

**SCIENCE INSTRUMENT  
AIRWORTHINESS AND CERTIFICATION PROCEDURES  
MANUAL  
Section 350:  
Manufacturing and Testing**

## **350 Manufacturing and Testing**

As the drawings have now been reviewed and approved, the SI teams can begin part manufacturing. The science team should communicate with the DAR prior to manufacturing of critical items identified at the CADR. They should schedule with the DAR the in-process conformity inspections that may need to occur during the manufacturing process. Part manufacturing prior to DER review and approval of drawings and compliance data will result in “at risk” manufactured parts. This means the parts are being manufactured “at risk” and there is a possibility that they will have to be scrapped, either due to DER concerns or because they have not had the “in-process” conformity performed.

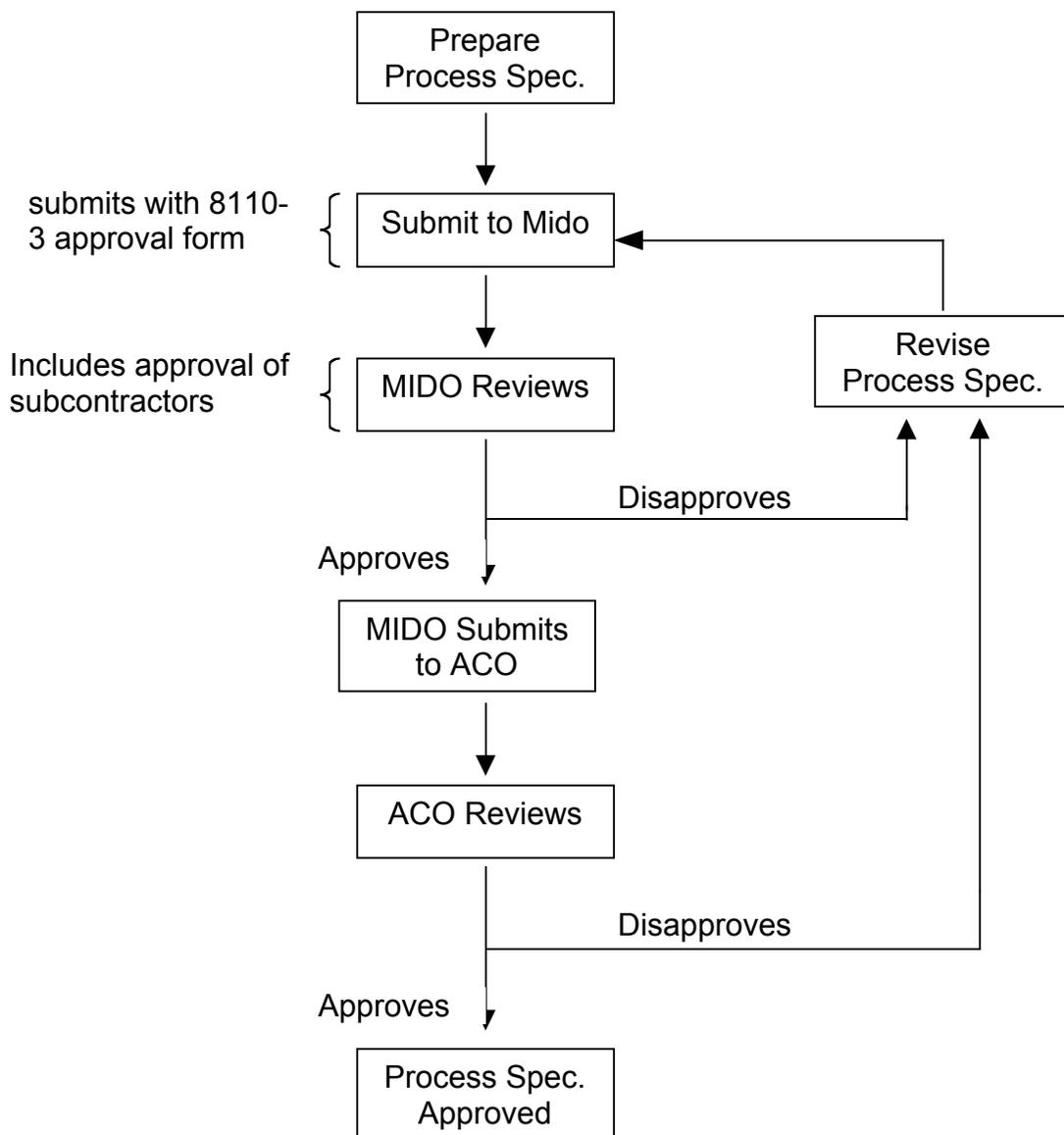
### **350.1 Shop Practices**

The instrument can be manufactured in SI institutional shops if the part can be conformed by the DAR (i.e., if the parts can be manufactured per the drawings). The parts should be designed and dimensioned in a sensible way. The part will be easier to manufacture if tight tolerances are not required. Some parts will have certain processes called out on the part drawing. These processes will be followed as specified. Certification papers for materials that require certification will be kept on file. Commercial fasteners can be tracked by filing the original purchase orders and receipts. This will allow the FAA to review the batch/lot and other properties of the material and hardware if desired. The materials and hardware can be identified and stored in a separate area of the shop. A production “traveler” could accompany each part through the process to keep track of the material and the part production history. This is not absolutely necessary, but may be a useful tool in keeping track of parts and materials.

### **350.2 Process Specification**

A certified shop follows standard process specifications. The process for drilling and tapping holes is an example. Following MIL-STD-2219 for welding would be another standard process. These standard processes will be followed in the manufacture of critical components to fly on SOFIA. There may be some processes that are not covered under standard processes. One example might be attaching G-10 fiberglass to aluminum using epoxy. If the process is non-standard, a standard process would have to be formulated, approved, tested, and design allowables developed. The DER will assist teams in identifying processes that fall into this area and help to develop a plan and test procedure that will establish the process.

The following is a process specification flow chart. It may be that a process called out on a drawing (G-10 fiberglass/epoxy joint, for example) is non-standard and needs to be approved by the FAA prior to implementation. The applicant prepares the process specification and sends it to the DER for review. The DER then forwards it to the Manufacturing Inspection District Office (MIDO). MIDO reviews the quality control aspects and then forwards the process specification to the FAA ACO for review. If either the ACO or MIDO disapproves, the applicant must revise the process specification and resubmit to the DER.



**Figure 350.2-1 Process Specification Flow Chart**

### 350.2.2 Welding Certification

A laboratory will perform tests on and certify all weld joint coupons (butt, T, L, etc.) prepared and submitted by the welder. The welding will be witnessed by a qualified individual or group, to be determined later.

The certifying laboratory will perform X-ray, ultra-sonic, eddy current, and other tests upon the coupons as required. Upon satisfactory completion of these tests, a welding certificate will be issued.

Raytheon DER Bill Johns can assist the instrument team's welding sub-contractor in determining welding certification. Raytheon will need the name and address of the person to contact at the sub-contractor and instrument builder.

### 350.3 Witnessing

Various procedures have to be identified and witnessed during the construction of the instrument. These will be identified by the DER or DAR as various reviews take place. The welding certification process is an example of something that needs to be witnessed. Pressure testing of pressure vessels is another. For witnessing to occur, a test plan must be written and approved by the DER and finally approved by the FAA before the procedure can take place. The process is then witnessed by either the FAA or FAA designate.

### 350.4 Part Manufacturing Change Process

For this section, it is assumed that a particular item is or has been manufactured. During or after the manufacturing process, a discrepancy or deviation was found between the manufactured part and the approved drawing. This must be documented in a discrepancy report. In this way, the part can be used, and the drawing does not have to be updated. The discrepancy report shall be generated by the SI team and must then be reviewed and approved by the DERs. The flow chart shown in Figure 350.4-1 follows this process from the discrepancy report on a particular part through conformity.

### Part Mfg. Change Process Flow Chart

During the manufacturing of a part, it is found that the part was not built to the drawing.  
If the deviations are not critical the drawing does not have to be updated or revised.  
For example, there are several dimensions on the mfg. Part that are not in accordance with the drawing. What path can be taken so that the drawing does not require updating?



A “Discrepancy Report” is written to address the discrepancy on the part.  
Discrepancy Reports are forms with a unique number.  
Each discrepancy report addresses just one drawing. There can be more than one Discrepancy report per drawing. These discrepancy reports do not get Incorporated into the drawing.



Items to be put into the discrepancy report are:  
Discrepancy Record #, drawing number, origin, date, quantity, discrepancy description, disposition/corrective action, mechanic and date, QC/test acceptance and date.



All Discrepancy Reports will require review by all people involved.  
People who should review the DRs are: SI team members responsible for mfg. SI QC, ALL DERs, and anyone else required for review.



Once the DR has been reviewed and signed by all parties, it is submitted to the Admin. DER.



DERs review, approve, and send to the Admin. DER the original FAAS Form 8110-3.



Admin DER sends a copy of the DR and 8110-3 to the Company Inspector and FAA/DAR inspector.



Company conformity is performed by the manufacturer. (FAA Form 8130-9)



FAA MIDO/DAR conformity is performed. (FAA Form 8100-3)

Note: As of June 1999, the Administrative DER is Bill Johns.

Figure 350.4-1 Manufacturing Change Process

### **350.5 Testing**

Areas of testing will be:

#### 350.5.1 Cryostat Qualification Testing

Pressure boundary for the window or flange

Proof and burst testing for the reservoirs

#### 350.5.2 Electronics

EMI testing (ground and flight)

#### 350.5.3 Functional

Operational demonstration (ground and flight)

This is not a science operational test. Functional testing guidelines can be found in the operations section (Section 600)

### **Test Procedure Flow Chart Example**

Figure 350.5-1 is a Test Procedure flow chart example. In order to obtain FAA approval to perform such a test, the applicant must write a test plan, and include all information pertaining to the test, such as:

- 1) Who will perform the tests?
- 2) What will the tests involve?
- 3) Why are the tests to be done?
- 4) Where will the tests be performed?
- 5) When will the tests be performed?
- 6) Who will witness the tests?
- 7) Conditions for conducting test?
- 8) Pass/Fail criteria

The test plan will include drawings and relevant information about the parts to be tested. The applicant (client) must have all documents available at the time of submitting the test plan to the FAA. An example qualification test plan can be found in Appendix 350.I, Qualification Test Plan.

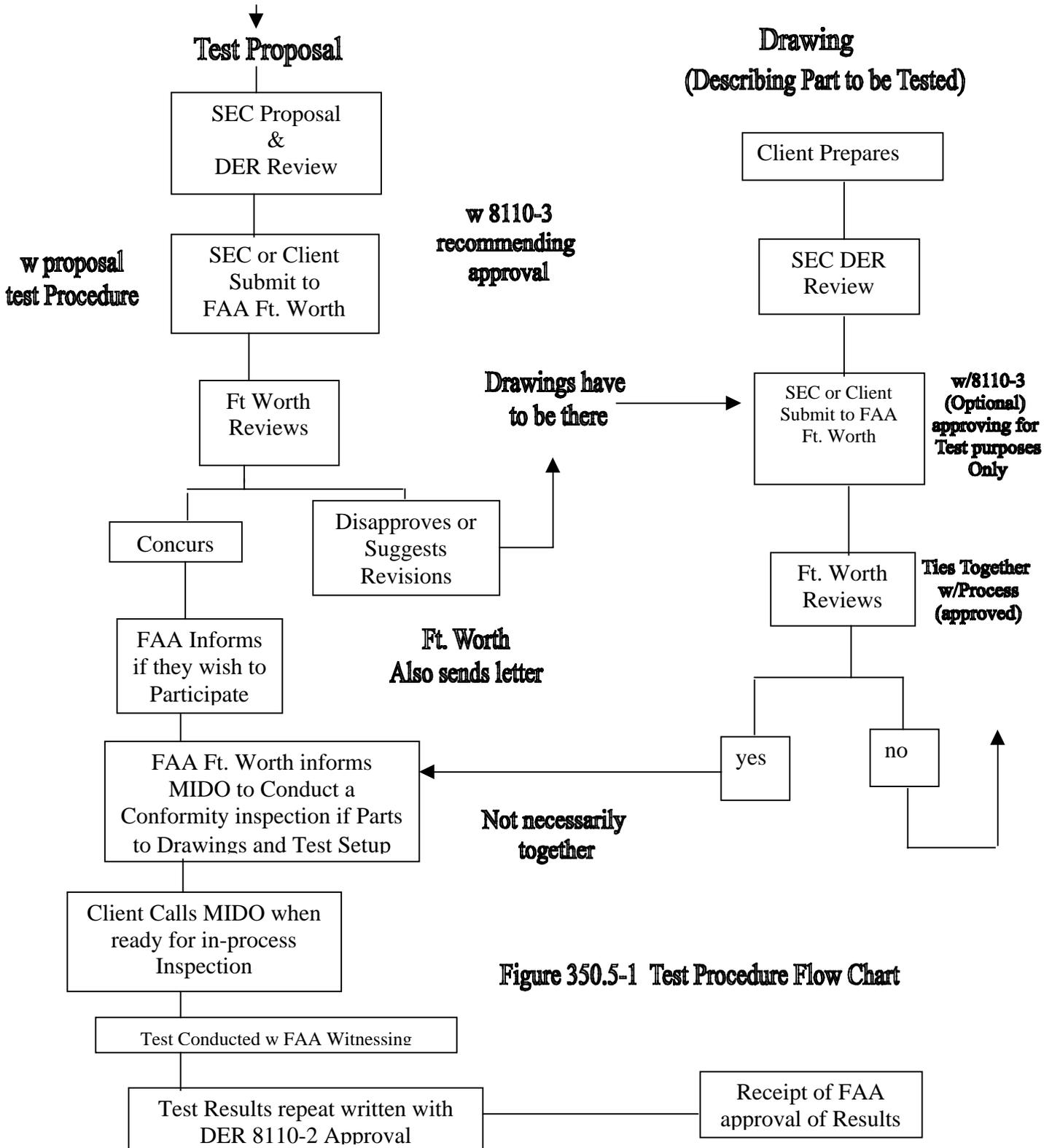


Figure 350.5-1 Test Procedure Flow Chart

### **350.6 Conformity**

Any critical part designed and approved for construction must be conformed. This is called “conformity inspection.” The DAR is responsible for the inspection conformity, but portions of the inspection can be delegated to someone capable within the group. A conformity inspection simply means that an inspection occurs to assure that the designed part as specified in the drawings is in fact what was manufactured. If you specify that a part is 12.000” +/- 0.001 in diameter, then the inspection must verify this. Finally, be careful how parts are dimensionally specified, including tolerances, in the design drawings.

#### **350.6.1**

The conformity inspection of the assembly may occur by an inspector from the FAA MIDO or a DAR. The entire Science Instrument will be subject to in-process conformity as well as a final conformity on-site at the investigator’s facilities. This means that the FAA MIDO and/or DAR have the option to witness any or all building of the assembly. This could also occur at facilities that might be building sub-assemblies. The final conformity, in the assembled state, shall occur at the investigator’s manufacturing site. This will occur prior to shipment of the SI to NASA/Ames for flight test.

Once the SI conformity has been completed, the unit is now available for Qualification Testing or shipment to the aircraft. Figure 350.6-1 shows the conformity process from start of manufacturing through FAA final approval.

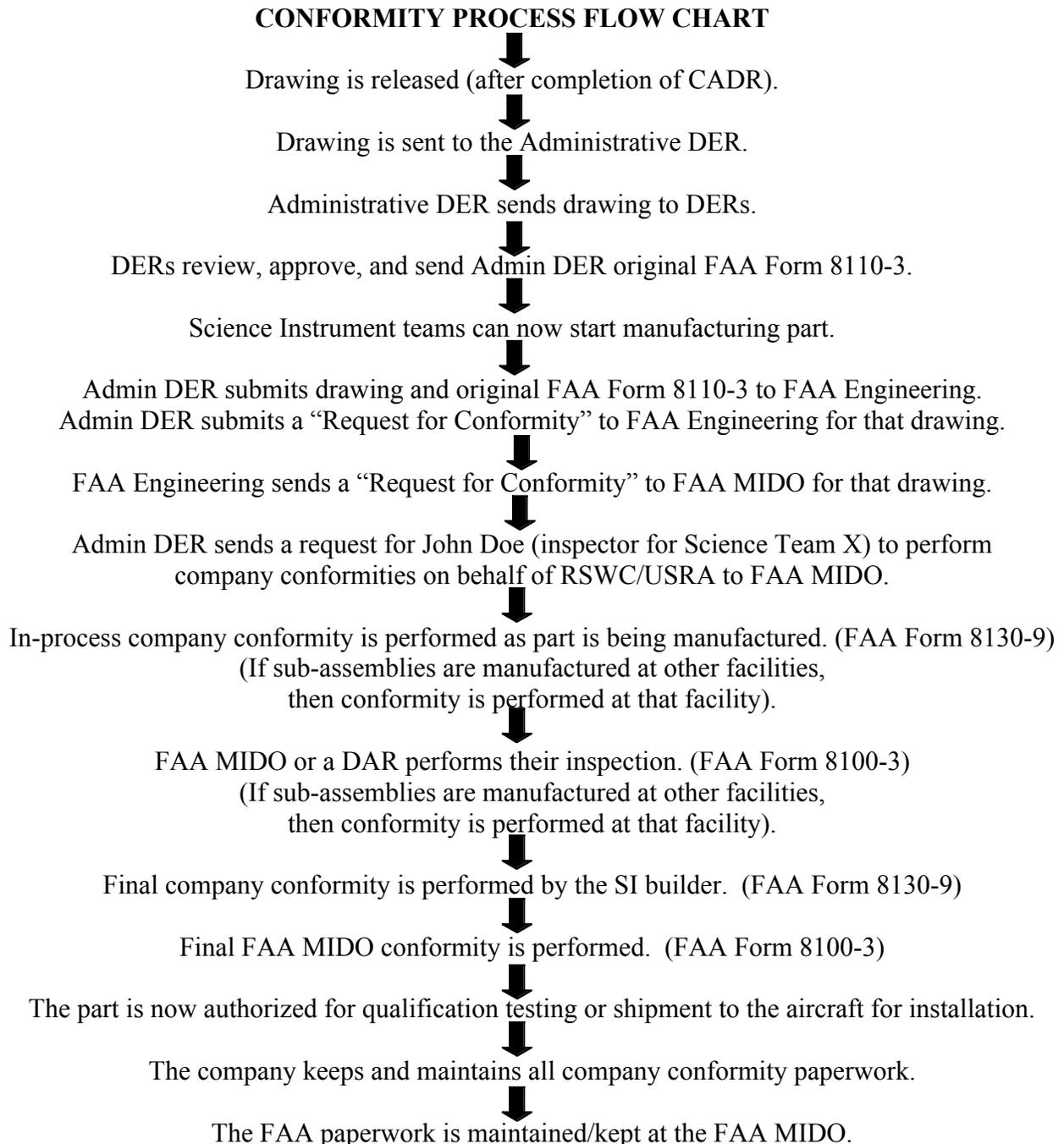


Figure 350.6-1 Conformity Process

## NOTE:

- 1) The above process is also followed for changes to drawings. For example, if a drawing is revised (from revision level A to revision B), then the entire process is repeated.
- 2) As of June 1999, the Administrative DER is Bill Johns at RSC.

**350.9 Conclusion**

This section is intended to explain the steps involved in proceeding from DER approval of a data package to manufacturing, testing, and conformity inspections which will be required prior to receipt of the STC for a SOFIA science instrument. This section is still a work in progress, which will be revised with specific test plans and procedures as these become available.