CSI SECTION  03 60 00 – GROUTING
03 61 00 – CEMENTITIOUS GROUTING, SHRINKAGE-COMPENSATING

Type K Shrinkage-Compensating, Multi-Purpose, Cementitious Grout

EDITOR NOTE: The following guideline specification has been prepared to assist architects and design professionals in the preparation of project master specifications. It is intended for use by qualified design professionals and is not intended to be used verbatim. Appropriate modifications to meet specific project requirements are required. Make appropriate [selections] where options are provided and delete items that are not applicable to the project. Contact CTS Cement Technical Service for additional information or project specification assistance.

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Supply and installation of a shrinkage-compensating, cementitious grout for anchoring, patching, casting and repairing concrete substrates in structural and non-structural applications.

1.2 RELATED SECTIONS

[A. Section 03 01 00 - Maintenance of Concrete
[B. Section 03 01 40 - Maintenance of Precast Concrete
[C. Section 03 01 50 - Maintenance of Cast Decks and Underlayment
[D. Section 03 01 60 - Maintenance of Grouting
[E. Section 03 01 80 - Maintenance of Concrete Cutting and Boring
[F. Section 03 30 00 - Cast-in-Place Concrete
[G. Section 03 40 00 - Precast Concrete
[H. Section 03 50 00 - Cast Decks and Underlayment
[I. Section 03 54 16 - Hydraulic Cement Underlayment
[J. Section 03 70 00 - Mass Concrete
[K. Section 05 05 19 - Post-Installed Concrete Anchors

1.3 REFERENCES

A. ASTM C78  Test Method for Flexural Strength of Concrete
C. ASTM C150  Standard Specification for Portland Cement
H. ASTM C827  Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
J. ASTM C878  Standard Test Method for Restrained Expansion of Shrinkage-Compensating Concrete
K. ASTM C939  Test Method for Flow of Grout for Preplaced Aggregate Concrete (Flow Cone Method)


M. ACI 301  Specification for Structural Concrete

N. ACI 305  Guide to Hot Weather Concreting

O. ACI 306  Guide to Cold Weather Concreting

P. ACI 318  Building Code Requirements for Structural Concrete

Q. ACI 350  Code Requirements for Environmental Engineering Concrete Structures

R. CRD-C 621  Corps of Engineers Specification for Non-Shrink Grout

1.4 SUBMITTALS

A. General: Submit samples and manufacturer’s product data sheets, installation instructions, etc. in accordance with Division 01 General Requirements Submittal Section.

B. Test Data: Submit qualified testing data that confirms compliance with specified performance requirements and as required in Section 03 30 00 for concrete to be used as grout.

1.5 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer:
      a. Must have marketed shrinkage-compensating grouting materials in the United States for at least five years and must have completed projects of the same general scope and complexity.
      b. Grout and complementary cementitious or admixture materials must be manufactured by or approved for use by CTS Cement Manufacturing Corp. (800-929-3030, www.CTScement.com) and distributed by the same or an authorized CTS Cement dealer.
   2. Applicator:
      a. Must be experienced and competent in installation of non-shrink or shrinkage-compensating grouting materials and provide evidence of a minimum of five years experience in work similar in size and scope to that required by this section.
   3. Pre-Installation Conference: Conduct conference at the Project Site located at [enter site address] at least three (3) weeks prior to initial concrete grout placement. Require representatives of each entity directly concerned with cast-in-place concrete grout to attend.
   4. Services of Manufacturer’s Representative – A qualified field technician of the shrinkage-compensating, non-shrink grout manufacturer, specifically trained in the installation of the products, must attend the pre-installation conference to review materials, placement and curing.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver products in original, unopened, undamaged packaging with manufacturer's identification (i.e., brand logo, product name, weight of packaged unit, lot number).

B. Storage: Store products in a dry location, covered, out of direct sunlight, off the ground, and protected from moisture. Maintain storage temperature required by the manufacturer. Keep materials dry until used. Store bulk sand in a well-drained area on a clean, solid surface. Cover sand to prevent contamination.
C. Handling: Handle products in accordance with manufacturer's published recommendations.

1.7 SITE / ENVIRONMENTAL CONDITIONS

A. Temperature: Maintain ambient and surface temperatures between 40°F (4.4°C) to 90°F (32°C) for three successive days. Do not apply grout materials if ambient temperature falls below 40°F (4.4°C) within 24 hours of application. Protect grout from uneven and excessive evaporation during dry weather, windy conditions and strong blasts of dry air.

1. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   a. When average high and low temperature is expected to fall below 40°F (4.4°C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
   b. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   c. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

2. Hot-Weather Placement: Comply with ACI 305.1 and as follows:
   a. Maintain concrete temperature below 90°F (32°C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   b. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

B. Inclement Weather: Do not apply grout materials during inclement weather unless appropriate protection is employed.

C. Sunlight Exposure: Avoid, whenever possible, installation of grout materials in direct sunlight which could adversely affect aesthetics.

D. Substrate: Prior to installation, the substrates must be inspected for surface contamination or other conditions that may adversely affect the performance of the grouting materials and be free of residual moisture.

1.8 COORDINATION AND SCHEDULING

A. Coordinate installation of grout materials with all other trades to avoid impeding other construction.

B. Sufficient manpower must be provided to ensure continuous application and timely finishing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS


B. Components: Obtain grout and complementary admixture materials manufactured by CTS Cement from authorized distributors. No substitutions or additions of other materials are permitted without prior written permission from the manufacturer for this project.
2.2 MATERIALS

A. Type K Shrinkage-Compensating, Cementitious Grout
   1. Must conform to the requirements of Section 03 30 00 except as specified herein. Grout must be proportioned with cement, water, [fine and coarse aggregates if extended], and water reducer to produce a mix having an average strength of [_____] psi at 28 days, or nominal [_____] psi.
      a. Type K Shrinkage-Compensating Cement Grout: a high quality pre-blended grout consisting of Komponent® expansive cement additive combined with ASTM C150 Type I, II, or V portland cement at approximately 15% Komponent® and 85% portland cement to produce a shrinkage-compensating cementitious grout with exceptional durability. Mix with sand and water on site to appropriate consistency. Suitable for structural and non-structural applications.

[2. Synthetic Fibers: Add fibers to the shrinkage-compensating concrete grout mix at the rate of [_____]-pounds of fibers per cubic yard of grout. Fibers must be added from the manufacturer's pre-measured bags and according to the manufacturer's recommendations in a manner that will ensure complete dispersion of the fibers as single monofilaments within the shrinkage-compensating concrete grout.
   a. K-Fiber™: small synthetic fibers designed to restrain the expansion of Type K Shrinkage-Compensating Concrete and minimize temperature steel requirements.

B. Water: Clean, potable water free of deleterious amounts of silt and dissolved salts. Do not use recycled water.

2.3 MATERIAL PROPERTIES

A. Type K Shrinkage-Compensating, Cementitious Grout
   2. Material must provide expansion from 0.04% to 0.10% at 7 days when tested in accordance with ASTM C806 by a laboratory approved by CTS Cement Manufacturing Corp.
   3. Grout trial batches must be performed per CTS Cement’s recommended mix designs. Type K Shrinkage-Compensating Grout must provide expansion from 0.05% to 0.09% at 7 days when tested in accordance with ASTM C878 when extended.

2.4 PERFORMANCE REQUIREMENTS, GROUT MIX DESIGN

A. Compressive Strength, Minimum: [4,800 psi (33.1 MPa)] at 7 Days
B. Compressive Strength, Minimum: [7,250 psi (49.6 MPa)] at 28 Days
C. Expansion: [0.045%] at 7 days
D. Water/Cement Ratio: 0.5 Minimum, [________] Maximum
E. Slump Limit: [_____] plus or minus one (1) inch

EDITOR NOTE: Acceptable Slump range for shrinkage-compensating cement grout is from zero (0) to twelve (12) inches.
2.5 RELATED MATERIALS

A. Admixtures:
   1. Admixtures must conform to ASTM C494.
   2. All additives and admixture materials must be approved prior to use by the Project Engineer and CTS Cement Manufacturing Corp. (800-929-3030, www.CTScement.com).

B. Aggregates:
   3. Fine and coarse aggregates must conform to ASTM C33/C33M.
   4. Lightweight aggregates must conform to ASTM C330/C330M.
   5. Provide aggregates from a single source with a documented satisfactory service record for at least 10 years in similar applications and service conditions using similar aggregates and cementitious materials.
   6. Aggregates must be approved prior to use by the Project Engineer and by CTS Cement Manufacturing Corp. (800-929-3030, www.CTScement.com).

C. Consult with a qualified CTS Cement Technical Representative prior to the project if grout will be pumped, mixed in a ready-mix truck, extended with aggregate, used at temperature extremes, installed less than 1/2 inch thick or over 6 inches thick, or when unusual job site conditions are anticipated. (800-929-3030, www.CTScement.com)

D. Concrete Cleaner: Citrus-based concrete cleaner to clean and strip dirt, grease and laitance from surfaces to receive grout.

E. Curing Materials: Prevent rapid water loss from grout during the first seven (7) days by use of
   1. Absorptive Cover: Burlap compliant with AASHTO M182, Class 3 or Class 4 or two (2) layers of Class 1 or Class 2.
   2. Moisture-Retaining Cover: Compliant with ASTM C171 for white opaque polyethylene film or white burlap-polyethylene sheets. Clear or black polyethylene film may be used for cold weather protection.
   3. Evaporation Retardant: Water-based, VOC-compliant, and designed to form a thin, monomolecular film to reduce rapid moisture loss from the concrete surfaces prior to curing. Submit evaporation retardant product information to the Project Engineer for approval prior to use.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify project site conditions under provisions of Section 01 00 00.
B. Compliance: Comply with manufacturer's instructions for installation of grouting materials.
C. Coordinate installation with adjacent work to ensure proper sequencing of construction.
D. Protect adjacent and surrounding surfaces not specified to receive grout with necessary means to ensure protection against overspray, water or other harmful debris.
E. Advise Contractor of discrepancies preventing proper installation of grouting materials. Do not proceed with the work until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Comply with manufacturer's printed instructions, ICRI Surface Preparation reference materials, and the following:
B. Mechanically roughen existing surfaces and remove all loose, unsound, contaminated material.
C. Bonding surfaces must be clean, sound, and free from any materials that may inhibit bond such as oil, dirt, asphalt, sealing compounds, acids, wax and loose dust and debris.
D. Reinforcing steel, metal embedments, baseplates and other exposed metal surfaces must be free from rust and all other materials that may inhibit bond.
E. Air compressors used to clean surfaces in contact with grout must be the oil less type or equipped with an oil trap in the air line to prevent oil from being blown onto the surface.
F. Grout must be placed over cured concrete that has attained full design strength unless otherwise approved by the Project Engineer.
G. Thoroughly saturate the area to receive grout with water for a minimum of 4 hours, preferably 24 hours, before grout placement. Remove any standing water before material placement.
H. Minimum substrate temperature must be 40°F (4.4°C) and maximum substrate temperature 90°F (32°C).
I. For formed grouting applications, construct watertight, non-absorbent forms. Build forms a minimum one (1) inch higher than the bottom of the plate and one (1) to three (3) inches between the side of the plate, and in compliance with Section 03 10 00. Forms must be of adequate strength, securely anchored in place and shored to resist the forces imposed by the placement of grout.
J. Level and align structural or equipment bearing plates in accordance with structural requirements and the recommendations of the equipment manufacturer.
K. Prevent adjacent surfaces from bonding to the grout by using appropriate methods and bond breaking coatings.
L. Joints must be sealed with foam, caulk or putty.
M. Provide vent holes to avoid air entrapment.
N. Provide a head placement of a 45 degree angle to facilitate placement for grout pour.
O. Take precautions to minimize differential heating or cooling of baseplates and grout during the grout curing period.

3.3 MIXING
A. Type K Shrinkage-Compensating Cement Grout: Comply with manufacturer’s printed instructions and the following:
   1. Organize installation personnel and equipment before mixing begins.
   2. Production:
      a. Bulk Delivery: Central mixing or ready-mix plant. Use slurry machine to incorporate Komponent® and ensure full dispersion.
      b. On-Site Mixing: Use portable silos to store Komponent®. Use slurry machine to incorporate Komponent® and ensure full dispersion.
      c. Slurry machine required for pre-packaged bag units.
      d. Viscosity modifying admixtures used to prevent segregation must be approved prior to use by CTS Cement Manufacturing Corp. (800-929-3030, www.CTScement.com).
   3. Do no use damaged or broken bags/units, or partially used bags/units from previous projects.
   4. Weigh Komponent® prior to weighing portland cement to avoid cumulative weighing errors of cementitious materials.
5. To increase the slump or workability at the job site, use water reducers or superplasticizers per manufacturer’s dosage rates and recommendations. Do not add water to concrete during delivery, at Project site, or during placement.

EDITOR NOTE: Water is ONLY added during initial production of the batch. Adding water after initial mixing prevents designed expansion of the shrinkage-compensated concrete.

6. Do not add cement, sand, pea gravel, other aggregates, additives or admixtures without prior approval of the Project Engineer. When used, pea gravel, other aggregates and additives are used, they must be approved prior to use by CTS Cement Manufacturing Corp. (800-929-3030, www.CTScement.com).

7. Never mix by hand. Do not re-temper, add water, or remix after the grout stiffens. Grout that stiffens before use must be discarded.

8. Mixing in a mortar mixer with moving blades is recommended. Pre-wet the mixer and empty excess water. Add pre-measured amount of water for mixing, followed by the grout.

9. Use sufficient water based on the following mix design to achieve performance requirements.

EDITOR NOTE: The following Mix Design Guidelines are provided with ranges for each component proportioned to produce effective mix designs. Actual mix designs must be modified to meet specific project requirements and qualified with the materials being used on site by appropriate testing prior to installation. Contact CTS Cement (800-929-3030) for assistance with specific project mix designs based on project requirements.

<table>
<thead>
<tr>
<th>Mix Design</th>
<th>Guidelines</th>
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<tbody>
<tr>
<td>a. Portland Cement Type I/II/V</td>
<td>845 - 865 lbs</td>
</tr>
<tr>
<td>b. Komponent®</td>
<td>95 - 115 lbs</td>
</tr>
<tr>
<td>c. Fine Aggregate (ASTM C33)</td>
<td>2,100 - 2,600 lbs</td>
</tr>
<tr>
<td>d. Water</td>
<td>50 - 65 gallons</td>
</tr>
<tr>
<td>e. Water Reducer (ASTM C949)</td>
<td>4 oz/100 lbs of cementitious material</td>
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10. Adjust water to achieve the desired flow consistency. Do not exceed water/cement ratio maximum per mix. Gauge fluid consistency within 25-35 seconds per ASTM C939 Flow Cone Method.

3.4 APPLICATION

A. Type K Shrinkage-Compensating Cement Grout: Comply with manufacturer’s printed instructions and the following:

1. Grout temperature at placement must not exceed 90°F (32°C). No grout shall be placed that is 90 minutes or older measured from the time of initial production.

2. Concrete temperature at placement must not be less than 55°F (13°C). Protect concrete from freezing temperatures for 7 days after placement.

3. Subgrade temperature shall not be less than 40°F at time of placement. Ambient conditions must be 40°F (4°C) and rising at time of placement.

4. Install grout in a manner that will preserve the isolation between the elements on either side of the joint where grout is placed in the vicinity of an expansion or control joint.
5. Place grout into forms continuously by pump or pouring in one placement. Fill all areas to be grouted and stay in contact with load bearing areas. If a section cannot be placed continuously, provide construction joints as indicated. Avoid cold joints. Deposit grout to avoid segregation and air entrapment.

6. Do not vibrate grout to release air or to consolidate the material. Limit the amount of surrounding vibration during grout placement to prevent segregation. All machinery near grout placement should be shut down for 24 hours after placement.

7. Provide grout holes as necessary.

8. Just prior to final set, cut back the grout to the substrate at a 45 degree angle from the lower edge of the bearing plate unless otherwise approved by the Engineer. Finish the surface with a wood float to a [_______] finish.

9. Remove forms once the grout has achieved final set.

3.5 CURING

A. Begin curing immediately after form removal, cutback and finishing and as soon as it can be done without marring the surface. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement.

B. Wet cure grout placement with clean, potable water for seven (7) full days. Avoid surface drying. Provide sunshades as necessary. If drying winds inhibit the ability of a given curing method to keep grout moist, erect wind breaks until wind is no longer a problem or curing is finished.

3.6 CLEAN-UP

A. Remove and legally dispose of grouting debris material from job site.

B. Clean excess material from surrounding areas and all tools immediately, before material cures. If materials have cured, remove using mechanical methods that will not damage the substrate.

C. Clean adjacent surfaces as needed using materials and methods recommended by the manufacturer of the material being cleaned. Remove and replace work that cannot be cleaned to the satisfaction of the Project Designer/Owner.

END OF SECTION

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This sample guideline specification is intended for use by a qualified design professional. The sample guideline specification is not intended to be used verbatim as an actual specification without appropriate modifications for the specific project requirements.