Standard Method of Test for

FLEXURAL STRENGTH OF MAGNESIUM OXYCHLORIDE CEMENTS (USING SIMPLE BAR WITH TWO-POINT OR SINGLE-POINT LOADING)[1]

3, p. 332 (C 256 – 52).

Make the following editorial change in Standard Method C 256 – 52:

Section 4 (b).—In line 3 change "a minimum of 12 hr. after final set" to read "not less than 12 nor more than 24 hr. after final set."

ASTM Designation: C 256 – 52

ADOPTED, 1952.[2]

This Standard of the American Society for Testing Materials is issued under the fixed designation C 256; the final number indicates the year of original adoption as standard or, in the case of revision, the year of last revision.

Scope

1. This method of test covers the procedure for determining the flexural strength of magnesium oxychloride cement compositions by the use of a simple flat bar with two-point loading, or, alternatively single-point loading.

Apparatus

2. (*a*) *Flexure Test Apparatus:*

(*1*) *Two-Point Loading.*—The apparatus for two-point loading shall employ bearing blocks that will ensure that the forces applied to the beam will be vertical only and applied without eccentricity, provided the points of load application are spaced equidistant between the supports and provided that the ratio of the distance between point of load application and nearest reaction to the depth of the beam is not less than one. The essential features of one type of flexure testing machine that satisfactorily meet these requirements are as follows: The testing machine (Fig. 1) is self-contained in a 26 by 30-in. frame of channel iron. The load is applied to the test bar by shot from a reservoir, *A*, which throws the system out of balance and allows the weights *B*, *C*, and *D* to load the test bar, *E*, through a series of fulcrums, *F*, *G*, *H*, and *I*, with a mechanical advantage of approximately four. The two-point loading jig, *J*, is designed so that the load applied will be entirely perpendicular (no horizontal component). It is adjustable vertically by a turnbuckle, *K*, and means is provided for automatically centering it on the test piece. The support fulcrums, *L* and *M*, are separated by a fixed distance of 10 in. Support *L* is rigid while support *M* is pivoted at the center to take care of possible nonuniformities in the test bar. Stops are provided at the rear of each to ensure that the test bar will always be centered properly. When the specimen breaks, the flow of shot is automatically cut off at *N*. The system is balanced before starting the test by removing or adding shot to the reservoir, *A*, until the pointer, *O*, coincides with the reference mark, *P*. After breaking the test bar, the system is again balanced by sliding the weights *B* and *C* along the graduated beams *Q* and the load applied to the specimen is read directly.

(*2*) *Single-Point Loading.*—The apparatus for single-point loading shall consist of knife edges 10 ± $\frac{1}{16}$ in. apart and means for applying the load through a knife edge at a point within $\frac{1}{32}$ in. of the center of the 10-in. span. A diagram of an apparatus that accomplishes this purpose is shown in Fig. 2.

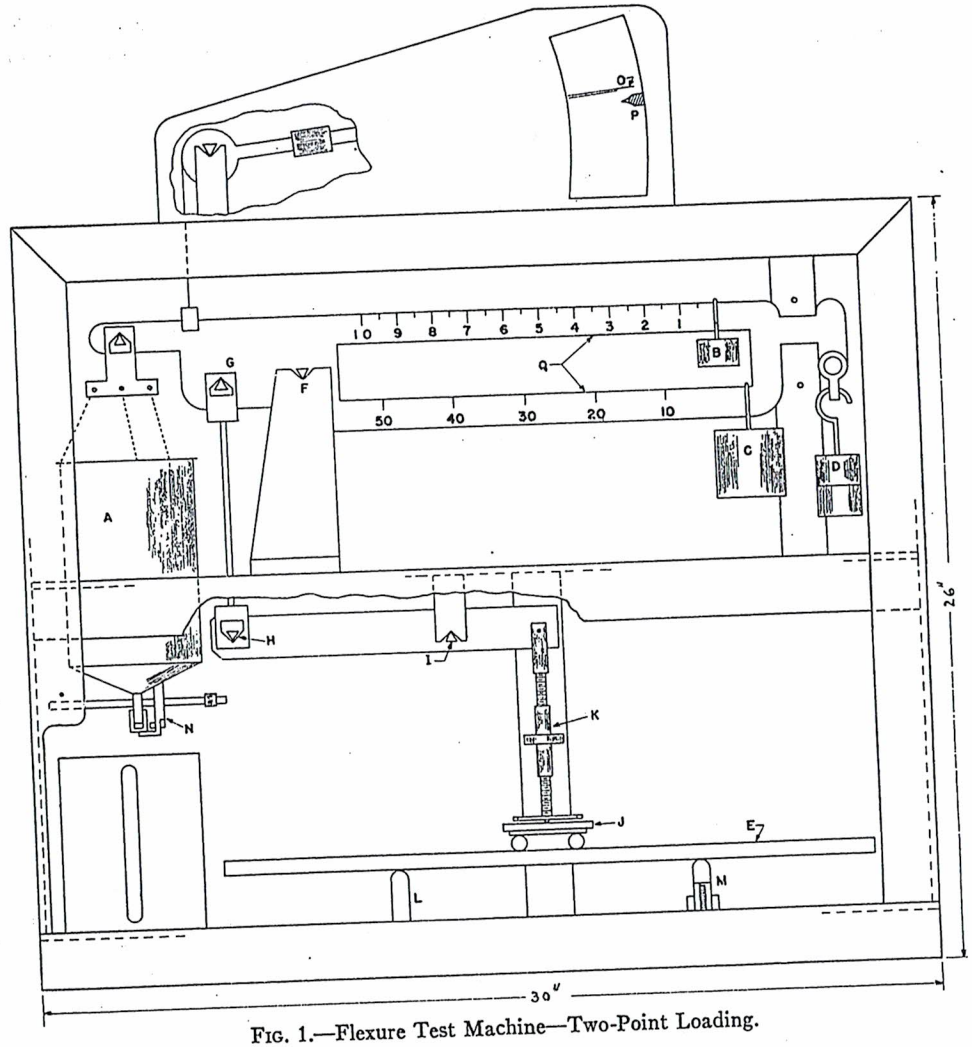

FIG. 1.—Flexure Test Machine—Two-Point Loading.

(*3*) The accuracy of load indicatio for either two-point or single-point load ing shall be within plus or minus 1 pe cent of the applied load over the entir range and shall be verified, at leas every three months, by means of

[1] Under the standardization procedure of the Society, this method is under the jurisdiction of the ASTM Committee C-2 on Magnesium Oxychloride and Magnesium Oxysulfate Cements.

[2] Prior to adoption as standard, this method was published as tentative from 1950 to 1952.

dynamometer that is accurate within plus or minus 0.25 per cent.

(*b*) *Test Specimen Molds.*—Suitable molds shall be provided for the preparation of test specimens in the form of flat bars 23 ± 1 in. long, 2 in. wide, and ½ in. thick. A diagram of a suitable mold is shown in Fig. 3.

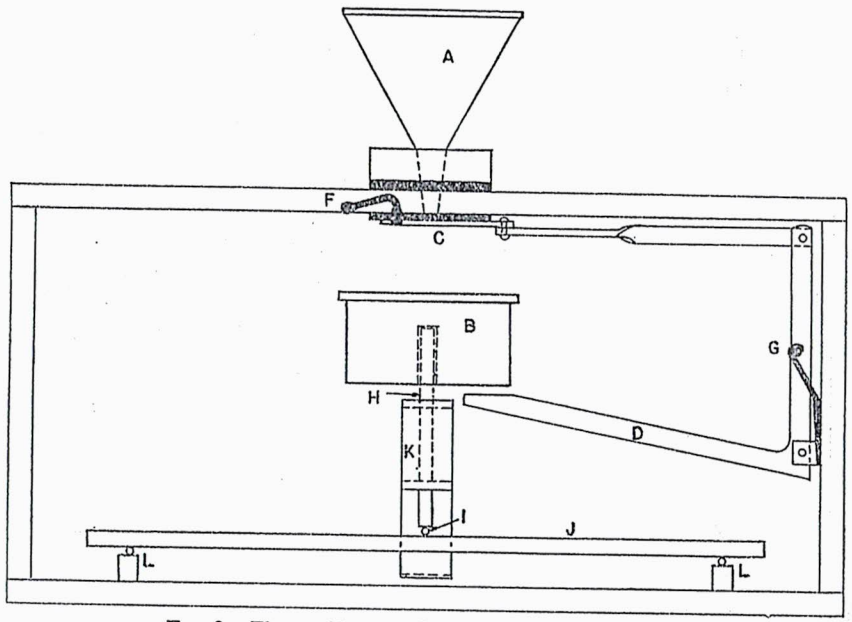

FIG. 2.—Flexure Test Machine—Single-Point Loading.

A—Shot reservoir.
B—Shot cup.
C—Trip rod.
D—Trip lever.
F—Release rod.
G—Trip rod catch.
H—Shot cup stem.
I—Bar fulcrum.
J—Test specimen.
K—Cup stem guide.
L—Bar supports.

Storage and Test Conditions

3. The complete preparation of test specimens, including storage of materials and solutions and the curing, shall be carried out in an atmosphere maintained at 70 ± 1 F. and at a relative humidity of 50 ± 5 per cent (corresponding to a wet bulb temperature range of 56.5 to 60.5 F.). After removal from the molds, the test specimens shall be stored, for the designated duration of the test, on a rack or grating that will permit access of the standard atmosphere at a velocity of not less than 20 nor more than 500 ft. per min. to all sides of the test specimen.

Test Specimens

4. (*a*) *Molding Test Specimens.*—Prepare the plastic cement by mixing the dry composition with magnesium chloride gauging solution as specified in the Standard Method for Mixing Magnesium Oxychloride Cement Compositions with Gauging Solution (ASTM Designation: C 251).[3] Spread the plastic cement along the length of the mold and work it into the corners with a trowel. Use somewhat more than needed to fill the molds, and strike off the excess by not more than three strokes of the trowel forward and three backward over the full length of the mold. Further trowel-

[3] Appears in this publication, see Contents in Numeric Sequence of ASTM Designations at front of book.

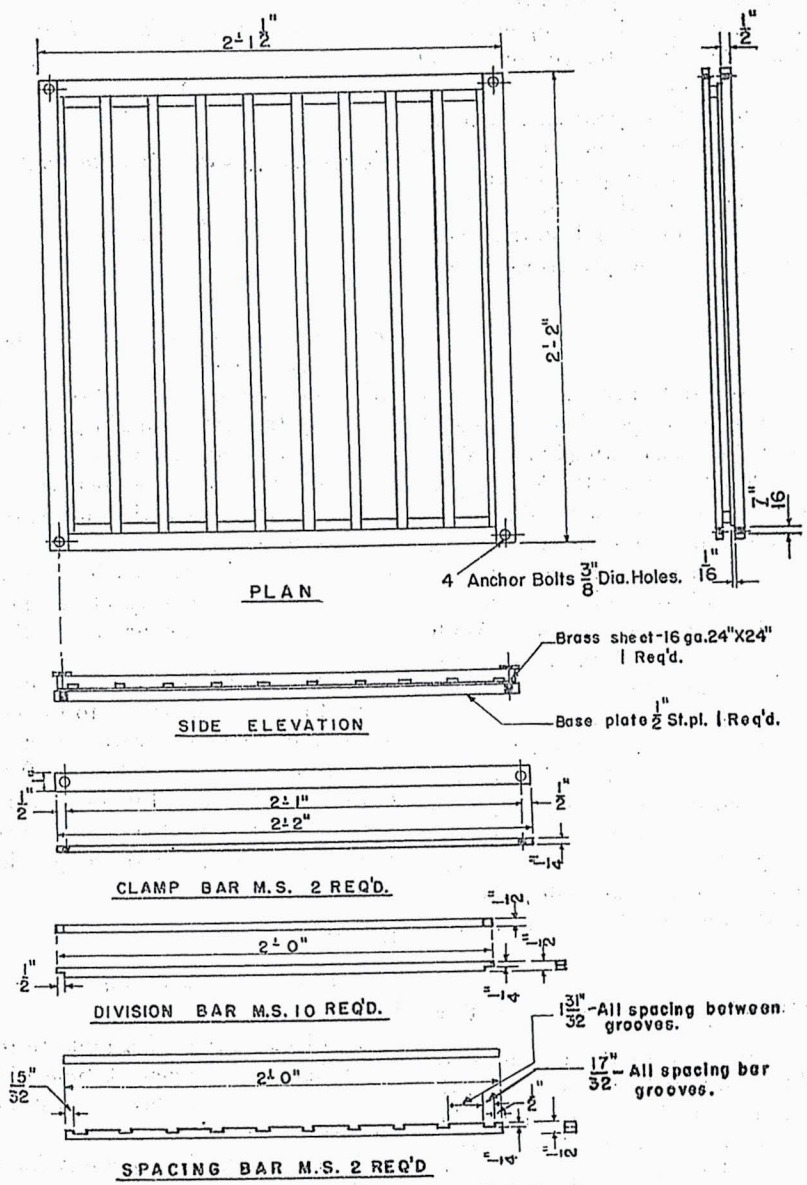

FIG. 3.—Molds for Flexure Test Specimens.

ing should not be done, since excessive troweling materially changes the surface of the test piece. The preparation of the last specimen shall be completed not more than 20 min. after completion of mixing of the cement.

(*b*) *Storage of Test Specimens.*—All test specimens shall be retained in the molds on the plane plates for a minimum of 12 hr. after final set, when they shall be freed from the forms and stored under standard conditions as prescribed in Section 3.

Procedure

5. Turn the test specimen face down with respect to its position as molded and center it on the bearing blocks. With two-point loading, bring the load-applying blocks in contact with the upper surface at the third points between the supports. With single-point loading, apply the load at the mid-point of the specimen between the supports. Apply load at the rate of 20 ± 0.5 lb. per min. The breaking strength shall be the average flexural strength of nine breaks. Break each 23 ± 1-in. bar three times on 10-in. spans, first by breaking in the center and subsequently breaking each of the halves resulting from the first break. If the fracture occurs more than 1 in. either side of the middle of the span length, discard the results of the test.

Measurement of Specimens After Test

6. Measurements to the nearest 0.01 in. shall be made to determine the width and thickness of the specimen at the section of failure. Three thickness measurements shall be made and averaged.

Calculations

7. (*a*) If the fracture occurs within 1 in. on either side of the middle of the 10-in. span length, calculate the modulus of rupture as follows:

In the case of two-point loading:

$$R = \frac{3W(L - l)}{2bh^2}$$

In the case of single-point loading:

$$R = \frac{3WL}{2bh^2}$$

where:

R = modulus of rupture in pounds per square inch,
W = maximum applied load indicated by the testing machine, in pounds,
L = span length in inches,
l = distance in inches between points of load application for two-point loading,
b = width of specimen in inches, and
h = average thickness of specimen in inches, to the nearest 0.01 in.

(*b*) Round off the average modulus of rupture for nine breaks to the nearest 100 psi., in accordance with the rounding-off method given in Section 3 (*d*) to (*h*) of the Recommended Practices for Designating Significant Places in Specified Limiting Values (ASTM Designation: E 29).[3]

Report

8. The report shall include the following:

(*1*) Identification of sample tested,
(*2*) Age of specimen at time of test,
(*3*) Average modulus of rupture, to the nearest 100 psi.,
(*4*) Applied load in pounds for each break,
(*5*) Width to the nearest 0.01 in. for each break, and
(*6*) Average thickness to the nearest 0.01 in. for each break.

Standard Method of Test for
COMPRESSIVE STRENGTH OF MAGNESIUM OXYCHLORIDE CEMENTS[1]

ASTM Designation: C 257 – 52

ADOPTED, 1952.[2]

This Standard of the American Society for Testing Materials is issued under the fixed designation C 257; the final number indicates the year of original adoption as standard or, in the case of revision, the year of last revision.

Scope

1. This method of test covers procedures for the determination of the compressive strength of oxychloride magnesia and magnesium oxychloride cements.

Apparatus

2. (*a*) *Molds.*—Molds for 2-in. cube test specimens shall be provided. The molds shall be tight-fitting. The parts of the molds, when assembled, shall be positively held together. The molds shall be made of hard metal not attacked by the cement mortar. For new molds, the Rockwell hardness number of the metal shall be not less than B 55 (the Brinell hardness number not less than 95). There shall be sufficient material in the sides of the molds to prevent spreading or warping. The interior faces of the molds shall be true plane surfaces with a permissible variation of 0.001 in. for new molds and 0.002 in. for molds in use. The distance between opposite faces of the molds shall be 2 ± 0.005 in. for new molds, or 2 ± 0.01 in. for molds in use. The height of the molds, measured separately for each cube compartment, shall be 2 in. with permissible variations of plus 0.01 in. and minus 0.005 in. for new molds, or plus 0.01 in. and minus 0.015 in. for molds in use. The angle between adjacent interior faces and between interior faces and top and bottom planes of the mold shall be 90 ± 0.5 deg. Molds shall be coated with a saturated solution of stearic acid in trichlorethylene.

(*b*) *Testing Machine.*—The testing machine may be of either the hydraulic or the screw type, with sufficient opening between the upper bearing surface and the lower bearing surface of the machine to permit the use of verifying apparatus. The load applied to the test specimen shall be indicated with an accuracy of plus or minus 1.0 per cent. The upper bearing shall be a spherically seated hardened metal block firmly attached at the center of the upper head of the machine. The center of the sphere shall be at the center of the surface of the block

[1] Under the standardization procedure of the Society, this method is under the jurisdiction of the ASTM Committee C-2 on Magnesium Oxychloride and Magnesium Oxysulfate Cements.

[2] Prior to adoption as standard, this method was published as tentative from 1950 to 1952.

) ml. of water, to the end point
l red. Estimate all buret read-
ıe nearest 0.01 ml. Calculate the
y of the HCl as follows:

$$N_a = \frac{A}{B \times 0.19072}$$

rmality of the HCl,
ıms of $Na_2B_4O_7 \cdot 10H_2O$ used, and
lliliters of the HCl required for
e titration.

: the normality of the HCl to
.0002 *N*.

:e

Transfer 2.800 ± 0.001 g. of
)le to a dry 500-ml. Erlenmeyer
ld 200 ml. of $MgCl_2$ solution by
f a 200-ml. pipet. Stopper se-
ıd agitate for 16 hr. on a shaking
. Filter through a 15-ml., coarse,
lass filter, using suction. Wash
:s with water.
dd 0.5 ml. of trinitrobenzene
: and, while swirling vigorously,
ith 1 *N* NaOH solution, adding
ml. excess (Note). By observing
layer of liquid thrown against
l of the flask by the swirling
he end point may be estimated
)sely (Note 2, Section 5 (*a*)).

—If, after back-titrating the excess
aragraph (*d*)), it is found that the ex-
NaOH was not between 1.50 and 2.50
value for active calcium oxide may
)r by an amount exceeding the LU_1
ıncertainty under the best conditions)
thod.

ransfer the solution quantita-
) a 500-ml. glass-stoppered grad-
lute to 500 ml., and mix well.
) settle 2 hr. Decant about 350
) a dry Erlenmeyer flask and
:ough a 12.5-cm., medium paper,
ry apparatus (Note 3, Section

easure 300 ml. of the clear filtrate in a graduate and transfer to a 500-ml. Erlenmeyer flask. Add 5 drops of methyl red indicator and titrate the excess NaOH with 0.1 *N* HCl. The end point will fade due to the presence of $CaCO_3$ formed by reaction of Ca^{++} with CO_2. Add 0.1 *N* HCl until the end point no longer fades.

(*e*) Calculate the percentage of active calcium oxide as follows:

$$S = BN_b - \tfrac{6}{5}AN_a$$

Active calcium oxide, per cent

$$= \frac{E - S}{1000} \times \frac{28.0}{2.80} \times 100 = E - S$$

where:

S = milliequivalents of unconsumed Mg^{++} after reaction of the active calcium oxide with 200 ml. of the $MgCl_2$ solution added,
B = total milliliters of 1 *N* NaOH solution added,
N_b = normality of the NaOH solution,
A = milliliters of 0.1 *N* HCl solution required for titration of 300 ml. of the filtered solution to the methyl red end point,
N_a = normality of the HCl, and
E = milliequivalents of Mg^{++} in 200 ml. of the $MgCl_2$ solution (Section 5 (*a*)).

REPORT

Report

7. The values for the percentages of the constituents determined shall be rounded off in accordance with the rounding-off method given in Section 3 (*d*) to (*h*) of the Recommended Practices for Designating Significant Places in Specified Limiting Values (ASTM Designation: E 29),[4] and reported as follows:

(*1*) Loss on ignition to the nearest 0.1 per cent, and

(*2*) Active calcium oxide to the nearest 0.1 per cent.

Standard Methods for

PHYSICAL TESTING OF MAGNESIA FOR MAGNESIUM OXYCHLORIDE CEMENTS[1]

ASTM Designation: C 246 – 52

ADOPTED, 1952.[2]

This Standard of the American Society for Testing Materials is issued under the fixed designation C 246; the final number indicates the year of original adoption as standard or, in the case of revision, the year of last revision.

Scope

1. These methods of test cover physical test procedures for evaluating magnesia (MgO) for use in magnesium oxychloride cements.

Magnesia

2. The sample of magnesia to be tested shall be dry and shall have been taken in accordance with the Standard Method of Sampling Magnesium Oxychloride Compositions and Ingredients (ASTM Designation: C 237).[3] The sample as received shall be thoroughly mixed and, if necessary, reduced to convenient size by quartering or by means of an automatic sample splitter. The sample shall be stored in an airtight container.

Inert Ingredients

3. (*a*) *Standard Sand.*—The sand to be used in preparing the test mix shall be dry, natural silica sand from Ottawa, Ill., and shall conform to the following sieve analysis when tested in accordance with the Standard Method of Test for Sieve Analysis of Magnesium Oxychloride Compositions, Aggregates, and Fillers (ASTM Designation: C 238).[3]

Sieve	Percentage Retained
No. 20 (840-micron)	15 max.
No. 30 (590-micron)	95 min.

(*b*) *Standard Silex.*—The silex (ground silica) to be used in preparing the test mix shall be dry, natural silica sand from Ottawa, Ill., ground and air-separated to conform to the following sieve analysis when tested in accordance with Method C 238 (Note 1).

Sieve	Percentage Retained
No. 140 (105-micron)	2 max.
No. 200 (74-micron)	10 ±2
No. 325 (44-micron)	33 max.

NOTE 1.—This grade of ground silica is commonly referred to as "minus 140-mesh" silex.

(*c*) *Standard Asbestos Fiber.*—The asbestos fiber to be used in preparing the test mix shall be a clean, dry, air-separated, short fiber, chrysolite type asbestos of Canadian origin, commercially designated as 7RF and approved for this use (Note 2).

[1] Under the standardization procedure of the Society, these methods are under the jurisdiction of the ASTM Committee C-2 on Magnesium Oxychloride and Magnesium Oxysulfate Cements.
[2] Prior to adoption as standard, these methods were published as tentative from 1950 to 1952.
[3] Appears in this publication, see Contents in Numeric Sequence of ASTM Designations at front of book.

NOTE 2.—The term 7RF is a trade designation or grading and specifications for the particular material are relatively indefinite. A stock of satisfactory material from a Canadian source has been set aside for availability on order and subsequent lots will be tested by the supplier to determine that they yield the same results when all other ingredients of the standard test mix (Section 4(*a*)) remain constant.[4]

Proportioning and Preparation of Standard Test Mix

4. (*a*) The proportions by weight of the dry materials for the standard test mix shall be as follows:

	Percentage by Weight
Magnesia	30
Standard sand	52
Standard silex	15
Standard asbestos fiber	3

(*b*) The calculated quantities of the dry materials, sufficient to yield the required amount of the test mix, shall be mixed in accordance with the Standard Method for Mixing Magnesium Oxychloride Cement Compositions with Gauging Solution (ASTM Designation: C 251).[3] The required quantity of standard asbestos fiber shall be brushed through a No. 8 (2380-micron) sieve into the mixing can prior to dry mixing in accordance with Section 5(*a*) of Method C 251.

Methods of Testing

5. Test the plastic cement (Section 4) in accordance with the following methods of the American Society for Testing Materials:

(*a*) *Consistency.*—Standard Method of Test for Consistency of Magnesium Oxychloride Cements by the Flow Table (ASTM Designation: C 255).[3]

(*b*) *Setting Time.*—Standard Method of Test for Setting Time of Magnesium Oxychloride Cements (ASTM Designation: C 254).[3]

(*c*) *Linear Change.*—Standard Methods of Test for Linear Change of Magnesium Oxychloride Cements (ASTM Designation: C 253).[3]

(*d*) *Linear Contraction.*—Standard Method of Test for Linear Contraction of Magnesium Oxychloride Cements (ASTM Designation: C 252).[3]

(*e*) *Flexural Strength.*—Standard Method of Test for Flexural Strength of Magnesium Oxychloride Cements (ASTM Designation: C 256).[3]

(*f*) *Compressive Strength.*—Standard Method of Test for Compressive Strength of Magnesium Oxychloride Cements (ASTM Designation: C 257).[3]

Check Tests

6. In the event of disagreement between results of tests by different laboratories, confirmation of the identity of mixing procedures and of conformity to these Methods C 246 shall be required. Confirmation of the identity of mixing procedures shall be established as prescribed in Section 6 of Method C 251. Conformity to these Methods C 246 shall be considered to have been established when the two laboratories, employing the manufacturer's recommended ratio of gauging solution to magnesia and equivalent representative portions of a single magnesia sample and testing in accordance with the methods listed in Section 5 (*b*) to (*f*), obtain values within the permissible differences. Check tests shall consist of ten determinations, the average of which shall agree within the following permissible differences:

Test	Permissible Difference in Results Between Two Laboratories, plus or minus
Setting time, min:	
Initial set	16
Final set	30
Linear change, per cent:	0.005
Linear contraction, per cent:	
Nonplastic contraction	0.030
Net contraction	0 033
Flexural strength, psi	300
Compressive strength, psi	400

[4] Suitable tested asbestos fiber may be purchased in

Report

7. The report shall include the following:

(*1*) Identification and preparation of the sample of magnesia, with any pertinent information regarding its nature and source,

(*2*) Weights of ingredients used,

(*3*) Ratio of volume of gauging solution to weight of magnesia and the value obtained for flow-table consistency,

(*4*) Information required in all physical testing methods employed, and

(*5*) Results of check tests, when required.