SECTION 18250

STRUCTURAL WELDING PROCEDURE SPECIFICATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. WPSs for welding structures on-site.

1.2 RELATED SECTIONS

A. Section 18100, General Welding Requirements.

B. Section 18210, General Structural Welding Requirements.

C. Section 18260, Structural Welder Performance Qualification Test.

D. Section 18270, Structural Weld Joint Details.

PART 2 - PRODUCTS

A. See Sect. 18100, General Welding Requirements.

PART 3 - EXECUTION

3.1 PROCEDURES

A. Each structural WPS is uniquely labeled to indicate the welding process, base material(s) and weld joint type, as follows:

XX-YY-N(ST)

Where

XX = Welding process abbreviation
YY = Base material P- or S-Number from ASME Sect. IX
N = Sequence number
ST = Designates a structural WPS

1. Welding processes:
   a. SM – Manual Shielded Metal Arc
   b. GT – Manual Gas Tungsten Arc
   c. GM – Gas Metal Arc, Semiautomatic
   d. FC – Flux Cored Arc
   e. SMASW – Manual Shielded Metal Arc, Arc Spot Weld
2. Base materials:
   a. Ferrous
   b. P1 – Carbon Steel

B. Each WPS specifies welding conditions, including base materials, current, current type, voltage, polarity, electrode size and type, filler materials, shielding gas type and flow rate, purging gas, preheat, postweld heat treatment, etc. Do not use variables not specifically addressed by the applicable WPS.

C. This section contains the electronic copy of the original WPSs.

END OF SECTION 18250

STRUCTURAL WPS SUMMARY

WPS	BASE MATERIAL	FILLER MATERIAL	THICKNESS	COMMENTS
CARBON STEEL				
FC11-1(ST)	Carbon Steel	E70T-1 or E71T-1	1/8 -Unlimited	
FC11-2(ST)	Carbon Steel	E71T-7, -8, or -11	1/8 - Unlimited	Self-Shielding Wire
GM11-1(ST)	Carbon Steel	ER70S-3 or ER70S-6	1/8 -Unlimited	
SM11-1(ST)	Carbon Steel	E7015, 16, or 18	1/8 - Unlimited	
SM11-2(ST)	Carbon Steel	E7024	1/8 -Unlimited	Limited Position
SMASW-1(ST)	Carbon Steel	E6010		Arc Spot Welds

STRUCTURAL WELDING PROCEDURE SPECIFICATION (WPS)	NUMBER:	**FC11-1(ST)**
AWS D-1.1 PREQUALIFIED	REVISION:	2

DATE: February 2, 1994

COMPANY NAME: Energy Systems

WELDING PROCESS: FCAW

BASE MATERIAL(S): See page 2
Qualified Thickness Range: 1/8 in. through unlimited

IMPACTS: No

FILLER MATERIAL(S): Type: SFA/A5.20
Class: E70T-1 or E71T-1

PREHEAT/INTERPASS: Preheat: See page 2
Interpass: 500EF max

WELDING CONDITIONS:

Process	FCAW
Increment	All
Polarity	DCRP
Transfer mode	N/A
Weld filler material	E70T-1 or E71T-1
Electrode diam (in.)	0.045 in., 0.052 in., 0.062 in.
Current (amps)	120-350 **(R)**
Arc voltage (volts)	22-28
Shielding gas	75%A-25%CO_2
Gas flow rate	30-40 cfh
Contact tube to work distance	3/4 in. max
Gas cup size	3/4 in. max
Travel speed (ipm)	7 min

PWHT/PREHEAT MAINTENANCE: N/A

JOINT TYPE(S): * Those specified in Sect. 18270 or on drawings or specifications.
* Complete joint penetration (with backing or backgouged).
* Partial joint penetration, fillet, build-up, and repair.
* Fillet size per drawings or specifications.

POSITIONS: * All positions (vertical welding upwards).

STRUCTURAL WELDING PROCEDURE SPECIFICATION (WPS)	NUMBER:	**FC11-1(ST)**
AWS D-1.1 PREQUALIFIED	REVISION:	2

TECHNIQUES: * See Sect. 18210, para. 3.07C.

* Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
* Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
* Multipass or single pass - single or multipass as required.
* String or weave bead - see Sect. 18210, para. 3.07C.
* Peening - see Sect. 18210, para. 3.07A.
* Variables not listed in this WPS or the references are not applicable.

REFERENCES: * Sect. 18210

* Supporting PQRs - N/A

BASE MATERIALS: This WPS may be used with any Category B material listed in Table 4.3 of AWS D-1.1. Some of the more commonly used of these materials are:

ASTM A-36	ASTM A-501
ASTM A-53, Gr. B	ASTM A-516, Gr. 55-70
ASTM A-106, Gr. B	ASTM A-570, all grades
ASTM A-242	ASTM A-572, Gr. 42 and 50
ASTM A-500, Gr. A and B	ASTM A-588

PREHEAT:

Material thickness	Minimum preheat (EF)
≤3/4 in.	None (See Note)
>3/4 in. and ≤1 1/2 in.	50
>1 1/2 in. and ≤2 1/2 in.	150
>2 1/2 in.	225

Note: When base metal temperature is below 32EF, preheat the base material to 70EF and maintain this temperature during welding.

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STRUCTURAL WELDING PROCEDURE SPECIFICATION (WPS)	NUMBER:	**FC11-2(ST)**
AWS D-1.1 PREQUALIFIED	REVISION:	1

DATE: February 2, 1994

COMPANY NAME: Energy Systems

WELDING PROCESS: FCAW

BASE MATERIAL(S): See page 2
Qualified Thickness Range: 1/8 in. through unlimited

IMPACTS: No

FILLER MATERIAL(S): Type: SFA/A5.20
Class: E71T-7, E71T-8, or E71T-11

PREHEAT/INTERPASS: Preheat: See page 2
Interpass: 500EF max

WELDING CONDITIONS:

Process	FCAW
Increment	All
Polarity	DCSP
Transfer mode	N/A
Weld filler material	E71T-7, -8, or -11
Electrode diam (in.)	0.023-0.062 in. **(R)**
Current (amps)	70-350 **(R)**
Arc voltage (volts)	17-28
Shielding gas	None
Gas flow rate	N/A
Contact tube to work distance	3/4 in. max
Gas cup size	3/4 in. max
Travel speed (ipm)	7 min

PWHT/PREHEAT MAINTENANCE: N/A

JOINT TYPE(S): * Those specified in Sect. 18270 or on drawings or specifications.
* Complete joint penetration (with backing or backgouged).
* Partial joint penetration, fillet, build-up, and repair.
* Fillet size per drawings or specifications.

POSITIONS: * All positions (vertical welding upwards).

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STRUCTURAL WELDING PROCEDURE SPECIFICATION (WPS)	NUMBER:	**FC11-2(ST)**
AWS D-1.1 PREQUALIFIED	REVISION:	1

TECHNIQUES: * See Sect. 18210, para. 3.07C.

* Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
* Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
* Multipass or single pass - single or multipass as required.
* String or weave bead - see Sect. 18210, para. 3.07C.
* Peening - see Sect. 18210, para. 3.07A.
* Variables not listed in this WPS or the references are not applicable.

REFERENCES: * Sect. 18210

* Supporting PQRs - N/A

BASE MATERIALS: This WPS may be used with any Category B material listed in Table 4.3 of AWS D-1.1. Some of the more commonly used of these materials are:

ASTM A-36	ASTM A-501
ASTM A-53, Gr. B	ASTM A-516, Gr. 55-70
ASTM A-106, Gr. B	ASTM A-570, all grades
ASTM A-242	ASTM A-572, Gr. 42 and 50
ASTM A-500, Gr. A and B	ASTM A-588

PREHEAT:

Material thickness	Minimum preheat (EF)
≤3/4 in.	None (See Note)
>3/4 in. and ≤1 1/2 in.	50
>1 1/2 in. and ≤2 1/2 in.	150
>2 1/2 in.	225

Note: When base metal temperature is below 32EF, preheat the base material to 70EF and maintain this temperature during welding.

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STRUCTURAL WELDING PROCEDURE SPECIFICATION (WPS)	NUMBER:	**GM11-1(ST)**
AWS D-1.1 PREQUALIFIED	REVISION:	1

DATE: May 14, 1993

COMPANY NAME: Energy Systems

WELDING PROCESS: GMAW

BASE MATERIAL(S): See page 2
Qualified Thickness Range: 1/8 in. through unlimited

IMPACTS: No

FILLER MATERIAL(S): Type: SFA/A5.18
Class: ER70S-3 or ER70S-6

PREHEAT/INTERPASS: Preheat: See page 2
Interpass: 500EF max

WELDING CONDITIONS:

Process	GMAW	GMAW
Increment	All	All
Polarity	DCRP	DCRP
Transfer mode	Spray	Spray
Weld filler material	ER70S-3 or ER70S-6	ER70S-3 or ER70S-6
Electrode diam (in.)	0.035 in.	0.045 in.
Current (amps)	140-300	140-350
Arc voltage (volts)	25-29	25-29
Shielding gas	98%A-2%O_2	98%A-2%O_2
Gas flow rate	25-35 cfh	25-35 cfh
Contact tube to work distance	3/4 in. max	3/4 in. max
Gas cup size	3/4 in. max	3/4 in. max
Travel speed (ipm)	7 min	7 min

PWHT/PREHEAT MAINTENANCE: N/A

JOINT TYPE(S): * Those specified in Sect. 18270 or on drawings or specifications.
* Complete joint penetration (with backing or backgouged).
* Partial joint penetration, fillet, build-up, and repair.
* Fillet size per drawings or specifications.

POSITIONS: * All positions (vertical welding upwards).

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STRUCTURAL WELDING PROCEDURE SPECIFICATION (WPS)		NUMBER:	**GM11-1(ST)**
AWS D-1.1	PREQUALIFIED	REVISION:	1

TECHNIQUES: * See Sect. 18210, para. 3.07C.

* Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
* Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
* Multipass or single pass - single or multipass as required.
* String or weave bead - see Sect. 18210, para. 3.07C.
* Peening - see Sect. 18210, para. 3.07A.
* Variables not listed in this WPS or the references are not applicable.

REFERENCES: * Sect. 18210

* Supporting PQRs - N/A

BASE MATERIALS: This WPS may be used with any Category B material listed in Table 4.3 of AWS D-1.1. Some of the more commonly used of these materials are:

ASTM A-36	ASTM A-501
ASTM A-53, Gr. B	ASTM A-516, Gr. 55-70
ASTM A-106, Gr. B	ASTM A-570, all grades
ASTM A-242	ASTM A-572, Gr. 42 and 50
ASTM A-500, Gr. A and B	ASTM A-588

PREHEAT:

Material thickness	Minimum preheat (EF)
≤3/4 in.	None (See Note)
>3/4 in. and ≤1 1/2 in.	50
>1 1/2 in. and ≤2 1/2 in.	150
>2 1/2 in.	225

Note: When base metal temperature is below 32EF, preheat the base material to 70EF and maintain this temperature during welding.

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STRUCTURAL WELDING PROCEDURE SPECIFICATION (WPS)	NUMBER:	**SM11-1(ST)**
AWS D-1.1 PREQUALIFIED	REVISION:	1

DATE: May 14, 1993

COMPANY NAME: Energy Systems

WELDING PROCESS: SMAW

BASE MATERIAL(S): See page 2
Qualified Thickness Range: 1/8 in. through unlimited

IMPACTS: No

FILLER MATERIAL(S): Type: SFA/A5.1
Class: E70XX (XX - 15, 16, 18)

PREHEAT/INTERPASS: Preheat: See page 2
Interpass: 500EF max

WELDING CONDITIONS:

Process	SMAW	SMAW	SMAW	SMAW	
Increment		All	All	All	All
Polarity	DCRP	DCRP	DCRP	DCRP	
Weld filler material	E70XX	E70XX	E70XX	E70XX	
Electrode diam (in.)	3/32	1/8	5/32	3/16	
Current (amps)	50-115	80-145	115-205	170-275	
Arc voltage (volts)	22-26	23-27	23-27	23-27	
Travel Speed (ipm)	3 min	4 min	5 min	7 min	

PWHT/PREHEAT MAINTENANCE: N/A

JOINT TYPE(S): * Those specified in Sect. 18270 or on drawings or specifications.
* Complete joint penetration (with backing or backgouged).
* Partial joint penetration, fillet, build-up, and repair.
* Fillet size per drawings or specifications.

POSITIONS: * All positions (vertical welding upwards).

TECHNIQUES: * See Sect. 18210, para. 3.07B.
* Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
* Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
* Multipass or single pass - single or multipass as required.
* Peening - see Sect. 18210, para. 3.07A.
* Variables not listed in this WPS or the references are not applicable.

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STRUCTURAL WELDING PROCEDURE SPECIFICATION (WPS)	NUMBER:	**SM11-1(ST)**
AWS D-1.1 PREQUALIFIED	REVISION:	1

REFERENCES: * Sect. 18210
* Supporting PQRs - N/A

BASE MATERIALS: This WPS may be used with any Category B material listed in Table 4.3 of AWS D-1.1. Some of the more commonly used of these materials are:

ASTM A-36	ASTM A-501
ASTM A-53, Gr. B	ASTM A-516, Gr. 55-70
ASTM A-106, Gr. B	ASTM A-570, all grades
ASTM A-242	ASTM A-572, Gr. 42 and 50
ASTM A-500, Gr. A and B	ASTM A-588

PREHEAT:

Material thickness	Minimum preheat (EF)
≤3/4 in.	None (See Note)
>3/4 in. and ≤1 1/2 in.	50
>1 1/2 in. and ≤2 1/2 in.	150
>2 1/2 in.	225

Note: When base metal temperature is below 32EF, preheat the base material to 70EF and maintain this temperature during welding.

Energy Systems: Original signature on file Date: 7/30/93

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STRUCTURAL WELDING PROCEDURE SPECIFICATION (WPS)	NUMBER:	**SM11-2(ST)**
AWS D-1.1 PREQUALIFIED	REVISION:	0

DATE: May 14, 1993

COMPANY NAME: Energy Systems

WELDING PROCESS: SMAW

BASE MATERIAL(S): See page 2
Qualified Thickness Range: 1/8 in. through unlimited

IMPACTS: No

FILLER MATERIAL(S): Type: SFA/A5.1
Class: E7024

PREHEAT/INTERPASS: Preheat: See page 2
Interpass: 500EF max

WELDING CONDITIONS:

Process	SMAW	SMAW	SMAW	SMAW	
Increment		All	All	All	All
Polarity	DCRP	DCRP	DCRP	DCRP	
Weld filler material	E70XX	E70XX	E70XX	E70XX	
Electrode diam (in.)	3/32	1/8	5/32	3/16	
Current (amps)	90-120	120-150	180-230	250-300	
Arc voltage (volts)	22-26	23-27	23-27	23-27	
Travel Speed (ipm)	3 min	4 min	5 min	7 min	

PWHT/PREHEAT MAINTENANCE: N/A

JOINT TYPE(S): * Those specified in Sect. 18270 or on drawings or specifications.
* Complete joint penetration (with backing or backgouged).
* Partial joint penetration, fillet, build-up, and repair.
* Fillet size shall be per drawings or specifications.

POSITIONS: * Flat position groove welds; flat and horizontal position fillet welds.

TECHNIQUES: * See Sect. 18210, para. 3.07B.
* Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
* Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
* Multipass or single pass - single or multipass as required.
* Peening - see Sect. 18210, para. 3.07A.
* Variables not listed in this WPS or the references are not applicable.

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STRUCTURAL WELDING PROCEDURE SPECIFICATION (WPS)	NUMBER:	**SM11-2(ST)**
AWS D-1.1 PREQUALIFIED	REVISION:	0

REFERENCES: * Sect. 18210
* Supporting PQRs - N/A

BASE MATERIALS: This WPS may be used with any Category B material listed in Table 4.3 of AWS D-1.1. Some of the more commonly used of these materials are:

ASTM A-36	ASTM A-501
ASTM A-53, Gr. B	ASTM A-516, Gr. 55-70
ASTM A-106, Gr. B	ASTM A-570, all grades
ASTM A-242	ASTM A-572, Gr. 42 and 50
ASTM A-500, Gr. A and B	ASTM A-588

PREHEAT:

Material thickness	Minimum preheat (EF)
≤3/4 in.	None (See Note)
>3/4 in. and ≤1 1/2 in.	150
>1 1/2 in. and ≤2 1/2 in.	225
>2 1/2 in.	300

Note: When base metal temperature is below 32EF, preheat the base material to 70EF and maintain this temperature during welding.

Energy Systems: Original signature on file Date: 7/30/93

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STRUCTURAL WELDING PROCEDURE SPECIFICATION (WPS) NUMBER: **SMASW-1(ST)**

AWS D-1.3 REVISION: 1

DATE: February 2, 1994

COMPANY NAME: Energy Systems

WELDING PROCESS: SMAW - Arc Spot Welding

BASE MATERIAL(S): See page 2
Qualified Thickness Range: Sheet Steel - 18 or 20 gage, single or double thicknesses, structural backing - 1/8 in. through unlimited.

IMPACTS: No

FILLER MATERIAL(S): Type: SFA/A5.1
Class: E6010

PREHEAT/INTERPASS: Preheat: See page 2
Interpass: N/A

WELDING CONDITIONS:

Process	SMAW	SMAW	SMAW	SMAW	
Sheet Thickness	20 Ga	20 Ga	18 Ga	18 Ga	
Single or Double Sheet	Single	Double	Single	Double	
Polarity	DCRP	DCRP	DCRP	DCRP	
Electrode	E6010	E6010	E6010	E6010	E6010
Electrode diam (in.)	1/8	1/8	1/8	1/8	
Current (amps)	145-155	190-210	190-210	190-210	
Burnoff Rate (ipm)	15.7 min	20 min	20 min	20 min	

PWHT/PREHEAT MAINTENANCE: N/A

JOINT TYPE(S): * Arc spot welds of sheet steel decking to structural backing in accordance with Sect. 18270 or as specified in design output documents.
* Size, location, and spacing of spot welds per drawings or specifications.

POSITIONS: * Flat position.

WORKMANSHIP: * A minimum reinforcement of 1/32 in. is required.
* Undercut length 1/8 of the circumference of the spot weld or less is acceptable. Depth of undercut is not measured.

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STRUCTURAL WELDING PROCEDURE SPECIFICATION (WPS) NUMBER:
SMASW-1(ST)

AWS D-1.3 REVISION: 1

REFERENCES: * Sect. 18210
* Supporting PQRs - SMASW-1(ST)
SMASW-1A(ST)

BASE MATERIALS: Sheet Steels -

ASTM A-446,* Grades A, B, C, and E
ASTM A-570
ASTM A-606
ASTM A-607
ASTM A-611

* Galvanized coating thickness limited to G-90 or less.

Structural Backing - ASTM A-36 or any other Category B material listed in Table 4.3 of AWS D-1.1.

PREHEAT:

Material thickness	Minimum preheat (EF)
≤3/4 in.	None (See Note)
>3/4 in. and ≤1 1/2 in.	50
>1 1/2 in. and ≤2 1/2 in.	150
>2 1/2 in.	225

Note: When base metal temperature is below 32EF, preheat the base material to 70EF and maintain this temperature during welding.

Energy Systems: Original signature on file Date: 2/18/94

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