

# Grout



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## **C1180-10**



**grout,  $n$  – a mixture of cementitious materials, aggregates, water, with or without admixtures, initially produced to pouring consistency without segregation. Requirements for grout are contained in Specification C476.**

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# Purpose of Grout

- Grout is used to fill masonry cavities
- Bonds units, mortar, and reinforcement into a single composite assemblage
- Is an essential component of reinforced masonry
- Is an optional component of unreinforced masonry

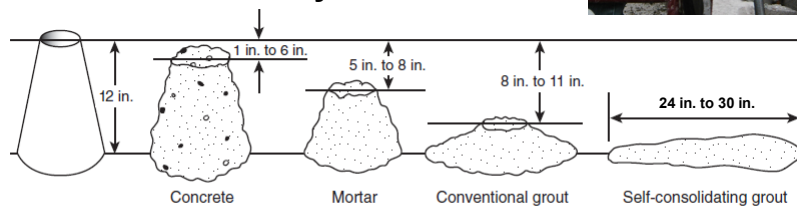
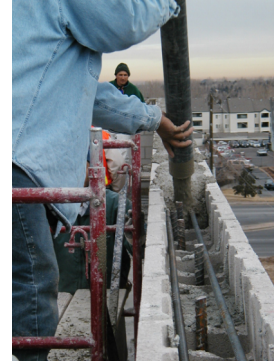


Figure 2-22.

Slump test comparison of concrete, mortar, conventional masonry grout, and self-consolidating grout (slump flow) (1 in. = 25.4 mm).

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Designation: C476 – 10

## Standard Specification for Grout for Masonry<sup>1</sup>

This standard is issued under the fixed designation C476; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense.*

### 1. Scope<sup>2</sup>

1.1 This specification covers two types of grout, coarse grout, for use in the construction of masonry structures. Each type (fine and coarse) is further classified as conventional grout (requiring mechanical consolidation by pumping or vibration when placed) and self-consolidating grout (requiring no mechanical consolidation when placed). Conventional grout is specified by (1) proportions or (2) strength requirements. Self-consolidating grout is specified by strength requirements.

1.2 The text of this specification references numerous footnotes that provide explanatory material. These footnotes (excluding those in tables and figures) shall be considered as requirements of this specification.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information and are not considered standard.



MS, or HS of Specification C476.

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## C476-10

### 1. Scope

- 1.1 This specification covers two types of grout, fine and coarse grout, for use in the construction of masonry structures. Each type (fine and coarse) is further classified as conventional grout (requiring mechanical consolidation by puddling or vibration when placed) and self-consolidating grout (not requiring mechanical consolidation when placed). Conventional grout is specified by (1) proportions or (2) strength requirements. Self-consolidating grout is specified by strength requirements.

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### 3.1.3 Aggregates—Aggregates shall conform to Specification C404.



sand



pea gravel

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### 3.1.4 *Water*—Water shall be clean and potable.



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### 3.1.5 *Admixtures*— Integral waterproofing compounds, accelerators, or other admixtures not mentioned definitely in the specification shall not be used in grout for use in reinforced masonry without approval from the purchaser.

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**3.1.5.1 *Admixtures for Self-consolidating Grout*— High-range water-reducing admixtures conforming to Specification C494/C494M, Type F or G, and viscosity-modifying admixtures conforming to Specification C494/C494M, Type S, for producing self-consolidating grout are permitted.**

**3.1.6 *Pumping Aids*— Pumping aids are permitted to be used in cases where the brand, quality, and quantity are approved in writing by the purchaser or are definitely stipulated in the specification.**

**3.1.7 Antifreeze Compounds—** No antifreeze liquids, salts, or other substances shall be used in grout to lower the freezing point.



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**3.1.8 Storage of Materials—** Cementitious materials and aggregates shall be stored in such a manner as to prevent deterioration or intrusion of foreign material or moisture. Any material that has become unsuitable for good construction shall not be used.



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### 4. Grout Type and Proportions

**4.1 Type**—Grout type shall be specified as fine or coarse.

#### Fine Grout

**Portland Cement  
Sand  
Water**

#### Coarse Grout

**Portland Cement  
Sand  
Pea Gravel  
Water**

**NOTE 3**—Building code provisions and grout space dimensions should be reviewed when selecting grout type or types.

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**Table 7 – Grout Space requirements**

Grout type <sup>1</sup>	Maximum grout pour height, ft.	Minimum width of grout space, <sup>2,3</sup> in.	Minimum grout space dimensions for grouting cells of hollow units, <sup>3,4,5</sup> in. x in.
Fine	1	$\frac{3}{4}$	1 $\frac{1}{2}$ x 2
Fine	5	2	2 x 3
Fine	12	2 $\frac{1}{2}$	2 $\frac{1}{2}$ x 3
Fine	24	3	3 x 3
Coarse	1	1 $\frac{1}{2}$	1 $\frac{1}{2}$ x 3
Coarse	5	2	2 $\frac{1}{2}$ x 3
Coarse	12	2 $\frac{1}{2}$	3 x 3
Coarse	24	3	3 x 4

<sup>1</sup> Fine and coarse grouts are defined in ASTM C476.

<sup>2</sup> For grouting between masonry wythes.

<sup>3</sup> Grout space dimension is the clear dimension between any masonry protrusion and shall be increased by the diameters of the horizontal bars within the cross section of the grout space.

<sup>4</sup> Area of vertical reinforcement shall not exceed 6 percent of the area of the grout space.

<sup>5</sup> Minimum grout space dimension for AAC masonry units shall be 3-in. x 3-in. or a 3-in. diameter cell.

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## Grout Type & Proportions

### ASTM C 476

#### Grout Type and Proportions

#### Proportions of Ingredients

##### Table 1

- By volume

##### Specified Compressive Strength

- Proportions established by 28-day comp. strength tests (C1019)
- Slump of 8 to 11 inches
- Minimum compressive strength of 2000 psi at 28 days

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TABLE 1 Grout Proportions by Volume

Type	Parts by Volume of Portland Cement or Blended Cement	Parts by Volume of Hydrated Lime or Lime Putty	Aggregate, Measured in a Damp, Loose Condition	
			Fine	Coarse
Fine Grout	1	0 – 1/10	2 1/4 - 3 times the sum of the volumes of cementitious materials	---
Coarse Grout	1	0 – 1/10	2 1/4 - 3 times the sum of the volumes of cementitious materials	1-2 times the sum of volumes of the cementitious materials

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## Compressive Strength

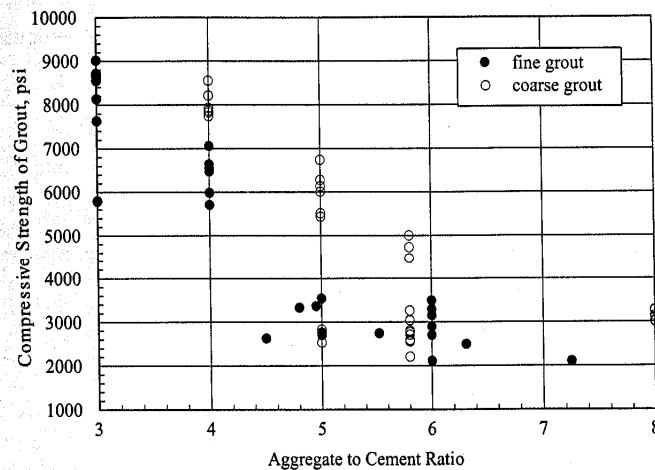


Figure 3—Relationship Between Grout Mix and Compressive Strength

NCMA TEK 9-2 (2002)

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**4.2.1.2 Specified Compressive Strength —**  
Proportions established by 28-day compressive strength tests in accordance with Test Method C1019 that equal or exceed the specified compressive strength. The grout shall be mixed to a slump of 8 to 11 in. as determined by Test Method C143/C143M and shall have a minimum compressive strength of 2000 psi at 28 days.

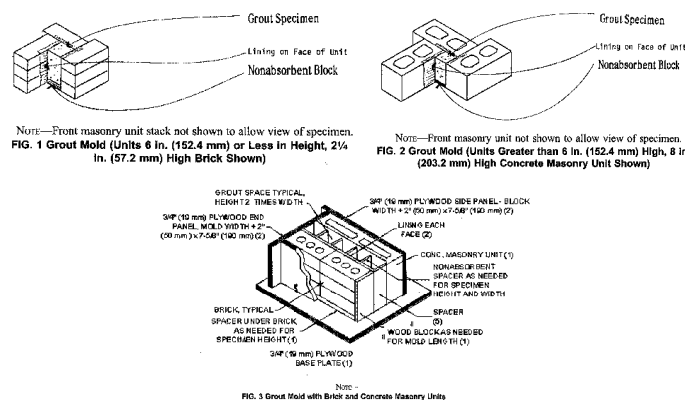
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**6.1.3 Form a space with a square cross-section, 3 in. or larger on each side and twice as high as its width, by stacking masonry units of the same type and moisture condition as those being used in the construction. The surface of the unit in contact with the grout specimen shall not have been previously used to mold specimens...**



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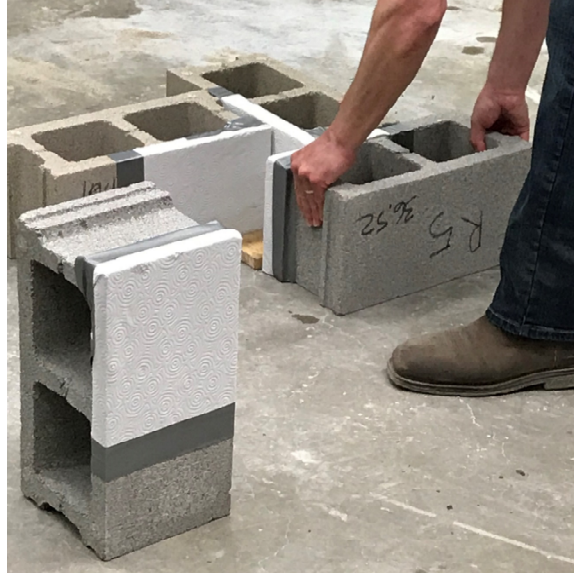
**6.1.3 ...Tolerance on space and specimen dimensions shall be within 5% of the specimen width. See Fig. 1, Fig. 2, and Fig. 3 and accompanying notes.**



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## Grout Testing



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## Grout Testing



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## Grout Testing



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## Grout Testing



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## Grout Testing



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## C1019-11

**NOTE 7 – Other methods of obtaining grout specimens and specimens of different geometry have been employed in grout testing, but are not described in this test method. Other methods used to obtain grout specimens include: drilling grout-filled cores of regular units; filling cores of masonry units specifically manufactured to provide grout specimens; filling compartments in slotted corrugated cardboard boxes specifically manufactured to provide grout specimens; and forming specimens from different sized masonry units of the same or similar material...**



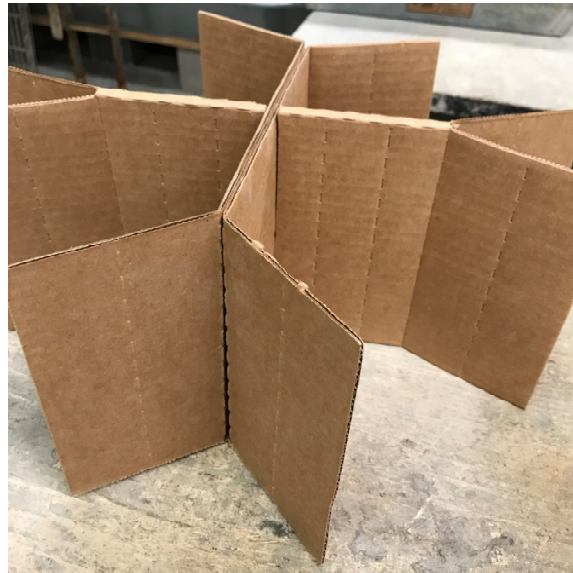
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## Grout Testing



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## Grout Testing



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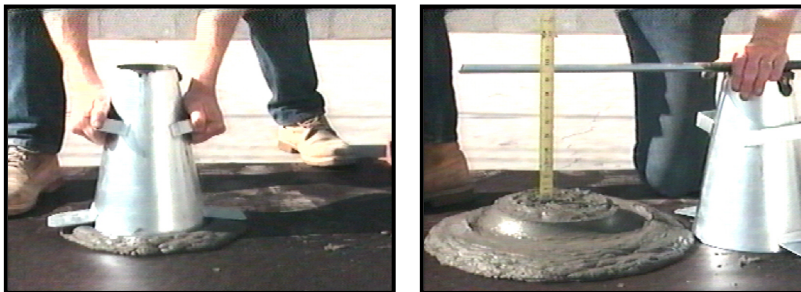
## Grout Testing



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## C1019-11

**8.3 For all grout except self-consolidating grout, measure and record the slump in accordance with the requirements of Test Method C143/C143M.**



**8 to 11 inches**

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**8.4 For self-consolidating grout, measure and record the slump flow in accordance with the requirements of Test Method C1611/C1611M and visual stability index (VSI) in accordance with the requirements of Test Method C1611/C1611M, Appendix XI.**

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Because of the fluid nature of SCG, traditional measures of consistency, such as the ASTM C143 slump test, are not applicable to SCG. The SCG slump flow test uses the same slump cone as the ASTM C143 test, but in an inverted position and the SCG is loaded in a single lift without consolidation. The cone is then removed (Figure 2.13) and the diameter of the grout slump flow is measured. MSJC Specification Article 2.2 A.2 requires the slump flow (spread) to be 24 to 30 in. (610 to 762 mm).

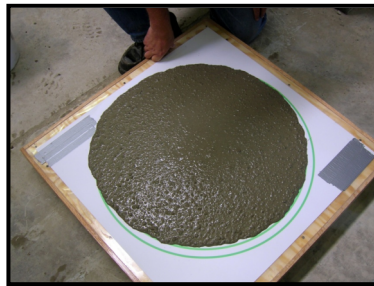


**Figure 2.13 Slump flow testing of self-consolidating grout.**

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**Visual Stability Index (VSI)** - VSI measurement, defined in ASTM C1611, is performed after the slump flow test to provide a qualitative assessment of the SCG's stability. The SCG specimen (Figure 2.14) resulting from the slump flow test is examined for aggregate segregation, bleeding and evidence of a mortar halo (a cement paste or mortar ring that has clearly separated from the coarse aggregate, around the outside circumference of the SCG specimen). The SCG mix is then assigned a VSI, from 0 (highly stable) to 3 (highly unstable) by comparing to the pictures and descriptions of the various indexes found in ASTM C1611.



**Figure 2.14 Self-consolidating grout specimen.**

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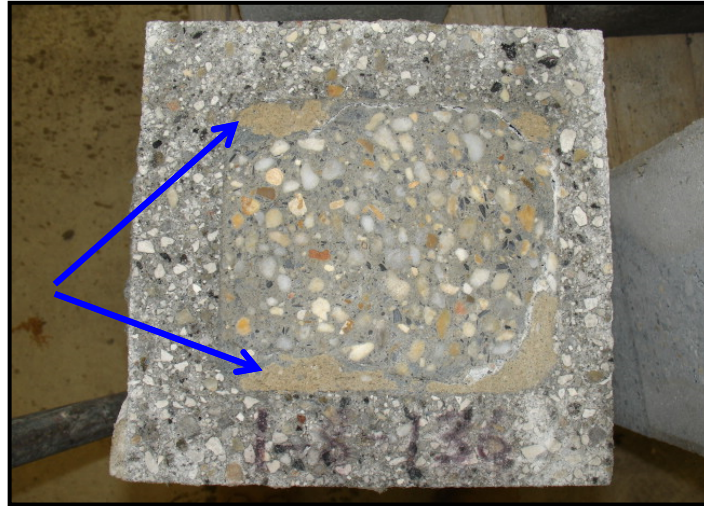
The common self-healing (non-disturbed) test is performed after the slump flow, and the VSI has been recorded. A 10 to 12 in. 'S' is drawn in the SCG specimen with a finger, making sure to scrape off the SCG all the way down to the board. The specimen is observed to see if the 'S' will self-heal. In cases where the self-healing is excellent, the SCG flows back together and there is little or no evidence of the 'S' remaining. In cases where the self-healing is poor, the SCG does not flow back together and the 'S' remains very visible with severe aggregate, paste or water segregation.



**Figure 2.15 Self-consolidating grout specimen – “S” Test.**

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## Grout Flow Around Mortar Fins



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### 5. Measurement and Production

**5.1 *Measurement of Materials* – Measure materials for grout such that the required proportions of the grout materials are controlled and accurately measured.**

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### **5.2.1 Materials Mixed with Water at the Job Site:**

#### **5.2.1.1 Conventional Grout:**

**(1) Individual cementitious materials and aggregates stored at the job site shall be mixed in a mechanical mixer for a minimum of 5 min with sufficient water to achieve the desired consistency.**



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#### **5.2.1.1 Conventional Grout:**

**(2) Individual ingredients transported to the job site in suitable compartments shall be mixed with water at the job site using continuous volumetric proportioning equipment to achieve the desired consistency. Mix with an auger of appropriate length to provide adequate mixing.**



*Typically not used  
in Michigan.*

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**5.2.1.1 Conventional Grout:**

**(3) Factory pre-blended grout materials delivered to the job site shall be mixed in a mechanical batch mixer for a minimum of 5 min or in a continuous mixer following mixer manufacturer's recommendation with sufficient water to achieve the desired consistency.**



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**5.2.1.2 Self-consolidating Grout:**

**(1) Individual ingredients transported to the job site as part of a self-consolidating grout manufacturer's system, shall be mixed at the job-site with water, per the manufacturer's recommendations, using continuous volumetric proportioning equipment to achieve the desired consistency. Mix with an auger of appropriate length to provide adequate mixing.**

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### ***5.2.1.2 Self-consolidating Grout:***

**(2) Factory preblended grout materials delivered to the job site shall be mixed in a mechanical mixer with sufficient water, per the self-consolidating grout manufacturer's recommendation, to achieve the desired consistency.**

**(3) Job site proportioning and mixing of individual materials that are not part of a self-consolidating grout manufacturer's system shall not be permitted.**

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### ***5.2.2 Ready-Mixed Grout Transported to the Job Site:***

#### ***5.2.2.1 Conventional Grout:***

**(1) Grout shall arrive at the job site in a ready-mixed condition. Slump shall be adjusted as necessary, and grout shall be re-mixed at mixing speed for at least 1 min before discharging to achieve the desired consistency.**



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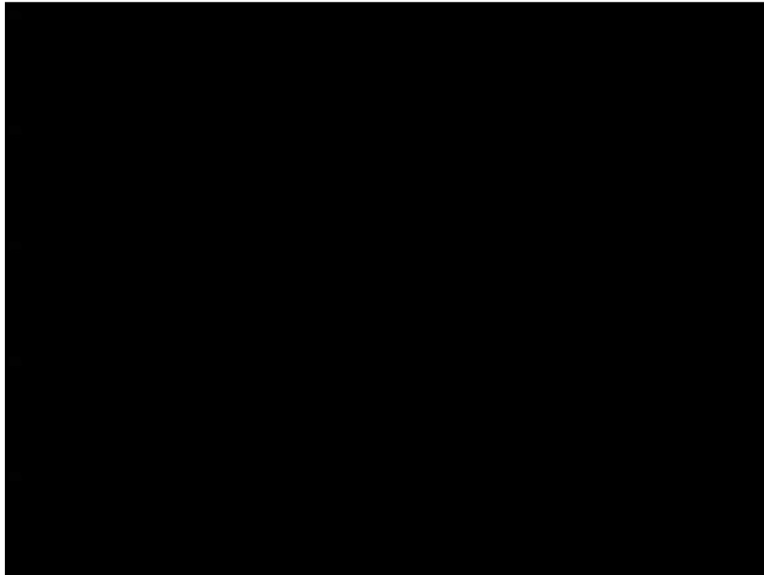
### **5.2.2 Ready-Mixed Grout Transported to the Job Site:**

#### **5.2.2.1 Self-consolidating Grout:**

**(2) Grout shall arrive at the job-site in a ready-mixed condition. The addition of water at the job site is permitted in accordance with the self-consolidating grout manufacturer's recommendations.**

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## Grouting Masonry



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