MILITARY SPECIFICATION

PROPELLANT FEED SYSTEM, ROCKET
PROPULSION, GENERAL SPECIFICATION FOR

1. SCOPE

1.1 Scope. This specification covers the propellant feed system consisting of the vehicle portion of the propulsion system and includes the propellant and pressurant tankage, all components such as the valves, regulators and switches, the lines and fittings, the propellant gaging and utilization system, the propellant orientation device or system, the vent and relief system, the servicing system, and other items needed to supply propellants to the rocket engine at the proper pressure, temperature, flow rate and mixture ratio. The propellant feed system interface with the rocket engine is usually the inlet to the engine pump in a pump-fed system and the inlet to the engine shut off valves in a pressure fed system.

1.2 Classification. This specification shall be applicable to the propulsion systems of the following classes of vehicles:

Class I - Ground Launched Systems

Class II - Air Launched Systems

Class III - Spacecraft Systems

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

Military

MIL-P-116	Preservation, Methods of
MIL-D-1000	Drawings, Engineering and Associated Lists
MIL-R-5149	Rocket Engine, Liquid Propellant, General Specification For

MIL-T-5208	Tanks, Removable, Liquid Propellant Rocket Engine, General Specification For
MIL-E-5272	Environmental Testing, Aeronautical and Associated Equipment, General Specification For
MIL-C-5501	Caps and Plugs, Protective, Dust and Moisture Seal
MIL-P-5518	Pneumatic Systems, Aircraft, Design, Installation, and Data Requirements for
MIL-I-6866	Inspection, Penetrant Method of
MIL-S-7742	Screw Threads, Standard, Optimum Selected Series, General Specification For
MIL-M-7911	Marking, Identification of Aeronautical Equipment Assemblies and Parts
MIL-I-8500	Interchangeability and Replaceability of Component Parts for Aircraft and Missiles
MIL-S-8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter, General Specification For
MIL-H-25475	Hydraulic Systems, Missile, Design Installation Tests, and Data Requirements, General Specification For
MIL-E-26144	Electric Power, Missile, Characteristics and Utilization, General Specification For
MIL-C-27410	Component, Rocket Propulsion Fluid, General Specification For

STANDARDS

Military

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of United States Military Property
MIL-STD-143	Specifications and Standards Order of Precedence for Selection of
MIL-STD-453	Inspection, Radiographic

MIL-STD-704	Electric Power, Aircraft Characteristics and Utilization of
MIL-STD-785	Requirements for Reliability Program
MIL-STD-810	Environmental Test Methods For Aerospace and Ground Equipment
MS33586	Metals, Definition of Dissimilar

PUBLICATIONS

Air Force - Navy Aeronautical Bulletins

No. 343	Specifications and Standards Applicable to Aircraft Engines and Propellers, Use of
No. 428	Engines, Rocket, Liquid Propellant, Design and Installation Criteria For
No. 445	Engineering Changes to Weapons, Systems, Equipment, and Facilities

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 Pre-production. The rocket propulsion feed system furnished under this specification shall be a product which meets the requirements specified herein.

3.2 Model specification. A rocket propulsion feed system model specification conforming to the appendix specified herein shall be submitted by the contractor and shall have been approved by the procuring activity (6.3.3) prior to design and development of the system.

3.3 Selection of specifications and standards. Specifications and standards for necessary commodities and services not specified herein shall be selected in accordance with MIL-STD-143.

3.4 Change notices. The contractor shall notify the procuring activity of any proposed changes to the propulsion feed system as defined in the model specification. Contracting agency approval is required prior to implementing the change and the model specification shall be changed accordingly.

3.5 Flow test model. A full scale flow test model shall be constructed by the contractor for the purpose of performing system flow testing. The model configuration shall be similar to the flight system except that heavy tanks and nonflight weight components may be used for testing until flight components are available.

3.6 Performance characteristics. The performance characteristics shall be specified in the model specification.

3.7 Ratings.

3.7.1 Flow. The mass flow rates of all fluids with associated tolerances shall be specified in the model specification for nominal design operating conditions.

3.7.1.1 Operating pressure. Fluid operating fluid pressures, pressure limits, and method of pressure control for the operating temperatures and limits specified in 3.7.1.2 shall be specified in the model specification.

3.7.1.2 Operating temperatures. Nominal fluid operating temperatures and limits shall be specified in the model specification.

3.7.1.3 System pressure loss. System pressure loss shall be specified in the model specification for each subsystem and component for the operating temperatures and limits specified in 3.7.1.2.

3.7.1.4 Engine propellant interface pressure. The propellant pressure and flow rate delivered to the engine/vehicle interface (6.3.2) shall be specified in the model specification. The operating temperatures and limits specified in 3.7.1.2 shall be specified in the model specification.

3.7.1.5 Thrust variation. The propellant feed system shall be capable of delivering propellant to the engine at the required pressure, flow rate, and mixture ratio during engine thrust variation. The response of the feed system to changing flow rates, if critical, shall be specified in the model specification.

3.7.1.6 Restart. The method of providing positive propellant feed for restart shall be specified in the model specification. Such items as propellant orientation and sequency of operation shall be described.

3.7.1.7 Weight. A weight tabulation shall be listed in the model specification. The tabulation shall include inert or dry weight (6.3.1) of hardware, fluid weight, and lubricants. The tabulation shall present complete feed system operational weights.

3.7.1.8 Operating life. The operational life of the feed system including all ground checkout operation and normal flight operation shall be specified in the model specification. The number of operational cycles and the total operational time shall be included.

3.7.1.9 Leakage. The maximum feed system leakage for each liquid and gas shall be specified in the model specification. This shall include all allowable leakage. Provisions for safe disposal of hazardous fluids shall be provided.

3.7.1.10 Contamination. Contamination limits shall be specified in the model specification for the liquid and gaseous subsystems of the feed system. The method of limiting contamination to levels acceptable to the rocket engines shall be specified in the model specification. Both particle count and size shall be included.

3.7.1.11 Safety factors. Safety factors for all pressurized containers and lines shall be specified in the model specification. Values for burst pressures less than 1.25 times maximum expected operating pressure for unmanned vehicles and 1.40 for manned vehicles shall be justified to the procuring activity.

3.7.1.12 Over pressure protection. All pressurized containers shall be protected with pressure relief devices which function independently from the pressure source and its control.

3.7.1.13 Ullage volume. Ullage volume limits for all liquid containers shall be specified in the model specification. The method of determining the ullage volume during ground servicing or flight operation shall be described.

3.7.1.14 Propellant slosh. The resonant liquid slosh frequency shall be specified in the model specification for all liquid containers. Methods of suppressing the slosh mode shall be described in the model specification.

3.7.1.15 Expulsion efficiency. The percentage of loaded propellant available to the rocket engines shall be specified in the model specification.

3.7.1.16 Propellant orientation. Propellant orientation shall be provided for systems requiring restart when subjected to adverse acceleration conditions. The methods employed shall be described in the model specification.

3.7.1.17 Attitude. Propulsion feed system attitude limits shall be specified in the model specification for flight operation and ground handling.

3.7.1.18 Storage life. The storage life (6.3.7) of the feed system for ground inert, ground armed, and flight or space as applicable shall be specified in the model specification.

3.7.1.19 Purging. Purging requirements for the feed system shall be specified in the model specification.

3.7.1.20 Thermal control. Requirements for propulsion feed system thermal control on the ground and during flight shall be specified in the model specification. The method of providing this control shall be described.

3.7.2 Start and shutdown characteristics.

3.7.2.1 Start. Feed system start capabilities and allowable limits on pressure and temperature transients shall be specified in the model specification.

3.7.2.2 Shutdown. Feed system shutdown capabilities and allowable limits on pressure and temperature transients shall be specified in the model specification. In addition, emergency shutdown capabilities shall be specified, if applicable.

3.7.3 Reliability. The contractor shall establish feed system reliability objectives and minimum acceptable requirements in the model specification as referenced in MIL-STD-785. The provisions of MIL-STD-785 will apply in demonstrating the ability of the system to meet these requirements and objectives. The increase in reliability obtained through the use of a malfunction detection system and pilot control in manned vehicles shall be specified in the model specification.

3.7.4 Propellants and fluids.

3.7.4.1 Propellants. The propellants which may be used in the feed system shall be specified in the model specification. The propellants shall conform to the requirements of the applicable military propellant specifications.

3.7.4.2 Pressurizing gas. The pressurizing gas which may be used in the feed system and the quantity shall be specified in the model specification. The gases shall conform to the requirements of the applicable military specifications.

3.7.4.2.1 Solid gas generator. The use of solid propellant gas generators for pressurization, the composition of the gas produced and the amount and composition of solid contaminant in the gas shall be specified in the model specification.

3.7.4.3 Lubricants. The type and quantity of lubricants required by the feed system shall be specified in the model specification. Lubricants shall be capable of operation in the environments imposed on the vehicle.

3.7.4.4 Other fluids. Other fluids required for operation test or storage of the feed system shall be specified in the model specification.

3.7.5 Propellant.

3.7.5.1 Quantities. A propellant weight statement shall be included in the model specification and shall provide an accounting of the following propellant quantities as applicable.

(a) Usable propellant (6.3.9).

(b) Trapped propellant (6.3.8).

(c) Purge, bleed, and pressurization gas.

3.7.5.2 Utilization. The accuracy of the propellant utilization system shall be specified in the model specification and shall consist of the percentage of loaded propellant remaining at the completion of the required duty cycle. Allowable variation in mixture ratio limits of propellants supplied to the rocket engines shall be specified in the model specification.

3.7.5.2.1 Change rate. The change rate of propellant utilization system employing variable flow control devices for mixture ratio control shall be sufficient to maintain the mixture ratio within the limits of 3.7.5.2, when subjected to variations in tank pressure, propellant temperature, vehicle acceleration, and engine mixture ratio.

3.7.5.3 Propellant loading.

3.7.5.3.1 Limits. Propellant loading tolerances for each propellant shall be specified in the model specification. The limit established shall consider: loading control system accuracy, propellant temperature, tank manufacturing tolerances, tank thermal shrinkages and expansions, and other factors which might affect the quantity of loaded propellant.

3.7.5.3.2 Rates. Propellant loading rates commensurate with plumbing design limits and boiloff rates shall be established and specified in the model specification.

3.7.5.3.3 Temperature control. Temperature limits of the propellants during loading shall be specified in the model specification.

3.7.5.4 Defueling. Provisions for safe removal of all fluids and gases from the feed system shall be made. The defueling method and rate shall be specified in the model specification.

3.8 Environmental and load factors.

3.8.1 Environmental conditions. The feed system, and where applicable, its major subassemblies shall be capable of accomplishing intended functions under the environmental conditions imposed during its service life (6.3.5).

3.8.1.1 Transportation and storage. The feed system shall not be adversely affected by transportation and storage environments specified in the model specification. The requirement to transport the feed system in a loaded or empty condition shall be specified in the model specification.

3.8.1.2 Checkout and prelaunch. The feed system shall not be adversely affected by the prelaunch environment specified in the model specification.

3.8.1.3 Mission and trajectory. The feed system shall operate satisfactorily in the launch and flight environment specified in the model specification.

3.9 System components. General requirements for propulsion subsystem components shall be as specified in MIL-C-27410.

3.9.1 Lines and fittings. Propulsion feed system lines and fittings shall conform to the requirements in 3.7.1.11. Provisions for flexibility shall be provided to prevent line failure due to vehicle flexure or thermal extremes.

3.9.2 Drains. Drains for reactive fluids should be separate with suitable provisions made to drain all hazardous fluids from the feed system. Drain fittings shall be located so that complete draining can be effected with the feed system installed in its normal launch attitude so that the fluid will drain by the force of gravity.

3.9.3 Tankage. Propulsion feed system tankage shall conform to the requirements in MIL-T-5208.

3.9.4 Filters. Filters shall be incorporated in the feed system when contamination impairs subsystem or engine operation. Filter requirements shall be specified in the model specification.

3.9.5 Service connections. Service connections such as propellant fill and drain, pressurization, pneumatic, and hydraulic line connections shall conform to MIL-C-27410.

3.10 Auxiliary power requirements. Propulsion feed system requirements for electrical, pneumatic, and hydraulic support shall be specified in the model specification as applicable. These requirements shall include electrical power, fluid type, operating pressures, temperatures, flow rates, response, and duty cycle. The requirements shall be established in accordance with MIL-P-5518, MIL-H-25475, MIL-E-26144, and MIL-STD-704.

3.11 Installation and maintainability.

3.11.1 Mounting. All components, lines, and fittings shall be supported from vehicle structure by suitable mounting bracketry, clamps, and other associated hardware. These mounting provisions shall provide for thermal expansions and contractions, facilitate component inspection and replacement, and provide sufficient access for component and subsystem servicing in accordance with ANA Bulletin 428. When required, the mounting hardware shall provide shock mounting for the components. The location of components, lines, and fittings shall be described in schematics and drawings as specified in MIL-D-1000.

3.11.2 Protective shielding. Thermal, electric, magnetic, and nuclear shielding shall be applied to all components of the feed system as required to assure safe, compatible operation. Protective coverings may be used for component protection during extended inert ground storage.

3.12 Design and fabrication.

3.12.1 Design. The detailed design of the propulsion feed system shall be accomplished by the contractor subject to the requirements of this specification and any associated specifications. The relative importance of cost, weight, schedule, envelope, and reliability as design considerations shall be specified in the model specification.

3.12.1.1 Design standards. MS and AND design standards shall be used wherever applicable.

3.12.1.2 Standards. MS or AN standard parts shall be used wherever they are suitable for the purpose, and shall be identified by their standard part numbers. The use of nonstandard parts will be acceptable only when standard parts have been determined to be unsuitable. MS and AND design standards shall be used wherever applicable. MS or AN utility standard parts shall conform to applicable standards in accordance with paragraph entitled "Utility Parts Standards" in ANA Bulletin 343.

3.12.1.3 Threads. Conventional straight screw threads shall conform to the requirements in MIL-S-7742 or MIL-S-8879. Duplicate parts, differing only in thread form, shall not be permitted. Unless otherwise specified, threaded parts smaller than 0.164 inch diameter shall have threads in accordance with MIL-S-7742. When an allowance is required for application in elevated temperature, corrosive atmosphere, or other conditions which may cause thread seizure, this allowance shall be obtained by increasing the diameters of the internal threads. Pipe threads may be used only with specific approval of the procuring activity.

3.12.2 Materials and processes.

3.12.2.1 Quality. Materials and processes used in the manufacturer of the feed system shall conform to applicable specifications in accordance with paragraph entitled "Material Specifications" in ANA Bulletin 343. When feed system manufacturer's specifications are used for materials and processes that may affect performance or durability of the feed system, such specifications shall be made available to the Government for review prior to the applicable PFRT or qualification tests. These specifications, unless specifically disapproved, shall be considered released for use in manufacture of the feed system upon completion of the qualification test program. The use of non-Government specifications shall not constitute a waiver of Government inspection.

3.12.2.2 Dissimilar metals. Dissimilar metals are defined by MS33586 and shall not be used in intimate contact with each other unless suitably protected against electrolytic corrosion by means of protective coating or hermetic sealing.

3.12.2.3 Compatibility. All materials shall be compatible with the fluid used in the operational environment. The materials shall also be compatible with the environments expected during long term, inert storage unless suitable coatings or similar protection is provided. Nameplates need only be splash resistant to the fluids used in the system.

3.12.2.4 Protective treatment. All protective coatings and treatments shall be applied in accordance with applicable military and Federal standards and specifications.

3.12.2.5 Interchangeability. All parts and components having the same manufacturer's part number shall be functionally and dimensionally interchangeable. Changes in manufacturer's part numbers shall be governed by the drawing number requirements specified in MIL-D-1000. Interchangeability requirements shall be in accordance with MIL-I-8500.

3.12.3 Parts list. A manufacturer's parts list shall be included in the model specification. Changes to the parts list shall be in accordance with the requirements in 3.12.4.1.

3.12.4 Changes.

3.12.4.1 Design. Feed system design changes shall be made in accordance with requirements in ANA Bulletin 445. Two classes of changes shall be defined.

3.12.4.2 Approval. Approval of changes does not relieve the contractor of full responsibility for the results of such changes to the propulsion feed system.

3.12.5 Product identification. Equipment, assemblies, and parts shall be marked for identification in accordance with MIL-M-7911 (for the Bureau of Aeronautics only) and MIL-STD-130.

3.12.6 Drawings and diagrams. Drawings and diagrams shall include and identify all applicable components required for the feed system in accordance with MIL-D-1000. The following data shall be provided:

(a) Feed system assembly drawings complete with component assembly drawings and identifying part numbers.

(b) Final installation drawing.

(c) Fluid flow diagrams.

(d) Electrical system diagram.

(e) Control system diagram.

The following preliminary data shall be provided with the preliminary model specification:

(a) General layout drawing.

(b) Fluid flow diagram.

3.12.7 System weight. System weight shall be included on the drawings and in the model specification.

4. QUALITY ASSURANCE PROVISIONS

4.1 Classification of tests. Propulsion feed system testing shall be classified as follows:

4.1.1 Development tests. Development tests shall be conducted to verify and refine propulsion feed system operating characteristics during the development cycle.

4.1.2 Qualification tests. Qualification tests shall be conducted to demonstrate the suitability of the propulsion feed system for flight and production.

4.1.3 Acceptance tests. Acceptance tests shall be conducted to demonstrate the suitability of the production feed system for operational use.

4.2 Tests and test methods.

4.2.1 Development tests. Development tests shall be conducted on a full-scale propulsion feed test system. Heavy weight tankage may be used in the interest of safety. This test system will be used as a development tool to determine the interaction between components and subsystems, to explore thermal effects, and to determine system operating and response characteristics. System operating and response tests may be repeated in flight systems when structural stiffness has a significant effect upon system pressure or dynamic response characteristics. The system shall be capable of operating with the actual propellants and gases; however, an engine firing capability is not required.

4.2.2 Qualification tests. Qualification tests shall be conducted with full-scale flight weight feed systems capable of supporting engine firings. The feed system, its components, and the test apparatus shall be subject to inspection by authorized Government inspectors. Two copies of the complete parts list, drawings, and specifications for all components of the qualification test feed system shall be provided to the procuring activity prior to beginning the qualification tests.

4.2.2.1 Test apparatus and procedures. Schematic drawings and descriptions of all test apparatus including points of measurement shall be provided prior to initiation of the qualification test. Test procedures and methods to be used shall be provided the procuring activity.

4.2.2.2 Instrumentation calibration. Each instrument and other measuring apparatus upon which the accuracy of test results depends shall be calibrated frequently enough to insure attainment of steady state accuracy of ± 1 percent of the specified value of the measurement. Calibration records shall be maintained and made available for inspection by the procuring activity upon request.

4.2.2.2.1 Automatic recording equipment. Automatic recording equipment of adequate response shall be used to obtain data during transient conditions of feed system and component operation requiring an evaluation of time critical variables.

4.2.3 Test conditions. Unless otherwise specified, all inspections and tests shall be conducted in an external environment at ambient temperatures (4.2.3.1.2) and at ambient pressure.

4.2.3.1 Temperatures.

4.2.3.1.1 Low temperature. Low temperature tests shall be conducted with the temperature of ambient air, test system, and fluids at the minimum expected operating temperature as specified in the model specification.

4.2.3.1.2 Ambient temperature. Ambient temperature tests shall be conducted with the temperature of ambient air, test system, and fluids at the normally expected ambient temperature range as specified in the model specification.

4.2.3.1.3 High temperature. High temperature tests shall be conducted with the temperature of ambient air, test system, and fluids at the maximum expected operating temperature as specified in the model specification.

4.2.4 Parts failure and replacement. Maintenance, adjustment, or replacement of parts other than normal expendables such as squibs, burst diaphragms or single cycles positive expulsion devices shall not be permitted during qualification and acceptance testing. The qualification test on the feed system shall be considered complete when every part of the system has been subjected to and has satisfactorily completed the entire test. At the discretion of the procuring activity, redesign and retesting may be conducted on any part which fails or indicates a weakness after completing the qualification test but is retained in the system to complete the testing on other parts.

4.3 Propulsion feed system qualification tests. The feed system(s) submitted for qualification testing shall have passed the acceptance tests (4.4) and then shall be subjected to the following tests. Each series of tests shall be performed on the feed system in the sequence listed unless impractical due to feed system size, lack of facilities, or cost. Tests may be conducted on part of the feed system when such a procedure is more practical. Elimination or substitution of any test shall be the perogative of the procuring activity. Two feed systems may be used for these tests (one for series A and one for series B).

SERIES A

(a) Fluid resistance and extreme temperature

(b) Vibration

(c) Shock

(d) Thermal altitude

(e) Attitude

(f) Humidity

(g) Salt spray

(h) Sand and dust

SERIES B

(a) Acceleration

(b) Slosh

(c) Response

(d) Propellant utilization

(e) Ignition

(f) Acoustic noise

(g) Electrical interference

(h) Endurance

(i) Proof pressure

4.3.1 Fluid resistance and extreme temperature. The feed system fluid resistance and extreme temperature tests shall be conducted in accordance with table I. The system shall be tested in an environmental chamber, if practical. The test may be conducted in two parts with the fuel and oxidizer tested separately for reasons of safety. Phase I of the test may be eliminated for low boiling point propellants and Phase III eliminated for high freezing point propellants at the option of the procuring activity. Propellant or gaseous leakage in excess of the amount specified in the model specification which occurs at any time during the test shall be considered disqualifying.

TABLE I

Fluid resistance and extreme temperature

Conditions	Phase I	Phase II	Phase III
System configuration	Flight	Flight	Flight
Test fluid	Fuel or oxidizer, and pressurizing gas loaded at normal operating temperature	Fuel or oxidizer, and pressurizing gas	Fuel or oxidizer, and pressurizing gas
Duration	96 hours	48 hours	48 hours
Ambient temperature	160° ±5°F (71.1° ±5°C) or the operating temperature of the system whichever is higher	60° ±5°F (15.6° ±5°C)	-65° ±5°F (-53.9° ±5°C) or the operating temperature of the system whichever is lower
Test operations	Cycle all intermittent duty components once every 6 hours. Run all continuous duty components 10 minutes every 6 hours, normal system operating pressure shall be maintained	Cycle all intermittent duty components once every 6 hours. Run all continuous duty components 10 minutes every 6 hours, normal system operating pressure shall be maintained	Cycle all intermittent duty components once every 6 hours. Run all continuous duty components 10 minutes every 6 hours, normal system operating pressure shall be maintained.

Notes:

1. Phases I, II and III shall be run consecutively.
2. Propellant or gaseous flow is not required during this test.
3. Feed systems having self generating pressurization systems may use helium or nitrogen for this test.

4.3.2 Vibration. Vibration tests shall be conducted in accordance with MIL-E-5272 or MIL-STD-810. Amplitudes and acceleration levels may be increased to better simulate the actual environment. This test may be waived at the option of the procuring activity when it becomes impractical due to feed system size. The calibration (4.4.3) and static leakage (4.4.2) tests shall be performed at the completion of this test. Substitute fluids may be used in lieu of propellants.

4.3.3 Shock. The feed system mounted in a normal shipping configuration shall be subjected to a shock test in the applicable direction to an acceleration level and duration as specified in the model specification. The static leakage test (4.4.2) shall be performed at the completion of this test.

4.3.4 Thermal altitude. The feed system shall be tested at maximum expected altitude and temperature extremes as specified in the model specification for proper operation. The feed system shall be pressurized to normal operating pressure and maintained at the altitude condition at each temperature extreme for 6 hours. A calibration sequency (4.4.3) shall be performed on the system at each temperature. Malfunction of any component or electrical shorts as noted by increased power consumption shall be cause for rejection.

4.3.5 Attitude. Satisfactory operation of the feed system pressurized to operating pressure shall be demonstrated in all attitudes expected during flight. This test may be combined with the thermal altitude test (4.3.4).

4.3.6 Humidity. Humidity tests shall be conducted in accordance with MIL-E-5272 or MIL-STD-810. A calibration test (4.4.3) shall be performed at the completion of this test.

4.3.7 Salt spray. Salt spray tests shall be conducted in accordance with MIL-E-5272 or MIL-STD-810. A calibration test (4.4.3) shall be performed at the completion of this test.

4.3.8 Sand and dust. Sand and dust tests shall be conducted in accordance with MIL-E-5272 or MIL-STD-810. A calibration test (4.4.3) shall be performed at the completion of this test.

4.3.9 Acceleration. The acceleration tests in MIL-E-5272 or MIL-STD-810 shall be performed on the feed system where possible up to the acceleration levels specified in the model specification. The feed system shall be loaded with propellant or substitute fluids having a specific gravity within $\pm$ 5 percent of the propellants, and the acceleration test conducted with propellant quantities from empty to full in 10 percent increments at the appropriate mission acceleration levels. A calibration test (4.4.3) shall be conducted at the completion of this test.

4.3.10 Slosh. The resonant slosh frequencies of the feed system shall be determined experimentally for each 10 ±2 percent increment of propellant quantity from 10 to 100 percent. Substituted fluids and subscale tankage may be used if the final results are corrected for fluid density, viscosity, size, and acceleration in accordance with the relationship shown below.

$$dr = \left(\frac{\mu r}{\rho r}\right)^{2/3} (ar)^{-1/3}$$

d = tank diameter

μ = fluid viscosity

ρ = fluid density

a = acceleration

r = ratio of subscale to full-scale feed system or substitute fluid to actual propellants.

4.3.11 System response. The response of the feed system to start and throttling, if applicable, and the fluid surge that occurs at shutdown shall be determined. In the event the propellant system supplies more than one engine, the appropriate operation of these engines shall be performed or simulated as is applicable. This test may be conducted in accordance with the rocket engine firing tests in MIL-R-5149 or may be conducted with feed system shut-off valves capable of equalling or exceeding the response of the rocket engine. Pressurization and propellant system pressures shall be recorded with instrumentation of 500 cycles per second (cps) response or better. System response and surge characteristics shall be determined at each 10 ±2 percent increment of propellant and pressurant quantity from 10 percent to 100 percent at rated flow or at each 10 ±2 percent increment of rated flow if the system is throttleable.

4.3.12 Propellant utilization. The propellant utilization accuracy of the feed system shall be determined. This test may be conducted in conjunction with the rocket engine firing tests in MIL-R-5149. The system shall be fully loaded with propellants and pressurization gas and a full duration run conducted simulating the mission profile. Propellant quantities in the tanks shall be determined at the beginning and at the completion of the run and the propellant utilization accuracy shall be the percent of total fuel or oxidizer, whichever is larger, remaining in the tanks at the end of the run.

4.3.13 Ignition. The feed system shall be installed in a test chamber containing a combustible mixture capable of being ignited by an electrical spark. Maximum input voltage shall be applied to the electrical system and the system actuated through 11 complete cycles. Each cycle will be conducted

at 10,000-foot increments starting at sea level and progressing to 100,000 feet. Any reaction or explosion occurring during the test shall be cause for rejection. At the completion of the test, a sample of the mixture shall be ignited by an electrical spark. Small tankage may be used to replace the full-scale tankage. Gases and propellants are not required during this test.

4.3.14 Acoustic. The feed system shall be subjected to the maximum expected acoustic noise level as specified in the model specification for 10 minutes. The system shall be pressurized to normal operating pressure during this test. Small tankage may be used to replace the full-scale tankage.

4.3.15 Electrical interference. The feed system shall conform to the electrical interference requirements of MIL-R-5149. The tests entitled "Electrical and electronic interference and susceptibility check" in MIL-R-5149 shall be conducted on the feed system and its components to demonstrate compliance with these requirements.

4.3.16 Endurance. A single duty cycle feed system shall be required to accumulate, through qualification testing and additional calibration tests, a total running time equal to 25 rated duration runs. A multiple duty cycle feed system shall be required to accumulate, through qualification testing and additional calibration tests, a total running time equal to 100 rated duration runs. Failure of the system to meet any of its performance requirements during these tests shall be cause for rejection. These tests may be combined with rocket engine testing in MIL-R-5149.

4.3.17 Proof pressure. Proof pressure (6.3.4) tests shall be conducted on the propulsion feed system by pressurizing both the pressurization and propellant systems. The pressure shall be imposed and held for at least 2 minutes. Evidence of deformation or permanent set shall be cause for rejection.

4.4 Acceptance test. The acceptance tests specified in 4.4.1 through 4.4.6.4 shall be conducted on each propulsion feed system. Each feed system or its components shall be visually examined to determine conformance with its applicable drawings.

4.4.1 Weight. The dry weight (6.3.1) of the feed system shall be determined by either weighing the assembled system or adding the weights of the component parts. This weight shall not exceed that specified in the model specification.

4.4.2 Static leakage. The feed system shall be tested for leakage by pressurizing the propellant and pressurization system with helium to normal operating pressures. The loading system shall be isolated from the feed system and feed system pressures and temperatures monitored for a period of one hour. Leakage shall not exceed the amount specified in the model specification.

4.4.3 Calibration. The feed system shall be operated through one complete cycle to demonstrate compliance with the performance characteristics of the model specification. System pressures, flow rates, temperatures, and pressure drops will be recorded. The amount of propellant required to fill the system and the propellant residuals remaining at the completion of the operating cycle shall also be determined. The test shall be performed at ambient temperature and pressure. Propellants shall be used for the calibration tests unless substitute fluids are approved by the procuring activity.

4.4.4 Additional tests. For the purpose of testing special features of the feed system, additional tests may be required. These tests shall be outlined in the model specification.

4.4.5 Rejection. Malfunction of the system during calibration and leakage testing in excess of allowable limits specified in the model specification shall be cause for rejection. Rejected systems may have their faulty components repaired or replaced and be subjected to those tests necessary to confirm acceptance.

4.4.6 Quality evidence tests. Evidence of suitable quality of material, parts, and components shall be based on physical inspection and process control data and may be supplemented by physical and chemical tests to determine the extent of conformance of the quality characteristics to the manufacturer's specifications and drawings.

4.4.6.1 Magnetic inspection. All stressed parts made of magnetic materials shall be subjected to magnetic particle inspection in accordance with MIL-I-6866.

4.4.6.2 Fluorescent penetrant inspection. All stressed parts made of nonmagnetic materials shall be subjected to fluorescent penetrant inspection in accordance with MIL-I-6866.

4.4.6.3 Antifriction bearings. Assembled ball or roller bearings shall not be inspected magnetically or with a penetrant.

4.4.6.4 Radiographic inspection. All magnesium and aluminum castings shall be subjected to radiographic inspection in accordance with MIL-STD-453.

5. PREPARATION FOR DELIVERY

5.1 Storage and shipment requirements. The propulsion feed systems and accessories shall be prepared for storage and shipment in accordance with the requirements set forth in subsequent paragraphs.

5.1.1 Draining and purging. Prior to packaging for shipment, all working fluids shall be drained from the propulsion feed systems. The feed systems shall be purged with an inert gas having characteristics and purity that are compatible with the contamination limitations of the feed systems.

5.1.2 Cleaning, preservation, and packaging. Cleaning, preserving, and packaging of the propulsion feed systems and associated equipment shall be accomplished in accordance with MIL-P-116. All caps, plugs, and covers used for closures of open ports shall be in accordance with MIL-C-5501.

5.1.3 Hazardous conditions. Hazardous conditions during shipment of the feed system shall be minimized. Explosive ordnance equipment such as squibs or igniters shall not be transported while installed in the feed system. Desiccant type breathers shall be employed on all feed systems during storage and transportation except where internal pressurization is required for structural purposes. For systems requiring pressurization, provisions shall be made for maintaining pressure within required limits. For air transport, maximum rate of altitude change shall be specified in the model specification.

5.1.4 Marking of shipments. Shipping containers shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. The propulsion feed system specification is intended for use in either manned or unmanned remote-launched, air-launched, and spacecraft systems.

6.2 Symbols. The symbols used herein and in the model specification will be those in American Association Standard ASA Y10.14 - 1959. Symbols not included, that may be required, shall be defined in the model specification.

6.3 Definitions.

6.3.1 Dry weight. Dry weight is the weight of the assembled propellant feed system when completely dry of all propellants, lubricant, hydraulic fluids, etc.

6.3.2 Interfaces. Interfaces are those requirements or physical features of the propellant feed system which attach to or otherwise affect the characteristics of the engine or vehicle or the characteristics of aerospace ground equipment which is not furnished by the engine manufacturer.

6.3.3 Procuring activity. Procuring activity is the activity which negotiates the contract.

6.3.4 Proof pressure. Proof pressure is the test pressure to which an item is subjected without leakage, deformation or detrimental permanent set adversely affecting engine operation.

6.3.5 Service life. Service life is the sum of storage and operating lifes.

6.3.6 Standard condition. Standard conditions are the values of air temperature and pressure given in the U. S. Standard Atmosphere 1962. The standard humidity, for the purpose of this specification, is zero vapor pressure for all altitudes.

6.3.7 Storage life. Storage life is the time that the propellant feed system can be stored, after quality conformance tests, without replacement of parts and subsequently operate within specification limits.

6.3.8 Trapped propellant. Trapped propellant is the residual propellant remaining in the propellant feed system which is unavailable to the rocket engine.

6.3.9 Usable propellant. Usable propellant is that propellant consumed in the production of useful impulse. It does not include that consumed during vehicle holddown during launch.

Custodian:	Preparing activity:
Air Force - 12	Air Force - 12
Review activities:	Civilian agency interest:
Air Force - 14, 19, 70	NAS

Reviewer/user information is current as of the date of this document. For further coordination of changes to this document, draft circulation should be based on the information in the current DoD Index of Specifications and Standards.

APPENDIX

10. SCOPE

10.1 Scope. This appendix establishes the form to be used by manufacturers in the preparation of a Rocket Propulsion Feed Systems model specification.

20. APPLICABLE DOCUMENTS

20.1 The following specification in effect on date of invitation for bids or request for proposal, forms a part of this appendix to the extent specified herein:

SPECIFICATION

MIL-P-27409	Propellant Feed System, Rocket Propulsion, General Specification For

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

30. APPLICATION

30.1 A complete rocket propulsion feed system model specification, in accordance with the outline and instructions for preparation as specified herein, shall be prepared for each specific propulsion feed system model. Changes to a feed system model specification shall not be submitted to the procuring activity by means of amendments prior to approval of the feed system model specification. Revisions by amendment form, to an approved feed system model specification, which has been released and is forming a part of a contract, shall be acceptable to the procuring activity. Each amendment shall include and supersede the previous amendment. Revision pages shall not be used. An appropriate approval statu shall be shown on page 1 of the model specification.

30.2 The feed system manufacturer's model specification shall be a fully definitive specification and shall include all applicable standard requirements of MIL-P-27409 supplemented by the additional data requirements and statements shown herein. The paragraphs of MIL-P-27409 shall be repeated verbatim when applicable. When departures are necessary from the requirements of this appendix and of MIL-P-27409, the details of such departures shall be stated as specific requirements bearing the same section, paragraph heading, and numbering as in this appendix and MIL-P-27409. Such departures shall be indicated by the symbol "ϕ" preceding the paragraph number.

30.3 Parenthetical sentences, phrases, and words are included herein for the guidance of the feed system manufacturer in connection with the preparation of the model specification. Parenthetical statements shall not be copied in the model specification.

30.4 The specification number shall be the number assigned by the feed system manufacturer. When revisions are made they shall be designated by the use of a letter following the number, with a revision date therefore, which shall be shown on page 1. Only the specification number, and the revision suffix letter, if applicable, shall be shown on subsequent pages. The first revision will be identified by the letter "A" and succeeding revisions will be indicated by the other letters in alphabetical sequence except that the letters "I", "O", "Q", and "S" will not be used. All revisions shall include a summary of revision changes.

30.5 For purposes of permitting preliminary evaluation of a proposed feed system design, or for release of approved feed system performance characteristics in connection with a vehicle design competition, the feed system manufacturer may submit a preliminary model specification. However, a complete approved model specification will be required for a contract. Preliminary model specifications shall be identified by the word "PRELIMINARY."

30.5.1 It is desired that the preliminary model specification be prepared in accordance with the requirements stipulated herein, except that it is recognized that certain information not available or pertinent to the purpose of the preliminary specification may be omitted.

40. FORMAT AND CONTENT

40.1 The form and description of the model specification follow.

(Number and title. The number and title shall be shown as follows.)

Approval Status (include applicable statement) (This draft has not been approved. DO NOT USE FOR PROCUREMENT PURPOSES) (Approved by the procuring activity letter_____)

(Specification No.) _____
(Date)_____
(a) Revised_____(Date)
(b) Revised_____(Date)

MODEL SPECIFICATION

PROPELLANT FEED SYSTEM:_____(Insert service type and model designation if assigned.)

(NAME OF CONTRACTOR)
(CONTRACTOR'S MODEL DESIGNATION)

1. SCOPE

1.1 Scope. This specification covers the requirements for a rocket propulsion feed system.

1.2 Classification. The _____(insert type and model) feed system for installation in the _____, (insert designation(s) of applicable vehicle(s)) is a _____(insert a brief description of the salient features of this feed system.)

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of this specification, form a part of the specification to the extent specified herein. (List all documents referenced herein. This listing shall include the document number, revision letter, amendment number, date, and the complete document title. Titles shall be checked with the publication itself, rather than an index. SPECIFICATIONS, STANDARDS, DRAWINGS, and other PUBLICATIONS shall be listed numercially under these headings and in individual groups such as Federal or Military. No documents shall be listed in this section except those which are referenced in the body of the model specification wherein the extent of applicability shall be clearly indicated in those cases where the entire specification is not applicable.)

3. REQUIREMENTS

3.1 Pre-production. (Repeat text from MIL-P-27409.)

3.2 Model specification. The feed system shall be designed, fabricated, and tested as specified herein.

3.3 Selection of specifications and standards. (Repeat text from MIL-P-27409.)

3.4 Change notices. (Repeat text from MIL-P-27409.)

3.5 Flow test model. (Repeat text from MIL-P-27409.)

3.6 Performance characteristics. The rating and curves shown are based on the terms and standard conditions (6.3.6 MIL-P-27409) defined herein.

3.7 Ratings.

3.7.1 Flow. The performance ratings shall be as listed in table I. These data are based on the use of specified propellants and fluids under specified conditions, with an exhaust nozzle having an expansion ratio of _____.

3.7.1.1 Operating pressure. Nominal operating fluid pressures, pressure limits, and method of pressure control for the operating temperatures and limits in 3.7.1.2 shall be specified herein.

3.7.1.2 Operating temperatures. Nominal fluid operating temperatures and limits shall be specified herein.

3.7.1.3 System pressure loss. Specify the system pressure loss for each subsystem and component for the operating temperatures and limits in 3.7.1.2.

3.7.1.4 Engine propellant interface pressure. (Specify the propellant pressure delivered at the engine/vehicle interface at the required flow rate.)

3.7.1.5 Thrust variation. Specify the response of the feed system to changing flow rates, if critical.

3.7.1.6 Restart. The method of providing positive propellant feed for restart shall be specified. Such items as propellant orientation, tank pressure control, and sequence of operation shall be described.

3.7.1.7 Weight. List a weight tabulation to include inert or dry weight of hardware, fluid weight, and lubricants. The tabulation shall present complete feed system operational weights.

3.7.1.8 Operating life. The feed system shall have an operating life of (specify in terms of calendar time, ground checkout operation, and normal flight operation). The number of operational cycles and the total operational time shall be included.

3.7.1.9 Leakage. The maximum feed system leakage for each liquid and gas shall be specified herein. This shall include all allowable leakage. (Specify source of leakage, fluids, and leakage rates, and describe provisions for disposition.)

3.7.1.10 Contamination. The following are the contamination limits for the liquid and gaseous subsystems of the feed system. Specify the method of limiting contamination to levels acceptable to the rocket engine. (Include particle count and size.)

3.7.1.11 Safety factors. (Specify all pressurized containers and lines.)

3.7.1.12 Over pressure protection. (Repeat text from MIL-P-27409.)

3.7.1.13 Ullage volume. (Specify ullage volume limits for all liquid containers. Describe the method of determining the ullage volume during ground servicing or flight operation.)

3.7.1.14 Propellant slosh. (Specify the resonant liquid slosh frequency for all liquid containers. Methods of suppressing the slosh mode, if required, shall be described.)

3.7.1.15 Expulsion efficiency. _____ percent of loaded propellant shall be available to the rocket engine.

3.7.1.16 Propellant orientation. The methods employed in propellant orientation for systems requiring restart when subjected to adverse acceleration conditions shall be described.

3.7.1.17 Attitude. (Specify propulsion feed system attitude limits for flight operation and ground handling.)

3.7.1.18 Storage life. (Specify the storage life of the feed system for ground inert, ground armed, and flight or space as applicable.)

3.7.1.19 Purging. (Specify purging requirements for the feed system to include fluids, flow rates, temperatures, pressures, and duration to be used.)

3.7.1.20 Thermal control. (Specify requirements for propulsion feed system thermal control on the ground and during flight. The method of providing this control shall be described.)

3.7.2 Start and shutdown characteristics.

3.7.2.1 Start. (Specify feed system start capabilities and allowable limits on pressure and temperature transients.)

3.7.2.2 Shutdown. (Specify feed system shutdown capabilities and allowable limits on pressure and temperature transients. If applicable, specify emergency shutdown capabilities.)

3.7.3 Reliability. The contractor shall establish feed system reliability objectives and minimum acceptable requirements herein as referenced in MIL-STD-785. (Specify the increase in reliability obtained through the use of a malfunction detection system and pilot control in manned vehicles.)

3.7.4 Propellant and fluids.

3.7.4.1 Propellants. (Specify the propellants which may be used in the feed system as follows: _____ _____ _____.)

3.7.4.2 Pressurizing gas. (Specify the pressurizing gas which may be used in the feed system and the quantity, purity, and water content as follows: _____ _____ _____ _____ _____ _____ _____.)

3.7.4.2.1 Solid gas generator. (Specify the use of solid propellant gas generators for pressurization, the composition of the gas produced and the amount and composition of solid contaminant in the gas.)

3.7.4.3 Lubricants. Specify the type and quantity of lubricants required by the feed system.

3.7.4.4 Other fluids. Other fluids required for operation test or storage of the feed system are as follows: _____ _____ _____ _____ _____.

3.7.5 Propellant.

3.7.5.1 Quantities. A propellant weight statement shall be included herein and shall provide an accounting of the following propellant quantities as applicable:

(a) Usable propellant _____

(b) Trapped propellant _____

(c) Purge, bleed, and pressurization gas _____

3.7.5.2 Utilization. The accuracy of the propellant utilization system is _____. Specify the allowable variation in mixture ratio limits of propellants supplied to the rocket engines.

3.7.5.2.1 Change rate. (Repeat text from MIL-P-27409.)

3.7.5.3 Propellant loading.

3.7.5.3.1 Limits. (Specify the propellant loading tolerances for each propellant.)

3.7.5.3.2 Rates. (Specify and establish propellant loading rates commensurate with plumbing design limits and boiloff rates.)

3.7.5.3.3 Temperature control. (Specify temperature limits of the propellants during loading.)

3.7.5.4 Defueling. (Specify the defueling method and rate as follows: provisions for safe removal of all fluids and gases from the feed system.)

3.8 Environmental and load factors.

3.8.1 Environmental conditions. The feed system shall be capable of accomplishing the intended functions under environmental conditions imposed upon the feed system during its service life. The feed system during its service life shall not suffer any detrimental effects during or after exposure to the following environmental conditions:

Temperature: Ground _____ °F to _____ °F (_____ °C to _____ °C)

Flight _____ °F to _____ °F (_____ °C to _____ °C)

Storage _____ °F to _____ °F (_____ °C to _____ °C)

Vibration: Inflight: frequencies of _____ to _____ cps, with acceleration of _____ to _____ g's.

Boost: frequencies of _____ to _____ cps, maximum double amplitude of _____ inch, and maximum acceleration of _____ g's.

Acoustical: maximum acoustical energy from _____ to _____ db (reference: _____ dynes _____) between _____ and _____ cps during boost.

Attitudes: from vertical positive _____ g condition to negative _____ g condition shall be specified herein.

3.8.1.1 Transportation and storage. The feed system shall not be adversely affected by transportation and storage environements. These environments shall include but need not be limited to the following: temperature and pressure extremes; shock, acceleration, and vibration loads; rain, sand, dust, salt spray, explosive atmosphere, and others as applicable. Specify the requirements for transporting the feed system in a loaded or empty condition.

3.8.1.2 Checkout and prelaunch. The feed system shall not be adversely affected by prelaunch environments. These environments shall include, but need not be limited to, the following: ambient temperature and pressure; handling and vibration loads; humidity, rain, sand, dust, salt spray, explosive atmosphere, and others as applicable.

3.8.1.3 Mission and trajectory. The feed system shall operate satisfactorily in the launch and flight environments. These environments shall include, but need not be limited to, the following: temperature and pressure extremes; vibration, acceleration, shock loads, and slosh; acoustic noise, explosive atmosphere, and others as applicable.

3.9 System components. (Repeat text from MIL-P-27409.)

3.9.1 Lines and fittings. (Repeat text from MIL-P-27409.)

3.9.2 Drains. (Repeat text from MIL-P-27409.)

3.9.3 Tankage. (Repeat text from MIL-P-27409.)

3.9.4 Filters. (Specify filter requirements as follows: flow rate _____, pressure loss _____, physical dimensions _____, and element life _____.)

3.9.5 Service connections. (Repeat text from MIL-P-27409.)

3.10 Auxiliary power requirements. The feed system requirements shall be specified as follows: electrical power _____ watts, pneumatic _____ cfps, and hydraulic _____ gpm at _____ psi.

3.11 Installation and maintainability.

3.11.1 Mounting. (Repeat text from MIL-P-27409.)

3.11.2 Protective shielding. (Repeat text from MIL-P-27409.)

3.12 Design and fabrication.

3.12.1 Design. (Specify the relative importance of cost, weight, schedule, envelope, and reliability as design considerations.)

3.12.1.1 Design standards. (Repeat text from MIL-P-27409.)

3.12.1.2 Standards. (Repeat text from MIL-P-27409.)

3.12.1.3 Threads. (Repeat text from MIL-P-27409.)

3.12.2 Materials and processes.

3.12.2.1 Quality. (Repeat text from MIL-P-27409.)

3.12.2.2 Dissimilar metals. (Repeat text from MIL-P-27409.)

3.12.2.3 Compatibility. (Repeat text from MIL-P-27409.)

3.12.2.4 Protective treatment. (Repeat text from MIL-P-27409.)

3.12.2.5 Interchangeability. (Repeat text from MIL-P-27409.)

3.12.3 Parts list. A manufacturer's parts list shall be included herein, containing the unit nomenclature, type numbers, and drawing numbers for each component of the feed system.

3.12.4 Changes.

3.12.4.1 Design changes. (Repeat text from MIL-P-27409.)

3.12.4.2 Approval. (Repeat text from MIL-P-27409.)

3.12.5 Product identification. (Repeat text from MIL-P-27409.)

3.12.6 Drawings and diagrams. (Repeat text from MIL-P-27409.)

3.12.7 System weight. (Specify the value of the system weight as shown on the drawings. Do not exceed this value.)

4. QUALITY ASSURANCE PROVISIONS

4.1 Classification of tests. (Repeat text from MIL-P-27409.)

4.1.1 Development tests. (Repeat text from MIL-P-27409.)

4.1.2 Qualification tests. (Repeat text from MIL-P-27409.)

4.1.3 Acceptance tests. (Repeat text from MIL-P-27409.)

4.2 Tests and test methods.

4.2.1 Development tests. (Repeat text from MIL-P-27409.)

4.2.2 Qualification tests. (Repeat text from MIL-P-27409.)

4.2.2.1 Test apparatus and procedures. (Repeat text from MIL-P-27409.)

4.2.2.2 Instrumentation calibration. (Repeat text from MIL-P-27409.)

4.2.2.2.1 Automatic recording equipment. (Repeat text from MIL-P-27409.)

4.2.3 Test conditions. (Repeat text from MIL-P-27409.)

4.2.3.1 Temperatures.

4.2.3.1.1 Low temperature. Low temperature tests shall be conducted at the minimum operating temperature with ambient air at _____ (specify temperature), test system at _____ (specify temperature), and fluids at _____ (specify temperature).

4.2.3.1.2 Ambient temperature. Ambient temperature tests shall be conducted at the normal ambient temperature range with ambient air at _____ (specify temperature), test system at _____ (specify temperature), and fluids at _____ (specify temperature).

4.2.3.1.3 High temperature. High temperature tests shall be conducted at the maximum operating temperature with ambient air at _____ (specify temperature), test system at _____ (specify temperature), and fluids at _____ (specify temperature).

4.2.4 Parts failure and replacement. (Repeat text from MIL-P-27409.)

4.3 Propulsion feed system qualification tests. (Repeat text from MIL-P-27409.)

4.3.1 Fluid resistance and extreme temperature. (Repeat text from MIL-P-27409.)

4.3.2 Vibration. (Repeat text from MIL-P-27409.)

4.3.3 Shock. The feed system mounted in a normal shipping configuration shall be subjected to a shock test in the applicable direction to _____ (specify acceleration level and duration).

4.3.4 Thermal altitude. The feed system shall be tested at _____ and _____ (specify maximum expected altitude and temperature extremes).

4.3.5 Attitude. (Repeat text from MIL-P-27409.)

4.3.6 Humidity. (Repeat text from MIL-P-27409.)

4.3.7 Salt spray. (Repeat text from MIL-P-27409.)

4.3.8 Sand and dust. (Repeat text from MIL-P-27409.)

4.3.9 Acceleration. The acceleration tests of MIL-C-5272 or MIL-STD-810 shall be performed on the feed system where possible up to _____ (specify the acceleration levels).

4.3.10 Slosh. (Repeat text from MIL-P-27409.)

4.3.11 System response. (Repeat text from MIL-P-27409.)

4.3.12 Propellant utilization. (Repeat text from MIL-P-27409.)

4.3.13 Ignition. (Repeat text from MIL-P-27409.)

4.3.14 Acoustic. The feed system shall be subjected to _____ (specify the maximum expected acoustic noise level).

4.3.15 Electrical interference. (Repeat text from MIL-P-27409.)

4.3.16 Endurance. (Repeat text from MIL-P-27409.)

4.3.17 Proof pressure. (Repeat text from MIL-P-27409.)

4.4 Acceptance test. (Repeat text from MIL-P-27409.)

4.4.1 Weight. (Specify the dry weight of the feed system as determined by either weighing the assembled system or adding the weights of the component parts.) Dry weight shall not exceed _____.

4.4.2 Static leakage. The feed system shall be tested for leakage by pressurizing the propellant and pressurization system with helium to normal operating pressures. The loading system shall be isolated from the feed system and feed system pressures and temperatures monitored for a period of one hour. Leakage shall not exceed _____.

4.4.3 Calibration. (Repeat text from MIL-P-27409.)

4.4.4 Additional tests. (Specify additional tests which may be required for the purpose of testing special features of the feed system.)

4.4.5 Rejection. (Specify allowable limits during calibration and leakage tests.)

4.4.6 Quality evidence tests. (Repeat text from MIL-P-27409.)

4.4.6.1 Magnetic inspection. (Repeat text from MIL-P-27409.)

4.4.6.2 Fluorescent penetrant inspection. (Repeat text from MIL-P-27409.)

4.4.6.3 Antifriction bearings. (Repeat text from MIL-P-27409.)

4.4.6.4 Radiographic inspection. (Repeat text from MIL-P-27409.)

5. PREPARATION FOR DELIVERY

5.1 Storage and shipment requirements. (Repeat text from MIL-P-27409.)

5.1.1 Draining and purging. (Repeat text from MIL-P-27409.)

5.1.2 Cleaning, preservation, and packaging. (Repeat text from MIL-P-27409.)

5.1.3 Hazardous conditions. (Specify maximum rate of altitude change for air transport during shipment of the feed system.)

5.1.4 Marking of shipments. (Repeat text from MIL-P-27409.)

6. NOTES

6.1 Intended use. (Repeat text from MIL-P-27409.)

6.2 Symbols. The symbols used herein will be in accordance with American Association Standard ASA Y10.14 - 1959 and the following: (if symbols not included in this standard are used, a tabular list of the symbol(s) and its definition(s) shall be included under this paragraph).

6.3 Definitions. (Repeat text of all subparagraphs of this paragraph adding any definitions needed for undefined new terms used in tabular form under the succeeding paragraph number from MIL-P-27409.)

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SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 119-R004

INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity *(as indicated on reverse hereof)*.

SPECIFICATION
MIL-P-27409(USAF) Propellant Feed System, Rocket Propulsion, General Specification For

ORGANIZATION *(Of submitter)*	CITY AND STATE

CONTRACT NO.	QUANTITY OF ITEMS PROCURED	DOLLAR AMOUNT
		$.

MATERIAL PROCURED UNDER A

☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

☐ YES ☐ NO IF "YES", IN WHAT WAY?

4. REMARKS *(Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)*

SUBMITTED BY *(Printed or typed name and activity)*	DATE

DD FORM 1 APR 63 1426 REPLACES NAVSHIPS FORM 4863, WHICH IS OBSOLETE C-8279