DMSC: One Consortium; Trinity of Standards

Impacting the Digital Thread with Quality

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Abstract

• The DMSC is a non-for-profit, cooperative sponsorship, consortium organization. It was conceived & sponsored in 1983 and became a separate legal entity in 2005. Its mission is dedicated to identifying, promoting, fostering, and encouraging the development and interoperability of standards that benefit the digital metrology community. Its membership participants consist of a professional group of manufacturing metrologists, software developers, and innovators worldwide. As an ANSI accredited standards making organization the DMSC is the maintainers of Dimensional Measuring Interface Standard (DMIS) standard, developers & maintainers of the Quality Information Framework (QIF) standard, and the most recent soon, very soon developers of the Model-Based Characteristics (MBC) standard.

• The speaker will provide a brief on the DMSC and provide updates on its current triad of standards and how they work together to contribute to connecting the digital thread.
What is the DMSC?

Digital Metrology Standards Consortium (DMSC)

Mission: *We provide a standardized, interoperable, data framework for manufacturing.*

Vision: *Quality Standards that impact the digital thread through digital metrology and interoperability.*

Tagline: *Impacting the Digital Thread with Quality*

Goal: *Publish and maintain industry standards that enable and enhance digital metrology workflows in a model-based extended enterprise.*
Who is the DMSC?

Digital Metrology Standards Consortium (DMSC)

- A **non-for-profit**, cooperative sponsorship, **consortium** organization. Conceived & sponsored in 1983; Separate legal entity 2005.
- Dedicated to identifying, promoting, fostering, and encouraging the **development** and **interoperability** of standards that benefit the digital metrology community.
- Preparing standards that **impact** the digital **model-based quality** enterprise.
- A professional **group** of manufacturing metrologists, software developers, and innovators worldwide.
- **ANSI accredited** standards making organization
- Maintainers of **Dimensional Measuring Interface Standard** (DMIS) standard.
- Developers & maintainers of **Quality Information Framework** (QIF) standard.
- Developers of **Model-Based Characteristics** (MBC) proposed standard.
- **A-Liaison** member of ISO / TC184 / SC 4 (The makers of STEP)
DMSC Objectives . . .

• To **reduce** the cost of quality
• To **develop** and maintain **trusted digital** interoperability standards
• To **interconnect Quality** within the **digital thread**.
• To **enable** digital **metrology** within manufacturing, specifically within Model-Based Enterprise
• To **enable** organizations the **freedom** to choose solutions
  • Best in class
  • Best in value
  • Best in connection
With the passing of Bailey Squier on July 26th 2023, the inspiration for the Digital Metrology Standards Consortium (DMSC), its Board of Directors established the Bailey H. Squier DMSC Metrology Memorial Scholarship as a symbol of gratitude and admiration for the life, contribution, and legacy of Mr. Squier.

Curtis Brown, DMSC President, and Bailey H. Squier, DMSC Executive Director Emeritus at a recent DMSC MBC meeting, July, 2023, Arlington, TX.

With great appreciation to Ray & Tanya Admire for their support and friendship to Bailey during his later years!
DMSC’s Quality Standards Pedigree

DMIS 1.0
Began

DMIS 2.1
Accepted as ANSI Standard

DMIS 2.0
Released

DMIS 3.0
ANSI Update

DMIS 4.0
ANSI Update

DMIS 5.1
ANSI Update

DMIS 5.2
Accepted as ISO Standard

DMIS 5.3
ANSI Update w/ QIF Persistence

QIF v1.0
Accepted as ANSI Standard

QIF v2.0
ANSI Update

QIF v2.1
ANSI Update

QIF v3.0
ANSI Update

QIF v3.0
Harvested as ISO/DIS

QIF v3.0
Accepted as ISO Standard

MBC v1.0
ANSI Standard

DMIS 5.2
ANSI Update

DMIS 5.1
ANSI Update

DMIS 5.0
ANSI Update

DMIS 5.0
ANSI Update

DMIS 5.1
ANSI Update

DMIS 5.2
ANSI Update

DMIS 5.3
ANSI Update w/ QIF Persistence

QIF v3.0
Harvested as ISO/DIS

QIF v3.0
Accepted as ISO Standard


DMSC’s Quality Standards Pedigree

Digital Metrology Standards Consortium

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What is DMIS?

• **Dimensional Measuring Interface Standard (DMIS)** is an internationally recognized standard carrying [ISO 22093:2011](https://www.iso.org/standard/48082.html) status and is one of the most widely used standards related to dimensional metrology in the world. This standard has contributed to significant improvement of interoperability between CMMs, and traceability of measurement processes.

• Bi-direction communication of information between computer systems and inspection equipment (e.g., CMM)
• Establish neutral format for inspection programs and inspection results data.
• Enables machine-readable between computer equipment
• Allows human-readable and human-writable
  • Inspection Program
  • Inspection Results
• Contains high-level language extensions
• Functions as a Dimensional Measuring Equipment (DME) language.
• Provides Standard vocabulary of terms that support
  • Exchange of Inspection Program to DME Execution systems
  • Exchange of measurement and process data back to an analysis, record, and/or archiving systems.
Pre-DMIS Environment

Digital Metrology Standards Consortium | 2024

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DMIS Environment

Manual Programming

DMIS Auto Programming

Standards-Based Interoperability

Quality Information System

DME II

DME III

DMIS by DMSC

Digitally Metrology Standards Consortium | 2024
DMIS Word Count by Version

DMIS Words by Version

DMIS Standard Version

DMIS Standard Version

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What is DMIS?

- Fulfillment of a Technology Void
- Standard for Bi-directional Communication for Dimensional Measurement Data
- Specifies a Vocabulary of Terms
  - Metrology Measurement (e.g., CMM) Programs
  - Dimensional Measurement Results Data
- Neutral Information Exchange Format
- Human Readable and Writeable
- Functions as a CMM Inspection Program Language
- American & ISO Standard
DMSC at the IMTS 2008
DMIS Interoperability Demonstration

- Oct. 2008

Ray Admire, Lockheed Martin Missiles & Fire Control; John Horst, NIST; Curtis Brown, Honeywell FM&T; Jerry Lewis, Siemens; Bill Rippey, NIST; Vince Clements, Wenzel Xspect Solutions; Not Pictured: Keith Morton, Metris.
• ANSI Approved: October 5th, 2018
• Information Model: Schema: XSD/XSLT
  • QIF Document: 1
  • QIF Applications: 6
  • QIF Libraries: 15
• Normative Document: PDF
  • Pages: 537
  • Definitions: 143
  • References: ASME, ISO Standards
  • Sections: 12
  • Figures: 239
  • Tables: 11
  • Annex: 4
The QIF Standard

- Quality Information Framework (QIF) – ANSI/DMSC QIF v3.0 - 2018
- An Integrated Model for Manufacturing Quality Information
- Defines, Constrains, and Exchanges:
  - Model-Based Definition
    - Feature-Based (Metrology/Measurement)
    - Semantic PMI (Characteristics)
  - Quality Planning
    - Whats: Bill of Characteristics (BoC)
    - Hows: Inspection Plan (Methods)
  - Measurement Execution
    - DMIS 5.3 w/QPIIds
  - Measurement Results
    - Part
    - Statistical
  - Enterprise Connectivity for Quality Feedback
    - Quality Persistent ID (QPId) (i.e., Universal Unique ID (UUID))
    - 651aded1-ff04-498a-968e-044147a2506d
DMSC QIF Activity Workflow
What is the QIF?

Characteristic-Centric, Feature-Based Ontology of Manufacturing Quality Metadata

XML Technology: Simple, Modern Implementation with Built-In Code Validation

Information Semantically Linked to the Model-Based Definition for Full Information Traceability

Approved ANSI Interoperability Standard Harvested by ISO/TC 184/SC 4 as ISO/QIF 23952

(Structured Data) (Modern Approach) (Connected Data) (Standard Artifacts)
QIF Persistent Identifier (QPId) noun Cu·pid \ˈkyü-pəd\  • Universally Unique Identifier (UUID) (adopted by Microsoft as GUID)  
  • ISO/IEC 9834-8  
  • 550e8400-e29b-41d4-a716-446655440000  
  • Chances of generating two that are the same within the universe are practically nil.  
    • 340000000000000000000000000000000000000 (3.4x10^{38}) possible UUIDs  
• Allows information to be combined later without resolving identifier conflicts  
• Many software development libraries generate UUIDs  
• QPIIds uniquely identify  
  • QIF Document  
  • QIF Plan  
  • QIF Result  
  • QIF Rule Set  
  • Feature Item  
  • Characteristic Item  
  • Product Item  
  • Resource Item  

An Important Mechanism that facilitates Lifecycle Connectivity w/ Traceability
The fundamental constructs behind QIF:

- **Metrology Features & Characteristics**

Features are referenced by **Characteristics**

(aka, Product Characteristics, Verification Requirements)

- Geometric Tolerances
- Dimensional Tolerances
- Specifications
- Notes

Model geometry is wrapped by **Features**

- Different concept than CAD features!
- Sometimes referred to as:
  - Tolerance Features
  - Metrology Features
  - Measurement Features
QIF MBD (Model-Based Definition) is the basis for providing traceability to authority CAD data. It is not required for basic QIF use cases. Considered to be the strongest semantic CAD+PMI standard available.

Wide range of optional levels of detail for measurement plans:
- What to Measure: Bill of Characteristics
- How to Measure: Inspection Plan
- Assign measurement resources
- Specify sampling point locations

Specify basic or highly detailed information about available measurement equipment (e.g., CMMs, probes, calipers, gages). As always, this data is contextual and semantic.

DMIS is not part of QIF, ISO 22093, however the latest ANSI DMIS 5.3 has been updated to harmonize with the data traceability mechanisms in QIF.

Reference a bundle of QIF Results sets and specify a statistical analysis method to be carried out. Can optionally include the results of the statistical analysis as well.

Measurement results data, associated with the MBD! This can be just tolerance evaluation results and can even include all the point cloud data from the features.

Rule templates for creating measurement rule instances. (e.g., If a Surface Profile tolerance value is less than x, then use a CMM method with at least y number of point/sq.in.)
New ANSI Standard:

- **defines** common nomenclature, definitions, symbols, data structures
- **practices** for identifying, communicating, and exchanging model-based characteristics with various optional augmentations
- **behaviors** within a model-based system
- **through** both a logical data model and supporting documentation.

Enables connection points that establishes a **digital thread** at the PC definition level.
Product Characteristic (PC) Tag w/Annotation

Electronic – Intended as human-readable

Visualization of a Product Characteristic Reference Tags on at Model-Based Definition
Product Characteristic (PC) UUID Attributes

Digital – Intended as machine-readable

Representation of Product Characteristic Reference Tags & UUIDs within a Model-Based Definition
Product Characteristics Designations with all optional Augmentations Example

Example: PC Reference Tag with Every Augmentations

<REQ-ME-044< <PC041> >CR:S.2> /CMM:100%/
DMSC

Who is the DMSC?
- A professional group of manufacturing metrologists, software engineers, and digital innovators worldwide.

What is the DMSC currently doing?
- Defining & maintaining quality information exchange standards like:
  - Dimensional Measuring Interface Standard (DMIS),
  - Quality Information Framework,
  - Model-Based Characteristics
- QIF Training and Certification
- QIF 4.0 Enhancements
- Roadmap Planning

How will DMSC membership benefit your company?
- Next Slide

How do I join the DMSC?
- Final Slide
Benefits of DMSC Membership

- **Participate** in the development of new / enhancing standards through DMSC’s active Working Groups
- **Have a direct influence** on the direction and development of the worldwide QIF (and ISO) standard
- **Have access to Subject Matter Experts** (SMEs) already doing QIF production implementations
- **Share Best Practices** through educational Webinars, Technical Workshops and Round Tables
- **Engage major OEMs** that have adopted QIF as part of their Model-Based-Enterprise (MBE) Strategy
- **Solve mutual metrology industry issues** through collaboration with other DMSC members
- **Build relationships** with key vendors that have proven technology products and services
- **Advance national and international standards** for product quality data exchange
- **Gain an understanding** of how QIF relates to other accepted standards (e.g., STEP, MTConnect)
- **Establish yourself and your company** as an industry thought leader
- **Promotional opportunities** (no-cost webinars for Solution Providers) to reach scores of potential new customer
- **Early access** to innovative specifications and thinking.
Join the DMSC

www.dmsc-inc.org