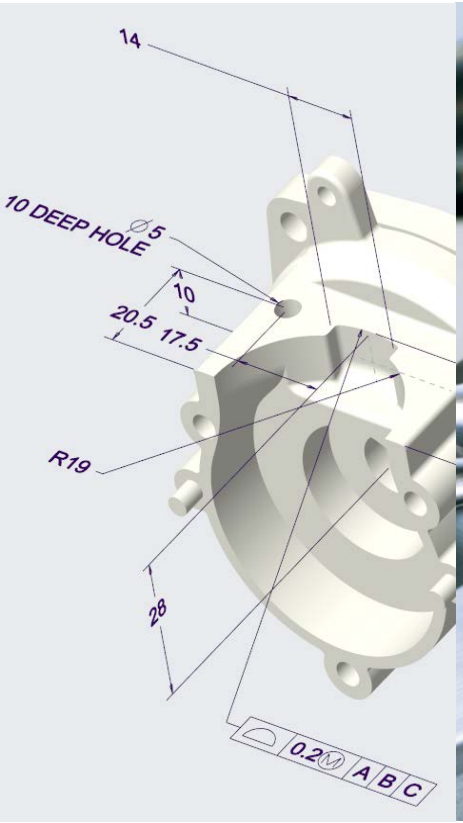

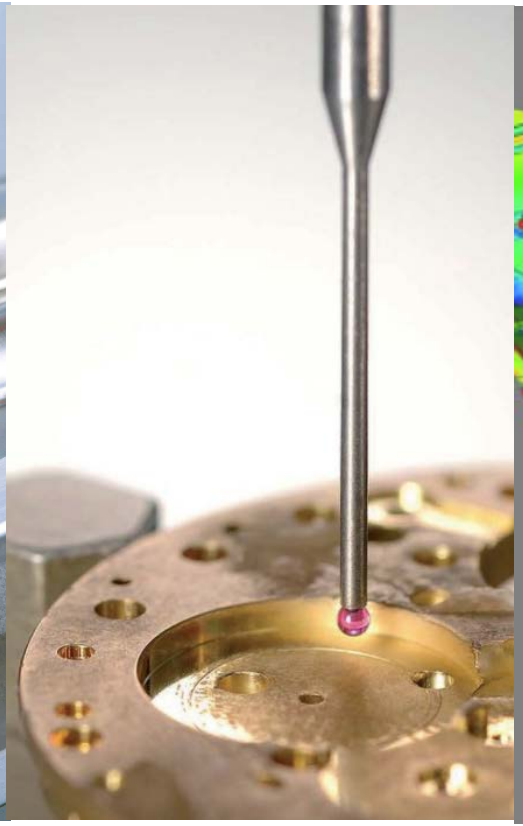

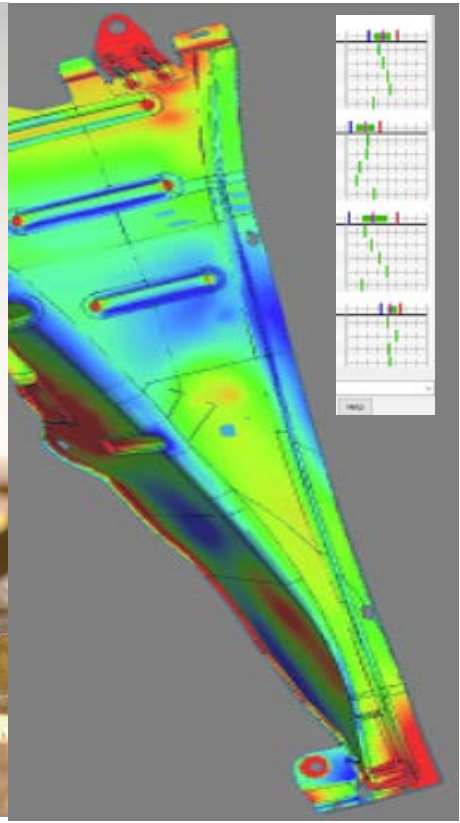

Mark Nielsen
Curtis Brown

MODEL-BASED PRODUCT CHARACTERISTICS

Enabling Metrology and Model-Based Enterprise

20180330

Presenting Today

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* 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!

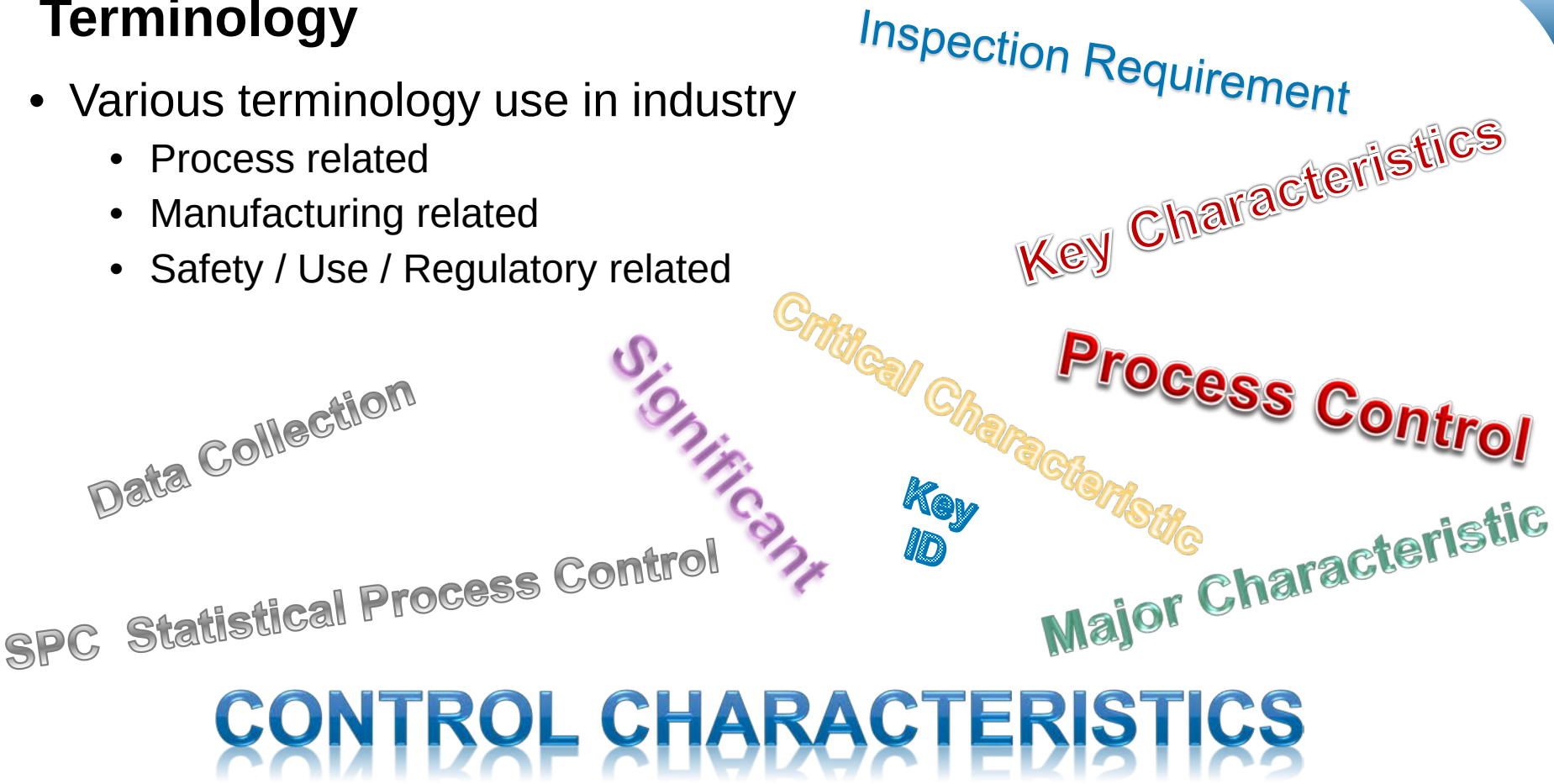
- Assurance that product **acceptance** can be performed from an **authorized part defining model** is a critical driver toward achieving **maximum MBE return on investment**!

- 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



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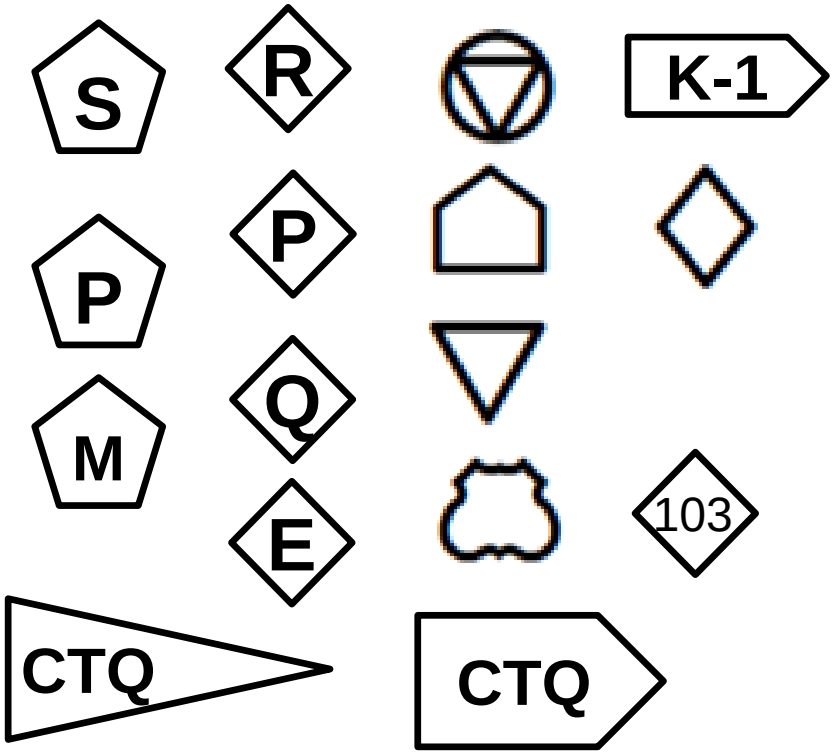
Variety of Symbols used on Drawings across Industries



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

Inspection Frequency & Applicability

- First Article Insp
- Tooling Inspection
- Production
- Lot Sample
- SPC Statistical Ctrl

Should there be a move to Standardize Letters & Applicability?

Symbols Specify Feature Criticality

- Product
  - Definition
  - Realization
  - Acceptance
- Communicates:
  - Manufacturing
  - Inspection
  - Quality
  - Support / Field Service

AS/EN/SJAC 9102 Rev A First Article Inspection
Form 1: Part Number Accountability

Sheet 1 of _

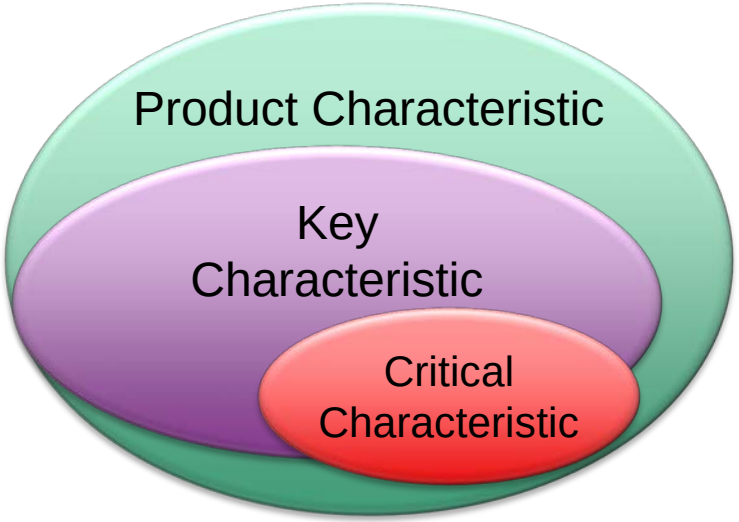
1. Part Number	2. Part Name	3. Serial Number	4. FAI Report Number
5. Part Revision Level	6. Drawing Number	7. Drawing revision level	8. Additional Changes
9. Manufacturing Process Reference	10. Organization Name	11. Supplier Code	12. P.O. Number
13. Detail FAI ☐ Assembly FAI ☐	14. Full FAI ☐ Partial FAI ☐ Reason for Partial FAI:	Baseline Part Number including revision level	
a) if above part number is a detail part only, go to Field 19 b) if above part number is an assembly, go to the "INDEX" section below.			
INDEX of part numbers or sub-assembly numbers required to make the assembly noted above.			
15. Part Number	16. Part Name	17. Part Serial Number	18. FAI Report Number

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.

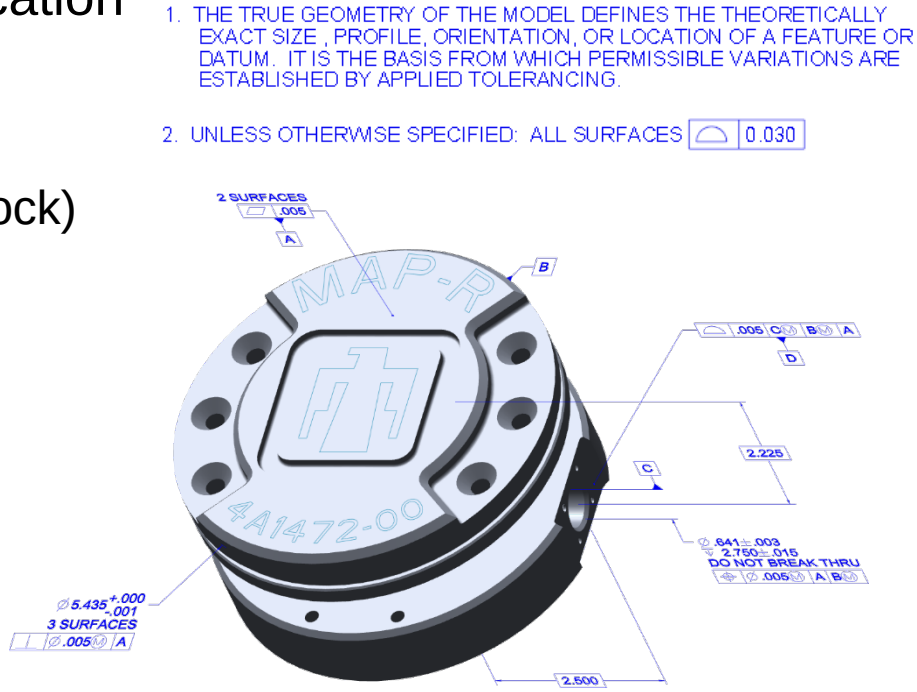
- **Critical Characteristic:** a product characteristic that has a criticality designation associated with it.



- **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



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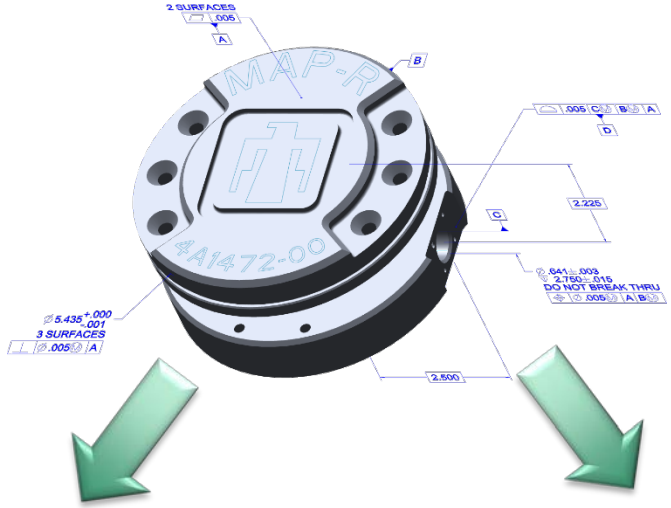
Bill of Characteristics (BoC)



Human Readable

Machine Readable

Balloon #	Char #	Char Z...	Qty	Type	Sub-Type	Units	Upper Limit	Lower Limit
10	10		1	Dimension	Linear Dimension	in	0.270	0.230
11	11		1	Dimension	Linear Dimension	in	2.895	2.855
12	12		1	Dimension	Linear Dimension	in	3.209	3.202

```
<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-044147a2506d</QPId>
      <ProductCharacteristic>
```

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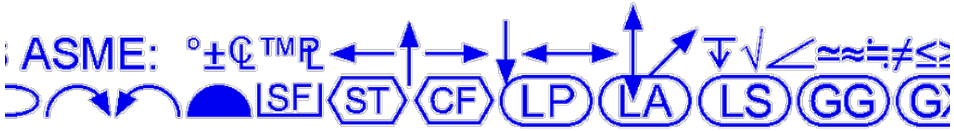
What makes a good product characteristic symbol?

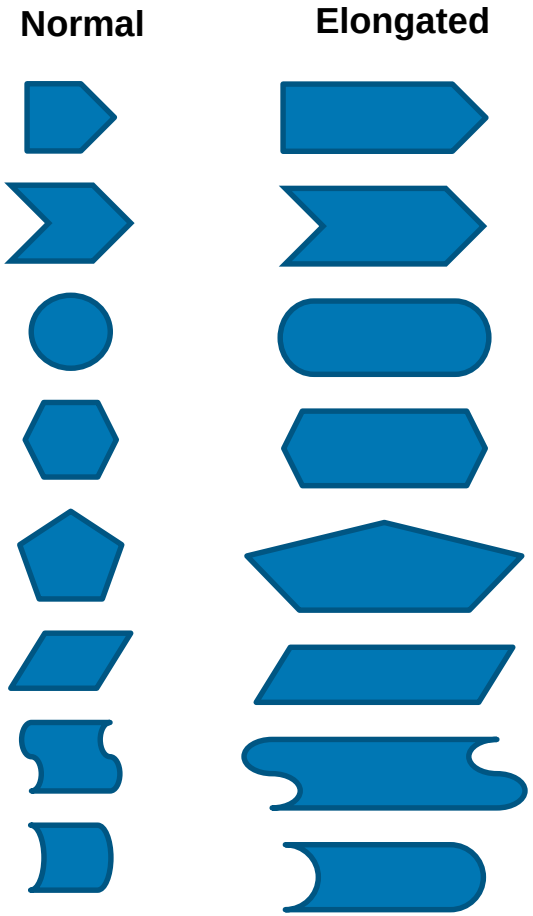
Critical elements for a characteristic symbol

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





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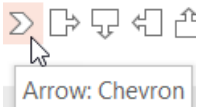
Proposed Symbology

- Product Characteristic <PC007> PC007

Elongated Hexagon

  - Unique to each entity
    - Geometric, Dimensional tolerances, Notes, Surfaces Finishes, etc
- Criticality < S < S



Backward Chevron

  - Defined by company business practices
  - Examples
    - S for Safety
    - M Manufacturing
    - R regulatory
- Product Requirement >REQ-MD-44> 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)
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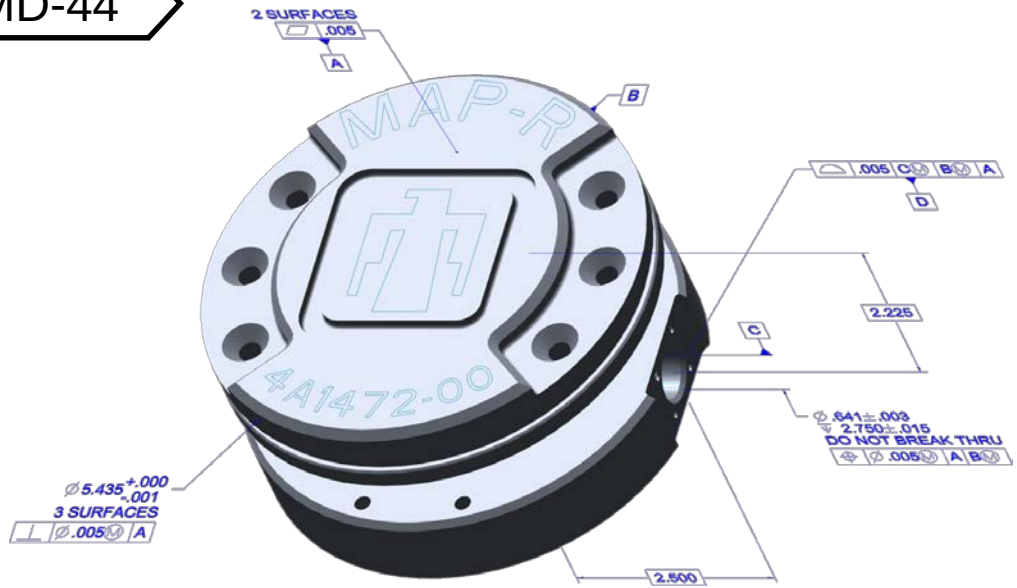
8. Symbol must be easily created in an ASCII text field
9. Symbol must be applicable for both 2D drawings and 3D MBDs
10. …..others?

<S<<PC007>>REQ-ME-29 >

Model-Based Product Characteristics (MBPC):

- Symbolic Form

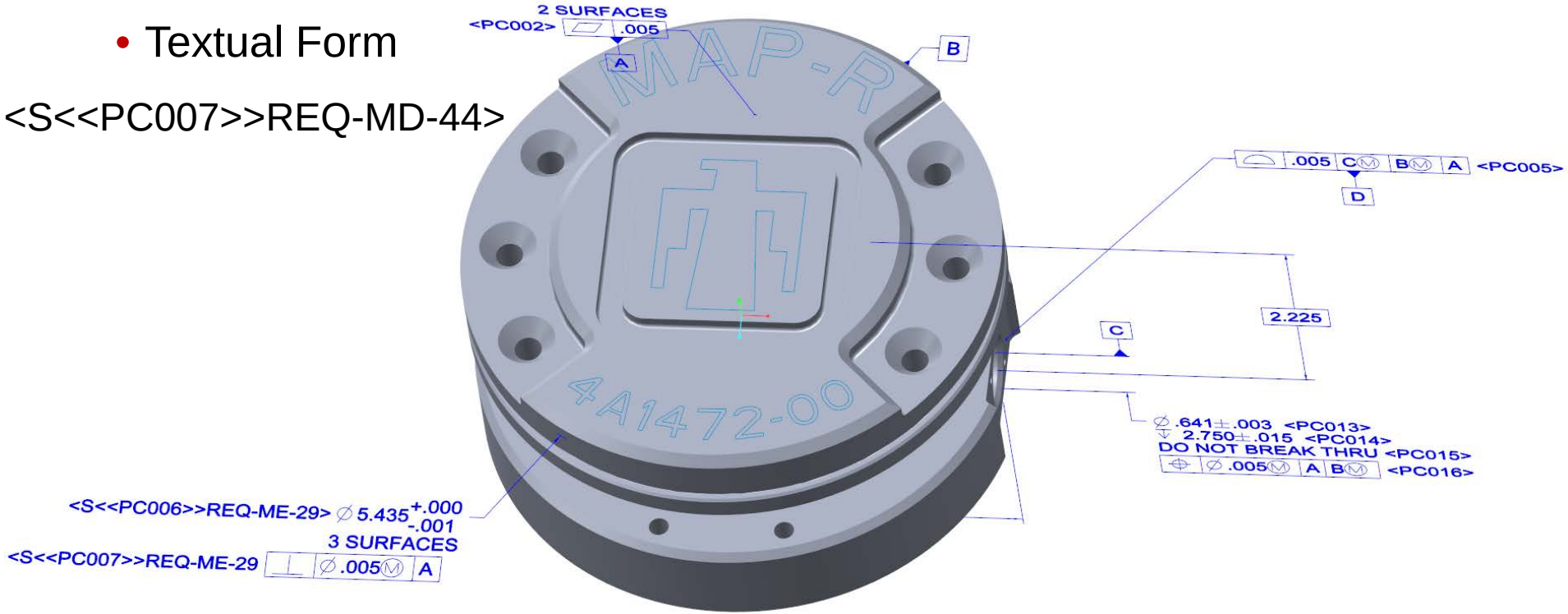
S | PC007 | REQ-MD-44



Model-Based Product Characteristics (MBPC):

- Textual Form

<S<<PC007>>REQ-MD-44>



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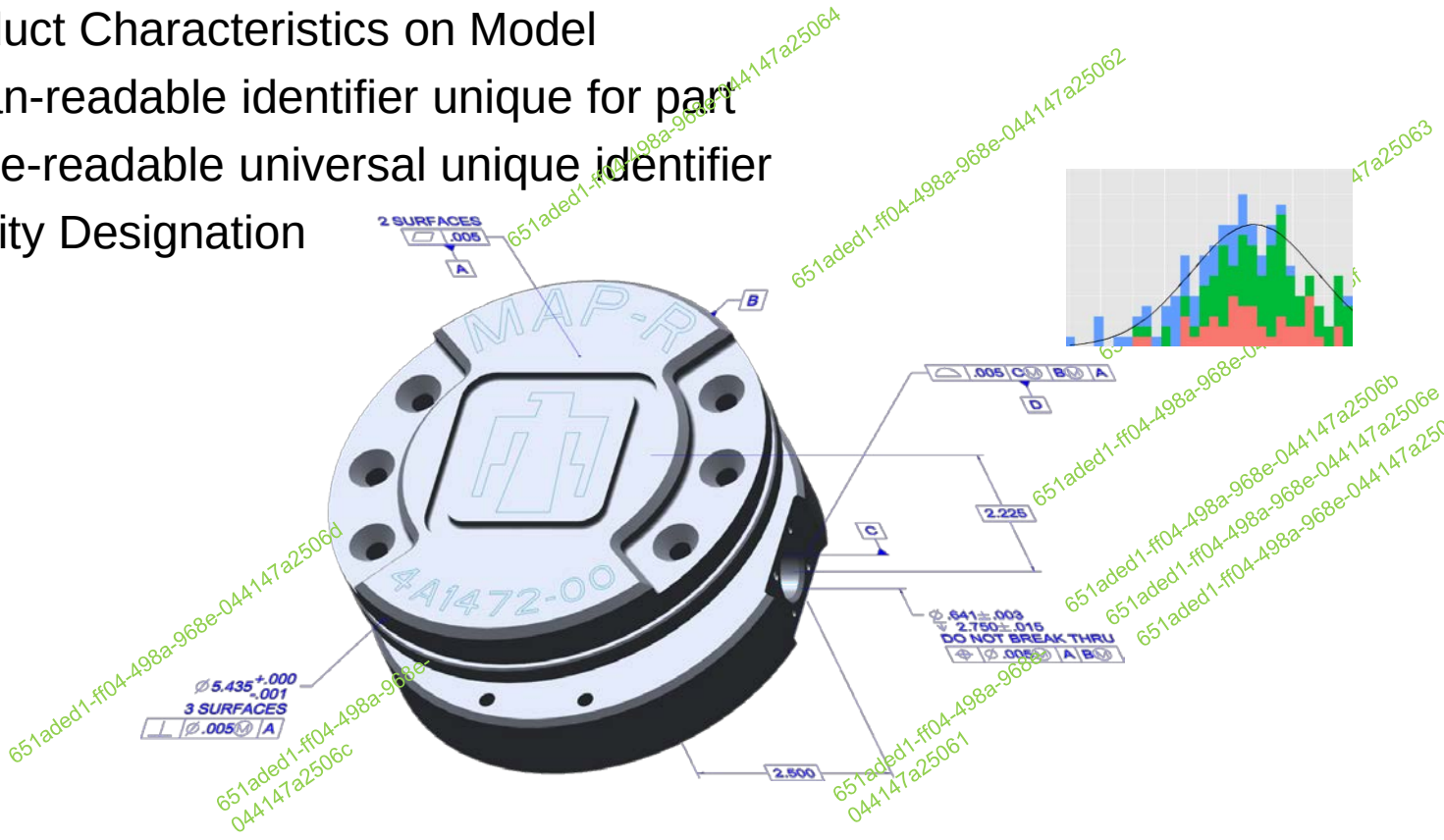
MBPC Enables Measurement Results Traceable to Model

- 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



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Take A Ways

- 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

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