Truck Mixer,
Agitator and
Front
Discharge
Concrete
Carrier

Standards
Your Choice is Complete

New Standards provide for mixing performance evaluated truck mixers with a size for every condition and need...

Effective June 1, 2001, truck mixers of similar design have been evaluated for uniformity of mixing in accordance with the provisions in ASTM C 94, Standard Specification for Ready Mixed Concrete and as outlined in the Annex to these standards. With moving to a performance-based standard, the TMMB assures the purchaser and the concrete customer that at the time of manufacture, the truck mixer is capable of mixing and producing uniform concrete properties within the same batch.

Effective August 5, 2003, the rating sizes listed in these Standards on page 3 were established as standard for truck mixers, agitators and front discharge concrete carriers, whether truck or trailer mounted. The volume requirements for each rated capacity remain unchanged. The principal purpose of maintaining continuous review of these Standards is to enable truck mixer manufacturers to keep pace with the changing requirements of user industries.

With these 15 sizes, from 7 to 20 cubic yards, it is possible for every user to realize the maximum payload potential in today's trucks, consistent with his requirements and the conditions and weight laws under which he operates.

Copies of the new Standards are offered to architects and engineers who help maintain these high standards by writing them into concrete specifications. Please address your request to the Truck Mixer Manufacturers Bureau, 900 Spring Street, Silver Spring, Maryland, USA 20910.

SAMPLE FRONT AND REAR DISCHARGE RATING PLATES
1. **Scope** - These Standards cover truck mixers, agitators, and front discharge concrete carriers, whether truck or trailer mounted, designated as standard by the Truck Mixer Manufacturers Bureau and eligible to carry a rating plate issued by the Bureau.

The values stated in U.S. customary units are to be regarded as standard. The SI (metric) units may be approximate and are provided for information.

2. **Effective Date** - These revised Standards shall become effective March 12, 2005. Truck mixers and agitators delivered prior to the effective date established by these revised Standards are subject to the Truck Mixer and Agitator Standards, 16th Revision, effective August 5, 2003.

3. **Mixer and Agitator Units** - The size of a unit as a mixer shall be designated on a standard Bureau rating plate by a number equal to the maximum capacity in cubic yards of mixed concrete as well as its metric equivalent. The agitator rating shall be designated on the manufacturer's data plate. To qualify for a rating plate, the unit must conform to the requirements of these Standards.

4. **Types of Mixers, Agitators and Front Discharge Concrete Carriers** - These Standards are applicable to inclined-axis revolving drum type mixers.

5. **Sizes** - The sizes shown in Table No. 1 shall be standard. No intermediate size shall be considered standard. However, sizes larger than 15 cubic yards, in increments of 1 cubic yard only, will be regarded as standard if they conform to the volume relationships defined in Appendix X1 of these Standards and to all other requirements of these Standards.
Table No. 1 – Standard Sizes

<table>
<thead>
<tr>
<th>Cubic Yards</th>
<th>Cubic Meters (2)</th>
<th>Gross Drum Volume Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rear Discharge Only (3)</td>
<td>Rear and Front Discharge</td>
<td></td>
</tr>
<tr>
<td>As Mixer</td>
<td>As Agitator (1)</td>
<td>Maximum</td>
</tr>
<tr>
<td>Cubic Feet</td>
<td>Cubic Meters (2)</td>
<td>Cubic Feet</td>
</tr>
<tr>
<td>7</td>
<td>9 1/4</td>
<td>5.4</td>
</tr>
<tr>
<td>8</td>
<td>10 1/2</td>
<td>6.1</td>
</tr>
<tr>
<td>8 1/2</td>
<td>11 1/4</td>
<td>6.5</td>
</tr>
<tr>
<td>9</td>
<td>12</td>
<td>6.9</td>
</tr>
<tr>
<td>9 1/2</td>
<td>12 3/4</td>
<td>7.3</td>
</tr>
<tr>
<td>10</td>
<td>13 1/4</td>
<td>7.6</td>
</tr>
<tr>
<td>10 1/2</td>
<td>14</td>
<td>8.0</td>
</tr>
<tr>
<td>11</td>
<td>14 3/4</td>
<td>8.4</td>
</tr>
<tr>
<td>11 1/2</td>
<td>15 1/2</td>
<td>8.8</td>
</tr>
<tr>
<td>12</td>
<td>16</td>
<td>9.2</td>
</tr>
<tr>
<td>12 1/2</td>
<td>16 3/4</td>
<td>9.6</td>
</tr>
<tr>
<td>13</td>
<td>17 1/2</td>
<td>9.9</td>
</tr>
<tr>
<td>14</td>
<td>19</td>
<td>10.7</td>
</tr>
<tr>
<td>15</td>
<td>20 1/4</td>
<td>11.5</td>
</tr>
<tr>
<td>20</td>
<td>27 1/4</td>
<td>15.3</td>
</tr>
</tbody>
</table>

(1) Maximum agitator capacity may be less, as designated on manufacturer’s data plate.
(2) Metric equivalents provided for information and may be approximate.
(3) In 1991 The Bureau voted to reinstate the maximum gross drum volume requirements for rear discharge inclined axis truck mixers only, to be effective January 1, 1994.

6. **Volume Limitations** - The gross volume of any truck mixer and front discharge concrete carrier shall conform to the limits shown in Table No. 1, which are based on volume requirements approved by the Bureau June 23, 1944, revised December 10, 1948, and further revised on May 2, 1956, (as shown in Appendix X1 of these Standards) and to all other requirements of these Standards.

Gross volume is the total interior volume of the revolving portion of the mixer drum. In 1991 the Bureau voted to reinstate the maximum gross drum volume requirements for rear discharge inclined axis truck mixers only, to be effective January 1, 1994.

7. **Water Tank(s) and Water System Options** - Truck mixers, agitators and front discharge concrete carriers shall be furnished with one of the following options:

(a) No water tank or system.
(b) Flush water tank only and water system.
(c) Mix and flush water tank(s) and water system.

8. **Water Tank(s): Mix and Flush** - The total capacity of the tank(s) shall be not more than 50 gallons per cubic yard (250 L per m³) of maximum mixer capacity. The tank(s) may be equipped with an automatic measuring device as specified in Section 10(b) of these Standards. The tank(s) shall also be equipped with sight gauges on all compartments, on which the gauge markings shall be visible through the entire range. Measuring tank(s) shall
be equipped with necessary plumbing to provide for checking their calibration.

9. **Water Tank(s): Flush** - If a flush water tank(s) is furnished, the total capacity of the tank(s) shall not exceed 25 gallons per cubic yard (125 L/m³) of maximum mixer capacity. The tank(s) shall be equipped with a gauge glass on which the markings shall be visible for the entire range.

10. **Water Measuring Devices** –
(a) Water measuring devices shall be required whenever a water tank(s) is furnished. The water measuring device shall be one of the following types:
   (1) Automatic cut-off siphon type.
   (2) Water meter of the automatic shut-off type.
   (3) Sight gauge(s).
(b) Whenever a mix and flush water tank(s) is furnished, an automatic water measuring device may be required. It shall be one of the two automatic devices described in (1) and (2).
(c) On new equipment, automatic water measuring devices shall be accurate to 1 percent of the total capacity of the tank(s) when the truck mixer or front discharge concrete carrier is stationary and essentially level.

11. **Water System** - A water pump or other method for delivering water shall be furnished with the water system. The water system shall be capable of delivering not less than 45 gallons (170 L) of water per minute into the batch, providing, in the case of air pressure systems, that the air delivery from the truck or concrete carrier is sufficient.

12. **Water Injection** - Mixing water: Water for the entire batch, when taken only from the truck mixer or front discharge concrete carrier water system, shall be introduced into the batch at the head section of the drum or by dual injection into the head and discharge section of the drum.

13. **Inspection Hatch** - Truck mixers, agitators, and front discharge concrete carriers must be equipped with a hatch in the periphery of the drum shell of such design as to permit access to the inside of the drum for inspection, cleaning and repair of the drum and blades.

14. **Mixing Speed** - Mixing speed shall be as designated on the manufacturer's data plate, but shall be not less than 6 nor more than 18 rpm of the drum.

15. **Agitator Speed** - Agitating speed shall be as designated on the manufacturer's data plate, but shall be not more than 6 rpm of the drum.

16. **Mixing** - All new standard mixers shall be capable of mixing a volume of concrete less than or equal to their rated capacity as a mixer. When method of loading other than nominal one-stop loading is employed, it may be necessary to reduce the size of the batch or to make adjustments in the loading technique. A procedure to evaluate mixing uniformity is described in Annex A1 of this standard. The number of the revolutions of the drum at mixing
speed will be 70 to 100 revolutions after all ingredients, including mixing water, have been charged into the drum. If water is added after the concrete has been mixed, the drum shall be rotated a minimum of 30 additional revolutions at mixing speed. All additional rotations of the mixer shall be at agitating speed. The overall total number of revolutions shall not exceed 300.

17. **General Requirements** - Standard of measurements for drum capacities shall be the cubic yard (27 cubic feet) and the cubic meter. Water tank capacities will be reflected in gallons and liters.

18. Drum drawings of all truck mixers, agitators, and front discharge concrete carriers manufactured shall be submitted in duplicate by each member of the Bureau to the Executive Secretary who in turn will submit them to a competent authority mutually acceptable to the Bureau and the National Ready Mixed Concrete Association for checking as to conformity with the minimum drum volume ratios and, when approved, one copy shall be returned to manufacturer. Such drawings shall be adequately dimensioned, showing inside dimensions, and accompanied by the manufacturer's detailed computations of the drum volume. As subsequent dimensional changes are made, new drawings shall be submitted for checking in the same manner as prescribed above.

19. 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. The Executive Secretary will submit them to a competent authority mutually acceptable to the Bureau and the National Ready Mixed Concrete Association for checking as to conformity with the requirements of Table A1.1 of Annex A1 of these standards. When approved, one copy appropriately indicating conformity will be returned to the manufacturer. A sample report format is provided in Appendix X2 of these standards. When subsequent changes in mixer design and configuration are made, the uniformity of mixing will be re-evaluated and submitted to the Bureau with a copy of the revised drawings as required in Item 18.

20. A standard rating plate, furnished by the Bureau, shall be attached to each new standard unit. The Bureau rating plate shall state the maximum capacity as a mixer permitted by these Standards and shall also state that the mixer complies with the Standards of the Truck Mixer Manufacturers Bureau. A plate, indicating conformance with the Standards of the Truck Mixer Manufacturers Bureau shall also be attached near the hatch opening of new and replacement mixer drums manufactured by members of the Bureau.

21. Each manufacturer shall attach a data plate of its own design to each standard unit which shall state any qualifications or limitations to the agitator capacity, the minimum and maximum mixing and agitating speeds, drum volume in cubic feet and or its metric equivalent and any other data desired, such as serial number and patent numbers. Each manufacturer's data plate shall designate the country in which the mixer was manufactured.
22. Paving Mixers – Paving mixers shall meet all the requirements of these standards and the requirements of this section. Mixers to be qualified as paving mixers shall be capable of mixing a volume of low slump - 1½ ± ½ in. (38 ± 12 mm) - concrete less than or equal to their rated mixing capacity as a mixer. These mixers shall be further qualified to be capable of discharging the rated capacity load of low slump concrete at a rate of 1 cubic yard or greater in 10 s. The qualification procedure to be used and the reporting shall be in accordance with Annex A2 of these standards. The mixing uniformity evaluation is waived if a unit similar in design has been qualified in accordance with Annex A1. A report of the evaluation on one mixer representing all sizes of essentially similar design and configuration shall be submitted in duplicate to the Executive Secretary of the Bureau. A competent authority mutually acceptable to the Bureau and the National Ready Mixed Concrete Association shall verify the report of evaluation. A paving mixer rating plate, furnished by the Bureau and with the marking “PAV” in addition to the other information on the standard rating plate, shall be attached to applicable mixers in accordance with Section 20.
ANNEX A1 to TMMB 100-05
(Mandatory Information)
Test Procedures for Measuring the Within-Batch Uniformity of Truck Mixed Concrete

A1.1. Scope

This Annex provides procedures for determining the within-batch uniformity of truck mixed concrete. The principal objective is to determine compliance with the mixing uniformity requirements of TMMB 100-05 Truck Mixer and Front Discharge Concrete Standards of the Truck Mixer Manufacturers Bureau. The data generated can be used by concrete producers and contractors to establish the amount of mixing required or the appropriate loading and charging procedures to obtain adequately mixed concrete. The procedures and requirements described herein are those required in ASTM C 94 - Specification for Ready Mixed Concrete.

A1.2. Referenced Documents

ASTM Standards

C 31/C31M Practice for Making and Curing Concrete Test Specimens in the Field
C 33 Specification 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 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 172 Practice for Sampling Freshly Mixed Concrete
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 truck mixers of similar design and meeting the gross volume requirements of the TMMB 100 for rated mixing capacity will meet the requirements of this Annex for within-batch uniformity of truck-mixed concrete. Compliance with the requirements of this ANNEX is essential for obtaining a rating plate issued by the TMMB.

A1.3.2. The sequence and method of charging truck and other concrete mixers has very significant effects on the ability of a mixer to produce uniformly mixed concrete. For this reason, the use of this standard method not only measures the efficiency of the mixer, but also the effect of the method of charging or loading the mixer.

A1.3.3. This Annex includes a recommended method of charging truck mixers. Practice at the specific plant where the tests are being conducted may vary. The recommendations of the mixer manufacturer should be followed.
A1.4. Concrete Mixture

A1.4.1. Concrete to be mixed in truck mixers for the mixing uniformity evaluation shall have the following characteristics to the extent feasible. The intent is to evaluate the mixing efficiency of the mixer with a relatively standard air-entrained concrete mixture.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>ASTM C 150</td>
</tr>
<tr>
<td>Coarse Aggregate</td>
<td>ASTM C 33</td>
</tr>
<tr>
<td>Sand</td>
<td>ASTM C 33</td>
</tr>
<tr>
<td>Slump</td>
<td>4 to 6 in. [100 to 150 mm]</td>
</tr>
<tr>
<td>Air Content</td>
<td>4.0 to 6.0%</td>
</tr>
<tr>
<td>Chemical Admixtures</td>
<td>Not recommended, except to entrain air</td>
</tr>
<tr>
<td>Fly ash, Slag or Silica fume</td>
<td>Not recommended</td>
</tr>
</tbody>
</table>

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 TMMB 100 shall be within 1 cubic yard (0.5 m³) 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. Determine the required batch quantities to account for the aggregate moisture content.

A1.5. Measuring Materials

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

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

Unless recommended otherwise by the manufacturer, load and mix the materials as follows:

A1.6.1. Water Distribution – Retain about 15 to 35% of the amount of water to be added as the last ingredient following addition of all solids. The remaining portion can be added before the solids or distributed throughout the loading sequence.

A1.6.2. About 25% of the required batch weight of coarse aggregate should be batched as the first solid material before any sand is loaded. The remaining coarse aggregate can be ribbon-loaded throughout the charging of solids.

A1.6.3. Charge the sand into the mixer after the coarse aggregate starts so that it ribbon-loads with the coarse aggregate. When possible, complete charging sand before all the coarse aggregate enters the drum in order to clean the discharge end of the drum.

A1.6.4. Cementitious materials – These materials are ribbon-loaded with coarse and fine aggregate during the middle one-half or two-thirds of the load.

A1.6.5. For evaluating conformance to mixing uniformity requirements of TMMB 100, after all the materials are in the mixer drum, mix the concrete at a drum speed exceeding 12 RPM and complete the mixing between 50 and 80 revolutions of the drum at mixing speed. In determining mixer drum revolutions - loading is completed and mixing has started when all of the solids have been loaded or at least 90% of the water has been added, whichever is earlier.
A1.7. Testing Apparatus and Materials

A1.7.1. The apparatus and materials shall conform to the requirements of the appropriate referenced ASTM Standards and as required by this Annex.

A1.8. Sampling

A1.8.1. Sample the concrete discharged from the mixer in accordance with the requirements of Practice C 172, except do not composite samples. For uniformity testing, obtain individual samples after discharge of approximately 15% and 85% of the load. Observe a 15-minute time limit for obtaining the two samples. Cover the samples to prevent loss of water from evaporation and remix each sample the minimum necessary immediately before performing the tests.

A1.8.2. Take the samples by intercepting the full discharge stream from the chute without stopping and starting the discharge stream during the collection of the sample.

Note 1. Concrete with slump exceeding about 5 inches (125 mm) will often segregate on the mixer blades and in the chute if discharge is stopped and started during the sampling process. Also there is a tendency to scrape down the chute when discharge is stopped. There are safety concerns to the operator obtaining the sample at a rapid rate of discharge. For these reasons the discharge rate of concrete may be slowed down but not completely stopped during the sampling.

A1.9. Slump Testing

A1.9.1. 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 2. 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. After conducting the slump test cover the sample, protect it from evaporation and start the other tests after both the samples are secured.

A1.10. Density (Unit Weight) of Fresh Concrete

A1.10.1. Determine the density on the two concrete samples in accordance with ASTM C 138. Use a measure with a minimum volume of 0.2 ft³ (6L), or as required by ASTM C 138 based on the nominal maximum size of the coarse aggregate in the concrete mixture.

Note 3: Determination of fresh concrete density in a larger ½ ft³ (14L) container may provide a somewhat more accurate determination of density.

Note 4: If the ASTM C 138 restrictions on minimum volume of the measure permits the use of the base of the air meter used for measuring air content by the pressure method, it is acceptable to use the same compacted sample to determine air content by C 231 in A1.11 and then use it to determine the coarse aggregate content of the sample in A1.13.

A1.10.2 Calculate the density (unit weight) of the sample as follows:

\[
D = \frac{M}{V}
\]

Where:  
D is the measured density (unit weight), in lb/ft³ [kg/m³]  
M is the net mass of concrete in the container, lb. [kg]  
V is the volume of the container, ft³ [m³]
A1.11 Air Content

A1.11.1 Use Method ASTM 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 when the coarse aggregate in the concrete has an aggregate correction factor larger than 2% when tested by C 231.

A1.12 Air Free Unit Weight of Concrete

A1.12.1 Calculate the air-free density (unit weight) of each sample as follows:

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

Where: 
- \(D\) is the measured density, in lb/ft\(^3\) [kg/m\(^3\)]
- \(A\) is the air content measured in A1.11 on that sample, in percent

A1.13 Coarse Aggregate Content

A1.13.1 The sample used for density and air content measurement can be used for determination of 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 40 lb. [18 kg]. 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 larger size sample of concrete may improve the determination of the coarse aggregate content.

A1.13.2 Wash each sample over a No. 4 [4.75mm] sieve sufficiently to remove the cement and most of the sand. Determine the mass of 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.

A1.13.3 Express the mass of the dry coarse aggregate as a percentage of the mass of the original concrete sample as follows:

\[P = \left(\frac{c}{b}\right) \times 100\]

Where:
- \(P\) = percent mass of dry coarse aggregate in concrete
- \(c\) = dry mass of aggregate retained on the No. 4 (4.75 mm) sieve
- \(b\) = mass of concrete sample

A1.14 Compressive Strength

A1.14.1 Make a minimum of two cylinders from each sample of concrete. Either 6x12 in. [150 x 300 mm] or 4x8 in. [100x200 mm] cylinders can be used. Cure the specimens in accordance with procedures in ASTM C 31 for Standard Curing.

A1.14.2 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 Batch Size and Quantities

A1.15.1 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.

**A1.16. Requirements for Mixing Uniformity Qualification**

A1.16.1. To conform to the mixing uniformity requirements of this Standard, truck mixers are required to meet all of the five requirements in Table A1.1.

**A1.17. Reporting**

A1.17.1. Appendix X2 provides a sample report format for the requirements of Section 19 of the Standard.

A1.17.2. A separate evaluation and report is required for each unique design of the truck mixer. 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 6: Sample calculations that detail the process of mixing uniformity evaluation are available from the TMMB upon request.

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

<table>
<thead>
<tr>
<th>Test</th>
<th>Range of 2 Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Content, %</td>
<td>1.0</td>
</tr>
<tr>
<td>Air-free Density (Unit Weight) of Concrete, lb/cu. ft. [kg/m³]</td>
<td>1.5 [24]</td>
</tr>
<tr>
<td>Slump, in. [mm]</td>
<td></td>
</tr>
<tr>
<td>Average Slump 4 in. [100mm] or Less</td>
<td>1.0 in. [25mm]</td>
</tr>
<tr>
<td>Average Slump, 4 to 6 in. [100 to150mm]</td>
<td>1.5 in. [40mm].</td>
</tr>
<tr>
<td>Coarse Aggregate, % by mass of concrete</td>
<td>5.0</td>
</tr>
<tr>
<td>7-day Compressive Strength, % of Average ^</td>
<td>7.5</td>
</tr>
</tbody>
</table>

^ 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.
A2.1. Scope
This Annex provides procedures for evaluating the discharge rate of low slump concrete. The requirements are that the mixer shall be able to discharge concrete at a slump of 1½ ± ½ in. (38 ± 12mm) at a rate of 1 cubic yard (0.76m³) in 10 seconds or less.

A2.2. Reference Documents
ASTM Standards
C 33  Specification for Concrete Aggregates
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
ACI Documents
ACI 211.1 Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete

A2.3. Significance and Use
A2.3.1. This Annex outlines procedures to evaluate the discharge rate of concrete truck mixer. Its primary use is to ensure that truck mixers of similar design and meeting the requirements of the TMMB 100 will meet the requirements of this Annex for discharge rate to qualify for a rating plate that identifies the unit as a paving mixer.

A2.3.2. Paving mixers are identified as those that can produce a uniform concrete mixture at a low slump and that it can discharge the concrete from the mixer at a rapid rate that is required for concrete paving applications.

A2.3.3. Compliance with the requirements of this Annex in addition to the requirements of the TMMB 100 Standards is essential for obtaining a rating plate that indicates the rated capacity as a mixer and an agitator and with the identification “PAV”

A2.4. Concrete Mixture
A2.4.1. The following are recommended characteristics for the concrete mixture to be batched in the discharge rate evaluation. The intent is to use a relatively typical concrete mixture used for concrete paving applications. Since the tolerance of slump of the discharged mixture is relatively small, a non-air entrained concrete mixture is permitted in this evaluation.

- Cementitious material content  500 to 550 lb./cubic yard (295 to 325 kg/m³)
- Coarse Aggregate  ASTM C 33, Size # 57 or # 67
- Fine Aggregate  ASTM C 33, Fineness Modulus 2.5 to 3.0
- Slump as discharged  1½ ± ½ (38 ± 12mm)
- Air content  Non-air entrained or air entrained 4 to 6%
- Chemical Admixtures  As required to achieve target slump

A2.4.2. The mixture proportions shall be determined in accordance with ACI 211.1.
A2.4.3. The volume of concrete mixed or charged in the mixer shall be within 1 cubic yard (0.5 m³) of the rated mixing capacity of the mixer used in the evaluation.
A2.5. Measuring Materials and Mixing Concrete

A2.5.1. Follow the requirements of sections A1.5 and A1.6 in Annex A1 of these standards. If only the discharge rate is being evaluated, the concrete mixture can be produced in a plant mixer and charged into the truck mixer.

A2.6. Discharge Rate Evaluation

A2.6.1. Either Option A or Option B may be used. Participants are advised to follow all safety procedures in this evaluation.

A2.6.2. Option A – If a truck scale is available on site, a smaller quantity of concrete may be discharged during the evaluation. The truck mixer shall be weighed at capacity load and after the desired quantity of concrete has been discharged. A minimum of 3 cubic yards (2 m³) of concrete shall be discharged for this evaluation. The truck scale shall be accurate to 10 lbs (5 kg).

A2.6.3 Option B – If a truck scale is not available, the entire load of concrete shall be discharged. The plant shall have a recordation device that records the actual batch weights of materials used. Water can be batched by volume but the quantity batched shall be converted to mass to determine the total mass of materials batched into the truck mixer. The quantity of water or other material not added through the plant shall be determined and included in the total mass of materials batched.

A2.7. Discharge Rate Measurement

A2.7.1. The truck mixer shall be positioned at a location that can accept the anticipated volume of discharged concrete and taking into account that the truck may need to be moved forward during the discharge. The mixer drum shall be put in discharge mode and built up to the discharge revolution speed in less than 20 s. Using a stopwatch, accurate to at least 0.1 s, start the time measurement when the discharging concrete first hits the chute. Continue discharge at a constant rate until the required amount of concrete has been discharged. Stop the stopwatch when the mixer revolution has been shut off. Remove any concrete remaining on the chute.

A2.7.2. Record the total time for the discharge in s, to the nearest 0.1 s.

A2.8. Testing

A2.8.1. Fresh concrete testing shall be conducted by technicians with an ACI Grade I Field Testing Technician certification or equivalent.

A2.8.2. A registered professional engineer, independent from the mixer manufacturer, shall observe the discharge rate evaluation. The PE shall sign off on the evaluation report.

A2.9. Slump

A2.9.1. Perform the slump test in accordance with ASTM C 143. Obtain portions of concrete for the test taking random scoops from a representative portion of the discharged concrete, while avoiding concrete close to the ground or near the initial and final portions of the discharge. The slump test shall be started within 30 s after the discharge has been stopped. If the concrete slump is not within the required limits, one retest is permitted. This retest shall be started within 3 minutes after the discharge has been stopped.

A2.9.2. Record and report the slump to the nearest ¼ inch (5 mm).

A2.10. Density (Unit Weight) of Fresh Concrete

A2.10.1. Make two determinations of density of the discharged concrete in accordance with ASTM C 138. Use a measure with a minimum volume of 0.2 ft³ (6 L) or as required by C 138 based on the nominal maximum size of the coarse aggregate in the concrete mixture. Each density test shall use concrete from different portions of the discharged concrete while avoiding concrete close to the ground or near the initial and final portions of the discharge. Complete the density tests within 15 minutes after the discharge has been stopped.
A2.10.2. Calculate the density (unit weight) as follows:

\[ D = \frac{M}{V} \]

Where:
- \( D \) is the density (unit weight) in \( \text{lb/ft}^3 \) (\( \text{kg/m}^3 \))
- \( M \) is the net mass of concrete in the measure, lb. (kg)
- \( V \) is the volume of the measure, \( \text{ft}^3 \) (\( \text{m}^3 \))

A2.10.3 Determine the average density of the concrete to the nearest 0.1 \( \text{lb/ft}^3 \) (1 \( \text{kg/m}^3 \)) from the two determinations.

**A2.11. Discharged Volume of concrete**

A2.11.1. For Option A, determine the weight of the concrete discharged from the difference in weight of the truck mixer before and after discharge. The truck scale readings shall be recorded and included in the report.

A2.11.2. For Option B, determine the total weight of concrete mixed and discharged from the recordation of the quantities batched. Include any materials in the batch that were not recorded in the batching process.

A2.11.3 Calculate the volume of concrete discharged:

\[ \text{Volume Concrete Discharged, cubic yards (m}^3) = \frac{\text{Total weight discharged, lb (kg)}}{\text{Density, lb/ft}^3 x 27 \text{ (kg/m}^3)} \]

**A2.12. Discharge Rate**

A2.12.1. Calculate the discharge rate of the mixer

\[ \text{Discharge Rate, yd}^3 \text{ per 10 s} = \frac{\text{Volume discharged, yd}^3 \text{ (m}^3)}{\text{Discharge time, s}} \times 10 \]

**A2.13. Requirements for Paving Mixer Qualification**

A2.13.1. To conform to the discharge rate requirements of this Standard for paving mixers, the slump of the concrete shall be between 1 and 2 inches (25 to 50 mm) and the discharge rate shall be greater than or equal to 1 cubic yard (0.76 \( \text{m}^3 \)) in 10 s.

**A2.14. Reporting**

A2.14.1. Appendix X3 provides a sample report format for the requirements of Section 22 of the Standard

A2.14.2. A separate discharge rate evaluation and report is required for each unique design of truck mixer. The representative of the manufacturer shall list the standard sizes that will be manufactured with the same design and configuration and sign the report. An independent registered professional engineer who has observed the evaluation shall sign off on the evaluation report.
Appendix X1

Basis For Calculating Volumes of Truck Mixers, Agitators, and Front Discharge Concrete Carriers.

Standards of the Truck Mixer Manufacturers Bureau established, among other things, standard sizes of mixers in terms of their capabilities and the volumes of drums required for the different capacities. The relationships between drum volume and capacity are based on broad experience and comprehensive tests. Those established by the Bureau are, and have been from the beginning, consistent with the standards of operation of truck mixers, agitators, and front discharge concrete carriers of the National Ready Mixed Concrete Association. Any standard of the Bureau is promulgated only after approval by the NRMCA Board of Directors, and that approval is made in light of recommendations of the Association’s Committee on Research, Engineering and Standards.

Volume requirements were established by the Bureau June 23, 1944, revised December 10, 1948, and further revised May 2, 1956. In each case, these requirements were approved by the NRMCA Board. In 1989, the maximum gross drum volume requirements were removed while maintaining the then current minimum gross volumes. This revision was undertaken to permit inclusion of both front discharge concrete carriers and rear discharge incline-axis truck mixers under the same standard minimum gross drum volume requirements.

In 1991, the Bureau voted to reinstate the maximum gross drum volume requirements for rear discharge incline-axis truck mixers only, to be effective January 1, 1994. The relationship between minimum gross volume requirement (designated as "V") in cubic feet and maximum mixer capacity (designated as "C") in cubic yards is shown below. The value of “C” is rounded off to the nearest cubic foot.

1. For inclined-axis revolving drum type mixers up to a capacity of 7.65 cubic yards:
   \[ V = 45C - 8.55 \]

2. For inclined-axis revolving drum type mixers having capacities of 7.65 cubic yards and greater:
   \[ V = 46.96C - 23.48 \]

The minimum gross drum volume of front discharge units is calculated from the above formula, however for these units there is no required maximum gross drum volume.

The maximum gross drum volume for rear discharge truck mixers is 4 cubic feet larger than the minimum calculated by the above formulas.

The maximum agitator capacity shall be \( 0.8 \times (V+4) / 27 \), expressed to the nearest 1/4 cubic yard.
### Qualification of Truck Mixers for Mixing Uniformity

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Mixer Design Identification</th>
<th>Mixer Serial No.</th>
<th>Rated Capacity</th>
<th>Evaluation Date</th>
<th>Location</th>
<th>Production Rate</th>
<th>Target Batch Size</th>
<th>Actual Yield</th>
<th>cu. yd. (m³)</th>
</tr>
</thead>
</table>

#### Materials

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fly Ash / Slag</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coarse Aggregate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air Entrain Admix.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Admix.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes for material characteristics:** For cementitious materials indicate: ASTM Type and/or Classification; For coarse aggregate indicate: ASTM Size; specific gravity (bulk-dry or SSD); dry-rodded unit weight; absorption; and moisture content prior to batching; For fine aggregate indicate: specific gravity (bulk-dry or SSD); fineness modulus (FM); absorption; and moisture content prior to batching; Report Mix Design values in terms of dry or SSD mass of aggregates and indicate which; Report the actual batch quantities based on recording of calibrated controls for each material ingredient.

### Statement of Certification

Our company hereby certifies that the mixer unit evaluated represents the equipment we manufacture and that rating plates will be attached to units that conform to the Standards of the Truck Mixer Manufacturers Bureau.

Certified by: ___________________________ Date: __________________

Signature of Official of the Truck Mixer Manufacturer

Printed Name: ____________________________

Title: ____________________________

Company: ____________________________

Date Submitted to TMMB: ____________________________
# Report of Uniformity Tests

<table>
<thead>
<tr>
<th>Test</th>
<th>Sample 1</th>
<th>Sample 2</th>
<th>Range</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slump, in.</td>
<td></td>
<td></td>
<td></td>
<td>1.0 or 1.5</td>
</tr>
<tr>
<td>Air Content, %</td>
<td></td>
<td></td>
<td></td>
<td>1.5</td>
</tr>
<tr>
<td>Measured unit weight, lb./cu. ft.</td>
<td></td>
<td>Avg.</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>Concrete Air-free unit weight, lb./cu. ft.</td>
<td></td>
<td></td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>Coarse aggregate content, %</td>
<td></td>
<td></td>
<td></td>
<td>6.0</td>
</tr>
<tr>
<td>7-day compressive strength, psi</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylinder 1</td>
<td></td>
<td></td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>Cylinder 2</td>
<td></td>
<td></td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>N/A</td>
<td></td>
<td>7.5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test</th>
<th>Sample 1</th>
<th>Sample 2</th>
<th>Range</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-day compressive strength, psi Cylinder 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-day compressive strength, psi Cylinder 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-day compressive strength, psi Average</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The evaluation and testing for the mixing uniformity was conducted in accordance with the Standards of the Truck Mixer Manufacturers Bureau and pertinent ASTM Standards.

Signature of Responsible Official of the Testing Agency

Printed Name: _____________________________  Date: ___________________________

For TMMB Use

Reviewed and approved _____________________  Date: ______________
## Sample Report Format

### Qualification of Paving Truck Mixers for Discharge Rate

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Evaluation Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixer Design Identification</td>
<td>Location</td>
</tr>
<tr>
<td>Mixer Serial No.</td>
<td>Batch Size cu. yd. (m³)</td>
</tr>
<tr>
<td>Rated Capacity</td>
<td></td>
</tr>
</tbody>
</table>

### Recorded Batched Quantities

<table>
<thead>
<tr>
<th>Material</th>
<th>Mass, lbs</th>
<th>Option A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td></td>
<td>Scale at capacity load</td>
</tr>
<tr>
<td>Fly Ash/Slag</td>
<td></td>
<td>Scale after discharge</td>
</tr>
<tr>
<td>Wet Coarse Aggregate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wet Fine Aggregate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Added Water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other unrecorded matl.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Mass</strong></td>
<td><strong>Discharge time, s</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:** Record and report recorded batch quantities for the mixture evaluated. If water is batched by volume in gallons, convert to mass (1 gallon = 8.33 lb.). Record quantity of water in the mixer prior to batching and if any was added through the saddle tanks.

### Test Results

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slump, in. Test 1</td>
<td></td>
<td>1.0 to 2.0</td>
</tr>
<tr>
<td>(if reqd.) Test 2</td>
<td></td>
<td>1.0 to 2.0</td>
</tr>
<tr>
<td>Density, lb/ft³ Sample 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Average Density</strong></td>
<td></td>
<td>NA</td>
</tr>
<tr>
<td>Volume Discharged, yd³</td>
<td></td>
<td>NA</td>
</tr>
<tr>
<td><strong>Discharge Rate, yd³/10s</strong></td>
<td></td>
<td>≥1.0</td>
</tr>
</tbody>
</table>

### Statement of Certification

Our company hereby certifies that the mixer unit evaluated represents the equipment we manufacture and that rating plates will be attached to units that conform to the Standards of the TMMB.

Certified by: [Signature of Official of the Truck Mixer Manufacturer]

Printed Name: [Name] Title: [Title]

Company [Company Name] Date Submitted to TMMB [Date]

The evaluation and testing for the discharge rate was conducted in accordance with the Standards of the TMMB and pertinent ASTM Standards. Certified technicians conducted the testing.

[Signature of Independent Professional Engineer]

Printed Name: [Name] Date: [Date]
<table>
<thead>
<tr>
<th>For TMMB Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reviewed and approved</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

19
NRMCA endorses the members of the Truck Mixer Manufacturers Bureau as the preferred providers of truck mixer, agitator and front discharge concrete carrier equipment conforming to the standards and specifications of NRMCA and the truck mixer manufacturers standards.
Member Companies

October, 2009

Beck Industrial, Inc.
Lubbock, Texas

Con-Tech Manufacturing, Inc.
Dodge Center, Minnesota

CBMW/Continental Manuf. Co., Inc.
Houston, Texas

Housby Mixer
Des Moines, Iowa

Kimble Mixer Company
New Philadelphia, Ohio

London Machinery
London, Ontario, Canada

McNeilus, an Oshkosh Corporation Co.
Dodge Center, Minnesota

Oshkosh Corporation
Oshkosh, Wisconsin

Schwing America, Inc.
White Bear Lake, Minnesota

Summit Performance Systems, Inc.
Oshkosh, Wisconsin

Terex®
Ft. Wayne, Indiana