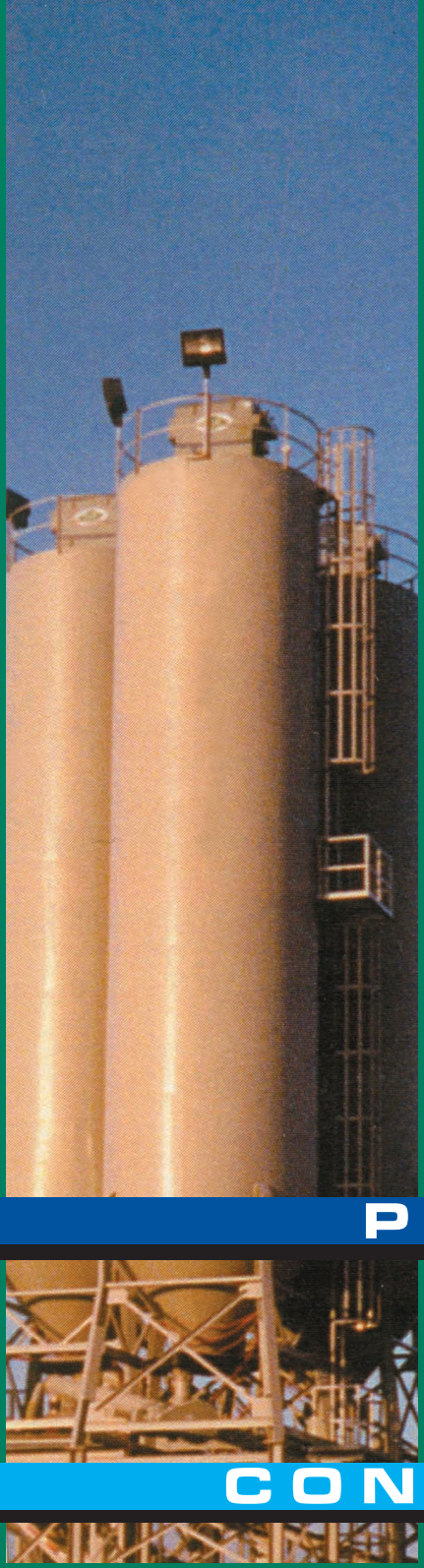
METRIC

Concrete Plant Standards

of the Concrete Plant Manufacturers Bureau

First Revision, November 2000



PLANTS

CONTROLS

CONCRETE PLANT CPMB MANUFACTURERS BUREAU

CONTROL SYSTEMS CSMD MANUFACTURERS DIVISION

PLANT MIXER PMMD MANUFACTURERS DIVISION

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PLANT MIXERS

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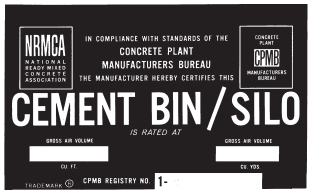

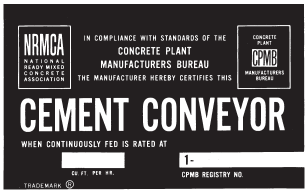

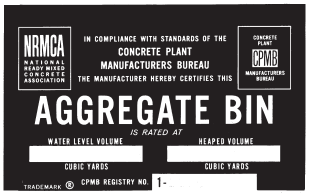

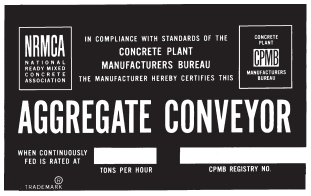

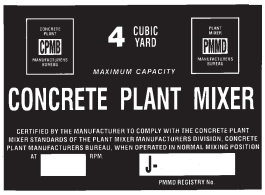

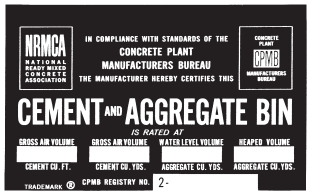

FOREWORD

The **Concrete Plant Mixer Manufacturers Bureau (CPMB)** is an organization composed of companies directly involved in the design, manufacture and sale of concrete plants and components thereof. The function of the CPMB is to establish minimum standards for rating various components of concrete plants for the protection of and assurance to the user that the plated components of the plants conform to these Standards. The CPMB also provides a means for mutual consideration of matters common to the concrete industry whereby concrete plant technology, user services, agency specifications and related common problems can better be served through coordinated efforts of the members of the CPMB and its Divisions.

The **Control Systems Manufacturers Division (CSMD)** of the CPMB is an organization composed of manufacturers directly involved in the design, manufacture and sale of controls for concrete batching plants. The CSMD establishes minimum standards for rating control systems for concrete plants - Part 2 of these Standards.

The **Plant Mixer Manufacturers Division (PMMD)** of the CPMB is an organization composed of companies directly involved in the design, manufacture and sale of concrete plant mixers. The function of the PMMD is to establish minimum standards for rating concrete plant mixers - Part 3 of these Standards.

The **Air Quality Manufacturers Division (AQMD)** of the CPMB is composed of manufacturers directly involved in the design, manufacture and sale of air quality equipment for concrete batching plants. Standards for these components of concrete plants are under development.

INTRODUCTION

Members of the CPMB and its Divisions attach rating plates to components of concrete plants as allowed by these Standards. The rating plates serve to indicate that the component conforms to the requirements of these Standards. Rating plates for plant mechanical equipment may be attached to items listed in Part 1 of these Standards.

Members of the CSMD attach rating plates to components of control systems for concrete plants listed in Part 2 of these Standards.

Members of the PMMD attach rating plates to concrete mixers to specify the maximum mixing capacity to standard sizes as indicated in Part 3 of these Standards. The rating plate on a concrete mixer does not guarantee that the mixer will mix concrete at the rated capacity under all actual field conditions, but that it meets the requirements for volumetric requirements in Table 3.1M of these Standards.

Rating plates guarantee that components of concrete plants that have them attached conform to the requirements of these Standards established and unanimously agreed upon by all members of the CPMB and its Divisions. These methods continue to represent industry practice and are used by all members of CPMB, whose membership represents the majority of concrete plant manufacturers.

These standards provide useful tables, formulas and considerations, so that the purchaser who is concerned with the actual performance can depend on these standards as a guide in the selection of concrete plant components. In addition these standards include rating criteria, methodology, formulas and available sizes of concrete plant components currently used by the industry.

Current Edition approved November 4, 2000, originally published September 1, 1996. CPMB 100 in U.S. Customary Units originally published March 1, 1960.

Part 3 of these Standards was previously published in US Customary Units as PMMD 100-96 *Concrete Plant Mixer Standards of the Plant Mixer Manufacturers Division, Concrete Plant Manufacturers Bureau*, Seventh Revision, April 17, 1996, originally published January 1, 1966.

See companion Standard CPMB 100-00 for US Customary Units.

Concrete Plant Standards of the Concrete Plant Manufacturers Bureau
CPMB 100M-00

Twelfth Revision - Effective November 4, 2000

PURPOSE

These Standards have been prepared for the information of users of concrete plant equipment, including plants, controls and plant mixers. They have been established pursuant to Articles VI-VII of the Bylaws of the Concrete Plant Manufacturers Bureau to describe and identify the products and combinations of products manufactured or furnished by members of the Bureau, its Control Systems Manufacturers Division and its Plant Mixer Manufacturers Division, and to standardize rated capacities, the basis for determining rated capacities, and certain other features of concrete plant components, control systems and plant mixers.

EFFECTIVE DATE

These revised Standards shall become effective on November 4, 2000. Members of the Bureau shall attach rating plates to all eligible equipment shipped thereafter and certified by them as complying with these Standards. Equipment shipped prior to November 4, 2000 shall be subject to the Concrete Plant Standards in effect at time of shipment. Equipment shipped prior to March 1, 1960 shall not be entitled to a rating plate.

CERTIFICATION

A copyrighted rating plate furnished by the Bureau shall be attached to those eligible items of concrete plant equipment shipped by a member of the Bureau, its Control Systems Manufacturers Division and Plant Mixer Manufacturers Division and certified by the company as complying with these Standards. The rating plate shall define size, capacity or performance. Each member of the Bureau shall execute annually the following stipulation:

"Our company hereby certifies that rating plates of the Concrete Plant Manufacturers Bureau have been attached during the year just ended and will be attached in the forthcoming year to eligible items of concrete plant equipment which conform to the Standards of the Bureau and only to such eligible items."

This stipulation shall be signed by an authorized officer of the member company. Any member company shall furnish the Bureau, upon request, structural drawings, steel design computations and any other information pertinent to determining that items of equipment conform to these Standards.

SCOPE

These Standards specify requirements for concrete plant, controls and plant mixer equipment eligible to be designated as standard by the Concrete Plant Manufacturers Bureau.

GOVERNING UNITS

The values stated in SI units are to be regarded as the standard. The US Customary equivalent values given in parenthesis are for information only. See CPMB 100-00 for the version of this standard in US Customary units.

PART 1 — Plant Mechanical Equipment

PART 2 — Plant Control Systems

PART 3 — Plant Mixer Equipment

Part 1 - Plant Mechanical Equipment

Concrete Plant Standards of the Concrete Plant Manufacturers Bureau

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1. SPECIFICATIONS FOR EQUIPMENT

The following items of equipment covered by these Standards are eligible to have rating plates attached to them:

- **batchers for aggregates,**
- **batchers for cement or cementitious materials,**
- **batchers for water,**
- **bins for aggregates,**
- **bins or silos for cement or cementitious materials,**
- **bins for both aggregate and cement or cementitious materials,**
- **belt conveyors for aggregates,**
- **bucket elevators for aggregates,**
- **bucket elevators for cement or cementitious materials,**
- **other conveyors for cement or cementitious materials.**

Rating plates are not furnished for the following items of equipment covered by these standards:

- **water meters,**
- **admixture batching equipment.**

Items of equipment eligible to be designated as standard shall conform to the applicable requirements set forth hereafter in these Standards.

1.1. Bins or Silos. A bin or silo shall consist of a suitable container for storing aggregates or cement and cementitious materials and, in the case of the latter, protecting it from moisture. Bins or silos shall be designed structurally in accordance with the current specifications of the American Institute of Steel Construction.

1.1.1. Bins, Aggregate. Aggregate bins shall be structurally designed to contain the rated capacity plus heaping, based on material weighing 1760 kg/m^3 (109.9 lb/ft^3). Rated capacities, as shown on the rating plate, shall be stated in terms of cubic meters (yd^3) of bin volume at the bin water level. Bin water level shall be the sum of water level volumes of each individual compartment in the bin. In addition, rated capacities may be stated in terms of cubic meters (yd^3) of heaped volume. The heaped volume shall not exceed the

lowest bin water level volume plus the volume represented by the frustum of a cone or pyramid above that water level, sloping from the perimeter of the bin at an angle of 40 degrees from the horizontal, to a vertical height equal to 25 percent of the minimum width of the bin at the lowest water level line. Rated capacities may also be stated in metric tons (1.10 short tons) based on material weighing 1600 kg/m^3 (99.9 lb/ft^3)

1.1.2. Bins or Silos, Cement. Cement bins or silos shall be designed to contain rated capacity loads of material weighing 1500 kg/m^3 (94 lb/ft^3). Rated capacity as shown on the rating plate shall be stated in terms of cubic meters (yd^3) of gross air volume. In addition, they may be stated in metric tons, based on 1.2 metric tons of partially aerated cement per m^3 of gross air volume (one short ton equal to 1 yd^3).

1.1.3. Multiple Compartment Cement and Fly Ash Bin or Silo. Any multiple compartment bin or silo for storage of fly ash and cement constructed after January 1989, shall have a fly ash compartment with double walls separating it from other compartments for cementitious materials. Such double walls shall be constructed in a manner that permits detection of leakage of the cementitious materials by manual inspection.

1.1.4. Bins, Combination. Bins for the storage of both aggregates and cement shall be designed and their capacities computed and stated on the rating plate separately for aggregates and cement in accordance with the applicable provisions of Paragraphs 1.1.1 and 1.1.2 above.

1.2. Conveying Equipment. All conveyor capacities, as shown on the rating plate, shall be based on the equipment being uniformly and continuously fed.

1.2.1. Belt Conveyors for Aggregates shall conform to the current Standards of the Conveyor Equipment Manufacturers Association. Rated capacities, as shown on the rating plate, shall be stated in metric tons per hour (tons per hour) assuming the material to weigh 1600 kg/m^3 (99.9 lb/ft^3).

1.2.2. Bucket Elevators for Aggregates shall have their rated capacities, as shown on the rating plate, stated in terms of tons per hour (metric tons/hr) computed by assuming that the buckets are filled to 75 percent of their actual volume capacity with material weighing 1600 kg/m^3 (99.9 lb/ft^3).

1.2.3. Bucket Elevators for Cement shall have their rated capacities, as shown on the rating plate, stated in terms of ft^3/hr (m^3/hr) computed on the assumption that the buckets are filled to 100 percent of their water-level capacity.

1.2.4. Other Conveyors for Cement, such as screw conveyors, slides and pumps shall have their rated capacities as shown on the rating plate stated in terms of cubic meteris per hour based on the volumetric capacity rating by the manufacturer of the conveyor.

1.3. Batching Equipment shall provide that:

- cement or cementitious materials shall be batched by weight;
- aggregates shall be batched by weight;
- water shall be batched by weight or volume;
- powdered admixtures shall be batched by weight; and
- liquid admixtures shall be batched by weight or volume.

1.3.1. Scales. Scales for batching shall consist of one of the following:

(1) A lever system suspending the weighing container, and, by means of secondary levers, transmitting reduced loads to a beam scale with balance indicator or a full reading springless dial.

(2) A lever system as in (1) above with a single load cell within the lever system as the primary load indicator and the beam scale or dial as secondary load indicators.

(3) A lever system as in (1) above with either the primary or secondary levers transmitting reduced loads to a single load cell and not having a beam scale or dial.

(4) A multiple load cell system directly supporting the weighing container.

The construction shall conform to the applicable sections of the NIST Handbook 44-96, "Specifications, Tolerances and Other Technical Requirements for Weighing and Measuring Devices," except as herein specified. Methods other than those specifically described in this paragraph, which meet all weighing tolerances and requirements to assure reliability as specified in these standards, are acceptable.

1.3.1.1. Scale Accuracy. When scales are first installed they shall be accurate to the basic tolerance values specified in NIST Handbook 44-96 Section T.N.3.4. The tolerance limit shall be 0.1% of the capacity of the scale.

1.3.1.2. Scale Lever Systems shall be so designed to have a cross carrying capacity sufficient to support the fully loaded weighing container without loss of accuracy or abnormal wear and to have the center of gravity of the gross load on the scale always between the load supports. Scale lever pivots shall be hard, tempered, sharpened and gauged for sustained accuracy. The bearing loops shall be constructed with hardened bearing surfaces. Means shall be provided for leveling, aligning, balancing and calibrating scale systems in the field.

1.3.1.3. Beam Scales. Beams for indicating the load shall include a zero balance beam, a balance indicator and a weighing beam for each ingredient used in any batch. Beams shall be precision constructed devices with properly hardened pivots and bearings capable of holding positive alignment. All poises shall have positive and accurate holding devices. All wearing parts of poises shall be hardened and protected against corrosion. The clear interval between beam graduations shall not be less than 0.76 mm (0.03 in.). The balance indicator shall be sufficiently sensitive to show movement when a weight of 0.1 percent of the scale capacity is placed in the batch hopper. Pointer travel shall show a minimum of 5 percent of the net rated capacity of the largest weigh beam for underweight and 4 percent for overweight. A readily adjustable mechanism shall be provided for dampening excessive oscillation of the indicator pointer.

1.3.1.4. Dial Scale. A dial scale mechanism shall be enclosed so as to be dust-tight. The dial pointer shall indicate the load in the batcher continuously from zero balance to the scale capacity. The chart shall be of durable material to ensure good readability. Charts used on the primary dial attached to the scale shall have a minimum of 1000 graduations placed on a circular reading line with a clear interval of not less than 0.76 mm (0.03 in.).

1.3.1.5. Load Cell Systems shall be so designed to have a gross carrying capacity sufficient to support the fully loaded weighing container without a loss of accuracy or abnormal wear and to have the center of gravity of the gross load on the scale always between the load supports. A single load cell may be used with a scale lever system, or multiple load cells may be used to support a weighing container. Load cell supports shall be designed to prevent any lateral or other nonaxial forces. Load cells shall be sealed for environmental protection. Load cell systems shall be designed to resist

(a) moisture,

(b) leakage,

(c) damage from overload or shock,

(d) drift from high voltage or high temperature,

(e) line noise or radio frequency interference.

A load cell system shall include a convenient means to allow the operator to check the condition and proper functioning of both the load cell circuit and the signal conditioning and load display circuit. A means may be provided to automatically check these circuits on a more frequent basis. Digital weight indicators shall be capable of reading full scale capacity and a maximum weight indication of 0.1 percent of full scale capacity. Digital indications shall be clear, definite, accurate and easily read under all conditions of normal operation.

1.3.2. Batchers, General. A batcher shall consist of a suitable container for weighing an ingredient for concrete. A combination of aggregates or a combination of cements (or cement and other cementitious materials) may each be considered as a single ingredient. Aggregates and cement or cementitious materials shall not be weighed in the same batcher. Each batcher shall be equipped with a scale and also with the necessary mechanisms for its operation. The charging device shall be capable of stopping the flow of material within the weighing tolerances specified in these Standards. Charging and discharging devices shall not permit loss of materials when closed. The discharge device shall be capable of controlling the rate of flow of the material.

When furnished, vibrators, or other aids to charging and discharging, shall be attached in such a manner that they will not affect accuracy of weighing.

The batcher shall be so designed and of such capacity that it will receive its rated load without the weighed materials being in contact with the charging mechanism.

The criteria to qualify batchers for rating plates are based on minimum volumetric capacities.

Volumetric capacities may exceed the minimum requirements. In use, the rated batcher capacity may be exceeded providing the load does not:

(a) exceed the scale capacity,

(b) overflow the batcher,

(c) affect the scale by the closing of the charging device.

The rated batcher capacities in Column 1 of Table 1.1M and Column 1 of Table 1.2M for aggregate and cementitious materials, respectively, are the standard sizes and are required to have rating plates attached. These rated capacities are stated in terms of the volume of concrete produced in a single batch.

1.3.2.1. Batchers, Aggregate. Individual batchers shall be rated separately at their maximum single batch capacity rather than indicating the total batch resulting from the use of all batchers.

The minimum volume of the batcher in m^3 (ft^3), calculated from dimensioned drawings, shall be equal to its rated batcher capacity multiplied by 1.407 (38) (See Table 1.1M).

The volume of the batcher shall be calculated on two bases, the lesser of which shall govern, as follows:

(a) based on an angle of repose for the aggregates of 30 degrees from the horizontal measured from the bottom of all charging mechanisms; or

(b) based on actual water level capacity.

There shall be sufficient clearance above aggregate batchers to permit convenient removal of overload.

The reading face capacity or the sum of weigh-beam capacities of a scale on an aggregate batcher shall be not less than 2000 kg/m^3 (3,370 lb/yd^3) of rated batcher capacity.

1.3.2.2. Batchers, Cement (Cementitious Materials). The minimum volume of the batcher in m^3 (ft^3), calculated from dimensioned drawings, shall be 0.09 m^3 (3 ft^3) to allow for fluffing and variations in filling, plus 1/3 of the rated capacity of the plant in m^3 (9 times the yardage rating). (See Table 1.2M).

Cement batchers shall be provided with a dust seal between the charging mechanism and the batcher installed in such a manner that it will not affect the accuracy of weighing. The batcher shall be vented to permit escape of air. It shall be self-cleaning and may be fitted with a vibrator to ensure complete discharge.

The reading face capacity or the sum of weigh-beam capacities of a scale on a cement batcher shall be not less than 400 kg/m^3 (674 lb/yd^3) of rated batcher capacity.

It is recognized that mass concrete work for dams, etc., requires special rating based on a minimum of 200 kg/m^3 (337 lb/yd^3).

The above volumes and scale capacities are not applicable to individual batchers for cementitious materials other than cement.

1.3.2.3. Batchers, Water. Scales for measuring the water may be graduated either in kg (pounds) or liters, L, (U.S. gallons) or both.

The minimum volume of the batcher tank, calculated from dimensioned drawings, shall be not less than its rated batcher capacity. Any water batcher shall have a volume providing not less than 200 L/m^3 (40.4 gal/yd^3) of concrete to be produced in a single batch.

The reading face capacity or the sum of weigh-beam capacities of a scale on a water batcher shall be not less than 200 kg/m^3 or 200 L/m^3 (337 lb/yd^3 or 40.5 gal/yd^3) of rated batcher capacities.

1.3.3. Water Meters shall not be furnished with a rating plate and shall conform to the Standards of the American Water Works Association, except as herein specified. The metering equipment, in addition to the meter, shall include:

(1) A cut-off device capable of stopping the flow within the accuracy tolerances specified in these Standards. The cut-off device shall be free from leaks when closed;

(2) A strainer of a size and porosity as is recommended by the meter manufacturer;

(3) A register integral with the meter or a separate device to indicate the volume batched, at any point in the metering operation;

(4) A volume setting device capable of being set 5 L (1.3 gal) increments, or a register capable of being read to 5 L (1.3 gal) or both;

(5) Capability for field adjustment for purposes of calibration.

1.3.4. Dispensing Equipment for Admixtures. Admixture dispensing equipment furnished by the plant manufacturer shall not be furnished with a rating plate but shall be subject to the following specifications: powdered admixtures shall be batched by weight, liquid admixtures may be batched by weight or volume and the specifications shall be applicable only for dispensing admixtures having a minimum recommended dosage rate of 65 mL per 100 kg (1 oz. per 100 lb) of cement; or for concentrated additives that have been reconstituted to the point where the dosage rate is 65 mL per 100 kg (1 oz per 100 lb) of cement.

The batching or dispensing devices shall be capable of repetitively controlling the batching of the admixture to the accuracy tolerances specified in these Standards. Piping for liquid admixtures shall be free from leaks and properly valved to prevent backflow or siphoning.

A separate dispenser is recommended for each admixture, although multiple use of dispensing controls is permitted and compatible admixtures may be stored in the same holding or checking reservoir after batching and prior to introduction into the mixer. If, contrary to this recommendation, the same dispensing equipment is used for non-compatible admixtures, the common device shall be flushed at the end of each cycle.

1.3.4.1. Admixture Batchers. Scales for admixture batchers may be graduated by weight or volume, with the minimum graduation being the amount or weight of the admixture required per 100 kg (per 100 lb) of cement.

Admixtures that are compatible may be cumulatively weighed in the same batcher providing the accuracy of batching of each is equivalent to the accuracy of batching required by these Standards when each is batched individually.

Liquid admixtures that are compatible may be cumulatively weighed with the water providing that the accuracy of batching of each is equivalent to the accuracy of batching required by these Standards when each is batched individually.

1.3.4.2. Volumetric Admixture Dispenser. All admixture dispensing equipment other than weigh batchers shall be classified as volumetric dispensers.

All volumetric dispensers shall be used only for liquid admixtures and each plant shall be equipped with the necessary calibrated devices that will permit convenient checking of the dispensed volume to the required accuracy of the particular admixture.

The dispensing system shall include a device or devices that shall either detect and indicate the presence or absence of flow of the admixture, or detect and indicate the presence or absence of the admixture, or provide a convenient means of visually observing the admixture in process of being batched or discharged.

1.3.5. Accuracy for Batching for equipment covered by these Standards shall be as follows:

1.3.5.1. For Individual Batchers, the following tolerance values shall apply based on the required scale reading:

Cement and other Cementitious Materials[1] —

±1% of the required weight of materials being weighed OR ±0.3% of scale capacity, whichever is greater

Aggregates —

±2% of the required weight of material being weighed OR ±0.3% of scale capacity, whichever is greater

Water —

±1% of the required weight of material being weighed OR ±0.3% of scale capacity, whichever is greater

Admixtures —

±3% of the required weight of material being weighed OR ±0.3% of scale capacity, OR ± the minimum dosage rate per 100 kg (per 100 lb) of cement, whichever is greater.

1.3.5.2. For Cumulative Batchers With A Tare Compensated Control (see 2.1.4), the tolerances of Paragraph 1.3.5.1 shall apply based on the required weight of each material.

1.3.5.3. For Cumulative Batchers Without a Tare Compensated Control (see 2.1.4.), the following tolerances shall apply to the required cumulative weight:

Cement and other Cementitious Materials or Aggregates —

±1% of the required cumulative weight of material being weighed OR ±0.3% of scale capacity, whichever is greater

Admixtures —

±3% of the required cumulative weight of material being weighed OR ±0.3% of scale capacity, OR ± the minimum dosage rate per 100 kg (per 100 lb) of cement as it applies to each type of admixture, whichever is greater.

1.3.5.4. For Volumetric Batching Equipment the following tolerances shall apply to the required volume of material being batched:

Water -

±1% of the required volume of material being batched OR ±5 L (1.3 gal), whichever is greater

Admixtures -

±3% of the required volume of materials being batched OR ± the minimum recommended dosage rate per 100 kg (per 100 lb) of cement, whichever is greater.

1.3.5.5. Range of Accuracy. For ingredients batched by weight the accuracy tolerances required of the batching equipment shall be applicable for batch quantities between 10% and 100% of scale capacity.

For water or admixtures batched by volume, the required accuracy tolerances shall be applicable for all batch sizes from minimum to maximum, as is determined by the associated cement or aggregate batcher rating. (See Table 1.1M).

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[1] *Other cementitious materials are considered to include fly ash, ground granulated blast furnace slag, and other natural or manufactured pozzolans.*

Table 1.1M

Standard Aggregate Batcher Sizes and Minimum Required Volumetric Capacity in SI Units.

Note: SI Sizes are Standard. US Customary values are approximate and are only provided as information.

Standard SI Sizes			Nearest US Customary Size[3]	
Rated Capacity, m^3 [1]	Minimum Volume[2]		Rated Capacity, yd^3 [1]	Minimum Volume, ft^3 [2]
	Standard, m^3	Approximate, ft^3		
0.375	0.528	18.6	½	19
0.75	1.056	37.3	1	38
1	1.407	49.7	1½	57
1.5	2.11	75	2	76
2	2.81	99	3	114
3	4.22	149	4	152
3.5	4.93	174	4½	171
4	5.63	199	5	190
4.5	6.33	224	6	228
5	7.04	249	7	266
6	8.44	298	8	304
7	9.85	348	9	342
7.5	10.56	373	10	380
8	11.26	398	11	418
9	12.67	447	12	456
10	14.07	497	13	494
11	15.48	547	14	532
11.5	16.19	572	15	570
12	16.89	596	16	608

[1] of plant in m^3 or yd^3 of concrete.
[2] of volumetric space in an aggregate batcher.
[3] see the companion standard, CPMB 100.

Table 1.2M

Standard Cementitious Material Batcher Sizes and Minimum Required Volumetric Capacity in SI Units.

Note: SI Sizes are Standard. US Customary values are approximate and are only provided as information.

Standard SI Sizes			Nearest US Customary Size[3]	
Rated Capacity, m^3 [1]	Minimum Volume[2]		Rated Capacity, yd^3 [1]	Minimum Volume, ft^3 [2]
	Standard, m^3	Approximate, ft^3		
0.375	0.215	7.6	½	7.5
0.75	0.340	12.0	1	12.0
1	0.42	14.9	1½	16.5
1.5	0.59	20.8	2	21.0
2	0.76	26.7	3	30.0
3	1.09	38.5	4	39.0
3.5	1.26	44.4	4½	43.5
4	1.42	50	5	48
4.5	1.59	56	6	57
5	1.76	62	7	66
6	2.09	74	8	75
7	2.42	86	9	84
7.5	2.59	91	10	93
8	2.76	97	11	102
9	3.09	109	12	111
10	3.42	121	13	120
11	3.76	133	14	129
11.5	3.92	138	15	138
12	4.09	144	16	147

[1] of plant in m^3 or yd^3 of concrete.
[2] of volumetric space in a cement or cementitious material batcher.
[3] see the companion standard, CPMB 100.

Part 2 - Plant Control Systems

Concrete Plant Standards of the Concrete Plant Manufacturers Bureau

Control Systems Manufacaturers Division

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2. SPECIFICATIONS FOR EQUIPMENT

The following items of equipment covered by these Standards are eligible to have rating plates attached to them:

- **semi-automatic batching control for an individual batcher,**
- **semi-automatic interlocked batching control for an individual batcher,**
- **automatic batching control for an individual batcher,**
- **partially automatic batching system for multiple batchers and volumetric devices,**
- **semi-automatic batching system for multiple batchers and volumetric devices,**
- **automatic batching system for multiple batchers and volumetric devices,**
- **recorders.**

Rating plates are not furnished for the following items of equipment covered by these Standards:

- **manual batching controls,**
- **manual batching systems.**

Items of equipment eligible to be designated as standard shall conform to the applicable requirements set forth hereafter in these Standards.

2.1. Batching Controls and Systems. Batching controls are that part of the batching equipment that provides the means for controlling the batching device for an individual material. They may be mechanical, hydraulic, pneumatic, electrical, etc. or a combination of these means.

A batching system is a combination of batching controls necessary to proportion the ingredients for concrete. A batching system may consist of controls for batching cement and aggregate only, if the mixing water is not added at the batching plant. Volumetric admixture batching controls are included in the scope of these Standards only when they are a part of a batching system.

Batching controls or systems shall be so located with respect to the batching equipment being controlled that visual monitoring for accuracy, calibration of controls and manual batching can be accomplished. If manual batching is not normally done, monitoring devices shall be sufficiently accurate to detect an error equal to the specified tolerance when a batch equal to the rated size of the batcher is batched.

Where batching controls or systems are remotely located with respect to the batching equipment and manual batching is not normally done, monitoring devices shall be sufficiently accurate to detect an error equal to the specified tolerance when a batch equal to the rated size of the batcher is batched.

Where batching controls or systems are remotely located with respect to the batching equipment, follower scales or other remote monitoring devices may be used for manual batching if they repeat the reading of the master scale within ±0.2% of scale capacity.

2.1.1. Manual Controls shall not be furnished with a rating plate. Manual control exists when the batching devices are actuated manually with the accuracy of the batching operation being dependent on the operator's visual observation of a scale or volumetric indicator. The batching devices may be actuated by hand or by pneumatic, hydraulic, or electrical power assists.

2.1.2. Semi-Automatic Batcher Controls shall be furnished with rating plates only when ingredients are weighed. This rating plate is to be used only for an individual batcher control. When actuated by one or more starting mechanisms, a semi-automatic batcher control shall start the weighing operation of each material and stop automatically when the designated weight of each material has been reached. No interlocks are required.

2.1.3. Semi-Automatic Interlocked Batcher Controls shall be furnished with rating plates only when ingredients are weighed. This rating plate is to be used only for an individual batcher control. When actuated by one or more starting mechanisms, a semi-automatic interlocked batcher control shall 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 the discharge device cannot be actuated until the indicated material is within the applicable tolerances.

2.1.4. Automatic Batcher Controls shall be furnished with rating plates only when ingredients are weighed. This rating plate is to be used only for an individual batcher control. When actuated by a single starting signal, an automatic batcher control shall 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:

(1) The charging device cannot be actuated until the scale has returned to zero balance within ±0.3% of the scale capacity;

(2) The charging device cannot be actuated if the discharge device is open;

(3) The discharge device cannot be actuated if the charging device is open; and

(4) The discharge device cannot be actuated until the indicated material is within the applicable tolerances.

A tare compensated control is one that treats the start of the weighing of each ingredient as zero.

For cumulative batchers with tare compensated controls, interlocked sequential controls shall be provided, and the applicable tolerances shall apply to the required weight of each individual material.

For cumulative batchers without tare compensated controls, interlocked sequential controls shall be provided, and the applicable tolerances shall apply to the required cumulative weight of material as batched.

2.1.5. Automatic Volumetric Controls for water or admixtures shall not be furnished with rating plates. When actuated by a single starting signal, automatic volumetric controls shall start the batching operation and stop automatically when the designated volume has been reached. The batching control shall include visual means of observing either the quantity sent or the quantity batched and the indication of the completion of the batching operation.

2.1.6. A Manual Batching System shall consist of the required combination of individual manual batcher controls and shall not be furnished with a rating plate.

2.1.7. A Partially Automatic Batching System shall consist of the required combination of batching controls, at least one of which shall be for controlling the cement or aggregates, either semi-automatically or automatically. Inclusion of admixture controls is optional. This system shall be furnished with a rating plate. Interlocking in any degree shall be optional.

2.1.8. A Semi-Automatic Batching System shall consist of the required combination of semi-automatic interlocked batching controls or of semi-automatic interlocked and automatic batching controls. This system shall be furnished with a rating plate. Inclusion of admixture controls is optional, unless the admixture batching is initiated by the act of batching one of the other ingredients. Interlocking in any degree shall be optional.

2.1.9. An Automatic Batching System shall consist of the required combination of automatic batching controls and be furnished with a rating plate only when meeting the following requirements:

2.1.9.1. All batching equipment in the system for batching ingredients by weight must be activated by a single starting mechanism. A separate starting mechanism is permitted for volumetric batching of water and/or admixtures not batched at the time of weighing.

2.1.9.2. Each automatic batcher must return to zero tolerance, and each volumetric device must reset to start or signal empty before it may be charged.

2.1.9.3. The discharge of any ingredient in the system may not start unless all batching controls have been cleared of the previous batch with scales returning to zero tolerance and volumetric devices resetting to start or signaling empty. The discharge of any scale may start when all the ingredients weighed on that scale have been batched.

2.1.9.4. Provisions shall be made for adjusting the sequential discharge of the batchers or measuring devices and the rate of discharge of materials.

2.2. Batching Recorders, General. A batching recorder may be either graphic or digital as described in the following paragraphs. All batching recorders shall produce a record of the batch weights or volume of each material requiring recordation, a batch identification or a batch count, day, month, year, time of day to the nearest minute and shall register empty balance. Any automatically produced permanent record, including the above minimum information, shall be considered an acceptable batching record. Target weights, simulated weights or any other weights other than actual batch weights shall be clearly identified as to their representation.

2.2.1. A Graphic Recorder is an instrument that scribes a line on a graphic chart simultaneously with the indication of the scale as the materials are being weighed. Each scale may have its own recorder, or a series of scales may simultaneously record on a single graphic chart. The housing shall be capable of being locked and the batch weights or volumes observed without unlocking. The chart for each scale to be recorded shall not be less than 100 mm (3.9 mm) wide and shall have at least one line for each 2 percent of scale capacity, but not more than one line per millimeter (25 lines per inch). The graphic record shall correspond to the reading on the scale within ± one graduation of the recorder.

2.2.2. A Digital Recorder is an instrument that prints the weight or volume of a material or materials. The recording of each material may be done after each material is properly batched or after the total batch has been properly batched. Each measuring device may have its own recorder or a series of measuring devices may record on the same tape or ticket. A digital recorder shall reproduce the reading of the scale being recorded within ± 0.1% of scale capacity and ± one increment of any volumetric batching device.

2.2.3. A Digital Batch Documentation Recorder shall record the required information for each material in the total batch, identifying each material used along with a mix formula identification, the size of the total batch or load in commercial units, and an identification of the production facilities. Where certain required information is unchanged from batch to batch, it may be preprinted, stamped or written on the record. The load may be identified by a batch count number, a ticket serial number or both. The recorder shall be capable of producing at least two documents. If the recorder is interlocked to an "Automatic Batching System" as defined in these Standards, a single indication of all batching devices meeting the zero or empty balance interlocks shall be sufficient.

2.2.4. A Digital Concrete Certification Recorder shall produce at least two tickets of the batch or load, which in addition to the information required in the preceding paragraphs shall include the percent of sand moisture compensation, identification of the purchaser, his job or project and/or the particular placement location of the concrete. Space shall be provided for the identification of the delivery vehicle (truck number), the driver's signature, the signature of the purchaser or his representative receiving the concrete and the amount of water added on the job.

Part 3 - Plant Mixer Equipment

Concrete Plant Standards of the Concrete Plant Manufacturers Bureau

Plant Mixer Manufacturers Division

TABLE OF CONTENTS

3. SPECIFICATIONS FOR EQUIPMENT

These standards cover fifteen (15) standard sizes in five (5) types of plant mixers that are eligible to have rating plates attached to them.

Plant mixers eligible to be designated as standard shall conform to the applicable requirements set forth hereafter in these Standards.

3.1. Standard Sizes. The sizes listed in Table 3.1M shall be standard for each type shown.

3.2. Volume Limitations. The gross volume of a standard concrete plant mixer shall conform to the following minimum volumes set forth in Table 3.1M. The basis for establishing the minimum volumes for the five mixer types is provided in Appendix A-1.

3.3. Specifications

3.3.1. Size and Mixing Capacity. The size of a mixer shall be its rated maximum mixing capacity. The rated maximum mixing capacity as shown in Table 3.1M is the maximum volume of concrete that can be held and mixed properly when the mixer is operated in its normal mixing position, based on the slump range and maximum aggregate size as indicated in Table 3.2M. However, the manufacturer may provide a data plate on the mixer showing the same or a lower capacity, in which case such limitations shall govern.

3.3.2. Computed Interior Volume. The computed interior volume of the mixing compartment shall be not less than the minimum volume prescribed for its size and type in Table 3.1M.

3.3.3. Water Level Capacity. The water level capacity of the mixing compartment (below a horizontal plane through the lowest edge of the lowest opening that is open while mixing) when the mixer is operating in its normal mixing position shall be not less than 70 percent of the rated maximum mixing capacity prescribed for its size and type in Table 3.1M.

3.3.4. Mixing Speed. A data plate indicating mixing speed in rpm shall be attached to the mixer. The mixing speed shall be as designated by the manufacturer as best suited for the maximum rated capacity.

3.4. Definitions

3.4.1. Concrete Plant Mixer — A machine used to combine cementitious materials, water, aggregates and other ingredients to produce concrete in a batch, and usually operated in a fixed plant location while mixing concrete.

3.4.2. Non-Tilting Mixer — A rotating drum mixer that charges, mixes and discharges with the drum axis horizontal.

3.4.3. Tilting Mixer — A rotating drum mixer that discharges by tilting the drum about a fixed or movable horizontal axis at right angles to the drum axis. The drum axis may be horizontal or inclined from the horizontal while charging and mixing.

3.4.4. Vertical Shaft Mixer — A mixer with an essentially level floor and cylindrical or annular mixing compartment, with one or more vertical rotating shafts to which blades or paddles are attached. The mixing compartment may be stationary or rotate about a vertical axis.

3.4.5. Horizontal Shaft Mixer — A mixer with a stationary or rotatable cylindrical mixing compartment with the axis of the cylinder horizontal and one or more rotating horizontal shafts to which mixing blades are attached.

Table 3.1M

Standard Sizes and Minimum Volume in Cubic Meters for 5 Types of Mixers

Size and Maximum Mixing Capacity (C), m^3	Minimum Volume (V), m^3	Approximate Volume (ft^3)	Nearest Mixer Size and Volume in US Customary Units (See CPMB 100-00)	
			C, yd^3	V, ft^3
Single Compartment Two Opening Non-Tilting Type				
0.75	2.6	(92)	1	94
1.5	4.9	(173)	2	178
2.5	8.1	(286)	3½	304
3.5	11.2	(396)	4½	388
One Opening Tilting Type, Mixing Angle of Drum 15° with Horizontal				
1.5	4.3	(152)	2	153
3.5	8.3	(293)	4½	288
4.5	10.3	(364)	6	369
6	13.3	(470)	8	477
7	15.3	(540)	9	531
7.5	16.3	(576)	10	585
9	18.9	(667)	12	678
11.5	22.6	(798)	15	798
Two Opening Front or Rear Charge and Front Discharge Tilting Type				
1.5	5.3	(187)	2	192
3.5	11.5	(406)	4½	401
4.5	13.8	(487)	6	492
6	16.9	(597)	8	604
7	18.8	(664)	9	657
7.5	19.8	(699)	10	708
9	22.5	(795)	12	806
10.5	25.1	(886)	14	899
11.5	26.8	(946)	15	944
Vertical Shaft Type				
0.375	0.8	(28)	½	29
0.75	1.6	(57)	1	56
1	1.9	(67)	1½	72
1.5	2.4	(85)	2	87
2	3.0	(106)	3	118
2.5	3.6	(127)	3½	134
3.5	4.7	(166)	4½	165
Horizontal Shaft Type				
0.375	0.35	(12)	½	13
0.75	0.8	(28)	1	29
1.5	1.7	(60)	2	60
2.5	2.9	(102)	3	92
3	3.5	(124)	4	124
3.5	4.4	(155)	4½	153
4.5	5.7	(201)	6	204
6	7.6	(268)	8	272
7	8.8	(311)	9	306
7.5	9.5	(335)	10	340
9	11.3	(399)	12	408

Table 3.2M

Concrete Characteristics

Type Mixer	Slump Range, mm (inches)	Maximum Aggregate Size, mm (inches)
Single Compartment Two Opening non-Tilting Type	38 - 75 (1½ - 3)	50 (2)
One Opening Tilting Type, Mixing Angle of Drum 15° With Horizontal	38 - 75 (1½ -3)	75 (3)
Two Opening Front or Rear Charge and Front Discharge Tilting Type	38 - 75 (1½ -3)	75 (3)
Vertical Shaft	25 - 100 (1 - 4)	50 (2)
Horizontal Shaft	25 - 150 (1 - 6)	75 (3)

The use of slumps and aggregate sizes other than those given here may require a capacity less than those indicated in Table 3.1M.

APPENDIX A-1

Basis for Calculating Minimum Volumes of Concrete Plant Mixers in Accordance with Part 3 of the Concrete Plant Standards of the Concrete Plant Manufacturers Bureau

(See CPMB 100 for sizes in US Customary Units)

Part 3 of the Concrete Plant Standards for Plant Mixer Equipment establish standard sizes of mixers in terms of their rated maximum mixing capacities and the minimum volumes of drums or troughs required for the different capacities. The relationships between rated capacity or drum or trough volumes are based on tests and experience of mixer manufacturers. The relationships between minimum volume requirements (designated as "V") in *cubic meters* and rated maximum mixing capacity (designated as "C") in *cubic meters* are shown below.

1. For single compartment two opening non-tilting type mixers:

   $V = 3.11C + 0.28$

2. For one opening tilting type mixers, mixing angle of drum 15° with horizontal:

   For less than 1.5 m^3 sizes:
   $V = 2.44C + 0.57$

   For 1.5 through 8.4 m^3 sizes:
   $V = 2C + 1.27$

   For sizes larger than 8.4 m^3:
   $V = 1.48C + 5.61$

3. For two opening front or rear charge and front discharge tilting type mixers:

   For sizes less than or equal to 3 m^3:
   $V = 3.64(C)^{0.94}$

   For sizes larger than 3 m^3:
   $V = 4.73(C)^{0.71}$

4. For vertical shaft type mixers:

   For 0.375 m^3 size:
   $V = 0.8$

   For sizes larger than 0.375 m^3:
   $V = 1.15C + 0.71$

5. For horizontal shaft mixers:

   For sizes less than or equal to 3 m^3:
   $V = 1.19C - 0.10$

   For sizes larger than 3 m^3:
   $V = 1.26C$

Volume computations are made in the following manner:

A. **Non-Tilting and Tilting Type Mixers (1-3).** Volume is the computed volume of the drum inside liners, if any. Blades, buckets, or paddles and the arms or brackets that support them are not deducted. Any part of the mixer drum at a conical end terminating in an opening is excluded from the volume beyond a plane where the drum diameter is twenty-four inches. The volume of cylindrical or conical discharge spouts or charging chute extensions beyond the main part of the mixer drum is excluded from the drum volume.

B. **Vertical Shaft Type Mixers (4).** Volume is computed as the water level volume of the mixer after deducting any space occupied by inner housings, heads, spinners, or liners, if any. Blades or paddles and the arms or brackets that support them are not deducted.

C. **Horizontal Shaft Type Mixers (5).** Volume is the net volume of the mixing compartment below a plane extending horizontally across the top arc of the inside body shell radius; but not higher than the lowest point on the top edge of the body shell; and excluding the volume occupied by the shafts, liners, paddle or blade arms, and blades, paddles or tips.

APPENDIX A-2

Conversion factors from SI to US Customary Units

From SI (Metric)	To US Customary		Multiply by
	Base Unit	Symbol	
mm	inch	in.	0.03937
kg	pound	lb.	2.2046
metric ton (1000 kg)	short ton, (2000 lb.)	ton	1.1023
m^3	cubic yard	yd^3	1.3080
m^3	cubic foot	ft^3	35.315
kg/m^3		lb/ft^3	0.062428
kg/m^3		lb/yd^3	1.6856
mL	fluid ounce	fl.oz.	0.033814
mL/100 kg		fl.oz./100 lb.	0.015338
liter, L	gallon	gallon	0.26417
L/m^3		gal/yd^3	0.20197

IEEE/ASTM SI-10 - Standard for Use of the International System of Units (SI): The Modern Metric System

NEED HELP

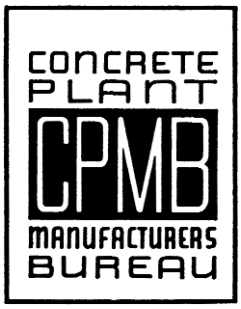
It is the policy of the Bureau to make its services available to all specifying agencies on problems involving those specifications allied with concrete plant equipment. Requests for assistance can be made by contacting any Bureau member or the Executive Secretary of the Bureau at Bureau Headquarters in Silver Spring, Maryland. All problems involving specifications are then directed to the Chairman of the Bureau. If immediate action is not required, the Chairman includes the problem on the agenda for the next regularly scheduled Bureau meeting. If the Chairman determines that immediate action is required, he designates two or more representatives from member companies to act on behalf of the Bureau and notifies all other member companies. Each member has the right to send one representative to meetings and conferences.

OTHER CPMB PUBLICATIONS

Publication No. CPMB 100-00 — Concrete Plant Standards (US Version)

Publication No. CPMB-101 — Bin or Silo Capacity Rating and Method of Computation

Publication No. CPMB-102 — Recommended Guide Specifications for Batching Equipment and Control Systems in Concrete Batch Plants



NRMCA endorses the members of the Concrete Plant Manufacturers Bureau as the preferred provider of concrete plants and associated equipment as providing quality equipment conforming to the standards and specifications of NRMCA's plant certification program and the concrete plant manufacturers standards.

Concrete Plant Manufacturers Bureau
Member Companies

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