SECTION 03 6000

GROUTING

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This section includes concrete repair material, Portland cement grout, rapid-curing epoxy grout, and non-shrink cementitious grout that will be used in structural applications (i.e., the grout will be part of a load path)\* vs. nonstructural applications (e.g., minor/local concrete surface repair, etc.).

* The concrete repair material herein is a dimensionally stable (i.e., “shrinkage-compensated”), pre-mixed, pre-packaged product. Although generally termed “material” (versus grout) herein, its procurement and use is similar enough to warrant inclusion in this Section.
* The Portland cement grout herein is a site-mixed, “general purpose grout.” While being the cheapest of the alternatives herein, it lacks many of the attributes the others have, chief among them being dimensional stability (i.e., it’s much more subject to shrinkage than the alternatives).
* The rapid-curing epoxy grout herein is a pre-mixed, pre-packaged product that is typically used for grouting base plates, machinery, equipment, etc.; and when dynamic/impact loading, vibration, or chemical attack is/are applicable. It’s ideal for applications where precise change in elevation during curing is required. Additionally, epoxy grout can be tailored to provide improved properties related to high early strength; and high chemical, acid, and fatigue resistance
* The non-shrink cementitious grout herein is a pre-mixed, pre-packaged product typically used for grouting base plates, machinery, equipment, etc. While non-shrink cementitious grout is typically less resistant to chemical attack and fatigue than epoxy grout, it is more resistant to heat and tends to be less expensive. It is also more “precise” than the Portland cement grout option herein.

\* Although grout for prestressed, precast concrete (ref. 03 4100) and reinforced masonry (ref. 04 2220) is structural, its use in those applications is too specialized to be included herein; therefore, Sections 03 4100 and 04 2220 have their own grout requirements.

This section has been written to meet requirements of buildings classified as Natural Phenomena Hazard (NPH) Risk Category (RC) I, II, III or IV, and projects classified as ML-3 or ML-4. In general, this section does not apply to nuclear facilities. This section may apply to facilities that, because of the low amount of nuclear material at risk, are classified as RC IV.

For nuclear applications, ML-1/ML-2 (and ML-3 potentially), and NPH Design Category (NDC) -3, Section 03 6021 *Grouting – High Confidence* should be used.

This template must be edited for each project.  In doing so, specifier must add job-specific requirements.  Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.  Once the choice is made or text supplied, remove the brackets.  The specifications must also be edited to delete specification requirements for processes, items, or designs that are not included in the project—and specifier’s notes such as these.  To seek variance from requirements in the specifications that are applicable, contact the Engineering Standards Manual Structural [POC](http://engstandards.lanl.gov/POCs.shtml#struc). Please contact POC with suggestions for improvement as well.

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1. GENERAL
   1. SUMMARY
      1. Section Includes requirements for furnishing, delivering, and installing site-mixed and/or pre-mixed, pre-packaged material including:

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If project will not include all 4 of the following materials, then edit these subparagraphs accordingly, as well as the remainder of the section.

If two or more materials/subparagraphs are retained, and the location(s) of where each material is to be used isn’t indicated elsewhere (e.g., other spec sections, drawings, etc.), then this Section must be edited (i.e., at least PART 3) to indicate the location(s).

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* + - 1. Concrete repair material
      2. Portland cement grout
      3. Rapid-curing epoxy grout
      4. Non-shrink cementitious grout

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List sections specifying installation of products included in this section and indicate specific items.

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* + 1. Related Sections:
       1. Section 03 3001 -- *Reinforced Concrete*: [Formwork Products] [, and] [Joining existing concrete with new concrete].
       2. Section 05 0520 – *Post-Installed Concrete and Grouted-Masonry Anchors – Normal Confidence*: [Use of an anchorage system consisting of grout and an anchor rod, wherein the latter consists of concrete reinforcing steel (i.e., rebar)].
       3. Section 05 1000 – *Structural Metal Framing*: [grouted baseplates, bearing plates, and/or leveling plates].
  1. ACRONYMS, DEFINITIONS, AND SYMBOLS
     1. Cementitious materials: Materials as defined in ACI 318 Chapter 2, which have cementing value when used in concrete either by themselves, such as Portland cement, blended hydraulic cements, and expansive cement; or such materials in combination with fly ash, other raw or calcined natural pozzolans, silica fume, and slag cement.
     2. Creep: Time-dependent deformation due to sustained load.

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In the last sentence of the following paragraph delete the brackets if Project’s usage of this section will be performed by LANL (i.e., “self-performed work”).

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* + 1. Engineer/Engineer of Record (EOR): The licensed professional engineer, employed by the owner-contracted design authority or other agency, responsible for the overall design of the facility or Project (e.g., issues Construction Drawings, Specifications, or other documents, etc.). EOR and Architect/Engineer are synonymous. [For this Project the EOR and LANL are the same entity.]
    2. Los Alamos National Laboratory (LANL): The managing contractor of LANL is a corporation (e.g., TRIAD National Security, LLC); however, “LANL” is used herein, which acts as Owner. LANL also means Subcontract Administrator, the individual authorized to act on the behalf of LANL.
    3. LANL Building Official (LBO).
    4. Material: Unless stated otherwise, any/all of concrete repair material, Portland cement grout, rapid-curing epoxy grout, and non-shrink cementitious grout.
    5. Restore: Repair a structural item (e.g., beam, column, foundation, etc.) to its near-original state.
    6. Shrinkage: Time-temperature-humidity-dependent volume reduction of concrete as a result of hydration, moisture migration, and drying process.
    7. Specified compressive strength of material (f’c), psi.
  1. REFERENCES

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List reference standards included within text of this section. Edit the following for Project conditions.

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* + 1. American Concrete Institute
       1. ACI 301 - *Specifications for Structural Concrete*
       2. ACI 318 - *Building Code Requirements for Structural Concrete*
    2. ASTM International
       1. ASTM C33 - *Standard Specification for Concrete Aggregates*
       2. ASTM C40 - *Test Method for Organic Impurities in Fine Aggregates for Concrete*
       3. ASTM C109 - *Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens)*
       4. ASTM C150 - *Standard Specification for Portland Cement*
       5. ASTM C 157 – *Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete*
       6. ASTM C191 - *Test Method for Time of Setting of Hydraulic Cement by Vicat Needle*
       7. ASTM C307 - *Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings*
       8. ASTM C531 - *Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes*
       9. ASTM C579 - *Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings and Polymer Concretes*
       10. ASTM C 666 – *Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing*
       11. ASTM C827 - *Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.*
       12. ASTM C 882 – *Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear*
       13. ASTM C 942 - *Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory*
       14. ASTM C1090 - *Standard Test Method for Measuring Changes in Height of Cylindrical Specimens of Hydraulic-Cement Grout*
       15. ASTM C1107 – *Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)*
       16. ASTM C 1202 – *Standard Test Method for Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration*
  1. ACTION SUBMITTALS

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Only request submittals needed to verify compliance with Project requirements. For example, due to the way in which the four types of material are specified in Part 2, the 1st Para. is needed to verify compliance only for Portland cement grout.

Retain the “inspections option” in the Field-QC paragraph (E) below if this option is also to be retained in the Field-QC article in PART 3.

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* + 1. Product Data: Submit product data on grout, fine aggregate (demonstrating compliance with ASTM C33 and C40), and [\_\_\_\_\_\_\_\_].
    2. Manufacturer's Installation Instructions: Submit manufacturer’s instructions for mixing, handling, surface preparation and placing pre-mixed, pre-packaged material to be used.
    3. Manufacturer's Certificates of Compliance: Certify [non-shrink cementitious grout] and [Insert Other Products Here] meet or exceed [ASTM C 1107] and [Insert Other Specified Requirements Here].
    4. Mix Designs: Submit proposed mix design [of each class of site-mixed Portland-cement grout] to LANL for review prior to commencement of Work.
    5. Field Quality-Control Results: Submit results of Subcontractor-furnished tests [and inspections].
  1. SUSTAINABLE DESIGN SUBMITTALS
     1. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements related to recycled content and point of origin of materials.

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Edit material certifications list to suit products specified in this section and Project sustainable design requirements.

If both sustainability requirements shown here are determined to be cost-prohibitive to the project, delete SUSTAINABILITY DESIGN SUBMITTALS section.

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* + - 1. Materials Resources Certificates:
         1. Certify recycled material content for recycled content products.
         2. Certify source for regional materials and distance from Project site.
  1. QUALITY ASSURANCE

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Use this article to specify compliance with overall reference standards affecting all products and installation included in this section.

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* + 1. The work shall be subject to inspection at all times by LANL and, if applicable, LANL’s Independent Testing Agency for the purpose of determining that the work is properly executed in accordance with this section. Failure to detect defective workmanship or material during any interim inspection shall not constitute acceptance of workmanship and materials.
    2. Site-Mixed Portland Cement Grout: Acquire all materials from same source as used to produce the specific mix design for all work. Formally notify LANL of any material source changes prior to grout placement including the test agency test documentation. The Subcontractor must provide LANL a certificate of conformance prior to the initial placement that confirms the source of the constituents, that tests confirm compliance, and that these sources are the same for the mix design testing and the placed mix.
  1. DELIVERY, STORAGE, AND HANDLING
     1. Section 01 6000 - *Product Requirements*: Requirements for transporting, handling, storing, and protecting products.
     2. Deliver pre-mixed, pre-packaged material in manufacturer's unopened containers with proper labels intact.
     3. Store all materials in a dry shelter, protected from moisture and, for pre-mixed, pre-packaged material, maintained at a temperature and humidity as required by manufacturer(s)
     4. Do not use material stored beyond the shelf life recommended by the manufacturer(s).
  2. ENVIRONMENTAL REQUIREMENTS
     1. Section 01 6000 - *Product Requirements*: Environmental conditions affecting products on site.
     2. For pre-mixed, pre-packaged material, do not perform installation if ambient temperature exceeds that which is specified by manufacturer(s). In the case of non-prepackaged, Portland cement grout, comply with ACI 301.
     3. For pre-mixed, pre-packaged material, maintain minimum temperature specified by manufacturer before, during, and after installation, until material has set. In the case of site-mixed Portland cement grout, comply with ACI 301.

1. PRODUCTS
   1. GENERAL

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The reason for the prohibition in the following paragraph is that non-shrink grouts are intended for placement into confined conditions, primarily because they exhibit expansive characteristics. Placing them in unconfined conditions (as can be the case in some concrete repairs) can lead to cracking, issues with thermal expansion (since these grouts expand differently than concrete), and other issues.

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* + 1. Neither rapid-curing epoxy grout nor non-shrink cementitious grout shall be used for concrete repair.
  1. SUSTAINABILITY CHARACTERISTICS

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Edit sustainable design requirements to suit content of this section and Project sustainable design requirements.

If both sustainability requirements shown here are determined to be grossly prohibitive to the project, delete SUSTAINABILITY CHARACTERISTICS section.

It is recognized that the nature of grout materials significantly inhibits the use of high recycled content. However, this section is retained such that to encourage specification towards those manufacturers that can provide high recycled content that meets design requirements. If high recycled content grout is not available to meet the requirements of the design, delete this section.

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* + 1. Materials and Resources Characteristics:
       1. Recycled Content Materials: Furnish manufacturers certification of production with maximum available recycled content. [including:] [.]

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List materials specified in this section required to have recycled content.

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* + - * 1. [\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.]

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List materials specified in this section required to be regional materials.

Note to specifier: It is recognized that many grout manufacturers will not be local to LANL. However, this section is retained such that to encourage specification towards those manufacturers that can provide local materials. If this is not consistent to the requirements of the project, delete this section.

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* + - 1. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles of Project site [including:] [.]
         1. [\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.]
  1. CONCRETE REPAIR MATERIAL

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The products listed in paragraph below meet the descriptive specifications and Properties in the two subsequent paragraphs; thus, if a product other than those listed is selected, author must be sure there are no conflicts amongst/between these affected paragraphs.

Either retain the “Manufacturer” paragraph, or the descriptive specifications and Properties paragraphs, and delete the “OR note” in-between these options.

If retaining the Manufacturer paragraph, retain the 1st product option if the concrete requiring repair isn’t vertical or overhead (V/O), and retain the 2nd option if it is. If retaining both options then edit the paragraph to indicate that the 1st option shall not be used for vertical or overhead repairs.

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* + 1. Manufacturer
       1. Five Star Products, Inc.: [Structural Concrete] [and] [Structural Concrete V/O].
       2. BASF MasterEmaco: [S 466CI] [and] [S 488CI]
       3. Substitutions: [Section 01 2500 – Substitution Procedures] [Not Permitted – No Substitutions].

\*\*\*\*\*\*[OR]\*\*\*\*\*\*

* + 1. Concrete Repair Material: Blended, packaged cement-based mortar requiring only the addition of potable water. The material shall not contain any chlorides or lime other than amounts contained within the hydraulic cement composition, and it shall be dimensionally stable (i.e., “shrinkage-compensated”).
    2. Properties: Certified to meet the following minimum properties when tested in accordance with the respective indicated ASTM standard:

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Edit the options in the following table in accordance with project requirements.

Regarding the tabulated default values, the 1st option pertains to material not used for overhead or vertical repairs, and the 2nd option pertains to material that is used for overhead and/or vertical repairs. If both of the aforementioned repair types are applicable, then edit Result column of table accordingly. For example, in the “f’c row,” the Result would include both of the following statements:

6,000 psi min. at 7days for horizontal repairs

4,000 psi min. at@ 7days for overhead/ vertical repairs

The reason for the range (of coulombs) in the option for chloride permeability is because ASTM C 1202 results are expressed this way (ref. Table X1.1 therein). Per Table X1.1, a result of 100 – 1,000 coulombs is, qualitatively, “Very Low.”

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|  |  |  |
| --- | --- | --- |
| Property | Test | Result |
| f’c | ASTM C 109  (Field-QC test)\* | [6,000] [4,000] psi minimum at 7 days\* |
| Bond Strength | ASTM C 882 | [2,150] [2,200] psi minimum at 7 days |
| Length Change/Drying Shrinkage | ASTM C 157 | [-0.09] [-0.13] % maximum at 28 days |
| Freeze/Thaw Resistance | ASTM C 666 Procedure A | [95] [95]% minimum at 300 cycles |
| Chloride Permeability | ASTM C 1202 | [100–1,000] coulombs maximum at 28 days |

**\***Compliance shall be proven via the field-quality-control testing indicated in PART 3 herein.

* 1. PORTLAND CEMENT GROUT MATERIALS
     1. Portland cement: ASTM C150, Type I and II.
     2. Water
        1. Potable; containing no impurities, suspended particles, algae or dissolved natural salts in quantities capable of causing:
           1. Corrosion of steel.
           2. Volume change increasing shrinkage cracking.
           3. Efflorescence.
           4. Excess air entraining.

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Grout used in a large-volume placement to fill space(s) > 3” should include coarse aggregate (CA). See Five Star Products’ *A Professional’s Handbook on Grouting and Concrete Repair* for more detail.

This section doesn’t include CA for the following reasons: Large-volume, deep pours aren’t common; the addition of CA has the potential to result in the occurrence of alkali-silica reaction (ASR), and the mixture proportions aren’t prescriptive (e.g., x part cement, y part sand, z part CA, etc.).

If a deep pour is necessary, prior to proceeding, contact Engineering Standards Manual Structural [POC](http://engstandards.lanl.gov/POCs.shtml#struc).

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* + 1. Fine Aggregate
       1. Washed natural sand.
       2. Gradation in accordance with ASTM C33 and represented by smooth granulometric curve within required limits.
       3. Free from injurious amounts of organic impurities as determined by ASTM C40.
    2. Mix
       1. Portland cement, sand and water. Do not use ferrous aggregate or staining ingredients in grout mixes.
  1. RAPID-CURING EPOXY GROUT

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Epoxy grout is typically used for grouting base plates, machinery, equipment, etc.; and when dynamic/impact loading, vibration, or chemical attack is/are applicable. It’s ideal for applications where precise change in elevation during curing is required. Additionally, epoxy grout can be tailored to provide improved properties related to: high early strength, and high chemical, acid, and fatigue resistance.

The products listed in Para. below meet the descriptive specifications and Properties in the two subsequent Paras.

Either retain the “Manufacturer” para. or the descriptive specifications and Properties paras, and delete the “OR note” in-between these options.

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* + 1. Manufacturers:
       1. Five Star Products, Inc.: Five Star HP Epoxy Grout
       2. Dayton Superior: Epoxy Grout J55
       3. Master Builders: MasterFlow 648
       4. [\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_] Model [\_\_\_\_\_\_\_\_].
       5. Substitutions: [Section 01 2500 – Substitution Procedures] [Not Permitted-No Substitutions].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

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Edit the following descriptive specifications to identify project requirements and to eliminate any/all conflicts with Properties indicated subsequently.

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* + 1. Rapid-Curing Epoxy Grout: Precision, high strength, minimal shrinkage, 100% solids, three-component epoxy grout. Rapid-curing, low creep, high effective bearing area, high-vibration and chemical resistance.
    2. Properties: Certified to meet the following minimum properties when tested in accordance with the respective indicated ASTM standard:

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Ensure the “C 579” Procedure used here is mirrored in the Epoxy-Grout paragraph in PART 3 Article FIELD QUALITY CONTROL.

Regarding the default value of f’c, it is the lowest strength that all of the manufacturers considered report. The reason being, f’c can be reported for multiple consistencies (i.e., flowable/standard and fluid/high flow), and the number and /or names of the consistencies can vary from manufacturer to manufacturer.

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| Property | Test | Result |
| --- | --- | --- |
| Compressive Strength | ASTM C 579  [Procedure B]  (Field-QC test)\* | [12,000] psi minimum at 7 days\* |
| Tensile Strength | ASTM C 307 | [2,000] psi minimum |
| Coefficient of Expansion | ASTM C 531 | [30x10-6] maximum per degree F |
| Shrinkage | ASTM C 827 | Very Low - None |

**\***Compliance shall be proven via the field-quality-control testing indicated in PART 3 herein.

* 1. NON-SHRINK CEMENTITIOUS GROUT

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Non-shrink cementitious grout is typically used for grouting base plates, machinery, equipment, etc. While non-shrink cementitious grout is typically less resistant to chemical attack and fatigue than epoxy grout, it tends to be more resistant to heat and less expensive. It is also more “precise” than a Portland cement grout, especially one that requires measurement of dry constituents.

The products listed in paragraph below meet the descriptive specifications and the Properties in the two subsequent paragraphs.

Either retain the “Manufacturer paragraph” or the descriptive specifications and Properties Paragraphs, and delete the “OR note” in-between these options.

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* + 1. Manufacturers (listed in descending order of precision/performance):
       1. Five Star Products, Inc.: Five Star Grout
       2. QUIKRETE: Non-shrink Precision Grout
       3. [\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_] Model [\_\_\_\_\_\_\_\_].
       4. Substitutions: [[Section 01 2500 – *Substitution Procedures*] [Not Permitted- No Substitutions].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

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Edit the following descriptive specifications to identify project requirements and to eliminate any/all conflicts with Properties indicated subsequently.

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* + 1. Non-shrink Cementitious Grout: Pre-mixed, ready-for-use formulation requiring only addition of water; non-shrink, non-corrosive, non-metallic, non-gas forming, no chlorides.
    2. Properties: Certified to maintain initial placement volume or expand after set, and to meet the following minimum properties when tested in accordance with the respective indicated ASTM standard:

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Regarding the tabulated default values of f’c, they are the lowest strengths that all the manufacturers considered report (i.e., for grout that is fluid/contains max. amount of water). The reason being, f’c is typically reported for multiple consistencies (i.e., plastic, flowable and fluid), and the number and /or names of the consistencies can vary from manufacturer to manufacturer.

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|  |  |  |  |
| --- | --- | --- | --- |
| Property | Test | Time | Result |
| Early Height Change | ASTM C 827 |  | [+4.0%] maximum |
| Hardened Height Change | ASTM C 1090 |  | [0%] minimum  [+0.3%] maximum |
| f’c \* | ASTM C 109 (as modified by ASTM C 1107, or as indicated in ASTM C 942)  (Field-QC test)\* | 1 day | [2,000] psi minimum |
| 7 days | [5,000] psi minimum |
| 28 days | [6,500] psi minimum\* |

**\***Compliance shall be proven via the field-quality-control testing indicated in PART 3 herein.

* 1. FORMWORK
     1. Follow all recommendations pertaining to formwork material and accessories made by the manufacturer(s) of the pre-mixed, pre-packaged concrete-repair and/or grout material(s) to be used.
     2. Where there is no conflict with the preceding formwork provision, as well as for site-mixed Portland cement grout, formwork shall be as specified in the Article, Form Materials and Accessories in in PART 2 of Section 03 3001, *Reinforced Concrete*.

1. EXECUTION
   1. EXAMINATION
      1. Verify areas to receive material.
   2. PREPARATION
      1. Follow all recommendations pertaining to preparation made by the manufacturer(s) of the pre-mixed, pre-packaged material to be used.
      2. Remove foreign materials from metal surfaces in contact with material.
      3. Align, level, and maintain final positioning of components to be grouted.
      4. If it is necessary to use a bonding agent, then it shall be installed in accordance with the manufacturer’s installation instructions.
      5. For site-mixed Portland cement grout only, in addition to the preceding three (3) Paragraphs, the following shall be done (as applicable):
         1. Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until sound, clean concrete surface is achieved.
         2. Roughen concrete lightly, but not enough to interfere with placement of grout.
         3. Saturate concrete surfaces with clean water; remove excess water, leave none standing.
   3. INSTALLATION
      1. Formwork
         1. Follow all recommendations pertaining to formwork installation made by the manufacturer(s) of the pre-mixed, pre-packaged concrete-repair and/or grout material(s) to be used.
         2. Where there is no conflict with the preceding formwork provision, as well as for site-mixed Portland cement grout, formwork shall be as follows.
      2. Constructed to be leak-proof, and anchored and shored to withstand material pressures.
      3. Installed with clearances to permit proper placement of material.
      4. Coated with approved form release agents
      5. As specified in the Article, General in PART 3 of Section 03 3001, *Reinforced Concrete*.
      6. Mixing
         1. Follow all recommendations pertaining to mixing made by the manufacturer(s) of the pre-mixed, pre-packaged material to be used.
         2. Assuming the work necessitates extending pre-mixed, pre-packaged material with aggregate, and such is allowed by the manufacturer, written approval from LANL is required prior to doing so.
         3. For site-mixed Portland cement grout only, in addition to the preceding Paragraph, the following shall be done:
         4. Use proportions of two (2) parts sand and one (1) part cement, measured by volume.
         5. Prepare grout with water to obtain consistency to permit placing and packing.
         6. Mix water and grout in two steps;

Pre-mix using approximately 2/3 of water.

After partial mixing, add remaining water to bring mix to desired placement consistency and continue mixing two (2) to three (3) minutes.

* + - 1. Mix only quantities of grout capable of being placed within 30 minutes after mixing.
      2. Do not add additional water after grout has been mixed.
      3. f’c per ASTM C 109 (Field-QC test)\*: [2,400] psi minimum in 48 hours, and [7,000] psi minimum in 28 days\*.

\* Compliance shall be proven via the field-quality-control testing indicated subsequently herein.

* + - 1. Mix material in proximity to work area and transport mixture quickly and in manner not permitting segregation of materials.
    1. Placing
       1. Develop a grouting plan that includes application and finishing of the material. The plan shall, at a minimum, include all related recommendations made by the manufacturer(s) of the pre-mixed, pre-packaged material to be used.
       2. Where there is no conflict with the preceding placing provision, as well as for site-mixed Portland cement grout, the grouting plan shall also include the following:
          1. Elimination of the possibility of entrapping air.

NOTE: This is typically achieved for grouted base plates by providing an additional hole(s) in the plate that allows for an air path for the air to escape during grouting operations.

* + - * 1. Placement of material quickly and continuously.
        2. Where leveling shims are to be removed after grouting they shall be coated/wrapped with a bond breaker (e.g., paste wax, polyethylene film, etc.), and removal shall occur no sooner than 48 hours after grout has been placed.

NOTE: Leveling jack screws may be used in lieu leveling shims that are to be removed.

* + - 1. The grouting plan shall not include the following:
         1. Use of pneumatic-pressure or dry-packing methods.
         2. Vibration of placed material, or material placement when area is being vibrated by nearby equipment.
      2. Obtain LBO approval of grouting plan, and then place material in accordance with the plan.
    1. Curing
       1. Follow all recommendations pertaining to curing made by the manufacturer(s) of the pre-mixed, pre-packaged material to be used.
       2. Where there is no conflict with the preceding curing provision, as well as for site-mixed Portland cement grout, curing of cementitious materials shall include the following:
          1. Prevent rapid loss of water from material during first 48 hours by use of approved membrane curing compound or by using of wet burlap method.
          2. After material has attained its initial set, keep damp for minimum of three (3) days.
       3. Immediately after placement, protect material from premature drying, excessively hot or cold temperatures, and mechanical injury.
  1. FIELD QUALITY CONTROL
     1. Provide a certified testing agency to perform field testing in accordance with ACI 301 and under provisions of Section 01 4000 - *Quality Requirements*. [\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.]

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Five Star Products recommends requiring compressive-strength testing for QC. And their “Handbook” points out that there are 3 different test-method procedures in ASTM C 579 (i.e., A–C), and that the difference between the results from them can be as much as 2000 psi. Thus, the following epoxy-grout paragraph allows for flexibility in demonstrating that the f’c value indicated in PART 2 is met/exceeded. The default option is Procedure B since that’s what’s indicated in PART 2. If the user opts for a different Procedure, ensure the one indicated here is the same as that which is applicable to the 7-day f’c value indicated in PART 2.

Other than the subparagraph applicable to testing epoxy-grout, the verbiage of these paragraphs was adapted from ACI 301 Section 13 para. 13.1.4.4(c).

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* + 1. Rapid-Curing Epoxy grout: Determine f’c per ASTM C 579 [Procedure B]. The test result shall be considered satisfactory if 7-day f’c value meets or exceeds that which is indicated herein.
    2. Concrete Repair Material, Non-Shrink Cementitious Grout, and Portland Cement Grout: Determine f’c per ASTM C 109. The test result shall be considered satisfactory if the 28-day f’c value meets or exceeds that which is indicated herein.

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The verbiage in the next paragraph was adapted from the Field-QC Article (i.e., 3.5) in the NNSA MOX Project Section 03601.

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* + 1. 2-inch cube samples shall be made and tested for each material each day it is used. The results of each test will be used to verify the applicable material strength indicated in PART 2 herein has been attained prior to final acceptance of the work. The number of cubes made and tested daily shall be as follows:
       1. Concrete Repair Material and Portland Cement Grout: Two (2) of the installed material.
       2. Rapid-Curing Epoxy Grout: Two (2) per batch consistency (i.e., fluid, flowable, or plastic) to be used in the installation.
       3. Non-Shrink Cementitious Grout: Two (2) per batch consistency (i.e., fluid or flowable) to be used in the installation.

END OF SECTION

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Do not delete the following information:

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THE FOLLOWING STATEMENT IS FOR LANL USE ONLY

This project specification section is based on LANL Master Specification Section 03 6000 Rev. 4, dated February 5, 2019.