Specialty Engine Components L.L.C. Quality Assurance Procedure
Key Characteristic Designation System

1. Purpose

The purpose of the Key Characteristic Designation System is:

- to identify characteristics which demand extra control because excessive variation may affect a products function, safety/compliance, or quality of a product
- to aid in the economical manufacture of quality parts
- to provide a uniform system for prioritizing product and characteristics
- to provide a framework for facilities simultaneous engineering, teamwork and cross functional involvement in product and process design, control methods, continuous improvement and variation reduction
- to provide a method of focusing SEC's technical and human resources on improvement activities that will add the most value to SEC products and improve customer satisfaction
- to provide insight to manufacturing and suppliers to the effects of variation on the product and customer satisfaction
- to provide information to develop designs and processes which are insensitive to variation.

2. Scope

This procedure serves as a guideline for applying the SEC Key Characteristic Designation System (KCDS). It shall be applied to product and process design, manufacturing and assembly processes and to suppliers of product, parts and processes to SEC used in the manufacture and distribution of SEC products.

The Key Characteristic Designation System procedure outlines a common system for the identification of Key Product Characteristics, as defined by the customer and/or SEC, and the related Key Control Characteristics as they apply to SEC products for the purpose of contributing to and prioritizing the continuous improvement and variation reduction efforts to achieve and drive customer satisfaction.

This document will be part of the SEC Quality Manuals. Periodic review and change will be handled within the same bounds as applies for the SEC Quality Manuals.

This system does not supersede or replace requirements outlined in QS-9000.

3. Responsibilities

- Product Engineering - Identify Key Product Characteristics.
- Manufacturing Engineering and Quality Engineering - Identify Key Control Characteristics and develop control plans and reaction plans.
- Manufacturing - Continuous improvement, variation reduction and control plan maintenance, on-

going review of Key product Characteristics and Key Control Characteristics

4. Definitions

Product Characteristic:

A product characteristic is a physical, chemical or visual characteristic of a final product or part and is specified on product documentation such as blueprints or standards. They are classified as either standard or Key Product Characteristics (KPC)

Examples: Lengths, diameters, torque, position, hardness, chemistry, color, finish, involute form, size, presence, etc.

Control (Process) Characteristic:

A control (process) characteristic is not specified on any final product documentation or blueprint. Process characteristics define the process that create the product and show up on: Tool and Operation sheets, in-process drawings, set up or operator instructions, control/reaction plans, process flow charts, etc. Control characteristics are process parameters, variable or attribute, which control or affect product characteristics. They are classified as either standard or Key Control Characteristics (KCC)

Examples: Feeds, speeds, in process dimensions (such as green sizes), Heat Treat time, Heat Treat temperature, quench oil temperature, tool change frequency, air pressure, gage replacement, tool geometry, tool regrind procedures, etc.

Standard Product Characteristics:

Reasonably anticipated variation of a standard product characteristic is not likely to significantly affect a product's fit/function, or safety/compliance. A standard product characteristic is not indicated with any special symbol on the blueprint.

Key Product Characteristic (KPC):

Reasonably anticipated variation of a Key Product Characteristic could significantly affect a products safety/compliance or is likely to significantly affect a products fit/function, or safety/compliance. A Fit/Function (F/F) KPC is indicated with a ◇ open diamond symbol on SEC drawings. A Safety/Compliance (S/C) KPC is indicated with an ▽ inverted delta symbol on SEC drawings. See table II-1 below for customer identified special characteristics and the SEC equivalent. KPCs require ongoing monitoring per an approved Part Control Plan.

Standard Control (Process) Characteristic:

A process parameter which controls or affects product characteristic(s).

Key Control (Process) Characteristic (KCC):

Is a process parameter for which variation must be controlled around a target value to ensure that

variation of a KPC is minimized or maintained around its target value. If a KCC is an in-process dimension, a u filled diamond symbol will be used on SEC in-process drawings to indicate statistical process control requirement. KCCs require ongoing monitoring per an approved Part Control Plan and should be considered as candidates for process improvement.

Reasonably Anticipated Variation:

This refers to the variation experienced in the everyday manufacturing or assembly processes. It is slightly broader than normal variation, however, the variation is not expected to be unlimited. The determination or perception of the level of reasonably anticipated variation is based on the application of usual and customary practices and controls for that particular process or part specification and generally does not include special assignable causes.

Significantly Affect:

This indicates that the affect of the variation should be significant or major for Key Product Characteristics. The effect should be applied to a customer satisfaction issue, rather than maintaining print specifications, since all print specifications need to be met. Severity of an occurrence or problem in relation to customer satisfaction needs to be accessed. For instance, a safety concern would weigh heavier than a decrease in product performance detectable only to very delicate measuring devices or trained evaluators under controlled conditions.

SAFETY AND/OR GOVERNMENT-REGULATED CHARACTERISTICS

Customer	Term	Symbol
Chrysler	Safety Item	Shield ( ) <S>*
Ford	Critical Characteristic	Inverted Delta (▽)
General Motors	Safety/Compliance Key Product Characteristic	Inverted Delta (⍒) <S/C> *
NVG	Safety/Compliance Key Product Characteristic	Inverted Delta (⍒) <S/C> *
SEC	Safety/Compliance Key Product Characteristic	Inverted Delta (▽) <S/C>*

- Alternate symbol for electronic transmission.

IMPORTANT PERFORMANCE, FIT, OR APPEARANCE CHARACTERISTICS

Customer	Term	Symbol
Chrysler	Critical Characteristic Critical Verification	Diamond (◇) <D> * Pentagon (⏢) <P> *
Ford	Significant Characteristic	None- Identified in Control Plan
General Motors	Fit/Function Key Product Characteristic	Diamond (◇) <F/F> *
NVG	Fit/Function Key Product Characteristic	Diamond (◇) <F/F> *
SEC	Fit/Function Key Product Characteristic	Diamond (◇) <D> * <F/F>*

* Alternate symbol for electronic transmission.

5. Identifying Key Product Characteristics

Customer identified special characteristics are shown on customer drawings. Refer to individual customer quality manuals and/or standards for additional information. The customer designated special characteristic will be used on all applicable documentation.

For SEC KPCs, a cross functional team is established consisting of (but not limited to) the following: Product Engineering (leader), Manufacturing Engineering, Quality Engineering, Customer Engineering, Manufacturing, Suppliers, Supplier Management & Development etc.

The role of the team is to review the product specifications and requirements and identify the Key Product Characteristics. Product Engineering should conduct a review prior to reviewing with the cross functional team to develop a list of potential or candidate Key Product Characteristics.

The following tools are used during the review and Key Product Characteristic identification process:

- past test data
- QFD
- Product Benchmarking
- blueprints and standards
- PFMEA (Potential Failure Mode and Effects Analysis)
- past part quality history
- team input/consensus
- product evaluation experience
- design of experiments
- process capability information

The following criteria should be used in KPC selection.

1) A KPC is a product characteristic for which reasonably anticipated variation could significantly affect a product's safety/compliance, or is likely to significantly affect customer satisfaction with the product.

And/or

2) A KPC is a characteristic that is particularly significant to the part performing its function and warrants additional control and/or capability studies and on going control because the effects of manufacturing variations are significant.

And/or

3) A KPC is a characteristic in which reduction of variation around a target value is likely to improve quality, increase customer satisfaction and/or reduce cost.

And/or

4) A KPC is a characteristic traceable back to design/performance requirements.

The following guidelines apply in identifying KPCs:

- A product characteristic should not be designated a KPC to ensure the part is made to print, since all parts must meet print specifications.
- A KPC may be a variable or an attribute characteristic. Attribute characteristics could be go/no-go, part/feature presence, etc.
- KPCs should be identified such that they add to the total quality of the component and increase customer satisfaction.
- Over application of KPCs should be avoided since one of the goals of the Key Characteristic Designation System is to aid in the economical manufacture of quality parts.
- The team approach should be use for the proper identification of KPCs. There should be a team consensus to make a characteristic a KPC. Consideration for manufacturing concerns should be given during the review whenever possible.
- Customer indicated critical characteristics shall not be revised without customer concurrence. Whenever possible, the customer should be part of the cross functional review of the requirements. Special customer requirements for the control of these items should be covered in the control plan.
- Suppliers should be invited to participate in the team review whenever possible.
- Variable characteristics should be chosen over attribute characteristics. If an attribute characteristic is chosen, the method of control should be evaluated carefully and the capability defined. Error proofing should be considered where practical.
- KPCs may change over time as a result of product or process changes, or tests that may establish that the chosen KPC may not have been correct.
- Standard or common KPC selection should be considered on similar parts or assemblies, particularly on parts produced by similar processes or utilize shared features.

6. Identifying Key Control Characteristics

After KPCs are identified, the lead role of the Key Characteristic Designation System process is taken over by Manufacturing Engineering and Quality Engineering. Key Control Characteristics are identified and documentation requirements for the control plan and reaction plan are generated. A cross functional review is used in determining KPCs. As with KPCs, KCCs have certain tests to help determine if a control characteristic is a KCC or not:

The following tests should be used in consideration of a characteristic as a KCC.

1) A KCC is a process parameter in which variation must be controlled around a target value to ensure that variation of a KPC is maintained around its target value. The KCC is used to adjust the KPC to its target value.

And/or

2) A KCC is a process parameter for which variation reduction will reduce variation of a KPC.

And/or

3) It is directly traceable to a KPC. (examples - KPC - final PD size, KCC - green PD size)

And/or

4) It is particularly significant to assuring a KPC achieves its target value.

The following guidelines apply in identifying KCCs:

- A KCC can be either a variable or attribute process parameter
- KCCs and other process parameters are (generally) not shown on any final product documentation or blueprint. A u filled diamond symbol will be used on SEC in-process drawings to indicate statistical process control requirement. The letters KCC or <D> should be used where appropriate as identification on written documents.
- KCCs shall be shown on:
  - Control plans
  - Process sheets
  - Reaction plans
  - In-Process drawings
  - Operator instructions
  - Relevant Inspection instructions
  - Operation and tool sheets
- KCCs are related to KPC, KCCs should not be specified for standard product characteristics.
- The following tools should also be considered in determining KCC's:

- List of KPCs	- Heat treat studies
- PFMEA	- Tool and operation sheets
- Process Flow diagram	- Failure root cause analysis
- Control Plan	- Cause and Effect (Fish Bone) Diagrams

- QFD	- Design of Experiments
- FMA (Failure Mode Analysis)	- Team input
- Process capability information	

7. Control Plan and Reaction Plan

Product control plans shall be maintained and documented as indicated in the AIAG Advanced Product Quality Planning and Control Plan Reference Manual (APQP) KPCs shall be included in the control plan and reaction plans should be drawn up for processes with KPCs. The control plan should outline control and verification steps for KCCs and should be done in accordance with APQP. (Refer to AIAG APQP manual and QS-9000 for more specific control plan requirements for KPCs and all other print specifications).

8. Continuous Improvement and Variation Reduction

The Key Characteristic Designation System is an evolutionary process which requires continual review and allows change as processes develop and improve. Under standard and usual practices, systems are in place to maintain all print characteristics within specification and the appropriate methods of control are applied on them. Since the Key Characteristic Designation System requires that KPCs need additional care, additional resources are allocated to study KPCs and KCCs and to implement variation reduction actions as part of the continuous improvement process.

9. Control Requirements for KPCs and KCCs

Appropriate Control Method Application:

Under the Key Characteristic Designation System and QS-9000, it is expected that all part features are maintained within print specification and that the appropriate control method and process have been chosen for that particular characteristic. This applies equally for Standard and Key Characteristics (product and process). Preventions, precautions and error proofing still need to be applied smartly and appropriately on all characteristics. Any changes in control methods, such as removing SPC or reducing sampling frequency, should be done only after confirming that a stable, predictable and in-control process exists. The decision on the change should be reviewed with the appropriate Quality and Engineering function to review the data. Changes in control methods or processes fall under approval restrictions and procedures outlined in PPAP, SEC Quality Manuals and QS-9000. Over control of processes adds costs and could have quality implications that add cost that may have been prevented by applying appropriate control method.

Quality Requirements:

By nature and definition, KPC's are characteristics which demand improvement since variation reduction would provide significant benefits to customer satisfaction. As outlined in QS-9000, capability targets for KPCs of C_{pk} >1.33 and P_{pk} >1.67 apply for variable characteristics and the

prescribed acceptability for attribute characteristics is zero defects. Processes shall be designed and maintained to remain stable and in control. Standard corrective action and reaction procedures apply for all non conformances or out of control or instable processes. In addition, continuous improvement is necessary on all aspects of the design, processes and systems aspect of the business and product. KPCs and KCCs require additional resources and attention to facilitate variation reduction and continuous improvement. Additional requirements and expectations apply as follows:

Standard Care:

Standard care is conformance to usual and customary practice and to ensure conformance to requirements. Standard care also includes continuous improvement, as all organizations need to continuously improve to keep up with the demands and changes of the marketplace. Standard care applies to the provisions in SEC Supplier Development Manual, PPAP, APQP, SEC Quality Manuals, SEC Engineering Manuals, and QS-9000. Standard care applies to all characteristics and processes, both Key and standard.

Usual and Customary Care:

Usual and customary care includes accepted practices, procedures, and systems such as:

- Gage maintenance, certification, control and calibration programs
- Preventative and planned maintenance
- Operator training
- Utilize Advanced Product Quality Planning (APQP)
- Process qualification and audit systems (machine runoffs, audit, setup approvals etc. ...) this includes systems to assure that processes are capable to produce the parts within specification consistently.
- Engineering change control and implementation systems
- PPAP (Production Part Approval Process)
- Purchase part and process quality assurance
- Measurement and assessment systems
- Material control and identification systems
- Nonconformance identification, containment, disposition and corrective action systems.
- Systems to ensure adherence to procedures
- Quality and Engineering procedures
- Record control and retention systems

Additional Care:

Additional care applies to all KPC's, Both Fit / Function and Safety / Compliance. Additional care includes all the provisions under standard care and usual and customary care, however includes the following additional factors:

- Process review and KCC identification
- Process flow diagrams and control plan development
- Ensuring process in-control and stability
- Ensure conformance to target and variation reduction

Special Care:

Special care applies to Safety / Compliance KPC's only and special care requirements are in addition to standard and additional care that should be applied to these characteristics. Special care includes:

- Communication of non-conformance of material/product
- Implementation of containment on the nonconforming material
- Provide documentation and retention requirements

These reporting and containment requirements can be found in more detail in the SEC Quality Manual.

Due Care:

Due care applies to SEC, Customers and Supplier Employees. Due care is what the knowledgeable and responsible person would do to assure that products are designed and manufactured in compliance with applicable governmental standards and regulations.

10. SEC Manufacturing Requirements

Requirements for SEC manufactured parts and processes are as outlined in this document and include the following: (These requirements apply in addition to and in accordance with individual customer requirements and the requirements outlined in QS-9000 and PPAP)

- Except in the case of increase in control, approval of process and/or control method change must be obtained prior to implementation.
- The request for Control and Process change should be submitted with the following:
  - Updated control plan
  - Current and past capability data to support the requested change
  - New machine capability (if applicable)
  - Background information and justification for the change
- Demonstration of Capability on all characteristics.
- Monthly reporting and maintenance of process data and capabilities on KPCs.
- Retention of KPC capability data for 2 years
- Tracking of variation reduction on KPCs and KCCs
- Variation reduction and continuous improvement projects on KPCs and KCCs in addition to continuous improvement programs required in QS-9000.

11. Related Documents

QS-9000
Quality System, QAP 4.2.3
SEC - Quality Manuals
SEC - *Supplier Quality Development Manual - SQD-9000*
AIAG- Potential Failure Mode Effects Analysis (PFMEA)
AIAG - Statistical Process Control (SPC)
AIAG - Production Part Approval Process (PPAP)
AIAG - Advanced Product Quality Planning and Control Plan

Change Record

Rev	Date	Reviewed by:	Approved by:	Description of Change
I	05/01/03	Steve Brown	Bob Eakin	All references to W. A. Thomas Company removed and replaced with Specialty Engine Components L.L.C.
H	5/14/02	Bob LaVoie	Bob Eakin	**changed Footer :removed NOTE: The Corporate Quality Departmanet ~~Managers at each facility have~~ has the only printed controlled copy ~~copies~~ of this document (logo in Blue), all other documents appearing in paper form are not controlled.**
G	05/01/02	Bob LaVoie	Bob Eakin	**NOTE: The Corporate Quality Departmanet ~~Managers at each facility have~~ has the only printed controlled copy ~~copies~~ of this document**
F	1/7/02	Bob LaVoie	Bob Eakin	Formatted for staroffice conversion – no procedural change