



AEROSPACE STANDARD	AS5372™	REV. A
	Issued 1997-12 Revised 2015-01 Reaffirmed 2023-03	
Superseding AS5372		
(R) Fuse, Current Limiter Type, Aircraft		

RATIONALE

This revision is required to correct the overload damage test requirement in 4.7.10, to delete the packaging requirements of Section 5 (MIL-P-17555 has been cancelled without replacement), to update all references, and to update the document format to the most current SAE guidelines.

AS5372A has been reaffirmed to comply with the SAE Five-Year Review policy.

1. SCOPE

1.1 Scope

This specification covers the requirements for current limiter type fuses for use in aircraft primary electrical power systems conforming to MIL-STD-704. These limiters are suitable for use in AS53731 fuse holders for operation at -54 to 125 °C.

1.2 Classification

Limiters shall be as described on the applicable specification or specification detail sheet (see 6.2).

1.2.1 Style

A style of limiter shall consist of all part numbers in the same current range (0-30A and 35-60A) covered by one specification sheet. For example: all part numbers 0-30A of AS28937 shall be the same style (see 6.5 for part number example).

1.2.2 Ampere Rating

The ampere rating designator shall be a number specified on each military standard or specification sheet to indicate the ampere rating.

2. APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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<https://www.sae.org/standards/content/AS5372A/>

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AS7928	Terminals, Lug: Splices, Conductor: Crimp Style, Copper, General Specification For
AS20659	Terminal, Lug, Crimp Style, Copper, Uninsulated, Ring Tongue, Type I, Class 1, For 175 °C Total Conductor Temperature
AS28937	Fuse, Limiter Type, Enclosed Link, 5-60 Amp, Aircraft
AS28938	Fuse, Limiter Type, Enclosed Link, Intermediate Rating, Aircraft
AS50861	Wire, Electric, Polyvinyl Chloride Insulated, Copper or Copper Alloy
AS53731	Fuse Holder, Block Type, Aircraft

2.2 U. S. Government Publications

Copies of these documents are available online at <http://quicksearch.dla.mil>.

MIL-STD-202	Test Methods for Electronic And Electrical Component Parts
MIL-STD-704	Aircraft Electric Power Characteristics
MIL-STD-889	Dissimilar Metals
MIL-STD-1285	Marking of Electrical and Electronic Parts

2.3 ANSI Publications

Available from American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, Tel: 212-642-4900, www.ansi.org.

ANSI/NCSL-Z540-1 or ISO-10012-1	Calibration System Requirements
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2.4 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM-D5948	Molding Compounds, Thermosetting
ASTM D635-88	Plastics, Self-supporting, In a Horizontal Position, Rate of Burning and/or Extent of Time of Burning of

2.5 Order of Precedence

In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets or military standards), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.6 Definitions

The following definitions apply to terminology used in this specification.

2.6.1 ARCING TIME

Arcing time is the time measured from that point when element melt time ends to that point when current is interrupted and permanently becomes a zero. If a mechanical indicator is utilized which incorporates a secondary element parallel to the fusible element, arcing time will commence from the point at which indicator melt time ends.

2.6.2 CURRENT DROOP

Current droop is the percentage decrease of the fusing current from the moment fusing current is initiated to the point where indicator melt time or arcing time begins. Current droop is usually caused by increase in limiter element resistance due to increased temperature caused by flow of current. Current droop can be encountered if care is not exercised in the selection of interconnecting wire, resistive loads, and battery source (see Figure 3).

$$\text{Current droop} = \frac{\text{initial current} - \text{final current}}{\text{initial current}} \times 100 \quad (\text{Eq. 1})$$

2.6.3 ELEMENT MELT TIME

Element melt time is the time elapsed from the moment a fusing current begins to flow to the moment the current sharply drops in value and indicator melt time or arcing commences.

2.6.4 CURRENT LIMITER

A current limiter is an aircraft fuse designed specially with a high temperature melting point to provide protection for electrical power distribution systems against fault current.

2.6.5 LIMITER CURRENT RATING

Limiter current rating is a value of current assigned to a limiter that is below the minimum fusing current and can be carried continuously under all environmental conditions encountered by the limiter without deterioration of the element, the body, or the terminals.

2.6.6 LIMITER ELEMENT

That part of a limiter designed to melt by an excessive flow of current and thus interrupt a faulty condition.

2.6.7 LIMITER VOLTAGE RATING

Limiter voltage rating is that value assigned to a limiter denoting the maximum open-circuit voltage it can safely interrupt under specified test conditions.

2.6.8 LIMITER HOLDER

A limiter holder is a mounting device with contacts and terminals for the purpose of accepting limiters for easy connection within a circuit.

2.6.9 FUSING CURRENT

A fusing current is a current of such a magnitude that, under specified environmental conditions, the limiter element will melt.

2.6.10 MINIMUM FUSING CURRENT

The smallest value of current that will melt the limiter element at a specified ambient temperature.

2.6.11 PROSPECTIVE CURRENT

The value of short-circuit current (rms or DC) that would flow in a circuit if the limiter element were replaced by an element of negligible impedance.

2.6.12 INTERRUPT CAPACITY

The largest prospective current the fuse can safely interrupt under specified conditions of voltage and of power factor or time constant.

2.6.13 SELF-INDICATING CURRENT LIMITER

The type of limiter that incorporates a device to visually denote severance of the fusible element as an integral part of the limiter. Those limiters that visually display the fusible element or incorporate a mechanical indicating device are classified as self-indicating current limiters.

2.6.14 TOTAL CLEARING TIME

Total clearing time is the total time obtained by adding element melt time, indicator melt time, and arcing time (see Figure 2).

3. REQUIREMENTS

3.1 Specification Sheet or Military Standard

The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 Qualification

The current limiters furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable Qualified Products Database (QPD) at the time of award of contract (see 4.5 and 6.3).

3.3 Materials

Materials shall be as specified herein. However, when a definite material is not specified, a suitable material shall be used that will enable the current limiters to meet the performance requirements of this specification. Recovered material shall be used to the maximum extent possible.

3.3.1 Fungus

Materials shall be used which are not nutrients for fungus.

3.3.2 Metal

All metals used in the construction of current limiters shall be corrosion resistant or shall be suitably protected to resist corrosion. The use of dissimilar metals, especially contacts between brass, copper, or steel and aluminum or magnesium alloys, shall be avoided. Where contact between dissimilar metals is unavoidable, the metals shall be protected against electrolytic corrosion. Dissimilar metals are defined in MIL-STD-889.

3.3.3 Plastics

Plastic materials used in the limiters shall be in accordance with MIL-M-14, type MSI-30 (silicone) or Type GII-30F (diallyl isophthalate) as specified on the individual specification sheet or military standard. When other plastic materials are used, the manufacturer shall submit satisfactory evidence to the activity responsible for qualification that the materials are suitable for the purpose intended. The plastic materials used shall neither support combustion nor release noxious gases when subject to arcs, such as those arcs caused by interrupting heavy short circuit currents, or explosions of gaseous vapors to which the materials may be subjected in service. Plastic materials with cellulose fillers will not be permitted in parts that may be subjected to arcing or surface creepage. Plastic materials used shall be certified to exhibit a minimum ignition time of 90 seconds and a maximum extinguishing time of 90 seconds when tested for flammability in accordance with ASTM D635-88.

3.3.3.1 Color

The color of external plastic parts shall be as specified on the applicable specification sheet. After exposure to the temperature conditions specified in 4.7.3, there shall be no degradation of these requirements.

3.3.4 Protective Coating

Protective coating shall not be used.

3.4 Design and Construction

The current limiter shall conform to the requirements specified herein and in the applicable military standard or specification sheet.

3.4.1 Visual Indication

An open limiter shall be self-indicating and so designed that visual indication of an open condition will not require removal from the limiter holder. The design shall be such that an energized electrical circuit will not be necessary to visually indicate an open-circuit limiter after a fault has occurred.

3.4.2 Insertion and Removal

The design shall be such that the limiter can be inserted into or removed from the limiter holder without requiring use of a tool. The contour of the molding shall provide finger grips or other means to facilitate removal by hand.

3.4.3 Fuse holders

The limiter shall be designed for use with fuse holders in accordance with AS53731.

3.4.4 Mounting Position

Limiter performance shall not be affected by its mounting position.

3.4.5 Terminals

Limiter terminals shall be as specified on AS20659.

3.4.6 Current Rating

The rating of the limiter shall be as specified on the applicable specification sheet.

3.4.7 Dimensions

The dimensions of the limiter shall be as specified on the applicable specification sheet.

3.4.8 Weight

The weight of the limiter shall be as specified on the applicable specification sheet.

3.5 Performance

Limiters shall pass the performance requirements of this specification and the applicable specification sheet when tested as specified in Section 4.

3.5.1 Time-Current Characteristics

Time-current characteristics shall be as specified on the applicable specification sheet.

3.5.2 Initial Loading

Loads up to 100% of rating may not reduce the current required to melt the limiter by more than 10% in any specified time (see 4.7.11).

3.5.3 Ambient Temperature Influence

The time-current characteristics of the limiter shall be within the tolerance limits specified on the applicable specification sheet (see 4.7.3) for the temperatures specified.

3.5.4 Overloading

The characteristics specified herein shall not be altered by overloading the limiter up to 70% of the current required to melt the limiter in a specified time, as shown on the applicable specification sheet (see 4.7.10).

3.5.5 Terminal Voltage Drop

The voltage drop across the limiter terminals, while the limiter is carrying rated current, shall not exceed the following (see 4.7.20):

Table 1

Ampere Rating	Terminal Voltage Drop
1	1.2
2, 3, and 5	0.25
10 through 60	0.1

3.5.6 Alternating Current Interruption Capacity

When specified, the current limiter shall be capable of interrupting prospective line-to-neutral faults on a 115/200 V, three phase, 400 Hz system that is capable of producing a line-to-neutral fault current of 6000 A during the first cycle of fault current; for a sustained fault, the current may be allowed to decrease at a gradual rate to 3600 A within 0.05 second after fault initiation. Two limiters, connected in series, shall be capable of interrupting line-to-line faults on a system conforming to MIL-STD-704 and capable of producing a line-to-line fault current of 4200 A during the first cycle of fault current and, for a sustained fault, the current may be allowed to decrease in a gradual rate of 2500 A within 0.05 second after fault initiation (see 4.7.14).

3.5.7 Direct Current Interruption Capacity

When specified, the limiter shall be capable of interrupting prospective fault currents of 6000 A, with this value achieved in 0.01 to 0.03 second after fault initiation. The system voltage shall not be less than 28 V before the fault. The transient recovery voltage at the terminals of the limiter holder shall not be less than 28 V within 0.002 second after the interruption and shall maintain 28 V at maximum value with the steady-state, open-circuit voltage reaching no less than 28 V after the fault.

3.5.8 Temperature Rise

The temperature rise shall not exceed 90 °C (194 °F) when subjected to the test of 4.7.21.

3.5.9 Continuity

When tested as specified in 4.7.23, fuses shall have electrical continuity.

3.5.10 Environment

The limiter shall perform satisfactorily when subjected to any natural combination of the following environmental conditions. There shall be no breakage, malfunction, or evidence of damage that would prevent additional testing.

3.5.10.1 Temperature

Temperatures shall be from -54 to +125 °C (see 4.7.2 through 4.7.5)

3.5.10.2 Altitude

Pressure altitude shall be from sea level to 60 000 feet (see 4.7.14).

3.5.10.3 Moisture Resistance

Moisture resistance shall be as specified in 4.7.4.

3.5.10.4 Salt Spray

There shall be no peeling, chipping, or blistering of metal or plastic surfaces, or exposure of base metal when the limiter is subjected to the test of 4.7.7.

3.5.10.5 Sand and Dust

There shall be no peeling, chipping, or blistering of metal or plastic surfaces, or exposure of base metal. The indicator shall operate on the subsequent time current test when the limiter is subjected to the test of 4.7.17.

3.5.10.6 Vibration

When the limiter is tested in accordance with 4.7.12, there shall be no physical or electrical damage to the limiter and each limiter shall meet the room ambient time-current requirements of the applicable military standard at 500% of rated current.

3.5.10.7 Mechanical Shock

Mechanical shock shall be as specified in 4.7.19. Following this test, the limiter shall withstand the time-current test of 4.7.13 for 500% of the rated current.

3.5.10.8 Indicator Pin

The indicator pin shall be extended as the result of the current limiter opening during any overcurrent test requiring the fuse element to open.

3.5.10.9 Acceleration

The limiter shall be subjected to and pass the acceleration test as specified in 4.7.18.

3.5.10.10 Explosion Proof

The limiter shall be subjected to and pass the explosion test conditions specified in 4.7.16.

3.5.11 Terminal strength

There shall be no physical damage to the limiter after the forces specified in 4.7.9 are applied.

3.5.12 Thermal Shock

The limiter shall withstand the thermal shock test of 4.7.5 with no evidence of limiter cracks, delamination of finishes, obscuring of identification markings, severance of the fuse element, loosening of parts, or false indication. Following this test, the limiter shall withstand the time-current test of 4.7.13 for 500% of the rated current.

3.5.13 Random Drop

There shall be no physical damage and the limiter shall remain in proper position with respect to the fuse holder clips when subjected to the random drop test of 4.7.8.

3.5.14 Life Test

There shall be no physical damage to the limiter when subjected to the life test specified in 4.7.2.

3.5.15 Rated Current

When tested as specified in 4.7.22 there shall be no evidence of mechanical damage or failure. The temperature of the terminals shall not rise more than 90 °C (194 °F) above ambient temperature.

3.6 Identification of Product

All current limiters shall be permanently and legibly marked as shown on the applicable military standard or specification sheet. The markings shall remain legible during and after all of the tests specified in this specification. The marking for identification shall be in accordance with MIL-STD-1285 as follows:

Part number (see 6.5)

Current rating

Manufacturer's name or trademark

3.7 Position

Current limiters shall operate satisfactorily in any position.

3.8 Workmanship

Limiters shall be in accordance with the requirements of this specification and shall be free from defects which will affect life, serviceability, or appearance. All corners shall be broken and smooth. Surfaces shall be free from burrs and cracks.

3.8.1 Cleaning

The limiter shall be thoroughly cleaned of metal chips and other foreign material, before and after final 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, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government 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. Qualification by similarity may be granted. The acceptance and extent of qualification by similarity shall be determined by the Qualifying Activity. Similarity is established through a rationale that certain designs, materials, and/or processes are identical to those already approved through qualification of the components. Verification testing for the new product is not required for designs, materials, and/or processes already approved. When a Qualified Products List is being established the qualification by similarity rationale shall be approved by the qualifying activity prior to initiation of the remaining portions of the qualification inspection process.

4.1.1 Responsibility for Compliance

All items shall meet all requirements of Sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements; however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Test Equipment and Inspection Facilities

Test and measuring equipment and inspection facilities of sufficient accuracy, quality and quantity to permit performance of the required inspection shall be established and maintained by the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with ANSI/NCSL-Z540.3.

4.2 Classification of Inspections

The inspection requirements specified herein are classified as follows:

- a. Materials inspection (4.3).
- b. Qualification inspection (4.5).
- c. Quality conformance inspection (4.5).
- d. Periodic inspection (4.5.3).

4.2.1 Concurrent Examinations

When examinations and tests in this specification require the use of fuse holders conforming to AS53731, and the requirements of AS53731 duplicate those requirements of this specification, it is acceptable to conduct the tests simultaneously if approved by the qualifying activity.

4.3 Materials Inspection

Material inspection shall consist of certification that the materials are in accordance with the requirements of 3.3.

4.3.1 Inspection Conditions

Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in MIL-STD-202. Performance of the inspection shall be the responsibility of the qualification applicant under authorization of the qualifying activity (NAVAIR). The qualifying activity shall authorize the applicant to begin qualification testing by written notice that describes the requirements of submission in accordance with this specification. The qualification applicant shall furnish test results, certifications, and tested product to the qualifying activity. The samples shall be taken from the same lot as tested by the supplier and plainly identified by attached durable tags marked with the information listed below. The tags must be stamped by the supplier and qualifying activities designated quality Assurance Representative (QAR) inspector as representative samples of the manufacturer's normal production capability. Samples submitted without the stamp will not be accepted. All inspections shall be performed in accordance with the following conditions:

- a. Temperature - 15 to 35 °C
- b. Relative humidity - 45 to 75%
- c. Barometric pressure - 650 to 800 mm of mercury

4.4 Qualification Inspection

Qualification inspection shall consist of the examinations and tests performed in the qualification inspection table (Table 2) on the qualification test samples specified in 4.4.1. The supplier shall perform all testing with the exception of test groups 1 and 7. After receipt of the letter of authorization from the activity responsible for qualification (see 6.3), the applicant shall submit a copy of his test reports (certified by the Government inspector indicating the extent to which the tests were witnessed), together with required samples specified in 4.4.1 for test groups 1 and 7 of Table 2, to the activity responsible for qualification.

4.4.1 Sampling

4.4.1.1 Single Rating

For limiters of a single rating, the qualification inspection shall consist of all of the tests specified in Table 1 in the order shown. The quantities shall be as shown in Table 1.

4.4.1.2 Group Submission

For group qualification of limiters with the same physical sizes and construction, the maximum and minimum ratings shall be subjected to the tests specified in Table 1 in the order shown.

4.4.1.2.1 Intermediate Ratings

In addition, the intermediate ratings shall be submitted to the following tests.

- a. Time-current measurements - 4.7.13
(2 samples - each rating)
- b. Overload damage 4.7.10
Time current - 1000%
(2 samples - each rating)

4.4.1.3 Sampling Instructions

Qualification inspection samples shall consist of not less than 51 limiters of each current rating. Samples shall be representative of the manufacturer's normal production and shall be identified by the manufacturer's part number.

4.4.2 Test Routine

The qualification inspection samples for current limiters shall be subjected to the tests specified in Table 2. All sample units shall be subjected to Test Group I then divided as indicated into the various remaining tests groups.

4.4.3 Retention of Qualification

Retention of qualification inspection (Table 5) shall be performed by the Qualifying Activity on sample units produced with equipment and procedures normally used in production. To retain qualification, the supplier shall forward their periodic qualification submittal every 36 months to the Qualifying Activity. The Qualifying Activity shall establish the initial reporting date. Failure to submit test samples/data within 30 days after the end of the sampling interval may result in loss of qualification for the products. Except where the results of these inspections show non-compliance with the applicable requirements, delivery of products which have passed Group A inspection shall not be delayed pending the results of retention of qualification inspections.

4.5 Quality Conformance Inspection

4.5.1 Inspection of Product for Delivery

Inspection of product for delivery shall consist of Group A and Group B inspection. Except as specified in 4.5.2, delivery of products that passed Group A and Group B inspection shall not be delayed pending the results of Group C inspection.

4.5.1.1 Inspection Lot

An inspection lot shall consist of all limiters of the same style and current rating produced under essentially the same conditions, and submitted for inspection at one time.

Table 2 - Qualification inspection

Test and Samples Units	Requirement Paragraph	Test Paragraph	Test Responsibility	
			QA	Manufacturer
TEST GROUP I - 4 samples				
Examination of Product	3.4	4.7.1	X	
Voltage Drop	3.5.5	4.7.20	X	
TEST GROUP II - 2 samples				
Thermal Shock	3.5.12	4.7.5	X	
Moisture Resistance	3.5.10.3	4.7.4	X	
Time Current	3.5.1	4.7.13	X	
TEST GROUP III - 3 samples				
Terminal Strength	3.5.11	4.7.9		X
Vibration	3.5.10.6	4.7.12		X
Salt Spray	3.5.10.4	4.7.7		X
Rated Current	3.5.15	4.5.22		X
TEST GROUP IV - 3 samples				
Random Drop	3.5.13	4.7.8		X
Temperature Rise	3.5.8	4.7.21		X
Rated Current	3.5.15	4.7.22		X
TEST GROUP V - 7 samples				
Explosion Proof	3.5.10.10	4.7.16		X
TEST GROUP VI - 2 samples				
Acceleration	3.5.10.9	4.7.18		X
Mechanical Shock	3.5.10.7	4.7.19		X
Sand and Dust	3.5.10.5	4.7.17		X
Time Current	3.5.1	4.7.13		X
TEST GROUP VII - 4 samples				
Life Test	3.5.14	4.7.2		X
Time Current	3.5.1	4.7.13		X

Table 2 - Qualification inspection (continued)

Test and Samples Units	Requirement Paragraph	Test Paragraph	Test Responsibility	
			QA	Manufacturer
TEST GROUP VIII - 8 samples				
Ambient Temp. Influence	3.5.3	4.7.3		X
Time Current	3.5.1	4.7.13		X
TEST GROUP IX - 6 samples				
Overload Damage	3.5.4	4.7.10		X
Time Current	3.5.1	4.7.13		X
TEST GROUP X - 6 samples				
Initial Loading Influence				
Time Current				
TEST GROUP XI - 8 samples				
Alternating Current Interrupt	3.5.2	4.7.11		X
	3.5.1	4.5.13		X
TEST GROUP XII - 2 samples				
Direct Current Interrupt	3.5.6	4.7.14		X
	3.5.7	4.7.15		X

NOTES:

- 1/ Only four limiters need be measured for dimensions and for voltage drop.
- 2/ Time current shall be measured at 500% of rated current.
- 3/ Three sample limiters shall be tested in a 3 pole block. The center limiter and one other limiter shall carry 100% of rated current. The third limiter shall carry no current for the entire vibration test.
- 4/ Four sample limiters shall be conditioned at $-54\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and four sample limiters shall be conditioned at $125\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$. After stabilizing at the temperature extremes for a minimum of 4 hours. Two sample limiters from each temperature exposure shall meet the 500% rating requirements and two sample limiters from each temperature exposure shall meet the 100% rating requirement.
- 5/ Time current shall be measured at 500% and 1000% of rated current (two samples at each overload).
- 6/ Time current shall be measured at 300%, 500%, and 1000% of rated current (two samples at each overload).

4.5.1.2 Group A Inspection

Group A inspection shall consist of the examinations and tests specified in Table 3 and shall be made on all production items, in the order shown. If the manufacturer has established a statistical process control (SPEC) system that is approved by the qualifying activity, and this system includes testing limiters to the Group A inspections, the Group A inspection need not be performed. The manufacturer must provide access to the information developed by his SPEC system when requested by the qualifying activity.

Table 3 - Group A inspections

Test	Sample Qty.	Remit. Para.	Test Para.	Defects	
				Accept	Reject
Critical Dimensions ^{1/}	100%	3.4.7	4.7.1	0	1
Continuity		3.5.9	4.7.23	0	1

^{1/} Critical dimensions are those dimensions indicated on the applicable military standard or individual specification sheet.

4.5.1.3 Sampling

Sampling for critical dimensions shall be as follows:

First 100 limiters - four samples

Each additional 250 limiters (up to 1000 limiters)

four samples each 250 limiters

Over 1000 limiters - four samples from each additional 1000 limiters.

4.5.2 Group B Inspection

Current limiters shall be tested as specified in Table 4 in the order shown.

4.5.2.1 Sampling Plan

Sample units shall be selected from each production lot from each ampere rating manufactured. Group B inspection shall be performed on nine sample units which have passed Group A inspection, unless the Government considers it more practical to select a separate sample. If more than one limiter fails, reject the lot. If one limiter fails, a second sample of six limiters shall be tested for the failure point. If there are no additional failures, accept the lot. If there is a failure in the second sample test, reject the lot.

Table 4 - Group B inspections

Test	Sample Qty.	Remit. Para.	Test Para.
Time Current at:		3.5.1	4.7.13
300% of rating	3		
500% of rating	3		
1000% of rating	3		

4.5.3 Retention (Periodic) of Qualification Inspection

Retention of qualification inspection shall consist of Group C inspection and occur every 36 months after the initial qualification date. The qualifying activity may shift the reporting date to accommodate testing schedules, but no later than 18 months from retention of qualification due date. Retention of qualification shall be performed by the Qualifying Activity and in accordance with Table 5.

- a. **Certification:** If no production of products previously qualified has occurred for the entire reporting period, the Supplier may provide a certification to the Qualifying Activity that no changes in the product materials, manufacturing processes, or site of production has occurred since the initial qualification inspection. Certification for more than one reporting period shall not be permitted. The supplier shall contact the Qualifying Activity to determine the conditions of the certification. The supplier may be required to submit the certification on a specified form provided by the qualifying activity.
- b. **Component Production:** If a qualified component has been produced in the retention period, a component from that family shall be submitted. Retention of qualification consists of the tests specified in Table 5 and shall be performed by qualifying activity.

4.5.3.1 Group C Inspection

Current limiters shall be tested as specified in Table 5. Sample units that have been subjected to and have passed Group A inspections shall be submitted to the Qualifying Activity, unless the qualifying activity considers it more practical to select separate samples.

4.5.3.2 Group Submission

For group periodic testing of limiters with the same physical sizes and construction, the maximum and minimum ampere ratings shall be submitted and subjected to the tests specified in Table 5 in the order shown.

4.5.3.2.1 Intermediate Ratings

Intermediate ratings shall be submitted to the following tests.

- a. Time-current measurements (4.7.13) (two samples - each rating)
- b. Overload damage (4.7.10) Time current - 1000% (two samples - each rating)

4.5.3.3 Non-Compliance

If a sample fails to pass Group C inspections, the supplier shall take corrective action on the materials or processes, or both, as warranted, and on all units or processes which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials, processes, etc., and which are considered subject to the same failure. Acceptance of the product shall be discontinued until corrective action, acceptable to the Government has been taken. After the corrective action has been taken, Group B or C inspection shall be repeated on additional sample units (all inspections, or the inspection which the original sample failed, at the option of the Government). Group A inspection may be reinstated; however, final acceptance shall be withheld until the Group B or C re-inspection has shown that the corrective action was successful. In the event of failure after re-inspection, information concerning the failure and the corrective action taken shall be furnished to the cognizant inspection activity and the qualifying activity.

4.5.3.4 Inspection of Preparation for Delivery

Sample packages or packs and the inspection of the preservation, packaging, packing and marking for shipment and storage shall be in accordance with the requirements of Section 5.

4.5.3.5 Retention of Qualification Test Report

The qualifying activity will provide certified Table 5 test results. The supplier shall furnish the qualifying activity one certified test report containing the following information:

- a. A summary of results for tests specified for the Quality Conformance Requirements (see 4.5).
- b. Corrective Action Reports (as applicable)

The supplier will maintain all results for a period of six years and provide the information to the qualifying activity upon request.

4.6 Test Conditions

4.6.1 Standard Conditions

Unless otherwise specified, all load tests shall be conducted in still air at a temperature of $25\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ which shall be considered room ambient and at sea level pressure. The atmospheric pressure at the test facility may be used in lieu of sea-level pressure if the elevation of the test facility is not greater than 3000 feet above sea level.

4.6.2 Power Supply

For qualification tests, unless otherwise specified, the power source for AC current tests shall be $118\text{ V} \pm 3\text{ V}$ at a frequency of $400\text{ Hz} \pm 20\text{ Hz}$ with waveform and harmonic content in accordance with the requirements of MIL-STD-704, and for DC shall be $28\text{ V} \pm 1\text{ V}$. For Group B tests and Group C tests, unless otherwise specified, all AC current tests shall be $118\text{ V} \pm 3\text{ V}$ at a frequency of $60\text{ Hz} \pm 1\text{ Hz}$ and for DC shall be $28\text{ V} \pm 1\text{ V}$. Higher voltages may be used at manufacturer's option.

Table 5 - Group C inspection

Test	Requirement Paragraph	Test Paragraph	Note
TEST GROUP I - 2 samples			
Thermal Shock	3.5.12	4.7.5	
Salt spray	3.5.10.4	4.7.7	
Moisture Resistance	3.5.10.3	4.7.4	
Time Current	3.5.1	4.7.13	<u>1/</u>
TEST GROUP II - 8 samples			
Ambient Temperature Influence	3.5.3	4.7.3	
Time Current	3.5.1	4.7.13	<u>2/</u>

1/ Time current shall be measured at 500% of rated current.

2/ Four sample limiters shall be conditioned $-54\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and four sample limiters shall be conditioned at $125\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ after stabilizing at the temperature extremes for a minimum of 4 hours. Two sample limiters from each temperature exposure shall meet the 500% rating requirements and two sample limiters from each temperature exposure shall meet the 100% rating requirement.

3/ Time current shall be measured at 500% and 1000% of rated current (two samples at each overload).

4/ Time current shall be measured at 300%, 500%, and 1000% rated current (two samples at each overload).

4.6.3 Test Cables

Test cables in accordance with Table 6 shall be used for all tests that require limiters to carry current except the tests requiring currents of fault magnitude in the rupture and explosion-proof tests. Test leads from the fuse holder to the source of power shall be a minimum of 3 feet in length and shall conform to AS50861/2.

4.6.4 Limiter Holders

All tests requiring holders shall be performed with applicable holders as specified in AS53731.

Table 6 - Test leads

Limiter Rating (Amperes)	Wire Size	Terminal Lug AS7928 Type
1 thru 10	20	MS20659-102
15	18	MS20659-102
20	16	MS20659-107 or 127
25 - 30	14	MS20659-107 or 127
35 - 40	12	MS20659-105 or 128
50	10	MS20659-105 or 128
60	8	MS20659-107 or 129

4.7 Test Methods

4.7.1 Examination of Product

All limiters shall be inspected to verify that materials, design, construction, weight, physical dimensions, marking and workmanship conform to applicable requirements (see 3.3 through 3.4.8, 3.6 and 3.7).

4.7.2 Life Test

The limiter shall be inserted into the specified limiter holder and subjected to a 1000-hour life test (see 3.5.14) at any convenient AC or DC voltage, consisting of 500 hours of operation at each of the ambient temperature extremes of $-54\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and $125\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$. While at each of these temperature extremes, the limiter shall carry rated current at any convenient AC or DC voltage continuously for 250 hours and then be subjected to 2500 off and on cycles with each cycle consisting of 3 minutes at rated current and 3 minutes at no current. The temperature of the limiter bodies shall be monitored continuously and the temperature rise determined and recorded. The maximum temperature shall not exceed $218\text{ }^{\circ}\text{C}$. Time-current measurements performed subsequent to this test shall be distributed evenly at 500 and 1000% of current rating and shall be conducted at 28 V DC. The time-current test method shall be in accordance with 4.7.13.

4.7.3 Ambient Temperature Influence

Fifty percent of the limiters, as required for this test as specified in Table 2, shall be conditioned at the low ambient temperature extreme of $-54\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and the remaining 50% shall be conditioned at the high ambient temperature extreme of $125\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$. The limiters shall be stabilized at each temperature extreme for a minimum of 4 hours. After thermal stabilization at these temperature extremes, the time-current measurements of the limiters shall be obtained at 500 and 1000% of the current rating at 28 V DC. These measurements shall be in accordance with the requirements of 4.7.13 except at the temperatures stated in this paragraph. The specified limiter holder with at least a 3-foot length of wire attached to the limiter holder terminals shall be stabilized at the same ambient temperature as the limiters (see 3.5.3).

4.7.4 Moisture Resistance

The limiter shall be inserted in the specified limiter holder and subjected to the moisture resistance test in accordance with MIL-STD-202, Method 106 except that step 7B of this method shall be omitted. Subsequent to this test and immediately after a 24-hour conditioning at $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and at a relative humidity of $50\% \pm 5\%$, the limiter shall be tested and shall meet the time-current requirements of 4.7.13 for 500% of rated current (see 3.5.10.3).

4.7.5 Thermal Shock

The limiter shall be inserted in the specified limiter holder and subjected to five thermal-shock cycles in accordance with MIL-STD-202, Method 107, test condition B except that -54 °C shall be used in lieu of -65 °C (see 3.5.12).

4.7.6 Indicator Pin Operation

After each overcurrent test requiring the fuse element to open, verification shall be made that the indicator pin has properly extended to the “blown” position (see 3.5.10.8).

4.7.7 Salt Spray

The limiter shall be inserted in the specified limiter holder and subjected to salt-spray exposure in accordance with MIL-STD-202, Method 101, test condition B using a salt solution concentration of 5%. After drying, residue may be removed using a brush (see 3.5.10.4).

4.7.8 Random Drop

The limiter shall be inserted in the specified limiter holder which shall be rigidly mounted in a mounting fixture and subjected to the random-drop test in accordance with MIL-STD-202, Method 203. The limiters shall remain inserted in the limiter holders throughout the test (see 3.5.13).

4.7.9 Terminal Strength Test

The limiter shall be clamped firmly at one end and the forces specified in Table 7 applied to the opposite end. The test shall be done only once on a sample (3.5.11).

Table 7 - Terminal strength test

Direction of Application of Force	Ampere Ratings	
	Up to 30	Above 30
	Force in Pounds (minimum)	
To edge of blade, as inserted into clip of holder	10	25
To flat side of blade	5	10
To end of blade so as to push into limiter body	30	40

4.7.10 Overload Damage

Using equipment suitable for the time-current tests of 4.7.13, with provisions added to interrupt current at predetermined times before limiter damage, apply the test current for the time shown on the applicable time-current curve for 70% of the melting current at 300, 500, and 1000% of rated current. The test shall be conducted at 28 V DC, or at a higher voltage at the manufacturer's option. With the limiter stabilized at the ambient temperature of 125 °C ± 5 °C, apply each of the test currents one time, allowing a minimum of 10 minutes between applications. Stabilize the limiter at room temperature and perform the calibration test of 1000% of rating. Failure will be indicated by inability of the limiter to complete the above procedure or to melt at a time outside the calibration requirement of 4.7.13 (see 3.5.4).

4.7.11 Initial Loading Influence

Adjust the limiter to 100% of rated current. Maintain this current until temperature stabilization is achieved at the limiter-holder clips. While at this condition, apply the 1000% calibration current, and measure the fuse melt time by means of a transient recorder, typically a digital oscilloscope or a recording oscilloscope and a galvanometer, complete with shunts and amplifiers (3.5.2).

4.7.12 Vibration

The vibration test shall be accomplished in accordance with of MIL-STD-202, Method 204, test condition B (see 3.5.10.6).

- a. Three similar samples of the limiter shall be inserted in the applicable AS holder and mounted on the vibration fixture. The center limiter and one other shall carry 100% of rated current at any convenient voltage, while the third limiter shall carry no current for the entire vibration test.
- b. The test shall be done at room ambient condition. The limiters that carry current shall have current applied for at least 30 minutes prior to the vibration test.
- c. Suitable test circuitry with indicating provisions shall be connected to the terminals of the limiter holder to establish that electrical continuity is maintained by each limiter during the entire vibration test.

4.7.13 Time-Current Measurements (3.5.1)

- a. Time-current measurements shall be taken at an ambient temperature of $25\text{ °C} \pm 5\text{ °C}$ on two samples of each rating of each type of current limiter at 300, 500, and 1000% of limiter rating.
- b. For each test current, the load bank shall be adjusted at the start to a value that will result in $\pm 5\%$ of the current for the test.
- c. Measurements shall be taken, utilizing a high-drain battery source with a potential between 28 and 48 V and connected similar to Figure 1.
- d. A visual record shall be made of time-current measurements of 10 seconds or less. The limiter element melt time and fusing current shall be determined from these records and tabulated (see Figure 2).
- e. The limiter shall conform to the tolerance stated on the applicable time-current curve.
- f. The percent deviation of fusing current from the curve of the applicable AS shall be calculated and recorded. The measurements shall be performed with the limiters inserted in the limiter holders as specified in the applicable AS. Percent current deviation (X) is defined as follows:

$$\% \text{ deviation} = X = (-100) \frac{I_c - I_x}{I_c} \quad (\text{Eq. 2})$$

where I_x is the current that melts the test limiter at the time T_x (see Figure 2) and I_c is the current obtained from applicable time-current curve at time T_x .

- g. The limiter shall not suffer external physical damage as a result of this test.

4.7.13.1 Test Apparatus

The test apparatus shall be:

- Load current meter, accurate to $\pm 0.5\%$.
- Transient recorders, typically a digital oscilloscope or a recording oscillograph and galvanometer, complete with shunts and amplifiers. These devices shall have a minimum frequency of 3000 Hz, and a timing marker to allow time measurements accurate to the nearest 0.5 ms; and current and voltage measurements accurate to $\pm 2\%$.
- Load bank, resistive, capable of setting current flow to desired value $\pm 5\%$, current droop not to exceed 10%. Provide cooling if necessary.

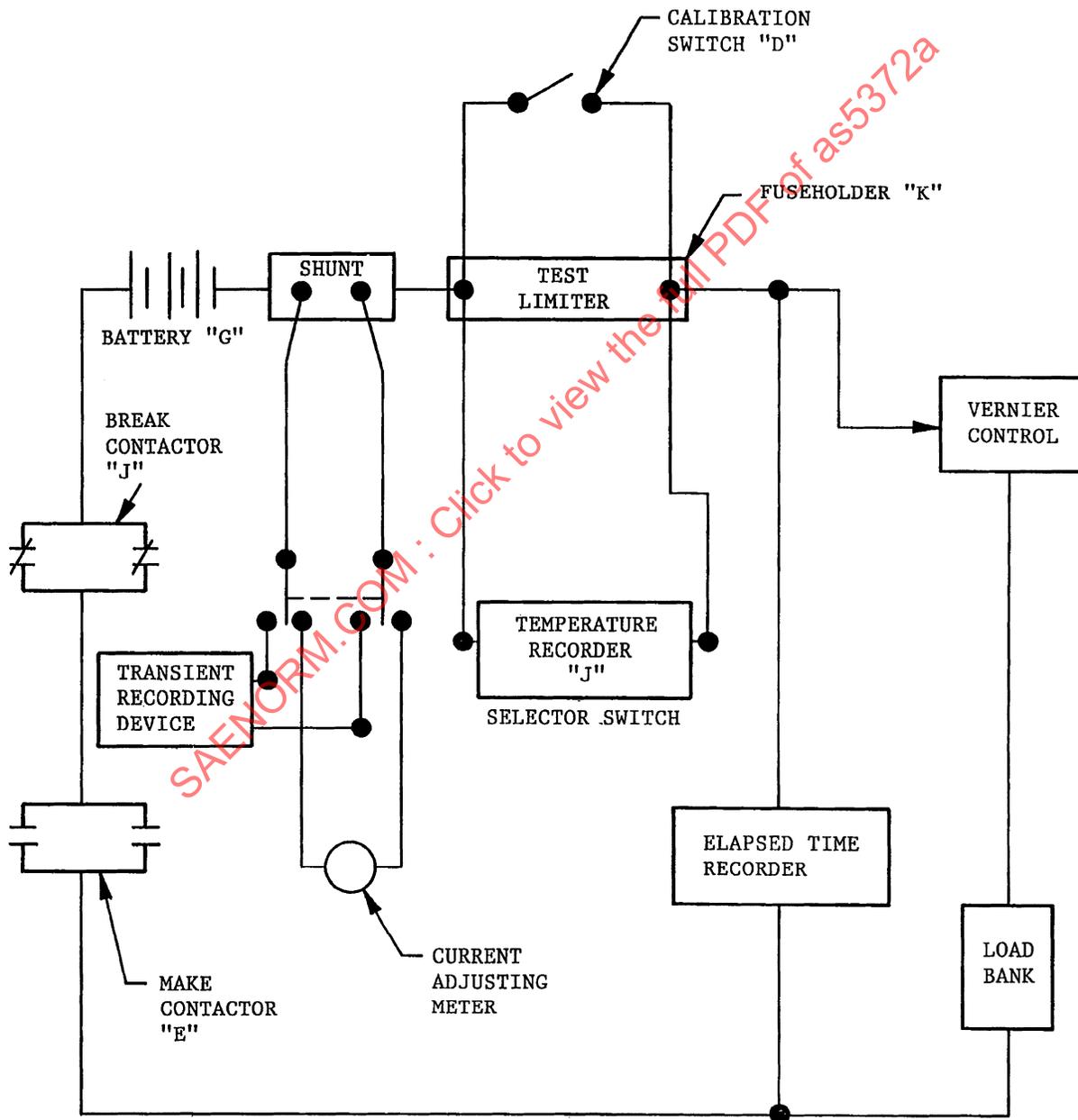


Figure 1 - Time-current test block diagram

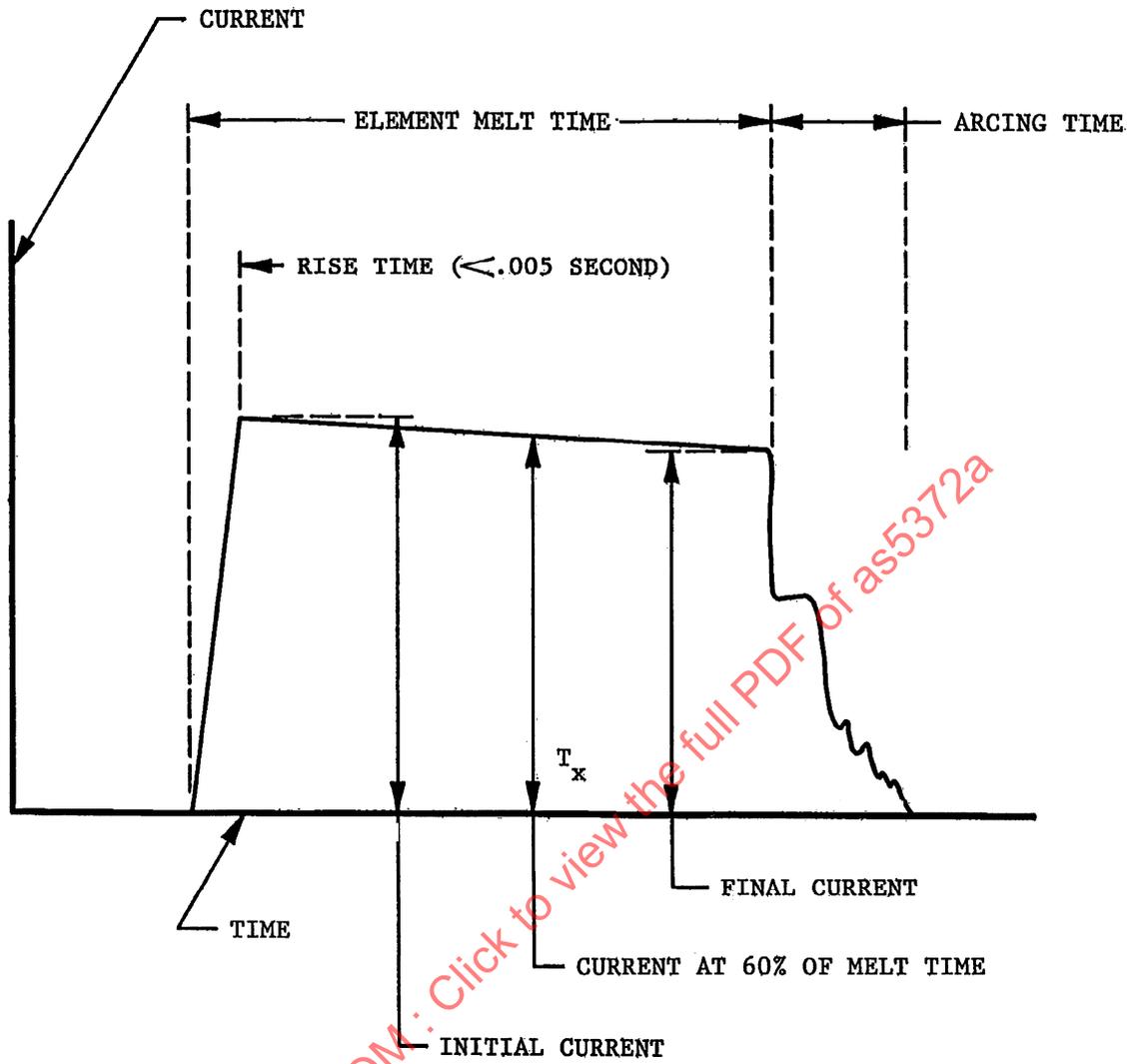


Figure 2 - Typical time current oscillograph

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