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MIL-DTL-6193D
w/AMENDMENT 1
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SUPERSEDING
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DETAIL SPECIFICATION

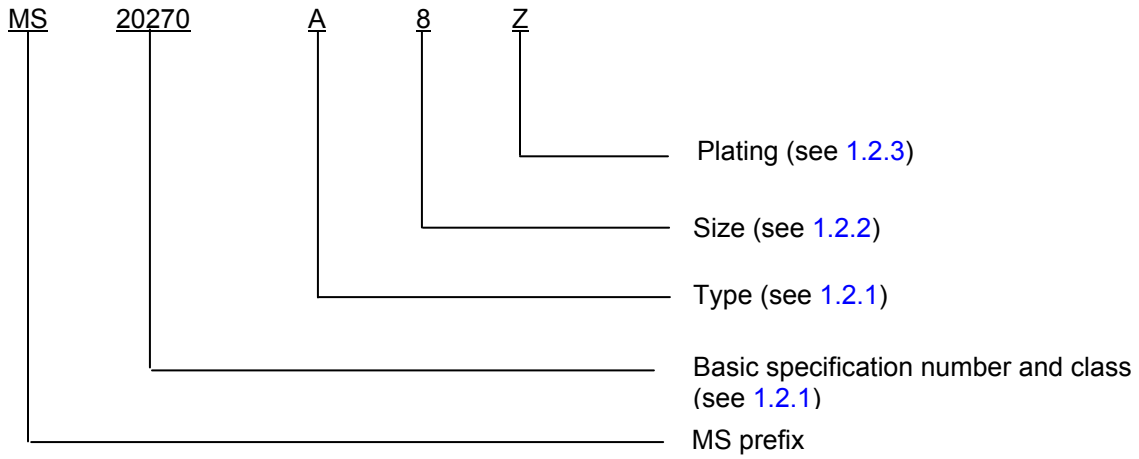
JOINTS, UNIVERSAL, PLAIN, LIGHT AND HEAVY DUTY, GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification covers the requirements for joints, universal, plain, light and heavy duty, for use in intermittent operations (see 6.1).

1.2. Part or Identifying Number (PIN). The PIN consists of the letters MS (see 3.6), the basic specification number, a dash, a letter for type, a number for size, a letter for lubrication cover, and a letter for the plating.



Comments, suggestions, or questions on this document should be addressed to: Commander, Defense Supply Center Columbus, Attn: VAI, P.O. Box 3990, Columbus, Ohio, 43218-3990 or email: Construction@dscc.dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at http://assist.daps.dla.mil.

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1.2.1 Classification. The universal joints are of the following classes and types:

Class 1 - Light duty specification sheet MS20270.

Type A - Square end.
Type B - Round end.

Class 2 - Heavy duty specification sheet MS20271.

Type A - Not applicable.
Type B - Round end.

1.2.2 Size. See table I and the individual specification sheets, specified in 1.2.1.

TABLE I. Class to size designator.

Class (see 1.2.1)	Size designator (Nominal size of joint)	Nominal OD of universal joint inch	Nominal size of universal joint mm
1	6 1/	.375	9.53
1	8	.500	12.70
1	10	.625	15.88
1	12	.750	19.05
1	14 1/	.875	22.23
1	16	1.000	25.40
1	20	1.250	31.75
1	24	1.500	38.10
2	6	.375	9.53
2	8	.500	12.70
2	10	.625	15.88
2	11	.625	15.88
2	12	.750	19.05
2	14	.875	22.23
2	16	1.000	25.40
2	20	1.250	31.75
2	24	1.500	38.10

1/ Type B only.

1.2.3 Plating.

Blank - Cadmium
Z - Zinc

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2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-7870	-	Lubricating Oil, General Purpose, Low Temperature
MIL-PRF-32014	-	Grease, Water Resistant, High Speed, Aircraft and Missile
MIL-PRF-81322	-	Grease, Aircraft, General Purpose, Wide Temperature Range

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-130	-	Identification Marking of U.S. Military Property
MS20270	-	Joint - Universal, Plain, Light Duty
MS20271	-	Joint - Universal, Plain, Heavy Duty

(Copies of these documents are available online at http://assist.daps.dla.mil or http://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

ASTM INTERNATIONAL

ASTM-B633	-	Zinc On Iron And Steel Electro-deposited Coatings Of
ASTM B659	-	Standard Guide for Measuring Thickness of Metallic and Inorganic Coatings
ASTM-D1171	-	Standard Test Method for Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)

(Copies of these documents are available from http://www.astm.org or from the ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, Pennsylvania, 19428-2959.)

NATIONAL CONFERENCE OF STANDARD LABORATORIES (NCSL)

NCSL Z540.1	-	Laboratories Calibration and Measuring and Test Equipment

(Copies of these documents are available online at http://www.ncsli.org or from the NCSL International, 2995 Wilderness Place, Suite 107 Boulder, Colorado 80301-5404.)

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SAE INTERNATIONAL

SAE-AMS-M-7866 - Molybdenum Disulfide, Technical, Lubrication Grade
SAE AMS-QQ-P-416 - Plating, Cadmium (Electro-deposited)

(Copies of these documents are available online at http://www.sae.org or from the SAE World Headquarters, 400 Commonwealth Drive, Warrendale, PA 15096-0001.)

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

3. REQUIREMENTS

3.1 Specification sheets. 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. Universal joints furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list (QPL) before contract award (see 4.3 and 6.3).

3.3 Materials. Materials shall be as identified herein or as approved by the qualifying activity. However, when a definite material is not specified, a material shall be used which will enable the universal joint to meet the requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guarantee of acceptance of the finished product.

3.3.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle cost.

3.4 Design and construction.

3.4.1 Dimensions. Dimensions shall be as specified in MS20270 and MS20271.

3.4.2 Assembly. The joints shall be assembled with pins and bearings pinned or locked into place to prevent disassembly of the finished joint.

3.4.3 Hardness. The hub sections of joints (defined by area bounded by dimension H in MS20270 and MS20271) shall not exceed Rockwell hardness C-40.

3.4.4 Finish.

3.4.4.1 Steel parts.(excluding CRES). All external steel parts of joints shall be cadmium plated in accordance with SAE-AMS-QQ-P-416, type II, class 2 or zinc plated in accordance with ASTM-B633 (see 1.2.1).

3.4.4.2 Verification of plating thickness. Verification of plating thickness shall be in accordance with ASTM B659.

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3.4.5 Lubrication retaining covers (class 2). Lubrication retaining covers shall be made so they that exclude dirt and dust from the bearing surfaces and shall retain the lubricant on those surfaces at all temperatures between -55°C and +71°C during operation.

3.4.5.1 Ozone resistance. The lubrication retaining cover when tested in accordance with 4.7.9 shall not exhibit any evidence of cracking.

3.4.5.2 Hazardous substances and ozone depleting chemicals. The ozone resistance test (see 4.7.9) may contain hazardous chemicals. It shall be handled in accordance with Federal regulations and guidelines to perform those tests. For further information about toxic chemicals and hazardous materials list, consult the Environmental Protection Agency web database at www.epa.gov/ebtpages/pollutants.html.

3.4.5.3 Without lubrication retaining covers. Class 1 universal without lubrication retaining covers joints shall be lubricated with oil conforming to MIL-PRF-7870.

3.4.5.4 With lubrication retaining covers. Class 2 joints with lubrication retaining covers shall be lubricated with a lubricant consisting of a uniform mixture of grease conforming to MIL-PRF-32014 or MIL-PRF-81322 with a 6 ± 0.5% by weight additive of molybdenum disulfide lubricant conforming to SAE-AMS-M-7866.

3.5 Performance.

3.5.1 Angularity. The joints shall be such a design and construction as to be operable at an angle of not less than 30° when measured between the axes of the hubs.

TABLE II. Axial tensile and compression loads. 1/

Class (see 1.2.1)	Nominal size of universal joint (in.)	Torsional play		Axial tension and compression load	Static torque load ±2% (lb. in.)	Dynamic torque load ±2% (lb. in.)
		Torque ±2% (lb. in.)	Limit ±2% (degrees)	±2% (lb.)		
1	.375	4	1.00	200	175	26
1	.500	4	.80	200	250	38
1	.625	4	.64	300	500	75
1	.750	4	.53	400	1,000	150
1	.875	8	.46	500	1,750	262
1	1.000	8	.40	600	2,500	375
1	1.250	8	.32	800	5,000	750
1	1.500	8	.27	1,100	7,500	1,125
2	.375	4	.83	500	200	30
2	.500	4	.62	1,000	600	90
2	.625	4	.50	1,500	1,080	162
2	.750	4	.42	2,000	1,900	285
2	.875	8	.36	3,500	3,000	450
2	1.000	8	.32	5,000	4,700	705
2	1.250	8	.24	7,000	9,500	1,425
2	1.500	8	.20	9,000	14,500	2,175

See notes at end of table.

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TABLE II. Axial tensile and compression loads - Continued. 1/

Class (see 1.2.1)	Nominal size of universal joint (mm)	Torsional play		Axial tension and compression load	Static torque load ±2% (N-m.)	Dynamic torque load ±2% (N-m.)
		Torque ±2% Newton-meters (N-m)	Limit ±2% (degrees)	±2% (kg)		
1	9.53	0.45	1.00	90.72	19.77	2.94
1	12.70	0.45	.80	90.72	28.25	4.29
1	15.88	0.45	.64	136.08	56.49	8.47
1	19.05	0.45	.53	181.44	112.98	16.95
1	22.23	0.90	.46	226.80	197.72	29.60
1	25.40	0.90	.40	272.16	282.46	42.37
1	31.75	0.90	.32	362.87	564.92	84.74
1	38.10	0.90	.27	498.95	847.39	127.11
2	9.53	0.45	.83	226.80	22.60	3.39
2	12.70	0.45	.62	453.59	67.79	10.17
2	15.88	0.45	.50	680.39	122.02	18.30
2	19.05	0.45	.42	907.18	214.67	32.20
2	22.23	0.90	.36	1587.57	338.95	50.84
2	25.40	0.90	.32	2267.96	531.03	79.65
2	31.75	0.90	.24	3175.15	1073.36	161.00
2	38.10	0.90	.20	4082.33	1638.28	245.74

1/ Metric equivalents are for information only.

3.5.2 End and side play. When tested as specified in 4.7.2 the play in the joint shall not exceed the maximum allowable end and side play in table III.

TABLE III. End and side play limits.

Class of universal joint	End play (mm)	Side play (mm)
Class 1	.0035 (0.089)	.0080 (0.020)
Class 2	.0027 (0.069)	.0055 (0.134)

3.5.3 Axial load. Universal joints when tested as specified in 4.7.3 the joint shall support, for 30 seconds -0, +1 second, the axial tension and compression load shown in table II, with angle “A” (see figure 1) equal to 0°, without any permanent deformation or excessive tightness after the load is removed.

3.5.4 Tightness. Universal joints when tested as specified in 4.7.4, the moment of force required to move the joint throughout the minimum angle of 30° shall not exceed 0.20 pound-inch ± 2% (2.26 N-m).

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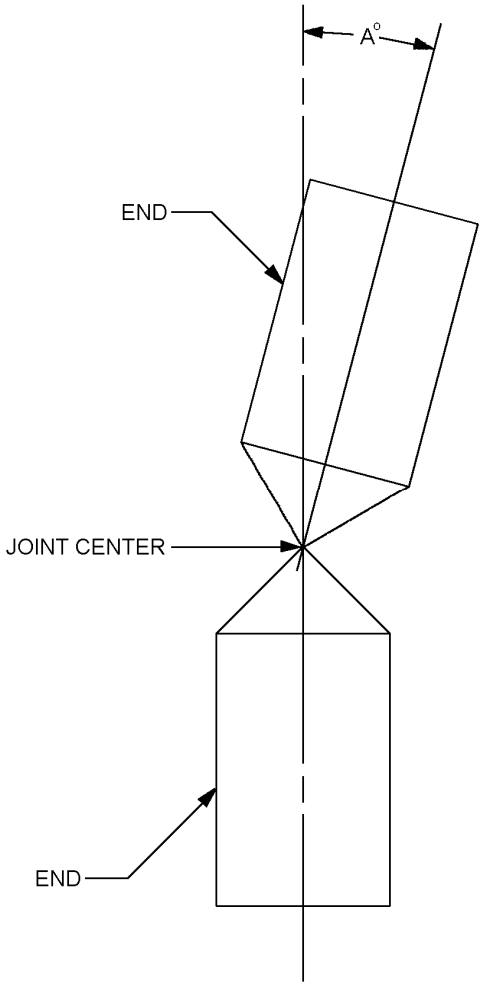

FIGURE 1. Universal joint.

3.5.5 Static torque load. Specimens shall be subjected to torque load conditions specified in 4.7.5.

3.5.6 Torsional play. The torsional play shall not exceed the applicable limit specified in table II when tested as specified in 4.7.6.

3.5.7 Endurance test. The universal joint shall be endurance tested as specified in 4.7.7. Failure of the universal joint is indicated by:

a. 5° or more torsional play.
b. When lubrication retaining covers are in place:
   (1) Failure of the lubricant retaining cover.
   (2) Lubricant shall be retained by the lubrication retaining covers throughout the endurance run.

3.5.8 Lubrication retention (class 2). The lubricant retention cover shall retain the lubricant and not crack or show signs of failure when tested as specified in 4.7.8. Slight bleeding of lubricant on surface of cover is permissible.

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3.6 Identification of product. Each joint shall be permanently and legibly marked in accordance with provisions of MIL-STD-130. The minimum marking requirements shall be the PIN and manufacturer's CAGE.

3.6.1 Use of AN or MIL designations. AN or MIL designations shall not be applied to a product, except for qualification test samples, nor referred to in correspondence or sales matter, until notification has been received from the qualifying service that the product has been approved for military use.

3.7 Workmanship. All details of manufacture shall be in accordance with the best practices for high quality military parts.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.3).

b. Conformance inspection (see 4.4)

4.2 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified herein.

4.2.1 Verification testing. The following tests and test methods assure universal joint integrity within typical operating conditions and applications. Alternate methods are allowed with prior approval by the qualifying activity. The test methods described herein are the preferred methods, and shall take precedence when alternate test methods result in differing or conflicting results.

4.2.2 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, qualify and quality 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 in accordance with NCSL Z540.1 or equivalent shall be required.

4.2.3 Responsibility for compliance. All items shall meet all requirements of sections 3 and 4. 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.

4.3 Qualification inspection. Qualification inspection shall consist of the examinations and tests specified in table IV. Samples subjected to group I testing shall be divided and subjected to group II and group II tests. Qualification Inspections and tests shall be performed at a laboratory acceptable to the Government (see 6.3) on sample units produced with equipment and procedures normally used in production. Use of alternate materials, plating, and processes shall be identified in the product test documentation (see 3.3).

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4.3.1 Qualification test articles. Samples for qualification shall be representative of the products proposed to be furnished to the Government. Qualification test articles shall consist of 10 universal joints for each type and size of universal joint for which qualification is desired.

TABLE IV. Qualification inspection and verification of qualification inspection.

Inspection	Requirement paragraph	Test method paragraph
Group I (10 samples) 1/		
Visual and mechanical inspection	3.4.1, 3.4.2, 3.6, and 3.7	4.7.1
Verification of plating thickness 2/	3.4.4.2	---
Ozone resistance 2/	3.4.5.1	4.7.9
Hardness	3.4.3	---
Group II (4 samples)		
Torsional play	3.5.6	4.7.6
End and side play	3.5.2	4.7.2
Tightness	3.5.4	4.7.4
Axial load Tightness	3.5.3 3.5.4	4.7.3 4.7.4
Static torque load	3.5.5	4.7.5
Group III (4 samples)		
Endurance (sequence shown below) Endurance Lubrication retention 3/ Torsional play	 3.5.7 3.5.8 3.5.6	 4.7.7 4.7.8 4.7.6

1/ Any samples not tested shall be retained as a reference standard.
2/ At the discretion of the qualifying activity the manufacturer may verify conformance to 3.4.4.3 or 3.4.5.1 as applicable with a certificate of compliance stating testing has been completed in accordance with ASTM B659 or 4.7.9 as applicable.
3/ Three samples from endurance test with lubrication retention covers in place.

4.3.2 Failures. One or more failures shall be cause for refusal to grant qualification approval.

4.3.3 Test plans and qualification reports.

4.3.3.1 Test plans. Test plans shall be prepared and submitted in accordance with the requirements of the qualification activity. The method of qualification proposed by the contractor is subject to the approval of the qualification activity. Manufacturers shall discuss with the qualifying activity the test specimens and test plans. These plans should state specifically the component characteristic requirements to be monitored during the test, such as test fixtures, setup, conditions, and identification of the successor failure criteria should be included as appropriate.

4.3.4 Qualification reports. Qualification reports shall be submitted in accordance with requirements of the qualifying activity. As a minimum manufacturers shall submit a report identifying test specimens, and test results.

4.4 Conformance inspection. Conformance inspection shall consist of group A inspections.

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4.4.1 Inspection lot. An inspection lot shall consist of all universal joints produced under essentially the same conditions, and offered for inspection at one time.

4.4.2 Group A inspection. Group A inspection shall consist of the inspection specified in table V.

4.4.2.1 Sampling plan (group A). table V tests shall be performed on a production lot basis. Samples shall be selected in accordance with table VI.

4.4.2.2 Failures (group A). If one or more sample units fail to pass group A inspection, the lot shall be screened for that particular defect and defective parts removed. A new sample of parts shall be selected in accordance with table VI and all group A tests again performed. If one or more defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification (see 4.5.5.1).

TABLE V. Group A inspection.

Inspection	Requirement paragraph	Test method paragraph
Visual and mechanical inspection	3.4.1, 3.4.2, 3.6, and 3.7	4.7.1
Verification of plating thickness 1/	3.4.4.2	---
Hardness	3.4.3	---
Torsional play End and side play Tightness	3.5.6 3.5.2 3.5.4	4.7.6 4.7.2 4.7.4

TABLE VI. Inspection sample.

Production lot size	Accept on zero sample size
Under 200	3
Over 200	4

4.5 Periodic inspection. Periodic inspection shall consist of group B inspection. Except where the results of these inspections show noncompliance with the applicable requirements (see 4.5.4), delivery of products which have passed group A inspections shall not be delayed pending the results of these inspections.

4.5.1 Group B inspection. Group B inspection shall consist of the inspections specified in table VII in the order shown. Group B inspection shall be made on sample units selected from inspection lots that have passed group A inspections.

TABLE VII. Group B inspection.

Inspection	Requirement paragraph	Test method paragraph
Ozone resistance 1/	3.4.5.1	4.7.9

1/ At the discretion of the qualifying activity the manufacturer may verify conformance to 3.4.5.1 as applicable with a certificate of compliance stating testing has been completed in accordance with ASTM D117 or 4.7.9 as applicable.

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4.5.1.1 Sampling plan. Group B inspection shall be performed every 36 months on universal joint samples produced during that period. Ozone resistance samples may be randomly selected from sheets of finished manufactured samples that will be used during manufacture.

4.5.2 Failures. If one or more sample units fail to pass group B inspection, the samples shall be considered to have failed (see 4.5.4.1).

4.5.3 Disposition of sample units. Sample units, which have been subjected to group B inspection, shall not be delivered on a contract or purchase order.

4.5.4 Nonconformance.

4.5.4.1 Failures. If a sample fails to pass any group A inspections, see table V, or group B inspections, see table VII, the manufacturer shall immediately notify the qualifying activity and cognizant inspection activity of such failure. The manufacturer shall take corrective action on the materials or processes or both as warranted, on all units of product which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials and processes, and which are considered subject to the same failure.

4.5.4.2 Acceptance and shipment. Acceptance and shipment of the product shall be discontinued until corrective action acceptable to the qualifying activity has been taken. After the corrective action has been taken group A testing shall be repeated on additional samples. At the discretion of the qualifying activity this may included all inspections, or the inspection which the original sample failed. Individual and sampling and periodic inspections, if applicable, may be reinstituted. However final acceptance of the universal joints shall be withheld until the group A inspection has shown that the corrective action was successful.

4.6 Additional QPL test and reporting requirements.

4.6.1 Retention of qualification. To retain qualification, the contractor shall submit a test report to the qualifying activity at 12 month intervals. The qualifying activity shall establish the initial reporting date. Each report shall consist of a summary of test and inspection results required by this specification that were performed during the 12 month reporting interval. As a minimum, the report shall include the following:

a. Number of lots produced and tested, including lot and sample sizes for each lot.
b. Identify which tests were performed.
c. Quantities passed.
d. Quantities failed.
e. All reworked sampling lots shall be accounted for and identified. A summary of corrective action taken shall be included.

4.6.2 Loss of product qualification.

4.6.2.1 Failure to meet test requirements. The manufacturer shall immediately notify the qualifying activity at any time during the 12-month reporting period when the qualified product fails to meet the test and inspection requirements of this specification. The manufacturer shall identify and indicate what corrective action will be taken to correct the problem. Failure to take corrective action acceptable to the qualifying activity may result in removal of the product from the QPL.

4.6.2.2 Failure to submit summary test data report. Failure to submit a test report within 30 days after the end of the 12 month reporting period may result in removal of qualification for the product.

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4.6.2.3 Change to manufacturing process, materials or equipment. The manufacturer shall notify the qualifying activity, in writing, of any changes in the manufacturing process, materials, or equipment used to manufacture a QPL product. Subsequently, the qualifying activity will notify the manufacturer, in writing, if a full re-qualification, partial re-qualification, or no additional testing is required as a result of these changes.

4.6.2.4 No production during reporting period. When no production occurs during the reporting period, a report shall be submitted to the qualifying activity certifying that the manufacturer still has the capability and facilities necessary to produce the QPL product. If during two consecutive 12 month reporting periods there has been no production, the manufacturer may be required, at the discretion of the qualifying activity, to submit QPL products to a full qualification inspection in accordance with this specification.

4.7 Performance.

4.7.1 Examination of product. The universal joint and its manufacturing records shall be examined to verify conformance with the materials, construction, dimensions, identification of product of this specification and the applicable specification sheets.

4.7.2 End and side play (see 3.5.2). Both the end play and side play of the universal joints shall be measured and shall meet the requirements of 3.5.2. The following details shall apply:

a. Class 2 universal joints the lubricant retaining cover shall be removed for this test.
b. Lubricant shall be removed for this test.
c. For each measurement, a five-pound (2.27 kg) load shall be applied to obtain an initial reading.
d. The load shall then be reversed and a second reading taken.
e. The total play is the play recorded between the two readings.
f The side play of the universal joint shall be measured in the same plane as an inspection hole.
g. The side play is measured a second time with the universal joint rotated 90 degrees from the first side play measurement.

4.7.3 Axial load (see 3.5.3). The axial load for a particular type and size of universal joint shall meet the requirements of 3.5.3. The following details shall apply:

a. The axial load shall be applied in both tension and compression directions for 30 seconds with angle A, as shown on figure 1, equal to 0°.
b. After application of the axial load, the universal joint shall be inspected for permanent deformation and for tightness in accordance with 4.7.4.

4.7.4 Tightness (see 3.5.4). Tightness for universal joints shall meet the requirements of 3.5.4. The following details shall apply:

a. Universal joints shall be tested for tightness with the lubricant retaining cover removed and may be lubricated during the test.
b. The lower end of the universal joint shall be clamped in a vertical position.
c. The moment of force required to move the upper end of the universal joint through the minimum angle of 30° shall be measure.

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4.7.5 Static torque load (see 3.5.5). The universal joint when subjected to static load test shall meet the requirements of 3.5.5. The following details shall apply:

a. The universal joints shall be subjected to 90% of the static torque load specified in table II, without exceeding 12° torsional deflection and shall not fail.
b. If no failures occurred during the 90% static load test, the same universal joints shall then be subjected to 100% torque load shown in table I and shall not fail.

4.7.6 Torsional play (see 3.5.6). Universal joints subjected to torsional play shall meet the requirements of 3.5.6. The following details shall apply:

a. With the lubrication retaining covers and lubricant removed, the applicable torque specified in table I under "Torsional play" shall be applied to the universal joint to obtain an initial reading.
b. The torque load shall then be reversed and a second reading taken.
c. The torsional play at the circumference of the universal joint is the difference between the two readings.
    (1) The torsional play for samples that have not been subjected to endurance testing shall not exceed the limits specified in 3.5.6.
    (2) The torsional play for samples that have been subjected to endurance testing shall not exceed 5°.

4.7.7 Endurance (see 3.5.7). Universal joints when subjected to endurance testing shall meet the requirements of 3.5.7. The following details shall apply:

a. Test specimens:
    (1) Class 1 universal joints before starting the endurance test, shall be submerged in lubricating oil conforming to MIL-PRF-7870.
    (2) Class 2 universal joints test specimens shall be subjected to the endurance test with lubricant retaining covers in place.

b. Test equipment shall be of such design and construction that the test specimen will be free from inadvertent end loads during the entire test. The following details shall apply:
    (1) A means shall be provided to avoid high starting torque loads.
    (2) The test equipment shall be a smooth-running mechanism free from vibration and shock loads.
    (3) After startup, the dynamic torque load applied shall be constant.

c. Testing:
    (1) Forced cooling shall be used during the test.
    (2) The universal joint shall be continuously operated at 120 rotations per minute under the applicable dynamic torque loads and for the lengths of run shown in table I, with the angle shown on figure 1 equal to 15°.

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4.7.8 Lubricant retention (see 3.5.8). Universal joints subjected to lubrication retention shall meet the requirements of 3.5.8. The following details shall apply:

a. Test specimens shall be universal joints with lubrication covers that have successfully passed endurance testing specified in 4.7.7.
b. Test specimens shall be exposed to -65 °F (-53.89°C) for 24 hours.
c. The universal joints shall then operated at angle "A" of 20° (see figure 1) for 1 hour at 3 rotations per minute.
d. The temperature shall then be raised to 160°F (71.11°C) for 160 hours and the universal joint operated at angle "A" of 20° (see figure 1), for 1 hour at 3 RPM.
e. Failure of the lubrication retaining cover shall also be considered failure of the universal joint.

4.7.9 Ozone (see 3.4.5.1). Unless specified otherwise, all rubber or elastomeric components used on the universal joint when exposed to ozone shall meet the requirements of 3.4.5.1. Rubber or elastomeric components shall be tested in accordance with ASTM D1171, method A exposure rating, utilizing ozone-chamber exposure method B with 70-hour exposure time.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Controls Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The universal joints covered by this specification are used for intermittent mechanical linkages i.e. gun controls, steering, and flap/slat actuation on aerospace equipment. The universal joints described in this specification are military unique because they must be able to operate satisfactorily when subjected to torsional and axial overload capacity, and low torsional deflection. Commercial universal joints are not designed to withstand these extreme conditions or sudden mechanical changes, and would experience catastrophic failure.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. PIN to be used with universal joints being acquired (see 1.2).

c. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).

d. Packaging requirements (see 5).

e. Shelf life requirements (see 6.4).

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6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List No. 6193, whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center, Columbus, ATTN: VQ, P.O. Box 3990, Columbus, OH 43218-3990.

6.3.1 Provisions governing qualification (SD-6). Copies of "Provisions Governing Qualification" are available online at http://assist.daps.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.

6.4 Shelf life. This specification covers items where shelf life is a consideration. Specific shelf-life requirements should be specified in the contract or purchase order. The shelf-life codes are contained in the Federal Logistics Information System Total Item Record. Additive information for shelf-life management may be obtained from DoD 4140.27-M, Shelf- life Management Manual, or the designated shelf-life Points of Contact (POC). The POC should be contacted in the following order: (1) the Inventory Control Points (ICPs), and (2) the DoD Service and Agency administrators for the DoD Shelf-Life Program. Appropriate POCs for the DoD Shelf-Life Program can be contacted through the DoD Shelf-Life Management website: http://www.shelflife.hq.dla.mil/.

6.5 Supersession information. The MS specification sheets associated with MIL-J-6193C has been canceled, and is superseded by the specification sheets listed in 2.2.1.

6.5.1 Substitutability information. Items in inventory having a PIN identified in the canceled MS specification sheets may be substituted for the corresponding item identified by a PIN that has been assigned by the preparing activity under this specification. Existing items in inventory need not be re-identified with the PIN assigned to newly acquired items.

6.6 Environmentally preferable materials. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. Table VIII lists the Environmental Protection Agency (EPA) top seventeen hazardous materials targeted for major usage reduction. Use of these materials should be minimized or eliminated unless needed to meet the requirements specified herein (see section 3).

TABLE VIII. EPA top seventeen hazardous materials.

Benzene	Dichloromethane	Tetrachloroethylene
Cadmium and compounds	Lead and compounds	Toluene
Carbon Tetrachloride	Mercury and compounds	1,1,1 - Trichloroethane
Chloroform	Methyl Ethyl compounds	Trichloroethylene
Chromium and compounds	Methyl Isobutyl Ketone	Xylenes
Cyanide and compounds	Nickel and compounds	

6.7 Guidance on use of alternative parts with less hazardous or non-hazardous materials. This specification provides for a number of alternative plating materials via the PIN. Users should select the PIN with the least hazardous material that meets the form, fit, and function requirements of their application.

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6.8 Subject term (key word) listing.

Cadmium
Ozone
Plating
Zinc

6.9 Amendment notations. The margins of this specification are marked with vertical lines to indicate where modifications from this amendment were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this documents based on the entire content irrespective of the marginal notations.

CONCLUDING MATERIAL

Custodians:
Army - AR
Navy - AS
Air Force - 99
DLA - CC

Review activities:
Army - AV, CR4
Navy - CG, MC, SA
Air Force - 71

Industry association:
SAE - A6

Preparing activity:
DLA - CC

(Project 3010-2006-002)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at http://assist.daps.dla.mil.