
USACE / NAVFAC / AFCEC / NASA UFGS-32 16 13 (April 2008)
Change 2 - 08/17

Preparing Activity: USACE Superseding
UFGS-32 16 13 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2017

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SECTION 32 16 13

CONCRETE SIDEWALKS AND CURBS AND GUTTERS
04/08

NOTE: This guide specification covers the requirements for concrete sidewalks and curbs and gutters.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

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

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

PART 1 GENERAL

NOTE: This specification may be adjusted to cover separate curbs and gutters or combination curbs and gutters. This guide specification will not be used for integral or monolithic curbs of concrete pavement or for curbs and gutters for bridges.

1.1 MEASUREMENT FOR PAYMENT

NOTE: The MEASUREMENT FOR PAYMENT and BASIS FOR PAYMENT paragraphs will be deleted if the work covered by this section of the specifications is included in one lump sum Contract price for the

entire work covered by the invitation for bids.

1.1.1 Sidewalks

The quantities of sidewalks to be paid for will be the number of square meters yards of each depth of sidewalk constructed as indicated.

1.1.2 Curbs and Gutters

The quantities of curbs and gutters to be paid for will be the number of linear metersfeet of each cross section constructed as indicated, measured along the face of the curb at the gutter line.

1.2 BASIS FOR PAYMENT

1.2.1 Sidewalks

Payment of the quantities of sidewalks measured as specified will be at the Contract unit price per square meter yard of the thickness specified.

1.2.2 Curbs and Gutters

Payment of the quantities of curbs and gutters measured as specified will be at the Contract unit price per linear meter foot of each cross section.

1.3 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 Reference Identifier (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.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 182

(2005; R 2017) Standard Specification for
Burlap Cloth Made from Jute or Kenaf and
Cotton Mats

ASTM INTERNATIONAL (ASTM)

ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A615/A615M	(2016) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C143/C143M	(2015) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C171	(2016) Standard Specification for Sheet Materials for Curing Concrete
ASTM C172/C172M	(2014a) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C31/C31M	(2017) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C920	(2014a) Standard Specification for Elastomeric Joint Sealants
ASTM D1751	(2004; E 2013; R 2013) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2004a; R 2013) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D5893/D5893M	(2016) Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1 COMM	(2017) Standard And Commentary Accessible and Usable Buildings and Facilities
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1.4 SYSTEM DESCRIPTION

1.4.1 General Requirements

Provide plant, equipment, machines, and tools used in the work subject to approval and maintained in a satisfactory working condition at all times. The equipment must have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment must be discontinued if it produces unsatisfactory results. The Contracting Officer must have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.4.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial use on the job and must be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in 1 pass.

1.5 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.

The Guide Specification technical editors have designated those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, 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.

Use the "S" classification only in SD-11 Closeout Submittals. The "S" following a submittal item indicates that the submittal is required for the Sustainability eNotebook to fulfill federally mandated sustainable requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.

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.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Concrete

[Biodegradable Form Release Agent]

SD-06 Test Reports

Field Quality Control

1.6 ENVIRONMENTAL REQUIREMENTS

1.6.1 Placing During Cold Weather

Do not place concrete when the air temperature reaches 5 degrees C 40 degrees F and is falling, or is already below that point. Placement may begin when the air temperature reaches 2 degrees C 35 degrees F and is rising, or is already above 5 degrees C 40 degrees F. Make provisions to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 2 degrees C 35 degrees F, placement and protection must be approved in writing. Approval will be contingent upon full conformance with the following provisions. The underlying material must be prepared and protected so that it is entirely free of frost when the concrete is deposited. [Mixing water and aggregates] [Mixing water] [Aggregates] must be heated as necessary to result in the temperature of the in-place concrete being between 10 and 30 degrees C 50 and 85 degrees F. Methods and equipment for heating must be approved. The aggregates must be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means must be provided for maintaining the concrete at a temperature of at least 10 degrees C 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.6.2 Placing During Warm Weather

The temperature of the concrete as placed must not exceed 30 degrees C 85 degrees F except where an approved retarder is used. The mixing water and aggregates must be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature must not exceed 35 degrees C 95 degrees F at any time.

PART 2 PRODUCTS

2.1 CONCRETE

Provide concrete conforming to the applicable requirements of [Section 03 30 00.00 10 CAST-IN-PLACE CONCRETE] [Section 32 13 14.13 CONCRETE PAVING

FOR AIRFIELDS AND OTHER HEAVY DUTY PAVEMENTS] except as otherwise specified. Concrete must have a minimum compressive strength of 24 MPa 3500 psi at 28 days. Size of aggregate must not exceed 37.5 mm 1-1/2 inches. Submit copies of certified delivery tickets for all concrete used in the construction.

2.1.1 Air Content

NOTE: The air content specified is for concrete that will be subjected to freezing weather and the possible action of deicing chemicals. In climates where freezing is not a factor but where air entrainment is used in local commercial practice to improve the workability and placeability of concrete, concrete having air content percent of 4.5 plus or minus 1.5 percent may be specified as Contractor's option to non air-entrained concrete.

Mixtures must have air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

NOTE: The desired slump will be inserted. Suggested limits are 75 mm 3 inches plus or minus 25 mm 1 inch for hand placed concrete or 25 mm 1 inch plus or minus 10 mm 1/2 inch for slipformed concrete.

The concrete slump must be 50 mm plus or minus 25 mm 2 inches plus or minus 1 inch where determined in accordance with ASTM C143/C143M.

2.1.3 Reinforcement Steel

NOTE: Reinforcement steel normally will not be required for curb and gutter construction. Where conditions exist that make it advantageous to use reinforcement steel, include the reinforcing steel details in the drawings, and include the following paragraphs in the Contract specification.

Reinforcement bars must conform to ASTM A615/A615M. Wire mesh reinforcement must conform to ASTM A1064/A1064M.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Impervious sheet materials must conform to ASTM C171, type optional, except that polyethylene film, if used, must be white opaque.

2.2.2 Burlap

Burlap must conform to AASHTO M 182.

2.2.3 White Pigmented Membrane-Forming Curing Compound

White pigmented membrane-forming curing compound must conform to ASTM C309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Concrete protection materials must be a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the Contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter must consist of hard-pressed fiberboard.

2.4.2 Expansion Joint Filler, Premolded

NOTE: Either type of joint sealer may be specified if determined necessary by the Contracting Officer and the inapplicable publication removed. Joint sealing material may be omitted where sealing of expansion joints is not deemed essential or advisable.

Expansion joint filler, premolded, must conform to ASTM D1751 or ASTM D1752, 13 mm 1/2 inch thick, unless otherwise indicated.

2.5 JOINT SEALANTS

Joint sealant, cold-applied must conform to ASTM C920 or ASTM D5893/D5893M.

2.6 FORM WORK

Design and construct form work to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms must be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms must be surfaced plank, 50 mm 2 inches nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms must have a nominal length of 3 m 10 feet. Radius bends may be formed with 19 mm 3/4 inch boards, laminated to the required thickness. Steel forms must be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms must be interlocking and self-aligning. Steel forms must include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms must have a nominal length of 3 m 10 feet with a minimum of 3 welded stake pockets per form. Stake pins must be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.1 Sidewalk Forms

Sidewalk forms must be of a height equal to the full depth of the finished sidewalk.

2.6.2 Curb and Gutter Forms

Curb and gutter outside forms must have a height equal to the full depth of the curb or gutter. The inside form of curb must have batter as indicated and must be securely fastened to and supported by the outside form. Rigid forms must be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 3 m 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 38 mm 1-1/2 inch benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

NOTE: Concrete release fluids are recognized as a biobased material. Use materials with biobased content where suitable for application and cost effective. Verify suitability, availability within the region, cost effectiveness, and adequate competition before specifying product biobased content requirements. A resource that can be used to identify products with bio-based content is the "Catalog" tab within the USDA's "Biopreferred" website at <https://www.biopreferred.gov/BioPreferred/>. Other products with biobased content are also acceptable when meeting all requirements of this specification.

[2.6.3 Biodegradable Form Release Agent

Provide form release agent that is colorless and biodegradable. A minimum of 87 percent of the total product must be biobased material. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces. Provide form release agent that does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene.

]2.7 Detectable Warning System

Detectable Warning Systems shown on the Contract plans are to meet requirements of ICC A117.1 COMM - Section 705.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

NOTE: On most projects, major grading operations involving excavation and construction of embankments will be performed and paid for under other sections of the specifications and, therefore, are not included in this guide specification. Where such

work, including the construction of any required subbase, must be done under this section, paragraphs FORM SETTING, SIDEWALK CONCRETE PLACEMENT AND FINISHING, and CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING will be revised to cover necessary additional requirements. The subgrade will be indicated as extending at least 600 mm 2 feet in width back of curb, gutter, entrance, and combination curb and gutters.

The subgrade must be constructed to the specified grade and cross section prior to concrete placement. Subgrade must be placed and compacted [as directed] [in conformance with Section [____]].

3.1.1 Sidewalk Subgrade

The subgrade must be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Curb and Gutter Subgrade

The subgrade must be tested for grade and cross section by means of a template extending the full width of the curb and gutter. The subgrade must be of materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

The subgrade must be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade must be in a moist condition when concrete is placed. The subgrade must be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

Set forms to the indicated alignment, grade and dimensions. Hold forms rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 1.2 m 4 feet. Corners, deep sections, and radius bends must have additional stakes and braces, as required. Clamps, spreaders, and braces must be used where required to ensure rigidity in the forms. Forms must be removed without injuring the concrete. Bars or heavy tools must not be used against the concrete in removing the forms. Concrete found defective after form removal must be promptly and satisfactorily repaired. Forms must be cleaned and coated with form oil or biodegradable form release agent each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Set forms for sidewalks with the upper edge true to line and grade with an allowable tolerance of 3 mm 1/8 inch in any 3 m 10 foot long section. After forms are set, grade and alignment must be checked with a 3 m 10 foot straightedge. Forms must have a transverse slope [as indicated] [of 20 mm per meter 1/4 inch per foot] with the low side adjacent to the roadway. Side forms must not be removed for 12 hours after finishing has been completed.

3.2.2 Curbs and Gutters

The forms of the front of the curb must be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb must remain in place until the face and top of the curb have been finished, as specified for concrete finishing. Gutter forms must not be removed while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Place concrete in the forms in one layer. When consolidated and finished, the sidewalks must be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms must be used to bring the surface to proper section to be compacted. The concrete must be consolidated by tamping and spading or with an approved vibrator, and the surface must be finished to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, finish the surface with a wood or magnesium float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface must be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, must be finished with an edger having a radius of 3 mm 1/8 inch. Transverse joint must be edged before brooming, and the brooming must eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing must be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.3.4 Surface and Thickness Tolerances

Finished surfaces must not vary more than 8 mm 5/16 inch from the testing edge of a 3 m 10-foot straightedge. Permissible deficiency in section thickness will be up to 6 mm 1/4 inch.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Concrete must be placed to the section required in a single lift. Consolidation must be achieved by using approved mechanical vibrators. Curve shaped gutters must be finished with a standard curb "mule".

3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.4.3 Concrete Finishing

Exposed surfaces must be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces must then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb must be rounded with an edging tool to a radius of 13 mm 1/2 inch. Immediately after removing the front curb form, the face of the curb must be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, must be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance must be finished to grade with a wood float.

3.4.4 Joint Finishing

Curb edges at formed joints must be finished as indicated.

3.4.5 Surface and Thickness Tolerances

Finished surfaces must not vary more than 6 mm 1/4 inch from the testing edge of a 3 m 10-foot straightedge. Permissible deficiency in section thickness will be up to 6 mm 1/4 inch.

3.5 SIDEWALK JOINTS

Sidewalk joints must be constructed to divide the surface into rectangular areas. Transverse contraction joints must be spaced at a distance equal to the sidewalk width or 1.5 m 5 feet on centers, whichever is less, and must be continuous across the slab. Longitudinal contraction joints must be constructed along the centerline of all sidewalks 3 m 10 feet or more in width. Transverse expansion joints must be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints must be installed as indicated. Expansion joints must be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. Expansion joints are not required between sidewalks and curb that abut the sidewalk longitudinally.

3.5.1 Sidewalk Contraction Joints

The contraction joints must be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints must be constructed by sawing a groove in the concrete with a 3 mm 1/8 inch blade to the depth indicated. An ample supply of saw blades must be available on the job before concrete placement is started, and at least one standby sawing unit in good working order must be available at the jobsite at all times during the sawing operations.

3.5.2 Sidewalk Expansion Joints

**NOTE: For projects which do not reference Section
32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS
IN RIGID PAVEMENTS, the last paragraph will replace
the reference to Section 32 01 19.**

Expansion joints must be formed with 13 mm 1/2 inch joint filler strips. Joint filler in expansion joints surrounding structures and features within the sidewalk may consist of preformed filler material conforming to ASTM D1752 or building paper. Joint filler must be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges must be rounded with an edging tool having a radius of 3 mm 1/8 inch, and concrete over the joint filler must be removed. At the end of the curing period, expansion joints must be cleaned and filled with cold-applied joint sealant. Joint sealant must be gray or stone in color. [Joints must be sealed as specified in Section 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS.] [The joint opening must be thoroughly cleaned before the sealing material is placed. Sealing material must not be spilled on exposed surfaces of the concrete. Concrete at the joint must be surface dry and atmospheric and concrete temperatures must be above 10 degrees C 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete must be removed immediately and concrete surfaces cleaned.]

3.5.3 Reinforcement Steel Placement

NOTE: Reinforcement steel normally will not be required for curb and gutter construction. Where conditions exist that make it advantageous to use reinforcement steel, the reinforcing steel details will be indicated, and the following paragraphs will be included in the Contract specification.

Reinforcement steel must be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

3.6 CURB AND GUTTER JOINTS

Curb and gutter joints must be constructed at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Contraction joints must be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 1.5 m 5 feet nor greater than 4.5 m 15 feet in length.

- a. Contraction joints (except for slip forming) must be constructed by means of 3 mm 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators must be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.
- b. When slip forming is used, the contraction joints must be cut in the top portion of the gutter/curb hardened concrete in a continuous cut across the curb and gutter, using a power-driven saw. The depth of cut must be at least one-fourth of the gutter/curb depth and 3 mm 1/8 inch in width.

3.6.2 Expansion Joints

**NOTE: For projects which do not reference Section
32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN
RIGID PAVEMENTS, the last paragraph will replace the
reference to Section 32 01 19.**

Expansion joints must be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints must be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and must be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 13 mm 1/2 inch in width must be provided at intervals not less than 10 meters 30 feet nor greater than 36 meters 120 feet. Expansion joints must be provided in nonreinforced concrete gutter at locations indicated. Expansion joints must be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. [Joints must be sealed as specified in Section 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS.] [Expansion joints and the top 25 mm 1 inch depth of curb and gutter contraction-joints must be sealed with joint sealant. The joint opening must be thoroughly cleaned before the sealing material is placed. Sealing material must not be spilled on exposed surfaces of the concrete. Concrete at the joint must be surface dry and atmospheric and concrete temperatures must be above 10 degrees C 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete must be removed immediately and concrete surfaces cleaned.]

3.7 CURING AND PROTECTION

**NOTE: Only the methods of curing appropriate to
local weather conditions and construction practices
will be retained, but Contractor's option of at
least 2 curing methods will be retained to promote
competition in bidding.**

3.7.1 General Requirements

Protect concrete against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete must be on hand and ready for use before actual concrete placement begins. Protection must be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.7.1.1 Mat Method

The entire exposed surface must be covered with 2 or more layers of burlap. Mats must overlap each other at least 150 mm 6 inches. The mat must be thoroughly wetted with water prior to placing on concrete surface and must be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.7.1.2 Impervious Sheeting Method

The entire exposed surface must be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets must be laid directly on the concrete surface with the light-colored side up and overlapped 300 mm 12 inches when a continuous sheet is not used. The curing medium must not be less than 450 mm 18-inches wider than the concrete surface to be cured, and must be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets must be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium must remain on the concrete surface to be cured for not less than 7 days.

3.7.1.3 Membrane Curing Method

A uniform coating of white-pigmented membrane-curing compound must be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces must be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Concrete must not be allowed to dry before the application of the membrane. If drying has occurred, the surface of the concrete must be moistened with a fine spray of water and the curing compound applied as soon as the free water disappears. Curing compound must be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 5 square meters/L 200 square feet/gallon for the total of both coats. The second coat must be applied in a direction approximately at right angles to the direction of application of the first coat. The compound must form a uniform, continuous, coherent film that will not check, crack, or peel and must be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, an additional coat must be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied must be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period must be resprayed. Necessary precautions must be taken to ensure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. The top of the joint opening and the joint groove at exposed edges must be tightly sealed before the concrete in the region of the joint is resprayed with curing compound. The method used for sealing the joint groove must prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement must be provided at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Concrete surfaces to which membrane-curing compounds have been applied must be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from other possible damage to the continuity of the membrane.

3.7.2 Backfilling

After curing, debris must be removed and the area adjoining the concrete must be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Completed concrete must be protected from damage until accepted. Repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged must be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions must be disposed of as directed.

3.7.4 Protective Coating

NOTE: Concrete may require protection against the action of urea, sodium chloride, and calcium chloride used for de-icing purposes. Protection against these chemicals is not required for concrete of the specified air content that will be in place for a cumulative time of 6 weeks at a continuous minimum temperature of 5 degrees C 40 degrees F, excluding the curing time. Concrete which is to receive protective coating should be moist cured to eliminate the need for removing a curing membrane prior to application of the protective coating. ACI Committee Report 515 provides a detailed discussion of protective coating for concrete. The following paragraphs will be inserted if protective coating is required.

Protective coating, of linseed oil mixture, must be applied to the exposed-to-view concrete surface after the curing period, if concrete will be exposed to de-icing chemicals within 6 weeks after placement. Concrete to receive a protective coating must be moist cured.

3.7.4.1 Application

Curing and backfilling operation must be completed prior to applying two coats of protective coating. Concrete must be surface dry and clean before each application. Coverage must be by spray application at not more than 11 square meters/L 50 square yards/gallon for first application and not more than 15.5 square meters/L 70 square yards/gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture must be in accordance with the manufacturer's instructions. Coated surfaces must be protected from vehicular and pedestrian traffic until dry.

3.7.4.2 Precautions

Protective coating must not be heated by direct application of flame or electrical heaters and must be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material must not be applied at ambient or material temperatures lower than 10 degrees C 50 degrees F.

3.8 FIELD QUALITY CONTROL

Submit copies of all test reports within 24 hours of completion of the test.

3.8.1 General Requirements

Perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, take the action and submit reports as required below, and additional tests to ensure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

Provide molded concrete specimens for strength tests. Samples of concrete placed each day must be taken not less than once a day nor less than once for every 190 cubic meters 250 cubic yards of concrete. The samples for strength tests must be taken in accordance with ASTM C172/C172M. Cylinders for acceptance must be molded in conformance with ASTM C31/C31M by an approved testing laboratory. Each strength test result must be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 4 MPa 500 psi.

3.8.2.2 Air Content

Determine air content in accordance with ASTM C173/C173M or ASTM C231/C231M. ASTM C231/C231M must be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content must be made on randomly selected batches of each class of concrete placed during each shift. Additional tests must be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. If results are out of tolerance, the placing foreman must be notified and he must take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Two slump tests must be made on randomly selected batches of each class of concrete for every 190 cubic meters 250 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests must be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.8.3 Thickness Evaluation

The anticipated thickness of the concrete must be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, the subgrade must be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

The finished surface of each category of the completed work must be uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 6 mm 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas must be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete must not exceed 5 percent of the area of any integral slab, and the depth of grinding must not exceed 6 mm 1/4 inch. Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above must be removed and replaced.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Contracting Officer and deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work must be removed and replaced.

3.10 Detectable Warning System

Install Detectable Warning Systems required by Contract plans in accordance with ICC A117.1 COMM, Section 705, and by manufacturers' installation instructions.

-- End of Section --