

ASTM C94

Standard Specification for Ready Mixed Concrete

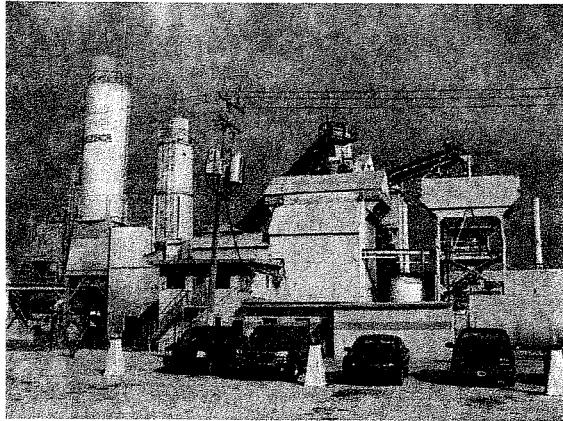
2006 Level I Certification



Michigan Concrete Association

ASTM C94

Standard Specification for Ready Mixed Concrete



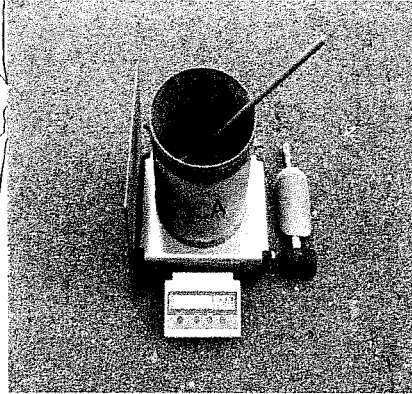
ASTM C94

- 1.1 Specification covers ready-mixed concrete manufactured and delivered in a freshly mixed and unhardened state.

Where the requirements of the purchaser differ from those noted in this specification, the purchaser's specification shall govern.

The specification does not cover the placement, consolidation, curing, or protection of the concrete after delivery to the purchaser.

ASTM C94



3.1 Basis of purchase shall be the cubic yard or cubic meter.

3.2 The volume (yield) shall be determined from the total mass of the batch divided by the mass per unit volume (density) of the concrete.

The mass per unit volume (density) shall be determined from the average of at least 3 measurements (using $\frac{1}{2}$ ft³ container) taken from the mid-point of 3 different truck loads.

ASTM C94

- 4.1 In the absence of a stated general specification (mix design requirements), the purchaser shall specify the following information:
 - 4.1.1 Size, or sizes of coarse aggregate.
 - 4.1.2 Slump or slumps desired at the point of delivery - chute of ready-mix truck or end of pump line?
 - 4.1.3 When air-entrained concrete is specified, the air content taken at the point of discharge from the transportation unit.
 - 4.1.4 Which of options A, B or C shall be used as the basis for determining the concrete proportions.

ASTM C94

4.2 *Option A – Performance Specification*

4.2.1 When the purchaser requires the manufacturer to assume full responsibility for the selection of the proportions for the concrete mixture. The purchaser must then specify the requirement for compressive strength i.e. 3500 psi

- unless otherwise stated, the age at test shall be 28 days and the specimens shall be moist cured under standard laboratory conditions

4.2.2 The manufacturer may, at the purchaser's request, be required to furnish evidence that the materials to be used and the proportions selected will produce concrete of the desired quality.

ASTM C94

4.3 *Option B – Prescriptive Specification*

4.3.1 When the purchaser assumes responsibility for the proportioning of the concrete mixture, they shall specify the following information:

A. Cement content – bags or lbs/yd³

B. Maximum water content – gals/yd³

C. If admixtures are required, the type, name and dosage to be used. The cement content shall not be reduced without written approval of the purchaser.

4.3.2 The mfr. may, at the purchaser's request, be required to provide information regarding aggregate sources and properties, admixtures used and water content.

ASTM C94

4.4 Option C – Combination Specification

- 4.4.1 When the purchaser requires the manufacturer to assume responsibility for the selection of the proportions with a minimum cement content, the purchaser shall specify the following information:
- A. Required compressive strength
 - B. **Minimum** cement content – bags or lbs/yd³
 - C. If admixtures are required, the type, name and dosage to be used.

Note: durability and finishability are the determining factors

ASTM C94



St. Marys Cement Inc. (U.S.)
 Boston Portland Laboratory
 833 Broadway, Boston, MA 02126
 Phone: 617-452-4175

COMPRESSIVE STRENGTH CYLINDER DATA SHEET

Customer:		Date Received:	
Address:		Date Cast:	
Phone:			
CONTRACTOR:			
PROJECT:			
LOCATION ON STRUCTURE:			
Cylinders cast by:			
Max. Depth, Cyl. in.			
Cyl. No.	Test	Age	Notes
1	1000	28	1000
2	1000	28	1000
3	1000	28	1000
4	1000	28	1000
5	1000	28	1000
6	1000	28	1000
7	1000	28	1000
8	1000	28	1000
9	1000	28	1000
10	1000	28	1000
11	1000	28	1000
12	1000	28	1000
13	1000	28	1000
14	1000	28	1000
15	1000	28	1000
16	1000	28	1000
17	1000	28	1000
18	1000	28	1000
19	1000	28	1000
20	1000	28	1000
21	1000	28	1000
22	1000	28	1000
23	1000	28	1000
24	1000	28	1000
25	1000	28	1000
26	1000	28	1000
27	1000	28	1000
28	1000	28	1000
29	1000	28	1000
30	1000	28	1000
31	1000	28	1000
32	1000	28	1000
33	1000	28	1000
34	1000	28	1000
35	1000	28	1000
36	1000	28	1000
37	1000	28	1000
38	1000	28	1000
39	1000	28	1000
40	1000	28	1000
41	1000	28	1000
42	1000	28	1000
43	1000	28	1000
44	1000	28	1000
45	1000	28	1000
46	1000	28	1000
47	1000	28	1000
48	1000	28	1000
49	1000	28	1000
50	1000	28	1000
51	1000	28	1000
52	1000	28	1000
53	1000	28	1000
54	1000	28	1000
55	1000	28	1000
56	1000	28	1000
57	1000	28	1000
58	1000	28	1000
59	1000	28	1000
60	1000	28	1000
61	1000	28	1000
62	1000	28	1000
63	1000	28	1000
64	1000	28	1000
65	1000	28	1000
66	1000	28	1000
67	1000	28	1000
68	1000	28	1000
69	1000	28	1000
70	1000	28	1000
71	1000	28	1000
72	1000	28	1000
73	1000	28	1000
74	1000	28	1000
75	1000	28	1000
76	1000	28	1000
77	1000	28	1000
78	1000	28	1000
79	1000	28	1000
80	1000	28	1000
81	1000	28	1000
82	1000	28	1000
83	1000	28	1000
84	1000	28	1000
85	1000	28	1000
86	1000	28	1000
87	1000	28	1000
88	1000	28	1000
89	1000	28	1000
90	1000	28	1000
91	1000	28	1000
92	1000	28	1000
93	1000	28	1000
94	1000	28	1000
95	1000	28	1000
96	1000	28	1000
97	1000	28	1000
98	1000	28	1000
99	1000	28	1000
100	1000	28	1000

- 4.6 The **purchaser** shall ensure that the manufacturer (ready-mixed concrete producer) is provided copies of all reports of tests performed on concrete samples to determine compliance with the specification requirements.

Reports shall be provided on a timely basis.

ASTM C94

5.1 *Materials*

Requirements for material qualities and specifications are outlined in this section.

5.1.3.1

Mix water shall be clear and apparently clean.

Water of questionable quality shall be subject to the acceptance criteria of Table 2.

TABLE 2 Acceptance Criteria for Questionable Water Supplies

	Limits	Test Method
Compressive strength, min % control at 7 days	90	C109/C109M
Time of set, deviation from control, h:min	from 1:00 early to 1:30 later	C191

ASTM C94

5.1.3.2 *Wash water*

Wash water is permitted to be used provided that it complies with the physical test limits of Table 2.

Wash water shall be tested at weekly intervals for 4 weeks, then at monthly intervals.

- optional chemical limits (Table 3) may be specified

TABLE 3 Optional Chemical Limits for Wash Water

Chemical requirements, maximum concentration in mixing water, ppm	Limits	Test Method
Chloride as Cl: Prestressed concrete/bridge decks	500	D512
Other reinforced concrete in moist environments or containing aluminum	1000	
Sulphate as SO ₄	3000	D516
Alkalies (Na ₂ O + 0.658 K ₂ O)	600	
Total solids	50000	AASHTO T26

ASTM C94

6. *Tolerances in Slump*

6.1 Unless other tolerances are included in the project specifications, the following shall apply:

6.1.1

When the project specs are written as a 'maximum' or 'not to exceed':

	3" or less	more than 3"
Plus tolerance	0	0
Minus tolerance	1 1/2"	2 1/2"

Note: Only one addition of water is permitted provided such addition does not increase the water-cement ratio above the maximum permitted.

ASTM C94

6.1.2

When the project specs are *not* written as a 'maximum' or 'not to exceed' (i.e. nominal or perhaps a target slump):

Nominal Slump	Tolerance
2" and less	+/- 1/2"
more than 2" thru 4"	+/- 1"
more than 4"	+/- 1 1/2"

ASTM C94

7. *Air Entrained Concrete*

7.2 The air content of air-entrained concrete, when sampled from the transportation unit at the point of discharge, shall be within a tolerance of ± 1.5 of the specified value.

example: $6.5 \pm 1.5 \rightarrow 5 - 8\%$

7.3 When a preliminary sample (after $\frac{1}{4}$ yd³ discharge - see section 16.6) shows an air content below the specified level, the manufacturer may use additional air entraining admixture to achieve the desired air content level, followed by a minimum of 30 revolutions at mixing speed.

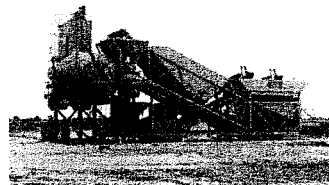
Note: Preliminary samples are not to be used for strength testing and cannot be used as the reported acceptance test. ASTM C172 still requires sampling from the middle portion of the batch.

ASTM C94

10. *Mixers and Agitators*

10.1 Mixers can be stationary or truck mixers. Agitators can be truck mixers or truck agitators.

10.1.1 Stationary mixers shall be equipped with a metal plate on which is clearly marked the mixing speed of the drum or paddles and the maximum capacity in terms of the volume of mixed concrete.

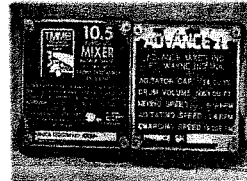


ASTM C94

10.1.2 Each truck mixer or agitator shall have attached a metal plate that identifies

- the gross volume of the drum,
- the capacity of the drum in terms of the volume of mixed concrete and,
- the minimum and maximum mixing speeds of the drum, blades or paddles.

Truck mixers and agitators shall also be equipped with a means of verifying the number of revolutions of the drum blades or paddles.



ASTM C94

11. *Mixing and Delivery*

11.1 Ready mixed concrete shall be mixed and delivered to the point designated by the purchaser by means of one of the following combinations of operations:

- A. Central-mixed concrete
- B. Shrink-mixed concrete
- C. Truck-mixed concrete



ASTM C94

11.3 *Central-mixed concrete*

Concrete that is mixed completely in a stationary mixer and transported to the point of delivery either in a truck agitator, a truck mixer operating at agitating speed, or in non-agitating equipment approved by the purchaser (i.e. dump truck).

11.4 *Shrink-mixed concrete*

Concrete that is first partially mixed in a stationary mixer, and then completely mixed in a truck mixer. The time of partial mixing shall be the minimum required to intermingle the ingredients.



ASTM C94

11.5 *Truck-mixed concrete*

Concrete that is completely mixed in a truck mixer, 70-100 revolutions at the mixing speed designated by the manufacturer.

- NRMCA estimates that 80% of all concrete is truck mixed or dry batched

11.7

When a truck mixer or agitator is approved for mixing or delivery of concrete, no water from the truck water system or elsewhere shall be added after the initial introduction of mixing water for the batch, except when on arrival at the job site the slump of the concrete is less than that specified.

ASTM C94

11.7 continued

The drum or blades shall be turned an additional 30 revolutions or more at mixing speed. Water shall not be added to the batch at any time later.

Discharge of the concrete shall be complete within 1 ½ hours, or before the drum has revolved 300 revolutions, after the introduction of the mix water to the cement and aggregates or introduction of the cement to the aggregates.

Exception: These limitations can be waived by the *purchaser* provided that the concrete can still be placed without the addition of water to the batch.

ASTM C94

11.8 Concrete delivered in cold weather shall have the applicable minimum temperature indicated in the following table:

Section size, inch	Temperature °F
<12	55
12-36	50
36-72	45
>72	40

The maximum temperature of concrete produced with heated aggregates, heated water, or both, shall at no time during its production or transportation exceed 90°F.

ASTM C94

- 11.9 The producer shall deliver ready-mixed concrete during hot weather at concrete temperatures as low as possible, subject to the approval of the purchaser.
- no maximum concrete temperature is stated for hot weather conditions

Note 15: In some situations, difficulty may be encountered when concrete temperatures approach 90°F.

ASTM C94

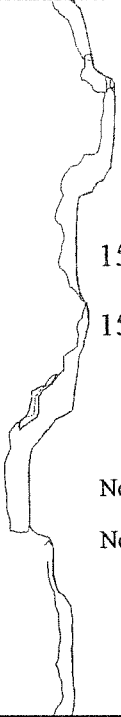
13. Batch ticket information

Batch tickets must include the following information:

- 1.1 Name of ready-mixed company
- 1.2 Serial number of ticket
- 1.3 Date
- 1.4 Truck number
- 1.5 Name of purchaser
- 1.6 Job designation
- 1.7 Class or designation of concrete
- 1.8 Amount of concrete, yd³
- 1.9 Time loaded or of first mixing
- 1.10 *Water added by receiver of concrete and their initials*

Form showing batch ticket information, including fields for Name of ready-mixed company, Serial number of ticket, Date, Truck number, Name of purchaser, Job designation, Class or designation of concrete, Amount of concrete, yd³, Time loaded or of first mixing, and Water added by receiver of concrete and their initials. The form also includes a section for Remarks and a section for the Receiver's signature and initials.

Form showing batch ticket information, including fields for Name of ready-mixed company, Serial number of ticket, Date, Truck number, Name of purchaser, Job designation, Class or designation of concrete, Amount of concrete, yd³, Time loaded or of first mixing, and Water added by receiver of concrete and their initials. The form also includes a section for Remarks and a section for the Receiver's signature and initials.

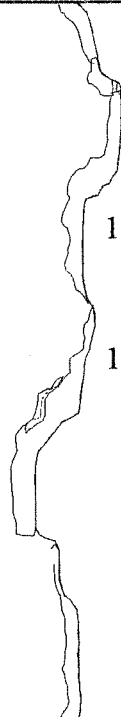


ASTM C94

- 15.2 The testing laboratory performing acceptance tests shall meet the requirements of ASTM C1077.
- 15.3 The laboratory report shall include a statement that all tests were conducted in accordance with the applicable test methods or shall note all known deviations.

Note 16: Deviation from standard test methods may adversely affect test results.

Note 17: Deviation from standard moisture and temperature curing conditions is often a reason for low strength test results. Such deviations may invalidate the use of such test results as a basis for rejection of the concrete.



ASTM C94

- 16.2 Tests of concrete required to determine compliance with this specification shall be made by a certified ACI Concrete Field Testing Technician, Grade I or equivalent.
- 16.4 Slump, air content, density and temperature tests shall be made at the time of placement at the option of the inspector as often as is necessary for control checks. In addition, these tests shall be made when specified and *always* when strength specimens are made.

Note: Section 16.4 differs from ASTM C31 by requiring the testing for density.



ASTM C94

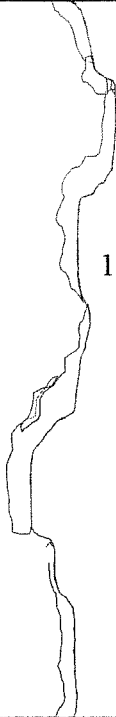
- 16.6 If preliminary checks of slump or air content are made, a single sample shall be taken after the discharge of not less than $\frac{1}{4}$ yd³. All other requirements of ASTM C172 shall be retained. If the preliminary measurement of slump or air content falls outside the specified limits, address as follows:
- A. If the slump or air content, or both, is greater than the specified upper limit, a check test shall be made on a new test sample. If the check test fails, then the concrete fails the specification.
 - B. If the slump or air content, or both, is less than the lower limit, permit adjustments (water, AEA) and obtain a new sample. If the sample of adjusted concrete fails, a check test shall be performed on a new sample of adjusted concrete. In the event the check test fails, then the concrete fails the specification.



ASTM C94

- 17.2 For a strength test, at least 2 standard test specimens shall be cast from a composite sample. A test is defined as the average of the strengths obtained at the age specified – i.e. 28 days. If a specimen shows evidence of improper sampling, molding, handling, curing or testing it shall be discarded.

Note 18: Additional tests may be made at other ages to obtain information for determining form removal time or when a structure may be put into service. Specimens for such tests are field cured as compared with lab cured.



ASTM C94

- 17.4 To conform to the requirements of this specification, strength tests representing each class of concrete must meet the following:
- A. The average of any three consecutive strength tests shall be equal to, or greater than, the specified strength, f'_c and
 - B. No individual strength test shall be more than 500 psi below the specified strength, f'_c