NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
REBAR INDIRECT BUTT JOINT WITH SPLICE ANGLE
WELDING PROCEDURE SPECIFICATION (WPS) AWS D1.4

Specifications, Codes & Supporting Document: **NCDOT Standard Specifications/AASHTO/AWS D1.4, PQR-030**

Material Specifications: **ASTM A615 Grades 75, 60 & 40, ASTM A706 Grade 60; Bar size 4 to 18 Inclusive**

Welding Process: **SMAW** Manual or Semi- Automatic or Automatic: **Manual**

Filler Metal Specification: **AWS A5.1** Classification: **E-7018**

Manufacturer: **NCDOT Approved Electrodes** Single or Multiple Pass: **both** Position of Weld: **Flat**

Welding Current: **DC** Polarity: **Positive** Progression: **N/A**

Root Treatment: **N/A**

Preheat Temp: **Refer to preheat table below** Interpass: **1100° maximum** Post Heat: **N/A**

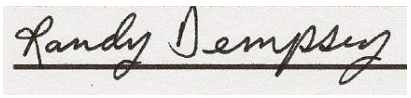
Pass Num.	Electrode Size	Welding Current Amperes	Welding Current Volts	Travel Speed	Position	Joint Details
All	**1/8”**	**90-150**	**20-23**	**6-9 ipm**	All	SEE ATTACHMENT

PREHEAT TABLE	
Rebar Size	**Min. Temp.**
#6 or less	300°
#7 or larger	500°

COMMENTS:
Remove all coating, rust, dirt and mill scale within one inch of the area to be welded.
Pre-heat shall extend 6" in each direction beyond the joint.
Remove all slag, spatter and weld discontinuities between passes.
Check interpass temperature prior to the application of each pass.
Clean the completed weld of all debris, slag and spatter.

WPS Description: **REBAR Indirect Butt Joint With Splice Angle**

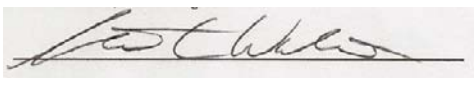
Written By: **Randy Dempsey, CWI/CWE, TT IV**

Signature: 

WPS #: **062111030**

Authorized By: **Steve Walton, Metals Engineer**

Revision #: **1**

Signature: 

Workmanship (AWS D1.4)

4.4 Quality of Welds

4.4.2 Any crack shall be unacceptable, regardless of size or location.

4.4.3 There shall be complete fusion between weld metal and base metal and between successive passes of weld.

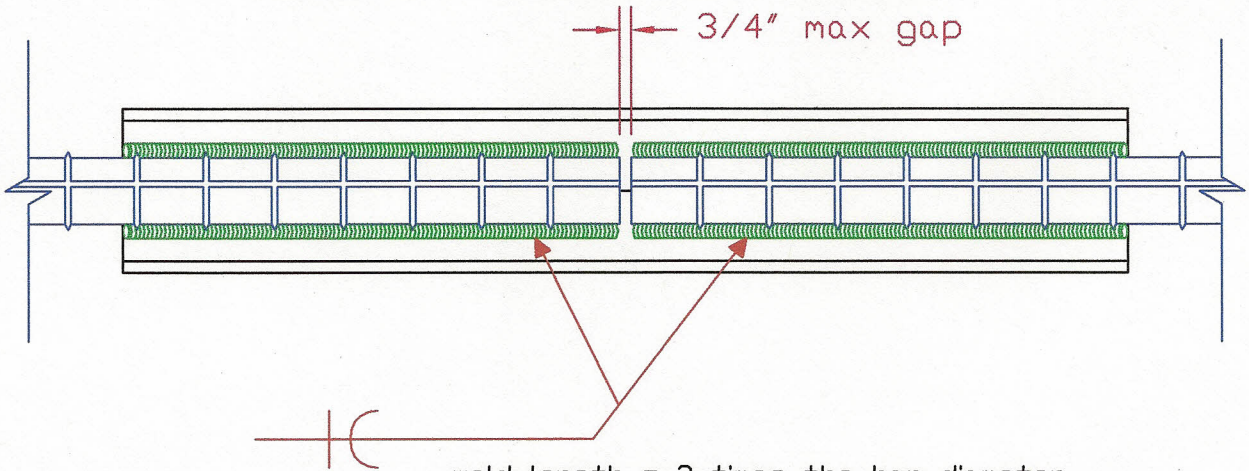
4.4.4 All weld craters shall be filled to a cross section that meets the miniimum specified weld size.

4.4.5 Welds shall be free from overlap.

4.4.6 Undercut depth greater than 1/32" in the solid section of the bar or structural member shall not be allowed.

4.4.10 The weld size shall be equal to or greater than the weld size specified. The length of weld containing this weld size shall be equal to or greater than the weld length specified. Any portion of the length, including starts or stops, that contain a smaller weld size shall not be measured in the weld length.

WPS REBAR Indirect Butt Joint with Splice Angle 062111030R1
JOINT DETAIL ATTACHMENT

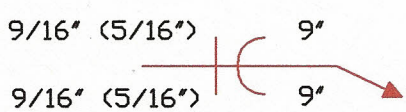


weld size = 40 percent of the bar radius (min), or as directed by the plans

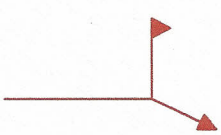
weld length = 2 times the bar diameter (min), or as directed by the plans

REBAR Indirect Butt Joint with Splice Angle
JOINT DETAILS

Weld Symbol definitions per AWS A2.4:2007



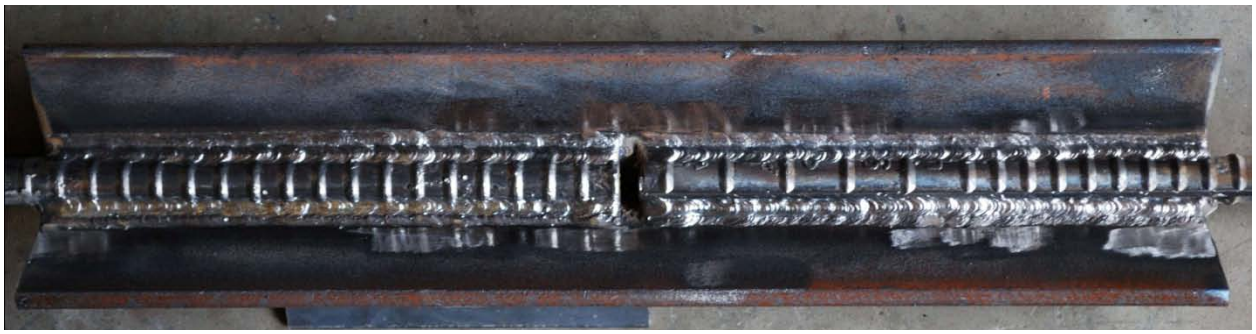
Flare Bevel, Both Sides with Groove Depth, Weld Size and Length of Weld



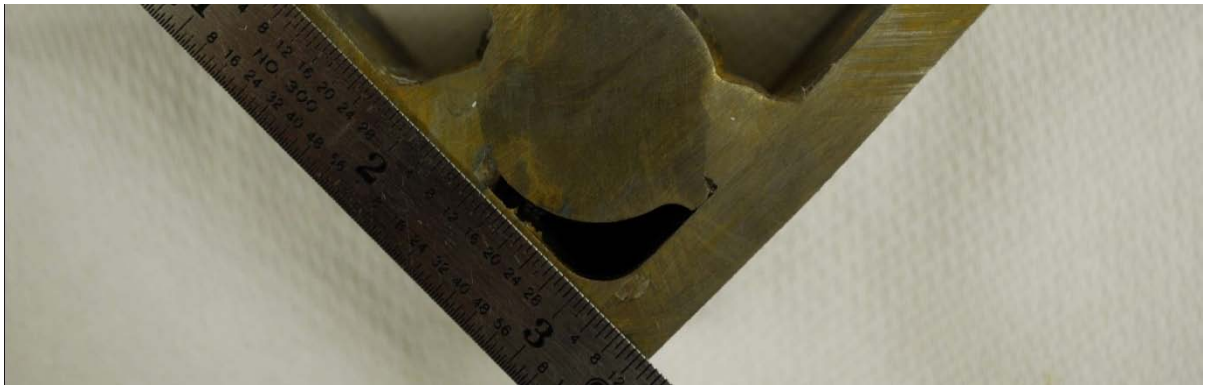
FIELD WELD SYMBOL

Illustrations for a rebar indirect butt joint with splice angle.

Joint fit-up.



Completed weld (3 passes).



A cross section was tested to verify that a 5/16" weld can be achieved with 3 passes using 1/8" E7018.

A tensile test was performed to verify that the integrity of the material was not compromised (a 500°F preheat and interpass temperature was maintained).

North Carolina Department of Transportation
Materials Tests Unit (Steel Section)

Rebar Indirect Butt Joint with Splice Angle PQR

Procedure Qualification Record No. PQR-030

Contractor: **NCDOT Materials & Tests (Steel Section)**
Authorized By: **Steve Walton** Revision No.: **1**
Welder: **Randy Dempsey, CWI/CWE** Test Date: **Monday, June 27, 2011**
Welding Process: [ ] FCAW-G [ ] FCAW-S [ ] GMAW [X] SMAW

PQR Joint Type [ ] Direct Butt [X] Indirect Butt [ ] T-Joint
Test Assembly: [ ] Figure 6.5 A [ ] Figure 6.5 B [X] Figure 6.5 C [ ] Figure 6.5 D
Position: **flat** Groove Type: **flare bevel** [ ] single bevel
Joint Opening: **3/4" max** Root Face: **n/a** [X] double bevel
Backing: [ ] yes [X] no Backing Type: **n/a**
Backgouging: [ ] yes [X] no Backgouging Method: **n/a**
Technique: [X] stringers [ ] weave Groove Angle: **n/a**

Electrical Characteristics
Current: [ ] AC [X] DCEP [ ] DCEN
Transfer Mode (GMAW): [ ] Short-circuiting [ ] Globular [ ] Spray

Base Metal Material Specification: **ASTM A615** Grade: **60**
welded to: Material Specification: **ASTM A36-08/A529-05** Grade: **60**
Carbon Equivalent (Bar): **not available** Bar Size: **#6**
Coated Bar: [ ] yes [X] no Type of Coating: **n/a**

Filler Metal
AWS Specification: **AWS A5.1** AWS Classification: **E-7018**

Shielding
Gas: [ ] single [ ] mixture Composition: **n/a** Flow Rate: **n/a**

Preheat/Interpass
Preheat/Interpass Temperature (min): **300° F**
Interpass Temperature (max): **1100° F**

Welding Parameters

Pass Number	Electrode Diameter	Type	Amperage	IPM	Volts	Joint Detail
1	**1/8"**	**E7018**	**115**	**7**	**29**	**see attachment**
2-3	**1/8"**	**E7018**	**110**	**8**	**29**	

North Carolina Department of Transportation
Materials Tests Unit (Steel Section)

Rebar Indirect Butt Joint with Splice Angle PQR

Procedure Qualification Record No. PQR-030 (continued)

TEST RESULTS

Visual Examination

Test Assembly Number One		Test Assembly Number Two	
[X] pass	[ ] fail (AWS) D1.4, Clause 4.4	[X] pass	[ ] fail (AWS) D1.4, Clause 4.4
Comments **Within tolerance of specifications.**		Comments **Within tolerance of specifications.**	

Tensile Test

Test Assembly Number One		Test Assembly Number Two	
[X] pass	[ ] fail (AWS) D1.4, Clause 6.3.7.2	[ ] pass	[ ] fail (AWS) D1.4, Clause 6.3.7.2

Specimen No.	bar size		Area	Ultimate Tensile Load (lbs)	Ultimate Unit Stress (psi)	Character of Failure and Location
1	**#6**		**0.44**	**47,954**	**108,986**	**aprox. 3" outside the heat affected zone (see photo)**

Macroetch Test

Test Assembly Number One		Test Assembly Number Two	
[ ] pass	[ ] fail (AWS) D1.4, Clause 6.3.7.3	[X] pass	[ ] fail (AWS) D1.4, Clause 6.3.7.3

Specimen No.	Results	Remarks
2	**pass**	**A 5/16" weld was achieved with the application of 3 passes.**

Welder's Name **Randy Dempsey, CWI/CWE** Welder ID No. **2659 SCW**

Visual Test Conducted By **Richard Maxon, CWI**

Tensile Test Conducted By **Dan Miller** HiCams No. **543029**

Macroetch Test Conducted By **Richard Maxon, CWI**

We certify that the statements in this record are correct and that the welds were prepared and tested in accordance with the requirements of AWS D1.4, Structural Welding Code-Reinforcing Steel.

Contractor **NCDOT Materials & Tests (Steel Section)**

Authorized by **Steve Walton** Date **Monday, June 27, 2011**

Sample Status: Meets Specs

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
MATERIALS AND TESTS UNIT
1801 BLUE RIDGE RD. RALEIGH, N.C. 27607
06/28/2011
Reinforcing Steel Test

Hicams No.: 543029
Contract No.:
County: Forsyth
Date Sampled: 06/28/2011
Sampled By: Dempsey, Randy
Sampled From: Project
Contractor:
Prod./Suppl.:
Facility:
Material: Reinforcing Steel, Plain

T.I.P. No.:
Field ID: 1
Engineer:
Received: 06/28/2011

Work Order No.:
P.O./Other No.:
Reported: 06/28/2011
Test Category: Informational
Represented Qty.: 20.000 LB

Lab No.: P367530

Test No.: ASTM A615

TENSILE TESTING

METRIC

	Results
Bar Size:	6
Nominal Area, sq. in.:	0.44
Wt. Actual % of Theoretical:	
Yield Strength, P.S.I.:	65718
Total Load, lbs.:	47954
Tensile Strength, P.S.I.:	109000
Elongation (8 in.), %:	

Comments:

V. O. Cordle

V. OWEN CORDLE
PHYSICAL TEST ENGINEER

cc:

0.44
6
ASTM A615

Page 1 of 1

Test Summary

Counter:	33967
Elapsed Time:	00:01:29
Heat Number:	
Lab:	
Procedure Name:	Rebar
Start Date:	6/28/2011
Start Time:	10:57:13 AM
End Date:	6/28/2011
End Time:	10:58:42 AM
Workstation:	N.C. DOT
Tested By:	owen

Test Results

Area:	0.4400 in²
Peak Load:	47954 lbf
Tensile Strength:	108986 psi
Halt of Force Yield:	65718.1800 psi