



**MATERIAL SPECIFICATION FOR  
PACKAGED SILICA FUME DRY GROUT MIXTURE  
FOR POST TENSIONING**

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**TABLE OF CONTENTS**

<b>1304.01</b>	<b>SCOPE</b>
<b>1304.02</b>	<b>REFERENCES</b>
<b>1304.03</b>	<b>DEFINITIONS</b>
<b>1304.04</b>	<b>SUBMISSION AND DESIGN REQUIREMENTS - Not Used</b>
<b>1304.05</b>	<b>MATERIALS</b>
<b>1304.06</b>	<b>EQUIPMENT - Not Used</b>
<b>1304.07</b>	<b>PRODUCTION</b>
<b>1304.08</b>	<b>QUALITY ASSURANCE</b>
<b>1304.09</b>	<b>OWNER PURCHASE OF MATERIALS - Not Used</b>

**APPENDICES**

<b>1304-A</b>	<b>Commentary</b>
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**1304.01 SCOPE**

This specification covers the requirements for packaged silica fume dry grout mixture for use in post-tensioning of ducts.

**1304.01.01 Specification Significance and Use**

This specification is written as a municipal-oriented specification. Municipal-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of many municipalities in Ontario.

Use of this specification or any other specification shall be as specified in the Contract Documents.

## **1304.01.02 Appendices Significance and Use**

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

## **1304.02 REFERENCES**

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

### **Ontario Provincial Standard Specifications, Construction**

OPSS 910      Stressing Systems for Post Tensioning

### **Ontario Provincial Standard Specifications, Material**

OPSS 1301      Cementing Materials  
OPSS 1302      Water

### **CSA Standards**

A23.2-1B      Viscosity, Bleeding, Expansion, and Compressive Strength of Flowable Grout [Part of  
CSA A23.1-19/A23.2-19, Concrete Materials and Methods of Concrete  
Construction/Methods of Test and Standard Practices for Concrete]  
A283-19      Qualification Code for Concrete Testing Laboratories  
A3000-18      Cementitious Materials Compendium

### **ASTM International**

C1152/C1152M      Standard Test Method for Acid-Soluble Chloride in Mortar and Concrete  
D962-81(2014)      Aluminum Powder and Paste Pigments for Paints

### **1304.03 DEFINITIONS**

For the purpose of this specification, the following definition applies:

**Cementing Materials** means Type GU or GUL Portland cement and silica fume.

### **1304.05 MATERIALS**

#### **1304.05.01 Cementing Materials**

The cement shall be according to OPSS 1301 and certified to be free from early stiffening tendency when tested according to CAN/CSA A3000. Silica fume shall be according to CAN/CSA A3000 and in an uncompacted form. Silica fume shall constitute a 6% replacement by mass of cement in the dry grout mixture.

#### **1304.05.02 Superplasticizer**

Superplasticizer shall be a non-retarding naphthalene sulphonate in powdered form.

#### **1304.05.03 Aluminum Powder**

Aluminum powder shall be according to ASTM D962 Type 1, Class C. Aluminum powder shall be used in a quantity sufficient to provide the expansion specified herein.

#### **1304.05.04 Water**

Water for testing grout mixture shall be according to OPSS 1302.

#### **1304.05.05 Grout**

The grout and grout cubes, when tested by the manufacturer as specified in the Testing for Certificate of Compliance clause, shall exhibit the following properties:

- a) The grout shall not bleed or segregate when allowed to stand for 1 hour immediately after mixing.
- b) The grout shall expand by  $6\% \pm 2\%$  of its original volume when measured at 1 hour after mixing. Cylinders shall be poured within five minutes of batching.
- c) The time for the grout to flow through the flow cone shall be between 11 and 25 seconds when the measurements are performed immediately after the grout is removed from the mixer and shall remain between 11 and 25 seconds, when measured 30 minutes after mixing.
- d) Cubes made from the grout shall have a minimum specified 28-Day compressive strength of 60 MPa.
- e) The constituent materials used shall be such that the acid-soluble chloride ion content of the mixed grout shall not exceed 0.08% by weight of the mixed grout as measured by ASTM C1152/C1152M.

### **1304.07 PRODUCTION**

#### **1304.07.01 Dry Grout Mixture**

The dry grout mixture shall consist of cementing materials, superplasticizer, and aluminum powder.

### **1304.07.01.02 Compressive Strength Development Curve**

The manufacturer shall establish a compressive strength development curve for the grout to demonstrate that the early compressive strength provided in the certificate of compliance meets the strength development curve developed for that type of grout. A minimum of three different batches, each representing a different grout production day, shall be prepared and compressive strength cubes made and tested at 3, 7, 14, and 28 Days to generate the compressive strength development curve. Testing shall be according to the Sampling and Testing clause of this specification. A minimum of six cubes shall be tested for each compressive strength determination.

The manufacturer shall establish a new compressive strength development curve every 12 months or sooner or every time the material sources change, whichever is more frequent.

### **1304.07.02 Packaging, Handling, and Delivery**

The dry ingredients of the grout shall be thoroughly mixed and packaged in bags, with a maximum bag size of 30 kg. The bag shall be of sufficient strength to withstand handling and to protect the grout from contamination. Bags shall be shipped and stored with a plastic or other waterproof covering to fully protect the grout from moisture.

The packaged bags shall have the following information printed on the outside:

- a) Name of manufacturer.
- b) Maximum amount of water to be used per bag of dry grout mixture.
- c) Date packaged.

The packaged dry grout mixture shall be supplied on skids and covered with polyethylene sheeting.

The packaged dry grout mixture shall be stored in a dry condition up to the time of shipment and suitably protected against the weather during delivery.

### **1304.07.03 Certificate of Compliance**

A certificate of compliance prepared by a testing laboratory certified according to the Testing for Certificate of Compliance clause and signed by the manufacturer's representative of the dry grout mixture shall be submitted to the Contract Administrator with each shipment. The certificate shall include the following information:

- a) A strength development curve prepared according to the Production section. The strength development curve shall be not more than 12 months old at the time of submission.
- b) A statement that grout representing the shipment, meets the grout properties a, b, and c as specified in the Production section, when tested according to the Production section.
- c) Early compressive strength test results determined according to the Production section that show compliance with the attached strength development curve.

#### **1304.07.03.01 Testing for Certificate of Compliance**

##### **1304.07.03.01.01 Qualification of the Testing Laboratory**

The testing laboratory shall be certified by a recognized certifying body to the requirement of CSA A283 for Additional Tests according to CSA A23.2-1B.

#### **1304.07.03.01.02      Batch Preparation**

The batch shall be prepared from the dry grout mixture and water using the equipment specified in OPSS 910 or using a 1200 to 2000 rpm laboratory colloidal mixer.

The mixing procedure for the batch of grout shall be as follows:

- a) The amount of water less than or equal to that specified by the manufacturer shall be added by means of the calibrated measuring device attached to the mixer or manually if the mixing is done in a laboratory colloidal mixer. No further water shall be added to the grout.
- b) The packaged dry grout mixture shall be added to the mixer with the mixer running.
- c) The grout shall be mixed for at least 1 minute after the dry grout mixture is added and until the grout is mixed thoroughly and uniformly.

#### **1304.07.03.01.03      Sampling and Testing**

##### **1304.07.03.01.03.01      General**

Tests shall be according to CSA A23.2-1B and this specification.

Viscosity, bleeding, and expansion measurements and preparation of grout cubes for compressive strength tests shall be done on a level, vibration free surface.

Fluid grout shall be sampled from the mixer or holding tank of the mixer immediately following completion of mixing.

##### **1304.07.03.01.03.02      Viscosity**

The grout used for the first set of viscosity measurements shall be discarded after testing and shall not be used for the 30-minute measurement. The grout used for the 30-minute viscosity measurement shall be left undisturbed in a clean container, covered with a lid, until the measurement is performed.

##### **1304.07.03.01.03.03      Compressive Strength Tests**

Compressive strength test cubes, 50 mm in size, shall be prepared from the grout sample. A minimum of three sets of six cubes each shall be made. Two sets shall be tested each set at a different age from the other at either 3, 7, or 14 Days. The remaining set shall be used for 28-Day compressive strength test. The test results of the 28-Day compressive strength test shall be forwarded to the Contract Administrator within 7 Days of the testing.

Grout cubes shall be cast as specified in OPSS 910. The cubes shall be demoulded and stored according to CSA A23.2-1B.

If the cubes are to be transported to a certified laboratory, the cubes shall be removed from the moulds, placed in a sealed white opaque plastic bag containing at least 250 ml of water and maintained at a temperature between 15 and 25 °C during transportation.

**1304.08**                      **QUALITY ASSURANCE**

**1304.08.01**                  **General**

The Owner may carry out sampling and testing for viscosity, bleeding, expansion, and compressive strength using material from a batch of fluid grout prepared from the packaged dry grout mixture and water using the equipment specified in OPSS 910.

Sampling and testing will be done randomly using the packaged dry grout mixture delivered to the Working Area.

**1304.08.02**                  **Acceptance, Rejection**

When notified by the Owner as to the uncertainty of the quality of any dry grout mixture, it shall be rejected and no additional dry grout mixture shipped until the manufacturer has performed additional testing and notice of acceptance has been received from the Owner.

## **Appendix 1304-A, November 2021**

**Note:** This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

### **Designer Action/Considerations**

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

### **Related Ontario Provincial Standard Drawings**

No information provided here.