

# INSPECTORS GUIDE FOR DRAWINGS AND SPECIFICATIONS

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This guide has been developed for use during conformity inspections. These questions/statements are memory joggers that can effect the outcome the conformity inspection. Should the answer be negative it may be necessary to note that on the conformity report, if that subject is applicable to the part in question. The adequacy of drawings and related change records is very important in ensuring conforming products are produced. Inspectors should be aware that not every drawing is reviewed by an FAA engineer or DER. Drawing and specifications may be released with errors, omissions, not enough details or information needed to produce the product. With this in mind the guidance should be used by the inspectors when conformity inspections are accomplish using released drawings and specifications:

**GENERAL GUIDANCE:** Multiple design data approvals should completely and accurately describe the fabrication, assembly, and installation of all portions of the modification. This includes: engineering drawings; material and manufacturing processes, specifications and tolerances; data necessary for fabrication of all parts and assemblies; and installation drawings and/or instructions. Drawings and specifications must be adequate for reproduction of parts and/or installation of subsequent modifications. When drawings or specifications reference Original Equipment Manufacture (OEM) or Supplier parts, accessories and equipment they become part of the design. The data submitted in any process for approval should not contain terms which are subject to various degrees of interpretation such as: adequate, as necessary, as required, room temperature, periodically, etc. Also any tolerances that are required to control the process, should be clearly defined.

**Use of Shall, Will, Should, and May:** “Shall, Will, and Must ” establishes a mandatory requirement. “Should and May” indicates a preferred approach. If the preferred approach is not used the an alternative approach must be able to show that it meets the intent of the design requirements.

**CONTROL DRAWINGS:** Control drawings are drawings which show the engineering form, fit, function, and performance requirements for purchased parts of existing designs that were developed by suppliers. Control drawings are used when the design holder allows a supplier to develop a part design without disclosing the exact details of design or divulging proprietary data. The control drawing details must be specific enough so the product can be inspected to determine that the requirements have been met.

Products may require a specification-control drawing (envelope drawing) identifying the product by manufacturer, part number, drawing number, revision level, or any other necessary data. Installation instructions for the modification should include all pertinent information provided by the equipment's manufacturer. The first thing to do is document exactly what is needed in an item for it to function as desired in the intended application(s). After one or more products get qualified, the document itself must be converted to a source control drawing per MIL-STD-100. One of the first sheets must include the standard notes/notices required for source control drawings and should reference the notes or paragraphs with the qualification requirements. The drawing must include the standard "approved sources of supply" table required for source control drawings. Material in specification format can be used in that format (except for the title page) as the following sheets. It all should be reviewed for technical requirements, clarity, etc. if it hasn't been already.

**PROCESS SPECIFICATIONS:** Process specifications necessary for production of parts should be included in the descriptive data package. These specifications should include all materials, fabrication, and assembly procedures.

- A. Do non-standard specifications include a complete and unambiguous definition of the materials to be used, detailed procedures, critical processes (e.g. temperatures, times, etc.), inspection criteria, rework limits, etc.?

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**DRAWINGS:** Drawing data must describe the manufacture and installation of all parts necessary for the STC modification. Drawings are a major portion of the descriptive data required for a multiple STC. All drawings must be DER or FAA approved prior to FAA acceptance and conformity inspection. See 14 CFR part 21, section 21.33. All part contours, materials, manufacturing operations, dimensions, finish specifications, etc., must be identified either directly on the face of the drawing or by reference to a process specification or other appropriate material. Drawings should not reference general industry standards or specifications that are not definitive enough to produce the part. Drawings must completely define the configuration, material, and production processes necessary to produce each part in accordance with the certification basis of the product. Drawing must not rely on “standard practices” or other general guidance which has open interpretation. Drawings must not make references to FAA Advisory Circular (AC) 43-13. When performing a conformity inspection the inspector should determine if the part can be produced and inspected using the information on the drawing.

## A. Do drawings show:

Materials to be used to produce the part, including the material specification number?

Material testing criteria and testing procedures?

Installed placards or data plates and the process to install them?

Instrument markings?

Qualification test procedures?

Software documents?

The fasteners to be used and their location? *(Each rivet, bolt, nut, screw, or other fasteners should be identified by specification/standard part numbers, such as Air Force - Navy Aeronautical Standard (AN), National Aerospace Standard (NAS), and Military Standard (MS), are acceptable.)*

## B. INSTALLATION INSTRUCTIONS:

1. Are installation instructions sufficient to allow the installer to duplicate the installation without the need for training?
2. Are the installation instructions located in a separate document and is the document identified by a number and an original issue/revision date?
3. Is each page of the instructions controlled and dated?
4. Are installation instructions clear and concise, are they adequate?

## D. DRAWING CONTROL.

1. Do drawings show each revision level and identify the changes and approval dates?
2. Does each page of the drawing have a number and revision date?

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3. Does the applicant thoroughly check drawings for accuracy and completeness prior to FAA submittal?
4. Does the drawing have a revision control page?
5. Are released drawings reviewed by someone other than the person responsible for drafting the drawings and is there a signature or initials on the drawing checker block?
6. Do drawing numbers follow a logical pattern that can be understood? For instance:
  - a. 60000, Final Installation.
  - b. 60100, Major Assembly.
  - c. 60101, Detail.
  - d. 60102, Detail.
  - e. 60200, Major Assembly, etc.
7. Does the revision block show the following information?
  - a. The identification symbol.
  - b. The listing of the numbered or lettered changes (A through Z is followed by AA through ZZ; I, O, Q, and X are never used).
  - c. The date.
  - d. The nature of the revision.
  - e. The authority for the change.
  - f. The name of the draftsman who made the change.

## E. TOLERANCES / DIMENSIONS:

1. Are standard tolerances specified?
2. Are standard manufacturing tolerances noted on the drawing, such as: XX.XXX inches  $\pm$  .010; XX.XX inches  $\pm$  .03; XX X/X inches  $\pm$  1/16; with tolerances which differ from these standards called out on the face of the drawing, (i.e., .625 + .001, - .000)?
3. Are unnecessary narrow and/or broad tolerances being avoided to prevent the manufacturing person from misinterpretation?
4. Does the drawing use ANSI Specification Y14.5 for critical tolerances?
5. Does the drawing show all dimensions necessary to produce the part? (Note: Some manufacturers use un-dimensioned drawings)
6. If un-dimensioned drawings are used are the critical characteristics including the inspection requirements shown in the design data?
7. Are dimensions complete so "no" adding or subtracting is required for a needed dimension?
8. Are tolerances to "fine" or to "coarse," which might impact the duplication accuracy or operation? (Each production part should meet or exceed the established tolerances)
9. Are proper clearance and interference fits shown on the drawing?

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10. Are mechanical movement clearances laid out on the drawing for interference positions at the extreme limits of travel?
11. Are the dimensions and views sufficient in describing the part or assembly, including a full sectional view of assembled parts?
12. Are decimal dimensions being used correctly?
13. Are tolerances that are different than the title block clearly noted in the area of the part being affected?

**F. MASTER DRAWING LISTS:** MDLs are the top drawing that describes the complete type design approved by the FAA and they must be complete and accurate.

1. Does the Master Drawing List (MDL) include:
  - a installation instructions
  - b process specifications
  - c drawing or document numbers
  - d revision levels
  - e any engineering change orders in effect
  - f date prepared
  - g approval dates of all material
2. Is the Master Drawing List (MDL) accurate?

**G. INSPECTION CRITERIA / INSTRUCTIONS / PROCESSES:**

1. Do critical casting drawings include 100% inspection by visual, radiographic, and magnetic particle or penetrant inspection or approved equivalent nondestructive inspection methods? (Ref 25.621, 23.621)
2. Are process specifications for plating and inspection, as well as the installation instructions, included in the drawing?
3. Are material specifications shown on the drawing for producing the parts? Is it clear what material specification is used to produce each part on the drawing?
4. Are finish specifications shown on the drawing for each part and assembly?
5. Is the process specification indicated, such as: cadmium plate, zinc chromate coat, anodize, shot peen, tumble, sand blast, vinyl wash, epoxy, etc? (*Zinc chromate and vinyl wash denote primers; final finishes should be specified as well, e.g. enamel, epoxy, lacquer, dope, etc*)
6. Are detail parts and stock sizes shown i.e. screws, bolts, pins, rivets, etc.?
7. Does the drawing show the welding specification and welding method for welding materials and parts to one another?
8. Are parts being inspected to a dimensioned drawing if so is the drawing scale correct and are the instruction clear?

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9. Are plastic vellum full scale drawings used for inspection maintained in a environmentally control area?

## H. ILLUSTRATIONS / NOTES / LAYOUT:

1. Is each part shown and correctly illustrated on the drawing with all necessary views?
2. Are views with hidden lines avoided when possible? (*Dimensions to hidden lines should not be used*)
3. Are parts indicated by a noun, followed by a description of what they do, and where they are located on the aircraft?
4. Are general notes clear and unambiguous for so manufacturing personnel can produce the part?
5. Does specific notes listed under the general notes column that apply to particular parts, areas or operations, shown with a triangle or other symbol, and is it clear where the specific notes should be applied?
6. Are the drawing lines per industry standards so the manufacturing person can understand it (*i.e. hidden line, center line, cutting plane, dim line, etc.*)?
7. Are at least two detail part views shown on each drawing?
8. Are opposite part views shown on the drawing and is it clear which side of the airplane the view is shown?
9. Does the drawing table of contents and revision record showing the latest change for each sheet of the drawing?
10. Is the grain direction shown (arrow) on forging, or other critical part drawings to allow the part to be oriented in the machine correctly?
11. Are tooling points and datum planes shown on the drawing for part layouts to assist production?
12. Are surface conditions for roughness shown for castings?
13. Does the drawing show the edge distance for fasteners in structural areas?
14. Does the drawing illustrate the safety wire method for fasteners, connectors, adjustable connections, etc?
15. Are torquing requirements for fasteners shown on drawings?
16. Are special techniques, (i.e., structural shot peening, etching, etc.) shown on major and/or critical parts?
17. Are there clear requirements for welding, brazing, and normalizing of major and/or critical parts?
18. Are process specifications for bonding, gluing, sealing and finishing of major and/or critical parts on the drawing?

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19. Are adequate drainage provisions shown on drawing to prevent the accumulation of fuel, water, hydraulic oil, etc?
20. Are self-locking nuts used on any bolt subject to rotation during aircraft operation clearly shown on the drawing?
21. Do drawings provide requirements to inspect flight control systems (i.e.. bell cranks, push-pull tubes, chains, cables, operating cylinders, jackscrews, etc.) for binding conditions and interference clearances?
22. Where cable systems are used, do drawings provide for the visual inspection of fairleads, pulleys, terminals and turnbuckles?
23. Does the title block present the following information?
  - a A drawing number to identify the print for filing purposes and to prevent confusing it with other prints.
  - b The name of the part or assembly.
  - c The scale to which it is drawn.
  - d The date.
  - e The name and address of the applicant and firm.
  - f The name of the draftsmen, checker, and person approving the drawing.
  - g The aircraft model, detail or assembly it is to be used on.
  - h The drawing number of the next higher assembly.
24. Does the drawing have a Bill Of Material (BOM) block and does it present the following information?
  - a The number of the part or assembly.
  - b The name of the part of assembly.
  - c The material from which the part is to be constructed.
  - d The quantity required.
  - e The source of the part or material.

## I. DRAWING CHANGES / APPROVALS:

- a Are Engineering Orders (EO), Engineering Change Notices (ECN), etc, shown on the drawing?
- b Has the design engineer signed the drawing block before releasing the drawing?
- c Are there more than “5” engineering orders released before incorporation into the drawing?  
*(Acceptable industry standard is no more than 5 design changes allowed before incorporation into the drawing. Too many un-incorporated design changes will lead to confusion in manufacturing and inspection.)*
- d Is there only one page to an EO, ECN, etc? *(Note: Some manufacturers have been known to have as high as 30 pages per EO, 30 x 5 = 150 pages of drawing changes. This leads to confusion and complexity in manufacturing a product.)*
- e Does the drawing contain appropriate symbols to designate that the drawing has been changed or revised?

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Are tags and plates defined separately as parts by an applicable specification, standard, or drawing?

Are the requirements for attaching an identification plate specified on the drawing?

Is the phrase “unless otherwise specified” used to indicate the generally applied requirements and does it appear at the beginning of the “NOTES” column? (Is this phrase used when providing a reference to another document, or requirement on the drawing, that clearly specifies the exception(s).

Do drawing notes provide information that clarifies the requirements for the item or part delineated?

Do drawing notes apply to either a portion of the drawing or to the entire drawing?

Is the notes area of a drawing identified with the heading “NOTES”?

## **Drawing Requirements for Part Identification Marking.**

Are part marking requirements on drawings clear about content, method of application (e.g., stamp, stencil, bag, or tag), and materials?

### **Tags and Plates.**

Are tags and plates defined separately as parts by an applicable specification, standard, or drawing?

Are the requirements for attaching an identification plate specified on the assembly drawing?

Does the drawing describe what information is to be included on the identification plate or tag when it is installed on the part or assembly?

### **Drawing Notes - Contents.**

Drawing notes are pertinent data given in word form and used to complement the delineation of other given data.

Are the drawing notes concise, grammatically correct statements that are not left open to interpretation?

Are arrangement of notes interpreted as an order of precedence, or sequence in manufacturing or assembly if so is it specified as such on the drawing?

Do the general notes apply to the entire drawing or associated list if not should it?

Are local notes located at the specific area or point of application and do they only apply only to the areas?

Are flag notes identified with a flag note symbol including the note number and is it shown at each point of application on the drawing?

Are general notes identified numerically or alphabetically to prevent misinterpretation?

Are fag note and other nonstandard symbols defined on the drawing.

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Are reference made to a method, identified requirement, class, grade, or type clear to manufacturing personnel?

Are parts and assemblies associated with special items and processes shall be identified?

Do notes include requirements for submission, approval, or distribution of data, reports, or plans? If so is it apparent about what is being required?

Do Flag notes symbols conflict with or resemble other symbols?

## Drawing Verification and Approval

Does the drawing have verification and approval signature blocks and are they signed?

## Use of Specifications and Standards

When specifications and standards that do not completely fulfill the design requirements of an item, do the drawings specify the exact requirements of the specifications and standards and the variations necessary to produce the item, in lieu of preparing new design data?

## CAGE Codes.

Are industry cage codes used and are they correct?

## Graphics

Are graphic symbols, designations, letter symbols, and abbreviations explained on each drawing or referenced to an explanatory document?

Does the same title appear on all sheets of a multi-sheet drawing?

Are ambiguous nouns (one which designates several classes of items) being used? Example:

- |                         |    |                        |
|-------------------------|----|------------------------|
| • ACCEPTABLE            | VS | UNACCEPTABLE           |
| • SOLDERING IRON        | VS | IRON, SOLDERING        |
| • CIRCUIT CARD ASSEMBLY | VS | ASSEMBLY, CIRCUIT CARD |
| • PRINTED WIRING BOARD  | VS | BOARD, PRINTED WIRING  |

If so this may leave to confusion on the manufacturing floor. Are the words in the following examples distinguished by additional modifiers indicating their location, relative position, forms, types, dimensions:

- Apparatus – What is a apparatus?
- Equipment - What equipment is to be used?
- Plant – What manufacturing plant?
- Assembly - How do you know what is an assembly?
- Group - ?
- Assortment ?
- Compound ?
- Machine ?
- Tool ?
- Device ?
- Mechanism ?



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- Unit ?
- Element ?

## Symmetrically Opposite (Mirrored) Parts

Are symmetrically opposite parts described clearly on the drawings?

Is each part identified by a suffix identifier? Example:

- “747362-101 SHOWN” and “747362-102 OPPOSITE”
- or “-1 SHOWN” and “-2 OPPOSITE.”

## Identification of Protective Treatment

Are protective treatments identified on the drawing or parts list?

