STANDARDIZED PRODUCT CHARACTERISTICS

A Critical Knot on the Digital Thread

Mark Nielsen
Curtis Brown

20190402
Presenting Today

• Mark Nielsen
  TechAzul
  Manhattan Beach, CA

• Curtis W. Brown
  Honeywell FM&T *
  Kansas City, MO

* The Department of Energy’s Kansas City National Security Campus is operated and managed by Honeywell Federal Manufacturing & Technologies, LLC under contract number DE-NA0002839
Model-Based Quality Statement

• **Product acceptance** from a Model Based Definition (MBD) has been one of the **primary inhibitors** for moving towards Model-Based Enterprise (MBE) implementation!

• Assurance that product **acceptance** can be performed from an **authorized part defining model** is a critical driver toward achieving maximum MBE return on investment!

• The Model is the master authoritative definition of data: **Legally & Functionally**

• Determining an end-to-end model-based quality solution including **persistent product characteristics** will enable the **manufacturing quality** function to **become a primary advocate for MBE**!
Terminology

• Various terminology use in industry
  • Process related
  • Manufacturing related
  • Safety / Use / Regulatory related
Variety of Symbols used on Drawings across Industries

Letters Describe Criticality Area
- S  Safety
- P  Performance
- D  Design
- E  Engineering
- F  Fit
- A  Appearance
- M  Manufacturing
- P  Process
- A  Assembly
- Q  Quality
- R  Regulatory
- T  Test
Looking upstream and downstream of characteristic

- Other important information related to symbology NOT readily available:

**Source of Characteristic & Reporting recipient**
- Prime Contractor
- Prime Vendor
- Customer
- Engineering
- Manufacturing Group

**Product Development State**
- Tooling Inspection
- First Article Inspection
- Production

**Inspection Frequency & Applicability**
- Initial FAI
- Every part
  - Serialized
- Lot Sample
- In process
  - SPC Statistical Ctrl

Who's driving this? When does it apply? What do we need to do?
Currently used symbology

- S
- R
- P
- M
- Q
- E
- K-1
- CTQ
- CTQ
- 103
Symbols Specify Feature Criticality

- **Product**
  - Definition
  - Realization
  - Acceptance

- **Communicates:**
  - Manufacturing
  - Inspection
  - Quality
  - Support / Field Service
Symbols Specify Feature Criticality

- **Product**
  - Definition
  - Realization
  - Acceptance

- **Communicates:**
  - Manufacturing
  - Inspection
  - Quality
  - Support / Field Service
Lexicon - Important Terms and Definitions

• **Product Characteristic**: a tolerance or specification applied to a feature or product that requires verification.

• **Key Characteristic**: a product characteristic that exists because of a product requirement.

• **Critical Characteristic**: a product characteristic that has a criticality designation associated with it.

• **Usability**:
  - human readable unique for part,
  - computer readable universally unique
Lexicon - Important Terms and Definitions

• Product Characteristic:
• A tolerance or specification applied to a feature or product that requires verification
  - Dimensional Tolerance
  - Geometric Tolerance
  - Dimension & Tolerance (shown or block)
  - General Note
  - Flag Note
  - Symbol or Surface Finish
• Does NOT include
  - Basic Dimension
  - Reference Dimensions
Bill of Characteristics (BoC)

<Characteristics>
  <CharacteristicDefinitions>
    <DiameterCharacteristicDefinition id="10">
      <Tolerance>
        <MaxValue>0.1</MaxValue>
        <MinValue>-0.1</MinValue>
      </Tolerance>
    </DiameterCharacteristicDefinition>
  </CharacteristicDefinitions>
  <CharacteristicItems>
    <DiameterCharacteristicItem id="12">
      <Name>Sized +/- 0.1</Name>
      <QPId>651aded1-ff04-498a-968e-044147a2906d</QPId>
    </DiameterCharacteristicItem>
  </CharacteristicItems>
</Characteristics>
What makes a good product characteristic symbol?

Critical elements for a characteristic symbol

1. Symbol must be a recognizable unique shape
2. Symbol must be easily creatable using existing office/CAD tools
3. Symbol must be able to contain large alpha numeric identifiers
4. Symbol must not conflict with other symbols in related ASME / ISO standards
5. Symbol can be easily associated to an annotation (DimTol, GeomTol, Surface Finish, General Note, Flagged Note)
6. Symbol must be able to accommodate a Criticality Symbol before or after
7. Symbol can be chained with one or more Product Requirement Symbols
8. Symbol must be easily created in an ASCII text field
9. Symbol must be applicable for both 2D drawings and 3D MBDs
10. …..others?
Candidate Symbol Shapes

• Must look unique
  - Normal aspect ratio
  - Elongated aspect

• Not conflict with other standard shapes
  - Balloons (Item Numbers)
  - Flag notes
  - Callouts

• Symbols should integrate
  - Inspection Balloons (Drawing)
  - Inspection Tags (3D MBD Model)
  - Control Characteristics
  - Requirements

ASME: ±T<sub>MP</sub> <sup>TM</sup>
© TechAzul
Proposed Symbology

• Product Characteristic <PC007>  
  - Unique to each entity
    - Geometric, Dimensional tolerances, Notes, Surfaces Finishes, etc

• Criticality < S <  
  - Defined by company business practices
    - Examples
      - S for Safety
      - M Manufacturing
      - R regulatory

• Product Requirement >REQ-MD-44>  
  Forward Chevron
What makes a good product characteristic symbol?

**Key Criteria for a characteristic symbol**

1. Symbol must be a recognizable unique shape
2. Symbol must be easily creatable using existing office/CAD tools
3. Symbol must be able to contain large alpha numeric identifiers
4. Symbol must not conflict with other symbols in related ASME / ISO standards
5. Symbol can be easily associated to an annotation (DimTol, GeomTol, Surface Finish, General Note, Flagged Note)
6. Symbol must be able to accommodate a Criticality Symbol before or after
7. Symbol can be chained with one or more Product Requirement Symbols
8. Symbol must be easily created in an ASCII text field
9. Symbol must be applicable for both 2D drawings and 3D MBDs
10. …..others?
Model-Based Product Characteristics (MBPC):

- Symbolic Form

S<PC007>REQ-MD-44
Model-Based Product Characteristics (MBPC):

- Symbolic Form

PC007 REQ-ME-29

S

PC006

REQ-ME-29

3 SURFACES

\( \phi 5.435 \pm .001 \)

\( \phi .005 \)

S

PC005

D

A

CM

B

PC013

PC014

PC015

PC016

\( \phi .641 \pm .003 \)

2.750 \( \pm .015 \)

DO NOT BREAK THRU

TechAzul
Digital Thread Opportunities

• Allows traceability back to common product characteristic number
• These are an enabler to study critical product characteristics
• Examples
  - Criticality
  - Product requirement
  - Inspection method
  - RPN risk priority number
  - Producibility Rating
  - Histogram of manufacturing capability
  - Process capability number
  - Drill down from numerous data points to specific data item

TechAzul
Model-Based Product Characteristics (MBPC):

• Textual Form

\(<S<<PC007>>REQ-MD-44>\)
MBPC Enables Measurement Results Traceable to Model

- Model-Based Product Characteristics (MBPC):
  - Define Product Characteristics on Model
  - Show human-readable identifier unique for part
  - Tag machine-readable universal unique identifier
  - Link Criticality Designation

TechAzul
Take Aways

• Product acceptance from MBD is a primary inhibitor toward MBE implementation
• Assurance that product acceptance from a MBD is a critical driver toward achieving maximum MBE ROI
• Quality can become a primary advocate for MBE.
• It starts at the **MBD and with Model-Based Product Characteristics**
• Opportunity:
  - Industry has multiple definitions and representations of “characteristics”
  - Need a common standard approach for Product Characteristics
    - Lexicon
    - Human-Readable Symbology
    - Digital Persistent Identification
    - Model-Based
Thank you

• Mark Nielsen
• mark@techazul.com

• Curtis W. Brown
• cbrown@kcp.com