Publication Date: MAY- 17- 2023

Elements of Escape Prevention

Supplier Development

Template Rev MAR-30-2023

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Purpose/Scope

This Playbook provides reference material to Boeing supplier personnel which is designed to help reduce and eliminate escapes. Found within this Playbook is key reference material, including case studies, and other important tools.

Audience/Applicability

Boeing Commercial Airplanes (BCA); Boeing Defense, Space & Security (BDS); and Boeing Global Services (BGS) approved suppliers

This Playbook is supplemental to applicable requirements (e.g. policies, procedures, contractual agreements, engineering specifications, etc.) and is not authoritative. Additionally, this Playbook is not for use in finding or demonstrating regulatory compliance.

Note: For Boeing employees, authoritative sources for compliance can be found in Policy, Procedure, and Process writings (see PRO-1).

Distribution Limitation

This playbook may be distributed to all Boeing approved suppliers with a valid Proprietary Information Agreement (PIA) in place.

This document is Boeing Proprietary and is not subject to U.S. Export Administration Regulations (EAR) 15 Code of Federal Regulations (CFR) Parts 730-774) or U.S. International Traffic in Arms Regulations (ITAR) 22 CFR Parts 120-130.

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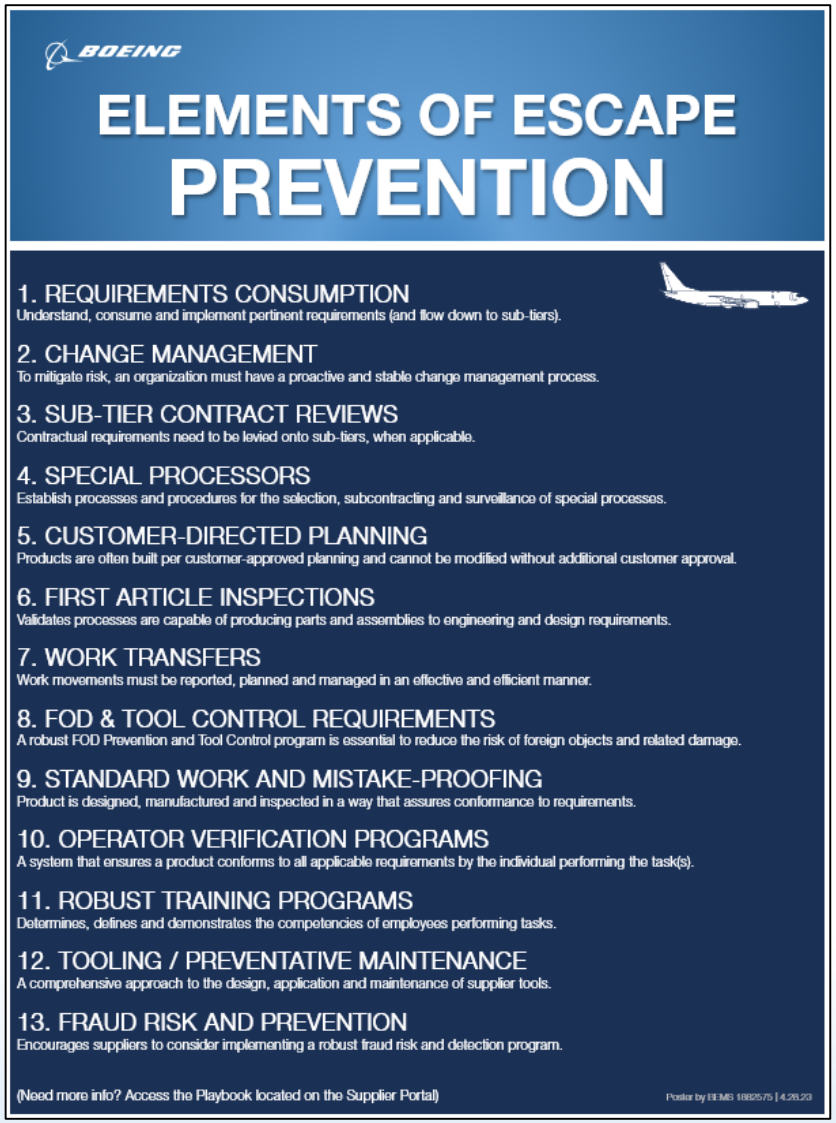


1. Requirements Consumption

1.1 Background

- In accordance with the contract, all suppliers are to:
    - Understand, consume, and implement pertinent requirements.
    - Flow requirements to subtiers.
- Part and assembly requirements are provided by Boeing directly to first-tier suppliers.
- Processes and procedural requirements are available online.
- Standards are acquired from industry sources.
- The implementation of requirements must be supported by a rigorous revision review process which supports documentation control processes.
    - The process should maintain the most current revisions and ensure changes are acted upon.
- Many requirements have implementation time constraints, specified by Boeing and regulatory entities such as the Federal Aviation Administration (FAA) and Defense Contract Management Agency (DCMA).
- Conformity
    - To be considered conforming, suppliers and partners must build products that comply with all requirements.
    - Verification that the documentation is correct and supports the product is paramount.
    - Conformity is assurance that the products meet all aspects of the design and manufacturing requirements.

1. Requirements Consumption (Cont.)

1.1 Background (cont.)

- The flow down of federal regulations is a focus area of some regulatory agency audits. Often, the focus areas are:
    - Record Retention.
    - First Article Inspection (FAI).
    - Notice of Escapement (NoE).
    - Right of Entry.

Note: Record retention, FAI, and NoE requirements are often interrelated and expand to entities upstream and downstream of the contract holder.

- The need to flow requirements downstream is simple:
    - If a problem is identified, the past records must be available for review.
    - Requirements must be flowed down so expectations are understood at each level.
    - The NoE requirements must be known by all parties involved in the production process.
    - It is expected that problems identified after shipment will be reported to Boeing.

1. Requirements Consumption (Cont.)

1.2 Good example

Supplier Y understands requirements consumption and regularly passes both internal and external process assessments with ease. As a Supplier of the Year candidate, Supplier Y is viewed as a benchmark supplier in regards to requirements consumption. The strength of Supplier Y's requirements consumption process is rooted in the following key elements:

1: Detailed understanding of the requirements

- Assign a Requirements Consumption Focal or Team to review all customer requirements.
- Document any questions and ask clarification to customer or entity.
- Classify requirements by category or subject.
- Create a matrix by requirement to maintain and review any changes on a monthly basis.

2: Perform requirement gap analysis

- Assign focals or subject matter experts (SME) by category or subject.
- Focals or SMEs provide all applicable documentation that would cover the requirement.
- Requirements Consumption Focal or Team in place to ensure all requirements are covered by an internal procedure or process document.

1. Requirements Consumption (Cont.)

1.2 Good example (cont.)

3: Create requirement matrix

- For requirements identified as not having clear linkage to an internal document, creation of internal corrective action plans to ensure applicable procedures and documents are created or revised to include the missing requirement.
- Once all documents are ready, the Requirements Consumption Focal or Team will review and ensure that all requirements are covered and will proceed to accept and close the internal corrective action.

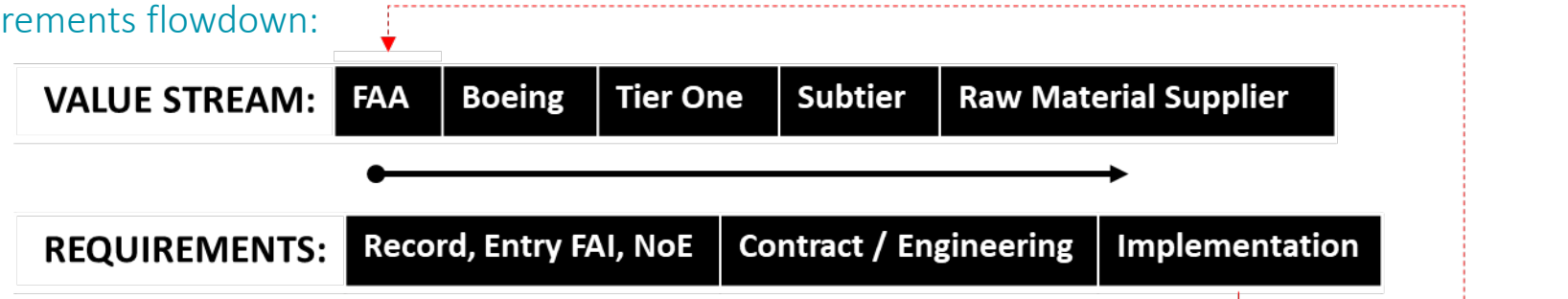
4: Continual improvement

- Requirements Consumption Focal or Team is to monitor customer requirement changes on a monthly basis (minimum) and ensure consumption by the customer-required implementation date.
- Requirements Consumption Focal or Team should be aware of any internal procedure or policy change and ensure changes do not affect the customer requirement.

1. Requirements Consumption (Cont.)

1.3 Bad example

Requirements flowdown:



Heat treat missed at sub-tier:

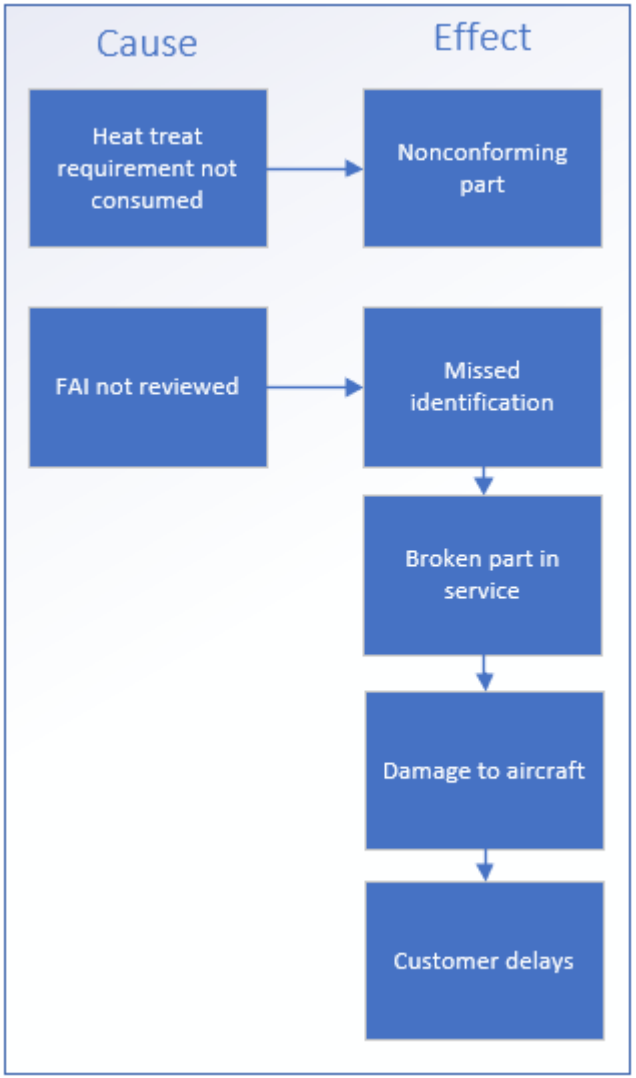
1. Requirements Consumption (Cont.)

1.3 Bad example (cont.)

Supplier X missed the consumption of requirements. In the photo on the next page, the pushrod was not heat treated.

The requirement for heat treatment was not flowed to Supplier X's sub-tier until late in the process.

Stronger Requirements Consumption most likely would have identified and remedied this problem prior to the in-service failure.



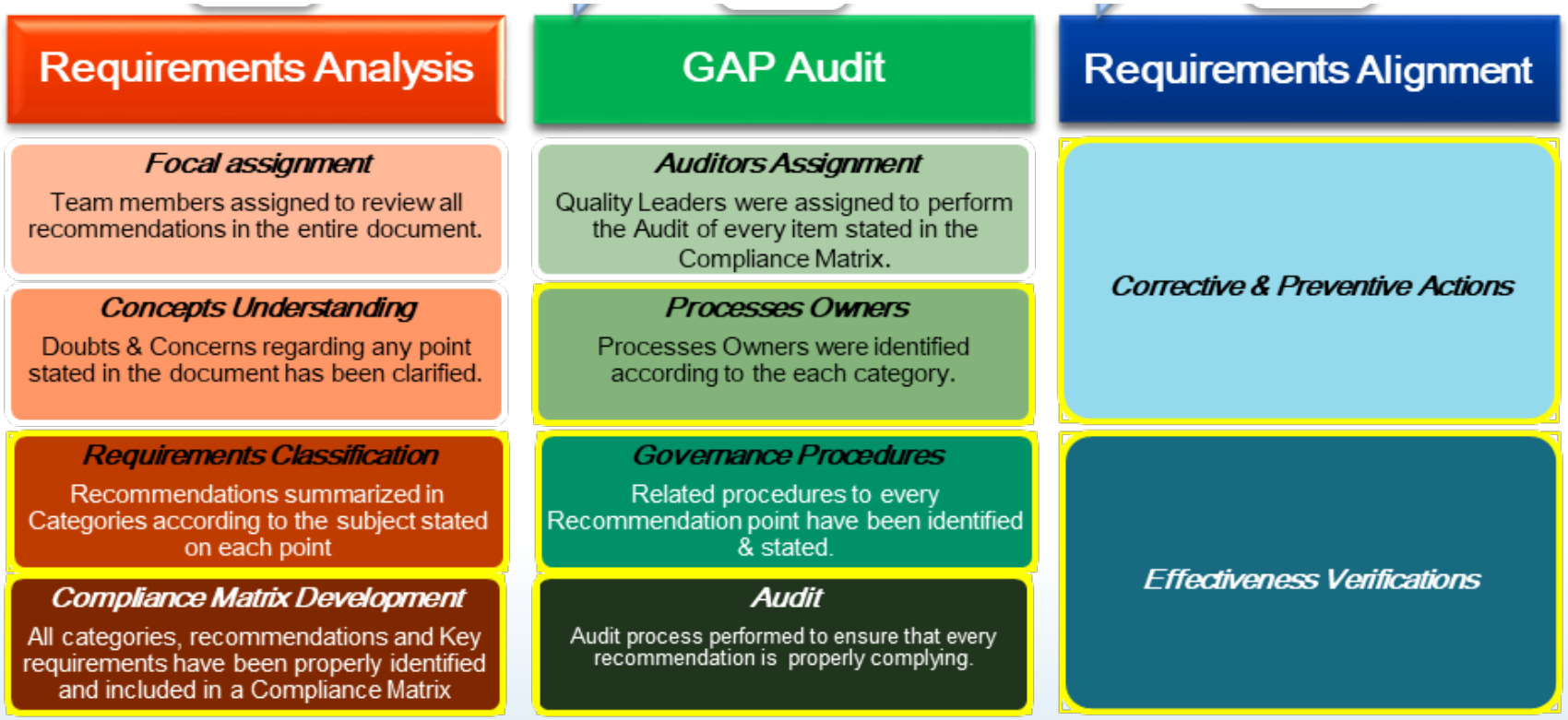
1. Requirements Consumption (Cont.)

1.4 Next steps

- Ensure Boeing and regulatory requirements are understood and followed.
- Develop a master list of all requirements from customers or any other regulatory entity.
- Identify internal procedures that cover requirements.
    - Document a scheduled review process considering the following:
    - When does the review take place?
    - Is the task clearly assigned?
    - Who is responsible for disseminating the information?
    - How do new requirements get implemented?
    - Who is responsible for implementation?
- Identify how requirements are flowed to sub-tier suppliers.
- Develop a process for assessing the implementation of the requirements at subtiers.
- Develop compliance measures to ensure all requirements are being controlled.

1. Requirements Consumption (Cont.)

1.4 Next steps (cont.)



2. Change Management

2.1 Background

- Every change has an inherent risk which could result in an escape.
- To mitigate risk, an organization must have a proactive and stable change management process which begins with:
    - A clear understanding of the nature of the change.
    - The deployment of proactive tools and measures as part of the consumption process.
    - A robust verification process.
- Change management is defined as the methods and manners in which an organization identifies, reviews and controls changes within its internal and external processes.
    - It is imperative to ensure changes are controlled to prevent adverse impacts on conformity and compliance to requirements.
    - Examples include:
        - Changes in the Quality Management System (QMS).
        - Employee attrition.
        - Process improvements.
        - Changes to design and configuration.
        - Production rate change.

Reference AS9100D, sections 6.3, 8.1.2, 8.2.4, 8.3.6 and 8.5.6.

2. Change Management (Cont.)

2.2 Good example

- Supplier Y invested in internal production optimization, which consisted of purchasing new equipment and increasing production rates.
- Although the new equipment was similar to the existing equipment, the supplier realized that a general revision of the process and key steps was necessary to detect risk.
- The supplier assigned the project to specific focals and SMEs for each potential impact which consisted of:
    - People and training.
    - Qualification.
    - Design and manufacturing.
    - Inspection and test.
    - Equipment, procurement, logistics etc.

2. Change Management (Cont.)

2.3 Bad example

- Supplier X received an engineering change request to modify the length of a detail part. The change was part of a corrective action with the aim to avoid interferences at Boeing during final assembly.
- The change request required a commitment from Supplier X to have parts ready by a certain date.
- Per internal process requirements, the supplier called a change board meeting and evaluated that the change had a low impact to them (the detail part was actually made by a sub-tier and there were no constraints in the assembly process that they were required to do).
- Therefore, Supplier X replied to the change request, confirming the availability to implement the engineering change by the date requested.
- Supplier X flowed applicable documentation to the sub-tier. The sub-tier replied that the change was impossible to make since the raw material had a long lead time.
- This process inadequacy forced the whole system to review the implementation date and to reschedule the get to green date for the original cause of the engineering change, with an unplanned increase of costs.

2. Change Management (Cont.)

2.4 Next steps

- The proactive management of risk associated with change is a must.
    - It begins with a critical review of the potential impact of the change, as well as the use of tools and techniques available throughout the industry.
        - Examples of these tools can include enhanced FAI, Process Failure Modes Effects Analysis (P-FMEA), and greater use of non-destructive inspection (NDI).
- The bad example is used to illustrate the risk associated with change.
    - Could this type of risk exist in your QMS?
    - Does your company employ robust controls for managing this type of risk?
- Create a process that involves any impacted functions, to evaluate any type of changes based on their risks. Risks can be determined based on a variety of areas:
    - Materials
    - Tooling
    - Design characteristics
    - Suppliers
    - Manufacturing process
    - People and training

2. Change Management (Cont.)

2.4 Next steps (cont.)

- Develop a plan and process for detecting and mitigating risk associated with changes.
- Cooperate with appropriate departments and/or subtiers to ensure they understand changes before they are implemented and impact production.
- Evaluate the risk mitigation process for effectiveness.
- Employ APQP method to identify, assess, manage, and control product change related risks when contractually required.

Note: It is very important for Boeing Suppliers to become familiar with the Engineering Change processes applicable to their Statement of Work (SoW). This requires a good understanding of how Boeing requests a supplier to implement a design change and how to request an engineering change from Boeing.

3. Sub-tier Contract Reviews

3.1 Background

Tier 1 suppliers are responsible for ensuring that all contractual requirements are met. Failure to review requirements with subtiers may result in process and product escapes.

Boeing has contractual requirements that need to be levied onto subtiers, when warranted contractually.

- AS9100D Section 8.2.2, Quality Clause Q29 Boeing Commercial Airplanes BCA/BGS and Quality Clause Q020 Boeing Defense, Space & Security (BDS)/BGS requirements:
    - Process in place to acknowledge, capture, and incorporate contractual requirements
    - Mechanism to evaluate and confirm sub-tier acknowledgement and effectiveness of implementation

Note: See D1-4426 Appendix D for flow down requirements.

3. Sub-tier Contract Reviews (Cont.)

3.2. Good example

Supplier X has a process in place and retains documented information to capture the review, implementation, deployment and verification of applicable contractual requirements.

Details of all applicable contracts

Organization's command media in which provisions are taken to implement PO Note requirements

List of actions to be taken as a result of the PO note review

Verification. Confirm that actions were conducted as planned and are effective.

List of PO notes that are included by section *(ERPLN Contracts)*

PO Note Revision Matrix / Status						Command Media	Actions					Verification/effectiveness		
Purchase Order review date:														
ERPLN Contract Number			######	######	...									
Contract description			Contract 1	Contract 2	..									
Revision			MM/DD/YY	MM/DD/YY	MM/DD/YY									
Status														
New Note														
Revised Note														
Suspended														
No Change														
Contract sections	PO Note Revision	Not applicable	PO listed in this contract?:			PO provisions captured and implemented at: (reference to process, procedure and/or work-instruction)	PO Note reviewed by:	Actions/Task	Responsible	Due Date	Status	Verified by:	Date	Status
GENERAL NOTES														
A02	8/15/2020		Yes	Yes	...									
A17	8/15/2020		Yes	Yes	...									
A18	8/15/2020		Yes	Yes	...									
...	...				...									
QA Header														
Q09	10/1/2020		Yes	Yes	...									
Q13	1/1/2021		Yes	Yes	...									
Q14	8/15/2020		Yes	Yes	...									
Q23	8/15/2020		Yes	Yes	...									
Q29	1/1/2021		Yes	Yes	...									
Form X31764	5/27/2022		Yes	Yes	...									
D6-82479	4/4/2019		Yes	Yes	...									
Q31	6/29/2018		Yes	Yes	...									
Q48	7/1/2016		Yes	Yes	...									
...	...		...	...	...									
DIRECT SHIP ORDERS														
APM51			Yes	Yes	...									
B14			Yes	Yes	...									
Q52			Yes	Yes	...									
...	...		...	...	...									
ITEM / PART NUMBER SPECIFIC NOTES														
...	...		...	...	...									

3. Sub-tier Contract Reviews (Cont.)

3.2. Good example (cont.)

Supplier X has a process in place and retains documented information to capture the review, implementation, deployment, verification and flow down of applicable contractual requirements.

Example section of PO (Purchase Order) Note Q29/X31764/D6-87282:

PO Note Revision Matrix / Status						Command Media	Actions					Verification/effectiveness			
Purchase Order review date:			1/1/2021												
ERPLN Contract Number			001122	003344	...										
Contract description			Legacy	Spot Buy	...										
Revision			WK2018	WK2020	...										
Status															
New Note															
Revised Note															
Supplied															
No Change															
Contract sections	PO Note Revision	(Not applicable)	PO listed in this contract?:			PO provisions captured and implemented at: (reference to process, procedure and/or work-instruction)	PO Note reviewed by:	Actions/Task	Responsible	Due Date	Status	Action:	Verified by:	Date	Status
Q29	1/1/2021	Revised Note	Yes	Yes	...	QMS-001 "Supplier's Quality Manual"	E. D. (Quality Manager)	Revise and update PUR-001 "Purchasing". To include necessary provision capturing change: *"Form X31764 identifies the sections, sub-sections, and applicable items the Seller shall evaluate for flow-down to its Supply Chain. If the Seller determines the item is not applicable, due to the complexity of the item being procured, they shall retain documented information to justify this decision."*	E. D. (Quality Manager)	2/1/2021	Open	Schedule and conduct internal audit for Purchasing process (PUR-001)	J. M. (Internal Audit)	4/15/2021	Open
								Revise and update PUR-TERMS-CONDITIONS-001. Update PO notes for sub-tiers to capture latest provisions as per Form X31764	B. C. (Purchasing Manager)	2/1/2021	Open				
								Deploy latest revision or PUR-TERMS-CONDITIONS-001	B. C.	2/15/2021	Open				
								Obtain and process justifications as per X31764.	B. C.	3/15/2021	Open				
Form X31764	5/27/2022		Yes	Yes	...										
Section 1: Quality System	"				...	QMS-001 "Supplier's Quality Manual"	E. D. (Quality Manager)								
Sub-section A: Aerospace Quality Management System (AQMS) Certification	"				...	QMS-001 "Supplier's Quality Manual"	E. D. (Quality Manager)								
Sub-section B: Application of Acceptance Authority Media (AAM):	"				...	QMS-007 "Documented Information and control"	E. D. (Quality Manager)	Revise and update PUR-TERMS-CONDITIONS-001. Update PO notes for sub-tiers to capture latest provisions as per Form X31764	B. C. (Purchasing Manager)	2/1/2021	Open	Request supplier questionnaire update On-site surveillance audit	T. L. (Procurement A.)	5/15/2021	Open
Sub-section C: Purchase Order Notes	"				...	QMS-001 "Supplier's Quality Manual"	E. D. (Quality Manager)								
a) English Language (Flow-down to Supply Chain):	"				...	QMS-007 "Documented Information and control"	E. D. (Quality Manager)	Revise and update PUR-TERMS-CONDITIONS-001. Update PO notes for sub-tiers to capture latest provisions as per Form X31764	B. C. (Purchasing Manager)	2/1/2021	Open	Request supplier questionnaire update On-site surveillance audit	T. L. (Procurement A.)	5/15/2021	Open
b) Quality Metrics & Reporting:	"				...	QMS-001 "Supplier's Quality Manual"	E. D. (Quality Manager)								
c) Seller's Inspection:	"				...	QMS-085 "Product control"	M. D. (QA Eng. Lead)								
d) Seller's Statistical Product Acceptance (Flow-down to Supply Chain):	"				...	QNS-084 "External Providers"	M. D. (QA Eng. Lead)	Revise and update PUR-TERMS-CONDITIONS-001. Update PO notes for sub-tiers to capture latest provisions as per Form X31764	B. C. (Purchasing Manager)	2/1/2021	Open	Request supplier questionnaire update On-site surveillance audit	T. L. (Procurement A.)	5/15/2021	Open
...	"				...										
D6-82479	4/4/2019		Yes	Yes	...										

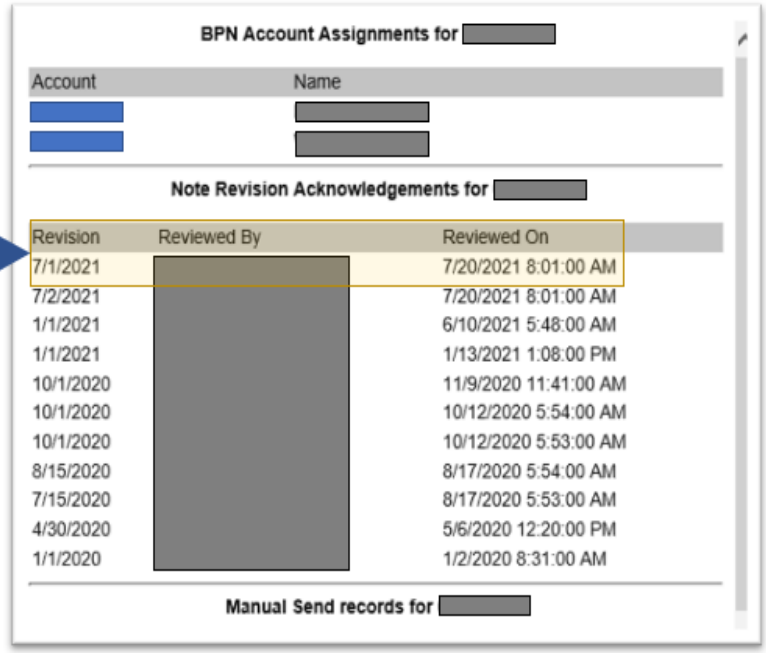
Supplier X reviews and considers need to also flowdown to its sub-tiers

3. Sub-tier Contract Reviews (Cont.)

3.3 Bad example

Supplier Y is not conducting a PO Note review.

Last PO Note review recorded is more than a year ago



BPN Account Assignments for [redacted]

Account	Name
[redacted]	[redacted]
[redacted]	[redacted]

Note Revision Acknowledgements for [redacted]

Revision	Reviewed By	Reviewed On
7/1/2021	[redacted]	7/20/2021 8:01:00 AM
7/2/2021		7/20/2021 8:01:00 AM
1/1/2021		6/10/2021 5:48:00 AM
1/1/2021		1/13/2021 1:08:00 PM
10/1/2020		11/9/2020 11:41:00 AM
10/1/2020		10/12/2020 5:54:00 AM
10/1/2020		10/12/2020 5:53:00 AM
8/15/2020		8/17/2020 5:54:00 AM
7/15/2020		8/17/2020 5:53:00 AM
4/30/2020		5/6/2020 12:20:00 PM
1/1/2020		1/2/2020 8:31:00 AM

Manual Send records for [redacted]

3. Sub-tier Contract Reviews (Cont.)

3.3 Bad example (cont.)

Supplier Y is missing a process to manage the Keep Up to Date (KUTD) list. This may result in a failure to initiate the FAI process due to an undetected engineering change, or late incorporation of product-related specifications.

Example: unacknowledged records pending in KUTD

	Details	Delegation Source (Supplier Code)	Data Item Number	Revision	Acronym (Type)	CAD Code	Category / PSDS Collection	Change Log Date	Change Log Status
☐	Delegated	Delegation Source (BEST Code)	Dash	Reissue	Program	Authority	Disclosure Level	Disposition Date	Dispositioned By
		Supplier Code	Sheet (ID)	Approved Date	Attachment	Change Numbers			
		BEST Code	Branch	Authorization Number				Auth. Expiration Date	Auth. Status
	Details	Boeing	BSS7066		STDEP		Product Standards / One Boeing Product Standards	28 JUN 2008 03:04 AM	
☐		Boeing			-	ADADS	9 COM		
		676232 MFG	6-6	27 JUN 2008					
		BE10088602 MFG							
	Export Sensitivity:	EAR99							
	Details	Boeing	BSS7693	C	STDS		Product Standards / One Boeing Product Standards	03 JUL 2008 08:38 AM	
☐		Boeing			-	ADADS	9 COM		
		676232 MFG		27 JUN 2008					
		BE10088602 MFG							
	Export Sensitivity:	EAR99							
	Details	Boeing	BACC10CC	AB	STDS		Product Standards / One Boeing Product Standards	11 JUL 2008 12:35 PM	
☐		Boeing			-	ADADS	9 COM		
		676232 MFG		03 JUL 2008					
		BE10088602 MFG							
	Export Sensitivity:	EAR99							
	Details	Boeing	BAC5337	D	STDS		Product Standards / One Boeing Product Standards	11 JUL 2008 12:35 PM	
☐		Boeing			-	ADADS	9 COM		
		676232 MFG		07 JUL 2008					
		BE10088602 MFG							
	Export Sensitivity:	EAR99							

3. Sub-tier Contract Reviews (Cont.)

3.4 Next steps

- Ensure all responsible stakeholders are part of the review process.
- Establish that the review process includes all inputs from contractually-required elements, such as:
    - Boeing Supply Chain Agreement (BSCA).
    - General Terms and Agreements (GTA).
    - Special Business Provisions (SBP).
    - Enterprise Resource Planning (ERPLN) contracts.
    - PO notes.
- A process should be in place to identify all applicable PO requirements that are required to be flowed to subtiers.
    - As part of this process, provisions to deploy, audit, and confirm should be in place.
- Verify adequate channels in which to receive engineering data are set up such as KUTD, Customer Supplier Data Transmittal (CSDT), Managed File Transfer Services, etc.
- Determine if contractual exceptions are needed (i.e. PO note is not accepted).
    - In these cases, a written agreement and Boeing confirmation is required.
    - A determination can be obtained by working with the Boeing PA.

4. Special Processors

4.1 Background

- Special process outputs may not always be measurable or inspected by the supplier
    - Some failures may only be realized when the product is in service. This requires suppliers to establish processes and procedures for the selection, subcontracting and surveillance of special processes.
    - Suppliers must define criteria for the selection and oversight of their special processors and use specific methods and procedures for implementing and monitoring the processors.
- Boeing-approved special processors are listed within D1-4426.
    - Additionally, engineering specifications may have approved sources, such as engineering Qualified Processor/Product List (QPL) (Reference AS9100D, Section 8.5.1.2, D1-4426).
- Although Boeing subcontractors and/or suppliers may utilize the standards manufacturers and authorized distributors identified in D1-4426 for purchases in support of Boeing requirements, no representation concerning their quality management system or the acceptability of any products or services procured direct from these entities is expressed or implied.
- The Boeing subcontractor and/or supplier shall be responsible to Boeing for the quality and conformity of the products shipped to Boeing.

4. Special Processors (Cont.)

4.2 Good example

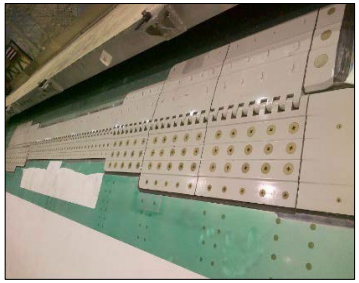
- Supplier X has:
  - A procedure and process in place to review PO and engineering requirements to identify applicable processing specifications, support specifications requiring D1-4426 approved sources and/or a Qualified processor listed in QPL.
  - Understood D1-4426 requirements, specifically Appendix D.
    - Incorporated D1-4426 requirements and review into the personnel training program.
  - A receiving inspection process in place to review Certificate of Conformance and periodic validation of purchase order requirements and acceptance criteria.
  - Included validation of the purchasing order requirements and acceptance criteria.

4. Special Processors (Cont.)

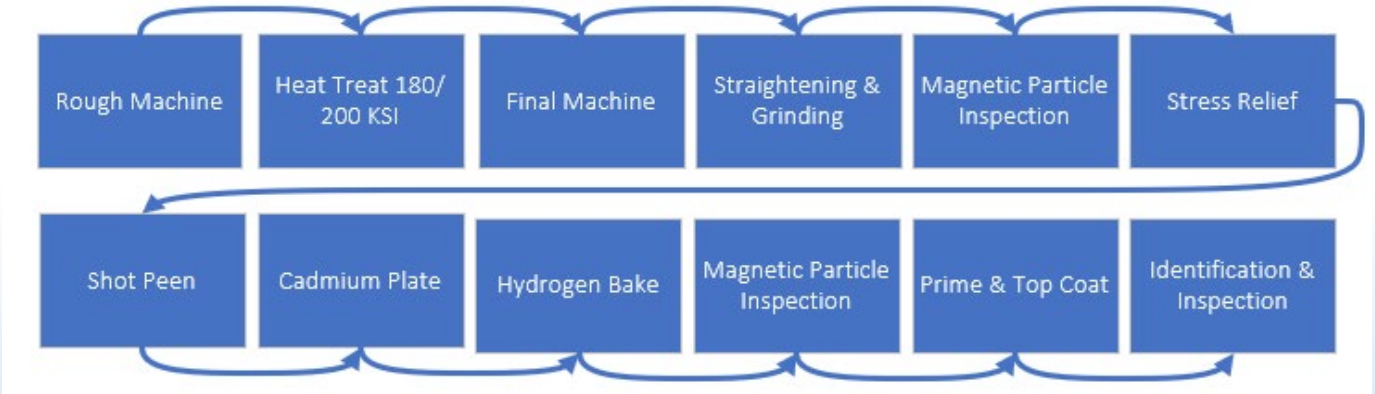
4.3 Bad example

Case #1

Multiple Special Processes



The 777 freighter door hinge is an assembly consisting of an upper and lower hinge and the hinge pin. Each piece is made of steel which must be fabricated through a series of processes to obtain its desired properties. The sequence of processing includes:



4. Special Processors (Cont.)

4.3 Bad example

Case #1- Requirements Consumption

- Many of the processes require the use of D1-4426 approved sources. In this example, Supplier Y subcontracted to multiple special process sources. The engineering drawing references a number of process specifications, one of which is the cadmium plating process.
- This specification requires that parts which have been heat treated to a minimum 180 kilopound force per square inch (ksi) be stress relieved prior to plating whenever straightening and/or grinding has been performed. It also requires that the stress relief be performed prior to shot peening.
- The Magnetic Particle Inspection (MPI) requirement was missed because a thorough review of supporting specs (to the prime spec) was not completed.
- Subcontracting special processes requires a technical knowledge to correctly plan the Statement of Work. It requires communication and adequate flow down of technical information on the PO to ensure a sufficient contract review by the processor. When this does not occur, the potential increases for processes to be missed or incorrectly

4. Special Processors (Cont.)

4.3 Bad example (cont.)

Case #1- Requirements Consumption

- The requirement to perform MPI after plating is not driven from a drawing referenced specification, but from a support specification referenced from a process specification. In this example, stress relief and MPI were not performed and an NoE was issued.
    - The stress relief requirement was missed because it was a requirement contained within the end plate spec.
    - The plater assumed the prime contractor had already accomplished stress relief.
    - The prime contractor assumed the plater would conduct stress relief since it was a requirement within the plate spec.
    - Poor communication by both parties resulted in a nonconformance and escapement.

IS	SHOULD BE
Stress relief not performed	Stress relieved
MPI not performed	MPI performed

4. Special Processors (Cont.)

4.3 Bad example (cont.)

Case #2- Shot Peening

- The process of shot peening involves impacting the surface of metallic parts with shot (metal, glass, or ceramics) to produce a compressive surface layer, which improves the resistance to metal fatigue.
    - Engineering specification Boeing Process Specification (BAC)5730 “Shot Peen Forming”, provides the processing requirements, and process specification departures (PSD) provide requirements unique to subcontractors and/or Boeing aircraft models.
- In this example, machine shops contracted with shot peen processors for Boeing Philadelphia product, which requires a processor to be listed in D1-4426, “Approved Process Sources”, and approved to Process Code 506 (BAC5730, Boeing Helicopter designs).
    - The subcontracted processors were not approved for D1-4426, process code 506.
- Additionally, neither the shot peen processors nor the machine shops performed an adequate contract review of the purchasing information or D1-4426 to correctly apply the engineering departure.
    - This violation of Quality requirements by the machine shops (not using customer approved sources) and the shot peen processors (inadequate contract review) resulted in a violation of Engineering requirements (failing to implement PSD) causing product escapes.

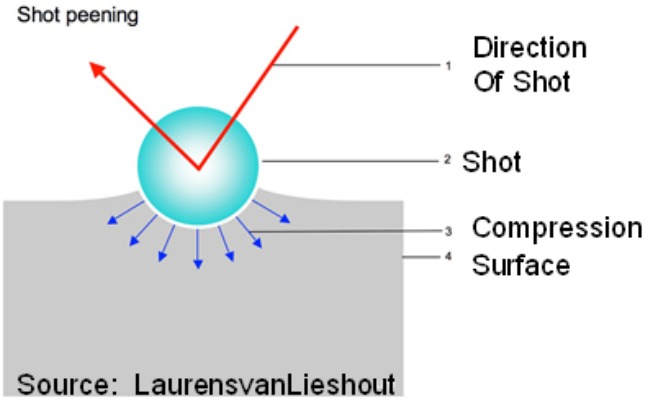
4. Special Processors (Cont.)

4.3 Bad example (cont.)

Case #2- Shot Peening

BAC 5730	Shot Peening	500
BAC 5730	Shot Peening (Boeing Helicopters only)	506
BAC 5730-1	Shot Peen Forming	501
BAC 5730-2	Shot Peening - Self Contained	502

D1-4426
Approved Process Sources



- Although the machine shops failed to evaluate and select suppliers, they did provide enough purchasing information for the shot peen processors to determine they were not approved in D1-4426 for the contracted process and product.

4. Special Processors (Cont.)

4.3 Bad example (cont.)

Case #2- Shot Peening

- Subcontracting of special processes can be complex which can require flowing down not only the process specification, but additional information about the Boeing model, the raw material information, pre or post processing information, etc. to adequately perform contract review.
- D1-4426 requires purchasers and processors to assess contracts to a list of flow down requirements prior to processing.
- Corrective action for the shot peen processors included:
    - Implementation of Contract Review per the requirements of D1-4426.
    - The use of a Contract Review checklist.
    - Revised internal procedures.
    - D1-4426 training.
    - Internal audits.
- Quality clauses (such as Q29-BCA, Q19 and Q20-BDS) on Boeing contracts state suppliers are obligated to flow the use of D1-4426 approved sources on their contracts.
- D1-4426 has requirements for the processors, but also requirements for the Boeing supplier.
- All suppliers, when performing assessments of the subcontractors need to assess if D1-4426 flow down requirements are included in the procurement processes.

4. Special Processors (Cont.)

4.3 Bad example (cont.)

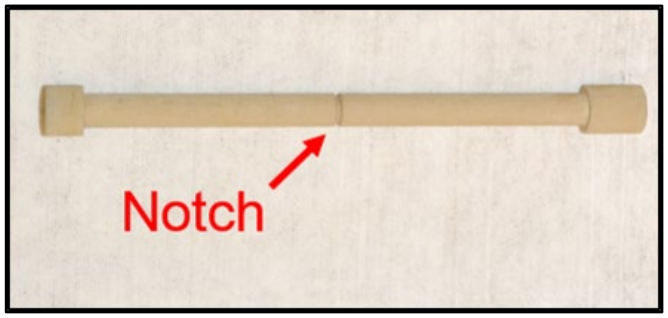
Case #3- Notched Tensile Testing

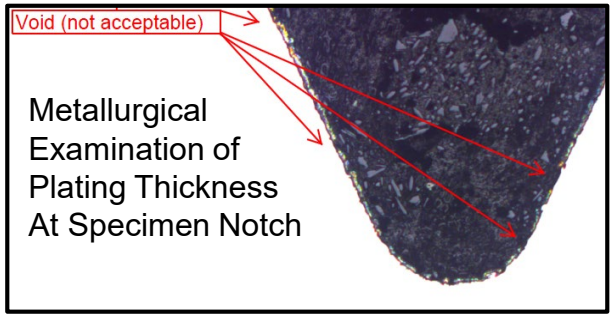
- Engineering specification BAC5804, "Low Hydrogen Embrittlement Cadmium-Titanium Alloy Plating," requires the processor to perform a hydrogen embrittlement process control test to validate proper maintenance of the plating solutions and tanks.
- This is typically performed using a Hydrogen Detection Instrument (HDI), and
    - If the HDI becomes inoperative the process control is performed using notched tensile testing.
- The notched tensile specimens are cylindrical specimens with a notch at the center.
- After plating the specimens, they are mechanically tested in a tensile loading condition to determine if the specimen will fracture at the notch.
    - After mechanical testing is complete, a specimen is cross-sectioned for metallurgical examination.
    - The specimen must have complete plating in the notch, otherwise the tensile test results are considered invalid.
- Testing requirements were not properly flowed to the laboratory and the notched tensile specimens were not cross-sectioned for metallurgical examination.
    - The validity of the hydrogen embrittlement test could not be determined and all product since the last successful test had to rejected, with notification of escapes issued to the customer.

4. Special Processors (Cont.)

4.3 Bad example (cont.)

Case #3- Notched Tensile Testing





- Although the process specification may reference a separate test method, it may also specify additional requirements important to the lab.
- When flowing requirements to laboratories it may be required to also flow such items as test methods, acceptance criteria, material alloy/temper, environmental requirements, specimen identification, and specimen retention requirements.
    - When planning for risk the processor needs to consider the frequency of tests.
- Since all product is at risk since the last successful process control test, a failed test could cause significant inventory of product to be affected, production stoppage, and product escapes.
    - In this specific example, the corrective action was to ensure proper flow down of the metallurgical examination requirements and an increase in testing frequencies.

4. Special Processors (Cont.)

4.3 Bad example (cont.)

Case #3- Notched Tensile Testing

- Special processes are complex. Processors must comprehend and consume the engineering requirements in order to properly plan the Statement of Work.
- The processor will not be successful unless all the necessary information is flowed on the purchase order.
    - This can include such items as the Boeing program to correctly apply engineering departures, material condition, and pre or post processing requirements.
- Customer approved sources for special processors must be used.
    - Boeing contractually flows D1-4426, Approved Process Sources.
    - Suppliers are obligated to flow D1-4426 to their supply chain.
    - D1-4426 has requirements which apply to both the supplier and their subcontracted processor.
        - This includes, but is not limited to: ensuring the Engineering and revision level is current, per contract.

4. Special Processors (Cont.)

4.4 Next steps

- Verify Quality Management System procedures comply with requirements in the D1-4426 User Instructions & Requirements.
    - Purchasing Information should be in compliance with D1-4426 Appendix D.
- Assess program, design, and process complexity risk when selecting special process sources.
- Review D1-4426 at least monthly to ensure contracted processors are approved.
- Provide product definition data to enable the subcontracted processor to plan, manufacture, inspect, and accept Boeing products.
- Regularly review special processor performance by evaluating quality data related to the contracted process.
- Verify the delivered product was processed by a D1-4426 approved source.
- Compare the certificate of conformance to the contract and purchase order.

5. Customer-Directed Planning

5.1 Background

- Failure to obtain proper authorization from Boeing before changing customer-directed planning may result in escapements.
- Critical aerospace products are often built to customer approved planning and cannot be modified without additional customer approval.
    - Suppliers are required to establish processes which ensure proper authorization is obtained by Boeing before modifying, changing or altering any planning that requires Boeing approval.
    - It is essential that suppliers utilize the governing documents for requirements of customer directed planning for themselves, as well as their supply chain.

Reference AS9100D section 8.1.J

5. Customer-Directed Planning (Cont.)

5.2 Good example

- Supplier X has a well-established planning process that includes an electronic method of identifying customer approval required classification at initial contract signing for all parts.
    - This part classification (shown as “customer approved”), trees into all planning documentation associated with the build, including detail parts and sub assemblies.
- Supplier X’s robust change process effectively controls all customer approved parts, at any level of the build, by initially freezing configuration and initiating its thorough change process if any change or modification is to be considered.
- When customer approval is in fact required, the change process requires electronic customer approval.
- The system physically will not allow type design manipulation (at any level) until designated customer and supplier signature authorities authorize the change.
    - Supplier X’s signature authority delegates must complete thorough initial training and complete annual refresher training.

5. Customer-Directed Planning (Cont.)

5.2 Good example (cont.)

In the example below, notice the clear demarcation of this being a "CUSTOMER APPROVED" item only:

OPERATION SHEET Page: 1 of 15

Released Rev: 7 Released Date: 7/30/2014

CUSTOMER: BOEING PART NAME: FTTG -FRT SPAR VERT. FIN PROJECT: 777 JOB NO:

OS ID: 2766 CUSTOMER APPROVED REV: 6 DATED: 7/26/2013

PART NUMBERS COVERED BY THIS OPERATION SHEET

172Wxxx-xxx

REV	SHEET	OP #	DESCRIPTION OF CHANGE	BY	DATE	CHK	DATE	QC	DATE
7	2	***	PER EO27286: UPDATED PSDL DOCUMENT TO REV-B. PER EO26870: ADDED SSP DOCUMENT REVISIONS. ***CUSTOMER SUBMITTAL IS NOT REQUIRED***	fiala	07/28/14	morales	07/28/14	marx	07/29/14
6	***	***		fiala	06/27/13	morales	06/27/13	marx	06/27/13
5	***	***		fiala	04/22/13	morales	04/22/13	marx	04/25/13

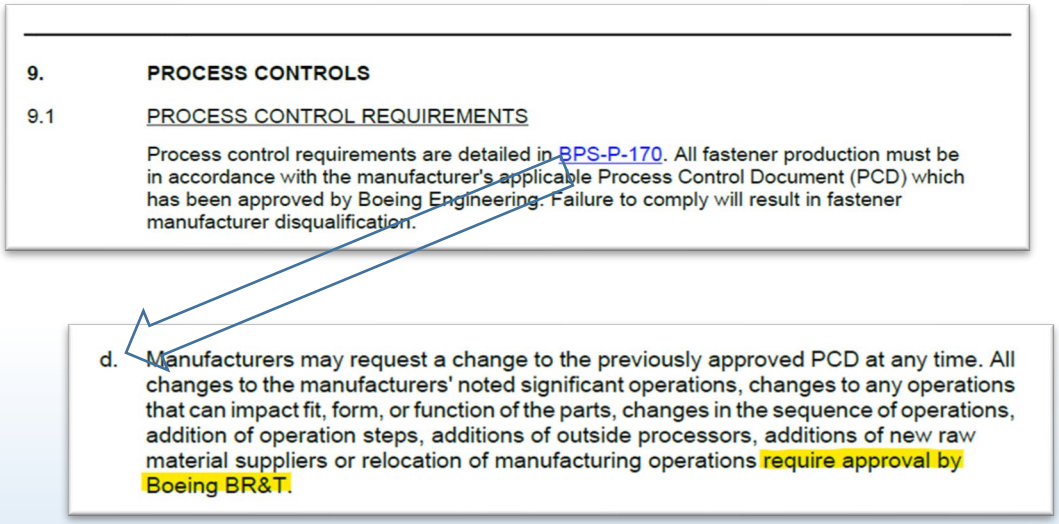
D6-1276 - THIS IS A D6-1276 PART MAINTAIN SERIALIZATION & TRACEABILITY
THIS DATA COULD BE SUBJECT TO EXPORT CONTROL RESTRICTIONS; CONFIRM AUTHORIZATION PRIOR TO FURTHER TRANSMITTAL.

Operation Sheet Tolerance Unless Otherwise Noted:
Decimals: .xx = ± .030 .xxx = ± .010 Fractions = ± .060

5. Customer-Directed Planning (Cont.)

5.3 Bad example

Supplier Y, a D590 standards supplier, departed from approved Process Control Documents (PCDs) without the required approvals. This resulted in an NoE. Fortunately, Boeing Liaison Engineering, working with specification custodians, were able to leave the affected installed hardware in place, without rework. However, the administrative cost and disruption to the supply chain and Boeing was significant (Material Review Requests [MRRs] to protect schedules, NoE processes, Root Cause Corrective Action [RCCA] activities at the supplier, etc.).



9. PROCESS CONTROLS

9.1 PROCESS CONTROL REQUIREMENTS

Process control requirements are detailed in BPS-P-170. All fastener production must be in accordance with the manufacturer's applicable Process Control Document (PCD) which has been approved by Boeing Engineering. Failure to comply will result in fastener manufacturer disqualification.

d. Manufacturers may request a change to the previously approved PCD at any time. All changes to the manufacturers' noted significant operations, changes to any operations that can impact fit, form, or function of the parts, changes in the sequence of operations, addition of operation steps, additions of outside processors, additions of new raw material suppliers or relocation of manufacturing operations require approval by Boeing BR&T.

Note: Suppliers that produce raw materials or standards per BCA specifications may need to develop a Boeing-approved PCD. Suppliers are required to prevent departures from an approved PCD from a specification custodian.

5. Customer-Directed Planning (Cont.)

5.4 Next steps

- Recognize customer-directed planning compliance requirements (i.e. approved sources, qualification maintenance, process control document requirements, D6-1276 consideration).
- Once approved and/or qualified, ensure plans are conspicuously marked or passively controlled if using computer-based work/inspection records to preclude unauthorized changes.
- Establish effective controls of subtiers by ensuring:
  - All sub-tier plans reference the parent company and that the part or engineering is designated as needing customer approval for any changes.
  - The parent plan references all of the sub-tier suppliers and that control of each sub-tier supplier submits a plan.
  - Sub-tier suppliers provide the necessary shot peen, inspection technique, or heat treatment racking procedure sheets.

6. First Article Inspections

6.1 Background

- The primary purpose of FAI is to validate that product realization processes are capable of producing parts and assemblies that meet engineering and design requirements.
    - A well-planned and executed FAI provides objective evidence that the manufacturer's processes can produce compliant and conforming products and that they have understood and incorporated all design requirements.

- FAI is conducted against the product design engineering requirements which may include the special operations (SPECOs), advance drawing change notices (ADCNs), etc.
    - It includes evaluation of the manufacturing planning, tooling, equipment, NC programs, inspection methods and supporting documentation.
    - A representative item from the first production run of the product is then inspected to assure conformance to requirements.
    - Sub-tier sources are also required to independently perform FAI to verify their production processes are compliant.
    - Consideration of specification requirements, such as applicable BAC specs, etc.

6. First Article Inspections (Cont.)

6.1 Background (cont.)

- FAI is repeated when changes occur that introduce new risk, thereby invalidating prior results.
    - These could be changes to the product design (e.g. engineering change), manufacturing process (e.g. location, operations or steps, inspection method, tooling, programing), and/or sub-tier sources.
    - A strong internal FAI process requires that any changes or events which may adversely affect the manufacturing process be reviewed.
- Failure of an organization to develop and implement an effective FAI process can result in missed engineering requirements, product nonconformances, and escapements.
- Reference AS9100D, section 8.5.1.3, AS9102

6. First Article Inspections (Cont.)

6.2 Good example

Supplier X preplans FAI inspections or verifications with callouts documented in the manufacturing plans, supported by inspection plans and prepopulated FAI forms that contain all design requirements.

- Supplier X strives to:
  - Utilize all applicable teams during the FAI.
  - Standardize inspection processes.
  - Ensure all characteristics are accounted for.
  - Collect and verify the accuracy of necessary supporting data.
  - Improve visibility of needed improvements.
  - Reduce confusion, reinspection, and other production disruptions prior to delivery.
- Regardless of whether a specification characteristic result is recorded on the First Article Inspection Report (FAIR) with variable data or attribute results, the Supplier X retains documented objective evidence to demonstrate conformity to all applicable requirements.
- Supplier X ensures that the internal audit program has an in-depth review of the FAI process.
  - After every audit cycle, the feedback is considered for the next audit to facilitate continual improvement efforts within the FAI process.

6. First Article Inspections (Cont.)

6.3 Bad example

- Supplier Y is attempting to take the “easy” route and save time by using manufacturing planning as the source of the requirements to be recorded on the FAIR.
    - This practice does not meet the requirements of AS9102 and can result in escapes not being detected.
- Supplier Y does not realize that manufacturing planning and the associated FAI could call out incorrect material.
- Supplier Y’s personnel who were performing the FAI were not diligent in verifying that the requirements were defined in product design.
    - Result: disruptions when the issue was identified downstream.

6. First Article Inspections (Cont.)

6.4 Next steps

1. Ensure that all FAI processes are defined for each affected function prior to production start.
2. FAI planning process is to be executed by a multidisciplinary team to ensure coordination of all affected organizations (engineering, quality, purchasing, operations, etc.).
3. Ensure leadership understands that there are no provisions to defer FAI.
4. Determine the competence of persons performing FAI activities, from all affected departments or disciplines.
5. Use a requirement consumption validation process to ensure every design characteristic has been consumed. Requirement consumption should be performed by Engineering and confirmed by Quality.
6. Ensure each design characteristic requirement is uniquely identified and recorded on the FAIR (s/w can be used to eliminate human errors).

6. First Article Inspections (Cont.)

6.4 Next steps (cont.)

7. Ensure personnel are aware of implicit and explicit design characteristics.

8. Develop or purchase the necessary tooling to ensure that every design characteristic can be properly measured during FAI.

9. Verify that material callouts include all necessary information including material or process classification, grade, type, form, thickness, or color.

10. Assess product escapes to determine if the escape was the result of a change that was not subject to partial or reaccomplishment of FAI.

11. Define processes to ensure timely and effective corrective actions are achieved to complete all FAIs.

12. Review First Article Inspection planning requirements.

A solid FAI process presents a good opportunity for Quality to review and confirm that all manufacturing planning complies with design requirements.

7. Work Transfers

7.1 Background

- Work movement initiated by suppliers poses inherent risk which can result in escapements.
- To reduce work movement risk exposure, work movement must be reported, planned and managed in an effective and efficient manner.
- Contractual requirements generally necessitate initiation of work movement as a formal, supplier-initiated notification, outlining the details of the proposed work movement.
    - Requirements should be captured and consumed.
    - The requirements imposed upon the supplier are to notify Boeing and obtain Boeing disposition.
    - These are driven from contractual and quality requirements but it should be noted that requirements can differ between Boeing business units (BCA, BDS, BGS) due to varying contract types within each business unit (Boeing Supply Chain Agreement, General Terms Agreement, General Provisions [GP], etc.).

7. Work Transfers (Cont.)

7.1 Background (cont.)

- It is imperative that a supplier has a thorough understanding contracts with Boeing
    - The supplier is required to ensure Boeing appropriately authorizes supplier-initiated work movements when the following events occur:
        - Manufacturing work transfer
        - Change in manufacturing address
        - Facility relocation
        - Sub-tier to supplier (Tier I)
        - Supplier (Tier I to sub-tier)
        - Sub-tier to sub-tier
        - Establish second sub-tier
        - Procurement work transfer (change in sub-tier or establishing new sub-tier)

7. Work Transfers (Cont.)

7.2 Good example

- Supplier X has a small, dedicated team that carries the responsibility for all work transfer activities, in and out of the company.
    - The team has created core documentation which captures all industry, customer, and contractual requirements related to work transfer activities.
    - Supplier X's work transfer team is also responsible for the documentation that requires the flow down of requirements to its sub-tier suppliers, via contract, and regular work transfer assessments within its sub-tier base.
- Supplier X has a robust process for work transfers that encompasses all requirements by using a vetted checks-and-balances system.
- Supplier X has drastically reduced the potential for issues related to work transfers through the implementation and use of a balanced work transfer process.

7. Work Transfers (Cont.)

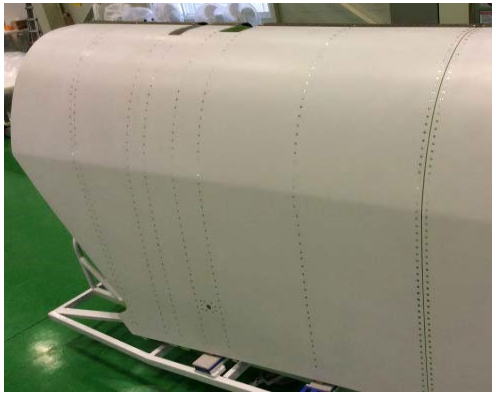
7.3 Bad example

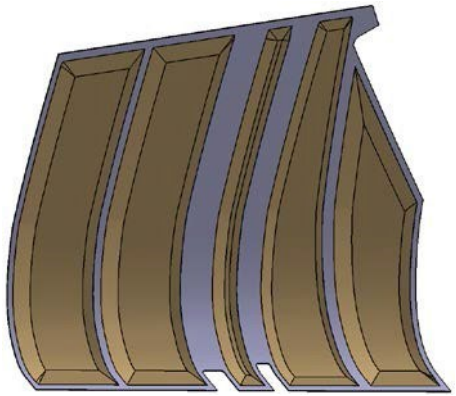
- On a recent work transfer of the 777 Fixed Leading Edge, Supplier Y elected to subcontract the manufacture of leading edge composite panels to a new sub-tier supplier.
- During the first part qualification activities, Supplier Y noted that the core material used in the manufacturing process at new sub-tier supplier was received from an unapproved source.
    - Use of unapproved sources requires a rejection of all parts and assemblies that utilize that material.
    - If this went undetected, these parts may have shipped to Boeing and been installed on the aircraft. Subsequently, the aircraft could have delivered to the airline customer.
    - Had this scenario presented a nonconforming condition that went undetected and shipped, it would require notification to Boeing via a NoE.
        - NoE issuance can result in further disruption, such as Boeing Engineering Evaluation and capture and control.

7. Work Transfers (Cont.)

7.3 Bad example (cont.)

Core material from unapproved source





- In this example, all installed panels may have required downstream removal and replacement, disrupting Supplier Y's production line by creating the need for replacement parts.
- The Boeing assembly line would have been impacted through remove and replace activities.
- This may have impacted delivered aircraft.
- Errors of this magnitude can also negatively impact the reputation of all companies involved and can cost hundreds of thousands of dollars to resolve and lost revenue for in-service aircraft.

7. Work Transfers (Cont.)

7.4 Next steps

1. Establish a robust process to ensure all requirements are captured.
    - These can include regulatory requirements, contractual requirements, engineering requirements, and AS9100 requirements.

2. Prior to production start, ensure all of the regulatory requirements are flowed down through the supply chain and clearly understood. This may include:
    - Engineering and planning approvals.
    - Digital product definition approvals.
    - Tooling approvals.
    - Pre-Production Verification (PPV).
    - First Part Qualification (FPQ).
    - Use of D1-4426 approved Special Process sources.
    - FAI.
    - Oversight and/or surveillance activities such as MRR, Quality Process Assessment (QPA), Boeing FAI (BFAI), Requirements Consumption Review (RCR), Joint Technical Assessment (JTA), etc.

7. Work Transfers (Cont.)

7.4 Next steps (cont.)

3. Establish a process to:
    - Evaluate to-be suppliers prior to moving the work.
    - Communicate requirements as work is moved.
    - Verify compliance after work is moved.
    - Evaluate risk of subtiers (capabilities, facilities, staffing, training, approvals, make/buy plan).
        - General Provisions (GP): GP4 and GP7 "Business Conduct" paragraph e
        - Quality requirements flowdown: BCA and BDS- D6-82479, D1-4426 BCA Only- D6-87282 Q20, Q23, Q29, R59, and R08
    - The process should include:
        - Engineering requirements and approvals.
        - Manufacturing Planning requirements and approvals.
        - FAI verification.
        - Product Verification Plan (Receiving Inspection, Source Inspection, Audits).
        - Export Requirements.
        - Establishing sub-tier performance measurement and monitoring methods.

8. FOD & Tool Control Requirements

8.1 Background

- A Foreign Object Damage (FOD) Prevention Program is essential to reduce the risk of foreign objects (FO) being introduced into products.
- FOD is any damage attributed to Foreign Object Debris (FOd), which can be expressed in physical or economic terms. It can degrade the product or systems required safety and/or performance characteristics.
- An effective foreign object damage Prevention Program begins with a FOD risk assessment of product and process characteristics and operations. It includes the following elements:
    - Operations
    - Area designation
    - Training and personnel access
    - Product protection
    - Housekeeping and “clean as you go”
    - Consumables, hardware, personal items accountability, and control
    - Tool accountability and control

Note: See the supplier-facing AS9146 FOD Prevention Requirements and Best Practices Playbook for more details.

8. FOD & Tool Control Requirements (Cont.)

8.2 Good example

This risk assessment addresses risks for product and operations characteristics. Procedure dictates how often assessments are performed (twice per year or as required based on risk). It addresses detectability characteristics, as applicable, to product type (mechanical assembly). The characteristics questions for each risk element have been reviewed, evaluated and recorded resulting in an overall risk rating. As a result, the supplier can take appropriate actions to reduce FO, FOd, and FOD risks to product.

Sup FOD Eval Matrix - Template

Product Characteristics

Product Type / Characteristic Question	Are there level areas where FO can accumulate (e.g. flat disk, flat pattern with large holes)?	Is there a product feature (groove, valley, blind hole) where FO can collect/nest in (e.g. fan hub with turned pocket, disk tangential grooves, simple gears, stripper, gear, fitting, hardware features)?	Are there compartments, cavities, passages, pockets with limited visual or physical access (e.g. sub-assemblies, pumps, valves, electrical components, cases, tubes, systems, tanks, bays)?	Are there any bonding agents used (e.g. sealant, adhesives, glue, etc.)?	Does the product have an applied surface finish (e.g. paint, primer, plasma spray, chrome, anti-gall, coatings, ceramic, etc.)?	Does the product definition require additional hardware (e.g. standards, fasteners, nuts, nut-plates, rivets, washers, screws, bolts, spacers, collars, cotter keys, threaded inserts, wire terminals)?	Are there blind assemblies (e.g. hardware installed where it is difficult to detect and retrieve if dropped)?	Are there complicated passages with very limited access (e.g. cast housings, cooled airfoils, sub-assemblies)?	Is the product fully encased, with very limited, or no access (e.g. composites, bearing compartments, hollow fan blades, fuel cells, wing bays)
PN 123456 Mechanical Assembly	1	2	3	1	2	3	4	4	5

Operations Characteristics

Product Type / Characteristic Question	Are any types of bonding agents applied (e.g. sealant, adhesives, glue, etc.)?	Is the product subject to stains, corrosion, delamination during processing?	Are there any bonding, welding, brazing processes?	Are there FO risks associated with packaging and shipping of the product?	Is there Mechanical Assy of details (riveting, bolting, fasteners, etc.)?	Are protective caps normally used in the process? Note: Caps can be either mistakenly omitted (allowing FO entry), or forgotten (becoming FO)	Is there risk of cracking, fracturing, splintering, rupturing of product during operations?	Is machining chips/shavings/slag/spatter/swarf/etc. generated?	Does the process install holes into an enclosed / limited access cavity?	Do the operations include testing (e.g. functional test, acceptance test, etc.)?	Do processes included use of manufacturing media (tumbling stones, shot peen, grit blast, brush, low-melt alloy, etc.)?	Is there opportunity for tools/items to be left inside during completion of operations?
PN 123456 Mechanical Assembly	1	1	2	2	3	4	1	5	5	1	1	6

Detectability Characteristics

Product Type / Characteristic Question	Is there no Line of Sight to accomplish 100% visual inspection?	Does the product require mirrors to accomplish 100% visual inspection?	Does the product require Bore-scope to accomplish 100% visual inspection?	Does the product require shake & listen, waterflow, flushing to accomplish 100% visual inspection?	Does the product require NDI inspection (x-ray, ultrasonic)?	Is there no fully capable inspection method to detect FO/FOd after completion (e.g. composites, powdered metallurgy forging, sealed compartment)?
PN 123456 Mechanical Assembly	1	2	4	5	6	7

FOD Prevention Program

Product Type / Characteristic Question	Does the product/operations have a history of FO/FOd nonconformities that was detected internally?	Does the product/operations have a history of FO/FOd nonconformities that was detected by external customer?	Weighted Total
PN 123456 Mechanical Assembly	1	5	88

8. FOD & Tool Control Requirements (Cont.)

8.3 Bad example

This risk assessment only addresses the risks for product characteristics; the risks for operations characteristics and detectability characteristics were not evaluated. The risk elements for operations and detectability are equally as critical as product characteristics. Some examples of operations and detectability risk elements that have resulted in FO being introduced into products are: manufacturing media (shot peen, grit blast, polishing compounds), machining chips and shavings, no line of sight to accomplish 100% visual inspection, and products requiring bore-scope to accomplish 100% visual inspection. It is critical to address both product characteristics and operations/detectability characteristics to mitigate the FO, FOd, and FOD risk to product.

		Product Characteristics									Operations Characteristics												Detectability Characteristics						FOD Prevention Program		
Product Type	Characteristic Question	Are there level areas where FO can accumulate (e.g. flat disk, flat pattern with large holes)?	Is there a product feature (groove, valley, blind hole) where FO can collect/nest in (e.g. fan hub with turned pocket, disk tangential grooves, simple gears, stringer, spar, fitting, hardware features)?	Are there compartments, cavities, passages, pockets with limited visual or physical access (e.g. sub-assemblies, pumps, valves, electrical components, cases, tubes, systems, tanks, bays)?	Are there any bonding agents used (e.g. sealant, adhesives, glue, etc.)?	Does the product have an applied surface finish (e.g. paint, primer, plasma spray, chrome, anti-gall, coatings, ceramic, etc.)?	Does the product definition require additional hardware (e.g. standards, fasteners, nuts, nut-plates, rivets, washers, screws, bolts, spacers, collars, cotter keys, threaded inserts, wire terminals)?	Are there blind assemblies (e.g. hardware installed where it is difficult to detect and retrieve if dropped)?	Are there complicated passages with very limited access (e.g. cast housings, cooled airfoils, sub-assemblies)?	Is the product fully encased, with very limited, or no access (e.g. composites, bearing compartments, hollow fan blades, fuel cells, wing bays)	Are any types of bonding agents applied (e.g. sealant, adhesives, glue, etc.)?	Is the product subject to stains, corrosion, delamination during processing?	Are there any bonding, welding, brazing processes?	Are there FO risks associated with packaging and shipping of the product?	Is there Mechanical Assy of details (riveting, bolting, fasteners, etc.)?	Are protective caps normally used in the process? Note: Caps can be either mistakenly omitted (allowing FO entry), or forgotten (becoming FO)	Is there risk of cracking, fracturing, splintering, rupturing of product during operations?	Is machining chips/shavings/slag/spatter/swarf/etc. generated?	Does the process install holes into an enclosed / limited access cavity?	Do the operations include testing (e.g. functional test, acceptance test, etc.)?	Do processes included use of manufacturing media (tumbling stones, shot peen, grit blast, brush, low-melt alloy, etc.)?	Is there opportunity for tools/items to be left inside during completion of operations?	Is there no Line of Sight to accomplish 100% visual inspection?	Does the product require mirrors to accomplish 100% visual inspection?	Does the product require Bore-scope to accomplish 100% visual inspection?	Does the product require shake & listen, waterflow, flushing to accomplish 100% visual inspection?	Does the product require NDI inspection (x-ray, ultrasonic)?	Is there no fully capable inspection method to detect FO/FOd after completion (e.g. composites, powdered metallurgy forging, sealed compartment)?	Does the product/operations have a history of FO/FOd nonconformities that was detected internally?	Does the product/operations have a history of FO/FOd nonconformities that was detected by external customer?	Weighted Total
PN 456789 Mechanical Assembly		1	2	3	1	2	3	4	3	3																					22

8. FOD & Tool Control Requirements (Cont.)

8.4 Next steps

- Review contractual requirements and PO notes. Boeing BCA, BDS, and BGS flow requirements for suppliers to establish and maintain a FOD prevention program in compliance with AS/European Norm (EN)/Society of Japanese Aerospace Companies, inc. (SJAC) 9146 FOD Prevention Program.
  - BCA via Form X31764/ D6-87282 as required in PO Note Q29
  - BDS with Q186
  - BGS as required in PO Notes Q40 and Q115.
- Ensure the FOD Prevention Program has an adequate risk assessment that addresses product characteristics, process characteristics, and operations.
- The International Aerospace Quality Group (IAQG) Supply Chain Management Handbook (SCMH) guidance section 3.4.3 includes a tool that can be used to perform a risk assessment.
- The FOD risk assessment tool in the IAQG SCMH section 3.4.3 provides an example of how to perform a risk assessment for three different types of products based on complexity. Each example in the tool has different levels of risk based on the product characteristics and operations characteristics.
  - The IAQG SCMH is accessible for free online.
- Other recommendations may include: establishing a FOD focal/committee, regular FOD walks, and assessments for continuous improvement.

9. Standard Work and Mistake-proofing

9.1 Background

- Mistake-proofing and continuous improvement are necessary for world-class manufacturing.
    - These ensure that product can be designed, manufactured and inspected in a way that prevents defects from occurring.
    - At the very least, these can help identify defects immediately after they occur.
- Mistake-proofing relies upon best practices.
- Areas of emphasis can include:
    - Work organization.
        - standardized planning and operations
    - Work presentation to the operator
        - Kitting
        - Parts orientation and color
        - Part integration and assembly:
            - Connectors
            - Fasteners
        - Work station utilization:
            - Tools
            - Part fixturing
            - Layout
            - Visual aids
            - Lighting
            - Consumables
- Mistake-proofing is an invaluable concept when executed properly.
    - It can have a direct impact on quality improvement, rework elimination, cost reduction, and cycle time reduction.

Reference AS9100 Rev D, section 10.1

9. Standard Work and Mistake-proofing (Cont.)

9.2 Bad example

Design didn't reduce the chance of improper installation

- On top of the forward fuselage of the 787 is a Flight Deck Egress Door. This door is located just above the co-pilot's seat and it provides an alternative exit route for the crew in case of emergency. Just inboard and slightly forward of the egress door is an egress step/handle that facilitates the departure of the crew through the escape hatch.
- By design, the egress step is tilted back towards the aft end of the airplane. During final paint inspection at Boeing, an airline customer representative discovered that the egress step was installed 180 degrees out of tolerance (OOT).
    - The step also was angled forward instead of aft. The defect had been created during integration of the step on the fuselage at a partner site. It had passed through partner final inspection, through the Boeing factory, and made it to the Boeing flightline without being detected.

9. Standard Work and Mistake-proofing (Cont.)

9.2 Bad example (cont.)

How did it occur?

When examining the design of the detail part, fastener attach points are essentially symmetrical in relation to the part.

- This allows for the part to be installed backwards. *The design was not mistake-proof.*

Incorrect Installation Orientation

9. Standard Work and Mistake-proofing (Cont.)

9.2 Bad example (cont.)

Correct Installation Orientation

- If the fastener locations would have been slightly altered from the left to right sides, the incorrect orientation of the part would have been impossible to achieve because installation could not be completed.

9. Standard Work and Mistake-proofing (Cont.)

9.3 Next steps

- Hold thorough internal audits and reviews in which mistake-proofing opportunities can be identified and techniques implemented. Place special emphasis on part installations that are safety critical, such as the air egress step example shown in 9.2.
- Obtain or create a flowchart of the process. Review each step, thinking about where and when human errors are likely to occur.
    - For each potential error, work back through the process to find its source.
    - For each potential error, consider ways to make it impossible for the error to occur.
        - *Elimination:* eliminating the step that causes the error
        - *Replacement:* replacing the step with an error-proof one
        - *Facilitation:* making the correct action far easier than the error
- The design of a product is a key element of mistake proofing – but it is not the only approach. Mistake proofing can extend to the tooling used to assist part fabrication and assembly. Mistake-proofing concepts should also be applied to the manufacturing planning (instructions) for the product.
- If it is not possible to eliminate the opportunity for an error to occur, develop ways to detect the error and minimize its effects.
    - Consider simplifying and/or standardizing the inspection method; inspect products with established methods and inspect products with established methods to ensure effectiveness.
- Choose the best mistake-proofing method or device for each error. Solicit input from key stakeholders. Test it, and then implement it.

10. Operator Verification Programs

10.1 Background

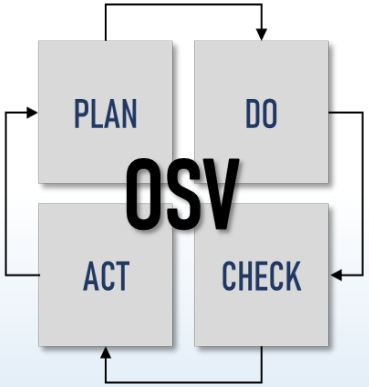
- An Operator Self-Verification (OSV) program is not a stand-alone process.
    - It augments the existing QMS to *improve* currently stable and capable processes.
- OSV determines if a product conforms to all applicable requirements by the individual who completed a specific step, or steps, in the build process.
- The foundation of a successful OSV program is built upon:
    - Identification of eligible processes.
    - Development of implementation plans.
    - Appropriate training provisions.
    - Establishment of performance measures
    - Assessment of competence (including performance) of identified operators.
    - Implementation of effective oversight and maintenance.

Reference AS9162.

10. Operator Verification Programs (Cont.)

10.2 Good example

- Supplier X has a specific procedure to select processes and products feasible for OSV practices, basing decisions on complexity and performance. Within Supplier X's procedure, the following key elements are in place:
    - OSV training includes employees and management which outlines general and technical OSV theory and practices. Training is offered initially and as an annual maintenance requirement.
    - Process monitoring is in place to provide objective evidence of the effectiveness of OSV.
    - OSV corrective actions are assessed and monitored as part of the process which integrates personnel eligibility and determination of appropriate products as candidates for OSV.
    - The OSV process, as a whole, follows the Plan, Do, Check, Act (PDCA) cycle.



10. Operator Verification Programs (Cont.)

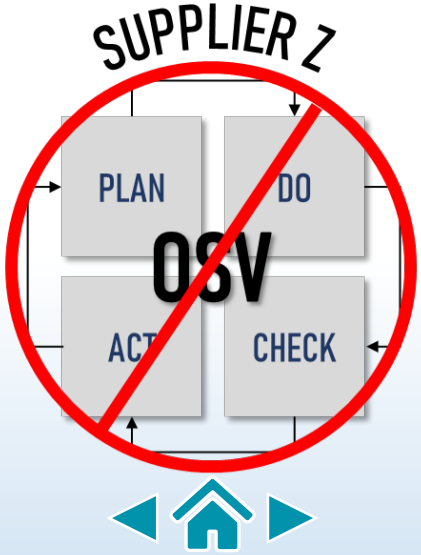
10.3 Bad example

- In an effort to reduce cost, Supplier Z made the decision to remove all of the Quality Inspectors from an area of the factory.
- Supplier Z immediately issued all of the production technicians in that area self-verification stamps, implementing OSV without a system in place.
    - The supplier used no criteria to determine which part numbers qualified for OSV or which operators were qualified to utilize self-verification stamps. The decision was based on cycle time reduction and perceived cost savings alone.
    - Supplier Z had no process to monitor OSV effectiveness. Therefore, corrective action never takes place because no risks are ever identified.
- As time progressed with this hastily-implemented OSV process in place, defect counts increased, and attribution of the defect increase was never correlated with poor OSV implementation.

10. Operator Verification Programs (Cont.)

10.3 Bad example (cont.)

- In an attempt to identify the systemic failures related to Supplier Z's high defect counts, the Boeing SQR scheduled a Manufacturing Process Assessment (MPA).
- During the MPA, it was discovered that the significant upward trend in defects was mainly caused by the poorly-implemented OSV program and its lack of detection capabilities.
    - While OSV itself didn't necessarily create the defects, the lack of identification of these defects (Quality no longer performing verification activities early in the process) did. The lack of a subsequent feedback mechanism allowed the defects to continue to downstream, undetected, until installation into the aircraft occurred. The SQR wrote a Major Supplier Evaluation Report (SER) and Supplier Z was placed on probation. Supplier Z's 3rd party certification body was also notified.



10. Operator Verification Programs (Cont.)

10.4 Next steps

- Ensure performance measures to assess OSV process effectiveness and efficiency are in place. Ideally, the Supplier evaluates their own OSV process. SQR may choose to add OSV to an existing Supplier Quality Surveillance event.
- Evaluate your existing OSV program and determine if the risks were appropriately identified and mitigated prior to implementation. Review the oversight methodology currently used to monitor OSV activities and determine if it is sufficient to determine the health of the program.
- Assess the effectiveness of training and the competency of the operators associated with the OSV program.
- Determine if any escapements were missed by the OSV program. If so, use them to help identify opportunities for improvement.
- Review AS9162 and determine if the OSV program is in compliance to the latest revision. Ensure a review interval is in place.
- For suppliers currently not utilizing OSV:
    - Identify where OSV implementation could be beneficial. Comply to AS9162 requirements for its implementation and consider the steps above.

Note: Review contractual requirements and PO notes. BCA and BGS flow requirements for suppliers via Form X31764 as required in PO Note Q29. If a supplier utilizes OSV, the supplier shall comply with the requirements set forth in Society of Automotive Engineers (SAE) industry standard AS9162, "Aerospace Operator Self-Verification Programs."

11. Robust Training Programs

11.1 Background

- Individual contributions can affect product conformance and the effectiveness of the QMS.
    - The absence of an effective training program may result in product nonconformances, process failures and escapements.
    - The organization should ensure that people understand the importance of their contribution and roles.
- Suppliers are to determine and define the competencies required for employees performing tasks related to products, processes and services (e.g. education, experience, training, etc.).
    - Suppliers are to assess personnel competence and develop plans to address and close any competency gaps.

Reference AS9100 Rev D, Section 7.2 Competence

11. Robust Training Programs (Cont.)

11.2 Good example

- Supplier X has a world class training program. Built into its core training principles, Supplier X has identified the following items as key aspects of the success of its program:
    - Clearly documented tools and processes that meet and exceed industry requirements and standards
    - Dedication by the training department to ensure the training program is successful
    - A robust assessment system that regularly determines training needs
    - A consistent method in which personnel can be quickly and fairly assessed for competency.
    - A job role-specific, self-assessment system that is available for all positions
        - Self-disclosed shortcomings without recourse or fear of reprimand
        - Commitment to providing assistance and resources to correct the concern

11. Robust Training Programs (Cont.)

11.2 Good example (cont.)

- The creation of numerous work cell “mock ups” which allows for individual and team focused training and testing in crucial manufacturing processes (e.g. FOD, deburr, drilling, electrical system best practices)
- Extensive use of professional training videos which are stored in an easily accessible internal location
- Utilization of classroom training, when appropriate. Teaching staff includes access to all different subject matter experts, both from inside and outside the company
- Integration of a corrective action system that addresses identified shortcomings related to training quickly, with special emphasis on the correction of *systemic failures* vs. individual disciplinary-type corrections
- A real-time training program status data system

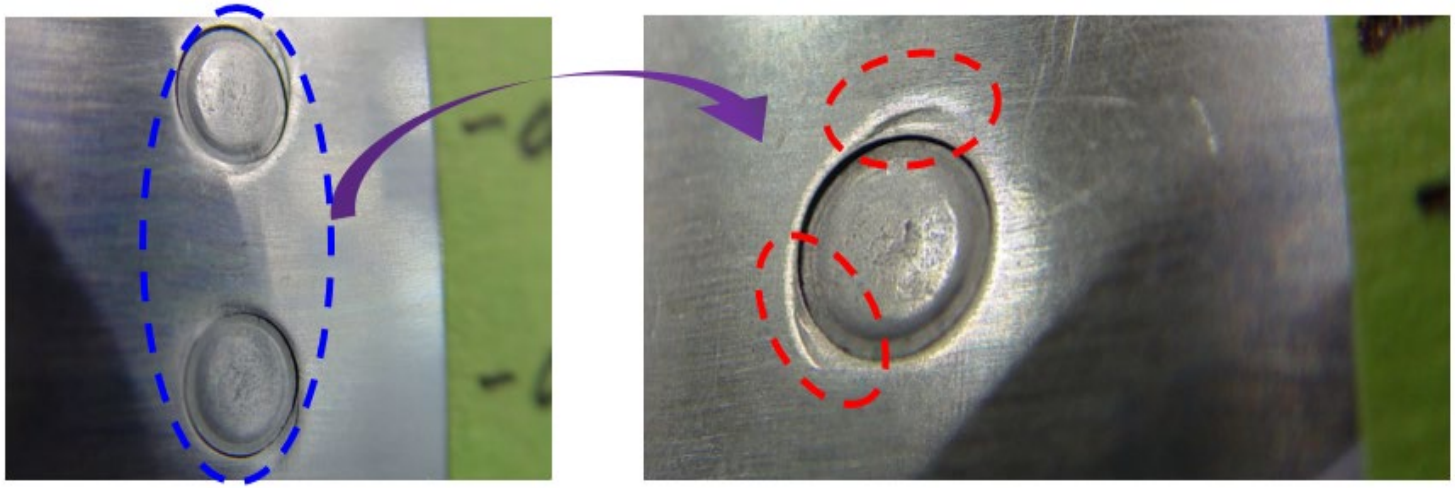
11. Robust Training Programs (Cont.)

11.3 Bad example

- Supplier Z does not have a formal training program because top management believes that the hiring process will act as the filter for bringing in only "trained" personnel.
    - Supplier Z completely lacks a documented training process, has no training department, and does not have any assigned personnel acting as designated trainers.
    - When new employees report to work, they are expected to learn using Supplier Z's "trial by fire" training system, which places employees directly in a work cell.
    - New employees are expected to learn rapidly, or disciplinary action will result.
- ***Result 1:*** Supplier Z suffers from extremely high attrition, unacceptable defects rates, and numerous QMS corrective actions. These issues have resulted in Supplier Z being placed on probation and because of that, the supplier is unable to bid on new work.
    - The supplier now has a full-time Boeing recovery team onsite and all product must be source inspected prior to shipment.
- ***Result 2:*** Supplier Z produced numerous defective end items which contained damage around fastener heads. This escape was due to lack of proper training and poor qualification practices of mechanics and inspectors. Basic drilling and fastening "trial by fire" training was provided, collectively, to a group of new hires on day two. Poor training contributed to these quality escapes.
    - See photos on P.75.

11. Robust Training Programs (Cont.)

11.3 Bad example (cont.)



11. Robust Training Programs (Cont.)

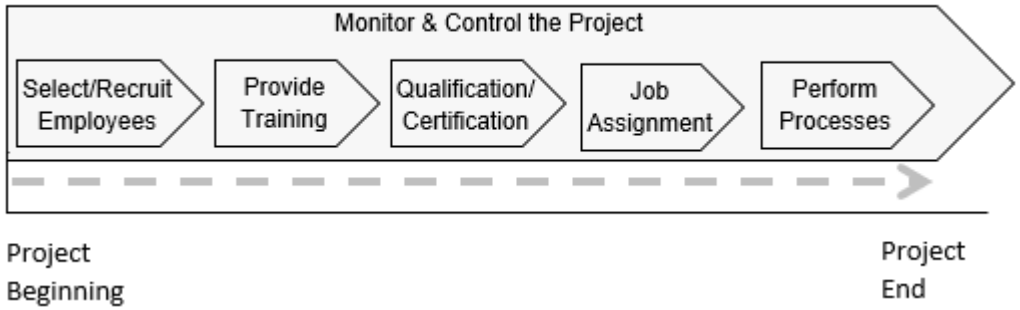
11.4 Next steps

- Competency and individual-based training
  - Ensure all employees are trained and their skills maintained via a competency-based approach per AS9100, 7.2 and 7.3. It should be an “individual based” training system, not a collective traditional approach.
  - Some core ideas and principles to be followed:
    - Determine required competency for each job function.
    - Compare individuals to the competency standard.
    - Take actions to close competency gaps.
    - Train to achieve the knowledge required and level of competence to be acquired.
    - Evaluate effectiveness.
    - Review the necessary competence on regular basis (defined interval).
    - Maintain records.

11. Robust Training Programs (Cont.)

11.4 Next steps (cont.)

- Select, train, and qualify employees.
    - Employee training should be managed as an ongoing process, with tasks planned and completed over time. This applies both to new hires and to employees transferred from other work areas.



Notes:

Review contractual requirements and PO notes. The Specification Support Standard (BSS)7600 series in Product Standards Data System (PSDS) specifications could be applicable.

Review the International IAQG SCMH guidance section 7.13.2 for *Competence Management Guidelines.*

Review the Aerospace Improvement Maturity Model (AIMM) Module 7.2 *Competence*

12. Tooling/Preventative Maintenance

12.1 Background

- The focus of this activity is "Special Tooling," specifically special tooling that is not under Boeing Supplier Quality (SQ) Tooling oversight (i.e. BCA Category III Tools).

Note: BDS SQ Tooling has oversight for all special tooling.

- Special Tooling is defined as: *Tools of such a specialized nature that, without modification or alteration, their use is limited to the development and/or manufacture of production parts and assemblies.*
    - Examples of special tooling include: jigs, fixtures, molds, patterns and gages as identified by site-specific documentation.
- Incidents have occurred where failure to maintain tooling has resulted in product nonconformance. See next slide for requirements. The requirement to maintain tools comes from:

12. Tooling/Preventative Maintenance (Cont.)

12.1 Background (cont.)

AS9100 D –
8.5.1.1 Control of Equipment, Tools, and Software Programs
Equipment, tools, and software programs used to automate, control, monitor, or measure production processes shall be validated prior to final release for production and shall be maintained. Storage requirements shall be defined for production equipment or tooling in storage including any necessary periodic preservation or condition checks.
BCA - D33200-1 –
1.12.1 Maintenance of Special Tools
Maintain all tools in good repair while they are in the possession of the supplier or their sub-tier suppliers. Location of the tools in direct use or storage must govern the type of protective finish to be applied. The supplier is required to provide and maintain a written procedure for storage, handling, and maintenance of all special tools to prevent damage from environmental elements. The term “maintained” includes maintenance of the tool to the latest tool design, and when that design is controlled by the supplier, it includes maintenance and configuration control of the tool design to the latest engineering configuration.

12. Tooling/Preventative Maintenance (Cont.)

12.1 Background (cont.)

BDS – D950-11059-1 –
9.0 Periodic Inspection
Any asset being used as control media or the only means to accept, test and determine asset configuration is subject to periodic inspections. Typically, assets subject to periodic inspection supports end item assets, including Major End-Item assembly assets for conformance and configuration to contracted engineering design/definition.

10.0 Each Use Condition Check
Any accountable asset being used during manufacturing of Boeing products is subject to Each Use Condition Checks. Sellers must maintain documented information to perform Each Use Condition Checks for all Boeing accountable assets, government and seller assets accountable to Boeing. This includes any Boeing provided asset data elements controlling configuration of seller owned assets.

13.0 Preventive Maintenance
Includes all Boeing-accountable and Government owned Boeing accountable assets in Seller's and its subcontractors' possession. Sellers must maintain documented information with clear roles and responsibilities to perform user maintenance and preventive maintenance, including development and control of Preventive Maintenance Plans (PMP), for all Boeing accountable assets, government and seller assets accountable to Boeing.

12. Tooling/Preventative Maintenance (Cont.)

12.2 Good example

Precision Invar Bar kit and attachments in a “Shadow Box” of dense foam to protect the bars, and a wooden adaptor box containing precision attachments:

12. Tooling/Preventative Maintenance (Cont.)

12.3 Bad example

Tool storage outside and unprotected from the elements, no rust preventative compound applied to critical details:

12. Tooling/Preventative Maintenance (Cont.)

12.3 Bad example (cont.)

Storage of tooling not currently in use, can create damage to the removable details “Parting Planes” and can affect product quality:

12. Tooling/Preventative Maintenance (Cont.)

12.4 Next steps

- Perform a thorough review of all identified Special Tooling.
- Create a maintenance plan for each tool to protect tools and products from nonconformances and noncompliances.
- Develop a schedule for periodic maintenance that is adequate to ensure the condition special tooling is maintained to such a level as to prevent product damage or noncompliance.
- Implement an “Each Use Condition Check” as a way to ensure proper condition of tool.

13. Fraud Risk and Prevention

13.1 Background

An important note about fraud: Boeing has experienced a significant uptick in fraud-related escapes in the past decade. Typically these escapes are related to the inadvertent consumption of counterfeit detail-level parts into next-higher assemblies. This can happen because the counterfeit part can get buried in the worldwide, multi-tiered supply chain model. This may include any or all of the following:

- Purposeful fraudulent creation of software (s/w) or hardware (h/w)
- Consumption of counterfeit s/w or h/w (knowingly or unknowingly)
- Loss of traceability of s/w or h/w due to complex multi-tiered business models

Why would a parts provider create counterfeit parts in the first place? The simple answer is almost always *to gain a financial business advantage with the least amount of required effort and cost*. A fraudulent s/w and/or h/w supplier typically copies the Intellectual Property (IP) of others to avoid research and development (R&D) and the time-consuming and often expensive certification requirements.

Because detection of fraudulent parts can be extremely challenging (e.g. a discrete electronic device within a power control module which is then installed in a complex end item assembly), requirements consumption and sub-tier-appropriate multi-level flowdown is extremely important.

Note: Industry standards and contractual requirements exist regarding fraudulent behavior and counterfeit parts. As an example, section 8.1.4 of AS9100D is dedicated to the prevention of counterfeit parts. Suppliers are encouraged to consult with the Boeing Supplier Quality Representative (SQR) and Procurement Agent (PA) if assistance is needed with any aspect of this topic.

13. Fraud Risk and Prevention (Cont.)

13.1 Background (cont.)

- Stated in *The International Fraud Handbook* by Wells (2018), the "Report to the Nations on Occupational Fraud and Abuse" issued by the Association of Certified Fraud Examiners (ACFE) in 2018 found that corruption was the most common form of occupational fraud committed in the US and in Western Europe between 2016-2017, at 30% and 36%, respectively. The most common form of detection was a whistleblower tip (Chapters 14 and 15, para. 1 and para. 2).

- Merriam-Webster defines corruption as, "dishonest or illegal behavior especially by powerful people" and "a departure from the original or from what is pure or correct."

- Fraud, in its general sense, can be a difficult topic of discussion because it can be received as accusatory in nature. However, in the context of *escape reduction*, it should be noted that the focus is primarily on the determination of fraud *risk* and *vulnerability* and the subsequent proactive *prevention* efforts, especially in regards to counterfeit parts. Boeing has a trusted worldwide supply base and, without question, the vast majority of suppliers and personnel seek to do the right thing.

- Unfortunately, some escapes have resulted from negligent and willful acts of fraud, such as the *purposeful creation and/or consumption of counterfeit parts*. The Next steps section of this element seeks to assist suppliers with proactive approaches to fraud reduction and elimination.

13. Fraud Risk and Prevention (Cont.)

13.1 Background (cont.)

- Black's Law Dictionary briefly defines fraud as, "an act of intentional deception or dishonesty perpetrated by one or more individuals, generally for financial gain."

- The aerospace industry is susceptible to fraud. Its multi-tiered supply chain, consisting of thousands of worldwide suppliers, can make detection of fraud, such as the known and unknown consumption and use of counterfeit parts, extremely challenging. Wells (2018) notes:

    - If an organization employs individuals, at some point one or more of those individuals will attempt to lie, cheat, or steal from the company for personal gain. So this hidden cost – one that offers no benefit to the company and, in fact, causes numerous kinds of damage to the company even beyond the direct financial consequence – is one that all organizations, in all countries, in all industries, and of all sizes, will encounter. However, the risk of fraud is most significant – that is, it has the potential to cause the most damage – for organizations that are unaware of, ignore, or underestimate whether and how fraud can occur within their operations (ch. 1, para. 3).

    - Wells (2018) continues, "[a]s long as organizations are employing individuals to perform the business functions, the risk for fraud exists. Only by recognizing and proactively and continually addressing this risk can organizations mitigate the potentially devastating impact (ch. 1, para. 29)."

13. Fraud Risk and Prevention (Cont.)

13.2 Good example

- Supplier X believed they operated honestly and ethically in all areas of business and internal surveys reflected this notion. However, instead of ignoring the inherent risk of fraud, Supplier X recognized the importance of conducting regular fraud evaluation and prevention activities.
- The supplier determined there was a need to get a fraud risk and detection program launched. Supplier X reached out to FDR Consulting LLC, who helped set up the fraud detection and prevention team (FDPT) and related processes.
- By utilizing a customized fraud risk assessment tool, Supplier X identified three risk areas within the company.
- One crucial area that scored high on the risk scale during the assessment was *scrap material traceability*.

13. Fraud Risk and Prevention (Cont.)

13.2 Good example (cont.)

- The assessment uncovered a situation where an individual had been committing fraud by removing scrapped parts from the site and transporting the parts (in the back of a company truck) to a non-certified vendor for cash.
    - The actions of this individual resulted in lost scrap recycling revenue for Supplier X. This issue also put Supplier X's trade secrets at risk because these parts were now uncontrolled and in the hands of non-certified recyclers, who had no formal contract in place with Supplier X.
- Further investigation revealed that the parts were being arranged to be sold to overseas vendors, who then intended to reverse-engineer the parts and sell them at a lower quality and cost. Had this act of fraud played out, the company's reputation would have been at risk as well.
- The individual was fired from Supplier X and now faces civil penalties and potential prison time. In this case, Supplier X's fraud risk detection process identified and eliminated fraud in an area of the business that was never suspected as a risk in the first place. This gave Supplier X enough time to identify, rectify and recover the situation.

13. Fraud Risk and Prevention (Cont.)

Note: Rulings related to high-profile cases of fraud in the aerospace industry are available to the general public via numerous online and printed sources. Many of these high-profile cases are similar in that they involve lucrative government contracts in which the manufacturer violated contractual terms.

Most examples include deliberate billing of downtime hours, such as lunches and extended breaks, inflation of charges, and manufacturing and/or supplying defective or counterfeit parts.

In this context, manufacturing and/or supplying defective or counterfeit parts is of special interest.

13.3 Bad example

- In one publicly available example, an original equipment manufacturer (OEM) consumed defective detail parts provided by Supplier Y. The OEM agreed to pay a $325 million-dollar settlement when it was found that they subsequently provided (and billed) the defective parts to a government entity.
    - While Supplier Y was certainly to blame for failing to properly test and qualify certain parts over a 10 year period, ultimately the OEM bore most of the responsibility. The investigation further concluded that Supplier Y and the OEM made misrepresentations and concealed certain material facts regarding the reliability of the parts.

- A recurring theme is that fraud detection is performed too late – the scenarios became more costly (and complex) to resolve as time elapses. By implementing a proactive method of fraud detection immediately, businesses can drastically reduce the likelihood of experiencing costly issues with fraud *prior* to the situation getting out of control.

13. Fraud Risk and Prevention (Cont.)

13.3 Bad example (cont.)

Misuse of Acceptance Authority Media (AAM) tends to strike in a collective – rather than singular – type of way. Issues related to AAM are typically falsely signing/stamping completion of a task.

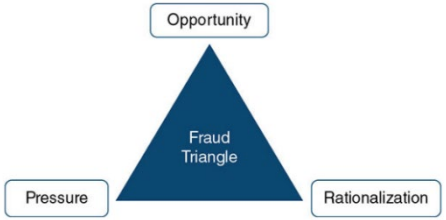
- During a QMS audit, a 3rd party certification body auditor observed Supplier M's personnel placing stamp impressions on work order operations that were not yet performed. The auditor decided to investigate further, and requested to sample build records and related nonconformance (NC) data.
    - Stamp impressions for key operations were selected, and the auditor asked to see all NC data related to the end item parts and serial numbers, including NC data from the OEM post-delivery.
    - A direct correlation was identified between some of the stamp impressions and NC data, which indicated that stamped-as-completed-operations were never performed.
    - In one sample, a special process (heat treat) was to be performed on a detail part. It was stamped as being completed, yet the NC tag condition indicated heat treat was never applied.
    - The auditor unearthed a 25% AAM failure rate. Supplier M received a major finding, went on probation and spent the next 6 months containing the issue. Supplier M issued 30 notifications of escapement and had to rebuild their AAM program from scratch.

13. Fraud Risk and Prevention (Cont.)

13.4 Next steps

This section lists some ways to reduce the likelihood of experiencing fraud. These are just a few suggestions out of many possibilities. Each organization may need to customize what works best based on need.

1. **Understand the "Fraud Triangle."** Noted by Wells (2018), Dr. Donald Cressey, a criminologist whose research focused on embezzlers (whom he called *trust violators*), developed the following model:



Dr. Cressey via Wells (2018), states that three factors must be present at the same time for an ordinary person to commit fraud: (1) pressure, (2) perceived opportunity, and (3) rationalization. (ch. 1, para. 14)

Once an organization understands the Fraud Triangle, it can be utilized as a filter in most aspects of the overall fraud detection process and associated countermeasures. For example, it can be the first "gate" when applying a fraud risk assessment in a specific area of the business. If one or more of the Fraud Triangle factors are not present, the organization may choose another area of focus or choose to rate the area of concern as low risk. Conversely, if all three factors are present, there may be an increased risk of fraud in the area of concern.

13. Fraud Risk and Prevention (Cont.)

13.4 Next steps (cont.)

2. Develop a fraud Risk Detection Plan (RDP).

- RDP development can be accomplished a number of ways and is designed to utilize existing policies and procedures. A RDP could include the development and regular use of a fraud risk assessment tool.
- Wells (2018) explains this as follows:
    - A *fraud risk assessment* is a process aimed at proactively identifying and addressing an organization's vulnerabilities to both internal and external fraud.
    - If performed and used correctly, a fraud risk assessment can be a powerful tool in the fight against fraud for any business. (ch. 2, para. 13).
- Wells (2018) further stresses that:
    - Every organization should conduct a fraud risk assessment and build procedures to keep the assessment process current and relevant. Not only is this practice good corporate governance, but it also makes good business sense. Specifically, engaging in a fraud risk assessment provides a number of benefits to an organization. (ch. 2, para. 17)

13. Fraud Risk and Prevention (Cont.)

13.4 Next steps (cont.)

- It is advised to consider the following when developing a fraud risk assessment:
  - Designate an appropriate sponsor
  - Determine who will be responsible for conducting it
  - The following are some examples of methods that can be used to conduct the fraud risk assessment.
  - Interviews
  - Focus Groups
  - Surveys
  - Other Anonymous Feedback Mechanisms

  (Wells, 2018)
- A robust and properly structured fraud detection risk assessment with strong internal controls will deter fraudulent behavior by seeking to eliminate opportunity and it will also make detection stronger.

13. Fraud Risk and Prevention (Cont.)

13.4 Next steps (cont.)

The extent of a supplier's counterfeit prevention program is determined by the nature of the organization and the parts it provides. This includes understanding the extent of controls needed and how quickly the controls need to be implemented.

- Some excellent reading on the topic of fraud is available here.
- A good resource on counterfeit parts is available via IAQG, SCMH, sec. 3.5.2.

For more information and other available resources on this topic, please consult with your SQR and PA.

Acronyms

ACFE	Association of Certified Fraud Examiners
ADCN	Advance Drawing Change Notice
AS	Aerospace Standard
BAC	Boeing Process Specification
BCA	Boeing Commercial Airplanes
BDS	Boeing Defense, Space & Security
BFAI	Boeing FAI
BGS	Boeing Global Services
BSCA	Boeing Supply Chain Agreement
CFR	Code of Federal Regulations
CSDT	Customer Supplier Data Transmittal
DCMA	Defense Contract Management Agency
EAR	Export Administration Regulations
EN	European Norm
ERPLN	Enterprise Resource Planning
FAA	Federal Aviation Administration
FAI	First Article Inspection
FAIR	First Article Inspection Report
FDPT	Fraud Detection and Prevention Team
FO	Foreign Object
FOD	Foreign Object Damage
FOd	Foreign Object Debris
FPQ	First Part Qualification
GP	General Provision
GTA	General Terms and Agreements
h/w	Hardware
HDI	Hydrogen Detection Instrument
IAQG	International Aerospace Quality Group
IP	Intellectual Property
ITAR	International Traffic in Arms Regulations
KSI	Kilopound Force per Square Inch
KUTD	Keep Up to Date
MPA	Manufacturing Process Assessment
MPI	Magnetic Particle Inspection
MRR	Manufacturing Review Request
NDI	Non-Destructive Inspection
NoE	Notice of Escapement
OEM	Original Equipment Manufacturer
OOT	Out of Tolerance
OSV	Operator Self-Verification
PA	Procurement Agent
PCD	Process Control Document
PDCA	Plan, Do, Act, Check
P-FMEA	Process Failure Modes Effects Analysis
PIA	Proprietary Information Agreement
PMP	Preventative Maintenance Plans
PO	Purchase Order

Acronyms

PPV	Pre-Product Verification
PSD	Process Specification Departures
PSDS	Product Standards Data System
QMS	Quality Management System
QPL	Qualified Processor/Product List
QPA	Quality Process Assessment
R&D	Research and Development
RCCA	Root Cause Corrective Action
RCR	Requirements Consumption Review
RDP	Risk Detection Plan
s/w	Software
SAE	Society of Automotive Engineers
SBP	Special Business Provisions
SCMH	Supply Chain Management Handbook
SER	Supplier Evaluation Report
SJAC	Society of Japanese Aerospace Companies, Inc.
SME	Subject Matter Expert
SoW	Statement of Work
SPECO	Special Operation
SQ	Supplier Quality
SQR	Supplier Quality Representative

Boeing Contacts

For any questions or comments, contact your Boeing Supplier Quality Representative (SQR) or your Procurement Agent (PA).

References

Boeing Forms, Standards, and Documents

BAC 5730 “Shot Peen Forming”
BAC5804 “Low Hydrogen Embrittlement Cadmium-Titanium Alloy Plating”,
BSS7600 “Employee Certification. General Requirements”
D1-4426 “Approved Process Sources”
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D6-82479 “Boeing Quality Management System Requirements for Suppliers”
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D33200-1 “Boeing Supplier’s Tooling”
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Doing Business with Boeing “First Article Inspection Planning Requirements”
PSDS
X31764 “Quality Purchasing Data Requirements (BCA/BGS)”

BDS PO Notes

Q19
Q20
Q23
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BCA PO Notes

Q29
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Q115
R59
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References

General Provisions

GP7 "Fixed Price Goods Contract Under U.S. Government Prime Contract"
GP4 "Cost Reimbursement Contract Under Government Prime Contract"

Industry Standards

AS9100D Requirements for aviation, space, and defense organizations
AS9102 "Aerospace First Article Inspection Requirement"
AS9146 "Foreign Object Damage (FOD) Prevention Program"
AS9162 "Aerospace Operator Self-Verification Programs"

Additional Resources

Aerospace Improvement Maturity Model
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Hammar, M. (2018). Practical guidance on preventing counterfeit parts by applying AS9100 Rev D.
IAQG, SCMH, sec. 3.4.3
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Merriam-Webster "Corruption"
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Wells, J.T. (2018). *International fraud handbook.* Wiley.

Summary of Changes

Section	Summary of Changes
N/A	Not applicable. New Playbook