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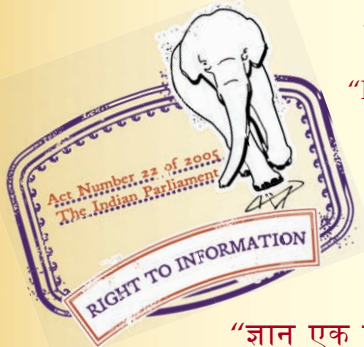
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“Step Out From the Old to the New”

IS 7293 (1974): Safety code for working with construction machinery [CED 29: Construction Management including safety in Construction]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”



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IS : 7293 - 1974
(Reaffirmed 1996)

Indian Standard

**SAFETY CODE FOR
WORKING WITH CONSTRUCTION MACHINERY**

(Fourth Reprint SEPTEMBER 1998)

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**BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BHADUR SHAH ZAFAR MARG
NEW DELHI 110002**

Indian Standard

SAFETY CODE FOR WORKING WITH CONSTRUCTION MACHINERY

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Indian Standard

SAFETY CODE FOR WORKING WITH CONSTRUCTION MACHINERY

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 15 March 1974, after the draft finalized by the Safety in Construction Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 With large scale increase in construction activity in recent years, it has become necessary to adopt measures for minimizing the likelihood of accidents in this nation wide industry. Experience has shown that many of the accidents occurring in the construction industry are attributable to faulty design or construction of the machinery used or, more often, to incorrect unsafe practices of using and handling construction machinery. It has therefore, been felt necessary to prepare a safety code giving the essential features for safe use and operation of various types of construction machinery.

0.3 This code is intended for use by all the construction authorities both in public and private sectors and managements of the various related enterprises. It covers earthmoving and lifting and hoisting machinery, such as power shovels (excavators), bull dozers, scrappers and cranes; transporting machinery such as, motor trucks and tractors and dumpers; and other construction machinery, such as asphalt plants, road rollers, concrete mixers and vibrators. Provisions have been drawn up under these headings which incorporate not only the essential requirements for safety in operation and maintenance but also some of the essential design and construction features.

0.4 In the formulation of this standard, due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard lays down the essential requirements for safety in the operation and maintenance of earth moving, lifting and hoisting, transporting and other construction machinery. It also includes some features of design and construction which are essential for safe working of construction machinery.

2. GENERAL PROVISIONS

2.1 Siting

2.1.1 In siting construction machinery for operation, attention shall be given to the strength of foundation or structure on which the machinery may stand or move or be supported and to the proximity of hazard, such as nearby structures, public access areas, other moving machinery, and in case of cranes, overhead electric conductors.

2.1.2 When static load lifting machinery like cranes, winches pile drivers and excavators is required to operate on edges of embankments or in boggy areas, the bearing capacity of the soil shall first be tested and a minimum three layers of criss-cross bearing packing shall be provided in addition to providing proper anchorage to the superstructure of the machinery.

2.2 Fencing of Machinery

2.2.1 All gears, revolving shafts, couplings and all other dangerous parts of machinery shall be effectively guarded unless they are so constructed, installed or placed as to be as safe as if they were guarded.

2.2.2 On all new machinery, all spur and worm gear and other toothed or friction gear which do not require frequent adjustment and every set screw, bolt or key on any revolving shaft, spindle, wheel or pinion shall be encased or so sunken or otherwise effectively guarded as to prevent danger.

2.2.3 Fencing of dangerous parts of machinery shall not be removed while the machinery is in use or in motion and when removed, it shall be replaced as soon as practicable and in any case before the machinery is again brought into use.

2.3 Safe Access — Safe and adequate means of access including handholds and footholds shall be provided to all parts where a person may have to walk, climb or work.

2.4 Maintenance

2.4.1 No part of machinery, while in motion or in operation shall be examined, lubricated, adjusted or repaired except by a duly authorized person. Any repairs to machinery while in motion or in operation shall be carried out only when unavoidable.

2.4.2 Parts of machinery shall be cleaned when the machinery is stopped. If the cleaning is unavoidable when the machinery is working, this shall be done by a duly authorized person in conformity with accepted standards of safety.

2.4.3 Electric power shall be shut off and relevant fuses removed when repairs are carried out to any electric machinery.

2.4.4 Any machinery, equipment or part thereof which is suspended or held apart by use of slings, hoist or jacks shall be substantially blocked or cribbed before men are permitted to work underneath or between such machinery, equipment or part thereof.

2.5 First Aid and Fire Fighting

2.5.1 A first aid box or kit shall be provided at the site.

2.5.2 When operation of the construction machinery is confined to one place or is within a restricted area of about 30 m radius, a fire point shall be established at a suitable and easily accessible location within the area. The fire point shall be provided with the following equipment, which shall always be kept in a serviceable condition:

- | | | |
|---------------------------------------------------------------|---|-------|
| a) 5 kg Dry Powder Extinguisher conforming to IS : 2171-1972* | — | 2 Nos |
| b) Sand Buckets | — | 2 Nos |

2.5.2.1 Where the construction machinery in use is a mobile type, and during the course of operation has to shift its location frequently, one 5-kg Dry Powder Extinguisher conforming to IS : 2171-1972* shall be carried on the machine itself at a suitable position on the machinery so as to ensure its easy availability. It shall also be ensured that these extinguishers are inspected and maintained properly according to IS : 2190-1971† and that all persons employed on construction work are well conversant with the method of operation of the equipment.

NOTE — When sand is used for extinguishing a machine fire it involves thorough cleaning immediately after the fire is extinguished. However, this work will be undertaken only under the supervision of a competent person.

3. EARTH MOVING, LIFTING AND HOISTING MACHINERY

3.1 General

3.1.1 Driver's Cabin

3.1.1.1 The driver shall be adequately protected from the weather by a cabin which, if enclosed, shall be provided with windows that give unrestricted maximum possible view and is well ventilated.

*Specification for portable fire extinguishers, dry powder type (*first revision*).

†Code of practice for selection, installation and maintenance of first-aid fire appliances (*first revision*).

3.1.1.2 The windows shall be provided with toughened safety glass and wipers.

3.1.1.3 Wherever, the arrangement of the controls permits, a seat of such design, construction and dimension as will permit safe operation of the machinery without undue fatigue and discomfort shall be provided.

3.1.1.4 The driver's seat shall be provided, if necessary, with fencing, guard rails and toe boards to prevent danger.

3.1.1.5 A dry powder extinguisher of 5 kg capacity conforming to IS : 2171-1972* shall be provided in the cabin or any other suitable place on the machinery, as stated under **2.5.2**, and operating and maintenance personnel shall be thoroughly conversant with the use and care of the extinguisher.

3.1.1.6 Emergency means of escape in case of fire or any accident shall be provided.

3.1.2 *Brakes and Controls*

3.1.2.1 Every earth moving and lifting and hoisting machinery having hoisting and derricking motions shall be fitted with one or more brakes on each of these motions, and where slewing gear is fitted, on the slewing motion as well, the latter having a device for locking the rotating structure when the machinery is left unattended.

3.1.2.2 Effective braking devices shall be provided on the wheels of the machinery. Where power assisted brakes are provided, a manual parking brake acting on the driving wheels shall also be provided.

3.1.2.3 Each control shall be clearly identified to show the motion and direction of movement.

3.1.2.4 Control handles, levers and switches shall be so arranged that these can be operated reliably, safely and easily from the driver's seat.

3.1.3 *Drivers and Signallers*

3.1.3.1 Only competent and reliable persons who are at least 18 years of age and who have been adequately trained shall be employed as drivers of earth moving and lifting and hoisting machinery or as signallers to give signals to a driver.

3.1.3.2 The driver shall not wear loose clothing and shall cover loose hair that might be caught by moving parts.

3.1.3.3 The driver shall have clear, uninterrupted and unrestricted view of the load and operational area, or shall act upon the instructions of an authorized signaller having such a clear and uninterrupted view.

3.1.3.4 The driver shall not leave his cabin while the engine or motor is running or the load is suspended. In no case, shall the machinery be left

*Specification for portable fire extinguisher, dry powder type (*first revision*).

unattended, even for short periods, until all loads are removed and, in case of lifting and hoisting machinery until the hook after removing the load is brought to the highest working position at the appropriate radius. Before leaving, the electric power supply shall be switched off, or the engine stopped and appropriate motion brakes and locks shall be applied to put the machine in a safe condition.

3.1.3.5 Before starting, driver shall ensure that the gear and clutch are in neutral, the brakes where hand brakes are provided, are "on" and on the throttle is adjusted to the required opening

3.1.3.6 Normally the driver shall be required to work only for the prescribed working hour. When unavoidable extra time shall be fixed after taking into consideration human fatigue.

3.1.3.7 No unauthorized person shall ride on the earth moving machinery.

3.1.4 *Inspection and Testing*

3.1.4.1 All earth moving and lifting and hoisting machinery including all parts and accessory gear whether fixed or movable before being taken into use shall be tested and examined by a competent person for specified ratings and for safe operation at intervals as specified by statutory regulations, and shall be retested and re-examined after any substantial alteration or repair.

3.1.4.2 All structural members of control mechanism and transmissions and all safety devices shall be inspected periodically depending on the frequency of use, severity of service and environment.

3.1.4.3 Steel wire ropes and other ropes including terminal fittings shall be examined at least once a week to check that these are not frayed or damaged.

3.1.4.4 A thorough visual examination followed by routine checks on automatic safe load or load-radius indicators and/or cut-outs limit switches, oil and fuel levels and brakes shall be carried out at the beginning of each shift and any defects reported to the person responsible for the safe use of the machinery who shall keep a suitable record. In case of pneumatic tyres, the tyre pressure shall be checked and any deficiency made good. The machinery shall not be put to service until clearance is given by the responsible person after ensuring that (a) the faults have been corrected; (b) all adjustments have been made; (c) working parts are properly lubricated; (d) nuts, bolts etc are properly tightened, and (e) all safety devices are in place.

3.1.5 *Work Near Overhead Power Line*

3.1.5.1 All practical steps shall be taken to prevent the earth moving and lifting and hoisting machinery being operated in dangerous proximity to a live overhead powerline. In particular, the machinery shall not be

permitted to approach within the following distance of overhead power lines:

| | |
|-----------------|--------|
| 11 kv and below | 1'40 m |
| 33 " " " | 3'60 m |
| 132 " " " | 4'70 m |
| 275 " " " | 5'70 m |
| 400 " " " | 6'50 m |

3.1.5.2 If it becomes necessary to operate the machinery with clearances less than those specified in **3.1.5.1**, it shall be ensured that the overhead power lines shall invariably be shut off during the period of operation of the machinery. Location of any underground power cables in the area of operation shall also be ascertained and necessary safety precautions taken.

3.1.6 Miscellaneous

3.1.6.1 As far as possible, earth moving and lifting and hoisting machinery shall not be left on highways at night. If it is at all left, it shall be adequately marked with red lanterns, red flags or other effective means.

3.1.6.2 No earth moving and lifting and hoisting machinery shall be operated without the ballast or counter weights in place and the tonnage shall be as specified by the manufacturer.

3.2 Earth Moving Machinery

3.2.1 Power Shovels (Excavators)

3.2.1.1 Stability

- a) Power shovels (excavators) shall be so operated as not to lose their stability.
- b) Power shovels (excavators) that are equipped with unit for deep digging shall either be so designed that the bucket teeth cannot come nearer the boom than 40 cm or be provided with a reliable stop that prevents the bucket to come nearer than the specified distance.

3.2.1.2 Boom

- a) The boom or power shovel (excavator) shall be prevented from accidentally swinging during operation or transport.
- b) The boom shall not be pulled tight against the emergency stops while supporting a load.
- c) The maximum boom length stipulated by the manufacturer shall not be exceeded. The wire ropes used for the boom suspension as well as for the shovel/bucket shall be of the specified diameter and construction.
- d) Due attention shall be paid to the length and condition of the pendant ropes and the end connections. The safe operating radius for the load under consideration shall not be exceeded.

- e) History sheet and schedule for replacement of ropes shall be maintained.

3.2.1.3 *Bucket or grab*

- a) The bucket or grab shall be of the right size taking into account the power of the machine or motor, length of the boom, the operating radius contemplated and total weight including the self-weight of the bucket or grab and other lifting accessories.
- b) While operating power shovels (excavators) the driver shall ensure that no person is working, passing or standing under the raised bucket or grab.
- c) The bucket or grab of a power shovel (excavators) shall be prevented from accidental dipping, tipping or swinging in operation. The bucket or grab of the shovel shall be pulled out of the bank as soon as it is full. When not in use, the bucket shall be kept resting on stable ground and shall not be left hanging.
- d) The bucket or grab of a power shovel (excavator) shall be fixed to restrict movement while it is being repaired.

3.2.1.4 *Miscellaneous*

- a) When power shovel (excavator) is operated near edges of excavations or embankments substantial space shall be provided to prevent it from approaching a dangerous position and the sides of the excavation shall be adequately shored. Heavy equipment, such as excavating machinery and road traffic shall be kept back from the excavated sides at a distance not less than the depth of trench or at least 6 m from trench deeper than 6 m.
- b) Power shovels (excavators) shall not be left on a slope with the engine or motor running.
- c) The height of the benches in over burden shall not be more than the height of the boom of the machine used for digging excavation or removal.

3.2.2 *Bulldozers*

3.2.2.1 When a bulldozer is moving uphill, the blade shall be kept low. When running down the hill the bulldozer shall be in the lowest gear.

3.2.2.2 The bulldozer blade should not be used as brake except in case of emergency.

3.2.2.3 The blade suspension arrangement (wire rope or hydraulic system) shall be inspected once a week.

3.2.2.4 After the close of work, the bulldozer shall be left on level ground. Before leaving, the driver shall apply the brakes, lower blade and put the shift lever in 'neutral'.

3.2.3 Scrapers

3.2.3.1 The scraper shall be joined to a tractor by a safety line when in operation.

3.2.3.2 Scraper moving down hill shall be left in gear.

3.2.3.3 Scraper bowls shall be blocked while blades are being replaced. Packing may be used while maintaining/altering the angle of the blade.

3.3 Lifting and Hoisting Machinery

3.3.1 General

3.3.1.1 Erection and dismantling

- a) When lifting and hoisting machinery is to be erected at site, proper procedures specified by the manufacturers shall be followed during erection and dismantling operations at site, particularly with reference to correct assembly and the sequence of the operations by identification of different parts and components which make assembly.
- b) The erection and dismantling operation shall be carried out under the supervision of a competent person.
- c) The erection crew shall wear safety helmets and where necessary, safety harness.

3.3.1.2 Stability — Cranes shall be so operated as not to be liable to over-turning particularly the following misadventures:

- a) By taking load in excess of the safe working load.
- b) By rapid deceleration of slowing motion by severe application of brake.
- c) By braking too hard in order to arrest descending load.
- d) By sudden release of a heavy load.
- e) By pulling loads from the sides.
- f) By operating the crane without sufficient counter-weight.
- g) By positioning the crane at a steep slope.

3.3.1.3 Jib

- a) When a crane is used at different times with jibs of different lengths, particulars of the lengths and the appropriate safe working loads shall be plainly marked in a prominent place on the crane and each driver, authorized to work it, shall be certified after a regular test, that he understands the limitations of each conditions of the working of the crane.

- b) No crane shall, except for the purpose of test, be loaded beyond the safe working load, and for this purpose, either a table showing the safe working loads at different radii of the jib shall be displayed in a prominent place or an automatic safe load indicator which takes into account both the radii of the jib and the weights of the load being lifted, with both visible and audible warnings shall be provided. Whenever possible, automatic device for cutting off power to hoisting and derricking motions when the safe working load is exceeded, shall also be provided.
- c) Where possible, the cranes shall be equipped with limit switches to prevent overwinding and over lowering on the hoisting motion and over-derricking beyond prescribed limits.

3.3.1.4 Signals

- a) A standard code of hand signals shall be adopted in controlling the movements of the crane and both the driver and the signaller shall be thoroughly familiar with the signals.
- b) The driver of the crane shall respond to signals only from the appointed signaller but shall obey stop signal at any time no matter who gives it.

3.3.1.5 Loads

- a) Before lifting, the load shall be checked to ensure that it is secure.
- b) When handling loads near to maximum safe working load, crane motions shall be operated with extra care. The load shall initially be lifted just clear of the supporting surface and brought to rest, while the slings, balance of the load, etc are checked before proceeding. Proper care shall be exercised by the driver, at all times to avoid shock or side loadings on the jib.
- c) The slinger or other persons shall stand well clear of the load and shall not walk, crawl or stand under the suspended load.

3.3.1.6 Ropes — Before lifting operations commence, the hook shall be lowered to the required lowest point to ensure that at least two dead coils remain on the drum, and to the highest point to check that the drum capacity will not be exceeded.

3.3.2 Tower Cranes

3.3.2.1 Climbing operation — When a climbing tower crane is erected and its height extended within a structure or building the climbing operation shall be carried out in accordance with the manufacturer's instructions. All climbing frames, ladders, locking devices and machinery shall be correctly installed, adjusted and kept in good working order. At the end of the climbing operation, wedges securing the tower shall be driven home and secured.

3.3.2.2 In case of mobile tower cranes, their movement shall be preferably on a level track. If there has to be a gradient in the track this shall be within the permissible limits as specified.

3.3.3 Mobile Cranes

3.3.3.1 When travelling up a gradient, the load shall be derricked out and when travelling down a gradient, the load shall be derricked into the minimum radius, and this position shall be corrected on reaching level ground. Cranes shall not move down the hill with the engine off or with the engine out of gear.

3.3.3.2 The mobile cranes shall be fitted with suitable horn, head lights, side lamps, rear and stop lights and flashing directional indicators.

3.3.3.3 On cranes with cantilever type jib, when travelling without load, the jib shall be lowered to a horizontal position.

3.3.3.4 When a load to be handled at a particular radius exceeds the rated load, the fore and aft out riggers shall be used and blocked

3.3.3.5 During operation of the rubber tyred crane, air brakes shall be put in 'ON' position.

3.3.3.6 The pneumatic tyres shall be maintained at the correct pressure at all times.

4. TRANSPORTING MACHINERY (MOTOR TRUCKS AND TRACTORS AND DUMPERS)

4.1 Driver's Cabin

4.1.1 Motor trucks, tractors and dumpers shall be equipped with a cabin or a canopy of sufficient strength and so installed as to provide adequate protection to the driver.

4.1.2 If the cabin is enclosed, it shall be provided with windows giving maximum possible view and shall be well ventilated. The driver shall be able to make an easy exit in case of any emergency.

4.1.3 Driver's seat shall have back rest and the seat shall be of such design, construction and dimensions as will absorb vibration sufficiently and provide reasonable comfort.

4.1.4 Motor trucks and tractors shall be equipped with a footboard or steps and hand-holds such that it is possible to get into and out of the driver's cabin safely and the cabin should be so arranged that the driver can easily get off in case of emergency.

4.2 Brakes and Controls — Motor trucks, tractors and dumpers shall be equipped with brakes that will hold them under the heaviest load that may be hauled in any operating conditions and shall enable the vehicle to be locked when stationary.

4.3 Draw Gears — Motor trucks, hauling trailers and tractors shall be equipped with draw gear such that during coupling no worker can come between the vehicles being coupled or the vehicles being coupled cannot run into each other.

4.3.1 Vehicles shall not move down the hill with the engine off or with the engine out of gear.

4.4 Drivers

4.4.1 Only competent and licensed persons shall drive motor trucks and tractors.

4.4.2 Drivers shall be required to leave the cabins and stand in the clear while the motor trucks are being loaded.

4.4.3 Drivers of tripper trucks used for hot mix plants and batch mix concrete plants and similar operations shall wear the industrial safety helmets conforming to IS : 2925-1964*

4.5 Other Operating Conditions

4.5.1 Every effort shall be made to avoid motor trucks being loaded in a place where there may be danger from materials, such as rocks falling from buckets passing overhead.

4.5.2 Motor trucks shall be stationed at such a distance from the power shovel (excavator) that there is a clearance of at least 0.6 m between the trucks and the superstructure of the power shovel (excavator) even when it pivots.

4.5.3 Where the driver does not have a clear field of vision the movement of motor trucks and tractors shall be controlled by a code of standard hand signals.

4.5.4 When uncoupling vehicles, both vehicles shall be blocked by brakes or chocks.

4.5.5 Vehicles being loaded or unloaded shall be effectively braked or blocked.

4.5.6 Motor trucks shall not be loaded beyond their capacity.

4.5.7 Before a loaded motor truck starts, the load shall be inspected to ensure that it is secure, evenly distributed and of safe height, length and width.

4.5.8 Sufficient stop blocks shall be provided at every tipping point and these shall be used on every occasion when material is dumped from the truck dumper or other such vehicle.

*Specification for industrial safety helmets.

5. OTHER CONSTRUCTION MACHINERY

5.1 Concrete Mixers

5.1.1 All gears, chains and rollers of concrete mixers shall be adequately guarded to prevent danger.

5.1.2 Concrete mixer skips shall be protected by side railings to prevent workers from passing under them and operators shall make sure before lowering the skip that all workers are in the clear.

5.1.3 Hoppers into which a person could fall and revolving plates of trough or batch type mixers shall be adequately guarded by grating.

5.2 Concrete Vibrators

5.2.1 Vibrating unit shall be completely enclosed and belt transmitting the power to the unit adequately guarded.

5.2.2 Vibrating needles of poker type vibrator shall be completely sealed against concrete.

5.2.3 Electrically operated compactum vibrators shall be totally enclosed units.

5.2.4 Air-operated type vibrators shall have arrangements to change the speed of rotating shaft and air motor to rotate the vibrating needle which shall be completely sealed against concrete.

5.2.5 Power operated vibrators shall be provided with effective means of stopping the vibration (if possible by disengaging the vibrator from the engine/motor drive).

5.2.6 Where possible, the vibrators shall be fitted with shock absorbing handles with rubber or other suitable grips for ease in handling.

5.2.7 Electrically operated vibrators shall be protected against overloads by suitable overload relays and shall be effectively earthed; and where the operator has to be in direct contact with the vibrator during its operation, low voltage drive with suitable transformer is recommended.

5.2.8 While starting the poker vibrators, the needle shall not be resting on a hard surface to avoid bouncing.

5.2.9 Excessive bending of the flexible shafts of the poker vibrators while in operation shall be avoided.

5.3 Road Rollers

5.3.1 No person shall climb a moving road roller.

5.3.2 Road rollers shall not move downhill with the engine out of gear.

5.3.3 As far as practicable, road rollers shall not be left on a highway after the close of work and, where this is not practicable, red lights shall be provided at the two ends at night to clearly show the presence of the road rollers on the road.

5.3.4 When the road roller is not in use, brake shall be applied, engine shall be put into gear and wheels shall be blocked.

5.4 Asphalt Plants

5.4.1 Piping for hot oil and asphalt shall be adequately inserted to protect workers from injury by burns and flexible piping shall be metal encased. The flexible pipe, when not in use, shall be left on the ground.

5.4.2 Operation of asphalt plant shall be under the supervision of a competent person and the plant shall be inspected by a competent person at periodical intervals.

5.4.3 Workers handling hot asphalt shall wear gloves, rubber boots, goggles and, if necessary, to prevent danger, suitable protective clothing.

5.4.4 No open light shall be used for ascertaining the level of asphalt and thinners shall not be heated over an open flame.

5.4.5 If burner goes out, the fuel supply shall be cut off and hot tube shall be thoroughly blown out by the fan so as to prevent backfire.

5.4.6 Spilled asphalt shall be promptly cleaned up.

5.4.7 A chimney or other suitable exhaust arrangements shall be provided to remove the combustion gases and dust.

5.5 **Towing of Static Plant** — Speed of the vehicles, when towed to static plants like compressors, concrete mixers, batching plants, etc, shall not exceed 15 kilometres per hour under any circumstances.

5.6 **Electric Power Operated Machines** — Bodies of all electric power operated machines shall be well earthed. This should be checked from time to time.

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

Telephones: 323 0131, 323 3375, 323 9402

Fax : 91 11 3234062, 91 11 3239399, 91 11 3239382

Telegrams : Manaksanstha
(Common to all Offices)

Central Laboratory:

Plot No. 20/9, Site IV, Sahibabad Industrial Area, Sahibabad 201010

Telephone

8-77 0032

Regional Offices:

Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002 323 76 17

*Eastern : 1/14 CIT Scheme VII M, V.I.P. Road, Maniktola, CALCUTTA 700054 337 86 62

Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022 60 38 43

Southern : C.I.T. Campus, IV Cross Road, CHENNAI 600113 235 23 15

†Western : Manakalaya, E9, Behind Marol Telephone Exchange, Andheri (East),
MUMBAI 400093 832 92 95

Branch Offices:

'Pushpak', Nurmohamed Shaikh Marg, Khanpur, AHMEDABAD 380001 550 13 48

‡Peenya Industrial Area, 1st Stage, Bangalore-Tumkur Road,
BANGALORE 560058 839 49 55

Gangotri Complex, 5th Floor, Bhadbhada Road, T.T. Nagar, BHOPAL 462003 55 40 21

Plot No. 62-63, Unit VI, Ganga Nagar, BHUBANESHWAR 751001 40 36 27

Kalaikathir Buildings, 670 Avinashi Road, COIMBATORE 641037 21 01 41

Plot No. 43, Sector 16 A, Mathura Road, FARIDABAD 121001 8-28 88 01

Savitri Complex, 116 G.T. Road, GHAZIABAD 201001 8-71 19 96

53/5 Ward No. 29, R.G. Barua Road, 5th By-lane, GUWAHATI 781003 54 11 37

5-8-56C, L.N. Gupta Marg, Nampally Station Road, HYDERABAD 500001 20 10 83

E-52, Chitaranjan Marg, C-Scheme, JAIPUR 302001 37 29 25

117/418 B, Sarvodaya Nagar, KANPUR 208005 21 68 76

Seth Bhawan, 2nd Floor, Behind Leela Cinema, Naval Kishore Road,
LUCKNOW 226001 23 89 23

NIT Building, Second Floor, Gokulpat Market, NAGPUR 440010 52 51 71

Pattiputra Industrial Estate, PATNA 800013 26 23 05

Institution of Engineers (India) Building 1332 Shivaji Nagar, PUNE 411005 32 36 35

T.C. No. 14/1421, University P.O. Palayam, THIRUVANANTHAPURAM 695034 6 21 17

*Sales Office is at 5 Chowringhee Approach, P.O. Princep Street,
CALCUTTA 700072 27 10 85

†Sales Office is at Novelty Chambers, Grant Road, MUMBAI 400007 309 65 28

‡Sales Office is at 'F' Block, Unity Building, Narashimaraja Square,
BANGALORE 560002 222 39 71