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PROCUREMENT SPECIFICATION

FOR

TITANIUM MAXIBOLT[®]

SHIFT WASHER TYPE

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1.0 SCOPE

- 1.1 This specification covers installation formed titanium fasteners which can be installed from only one side of an assembly.
- 1.2 Specification sheets: Fasteners furnished under this specification shall be per the requirements of the following specification sheets:

<u>Spec sheet</u>	<u>Head style</u>	<u>Shear strength</u>	<u>Sleeve material</u>	<u>Stem material</u>
CR7770S	100° Flush Tension Head	95 KSI	CP titanium	Beta C titanium
CR7771S	MS90354 Protruding Head	95 KSI	CP titanium	Beta C titanium
CR7773S	MS20470 Protruding Head	95 KSI	CP titanium	Beta C titanium
CR7774S	130° Flush Low Profile Head	95 KSI	CP titanium	Beta C titanium
CR7793S	MS20470 Protruding Head	95 KSI	CP titanium	Beta C titanium

2.0 APPLICABLE DOCUMENTS

2.1 Government documents

- 2.1.1 Specifications and standards: Unless otherwise specified, the following specifications and standards of the issue in effect at the time of solicitation form a part of this specification to the extent specified herein.

SPECIFICATIONS

Federal

PPP-H-1581 Hardware (Fasteners and Related Items), Packaging of

Military

MIL-T-9047 Titanium and Titanium Alloy Bars, Forgings and Forging Stock

MIL-STD-129 Marking for shipment and Storage

MIL-STD-889 Dissimilar Metals

(Copies of specifications, standards, drawings and publications required by manufacturers in connection with specific acquisition functions should be obtained from the procuring activity or as directed by the contracting officer.)

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2.2 Other publications: The following documents form a part of this specification to the extent specified herein.

American National Standards Institute:

ANSI B46.1 Surface Texture (Surface Roughness, Waviness and Lay)

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

(Copies of American National Standards may be obtained from the American National Standards Institute, 1430 Broadway, New York, New York 10018.)

Society of Automotive Engineers, Inc.:

AMS 5639 Bars, Forgings, Tubing and Rings - 19 Cr 10 Ni Sol. Heat Treated

AMS 5641 Bars and Forgings - 18.5 Cr 10 Ni, Free Machining; Swaging or Upsetting Sol. Heat Treated

AMS 5731 & 5732 Bars, Forgings, Tubing and Rings - 15 Cr 26 Ni 1.3 Mo

AMS 5737 Bars, Forgings and Tubing - 15 Cr 26 Ni 1.3 Mo 2.1 Ti

AMS2700 Passivation Treatments for Corrosion-Resisting Steel

Aerospace Industries Association:

NASM-1312 Fasteners, Test Methods

NASM-8975 Fastener, Blind, High Strength, Installation Formed, Cres, Heat Resistant Steel and Titanium, General Specification for

(Copies of Aerospace Material Specifications may be obtained from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.)

2.3 Order of precedence: In the event of a conflict between the text of the specification and the references cited herein, the text of this specification shall take precedence.

3.0 REQUIREMENTS

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

3.2 Product change: After each significant manufacturing design or process changes, qualification test shall be performed upon authorization by the activity responsible for qualification on material previously found satisfactory. Re-qualification tests may be waived on minor design or process changes provided substantiating test data is submitted indicating no change in performance characteristics and upon acceptance of such test data by the qualification activity.

3.3 Design and construction: The fastener shall be a multiple piece construction and furnished as an integral assembly. It shall consist of a bolt body, spindle and locking collar. It shall have a means, other than friction, of mechanically locking the spindle to the bolt body.

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- 3.3.1 Locking feature: The locking feature (locking collar) of the fastener shall be a secured component of the assembly. The fastener shall not disassemble during normal handling. Locking collars may be slotted. The slot width shall not be greater than 0.020 inch after assembly.
- 3.3.2 Dimensions: The fastener dimensions shall conform to the applicable specification sheet or standard.
- 3.3.3 Roundness and concentricity of heads: Fastener heads shall be round and concentric within the limits specified in Table I.
- 3.3.4 Blind head diameters: The blind head diameters shall be as specified in Table II.
- 3.3.5 Grip lengths: Grip lengths shall be in 1/16 inch increments. Mechanical property testing shall be performed within the 1/16 inch design grip range. Installation testing shall be conducted in max grip overlap condition.
- 3.3.6 Materials: Fasteners furnished under this specification shall be in accordance with the applicable specification sheet or standard.
- 3.3.6.1 Dissimilar materials: The use of dissimilar materials shall be in accordance with MIL-STD-889.
- 3.3.7 Passivation: All corrosion and heat resistant steel components shall be passivated in accordance with AMS2700.

3.4 Performance Characteristics

- 3.4.1 Installation: Installation shall be accomplished by the spindle being pulled into the sleeve, forming a blind head on the back side of the assembly, and removing the pulling portion of the spindle. A means of visual inspection for proper installation shall be provided (see 4.5.3).
- 3.4.2 Tensile strength and tensile preload: The ultimate tensile strength and tensile preload of the installed fastener shall be as specified in Table III (see 4.5.2).
- 3.4.2.1 Preload testing is applicable to the following sizes:
- 3.4.2.1.1 Flush head: -04-03 max, -05-03 max, -06-04 max, -08-05 max, -10-07 max, -12-09 max and longer.
- 3.4.2.1.2 Protruding head: -04-02 max, -05-02 max, -06-03 max, -08-04 max, -10-05 max, -12-06 max and longer.
- 3.4.3 Ultimate single shear strength: The ultimate single shear strength of the installed fastener shall be as specified in Table III (see 4.5.4) when tested in the specified grip condition.
- 3.4.4 Tension-tension fatigue: The fastener shall withstand an average of not less than 60,000 cycles, but no single specimen shall fail in less than 40,000 cycles. (see 4.5.5)
- 3.4.5 Spindle retention: The spindle of the installed fastener shall withstand a steadily applied axial push out load as specified in Table IV (see 4.5.5).

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3.5 Discontinuities and Surface Contamination

- 3.5.1 Seams and tool marks: Except as specified in 3.5.2 and 3.5.3, fasteners may possess seams and tool marks on any of the components of the fasteners. Seams and tool marks shall not be greater than the limits specified in Table V.
- 3.5.2 Fastener head: The fastener head shall not contain more than three imperfections (openings, seams, inclusions, nicks, gouges). The depth of the imperfection shall not be greater than the following:
- On the top of the head exceeding twice the depth limits shown in Table V.
 - On the periphery of the head exceeding four times the depth limits shown in Table V for protruding and flush head fasteners.
 - On the bearing surface of the head to depths exceeding the Table V values. Fastener surface shall not be mutilated so that firm seating is prevented.
- 3.5.3 Head shank junction: Longitudinal seams not greater than the limits of Table V are permitted in the head shank junction. Slight tool marks or undercuts of depth not greater than the limits specified in Table V are permitted provided they fair into the shank with no sharp scratches, gouges or corners.
- 3.5.4 For Titanium Beta C (38-6-44) material surface contamination refers to alpha case. It is usually continuous and shows a higher density of primary alpha on the surface as compared to the core. Fasteners shall be free of surface contamination except on non-bearing surface to 0.003" maximum.

4.0 QUALITY ASSURANCE PROVISIONS

- 4.1 Responsibility for inspection: Unless otherwise specified in the contract or purchase order, the fastener manufacturer is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the fastener manufacturer may use his own or any other facilities suitable for the performance of the inspection requirements specified herein.
- 4.2 Classification of inspections: The inspection requirements specified herein are classified as follows:
- Qualification inspection (see 4.3).
 - Quality conformance inspection (see 4.4).
- 4.3 Qualification inspection: Qualification inspection shall consist of the inspections in Table VI.
- 4.3.1 Sampling: Qualification test samples shall consist of fasteners of the diameter for which qualification is desired. The quantities shall be as indicated in Table VI. The fasteners shall have a grip length adequate to accommodate the test fixtures.
- 4.3.1.1 Qualification of the flush head configuration constitutes qualification of the equivalent protruding head configuration.
- 4.4 Quality conformance inspection: Quality conformance inspection shall be as specified in Table VII. Rivet Manufacturer shall retain MRB authority for minor defects (that do not affect fit, form or function) for parts procured under this specification.
- 4.4.1 Inspection lot: An assembly inspection lot shall consist of finished assembled components of the same configuration, diameter and heat of material. The inspection lot assemblies and their components shall have been manufactured under the same conditions, heat treated in the same manner in one continuous run and presented for delivery at the same time.

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4.4.2 Sampling: Samples shall be selected at random in accordance with ANSI/ASQC Z1.4, Inspection Level and Acceptance Quality Level (AQL) as specified in Table VII. Identical sample items may be used for any of the tests, provided selection of random samples is maintained and known characteristics of the sample are not used to influence the integrity of the test results. Reduced sampling level may be instituted after five consecutive lots have passed the acceptance criteria.

4.4.3 Manufacturer's inspection report: Each inspection lot shall be accompanied by a copy of the manufacturer's inspection report, signed by an authorized representative of the manufacturer. The report shall be retained by the manufacturer (for five years) and made available, upon request, to the purchaser. The report shall state that the fasteners are from an assembly lot which was manufactured and inspected in accordance with the requirements of this specification. The report shall identify the part number; assembly lot number and component lot numbers; and shall include the actual test results of each of the tests specified herein. In addition, the report shall contain information concerning the test procedures and instrumentation used in the quality conformance inspections.

4.4.4 Material certification: Mill certification on all materials shall be kept on file and available to the procuring activity.

4.5 Inspection methods:

4.5.1 Examination: Each of the sample fasteners, selected at random in accordance with Tables VI and VII shall be examined for conformance to the requirements for dimensions, concentricity, roundness, locking feature integrity, protective treatment and marking. These examinations shall be visual. Optical aids or special gages shall be used when necessary. All dimensions are considered defective when out of tolerance.

4.5.2 Ultimate tensile strength and tensile preload: Tensile strength tests and tensile preload tests shall be performed in accordance with NASM1312, Test 8 and 16 except load deflection curves are required for qualification tests only. Tensile strength tests are not applicable to fasteners having a grip length of less than twice the nominal diameter.
Conduct preload testing at band anneal only (see 3.4.2 for preload grips).

4.5.3 Installation: Fasteners shall be driven in overlap maximum grip $+0.002 -0.000$ in holes drilled within tolerances specified in Table VIII. Installed fasteners shall be visually examined for conformance to Figure I and Table II. The installed fasteners shall be visually inspected to establish that discontinuities of the blind head do not exceed the following limitations:

- Longitudinal discontinuities shall not be greater than three times the limits of Table V.
- Circumferential discontinuities shall not be greater than twice the limits of Table V.
- General folds shall not be greater than twice the limits of Table V.

4.5.4 Ultimate single shear strength: Ultimate single shear tests shall be performed within the specified grip range of the fasteners in accordance with NASM1312, Test 20. Shear test not applicable to fasteners having a nominal grip less than one diameter for protruding head type and one and one half diameter for flush head type. Fasteners subjected to this test shall meet minimum loads specified in Table III. The test need not be continued to destruction.

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4.5.5 Tension-tension fatigue: Tension-tension fatigue tests shall be conducted using a thimble type fixture in accordance with Figure 3. Hole diameters shall be within the limits specified in Table VIII. Fastener shall be tested in minimum grip $-.002/+0.000$ and in maximum grip $-.000/+0.002$. Setup in Fig 3 allows for visual inspection of blind head after driving. Fasteners in this test shall have the preload eliminated by removal of a low temperature melting washer (Parafilm 1/32 inch thick) from between the thimble and shim. Fatigue testing machine and test setup shall conform to NASM-1312-11

Test loading shall cycle between the minimum and maximum loads shown in table IV. The cycling speed shall not be greater than 3,600 cycles per minutes and test shall be performed at room temperature. Test shall not be conducted beyond 200,000 cycles.

4.5.6 Spindle retention: The spindle retention test shall be performed using test plates and fixtures in accordance with NASM1312, Test 8, as modified in Figure 2. The hole diameter shall be within limits specified in Table VIII. The load shall be steadily applied, at the rate shown in Table IX, to the top of the spindle from the top of the fastener. The lock shall withstand the minimum axial push out load values specified in Table IV. Caution shall be exercised to ensure that mandrel force is applied directly in line with the axis of the spindle. A means of accurately determining the force applied to the mandrel shall be provided. Fasteners having a grip length of less than one diameter shall be tested with a bushing support having a clearance of approximately 1/32 inch around the blind head.

4.6 Inspection of preparation for delivery: The sampling and inspection of the preservation-packaging, packing and container marking shall be in accordance with PPP-H-1581 and MIL-STD-129.

5.0 PACKAGING

5.1 Preservation: Preservation shall be level A or C as specified (see 6.2).

5.1.1 Level A: The fasteners shall be preserved and packaged in accordance with the applicable level A requirement of PPP-H-1581.

5.1.2 Level C: The fasteners shall be preserved and packaged in accordance with the supplier's standard practice.

5.2 Packing: Packing shall be level A, B, or C as specified (see 6.2).

5.2.1 Level A: The fasteners shall be packaged in accordance with the applicable level A requirements of PPP-H-1581.

5.2.2 Level B: The fasteners shall be packaged in accordance with the applicable level B requirements of PPP-H-1581.

5.2.3 Level C: The fasteners shall be packaged in a manner which will insure arrival at destination in satisfactory condition and be acceptable to the carrier at lowest rates. Containers and packing shall comply with Uniform Freight Classification rules, or with National Motor Freight Classification rules.

5.3 Marking: In addition to any special marking specified in the contract, marking shall be in accordance with MIL-STD-129.

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6.0 NOTES

6.1 Intended use: Fasteners covered by this specification are intended for structural attachments.

6.2 Ordering Data:

6.2.1 Acquisition requirements: Acquisition documents should specify the following:

- Title, number and date of this specification.
- Part number. (See applicable specification sheet).
- Selection of applicable levels of preservation and packing (see 5.1 and 5.2).
- Special marking (see 5.3).

Table I: Tolerances on Roundness and Concentricity of Heads

Nominal Diameter (inch)	Flush Heads (inch)	Protruding and Brazier Heads (inch)
1/8	.010	.015
5/32	.010	.015
3/16	.010	.015
1/4	.010	.020
5/16	.010	.020

Table II: Visual Inspection Tabulation

Nominal Diameter (inch)	Spindle Position "B" Max (inch) (see Fig 1)		Blind Head Diameter Min (inch)	Collar Position "A" Max (see Fig 1) (inch)
	Above Head	Below Head		
1/8	.010	.010	.185	.015
5/32	.010	.010	.235	.017
3/16	.010	.010	.275	.022
1/4	.015	.015	.350	.029
5/16	.020	.015	.410	.037

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 Table III: Mechanical Properties (Shear [Testing](#))

Nom. Dia	Single Shear Testing					
	Minimum Grip to Test			Minimum Blind Side	Reference Shear Strength Level	
(inch)	Protruding & Brazier Head Max	100° Flush Head Max	130° Flush Head Max	Sheet Thickness "t" (inch)	95 (KSI)	87 (KSI)
1/8 (-04)	-2	-3	n/a	.063.	1222	1120
5/32 (-05)	-3	-4	-4	.081	1980	1825
3/16 (-06)	-3	-5	-5	.099	2925	2690
1/4 (-08)	-4	-6	-6	.129	5005	4650
5/16 (-10)	-5	-7	TBD	.160	7220	6675

 Table IV: Minimum Mechanical Properties
(Tension-Tension Fatigue, Tensile Strength, Tensile Preload, Spindle [Retention](#))

Size (Diameter)		Grip to Test	TTF Loads (LBF)		For P/N CR7770, CR7771, CR7773, CR7793		For P/N CR7774		All Part Numbers
Inch	Dia. Code		High	Low	Tensile Strength LBF	Tensile Preload LBF	Tensile Strength LBF	Tensile Preload LBF	Spindle Retention LBF
1/8	-04	-04	N/A	N/A	600	60	--	--	250
5/32	-05	-05	405	41	900	180	900	162	575
3/16	-06	-06	630	63	1400	280	1400	252	845
1/4	-08	-08	945	95	2100	420	2100	378	1440
5/16	-10	-10	TBD	TBD	3100	620	2791	558	2080

 Table V: Limits for Surface Discontinuity and Tool Mark Depths, Type I

Nominal Diameter (inch)	Depth (inch)
5/16 and under	.005

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Table VI: Qualification Tests

Test	Requirement Paragraph	Method Paragraph	Sample Size Grip Condition		Sample Size	Recommended Grip	Number of Defectives Allowed
			Min.	Max			
Examination	3.3	4.5.1	---	---	10	2D	0
Installation	3.4.1	4.5.3	10	10	20	2D	0
Tensile Strength and Preload <u>1/</u>	3.4.2	4.5.2	5	5	10	2D	0
Shear Strength	3.4.3	4.5.4	---	---	3	2D	0
Tension-Tension Fatigue	3.4.4	4.5.5	3	3	6	2D	0
Spindle Retention	3.4.5	4.5.6	---	---	5	2D	0

1/ Tensile strength and tensile preload may be run on the same samples.

Table VII: Quality Conformance Tests

Test	Requirement Paragraph	Method Paragraph	Sample Size (MIL-STD-105)		Acceptance Limits
			Normal	Reduced	
Examination	3.3	4.5.1	S-3	S-2	4.0
Installation	3.4.1	4.5.3	S-3	S-2	4.0
Tensile Strength	3.4.2	4.5.2	S-2 <u>1/</u>	S-1	0
Shear Strength	3.4.3	4.5.4	S-2	S-1	0
Spindle Retention	3.4.5	4.5.6	S-2	S-1	0

1/ Test a full sample in each grip condition.

Table VIII: Hole Tolerances

Nominal Diameter (inch)	Hole Size (inch)
1/8	.129 - .132
5/32	.164 - .167
3/16	.199 - .202
1/4	.260 - .263
5/16	.312 - .315

Table IX: Loading Rates (lbs/minute $\pm$ 10%)

Nominal Diameter (inch)	Spindle Retention	Preload Rate (Paddle Method Only)
1/8	700	140
5/32	1150	230
3/16	1700	340
1/4	2900	580
5/16	4100	840

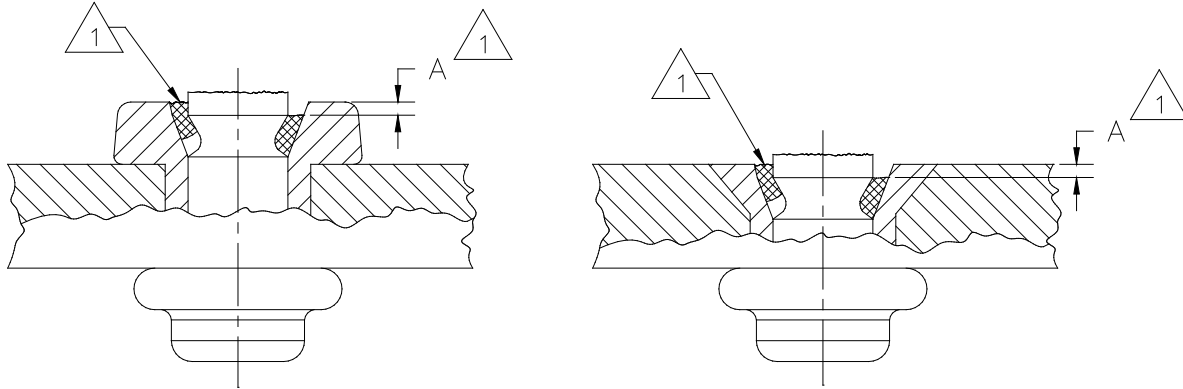
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INSPECTION OF LOCKING COLLAR POSITION



INSPECTION OF SPINDLE POSITION

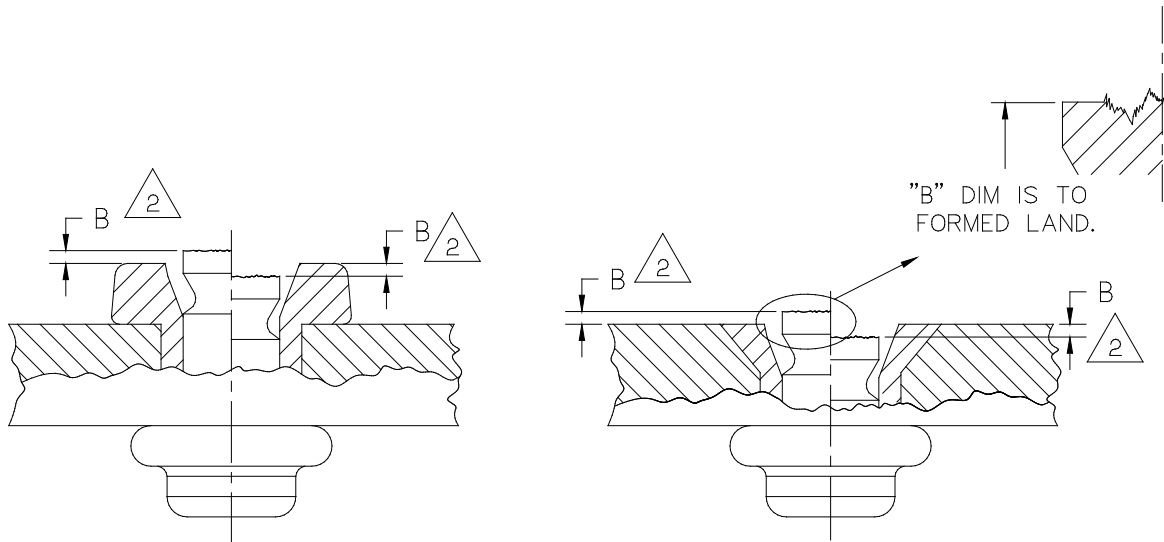


FIGURE 1 – Visual Inspection Illustration

NOTES:

1. The collar to be flush or below top of sleeve head and shall not protrude above the nominal pin fracture surface.
2. Maximum allowable distance above or below fastener head to land on the pin. Convex or concave fracture surface acceptable.

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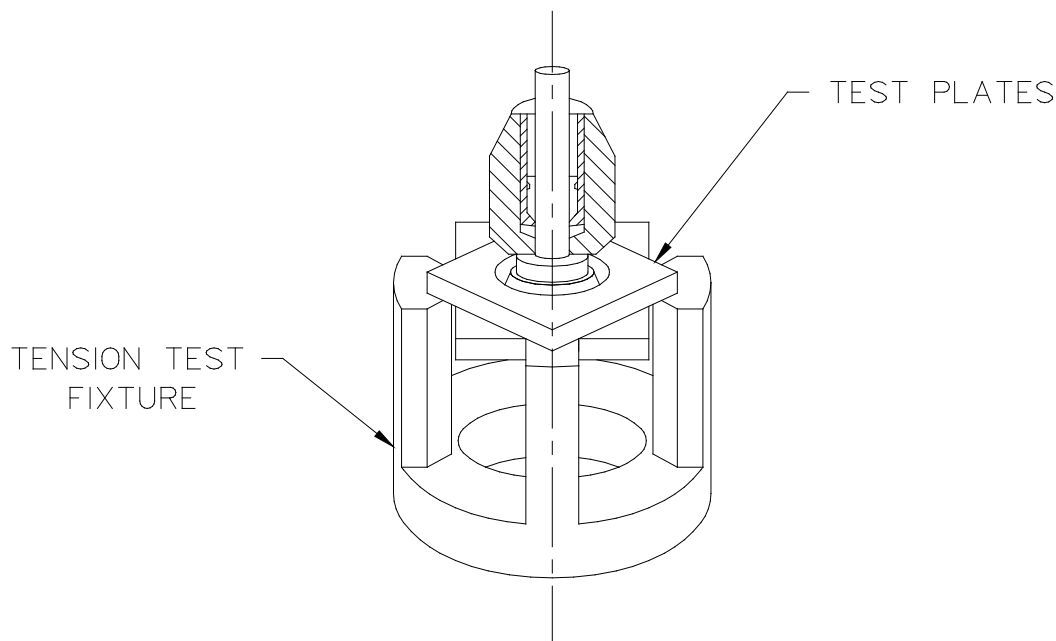


FIGURE 2 – Spindle retention test set-up

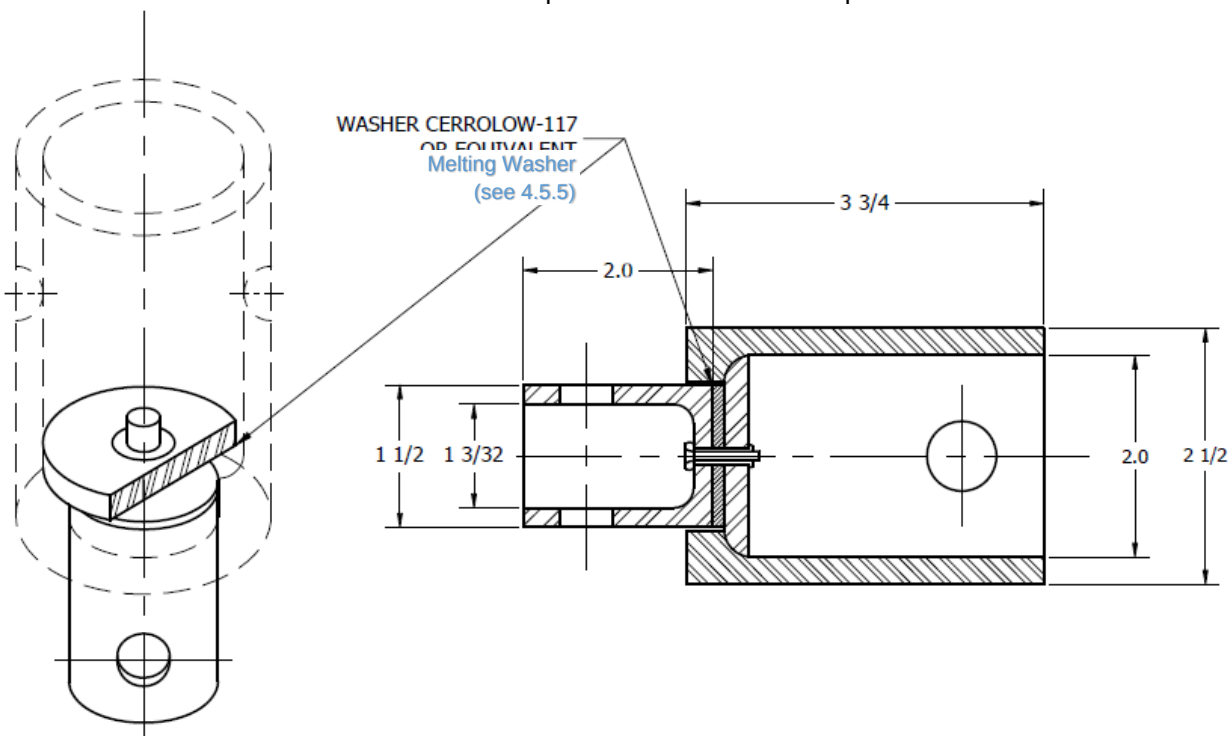


FIGURE 3 – Tension-Tension Fatigue Testing Set-Up

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