a) provided with substantial locking devices; and
- (b) safeguarded in accordance with the requirements of Regulations 70 to 81, concerning mechanical power transmission equipment.

5. Before filling or emptying a revolving steam-heated pressure vessel, the driving mechanism shall be locked in the "Off" position and the stop valves shall be locked in the closed position.

6. Revolving steam-heated pressure vessels shall be enclosed or adequately guarded to prevent any person from coming into contact with them when they are in motion.

Autoclaves

7. Autoclaves shall be provided with casings that—

- (a) in the event of a leak will prevent the contents from being forced directly out into working spaces; and
- (b) extend down to the floor, so that no person can walk under the vessels.

8. Doors and their counterweights, if there are any, shall be guided or arranged in such a manner that there is no risk of their falling out if the connection with the counterweight should break.

9. Autoclaves containing liquids should be installed over pits or in casings of light sheet steel or other suitable material, tight at the bottom and capable of holding the charge or of being drained to a suitable receiver.

10. All electric equipment in rooms in which autoclaves containing flammable substances are installed shall—

- (a) be effectively grounded; and
- (b) be of an officially approved explosion-proof type.

11. Linings of autoclaves shall be examined frequently for leaks and shall be renewed before the shells are damaged.

12. The heating of oil for oil-jacketed autoclaves shall be performed at points remote from the vessels.

Digesters

13. Digesters used for the cooking of wood chips shall be equipped with piping and valves of corrosion-resisting material of adequate thickness, if the piping and valves are subject to the action of corrosive substances.

14. Blow-off valves on digesters shall be so arranged that they can be operated from locations outside the digester rooms or from protected points remote from the valves.

15. When putting into operation new digesters or those which have been temporarily idle—

- (a) special care shall be taken to avoid dangerous stresses; and
- (b) the heating up of the digester and the raising of the pressure should be carried out slowly.

16. During operation, every digester shall be connected to—

- (a) a suitable recording pressure gauge; and
- (b) a signalling device which will act when the maximum permissible working pressure is exceeded.

17. A suitable safety device, approved by the competent authority, shall be connected to each digester to relieve pressure above the maximum permissible working pressure.

18. Digesters should be examined periodically by competent personnel for damage to the lining or other defects.

19. When a digester is to be relined or when the competent authority so requires, it shall be subjected to a hydrostatic test or other approved tests, which should be made after the old lining is removed and before the new lining is placed.

20. Openings of digester blow pits shall not be larger than necessary and shall be suitably guarded with standard railings and toeboards.

21. Openings of digester blow pits should preferably be located on the sides of the pits instead of on the tops.

22. Ladders for access to digester blow pits shall be so constructed that the doors of the blow pits cannot be closed when the ladders are in place.

23. Effective systems of bells, whistles or other signalling devices shall be installed in digester and blow-pit rooms, to be operated as a warning before and while digesters are being blown.

24. Before opening digester blow-off valves for discharging the contents, the following procedure shall be observed—

- (a) precautions shall be taken to ensure that all workers are out of the blow pit;

- (b) the door of the blow pit shall be securely fastened; and
- (c) workers in the digester and blow-pit rooms shall be warned by signals that the blow-off valve is to be opened.

25. Blow-off valves on digesters should be opened slowly.

26. Head covers on digesters shall not be loosened while any pressure is indicated on the steam gauge.

27. Digester operators shall notify workers in the chip bins before starting to load digesters with chips.

28. Persons not directly concerned should not be permitted in digester buildings while digesters are being blown.

29. The use of digester rooms or digester buildings as passage-ways should be prohibited.

30. Digester and blow-pit rooms, and each floor of digester buildings, shall be provided with not less than two unobstructed means of egress.

31. Digester and blow-pit buildings shall be suitably ventilated to carry away gases liberated during the operations.

32. Suspended scaffolds used at digesters during maintenance or repair shall be supported by chains.

33. Personnel shall not be allowed to enter a digester when there is a danger of being overcome by heat or gases.

Distilling Apparatus

34. Stills shall be equipped with duplicate pressure gauges, safety valves, and recording thermometers or pyrometers.

35. Charging, vapour, and steam lines on stills shall be—

- (a) fitted with dual valves, with a drain between them; or
- (b) provided with arrangements for disconnecting and blanking the lines.

36. Convenient and safe access for quick manipulation of overhead valves on stills shall be provided by—

- (a) locating the valves near railed walks, runways or stairs; or
- (b) extending the valve spindles so that the valves can be closed or opened from the usual workplaces.

37. When horizontal-shell stills are mounted at varying heights to allow gravity flow, the manhole ladders should be of different lengths so as to fit the front manhole of each still at the proper angle.

38. Stills shall be inspected frequently, especially oil, tar or pitch stills; continuous stills should be examined thoroughly after each run and after they have been cleaned.

39. When preparing apparatus used in distilling flammable, corrosive or toxic fluids for cleaning or repairs, the following procedure should be observed:

- (a) the steam inlet valves should be locked in the closed position;
- (b) all charging fluid should be pumped out;
- (c) all inlet lines should be disconnected and blanked, or the inlet valves shall be locked in the closed position; and
- (d) the stills should be blown through with live steam, admitted through a top connection.

40. When stills are to be charged with cold liquid, they shall first be purged with an inert gas or vapour until all air has been expelled.

41. When stills are to be charged with hot liquid, they shall first be steamed progressively from the still through the tower and condensing equipment to a try cock located on the final product line.

Hardening Cylinders

42. Pits of hardening cylinders for sand-lime brick shall be guarded at the sides by standard railings and toeboards, and at the front by removable rails or chains carrying warning signs.

43. Door bolts on hardening cylinders for sand-lime brick should be of the hinged type, securely attached to lugs on the shell rings.

44. Safety valves on hardening cylinders for sand-lime brick shall be attached directly to the shells of the cylinders.

45. Hardening cylinders for sand-lime brick shall be provided with steam traps for removing water of condensation.

46. Brick-car tracks in hardening cylinders shall be level.

47. Loaded brick cars placed in hardening cylinders should be—

- (a) coupled together before the steam is turned on; and
- (b) removed through the exit doors by mechanical means.

48. Bolts on entry and exit doors of hardening cylinders for sand-lime brick shall not be loosened until all steam pressure in the cylinders has been completely relieved.

49. Before allowing workers to enter hardening cylinders for sand-lime brick, the steam-supply valves shall be locked in the closed position and the interior of the cylinders shall be cooled sufficiently to prevent workers from being burned or being overcome by heat.

Kiers

50. Where hot liquids, such as solutions of caustic soda, lime or sulphuric acid, are used in circulating kiers for "boiling out" textile materials, or in similar closed pressure vessels, the liquids—

- (a) shall be prepared in separate vessels or tanks; and

- (b) shall not be admitted to the pressure vessels until loading of the material to be processed has been completed.

Rag and Straw Boilers

51. Rag and straw boilers, used for light cooking operations in the preparation of paper stock, shall be equipped with—

- (a) trap devices between the safety valves and the boilers to protect the valves from being plugged by the contents of the boilers after they have been shut down; and
- (b) rupture discs or other effective devices on the shells to protect the boilers in the event of excessive pressures being generated within through chemical reaction.

Rendering Tanks

52. Where rendering tanks or similar stationary vertical closed pressure vessels are filled by material blown by steam from storage retorts—

- (a) suitable signal communication shall be established between the pressure vessels and the retorts; and
- (b) the retort operator shall not open the blow line valve until signals have been exchanged and both operators have signified that conditions are safe.

Stationary Melters and Driers

53. (1) Filling doors on tallow melters, fertiliser driers and similar stationary horizontal closed pressure vessels shall be provided with springs which will allow the doors to open automatically to relieve excessive pressure in the vessels.

(2) The doors so fitted shall be in such a position that the escaping steam cannot injure the workers in any normal working position.

Vulcanisers and Devulcanisers — General Provisions

54. Vulcaniser and devulcaniser door fastenings shall be of ample strength, properly spaced and carefully secured.

55. Vulcanisers and devulcanisers should be installed high enough above the floors to permit piping, valves and traps on the same floors as the vessels: Provided that this requirement shall not apply where it is necessary to install bottoms of horizontal vulcanisers below floor levels in order to place the car tracks in the vulcanisers on the same level as the floor tracks.

56. Periodic and thorough internal and external inspections shall be made of vulcanisers and devulcanisers, including all attachments and connecting equipment, at intervals not exceeding three months.

57. Before allowing workers to enter vulcanisers or devulcanisers for the purpose of freeing jammed or derailed vulcaniser cars or for any other necessary operations—

- (a) steam valves and other supply valves shall be locked in the closed position;
- (b) the blow-down valves on the individual vessel and on any other vessel using the same drain shall be locked in the closed position;
- (c) the vessels shall be cooled sufficiently to prevent workers from being burned or overcome by heat; and
- (d) the vessels shall be free of hazardous fumes or vapours.

58. Safety valves for vulcanisers and for open-steam type devulcanisers shall be attached directly to the shells of the vessels.

59. Vulcanisers and open-steam type devulcanisers equipped with bolted doors shall be provided with hinged-type door bolts, securely attached to lugs on the shell rings.

60. Before any attempt is made to open the doors on vulcanisers or open-steam type devulcanisers—

- (a) the steam supply valves shall be closed;
- (b) the blow-down and telltale valves shall be opened until the telltale valve indicates that all internal pressure has been relieved; and
- (c) the drain valves shall be opened, unless steam traps are used so that the drain valves are open at all times.

61. Vulcanisers and open-steam type devulcanisers shall be equipped with individual blow-down piping, and the use of common blow-downs shall be prohibited.

62. Horizontal vulcanisers and open-steam type devulcanisers shall be equipped with—

- (a) a drain valve at the bottom near the front of the vessel for draining condensed or cooling water from the vessels and to avoid scalding of workers when the doors are opened; and
- (b) an additional drain valve near the centre, when the vessel is more than 7.5 m (25 ft.) in length.

63. Vertical vulcanisers and devulcanisers shall be provided with suitable platforms, equipped with standard railings and toe-boards and so arranged as to make all working areas accessible.

Vulcanisers

64. Where quick-opening doors are used on vulcanisers, they shall be equipped with fastening and locking arrangements in full sight of the operators.

65. Quick-opening vulcaniser doors shall be equipped with automatic interlocks that will prevent the doors from being opened until all pressure has been relieved.

66. Power-operated vulcaniser doors running in vertical guides shall be equipped with automatic latches in the guides, so as to prevent the doors from falling in the event of failure of the hoisting mechanisms.

67. Vulcanisers shall be equipped with telltale valves, preferably located on the vulcaniser doors, for reducing the pressure inside the vulcanisers to atmospheric pressure before the doors can be opened.

68. Where bottoms of horizontal vulcanisers extend below the floor levels, the pits shall be guarded at the sides by standard railings and toeboards, and at the ends by removable rails or by chains carrying warning signs.

69. Where vulcaniser cars are used, car stops shall be provided in the rear part of the vulcanisers to prevent the cars from striking the heads when being rolled in.

70. Plates over spiders on top of hydraulic rams on vertical tyre vulcanisers shall be perforated and provided with centre holes large enough to prevent the accumulation of steam within the rams and the blowing out of moulds or plates upon removal of the covers.

71. Vertical tyre vulcanisers shall be provided with exhaust pipes for the water operating the hydraulic rams, with a capacity not less than that of the water inlet pipes, inserted through the cylinder wall at the limit of travel necessary for the ram.

Alkali Devulcanisers

72. Where safety valves on alkali devulcanisers may become clogged by the contents of the vessels—

- (a) the safety valves should be protected as far as possible against clogging; and
- (b) in cases where satisfactory operation of the safety valves cannot be ensured, rupture discs should be substituted.

73. Alkali devulcanisers should be provided with baffles directly on the inner shells at the entrances to the safety valves, steam gauges and blow-down lines.

74. Workers exposed to splashes from caustic liquids used in alkali devulcanisers shall be provided with, and shall use, suitable personal protective equipment, conforming to the requirements of Chapter XIV of this Code.

75. Discharge pipes and closed dump tanks for stationary alkali devulcanisers shall be designed to withstand devulcaniser pressures in the event of the lines being opened under high pressure.

76. Revolving spherical alkali devulcanisers shall be provided with—

- (a) individual motor drives, or effective means for locking the drives to prevent the possibility of accidental starting;

- (b) remote power controls, out of reach of persons standing in front of the manholes; and
- (c) automatic interlocking devices which will prevent starting the driving mechanisms until the manhole covers are closed and locked unless the operators keep their hands on the power controls.

REGULATION 130. OPEN STEAM-HEATED PRESSURE VESSELS

General Provisions

1. Where the top edges of large open steam-heated pressure vessels are less than 1.2 m (4 ft.) above the floor or working level, the vessels shall be surrounded by standard railings with solid enclosures from the railings to the floor, so that workers can watch the operations without the possibility of falling into the vessels or being burned by splashing materials.

2. Batteries of open kiers or similar open steam-heated pressure vessels shall be so arranged that—

- (a) the distance between the edges of the vessels is at least 45 cm (18 in.); and
- (b) there is an unobstructed space for passage around each vessel of at least 45 cm (18 in.).

3. (1) Ladders, stairs and gangways placed over open steam-heated pressure vessels containing hot liquor or hot water shall be securely fastened and shall be provided with standard railings and toeboards preferably fitted with fillers.

(2) Loose planks shall not be placed over open steam-heated pressure vessels containing hot liquor or hot water.

4. Sitting or standing on the edges of open steam-heated pressure vessels or on guards surrounding such vessels shall be prohibited.

5. Where open steam-heated pressure vessels give rise to excessive water vapour, adequate steps shall be taken to reduce the relative humidity of the atmosphere of the workroom.

Open Steam-Jacketed Kettles

6. Jackets of steam-jacketed kettles shall be thoroughly drained before the steam supply valves are opened.

7. Workers shall be instructed, when admitting steam to cold kettles, to open the steam supply valves slowly.

8. Wooden scrapers should be provided and used for removing semi-solid or sticky finished products from steam-jacketed pivoted kettles or kettles with side discharge doors.

9. Open steam-jacketed starch kettles, used in the textile industry, should be provided with covers so arranged that the

process can be observed, or with large overflow rings with ample drains.

10. Workers exposed to danger from the contents of open steam-jacketed kettles shall be provided with, and use, suitable protective clothing conforming to the requirements of Chapter XIV of this Code.

11. Before starting cleaning or making repairs inside open steam-jacketed kettles—

- (a) all agitating devices shall be locked or so blocked as to be inoperative;
- (b) all valves or drains connected to common headers shall be closed or locked; and
- (c) all piping for introducing steam or other dangerous substances shall be disconnected and blanked, or their inlet valves shall be locked in the closed position.

Open Evaporating Pans

12. Open evaporating pans for substances which are flammable when dry shall, as far as possible, be kept free of impurities and be so operated that the steam coils are always covered by liquids.

13. Steam coils in open evaporator pans should be watched closely for leaks, to prevent the vacuum created through the condensation of steam from drawing the material being processed into the coils where it might decompose, form explosive gases and cause explosions.

REGULATION 131. WATER AND AIR PRESSURE TANKS

General Provisions

1. The water supplied to water pressure tanks shall be as far as possible free from suspended solids and sedimentary matter.

Hot Water Pressure Tanks (Calorifiers)

2. Hot water pressure tanks should be designed to withstand full boiler pressure.

3. Every hot water pressure tank which is not designed to withstand full boiler pressure shall be equipped with—

- (a) a reducing valve, located between the steam stop valve and the tank; and
- (b) one or more relief or safety valves on the low pressure side of the reducing valve.

4. Every hot water pressure tank should be equipped with automatic temperature regulators set to prevent the generation of steam in the water space.

5. Pressure gauges for hot water pressure tanks shall be installed between the reducing valves and the relief or safety valves.

6. Steam or hot water piping for hot water pressure tanks shall be adequately insulated where it is exposed to contact.

7. Hot water tanks shall be examined as frequently as required by the competent authority; such examinations shall include hydrostatic tests when deemed necessary by the inspector.

Cold Water Pressure Tanks

8. Pressure gauges for cold water pressure tanks for sprinkler systems shall be provided with separate shut-off valves with arrangements for draining.

9. Discharge valves on cold water pressure tanks for sprinkler systems shall be locked or sealed in the open position and shall be inspected frequently to make sure that they are open.

10. Cold water pressure systems shall be provided with one or more pressure relief valves, adjusted to relieve at a pressure slightly in excess of the maximum air pressure for the system.

11. Cold water pressure systems shall be effectively protected against freezing.

Air Receivers

12. Air receivers shall be so installed as to be—

- (a) protected from the weather; and
- (b) accessible for external and internal inspection.

13. Air receivers shall be provided with suitable openings for inspection and cleaning.

14. Where two or more air receivers are served by the same compressor, the air supply piping for each tank shall be equipped with a stop valve, and with a safety valve between the stop valve and the compressor.

15. Safety valves for air receivers should be proportioned to the maximum quantity of free air that can be supplied.

16. Stop valves shall be installed between air receivers and each consuming appliance, at points convenient to the operators.

17. Pipe lines of compressed-air systems shall be—

- (a) securely fastened in place; and
- (b) so installed as not to interfere with the free contraction or expansion of the piping between fixings.

18. Air receivers shall be equipped at the lowest point possible with automatic drain traps or with valves which shall be opened daily, for relieving the vessels of dirt, moisture and oil accumulated in the bottoms.

19. Air receivers should be cleaned of oil, carbon and other foreign substances at intervals of not more than two months.

20. Compressed air shall not be handled or used by any person except in the performance of his duties and in no case shall a jet of compressed air be directed against any person, as the introduction of any compressed air into the body may be fatal.

21. No vessel shall be used as an air receiver unless it conforms to the requirements of paragraph 1 of Regulation 127.

22. Compressed air shall not be used to force any liquid or substance out of a container which is not constructed to withstand the pressure of the air supplied.

Acid Blow Cases (Acid Eggs)

23. Acid lines for acid blow cases shall be provided with check valves, to prevent acid being drawn into the air lines after the pressure has been taken off the lines.

24. Air lines for acid blow cases, unless designed to withstand the maximum pressure of the air supply, shall be equipped with—

- (a) pressure reducing valves between the main air lines and the vessels; and
- (b) pressure gauges and safety relief valves or rupture discs between the reducing valves and the vessels.

25. Air lines for pressure vessels shall be drained before the air is admitted for blowing acids or other chemicals which generate heat as a result of reaction with water.

26. Particular care shall be taken that water is not accidentally dumped or pumped into acid blow cases containing acid, in order to avoid possible rupture of the vessels from chemical reaction.

27. Where acid blow cases are located in pits, the pits shall be kept dry, so that possible leakage from the vessels will not combine with water and explode, attack the outside surfaces or fittings of the vessels, or form toxic vapours or fumes.

28. Acid blow cases shall be examined periodically, both externally and internally, and tested frequently.

29. Before acid blow cases are examined internally—

- (a) the vessels shall be completely drained, and thoroughly washed and ventilated;
- (b) acid and air inlet lines shall be blanked off or the inlet valves locked in the closed position; and
- (c) warning signs shall be prominently displayed to indicate that there are workers inside the vessels.

30. The measures provided in Chapters XII and XIV of this Code shall apply to workers in inspection, maintenance or repair of the interior of acid blow cases.

31. Only electric lamps of an officially approved explosion-proof type shall be used during the inspection and repair of acid blow cases.

32. Where acid blow cases are lead lined, adequate provision shall be made to protect workers against lead poisoning.

REGULATION 132. REFRIGERATION TANKS

Refrigerator Rooms

1. Factory rooms in which refrigeration tanks and other parts of refrigerating systems are permanently installed and operated shall—

- (a) be provided with tight-fitting doors;
- (b) have no partitions or openings that will permit the passage of the refrigerants to other parts of the buildings; and
- (c) be provided with mechanical means of ventilation.

Installation

2. Not more than two refrigeration tanks shall be located one above the other within the same floor area between floor and ceiling.

Open Flames

3. All electrical equipment shall be of an officially approved explosion-proof type, and no flame-producing devices or hot surfaces which may cause explosions shall be permitted in rooms in which refrigeration tanks are installed.

Materials

4. All materials used in the construction and installation of refrigeration tanks shall be capable of withstanding the chemical action of the refrigerants or the oils, or the combination of both.

Gauge Glasses

5. Liquid level gauge glasses for refrigeration tanks, except when of the bull's-eye type, shall be fitted with automatic-closing shut-off valves.

Stop Valves

6. Refrigeration tanks shall be equipped with stop valves at each inlet and each outlet pipe.

Pressure-Relief Devices

7. Refrigeration tanks which may be shut off by valves from all other parts of refrigerating systems shall be equipped with—

- (a) at least two pressure relief valves or one pressure relief valve in parallel with a rupture member, when the capacity of the tank exceeds 140 litres (5 cu. ft.) and its diameter exceeds 15 cm (6 in.); or
- (b) a pressure relief device or a fusible plug, when the capacity of the tank does not exceed 140 litres (5 cu. ft.).

8. Pressure relief devices for refrigeration tanks shall, where practicable, be connected directly to the vessels and shall be placed above the liquid refrigerant level.

9. Pressure relief valves and fusible plugs for refrigeration tanks shall be provided with discharge pipes leading directly and separately to the outside of the buildings, with the outside outlets so located as to prevent persons from being subjected to any irritating or toxic fumes or vapours.

10. Pressure relief valves and fusible plugs for refrigeration tanks containing ammonia or sulphur dioxide shall discharge into substantial tanks that are of the closed type or are provided with hinged covers, used for no purpose except absorption of the refrigerants.

Section 3. Compressors

REGULATION 133. INSTALLATION, OPERATION AND MAINTENANCE OF AIR COMPRESSORS

Installation

1. Air compressors shall be installed on firm foundations and securely fastened in place.

Machine Guarding

2. All moving parts of air compressors shall be safeguarded in accordance with the provisions of Regulations 64 to 69, relating to prime movers.

Pressure-Limiting Devices

3. Air compressors shall be equipped with—

- (a) automatic mechanisms which will stop the air-compressing operation before the discharge pressure exceeds the allowable maximum; and
- (b) by-passes.

Speed Governors

4. Unloaders on air compressors and governor controls on engines driving them shall be inspected frequently and regularly and shall be maintained in good working condition.

Lubrication

5. Air compressor cylinders shall be lubricated with oil of a suitable type, and with just sufficient oil to furnish satisfactory lubrication and avoid carry-over to intercoolers, aftercoolers, receivers and other parts of the system.

Cooling

6. Where air-compressor cylinders are equipped with water-cooling jackets, a visible indication of water flow shall be provided.

7. Intercoolers and aftercoolers shall be designed and constructed to withstand safely the maximum pressure in the air discharge piping.

Air Intake and Discharge Piping

8. Air intakes for air compressors shall be located at a place where the air is as pure and clean as possible and free from any flammable or toxic gases or fumes.

9. Air-discharge piping from air compressors shall, where necessary, be provided with—

- (a) a fusible plug; and
- (b) insulating covers to protect the workers against burns and to prevent fire.

10. An oil separator shall be installed at a convenient point between the compressor and the air receiver unless exemption is granted by the competent authority.

Valves

11. Where stop valves are installed in air-discharge piping from air compressors—

- (a) the valves shall be easily accessible for inspection and cleaning; and
- (b) one or more safety valves shall be installed between the compressor and the stop valve.

12. Steam or gas-supply lines to steam-driven or gas-driven air compressors shall be provided with a manually-operable throttle valve in a readily accessible location.

13. Compressor valves shall be inspected frequently and regularly, and leaky valves shall be repaired or replaced.

14. The open and closed positions of the valves referred to in paragraphs 11 and 12 of this Regulation shall be clearly marked.

Starting of Compressors

15. When starting an air compressor, the drain cocks on the compressor cylinders and on the pipe leading to the air receiver shall be open.

Cleaning of Compressors

16. Where air compressors are used regularly or frequently, safety valves and oil separators shall be cleaned at least once a week.

17. No cleaning agent, other than that specified by the maker of the compressor, shall be introduced into air-compressor cylinders or connected piping.

REGULATION 134. COMPRESSORS FOR EXPLOSIVE,
FLAMMABLE OR NOXIOUS GASES

Scope

1. In addition to complying with the provisions of Regulation 133, compressors for explosive, flammable or noxious gases shall comply with the provisions of the present Regulation.

Construction

2. The materials used in the construction of the compressor shall be capable of offering adequate resistance to the chemical actions of the gases to be compressed and of their impurities.

3. Every compressor, when constructed or sold, shall be accompanied by a certificate showing all the technical specifications used in the manufacture of the parts subject to pressure of the gases, in accordance with the maker's number plate affixed on the compressor.

4. The certificate referred to in paragraph 3 shall also contain the results of all the control tests carried out during the manufacture of the material and the construction of the compressor.

5. The certificate referred to in paragraph 3 shall accompany the compressor during its whole life.

Compressor Records

6. Every compressor owner shall keep a compressor maintenance register in which shall be noted under the corresponding dates all tests, internal and external examinations, cleanings and repairs undertaken on the compressor. This register shall be submitted on request to the official inspector or other competent authority.

Inspection and Testing

7. With a view to ensuring safe operation, compressors shall be inspected by qualified inspectors—

- (a) before being placed in service, after installation;
- (b) before being placed in service, after reconstruction or major repairs; and
- (c) periodically at intervals not exceeding twelve months.

8. No new compressor shall be delivered or placed in service without having undergone adequate tests by a qualified inspector.

9. The tests shall be repeated after every substantial alteration or major repair of the compressor.

10. The test pressure for each stage of compression should be 1.5 times the maximum permissible working pressure of the stage.

11. Compressors which upon inspection or testing are found unsafe for use, or are not provided with the fittings necessary for safe operation, or have the fittings improperly arranged, shall not be operated until the compressors and their fittings are put into a condition to ensure safety of operation.

Markings

12. Every compressor shall bear, either on the metal itself or on a tablet affixed by riveting or welding, the following identification marks:

- (a) name of manufacturer;
- (b) year of manufacture;
- (c) pressure of initial test;
- (d) maximum permissible working pressure; and
- (e) type of gas for which the compressor is designed.

Emergency Stops

13. Provisions shall be made to allow the compressor to be stopped from a safe place.

Safety Valves

14. Safety valves shall be so arranged that—

- (a) gas escaping from them cannot cause any explosion or injury to persons; and
- (b) their good working order can be verified without damage to the valve while the compressor is in operation.

15. If safety valves are inaudible when in action, the compressor installation shall be provided with an audible alarm and/or a visual alarm in cases where noisy surroundings render an audible alarm ineffective.

Automatic Controls

16. Compressors shall be fitted with automatic devices which will actuate visible and audible alarm signals and stop compressing operations when the gas pressure—

- (a) in the suction pipe, falls slightly below atmospheric; or
- (b) in the discharge pipe, exceeds the maximum permissible pressure.



[New text of paragraphs 2, 4, 5 and 7.]

2. Cylinders for compressed, liquefied and dissolved gases shall conform to any specifications established by the competent authority and, in particular, shall be of material of good quality, free from significant defects, and of adequate thickness.

4. The certificate referred to in paragraph 3 shall be obtainable, during the whole life of the cylinder, from the owner of the cylinder.

5. Every cylinder owner shall keep a cylinder maintenance register in which shall be noted, under the corresponding dates, all tests, internal and external examinations, cleanings and repairs undertaken on the cylinder.

Inspection and Testing

7. (1) Cylinders shall be inspected, and tested, by qualified inspectors accepted by the competent authority—

- (a) before being placed in service for the first time;
- (b) before being placed in service after repairs other than changing the neck-ring which carries the cap, re-tapping the neck or changing the foot-ring; and
- (c) periodically, at intervals to be determined by the competent authority with due regard to the nature of the gas for which the cylinders are used: provided that such intervals should not exceed two years in the case of cylinders for corrosive gases and five years in the case of cylinders for other gases.

(2) It shall be the duty of the owner to ensure that the inspections are made.

17. All filling pipes for charging gas cylinders shall be fitted with an automatic check valve which will prevent the gas from flowing back into the compressor.

Section 4. Gas Cylinders

REGULATION 135. CYLINDERS FOR COMPRESSED, LIQUEFIED AND DISSOLVED GASES

Construction

1. Cylinders for compressed, liquefied and dissolved gases, their fittings and attachments, shall be—

- (a) so designed as to be suitable for the particular circumstances of their use; and
- (b) of sufficient strength to sustain the internal pressures to which they will normally be subjected.

2. Cylinders for compressed, liquefied and dissolved gases shall be of material of good quality, free from injurious defects, and of adequate thickness and weight in conformity with the specifications established by the competent authority.

Cylinder Records

3. Every cylinder, when constructed or sold, shall be covered by a certificate showing compliance with the specifications referred to in paragraph 2 of this Regulation.

4. The certificate referred to in paragraph 3 shall be obtainable, during the whole life of the cylinder, from the owner or other person responsible for the maintenance of the cylinder.

5. Every cylinder owner or other person responsible for the maintenance of the cylinder shall keep a cylinder maintenance register in which shall be noted, under the corresponding dates, all tests, internal and external examinations, cleanings and repairs undertaken on the cylinder.

6. The register referred to in paragraph 5 shall be produced on every request of the inspector or other competent authority.

Inspection and Testing

7. (1) Cylinders shall be inspected, and tested, by qualified inspectors accepted by the competent authority—

- (a) before being placed in service for the first time;
- (b) before being placed in service after repairs; and
- (c) periodically, at intervals to be determined by the competent authority with due regard to the nature of the gas for which the cylinder is used: Provided that such intervals should not exceed two years in the case of cylinders for corrosive gases and five years in the case of cylinders for other gases.

(2) It shall be the duty of the owner or other person responsible for the maintenance of the cylinder to ensure that the inspections are made.

8. The tests that cylinders, other than acetylene cylinders, shall undergo in conformity with paragraph 7 shall comprise—

- (a) a hydraulic pressure test;
- (b) a test of the weight; and
- (c) a test of the cubic capacity.

9. The hydraulic test pressure shall exceed the maximum permissible working pressure by a substantial amount.

10. Cylinders which are shown by inspection or testing to be unsafe for use, or are not provided with the fittings necessary for safe operation, or have the fittings improperly arranged, shall not be placed in service until the cylinders and their fittings have been put into a condition such as to ensure safety of operation.

Fittings

11. Every cylinder—

- (a) should be provided with a device that prevents damage to the bottom of the cylinder; and
- (b) shall be provided with a protective cap or other equivalent protection for the valve.

12. The protective cap shall have a vent of such size as to prevent any gas pressure accumulating inside the cap.

13. For parts of valves and other fittings, only such materials shall be used as are not attacked by the contents of the cylinder.

14. Copper and alloys containing copper shall not be used for parts of fittings on cylinders for liquefied ammonia or ammonia dissolved under pressure, unless the use of certain alloys specially composed for that purpose has been permitted by the competent authority.

15. All fittings of cylinders for oxygen and other oxidising gases shall be kept free from oil or grease.

16. For all flammable gases the connection-screw thread shall be left-handed, and for all other gases shall be right-handed.

Markings

17. On every cylinder the following particulars shall be marked in a durable and easily visible manner:

- (a) owner's name;
- (b) registered number;
- (c) clear indication of the gas to be charged;
- (d) weight when empty;
- (e) date of tests undertaken; and
- (f) permissible maximum charging pressure.

[New text: paragraphs 8 and 11-18.]

8. The tests that cylinders, other than acetylene cylinders, shall undergo in conformity with paragraph 7 shall comprise—

- (a) a hydraulic pressure test; and
- (b) an internal and external inspection.

Fittings

11. All cylinders other than those which are specifically intended to be used and transported horizontally shall, unless the base has been specially constructed for that purpose, be provided with a device that prevents damage to the bottom of the cylinder.

12. Every cylinder shall be provided with a protective cap or other equivalent protection for the valve.

*13. The protective cap shall have a vent of such size as to prevent any gas pressure accumulating inside the cap.

*14. For parts of valves and other fittings, only such materials shall be used as are not attacked by the contents of the cylinder.

*15. Copper and alloys containing copper shall not be used for parts of fittings on cylinders for liquefied ammonia or ammonia dissolved under pressure, unless the use of certain alloys specially composed for that purpose has been permitted by the competent authority.

*16. All fittings of cylinders for oxygen and other oxidising gases shall be kept free from oil or grease.

*17. For all flammable gases the connection-screw thread shall be left-handed, and for all other gases it shall be right-handed.

Markings

18. On every cylinder the following particulars shall be marked in a durable and easily visible manner:

- (a) owner's name;
- (b) registered number;
- (c) clear indication of the gas to be charged;
- (d) date of tests undertaken; and
- (e) permissible maximum charging pressure.

[New text: paragraphs 19-28.]

*19. Every cylinder for liquefied gases shall be durably marked in an easily visible manner, in addition to the particulars mentioned in paragraph 18, with the permissible maximum weight of the charge of the gas for which the cylinder is designed.

*20. Every cylinder for compressed gases shall be durably marked in an easily visible manner, in addition to the particulars mentioned in paragraph 18, with the cubic capacity.

*21. Markings shall not be—

- (a) cut into the metal of the cylinder unless special reinforcement has been provided for that purpose; or
- (b) placed on the cap.

Colours

*22. Cylinders for compressed, liquefied and dissolved gases shall be clearly marked for the purpose of identification of their contents in a manner to be prescribed by the competent authority, for example, with different colours.

*23. Where colours are used for identifying the contents, colour markings for distinguishing cylinders for other purposes shall not be allowed.

Charging

*24. Cylinders for compressed gases shall not be charged above the maximum permissible charging pressure marked on the cylinder.

*25. Cylinders for liquefied gases shall not be so charged that the ratio between the cubic capacity of the cylinder and the weight of the charge is less than that approved by the competent authority for the gas in question.

26. Before being charged every cylinder shall—

- (a) be carefully examined at the charging station to ensure that it complies in all respects with the provisions of this Regulation; and
- (b) be completely emptied, except in the case of acetylene cylinders.

*27. Cylinders for liquefied gases with a critical temperature exceeding the usual surrounding temperature shall not be completely filled, in order to prevent the generation of dangerous pressure when used at temperatures exceeding this critical temperature.

*28. Cylinders for liquefied gases shall be weighed during charging, and for the ascertainment of any overcharge shall undergo control weighing.

18. Every cylinder for liquefied gases shall be durably marked in an easily visible manner, in addition to the particulars mentioned in paragraph 17, with the permissible maximum weight of the charge of the gas for which the cylinder is designed.

19. Every cylinder for compressed gases, shall be durably marked in an easily visible manner, in addition to the particulars mentioned in paragraph 17, with the cubic capacity.

20. Markings shall not be—

- (a) cut into the metal of the cylinder unless special reinforcement has been provided for that purpose; or
- (b) placed on the cap.

Colours

21. Cylinders for compressed, liquefied and dissolved gases shall be clearly marked for the purpose of identification of their contents, in a manner to be prescribed by the competent authority, for example, with different colours.

22. Where colours are used for identifying the contents, colour markings for distinguishing cylinders for other purposes shall not be allowed.

Charging

23. Cylinders for compressed gases shall not be charged above the maximum permissible charging pressure marked on the cylinder.

24. Cylinders for liquefied gases shall not be so charged that the ratio between the cubic capacity of the cylinder and the weight of the charge is less than that approved by the competent authority for the gas in question.

25. Before being charged every cylinder shall be—

- (a) carefully examined at the charging station to ensure that it complies in all respects with the provisions of this Regulation;
- (b) completely emptied before it is passed for charging; and
- (c) freed of all foreign bodies.

26. Cylinders, for liquefied gases with a critical temperature exceeding the usual surrounding temperature, shall not be completely filled in order to prevent the generation of dangerous pressure when used at temperatures exceeding this critical temperature.

27. Cylinders for liquefied gases shall be weighed during charging, and for the ascertainment of any overcharge shall undergo control weighing.

Handling and Storage

28. Cylinders shall be adequately protected against excessive variations of temperature, direct rays of the sun, accumulation of snow, and continuous dampness.

29. The storage of charged cylinders inside buildings of industrial establishments shall comply with the following requirements:

- (a) the number of cylinders shall be as small as possible;
- (b) cylinders shall be stored in rooms with fire-resisting walls and apart from flammable substances, radiators and other sources of heat; and
- (c) cylinders shall be suitably placed and secured against falling and rolling.

30. Storage rooms containing charged cylinders shall be marked on the outside with appropriate and clearly visible danger signs.

31. Cylinders shall be segregated for storage by type of gas, and empty cylinders shall be stored apart from charged cylinders.

32. (1) Cylinders used inside industrial establishments shall be handled with great care; special attention shall be paid to the prevention of knocking, dropping or rolling cylinders.

(2) Except when absolutely necessary, cylinders shall not be left near a source of heat.

33. Storerooms shall—

- (a) be provided with adequate ventilation facilities to the outside air; and
- (b) have an adequate number of exits having regard to the quantity and nature of the gases stored.

34. Smoking in cylinder storerooms shall be prohibited.

35. Cylinders, together with their valves and other fittings and the markings, shall always be maintained in good condition.

36. The decanting and emptying of cylinders charged with liquefied gases shall not be hastened by directly heating the cylinders with open fire or flame, but only by heating in a water jacket.

37. The valves of the cylinder shall be closed immediately after emptying.

Transport

38. Cylinders shall be so transported as not to project beyond the sides or ends of the vehicles in which they are transported.

39. Adequate precautions shall be taken to prevent cylinders from falling off the vehicle and from being subjected to rough usage, excessive shocks or local stress.

40. No cylinder shall be moved by a lifting magnet.

41. When cylinders are moved by a hoisting mechanism, a properly designed cradle with suitable slings shall be used.

[New text: paragraph 29.]

Handling and Storage

*29. Cylinders shall be adequately protected against excessive variations of temperature, direct rays of the sun, accumulation of snow and continuous dampness.

Paragraphs 29-40 become paragraphs 30-41.

[New text: paragraphs 42-47.]

*42. When cylinders are moved by a hoisting mechanism, a properly designed cradle with suitable slings shall be used.

Dissolved Acetylene Cylinders

*43. In addition to complying with the provisions of paragraphs 1 to 42 inclusive of this Regulation, cylinders for dissolved acetylene shall comply with the provisions of paragraphs 44 to 52 inclusive.

44. (1) The quantity of acetylene charged into a dissolved-acetylene cylinder shall be determined by the weight of acetylene as a function of the quantity of solvent present in the cylinder.

(2) The weight of the cylinder when empty and when charged with porous mass and solvent shall be verified.

(3) The maximum weight of acetylene as a function of the quantity of solvent contained in a cylinder shall conform to the specifications laid down or accepted by the competent authority.

(4) The competent authority may also determine the maximum pressure in the cylinder as shown by a pressure gauge when the mean temperature is taken as 15° C (60° F).

(5) When the solvent used is acetone the maximum charging pressure of dissolved-acetylene cylinders shall not exceed 15 kg/cm² (215 lb./sq. in.) at 15° C (60° F).

45. (1) New cylinders for dissolved acetylene shall be manufactured from materials which conform to specifications prescribed by the competent authority and shall be filled, under the responsibility of the manufacturer, with a porous mass of a type accepted by the competent authority.

(2) The cylinders shall be examined by a qualified inspector accepted by the competent authority.

46. Periodical examinations and tests of cylinders for dissolved acetylene shall include—

- (a) an external examination;
- (b) verification that the cylinder is filled as completely as possible with porous mass;
- (c) verification of the weight of the cylinder together with the porous mass and the solvent saturated with acetylene at atmospheric pressure; and
- (d) any pressure test which may be prescribed by the competent authority.

47. If any cavities are found in the porous mass in the course of the periodical verification required under paragraph 46 (b), the owner or the person responsible for the cylinder shall withdraw the cylinder from use and restore its condition.

[New text: paragraphs 48-50 and 52.]

48. The porous mass shall—
- (a) fill the cylinder as completely as possible;
 - (b) be so composed that it—
 - (i) does not separate out; and
 - (ii) retains its physical and chemical properties unchanged;
 - (c) not attack the cylinder;
 - (d) not form harmful compounds either with acetylene or with the solvent;
 - (e) not agglomerate to such an extent as to form dangerous cavities, even after long and rough usage; and
 - (f) impede to the maximum extent possible the spread through the contents of the cylinder of any explosive decomposition of the acetylene.

49. (1) Every establishment charging cylinders for dissolved acetylene with porous mass shall keep a record of every cylinder showing the number, the date of the test, the weight and water capacity of the empty shell, the weight of the porous material, the weight of the solvent (not saturated with acetylene), the weight of acetylene dissolved at atmospheric pressure, and the weight of acetylene dissolved above atmospheric pressure.

(2) Every establishment charging cylinders for dissolved acetylene shall keep a record showing the date and the results of every periodical examination, and also the measures taken as a result of the examination.

50. The information referred to in paragraph 49 shall be available for inspection by the competent authority.

*51. Copper and alloys containing more than 70 per cent. of copper shall not be used for parts of fittings that may come into contact with acetylene unless the use of alloys specially composed for that purpose has been permitted by the competent authority.

52. A newly charged cylinder shall not be delivered until at least 12 hours after completion of charging.



Acetylene Cylinders

42. In addition to complying with the provisions of paragraphs 1 to 41 inclusive of this Regulation, cylinders for dissolved acetylene shall comply with the provisions of paragraphs 43 to 52 inclusive.

43. The maximum charging pressure of dissolved acetylene shall not exceed 15 kg/cm² (225 lb./sq. in.).

44. New cylinders for dissolved acetylene shall be examined by a qualified inspector accepted by the competent authority to see that the cylinder has been properly charged with porous mass and acetone.

45. For the purpose of paragraph 43 the inspector shall verify the weight of the cylinder when empty and when charged with porous mass and acetone.

46. Periodical tests of cylinders for dissolved acetylene shall include—

- (a) an external examination;
- (b) verification that the cylinder is completely filled with porous mass;
- (c) verification of the weight of the cylinder together with the porous mass and acetone; and
- (d) a hydraulic test with acetone or inert gas at a pressure of 60 kg/cm² (850 lb./sq. in.) when it is not possible to discharge the porous material and to fill the cylinder with water.

47. Deficiencies in the weight of the porous mass and acetone shall be made good by the owner or the person responsible for the maintenance of the cylinder before the cylinder is again put into service.

48. The porous mass shall—

- (a) completely fill the cylinder;
- (b) be so composed that it—
 - (i) can be tested at all times without difficulty as to the presence of all components;
 - (ii) does not separate out; and
 - (iii) retains its physical and chemical properties unchanged;
- (c) not attack the cylinder;
- (d) not form harmful compounds either with acetylene or with the solvent;
- (e) not subside or form dangerous cavities, even after long and rough usage; and
- (f) effectively prevent the spread through the contents of the cylinder of any explosive decomposition of the acetylene.

49. Every firm charging a cylinder for dissolved acetylene shall keep a record of every cylinder charged showing—

- (a) the date of each charging of the cylinder;
- (b) the date of each addition of acetone or porous mass; and
- (c) the date and results of each examination.

50. The records referred to in paragraph 49 shall be available to inspection by the competent authority.

51. Copper and alloys containing more than 70 per cent. of copper shall not be used for parts of fittings that may come into contact with acetylene, unless the use of certain alloys specially composed for that purpose has been permitted by the competent authority.

52. Charged acetylene cylinders shall be kept in an upright position for at least twelve hours before the contents are used.

CHAPTER VIII

FURNACES, KILNS AND OVENS

REGULATION 136. DEFINITIONS

In this Code the following terms have the meanings hereby assigned to them:

- (a) the term "furnace" means a structure or chamber, principally built of a steel frame lined with refractory materials, for the purpose of melting ores or metals or subjecting them to the continuous action of intense heat;
- (b) the term "kiln" means a heated structure or chamber, ordinarily built of refractory materials or of steel lined with refractory materials, for the purpose of calcining or firing stone or clay products;
- (c) the term "oven" means a heated chamber built of brick, stonework or metal, for the purpose of baking bakery products, foundry cores and moulds, or enamelled, lacquered or painted surfaces of articles;
- (d) the term "blast furnace" means a tall, upright, cylindrical furnace, built of firebrick or stone and reinforced externally by steel shells, in which the reaction of the material is forced by a blast of air under pressure for the purpose of obtaining crude metal by the reduction of ore mixed with coke or other suitable fuel and with a flux, and includes accessories necessary for such operations;
- (e) the term "cupola" means a furnace consisting of a vertical steel cylinder lined with refractory materials, topped with a stack for carrying off the gases of combustion, in which reaction of the material is forced by a current of compressed air for the purpose of melting pig iron with coke and suitable fluxes for foundry castings or for use in steel-making furnaces;
- (f) the term "steel-making furnace" means a furnace used for refining pig iron or mixtures of pig iron and steel scrap, usually with additions to deoxidise, dephosphorise or desulphurise the metal, for the purpose of producing steel, and includes accessories necessary for such operations;
- (g) the term "open-hearth furnace" means a horizontal, stationary or tiltable steel-making furnace, built of a steel frame lined with refractory materials, in which a current of burning

gases from solid, liquid or gaseous fuel is passed over the top of the charge, and which is equipped with regenerators for the gases;

- (h) the term " Bessemer converter " means a steel-making furnace consisting of an upright cylindrical or egg-shaped steel shell lined with refractory materials, equipped with a removable bottom, and supported at opposite sides of the body with trunnions resting in framework to permit tilting forwards or backwards for charging or for pouring, in which a blast of compressed air is forced through the molten pig-iron charge for burning out carbon and impurities;
- (i) the term " crucible furnace " means a furnace built of refractory materials, provided in the top with melting holes for insertion of crucibles;
- (j) the term " electric arc furnace " means a fixed or tiltable steel-making furnace, ordinarily consisting of a cylindrical or elliptical steel shell lined with refractory materials and provided in the top with openings for insertion of two or more electrodes, which are automatically raised or lowered to maintain proper arcing distance from the charge for melting and refining by heat energy from the arcs;
- (k) the term " heating furnace " means a reverberatory, regenerative, recuperative or other type of furnace, used for the purpose of—
 - (i) reheating steel ingots, billets, blooms, slabs, sheet bars, or forging rounds uniformly and gradually to predetermined temperatures suitable for mechanical shaping into rolled or forged steel products; or
 - (ii) heating rolled or forged steel products to predetermined temperatures suitable for annealing, hardening, tempering or other heat-treating processes;
- (l) the term " brick and pottery kiln " means an upright, cylindrical, up-draught or down-draught kiln with cone-shaped or dome-shaped top, or a tunnel-like kiln with horizontal draught, either type provided at the bottom with a fire box, for the purpose of firing brick, sewer pipe, terra cotta, tile or pottery products;
- (m) the term " rotary cement, lime, plaster, dolomite or agglomerating kiln " means a rotary steel cylinder slightly inclined to the horizontal, lined with refractory materials, supported on tyres revolving on friction rollers and used in the manufacture of cement, lime, plaster, dolomite and agglomerate;
- (n) the term " drying kiln " means a closed structure provided with doors and used for drying and seasoning cut lumber and other wood products;
- (o) the term " bakery oven " means an oven used for baking breadstuffs and similar food products;

- (p) the term "core oven and mould drying oven" means an oven used in foundries for baking sand cores or sand moulds;
- (q) the term "enamel, lacquer or paint baking oven" means an oven used for baking freshly enamelled, lacquered or painted articles.

REGULATION 137. GENERAL PROVISIONS

Enclosed Spaces

1. In the vicinity of blast furnaces or gas piping, enclosed spaces shall be so constructed that gas cannot accumulate in them. No heating apparatus fuelled with blast-furnace gas shall be used in these places.

Floors

2. Floors around furnaces, kilns or ovens should be of incombustible material and kept free of obstructions, and cleaned as often as may be necessary to provide and maintain safe working conditions.

3. Floors in or around furnaces, kilns or ovens and immediately adjoining tracks over which workers pass shall be firm and, wherever possible, flush with the tops of the rails.

4. Where steel floor plates are used around furnaces, kilns or ovens, the plates shall be chequered and shall be sufficiently heavy not to be easily displaced.

5. Pits or other openings in furnace, kiln or oven floors, when not in use, shall be protected either by covers or by standard guard rail and toeboards.

Tracks

6. Tracks and their accessories used for the transportation of cinder and iron ladles shall be carefully maintained to prevent jolting and derailing.

Doors and Counterweights

7. Where vertically lifting doors to furnaces, kilns or ovens are counterweighted—

- (a) counterweight cables shall be of adequate strength and of material resistant to high temperature;
- (b) counterweights and cables shall be enclosed over the whole height of travel;
- (c) overhead counterweights shall be so guarded as to prevent them from falling on anyone in case the cable should break; and
- (d) lifting doors should be so constructed that they will not fall if the power fails or if the lifting gear breaks.

Platforms and Walkways

8. (1) Furnaces, kilns and ovens shall be provided with—

- (a) suitable platforms or walkways at all elevated points where workers must go daily or frequently to perform their duties; and
- (b) convenient and safe access to the platforms by means of permanent stairways or ladders of substantial fire-resisting construction, or by means of elevators.

(2) The apertures in platforms or walkways made of open mesh construction shall be sufficiently small to prevent heavy objects falling through on to persons below.

9. Platforms, walkways and stairways on furnaces, kilns and ovens shall, wherever possible, be provided on all open sides with standard railings and toeboards or should preferably be panelled up to the intermediate rails.

Entry into Furnaces — Temperature Limit

10. Persons shall be prohibited from entering furnaces, kilns and ovens when the temperature exceeds 50° C. (122° F.), except in cases of emergency, for which special precautions shall be taken.

Fumes, Gases and Smoke

11. Where fumes, gases or smoke are emitted from furnaces, kilns and ovens in such quantities as to be injurious to the health or eyes of the workers or obnoxious to them, exhaust hoods and ducts or other effective means for removal should be provided.

Radiant Energy

12. Workers, visitors or other persons shall not be permitted to look into lighted furnaces and kilns, unless protected by goggles or shields which will absorb any harmful radiations.

Personal Protective Equipment

13. Workers on furnaces, kilns and ovens shall be provided with, and use, suitable protective clothing and equipment conforming to the requirements of Chapter XIV of this Code.

Fuel Control

14. (1) Gas-supply pipes for gas-fired furnaces, kilns and ovens shall be tight and fitted with—

- (a) explosion doors; and
- (b) safety cut-off valves allowing the immediate cut-off of fuel in case of failure of the gas or air supply or any failure of the main gas supply or of the air blast.

(2) If possible, these valves should operate automatically.

15. Oil-supply piping for oil-fired furnaces, kilns and ovens should be provided with automatic devices which shut off the oil feed when the pressure drops too low to maintain the flame at the burners.

16. The presence of automatic safety cut-off valves in the fuel-supply lines shall not absolve the operators from keeping constant watch on the fuel supply.

17. All furnace installations should be controlled from a central point, so located as to allow operation from a distance in order to avoid exposing the workers to danger.

Preparing for Service

18. Before any furnace, kiln or oven is lighted—

- (a) it shall be carefully examined so as to make sure that the plant and its fittings and appliances are in proper working condition in order to ensure the safety of workers; and
- (b) more especially, examination shall be made of—
 - (i) the setting, all pipes, air-supply equipment and stacks;
 - (ii) devices, pipes and fittings for the fuel supply; and
 - (iii) the control centre and its equipment.

19. (1) Where small furnaces, kilns or ovens are lighted by hand torches, the torches shall be fitted with shields and be of sufficient length to protect the user from burns.

(2) When applying the torch to the burners and opening the fuel supply valve, the air supply shall be turned on sufficiently to produce a slight draught, and kept in operation until all danger of losing the ignition has passed.

20. No person should stand or pass in front of the doors during the lighting operations.

21. In the event of oil, gas or coal burners on furnaces, kilns or ovens being accidentally extinguished, or of the fuel supply being accidentally cut off, the fuel-supply valves shall be closed and the combustion chambers thoroughly ventilated before the burners are relighted.

Electric Furnaces and Ovens

22. Electric furnaces and ovens and their appliances, devices, fittings and circuits shall be constructed, installed and maintained in accordance with the requirements of Chapter V relating to electrical equipment.

REGULATION 138. BLAST FURNACES

Platforms and Walkways

1. Unauthorised persons should be prevented from entering upon stairways or ladders leading to overhead platforms or walk-

ways on blast furnaces, hot-blast stoves, blowing engines, pig-casting equipment, dust catchers and gas washers, and the existence of danger should be indicated by means of signs.

2. Where platforms, walkways or stairways of blast furnaces or their auxiliary equipment are exposed to inclement weather conditions, roofed protection should be provided.

3. Platforms on top of hot-blast stoves serving the same group of blast furnaces should be connected by walkways.

4. Floors of walkways above bustle pipes (horseshoe mains) on blast furnaces and around bosh and furnace shells should be of grating, so that workers overcome by gas can be seen from below.

5. Where casting spouts project a considerable distance outside blast furnace casting floors, railed platforms should be provided.

6. Footwalks on blast furnace skip inclines should be provided with two or more shelter stations for the protection of workers in the event of a slip inside the furnace.

Controls

7. (1) Operating levers, switches and valves for controlling operations on blast furnaces, hot-blast stoves, blowing engines, pig-casting equipment, dust catchers and flue-gas washers—

(a) shall be provided with locking devices; but

(b) shall only be locked when the plant controlled is to be taken out of service, repaired or inspected.

(2) Where possible, controls should be centralised.

Skipways

8. Skipways on blast furnaces shall be enclosed with sheeting under the entire bottom for the protection of workers from falling material, and covered at the sides to a height of not less than 3 m (10 ft.) from the ground or working level so as to prevent workers from placing their hands on the skip rails.

9. Skip pits on blast furnaces shall be provided with ample clearance for workers on all sides of skip cars.

10. Where skip pits on blast furnaces cannot be entered at bottom levels, railed stairways or other safe means of access shall be provided.

11. Wherever practicable, track hoppers and bins for blast-furnace skipways shall be covered with gratings.

Cast Houses

12. Blast-furnace cast-house floors shall be provided with at least two exits of sufficient width which shall always be kept free from obstructions.

13. Where blast-furnace cast-house floors are elevated, suitable removable standard railings shall be installed.

14. When not in use, casting holes in blast-furnace cast-house floors for loading of transfer ladles shall be covered with heavy gratings.

15. Troughs, runners, gates and casting spouts on blast-furnace cast-house floors shall be kept warm and free of moisture.

16. Permanent gates for cinder or iron runners on blast-furnace cast-house floors should be operated by cables or other means of remote control.

17. An ample number of crossings, preferably consisting of iron plates, shall be provided over cinder and iron runners on blast-furnace cast-house floors.

Cinder Notches and Iron Notches

18. Cinder notches and iron notches (tapping holes) on blast furnaces should be provided with hinged or adjustable shields for the protection of workers against splashes.

19. When monkeys have been removed from cinder notches on blast furnaces, and the notches have been plugged with clay, the clay plugs shall be covered with metal plates.

20. Mechanically operated "botts" (stoppers) should be provided for plugging cinder notches on blast furnaces, so as to avoid exposure of operators to gas flames and flying drops of slag.

21. In tapping blast furnaces, iron notches should be opened by means of electric or pneumatic rotary drills of an approved type, inserted through openings in the tapping shields, and supplemented by oxygen lances for cutting out the solidified iron inside the clay stoppers.

Mud Guns

22. Mud guns for blast furnaces should be operated by remote control from a safe place, and should be provided with a mechanical clamp or other effective device to hold them in position when in use.

23. Mud guns operated by steam or compressed air shall be equipped with funnel-shaped guards, not less than 15 cm (6 in.) in height, round the receiving holes of the mud cylinders.

24. On steam-operated mud guns the steam-exhaust pipes shall be turned away from the operating sides or provided with mufflers.

Cinder or Iron Ladles

25. Cinder and iron ladle cars shall be provided with—

- (a) appropriate couplers conforming to local conditions and, where possible, of an automatic type; and
- (b) fenders or wheel guards.

26. Between the locomotive and the cars carrying molten material, an empty car should be inserted so as to protect the driver against splashes of molten material.

27. Cinder and iron ladles shall be inspected before filling, in order to make sure that they are absolutely free from moisture or moist material (bricks, scrap iron or shot) likely to cause explosion.

28. Cinder and iron ladles should not be filled so as to spill over, and in any case at least 25 cm (10 in.) of free board should be left.

29. Workers should keep as far away as possible from cinder and iron ladles while the ladles are being filled and transported.

Metal-Casting Equipment

30. Pig-casting machines shall be provided with—

- (a) shields or shelter houses at the pouring ends; and
- (b) shields at the discharge ends.

31. Where the return side of a pig-casting machine passes over a passageway or workplace, it shall be provided with appropriate guards under the bottom.

Tuyères

32. Observation glasses on blast-furnace tuyère stocks should be of the double-glass type, with air space between the glasses.

33. Bustle pipes (horseshoe mains) and other horizontal pipes for blast-furnace gas shall be provided with adequate manholes and cleaning holes with bolted covers.

Explosion Doors

34. Explosion doors for the relief of pressure, so constructed as to prevent ejection of heavy material from the furnace during slips or explosions, shall be provided on the bleeder pipes, oftakes or tops of blast furnaces.

Hot-Blast Stoves

35. Doors on blast-furnace stoves shall not be opened until it has been made certain that all pressure is off, and workers shall be prohibited from loosening or tightening nuts on blow-off doors or gas valves while the stoves are on blast.

36. Gas burners on blast-furnace stoves shall be so constructed that they can be locked and tightly blanked off when the stoves are to be entered for any purpose.

37. Blow-off valves on blast-furnace stoves should be turned into the chimney.

Cold- and Hot-Blast Mains

38. Cold-air mixing pipes between the cold-blast mains from blowing engines for blast furnaces and hot-blast mains from stoves should be equipped with automatic check valves, so as to prevent gas in hot-blast mains from being drawn into the engines.

Blowing Engines

39. Blowing engines for blast furnaces shall be installed, operated and maintained in accordance with the requirements of Regulation 133, relating to air compressors.

40. Air intakes of blowing engines shall be—

- (a) located outside blower rooms or buildings;
- (b) protected by filters; and
- (c) so arranged that no air containing flammable or toxic gases, vapours or dusts, and no steam, water or waste of any sort can be drawn into the engines.

41. Blowing engines shall be provided with devices to warn the operators when the engines are overheated.

42. Valves on blowing engines shall be frequently inspected and tested for tightness, and leaky valves shall be repaired or replaced.

Dust Catchers

43. Dust catchers for blast-furnace gas shall be provided with connections sufficiently large to permit rapid purging.

44. Operating devices of dust catchers for blast-furnace gas shall be so located that workers will not be exposed to being burned while dumping the catchers.

45. Where flue dust from blast-furnace gas is discharged into bins or railroad cars, the down legs of the dust catchers shall be so constructed that a minimum of dust is scattered.

46. Conditioning machines, when used, should form a part of the dust-catcher outlets.

Gas Washers

47. Gas washers shall be provided with weather protection but should not be enclosed to such an extent that gas can accumulate in the building.

48. Gas washers shall be provided with effective means for discharging the waste water without clogging.

49. Gas-inlet connections on gas washers shall be so designed as to minimise the accumulations of flue dust forming at the inlets, and shall be provided with facilities for safely and conveniently removing such accumulations.

50. Gas-cleaning and washing plants for blast furnaces shall be provided with—

- (a) one or more valves by which the gas can be shut off from each side; and
- (b) arrangements enabling any furnace to be completely shut off from the main gas leads.

51. Manometers on gas washers shall be, as far as possible, so fitted as to prevent accidental breakage and other dangers.

Communication and Signal Systems

52. Blast furnaces shall be provided with telephones, speaking tubes or other signalling systems, for communication between the furnace keepers, the skip operators, the stove tenders and the blowing-engine operators with connections to the furnace tops for use of signal men or workers engaged in constructing, repairing or inspecting the tops of the furnaces.

53. Communication and signalling systems for blast furnaces should be supplemented by gongs, whistles or other effective alarm systems at the various stations, preferably with switches located in the cast houses and with lights at the operating switches to indicate when the circuit is closed.

54. Blowing-engine rooms serving several blast furnaces shall be provided with individual signal lights which will indicate which furnace is signalling.

Slacking of Blast

55. During operation of blast furnaces, slacking of the blast shall be done only by the furnace foreman or other authorised person, or under their personal direction, and only after a warning by audible signals.

56. When breakdowns of blowing engines for blast furnaces necessitate lowering of blast pressure, workers at the furnaces shall be immediately warned by audible signals.

57. Furnaces should be kept free of slag in order to prevent slag from coming into the tuyères in the event of the blast pressure dropping.

Blowing-out

58. When a blast furnace is to be shut down for taking out of use, for repairs or for relining—

- (a) all necessary safety measures shall be taken to protect the workers; and
- (b) more especially—
 - (i) the greatest care shall be taken to avoid the occurrence of a mixture of gas and air in the furnace or in the mains;
 - (ii) where appropriate, only one bleeder on the furnace top should be opened to avoid setting up a circuit which might draw in air;

- (iii) the whole furnace system shall be purged for at least 24 hours before raking out is started; and
- (iv) as soon as the tuyères can be removed, the tuyère holes shall be plugged to minimise the hazard from falling material inside the furnace.

New and Relined Furnaces

59. Before new blast furnaces or blast furnaces with new linings are placed in service, the furnaces shall be carefully and thoroughly dried, preferably by heat generated by fuel burned outside the furnace in a temporary oven.

Blowing-in

60. Where a blast furnace is one of a series connected by a common gas main, it shall be isolated from the main by its valves until it is filled and ready to light.

61. When blowing in a blast furnace—

- (a) the greatest possible care shall be taken to avoid the formation of an explosive mixture within the furnace, the dust catchers and the mains;
- (b) the furnace shall be effectively isolated from the mains until there is no longer any danger of air being drawn into the system and until gas shows at the furnace top;
- (c) the mains and dust catchers shall be thoroughly purged until gas is introduced into them; and
- (d) during this period, only authorised persons shall be allowed near the furnace.

62. Gas burners on hot-blast stoves shall be kept closed until all air has been expelled from the pipes and flues.

Cleaning and Repairing

63. Before making any repairs on blast furnaces, to explosion doors, bell rods, or hangers, or doing any work between the big bell and the gas seal, the worker operating the bells shall be notified.

64. In the case of work between the big bell and the gas seal, workers shall wear safety belts and be provided with respirators of a type approved by the competent authority.

65. Hot metal ladles for blast furnaces shall be kept cleaned in order to prevent leakage of hot metal through the linings of the shells.

66. Before entering blast-furnace stoves for any purpose, cold-blast, hot-blast, and gas-supply pipes shall be disconnected; if this is not possible, blanks shall be inserted.

67. Workers cleaning checkerwork in blast furnace stoves should stand under the arches, for protection from falling brick and flue dust.

68. Before starting repairs or other necessary work on reciprocating blowing engines of blast furnaces—

- (a) if the engine is steam or gas driven, the cylinder drain cocks shall be opened and the steam or gas throttle valve locked in the closed position and marked with warning tags or devices; and
- (b) if the engine is motor driven, the line switch supplying the motor shall be locked in the open position and marked with warning tags or devices.

69. When it is necessary for workers to enter air or steam cylinders of blowing engines of blast furnaces—

- (a) one flywheel shall be blocked on front and back;
- (b) the crosshead shall be blocked on top and bottom; and
- (c) the piston shall be blocked.

70. Cleaning and repairing of blast-furnace gas washers and dryers while the furnace is in operation shall be done only after all the valves have been closed.

REGULATION 139. CUPOLAS

Floors

1. Floors beneath and immediately surrounding cupolas shall slope and drain away from the bases, be kept free from pools of water, and be only damp enough to hold down the dust, in order to prevent explosion hazards when dropping the cupola bottoms.

Charging Equipment

2. Cupolas should be equipped with mechanical devices for charging.

3. Cupola-charging elevators or hoists shall be constructed and operated in accordance with the requirements of Regulation 15 relating to elevators and built-in hoists.

4. Charging doors or gates on cupolas shall be kept closed except during actual charging operations.

Botting-up

5. When "botting-up" tapping holes on cupolas, the bot should not be thrust directly into the stream of molten metal, but should be brought up immediately over it close to the hole and applied at a sharp angle, so as to minimise spattering of the metal.

Slag Spouts

6. Slag spouts on cupolas shall be provided with suitable shields for protection against spattering of slag.

Dropping of Bottoms

7. During the dropping of bottoms of cupolas, workers or other persons shall remain at a sufficient distance from the cupolas.

8. Props for bottom doors of cupolas shall be pulled out by means of mechanical appliances of a safe type.

9. Coke, slag and unmelted metal falling from cupolas when the bottoms are dropped should be removed with mechanical rakes after the fire has been extinguished.

Air Pipes

10. Air-supply pipes for cupolas shall be provided close to the cupolas with blast gates or dampers, which shall be closed immediately whenever the blast fails or is shut off, so as to prevent gas from getting into the wind boxes and blast pipes.

Repairs

11. Workers entering cupolas for chipping out linings, relining or other repairs, shall be protected against falling objects, and charging doors, if any, shall be locked.

12. When cupolas are shut down for relining, the condition of the shells and riveting shall be closely inspected, and all defects shall be remedied.

13. An inspection of the interior of cupolas shall be carried out periodically.

14. In relining of cupolas, a sufficient clearance shall be left between the lining and the shell to allow for expansion, and the space shall be filled with dry sand to serve as a cushion for protection of the shell.

15. Before starting relined or repaired cupolas, steps shall be taken to ensure that—

- (a) the lining is thoroughly dry; and
- (b) repair guards, tools and other equipment have been removed.

REGULATION 140. STEEL-MAKING FURNACES

Pouring Platforms

1. Pouring platforms of steel-making furnaces, and other places where workers may be endangered by molten metal, shall be provided with at least two separate and safe exits.

Teeming Ladles

2. Crane, truck and trolley teeming ladles shall be equipped with locking devices to prevent accidental tilting.

3. Tilting-type teeming ladles of 1,000 kg (2,200 lb.) capacity or more if equipped with mechanically or electrically operated

worm-gear tilting mechanisms, shall be so designed that at least two teeth of each gear are in mesh at all times.

4. Machinery guards on gears and motors of tilting mechanisms on teeming ladles shall be so constructed that they will adequately protect the mechanisms against metal splashes.

5. Teeming ladles shall be inspected before being put into use after relining and during each period in which they are allowed to cool down.

6. Teeming ladles shall be kept in dry places when not in use, and when newly lined shall be thoroughly dried and baked before being placed in service.

7. Stoppers on teeming ladles should not be used more than once.

8. When stoppers or refractory outlet nozzles are being replaced on teeming ladles, they shall be carefully fitted.

Hot-Metal Mixers

9. Hot-metal mixers shall be so designed that they will automatically return to their horizontal position if the tilting mechanism fails.

10. Audible and visible warning signals shall be given before transfer ladles are emptied into hot-metal mixers, and when the mixers are about to be poured.

Ingot Pouring and Handling

11. Ingot-mould cars should have low centres of gravity.

12. Bodies of ingot-mould cars shall be constructed with aprons which will protect the tracks and the running gear of the cars from hot-metal splashes during teeming.

13. Ingots shall be sufficiently cooled before stripping.

Hot-Metal Cranes

14. (1) Subject to the requirements of paragraphs 15 to 17 of this Regulation, safety requirements for the construction and operation of cranes used for transporting ladles of molten metal to and from steel-making furnaces and mixers shall conform to the requirements of Regulation 155 concerning travelling cranes.

(2) In addition, suspension gear of the crane, which may be subjected to excessive heat, shall be specially designed for safe working under the particular circumstances.

15. Protection shall be afforded operators of hot-metal cranes by means of—

- (a) a crane cage lined with heat-resisting material and provided with an emergency exit through the roof; or
- (b) a railed gallery extending along the whole length of the crane runway, and of easy access.

16. The best possible safety measures shall be taken to protect hot-metal crane operators against gases, fumes, toxic vapours, radiant heat and other noxious emanations.

17. Hot-metal cranes shall be equipped with two brakes, each being capable of holding the full load.

18. Before transporting by crane a ladle containing molten metal, the hoist brake shall be tested.

REGULATION 141. OPEN-HEARTH FURNACES

Construction

1. Open-hearth furnaces shall be so constructed, insulated and/or water-cooled as to prevent the workers being subjected to excessive heat.

2. Parts of furnaces requiring cooling shall be water-cooled with softened water.

Tapping Guards

3. Where tapping holes on open-hearth furnaces are cut with oxygen, shields or guards shall be placed in front of the tapping holes to prevent hot metal being blown where it will injure workers.

4. Before open-hearth furnaces are tapped, warning shall be given by gongs, whistles or other effective signals, so that all workers may safely leave the danger zone.

Breakouts

5. Whenever sections of open-hearth furnace bottoms become detached and rise to an extent which might endanger the workers, the charge shall be tapped at once, so as to avoid breakouts in the bottom, and the furnace shall not be charged again until the damaged bottom has been repaired.

6. In the event of breakouts on open-hearth furnaces, the tapping hole shall immediately be opened, so as to draw as much as possible of the charge into the ladle or the cinder pit, and the spread of metal shall be limited.

Spaces under Platforms

7. Spaces under charging platforms of open-hearth furnaces shall not be used for rest rooms or locker rooms, on account of the possible hazards from objects falling from the platforms or from carbon monoxide gas escaping from the flues.

Charging Machines

8. Open-hearth charging machines shall be provided with—
(a) enclosure guards for operating gears and pinions;

- (b) wheel guards in front of wheels moving on tracks; and
- (c) shields for the protection of the operators from metal splashes and sparks.

9. An adequate horizontal clearance shall be left between open-hearth charging machines, when travelling, and any fixed object.

10. Traversing-carriage tracks on open-hearth charging machines shall be provided with all necessary appliances for the protection of workers.

Charging Boxes and Buggies

11. Bottoms of open-hearth charging boxes shall have openings of sufficient size to assure proper drainage.

12. Charging boxes and materials containing ice, snow or moisture, and objects having hermetically sealed cavities shall not be charged into open-hearth furnaces.

13. Where possible, open-hearth charging-box buggies shall be equipped with automatic couplers, which are protected against damage from falling scrap.

14. Tops of open-hearth charging-box buggies shall be provided along the edges with stops to prevent the charging boxes from slipping off during transit.

Disposal of Slag

15. Open-hearth slag shall be dumped in places where there is no water that might cause explosions, and allowed to solidify before being broken up.

REGULATION 142. BESSEMER CONVERTERS

Regulator Platforms

1. Regulator platforms for Bessemer converters shall be so located and arranged that the operators—

- (a) have at all times a clear and unobstructed view of all the operations; and
- (b) are protected against sparks and splashes.

Tilting Mechanisms

2. Controls of tilting mechanisms for Bessemer converters shall be provided with locks or otherwise so arranged as to prevent accidental movements of the converters during inspections or during repairs.

3. Warning shall be given by means of effective signals before tilting or raising Bessemer converters.

4. In the event of failure of the tilting mechanism of a Bessemer converter, warning shall immediately be given by signals so

as to permit immediate return of the converter to its position of rest, in which position it shall be locked.

Charging Platforms

5. Charging platforms for Bessemer converters shall be equipped with chutes for supplying the converters with cold steel scrap or other materials to reduce temperature, so as to avoid possible injury to workers below from falling material.

6. The best possible safety measures shall be taken to protect workers against dust, gases, fumes, toxic vapours, radiant heat and other noxious emanations.

Bottoms and Linings

7. Spare bottoms for Bessemer converters shall be carefully dried and baked.

8. New linings of Bessemer converters shall be slowly and thoroughly dried before the converters are put into service.

Air Supply

9. Air inlets for Bessemer blowers shall be so located and arranged that no flammable or explosive gases can be drawn into the blowers.

10. Blast pipes on Bessemer converters shall be insulated.

11. In the event of failure of the air supply for Bessemer converters, the regulator operators shall immediately be warned by signals, so that the converters can be turned down to bring the tuyères above the surface of the liquid metal.

12. In the event of a tuyère on a Bessemer converter becoming defective or badly worn during a blow, the converter shall be turned down, the windbox lid removed, the openings of the defective tuyère plugged with clay, the windbox lid replaced, the converter righted, and the blow continued.

REGULATION 143. CRUCIBLE FURNACES

Platforms on Elevated Upright Crucible Furnaces

1. Upright crucible furnaces with crown plates elevated more than 30 cm (12 in.) above the surrounding floor shall be equipped with platforms—

- (a) constructed of metal or other fire-resisting material;
- (b) of sufficient width;
- (c) extending along the front and sides of the furnace flush with the crown;
- (d) provided with standard guard rails and toeboards; and
- (e) free from all obstruction.

Oil-Fired Crucible Furnaces

2. Where blowers and oil pumps for a bank of oil-fired crucible furnaces are not connected to the same source of power, a manually-operated or automatic gate valve shall be installed in the main oil-supply line, so that in the event of air failure the oil supply for all of the furnaces can be stopped at once.

Crucibles

3. Crucibles shall be stored in warm and dry places, inspected thoroughly for cracks and flaws before being used, charged carefully without damage to the bottoms or side walls, heated slowly and lifted only with tongs of proper size and shape.

Removal of Crucibles

4. The removal of crucibles shall be undertaken in such a manner and by a sufficient number of men, to avoid undue strain on the workers.

REGULATION 144. ELECTRIC ARC FURNACES

Charging Doors

1. Charging doors of electric arc furnaces shall be provided with latches or fastenings of the locking type, or otherwise so secured as to avoid danger from flying sparks.

Panelboards

2. Control panels for electric arc furnaces—

- (a) shall be so located that the operators at all times are afforded a clear and unobstructed view of the furnaces;
- (b) shall be protected from water, oil, dust and vibrations; and
- (c) shall not be placed in close proximity to cables or leads carrying heavy current that might affect the indicators.

3. Panelboards for electric arc furnaces should be provided with manual control devices for raising or lowering the electrodes independently of the automatic regulators.

Transformers

4. Transformer stations for electric arc furnaces and their supplementary equipment shall be located as close to the electrode control masts of the furnaces as operating conditions permit.

Electrodes

5. Before starting an electric arc furnace, the electrodes shall be set in the correct position relative to the charge, and after operation commences their position should be controlled automatically.

Radiant Energy

6. Stationary or movable guards shall be provided in front of doors and spouts of electric arc furnaces, to prevent the direct or reflected light of the arcs from shining in the eyes of workers engaged in other occupations and who may not be protected by goggles or eyeshields.

Protection from Heat

7. Doors, door-frames, electrode holders, electrode economisers and roof coolers of electric arc furnaces shall, where possible, be cooled by circulating water.

Pouring Pits

8. Where pouring pits are used at electric arc furnaces for holding the ladles during pouring of the molten metal, such pits shall—

- (a) be of a depth proportionate to the general design of the furnace and the ladles;
- (b) provide an adequate clearance on all sides over the greatest outside dimension of the ladles; and
- (c) be provided with removable standard railings and toeboards or with cover plates when they are not in use.

9. All reasonable precautions shall be taken before pouring commences to ensure that operators are clear of danger.

REGULATION 145. HEATING FURNACES

Protection from Heat

1. The effects of the radiation of heat from the fronts of heating furnaces shall be decreased by—

- (a) proper insulation of the furnace; or
- (b) sheet steel or chain shields to absorb radiant heat; or
- (c) fans or air jets to produce air movement.

2. Charging and discharging openings of skelp-heating furnaces for butt-welded tubes shall be provided with movable shields which almost or entirely close the openings during the operations, so as to protect the workers.

Protection from Water

3. Where slides or chutes are used to transfer heated metal from continuous heat-treating furnaces to the quenching tanks, they shall be provided with covers to prevent water being splashed and to minimise the escape of steam.

4. Quenching tanks shall be provided with splash guards.

Operation of Doors

5. Heavy doors on heating furnaces shall be operated by mechanical means.

Charging Machines and Pushers

6. Exposed moving parts of charging machines for reheating furnaces and pushers for heat-treating furnaces shall be so enclosed or guarded as to prevent workers or other persons from coming into contact with them.

7. Charging machines for reheating furnaces and pushers for heat-treating furnaces should be equipped with devices for giving audible or other signals before and during operations.

Soaking Pits

8. Before making up bottoms in soaking pits for steel ingots, gas and air-supply valves shall be locked in a closed position, the pit covers taken off and the stacks arranged to draw air through the cover openings.

Liquid-fuel, Gas-fuel and Pulverised-fuel Systems

9. Oil, gas and pulverised-fuel supply lines for heating furnaces shall not be placed directly over furnace vents or so located that the furnace heat can dangerously affect them.

10. Oil or gas-fired heating furnaces should be equipped with gas pilot lights, well protected from strong draughts.

11. Oil, gas and pulverised-fuel supply lines for heating furnaces shall be inspected at regular and frequent intervals.

12. Water seals used to relieve excessive pressure in main gas-supply lines for heating furnaces shall be provided with vents leading to the outside and above the roofs.

13. Oil, gas and pulverised fuel-fired furnaces for heat-treating shall be examined periodically for defects which might permit escape of harmful gases into workrooms.

14. Unless absolutely necessary, workers adjusting burners or testing furnace conditions of oil, gas or pulverised fuel-fired heating furnaces should not look directly into the peek-holes of the combustion chambers, but should stand back at a safe distance and look into them from an angle, in order to avoid being caught by a flare-back or explosion.

Electric-Heating Furnaces

15. Heating elements in electric-heating furnaces shall be provided with reliable temperature-controlling devices and with easy readable thermometers and high temperature fuses.

16. When articles being heated in electric heat-treating furnaces fall against the heating elements, the control switches shall be opened before attempts are made to remove the articles.

REGULATION 146. BRICK AND POTTERY KILNS

Beehive Kilns

1. Beehive kilns for burning brick or pottery shall be—
 - (a) carefully constructed and maintained in a safe condition; and
 - (b) frequently inspected for cracks and other defects.

Doors

2. Doors for brick or pottery kilns shall not be left in passage-ways or other places where they create stumbling hazards.

Continuous Kilns

3. Tops of firing openings and waste-heat holes on continuous brick or pottery kilns shall be guarded with standard handrails of metal or with wire-mesh screens.

Mechanical Setters

4. Mechanical setters for loading or unloading brick kilns shall be safeguarded in accordance with the requirements of Regulation 155 concerning travelling cranes.

Entering Kilns

5. No worker shall enter any brick or pottery kiln after firing until the kiln has been thoroughly ventilated.

REGULATION 147. ROTARY CEMENT, LIME, PLASTER,
DOLOMITE AND AGGLOMERATING KILNS*Gear and Roller Guards*

1. Girth gears and driving mechanisms on rotary kilns shall be adequately guarded.
2. Supporting rollers on rotary kilns shall be so guarded as to make it impossible for the workers to be caught between the rollers and the tyres.

Feeding Devices

3. Where rotary kilns are fed by means of bucket elevators—
 - (a) floor openings for the elevators shall be guarded by standard railings and toeboards; and
 - (b) parts of the elevators extending above the floors shall be securely enclosed.

Clinker Pits

4. Where clinker pits are used with rotary kilns, the pits shall be provided with gratings or other covers.

Backfires and Hot Dust

5. Workers around cooler housings under rotary kilns shall be protected against burns by backfires from discharge or clean-out openings of the kilns.

6. Guards shall be provided to protect the feet and legs of the workers cleaning or removing fine dust from back housings of kilns against possible rushes of hot dust.

Removing Clinker Rings

7. Before punching clinker rings in rotary cement kilns, the fires shall be shut off.

8. Guns for shooting clinker rings in rotary cement kilns shall be securely mounted and provided with adequate safeguards to restrict their movements and prevent them from slipping into positions permitting bullets to ricochet from the kilns.

9. Breech mechanisms of clinker-ring guns for rotary cement kilns shall be kept thoroughly clean, so as to prevent premature firing when closing the breech.

10. Cartridges for clinker-ring guns for rotary cement kilns shall be protected from heat and shock.

Linings

11. Linings of rotary kilns should be inspected after each shut-down for possible cracks.

12. Each time that a rotary kiln is relined, the shell and the rivet heads shall be examined for damage.

Cleaning and Repairs

13. Before shutting down rotary kilns for cleaning, relining or other repairs, most of the loads should be burned out.

14. Before allowing workers to enter rotary kilns for the purpose of cleaning or making repairs—

- (a) all fuel-supply valves shall be closed and locked or the lines disconnected and blanked off;
- (b) motor starters shall be locked in the " Off " position;
- (c) warning signs shall be displayed; and
- (d) the kilns shall be cooled sufficiently to prevent workers from being burned or overcome by heat.

15. When entering rotary kilns, workers should remove all overhead loose coating or brick ahead of them as they advance.

16. When removing worn-out linings in rotary kilns—

- (a) workers should stand clear of the section being removed; and
- (b) the removal shall begin with the top brick and proceed downward both ways around the kiln, so as to prevent sliding of the section and sudden dropping of the lining parts.

17. When replacing linings in rotary kilns, lining jackets shall be used for holding the ring in place before the lower half of the ring has been completed.

Starting Up

18. Before starting up rotary kilns after completion of repairs—

- (a) fuel-supply connections shall be checked for possible leaks;
- (b) steps shall be taken to ensure that all tools or other equipment and all workers are out of the kilns; and
- (c) workers handling auxiliary equipment shall be notified.

REGULATION 148. DRYING KILNS

Doors

1. Doors to drying kilns shall be provided with means for fastening them in the open position when the kilns are being loaded or unloaded.

2. Except where chain-controlled vertical rolling doors or other doors which can be operated from inside the kilns by one person are used, double-end drying kilns shall be provided at each end with one or more exit doors, not less than 1.7 m (66 in.) in height and so arranged that they can be easily opened from inside the kilns.

3. Drying-kiln doors shall be so constructed and hung that they cannot become disengaged from their carriers or hangers.

Vents

4. Any enclosed space into which drying-kiln doors open shall be adequately ventilated to allow the escape of steam and hot air.

Car Tracks

5. Where the operation requires that men must enter the drying kiln when loading, car or truck tracks shall be so located as to afford a safe clearance between the loaded cars and the walls or the kiln.

6. Car or truck tracks in drying kilns should be horizontal but where they are inclined—

- (a) the slope shall not exceed 1.25 per cent. (15 in./100 ft.); and
- (b) a stock of stop blocks or clamps should be provided.

Walkways

7. Drying kilns shall be provided with walkways of open or latticework fire-resisting material on at least one side or in the centre of end-piling kilns, and on two sides of cross-piling kilns.

Access to Roofs

8. Where it is necessary for operators of drying kilns to adjust ventilators or other equipment on the roofs of kilns, permanent safe access to the roofs shall be provided.

Sprinklers

9. Drying kilns should be equipped with automatic sprinkler systems, conforming to the requirements of Regulation 41.

Operating Pits

10. All control and operating devices for drying kilns should be above ground level, but if operating pits are necessary, they shall be--

- (a) not less than 1.8 m (6 ft.) in depth, 90 cm (3 ft.) in width, and of sufficient length to accommodate and provide convenient access to all valves, damper rods, traps and other operating devices;
- (b) so arranged that it will not be necessary to enter the kilns themselves in order to regulate any operation;
- (c) ventilated, drained and lighted; and
- (d) covered with roofs, including ventilating openings and man-holes, so constructed as to prevent injury to the operators and provided with gratings, doors and guards.

11. Steam mains located in or adjacent to the operating pits shall be adequately insulated.

Steam-heated Drying Kilns

12. Where drying kilns are heated by steam--

- (a) the steam pipes should be placed at the sides of the kilns and screened to prevent workers or material from coming into contact with them;
- (b) the steam traps should be so installed that persons will not be burned by steam when the traps discharge; and
- (c) steam shall not discharge in places where it might obscure the vision of workers or other persons.

Air-heated Kilns

13. Where drying kilns are heated by hot air supplied by blowers--

- (a) the flues and pipes shall be of incombustible material;
- (b) the draught flues shall be provided with gravity-closing dampers, held open by fusible links;
- (c) the blower rooms shall be of fire-resisting construction; and
- (d) the blades of the fans shall be guarded to prevent workers from coming into contact with them.

REGULATION 149. BAKERY OVENS

Draw-Plate Ovens

1. Draw-plate bakery ovens shall be provided with fenders for the rollers, so as to protect the operators from foot injuries.

Relief Covers

2. Tops of gas-fired or oil-fired bakery ovens shall be equipped with automatic safety relief covers provided with hinges or safety chains.

Gas Leaks

3. Gas valves on gas-fired bakery ovens shall be inspected frequently for leaks.

Storage

4. Spaces at tops or sides of bakery ovens shall not be used for storage and shall be kept free of combustible material.

Cleaning

5. Bakery ovens, chimneys and flues shall be thoroughly cleaned at frequent and regular intervals.

REGULATION 150. CORE OVENS AND MOULD-DRYING OVENS

Doors

1. Doors on core ovens and mould-drying ovens shall be inspected at frequent intervals.

Stairways and Ladders

2. All vertical core or mould-drying ovens shall be provided with safe means of access to the conveyor-driving mechanism.

3. Where necessary to use vertical metal ladders for access to the tops of core ovens or mould-drying ovens, a clearance of at least 15 cm (6 in.) shall be maintained from the centre of each ladder rung to the side of the oven.

Oven Cars

4. Where flat cars running on surface tracks are used for loading large core ovens or mould-drying ovens—

- (a) the tracks shall be kept level or slope slightly downwards towards the rear of the oven;
- (b) a stock of stop blocks or clamps shall be provided; and
- (c) the cars shall be removed from the ovens by mechanical means.

Firing Floors and Pits

5. Core ovens or mould-drying ovens should be so arranged that firing can be done at ground level but, if firing pits are necessary, they shall be guarded with substantial railings, or with grating covers provided with trap doors for access to the steps leading into the pit.

Flues

6. Flues of core ovens or mould-drying ovens shall be of adequate size and frequently cleaned.

Gas-fired and Oil-fired Ovens

7. Wherever possible, gas- and oil-fired core ovens or mould-drying ovens shall be located in rooms separated by partitions from core-making rooms or moulding rooms.

8. Blast-tip pipe burners for gas and oil-fired core ovens or mould-drying ovens shall be equipped with baffles to spread the flames and to keep the sand out of the tips, which should be turned into a horizontal position for further protection.

9. Burners on gas or oil-fired core ovens or mould-drying ovens shall be provided with safety pilot valves that will prevent the flow of unburned gas or oil if the pilot light is extinguished.

Gas-fired Ovens

10. Gas-fired core ovens or mould-drying ovens shall be equipped with explosion vents of adequate size.

11. Gas-fired core ovens or mould-drying ovens shall be provided with adequate means of ventilation so that the burners may be lit without danger of explosion.

Oil-fired Ovens

12. Oil-fired core ovens or mould-drying ovens shall be equipped with explosion vents of adequate size.

13. Control valves for burners on oil-fired core ovens or mould-drying ovens shall be located well to one side of the firebox doors, so that the operator must stand to one side while turning on the valves after placing the lighting torch in position.

REGULATION 151. ENAMEL, LACQUER AND PAINT-BAKING OVENS

Doors

1. Where solid fuel is used for ovens for baking freshly enamelled, lacquered or painted articles, the firing doors shall be located on the side opposite to the baking-chamber doors.

Exhaust

2. Baking chambers of enamel, lacquer or paint-baking ovens shall be provided with ventilation—

- (a) to prevent the formation of explosive mixtures in the oven;
- (b) to protect the workers near the ovens from noxious emanations; and
- (c) so arranged as to discharge at a point where the gases or vapours will cause no harm to persons.

Oil- or Gas-fired Ovens

3. (1) Enamel, lacquer, and paint-baking ovens heated by oil or gas shall be provided with cut-off valves on the supply line to each burner, in addition to the main control valve for each oven.

(2) Close to the cut-off valve at each burner, a device shall be fixed that will completely cut off the gas supply if the gas pressure in the pipe falls, and shall keep the supply cut off until the device is deliberately reset by hand.

Electric Ovens

4. Heating elements on electric enamel, lacquer or paint-baking ovens shall be protected against contact with the materials or their solvents.

CHAPTER IX

HANDLING AND TRANSPORTATION OF MATERIALS

Section 1. Hoisting Equipment other than Elevators

REGULATION 152. DEFINITIONS

In this Section the following terms have the meanings hereby assigned to them:

- (a) the term "hoisting apparatus" includes cranes, overhead travelling cranes, portable floor and tiering hoists and other hoists, excluding elevators and built-in hoists which are dealt with in Regulation 15;
- (b) the term "crane" means a hoisting apparatus for raising and lowering loads vertically, and moving them horizontally while holding them suspended;
- (c) the term "travelling crane" means a crane that travels on a rail, or rails;
- (d) the term "overhead travelling crane" means a travelling crane in which the bridge is supported at each end by wheeled trucks that travel on overhead rails;
- (e) the term "gantry crane" means a travelling crane in which the bridge is mounted at each end on a tower, that in turn is supported on flanged wheels running on tracks;
- (f) the term "monorail crane" (telpher, transporter or runway) means a travelling crane in which the hoisting unit and the cab, if any, are suspended on a wheeled truck running on the flanges of an overhead monorail;
- (g) the term "locomotive crane" means a crane mounted on a self-propelled car;
- (h) the term "jib crane" means a stationary or mobile crane in which the suspension rope is supported by a projecting horizontal or inclined member, known as the jib, and the position of the hook relative to the supporting structure of the crane is determined by the length and inclination of that member or, in certain cases, by the position of a trolley running on that member when it is horizontal;
- (i) the term "portable floor hoist" (floor crane) means a hoisting apparatus mounted on wheels and not operated on tracks;

- (j) the term "tiering hoist" means a hoisting apparatus designed to raise objects or material vertically by means of a platform travelling in upright side rails mounted on fixed or rotatable bases, which are supported by wheels or trucks, and used in piling and storing materials;
- (k) the term "crabs and winches" means hoisting apparatus in which the hoisting rope or chain is coiled on one or more revolvable horizontal or vertical drums mounted on legs or in frames securely anchored to suitable foundations;
- (l) the term "electric hoist" means an electrically driven stationary or mobile suspended hoisting apparatus in which a hoisting motor operates a drum carrying a hoisting rope or chain for raising or lowering loads vertically, which is used either as independent hoisting apparatus or as a hoisting appliance on other hoisting apparatus;
- (m) the term "pneumatic hoist" means a stationary or mobile hoist as defined under (l), but operated by compressed air;
- (n) the term "chain hoist" means a hand-operated hoisting apparatus consisting of one or more pulley blocks reeved with chains;
- (o) the term "block and tackle" means a hand-operated hoisting apparatus consisting of one or more pulley blocks reeved with fibre or wire rope;
- (p) the term "hoisting tackle" means fibre ropes, wire ropes and chains, including their attachments for hoisting purposes, such as hooks, rings, shackles, couplings, sockets, clamps and slings.

REGULATION 153. GENERAL PROVISIONS

Construction and Maintenance

1. All parts of the framework, working gear, and appliances of hoisting apparatus shall be—

- (a) of good mechanical construction, sound material and adequate strength and substance;
- (b) kept in good repair and in good working order; and
- (c) examined daily in position by the operator and, at least once a week, by another competent person on the staff of the industrial establishment.

Capacity Markings

2. The maximum safe working load in kilogrammes (pounds) shall be marked on all hoisting apparatus, at a conspicuous place, where it is clearly legible from the floor or ground.

Overloading Prohibited

3. (1) All hoisting apparatus shall not, except for actual testing purposes, be loaded beyond the maximum safe working load.

(2) Loads shall be raised and lowered smoothly, avoiding sudden starts and stops.

Bolts

4. All bolts which are used on hoisting apparatus shall be threaded on a length sufficient to allow for tightening, if necessary, and those used for fixing the mechanisms shall be provided with effective lock nuts or lock washers.

Hoisting Drums

5. The diameter of hoisting drums on hoisting apparatus shall not be less than 30 times the diameter of the ropes on condition that it is at least 300 times the diameter of the largest wire (minimum required) or, preferably, 450 times the diameter of the largest wire (minimum recommended).

6. Rope drums on hoisting apparatus shall be provided with a flange on each end, projecting at least two and one-half times the diameter of the ropes.

7. The drum ends of ropes on hoisting apparatus shall be securely anchored on the inside of the hoist drums, and there shall be at least two full turns of hoisting rope on the drums when the load hooks are in their lowest position.

Electrical Equipment

8. Electrical appliances, devices, fittings, and circuits on hoisting apparatus shall be constructed, installed, and maintained in accordance with the requirements of Chapter V relating to electrical equipment.

Hoisting Limit Stops

9. All electrically-operated hoisting apparatus shall be equipped with limiting devices which will automatically cut off the power when the load passes its highest permissible position.

Hoisting Brakes

10. All hoisting apparatus shall be equipped with hoisting brakes, so designed and installed as to be capable of effectively braking a weight of not less than one and one-half times the rated load.

Control Ropes for Floor Operation

11. Control ropes for floor-operated cranes, electric and pneumatic hoisting apparatus should be provided with spreaders, through which the ropes pass to prevent them from becoming

tangled, and each control rope should be plainly marked to indicate the direction in which the load will move when the rope is pulled.

12. Handles of control ropes for floor-operated cranes, electric hoists and pneumatic hoists shall be distinctly different in contour, so that the operators will be able to tell easily which handle to pull for hoisting or for lowering.

13. Sets of handles of control ropes for any floor-operated hoisting apparatus shall be of the same pattern and arranged in the same relative positions throughout each industrial establishment.

Inspection

14. Before being placed in service, all new hoisting apparatus shall be thoroughly inspected and tested by competent persons.

15. Stress-bearing parts of hoisting apparatus, including runways if any, shall be—

- (a) carefully examined for loose parts or defects by the operators on each day on which they are in use;
- (b) examined carefully once a week, by another competent person on the staff of the industrial establishment;
- (c) thoroughly and completely inspected at least once every twelve months by a competent person; and
- (d) tested after every substantial alteration or repair and at such other times as are deemed necessary by the competent person.

16. Ropes, chains, hooks, slings and all material-handling appliances on hoisting apparatus shall be carefully examined by the hookers-on, signalmen, or other assigned floormen each day on which they are in use.

17. Ropes, chains, hooks, slings, sheaves, brakes and limit switches shall be thoroughly and completely inspected at least once every three months by a competent person.

18. After every inspection and test a certificate shall be drawn up by the competent person, and the certificates shall be kept available at the establishment.

Operating Signals

19. Hoisting, lowering and transporting of loads by hoisting apparatus shall be governed by a well-understood and uniform code of signals, with a distinctive signal for each operation, preferably by motion of the arms and hands.

20. Where more than one worker is engaged on a hoisting apparatus, the operator shall recognise signals from only one person, the "hooker-on", chainman, slingman or other designated signalman for the individual hoisting apparatus, who shall always be in full view of the operator: Provided that every stop signal shall be obeyed regardless of who gives it.

Handling Loads

21. (1) Loads shall be raised vertically so as to avoid swinging during hoisting.

(2) When it is absolutely necessary to raise a load obliquely—

- (a) the precautions required in view of the circumstances shall be taken to avoid endangering the workers; and
- (b) this operation shall be performed in the presence of a responsible person.

22. Before giving signals to raise a load, the signalmen shall make sure that—

- (a) all ropes, chains, slings or other attachments are properly applied to the load and secured to the hook;
- (b) the load is properly balanced and will not come into contact with any objects in such a manner that part of the load or object can become displaced; and
- (c) other workers will not be in danger of injury from the hoisting of the load.

23. When a load does not ride properly after being hoisted, the operator shall immediately sound the warning signal and lower the load for readjustment.

24. During the horizontal transfer and the lowering of suspended loads the signalmen shall direct the movement in such a way as to prevent the load from striking any object.

25. Operators of hoisting apparatus shall avoid, so far as possible, carrying loads over persons.

26. When necessary to move dangerous loads such as molten metal or objects carried by magnets over workplaces—

- (a) sufficient warning shall be given to permit the workers to reach safe places; and
- (b) if the workers cannot leave their work promptly, the hoisting apparatus shall be stopped until the workers have left the danger zone.

27. Hoisting apparatus should not be permitted to remain over moving machinery while a load is suspended or while it is undergoing repairs.

28. Signalmen on hoisting apparatus shall make sure that all workers are in the clear before giving signals to pull slings from under loads.

29. When the hoisting apparatus is operating without a load—

- (a) the slingmen and chainmen shall hook their slings or chains securely to the appliances before signalling the operator to move; and
- (b) the operators shall raise the hook sufficiently to keep clear of persons and objects.

30. Operators of hoisting apparatus shall not leave the apparatus unattended with a load suspended.

REGULATION 154. CRANES

Construction

1. All strain-bearing structural members of cranes, which are also subject to shock, shall be constructed of steel or other metal of equivalent characteristics.

2. Cranes shall be so designed and constructed that all parts can be safely lubricated and inspected when the cranes are not in operation.

Guarding of Transmission Parts

3. All gears and other mechanical power transmission appliances on cranes shall be enclosed by standard machinery guards.

Lifting Magnets

4. Where cranes are fitted with electric magnets—

- (a) the electric circuits for the magnets shall be maintained in good condition and the insulation resistance shall be tested regularly;
- (b) the switches for the magnet control system shall be so located, or their handles so protected, as to prevent them from being accidentally moved into the "Off" position; and
- (c) either electrically-operated take-up drums, or pulleys and counterweights, shall be provided for taking up the slack of the electric cables for the magnets.

5. Lifting magnets on cranes shall never be left suspended in the air during temporary idleness, but shall be lowered to the ground or to platforms erected for such purpose, and shall be detached when the cranes are to be used for other operations.

6. In order to prevent injuries from loads released by lifting magnets on cranes as the result of the blowing of fuses or other interruptions of the current—

- (a) magnet placers shall use tongs of non-magnetic material for guiding the magnets and shall at all times keep from under the loads; and
- (b) no other persons shall be permitted to stand or pass near places where magnets are being used.

Aisles for Floor-Operated Cranes

7. Where cranes are operated from the floor, an unobstructed aisle, not less than 90 cm (36 in.) in width, shall be maintained along the whole travelway of the crane.

Cabs or Cages

8. Crane cabs or cages shall be so located and arranged that the operator at all times has the best possible view of the operations.

9. Where crane operators cannot conveniently watch the loads and the places over which they may pass, one or more lookout or signalmen shall be stationed to give the necessary signals to the operators.

10. Cabs or cages on cranes in outside service shall be enclosed and provided with windows on all sides, the windows to be movable up or down, and so designed as to provide the operator with the maximum visibility; the door shall also be equipped with movable windows.

11. During cold weather the cage of every power-driven crane in use shall, where necessary, be adequately heated by suitable means.

Tool Boxes

12. Oil cans and tools on cranes shall be kept in tool boxes or receptacles, permanently secured in the cages or on the footwalks.

Qualification of Operators

13. Cranes shall be operated only by regular crane operators, authorised substitutes with not less than two weeks' experience and training acquired under competent supervision, or crane repairmen or inspectors, who shall be familiar with the mechanical and electrical equipment and with the accident hazards.

14. No person shall be employed as a crane operator unless his physical condition conforms to the requirements of Regulation 236 of Chapter XV of this Code.

15. Crane operators shall not eat, smoke or read while actually engaged in the operation of the cranes.

Riding on Cranes or Attachments

16. Only duly authorised persons shall be permitted to enter or ride in crane cabs or cages or on crane trucks.

17. Crane operators shall not permit any person to ride on loads, blocks or empty hooks or slings.

REGULATION 155. TRAVELLING CRANES*General Provisions*

1. Subject to the requirements of this Regulation, travelling cranes shall be constructed, operated and maintained in accordance with the requirements of Regulation 153 relating to hoisting apparatus and of Regulation 154 relating to cranes.

Crane Clearances

2. Travelling cranes shall be so designed and installed that there will at all times be adequate clearance between—

- (a) the highest point of the cranes and the overhead trusses;
- (b) any part of the cranes and the walls, columns or other stationary structures; and
- (c) the extremities of cranes in two parallel runways.

Factor of Safety

3. Travelling cranes shall be designed with a factor of safety under the full rated load of at least—

- (a) three for hooks used in hand-operated hoists;
four for hooks used in power-operated hoisting equipment;
and
five for hooks used for handling dangerous material, such as molten metals, corrosive substances, etc.;
- (b) eight for gear and hoist shafting;
- (c) six for hoisting ropes; and
- (d) four for structural members.

Wind Pressure

4. Travelling cranes in outside service shall be—

- (a) designed to take wind pressure into account; and
- (b) equipped with wheel locks, rail clamps, moorings and brakes provided with locking ratchets. These devices shall be so designed and installed as to take into account the heaviest wind pressure expected under local conditions.

Structural Work

5. Fabricated and assembled structural work on travelling cranes, such as brackets supporting footwalks and bridge line shafts or angles supporting operators' cabs or cages, should be riveted or welded.

Safety Lugs or Brackets

6. Trolley frames and bridge ends of travelling cranes shall be provided with heavy safety lugs or brackets, so as to limit the drop of the trolley on the bridge in the event of a wheel or axle breaking.

7. Travelling cranes shall be provided with effective means to prevent any overhung gears or wheels from falling if they break or work loose.

Safety Catches for Monorail Cranes

8. Monorail cranes operating on swivels shall be provided with one or more safety catches, which will support the load in the event of a suspension pin failing.

Trolley Frames on Monorail Cranes

9. Trolley frames on monorail cranes shall be safeguarded against spreading.

Rail Stops, Bumpers and Fenders

10. Travelling cranes shall be provided—

- (a) at both ends of the crane runways and at the ends of crane bridges with adequate rail stops or bumpers extending at least as high as the centres of the wheels; and
- (b) on bridges and frames and on trolleys with fenders which extend below the tops of the rails and project in front of all bridge and trolley track wheels, and are of a shape or form that will push and raise a hand, arm or leg off the rail and away from the wheel.

Tracks for Monorail Cranes

11. The tracks of all monorail crane systems shall be so arranged as to make it impossible to run the cranes into open switches.

12. Where monorail cranes serve several branch tracks, locks shall be provided which will ensure accurate alignment of tracks.

Travelway for Monorail Cranes

13. A clear travelway shall be maintained under all tracks for monorail cranes and the sides of the travelway shall be marked by conspicuous lines.

Footwalks and Platforms

14. Travelling cranes shall be provided with—

- (a) safe access by stairways or fixed ladders from the ground or floor to the crane cages and from the crane cages to the bridge footwalks;
- (b) footwalks or platforms at least 45 cm (18 in.) in width along the entire length of the bridges on both sides;
- (c) footwalks or platforms at least 30 cm (12 in.) in width across the ends of the trolleys at right angles to the bridge walks; and
- (d) footwalks or platforms at least 38 cm (15 in.) in width across the ends of the bridges if the trolley walks do not afford safe access to the opposite sides of the bridges.

15. Footwalks or platforms on travelling cranes shall be—

- (a) of substantial construction and rigidly braced; and
- (b) provided on all open sides with standard railings and toeboards.

16. For all new constructions the vertical clearance between floors of bridge or trolley footwalks or platforms on travelling cranes and overhead trusses, structural parts or other permanent fixtures, should not be less than 2 m (6 ft. 6 in.) and shall in no case be less than 1.8 m (6 ft.).

17. Opening between bridge footwalks and crane girders on travelling cranes shall be under 20 cm (8 in.).

18. Floors of footwalks or platforms on travelling cranes in outdoor service shall be provided with drainage openings between the boards or plates not more than 6 mm ($\frac{1}{4}$ in.) in width.

19. Where the regular footwalks or platforms on travelling cranes do not afford safe support for changing or repairing wheels of end trucks, special platforms shall be provided for that purpose.

Passageways for Gantry Cranes

20. An unobstructed passageway, at least 75 cm (30 in.) in width on each side of each rail, shall be maintained parallel to and extending the entire length of the tracks upon which any gantry crane is operated.

Cabs or Cages

21. Travelling cranes operated from the crane itself shall be equipped with cabs or cages for the operators and all the control equipment, and the cabs or cages shall be—

- (a) constructed of fire-resisting materials and, on cranes in outside service, also be of weather-proof construction;
- (b) so located that the operator can have a full view of the operations from his post and will not be placing himself in a dangerous position even if he must lean out to direct operations;
- (c) arranged and equipped in such a way as to protect the operator from the projection of molten or corrosive material and provided with all the necessary safeguards against the resulting risks;
- (d) so constructed and equipped as to protect the operator from radiations, fumes, gases, toxic vapours and other harmful emanations; and
- (e) securely fastened in place and well braced so as to minimise vibrations.

22. Where cage doors on travelling cranes are more than 30 cm (12 in.) from the footwalks, permanent metal steps shall be provided to cover the open spaces.

23. Cages on travelling cranes should be supplied with a pail filled with sand and a fire extinguisher containing a non-conductive material.

Trolleys

24. Trolleys on travelling cranes shall be provided with floors.

Guarding Bridge Line Shafts

25. All projecting parts of bridge line shafts on travelling cranes shall be enclosed by standard guards.

Electrical Equipment

26. (1) In addition to the main switch in the cage of travelling cranes, a main duplicate switch, so arranged that it can be locked in the open position, should be mounted above the cage where it can be conveniently reached from the footwalk.

(2) In a convenient place, at floor level, a special control switch capable of being locked-off and labelled "Crane Switch" shall be installed and be—

- (a) arranged to control the whole trolley run; and
- (b) be used when structural or other work makes it necessary to approach the trolley conductors.

27. The control levers or handles for all crane movements shall automatically return to the "Stop" position when released.

28. Control levers of travelling cranes shall be so located that the operators can readily face the direction of travel.

Hoisting Limit Stops

29. (1) Hoist-limiting devices on travelling cranes shall be operated directly by the hoist blocks or the crane hooks.

(2) The tripping mechanism of hoist-limiting devices shall be of the direct-action type and not depend on springs.

(3) The hoist-limiting device shall be—

- (a) directly interlocked with the braking mechanism so as to apply the latter and prevent the accidental descent of the load; and
- (b) so arranged as to be capable of being re-set from within the cabin.

30. Limit switches on travelling cranes shall be tested by the crane operators at the beginning and end of each shift.

Hoisting Motion Brakes

31. Hoisting motors on travelling cranes shall be provided with—

- (a) electrically released and spring-set holding brakes, providing not less than 100 per cent. motor torque on the ends of the armature shafts; or
- (b) mechanical brakes, capable of sustaining one and one-half times the rated load.

32. Hoisting motors on travelling cranes having a maximum safe working load of 5,000 kg (5 tons) or more shall be provided with two electrical brakes or with one electrical and one mechanical brake.

Illumination

33. Travelling cranes in outside service shall be provided with lights on the bridges, so placed as to illuminate effectively the load hook at all times when working after dark.

Bridge Travel Control for Overhead Cranes

34. Overhead travelling cranes shall be equipped with adequate hand or foot brakes for controlling the bridge travel.

Gantry Crane Trucks

35. Truck wheels of gantry cranes shall be equipped with wheel guards or fenders.

36. Trucks supporting gantry cranes shall be provided at all corners with rail clamps for attaching them to the rails when the cranes remain at work in one location or are standing idle.

Warning Devices

37. Travelling cranes shall be equipped with gongs or other effective audible signalling devices installed within easy reach of the operators, for warning persons who may be endangered by any movement of the crane or the load.

Operation of Control Apparatus

38. Before closing main or duplicate main switches on travelling cranes, operators shall make sure that all controllers are in the "Off" position and that no person can be endangered by the current or by any inadvertent movement of the crane.

39. If the power on a travelling crane fails, the operator shall immediately throw all controllers to the "Off" position, in which they shall be left until the power again is available.

40. Operators on travelling cranes shall not depend on limit switches to stop the motors and shall control the movements from the cabs.

41. Before leaving cages, operators of travelling cranes shall throw all controllers to the "Off" position and lock main switches in the "Open" position.

Two or more Cranes on the same Runway

42. Where two or more travelling cranes are operated on the same runway, they shall be kept at least 9 m (30 ft.) apart when possible.

Coupling of Cranes

43. Where two travelling cranes are used to handle the same load—

- (a) operating signals shall be given by one signaller only to both operators;
- (b) special precautions shall be taken to ensure that the movements of the two cranes are properly co-ordinated; and
- (c) where the cranes used for such operations have jibs or booms care shall be taken that both jibs or booms are set at the same angle of inclination.

Walking ahead of Gantry Crane Loads

44. Where gantry cranes are used for transporting loads, signalmen or other designated floormen should walk ahead of the loads, so as to warn others and see that the switches are properly set and that the loads are carried high enough to clear all obstructions.

Repairs on Travelling Cranes

45. When repairs on travelling cranes are necessary, the cranes should be run to locations where the repair work will cause the least interference with other cranes or with workers on the floor and whenever possible a platform shall be erected or a canvas stretched underneath the crane.

46. Travelling cranes which have no members suitable for attaching blocks for use in repair work shall be provided with structural steel outriggers of sufficient strength to lift the heaviest part of the trolley.

47. Before starting repairs on travelling cranes, repairmen shall—

- (a) make sure that all controllers are in the "Off" position and that the main switch and the duplicate main switch are open with one of them locked;
- (b) place warning signs on the crane and on the floor beneath; and
- (c) where other cranes are operated on the same runway, place rail-stops at a safe distance or make other safety provisions for stopping them.

48. Before starting to remove hoisting drum shafts or change armatures of hoisting motors on travelling cranes, hoisting ropes should be run entirely off the drums: Provided that where this is not practicable, the gearing shall be securely blocked to prevent the drum from turning.

49. After actual repairs on travelling cranes have been completed, all guards and safety devices shall be replaced, and all tools and other loose material shall be removed before the crane is again placed in service.

Working near Crane-Wheel Tracks

50. When any person is working on or near the wheel track of an overhead travelling crane, effective measures shall be taken to ensure that the crane does not approach within 6 m (20 ft.) of the place where he is working.

REGULATION 156. LOCOMOTIVE CRANES

General Provisions

1. Subject to the provisions of this Regulation, locomotive cranes used in factories shall be constructed, operated, and main-

tained in accordance with the requirements of Regulation 153 relating to hoisting apparatus and of Regulation 154 relating to cranes.

Capacity Markings

2. Capacity markings for locomotive cranes shall be posted in or on the cabs and shall clearly show the maximum loads permitted at various positions of the booms or for various radii of the hoisting blocks, both with and without outriggers.

Overload Indicators

3. Locomotive cranes shall be fitted with automatic indicators which will give an efficient sound signal when the load being hoisted is in excess of the safe maximum working load.

Body Clearance

4. A clearance of at least 35 cm (14 in.) shall be provided between rotatable bodies of locomotive cranes and the frames of the crane trucks, in order to prevent workers from being crushed against the frames if caught by the revolving body.

Steps and Handholds

5. Truckbeds and cabs of locomotive cranes shall be provided with steps and handholds, so as to permit easy and safe access to the crane cabs and operators' stations.

Cabs

6. Locomotive crane cabs shall be provided with two doorways, one on each side of the cab, hinged on the rear sides, opening outward, and fitted with double-acting latches so as to open when the handles are turned in either direction.

7. Platforms for locomotive crane operators shall be of anti-slip wood or anti-slip plate, so as to reduce slipping hazards.

8. The cabs of steam-operated locomotive cranes shall have a clear passageway from one side to the other.

Boilers

9. Boilers on steam-powered locomotive cranes shall be constructed, operated, and maintained in accordance with the relevant requirements of Regulations 122, 123 and 125 relating to power boilers.

Engines

10. Steam, gasoline and Diesel engines on locomotive cranes shall be provided with suitable safeguards to prevent the operators from accidental contact with moving parts.

11. Drip cocks for steam-engine cylinders and exhaust pipes on locomotive cranes shall be fitted with long drain pipes, so as to

prevent water from falling on the deck plates and creating slipping hazards.

12. Exhaust pipes and injector overflow pipes on locomotive cranes shall discharge downward and not to the sides of the cabs.

Wheel Brakes

13. Locomotive cranes shall be equipped with both power brakes and hand brakes for the truck wheels.

Automatic Couplers

14. Locomotive crane trucks shall be provided on both ends with automatic couplers which can be released from either side of the crane.

Slewing Levers

15. Slewing levers on locomotive cranes shall be provided with means for locking them in the neutral position.

Rope Guards

16. Rope guards shall be provided on locomotive cranes—

- (a) at the end of the boom, to prevent the thimble on the rope from coming into contact with the sheave wheel; and
- (b) at the point where the boom rope passes over the idler.

Electrical Equipment

17. Special precautions shall be taken to provide effective ground connections for electric-powered locomotive cranes.

Illumination

18. When locomotive cranes are used after dark, they shall be provided with—

- (a) head lights and at least one red tail light; and
- (b) sufficient light in the cabs, so placed and constructed as not to interfere with the vision of the operators and such as to enable the latter to see clearly how to perform their work and especially to see steam and water gauges correctly.

Warning Devices

19. Locomotive cranes shall be provided with effective audible signalling devices, which shall be sounded before the cranes are put in motion and, if necessary, while the cranes are travelling.

Operation

20. When locomotive cranes are being moved—

- (a) only authorised persons shall be allowed to throw switches in the case of cranes which move on rails; and

- (b) crane operators shall make sure that the body or the boom will not strike buildings or structures and that the boom is carried low enough to clear all overhead objects.

21. Before operators leave locomotive cranes at the end of shifts or for temporary shutdowns, the truck brakes shall be applied, the booms lowered upon rests and the control appliances locked or fastened in neutral positions.

REGULATION 157. JIB CRANES

General Provisions

1. Subject to the provisions of this Regulation, jib cranes used in factories shall be constructed, operated, and maintained in accordance with the requirements of Regulation 153 relating to hoisting apparatus and of Regulation 154 relating to cranes.

Capacity Markings

2. Capacity markings for jib cranes, clearly showing the maximum safe working loads for the various inclinations of the jib or the various positions of the trolley on a horizontal jib shall be fastened or marked on the sides of the jibs or on the masts or pillars.

Safe-Load Indicators

3. Jib cranes shall be fitted with automatic indicators which will give efficient sound signals whenever the load being moved is in excess of the maximum safe working load.

Masts

4. Bottom pivot plates for jib crane masts shall be supported by substantial foundations and upper pivots shall be firmly secured to withstand the stresses to which they may be subjected.

Trolley Stops

5. Jibs carrying trolleys shall be provided with effective stops to prevent the trolleys from running off the ends of the jibs.

Hand-Operated Winches

6. When jib cranes are equipped with winches operated by hand power, the winches shall be provided with—

- (a) ratchet wheels on the drum shafts with locking pawls, or self-locking worm gears, for holding the loads suspended when the hand cranks are released; and
- (b) braking devices for controlling the descent of the loads.

REGULATION 158. PORTABLE FLOOR HOISTS AND TIERING HOISTS*General Provisions*

1. Subject to the provisions of this Regulation, portable floor hoists and tiering hoists shall be constructed, operated and maintained in accordance with the requirements of Regulation 153 relating to hoisting apparatus.

Control Devices

2. Travel controls and operating controls on power-operated portable floor hoists and tiering hoists should be designed with similar direction of movement for each type of control on all hoists in any one factory.

Control Handles

3. Control handles on power-operated portable floor hoists and tiering hoists shall be protected by location or by guards against accidental contact with fixed or moving objects.

Grounding

4. Electrically-operated portable floor hoists and tiering hoists shall be effectively grounded.

Platform Guards

5. The operator's platform on power-operated portable floor hoists and tiering hoists shall be provided with a substantial guard for the protection of the operator, with provision for access.

Wheel Guards

6. Truck wheels on portable floor hoists and tiering hoists shall be provided with sweep guards.

Wheel Brakes

7. Power-operated portable floor hoists and tiering hoists shall be equipped with adequate travel-braking devices on the transmission shafts or on the wheels.

Warning Devices

8. Power-operated portable floor hoists and tiering hoists shall be provided with manually-operated audible warning devices.

Riding on Hoists Prohibited

9. Operators of portable floor hoists and tiering hoists shall not permit other persons to ride on loads or on the platforms or other parts of the hoists.

Truck Handles on Floor Hoists

10. Truck handles on portable floor hoists shall be so designed and arranged that they will stand upright when not in use and will be capable of being secured in that position.

Telescopic Tiering Hoists

11. Telescopic or hinged types of tiering hoists shall be provided with automatic latches or other adequate means for preventing accidental release of the upper sections.

Limit Switches and Load Brakes on Tiering Hoists

12. Electrically-operated tiering hoists shall be provided with—

- (a) limit switches for upper and lower limits of platform travel; and
- (b) electrical or mechanical braking for controlled lowering of loads.

Unloading Tiering Hoists

13. When possible, material shall be removed from platforms of tiering hoists by mechanical means.

Moving Tiering Hoists

14. When loaded tiering hoists are moved from one location to another the platforms should be lowered so as to minimise the tipping hazards.

REGULATION 159. CRABS AND WINCHES

General Provisions

1. Subject to the provisions of this Regulation, crabs and winches used in factories shall be constructed, operated and maintained in accordance with the relevant requirements of Regulation 153 relating to hoisting apparatus.

Construction

2. All parts of the framework for crabs and winches shall be of metal.

Factor of Safety

3. Frames and hoisting drums of crabs and winches shall be designed with a factor of safety under the full rated load of not less than—

- (a) twelve for cast iron;
- (b) eight for cast steel; and
- (c) five for structural steel or forged steel.

Foundations

4. Legs or frames of crabs and winches shall be securely anchored to substantial foundations.

Brakes

5. Crabs and winches, except self-locking worm-gear winches, shall be equipped with effective devices which will automatically stop the load in any position in the event of the motive power being cut off.

Hoisting Drums

6. Where practicable, hoisting drums on crabs and winches should be of such diameter and length as to take all the rope in one layer.

Control Levers

7. Control levers on crabs and winches shall be provided with suitable locking devices.

Steam-Operated Crabs and Winches

8. Crabs and winches operated by steam power shall be so constructed and installed that—

- (a) workers will not be scalded by hot water or steam; and
- (b) steam from the exhaust pipes will not obscure the field of vision of the operators.

Hand-Operated Crabs and Winches

9. Hand-operated crabs and winches shall be so constructed that the maximum effort to be applied by any one person at the handle or handles will not exceed 10 kg (22 lb.) when the crab or winch is lifting its maximum safe working load.

10. Crabs and winches operated by hand power shall be provided with—

- (a) ratchet wheels on the drum shafts and locking pawls, or self-locking worm gears, to prevent reversing while loads are being hoisted; and
- (b) effective braking devices for controlling the lowering of the loads.

11. Crank handles for hand-operated crabs and winches shall be—

- (a) so constructed that they do not turn while the loads are being lowered by means of the brake; or
- (b) removed before the loads are lowered.

12. Detachable crank handles for hand-operated crabs or winches shall be secured against accidental removal.

REGULATION 160. ELECTRIC, PNEUMATIC AND CHAIN HOISTS

General Provisions

1. Subject to the provisions of this Regulation, electric, pneumatic and chain hoists shall be constructed, operated and maintained in accordance with the relevant requirements of Regulation 153 relating to hoisting apparatus.

Electric Hoists

2. Electric hoists shall be—

- (a) of all-steel construction;
- (b) designed with a factor of safety under the full rated load of not less than eight for cast steel and five for structural or forged steel; and
- (c) equipped with automatic braking devices which will hold the load when the hoist is stopped.

3. Hoisting controls on electric hoists shall be provided with devices which will automatically return the controls to their neutral positions when the handles on the control ropes are released.

4. Control ropes for electric hoists shall be of non-conducting material.

Pneumatic Hoists

5. Suspended pneumatic hoists shall be of all-steel construction and designed with a factor of safety under the full rated load of not less than eight for cast steel and five for structural or forged steel.

6. Air cylinders on suspended pneumatic hoists shall be so suspended from the trolleys or other supports, by clevises, safety hooks or other attachments, as to prevent them from becoming detached.

7. Pistons of suspended pneumatic hoists shall be secured to the piston rods by means of castellated nuts and cotter pins.

8. Valve control levers on suspended pneumatic hoists shall be provided with devices for automatically returning them to their neutral positions when the handles on the control ropes are released.

Chain Hoists (Hand-Operated)

9. Supports for chain hoists shall be of sufficient strength to carry safely the loads to which they will be subjected.

10. Load-sustaining parts of chain hoists shall—

- (a) be designed with a factor of safety under the full rated load of not less than eight for cast steel and five for structural steel, forged steel or wrought iron; and
- (b) not contain any cast iron.

11. Chain hoists shall be provided with worm gears or other devices which will hold the loads automatically when the hoisting is stopped.

REGULATION 161. BLOCKS AND TACKLE

General Provisions

1. Subject to the provisions of this Regulation, hoisting blocks shall be constructed and maintained in accordance with paragraphs 1 to 3 and 14 to 27 of Regulation 153 relating to hoisting apparatus.

Supports

2. Upper hoisting blocks shall be provided with hooks, eyes or straps, by which they can be securely attached to the supports from which they are suspended.

Ropes

3. Ropes used in blocks and tackle shall be of the type and size for which the sheaves were designed.

4. Hoisting blocks shall be provided with devices enabling them to be moved as they are being loaded without requiring the workers to place their hands on the ropes or chains.

REGULATION 162. HOISTING TACKLE

Chains

1. Hoisting and sling chains shall be made of wrought iron or steel conforming to such standard specifications as shall be laid down by national institutes for standardisation, where they exist, or other competent authority.

2. (1) Rings, hooks, shackles, swivels and end links for hoisting and sling chains should be made of the same materials as the chains to which they are fastened when the latter are of wrought iron or ordinary steel.

(2) Special cases shall be considered individually.

3. The factor of safety for new hoisting or sling chains shall be at least five under the full rated load.

4. Hoisting or sling chains shall be withdrawn from use whenever—

- (a) the chains have become unsafe from overloading or through faulty or improper annealing;
- (b) the chains have stretched more than 5 per cent. of their length;
or
- (c) the interlink wear exceeds one-fourth the thickness of the original link stock.

5. All new or reconditioned hoisting and sling chains shall be subjected to a tensile test before being placed in service, and the safe loads which may be lifted vertically by them shall be plainly stamped on the bull rings or hooks or on special links near the ends of the chains which are not load-carrying units of the chains.

6. Tables showing safe working loads for hoisting chains, and for sling chains at various angles, shall be posted in conspicuous places, and users of chains shall be carefully instructed regarding the safe loads and the tables.

7. Except as provided in paragraph 8 of this Regulation, hoisting chains which are wound on drums or pass over sheaves shall be lubricated at frequent and regular intervals.

8. Grease or oil shall not be applied to—

- (a) hoisting chains used in foundries or other places where the lubricants might pick up and retain sand or grit; or
- (b) sling chains.

9. Chains shall be free of kinks, knots and twists when used for hoisting loads.

10. When objects with sharp edges are to be hoisted with chains, pads shall be placed between the edges and the chains.

11. Splicing broken hoisting or sling chains by wiring links together, by inserting bolts between links, or by passing one link through another and inserting a bolt or nail to hold it, shall be prohibited.

12. Hoisting chains shall be wound only on drums, shafts or sheaves that are provided with grooves of such size and shape as to allow the chains to work smoothly without twisting.

13. Unless they have been inspected during the preceding three months, hoisting or sling chains, and their rings, hooks, shackles and swivels shall be examined for stretch, wear, gouge marks, cracks and open welds before each occasion on which they are to be used.

14. When individual links of hoisting or sling chains show excessive wear, or are bent, cut, gouged or cracked, they shall be cut out and replaced.

15. Hoisting and sling chains shall be annealed or normalised at intervals not exceeding—

- (a) six months in the case of chains not exceeding 12.5 mm ($\frac{1}{2}$ in.) in diameter and chains used for carrying molten metal; and
- (b) twelve months in the case of all other chains.

16. Annealing, normalising and repairing of hoisting or sling chains shall be done only by experienced firms, and chains of steel, which have been subjected to special thermic treatment, shall be returned to the manufacturers for any heat treatment required.

17. When not in use, hoisting or sling chains should be stored—

- (a) by hanging them on racks so arranged that workers handling the chains will not be exposed to lifting hazards; and
- (b) under such conditions as will minimise rusting.

18. Hoisting or sling chains shall not be stored where they might be run over by trucks or might be exposed to corrosive action.

19. When chains have been exposed to extremely low temperature for a period of several hours, they shall be warmed before being used.

Wire Rope

20. Wire rope for hoisting, lowering or hauling loads shall be—

- (a) manufactured to such standard specifications as shall be laid down by national institutes for standardisation, where they exist, or other competent authority;
- (b) of proper construction and size for the operations; and
- (c) free from defects.

21. The factor of safety for wire rope shall be not less than six.

22. (1) Eye splices, sockets and rope anchorages subjected to a direct tensile load shall be capable of withstanding a load equal at least to the maximum permissible working load multiplied by the factor of safety.

(2) They should be capable of withstanding a load of 95 per cent. of the rated breaking load of the ropes.

23. Eye splices and loops for the attachment of hooks, rings and other parts to wire ropes shall be provided with suitable thimbles.

24. (1) Wire ropes shall be inspected at the time of installation and examined thereafter in accordance with the provisions laid down under paragraph 15 of Regulation 153 of this Code.

(2) Wire ropes shall be removed from service whenever their strength is affected by broken wires, wear or corrosion according to the following specifications:

- (a) 6 by 7 wire rope: 12 per cent. on a length of 50 cm (20 in.);
- (b) 6 by 19 wire rope: 20 per cent. on a length of 50 cm (20 in.);
- (c) 6 by 37 wire rope: 25 per cent. on a length of 50 cm (20 in.);
- (d) 6 by 61 wire rope: 25 per cent. on a length of 50 cm (20 in.);
- (e) special cables:
 - (i) " Seal " cables: 12 per cent. on a length of 50 cm (20 in.);
 - (ii) cables with strands of triangular section: 15 per cent. on a length of 1 m (40 in.);
 - (iii) " Nuflex " cables: 20 per cent. on a length of 1 m (40 in.).

25. The size and material and the maximum safe working load shall be marked on all wire ropes by means of metal tags or in another suitable way.

26. Wire ropes used for hoisting, lowering, or hauling loads shall be free from kinks and knots.

27. In order to prevent kinking, twisting, or untwisting of new wire rope, the rope shall—

- (a) when received in coils, be uncoiled by rolling the coils like hoops on level surfaces which are free of grit and be straightened out before being put on the sheaves; and
- (b) when received on reels, be unwound by rolling the reels along the ground, or by pulling the ends from reels mounted horizontally on spindles or vertically on turntables with sufficient tension on the reels to prevent accumulation of slack.

28. Ends of wire rope shall be seized to prevent the strands from becoming loose.

29. Before cutting wire rope, the rope shall be seized on each side of the intended cut.

30. Fastenings of wire ropes shall be carefully examined at regular intervals, and clips or clamps tightened if they show signs of loosening.

31. At the least sign of a dangerous condition at sockets or other fastenings of wire ropes, a section of the rope from 1 to 3 m (3 to 10 ft.) above the fastening shall be cut off and the rope refastened.

32. A thimble or loop splice made in any wire rope shall have at least three tucks with a whole strand of rope and two tucks with one half of the wires cut out of each strand.

33. In order to keep wire ropes pliable and prevent rust, the ropes shall be treated at regular intervals with suitable lubricants free from acid or alkalies.

34. Wire ropes shall be stored in cool places which are free from moisture, excessive heat, and acid fumes.

Fibre Rope

35. (1) Fibre rope for hoisting, lowering or hauling loads should be of high grade manila hemp (abaca), or other hemp of equal quality, capable of withstanding a load of at least 800 kg/cm² (11,400 lbs./sq. in.).

(2) The factor of safety shall not be less than ten.

36. When ropes of fibres other than high-grade manila are used for hoisting purposes, proper allowance shall be made for the proportionate tensile strength.

37. All fibre ropes should bear a metal tag on which is stamped a number referring to an inventory, giving—

- (a) the name of the supplier;

- (b) the date of placing in service; and
- (c) the maximum permissible load.

38. Before being put into use and while in use at intervals to be determined according to the causes of destruction, but not to exceed three months, fibre ropes for hoisting purposes shall be examined for abrasions, broken fibres, cuts, fraying, displacement of yarns or strands, variation in size or roundness of strands, discoloration and other defects.

39. When cutting fibre rope to required lengths for hoisting purposes, seizings of yarn shall be applied on each side of the intended cut.

40. Eye splices on fibre ropes shall be made around suitable thimbles.

41. Fibre ropes for hoisting purposes shall not be dragged over rough surfaces or where they might come into contact with grit or sand.

42. When fibre ropes become saturated with water, they shall be—

- (a) hung up or laid in loose coils in a dry place, kept from excessive heat, until properly dried out; and
- (b) protected against freezing.

43. Fibre ropes shall not be used for hoisting purposes or stored in locations where they will be exposed to contact with acids, acid fumes, or other destructive chemicals.

44. When not in use, fibre ropes shall be hung in loose coils on wooden pegs, or coiled loosely on wood-grating platforms about 15 cm (6 in.) above the floor, in well-ventilated places, away from boilers, steam pipes, or other sources of heat, and away from dampness or moisture.

45. Before fibre ropes used for hoisting purposes are stored, they shall be dried if wet, or cleaned and dried if dirty.

Sheaves

46. Grooves of sheaves used in connection with chains shall be provided with pockets to fit the links of the chains.

47. Grooves of sheaves shall—

- (a) have rounded edges and a smooth surface without any defects which might injure the rope; and
- (b) be of such dimensions that the rope will run free without chafing against the block or other suspension parts.

48. Bottom blocks for hoisting apparatus shall be protected with close fitting guards and ring handles, so as to prevent the tackle from becoming misplaced and to prevent the hands of workers from being caught in the sheaves or between the sheaves and the loads.

Hooks

49. Hooks for hoisting apparatus shall—
- (a) be of forged steel or wrought iron, or built up of steel plates;
 - (b) be fitted with safety latches or other safety devices, or be so shaped, when the nature of the work requires it, as to prevent the loads from slipping off; and
 - (c) in the case of heavy equipment be provided with dustproof and waterproof ball or roller bearings.
50. The maximum safe working load shall be legibly stamped on each hook for hoisting apparatus.
51. Where the work permits, hooks for hoisting apparatus should be provided with handles for holding and placing the hooks.
52. Parts of hooks liable to come into contact with chains or ropes during hoisting operations shall be rounded.

Slings

53. Subject to the requirements of paragraphs 54 to 64, the construction, use and maintenance of hoisting slings shall conform to the provisions of paragraphs 1 to 45 of this Regulation relating to chains, wire rope and fibre rope.

54. Slings for hoisting purposes shall be made of chains, wire rope or fibre rope of sufficient strength to carry the loads to which they will be subjected.

55. The maximum safe working load shall be plainly marked on all slings by means of metal tags or code colour marking or in another suitable manner.

56. Slings for hoisting purposes shall be examined—
- (a) before each use by the hookers-on or other designated floormen;
 - (b) each week by another competent person on the staff of the establishment; and
 - (c) periodically, at intervals determined according to the causes of destruction but not exceeding three months, by a competent person.

57. All slings except endless slings shall be provided with rings, shackles, links, hooks or eyes so that they can be safely suspended from hooks.

58. When placing hoisting slings around loads with sharp edges or with projections that would subject the tackle to sharp bends, pads shall be inserted between the loads and the slings in such places.

59. Slings with legs of unequal length shall be provided where necessary for use on loads which cannot be safely raised or lowered with slings with equal legs.

60. Where double or multiple slings are used for hoisting purposes, the upper ends of the slings shall be connected by means

of a suitable shackle or ring, and not be placed separately in the lifting hooks.

61. The angle between the legs of slings should not exceed 60°.

62. Bridle slings or spreaders shall be used on all horizontal loads more than 3.6 m (12 ft.) in length which are composed of two or more pieces of material, and for all loads with which there is a danger of the slings or clamps slipping together.

63. Hoisting slings that show evidence of cuts, excessive wear or other damage shall be discarded and destroyed.

64. Storage racks should be provided for all hoisting slings at points convenient for the operations and all slings not in use should be kept in these racks.

Section 2. Conveyors

REGULATION 163. DEFINITIONS

In this Section the following terms have the meanings hereby assigned to them:

- (a) the term "gravity conveyor" means a conveyor for carrying packages or loose materials to lower levels by force of gravity without mechanical power;
- (b) the term "chute conveyor" means a gravity conveyor consisting of straight or spiral chutes made of metal, wood or other suitable material, provided with smooth slideways, and mounted on inclined frames;
- (c) the term "gravity roller conveyor" means a gravity conveyor provided with a series of rollers mounted on a slightly inclined frame so as to revolve when material is placed upon it and move the material along in the direction of the descending incline;
- (d) the term "belt conveyor" (band conveyor) means a power-driven conveyor for carrying packages or loose materials, ordinarily in a horizontal plane, by means of belts operating over terminal drums or pulleys, usually with both carrying and returning parts supported by rollers or pulleys;
- (e) the term "chain conveyor" means a power-driven conveyor for carrying articles or materials, in a horizontal, vertical or inclined plane by means of a single or two or more parallel continuous chains operating over sprocket wheels at either end;
- (f) the term "log haul" means a trough for carrying logs in sawmills from the ponds or from the ground to the mill-floor level by means of chains provided with hooks, lugs or tongs for holding the logs;
- (g) the term "overhead chain conveyor" means a chain conveyor in which articles or material are carried on hooks or in con-

- tainers, such as baskets or carriages, attached to chains suspended from overhead supports;
- (h) the term "apron conveyor" means a chain conveyor in which the material is carried on individual carrying plates connected to the links at regular intervals, or on a series of plates, so attached to the links that they form a continuous band or apron;
 - (i) the term "bucket conveyor" means a chain conveyor in which buckets, attached to the links at regular intervals, carry the material in a horizontal, vertical, or inclined plane, and which sometimes are provided with fixed or movable tripping devices for emptying the buckets at desired locations;
 - (j) the term "live-roll conveyor" means a conveyor for carrying packages or objects in a horizontal or slightly inclined plane by means of a series of horizontal rollers, usually spaced close together, mounted in frames and turned by power in the same direction;
 - (k) the term "portable conveyor" means a belt, flight, apron or live-roll conveyor built as a portable motor-driven unit, mounted on wheels or suspended from overhead tracks, and moved from one location to another;
 - (l) the term "screw conveyor" means a power-driven conveyor for transporting loose materials by means of a single-plate or double-plate helix formed around a driving shaft revolving inside a closed horizontal or inclined conveyor trough containing the materials;
 - (m) the term "pneumatic conveyor" means a horizontal, vertical or inclined duct or tube, through which articles or solid materials are forced by air pressure or vacuum.

REGULATION 164. GENERAL PROVISIONS

Construction and Installation

1. The carrying mechanisms of conveyors shall be of sufficient strength to support safely the loads for which they are intended.
2. All conveying machinery shall be so constructed and installed as to avoid hazardous points of shear between moving and stationary parts or objects.

Floors, Footwalks and Platforms

3. Elevated conveyors requiring frequent access shall be provided with footwalks or platforms along their entire length, not less than 45 cm (18 in.) in width and equipped with standard railings and toeboards.
4. Floors or working platforms at loading and unloading stations shall be maintained in a non-slippery condition.

5. Floors, platforms and footwalks alongside conveyors shall be kept free of spillage and other materials.

6. Proper floor drainage shall be provided around conveyors where the operations might involve the spillage of water or other liquids liable to create slipping hazards, and any oil or grease drippings shall be immediately cleaned up.

7. When workers have to cross over conveyors and this exposes them to danger, regular crossing facilities affording safe passage shall be provided.

8. Workers shall be prohibited from standing on the supporting frames of open conveyors while loading or removing articles, or when clearing blockages.

9. Where conveyors that are not entirely enclosed are located in pits or at floor level, any floor openings shall be guarded by standard railings and toeboards.

Machinery Guards

10. Belts, chains, driving gears, driving shafts, drums or pulleys, and sprockets of conveyor equipment shall be safeguarded in accordance with the requirements of Regulations 70 to 89, relating to mechanical power transmission equipment.

Guarding Elevated Conveyors

11. When conveyors that are not entirely enclosed cross over places where workers are employed or might pass beneath them, sheet or screen guards shall be provided to catch any material which might fall from the conveyors.

Riding on Conveyors

12. Workers shall be prohibited from riding on conveyors, except where specially permitted for the purpose of the work.

Safety Relief Vents

13. Enclosed conveyors used for carrying combustible materials of an explosive nature shall be provided with safety relief vents, leading as directly as possible to the outside air and not connected with any chimneys, pipes, vents or flues used for any other purpose.

14. Where non-escape of materials is essential, safety relief vent outlets on conveyors shall be provided with counterbalanced relief valves.

Control Devices

15. Power-driven conveyors shall be provided at loading and unloading stations, at drive and take-up ends, and at other frequent and convenient places, with devices for stopping the conveyor machinery in the case of an emergency.

16. Conveyors which carry loads up inclines shall be provided with mechanical devices that will prevent the machinery from reversing and carrying the loads back towards the loading point in the event of the power being cut off.

17. Where two or more conveyors are operated together, the controlling devices shall be so arranged that no conveyor can feed on to a stopped conveyor.

Loading and Unloading

18. Where material is loaded on moving conveyors by hand, the speed of the conveyors shall be slow enough to allow loaders sufficient time to place the material in position without losing their balance, and in such a manner that the material will not project to a dangerous extent over the sides of the conveyors or be likely to fall.

19. When practicable, conveyors for transporting cement, fertiliser, grain, sand or similar loose materials, shall be provided with hoppers or other feeding devices.

20. Heavy or bulky articles shall be removed by hand from moving conveyors at designated stations only.

Warning Devices

21. Where conveyors extend to points not visible from the control stations, they shall be equipped with gongs, whistles or signal lights, to be used by the operators before starting the machinery so as to warn workers who might be in positions of danger.

Lubrication

22. Conveying equipment shall be provided with automatic and continuous lubrication systems, or with lubricating facilities so arranged that oiling and greasing can be performed without the oilers coming within dangerous proximity to moving parts.

Adjustments and Repairs

23. Workers shall be prohibited from attempting to adjust or repair conveying equipment without first stopping the machinery and locking the starting levers or control switches in the " Off " position.

Hoppers

24. Where the tops of hoppers for feeding conveyors are less than 1 m (40 in.) above the floors, the openings shall be guarded in conformity with the provisions of this Code relating to the protection of floor openings.

Inspection

25. (1) Where conveying equipment is used regularly or frequently, it shall be thoroughly inspected at suitable intervals so as to make sure that it is in proper order.

(2) If found defective the equipment shall be taken out of service until repairs have been made and it can be operated safely.

REGULATION 165. GRAVITY CONVEYORS

Chute Conveyors

1. Where heavy articles are normally transported in chute conveyors and cannot be plainly seen in their descent, the delivery ends of the conveyors shall be provided with electrically or mechanically operated devices to give warning that a package is about to be delivered.

2. Where it is necessary to maintain the separation of parts of buildings to prevent the spread of fire, spiral chute conveyors shall be—

- (a) enclosed in shafts made of fire-resisting materials, with a door at each charging station and at the delivery end; or
- (b) provided with automatic fire doors or with draught checks where the chutes pass through the floors.

Gravity Roller Conveyors

3. Gravity roller conveyors shall be provided with guides or guard rails on each side of the conveyor way at corners or turns and on each side of those portions of the conveyor way which are more than 1.5 m (5 ft.) above the floor.

REGULATION 166. BELT CONVEYORS

Pinch Guards

1. Belt conveyors shall be provided with guards at the pinch points of the belts and the drums, where they shall extend at least 1 m (40 in.) from the drums.

Hoppers

2. When movable hoppers are used for feeding materials to belt conveyors, the hoppers shall be securely and rigidly fastened in place.

Tripping Devices

3. Where self-propelled trippers are used for emptying belt conveyors, devices shall be installed at each end of the runways for throwing the propelling mechanism into neutral position in the event of the tripper being thrown into gear running along to the end of the belt or runway.

4. Where trippers for belt conveyors discharge into bins directly under them through holes in walkways, the openings shall be covered with gratings just large enough to admit the material, or shall be guarded with standard railings and toeboards.

Cleaning Tail Drums

5. Belt conveyors carrying materials which might stick to tail drums or pulleys should be equipped with fixed scrapers or revolving brushes for removing the deposits so as to avoid the hazards arising in cleaning the drums or pulleys by hand while the belts are in motion.

REGULATION 167. CHAIN CONVEYORS

Guarding Return Runs

1. Where return runs of chain conveyors offer a hazard to persons working or passing beneath them, they shall be guarded in conformity with the provisions of Regulation 79 of this Code.

Log Hauls

2. Log hauls in sawmills, used for carrying logs from the ponds or from the ground to the mill-floor level shall be so constructed as to possess a factor of safety of not less than ten when loaded with the heaviest log handled.

3. Log-haul chutes shall be lined with iron or provided with skid rails.

4. Log hauls shall be provided with at least one walkway, which shall be—

- (a) of sufficient width to enable workers to stand clear of the logs in the chute; and
- (b) equipped on the outside with standard railings and toeboards.

Overhead Conveyors

5. Overhead chain conveyor systems shall be so designed and installed that ample clearance is provided between the material transported and any fixed or moving objects.

Apron Conveyors

6. Apron conveyors used for carrying unpacked bottles, jars or other glass containers shall be provided with side rails at a suitable distance above the conveying surfaces to prevent the containers from tipping over or falling off.

Bucket Conveyors

7. Inclined bucket conveyors shall be enclosed with solid guards which—

- (a) are not less than 2.15 m (7 ft.) in height, but preferably extend to the full height of the machinery, so as—
 - (i) to prevent anything being pushed or thrown into the shaftways; and
 - (ii) to hold any material which might drop from the buckets; and

(b) are provided with wire-glass windows or doors, or with removable sections to facilitate inspection, cleaning and repairs.

8. Controls of movable tripping devices for bucket conveyors shall be so located that they can be operated from a safe position.

REGULATION 168. LIVE-ROLL CONVEYORS

1. Where the rollers on live-roll conveyors are not placed close together, the spaces between them shall be provided with covers of metal, wood or other suitable material, so supported that they will not be visibly displaced by a load of 70 kg (150 lb.) applied at any point.

2. Driving shafts and exposed bevel gears on live-roll conveyors shall be covered by standard machinery guards extending under the bottom where the gears mesh.

REGULATION 169. PORTABLE CONVEYORS

General Provisions

1. Subject to the provisions of this Regulation, portable belt, chain and live-roll conveyors shall be constructed, operated and maintained in accordance with the requirements for the respective stationary types in Regulations 166 to 168.

Width of Tread

2. The tread of portable conveyors shall be so designed as to minimise the danger of upsetting.

Booms

3. Mechanisms for raising or lowering booms on portable conveyors shall be of the self-locking worm, jack-screw or other positive type.

4. When portable conveyors are equipped with booms in two sections, these shall be so designed that material will not roll back from one section to the other at the transfer point.

Electrical Equipment

5. Feed circuits for portable conveyors shall be armoured or cab-tyre cable, all live electrical parts shall be properly enclosed, and all exposed metal parts shall be effectively grounded.

REGULATION 170. SCREW CONVEYORS

Construction

1. Screw conveyors shall be placed in steel or steel-lined troughs, fitted with well-secured tight covers of not less than 3 mm ($\frac{1}{8}$ in.) steel plates in removable sections, and should be provided

with second covers of heavy wire mesh in corresponding removable sections underneath the solid top covers so as to guard the screw when the solid cover is removed for inspection of the interior.

Driving Equipment

2. Inside covers of screw conveyors, or outside covers where no inside covers are provided, should be mechanically or electrically interlocked with the control units or driving mechanisms in such manner that the power is automatically shut off whenever a section of the cover is removed.

3. Where the removal of screw-conveyor covers does not automatically shut off the driving power, workers shall not attempt to loosen material in clogged conveyors or to repair conveyor troughs without first shutting off the power and locking the controls.

4. Motors for driving screw conveyors shall be provided with overload releases.

Standing on Housings

5. Workers shall be prohibited from standing or walking on housings of screw conveyors.

REGULATION 171. PNEUMATIC CONVEYORS

Blower and Exhaust Fans

1. Blower or exhaust fans for pneumatic conveyor systems shall be—

- (a) of non-combustible construction;
- (b) of adequate but not greatly excessive capacity properly to perform the functions required;
- (c) firmly secured to substantial supports or foundations;
- (d) so located and arranged as to afford ready and safe access for cleaning, inspection, lubrication and repairing; and
- (e) provided with remote control in addition to any controls located close to the systems.

2. Where readily ignitable materials are passed through fans for pneumatic conveyor systems, the blades and spiders of the fans shall be of non-ferrous material, or the casings shall be lined with non-ferrous material.

3. Blades or runners of blower or exhaust fans for pneumatic conveyor systems shall be of sufficient strength to prevent contact with casings or distortion under conditions of deposit loading or other operating factors.

4. Housings or casings of blower or exhaust fans for pneumatic conveyors shall be so constructed as to prevent distortion and loss of alignment under operating conditions.

5. Intake openings of blowers or exhaust fans for pneumatic conveyors shall be protected with substantial metal screens or gratings.

6. Bearings of blower or exhaust fans for pneumatic conveyors shall be self-lubricating, dust-tight, and located outside casings and ducts.

Ducts

7. Ducts for pneumatic conveyor systems shall be constructed of steel, or other metal equal in strength to steel plate of at least—

- (a) 0.6 mm (0.02 in.) in thickness for ducts less than 25 cm (10 in.) in greatest dimension;
- (b) 0.8 mm (0.03 in.) in thickness for ducts 25 to 50 cm (10 to 20 in.) in greatest dimension;
- (c) 1 mm (0.04 in.) in thickness for ducts 50 to 75 cm (20 to 30 in.) in greatest dimension; or
- (d) 1.25 mm (0.05 in.) in thickness for ducts 75 cm (30 in.) or more in greatest dimension.

8. Where materials with marked abrasive or wearing characteristics are transported in pneumatic conveyor ducts, heavier metal than specified in paragraph 7 shall be used.

9. Ducts for pneumatic conveyor systems shall be—

- (a) reasonably tight throughout, with no openings other than those required for the proper operation and maintenance of the systems;
- (b) substantially supported by metal brackets or hangers, and thoroughly braced where required; and
- (c) kept open and unobstructed throughout their entire length with no screens inside them.

10. Handholes for cleaning purposes in ducts for pneumatic conveyors shall be equipped with tight-fitting sliding or swinging doors provided with substantial latches.

11. The precautions necessary to avoid the accumulation of static electricity shall be taken.

Hand Feeding

12. Where material is fed by hand into pneumatic conveyors through openings 30 cm (12 in.) or larger, provision shall be made to prevent workers from being drawn into the ducts, such as by installing feed hoppers extending at least 1 m (40 in.) from the ducts.

Section 3. Power Trucks and Hand Trucks**REGULATION 172. DEFINITIONS**

In this Section the following terms have the meanings hereby assigned to them:

- (a) the term "power truck" means a power-driven wheeled vehicle not running on rails, used for carrying objects or materials or for pulling or pushing trailer trucks;
- (b) the term "tractor" means a power-driven, wheeled or caterpillar-type vehicle not running on rails, and primarily used for pulling or pushing trailer trucks;
- (c) the term "low-lift truck" means a truck provided with a low platform that can be inserted under skids on which loads have been placed, lift the skids from the floors, and support them while the truck is moved to other locations;
- (d) the term "high-lift truck" means a power truck provided with a two-pronged fork or with an elevating platform traveling in upright side rails mounted on fixed or rotatable bases, and used for transporting and piling materials;
- (e) the term "trailer truck" means a truck provided with coupling attachments by which the truck may be coupled to a tractor or power truck and moved from one location to another;
- (f) the term "hand truck" means any truck propelled by hand power;
- (g) the term "wheelbarrow" means a small, hand-propelled vehicle with a single wheel.

REGULATION 173. GENERAL PROVISIONS*Floors*

1. Factory floors over which trucking is done shall be—

- (a) constructed to support safely the concentrated heavy loads that they are intended to carry, with due regard to the speed of the trucks and the type of wheels or tyres used;
- (b) sufficiently even to afford safe trucking of materials; and
- (c) kept smooth and free from holes, projections or other obstructions.

Aisles

2. Aisleways used for trucking shall be—

- (a) so laid out as to avoid sharp turns and corners, steep inclines and ramps, narrow passageways, and low ceilings;

- (b) plainly marked on both sides for their entire length; and
- (c) kept clear of all obstructions.

3. The width of aiseways used for trucking shall be not less than—

- (a) 60 cm (2 ft.) more than the width of the widest vehicle or load, when used for one-way traffic; or
- (b) 90 cm (3 ft.) more than twice the width of the widest vehicle or load, when used for two-way traffic.

Tyres and Bearings

4. Where practicable, power or hand trucks, tractors and wheelbarrows should be equipped with rubber tyres and with ball or roller bearings.

Storage

5. When not in use, trucks, tractors and wheelbarrows shall be kept in regular storage places and protected from the weather.

Inspection and Repairs

6. All truck and tractor equipment shall be inspected at least once a week by maintenance men or other competent persons, and when any defects which are likely to lead to accidents are discovered the vehicle shall be taken out of service until repairs have been made.

REGULATION 174. POWER TRUCKS, TRACTORS AND TRAILER TRUCKS

Control Devices

1. Where practicable, operating controls for starting, travel, gear shift, steering, braking, raising or lowering, and tilting actions shall be designed with similar direction of movement for each type of control on all power trucks and tractors in any one factory.

2. Control handles on power trucks and tractors shall be protected by location or by guards against accidental contact with fixed or moving objects which might cause an unexpected movement of the vehicle or result in injuries to hands or fingers of the drivers.

Electrical Equipment

3. Electric appliances, devices, fittings and circuits on power trucks and tractors shall be constructed, installed and maintained in accordance with the requirements of Chapter V of this Code, relating to electrical equipment.

Headlights and Tail Lights

4. Where power trucks or tractors may be used after dark or travel through dimly lighted places, they shall be provided with headlights and tail lights.

Platform Guards

5. Operating platforms of power trucks and tractors shall be provided with substantial iron or steel guards to prevent the operators from being crushed in the event of collision with other trucks or with objects.

Wheel Brakes

6. Power trucks and tractors shall be equipped with effective brakes.

Wheel Guards

7. Where wheels on power trucks or tractors project beyond the truck or tractor bodies, wheel guards shall be provided.

Rear-View Mirrors

8. Power trucks and tractors shall be provided with rear-view mirrors.

Low-Lift Trucks

9. Lifting platforms of low-lift trucks shall elevate sufficiently to prevent catching of the skids when the trucks are moved on inclines.

High-Lift Trucks

10. Subject to the provisions of this Regulation, high-lift trucks shall be constructed, operated, and maintained in accordance with the requirements of Regulation 158 relating to portable floor hoists and tiering hoists.

Internal-Combustion Engines

11. Trucks or tractors propelled by internal-combustion engines shall not be operated—

- (a) in proximity to areas containing explosive dusts or flammable vapours;
- (b) in buildings where the ventilation is not sufficient to eliminate the hazards from exhaust gases; or
- (c) where the fuel tanks cannot be filled in the open air.

12. Exhausts of internal-combustion engines on trucks and tractors shall be directed in such a way as not to inconvenience the operator.

Warning Devices

13. Power trucks and tractors shall be equipped with manually-operated warning horns, whistles or gongs for use when approaching pedestrians, other trucks, corners, doorways, dangerous locations and places where visibility is insufficient.

14. Warning signals for power trucks and tractors shall—

- (a) have a sound differing from that of any other warning device in the same establishment;
- (b) be loud enough to be clearly heard over the noise of machinery; and
- (c) be standardised for all power trucks and tractors in any one establishment.

15. The location of warning devices on power trucks or tractors should be standardised for all vehicles of a similar kind in any one establishment.

Qualification of Drivers

16. Power trucks and tractors shall be operated only by thoroughly trained drivers who have passed tests for physical fitness and for ability to operate the equipment safely in accordance with the provisions of Chapter XV of this Code.

Riding on Vehicles

17. Drivers shall not permit unauthorised persons to ride on trucks, tractors and trailer trucks.

Automatic Couplers

18. Trailer trucks and power trucks should be equipped with automatic couplers so designed as to avoid deviation of the trains.

Loading and Unloading

19. Before loading or unloading power trucks, or trailer trucks attached to tractors, the brakes shall be applied and if on a grade or incline, the wheels shall be blocked.

20. Power trucks and trailer trucks shall not be loaded beyond their rated carrying capacity and the latter shall be visibly indicated in a durable way.

21. Power trucks and trailer trucks shall not be so loaded that they will become top-heavy and liable to turn over or cause the loads to spill.

22. Loads shall be placed carefully on power trucks and trailer trucks, and where necessary so secured that they cannot shift.

23. Side stakes on power trucks and trailer trucks for carrying metal parts or other heavy material shall be—

- (a) of substantial construction and free from defects; and
- (b) provided with tie chains, attached to the tops across the loads, for preventing the stakes from spreading.

Operation

24. Power-truck and tractor drivers shall check the condition of controls, brakes, warning devices and other parts before using

trucks or tractors assigned to them, and shall be authorised to refuse to move defective or improperly loaded vehicles.

25. Power trucks and tractors shall be operated at a reasonable and safe speed inside industrial establishments.

26. When operating power trucks or tractors, drivers shall—

- (a) face the direction of travel except when acting under directions from signalmen; and
- (b) keep their feet inside the platform guards while the trucks or tractors are moving.

27. When it is necessary for drivers to leave power trucks or tractors unattended, the engines shall be stopped, the brakes shall be applied, the operating controls shall be locked, and if the vehicle is on an incline the wheels shall be blocked.

REGULATION 175. HAND TRUCKS AND WHEELBARROWS

Construction

1. In order to facilitate handling and transporting of material by means of hand trucks or wheelbarrows, and to reduce the accident hazards, the hand trucks or wheelbarrows shall be—

- (a) of the proper type for the specific work in hand;
- (b) of adequate strength to withstand the loads and the treatment to which they may be subjected; and
- (c) free from cracked or broken handles, damaged wheels, loose legs and other defects.

2. Hand trucks used for transporting carboys or other unstable objects shall be designed and constructed for such specific purpose.

Brakes

3. Where push trucks are used on inclined surfaces, or where it is advisable to prevent them from moving when left standing, they shall be provided with effective brakes.

4. Two-wheeled hand trucks should be provided with brake bands which can be applied to the wheels to prevent them from turning while the trucks are being tilted with the loads.

Handles

5. Three-wheeled or four-wheeled push trucks shall be provided with spring clips or other locking devices by which the truckers can secure the handles in an upright position, and which they shall be required to use when the trucks are standing still.

6. Handles of wheelbarrows and two-wheeled hand trucks shall be so designed as to protect the hands or be provided with knuckle guards.

Loading

7. When loading two-wheeled hand trucks—

- (a) the heaviest objects shall be placed at the bottom of the load, so as to keep the centre of gravity as low as possible; and
- (b) the load shall be well balanced and so placed that it will not tip, shift or fall off the truck.

8. When loading wheelbarrows—

- (a) the load shall be well balanced; and
- (b) overloading shall be avoided.

Section 4. Plant Railways**REGULATION 176. DEFINITIONS**

In this Section the following terms have the meanings hereby assigned to them:

- (a) the term “ plant railway ” means a railway which is operated by the owners or operators of a factory, and includes both roadway and equipment;
- (b) the term “ roadways and tracks ” means permanent roads or ways having a line of rails fixed to ties or sleepers and laid to gauge, providing tracks for locomotives, cars (wagons), or other equipment of plant railways, and includes the necessary switches, turntables, and sidings;
- (c) the term “ railway equipment ” means locomotives and freight cars (goods wagons), including tank cars;
- (d) the term “ locomotive ” means a self-propelled engine mounted on a truck designed to run on gauged tracks, and used for hauling other rolling stock in the transportation of materials;
- (e) the term “ boxcar ” (box wagon) means a roofed freight car (goods wagon);
- (f) the term “ gondola car ” (open wagon) means a freight car (goods wagon) designed to run on gauged tracks, provided with raised sides and ends but without top coverings;
- (g) the term “ hopper car ” means a gondola car (open wagon) with a hopper bottom;
- (h) the term “ flat car ” (platform wagon) means a freight car (open wagon) without sides or roof;
- (i) the term “ tank car ” means a freight car on which a tank for carrying the load is permanently mounted on the car platform or the truck.

REGULATION 177. ROADWAYS AND TRACKS

Construction

1. Roadways and tracks of plant railways shall be substantially built, with due regard to the bearing capacity of the roadbeds, the quality and installation of the ties and rails, the surface curves and gradients, and the working loads and operating speed of the railway equipment.

2. Rails shall be of good material and adequate section, free from defects and uniform in weight and surface and shall be—

(a) properly fastened to the ties or sleepers; and

(b) securely fastened at the joints, with due allowance for expansion and contraction.

3. Switch or point rods and signal wires in such a position as to be a source of danger shall be adequately covered or otherwise guarded.

Inspection

4. Roadways and tracks shall be inspected at regular intervals, with due regard to the traffic which they carry.

Guard Rails

5. Guard rails, of adequate weight and securely fastened to every tie, shall be placed not more than 25 cm (10 in.) inside the inner train rails on sections of railway tracks where the curvature exceeds—

(a) 25° on tracks of 1.435 m (56½ in.) gauge line, or over;

(b) 40° on tracks of less than 1.435 m (56½ in.) gauge line; and

(c) 20° on all tracks with a grade of 2 per cent. or over.

6. Railway tracks on bridges or trestles 30 m (100 ft.) or more in length shall be provided with guard rails.

Trestles

7. Where railway tracks run on trestles or over bins into which materials are unloaded, the supporting structures shall be designed to withstand the maximum stresses to which the structure can be subjected.

8. Trestles carrying railway tracks shall be provided on both sides with footwalks, equipped on the outer sides with standard railings and toeboards and having a clearance of at least 1 m (40 in.) between the railing and the widest load that can pass over the trestle.

9. Where plant railway trestles pass over walkways, roadways, or work places, the trestles shall be provided with protective plat-

forms of sufficient size and strength to prevent any dislodged material from falling into the spaces below.

Unloading Openings

10. Where practicable, openings for bins or hoppers under plant-railway tracks used in unloading materials from drop-bottom cars or tip cars, shall be covered with gratings having openings of sufficient size to allow the materials to pass through, but not permit a person who may pass over the gratings to fall through.

Frog Guards

11. Wedge-shaped openings between the rails at frogs, switch points, and ends of guard rails shall be so filled in by suitable materials as to eliminate the danger of workers getting their feet jammed in them.

Switch Stands

12. Switch stands on plant railways shall be so constructed and installed that the levers will not be thrown at right-angles to the rails.

13. Corners on switch targets for plant railways shall be rounded.

Turntables

14. Turntables on plant railways shall be provided with locking devices which will prevent the tables from turning while locomotives or cars are being run on or off the tables.

Clearances

15. Sufficient clearance to ensure safety shall be allowed between structures or material piles and railway tracks.

16. The horizontal clearance from the sides of locomotives or the widest parts of railway cars (wagons) or their loads to structures, except loading and unloading platforms and walls of depressed tracks, to other fixed objects, or to piles of material, shall be not less than 75 cm (30 in.).

17. Between side tracks and double tracks, the horizontal clearance between the widest parts of locomotives or railway cars (wagons) shall be not less than 75 cm (30 in.).

18. Where workers may be required to ride on the top of railway cars (wagons) or their loads, the vertical clearance shall be not less than 2.15 m (7 ft.) to any structure or other obstruction, 3 m (10 ft.) to any wire, and 4.3 m (14 ft.) to any electrical conductor.

19. Where the overhead clearances specified in paragraph 18 cannot be obtained, head tappers (tell-tales) shall be installed at proper distances on each side of the structure.

20. Where factory premises are surrounded by fencing, entrance and exit gates for plant railways shall be of such width that no person can be caught between the cars (wagons) and the gate posts and no person riding on the train can strike against the gate posts: Provided that where, on existing installations, sufficient clearances cannot be obtained, the competent authority may grant exemption from the provisions of paragraphs 16 to 18, in which case plainly visible and legible "No clearance" signs shall be posted at all such places to warn train crews against the danger.

21. Where plant-railway tracks are so close to buildings that workers cannot safely stand or pass between the buildings and moving cars (wagons)—

- (a) obstruction guards shall be installed alongside the buildings to prevent use of the space for passageways; and
- (b) no door leading out of any building on to the tracks shall be permitted.

Crossings

22. All important grade crossings of plant-railway tracks should be eliminated by the use of overhead bridges or subways for vehicular or pedestrian traffic.

23. Where the construction of bridges or subways at railway crossings is impracticable—

- (a) "Danger" or "Crossing" signs, and gates or barriers, shall be provided, and supplemented at important crossings by watchmen or flagmen, or by automatic wig-wags, blinking lights or alarm bells; and
- (b) the crossing surface shall be made flush with the tops of the rails.

24. No vehicle shall be left standing within 3.0 m (10 ft.) of any authorised crossing.

25. Workers shall be prohibited from passing under or between railway vehicles standing on tracks.

Building Doorways and Blind Corners

26. Where factory buildings have doorways opening directly on to plant-railway tracks, at blind corners or at other places where the field of vision is restricted, workers shall be protected against stepping onto the tracks in front of moving vehicles by suitable warning signs and by fixed detour railings across the direct path, so installed as to ensure safe clearance for trainmen riding on cars (wagons).

Bumpers

27. Substantial bumping posts or blocks shall be installed at the ends of all dead-end or stub tracks of plant railways, with adequate space for safe passage behind the bumpers.

Derailers

28. Movable derailleurs or car blockers should be used on plant-railway sidings when located on grades, so that if the car brakes become unlocked the cars (wagons) will not run away.

Warning Signs and Obstruction Guards

29. Swinging gates and barriers on plant railways shall be secured against inadvertent opening or closing.

30. Warning signs and obstruction guards on plant railways shall be made conspicuous by painting, as, for example, with alternate diagonal stripes of black and white or black and yellow.

31. Where plant railways are operated during hours of darkness, all warning signs, obstruction guards and switch stands shall be illuminated.

Electric Railway Tracks

32. (1) Where current for electric locomotives of plant railways is transmitted by means of overhead trolley wires, all trolley contact conductors shall be so supported and arranged that the breaking of a single contact conductor fastening will not allow trolley conductors, live wires or current-carrying connections to come within 3 m (10 ft.) vertical distance from the ground or any generally accessible place.

(2) Where current for electric locomotives of plant railways is transmitted by means of third rails not located on enclosed roadways, the live rails shall be so covered by adequate guards, composed of wood or other insulating materials, as to leave only the contact side exposed, and plainly visible " Danger " signs shall be posted for warning against inadvertent contact.

REGULATION 178. LOCOMOTIVES

General Provisions

1. Plant-railway locomotives shall be equipped with grab handles and suitable running boards at both ends, or with steps, railed platforms and handholds on the front of the locomotives and the rear of the tenders, for access to or exit from the cabs.

2. Cabs of locomotives shall be provided with suitably constructed sides and roofs.

3. Plant-railway locomotives shall be equipped with effective power brakes and with bells or whistles.

4. Plant-railway locomotives shall be provided with sand boxes and ejecting mechanisms.

5. Plant-railway locomotives shall be equipped with headlights and tail-lights and with glare-free lighting for the front and rear platforms.

Steam Locomotives

6. Boilers on steam locomotives of plant railways shall be constructed, operated and maintained in accordance with the requirements of Regulation 122 of this Code relating to steam boilers; paragraphs 15 to 65 of Regulation 123, relating to medium- and high-pressure boilers; and Regulation 125, relating to operation and maintenance of boilers.

7. Solid fuel-burning locomotives of plant railways shall be provided with ash pans, no part of which shall be less than 65 mm ($2\frac{1}{2}$ in.) above the rails, and which can be dumped or emptied and cleaned without the necessity of workers going under the locomotives.

8. Steam locomotives operating where fire hazards exist shall be equipped with spark arresters on the smokestacks.

Electric Locomotives

9. Wiring on electric locomotives of plant railways shall be properly insulated.

10. Platforms for motormen on plant-railway electric locomotives, and all control levers and pedals, shall be insulated.

11. Master controls for electric locomotives shall—

- (a) be of the "dead man" type; and
- (b) have handles or levers that are removable and so arranged that it is impossible to remove or replace them unless the controls are in the "Off" position.

Internal-Combustion Locomotives

12. Internal-combustion locomotives of plant railways shall be equipped with self-starters.

13. Internal-combustion locomotives of plant railways should be equipped with suitable fire extinguishers.

14. The outer sides of all deck walks on Diesel-electric locomotives of plant railways shall be equipped with standard railings.

Compressed-Air Locomotives

15. Air tanks on plant-railway locomotives operated by means of compressed air shall be constructed and maintained in accordance with the requirements of Regulation 127 of this Code relating to pressure vessels, and paragraphs 12 to 22 of Regulation 131 of this Code relating to air pressure tanks.

REGULATION 179. RAILWAY CARS (WAGONS)*General Provisions*

1. All cars used on plant railways should be equipped with automatic couplers which can be uncoupled without the necessity of workers going between the ends of the cars.

2. All cars used on plant railways shall be equipped with—
- (a) hand brakes of efficient design so located:
 - (i) that they can be safely operated while the cars are in motion; and
 - (ii) that the brake shafts and the brake wheels do not obstruct running boards or end ladders;
 - (b) sill steps, one near each end on each side of the car, so placed that the treads are not more than 55 cm (22 in.) above the tops of the rails;
 - (c) side or end hand holds, or both; and
 - (d) push pole pockets, one at each corner of the underframe of each car or attached to the body bolsters.

3. Where necessary for their operation, boxcars (box wagons) and highside gondola or hopper cars (open wagons) shall be provided with fixed side ladders, or end ladders, or both.

Gondola and Hopper Cars (Open Wagons)

4. Gondola cars with drop ends, swinging side doors, or hopper bottoms, and hopper cars, shall be—

- (a) provided with locking devices which will keep the car ends, car sides, or car bottoms firmly closed; and
- (b) so arranged as to permit the contents to be dumped easily without requiring the workers to place themselves in a dangerous position.

Flat Cars

5. Flat cars shall be provided with permanent stake pockets, securely attached to the side sills and end sills, and spaced not more than 1.2 m (48 in.) apart.

Tank Cars

6. Tank cars operated on plant railways shall be designed, constructed and provided with safety appliances in accordance with national railway regulations.

7. Tank cars shall be provided with suitable means of safe access to all filling openings and other operating points.

REGULATION 180. OPERATION AND MAINTENANCE OF PLANT RAILWAYS

Roadways and Tracks

1. Roadways and tracks of plant railways shall be maintained in good condition, and the surface between the tracks and their

immediate vicinity shall be kept free of tools, debris and other obstacles that might create stumbling hazards.

2. Each track gang at work shall be protected by a flagman who shall clear all tracks on the approach of trains over the tracks on which the gang is working.

Turntable Pits

3. Workers shall be prohibited from entering turntable pits of plant railways without first locking the table.

Locomotives

4. Wheel flanges, brakes and other operating parts of locomotives shall be inspected daily, and when any defects which are likely to lead to accidents are discovered the locomotive shall be taken out of service until repairs have been made.

5. Warning devices, brakes, and "dead-man" devices on locomotives shall be tested by the driver at the beginning of each shift.

Steam Locomotives

6. Where steam locomotives are fired by solid fuel—

- (a) tenders or other places provided for the storage of fuel shall not be overloaded;
- (b) the loads shall be so trimmed that the fuel will not fall off during operation of the locomotives; and
- (c) shovel sheets, decks and sills shall be kept clean.

7. Ashes from solid fuel shall be dumped only in specified safe places.

8. Where water is supplied to steam locomotives from water tanks, firemen, after filling the tenders, shall return the waterspouts to the position that they should occupy when out of use.

9. Injectors on standing steam locomotives shall not be operated until the driver is sure that no workers or other persons might be scalded by steam or hot water escaping from the overflow pipe.

Internal-Combustion Locomotives

10. Filling openings of fuel tanks on internal-combustion locomotives shall be kept closed except during fuelling operations.

11. During fuelling operations the motor shall be stopped.

Electric Locomotives

12. Power equipment on electric locomotives and storage battery locomotives shall be inspected daily by plant electricians or other qualified persons.

13. On storage-battery locomotives—

- (a) the level of the electrolyte in the batteries shall be checked daily and pure distilled water added when necessary; and
- (b) the terminals shall be kept clean, and shall be coated with heavy grease after each cleaning.

14. Operators (motormen) of electric locomotives shall not leave their posts without locking the doors of the cabs or removing the control levers or handles.

Railway Cars (Wagons)

15. When a hazardous defect is found in any part of a railway car (wagon) the car shall be taken out of service until the defect is remedied.

Tank Cars

16. Tank cars shall not be used for the transportation of commodities other than those for which they are currently equipped.

17. Tanks of railway tank cars shall be tested, inspected and maintained in accordance with national railway regulations.

Qualification of Operators

18. No person under the age of eighteen shall be employed on any work involving responsibility for the movement of locomotives or other rolling stock of plant railways.

19. Locomotives shall be operated only by properly qualified employees who have passed the examinations required by the competent authority, in accordance with the provisions of Chapter XV of this Code.

Operating Signals

20. Train movements shall be governed by a uniform code of signals, with a distinctive signal for each operation.

21. Locomotive drivers shall act only on signals given by an authorised person: Provided that stop signals shall always be acted on, irrespective of their source.

22. Adequate signal equipment shall be provided for all persons authorised to give signals to locomotive drivers.

Warning Signals

23. Locomotive warning devices shall be actuated before moving standing locomotives or trains, and when approaching grade crossings, building entrances or other hazardous locations.

Riding on Equipment

24. Trainmen shall not permit unauthorised persons to ride on locomotives or railway cars (wagons).

25. Switchmen shall not ride in the gangways of locomotives between the cabs and the tenders, or on the footboards between engines and cars (wagons) that are being pushed.

26. Members of train crews shall be prohibited from riding on the tops of railway cars (wagons) while passing through building entrances or exits.

27. Members of train crews shall be prohibited from standing on tracks in front of approaching locomotives or railway cars (wagons) for the purpose of boarding the front or leading footboards or steps.

Moving of Cars (Wagons)

28. Flying switches (shunts) shall be prohibited, and all trains shall be brought to a full stop before any cars (wagons) are cut loose.

29. The use of crowbars or pinchbars for starting or moving railway cars (wagons) shall be prohibited.

30. Where it is necessary to move railway cars (wagons) not directly connected to locomotives, and no locomotive is available, the cars (wagons) should be shifted by means of—

- (a) special power-driven car movers with projecting arms at the sides, operated on adjacent tracks; or
- (b) manually or mechanically operated winches or capstans, installed in fixed positions alongside the tracks and provided with substantial screens of wire or expanded metal behind the drums for protection of the winch operators in case the cables break under tension.

31. The movement of railway cars (wagons) on adjacent tracks or on cross-overs by means of push poles between engines and cars (wagons) shall be prohibited unless it is impracticable to move the cars (wagons) with engines in any other manner.

32. Where push poles are used for moving railway cars (wagons) with engines on adjacent tracks, workers handling the poles shall face the direction of the motion so that the poles will move away from them.

33. When a railway car (wagon) or a group of cars not directly connected to a locomotive is being moved, a worker shall be appointed to control each car (wagon) or group it by means of the hand brake.

34. Before moving railway cars (wagons), train crews shall make sure that all plant workers are out of the cars (wagons) and the danger zone.

35. When engines or railway cars (wagons) are being moved into or out of buildings, a member of the train crew shall walk ahead of the engine or the cars (wagons) to warn any person who

may be in the way or who might step in front of the approaching rolling stock.

Protecting Standing Cars

36. After one or more railway cars (wagons) have been placed for repairs, the hand brakes shall be applied or the wheels blocked, and a distinctively coloured metal flag during the day, or a distinctively coloured light at night, shall be placed at each end of the car (wagon) or group of cars (wagons), in a position where it is visible from any approaching vehicle on the line, and kept there during the time that workmen are engaged about or under the rolling stock, to give warning that the equipment must not be coupled or moved until after the signals have been removed by the persons who placed them.

37. On repair tracks where workers may go between and underneath railway cars (wagons), and on tracks for loading or unloading tank cars carrying flammable, corrosive, explosive or other dangerous substances, the switch or switches shall be locked.

38. Tracks on which tank cars for the transportation of flammable liquids are placed for loading and unloading should be devoted solely to that purpose.

39. Tank cars used for transporting flammable liquids or gases when placed at loading stations shall be grounded and electrically connected to the loading spouts.

Loading and Unloading

40. The person in charge of the train shall be authorised to refuse to handle freight cars (goods wagons) which are improperly loaded and might endanger life.

41. Where gangplanks are used by workers loading or unloading from or to loading platforms, they shall be secured in place by positive means, such as cleats near each end on the underside of the planks, or dropbolts between the cars and the platform.

42. Workers shall be prohibited from being inside gondola cars (open wagons) during removal of bulk material by means of grab buckets, or of metal stock by means of electro-magnets.

43. Where gondola cars (open wagons) with swinging side doors or with drop bottoms, or hopper cars, are being emptied near passageways or walkways, danger signs shall be placed at either end of the exposed sections.

44. During unloading operations no worker shall enter a swinging side door or drop-bottom gondola car (open wagon), or a hopper car, when the doors are open or about to be opened, unless—

- (a) he is wearing a lifebelt attached to a lifeline that is as short as practicable and securely fastened to the top of the car or other fixed object; and
- (b) another worker is stationed outside during the entire operation to render such assistance as is needed.

45. Where wrenches are used for opening drop doors on gondola cars (open wagons) with hopper bottoms, or on hopper cars, they shall be of the safety type, provided with a hinged jaw that releases when the door shaft starts to revolve and with a safety disc that will prevent the fingers of the operator from being crushed between the handle and the car or the ground.

46. Material unloaded from freight cars (goods wagons) to the ground—

- (a) shall not, except as necessary for unloading operations, be placed inside the clearance lines for railway tracks; and
- (b) shall be so placed or piled that it will not slide or otherwise shift toward the tracks.

47. The side clearance for railway tracks shall be checked immediately after unloading of freight cars (goods wagons) has been completed, and any material found inside the clearance line shall be removed at once.

48. Tank cars that leak, or have defects which would make leakage during transit probable, shall not be used for the transportation of corrosive, flammable or poisonous liquids, pastes or semi-solids, or compressed gases.

49. Before starting to load tank cars, measures shall be taken to make sure that the safety and outlet valves, the safety vents, the closures for all openings and the protective covers of all appliances are in proper condition.

50. Outlet valve caps on tank cars equipped with bottom discharge outlets, and heater-coil inlet and outlet caps on tank cars equipped with interior heater coils, shall be left off during the entire time the tanks are being loaded, and should any leakage appear at such inlets and outlets the tank car shall not be transported until proper repairs have been made.

51. Tank cars used for the transportation of corrosive, flammable or poisonous liquids, pastes or semi-solids, or compressed gases, shall be attended during the entire period of unloading, and shall not be allowed to stand with unloading connections attached after the unloading is completed.

52. If it is necessary for any reason to discontinue unloading of corrosive, flammable or poisonous liquids, pastes or semi-solids, or compressed gases, from tank cars, all unloading connections shall be disconnected.

Section 5. Piping Systems

REGULATION 181. INSTALLATION AND MAINTENANCE OF PIPING SYSTEMS

Definitions

1. In this Section the term "piping system" means one or more conduits, including their valves and fittings, used within or in connection with factories for the transportation of gases, vapours, liquids, semi-liquids or plastics, but does not include process apparatus or parts thereof or pipes for carrying solids in air or gas, or electric conduits.

Material

2. Pipes, fittings and valves used in piping systems shall be of materials capable of resisting the chemical action of the substances handled and suitable for the maximum pressure and temperature to which they may be subjected.

Installation

3. All piping systems shall be so installed as to prevent accidental syphoning of the content of any vessel.

4. Pipe lines of piping systems shall be—

- (a) so provided with pipe bends, offsets or expansion joints as to ensure free expansion and contraction;
- (b) securely anchored at points between bends or expansion joints with the remainder of the piping carried on adjustable hangers or properly aligned supports; and
- (c) provided with inspection and drainage openings at appropriate places, and among others, at the lowest point of each circuit.

5. Where pipe lines carrying hot substances pass through walls, partitions, floors or other parts of buildings—

- (a) when the building parts are constructed of combustible materials, protecting metal sleeves or thimbles, which give a clearance of not less than 6 mm ($\frac{1}{4}$ in.) all round the pipes or pipe coverings, shall be provided;
- (b) when the building parts are of metal, a clearance of not less than 6 mm ($\frac{1}{4}$ in.) shall be left round the pipes or pipe coverings; and
- (c) regardless of building construction, the pipes shall be provided with insulating covers when conveying steam, gases or liquids at a temperature exceeding 100° C. (212° F.).

6. Piping systems for transporting flammable liquids should not run close to boilers, motors, switches or open flames where drips might be ignited.

7. Joints and valves of piping systems for transporting acids, alkalis or other corrosive liquids shall be provided with devices for collecting drips.

8. Lines of piping systems for the distribution of fuel gas or fuel oil should be placed underground.

9. Underground lines of piping systems located outside buildings in cold climates should be installed below the frost line, or otherwise protected against frost.

Identification and Instructions

10. Pipes, fittings and valves of piping systems shall be—

- (a) so arranged that they can be easily traced; and
- (b) distinctively coloured or marked at conspicuous places for identification of the contents.

11. Directions should be posted in conspicuous places at distributing ends of piping systems, to indicate plainly what precautions should be taken in handling the contents.

Valves and Cocks

12. Cocks and non-rising stem valves on piping systems shall be equipped with indicators to show whether they are open or closed.

13. Automatic control valves shall be capable of being bypassed or otherwise so installed in the line as to permit manual operation in the event of failure of the automatic valves.

14. Piping connections to vessels or units of equipment which may be isolated from operating units to be entered by workers for cleaning or repairs shall be installed with double valves having bleeders between them, or so arranged that they can be disconnected or blanked off.

15. Stems and bonnets of valves on piping systems conveying acids or other corrosive liquids under pressure shall be covered with metal hoods or shields.

Drains

16. Suitable drains, drips or traps shall be provided wherever necessary to drain condensation or oils from any section of piping systems where they may accumulate, with at least one valve fitted in each drain or drip line.

Inspection

17. Piping systems shall be inspected at regular and frequent intervals and all faulty valves, leaky connections and corroded lengths of pipe shall be replaced.

Section 6. Lifting, Carrying, Piling and Storage of Material**REGULATION 182. LIFTING AND CARRYING MATERIAL***Limitations*

1. Where practicable, mechanical appliances shall be provided and used for lifting and carrying materials and articles.

Methods

2. Workers assigned to handle material shall be instructed how to lift and carry material safely.

3. Where heavy objects are lifted or carried by two or more workers, the raising and lowering of the loads shall be governed by well-understood signals in order to ensure unity of action.

4. Where heavy objects, such as loaded drums or tanks, are handled on inclines in either direction—

- (a) ropes or other tackle shall be used to control their motion, in addition to the necessary chocks or wedges; and
- (b) workers shall be prohibited from standing on the down-hill side.

5. Where heavy objects are moved by means of rollers, bars or sledges shall be used instead of hands or feet for changing the direction of the rollers while in motion.

Protective Equipment

6. Workers handling objects with sharp edges, fins, slivers, splinters or similar dangerous projecting parts, or handling hot, caustic or corrosive materials, shall be provided with and shall use suitable protective clothing and equipment conforming to the requirements of Chapter XIV of this Code.

REGULATION 183. PILING MATERIAL*General Provisions*

1. Material shall be so piled that the piles will not interfere with—

- (a) the adequate distribution of natural or artificial light;
- (b) the proper operation of machines or other equipment;
- (c) the unobstructed use of passageways or traffic lanes; and
- (d) the efficient functioning of sprinkler systems or the use of other fire-fighting equipment.

2. Material piles shall be placed on firm foundations not liable to settle and shall be subject to weight control so as not to overload the floors.

3. Material shall not be piled against partitions or walls of buildings unless it is known that the partition or wall is of sufficient strength to withstand the pressure.

4. Material shall not be piled to a height which would render the pile unstable.

Bags

5. When piling heavy bagged material—

- (a) the mouths of the bags shall be placed inwards;
- (b) the first four end bags of each pile shall be cross-tied; and
- (c) a step-back of one bag shall be made at every fifth bag in height.

Boxes, Crates and Cartons

6. (1) Unless specific instructions are given to the contrary, loaded boxes and crates shall be piled on the sides having the largest area.

(2) The piles shall be effectively cross-tied by suitable means.

7. Loaded cartons shall not be piled to such a height as to cause collapse of the lower cartons in the pile and shall be protected against moisture.

Lumber

8. In order to avoid overheating and ensure stability, lumber should be piled on supports above the ground, with horizontal or slightly inclined layers separated by tie pieces, the ends of which will not project into walkways.

Pipe and Bar Stock

9. Pipe and bar stock should be piled on stable storage racks so located that the withdrawal of the material does not create a hazard.

10. Where storage racks are not provided for pipe and bar stock, the stock shall be piled in layers resting on wood strips with stop blocks fixed on the ends or on metal bars with upturned ends.

Round Objects

11. Where empty barrels or drums, large pipe, rolls of paper or other cylindrical objects are piled on their sides—

- (a) the pile shall be symmetrical and stable; and
- (b) every unit in the bottom row shall be carefully wedged.

12. Where loaded barrels, drums or kegs are piled on their ends, the piles should be low and two planks should be laid side by side on top of each row before another row is started.

Equipment and Products

13. Equipment or objects, such as foundry flasks, forging dies, foundry castings and the like, shall be piled in a stable orderly way on level and substantial foundations and arranged in order of size and type.

REGULATION 184. STORAGE

Definitions

1. In this Regulation the following terms have the meanings hereby assigned to them:

- (a) the term "flammable liquid" means a liquid with a flashpoint of 100° C. (212° F.) or less;
- (b) the term "non-flammable liquid" means a liquid with a flashpoint above 100° C. (212° F.);
- (c) the term "above-ground tank" means a tank no part of which is below the level of the surrounding ground;
- (d) the term "sunken tank" means a tank that is partly or wholly below the level of the surrounding ground but is not covered by at least 60 cm (2 ft.) of earth; and
- (e) the term "buried tank" means a tank so buried underground as to be covered by at least 60 cm (2 ft.) of earth.

General Provisions

2. All objects and material shall be so placed or stored as to be secure against falling.

Hazardous Substances

3. Commercial explosives, flammable liquids, compressed gases, coal and other materials of a flammable nature shall be stored in compliance with the requirements of Regulations 45 to 50, relating to fire prevention and fire protection.

4. Chemicals which might react together to give off dangerous fumes or cause fire or explosion shall be stored remote from each other.

Storage Tanks for Flammable Liquids

5. (1) All storage tanks for flammable liquids shall be equipped with a filling pipe having contact with the bottom of the tank and electrically connected to it.

(2) The precautions necessary to avoid the accumulation of static electricity shall be taken.

6. The storage of flammable liquids in above-ground tanks shall be subject to an authorisation by the competent authorities.

7. The amount of flammable liquids which may be stored in tanks buried underground shall be limited on the basis of the distance from, and the location of, buildings or prospective building

sites with due regard to the hazards of fire and explosion during transport to the tanks and during filling and unloading.

8. Above-ground tanks for storing flammable liquids shall be—

- (a) placed on firm foundations of non-combustible material at a distance of at least 20 m (65 ft.) from any building;
- (b) surrounded with pits, catch basins or depressions of sufficient size to hold the contents of the tanks in the event of rupture, provided that the size of the pit, catch basin or depression shall be at least—
 - (i) 10 per cent. more than the content of a single tank;
 - (ii) 80 per cent. of the contents of the tanks, if there are at least two tanks which are surrounded by the same pit, catch basin or depression, provided that their combined contents do not exceed 250,000 l (50,000 gal.); or
 - (iii) 50 per cent. of the contents of the tanks, if there are at least two tanks which are surrounded by the same pit, catch basin or depression, provided that their combined contents exceed 250,000 l (50,000 gal.);
- (c) provided with adequate fire-extinguishing equipment;
- (d) constructed in such a way that no pressure or vacuum can exist in the tanks above the liquid; and
- (e) equipped with effective protection against lightning.

9. Tanks buried underground for storing flammable liquids shall be—

- (a) placed in a firm and rigid position with no part higher than 50 cm (20 in.) beneath the ground level;
- (b) protected against outside corrosion;
- (c) fitted with a filling pipe that ends outside any building and shall be—
 - (i) locked except during filling operations; and
 - (ii) suitably protected against external damage;
- (d) in no other contact with the atmosphere than by a vent pipe which shall always be open, and a control-pipe for measuring the liquid which shall be locked except during control operations; and
- (e) so constructed that they can resist an internal pressure of 7 kg/cm² (100 lb./sq. in.).

10. The vent pipe shall—

- (a) extend into the atmosphere not less than 2.5 m (8 ft.) above the ground level in a location remote from fire escapes, chimneys, any building openings or places where vapour can accumulate; and
- (b) be not more than 20 mm ($\frac{3}{4}$ in.) in diameter if a vapour return pipe is used and at least 25 mm (1 in.) in diameter if there is no vapour return pipe.

11. If the tank is used for a liquid with a flashpoint below the maximum normal temperature of the locality, adequate measures shall be taken to prevent the presence of an explosive vapour-air mixture in the tank or the ventilation pipe shall have an effective flame arrester at the end extending in the atmosphere.

Storage Tanks for Non-Flammable Hazardous Liquids

12. Tanks used for storing non-flammable hazardous liquids should be—

- (a) located above ground or floor level;
- (b) so supported that leakage from any part of the tank will be noticeable;
- (c) surrounded with pits, catch basins or depressions of sufficient size to hold the entire contents of the largest tank in the event of rupture;
- (d) covered with protective paint to prevent corrosion from moisture or fumes; and
- (e) provided with stairways or permanent ladders, and platforms where necessary, for convenient and safe access to all parts of the tank, with standard railings on both stairways and platforms and preferably with floors of platforms constructed of grating.

13. Where necessary, above-ground tanks used for storing non-flammable hazardous liquids shall be suitably protected against low temperatures.

14. Tanks used for storing non-flammable hazardous liquids shall not be placed above passageways.

15. Where tanks used for storing non-flammable hazardous liquids are installed in pits below ground level—

- (a) the pits shall be made of concrete or masonry, with sufficient space between the walls and the tank to permit the passage of a person at any point; and
- (b) the tanks shall be mounted 38 to 45 cm (15 to 18 in.) above the bottom of the well.

16. Pits containing sunken tanks used for storing non-flammable hazardous liquids—

- (a) shall be kept free of water; and
- (b) should be provided with covers and fixed ladders for safe access.

17. All control valves for sunken tanks used for storing non-flammable hazardous liquids shall be—

- (a) so situated or of such design that they can be turned without any person entering the pit; and
- (b) provided with locking devices operated from outside the pit.

18. Where it is necessary for workers to enter storage-tank pits which might contain hazardous vapours or fumes, the provisions of paragraph 23 of Regulation 212 of this Code shall apply.

19. Tanks used for storing non-flammable hazardous liquids shall be—

- (a) placed on foundations that will resist action by the contents of the tank; and
- (b) provided with overflow pipes discharging into a safe place.

20. Tanks used for storing corrosive or caustic liquids shall be provided with—

- (a) a permanently open vent pipe, not less than 5 cm (2 in.) in diameter, at the highest point in the tank; and
- (b) a drain connection at the lowest point in the tank discharging into a safe place.

21. Tanks used for storing corrosive or caustic liquids shall have the filling connection at the top and the discharge pipe 15 cm (6 in.) above the bottom.

Barrels and Drums for Hazardous Liquids

22. Where barrels or drums containing flammable liquids are stored in special store rooms inside factories or in small isolated store houses, the store room or house shall be of fire-resisting construction and—

- (a) the floor of the store room or house shall—
 - (i) slope to a drain pipe leading outside to a catch basin not connected to a sewer; and
 - (ii) be waterproof, with the waterproofing extended up the side walls for not less than 7.5 cm (3 in.); and
- (b) the barrels or drums shall be placed on cement platforms, concrete blocks, brick or metal racks.

23. Drums containing acids shall be stored in cool places with the bung up; they should be carefully opened sufficiently to relieve any internal pressure, and subsequently sealed again, with the operation repeated each time the drum has been moved or once a week if stored for a period of time.

24. When barrels or drums containing hazardous liquids have been emptied, and are stored for re-use—

- (a) if used for flammable liquids, the bungs or outlet plugs shall be replaced and securely tightened in order to confine all flammable vapours, and the drums removed to outside storage spaces, apart from storage for filled containers and these be left open; and
- (b) if used for acids or other non-flammable liquids, the drums shall be promptly cleaned, and stored apart from filled containers.

25. (1) When barrels or drums which have contained hazardous non-flammable liquids are unfit for further use, they shall be destroyed by being crushed or broken up so as definitely to prevent any further use.

(2) Barrels or drums used for flammable liquids should be steamed before being crushed or broken up.

26. (1) Drums and barrels used for hazardous liquids, and intended for further use, shall be closely inspected for leaks and other defects, and if to be used for a different liquid shall be thoroughly cleansed with an appropriate neutralising solution, steam or boiling water, and drained, dried and reinspected, with the operations repeated until the inside is entirely clean.

(2) If it is necessary to carry out an inspection of the inside of the drums or barrels with portable electric lamps, these lamps shall be designed in accordance with the relevant provisions laid down under Chapter V of this Code.

Carboys for Acids

27. Carboys containing acids should be encased singly in baskets or in boxes cushioned with non-combustible packing.

28. Carboys containing acids should be stored in separate store-rooms or buildings with concrete floors having an anti-acid protection or with brick floors, properly drained to catch basins, and should not be subjected to dampness, extreme heat or sudden changes in temperature.

29. Carboys containing acids shall not be piled one on top of another, but should be placed in suitable storage racks or on wooden strips laid on the floor.

30. (1) Special handling equipment, such as two-wheeled carboy trucks, shall be provided for transporting carboys containing acids to and from storage.

(2) Adequate equipment shall be provided and used for the emptying of such carboys.

31. Before empty acid carboys are stored, they shall be thoroughly washed out by turning them upside down over an upward stream of water, and drained.

32. Empty acid carboys shall be stored apart from filled carboys.

33. Carboys together with their baskets or boxes shall be examined as to their condition before the carboys are filled.

Storage Bins for Dry Material

34. Dry bulk material should be stored in bins which will permit removal from the bottom.

35. Open-top hopper bins containing bulk material which is discharged at the bottom either by hand or by mechanical means

shall be covered with gratings which will allow the use of pokers to break up bridging of the stored material, but which will prevent workers from falling into the bins.

36. Where it is necessary for workers to enter bins used for storing dry bulk material—

- (a) each worker shall be provided with, and shall use, a lifebelt attached to a lifeline that is as short as practicable and securely fastened to a fixed object; and
- (b) another worker shall be stationed outside during the entire operation to render such assistance as is needed.

37. Workers shall not be permitted to enter bins used for storing dry bulk material until all supply of material to the bin has been discontinued and precautions have been taken against accidental renewal.

38. Bins used for storing dry bulk material shall be provided with stairways or permanent ladders, and platforms where necessary, for easy and safe access to all parts, with standard railings on both stairways and platforms.

39. Bins used for storing combustible dry materials shall be of fire-resisting construction and provided with lids and an adequate ventilation system.

40. Where dry bulk material is piled and removed manually, undermining of piles shall not be permitted.

41. Special precautions shall be taken where the dry material stored is such as to lead to the formation and release of explosive or toxic mixtures.

CHAPTER X

DANGEROUS AND OBNOXIOUS SUBSTANCES

Section 1. General Provisions

REGULATION 185. DEFINITIONS

In this Chapter the following terms have the meanings hereby assigned to them:

- (a) the term "fibres" means any tough solid substance composed of threadlike tissue, whether of mineral, vegetable or animal origin;
- (b) the term "dusts" means solid particles capable of being blown about or suspended in the air, which are generated by handling, crushing, cutting, drilling, grinding, rapid impact, spraying, detonation or disintegration of inorganic or organic materials such as coal, grain, metal, ore, rock or wood and are of a composition similar to the substance or substances from which they are derived;
- (c) the term "fumes" means suspended solid particles which are generated by condensation from the gaseous state, generally after volatilisation from molten metals or formation of incomplete combustion products from fuel or other organic substances, and differ from the substance of their origin;
- (d) the term "gases" means normally aeriform fluids which have neither shape nor specific volume but tend to expand indefinitely and which can be changed to the liquid or solid state by the effect of increased pressure or decreased temperature;
- (e) the term "mists" means suspended liquid droplets generated by condensation from the gaseous to the liquid state or by breaking up of a liquid into a dispersed state, such as by atomising, foaming or splashing;
- (f) the term "vapours" means the gaseous form of substances which are normally in the liquid or solid state, and which can be changed to these states either by increasing the pressure or decreasing the temperature alone.

REGULATION 186. GENERAL RULES

Scope

1. The provisions of this Regulation shall apply to all factory premises in which harmful substances in solid, liquid or gaseous

form are manufactured, handled or used, or in which flammable, infectious, irritating, offensive or toxic dusts, fibres, fumes, gases, mists, vapours or ionising radiations are generated or released in quantities liable to injure health.

Reduction of Hazards

2. Where practicable, harmless substances shall be substituted for harmful substances.

Methods of Protection

3. Unless otherwise specifically excepted by the competent authority, processes that involve hazards should be carried on in separate rooms or buildings with a minimum number of workers and with special precautions.

4. Unless otherwise specifically excepted by the competent authority the processes shall be carried out in airtight apparatus, so as to prevent personal contact with the harmful substances and the escape of dusts, fibres, fumes, gases, mists or vapours into the air of any room in which persons work.

5. Where airtight apparatus cannot be used, harmful dusts, fibres, fumes, gases, mists or vapours shall, unless otherwise specifically excepted by the competent authority, be removed at or near their point of origin by means of fume chambers or suction hoods properly connected to efficient exhaust systems conforming to the requirements of Section 2 of Chapter XIII of this Code.

6. (1) Where necessary, the workers shall be provided with, and shall use, personal protective clothing and personal protective equipment conforming to the requirements of Chapter XIV.

(2) Personal protective equipment alone shall not be depended upon to protect workers against hazardous substances, except in connection with isolated or infrequent operations, but may be used together with positive measures to remove the risk where such measures cannot be made to ensure adequately safe conditions.

Marking, etc., of Containers

7. Containers filled with hazardous substances shall be—

- (a) plainly painted, marked or labelled in a distinctive manner so as to be readily identifiable; and
- (b) accompanied by instructions for safe handling of the contents.

Testing of Atmosphere

8. The atmosphere of workrooms shall be tested periodically at such intervals as may be necessary to ensure that the concentration of irritating or toxic dusts, fibres, fumes, gases, mists or vapours is kept within the limit specified by the competent

authority and periodically revised by this authority in keeping with new developments in the science of industrial pathology.¹

Ventilation and Exhaust Systems

9. Ventilating and exhaust equipment shall be constructed, installed, operated, inspected, tested and maintained in conformity with the requirements of Section 2 of Chapter XIII of this Code.

Prevention of Dust Accumulation

10. (1) All parts of the structure and equipment of rooms in which harmful dust is liberated shall be so designed and installed that surfaces on which dust can accumulate are reduced to a minimum.

(2) All parts of such rooms and equipment shall be frequently cleaned in accordance with Regulation 193, paragraph 8, and Regulation 215 of this Code.

Floors

11. Where practicable, floors of rooms in which harmful dust is liberated shall—

- (a) be smooth, impervious and easy to clean; and
- (b) not be covered with loose linoleum, loose sheets of metal or other material under which the dust might accumulate.

Section 2. Flammable and Explosive Substances

REGULATION 187. GENERAL RULES

Scope

1. The provisions of this Regulation, together with the provisions of Regulation 186, shall apply to premises in which—

- (a) explosive or particularly flammable substances are manufactured; or
- (b) explosive gases, vapours, fumes or dust may occur.

Segregation

2. (1) Operations involving an explosion risk shall be carried on in separate buildings situated at such distances as may be specified by the competent authority or in rooms separated from one another and from other rooms or compartments by approved type of fire-resisting walls.

¹ As a guide, see Appendix III.

(2) Any necessary doors shall be self-closing and fire-resisting and any such doors provided in the explosion-resisting wall shall in addition be explosion resisting.

(3) Such distances as may be determined by the competent authority shall be kept clear all around the premises and no fire, forge, furnace, drier or other source of ignition shall be allowed within such safety zone.

Explosion Vents

3. Explosion vents should be provided in accordance with paragraph 2 of Regulation 193 of this Code.

Floors

4. Floors shall be—

- (a) impervious and incombustible; and
- (b) of such material that objects falling or sliding on them cannot generate sparks.

Prevention of Escape of Liquids

5. (1) In premises in which flammable liquids are manufactured, handled or used, arrangements shall be made to convey to a safe place all flammable liquids which may escape due to failure of any vessel or the overflow or accidental discharge of the liquid.

(2) Buildings or premises containing flammable or explosive liquids should be—

- (a) surrounded by a watertight wall of such a height that the enclosed space is large enough to contain all the liquid; or
- (b) constructed in such a way that no liquid can spread outside the building, whether under the action of fire or otherwise.

Exits

6. (1) In every room in which flammable or explosive substances are manufactured, handled or used there shall be provided adequate means of escape from every point at which a person is employed.

(2) Such means of escape shall—

- (a) consist of at least two exits with outward opening doors; and
- (b) be kept free from obstructions.

Electrical Equipment

7. All electrical equipment in industrial establishments shall comply with the requirements of Regulation 114 of Chapter V of this Code.

Smoking, etc.

8. Smoking and the carrying of matches, open lights, incandescent objects or any other substance likely to cause explosion

or fire shall be prohibited within the safety zone of the workrooms, and warning notices to this effect shall be posted at conspicuous places.

Heating

9. (1) No heating system shall be used in which an exposed heating element is of such temperature that it is capable of igniting any material, dust or vapour in any room.

(2) The temperature of the heating elements shall be so regulated as not to exceed a maximum limit to be determined by the competent authority.

(3) Radiators shall be—

- (a) smooth, without gills;
- (b) at least 15 cm (6 in.) from wooden walls and combustible substances; and
- (c) protected against deposits of dust and against splashes of flammable or explosive liquid.

10. Where highly volatile flammable substances are used or kept, special provision should be made to prevent excessive temperatures of the atmosphere in the workrooms.

Static Electricity

11. The provisions of Regulation 114 of Chapter V of this Code shall apply for the protection against hazards caused by static electricity.

Footwear

12. Workers shall wear boots or shoes without iron or steel nails or any other exposed ferrous material.

Fire-Detecting Equipment

13. (1) The premises shall be provided with effective automatic fire-alarms of a type approved for each particular purpose by the competent authority.

(2) Provision shall be made for manual operation of the fire alarms.

Fire-Extinguishing Equipment

14. The premises shall be provided with one or more types of fire-extinguishing equipment as required by the competent authority.

15. All fire-extinguishing equipment shall be—

- (a) maintained in good order; and
- (b) examined at intervals not exceeding three months.

16. An adequate number of workers shall be instructed in the use of the fire-extinguishing equipment.

Apparatus

17. In so far as is practicable all apparatus liberating flammable or explosive gases, vapours, fumes or dust shall be—

- (a) installed in an adequate enclosure;
- (b) provided with adequate equipment for removal of the gases, vapours, fumes or dust;
- (c) without any source of ignition; and
- (d) either of explosion-proof construction or provided with adequate explosion-relief devices and with devices, such as chokes and baffles, to prevent the spread of explosion.

Transfer of Flammable Liquids

18. Pneumatic transfer of flammable solvents or other flammable liquids should be effected by means of an inert gas.

19. Flammable liquids shall only be introduced into vessels through inlet pipes having contact with the bottom or the side of the vessel and electrically connected to the latter.

20. Vapour return lines should be provided in all installations used for the transfer of flammable liquids from one closed vessel to another.

Floor Drains

21. Floor drains in premises where flammable liquids are manufactured shall be—

- (a) of a capacity sufficient to remove the water from all the sprinklers liable to operate at one time, together with the water from at least one hose stream, without overflowing at the door sills; and
- (b) connected to a waste water tank equipped with an overflow pipe so arranged that excess water can be drawn off, leaving the lighter flammable liquids above the remaining water for collection and recovery.

Recovery of Gases and Vapours

22. All gases and vapours liberated in the manufacture of flammable liquids should be recovered or disposed of in a safe manner.

Hazardous Mixtures of Gases

23. In premises producing different types of gases, which individually are not explosive but react violently if mixed, the equipment for the manufacture of each type, except as provided in paragraph 24 of this Regulation, shall be installed in rooms separated from the rooms for the other types by means of an open space of sufficient width or by adequate explosion-resisting walls.

24. The electrolytic production of hydrogen and oxygen, hydrogen and chlorine, and hydrogen and fluorine may be carried

on in the same rooms provided that they are separated from rooms for the production of other gases.

Storage

25. Flammable liquids and gases shall be stored in accordance with the requirements of Regulation 184 relating to storage.

Irritating or Poisonous Substances

26. Where flammable or explosive substances are also irritating or toxic, additional precautions shall be taken against contact, ingestion or inhalation, in accordance with the relevant provisions of Regulations 198 to 201 relating to irritating or poisonous substances.

REGULATION 188. MANUFACTURE OF COMMERCIAL EXPLOSIVES

Authorisation

1. No commercial explosives shall be manufactured or stored except at places and subject to conditions approved by the competent authority.

2. No building authorised by the competent authority for the manufacture of commercial explosives shall be used for any other purpose.

3. Special precautions as laid down by the competent authority shall be taken where particular explosives of exceptionally high hazard are manufactured or stored.

Situation

4. Explosives factories shall be situated at such distances from other occupied buildings, railways, public roads, furnaces, boilers, etc., not a part of the factory, as shall be determined by the competent authority with due regard to the nature of the explosives manufactured or stored.

5. The different buildings of an explosives factory shall be at such distances from one another as shall be determined by the competent authority, with due regard to the nature of the explosives manufactured or stored.

Enclosure of Danger Buildings

6. (1) Every danger building shall be surrounded by—

- (a) an earth embankment;
- (b) an earth-filled wall; or
- (c) a masonry wall.

(2) The embankments or walls shall be at least 1 m (40 in.) distant from the building at ground level.

7. Earth embankments shall be at least—

- (a) 1 m (40 in.) higher than the building;
- (b) 1 m (40 in.) broad at the top and sloped at the natural angle of repose towards the base; and
- (c) 1 m (40 in.) distant from the building at ground level.

8. Passageways through embankments shall be such that persons passing by the openings cannot be injured by the force of an explosion or by sheets of flame.

9. Earth-filled walls shall—

- (a) consist of facings of corrugated iron or other suitable incombustible material with the space between them tapering towards the top and filled with earth; and
- (b) be at least 1 m (40 in.) broad at the top.

10. Masonry walls, unless of reinforced concrete, shall be at least 75 cm (30 in.) broad at the top and at least 1 m (40 in.) broad at the base.

Construction

11. Danger buildings shall be—

- (a) limited in height to one storey; and
- (b) constructed of material that in the event of an explosion will not break into large fragments.

Exits

12. Exit doors shall—

- (a) be as large as possible;
- (b) open outwards easily; and
- (c) lead directly into the open.

Inside Walls

13. Inside walls of danger buildings shall be—

- (a) smooth and free from cracks;
- (b) coated with a light-coloured coating; and
- (c) easy to clean.

Floors

14. Floors of danger buildings shall be—

- (a) made of or faced with soft material such as wood, asphalt free from sand, rubber, lead and linoleum;
- (b) perfectly smooth and free from cracks and crevices;
- (c) without iron nails or screws; and
- (d) easy to clean.

Windows

15. Windows of danger buildings shall—

- (a) be dimmed on sides of the building exposed to the sun; and
- (b) open outwards easily.

Number of Persons in Workrooms

16. The number of persons in any danger building shall be the minimum required for the process or processes carried on in such building.

Quantities of Explosives in Workrooms

17. The quantities of explosives and ingredients thereof in any workroom shall be the minimum required for the process or processes carried on in such room.

Separation of Work Tables

18. Work tables used in the processing or packing of explosives shall be provided with individual stations, separated from each other by means of partitions at least 1 m (40 in.) in height.

Lightning Protection

19. (1) All danger buildings shall be equipped with adequate lightning protection systems.

(2) Lightning conductors and other devices for protection against lightning shall be thoroughly examined by a competent person at intervals not exceeding twelve months.

(3) Any faults discovered in such conductors and devices shall be rectified without delay.

Tools

20. All tools and implements used in a danger building shall be made of, or effectively covered with, non-sparking material.

Smoking, Open Lights, etc.

21. (1) No person shall smoke in or near any part of the danger area of the factory, or carry any open light, incandescent object, matches or any other substance or article liable to cause explosion or fire.

(2) Receptacles shall be provided in safe places for the deposit of smoking material and any other articles referred to in subparagraph (1).

(3) Adequate arrangements shall be made, by searching and otherwise, to ensure compliance with the provisions of subparagraph (1).

Vehicles, etc.

22. Every vehicle, truck or other receptacle in which explosives, or the partly mixed ingredients thereof, are conveyed to or from a danger building in a factory shall—

- (a) be constructed without any exposed iron or steel in the interior thereof;
- (b) contain only explosives and ingredients thereof;
- (c) be closed or otherwise properly covered; and
- (d) when loaded be moved with all due caution so as effectively to prevent any ignition.

Raw Materials

23. Before being processed, powdery raw materials shall be thoroughly freed of mechanical admixtures.

24. If explosive materials are spilled during transport—

- (a) the place shall be conspicuously marked;
- (b) the supervisor shall be informed; and
- (c) the spillage shall be removed under expert supervision.

Articles Liable to Spontaneous Ignition

25. Charcoal, whether ground or not, oily cotton, oily rags, oily waste and any other articles whatever, liable to spontaneous ignition, shall not be taken into any danger building except for immediate use in such building and shall be removed without delay after use.

Acids and Other Chemicals

26. Acids and other chemicals necessary in the manufacture of commercial explosives shall be handled and used in accordance with the relevant requirements of this Code relating to such chemicals.

Waste

27. Dangerous waste shall not be buried.

28. Waste of different kinds of powdery substances shall not be mixed together.

29. All detonating bodies, such as caps and cartridges with igniters, shall be carefully removed from waste.

30. Waste shall be burned only by a specially appointed person and under expert supervision.

Clothing, etc.

31. All persons in and around danger buildings shall be prohibited from—

- (a) wearing shoes with iron or steel nails or any other exposed ferrous material;

- (b) wearing clothes with iron or steel buttons, buckles or any other exposed ferrous attachments; and
- (c) carrying knives, keys or other ferrous materials in their pockets.

Personnel

32. No person under the age of 18 shall be employed in any building where specially dangerous work is carried on.

Repairs

33. No repairs to structural parts and equipment in danger buildings shall be undertaken unless—

- (a) the permission of the manager has been obtained;
- (b) all explosives and ingredients thereof have been removed;
- (c) the part of the building affected by the repairs has been thoroughly washed; and
- (d) the work is carried out under expert supervision.

Unauthorised Persons

34. Every explosives factory shall be so fenced and guarded as to prevent the admission of unauthorised persons.

35. No person other than the factory personnel and official inspectors shall enter any danger building unless accompanied by a responsible employee.

Notices

36. Every explosives factory shall be provided with the following notices which shall be durable and legible—

- (a) at all entrances to the factory area, a prohibition of admission of unauthorised persons;
- (b) on the outside of every building in a danger area—
 - (i) an indication of the purpose for which the building is used; and
 - (ii) a prohibition of smoking and carrying open lights, incandescent objects, matches or any other substance or article liable to cause explosion or fire; and
- (c) inside every danger building—
 - (i) a statement of the maximum quantities of explosives or ingredients thereof allowed in the building;
 - (ii) a statement of the operations allowed in the building;
 - (iii) a statement of the maximum number of persons allowed in the building; and
 - (iv) a list of the tools and implements allowed to be used in the building.

REGULATION 189. MAGNESIUM AND MAGNESIUM ALLOYS

Authorisation

1. No person shall melt, cast, work, store or transport magnesium or magnesium alloys or their dust except at places and subject to conditions approved by the competent authority.

Personnel

2. Before they are first employed on any work in connection with magnesium and magnesium alloys, and at least once in every year thereafter, the workers shall be instructed, preferably by means of demonstrations and drills, in the risks attaching to the working of magnesium alloys, the procedure in case of fire and the handling and removal of waste.

Workrooms

3. It shall be possible, in case of danger, to escape quickly and without hindrance from every workplace.

4. Ways of escape from other workrooms shall not lead through workrooms in which magnesium or magnesium alloys are melted, cast, worked with swarf-producing tools, or ground.

Additional Fire-Extinguishing Equipment

5. In every workroom there shall be provided sufficient numbers of—

- (a) easily transportable containers with a lid and filled with dry cast-iron swarf or dry sand, or other fire-extinguishing materials approved by the competent authority;
- (b) long-handled shovels;
- (c) hand containers filled with dry cast-iron swarf; and
- (d) fire-resisting blankets.

6. No fire-extinguishing material not approved by the competent authority shall be used for extinguishing magnesium fires.

Unusable Waste

7. Where practicable, workroom waste that is mixed with dust or swarf of magnesium or magnesium alloys, residue from melting crucibles, grinding sludge and other unusable waste, shall be burned as soon as possible at a safe place, and shall in no case be burned in furnaces, not even in refuse incinerators.

8. If it cannot be burned at a safe place, the unusable waste shall be well mixed with sand in the proportion of at least five volumes of sand to one volume of magnesium and magnesium alloys; when so mixed it may be deposited on refuse dumps.

9. Unmixed waste of magnesium or magnesium alloys shall not be deposited on refuse dumps or buried.

Casting Shops

10. Rooms in which magnesium and magnesium alloys are melted or cast otherwise than by die casting or in metal moulds shall be in single-storey buildings.

11. The walls, ceilings and floors of the casting' shops shall consist of non-combustible materials.

Ventilation

12. The gases and fumes arising during melting and casting shall be removed by locally applied exhaust ventilation conforming to the requirements of Section 2 of Chapter XIII of this Code.

Melting Furnaces

13. Melting furnaces shall be easily accessible and shall be easy to clean.

14. The inside of the furnace shall be cleaned at least once in every day of crucible scale and loose slag.

15. The appliances for regulating the furnace firing shall be easily accessible above the floor.

16. In the case of oil firing and gas firing, if the furnace-regulating appliances are near the furnace, it shall also be possible to cut off the fuel and air supplies from a safe and easily accessible place.

17. The provisions of paragraph 16 shall also apply to the air supply of coke-fired furnaces.

18. The different cut-off devices shall be so marked that there is no possibility of mistaking one for another.

19. The burners shall be so installed and operated that the flames cannot impinge directly upon the crucible.

20. Melting crucibles should be made of welded or drawn sheet iron with a low carbon content, or of cast steel.

Open Fires, Smoking, etc.

21. No person shall smoke, and there shall be no open fires, naked lights, incandescent objects, matches or any other substance or article liable to cause explosion or fire, in any room in which magnesium or magnesium swarf, dust, sludge or scale is handled, collected or stored.

22. The prohibition referred to in paragraph 21 shall be incorporated in conspicuous notices posted at suitable places.

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Handling of Melting Crucibles

23. Melting crucibles shall not be filled to a point which presents dangers.

24. The crucibles shall be so inserted that the flames do not always touch the same places.

25. When not in use, the containers for the supply of smothering salts for covering the liquid contents of the crucible shall always be kept tightly closed.

26. Lumpy and damp salts shall not be used.

27. After every pouring the crucibles shall be thoroughly cleansed of adhering metal and salt residues, cleared of scale and, by being tapped all round, examined to see whether they are tight everywhere and strong enough to withstand the melt.

28. The residues from the crucibles shall be kept in a metal waste bin.

Melting of Swarf

29. Swarf shall not be directly emptied from a container into the melting crucible but shall be previously spread out and examined for foreign bodies and dampness.

30. Damp swarf shall be dried in the air before being melted but large quantities of swarf shall not be spread out near the melting furnaces.

Ignition of Molten Metal

31. Fires of small quantities of molten metal outside the crucible should be extinguished by smothering with smothering salts.

32. Large fires of molten metal shall not be smothered with sand, but shall be left to burn out after the gas and air supplies have been cut off.

Removal of Swarf, etc., from Machine Rooms

33. The machines and workplaces shall be cleansed of swarf and dust at short intervals—several times a day; the accumulation of swarf shall be avoided.

34. Swarf and other waste shall be collected in self-closing metal containers at the workplaces and removed several times a day to the collecting place.

35. Separate containers shall be installed for dry, wet and dirty swarf respectively and shall be marked correspondingly.

36. After the close of work, no swarf or other waste shall remain at the workplaces.

37. Corners, piping and other places in the workrooms difficult of access shall be kept clear of metal dust by regular sweeping; vacuum cleaners shall not be used for this purpose, unless they are of a type approved for the purpose by the competent authority.

Swarf-Producing Tools

38. Swarf-producing tools shall—

- (a) be properly ground;
- (b) always have a sharp cutting edge; and
- (c) be used at the correct speed to avoid excessive frictional heat.

39. If in a swarf-producing process cooling is necessary, this shall be done with cool, dry compressed air, or with oil or oil mixtures of a sufficiently high flash-point, free from acid and water or other admixtures that might conduce to the outbreak or spread of fire.

Belt-Driven Grinding Machines

40. Grinding machines shall not be driven by belts with iron fastenings.

Wet Grinding

41. During grinding with oil no dust shall be liberated; during grinding with water, the water shall be applied so abundantly that the grinding dust liberated is washed away.

Dry Grinding

42. The grinding machines shall have no pockets in which dust can be deposited.

43. Abrasive wheels and bands and polishing wheels on which iron has been previously worked shall not be used, since they may generate a considerable quantity of sparks.

Exhaust Equipment

44. With dry grinding the dust shall be exhausted as near as possible to its point of origin by mechanical means and at high velocity.

45. Exhaust ducts shall—

- (a) be as short and as straight as possible;
- (b) have smooth inner surfaces;
- (c) be provided with pressure-equalising devices at bends;
- (d) have no pockets in which dust or sludge can settle; and
- (e) be completely earthed.

46. Not more than two grinding machines shall be connected to the same exhaust equipment.

47. When two grinding machines are connected to the same exhaust equipment—

- (a) there shall be sufficient suction at each machine; and
- (b) the installation of devices enabling either machine to be cut off from the exhaust equipment shall not be allowed.

48. Exhaust ducts shall be provided, as near as practicable to the exhaust hood, with a dust separator in which the dust is effectively laid with water.

49. The water shall be so discharged in the separator that dust cannot settle on the walls.

50. Every dust separator shall be provided with an explosion-relief device.

51. The exhausted air shall be discharged into the open.

52. Exhaust ducts and dust separators shall be provided with a sufficient number of inspection and cleaning openings.

53. Exhaust equipment, ducts and dust separators shall be cleaned thoroughly—

(a) at least once a week; and

(b) before lengthy stoppages.

54. If, owing to the bulkiness of the object being ground, an exhaust hood cannot be fitted and the work cannot be done by means of a cutting tool, grinding shall as far as possible be done with coarsely granulated abrasives and at a low peripheral velocity (6 m) (20 ft) per sec.

55. Automatic arrangements shall be made to ensure that no grinding or polishing device is being driven by mechanical power unless the appliances for the removal and collection of dust are in effective operation.

56. Belt drives for transmission of power to the fan shall be of the V type, with multiple belts.

Portable Grinding Machines

57. (1) Portable grinding machines shall only be used in special enclosures provided with exhaust equipment conforming to the provisions of paragraphs 44 to 56 of this Regulation.

(2) Not more than four portable machines shall be used in one enclosure.

Grinding Sludge, etc.

58. The grinding dust, sludge and scale deposited in the dust collector shall be removed as often as necessary and at least once a week.

59. No tool containing iron or ferrous material shall be used for the purpose of paragraph 58.

60. Grinding dust, sludge and scale shall be disposed of as soon as possible by being spread on the surface of the ground and burned in the open at least 30 m (100 ft.) from any building.

Packing

61. Magnesium and magnesium alloys in the form of swarf or dust shall only be transported in tightly closed containers of incombustible material.

62. On every container the following notice shall be affixed:

“ Caution ! Magnesium ! In case of fire, smother with dry sand. Do not use water or fire extinguishers ”.

Storage of Usable Waste

63. Usable swarf and waste shall not be mixed with waste of other kinds.

64. Separate containers shall be provided for the storage of dry, wet and dirty swarf respectively and shall be marked correspondingly.

65. Containers shall be—

- (a) of incombustible material;
- (b) provided with a self-closing lid; and
- (c) kept in dry rooms used only for storage.

66. Other highly combustible substances shall not be stored in the same room together with magnesium or magnesium alloys in the form of swarf or dust.

Personal Protective Equipment

67. Workers who come into contact with the dust or fine swarf of magnesium or magnesium alloys shall be provided with, and use, suitable protective clothing and equipment, conforming to the requirements of Chapter XIV of this Code, and which are fire resistant.

68. Protective clothing shall be thoroughly freed from dust every day in the open by a person specially appointed for this purpose and at a place designated by the management.

Electrical Equipment

69. All electrical equipment and apparatus shall conform to the requirements of Regulation 115 of Chapter V of this Code.

REGULATION 190. MANUFACTURE, PROCESSING AND STORAGE OF CELLULOID AND ARTICLES CONTAINING CELLULOID

Authorisation

1. No person shall manufacture, process or store celluloid or articles containing celluloid except at places and subject to the conditions approved by the competent authority.

Workrooms

2. Workrooms should be in single-storey buildings.

3. Workrooms situated under other rooms shall have fire-resisting ceilings.

4. Walls separating workrooms from other rooms or from passageways shall be—

- (a) fire resisting; and
- (b) so constructed as to resist lateral pressure or be provided with adequate gas-relief vents.

5. Walls of workrooms in which celluloid dust is liberated shall be easily washable.

6. Floors of workrooms shall be—

- (a) easily washable; and
- (b) free from cracks and crevices.

7. Every workroom shall have an adequate number of windows that—

- (a) are easily accessible;
- (b) easily open outwards; and
- (c) are free from all obstructions such as gratings and grilles.

8. All doors in workrooms shall—

- (a) be fire-resisting;
- (b) open outwards; and
- (c) close automatically.

9. Every workroom shall have sufficient safe ways of escape, at least two in number, that—

- (a) are so distributed as to afford ready egress from all parts of the room; and
- (b) do not endanger ways of escape from other parts of the building.

10. Furniture and equipment in workrooms shall be so arranged and maintained that access to the means of escape is not impeded.

Additional Fire-Extinguishing Equipment

11. An adequate supply of pails filled with water, and other suitable fire-extinguishing equipment, and fire-resisting blankets, shall be maintained in, and in the immediate proximity of, every workroom.

Machining

12. When celluloid is being sawn, drilled, milled or otherwise machined it shall be cooled with running water so far as the nature of the operation allows.

Warming of Celluloid

13. For warming celluloid or heating celluloid-moulding presses only steam, hot water or electricity shall be used.

14. The temperature of the heated apparatus parts shall not exceed 115° C. (240° F.).

15. Electrical heating equipment shall be so made that—

- (a) celluloid cannot come into contact with live or incandescent parts; and
- (b) when a temperature of 115° C. (240° F.) is reached, the current is automatically switched off.

Maximum Quantities of Celluloid in Workrooms

16. At every workplace there shall be only so much raw and processed celluloid as is required for the work in hand.

Celluloid Waste

17. Celluloid waste shall be collected at the workplaces—
- (a) automatically as it is created; or
 - (b) at frequent intervals during each shift.
18. If not collected automatically, celluloid waste at workplaces shall be placed in fireproof containers that—
- (a) are provided with a quick-closing and tight-fitting lid; and
 - (b) in the case of fine waste shall contain sufficient water to keep the waste covered.
19. Celluloid waste shall be removed from workrooms at least once in every shift, and placed in a suitable storage receptacle at a safe place.
20. The storage receptacle shall be emptied at least twice in every week.
21. Celluloid waste shall not be burned in closed fires.

Cleaning

22. Workplaces shall be thoroughly cleaned every day.
23. Workrooms shall be swept every day and thoroughly cleaned at least once in every week.
24. No implements capable of generating sparks shall be used for cleaning.

Repairs

25. No repair or similar work in which there is a risk of sparking shall be undertaken within 5 m (16 ft.) of any celluloid.

Finished Articles

26. Finished articles made wholly or partly of celluloid shall be removed from workrooms as soon as practicable.

Storage of Celluloid in Factories

27. No celluloid shall be stored in rooms underneath occupied rooms.
28. Not more than 1,000 kg (2,200 lb.) of celluloid film or 4,000 kg (9,000 lb.) of celluloid in other form shall be stored in any one storeroom.
29. Storerooms should be in detached, single-storey buildings.
30. Storerooms shall be so situated as not to endanger—
- (a) neighbouring premises; and
 - (b) ways of escape from the factory or any part of it.
31. Storerooms shall be constructed of fire-resisting materials, except for the gas-relief vents.

32. Storerooms shall be provided with gas-relief vents arranged to open under slight pressure, consisting of a lightly constructed section of the roof or a window in a wall and equal to 1 m² per 15 m³ (1 sq. ft. per 50 cu. ft.) of storeroom capacity.

33. Gas-relief vents shall be so situated as to prevent injury to persons and, as far as practicable, damage to neighbouring premises in the event of fire or explosion in the storeroom.

34. Storeroom windows shall be permanently dimmed as protection against the rays of the sun.

35. All doors in storerooms shall—

- (a) be fire-resisting;
- (b) open outwards; and
- (c) close automatically.

36. Storerooms shall have at least one safe way of escape that—

- (a) leads to the open or to another safe place; and
- (b) does not endanger ways of escape from other parts of the building.

37. Storerooms shall not contain any material other than celluloid.

38. Storerooms shall be provided with an efficient automatic water-sprinkling system.

39. Unauthorised persons shall not have access to storerooms

Packing

40. If metal containers for consignment have to be sealed by soldering—

- (a) the contents shall be covered by a poor conductor of heat;
- (b) the soldering shall be done outside the workrooms by specially trained and reliable workers; and
- (c) all suitable precautions shall be taken to prevent the heat generated from affecting the celluloid.

41. Sealing wax shall not be used on any parcel or package containing celluloid unless the packing material is metal or other incombustible material and the sealing is done in a room in which no exposed celluloid is present.

Processing of Film Waste

42. The processing of film waste shall comply with the provisions of paragraphs 1 to 41, subject to the additions and modifications embodied in paragraphs 43 to 55 inclusive.

43. Workrooms in which film waste is processed shall be in one-storey buildings of fire-resisting construction throughout.

44. Buildings containing workrooms shall be at least 20 m (65 ft.) distant from each other and from any other building: Provided that this distance may be reduced to 10 m (33 ft.) when one of any two opposite building fronts is built as a blank fire-resisting wall.

45. Ways of escape from workrooms shall be—

- (a) so distributed as to give ready egress from all parts of the room;
- (b) not more than 6 m (20 ft.) from any workplace;
- (c) so arranged that at least half of the ways of escape are on a side of the building away from any storeroom containing celluloid; and
- (d) so arranged that at least one way of escape cannot be endangered by a fire in any neighbouring building.

46. All windows shall be so designed and installed that they can be immediately used as additional ways of escape.

47. The coating of emulsion shall be removed from films or film waste only by processes in which—

- (a) heating of the films to such an extent as to cause decomposition or ignition cannot occur; and
- (b) the chemical properties of the celluloid are not changed.

48. Film waste shall, as far as practicable, be shredded only when wet.

49. Shredding machines shall be so installed and driven that ignition is prevented.

50. Every shredding machine shall be installed by itself in a separate room, and shall be so enclosed that in case of fire the products of combustion are immediately led by a flue into the outside air.

51. The drying of waste shall be so effected that the temperature of the waste—

- (a) does not exceed 45° C. (113° F.);
- (b) is continuously recorded by indicators; and
- (c) is controlled by reliable automatic devices.

52. The drying plant shall be emptied and all parts of the equipment shall be cleaned of loose bits of film at least once a day.

53. Each of the following processes shall be carried out in a separate room in which no other processes shall be permitted:

- (a) sorting and reeling of unwashed film;
- (b) washing of loose film;
- (c) drying of loose film; and
- (d) packing of washed film.

54. Films and film waste shall be packed in suitable containers before being placed in storerooms.



[New text of paragraphs 2, 4, 5 and 6.]

2. It shall be prohibited to manufacture, store or transport acetylene gas at a pressure exceeding 1.5 kg/cm² (22 lb./sq. in.) unless it is contained in a homogeneous porous substance with acetone or other suitable solvent, or to manufacture liquid acetylene.

4. In any storeroom, calcium carbide containers shall be opened only as and when they are required for use.

5. (1) Storerooms for calcium carbide shall—

- (a) be dry, well ventilated and of fire-resisting construction;
- (b) have watertight walls and floors, and light weathertight roofs;
- (c) have at least one wall an outside wall;
- (d) have openings to other parts of the building protected by self-closing, fire-resisting doors; and
- (e) have no cellar or basement beneath.

(2) Where the storage premises comply with such requirements concerning safe distances as may be prescribed by the competent authority, alternative types of construction may be accepted.

6. At every means of access to premises on which calcium carbide is stored, warning notices shall be posted at conspicuous places with wording such as "CARBIDE STORAGE. ADMITTANCE OF UNAUTHORISED PERSONS PROHIBITED. SMOKING PROHIBITED. DO NOT USE WATER TO PUT OUT FIRES."

55. Loose film shall not be dried by hanging it on lines either in a room or in the open air.

REGULATION 191. STORAGE OF CALCIUM CARBIDE
AND MANUFACTURE OF ACETYLENE

Authorisation

1. No person shall store calcium carbide or manufacture acetylene except at places and subject to the conditions approved by the competent authority.

Limitation of Manufacture

2. It shall be prohibited to manufacture, store or transport acetylene gas at a pressure in excess of 1.5 kg/cm² (22 lb./sq. in.) unless contained in a homogeneous porous substance, with or without acetone or other suitable solvent, or to manufacture liquid acetylene.

Storage of Calcium Carbide

3. Calcium carbide shall be packed in watertight and airtight metal containers—

- (a) of sufficient strength to permit handling without rupture;
- (b) provided with a screw top or other airtight closing device; and
- (c) conspicuously marked "Calcium Carbide. Keep Dry" or with other suitable wording.

4. At no time shall more than one calcium-carbide receptacle be open in any storeplace.

5. Storerooms for calcium carbide shall—

- (a) be dry, well ventilated and of fire-resisting construction;
- (b) have watertight walls and floors, and light weathertight roofs;
- (c) have at least one wall an outside wall;
- (d) have openings to other parts of the building protected by self-closing, fire-resisting doors; and
- (e) have no cellar or basement beneath.

6. At every means of access to premises on which calcium carbide is stored, warning notices shall be posted at conspicuous places with wording such as "CARBIDE STORAGE. ADMITTANCE OF UNAUTHORISED PERSONS PROHIBITED. DO NOT USE WATER TO PUT OUT FIRES".

Opening of Carbide Containers

7. Heated tools or tools liable to give off sparks from their working parts shall not be used for opening calcium carbide containers.

Disposal of Carbide Dust

8. All calcium-carbide dust which is not usable shall be carefully removed from emptied containers and shall—

- (a) be completely destroyed by immersion in not less than ten times its weight of water in a place in the open air at an adequate distance from any flame; and
- (b) not be allowed to enter public drains or water courses.

Purity of Carbide and Acetylene

9. Calcium carbide for use in the manufacture of acetylene shall be free from dangerous impurities.

10. Acetylene gas used in industry shall not contain more than 0.05 per cent. by volume of phosphoretted hydrogen and not more than 0.15 per cent. by volume of sulphuretted hydrogen.

Generator Houses and Rooms

11. Stationary equipment for generation, collection or purification of acetylene should be placed either in the open or in separate well-ventilated one-storey generator houses having—

- (a) no opening located within 1.5 m (5 ft.) of any opening in another building; and
- (b) lightly constructed fire-resisting roofs.

12. Generator rooms inside buildings shall be so constructed as to prevent fire or gas from spreading from the room to other parts of the building.

13. Separate generator houses shall have—

- (a) impervious fire-resisting walls;
- (b) lightly constructed roofs of incombustible materials; and
- (c) fire resisting doors that open outwards under pressure.

14. Generator houses and rooms shall be—

- (a) well ventilated, if necessary by mechanical means;
- (b) adequately lighted by natural light in daytime; and
- (c) maintained at a temperature high enough to prevent freezing of the water in the generator.

15. Electrical equipment, including lighting equipment, shall be of a type officially approved as flame-proof in an atmosphere containing acetylene and shall be installed in generator houses or rooms.

16. (1) No person shall smoke, and there shall be no fires, naked lights, incandescent objects, matches or any other substance or article liable to cause explosion or fire within 5 m (16 ft.) of any generator house or room.

(2) A conspicuous notice embodying the prohibition in subparagraph (1) shall be posted outside the generator house or room.

17. Every stationary generator shall be easily accessible.

18. No unauthorised person shall have access to a generator house or room.

[New text of paragraph 9 and from paragraph 11 onwards.]

9. Carbide shall conform to an accepted standard of purity.

11. Except where otherwise stated, paragraphs 12-66 of the present Regulation shall apply only to acetylene generators with a carbide charge exceeding 1 kg (2.2 lb.).

12. (1) Acetylene generators shall be installed in the open air or in a room of fire-resistant construction with doors opening outwards.

(2) The room referred to in (1) shall be exclusively assigned to the generator or generators, well ventilated and completely isolated from any workroom.

(3) Generators shall be placed at such distance from open fire or inadequately insulated artificial lighting that in the event of an escape of gas no danger of explosion can arise.

(4) If necessary, suitable precautions shall be taken to prevent freezing of generators.

(5) The provisions of this paragraph shall not apply to portable generators that are temporarily used in a factory or workshop for welding, cutting or heating fixed objects or objects that are difficult to move.

13. Electrical equipment, including lighting equipment, shall be installed outside generator houses or rooms unless it is officially approved as flameproof in an atmosphere containing acetylene.

14. (1) No person shall smoke, and there shall be no fires, naked lights, incandescent objects, matches or any other substance or article liable to generate sparks and cause explosion or fire in any generator house or room, and no person shall smoke within 5 m (16 ft.) of a generator house or room.

(2) A conspicuous notice embodying the prohibition in subparagraph (1) shall be posted outside the generating house or room.

*15. Every stationary generator shall be easily accessible.

*16. No unauthorised person shall have access to a generator house or room.

[New text.]

Construction of Generators

*17. Generators shall be—

- (a) constructed of good quality metal and with no parts liable to come into contact with acetylene made of copper; alloys containing more than 70 per cent. copper shall not be used unless there is no danger of contact with acetylene;
- (b) of adequate strength safely to withstand any pressures that may normally be generated in them.

18. With generators of the continuously operating type it shall be possible—

- (a) to ascertain during working whether there is sufficient generating or cooling water; and
- (b) if necessary, to add water without appreciable quantities of acetylene escaping.

*19. The air space in the generator shall be as small as possible.

20. Generators in which the decomposition of carbide takes place under a movable gas bell shall not be permitted unless the design of the generator is approved by the competent authority, and arrangements are provided to avoid any entry of air during cleaning and any fall of carbide into the interior of the bell.

21. All water overflows shall be visible.

Marking of Generators

22. Acetylene generators shall bear durable and legible markings—

- (a) showing the size of the carbide to be used and the maximum weight permissible for a single charge;
- (b) showing the highest permissible production of acetylene per hour;
- (c) showing the maximum allowable working pressure of the generator;
- (d) permitting identification of the apparatus as regards its manufacture (e.g. type, date, number, etc.); and
- (e) showing the name and address of the manufacturer or distributor.

Water-Supply Connections

23. (1) Unless acetylene generators with a continuous water feed are provided with an adequate open water overflow, or an automatic water shut-off which will effectively prevent overflowing of the generator—

- (a) water shall not be supplied through a continuous connection; and

[New text.]

(b) facilities for observing the water supply shall be afforded by terminating the supply pipe at least 5 cm (2 in.) above the filling opening.

(2) The provisions of this paragraph shall not apply to dry-lime generators.

Gasholders

*24. Acetylene gasholders shall be provided with automatic devices which will stop the generator feeding mechanism before the bell reaches the upper limit of its travel.

*25. In order to prevent collapse of acetylene gasholder bells or breaking of the water seal due to vacuum caused by the booster or cooling of the gas, an automatic booster cut-off shall be provided at a point 30 cm (12 in.) or more above the landing point of the bell.

26. The gas bell shall move freely without any tendency to jam.

27. Every generator in which the pressure is not automatically controlled by a head of water open to the atmosphere shall be provided with a pressure gauge indicating the pressure in the generating chamber.

28. (1) On the dial of the pressure gauge the maximum permissible working pressure shall be indicated by a red mark and the range of the scale shall exceed this pressure by at least 50 per cent.

(2) The dial shall have no stop at the zero mark.

Safety Devices

29. (1) Every generator shall be provided with safety devices (overflow pipe or safety valve) of good design, made of corrosion-resisting material and so installed that their operation is not normally hampered by damp or lime or interrupted by any fitting that enables the flow of gas to be stopped.

(2) These devices shall be such that—

(a) their capacity is sufficient to prevent the maximum working pressure of the generator from being exceeded by more than 0.1 kg/cm² (1.5 lb./sq. in.);

(b) they cannot easily be put out of order and their proper working can be verified; and

(c) in the case of fixed generators, they discharge into a pipe—

(i) of ample dimensions;

(ii) discharging outside the premises at a place where the liberation of acetylene cannot cause any danger of

[New text.]

fire or explosion owing to the presence of any outside source of ignition such as a flame, an open fire, a fireplace or a chimney;

- (iii) the outlet of which is protected against obstruction by rain, snow, ice, insects, birds and other things.

30. The gasholder shall be provided with a device, such as an overflow pipe, to evacuate excess gas to the outside of the building.

31. A device shall be provided to prevent any return of gas from the gasholder into the generator.

Shut-off Valves

32. All acetylene distribution installations shall be provided with suitably located shut-off valves for the isolation of the service-piping system or systems.

33. Electric motors for driving acetylene boosters, unless they are of a type officially approved as flameproof in an atmosphere containing acetylene, shall be located outside the booster room, with the drive shaft passing through a gas-tight stuffing box, or equivalent device, in the dividing wall.

34. Acetylene boosters shall be provided with suitable devices for keeping the pressure below 1.5 kg/cm² (22 lb./sq. in.) without venting gas to the outside atmosphere.

35. Water-cooled acetylene boosters should have a visible water supply or be provided with an interlocking device to stop the booster in case of failure of the cooling-water supply.

Purifiers and Purifying Substances

36. Purifiers shall be so designed that they do not unduly impede the passage of the acetylene, and their walls shall resist attack by the purifying substance.

37. If acetylene is purified the purifying substances shall not contain ingredients that form explosive substances with acetylene

Hydraulic Seals and Interceptors

38. (1) At every delivery point in an acetylene distributing system, when acetylene is used mixed with a combustion gas under pressure, a hydraulic seal or equivalent device shall be installed that—

- (a) in the case of low-pressure hydraulic seals, will withstand an internal explosion of acetylene and oxygen;
- (b) will prevent the return of oxygen or air into the generator, gasholder or battery of cylinders;
- (c) will prevent backfires from reaching the generator, gasholder or battery of cylinders; and

[New text.]

(d) is fitted with a device for checking the level of the liquid used.

(2) Subparagraph 1 shall also apply to a single delivery point when the acetylene used is supplied from a generator.

39. Hydraulic seals and interceptors shall be so constructed and installed that they can easily be opened and inspected internally.

Sludge Pits

40. Sludge pits and drains for sludge from acetylene installations shall be open to the atmosphere.

*41. Sludge pits shall be adequately fenced.

Inspection of Installations

42. Users of acetylene installations shall verify and control the proper working of the installations.

43. Generators and the conditions in which they operate shall not be modified without the approval of the competent authority.

Instruction of Personnel

*44. No person shall have charge of an acetylene generator installation until he has been properly instructed in its operation.

*45. Printed rules and instructions for the operation and maintenance of acetylene-generator installations shall be supplied by the manufacturer and posted at conspicuous places where they can be easily read; and shall be strictly observed.

Operation

46. The hourly rate of production of an acetylene generator shall not exceed the rate for which it is marked.

47. When generators are coupled to deliver gas simultaneously arrangements shall be made such that the rate of output of each does not exceed the rate fixed by the maker and that the safety devices are adjusted to the increased output of gas.

48. The pressure in acetylene generators or their gasholders shall at no time exceed 1.5 kg/cm² (22 lb./sq. in.).

49. The supply of carbide and water to the generator shall be so regulated that the temperatures of the generating and cooling water do not rise above those indicated by the manufacturer.

50. The decomposition of carbide in the generator shall be such that the lime sludge discharged cannot produce acetylene in dangerous quantities.

51. Before recharging acetylene generators all residue of the previous charge shall be removed, and the generating chamber shall be flushed out with water, unless the generator is of such a type that this is impracticable, in which case the manufacturer's instructions should be followed.

[New text.]

52. During charging and cleaning of the generator, prolonged contact of carbide with insufficient quantities of water shall be avoided, if possible by keeping the water chambers full.

*53. Partially spent charges of carbide shall not be replaced in the generator.

54. No flame or any ignited source of heat shall be brought into direct contact with any apparatus containing acetylene.

*55. Before an acetylene installation is started up care shall be taken to see that all parts are free of ice.

*56. If an acetylene installation is to be left idle during freezing weather it shall be emptied of gas and carbide, the water drained off and the generator thoroughly cleaned.

*57. Acetylene installations that are frozen shall be thawed only by hot water or steam.

Portable Generators

*58. Portable acetylene generators shall not be used—

- (a) in rooms having a cubic capacity less than 50 times the total gas-generating capacity per charge of all generators in the room;
- (b) in rooms less than 3 m (10 ft.) in height; or
- (c) within 3 m (10 ft.) of combustible material other than the floor.

*59. Cleaning and charging portable acetylene generators and blowing off the gas-air mixture shall be done outside the buildings.

60. Portable acetylene generators shall not be moved when charged unless the necessary precautions are taken to prevent tilting or dropping

*61. When not in use, portable acetylene generators shall not be stored in any room having open lights or fires unless they have been emptied of carbide and thoroughly cleaned.

*62. Cleaning and repair shall as far as possible be undertaken in daylight.

Maintenance

*63. All parts of acetylene-generator installations shall be maintained in good condition at all times.

*64. Hydraulic seals shall be kept filled to the proper level and periodically examined and cleaned.

Repairs

65. In dismantling any part of an acetylene installation special care shall be taken to prevent the generation of sparks by friction

[New text.]

or impact, unless all the precautions required in paragraph 66 have been taken.

*66. Before any part of an acetylene installation undergoes repair, it shall be—

- (a) thoroughly cleaned;
- (b) carefully cleared of carbide, residue and sludge;
- (c) thoroughly flushed; and
- (d) completely filled with water, steam or an inert gas.

Manufacture of Dissolved Acetylene

*67. Dissolved acetylene shall only be manufactured under the responsibility and supervision of a manager having adequate experience and technical knowledge.

68. (1) In planning new premises and in extending existing premises for the manufacture of dissolved acetylene, account should be taken of the risk to occupied premises in the vicinity.

(2) Premises used for the manufacture of dissolved acetylene shall be—

- (a) readily accessible to the fire brigade on all sides; and
- (b) safeguarded by effective means against the danger of fire.

69. (1) The layout and equipment of acetylene-compressor rooms and filling rooms should be approved by the competent authority.

(2) Where no such system of approval exists the rooms should be—

- (a) separated from one another and from acetylene-generating and calcium-carbide storage rooms by an adequate distance or by heavy explosion-resisting walls;
- (b) situated not less than 30 m (100 ft.) from the boundaries of adjoining property and not less than 50 m (165 ft.) if the monthly capacity exceeds 25,000 m³ (883,000 cu. ft.); and
- (c) situated at least 5 m (16 ft.) from doors, windows and other openings in neighbouring buildings in which there are exposed sources of ignition such as bare lights, open flames and flammable materials.

70. Electric motors and their accessories, lighting equipment, and all electrical apparatus, unless officially approved as flameproof in an atmosphere containing acetylene shall be installed in separate and ventilated premises in which any accumulation of acetylene is prevented.

71. An adequate quantity of approved fire extinguishers and other fire-fighting equipment shall be kept readily available at suitable places on the premises.

[New text.]

*72. Filling platforms should be provided with sprinkler systems divided into sections so arranged that—

- (a) in the event of damage from bursting cylinders or other causes only a part of the system can be put out of action; and
- (b) the various sections can be turned on and off separately from a single safe place outside the filling room.

*73. Sprinkler systems shall be examined at intervals not exceeding one month.

74. Filling rooms for charging acetylene cylinders—

- (a) should be divided into filling platforms each equipped with not more than 30 filling connections; and
- (b) shall be so arranged that in an emergency the workers can leave the building quickly by a route as direct as possible.

75. (1) Supply piping from the compressor and the branch piping to each filling platform shall be provided with safety devices capable of arresting the explosive decomposition of acetylene.

(2) Means shall be provided outside the building for stopping each compressor motor and, if appropriate, each generator motor.

Acetylene Cylinders

*76. Cylinders for compressed acetylene shall comply with the provisions of Regulation 135.

77. The pressure of acetylene in the pipelines used for charging dissolved-acetylene cylinders shall be so adjusted that—

- (a) the pressure in the cylinder at no time during the operation exceeds 25 kg/cm² (355 lb./sq. in.); this pressure shall be reduced if the temperature falls below 4° C (39° F) in order to avoid the formation of liquid acetylene in the pipeline; and
- (b) no cylinder is under a pressure exceeding 15 kg/cm² (215 lb./sq. in.) at 15° C (60° F), when leaving the works.

78. Full acetylene cylinders ready for removal should be placed outside the filling room in a thoroughly ventilated place.

*79. Only reliable persons over 18 years of age shall be employed in filling rooms.

[Regulation 191 as amended only contains 79 paragraphs.]

- (b) the various sections can be turned on and off separately from a single safe place outside the filling room.

83. Sprinkler systems shall be examined at intervals not exceeding one month.

84. Filling rooms for charging acetylene cylinders should be divided into filling platforms—

- (a) with not more than 30 filling connections in each; and
(b) so arranged that in an emergency the workers can leave the building quickly and unimpeded by a route as direct as possible.

85. Where a number of filling platforms can be supplied simultaneously with acetylene gas from the same compressor, the supply piping to the platforms shall be so arranged that each platform can be separately disconnected from an easily accessible and safe station.

Acetylene Cylinders

86. Cylinders for compressed acetylene shall comply with the provisions of Regulation 135.

87. The filling pressure and velocity for charging acetylene cylinders with the gas shall be so adjusted that—

- (a) the pressure in the cylinder at no time during the operation exceeds 20 kg/cm² (285 lb./sq. in.); and
(b) no cylinder can leave the works under a pressure exceeding 15.5 kg/cm² (220 lb./sq. in.).

88. Full acetylene cylinders ready for removal should be placed outside the filling room on the loading platform or in the open air.

89. Only reliable persons over 18 years of age shall be employed in filling rooms.

REGULATION 192. SPRAY PAINTING WITH VOLATILE FLAMMABLE LIQUIDS

Scope

1. In addition to paragraphs 1, 2, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 and 16 of Regulation 187, spray painting shall be subject to paragraphs 2-21 of the present Regulation.

Authorisation

2. No person shall undertake spray painting except at places and subject to the conditions accepted by the competent authority.

Spraying Rooms

3. Spraying rooms, that is, rooms in which spraying is done

otherwise that in a spray booth (cabinet), should be in isolated, one-storey buildings not used for other purposes.

4. In buildings of two or more storeys the spraying rooms should be on the top storey.

5. The building or part of the building containing the spraying room shall be of fire-resisting construction.

Spraying Booths, Cabinets and Hoods

6. (1) The application of paint or lacquer by spraying on small or medium sized objects shall be done inside a cabinet, or, failing that, a hood. The worker must work outside the cabinet or hood.

(2) If, for technical reasons, the provisions of paragraph (1) cannot be observed, the application of paint or lacquer by spraying shall be carried out inside a booth or by other approved methods (water screens, tunnels, etc.).

(3) Whenever workers are exposed to mist and vapours from paint, respiratory apparatus which gives adequate protection shall be placed at their disposal.

7. The booth shall have smooth surfaces and rounded corners of fire-resisting material which can be easily cleaned.

Ventilation

8. The mists and fumes generated in spray-painting shall be so collected by means of exhaust ventilation as to prevent unhealthy concentrations of solvents in front of the booth and in the workroom and also to prevent the spread of explosive mixtures in the workroom.

9. The entrances to the exhaust duct shall be provided with an effective paint trap that is easy to clean.

10. Exhaust fans shall be made of non-sparking materials.

11. Exhaust ducts shall—

- (a) be of airtight, incombustible construction;
- (b) be of sufficient capacity;
- (c) discharge in the open air, at a safe distance from any building opening;
- (d) be effectively insulated from all combustible material;
- (e) be earthed;
- (f) contain no pockets in which explosive gas-air mixtures or sediment could settle; and
- (g) be easy to clean.

12. (1) Measures shall be taken for supplying fresh air to the workroom and booths (cabinets) by mechanical means.

(2) To prevent draughts the air shall be heated in the cold season.

Storage of Volatile Flammable Liquids in Workrooms

13. In spraying rooms volatile flammable liquids shall not be stored in quantities exceeding those required for one day's work, subject to a maximum of 25 kg (55 lb.).

14. Volatile flammable liquids shall be kept in securely closed metal containers.

15. Empty containers shall be removed without delay to a safe place outside the spraying room.

Position of Operator

16. Arrangements shall be made such as will render it unnecessary for the operator to be in a position between the ventilating outlet and the article being sprayed.

Personal Protective Equipment

17. Every person engaged in spray painting shall be provided with and use suitable protective clothing and equipment conforming to the requirements of Chapter XIV.

Cleaning of Rooms and Equipment

18. Paint and lacquer residues shall be removed from booths, fans, exhaust ducts, trunks, casings, etc., at least once in every week: Provided that in any plant in which paints containing unsaturated oils and paints containing organic nitrates or organic nitro-compounds have been used on the same day, the residues shall be removed from booths, fans, exhaust ducts, trunks, casings, etc., at the end of that day's work.

19. No iron or steel implement shall be used to remove paint or lacquer residues.

20. No highly flammable substance shall be used for cleaning purposes.

Drying of Painted Articles

21. (1) Painted or lacquered objects should be dried under conditions which exclude all risk of fire and explosion and of injury to health.

(2) Vapours emanating from this operation shall be evacuated, condensed or destroyed.

REGULATION 193. PREVENTION OF ORGANIC
DUST EXPLOSIONS

A. *General Rules*

Scope

1. In addition to complying with the provisions of Regulation 187, premises in which materials such as flour, grain, spice, starch, sugar and cocoa, that produce flammable dusts, are pro-

cessed, handled or stored, shall comply with the provisions of the present Regulation.

Explosion Vents

2. (1) Buildings in which explosive carbonaceous dust may be present in the atmosphere shall be provided in the outside walls or the ceiling of all rooms with explosion vent areas consisting of either—

- (a) light incombustible material, preferably glass of a thickness of 3.2 mm ($\frac{1}{8}$ in.); or
- (b) hinged windows, skylights or panels, so balanced as to open under a predetermined pressure.

(2) Such vent areas shall be provided at the rate of—

- (a) 1 m² per 24 m³ (1 sq. ft. per 80 cu. ft.) of volume for heavy reinforced concrete construction;
- (b) 1 m² per 20 m³ (1 sq. ft. per 65 cu. ft.) of volume for lighter reinforced concrete construction; and
- (c) 1 m² per 15 m³ (1 sq. ft. per 50 cu. ft.) of volume for light construction.

Stairways and Elevators

3. Stairways and elevators of buildings in which materials producing flammable dusts are processed, handled or stored shall be—

- (a) enclosed in separate dust-tight shafts of incombustible materials, with all doors incombustible and self-closing or, in the case of elevators, closed from within by the operator; or
- (b) situated outside the walls of the buildings, with fire doors on communications at floor levels.

Enclosures

4. All equipment used in processing or handling materials producing flammable dusts should be—

- (a) dust-tight, or so enclosed in dust-tight casings that dust will not escape from the equipment under normal conditions of use; and
- (b) provided with vent areas of not less than 1 m²/9 m³ (1 sq. ft. per 30 cu. ft.) of volume.

Electrical Equipment

5. All electrical apparatus and equipment shall conform to the provisions of Regulation 116 of Chapter V of this Code.

Lighting

6. All artificial lighting shall be supplied by electric lamps conforming to the requirements of Regulation 116 of Chapter V of this Code.

7. (1) The use of glass in the roof and wall openings liable to be in the direct rays of the sun shall be reduced to a minimum.

(2) Where glass is used care shall be taken to avoid dangerous concentration of sun rays due to defects in the glass or to the shape of the glass material used.

Dust Removal

8. In rooms where materials producing flammable dusts are processed, handled or stored—

- (a) the dust shall be removed daily from floors, equipment and all other horizontal surfaces, including tunnels and galleries, preferably by means of appropriate vacuum apparatus; and
- (b) all fixtures, bearings, ledges, projections, side walls, ceilings and other parts shall be cleaned and freed from dust at least once a week.

Bag Cleaning

9. Bags used for materials producing flammable dusts shall be cleaned by washing, by drawing them over the nose of a draught spout, or by means of entirely enclosed bag-cleaning devices.

B. Flour, Feed and Cereal Mills

Buildings

10. The distance between flour, feed and cereal mill buildings and their grain storage buildings should be as large as possible.

11. Flour, feed and cereal mills and their grain storage buildings should be—

- (a) of heavy construction, with floors, walls, partitions, roofs and bins for manufactured stock of brick or preferably of reinforced concrete;
- (b) provided with explosion-vent areas of 1 m^2 per 24 m^3 (1 sq. ft. per 80 cu. ft.) of volume.

Basements, Tunnels and Galleries

12. Basements, tunnels and galleries in flour, feed or cereal mills—

- (a) should be of sufficient height and width to afford easy access for cleaning under and at sides of belts or other equipment; and
- (b) shall be provided with artificial ventilation where the natural ventilation is insufficient to prevent dust clouds.

Grain Bins and Tanks

13. Grain bins and tanks in grain storage buildings should be provided with—

- (a) dust-tight covers or decks, and water-tight floors; and
- (b) exhaust ventilation, or be separately vented to the outside by means of vertical stacks not less than 30 cm (12 in.) in diameter and provided with weather hoods.

Grain Driers

14. Grain driers in grain storage houses shall be placed in individual fire-resisting rooms or sections, separated as much as possible from elevators or tanks.

Spontaneous Ignition

15. Molasses feeds, gluten, brewer's grains and other feedstuffs which may ignite spontaneously should not be stored in bulk, but where so stored shall—

- (a) have a safe moisture content at time of manufacture;
- (b) be protected against accumulation of moisture during storage; and
- (c) be provided with arrangements for temperature readings.

C. *Starch Factories*

Buildings

16. Each of the four principal processes in the manufacture of dried starch—

- (a) starch drying;
 - (b) dry starch grinding and grading;
 - (c) pearl and powdered starch bulk packing; and
 - (d) lump starch cooking, pressing, grading and packing;
- should be carried on in a separate building, located at least 15 m (50 ft.) from any of the others or from any other manufacturing building.

17. Buildings for the grinding, cooking, pressing, grading and packing of starch should—

- (a) be of daylight type construction with large windows of thin glass with at least 50 per cent. of the wall consisting of windows; or
- (b) of other light construction that shall not offer greater resistance to explosion than the glass area; and
- (c) not have more than three storeys above the basement.

Transfer of Starch

18. Transfer of dried starch between buildings should be effected by means of—

- (a) conveyors, equipped with a positive seal or choke, under wide shed roofs;
- (b) galleries having sides at least 50 per cent. open; or
- (c) closed containers operating on tramways.

Hoppers

19. All hoppers for bulk starch, pearl starch and ground or powdered starch shall be—

- (a) provided in one wall or in the top with an explosion relief panel of an area equal to at least one-third the horizontal cross section of the hopper and so arranged as to yield towards the outside of the building; and
- (b) separated from one another by partitions of at least twice the strength of the explosion relief panels.

Starch Drying

20. Except where starch kilns extend solid from floor to roof of starch-drying buildings—

- (a) the top of the kiln shall be finished smooth with cement;
- (b) the roof of the building shall be not less than 1.8 m (6 ft.) above the top of the kiln; and
- (c) the space above the kiln should be entirely separated from the rest of the drying house by fire-resisting partitions extending from the kiln structure to the roof, and lighted and ventilated by means of skylights and windows.

21. In kiln buildings—

- (a) the operations shall be limited to charging, discharging dumping of kilns and preliminary reeling of starch; and
- (b) the starch dumps shall be under exhaust hoods of fire-resisting construction, so designed and situated that they will remove all dust liberated in dumping.

Starch Grinding

22. In buildings used for dry starch grinding and grading—

- (a) dust-collecting appliances for equipment ahead of the mills shall be separate from the dust-collecting appliances for equipment after the mills; and
- (b) dust-collecting appliances for equipment after the mills should be independent for each mill.

Floors

23. Floors surrounding bulk starch bagging or barrelling stands and lump starch presses shall be of grating, so arranged over a spiral conveyor as to receive and remove any spillage of starch during the operations.

Lump Starch Operations

24. In buildings used for lump starch operations, the cooking room, the pressing and opening room, the cylinder seasoning room, the grading room and the packing room shall each be—

- (a) separated by draught-stopping partitions of fire-resisting construction from the additional space on the floor on which it is situated; and

- (b) provided with its own complete dust-collecting system having the collector as remote from the others as arrangements will permit.

D. *Sugar and Cocoa Pulverising Departments*

Location of Premises

25. Grinding and pulverising of sugar or cocoa—

- (a) should be carried on in detached buildings, used for no other purpose and located at a safe distance from other buildings; or
- (b) if carried on in a building housing other operations, shall be segregated and located along an outside wall or in the top storey of the building.

Construction of Buildings

26. Buildings or parts of buildings in which grinding or pulverising of sugar or cocoa is carried on should be—

- (a) constructed with walls, partitions, floors and ceilings of not less than 10 cm (4 in.) reinforced concrete, or the equivalent in strength and fire resistance; and
- (b) provided with explosion-vent areas equal to not less than 10 per cent. of the combined areas of the enclosing walls.

27. When grinding or pulverising of sugar or cocoa is carried on in buildings used also for other operations—

- (a) access to the grinding or pulverising sections should be either—
 - (i) from the outside, by means of balconies or fire-resisting stairways; or
 - (ii) indirect, through the separating walls by means of vestibules, with the wall opening protected by an automatic sliding fire door and the vestibule protected by a self-closing swinging fire door at right angles to the sliding door;
- (b) except for shaft holes, pipe openings and openings for spouts or screw conveyors, all of which shall be tightly sealed, the walls and floors separating the grinding or pulverising processes from other portions of the building shall be unpierced; and
- (c) the use of air for conveying the material, in either its raw or finished state, to or from the grinding or pulverising section shall be prohibited.

Section 3. Corrosive, Hot and Cold Substances**REGULATION 194. GENERAL RULES***Protection of Structures and Equipment*

1. In all premises where corrosive gases, fumes or vapours occur, adequate measures shall be taken to prevent dangerous damage by corrosion to structural parts and factory equipment.

Storage Vessels

2. Vats, pans and open tanks containing corrosive or hot liquids shall comply with the relevant provisions of Regulation 107.

3. Storage tanks for corrosive or hot liquids shall comply with the provisions of Regulation 184, paragraphs 12-21.

4. Receptacles, such as drums and barrels, containing corrosive liquids shall comply with the provisions of Regulation 184, paragraphs 22-26.

5. Carboys for acids shall comply with the provisions of Regulation 184, paragraphs 27-33.

Handling

6. Where corrosive or hot liquids are manufactured, handled or used, they should be handled in bulk only by gravity systems, compressed-air or inert gas displacement systems, or pressure-pump systems, with the respective system extending to the point or points of use so as to eliminate transportation in small containers.

7. For emptying receptacles containing corrosive or hot liquids and not provided with drain cocks, the workers shall be provided with, and shall use, pumps, tipping appliances or other suitable apparatus.

8. Where portable receptacles are used for corrosive liquids, transport inside factories shall be effected without escape of fumes, and preferably mechanically by means of conveyors or by special trucks such as roundbed trucks for drums or two-wheeled trucks with fork attachments for carboys.

9. Receptacles shall be kept securely closed except during extraction of the contents.

Spillage of Acids or Alkalies

10. Floors in rooms where corrosive liquids are manufactured, handled or used shall be maintained as dry as possible, avoiding spillage.

11. Spillage of corrosive liquids shall be guarded until removed, so as to prevent workers from stepping into it.

12. Spilled or escaping corrosive acid shall never be absorbed by sawdust, waste, cloth or other organic materials, but should be flushed out with water or neutralised with chalk or lime.

Diluting Acids

13. When diluting an acid with water, the acid shall always be poured slowly into the water, with constant stirring of the mixture; the water shall never be poured into the acid.

Corrosive Fumes

14. Where dense acid fumes or strong ammonia fumes are accidentally liberated, as through rupture or impairment of equipment or breakage of containers, the workroom shall immediately be cleared of all employees.

Physical Contact with Corrosive Substances

15. Workers who may be exposed to physical contact with corrosive or hot liquids, or with caustic compounds of calcium, potassium and sodium or their dusts, shall be provided with, and shall use, protective clothing and equipment conforming to the requirements of Chapter XIV of this Code.

16. (1) Where corrosive liquids are manufactured, handled or used, clear running water shall be readily accessible to all workers, and baths or tubs of water, each big enough to contain a man, or quick-operating shower baths shall be installed and maintained in or adjacent to each workroom or storeroom.

(2) The temperature of the water shall not differ appreciably from that of the surroundings so that it shall not scald injured persons.

(3) Where necessary, neutralising solutions shall be placed at the disposal of workers.

17. (1) Workers handling acids should rinse their mouths frequently with a suitable alkaline solution.

(2) Workers shall be given clear instructions as to the reasons for this measure.

REGULATION 195. NITRIC ACID

1. Nitric acid shall only be stored and transported in closed tight vessels.

2. Any vessel which is to contain nitric acid shall be well washed out and free from all foreign substances.

3. Vessels shall only be filled to an extent that leaves an adequate air space, in the case of glass carboys about 2 l ($\frac{1}{2}$ gal.).

4. Spilled or escaped acid—

(a) shall be washed away with large quantities of water, and while this is being done no person shall approach the fumes unless he is wearing suitable breathing apparatus.

(b) shall not be absorbed by sawdust, straw, wool waste, earth, etc., for this will lead to a violent generation of nitrous gases (brown or red fumes), inhalation of which may be fatal.

5. The competent authority should decide what quantity of acid is required for the continuance of the work and only such quantity should be in the workrooms.

6. In cleansing containers, apparatus, etc., of acid, water shall be used in large quantities.

7. Workers who have inhaled nitrous fumes shall immediately be given medical treatment.

REGULATION 196. HYDROFLUORIC ACID

1. In rooms in which hydrofluoric acid is used for etching (etching rooms) there shall be a plentiful supply of fresh air; draughts shall be avoided.

2. The floor shall be covered with lead, gutta-percha or other material that is not attacked by hydrofluoric acid and be tight and shall slope gently down to a drain.

3. (1) The workplaces shall be so enclosed in projecting hoods that openings required for bringing in the objects to be etched shall be as small as possible.

(2) No person shall lean under the hood.

(3) Work benches shall be covered with lead, gutta-percha or other material that is not attacked by hydrofluoric acid and the edges of the benches shall be raised so that spilt acid cannot escape from the benches.

4. The workplaces shall be provided with reliable devices for exhausting the poisonous gases produced in etching directly at the point of origin and carry them out of the workroom in closed pipes.

5. The exhaust shall be powerful, especially at the top rim of the acid tanks and the gases should be exhausted downwards.

6. The acid shall only be applied in an effective exhaust draught.

7. Hydrofluoric acid shall only be stored and transported in receptacles of material proof against hydrofluoric acid (rubber cylinders, lead cylinders, etc.).

8. In etching rooms only persons over 18 years of age should be employed.

9. Unauthorised persons shall not be admitted to etching rooms.

REGULATION 197. DRY ICE (SOLID CARBON DIOXIDE)

1. Tools for handling dry ice should be provided with wooden handles.

2. Where it is necessary to handle dry ice, or metal objects which have been in contact with dry ice, without tools, workers shall be supplied with, and shall use, suitable gloves conforming to the requirements of Regulation 233 of Chapter XIV of this Code.

3. Dry ice shall not be put in bottles or other closed containers which are not designed to withstand the pressure that may be generated.

4. No person shall enter stores containing dry ice unless adequate measures are taken to protect them from the dangers of carbon dioxide.

Section 4. Infectious, Irritating and Toxic Substances**REGULATION 198. GENERAL RULES****A. *Provisions Applying to All Infectious, Irritating and Toxic Substances******Scope***

1. The provisions of paragraphs 2 to 10 of this Regulation shall apply to premises of industrial establishments where infectious, irritating or toxic substances are manufactured, handled or used, or where such substances are or may be present, either during regular operations or through temporary failure of the control systems.

Warning Devices

2. In all establishments where toxic substances are manufactured, handled or used, suitable devices shall be installed wherever possible to give warning to the personnel in case of liberation of dangerous quantities of these substances.

Cleaning and Disinfection

3. (1) Floors, walls and other structural surfaces, workbenches, tables and equipment shall be thoroughly cleaned daily by means of vacuum cleaning or by wet brushing or sweeping, if possible out of working hours, and shall be washed as often as necessary and at least once a week.

(2) Where infectious substances are handled, disinfection by appropriate measures shall be carried out after each cleaning.

(3) As far as possible materials which are handled shall be disinfected before being used.

Working Clothing

4. All personnel exposed to infectious, irritating or toxic substances shall be provided with suitable overalls or working clothing and also head coverings where needed, which—

- (a) shall be removed before partaking of food or leaving the premises, and deposited in the places set apart for such purpose;
- (b) shall not be taken out of the factory by the users for any purpose; and
- (c) shall be maintained in good repair and shall be sterilised when necessary and washed, cleaned or changed for clean clothing at least once a week or more often if necessary.

Meals

5. The introduction, preparation or consumption in the workrooms of food, drink and tobacco shall be prohibited.

Personal Cleanliness

6. All personnel exposed to substances which are poisonous through ingestion shall be required to wash their faces and hands thoroughly before partaking of any food, drink or tobacco, or leaving the premises.

Instruction of Personnel

7. All personnel shall be thoroughly informed, by means of posters and by verbal instruction of the health hazards connected with their duties and the measures to be taken to protect themselves therefrom.

Medical Aid

8. All personnel exposed to infectious, irritating or toxic substances shall be required to report promptly any physical complaints. If handling any substance which may cause infection, workers shall be required to report any wound, however slight.

9. One or more first-aid kits or cabinets, containing sufficient and suitable first-aid dressings and other equipment, in charge of a specific person or persons properly trained to administer first aid in conformity with the provisions of Regulation 241 of Chapter XV of this Code shall be provided and maintained in easily accessible locations, for immediate temporary treatment in case of accident or sudden illness.

B. *Additional Provisions for Irritating or
Toxic Substances*

Walls, Ceilings and Floors

10. The walls, ceilings and floors of workrooms shall be made and kept smooth and impervious so that thorough cleaning by dry or wet methods is possible.

11. Every operation or process in the manufacture, handling and use of irritating or toxic substances shall be conducted in such a manner and with such safety devices as will protect the workers as far as possible from contact with the substances.

Personal Protective Equipment

12. Where exceptional circumstances make it necessary for a person to enter places where the atmosphere is contaminated by harmful quantities of irritating or toxic dusts, fibres, fumes, gases, mists or vapours he shall be provided with and shall wear adequate respiratory protective devices and, where necessary, adequate protective clothing, the whole conforming to the requirements of Chapter XIV of this Code.

C. *Carbon Monoxide*

13. (1) Where carbon monoxide is emitted in dangerous amounts from any plant in connection with any process of manufacture—

- (a) (i) either the plant shall be so designed or located that the gas is discharged to atmosphere in such a way as not to endanger workers; or
- (ii) the escaping gas shall be burnt; or
- (iii) gas escaping where anyone regularly works shall be removed by local exhaust; and
- (b) any person who has occasionally to be where carbon monoxide is being emitted in dangerous amounts shall wear a breathing apparatus of a type that does not draw its supply of air from the immediate vicinity of the worker.

REGULATION 199. IRRITATING OR TOXIC DRY SUBSTANCES

A. *General Rules*

Isolation of Workrooms

1. Workrooms used for melting or treating irritating or toxic metals or other dry substances or in the manufacture or use of irritating or toxic compounds in dry form shall be separated from all rooms in which the work or process is of a non-dusty character.

Atmospheric Contamination Control

2. Every operation or process involving melting or treating of irritating or toxic metals or other dry substances, or in the manufacture or use of irritating or toxic dry compounds, including transport from one apparatus to another and the packing of the products, shall be effected by mechanical means in apparatus provided with—

- (a) adequate enclosures; and
- (b) hoods, so constructed and located that any dust or fumes produced will be drawn into them and carried to dust-collecting systems.

3. All hoppers, chutes, conveyors, elevators, separators, vents from separators, screens, pulverisers and other grinding equipment, dryers and packing apparatus used for dry toxic materials in any form or combination, shall be connected to dust-collecting systems.

4. Stationary dust-collecting apparatus for irritating or toxic dry substances shall be placed outside or in isolated rooms used solely for that purpose, and no worker shall be required or permitted to enter such a room unless he is wearing adequate respiratory protective devices conforming to the requirements of Regulation 235 of Chapter XIV of this Code.

Spillage

5. Spillage of irritating or toxic dry substances shall be removed as quickly as possible, preferably by vacuum apparatus.

Time for Use of Washrooms

6. A time allowance of not less than 10 minutes, at the expense of the employer, for the use of the washroom before the lunch period shall be made to each worker employed in the manufacture or handling of—

- (a) irritating or toxic dry mineral or organic substances, such as arsenic, chrome, lead, manganese, mercury, phosphorus and zinc, and their compounds;
- (b) superphosphates and other mineral fertilisers;
- (c) dust-producing coal-tar products, such as pitch and soot;
- (d) dust-producing toxic dyestuffs and pigments; and
- (e) radioactive substances,

during which period the worker shall remove such substances from the skin.

Time for Use of Shower Baths

7. (1) A time allowance of not less than 10 minutes at the expense of the employer, for the use of the shower baths or baths at the end of the day's work shall be made to each worker employed in the manufacture or handling of the substances referred to in the preceding paragraph.

(2) A bath register shall be kept, containing a list of all persons employed in the process and an entry of the date when each person has taken a bath.

B. Special Precautions in the Manufacture of Lead Compounds

Metallic Lead

8. Where metallic lead is used in the manufacture of lead compounds—

- (a) lead (other than ingots of the metal) and lead compounds shall be kept in boxes with dust-proof covers or kept thoroughly damp;
- (b) no lead (other than ingots of the metal) and no lead compound shall be deposited or allowed to remain on any part of the floor not permanently set apart for the purpose, and no lead (other than ingots of the metal) and no lead compound shall be moved about the workrooms unless such material is—
 - (i) so enclosed as to prevent the escape of dust into the air of any place in which work is carried on; or
 - (ii) under efficient exhaust draught; or
 - (iii) damp.

Manufacture of White Lead

9. Where white lead is manufactured by the Dutch or stack process—

- (a) the beds for the corroding pots shall be made of tan bark or other organic materials which do not emit injurious or obnoxious emanations, and the use of manure for such purpose shall be prohibited;
- (b) a standpipe, with an adequate water supply and a movable hose provided with a spray nozzle, should be installed in each stack; and
- (c) when stripping the stacks, each white bed shall on removal of the covering boards be moistened sufficiently to lay the dust.

10. Where white lead is manufactured by the German or chamber process—

- (a) the oxidising chambers and their contents shall be kept moist while the process is in operation; and
- (b) after the corrosive action has finished, and the chambers have been cooled sufficiently, the white lead shall be detached from the walls, scaffolds and floors by means of heavy streams of water and flushed to tanks located outside the chambers for subsequent straining, filtering, etc.

11. Where white lead is manufactured by the Carter (or Wultze) process, the blow chambers shall—

- (a) be dustproof and so arranged that they will be emptied mechanically, preferably with the blown lead delivered automatically to the corroding cylinders by means of screw conveyors with dustproof covers; and
- (b) not be entered while the blowing is in progress, except for making repairs or for cleaning the chamber, and then

only by workers wearing adequate respiratory protective equipment.

12. Stoves or corridor dryers for drying pulp lead shall be provided with—

- (a) impermeable walls, smooth on the inside, and solid even floors, capable of being easily cleaned by either vacuum apparatus or water;
- (b) one or more openable windows, so placed as to allow adequate through ventilation;
- (c) racks for drying pans, with the top shelf not more than 3 m (10 ft.) above the floor; and
- (d) devices for emptying the drying pans, with controls located outside the stoves.

13. Stoves for drying pulp lead shall not be entered for drawing or other purposes until the temperature has fallen to 21° C. (70° F.) or to not more than 5° C. (9° F.) above the temperature of the outside air.

14. Where technically practicable, white lead used in processes for the manufacture of lead products, such as grinding in oil, shall be in the form of pulp or paste.

15. Furnaces, apparatus, pipes and all objects which workers have to manipulate in the manufacture of lead compounds or lead products shall be cleaned whenever necessary and not less than once in every two weeks.

C. Special Precautions in the Manufacture, Handling and Use of Phosphorus

Prohibition of Use

16. (1) The use of white phosphorus—

- (a) shall be prohibited in the manufacture of matches; and
- (b) should not be allowed in the manufacture of fireworks and in the production of phosphorus compounds when red (amorphous) phosphorus or phosphorus sesquisulphide can be substituted, or where it is technically practicable to replace it by other substances.

(2) No person shall work with white phosphorus where there is any danger of exposure of the jaw-bone to injury by phosphorus, due to defect of the teeth or gums or disease in the mouth.

(3) In particular, no one shall work with white phosphorus after tooth extraction until the socket is completely healed.

(4) Initial and periodic dental examination shall be provided and the qualified dentist shall certify at each examination as to the fitness of the worker on this account for this employment.

Bones and Bone Products

17. Preparation and handling of bones and bone products in the manufacture of white phosphorus shall be carried out in accordance with the requirements of Regulation 201 of this Code.

Storage

18. (1) In the process of manufacture, white phosphorus shall be stored under water in watertight cement reservoirs.

(2) For transport, white phosphorus shall be—

- (a) immersed in water, containing where necessary a suitable admixture to prevent freezing, in hermetically sealed metal containers packed in solid wooden boxes; or
- (b) immersed in water, in steel drums, tank cars or motor-vehicle cargo tanks.

Fire Precautions

19. In the event of a fire involving phosphorus—

- (a) all workers shall leave the vicinity unless equipped with respiratory protective devices affording adequate protection against phosphorus oxide fumes; and
- (b) the fire shall be deluged with large quantities of cold water until it is extinguished and the melted phosphorus is solidified, after which it should be covered with sand or dirt and kept moist until safely removed.

D. *Special Precautions in the Manufacture, Handling
and Use of Certain Other Irritating or Toxic
Dry Substances*

Calcium Cyanamide (Cyanamide)

20. Workers employed in the manufacture, handling or use of calcium cyanamide—

- (a) should cover all exposed parts of the body with a suitable protective coating; and
- (b) when cleaning up, should carefully remove all dust adhering to the protective coating or to the skin with vaseline before washing with neutral soap and water.

Chlorates

21. Chlorates and perchlorates shall be kept from contact with strong acids, antimony sulphide and sulphur and with charcoal, starch, sugar and similar combustible substances.

22. Chlorates and perchlorates shall not be crystallised, ground or packed except in a room or place not used for any other purpose.

23. Wooden vessels shall not be used for the crystallisation of chlorates and perchlorates or to contain chlorates and perchlorates.

24. (1) Workers employed in the manufacture, handling and use of chlorates shall keep away from open flames when wearing clothing impregnated with chlorates.

(2) There shall be provided and maintained for the use of all persons employed in any room or place in which chlorates are crystallised, ground or packed—

- (a) clothing of woollen or non-flammable material and boots or overshoes, the soles of which shall have no metal upon them; this clothing shall not be removed from the factory for any purpose, but shall be washed daily after use and thoroughly dried before being worn again; all such clothing when worn out shall be destroyed; and
- (b) means of drenching, as described in paragraph 16 of Regulation 194 of this Code.

Chromic Acid and Chromates

25. In places where workers employed in the manufacture, handling and use of chromic acid or chromates do not wear gloves, facilities shall be installed close to each worker's station for washing the hands frequently in running water in order to remove the chrome dust or chrome liquids before they have time to act.

Mercury

26. In the event of a break in equipment or piping containing hot mercury, all workers shall immediately leave the workroom unless wearing adequate respiratory protective devices conforming to the requirements of Regulation 235 of Chapter XIV of this Code.

27. Flasks or jugs containing metallic mercury shall not be left uncovered even at ordinary room temperature.

28. Spillage of metallic mercury should immediately be flooded with water and removed.

29. Workers employed in the manufacture or handling of mercury fulminate shall wash their hands and arms with a 10 per cent. solution of sodium hyposulphite (sodium thiosulphate) before meals and before leaving the premises.

Calcium, Potassium and Sodium

30. Metallic calcium, potassium and sodium, except when sealed in containers that are both air-tight and water-tight shall be kept immersed in naphtha, petroleum or other similar liquid which does not contain water or free oxygen.

Nitro- or Amino- Aromatic Derivatives

31. Workers employed in the manufacture or handling of dinitrotoluene, trinitrotoluene, dinitrophenol, trinitrophenol or other dry nitro- or amino-aromatic derivatives with similar harmful properties shall—

- (a) wear gloves of natural rubber or some equally suitable material fitting tightly round the wrists or shall protect their hands and forearms by some other equally effective means which shall be placed at their disposal;
- (b) wash their gloves, hands and arms with a 10 per cent. solution of sodium bisulphite or of acetone before meals and before leaving the premises; and
- (c) abstain from alcoholic drinks.

32. In the manufacturing or handling of dry aromatic nitro- or amino- derivatives with toxic properties—

- (a) continuous medical supervision should be provided;
- (b) the wearing of frequently laundered underwear, overalls, gloves and caps should be insisted upon;
- (c) suitable facilities for washing and bathing, conforming to the provisions of Regulation 217, shall be provided and at the end of the shift workers shall take a bath;
- (d) workers shall thoroughly wash their hands with soap and water before eating and at the end of each shift;
- (e) workers shall be advised to abstain from alcoholic drinks while potentially exposed to these chemical substances; and
- (f) respiratory protection devices shall be provided in conformity with the provisions of Regulation 235 of this Code where excessive exposure is unavoidable.

REGULATION 200. IRRITATING OR TOXIC LIQUIDS AND GASES

A. General Rules

Isolation of Workrooms

1. Workrooms in which irritating or toxic liquids and gases are manufactured, handled or used shall be isolated from all other workrooms.

Floors

2. Floors of workrooms where irritating or toxic liquids are manufactured, handled or used shall be conveniently sloped toward a channel or channels for carrying off liquids to tanks or cisterns for subsequent recovery or neutralisation.

Atmospheric Contamination Control

3. Workrooms in buildings where irritating or toxic liquids are distilled shall be so arranged as to prevent the entry of fumes and gases from the distillation processes into other workrooms if the cooling apparatus breaks down or the distilling apparatus boils over.

4. Every operation in the manufacture and use of irritating or toxic liquids or gases shall be effected in closed or enclosed apparatus.

5. Irritating or toxic liquids should be transported through closed pipelines, either by gravity or by mechanical, including pneumatic, means and shall be kept stored only in covered vessels.

6. Irritating or toxic gases should be transported through piping systems conforming to the provisions of Section 5 of Chapter IX of this Code by means of blowing or suction, and shall be kept and stored only in accordance with the relevant requirements of Regulation 184.

7. Spent compressed air from blowers used in transporting irritating or toxic liquids and gases, and air expelled from vacuum pumps of distilling apparatus for such liquids, shall be purified before being led into the outside atmosphere, unless otherwise safely disposed of.

8. Where highly irritating or toxic fumes, gases, mists or vapours might accidentally be liberated in harmful quantities, a supply of adequate respiratory protective devices shall be available in safe and conveniently accessible places.

9. In the event of leaks in apparatus or pipelines used in the manufacture, handling or use of irritating or toxic liquids or gases—

- (a) the distilling or other productive operation shall be stopped as quickly as possible;
- (b) if necessary, the workers shall be withdrawn; and
- (c) competent workers wearing adequate respiratory protective devices and, where necessary, protective clothing, shall locate the leak and make the necessary repairs.

Spillage

10. Irritating or toxic liquids accidentally spilled on floors of workrooms shall be removed as quickly as possible.

Time for Use of Washrooms

11. (1) A time allowance of not less than 10 minutes, at the expense of the employer, for the use of the washroom and baths before the lunch period and at the close of the day's work shall be made to each worker employed in the manufacture or handling of coal tar, paints, varnishes or other similar liquids, during which period the worker shall remove such substances from the skin.

(2) A bath register shall be kept containing a list of all persons employed in the process and an entry of the date when each person has taken a bath.

Prevention of Contact

12. Working clothing which has become saturated with an irritating or toxic liquid shall be removed, if possible before the liquid comes into contact with the skin, and replaced with uncontaminated clothing after thorough washing of the skin.

13. Where it is necessary for workers to place their hands in irritating or toxic liquids, the hands shall be protected by means of suitable gloves or protective ointments.

14. Irritating or toxic solvents shall not be used for cleaning hands or other parts of the body.

Storage

15. Tanks, barrels, drums or carboys containing irritating or toxic liquids or gases shall be stored in accordance with the relevant requirements of Regulation 184.

Flammable, Irritating or Toxic Liquids or Gases

16. When liquids or gases are flammable as well as irritating or toxic, additional precautions shall be taken to reduce the fire hazard, in accordance with the relevant provisions of Regulation 187.

B. *Special Precautions in the Manufacture, Handling and Use of Coal-Tar Derivatives*

General Provisions

17. Buildings or structures in which nitro-compounds of benzene (C_6H_6) or nitro-compounds of other coal-tar products are manufactured or used in manufacturing processes or regularly recovered in considerable quantities, should have no premises above or below the working level.

18. Floors of workrooms in which aniline, nitrobenzene or other nitro or amido compounds of benzene or other coal-tar products are manufactured, handled or used shall be free from asphalt, tar, or similar materials which readily absorb or combine with the coal-tar derivatives.

19. (1) Platforms in rooms where nitro or amido compounds of benzene or other coal-tar products are manufactured, handled or used shall be so laid out that they—

- (a) will not interfere with the circulation of air in the room; and
- (b) will permit of easy access to all parts, both for carrying out the operations and for rescue purposes.

(2) Only such platforms shall be installed on top of melting kettles and distilling apparatus as are absolutely necessary for the proper handling of the equipment.

20. Spillage of liquid nitro or amido compounds of benzene or other coal-tar products shall be removed as quickly as possible by scattering sawdust over it and, after removing the moist sawdust, burning this in small quantities at a time.

21. Workers employed in the fractional distillation of coal tar for extraction of benzene or other aromatic hydrocarbons, phenols and other constituents, shall remove contaminated clothing as soon as possible and shall in the meantime keep away from all sources of ignition.

22. (1) In order to reduce contact with coal tar by workers employed in distillation of the tar—

- (a) the stills should be charged mechanically; and
 - (b) the thick liquid remaining in the still after removal of the tar oils should be removed for cooling while still hot, through pipes into receptacles which should be—
 - (i) covered if indoors; or
 - (ii) covered or securely fenced if out-of-doors.
- (2) When pitch in solid form is to be broken—
- (a) this should, as far as possible, be done by mechanical means; and
 - (b) similar precautions to those applicable under Regulation 199 to irritating and toxic dry substances should be taken.

Benzene and All Mixtures of Benzene Hydrocarbons

23. (1) It shall be prohibited to use as solvents—

- (a) benzene (C_6H_6) and all mixtures of benzene hydrocarbons, the distillation of which begins below $100^\circ C$; and
- (b) gasoline or complex solvents, the fraction of which distilling below $100^\circ C$. contains benzene hydrocarbons in a volume exceeding 5 per cent. of the total volume of the solvent distilling below $200^\circ C$.

(2) Provided that this prohibition shall not apply in cases where solvents or solutions containing benzene hydrocarbons are used in apparatus closed during the whole process, including wringing and drying.

(3) Provided further that temporary exemptions from the prohibition may be granted by the competent authority—

- (a) under conditions fixed by the authority when the employer proves that it is impossible to comply immediately with the provisions of paragraph 1 of this Regulation; and
- (b) when, for handling these substances, sufficient ventilation is available to reduce the concentration of benzene (C_6H_6) hydrocarbons in the air to the figure indicated in the table in Appendix III.

Phenols

24. An abundant quantity of water shall be readily available and be used to wash thoroughly such parts of the body as may have been affected by splashes of liquid phenol.

C. Special Precautions for the Manufacture, Handling and Use of Other Asphyxiating, Irritating or Toxic Liquids and Gases

Ammonia

25. (1) Where ammonia may be liberated in large quantities in the event of failure of equipment to function properly, provision should be made to minimise the action of the gas by installation of—

- (a) sprinkler systems with manual control or with automatic control actuated by the ammonia in the atmosphere; and
- (b) readily accessible hose with adequate water supply for playing streams of water on workers when necessary for them to carry out rescue or repair work in high concentrations.

(2) The workers should be trained to run without breathing for a period of up to 20 seconds with one eye shut and the other half open.

Carbon Disulphide (Carbon Bisulphide)

26. Carbon disulphide as a solvent should be replaced by solvents of the lowest possible toxicity.

Chlorine

27. Where carbon electrodes are used in the electrolytic manufacture of chlorine, electrodes of other substances such as magnetite (magnetic iron ore) should be substituted in order to reduce the hazard of chloracne.

28. In workrooms where chlorine is manufactured, handled or used, an adequate supply of ammonium hydroxide shall be readily available for neutralising the effect of the chlorine in the event of sudden escape of the gas.

29. As soon as the pungent odour of chlorine gas is perceptible in a workroom, warning shall be given and the room shall be evacuated as quickly as possible, except for persons authorised to act in such an emergency for investigating the cause and making necessary repairs and who shall be equipped with adequate respiratory protective devices.

Cyanogen and Cyanogen Compounds

30. Employees working in rooms where toxic cyanogen compounds in bulk are handled shall always be kept under observation.

31. Toxic cyanogen compounds should be kept in metal containers clearly marked "POISON" and both toxic and non-toxic cyanogen compounds shall be kept away from acids.

Dimethyl Sulphate

32. (1) Where dimethyl sulphate is manufactured, handled or used, there should always be readily available—

- (a) a solution of bicarbonate of sodium, for distribution to workers who have inhaled dimethyl sulphate vapours; and
- (b) a supply of ammonium hydroxide, of suitable concentration, for neutralisation of dimethyl sulphate on the body or on the clothing of workers.

(2) Workers who believe they have inhaled dimethyl sulphate shall report the fact immediately and receive medical advice and treatment if necessary.

Methyl Bromide

33. The following precautions shall be taken in the manufacture and handling of methyl bromide:

- (a) the manufacture of, and chemical operations employing, this product shall be carried out in completely closed apparatus;
- (b) the non-enclosed transfer of methyl bromide shall be carried out over an effective mechanical downward exhaust system; the temperature of the products shall be maintained at a temperature of -10° C. or below;
- (c) methyl bromide used for the filling of extinguishers shall contain an odour-producing substance, the boiling point of which is sufficiently close to that of methyl bromide;
- (d) methyl bromide shall not be used indoors as an agent for extinguishing fires;
- (e) disinfestation of food products by methyl bromide shall be carried out in an isolated place separated from other workplaces; and
- (f) if methyl bromide has been used for disinfestation or destruction of rats in a workplace, access to the latter shall be prohibited to the personnel until it has been established that the atmosphere of the workplace is free from further danger.

Formic Acid

34. The use of formic acid as a solvent in lacquers or varnishes should be prohibited.

Phosgene

35. Workers who believe they have inhaled phosgene shall report the fact immediately and receive medical advice and treatment if necessary.

Tetra-Ethyl Lead

36. Workers employed in the manufacture or handling of tetra-ethyl lead shall—

- (a) avoid all contact between the liquid and the skin;
- (b) in the event of contact with the liquid, immediately wash the skin with kerosene, followed by soap and warm water; and
- (c) in the event of spillage—
 - (i) dissolve the fluid in kerosene and flush it with water; or
 - (ii) neutralise the fluid with a thin paste of chloride of lime and water, or with kerosene containing 2 per cent. sulphurylchloride (sulphuric oxychloride).

37. In the manufacture, mixing, handling and distribution of tetra-ethyl lead—

- (a) only males over 21 years of age shall be employed;
- (b) constant medical supervision shall be provided, particularly as regards the symptomatology of the intoxication by tetra-

ethyl lead and should include pre-employment physical examination;

- (c) working clothes, including underclothing shall be—
 - (i) furnished daily to all workers;
 - (ii) clean and of light coloured materials;
 - (iii) replaced at once when contaminated;
 - (iv) changed at the end of the working day;
- (d) immediately after any actual or suspected skin contact with tetra-ethyl lead the exposed part of the body shall be cleaned thoroughly with kerosene and then with soap and water; and
- (e) at the end of the working day, workers shall take a bath.

38. In establishments in which tetra-ethyl lead is manufactured, mixed, handled or distributed—

- (a) all parts of the plant where lead in any form is used shall be subject to sanitary measures to prevent the collection and dissemination of lead dust;
- (b) separate ventilation systems shall be provided for manufacturing apparatus and for the air of the rooms;
- (c) the outlets for the air of the rooms shall be located near the floors of each room;
- (d) all the external inlets and outlets shall be so situated as to avoid dustiness and appreciable contamination of the air around the plant;
- (e) daily inspections shall cover efficiency of systems, all joints, valves and gaskets of manufacturing apparatus, and of pressure-hose respirators;
- (f) all containers of ethyl fluid or tetra-ethyl lead shall—
 - (i) be labelled as to exact content and danger;
 - (ii) be carefully tested for leaks; and
 - (iii) have a plainly legible label stating that they are to be closed tightly immediately when emptied, without cleansing, and sent back to the plant;
- (g) kerosene or other material used for cleansing the used containers of ethyl fluid or tetra-ethyl lead shall be placed in the containers by means of a closed system with—
 - (i) air vents to outside air; and
 - (ii) adequate ventilation;
- (h) the filling shall be performed by means of a closed system with—
 - (i) air vent from the containers to the outside air; and
 - (ii) adequate ventilation;
- (i) a dye shall be added to ethyl fluid in sufficient amount to give staining qualities to the ethyl gasoline to deter individuals from using it for cleansing or other similar purposes.

39. When mixing ethyl fluid or tetra-ethyl lead with gasoline—
- (a) the maximum content of tetra-ethyl lead in commercial ethyl gasoline shall be in the proportion of 1: 1,260 by volume for commercial tetra-ethyl lead, or 1: 1,300 for Pb (C₂H₅)₄ chemically pure;
 - (b) the mixing of ethyl fluid with gasoline shall be done only at properly equipped distribution centres;
 - (c) adequate provision shall be made at each of such centres for thorough mechanical distribution of the ethyl fluid throughout the gasoline and the efficiency of such distribution shall be controlled by the analysis of samples;
 - (d) the building used for mixing operations shall be so constructed that one side of the plant is of solid construction and the other three sides enclosed only with heavy wire mesh so installed as to prevent the entrance of unauthorised persons;
 - (e) workplaces shall be entirely covered by a roof for protection from the heat of the sun;
 - (f) no person shall be engaged for mixing until adequately instructed as to the mechanics of mixing, the dangers and the precautions to be taken in conformity with the provisions of paragraph 2 of Regulation 4 of this Code;
 - (g) the distributor of ethyl fluid shall provide a special corps of adequately trained instructors and service men;
 - (h) all mixing operations shall be done with the maximum ventilation practicable under weather conditions existing at the time;
 - (i) at the appearance of a leak or other defect—
 - (i) pumping operations shall be immediately stopped; and
 - (ii) no attempt shall be made to repair or disconnect the system until a qualified person has taken charge of it;
 - (j) where any possibility of spilling is present—
 - (i) floors shall be provided with drains and proper facilities for making possible a complete flushing out of all spilled fluid; or
 - (ii) in their absence, provision shall be made for chemically neutralising any spillage as it occurs;
 - (k) no bulk mixing station shall be dismantled or disconnected for repairs except by a qualified person;
 - (l) kerosene or other efficient means of preventing skin absorption of tetra-ethyl lead, and washing facilities, shall always be conveniently available.

40. The warning "ETHYL GASOLINE CONTAINING TETRA-ETHYL LEAD TO BE USED AS MOTOR FUEL ONLY AND NOT FOR CLEANING OR ANY OTHER PURPOSE" or other warning of similar effectiveness shall be—

- (a) displayed at each filling station of ethyl gasoline at the pump or in other conspicuous place; and
- (b) labelled on containers of ethyl gasoline sold to the general public.

41. (1) The cleaning of storage tanks shall be carried out—

- (a) on the personal responsibility of a senior official of the distributing company; and
 - (b) only by personnel—
 - (i) suitably trained, supervised and protected;
 - (ii) selected from the medical point of view; and
 - (iii) under constant medical supervision.
- (2) The tank should not be entered until—
- (a) it has been thoroughly ventilated and all residual vapours and sludge removed; or
 - (b) the person concerned is adequately protected against skin contact with the sludge and has an air supply which is completely independent of the air in the tank.

REGULATION 201. PRODUCTS OF ANIMAL AND VEGETABLE ORIGIN

Buildings

1. Factories where animal or vegetable oils are manufactured, or used in the manufacture of soap, where animal bones are carbonised, ground or otherwise treated, or where glues are manufactured, shall be constructed of fire-resisting materials, with impermeable floors provided with proper facilities for drainage, and without any exposed woodwork.

2. Workrooms used for the manufacture of animal or vegetable chemical products shall frequently be washed down with a suitable disinfecting solution.

Animal and Vegetable Raw Materials

3. Before any industrial manipulation of bones in factories, all suspected bones shall, whenever technically possible, be disinfected by the use of chemical products or by boiling for at least 30 minutes in water at 100° C. (212° F.) or by any other effective method as a means of protection against infectious disease.

4. Workers in factories producing animal chemicals shall—

- (a) not touch raw materials with bare hands; and
- (b) be provided with—
 - (i) suitable gloves, boots, aprons and such other personal protective equipment as may be necessary; and
 - (ii) hand tools suitable for the operations to be carried out.

5. Factories producing animal or vegetable chemicals should avoid any accumulation of putrefying or badly smelling materials, unless kept in closed vats protected against the weather.

6. Soap factories should not use raw materials which of themselves or during saponification give off nauseating odours.

[New paragraph 7.]

7. In factories where materials of animal origin such as hides, bristles and wool are used these products shall be disinfected before being handled.



CHAPTER XI

DANGEROUS RADIATIONS

Section 1. Infra-Red and Ultra-Violet Radiations

REGULATION 202. INFRA-RED RADIATIONS

1. The duration of exposure of persons to infra-red radiations should be limited in relation to the intensity of the radiation and the nature of its source.

2. All sources of intense infra-red radiations shall, as far as practicable, be shielded as near the source as possible, by heat-absorbing screens, water screens or other suitable devices to prevent such radiation entering the eyes of workers not wearing goggles or eye shields.

3. Goggles or eye shields conforming to the provisions of Chapter XIV of this Code and to absorption standards approved by the competent authority shall be worn by workers necessarily exposed at frequent intervals, or continuously, to sources of intense infra-red radiation.

4. In workrooms where such goggles or eye shields are used, the partial loss of light occasioned by the use of the goggles or screens should be offset by appropriately increasing the general and local lighting.

5. Saline drinks or salt tablets should be provided for workers liable to heat-stroke, heat cramps or heat colics resulting from continued or frequent exposure to sources of intense infra-red radiation.

REGULATION 203. ULTRA-VIOLET RADIATIONS

General Protection

1. In industrial establishments where operations, other than welding, are carried on that entail dangerous emission of ultra-violet radiations—

(a) precautions shall be taken with a view to preventing the diffusion of ultra-violet radiations, especially of radiations reaching the eyes of the workers by—

(i) placing protective cabinets or screens around the sources of emission; or

- (ii) interposing a screen of ultra-violet-absorbing glass or other material between the source of radiation and any persons employed in the workroom; and
- (b) the area of ultra-violet irradiation should be limited to the minimum necessary.

Personal Protection

2. Where the methods of protection mentioned under paragraph 1 of this Regulation are inapplicable, goggles conforming to the provisions of Chapter XIV of this Code and to absorption standards approved by the competent authority shall be used.

3. Hands and forearms of workers exposed to appreciable amounts of ultra-violet radiation shall be protected by—

- (a) gloves with gauntlets made of cotton or other material suitable for the particular work; or
- (b) suitable barrier creams.

4. Workers exposed to appreciable amounts of ultra-violet radiation shall cover their faces with thin muslin masks or other suitable material.

Ventilation

5. Whenever ultra-violet lamps not within glass bulbs or covered with glass windows absorbing radiations of less than 2,900 Å wavelength are used, the rooms shall be well ventilated.

Welding

6. Electric arc welders shall, and gas welders should, be provided with suitable goggles, face shields, helmets and protective clothing to prevent ultra-violet irradiation of exposed parts of the body.

7. (1) Where electric arc welding is carried on, the internal walls of the welding bays or booths shall be rendered substantially non-reflecting to ultra-violet radiations.

(2) As far as practicable, the internal walls of welding bays or booths for electric welding should be painted in light colours which do not reflect dangerous radiation.

8. Electric arc welders should work within individual booths: Provided that where this is not practicable, movable screens shall be installed around the working place.

Notice to Workers

9. All workers exposed to appreciable amounts of ultra-violet radiation shall be informed by means of notices posted up, and verbally if necessary, of the dangers to which they are exposed and the appropriate means of protection.

New text of paragraph 6.]

Welding

6. Electric-arc welders shall be provided with suitable goggles, face shields, helmets and protective clothing to prevent ultra-violet irradiation of exposed parts of the body.



MODEL CODE OF SAFETY REGULATIONS FOR INDUSTRIAL ESTABLISHMENTS FOR THE GUIDANCE OF GOVERNMENTS AND INDUSTRY

AMENDMENTS 1959: IONISING RADIATIONS

The attached pages on pink paper replace pages 383-399 (Chapter XI, section 2) of the original text of the *Model Code of Safety Regulations for Industrial Establishments for the Guidance of Governments and Industry*.¹ Appendix IV (pages 481-483) of the original text should be cancelled.

The new pages contain model provisions as revised by an I.L.O. meeting of French, German (Fed. Rep.), U.S.S.R., United Kingdom and United States experts (Geneva, 25 November-11 December 1957), and take account of the latest recommendations on maximum permissible doses adopted by the International Commission on Radiological Protection in 1958.²

For the convenience of users particularly concerned with protection against ionising radiations, the revised version of Chapter XI, section 2, has been issued as a separate booklet.³

It will be noticed that the revision has involved considerable expansion and reorganisation of the subject matter under two main headings: "Sealed Sources and Equipment Generating Ionising Radiations" and "Unsealed Radioactive Sources".

A table of contents for the section is included; the pages should be inserted at the appropriate place in the main table.

To avoid revision of the index for the entire *Code* a separate index for Chapter XI, section 2, is also included. It may be placed at the end of the section.

¹ Geneva, I.L.O., 1949; amendments 1956.

² *Recommendations of the International Commission on Radiological Protection* (London, Pergamon Press, 1959).

³ *Model Code of Safety Regulations (Ionising Radiations)*, Manual of Industrial Radiation Protection, Part II (Geneva, I.L.O., 1959). 54 pp. Price: 75 cents; 4s. 6d.



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[New text, replacing pp. 383-399.]

Section 2. Ionising Radiations

REGULATION 204. DEFINITIONS

1. In this Code the following terms have the meanings hereby assigned to them:

- (a) the term "ionising radiations" means electromagnetic or corpuscular radiation capable of producing ions directly or indirectly in its passage through matter; it includes radiations emitted by X-ray tubes and particle accelerators, radiations emitted by radioactive substances, and neutrons;
- (b) the term "radioactive substance" means any substance which consists of, or contains, any radioactive chemical elements, whether natural or artificial;
- (c) the term "sealed source" means any radioactive source or ionising radiations that is firmly bonded within metals or sealed in a capsule or similar container of adequate mechanical strength so as to prevent dispersion of the active material into the surrounding workroom or other workplace;
- (d) the term "luminous compound" means luminous material containing a radioactive substance;
- (e) the term "radiation hazard" means the danger to health arising from exposure to ionising radiation; it may be due to external radiation or to radiation from radioactive materials within the body;
- (f) the term "external radiation" means radiation received by the body from sources external to it;
- (g) the term "internal radiation" means radiation received by the body from sources within it;
- (h) the term "adequate protection" means protection against ionising radiations such that the radiation dose received by any person from sources external and/or internal to the body does not exceed the maxima referred to in paragraphs 4 to 7;
- (i) the term "occupied area" means an area which may be occupied by personnel and where a radiation hazard may exist;
- (j) the term "controlled area" means an area in which the occupational exposure of personnel to radiation or radioactive material is under the supervision of a competent person;
- (k) the term "useful beam" means that part of the primary and secondary radiation which passes through the aperture, cone, or other device for collimating a beam of ionising radiations;
- (l) the term "leakage radiation" means all radiation except the useful beam coming from within a protective housing;
- (m) the term "protective housing" means a housing of an X-ray

- tube or of a sealed source intended to reduce the leakage radiation to a specified level;
- (n) the term "background radiation" means ionising radiation, other than that to be measured, which contributes to the background count or to the leak of ionisation measuring equipment;
 - (o) the term "natural background" means ionising radiation received by the body from natural sources, such as cosmic radiation, environmental radioactivity and radioactive potassium within the body;
 - (p) the term "half-value layer" means the thickness of a specified material required to reduce a beam of ionising radiation to one-half its incident dose rate;
 - (q) the term "nuclide" means a species of atom having a specific mass number, atomic number and energy state;
 - (r) the term "curie" means the quantity of a radioactive nuclide in which the number of disintegrations per second is 3.700×10^{10} ;
 - (s) the term "exposure dose of X- or gamma radiation" means a measure of the radiation at a certain place, based upon its ability to produce ionisation;
 - (t) the term "roentgen" means the unit of exposure dose of X- or gamma radiation and is defined as the exposure dose of X- or gamma radiation such that the associated corpuscular emission per 0.001293 g of air produces, in air, ions carrying one electrostatic unit of quantity of electricity of either sign;
 - (u) the term "absorbed dose" of any ionising radiation means the energy imparted to matter by ionising particles per unit mass of irradiated material at the place of interest;
 - (v) the term "rad" means the unit of absorbed dose; 1 rad is 100 ergs per gramme;
 - (w) the term "RBE" means relative biological effectiveness and is used to compare the effectiveness of absorbed dose of radiation delivered in different ways;
 - (x) the term "RBE dose" means the product of the dose in rads and an agreed conventional value of the relative biological effectiveness (RBE) with respect to a particular form of radiation effect;
 - (y) the term "rem" means the unit of RBE dose; in the case of mixed radiations, the RBE dose is assumed to be equal to the sum of the products of the absorbed dose of each radiation and its RBE.

REGULATION 205. SCOPE

2. (1) The provisions of this Code shall apply to industrial establishments where radioactive substances, sealed or unsealed,

are, or are proposed to be, stored, manipulated, operated or used, or where equipment capable of producing ionising radiations is, or is proposed to be, operated or used.

(2) They shall not apply to chemical and metallurgical factories treating natural radioactive materials or nuclear fuel, facilities for the bulk storage of radioactive substances, nuclear reactors, or high-energy accelerators for the production of radioactive nuclides.

(3) The provisions of this Code shall not apply to—

- (a) radioactive substances, the specific activity of which is lower than 0.002 microcurie of parent radioactive chemical element per gramme of substance;
- (b) sealed sources, exposure to which is such that the RBE dose cannot exceed 2 millirems per hour.

REGULATION 206. MAXIMUM PERMISSIBLE DOSES¹

3. (1) The following maximum permissible doses apply only to occupational exposure within controlled areas and are additional to non-occupational irradiation such as that from natural background and medical procedures.

(2) In any organ or tissue the total dose due to occupational exposure shall comprise the dose contributed by external sources during working hours and the dose contributed by internal sources taken into the body during working hours.

Exposure of the Gonads, the Blood-Forming Organs and the Lenses of the Eyes.

4. (1) The maximum permissible total dose accumulated in the gonads, the blood-forming organs and the lenses of the eyes at any age over 18 years shall be governed by the relation

$$D = 5(N - 18)$$

where D is the tissue dose in rems; and

N is the age in years.

(2) For a person who is occupationally exposed at a constant rate from the age of 18 years the formula implies a maximum weekly dose of 0.1 rem, and this value should be used for purposes of planning and design.

(3) To the extent that the formula permits an occupationally exposed person may accumulate the maximum permissible dose at a rate not in excess of 3 rems during any 13 consecutive weeks. If necessary the 3 rems may be received as a single dose, but this should be avoided as far as practicable.

¹ The maximum permissible doses referred to in this section are in accordance with the recommendations of the International Commission on Radiological Protection adopted in September 1958.

Special Cases of Exposure.

5. (1) When the previous occupational exposure history of an individual is not definitely known it shall be assumed that he has already received the full quota permitted by the formula referred to in paragraph 4.

(2) Persons who were exposed in accordance with the former maximum permissible weekly dose of 0.3 rem and who have accumulated a dose higher than that permitted by the formula should not be exposed at a rate higher than 5 rems in any one year, until the accumulated dose at a subsequent time is lower than that permitted by the formula.

(3) An accidental high exposure that occurs only once in a lifetime and contributes no more than 25 rems shall be added to the dose accumulated up to the time of the accident; and if the sum then exceeds the maximum value permitted by the formula, the excess need not be included in future calculations of the person's accumulated dose.

(4) Accidental exposure to doses higher than 25 rems shall be regarded as being potentially serious and shall be referred to the competent medical authorities for appropriate remedial action and recommendations on subsequent occupational exposure.

(5) The provisions of subparagraphs (3) and (4) above are intended as an administrative guide to allow the continuation of work with radiation following a bona fide accident, in cases in which interruption of such work, or curtailment of exposure, would handicap the individual in the pursuit of his career.

(6) Emergency work involving exposure above permissible limits shall be planned on the basis that the individual will not receive a dose in excess of 12 rems. This shall be added to the occupational dose accumulated up to the time of the emergency exposure. If the sum exceeds the maximum value permitted by the formula referred to in paragraph 4, the excess shall be made up by lowering the subsequent exposure rate so that, within a period not exceeding five years, the accumulated dose will conform with the limit set by the formula. Women of reproductive age shall not be subjected to such emergency exposure.

Exposure of Single Organs Other than the Gonads, the Blood-Forming Organs and the Lenses of the Eyes.

6. (1) For exposure that is essentially restricted to portions or single organs of the body, with the exception of the gonads, the blood-forming organs and the lenses of the eyes, a higher dose than the one derived from the formula referred to in paragraph 4 is permitted.

(2) The dose in the skin and in the thyroid, accumulated over any 13 consecutive weeks, shall not exceed 8 rems; this applies to all exposure of the skin, except of the skin of the hands and forearms, feet and ankles. As this dose of 8 rems is derived from an average of 0.6 rem per week, the annual dose for a 50-week year is limited to 30 rems.

(3) The dose in the hands, forearms, feet and ankles accumulated over any 13 consecutive weeks shall not exceed 20 rems; this applies to all tissues of the above-mentioned extremities. As this dose of 20 rems is derived from an average of 1.5 rems per week, the annual dose for a 50-week year is limited to 75 rems.

(4) The dose accumulated over any 13 consecutive weeks from the limited exposure of internal organs other than the thyroid, the gonads and the blood-forming organs and which would originate almost exclusively from radioactive substances within the body shall not exceed 4 rems. As this maximum is derived from a weekly average of 0.3 rem, the annual dose for a 50-week year is limited to 15 rems. This weekly average in the organ of interest¹ is expected to be maintained under equilibrium conditions if the concentration in air or water of the relevant radioactive substance is kept at the levels recommended by the International Commission on Radiological Protection.

(5) When the radioactive substances in a mixture are taken up by several organs the permissible levels of exposure shall be those applicable for the gonads, the blood-forming organs and the lenses of the eyes, since the combined exposure constitutes essentially whole-body exposure.

Exposure of Non-Radiation Workers.

7. (1) For any adults who work in the vicinity of controlled areas (non-radiation workers), or who enter controlled areas occasionally in the course of their duties (but are not regarded as radiation workers), the total annual dose, including contributions from external and internal sources, to the gonads, the blood-forming organs and the lenses of the eyes, due to operations within the controlled area, shall not exceed 1.5 rems, nor shall the contribution from a mixture of radioactive substances, whose combined exposure constitutes essentially whole-body exposure, make the total annual dose exceed 1.5 rems.

(2) In the case of the skin and the thyroid an annual maximum dose of 3 rems is allowed.

(3) The individual maximum permissible annual dose will not be exceeded from internal exposure of any single organ if the

¹ There are certain exceptions to this, as indicated in the I.C.R.P. recommendations.

release of radioactive substance is planned on the basis of one-tenth of the maximum permissible concentration in air or in water recommended by the I.C.R.P. for continuous occupational exposure (168-hour week).

REGULATION 207. GENERAL PROVISIONS RELATING TO ALL PROCESSES INVOLVING A RADIATION HAZARD

Notification.

8. The employer should give not less than one month's notice in writing to the competent authority—

- (a) before undertaking for the first time in the establishment work involving a radiation hazard, or
- (b) before carrying out substantial extensions or modifications to apparatus or plant emitting ionising radiations or affording protection against them.

Choice of Protection.

9. In the choice of methods of protection, preference should be given to protection permanently built into the installation rather than to personal protective equipment.

Reduction of Exposure.

10. Every effort shall be made to reduce to the lowest practicable level the exposure of workers to all external or internal sources of ionising radiations.

11. No person shall wilfully and unnecessarily expose himself or be exposed, without adequate protection, to ionising radiations.

12. (1) Wherever practicable the useful beam shall be directed away from adjacent occupied areas.

(2) The cross-section of the useful beam shall be the smallest value compatible with the work.

13. (1) Unsealed sources shall be manipulated with due regard to their toxicity.

(2) The methods of manipulation employed shall be chosen with a view to minimising the entry of radioactive material into the body.

(3) The quantity of radioactive material used shall be the minimum required for the work.

(4) Appliances and facilities provided to control the hazards shall at all times be used.

14. All work associated with sources of ionising radiations, including storage and disposal, shall be so arranged and conducted as to afford adequate protection.

Protective Devices.

15. (1) All protective devices, appliances and apparatus shall be suitable for the purpose for which they are intended.

(2) They should not only provide adequate protection but be convenient to use.

(3) Such devices, appliances and apparatus shall be examined by the competent person to determine whether they are in good condition and operating satisfactorily—

(a) before being put into use;

(b) whenever changes are made in procedures, equipment or shielding; and

(c) at least once in every three months.

(4) The results of these examinations shall be entered in a register.

(5) Any defects found shall be remedied forthwith.

Age Limit.

16. No person under the age of 18 shall be employed within controlled areas.

Monitoring.

17. (1) All occupied areas in which radiation hazards are likely to arise shall be monitored by a qualified expert in order to establish the levels of exposure.

(2) A qualified expert is a person having the knowledge and training needed to measure radiations and to advise regarding radiation hazards.

18. All persons who occupy such areas, and for whom this monitoring indicates that the levels of exposure may exceed the maximum permissible levels specified in paragraph 7, shall be personally monitored and undergo the medical examinations specified in paragraphs 27 to 30.

19. If the hazard is confined to external radiation the personal monitoring shall be continuous, and may be performed by carrying suitable films, pocket ionisation chambers or dosimeters.

20. If the hazard includes exposure to unsealed radioactive materials, the personal monitoring shall also include tests for radioactive contamination and if possible for body burden.

21. In addition to measuring the exposure of the whole body, the personal monitoring should measure the partial exposure of that part of the body where the exposure might lead to the greatest hazard for the person concerned.

22. Methods for the personal monitoring of external radiation

shall, as far as is practicable, not only measure the dose of radiation but also indicate the type and quality of the radiation concerned.

23. Methods for determining body burdens should, as far as practicable, be capable of identifying the radionuclides present.

24. The methods for personal monitoring shall be appropriate to the particular ionising radiations and radioactive substances involved, and the measuring devices shall be calibrated accordingly.

25. The personal monitoring procedures shall be set up in consultation with a qualified expert, who shall also be consulted whenever changes are contemplated.

26. The assessment of radiation exposure shall be made by a competent service or a qualified expert.

Medical Examinations.

27. No person shall be employed in work involving a radiation hazard unless, within the period of two months preceding his first employment in that work, he has undergone a medical examination in accordance with the provisions of paragraph 30.

28. All persons employed in work involving a radiation hazard shall undergo, at least every 12 months and, if possible, every six months, a medical examination in accordance with the provisions of paragraph 30.

29. Additional medical examinations shall be carried out as circumstances require, for example, in the case of over-exposure or radioactive contamination.

30. (1) Medical examinations should include—

- (a) in the case of pre-employment examinations, a complete medical record including the family, medical, and occupational history and, in the case of periodic or special examinations, general information related to the occupational radiation hazards;
- (b) a full clinical examination; and
- (c) special investigations relating to the organs or tissues most susceptible to the effects of irradiation or most exposed as a consequence of the particular type of exposure, for example—
 - (i) haematological examination in the case of whole-body irradiation of external or internal origin;
 - (ii) skin examination in the case of external partial irradiation or external contamination;
 - (iii) ophthalmological examination, particularly in the case of exposure to neutrons and to heavy corpuscular radiations;

- (iv) examination of the body burden in the case of an internal radiation hazard;
 - (v) pulmonary examination in the case of inhalation of radioactive aerosols and gases.
- (2) The blood examination should include—
- (a) red-cell, white-cell and thrombocyte counts;
 - (b) a differential white-cell count;
 - (c) a search for and record of abnormal cells;
 - (d) a haemoglobin estimation; and
 - (e) an assessment of the bleeding time and the coagulation time.
- (3) The skin examination should be concerned not only with the detection of dermatitis or cancer but also with slight changes such as the disappearance of finger-ridge detail.
- (4) The ophthalmological examination should be concerned particularly with changes in the crystalline lens.
- (5) The body burden examination should define the nature and degree of the internal contamination by means of measurements or analyses directly on the body or indirectly on the excreta (urine, faeces, exhaled air).
- (6) The pulmonary examination should be concerned with the detection of the complex effects (mechanical, chemical and radioactive) of radioactive aerosols and gases.

Suspension from Employment.

31. The medical officer making the examination of persons liable to exposure to a radiation hazard shall have power to—

- (a) require their temporary suspension from work;
- (b) request their transfer to other employment.

32. No person after suspension shall be employed on work liable to involve a radiation hazard without the written sanction of the medical officer.

Notification of Ailments and Over-exposure.

33. Persons exposed to radiation hazards shall report promptly any significant ailment and any suspected over-exposure.

Appointment of a Competent Person.

34. (1) The employer shall appoint a competent person to exercise special supervision with regard to the provisions of this section and to assist, by instruction in safe working methods, monitoring and otherwise in enforcing the observance of them.

(2) The name of the competent person shall be made known to

the persons liable to exposure to a radiation hazard by being posted up or by other means.

Health Records.

35. (1) Health records, in a form approved by the competent authority, shall be kept for every worker exposed to a radiation hazard.

(2) These records shall be kept in the medical service of the industrial establishment under the responsibility of the medical officer.

(3) Such records shall contain all relevant information concerning at least—

- (a) the nature of the work involving exposure to radiation and the types of radiation concerned;
- (b) the results of monitoring tests;
- (c) the results of medical examinations carried out in accordance with paragraph 30.

(4) Health records shall be retained in such a way and for such a time as the competent authority may require.

(5) Health records should be in a form standardised at the national level.

Instruction of Personnel.

36. All persons liable to be exposed to radiation hazards shall be instructed by the most appropriate means, either verbally or in writing, by the competent person, in—

- (a) the health hazards connected with their duties;
- (b) the safe working methods and techniques;
- (c) the precautions to be taken and the reasons therefor; and
- (d) the importance of complying with medical requirements.

Radiation Over-exposure.

37. Whenever a worker has been exposed to irradiation in excess of the permissible limits referred to in paragraphs 4 to 6—

- (a) he shall undergo the medical examinations made necessary by the circumstances of the over-exposure;
- (b) the employer shall notify the occurrence in accordance with the requirements of the competent authority;
- (c) the industrial medical officer and the competent person appointed in the industrial establishment in accordance with paragraph 34 shall examine the circumstances of the over-exposure and shall report to the employer;

- (d) the industrial medical officer shall draw the relevant conclusions concerning the possible effects on the worker concerned and take such action as may be necessary in accordance with paragraph 31;
- (e) the competent person shall recommend to the employer the measures to be taken to remedy any defect and to prevent its recurrence; and
- (f) the employer shall take the necessary action to implement such recommendations.

REGULATION 208. SEALED SOURCES AND EQUIPMENT GENERATING IONISING RADIATIONS

A. *General Provisions*

Scope.

38. The provisions of paragraphs 38 to 94 shall apply to sealed sources and to equipment liable to create external radiation hazards only, such as X-ray generators, particle accelerators and equipment liable to produce unwanted ionising radiations.

Warnings.

39. All areas in which the sources and equipment referred to in paragraphs 38 to 94 may give rise to an external radiation hazard shall be identified by means of an appropriate and easily recognisable warning sign.

40. Light or audible signals, or both, shall be provided inside and outside enclosures, and also in the vicinity of installations, to provide warning before and during the irradiation.

Exposure.

41. No worker shall expose himself or be exposed to the useful beam of ionising radiations.

Radiation Installations.

42. For the purposes of paragraphs 38 to 94 radiation installations are divided into enclosed and open installations.

43. As far as practicable, ionising radiations shall be used only within enclosures set apart for the purpose which provide under all operating conditions adequate protection against useful beam, leakage and scattered radiation for all persons outside the enclosures.

Enclosed Installations.

44. An enclosed installation is one in which the radiation source and all objects exposed thereto are within a permanent enclosure—

- (a) to which no person has access, or within which no person is permitted to remain during irradiation; and
- (b) which affords under all practical operating conditions adequate protection for all persons outside the enclosure.

45. Effective interlocks shall be provided to prevent any person from entering a radiation room during irradiation.

46. Suitable means of exit shall be provided so that any person who may be shut in by accident can leave the enclosure without delay.

47. Effective means which cannot be reset from outside shall be provided within the enclosure for preventing or quickly interrupting the irradiation.

Open Installations.

48. An open installation is one which, due to operational requirements, e.g. the use of mobile equipment, cannot be provided with the degree of protection specified for enclosed installations in paragraph 44.

49. In an open installation the radiation source and all objects exposed thereto shall be confined within an area designated as a high radiation area—

- (a) to which only authorised persons have access, and in which they may remain during irradiation only under the conditions indicated in paragraph 51 (1); and
- (b) outside which under all practical operating conditions adequate protection is afforded for all persons.

50. Such installations shall as far as practicable be isolated from other occupied areas.

51. (1) Where a sealed source is in use members of the staff concerned may, whilst ensuring adequate protection for themselves, enter or remain in the high-radiation area for the minimum time necessary to make essential adjustments to the apparatus.

(2) Before such adjustments the irradiation involved should be estimated, if necessary by means of trial runs.

Sealed Sources.

52. (1) Every sealed source shall be so constructed that remote-handling devices can be used with it.

(2) No sealed source shall be handled by other than remote means.

53. Wherever practicable a serial number or other identifying mark shall be on or attached to every sealed source to distinguish that sealed source from all other sealed sources in the establishment.

54. Sealed sources intended to produce gamma rays or neutrons shall have a wall thickness sufficient to absorb substantially all the beta-radiation emitted.

55. (1) A register shall be kept of all the sealed sources in the industrial establishment, and shall include the following particulars:

- (a) the serial number or other identification of each sealed source;
- (b) the nature of each source, its date of receipt in the establishment and its activity on receipt; and
- (c) the date and manner of disposal of the source when it leaves the control of the industrial establishment.

(2) The competent person shall at intervals specified by the competent authority, satisfy himself that each sealed source is satisfactorily accounted for, and an entry to this effect shall be made in the register.

56. (1) Every sealed source shall be examined for contamination by a competent service or a qualified expert at intervals laid down by the competent authority in the light of the nature of the source and the operating conditions.

(2) The period between such examinations should not exceed one year.

(3) The particulars of the examinations mentioned in subparagraph (1) shall be entered in the register referred to in paragraph 55.

57. (1) If any person has reasonable grounds for believing that a sealed source has been lost or mislaid he shall notify the competent person immediately.

(2) If the loss is confirmed the competent authority shall be notified without delay.

58. When any sealed source is corroded or damaged, or when there are reasonable grounds for believing that there is a risk of radioactive contamination, it shall be sealed in an airtight receptacle and shall not be brought into use again until it has been effectively repaired.

59. (1) Industrial establishments in which sealed sources are used shall establish an emergency procedure such as that outlined in paragraph 60 to be followed in the event of the breakage of the source capsule.

(2) This procedure shall be made known to all persons who use the sources.

60. The emergency procedure to be followed in the event of breakage of a sealed source shall include the following steps:

- (a) the workroom or any other place involved shall be immediately vacated, and the staff concerned shall take such emergency measures as are necessary to reduce the dispersal of contamination;
- (b) the industrial medical officer and the competent person shall be notified immediately, and emergency steps shall be taken to ascertain whether any worker is contaminated and to carry out any necessary decontamination procedures;
- (c) the occurrence shall be notified forthwith to the competent authority; and
- (d) pending the recovery and removal of the radioactive substance by a qualified person or persons properly equipped for the purpose, all practicable measures shall be taken to prevent the dispersal of the radioactive substance.

Storage and Transport of Sealed Sources.

61. When not in use sealed sources shall be stored in locked containers providing adequate protection.

62. Where the sealed sources are liable to release a radioactive gas, their place of storage shall be efficiently ventilated to the open air by mechanical means before it is opened.

63. Where more than one sealed source is stored each shall be kept in a separate compartment which shall afford adequate protection.

64. Sealed sources shall be returned to their storage containers as soon after use as possible.

65. (1) Sealed sources shall be transported within such protective receptacles, or by such remote-handling devices or automatic methods, as ensure adequate protection.

(2) All protective receptacles used for the transport or handling of sealed sources shall be distinguished by markings approved by the competent authority.

(3) As far as possible, use should be made of a pictorial warning symbol.

66. Sealed sources that are no longer required shall be either returned to the supplier or disposed of in a manner acceptable to the competent authority.

Protection of X-Ray Tubes.

67. Every X-ray tube used in an industrial establishment shall be mounted in a protective and electrically shock-proof housing.

Other Equipment for the Generation of Ionising Radiations.

68. All other high-energy equipment used in industry for the generation of ionising radiations, such as electron-beam generators, betatrons, linear accelerators, synchrotrons and the like, shall—

- (a) wherever possible, be operated in enclosed installations; and
- (b) always be operated in such a way as to provide adequate protection, having regard to the special conditions under which it is used.

69. Particular care shall be taken to protect against—

- (a) complex radiations (for example X-rays and neutrons) which may be indirectly produced by such equipment; and
- (b) radioactive materials which may be induced in the targets, shielding or neighbouring materials.

70. In order to ensure the protection of persons working with such equipment, the advice of a specialist familiar with the special hazards to which it may give rise shall be obtained.

Equipment Producing Ionising Radiations Inadvertently.

71. All equipment in which electrons are accelerated by voltages in excess of 5 kV shall be regarded as a potential source of ionising radiations.

72. Such equipment, e.g. electron microscopes, cathode-ray tubes, high-voltage electronic rectifiers, and the like, shall be so tested, installed and operated as to provide adequate protection.

73. Whenever possible such equipment shall be shielded and provided with interlocks so as to ensure that the levels of irradiation are less than those specified in paragraph 7, and thus avoid the need for monitoring procedures and special-medical examinations.

B. *Special Provisions*

Industrial Gamma-Ray Radiography.

74. Protective housing for sealed sources used for gamma-ray radiography shall conform to the following requirements—

- (a) with the housing closed or with the source in the “off” position—
 - (i) the average dose rate at 5 cm from the surface shall not exceed 20 milliroentgens per hour, and the maximum dose rate shall not exceed 100 milliroentgens per hour;
 - (ii) the average dose rate at 1 metre from the source shall not exceed 2 milliroentgens per hour, and the maximum dose rate shall not exceed 10 milliroentgens per hour;

(b) remote means shall be provided for bringing the source into operation.

75. (1) The radiographic set-up shall be completed before the sealed source is exposed.

(2) For radiography which requires the removal of the sealed source from its housing, a clearly identifiable dummy capsule should be used during any preliminary adjustments that may be necessary.

Thickness Gauges, Static Eliminators and Similar Devices Using Sealed Sources.

76. Radioactive materials used for thickness gauges, static eliminators and similar devices shall always be in the form of sealed sources, to which the relevant provisions of paragraphs 52 to 60 shall apply.

77. Wherever practicable the normally unshielded portion of the sealed source shall be protected against mechanical damage and be provided with a cover plate, shutter or shield that can be readily secured so as to intercept the useful beam.

78. Wherever possible such devices shall be installed or shielded so as to ensure that the levels of irradiation of all persons, including those installing or maintaining the sealed source or any machinery or plant in close proximity to it, are less than those specified in paragraph 7 and thus avoid the need for monitoring procedures and special medical examinations.

79. Such devices shall be conspicuously and permanently marked so as to warn personnel of the presence of radioactive material and the need to avoid unnecessary exposure.

Industrial X-Ray Radiography.

80. The protective housing of tubes used for radiography shall be such that at its maximum specified rating the leakage radiation at a focal distance of 1 metre does not exceed 1 roentgen in 1 hour.

81. (1) Techniques requiring personnel to enter the X-ray room or radiation area while the X-ray tube is energised should be avoided.

(2) When such techniques are used—

(a) the exciting voltage should be reduced by half, and the beam shutter closed before the radiation area (e.g. the X-ray room) is entered;

(b) the protection afforded by the beam shutter shall be at least equal to that of the tube housing;

- (c) the beam shutter shall be so arranged that it can only be opened from the control panel; and
- (d) the shutter control shall, in the case of installations which would otherwise be regarded as enclosed installations, be interlocked with the door of the enclosure in such manner that when the door is opened, the shutter closes and cannot be opened again except from the control panel.

Industrial X-Ray Fluoroscopy.

82. The protective housing of tubes used for fluoroscopy shall conform to the requirements of paragraph 80.

83. Fluoroscopic equipment shall be installed in enclosures providing adequate protection and fitted with interlocks so as to prevent access to the interior of the enclosure during irradiation.

84. Wherever practicable, fluoroscopic screens shall be viewed either indirectly by the use of inclined mirrors, or remotely, for example by television techniques.

85. If lead glass or other transparent protective material is used, it shall provide adequate protection.

86. Care shall be taken to ensure adequate protection for all persons associated with fluoroscopic procedures, for example those who load articles for examination on to moving belts.

87. When it is necessary to manipulate or mark examined objects, provision shall be made for this to be done while still maintaining adequate protection.

X-Ray Diffraction and Similar Uses of X-Rays.

88. The protective housing of tubes used for X-ray diffraction and similar equipment shall be such that at its maximum specified rating the leakage radiation at any accessible point on the surface does not exceed 100 milliroentgens in 1 hour.

89. X-ray diffraction and similar equipment shall be so constructed, installed, and operated as to afford adequate protection.

90. (1) Wherever practicable, effective means shall be provided to eliminate the hazard of exposure of the fingers to the useful beams while making adjustments.

(2) Personal monitoring is often difficult and sometimes impossible to carry out and should not be relied upon to control this hazard.

91. Wherever practicable, shields shall be provided close to and surrounding the useful beams to absorb scattered radiation.

92. Effective beam stops shall be provided to absorb the useful beams.

X-Ray Thickness Gauges.

93. (1) The operator of an X-ray thickness gauge and all other persons in the vicinity shall at all times be adequately protected.

(2) Whenever possible, the installation shall be such that the irradiation of all persons is less than the levels specified in paragraph 7, so avoiding the need for monitoring procedures and special medical examinations.

94. During the excitation of an X-ray tube forming part of a thickness gauge, a warning light shall be exhibited.

REGULATION 209. UNSEALED RADIOACTIVE SOURCES

A. *General Provisions*

Scope.

95. (1) The provisions of paragraphs 95 to 214 shall apply to unsealed radioactive sources liable to create not only an external but also an internal radiation hazard.

(2) They shall apply in particular to the preparation, adaptation, use and storage of unsealed radioactive sources in industry.

(3) They shall not apply to chemical and metallurgical factories treating natural radioactive materials or nuclear fuel, or facilities for the bulk storage of radioactive substances, or nuclear reactors.

Limitation of Exposure.

96. No person shall expose himself or be exposed to risks of external or internal radiation exceeding the maximum permissible levels referred to in paragraphs 4 to 6.

Classification of Workplaces.

97. In view of the extreme diversity of processes carried out with unsealed radioactive sources and the great variety of the resulting risks, workshops should be classified according to—

- (a) the nature of the operations and the physical properties of the substances used;
- (b) the particular radioactive nuclides; and
- (c) the quantities used.

98. The classification of operations should distinguish, in increasing order of radiation hazard, between:

- (a) storage (for example, storage of stock solutions);
- (b) very simple wet operations (for example, the preparation of aliquots of radioactive solutions);
- (c) normal operations (for example, simple chemical separations);
- (d) complex wet operations and simple dry operations (for example, operations involving a risk of spilling liquids or powders); and
- (e) dry and dusty operations (for example, grinding of radioactive substances).

99. Radioactive nuclides may be classified in four categories according to their radioactive toxicity as follows:

- (a) Slight toxicity: H^3 , Be^7 , C^{14} , F^{18} , Cr^{51} , Ge^{71} , Tl^{201} ;
- (b) Moderate toxicity: Na^{24} , P^{32} , S^{35} , Cl^{36} , K^{42} , Sc^{46} , Sc^{47} , Sc^{48} , V^{48} , Mn^{56} , Fe^{55} , Co^{60} , Ni^{59} , Cu^{64} , Zn^{65} , Ga^{72} , As^{76} , Rb^{86} , Zr^{95} + Nb^{95} , Nb^{95} , Mo^{99} , Tc^{96} , Rh^{105} , Pd^{103} + Rh^{103} , Ag^{105} , Ag^{111} , Cd^{109} + Ag^{109} , Sn^{113} , Te^{127} , Te^{129} , Cs^{137} + Ba^{137} , Pr^{143} , Pm^{147} , Ho^{166} , Lu^{177} , Ta^{182} , W^{181} , Re^{183} , Ir^{190} , Ir^{192} , Pt^{191} , Pt^{193} , Au^{198} , Au^{199} , Tl^{200} , Tl^{202} , Tl^{204} , Pb^{203} ;
- (c) High toxicity: Ca^{45} , Fe^{59} , Sr^{89} , Y^{91} , Ru^{106} + Rh^{106} , I^{131} , Ba^{140} + La^{140} , Ce^{144} + Pr^{144} , Sm^{151} , Eu^{154} , Tm^{170} , Pb^{210} + Bi^{210} (RaD+E), U^{233} , Th^{234} + Pa^{234} ;
- (d) Very high toxicity: Sr^{90} + Y^{90} , Po^{210} , At^{211} , Ra^{226} + daughter products, Ac^{227} , Pu^{239} , Am^{241} , Cm^{242} .

Adaptation of Installations to the Hazards of Internal and External Radiation.

100. Installations shall be adapted to the hazards of internal and external radiation, taking into account the nature of the operation, the category of radioactive material and the quantities used.

101. A distinction should be drawn between two main classes of installation: specialised installations and non-specialised installations.

102. Specialised installations should be divided into three types of workplace, depending on the three factors referred to in paragraph 97 and in accordance with the appended table.¹

103. (1) Taking into account the above general considerations:
- (a) for type I workplaces, normal equipment and methods of work are, in general, adequate;
 - (b) for type II workplaces, normal equipment and methods of work shall be modified or supplemented, with due regard to the increased external and internal radiation hazards;

¹ See p. 399p.

(c) for type III workplaces, equipment and methods of work shall be particularly selected in relation to the external and internal radiation hazards.

(2) Workplaces of all three types should be—

- (a) reserved exclusively for work with radioactive substances; and
- (b) isolated from other workplaces as far as practicable.

104. Each non-specialised installation shall be considered as a particular case for which—

- (a) the methods of protection shall be based on the classification referred to in paragraph 97; and
- (b) a qualified expert shall be consulted on the problems of protection arising in each different type of operation.

105. All workplaces, regardless of type, shall be identified by means of an appropriate and easily recognisable warning sign.

Protective Measures.

106. Suitable collective and individual protective measures shall be taken to ensure that the maximum permissible doses, concentrations and body burdens referred to in paragraphs 4 to 7 are not exceeded as regards external and, more particularly, internal radiation hazards.

107. The measures to be taken with respect to the risks of external radiation should be analogous to the relevant provisions of paragraphs 52 to 66 concerning sealed sources.

108. The measures to be taken against radioactive contamination and internal radiation shall conform to those referred to in paragraphs 109 to 136.

Collective Protection.

109. (1) Collective protection shall cover both the design and arrangement of workplaces and the choice of ordinary and special equipment.

(2) Workplaces shall be identified by means of an appropriate and easily identifiable warning sign.

110. Workplaces shall be so designed and arranged as to limit as far as possible the contamination of surfaces and of the atmosphere.

111. (1) The walls and floors of workplaces shall—

- (a) be made of smooth and impermeable materials; or
- (b) be covered with a completely smooth and impermeable material with all the interstices effectively sealed.

(2) The walls and the floors shall be kept clean and clear of all obstructions.

112. (1) As far as practicable, the radioactive concentration in the air of workrooms shall be kept below the maximum permissible values referred to in paragraph 6 (4).

(2) The air shall be renewed by appropriate systems of ventilation.

(3) In addition, the ventilation shall be such that there can be no recirculation, and the expelled air cannot contaminate another workplace.

(4) If the radioactive concentration in the air cannot be brought below the maximum permissible values referred to in paragraph 6 (4), individual means of protection against respiratory contamination should be provided for the personnel in conformity with paragraph 134 (3).

113. Ordinary equipment in the workplace such as seats, cupboards, tool racks and glass cabinets shall have smooth surfaces and be kept clean.

114. Every person handling radioactive substances shall be allowed a working space at least 48 inches (1.20 m) wide and 20 inches (50 cm) deep.

115. (1) Working surfaces shall—

- (a) be made of a hard, smooth and impermeable material;
- (b) be covered with a smooth and impermeable covering; or
- (c) consist of a hard surface covered with an absorbent material.

(2) Working surfaces shall be cleared of all articles not required for the work and shall be kept clean.

116. All processes liable to cause radioactive contamination of the atmosphere should be carried out inside a working space that ensures protection—

- (a) by complete enclosure in a glove box kept at a reduced atmospheric pressure;
- (b) by partial enclosure; or
- (c) by exhaust ventilation.

117. The exhaust system shall—

- (a) satisfy the general requirements of section 2 of Chapter XIII of the *Model Code of Safety Regulations for Industrial Establishments for the Guidance of Governments and Industry*;
- (b) be so constructed that it can easily be dismantled for cleaning;
- (c) terminate in the open air at a place satisfying the necessary safety requirements after passing through a filtration or recovery plant if necessary, and so that contaminated air cannot re-enter any occupied area; and

- (d) comply with any other requirements prescribed by the competent authority.

Individual Protection.

118. Individual protection shall comprise—

- (a) the selection and use of satisfactory working methods and procedures;
- (b) the adoption of safe working habits;
- (c) the provision and use of appropriate tools and facilities; and
- (d) the provision and use of appropriate protective clothing.

119. The selection of working methods and procedures shall be based on—

- (a) the adoption of techniques entailing the minimum radiation hazards; and
- (b) the prohibition of dangerous practices.

120. (1) Operating techniques shall be so chosen as to avoid, as far as practicable, dispersion of radioactive substances.

(2) The physico-chemical form of the radioactive substance should be selected with this in mind.

(3) In particular, techniques liable to cause the formation of radioactive aerosols should be avoided as far as practicable.

121. New or modified processes should undergo trial runs and be approved by a competent person before they are introduced.

122. Working habits shall comply with the high standards of hygiene necessary in the circumstances.

123. Working habits in so far as concerns risks of external radiation shall conform to the requirements of paragraphs 38 to 94.

124. Working habits in so far as concerns risks of internal irradiation shall conform to the requirements of paragraphs 125 to 136.

125. Undue haste in handling shall be avoided.

126. No unsealed radioactive source shall be handled with bare hands or, in the case of solutions, be pipetted with the mouth.

127. All persons working with unsealed radioactive sources shall be provided with wash-basins and, if the risks of contamination are sufficiently serious, with shower-baths.

128. (1) A sufficient time at the employer's expense for the use of the washroom before the lunch period and at the end of the day's work shall be allowed to each person working with unsealed radioactive sources.

(2) A sufficient time shall also be allowed where necessary for the use of shower-baths at the end of the day's work.

129. (1) Disposable paper towels and handkerchiefs shall be provided for the persons employed.

(2) Special receptacles shall be provided in every workroom for disposing of such towels and handkerchiefs.

(3) The towels and handkerchiefs shall be disposed of as combustible radioactive refuse.

130. No person shall introduce into any room in which unsealed radioactive sources are prepared or used—

(a) food, drink or utensils for eating or drinking;

(b) smokers' articles or snuff;

(c) handbags, cosmetics or articles for their application; or

(d) pocket handkerchiefs other than the paper handkerchiefs referred to in paragraph 129.

131. No person employed in a workplace where unsealed radioactive sources are prepared or used shall eat, drink, smoke, take snuff or use cosmetics in the working areas.

132. Persons shall be forbidden to leave workplaces where unsealed radioactive sources are prepared or used without undergoing such tests for the contamination of the hands, the body and clothes as are specified by the competent authority.

133. Persons shall be forbidden to work without protective clothing in workplaces where unsealed radioactive sources are prepared or used.

134. (1) Protective clothing adapted to the risks of contamination, and suitably marked, shall be provided by the employer.

(2) According to the risks, coveralls, head coverings, gloves, tight-closing boiler suits, impermeable footwear and impermeable aprons shall be provided.

(3) If the atmospheric contamination cannot be reduced to the maximum permissible concentration, effective respirators, hoods or helmets shall be provided.

135. (1) All protective clothing shall be checked periodically and be kept clean.

(2) Contaminated clothing shall be cleaned separately from other clothing by methods which minimise dispersal of contamination.

136. Changing from working clothes to outdoor clothes; and vice versa shall, when necessary, be done in suitable locker rooms adjacent to the washrooms, so as to avoid any contamination of outdoor clothes.

Monitoring.

137. Monitoring shall be done periodically or continuously with due regard to the external and internal radiation hazards for the purpose of determining to the satisfaction of the competent authority the degree of contamination of workplaces, articles and persons.

Area Monitoring.

138. Suitable monitoring devices, fixed or portable, shall be provided and used to measure the levels of external radiation in workplaces.

139. For the purpose of detecting contamination of floors, work benches, sinks, apparatus, tools, etc., periodic monitoring shall be carried out by suitable means and to the satisfaction of the competent authority in all workplaces where unsealed radioactive sources are prepared or used.

140. Monitoring shall be carried out periodically, and if necessary continuously, for the purpose of determining to the satisfaction of the competent authority the level of atmospheric contamination.

Personal Monitoring.

141. If work on unsealed sources is associated with a risk of external radiation, personal monitoring devices (for example film badges, pocket ionisation chambers or dosimeters) shall be continuously worn by the persons employed in conformity with the relevant provisions of paragraphs 8 to 37.

142. Suitable monitoring devices, fixed or portable, shall be provided and used to determine to the satisfaction of the competent authority the radioactive contamination of the hands, clothes and footwear of all workers employed in workshops where unsealed radioactive sources are used.

143. The assessment of body burden should be carried out at intervals consistent with the hazards involved and as required by the competent authority, either directly by measurements on the body or indirectly by measurements on the excreta in conformity with the provisions of paragraph 30.

Decontamination.

144..(1) In the event of radioactive contamination exceeding the maximum permissible levels set by the competent authority, decontamination procedures shall be applied.

(2) Such procedures shall be established before commencing work with unsealed radioactive sources.

145. The decontamination procedures should be carried out in the following order:

- (a) discovery and assessment of the contamination;
- (b) limitation of contamination;
- (c) reduction of contamination; and
- (d) verification of the efficacy of the decontamination.

146. Decontamination of workplaces and equipment shall be carried out immediately—

- (a) preferably by wet methods; or
- (b) by other suitable methods such as adhesive tapes or stripping paints that cause the least practicable contamination of the air during the cleaning operations and the smallest practicable spread of contamination to other areas.

147. Spilled radioactive liquid shall be absorbed by means of suitable material such as blotting paper, sawdust or flannel.

148. If radioactive powder is spilled, all fans and ventilating systems liable to raise dust shall be stopped immediately.

149. Decontamination shall be carried out by the smallest practicable number of workers, equipped with special clothing for this purpose.

150. All cleaning appliances shall—

- (a) be used solely for cleaning;
- (b) be decontaminated after use; and
- (c) be kept in suitable cupboards.

151. (1) If, after decontamination, adequate protection cannot be assured, the contaminated rooms or premises shall be abandoned, and contaminated objects disposed of in accordance with the requirements of the competent authority.

(2) Access to these abandoned areas shall be forbidden to unauthorised persons.

(3) Such areas shall be identified by an appropriate and easily recognisable warning sign.

152. Contaminated clothing shall be cleaned by suitable processes and shall not be used again until the efficacy of decontamination has been verified; if decontamination has not been effective, the clothing shall be destroyed as radioactive waste.

153. (1) Instructions shall be laid down in advance by the industrial medical officer and the competent person regarding the immediate measures to be taken in various possible types of personal radioactive contamination.

(2) These instructions shall require—

- (a) the immediate notification of the competent person, who shall notify the industrial medical officer if simple measures prove insufficient to reduce the contamination to an acceptable level; and
- (b) the subsequent examination by the industrial medical officer of the persons concerned.

154. In the event of contamination accompanied by injuries, urgent measures shall be taken to avoid the entry of radioactive substances into the body.

Storage of Unsealed Radioactive Sources.

155. Special facilities shall be provided for the storage of unsealed radioactive sources:

- (a) to control the external radiation hazard; and
- (b) to control the internal radiation hazard by minimising the possibility of dispersal of the radioactive material.

156. (1) With regard to the external radiation hazard, the provisions of paragraphs 61 to 66 shall be applied.

(2) With regard to the internal radiation hazard, the following special precautions should be taken where appropriate:

- (a) active residues should not be stored in glass bottles with glass or screw-on caps (stoppers of rubber, cork or similar material should be used);
- (b) stable solutions containing more than 5 millicuries of alpha activity or 50 millicuries of beta activity, and unstable solutions of any activity, should be stored in vented containers;
- (c) solutions having an alpha activity in excess of 1 millicurie per millilitre should not be stored in thin glass vessels; and
- (d) bottles containing radioactive liquids should be kept on trays or in pails of adequate size to retain all their contents in the event of breakage.

157. Arrangements shall be provided for the efficient ventilation of stores for unsealed sources that are liable to liberate radioactive gases.

158. Special care shall be taken when opening receptacles containing radioactive materials to minimise the danger of fire, bursting or frothing.

159. (1) Adequate records shall be kept of all stored radioactive substances.

(2) Stores shall be inspected at regular intervals.

Radioactive Waste.

160. (1) Since any use of an unsealed source of radiations raises problems of waste disposal, instructions on the subject shall be drawn up in advance in conformity with regulations prepared by the competent authority.

(2) Before receiving any unsealed source the employer shall take such measures as will enable him to comply with these instructions.

161. (1) Paragraphs 162 to 166 shall apply only to radioactive wastes arising in the processes referred to in paragraph 95.

(2) Radioactive waste shall mean either the residues of unsealed sources or waste resulting from work with these sources.

162. The disposal of radioactive waste shall be considered with due regard to—

(a) the physical state of the waste: solid, liquid, aerosol or gas; and

(b) the radioactive properties and specific activity of the waste.

163. (1) Solid radioactive waste should be divided into combustible and non-combustible waste.

(2) Combustible waste should be burnt in a suitable incinerator specially designed which shall avoid dispersion of radioactivity.

(3) The ash from the burnt waste together with any non-combustible waste shall be stored or disposed of in such a manner as to avoid subsequent dispersion, in conformity with the instructions of the competent authority.

164. (1) Liquid wastes should be segregated on the basis of specific activity and the toxicity of the radioactive substances present.

(2) Discharge of liquid waste into the public sewage system shall only take place in accordance with the requirements of the competent authority.

(3) Liquid waste other than that which may be discharged in accordance with subparagraph (2) shall be treated by precipitation, concentration, or otherwise, in conformity with the instructions of the competent authority; the solid forms that may result from these methods shall then be treated in conformity with paragraph 163 (3).

165. (1) Radioactive waste in the form of aerosols or gases shall be either—

(a) dispersed with or without dilution into the atmosphere if the resulting risk of irradiation is less than one-tenth of the maximum permissible values referred to in paragraph 6 (4); or

(b) filtered in conformity with the instructions of the competent authority.

(2) The solid waste that may result from filtration shall be treated in conformity with paragraph 163.

166. In the course of the various manipulations the waste shall be collected in suitable special receptacles which shall be stored in accordance with the provisions of paragraphs 155 to 159.

Cessation of Work with Unsealed Radioactive Sources.

167. In the case of specialised installations, where any process involving the storage or use of unsealed radioactive sources in any workplace is abandoned, the workplace shall not be used for any other purpose—

- (a) unless the employer has given to the competent authority within the time prescribed by the authority notice in writing of the new intended use; and
- (b) until the workplace and any apparatus or equipment which remains therein have been decontaminated to levels approved by the competent authority.

168. Unless it has been decontaminated in accordance with the standards of the competent authority, apparatus or equipment removed from the room shall not be used or kept in any other part of the industrial establishment but shall be disposed of as waste radioactive material in conformity with paragraph 163.

169. On the cessation of work in non-specialised installations decontamination shall be carried out in accordance with the advice of a qualified expert.

B. *Special Provisions*

170. The construction, facilities and methods employed in workplaces of types I, II and III shall comply with all the appropriate general provisions of paragraphs 95 to 214.

Type I Workplaces.

171. In type I workplaces—

- (a) the walls and floors shall be smooth and be kept clean; and
- (b) the working surfaces shall be smooth and impermeable and be kept clear.

172. The ventilation adequate for a good chemical laboratory shall be provided.

173. The personnel shall wear simple protective clothing, e.g. coats as used in chemical or metallurgical laboratories.

174. Monitoring of the workplaces shall be carried out periodically to determine any contamination of surfaces.

175. The personnel shall carry external radiation monitoring devices and shall check any contamination of clothing or hands in the event of an accident.

176. Sources of radiation shall be stored in cupboards used only for this purpose and affording adequate protection.

177. The mere decay of short half-life substances or dilution in adequate volume should, in general, be sufficient to satisfy the requirements of the competent authority regarding waste disposal.

Type II Workplaces.

178. In type II workplaces—

- (a) the walls and the floors shall be provided with smooth and impermeable coverings; and
- (b) the coverings of the working surfaces shall be adapted to the type of operation.

179. The ventilation shall ensure the removal of dangerous substances and avoid recirculation and dispersion of contamination into other occupied areas.

180. For work involving risks of atmospheric contamination exhaust ventilation shall be provided in all cases and, if practicable, completely enclosed glove boxes or similar arrangements shall be installed.

181. Access to the workplace shall be prohibited to unauthorised persons.

182. Protective clothing shall consist of tightly closing overalls, special head coverings, impermeable footwear, and protective gloves.

183. Handling appliances shall be used.

184. Operations involving radioactive solutions should be carried out over suitable drip trays or with the use of double containers so as to minimise the consequences of breakages and spills.

185. Regular monitoring of the workplace shall be carried out to control external irradiation, and frequent monitoring to control surface and atmospheric contamination.

186. (1) The personnel shall continuously wear individual monitoring devices for external irradiation.

(2) Contamination of the hands and clothes shall be checked at the end of each work period.

187. A special room shall be provided for the storage of radioactive substances.

188. Special receptacles, with separate arrangements for solid and liquid residues, shall be provided for the disposal of radioactive waste.

189. Liquid wastes should be divided into two categories:

- (a) those with low specific radioactivity, that is, of the order of the maximum permissible concentration for drinking water, should be disposed of in accordance with paragraph 177; and
- (b) those with higher specific radioactivity should be specially treated.

Type III Workplaces.

190. Type III workplaces shall be used only for processes with radioactive substances and shall be completely isolated from other working areas.

191. Special attention shall be paid to the covering of the walls and the floors in order to facilitate their decontamination.

192. The coverings of working surfaces shall allow of easy decontamination with due regard to the risks involved in the processes.

193. The ventilation system shall not only ensure renewal of the air of the rooms but render any recirculation impossible, and include filters capable of preventing dispersal in case of accidental radioactive contamination.

194. Processes involving risks of air contamination shall be carried out in completely enclosed glove boxes under negative pressure and provided with filters and transfer boxes.

195. Operations involving radioactive solutions shall be carried out in accordance with the provisions of paragraph 184.

196. (1) Access to the workplace shall be prohibited to all unauthorised persons.

(2) Access for authorised persons shall be subject to special conditions such as those referred to in paragraphs 197 to 199.

197. Special dressing rooms shall be provided for the staff and shall be so designed as to avoid any contamination of outdoor clothing.

198. (1) Special protective clothing shall be provided.

(2) A first set, conspicuously identified, shall be kept for work in the active zone and shall comprise tightly closing overalls, head coverings, impermeable footwear, and all necessary accessories.

(3) A second set identified in a different manner shall be kept for work not involving risks of contamination.

(4) The garments of the first set shall be washed separately with all necessary precautions.

199. If the maximum permissible concentrations in the air are likely to be exceeded, special equipment (for example, respirators, hoods, helmets) shall be immediately available to the personnel.

200. The radiation control of the workplaces shall include continuous monitoring of atmospheric contamination and, if necessary, of external radiation, and regular monitoring of surface contamination.

201. (1) The personnel shall continuously wear individual monitoring devices for external radiation.

(2) The contamination of hands and clothing shall be checked every time on leaving the working area.

202. Radioactive substances shall be stored only in a special room equipped with suitable shielding and ventilation in accordance with the provisions of paragraphs 155 to 159.

203. Particular attention shall be paid to radioactive wastes, which shall be disposed of in accordance with the provisions of paragraphs 160 to 166.

Additional Provisions for Luminising.

204. (1) Luminising, whether by hand or by machine, shall be done only within workplaces of a standard not lower than type II.

(2) The provisions relating to wall and floor coverings, covering of working surfaces, ventilating systems, prohibiting of eating, drinking, smoking, snuff-taking and use of cosmetics, storage of sources and treatment of radioactive residues shall, however, be those appropriate to type III workplaces.

205. (1) Glove boxes or similar arrangements shall be used wherever practicable for the application of luminous compound.

(2) Where the equipment referred to in subparagraph (1) cannot be used, additional protective clothing, including washable aprons and bibs of rubber or other waterproof materials, shall be provided and used.

(3) Such additional protective clothing shall be cleaned daily by a wet method.

206. Operations with dry luminous compound, such as filling glass capillary tubes or weighing out, shall only be performed within glove boxes or similar arrangements.

207. Luminised work awaiting drying, or completed, shall not be allowed to accumulate on or near luminisers' work benches, but shall be removed at frequent intervals to a place of storage affording adequate protection in accordance with the provisions of paragraphs 155 to 159.

208. Every stove or receptacle used for drying luminous compound shall be—

- (a) not less than 10 ft. (3 m) from any working place;
- (b) enclosed as far as practicable; and
- (c) effectively ventilated to the open air so that gases or vapours from the stove or receptacle do not contaminate the atmosphere of an occupied area.

209. (1) Instruments for the application of luminous compound shall on no account be put in the mouth or in contact with the skin.

(2) The use of brushes for the application of luminous compound should be discouraged.

210. Suitable receptacles for luminous compound shall be provided for the use of persons handling such compound, and shall be so constructed as to—

- (a) limit exposure to beta and gamma radiation; and
- (b) prevent contamination of the hands.

211. (1) A survey by means of ultra-violet light or by a suitable radiation monitor, should be carried out at least once a month in every workroom in which persons are employed on processes involving the use of luminous compound, for the purpose of detecting areas of radioactive contamination.

(2) Any such area shall be cleaned forthwith by a wet method.

212. Luminising machines shall be so constructed as to afford adequate protection.

213. No person shall, otherwise than by a wet method or within a glove box—

- (a) remove waste material containing luminous compound from applicators or other tools;
- (b) remove luminous compound from the surface of any other article or from glass tubing; or
- (c) clean contaminated luminising machine parts.

214. Waste material arising from luminising shall be disposed of in accordance with the provisions of paragraphs 160 to 166.

APPENDIX

CLASSIFICATION OF WORKPLACES IN RELATION TO THE QUANTITY AND THE TOXICITY OF THE NUCLIDES USED

Relative radiotoxicity of nuclide	Quantity used									
	$\leq 1 \mu\text{c}$	10 μc	100 μc	1 mc	10 mc	100 mc	1 c	10 c	$\geq 100 \text{ c}$	
Very high										
High										
Moderate										
Slight										

The above diagram provides, as precisely as the complexity of the subject will allow, a basis for assessing the type of workplace required for normal operations. According to the nature of the operations, the following modifying factors should be applied:

Operation	Modifying factor
Storage (stock solutions)	× 100
Very simple wet operations	× 10
Normal operations	× 1
Complex wet operations with risk of spills and simple dry operations	× 0.1
Dry and dusty operations	× 0.01

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[New paragraph 7.]

7. (1) No person shall clean or oil any dangerous part of machinery in motion except by methods which will prevent risk of injury.

(2) In carrying out such work no guard or safety device shall be rendered inoperative except under conditions laid down by the competent authority.

Paragraph 7 becomes paragraph 8.

7. Adequate and suitable lighting shall be provided for all maintenance and repair work, where necessary by specially installed temporary equipment.

REGULATION 211. EQUIPMENT AND TOOLS

Working Clothes

1. All persons assigned to maintenance or repair work should wear suitable and safe working clothes which should—

- (a) be close fitting, particularly at the neck, wrists and ankles; and
- (b) have no dangerous pockets or loose ends.

2. Safety footwear of a suitable type, conforming to the requirements of Regulation 234 of Chapter XIV of this Code, should be worn by all persons employed on maintenance or repair work.

3. When maintenance or repair work has to be carried out at places where there is a risk of objects falling from above, and overhead protection cannot be installed, all persons exposed to the hazard shall be provided with and shall wear suitable protective hats or helmets conforming to the requirements of Regulation 227 of Chapter XIV of this Code.

4. (1) Gloves and other hand protection of a suitable type conforming to the requirements of Regulation 233 of Chapter XIV of this Code, shall be provided for, and used in, all operations involving the handling of rough or sharp objects, hot or corrosive substances, and the like.

(2) The use of hand coverings shall be regulated in each case.

Protective Equipment

5. Where necessary, special protective clothing and footwear suitable for use on the work to be carried out and conforming to the requirements of Chapter XIV of this Code shall be issued to and worn by all persons employed on maintenance or repair work.

6. Maintenance and repair men shall be provided with, and where appropriate shall use, safety goggles or other suitable eye protection conforming to the requirements of Regulation 228 of Chapter XIV of this Code and affording adequate protection against the various hazards involved in the work on which they are engaged.

7. For work in places in which noxious dusts, fumes, vapours or gases may be encountered, maintenance and repair men shall be provided with and shall use respiratory protective equipment of a type offering adequate protection against the expected hazard and conforming to the requirements of Regulation 235 of Chapter XIV of this Code.

8. Suitable safety belts conforming to the requirements of Regulation 232 of Chapter XIV of this Code and provided with

life lines of suitable length and adequate strength shall be issued to and used by all maintenance and repair men who have to—

- (a) enter tanks, vats, boilers and other closed or confined spaces in which noxious or injurious gases, vapours or fumes may be present;
- (b) descend into silos, bins or similar places in which there is a danger of their being buried by loose sand, grain or other loose material;
- (c) work on roofs or in other places in which there is a risk of their falling from a dangerous height; or
- (d) work in places in which there is a risk of their falling into deep water or into open tanks or similar vessels containing toxic, hot or corrosive liquids.

Tools

9. A sufficient supply of tools of the various types required shall always be kept available for maintenance and repair men.

10. Such tools shall be kept in safe condition and should be inspected at regular intervals by a competent person appointed by the management.

11. (1) Maintenance and repair personnel shall be provided with special tool bags or portable tool boxes of a size sufficient to hold all the hand tools needed for their work and so constructed that they can easily and safely be hoisted on to platforms and other elevated workplaces.

(2) Where necessary, special hand trucks shall be provided for the transport of heavy tools needed in repair and maintenance work.

12. In large establishments special fixed tool cabinets or tool boxes for maintenance and repair men should be provided in each department, particularly where special tools or tools too heavy to carry over considerable distances may be frequently needed for their work.

13. All repair men shall be provided with strong electric flashlights, which shall preferably be of the flame-proof type.

Ropes and Chains

14. The quality, treatment, handling and storage of fibre ropes, wire ropes, chains and other lifting gear used in repair work shall be in accordance with the requirements of Regulation 162 of Chapter IX of this Code.

Ladders and Platforms

15. In addition to complying with the relevant requirements of Regulations 3 and 22 of the Model Code annexed to the Recommendation (No. 53) concerning safety provisions in the building industry (1937) portable ladders shall comply with the requirements of paragraphs 16-36 of the present Regulation.

16. An adequate supply of portable ladders of good construction and of such types and lengths as may be required should be kept in readiness for use in maintenance and repair work.

17. Ladders shall always be kept in good condition and shall be inspected at regular intervals by a competent person.

18. Portable ladders that have missing or damaged rungs or are otherwise defective shall not be issued or accepted for use.

19. Defective ladders shall be promptly repaired or destroyed.

20. Portable ladders should be equipped with non-slip bases, when such bases will decrease the hazard of slipping.

21. The person in charge of repair work for which portable ladders or platforms are required shall see that the ladders and platforms are of the proper type for the work in question.

22. Portable ladders should be used at a pitch such that the horizontal distance from the top support to the foot of the ladder is one-quarter of the length of the ladder.

23. Crowding on ladders shall not be allowed.

24. Portable ladders shall not be placed in front of doors opening towards the ladder unless the door is blocked open, locked or guarded.

25. Portable ladders shall not be spliced together.

26. Portable ladders shall not be used as a guy, brace or skid or for any other purpose for which they are not intended.

27. Portable ladders shall be so stored that—

- (a) they are easy of access;
- (b) they can be easily and safely withdrawn for use;
- (c) they are not exposed to the weather, excessive heat or excessive dampness;
- (d) they are exposed to good ventilation; and
- (e) if horizontal, they are sufficiently well supported to avoid sagging and permanent set.

28. Every extension ladder shall be equipped with two adequate automatic locks.

29. Locks and guide irons of extension ladders shall be of such construction as to give the extension ladder the same strength as if it were a continuous ladder.

30. Every extension ladder should be equipped with a metal shackle and pulley.

31. Sectional ladders over 9.5 m (31 ft.) in length should not be used.

32. Connection joints of sectional ladders shall be of adequate strength and have a good fit.

33. Bottom and intermediate sections of sectional ladders shall not exceed 2 m (6 ft. 6 in.) in length, and top sections shall not exceed 2.75 m (9 ft.) in length.

34. Step ladders and trestle ladders over 6 m (20 ft.) in length shall not be used.

35. Step ladders and trestle ladders shall be so constructed that when in the open position the spread will afford adequate stability.

36. Every step ladder and trestle ladder shall have a locking device or spreader to hold the two sections firm in the open position.

37. For repairs entailing a considerable amount of overhead work and for which the construction of a temporary, fixed stage or platform is not practicable, portable platforms of a suitable type should be provided and used.

38. Portable platforms shall be of sound construction and be provided with guard-rails and toeboards conforming to the requirements of paragraph 11 of Regulation 18 of the Model Code annexed to the Recommendation (No. 53) concerning safety in the building industry (1937).

REGULATION 212. SAFETY MEASURES FOR MAINTENANCE AND REPAIR WORK

Work on Buildings and Structures

1. For maintenance or repair work on buildings and structures that cannot be safely carried on from portable ladders or platforms, where necessary safe and adequate fixed scaffolds, working platforms, stagings, ladders, passageways, and other temporary, fixed constructions shall be erected.

2. All such temporary constructions erected for use in maintenance or repair work shall comply with the relevant provisions of Part I of the Model Safety Code annexed to the Recommendation (No. 53) concerning safety provisions in the building industry (1937).

3. All maintenance and repair work on buildings and structures used as factories or workshops or in direct connections therewith shall be carried out in conformity with the provisions of the Model Safety Code annexed to the Recommendation (No. 53) concerning safety provisions in the building industry (1937).

4. (1) If repairs to the buildings or structures referred to in the preceding paragraph of this Regulation are carried out without stopping the operations or processes carried on therein, all necessary steps shall be taken to ensure that the factory workers and all the machines, installations and equipment used in or in connection with the operations or processes are fully protected against all hazards that might arise out of the repair work.

(2) All necessary steps shall be taken to protect persons engaged on repair or maintenance of buildings and structures from any moving machinery near which they may be working.

5. Where repairs to buildings or structures are carried out above or around machinery, installations or equipment in a factory or workplace in which the operations or processes have been

suspended during the repairs, all necessary steps shall be taken to prevent damage to such machinery, installations or equipment.

Underground Repair Work

6. (1) When repairs have to be carried out in wells or other places underground in which there may be dangerous accumulations of noxious, asphyxiating or flammable gases, liquids or other substances, before assigning men to such work the person in charge shall take adequate steps to ensure, as far as possible, that the place is safe for the work to be carried out.

(2) If the place is found to contain dangerous gases or other substances, all necessary precautions shall be taken to ensure that the work can be carried out in safety, and in particular—

- (a) only specially trained workers with adequate experience in work under the prevailing conditions shall be assigned to the task;
- (b) the workers shall be under the direct and constant supervision of one or more fully competent and experienced persons; and
- (c) all persons assigned to the work shall be provided with and shall use suitable and adequate protective clothing and other protective equipment, in conformity with the requirements of Chapter XIV of this Code.

7. All open trenches, ditches and other excavations shall be—

- (a) properly fenced at all times so as to prevent persons from falling into the excavations; and
- (b) provided with appropriate warning signs, and with warning lights if they are left open over-night.

8. Sufficiently strong and adequately constructed shoring or bracing of suitable material shall be provided in all trenches, pits and other excavations in which repair work is being carried out and in which workers might be injured by the caving in of the surrounding ground or by stones, earth and other material falling from the walls of the excavation.

9. Repair men working in deep trenches or other excavations should always wear hard hats and suitable safety footwear conforming to the requirements of Regulations 227 and 234 of Chapter XIV of this Code.

10. When repairs have to be carried out in deep open trenches, pits or other excavations in which emanations of asphyxiating gases or other dangerous substances may occur, a reliable person shall be posted on the surface near the excavation to assist the workers in case of need and the workers should be provided with—

- (a) suitable and adequate respiratory protective equipment; and
- (b) safety belts with life lines of adequate length and strength.

Repair Work on Machines

11. When repair work has to be undertaken on a machine—
- (a) the machine shall be stopped before the work is begun; and
 - (b) adequate measures shall be taken, preferably by locking the starting or controlling device, to ensure that the machine cannot be restarted until the work has been finished and all the repair men withdrawn: Provided that, when necessary for testing and adjustment, the machine may be restarted by the person responsible for the repair work.
12. Locks used for the purpose referred to in paragraph 11 (b) of this Regulation shall be of a special type, not operable by keys other than those in the hands of the designated persons.
13. If repairs have to be carried out on a machine any part of which may move without the power having been applied, *e.g.*, under its own weight, such parts shall be securely blocked before the work is begun.
14. When repair work on a machine has been finished, and before the power is again applied for purposes of production—
- (a) all tools, implements and materials used during the work shall be carefully removed and collected at a safe place outside the machine;
 - (b) the machine shall be fully restored to its proper working condition;
 - (c) when possible the machine should be turned slowly by hand to ensure that no objects of any kind have been left in such a place or position as to interfere with the safe operation of the machine; and
 - (d) the place around the machine should be properly tidied and restored to its normal condition.
15. When repairs have to be carried out near machinery or other dangerous parts that cannot be stopped or switched off, and when repairmen have to pass close to such machinery or parts in such a way or at such places as not to be adequately protected by the ordinary guards, all necessary temporary measures shall be taken for their protection.

Transmissions

16. The repairing and replacing of transmission belts and other parts of mechanical power transmission installations should be carried out only by persons specially trained and selected for such work.

17. (1) When belts or other transmission parts are to be repaired or replaced in rooms in which non-continuous operations are carried on, before beginning the work the repairman shall be sure that—

- (a) the machinery to which the belt or other transmission part belongs is shut off from the power supply;
- (b) the power control is securely locked in the "Off" position; and
- (c) such additional precautions have been taken as may be deemed necessary in each particular case.

(2) In rooms in which continuous processes are carried on and the machines can only be stopped at certain times, belts shall be suspended during repairs, on a proper perch or other fixed device, so as to be kept securely away from any moving parts.

Electrical Repairs

18. Electrical repair work shall be carried out in accordance with the requirements of Regulation 118 of Chapter V of this Code.

Boilers, Tanks and Vats

19. No repairs shall be carried out on any boiler or other pressure vessel so long as the boiler or vessel is under pressure.

20. Repair work on steam boilers and other fired pressure vessels shall be carried out in conformity with the requirements of paragraphs 56-69 of Regulation 125 of this Code.

21. Special precautions should be taken for work in tanks or other vessels constructed of concrete or with a concrete or masonry floor or lining, particularly if parts of the concrete are to be broken up, as experience has shown that in such cases, in spite of careful cleaning, the concrete may give off considerable quantities of dangerous gas or vapour.

22. When workers have to enter tanks or other vessels in which dangerous gases, vapours or mists are liable to occur, the following measures shall be taken—

- (a) each worker entering the tank or vessel shall be provided with and shall wear—
 - (i) an efficient respiratory protective device approved for the dangerous substance that is to be expected and conforming to the requirements of Regulation 235 of Chapter XIV of this Code; and
 - (ii) where necessary, a suitable safety belt with attached life line of adequate dimensions leading to a convenient point outside the tank or vessel; and
- (b) a reliable and competent person shall be stationed at the entrance to the tank or vessel to supervise the operations and to take such action as may be necessary in an emergency.

23. If tanks or vessels in which repairs are to be carried out are connected to other tanks or vessels, the connecting pipes shall be securely blocked, by either—

- (a) closing the valves and securely locking them in the closed position; or

- (b) disconnecting the pipe lines and blanking them off by means of blind flanges.

24. If repairs are to be carried out in a tank or vessel in which stirring or mixing apparatus or machinery is installed, before workers are permitted to enter the tank or vessel the stirring or mixing apparatus shall be—

- (a) reliably disconnected from its power supply; and
(b) so locked or blocked that no movement can occur that could endanger the workers.

25. Tanks used for storing hazardous liquids shall be inspected at regular intervals, and all leaks or other defects shall be promptly remedied.

26. When preparing tanks used for storing hazardous liquids for repairs, the procedure shall be as follows:

- (a) the tank shall be drained as completely as possible;
(b) all inlet pipes shall be disconnected and blanked or moved out of alignment, or the inlet valves shall be locked in the closed position;
(c) residual pools and sludge shall be removed by workers stationed outside the tank and operating through manholes or hatches with water from a hose line equipped with a curved nozzle for washing all parts of the tank thoroughly and, if necessary, with long-handled scrapers;
(d) where steam is available, all openings except the vent pipe and a steam inlet shall be closed and live steam blown into the tank for a period of time suitable for the conditions and the nature of the liquid, with the lids or manhole plates opened during the last one-fifth of the steaming period;
(e) where steam is not available, the tank shall be kept filled with flowing water for a period of at least 24 hours;
(f) after steaming or flooding, the tank shall be thoroughly ventilated by means of air under forced or induced draught for a period of at least two hours;
(g) after ventilation, a competent person or persons shall examine the interior of the tank to see that it is free from residue, and shall take and test samples of the air in the tank to ascertain that all hazardous vapours have been removed; and
(h) where the tests indicate the presence of harmful vapours or fumes the steaming or flooding and ventilating operations shall be repeated.

27. The procedure prescribed by paragraph 26 of this Regulation may be varied to the extent necessary to meet any special circumstances, subject to the approval of the competent authority.

28. Except with the approval of the competent authority, no open light or flames shall be permitted within 15 m (50 ft.) of

Paragraph 33 is deleted.

Paragraphs 34-35 become paragraphs 33-34.

an opening of any tank used for storing flammable liquids or acids, which is not conditioned for repairs in accordance with the requirements of paragraph 26 of this Regulation.

29. Where necessary, an adequate supply of clean, fresh air shall be constantly blown into vessels or confined spaces in which persons are at work.

Piping Systems

30. Before starting repairs on any piping systems used for transporting corrosive, explosive, flammable or poisonous substances—

- (a) all valves shall be closed and locked, the piping shall be drained and sufficient time shall be allowed for any gas to escape; and
- (b) if a cutting or welding torch is used, the piping shall be thoroughly washed, if necessary with a neutralising substance, and flushed with steam or boiling water.

31. In opening flanges on piping systems used for transporting hazardous substances—

- (a) a lead shield shall be laid over the flanges so as to protect the operator from possible spurts;
- (b) on horizontal pipes the bottom bolts shall be removed first;
- (c) the remaining bolts shall be loosened gently until the contents start to drip; and
- (d) unless the flanges part readily, they shall be carefully separated by means of a small metal wedge or a special tool designed for the purpose.

32. Repairmen assigned to work on piping systems carrying dangerous substances shall be provided with and shall use such personal protective equipment as may be deemed necessary in each particular case.

Welding and Cutting

33. Only well trained welders with sufficient practical experience shall be allowed to do repair work.

34. If parts of installations subjected to great stresses, such as steam boilers and other pressure vessels, are to be repaired by welding—

- (a) such repairs shall only be carried out by welders authorised for such work by the competent authority; and
- (b) only such methods, equipment and filling metal as have been declared permissible for such purposes by the competent authority shall be used.

35. All persons engaged in welding operations shall be provided with and shall use proper protective equipment, such as goggles,

helmets, shields, asbestos or leather aprons and gloves, conforming to the requirements of Chapter XIV of this Code.

36. All portable welding equipment, such as gas cylinders, hoses, electric cables, etc., shall be so installed at the workplace as to prevent all risks of equipment falling or tipping and of persons stumbling or tripping.

37. Appropriate and adequate screening shall be provided around all workplaces in which electric arc welding is to be carried out, so as to ensure full protection against injury by radiation from the welding arc to all persons working or passing near the point at which the welding is being done.

38. Before beginning any welding or cutting operation on a barrel, drum or other similar vessel which may possibly have contained combustible substances, such as benzine, oil, alcohol, or paint, the barrel, drum or vessel shall be—

- (a) thoroughly cleaned by washing with water or with a suitable chemical solution and, if possible, steamed out; and
- (b) filled with water nearly up to the point at which the welding or cutting is to be done or with an inert gas (carbon dioxide or nitrogen).

39. If an inert gas is used for this purpose, after the vessel has been filled the gas should be allowed to flow slowly into it throughout the welding or cutting operation.

40. Before starting any welding operations on, or otherwise applying heat to closed or jacketed containers or other hollow parts, such containers or parts shall be adequately vented in a suitable manner.

41. When oxy-acetylene welding or cutting operations are being carried out inside large tanks or similar vessels—

- (a) adequate ventilation by means of exhaust fans or forced draught shall be constantly provided;
- (b) no blowpipe shall be left unattended inside the tank or vessel during meals or other interruptions of the work; and
- (c) the workers shall take all necessary precautions to prevent unburned acetylene or free oxygen from escaping inside the tank or vessel.

42. It shall be strictly prohibited to use any compressed gas or air jet to clean dust, etc., off workers' clothes.¹

REGULATION 213. WINDOW CLEANING

General Provisions

1. In buildings in which there are windows that cannot be conveniently and safely reached by means of a ladder or portable platform, either from the ground or from an adjoining flat roof

¹ See also paragraph 20 of Regulation 131.

Paragraphs 36-37 become paragraphs 35-36.

[New text from paragraph 37 onwards.]

37. Welding or cutting operations on any container that has held explosive or flammable substances or in which flammable gases may have been generated shall only be undertaken after—

- (a) the container has been—
 - (i) thoroughly cleansed by steam or other effective means; and
 - (ii) found by air tests to be completely free from combustible gases or vapours; or
- (b) the air in the container has been replaced by an inert gas.

*38. If an inert gas is used for this purpose, after the vessel has been filled the gas should be allowed to flow slowly into it throughout the welding or cutting operation.

*39. Before starting any welding operations on, or otherwise applying heat to, closed or jacketed containers or other hollow parts such containers or parts shall be adequately vented in a suitable manner.

40. When welding and cutting operations are being carried out in a confined space, for example, inside tanks or similar vessels, or on board ship—

- (a) adequate ventilation by means of exhaust fans or forced draught shall be constantly provided; oxygen shall not be used for this purpose;
- (b) no blowpipe shall be left unattended inside the tank or vessel or other confined space during meals or other interruptions of the work;
- (c) the workers shall take all necessary precautions to prevent unburned combustible gas or oxygen from escaping inside the tank or vessel or other confined space; and
- (d) when necessary an attendant should watch the welder or welders from outside.

Use of Compressed Air, etc.

41. It shall be strictly prohibited to use any compressed-gas or compressed-air jet to clean dust, etc., off workers' clothes when these are being worn.¹

¹ See also paragraph 20 of Regulation 131.



or a sufficiently wide balcony, and so constructed that they have to be cleaned from the outside, adequate safety devices approved by the competent authority shall be provided for the protection of window cleaners and shall be used by them.

2. All safety devices for window cleaners shall be of adequate strength and durability and so designed and constructed that they—

- (a) can be readily put into position and removed; and
- (b) are safely held in place during cleaning operations.

Safety Devices on Buildings

3. The following safety devices shall be provided on buildings to which paragraph 1 of this Regulation applies:

- (a) on all such buildings belt anchors of approved construction shall be securely attached to the building on both sides of each window, at a distance not less than 1.05 m (42 in.) or more than 1.3 m (51 in.) above the window sill;
- (b) on buildings in which the masonry openings for mullion windows are more than 1.65 m (5 ft. 6 in.) wide, at least one belt anchor shall be installed in each mullion; and
- (c) on buildings with windows of such a width that the distance between the belt anchors exceeds 1.8 m (6 ft.)—
 - (i) special back-support anchors of an approved type shall be installed at a distance of 1.05 m (42 in.) above the window sills; and
 - (ii) the ordinary belt anchors shall be installed above these special anchors.

Safety Belts and Life Lines

4. Window cleaners in buildings of the type referred to in paragraph 1 of this Regulation shall be provided with and shall use the following safety devices, which shall be of types approved by the competent authority:

- (a) safety belts of good construction, suitable material and adequate strength and durability; and
- (b) life lines of adequate length and strength with devices enabling them to be attached—
 - (i) to the safety belt in such a manner that the window cleaner can move freely along the whole width of the window; and
 - (ii) to the belt anchors in a manner that will reliably prevent their becoming unfastened during the work.

Special Devices

5. In buildings in which the window sills extend less than 15 cm (6 in.) outwards from the window frame, window cleaners

shall also be provided with an approved auxiliary sill not less than 25 cm (10 in.) wide and 75 cm (30 in.) long.

6. In buildings having windows of such width that the distance between belt anchors exceeds 1.8 m (6 ft.) the owner of the building shall provide, for each such window when it is being cleaned, a brass cable or chain to be attached to the special anchors provided under paragraph 3 (c) of this Regulation and used as a back support for the window cleaner.

Inspection of Equipment

7. Belt and back-support anchors shall be regularly inspected by a competent person at least once in every six months, and anchors that have become loose or worn shall be immediately replaced.

8. (1) Belts and life lines for window cleaners shall be inspected by a competent person at least once a week or immediately before use, and a record of the condition and the age of the equipment shall be kept.

(2) Belts, lines and attachments showing signs of wear or weakness shall be removed from service.

(3) The records of the inspections of the equipment shall be made available to the competent authority, upon request.

CHAPTER XIII

HEALTH PROTECTION

Section 1. Sanitation

REGULATION 214. WATER SUPPLY

Quality of Drinking Water

1. An adequate supply of clean, cool, wholesome and safe drinking water shall be provided for, and be readily accessible to, all employees in all workplaces.

2. (1) All water furnished for drinking purposes shall be from a source approved by the competent health authority and controlled in the manner prescribed by this authority.

(2) Where such water is not available the competent health authority shall furnish the necessary directions for rendering the water safe for human consumption.

Cooling of Drinking Water

3. Where water is cooled by ice the water container shall be so constructed that the ice does not come into direct contact with the water.

Salt

4. Where employees have to work in great heat for considerable periods the employer should provide salted water or salt tablets.

Drinking Cups

5. The use of common drinking cups shall be prohibited.

6. When individual drinking cups (to be used but once) are supplied there shall be provided—

- (a) a suitable container for the unused cups so constructed that the cups are protected against dust and other impurities; and
- (b) a receptacle for the used cups.

Drinking Fountains

7. Where sanitary drinking fountains are installed they shall be of a type and construction approved by the competent health authority.

Prohibition of Open Containers

8. Open barrels, pails, tanks or other containers from which the water must be dipped or poured shall not be allowed for drinking water, whether they are fitted with a cover or not.

Water Unsafe for Drinking Purposes

9. Where water unsafe for drinking purposes is provided for use in industrial processes or for fire protection—

- (a) conspicuous notices shall be posted at the points of supply stating clearly that such water is unsafe and not to be used as drinking water;
- (b) every reasonable effort shall be made to prevent it from being so used; and
- (c) points of supply of safe drinking water shall be clearly marked "Drinking Water"

10. There shall be no connections, open or potential, between a water-supply system furnishing drinking water and a system furnishing water unsafe for human consumption.

REGULATION 215. HOUSEKEEPING, CLEANLINESS*Cleanliness*

1. All workplaces, workrooms, passageways, storerooms and service rooms shall be kept in a sanitary condition.

2. Surfaces of walls and ceilings, including windows and skylights, shall always be kept in a proper state of repair and cleanliness.

3. The floor of every workroom shall be maintained in a clean and, so far as possible, dry and non-slippery condition.

Wet Work Processes

4. Where wet work processes are used—

- (a) effective drainage shall be maintained;
- (b) false floors, platforms, mats or other dry standing places shall be provided; and
- (c) the employer shall, without expense to the workers, furnish them with suitable footwear for use while at work in such places.

Cleaning and Sweeping

5. Workrooms shall be cleaned as often as required by the nature of the work carried on.

6. As far as practicable, sweeping and cleaning shall be done—

- (a) during intervals between work; and

(b) in such a manner as to prevent the raising of dust.

7. Where, for technical reasons, cleaning must be done during working hours, vacuum cleaners should be used and special precautions shall be taken to avoid contamination of the air with dust or other obnoxious substances.

Spitting

8. Notices explicitly forbidding spitting on the floor, walls or stairs shall be posted where necessary.

9. Where it is found necessary to provide spittoons they shall be—

- (a) sufficient in number;
- (b) so made as to satisfy hygienic requirements; and
- (c) cleaned and properly disinfected at least once every working day.

Waste Disposal

10. All receptacles used for waste or refuse shall be—

- (a) so constructed that they cannot leak and that they can be conveniently and thoroughly cleaned; and
- (b) maintained in a sanitary condition and disinfected if necessary.

11. All sweepings, waste, refuse and residual matter shall be removed—

- (a) if possible, outside working hours;
- (b) in such a manner as to avoid creating a menace to health; and
- (c) as often as necessary to maintain the workroom in a sanitary condition, and not less than once every day.

12. Adequate drains capable of ensuring effective removal of waste water, and provided with hydraulic seals or other effective devices to prevent escape of effluvia shall be provided and constantly kept in good order and repair.

Inspection of Equipment

13. Wherever mechanical equipment is used to ensure proper sanitation, such equipment shall be inspected at regular intervals to verify its efficiency.

Miscellaneous Requirements

14. (1) Every workroom or workplace shall, as far as practicable, be so constructed and maintained as to prevent the entrance or harbouring of rodents, insects and vermin of any kind.

(2) Infestation of rodents, insects and vermin shall be eliminated by suitable measures, and control measures shall be taken to prevent reinfestation.

15. In districts where malaria is endemic, all workplaces shall, as far as practicable, be adequately screened against mosquitoes.

16. The employment of persons suffering from any communicable diseases shall be governed by the regulations issued by the competent health authority.

17. No person shall be allowed to use any workroom or workplace as living or sleeping quarters.

REGULATION 216. SEATS AND WORK BENCHES

Seats

1. For all workers who can perform their work in the sitting posture suitable seats shall be provided which should—

- (a) be of such shape and height as to allow a normal and healthy position, freeing the legs entirely from the weight of the body;
- (b) be supplied with a back rest, suitably shaped and adjustable in height, so that it will conveniently support the lower part of the back of the workers, regardless of their size;
- (c) if necessary, be fitted with special foot and arm rests;
- (d) be so placed that the working material can be reached easily and without strain;
- (e) not be such as to impede the exit of the workers in case of accidents; and
- (f) wherever possible be so arranged as to allow of a voluntary change of position.

2. Where, owing to the nature of the operations, the worker has to change his position from time to time, adjustable seats should be provided.

3. Seats should also be provided for all workers obliged to work in a standing position, for use during short, occasional interruptions of their work.

Work Benches and Tables

4. Work benches and work tables shall be of convenient height and width so that the work can be carried out easily and without undue strain.

5. Where racks or shelves for tools and/or materials are installed above the work bench or table, their height and position shall be such as to enable the worker to reach all parts of them easily and without strain from his working position.

REGULATION 217. PERSONAL SERVICE ROOMS

General Provisions

1. The provisions of Sections 2 and 3 of Chapter II of this Code, respecting lighting, ventilation, temperature and humidity shall apply, *mutatis mutandis*, to all personal service rooms and other spaces allotted to employees for personal services.

2. All personal service rooms shall be—
 - (a) as far as possible so protected, either by screening or otherwise, as to prevent the entrance or harbouring of rats, insects or vermin of any kind; and
 - (b) constantly maintained in a good and sanitary condition.
3. All personal service rooms so located that they have no direct communication with the open air shall be mechanically ventilated, with all exhaust ducts discharging into the outside air.

Toilet Rooms in General

4. (1) Every factory and workshop shall be provided with adequate water closets, chemical closets or privies, separate for each sex, as well as an adequate number of urinals.
 - (2) Closets and urinals in the interior of the building shall be of the water-flush type.
5. An adequate supply of toilet paper and, where conditions require, water shall be provided for every toilet facility.
6. Adequate washing facilities shall be provided in each toilet room or adjacent thereto: Provided that this requirement shall not apply where the general washing facilities are on the same floor as, and in close proximity to, the toilet rooms.
7. Toilet rooms shall be readily accessible and located not more than one floor above or below the regular place of work of the persons using them: Provided that this latter requirement shall not apply if passenger elevators are available for use by persons going to and from toilet rooms.
8. There shall be at least one closet for every 25 men, and at least one for every 15 women employed at the same time; there shall be at least one urinal for every 15 men employed at the same time.
9. Special covered waste receptacles shall be installed in all toilet rooms used by women.
10. Toilet facilities shall not communicate directly with the actual workplaces, but they shall open only on to corridors, halls, landings or courtyards.

Construction of Toilet Rooms

11. Each toilet facility (closet) shall be under cover and occupy a separate compartment which shall—
 - (a) have a separate door; and
 - (b) be installed in a special, well ventilated toilet room.
12. The walls or partitions of toilet compartments may be less than the height of the room walls, but the top shall not be less than 1.8 m (6 ft.) and the bottom not more than 20 cm (8 in.) from the floor.

13. All toilet room doors shall be fitted with an effective self-closing device and so screened that the interior is not visible from outside.

14. Each compartment door shall be provided with a latch on the inside.

15. Urinals shall preferably consist of a row of stalls. If they are of a smaller type (cuvettes) they shall be adequately separated by side partitions. The width of the urinal shall not be less than 60 cm (2 ft.). Where urinals are situated outside buildings, they should be screened from view by a partition.

16. In all new toilet rooms the floors, walls and partitions including the angle formed by the floor and the walls, shall be water tight and impervious to moisture.

17. The floors, walls and ceilings of all toilet rooms shall be of a finish that can easily be cleaned.

18. The walls of every toilet room shall be of solid construction and shall extend to the ceiling, or the area shall be independently ceiled over.

19. In new installations, toilet facilities (closets) shall be of at least the following dimensions: width, 80 cm (2 ft. 8 in.); depth, 1.1 m (3 ft. 6 in.); minimum total floor space, 1.5 m² (16 sq. ft.).

20. A floor drain with water seal should be provided in each toilet room to facilitate flushing the floor.

21. Premises containing toilet rooms shall be effectively ventilated.

Toilet Fixtures

22. Toilet fixtures shall be constructed and maintained in conformity with the requirements of national building and plumbing regulations.

23. Water closet bowls shall be—

- (a) entirely free from any enclosing woodwork; and
- (b) so installed that the space around the fixture can be easily cleaned.

24. (1) Water closet seats should be of the open-front type and shall be of substantial construction and of non-absorbent material.

(2) If absorbent material is used, the seats shall be coated with varnish or other substances so as to make them impervious to moisture.

(3) The seats should be of light colour.

Chemical Closets and Privies

25. Chemical closets and privies shall only be permitted where the water-carriage system is impossible.

26. Where permitted, chemical closets shall be—

- (a) of a type approved by the competent health authority; and
- (b) constantly maintained in a sanitary condition with the contents disposed of in accordance with the requirements prescribed by the competent health authority.

27. The installation of privies shall be prohibited—

- (a) in all establishments in which they cannot be installed without the risk of contaminating any source of drinking water; and
- (b) in all locations within 30 m (100 ft.) of any room or place where foodstuffs are stored or handled.

28. Where permitted, privies shall be constructed and maintained in accordance with the requirements prescribed by the competent health authority.

29. In factories where there is a considerable difference between the inside and outside temperature, the toilets shall be—

- (a) connected with the factory by means of a covered passageway so constructed that the employees are not exposed to outdoor temperature in passing to and from them; and
- (b) kept heated during working hours to a temperature of not less than 10° C. (50° F.).

Washing Facilities

30. (1) Adequate facilities for maintaining personal cleanliness shall be provided in all industrial establishments.

(2) Such facilities shall be—

- (a) separated from the workplaces;
- (b) conveniently located for the employees for whom they are provided; and
- (c) maintained in a sanitary condition.

(3) Taps of wash basins, showers, etc., as well as opening devices of closet covers should preferably be operated by pedal rather than by hand.

31. The use of common towels shall be prohibited.

32. Individual cloth or paper towels shall be provided, together with proper receptacles for disposing of used towels.

33. Other apparatus for drying the hands shall only be installed if it is approved by the competent health authority.

34. (1) At least one wash basin with adequate water supply, including hot water where necessary, shall be provided for every 7 employees, or portion thereof, ceasing work simultaneously.

(2) Twenty-four inches (60 cm) of sink or circular trough with adequate water supply shall be considered equal to one basin.

35. Suitable, non-irritating soap shall be provided, either—

- (a) in hygienic dispensing containers with inreach of each wash-place; or

(b) in the form of individual pieces furnished to each employee.

36. In establishments in which employees are exposed to skin contamination with poisonous, infectious or irritating substances, or oil, grease or dust, at least one wash basin supplied with hot and cold water from one tap shall be provided for every five employees ceasing work simultaneously and exposed to such contamination.

37. In establishments in which employees are exposed to excessive heat or skin contamination with poisonous, infectious, irritating or particularly dirty substances or dust, at least one shower bath or bath tub with an ample supply of hot and cold water from one fixture shall be provided for every 6 workers or portion thereof exposed to such contamination and ceasing work simultaneously.

38. Shower baths shall be under cover and enclosed in individual compartments, with the entrances suitably screened, either by location or by partitions or curtains.

39. Mixing valves for shower baths should be of such type and be so installed and adjusted that no water can be supplied at a temperature exceeding 38° C. (100° F.).

40. Shower bath equipment shall be thoroughly cleaned at least once a day, and an effective disinfectant shall be used to destroy fungi and ringworm organisms.

Dressing Rooms

41. (1) All industrial establishments shall have suitable and sufficient installations for accommodating the workers' clothes and drying them.

(2) These installations shall be placed in rooms separate from the workrooms.

42. A separate dressing room shall be made available for all employees whose working clothes are exposed to contamination with poisonous, infectious, irritating or radioactive substances and shall be provided with well separated facilities for street and working clothes.

43. When workers are engaged in processes of such a nature that their working clothes are liable to become wet or have to be washed between shifts, suitable arrangements shall be made to ensure that dry clothes are always available to each employee on his return to work.

44. Dressing rooms should be provided with—

- (a) individual lockers of adequate size and with adequate ventilation, preferably of metal and fitted with locks, for clothing taken off during working hours; and
- (b) benches or other suitable seating arrangements.

45. Dressing rooms and lockers shall be kept clean, and suitable arrangements shall be made for their disinfection, in conformity with the requirements laid down by the competent health authority.

Rest and Dressing Rooms for Women

46. In factories employing 10 or more women at any one time at least one rest and dressing room for their exclusive use shall be provided, separated by solid partitions from any adjoining water closets.

47. Where less than 10 women are employed and no rest room is available, some equivalent space shall be provided which can be—

- (a) properly screened; and
- (b) made suitable for the use of women employees.

48. The minimum floor space for a rest room for not more than 10 women shall be 9 m² (100 sq. ft.) with an additional space of at least 2 m² (20 sq. ft.) for every additional 10 or fraction of 10 women employed.

49. Beds or couches shall be provided in women's rest rooms in the following numbers:

- (a) where not more than 40 women are employed, one bed or couch;
- (b) where 41 to 100 women are employed, two beds or couches;
- (c) where 101 to 250 women are employed, three beds or couches; and
- (d) for each additional 250 women employed at least one additional bed or couch.

Use of Canteens, Washrooms and Dressing Rooms

50. (1) In all establishments where employees are permitted to take meals on the premises, a room adequate for that purpose shall be provided for the maximum number of persons who have to take their meal at one time.

(2) This room shall be completely separate from the work-rooms and reserved exclusively for the purposes of a canteen.

51. Covered receptacles shall be provided for disposing of waste food, and employees shall use these for the disposal of all such material.

52. The size of lunch rooms shall be calculated on the basis of the maximum number of persons using them at any one time, with the following minima:

- (a) 25 persons or less, 18.5 m² (200 sq. ft.);
- (b) 26 to 74 persons, 18.5 m² (200 sq. ft.) plus 0.65 m² (7 sq. ft.) for each person above 25;

- (c) 75 to 149 persons, 50 m² (550 sq. ft.) plus 0.55 m² (6 sq. ft.) for every person above 74;
- (d) 150 to 499 persons, 92 m² (1,000 sq. ft.) plus 0.50 m² (5 sq. ft.) for each person above 149; and
- (e) 500 persons and over, 255 m² (2,750 sq. ft.) plus 0.40 m² (4 sq. ft.) for each person above 499.

53. (1) Employers shall formally prohibit their personnel from—

- (a) depositing cloths or toilet articles elsewhere than in the dressing rooms;
- (b) depositing parcels, brief cases or vessels containing food elsewhere than in the canteens or the dressing rooms;
- (c) taking meals in the workrooms or ancillary rooms;
- (d) entering canteens before taking off their working clothes, at least when these clothes are impermeated with poisonous, irritating, infectious or particularly dirty substances.

(2) The personnel shall—

- (a) use the washrooms before meals and at the close of work;
- (b) take a bath or a shower bath at the close of the working day when bath tubs or shower baths are placed at their disposal, where these are provided in accordance with paragraph 37 of this Regulation.

Employers shall see that the provisions of (a) and (b) are complied with.

Section 2. Local Exhaust Systems

REGULATION 218. GENERAL PROVISIONS

Definitions

1. In this Code the following terms have the meanings hereby assigned to them:

- (a) the term "exhaust system" means a system of mechanical ventilation operating by suction for the removal of dusts, fibres, fumes, gases, mists, vapours or refuse, including all hoods, ducts, exhausters, air-cleaning equipment and receptacles when required, and any other part necessary for the proper installation and operation of the system, but not including any part of the building structure;
- (b) the term "hood" means the total or partial enclosure forming that part of an exhaust system which is nearest to the point of origin or liberation of the atmospheric contaminant or the refuse, and through which air enters the system during operation;

- (c) the term "duct" means any duct or piping forming part of an exhaust system;
- (d) the term "branch duct" means a duct or pipe connected directly to the hood;
- (e) the term "main duct" means a duct or pipe to which one or more branch ducts are connected, and which connects such branch ducts to the remainder of an exhaust system;
- (f) the term "exhauster" means the exhaust fan or other suction device which serves to move the air through an exhaust system, including its housing and source of motive power;
- (g) the term "air-cleaning equipment" means that part of an exhaust system in which the atmospheric contaminants collected by the system are removed from the air stream before it is expelled through the discharge duct, and includes settling chambers, cyclone separators, cloth filters, oil and water air washers, electrostatic precipitators, centrifugal separators, and fan-type collectors;
- (h) the term "refuse receptacle" means a box, chamber, vault or tank into which the dust or other refuse from the air-cleaning equipment is deposited;
- (i) the term "fire wall" means a wall which subdivides a building or separates buildings to restrict the spread of fire and which starts at the foundation and extends continuously through all stories to and above the roof;
- (j) the term "Pitot tube" means a velocity pressure-indicating instrument consisting of an impact tube within an outer or static pressure tube terminating in connections for attachment to a manometer gauge.

Arrangement of System

2. In order to permit the use of the shortest lengths of ducts and the least number of bends and to ensure proper proportioning of air flow from the various hoods, processes to be connected to the same exhaust system should be located close together.

3. Processes generating or liberating different kinds of dusts, fumes or vapours which might combine into explosive, flammable or toxic compounds shall not be connected to the same exhaust system.

Capacity of System

4. The capacity of exhaust systems shall be determined on the assumption that all hoods connected to the system are open, except where the system is so interlocked that only a part or parts of it can be operated at a given time, in which case the capacity may be calculated on the assumption that all the hoods which can be operated at a given time are open.

Construction

5. All parts of exhaust systems shall be as free as possible from air leakage either into or out of the system except at points where air is taken into or discharged from the system by design, and the interior of all parts should be smooth and free of obstructions.

Grounding

6. All metal parts of exhaust systems shall be effectively grounded.

Operation

7. Exhaust systems shall be kept running at all times when the process connected to them is working and for a sufficient time before the process is started and after the process has ceased.

Downward Exhaust

8. Fumes, gases and vapours that are heavier than air, and metal particles, sand and similar heavy substances, should be removed by means of a downward system of exhaust.

Corrosive Gases

9. Hoods, ducts and other parts of exhaust systems subject to contact with corrosive gases should be—

- (a) constructed of corrosion-resisting materials; or
- (b) coated, inside and outside, with asphalt, rubber, bitumastic paint or other corrosion-resisting substances.

Fresh-Air Supply

10. Workrooms equipped with exhaust systems shall be provided with suitable fresh-air inlets of sufficient capacity to replace the air removed by the systems and so arranged and located that the workers are not subjected to unpleasant and injurious draughts of air.

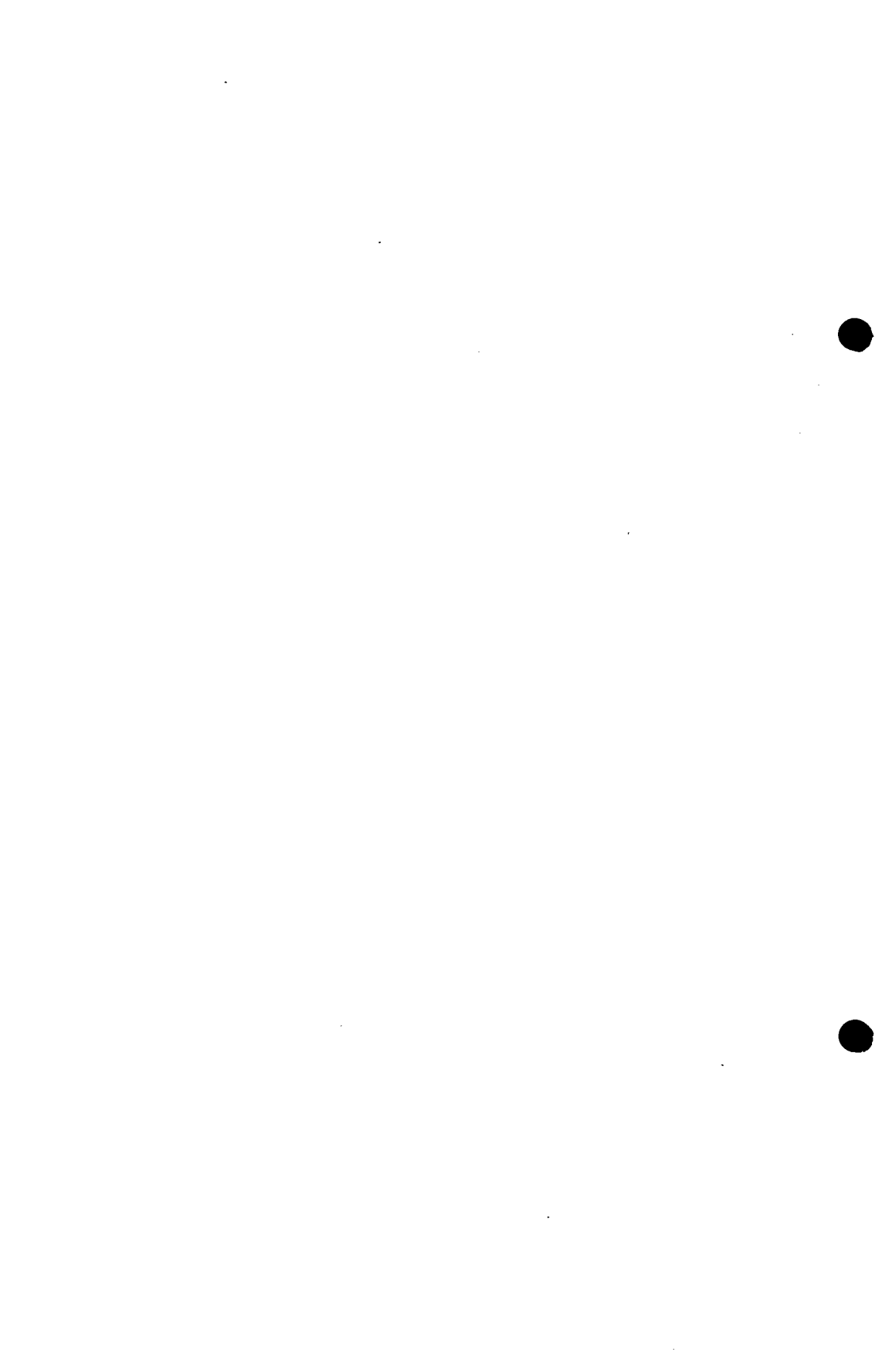
Hoods

11. Suction hoods for exhaust systems shall be so designed and located as to provide the necessary air velocity with the smallest possible volume of air flowing into the hood, either by enclosing the process as much as possible or, where it cannot be enclosed, by—

- (a) placing the hood with the opening as close as practicable to the source of contamination;
- (b) shaping the hood to conform to the area of contamination;
- (c) providing flanges, vanes or baffles if necessary; and
- (d) locating the hood opening, or part of it, so that the dusts, fibres, fumes, gases, mists, vapours or refuse will fall, be projected or be drawn into the hood in the direction of the air flow.

Paragraph 8 (*Downward Exhaust*) is deleted.

Paragraphs 9-59 become paragraphs 8-58.



12. Provision shall be made to eliminate or control cross currents or other air movement which would interfere with the control air currents created by the hood and render the exhaust system ineffective.

13. Where hoppers, troughs or other receptacles beneath work tables, work benches or floors serve as suction hoods for downward exhaust of heavy particles, the connection with the branch duct should be made at the side of the hood and the bottom utilised for trapping the larger particles.

14. When suction hoods for abrasive wheels also serve as protection hoods, they shall be constructed and mounted in accordance with the requirements of paragraphs 12 to 26 of Regulation 91, relating to abrasive grinding, polishing and buffing equipment.

15. When suction hoods for factory equipment other than abrasive wheels form all or part of the protection guards for such equipment, they shall conform to the provisions for the respective machines or other equipment in Regulations 82 to 89, Regulations 92 to 107 and Regulations 121 to 151.

16. Suction hoods for exhaust systems shall be free from sharp edges and rough burrs, and suitably reinforced when necessary.

17. Movable suction hoods on exhaust systems shall be provided with convenient and rapid-action adjusting devices.

18. Dipping, electroplating and pickling tanks, and other tanks from which corrosive, irritating or toxic gases, mists or vapours are liberated shall be provided—

(a) on the inside of the tank near the upper edge with slot-type lateral suction hoods along—

(i) at least one of the longer sides on tanks less than 50 cm (20 in.) in width;

(ii) each of the two longer sides on tanks 50 to 120 cm (20 to 48 in.) in width; or

(iii) each of the exposed sides on tanks more than 60 cm (24 in.) in width and so located against a wall that they are inaccessible from one of the longer sides; or

(b) with other means of ventilation not less effective than slot-type lateral suction.

19. Slot-type lateral suction hoods for tanks shall be—

(a) located at least 10 cm (4 in.) but preferably 15 to 20 cm (6 to 8 in.) above the bath level;

(b) placed flush with the inside of the tank lining and extend along the greater length of the tank; and

(c) provided with a full-length exhaust slot not less than 2.5 cm (1 in.) or more than 7.5 cm (3 in.) in width.

Ducts

20. The entire duct system for removal of dusts, fibres, fumes, gases, mists, vapours or refuse shall be self-contained, and no room or other portion of a factory building shall be used as an integral part of the system unless it is of non-combustible construction and used for no other purpose.

21. Ducts for exhaust systems shall be so located as to require the minimum length of duct and a minimum number of bends or elbows.

22. Ducts for exhaust systems shall be—

- (a) constructed entirely of non-combustible materials;
- (b) of adequate strength and thickness to meet the conditions of service and the installation requirements; and
- (c) protected as far as practicable from damage due to accidental contact.

23. Flexible metallic hose may be used for the connection between suction hoods and exhaust ducts where movement of the hood is required.

24. Exhaust ducts shall be so installed as to—

- (a) be readily accessible for inspection, cleaning and repairs;
- (b) prevent condensation of moisture, etc., within them;
- (c) provide maximum protection against outside damage to them; and
- (d) avoid interference with the operation of cranes, elevators, trucks, etc.

25. Where possible, exhaust ducts shall be placed so that no part is less than 15 cm (6 in.) above the floor or 15 cm (6 in.) below the ceiling.

26. Where it is necessary to pass exhaust ducts or their inlets or outlets through a fire wall, an automatic fire door or shutter shall be provided on each side of the wall.

27. Where exhaust ducts pass through floors, partitions or walls, the space around the duct shall be sealed with asbestos, mineral wool or other non-combustible material, to prevent the passage of flame or smoke.

28. All reinforcing of exhaust ducts shall be done on the outside of the duct.

29. All exhaust ducts shall be adequately supported.

30. Unless space will not permit, every bend, turn or elbow in exhaust ducts shall be made with a centre line radius at least equal to twice the diameter of the duct to which it is connected.

31. All lap joints in exhaust ducts shall be so constructed that the outlet end of one length of duct enters the inlet end of the next length in the direction of the air flow, with the length of the lap not less than 2.5 cm (1 in.).

In paragraph 34 (new numbering) the words " paragraph 26 " in the second line become " paragraph 25 ".

32. Increases in size of main ducts in exhaust systems through the junction of branch ducts shall be effected by means of tapered transformation sections, each at least 12.5 cm (5 in.) in length for each 2.5 cm (1 in.) increase in diameter.

33. Branch duct junctions to main ducts in exhaust systems shall be—

- (a) made at the side or top of the larger end of a transformation section of the main duct;
- (b) made in the direction of the air flow at an angle of not more than 45° measured on the centre lines of the two ducts; and
- (c) limited to a single branch duct at any one point of intersection.

34. Telescopic joints, to permit raising and lowering of suction hoods for exhaust systems, shall have the duct directly attached to the hood with a sliding fit into the larger connecting duct and extending into the outside duct at least one duct diameter but not less than 15 cm (6 in.) when the joint is fully extended.

35. The use of dampers, gates or orifice plates in exhaust ducts shall, except as provided in paragraph 26 of this Regulation, be prohibited unless provided for the purpose of balancing the air flow in the system, in which case they shall be securely fastened to prevent unauthorised manipulation.

36. Exhaust ducts shall have no openings other than those required for the proper operation and maintenance of the system.

37. Horizontal exhaust ducts shall be provided with cleaning openings—

- (a) of a size that will permit ready access to the interior of the duct;
- (b) as far as practicable, located not more than 3 m (10 ft.) apart; and
- (c) equipped with tight-fitting sliding or swinging doors provided, except in the case of vertical sliding doors, with substantial latches.

38. Main exhaust ducts shall be blanked off at the tail end with removable caps, and the last branch connections shall be not more than 15 cm (6 in.) from the capped end.

39. The inside diameter of any duct or elbow connected to the collars on suction hoods shall be full branch-duct size and the collars on the hoods shall fit tightly into such connecting ducts or elbows without clearance.

40. The area of the inlet and outlet of the fan housing for exhaust systems, and the air-discharge duct throughout its entire length, shall be at least equal to the area of the main duct at the fan inlet.

Exhausters

41. Fans for exhaust systems shall be—

- (a) of a suitable type and of non-combustible construction;

- (b) of adequate, but not greatly excessive, capacity to maintain the designed rate of air flow when operating against the total resistance pressure of the system;
- (c) placed on adequate foundations or firmly secured to substantial supports;
- (d) so located and arranged as to afford ready and safe access for cleaning, inspection, lubrication and repairs; and
- (e) in places with high fire hazards, provided with remote control in addition to any control located close to the equipment.

42. Where conditions permit, fans for exhaust systems shall be located on the clean-air side of the air-cleaning equipment.

43. Where flammable materials or vapours are passed through fans for exhaust systems, the blades or runners and the spider of the fan shall be of non-ferrous material, or the casing shall consist of or be lined with non-ferrous material.

44. Blades or runners of fans for exhaust systems shall be of sufficient strength to prevent contact with casings or distortion under conditions of deposit loading or other operating factors.

45. Housings or casings of fans for exhaust systems shall be so constructed as to prevent distortion and loss of alignment under operating conditions.

46. Exposed openings into housings of fans for exhaust systems shall be protected by substantial metal screens to prevent accidents or the entry of foreign materials.

47. Bearings of fans for exhaust systems shall be self-lubricating, dust-tight and located outside casings and ducts.

48. Ready access to fans for exhaust systems should be provided by installation, at the point where the duct connects to the suction side of the fan, of a detachable sleeve at least 45 cm (18 in.) in length.

49. Fans for exhaust systems shall be operated at a speed sufficient to maintain the air flow into the system at such velocity that there will be no exposure in the workrooms to concentrations of harmful substances in excess of the limits tabulated in Appendix III to this Code.

50. Motors employed in exhaust systems shall be of a type designed and constructed for the particular conditions or hazards, or shall be located outside rooms in which flammable dusts or vapours are being generated or removed.

Air-Cleaning Equipment

51. Air-cleaning equipment for exhaust systems shall be of such capacity and operating characteristics as to ensure steady and continuous operation from the beginning to the end of a continuous working period.

52. Air-cleaning equipment for exhaust systems shall be so designed and installed as to permit—

- (a) removal of dust or other extracted contaminants from the equipment without creating a hazard; and
- (b) cleaning and repairing the equipment without recontaminating the air in the factory.

Exhaust Discharge

53. Exhaust systems should discharge to the outside atmosphere with the point of outlet at least 1.8 m (6 ft.) above the roof and 7.6 m (25 ft.) from the nearest door, window or other opening of any occupied building.

54. (1) Air discharged from exhaust systems shall not be recirculated unless it has been passed through suitable and efficient air-cleaning equipment which has removed all dirt, dust or fume contamination.

(2) Air discharged from any air-cleaning equipment used for the removal of lead dust, lead fumes or other highly toxic substances shall in no case be discharged into any workroom.

(3) Air exhausted from any process where silica dust is present shall in no case be returned to any workroom or discharged outside the factory in a manner which will create a health hazard.

55. Air discharge ducts for exhaust systems shall be provided with suitable canopies for protection against the weather but shall otherwise be unobstructed.

Inspection

56. Exhaust systems shall be inspected regularly, at intervals not exceeding three months, for leaks and deposits of dust or residues, and all worn or damaged parts shall be repaired or replaced without delay: Provided that exhaust systems on plant used for spray painting shall be cleaned in accordance with the provisions of paragraph 8 (b) of Regulation 193 of this Code.

57. Unless a flow meter has been provided in the main duct of an exhaust system, the routine inspection of the system should include measurement of the velocity pressure of the air flow in the branch ducts, by means of a Pitot tube or other reliable instruments, to determine whether the system is working in accordance with the original design.

58. All tests for air velocity of exhaust systems shall be made with all suction hoods that can be operated at a given time open and in operation.

59. The routine inspection of exhaust systems should from time to time also include measurement of the concentrations of contaminants in the atmosphere of the workrooms served by the systems by suitable methods of sampling and testing, supplemented

by additional tests whenever a health hazard is suspected, new machines are added, or changes made in the composition of material which might affect the efficiency of the system.

REGULATION 219. ADDITIONAL PRECAUTIONS FOR SYSTEMS FOR REMOVAL OF FLAMMABLE, UNHEALTHY OR OBNOXIOUS FUMES, GASES, MISTS, VAPOURS AND RESIDUES

Segregation

1. Exhaust systems for removal of flammable fumes, gases, mists, vapours and residues shall not be connected to any other ventilating system or discharged into a chimney or flue used for conveying gases of combustion.

Ducts

2. Circular exhaust ducts for removal of flammable fumes, gases, mists, vapours and residues shall be constructed of steel or other metal equal in strength to steel plate of not less than—

- (a) 1 mm (0.04 in.) for ducts up to 50 cm (20 in.) in diameter;
- (b) 1.25 mm (0.05 in.) for ducts over 50 cm (20 in.) and less than 75 cm (30 in.) in diameter; or
- (c) 1.5 mm (0.06 in.) for ducts 75 cm (30 in.) or more in diameter.

3. The area of the main duct in an exhaust system for removal of flammable fumes, gases, mists, vapours and residues shall be not less at any point than the combined areas of the branch ducts joining it between such point and the tail end of the system.

4. Exhaust ducts for removal of flammable fumes, gases, mists, vapours and residues should lead to the outside of the building as directly as possible, and not through intermediate rooms unless this is unavoidable.

5. Dampers, valves and shutters shall not be installed in exhaust ducts for removal of flammable fumes, gases, mists, vapours and residues except where necessary at outlets to afford weather protection when the system is shut down.

Unhealthy and Obnoxious Substances

6. When fumes, gases, mists, vapours, dust and other refuse discharged from exhaust systems might be unhealthy or noxious for the workers or the neighbourhood, exhaustion shall be effected through a system that will neutralise toxic substances, sterilise infectious substances and deodorise fumes, gases, mists and vapours.

REGULATION 220. ADDITIONAL PRECAUTIONS FOR SYSTEMS FOR REMOVAL OF DUSTS, FIBRES, STOCK OR REFUSE***Ducts***

1. Except as provided in paragraph 2 of this Regulation, circular exhaust ducts for removal of dusts, fibres, stock or refuse shall be constructed of steel or other metal equal in strength to steel plate of a thickness not less than—

- (a) 0.6 mm (0.02 in.) for ducts 20 cm (8 in.) or less in greatest dimension;
- (b) 0.8 mm (0.03 in.) for ducts over 20 cm (8 in.) up to 50 cm (20 in.) in greatest dimension;
- (c) 1 mm (0.04 in.) for ducts 50 cm (20 in.) and less than 75 cm (30 in.) in greatest dimension; or
- (d) 1.25 mm (0.05 in.) for ducts 75 cm (30 in.) or more in greatest dimension.

2. Stationary circular exhaust ducts for removal of granite dust or other dust with marked abrasive or erosive characteristics shall be constructed of steel or other metal equal in strength to steel plate of a thickness not less than—

- (a) 1.25 mm (0.05 in.) for ducts 14 to 45 cm (5½ to 18 in.) in greatest dimension;
- (b) 1.5 mm (0.06 in.) for ducts over 45 and up to 75 cm (18 and up to 30 in.) in greatest dimension; or
- (c) 2 mm (0.08 in.) for ducts over 75 cm (30 in.) in greatest dimension.

3. The area of the main duct in an exhaust system for removal of dusts, fibres, stock or refuse shall be at any point at least 20 per cent. greater than the combined area of the branch ducts joining it between such point and the tail end of the system.

4. Ducts for removal of dusts, fibres, stock or refuse shall be kept open and unobstructed throughout their length, and free from screens.

5. Exhaust ducts for removal of dusts, fibres, stock and refuse shall be provided near bends, junctions or dead ends in horizontal runs, and at the bottom of all long vertical runs, with special additional cleaning openings.

6. Sweep-up ducts for removal of dusts, fibres, stock or refuse shall be so installed or protected as not to admit material which would cause obstructions in the ducts.

Dust Traps

7. Dust traps for collecting large particles of dust may be installed in exhaust ducts for removal of dust.

8. Material collected in any dust trap of an exhaust system shall discharge into an enclosed container, which shall be readily removable for disposal of the accumulated material.

Air-Cleaning Equipment

9. Exhaust systems for the removal of dust shall be provided with dust collectors or other air-cleaning equipment of a type determined by the fineness, toxicity and weight of the dust to be removed.

10. Separators for flammable dusts shall be installed outdoors or in detached rooms with adequate explosion vents for both apparatus and rooms.

11. Separators for flammable dusts shall not serve several separated processes, and individual collectors should be used for progressive stages in any one process.

12. Where conditions permit, cyclone separators for exhaust systems shall be installed outdoors, and when so located shall be—

- (a) substantially supported by rigid framework; and
- (b) protected, where necessary, against wind pressure by means of wire guy ropes of adequate strength.

13. Cyclone separators for exhaust systems shall be made of steel at least 0.8 mm (0.03 in.) in thickness.

14. The hopper discharge opening on cyclone separators for exhaust systems shall be not less than 45° from the horizontal.

15. Suitable means shall be provided for access to the body of cyclone separators for exhaust systems for the purpose of cleaning the separators and examination of the interior.

16. Cloth-screen dust arresters for exhaust systems shall be provided with—

- (a) means for shaking or otherwise removing the dust mat from the cloth; and
- (b) a damper in the duct just ahead of the arrester to prevent the dust from drifting back into the exhaust system during the process when the fan is shut down.

17. Bag-type collectors for exhaust systems shall be enclosed in substantial metal housings, provided inside with automatic sprinkler protection.

Vents

18. Exhaust systems for removal of refuse or stock shall be vented to the outside of the building, either directly by means of flues or separators or indirectly by means of the bins, vaults or other receptacles into which they discharge.

19. Exhaust systems for removal of combustible refuse or stock of an explosive nature shall be provided with safety relief or explosion vents—

- (a) of at least the same area as the ducts they serve;
- (b) leading in as nearly a vertical direction as possible and by the most direct route practicable to the outside of the building, but not through adjoining buildings;
- (c) deviating not more than 22.5° from the direction of the ducts from which they lead;
- (d) not connected to chimneys, pipes, vents or flues used for any other purpose; and
- (e) terminating in an outlet provided with a cowl, or, where non-escape of materials is essential, with counter-balanced relief valves or covers.

Refuse Receptacles

20. Suitable refuse receptacles devoid of air under pressure shall be provided for the refuse discharge from separators.

21. Vaults for combustible refuse or stock delivered by gravity from separators for exhaust systems—

- (a) should be located outside the factory building;
- (b) shall be of substantial brick or reinforced concrete construction throughout;
- (c) should not be used for receiving refuse or stock by other methods of conveying or by hand;
- (d) shall be provided with screened ventilating roof openings of an area at least equal to the total area of the inlet openings; and
- (e) if containing combustible material of an explosive nature, shall be provided with explosion relief vents of 1 m² per 24 m³ (1 sq. ft./80 cu. ft.) of vault volume.

22. Where dust or refuse is discharged only in small quantities by separators from exhaust systems it may be discharged into, instead of a vault—

- (a) a substantial metal dust box, located outside the factory building and provided with a self-closing door or cover which will readily open and vent a fire or explosion within; or

- (b) a receptacle substantially constructed of sheet metal at least 1.25 mm (0.05 in.) in thickness, not exceeding 90 by 90 by 60 cm (3 by 3 by 2 ft.) in size but adequate to hold the refuse, located inside the building and provided with ventilation directly to the open air.

REGULATION 221. MINIMUM SIZES OF EXHAUST DUCTS FOR METAL GRINDING, POLISHING AND BUFFING EQUIPMENT

Grinding Wheels

1. Exhaust outlets of suction hoods for abrasive grinding wheels on floor stands, pedestals, benches or special-purpose grinding machines and for cutting-off wheels, and the branch ducts connected to the hoods, shall have not less than the following inside diameters:

Size of abrasive grinding or cutting-off wheel			Minimum diameter of outlet and branch duct	
Maximum diameter	Maximum thickness			
	cm	in.			cm	in.
Up to 22.5 cm (9 in.) inclusive	3.8	1½	7.5	3
Over 22.5 to 30 cm (9 to 12 in.) inclusive	5.0	2	10.0	4
Over 30 to 47.5 cm (12 to 19 in.) inclusive	7.5	3	11.3	4½
Over 47.5 to 60 cm (19 to 24 in.) inclusive	10.0	4	12.5	5
Over 60 to 75 cm (24 to 30 in.) inclusive	12.5	5	15.0	6
Over 75 to 90 cm (30 to 36 in.) inclusive	15.0	6	17.5	7

Buffing and Polishing Wheels

2. Exhaust outlets of suction hoods for scratch brush wheels over 15 cm (6 in.) in diameter and for all buffing and polishing wheels mounted on floor stands, pedestals, benches or special-purpose grinding machines, and the branch ducts connected to the hoods, shall have not less than the following inside diameters:

Size of buffing, polishing or scratch brush wheel			Minimum diameter of outlet and branch duct	
Maximum diameter	Maximum thickness			
	cm	in.	cm	in.
Up to 22.5 cm (9 in.) inclusive	5.0	2	8.8	3½
Over 22.5 to 40 cm (9 to 16 in.) inclusive	7.5	3	11.3	4½
Over 40 to 47.5 cm (16 to 19 in.) inclusive	10.0	4	12.5	5
Over 47.5 to 60 cm (19 to 24 in.) inclusive	12.5	5	13.8	5½
Over 60 to 75 cm (24 to 30 in.) inclusive	15.0	6	16.3	6½

3. Where wheels used for grinding, polishing, buffing or scratch grinding exceed the thickness for the corresponding diameters specified in paragraphs 1 or 2 of this Regulation, the minimum inside diameter of the hood outlet and the branch duct connected to the hood shall be increased 7.5 mm (0.3 in.) for each 2.5 cm (1 in.) or fraction thereof increase in wheel thickness; provided that the increase shall be such as to bring the diameter at least up to the next higher diameter in the tables in paragraphs 1 or 2.

Disc Grinders

4. Suction hoods for horizontal disc grinders shall be connected to one or more branch ducts of the following minimum inside diameters—

Maximum diameter of disc, by type of machine	Minimum number of branch ducts	Minimum diameter of each branch duct	
		cm	in.
Single-spindle horizontal grinders:			
Up to 30 cm (12 in.) inclusive	1	7.5	3
Over 30 to 47.5 cm (12 to 19 in.) inclusive	1	10.0	4
Over 47.5 to 75 cm (19 to 30 in.) inclusive	1	12.5	5
Over 75 to 90 cm (30 to 36 in.) inclusive	1	15.0	6
Double-spindle horizontal grinders:			
Up to 47.5 cm (19 in.) inclusive	1	12.5	5
Over 47.5 to 62.5 cm (19 to 25 in.) inclusive	1	15.0	6
Over 62.5 to 75 cm (25 to 30 in.) inclusive	1	17.5	7
Over 75 to 132.5 cm (30 to 53 in.) inclusive	2	15.0	6
Over 132.5 to 180 cm (53 to 72 in.) inclusive	4	20.0	8

5. Suction hoods for vertical disc grinders shall be connected to one or more branch ducts of the following minimum inside diameters:

Maximum diameter of disc, by extent of hood	Minimum number of branch ducts	Minimum diameter of each branch duct	
		cm	in.
Where one half or more of the top of the disc is covered:			
Up to 50 cm (20 in.) inclusive	1	11.3	4 ½
Over 50 to 75 cm (20 to 30 in.) inclusive	2	10.0	4
Over 75 to 132.5 cm (30 to 53 in.) inclusive	2	15.0	6
Over 132.5 to 180 cm (53 to 72 in.) inclusive	2	20.0	8
Where less than one half of the top of the disc is covered:			
Up to 50 cm (20 in.) inclusive	2	10.0	4
Over 50 to 75 cm (20 to 30 in.) inclusive	2	13.8	5 ½
Over 75 to 132.5 cm (30 to 53 in.) inclusive	4	15.0	6
Over 132.5 to 180 cm (53 to 72 in.) inclusive	5	17.5	7

Belt Grinders

6. Suction hoods for belt grinders shall be connected to branch ducts of a minimum inside diameter of 7.5 cm (3 in.) for belts up to 7.5 cm (3 in.) in width and increased 1.25 cm (½ in.) for each 5 cm (2 in.) or fraction thereof increase in belt width.

REGULATION 222. MINIMUM SIZE OF EXHAUST DUCTS FOR GRANITE-WORKING TOOLS AND MACHINES

The inside diameter of stationary branch ducts connected to suction hoods for granite-working tools and machines shall be at least 13.8 cm (5½ in.).

REGULATION 223. MINIMUM SIZES AND NUMBERS OF EXHAUST DUCTS FOR SANDING MACHINES

Disc Sanders

1. Suction hoods for disc sanders shall be connected to one or more branch ducts of the following minimum inside diameters;

Maximum diameter of disc	Minimum number of branch ducts	Minimum diameter of each branch duct		
		cm	in.	
Up to 30 cm (12 in.) inclusive.	1	10.0	4	
Over 30 to 45 cm (12 to 18 in.) inclusive .	1	11.3	4½	
Over 45 to 65 cm (18 to 26 in.) inclusive .	1	12.5	5	
Over 65 to 80 cm (26 to 32 in.) inclusive .	2	10.0	4	
Over 80 to 95 cm (32 to 38 in.) inclusive .	2	1	10.0	4
		1	12.5	5
Over 95 to 120 cm (38 to 48 in.) inclusive.	3	1	12.5	5
		2	10.0	4

Drum Sanders

2. The minimum inside diameter of branch ducts connected to suction hoods for single drum sanders shall be 10 cm (4 in.) for sanders up to 25 cm (10 in.) in diameter and not over 0.129 m² (200 sq. in.) of working surface, and for sanders over 25 cm (10 in.) in diameter shall be—

- (a) 11.3 cm (4½ in.) when the working surface is not over 0.258 m² (400 sq. in.);
- (b) 12.5 cm (5 in.) when the working surface is from 0.258 m² to 0.45 m² (400 to 700 sq. in.);
- (c) 15 cm (6 in.) when the working surface is from 0.45 m² to 0.9 m² (700 to 1,400 sq. in.); or
- (d) 17.5 cm (7 in.) when the working surface is from 0.9 m² to 1.55 m² (1,400 to 2,400 sq. in.).

3. Suction hoods for triple drum sanders shall be connected to branch ducts of a minimum inside diameter of either—

- (a) 17.5 cm (7 in.) for sanders less than 75 cm (30 in.) in length, and increased 2.5 cm (1 in.) for each 15 cm (6 in.) or fraction thereof increase in the length of the sander up to 1.20 m (48 in.); or
- (b) 27.5 cm (11 in.) for sanders over 1.20 m (48 in.) in length.

Belt Sanders

4. Suction hoods for each horizontal belt sander using the bottom run of the belt shall be connected to two branch ducts, one at the bottom and the other at the top, having the following minimum inside diameters:

Width of belt	Minimum diameter of branch duct			
	Bottom duct		Top duct	
	cm	in.	cm	in.
Less than 15 cm (6 in.)	11.3	4½	10.0	4
15 to 22.5 cm (6 to 9 in.)	12.5	5	10.0	4
Over 22.5 to 35 cm (9 to 14 in.)	15.0	6	11.3	4½
Over 35 cm (14 in.)	17.5	7	12.5	5

5. Where horizontal belt sanders using the top run of the belt are operated exclusively on flat work, top ducts are not necessary, but where other work is done a suction hood above the work shall be connected to telescopic branch ducts conforming to the dimensions specified in paragraph 4 of this Regulation.

6. Suction hoods for vertical belt sanders shall be connected at the bottom to a single branch duct conforming to the dimensions for bottom ducts specified in paragraph 4 of this Regulation.

Post Sanders

7. Suction hoods for post or column swing arm sanders shall be connected to one branch duct of 10 cm (4 in.) minimum inside diameter by two 7.5 cm (3 in.) diameter ducts.

REGULATION 224. MINIMUM SIZES AND NUMBERS OF EXHAUST DUCTS FOR WOODWORKING MACHINES OTHER THAN SANDERS

Lathes

1. The inside diameter of branch ducts connected to suction hoods on automatic wood-turning lathes shall be not less than 7.5 cm (3 in.) to 25 cm (10 in.) according to the length of the bed.

2. The inside diameter of branch ducts on non-automatic wood-turning lathes shall be not less than 10 cm (4 in.).

Jointers (Buzz Planers)

3. The inside diameter of branch ducts connected to suction hoods for jointers shall be not less than—

- (a) 10 cm (4 in.) for knives up to 15 cm (6 in.);
- (b) 11.3 cm (4½ in.) for knives from 15 to 30 cm (6 to 12 in.);
- (c) 12.5 cm (5 in.) for knives from 30 to 50 cm (12 to 20 in.); or
- (d) 15 cm (6 in.) for knives over 50 cm (20 in.).

Matchers, Moulders and Sizers

4. Suction hoods for each matcher, moulding planer or timber sizer shall be connected to four branch ducts, one at the top head, one at the bottom head and one at each side, having the following minimum inside diameters:

Size of machine	Minimum diameter of branch duct					
	Top head duct		Bottom head duct		Each side duct	
	cm	in.	cm	in.	cm	in.
Up to 17.5 cm (7 in.)	12.5	5	11.3	4½	10.0	4
Over 17.5 to 30 cm (7 to 12 in.)	15.0	6	12.5	5	11.3	4½
Over 30 to 45 cm (12 to 18 in.)	17.5	7	15.0	6	12.5	5
Over 45 to 60 cm (18 to 24 in.)	20.0	8	17.5	7	15.0	6
Over 60 cm (24 in.)	22.5	9	20.0	8	17.5 to 20.0	7 to 8

Sash Stickers

5. Suction hoods for sash stickers shall be connected at each head to a branch duct of a minimum inside diameter of 10 cm (4 in.).

Planers

6. The inside diameter of branch ducts connected to single wood planers shall be not less than—

- (a) 12.5 cm (5 in.) for cutter knives up to 50 cm (20 in.);
- (b) 15 cm (6 in.) for knives from 50 to 65 cm (20 to 26 in.);
- (c) 17.5 cm (7 in.) for knives from 65 to 90 cm (26 to 36 in.); or
- (d) 20 cm (8 in.) for knives over 90 cm (36 in.).

7. Suction hoods for each double wood planer shall be connected to two branch ducts, one at the bottom and the other at the top, having the following minimum inside diameters:

Size of cutter knives	Minimum diameter of branch duct			
	Bottom duct		Top duct	
	cm	in.	cm	in.
Up to 50 cm (20 in.)	12.5	5	12.5	5
Over 50 to 65 cm (20 to 26 in.)	12.5	5	15.0	6
Over 65 to 90 cm (26 to 36 in.)	15.0	6	17.5	7
Over 90 cm (36 in.)	17.5	7	20.0	8

Shapers and Variety Machines

8. Suction hoods for wood shapers and variety machines shall be connected at each spindle to a branch duct of a minimum inside

diameter of 11.3 to 15 cm (4½ to 6 in.) according to the size and character of the work.

Panel Raisers

9. Suction hoods for panel raisers shall be connected at each head to a branch duct of a minimum inside diameter of 10 cm (4 in.).

Tenoners

10. Suction hoods for tenoners shall be connected to one branch duct at the bottom head and one at the top head, each having a minimum inside diameter of 12.5 cm (5 in.), and at each additional head to one branch pipe having a minimum inside diameter of 11.3 to 12.5 cm (4½ to 5 in.).

Dovetailers, Dowel Machines, Gainers, Ploughs and Relishers

11. The inside diameter of branch ducts connected to suction hoods for dovetailers, dowel machines, gainers, ploughs and relishers shall be not less than 10 cm (4 in.).

Band Saws

12. Suction hoods for each woodworking band saw shall be connected to two branch ducts, one at the front of the saw and the other at a point near the floor on the up run side of the lower wheel, having the following minimum inside diameters:

Maximum width of sawblade	Minimum diameter of branch duct			
	Down run		Up run	
	cm	in.	cm	in.
Less than 5 cm (2 in.)	10.0	4	10.0	4
5 to 7.5 cm (2 to 3 in.)	12.5	5	12.5	5
Over 7.5 to 10 cm (3 to 4 in.)	15.0	6	12.5	5
Over 10 to 15 cm (4 to 6 in.)	17.5	7	12.5	5
Over 15 to 20 cm (6 to 8 in.)	20.0	8	12.5	5

Circular Saws

13. Suction hoods for woodworking self-feed circular rip saws shall be connected at the top to one branch duct of 10 cm (4 in.) minimum inside diameter, and at the bottom to a second branch duct of a minimum inside diameter of either 11.3 cm (4½ in.) for saws up to 40 cm (16 in.) in diameter or 12.5 cm (5 in.) for saws over 40 cm (16 in.) in diameter.

14. Suction hoods for large self-feed circular rip saws for green lumber shall be connected at the bottom to one branch duct of 15 cm (6 in.) minimum diameter, and at the top to a second branch duct of 12.5 cm (5 in.) minimum inside diameter.

15. Suction hoods for circular resaw mills shall be connected to two branch ducts, one at the top and the other at the bottom, having the following minimum inside diameters:

Maximum diameter of rip saw	Minimum diameter of branch duct			
	Bottom duct		Top duct	
	cm	in.	cm	in.
Up to 60 cm (24 in.)	12.5	5	10.0	4
60 to 90 cm (24 to 36 in.) . .	15.0	6	11.25	4 1/2
90 to 120 cm (36 to 48 in.) . .	17.5	7	12.5	5
Over 120 cm (48 in.)	20.0	8	13.75	5 1/2

16. Suction hoods for woodworking swing saws shall be connected to a single branch duct of a minimum inside diameter of either 10 cm (4 in.) for saws up to 50 cm (20 in.) in diameter or 11.3 cm (4 1/2 in.) for saws over 50 cm (20 in.) in diameter.

17. The inside diameter of branch ducts connected to suction hoods for woodworking circular saws other than those specified in paragraphs 13 to 16 of this Regulation shall be at least—

- (a) 10 cm (4 in.) for saws up to 40 cm (16 in.) in diameter;
- (b) 11.3 cm (4 1/2 in.) for saws 40 to 60 cm (16 to 24 in.) in diameter;
or
- (c) 12.5 cm (5 in.) for saws over 60 cm (24 in.) in diameter.

Chain Mortise Machines

18. Suction hoods for chain mortise machines shall be connected to a single branch duct of not less than 7.5 cm (3 in.) inside diameter.

Hog Chippers

19. The inside diameter of branch ducts connected to suction hoods for hog mills shall be not less than 20 cm (8 in.) for machines up to 30 cm (12 in.) wide or 30 cm (12 in.) for machines over 30 cm (12 in.) wide.

Floor Sweeps

20. The inside diameter of exhaust ducts for floor sweeps in woodworking plants shall be at least 15 cm (6 in.) for fine dust and up to 20 cm (8 in.) for coarse material, and the mouth at the floor shall be at least 25 by 10 cm (10 by 4 in.) up to 30 by 12.5 cm (12 by 5 in.).

CHAPTER XIV

PERSONAL PROTECTIVE EQUIPMENT

REGULATION 225. DEFINITIONS

In this Chapter the following terms have the meanings hereby assigned to them:

- (a) the term "hard hat" means a hat having a hard shell so supported upon a cradle or hammock as to keep it clear of the head and to cushion blows on the top of the hat;
- (b) the term "goggles" means spectacles of various designs, the predominant function of which is to protect the eyes;
- (c) the term "gas-tight goggles" means goggles in which eye-cups and frames are made of soft flexible rubber and provide a sealed contact with the face of the wearer;
- (d) the term "face mask" means a transparent visor of non-flammable material that is hinged on an adjustable headband and can easily be turned up and down in front of the face and used for protection of the eyes and face;
- (e) the term "helmet" means a device worn by the worker, made of electrically non-conducting material, and used for the protection of the eyes, face, neck and a portion or all of the other parts of the head;
- (f) the term "shield" means a device to be held in the hand or supported without the aid of the worker and used for the protection of the eyes and the face;
- (g) the term "filter respirator" means a facepiece designed for the wearer to inhale the surrounding atmosphere after it has passed through a filtering medium to remove the impurities;
- (h) the term "cartridge respirator" means a facepiece with a single or twin cartridge mounted on the facepiece and containing a chemical;
- (i) the term "canister mask" means a facepiece with a corrugated tube connecting the facepiece to a canister containing a chemical;
- (j) the term "supplied-air respirator" means a respirator equipped with a hose line, through which fresh air is supplied under positive pressure;

- (k) the term "hose mask" means a mask equipped with a hose line through which the wearer can inhale air at atmospheric pressure;
- (l) the term "oxygen breathing mask" means a facepiece with a corrugated tube connecting it to an oxygen tank or cylinder;
- (m) the term "self-generated-oxygen mask" means an oxygen breathing mask in which oxygen is generated by a chemical process.

REGULATION 226. WORKING CLOTHES

1. When selecting working clothes, consideration should be given to the hazards to which the wearer may be exposed, and those types should be selected which will reduce the hazards to the minimum attainable in each case.

2. Working clothes should fit well; there should be no loose flaps or strings, and pockets, if any, should be few and as small as practicable.

3. Loose, torn or ragged garments, neckties and key chains or watch chains shall not be worn near moving parts of machines.

4. When the operations involve a danger of explosion or fire, it shall be prohibited, during working hours, to wear articles such as collars, eyeshades, cap visors and spectacle frames made of celluloid or other flammable materials.

5. Shirts with short sleeves should be worn in preference to shirts with rolled-up sleeves.

6. Sharp or pointed objects, explosive substances or flammable liquids shall not be carried in pockets.

7. Persons exposed to flammable, explosive or toxic dusts shall not wear clothing having pockets, cuffs or turn-ups that might collect such dusts.

8. (1) The use and condition of footwear shall be regulated where necessary.

(2) In cases where ordinary footwear is not suitable, employers shall provide for the supply of footwear, boots, heavy shoes or other means of suitable protection.

9. Shoe laces should be kept tied.

REGULATION 227. HEAD PROTECTION

Hard Hats

1. Workers exposed to falling or flying objects and blows on the head shall wear well-fitting hard hats.

2. The total weight of the complete hard hat should be less than 0.4 kg (14½ ounces).

3. Hard hats shall be made of non-combustible or slow-burning material, and they should be non-conductors of electricity.

4. Hard hats should have a brim all round to provide protection for the head, face and back of the neck.

5. For work in confined spaces, hard hats may be without brims and should have low crowns.

6. For work in excessive moisture, hard hats shall be of waterproof material.

7. The cradle and sweatband of hard hats shall be detachable and replaceable.

8. Before a hard hat worn by one person is worn by another—

(a) the shell should be sterilised; and

(b) the cradle and sweatband should be either replaced or sterilised.

Hair Protection

9. Where necessary, all persons employed around machinery shall completely cover their hair with well-fitting caps or equivalent protection.

10. Caps shall be of material which is not easily flammable and is sufficiently durable to withstand regular laundering and disinfecting by commercial methods.

11. Caps shall be easy to clean.

REGULATION 228. EYE PROTECTION

1. Suitable eye protection shall be provided for all workers performing any operation which may endanger their eyes.

2. Workers whose vision requires the use of corrective lenses in spectacles and who are required to wear protective goggles shall be provided with goggles of one of the following types:

(a) goggles the protective lenses of which provide the proper optical correction;

(b) goggles which can be worn over corrective spectacles without disturbing the adjustment of the spectacles; or

(c) goggles which incorporate corrective lenses mounted inside the protective lenses.

3. Glass or transparent plastic materials for lenses and windows of protectors shall be—

(a) strong enough for the purpose for which it is intended; and

(b) substantially free from striae, air bubbles, waves and other flaws.

4. The front and rear surfaces of lenses and windows shall be parallel and the lenses and windows shall not cause any lateral distortion except when the lens provides proper optical correction for defective vision.

5. Goggle lenses shall be not less than 38 mm (1.5 in.) in height and 44.5 mm (1.75 in.) in width.

6. Circular lenses not providing optical correction shall be of a minimum diameter of 50 mm (1.97 in.).

7. All lenses for goggles intended solely for mechanical protection shall, when new, be capable of transmitting at least 89 per cent. of the incident visible light.

8. Frames should be light and adjustable to the face and should be equipped, where necessary, with side screens.

9. If goggles are provided with side screens, such screens shall be made of metal, leather or other material of adequate durability.

10. Goggles for workers engaged in chipping, riveting, caulking, scaling and dry grinding and similar operations shall conform to standards of strength accepted by the competent authority.

11. Goggles for workers exposed to wind and dust shall have flexibly connected lens holders shaped to conform to the configuration of the face.

12. Goggles for workers employed in handling molten metal shall conform to standards of heat resistance accepted by the competent authority.

13. Goggles for workers handling corrosive liquids, such as acids and caustics, shall have eyecups of soft, non-flammable material flexible enough to conform readily to the configuration of the face, and so constructed that no splashing liquid can enter the eyes through the openings provided for ventilation.

14. Goggles for workers exposed to fumes which would cause injury or discomfort to the eyes of the wearer shall have eyecups which fit the face closely and have no ventilation openings.

15. Goggles, helmets and shields for workers engaged in arc welding, oxy-acetylene welding, furnace work or any other operation where their eyes are exposed to glare shall have filter lenses or windows conforming to absorption standards accepted by the competent authority.

16. (1) Face masks and shields for protecting the face against light impacts or sparks should have non-flammable transparent visors, free from scratches or other flaws.

(2) All such equipment shall be of appropriate optical quality.

17. Before goggles which have been worn by one worker are issued to another—

(a) the goggles shall be sterilised; and

(b) any non-sterilisable parts, such as elastic head bands, shall be replaced.

18. When not in use, goggles and face masks shall be kept in special, closed containers protecting them from mechanical damage and contamination by oil, grease and other materials.

19. Goggles and face masks shall be inspected at regular intervals and all defective parts immediately replaced.

REGULATION 229. EAR PROTECTION

1. Men working in intensive prolonged noise should wear suitable ear plugs.

2. Ear plugs—

- (a) shall be cleaned daily, unless discarded after each use; and
- (b) shall not be transferred from one user to another without sterilisation.

3. Guards for protecting the ears against sparks, molten metal particles or other foreign bodies shall consist of a strong, light-weight non-rusting screen mounted on leather-bound ear cups and held in place by an adjustable steel spring worn round the head or an equivalent protective device.

4. When not in use, all ear protection devices shall be kept in closed containers protecting them against mechanical damage and contamination by oil, grease or other substances.

REGULATION 230. PROTECTIVE SUITS

1. Protective suits and hoods for workers exposed to corrosive or other harmful substances shall be—

- (a) liquid-proof or gas-proof, according to the nature of the substance or substances involved; and
- (b) of such construction and material as are accepted by the competent authority.

2. Asbestos suits for protection where sudden fire or explosion may occur during emergency operations shall consist of a complete garment with helmet, gloves and boots attached.

3. Protective suits and overalls for workers exposed to radioactive substances shall be—

- (a) of washable material;
- (b) so designed as to cover other clothing at the neck and wrists;
- (c) of adequate length; and
- (d) washed or renewed at least once a week.

REGULATION 231. APRONS

1. Aprons should not be worn near revolving or reciprocating machine parts.

2. If aprons have ordinarily to be worn near revolving or reciprocating machine parts, the skirt should be separate from the bib, and both should be very lightly secured to the body so that should either be caught in a moving part, it will be instantly and safely detached.

3. Aprons for workers employed near open flames, fires and incandescent objects, or handling molten metal shall be made of fire-resisting material and have bibs.

4. Aprons for workers handling corrosive liquids, such as acids and caustics, shall be made of natural rubber, synthetic rubber or other corrosion-resisting material and have bibs.

5. Aprons for workers exposed to radioactive substances shall be made of rubber or other waterproof material and have bibs.

6. (1) Lead aprons for X-ray protection shall cover the collar bones, the entire breast bone and the greater part of the chest in front, and below the chest be extended round the whole body to 30 to 40 cm (12 to 16 in.) below the waist line.

(2) The protection afforded by lead aprons shall be at least equal to that afforded by lead 1 mm (0.04 in.) thick.

REGULATION 232. SAFETY BELTS

1. Safety belts and harness shall be made of substantial chrome tanned leather, linen or cotton webbing, or other suitable material.

2. Safety belts shall be at least 12 cm (4½ in.) wide and 6 mm (¼ in.) thick and have an ultimate breaking strength of at least 1,150 kg (2,500 lb.).

3. Lifelines shall be of good quality manila rope or equivalent material and shall have an ultimate breaking strength of at least 1,150 kg (2,500 lb.).

4. All belts and their fittings shall be examined at frequent intervals and defective parts replaced.

5. Leather safety belts shall be examined at frequent intervals for cuts or scratches on the skin side of the hide.

6. Every rivet in a belt shall be examined separately to make sure that it is still holding properly.

7. All fittings and fastenings of a safety belt shall be capable of supporting a load at least equal to the ultimate breaking strength specified for the belt.

REGULATION 233. HAND AND ARM PROTECTION

1. When selecting gloves, consideration should be given to the hazards to which the wearer may be exposed and to the need for free movement of the fingers.

2. Gloves shall not be worn by workers operating drills, punch presses or other machines with which the hand may be caught in moving parts.

3. Gloves, mittens, hand leathers or pads for workers handling sharp-edged or abrasive objects shall be made of tough material and where necessary provided with special reinforcement.

4. Gloves for workers engaged in cutting or boning meat, fish, etc., shall be made of steel-mesh.

5. Gloves, mittens and sleeves for workers handling hot metals shall be made of asbestos or other suitable heat-resisting material.

6. Gloves and sleeves for electrical workers shall be made of rubber or other suitable materials and shall conform to standards of dielectric strength accepted by the competent authority.

7. Gauntlets for workers handling corrosive substances such as acids and caustics shall be made of natural rubber, synthetic rubber or pliable plastic films, and their resistance to corrosion shall conform to standards accepted by the competent authority.

8. (1) Gauntlets for protecting workers against the action of toxic, irritating or infectious substances shall—

- (i) cover as much of the forearm as possible;
- (ii) have a close fit at the upper end; and
- (iii) not have the slightest break.

(2) When gloves are torn during the work they shall be replaced immediately.

9. (1) Lead gloves for protection against X-ray shall afford unbroken protection on all sides and shall be provided with sleeves to cover at least half the forearm.

(2) The protection afforded by lead gloves shall be at least equal to that afforded by lead 0.55 mm (0.02 in.) thick.

(3) In view of the weight of such gloves, the lightest and most flexible types affording adequate protection should be used.

REGULATION 234. FOOT AND LEG PROTECTION

Leggings

1. Protective leggings shall be so designed that they can be removed instantly in case of emergency.

2. Suitable leggings should be worn by workers who are required to climb masts, poles and trees.

3. Leggings for workers handling molten metals shall be made of asbestos or other suitable heat-resisting material, extend to the knee and be so fitted as to prevent the entry of molten metal.

4. Leggings for workers who are exposed to light splashes or large sparks, or who handle rough or sharp objects shall be made of chrome leather or other sufficiently tough material.

5. Shin guards of sufficiently strong material shall be worn when workers use axes, adzes and similar tools.

Footwear

6. Metal toe guards or safety boots or shoes shall be worn in operations such as piling pig iron and logs, or where heavy materials are being handled.

7. Footwear for workers handling corrosive liquids, such as acids and caustics, should be made of rubber, specially treated leather, wood or other suitable corrosion-resisting material.

8. Footwear for workers handling molten metals or hot or corrosive liquids shall—

- (a) fit the feet and ankles closely, so that the material handled cannot penetrate between the ankle and the footwear; and
- (b) have no lace openings which will admit liquids or molten metals.

9. Safety boots shall have toe boxes made of steel or other metal conforming to standards of strength accepted by the competent authority.

10. Footwear for electrical workers should be free from metal fittings and have wooden pegged or sewn soles and heels.

11. Footwear for workers employed in operations where a spark might be hazardous shall not have any iron or steel nails or any other exposed ferrous material.

REGULATION 235. RESPIRATORY PROTECTION

General Provisions

1. All respiratory protective equipment shall be of a type suitable for the conditions in which it is to be used and accepted by the competent authority for use in such conditions.

2. In selecting respiratory equipment, the following considerations should be taken into account:

- (a) the process and conditions that create the exposure;
- (b) the chemical, physical, toxic or other hazardous properties of the substance from which protection is required;
- (c) the nature of the duties to be performed by the persons who wear the equipment and the encumbrance or restriction of movement in the working area; and
- (d) the facilities for maintenance, upkeep and supervision of use

3. Respiratory protective equipment shall be capable of fitting various types of facial contours without leaking.

Filter Respirators

4. Mechanical filter respirators shall not be used for protection against solvent vapours, injurious gases or in atmospheres deficient in oxygen.

5. Filters shall be changed when breathing resistance becomes uncomfortable.

Chemical Cartridge Respirators and Canister Masks

6. Cartridge respirators and canister masks shall not be worn in any confined space or in any other place that is poorly ventilated, or in atmospheres deficient in oxygen.

7. Cartridges and canisters shall be marked in conformity with an identification code accepted by the competent authority.

8. Cartridges and canisters shall be replaced after each use and, if not used, at intervals not exceeding one year or such other period as may have been specified by the manufacturer.

9. Canisters shall be replaced at the first detection of leakage.

10. Body harness for canister masks should be comfortable and shall allow free movement of the wearer.

Breathing Apparatus

11. Supplied-air respirators or hose masks—

- (a) should be used for work in dangerous atmospheres in all cases where the work is of such nature and carried out in such places that the fresh air supply can be safely maintained; and
- (b) shall be used for non-emergency operations in atmospheres in which the content of dangerous gas or fumes is too high for the safe use of canister or cartridge respirators.

12. The supply of air to a mask or a respirator shall not be at a pressure exceeding 1.75 kg/cm^2 (25 lb./sq. in.).

13. When compressed air is supplied for a mask or a respirator at a pressure higher than that prescribed in paragraph 12—

- (a) a pressure-reducing valve shall be installed near the point where the mask or respirator hose is attached to the compressed-air line; and
- (b) as a further precaution against high pressure, in case the reducing valve fails to function, a relief valve shall be installed, pre-set to release at a pressure slightly above the setting of the pressure-reducing valve.

14. (1) Compressed air should not be supplied directly to a mask or respirator without first being filtered by air-line filters to ensure that it is clean and dry.

(2) Compressed air for masks and respirators should preferably be supplied by blowers rather than by compressors.

15. The compressor air intake should be so situated and the compressors or blower so maintained as to ensure a supply of clean and pure air.

16. (1) The distance between the source of air and any supplied-air respirator shall not exceed 45 m (150 ft.).

(2) The distance between the source of air and any hose mask shall not exceed 7.5 m (25 ft.).

17. For hose masks, the inside diameter of the hose shall be not less than 2.5 cm (1 in.) and the hose shall be of the non-collapsible type.

18. All component parts of body harness shall withstand a pull of at least 115 kg (250 lb.).

Oxygen Breathing Apparatus

19. Oxygen breathing apparatus of a type approved by the competent authority shall be carried by—

- (a) workers engaged in fire fighting, rescue or repair work in atmospheres containing high concentrations of gases or deficient in oxygen;
- (b) workers whose respiratory organs must be protected and who are situated at more than 45 m (150 ft.) from the closest possible source of sufficiently pure air, provided, however, that in such case, the use of filter respirators is not permitted.

20. Oxygen breathing apparatus shall be worn only by specially trained persons.

21. The oxygen cylinders shall be charged at a pressure not exceeding 150 atmospheres and a visible pressure gauge should indicate continuously the amount of oxygen remaining in the cylinder.

22. In every breathing apparatus designed to give a uniform oxygen delivery, the reducing valve shall be so adjusted as to supply not less than 2 l (½ gal.) of oxygen per minute.

Inspection, Maintenance and Use

23. At intervals not exceeding one month, every breathing apparatus shall be—

- (a) carefully examined by a competent and authorised person, with respect to its general condition and with particular attention to any delicate and perishable parts; and
- (b) tested for leakage.

24. The pressure at which any automatic relief valve of an oxygen breathing apparatus discharges shall be measured at intervals not exceeding one month.

25. Flow-meters on oxygen breathing apparatus shall be tested for accuracy at least once in every six months.

26. Suitable provision shall be made to ensure that the oxygen supplied for use in oxygen breathing apparatus contains no harmful substances.

27. Every person who may have to use an oxygen breathing apparatus shall be trained—

- (a) in the proper method of putting the mask or facepiece on and rapidly adjusting it to the face; and
- (b) in the proper use of the apparatus under emergency conditions.

28. Workers shall immediately report to the competent supervisor any broken or otherwise defective breathing apparatus assigned to them.

29. Breathing apparatus shall be—

- (a) under the direct supervision of a competent and authorised person responsible for its proper maintenance; and
- (b) stored in a clean, cool and dry place that is conveniently situated and readily accessible.

30. Cartridge respirators and canister masks shall be cleaned and their facepieces sterilised after each use.

31. Facepieces and air lines or hoses should be washed with soap and water, rinsed in clean water and dried before being put away.

32. Breathing apparatus used by one person shall not be used by another before it has been washed with soap and lukewarm water and then sterilised.

CHAPTER XV

SELECTION OF WORKERS, MEDICAL SERVICE, MEDICAL AID

Section 1. Selection of Workers

REGULATION 236. GENERAL PRINCIPLES FOR THE SELECTION AND PLACEMENT OF WORKERS

1. For the selection of workers and their placement in industrial establishments the following general principles should be applied:

- (a) where the nature of the work or the conditions in which it has to be carried out do not involve any particular hazards for women in relation to their physiological limitations as it affects their biological function, no discrimination should be made between male and female workers;
- (b) as far as practicable, care should be taken to see that each worker is given the job for which he or she is best qualified from the point of view of aptitude, experience and physical strength; and
- (c) workers should be allocated to a given occupation in accordance with their previous experience on the job and only after appropriate explanation of the possible dangers of the work and training in the use of machinery equipment and tools.

2. Persons suffering from physical defects or infirmities, such as epilepsy, cramps, dizziness, deafness, defective vision and colour blindness, or from other weaknesses or infirmities, as well as feeble-minded persons, shall—

- (a) not be employed on any machine or on any work in which, owing to their defects or infirmities, they or their fellow workers might be particularly endangered; and
- (b) as far as possible and necessary, be placed under the direct supervision of a competent and reliable person.

REGULATION 237. RESTRICTIONS RESPECTING THE EMPLOYMENT OF CERTAIN CATEGORIES OF WORKERS

Children

1. Children under 15 years of age or of an age fixed by an international labour Convention shall not be employed at work in any public or private industrial establishment or in any branch thereof.

2. The provisions of paragraph 1 of this Regulation shall not apply to—

- (a) work done by children in technical schools, provided that such work is approved and supervised by public authority, is essentially of an educative character and is not intended for commercial profit; and
- (b) work done by children in special training shops or apprenticeship courses organised and directed in conformity with requirements laid down by the competent authority and subject to supervision by such authority.

Young Persons — Admission to Employment

3. No person under 18 years of age shall be employed in any industrial establishment unless he (she) possesses a permit issued by an appropriate authority, giving satisfactory proof that the holder has—

- (a) reached the minimum age prescribed for the occupation in which he (she) is to be engaged; and
- (b) been found physically fit for that occupation by a medical examination carried out in accordance with the provisions of Regulation 238 of this Code and with the provisions of the Convention (No. 77) concerning medical examination for fitness for employment in industry of children and young persons (1946).

4. The authority responsible for granting the permit referred to in paragraph 3 of this Regulation shall have power to lay down in the permit such special conditions as may be deemed necessary, taking into consideration—

- (a) the applicant's health as determined by the medical examination; and
- (b) the nature of the employment.

Young Persons — Prohibition of Employment

5. No young woman under 18 years of age shall be employed on foot actuated (pendulum) presses or other pedal-driven machinery if this would require an effort injurious to her health.

6. The employment of young persons of both sexes under 18 years shall be prohibited in the following occupations and processes except as permitted by the competent authority:

- (a) loading, unloading, transport and other operations and processes involving the carrying of heavy loads or objects;



[Paragraph 6: new subparagraph (b)].

- (b) cleaning or oiling any part of any machinery in motion if the young person would be exposed to risk of injury from any part of the machinery or any adjacent machinery;

Paragraphs (b) to (q) become paragraphs (c) to (r).

- (b) work as stokers or firemen on steam boilers, as steam engine attendants, and as load despatchers (switchboard operators) in electric power stations;
- (c) work on grinding machines, tool sharpening, etc., on high-speed abrasive wheels, and similar operations;
- (d) beet washing in sugar factories and work in filling, mixing, crystallising, drying and other rooms in such factories and in other factories in which a very high temperature and humidity is maintained;
- (e) work at blast furnaces, smelting furnaces and annealing ovens, work in foundries, metal smelting and refining plants, steel mills, rolling mills, forges and heavy metal press works;
- (f) in brick works—moulding of bricks by hand, work on brick presses and kilns, transport of coal and bricks, and all other work involving the handling of heavy loads;
- (g) work involving responsibility for the movement of locomotives or other rolling stock of plant railways;
- (h) operation of cranes, winches and other hoisting appliances, other than elevators used exclusively for the transport of persons and conforming to the requirements of Regulation 15 of this Code, and work as signallers to drivers of such appliances;
- (i) shifting of belts, oiling, greasing and other work on or near heavy or high-speed transmissions while in motion;
- (j) operation and maintenance of circular saws, frame saws and band saws, wood splitting machines, spindle moulders, veneer cutting machines and other similarly dangerous woodworking machines;
- (k) work on shearing, cutting, rolling and other particularly dangerous machines;
- (l) in glassworks and potteries—crushing and mixing of raw materials, work at furnaces, dry grinding and polishing of glassware, sandblasting operations, work in etching and glazing rooms;
- (m) work in shipbuilding involving rigging, erecting, or the handling of heavy materials or heavy punching, shearing or bending machines or heavy work in foundries;
- (n) gas or arc-welding and oxygen cutting in tanks or confined spaces, on scaffoldings or on pre-heated assemblies;
- (o) work as an operator of boot or shoe-polishing and smoothing machines;
- (p) all occupations and operations in which the workers are liable to come in contact with, or otherwise be exposed to, lead and lead compounds, such as: painting work of an industrial character involving the use of white lead, sulphate of lead or other products containing these pigments; manufacture of litharge, massicot, red lead, white lead, orange lead, or sulphate, chromate and silicate (frit) of lead; manufacture of solder or alloys containing more than 10 per cent. of lead; mixing and

pastings in the manufacture or maintenance of electric accumulators; work with lead or lead compounds in the pottery industry, or the rubber industry, as well as in any operations and processes in which the workers are exposed to dust or fumes containing lead; and

- (g) all occupations, operations and processes in which the workers are exposed to—
- (i) inorganic substances in fume, mist, dust or gaseous form which are, in general, considered injurious, such as lead, mercury, arsenic, antimony, thallium manganese and cadmium, or their compounds, chromic acid, cyanide mist from plating baths, dust containing free silica, fluoride dusts and fumes, or toxic gases, such as carbon monoxide, carbon disulphide, hydrocyanic acid, and hydrogen sulphide;
 - (ii) toxic organic compounds, such as benzene and other harmful aromatic hydrocarbons, nitro and amino (amido) compounds, halogenated hydrocarbons, and substances in general which may not be considered poisons in the general sense but which are active skin irritants;
 - (iii) radioactive substances and X-rays; and
 - (iv) other substances which by ingestion or inhalation or by direct or remote contact are capable of producing injury, which substances shall be specified by the competent authority.

7. Provided that workers under 18 but over 16 years of age may be employed at any of the occupations and processes referred to in paragraph 6 of this Regulation, for purposes of apprenticeship and training, subject to special regulations to be issued for such work by the competent authority and provided also that in the case of female apprentices and trainees the conditions of employment are in accordance with the requirements of paragraph 8 of this Regulation.

Women — Prohibition of Employment

8. The employment of women shall be prohibited in the following operations and processes:

- (a) loading, unloading and other operations and processes involving frequent lifting and carrying of heavy loads or objects, unless—
- (i) individual suitability is taken into account in placing workers on such jobs;
 - (ii) prior to assignment to such employment the workers have received instruction as to approved methods of lifting and carrying loads; and
 - (iii) maximum weights are fixed for loads to be lifted or carried, taking into account the character of the loads



[Paragraph 8: new subparagraph (b)].

- (b) cleaning or oiling any part of any machinery in motion if the woman would be exposed to risk of injury from any part of the machinery or any adjacent machinery;

Subparagraphs (b) to (d) become subparagraphs (c) to (e).

- (rigid or non-rigid), the height and distance which they are to be lifted or carried, the frequency of the lifting and carrying operations, and any special obstacles or hazards that may be present, such as uneven ground, stairs, ladders, or the like;
- (b) in operations and processes requiring great physical effort, or involving exposure to extremes of temperature, or in which great muscular force is required, e.g., working as stokers or firemen at steam boilers, or work at blast furnaces, smelting furnaces and annealing ovens;
 - (c) in operations and processes involving accident risks from moving belts and machinery, unless by wearing proper shoes, safe clothing and appropriate headgear (or closely cut hair) they are so protected that the risk is reduced to the same level as that for men; and
 - (d) in occupations, operations and processes involving exposure to toxic or other dangerous substances in which the risks are specially serious for women for physiological and biological reasons unless the risks are eliminated by means of special and adequate protective measures and periodical health examinations.

9. The competent authority shall draw up a list of the substances to be considered dangerous or toxic within the meaning of paragraph 8 (d) of this Regulation, and this list shall be revised from time to time in the light of technical development and medical experience.

Carrying and Lifting of Loads

10. (1) No person shall be employed to lift, carry or move any load so heavy as to be likely to cause injury to him.

(2) The competent authority should make regulations prescribing the maximum weights which may be lifted, carried or moved by persons employed in industrial establishments.

Section 2. Medical Service¹

REGULATION 238. MEDICAL EXAMINATIONS

General Provisions

1. (1) All workers, irrespective of age and sex, should undergo a medical examination—

- (a) before entering industrial employment for the first time (engagement or pre-employment examination);

¹ The aim of the provisions of this Section is to contribute towards the elaboration of means of ensuring the health and safety of workers in relation to their occupation. Adequate industrial health services shall be instituted by all countries, and the competent authority shall determine the medical services required by any region, industry or industrial establishment, and shall make regulations to secure and maintain the efficiency of these services.

The following sets out some of the points which were carefully considered by the Committee and accepted by the Tripartite Technical Conference.

- (b) periodically, at such intervals as may be considered necessary in view of the risks inherent in the work, and the conditions under which it is performed (periodical re-examination); and
- (c) at times of changes in circumstances, caused either by a change of employment or by a health defect affecting their previous ability.

(2) Provided that unless the competent authority decides otherwise, pre-employment and periodical medical examinations of workers aged 21 or over may be dispensed with in the case of industrial establishments where there are no special health risks for the workers.

2. All medical examinations, whether pre-employment or periodical, shall—

- (a) be complete and free to the workers; and
- (b) as far as is considered necessary, include laboratory tests and the necessary X-ray examinations.

3. The purposes of these medical examinations shall be—

- (a) to inform the workers of the maladies and deficiencies by which they may be affected and to indicate to them the institutions which would assist in the treatment of their condition;
- (b) to draw the attention of young persons to their physical and mental aptitudes in order to facilitate correct vocational guidance;
- (c) to help employers to ensure a wise and rational distribution of workers in the various occupations in industrial establishments, taking into account not only their technical qualifications but also their physical and mental aptitudes;
- (d) to avoid the entry into employment of persons who, by reason of their state of health, would constitute a permanent risk of infection or accident to their fellow workers in industrial establishments;
- (e) to prevent the total exclusion of any worker from employment and to provide for the employment of each worker, in spite of his deficiencies, in work which he is capable of performing, taking into account the employment opportunities in the establishment;
- (f) to look for the first symptoms of occupational diseases in workers who are exposed to them, *i.e.*, to arrest these illnesses when they are generally still easily curable, and consequently to increase the chance of curing the victims in the shortest time and before their aptitude for employment is lessened.

4. The results of these medical examinations shall be recorded on cards or in special registers by the medical services entrusted with carrying them out, and carefully kept by these services for easy reference.

5. Diagnoses made at these medical examinations shall be strictly confidential and shall be considered as the professional secret of the doctor and his assistants.

6. Employers, and if appropriate, unemployment services, shall be informed of the results of these medical examinations only in so far as they concern the suitability or unsuitability of the workers concerned for the occupation which they are seeking or occupying.

Pre-employment Medical Examinations

7. (1) Pre-employment medical examinations shall include a general clinical examination completed, if appropriate, by special investigations deemed indispensable owing to the particular nature of the employment sought.

(2) For all young persons of both sexes, under 21 years, these pre-employment medical examinations should also be completed by a chest X-ray examination.

8. The pre-employment medical examination shall take place before the worker is placed at work or at the latest within 15 days of his employment.

Periodical Medical Examinations

9. (1) Periodical medical examinations shall—

(a) be as complete and as thorough as the pre-employment examinations; and

(b) include a general clinical examination.

(2) In the case of workers exposed to occupational health hazards, the periodical medical examinations shall also include all special investigations deemed necessary for the diagnosis of these diseases.

(3) For young persons under 21 years the periodical medical examinations shall also include, at least once a year, a chest X-ray examination.

10. (1) The periodical medical examinations shall be as frequent as the nature of the worker's employment may warrant, taking into consideration the special hazards involved and their relative importance.

(2) If this is warranted by their state of health, workers shall be examined as often as is deemed necessary for their individual protection and the protection of public collective interests.

(3) The interval between two consecutive periodical examinations shall not be longer than one year.

11. In occupations that entail a risk to the health of the workers, either because of the toxic substances that they handle or because of the environment in which they remain during their work, only persons who are pronounced medically fit shall be employed.

12. (1) When occupational diseases have been detected in workers and continued employment might jeopardise their health, their employment shall be discontinued at least until complete or satisfactory recovery.

(2) If circumstances permit, such workers shall meanwhile be given some other occupation consistent with their state of health and not liable to impede or retard their recovery.

13. (1) In all cases where, for the diagnosis of occupational diseases, the establishment or industrial medical service does not possess the equipment required for the necessary examinations, the workers subject to medical supervision should be sent for examination to specialised medical centres.

(2) These centres should be organised on a local or regional basis according to the concentration of industries and, if necessary, should be itinerant.

Section 3. Medical Service Organisation and Medical Aid

REGULATION 239. MEDICAL SERVICE ORGANISATION

1. (1) An inter- or intra-plant medical service shall be organised within every industrial establishment or among industrial establishments grouped by nature, type or locality.

(2) The scope of these medical services shall be determined by the competent authority in accordance with the nature of the work and the risks inherent in it, the number of workers, and the distances from first-aid and hospital services.

2. Inter- or intra-plant medical services shall include—

- (a) one or more physicians, whose duties shall be to carry out medical examinations as prescribed in Regulation 238 of this Code and, if appropriate, to administer first-aid to injured or sick workers;
- (b) a sufficient number of medical assistants to the physicians, bound by professional secrecy; and
- (c) adequate administrative personnel.

3. Inter- or intra-plant medical services shall be provided with rooms—

- (a) sufficiently numerous and large and with space for an extension of the services;
- (b) provided with adequate natural and artificial lighting and adequate ventilation;
- (c) isolated from noise and vibration; and
- (d) placed sufficiently far from dangerous operational zones to permit medical activities in case of catastrophe.

4. Inter- or intra-plant medical services should be provided with all the necessary medical and X-ray equipment for adequate and rapid medical examination.

5. Inter-orintra-plant medical services shall collaborate closely with the technical services of industrial establishments to ensure as perfect a selection of workers as possible from the standpoint of physical, physiological and psychological suitability and also from that of the worker's skill.

REGULATION 240. MEDICAL AID — GENERAL PROVISIONS

1. In every industrial establishment, the necessary measures shall be taken to ensure that injured and sick workers are provided with suitable first-aid treatment as easily and as adequately as possible.

2. Every industrial establishment shall secure the use of public hospital facilities readily available to injured or sick persons in emergencies.

REGULATION 241. FIRST AID

1. Every industrial establishment shall be provided with a first-aid station fully equipped, placed under the administration of one or more physicians, or one or more registered nurses and kept in readiness for the administration of first-aid to injured or sick persons.

2. In the absence of such a first-aid station, industrial establishments shall have one or more first-aid boxes, the contents of which shall be determined by the competent authority according to the number of personnel and the nature of the hazards.

3. The contents of each first-aid box shall be inspected at least once in every month, and if necessary, replenished after each occasion of use.

4. Every first-aid box shall contain simple and easily understandable instructions to be followed in emergencies.

5. Each first-aid box shall be installed in a suitable, clean and readily accessible place which shall be provided with the necessary facilities for administering first aid.

6. In establishments in which the conditions of work involve a risk of suffocation, asphyxiation or electrocution, there shall be rescue equipment which shall include resuscitation apparatus, and also personnel trained in its operation and familiar with procedures of artificial respiration.

7. Industrial establishments which do not possess qualified medical personnel shall entrust the administration of first aid to the injured or sick to qualified first-aid personnel or to persons

having equivalent qualifications, and at least one such person shall be available on each shift.

REGULATION 242. FURTHER MEDICAL AID

1. Medical attention to be given after first aid to victims of occupational injuries or diseases, or other troubles or diseases arising while at work, as well as the furnishing of medical advice, shall be subject to the provisions of national legislation.

2. The nature and extent of medical and surgical treatment which in certain special circumstances should be given to workers shall be determined by the extent of the resources of the medical services in the industrial establishments, and their distance from the local hospital centres.

REGULATION 243. ABSENTEE REGISTER

1. Industrial establishments should record all causes of absence by means of a special register.

2. The competent authority should determine, with due regard to the nature of the establishment, the data to be recorded in the absentee register.

3. The data to be recorded should include the following:

- (a) name, age, sex of worker;
- (b) date of beginning of absence;
- (c) date of termination of absence;
- (d) manner of termination of absence (return to work, death, resignation, dismissal, permanent incapacity, other causes);
- (e) cause of absence (illness, non-industrial accident, occupational disease, industrial accident, other causes);
- (f) diagnosis; and
- (g) name of person making the diagnosis.

4. A summary of these data shall be communicated to the inter- or intra-plant medical services in so far as they concern personnel exposed to the risk of occupational disease.

CHAPTER XVI

SAFETY ORGANISATION

REGULATION 244. SAFETY ORGANISATION

General Provisions

1. In every industrial establishment the employer should, in addition to complying with all official regulations relating to industrial safety and hygiene, assume responsibility and leadership for safety and hygiene activities within the establishment, actively work with and promote the co-operation of his entire personnel with a view to achieving and maintaining the highest possible standards of safety and hygiene by taking into account, both during the carrying out of the positive technical requirements and as a supplement to them, such factors as are dependent upon the human nature of the worker.

Safety Rules

2. In every industrial establishment, safety rules should be drawn up for each occupation represented in the establishment.

3. Industrial safety rules should incorporate appropriate extracts of all official regulations relating to the occupation in question and should include all appropriate additional provisions.

4. Industrial safety rules should be drawn up or approved by the safety official in consultation with the workers, their delegates and the safety committee, if there is one.

5. Industrial safety rules should be communicated to the competent official inspector.

Discipline

6. In every industrial establishment, any persons who render distinguished service in the promotion of industrial safety and hygiene should be suitably recognised.

7. In every industrial establishment, any persons who violate any safety rules should be reprimanded and, if the offence is serious or repeated, suitably punished.

Suggestions

8. In every industrial establishment, the employer should invite all workers to submit suggestions for the improvement of industrial safety and hygiene.

9. The authors of such suggestions as are acceptable should be suitably recognised.

10. The authors of such suggestions as are not acceptable should be thanked and given the reasons for the non-acceptance of their suggestions.

11. All such suggestions should be examined by the safety committee, if there is one.

Workers' Safety Delegates

12. In every industrial establishment regularly employing less than 25 workers, the workers should be entitled to appoint at least one of their number to be a safety delegate.

13. Safety delegates shall be entitled to represent the workers in all matters bearing on safety in the establishment.

14. The names of the safety delegates shall be available to the competent official inspector.

15. Safety delegates shall—

- (a) keep themselves as fully informed as possible of conditions in the establishment as regards safety and hygiene;
- (b) endeavour to promote all improvements that they consider desirable in such conditions;
- (c) endeavour to secure the co-operation of all workers in the promotion of safety and hygiene;
- (d) report unsatisfactory conditions as regards safety and hygiene to the employer or his authorised representative and endeavour to have them remedied; and
- (e) report to the competent official inspector all unsatisfactory conditions as regards safety and hygiene that the employer fails to remedy within a reasonable time.

16. The employer shall—

- (a) encourage the appointment of safety delegates by the workers in the industrial establishment;
- (b) give safety delegates all reasonable encouragement and facilities in the performance of their duties;
- (c) consult safety delegates in all matters relating to safety and hygiene in the establishment;
- (d) take all practicable measures to remedy forthwith any unsatisfactory conditions as regards safety and hygiene reported to him by safety delegates; and
- (e) in cases in which he does not adopt requests or suggestions of safety delegates as regards matters of safety or hygiene, inform the delegates of the reasons thereof within a reasonable time.

Safety Committees

17. In every industrial establishment regularly employing 25 workers or more there should be a safety committee.

18. Every safety committee should consist of representatives of the employer and representatives of the workers, and should include—

- (a) a high executive official;
- (b) the safety official;
- (c) foremen; and
- (d) a representative of the industrial establishment medical service, if any.

19. The names of the members of the safety committee shall be available to the competent official inspector.

20. If an industrial establishment comprises a number of separate departments—

- (a) a safety committee should be appointed in each department in which at least 25 workers are regularly employed;
- (b) a central safety committee should be appointed for the establishment; and
- (c) the central safety committee should include members of the departmental safety committees elected by those committees.

21. The workers' representatives on safety committees should be elected by all the workers—

- (a) for one year or other suitable period; and
- (b) in such a manner that all suitably qualified workers are enabled to serve on the committee in turn.

22. Safety committees should—

- (a) meet at least once a month; and
- (b) keep adequate records of all meetings.

23. The duties of the safety committee should be to—

- (a) consider the circumstances and causes of all accidents occurring in the establishment;
- (b) make recommendations to the employer for preventing the recurrence of accidents;
- (c) make periodical inspections of the establishment and all its equipment in the interests of safety and hygiene;
- (d) make appropriate recommendations to the employer for the improvement of conditions as regards safety and hygiene, and watch over the carrying out of the measures adopted and their efficiency;
- (e) watch over compliance with official regulations, instructions, etc., relating to safety and hygiene in the establishment;
- (f) endeavour to secure the co-operation of all workers in the promotion of safety and hygiene;
- (g) participate in drawing up the establishment safety rules;

- (h) study the statistics of accidents occurring in the establishment;
- (i) see that all new workers receive adequate safety training, instruction and guidance;
- (j) see that all official regulations, instructions, notices and other written and pictorial material relating to safety and hygiene in the establishment are brought to the notice of all workers;
- (k) co-operate with the medical services of the industrial establishment, if any, and with its first-aid services; and
- (l) report to the competent official inspector all unsatisfactory conditions as regards safety and hygiene that the employer fails to remedy within a reasonable time.

24. The employer shall—

- (a) give the safety committee all reasonable encouragement and facilities in the performance of its duties;
- (b) consult the safety committee in all matters relating to safety and hygiene in the establishment;
- (c) take all practicable measures to give effect to recommendations of the safety committee; and
- (d) in cases in which he does not adopt recommendations of the safety committee, inform the committee of the reasons thereof within a reasonable time.

25. Establishments in one and the same industry and district that regularly employ less than 25 workers and do not have their own safety committees should combine for the joint promotion of safety and hygiene.

Safety Officials

26. In every industrial establishment with a small number of employees or where the accident hazard is low—

- (a) an official should be appointed to be in complete charge of all matters relating to industrial safety and hygiene; and
- (b) a joint arrangement should be made, if possible, with other industrial establishments in the same neighbourhood to share the services of an accident prevention officer.

27. In large industrial establishments and establishments with a high hazard the employer should appoint a full-time safety official whose duties shall be exclusively concerned with industrial safety and hygiene.

28. If an industrial establishment with a high accident hazard comprises a number of separate departments—

- (a) a full-time accident prevention officer should be appointed for each department in which at least 250 workers are regularly employed; and
- (b) a chief accident prevention officer should be appointed for the industrial establishment.

29. The competent authority shall organise periodical meetings to which safety officials and representatives of safety committees shall be invited in order that they may increase their knowledge of safety matters by an exchange of information obtained through practical experience.

Accident Reports

30. The safety official should compile a report containing full information on the cause of every lost-time accident, minor accident and dangerous occurrence with a view to preventing its recurrence, and copies should be sent to—

- (a) the manager;
- (b) the workers' delegates or the safety committee as the case may be; and
- (c) where appropriate, the medical service of the industrial establishment.

Accident Statistics

31. Every industrial establishment should keep records of all lost-time accidents, minor accidents and dangerous occurrences.

32. Every industrial establishment should compile accident statistics that will—

- (a) show the accident record of each department, occupation and individual; and
- (b) show the distribution of accidents by causes, so that means of prevention can be determined.

33. Accident records and statistics of industrial establishments should be constantly available to—

- (a) the official inspector;
- (b) the safety official;
- (c) the safety delegates; and
- (d) the safety committee, if any.

34. Accident statistics of industrial establishments should be compiled by methods approved by the competent authority as national standards and such as to ensure the maximum degree of comparability with all other establishments in the same industry and with establishments in other industries.

Industrial Establishment Medical Service

35. If an industrial establishment has a medical service, the service should co-operate in the promotion of industrial safety and hygiene in the establishment, for example, by—

- (a) keeping adequate accident and health records of all workers in the establishment;

- (b) making recommendations to the management as to vocational selection with due regard to the physical and mental suitability and accident proneness of the workers; and
- (c) making all appropriate recommendations to the management as to measures for the improvement of industrial safety and hygiene in the establishment.

Personnel Services in Industrial Establishments

36. If an industrial establishment has an industrial relations department, a personnel, social, or other similar service, such department or service should co-operate in the promotion of industrial safety and hygiene in the establishment, for example, by—

- (a) endeavouring to eliminate sources of friction between members of the personnel;
 - (b) affording adequate means for the ventilation of personnel grievances;
 - (c) affording facilities for the sympathetic consideration of personal troubles; and
 - (d) seeing that special care is taken of workers known to be suffering from emotional disturbances such as grief or anxiety.
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APPENDICES

APPENDIX I

MINIMUM SPINDLE DIAMETERS AND RECOMMENDED SPEEDS FOR ABRASIVE WHEELS

TABLE 1. — MINIMUM DIAMETERS OF SPINDLES FOR OVERHUNG WHEELS OF VARIOUS DIAMETERS AND THICKNESSES OPERATING AT PERIPHERAL SPEEDS UP TO 35 M/SEC.

Diameter of wheel	Thickness of wheel (mm)																			
	6.4	9.5	12.7	15.8	19.0	25.4	31.7	38.1	44.5	50.8	57.2	63.5	70.0	76.2	82.6	88.9	102	114	127	
mm	Diameter of spindle (mm)																			
50	3.2	4.8	4.8	6.4	6.4	9.5	9.5	12.7	12.7	15.8	15.8	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
75	6.4	6.4	9.5	9.5	9.5	12.7	12.7	12.7	12.7	15.8	15.8	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
100	7.9	9.5	9.5	9.5	9.5	12.7	12.7	12.7	12.7	15.8	15.8	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
125	9.5	9.5	12.7	12.7	12.7	12.7	12.7	12.7	12.7	15.8	15.8	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
150	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	15.8	15.8	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
175	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	15.8	15.8	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
200	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
230	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
255	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
305	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
355	22.2	22.2	22.2	22.2	22.2	22.2	22.2	22.2	22.2	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4
405	...	...	...	...	...	...	...	...	...	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4
460	...	...	...	...	...	...	...	...	...	31.7	31.7	31.7	31.7	31.7	31.7	31.7	31.7	31.7	31.7	31.7
510	...	...	...	...	...	...	...	...	...	31.7	31.7	31.7	31.7	31.7	31.7	31.7	31.7	31.7	31.7	31.7
610	...	...	...	...	...	...	...	...	...	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1
660	...	...	...	...	...	...	...	...	...	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1
760	...	...	...	...	...	...	...	...	...	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1	38.1
915	...	...	...	...	...	...	...	...	...	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5

Nors.: For speeds exceeding 35 m/sec. and for wheels with heavy mountings, the spindle sizes shown in the above table are usually not adequate. Inasmuch as the proper spindle size is dependent upon many factors, such as general design of the machine, type of bearings, quality of materials and workmanship, a simple table is not practicable. Wheels larger than specified by the machine manufacturer should not be used on any given machine.

TABLE 2. MINIMUM DIAMETERS OF SPINDLES FOR OVERHUNG WHEELS OF VARIOUS DIAMETERS AND THICKNESSES OPERATING AT SPEEDS UP TO 7,000 PERIPHERAL FEET PER MINUTE

Diameter of wheel	Thickness of wheel (inches)																			
	¼	⅜	½	⅝	¾	1	1¼	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	4	4½	5	
Inches	Diameter of spindle (inches)																			
	2	⅛	3/16	3/16	¼	¼	⅜	...	...	...	...	...	...	...	...	...	...	...	...	...
3	¼	¼	⅜	⅜	⅜	½	...	...	...	...	...	...	...	...	...	...	...	...	...	...
4	5/16	⅜	⅜	⅜	⅜	½	...	...	...	...	...	...	...	...	...	...	...	...	...	...
5	⅜	⅜	½	½	½	½	...	...	...	...	...	...	...	...	...	...	...	...	...	...
6	½	½	½	½	½	½	⅝	⅝	¾	¾	¾	¾	¾	¾	¾	¾	1	1	1	1
7	½	½	½	½	⅝	⅝	⅝	¾	¾	¾	¾	¾	¾	¾	¾	¾	1	1	1	1
8	⅝	⅝	⅝	⅝	⅝	⅝	¾	¾	¾	1	1	1	1	1	1	1	1	1¼	1¼	1¼
9	⅝	⅝	⅝	⅝	¾	¾	¾	¾	1	1	1	1	1	1	1¼	1¼	1¼	1¼	1¼	1¼
10	¾	¾	¾	¾	¾	¾	¾	¾	1	1	1	1	1¼	1¼	1¼	1¼	1¼	1¼	1¼	1¼
12	¾	¾	¾	¾	¾	1	1	1	1	1	1	1	1¼	1¼	1¼	1¼	1¼	1½	1½	1½
14	⅞	⅞	⅞	⅞	1	1	1¼	1¼	1¼	1¼	1¼	1¼	1¼	1¼	1½	1½	1½	1½	1½	1½
16	..	..	..	..	1¼	1¼	1¼	1¼	1¼	1¼	1½	1½	1½	1½	1½	1½	1¾	1¾	1¾	1¾
18	..	..	..	..	1¼	1¼	1¼	1½	1½	1½	1½	1½	1½	1½	1¾	1¾	1¾	1¾	1¾	1¾
20	..	..	..	..	..	1½	1½	1½	1½	1½	1½	1½	1¾	1¾	1¾	1¾	1⅞	1⅞	1⅞	1⅞
24	..	..	..	..	..	1½	1½	1½	1¾	1¾	1¾	1¾	1¾	1¾	2	2	2	2	2	2
26	..	..	..	..	..	..	1½	1½	1¾	1¾	1¾	1¾	2	2	2	2	2¼	2¼	2¼	2¼
30	..	..	..	..	..	..	..	1¾	1¾	2	2	2	2	2	2	2¼	2¼	2½	2½	2½
36	..	..	..	..	..	..	..	..	2	2¼	2¼	2¼	2½	2½	2½	2¾	2¾	3	3	3

NOTE: For speeds exceeding 7,000 peripheral feet per minute and for wheels with heavy mountings, the spindle sizes shown in the above table are usually not adequate. Inasmuch as the proper spindle size is dependent upon many factors, such as general design of the machine, type of bearings, quality of materials and workmanship, a simple table is not practicable. Wheels larger than specified by the machine manufacturer should not be used on any given machine.

APPENDIX I

TABLE 3. RECOMMENDED OPERATING SPEEDS FOR ABRASIVE WHEELS

Classification No.	Types of wheels	Vitrified and silicate bonds						Organic bonds					
		Low strength		Medium strength		High strength		Low strength		Medium strength		High strength	
		ft./min.	m/sec.	ft./min.	m/sec.	ft./min.	m/sec.	ft./min.	m/sec.	ft./min.	m/sec.	ft./min.	m/sec.
1	Type 1: Straight wheels (including plate mounted and inserted nut wheels) Type 4: Taper wheels Type 12: Dish wheels Type 13: Saucer wheels	5,500	28	6,000	30	6,500	33	6,500	33	8,000	40	9,500	48
2	Types 5 and 7: Recessed wheels	5,500	28	6,000	30	6,500	33	6,500	33	8,000	40	9,500	48
3	Type 2: Cylinder wheels (including plate mounted and inserted nut wheels)	4,500	23	5,500	28	6,000	30	6,000	30	8,000	40	9,500	48
4	Dovetail wheels Type 11: Flaring cups	4,500	23	5,500	28	6,000	30	6,000	30	8,000	40	9,500	48
5	Type 6: Deep recessed cup wheels	4,500	23	5,000	25	5,500	28	6,000	30	7,500	38	9,000	45
6	Cutting wheels larger than 16" (40 cm) diameter	—	—	—	—	—	—	—	—	—	—	7,500 to 14,000	38 to 70
7	Cutting wheels 16" (40 cm) in diameter and smaller	—	—	—	—	—	—	—	—	—	—	10,000 to 16,000	50 to 80
8	Thread grinding wheels	5,500 to 8,000	28 to 40	6,000 to 10,000	30 to 50	6,500 to 12,000	33 to 60	—	—	—	—	9,500 to 12,000	48 to 60
9	Automotive and aircraft crank grinding	5,500	28	6,000 to 7,300	30 to 37	6,500 to 8,500	33 to 43	—	—	—	—	—	—
10	Automotive and aircraft cam grinding	5,500	28	6,000 to 8,000	30 to 40	6,500 to 8,500	33 to 43	—	—	—	—	—	—
11	Diamond wheels { Cutting wheels: (a) Metal bonded with steel centre (b) Metal bonded with metallic compound centre (c) Resin bonded with resin or metallic compound centre All other types							ft./min.			m/sec.		
								14,000			70		
								7,500			38		
								7,500			38		
								6,500			33		

Notes: When wheels of unusual and extreme shapes such as deep cups with thin walls or backs, long drums or with large centre holes are required, consult wheel manufacturer for speeds recommended.

Maximum speeds indicated are based on the strength of the wheels and not on their cutting efficiency. Best speeds may sometimes be considerably lower.

TABLE 4. RECOMMENDED TESTING SPEEDS FOR ABRASIVE WHEELS

Class of wheel	Peripheral operating speed		Minimum test factor
	ft./min.	m/sec.	
Cutting wheels	Up to 16,000	80	1.2
Resinoid rubber and shellac (except cutting wheels)	Up to 5,000	25	1.25
	Faster than 5,000	25	1.5
Vitrified and silicate wheels (wet grinding)	Up to 5,000	25	1.25
	Faster than 5,000	25	1.5
Vitrified wheels (dry grinding)	Up to 5,000	25	1.25
	{ Faster than 5,000 Up to 6,500 }	25	1.5
		33	
	Faster than 6,500	33	1.75

Actual operating speed shall be multiplied by this test factor to establish minimum speed at which wheels shall be tested by the wheel manufacturer.

All wheels shall be tested by the wheel manufacturer in accordance with table 4.

Exceptions :

The following wheels need not be tested unless the peripheral operating speed exceeds 6,500 ft./min. (33 m/sec.) for vitrified and 9,500 ft./min. (48 m/sec.) for organic wheels:

- (a) Wheels less than 8 inches (20 cm) in diameter where product of square of diameter in inches (in centimetres) and thickness is less than 80 (1,300).
- (b) Wheels less than 6 inches (15 cm) in diameter.
- (c) Diamond wheels.

Note: Where wheels are to be operated at the higher speeds and it is found impractical for mechanical reasons to speed test them at the prescribed overspeed the wheel manufacturer shall establish the operating speed by calculations from available data.

APPENDIX II

PROTECTION OF PRESSES

PRESSES WITHOUT STRIPPERS

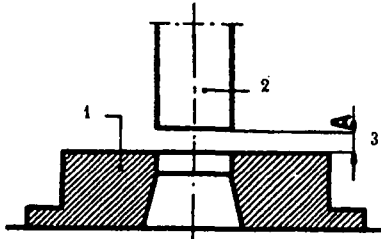


FIG. 1

1. Lower die. — 2. Cutting or bending tool. — 3. If A does not exceed 8 mm no guard need be fitted.

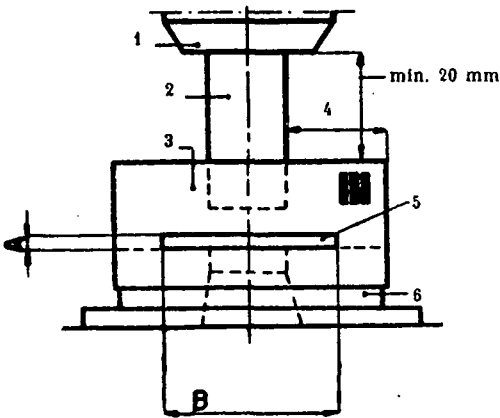


FIG. 2

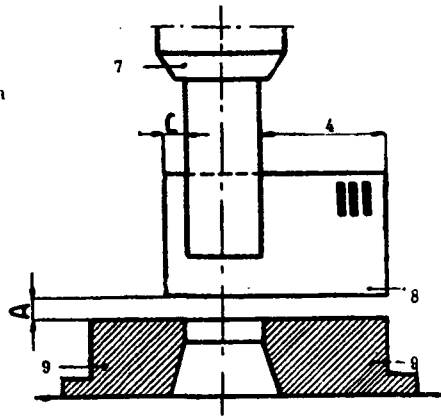


FIG. 3

1. To avoid jamming this edge should be bevelled. — 2. Cutting tool. — 3. Guard. — 4. If this distance is less than 10 mm a top cover is not necessary. — 5. Slot in guard. — 6. Lower die. — 7. Cutting or bending tool. — 8. Guard. — 9. Lower die.

Steel-plate guard: For a given value of A, B and C must be obtained from the graph (fig. 8).

PRESSES WITH STRIPPERS

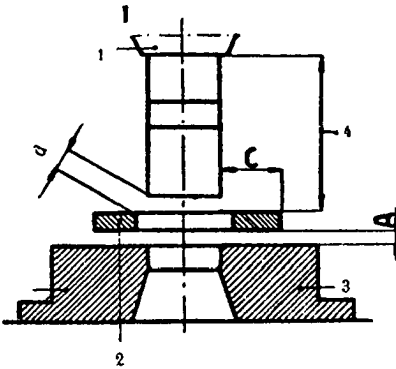


FIG. 4

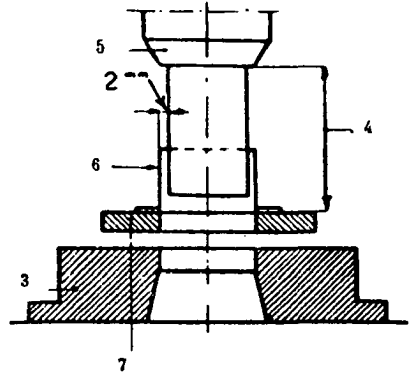


FIG. 5

1. Cutting tool. — 2. Fixed stripper. — 3. Lower die. — 4. Min. 20 mm at the lowest position of the cutting tool. — 5. Cutting or bending tool. — 6. Guard. — 7. Fixed stripper.

If the distance d does not exceed 5 mm no guard need be fitted. — If the distance d (see Fig. 4) exceeds 5 mm, the cutting tool must be provided with a guard at a distance not exceeding 2 mm.

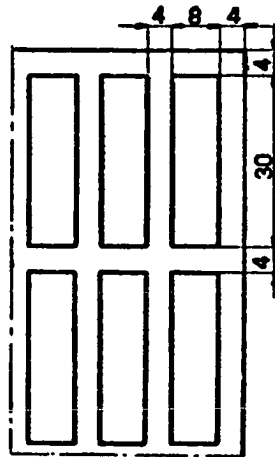
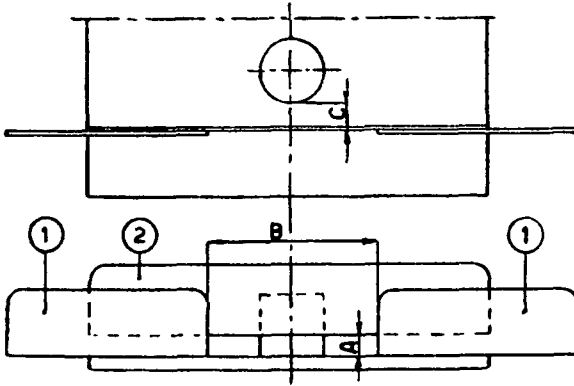


FIG. 6

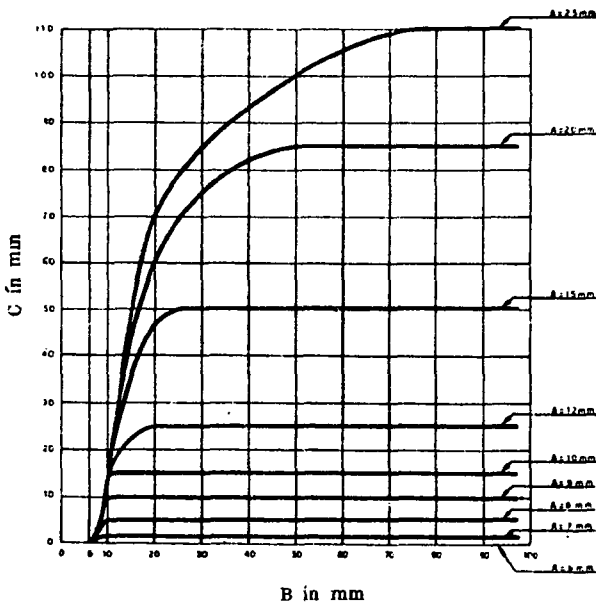
Example of perforation. For steel-plate guards of presses, minimum thickness of plate 1.5 mm.

MODEL AND GRAPH USED FOR DETERMINING THE DISTANCE C FOR GIVEN VALUES OF A AND B



Guards ① are adjustable horizontally. Guard ② is adjustable vertically.

FIG. 7



The distances A and B are determined by the form and size of the work. The distance C can be determined by reference to the graph.

FIG. 8

MAXIMUM ALLOWABLE CONCENTRATIONS OF HARMFUL SUBSTANCES

The table of maximum allowable concentrations of dangerous substances, which is revised annually by the American Conference of Governmental Industrial Hygienists, has been altered in a number of important respects since it was first used in 1948 as the basis of Appendix III of the Model Code. The amended table for 1956 is therefore published for the information of users of the Model Code.

It is important to remember that as sufficient scientific information on the toxicity of a certain number of these substances is not available, as sufficiently sensitive and accurate analytical methods have not yet been developed for the determination of certain of the concentrations listed, and as variations in sampling and analytical methods may considerably influence the results, the figures contained in the table should be used only as a basis for improving hygienic conditions; they should not be considered as concentrations safe for workers.

MAXIMUM ALLOWABLE CONCENTRATIONS OF HARMFUL SUBSTANCES

1. Gases and Vapours

Substance	Parts per million parts of air, by volume	Approximate milligrams of dust, fume or mist per cubic metre of air
Acetaldehyde — CH_3CHO	200	360
Acetic acid — CH_3COOH	10	25
Acetic anhydride — $(\text{CH}_3\text{CO})_2\text{O}$	5	20
Acetone — CH_3COCH_3	1,000	2,400
Acrolein — $\text{CH}_2:\text{CHCHO}$	0.5	1.2
Acrylonitrile — $\text{CH}_2:\text{CHCN}$	20	45
Allyl alcohol — $\text{CH}_2:\text{CHCH}_2\text{OH}$	5	12
Allyl propyl disulfide — $(\text{C}_3\text{H}_7\text{CH}_2:\text{CHCH}_2)_2\text{S}_2$	2	12
Ammonia — NH_3	100	70
Amyl acetate — $\text{CH}_3\text{COOC}_5\text{H}_{11}$	200	1,050
Amyl alcohol (isoamyl alcohol) — $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_2\text{OH}$	100	360
Aniline — $\text{C}_6\text{H}_5\text{NH}_2$	5	19
Arsine — AsH_3	0.05	0.2
Benzene (benzol) — C_6H_6	35	110
Benzyl chloride — $\text{C}_6\text{H}_5\text{CH}_2\text{Cl}$	1	5
Bromine — Br_2	1	7
Butadiene (1,3-butadiene) — $\text{CH}_2:\text{CHCH}:\text{CH}_2$	1,000	2,200
Butanone (methyl ethyl ketone) — $\text{CH}_3\text{COC}_2\text{H}_5$	250	740
Butyl acetate (n-butyl acetate) — $\text{CH}_3\text{COOC}_4\text{H}_9$	200	950
Butyl alcohol (n-butanol) — $\text{CH}_3(\text{CH}_2)_3\text{CH}_2\text{OH}$	100	300
Butylamine — $\text{CH}_3(\text{CH}_2)_3\text{CH}_2\text{NH}_2$	5	15
Butyl cellosolve (2-butoxyethanol) — $\text{C}_4\text{H}_9\text{OCH}_2\text{CH}_2\text{OH}$	200	970
Carbon dioxide — CO_2	5,000	9,000
Carbon disulfide — CS_2	20	60
Carbon monoxide — CO	100	110
Carbon tetrachloride — CCl_4	25	160
Cellosolve (2-ethoxyethanol) — $\text{C}_2\text{H}_5\text{OCH}_2\text{CH}_2\text{OH}$	200	740

Substance	Parts per million parts of air, by volume	Approximate milligrams of dust, fume or mist per cubic metre of air
Cellosolve acetate (2-ethoxyethyl acetate) — $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{OC}_2\text{H}_5$	100	540
Chlorine — Cl_2	1	3
Chlorine trifluoride — ClF_3	0.1	0.4
Chlorobenzene (monochlorobenzene) ($\text{C}_6\text{H}_5\text{Cl}$)	75	350
Chloroform (trichloromethane) — CHCl_3	100	490
1-Chloro-1-nitropropane — $\text{CH}_3\text{CH}_2\text{CH}(\text{NO}_2)\text{Cl}$	20	100
Chloroprene (2-chloro-1,3-butadiene) — $\text{CH}_2=\text{CHCl}:\text{CH}_2$	25	90
Cresol (all isomers) — $\text{CH}_3\text{C}_6\text{H}_4\text{OH}$	5	22
Cyclohexane — C_6H_{12}	400	1,400
Cyclohexanol — $\text{C}_6\text{H}_{11}\text{OH}$	100	410
Cyclohexanone — $\text{CO}(\text{CH}_2)_4\text{CH}_2$	100	400
Cyclohexane — $\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}:\text{CH}$	400	1,350
Cyclopropane — $\text{CH}_2\text{CH}_2\text{CH}_2$	400	690
Diacetone alcohol (4-hydroxy-4-methyl-2-penta- none) — $\text{CH}_3\text{COCH}_2\text{C}(\text{OH})(\text{CH}_3)_2$	50	240
Diborane — B_2H_6	0.1	0.1
o-Dichlorobenzene — $\text{C}_6\text{H}_4\text{Cl}_2$	50	300
Dichlorodifluoromethane — CCl_2F_2	1,000	4,950
1,1-Dichloroethane — CH_3CHCl_2	100	400
1,2-Dichloroethylene — $\text{CHCl}:\text{CHCl}$	200	790
Dichloroethyl ether — $\text{ClCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{Cl}$	15	90
Dichloromonofluoromethane — CHCl_2F	1,000	4,200
1,1-Dichloro-1-nitroethane — $\text{CH}_3\text{C}(\text{NO}_2)\text{Cl}_2$	10	60
Dichlorotetrafluoroethane — CCl_2FCF_3	1,000	7,000
Diethylamine — $(\text{C}_2\text{H}_5)_2\text{NH}$	25	75
Difluorodibromomethane — CF_2Br_2	100	860
Diisobutyl ketone — $\{(\text{CH}_3)_2\text{CHCH}_2\}_2\text{CO}$	50	290
(4-Heptanone 2,6-dimethyl)		
Dimethylaniline (N-dimethylaniline) — $\text{C}_6\text{H}_5\text{N}(\text{CH}_3)_2$	5	25
Dimethylsulfate — $(\text{CH}_3)_2\text{SO}_4$	1	5
Dioxane (diethylene dioxide) — $\text{OCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2$	100	360
Ethyl acetate — $\text{CH}_3\text{COOC}_2\text{H}_5$	400	1,400
Ethyl alcohol (ethanol) — $\text{C}_2\text{H}_5\text{OH}$	1,000	1,900
Ethylamine — $\text{C}_2\text{H}_5\text{NH}_2$	25	45
Ethylbenzene — $\text{C}_2\text{H}_5\text{C}_6\text{H}_5$	200	870
Ethyl bromide — $\text{CH}_3\text{CH}_2\text{Br}$	200	890
Ethyl chloride — $\text{CH}_3\text{CH}_2\text{Cl}$	1,000	2,600
Ethyl ether — $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$	400	1,200
Ethyl formate — HCOOC_2H_5	100	300
Ethyl silicate — $(\text{C}_2\text{H}_5)_4\text{SiO}_4$	100	850
Ethylene chlorohydrin — $\text{CH}_2\text{ClCH}_2\text{OH}$	5	16
Ethylenediamine — $\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$	10	30
Ethylene dibromide (1,2-dibromoethane) — $\text{CH}_2\text{BrCH}_2\text{Br}$	25	190
Ethylene dichloride (1,2-dichloroethane) $(\text{CH}_2\text{ClCH}_2\text{Cl}$	100	400
Ethylene imine — NHCH_2CH_2	5	9
Ethylene oxide — $(\text{CH}_2)_2\text{O}$	100	180
Fluorine — F_2	0.1	0.2
Fluorotrichloromethane — CFCl_3	1,000	5,600
Formaldehyde — HCHO	5	6
Gasoline	500	2,000

Substance	Parts per million parts of air, by volume	Approximate milligrams of dust, fume or mist per cubic metre of air
Heptane (n-heptane) — $\text{CH}_3(\text{CH}_2)_5\text{CH}_3$	500	2,000
Hexane (n-hexane) — $\text{CH}_3(\text{CH}_2)_4\text{CH}_3$	500	1,800
Hexanone (methyl butyl ketone) — $\text{CH}_3\text{CO}(\text{CH}_2)_3\text{CH}_3$	100	410
Hexone (methyl isobutyl ketone) — $\text{CH}_3\text{COCH}_2\text{CH}(\text{CH}_3)_2$	100	410
Hydrazine — NH_2NH_2	1	1.3
Hydrogen bromide — HBr	5	17
Hydrogen chloride — HCl	5	7
Hydrogen cyanide — HCN	10	11
Hydrogen fluoride — HF	3	2
Hydrogen peroxide, 90% — H_2O_2	1	1.4
Hydrogen selenide — H_2Se	0.05	0.2
Hydrogen sulfide — H_2S	20	30
Iodine — I_2	0.1	1
Isophorone — $\text{COCH}:\text{C}(\text{CH}_3)\text{CH}_2\text{C}(\text{CH}_3)_2\text{CH}_3$	25	140
Isopropylamine — $(\text{CH}_3)_2\text{CHNH}_2$	5	12
Mesityl oxide — $(\text{CH}_3)_2\text{C}:\text{CHCOCH}_3$	50	200
Methyl acetate — $\text{CH}_3\text{COOCH}_3$	200	610
Methyl acetylene — $\text{CH}_3\text{C}:\text{CH}$	1,000	1,650
Methyl alcohol (methanol) — CH_3OH	200	260
Methyl bromide — CH_3Br	20	80
Methyl cellosolve (2-methoxyethanol) — $\text{CH}_3\text{OCH}_2\text{CH}_2\text{OH}$	25	80
Methylcellosolve acetate (ethylene glycol mono- methyl ether acetate) — $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{OCH}_3$	25	120
Methyl chloride — CH_3Cl	100	210
Methylal (dimethoxymethane) — $\text{CH}_2(\text{OCH}_3)_2$	1,000	3,100
Methyl chloroform (1,1,1-trichloroethane) — CH_3CCl_3	500	2,700
Methylcyclohexane — $\text{CH}_3\text{CHC}_6\text{H}_{10}$	500	2,000
Methylcyclohexanol — $\text{CH}_3\text{C}_6\text{H}_{10}\text{OH}$	100	470
Methylcyclohexanone — $\text{COCH}(\text{CH}_3)\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2$	100	460
Methyl formate — HCOOCH_3	100	250
Methyl isobutyl carbinol (methyl amyl alcohol) — $(\text{CH}_3)_2\text{CHCH}_2\text{CHOHCH}_3$	25	100
Methylene chloride (dichloromethane) — CH_2Cl_2	500	1,750
Naphtha (coal tar)	200	800
Naphtha (petroleum)	500	2,000
Nickel carbonyl — $\text{Ni}(\text{CO})_4$	0.001	0.007
p-Nitroaniline — $\text{NO}_2\text{C}_6\text{H}_4\text{NH}_2$	1	6
Nitrobenzene — $\text{C}_6\text{H}_5\text{NO}_2$	1	5
Nitroethane — $\text{CH}_3\text{CH}_2\text{NO}_2$	100	310
Nitrogen dioxide — NO_2	5	9
Nitroglycerin — $\text{C}_3\text{H}_5(\text{ONO}_2)_3$	0.5	5
Nitromethane — CH_3NO_2	100	250
2-Nitropropane — $(\text{CH}_3)_2\text{CHNO}_2$	50	180
Nitrotoluene ($\text{NO}_2\text{C}_6\text{H}_4\text{CH}_3$	5	30
Octane — $\text{CH}_3(\text{CH}_2)_6\text{CH}_3$	500	2,350
Ozone — O_3	0.1	0.2
Pentane — $\text{CH}_3(\text{CH}_2)_3\text{CH}_3$	1,000	2,950
Pentanone (methyl propyl ketone) — $\text{CH}_3\text{CO}(\text{CH}_2)_2\text{CH}_3$	200	700
Perchlorethylene (tetrachloro-ethylene) — $\text{CCl}_2:\text{CCl}_2$	200	1,350

Substance	Parts per million parts of air, by volume	Approximate milligrams of dust, fume or mist per cubic metre of air
Phenol — C_6H_5OH	5	19
Phenylhydrazine — $C_6H_5NHNH_2$	5	22
Phosgene (carbonyl chloride) — $COCl_2$	1	4
Phosphine — PH_3	0.05	0.07
Phosphorus trichloride — PCl_3	0.5	3
Propyl acetate — $CH_3COOC_3H_7$	200	840
Propyl alcohol (isopropyl alcohol) — $CH_3CHOHCH_3$	400	980
Propyl ether (isopropyl ether) — $(CH_3)_2CHOCH(CH_3)_2$	500	2,100
Propylene dichloride (1,2-dichloropropane) — $CH_2ClCHClCH_3$	75	350
Propylene imine — $NHCH_2CH_2CH_2$	25	60
Pyridine — $N:CHCH:CHCH:CH$	10	30
Quinone — $O:C_6H_4:O$	0.1	0.4
Stibine — SbH_3	0.1	0.5
Stoddard solvent	500	2,900
Styrene monomer (phenylethylene) — $C_6H_5CH:CH_2$	200	850
Sulphur dioxide — SO_2	10	25
Sulphur hexafluoride — SF_6	1,000	6,000
Sulphur monochloride S_2Cl_2	1	6
Sulphur pentafluoride — SF_5	0.025	0.25
p-Tertiarybutyltoluene — $(CH_3)_3CCH_2C_6H_4$	10	60
1,1,2,2-Tetrachloroethane — $CHCl_2CHCl_2$	5	35
Tetranitromethane — $C(NO_2)_4$	1	8
Toluene (toluol) — $C_6H_5CH_3$	200	750
o-Toluidine — $CH_3C_6H_4NH_2$	5	22
Trichloroethylene — $CHCl:CCl_2$	200	1,050
Trifluoromonobromomethane — CF_3Br	1,000	6,100
Turpentine	100	560
Vinyl chloride (chloroethylene) — $CH_2:CHCl$	500	1,300
Xylene (xylol) — $C_6H_4(CH_3)_2$	200	870

2. Toxic Dusts, Fumes and Mists

Aldrin (1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-dimethanonaphthalene)	0.25
Ammate (ammonium sufamate) — $NH_4OSO_2NH_2$	15
Antimony	0.5
Arsenic	0.5
Barium (soluble compounds)	0.5
Cadmium oxide fume	0.1
Chlordane (1,2,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene)	2
Chlorinated diphenyl oxide	0.5
Chlorodiphenyl (42% chlorine)	1
Chromic acid and chromates (as CrO_3)	0.1
Crag herbicide (sodium 2-[2,4-dichlorophenoxy] ethanol hydrogen sulfate)	15
Cyanide (as CN)	5
2,4-D(2,4-dichlorophenoxyacetic acid)	10
Dieldrin (1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-dimethanonaphthalene)	0.25
Dinitrotoluene $(NO_2)_2C_6H_3CH_3$	1.5
Dinitro-o-cresol $(NO_2)_2C_6H_2(CH_3)OH$	0.2
EPN (O-ethyl O-p-nitrophenyl thionobenzenephosphonate)	0.5

Substance	Approximate milligrams of dust, fume or mist per cubic metre of air
Ferrovandium dust	1
Fluoride	2.5
Hydroquinone — $C_6H_4(OH)_2$	2
Iron oxide fume	15
Lead	0.15
Lindane (hexachlorocyclohexane, gamma isomer)	0.5
Magnesium oxide fume	15
Malathion (0,0-dimethyl dithiophosphate of diethyl mercaptosuccinate)	15
Manganese	6
Mercury (organic compounds)	0.01
Mercury	0.1
Methoxychlor (2,2-di-p-methoxyphenyl-1,1,1-trichloroethane)	15
Molybdenum	
(soluble compounds)	5
(insoluble compounds)	15
Parathion (0,0-diethyl 0-p-nitrophenyl thiophosphate)	0.1
Pentachloronaphthalene — $C_{10}H_3Cl_5$	0.5
Pentachlorophenol — Cl_5C_6OH	0.5
Phosphorus (yellow)	0.1
Phosphorus pentachloride — PCl_5	1
Phosphorus pentasulfide — P_2S_5	1
Picric acid — $(NO_2)_3C_6H_2OH$	0.1
Selenium compounds (as Se)	0.1
Sodium hydroxide	2
Sulphuric acid	1
TEDP (tetraethyl dithionopyrophosphate)	0.2
TEPP (tetraethyl pyrophosphate)	0.05
Tellurium	0.1
Tetryl (2,4,6-trinitrophenylmethylnitramine)	1.5
Titanium dioxide — TiO_2	15
Trichloronaphthalene — $C_{10}H_5Cl_3$	5
Trinitrotoluene — $(NO_2)_3C_6H_2CH_3$	1.5
Uranium	
(soluble compounds)	0.05
(insoluble compounds)	0.25
Vanadium	
(V_2O_5 dust)	0.5
(V_2O_5 fume)	0.1
Zinc oxide fumes	15
Zirconium compounds (as Zr)	5

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Aluminum oxide	50
Asbestos	5
Dust (nuisance, no free silica)	50
Mica (below 5% free silica)	20
Portland cement	50
Talc	20
Silica	
high (above 50% free SiO_2)	5
medium (5 to 50% free SiO_2)	20
low (below 5% free SiO_2)	50
Silicon carbide	50
Slate (below 5% free SiO_2)	50
Soapstone (below 5% free SiO_2)	20
Total dust (below 5% free SiO_2)	50



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