



Belcan



— Engineering Better Outcomes

Characteristic Accountability



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Vision

Belcan Digital Engineering Solutions is your trusted partner to bridge strategy and execution to achieve your digital vision.

Strategy

Purpose and Scope
Readiness Assessment
Digital Capability Targets
Strategy and Governance
Viable Business Case
Executive Support
Enterprise Lead Team
Transformation Roadmap
Org Change Management

Execution

Agile Task Execution
Industry Standard Alignment
Creator and Consumer Training
Software Selection
Pilot Execution
Digital Thread Traceability
Supply Chain Enablement
Process Automation
Rapid Response

Lead Team

- **Experience:** 10 SMEs, each with 5+ Years of MBE Implementation
- **Industry Engagement:** ASME, DMSC, DEDMWG, AIA, INCOSE, CCSU
- **Certifications:** Agile, ASME GD&T Senior Level, OCSMP
- **Software:** Tool Agnostic, Multi-CAD/PLM/MBE/MBSE

Belcan Overview

- 65 years of Engineering Better Outcomes
- Global Delivery Network
- 10,000 Professionals
- Annual Revenue of ~\$1B



Characteristic: a verification requirement such as a tolerance or specification that is conveyed through the engineering definition

Characteristic Tag: a human and/or machine-readable tag applied to a characteristic

Bill of Characteristics (BoC): a list of all the characteristics applied to a product

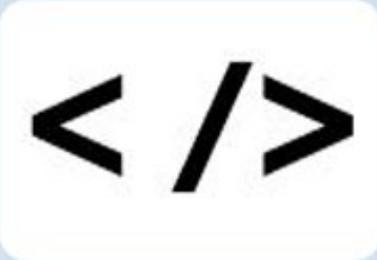
Characteristic Accountability: ensuring all characteristic requirements have been met with traceability through verification results

Characteristic Characteristic Tag



Bill of Characteristics (BoC)

Tag	Saved View	Feature Name	Annotation Name	GD&T	(-)	/	(+)	DRF
1	01_TOP	Opposite Planes 517	ad21	3.000 ±.005	-.005	3.000	.005	-
2.1	01_TOP	Cylinder 512	ad11	Ø.350 ±.010	-.010	.350	.010	-
2.2	01_TOP	Cylinder 514	ad11	Ø.350 ±.010	-.010	.350	.010	-
2.3	01_TOP	Cylinder 513	ad11	Ø.350 ±.010	-.010	.350	.010	-
2.4	01_TOP	Cylinder 515	ad11	Ø.350 ±.010	-.010	.350	.010	-
3.1	01_TOP	Cylinder 512	gp0	⊕ Ø.015 @ A B C	-	-	.015	A/B/C
3.2	01_TOP	Cylinder 514	gp0	⊕ Ø.015 @ A B C	-	-	.015	A/B/C
3.3	01_TOP	Cylinder 513	gp0	⊕ Ø.015 @ A B C	-	-	.015	A/B/C
3.4	01_TOP	Cylinder 515	gp0	⊕ Ø.015 @ A B C	-	-	.015	A/B/C
4	01_TOP	Opposite Planes 521	ad23	1.500 ±.005	-.005	1.500	.005	-
5.1	01_TOP	Generic 538	gp1	⊖ .01 @ A B C	-	-	.01	A/B/C
5.2	01_TOP	Generic 542	gp1	⊖ .01 @ A B C	-	-	.01	A/B/C

			
<p>Feature-Based Characteristic Centered Ontology of Manufacturing Quality Metadata</p>	<p>XML Technology: Simple Implementation with Built-In Code Validation</p>	<p>Information Semantically Linked to MBD for Full Data Traceability via Persistent IDs (QPId/UUID)</p>	<p>QIF 3.0 Approved as an Digital Interoperability Standard ANSI/DMSC 3.0; ISO 23952:2020</p>

Learn more!

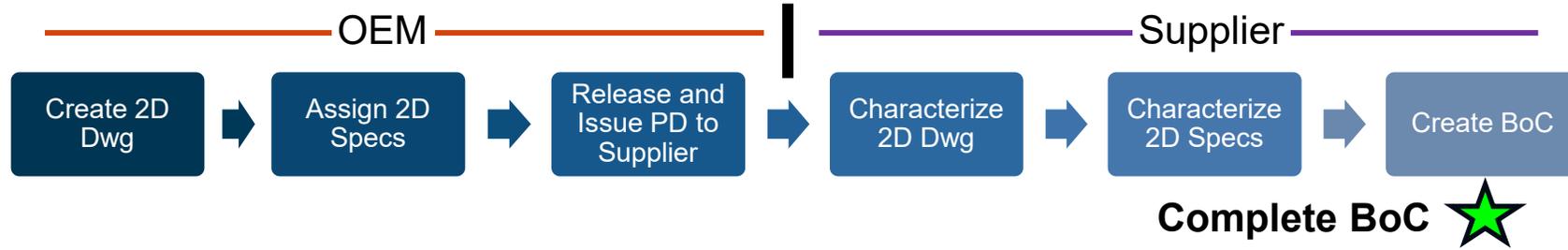
<https://qifstandards.org/>



Belcan Blog:
How QIF Can
Improve Data
Interoperability

Developed and Maintained by the Digital Metrology Standards Consortium (DMSC)





Suppliers author complete BoC

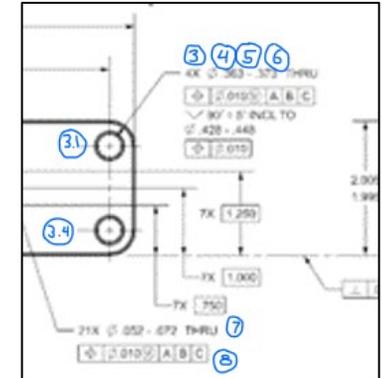
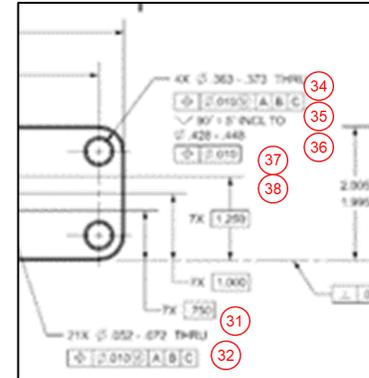
Gaps to a Digital Thread

- **Single Source of Truth:** Characterization is unique to each supplier
- **Speed:** Time consuming with little automation
- **Quality:** Manual data transcription is error prone
- **Traceability:** Manual effort to align inspection results and req's
- **Interoperability:** BoC does not support machine workflows
- **Consistency:** Characterization is not done to any industry stds

Supplier A

Supplier B

2D Dwgs



2D Specs

52 Technical Specification of Road Sign Board

Technical Specifications
Schedule 1: Retro-reflective sheeting

The retro-reflective sheeting used on this sign consist of white or coloured sheeting having a smooth outer surface which has the property of retro reflection over its entire surface. It shall be weather resistant and show colour fastness. It shall be new and unused and shall show no evidence of cracking, scaling, pitting, blistering, edge lifting or curling and shall have negligible shrinking or expansion. A certificate of having tested the sheeting for these properties in an unprotected outdoor exposure facing the sun for two years and to having passed these tests shall be obtained from a reputed laboratory by the manufacturer of the sheeting. These reflective sheeting shall either of Engineering Grade material or of High Intensity Grade with encapsulated lens. Micro prismatic type. The type of sheeting to be used would depend upon the type, functional hierarchy and improvement of the road.

High Intensity Grade sheeting.
A) Encapsulated Lens type:
52.1 This sheeting shall be of encapsulated lens type consisting of spherical glass lens element, adhered to a synthetic resin and encapsulated by a flexible, transparent water proof plastic having a smooth surface. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection determined in accordance with ASTM standard E: 810 as indicated in table 800-1(a).

Observation Angle (In Degrees)	Entrance Angle (In Degrees)	White	Yellow	Orange	Green/Red	Blue
0.2	25	250	170	100	45	20
0.2	30	150	100	60	25	11

3 Technical Specification of Road Sign Board

Technical Specifications
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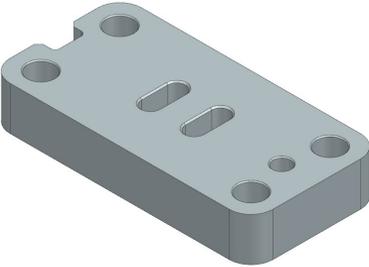
High Intensity Grade sheeting.
A) Encapsulated Lens type:
3.1 This sheeting shall be of encapsulated lens type consisting of spherical glass lens element, adhered to a synthetic resin and encapsulated by a flexible, transparent water proof plastic having a smooth surface. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection determined in accordance with ASTM standard E: 810 as indicated in table 800-1(a).

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0.2	25	250	170	100	45	20
0.2	30	150	100	60	25	11

MBD DATA ELEMENTS

Geometry

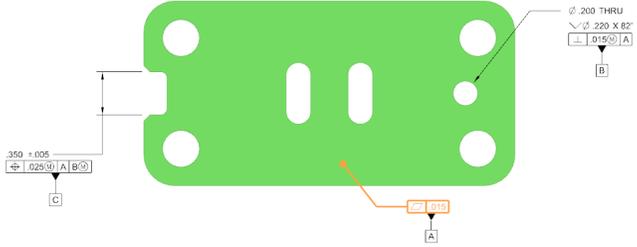
Geometry Definition



Annotations

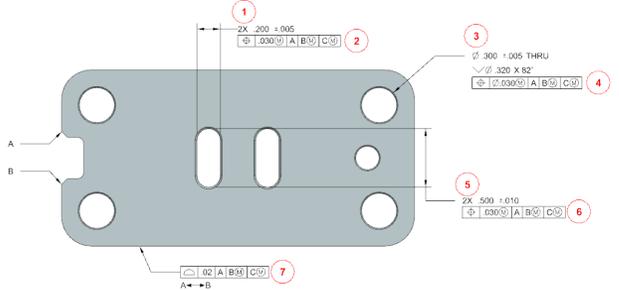
Explicit Requirements

GD&T – Notes – Symbology – Semantic References



Characteristic Annotations

Characteristic Identifiers



*Annotations are also known as Product and Manufacturing Information (PMI)

Attributes and Parameters

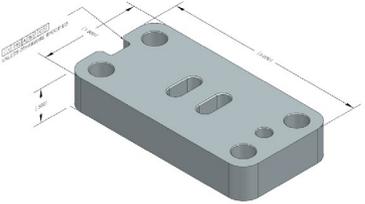
Implicit Requirements

Titleblock Data

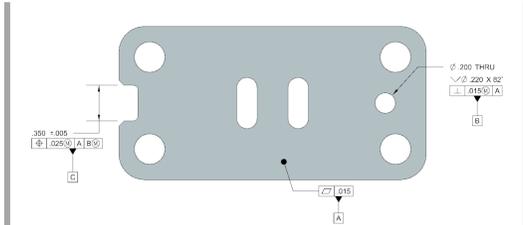
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1	Default Group											Default Group	
2	Length											Default Group	
3	p0	0.25	0.25	in	Length	Number	SKETCH_000(Sk...					Default Group	
4	p1	0.0	0.25	in	Length	Number	SKETCH_000(Sk...					Default Group	
5	p2	0.0	0.25	in	Length	Number	SKETCH_000(Sk...					Default Group	
6	p3	0.0	0.25	in	Length	Number	SKETCH_000(Sk...					Default Group	
7	p4	0	0	in	Length	Number	SketchES Start...					Default Group	
8	p5	.5	0.5	in	Length	Number	SketchES End...					Default Group	
9	p6	.250	0.25	in	Length	Number	DD_35 HAN(C)P...					Default Group	
10	p10	.5	0.5	in	Length	Number	DD_35 HAN(C)P...					Default Group	
11	p19	0.125	0.125	in	Length	Number	DD_35 HAN(C)P...					Default Group	
12	p20	0.250	0.250	in	Length	Number	DD_35 HAN(C)P...					Default Group	
13	p21	0.125	0.250	in	Length	Number	DD_35 HAN(C)P...					Default Group	
14	p22	.200	0.2	in	Length	Number	SKETCH_000(Sk...					Default Group	
15	p23	0.125	0.2	in	Length	Number	SKETCH_000(Sk...					Default Group	
16	p24	0.5	0.5	in	Length	Number	SketchES End...					Default Group	
17	p36	.050	0.05	in	Length	Number	Charfe(S) Cha...					Default Group	
18	p39	.015	0.015	in	Length	Number	Charfe(S) Cha...					Default Group	

Presentation States

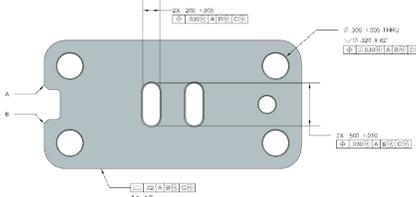
Functionally Named Views and States



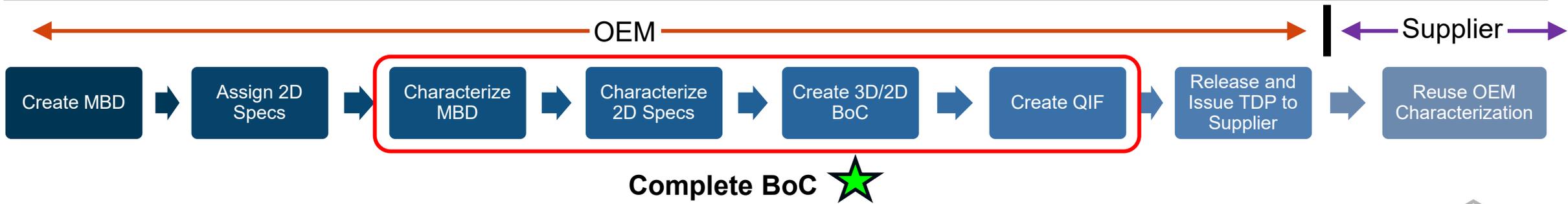
01-ISOMETRIC



02-BOTTOM



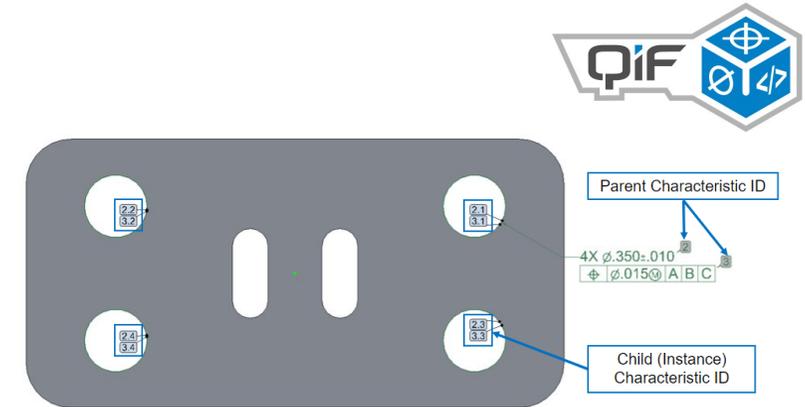
03-TOP



Engineering authors complete BoC

Enabling a Digital Thread

- **Single Source of Truth:** Characterization is authored once in Eng definition
- **Speed:** Automation enabled by machine readable formats
- **Quality:** Software integration replaces manual transcription
- **Traceability:** Unique characteristic IDs persist in digital thread
- **Interoperability:** Characteristics are embedded in interop file format
- **Consistency:** Characteristic authored to industry std format



Bill of Characteristics [042a54c3-3330-4d25-ab51-0f6956b8517d]

Tag	Saved View	Feature Name	Annotation Name	GD&T	(-)	/	(+)	DRF
1	01_TOP	Opposite Planes 517	ad21	3.000 ±.005	-0.005	3.000	.005	-
2.1	01_TOP	Cylinder 512	ad11	∅.350 ±.010	-0.010	.350	.010	-
2.2	01_TOP	Cylinder 514	ad11	∅.350 ±.010	-0.010	.350	.010	-
2.3	01_TOP	Cylinder 513	ad11	∅.350 ±.010	-0.010	.350	.010	-
2.4	01_TOP	Cylinder 515	ad11	∅.350 ±.010	-0.010	.350	.010	-
3.1	01_TOP	Cylinder 512	gp0	∅.015 @ A B C	-	-	.015	A/B/C
3.2	01_TOP	Cylinder 514	gp0	∅.015 @ A B C	-	-	.015	A/B/C
3.3	01_TOP	Cylinder 513	gp0	∅.015 @ A B C	-	-	.015	A/B/C
3.4	01_TOP	Cylinder 515	gp0	∅.015 @ A B C	-	-	.015	A/B/C

Measurement Results

- Inspection results captured and linked to req's in QIF
- SPC and statistical analysis



Hole Size & Position

Instance 1	Face [1]	CID# 1.1, 2.1
Instance 2	Face [2]	CID# 1.2, 2.2
Instance 3	Face [3]	CID# 1.3, 2.3
Instance 4	Face [4]	CID# 1.4, 2.4

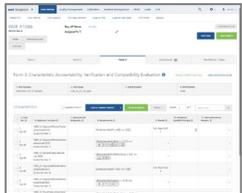


3D MBD

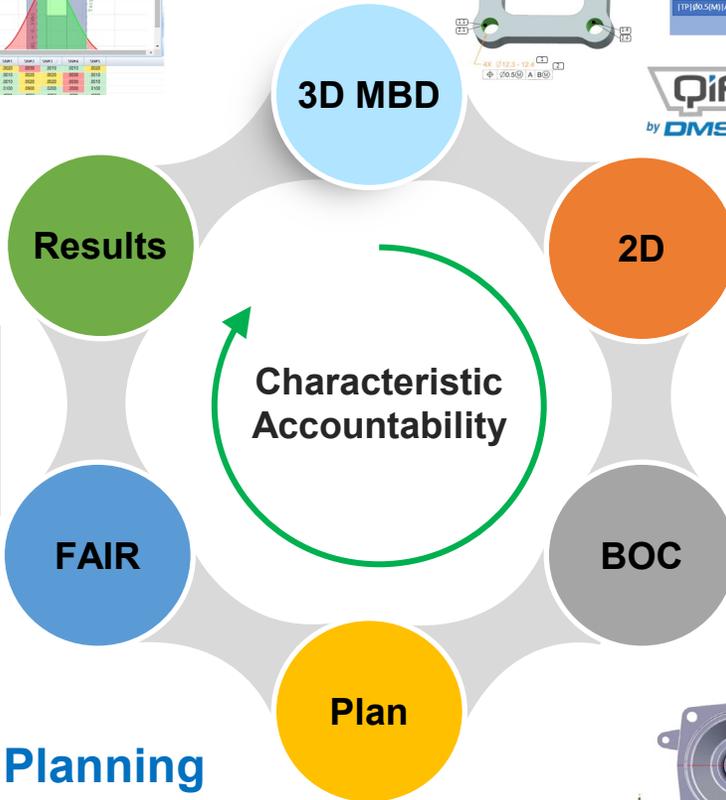
- 3D req's characterized, associated to features
- QIF MBD published for quality workflows

Generate FAIR

- Complete set of requirements published to quality database



Characteristic Accountability



2D Req's

- OCR characterizes 2D req's

Standard Practice for Heat Treatment of Aluminum-Alloy Castings from All Processes¹

This standard is based on the third edition of ASTM B709. The number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript letter indicates editorial changes since the last revision or approval.

Scope¹

1.1 This practice is intended, when specified by material specification or purchase order, for the use in the heat treatment of aluminum alloy castings from all casting processes.

1.1.1 The heat treatment of aluminum alloy castings used in static aerospace applications is covered in AMS 2771² and other AMS³ material specifications.

1.1.2 The heat treatment of wrought aluminum alloys is covered in Practice B709.

1.2 The values stated in either inch-pound units or SI units are to be regarded separately as standards. The SI units are in brackets or in separate tables. The values stated in inch-pound units are not exact equivalents, therefore each system is to be used independently of the other. Combining values from the two systems may result in non-conformance with the code.

1.3 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

Referenced Documents

1.1 The following documents of the issue in effect on the date of issuance of this standard form a part of this specification to the extent specified herein.

1.2 Terminology

1.2.1 Refer to Terminology B 011 for terminology relating to the heat treatment of castings.

2.3.1 Equipment

2.3.1.1 Heating Media—Aluminum castings are typically heat treated in air chamber furnaces, however lead baths, oil baths, molten salts, or even superheated steam may be used in specific applications. However the use of superheated steam

2.3.2 Test Methods

2.3.2.1 Test Methods of Tensile Testing Wrought and Cast Aluminum and Magnesium-Alloy Products (Metric)

2.3.2.2 Specification for Aluminum-Alloy Aerospace Castings

2.3.2.3 Terminology Relating to Aluminum-Alloy Castings, High Strength

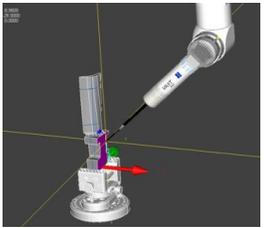
2.3.2.4 Terminology Relating to Aluminum-Alloy Castings

2.3.2.5 Practice for Heat Treatment of Wrought Aluminum Alloys

2.3.2.6 Practice for Evaluating Intergranular Corrosion Resistance of Heat-Treated Aluminum Alloys by Immersion in Sodium Chloride + Hydrogen Peroxide Solution

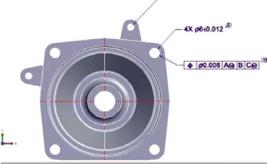
2.3.2.7 AMS Standard

2.3.2.8 Alloy and Temper Designation Systems for Aluminum



Measurement Planning

- QIF automates coordinate metrology



ID	Feature Name	Attribution Name	CLASS
01	FRONT_VIEW	Cylinder 4249 AL_DRIVE_DWG	DS #1012
02	FRONT_VIEW	Cylinder 4217 AL_DRIVE_DWG	DS #1012
03	FRONT_VIEW	Cylinder 4278 AL_DRIVE_DWG	DS #1012

Complete BOC

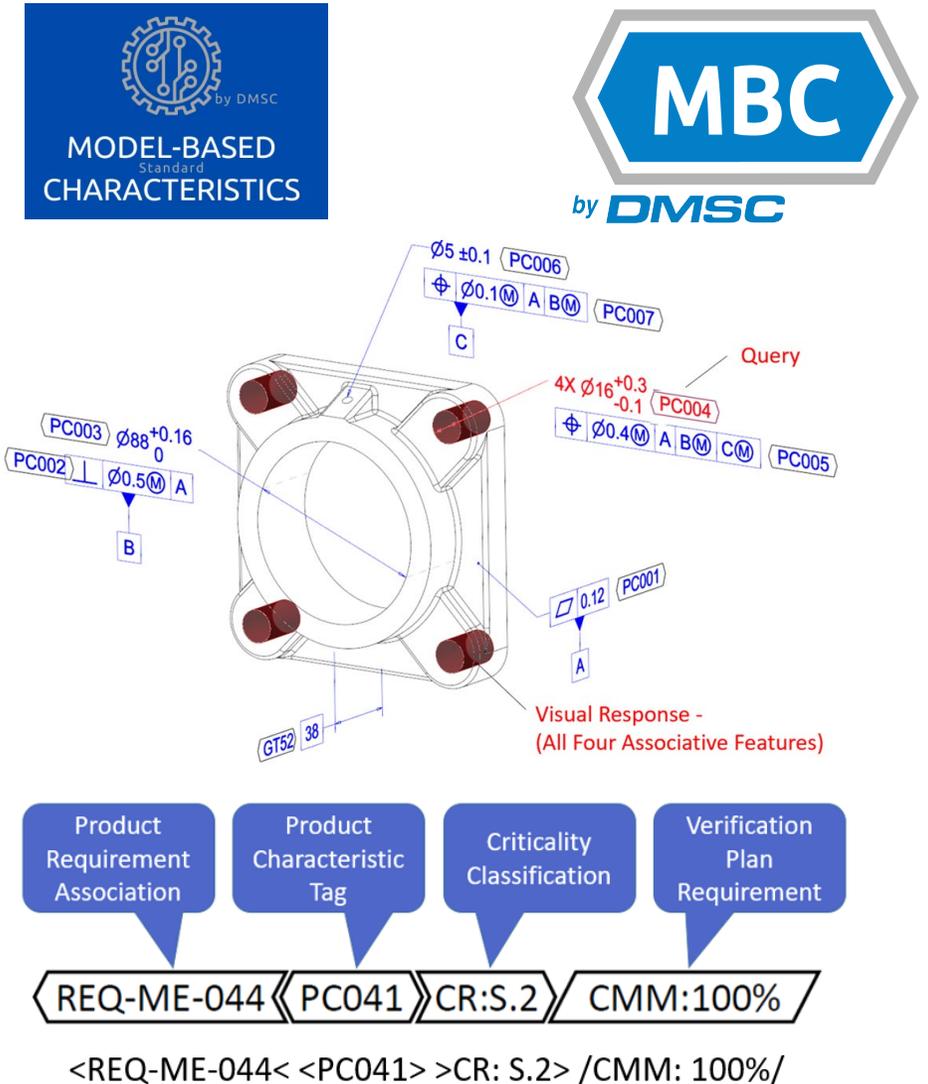
- Unified 3D and 2D req's
- 3D interactive viewer of measurement req's

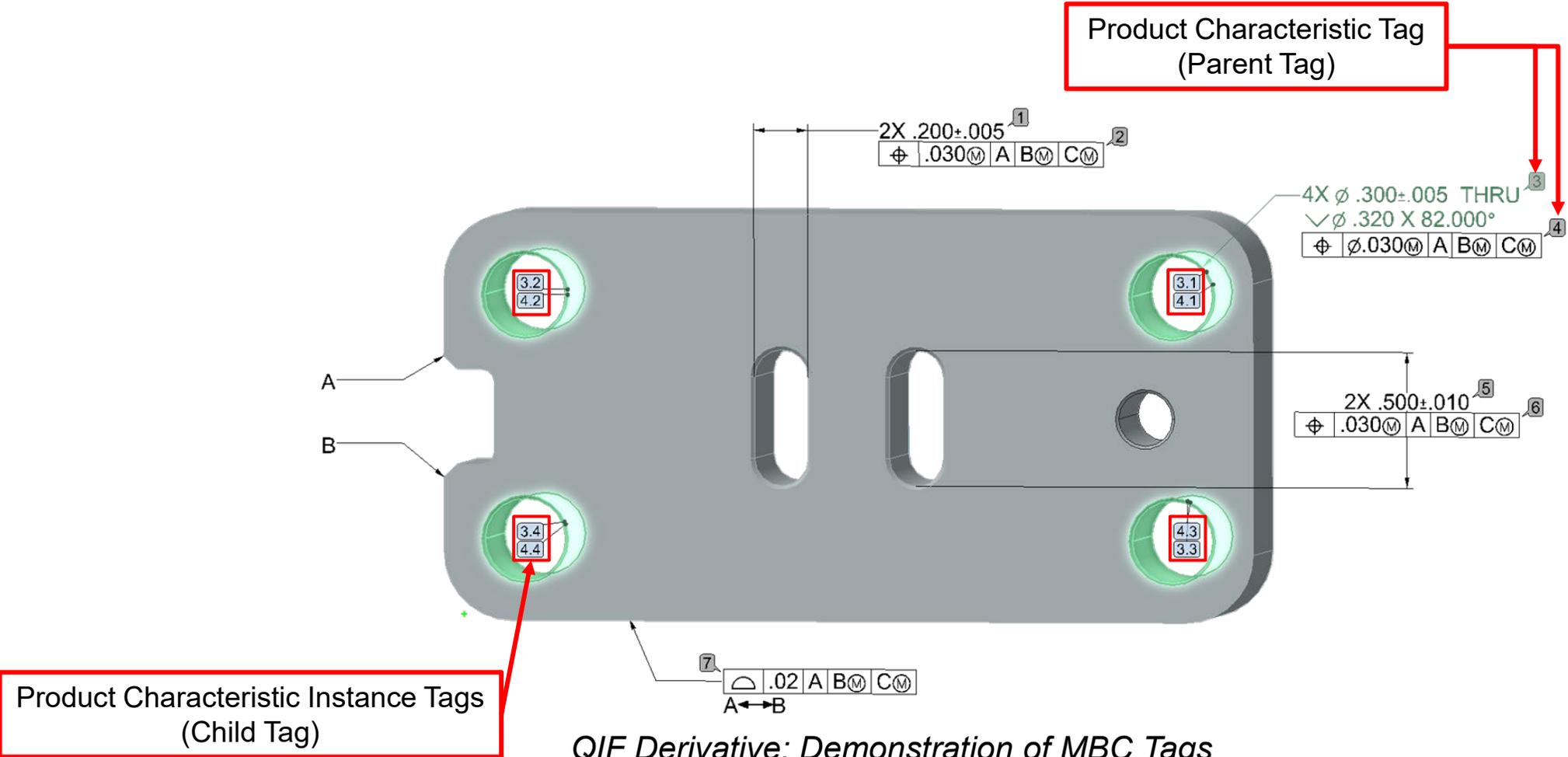


3D MBD

- 3D req's characterized, associated to features
- QIF MBD published for quality workflows

- DMSC’s “ Model-Based Characteristics” document
- Same organization that manages QIF std
- ~180 page document
- Identifies specific types and categories of product characteristics and optional augmentations
- Nomenclature, definitions, symbols, practice, and data structure for the representation and communication of Model-Based characteristics
- June 2023 – voted to submit document for ANSI std consideration





QIF Derivative: Demonstration of MBC Tags

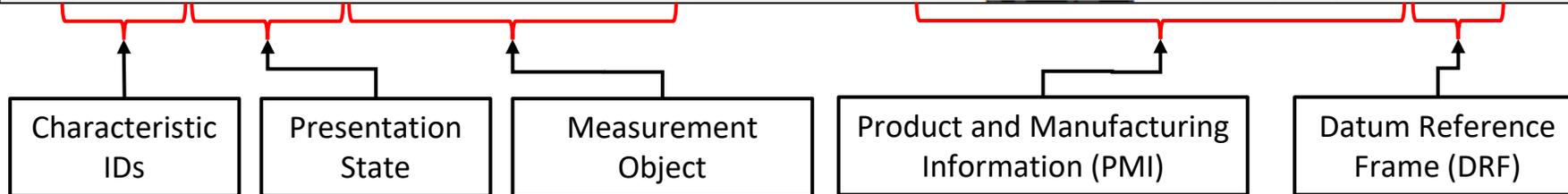
Bill of Characteristics (BoC)

Bill of Characteristics [4d70ac6e-f771-47b3-b3e3-c33122bcf74d] Universal Unique Identifier (UUID)

AS9102

Report Type Report Camera Reset Decolorize Hide Re-Balloon Export Import Bind HTML Report 3D HTML Report PDF Report Net-Inspect

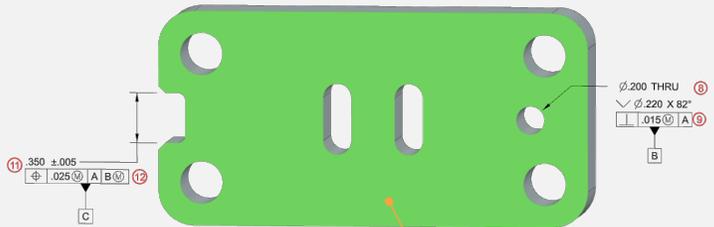
<input type="checkbox"/>	Tag	Saved View	Feature Name	Annotation Name	GD&T	(-)	/	(+)	DRF	Criticality
<input checked="" type="checkbox"/>	⊕ 2.1	03-TOP	Opposite Planes 3401	Feature Control Frame (86)	⊕ .030(M) A B(M) C(M)	-	-	.030	A/B(M)/...	
<input checked="" type="checkbox"/>	⊕ 2.2	03-TOP	Opposite Planes 3402	Feature Control Frame (86)	⊕ .030(M) A B(M) C(M)	-	-	.030	A/B(M)/...	
<input checked="" type="checkbox"/>	∅ 3.1	03-TOP	Cylinder 3415	Radial Dimension (185)	∅.300 ±.005 THRU √∅.3...	-.005	.300	.005	-	
<input checked="" type="checkbox"/>	∅ 3.2	03-TOP	Cylinder 3413	Radial Dimension (185)	∅.300 ±.005 THRU √∅.3...	-.005	.300	.005	-	
<input checked="" type="checkbox"/>	∅ 3.3	03-TOP	Cylinder 3414	Radial Dimension (185)	∅.300 ±.005 THRU √∅.3...	-.005	.300	.005	-	
<input checked="" type="checkbox"/>	∅ 3.4	03-TOP	Cylinder 3412	Radial Dimension (185)	∅.300 ±.005 THRU √∅.3...	-.005	.300	.005	-	
<input checked="" type="checkbox"/>	⊕ 4.1	03-TOP	Cylinder 3415	Feature Control Frame (84)	⊕ ∅.030(M) A B(M) C(M)	-	-	.030	A/B(M)/...	
<input checked="" type="checkbox"/>	⊕ 4.2	03-TOP	Cylinder 3413	Feature Control Frame (84)	⊕ ∅.030(M) A B(M) C(M)	-	-	.030	A/B(M)/...	
<input checked="" type="checkbox"/>	⊕ 4.3	03-TOP	Cylinder 3414	Feature Control Frame (84)	⊕ ∅.030(M) A B(M) C(M)	-	-	.030	A/B(M)/...	
<input checked="" type="checkbox"/>	⊕ 4.4	03-TOP	Cylinder 3412	Feature Control Frame (84)	⊕ ∅.030(M) A B(M) C(M)	-	-	.030	A/B(M)/...	
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<input checked="" type="checkbox"/>	⊕ 6.2	03-TOP	Elongated Cylinder 3410	Feature Control Frame (94)	⊕ .030(M) A B(M) C(M)	-	-	.030	A/B(M)/...	
<input checked="" type="checkbox"/>	∩ 7	03-TOP	Generic 3439	Feature Control Frame (87)	∩ .02 A B(M) C(M) A	-	-	.02	A/B(M)/...	
<input checked="" type="checkbox"/>	∅ 8	02-BOTTOM	Group 3441	Radial Dimension (115)	∅ .200 THRU √∅ .220...	-.005	.200	.005	-	



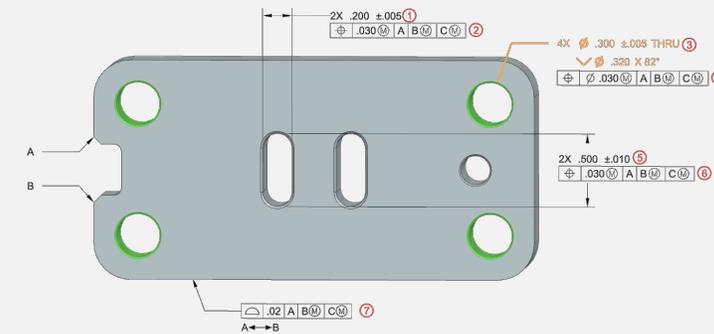
Native CAD System



- Source 3D MBD CAD
- Machine/Software-Readable



02_BTM



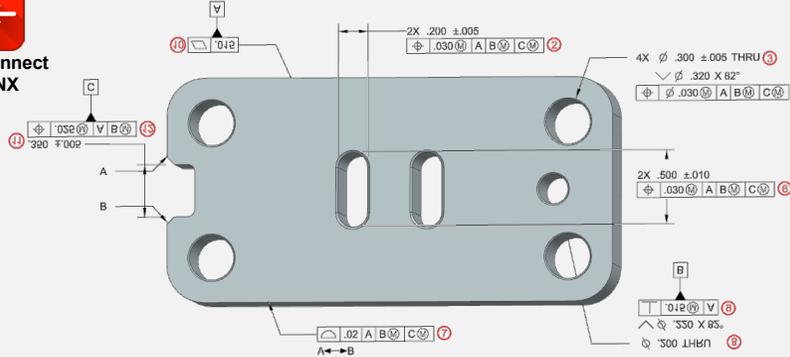
03_TOP

QIF Export



Harvesting Source CAD MBD Elements:

- Geometry
- Annotation
- Characteristics
- Presentation States
- Attributes



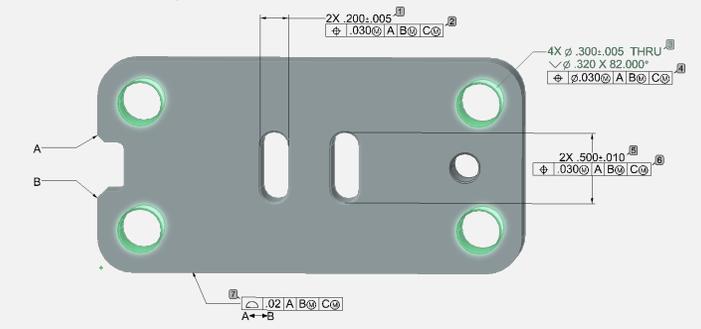
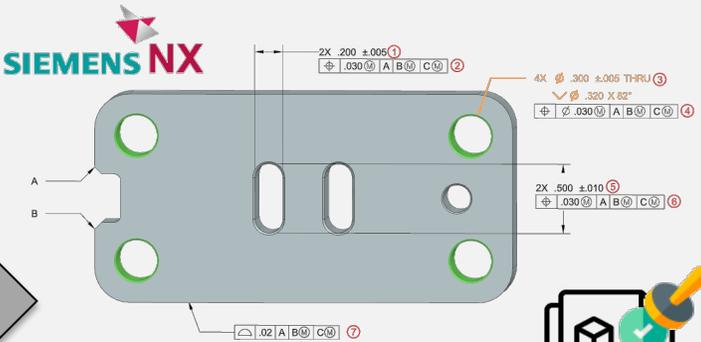
Bill of Characteristics (BoC)

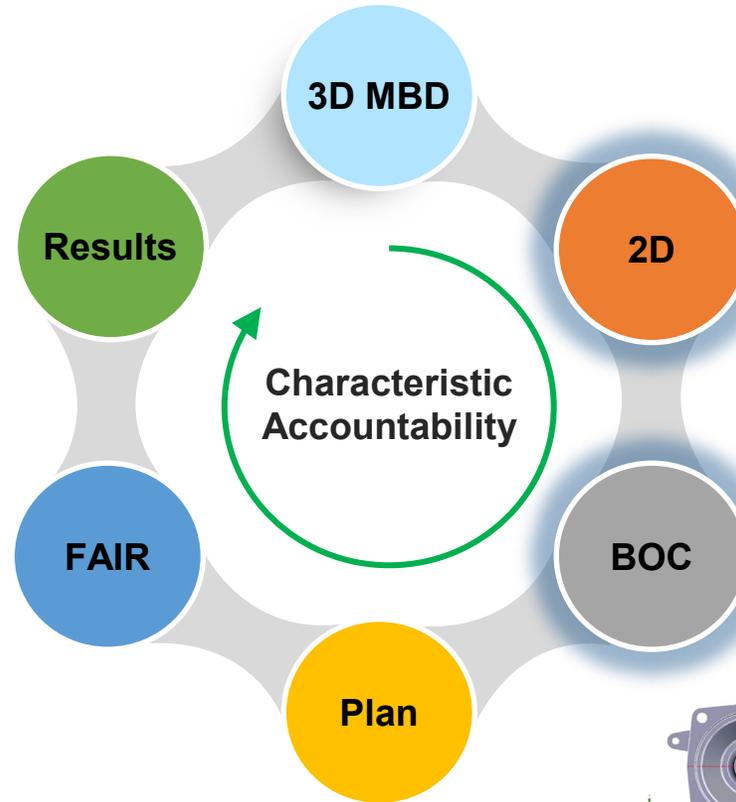
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AS9102												
Tag	Saved View	Feature Name	Annotation Name	GD&T	(-)	/	(+)	DRF	Critic			
1.1	03-TOP	Opposite Planes 1830	Linear Dimension (85)	.200 ±.005	-.005	.200	.005	-				
1.2	03-TOP	Opposite Planes 1831	Linear Dimension (85)	.200 ±.005	-.005	.200	.005	-				
2.1	03-TOP	Opposite Planes 1830	Feature Control Frame (86)	⌀ .030Ⓜ A BⓂ CⓂ	-	-	.030	A/BⓂ/...				
2.2	03-TOP	Opposite Planes 1831	Feature Control Frame (86)	⌀ .030Ⓜ A BⓂ CⓂ	-	-	.030	A/BⓂ/...				
3.1	03-TOP	Group 1857	Radial Dimension (120)	⌀ .300 ±.005 THRU	-.005	.300	.005	-				
3.2	03-TOP	Group 1853	Radial Dimension (120)	⌀ .300 ±.005 THRU	-.005	.300	.005	-				
3.3	03-TOP	Group 1855	Radial Dimension (120)	⌀ .300 ±.005 THRU	-.005	.300	.005	-				
3.4	03-TOP	Group 1851	Radial Dimension (120)	⌀ .300 ±.005 THRU	-.005	.300	.005	-				
4.1	03-TOP	Group 1857	Feature Control Frame (84)	⌀ .030Ⓜ A BⓂ CⓂ	-	-	.030	A/BⓂ/...				
4.2	03-TOP	Group 1853	Feature Control Frame (84)	⌀ .030Ⓜ A BⓂ CⓂ	-	-	.030	A/BⓂ/...				
4.3	03-TOP	Group 1855	Feature Control Frame (84)	⌀ .030Ⓜ A BⓂ CⓂ	-	-	.030	A/BⓂ/...				
4.4	03-TOP	Group 1851	Feature Control Frame (84)	⌀ .030Ⓜ A BⓂ CⓂ	-	-	.030	A/BⓂ/...				
5.1	03-TOP	Elongated Cylinder 1838	Linear Dimension (93)	.500 ±.010	-.010	.500	.010	-				
5.2	03-TOP	Elongated Cylinder 1839	Linear Dimension (93)	.500 ±.010	-.010	.500	.010	-				
6.1	03-TOP	Elongated Cylinder 1838	Feature Control Frame (94)	⌀ .030Ⓜ A BⓂ CⓂ	-	-	.030	A/BⓂ/...				
6.2	03-TOP	Elongated Cylinder 1839	Feature Control Frame (94)	⌀ .030Ⓜ A BⓂ CⓂ	-	-	.030	A/BⓂ/...				

Validate QIF Translation



- CompareVidia Tool
- Validate QIF back to Source CAD





2D Req's

- OCR characterizes 2D req's

Standard Practice for Heat Treatment of Aluminum-Alloy Castings from All Processes¹

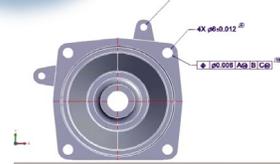
This standard is based on the third edition of the third supplement to ASTM B770. The number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript letter indicates an editorial change since the last revision or reapproval.

Scope¹
 1.1 This practice is intended, when specified by material specification or purchase order, for the use in the heat treatment of aluminum alloy castings from all casting processes.
 1.1.1 The heat treatment of aluminum alloy castings used in static aerospace applications is covered in AMS 2771² and with AMS³ material specifications.
 1.1.2 The heat treatment of wrought aluminum alloys is covered in Practice B708.
 1.2 The values stated in either inch-pound units or SI units are to be regarded separately as standards. The SI units are given in brackets or in separate tables. The values stated in inch-pound units are not exact equivalents; therefore, each system is to be used independently of the other. Combining values from the two systems may result in non-conformance with the code.
 1.3 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

Referenced Documents
 1.1 The following documents of the issue in effect on the date of material purchase form part of this specification to the extent specified herein:
 B.572M Test Methods of Tension Testing Wrought and Cast Aluminum and Magnesium-Alloy Products (Metric Units)
 B.640 Specification for Aluminum-Alloy Investment Castings⁴
 B.551 Terminology Relating to Aluminum-Alloy Magnesium-Alloy Products⁵
 B.740 Practice for Heat Treatment of Wrought Aluminum Alloys⁶
 C.103 Practice for Evaluating Intergranular Corrosion Resistance of Heat-Treatable Aluminum Alloys by Immersion in Sodium Chloride + Hydrogen Peroxide Solution⁷
 2.3 AMS Standard
 103.1 Alloy and Temper Designation Systems for Aluminum⁸

3. Terminology
 3.1 Definitions:
 3.1.1 Refer to Terminology B.551 for terminology relating to the heat treatment of castings.

4. Equipment
 4.1 Heating Media—Aluminum castings are typically heat treated in air chamber furnaces, however lead baths, oil baths, molten salt, or even superheated steam may be used in specific applications. However the use of materials that become



ID	Symbol Name	Feature Name	Attribution Name	CSG1
S1	FRONT_VDR	Cylinder 4249	AL_DRIVEV_DMG	DS 15312
S2	FRONT_VDR	Cylinder 4217	AL_DRIVEV_DMG	DS 15312
S3	FRONT_VDR	Cylinder 4278	AL_DRIVEV_DMG	DS 15312

Complete BOC

- Unified 3D and 2D req's
- 3D interactive viewer of measurement req's



Capvidia MBDVidia Software

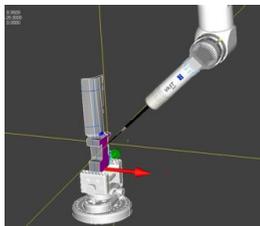
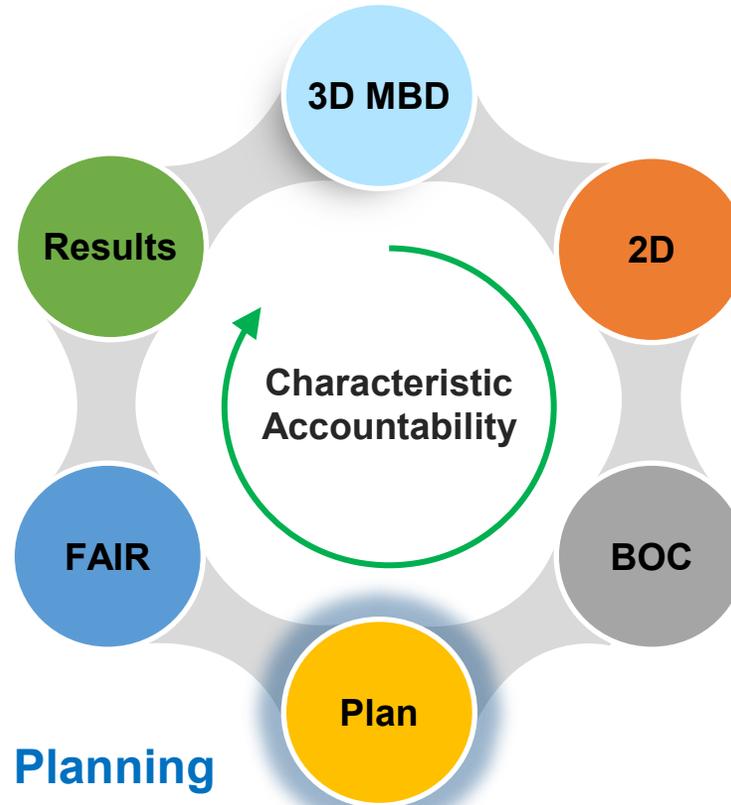
Example Workflow to a Complete BoC

1. Example has PMI general note that references an ISO std req contained in a 2D spec
2. 2D spec characterized with software
3. OCR is used to pull text into software
4. 2D req is appended to 3D general note in BoC

The screenshot shows the software interface with four key areas highlighted in green boxes:

- 1) Notes in MBD:** A text area containing notes such as "INTERPET IN ACCORDANCE WITH ASME Y14.5-2009, ASME Y14.41-2010", "STAINLESS STEEL CERTIFIED PER ISO 10374", "UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN MM.", "SCALE AND SIZE ARE NOT APPLICABLE.", and "ALL DIMENSIONS OBTAINED FROM THE MODEL ARE BASIC UNLESS OTHERWISE SPECIFIED".
- 2) Req in 2D Spec:** A 2D drawing of a part with a table below it. The table includes fields for Certificate No., Product, Order No., Consignment, Cast No., Quantity, and Size. A specific requirement is highlighted: "TEST CERTIFICATE IN ACCORDANCE WITH BS EN 10204 3.1/ISO 10474 3.1".
- 3) OCR of 2D Req:** A text area showing the extracted requirement: "TEST CERTIFICATE IN ACCORDANCE WITH BS EN 10204 3.1/ISO 10474 3.1".
- 4) BoC with 3D Note appended with 2D Spec Req:** A table listing features and annotations. The table includes columns for Tag, Saved View, Feature Name, Annotation Name, GD&T, and External Spec. The extracted requirement from step 3 is appended to the 3D note in the External Spec column.

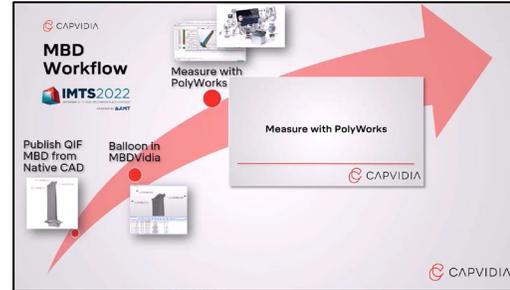
Tag	Saved View	Feature Name	Annotation Name	GD&T	External Spec
AB 1	NOTES		Note_38_1	1 INTERPET IN ACCORDANCE WITH ASME Y14.5-2009,	
AB 2	NOTES		Note_38_2	2 STAINLESS STEEL CERTIFIED PER ISO 10374	
AB 3	NOTES		Note_38_3	3 UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE	
AB 4	NOTES		Note_38_4	4 SCALE AND SIZE ARE NOT APPLICABLE.	
AB 5	NOTES		Note_38_5	5 ALL DIMENSIONS OBTAINED FROM THE MODEL ARE	
AB 6	NOTES		Note_38_6	6 KEY CHARACTERISTICS (KC) SHALL BE VALIDATED I	
7.1	FRONT_VIEW	Cylinder 4181	DRV_DIM_D120	Ø4 ±0.012	
7.2	FRONT_VIEW	Cylinder 4275	DRV_DIM_D120	Ø4 ±0.012	
8.1	FRONT_VIEW	Cylinder 4181	AE_GSTOL3	±0.006 A@B C@D	
8.2	FRONT_VIEW	Cylinder 4275	AE_GSTOL3	±0.006 A@B C@D	
9.1	FRONT_VIEW	Cylinder 4249	AE_DRIVEN_DIM8	Ø6 ±0.012	
9.2	FRONT_VIEW	Cylinder 4277	AE_DRIVEN_DIM8	Ø6 ±0.012	
9.3	FRONT_VIEW	Cylinder 4278	AE_DRIVEN_DIM8	Ø6 ±0.012	
9.4	FRONT_VIEW	Cylinder 4276	AE_DRIVEN_DIM8	Ø6 ±0.012	



Measurement Planning

- QIF automates coordinate metrology

Video



QIF Derivative



Inspection Plan



Enabling a Digital Thread

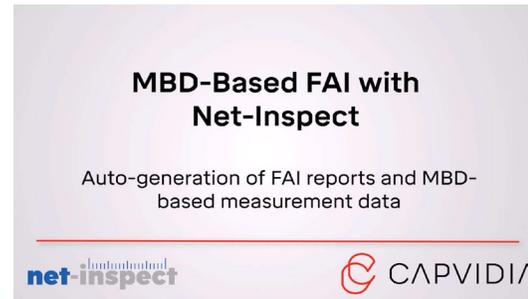
Single Source of Truth, Speed, Quality, Traceability, Interoperability, Consistency

Generate FAIR

- Complete set of requirements published to quality database



Video



QIF Derivative



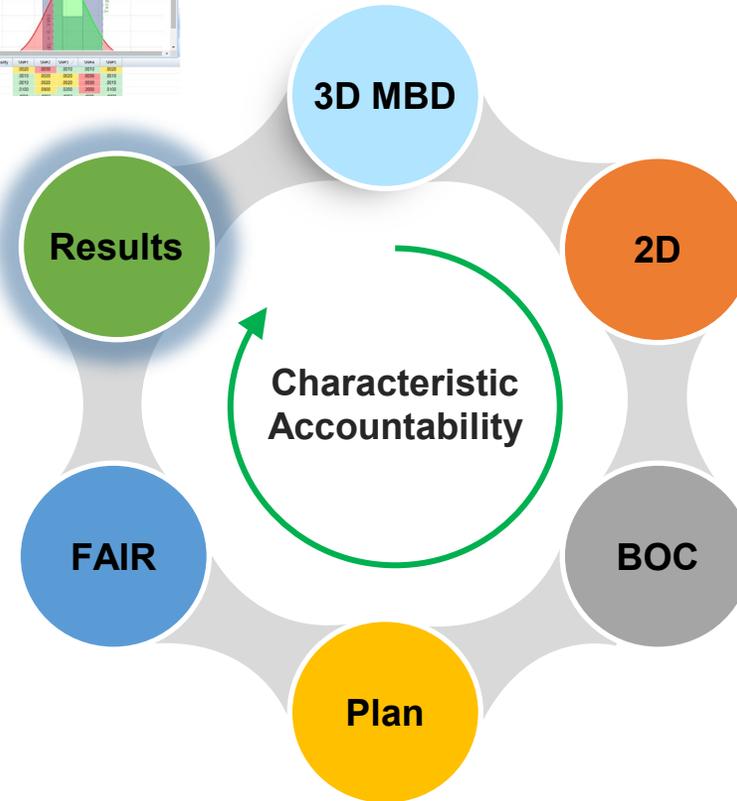
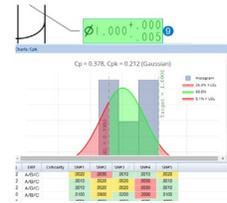
FAIR Characteristic List



Enabling a Digital Thread
Single Source of Truth, Speed, Quality, Traceability, Interoperability, Consistency

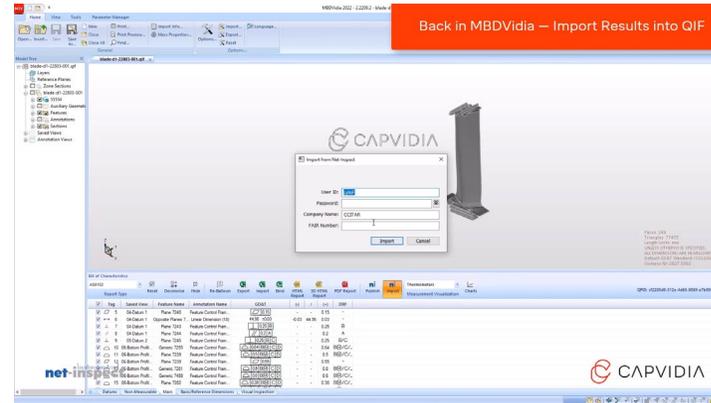
Measurement Results

- Inspection results captured and linked to req's in QIF
- SPC and statistical analysis



QIF – Measurement Results (Net-Inspect)

Video



QIF Results

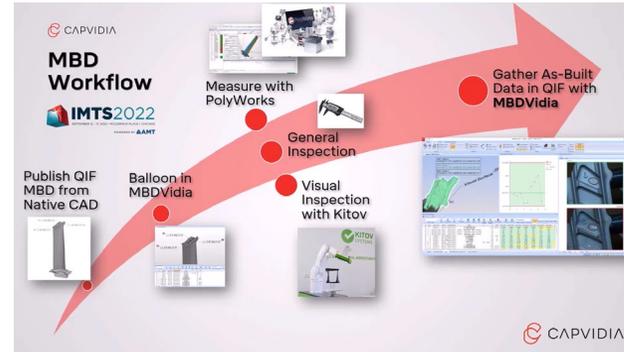


Measurement Analysis



Enabling a Digital Thread
Single Source of Truth, Speed, Quality, Traceability, Interoperability, Consistency

Video



QIF Results



Measurement Analysis



Enabling a Digital Thread

Single Source of Truth, Speed, Quality, Traceability, Interoperability, Consistency

How QIF Can Improve Data Interoperability

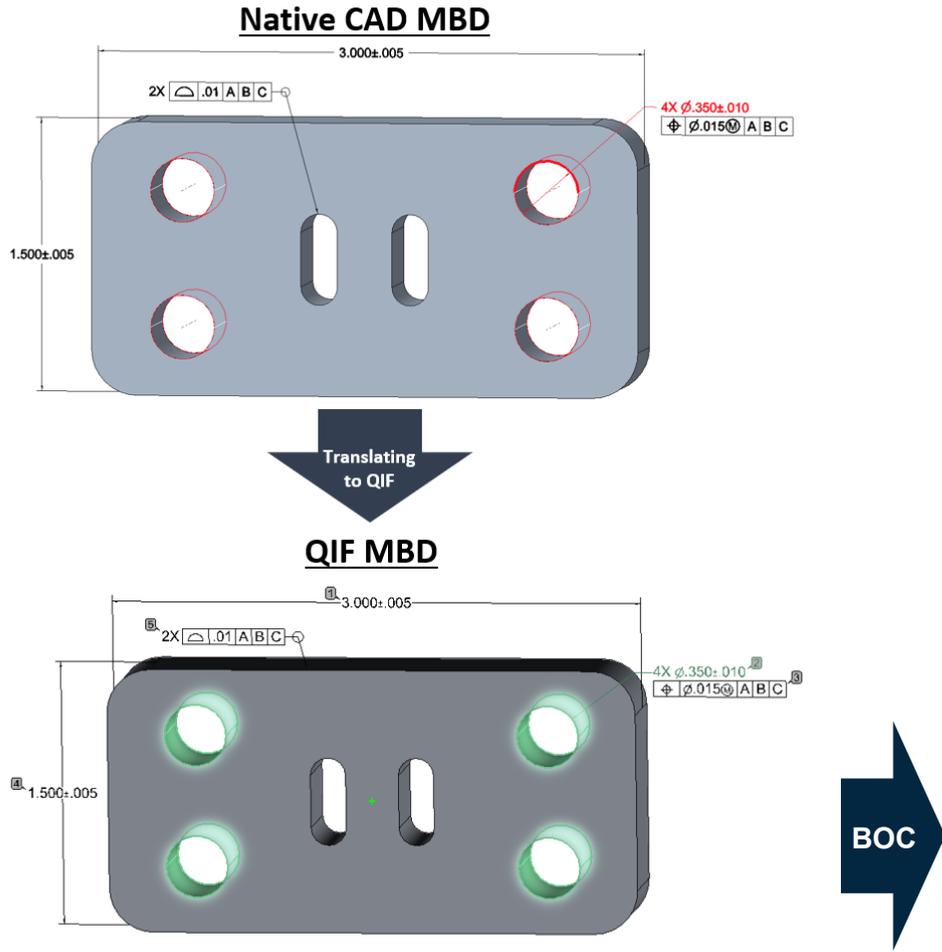


Figure 1: Native MBD Translated to QIF, Harvesting All the Native MBD Elements



Belcan Blog: [How QIF Can Improve Data Interoperability](#)

Bill of Characteristics (BoC)

Bill of Characteristics [042a54c3-3330-4d25-ab51-0f6956b8517q] **Universal Unique Identifier (UUID)**

information Bill of Characteristics [042a54c3-3330-4d25-ab51-0f6956b8517q]

Report Type: Reset Decolorize Hide Re-Balloon Export Import Bind HTML Report 3D HTML Report PDF Report Publish Import

Tag	Saved View	Feature Name	Annotation Name	GD&T	(-)	/	(+)	DRF
1	01_TOP	Opposite Planes 517	ad21	3.000 ±.005	-.005	3.000	.005	-
2.1	01_TOP	Cylinder 512	ad11	Ø.350 ±.010	-.010	.350	.010	-
2.2	01_TOP	Cylinder 514	ad11	Ø.350 ±.010	-.010	.350	.010	-
2.3	01_TOP	Cylinder 513	ad11	Ø.350 ±.010	-.010	.350	.010	-
2.4	01_TOP	Cylinder 515	ad11	Ø.350 ±.010	-.010	.350	.010	-
3.1	01_TOP	Cylinder 512	gp0	⊕ Ø.015 A B C	-	-	.015	A/B/C
3.2	01_TOP	Cylinder 514	gp0	⊕ Ø.015 A B C	-	-	.015	A/B/C
3.3	01_TOP	Cylinder 513	gp0	⊕ Ø.015 A B C	-	-	.015	A/B/C
3.4	01_TOP	Cylinder 515	gp0	⊕ Ø.015 A B C	-	-	.015	A/B/C
4	01_TOP	Opposite Planes 521	ad23	1.500 ±.005	-.005	1.500	.005	-
5.1	01_TOP	Generic 538	gp1	⊖ .01 A B C	-	-	.01	A/B/C
5.2	01_TOP	Generic 542	gp1	⊖ .01 A B C	-	-	.01	A/B/C

↑ ↑ ↑ ↑ ↑

Characteristic IDs Presentation State Measurement Object Product and Manufacturing Information (PMI) Datum Reference Frame (DRF)

Figure 4: Characterized Bill of Characteristics (BoC)

What Foundational Elements are Needed to Support a Digital Thread?

-  Shift Characterization Left
-  Author a Complete BoC
-  Leverage Industry Standards
-  Work with trusted SMEs



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QUESTIONS?