

SAE INTERNATIONAL

SAE AEROSPACE STANDARDS – ADDITIVE MANUFACTURING ECOSYSTEM

J. Hector Sandoval
Lockheed Martin Fellow
SAE AMS AM Committee Chair
13 July 2021



AMSC Workshop on AM Feedstock

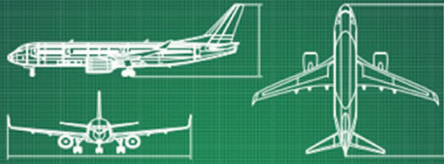
Copyright © SAE International. Further use or distribution is not permitted without permission from SAE



AMS-AM Committee Current Status

SAE AMS-AM - COMMITTEE ON ADDITIVE MANUFACTURING

ADDITIVE MANUFACTURING STANDARDS FOR AEROSPACE



550+ Members from **24** countries

Membership from all parts of the value chain including:

- Airlines and aircraft operators
- Aircraft/spacecraft/engine OEMs
- Tier 1, 2 & 3 suppliers
- Equipment suppliers
- Material suppliers
- Service providers
- Test laboratories
- Defense agencies
- Regulatory authorities

Established in **July 2015**, SAE AMS-AM was tasked by the FAA to develop and maintain aerospace-grade specifications for additive manufacturing, including:

- Precursor Materials
- Additive Processes
- Post-Processing
- System Requirements & Post-build Materials
- Qualification
- Quality Assurance

21 Specs published

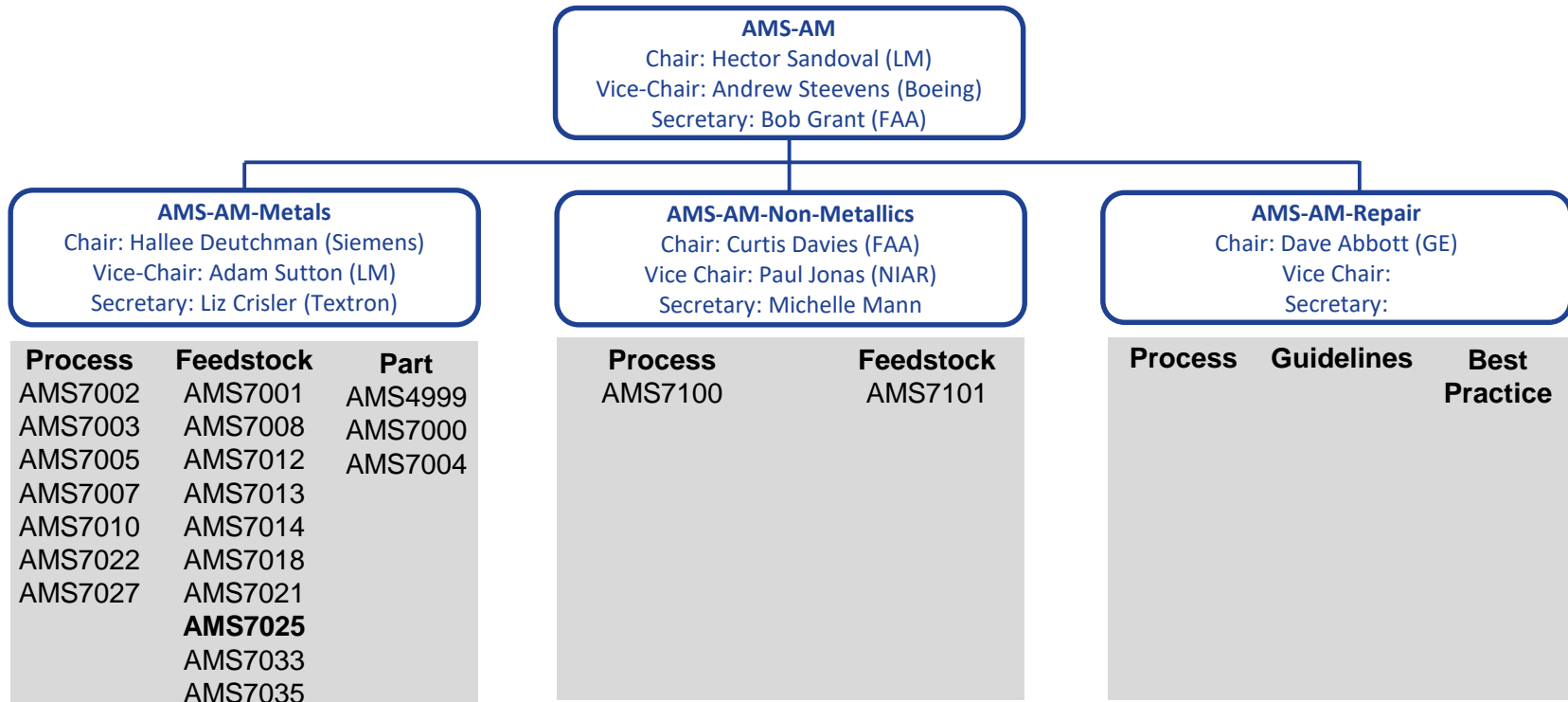
31 Specs and guidance documents under development

To join the committee visit:
<https://www.sae.org/works/committeeHome.do?comtID=TEAAMSAM>



Well balanced industry representation

AMS-AM Committee Organization



Focused on areas relevant to aerospace

* Other key spec: AMS7032 for machine qual

AMS-AM Feedstock Specifications

Production Requirements

- AMS7002 - Process Requirements for Production of Metal Powder Feedstock for Use in Additive Manufacturing of Aerospace Parts
- AMS7025 - Metal Powder Feedstock Size Classifications
- AMS7031 - Process Requirements for Recovery and Recycling of Metal Powder Feedstock for Use in Additive Manufacturing of Aerospace Parts*
- AS7040 – Requirements for Powder Distributors
- GAAM20A-C- Templates for Aluminum, Cobalt, Iron, Nickel, and Titanium

Nickel Alloys

- AMS7001 - Nickel Alloy, Corrosion and Heat-Resistant, Powder for Additive Manufacturing, 62Ni - 21.5Cr - 9.0Mo - 3.65Nb (Inconel 625)
- AMS7006 - Nickel Alloy, Corrosion and Heat-Resistant, Powder for Additive Manufacturing, 52.5Ni - 19Cr - 3.0Mo - 5.1Cb (Nb) - 0.90Ti - 0.50Al - 18Fe (Hastelloy X)
- AMS7008 - Nickel Alloy, Corrosion and Heat-Resistant, Powder for Additive Manufacturing, 47.5Ni - 22Cr - 1.5Co - 9.0Mo - 0.60W - 18.5Fe (Inconel 718)*
- AMS7013 - Nickel Alloy, Corrosion and Heat-Resistant, Powder for Additive Manufacturing, 60Ni - 22Cr - 2.0Mo - 14W - 0.35Al - 0.03La (Haynes 230)

Aluminum Alloys

- AMS7018 - Aluminum Alloy Powder, 10.0 Si -0.35Mg (AlSi10Mg)
- AMS7020 - Aluminum Alloy Powder, 7.0 Si - .55Mg – 0.12Ti (F357)*
- AMS7033 - Aluminum Alloy Powder, 4.6Cu - 3.4Ti - 1.4B - 0.75Ag - 0.27Mg (A205)

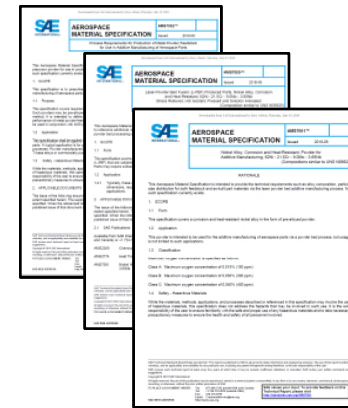
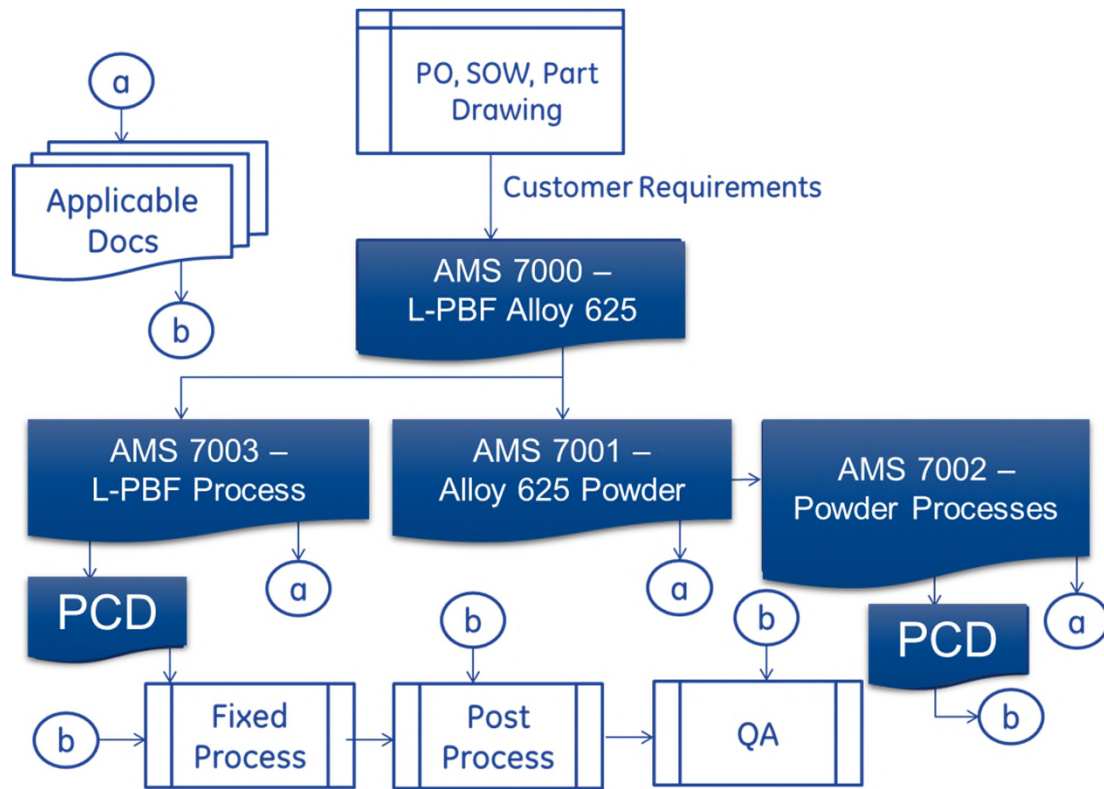
Titanium Alloys

- AMS7014 - Titanium Alloy, High Temperature Applications, Powder for Additive Manufacturing, Ti - 6.0Al - 2.0Sn - 4.0Zr - 2.0Mo (Ti6242)
- AMS7015 - Titanium Alloy, Powder for Additive Manufacturing, Ti – 6Al – 4V (Ti6Al4V Grade 5)*
- AMS7017 - Titanium Alloy, Powder for Additive Manufacturing, Ti – 6Al – 4V (Ti6Al4V Grade 23)*
- AMS7023 - Gamma Titanium Aluminide Powder for Additive Manufacturing, Ti - 48Al - 2Nb - 2Cr (TiAl)
- AMS7026 - Titanium Alloy, Powder for Additive Manufacturing, Ti - 5Al - 5Mo - 5V - 3Cr (Ti553)

Steel Alloys

- AMS7012 - Precipitation Hardenable Steel Alloy, Corrosion and Heat-Resistant Powder for Additive Manufacturing 16.0Cr - 4.0Ni - 4.0Cu - 0.30Nb (17-4 Stainless)
- AMS7021 - Precipitation Hardenable Steel Alloy, Corrosion and Heat Resistant, Powder for Additive Manufacturing, 15.0Cr - 4.5Ni - 3.5Cu - 0.30Nb (15-5 Stainless)
- AMS7035 - Precipitation Hardenable Steel Alloy, Corrosion and Heat-Resistant, Powder for Binder Jet Additive Manufacturing, 16.0Cr - 4.0Ni - 4.0Cu - 0.30Nb (17-4 Stainless for Binder Jet)
- AMS7037 - Steel, Corrosion and Heat-Resistant, Powder for Additive Manufacturing 17Cr – 13Ni – 2.5Mo (316L)*

Hierarchy Applied to AMS AM Specifications



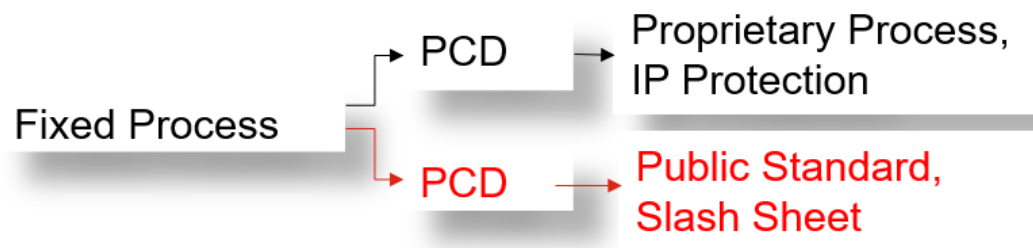
Framework valid for all AM processes & materials

AMS-AM & Aerospace Data Pedigree



Near term:

- Industry managed Process Control Document (PCD)
- Current focus on S-basis for spec mins, lot acceptance, quality assurance
- Supplier IP protected

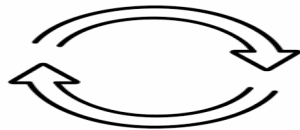


SAE AMS-AM and SAE ITC-AMDC Overview



SAE TECHNICAL COMMITTEE
AMS AM ADDITIVE MANUFACTURING

Individual membership

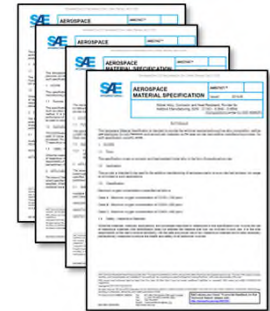


SAE AMS-AMDC™
Additive Manufacturing Data Consortium
A Program of SAE ITC

Company membership

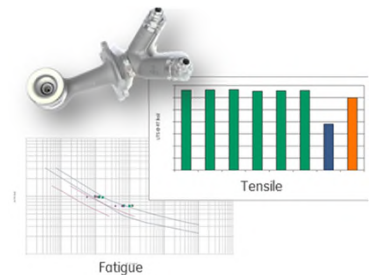
Standards

- Purpose:* Consensus industry specifications
Focus: Solely on Additive for Aerospace
Requires: Industry need, technical sponsor, and S-basis properties for material spec mins



Data Generation

- Purpose:* Facilitate generation of data for specification minimums
Long-term: Repository for design data for analyses, trade studies, and certification properties for material spec mins



QUESTIONS?

Interested in participating, please contact:

J Hector Sandoval

AMS-AM –Chair

Lockheed Martin

m +1 972 603 3805

e jose.h.sandoval@lmco.com

Jeff Adkins

AMS Committee Manager

SAE International

o +1.724.772.7176

e Jeff.Adkins@sae.org

