

## Fundamentals

### *“Engineering Drawing Practices”*

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**ASME Y14.24: This Standard defines the types of engineering drawings most frequently used to establish engineering requirements. It describes typical applications and minimum content requirements. Drawings for specialized engineering disciplines (e.g., marine, civil, construction, optics, etc.) are not included in this Standard.**

NOTE: Approved and Preferred by DoD Policy for Drawing Guidance.

# Fundamentals

## *“Engineering Drawing Practices”*

### 1. Layout Drawing

A layout drawing depicts design development requirements. It is similar to a detail, assembly, or installation drawing, **except that it presents pictorial, notational, or dimensional data** to the extent necessary to convey the design solution used in preparing other engineering drawings.

**Applications.** A layout drawing may be prepared for a complete end product or any portion thereof and is prepared either as,

- a) A **conceptual design layout** to present one or more solution for meeting the basic design parameters and to provide a basis for evaluation and selection of an optimum design approach;
- b) A **design approval layout** to present sufficient detail of the design approach for cost estimating and design approval;

(Continued on next slide)

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### *“Engineering Drawing Practices”*

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#### Layout Drawing

- c) A **detailed design layout** depicting the final development of the design in sufficient detail to facilitate preparation of detail and assembly drawings; or
- d) A **geometric study** to develop movement of mechanical linkages, clearances, or arrangements.

**NOTE:** A layout is not normally used to fabricate equipment; however, a detailed design layout is sometimes used as an interim assembly drawing for development equipment.

## Fundamentals “Engineering Drawing Practices”

### Layout Drawing

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7 5 6 9

TYPES AND APPLICATIONS OF ENGINEERING DRAWINGS

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FIG. 3 LAYOUT DRAWING

18 of 83 10.88 x 8.34 in

# Fundamentals

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### 2. Detail Drawing

A detail drawing provides the **complete end-product definition** of the part or parts depicted on the drawing. A detailed drawing establishes item identification for each part depicted thereon.

- **Monodetail Drawing.** **Delineates a single part.** Prepared to provide maximum clarity. Identifies all features of the part including: Configuration, Dimensions, Tolerances, Materials, Mandatory Processes, Surface Texture, Protective Finishes and Coatings, and Markings.
- **Multidetail Drawing.** **Delineates two or more uniquely identified parts** in separate views or in separate sets of views on the same drawing. Is a single drawing prepared to describe parts usually related to one another.

## Fundamentals “Engineering Drawing Practices”

### Detail Drawing (Monodetail Drawing)

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**NOTES:**

1. APPLICABLE STANDARDS/SPECIFICATIONS:  
ASME Y14.5M-1994
2. FINISH  $3.2/\sqrt{\phantom{x}}$
3. ALL FILLETS AND EDGES SHALL BE  $0.025 \pm 0.13$  UNLESS OTHERWISE SPECIFIED
4. MATERIAL:  
WROUGHT MATERIAL STEEL BARS,  
MIL-S-5826 4140
5. PROTECTIVE FINISH:  
FINISH IAW 5.3.1.3 OR  
5.3.2.3 OF MIL-STD-171
6. MARK IAW WITH MIL-STD-130.  
METHOD RUBBER STAMP, THE  
FOLLOWING INFORMATION:  
XXXXX-XXXXXXX-1

**SAMPLE DRAWING**  
THIS DRAWING SHALL BE CON-  
STRUED AS INFORMATION ONLY. IT IS  
COMPLETE ONLY TO THE DEGREE NECES-  
SARY TO ILLUSTRATE A PARTICULAR  
DRAWING TYPE.

**FIG. 4 MONODETAIL DRAWING**

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TYPES AND APPLICATIONS OF ENGINEERING DRAWINGS  
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19 of 83 10.86 x 8.33 in

## Fundamentals

### “Engineering Drawing Practices”

#### Detail Drawing (Multidetail Drawing)

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**NOTES: UNLESS OTHERWISE SPECIFIED**

1. MACHINED CORNER RADI .03 MAX
2. MATERIAL:  $\varnothing 25.4$  AL ALY ROD, 6061, T6 PER XXXXXXX-5

$\varnothing 25.4$  STOCK

M6x1-6g

0.8 x 45°

44

**NOTES: UNLESS OTHERWISE SPECIFIED**

1. MATERIAL: 6.3 THK AL ALY PLATE, 6061, T6 PER XXXXXXX-2

22

16

$\varnothing 3.55$

$\sqrt{82^\circ}$  x  $\varnothing 7.11$

31.8

16

50.8  $\pm 0.05$

M6x1-6H

6.3 STOCK

44

2x R6.3

2x 25.4

**NOTES: UNLESS OTHERWISE SPECIFIED**

1. MATERIAL: 6.3 DIA AL ALY ROD 6061, T6 PER XXXXXXX-4

8.12

3.04

1.27

$\varnothing 1.57 \pm 0.07$

$\varnothing 6.3$  STOCK

M3x-6H T 6

FLAT BOTTOM

**NOTES: UNLESS OTHERWISE SPECIFIED**

1. MATERIAL:  $\varnothing 9.5$  AL ALY ROD 6061, T6 PER XXXXXXX-1

6.89  $\pm 0.02$

$\varnothing 9.5$  STOCK

M6x1-6H T 6

FLAT BOTTOM

SEE SEPARATE PARTS LIST

**SAMPLE DRAWING**

THIS DRAWING SHALL BE CON-SIDERED AS INFORMATION ONLY. IT IS COMPLETE ONLY TO THE DEGREE NECESSARY TO ILLUSTRATE A PARTICULAR DRAWING TYPE.

**FIG. 6 MULTIDETAIL DRAWING**

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## Fundamentals

### *“Engineering Drawing Practices”*

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#### 3. Assembly Drawings

An Assembly drawing defines the configuration and contents of the assembly or assemblies depicted thereon. It establishes item identification for each assembly. **When an assembly drawing contains detailed requirements for one or more parts used in the assembly, it is a detail assembly drawing.**

**Application.** An assembly drawing is prepared for each group of items that are to be joined to form an assembly and that reflect one or more of the following;

- a) A logical level in the assembly or disassembly sequence.
- b) A testable item.
- c) A functional item.
- d) A deliverable item.



## Fundamentals “Engineering Drawing Practices”

### Assembly Drawing

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BOOKMARKS

NOTES:

- 1 THE AXIAL LOAD REQUIRED TO MOVE THE SHAFT THROUGH ITS COMPLETE RANGE OF TRAVEL OVER OTHER ASSEMBLED PARTS SHALL NOT EXCEED 7 OUNCES. THE ASSEMBLY SHALL BE CYCLED IF NECESSARY TO MEET THIS REQUIREMENT.
- 2 SURFACES OF BALLS AND BALL RACE SHALL BE COATED WITH A FILM OF GREASE. MIL-G-23827.
- 3 AXIAL LOAD APPLIES WITH ASSEMBLY IN HORIZONTAL PLANE AS SHOWN.

SEE SEPARATE PARTS LIST

TYPES AND APPLICATIONS OF ENGINEERING DRAWINGS

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 DRAWING TYPE.

FIG. 7 ASSEMBLY DRAWING

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## Fundamentals

### *“Engineering Drawing Practices”*

#### 4. Installation Drawings

An Installation Drawing provides **information for properly positioning and installing items relative to their supporting structure and adjacent items**, as applicable. Information may include; **Dimensional Data, Hardware Descriptions, and General Configuration information** for the installation site. An installation drawing does not establish item identification except for a work package or kit.

**Application.** An installation drawing is prepared to provide detailed installation information for;

- a) Functionally related items that **cannot be effectively shown** on a assembly drawing of the item to which it belongs (Control System, Electrical System, or Hydraulic System.)
- b) An assembly which is **so large or complex** that the major assembly drawing cannot accommodate all relevant data.

## Fundamentals “Engineering Drawing Practices”

### Installation Drawing

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TYPES AND APPLICATIONS OF ENGINEERING DRAWINGS

**NOTES:**

- 1  $\odot$  DENOTES APPROXIMATE CENTER OF GRAVITY. (DOES NOT INCLUDE MLU CCA)
- 2 ESTIMATED HEAT DISSIPATION: 337 WATTS
- 3 WEIGHT: 36.7 POUNDS MAX. (DOES NOT INCLUDE MLU CCA)
- 4 MINIMUM CLEARANCE FOR AIR FLOW
- 5 INDICATES APPROX. MASTER KEYWAY
- 6 MAX. PIN PENETRATION INTO CASE EQ. 50
- 7 PROTECTION CAP
- 8 SITE INDICATOR
- 9 CONNECTORS - SEE CHART
- 10 SUPPORT HOOK NAS82CT4 ALTERED

REF. DESIG.	CONNECTOR PART NO.	SUGGESTED MAT'NG. CON.	USE
J1	MS27566T1B35P	MS27487112935	POWER INPUT
J2	MS27566T1T505P	MS274911176355	TEST/STATE
J3	MS27566T1B35P	MS274871116355	DATA BUS
J4	MS27566T10835S	MS27497113833P	ANAPS-124 INTERFACE
J5	MS27566T1T505	MS27497111785P	ANAPS-124 INTERFACE

**SAMPLE DRAWING**  
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**FIG. 10 INSTALLATION DRAWING**

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### Installation Drawing

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NOTES:

- 1 ⦿ DENOTES APPROXIMATE CENTER OF GRAVITY. (DOES NOT INCLUDE MLU CCA.)
2. ESTIMATED HEAT DISSIPATION: 337 WATTS
- 3 WEIGHT: 35.7 POUNDS MAX. (DOES NOT INCLUDE MLU CCA.)
- 4 MINIMUM CLEARANCE FOR AIR FLOW
- 5 INDICATES APPROX MASTER KEYWAY
- 6 MAX. PIN PENETRATION INTO CASE EQ. 50
- 7 PROTECTION CAP
- 8 BITE INDICATOR
- 9 CONNECTORS - SEE CHART
- 10 SUPPORT HOOK NAS622CT4 ALTERED

5.14 1

3.40 MAX

7.59

2.86

8

AIR INLET

J1

TEST

FAIL

7

AIR INLET

25 of 83 10.89 x 8.33 in

Start TV Novell G... OMF Ne... OMF Se... Y:\apps... Home C... Microsof... C:\Docu... Acroba... 8:30 AM

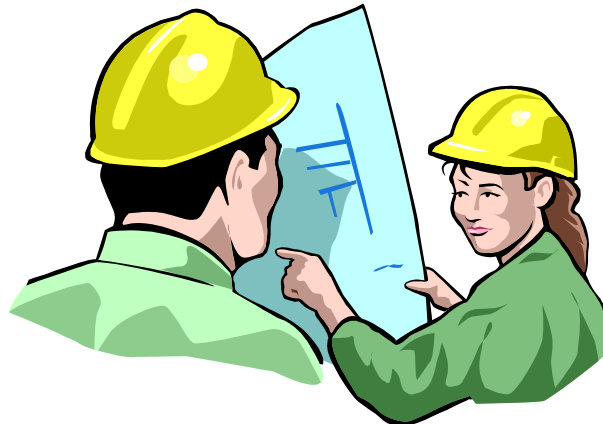
## Fundamentals

### *“Engineering Drawing Practices”*

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#### 5. Modifying Drawings

Modifying drawing types are **Altered Item**, **Selected Item**, and **Modification Drawings**. These drawing types are not used for items made from raw or bulk materials, items purchased in bulk lengths, or such semiprocessed items as blank panels, castings, electronic equipment drawers, etc. (For such items, use detail or detail assembly drawings.)



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#### 5. Modifying Drawings

##### a) Altered Item Drawing

An altered item drawing **delineates the physical alteration of an existing item** under the control of another design activity or defined by a nationally recognized standard. The drawing type permits the required alteration to be performed by any competent manufacturer including the original manufacturer, the altering design activity, or a third party. **It establishes a new item identification for the altered item.**

**Application.** An Altered Item drawing is prepared **when alteration of an existing item is required**. An altered item drawing **shall not** be prepared to modify an existing item that was developed by the design activity.

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### Altered Item Drawing

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NOTES:

1. APPLICABLE STANDARDS/SPECIFICATIONS:  
ASME Y14.5M-1994
2. FINISH  $\sqrt{3.2}$  ALL ALTERED SURFACES
3. ALL EDGES SHALL BE BROKEN  $0.07 \pm 0.01$  UNLESS OTHERWISE SPECIFIED
4. BOLT SHALL BE IN ACCORDANCE WITH REQUIREMENTS OF MS9490-15 EXCEPT AS SPECIFIED HEREON
5. PROTECTIVE FINISH 54.1 OF MIL-STD-171
6. ALTERED FEATURES

Ø 8.13  $\begin{matrix} 0 \\ -0.1 \end{matrix}$

$\sqrt{0.25}$  A

(3.96)

1.67  $\begin{matrix} +0.13 \\ 0 \end{matrix}$  6

R 0.25  $\begin{matrix} 0 \\ -0.13 \end{matrix}$  6

R 0.38  $\begin{matrix} 0 \\ -0.13 \end{matrix}$  6

A O.D.

0.5 ± 0.25 X 45' 6

25  $\begin{matrix} 0 \\ -0.25 \end{matrix}$  6

TYPES AND APPLICATIONS OF ENGINEERING DRAWINGS

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SAMPLE DRAWING

THIS DRAWING SHALL BE CON-  
STRUED AS INFORMATION ONLY. IT IS  
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DRAWING TYPE.

ALTERED ITEM DRAWING

FIG. 11 ALTERED ITEM DRAWING (Mechanical Alteration)

26 of 83 10.9 x 8.35 in

Start

Novell Gro... OMF Netw... OMF Servi... Y:\apps\pi... Home Coll... C:\Docum... Acrobat ...

2:37 PM

## Fundamentals

### *“Engineering Drawing Practices”*

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#### 5. Modifying Drawings

##### b) Selected Item Drawing

A Selected Item Drawing defines **refined acceptance criteria for an existing item** under the control of another design activity or defined by a nationally recognized standard which requires further selection, restriction, or testing for such characteristics as fit, tolerance, material, performance, reliability, etc. This drawing type generally permits selection to be performed by any competent inspection or test facility including those of the original manufacturer, the selecting design activity, or third party.

A Selected Item Drawing establishes a new item identification for the selected item. Although visible physical modification is not performed, the item is, demonstratively different from other items which meet only the requirements imposed on the original item.



#### 5. Modifying Drawings

##### b) Selected Item Drawing

**Application.** A Selected Item Drawing is prepared when it is feasible to select from an existing group of existing items those items that, as applicable,

- 1) Meet the required characteristics for a particular application;
- 2) Pass additional tests or inspections imposed by the using-design activity for characteristics not normally specified for the original item; and
- 3) Survive burn-in or run-in requirements.

**NOTE:** A selected item drawing **shall not** be prepared to select items that were developed by the design activity.

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### Selected Item Drawing

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TYPES AND APPLICATIONS OF ENGINEERING DRAWINGS

NOTES:

1. PART SHALL CONFORM TO MIL-R-XXX
2. POWER RATING 150 WATTS AT 25°C
3. NOMINAL TOTAL RESISTANCE VALUE 2.5 OHMS
4. SELECT FOR RESISTANCE TOLERANCE RANGE +2% -3%. PURCHASE FROM A.B.C. RESISTANCE COMPANY, CAGE CODE XXXXX, PART NO 72759
5. REIDENTIFY WITH "0856X-12345" PER XXXXXX. REMOVE ORIGINAL ITEM IDENTIFICATION

Ø14 MAX

5 MAX

12.7

2X R

2X 6.6 ± 0.76

2X Ø 3.3 ± 0.12

Ø 1.52

Ø 0.4

19

SAMPLE DRAWING

THIS DRAWING SHALL BE CON-  
STRUED AS INFORMATION ONLY. IT IS  
COMPLETE ONLY TO THE DEGREE NECES-  
SARY TO ILLUSTRATE A PARTICULAR  
DRAWING TYPE.

SELECTED ITEM DRAWING

FIG. 13 SELECTED ITEM DRAWING (Mechanical Selection)

18

29 of 83 10.89 x 8.34 in

Start Novell G... OMF Ne... OMF Se... Y:\apps... Home C... C:\Docu... Acroba...

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## Fundamentals

### *“Engineering Drawing Practices”*

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#### 5. Modifying Drawings

##### c) Modification Drawing (pg. 17)

A Modification Drawing **delineates changes to items after they have been delivered**. When required for control purposes, a modification drawing shall require re-identification of the modified item.

**Application.** A Modification Drawing is prepared to add, remove, or rework items to satisfy the user’s requirements or to incorporate mandatory changes in delivered equipment. (Engineering changes are incorporated into the latter drawing types to the extent that future production is to reflect the modifications.)

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### Modification Drawing

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**SAMPLE DRAWING**  
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SARY TO ILLUSTRATE A PARTICULAR  
DRAWING TYPE.

VIEW A-A  
2 PLACES

VIEW B  
SCALE 2/1

ASSEMBLY

SEE SEPARATE PARTS LIST  
MODIFICATION DRAWING

NOTES: UNLESS OTHERWISE SPECIFIED

1. INSTALL ITEM 1 PER 987641.
2. DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994

FIG. 15 MODIFICATION DRAWING

Item	Description	Quantity	Notes
1	Item 1	Per 987641	

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#### 6. Arrangement Drawing (pg. 21)

An Arrangement Drawing **depicts the physical relationship of significant items using appropriate projections or perspective views.** Reference dimensions may be included. An Arrangement Drawing **does not** establish item identification.

**Application.** An Arrangement Drawing is prepared to convey a general description of the configuration and location of significant items. It is not normally used to control design.

## Fundamentals “Engineering Drawing Practices”

### Arrangement Drawing

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**FIG. 16 ARRANGEMENT DRAWING (Pictorial)**

**SAMPLE DRAWING**  
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**ARRANGEMENT DRAWING**

FOR PART NUMBERS SEE EQUIPMENT LIST XXXXX.

1. PRESSURIZED EQUIPMENT SPACE PROVISIONS	12. RUDDER TRIM TAB	23. OXYGEN BOTTLE
2. EQUIPMENT SPACE PROVISIONS	13. FUEL JETTISON AND VENT	24. 2500 VA INVERTERS
3. PILOT HEAD (TYPICAL BOTH SIDES)	14. TRANSLABLE HORIZONTAL STABILIZER	25. LANDING AND TAXILIGHTS
4. WING SLATS	15. HYDRAULIC RESERVOIR	
5. INTEGRAL WING FUEL TANK	16. FUSELAGE FUEL TANK	
6. WING FLAP	17. BATTERIES (TWO)	
7. GROUND ESCAPE HATCH	18. JT 15A-6A TURBOJET ENGINE	
8. RAM-AIR INLET	19. AILERON TRIM TAB	
9. VEAT EXCHANGER	20. ENTRANCE DOOR	
10. ANTI COLLISION LIGHT	21. SPEED BRAKE	
11. VOR LOCALIZER ANTENNA	22. WING CHECK LIGHT	

