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SPECIFICATION FOR CONCRETE BATCHING AND MIXING PLANT

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

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SPECIFICATION FOR CONCRETE BATCHING AND MIXING PLANT

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Indian Standard

SPECIFICATION FOR CONCRETE BATCHING AND MIXING PLANT

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 14 December 1968, after the draft finalized by the Construction Plant and Machinery Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 On large works where considerable quantity of concrete is required, central batching plants or batching and mixing plants are generally used. The plant is erected in a suitable central position and either the mixed concrete is directly transported from it to the working sites, or the dry aggregates or dry mix of concrete is delivered to site mixers.

0.2.1 These plants are usually specially designed to suit the local conditions and the output required. Small plants may have an output of as low as 30 m^3 of mixed concrete per hour, medium plants may have the output in the range of 100 to 300 m^3 of mixed concrete per hour and large plants may have an output of over 300 m^3 of mixed concrete per hour. The plants may be manually controlled, semi-automatic or fully automatic (*see* **5.1**). The composition of the plant may also vary depending upon the type and composition of aggregates, cement, admixtures for concrete, and various other requirements, such as temperature control of aggregates, mixing water and concrete and above all the quality of concrete expected from the plant.

0.2.2 This performance oriented specification lays down general requirements and guide lines for medium and large size centralized batching plants with the object of providing guidance to prospective users and manufacturers and for guiding the purchaser in covering all the requisite technical points in the enquiry or tender notice, and to define the same more precisely while placing the order on the manufacturer. With suitable modifications, the specification may also be used for small plants.

0.3 In view of intricate nature of such plants and of the variety of combination of ancillary equipment that may be required under different conditions, information on many aspects may have to be supplied both by the user for the guidance of the manufacturer and by the manufacturer to the prospective user, to obtain a true comparative assessment of different plants available and to ensure that the plant selected is suited to the conditions prevailing. For this reason, the specification contains clauses

which call for agreement between the purchaser and the supplier and which permit the purchaser to use his option for selection to suit his requirements. These clauses are **3.1, 3.1.1, 3.2, 4.2, 5.4, 5.6, 6.5, 7.2, 8.2** and **9.1.**

0.4 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.

1. SCOPE

1.1 This standard covers the requirements of manual, semi-automatic or fully automatic central mix, batching and mixing plant capable of producing not less than 100 m^3/h of mixed concrete.

2. CAPACITY

2.1 The maximum capacity of the plant shall be based on the minimum mixing time cycle, after all materials are put in the mixer (*see* **6.1.1**).

3. COMPOSITION OF THE PLANT

3.1 The plant shall be capable of accurate batching and mixing of the following materials, the provision regarding material (e) depending upon prior agreement between the supplier and the purchaser:

a) Cement;

b) Fine aggregate;

c) Coarse aggregate in proportions and size as specified by the purchaser;

d) Water; and

e) Dispensing arrangements for admixtures, such as, air entraining agents or water reducing and set retarding agent or both as specified by the purchaser.

3.1.1 If so desired by the purchaser, the plant shall also have suitable arrangements for cooling or heating of concrete. The actual details of the cooling or heating arrangements shall be as agreed to between the purchaser and the supplier.

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

3.2 Unless otherwise agreed to between the purchaser and the supplier, the plant shall consist of the following components of suitable size related to the capacity of the plant:

a) Storage bins for different sizes of aggregates and cement;

b) Batching equipment;

c) Mixers;

d) Control panels;

e) Concrete cooling or heating arrangements (*see* **3.1.1**);

f) Mixing water re-cooling or heating system, or both; and

g) Material feeding and elevating arrangements, when required.

3.2.1 The various components shall conform to the requirements specified in **4** to **10.**

4. STORAGE

4.1 Storage bins shall be provided for different sizes of fine and coarse aggregates, and cement in a way that the compartments for each type of material are approximately equal or of sizes to suit the requirements as defined by the purchaser for specific job applications. Unless otherwise specified, the cement storage bin shall be centrally located. The cement compartment shall be watertight and provided with necessary air vent; aeration fittings for proper flow of cement and emergency cement cut off gate. The aggregate storage capacity of bins shall be based on a weight of 1 800 kg/m^3 of the material. Rock ladder shall be provided in 40, 75 and 175 mm compartments, limiting the fall to 1·2 m.

NOTE — The processed aggregate of the grading required by the user will be conveyed into the bins of the plant by a suitable means, such as belt conveyor or elevator, or both belt conveyor from the aggregate plant.

4.1.1 The aggregate and sand as conveyed to the top of the bins shall be charged by a power-operated (or manually operated in the case of smaller plants), centrally revolving heavy duty chute mounted on central pivot and capable of operation from the top of bins. The bin tops shall have necessary provision for locating the drive and truss end of the prescribed width of inclined belt conveyor or other material feeding and elevating arrangements.

4.2 Unless otherwise agreed to between the purchaser and the supplier, the entire plant from mixer floor upward shall be enclosed. If desired by the purchaser, the plant from mixer floor upwards shall be provided with insulation. Batch bins shall be constructed so as to be self-cleaning during draw down. Materials shall be deposited in the batch bins directly over the discharge gates.

5. BATCHING EQUIPMENT

5.1 Batchers shall be manual or semi-automatic or automatic in accordance with the requirements given below:

a) *Manual Batcher* — Manual batcher shall be charged by devices which are actuated manually, with the accuracy of the weighing operation being dependent upon the operator's visual observation of the scale. The charging devices may be actuated by hand or by pneumatic, hydraulic, or electrical power assists.

b) *Semi-Automatic Batcher* — Semi-automatic batcher shall be charged by devices which are separately actuated manually to allow the material to be weighed but which are actuated automatically when the designated weight of each material has been reached. The weighing accuracy shall be within the tolerances specified in **5.1** (c) (iv).

c) *Automatic Batcher* — Automatic batcher shall be charged by devices which, when actuated by a single starter switch, will automatically start the weighing operation of each material and stop automatically when the designated weight of each material has been reached, interlocked in such a manner that:

i) the charging device cannot be actuated until the scale has returned to zero balance within ± 0·3 of 1 percent of the scale capacity;

ii) the charging device cannot be actuated if the discharge device is open;

iii) the discharge device cannot be actuated if the charging device is open; and

iv) the discharge device cannot be actuated until the indicated material is within the applicable tolerances.

5.1.1 For individual batchers the following tolerances shall apply, based on the required weight of the material being weighed:

	Percent
Cement and other cementitious materials	± 1
Aggregates	± 2
Water	± 1
Admixture	± 3

5.1.2 For cumulative batchers interlocked sequential controls shall be provided and the above tolerances shall apply to the required cumulative weight of material as batched.

5.1.3 The minimum weight of any material weighed to which the above tolerances shall apply is determined by the following formula:

$$\frac{0{\cdot}3 \times \text{scale capacity (in kg)}}{\text{Weigh tolerance (in percent from above)}} = \text{minimum weight in kg}$$

5.2 The batching equipment shall be such so as to accurately determine and control the prescribed amounts of various constituent materials for concrete, that is, water, cement, admixtures, sand and individual size of coarse aggregate. The amounts of cement and water shall be determined by separate weighing and that of each size of aggregate shall be determined by separate weighing. In case of small plants, the amount of each size of aggregate shall be determined by cumulative weighing. The amounts of each admixture shall be determined by volumetric measurement for each batch.

5.2.1 Equipment for conveying batched materials from the batch hoppers to and into the mixer shall be such that there will be no spillage of the batched materials or overlap of batches. Equipment for handling cement in the batching plant shall be such as to prevent noticeable increase of dust in the plant during the measuring and discharging of each batch of material. If the batching and mixing plant is enclosed, exhaust fans or other suitable equipment for removing dust shall be installed.

5.3 Batching system shall have rated capacity (in terms of concrete in a single batch) to match the maximum rated size of the mixer that could be adopted for use with the plant. All the batchers shall be semi-automatic or automatic. Semi-automatic or automatic batchers shall be operated from the central control panel. To achieve greater accuracy, the weighing 'cut off' shall be in two stages, that is, 'initial' and 'final' with necessary jogging action, fox dribble feed as the final weight is approached. All the weights shall be indicated on respective dials of the central control panel. Respective scales, batchers and dials shall be provided for each of the aggregates, cement, water, air entraining agent, water reducing agent as required. Cement batcher shall be complete with dust preventive arrangements. Emergency gates shall be included for various batchers. The scales shall be calibrated in kilograms. The weighing hoppers shall permit obtaining representative samples of each material. The weighing and measuring equipment shall conform to the requirements given in **5.3.1** to **5.3.5**. Scale system shall have provision for necessary adjustments, levelling, aligning, balancing and calibration from time to time.

5.3.1 Notwithstanding the requirements given in **5.1**, the construction and accuracy of the equipment shall conform to the applicable requirements of IS : 2722-1964*, except that an accuracy of 0·4 percent over the entire range of equipment will be required.

*Specification for portable swing weighbatchers for concrete (single and double bucket type).

5.3.2 Each weighing unit shall be equipped with a visible springless dial which will register the scale load at any stage of the weighing operation from zero to full capacity. The weighing hoppers shall permit the convenient removal of overweight materials in excess of the prescribed tolerances. The scales shall be interlocked so that a new batch cannot be started until the weighing hoppers have been completely emptied of the last batch and the scales are in balance.

5.3.3 The batching equipment for large size plants shall preferably include an accurate recorder for making a continuous visible combined record on a single chart of the separate measurement of each concrete ingredient including all mixing water, air-entraining agent, and water-reducing and set-retarding agent. A portion of the recorder chart equivalent to at least 30 minutes of plant operation shall be visible after recording. The recording equipment shall include facilities for automatically registering on the chart the time of day at intervals of not more than 15 minutes.

5.3.4 The equipment shall be capable of ready adjustment by operator for compensating for the varying weight of any moisture contained in the aggregate and for changing the mix proportions.

5.3.5 The equipment shall be capable of controlling the delivery of material for weighing or volumetric measurement so that the combined inaccuracies in feeding and measuring during normal operation will not exceed 1 percent for water; 1 percent for cement; 3 percent for admixtures; 2 percent for sand, 20 mm and 38 mm coarse aggregate; and 3 percent for 75 mm coarse aggregate.

5.4 Batching of water shall be by weight but may be by volume in case of small plants and the scale shall be suitably calibrated. Reservoir tank for storage of water and of capacity as agreed to between the purchaser and the supplier shall be provided above the batcher and shall be complete with water piping, float valves and other fittings for direct delivery to mixers without coming in contact with cement or the aggregate prior to the mixing operations. Water batcher shall be such that it can measure and discharge full batch of specified quantity of water simultaneously and within the same time as set for the rest of the batch.

5.4.1 In case of small plants where water batching is provided by volume, water metering arrangement shall be so constructed that the flow may be cut off automatically after a predetermined volume of water has gone in or can be stopped manually at any time. Suitable arrangements shall be included in water meter system so that variations in the water supply pressure do not effect the rate of delivery and accuracy of the meter.

5.4.2 The operating mechanism in the water-measuring device shall be such that leakage will not occur when the valves are closed. The water-measuring device shall be constructed so that the water will be discharged

quickly and freely into the mixer without objectionable dribble from the end of the discharge pipe. In addition to the water-measuring device, there shall be supplemental means for measuring and introducing small increments of water into each mixer when required for final tempering of the concrete.

5.5 Dispensers, if provided, for air-entraining, water-reducing, set-retarding agents shall have sufficient capacity to measure at one time the full quantity of the properly diluted solution required for each batch, and shall be maintained in a clean and freely operating condition. Equipment for measuring shall be designed for convenient confirmation of the accuracy of the measurement for each batch and shall be so constructed that the required quantity can be added only once to each batch.

5.5.1 Batching system for admixtures (*see* **3.1**) shall be volumetric and shall be such that the admixture is automatically added to the mixing water. The quantity may vary up to 400 ml/m^3 of concrete. This system shall include a storage tank of adequate capacity for air-entraining solution at the batcher floor for gravity feed, delivery pump from the ground storage, float switch with automatic start and stop control of the pump to maintain fixed levels. The feeding of air entraining agent shall be interlocked with the mixing water-feeding arrangements.

5.5.2 The water-reducing, set-retarding agent shall be measured for each batch by means of a reliable mechanical dispenser. The agent, in a suitably diluted form, may be added to water containing air-entraining agent for the batch provided the agents are compatible with each other. The agent may also be introduced separately to the batch in a portion of the mixing water.

5.6 The range of each scale shall be as required by the purchaser to suit the capacity of the batching plant (*see* **5.3**). The purchaser shall indicate this range in the order or enquiry.

5.7 The materials from the batchers shall be discharged into an intermediate collecting cone hopper which in turn shall feed the material into each of the mixers, in turn, by a power-operated, central charging chute in case the number of mixers is more than 2 and by a 2-way chute in case number of mixers is limited to 2. The controls of the power-operated chute shall be located on the central control panel. The charging chute operation shall be provided with necessary interlocks to fit into automatic operation of the plant.

6. MIXERS

6.1 The mixers shall be free fall tilting type, fitted with abrasion resistant replacable linears and blades conforming to the performance requirements of IS : 1791-1968*. The number and sizes of the mixer shall commensurate

*Specification for batch type concrete mixers (*first revision*).

with the rated output of the plant based on the mixing time indicated in **6.1.1.**

6.1.1 The mixing time for each batch after all materials, except the full amount of water, are in the mixer, provided that all the mixing water shall be introduced before one-fourth the mixing time has elapsed, shall be as follows:

Capacity of Mixer m^3	*Time of Mixing* min
Up to 2	$1\frac{1}{2}$
,, ,, 3	2
,, ,, 4	$2\frac{1}{2}$

6.1.2 The minimum mixing periods specified are based on standard speed of rotation of the mixer and of the introduction of the materials, including water into the mixer. Mixing time shall be increased if and when the charging and mixing operations fail to produce a concrete batch which conforms throughout with the foregoing requirements with respect to adequacy of mixing.

6.2 The concrete as discharged from the mixer shall be uniform in composition and consistency throughout the mixed batch and from batch to batch, except where changes in composition or consistency are required.

6.3 Mixers in centralized batching and mixing plants shall be so arranged that mixing action in the mixers can be observed from a location convenient to the mixing plant operator's station. In such plants the consistency of concrete during the mixing process shall also be recorded on the chart as mentioned in **5.3.3.**

6.4 Each mixer shall be equipped with a mechanically or electrically operated timing and signalling (or locking) and metering device which will indicate and assure the completion of the required mixing period.

6.5 Each mixer shall be complete with electric drive motor and starter, air or hydraulic operated tilting rams, controls, consistency indicators, etc. The operation of the mixer shall be controlled from the central control panel of the plant having necessary indication lights for the entire operation and adjustable mixing timers for each mixer. The arrangement for feeding the mixers shall not have any spillage or leakage of water or cement. Each mixer shall hold a full capacity batch concrete of the required consistency without undue spilling during rotation. The mixed concrete shall be discharged into concrete hopper. From the hopper, it shall be dumped into customer's concrete trucks or cars mounted on rails under-neath the plant. For that purpose, clearance of about 3·5 m height or as required by the purchaser shall be provided under-neath from the ground for the traffic of concrete carriers.

6.6 The concrete hopper shall also be provided with concrete sampling device for taking samples of wet concrete for laboratory tests.

7. CONTROL PANEL

7.1 In case of fully automatic plant, it shall have automatic desk type, single operator, push-button control panel completely inter-wired and having the following provisions:

a) *Front Located Weight Dials* — for each material, or as required.

b) *Complete Range of Push Buttons and Indication Lights for Batching* — that is, master batch and discharge switches, automanual selector switch, manual batch and discharge push buttons, etc. The operation of batching will be so designed that with a single master batch switch, all the constituents of the batch, that is, aggregates, cement, water admixtures ice, etc, shall be automatically batched and shall be discharged into the mixer in the desired sequence with a master discharge push button.

Necessary individual switches for manual batching and discharge of each material shall also be provided. Batching time for the completed batch for automatic operation shall be clearly indicated.

c) *Quick Mix Selector* — unit comprising at least 6 pre-set selections. Pre-setting of various mix formulae shall be simple and easy.

d) *Admixtures Batch Controls*

e) *Automatic and Individual Counters* — for each mix and also the Totalizer Counter.

f) *Truck Dump Light* — The light shall be turned on from ground when a truck is in position and will automatically go off when the mixer has been dumped. The discharge of the mixer shall be interlocked with the dump light for this arrangement.

g) *Partial Batch Selector Switch* — to batch proportioned materials between 0 to 4 m^3 (may be quoted as an extra optional, if not provided as standard arrangement on the control panel).

h) *Complete Range of Push Buttons and Indicator Lights for the Mixers* — The mixer shall automatically stop and give a ready light, when it has taken the pre-set mixing time. Indicator lights shall include such 'tilt', 'right', 'ready' and start and stop, dump buttons, etc, for the mixing system.

j) *Separate Mixing Time* — timers having a range of 0 to 10 minutes minimum for each mixer.

k) *Batch and Consistency Recorders*

m) *Current Meter for Each Mixer*

n) *Mixer Charging Chute Operation and Control Push Buttons and Position Indicator Light* — for each mixer charge.

p) *Moisture Indicator for Sand*

q) *Necessary Interlocks for Automatic and Safe Operation of the Plant* — All relays used be of heavy duty construction. The panel shall be made of dust-proof cabinet. All the weighing scales and linkages shall have strong vibration free connection at the panel. The control panel and other controls shall be centralized in one control room for the plant.

r) *Any Other Controls* — or fittings as per latest design and practice for mass concrete plants.

7.2 In case of manual or semi-automatic plants, the purchaser shall specifically indicate as to which of the items given in **7.1** would be required for the plant.

8. WATER RE-COOLING SYSTEM (OPTIONAL)

8.1 When it is proposed to use chilled water during mixing, necessary refrigeration equipment shall be quoted capable of cooling water for mixing of concrete as required. The chilled water storage tank shall be suitably located so as to keep on automatically feeding interim water storage tank of the water batcher. The capacity of the chilled water plant shall commensurate with the rated out-turn of concrete of the batching and mixing plant. The refrigeration equipment shall be a complete unit in all respects and shall include compressor using liquid ammonia as refrigerant, driving gear, motor and starter for the compressor, water cooler, condenser, purger, necessary safety controls and automatic cut outs for temperature and pressure, gauges, thermometers, etc. The motor shall be slip ring induction totally enclosed fan cooled type. Consideration shall be given to the ambient temperatures occuring at site and the insulation shall be suitable to withstand the tropical conditions.

NOTE — The customer shall supply in advance complete information in respect of climatology of the site, generally in the following form:

a) Height above sea level,

b) Maximum ambient temperature,

c) Minimum ambient temperature,

d) Average rainfall, and

e) Maximum temperature of water for the condensers and cooling of compressors.

8.2 Under critically cold conditions and, if so required by the purchaser, suitable arrangements for heating of mixing water or other arrangements for controlling the temperature of concrete shall be provided.

9. MATERIAL FEEDING AND ELEVATING ARRANGEMENTS

9.1 Suitable arrangements may be provided for elevating cement and aggregates to the respective compartment bins of the batching plant. This may be by means of bucket elevator or by pumping of cement from the storage silos, and belt conveyor system for the aggregates, or any other equally efficient arrangement. When these arrangements are to be made by the customer, it should be stated in the enquiry or order.

10. GENERAL REQUIREMENTS

10.1 Irrespective of the foregoing specifications for the plant, which are broad-based and generalized, the manufacturer or supplier shall ensure that whole of the equipment shall be complete with all the fixtures, fittings, accessories and any other erection material though not specifically detailed in the specifications. The manufacturer or supplier shall not be liable for any extra amount in respect of such accessories required for the efficient operation of the plant, even though these may not have been included in the specifications.

10.2 The electrical equipment shall be complete with starters for various motors and all internal wiring and cables and shall conform to the requirements of relevant Indian Standards. All motors shall be totally-enclosed fan-cooled, squirrel-cage slip ring induction type, and entire equipment capable of satisfactory operation in tropical conditions. All solenoid and air valves of the plant shall be provided with automatic oiler unit in the air lines.

10.3 In case the steel structure for the plant is to be fabricated by the customer locally with his own materials, necessary drawings based on customer's materials, for structure shall be furnished by the manufacturer of the plant in duplicate, at least 3 months before the stipulated date of delivery of the plant, so that the structure is fabricated for erection before the delivery of the plant. Such structures shall generally comprise of all or some of the following:

a) Complete bin structure of the plant with the supporting columns and supporting structure for the mixers,

b) Concrete dump hopper,

c) Sheeting steel and insulation of the entire plant,

d) All stairs, ladders and railings,

e) Structure for cooling or heating arrangements for concrete or mixing water arrangements or both, and

f) Any other items the manufacturer may propose to complete.

10.3.1 Notwithstanding the requirements of **10.2**, the manufacturer shall be responsible that the plant forms a complete working unit of desired

efficiency, using the items supplied by the manufacturer as well as those items agreed for manufacture and supply by the customer.

10.3.2 Erection bolts for the bins and supporting structures and foundation bolts shall be provided by the customer, but the sizes and type thereof shall be intimated in advance by the manufacturer.

10.4 At the time of offering the equipment, the manufacturer shall furnish a complete set in triplicate of operation and maintenance manuals, spare parts catalogue and any other relevant literature required for the plant. The manufacturer shall also supply duplicate set of drawings of all installation and erection details, foundation plans, control wiring diagrams, etc.

10.5 The manufacturer shall give complete specifications of the plant and equipment offered, and enclose complete illustrations and technical literature thereof.

10.6 The manufacturer or supplier shall furnish price list of recommended spare parts for normal 2 year operation (5 000 working hours).

10.7 The price of the following items shall be indicated separately as optional items:

a) Concrete cooling or heating system,

b) Water re-cooling or heating system or both, and

c) Aggregate belt conveyor drive system.

10.8 When erection of the plant and all civil engineering works including foundations in connection with the erection and working of the plant are to be done by the purchaser, the manufacturer shall provide technical guidance for the same. The manufacturer shall also provide to the user, technical advice during commissioning and trial runs of the plant.

10.9 The customer shall indicate in advance to the manufacturer or supplier, the characteristics of the available electric supply at the project. The customer shall also indicate the pressure at which air would be available at the mains at the project.

11. GUARANTEE AND WORKMANSHIP

11.1 Notwithstanding any qualification by the customer, the ultimate responsibility for the supply of complete plant and its satisfactory performance and out-turn shall rest with the supplier and he shall guarantee against any defect in the plant, either in design, material or workmanship. The plant and equipment supplied shall be a complete unit and shall conform to high standards of engineering design and workmanship.

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Gangotri Complex, 5th Floor, Bhadbhada Road, T.T. Nagar, BHOPAL 462003	55 40 21
Plot No. 82/83, Lewis Road, BHUBANESHWAR 751002	5 36 27
Kalai Kathir Building, 6/48-A Avanasi Road, COIMBATORE 641037	2 67 05
Quality Marking Centre, N.H. IV, N.I.T., FARIDABAD 121001	—
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	3 31 77
5-8-56C L. N. Gupta Marg, (Nampally Station Road) HYDERABAD 500001	23 10 83
R14 Yudhister Marg, C Scheme, JAIPUR 302005	6 34 71
117/418 B Sarvodaya Nagar, KANPUR 208005	21 68 76
Plot No. A-9, House No. 561/63, Sindhu Nagar, Kanpur Road, LUCKNOW 226005	5 55 07
Patliputra Industrial Estate, PATNA 800013	6 23 05
District Industries Centre Complex, Bagh-e-Ali Maidan, SRINAGAR 190011	—
T. C. No. 14/1421, University P. O., Palayam, THIRUVANANTHAPURAM 695034	6 21 04

Inspection Offices (With Sale Point) :

Pushpanjali, First Floor, 205-A West High Court Road, Shankar Nagar Square, NAGPUR 440010	52 51 71
Institution of Engineers (India) Building, 1332 Shivaji Nagar, PUNE 411005	5 24 35

*Sales Office Calcutta is at 5 Chowringhee Approach, P. O. Princep Street, CALCUTTA	27 68 00
† Sales Office is at Novelty Chambers, Grant Road, BOMBAY	89 65 28
‡ Sales Office is at Unity Building, Narasimharaja Square, BANGALORE	22 39 71

Reprography Unit, BIS, New Delhi, India