
USACE / NAVFAC / AFCEA / NASA UFGS-03 20 00.00 10 (August 2010)

Preparing Activity: USACE Superseding
 UFGS-03 20 01.00 10 (October 2007)
 UFGS-03 20 02 (November 2009)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2011

SECTION TABLE OF CONTENTS

DIVISION 03 - CONCRETE

SECTION 03 20 00.00 10

CONCRETE REINFORCING

08/10

PART 1 GENERAL

1.1 UNIT PRICES

1.1.1 Deformed Steel Bars

1.1.1.1 Payment

1.1.1.2 Measurement

1.1.1.3 Unit of Measure

1.1.2 Fabricated Deformed Steel Bar Mats

1.1.2.1 Payment

1.1.2.2 Measurement

1.1.2.3 Unit of Measure

1.1.3 Butt-Splices in Deformed Steel Bars

1.1.3.1 Payment

1.1.3.2 Measurement

1.1.3.3 Unit of Measure

1.1.4 Steel Welded Wire Fabric

1.1.4.1 Payment

1.1.4.2 Measurement

1.1.4.3 Unit of Measure

1.1.5 Resplicing Bars

1.1.5.1 Payment

1.1.5.2 Measurement

1.1.5.3 Unit of Measure

1.1.6 Accessories

1.2 REFERENCES

1.3 SUBMITTALS

1.4 QUALITY ASSURANCE

1.4.1 Welding Qualifications

1.4.2 Qualification of Steel Bar Butt-Splicers

1.4.3 Qualification of Butt-Splicing Procedure

1.5 DELIVERY, STORAGE, AND HANDLING

PART 2 PRODUCTS

2.1 DOWELS

2.2	FABRICATED BAR MATS	
2.3	REINFORCING STEEL	
2.3.1	Zinc-Coated (Galvanized) Bars	
2.3.2	Epoxy-Coated Bars	
2.4	WELDED WIRE FABRIC	
2.5	WIRE TIES	
2.6	SUPPORTS	
2.7	SYNTHETIC FIBER REINFORCEMENT	
2.8	TESTS, INSPECTIONS, AND VERIFICATIONS	
2.8.1	Reinforcement Steel Tests	
2.8.2	Radiographic Examination of Welds	
PART 3 EXECUTION		
3.1	REINFORCEMENT	
3.1.1	Placement	
3.1.2	Splicing	
3.1.3	Placing Tolerances	
3.1.3.1	Spacing	
3.1.3.2	Concrete Cover	
3.1.4	Splicing	
3.1.4.1	Lap Splices	
3.1.4.2	Butt-Splices	
3.2	WELDED-WIRE FABRIC PLACEMENT	
3.3	DOWEL INSTALLATION	
3.4	SYNTHETIC FIBER REINFORCED CONCRETE	
3.5	SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS	
3.6	FIELD TESTS AND INSPECTIONS	
3.6.1	Identification of Splices	
3.6.2	Examining, Testing, and Correcting	
-- End of Section Table of Contents --		

USACE / NAVFAC / AFCEA / NASA UFGS-03 20 00.00 10 (August 2010)

Preparing Activity: USACE Superseding
 UFGS-03 20 01.00 10 (October 2007)
 UFGS-03 20 02 (November 2009)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2011

SECTION 03 20 00.00 10

CONCRETE REINFORCING 08/10

NOTE: This specification covers the requirements for concrete reinforcement, including welded wire fabric and fibrous reinforcing.

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 items(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: Use this Section in conjunction with Section
03 30 00.00 10 CAST-IN-PLACE CONCRETE

1.1 UNIT PRICES

NOTE: If Section 01 22 00.00 10 MEASUREMENT AND PAYMENT is included in the project specifications, this paragraph title (UNIT PRICES) should be deleted from this section and the remaining appropriately edited subparagraphs below should be inserted into Section 01 22 00.00 10.

1.1.1 Deformed Steel Bars

1.1.1.1 Payment

Payment will be made for costs associated with furnishing and placing deformed steel bars for concrete reinforcement. Payment for steel in laps will be made as indicated or required. No payment will be made for additional steel in laps wherein the additional steel lap was made for the convenience of the Contractor.

1.1.1.2 Measurement

Deformed Steel Bars for Concrete Reinforcement will be measured for payment based upon the quantity of kilograms pounds in place. The measured lengths will be converted to weights for the size of bars listed by the use of the nominal weights per linear meter foot specified in ASTM A615/A615M.

1.1.1.3 Unit of Measure

Unit of measure: per kilogram pound.

1.1.2 Fabricated Deformed Steel Bar Mats

1.1.2.1 Payment

Payment will be made for costs associated with furnishing and placing fabricated deformed steel bar mats for concrete reinforcement. Payment for steel in laps will be made as indicated or required. No payment will be made for additional steel in laps wherein the additional steel lap was made for the convenience of the Contractor.

1.1.2.2 Measurement

Fabricated Deformed Steel Bar Mats for Concrete Reinforcement will be measured for payment based upon the quantity of kilograms pounds in place. The weights shall be determined by weighing or by manufacturer's or catalog weights when weighing is not practicable.

1.1.2.3 Unit of Measure

Unit of measure: per kilogram pound.

1.1.3 Butt-Splices in Deformed Steel Bars

1.1.3.1 Payment

Payment will be made for costs associated with making butt-splices in deformed steel bars for concrete reinforcement. No separate payment will be made for test splices, tension testing, or radiographic examination of butt-splices since these costs are included in the contract unit price for Butt-Splices in Deformed Steel Bars for Concrete Reinforcement.

1.1.3.2 Measurement

Butt-Splices in Deformed Steel Bars for Concrete Reinforcement will be measured for payment based upon each butt-splice in place.

1.1.3.3 Unit of Measure

Unit of measure: each.

1.1.4 Steel Welded Wire Fabric

1.1.4.1 Payment

Payment will be made for costs associated with furnishing and placing steel welded wire fabric for concrete reinforcement. Payment for steel in laps will be made as indicated or required. No payment will be made for additional steel in laps wherein the additional steel lap was made for the convenience of the Contractor.

1.1.4.2 Measurement

Steel Welded Wire Fabric for Concrete Reinforcement will be measured for payment based upon the quantity of kilograms pounds in place. The weights shall be determined by weighing or by manufacturer's or catalog weights when weighing is not practicable.

1.1.4.3 Unit of Measure

Unit of measure: per kilogram pound.

1.1.5 Resplicing Bars

1.1.5.1 Payment

Payment will be made for costs associated with resplicing bars selected for supplemental examinations and tests for those splices found to be acceptable. No payment will be made for costs associated with resplicing bars selected for supplemental examinations and tests for those splices found to be defective. No payment will be made for costs associated with the supplemental examinations and tests performed by the Government.

1.1.5.2 Measurement

Resplicing Bars, selected for examinations and tests and found to be acceptable, will be measured for payment based upon 150 percent of the applicable contract unit price for pay item Butt-Splices in Deformed Steel Bars for Concrete Reinforcement. Resplicing Bars, selected for examinations and tests and found to be defective, will not be measured for payment.

1.1.5.3 Unit of Measure

Unit of measure: each.

1.1.6 Accessories

No payment will be made for costs associated with furnishing and placing accessories incidental to and included in the payment for other items of work.

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.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

- | | |
|-----------|---|
| ACI 318 | (2011) Building Code Requirements for Structural Concrete and Commentary |
| ACI 318M | (2008; Errata 2011) Building Code Requirements for Structural Concrete & Commentary |
| ACI SP-66 | (2004) ACI Detailing Manual |

AMERICAN WELDING SOCIETY (AWS)

- | | |
|----------------|--|
| AWS D1.4/D1.4M | (2011) Structural Welding Code - Reinforcing Steel |
|----------------|--|

ASTM INTERNATIONAL (ASTM)

- | | |
|-------------------|---|
| ASTM A1035/A1035M | (2009) Standard Specification for Deformed and Plain, Low-carbon, Chromium, Steel Bars for Concrete Reinforcement |
| ASTM A184/A184M | (2006e1) Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement |
| ASTM A185/A185M | (2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete |
| ASTM A370 | (2011) Standard Test Methods and Definitions for Mechanical Testing of Steel Products |
| ASTM A496/A496M | (2007) Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement |

ASTM A497/A497M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
ASTM A53/A53M	(2010) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A615/A615M	(2009b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A675/A675M	(2003; R 2009) Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A706/A706M	(2009b) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A767/A767M	(2009) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A775/A775M	(2007b) Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A82/A82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A884/A884M	(2006) Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM A934/A934M	(2007) Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM C1116/C1116M	(2010a) Standard Specification for Fiber-Reinforced Concrete
ASTM E 94	(2004; R 2010) Radiographic Examination
CONCRETE REINFORCING STEEL INSTITUTE (CRSI)	
CRSI 10MSP	(2009; 28th Ed) Manual of Standard Practice
U.S. DEPARTMENT OF DEFENSE (DOD)	
UFC 3-310-04	(2007; Change 1) Seismic Design for Buildings

1.3 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-02 Shop Drawings

Reinforcement[; G][; G, [_____]]

SD-03 Product Data

Welding
Butt-Splices[; G][; G, [_____]]
Material[; G][; G, [_____]]

[SD-04 Samples

Epoxy-Coated Bars

]

SD-06 Test Reports

Material[; G][; G, [_____]]
Tests, Inspections, and Verifications[; G][; G, [_____]]

SD-07 Certificates

Reinforcing Steel

Qualification of Steel Bar Butt-Splicers

1.4 QUALITY ASSURANCE

NOTE: Delete this paragraph and submittal requirement under SD-03 when welding is not permitted. Welding will not be specified in blast-resistant structures.

1.4.1 Welding Qualifications

Welders shall be qualified in accordance with AWS D1.4/D1.4M. Qualification test shall be performed at the worksite and notify the Contracting Officer 24 hours prior to conducting tests. Special welding procedures and welders qualified by others may be accepted as permitted by AWS D1.4/D1.4M. Submit a list of qualified welders names.

1.4.2 Qualification of Steel Bar Butt-Splicers

Qualification of steel bar butt-splicers shall be certified to have satisfactorily completed a course of instruction in the proposed method of butt-splicing or have satisfactorily performed such work within the preceding year. Submit certificates on the Qualifications of Steel Bar Butt-Splicers prior to commencing butt-splicing.

1.4.3 Qualification of Butt-Splicing Procedure

As a condition of approval of the butt-splicing procedure, make three test butt-splices of steel bars of each size to be spliced using the proposed butt-splicing method, in the presence of the Contracting Officer. These test butt-splices and unspliced bars of the same size shall be tension tested to destruction with stress-strain curves plotted for each test. Test results shall show that the butt-splices meet the specified strength and deformation requirements in order for the splicing procedure to be approved.

1.5 DELIVERY, STORAGE, AND HANDLING

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

PART 2 PRODUCTS

NOTE: Designer should require materials, products, and innovative construction methods and techniques which are environmentally sensitive, take advantage of recycling and conserve natural resources.

2.1 DOWELS

Dowels shall conform to ASTM A675/A675M, Grade 80[or ASTM A1035/A1035M]. Steel pipe conforming to ASTM A53/A53M, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar.

2.2 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A184/A184M.

2.3 REINFORCING STEEL

NOTE: Grades and sizes of reinforcing steel will be shown on the drawings. Low-alloy steel conforming to ASTM A706/A706M is specified for its special qualities such as bending ability and ease of welding.

Specially coated bars (epoxy and zinc) may be specified for use in a highly corrosive atmosphere where concrete cover is not considered sufficient. ASTM A1035/A1035M may also be considered in highly corrosive environments.

Certified mill reports should be obtained when welding is specified or permitted. On minor projects with no welding, submittal SD-07 may be deleted.

Reinforcing steel shall be deformed bars conforming to ASTM A615/A615M, ASTM A706/A706M, or ASTM A1035/A1035M grades and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A82/A82M. In highly corrosive environments or when directed by the Contracting Officer, reinforcing steel shall conform to ASTM A767/A767M, ASTM A775/A775M, ASTM A1035/A1035M or ASTM A934/A934M as appropriate. [If Grade 300 40 bars are unavailable the Contractor may substitute Grade 350 50 or Grade 400 60 bars of the same size and spacing as indicated for Grade 300 40 bars when authorized.]

Submit certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

[2.3.1 Zinc-Coated (Galvanized) Bars

Zinc-coated (galvanized) bars shall comply with the requirements of ASTM A767/A767M, Class [_____] coating, galvanized after fabrication.

] [2.3.2 Epoxy-Coated Bars

Epoxy-coated steel bars shall comply with the requirements of [ASTM A775/A775M] [ASTM A934/A934M], including written certifications for coating material and coated bars, sample of coating material, and 700 g 1.5 pounds of patching material.

] 2.4 WELDED WIRE FABRIC

Welded wire fabric shall conform to [ASTM A185/A185M] [ASTM A496/A496M] [ASTM A497/A497M]. When directed by the Contracting Officer for special applications, welded wire fabric shall conform to ASTM A884/A884M. For wire with a specified yield strength (fy) exceeding 400 MPa 60,000 psi, fy shall be the stress corresponding to a strain of 0.35 percent.

2.5 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire. [Ties for epoxy-coated bars shall be vinyl-coated or epoxy-coated.] [Ties for zinc-coated bars shall be zinc-coated.]

2.6 SUPPORTS

NOTE: Do not use the first paragraph for Civil
Works projects, use only the second paragraph.

Bar supports for formed surfaces shall be designed and fabricated in accordance with **CRSI 10MSP** and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than **100 by 100 mm 4 inches square** when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within **13 mm 1/2 inch** of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

Bar supports shall comply with the requirements of **ACI SP-66**. Supports for bars in concrete with formed surfaces exposed to view or to be painted shall be plastic-coated wire, stainless steel or precast concrete supports. Precast concrete supports shall be wedged-shaped, not larger than **90 by 90 mm 3-1/2 by 3-1/2 inches**, of thickness equal to that indicated for concrete cover and have an embedded hooked tie-wire for anchorage. Bar supports used in precast concrete with formed surfaces exposed to view shall be the same quality, texture and color as the finish surfaces.

2.7 SYNTHETIC FIBER REINFORCEMENT

Synthetic fiber shall be polypropylene with a denier less than 100 and a nominal fiber length of **50 mm 2 inches**.

2.8 TESTS, INSPECTIONS, AND VERIFICATIONS

Perform **material** tests, specified and required by applicable standards, by an approved laboratory and certified to demonstrate that the materials are in conformance with the specifications. Tests, inspections, and verifications shall be performed and certified at the Contractor's expense. Submit certified tests reports of reinforcement steel showing that the steel complies with the applicable specifications for each steel shipment and identified with specific lots prior to placement. Submit three copies of the heat analyses for each lot of steel furnished certifying that the steel conforms to the heat analyses.

2.8.1 Reinforcement Steel Tests

Mechanical testing of steel shall be in accordance with **ASTM A370** except as otherwise specified or required by the material specifications. Tension

tests shall be performed on full cross-section specimens using a gage length that spans the extremities of specimens with welds or sleeves included. Chemical analyses of steel heats shall show the percentages of carbon, phosphorous, manganese, sulphur and silicon present in the steel.

2.8.2 Radiographic Examination of Welds

Radiographic examination of welds shall be in accordance with ASTM E 94 and shall be performed and evaluated by an approved testing agency adequately equipped to perform such services. Radiographs of welds and evaluations of the radiographs submitted for approval shall become the property of the Government.

PART 3 EXECUTION

3.1 REINFORCEMENT

NOTE: There may be special cases where reinforcing bars, at determined intervals, will be added across expansion, isolation or construction joints to provide continuity of reinforcement in meeting lightning protection criteria. The structural designer should coordinate this requirement with the electrical designer to minimize reinforcement across the joints.

Reinforcement steel and accessories shall be fabricated and placed as specified and shown and approved shop drawings. Fabrication and placement details of steel and accessories not specified or shown shall be in accordance with ACI SP-66 and ACI 318M ACI 318. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. [Zinc-Coated and epoxy-coated bars shall be mill-bent prior to coating. All steel shall be bent cold unless authorized.] Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms. Submit detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318M ACI 318 at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318M ACI 318. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

3.1.2 Splicing

NOTE: Edit this paragraph to remove welding requirements when welding is not permitted. The only type of connection allowed in blast resistant structures is Cadweld or lapping of rebars. Welding of rebars for corrosive applications is not recommended (ASTM A767/A767M, ASTM A775/A775M or ASTM A1035/A1035M).

Splices of reinforcement shall conform to **ACI 318M ACI 318** and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical or welded butt connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Welding shall conform to **AWS D1.4/D1.4M**. Welded butt splices shall be full penetration butt welds. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or **150 mm 6 inches**. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

3.1.3 Placing Tolerances

3.1.3.1 Spacing

The spacing between adjacent bars and the distance between layers of bars may not vary from the indicated position by more than one bar diameter nor more than **25 mm 1 inch**.

3.1.3.2 Concrete Cover

The minimum concrete cover of main reinforcement steel bars shall be as shown. The allowable variation for minimum cover shall be as follows:

MINIMUM COVER (mm/inch)	VARIATION (mm/inch)
150/6	plus 13/2
100/4	plus 10/3/8
75/3	plus 10/3/8
50/2	plus 6/1/4
38/1-1/2	plus 6/1/4
25/1	plus 3/1/8
19/3/4	plus 3/1/8

3.1.4 Splicing

Splices in steel bars shall be made only as required. Bars may be spliced at alternate or additional locations at no additional cost to the Government subject to approval.

3.1.4.1 Lap Splices

Lap splices shall be used only for bars smaller than size 45 14 and welded wire fabric. Lapped bars may be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than 1/5 the required length of lap or 150 mm 6 inches.

3.1.4.2 Butt-Splices

Use butt-splices only for splicing size 45 and 55 14 and 18 bars and for splicing #11 bars to larger bars except where otherwise shown or authorized. Make butt-splices by a method which develops splices suitable for tension, compression and stress reversal applications. Welded butt-splices shall be full penetration butt welds. Butt-splices shall develop 90 percent of the specified minimum ultimate tensile strength of the smallest bar of each splice. Bars shall be cleaned of all oil, grease, dirt, rust, scale and other foreign substances and shall be flame dried before splicing. Adequate jigs and clamps or other devices shall be provided to support, align and hold the longitudinal centerline of the bars to be butt-spliced in a straight line. Submit proposed procedure for butt-splicing steel bars prior to making the test butt-splices for qualification of the procedure. Properties and analyses of steel bars and splicing materials shall be included in the submitted procedure. Physical properties of splicing sleeves shall include length, inside and outside diameters, and inside surface details.. Butt-splices shall be as follows:

a. Thermit Welded Butt Splices - Bars to be thermit welded shall be restricted to steel shown by heat analysis to have a sulfur content not exceeding 0.05 percent. The ends of bars to be thermit welded shall be cut square and smooth. Flame cutting will be permitted provided grinding is employed to remove the resulting scale and to square and smooth the cut ends to a condition equivalent to a saw cut. No shearing will be permitted. Bars shall be cleaned and flame dried before splicing. The joint shall be properly aligned in the mold with a gap opening in accordance with the manufacturer's recommendations. Charging and firing shall conform to the manufacturer's recommendations. The end of bars and the welded mold shall be preheated before welding to a temperature of not less than 40 degrees C 100 degrees F and the mold shall be left in place for at least 15 minutes after ignition. Risers shall be broken or burned off after removing the mold. Tension splices shall be staggered longitudinally a minimum of 1500 mm 5 feet so that no more than half of the bars are spliced at any one section or as otherwise indicated.

b. Mechanical Butt-Splices - Mechanical butt-splices shall be an approved exothermic, threaded coupling, swaged sleeve or other positive connecting type. Bars to be spliced by a mechanical butt-splicing process may be sawed, sheared or flame cut provided the ends of sheared bars are reshaped after shearing and all slag is removed from the ends of flame cut bars by chipping and wire brushing prior to splicing. Surfaces to be enclosed within a splice sleeve or coupling shall be cleaned by wire brushing or other approved method prior to splicing.

Splices shall be made using manufacturer's standard jigs, clamps, ignition devices and other required accessories. In addition to the strength requirements specified paragraph BUTT-SPLICES the additional deformation of number 45 14 and smaller bars due to slippage or other movement within the splice sleeve shall not exceed 0.38 mm (unit strain 0.0015 mm/mm) 0.015 inches (unit strain 0.0015 inches/inch) beyond the elongation of an unspliced bar based upon a 250 mm 10 inch gage length spanning the extremities of the sleeve at a stress of 200 MPa 30,000 psi. The additional deformation of number 55 18 bars shall not exceed 0.75 mm (unit strain 0.003 mm/mm) 0.03 inches (unit strain 0.003 inches/inch) beyond the elongation of an unspliced bar based upon a 250 mm 10 inch gage length spanning the extremities of the sleeve at a stress of 200 MPa 30,000 psi. The amount of the additional deformation shall be determined from the stress-strain curves of the unspliced and spliced bars tested as required paragraph QUALIFICATION OF BUTT-SPLICING PROCEDURE for qualification of the butt-splicing procedure. Tension splices of number 45 14 or smaller bar shall be staggered longitudinally a minimum of 1500 mm 5 feet or as otherwise indicated so that no more than half of the bars are spliced at any one section. Tension splices of number 55 18 bars shall be staggered longitudinally a minimum of 1500 mm 5 feet so that no more than 1/3 of the bars are spliced at any one section.

3.2 WELDED-WIRE FABRIC PLACEMENT

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 50 mm 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 1.2 m 4 feet. Fabric shall be positioned by the use of supports.

3.3 DOWEL INSTALLATION

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

3.4 SYNTHETIC FIBER REINFORCED CONCRETE

NOTE: Synthetic fiber reinforcement may be used in concrete slabs as an aid in preventing plastic or shrinkage cracking in placements susceptible to this condition. Fiber reinforcement will not be used as a substitute for wire mesh and where service temperature may exceed 150 degrees C (300 degrees F). Concentrations above 0.1 percent by volume are not cost-effective.

Fiber reinforcement shall be added to the concrete mix in accordance with the applicable sections of ASTM C1116/C1116M and the recommendations of the manufacturer, and in an amount of [0.1] [_____] percent by volume.

3.5 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

NOTE: Include this paragraph only when special inspection and testing for seismic-resisting systems is required by Appendix 11A of ASCE 7.

This paragraph will be applicable to both new buildings designed according to UFC 3-310-04 SEISMIC DESIGN FOR BUILDINGS and to existing building seismic rehabilitation designs.

The designer must indicate on the drawings all locations and all features for which special inspection and testing is required in accordance with UFC 3-310-04 and Appendix 11A of ASCE 7. This includes indicating the locations of all structural components and connections requiring inspection.

Add any additional requirements as necessary.

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with **UFC 3-310-04** and Section **01 45 35** SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

3.6 FIELD TESTS AND INSPECTIONS

3.6.1 Identification of Splices

Establish and maintain an approved method of identification of all field butt-splices which will indicate the splicer and the number assigned each splice made by the splicer.

3.6.2 Examining, Testing, and Correcting

NOTE: If the total number of butt-splices exceed 5,000, the number of tension tests may be decrease to one test specimen for every 50 splices in excess of the first 5,000 splices provided that no splices are rejected in the last 500 splices made and the splicing operation will not be interrupted for more than 3 months.

Perform the following during the butt-splicing operations as specified and as directed:

- a. Visual Examination - All welded splices shall be visually examined for the presence of cracks, undercuts, inadequate size and other visible defects. Respliced connections resulting from correction of visual defects may be radiographically examined at the option of the Contracting Officer as specified in paragraph SUPPLEMENTAL EXAMINATION. Exothermic mechanical butt-splices shall be visually examined to determine if the filler metal is clearly visible at the tap holes and completely fills the sleeves at both ends except for spaces of not more than **10 mm 3/8 inch** occupied by packing.

b. Tension Tests - Tensions tests to 90 percent of the minimum specified ultimate tensile strength of the spliced bars or to destruction shall be performed on one test specimen made in the field for every 25 splices made. Test specimens shall be made by the splicers engaged in the work, using the approved splicing procedure and the same size bars placed in the same relative position, and under the same conditions as those in the groups represented by the specimens. Stress-strain curves shall be furnished for each butt-splice tested.

c. Radiographic Examination - Not less than one of each 25 welded splices selected at random by the Contracting Officer shall be examined radiographically and evaluated for defects. The greatest dimension of any porosity (gas pocket or similar void) or fusion-type defect (slag inclusion, incomplete fusion or similar generally elongated defect in weld fusion) shall not exceed 6 mm 1/4 inch. The minimum clearance between edges of porosity or fusion-type defects shall not be less than 25 mm 1 inch.

d. Correction of Deficiencies - No splice shall be embedded in concrete until satisfactory results of visual examination and the required tests or examinations have been obtained. All splices having visible defects or represented by test specimens which do not satisfy the tests or examinations shall be removed. If any of the tension test specimens fail to meet the strength requirements or deformation limitations two production splices from the same lot represented by the test specimens which failed shall be cut out and tension tested. If both of the retests pass the strength requirements and deformation limitations all of the splices in the lot will be accepted. If one or both of the retests fail to meet the strength requirements or deformation limitations all of the splices in the lot will be rejected. All costs of removal, testing and resplicing of the additional production splices shall be borne by the Contractor. The bars of rejected splices shall be cut off outside the splice zone of weld metal, filler metal contact, coupling or sleeve. The cut ends shall be finished as specified and the joints shall be respliced and reinspected at no additional cost.

e. Supplemental Examination - The Contracting Officer may require additional or supplemental radiographic examination and/or tension test of any completed splice. For costs of such examinations and tests see paragraph UNIT PRICES.

-- End of Section --