

AIR FORCE
QUALIFICATION TRAINING PACKAGE (AFQTP)



FOR
STRUCTURAL
(3E3X1)

MODULE 34

SHIELDED METAL ARC WELDING

TABLE OF CONTENTS

MODULE 34

SHIELDED METAL ARC WELDING

AFQTP GUIDANCE

INTRODUCTION 34-3

AFQTP UNIT 4

SET UP WELDING MACHINE FOR A SPECIFIC WELDING JOB (34.4.) 34-4

AFQTP UNIT 5

PREPARE JOINTS FOR WELDING (34.5.) 34-10

AFQTP UNIT 6

BUTT JOINT POSITIONS

FLAT (34.6.1.1.) 34-16

VERTICAL (34.6.1.3.) 34-22

LAP JOINT POSITIONS

FLAT (34.6.2.1.) 34-28

VERTICAL (34.6.2.3.) 34-35

TEE JOINT POSITIONS

FLAT (34.6.3.1.) 34-42

VERTICAL (34.6.3.3.) 34-49

REVIEW ANSWER KEY KEY-1

CORRECTIONS/IMPROVEMENT LETTER APPENDIX A

Career Field Education and Training Plan (CFETP) references from 1 August 2002 version.

OPR: HQ AFCESA/CEOF
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Supersedes AFQTP 3E3X1-33, 14 Jul 00

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Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

AIR FORCE QUALIFICATION TRAINING PACKAGES
FOR
STRUCTURAL
(3E3X1)

INTRODUCTION

Before starting this AFQTP, refer to and read the “[AFQTP Trainer/Trainee Guide](#)”

AFQTPs are mandatory and must be completed to fulfill task knowledge requirements on core and diamond tasks for upgrade training. **It is important for the trainer and trainee to understand** that an AFQTP **does not** replace hands-on training, nor will completion of an AFQTP meet the requirement for core task certification. AFQTPs will be used in conjunction with applicable technical references and hands-on training.

AFQTPs and Certification and Testing (CerTest) must be used as minimum upgrade requirements for Diamond tasks.

MANDATORY minimum upgrade requirements:

Core task:

AFQTP completion
Hands-on certification

Diamond task:

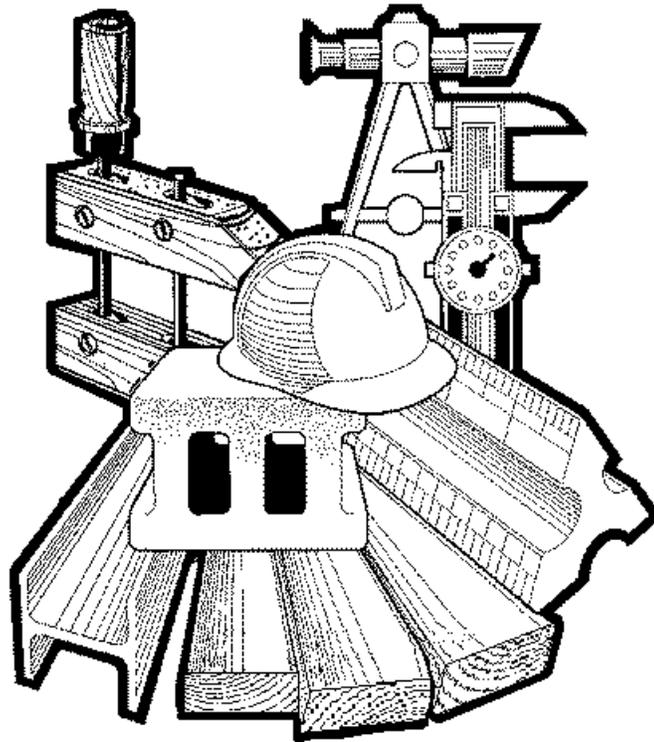
AFQTP completion
CerTest completion (80% minimum to pass)

Note: Trainees will receive hands-on certification training for Diamond Tasks when equipment becomes available either at home station or at a TDY location.

Put this package to use. Subject matter experts under the direction and guidance of HQ AFCESA/CEOF revised this AFQTP. If you have any recommendations for improving this document, please contact the Career Field Manager at the address below.

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SHIELDED METAL ARC WELDING

MODULE 34

AFQTP UNIT 4

SET UP WELDING MACHINE FOR A SPECIFIC WELDING JOB
(34.4.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

SET UP WELDING MACHINE FOR A SPECIFIC WELDING JOB

Task Training Guide

STS Reference Number/Title:	34.4. - Set up welding machine for a specific welding job.
Training References:	<ol style="list-style-type: none"> 1. Career Development Course (CDC) Structural Journeyman 3E351B, Volume 4, Unit 2; <i>Shielded Metal Arc Preparation</i>. 2. Commercial Manual, <i>Welding Skills</i> by R.T. Miller, 1994. 3. Commercial Manual, <i>Modern Metalworking</i> by John R. Walker, 1993. 4. Air Force Qualification Training Package (AFQTP) Video PIN # 613764: Shielded Metal Arc Welding.
Prerequisites:	<ol style="list-style-type: none"> 1. Possess as a minimum a 3E331 AFSC. 2. Review the following references: <ol style="list-style-type: none"> 2.1. CDC Structural Journeyman 3E351B, Volume 4, Unit 2. 2.2. Welding Skills, <i>Shielded Metal Arc Welding</i>, Chapter 12, <i>Machines and Accessories</i>, and Chapter 13, <i>Selecting Electrodes</i>. 2.3. Modern Metalworking, Unit 18, <i>Welding</i>, Pages 247-252. 3. Complete AFQTP Video # 613764: <i>Shielded Metal-Arc Welding</i>.
Equipment/Tools Required:	<ol style="list-style-type: none"> 1. Welding machine. 2. Wire brush. 3. Electrode. 4. Metal plate.
Learning Objective:	Individual should be able to set up a welding machine correctly for a specific job.
Samples of Behavior:	Trainee will able to set up machine for a specific job.
Notes:	
Failure to set-up equipment correctly will result in test failure.	

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SET UP WELDING MACHINE FOR A SPECIFIC WELDING JOB

1. Background. Learning to shield arc weld involves mastery of a specific series of operations. Performing these operations requires being proactive. Setting a welding machine for accurate work amperage is one of the most important operation that a beginner welder **must understand and apply proficiently**. Let us start with this process by discussing five factors to be considered.

2. Welding Factors. When setting up a welding machine there are **five** factors that must be considered:

- 2.1. Type of work.
- 2.2. Type of machine.
- 2.3. Type of electrode.
- 2.4. Current.
- 2.5. Safety factors.

All of them are closely related and each one depends on the other.

3. Welding Machines. There are two types of welding machines: Direct Current (DC), and Alternating Current (AC). DC has some advantages over the AC machine; DC is better for welding sheet metal and has a wider selection of electrodes to choose from versus AC machines.

SAFETY:

THERE ARE MANY SAFETY HAZARDS WHEN DEALING WITH ARC WELDING, FROM ELECTRICAL SHOCK TO TOXIC FUMES. MAKE SURE THAT ALL SAFETY PRECAUTIONS ARE FOLLOWED WHEN WELDING.

Figure 4-1. Amperage Setting Chart for Electrode Diameter Rods.

ELECTRODE DIAMETER (IN)	AMPERES		STANDARD ELECTRODE LENGTH (IN)
	MINIMUM	MAXIMUM	
$\frac{1}{16}$	40	60	11 $\frac{1}{2}$
$\frac{3}{32}$	70	90	14 or 18
$\frac{1}{8}$	110	135	14 or 18
$\frac{5}{32}$	150	180	14 or 18
$\frac{3}{16}$	180	220	14 or 18
$\frac{1}{4}^*$	250	300	14 or 18
$\frac{5}{16}^*$	300	425	14 or 18
$\frac{3}{8}^*$	450	550	14 or 18

* Diameters $\frac{1}{4}$ " , $\frac{5}{16}$ " , and $\frac{3}{8}$ " are for flat position welding only.

4. View AFQTP Video PIN # 613764: Shielded Metal Arc Welding. Upon completion of the above-mentioned video, properly set up a shielded arc-welding machine for a specific welding job using the step-by-step procedures listed below.

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

NOTE TO TRAINER/CERTIFIER:

For this task provide the trainee with a metal plate, electrode, and the position of weld. Then have the trainee set-up welding machine according to the material and information provided.

5. Procedures. Follow these steps to set-up a welding machine for a specific welding job.

Step 1: Trainee is provided with metal plate, electrode, and position of weld.

Step 2: Check all electric wires, welding/grounding cables, and electrode holders for any loose fitting or cracks.

Step 3: Check work area for adequate (working) ventilation.

Step 4: Ensure grounding clamp is securely attached on to a pre-cleaned metal work surface.

Step 5: Select correct polarity (AC or DC) according to the metal plate, electrode, and position of weld provided by trainer/certifier.

Step 6: Select appropriate amperage according to the electrode provided by trainer/certifier. (Use Figure 4-1 to select the minimum/maximum amperes.)

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**REVIEW QUESTIONS
FOR
SET UP WELDING MACHINE FOR A SPECIFIC WELDING JOB**

QUESTION	ANSWER
1. AC and DC are the two types of welding machines used most often.	a. True. b. False.
2. Electrical shock and Toxic fumes are two of the hazards you deal with when you're arc welding.	a. True. b. False.
3. How should you adjust the current before you start welding?	a. Adjust the current then start your work. b. Adjust your current then weld some trial beads and adjust your current. c. Start welding then turn the current up or down while you're welding. d. Adjust your welding speed according to the machines adjustment.

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SET UP WELDING MACHINE FOR A SPECIFIC WELDING JOB

PERFORMANCE CHECKLIST

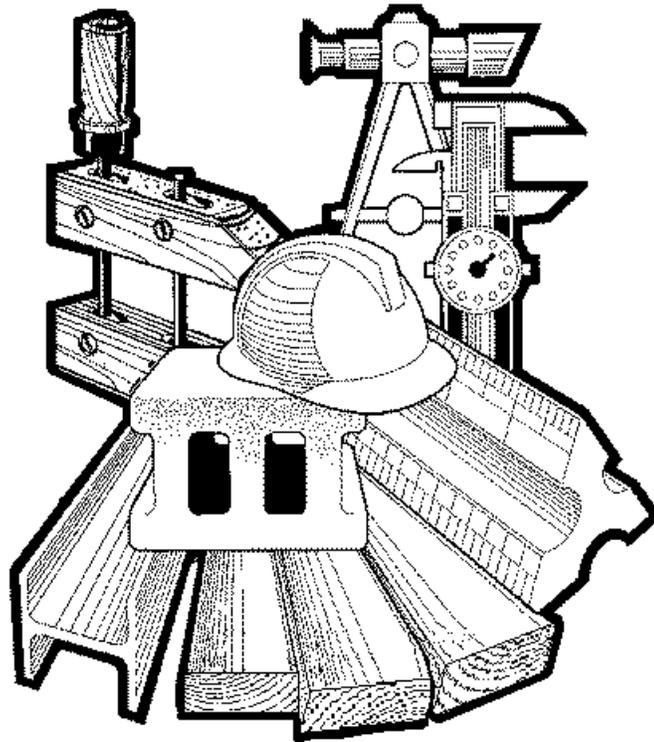
INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE....	YES	NO
1. perform safety and ventilation system check?		
2. select correct AC/DC setting?		
3. adjust the amperes to the recommended range?		
4. comply with all safety requirements?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

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SHIELDED METAL ARC WELDING

MODULE 34

AFQTP UNIT 5

PREPARE JOINTS FOR WELDING (34.5.)

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PREPARE JOINTS FOR WELDING
Task Training Guide

STS Reference Number/Title:	34.5. - Prepare joints for welding.
Training References:	<ol style="list-style-type: none"> 1. Career Development Course (CDC) Structural Journeyman 3E351B, Volume 4, Unit 3, Section 3-3; <i>Preparing and Welding Joints in the Flat Position</i>. 2. Commercial Manual, <i>Welding Skills</i> by R.T. Miller, 1994. 3. Commercial Manual, <i>Modern Metalworking</i> by John R. Walker, 1993. 4. Air Force Qualification Training Package (AFQTP) Video PIN # 613764: Shielded Metal Arc Welding.
Prerequisites:	<ol style="list-style-type: none"> 1. Possess as a minimum a 3E331 AFSC. 2. Review the following references: <ol style="list-style-type: none"> 2.1. CDC Structural Journeyman 3E351B, Volume 4, Unit 3 , Section 3-3. 2.2. <i>Welding Skills, Introduction to Welding, Chapter 2, Safety in Arc Welding, Page 14, and Chapter 4, Joint Design and Welding Terms, Pages 39-49.</i> 3. Complete the following: <ol style="list-style-type: none"> 3.1. AFQTP Video # 613764 <i>Shielded Metal-Arc Welding</i>. 3.2. AFQTP 3E3X1-34, Unit 4; <i>Set-up Welding Machine for a Specific Welding Job</i>.
Equipment/Tools Required:	<ol style="list-style-type: none"> 1. Work or Welding Gloves. 2. Hearing Protection. 3. Eye Protection. 4. Clear safety face shield 5. Grinder. 6. Wire Brush. 7. Two steel plate 6" x 2" x 3/8".
Learning Objective:	Individual should be able to prepare all types of joints for welding.
Samples of Behavior:	Trainee will be able to successfully and safely prepare a joint for welding.
Notes:	Any safety violation will result in a test failure.

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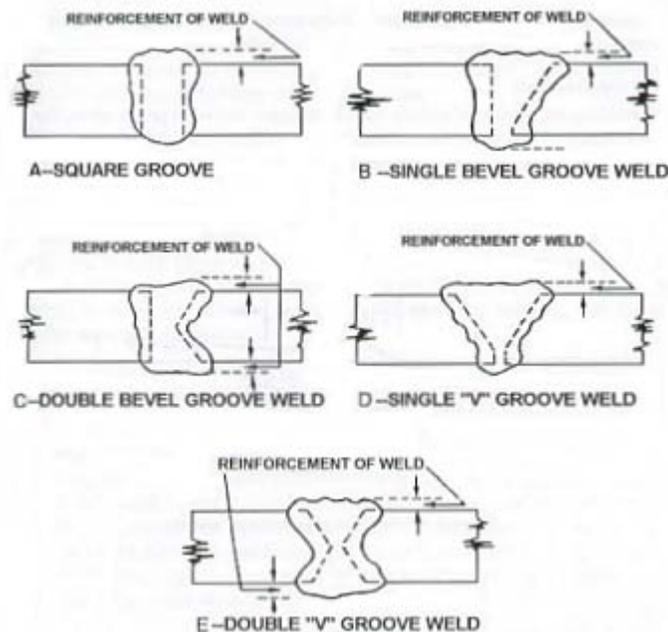
PREPARE JOINTS FOR WELDING

1. Background. The preparation of a joint is one of the most important processes in welding. The selection is sometimes dictated by welding location, blue prints, or other written specifications, but of course the best joint is the most economical one. No matter what type of joint chosen, not applying proper joint preparation can cause a substantial weak joint weld.

SAFETY:

WHEN PREPARING THESE JOINTS BE SURE THAT ALL SAFETY EQUIPMENT IS WORN.

Figure 5-1. Joint Preparation for Butt Joints.



2. View AFQTP Video PIN # 613764: Shielded Metal Arc Welding. Upon completion of the above-mentioned video, properly prepare a joint on a metal plate by using the step-by-step procedures listed below.

NOTE TO TRAINER/CERTIFIER:

For this task have the trainee obtain two pieces of 6" x 2" x $\frac{3}{8}$ " steel plate and prepare them for a butt joint single "V" groove weld. If $\frac{3}{8}$ " steel plate is not available, then substitute the thickness with what available and make the necessary changes in the steps below.

3. Procedures. Follow these steps to perform joint preparations on carbon steel metal:

Step 1: Obtain two 6" x 2" x $\frac{3}{8}$ " steel plates.

Step 2: Ensure metal plates are relatively clean of any, oil, rust, or paint which may hinder welding process.

Step 3: Secure the 2" side of the plate to a table vise, allowing 1" to 1 $\frac{1}{2}$ " of metal protrusion.

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Step 4: Inspect the grinder electrical cord and grinding wheel for defect.

Step 5: Don work gloves, safety glasses, safety face shield, and hearing protection.

Step 6: With very light pressure, grind the top edge evenly flat, and then on one side of exposed end gradually grind a 30-35 degree angle. Refer to Figure 5-1, view D. (For metal $\frac{3}{8}$ " and larger ensure you have a face root of $\frac{1}{16}$ " to $\frac{1}{8}$ " on the metal.)

Step 7: Repeat step 6 for the second steel plate.

Step 8: Check bevel degree accuracy using a T-bevel.

Step 9: Clean joint with wire brush.

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**REVIEW QUESTIONS
FOR
PREPARE JOINTS FOR WELDING**

QUESTION	ANSWER
1. The four types of joints are the butt, lap, edge, and tee joint.	a. True. b. False.
2. What is a correct angle for one edge of a single "V" grooved butt joint?	a. 20 ⁰ . b. 30 ⁰ . c. 50 ⁰ .
3. You can clean a joint with sandpaper before welding.	a. True. b. False.

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PREPARE JOINTS FOR WELDING

PERFORMANCE CHECKLIST

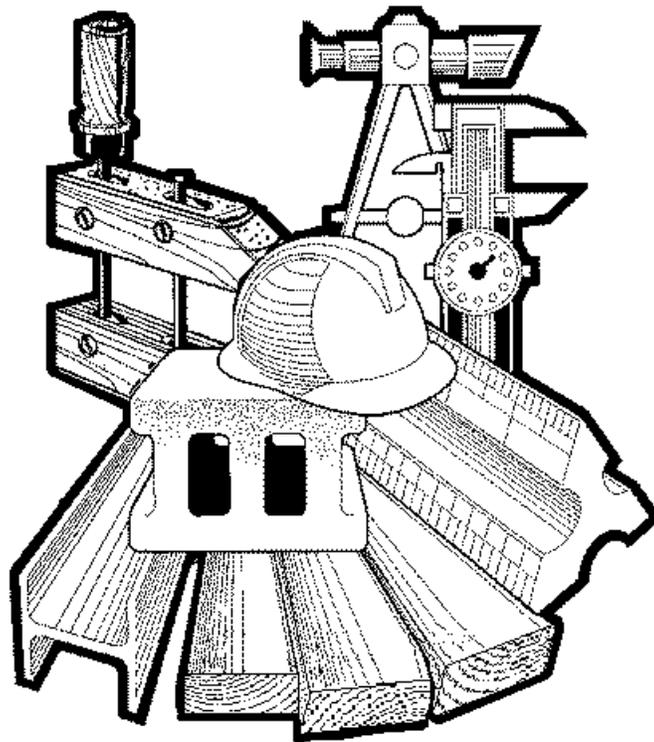
INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE....	YES	NO
1. wear all safety equipment during the task performance?		
2. grind the correct angle on the single "V" grooved butt joint?		
3. have the correct root opening for each joint?		
4. comply with all safety requirements?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

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USE SHIELDED METAL ARC WELDING EQUIPMENT TO WELD CARBON STEEL

BUTT JOINT POSITIONS

MODULE 34

AFQTP UNIT 6

FLAT (34.6.1.1.)

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WELD A CARBON STEEL BUTT JOINT IN THE FLAT POSITION

Task Training Guide

STS Reference Number/Title:	34.6.1.1. – Use shielded metal arc welding equipment to weld a carbon steel butt joint in the flat position.
Training References:	<ol style="list-style-type: none"> 1. Career Development Course (CDC) Structural Journeyman 3E351B, Volume 4, Unit 3, Section 3-3; <i>Preparing and Welding Joints in the Flat Position</i>. 2. Commercial Manual, <i>Welding Skills</i> by R.T. Miller, 1994. 3. Air Force Qualification Training Package (AFQTP) Video PIN # 613764: Shielded Metal Arc Welding.
Prerequisites:	<ol style="list-style-type: none"> 1. Possess as a minimum a 3E331 AFSC. 2. Review the following references: <ol style="list-style-type: none"> 2.1. CDC Structural Journeyman 3E351B, Volume 4, Unit 3, Section 3-3. 2.2. <i>Welding Skills, Shielded Metal-Arc Welding, Chapter 16, Flat Position.</i> Pages 135-137. 3. Complete the following: <ol style="list-style-type: none"> 2.1. AFQTP Video # 613764: <i>Shielded Metal-Arc Welding.</i> 2.2. AFQTP 3E3X1-34, Unit 4; <i>Set-up Welding Machine for a Specific Welding Job</i> and Unit 5; <i>Prepare Joints for Welding.</i>
Equipment/Tools Required:	<ol style="list-style-type: none"> 1. Gloves. 2. Hearing Protection. 3. Eye Protection. 4. Grinder. 5. Wire Brush. 6. Leather Jacket. 7. Chipping Hammer. 8. Welding Hood. 9. Three steel plates 6" x 2" x $\frac{3}{8}$".
Learning Objective:	Individual should be able to weld in the flat position.
Samples of Behavior:	Trainee will be able to successfully and safely weld in a flat position.
Notes:	Any safety violation will result in a test failure.

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WELD A CARBON STEEL BUTT JOINT IN THE FLAT POSITION

1. Background. There are four positions used in welding: flat, horizontal, vertical, and overhead. The flat position is the **most widely used position in the Structural career field**, because the welding can be done faster and easier.

NOTE TO TRAINER:

Ensure trainee is proficient in flat stringer beads welds before performing this task. See Figure 6-1 to determine trainee's proficiency.

Figure 6-1. Arc Welding Results.

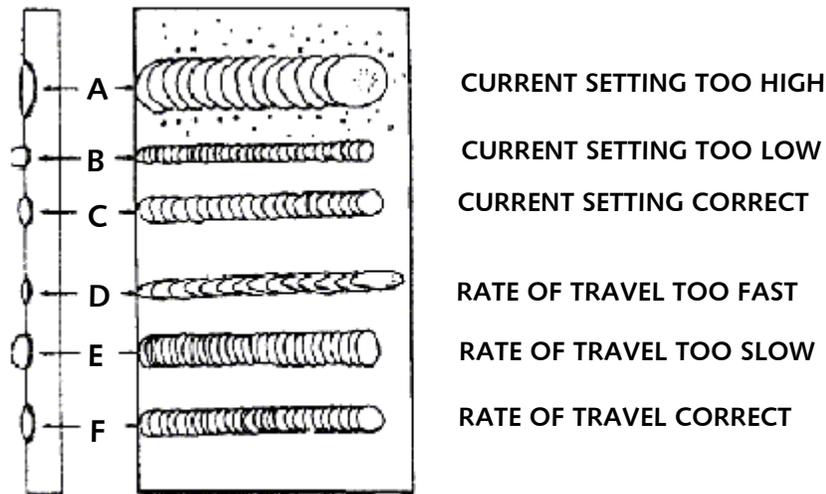
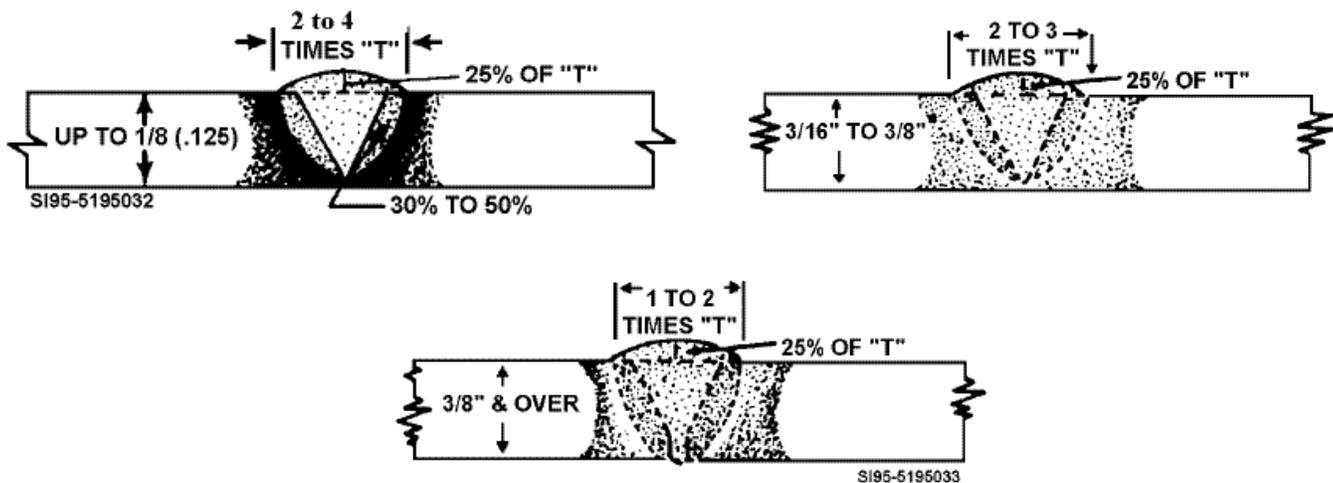


Figure 6-2. Welding Specifications on Flat Weld Butt Joints.

T = Thickness



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SAFETY:

THERE ARE MANY SAFETY HAZARDS WHEN DEALING WITH ARC WELDING, FROM ELECTRICAL SHOCK TO TOXIC FUMES. MAKE SURE THAT ALL SAFETY PRECAUTIONS ARE FOLLOWED WHEN WELDING.

2. View AFQTP Video PIN # 613764: *Shielded Metal Arc Welding*. Upon completion of the above-mentioned video, properly weld two carbon steel pieces by utilizing the butt joint flat position step-by-step procedures listed below.

NOTE TO TRAINER/CERTIFIER:

For this task have the trainee obtain three pieces of 6" x 2" x $\frac{3}{8}$ " steel plate (the trainee can use the two pieces of metal from unit 5). Provide the trainee with the electrode (welding rod) nomenclature. Then have the trainee follow the below steps in welding a butt joint in the flat position and inspect weld using the specification in Figure 6-2. If $\frac{3}{8}$ " steel plate is not available, then substitute the thickness with what available and make the necessary changes in the steps below.

3. Procedures. Follow these steps to weld a carbon steel butt joint in the flat position:

SAFETY:

WHEN WELDING, ALL SAFETY EQUIPMENT MUST BE WORN AT ALL TIMES!

Step 1: Obtain 3 pieces of 6" x 2" x $\frac{3}{8}$ " steel plates.

Step 2: Don all safety equipment.

Step 3: Perform joint preparations on two of the plates. (Refer to AFQTP 3E3X1-34, Unit 5 for joint preparations.)

Step 4: Pre-select amperage and AC/DC current setting. (Refer to AFQTP 3E3X1-34, Unit 4 for equipment set-up procedures.)

Step 5: Perform a test weld on third plate to ensure amperage setting accuracy. (Refer to Figure 6-1 for proper setting.)

Step 6: Place remaining plates to appropriate root space, tack, and weld butt joint in a flat position.

Step 7: Chip and clean weld deposits after each pass.

Step 8: Give plate to trainer/certifier for inspection. (Trainer/Certifier perform visual inspection using the weld specification in Figure 6-2 for $\frac{3}{8}$ " and over.)

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**REVIEW QUESTIONS
FOR
WELD A CARBON STEEL BUTT JOINT IN THE FLAT POSITION**

QUESTION	ANSWER
1. The flat position is the easiest position to weld.	a. True. b. False.
2. What is the first pass called when arc welding?	a. Root. b. Filler. c. Cover. d. Initial.
3. What is the last pass called when arc welding?	a. Filler. b. Cover. c. Root. d. Initial.

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WELD A CARBON STEEL BUTT JOINT IN THE FLAT POSITION

PERFORMANCE CHECKLIST

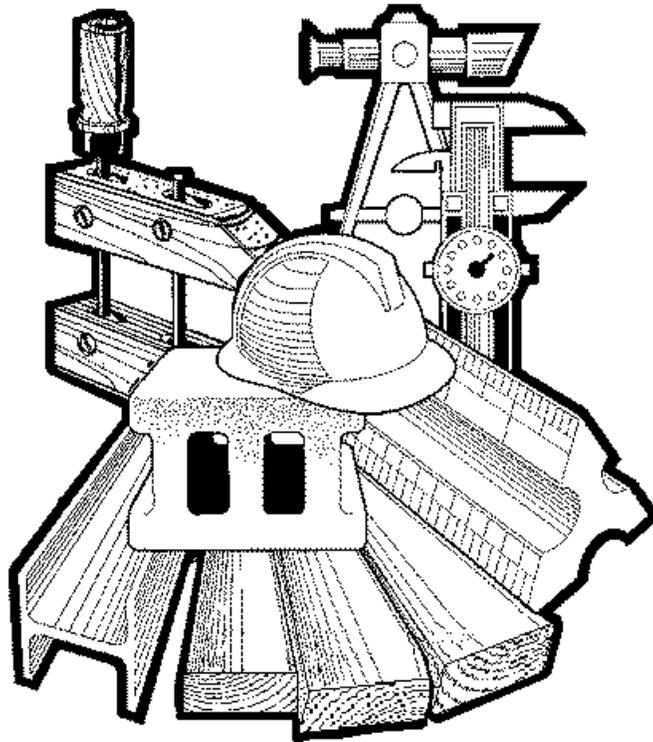
INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE....	YES	NO
1. wear all safety equipment during the task performance?		
2. prepare joint preparation correctly?		
3. have the correct root spacing?		
4. clean the metal before the welding began?		
5. keep the correct angle through out the weld?		
6. complete the weld by chipping the slag and cleaning with a wire brush?		
7. comply with all safety requirements?		
8. flat butt joint meet all weld specifications?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

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USE SHIELDED METAL ARC WELDING EQUIPMENT TO WELD CARBON STEEL

BUTT JOINT POSITIONS

MODULE 34

AFQTP UNIT 6

VERTICAL (34.6.1.3.)

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WELD A CARBON STEEL BUTT JOINT IN THE VERTICAL POSITION

Task Training Guide

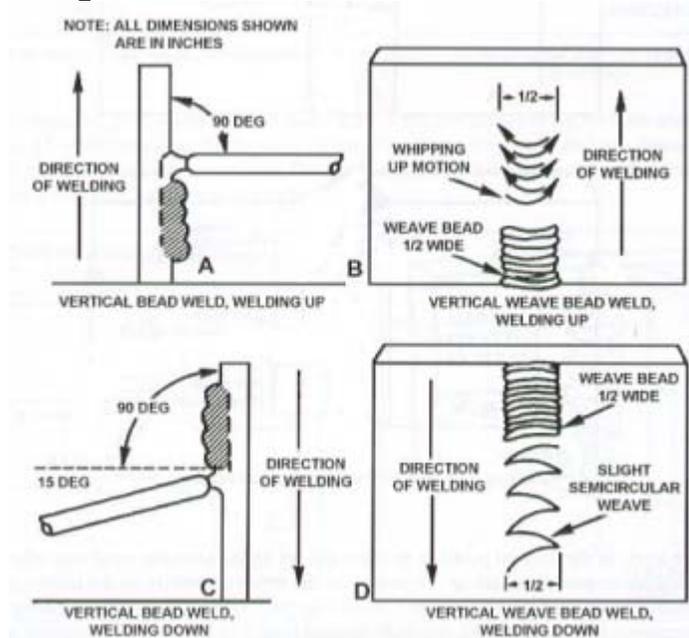
STS Reference Number/Title:	34.6.1.3. - Use shielded metal arc welding equipment to weld a carbon steel butt joint in the vertical position.
Training References:	<ol style="list-style-type: none"> 1. Career Development Course (CDC) Structural Journeyman 3E351B, Volume 4, Unit 3, Section 3-4, Lesson 612; <i>Vertical Position Welding</i>. 2. Commercial Manual, <i>Welding Skills</i> by R. T. Miller, 1994. 3. Air Force Qualification Training Package (AFQTP) Video PIN # 613764: Shielded Metal Arc Welding.
Prerequisites:	<ol style="list-style-type: none"> 1. Possess as a minimum a 3E331 AFSC. 2. Review the following references: <ol style="list-style-type: none"> 2.1. CDC Structural Journeyman 3E351B, Volume 4, Unit 3, Section 3-4, Lesson 616. 2.2. <i>Welding Skills, Shielded Metal-Arc Welding, Chapter 18, Vertical Position.</i> 3. Complete the following: <ol style="list-style-type: none"> 3.1. AFQTP Video # 613764: <i>Shielded Metal-Arc Welding.</i> 3.2. AFQTP 3E3X1-34, Unit 4; <i>Set-up Welding Machine for a Specific Welding Job</i> and Unit 5; <i>Prepare Joints for Welding.</i>
Equipment/Tools Required:	<ol style="list-style-type: none"> 1. Gloves. 2. Hearing Protection. 3. Eye Protection. 4. Grinder. 5. Wire Brush. 6. Leather Jacket. 7. Chipping Hammer. 8. Welding Hood. 9. Three steel plates 6" x 2" x 1/4".
Learning Objective:	Trainee should be able to weld vertical joints.
Samples of Behavior:	Trainee will be able to successfully and safely weld a vertical joint.
Notes:	
Any safety violation will result in a test failure.	

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WELD A CARBON STEEL BUTT JOINT IN THE VERTICAL POSITION

1. Background. A vertical weld is a joint or line that is running up and down. Most often structural technicians will utilize this technique while out in the field or a task that has no alternative to weld in the flat or horizontal position. One of the problems of vertical welding is that gravity tends to pull down the molten pool. Puddle control can be achieved by using several types of welding beads. There are two basic types of vertical welds: *vertical up* and *vertical down*. *Vertical down* is used for lighter gage metal because penetration is shallow. *Vertical up* is practical on metal thickness $\frac{1}{4}$ -inch and up and to achieve maximum penetration. Below is an example of vertical up and down welding.

Figure 6-3. Bead Welding in the Vertical Position.



SAFETY:

THERE ARE MANY SAFETY HAZARDS WHEN DEALING WITH ARC WELDING, FROM ELECTRICAL SHOCK TO TOXIC FUMES. MAKE SURE THAT ALL SAFETY PRECAUTIONS ARE FOLLOWED WHEN WELDING.

2. View AFQTP Video PIN # 613764: Shielded Metal Arc Welding. Upon completion of the above-mentioned video, properly weld two carbon steel pieces by utilizing the butt joint vertical position step-by-step procedures listed below.

NOTE TO TRAINER/CERTIFIER:

For this task have the trainee obtain three pieces of 6" x 2" x $\frac{1}{4}$ " steel plate. Provide the trainee with the electrode (welding rod) nomenclature. Then have the trainee follow the below steps in welding a butt joint in the vertical position and inspect weld using the specification in Unit 6, Figure 6-2. If $\frac{1}{4}$ " steel plate is not available, then substitute the thickness with what available and make the necessary changes in the steps below.

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

3. Procedures. Follow these steps to weld a carbon steel butt joint in the vertical position:

SAFETY:

WHEN WELDING, ALL SAFETY EQUIPMENT MUST BE WORN AT ALL TIMES!

Step 1: Obtain 3 pieces of 6" x 2" x $\frac{1}{4}$ " steel plates.

Step 2: Don all safety equipment.

Step 3: Ensure metal plates are relatively clean of any, oil, rust, or paint which may hinder welding process.

Step 4: Perform joint preparations on two of the plates. (Refer to AFQTP 3E3X1-34, Unit 5 for joint preparations.)

Step 5: Pre-select amperage and AC/DC current setting. (Refer to AFQTP 3E3X1-34, Unit 4 for equipment set-up procedures.)

Step 6: Perform a test weld on third plate to ensure amperage setting accuracy. (Refer to Unit 6, Figure 6-1 for proper setting.)

Step 7: Tack weld the remaining plates in the flat position with a $\frac{1}{16}$ " root opening and use a table vise to hold test plates in the upright position to provide a vertical butt joint.

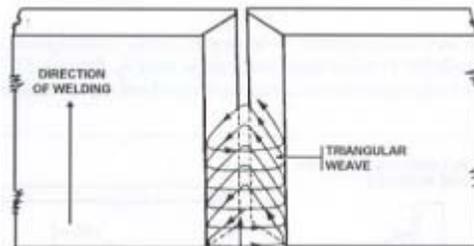
Step 8: Start welds at the bottom of the plate with a short whipping arc and carefully controlling the motion by using a triangular weave motion, as shown in Figure 6-4.

Step 9: Chip and clean weld deposits.

NOTE:

If multiple passing is performed ensure cleaning after each weld.

Figure 6-4. Butt Joint Weld (Triangular Weave).



Step 10: Give plate to trainer/certifier for inspection. (Trainer/Certifier perform visual inspection using the weld specification in Unit 6, Figure 6-2 for $\frac{3}{16}$ " to $\frac{3}{8}$ ".)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

**REVIEW QUESTIONS
FOR
WELD A CARBON STEEL BUTT JOINT IN THE VERTICAL POSITION**

QUESTION	ANSWER
1. One of the problems of vertical welding is gravity tends to pull down on the weld?	a. True. b. False.
2. Vertical up and vertical down are the two types of vertical welding.	a. True. b. False.
3. When performing vertical up welding, you should strike the arc at the _____ of the metal and use a whipping action after the arc is achieved.	a. bottom b. middle c. top d. side

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

WELD A CARBON STEEL BUTT JOINT IN THE VERTICAL POSITION

PERFORMANCE CHECKLIST

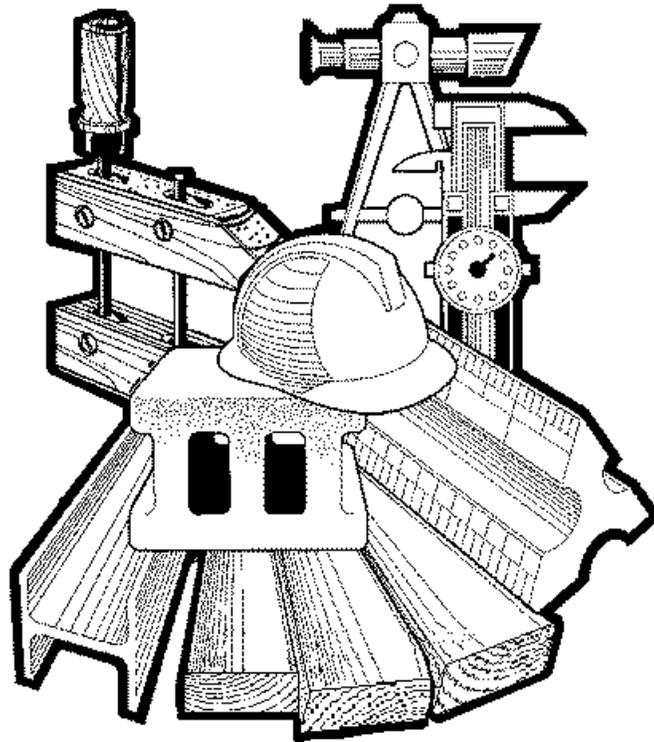
INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE....	YES	NO
1. wear all safety equipment during the task performance?		
2. prepare joint preparation correctly?		
3. have the correct root spacing?		
4. clean the metal before the welding began?		
5. perform both vertical welding types (vertical up and vertical down if required) correctly?		
6. complete the weld by chipping the slag and cleaning with a wire brush?		
7. comply with all safety requirements?		
8. vertical butt joint meet all weld specifications?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.



USE SHIELDED METAL ARC WELDING EQUIPMENT TO WELD CARBON STEEL

LAP JOINT POSITIONS

MODULE 34

AFQTP UNIT 6

FLAT (34.6.2.1.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

WELD A CARBON STEEL LAP JOINT IN THE FLAT POSITION
Task Training Guide

STS Reference Number/Title:	34.6.2.1. - Use shielded metal arc welding equipment to weld a carbon steel lap joint in the flat position.
Training References:	<ol style="list-style-type: none"> 1. Career Development Course (CDC) Structural Journeyman 3E351B, Volume 4, Unit 3, Section 3-3; Lesson 609; <i>Lap- and Tee- Joint Procedures</i>. 2. Commercial Manual, <i>Welding Skills</i> by R.T. Miller, 1994. 3. Air Force Occupational Safety and Health Standard (AFOSHSTD) 91-5, Welding, Cutting, and Brazing. 4. Technical Order (TO) 34W4-1-5, Welding Theory and Application. 5. Navy Advancement Training (NAVEDTRA) Course, 14250, Steelworker Volume 1.
Prerequisites:	<ol style="list-style-type: none"> 1. Possess as a minimum a 3E331 AFSC. 2. Review the following references: <ol style="list-style-type: none"> 2.1. CDC Structural Journeyman 3E351B, Volume 4, Unit 3, Section 3-3, Lesson 609. 2.2. <i>Welding Skills, Shielded Metal-Arc Welding, Chapter 16, Flat Position.</i> 2.3. NAVEDTRA 14250, Chapter 7, <i>Shielded Metal Arc Welding and Wear Facing</i>; Pages, 7-13 to 7-15, <i>Flat-Position Welding.</i>
Equipment/Tools Required:	<ol style="list-style-type: none"> 1. Welding Machine. 2. Welding Hood. 3. Leather Jacket. 4. Safety glasses 5. Welding Gloves. 6. Chipping Hammer. 7. Wire Brush. 8. Three pieces of steel 4" x 6" x ¼".
Learning Objective:	Trainee should be able to use shielded metal arc to weld a carbon steel lap joint in the flat position.
Samples of Behavior:	Trainee will be able to demonstrate the use of shielded metal arc to weld a carbon steel lap joint in the flat position.
Notes:	Any safety violation will result in a test failure.

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

WELD A CARBON STEEL LAP JOINT IN THE FLAT POSITION

1. Background. The lap joint flat position is one of the most frequently used lap welding joints. It is a relatively simple joint since no beveling or machining is necessary. One standard requirement is to have a clean, evenly aligned surface. The joint consists of lapping one edge over another and joining. For the structural technician the most common use for a lap joint welds are cover plates, quick fixes where flush surfacing is not required, and adding additional metal protection to facilities.

2. Flat Lap Joints. The two most common lap joints used to join metals by arc welding are the single fillet lap joint and the double fillet lap joint as shown in Figure 6-5. The single fillet lap joint is used frequently, since it requires no preparation to the edges of the plate. If the loading is not too severe, this joint is suitable for welding plates of all thickness; but if fatigue or impact loads are encountered, concentrations of stress will occur at the edge of the weld. Under tension, the plates will pull out of line, thus subjecting the root to bending. The double-fillet lap joint is suitable for more severe loading conditions than can be met by the single-fillet lap joints.

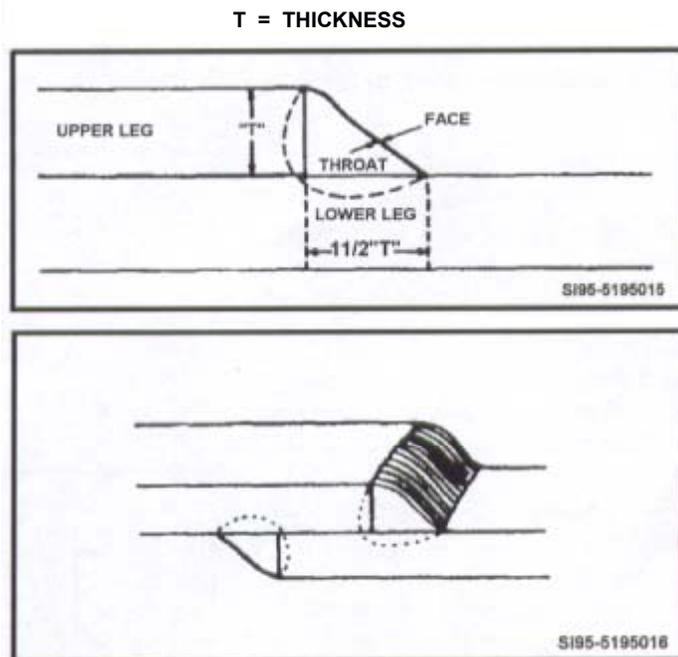
NOTE:

Lap joints are not desirable under fatigue or impact, but they're capable of developing high efficiency under shear and tension stresses.

Figure 6-5. Single- and Double-Fillet Lap Joint in Flat Position.

3. Weld Specification. The following is a list of weld specification for lap joints in the flat position. (T = Thickness of Plate).

- 3.1. Minimum overlap:** 3 T
- 3.2. Upper Leg:** 1T
- 3.3. Lower Leg:** 1 ½T
- 3.4. Penetration:** 1/16-inch minimum for metals over 1/8-inch thick.
- 3.5. Bead Contour:** Even to slightly convex.
- 3.6. Bead Height:** No more than 1/8-inch from highest to lowest point on the finished bead.



NOTE TO TRAINER/CERTIFIER:

For this task have the trainee obtain three pieces of 4" x 6" x 1/4" steel plate. Provide the trainee with the electrode (welding rod) nomenclature. Then have the trainee follow the below steps in welding a single-fillet lap joint in the flat position and inspect weld using the specification in paragraph 3. If 1/4" steel plate is not available, then substitute the thickness with what available and make the necessary changes in the steps below.

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

SAFETY:

THERE ARE MANY SAFETY HAZARDS WHEN DEALING WITH ARC WELDING, FROM ELECTRICAL SHOCK TO TOXIC FUMES. MAKE SURE THAT ALL SAFETY PRECAUTIONS ARE FOLLOWED WHEN WELDING.

4. Procedures. Follow these steps to weld a carbon steel single-fillet lap joint in the flat position:

SAFETY:

WHEN WELDING, ALL SAFETY EQUIPMENT MUST BE WORN AT ALL TIMES!

Step 1: Obtain 3 pieces of 4" x 6" x $\frac{1}{4}$ " steel plates.

Step 2: Don all safety equipment.

Step 3: Ensure metal plates are relatively clean of any, oil, rust, or paint which may hinder welding process.

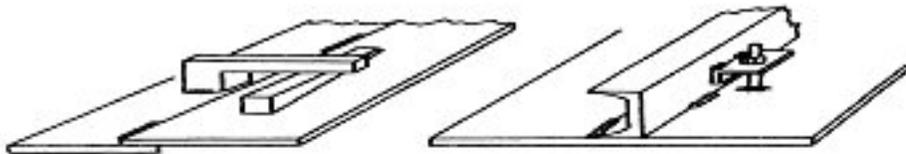
Step 4: When joining metal thickness greater than $\frac{1}{8}$ -inch, the edges of the sheet should overlap approximately three to four times the metal thickness.

Step 4: Pre-select amperage and AC/DC current setting. (Refer to AFQTP 3E3X1-34, Unit 4 for equipment set-up procedures.)

Step 5: Perform a test weld on third plate to ensure amperage setting accuracy. (Refer to Unit 6, Figure 6-1 for proper setting.)

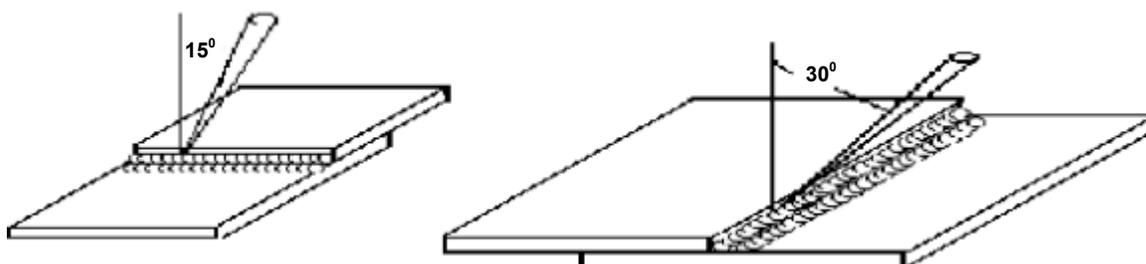
Step 6: Tack welds plates at each end. If you must force the fit up by means of dogs, as illustrated in Figure 6-6, short welds are preferred to tack welds.

Figure 6-6. Using Fit Up Dogs.



Step 7: Hold the electrode at an angle of 30° from vertical, and tilt the top of the electrode to an angle of 15° in the direction of travel, as shown in Figure 6-7.

Figure 6-7. Angle of Electrode.



Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

Step 8: Strike and hold a long arc momentarily at the start of the weld to ensure penetration.

8.1. Heavy plates conduct heat away more quickly than light sheets; therefore, the speed of travel should be slower.

8.2. For the same reason, higher current values may be used on heavy work.

8.3. Direct the arc so that penetration will be obtained in both the upper and lower plates.

8.4. When one pass or bead **will not** provide the proper size of weld, make a multiple-pass fillet weld.

NOTE:

In making lap joints on plates of different thickness, hold the electrode at an angle of approximately 20° from vertical. Take care not to overheat or undercut the thinner plate edge.

Step 9: Chip and clean weld deposit.

NOTE:

If multiple passing is performed ensure cleaning after each weld.

Step 10: Give plate to trainer/certifier for inspection. (Trainer/Certifier perform visual inspection using the weld specification in paragraph 3).

**REVIEW QUESTIONS
FOR
WELD A CARBON STEEL LAP JOINT IN THE FLAT POSITION**

QUESTION	ANSWER
1. Which is the most frequently used joint?	a. Tee Joint. b. Lap Joint. c. Vertical Joint.
2. What are the two most common types of lap joints used to join metal?	a. Tee and Single-Fillet. b. Tee and Butt. c. Single-Fillet and Double-Fillet. d. Double-Fillet and Butt.
3. A single-fillet lap joint is the strongest lap joint possible.	a. True. b. False.
4. How much should a ¼" plate overlap the other?	a. 1-inch. b. 2-inch. c. ½-inch. d. ¼-inch.

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

WELD A CARBON STEEL LAP JOINT IN THE FLAT POSITION

PERFORMANCE CHECKLIST

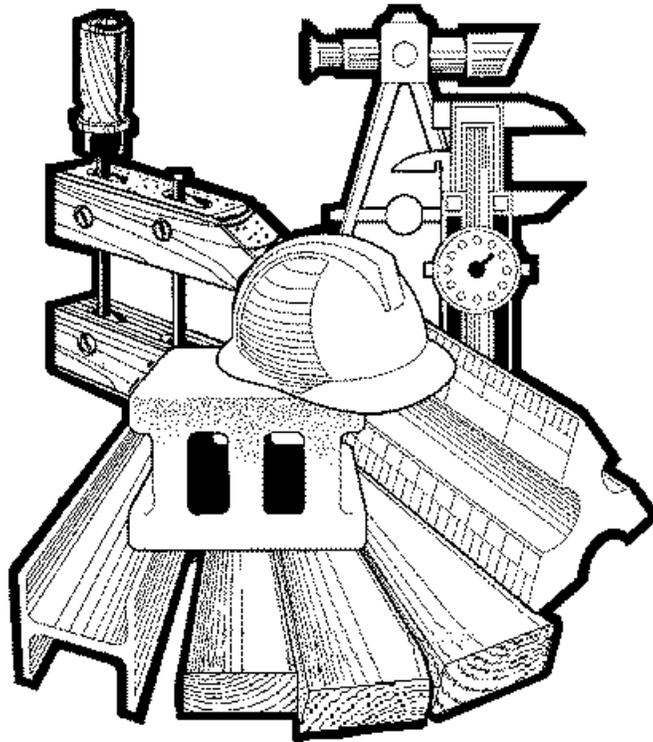
INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE....	YES	NO
1. wear all safety equipment during the task performance?		
2. clean the metal before the welding began?		
3. correctly overlap the joint for the thickness of the plate?		
4. tack welds at the correct intervals?		
5. keep the correct angle throughout the weld?		
6. complete the weld by chipping the slag and cleaning with a wire brush?		
7. comply with all safety requirements?		
8. flat lap joint meet all weld specifications?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.



USE SHIELDED METAL ARC WELDING EQUIPMENT TO WELD CARBON STEEL

LAP JOINT POSITIONS

MODULE 34

AFQTP UNIT 6

VERTICAL (34.6.2.3.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

WELD A CARBON STEEL LAP JOINT IN THE VERTICAL POSITION
Task Training Guide

STS Reference Number/Title:	34.6.2.3. - Use shielded metal arc welding equipment to weld a carbon steel lap joint in the vertical position.
Training References:	<ol style="list-style-type: none"> 1. Career Development Course (CDC) Structural Journeyman 3E351B, Volume 4, Unit 3, Section 3-3; Lesson 609; <i>Lap- and Tee- Joint Procedures</i>. 2. Commercial Manual, <i>Welding Skills</i> by R.T. Miller, 1994. 3. Air Force Occupational Safety and Health Standard (AFOSHSTD) 91-5, Welding, Cutting, and Brazing. 4. Technical Order (TO) 34W4-1-5, Welding Theory and Application. 5. Navy Advancement Training (NAVEDTRA) Course, 14250, Steelworker Volume 1.
Prerequisites:	<ol style="list-style-type: none"> 1. Possess as a minimum a 3E331 AFSC. 2. Review the following references: <ol style="list-style-type: none"> 2.1. CDC Structural Journeyman 3E351B, Volume 4, Unit 3, Section 3-3, Lesson 609. 2.2. <i>Welding Skills, Shielded Metal-Arc Welding, Chapter 18, Vertical Position.</i> 2.3. NAVEDTRA 14250, Chapter 7, <i>Shielded Metal Arc Welding and Wear Facing</i>; Pages, 7-18 to 7-21, <i>Vertical-Position Welding.</i>
Equipment/Tools Required:	<ol style="list-style-type: none"> 1. Welding Machine. 2. Welding Hood. 3. Safety glasses 4. Leather Jacket. 5. Welding Gloves. 6. Chipping Hammer. 7. Wire Brush. 8. Three pieces of steel plate 4" x 6" 1/4".
Learning Objective:	Trainee should be able to use shielded metal arc to weld a carbon steel lap joint in the vertical position.
Samples of Behavior:	Trainee will be able to demonstrate the use of shielded metal arc to weld a carbon steel lap joint in the vertical position.
Notes:	Any safety violation will result in a test failure.

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

WELD A CARBON STEEL LAP JOINT IN THE VERTICAL POSITION

1. Background. Welding on a vertical surface is more difficult than welding in the flat position because the force of gravity tends to cause metal to flow downward. For this reason the current settings should be lower than those used for the same electrode in the flat position, and the currents used for welding upward on vertical plates should be slightly higher than those used for welding downward on the same plate. The proper angle between the electrode and the base metal is also necessary in order to deposit a good bead weld in vertical welding.

2. Vertical Lap Joints.

2.1. The electrode used for vertical welding is a heavy-coated, reverse-polarity electrode, which has slightly lighter coatings than the type used only for flat-position welding. Electrodes of this type allow the weld metal and slag to solidify quickly. Since the greater amount of heat is at the positive side of the welding circuit (the tip of an electrode), you can get penetration more easily with reverse polarity. This serves as an aid in a position in which penetration is otherwise difficult to get.

2.2. When using coated electrodes in the vertical position, it is necessary to use smaller electrodes at lower current settings, as compared with those for flat-position welding. Use of smaller electrodes is an aid in maintaining a small pool of molten metal, permitting surface tension to overcome the force of gravity. The current settings recommended by the electrode manufacturer are your guides when you are making initial settings for a given electrode size.

3. Weld Specification. The following is a list of weld specification for lap joints in the vertical position. (T = Thickness of Plate).

3.1. Minimum overlap: 3 T (Thickness)

3.2. Upper Leg: 1T

3.3. Lower Leg: 1 ½T

3.4. Penetration: 1/16-inch minimum for metals over 1/8-inch thick.

3.5. Bead Contour: Even to slightly convex.

3.6. Bead Height: No more than 1/8-inch from highest to lowest point on the finished bead.

NOTE TO TRAINER/CERTIFIER:

For this task have the trainee obtain three pieces of 4" x 6" x 1/4" steel plate or use the reverse side of the flat lap joint used in the previous unit. Provide the trainee with the electrode (welding rod) nomenclature. Then have the trainee follow the below steps in welding a single-fillet lap joint in the vertical position and inspect weld using the specification in paragraph 3. If 1/4" steel plate is not available, then substitute the thickness with what available and make the necessary changes in the steps below.

SAFETY:

THERE ARE MANY SAFETY HAZARDS WHEN DEALING WITH ARC WELDING, FROM ELECTRICAL SHOCK TO TOXIC FUMES. MAKE SURE THAT ALL SAFETY PRECAUTIONS ARE FOLLOWED WHEN WELDING.

4. Procedures. Follow these steps to weld a carbon steel single-fillet lap joint in the vertical position:

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

SAFETY:

WHEN WELDING, ALL SAFETY EQUIPMENT MUST BE WORN AT ALL TIMES!

Step 1: Obtain 3 pieces of 4" x 6" x 1/4" steel plates or use the reverse side of the flat lap joint for this task.

Step 2: Don all safety equipment.

Step 3: Ensure metal plates are relatively clean of any, oil, rust, or paint which may hinder welding process.

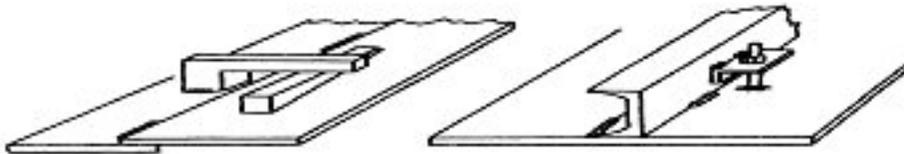
Step 4: Overlap metal edges of the test plate and overlap approximately 2 to 3 times the metal thickness (thickness greater than 1/8-inch, must overlap three to four times the metal thickness).

Step 5: Pre-select amperage and AC/DC current setting. (Refer to AFQTP 3E3X1-34, Unit 4 for equipment set-up procedures.)

Step 6: Perform a test weld on third plate to ensure amperage setting accuracy. (Refer to Unit 6, Figure 6-1 for proper setting.)

Step 7: Tack welds plates at each end. If you must force the fit up by means of dogs, as illustrated in Figure 6-8, short welds are preferred to tack welds.

Figure 6-8. Using Fit Up Dogs.



Step 8: Secure the piece in a vertical position by tacking it to a flat scrap piece or by mounting it in a vise.

Step 9: Strike the arc on the bottom of the plate. Hold your electrode at 90-degree angle and focus most of your heat at the base plate. Deposit a small stringer bead in the root without any electrode motion.

Step 10: If performing layer beads thoroughly clean each layer and deposit succeeding layers. The precautions outlined above ensure good fusion and uniform weld-metal deposit in lap joints in the vertical position.

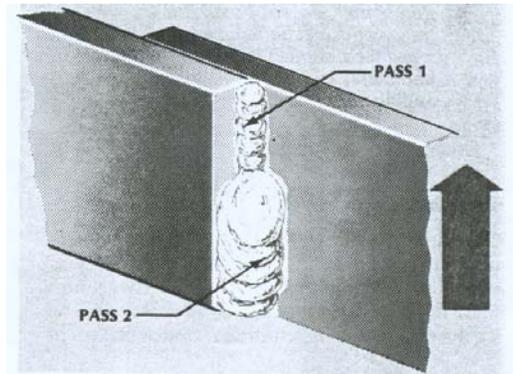
Step 11: Deposit a cover pass using a weaving motion from the bottom to the top. (Make certain the second pass completely penetrates the first pass, as shown in Figure 6-9).

11.1. Strike and hold a short arc and pause slightly longer at the surface of plate. (To establish the arc hold a long arc momentarily, then shorten it. Use a short arc for better arc control).

11.2. Be careful not to undercut either of the plates or to allow the molten metal to overlap at the edges of the weave.

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

Figure 6-9. Vertical Up Lap Joint.



Step 12: Chip and clean weld deposit.

Step 13: Give plate to trainer/certifier for inspection. (Trainer/Certifier perform visual inspection using the weld specification in paragraph 3).

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

**REVIEW QUESTIONS
FOR
WELD A CARBON STEEL LAP JOINT IN THE VERTICAL POSITION**

QUESTION	ANSWER
1. What makes welding in the vertical position so difficult?	a. Murphy's Law. b. Gravity. c. Welders Experience. d. Steady Hand.
2. In what position should the electrode be held in vertical up welding?	a. 80-degree's b. 70-degree's c. 90-degre's d. 65-degre's
3. What type of electrode is commonly used in vertical welding?	a. Light-coated, straight polarity. b. Light-coated, reverse polarity. c. Heavy-coated, straight polarity. d. Heavy-coated, reverse polarity.
4. How much should a 1/4" plate overlap the other?	a. 1-inch. b. 2-inch. c. 1/2-inch. d. 1/4-inch.
5. What type of motion should you apply for a cover pass?	a. Whipping. b. No Motion. c. Weaving. d. Stop-Start.

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

WELD A CARBON STEEL LAP JOINT IN THE VERTICAL POSITION

PERFORMANCE CHECKLIST

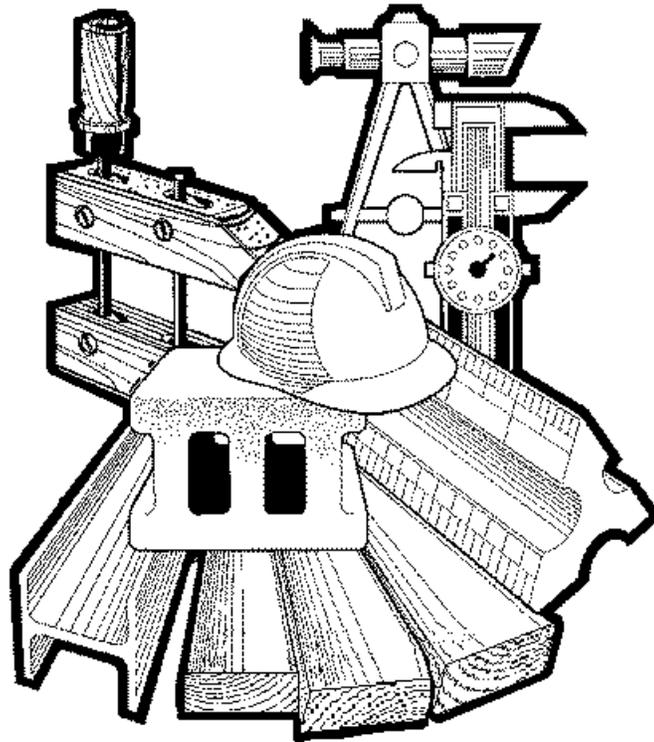
INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE....	YES	NO
1. wear all safety equipment during the task performance?		
2. clean the metal before the welding began?		
3. correctly overlap the joint for the thickness of the plate?		
4. tack welds at the correct intervals?		
5. keep the correct angle through out the weld?		
6. complete the weld by chipping the slag and cleaning with a wire brush?		
7. comply with all safety requirements?		
8. vertical lap joint meet all weld specifications?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.



USE SHIELDED METAL ARC WELDING EQUIPMENT TO WELD CARBON STEEL

TEE JOINT POSITIONS

MODULE 34

AFQTP UNIT 6

FLAT (34.6.3.1.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

WELD A CARBON STEEL TEE JOINT IN THE FLAT POSITION
Task Training Guide

STS Reference Number/Title:	34.6.3.1. - Use shielded metal arc welding equipment to weld a carbon steel tee joint in the flat position.
Training References:	<ol style="list-style-type: none"> 1. Career Development Course (CDC) Structural Journeyman 3E351B, Volume 4, Unit 3, Section 3-3; Lesson 609; <i>Lap- and Tee- Joint Procedures</i>. 2. Commercial Manual, <i>Welding Skills</i> by R.T. Miller, 1994. 3. Air Force Occupational Safety and Health Standard (AFOSHSTD) 91-5, Welding, Cutting, and Brazing. 4. Technical Order (TO) 34W4-1-5, Welding Theory and Application. 5. Navy Advancement Training (NAVEDTRA) Course, 14250, Steelworker Volume 1.
Prerequisites:	<ol style="list-style-type: none"> 1. Possess as a minimum a 3E331 AFSC. 2. Review the following references: <ol style="list-style-type: none"> 2.1. CDC Structural Journeyman 3E351B, Volume 4, Unit 3, Section 3-3, Lesson 609. 2.2. <i>Welding Skills, Shielded Metal-Arc Welding, Chapter 16, Flat Position.</i> 2.3. NAVEDTRA 14250, Chapter 7, <i>Shielded Metal Arc Welding and Wear Facing</i>; Pages, 7-13 to 7-15, <i>Flat-Position Welding.</i>
Equipment/Tools Required:	<ol style="list-style-type: none"> 1. Welding Machine. 2. Welding Hood. 3. Leather Jacket. 4. Safety glasses 5. Welding Gloves. 6. Chipping Hammer. 7. Wire Brush. 8. Three pieces of steel plate 3" x 6" x ¼".
Learning Objective:	Trainee should be able to use shielded metal arc to weld a carbon steel Tee joint in the flat position.
Samples of Behavior:	Trainee will be able to demonstrate the use of shielded metal arc to weld a carbon steel Tee joint in the flat position.
Notes:	Any safety violation will result in a test failure.

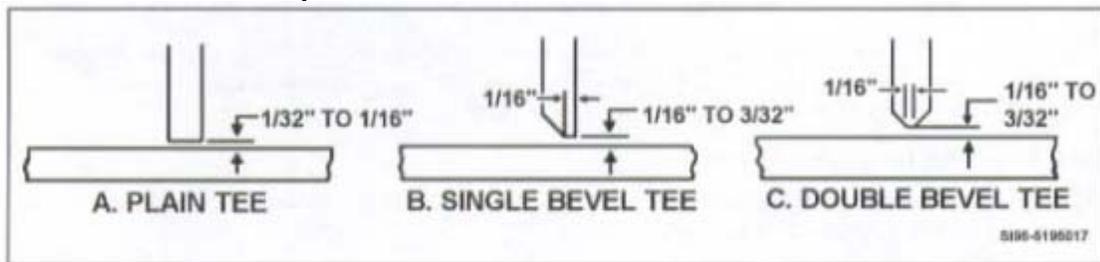
Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

WELD A CARBON STEEL TEE JOINT IN THE FLAT POSITION

1. Background. A tee joint is formed when the edge of one plate is joined approximately perpendicular to the face of another plate. The weld in this joint is a fillet weld and is generally triangular in cross section. It is a very rigid joint and is used extensively in structural work, for example steel columns and steel beams.

2. Tee Joints Preparation. View A of Figure 6-10 shows a square edge or plain tee joint used for joining metals up to $\frac{5}{16}$ " thick in which no edge preparation is required. You may weld from one or both sides, depending on the strength desired. When heavier metal is involved, up to $\frac{3}{8}$ ", use a single bevel, as shown in view B of Figure 6-10, and weld the joint from one side. View C of Figure 6-10 shows a double-bevel tee joint used on steel over $\frac{1}{2}$ " thick, with the joint welded from both sides.

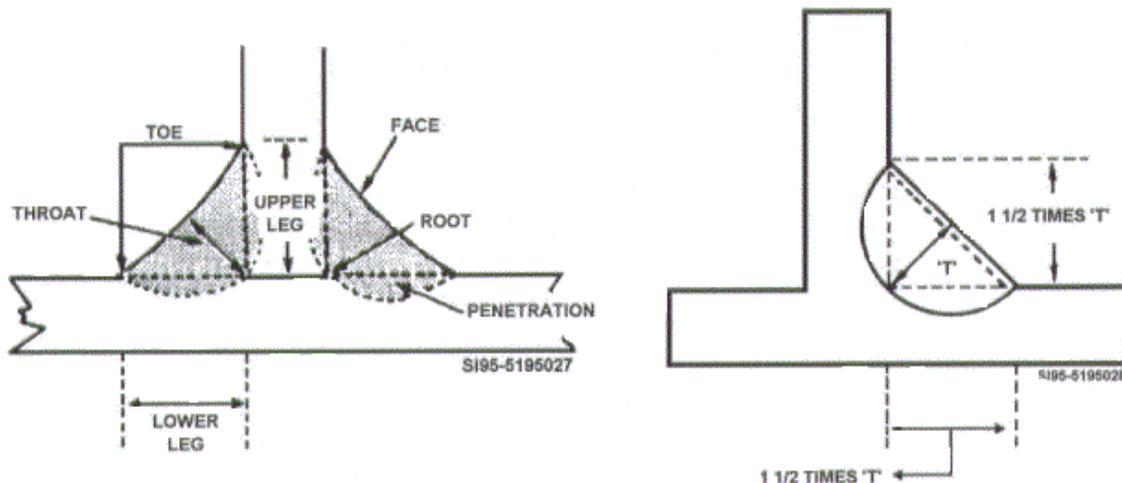
Figure 6-10. Tee Joint Preparation.



3. Weld Specification. The following is a list of weld specification for tee joints in the flat position. (T = Thickness of Plate).

- 3.1. **Upper Leg:** $1 \frac{1}{2}T$ (Thickness)
- 3.2. **Lower Leg:** $1 \frac{1}{2}T$
- 3.3. **Bead Height:** $\frac{1}{8}$ -inch from the highest to lowest point on the weld.
- 3.4. **Bead Contour:** Slightly concave.
- 3.5. **Penetration:** $\frac{1}{16}$ -inch minimum for metals over $\frac{1}{8}$ -inch.

Figure 6-11. Tee Joint Nomenclature and Specification.



Notice. This AFQTP is NOT intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

4. Welding Tip. When welding Tee joints in the flat and horizontal position, the direction of travel will be 75- degree's, Figure 6-12. Even when performing multiple welds each layers has different plate angles shown in Figure 6-13. **Remember the direction of travel will remain the same.**

Figure 6-12. Electrode Angle For A Tee Joint In A Flat Position.

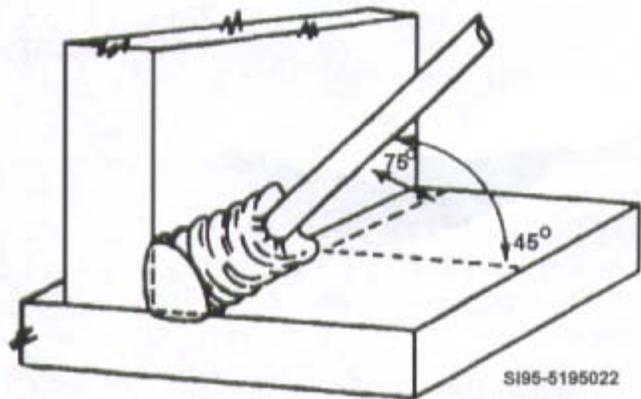
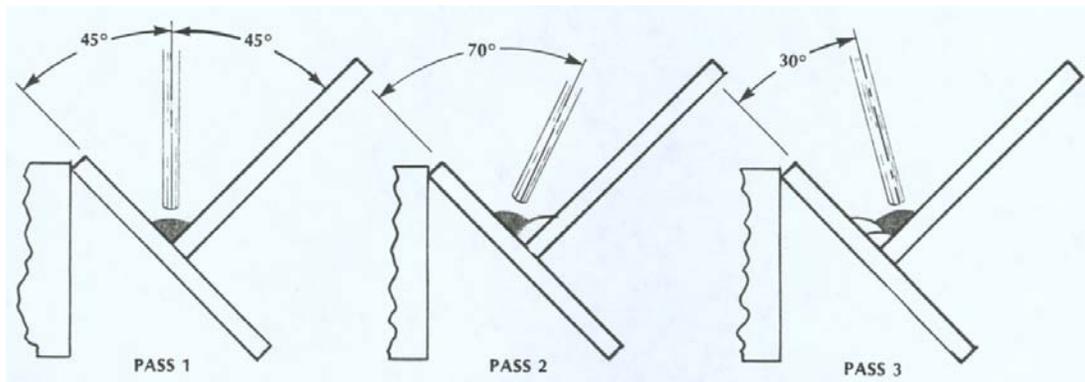


Figure 6-13. Multiple-Pass Tee-Fillet Joint.



NOTE TO TRAINER/CERTIFIER:

For this task have the trainee obtain three pieces of 3" x 6" x 1/4" steel plate. Provide the trainee with the electrode (welding rod) nomenclature. Then have the trainee follow the below steps in welding a tee joint in the flat position and inspect weld using the specification in paragraph 3. If 1/4" steel plate is not available, then substitute the thickness with what available and make the necessary changes in the steps below.

SAFETY:

THERE ARE MANY SAFETY HAZARDS WHEN DEALING WITH ARC WELDING, FROM ELECTRICAL SHOCK TO AVOIDING FUMES. MAKE SURE THAT ALL SAFETY PRECAUTIONS ARE FOLLOWED WHEN WELDING.

5. Procedures. Follow these steps to weld a carbon steel single pass tee-fillet joint in the flat position:

SAFETY:

WHEN WELDING, ALL SAFETY EQUIPMENT MUST BE WORN AT ALL TIMES!

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

Step 1: Obtain 3 pieces of 3" x 6" x 1/4" steel plates.

Step 2: Don all safety equipment.

Step 3: Ensure metal plates are relatively clean of any, oil, rust, or paint which may hinder welding process.

Step 4: Prepare joint as outline in paragraph 2 (if required).

Step 5: Pre-select amperage and AC/DC current setting. (Refer to AFQTP 3E3X1-34, Unit 4 for equipment set-up procedures.)

Step 6: Perform a test weld on third plate to ensure amperage setting accuracy. (Refer to Unit 6, Figure 6-1 for proper setting.)

Step 7: Set the vertical plate on the middle of the horizontal plate and tack weld each end and ensure metal pieces have proper root spacing. Refer to Figure 6-10.

Step 8: Position the tacked pieces against a firebrick or scrap metal to achieve the correct welding position.

Step 9: Deposit a 1/4" fillet bead along the edge/center of the tee and hold the electrode at a work angle of 45° and a travel of 30° and advance it in a straight line without any weaving motion.

Step 10: If performing layer beads thoroughly clean each layer and deposit succeeding layers as shown in Figure 6-13.

Step 11: Chip and clean weld deposit.

Step 12: Give plate to trainer/certifier for inspection. (Trainer/Certifier perform visual inspection using the weld specification in paragraph 3).

Notice. This AFQTP is NOT intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

**REVIEW QUESTIONS
FOR
WELD A CARBON STEEL TEE JOINT IN THE FLAT POSITION**

QUESTION	ANSWER
1. When welding a Tee Joint, why should the arc favor the lower plate?	<ul style="list-style-type: none"> a. Prevent undercutting the lower plate. b. Prevent undercutting the upper plate. c. Prevent penetration. d. Aid penetration.
2. What is the work angles for the second pass of a multiple-pass tee-joint?	<ul style="list-style-type: none"> a. 30° work, 30° travel. b. 70° work, 30° travel. c. 30° work, 70° travel. d. 70° work, 70° travel.
3. What is the specification for the lower leg of a tee-joint?	<ul style="list-style-type: none"> a. 1 T. b. 2 T. c. 2 ½ T. d. 1 ½ T.
4. The plates of a tee-joint are joined parallel to each other.	<ul style="list-style-type: none"> a. True. b. False.
5. You should concentrate the arc more to the upper plate to prevent undercutting the upper plate.	<ul style="list-style-type: none"> a. True. b. False.

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

WELD A CARBON STEEL TEE JOINT IN THE FLAT POSITION

PERFORMANCE CHECKLIST

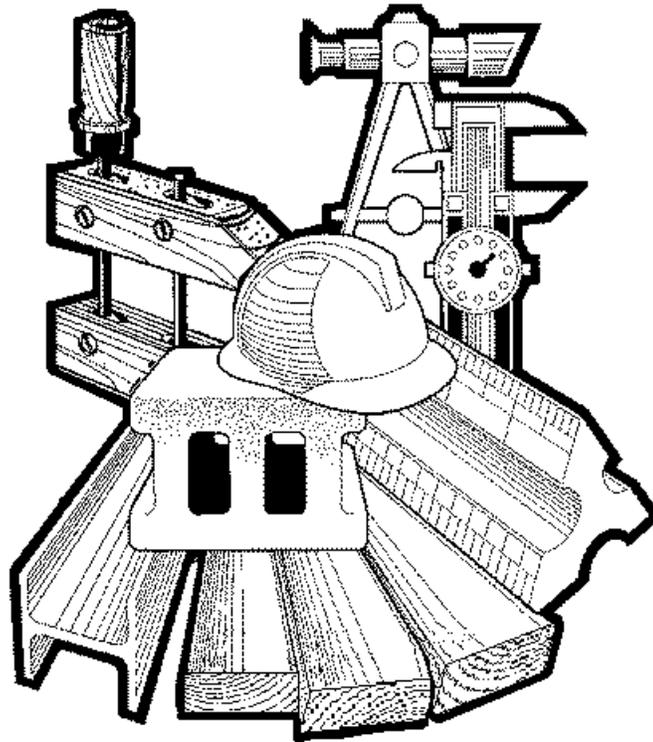
INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE....	YES	NO
1. wear all safety equipment during the task performance?		
2. clean the metal before the welding began?		
3. use correct amperage setting?		
4. tack welds and position the plates correctly?		
5. keep the correct angle through out the weld?		
6. complete the weld by chipping the slag and cleaning with a wire brush?		
7. comply with all safety requirements?		
8. flat tee joint meet all weld specifications?		

FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

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USE SHIELDED METAL ARC WELDING EQUIPMENT TO WELD CARBON STEEL

TEE JOINT POSITIONS

MODULE 34

AFQTP UNIT 6

VERTICAL (34.6.3.3.)

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

WELD A CARBON STEEL TEE JOINT IN THE VERTICAL POSITION
Task Training Guide

STS Reference Number/Title:	34.6.3.3. - Use shielded metal arc welding equipment to weld a carbon steel tee joint in the vertical position.
Training References:	<ol style="list-style-type: none"> 1. Career Development Course (CDC) Structural Journeyman 3E351B, Volume 4, Unit 3, Section 3-4, Lesson 612; <i>Vertical Position Welding</i>. 2. Commercial Manual, <i>Welding Skills</i> by R.T. Miller, 1994. 3. Air Force Occupational Safety and Health Standard (AFOSHSTD) 91-5, Welding, Cutting, and Brazing. 4. Technical Order (TO) 34W4-1-5, Welding Theory and Application. 5. Navy Advancement Training (NAVEDTRA) Course, 14250, Steelworker Volume 1.
Prerequisites:	<ol style="list-style-type: none"> 1. Possess as a minimum a 3E331 AFSC. 2. Review the following references: <ol style="list-style-type: none"> 2.1. CDC Structural Journeyman 3E351B, Volume 4, Unit 3, Section 3-4, Lesson 612. 2.2. <i>Welding Skills, Shielded Metal-Arc Welding, Chapter 18, Vertical Position.</i> 2.3. NAVEDTRA 14250, Chapter 7, <i>Shielded Metal Arc Welding and Wear Facing</i>; Pages 7-19 to 7-21.
Equipment/Tools Required:	<ol style="list-style-type: none"> 1. Welding Machine. 2. Welding Hood. 3. Leather Jacket. 4. Safety glasses 5. Welding Gloves. 6. Chipping Hammer. 7. Wire Brush. 8. Three pieces of steel plate 3" x 6" x ¼".
Learning Objective:	Trainee should be able to use shielded metal arc to weld a carbon steel Tee joint in the vertical position.
Samples of Behavior:	Trainee will be able to demonstrate the use of shielded metal arc to weld a carbon steel Tee joint in the vertical position.
Notes:	
Any safety violation will result in a test failure.	

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

WELD A CARBON STEEL TEE JOINT IN THE VERTICAL POSITION

1. Background. Welding vertical Tee joints is closely related to welding lap joints with thickness greater than $\frac{1}{2}$ ". Usage for this weld is the same as welding Tee's in the flat position. The only difference in Tee joint vertical welds is the member would use this technique in projects that cannot be welded flat or horizontal and cannot be moved.

2. Vertical Tee Joint. Vertical welding can be accomplished by either vertical up or vertical down welding. The method depends on the thickness of the metal being welded. Welding vertical down is recommended for metals that are less than $\frac{1}{4}$ ". Vertical up welding is recommended for metals of $\frac{1}{4}$ " thickness or greater to achieve greater penetration. When welding vertical down, place the electrode at a right angle to the joint and lower the electrode 15° to 30° in the direction of travel. To weld vertical up, place the electrode at a right angle to the joint and lower the electrode 10° to 15° away from the direction of travel.

2.1. Tee joints on plates in the vertical position are prepared for welding in the same way that tee joints in the flat position are. To get good fusion and penetration with no undercutting, hold a short arc and carefully control its motion. The recommended method is vertical up to weld tee joints on plates $\frac{1}{4}$ -inch in thickness by using a triangular weave motion. Make welds on $\frac{1}{2}$ -inch plate or heavier in several passes.

2.2. When starting a vertical Tee weld, start from the bottom working your way up as shown in Figure 6-14.

2.3. When multiple passes are made use the technique shown in Figure 6-15.

Figure 6-14. Vertical Tee Joint.

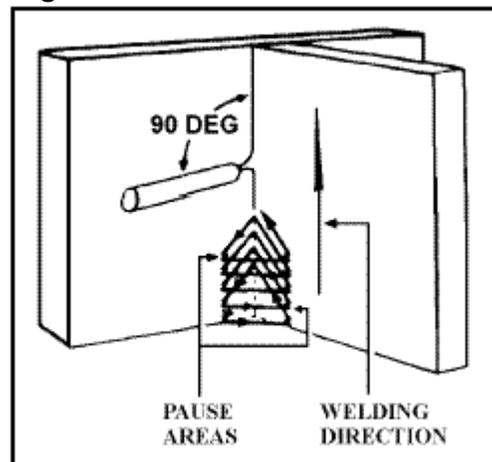
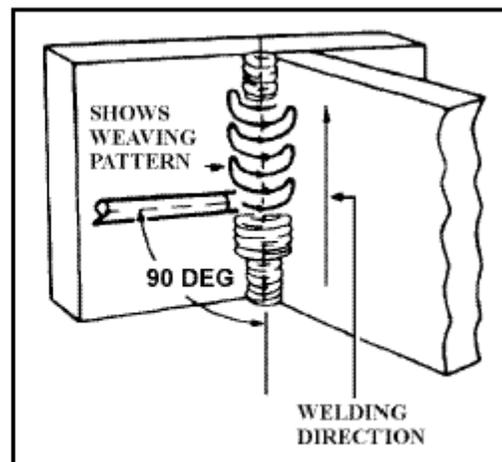
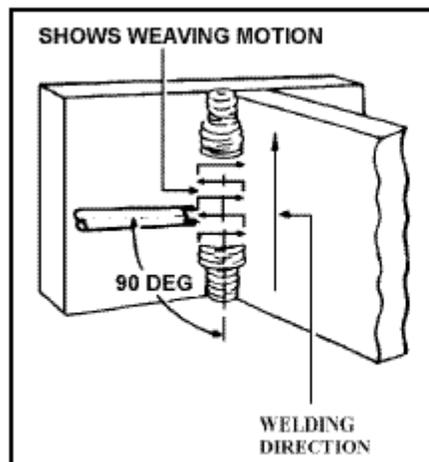


Figure 6-15. Multiple Pass Tee Joint.



Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

3. Weld Specification. The following is a list of weld specification for tee joints in the vertical position. (T = Thickness of Plate).

3.1. Upper Leg: $1 \frac{1}{2}T$ (Thickness)

3.2. Lower Leg: $1 \frac{1}{2}T$

3.3. Bead Height: $\frac{1}{8}$ -inch from the highest to lowest point on the weld.

3.4. Bead Contour: Slightly concave.

3.5. Penetration: $\frac{1}{16}$ -inch minimum for metals over $\frac{1}{8}$ -inch.

NOTE TO TRAINER/CERTIFIER:

For this task have the trainee obtain three pieces of 3" x 6" x $\frac{1}{4}$ " steel plate. Provide the trainee with the electrode (welding rod) nomenclature. Then have the trainee follow the below steps in welding a tee joint in the vertical position and inspect weld using the specification in paragraph 3. If $\frac{1}{4}$ " steel plate is not available, then substitute the thickness with what available and make the necessary changes in the steps below.

SAFETY:

THERE ARE MANY SAFETY HAZARDS WHEN DEALING WITH ARC WELDING, FROM ELECTRICAL SHOCK TO TOXIC FUMES. MAKE SURE THAT ALL SAFETY PRECAUTIONS ARE FOLLOWED WHEN WELDING.

4. Procedures. Follow these steps to weld a carbon steel single pass tee-fillet joint in the flat position:

SAFETY:

WHEN WELDING, ALL SAFETY EQUIPMENT MUST BE WORN AT ALL TIMES!

Step 1: Obtain 3 pieces of 3" x 6" x $\frac{1}{4}$ " steel plates.

Step 2: Don all safety equipment.

Step 3: Ensure metal plates are relatively clean of any, oil, rust, or paint which may hinder welding process.

Step 4: Prepare joint as outline in paragraph 2 (if required).

Step 5: Pre-select amperage and AC/DC current setting. (Refer to AFQTP 3E3X1-34, Unit 4 for equipment set-up procedures.)

Step 6: Perform a test weld on third plate to ensure amperage setting accuracy. (Refer to Unit 6, Figure 6-1 for proper setting.)

Step 7: Set the vertical plate on the middle of the horizontal plate and tack weld each end and ensure metal pieces have proper root spacing. Refer to Figure 6-10.

Step 8: Position the tacked pieces in a vertical position by tacking it to a flat scrap piece or by mounting it in a vise.

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

Step 9: Deposit a narrow root pass using the vertical up technique.

9.1. Establish a short arc for better weld control and hold the electrode at a work angle of 90° from the direction of travel and advance it in a straight line without any weaving motion.

9.2. Travel rapidly enough to stay ahead of the molten pool.

Step 10: If performing layer beads use a weaving pattern with a 90-degree angle from the direction of travel, thoroughly clean each layer, and deposit succeeding layers as shown in Figure 6-13.

Step 11: Chip and clean weld deposit.

Step 12: Give plate to trainer/certifier for inspection. (Trainer/Certifier perform visual inspection using the weld specification in paragraph 3.

**REVIEW QUESTIONS
FOR
WELD A CARBON STEEL TEE JOINT IN THE VERTICAL POSITION**

QUESTION	ANSWER
1. What is the correct electrode angle for vertical down welding?	<ul style="list-style-type: none"> a. 15° to 30° away from the direction of travel. b. 10° to 15° away from the direction of travel. c. 15° to 30° in the direction of travel. d. 10° to 15° in the direction of travel.
2. What is the correct electrode angle for vertical up welding?	<ul style="list-style-type: none"> a. 65° b. 90° c. 85° d. 70°
3. What is the weld specification for the bead contour?	<ul style="list-style-type: none"> a. Concave. b. Convex. c. Slightly concave. d. Slightly convex.
4. How do you control the arc?	<ul style="list-style-type: none"> a. Increase amperage. b. Decrease amperage. c. Shorten arc. d. Length arc.
5. When should you make multiple passes on a tee joint?	<ul style="list-style-type: none"> a. $\frac{1}{8}$-inch plate. b. $\frac{1}{4}$-inch plate. c. $\frac{1}{2}$-inch plate. d. $\frac{1}{16}$-inch plate.

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WELD A CARBON STEEL TEE JOINT IN THE VERTICAL POSITION

PERFORMANCE CHECKLIST

INSTRUCTIONS:

The trainee must satisfactorily perform all parts of the task without assistance. Evaluate the trainee's performance using this checklist.

DID THE TRAINEE....	YES	NO
1. wear all safety equipment during the task performance?		
2. clean the metal before the welding began?		
3. use correct amperage setting?		
4. tack welds and position the plates correctly?		
5. keep the correct angle through out the weld?		
6. complete the weld by chipping the slag and cleaning with a wire brush?		
7. comply with all safety requirements?		
8. vertical tee joint meet all weld specifications?		

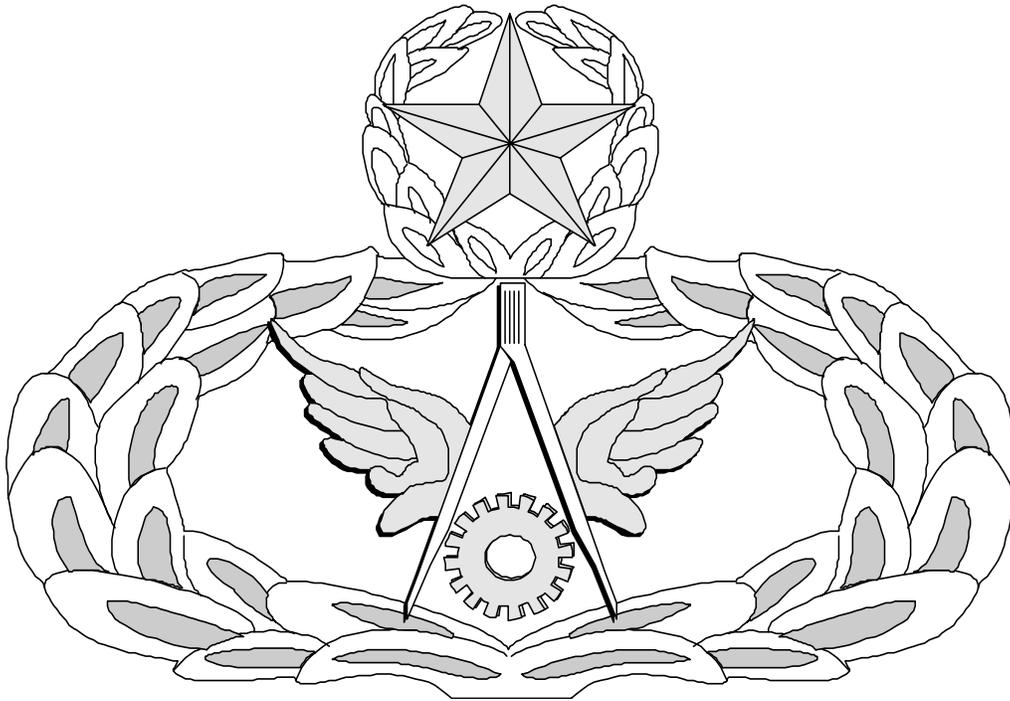
FEEDBACK: Trainer/Certifier should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer/certifier.

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Air Force Civil Engineer

QUALIFICATION TRAINING PACKAGE (QTP)

REVIEW ANSWER KEY



FOR
STRUCTURAL
(3E3X1)
MODULE 34
SHIELDED METAL ARC WELDING

Notice. This AFQTP is NOT intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

Key-1

**SET UP WELDING MACHINE FOR A SPECIFIC WELDING JOB
(3E3X1-34.4.)**

QUESTION	ANSWER
1. AC and DC are the two types of welding machines used most often.	a. True.
2. Electrical shock and Toxic fumes are two of the hazards you deal with when you're arc welding.	a. True.
3. How should you adjust the current before you start welding?	b. Adjust your current then weld some trial beads and adjust your current.

**PREPARE JOINTS FOR WELDING
(3E3X1-34.5.)**

QUESTION	ANSWER
1. The four types of joints are the butt, lap, edge, and tee joint.	a. True.
2. What is a correct angle for one edge of a single "V" grooved butt joint?	b. 30.
3. You can clean a joint with sandpaper before welding.	a. True.

**WELD A CARBON STEEL BUTT JOINT IN THE FLAT POSITION
(3E3X1-34.6.1.1.)**

QUESTION	ANSWER
1. The flat position is the easiest position to weld.	a. True.
2. What is the first pass called when arc welding?	a. Root.
3. What is the last pass called when arc welding?	b. Cover.

**WELD A CARBON STEEL BUTT JOINT IN THE VERTICAL POSITION
(3E3X1-34.6.1.3.)**

QUESTION	ANSWER
1. One of the problems of vertical welding is gravity tends to pull down on the weld?	a. True.
2. Vertical up and Vertical down are the two types of vertical welding.	a. True.
3. When performing vertical up welding, you should strike the arc at the _____ of the metal and use a whipping action after the arc is achieved.	a. bottom

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**WELD A CARBON STEEL LAP JOINT IN THE FLAT POSITION
(3E3X1-34.6.2.1.)**

QUESTION	ANSWER
1. What is the most frequently used joint?	b. Lap Joint.
2. What are the two most common types of lap joints used to join metal?	c. Single-Fillet and Double-Fillet.
3. A single-fillet lap joint is the strongest lap joint possible.	b. False.
4. How much should a ¼-inch plate overlap the other?	a. 1-inch.

**WELD A CARBON STEEL LAP JOINT IN THE VERTICAL POSITION
(3E3X1-34.6.2.3.)**

QUESTION	ANSWER
1. What makes welding in the vertical position so difficult?	b. Gravity.
2. In what position should the electrode be held in vertical up welding?	c. 90°.
3. What type of electrode is commonly used in vertical welding?	c. Heavy-coated, reverse polarity.
4. How much should a ¼" plate overlap the other?	a. 1-inch.
5. What type of motion should you apply the cover pass?	c. Weaving.

**WELD A CARBON STEEL TEE JOINT IN THE FLAT POSITION
(3E3X1-34.6.3.1.)**

QUESTION	ANSWER
1. When welding a Tee Joint, why should the arc favor the lower plate?	b. Prevent undercutting the upper plate.
2. What is the work angles for the second pass of a multiple-pass tee-joint?	b. 70° work, 30° travel.
3. What is the specification for the lower leg of a tee-joint?	d. 1 ½ T.
4. The plates of a tee-joint are joined parallel to each other.	b. False.
5. You should concentrate the arc more to the upper plate to prevent undercutting the upper plate.	b. False.

Notice. This AFQTP is *NOT* intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

**WELD A CARBON STEEL TEE JOINT IN THE VERTICAL POSITION
(3E3X1-34.6.3.3.)**

QUESTION	ANSWER
1. What is the correct electrode angle for vertical down welding?	c. 15° to 30° in the direction of travel.
2. What is the correct electrode angle for vertical up welding?	b. 90 degree's.
3. What is the weld specification for the bead contour?	c. Slightly concave.
4. How do you control the arc?	c. Shorten arc.
5. When should you make multiple passes on a tee joint?	c. ½-inch plate.

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MEMORANDUM FOR HQ AFCESA/CEOF
139 Barnes Drive Suite 1
Tyndall AFB, FL 32403-5319

FROM:

SUBJECT: Qualification Training Package Improvement

1. Identify module.

Module # and title _____

2. Identify improvement/correction section(s):

- | | |
|--|--|
| <input type="checkbox"/> STS Task Reference | <input type="checkbox"/> Performance Checklist |
| <input type="checkbox"/> Training Reference | <input type="checkbox"/> Feedback |
| <input type="checkbox"/> Evaluation Instructions | <input type="checkbox"/> Format |
| <input type="checkbox"/> Performance Resources | <input type="checkbox"/> Other |
| <input type="checkbox"/> Steps in Task Performance | |

3. Recommended changes--use a continuation sheet if necessary.

4. You may choose to call in your recommendations to DSN 523-6445 or FAX DSN/Commercial 523-6488 or (850) 283-6488 or email ceof.helpdesk@tyndall.af.mil.

5. Thank you for your time and interest.

YOUR NAME, RANK, USAF
Title/Position