Metallic Materials Properties Development and Standardization (mmpds)

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MMPDS Bottom Line

- The MMPDS Handbook is the primary source in the United States and many other countries of statistically-based, design allowable properties for metallic materials and fastened joints used by the commercial and military aerospace industries

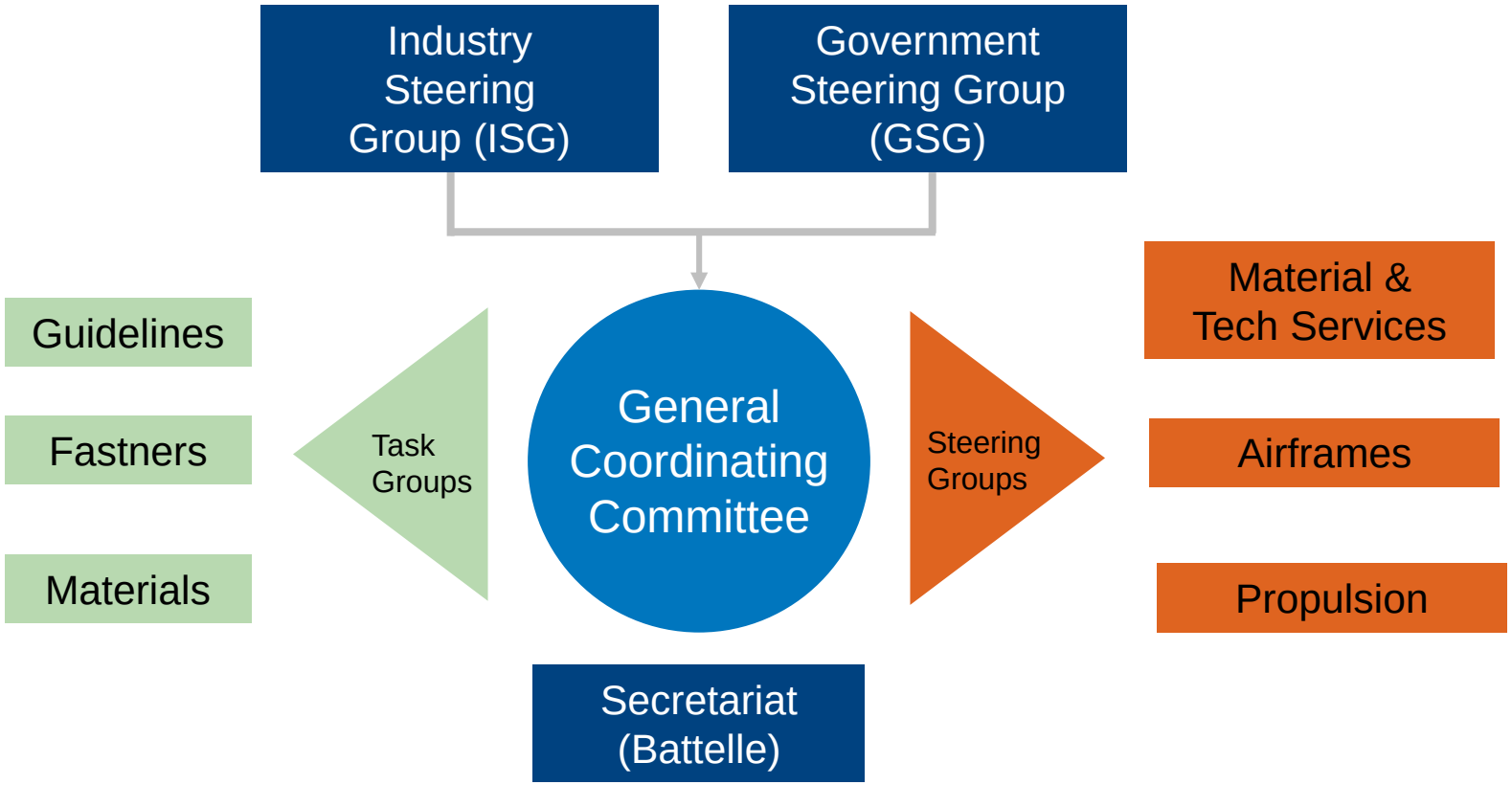
Background

Date	Key MMPDS Program Events
1937	First publication of Army-Navy-Commerce Handbook 5 (ANC-5), which was “free issue”
1954	Proponency shifted to the Air Force; Battelle began functioning as the MMPDS Secretariat
1997	Industrial Steering Group (ISG) established to provide a source for increased partnership and additional sources of revenue via Handbook sales
2003	Federal Aviation Administration (FAA) assumed responsibility for performing government oversight and continues to exercise that function today

MMPDS Overview

- Battelle serves as impartial data reviewer
  - All data is held company proprietary
  - Established statistical guidelines
- Recognized by the FAA, all Department of Defense (DoD) organizations and agencies, and the National Aeronautics and Space Administration (NASA) within the limitations of the certifications of the specific governments

MMPDS Organizational Chart



2014 ISG Members*

Metallic Material Producers or Technical Service Providers	Aircraft Producers (Metallic Material Users)
Alcoa	Airbus
Aleris Aluminum	Boeing
Allfast	Bombardier
Alro S.A.	Cessna
ATI Metals	Embraer
Aubert & Duval	Honeywell
Constellium	IHI Corp.
Granta Design	ITP Industries
Haynes International	Korea Aerospace
Kaiser Aluminum	Lockheed Martin Corp.
Magnesium Elektron	Lord Corp.
Materion Brush	Mitsubishi Heavy Ind.
QuesTek Innovations	Northrop Grumman
Universal Alloy	Rolls Royce
Weber Metals	Spirit Aerosystems
Westmoreland Labs	UTC Aerospace Systems

* Member organizations headquartered in 9 different countries worldwide

GSG Members

Current	Previous
FAA	Air Force
Navy	Army
	DLA
	NASA

MMPDS is recognized by FAA, DoD, NASA and other agencies for certification.

Key MMPDS Program Value Propositions

- Standards definition
- Governance construct
- Homeland defense

Table 3.2.2.0(b_2). Design Mechanical and Physical Properties of 2014 Aluminum Alloy Sheet and Plate (Continued)

Specification	AMS 4028[a]							
Form	Sheet				Plate[b]			
Temper	T62[c]							
Thickness, in.	0.020-0.039		0.040-0.249		0.250-0.499		0.500-1.000	
Basis	A	B	A	B	A	B	A	B
Mechanical Properties:								
F_{tu}, ksi:								
L	65	67	67	68	65	67	65	67
LT	64	66	66	67	67	69	67	69
F_{ty}, ksi:								
L	58	60	59	60	57	59	57	59
LT	57	59	58	59	59	61	59	61
F_{cy}, ksi:								
L	58	60	59	60	59	61	59	61
LT	59	61	60	61	60	62	60	62
F_{su}, ksi	39	40	40	41	37	39	37	39
F_{bru}, ksi:								
(e/D = 1.5)	97	100	100	102	100	103	100	103
(e/D = 2.0)	123	127	127	129	127	131	127	131
F_{bry}, ksi:								
(e/D = 1.5)	81	84	83	84	84	87	84	87
(e/D = 2.0)	93	96	95	96	99	103	99	103
e, percent (S-Basis):								
LT	6	...	7	...	7	...	6	...
E, 10^3 ksi	10.5				10.7			
E_c, 10^3 ksi	10.7				10.9			
G, 10^3 ksi	4.0				4.0			
μ	0.33				0.33			
Physical Properties:								
ω, lb/in.^{3}	0.101							
C, K, and α	See Figure 3.2.1.0							

a Inactive for new design.
b Bearing values are "dry pin" values per Section 1.4.7.1.
c Design allowables were based upon data obtained from testing samples of material, supplied in the O or F temper, which were heat treated to demonstrate response to heat treatment by suppliers. Properties obtained by the user may be lower than those listed if the material has been formed or otherwise cold or hot worked, particularly in the annealed temper, prior to solution heat treatment.

MMPDS Handbook is the primary source of statistically-based, design allowable metallic properties and joints.

Mechanical Properties:
F_{tu}, ksi:
L
LT
ST
F_{ty}, ksi:
L
LT
ST
F_{cy}, ksi:
L
LT
ST
F_{su}, ksi:
L-S
T-S
S-L
F_{bru}^{c}, ksi (e/D = 1.5):
L
LT
ST
F_{bru}^{c}, ksi (e/D = 2.0)
L
LT
ST
F_{bry}^{c}, ksi (e/D = 1.5):
L
LT
ST
F_{bry}^{c}, ksi (e/D = 2.0)
L
LT
ST

- Tensile
- Compression
- Shear
- Bearing

Table 3.7.11.0(b_2). Design Mechanical and Physical Properties of 7140 Aluminum Alloy Plate

Specification	AMS 4408								
Form	Plate								
Temper	T7651								
Thickness, in.	4.000-5.000		5.001-6.000		6.001-7.000		7.001-8.000	8.001-9.000	9.001-10.000
Basis	A	B	A	B	A	B	S	S	S
Mechanical Properties:									
F_{tu}, ksi:									
L	74	76	74	75	73	74	72	72	71

Modulus (Typical)

E, 10^3 ksi	10.3
E_c, 10^3 ksi	10.4
G, 10^3 ksi	3.9
μ	0.33

Physical Properties (Typical)

Physical Properties:	
ω, lb/in.^{3}	0.102
C, K, and α	See Figure 3.7.11.0

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Joint Allowables

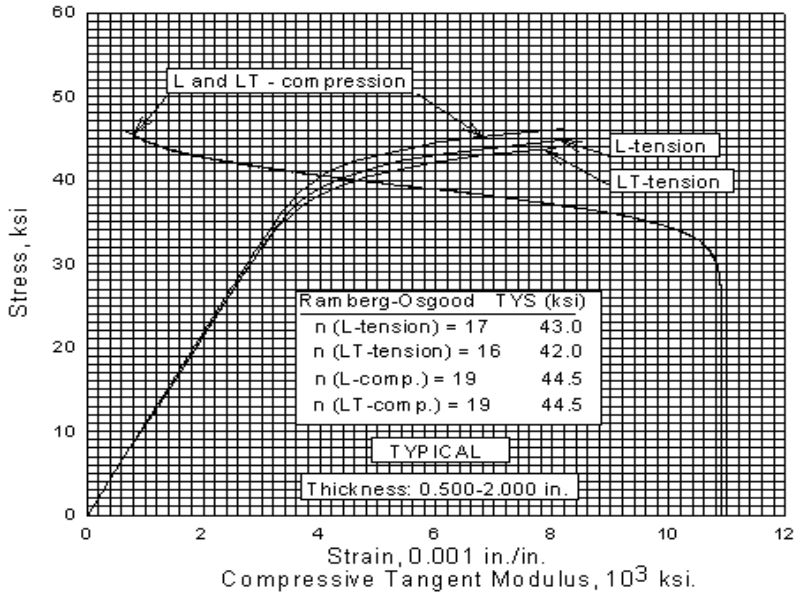
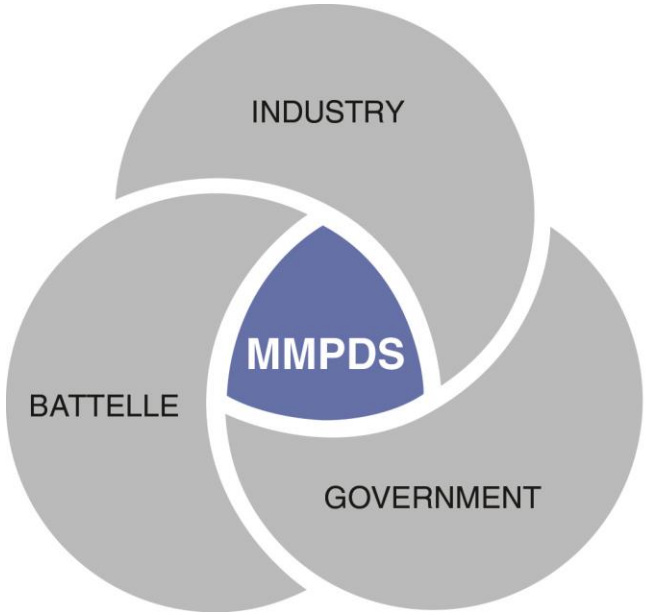


Figure 3.2.4.1.6(j). Typical tensile and compressive stress-strain and compressive tangent-modulus curves for 2024-T42 aluminum alloy plate at room temperature.

Table 8.1.5.2(f). Static Joint Strength of 100° Flush Shear Head Ti-6Al-4V Fasteners in Machine-Countersunk Aluminum Alloy Sheet

Fastener Type	KLBHV Pin (F_{su} = 95 ksi), KFN 600 Nut[a]				
Sheet Material	Clad 7075-T6				
Fastener Diameter, in. (Nominal Shank Diameter, in.)[b]	5/32 (0.164)	3/16 (0.190)	1/4 (0.250)	5/16 (0.3125)	3/8 (0.375)
	Ultimate Strength, lbs. (Estimated Lower Bound)				
Sheet thickness, in.:					
0.040	748[c]	...	...	...	...
0.050	987	1112	...	...	...
0.063	1291	1462	1813[c]	...	...
0.071	1428	1679	2100	...	...
0.080	1571	1888	2438	2902	...
0.090	1722	2058	2794	3322	3867
0.100	1883	2231	3150	3810	4402
0.125	2007	2694	3725	4924	5724
0.160	...	...	4531	4901	7397
0.190	...	...	4660	6790	8452
0.200	...	...	...	7083	8789
0.250	...	...	...	7290	10490
Fastener shear strength[d]	2007	2694	4660	7290	10490

MMPDS is a collaborative effort between industry and government with Battelle serving as secretariat



MMPDS is vital to military and civil aerospace

- Consensus on design allowable properties and guidelines
- Cost saving collaboration
- Recognition for certification

Summary

- MMPDS is a long-term, Battelle flagship program built upon a foundation of partnership with FAA, Navy, and other government agencies
- Industry funding support (31 companies from 8 countries) recognizes the key benefits of the program

Questions?

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