

ASTM/ISO Additive Manufacturing Joint Standardization Efforts

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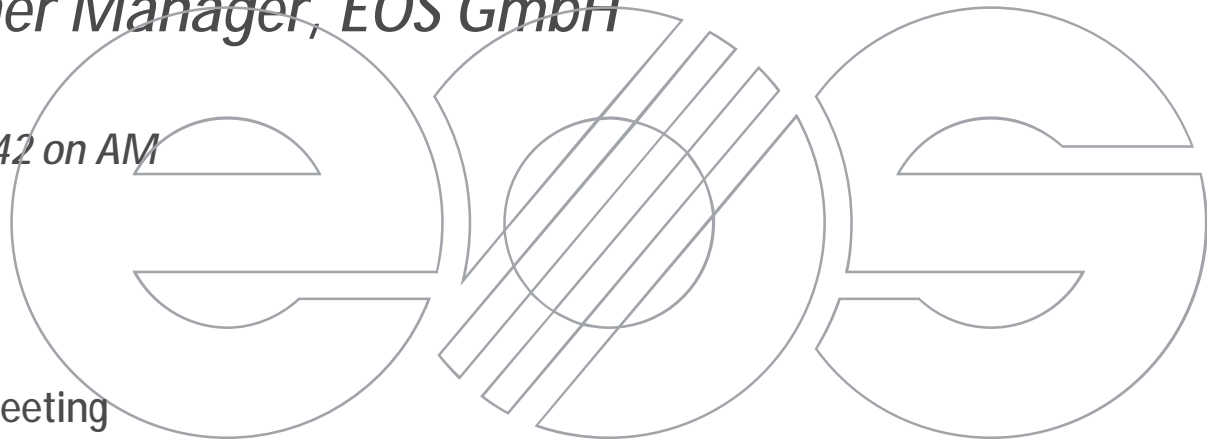
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Basics of AM standardization

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Why AM standards

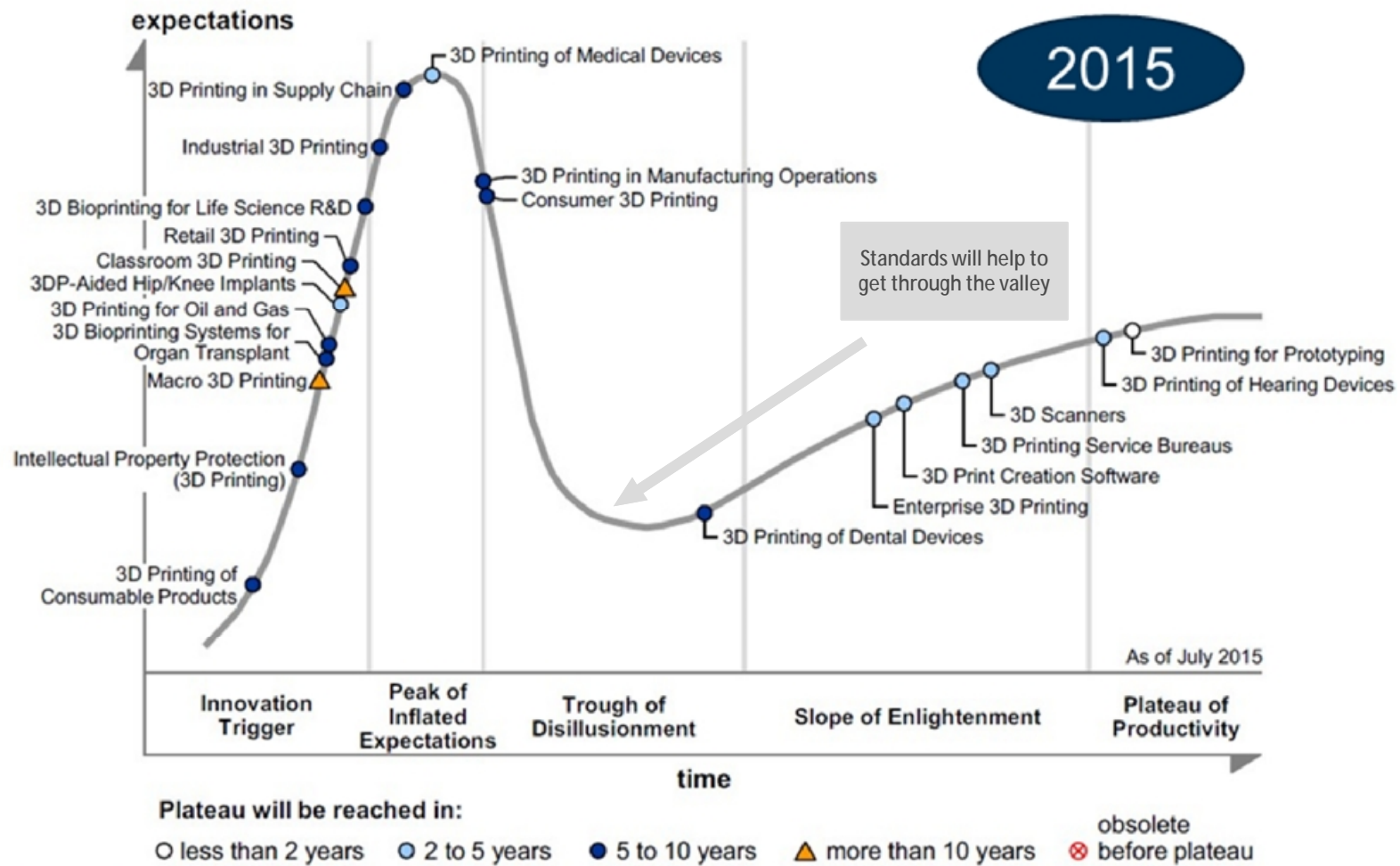
No doubt about the general need

Standards have been identified as the most important and urgent topic to enable commercialization and further push the technologies

- Various industries ask for it as a prerequisite to industrialize AM applications
- In certification-relevant industries standards are a must-have
- Supplier to the process chain need guidance and defined interfaces
- European Commission (EC) and other funding bodies consider it as a must in every project proposal
- Standard Developing Organizations (SDO) and policy identified the need in various inquiries



High Expectations – reality differs



Source: Gartner

Basics of AM Standardization

How to approach

- § Development of new AM standards plus adaptation of conventional standards (if partly applicable), but
 - § not end up in re-inventing the wheel!
 - § Involve the right people with the right expertise
 - § not lay out too wide or too academic
 - § Avoid parallel activities; risk of “losing” experts
- § Common approach with all world-wide standardization bodies and industry associations, as in a global economy there is no reason why standards/guides should define the same context differently in Europe, Asia and the US: One world – One standard
- § In the future: Also involving certification authorities



AM Technologies according to EN ISO/ASTM 52900



PSDO agreed between ISO/TC 261 and ASTM F42



A unique opportunity

- § Formal collaboration between ASTM and ISO (first of its kind!) for joint development of AM standards
- § Will result in co-branded ISO and ASTM standards (same content, no need for future harmonization)
- § Procedures for how ASTM and ISO will cooperate and work together in a practical sense are defined in the “Joint Plan for Standards Development”



CEN/TC 438 on Additive Manufacturing



The European AM committee closely linked to ISO/TC 261

- § The aim is to apply the Vienna Agreement with ISO/TC 261 "Additive Manufacturing" (DIN) to ensure consistency and harmonization
- § To strengthen the link between European Research programs and standardization in additive manufacturing
- § To ensure visibility to the European standardization in additive manufacturing by centralizing standardization initiatives in Europe on additive manufacturing



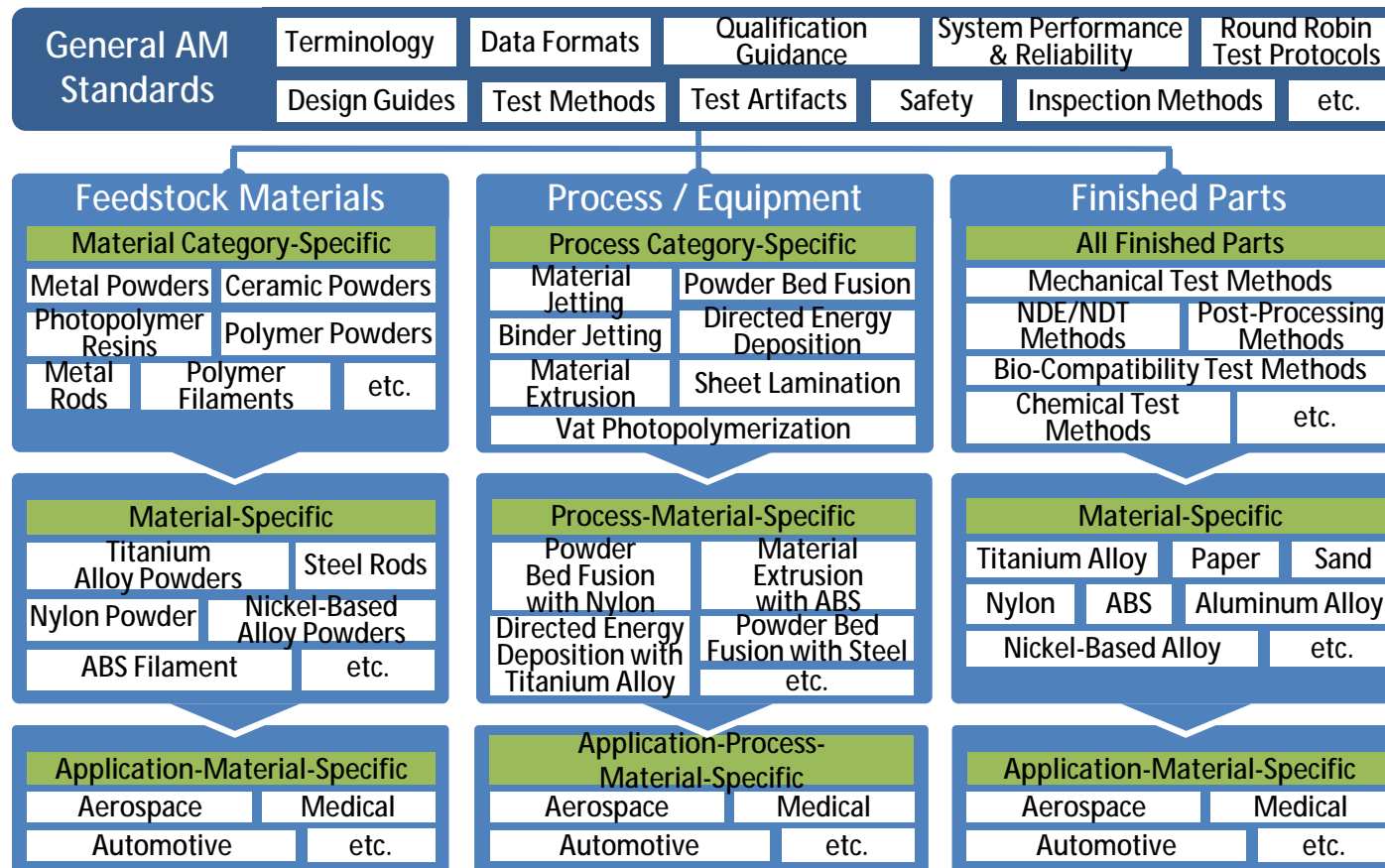
Guiding principles

The community has a plan

- § One set of AM standards – to be used all over the world
- § Common roadmap and organizational structure for AM standards
- § Use and build upon existing standards, modified for AM when necessary
- § For efficiency and effectiveness, ISO TC261 and ASTM F42 should begin the work together and in the same direction
- § Emphasis on joint standards development



Structuring the AM standard development



General Top-Level AM Standards

- General concepts
- Common requirements
- Generally applicable

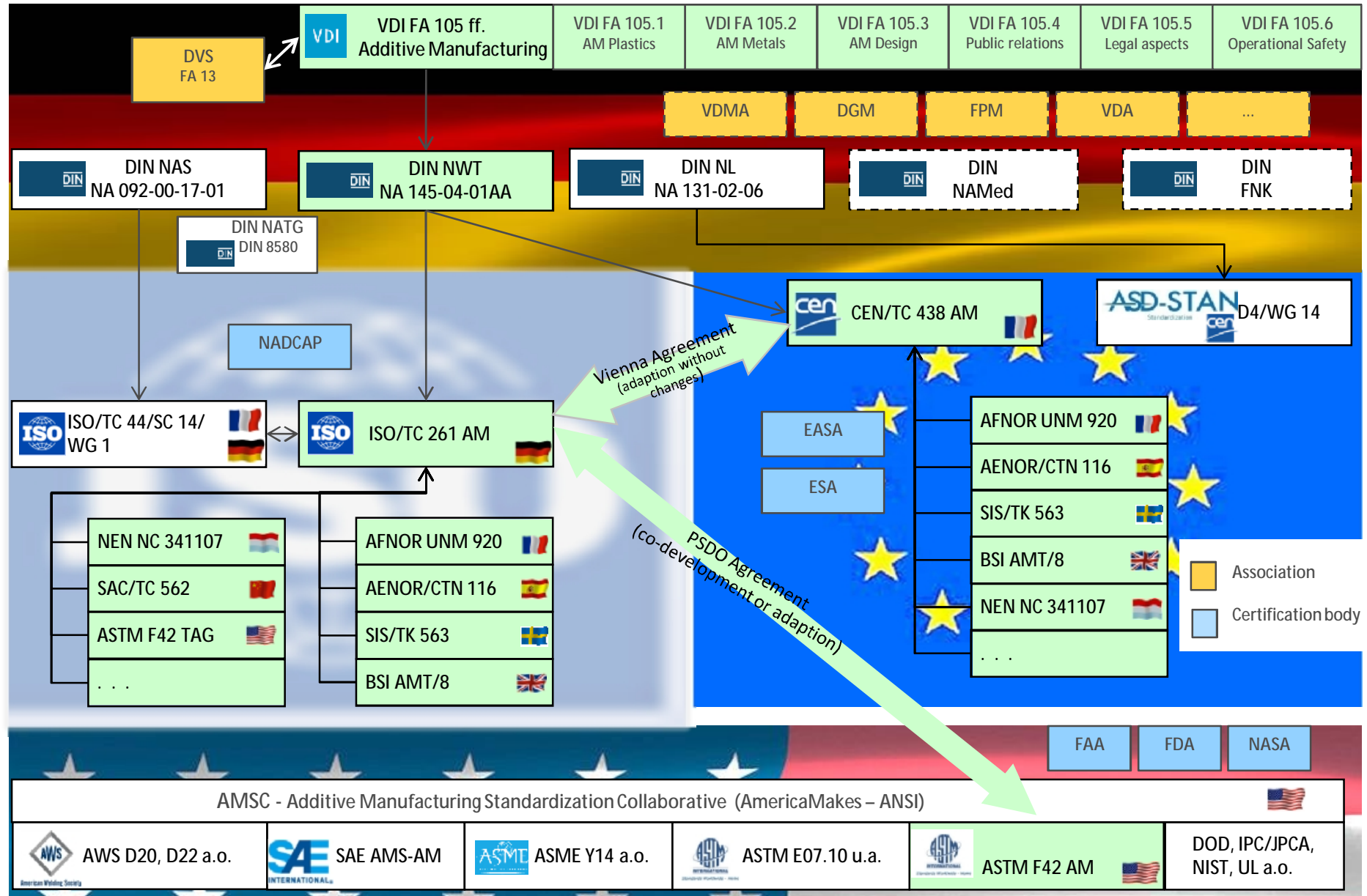
Category AM Standards

Specific to material category or process category

Specialized AM Standards

Specific to material, process, or application

The world of AM standardization



ISO/TC 261 Liaisons

Liaison to ISO/TC 261

IEC/TC 76	Optical radiation safety & laser equipment
ISO/IEC JTC 1	Information technology
ISO/TC 39	Machine tools
ISO/TC 44	Welding and allied processes
ISO/TC 44/SC 14	Welding and brazing in aerospace
ISO/TC 119	Powder metallurgy
ISO/TC 150	Implants for surgery
ISO/TC 184/SC 1	Physical device control
ISO/TC 184/SC 4	Industrial data
ISO/TC 292	Security and resilience

CEN/TC 438, EWF

Liaison from ISO/TC 261

IEC/TC 76	Optical radiation safety & laser equipment
ISO/IEC JTC 1	Information technology
ISO/TC 35	Non-destructive testing
ISO/TC 44	Welding and allied processes
ISO/TC 44/SC 5	Testing and inspection of welds
ISO/TC 44/SC 14	Welding and brazing in aerospace
ISO/TC 61	Plastics
ISO/TC 61/SC 9	Thermoplastic materials
ISO/TC 119	Powder metallurgy
ISO/TC 184	Automation systems and integration
ISO/TC 213	Dimensional & geometrical product specifications & verification
ISO/TC 292	Security and resilience

Standards published

ISO/TC 261 (*as of September 2017*)

- § ISO/ASTM 52900:2015, Additive manufacturing -- General principles – Terminology
- § ISO/ASTM 52901:2017, Additive manufacturing -- General principles -- Requirements for purchased AM parts
- § ISO/ASTM 52915:2016, Standard specification for additive manufacturing file format (AMF) Version 1.2
- § ISO/ASTM 52921:2013, Standard terminology for additive manufacturing -- Coordinate systems and test methodologies
- § ISO 17296-2:2015, Additive manufacturing -- General principles -- Part 2: Overview of process categories and feedstock
- § ISO 17296-3:2014, Additive manufacturing -- General principles -- Part 3: Main characteristics and corresponding test methods
- § ISO 17296-4:2014, Additive manufacturing -- General principles -- Part 4: Overview of data processing



Standards published



ASTM F42 (as of September 2017)

- § F2971-13 Standard Practice for Reporting Data for Test Specimens Prepared by Additive Manufacturing
- § F3122-14 Standard Guide for Evaluating Mechanical Properties of Metal Materials Made via Additive Manufacturing Processes
- § ISO/ASTM 52910 Guide for Design for Additive Manufacturing
- § F2924-14 Standard Specification for Additive Manufacturing Titanium-6 Aluminum-4 Vanadium with PBF
- § F3001-14 Standard Specification for Additive Manufacturing Titanium-6 Aluminum-4 Vanadium ELI (Extra Low Interstitial) with PBF
- § F3049-14 Standard Guide for Characterizing Properties of Metal Powders Used for Additive Manufacturing Processes
- § F3055-14a Standard Specification for Additive Manufacturing Nickel Alloy (UNS N07718) with PBF
- § F3056-14e1 Standard Specification for Additive Manufacturing Nickel Alloy (UNS N06625) with PBF
- § F3091/F3091M-14 Standard Specification for PBF of Plastic Materials
- § F3184-16 Standard Specification for Additive Manufacturing Stainless Steel Alloy (UNS S31603) with PBF
- § F3187-16 Standard Guide for Directed Energy Deposition of Metals



ISO/TC 261 and ASTM F42 collaboration



Joint Groups (*as of September 2017, much more to come*)

- JG51: Terminology – Klas Boivie: Klas.Boivie@sintef.no
- JG52: Standard Test Artifacts – Shawn Moylan: shawn.moylan@nist.gov
- JG53: Requirements for Purchased AM Parts – Philippe Bertrand: philippe.bertrand@enise.fr
- JG54: Design Guidelines – David Rosen david.rosen@me.gatech.edu
- JG55: Standard Specification for Extrusion Based Additive Manufacturing of Plastic Materials – Ralph Buoniconti: Ralph.Buoniconti@sabic.com
- JG56: Standard Practice for Metal PBF to Meet Rigid Quality Requirements – Shane Collins scollins@calraminc.com
- JG57: Specific Design Guidelines on PBF – Christian Seidel: christian.seidel@iwb.tum.de
- JG58: Qualification, Quality Assurance and Post Processing of PBF Metallic Parts – Marius Lakomic: marius.lakomic@eos.info
- JG59: NDT for AM Parts – Ben Dutton: ben.dutton@the-mtc.org



ISO/TC 261 and ASTM F42 collaboration



Joint Groups (*as of September 2017, much more to come*)

- JG60: Guide for Intentionally Seeding Flaws in Additively Manufactured (AM) Parts – TBD
- JG61: Guide for Anisotropy Effects in Mechanical Properties of AM Parts – Mohsen Seifi mohsen.seifi@case.edu
- JG62: Guide for Conducting Round Robin Studies for Additive Manufacturing – Peter Wooliams peter.wooliams@npl.co.uk
- JG63: Test Methods for Characterization of Powder Flow Properties for AM Applications – Justin Whiting justin.whiting@nist.gov
- JG64: Specification for AMF Support for Solid Modeling: Voxel Information, Constructive Solid Geometry Representations and Solid Texturing – Jérémie Farret
- JG65: Specification for Additive Manufacturing Stainless Steel Alloy with PBF –
- JG66: Technical Specification on Metal Powders – Remi Giraud: remi.giraud@eramet-erasteel.com
- JG67: Design of Functionally Graded Materials – Eujin Pei eujinpei1@gmail.com
- JG68: Additive Manufacturing Safety – TBD



Summary

We are just in the beginning of exploring the many possibilities of AM technology

Knowledge is critical; this is a learning process for all of us

Misdirected expectations leads to disappointments - Demand-orientation

No one benefits from competing standards - Coordinated development

Faster development/publishing of standards – without loss of quality !

Acquire more experts by offering incentives

Look for financing possibilities (funding, donations, regrouping of contributions, ...)

Please join and take part in the ongoing efforts through ASTM, ISO and your national standardization organizations!

Let's work together and get this right!



THANK YOU FOR YOUR ATTENTION !

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