

# AIR FORCE QUALIFICATION TRAINING PACKAGE (AFQTP)



FOR  
ENGINEERING  
(3E5X1)

MODULE 16  
COMPUTER AIDED DESIGN (CAD) / GEOGRAPHIC  
INFORMATION SYSTEM (GIS)

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Career Field Education and Training Plan (CFETP) references from 1 April 02 version.

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 Supersedes AFQTP 3E5X1-15, 1 May 01

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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**  
**ENGINEERING**  
**(3E5X1)**

**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:**

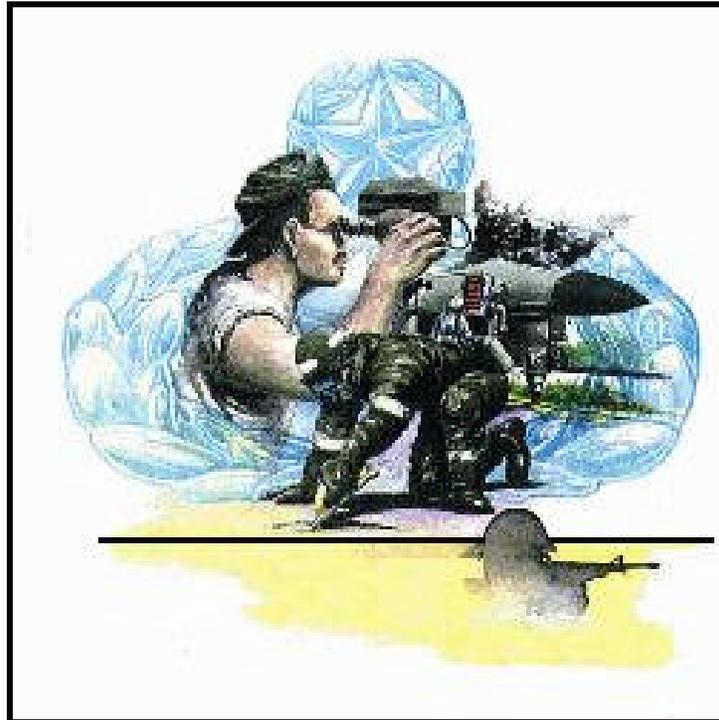
AFQTP completion  
CerTest completion (80% minimum to pass)

**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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## CAD FUNDAMENTALS

MODULE 16

AFQTP UNIT 1

---

### SETUP DRAWINGS (16.1.1.)

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**SETUP (CAD) DRAWING**  
***Task Training Guide***

<b>STS Reference Number/Title:</b>	16.1.1. - Setup CAD drawing.
<b>Training References:</b>	<ol style="list-style-type: none"> <li>1. Manufacturers operators' manual.</li> <li>2. AutoCad v14 reference manual (or current version).</li> <li>3. Career Development Course (CDC) 3E551B Engineering Journeyman, Volume 1, Unit 1, <i>Drafting Principles and Techniques</i>.</li> <li>4. Spatial Data Standard for Facilities, Infrastructure, and Environment (SDSFIE), v2.2 or higher</li> </ol>
<b>Prerequisites:</b>	<ol style="list-style-type: none"> <li>1. <b>Possess as a minimum a 3E531 AFSC.</b></li> <li>2. <b>Review the following references:</b> <ol style="list-style-type: none"> <li>2.1. Manufacturers operators' manual.</li> <li>2.2. AutoCad reference manual.</li> </ol> </li> <li>3. <b>Complete the following:</b> <ol style="list-style-type: none"> <li>3.1. CDC 3E551B Engineering Journeyman, Volume 1, Unit 1.</li> <li>3.2. AutoCad tutorial program, v14 or higher.</li> </ol> </li> </ol>
<b>Equipment/Tools Required:</b>	<ol style="list-style-type: none"> <li>1. Desktop Personal Computer.</li> <li>2. AutoCad v14 or higher.</li> <li>3. Plotter/Printer.</li> </ol>
<b>Learning Objective:</b>	Given the equipment, trainee will be able to setup a CAD drawing.
<b>Samples of Behavior:</b>	Trainee will know how to setup a drawing in CAD.
<b>Note:</b>	Local templates should be utilized to maximum extent possible.

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## SETUP (CAD) DRAWINGS

**1. Background.** The drawing setup phase of any drafting project, either manually or electronically, is the most critical step in beginning a drafting project. The correct page setup drives things such as drawing sheet layout, titleblock information, potential view scales, and the gives the project an overall professional look. Other parameters requiring set up include, but are not limited to, drawing units, default settings for text, layer names and symbology, and dimensioning default styles.

**2. To perform this task, follow these steps:**

**Step 1: Determine if standard drawing templates are used (stored as .dwt files). If so, the drawing setup is complete. If not:**

**Step 2: Define drawing units.**

**Step 3: Define default text type, size and color.**

**Step 4: Define dimensioning defaults.**

**Step 5: Define layer names and symbology (layer name, line color weight, size and color).**

**Step 6: Insert local standard drawing sheet block (usually “D” size) into Paper Space.**

**Step 7: Edit block attribute data with current information.**

**Step 8: Insert Viewports as necessary.**

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**REVIEW QUESTIONS  
FOR  
SETUP (CAD) DRAWINGS**

<b>QUESTION</b>	<b>ANSWER</b>
1. What drawing formats are AutoCad templates?	a. .dwg b. .dwt c. .pgp d. .dxf
2. Where does the drawing sheet block get inserted?	a. Doesn't matter. b. Model Space. c. Paper Space. d. View Space.
3. How many Viewports are used in a drawing?	a. 3. b. 2. c. 1. d. As many as required.

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## SETUP (CAD) DRAWINGS

### PERFORMANCE CHECKLIST

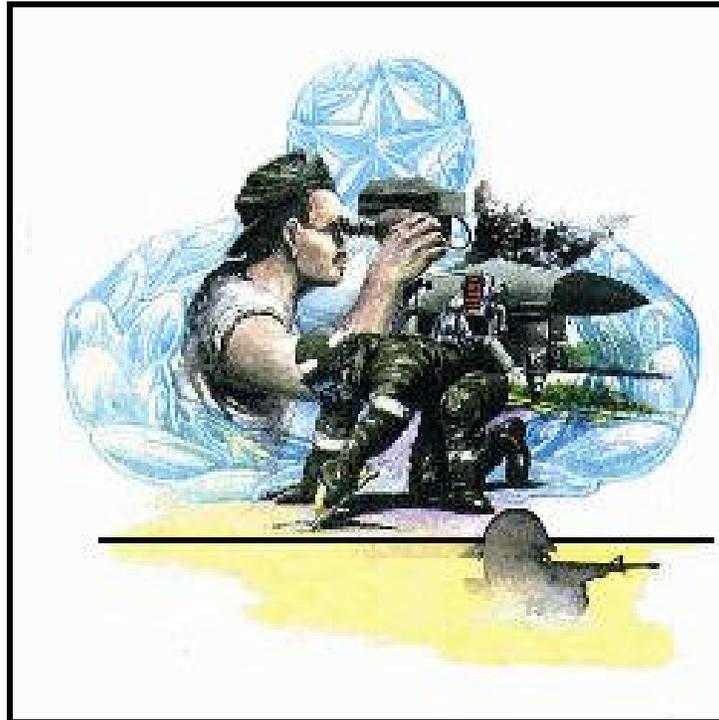
#### INSTRUCTIONS:

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. check to ensure templates (.dwt files) are used to the maximum extent?		
2. setup the minimum defaults (drawing units, text and dimension defaults, and layering information)?		
3. insert the drawing sheet block into the correct space?		
4. create the correct number of Viewports?		

**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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## CAD FUNDAMENTALS

MODULE 16

AFQTP UNIT 1

---

UTILIZE BASIC DRAWING COMMANDS (16.1.2.)

---

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**UTILIZE BASIC (CAD) DRAWING COMMANDS**  
***Task Training Guide***

<b>STS Reference Number/Title:</b>	16.1.2. - Utilize basic CAD drawing commands.
<b>Training References:</b>	<ol style="list-style-type: none"> <li>1. Manufacturers operators' manual.</li> <li>2. AutoCad v14 reference manual (or current version).</li> <li>3. Career Development Course (CDC) 3E551B Engineering Journeyman, Volume 1, Unit 1, <i>Drafting Principles and Techniques</i>.</li> <li>4. Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE), v2.2 or higher.</li> </ol>
<b>Prerequisites:</b>	<ol style="list-style-type: none"> <li>1. <b>Possess as a minimum a 3E531 AFSC.</b></li> <li>2. <b>Review the following references:</b> <ol style="list-style-type: none"> <li>2.1. Manufacturers operators' manual.</li> <li>2.2. AutoCad v14 reference manual.</li> </ol> </li> <li>3. <b>Complete the following:</b> <ol style="list-style-type: none"> <li>3.1. CDC 3E551B Engineering Journeyman, Volume 1, Unit 1.</li> <li>3.2. AutoCad tutorial program, v14 or higher.</li> </ol> </li> </ol>
<b>Equipment/Tools Required:</b>	<ol style="list-style-type: none"> <li>1. Desktop Personal Computer.</li> <li>2. AutoCad v14 or higher Software.</li> <li>3. Plotter/Printer.</li> </ol>
<b>Learning Objective:</b>	Given the equipment, trainee will be able to utilize basic CAD drawing commands.
<b>Samples of Behavior:</b>	Trainee will know how to utilize basic CAD drawing commands.
<b>Note:</b>	There are several ways to complete each task (pull down menus, command line prompts, and icons). Trainees should mix and match to suit their drawing style.

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## UTILIZE BASIC (CAD) DRAWING COMMANDS

**1. Background.** The basic drawing commands for CAD are considered those tools required to draw simple floor plans. There are many different ways to accomplish each task, but those listed below are considered to be the most basic.

**2. To perform this task, follow these steps:**

**Step 1: *Open, Save, and Close* a drawing.**

**Step 2: Draw a Line.**

- 2.1. Draw a simple line.
- 2.2. Draw a polyline.
- 2.3. Utilize snap commands when connecting two lines.

**Step 3: Draw a circle.**

- 3.1. Draw a circle.
- 3.2. Draw an ellipse.
- 3.3. Draw an arc.

**Step 4: Perform Edits on objects.**

- 4.1. Perform the standard Cut/Copy/Paste functions.
- 4.2. Erase an object.
- 4.3. Rotate an object.
- 4.4. Move an object.
  - 4.4.1. Freely.
  - 4.4.2. Determined distance.
- 4.5. Scale an object.
  - 4.5.1. Freely.
  - 4.5.2. By reference.
- 4.6. Mirror an object
- 4.7. Offset a line or object
- 4.8. Trim a line or an object.
- 4.9. Extend a line or an object.
- 4.10. Insert text.
  - 4.10.1. Single-line text.
  - 4.10.2. Multi-line text.

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**REVIEW QUESTIONS  
FOR  
UTILIZE BASIC (CAD) DRAWING COMMANDS**

<b>QUESTION</b>	<b>ANSWER</b>
1. What ways can most AutoCad commands be accomplished?	a. Command prompt. b. Icons. c. Pull down menus. d. Any of the above.
2. What are the two most common line types?	a. Single and Multi lines. b. Simple and Double lines. c. Simple and Multi lines. d. Simple and Polyines.
3. What is the purpose of utilizing snap commands?	a. Makes drafting faster. b. Ensures lines are attached to each other. c. There is no purpose. d. Makes the drawing look cleaner.

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## UTILIZE BASIC (CAD) DRAWING COMMANDS

### PERFORMANCE CHECKLIST

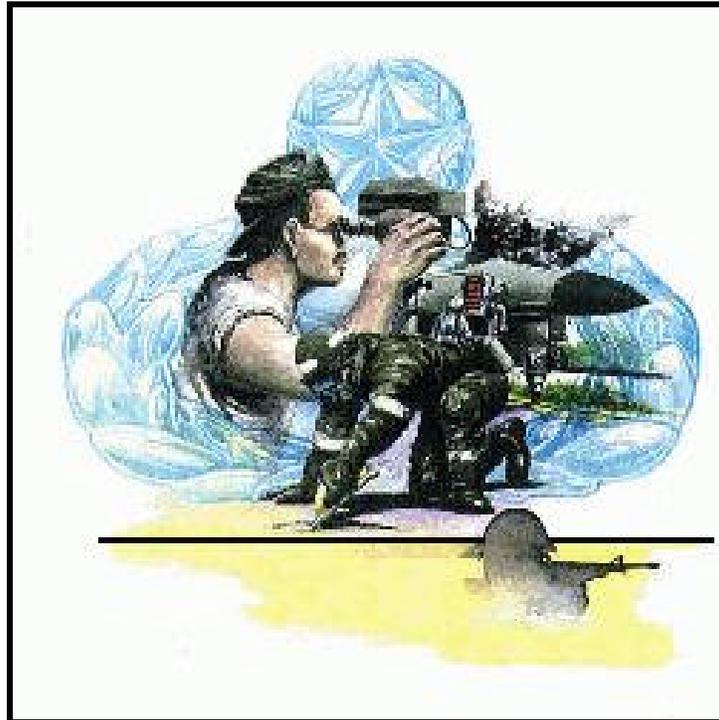
#### INSTRUCTIONS:

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. open, save, and close a drawing?		
2. draw lines utilizing various snap commands?		
3. draw circles, arcs, and ellipses?		
4. perform basic edits on objects (cut, copy, paste, erase, rotate, move, scale, mirror, offset, trim and extend)?		

**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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## CAD FUNDAMENTALS

MODULE 16

AFQTP UNIT 1

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UTILIZE DISPLAY COMMANDS (16.1.3.)

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**UTILIZE (CAD) DISPLAY COMMANDS**  
***Task Training Guide***

<b>STS Reference Number/Title:</b>	16.1.3. - Utilize CAD display commands.
<b>Training References:</b>	<ol style="list-style-type: none"> <li>1. Manufacturers operators' manual.</li> <li>2. AutoCad v14 reference manual (or current version).</li> <li>3. Career Development Course (CDC) 3E551B Engineering Journeyman, Volume 1, Unit 1, <i>Drafting Principles and Techniques</i>.</li> <li>4. Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE), v2.2 or higher</li> </ol>
<b>Prerequisites:</b>	<ol style="list-style-type: none"> <li>1. <b>Possess as a minimum a 3E531 AFSC.</b></li> <li>2. <b>Review the following references:</b> <ol style="list-style-type: none"> <li>2.1. Manufacturers operators' manual.</li> <li>2.2. AutoCad reference manual.</li> </ol> </li> <li>3. <b>Complete the following:</b> <ol style="list-style-type: none"> <li>3.1. CDC 3E551B Engineering Journeyman, Volume 1, Unit 1.</li> <li>3.2. AutoCad tutorial program, v14 or higher.</li> </ol> </li> </ol>
<b>Equipment/Tools Required:</b>	<ol style="list-style-type: none"> <li>1. Desktop Personal Computer.</li> <li>2. AutoCad v14 or higher Software.</li> <li>3. Plotter/Printer.</li> </ol>
<b>Learning Objective:</b>	Given the equipment, trainee will be able to utilize CAD display commands.
<b>Samples of Behavior:</b>	Trainee will know how to utilize CAD display commands.
<b>Note:</b>	There are several ways to complete each task (pull down menus, command line prompts, and icons). Trainees should mix and match to suit their drawing style.

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## UTILIZE (CAD) DISPLAY COMMANDS

**1. Background.** Display commands are those commands that help the draftsman manipulate the screen appearance of the drawings. They do not alter the actual drawing attributes. However, they will aid you in drafting detailed or complicated drawings.

**2. To perform this task, follow these steps:**

**Step 1: Zoom In.**

- 1.1. Window.
- 1.2. Dynamic.
- 1.3. Scale.

**Step 2: Zoom Out.**

- 2.1. Window.
- 2.2. Dynamic.
- 2.3. Scale.

**Step 3: Pan.**

- 3.1. Real time.
- 3.2. Point.

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**REVIEW QUESTIONS  
FOR  
UTILIZE (CAD) DISPLAY COMMANDS**

<b>QUESTION</b>	<b>ANSWER</b>
1. Do any of the display commands change the drawing attributes?	a. Yes. b. No.
2. What are the sub commands of the Zoom command?	Written Answer.

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## UTILIZE (CAD) DISPLAY COMMANDS

### PERFORMANCE CHECKLIST

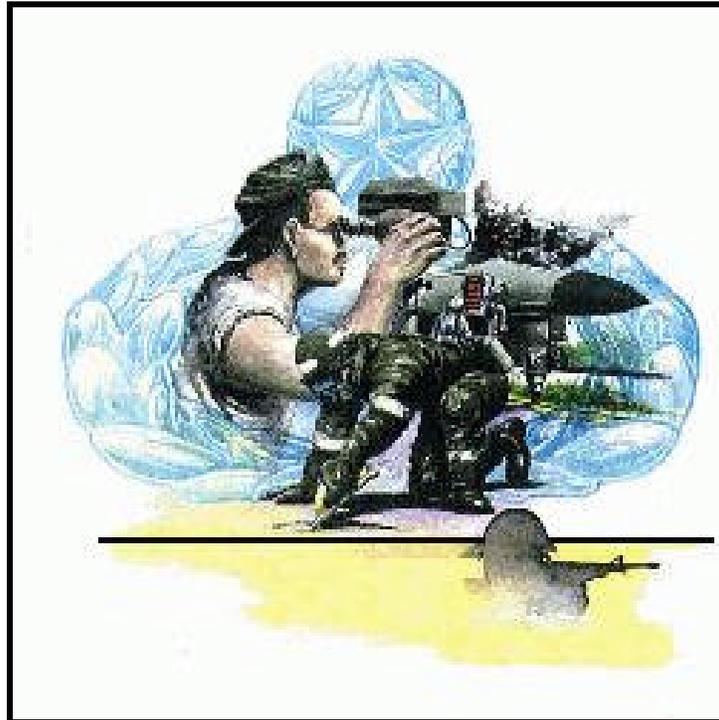
#### INSTRUCTIONS:

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. zoom into a drawing?		
2. zoom out of a drawing?		
3. pan around a drawing?		

**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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## CAD FUNDAMENTALS

MODULE 16

AFQTP UNIT 1

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CREATE AND UTILIZE SYMBOLS (16.1.4.)

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**CREATE AND UTILIZE (CAD) SYMBOLS**  
***Task Training Guide***

<b>STS Reference Number/Title:</b>	16.1.4. - Create and utilize CAD symbols.
<b>Training References:</b>	<ol style="list-style-type: none"> <li>1. Manufacturers operators' manual.</li> <li>2. AutoCad v14 reference manual (or current version).</li> <li>3. Career Development Course (CDC) 3E551B Engineering Journeyman, Volume 1, Unit 1, <i>Drafting Principles and Techniques</i>.</li> <li>4. Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE), v2.2 or higher.</li> </ol>
<b>Prerequisites:</b>	<ol style="list-style-type: none"> <li>1. <b>Possess as a minimum a 3E531 AFSC.</b></li> <li>2. <b>Review the following references:</b> <ol style="list-style-type: none"> <li>2.1. Manufacturers operators' manual.</li> <li>2.2. AutoCad v12 or higher reference manual.</li> </ol> </li> <li>3. <b>Complete the following:</b> <ol style="list-style-type: none"> <li>3.1. CDC 3E552B Engineering Journeyman, Volume 1, Unit 1.</li> <li>3.2. Complete AutoCad tutorial program, v14 or higher.</li> </ol> </li> </ol>
<b>Equipment/Tools Required:</b>	<ol style="list-style-type: none"> <li>1. Desktop Personal Computer.</li> <li>2. AutoCad v14 or higher Software.</li> <li>3. Plotter/Printer.</li> </ol>
<b>Learning Objective:</b>	Given the equipment, trainee will be able to create and utilize CAD symbols.
<b>Samples of Behavior:</b>	Trainee will know how to create and utilize CAD symbols.
<b>Note:</b>	There are several ways to complete each task (pull down menus, command line prompts, and icons). Trainees should mix and match to suit their drawing style.

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## CREATE AND UTILIZE (CAD) SYMBOLS

**1. Background.** To exploit the true power of CAD, and eliminate the tedious act of repetitive drafting, symbols are created once and copied over and over. Many offices maintain symbol libraries for each engineering discipline. Remember these symbols must meet ANSI standards.

**2. To perform this task, follow these steps:**

**Step 1: Draw the symbol to be duplicated.**

**NOTES:**

1. Symbols should be kept simple.
2. Symbol attributes should be "by layer". This way when inserted into a drawing, the symbol attributes will take on the attributes of the layer.
3. Symbol should be drawn on layer "0". This ensures no extra layers are created in the new drawing file.

**Step 2: Block the symbol.**

- 2.1. Select all objects to be blocked.
- 2.2. Select an insertion point.
- 2.3. Save block either internally to the drawing (Block command) or externally (Wblock) to a drive for use in other drawings.

**Step 3: Insert the block into a drawing.**

- 3.1. Select layer for block insertion.
- 3.2. Select drawing space to insert block (paper/model).
- 3.3. Set scale of inserted block.
- 3.4. Set location of inserted block.

**NOTE:**

Blocks inserted take the layer attributes if created as described in step 1.

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**REVIEW QUESTIONS  
FOR  
CREATE AND UTILIZE (CAD) SYMBOLS**

<b>QUESTION</b>	<b>ANSWER</b>
1. What layer should symbols be drawn on	a. Same layer they will be used on. b. It doesn't matter. c. Layer "0". d. A layer named "symbols".
2. How should block attributed be set?	a. By block. b. By layer. c. By entity. d. By layer.
3. Where are blocks stored?	a. Within the drawing. b. Outside the drawing. c. Both places. d. Either place.

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## CREATE AND UTILIZE (CAD) SYMBOLS

### PERFORMANCE CHECKLIST

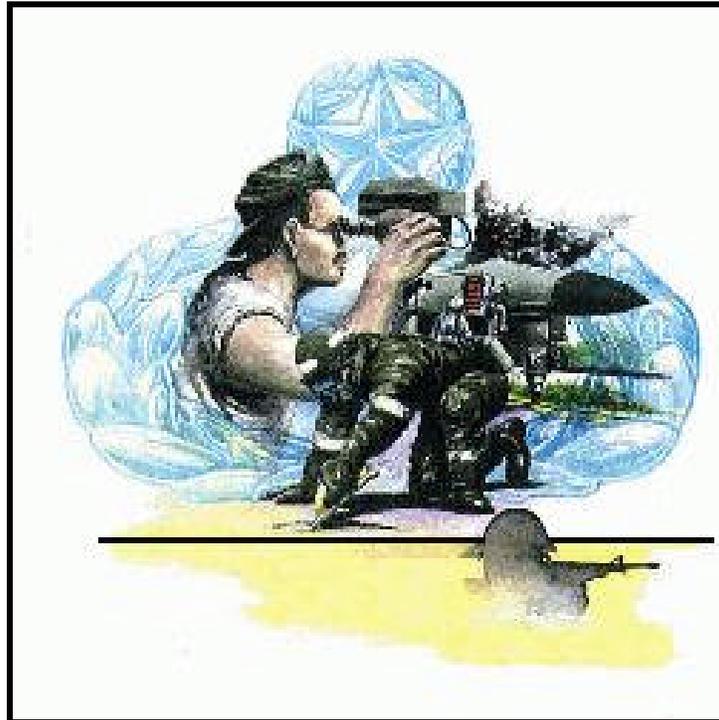
#### INSTRUCTIONS:

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. create a simple drawing for create as a block?		
2. correctly set the attributes for the block?		
3. choose an insertion point for the block?		
4. choose the correct layer for insertion of the block?		

**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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## CAD FUNDAMENTALS

MODULE 16

AFQTP UNIT 1

---

UTILIZE ADVANCED COMMANDS (16.1.5.)

---

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**UTILIZE (CAD) ADVANCED COMMANDS**  
***Task Training Guide***

<b>STS Reference Number/Title:</b>	16.1.5. - Utilize CAD advanced commands.
<b>Training References:</b>	<ol style="list-style-type: none"> <li>1. Manufacturers operators' manual.</li> <li>2. AutoCad v14 reference manual (or current version).</li> <li>3. Career Development Course (CDC) 3E551B Engineering Journeyman, Volume 1, Unit 1, <i>Drafting Principles and Techniques</i>.</li> <li>4. Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE), v2.2 or higher</li> </ol>
<b>Prerequisites:</b>	<ol style="list-style-type: none"> <li>1. <b>Possess as a minimum a 3E531 AFSC.</b></li> <li>2. <b>Review the following references:</b> <ol style="list-style-type: none"> <li>2.1. Manufacturers operators' manual.</li> <li>2.2. AutoCad v12 or higher reference manual.</li> </ol> </li> <li>3. <b>Complete the following:</b> <ol style="list-style-type: none"> <li>3.1. CDC 3E552B Engineering Journeyman, Volume 1, Unit 1.</li> <li>3.2. AutoCad tutorial program, v14 or higher.</li> </ol> </li> </ol>
<b>Equipment/Tools Required:</b>	<ol style="list-style-type: none"> <li>4. Desktop Personal Computer.</li> <li>5. AutoCad v14 or higher Software.</li> <li>6. Plotter/Printer.</li> </ol>
<b>Learning Objective:</b>	Given the equipment, trainee will be able to utilize CAD advanced commands.
<b>Samples of Behavior:</b>	Trainee will know how to utilize CAD advance commands.
<b>Note:</b>	
There are several ways to complete each task (pull down menus, command line prompts, and icons). Trainees should mix and match to suit their drawing style.	

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## UTILIZE (CAD) ADVANCED COMMANDS

1. **Background.** Now we'll continue to build on the simple drafting tools discussed earlier.

2. **To perform this task, follow these steps:**

**Step 1: Hatch.**

- 1.1. Select hatch pattern.
- 1.2. Select hatch scale.
- 1.3. Select the hatch angle.
- 1.4. Select bounding lines/area.

**Step 2: Dimensioning drawings.**

- 2.1. Select dimension style.
- 2.2. Select appropriate dimension tool for required dimension.

**Step 3: Chamfer.**

- 3.1. Select lines to chamfer.
- 3.2. Set chamfer distance.

**Step 4: Fillet.**

- 4.1. Select lines to fillet.
- 4.2. Set radius.

**Step 5: Explode.** Explode is used to change blocks back to individual entities with the original attribution.

**REVIEW QUESTIONS  
FOR  
UTILIZE (CAD) ADVANCED COMMANDS**

<b>QUESTION</b>	<b>ANSWER</b>
1. Do hatches have attributes?	a. Yes. b. No.
2. Why would an object be exploded?	a. No reason. b. To edit a block. c. To reset the object attributes.

**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.

## UTILIZE (CAD) ADVANCED COMMANDS

### PERFORMANCE CHECKLIST

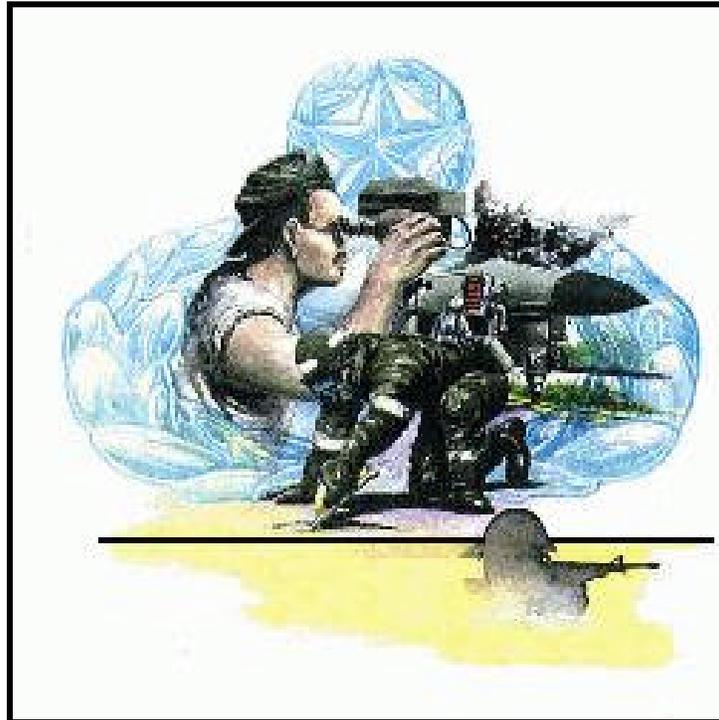
#### INSTRUCTIONS:

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. properly set the hatch attributes?		
2. properly identify all the bounding lines?		
3. properly select the correct dimension style?		
4. use the correct dimension tool?		
5. set the chamfer distance or the fillet radius?		
6. properly explode an object?		

**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.



## CAD FUNDAMENTALS

MODULE 16

AFQTP UNIT 1

---

UTILIZE REFERENCES FILES (16.1.6.)

---

**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.

**UTILIZE (CAD) REFERENCE FILES**  
***Task Training Guide***

<b>STS Reference Number/Title:</b>	16.1.6. - Utilize (CAD) reference files.
<b>Training References:</b>	<ol style="list-style-type: none"> <li>1. Manufacturers operators' manual.</li> <li>2. AutoCad v14 reference manual (or current version).</li> <li>3. Career Development Course (CDC) 3E551B Engineering Journeyman, Volume 1, Unit 1, <i>Drafting Principles and Techniques</i>.</li> <li>4. Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE), v2.2 or higher.</li> </ol>
<b>Prerequisites:</b>	<ol style="list-style-type: none"> <li>1. <b>Possess as a minimum a 3E531 AFSC.</b></li> <li>2. <b>Review the following references:</b> <ol style="list-style-type: none"> <li>2.1. Manufacturers operators' manual.</li> <li>2.2. AutoCad v14 or higher reference manual.</li> <li>2.3. SDSFIE, v2.2 or higher.</li> </ol> </li> <li>3. <b>Complete the following:</b> <ol style="list-style-type: none"> <li>3.1. CDC 3E551B Engineering Journeyman, Volume 1, Unit 1.</li> <li>3.2. Complete AutoCad tutorial program, v14 or higher.</li> </ol> </li> </ol>
<b>Equipment/Tools Required:</b>	<ol style="list-style-type: none"> <li>1. Desktop Personal Computer.</li> <li>2. AutoCad v14 or higher Software.</li> <li>3. Existing AutoCad file (preferably a single line floor plan).</li> <li>4. Plotter/Printer.</li> </ol>
<b>Learning Objective:</b>	Given the equipment, trainee will be able to utilize CAD reference files.
<b>Samples of Behavior:</b>	Trainee will know how to utilize CAD reference files.
<b>Note:</b>	There are several ways to complete each task (pull down menus, command line prompts, and icons). Trainees should mix and match to suit their drawing style.

**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.

## UTILIZE (CAD) REFERENCE FILES

**1. Background.** Another powerful aspect of CAD is the ability to create layers of information on top of each other. In many instance there is a base layer used in several different drawings. If changes are required in the base layer it would be inefficient to change the same base layer in each drawing thus external references are utilized. The referenced drawing can be changed thus automatically updating all the other drawings. (This effort is highlighted in building drawings. A floor plan is drawn once, but used under mechanical and electrical plans.)

**2. To perform this task, follow these steps:**

**Step 1: Identify the drawing to be referenced.**

**Step 2: Set reference scale.**

**Step 3: Set insertion reference point.**

**Step 4: Set rotation angle.**

**NOTE:**

Portions of the working drawing may also be referenced back into itself. This is known as a Nested External Reference.

**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  
UTILIZE (CAD) REFERENCE FILES**

<b>QUESTION</b>	<b>ANSWER</b>
1. What is the benefit of using an external reference?	a. Quicker drawing updates. b. No benefit. c. Fewer blocks in a drawing. d. Smaller drawing sizes.
2. Does rotating the referenced drawing change the original?	a. Yes. b. No.

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## UTILIZE (CAD) REFERENCE FILES

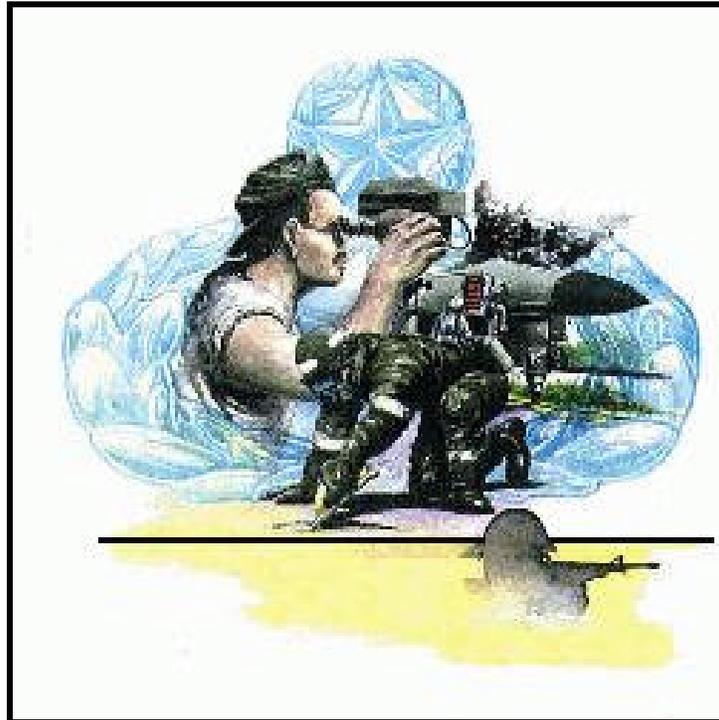
### PERFORMANCE CHECKLIST

#### 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. properly identify a drawing for reference?		
2. properly set the reference attributes?		

**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.



## CAD FUNDAMENTALS

MODULE 16

AFQTP UNIT 1

---

APPLY SCALING FACTORS (16.1.7.)

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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.

**APPLY (CAD) SCALING FACTORS**  
***Task Training Guide***

<b>STS Reference Number/Title:</b>	16.1.7. - Apply CAD scaling factors.
<b>Training References:</b>	<ol style="list-style-type: none"> <li>1. Manufacturers operators' manual.</li> <li>2. AutoCad v14 reference manual (or current version).</li> <li>3. Career Development Course (CDC) 3E551B Engineering Journeyman, Volume 1, Unit 1, <i>Drafting Principles and Techniques</i>.</li> <li>4. Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE), v2.2 or higher.</li> </ol>
<b>Prerequisites:</b>	<ol style="list-style-type: none"> <li>1. <b>Possess as a minimum a 3E531 AFSC.</b></li> <li>2. <b>Review the following references:</b> <ol style="list-style-type: none"> <li>2.1. Manufacturers operators' manual.</li> <li>2.2. AutoCad v14 or higher reference manual.</li> <li>2.3. SDSFIE, v2.2 or higher.</li> </ol> </li> <li>3. <b>Complete the following:</b> <ol style="list-style-type: none"> <li>3.1. CDC 3E551B Engineering Journeyman, Volume 1, Unit 3.</li> <li>3.2. Compete AutoCad tutorial program, v14 or higher.</li> </ol> </li> </ol>
<b>Equipment/Tools Required:</b>	<ol style="list-style-type: none"> <li>1. Desktop Personal Computer.</li> <li>2. AutoCad v14 or higher Software.</li> <li>3. Plotter/Printer.</li> </ol>
<b>Learning Objective:</b>	Given the equipment, trainee will be able to apply CAD scaling factors.
<b>Samples of Behavior:</b>	Trainee will know how to apply CAD scaling commands.
<b>Note:</b>	
There are several ways to complete each task (pull down menus, command line prompts, and icons). Trainees should mix and match to suit their drawing style.	

**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.

## APPLY (CAD) SCALING FACTORS

**1. Background.** Like hand drafted projects, drawings not to scale are not very productive to the customer and are what separate sketches from working engineering drawings. Unlike hand drafted projects, CAD projects are drawn to true scale, 1:1, at all times, then the view scale is changed to represent a scaled drawing.

**2. To perform this task, follow these steps:**

**Step 1: Draw the entire drawing in Model Space at a true scale of 1:1 (if a line is 100', draw it 100').**

**Step 2: Create a new Layer called Viewports.**

**Step 3: In Paper Space (Layout Tab) create a new Viewport.** Size the Viewport to the appropriate size. The image showing in the Viewport automatically zooms to fit and is not to a scale.

**Step 4: To manipulate the image in the Viewport, switch to Model Space and click in the Viewport to activate it.**

- 4.1. Select the Zoom tool.
- 4.2. Select Zoom to Scale sub-command.
- 4.3. Type the desired scale, followed by XP.

**NOTES:**

1. The scale is entered as 1/"the desired scale". (i.e. 1" = 100' – 1/1200, 1" = 200' – 1/2400)
2. The XP following the scales ensures the drawing is scaled in relation to itself, not the to the relative view scale.

4.4. The drawing can then be positioned in the Viewport using the Pan tool.

**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  
APPLY (CAD) SCALING FACTORS**

QUESTION	ANSWER
1. Drawings are always drawn to true scale (1:1)?	a. Yes. b. No.
2. The Layout tab (Paper Space) is used:	a. as the only drafting space in CAD. b. the same as Model Space. c. used to create what the printed product will look like.
3. In order to scale a Viewport, it must be:	a. highlighted. b. scaled. c. activated. d. drawn in Paper Space.
4. You use what Zoom sub-command is used to scale a Viewport?	a. Dynamic. b. Center. c. Scale. d. Window.
5. The Scale command is entered in what format for a 1" =400' scaled view (assuming the units are set to architectural)?	a. 1"=400'. b. 1:400. c. 1:4800. d. 1/4800.

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## APPLY (CAD) SCALING FACTORS

### PERFORMANCE CHECKLIST

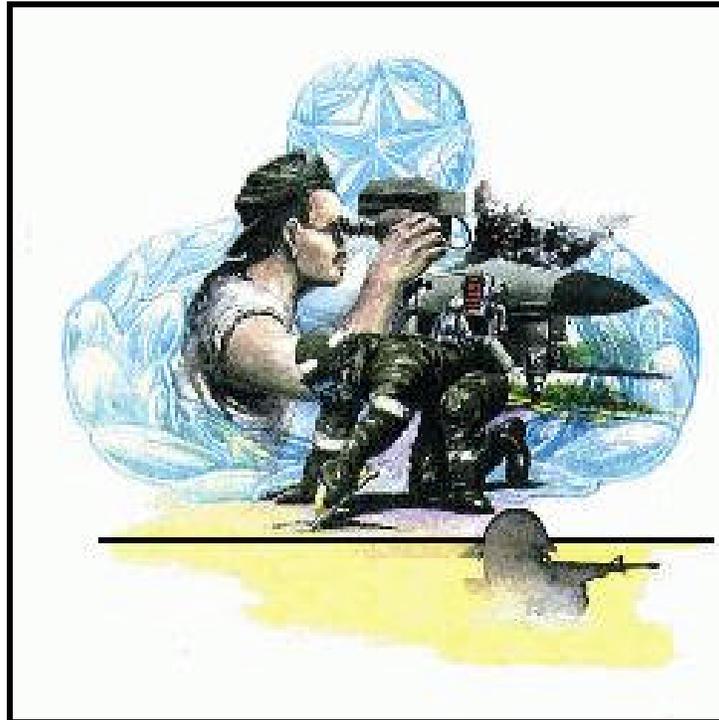
#### INSTRUCTIONS:

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. draw the drawing to true scale (1:1) in Model Space?		
2. create a new layer for the Viewports?		
3. scale the Viewport correctly?		
4. center the drawing in the Viewport?		
5. size the Viewport correctly?		

**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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## CAD FUNDAMENTALS

MODULE 16

AFQTP UNIT 1

---

PERFORM PRINTING AND PLOTTING (16.1.8.)

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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.

**PERFORM (CAD) PRINTING AND PLOTTING**  
***Task Training Guide***

<b>STS Reference Number/Title:</b>	16.1.8. - Perform CAD printing and plotting.
<b>Training References:</b>	<ol style="list-style-type: none"> <li>1. Plotter manufacturer's operator's manuals</li> <li>2. AutoCad v14 or higher reference manual (or current version)</li> <li>3. Career Development Course (CDC) 3E551B Engineering Journeyman, Volume 1, Unit 3, Section 018, <i>Principles and Techniques of Dimensioning Drawings</i>.</li> <li>4. Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE), v2.2 or higher.</li> </ol>
<b>Prerequisites:</b>	<ol style="list-style-type: none"> <li>1. <b>Possess as a minimum a 3E531 AFSC.</b></li> <li>2. <b>Review the following references:</b> <ol style="list-style-type: none"> <li>2.1. Manufacturer's operator's manual</li> <li>2.2. CDC 3E551B Engineering Journeyman, Volume 1, Unit 3, Section 018.</li> <li>2.3. SDSFIE, v2.2 or higher.</li> </ol> </li> <li>3. <b>Complete AutoCad tutorial program, v14 or higher.</b></li> </ol>
<b>Equipment/Tools Required:</b>	<ol style="list-style-type: none"> <li>1. Desktop Personal Computer.</li> <li>2. AutoCad v14 or higher software.</li> <li>3. Plotter/Printer.</li> </ol>
<b>Learning Objective:</b>	Given the equipment, trainee will be able to perform CAD printing and plotting
<b>Samples of Behavior:</b>	Trainee will know how to perform CAD printing and plotting
<b>Note:</b>	
There are several ways to complete each task (pull down menus, command line prompts, and icons). Trainees should mix and match to suit their drawing style.	

**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.

## PERFORM (CAD) PRINTING AND PLOTTING

**1. Background.** The final products of our efforts are printed engineering drawings and maps. If the end user is unable to carry our products to field, our efforts are for naught.

**2. To perform this task, follow these steps:**

**Step 1: Ensure the drawing is Layout (Paper Space) mode.**

**Step 2: Select the Plot/Print command.**

**Step 3: Select the proper device.**

**Step 4: If plotting templates are used, select the proper template (then select OK).**

**Step 5: Select the proper pen palette.**

**Step 6: Select the proper paper size and page layout.**

**Step 7: Select the proper plot area.**

**Step 8: Select the proper scale.**

**Step 9: Perform as Plot review prior to printing/plotting to ensure the settings are correct.**

**Step 10: Select OK.**

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**REVIEW QUESTIONS  
FOR  
PERFORM (CAD) PRINTING AND PLOTTING**

<b>QUESTION</b>	<b>ANSWER</b>
1. What drawing space should most prints be made from?	a. Paper Space. b. Model Space.
2. Do plotting templates have to be used?	a. Yes. b. No.

**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.

## PERFORM (CAD) PRINTING AND PLOTTING

### PERFORMANCE CHECKLIST

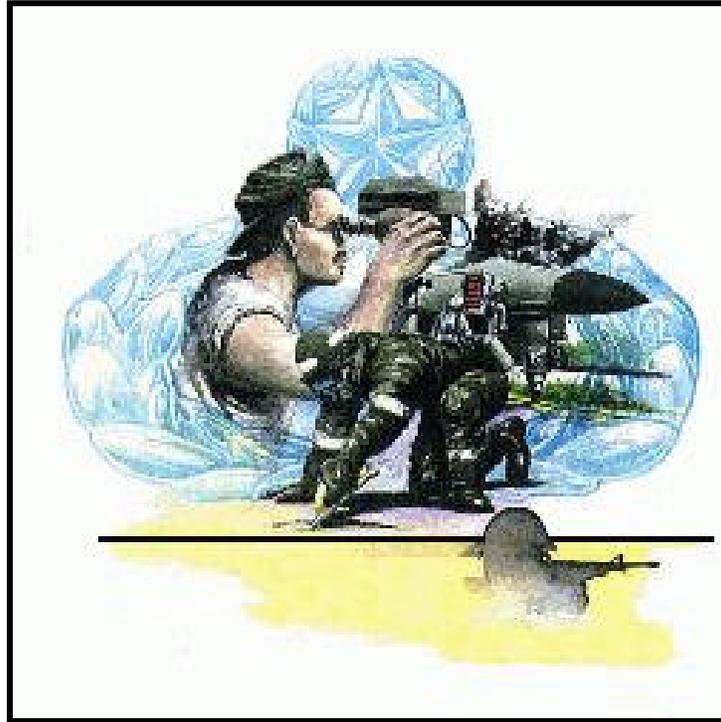
#### INSTRUCTIONS:

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. ensure the drawing is in Layout (Paper Space) mode?		
2. select the proper device?		
3. select the proper template if being utilized?		
4. select the proper pen palette?		
5. select the proper paper size and page layout?		
6. select the proper plot area?		
7. select the proper scale?		

**FEEDBACK:** Trainer 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.

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## **GEOGRAPHIC INFORMATION SYSTEM (GIS) (OPTIONAL)**

**MODULE 16**

**AFQTP UNIT 10**

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**GIS CONCEPTS (16.10.1.)**

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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.

**GIS CONCEPTS**  
***Task Training Guide***

<b>STS Reference Number/Title:</b>	16.10.1. - GIS Concepts.
<b>Training References:</b>	<ol style="list-style-type: none"> <li>1. ESRI ArcMap 8.x manual.</li> <li>2. Career Development Course (CDC) 3E551B Engineering Journeyman, Volume 1, Unit 5, <i>Geographic Information System</i>.</li> <li>3. Spatial Data Standard for Facilities, Infrastructure, and Environment (SDSFIE), v2.2 or higher.</li> <li>4. CD-ROM Geospatial Information and Services Fundamentals, v1.0, Reference Number GISFUNDCBT (produced by NIMA for the Defense Mapping School).</li> </ol>
<b>Prerequisites:</b>	<ol style="list-style-type: none"> <li>1. <b>Possess as a minimum a 3E531 AFSC.</b></li> <li>2. <b>Review the following references:</b> <ol style="list-style-type: none"> <li>2.1. Manufacturers operators' manual.</li> <li>2.2. CDC 3E551B Engineering Journeyman, Volume 1, Unit 5.</li> <li>2.3. SDSFIE, v2.2 or higher</li> </ol> </li> <li>3. <b>Complete the CD-ROM Geospatial Information and Services Fundamentals, v1.0.</b></li> </ol>
<b>Equipment/Tools Required:</b>	<ol style="list-style-type: none"> <li>1. Desktop Personal Computer.</li> <li>2. ESRI ArcGIS 8.2 or newer.</li> <li>3. Sample data set.</li> </ol>
<b>Learning Objective:</b>	Trainee will be able to discuss GIS concepts.
<b>Samples of Behavior:</b>	Trainee will understand GIS concepts.
<b>Note:</b>	
<ol style="list-style-type: none"> <li>1. GIS concepts are generic, but instruction should lead towards an ESRI software solution.</li> <li>2. The CD-ROM Geospatial Information and Services Fundamentals, v1.0 can be ordered through the Defense Logistics Agency with NSN 7644-01-491-5152.</li> <li>3. Recommend trainee also view <a href="http://www.GeoBase.hq.af.mil">www.GeoBase.hq.af.mil</a> for current GeoBase initiatives.</li> </ol>	

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## GIS CONCEPTS

### 1. Background.

**1.1.** A GIS is a computer-based tool for mapping and analyzing geospatial features that exist and events that happen on the earth. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geospatial analysis benefits offered by maps. In layman's terms, it's a smart map (raster or vector products) tied to a database.

**1.2.** There are two standards governing data development in the GIS format.

**1.2.1.** First, the Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE). This standard controls the "how to draw" and attribute GIS products. It covers things from layer naming conventions, to what field must be populated in the database.

**1.2.2.** Second, the Federal Geographic Data Committee (FGDC) standard. This standard controls the Metadata (the information about the data) attributes. GIS products are only useful if the data is current, accurate, and from a reliable source.

**1.3.** The look and feel of a GIS product is quite similar to CAD products.

**1.3.1.** Spatial data, made up of points, lines, and polygons, is the heart of every GIS. Spatial data forms the location and shapes of map features such as buildings, streets, or utilities infrastructure.

**1.3.2.** Tabular data is information describing a map feature. For example, a map of airfield obstruction may be linked to programmatic information about those obstructions.

**1.3.3.** Image data includes such diverse elements as satellite images, aerial photographs, and scanned data (data converted from paper to digital).

**1.3.4.** In addition, this data can be further classified into two types of data models:

**1.3.4.1. Vector.** These are discrete features, such as utility pole locations and data summarized area. There are several vector data formats used by ESRI software: Coverages were the native data format for ArcInfo until version 8 and Shape files are the native data format for ArcView 3.x. The Geodatabase is a data format introduced with ESRI's ArcGIS software. Coverages and shape files permit you to directly associate attributes with their graphic representations in the data set. For example, a coverage characterizing exterior electrical distribution will store arcs representing distribution lines and points representing poles. Attributes of these objects (e.g. voltage associated with a particular line segment) are stored internally in the coverage as part of the INFO database. If these same features were mapped with shape files, the arcs (electric lines) and points (poles) would be stored in two separate shape files, one for the lines and one for the points. Attributes for features in shape files are stored in an external .dbf file that accompanies the shape file. These formats are useful because they provide a simple way to capture geographic features in real-world coordinates and 'link' the features to their descriptive attributes. The Geodatabase takes this concept a step further, providing an even more powerful way to model geographic features. In addition to 'linking' attributes with the features they describe, the Geodatabase provides a way to associate behavior with the features so that geographic data more closely represents the way the features exist in the real world. The Geodatabase also takes advantage of conventional relational database management concepts to provide more powerful data creation and editing tools. For example, because of the way a water distribution network is configured, it may be impossible to connect a certain kind of pipe to a certain kind of

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valve. If a GIS operator is unaware of this 'rule', and simply connects the line to the point (valve), then records the type of valve, he or she may be inadvertently creating an error in the GIS data set. But if the data has a way to 'enforce' the rule, then the operator would be prevented from creating this connection. The Geodatabase makes it easy to define and enforce these rules against the data.

**1.3.4.2. Raster.** These are continuous numeric values, such as elevation, and continuous categories, such as vegetation types.

**2. Complete the CD-ROM Geospatial Information and Services Fundamentals, v1.0 for detailed instruction on the fundamentals of the GIS.**

**NOTE:**

The review questions for this material are contained in the CD-ROM Geospatial Information and Services Fundamentals.

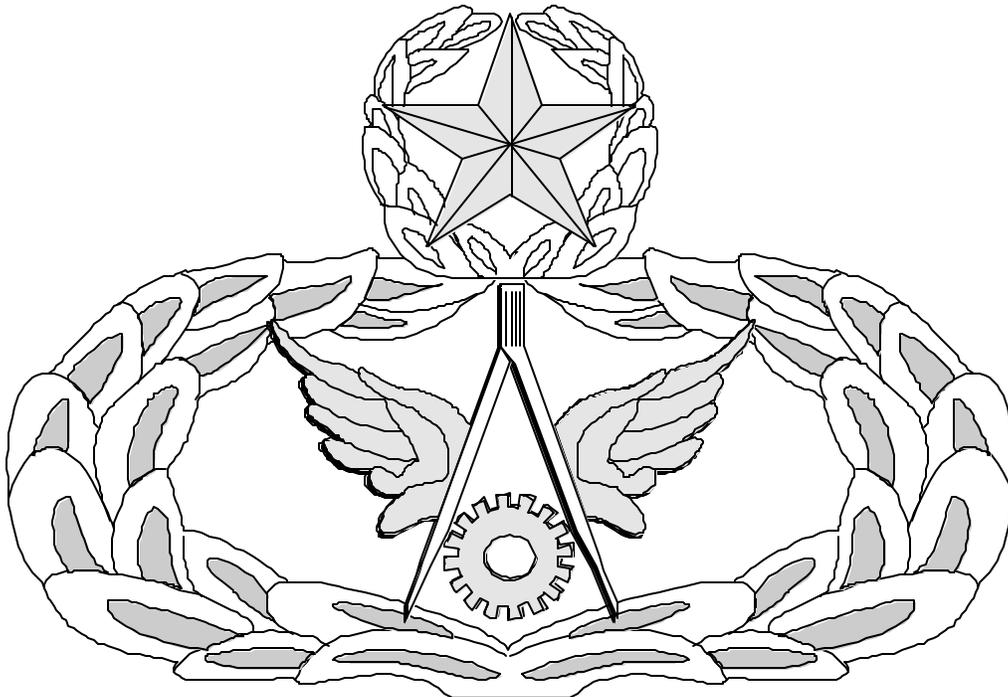
**NOTE TO TRAINER:**

At this time, there no performance steps required for this task.

# Air Force Civil Engineer

## QUALIFICATION TRAINING PACKAGE (QTP)

### REVIEW ANSWER KEY



FOR  
ENGINEERING  
(3E5X1)

MODULE 16  
COMPUTER AIDED DESIGN (CAD) / GEOGRAPHIC  
INFORMATION SYSTEM (GIS)

**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

**SETUP (CAD) DRAWINGS  
(3E5X1-16.1.1.)**

QUESTION	ANSWER
1. What drawing formats are AutoCad templates?	b. .dwt
2. Where does the drawing sheet block get inserted?	c. Paper Space.
3. How many Viewports are used in a drawing?	d. As many as required.

**UTILIZE BASIC (CAD) DRAWING COMMANDS  
(3E5X1-16.1.2.)**

QUESTION	ANSWER
1. What ways can most AutoCad commands be accomplished?	d. Any of the above.
2. What are the two most common line types?	d. Simple and Polylines.
3. What is the purpose of utilizing snap commands?	b. Ensures lines are attached to each other.

**UTILIZE (CAD) DISPLAY COMMANDS  
(3E5X1-16.1.3.)**

QUESTION	ANSWER
1. Do any of the display commands change the drawing attributes?	a. Yes. b. No.
2. What are the sub commands of the Zoom command?	All, Center, Dynamic, Extents, Previous, Scale, or Window.

**CREATE AND UTILIZE (CAD) SYMBOLS  
(3E5X1-16.1.4.)**

QUESTION	ANSWER
1. What layer should symbols be drawn on?	c. Layer "0".
2. How should block attributes be set?	d. By layer.
3. Where are blocks stored?	d. Either place.

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**UTILIZE (CAD) ADVANCE COMMANDS  
(3E5X1-16.1.5.)**

QUESTION	ANSWER
1. Do hatches have attributes?	a. Yes.
2. Why would an object be exploded?	b. To edit a block.

**UTILIZE REFERENCES FILES  
(3E5X1-16.1.6.)**

QUESTION	ANSWER
1. What is the benefit of using an external reference?	a. Quicker drawing updates.
2. Does rotating the referenced drawing change the original?	b. No.

**APPLY (CAD) SCALING FACTORS  
(3E5X1-16.1.7.)**

QUESTION	ANSWER
1. Drawings are always drawn to true scale (1:1)	a. Yes.
2. The layout Tab (Paper Space) is used:	c. to create what the printed product will look like.
3. In order to scale a ViewPort, it must be:	c. activated.
4. You use what Zoom sub-command is used to scale a Viewport?	c. Scale.
5. The scale is entered in what format for a 1"=400' scaled view (assuming the units are set to architectural)?	d. 1/4800.

**PERFORM PRINTING AND PLOTTING  
(3E5X1-16.1.8.)**

QUESTION	ANSWER
1. What drawing space should most prints be made from?	a. Paper Space.
2. Do plotting templates have to be used?	b. No.

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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.

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4. You may choose to call in your recommendations to DSN 523-6322 or FAX DSN/Commercial 523-6488 or (850) 283-6488 or email [ceof.helpdesk@tyndall.af.mil](mailto:ceof.helpdesk@tyndall.af.mil).

5. Thank you for your time and interest.

YOUR NAME, RANK, USAF  
Title/Position