AEROSPACE STANDARD

AS6136™	REV. B

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Superseding AS6136A

Conduit, Electrical, Flexible, Shielded, Aluminum Alloy for Aircraft Installations

FSC 5975

RATIONALE

AS6136 is being stabilized because the processes/product is considered mature and the committee does not anticipate future technical changes. Stabilization does not imply the process or product is unacceptable for applications for which it is designed. Any technical changes noted by a supplier or user which results in a product or requirement change will be addressed by a new revision. Qualification is not required.

STABILIZED NOTICE

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1. SCOPE

This specification covers the requirements for flexible shielded electrical conduit for aircraft installations.

1.1 Classification

Flexible shielded conduit shall be furnished in two types, as specified (see 6.2):

Type I - Without outer synthetic compounded covering

Type II - With outer synthetic compounded covering

2. APPLICABLE DOCUMENTS

The following publications form a part of this standard 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.

2.1 U.S. Government Publications

Copies of these documents are available online at https://quicksearch.dla.mil.

FED-STD-601	Rubber, Sampling and Testing
MIL-PRF-6855	Synthetic Rubber Sheets, Strips, Molded or Extruded Shapes
MIL-STD-129	Marking of Shipments
MIL-STD-2073-1	Standard Practice for Military Packaging
QQ-A-430	Aluminum Alloy Rod and Wire; for Rivets and Cold Heading

2.2 ASTM Publications

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

ASTM B209 Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B211 Aluminum and Aluminum-Alloy Bar, Rod, and Wire

ASTM D149 Dielectric Breakdown Voltage and Dielectric Strength of Electrical Insulating Materials at Commercial Power Frequencies

ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension

ASTM D570 Standard Test Method for Water Absorption of Plastics

ASTM D624 Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

ASTM D746 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

ASTM D792 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

ASTM D2240 Standard Test Method for Rubber Property - Durometer Hardness

2.3 ASQ Publications

Available from American Society for Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203, Tel: 800-248-1946 (United States or Canada), 001-800-514-1564 (Mexico), or +1-414-272-8575 (all other locations), www.asq.org.

ANSI/ASQC-Z1.4 Sampling Procedures and Tables for Inspection by Attributes

2.4 National Conference of Standards Laboratories (NCSL) Publications

Available from NCSL International, 2995 Wilderness Place, Suite 107, Boulder, CO 80301, Tel: 303-440-3339, www.ncsli.org.

NCSL Z540-3 Calibration of Measuring and Test Equipment, Requirements for

2.5 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AIR1351 Manufacturers' Identification of Aerospace Electrical and Electronic Wiring Devices and Accessories

AS10380 Coupling Installations, Standard Conduit, Electrical

3. REQUIREMENTS

3.1 Materials

Materials shall conform to applicable specifications and be as specified herein and on applicable drawings. Materials which are not covered by specifications or which are not specifically described herein shall be of the best quality, of the lightest practicable weight, and suitable for the purpose intended.

3.1.1 Tubing Material

The tubing shall be formed from aluminum alloy sheet conforming to ASTM B209 Aluminum Alloy 3003 or from flattened wire conforming to ASTM B211 Aluminum Alloy 3003.

3.1.2 Packing Material

The packing material used shall be such as not to cause corrosion when the tubing is exposed to salt atmosphere. If cotton packing is used, it shall be impregnated with bituminous paint or other acceptable compound.

3.1.3 Braid Material

The wire from which the braid is made shall be aluminum alloy conforming to QQ-A-430, temper O.

3.1.4 Outer Covering Material (Type II)

The outer cover of Type II conduit shall be either synthetic rubber or equavalent plastic. Nitrile rubber plasticized polyvinyl chloride or nitrile rubber plasticized polyvinyl chloride - acetate insulating materials shall not be used.

3.1.4.1 Synthetic Rubber

The synthetic rubber shall conform to Class 2 of MIL-PRF-6855 and shall be of uniform thickness and free from pits and pinholes.

Table 1

Property	Value	Applicable Test Procedure
Tensile Strength (psi minimum)	1800	ASTM D412
Elongation (% minimum)	350	ASTM D412
Modulus at 100% Elongation (psi)	900	ASTM D412
Tear Strength (lb/in minimum)	350	ASTM D624 Die (c)
Water Absorption (g/in^2 maximum)	0.04	ASTM D624
Hardness (Durometer ±3)	82	ASTM D2240
Specific Gravity (maximum)	1.20	ASTM D792
Low Temperature Flexibility (°F)	-70	FED-STD-601 Method 5211
Dielectric Strength (V/mil minimum)	600	ASTM D149 1/

1/ Short time in air- 0.30 mil sheet, 2-inch diameter electrodes.

3.2 Design and Construction

3.2.1 Type I complete conduit shall consist of flexible aluminum alloy tubing covered with a woven aluminum alloy wire braid (see Figure 1). Type II complete conduit shall be identical to Type I, except that it shall be provided with an outer protective synthetic rubber covering.

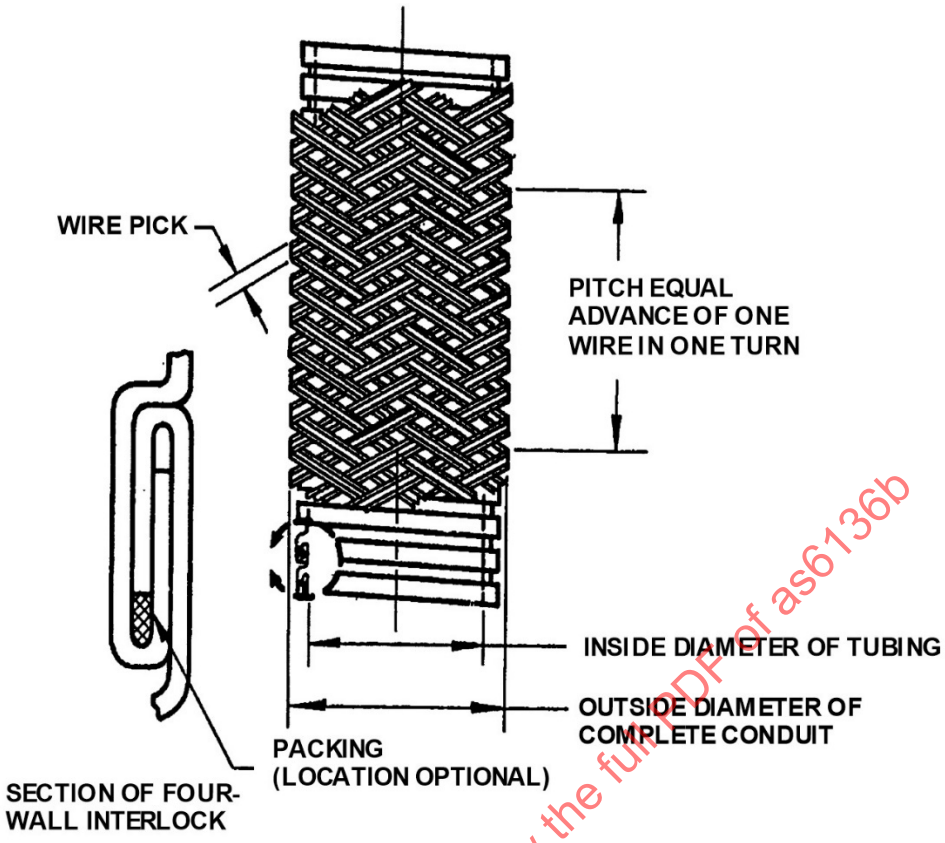

Figure 1 - Shielded conduit Type I and Type II
(before outer covering is applied)

3.2.1.1 Sizes and Dimensions

The nominal sizes and inside and outside diameters of the complete conduit shall be as specified in Table 2.

3.2.1.2 Bending Radius

All conduit (minus the outer synthetic rubber covering of Type II) shall withstand bending in a loop, with the inside radius as specified in Table 3, without damage.

3.2.2 Tubing

The tubing shall be of a rugged, full four-wall inter locking type, suitably packed to provide the specified water tightness (see 3.2.2.3). The tubing shall be made by helically coiling a formed aluminum alloy strip in such manner that it will not unravel or show loose ends when cut. The width of the strip and pitch of the helix shall be designed to provide for the required bending radius (see 3.2.1.2).

3.2.2.1 Tubing Dimensions

The dimensions of the tubing and the thickness of the strip used in its forming shall be as specified in Table 2.

3.2.2.2 Tubing Yield Load

The yield load of the tubing (conduit with outer covering and braid removed) shall be as specified in Table 3.

Table 2 - Sizes and dimensions

Complete Conduit							Tubing	Shield Braid			
AS6136 Part Number	Nom Size (inches)	Inside Dia (inches)		Type I Outside Dia (inches)		Type II Outside Dia (inches)	Strip Thickness (inches)	Wires Per Pick Max (optional)		Wire Dia (inches)	
		Min	Max	Min	Max	Max		2/2 Weave	1/1 Weave	Min	Max
-1	3/16	0.183	0.193	0.318	0.338	0.386	0.010	6	8	0.0075	0.0085
-2	1/4	0.245	0.255	0.380	0.400	0.448					
-3	3/8	0.370	0.380	0.505	0.525	0.573					
-4	1/2	0.495	0.505	0.630	0.650	0.698					
-5	5/8	0.620	0.630	0.755	0.775	0.823					
-6	3/4	0.755	0.755	0.910	0.930	0.983		7	14		
-7	1	0.995	1.005	1.200	1.220	1.345	0.012			0.0095	0.0105
-8	1-1/4	1.245	1.255	1.450	1.475	1.600					
-9	1-1/2	1.495	1.505	1.703	1.728	1.853		7	15		
-10	1-3/4	1.745	1.755	1.953	1.978	2.103		8	15		
-11	2	1.995	2.005	2.208	2.233	2.353		8	16	0.0121	0.0131
-12	2-1/2	2.495	2.720	2.720	2.870	2.870		8	16		

Table 3 - Performance requirements

AS6136 Part Number	Nom Size (inches)	Complete Conduit		Tubing	Shield Braid
		Inside Bending Radius (inches)	Bending Test Load (pounds)	Min Yield Load (pounds)	Min Coverage (%)
-1	3/16	2-1/4	1	50	85
-2	1/4	2-3/4		75	
-3	3/8	3-3/4		85	
-4	1/2	3-3/4	2	100	
-5	5/8	3-3/4		105	
-6	3/4	4-1/4		110	90
-7	1	5-3/4		120	
-8	1-1/4	8		160	
-9	1-1/2	8-1/4	7-1/2	190	
-10	1-3/4	9		225	
-11	2	9-3/4		265	
-12	2-1/2	10		335	

3.2.2.3 Water Tightness

Tubing from which the shielding braid has been removed, or tubing from which the outer covering and the shielding braid have been removed and which has been flexed to the bending radius specified in Table 3, shall not leak more than one-third of its interior volume per hour when tested as specified in 4.5.2.

3.2.3 Braid

The braid shall be applied in such manner that the finished conduit may be bent to the specified radius without damage (see 3.2.1.2). The braid shall fit the tubing closely enough to prevent appreciable bunching or undue slipping.

3.2.3.1 Braid Design

The weave of the braid shall be either of the basket types, over two and under two, or over one and under one. The diameter of the wire used for the braid and the number of wires per pick shall be as specified in Table 2. Each pick shall contain the same number of wires.

3.2.3.2 Braid Coverage

The total number of wires in the complete braid and the number of parallel wires per inch length of conduit shall be such as to provide the percentage of coverage specified in Table 3, when calculated by the method specified in 4.5.4.

3.2.4 Physical Properties of Outer Cover

The physical properties of the outer synthetic rubber covering, both before and after testing, shall conform to class 2 of MIL-PRF-6855.

3.3 Identification and Marking

Types I and II conduit shall be marked by either of the following methods:

a. Continuous or intermittent lengths of waterproof tape marked with the AS6136 part number, manufacturer's name or trademark in accordance with AIR1351, and at intervals of not more than 1 foot shall be incorporated between the metal tubing and the braid.

b. Manufacturer's identification shall be placed at not more than 3-inch intervals on the inner side of the spiral convolutions of the conduit.

c. Part identification number shall be as follows:

AS6136 -1 A
I I I_____ A – Type I, B – Type II (See 1.1)
I I_____ Nominal Size Identification (ID) - (See Table 2)
I_____ Specification Control Number

3.4 Minimum Continuous Length of Cut

The maximum permissible length of a single piece within any quantity ordered (see 6.2, item c) is limited only by manufacturing and handling facilities. Not less than 85% of the total quantity of each size on order shall be furnished in lengths equal to or greater than the nominal lengths specified in Table 4. Pieces shorter than the minimum acceptable lengths specified in Table 4 will not be accepted. All lengths shall be continuous, unspliced, and shall be measured when the conduit is fully extended under a tension of approximately 10% of the tubing yield load specified in Table 3.

Table 4 - Piece lengths

Nom Size (inches)	Nom Extended Length (feet)	Min Acceptable Extended Length (feet)
3/16	50	25
1/4		20
3/8		20
1/2	40	15
5/8		14
3/4		10
1	30	
1-1/4	20	
1-1/2	17	
1-3/4	15	
2	13	
2-1/2	10	

3.4.1 End Protection

Each end of each length of type I conduit shall be provided with a removable ferrule or with suitable seizing or tape, which will prevent unraveling of the braid and cover the ends of the braided wires (refer to AS10380).

3.5 Workmanship

All details of manufacture shall be in accordance with the best practice for aircraft flexible conduit. The conduit shall be free from all defects which would adversely affect its serviceability.

3.5.1 Interior

The interior surface of the conduit shall be free from burrs or sharp edges which might cause abrasion of cable insulation, and shall be free from obstructions.

3.5.2 Splices

Splices in braids shall be neatly made, and shall cause no sharp or rough projections on the conduit. There shall be not more than one spliced pick in any 2-foot length of conduit. All loose ends shall be trimmed closely.

3.5.3 Ends

The ends of each length of conduit shall be cut square, and shall be free from burrs or sharp edges which would interfere with the assembly of the conduit with parts with which it is intended to be used (refer to AS10380).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

Unless otherwise specified in the contract or purchase order, the manufacturer is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the manufacturer may use his own or any other facilities suitable for the performance of the inspection requirements specified herein. The purchaser 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 Responsibility for Compliance

All items must meet all technical requirements of this product standard. The inspection set forth in this standard shall become a part of the supplier's overall inspection system or quality program. The absence of any inspection requirements in the standard shall not relieve the supplier of the responsibility of assuring that all products comply with all requirements of the contract or purchase order. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the purchaser to acceptance of defective material.

4.3 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 supplier. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with NCSL Z540-3 or equivalent standards.

4.4 AS9003 Quality Assurance Compliance

The supplier's quality assurance program for conduit production shall comply with the AS9003 Inspection and Test Quality System. Independent certification of the processes is not required. Other established and industry recognized quality assurance standards that assure all products produced conform to the contract requirements are acceptable. However, if used, it is the responsibility of the supplier to have evidence of compliance to AS9003.

4.5 Sampling

Unless otherwise specified, sampling for examinations and tests shall be in accordance with ANSI/ASQC-Z1.4

4.6 Inspection Lot

Conduit of one type and size presented at one time shall be considered a lot. The inspection lot size shall be determined by the number of coils or reels presented. The sample unit for examination shall consist of 4 consecutive feet of conduit.

4.6.1 Visual Examination

The conduit shall be examined for defects in material, design, construction, marking, and workmanship. Any area of nonconformance with specified requirements shall be classified a defect. The inspection level shall be Level II with an AQL of 4.0 defects per 100 units.

4.6.2 Dimensional Examination

An examination shall be made to determine compliance with dimensional requirements. Any dimension that is not within the specified tolerances shall be classified a defect. The inspection level shall be S-3 with an AQL of 6.5 defects per 100 units.

4.6.3 Testing of the End Item

Testing shall be performed on each sample unit in accordance with 4.8.1, 4.8.2, 4.8.3, and 4.8.4. The inspection level shall be S-2 and any failure to meet the specified requirements shall be cause for rejection of the lot.

4.7 Test Reports

When required by the contract or order (see 6.2), test reports shall be furnished in duplicate showing quantitative results for all tests and analyses required by this specification.

4.8 Inspection Methods

4.8.1 Bending Radius

The specimens for the bending test shall be of a length approximately four times the required bending radius. One end of the specimen shall be fastened tangentially to the surface of a cylindrical form so as to hang vertically, in a plane normal to the axis of the form, and the bend load specified in Table 3 shall be attached to the lower end. The inside bending radius of the form shall be as specified in Table 3. The form shall be slowly rotated 225 degrees to the position shown on Figure 2. Failure of the conduit to come within 1/8 inch of the form, at any point along its curvature between the point of attachment and a point diametrically opposite shall constitute cause for rejection.

4.8.2 Water Tightness

Specimens for this test shall be taken from the flexed portion of specimens previously subjected to the bending radius test and shall be of a length approximately 15 times the nominal inside diameter in Table 2. After removing the shielding braid, both ends shall be taped with friction or masking tape over a distance equal to the nominal inside diameter. Corks shall be fitted snugly in each end and the ends shall then be dipped in molten paraffin or wax as far back as the inner edge of the tape to insure water tightness.

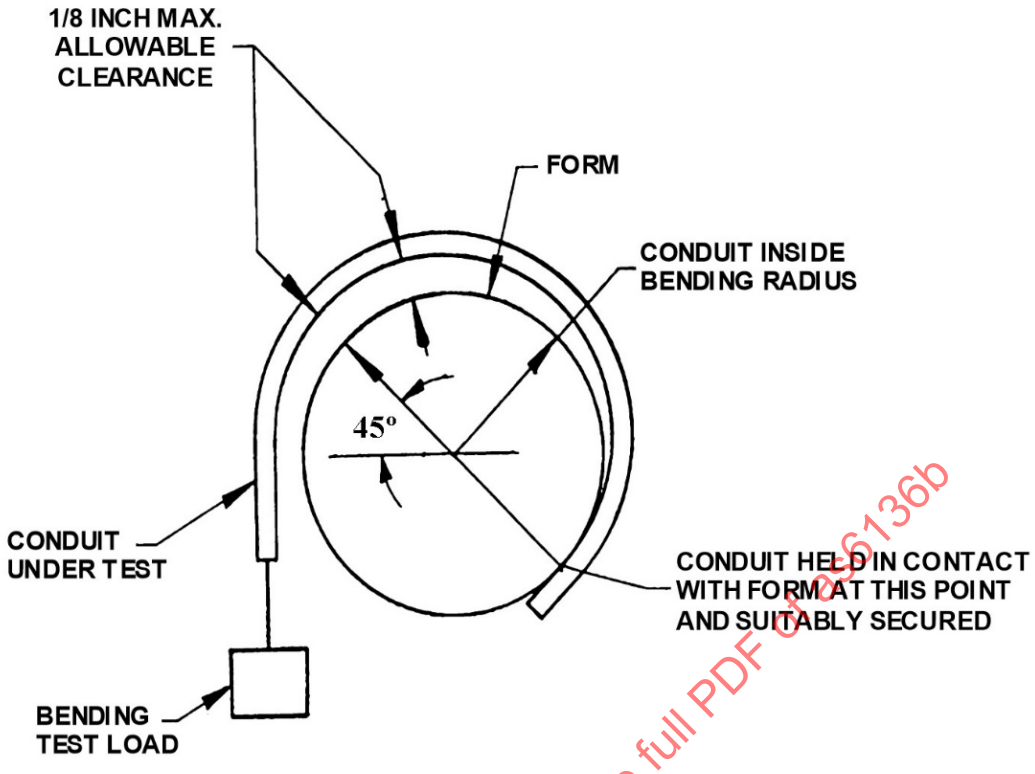

Figure 2 - Bending radius test setup (diagrammatic)

4.8.2.1 Specimens prepared as noted above and in an axially straight position shall be submerged horizontally in water so that the top of the conduit is at least 2 inches below the surface of the water. After submersion as specified in 3.2.2.3 the specimen shall be quickly and carefully removed. The contents (admitted water) shall be drained into a suitable receptacle, and weighed for calculation of amount of leakage. For the purpose of this test, the interior volume of the specimen shall be taken as the volume of a cylinder with a diameter equal to the minimum inside diameter permitted for the conduit under test, and with a length equal to the extended length of the specimen.

4.8.3 Yield Load of Tubing

Specimens for this test shall be at least 7-1/2 inches long and the shielding braid shall be removed. Gripping of the specimen in the testing machine shall be accomplished by means of plugs inserted at least 1-1/2 inches with clamps over the plugged portion or by means of suitable jaws which do not deform the tubing. The testing machine shall be operated so that the movable head travels at a rate not exceeding 0.022 inch per minute. The drop of the beam of the testing machine, and subsequent failure of the specimen to sustain increased loading, shall be taken as the indication of yield. The final value of the yield load shall be the average of not less than two tests. Failure to meet minimum yield load requirements specified in Table 3 shall be cause for rejection of the lot.