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MILITARY SPECIFICATION

VALVES, CHECK, AIRCRAFT FUEL SYSTEM

This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers low-pressure check valves suitable for use in aircraft fuel systems. They are intended for use with hydrocarbon fuels, fuel vapors, and air throughout the temperature ranges stated herein.

1.2 Classification. Check valves shall be of the following classes:

Class A - Normal temperature range
Class B - Medium temperature range

(For applicable temperature range, see 3.6.8.)

1.3 Usage. Check valves approved for class B are automatically approved for class A.

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

Federal

P-D-680	Dry Cleaning Solvent
TT-S-735	Standard Test Fluids; Hydrocarbon

Military

MIL-G-5572	Gasoline, Aviation, Grades 80/87, 100/130, 115/145
MIL-T-5624	Turbine Fuel, Aviation, Grades JP-4 and JP-5

FSC 2915

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MIL-C-7024	Calibrating Fluid, Aircraft Fuel System Components
MIL-F-8615	Fuel System Components: General Specification for
MIL-S-8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter; General Specification for
MIL-N-25027	Nut, Self-Locking, 250°F, 450°F, and 800°F, 125 KSI FTU, 60 KSI FTU, and 30 KSI FTU
MIL-J-25656	Jet Fuel, Grade JP-6
MIL-R-25897	Rubber, High-Temperature, Fluid-Resistant
MIL-R-25988	Rubber, Silicone, Oil and Fuel Resistant

STANDARDS

Military

MIL-STD-100	Engineering Drawing Practices
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of US Military Property
MIL-STD-143	Standards and Specifications, Order of Precedence for the Selection of
MIL-STD-794	Parts and Equipment, Procedures for Packaging and Packing of
MIL-STD-810	Environmental Test Methods
MIL-STD-831	Test Reports, Preparation of
MIL-STD-889	Dissimilar Metals
MS20995	Wire, Safety
MS28882	Valve, Fuel Check, Low Pressure, Gasket Seal Straight Thread Connection
MS28884	Valve, Fuel Check, Low Pressure, Flared Tube Connector
MS33540	Safety Wiring and Cotter Pinning, General Practices for
MS33588	Nuts, Self-Locking, Aircraft Design and Usage Limitations of
MS33666	Packing, Preformed - Aeronautical, Elastomeric, Range of Sizes
MS33668	Packing, Preformed - Tube Fitting, Elastomeric, Range of Sizes

Air Force-Navy Aeronautical

AND10064	Fittings - Installation of Flared Tube, Straight Threaded Connectors

PUBLICATIONS

Air Force-Navy Aeronautical Bulletin

No. 438	Age Controls of Age-Sensitive Elastomeric Items

(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.)

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2.2 Other publications. The following document forms a part of this specification to the extent specified herein. Unless otherwise specified, the issue in effect on date of invitation for bids or request for proposal shall apply.

Society of Automotive Engineers, Inc.

ARP 868 Pressure Drop Test for Fuel System Components

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., Two Pennsylvania Plaza, New York, New York 10017.)

3. REQUIREMENTS

3.1 Preproduction. This specification makes provisions for preproduction testing (see 4.4).

3.2 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.

3.3 Materials. Materials and processes used in the manufacture of check valves shall be suitable for the purpose and shall conform to applicable Government specifications. Materials conforming to contractor's specifications may be used provided the specifications are released by the services and contain provisions for adequate tests. The use of contractor's specifications shall not constitute waiver of Government inspection.

3.3.1 Metals. All metals used in construction of the valves shall be corrosion resistant or protected to resist corrosion during normal service life of the valve when in storage or during normal service use. The selection of metals shall be based on the stress corrosion limits of the material and not on the normal yield strength. Internal stresses due to assembly methods and stresses due to assembly in the next assembly shall be considered. The torque limits specified in AND10064 for the applicable fitting end shall be used for this purpose.

3.3.1.1 Dissimilar metals. Unless suitably protected against electrolytic corrosion, dissimilar metals as defined in MIL-STD-889 shall not be used in intimate contact with each other.

3.3.1.2 Magnesium. Magnesium or magnesium alloy shall not be used in the manufacture of check valves.

3.3.1.3 Copper, copper alloys, and cadmium plating. Copper, copper alloys, and cadmium plating shall not be used on parts which come into contact with fuel.

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3.3.2 Fungus resistance. Materials that contain nutrients to fungi shall not be used in the valves.

3.4 Design

3.4.1 Valves shall be designed to permit flow of fuel, fuel vapors, or air in one direction and check flow in the opposite direction. The design of the valve shall be such that the sealing element shall be closed in all attitudes of the valve in the absence of fluid pressure.

3.4.2 Flow capacity. The valves shall be designed to be used with the rated flow capacities shown in table I.

3.4.3 Pressure drop. The valves shall be designed to provide minimum pressure drop. The pressure drop for the applicable size shall not exceed that shown in table I.

TABLE I. Flow Capacity and Pressure Drop

Valve Size (MS designation)	Rated Flow Capacity, GPM	Maximum Pressure Drop, Inches of Water
-04	1.25	28
-06	3.75	28
-08	6.0	28
-10	10	28
-12	15	20
-16	30	20
-20	50	20
-24	70	20
-32	130	20

3.5 Construction. The valves shall be constructed to withstand the strains, jars, vibrations, and other conditions incident to shipping, storage, installation, and service use.

3.5.1 Envelope. Check valves shall conform to MS28882 and MS28884.

3.5.2 Lubrication. The valves shall function satisfactorily without the use of lubricants during their entire service life.

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3.5.3 Castings. Castings shall be clean, sound, and free from holes, cracks, and other defects.

3.6 Performance

3.6.1 Air pressure leakage. With the inlet portion of the valve filled with fuel, there shall be no air leakage through the valve at outlet air pressures equivalent to 4 inches of fuel to 60 pounds per square inch gage (psig).

3.6.2 Fuel leakage. Fuel leakage shall not exceed 0.01 cubic centimeter per minute at outlet pressures from 4 inches of fuel to 60 psig.

3.6.3 Cracking pressure. The cracking pressure of all valves shall not exceed 8 inches of water with the valve mounted in any position (see 6.3).

3.6.4 Pressure ranges

3.6.4.1 Proof pressure. The valves shall function properly with any inlet or outlet pressure from zero to 120 psig.

3.6.4.2 Burst pressure. The valve shall withstand a burst pressure of 180 psig without external leakage. When the pressure is reduced to 120 psig, the valve shall function properly.

3.6.5 Contaminated fuel. The valves shall function properly during and after exposure to fuel contaminated as specified in 4.6.3.

3.6.6 Vibration. The valves shall function properly after subjection to the vibration test in 4.6.4.

3.6.7 Corrosion resistance. The valves shall function properly after subjection to the accelerated corrosion test in 4.6.5.

3.6.8 Temperature ranges. The valves shall function properly throughout the temperature ranges specified below:

Valve Class	Temperature Ranges °F Ambient	Fluid
A	-67 to +160	-67 to +135
B	-67 to +350	-67 to +200

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3.6.9 Fuel resistance. The valves shall be resistant to and shall function properly when used in fuels and fluids conforming to MIL-G-5572, MIL-T-5624, MIL-J-25656, MIL-C-7024, P-D-680, and TT-S-735 having an aromatic content from 0 to 30 percent.

3.6.10 Endurance. The valves shall be capable of successfully completing 100,000 cycles of pressure reversals from the inlet to the outlet port. A cycle is defined as follows:

(a) Valve open and flowing rated flow as specified in 3.4.2

(b) No-flow pressure shall be 60 psig

(c) Inlet flow is shut off and vented to zero psig with the outlet being simultaneously pressurized to 60 psig.

The cycle rate shall be 15 cycles per minute (maximum).

3.7 Part numbering of interchangeable parts. All parts having the same manufacturer's part number shall be functionally and dimensionally interchangeable. The item identification and part number requirements of MIL-STD-100 shall govern the manufacturer's part numbers and changes thereto.

3.8 Screw threads. All screw threads shall be in accordance with MIL-S-8879.

3.8.1 Locking of parts. All threaded parts shall be locked by safety wiring, by fuel-resistant self-locking nuts conforming to MIL-N-25027, cotter pins, or other approved methods. Safety wires shall be installed in accordance with MS33540 and shall conform to MS20995. Self-locking nuts shall be used in accordance with MS33588. Self-locking nuts shall not be used where loosening or disengagement of the nut could result in the nut or other parts entering the fuel system. The use of lockwashers or staking is prohibited. Retaining rings shall not be used unless the design is such that a failure of the ring will have no effect on the function of the valve.

3.9 Weight. The weight of the valves shall be kept to a minimum consistent with acceptable aircraft practices.

3.10 Synthetic rubber parts. The use of synthetic rubber parts shall be kept to a minimum, and when practicable, their use shall be limited to those that do not require age control.

3.10.1 Synthetic rubber materials. Synthetic rubber parts for class B valves shall conform to MIL-R-25897 or MIL-R-25988.

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3.10.2 Marking. Parts made from synthetic rubber compounds specified in ANA Bulletin No. 438, except for preformed packings and other parts with no suitable surface, shall have the year and quarter of the curing date of the part painted, stamped in ink, or otherwise noted thereon.

3.10.3 Age control. Information in accordance with the requirements of ANA Bulletin No. 438 shall be marked on the outside of the valve.

3.10.4 Serviceability. Wherever practicable, synthetic rubber parts shall be readily replaceable with a minimum replacement of attaching parts.

3.10.5 Uniformity. For valves which include parts fabricated of synthetic materials in contact with fuel, the manufacturer shall control subsequent batches to provide for uniformity.

3.10.6 Preformed packings. All preformed packings shall dimensionally conform to MS33666 or MS33668.

3.11 Identification and markings

3.11.1 Valve part numbering. The valve manufacturer shall assign a drawing number for each size listed on the applicable MS drawing for which approval is desired. The valve part number shall consist of the drawing number plus the size as shown on the applicable MS drawing and the class in accordance with 1.2.

3.11.2 Color identification. The valves shall be identified as fuel system components in accordance with the paragraph entitled "Color Identification" of MIL-F-8615.

3.11.3 Identification of product. Assemblies, subassemblies, and parts shall be marked in accordance with MIL-STD-130.

3.11.3.1 Nameplate. A nameplate containing the following information in accordance with MIL-STD-130 shall be securely attached to the valve, or the same information may be etched, engraved, embossed, or stamped in a suitable location on the valve:

VALVES, CHECK, AIRCRAFT FUEL SYSTEM
MS part number
Manufacturer's part number
Manufacturer's name or trade-mark.

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3.11.3.2 Special markings. The word HINGE shall be marked on the outside of the valve adjacent to the pivot location for all swing-type valves. Direction of flow shall be indicated by arrows in two places approximately 180° apart as shown on the applicable MS drawing.

3.12 Workmanship. Attention shall be given to quality of workmanship such as alignment of parts, tightness of assembly screws and bolts, marking of parts, and removal of burrs and sharp edges.

3.12.1 Cleaning. All parts shall be clean and free from dirt, sand, metal chips, and other foreign matter during and after assembly.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for performance of the inspection requirements specified herein, unless disapproved by the Government. The procuring activity reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of tests. The inspection and testing of the valves shall be classified as follows:

(a) Preproduction tests (4.4)

(b) Quality conformance tests (4.5).

4.3 Test conditions

4.3.1 Cleaning. Prior to testing the valves, all internal parts normally in contact with the fuel shall be thoroughly cleaned to remove all foreign matter.

4.3.2 Test fluid. Unless otherwise specified, fluid in accordance with P-D-680 shall be used for all tests. With the approval of the procuring activity, any other fluid acceptable to the procuring activity may be used as a substitute for the test fluid for all tests, except those tests wherein a specific fluid is specified.

4.3.3 Temperature and pressure. Unless otherwise specified, the tests shall be conducted with the valves and fuel at temperature between 60° and 90°F and at atmospheric pressure. All pressures specified are gage pressures.

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4.4 Preproduction testing

4.4.1 Test samples. The test samples shall consist of two samples of each size representative of the production equipment. The samples shall be identified with the manufacturer's part number and such other information as required by the procuring activity and forwarded to the testing facility designated in the contract.

4.4.1.1 Data to accompany test samples. The following data shall be prepared:

(a) Engineering data in the form of manufacturer's drawings (one set) and parts list

(b) Three copies of a test report in accordance with MIL-STD-831.

4.4.2 Preproduction tests. The preproduction tests shall consist of the following tests conducted in the order listed, as described under 4.6. The tests may, at the option of the procuring activity, be supplemented with tests under actual or simulated service conditions.

Valve No. 1

(a)	Examination of product	4.6.1
(b)	Calibration	4.6.2
(c)	Contaminated fuel endurance	4.6.3
(d)	Vibration	4.6.4
(e)	Accelerated corrosion	4.6.5
(f)	Fuel resistance and extreme temperature	4.6.6
(g)	Disassembly and inspection	4.6.9

Valve No. 2

(a)	Examination of product	4.6.1
(b)	Calibration	4.6.2
(c)	Fuel resistance and extreme temperature	4.6.6
(d)	Endurance	4.6.7

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(e)	Burst pressure	4.6.8
(f)	Disassembly and inspection	4.6.9

4.4.3 Rejection and retest of preproduction samples. If, during the preproduction tests, a major part fails, the test shall be terminated. The replacement unit assembly shall have a redesigned part or one of different material corresponding to the failed part, except that if the failure was caused by faulty material or workmanship, the procuring activity may authorize the installation of a part of the original design and material with the defect overcome. The preproduction tests shall be considered complete when every part has concurrently completed the preproduction tests. Quantity production shall be withheld until the preproduction samples have been pronounced satisfactory by the procuring activity. The approval of the preproduction samples shall not relieve the contractor of the obligation to subject samples to the quality conformance tests.

4.5 Quality conformance tests. The quality conformance tests shall consist of the individual tests.

4.5.1 Individual tests. Each valve shall be subjected to the following tests, in the order listed, as described under 4.6:

(a)	Examination of product	4.6.1
(b)	Leakage	4.6.2.1
(c)	Proof pressure	4.6.2.3

4.5.2 Rejection and retest of individual samples. Check valves failing the individual tests may be reworked and retested provided the condition causing the failure does not indicate possible failure of other flight items. If a condition of probable repeated failure does exist, the supplier shall immediately notify the procuring activity. The procuring activity shall have the prerogative of either accepting or rejecting the items.

4.6 Test methods

4.6.1 Examination of product. The valves shall be examined to determine conformance to all the requirements of this specification with respect to materials, weight, workmanship, design, interchangeability, exterior surface, construction, exterior finishes, markings, and applicable MS drawings.

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4.6.2 Calibration

4.6.2.1 Leakage. Air and fuel leakage shall be tested as specified in 4.6.2.1.1 and 4.6.2.1.2.

4.6.2.1.1 Air pressure leakage. An air pressure equivalent to 4 inches of fuel shall be applied to the outlet of the valve. The inlet portion of the valve shall be filled with fuel or other suitable liquid. There shall be no air bubbles in a 1-minute period. The test shall be repeated for air pressures of 1 psig, 10 psig, 30 psig, and 60 psig. For individual tests, leakage shall be measured at pressures equivalent to 4 inches of fuel and 60 psig only.

4.6.2.1.2 Fuel pressure leakage. Fuel under pressure from 4 inches of test fluid to 6 psi in 1 psi increments, and from 10 to 60 psi increments shall be applied to the outlet port. The test setup shall be as shown on figure 1 or such as to give equivalent results. After a 2-minute maximum waiting period, leakage shall not exceed that specified in 3.6.2. For individual tests, leakage shall be measured at pressures of 4 inches of fluid and 60 psi only.

4.6.2.2 Valve opening and closing. The valve shall meet the cracking pressure requirements specified in 3.6.3. On checking for closing, the valve shall close before the outlet pressure rises to equal the inlet pressure when the valve flow path is vertical and the outlet port down.

4.6.2.3 Proof pressure. With the valve submerged in fuel, or other suitable liquid, and with the inlet port open, air pressure from 0 to 120 psi shall be applied to the outlet port for a minimum of 1 minute. There shall be no leakage at any required pressure. There shall be no structural damage, malfunction, or distortion either during or as a result of this test.

4.6.2.4 Pressure drop. The pressure drop through the valve shall be determined in accordance with SAE ARP 868 to the fuel flow specified in table I. The pressure drops shall not exceed the values specified in 3.4.3. Pressure drop values shall be converted to a standard specific gravity of 0.770 by the following formula:

$$\Delta P \text{ Corrected} = \frac{0.770}{SG} \times \Delta P$$

Where SG = Specific gravity of test fluid

Sufficient data shall be taken to satisfactorily plot a "Pressure Drop versus Flow" curve.

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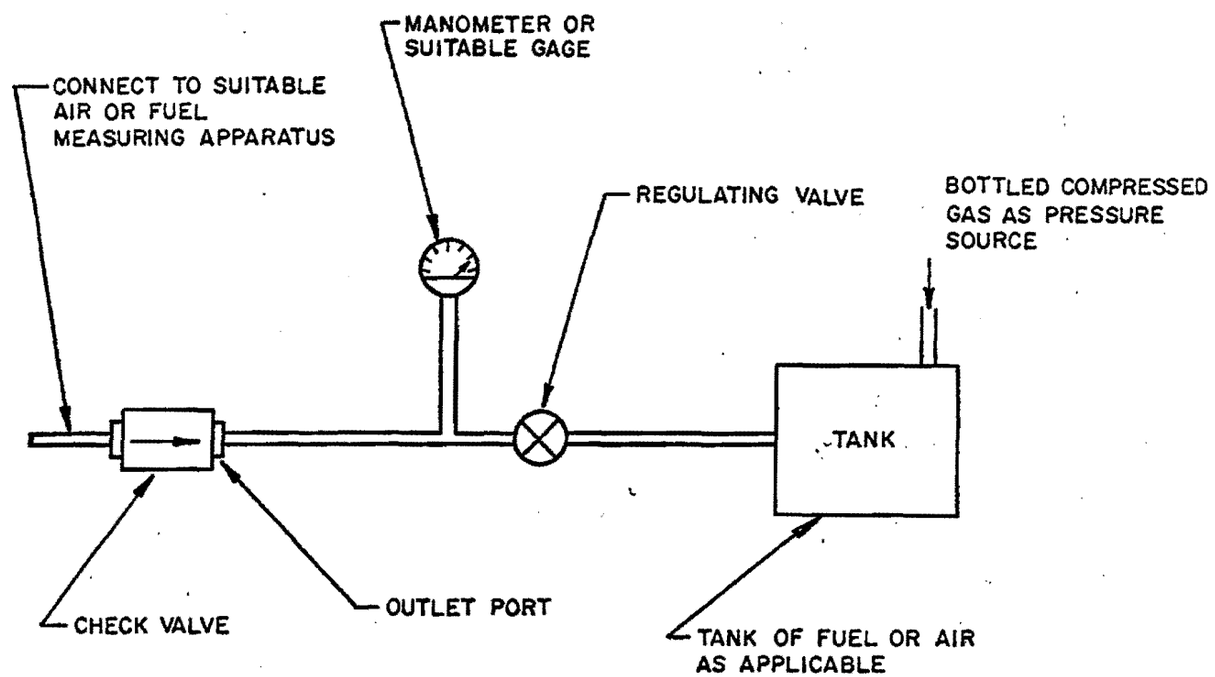

FIGURE 1. Test Set-Up for Fuel (or Air) Pressure Leakage

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4.6.3 Contaminated fuel endurance. The valve shall be subjected to the contaminated fuel endurance test in accordance with MIL-F-8615. After the test, the valve shall be subjected to the leakage test specified in 4.6.2.1.2.

4.6.4 Vibration. The valve shall be vibrated in a dry condition in accordance with MIL-STD-810, method 514, category (a), procedure I, curve AT, part 1. At the conclusion of this test, the tests specified in 4.6.2.1 and 4.6.2.2 herein shall be conducted.

4.6.5 Accelerated corrosion. The complete valve with open ports shall be immersed in a solution consisting of 2-1/2 percent of weight of sodium chloride in distilled water. After immersion, the solution shall be drained, and the valve shall be heated in an oven to a temperature of 130 $\pm 5^{\circ}F$ for 1 hour. The immersion and heating cycle shall be repeated 50 times. The valve shall not be operated any time during the above 50 cycles. Immediately after completion of the immersion cycles, the valve, in the assembled state, shall be flushed with warm water to remove salt accumulations, after which the valve shall be dried, wetted with fuel, and subjected to the tests specified in 4.6.2.1.

4.6.6 Fuel resistance and extreme temperature. This test shall be conducted in accordance with the table entitled "Fuel Resistance and Extreme Temperature Test Schedule for Components Incorporating Moving Parts, but No Electrical Equipment" of MIL-F-8615.

4.6.7 Endurance. An endurance test of 100,000 cycles shall be conducted in accordance with the table entitled "Endurance Test Schedule" of MIL-F-8615.

4.6.8 Burst pressure. A fluid pressure of 180 psig shall be applied for a period of 1 minute to the inlet port with the outlet capped and then to the outlet port with the inlet capped. There shall be no external leakage. After application of the 180 psig pressure, the valve shall successfully complete the fuel pressure leakage test of 4.6.2.1.2.

4.6.9 Disassembly and inspection. The valve shall be disassembled and inspected. There shall be no evidence of deterioration, corrosion, or undue wear which might affect the performance of the valve.

5. PREPARATION FOR DELIVERY

5.1 Preservation and packaging. Check valves shall be preserved and packaged levels A or C in accordance with MIL-STD-794, as specified (see 6.2).

5.2 Packing. Packing shall be levels A, B, or C in accordance with MIL-STD-794, as specified (see 6.2).

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5.3 Marking. In addition to any marking required by the contract or order, interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. The fuel check valves covered by this specification are intended for use in aircraft fuel systems.

6.2 Ordering data. Procurement documents should specify:

(a) MS part number

(b) Quantity required

(c) Applicable levels of preservation, packaging, and packing

(d) Preproduction test procedure

(e) Preproduction test report

(f) Quality conformance test procedure

(g) Quality conformance test results

(h) Engineering drawings for procuring activity review.

6.3 Definitions. Cracking pressure is the pressure at which 1/2 percent of the flow specified in 3.6.3 is obtained.

6.4 Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Custodians:
Army - AV
Navy - AS
Air Force - 11

Review activities:
Army - AV, ME, MI
Navy - AS
Air Force - 82

Preparing activity:
Air Force - 11

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