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STANDARDIZED PRODUCT CHARACTERISTICS

A Critical Knot on the Digital Thread

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Presenting Today

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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

Inspection Requirement

Key Characteristics

Process Control

Critical Characteristic

Major Characteristic

Significant

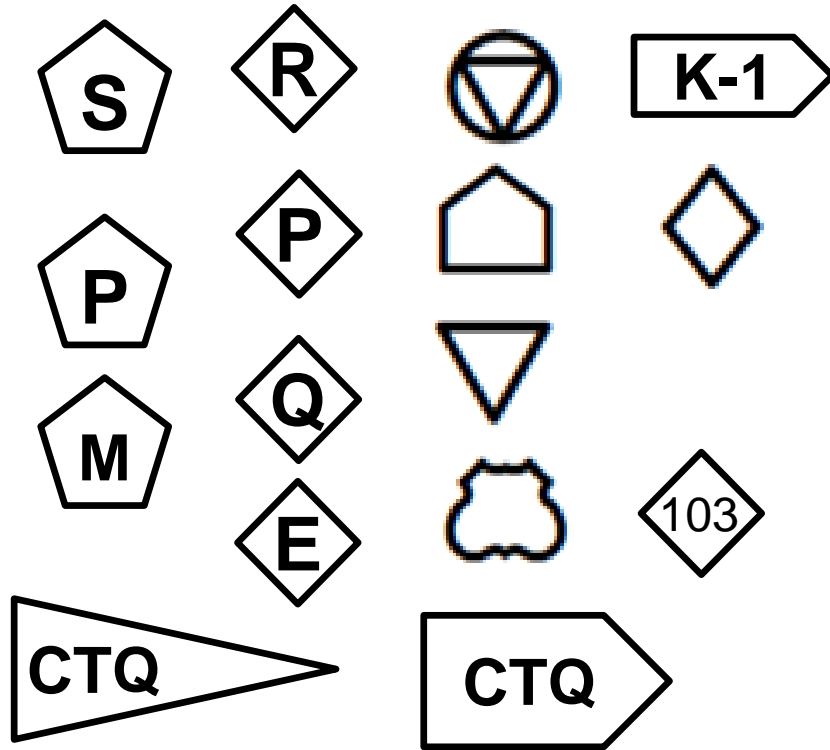
Key ID

Data Collection

SPC Statistical Process Control

CONTROL CHARACTERISTICS

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

Who's driving this?

Product Development State

- Tooling Inspection
- First Article Inspection
- Production

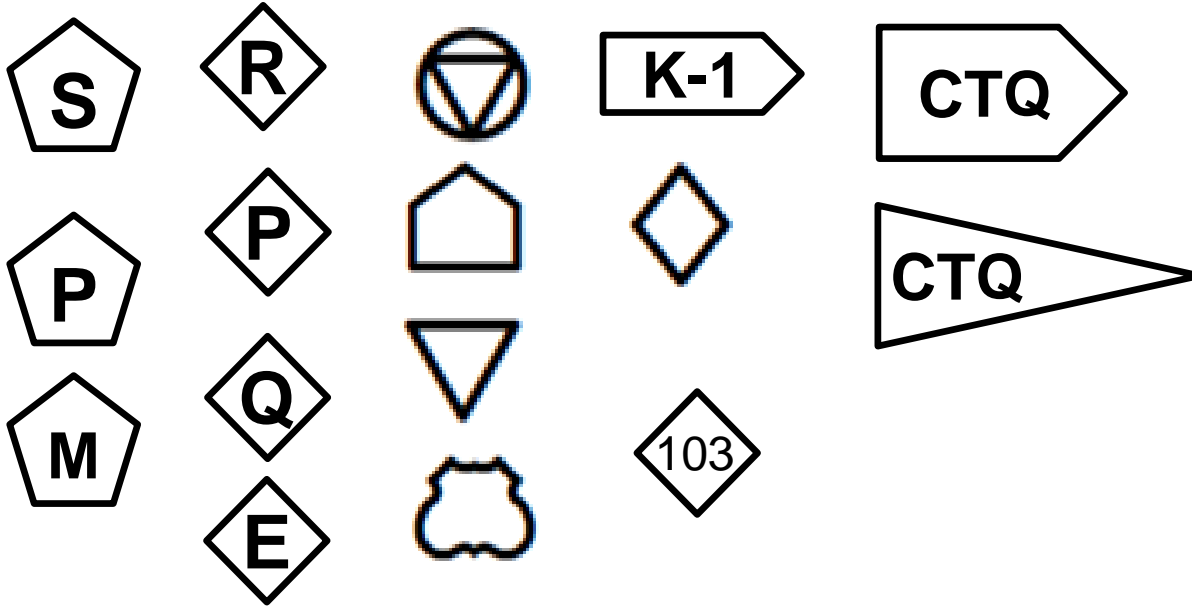
When does it apply?

Inspection Frequency & Applicability

- Initial FAI
- Every part
 - Serialized
- Lot Sample
- In process
 - SPC Statistical Ctrl

What do we need to do?

Currently used symbology



Symbols Specify Feature Criticality

- Product

- Definition
- Realization
- Acceptance

- Communicates:

- Manufacturing
- Inspection
- Quality
- Support / Field Service

SAE AS9102 First Article Inspection (Rev. B) Sheet **1** of **27**

Form 1: Part Number Accountability

1. Part Number	2. Part Name	3. Serial Number	4. FAI Report Number
	ENGINE_BLOCK_FRONT	N/A	N/A

5. Part Revision Level
N/A

9. Manufacturing Process

SAE AS9102 First Article Inspection (Rev. B) Sheet **3** of **27**

Form 3: Characteristic Accountability, Verification, and Compatibility Evaluation

1. Part Number		2. Part Name		3. Serial Number	4. FAI Report		
		ENGINE_BLOCK_FRONT		N/A	N/A		
Characteristic Accountability				Inspection / Test Results			
5. Char. Num.	6. Reference Location	7. Characteristic Designator	8. Requirement	9. Results	10. Designed Tooling/Gauging used to accept product	11. Non-Conformance Number	14. Comments Related To This Requirement Or Result
2	1_MAP	N/A	7E ROUNDS		N/A	N/A	
3	1_MAP	N/A	7B MOTOR INTERFACE		N/A	N/A	
4	1_MAP	N/A	7C INDEX HOLE		N/A	N/A	
5	1_MAP	N/A	7D INDEX TAB DETAILS		N/A	N/A	
6	1_MAP	N/A	2 GENERAL INFORMATION		N/A	N/A	
7	1_MAP	N/A	3 PROPERTIES		N/A	N/A	
8	1_MAP	N/A	4 NOTES		N/A	N/A	
9	1_MAP	N/A	5 GD&T DATUMS		N/A	N/A	
10	1_MAP	N/A	6 CHANGE REVISION		N/A	N/A	
11	1_MAP	N/A	8 FINISHES		N/A	N/A	
12	1_MAP	N/A	8 RENDER PRODUCTION		N/A	N/A	
13	1_MAP	N/A	9 TEST LOCATIONS		N/A	N/A	
14	1_MAP	N/A	7A TRANSMISSION INTERFACE		N/A	N/A	

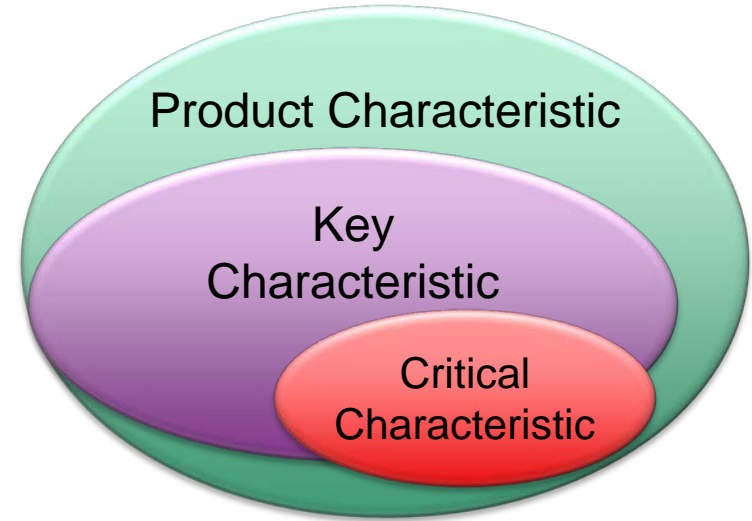
13. Detail FAI Assembly FAI
a) If above part number is INDEX of part number
b) If above part number is INDEX of part number

4. FAI Report M
N/A

LOCATIONS
A [A] B [B]

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

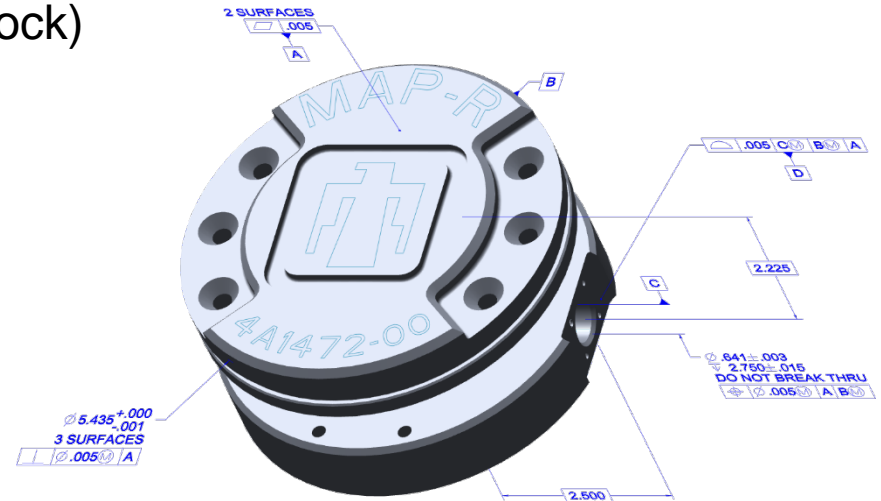


Lexicon - Important Terms and Definitions

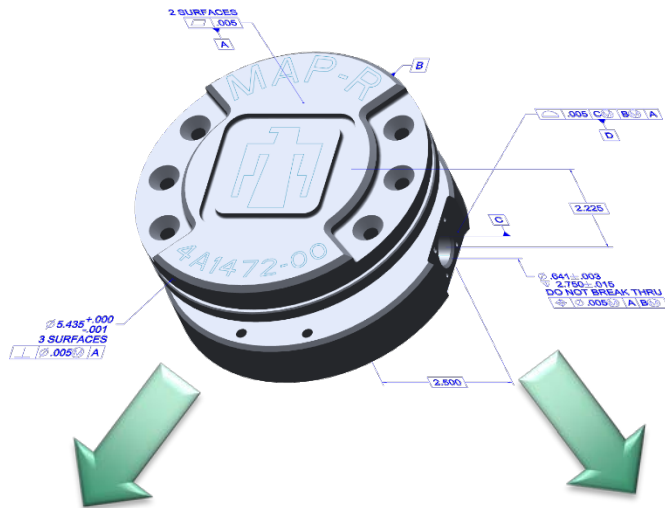
- **Product Characteristic:**
- A tolerance or specification applied to a feature or product that requires verification
 - Dimensional Tolerance
 - Geometric Tolerance
 - Dimension & Tolerance (shown or block)
 - General Note
 - Flag Note
 - Symbol or Surface Finish
- Does NOT include
 - Basic Dimension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

1. THE TRUE GEOMETRY OF THE MODEL DEFINES THE THEORETICALLY EXACT SIZE, PROFILE, ORIENTATION, OR LOCATION OF A FEATURE OR DATUM. IT IS THE BASIS FROM WHICH PERMISSIBLE VARIATIONS ARE ESTABLISHED BY APPLIED TOLERANCING.

2. UNLESS OTHERWISE SPECIFIED: ALL SURFACES  0.030



Bill of Characteristics (BoC)



Human
Readable

Machine
Readable

Bill of Material	Specifications	Bill of Characteristics						
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>

<ProductCharacteristics>



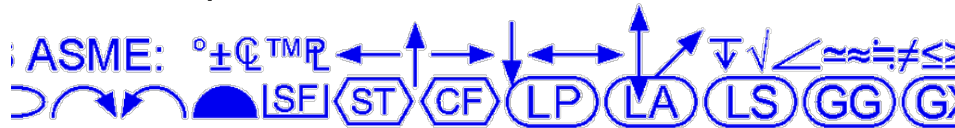
What makes a good product characteristic symbol?

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






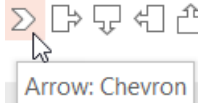
Normal


Elongated



Proposed Symbology






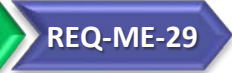

- Product Characteristic <PC007>   Elongated Hexagon
 - Unique to each entity
 - Geometric, Dimensional tolerances, Notes, Surfaces Finishes, etc

- Criticality < S <   Backward Chevron
 - 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?

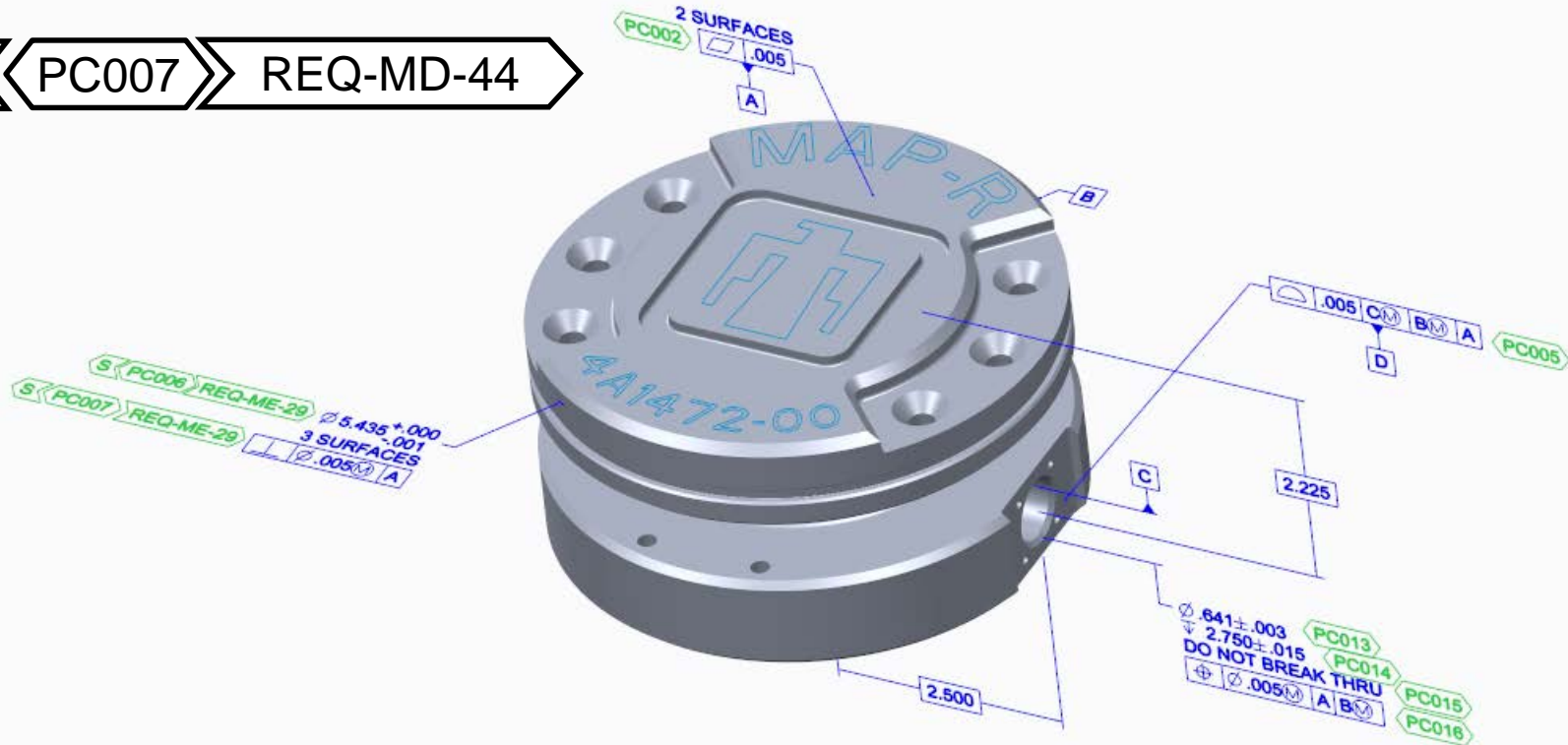
Key Criteria for a characteristic symbol

1. Symbol must be a recognizable unique shape 
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10.others?

Model-Based Product Characteristics (MBPC):

- Symbolic Form

S << PC007 >> REQ-MD-44



Model-Based Product Characteristics (MBPC):

S PC006 REQ-ME-29 $\varnothing 5.435^{+.000}_{-.001}$
3 SURFACES

S PC007 REQ-ME-29 \perp $\varnothing .005^{\text{M}}$ A

$\frac{1}{2}$.005 C^{M} B^{M} A PC005

D

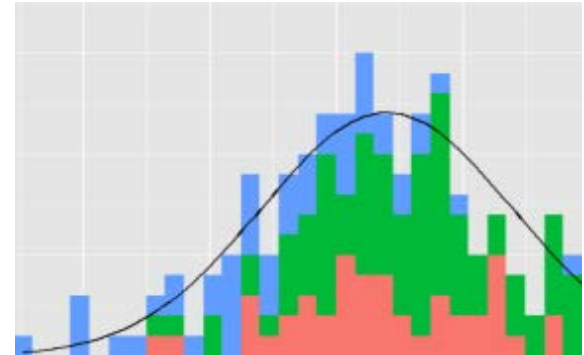
S PC006 REQ-ME-29 $\varnothing 5.435^{+.000}_{-.001}$
3 SURFACES
S PC007 REQ-ME-29 \perp $\varnothing .005^{\text{M}}$ A

$\frac{1}{2}$.005 C^{M} B^{M} A PC005
D

$\varnothing .641 \pm .003$ PC013
 $\nabla 2.750 \pm .015$ PC014
DO NOT BREAK THRU PC015
 \oplus $\varnothing .005^{\text{M}}$ A B^{M} PC016

Digital Thread Opportunities

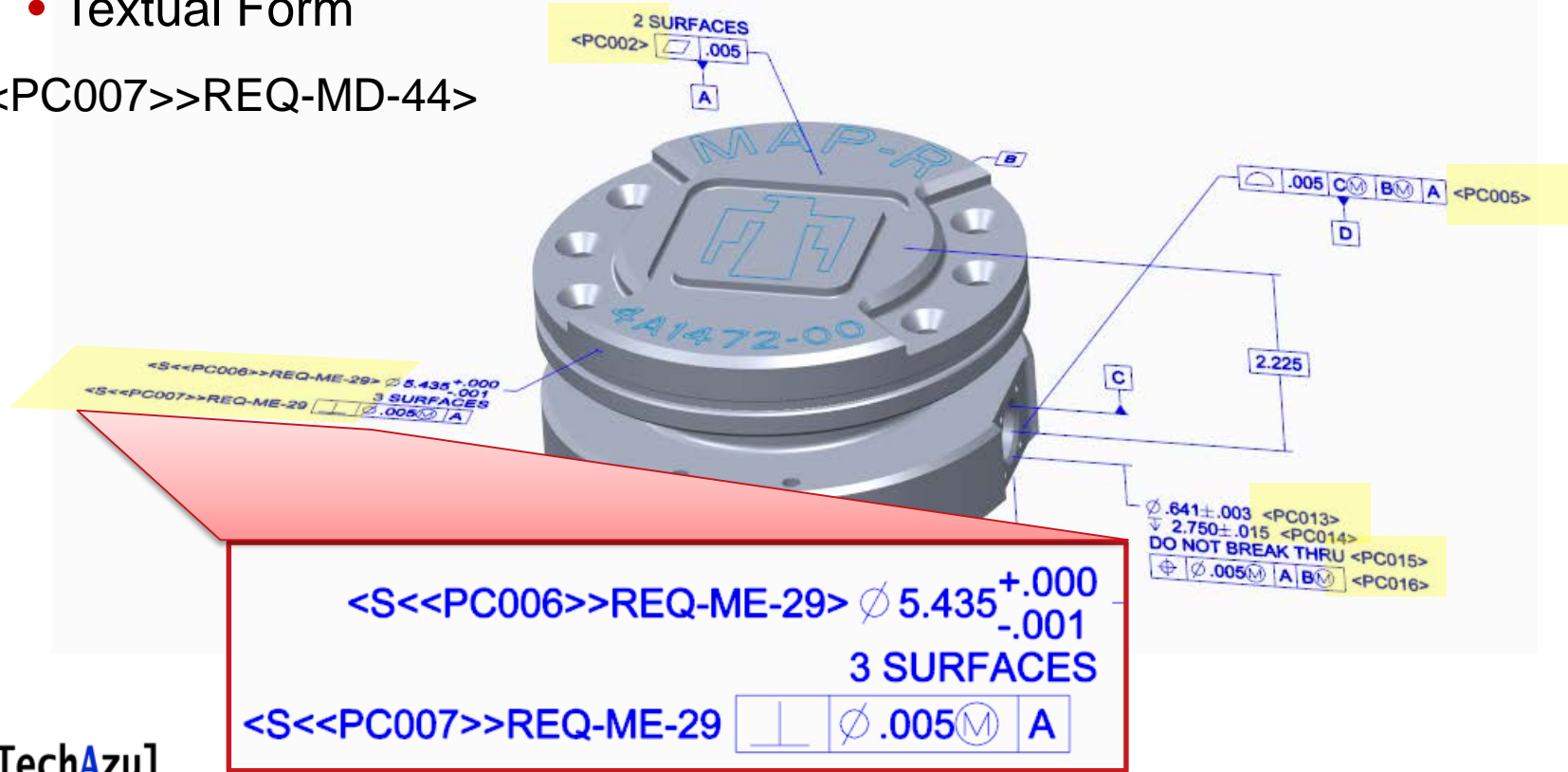
- Allows traceability back to common product characteristic number
- These are an enabler to study critical product characteristics
- Examples
 - Criticality
 - Product requirement
 - Inspection method
 - RPN risk priority number
 - Producibility Rating
 - Histogram of manufacturing capability
 - Process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



Model-Based Product Characteristics (MBPC):

- Textual Form

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

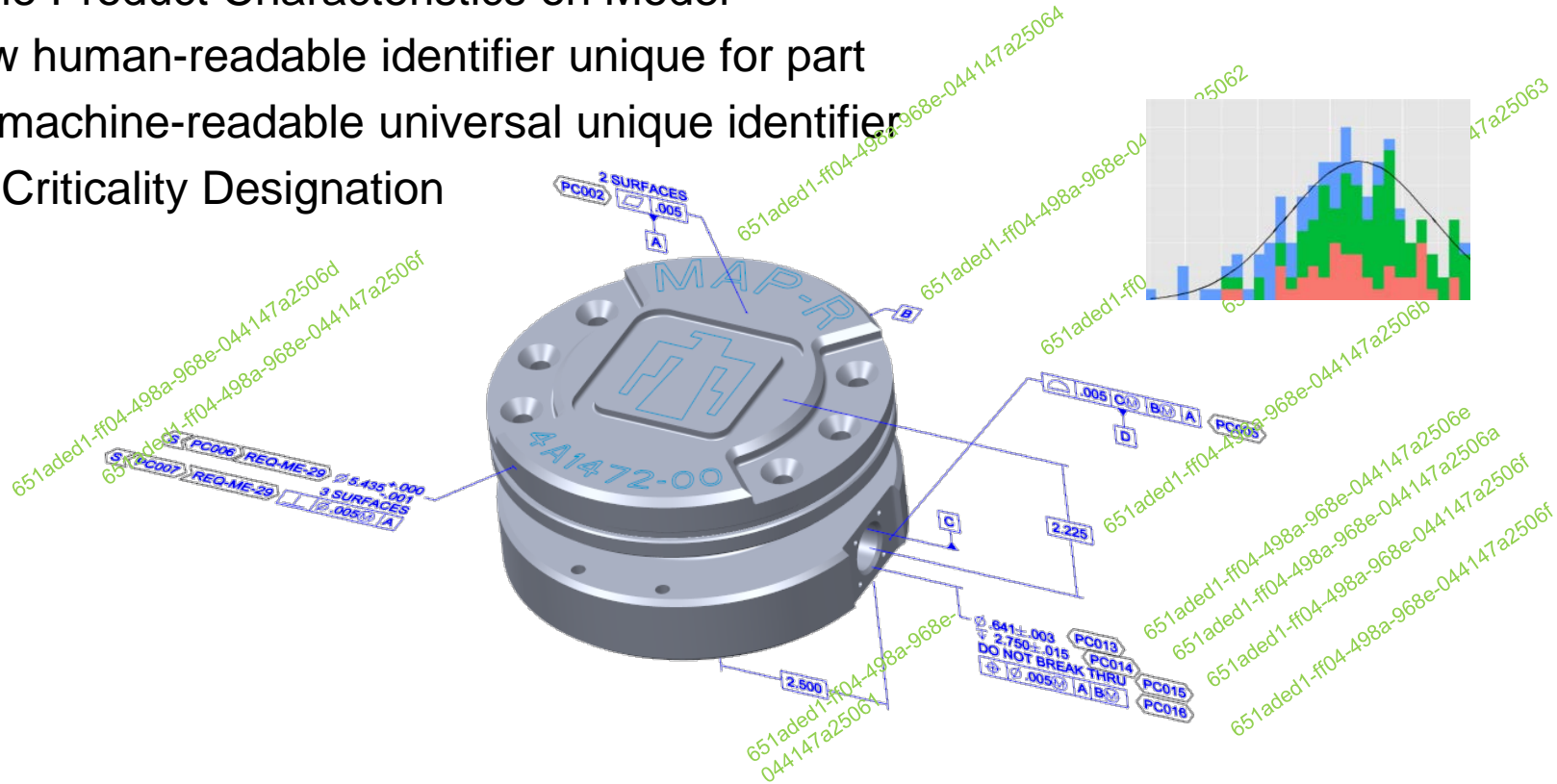


MBPC Enables Measurement Results Traceable to Model

- 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



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

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