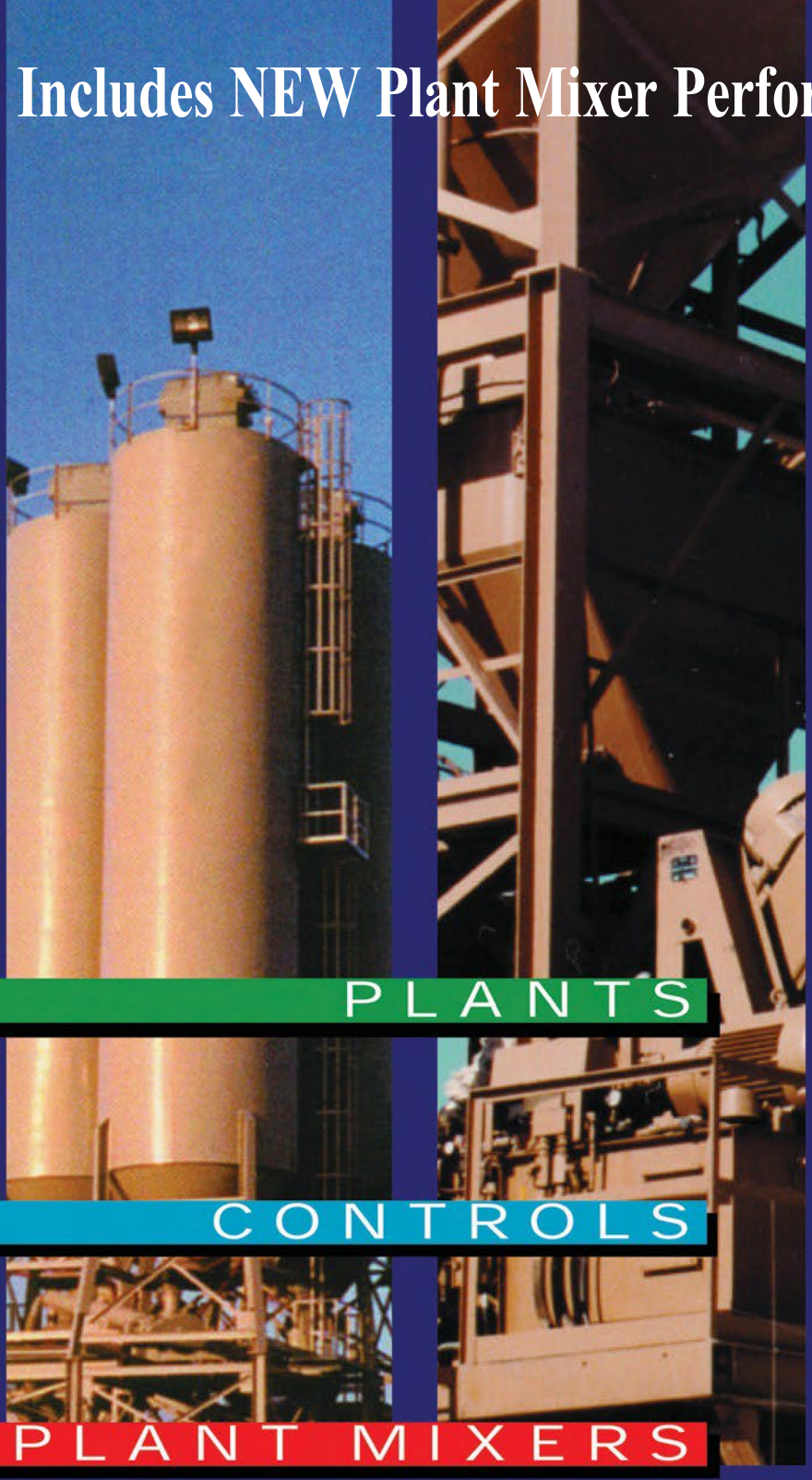
Includes NEW Plant Mixer Performance Standards!



PLANTS

CONTROLS

PLANT MIXERS

Concrete Plant Standards

of the Concrete Plant Manufacturers Bureau

Sixteenth Revision,
January 22, 2018

CONCRETE PLANT CPMB MANUFACTURERS BUREAU

CONTROL SYSTEMS CSMD MANUFACTURERS DIVISION

PLANT MIXER PMMD MANUFACTURERS DIVISION

AIR QUALITY AQMD MANUFACTURER DIVISION

Endorsed by and Affiliated with

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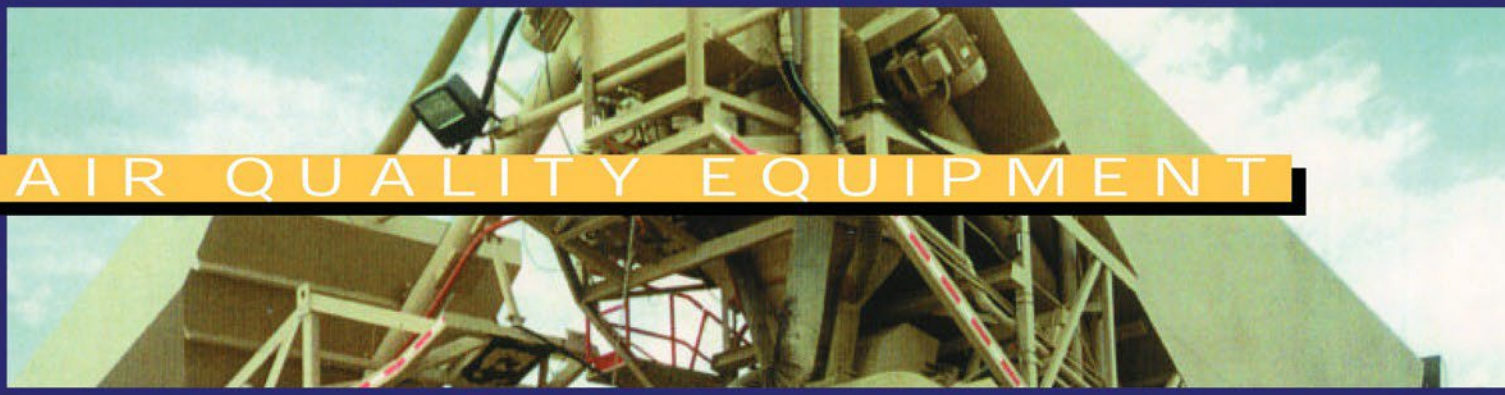

AIR QUALITY EQUIPMENT

CPMB 100-18

Your Assurance of Quality!

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. The AQMD establishes minimum standards for rating air quality equipment – Part 4 of these Standards.

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 3.1 of these Standards.

Members of the AQMD attach rating plates to air quality equipment to specify the type, CFM and Filter Surface Area as indicated in Part 4 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 January 22, 2018, originally published March 1, 1960. Previous Edition, Fifteenth Revision, March 20, 2007.

Part 3 of these Standards was previously published 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 100M-18 for SI Units

Concrete Plant Standards of the Concrete Plant Manufacturers Bureau CPMB 100-18

Sixteenth Revision – Effective January 22, 2018

PURPOSE

These Standards have been prepared for the information of users of concrete plant equipment, including plants, controls, plant mixers and air quality equipment. 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, Plant Mixer Manufacturers Division and its Air Quality Manufacturers Division, and to standardize rated capacities, the basis for determining rated capacities, and certain other features of concrete plant components, control systems, plant mixers and air quality equipment.

EFFECTIVE DATE

These revised Standards shall become effective on January 22, 2018. 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 January 22, 2018 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 and its Control Systems Manufacturers Division, Plant Mixer Manufacturers Division and Air Quality 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, plant mixer equipment and air quality equipment eligible to be designated as standard by the Concrete Plant Manufacturers Bureau.

GOVERNING UNITS

The values stated in inch-pound units are to be regarded as the standard. The SI (metric) equivalent values given in parenthesis are for information only. See CPMB 100M-18 for the version of this standard in SI units.

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.

1.1.1. Bins, Aggregate. Aggregate bins shall be structurally designed to contain the rated capacity plus heaping, based on material weighing 110 lb/ft^3 (1760 kg/m^3). Rated capacities, as shown on the rating plate, shall

be stated in terms of cubic yards (m^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 yards (m^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 tons (metric tons) based on material weighing 100 lb/ft^3 (1600 kg/m^3).

1.1.2. Bins or Silos, Cement. Cement bins or silos shall be designed to contain rated capacity loads of material weighing 94 lb/ft^3 (1500 kg/m^3). Rated capacity as shown on the rating plate shall be stated in terms of cubic feet and cubic yards (m^3) of gross air volume. In addition, they may be stated in tons, based on one ton, or 2000 pounds, equal to one cubic yard of partially aerated cement (one metric ton = 0.843 m^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 tons per hour (metric tons/hr.), assuming the material to weigh 100 lb/ft^3 (1600 kg/m^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 cubical capacity with material weighing 100 lb/ft^3 (1600 kg/m^3).

1.2.3. Bucket Elevators for Cement shall have their rated capacities, as shown on the rating plated, 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 ft^3/hr (m^3/hr) 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 minimum tolerance 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 remain 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 0.03 in. (0.76 mm). The balance indicator shall be sufficiently sensitive to show movement when a weight of 1/10 of 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 0.03 in. (0.76 mm).

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 remain 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 resistance,
(c) overload or shock damage,
(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 1/10 of 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 1.1 and Column 1 of Table 1.2 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 ft^3 (m^3), calculated from dimensioned drawings, shall be equal to its rated batcher capacity multiplied by 38 (1.407). (See Table 1.1).

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 measuring 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 3,300 lb/yd^3 (1966 kg/m^3) of rated batcher capacity.

1.3.2.2. Batchers, Cement (Cementitious Materials). The minimum volume of the batcher in ft^3 (m^3), calculated from dimensioned drawings, shall be 3 ft^3 (0.085 m^3) to allow for fluffing and variations in filling, plus 9 times the yardage rating (1/3 of the rated capacity of the plant in m^3). (See Table 1.2).

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 660 lb/yd^3 (392 kg/m^3) of rated batcher capacity.

It is recognized that mass concrete work for dams, etc., requires special rating based on a minimum of 350 lb/yd^3 (208kg/m^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 pounds (kg) or U.S. gallons (L) 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 40 U.S. gallons/yd^3 (198 L/m^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 320 lb/yd^3 or 38 gal/yd^3 (190 kg/m^3 or 188 L/m^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 to one gallon (3.8L) increments, or a register capable of being read to one gallon (3.8L) 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 one fluid ounce (or more) per 100 lb (29.6 mL per 45.4 kg) of cement; or for concentrated additives that have been reconstituted to the point where the dosage rate is one fluid ounce (or more) per 100 lb (29.6 mL per 45.4 kg) 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 lb (45.4 kg) 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 tolerances 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 lb (45.4 kg) 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 lb (45.4 kg) 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 ±1 gallon (3.8L), whichever is greater

Admixtures -

±3% of the required volume of materials being batched OR ± the minimum recommended dosage rate per 100 lb (45.4 kg) 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 1.1).

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

Table 1.1 Standard Aggregate Batcher Sizes and Minimum Required Volumetric Capacity in US Customary Units.

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

Standard US Customary Sizes			Nearest SI Size (3)	
Rated Capacity, yd^3 (1)	Minimum Volume (2)		Rated Capacity, m^3 (1)	Minimum Volume, m^3 (2)
	Standard, ft^3	Approximate, m^3		
½	19	0.54	0.375	0.528
1	38	1.08	0.75	1.056
1 ½	57	1.61	1	1.407
2	76	2.2	1.5	2.11
3	114	3.2	2	2.81
4	152	4.3	3	4.22
4 ½	171	4.8	3.5	4.93
5	190	5.4	4	5.63
6	228	6.5	4.5	6.33
7	266	7.5	5	7.04
8	304	8.6	6	8.44
9	342	9.7	7	9.85
10	380	10.8	7.5	10.56
11	418	11.8	8	11.26
12	456	12.9	9	12.67
13	494	14.0	10	14.07
14	532	15.1	11	15.48
15	570	16.1	11.5	16.19
16	608	17.2	12	16.89

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

Table 1.2 Standard Cementitious Material Batcher Sizes and Minimum Required Volumetric Capacity in US Customary Units.

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

Standard US Customary Sizes			Nearest SI Size (3)	
Rated Capacity, yd^3 (1)	Minimum Volume (2)		Rated Capacity, m^3 (1)	Minimum Volume, m^3 (2)
	Standard, ft^3	Approximate, m^3		
½	7.5	0.21	0.375	0.215
1	12.0	0.34	0.75	0.340
1 ½	16.5	0.47	1	0.42
2	21.0	0.59	1.5	0.59
3	30.0	0.85	2	0.76
4	39.0	1.10	3	1.09
4 ½	43.5	1.23	3.5	1.26
5	48	1.36	4	1.42
6	57	1.61	4.5	1.59
7	66	1.87	5	1.76
8	75	2.1	6	2.09
9	84	2.4	7	2.42
10	93	2.6	7.5	2.59
11	102	2.9	8	2.76
12	111	3.1	9	3.09
13	120	3.4	10	3.42
14	129	3.7	11	3.76
15	138	3.9	11.5	3.92
16	147	4.2	12	4.09

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

Part 2 – Plant Control Systems

Concrete Plant Standards of the Concrete Plant Manufacturers Bureau Control Systems Manufacturers 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 of 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 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 charge 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 4

inches (100 mm) wide and shall have at least one line for each 2 percent of scale capacity, but not more than 25 lines per inch (one line per mm). 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

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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 3.1 shall be standard for each type shown.

3.2. Volume Limitations The gross volume of a standard size concrete plant mixer shall conform to the minimum volumes set forth in Table 3.1. 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 3.1 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 3.2. 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 3.1.

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 3.1.

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.

3.3.5. Mixer Performance. All new standard mixers shall be capable of mixing a volume of concrete as defined in A1.4.3 of the Annex. A procedure to evaluate mixing uniformity is described in Annex A1 of this Standard. Mixing uniformity shall be evaluated for a minimum mixing time of 30 seconds and a maximum mixing time not to exceed a period of 90 seconds after all the materials have entered the mixer. A report on the evaluation of within-batch uniformity of concrete performed on one mixer representing all sizes of essentially similar design and configuration and evaluated in accordance with the provisions of Annex A1 of this Standard shall be submitted in duplicate by each member of the Bureau to the Executive Secretary, which shall be verified by a competent authority mutually acceptable to the Bureau and the National Ready Mixed Concrete Association for conformity with the requirements of Table A1.1 of Annex A1 of these Standards. A sample report format is provided in Appendix X3 of this Standard. When approved, one copy appropriately indicating conformity will be returned to the manufacturer. When subsequent changes in mixer design and configuration are made, the uniformity of mixing shall be re-evaluated and submitted to the Bureau.

3.3.6. Mixing Time. The minimum mixing time to attain the mixing uniformity requirements of Table A1.1 of Annex A1 of these Standards shall be designated by the manufacturer on a data plate attached to the mixer.

3.3.7. Condition of Mixer Blades. The manufacturer shall supply to the purchaser of the equipment the minimum dimension of mixer blades that will be adequate for mixing concrete in accordance with these Standards.

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. A reversing drum mixer rotates in one direction when charging and reverses rotation to discharge.

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 3.1. Standard Sizes and Minimum Volume in Cubic Feet for 5 Types of Mixers				
Size and Maximum Mixing Capacity (C), cu. yd.	**Minimum Volume (V), ft^3**	**Approximate Volume, (m^3)**	**Nearest Mixer Size and Volume in SI units (See CPMB 100M-18)**	
			C, m^3	**V, m^3**
Single Compartment Two Opening Non-Tilting Type [A]				
1	94	(2.7)	0.75	2.6
2	178	(5.0)	1.5	4.9
3½	304	(8.6)	2.5	8.1
4	346	(9.8)	3.0	9.6
4½	388	(11.0)	3.5	11.2
6	514	(14.6)	4.5	14.3
8	682	(19.3)	6.0	18.9
10	850	(24.0)	7.5	23.6
12	1018	(28.8)	9.0	28.3
14	1186	(33.6)	10.5	32.9
15	1270	(36.0)	11.5	36.0
One Opening Tilting Type, Mixing Angle of Drum 15° with Horizontal				
2	153	(4.3)	1.5	4.3
4½	288	(8.2)	3.5	8.3
6	369	(10.4)	4.5	10.3
8	477	(13.5)	6	13.3
9	531	(15.0)	7	15.3
10	585	(16.6)	7.5	16.3
12	678	(19.2)	9	18.9
15	798	(22.6)	11.5	22.6
Two Opening Front or Rear Charge and Front Discharge Tilting Type				
2	192	(5.4)	1.5	5.3
4½	401	(11.4)	3.5	11.5
6	492	(13.9)	4.5	13.8
8	604	(17.1)	6	16.9
9	657	(18.6)	7	18.8
10	708	(20.0)	7.5	19.8
12	806	(22.8)	9	22.5
14	899	(25.5)	10.5	25.1
15	944	(26.7)	11.5	26.8
Vertical Shaft Type				
½	29	(0.8)	0.375	0.8
1	56	(1.6)	0.75	1.6
1½	72	(2.0)	1	1.9
2	87	(2.5)	1.5	2.4
3	118	(3.3)	2	3.0
3½	134	(3.8)	2.5	3.6
4½	165	(4.7)	3.5	4.7

[A] Applies to Reversing Drum Mixers

Table 3.1 (cont.) Standard Sizes and Minimum Volume in Cubic Feet for 5 Types of Mixers				
Size and Maximum Mixing Capacity (C), cu. yd.	**Minimum Volume (V), ft^3**	**Approximate Volume, (m^3)**	**Nearest Mixer Size and Volume in SI units (See CPMB 100M-18)**	
			C, m^3	**V, m^3**
Horizontal Shaft Type				
½	13	(0.37)	0.375	0.35
1	29	(0.8)	0.75	0.8
2	60	(1.7)	1.5	1.7
3	92	(2.6)	2.5	2.9
4	124	(3.5)	3	3.5
4½	153	(4.3)	3.5	4.4
6	204	(5.8)	4.5	5.7
8	272	(7.7)	6	7.6
9	306	(8.7)	7	8.8
10	340	(9.6)	7.5	9.5
12	408	(11.6)	9	11.3

Table 3.2. Concrete Characteristics		
Type Mixer	**Slump Range, inches (mm)**	**Maximum Aggregate Size, inches (mm)**
	1 ½ - 3	2
Single Compartment Two Opening Non-Tilting Type	(38 - 75)	(50)
One Opening Tilting Type, Mixing Angle of Drum 15° With Horizontal	1 ½ -3 (38 – 75)	3 (75)
Two Opening Front or Rear Charge and Front Discharge Tilting Type	1 ½ -3 (38 – 75)	3 (75)
Vertical Shaft	1 – 4 (25 – 100)	2 (50)
Horizontal Shaft	1 – 6 (25 – 150)	3 (75)

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

Part 4 – Air Quality Equipment

Concrete Plant Standards of the Concrete Plant Manufacturers Bureau
Air Quality Manufacturers Division

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4. SPECIFICATIONS FOR EQUIPMENT

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

- filter vent dust collectors
- central dust collectors

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

4.1. Definitions

4.1.1. Types of Dust Collection Systems

4.1.1.1. Filter Vents. A filter vent is a filtration device for a single source point that prevents escape of emissions from the source. Examples are silo top vents or cement batcher vents.

4.1.1.2. Central Dust Collector. A central dust collector is a filtration device for one or more source points that captures emissions in a central location. Typical locations include the truck load out point, silos, and batcher.

4.1.2. Cleaning Methods.

4.1.2.1. Shaker. A shaker type collector is a single compartment collector designed for intermittent use and must be shut down to be cleaned. One end of each bag is attached to a rigid plate and the other to a shaker mechanism. Collected material is then shaken from the filter media.

4.1.2.2. Reverse Air. A reverse air type collector is a multiple compartment collector designed for continuous use, which does not need to be shut down to be cleaned. One compartment is taken off-line for cleaning while the other(s) continue to filter the air flow. Using a fan, the filter media in the off-line compartment are shaken by reverse air flow, releasing the collected material from the filter media.

4.1.2.3. Pulse Jet. A pulse jet type collector is a single compartment collector designed for continuous use, which does not need to shut down to be cleaned. A pulse of high pressure air is periodically directed down the inside of the filter media, blowing the collected material off the outside. A portion of the total media are cleaned at any given time utilizing a timed sequence to clean all the media.

4.1.3. Filter Media.

4.1.3.1. Bags. When bags are used for the filter media they may be either woven or non-woven. Cages or sewn in rings shall be utilized to support the bags. The fabric material may be either natural or man-made.

4.1.3.2. Cartridges. Cartridge filter media utilizes a pleated fabric on a frame. The fabric material may be man-made or non-woven fabrics.

4.1.4. Air Flow Rate. Air flow rate is defined as the volume of air passing through clean filter media per unit time and is expressed in cubic feet per minute (CFM). The actual air flow rate will depend on several factors including the elevation of the installation from mean sea level.

4.2. Points of Emission. A dust collection system shall be designed to capture fugitive cementitious air emissions from sources that may include silos, weigh batchers, plant discharge to truck mixers or central mixers, holding hoppers, and others.

4.3. Cleaning Cycles. The dust collector may utilize either intermittent or continuous cleaning cycles.

4.3.1. Intermittent. The filter media does not operate in a filtration mode during a shut-down cleaning cycle.

4.3.2. Continuous. The filter media operates in a continuous filtration mode, allowing for cleaning and filtration simultaneously.

4.4. Rating Criteria. The dust collector shall meet or exceed the performance criteria established by this standard.

4.4.1. Air Flow Rate. The system shall be designed for an air flow rate sufficient to keep the material airborne, at the fugitive dust pick-up points and through transfer systems.

4.4.2. Filter Surface Area. Filter surface area is the total filtration area of the filter media in square feet.

4.4.3. Air-to-Cloth Ratio. Air-to-cloth ratio is the ratio of air flow in cubic feet per minute (CFM) to the cloth area of the filter media.

4.4.3.1. Shakers. Shaker type collectors shall have a maximum air-to-cloth ratio of 5:1 for bags and 4:1 for cartridges.

4.4.3.2. Reverse Air. Reverse Air type collectors shall have a maximum air-to-cloth ratio of 6:1.

4.4.3.3. Pulse Jet. Pulse jet type collectors shall have a maximum air-to-cloth ratio of 7:1 for central units and 6:1 for filter vents.

4.4.3.4. Exceptions. Air-to-cloth ratio can exceed those in 4.4.3.1 through 4.4.3.3 by documentation from the manufacturer indicating that it meets the efficiency requirements at the design air flow rate (CFM).

4.4.4. Collector Sizing. The size of the dust collector shall be based on the amount of CFM required at the pick-up points and the air-to-cloth ratio for the collector type chosen. The following calculation shall be used to determine the minimum cloth area required:

A = Total air flow rate needed, eg. 6000 CFM

B = Air-to-Cloth Ratio, eg. 6:1

C = Minimum Cloth Area **= A/B,** eg. **C** = 6000/6 = 1000 sq. ft.

4.4.5. Efficiency. Filter media shall capture a minimum of 99% of the fugitive emissions passing through it for particles greater than 10 microns (PM10).

Note: The particle size of different cementitious materials vary and the performance of the system depends on the material being filtered. Consult manufacturer for design requirements.

4.5. Nameplate Stamping. The CPMB nameplate for dust collectors shall be stamped with the Filter Surface Area and the Air Flow Rate in CFM.

4.6. Pressure Drop. Central dust collection systems shall have a means of measuring pressure drops across filter. Examples include but are not limited to magnehelic and photohelic types.

4.7. Ductwork. Central dust collector systems shall have ductwork provided as a means of transporting the fugitive emissions from the source to the dust collector. Ductwork shall be watertight, and shall be sized properly to maintain the velocity to keep fugitive materials in suspension.

4.8. Hoods and Shrouds. Hoods and shrouds shall be sized appropriately at pick-up points for the designed CFM and to maintain adequate pick-up velocity.

4.9. Collected Dust. Central dust collector systems shall provide a means of removing the collected dust.

4.9.1. Manual. The dust may be manually discharged from the collector using a manual gate.

4.9.2. Manual Recycle. The dust may be manually recycled to a properly designated collection vessel using a tanker blower or other type of manually controlled blower.

4.9.3. Automatic Recycle. The dust may be automatically recycled to a properly designated collection vessel using automatic controls to monitor the build up in the collector.

ANNEX A1 to CPMB 100-18

(Mandatory Information)

Test Procedures for Measuring the Within-Batch Uniformity of Plant Mixed Concrete

A1.1. Scope

This Annex provides procedures for determining the within-batch uniformity of concrete mixed in a plant mixer. The principal objective is to determine compliance with the mixing uniformity requirements of, Part 3 for Plant Mixer Equipment in CPMB 100-05 *Concrete Plant Standard* of the Concrete Plant Manufacturers Bureau. The data generated can be used by producers and users of concrete to establish the amount of mixing required to obtain adequately mixed concrete. The procedures and requirements described herein are those required in ASTM C 94 - *Specification for Ready Mixed Concrete*.

A.1.2. Referenced Documents

ASTM Standards

C 31/C31M Practice for Making and Curing Concrete Test Specimens in the Field

C 33 Specifications for Concrete Aggregates

C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens

C 94 Specification for Ready Mixed Concrete

C 138 Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete

C 143 Test Method for Slump of Hydraulic Cement Concrete

C 150 Specification for Portland Cement

C 173 Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

C 231 Test Method for Air Content of Concrete by the Pressure Method

C 566 Test Method for Total Moisture Content of Aggregate by Drying

ACI Documents

ACI 211.1 Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete

A1.3. Significance and Use

A1.3.1. This Annex provides procedures to evaluate the ability of concrete mixers to produce uniformly mixed concrete. Its primary use is to ensure that plant mixers of similar design will meet the requirements of this Annex for within-batch uniformity of concrete mixed in plant mixers to its rated capacity. Compliance with the requirements of this Annex is essential for obtaining a rating plate issued by the CPMB on mixers manufactured after the date of approval of these standards.

A1.3.2. This Annex provides additional procedures and cautions that are necessary in the application of existing test methods and practices for the determination of the uniformity of a quantity of freshly mixed concrete.

A1.4. Concrete Mixture

A1.4.1. The following are recommended characteristics of a concrete mixture for the purpose of evaluating the mixing uniformity of the plant mixer. The intent is to evaluate the mixing efficiency of the mixer with a relatively standard air-entrained concrete mixture. To qualify a mixer for mixing performance for paving mixtures, conform to the slump requirements for paving operations indicated below separate from the mixing performance evaluation for general use.

Cement:	ASTM C 150	500 to 600 lb/yd^3 [300 to 350 kg/m^3]
Coarse Aggregate:	ASTM C 33	Size #57 or #67
Sand	ASTM C 33	Fineness Modulus 2.5 to 3.0
Slump	For general use	4 to 6 in. [100 to 150 mm]
	For paving operations	1 to 2 in. [25 to 50 mm]
Air Content		4.0 to 6.0%
Chemical Admixtures		Not recommended, except to entrain air
Fly ash, Slag or Silica Fume		Not recommended

A1.4.2. Mixture proportions shall be determined in accordance with ACI 211.1, including the amount of coarse aggregate determined from Table 6.3.6 on "Volume of coarse aggregate per unit of volume of concrete" within a tolerance of ±0.03.

A1.4.3. The volume of concrete mixed for evaluating compliance with the uniformity requirements of CPMB 100 shall be within -20% and +10% of the rated mixing capacity of the mixer used for this evaluation.

A1.4.4. Determine the aggregate moisture content used in test batches in accordance with ASTM C 566 to allow calculation of the total mixing water content.

A1.4.5. Report the proportions of the design mixture and the actual batched quantities for the total load.

A1.5. Measuring Materials

Measure materials to the required tolerances in accordance with C 94.

A1.6. Loading Materials, Batching Sequence and Mixing for Plant Mixers

The sequence of batching materials into the mixer and the speed of mixing can have a significant effect on the ability to obtain a homogeneous mixture of concrete. Manufacturer's recommendations shall be followed for loading materials, batching sequence and mixing speed.

A1.6.1. Using a suitable device, measure the time duration of mixing. In determining start time of mixing; loading is completed and mixing has started when all of the solids have been loaded and at least 90% of the water has been added. Mixing time is complete when the first material is discharged.

A1.6.2. Record and report the following about the loading and mixing procedure used:

a) Drum speed (RPM) during mixing.

b) Total time of mixing.

A1.7. Testing Agency and Personnel

A1.7.1. Testing for the mixer performance evaluation shall be conducted by an independent testing agency. The field and laboratory technicians shall be certified as ACI Grade I Field Testing Technician and ACI Strength Testing Technician, respectively, or equivalent. A responsible official of the testing agency shall sign the report of the test results.

A1.8. Testing Apparatus and Materials

A1.8.1. The apparatus and materials shall conform to the requirements of the appropriate referenced ASTM Standards

A1.8.2. A balance or scale for use in method C 138 capable of weighing to 0.1 lb. [50 g] of the test load throughout the range of use.

A1.8.3. Other special equipment as required by this Annex and not specifically described in the referenced ASTM Standard Test Methods or Practices.

A1.9. Sampling

A1.9.1. The method of sampling shall ensure that the samples are representative of widely separated portions, but not from the very ends of the batch. Obtain two distinct samples of a minimum size of 2 cubic feet [56 L] within an elapsed time of 15 minutes. Do not combine portions to obtain a composite sample. Ensure that concrete is sampled from the entire discharge stream.

A1.9.1.1. Procedure 1 – The mixer shall be stopped, and the required samples removed by any suitable means from the concrete at approximately equal distances from the front and back of the mixer, or

A1.9.1.2. Procedure 2 – As the mixer is emptied, individual samples shall be taken after discharge of approximately 15% and 85% of the load.

Note 1. Concrete with slump exceeding about 5 inches (125 mm) will often segregate if discharge is stopped and started during the sampling process. There are safety concerns to the operator obtaining the sample at a rapid rate of discharge.

Note 2. It is acceptable to discharge concrete into a delivery vehicle and discharge the distinct samples from the vehicle without any additional mixing during the sampling process. Another method of sampling is to stop the mixer at the desired time of sampling and discharge the sample into a front end loader or similar large container or transportation unit.

A1.9.2. Cover the samples to prevent loss of water from evaporation and remix each sample the minimum necessary immediately before performing the tests.

A1.9.3. Start slump tests on each sample within 5 minutes of obtaining the sample and start all other tests within 15 minutes of obtaining both samples.

A1.10.Slump Testing

Perform the slump tests in accordance with ASTM C 143. Start testing the slump of each sample within 5 minutes after it was obtained.

Note 3. The effects of slump loss with time, especially at higher concrete temperatures, needs to be considered. Conduct the slump test soon after each sample is obtained and do not wait until all the concrete has been sampled and discharged. Cover the samples to protect from evaporation and

contamination.

A1.11. Density (Unit Weight) of Fresh Concrete

A1.11.1. General – It is acceptable to use the ¼ ft^3

[7 L] air meter container to determine the density (unit weight) of the concrete and to use that same compacted sample to determine air content by C 231. Then use it to determine the coarse aggregate content of the sample.

Note 4: Determination of fresh concrete density in a ½ ft^3 [14 L] container may provide a more accurate determination of density.

A1.11.2. Apparatus – As required in C 138, except that the scale must be accurate to 0.1 lb. [0.4 kg] throughout the range of use. Perform the test on a work area that is level to 1/8 in. [3 mm] in 15 in. [40 mm].

A1.11.3. Determine the density (unit weight) of each sample in accordance with C 138. When using No. 57 or 67 coarse aggregate, C 138 requires a minimum measure capacity of 0.2 cu. ft. [6 L]. This test can be made in the calibrated ¼ ft^3 [7 L] base of the air meter or a ½ ft^3 [14 L] density container.

A1.11.4. Calculate the density (unit weight) of the sample as follows:

$$D = \frac{M}{V}$$

Where: D is the measured density (unit weight), in lb/ft^3 [kg/m^3]

M is the net mass of concrete in the container, lb. [Kg]

V is the volume of the container, ft^3 [m^3]

A1.12. Air Content

A1.12.1. Use Method C 231 to determine air content of normal weight aggregate concrete. Method C 173 should be used only if the concrete is made with structural lightweight aggregate or with an aggregate correction factor larger than 0.5% when tested by C 231.

A1.13. Air Free Density (Unit Weight) of Concrete

A1.13.1. Calculate the air-free density (unit weight) of each sample as follows:

$$\text{Air free density, lb./cu.ft.}[kg/m^3] = \frac{D}{100 - A} \times 100$$

3

Where: D is the measured density, in lb/ft [kg/m^3]

A is the air content measured in A1.11 on that sample, in percent

A1.14. Coarse Aggregate Content

A1.14.1. As noted in A1.11.1 the sample used for density and air content sample can be used for determination of coarse aggregate content.

A1.14.2. It is also permitted to use a separate portion of the concrete sample to measure the coarse aggregate content. When the coarse aggregate content is determined from a separate sample of concrete not used for other tests, the minimum size of the concrete sample shall be 20 lb. [9 kg] or 40 lb. [18 kg] for concrete made with ¾ in. [19.0 mm] or 1 in. [25.0 mm] nominal maximum size coarse aggregate, respectively. Take the sample in a convenient sized container and determine the mass of concrete.

Note 5: When the sample used for density and air content measurement is used to determine the amount of coarse aggregate, the quantity of aggregate recovered may be insufficient to obtain an accurate value. The use of a separate sample of concrete may improve the determination of the coarse aggregate content if a larger sample is used.

A1.14.3. Wash each sample over a No. 4 [4.75mm] sieve sufficiently to remove the cement and most of the sand. Weigh the wet coarse aggregate, store in a plastic bag and transport it to a laboratory facility. Dry the sample in an oven at 230°F (110°C) for 16± 2 hours and sieve in accordance with Method C 136

to determine the mass of dry aggregate retained on the No. 4 [4.75mm] sieve.

A1.14.4. Calculate the coarse aggregate content expressing the mass of dry coarse aggregate as a percentage of the mass of the original concrete sample.

A1.15. Compressive Strength

A1.15.1. Make a minimum of two cylinders from each sample of concrete. Either 6 x 12 [150 x 300 mm] or 4 x 8 in. [100 x 200 mm] cylinders can be used. Cure cylinders as required in C 31/C31M except that initial curing shall be by immersion in water immediately after molding. Maintain the water temperature between the required 60 – 80°F [16 to 27°C] for the initial 24 to 48 hours.

A1.15.2. Test the cylinders in accordance with C 39 at an age of 7 days. Average the strength of the 7-day tests of cylinders from each sample and express that value as a percentage of the average of all cylinders made from that batch.

A1.15.3. Examine the results of tests of individual cylinders made from the same sample of concrete and question the results from that sample if the range of individual cylinder strengths exceeds 8.0% when two cylinders are tested and 9.5% when three are tested.

Note 6 The values for permissible ranges of individual cylinders are from the precision statement in C 39. Although the d2s (difference two sigma) values in C 39 are for 6 x 12-inch cylinders, available data suggest comparable precision with 4 x 8-inch cylinders.

A1.16. Batch Size and Quantities

Calculate the actual volume of concrete mixed by dividing the weight of materials batched by the average unit weight measured on the two samples. Calculate the batch quantities per unit volume of concrete from the actual yield.

A1.17. Requirements for Mixing Uniformity

A1.17.1. To conform to the mixing uniformity requirements of this Standards, plant mixers are required to meet all of the five requirements of Table A1.1

A1.18. Report

A1.18.1. Appendix X3 provides a sample report format to comply with the requirements of Section 3.3.5 of these standards and the following reporting requirements.

A1.18.2. A separate mixer performance evaluation and report is required for each unique design of plant mixers. A separate mixer performance evaluation is required for concrete for general use or for paving applications. The representative of the mixer manufacturer shall list the standard sizes that will be manufactured with the same design and configuration and sign the report. The official of the testing agency who conducted the mixing uniformity evaluation shall sign the report.

Note 7. Sample calculations that detail the mixing uniformity evaluation are available from the CPMB upon request.

A1.18.3. Mixer identification including:

Manufacturer

Mixer design identification and serial no.

Mixer rated mixing capacity

Mixer gross volume in cubic feet

A1.18.4. Location of the plant and the date of the mixer performance evaluation

A1.18.5. Mixing drum speed and total mixing time

A1.18.6. Mix Design of the concrete expressed on the basis of dry or SSD weights of aggregates in lb/yd^3 (kg/m^3). Also indicate the following:

Type or classification of cementitious materials

Coarse aggregate – type of aggregate, ASTM Size number or nominal maximum size, specific gravity (bulk-dry or SSD), dry-rodded density (unit weight), absorption and total moisture content prior to batching.

Sand or fine aggregate – type of aggregate, specific gravity (bulk-dry or SSD), fineness modulus (FM), absorption and total moisture content prior to batching.

Types and characteristics of other materials used, if any. Do not indicate brand names.

A1.18.7. Concrete mixture quantities as recorded during batching:

Cementitious materials, lb. [kg]

Added water, lb. [kg]

Wet Coarse aggregate, lb. [kg]

Wet Sand, lb. [kg]

Air entraining admixture, fl. oz. [L]

Other materials used, if any

A1.18.8. Target batch size and actual yield determined as per A1.16.

A1.18.9. Identification of Testing agency or agencies including:

Corporate name and address

Responsible official

An indication that all testing personnel are certified required in A1.7

An acknowledgement that all tests were performed in accordance with the referenced ASTM Standards as modified herein.

A1.18.10. Concrete test data including:

The individual test results,

The averages of duplicate tests made on the same sample, if any

The maximum range of results on the two samples and

A comparison of that range with the maximum permitted in Table A1.1

A1.18.11 The required results of tests to be reported are:

Slump

Air content

Measured density of concrete (used to calculate yield)

Air-free density (unit weight) of concrete

Coarse aggregate content on a dry basis as a percentage of the original concrete sample

7-day compressive strength (report cylinder size)

Table A1.1 Requirements for Within-Batch Uniformity of Concrete

Test	Range of 2 Samples
Air Content, %	1.0
Air-free Density (Unit Weight) of Concrete, lb./cu. Ft. [kg/m^3]	1.5 [24]
Slump, in. [mm]	
Average Slump 4 in. [100mm] or Less	1.0 in. [25mm]
Average Slump, 4 to 6 in. [100 to150mm]	1.5 in. [40mm].
Coarse Aggregate, % by mass of concrete	5.0
7-day Compressive Strength, % of Average [A]	7.5

[A] Calculated as a percent of the average strength for the two samples taken from the batch. Either 2 or 3 cylinders must be tested from each of the two samples from the batch tested.

APPENDIX X-1

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

(See CPMB 100M for SI sizes)

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 feet* and rated maximum mixing capacity (designated as "C") in *cubic yards* are shown below.

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

   $$V = 84\ C + 10$$

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

   For less than 2 cu. yd. sizes:
   $$V = 66\ C + 20$$

   For 2 through 11 cu. yd. sizes:
   $$V = 54\ C + 45$$

   For sizes larger than 11 cu. yd.:
   $$V = 40\ C + 198$$

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

   For 1 through 4 cu. yd. sizes:
   $$V = 100\ (C)^{0.94}$$

   For 4 ½ cu. yd. and larger sizes:
   $$V = 138\ (C)^{0.71}$$

4. For vertical shaft type mixers:

   For ½ cu. yd. size:
   $$V = 29$$

   For larger than ½ cu. yd. sizes:
   $$V = 31\ C + 25$$

5. For horizontal shaft mixers:

   For ½ through 4 cu. yd sizes:
   $$V = 32\ C - 3.5$$

   For 4 ½ and larger sizes:
   $$V = 34\ C$$

Volume computations are made in the following manner:

A. **Non-Tilting and Tilting Type Mixers.** 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.** 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.** 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 X-2
Conversion factors from US Customary to SI (Metric) Units

From US Customary	To SI (Metric)		Multiply by
	Base Unit	Symbol	
in.	millimeter	mm	25.4 (exact)
lb.	kilogram	kg	0.45359
short ton, (2000 lb.)	metric ton, (1000 kg)	t	0.90718
yd^3	cubic meter	m^3	0.76455
ft^3	cubic meter	m^3	0.028317
Lb/ft^3		kg/m^3	16.01846
lb/yd^3		kg/m^3	0.59328
fl. oz.	milliliter	mL	29.574
fl. oz./100 lb.		mL/100 kg	65.198
gallon	liter	L	3.7854
Gal/yd^3		L/m^3	4.9511

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

APPENDIX X-3

Sample Report Format
Qualification of Plant Mixers for Mixing Performance
(non-mandatory information)

Mixer Manufacturer			
Mixer Design Identification		Mixer Serial No.	
Rated Mixing Capacity, yd^3		Mixer Volume, ft^3	
Evaluation Date			
Location (Plant)			
Mixing: Drum RPM		Total Mixing Time, s	
Target batch size, yd^3 (m^3)		Actual Yield*, ft^3 (m^3)	

*Calculated from batch quantities as per A1.15

Materials

Material	Mix Design, lb/cu. yd. (kg/m^3)	Actual Batch Quantities, lb. (kg)	Notes
Cement			
Fly ash/Slag			
Coarse Aggregate			
Fine Aggregate			
Water			
Air Entrain Admix.			
Other Admix.			

Notes for Materials: Indicate the mix design quantities on the basis of dry or SSD aggregates. Report actual batch quantities from recordation of ingredients batched. Indicate the type of cement, size of coarse aggregate used, FM of sand, moisture content of the aggregates

Statement of Certification

Our company hereby certifies that the mixer unit evaluated represents the equipment we manufacture and is of the same design and configuration as the mixers of the following standard sizes. We further certify that rating plates will be attached to only these units that conform to the requirements of the Standards of the Concrete Plant Manufacturers Bureau.

Standard Rated Capacity of Units Manufactured of Similar Design to the Unit in this Evaluation

Certified by:_____ Date: _____
Signature of Official of the Concrete Mixer Manufacturer

Name: _____

Title _____

Company: _____

Date Submitted to CPMB: _____

REPORT OF UNIFORMITY TESTS				
Test	**Sample 1**	**Sample 2**	**Range**	**Limit**[**]
Slump, in.				**1.0 or 1.5**
Air Content, %				**1.5**
Measured density, lb./cu. ft.			Avg.:	N/A
Concrete air-free density, lb./cu. ft.				**1.5**
Coarse aggregate content, %				**5.0**
7-day compressive strength, psi	Cylinder Size (4 x 8 in. or 6 x 12 in.):			
Cylinder 1			N/A	N/A
Cylinder 2			N/A	N/A
Average				**7.5%**

[**] From Table A1.1

Testing Agency:_____

Address:_____

Responsible Official:_____

Field Technician 1		Certification	
Field Technician 2		Certification	
Laboratory Technician		Certification	

Note Deviations from Testing Standards:_____

This mixer performance evaluation was conducted in accordance with the Standards of the Concrete Plant Manufacturers Bureau and pertinent ASTM Standards

_____

Signature of Responsible Official of the Testing Agency

Name: _____

Date: _____

For CPMB Use

Reviewed and Approved _____ Date: _____

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 Annual 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 100M-18 -- Concrete Plant Standards (Metric 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 providers 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
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(as of January 2026)

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