

Submitted for recognition as an American National Standard

**VALVE, STARTER CONTROL, PNEUMATIC, AIRCRAFT ENGINE
GENERAL SPECIFICATION FOR**

1. SCOPE:

1.1 Scope:

This specification covers the general requirements for pneumatic control valves for use with the starters on aircraft gas turbine engines.

This specification shall be used in conjunction with AS943, ARP949, and AIR1639.

1.2 Classification:

Pneumatic starter control valves shall be one of the following two types:

- a. Type I: Regulating (pressure)
- b. Type II: Nonregulating (on-off)

The type will be assigned by the procuring activity in accordance with MIL-STD-875 and shall be specified in the model specification.

2. REFERENCES:

The following documents, of the issue in effect on date of invitation for bids or request for proposals, form a part of this specification to the extent specified herein:

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AS943 Starter, Pneumatic, Aircraft Engine, General Specification
ARP949 Turbine Engine Starting System Design Requirements
AIR1639 Safety Criteria for Pneumatic Starting Systems

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2.2 U.S. Government Publications:

Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-P-116	Preservation-Packaging, Method of
MIL-B-5087	Bonding, Electrical, and Lightning Protection for Aerospace Systems
MIL-E-7080	Electric Equipment, Aircraft, Selection and Installation of
MIL-P-7105	Pipe Threads, Taper, Aeronautical National Form, Symbol ANPT, General Requirements for
MIL-S-7742	Screw Threads, Standard, Optimum Selected Series; General Specification for
MIL-I-8500	Interchangeability and Replaceability of Component Parts for Aircraft and Missiles
MIL-S-8516	Sealing Compound, Polysulfide Rubber, Electric Connectors and Electrical Systems, Chemically Cured
MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-S-8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter, General Specification for
MIL-S-23586	Sealing Compound, Electrical, Silicone Rubber, Accelerator Required
MIL-I-81550	Insulating Compound, Electrical, Embedding, Reversion Resistant Silicone
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of US Military Property
MIL-STD-453	Inspection, Radiographic
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-461	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
MIL-STD-462	EMI Characteristics, Measurement of
MIL-STD-470	Maintainability Program Requirements (For Systems and Equipment)
MIL-STD-480	Configuration Control - Engineering Changes, Deviations and Waivers
MIL-STD-490	Specification Practices
MIL-STD-704	Aircraft Electric Power Requirements
MIL-STD-794	Parts and Equipment, Procedures for Packaging and Packing of
MIL-STD-810	Environmental Test Methods and Engineering Guidelines
MIL-STD-831	Test Reports, Preparation of
MIL-STD-875	Type Designation System for Aeronautical and Aeronautical Support Equipment
MIL-STD-889	Dissimilar Metals
MIL-STD-970	Standards and Specifications, Order of Precedence for the Selection of
MIL-STD-1523	Age Control of Age Sensitive Elastomeric Material (for Aerospace Applications)
MIL-STD-1595	Qualification of Aircraft Missile and Aerospace Fusion and Welders
MIL-STD-1949	Inspection Process, Magnetic Particle

2.2 (Continued):

MIL-C-2175	Castings, Classification and Inspection of (For Aeronautical Applications)
MIL-STD-6866	Inspection Liquid Penetrant
MIL-STD-8706	General Specification for Design Examinations, Engineering, Aircraft Weapon Systems
DOD-STD-100	Engineering Drawing Practices
MS 20995	Wire, Safety or Lock
MS 33540	Safety Wiring, and Cotter Pinning, General Practices for
MS 33588	Nut, Self-Locking, Aircraft, Reliability and Maintainability Usage Requirements
FORM 1423	CDRL
REPORT #217	FAA Technical Report

2.3 Definitions:

The applicable definitions and symbols used herein and in the model specification are as specified below:

- 2.3.1 **PROCURING ACTIVITY:** The procuring activity is responsible for the valve contract.
- 2.3.2 **PROOF PRESSURE:** Proof pressure is that internal pressure to which all high pressure valve parts are pressure tested to prove their structural integrity without causing damage.
- 2.3.3 **MINIMUM BURST PRESSURE:** Minimum burst pressure is the greatest applied internal pressure to which the valve can be subjected before ultimate strength of the valve is exceeded.
- 2.3.4 **TRANSFER TIME:** Transfer time is the time interval from the removal of the valve or component from one conditioning chamber to the insertion of the valve or component into another conditioning chamber, or the time interval from the removal of the valve or component from the conditioning chamber to the initiation of testing.
- 2.3.5 **RATING:** A rating is the value of some characteristic of performance as specified in the model specification. The valve shall be rated at that condition at which its associated starter is rated unless otherwise specified by the procuring activity. This is typically APU standard day sea level operating conditions.
- 2.3.6 **MODEL SPECIFICATION:** The model specification referred to herein is defined as the valve supplier prepared document used to define a particular valve.
- 2.3.7 **DETAIL SPECIFICATION:** The detail specification referred to herein is defined as a procuring activity prepared document used to define the applicable design and performance parameters required for a particular valve application.

2.4 Symbols:

The units for these symbols are defined herein:

- a. G: Gravitational constant
- b. T: Temperature
- c. Wv: Total weight of the valve
- d. P: Pressure

3. REQUIREMENTS:

3.1 Preproduction:

This specification makes provisions for preproduction testing.

3.2 Model Specification and Data Submittal:

When specified in the procurement contract, a valve model specification conforming to the outline and instructions for preparation specified herein, shall be prepared by the valve supplier and submitted by contractor to the procuring activity for approval (see 2.3.6 and 6.2). The model specification shall provide all the necessary information to completely describe the starter control valve for one system application. Approval of the model specification is required prior to initiation of preproduction and quality conformance testing. Changes and revisions to the model specification shall be in accordance with MIL-STD-490.

- a. The headings and numbering of sections and paragraphs in the model specification shall correspond to those in this specification. Specific data required by this specification and such other additional data as may be required to completely describe the unit shall be included in the model specification. Omission of reference in the model specification to a particular requirement of this specification by the manufacturer shall be interpreted as compliance therewith. When departures from the requirements of this specification are necessary, the details of such departures shall be stated as specific requirements bearing the same section, paragraph heading, and numbering as in this specification.
- b. All applicable documents shall be listed in numerical order in Section 2 of the model specification.
- c. All curves shall be presented on graph paper having an adequate number of subdivisions to permit easy interpolation.
- d. Definitions and Symbols - Terms, their definitions, and symbols used in the model specification shall be in accordance with Section 2 herein.

- 3.2.1 Detail Specification: Requirements for individual items shall be as specified herein and shall be in accordance with the applicable detail specification (see 2.3.7) for the system.

3.2.2 Valve Data Submittal and Approval: Valve data submittal and approval requirements for a specific model aircraft will be covered by a contract with the appropriate procuring activity. Typical information and data required are listed in 6.2. The data shall be furnished in accordance with MIL-STD-8706 or in accordance with the appropriate line items of the Contractor Data Requirement List (DD Form 1423), as applicable.

3.3 Mockup:

A full-scale mockup shall be prepared for examination and aircraft installation suitability as soon as the contractor has established the necessary design features of the valve. Prior to initiation of the preproduction testing, the mockup shall be installed on the aircraft for which the design was finalized to demonstrate satisfactory fit and installation features. Examination shall be at the option of the procuring activity.

3.3.1 Changes: Changes to the valve features requiring changes in the vehicle or ground support equipment made after approval of the mockup shall be submitted to the procuring activity for approval in accordance with MIL-STD-480. Any changes required by the procuring activity shall be subject to negotiation as provided in the contract. Unless otherwise authorized, the mockup shall be kept current with approved changes at least through the first production contract.

3.4 Components:

Normally, the complete valve shall consist of a valve body assembly which includes a mechanism (such as butterfly) for controlling airflow through the valve, a pressure regulating or on-off actuating power device, and a solenoid-operated pilot valve for control of the actuator.

3.5 Selection of Specifications and Standards:

Specifications and standards for necessary items and services not specified herein shall be selected according to MIL-STD-970.

3.6 Materials:

3.6.1 Metals: Metal parts shall be of the corrosion-resistant type or suitably treated to resist corrosion due to combustion gases or residue, or atmospheric conditions likely to be met in storage or service use. Any corrosion resistant protective coating applied shall provide maximum protection against cracking, chipping, or scaling of the coating with age, use, or extremes of atmospheric conditions.

3.6.1.1 Dissimilar Metals: Unless protected against electrolytic corrosion, dissimilar metals shall not be used in contact with each other. Dissimilar metals are defined in MIL-STD-889.

3.6.2 Nonexpendable Metal Parts: Nonexpendable metal parts may be reworked and reused as agreed between the procuring activity and the contractor, if such parts comply with specifications and drawings in all respects.

- 3.6.3 Synthetic Rubber Parts: Age of synthetic rubber parts shall be controlled in accordance with MIL-STD-1523.
- 3.6.4 Castings: Castings shall be in accordance with MIL-C-2175.
- 3.6.5 Potting Compounds: Requirement 47 of MIL-STD-454 shall be adhered to for encapsulation and embedment. Only those materials that meet the requirements of MIL-S-8516, MIL-S-23586, or MIL-I-81550 shall be used.
- 3.6.6 Organic Materials: Materials that are nutrients for fungi shall not be used where it is practical to avoid them. Where used, they shall be treated with a suitable fungicidal agent.

3.7 Design and Construction:

The valve shall be designed for operational use with a specific pneumatic energy source, and shall be compatible with the starter in a specific application (see AS943). The design shall be amendable to production processing methods. The valve shall be constructed to withstand the strains, jars, vibrations, and other conditions incident to shipping, storage, installation, and service usage. The pneumatic energy sources shall be defined in the detail specification and model specification.

3.7.1 Special Features:

- 3.7.1.1 Failsafe Features: The valve shall be designed to automatically close in the event of loss of electrical power or pneumatic energy source.
- 3.7.1.2 Other Features: Manual override, remote position indication, and other such features shall be specified in the detail specification.
- 3.7.1.3 Installation: The valve shall incorporate features to preclude installing the valve in the opposite airflow direction from that intended.

3.7.2 Reliability and Maintainability:

- 3.7.2.1 Reliability: The valve manufacturer shall prepare, as part of the model specification, a reliability analysis predicting the confidence level and reliability factor based on a one-cycle mission. MIL-STD-470 should be used as a guide. Demonstration of the predicted reliability factors shall be specified in the contract with the procuring activity. Factors to be considered during the design and manufacture of the valve to assure in-service reliability are:

- a. Simplicity of design
- b. Selection and application of reliable components
- c. Consideration of operational and environmental parameters
- d. Mechanical structures - adequate design stress margin on all parts
- e. Design review by technical specialists prior to drawing release
- f. Use of proven manufacturing techniques
- g. Rigid quality control procedures imposed throughout procurement, manufacturing, assembly, and testing to assure the maximum design reliability is built into the equipment

- 3.7.2.2 Maintainability:** The valve design shall permit easy assembly, disassembly, location of trouble sources, routine service checking, adjustment, and maintenance with tools and equipment normally available commercially, by service maintenance personnel with a minimum of training. Maintenance between overhaul periods shall be held to an absolute minimum.
- 3.7.3 Flight and Ground Loading Conditions:** The valve shall withstand, without permanent deformation or failure, the largest forces resulting from ground loading conditions and the largest forces resulting from all critical combinations of maximum flight maneuver conditions specified in the detail specification, acting in any direction through the center of gravity of the valve. In addition, unless otherwise specified, the valve's air inlet connecting flanges shall be capable of withstanding, without permanent deformation or failure, a force of 222 N (50 lb) acting in any direction around the axial centerline of the flange.
- 3.7.4 Threads:**
- 3.7.4.1 Straight Screw Threads:** All conventional straight screw threads shall conform to the requirements of MIL-S-8879 Classes 3A or 3B. The use of MIL-S-7742 is optional for threads used for:
- a. Electrical connections
 - b. Screw threads 3.5 mm (0.138 in) diameter and smaller
 - c. Interference fits and other applications where MIL-S-7742 threads are suitable for the intended purpose, such as installation of studs or external threads of inserts and their mating tapped holes
- 3.7.4.2 Tapered Pipe Threads:** Tapered pipe threads shall be in accordance with MIL-P-7105 and may be used only for permanently plugging drilled or cored openings.
- 3.7.4.3 Threaded Inserts:** All threaded connections in nonferrous materials which are heavily loaded or removed frequently shall have steel inserts which are suitably protected from electrolytic corrosion and meet specified bonding requirements.
- 3.7.5 Inspection Seals:** Calibration adjustment points and other critical points shall be assembled at the factory with inspection seals so that no part of the valve can be disassembled without breaking the seal.
- 3.7.6 Safety Wiring:** All threaded connections shall be locked to prevent in-service loosening by means of safety wiring, self-locking nuts, cotter pins, or other methods approved by the procuring activity. Safety wire shall conform to MS20995 and be installed in accordance with MS33540. The use of lockwashers or staking is prohibited if used as a primary locking device. The general design and usage limitation of self-locking nuts specified in MS33588 shall be applied. The use of safety wire is recommended for calibration points.

- 3.7.7 Drainage:** The valve shall incorporate provisions for drainage or be sealed to prevent water from accumulating within the unit. Drainage shall be such that any condensed or accumulated water will not cause malfunction or cause delay in operation if frozen. Details of valve orientation for the aircraft installation shall be included in the detail specification.
- 3.7.8 Direction of Flow:** The direction of airflow through the valve shall be prominently and permanently marked on the valve housing.
- 3.7.9 Snap Ring Retainer:** The use of snap ring retainers is prohibited except where failure of the retainer will not affect operation of the valve.
- 3.7.10 Pneumatic Bleed:** Bleed ports and passages shall be as large as is practical to preclude blockage by contamination except for heater flow which shall be minimum.
- 3.7.10.1 Continuous Bleed:** The valve shall be designed such that continuous bleed is not required for the valve actuation system with the valve actuated in the closed position. There is no continuous bleed for the valve actuation system with the valve in the closed position.
- 3.7.10.2 Filter:** If filters are required, the maximum opening shall be sufficient to protect the valve from the contamination required in 4.6.13.2. The filter shall be of sufficient size to minimize the need for cleaning and shall be readily removable for replacement or cleaning without performing a major disassembly of the valve.
- 3.7.11 Envelope Requirements:** All components of the valve shall be contained within the envelope and the mounting flanges and electrical connector shall be as defined in the detail specification or specification control drawing. The valve shall meet all of the applicable requirements of this specification when mounted in any position except as limited by the requirements of 3.7.7. Dimensions and tolerances not specified shall be as close as is consistent with aircraft quality shop practices. Where dimensions and tolerances may affect interchangeability, durability, or performance of the valve, they shall be limited and held accordingly.
- 3.7.12 Electrical Requirements:** The valve shall meet the requirements of this specification with a typical electrical power from a 28 V DC system conforming to MIL-STD-704, both normal and abnormal conditions. The 28 V DC is typical and alternative power sources are available. All electrical equipment shall be designed in accordance with MIL-E-7080. Steady-state operating or holding current of the unit shall be specified in the detail specification.
- 3.7.12.1 Solenoid Preload:** The solenoid armature and pilot valve parts shall be designed to provide sufficient preload in the closed position to overcome the forces associated with the environmental conditions (vibrations, etc.) specified in the detail specification. If pressure assist is utilized in accomplishing this, the conditions must be met with the minimum operating pressure specified in the detail specification.

- 3.7.12.2 Connectors: Electrical connectors shall be in accordance with the detail specification. Provisions for lockwiring the connector plug shall be incorporated at the electrical receptacle unless self-locking connectors are used.
- 3.7.12.3 Dielectric Strength: The valve shall meet the dielectric strength requirements as specified in the detail specification.
- 3.7.12.4 Insulation Resistance: The valve shall meet the insulation resistance requirements as specified in the detail specification.
- 3.7.12.5 Electromagnetic Interference and Compatibility (EMIC): The valve shall meet the EMIC requirements as specified in the detail specification.
- 3.7.12.5.1 Spike Emission: Spikes (transients of duration less than 500 ms) generated by the equipment shall not exceed the following values when measured from the base of the transient:
- a. DC power lines: +50% of the normal DC line voltage
 - b. AC power lines: $\pm 50\%$ of the normal rms voltage
 - c. Other lines: limits shall be specified in the approved EMC qualification test procedure
- 3.7.13 Bonding: Bonding control shall be in accordance with the requirements of MIL-B-5087.
- 3.7.14 Lubrication: The valve shall not require relubrication during the overhaul life.
- 3.7.15 Position Indicator: The valve shall be equipped with an external position indicator which shall include suitable markings to indicate the valve (open) and (closed) positions.
- 3.7.16 Proof and Minimum Burst Pressure: The valve shall meet the operational requirements of this specification and shall not have evidence of damage or permanent deformation after having been subjected to a proof pressure equal to two times the maximum operating pressure specified in the detail specification applied at the inlet port with the valve in both the open and closed positions and while at maximum operating temperatures. Minimum burst pressure shall be one and one-half times the proof pressure.
- 3.7.17 Weight: The actual weight of the complete unit shall be specified in the model specification and shall not exceed the maximum weight specified in the detail specification.
- 3.7.18 Design and Fabrication Changes: No changes shall be made in the design of parts or materials listed in the approved valve parts list except when such changes are approved in accordance with the provisions of MIL-STD-480. Approval of changes does not relieve the contractor of full responsibility for the results of such changes on valve characteristics.
- 3.7.19 Parts List: The parts list for the valve that successfully completes the preproduction test shall constitute the approved parts list for subsequent valves of the same model to be delivered to the procuring activity.