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General Components Specification for Explosive Actuated Valves One Cycle

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1. SCOPE:

The purpose of this recommended practice is to establish a general form which may be used as a guide in the preparation of detail specifications. This recommended practice shall not be used for procurement or be referred to in the detail specification.

2. APPLICABLE SPECIFICATIONS, OTHER PUBLICATIONS AND DRAWINGS:

2.1 The following specifications, standards, drawings, and publications of the issue in effect on date of invitation for bids shall form a part of this recommended practice to the extent specified herein. When the requirements of the below listed specifications conflict with the requirements of this document, the requirements of this document shall govern.

2.2 Military Specifications:

MIL-B-121	Barrier Material Grease Proofed, Flexible (Water Proofed)
MIL-D-70327	Drawings, Engineering and Associated Lists
MIL-E-5272	Environmental Testing, Aeronautical and Associated Equipment
MIL-P-5514	Packings, Installation and Gland Design, Hydraulic and Pneumatic
MIL-G-5572	Gasoline, Aviation; Grades 80/87, 91/96, 100/130, 115/145
MIL-N-6011	Nitrogen, Liquid and Gas
MIL-P-7105	Pipe Threads, Taper, Aeronautical
MIL-S-7742	Screw Threads, Standard Aeronautical
MIL-A-8625	Anodic Coatings; for Aluminum and Aluminum Alloys
MIL-C-9435	Chamber, Explosion Proof Testing
MIL-N-25027	Nut, Self-locking, 250 F, 550 F and 800 F

2.3 Military Standards:

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking of Shipments
MIL-STD-130	Identification Marking of U. S. Military Property
MIL-STD-143	Specifications and Standards, Order of Precedence for the Selection of
MS 20995	Wire, Lock
MS 33586	Metals, Definition of Dissimilar
MS 33588	Nuts and Plate Nuts, Self Locking, Functional Limitations of

2.4 Air Force - Navy Aeronautical Bulletin:

No. 438 Age Controls for Synthetic Rubber Parts

2.5 Other SAE Reference Publications:

AS 478	Identification Marking Methods
AS 567	General Practices for Use of Lock Wire, Key Washers, and Cotter Pins

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3. REQUIREMENTS:

3.1 General:

The explosive actuated valve shall be actuated (open or closed) through electrical energization of the squib contained therein. The squib is an electrically activated device for rapidly producing high pressure gas by igniting gas producing chemicals through the heating or explosive vaporization of small wire resistance elements (bridgewires). Samples of the valve, designed in accordance with the detail specification, shall pass the qualification tests specified therein, and all valves shall pass the acceptance tests to the extent specified therein.

3.1.1 Classification: Explosive actuated valves shall be of the following types, classes, and configurations for one cycle operation:

Type	I	Normally closed
	II	Normally open
	III	Combination normally open/normally closed
Class	A	Single operation
	B	Simultaneous multiple operation
	C	Sequence multiple operation

3.1.2 Configuration: Various flow configurations of the types and classes listed in paragraph 3.1.1 are illustrated in Appendix A. The general configurations illustrated are not intended as design limitations. They illustrate many of the configurations presently employed and are shown as a guide to the design versatility of explosive actuated valves.

3.2 Materials:

Materials and processes used in the manufacture of explosive actuated valves shall be of high quality, suitable for the purpose, and shall conform to applicable government specifications. Materials conforming to supplier specifications may be used provided the specifications are acceptable to the purchaser. The use of supplier specifications will not constitute waiver of purchase inspection. All materials used in the valve shall be compatible with the contacting fluid, and/or explosive chemical, to the extent specified therein.

3.2.1 Metals: All metals used in the construction of explosive actuated valves shall be of a corrosion-resisting type or shall be suitably protected to resist corrosion. The use of dissimilar metals, as defined in MS 33586, shall be avoided where practicable.

3.2.2 Synthetic Materials: Where synthetic materials are used, the supplier shall control critical properties to provide uniformity. Where synthetic rubber parts are used, they shall be supplied in accordance with ANA Bulletin 438.

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3.2.3 Selection of Materials: Specifications and standards for all materials, parts, government certification and approval of processes and equipment which are not specifically designated herein and which are necessary for the execution of this specification, shall be selected in accordance with MIL-STD-143, except as outlined in paragraph 3.2.

3.2.4 Critical Materials: The use of critical materials shall be held to a minimum.

3.2.5 Lubrication: The lubricants shall be compatible with the service fluids and environment. The explosive actuated valve shall require no additional lubrication between overhaul periods.

3.2.6 Packings, Gaskets and O-Rings: Packings, gaskets and O-rings shall be compatible with the fluid used and operational conditions specified for the explosive valve. Where possible, installation and gland design shall be in accordance with specification MIL-P-5514.

3.2.7 Reliability: The explosive actuated valve shall be designed so that any checked out, delivered unit shall operate satisfactorily without malfunction, under specified operating and environmental conditions. The specific reliability level shall be as specified in the detail specification.

It is not the intent of this recommended practice to specify the method of demonstrating reliability; however, included below are suggested methods by which this may be accomplished.

a. Evaluation and/or qualification testing
b. Field data
c. Safety margins
d. Statistical test programs

It is recommended that “Bruceton” test techniques be considered for determining adequate margins and establishing confidence of maximum reliability.

3.3 Design:

3.3.1 Environmental Conditions: Consideration should be given the following environmental conditions, such that after exposure to both continuous and intermittent periods, the explosive actuated valve shall meet all requirements of the detail specification when operated under all natural combinations of these environmental conditions:

a. Ambient Pressure
b. Humidity
c. Sand and Dust
d. Salt Spray
e. Fungus
f. Vibration
g. Acceleration
h. Shock
i. Operating Temperature
j. Storage Temperature

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3.3.2 Operating Attitude: The explosive actuated valve shall be capable of operating satisfactorily in all attitudes.

3.3.3 Operating Life: The explosive actuated valve shall be capable of operation for one cycle.

3.3.4 Physical Characteristics: The overall weight and dimensions shall be kept to a minimum consistent with the design requirements.

3.3.5 Mounting: To be as specified in the detail specification.

3.3.6 Structural Design: The explosive actuated valve shall be designed to withstand the strains, jars, vibrations, and other conditions incident to shipping, storage, installation, and service use.

3.3.7 Pressure:

3.3.7.1 Operating Pressure: The explosive actuated valve shall be designed to withstand the nominal operating pressure as specified in the detail specification.

3.3.7.2 Proof Pressure: The explosive actuated valve shall be capable of meeting all requirements of the specification after being subjected to a proof pressure of 150% of the nominal operating pressure for a period of two (2) minutes.

3.3.7.3 Burst Pressure: The explosive actuated valve shall be capable of sustaining for two (2) minutes duration 200% of the nominal operating pressure, without bursting. The valve need not be capable of normal functioning after having been subjected to burst pressure.

3.3.8 Leakage: The leakage, both internally and externally, shall be zero, consistent with measurable values over the pressure range from zero to the nominal operating pressures.

3.3.9 Rated Flow: The explosive valve shall be designed to flow the specified flow rate relative to an equivalent C_V value, specified flow factor, or equivalent sharp edged orifice. (The C_V coefficient of a valve is defined as the flow of water at 60 F, in gpm, at a ΔP of 1 psi across the valve.)

3.3.10 Actuation Time: The explosive actuated valve shall be designed to operate after electrical energization of the explosive squib within the specified time. (Means for determining compliance with this requirement shall be mutually agreed upon.)

3.3.11 Contamination:

3.3.11.1 Before Firing: Normally open explosive actuated valves or normally closed valves, with the actuating mechanism exposed to the working medium, shall be designed to prevent contamination of the explosive charge by the fluid medium.

3.3.11.2 After Firing: There shall be no contamination of the working fluid by the products of combustion as a result of valve actuation.

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3.3.12 Safety: The explosive actuated valve shall be designed to avoid hazardous conditions during normal assembly, handling, installation, or operation.

3.3.13 Non-Explosive Characteristics: The explosive actuated valve shall be designed to fire safely in an atmosphere containing explosive vapors, without propagating the explosion to the external atmosphere.

3.3.14 Electrical: (All electrical rating shall apply to each individual squib circuit.)

3.3.14.1 Voltage: The explosive valve shall operate in accordance with the requirements of the specification within the input voltage limits specified.

3.3.14.2 Current Rating: Intermittent or prolonged application of current as specified shall not affect the subsequent performance of the explosive actuated valve.

3.3.14.2.1 No-Fire Current: The explosive squib shall not fire when subjected to the specified current applied indefinitely. It shall not be required to meet the requirements of the specification after such exposure.

3.3.14.3 Resistance: The squib bridgewire resistance shall be as specified per bridge circuits.

3.3.14.4 Dielectric and Insulation Resistance: Prior to and following any of the environments specified, the explosive actuated valve shall be capable of withstanding a specified test voltage applied for a specified time between any two terminals not electrically connected or between any terminal and the squib case. The resistance of this level shall not be less than that specified.

3.3.14.5 Electrostatic Discharge: The explosive actuated valve must be capable of withstanding the specified discharge without operation or degradation of operability.

3.3.14.6 Open Circuit Resistance After Firing: Should the detail specification specify an open circuit after firing, consideration should be given during design to eliminate possible shorting due to the products of combustion and/or wires coming in contact with the case.

(NOTE: This requirement may require coordination between the procuring activity and the valve manufacturer.)

3.3.14.7 Electrical Connection: The explosive valve shall be provided with electrical connectors as specified in the detail specification.

3.3.15 Drawings: The explosive actuated valve shall be constructed to conform with requirements of applicable drawings. The control drawing shall be established through coordinated efforts of purchaser and supplier and shall conform to Specification MIL-D-70327.

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3.3.15.1 Change Control: Subsequent to satisfactory qualification, all anticipated supplier changes in design, materials, dimensions, tolerances, fabricating sequences and techniques, and test sequence and methods shall be brought to the attention of the purchaser. Similarly, all purchaser changes in test sequence and methods and inspection sequence and methods shall be brought to the attention of the supplier. All actual changes shall be in accordance with 4.5.

3.3.16 Special Tools: The design shall be such as to accommodate to the greatest possible extent, disassembly, reassembly, or service maintenance by those tools and items of maintenance equipment which are normally available as commercial standards.

3.3.17 Cleaning: The explosive actuated valve shall be thoroughly free of oil, grease, and other foreign materials during and after final assembly. The assembled valve shall be dry and suitably sealed to prevent subsequent corrosion.

3.3.18 Finish:

3.3.18.1 General: No finishes or paints, other than those specified herein or on the applicable procuring control drawing, shall be applied to the explosive actuated valve, either externally or internally.

3.3.18.2 Aluminum: All aluminum parts shall be suitably protected by an anodic film per specification MIL-A-8625.

3.3.19 Locking Provisions: All threaded parts shall be positively locked by means of nylon or teflon inserts, safety wiring, self-locking nuts, sealant, cotter pins, or other approved methods. Safety wiring shall comply with the requirements of AS 567 and the wire shall have a minimum diameter of 0.032 inch and shall conform to MS 20995. Self-locking nuts shall conform to MIL-N-25027 and shall be used in accordance with MS 33588. Sealant shall not be used in threaded ports exposed to the fluid medium. Staking and lock washers shall not be used.

3.3.20 Markings and Identification:

3.3.20.1 Identification of Components: All parts and components, where possible, shall be marked clearly with their respective designations or part numbers in accordance with MIL-STD-130. All markings shall be permanent to prevent obliteration during service usage under all conditions specified.

3.3.20.2 Identification of Fluid Connections: All fluid connections shall be marked where practicable to indicate purpose or direction of flow.

3.3.20.3 Assembly Date Identification: Assembly dates shall be suitably marked on explosive actuated valves. Where synthetic rubber parts are utilized in the valve assembly, the appropriate provisions of ANA Bulletin No. 438 shall apply.

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3.3.20.4 Name Plate: The following data shall be suitably marked on the explosive actuated valve, or on a name plate:

Part Name
Specification No. (If required by procuring agency)
Serial Number
Stock Number (If required by procuring agency)
Manufacturer's Part Number
Manufacturer's Name or Trademark
Explosive Loading Date
Type
Pressure Rating
Fluid

3.3.20.5 Squib Warning Tag: A tag with the following warning shall be securely attached to each squib:

WARNING! DO NOT REMOVE CLIP OR TAG UNTIL READY TO CONNECT INTO THE ELECTRICAL SYSTEM. TEST CIRCUIT FOR NO CURRENT BEFORE CONNECTING.

3.3.21 Squib Shorting Clip: Each squib shall be equipped with a shorting clip that electrically shorts each connector pin and either the connector housing or a ground pin.

3.4 Construction:

3.4.1 Standard Parts: Standard parts MS, or AN, shall be used wherever they are suitable for the purpose, and shall be identified on the drawing by their part numbers. In the event there is no suitable corresponding standard part in effect on date of invitation for bids, commercial parts may be used provided they otherwise conform to all requirements of this specification.

3.4.2 Threads:

3.4.2.1 Screw Threads: Screw threads shall conform to Class 2A, 2B, 3A, or 3B of Specification MIL-S-7742.

3.4.2.2 Pipe Threads: Pipe threads may be used only for permanent closures. Pipe threads, when used, shall conform to Specification MIL-P-7105.

3.4.3 Fluid Connections: All fluid connections shall conform to applicable military specifications as specified in the detail specification.

3.4.4 Interchangeability: All parts having the same supplier's part number shall be directly and completely interchangeable with each other with respect to installation and performance, except that individual parts or lapped or matched assemblies need not be interchangeable. Change in supplier's part numbers shall be governed by the drawing number requirements of Specification MIL-D-70327.

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3.5 Workmanship:

The workmanship shall be of sufficiently high grade to insure satisfactory operation, reliability, and durability consistent with the service life and application of the explosive actuated valve.

4. QUALITY PROVISIONS:

4.1 Classification of Tests:

The tests to be performed shall be classified as qualification tests or acceptance tests.

a. Qualification Tests: Qualification tests are those tests performed to demonstrate that the required design objectives have been attained on designs intended for production.

b. Acceptance Tests: Acceptance tests are those inspection tests performed to verify the continuing quality and proper functioning of items produced for delivery.

4.2 General:

The explosive actuated valve at convenient times prior to and after the tests, shall be subject to examination to determine if it conforms with all requirements of the contract and specifications under which it was built, with due allowance for tolerable warpage, wear, and intentional destruction. Test apparatus shall be subject to inspection, and all tests outlined in this specification shall be subject to witnessing by authorized purchaser representatives. During the progress of the tests, inspection of the component may be made which does not require disassembly. The results of such inspections shall be submitted as part of the qualification test report. Two copies of the complete parts list, drawings and specifications for the valve, exclusive of any vendor proprietary information, shall be furnished to the purchaser with the qualification test report.

4.2.1 Test Apparatus and Procedures: Schematic drawings and descriptions of all test apparatus, including location of all test points, shall be furnished with the test report.

4.2.1.1 Instrument Calibration: Each instrument and other measuring apparatus upon which the accuracy of test results depends, shall be calibrated frequently enough to insure measurement of steady state conditions with the performance requirements for the explosive actuated valve.

4.2.1.2 Automatic Recording Equipment: Automatic recording equipment of adequate response shall be used to obtain data during transient conditions of component operation as required by the actuation test (4.3.19).

4.2.2 Test Conditions:

4.2.2.1 Temperature: Unless otherwise specified herein, all tests and inspections, except critical dimensional inspections, shall be conducted at a room temperature of 80 ± 20 F. Test fluids and explosive actuated valves shall be stabilized initially at this temperature. Critical dimensional inspections shall be conducted at temperatures of 70 ± 10 F.

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4.2.2.2 Pressure: Unless otherwise specified herein, the test shall be conducted at an ambient pressure of 28 to 32 inches of mercury absolute.

4.2.3 Failure of Test: In the event of failure of a test resulting from inadequate testing technique or apparatus, it shall be permissible to reconduct, under improved conditions without further penalty, that specific test during which failure occurred.

4.2.3.1 Parts Failure and Replacement: Parts maintenance, adjustment, or replacement shall not be permitted during testing, except as follows:

4.2.3.1.1 Failure Resulting From Defective Material or Workmanship: In the event of failure resulting from defective material or workmanship, it shall be permissible to replace the defective part or entire assembly. In the case of such replacement, only that group of tests during which failure occurred shall be reconducted.

4.2.3.1.2 Failure Necessitating Redesign: In the event of an unintentional failure which interferes with normal operation of the component and which necessitates redesign of the component or any part thereof, the entire qualification test shall be reconducted upon the replacement component design.

4.2.4 Test Fluids: The working fluid shall be established by the detail specification. Where the specified working fluid cannot be used, a test fluid approved by the procuring activity may be substituted. Contamination level shall be as specified in the detail specification.

4.2.5 Pressurization Rate: Unless otherwise specified, the working fluid pressure applications during testing shall be accomplished at a rate not exceeding 25,000 psi per minute for increasing as well as decreasing pressure.

4.3 Qualification Test:

The tests outlined in this section are based on standard requirements. No reference to these tests shall be made in the detail specification. These tests are written as examples for guidance only.

4.3.1 Qualification Test Examples: The number of explosive actuated valves and squibs utilized for qualification testing shall be determined by the procuring activity.

4.3.2 Sequence of Tests: The qualification tests shall be conducted in the order listed by successive groups for Types I and II valves. Sequence of tests for Type III valves will be dependent on the operational requirements of the particular configuration used.

The following test schedules are based on performance with 22 valves and 10 squibs used as the qualification sample size. This may be used as a guide to set up any size of test sample.

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TYPE I

	Test	Group I	Group II	Group III	Group IV	Group V	Group VI
(1)	Examination (4.3.3)	Units #1-22					
(2)	Proof Press. & Leakage (4.3.4.1 and 4.3.4.2)	#1-22					
(3)	Elec. Resist. (4.3.5)	#1-22	Units #7-22	Units #11-22	Units #15-22	Units #19-22	
(4)	Dielectric (4.3.6)	#1-22	#7-22	#11-22			
(5)	No-fire (4.3.7)						10 Squibs Only
(6)	Explosion Proof (4.3.8)	#1					
(7)	Burst Press. (4.3.9)	#2				#18	
(8)	Fungus Resist. (4.3.10)	#3					
(9)	Fluid Resist. (4.3.11)	#4 if applicable					
(10)	Salt Spray (4.3.12)		#7-22				
(11)	Sand & Dust (4.3.13)		#7-22				
(12)	Humidity (4.3.14)		#7-22				
(13)	Temp-shock (4.3.15)			#11-22			
(14)	Vibration (4.3.16)				#15-22		
(15)	Acceleration (4.3.17)				#15-22		
(16)	Shock (4.3.18)					#19-22	
(17)	Actuation (4.3.19)	#3	#7	#11	#15	#19	
(18)	Hi-Temp Actuation (4.3.20)	#4	#8	#12	#16	#20	
(19)	Low-Temp Actuation (4.3.21)	#5	#9	#13	#17	#21	

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TYPE I (Cont'd)

(20)	High Alt. Actuation (4.3.22)	#6	#10	#14	#18	#22
(21)	Proof Press. & Leakage (4.3.4.3)	#3-6	#7-10	#11-14	#15-18	#19-22
(22)	Flow (4.3.23)	#3-6	#7-10	#11-14	#15-18	#19-22

TYPE II

	Test	Group I	Group II	Group III	Group IV	Group V	Group VI
(1)	Examination (4.3.3)	Units #1-22					
(2)	Proof Press. & Leakage (4.3.4.4)	#1-22				Units #19-22	10 Primers Only
(3)	Elec. Resist. (4.3.5)	#1-22	Units #7-22	Units #11-22	Units #15-22	#19-22	
(4)	Dielectric (4.3.6)	#1-22	#7-22	#11-22			
(5)	No-fire (4.3.7)						No-fire Test (4.3.7)
(6)	Explosion Proof (4.3.8)	#1					
(7)	Burst Press. (4.3.9)	#2				#18	
(8)	Fungus Resist. (4.3.10)	#3					
(9)	Fluid Resist. (4.3.11)	#4 if applicable					
(10)	Salt Spray (4.3.12)		#7-22				
(11)	Sand & Dust (4.3.13)		#7-22				
(12)	Humidity (4.3.14)		#7-22				
(13)	Temp-shock (4.3.15)			#11-22			
(14)	Vibration (4.3.16)				#15-22		
(15)	Acceleration (4.3.17)				#15-22		

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TYPE II (Cont'd)

(16) Shock (4.3.18)					#19-22
(17) Flow (4.3.23)	#1-22				
(18) Actuation (4.3.19)	#3	#7	#11	#15	#19
(19) Hi-Temp Actuation (4.3.20)	#4	#8	#12	#16	#20
(20) Low-Temp Actuation (4.3.21)	#5	#9	#13	#17	#21
(21) High Alt Actuation (4.3.22)	#6	#10	#14	#18	#22
(22) Proof Press. & Leakage (4.3.4.5)	#3-6	#7-10	#11-14	#15-18	#19-22

4.3.3 Examination: The explosive actuated valve shall be physically examined to determine compliance with the requirements of the detail specification with respect to materials, design, marking, and workmanship.

4.3.4 Proof Pressure and Leakage Test: The explosive actuated valve shall be pressurized with dry nitrogen gas per MIL-N-6011 to 1½ times the operating pressure specified in 3.3.7. The valve shall be submerged in clean water for this test and any leakage, as evidenced by the appearance of bubbles, shall be cause for rejection. After this test there shall be no evidence of permanent set, distortion or displacement of parts which would impair normal valve functioning. (Note: When the valve is to be used for long-term storage with a fluid medium having a higher degree of membrane permeability than nitrogen or at the discretion of the vendor, the helium mass-spectrometer may be utilized to check for leakage. There shall be no indication of helium leakage.)

4.3.4.1 Internal Leakage (Normally Closed Valves): Prior to actuation the valve shall be pressurized for a minimum of 1 minute as specified in 4.3.4 at the inlet port with the outlet port open. There shall be no internal leakage.

4.3.4.2 External Leakage (Normally Closed Valves): Prior to actuation the valve shall be pressurized for a minimum of 1 minute as specified in 4.3.4 simultaneously at both the inlet and outlet ports.

4.3.4.3 Leakage after Actuation (Normally Closed Valves): After actuation the valve shall be pressurized for a minimum of 1 minute as specified in 4.3.4 with the pressure applied to either the inlet or outlet port with the other port sealed. If a removable squib or squib chamber is utilized in the valve design, it shall be removed prior to this test. There shall be no evidence of external leakage or leakage past the ram, and the ram shall not be displaced.

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4.3.4.4 Leakage Prior to Actuation (Normally Open Valves): Prior to actuation, the normally open valve, with the squib or squib chamber removed, if not an integral part of the trigger assembly, shall be pressurized for a minimum of 1 minute as specified in 4.3.4, at either the inlet or outlet port with the other port sealed. There shall be no evidence of external leakage or leakage past the ram, and the ram shall not be displaced.

4.3.4.5 Leakage After Actuation (Normally Open Valves): After actuation, the closed valve, with the squib or squib chamber removed, if not an integral part of the trigger assembly, shall be pressurized for a minimum of 1 minute as specified in 4.3.4 initially at the inlet port with the outlet port open and finally at the outlet port with the inlet port open. There shall be no evidence of leakage, distortion or displacement of the ram.

4.3.5 Electrical Resistance Test: Electrical continuity of the squib shall be determined by means of a resistance measurement. The resistance value measured shall conform with the requirements as specified in the detail specification.

4.3.6 Dielectric and Insulation Resistance Test: The explosive actuated valve shall be tested for dielectric strength by applying the required test voltage, as specified in the detail specification, between any two points not electrically connected. Current flow in excess of that specified or breakdown of insulation shall constitute failure.

4.3.7 No-Fire Test (Squib Only): Adequate margins, as established by the detail specification, should be determined between the no-fire and the all-fire current. A no-fire current as specified shall be impressed on the squib circuit for a minimum of 5 minutes. The squib shall not fire under this condition. Current shall be improved in increasing increments from the no-fire current until firing. Current shall be applied for adequate time at each level. Bruceton type tests on additional samples can be employed for further confidence of performance.

4.3.8 Explosion Proof Test: The explosive actuated valve shall be placed into an explosion chamber which shall be maintained at 160 $^{+0}_{-10}$ F and with ambient pressure of 15 psia.

Fuel conforming to Specification MIL-G-5572, grade 100/130 shall be introduced in the proper proportion to create an explosive mixture. The explosive valve shall be actuated by application of current as specified in 3.3.10. There shall be no ignition of the explosive atmosphere. If an explosion does not occur as a result of the valve actuation, the explosive mixture shall be ignited by the chamber spark plug. The explosion chamber shall be in accordance with Specification MIL-D-9435.

4.3.9 Burst Pressure Test: The explosive actuated valve shall be subjected to a hydrostatic pressure of two times the nominal operating pressure, applied and maintained for a period of at least 2 minutes at all pressure ports. The valve shall not burst. Permanent set may take place, and subsequent functioning of the valve is not required. Adequate safeguards shall be provided to protect personnel during this test.

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4.3.10 Fungus Resistance Test: The explosive actuated valve shall be subjected to a fungus test in accordance with Procedure I of Specification MIL-E-5272. Evidence of harmful effects which would affect normal operation of the explosive valve shall be causes for rejection. All inspections made immediately following this test shall be made without disassembly.

4.3.11 Fluid Resistance Test: This paragraph is applicable only to those explosive actuated valves designed for a system containing fluids which might affect the materials used in construction of this component.

4.3.11.1 The valve shall be mounted in a test chamber in such a way that the fluids will contact external and internal surfaces normally exposed to these fluids in service. In this condition the explosive valve shall be aged for a period of

$2\ ^{+1}_{-0}$ days, at room temperature.

Immediately following the exposure period the fluid shall be vented out of the explosive valve which shall be maintained in the vented condition, exposed to air, for a period of

$1\ ^{+0.05}_{-0}$ days, at room temperature.

This test shall be repeated until a total of 2 cycles has been completed.

4.3.11.2 The valve shall then be exposed again as in 4.3.11.1 to the test fluids and aged for a period of

$2\ ^{+1}_{-0}$ days at an ambient temperature of $130\ ^{+10}_{-0}$ F.

Immediately following the exposure period, the test fluids shall be vented out of the valve, which shall then be maintained in the vented condition, exposed to air, for a period not less than one day at an ambient temperature of

$160\ ^{+10}_{-0}$ F.

This test shall be repeated until a total of 2 cycles has been completed. Evidence of harmful effects which will affect normal operation of the valve shall be cause for rejection.

4.3.12 Salt Spray Test: With all normally connected ports suitably plugged, the explosive actuated valve shall be subjected to a salt spray test in accordance with Procedure I of Specification MIL-E-5272 for a period of 50 hours. The explosive valve shall then be inspected, without disassembly, for indications of harmful corrosion, evidence of which shall be cause for rejection.

4.3.13 Sand and Dust Test: With all normally connected ports suitably connected as in use, the explosive actuated valve shall be subjected to a sand and dust test in accordance with Procedure II of Specification MIL-E-5272. Evidence of any deleterious effects due to the sand and dust test impeding normal operation of the valve during the actuation test shall be cause for rejection.

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4.3.14 Humidity Test: The explosive actuated valve shall be subjected to a humidity test in accordance with Procedure I of Specification MIL-E-5272. Evidence of any deleterious effects due to humidity test impairing normal operation of the valve during the actuation test, shall be cause for rejection.

4.3.15 Temperature-Shock Test: The explosive actuated valve shall be alternated between temperature conditioning boxes maintained at -67 F and +160 F respectively. The minimum period in each box shall be 4 hours. The test shall be continued until 10 cycles have been completed. The transfer time shall not exceed 5 minutes.

4.3.16 Vibration Test: The explosive actuated valve shall be subjected to combined vibration and cycling tests as noted below:

4.3.16.1 Vibration Survey: Three vibration surveys shall be conducted over a frequency range of 15 to 2000 cycles per second along each of three mutually perpendicular axes (X, Y, Z) corresponding to the axes of principal moving parts where practicable, at amplitudes corresponding to ± 25 g or less as governed by the curve shown in Figure 1 of this specification. Critical frequencies (frequencies at which resonance occurs) shall be determined. The three vibration surveys shall be conducted at temperature conditions of -60 F, ambient, and +160 F, respectively.

4.3.16.2 Vibration Endurance Test: The explosive actuated valve shall be vibrated successively along each of the three mutually perpendicular axes for 4 hours at the resonant frequencies and resonant frequency temperatures encountered with the applied double amplitude or vibratory acceleration shown in Figure 1. When more than one resonant frequency is encountered with vibration along any one axis, the test period may be carried out at the most severe resonance, or the period may be divided uniformly among the resonant frequencies, whichever procedure is considered most likely to produce failure. When clearly defined resonance frequencies are not encountered within the specified frequency range, the test specimen shall be vibrated for 12 hours along each of its mutually perpendicular axes at ambient temperature within the limits shown in Figure 1.

4.3.17 Acceleration Test: The explosive actuated valve shall be mounted in a centrifuge successively in six positions so that each of the three major axes (X, Y, Z) of the explosive valve in turn extends to a plus and minus radial direction with respect to the centrifuge center of rotation. Where practicable, the X, Y, Z axes shall correspond to the axes of principal moving parts. An acceleration as specified shall be attained, stabilized, and maintained for a period of not less than 2 minutes for each position.

4.3.18 Shock Test: The explosive actuated valve shall be subjected to the shock test, Procedure IV, of Specification MIL-E-5272, obtaining an acceleration and duration as specified in the detail specification. This test is to be conducted to cause impact separately along three mutually perpendicular axes including the axis where failure is most likely to occur. The explosive valve shall not fire during any phase of this shock test.

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4.3.19 Actuation Test: With the nominal operating pressure applied to the inlet port, the explosive actuated valve shall be fored and the time required to either completely close (or open) the valve shall be measured. The time shall be measured from the current or voltage application to the termination of valve movement. The current applied and the actuating time resulting shall comply with 3.3.10.

4.3.20 High Temperature Actuation Test: The explosive actuated valve shall be soaked for a period of 6 $^{+2}_{-0}$ hours at a temperature of +160 $^{+10}_{-0}$ F. The valve shall then be fired while at a temperature of +160 $^{+10}_{-0}$ F in accordance with 4.3.19.

4.3.21 Low Temperature Actuation Test: The explosive actuated valve shall be soaked for a period of not less than 23 hours at a temperature of -80 $^{+0}_{-10}$ F followed by a soak period of 48 $^{+12}_{-0}$ hours at a temperature of -65 $^{+0}_{-10}$ F. The valve shall then be fired while at a temperature of -65 $^{+0}_{-10}$ F in accordance with 4.3.19.

4.3.22 High Altitude Actuation Test: The explosive actuated valve shall be actuated in accordance with 4.3.19 at the lowest ambient pressure specified in the detail specification.

4.3.23 Flow Test: A flow test shall consist of subjection the explosive actuated valve to at least four (4) values of weight flow, two (2) of which must bracket the design conditions specified in the detail specification. A system shall be used which supplies clean water to the inlet port of the valve. The flow through the valve shall be adjusted to each of the predetermined values and the corresponding pressure drop shall be determined. A curve of weight flow versus pressure drop shall be determined. A curve of weight flow versus pressure drop shall be plotted from the data obtained.

4.3.24 Drop Test: The explosive actuated valve shall be subjected to drop tests as specified in the detail specification. The valve must be operable at the completion of the drop test.

4.3.25 Qualification Test Report: The test report shall include the following:

a. Report of all tests, graphically presented where possible. In addition, the report shall indicate conformance to all requirements herein, referring specifically to paragraph numbers of this specification.
b. Diagrams and description of setups.
c. Copies of test log sheets.
d. Photographs when available.
e. Complete assembly cross sectional drawings and detail parts list with materials.

4.4 Acceptance Test:

Acceptance tests shall consist of:

a. Individual tests
b. Sampling plans and tests

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4.4.1 Individual Tests: Every explosive actuated valve shall be subjected to the following tests in the given sequence:

Examination (4.3.3)
Proof Pressure and Leakage Test (4.3.4)
Electrical Resistance Test (4.3.5)
Dielectric Test (4.3.6)

(NOTE: The explosive actuated valve shall not be dired during any phase of the individual tests.)

4.4.1.1 Rejection and Retest: Failure of any explosive actuated valve to meet all requirements of each of the acceptance tests listed shall be cause for rejection of that unit. Explosive valves which have been rejected by the purchaser may be reworked or have parts replaced to correct the defects found and be resubmitted for acceptance. Before resubmitting the assembly, full particulars concerning the previous rejection and the action taken to correct the defects found shall be furnished.

4.4.2 Sampling Plan and Tests of Complete Explosive Actuated Valve Assemblies:

4.4.2.1 Sampling Plan: The following sample units shall be selected at random and subjected to the tests in the sequence of 4.4.2.2.

One unit from the first 5 manufactured
One unit from the next 10, or portion thereof, manufactured
One unit from the next 20, or portion thereof, manufactured
One unit from each additional 50, or portion thereof, manufactured

4.4.2.2 Sampling Tests: Each sample chosen shall be subjected to the following tests in logical sequence:

a. Individual Tests (4.4.1)
b. Actuation Test (4.3.19)
c. Flow Test (4.3.23)
d. Proof Pressure and Leakage Test (4.3.4) after actuation test

4.4.2.2.1 Rejection and Retest: When one or more samples from a lot fails to meet the specification, acceptance of all items in the lot will be withheld until the extent and cause of failure is determined, and corrected to the satisfaction of the purchaser.

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4.4.3 Sampling Plan and Tests (Squibs Only):

4.4.3.1 Sampling Plan: The following sample units shall be selected at random from the same lot of squibs as used in the valves and subjected to the tests in the sequence listed in 4.4.3.2.

For lot sizes less than 50 pieces - add 20% for test samples
For lot sizes to 499 pieces - add 10% for test samples
For lot sizes over 500 pieces - check to MIL-STD-105A
AQL-0.25% Inspection Level 2.

4.4.3.2 Sampling Tests: The squib sample lot chosen shall be subjected to the following tests in the given sequence:

a. Functional low level fire: To 50% of sample lot (less 5 units) apply minimum specified firing current and record firing time and energy generated. Failure of any sample to fire will reject the lot.

b. Functional high level fire: To the remaining 50% of sample lot, apply the maximum specified firing current and record firing time and energy generated. Failure to fire within the specified time will reject the lot.

c. No-fire Test: To the remaining 5 units apply the no-fire-current as specified. Detonation of any sample will cause lot rejection.

4.5 Quality Assurance:

Prior to adoption of any change (3.3.15.1) which the purchaser suspects might invalidate previous component qualification and acceptance, it shall be the option of the purchaser to:

a. Refuse to accept the changed component, or

b. Subject one or more components, incorporating the change, to those tests of 4. through 4.4, which will substantiate that the changed component is at least equal to the previously qualified version. Successful completion of these tests to the satisfaction of the purchaser shall constitute agreement to the change.

c. When the purchaser and supplier agree that a proposed change does not invalidate prior qualification, then by mutual consent, the change shall be adopted.

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5. PREPARATION FOR DELIVERY:

5.1 Preservation:

No contact preservative shall be applied to any part of the explosive actuated valve and all external threads shall be covered with suitable protectors. The surfaces of these protectors shall be neutral and acid free as defined by Specification MIL-B-121. Openings to the interior of the component shall be sealed with closures. Vent openings which cannot be adequately sealed with closures shall be adequately masked to exclude dirt and other foreign materials. Positive precautions shall be taken to insure that all internal surfaces are clean and dry at the time of packaging.

5.2 Packaging:

The explosive actuated valves shall be packaged to withstand commercial transit so that upon receipt by the purchaser they shall be capable of meeting the requirements of this recommended practice.

5.3 Marking:

Interior and exterior containers shall be marked in accordance with Specification MIL-STD-129.

6. NOTES:

6.1 Usage:

This recommended practice shall not be used for procurement or be referenced in a detail specification used for the procurement of any explosive actuated valves.

6.2 Values:

All values used herein may be considered fictitious.

PREPARED BY SAE SUBCOMMITTEE A-6D, MISSILE & SPACE VEHICLE OF SAE COMMITTEE A-6, AEROSPACE FLUID POWER SYSTEMS & EQUIPMENT

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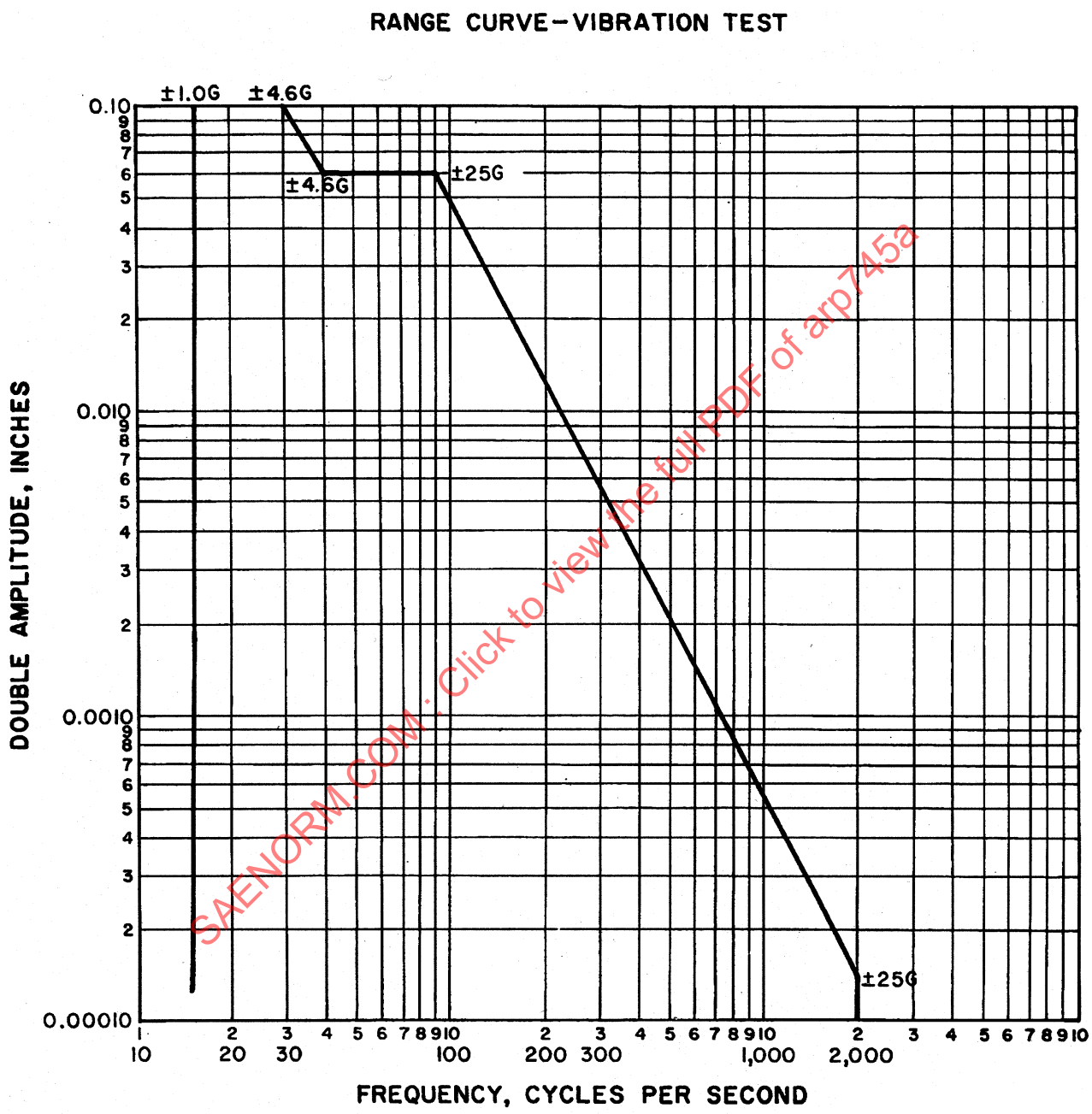

FIGURE 1

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