
USACE / NAVFAC / AFCEA / NASA UFGS-32 01 29.62 (August 2008)

Preparing Activity: USACE Superseding
UFGS-32 01 29.62 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2009

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SECTION 32 01 29.62

SLABJACKING RIGID PAVEMENTS 08/08

NOTE: This guide specification covers the requirements for slabjacking rigid pavements for roads, streets, parking areas, airfield and other general applications.

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

PART 1 GENERAL

1.1 UNIT PRICES

NOTE: Delete paragraphs MEASUREMENT and PAYMENT when lump sum bidding is used.

1.1.1 Measurement

Accurately measure the dry materials by weight or volume if delivered in bulk or packaged in uniform volume sacks. Batch the water through a meter or scale with a totalizer for the day's consumption. Make these measurements under the supervision of the Contracting Officer. Submit weigh bills for cement and sand after slabjacking operations are completed,

to validate mix proportions used.

1.1.1.1 Quantity of Portland Cement Grout

The quantity of portland cement grout to be paid for will be that actually used in the accepted work.

1.1.1.2 Quantity of Portland Cement

The quantity of portland cement to be paid for will be accurately measured by weight.

1.1.1.3 Number of Holes

The quantity of holes to be paid for will be the number of holes actually drilled to accomplish the work specified, and as shown on the drawings.

1.1.1.4 Broken Slabs

Repair or replacement of concrete slabs broken due to jacking shall not be measured for payment. Furnish all labor, equipment, tools, and materials necessary to repair or replace broken concrete pavement at no cost to the Government.

1.1.2 Payment

1.1.2.1 Portland Cement Unit Price

The quantity of portland cement, measured as specified, will be paid for at the contract unit price for portland cement. The unit price for portland cement will include full compensation for furnishing labor, grout materials, and tools and equipment; for furnishing, loading and unloading, storing, hauling and handling grout ingredients; for mixing and pumping grout; and for furnishing of manufacturer's test report for each lot of cement. All of the above will be considered in the unit price per **kg** **hundred weight** of portland cement.

1.1.2.2 Drilled Holes

The quantity of holes determined as specified, will be paid for at the contract unit price for Drilled Holes, which will include full compensation for furnishing all labor, equipment, tools, materials, and for filling of holes.

1.2 REFERENCES

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update

the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 142	(1997; R 2004) Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C 150/C 150M	(2009) Standard Specification for Portland Cement
ASTM C 266	(2008) Standard Test Method for Time of Setting of Hydraulic-Cement Paste by Gillmore Needles
ASTM C 31/C 31M	(2009) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 39/C 39M	(2005e1e2) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 494/C 494M	(2008a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 618	(2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 937	(2002) Grout Fluidifier for Preplaced-Aggregate Concrete
ASTM C 939	(2002) Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
ASTM C 940	(1998a; R 2003) Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C 953	(2006) Time of Setting of Grouts for Preplaced-Aggregate Concrete in the Laboratory

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 100

(1975) Method of Sampling Concrete
Aggregate and Aggregate Sources, and
Selection of Material for Testing

COE CRD-C 400

(1963) Requirements for Water for Use in
Mixing or Curing Concrete

1.3 SYSTEM DESCRIPTION

1.3.1 Equipment

Furnish all equipment, tools, and other apparatus necessary for the proper construction and acceptable completion of the work specified under this contract. The equipment shall be approved by the Contracting Officer prior to starting the work, and maintained in good working condition by the Contractor during the progress of the work.

1.3.2 Grout Plant

**NOTE: When the use of limestone dust grouts is
approved, a paddle type mixer may be substituted for
the high speed colloidal mixer.**

Provide a grout plant consisting of a positive displacement grout injection pump capable of applying up to 1.72 MPa 250 psi pressure, a high speed colloidal mixing machine, and a grout return system. Produce the colloidal grout by mixing in a colloidal mill connected to the cone-shaped bottom of a cylindrical drum. Operate the colloidal mill between 800 and 2,000 RPM, creating a high shearing action and subsequent pressure release to make a homogeneous mixture. Provide an injection system capable of continuously pumping grout at rates as low as 5.68 liters 1-1/2 gallons per minute and equipped with pressure monitoring devices and a quick action valving system that can be closed instantly and provide for the grout to be recirculated through the system.

1.3.3 Water Tanker

If water tanks and metered pumps are not an integral part of the plant, supply a water truck equipped with a metered pump for delivery to the grout plant.

1.3.4 Drilling

Provide an air compressor and rock drill or other device capable of drilling the grout injection holes through the pavement and base material. Keep the equipment in good condition. The holes shall be vertical and round. Down-feed pressure, whether by hand or mechanical means, not exceeding 1.38 MPa 200 psi. Drill holes to prevent breakout at the bottom of the pavement.

1.3.5 Flow Cone

Provide a flow cone, with necessary components and conforming to the dimensions and other measurements of ASTM C 939, so that the consistency of the mixture can be determined.

1.3.6 Miscellaneous

Provide all necessary hoses; valving, valve manifolds, and positive cut-off and bypass provisions to control pressure and volume; pressure gauges with gauge protectors; expanding packers for positive seal grout injection; wood plugs; hole washing tools; and drill steel and bits.

1.4 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Grout Mixture

Certified mix designs for each type of concrete, grout, or blended material including a complete list of ingredients, admixtures, and set time. The mix shall have been successfully tested to meet specification requirements. List of proposed

equipment to be used in performance of construction work, including descriptive data.

SD-06 Test Reports

Production Sampling and Testing Tests, Inspections, and Verifications

Certified copies of test reports for aggregates, cement, and fly ash, not less than [30] [_____] days before the material is required in the work and daily during construction. Certified reports of inspections and laboratory tests, including analysis and interpretation of test results. Properly identify each report by contract number, location, quantity of material placed, and timed events of milestones. Describe test methods used and compliance with specified standards.

SD-07 Certificates

Grout Mixture Equipment

The material supplier's or equipment manufacturer's statement that the supplied material or equipment meets specified requirements. Each certificate shall be signed by an official authorized to certify in behalf of material supplier or product manufacturer identifying quantity and date of shipment or delivery to which the certificates apply.

1.5 QUALITY ASSURANCE

1.5.1 Bench Marks

Elevations of bench marks used by the Contractor for grade control at the site of the work [will] [shall] be determined, established, and maintained by the [Government] [Contractor].

1.5.2 Testing Facilities

Perform tests using an approved commercial testing laboratory or at facilities furnished by the Contractor. Work requiring testing will not be permitted until the facilities have been inspected and approved by the Contracting Officer. The first inspection will be at the expense of the Government. Costs incurred for any subsequent inspection required because of failure of the first inspection will be charged to the Contractor.

1.5.3 Cement

Do not use cement until its test report is approved by the Contracting Officer. Sample cement at the mill or shipping point and at the work site. If tests prove that a cement that has been delivered is unsatisfactory, promptly remove it from the work site. Retest cement that has not been used within 6 months after testing when directed by the Contracting Officer and shall be rejected if test results are not satisfactory.

1.5.4 Aggregate

Take suitably sized aggregate samples representative of the materials to

be used in the work, under the supervision of the Contracting Officer and in accordance with COE CRD-C 100. Take samples sufficiently in advance, so that required testing can be completed prior to starting grouting operations. Conduct contractor testing in a lab approved by the Contracting Officer.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Provisions for Cement

Cement may be furnished in bulk or in suitable bags used for packaging cement. Plainly mark the bags with the manufacturer's name, brand, and lot number. Furnish cement that is dry and free from lumps and caking when delivered. Check shipments of bagged cement for weight when delivered. Furnish accurate scales and labor for checking the weight of bagged cement. Approximately 1 percent of each shipment will be selected at random and checked for weight, except that additional weight checks will be made to determine compliance with the cement specification when deficiencies in weight are found. Deliver bulk cement, if used, in weathertight carriers and unload it into the storage facilities by means of weathertight conveyors or other suitable means that will completely protect the cement from moisture. Storage facilities are subject to approval, and shall permit easy access for inspection and identification. Store and use different brands of cement separately so that a complete record will be available of the grade of cement used in all batches of grout mixes.

1.6.2 Provisions for Aggregates

Handle and store aggregates at the site so that segregation, intermixing between stockpiles, or contamination by foreign materials does not occur. Prepare and maintain sites for stockpiles to prevent the inclusion of foreign materials with the aggregate. Aggregate shall not be segregated. When segregation is apparent, discard the aggregate.

1.7 ENVIRONMENTAL REQUIREMENTS

Do not perform pavement slabjacking when the ambient temperature at the bottom of the pavement slab is less than 5 degrees C 40 degrees F, or when the subgrade or subbase is frozen.

PART 2 PRODUCTS

2.1 GROUT MIXTURE

Provide portland cement grout mixture, used for slabjacking, consisting of portland cement, pozzolan or fly ash, limestone dust, sand, and water. The use of accelerators, high range water reducers and fluidifiers are subject to the approval of the Contracting Officer.

2.2 MINERAL AGGREGATE

Aggregate to be used for slabjacking may consist of natural sand, manufactured sand, or a combination of natural and manufactured sand and limestone dust. If the aggregate is a combination of separately processed sizes from the same or different sources, or a blend of different materials, batch the different components separately or blended under approved conditions prior to delivery to the batching plant.

2.2.1 Particle Shape

Particles of the aggregate shall be generally spherical or cubical in shape. Aggregates containing flat platelet grains or rhombohedral grains will not be approved.

2.2.2 Grading

The aggregate, as delivered to the mixer, shall conform to the following gradation when tested in accordance with [ASTM C 136](#).

Sieve Designation	Percent By Weight Passing
2.36 mm	100
1.18 mm	80-95
0.300 mm	50-70
0.075 mm	25-45

Sieve Designation US Standard Square Mesh	Percent By Weight Passing
No. 8	100
No. 16	80-95
No. 50	50-70
No. 200	25-45

2.2.3 Deleterious Materials

Deleterious materials in the aggregate shall not exceed the following limits when tested in accordance with [ASTM C 142](#).

Material	Percentage by Weight
Clay lumps	2.0
Coal and lignite	1.0

2.3 POZZOLANS AND FLY ASH

Provide pozzolans and fly ash meeting the requirements of [ASTM C 618](#).

2.4 PORTLAND CEMENT

Furnish portland cement Type [_____] meeting the requirements of [ASTM C 150/C 150M](#). Do not use cement salvaged by cleaning bags mechanically or otherwise, or from discarded bags of cement. Use cement that has been stored at the site for 60 days or more before using cement of lesser age. The temperature of the cement as delivered to the mixer shall not exceed [65 degrees C](#) [150 degrees F](#).

2.5 WATER

Furnish water for mixing of grout that is clean, fresh, and free from

injurious amounts of oil, acid, salt, alkali, organic matter, or other deleterious substances. Water approved by Public Health authorities for domestic consumption may be accepted for use without being tested. Test the water, at the Contractor's expense, in accordance with COE CRD-C 400 if, in the opinion of the Contracting Officer, the water is of questionable quality.

2.6 CHEMICAL ADMIXTURES

Provide chemical admixtures that are proposed to be used to assist in pumping grouts, or to compensate for climatic conditions, conforming to ASTM C 494/C 494M and ASTM C 937.

2.7 PROPORTIONING OF MATERIALS

Proportion the grout mixture to be used for slabjacking as follows:

- a. One part (by volume) portland cement Type [_____].
- b. Three parts (by volume) aggregates or a mixture of aggregates and pozzolans or fly ash.
- c. Water to achieve fluidity.
- d. Additives (when approved), high range water reducers, water reducers, fluidifiers.

2.8 TESTS, INSPECTIONS, AND VERIFICATIONS

2.8.1 Daily Report

Provide daily mixture test results of the materials and additives used in the mixture, including aggregate gradation, the flow cone times, shrinkage and expansion observed, the time of initial set, one day, 3 day, and 7 day strengths of previous day's placements.

2.8.2 Compressive Strength

The 7 day strength shall be not less than 4 MPa 600 psi as measured using ASTM C 39/C 39M. Test specimens shall use the materials (including water and additives) which are to be used in the project and shall be made, cured, and tested as described in Field Test Specimens under paragraph PRODUCTION SAMPLING AND TESTING.

2.8.3 Expansion

Determine the expansion in accordance with ASTM C 940 at the beginning of the job and whenever the mix proportions are changed.

2.8.4 Set Time

Determine the time of initial set in accordance with ASTM C 266 or ASTM C 953 at the beginning of the job and when a different lot of cement is used.

2.8.5 Fluidity

Test the fluidity of each batch of grout slurry in accordance with ASTM C 939. Time of efflux (fluidity) for pozzolanic grouts shall range

from 16 to 26 seconds. Time of efflux for limestone dust grouts shall range from 22 to 32 seconds. A more fluid mix having a flow cone time of efflux of 9 to 15 seconds may be used during the initial injection at each hole.

PART 3 EXECUTION

3.1 PAVEMENT INSPECTION

Prior to jacking any pavement, closely examine the slabs for any existing cracks. Perform this investigation with the Contracting Officer; both parties shall agree regarding the existing condition of the pavement; and existing cracks shall be noted or marked.

3.2 DRILLING HOLES FOR GROUT INJECTION

Drill grout injection holes in a pattern as shown on the pdrawings. Holes shall not be larger than 50 mm 2 inches in diameter, drilled vertically to a depth sufficient to penetrate through any chemically stabilized base, but not more than 75 mm 3 inches into the subgrade. Drill holes so that breakout does not occur at the bottom of the slab.

3.3 WASH HOLES

Subject to the Contracting Officer's approval, holes may be washed or air blown to create a small cavity to allow the initial spread of grout.

3.4 JACKING

Prior to jacking operations erect string lines that will be blocked up from the pavement high points to monitor movement. Lower into the holes an expanding rubber packer or other approved device providing a positive seal and connected to the discharge hose on the grout plant. Do not extend the discharge end of the packer or hose below the lower surface of the concrete pavement. Pump in a pattern and in the amount required to raise the pavement to within 3 mm 1/8 inch from a string line grade. Grade tolerances shown in this section shall be applicable to transverse grades as well as longitudinal grades. Continuous pressures to 1.38 MPa 200 psi will be permitted. Pressures to 2.07 MPa 300 psi will be allowed only for short periods. In the event the pavement is bonded to the subbase, brief pressure rises (10 seconds or less) to 4.14 MPa 600 psi will be allowed. Loss of grout through cracks, joints, other injection holes, or from back pressure in the hose or in the shoulder area will not be tolerated. Grout held in the mixer or in the injection pump or hose for more than 1 hour after mixing shall not be used for jacking.

3.5 RAISING OF SLABS

Do not raise the slabs more than 5 mm 1/4 inch when pumping in any one hole at any time. No part of the slab shall lead any other part of the slab or any adjacent slab more than 5 mm 1/4 inch at any time. Keep the entire slab and all adjacent slabs on the same plane at all times, within the 5 mm 1/4 inch tolerance. Make observations to ensure that when pumping from one hole, the grout flows to adjacent holes filling all voids. The Contractor may cut a slab to prevent breakage when it is bound against an adjoining slab. If the temperature is 27 degrees C 80 degrees F, or higher during the jacking operation, moisten the slabs sufficiently to prevent expansion of the slabs.

3.6 SEALING OF INJECTION HOLES

After jacking has been completed at any one hole, immediately remove the packer and plug the hole temporarily with a tapered wooden plug. The temporary wooden plugs shall not be removed until the grout has set sufficiently so that back pressure will not force it through the hole. Permanently seal each hole flush with the pavement surface with a fast setting sand/cement or other patch material approved by the Contracting Officer. The patch material shall have a minimum thickness of 75 mm 3 inches.

3.7 PLAN GRADE REQUIREMENTS

NOTE: The designer will evaluate which procedure, i.e., grinding or raising the adjacent pavement, should be used to correct for overjacking. If the slabjacking is to be accomplished adjacent to a fixed structure it will be necessary to grind or remove the overjacked pavement. The 3 mm (1/8 inch) tolerance is appropriate for airfield and high-speed roadway pavements. For low-speed roadways and parking areas a tolerance of 6 mm (1/4 inch) should be specified.

During the raising of the slabs, furnish and utilize qualified personnel and equipment for determining the proper elevations required to conform to the plan elevations. Upon completion of jacking operations, slabs within the work area shall present an even grade at each joint and shall not vary from the plan elevations by more than [3] [6] mm [1/8] [1/4] inch. If slabs are found that are lower than the specified tolerance from the plan grade, these slabs shall be further jacked until the tolerance is met. [If slabs are found that are higher than the specified tolerance, raise the grade of the surrounding pavement, as determined by the Contracting Officer, to a newly established grade.] [Individual sections of pavement that are raised above the specified tolerances shall be brought to grade by grinding.] Should the overjacking be greater than 5 mm 1/4 inch the Contracting Officer has the option to require removal and replacement of the pavement. These repairs shall be accomplished at no additional cost to the Government.

3.8 REPLACING AND REPAIR OF DAMAGED PAVEMENT

Replace or repair any slabs broken due to jacking as determined by the Contracting Officer. Cracks emanating radially from the grout injection holes will be presumed to be caused by improper injection techniques by the Contractor. For each 1.5 m 5 feet of such crack measured, the Contractor's pay quantity will be reduced by 0.03 cubic meters 1 cubic foot of grout. In the event that transverse cracks develop between adjacent grout injection holes, the Contractor will be required to repair these cracks by an epoxy injection method to the satisfaction of the Contracting Officer. The Contracting Officer may require the removal and replacement of the entire slab or a portion of the slab damaged by radial or transverse cracks, at no cost to the Government. Replace the pavement in accordance with Section 32 13 11 CONCRETE PAVEMENT FOR AIRFIELDS AND OTHER HEAVY-DUTY PAVEMENTS MORE THAN 10,000 CUBIC YARDS.

3.9 PRODUCTION SAMPLING AND TESTING

3.9.1 Aggregates

During slabjacking operations, sample aggregates as delivered to the mixer, to determine compliance with specifications. Test aggregate gradation daily.

3.9.2 Field Test Specimens

Take samples of grout in the field from mixtures used for jacking to determine the adequacy of control of materials and the proportioning, consistency, and mixing of the grout. Take three sets of three cylinders from each day's operation, or when the mixture proportions are changed. Make and cure the test cylinders in accordance with [ASTM C 31/C 31M](#), and test them, as specified, for strength. At the start of jacking operations and when the aggregate source, aggregate characteristics, or mix design is changed, additional sets of test cylinders will be required until the Contracting Officer is satisfied that the grout mixture being used complies with the strength requirements specified. Curing and testing of the compressive strength specimens shall be by the Contractor or an approved commercial testing laboratory at no expense to the Government. The test result will be the average of the strength of the 3 cylinders. If the average strength of cylinders falls below the specified strength, the Contracting Officer may require changes in the mix proportions.

3.10 PROTECTION OF PAVEMENT

Do not permit traffic on the pavement slab until the grout has obtained a minimum set. The minimum set time shall be included in the mixture proportion approval, and shall be adjusted daily to account for variations in temperature.

3.11 ACCEPTANCE OF WORK

Prior to acceptance, remove loose concrete, joint filler, or grout spilled on the surface or shoulder. Remove waste construction material and leave the surrounding areas in a neat, orderly condition by the Contractor prior to opening to traffic or final acceptance.

-- End of Section --