
USACE / NAVFAC / AFCEA / NASA UFGS-32 01 29.62 (April 2006)

Preparing Activity: USACE Replacing without change
UFGS-02985 (September 2004)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 18 July 2006

Latest change indicated by CHG tags

SECTION TABLE OF CONTENTS

DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 32 01 29.62

SLABJACKING RIGID PAVEMENTS

04/06

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 EQUIPMENT
 - 1.3.1 General Requirements
 - 1.3.2 Grout Plant
 - 1.3.3 Water Tanker
 - 1.3.4 Drilling
 - 1.3.5 Flow Cone
 - 1.3.6 Miscellaneous
- 1.4 SAMPLING AND TESTING
 - 1.4.1 Testing Facilities
 - 1.4.2 Cement
 - 1.4.3 Aggregate
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - 1.5.1 Provisions for Cement
 - 1.5.2 Provisions for Aggregates
- 1.6 WEATHER LIMITATIONS
- 1.7 BENCH MARKS
- 1.8 MEASUREMENT
 - 1.8.1 Quantity of Portland Cement Grout
 - 1.8.2 Quantity of Portland Cement
 - 1.8.3 Number of Holes
 - 1.8.4 Broken Slabs
- 1.9 PAYMENT
 - 1.9.1 Portland Cement Unit Price
 - 1.9.2 Drilled Holes

PART 2 PRODUCTS

- 2.1 GROUT MIXTURE
- 2.2 MINERAL AGGREGATE
 - 2.2.1 Particle Shape

- 2.2.2 Grading
- 2.2.3 Deleterious Materials
- 2.3 POZZOLANS AND FLY ASH
- 2.4 PORTLAND CEMENT
- 2.5 WATER
- 2.6 CHEMICAL ADMIXTURES
- 2.7 PROPORTIONING OF MATERIALS
- 2.8 TESTS, INSPECTIONS, AND VERIFICATIONS
 - 2.8.1 Daily Report
 - 2.8.2 Compressive Strength
 - 2.8.3 Expansion
 - 2.8.4 Set Time
 - 2.8.5 Fluidity

PART 3 EXECUTION

- 3.1 PAVEMENT INSPECTION
- 3.2 DRILLING HOLES FOR GROUT INJECTION
- 3.3 WASH HOLES
- 3.4 JACKING
- 3.5 RAISING OF SLABS
- 3.6 SEALING OF INJECTION HOLES
- 3.7 PLAN GRADE REQUIREMENTS
- 3.8 REPLACING AND REPAIR OF DAMAGED PAVEMENT
- 3.9 PRODUCTION SAMPLING AND TESTING
 - 3.9.1 Aggregates
 - 3.9.2 Field Test Specimens
- 3.10 PROTECTION OF PAVEMENT
- 3.11 ACCEPTANCE OF WORK

-- End of Section Table of Contents --

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SECTION 32 01 29.62

SLABJACKING RIGID PAVEMENTS 04/06

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

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).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

PART 1 GENERAL

1.1 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	(2005) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 142	(1997; R 2004) Clay Lumps and Friable Particles in Aggregates
ASTM C 150	(2005) Portland Cement
ASTM C 266	(2004) Time of Setting of Hydraulic-Cement Paste by Gillmore Needles
ASTM C 31/C 31M	(2003a) Making and Curing Concrete Test Specimens in the Field
ASTM C 39/C 39M	(2005) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 494/C 494M	(2005a) Chemical Admixtures for Concrete
ASTM C 618	(2005) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture 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	(1987; R 1997) 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
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1.2 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.] The following shall be submitted 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. Each report shall be properly identified by contract number, location, quantity of material placed, and timed events of milestones. Test methods used and compliance with specified standards shall be described.

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 and shall identify quantity and date of shipment or delivery to which the certificates apply.

1.3 EQUIPMENT

1.3.1 General Requirements

The Contractor shall 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.

The grout plant shall consist 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. The colloidal grout shall be produced by mixing in a colloidal mill connected to the cone-shaped bottom of a cylindrical drum. The colloidal mill shall operate between 800 and 2,000 RPM, creating a high shearing action and subsequent pressure release to make a homogeneous mixture. The injection system shall be capable of continuously pumping grout at rates as low as 5.68 liters 1-1/2 gallons per minute and shall be 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, a water truck equipped with a metered pump for delivery to the grout plant shall be supplied.

1.3.4 Drilling

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

1.3.5 Flow Cone

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

1.3.6 Miscellaneous

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 shall be provided by the Contractor.

1.4 SAMPLING AND TESTING

1.4.1 Testing Facilities

Tests shall be performed by an approved commercial testing laboratory or may be performed 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.

1.4.2 Cement

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

1.4.3 Aggregate

Suitable size aggregate samples representative of the materials to be used in the work shall be taken, under the supervision of the Contracting Officer, in accordance with COE CRD-C 100. Samples shall be taken sufficiently in advance, so that required testing can be completed prior to starting grouting operations. Contractor testing shall be conducted in testing lab approved by the Contracting Officer.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Provisions for Cement

Cement may be furnished in bulk or in suitable bags used for packaging cement. The bags shall be plainly marked with the manufacturer's name, brand, and lot number. Cement shall be dry and free from lumps and caking when delivered. Shipments of bagged cement shall be checked for weight when delivered. The Contractor shall 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. Bulk cement, if used, shall be delivered in weathertight carriers and unloaded 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. Different brands of cement shall be stored and used separately so that a complete record will be available of the grade of cement used in all batches of grout mixes.

1.5.2 Provisions for Aggregates

Aggregates shall be handled and stored at the site so that segregation, intermixing between stockpiles, or contamination by foreign materials does not occur. Sites for stockpiles shall be prepared and maintained to prevent the inclusion of foreign materials with the aggregate. Aggregate shall not be segregated. When segregation is apparent, the aggregate shall be discarded.

1.6 WEATHER LIMITATIONS

Pavement slabjacking shall not be performed 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.

1.7 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].

1.8 MEASUREMENT

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

The dry materials shall be accurately measured by weight or volume if delivered in bulk or shall be packaged in uniform volume sacks. The water shall be batched through a meter or scale with a totalizer for the day's consumption. These measurements shall be made under the supervision of the Contracting Officer or his representative. Weigh bills for cement and sand shall be submitted after slabjacking operations are completed, to validate mix proportions used.

1.8.1 Quantity of Portland Cement Grout

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

1.8.2 Quantity of Portland Cement

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

1.8.3 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.

1.8.4 Broken Slabs

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

1.9 PAYMENT

1.9.1 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.

1.9.2 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.

PART 2 PRODUCTS

2.1 GROUT MIXTURE

Portland cement grout mixture used for slabjacking shall consist 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, the different components shall be batched 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

Pozzolans and fly ash shall meet the requirements of [ASTM C 618](#).

2.4 PORTLAND CEMENT

Portland cement shall be Type [_____] meeting the requirements of [ASTM C 150](#). Cement salvaged by cleaning bags mechanically or otherwise, or from discarded bags of cement, shall not be used. Cement that has been stored at the site for 60 days or more shall be used 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

Water for mixing of grout shall be 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. If, in the opinion of the Contracting Officer, the water is of questionable quality, it shall be tested in accordance with COE CRD-C 400. Test shall be at the expense of the Contractor.

2.6 CHEMICAL ADMIXTURES

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

2.7 PROPORTIONING OF MATERIALS

The grout mixture to be used for slabjacking shall be proportioned 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

The Contractor shall provide daily mixture test results of the materials and additives used in the mixture. Test results of the grout shall include aggregate gradation, the flow cone times, shrinkage and expansion observed, and the time of initial set. One day, 3 day, and 7 day strengths of previous day's placements shall be included on the daily reports.

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

The expansion shall be determined as per ASTM C 940 at the beginning of the job and whenever the mix proportions are changed.

2.8.4 Set Time

The time of initial set shall be determined as per 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

The fluidity of each batch of grout slurry shall be tested per 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, the slabs shall be closely examined for any existing cracks. This investigation shall be performed by the Contractor and 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

Grout injection holes shall be drilled in a pattern as shown on the plans. 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. Holes shall be drilled so that breakout shall 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 the Contractor shall erect string lines that will be blocked up from the pavement high points to monitor movement. An expanding rubber packer or other approved device providing a positive seal and connected to the discharge hose on the grout plant shall be lowered into the holes. The discharge end of the packer or hose shall not extend below the lower surface of the concrete pavement. The Contractor shall 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

The slabs shall not be raised 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. The entire slab and all adjacent slabs shall be kept on the same plane at all times, within the 5 mm 1/4 inch tolerance. The Contractor shall make observations to assure that when pumping from one hole, the grout flows to adjacent

holes to ensure that all voids are filled. 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, the slabs shall be sufficiently moistened to prevent expansion of the slabs.

3.6 SEALING OF INJECTION HOLES

After jacking has been completed at any one hole, the packer shall be removed and the hole temporarily plugged immediately 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. Each hole shall be permanently sealed 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, the Contractor shall 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, the Contractor shall 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

The Contractor shall 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. Replacement of the pavement shall be 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, aggregates shall be sampled as delivered to the mixer, to determine compliance with specifications. Aggregate gradation shall be tested daily.

3.9.2 Field Test Specimens

Samples of grout shall be taken 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. Three sets of three cylinders shall be taken from each day's operation, or when the mixture proportions are changed. The test cylinders shall be made and cured in accordance with ASTM C 31/C 31M, and tested, 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

The Contractor shall 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, the Contractor shall remove loose concrete, joint filler, or grout spilled on the surface or shoulder. Waste construction material shall be removed and the surrounding areas shall be left in a neat, orderly condition by the Contractor prior to opening to traffic or final acceptance.

-- End of Section --