

ASTM INTERNATIONAL  
Additive Manufacturing Center of Excellence

# Additive Manufacturing Programs Brief

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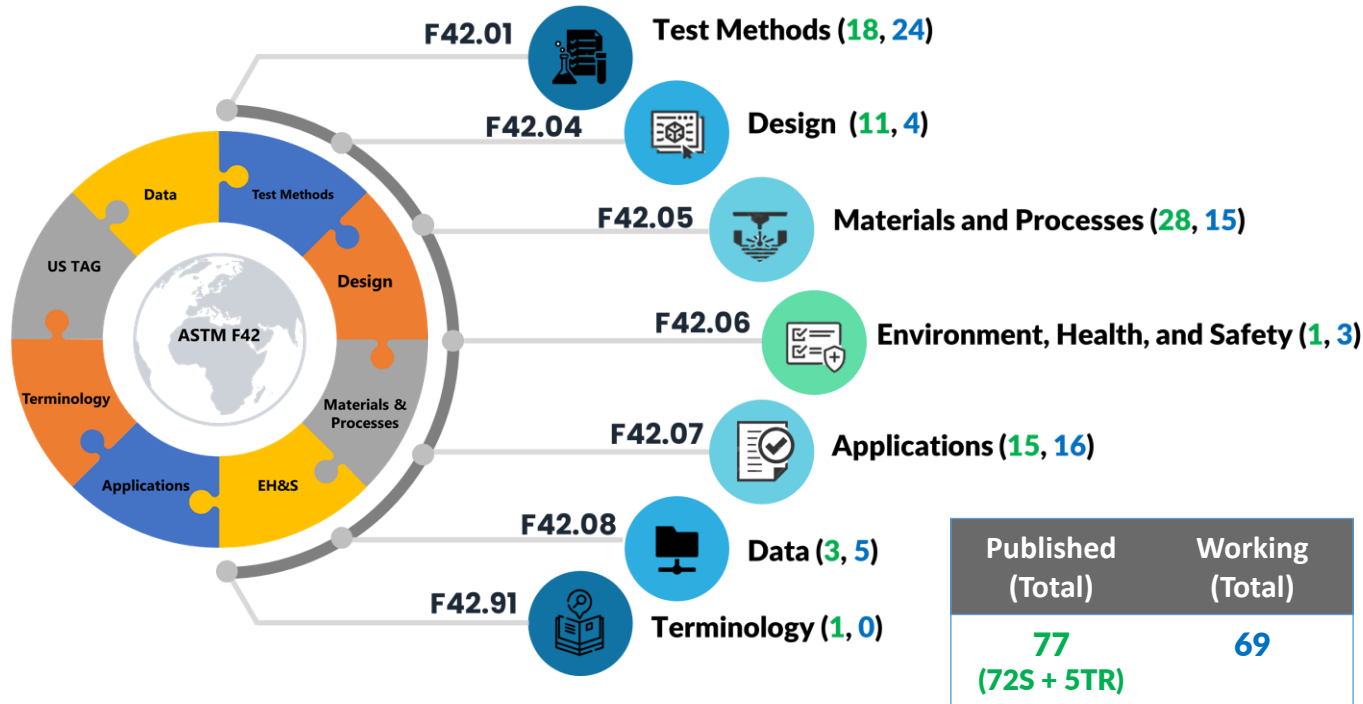
[www.amcoe.org](http://www.amcoe.org)

# ASTM AM Standards Footprint

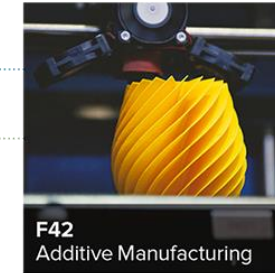
Co-operative Efforts  
Driven by AM Users



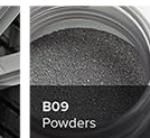
CENTER of  
EXCELLENCE  
Research to Standards  
ADDITIVE MANUFACTURING



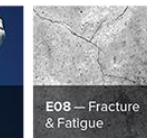
- More than 20 AM relevant Committees
- 1000+ standards applicable to AM
- 2000+ technical experts



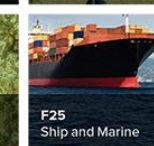
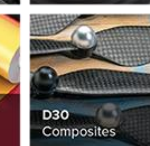
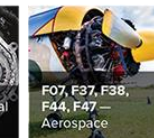
Feedstock



Test Methods



Applications



- **Established:** 2009 (Oldest, largest committee on AM)
- **Current Membership:** 1200+ members (30% outside the US)
- **Standards:** ~77 published, 69 work items in development
- **Global Representation:** 35+ countries involved

## • Collaboration:

- Partnership with ISO TC261 (& CEN TC438) – PSDO in 2011
- Strategic Relationships – America Makes, NIST, NASA, FAA, FDA, DOD, MMPDS, CMH17 ....

<https://www.astm.org/get-involved/technical-committees/committee-f42>



F42.01 Test Methods		F42.04 Design	F42.05 Materials & Processes		F42.06 Environment, Health, and Safety	F42.07 Applications		F42.08 Data	Others
ISO/ASTM 52902-23 Additive manufacturing – Test artifacts – Geometric capability assessment of additive manufacturing systems	ISO/ASTM 52907-19 Additive manufacturing – Feedstock materials – Methods to characterize metallic powders	ISO/ASTM 52910-18 Additive manufacturing – Design – Requirements, guidelines and recommendations	ISO/ASTM 52901-17 / F3167-2016 (2023) Additive manufacturing – General principles – Requirements for purchased AM parts	ISO/ASTM 52903-1-20/ F3241-2017 Additive manufacturing – Material extrusion-based additive manufacturing of plastic materials – Part 1: Feedstock materials	ISO/ASTM 52931-2023 / F3546-23 Additive manufacturing of metals – Environment, health and safety – General principles for use of metallic materials	ISO/ASTM 52926-1-2023/ F3500-2021 Additive Manufacturing of metals - Qualification principles - Part 1: General qualification of operators	ISO/ASTM 52926-2-2023/ F3466-2022 Additive Manufacturing of metals - Qualification principles - Part 2: Qualification of operators for PBF-LB	F3490-2021 Standard Practice for Additive Manufacturing – General Principles – Overview of Data Pedigree	B312-17 Standard Test Method for Apparent Density of Free-Flowing Metal Powders Using the Hall Flowmeter Funnel
ISO/ASTM 52909-22 Additive manufacturing of metals – Finished part properties – Orientation and location dependence of mechanical properties for metal powder bed fusion	ISO/ASTM TR52917-EB ISO/ASTM TR 52917-2022 Additive manufacturing – Round Robin Testing – General Guidelines	ISO/ASTM 52911-1-19 Additive manufacturing – Design – Part 1: Laser-based powder bed fusion of metals	ISO/ASTM 52903-2-20/ F3475-2019 Additive manufacturing – Material extrusion-based additive manufacturing of plastic materials – Part 2: Process equipment	ISO/ASTM 52904-2024/ F3303-2019 Additive Manufacturing – Process Characteristics and Performance- Practice for Metal Powder Bed Fusion Process to Meet Critical Applications	ISO/ASTM 52933-2024 / F3655-24 Additive manufacturing – Environment, health and safety – Test method for the hazardous substances emitted from material extrusion type 3D printers in the non-industrial places	ISO/ASTM 52926-3-2023/ F3467-2022 Additive manufacturing of metals - Qualification principles - Part 3: Qualification of operators for PBF-EB	ISO/ASTM 52926-4-2023/ F3468-2021 Additive manufacturing of metals - Qualification principles - Part 4: Qualification of operators for DED-LB	F3560-2022 Standard Specification for Additive Manufacturing – Data – Common Exchange Format for Particle Size Analysis by Light Scattering	B213-20 Standard Test Methods for Flow Rate of Metal Powders Using the Hall Flowmeter Funnel
ISO/ASTM 52921-13 (2019) ISO17295-2023 / F2921-2013(2019) Additive manufacturing – General principles – Part positioning, coordinates and orientation	ISO/ASTM 52927 / NEWSTD(3742Z) WK82656 Additive manufacturing – General principles – Main characteristics and corresponding test methods	ISO/ASTM52911-2-19 Additive manufacturing – Design – Part 2: Laser-based powder bed fusion of polymers	ISO/ASTM 52906-2022 Additive manufacturing – Non-destructive testing – Intentionally seeding flaws in metallic parts	ISO/ASTM 52908-2023/ F3591-2023 Additive manufacturing of metals – Finished part properties – Post-processing, inspection and testing of parts produced by powder bed fusion	NEWSTD(20422Z) WK73227 Guide for Investigation for Additive Manufacturing (AM) Facility Safety Management	ISO/ASTM 52926-5-2023 Additive manufacturing of metals - Qualification principles - Part 5: Qualification of operators for DED-Arc	ISO/ASTM 52939-23 Additive manufacturing for construction – Qualification principles – Structural and infrastructure elements	F3605-2023 Standard Guide for Additive Manufacturing of Metals—Data—File Structure for In-Process Monitoring of Powder Bed Fusion (PBF)	B214-16 Standard Test Method for Sieve Analysis of Metal Powders
ISO/ASTM 52936-1-2023 Additive manufacturing of polymers – Qualification principles – Part 1: General principles and preparation of test specimens for PBF-LB	ISO/ASTM TR 52952-2023 Additive Manufacturing of metals – Feedstock materials – Correlating of rotating drum measurement with powder spreadability in PBF-LB machines	ISO/ASTM52911-3-23 Additive manufacturing – Design – Part 3: PBF-EB of metallic materials	ISO/ASTM 52920-2023 / F3501-2023 Additive manufacturing - Qualification principles - Requirements for industrial additive manufacturing processes and production sites	ISO/ASTM 52924-2-2023 Additive manufacturing of polymers – Qualification principles – Classification of part properties	ISO/ASTM 52938-1 / NEWSTD(20827Z) WK74933 Specification for Additive manufacturing of metals – Environment, health and safety – Part 1: Safety requirements for PBF-LB machines	ISO/ASTM 52941-20 Additive manufacturing – System performance and reliability – Acceptance test for laser metal powder bed fusion machines for metallic materials for aerospace application	ISO/ASTM 52942-20 Additive manufacturing – Qualification principles – Qualifying machine operators of laser metal powder bed fusion machines and equipment used in aerospace applications	NEWSTD(20607Z) WK73978 Specification for Additive manufacturing for metals – General principles – Registration of data acquired from process-monitoring and for quality control	B215-20 Standard Practices for Sampling Metal Powders
F2971-13 Standard Practice for Reporting Data for Test Specimens Prepared by Additive Manufacturing	F3122-2023 Standard Guide for Evaluating Mechanical Properties of Metal Materials Made via Additive Manufacturing Processes	ISO/ASTM TR 52912-2020 Additive manufacturing – Design – Functionally graded additive manufacturing	ISO/ASTM 52925-2022/ F3465-2021 Additive manufacturing of polymers – Feedstock materials – Qualification of materials for laser-based powder bed fusion of parts	ISO/ASTM 52928-2024 Additive manufacturing of metals – Feedstock materials – Powder life cycle management		ISO/ASTM 52943-2-2024 / F3594-2023 Additive manufacturing for aerospace -- Process characteristics and performance -- Part 2: Directed energy deposition using wire and arc		NEWSTD(2230Z) WK6970 Standard Guide for Additive Manufacturing – General Principles – Guidelines for Technical and Intellectual Property Authentication and Protection	B243-20 Standard Terminology of Powder Metallurgy
ASTM F3489-23 Standard Guide for Additive Manufacturing of Polymers – Material Extrusion – Recommendation for Material Handling and Evaluation of Static Mechanical Properties	F3522-2022 Standard Guide for Additive Manufacturing of Metals – Feedstock Materials – Assessment of Powder Spreadability	ISO/ASTM52915-20 Specification for additive manufacturing file format (AMF) Version 1.2	ISO/ASTM TS 52930-21 / F3434-2021 Additive manufacturing – Qualification principles – Installation, operation and performance (IQ/OQ/PQ) of PBF-LB equipment	ISO/ASTM 52935-23/ F3621-2023 Additive manufacturing of metals – Qualification principles – Qualification of coordination personnel		F3456-2022 Guide for Powder Reuse Schema in Powder Bed Fusion Processes for Medical Applications for Additive Manufacturing Feedstock Materials	F3554-2022 Standard Specification for Additive Manufacturing – Finished Part Properties – Grade 4340 (UNS G43400) via Laser Beam Powder Bed Fusion for Transportation Applications	NEWSTD(21751Z) WK78322 Standard Guide for Additive Manufacturing – General Principles – Guidelines for AM Security	B329-20 Standard Test Method for Apparent Density of Metal Powders and Compounds Using the Scott Volumeter
F3571-2022 Standard Guide for Additive Manufacturing – Feedstock – Particle Shape Image Analysis by Optical Photography to Identify and Quantify the Agglomerates/Satellites in Metal Powder Feedstock	F3606-2022 Standard Guide for Additive Manufacturing – Feedstock Materials – Testing Moisture Content in Powder Feedstock	ISO/ASTM TR 52916-2022 / NEWSTD(20611Z) WK74006 Additive manufacturing for medical – Data – Optimized medical image data	ISO/ASTM 52948-2023 / F3608-2023 Additive manufacturing for automotive – Qualification principles – Generic machine evaluation and specification of key performance indicators for PBF-LB/M processes	F2924-14(2021) Standard Specification for Additive Manufacturing Titanium-6 Aluminum-4 Vanadium with Powder Bed Fusion		F3572-2022 Standard Practice for Additive Manufacturing – General Principles – Part Classifications for Additive Manufacturing Parts Used in Aviation	F3604-23 Standard Practice for Validating the Additive Manufacturing (AM) Production Process for Medical Devices Produced Using Laser Powder Bed Fusion	NEWSTD(25472Z) WK85641 Specification for Additive Manufacturing-Data -Data Packages for AM Parts	B417-18 Standard Test Method for Apparent Density of Non-Free-Flowing Metal Powders Using the Carney Funnel
F3615-23 Standard Practice for Additive Manufacturing – Powder Bed Fusion – Condition-Defined Maintenance for Optical Systems	F3624-2023 Standard Guide for Additive Manufacturing of Metals – Powder Bed Fusion – Measurement and Characterization of Surface Texture	ISO/ASTM52950-21 Additive manufacturing – General principles – Overview of data processing	F3001-14 Specification for Additive Manufacturing Titanium-6 Aluminum-4 Vanadium ELI (Extra Low Interstitial) with Powder Bed Fusion	F3049-14(2021) Guide for Characterizing Properties of Metal Powders Used for Additive Manufacturing Processes		F3605-23 Standard Specification for Additive Manufacturing – Finished Part Properties – Standard Specification for Niobium-Hafnium Alloy UNS R04295 via Laser Beam Powder Fusion for Spaceflight Applications	F3674-2024 Practice for Additive Manufacturing - Part Grades for Automotive Applications	NEWSTD(29654Z) WK89945 Specification for Additive Manufacturing – Data – Common Data Exchange Format for Laser Blown Powder Directed Energy Deposition (DED)	B527-20 Standard Test Method for Tap Density of Metal Powders and Compounds
F3626-2023 Standard Guide for Additive Manufacturing – Test Artifacts – Accelerated Build Quality Assurance for Laser Beam Powder Bed Fusion (PBF-LB)	F3637-23 Standard Guide for Additive Manufacturing of Metal – Finished Part Properties – Methods for Relative Density Measurement	F3488-2022 Guide for Additive Manufacturing Design - Decision Guide	F3055-14A(2021) Standard Specification for Additive Manufacturing Nickel Alloy (UNS N07718) with Powder Bed Fusion	F3056-14(2021) Standard Specification for Additive Manufacturing Nickel Alloy (UNS N06625) with Powder Bed Fusion		NEWSTD(20169Z) WK90347 Practice for Additive Manufacturing – Curing and Extraction of Sample from Additively Constructed Concrete and Mortar Components	NEWSTD(20173Z) WK90348 Test Method for Additive Manufacturing – Determination of Hardened Mechanical Properties of Additively Constructed Concrete and Mortar		B822-20 Standard Test Method for Particle Size Distribution of Metal Powders and Related Compounds by Light Scattering
NEWSTD(28396Z) WK40419 Test Methods for Performance evaluation of additive manufacturing systems through measurement of a manufactured test piece	NEWSTD(29605Z) WK66030 Guide for Additive Manufacturing of Metals – Feedstock Materials – Standard Guide of Metal Powder Feedstock Characterization Data for the Purpose of Comparative Quality Evaluation	F3529-2021 Guide for Additive Manufacturing Design Material Extrusion of Polymers	F3091-F3091M-14(2021) Standard Specification for Powder Bed Fusion of Plastic Materials	F3184-2016(2023) Specification for Additive Manufacturing Stainless Steel Alloy (UNS S31603) with Powder Bed Fusion		NEWSTD(20660Z) WK74302 Specification for Additively Manufactured Polymeric Residential Construction	NEWSTD(20899Z) WK75329 Practice for Nondestructive Testing (NDT), Inspection Levels and Acceptance Criteria for Parts Manufactured with Laser Based Powder Fusion	F42.91 Terminology	B855-17 Standard Test Method for Volumetric Flow Rate of Metal Powders Using the Arnold Meter and Hall Flowmeter Funnel
NEWSTD(29912Z) WK71391 Guide for Additive Manufacturing – Static Properties for Polymer AM (Continuation)	NEWSTD(20472Z) WK73340 Test Method for Additive Manufacturing – Dynamic Properties – Polymer Additive Manufacturing	F3530-2022 Guide for Additive Manufacturing – Design – Post-Processing for Metal PBF-LB	F3187-16(2023) Standard Guide for Directed Energy Deposition of Metals	F3213-17 Standard for Additive Manufacturing – Finished Part Properties – Standard Specification for Cobalt-28 Chromium-6 Molybdenum via Powder Bed Fusion		NEWSTD(21730Z) WK78110 Guide for Additive Manufacturing – General Principles – Development and Road mapping of Additive Construction Standards	NEWSTD(21767Z) WK78378 Specification for Additive Manufacturing for Automotive – Qualification Principles – Generic Machine Evaluation and KPI Definition for PBF-LB/M Processes	ISO/ASTM52900-21 Additive manufacturing – General principles – Fundamentals and vocabulary	B923-21 Standard Test Method for Metal Powder Skeletal Density by Helium or Nitrogen Pycnometry
NEWSTD(20949Z) WK75584 Test Method for Additive Manufacturing Non-destructive testing and evaluation of fatigue cracks using tensioned computed tomography	NEWSTD(21026Z) WK75901 Test Method for Additive Manufacturing – Test Artifacts – Miniature Tension Testing of Metallic Materials	NEWSTD(21082Z) WK83109 Guide for Additive Manufacturing – Design – Vat Photopolymerization	F3301-18A Standard for Additive Manufacturing – Post Processing Methods – Standard Specification for Thermal Post-Processing Metal Parts Made Via Powder Bed Fusion	F3302-18 Standard for Additive Manufacturing – Finished Part Properties – Standard Specification for Titanium Alloys via Powder Bed Fusion		NEWSTD(21808Z) WK78465 Specification for Additive Manufacturing for Medical- Non-destructive Testing and Evaluation-Test Method for Evaluation of Porous Structures in Medical Implants via Computed Tomography Scanning	NEWSTD(22757Z) WK81114 Practice for Additive Manufacturing – General Principles – Design Process of Additively Manufactured Construction Elements		B964-16 Standard Test Methods for Flow Rate of Metal Powders Using the Carney Funnel
NEWSTD(21074Z) WK76038 Test Method for Additive Manufacturing of Metals – Non-destructive testing and evaluation – Porosity Measurement with X-ray CT	NEWSTD(21101Z) WK76163 Test Method for Additive Manufacturing of Metals – Test Artifacts – Compression Validation Coupons for Lattice Designs	ISO/ASTM CD TR 52918 Additive manufacturing – Data formats – File format support, ecosystem and evolutions	F3318-18 Standard for Additive Manufacturing – Finished Part Properties – Specification for AISI30Mg with Powder Bed Fusion – Laser Beam	F3592-2023 Standard Guide for Additive Manufacturing of Metals – Powder Bed Fusion – Guidelines for Feedstock Re-use and Sampling Strategies		NEWSTD(21818Z) WK81194 Specification for Additive Manufacturing – Qualification Principles – Part Families-based Qualification in AM	NEWSTD(23646Z) WK82605 Specification for Additive Manufacturing - General Principles – Metal Laser Beam Powder Bed Fusion Machines for Spaceflight Applications		E1019-18 Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Inert Gas Fusion Techniques
NEWSTD(21329Z) WK77008 Guide for Additive Manufacturing – Laser Powder Bed Fusion – Guide for Benchmarking of Powder Bed Density	NEWSTD(22190Z) WK80171 Guide for Additive Manufacturing of Metals – Feedstock Materials – Measurement and Classification of Feedstock Contamination	ISO/ASTM CD 52922 / F3413-19E1 WK87652 Additive manufacturing – Design – Directed energy deposition of metals	F3607-2022 Standard Specification for Additive Manufacturing – Finished Part Properties – Maraging Steel via Powder Bed Fusion	F3701-2024 Specification for Additive manufacturing of ceramics – Feedstock materials – Characterization of ceramic slurry in vat photopolymerization		NEWSTD(23789Z) WK82776 Test Method for Additive Manufacturing for Medical - Powder Bed Fusion - Assessment of Residual Powder	NEWSTD(24749Z) WK84415 Practice for - Additive Construction - General Principles - Standard Practice for the Evaluation of Structural Printed Elements		E1834-18 Standard Test Method for Analysis of Nickel Alloys by Graphite Furnace Atomic Absorption Spectrometry
NEWSTD(23068Z) WK81710 Test Method for Additive Manufacturing of Polymers – Material Extrusion – Test method for In-Plane Shear Properties	NEWSTD(23937Z) WK83110 Practice for Additive Manufacturing - Powder bed fusion - Measurement for load-bearing area for mechanical testing with as-printed surfaces		NEWSTD(20403Z) WK65929 Specification for Additive Manufacturing- Finished Part Properties and Post Processing- Additively Manufactured Spaceflight Hardware by Laser Beam Powder Bed Fusion in Metals	NEWSTD(2466Z) WK69732 Guide for Wire Arc Directed Energy Deposition		NEWSTD(24825Z) WK84537 Specification for Additive Manufacturing – Finished Part Properties – Titanium-27Niobium-21Zirconium via Laser Beam Powder Bed Fusion for Medical Implant Applications	NEWSTD(29482Z) WK89706 Practice for Additive Manufacturing – Fresh and Very Early Age properties of concretes used for Additively Constructed Concrete by Means of Extrusion		E2465-19 Standard Test Method for Analysis of Ni-Base Alloys by Wavelength Dispersive X-Ray Fluorescence Spectrometry
NEWSTD(23944Z) WK83145 Practice for Additive Manufacturing - Feedstock Materials - Assessing the effect of moisture	NEWSTD(24543Z) WK84156 Test Method for Indentation Plastometry of Metallic Materials		NEWSTD(20434Z) WK73236 Additive manufacturing of metals – Qualification principles – Qualification of coordination personnel	NEWSTD(20823Z) WK74931 Specification for Additive manufacturing of metal – Feedstock materials – Powder life cycle management		NEWSTD(24959Z) WK89707 Practice for Additive Manufacturing – Construction and Documentation of Additively Constructed Concrete and Mortar Components	NEWSTD(29809Z) WK90089 Test Method for Additive manufacturing of medical devices - Test Method - Relative Density of Porous Structures via Gravimetric Analysis		E2823-17 Standard Test Method for Analysis of Nickel Alloys by Inductively Coupled Plasma Mass Spectrometry (Performance-Based)
NEWSTD(25141Z) WK85120 Test Method for Additive Manufacturing – Measurement of grain size distribution in additively manufactured materials	NEWSTD(25161Z) WK85121 Practice for Additive Manufacturing – Nondestructive examination of polymeric and nonmetallic additively manufactured parts after build		NEWSTD(20888Z) WK75265 Guide for Additive Manufacturing of Polymers– Powder Bed Fusion – Guidelines for Feedstock Reuse and Sampling Strategies	NEWSTD(22927Z) WK81462 Specification for Additive manufacturing of metals – Powder bed fusion – Presentation of material properties in material data sheets					E2954-15 Standard Test Method for Axial Compression Test of Reinforced Plastic and Polymer Matrix Composite Vertical Members
NEWSTD(25510Z) WK85661 Test Method for Additive Manufacturing - Procedure And Coupon Geometry - Distortion And Residual Stresses Assessment Of Additively Manufactured Parts	NEWSTD(25656Z) WK85748 Specification for Additive manufacturing – Qualification principles – Optical properties of fixed resolution UV engine		NEWSTD(23181Z) WK81994 Practice for Additive Manufacturing – Powder Bed Fusion – In-situ Defect Mitigation and Evaluation	NEWSTD(23743Z) WK82659 New Specification for Additive manufacturing – Powder bed fusion – Standard specification for maraging steel (UNS J93120)					E3047-16 Standard Test Method for Analysis of Nickel Alloys by Spark Atomic Emission Spectrometry
NEWSTD(27613Z) WK88124 Test Method For Additive Manufacturing for Metals – Qualification Principles – Test Method for Indentation Plastometry	NEWSTD(29074Z) WK89212 Test Method for Additive Manufacturing – Feedstock Materials – Tensile Testing Method for Filaments used in Material Extrusion		NEWSTD(23812Z) WK82889 Practice for Additive Manufacturing – Powder bed fusion – Build continuation after process interruption	NEWSTD(24732Z) WK84355 Practice for Additive Manufacturing – Design – Parts Using Ceramic Materials	ISO/ASTM DIS 52937 / NEWSTD(208Z6Z) WK74932 Additive manufacturing of metals – Qualification principles – Tasks and related skills for AM				E3166-20e1 Standard Guide for Nondestructive Examination of Metal Additively Manufactured Aerospace Parts After Build
NEWSTD(29598Z) WK89863 Test Method for Additive Manufacturing – Segmenting pores in X-ray computed tomography data of additively manufactured samples	NEWSTD(20379Z) WK90673 Specification for Additive manufacturing for metals- Non-destructive testing and evaluation – Imperfections classification in DED parts		NEWSTD(25597Z) WK85701 Specification For Additive Manufacturing – Finished Part Properties – Stainless Steel Alloys Made By Powder Bed Fusion	NEWSTD(26558Z) WK86878 Specification For Additive Manufacturing Of Metals – Qualification Principles – Installation, Operation And Performance (IQ/OQ/PQ) OF PBF-EB Equipment					F3335-20 Standard Guide for Assessing the Removal of Additive Manufacturing Residues in Medical Devices Fabricated by Powder Bed Fusion
ISO/ASTM CD 52919 WK82628 Test Method for Additive Manufacturing – Qualification Principles – Test Methods for Metal Casting Sand Moulds	ISO/ASTM DIS 52927 Additive manufacturing – General principles – Main characteristics and corresponding test methods		NEWSTD(19601Z) WK89874 Specification for Additive manufacturing – Qualification principles – Part 1: Common failure modes used for risk mapping	NEWSTD(20095Z) WK90287 Specification for Additive manufacturing – General Principles – Framework for the Implementation of a Level System for temporarily self-sufficient systems					WK73289 New Guide for In-Situ Monitoring of Additive Manufactured Aerospace Parts

Published Joint  
(35+5 TR)

Published ASTM  
(37+20 OTHER)

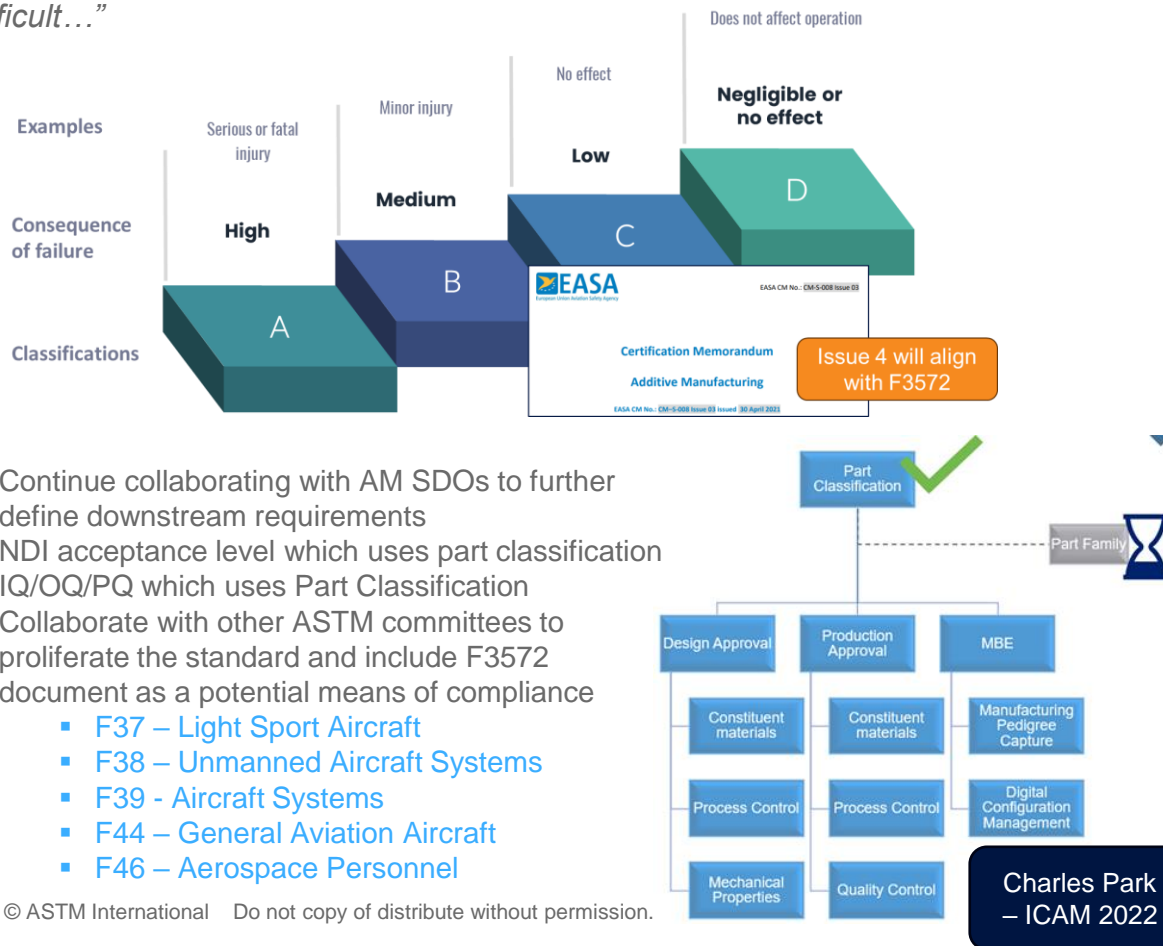
Working Document  
ASTM (61+1 OTHER)

Working Document  
Joint (6)

Legend

## AM Classification for Aerospace/Defense – ASTM F3572

“Without carefully defined part classes, the ability to accurately **gauge the consequence of failure** associated with additively manufactured aviation parts within and across programs, projects, and suppliers becomes exceedingly difficult...”



## Inspection Acceptance Criteria – WK 75329

- This work item applies to radiographic examination and liquid penetrant
- Specifies NDE acceptance criteria for parts manufactured via PBF-LB

Discontinuity	Level 1	Level 2
<b>Surface or Internal</b>		
Propagating discontinuities - cracks, solidification cracks, delamination cracks, Lack of Fusion or Incomplete Fusion - build layer separations, lateral, vertical, hatch, connected porosity, keyhole porosity, through wall separations	0	0
Voids	2.5% of the material thickness in its longest dimension.	0.060"
Inclusion	2.5% of the material thickness in its longest dimension	0.060"
Contamination	0	0
Trapped Powder	0	N/A
<b>Sub Surface Porosity</b>		
Individual distinguishable from cracks – keyhole, gas porosity	2.5% of the material thickness in diameter.	N/A
Group more than two distinguishable from cracks – keyhole, gas porosity	3 individual pores greater than 2.5% of the material thickness in diameter	N/A

Latest updates to Work Item will align the criteria against F3572 for Part Criticality



## Research to Standards

Conducts R&D identified and prioritized by the top minds in the field to significantly accelerate standards development.



## Training

Develops comprehensive education and training programs built on standardization and certification expertise that prepares the AM workforce of the future at all levels.



## Certification

Supports development of the AM standards roadmap, transitioning R&D to standards and technical publications, proficiency testing and certification programs.

## 6 Pillars



## Consortium

Develop and standardize the requirements and best practices for AM material data generation and create high-pedigree datasets for use by members to support design and rapid qualification.



## Advisory Services



Offered via Wohlers Associates to provide business and technical advice, strategy, roadmaps, etc.

## Market Intelligence



Wohlers Report, Wohlers Specialty Reports, and market related consulting services offered through Wohlers Associates.



# AM CoE Research to Standards (R2S)

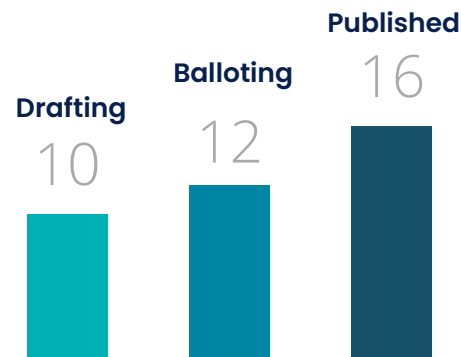


CENTER of  
EXCELLENCE  
Research to Standards  
ADDITIVE MANUFACTURING

## Activity since 2018:

- 7 Rounds of Project Call
- 38 R&D Projects
- 32 Technical Experts
- 27 Partners & Collaborators

### "Exceptional ROI"



Developed a powerhouse of research collaborators for standardization

### FACT!

F42 Membership  
has grown from  
600+ in 2018 to  
1300+ in 2024

217% growth!

Partners are  
globally located in  
US, Asia, Europe,  
and UK

## R2S – Convening Thought Leadership Workshops:

- Gain Insights, Identify Gaps, Prioritize Research and Standardization needs
- Findings have been publicly disseminated through the development of strategic guides and roadmaps.



# Qualification and Certification Programs – Surveillance is a crucial need



## Additive Manufacturing Quality (AMQ) Certification

- Qualify AM supply chain
- Based on published ISO/ASTM standards and inputs from AM stakeholders
- Multi-industry focused



## Additive Manufacturing Facility Safety Certification

- Safe and compliant AM facility
- Aligned with safety codes



## Additive Manufacturing Operator Certification

- Qualified operators for critical part production
- Applies to specific AM machine models and associated equipment

# AM Certification Committee is Key Driver



## Standards for AM Certification Audit Criteria

Overall industrial  
process & facility  
requirements

ISO/ASTM 52920

Covering  
requirements of  
material, process,  
personnel

ISO/ASTM 52901  
ISO/ASTM 52904  
ISO/ASTM 52930  
ISO/ASTM 52941  
ISO/ASTM 52942  
ISO/ASTM 52928  
ISO/ASTM 52931  
ISO/ASTM 52926  
ASTM WK73227

Requirements  
from other SDO  
standards

AWS D20.1  
API 20S  
SAE AME 7000 Series

## AM Certification Committee (22+ members)

Medical



Aerospace/  
Defense



Transportation





- AM CoE officially launched a Global Consortium for Materials Data and Standardization (CMDs) in 2022.
  - Research 2 Standards program to engage with external organizations, in addition to existing AM CoE partners, to standardize the requirements and best practices for generating and managing high-pedigree AM Materials Data.



## REQUIREMENTS & BEST PRACTICES

- Terminology, Pedigree, Specimen Geometry, Build & Test Plans
- Identify **Process-Structure-Property** Relationships
- Equivalency/Combinability of new or existing data



## HIGH-PEDIGREE DATA GENERATION

- Consortia-funded R&D projects create **shared high-pedigree** “reference” material **datasets** to drive process-based material specifications



## DATA – MANAGEMENT & LEARNING

- Secure, Access-controlled Data Management System
- Establishing data standards (e.g., CDD, CDM, CDEF) to ensure FAIR principles
- Modeling - Physics-based, AI/ML

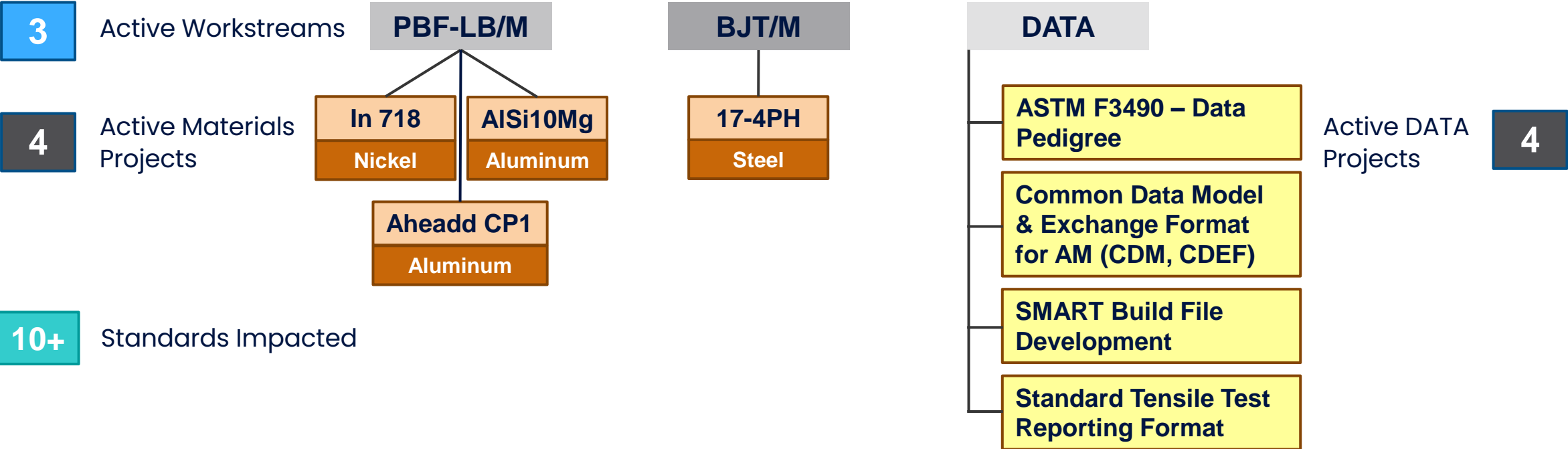


## STANDARDS DEVELOPMENT

- Transferring lessons learned and consortium approved materials data to standardization committees

**39** Members (representing entire AM ecosystem)

- OEM/LSI End Users
- AM Equipment Manufacturer
- AM Contract Manufacturer/Supplier
- AM Materials/Feedstock Producer
- AM Post-processing and Testing Service Provider
- AM Software
- AM Process/Health Monitoring
- Industrial Equipment Producer (e.g., Furnace, Powder Handling Equipment,...)
- Government Agencies and Laboratories (DoD, DOE, NASA, NIST)





## Professional Certificate Course in AM (PCCAM)

- Provide core technical knowledge related to common AM practices across the AM process chain.



### Certificate Program



Professional Certificate in  
Additive Manufacturing



## Role-based Courses

- AM Safety
- Design for AM (Intermediate level)
- Advanced Design for AM
- Intro to AM Quality and Inspection
- AM Qualification and Certification for Critical Application
- Establishing an AM Facility for Critical Part Production using PBF-LB/M
- Advanced metal PBF-LB
- AM cybersecurity



## Short Courses

- Fundamental knowledge in specific AM topics that can quickly be put to practice by attendees.



## E-Learning

- Flexible completion periods suitable for upskilling working professionals.



## Conferences and Workshops



## 1. Active Participation and Support in Standardization Efforts

- Continued engagement in the development and alignment of global standards to ensure safety, interoperability, and innovation.

## 2. Investment in R&D to Bridge Standardization Gaps

- Strategic funding and collaboration in research to address gaps in existing standards, enabling the industry to adopt new technologies confidently.
- ASTM research to standards program demonstrated the possible acceleration in closing gaps.

## 3. Policy Updates that Reflect Current Standards

- Timely updates to regulatory frameworks to incorporate the latest standards, as demonstrated by EASA's adoption of the ASTM part classification standard (ASTM F3572), ensuring harmonization and industry-wide consistency.

## 4. ISO/ASTM Joint Standards Development: A 15-Year Collaboration

- Over the past 15 years, ISO and ASTM have collaboratively developed more than 76 standards and another 60+ under development. However, many more are needed to meet the evolving demands of the industry.
- Support from FAA and EASA in this process is crucial to drive wider adoption, ensuring consistent global application and fostering innovation across the sector.



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# Thank you!

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