ASME Standards & Certification Digital Engineering Initiatives Report

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Technical and Strategic Advisory Board - Digital Twin Task Group

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This Board considers and evaluates products and services and makes recommendations to relevant Standards and Certification bodies and other ASME business units.

The Digital Twin Task Group is currently evaluating industry needs for Digital Twin applications. Topics of current consideration include development of a Digital Twin Guidance document related to Advanced reactors and SMRs.

Task group meets monthly. If you are interested in participating in this effort contact Ryan Crane.

B89 Dimensional Metrology

ASME Staff Contact: Justin Cassamassino CassamassinoJ@ASME.org

B89 Standards Committee on Dimensional Metrology has published twenty-eight documents (e.g., standards and technical report). They have twenty-six Project Teams that report to six Divisions. The following standards

B89.4.23- 2020 X-Ray Computed Tomography (CT) Performance Evaluation

This Standard specifies the dimensional measurement accuracy of industrial X-ray computed tomography (CT) systems for length, size, and form measurands of sphere-based test objects made of homogeneous materials. Medical CT systems are outside the scope of this Standard. The material properties of the measured test objects are restricted to three classes of material selected to be representative of industrial materials: plastic polymers, aluminum alloys, and steel alloys; other materials are outside the scope of this Standard. However, this Standard may be used as a guide for testing the performance of a CT system for other materials. The evaluation of workpieces composed of multiple materials or of “density gradient” measurements, e.g., gradual density variations within the material, is outside the scope of this Standard. This Standard applies to a variety of CT systems that may vary by scanning mode and system components involved in the acquisition of images.

B89.7 series of standards on Measurement Uncertainty

B89.7.1 – 2016 (R2021) Guidelines for Addressing Measurement Uncertainty in the Development and Application of ASME B89 Documents [Technical Report]

B89.7.2 – 2014 (R2019) Dimensional Measurement Planning

B89.7.3.1 – 2001 (R2019) Guidelines for Decision Rules: Considering Measurement Uncertainty in Determining Conformance to Specifications. Work is underway to update this standard.

B89.7.3.2 – 2007 (R2021) Guidelines for the Evaluation of Dimensional Measurement Uncertainty [Technical Report]

B89.7.3.3 – 2002 (R2022) Guidelines for Assessing the Reliability of Dimensional Measurement Uncertainty Statements

B89.7.4.1 – 2005 (R2016) Measurement Uncertainty and Conformance Testing: Risk Analysis [Technical Report]

B89.7.5 – 2006 (R2016) Metrological Traceability of Dimensional Measurements to the SI Unit of Length [Technical Report]. Work is underway to update this to a standard.

B89.7.6 - 2019 Guidelines for the Evaluation of Uncertainty of Test Values Associated with the Verification of Dimensional Measuring Instruments to their Performance Specification

Digital Engineering Standards Committee - Future Consideration

ASME Staff Contact: Fred Constantino constantinof@asme.org

- STB-1-2020 Guideline on Big Data/Digital Transformation Workflows and Applications for the Oil and Gas Industry
- A Committee is being considered to develop standards or related products that advance the understanding and use of data analytics techniques and provides guidance on the steps to utilize data analytics and machine learning/artificial intelligence (ML/AI) for a given application or to address an industry need.

MAM Manufacturing and Advanced Manufacturing

MAM Standards Committee on Manufacturing & Advanced Manufacturing. There are currently four Subcommittees.

Subcommittee on Additive Manufacturing

ASME Staff Contact: Justin Cassamassino CassamassinoJ@ASME.org

Charter: Develop standards or related products that provide rules, guidance, and examples of the design, manufacture and quality assurance of additively manufactured parts. There are thirteen members. It was approved in December 2020. Their Charter is to coordinate, promote and foster the development of standards, other products or events related to Advanced Manufacturing.

Working Group on Additive Manufacturing for Nonmetallic Materials Applications

This Working Group currently has twenty-five Members and two Contributing Members. That meet monthly. Topics could include NDE, characterization of feedstocks, sampling of liquid feedstock, design practices and use of recycled polymers.

Other proposals under consideration:

Design for AM workflow practices – A Practical Guide to Engineers - all applications available to them. Exploration of capabilities, feature identification, Software identification. Build preparation, scaling volumetric to stl conversion and other topics. Based on L&D Course on AM Design for Metals.
Document Preparation to meet FAA Certification Criteria - Public Domain standards that meet the requirements for FAA Type certification of processes do not exist. The industry relies on internal standards. ASME could develop a map to guide suppliers and aircraft manufacturers through the process of Title 14 of the Code of FR 25.603 Materials, 25.605 Fabrication Methods and 25.609 Protection of structure. Guideline document to be developed.

Subcommittee on PHM Prognostics and Health Management

ASME Staff Contact: Donnie Alonzo alonzod@asme.org

Charter: Develop standards and guidelines that advance the design and implementation of monitoring, diagnostic, and prognostic capabilities, along with ways of verifying and validating their performance, to enhance adaptive maintenance and operational control strategies within manufacturing. The Subcommittee was formed in July 2018

- Prognostics is the process of predicting the reliability of a product or process.
- Health Management refers to the process of measurement, recording, and monitoring equipment deviation from normal operation conditions.

A white paper has been developed to delineate the goals, scope, and benefit of implementing Prognostics & Health Management (PHM). This white paper characterizes key considerations that should be kept in mind when addressing manufacturing problems or pain points with PHM technologies. Whitepaper link to download.

The Committee has completed the draft guideline. It is an extension of the white paper and will cover: Baseline Metrics and identification of pain points, PHM readiness characterization, where to deploy and improve existing PHM deployments, and the determination of a PHM business case for manufacturing systems. The draft guideline is being balloted by the MAM Manufacturing and Advanced Manufacturing Standards Committee and may be published in 2023.

MBE Model Based Enterprise Standards Committee

ASME Staff Contact: Fred Constantino constantinof@asme.org

Charter: Develop standards or related products that provide rules, guidance, and examples for the creation, use and reuse of model-based datasets, data models, and related topics within a Model-Based Enterprise.

Areas of concentration for these standards include topics such as: types of models and their intended uses; rules for creating semantic PMI and its representation; types of features and data elements for model-based datasets; organizational schemas for datasets; managing links between product definition and process definition datasets; creating, managing and using technical data packages for product definition and process definition; rules governing the data quality of the model; managing discrepancies (between existing standards, data format standards, and other standards that affect model-based definition (MBD) and MBE).

A report was developed to provide a brief background and motivation for MBE and proposes a methodology for developing ASME MBE standards using a model-based approach. go.asme.org/MBEReport

MBE-1-2022 The Model-Based Enterprise (MBE) Framework.

The MBE Standards committee was issued in June 2022. This document defines the concept of an MBE, and its elements, by providing a high-level structural definition. An MBE may be viewed as a system of systems having its own elements and interfaces. The purpose of this standard is to support consistent definition, organization, and relationships for high-level elements of an MBE to facilitate integrating elements of an MBE, sharing information across the constituent elements of an MBE, and exploiting the requirements defined in the MBE standards. This standard provides understanding of what may comprise a specific MBE and the relationships between the elements in that enterprise. The MBE Framework will provide a prefabricated structure that the standards adopter can use to organize its implementation of the MBE architecture into complementary views.

PTC Performance Test Codes Standards Committee

ASME Staff Contact for PTC: Donnie Alonso AlonsoD@asme.org.

The PTC Standards Committee has 48 subcommittees related to performance measurements of powerplant related systems and equipment. Subcommittees related to Digitalization or Digital Engineering are noted below.

Charter: The Performance Test Code Standards Committee develops codes, supplements and other types of documents, which provide rules and procedures for the planning, preparation, execution, and reporting of results for performance tests and evaluations.

PTC 19.1 Committee on Test Uncertainty

Charter: Provides procedures for the evaluation of uncertainties in individual test measurements, arising from both random errors and systematic errors, and for the propagation of random and systematic uncertainties into the uncertainty of a test result.

PTC 19.1-2018 Test Uncertainty

Work is underway to update this standard.

NEW - PTC 19.1.1-202X Test Uncertainty: Example Applications and Calculations

This document is under development.

NEW - PTC DVR Committee on Control and Quality Improvement of Process Data

ASME Staff Contact: Michelle Pagano PaganoM@ASME.org

Charter: Develop procedures and guidelines for using techniques such as data validation and reconciliation to assess the quality of measurements and evaluate the reconciled results to reduce random uncertainties.

Working on development of DVR-1-20XX Data Validation and Reconciliation – Concepts, Methods, and Applications.

RAP Standards Committee on Power Plant Reliability, Availability, and Performance

ASME Staff Contact for RAP: Donnie Alonso AlonsoD@asme.org

Charter: Establish standards and guidelines that provide for the optimization of power plants to enhance reliability, availability and performance, which includes design for operation and design for maintenance. There are three Subcommittees and one joint Subcommittee.

NEW RAP/PTC Joint Subcommittee on Heat Rate

Charter: Provide procedures and methodology for power generating facilities to determine long-term power output and heat rate. This includes a measure of the quality of analysis and reporting programs used for power output and heat rate of power generating facilities.

The RAP/PTC Joint Subcommittee on Heat Rate was established in 2020 as a joint standards development activity between the RAP and PTC Standards Committees. To improve heat rate reporting, this subcommittee will apply techniques, including those from the PTC DVR Committee on Control and Quality Improvement of Process Data.

The subcommittee is working on the development of ASME HR-1-20XX Power Generating Facilities: Continuous Power Output and Heat Rate.

VVUQ Verification, Validation, and Uncertainty Quantification Standards Committee

ASME Staff Contact for both: Michelle Pagano PaganoM@ASME.org

Charter: Coordinate, promote, and foster the development of standards that provide procedures for *assessing and quantifying the accuracy and credibility* of computational models and simulations.

VVUQ 10	Computational Solid Mechanics	2001
VVUQ 20	Computational Fluid Dynamics and Heat Transfer	2004
VVUQ 30	Computational Simulation of Nuclear System Thermal Fluids Behavior	2010
VVUQ 40	Computational Modeling of Medical Devices	2011
VVUQ 50	Computational Modeling for Advanced Manufacturing	2016
VVUQ 60	Computational Modeling for Energy Systems	2017
VVUQ 70	Machine Learning	2019
	In Development: ASME VVUQ Subcommittee on Pharmaceutical Manufacturing and Airframes	

The year in the table is when that Subcommittee was formed.

Published Documents:

VVUQ 1-2022, Verification, Validation, and Uncertainty Quantification Terminology in Computational Modeling and Simulation. ANSI approved 8/8/22 and is expected to be published by the end of December 2022.

V&V 10 – 2019 Standard for Verification and Validation in Computational Solid Mechanics

V&V 10.1 – 2012 (R2022) An Illustration of the Concepts of Verification and Validation in Computational Solid Mechanics

VVUQ 10.2 – 2021 The Role of Uncertainty Quantification in Verification and Validation of Computational Solid Mechanics Models

V&V 20 – 2016 (R2021) Standard for Verification and Validation in Computational Fluid Dynamics and Heat Transfer

V&V 40 – 2018 Assessing Credibility of Computational Modeling through Verification and Validation: Application to Medical Device

Documents Under Development

There are a series of Documents under development as noted in this report. Those that are currently being balloted include:

VVUQ 20.1-202X, Supplement to V&V 20-2009 – Multivariate Metric for Validation. Working to resolve comments from first consideration ballot.

VVUQ 30.1-202X, Scaling Methodologies for Prototypical Nuclear Power Systems Response. Has been balloted twice. Working to try and resolve some remaining comments.

VVUQ 40.WG2.1-202X Assessing Computational Model Credibility Using the ASME VVUQ 40 Risk-Based Framework: Tibial Tray Component Worst-Case Size Identification for Fatigue Testing Technical Report. Working to try and resolve some remaining comments.

VVUQ 60.1-202X Considerations and Questionnaire for Simulation Software Selection - An ASME Guideline Document. Working to try and resolve some remaining comments.

VVUQ Symposium

VVUQ Symposium is held each year in May: https://event.asme.org/VandV. Next Event will be held May 17-19, 2023 in Baltimore, MD.

Y14 Standards Committee on Engineering Product Definition and Related Documentation Practices

ASME Staff Contact: Fred Constantino constantinof@asme.org

This Committee has twenty-six Subcommittees that report to it. They have published twenty-two standards. The following standards are being developed to help address Model Based Definition Standards to address data needs of Additive and Advanced Manufacturing.

Published Documents

Y 14.5 Dimensioning and Tolerancing

Y14.41-2019 Digital Product Definition Data Practices

Scope: Establishes requirements, defines exceptions, and references documents applicable to the preparation and revision of digital product definition data, such as data set(s) or graphic sheet(s) in digital format.

Y14.45 –2021 Measurement Data Reporting

Scope: Establishes uniform practices for reporting attribute or variable measurement data for the dimensioning and tolerancing specifications defined in ASME Y14.5-2018 and actual values defined in ASME Y14.5.1-2019. Measurement data used in support of product acceptance, manufacturing process evaluation, design development, and other uses is addressed. All reporting requirements are independent of the measurement process or equipment used to gather the data.

Y14.46-2022 Product Definition for Additive Manufacturing

Scope: Establishes definitions of terms and features unique to additive manufacturing (AM)

Y14.47-2019 Model Organization Practices

Scope: This standard establishes a schema for organizing a three-dimensional (3D) model and other associated information within the context of a digital product definition data set that enables a model-based enterprise.

- Formed from MIL-STD-31000A Appendix B to define a 3D technical data package (TDP)
- Includes organizational framework requirements for model-based definition (MBD)

Revision underway. Public review closed October 26, 2022.

Y14.48 – 202x Universal Direction and Load Indicators (in development)

Scope: Standardization of methods to unambiguously define and specify directions, directional requirements, loads, and loading requirements in product definition data sets.

Background - ASME product definition data standards lack a robust tool to define directions. There are methods for 2D drawings and 3D models, but none of these work on actual as-produced parts; they only work on perfect geometry in the product definition. This effort is intended to provide tools that bridge the world of perfect geometry of drawings and models and apply to actual imperfect as-produced parts and assemblies.

Uses include but are not limited to build direction in additive manufactured parts, direction of fibers in composite parts, direction of geometric tolerance zones, direction of surface texture requirements and other specifications.

PSD Plant Systems Design Standards Committee

ASME Staff Contact: Daniel Miro-Quesada miroquesadad@asme.org

Charter: To develop, review and maintain a technology neutral standard for design of plant systems for nuclear facilities, including power generation; fossil power generation facilities (e.g., coal, natural gas); oil refining; oil and natural gas production; petrochemical; chemical; and hazardous waste plants and facilities. This standard provides processes and procedures for organizations to:

(a) conduct process hazard evaluations and analysis in the early stages of design that

(1) advance as the design matures and

(2) provide structure to the development of a quantitative risk assessment;

(b) incorporate and integrate existing systems engineering design processes, practices and tools with traditional architect engineering design processes, practices and tools; and

(c) incorporate and integrate risk informed probabilistic design processes, practices and tools with traditional deterministic design processes using reliability and availability targets. The focus of this standard is to provide requirements and guidance for design processes, practices and tools that will provide a means for organizations to develop safer and more efficient system, structure, and product designs with quantified safety levels.

Document Under Development:

PSD-1 – 202X, Plant Systems Design

Subcommittees:

These subcommittees are responsible for developing toolboxes for the three technical areas of the PSD-1 Standard.

Subcommittee on Plant Risk Evaluation (PRE),

Subcommittee on Probabilistic Design Methods (PDM), and

Subcommittee on Systems Engineering Design Integration (SEDI)

Vision for publication:

The PSD Committee is using Innoslate, a model-based systems engineering (MBSE) tool, to write PSD-1 in the cloud. The goal is to also publish PSD-1 in the cloud. It is envisioned that a company can integrate their procedures with the cloud-based standard so that their procedures can easily be updated when a new edition is published. Users would also be to access the standard from multiple devices, such as phones and tablets.