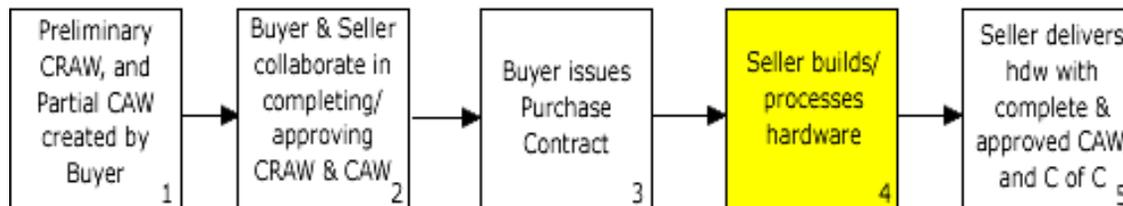


Q235 Characteristic Risk Analysis Characteristic / Accountability Worksheet
SSME Program Only- rev 11/22/02

Purpose

The purpose of the Characteristic Risk Analysis Worksheet (CRAW) and Characteristic Accountability Worksheet (CAW) is to identify the most important hardware/process characteristics, which ones must be recorded, how they will be controlled and what methods will be used to validate them. Requirements and their risk are determined using the CRAW with the highest risk items being transferred to the CAW for identification of how they will be controlled. The intent of this effort is for the Buyer and Seller to work together to understand the requirements, the processes that will be employed, the associated risks, and agree on how they will best be mitigated.

Flow



- 4 Any Process Changes during build must be forwarded to Buyer for approval

Requirements

1. Buyer will create a bid package that contains a Preliminary CRAW, and Partial CAW.
2. The Seller shall work with Buyer to complete the CRAW and CAW. In support of this process, the Seller must make Control Methods/Procedures/Inspections identified on the CAW available to Buyer for review.
3. The purchase contract will not be released until the CRAW has been completed and CAW approved by the Buyer. No hardware processing or fabrication shall start until the CAW has been approved and the purchase contract is released.
4. Once approved, the Seller shall perform all process controls and verifications as documented on the CAW. Any Process Changes must be forwarded to the Buyer for approval, the CAW revised and approved prior to the change being implemented. The Seller is responsible for managing the flow of CAW and Q235 requirements to the Sub-Tier suppliers.
5. Upon delivery of hardware to Buyer, the Seller shall submit a) the approved CAW along with b) a statement on their Certificate of Conformance that they have processed the hardware as documented on the CAW.

Agreement

- ✓ Seller must read, understand, and agree to all elements of Q235 including the Purpose, Requirements, CRAW Instructions, CAW Instructions, and Definitions contained herein.

Characteristic Risk Analysis Worksheet Instructions

(CRAW Example)

B O E I N G		Rocketdyne Propulsion & Power		Characteristic Risk Analysis Worksheet						
Part No. XXXX			Program SSME		Product Team MC C/Nozzle Team					
Part Name XXX			Supplier Suppliers Name				Supplier No.			
Date 10/01/00	Page 1 of 3	IPT Leader								
Candidate Characteristic	Drawing or Spec Location	Potential Cause of Variation	Potential Effect of Variation	Occurrence	Severity	Detectability	Risk Number	Mgmt Method	Classification	
Penetrant Inspection	RA0115-116	Cleanliness, wrong sensitivity level, process controls	Loss of vehicle, Defective parts accepted, good parts rejected, additional cost	6	10	8	480	Unique	Critical	
Seal groove depth .119-.121	SH1 Zone C-14	Speeds, feeds, cutting tools, set up, measurement errors	Loss of vehicle, U/S compressed seal, O/S inadequate pre-load	2	10	2	36	Unique	Critical	

- 1 **Candidate Characteristic:** This column identifies characteristics that are deemed by the Product Team or Supplier to be important enough to require a risk evaluation. This may include any feature that is felt to contribute to fabrication or operational risk.
- 2 **Drawing or Spec Location:** Identifies controlling requirement documentation.
- 3 **Potential Cause of Variation:** Identifies potential causes of variation for each candidate characteristic.
- 4 **Potential Effect of Variation:** Identifies possible adverse effects if the characteristic vary from target.
- 5 **Occurrence:** The probability (with 10 being most probable) that the characteristic will vary outside drawing limits.
- 6 **Severity:** Measures how adverse (with 10 being the most severe) the effects of variation will be to the customer, either internal or external.
- 7 **Detectability:** Identifies how difficult it would be to detect variation of the characteristic outside of drawing limits on the completed article (with 10 being the most difficult). This number reflects the probability of passing a defective part on to the customer.
- 8 **Risk Number:** This represents a composite risk number, which is calculated by multiplying Occurrence, Severity, and Detectability.
- 9 **Management Method:** Specific methods used to manage variation and outcome of each candidate characteristic.
- 10 **Classification:** (see CAW instructions for Classification)

CAW Instructions

(CAW Example)

Characteristic Accountability Worksheet						Last Change		
Process/Product Validation								
1 This document must be approved by Buyer prior to processing hardware								
Note: This document does not reflect fabrication sequence, nor does it reflect all drawing requirements. Drawing must be met and inspected per the Purchase Contract 2								
Work I.D.: Work Revision:			Part Number:					
Program:			Part Name:					
Supplier:			Prep By: 3		Date:			
Supplier Code:			Approved (R/D): 4		Date:			
Approval Level: 5			Supplier Approval:		Date:			
Requirements				Process Control			Verification	
Item No.	Note No. Dwg Sh Zone	Class of Char.	Requirements/ Characterization	Rec	Spec. No.	Key Process Characteristic	Control Method, Procedures or Verification (Identify Sub-Tier if applicable)	Acceptance Plan or Insp. Method
		6	7	8		9	1	1
10	Sh 1 GN 6	Critical	Penetrant Inspect after final mach	F	RA0115-116	Penetrant Sensitivity	NDT Supp. Name, NDT Technique #, Rev, Date Supp. NC	100% Record cert. & Tech. #
	SH1 Zone C 44		Seal groove depth 440 404			Set up.		100% Record actual dim
						Export Controlled 1		
Left Hand Side				Right Hand Side				

- 1 Reminder not to process hardware prior to obtaining an Approved CAW.
- 2 Reminder that compliance to the CAW does not relieve the Seller of the requirement to meet all drawing and specification requirements
- 3 **Prepared By:** Identifies who prepared the Requirements section of the CAW. This would be the person to contact for any questions regarding CAW content.
- 4 **Approval Block:** Signifies Buyer and Supplier approval of CAW. Buyer Approval of Preliminary or Complete CAW allows hardware processing to begin. Buyer approval is recognized subsequent to entry into Buyers database and re-issuance of the CAW to Seller with the approval fields type written.
- 5 **Approval level:** Identifies level of completeness of CAW document.
 - Partial: Left-Hand Side filled out, Right Hand Side blank. No supplier collaboration at this stage of the process.
 - Preliminary: Left-Hand Side complete. Right-Hand Side completed for some but not all characteristics.
 - Complete: Both Left-Hand Side and Right-Hand Side are complete. The Seller must have a Buyer approved, completed CAW, prior to delivery of hardware to Buyer.
- 6 **Classification of Characteristics:** This field indicates a classification of the characteristic identified in the Requirements/Characteristic column. Possible classifications include:

Class	Definition

Critical	Inspections and Tests defined in the SSME FMEA/CIL that represent the final level of verification(s) necessary to minimize the probability of failure. Critical characteristics are those features that, if nonconforming, are likely to cause hazardous or unsafe conditions which could result in loss of life, vehicle, or mission.
Primary	Inspections and Tests defined in the SSME FMEA/CIL which represent component or detail level verification(s) necessary to minimize the probability of failure. Primary characteristics are those features that, if nonconforming, are likely to result in loss of performance of the SSME, resulting in hazardous or unsafe conditions.
Key (KC)	Product characteristics whose variation from target poses the greatest threat to product fit, performance, service life, or manufacturability, and for which the potential for such variation is the greatest, are considered <i>Key</i> . A Key Characteristic is one that is likely to vary, is unlikely to be detected if it does, and in that case is likely to have severely detrimental effect on the product. Statistical process control (SPC) is used to manage risk for key characteristics.
Significant (SC)	A product characteristic that is sufficiently high in risk to warrant the use of special production management methods but that is not well suited to statistical process control.
Critical and Key	Characteristics determined to be both <i>Critical</i> through evaluation of the SSME FMEA/CIL <u>and</u> <i>Key</i> via Characteristic Risk Analysis, in accordance with above definitions.
Critical and Significant	Characteristics determined to be both <i>Critical</i> through evaluation of the SSME FMEA/CIL <u>and</u> <i>Significant</i> via Characteristic Risk Analysis, in accordance with above definitions.
Primary and Key	Characteristics determined to be both <i>Primary</i> through evaluation of the SSME FMEA/CIL <u>and</u> <i>Key</i> via Characteristic Risk Analysis, in accordance with above definitions.
Primary and Significant	Characteristics determined to be both <i>Primary</i> through evaluation of the SSME FMEA/CIL <u>and</u> <i>Significant</i> via Characteristic Risk Analysis, in accordance with above definitions.

- 7 Requirements/Characteristic:** Identifies characteristic to be controlled.
- 8 Record:** Identifies what characteristics are to be recorded. Provisions for these recordings must be made and identified in the Control Method/Procedure/Verification and Acceptance Plan/Verification Method columns of CAW.
(See **10** & **11**)
- 9 Key Process Characteristics:** Identifies various manufacturing process and product elements that exert significant influence upon the CAW identified characteristics and requirements. Key process characteristics are determined by the supplier in conjunction with Buyer.
- 10 Control Method/Procedure:** This identifies methods that will be used to control the identified characteristics. The method identified is preferably the lowest level document that controls the operation. (e.g., NC tape number vs. traveler number) Provisions must be made for any recording requirements identified in the Record column. Methods listed should be clearly documented, configuration controlled and identified as "Buyer controlled" within the controlling document. Copies of the control plans or procedures listed on the CAW must be made available to Buyer for review. Seller must identify a Control Procedure and may also utilize a Control Inspection or Control Method. (see Definition section)
- 11 Acceptance Plan/Verification Method:** This column identifies inspections and verifications that will be performed to assure Requirements/Characteristics are in conformance. Examples include 100% inspection, sampling inspection, 1st Article, record or some combination of these.

Note: Every characteristic listed on the CAW that has not been produced or performed previously is required to have 100% inspection of the 1st article, and a sufficient sample size, before the chosen control method can be validated.

- 12 Export Controlled:** Requires that viewing/sharing of CAW be restricted to U.S. citizens only. Seller is required to abide by this requirement when dealing with Sub-Tier suppliers.

Definitions

Process Change: Changes to the process controls defined in the CAW that alters assembly, fabrication, joining or inspection processes.

Control Method: Methods used to control execution of the process. This may be by operator training, operator certification, or by automation of the operation.

Control Procedure: A written description of how an operation is to be accomplished. This can be the Sellers shop floor traveler, job card, planning, NDT Technique, or a separate document referenced in the manufacturing planning.

Control Verification: A verification of a continuous process characteristic such as temperature, or it can be a test/inspection of a sample that processed with a production lot of parts.

First Article: First Article verifications are required tests and inspections performed on a part or parts (as opposed to the process) before initial production and before resumed productions after significant process or design changes have occurred. Sometimes First Article verifications result in destruction of a part to perform all testing.

NDT Technique: A written description of how an NDT operation is to be accomplished. NDT Techniques are part and feature specific processing procedures. Approval of Sellers NDT Techniques by Buyer is required for a) All NDT Inspections classified as Critical or Primary and b) All welds with double-wall X-Rays.

FMEA/CIL: Failure Mode & Effects Analysis (FMEA) and Critical Items List (CIL). The FMEA identifies component failure modes, categorized each failure mode according to its worst case failure effect, identifies possible failure mode causes, and assesses the failure effect on the engine, vehicle, and mission. The CIL provides rationale for the retention of the design, and inspection & tests for the component in question.