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## **Critical Characteristics and Key Product Characteristics (KC)**

### Purpose

This paper is intended to inform the reader regarding the differences (and similarities) between Critical Characteristics and Key Product Characteristics (KC). These two terms are not synonymous. Both require the expenditure of resources to assure that they are achieved, but the intended outcome is significantly different. In the case of a Critical Characteristic the intent is to assure that an unsafe condition will not exist when the item conforms to the engineering requirements and to alert those in the production and maintenance of the importance of this feature in assuring safety. For a KC the desired outcome is that the item is produced at its specified dimensional or performance condition rather than merely within the engineering tolerance, thereby providing significant value from this variation management.

It is not the intent of this paper to provide guidance on the identification and maintenance of Critical Characteristics and Key Characteristics. Rather it is to provide an understanding of the intent behind the classification of these two characteristics.

### Critical Characteristic - Definition

A Critical Characteristic is any feature throughout the life cycle of a Critical Safety Item, such as dimension, tolerance, finish, material or assembly, manufacturing or inspection process, operation, field maintenance, or depot overhaul requirement that if nonconforming, missing or degraded may cause the failure or malfunction of a Critical Safety Item. As used in this paper, the term "Critical Characteristic" is synonymous with "Critical Safety Characteristic" and "Flight Safety Characteristic."

### Critical Safety Item - Definition

A Critical Safety Item (CSI) is an item (part, assembly, installation, or production system) that, if missing or not conforming to the design data, quality requirements, or overhaul and maintenance documentation, would result in an unsafe condition per the established risk acceptance criteria. CSIs include items determined to be "life limited", "fracture critical", "fatigue sensitive", etc. The determining factor in CSIs is the consequence of failure, not the probability that the failure or consequence would occur. For the purpose of this paper "Critical Safety Item", "Flight Safety Critical Aircraft Part", "Flight Safety Part", "Flight Safety Critical Part" are all synonymous. The term Critical Safety Item is the encompassing term used throughout this paper.

### Key Characteristic - Definition

A Key Characteristic (KC) is a feature of a material, process, or part (includes assemblies) whose variation within the specified tolerance has a significant influence on product fit, performance, service life, or manufacturability.

### Identification and Maintenance of CSIs

The determination of a CSI and related Critical Characteristics is the responsibility of Engineering or Integrated Product Teams and is best accomplished during the design process, in association with system safety and system engineering activity. Preferably the Critical Characteristic(s) are identified on the drawing. Alternate methods of Critical Characteristic identification are implemented in accordance with approved documented processes.

Requests for a deviation or waiver of a Critical Characteristic's nonconformance must be reviewed and approved by personnel familiar with the criteria that resulted in the initial designation as a Critical Characteristic. Similar care must be exercised during the engineering change process to assure that the change does not adversely impact the design. Maintenance planning must assure that those servicing the product are aware of the Critical Characteristics.

The quality planning and/or inspection planning activity shall provide for the use of methods that provide assurance that the item conforms to the engineering requirements. This may involve inspection, testing and process control or a combination of these methods.

### Identification and Maintenance of Key Characteristics

A KC should be identified only after determining a significant benefit exists from controlling the characteristic to assure that the feature is at or very close to the specified dimension. Once a KC has been identified, variation management activities must be performed until the process or processes that influence that characteristic are in control and process capability ( $>1.33$  Cpk) has been established. Appropriate monitoring methodology is then implemented to assure continued performance.

### Economic Factors in Identification of Key Characteristics

Key Characteristics should not be used to classify those characteristics that are safety related or have a significant importance in being achieved, unless they also meet the definition for a KC. All drawing characteristics, specifications and customer requirements must be achieved. What differentiates KC's is the significant benefit when the characteristic is produced at the specified dimension rather than just within tolerance.

Examples of features that could qualify as a KC are bearing run out (where zero run out assures longer bearing life) and interference dimensions (such as when two parts are mated together). Users of the part in a higher-level assembly will identify many of the KCs. These users understand the few features that will have an economic benefit if the part is produced at or near the specified dimension. And in the case of product performance, engineering will make this identification.

Additional resources may be required to achieve and maintain the level of process capability required to assure that the part's characteristic is produced with minimum variation. For this reason the methods used for the identification of KCs should assure that the benefit obtained from this additional control exceeds the costs of the associated process control activity. Benefits could include easy in installation or assembly, improved performance or product life and ease in maintenance.

In some cases using an alternate design approach that accommodates the normal variation in the manufacturing process may eliminate the characteristic from being a KC. An example is the use of a slot to accommodate the variation in the location and/or diameter of a mating part. This may be less expensive than the use of variability reduction techniques.

### Conclusion

The identification of Critical Characteristics and KCs provide the producers and maintainers of these items with beneficial information. Each has a specific function and their use must not be confused. Critical Characteristics address product safety issues while KC's identify opportunities for improvement through the management of variation. Properly used both are cost-effective methods of ensuring product safety and quality.

### References:

Aerospace Standard AS9100 "Quality System - Aerospace – Model for Quality Assurance in design, development, Production, Installation and Servicing, Published by SAE, Warrendale, PA USA, 2001.

Aerospace Standard AS9103 "Variation Management of Key Characteristics, Published by SAE, Warrendale, PA USA, 2001.

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