Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE INFORMATION REPORT

AIR 1174

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INDEX OF STARTING SYSTEM SPECIFICATIONS AND STANDARDS

1. SCOPE

This report lists military and industry specifications and standards which are used in aerospace engine starting systems. Only those hardware standards which have been specifically designed for engine starting systems are listed. Revisions and amendments which are current for these specifications and standards are not listed.

1.1 Listing Documents: The following documents which list specifications and standards are used as a basis for this report.

1.1.1 Military Specifications and Standards: Department of Defense, Index of Specifications and Standards. This document is published annually with bi-monthly supplements.

1.1.2 Society of Automotive Engineers, Inc. Documents: Index of Aerospace Standards, Recommended Practices and Information Reports. This document is published annually by SAE, Inc., Two Pennsylvania Plaza, New York, N.Y. 10001.

2. ENGINE STARTING CHARACTERISTICS

2.1 Military Specifications:

Engines, Aircraft, Reciprocating, General Specification for	MIL-E-25109
Engines, Aircraft, Turbojet and Turbofan, General Specification for	MIL-E-5007
Engines, Aircraft, Turboprop, General Specification for	MIL-E-8593
Engines, Ramjet, General Specification for	MIL-E-8219
Engines, Rocket, Liquid Propellant, General Specification for	MIL-E-5149

2.2 Society of Automotive Engineers Documents:

Guide for Determining Engine Starter Drive Torque Requirements	AIR781
Guide for Determining, Presenting and Substantiating Turbine Engine Starting and Motoring Characteristics	AIR713

3. ENGINE STARTING SYSTEM

3.1 Society of Automotive Engineers Documents:

Aircraft Accessory Drag Torque During Engine Starts	AIR1087
A Means of Testing Turbojet Engine Starter Performance	ARP715
Final Report on Cold Starting of Reciprocating Aircraft Engines	AIR13
Glossary, Aircraft Engine Starting Systems	ARP906
Guide for Determining Engine Starter Drive Torque Requirements	ARP781
Oil Dilution and Cold Starting of Aircraft Engines	AIR6
Starting System Installation, Description and Guide	AIR912
Turbine Engine Starting System Design Requirements	ARP949

Printed in U.S.A.

3.2 Military Standards:

Adapter Installation - Type XII or XVI Drive Starter Jaw	MS33509
Drive Pad-Accessory, 5.000 BC Round, Design Standard for	MS3327 (AS)
Drive Pad-Accessory, 8.000 BC Round, Design Standard for	MS3328 (AS)
Drive Pad-Accessory, 5.000 BC Square, Design Standard for	MS3326 (AS)
Drive-Type XII Engine Accessory	AND20002
Drive-Type XIV Engine Accessory	AND20004
Drive-Type XVI Engine Accessory	AND20006
Drive-Type XIX Engine Accessory	AND20009
Flange Accessory, 5.000 BC Round, Design Standard for	MS3332 (AS)
Flange Accessory, 8.000 BC Round, Design Standard for	MS3333 (AS)
Flange-Type XII Accessory Mounting	AND10262
Flange-Type XVI Accessory Mounting	AND10266
Flange-Type XIX Engine Accessory	AND10269
Gasket-Type XII, XIV-A, XIV-B, XIV-E, XVII-A and XVII-B Engine Accessory Drive	MS9136
Gasket-Type XVI, XVII-C, -D, -E and -F Engine Accessory Drive	MS9139
Gasket-Type XIX Engine Accessory Drive	MS9140

3.3 Society of Automotive Engineers Standards:

Drive - Accessory, 5.000 BC Round, QAD, Design Standard for	AS969
Drive - Accessory, 8.000 BC Round, QAD, Design Standard for	AS970
Drive - Studded Accessory, 5.000 BC Round, Design Standard for	AS963
Drive - Studded, Accessory, 8.000 BC Round, Design Standard for	AS965
Flange - Accessory, 5.000 BC Round, Design Standard for	AS964
Flange - Accessory, 8.000 BC Round, Design Standard for	AS966
Spline Details, Accessory Drives and Flanges	AS972
Starter, Mounting Pads and Drives, Types I, II, III, IV	AS44

4. CARTRIDGE PNEUMATIC STARTING SYSTEM

4.1 Society of Automotive Engineers Documents:

4.2 System Components:

4.2.1 Starter:

4.2.1.1 Military Specifications:

Starter, Engine, Cartridge and Pneumatic Shaft Drive, General Specification for	MIL-S-27266

4.2.2 Energy Control:

4.2.2.1 Military Specifications:

Valve, Starter Control, Aircraft Engine General Specifictions for	MIL-V-38398

4.2.3 Connections:

4.2.3.1 Ducting:

4.2.3.1.1 Military Specifications:

Bleed Air Systems, General Specification for	MIL-B-81365
Coupling Half, Quick Disconnect, Pneumatic Starter, External, Low Pressure	MIL-C-25531
Duct, Pneumatic Start, Flexible	MIL-D-22706

4.2.3.1.2 Society of Automotive Engineers Documents:

High Temperature Pneumatic Duct Systems for Aircraft	ARP699

4.2.3.1.3 Military Standards:

Adapter, Pneumatic Starter, Duct Nipple and Flange "Male"	MS17834
Nipple, Pneumatic Starting, 3 Inch I.D., Outline Dimensions for	MS33740

4.2.3.2 Electrical:

4.2.3.2.1 Military Specifications:

Connectors, Electric "AN" Type	MIL-C-5015
Connector, Electric, Circular, Environment Resisting, General Specification for	MIL-C-83923
Connector, Electrical, Circular, Miniature, Quick Disconnect, Environment Resisting	MIL-C-26482
Connector, General Purpose, Electrical, Miniature, Circular, Environment Resisting, 200C Ambient Temperature	MIL-C-26500

4.2.3.2.2 Military Standards:

Connector, Receptacle, Electric, Wall Mounting	MS3100R14S-2P

4.3 Power Source:

4.3.1 Military Specifications:

Cartridge Engine Starter MXU-4A/A	MIL-C-27505
Cartridge Engine Starter MXU-129/A	MIL-C-27658
Power Units, Aircraft Auxiliary, Gas-Turbine-Type, General Specification for	MIL-P-8686

4.3.2 Society of Automotive Engineers Documents:

Pneumatic Power Supplies for Starting Aircraft	AIR944
Summary of Transportation, Handling and Storage Requirements for Starter Cartridges, Jet Engine, MXU-4/A and MXU-129/A	ARP956

5. ELECTRIC STARTING SYSTEM

5.1 Military Specifications:

Electric Equipment Aircraft, Selection and Installation of	MIL-E-7080
Generators, 30-Volt, Direct Current, Aircraft Engine Driven, and Starter-Generators, General Specification for	MIL-G-006162
Starting System; Installation of	MIL-S-5459

5.2 Society of Automotive Engineers Documents:

5.3 Military Standards:

Criteria, Jet Electrical Starting System, DC	MS17794
Turbine Engine Constant Current Starting System Wiring Diagram	MS28911
Electric Power, Alternating Current, Characteristics and Utilization of	MIL-STD-704

In multi-engine installations, many times the #2 and subsequent engines are started with electrical power from the aircraft bus rather than an external source. Starting systems should be designed to work with the aircraft electrical power as a prime or control source.

5.4 System Components:

5.4.1 Starter:

5.4.1.1 Military Specifications:

Starter; Drone, Direct Cranking, 24 Volt DC Type J-5	MIL-S-9160
Starter, Electric, Constant Current DC	MIL-S-7780
Starter, Engine, Electrical, Direct Cranking Aircraft, 28 Volts DC	MIL-S-6150
Starter-Generator, Engine, STU-6A	MIL-S-26547
Starter-Generator, Engine, STU-23/A24	MIL-S-38215
Starter-Generator, Engine, Type A-2	MIL-S-5928

5.4.1.2 Society of Automotive Engineers Documents:

D-C Starter-Generator, Engine, General Specification for	ARP892

5.4.1.3 Military Standards:

Starter-Aircraft, Direct Cranking, 28V DC	AN4116
Starter, Engine, Electrical Type STU-24/A	MS27375

5.4.2 Connections:

5.4.2.1 Electrical:

5.4.2.1.1 Military Specifications:

Cable Assemblies, Plugs and Receptacles, External Power	MIL-C-7974

5.4.2.1.2 Military Standards:

Cable Assembly, Power, Electrical, Jet Starting	MS25019
Cable and Attachable Plugs, External Electric Power, Aircraft, 28 Volt DC, Jet Starting	MS25487

5.5 Power Source:

5.5.1 Military Specifications:

Batteries, Storage, Aircraft, High Capacity, General Specification for	MIL-B-18013
Batteries, Storage, Aircraft, Maintenance Free, General Specification for	MIL-B-8565
Batteries, Storage, Aircraft, Nickel-Cadmium, General Specification for	MIL-B-26220
Batteries, Storage, Integrally Shielded, Lead-Acid Type, General Specification for	MIL-B-6428
Battery, Storage, Aircraft, Type MA-2	MIL-B-26026
Battery, Storage, Shielded, General Specification for	MIL-B-6146
Battery, Storage, Shielded, 24-Volt, 24-Ampere-Hour	MIL-B-6147

5.5.1 Continued:

Battery, Storage, Shielded, 24-Volt, 36-Ampere-Hour	MIL-B-6148
Battery, 24-Volt, 11-Ampere-Hour, Shielded Storage	MIL-B-6741
Starting Unit, Jet Engine, Battery Emergency, Trailer Mounted, Type ME-1	MIL-S-26916

5.5.2 Society of Automotive Engineers Documents:

5.5.3 Military Standards:

Battery, Aircraft Storage, Nickel-Cadmium 24-Volt, 11 Ampere Hour, 27 C (80 F)	MS24496
Battery, Aircraft Storage, Nickel-Cadmium 24-Volt, 22 Ampere Hour, 27 C (80 F)	MS24497
Battery, Aircraft Storage, Nickel-Cadmium 24-Volt, 34 Ampere Hour, 27 C (80 F)	MS24498
Battery Installation	AND10441
Battery, Storage, Aircraft, Heavy Duty, 18 Ampere-Hour, 24-Volt	MS90365
Battery, Storage, Aircraft, Nickel-Cadmium Type 24-Volt, 60 Ampere-Hour, 27 C (80 F)	MS24511
Battery, Storage, Aircraft, Receptacle-Connected, Dimensions for	MS18093
Battery, Storage, Aircraft, Receptacle-Connected, Installation of	MS25193
Battery, Storage, Aircraft 24 Volt, 11 Ampere Hour Light Duty	MS90449
Battery, Storage, Aircraft, Vibration-Resistant, Heavy Duty, 16 Ampere-Hour, 24 Volt	MS90377
Battery, Storage, Aircraft, Vibration-Resistant, Light Duty, 40 Ampere-Hour, 24 Volt	MS18122
Battery, Storage, Shielded, 24-Volt, 24-Ampere-Hour	AN3151
Battery, Storage, Shielded, 24-Volt, 36-Ampere-Hour	AN3150
Battery, 24-Volt, 11 Ampere-Hour Shielded Storage	AN3154

5.5.4 Connections:

5.5.4.1 Military Specifications:

Cable Assemblies, Plugs and Receptacles, External Power	MIL-C-7974

5.5.4.2 Military Standards:

Cable and Attachable Plugs, External Electric Power, Aircraft, 28 Volt DC Jet Starting	MS25487

6. GAS TURBINE STARTING SYSTEM

6.1 Military Specifications:

Gas Turbine Self Contained Starting System for Aircraft Gas Turbine Engines	XWS-4617
Starter, Engine, Jet Fuel, General Specification for	SEJ1A67-1

7. HYDRAULIC STARTING SYSTEM

7.1 Military Specifications:

Hydraulic System; Aircraft Type I and II, Design Installation and Data Requirements for	MIL-H-5440

7.2 Society of Automotive Engineers Documents:

Aerospace Hydraulic and Pneumatic Specifications and Standards	AIR737
Determination of Hydraulic Pressure Drop	ARP24
Hydraulic Fluid Characteristics	AIR81
Nomenclature, Aircraft Hydraulic and Pneumatic Systems	ARP243

7.3 System Components:

7.3.1 Starter:

7.3.1.1 Military Specifications:

Starter, Aircraft Engine, Hydraulic	MIL-S-22999

7.3.1.2 Society of Automotive Engineers Documents:

Aircraft Hydraulic Starters	AS714
Aircraft Hydraulic Starter/Pumps	AS838

7.4 Power Source:

7.4.1 Military Specifications:

Accumulator, Aircraft Hydraulic Pressure	MIL-A-5498
Accumulators, Hydraulic, Cylindrical 3000 PSI Aircraft Type II Systems	MIL-A-8897
Pump, Hydraulic Ram, Hand Driven	MIL-P-5515

7.4.2 Society of Automotive Engineers Documents:

Accumulators, Ground, Hydropneumatic Pressure	ARP763

7.4.3 Military Standards:

Accumulator, Cylindrical, 3000 PSI	MS28700
Accumulator, Hydraulic, Cylindrical, 3000 PSI, Aircraft Type II Systems	MS28797
Pump, Hydraulic Hand	AN6201
Pump, Hydraulic Hand, Type 3000	AN6248

8. MECHANICAL STARTING SYSTEM

8.1 System Components:

8.1.1 Starter:

8.1.1.1 Military Specifications:

Starter, Rope, Engine, Automatic Rewind V32-D2 Power Plant	MIL-S-26900

9. PNEUMATIC STARTING SYSTEM

9.1 Society of Automotive Engineers Documents:

9.2 System Components:

9.2.1 Starter: