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Maintenance

ENGINEERING DRAWING SYSTEM

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OPR: HQ AFMC/ENP (Mr Charles D. Crouse)
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This instruction implements AFD 21-4, *Engineering Data*. It provides guidance and designates responsibilities for preparing, approving, authenticating, revising, and releasing Air Force engineering drawings, associated lists, and AF Forms 3925, **Engineering Order**, 3926, **Engineering Order (Continuation Sheet)**, and 3927, **Engineering Order (Parts List)**.

This instruction applies to all major commands (MAJCOM), field operating agencies (FOA) and direct reporting units (DRU), including the Air Force Reserve Command and Air National Guard, that prepare, change, and revise engineering drawings, except those designated under the listed exemptions. Send comments, questions, and suggested improvements on AF Form 847, **Recommendation for Change of Publication**, through channels to HQ USAF/ILMM, 1030 Air Force Pentagon, Washington DC 20330-1030 with an information copy to HQ AFMC/ENPM, 4375 Chidlaw Road, Rm N145, Wright-Patterson AFB OH 45433-5006. See **Attachment 1** for a glossary of references and supporting information.

SUMMARY OF REVISIONS

This revision updates organizational references, provides for CAD generated drawing continuation sheets, updates CAD generated forms guidance, restructures Engineering Order guidance sequence, establishes AF Forms 3925, 3926, and 3927 replacing AF Forms 2600 and 2601, deletes AF Forms 2605 and 2606, and addresses design activity transfer criteria.

Section A—Responsibilities

1. HQ USAF/ILMM:

- 1.1. Establishes guidance for Air Force engineering drawing practices.
- 1.2. Implements new drawing preparation requirements issued by the Department of Defense and HQ USAF.
- 1.3. Serves as the policy focal point for Air Force engineering drawing practices.

- 1.4. Serves as the Chair of the Air Force Engineering Data Group (AFEDG).
- 1.5. Prescribes standard formats for generating Air Force engineering drawings and documenting changes to Air Force or contractor drawings.
- 1.6. Ensures that all records created by this AFI are maintained and disposed of IAW AFMAN 37-139, *Records Disposition Schedule*.

2. HQ AFMC/ENP:

- 2.1. Serves as co-vice Chair of the AFEDG for policy issues.
- 2.2. Serves as the Air Force designated focal point for the formulation of engineering drawing policies.

3. MSG/MMF:

- 3.1. Serves as co-vice Chair of the AFEDG for policy implementation and coordinates the schedule, site, and agenda of all group meetings.
- 3.2. Serves as the Air Force designated focal point for engineering drawing policy implementation and practices.
- 3.3. Assigns Air Force drawing numbers, on request, to all Air Force Design Activities.
- 3.4. Establishes and maintains a master record of all drawing number block assignments.

4. Major Commands and Field Operating Agencies (MAJCOM and FOA):

- 4.1. Establish and implement the procedures required by this instruction.
- 4.2. Maintain and secure all original engineering drawings generated by Air Force design activities as well as any other associated documents and originals acquired through design activity transfer to a Category V EDSC.
- 4.3. Designate a focal point for engineering drafting policy and procedures:
 - 4.3.1. Appoint drafting representatives to the AFEDG.
 - 4.3.2. Designate focal points to receive and control blocks of drawing numbers from the MSG/MMF issuing office and to provide quality control for all Government drawings generated at that location.
- 4.4. Authorize local officials to develop and implement specific guidelines when necessary.

5. Air Force Engineering Data Group (AFEDG):

- 5.1. Reviews and recommends beneficial changes to Air Force Drawing System policy in conjunction with AFI 21-401, *Engineering Data Distribution and Control*, and AFI 21-403, *Acquiring Engineering Data*.
- 5.2. Develops, recommends adoption of, and maintains a baseline for approved Air Force Drawing Requirements Manuals.
- 5.3. Develops and recommends changes to Air Force formats for generating Air Force engineering drawings.

- 5.4. Develops and recommends changes to Air Force formats used to document changes to drawings developed by the Air Force or contractors.
- 5.5. Reviews and recommends future actions on requests for waivers and deviations from this instruction.
- 5.6. Requests representatives from Air Force activities directly involved in:
 - 5.6.1. Preparing or revising engineering data.
 - 5.6.2. Processing and archiving master original engineering drawings and engineering orders (EO).
- 5.7. Appoints special ad hoc subgroups through the group Chair to address specific concerns such as security, engineering drawing preparation, storage, or distribution.

6. Exclusions. These activities are excluded from the requirements of this instruction:

- 6.1. AFCA units and other activities subject to the requirements of AFI 21-404, *Developing and Maintaining Communications and Computer Systems Installation Records*.
- 6.2. Base civil engineering organizations that prepare engineering data for real property related items or that function according to other established civil engineering procedures.
- 6.3. Air Education and Training Command (AETC) activities implementing the guidance of AF Pamphlet 36-2211, *Management of Air Force Training Systems*.

Section B— Drawing Elements

7. Drawing Requirements Manual (DRM). Air Force drafting activities may purchase and use the latest version of this manual to prepare or revise original drawings or to make changes to original engineering documents acquired through a design activity transfer.

Drawing Requirements Manual
Global Engineering Documents
15 Inverness Way
Englewood CO 80112-5704
(800) 854-7179
FAX (303) 397-7935

Section C— Drawing Authorization Signatures

8. Drawing Authorization. Air Force drawing activities must control signatures or electronic name entries on the drawings they produce and those they acquire through contracts. The drawing activity must specify the individuals or functions authorized to make entries under these blocks:

- 8.1. **Technician (mandatory):** Verifies that the preparing technician has developed and examined the completed work based on the required instructions and directions and that the drawing accurately depicts the required information.

8.2. **Checker (mandatory):** Indicates that the checker has thoroughly checked the drawing for conformance to MIL-STD-100 (*Engineering Drawing Practices*) and guidance cited therein to ensure that the drawing is correct, complete, and technically adequate.

8.3. **Engineer (mandatory):** Indicates that the responsible engineer has reviewed the checked drawing and approves its technical content in conformance with the applicable engineering design criteria.

8.4. **Engineering Approval (optional):** Signifies cognizance and approval of the project by the design engineer's supervisor.

8.5. **Coordinating Signatures.** Signifies additional professional approval as determined by the project engineer. (Most signing engineers represent a specialized engineering activity such as corrosion, environmental, safety, reliability, nuclear, and so on.)

8.6. **Air Force Authentication (Mandatory):** Indicates that the drawing has satisfied all requirements and is technically ready for final release. The authority to authenticate drawings rests with:

8.6.1. The cognizant Air Force engineer or other designated agent for Air Force drawings generated in-house.

8.6.2. A contractor preparing Air Force drawings by contract, who has been delegated this authority. Authorized contractors must be tasked to deliver drawings that include their release control authority signatures.

8.7. **Air Force Release (mandatory).** The locally designated activity must sign the Air Force release verifying that:

8.7.1. Drawing activities have accomplished administrative control functions.

8.7.2. The complete engineering drawing (defined by the design or design change) has been released.

8.7.3. The "X" has been removed from the drawing number.

8.7.4. The drawing is now under formal configuration management control.

9. Drawing Verification, Approval, and Authorization. Air Force design activities shall have an effective verification approval and authorization system (including electronic as applicable). Authorized individuals enter their names in the appropriate blocks to indicate that engineering drawings, associated lists or digital databases, and AF Forms 3925, 3926, and 3927 conform to all applicable requirements. AF Form 2602, **Engineering Document Release Record**, is used to enter these required signatures.

Section D— Air Force Drawing Formats

10. Forms Prescribed. Use these forms or automated products when generating drawings.

10.1. **AF Form Number, Title and Size (in inches):**

AF Form 1651, **Engineering Drawing Layout - A Horizontal** (8-1/2 x 11).

AF Form 1652, **Engineering Drawing Layout - A Vertical** (8-1/2 x 11).

AF Form 1652A, **Engineering Drawing Layout - A Vertical (Continuation sheet)** (8-1/2 x 11)

AF Form 1653, **Engineering Drawing Layout - B** (11 x 17).

AF Form 1654, **Engineering Drawing Layout - C** (17 x 22).

AF Form 1655, **Engineering Drawing Layout - D** (22 x 34)

AF Form 1656, **Engineering Drawing Layout - E** (34 x 44).

AF Form 1658, **Parts List** (8-1/2 x 11)

AF Form 1659, **Data List** (8-1/2 x 11)

AF Form 1660, **Index List** (8-1/2 x 11)

AF Form 1661, **Tube Bend Drawing** (8-1/2 x 11)

AF Form 2602, **Engineering Document Release Record** (8-1/2 x 11)

AF Form 3925, **Engineering Order** (8-1/2 x 11, hor.) (Formerly AF Form 2600)

AF Form 3926, **Engineering Order (Continuation Sheet)** (8-1/2 x 11, hor.) (Formerly AF Form 2601)

AF Form 3927, **Engineering Order (Parts List)** (8-1/2 x 11, hor.) (Formerly AF Form 2601)

NOTE: You may generate larger drawing sizes in accordance with ASME Y14.1, using current Air Force criteria as defined for E size drawings.

10.2. **CAD System.** These forms may be generated in a CAD system providing the final form output does not vary from the published form and includes the following exception notice in the lower right-hand corner of the form margin or border: "**Exception to (form number) for CAD generation approved by HQ AFMC/ENP (name of software and vendor)**"

10.2.1. **Continuation sheets.** When AF Forms 1653 through 1656, and larger drawing format sizes as defined in ASME Y14.1, are used to prepare multi-sheet drawings, and the forms are generated in a CAD system, the abbreviated title block described in ASME Y14.1, may be used for continuation sheets. All other features of the AF drawing forms, such as border, border sectioning, revision blocks, etc. are included. Identification as a continuation sheet is indicated by adding "**(Continuation Sheet)**" following the form name centered in the lower margin (i.e. ENGINEERING DRAWING LAYOUT D (Continuation Sheet)). Identification of computer generation status described in 10.2 also applies to continuation sheets with an "A" added to the drawing form identifier to indicate continuation sheet status (i.e. AF FORM 1655A).

Section E— Air Force Drawing and Dash Numbers

11. Assigning Drawing Numbers. Assign all Air Force drawings a drawing number. Each agency annually acquires blocks of official Air Force drawing numbers from MSG/MMF.

11.1. MSG/MMF distributes blocks of Air Force drawing numbers to authorized activities upon their request. Engineering activities must submit yearly distribution requests no later than December 1st. You may submit requests for additional drawing numbers at any time.

11.2. Use the prefix "X" in the drawing number blocks until final release. Do not prefix references to other Air Force drawings with an "X".

11.3. Air Force drawing numbers will be applied as assigned. Modification of Air Force drawing numbers by inserting the drawing size indicator or by adding a prefix or suffix to identify the drawing

function is not authorized except for associated lists identification as provided in ASME Y14.34M, *Associated Lists*.

12. Managing Drawing Numbers. Designated focal points assigned blocks of Air Force drawing numbers, manage, control, and distribute those drawing numbers within their local activity.

13. Dash Numbering System. Use a standard Air Force dash numbering system for items and assemblies when generating Air Force drawings. Adapt the drawing requirements manuals to the Air Force dash numbering system.

13.1. **Detailed Item Dash Numbers.** Use odd dash numbers on all defined detail items. Use even numbers for the opposite or mirror-image items. Do not use dash numbers ending in "9" or "0" (**Figure 1**).

13.2. **Assembly Dash Numbers.** Use dash numbers beginning with an odd number and ending with "0" for all defined assemblies. Use dash numbers beginning with an even number and ending with "0" for the opposite or mirror-image assemblies (**Figure 1**).

13.3. **Tabulated alignment.** You may use corresponding dash numbers for tabulated Air Force drawings that relate to other tabulated drawings or standards when necessary for clear cross-referencing and identification.

13.4. **Variations.** Submit requests for variations of the Air Force dash numbering system to MSG/MMF. Fully describe the variations you're requesting, explain why you need the variations, and assess the impact on your project if the variation is not approved. MSG/MMF evaluates the request and submits a recommendation to HQ USAF/ILMM for final resolution.

Figure 1. Dash Numbers.

<u>Parts</u>		<u>Assemblies</u>	
<u>Shown</u>	<u>Opposite</u>	<u>Shown</u>	<u>Opposite</u>
-01	-02	-10	-20
-03	-04	-30	-40
-05	-06	-50	-60
-07	-08	-70	-80
(do not use dash numbers ending in 9 or 0)		-90	-100
-11	-12	-110	-120
-13	-14	-130	-140
-15	-16	etc.	
etc.			

Section F— Control Drawings

14. Control Drawings. Prepare control drawings for commercial or vendor items in accordance with ASME Y14.24M.

Section G— Documenting Drawing Changes

15. Engineering Order. Use AF Forms 3925, 3926, and 3927 (formerly AF Forms 2600 and 2601), Engineering Order, to document information that affects the content or status of Air Force or contractor drawings. Anyone may initiate an Engineering Order request but it must be approved by the cognizant engineer(s) authorized by the responsible Configuration Control Board to change the product baseline.

15.1. **Engineering Order Forms.** AF Forms 3925, 3926, and 3927, provide an initial or first sheet (AF Form 3925), textual/graphical content continuation sheet (AF Form 3926) and continuation sheet for parts lists (AF Form 3927) for the generation of Engineering Orders. These forms are available digitally through AF Publications Distribution systems. When inclusion of graphical data is required on either the first sheet (AF Form 3925) or textual content continuation sheet (AF Form 3926), or both, these forms may be generated by a graphics capable data base for application of the graphical and textual data providing the final form output does not vary from the published form.

16. Engineering Order (EO) Number Assignment. Assign EO numbers in consecutive order beginning with number 0001, prefixed by the year and abbreviation "A" (Air Force) or "C" (contractor)": for example, 98A0001, 2001A0002 or 99C0001, 2001C0002. The basic EO number for the individual drawing continues to be assigned consecutively, regardless of the year assigned. A separate EO number is needed for each drawing that requires an EO application.

17. Engineering Order (AF Forms 3925, 3926, and 3927):

17.1. **Change Notice Engineering Order (CNEO).** CNEOs inform drawing users that a revision has been made. It describes and records changes incorporated during the revision action and precludes extensive revision descriptions in the drawing revision block.

17.1.1. The cognizant engineer uses CNEOs to direct a revision and describe changes incorporated into drawings. When using CNEOs cite the change authorization document number in the drawing revision block.

17.1.2. Maintain all CNEOs with the affected drawing to provide a history of drawing changes.

NOTE: The drafter who incorporates the changes and the responsible engineer complete the appropriate signature blocks on the drawing and the Engineering Order.

17.2. **Advance Engineering Change Orders (AECO).** Use AECOs to authorize drawing changes before revising the affected drawing master originals. Your released AECOs are considered an integral part of the drawing and represent changes that will be incorporated on Air Force and design activity transfer drawings controlled by the Air Force at the next drawing revision.

17.2.1. **AECOs Against Air Force Drawings.** Do not use AECOs against Air Force drawings except where the schedule for revising, releasing, and distributing the affected drawing doesn't leave you enough time to incorporate the change.

17.3. **Advance Engineering Supplemental Orders (AESO).** AESOs are used to supplement drawings of another design activity, government or contractor, to document and control Air Force required changes to the product baseline. Air Force engineering offices use AESOs to supplement the product baseline drawings of other design activities for modification or follow-on production of materiel. However, AESOs should be avoided to prevent configuration management and data conflicts between drawing originals and local Air Force "supplemented" copies. The AESO must accompany the

affected drawing to correctly implement the supplemental requirements until incorporated through formal revision action.

17.3.1. **AESO Incorporation.** The current design activity (CDA) of the affected drawing is the only activity authorized to incorporate an AESO on that drawing. The CDA of the affected drawing must be tasked to incorporate the AESO through contract action for contractor activities and other appropriate methods for Government activities.

17.4. **Change History.** Incorporate all applicable outstanding Engineering Orders when the Government causes an affected drawing to be revised, redrawn, or decides to develop a new drawing. Maintain the incorporated Engineering Orders with the associated drawing to provide drawing change history.

17.5. **Drawing Status.** When there are five or more advance change or supplemental orders outstanding against a drawing, the release activity alerts the cognizant engineer to the drawing status. The cognizant engineer decides whether to make the revisions and informs the release activity.

17.6. **Deviation Application.** The preferred practice of deviation authorization and documentation is that of MIL-STD-973 using DD Form 1694. However, Engineering Orders may be used to authorize and document deviations of items or processes defined on previously released engineering drawings and associated lists. This information allows engineers to substitute materials and processes for one time deviation from dimensions, tolerances, finishes, processes, and so on, for specific applications.

17.6.1. **Supplements.** Deviation supplements are variations to the drawings against which they are written, but do not document changes to the affected drawing. Deviation supplements give drawing activities specific written authorization to depart from a particular requirement of an item's current approved baseline for a specified number of units or for a specified period of time. When ordering deviation supplements:

17.6.1.1. Clearly and accurately describe on the Engineering Order under "field of deviation" in block 20 how the part is to differ from the part as defined on the drawing.

17.6.1.2. Define the "was" condition only to the extent necessary to clearly explain the difference.

17.6.1.3. Do not write deviation supplements against standard part drawings, Specification Control drawings, Source Control drawings, or Vendor Item Control drawings.

17.6.1.4. Don't use them to change the affected drawing.

17.6.2. **Limitations.** Limit deviation authorizations to specific quantities, serial numbers of items, or period of time as designated by the Cognizant Engineer. Do not use the term "and subsequent." When you require a deviation for more than a single application, convert the order to an AECO or AESO.

17.7. **Informational Application.** Disseminating information through Engineering Orders notifies users that a contractor's drawing has supplemental non-technical information text. Using Engineering Orders in this way does not normally instigate changes to a contractor's drawing.

18. Cancellation, Inactivation, Reactivation: Enter on each page of the affected drawing, in .25 inch (6mm) minimum lettering above the title block if possible, the changes specified in block 20 of the Engineering Order. The engineer provides superseding information on cancellations and inactivations. Include

on any Air Force drawing of a part, process or material which has been made “INACTIVE FOR NEW DESIGN” or “INACTIVE FOR NEW DESIGN AND PROCUREMENT”, a cross reference specifying the exact superseding drawing of the part, process, procedure, or material for each condition and the inactivation status. You may use notes or tabulations to cross reference.

18.1. **Canceling Drawings.** Do not cancel Air Force drawings unless the drawing was released in error. Use a change notice engineering change order to cancel a drawing. In the Engineering Order description of changes (block 20), enter: “Add above title block ‘CANCELED’”.

18.2. **Inactivating Drawings.** When the cognizant engineering office determines that an Air Force drawing no longer belongs on active status, designate the drawing “INACTIVE FOR NEW DESIGN,” or “INACTIVE FOR NEW DESIGN AND PROCUREMENT”. These drawings continue to be fully active where prescribed in existing designs.

18.2.1. **Inactive For New Design.** Use a change notice engineering change order to apply this status to a drawing. The Engineering Order description of changes (block 20) shall read: “Add above title block INACTIVE FOR NEW DESIGN - FOR NEW DESIGN USE .”

18.2.2. **Inactive For New Design and Procurement.** Use a change notice engineering change order to apply this status to a drawing. In the Engineering Order description of changes (block 20), enter: “Add above title block INACTIVE FOR NEW DESIGN AND PROCUREMENT. USE _____.”

18.3. **Reactivating Drawings.** The cognizant engineer uses a change notice engineering change order to reactivate a drawing. The Engineering Order description of changes (block 20), enter: “Add above the inactivation notice on the drawing, REACTIVATED (DATE)”.

19. Design Activity Transfer. Original engineering drawings transferred to an Air Force design activity are revised to show the current design activity per the guidance of ASME Y14.35M. Variations in placement of the Current Design Activity identification on the drawing may be required due to drawing formats and content. The original design activity CAGE code is retained without change or alteration and the current design activity legend added as prescribed by MIL-STD-100.

MICHAEL E. ZETTLER, Lieutenant General, USAF
DCS/Installations and Logistics

Attachment 1**GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION*****References***

AFPD 21-4, *Engineering Data*

AFI 21-401, *Engineering Data Distribution and Control*

AFI 21-403, *Acquiring Engineering Data*

AFI 21-404, *Developing and Maintaining Communications and Computer Systems Installation Records.*

AF Pamphlet 36-2211, *Management of Air Force Training Systems*

AFMAN 37-139, *Records Disposition Schedule*

MIL-STD-100, *Engineering Drawing Practices*

MIL-STD-973, *Configuration Management*

ASME Y14.1, *Decimal Inch Drawing Sheet Size and Format*

ASME Y14.24M, *Types and Applications of Engineering Drawings*

ASME Y14.35M, *Revision of Engineering Drawings and Associated Documents*

ASME Y14.100, *Engineering Drawing Practices*

Abbreviations and Acronyms

AETC—Air Education and Training Command

AFCA—Air Force Communication Agency

AFEDG—Air Force Engineering Data Group

AFMC—Air Force Materiel Command

ASME—American Society of Mechanical Engineers

CAD—Computer Aided Design

CAGE—Commercial and Government Entity (Code per H4/H8)

DRM—Drawing Requirements Manual

FOA—Field Operating Agency

Terms

Air Force Engineering Data Group (AFEDG) —A group of representatives from Air Force activities chartered to review and recommend changes to engineering drawing policy. Functions involved with Air Force engineering drafting issues select representatives for the group.

Air Force Engineering Drawing —An engineering drawing generated with an Air Force drawing number and Commercial and Government Entity (CAGE) code in the title block as the original design activity. An engineering drawing acquired through the design activity transfer process is also considered

an Air Force engineering drawing.

Air Force Engineering Office —The Air Force engineering office having Air Force engineering and design control responsibility for a contractor or Government design activity drawing. Also known as the cognizant engineering office.

Contractor Drawing —A drawing generated by a contractor with that contractor's drawing number and CAGE code in the title block as the original design activity.

Current Design Activity —The design activity currently responsible for the design of an item. This may be the Original Design Activity or a design activity to which the design responsibility has been transferred. (ASME Y14.100)

Design Activity —An activity that has, or had, responsibility for the design of an item. (ASME Y14.100)

Design Activity Transfer Drawing —A drawing with the drawing number and CAGE code of the original design activity to which an Air Force CAGE code has been added to transfer the design to a specific Air Force activity. It is subject to all conditions imposed on an Air Force drawing.

Drawing Change—Any change to an original drawing by direct manual or electronic means, or by a separate engineering change order.

Engineering Order—A basic form document that allows you to supplement design information for an existing drawing.

Non-Technical Information Text—Supplemental textual information, such as rights status clarification or other research information needed for clarification or expansion of original drawing information to fulfill the requirements of the completed technical data package.

Original Design Activity —The design activity originally responsible for the design and identification of an item whose drawing number and activity identification is shown in the title block of the drawings and associated documents. (ASME Y14.100)

Release Activity—An activity responsible for ensuring that all required administrative actions have been accomplished before a drawing is released.

Revision —Any change to an original drawing which requires the revision level to be advanced. (ASME Y14.35M)