Quality Assurance Acceptance Sampling Requirements for Suppliers

SQR–009

Revision Date: 02 December 2016

Approved

Frank Mariot
Supply Chain Quality Manager

Suppliers may view this document via the Internet at:


To obtain a hard copy, please notify Triumph Aerostructures, LLC or Triumph Aerostructures – Tulsa, LLC Procurement Representative
REVISION RECORD

The latest issue of this manual may be confirmed by viewing the “Suppliers” web site (address shown on the cover).

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rev. A</td>
<td>01 Mar 2008</td>
</tr>
<tr>
<td>Rev. B</td>
<td>11 Jul 2011</td>
</tr>
<tr>
<td>Rev. C</td>
<td>18 Jul 2014</td>
</tr>
<tr>
<td>Rev. D</td>
<td>02 Dec 2016</td>
</tr>
</tbody>
</table>

The following is for Triumph Aerostructures, LLC and Triumph Aerostructures – Tulsa, LLC internal use only:

The information contained in SQR-009 is controlled by the owner listed in the signature sign-off block and is linked to applicable command media. The owner is responsible for the integrity and maintenance of the SQR.

PROPRIETARY RIGHTS

Triumph Aerostructures, LLC and Triumph Aerostructures – Tulsa, LLC proprietary rights are retained for the information contained herein. The recipient, by acceptance of this document, agrees that neither this document nor the information contained herein, nor any part thereof shall be reproduced or transferred to any other document, used or disclosed to others for any purpose, except as specifically authorized in writing by Triumph Aerostructures, LLC and Triumph Aerostructures – Tulsa, LLC.

Employees of Triumph Aerostructures, LLC or Triumph Aerostructures – Tulsa, LLC may reproduce information contained in this document for internal purposes as necessary. All such copies must be prominently identified as “REFERENCE ONLY” and/or “UNCONTROLLED COPY.”
Rev. A Summary of changes

• Entire Document; All references to Northrop Grumman were replaced with “Vought”

Rev. B Summary of changes

• Format document to remove reference to Vought Aircraft Industries, Inc. and replace with Triumph Aerostructures – Vought Aircraft Division (TA-VAD)
• Removed reference to SQR-001 and added reference to SAE documentation location (page 5)
• Added purchase order clarification on inspection requirements to authorize sampling inspection (page 5)
• Removed reference to “Modified Sampling Plan” (page 6)
• Added statement to clarify sampling requirements and to follow SAE ARP9013 as an industry standard (page 7)
• Added requirement for SAE ARP9013 documentation (pages 9-11)

Rev. C Summary of changes

• Section 1 – added “Sampling is not allowed for Critical, Safety or Safety Critical parts/part characteristics these parts/part characteristics shall be inspected 100%” (page 6)

Rev E Summary of Changes

• Logos information updated
  Triumph Aerostructures, LLC and Triumph Aerostructures – Tulsa, LLC
• Approvals (Authorizing Signature on File)
  Frank Mariot - Supply Chain Quality Manager
• Introduction Section
  This Document is effective for the following Triumph Aerostructures Companies:
  Triumph Aerostructures, LLC and Triumph Aerostructures – Tulsa, LLC from here on inclusively refer to as Triumph.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Cover Sheet</strong></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><strong>Revision Record</strong></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td><strong>Summary of Current Changes</strong></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Table of Contents</strong></td>
<td>4</td>
</tr>
<tr>
<td>1.0</td>
<td>Sample Decision</td>
<td>7</td>
</tr>
<tr>
<td>2.0</td>
<td>Sampling Plans</td>
<td>7</td>
</tr>
<tr>
<td>3.0</td>
<td>Random Sampling</td>
<td>14</td>
</tr>
<tr>
<td>4.0</td>
<td>Stratified Sampling</td>
<td>14</td>
</tr>
<tr>
<td>5.0</td>
<td>Acceptance Sampling Records</td>
<td>15</td>
</tr>
<tr>
<td>6.0</td>
<td>Training</td>
<td>15</td>
</tr>
<tr>
<td>7.0</td>
<td>Audits</td>
<td>15</td>
</tr>
</tbody>
</table>

**Attachments:**

<table>
<thead>
<tr>
<th>Attachment</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Initial Reliability Requirements/ Classification of Characteristics</td>
</tr>
<tr>
<td>2</td>
<td>Lot and Continuous Sampling Tables</td>
</tr>
<tr>
<td>3</td>
<td>Random Number Table</td>
</tr>
</tbody>
</table>

**Figures:**

<table>
<thead>
<tr>
<th>Figure</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lot Sampling Flow Chart</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>Continuous Sampling Flow Chart</td>
<td>13</td>
</tr>
</tbody>
</table>
Introduction
This Document is effective for the following Triumph Aerostructures Companies: Triumph Aerostructures, LLC and Triumph Aerostructures – Tulsa, LLC from here on inclusively refer to as Triumph.

This document specifies the requirements for the application of acceptance sampling by attributes by Triumph suppliers. All SAE documents depicted in this SQR can be found on the internet at http://www.sae.org

General
Once the decision has been made by the supplier to perform acceptance sampling and when the purchase order authorizes sampling inspection, the requirements of this document must be incorporated into suppliers’ own internal procedures and acceptance sampling plans.

Acceptance sampling is an audit tool used to ensure that the output of a process conforms to given requirements. In comparison to 100% inspection, acceptance sampling provides no direct form of quality control; it simply accepts and rejects lots. Advanced quality practices and process methodologies are used to control and improve quality and acceptance sampling does not. Regardless, acceptance sampling does offer some advantages.

The sampling requirements found in this document are based on zero acceptance sampling to share any sampling risks equally between Triumph and suppliers.

Supplier shall not deviate from the requirements contained. Suppliers are also required to follow the SAE Aerospace Recommended Practice (ARP) in conjunction with the variety of sampling strategies, statistical techniques and process control methods depicted in ARP9013, ARP9013/1 through ARP9013/4

Definitions
100 % Inspection - The act of performing inspection on each characteristic of every product within the lot being inspected.

Acceptance Quality Level (AQL) - The poorest level of quality for a supplier process that consumer would consider being acceptable as a process average.

Acceptance Number, c - The maximum number of defective items in the sample that will permit acceptance of the entire lot.

Acceptance Sampling - A technique used to examine the characteristics of a small group of items and then make a judgment about the larger group. The technique used to sample is based on statistical laws of probability as defined in ANSI/ASQC Z1.4 Sampling Procedures and Tables for Inspection by Attributes.
c=o Sampling Plans - c=o refers to the acceptance number on all sampling plans that conform to Triumph requirements. An acceptance number of zero means that the entire lot must be rejected when any item in the sample is found to be defective.

Characteristic - A distinguishing feature on which inspection data can be collected.

Continuous Sampling - Sampling designed for inspection of processes that produce one unit at a time. Mil-STD-1235 (canceled) is the historical military standard for continuous sampling.

Defect - A feature of a product that departs from established standards.

Defective Item (also: Nonconforming or Discrepant Item) - A unit containing one or more defects with respect to the characteristics under inspection.

Sampling Plans - Stand-alone sampling instructions developed for specific areas of application. A sampling plan serves as comprehensive instructions given to the inspectors to perform sampling.

f-value - Used in continuous sampling plans, the fraction of the units inspected on the sampling level.

i-value - Used in continuous sampling plans, the number of conforming units required consecutively before the process may move down from 100% to the sampling inspection level.

Initial Reliability Requirement (IRR) - The expected rate at which defect-free parts are produced.

Inspection - The act of measuring, examining, testing or gauging the characteristics of a part or process and comparing the results to specified requirements in order to determine conformity.

Inspection/Test by Attributes - Inspection whereby the unit of product is classified as either defective or non-defective (pass/fail, go/no go, acceptable/rejected); or the number of defects in the unit of product is counted, with respect to a given requirement.

Lot Sampling - Lot sampling is designed for processes that make products in lots or batches.

Lot Size - A group of parts manufactured at approximately the same time that are expected to share similar quality levels for selected characteristics and are submitted for inspection at the same time.

Random Sample - A number of units chosen by a method that gives each unit in the population an equal chance of being selected.
s-value - Used in continuous sampling plans, if the "s" value (number of non-conforming units) is reached before the "i" value is satisfied, stop attempts to apply sampling.

Sample - A subset of items to be inspected, usually drawn randomly from a lot.

Sample Size - The number of units to be drawn from a lot in order to make up a sample. Symbol is “n”.

1.0 Sampling Decisions

1.1 Sampling is not allowed for Critical, Safety or Safety Critical parts/part characteristics these parts/part characteristics shall be inspected 100%

1.2 Prior to the creation of an acceptance sampling plan, it should be determined whether sampling is appropriate or not. This determination should be made by Quality Department personnel, with input from other organizations as appropriate. Answer the following questions to determine the viability of acceptance sampling as an inspection option:

   a Is there a need to perform acceptance sampling?
   b Does the drawing or related specifications prohibit sampling?
   c Is the rejection rate low?
   d Is 100% inspection disruptive?
   e Are the costs of escape low?
   f Are the costs of sampling low?
   g Has training been conducted?
   h Are the parts produced in high volume?
   i Will sampling provide a positive return on investment?

1.3 Answering “no” to any of the above questions may indicate that sampling may not be appropriate for the given task. However, corrective actions taken can change this situation to once again make sampling a viable option. If sampling is determined to be a viable option, a sampling plan must be generated.

2.0 Sampling Plans

2.1 Once the determination has been made to perform acceptance sampling, a sampling plan must be generated for each part, classification of part, or characteristic to be sampled. Each sampling plan must contain at a minimum:

   a Detailed instructions on the use of the plan, including the IRR tables, the use and creation of associated records, relative definitions, and the criteria for acceptance sampling application.

   b The sampling tables to be used. Whether Lot/Sample size based on IRR for Lot Sampling, or tables containing the parameters required based on IRR for Continuous Sampling.
c Acknowledgment of the plan owners (users). The process owner or person responsible for the performance to the plan shall provide some indication that the plan has been reviewed and understood.

d Regarding switching where lot sampling is used. If the nature of the process is unknown, lots should be viewed as isolated and the only switching that may take place is between sampling itself and 100% inspection. See section 2.3.3 for Lot Sampling Switching.

e The importance of random sampling cannot be understated; therefore, it is discussed in greater detail in section 3. Consequently, all sampling plans shall stress the importance of random sampling.

f To ensure the proper application of continuous sampling, proper sampling documentation shall be maintained (reference section 5).

2.2 Detailed below are some considerations that should be employed to build an acceptable plan.

2.2.1 Types of sampling depending upon the nature of the process and past performance history either lot sampling or continuous sampling may be employed.

a The attribute sampling plans implied within this document are all single level sampling plans with an acceptance number, \( c = 0 \). In other words, when executing the sampling plan, a single random sample is drawn and inspected. If a defective part is detected, the entire lot is rejected. Multilevel plans are not authorized for use.

b In situations where products are made in lots or batches, lot sampling should be employed. The parts within the lot or batch must be manufactured at approximately the same time and under the same conditions (Ref. SAE ARP9013/1 and 2). Examples of where lot sampling is appropriate include receiving inspection of packaged hardware, and the audit inspection of close-tolerance hole quality.

c In situations where units are made and accepted one at a time, continuous sampling should be employed. Significant breaks in production invalidate this approach. Due to the continuous stream nature of these processes, continuous sampling plans incorporate switching rules that switch the level or required inspection according to the inspection history (Ref. SAE ARP9013/4).

d Once the method of sampling has been decided, it must be documented in the sampling plan.
2.2.2 Classification of Characteristics is accomplished by arranging inspection characteristics in levels according to their importance to the product’s form and function. The result of accepting a defective part must be considered along with the determination of the sampling risks associated with each level. Guidelines for classifications are as follows and are to be used in conjunction with the assignment of quality levels addressed in section 2.2.3 Quality Level Assignment:

**Critical** - A characteristic, if defective, could result in hazardous or unsafe conditions or could prevent the performance of the intended function. This determination should be based on judgment and experience. Characteristics classified as critical usually require 100% inspection. However, where it is impractical to perform 100% inspection, such as destructive testing, sampling may be used as directed by Triumph.

**Major** - A characteristic other than critical that, if defective, could result in failure or reduce materially the usability of the unit or product for its intended purpose (i.e. defect could cause an unsafe condition in the end product). Major characteristics are generally assigned IRR values greater than or equal to 97%.

**Minor** - A characteristic, if defective, would not materially reduce the usability of the unit or product for its intended purpose, or would have no significant effect on the use, operation or safety of the unit. Minor characteristics are generally assigned IRR values less than or equal to 95%.

2.2.3 Quality level Assignment - Using Attachment 1 as guidance for classification of part, part type, or characteristic, assign Initial Reliability Requirement (IRR) by establishing the classification of the part or characteristic as Critical, Major, or Minor then assigning corresponding IRR value as indicated on the Attachment. In some instances, the determination of the amount of inspection necessary to assure compliance to the design requirements must include the following considerations:

a. Amount of inspection to be accomplished at other inspection stations.

b. The effect of discrepant material upon subsequent manufacturing operations.

c. The probability of detecting discrepant material during subsequent operations.

d. Cost of removing the discrepant material where discovered.

2.2.3.1 If a part, process or characteristic is not listed in Attachment 1, choose the closest related part, process or characteristic.
2.2.3.2 The sampling plan shall clearly identify the characteristics being inspected along with their designated classification and assigned IRR values.

2.3 Lot Sampling

2.3.1 All lot sampling shall be accomplished per the requirements of SAE ARP9013/1 and 2. Depending upon the classification of characteristics and associated IRR requirements, the appropriate IRR sampling tables shall be selected and incorporated for use in the sampling plan. Although inclusion is preferred, the plan may reference the tables contained within Attachment 2.

2.3.2 Shown in Figure 1 is a flow chart of the lot sampling process. In essence, a lot is presented to inspection for accept or reject based upon the IRR requirements for the characteristics of the product. The inspector randomly selects the required sample based on the lot size presented. The sample is inspected for the characteristics specified in the sampling plan and the results of the inspection compared to the engineering or standard requirements. The lot is then dispositioned based upon the findings of the inspection and an entry made in the appropriate recording system. Because we are using c=0 sampling plans exclusively, if any defective items are detected, the lot is rejected. Ideally, rejected lots should be returned to the internal or external supplier for screening inspection. This is one way that acceptance sampling can help to promote part/process improvement.

2.3.3 Lot Sampling Switching: Unlike the switching rules associated with ANSI/ASQC Z 1.4 (i.e., reduced, normal and tightened) the switching associated with the c=0 sampling plans takes place between performing sampling inspection and performing 100% inspection. For example: If a lot is rejected during the course of performing lot sampling, 100% inspection must be instituted on subsequent lots until such time that three consecutive lots are accepted. At such time, sampling may be re-instituted. Switching between lot sampling and 100% inspection.

2.4 Continuous Sampling

2.4.1 All continuous sampling shall be accomplished per the requirements of SAE ARP9013/4. As previously stated, continuous sampling is used where units are made one at a time from a continuous stream process. Again, breaks in production invalidate this approach and 100% inspection must be employed.
2.4.2 Depending upon the classification of characteristics and associated IRR requirements, the appropriate IRR sampling tables (reference Attachment 2) shall be selected and incorporated for use in the sampling plan. Although inclusion is preferred, the plan may reference the tables contained within this document.

2.4.3 The continuous sampling flow chart (shown in Figure 2.) and a set of sampling tables contained in Attachment 2 are used for the continuous sampling process. In essence, at the start of the plan, all units are inspected 100% for the characteristics specified in the plan. Once (i) consecutive units of product are found to be free of defects, 100% inspection is discontinued. At this time, only a fraction (f) of the units will be inspected. These samples are selected one at a time at random from the flow of production. If a sample is rejected, 100% inspection is resumed. If the (s) number is reached before the (i) value is satisfied do not sample this process, the process is in need of improvement.
Lot Sampling Flow Chart

Parts/Products are manufactured under homogeneous conditions

Lot is presented for inspection

Random sample is selected

Sample is inspected

Inspection results compared to standards

Lot is dispositioned (Accept or Reject)

Document inspection results

Figure 1
3.0 **Random Sampling**

3.1 For sampling to be effective, units selected for inspection should be chosen at random.

3.2 Unless samples are chosen at random, bias will be introduced. For example, a supplier may ensure that units packaged on top of a lot are of superior quality knowing that the inspector will likely sample from the top.

3.3 Randomness is achieved only when each item or combination of items has an equal chance of being selected for the sample. The procedures for random sampling are outlined below:

   a. Items in the lot must be numbered.
   b. Choose a number at random. This may be done using a computer with a random number generator or with a random number table (reference Attachment 3).

3.4 If using a Random Number Table, select the row number based on the position of a clock’s minute hand at the time of inspection. The column number can be obtained using the position of the hour hand at the time of inspection. Cross referencing these numbers in the table will yield a starting point for selection of as many random numbers as is needed to accommodate the sample size. Other methods of choosing the table entry point may be used; this is just one suggestion.

**EXAMPLE:** A lot of 80 items is received. Number the items 1 to 80. A random sample of 11 is required. The time shown on the clock is 9:25. Therefore, the starting point is determined to be column 9, row 25, making the starting point 23. The remaining numbers, moving across then down, would then be 46, 20, 32, 85, 83, 10, 66, 18, 3, and 81.

3.5 Numbers greater than the number of items in the lot should be discarded and another number selected.

3.6 Duplications should also be discarded and another number selected.

3.7 The above process should be continued until the complete sample has been selected.

4.0 **Stratified Sampling**

4.1 If a sample or portion of a sample is to be drawn from a single container, exercise care to select items from each section of the container. For example, if the container is filled with layers of parts, an attempt should be made to gather equal portions of the sample from each layer, etc.

4.2 If a lot of items are contained in multiple containers, select an equal portion of the total sample from each container.
4.3 In any lot sampled, exercise extreme care to assure that the sample includes not only items that are easily obtained, but also includes items that are difficult to obtain (i.e., on bottom, etc…).

4.4 In any lot where more than one process batch or heat lot is indicated to be in the inspection lot (such as paints, fasteners, extrusion, etc.), select a sample that includes all batches or heats.

5.0 Acceptance Records

5.1 Records of all acceptance sampling applications shall be maintained. As a minimum, these records shall include the following information:
   a. The part number and associated sampling plan
   b. Initial reliability requirements
   c. Lot size
   d. Sample size
   e. Number of non-conforming units in the sample
   f. Date
   g. Inspector’s stamp, code or signature
   h. Comments

5.2 These records will provide the data necessary to support switching activities and provide a means of lot traceability.

6.0 Training

6.1 To ensure the proper application of the requirements of this document, users shall be provided in depth training that addresses the following topics:
   a. Acceptance sampling philosophies
   b. Reading sampling tables
   c. Random sample selection
   d. Switching procedures
   e. Proper record keeping

6.2 Refresher training courses shall be conducted annually.

6.3 Attendance records of training shall be maintained.

7.0 Audits

7.1 Audits of acceptance sampling practices will be conducted by Triumph in conjunction with normal recurring quality audits. In addition to these formal audits, process owners shall conduct self-assessments.