PROCUREMENT SPECIFICATION

CHERRYMAX® FASTENING SYSTEM

Self-Plugging, Flush Fracturing
Mechanically Locked Spindle, Bulbed Rivet
Nominal and 1/64" Oversize Series

APPROVED: ***Authorizing Signature is on FILE***
DIRECTOR OF PRODUCT ENGINEERING

CHERRYMAX® FASTENING SYSTEM

1.0 SCOPE

1.1 Purpose

This specification establishes the requirements for procurement of CherryMax®, self-plugging, mechanically locked spindle fasteners of the bulbed configuration capable of being installed with CherryMax® tooling or other power or hand riveters with sufficient force and suitable pulling heads. These rivets are intended for use in aircraft structure or similar applications, in thin and double dimpled as well as thick sheets. The rivets can be installed in assemblies where access to only one side of the work is available and also may be installed in non-blind applications to achieve installation cost savings and eliminate noise due to solid rivet bucking. The rivets, once installed, have a visible mechanical locking device, measurable for acceptance.

1.2 Styles, Classes and Types. Rivets shall be furnished in the following styles, classes, and types.

Style 'A' Nominal Shank Diameter	**Cherry Part No.**
Class 1 - Protruding Head Rivets (MS20470)	
Type B - 5056 Aluminum Alloy Sleeve-Alloy Steel Stem	CR3213
Type E - 5056 Aluminum Alloy Sleeve-CRES Stem	CR3223
Type M - Monel Sleeve-CRES Stem	CR3523
Class 2 - 100° Flush Head (MS20426)	
Type B - 5056 Aluminum Alloy Sleeve-Alloy Steel Stem	CR3212
Type E - 5056 Aluminum Alloy Sleeve-CRES Stem	CR3222
Type M - Monel Sleeve-CRES Stem	CR3522
Class 3 - 100° Reduced Flush Head (NAS1097)	
Type B - 5056 Aluminum Alloy Sleeve-Alloy Steel Stem	CR3214
Type E - 5056 Aluminum Alloy Sleeve-CRES Stem	CR3224
Type M - Monel Sleeve-CRES Stem	CR3524

Style 'B' 1/64" Oversize Shank Diameter	**Cherry Part No.**
Class 1 - Protruding Head Rivets (MS20470)	
Type B - 5056 Aluminum Alloy Sleeve-Alloy Steel Stem	CR3243
Type E - 5056 Aluminum Alloy Sleeve-CRES Stem	CR3253
Type M - Monel Sleeve - CRES Stem	CR3553
Type C - Inconel 600 Sleeve - Inconel X-750 Stem	CR3853
Class 2 - 100° Flush Head (MS20426)	
Type B - 5056 Aluminum Alloy Sleeve-Alloy Steel Stem	CR3242
Type E - 5056 Aluminum Alloy Sleeve-CRES Stem	CR3252
Type M - Monel Sleeve - CRES Stem	CR3552
Type C - Inconel 600 Sleeve - Inconel X-750 Stem	CR3852
Class 4 - Unisink Head	
Type B - 5056 Aluminum Alloy Sleeve-Alloy Steel Stem	CR3245
Type E - 5056 Aluminum Alloy Sleeve - CRES Stem	CR3255
Type M - Monel Sleeve-CRES Stem	CR3555
Class 5 - 120° Flush Head	
Type B - 5056 Aluminum Alloy Sleeve-Alloy Steel Stem	CR3246
Type M - Monel Sleeve-CRES Stem	CR3556

2.0 APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

2.1.1 Military Standards and Specifications

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-1312	Fastener, Test Methods
MIL-C-5541	Chemical Films and Chemical Film Materials for Aluminum and Aluminum Alloys
MIL-H-6088	Heat Treatment of Aluminum Alloys
MIL-H-6875	Heat Treatment of Steels (Aircraft Practice, Process for)
MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloy
MIL-R-7885	Rivets; Blind, Structural, Pull-Stem
MIL-C-83488	I.V.D. Aluminum Coating for Fasteners
MIL-R-85188	Riveters, Power, Pneumatic-Hydraulic
MIL-P-3982	Packing and Packing for Shipment and Storage of Hardware
MIL-P-3803	Plastic, Polyethylene, Molded and Extruded Shapes, Sheets and Tubing
MIL-L-10547	Liners: Case, Waterproof

2.1.2 Federal Standards and Specifications

No. 151	Federal Test Method
QQ-A-430	Aluminum Alloy Rod and Wire; For Rivets and Cold Heading
QQ-N-281	Nickel Copper Alloy (Monel and R-Monel) Bars, Plates, Rods, Sheets, Strips, Wire, Forgings and Structural and Special Shaped Sections
QQ-P-416	Plating, Cadmium (Electro-Deposited)

2.1.3 Industry Specifications

AMS 5665	Alloy Bars, Forgings and Rings, Corrosion and Heat Resistant
AMS 5731	Steel Bars, Forgings, Corrosion and Heat Resistant (A-286 CRES)
AMS 5657	Alloy Wire, Corrosion and Heat Resistant (15-7 PH CRES)
AMS 5732	Steel Bars, Forgings, Tubing and Rings, Corrosion and Heat Resistant
AMS 5737	Steel Bars, Forgings and Tubing, Corrosion and Heat Resistant
AMS 5698	Alloy Wire, Corrosion and Heat Resistant (INCO X750 CRES)
AMS 4911	Ti-6-4 Annealed Sheet
AMS 5687	Alloy Wire, Corrosion and Heat Resistant (INCO 600 CRES)
AMS 6322	Steel Bars, Forgings and Rings (8740 Alloy Steel)
ASTM E3	Standard Methods of Preparation of Metallographic Specimens

2.1.4 NAS Standards

NAS4006 Coating, Aluminum Pigmented, organically bonded

2.1.5 MS

MS33522 Rivets for blind attachment, limitations for design usage

3.0 REQUIREMENTS

3.1 Fasteners shall meet all engineering requirements of TABLE I.

3.2 Specification sheets and product drawings. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheets and product drawings. In the event of any conflict between requirements of this specifications and the applicable product drawing (or standards), the latter shall govern.

3.3 Design and Construction

3.3.1 Construction. The fasteners shall be a four-component assembly consisting of a tubular rivet sleeve, a spindle (stem) with an integral shear ring which forms the blind side head, a separate locking collar pre-locked into a locking groove on the stem and a disposable driving anvil to form the locking collar into the dimpled recess in the rivet sleeve during the installation cycle and to be visible dimensionally inspectable after installation.

3.3.2 Installation. The rivet shall be installed by mechanical means. Installation is to be accomplished by pulling the spindle into the rivet shank thereby forming the blind head and subsequently locking the spindle to the sleeve by deformation of the separate locking collar against the disposable driving anvil. The pulling portion of the spindle and the driving anvil shall be discarded after the installation operation.

3.3.3 Lubrication. Lubrication as necessary to assure proper function of the rivet is permissible. The lubricant used shall pass the lubricant tests as specified in Para. **4.5.8**. Lubricants used shall be stable and not subject to deterioration under recommended handling and storage conditions.

3.3.4 Workmanship. Rivets shall be of uniform quality and shall be finished in accordance with high-grade aircraft manufacturing practice. Discontinuities such as seams and clinch or die marks are permitted within the limits specified in TABLE II provided they do not affect other requirements of this specification.

3.3.5 Dimensions. Blind rivets shall conform dimensionally to the applicable drawings.

3.3.6 Concentricity of Heads. The blind rivet manufactured head shall be concentric with the shank within the limits specified in TABLE III when tested as specified in para. 4.4.

3.3.7 Protective Treatment. Protective treatment shall be as specified on the applicable drawings.

3.3.7.1 Cadmium Plating. Stems requiring cadmium plate shall be plated to the requirements of QQ-P-416 with the following exceptions:

3.3.7.1.1 8740 Alloy Steel and 15-7 CRES stems shall be baked at 375° ±25°F (191° C ±14°C) for a minimum of four (4) hours, starting within three (3) hours after plating.

3.3.7.1.2 Stress durability testing will not be required.

3.3.8 Lubricant. A lubricant may be used on any component to improve installation, provided the lubricant is not detrimental to the corrosion resisting properties of the rivet. The lubricant used shall be subjected to and pass the lubricant test (see 4.5.8). Lubricants used shall be stable and shall not deteriorate under recommended handling and storage conditions.

3.3.9 Heat Treatment. Heat treatment of all aluminum alloys shall be in accordance with MIL-H-6088. Monel and CRES materials shall be in accordance with MIL-H-6875. Deviations that are necessary to manufacture rivets shall be noted in detail and shall accompany the rivets for qualification inspection.

3.3.10 Installation Flushness. The installed spindle (see Figure 1) shall be flush with the top surface of the rivet head and within the limits "A" and "B" shown in TABLE VIII when tested as specified in 4.5.7. The locking feature (see Figure 1) shall not protrude above the "A" limit of TABLE VIII.

3.3.11 Acceptable Blind Head Formations. The installed blind rivet may show formations as shown in Figure 2.

3.3.12 Identification of Product. The rivets shall have the driving anvils identified by color code, to distinguish between Style A and Style B, in accordance with the applicable drawings. Appropriate head markings pertaining to Style, Type and Class shall be per TABLE XII.

3.4 Mechanical Properties

3.4.1 Shear Strength. The ultimate single shear strength of the rivets shall be not less than the value specified in TABLE IV, when tested as specified in 4.5.1.

3.4.2 Tensile Strength. The ultimate tensile strength of the rivet shall be not less than the value specified in TABLE V, when tested as specified in 4.5.2.

3.4.3 Tensile Strength in Thin Sheet. The rivet shall meet the minimum pull through strength specified in TABLE VI, when tested as specified in 4.5.3. This requirement is not applicable to rivets shorter than -4 grip.

3.4.4 Spindle Retention. The rivet spindle shall withstand the steadily applied axial minimum push-out load specified in TABLE VII, when tested as specified in 4.5.5.

3.4.5 Shank Expansion. The rivet shall be capable of passing the expansion test specified in 4.5.6.

3.4.6 Fatigue Strength. The rivet shall be capable of passing the fatigue test specified in 4.5.4.

3.4.7 Installation. Installed rivets in minimum and maximum grip test plates (see Figure 9) shall be in accordance with 4.5.7.

4.0 QUALITY ASSURANCE PROVISION

4.1 Classification of Tests. The inspection and testing of blind rivets shall be classified as follows:

(A) Qualification Tests (See 4.2).
(B) Acceptance Tests (See 4.3).

4.2 Qualification Testing

4.2.1 Sampling Instructions. Qualification test samples shall be selected in accordance with TABLE X. Qualification test samples shall be accompanied by the manufacturer's test results, or the results of tests conducted by an approved independent test laboratory, of the tests listed herein. Samples shall be identified as required and forwarded to the activity responsible for qualification. Samples shall be packaged in accordance with the requirements of Section 5.0 and plainly identified by securely attached labels or tags marked with the following information:

Sample for Qualification Test
Rivets, Blind, Self-Plugging, Mechanically Locked Spindle Bulbed
Type: (Material)
Class: (Flush or protruding head)
Grip Length:
Diameter:
Manufactured by: (Name and symbol)
Submitted by: (Name)
Lubricant Coating: (Manufacturer's Designation)

4.2.2 Tests. The qualification tests of blind rivets shall consist of all the tests of this specification as specified in TABLE X. After each significant manufacturing design or process change, qualification tests shall be performed upon authorization of the activity responsible for qualification, on materials previously found satisfactory and at other times as may be specified. Requalification 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. Qualification testing of one class of rivets shall not qualify the other class of rivets, except for thin sheet pull-thru.

4.3 Acceptance Tests. Lot acceptance tests consist of all tests specified in TABLE I other than those specified as qualification only. Rivet manufacturer shall use sufficient in-process controls and/or inspection of product to assure conformance to all requirements of this specification. Rivet manufacturer shall retain MRB authority for minor defects (do not affect fit, form or function) for parts procured under this specification.

4.3.1 Lot. A lot shall consist of finished blind rivets which are of the same type, class, grip and diameter, fabricated by the same process, heat treated in the same manner and produced as one continuous run or order, or part thereof.

4.3.1.1 A lot of component members of blind rivets (such as sleeves or stems) shall consist of those components which are of the same type, class, grip and diameter, fabricated by the same processes, heat treated in the same manner and produced as one continuous run or order or part thereof. Dimensional inspection already performed on component members need not be repeated after assembly of finished blind rivets submitted as an inspection lot.

4.3.2 Responsibility of Tests. Cherry Aerospace LLC shall be responsible for accomplishing the required tests. Cherry Aerospace LLC shall maintain a record available to the inspector or customer of the quantitative results of all tests required by the specification.

4.3.3 Examination. Each of the sample rivets selected at random in accordance with TABLE XI shall be examined for conformance to the requirements for dimensions, locking feature integrity, protective treatment and marking. These examinations shall be accomplished visually. Optical aids and special gages are permissible to ensure compliance with this specification.

4.4 Concentricity of Head

4.4.1 Class 1 and Class 4 Protruding Head Rivets. Concentricity of protruding head blind rivets shall be determined by observing the total variation of a dial indicator in contact with the periphery of the head as the rivet is rotated along the axis of the shank. (See TABLE III)

4.4.2 Class 2, Class 3 and Class 5 Flush Head Rivets. Concentricity of flush head rivets shall be determined by observing the total variation of a dial indicator testing the conical surface of the head (adjacent to the top of the rivet), as the rivet is rotated along the axis of the shank (See TABLE III).

4.5 Mechanical Testing

4.5.1 Shear Strength. Test rivets shall be installed in a fixture as shown in Figure 3. Specimens shall be tested at the maximum grip of the particular rivet under test. The actual tests of the specimens shall be in accordance with the methods specified in MIL-STD-1312-4. The tests need not be carried to destruction if the test specimens meet the rated strengths specified in TABLE IV without failure. MIL-STD-1312-20 can be used as an alternate test method with blade thickness equivalent to 1/2 the maximum grip of the rivet being tested. Test speed (load rate) per NAS 1740 is acceptable as an option.

4.5.2 Tensile Strength. Tensile strength of riveted specimens shall be tested in the rivets maximum grip in a fixture as shown in Figure 4. Rivet grip lengths that will not accommodate the minimum sheet thickness specified in the table of Figure 4 need not be tested. Tests shall be in accordance with methods specified in MIL-STD-1312-8. Test speed (load rate) per NAS 1740 is acceptable as an option.

4.5.3 Thin Sheet Pull-Thru (Qualification Only). The resistance to pull-thru of the blind side head shall be determined using the specimen shown in Figure 5. Test method procedure shall be per MIL-STD-1312-8. Unless otherwise specified, tests shall be conducted such that the blind head bears against the thin sheet. Rivets shall meet the appropriate requirement in pounds of TABLE IV prior to pull-thru of the blind head or rivet failure. Fasteners to be tested in prescribed maximum grip.

4.5.4 Fatigue Strength (Qualification Only). Fatigue strength shall be determined by the full load transfer method per MIL-STD-1312-21. Minimum load shall be 10% of maximum load as indicated in TABLE IX. Minimum life requirement at the loads listed in TABLE IX shall be $3X10^6$ cycles. If no failure after $3X10^6$ cycles, tests may be discontinued.

4.5.5 Spindle Retention Test. A full sample of the rivet test specimens shall be tested in a minimum specified grip thickness (except that rivets with minimum grip length equal to or less than their diameters shall be installed in a test plate of maximum specified grip thickness). The installed specimens shall be completely and properly locked. An additional full sample shall be in the uninstalled condition. In determining the spindle retention loads, a test device similar to that shown in Figure 7 shall be used. The load shall be applied at a maximum rate of .05 inch per minute to the spindle from the manufactured head of the rivet. The loads required to push out the spindles of the installed rivets shall be equal to or greater than those in TABLE VII, Column A. Also, the loads required to push out the spindles of the uninstalled rivets shall be equal to or greater than those in TABLE VII, Column B. A means for accurately determining the force applied to the rivet spindle shall be provided. The push out load shall be applied directly in line with the axis of the rivet spindle.

4.5.6 Shank Expansion (Qualification Only). The test rivet shall be installed in 7075-T6 (UNS A90705) coupon and steel split plate fixture in total grips equal to the nominal diameter of the rivet being tested. Headside coupon thickness and hole size, and split plate thickness and hole size shall be as shown in Figure 8. Insert the rivet into the headside coupon. The shank diameter shall be measured at the faying surface and recorded. Install the rivet as previously described. After installation, the plates shall be separated from one another and from the rivet, leaving the rivet and headside coupon together. The shank diameter of the installed rivet shall be measured at the faying surface of the split plate and the solid head side aluminum coupon.

The difference between the two recorded measurements shall be a minimum of .002 inch. Rivets with grip lengths greater than their diameter are not required to meet the shank expansion requirements.

4.5.7 Installation. Test rivets shall be installed in test plates as shown in Figure 9. Holes shall be in accordance with Figure 9. One half of the rivets shall be tested at minimum grip and other half at the rivet's maximum grip. After installation, the fastener shall be inspected for defects such as deformed heads, split sleeves, locking feature protrusion or spindle flushness outside the limits of Figure 1, TABLE VIII.

4.5.8 Suitability of Lubricant Coatings. Lubricant coated and unlubricated "scratch specimens" made of the same materials as the finished rivet sleeves and having the same protective or other surface finish (if any) shall be scratched through to the basic metal. Specimens may be of any convenient size and shape but the total surface area of each shall exceed six square inches. These specimens shall be subjected to a 96-hour salt spray test in accordance with Method 811 of Federal Test Method Standard 151. After exposure, no significant increase in corrosions shall be found when a comparison is made between lubricated and unlubricated panels.

5.0 PREPARATION FOR DELIVERY

5.1 Inspection of Preparation for Delivery. Preparation, packing and marking shall be inspected to determine conformance to Section 5.

5.2 Packaging.

5.2.1 Preservation. Preservation shall be level A or C as specified in the contract or order.

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

5.2.1.2 Level C. The rivets shall be preserved and packaged in accordance with the supplier's standard practice.

5.2.2 Packing. Packing shall be Level A or Level C as specified in the contract or order.

5.2.2.1 Level A. The rivets shall be packed in accordance with the applicable level A requirements of PPP-H-1581.

5.2.2.2 Level C. The rivets shall be packed in a manner which will ensure 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.

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

TABLE I

CHARACTERISTICS	ENGINEERING REQUIREMENTS	INSPECTION REQUIREMENTS	
		TEST METHOD	SAMPLING
IDENTIFICATION	Per applicable rivet drawing and **TABLE XII** for appropriate head markings.	Visual examination and depth or height measurement. Depth of marking to be measured from undisturbed surface	MIL-STD-105 Level S-3 AQL 1.0
MATERIALS	Per applicable product drawing	Per material specification	
DIMENSIONS	Per applicable product drawing.	Conventional measuring methods.	MIL-STD-105 Level S-3 AQL 4.0
DISCONTINUITIES	Rivets shall meet the dimension requirements of TABLE II.	Microscopic examination per ASTM E3	MIL-STD-105 Level S-1 Zero (Defective)
CONCENTRICITY	Rivet head shall be concentric with the shank within the limits specified in TABLE III.	Test per Paragraph 4.4	MIL-STD-105 Level S-1 AQL 4.0
SHEAR STRENGTH	Rivets shall meet minimum single shear strengths per TABLE IV.	Test per Paragraph 4.5.1	MIL-STD-105 Level S-1 Zero (Defective)
TENSION STRENGTH	Rivets shall meet minimum tensile strength in steel coupons per TABLE V.	Test per Paragraph 4.5.2	MIL-STD-105 Level S-1 Zero (Defective)
THIN SHEET PULL-THRU	Rivets shall meet minimum pull-thru values of TABLE VI.	Test per Paragraph 4.5.3	Per TABLE XI Qualification Only
FATIGUE	Rivets shall withstand a minimum of 3x10^6 cycles when tested per Paragraph 4.5.4 and TABLE X.	Joint Shear fatigue test. Method per MIL-STD-1312-21. Per Paragraph 4.5.4	Per TABLE X Qualification Only
SPINDLE RETENTION	Rivets shall develop minimum loads of TABLE VII.	Test per Paragraph 4.5.5.	MIL-STD-105 Level S-1 Zero (Defective)
SPINDLE & COLLAR FLUSHNESS	Installed rivets shall meet the spindle and collar flushness limits specified in Paragraph 3.3.10 and TABLE VIII.	Conventional measuring methods.	MIL-STD-105 Level S-3 AQL 2.5
SHANK EXPANSION	Installed rivets shall exhibit shank expansion characteristics required per Paragraph 4.5.6	Test per paragraph 4.5.6	Per TABLE XI Qualification Only
INSTALLATION	Installed rivets in the min. and max. grip test plates shall not have splits in excess of 5% of the total number tested.	Test per Paragraph 4.5.7	MIL-STD-105 Level S-3 AQL 2.5
HEAT TREATMENT	15-7PH CRES per MIL-H-6875 Aluminum Alloy per MIL-H-6088 Inconel per MIL-H-6875 Monel per MIL-H-6875 Alloy steel per MIL-H-6875	Tests of Mechanical properties to verify heat treatment.	As Required.
PACKAGING	Unit packages to be sealed in plastic bags to protect against lubricant degradation.	Visual examination.	MIL-STD-105 Level S-3 AQL 1.0
MARKING	Unit packages to be labeled with part number, grip range, hole size, lot number and manufacturer's identification	Visual examination.	MIL-STD-105 Level S-3 AQL 1.0

TABLE II

Discontinuity Limits	
Location	Maximum Depth of Discontinuity (Inch)
Shank	0.005
Periphery of Head	0.020
Other Surfaces	0.010

TABLE III

Tolerances on Concentricity of Head		
	Total Variation in Indicator Reading on Rivet Head (Max.)	
Rivet Diameter	Flush Head (Inch)	Protruding Head (Inch)
1/8 (-4)	0.010	0.010
5/32 (-5)	0.010	0.015
3/16 (-6)	0.010	0.015
1/4 (-8)	0.010	0.020

TABLE IV

Rivet Diameter	Grip (1)	Single Shear Strength / Minimum Shear Strength (lbs.)									
		CR3212 CR3222 CR3214 CR3224	CR3213 CR3223	CR3242 CR3252 CR3246	CR3243 CR3253 CR3245 CR3255	CR3522 CR3524	CR3523	CR3552 CR3556	CR3553 CR3555	CR3852	CR3853
1/8 (-4)	-2	411	505	480	592	486	651	574	751	816	921
	-3	531	584	614	692	660	846	784	968	1010	1115
	-4	651	655	741	771	836	995	994	1185	1160	1220
	-5	664	664	814	814	995	995	1205	1220	1220	1220
	-6	664	664	814	814	995	995	1220	1220	1220	1220
5/32 (-5)	-2	(2)	699	(2)	805	(2)	888	(2)	1020	(2)	1285
	-3	714	840	815	982	863	1130	1010	1285	1375	1545
	-4	862	929	977	1080	1080	1375	1270	1555	1605	1745
	-5	1010	1020	1135	1175	1300	1545	1530	1820	1775	1865
	-6	1030	1030	1245	1245	1525	1545	1800	1865	1865	1865
	-7	1030	1030	1245	1245	1545	1545	1865	1865	1865	1865
3/16 (-6)	-2	(2)	920	(2)	1015	(2)	1145	(2)	1255	(2)	1625
	-3	918	1130	1005	1240	1030	1450	1220	1585	1720	1945
	-4	1095	1250	1200	1385	1290	1740	1520	1900	1990	2250
	-5	1310	1355	1390	1505	1550	2030	1825	2210	2260	2420
	-6	1455	1460	1580	1615	1820	2215	2135	2525	2435	2525
	-7	1480	1480	1685	1685	2080	2215	2440	2525	2525	2525
	-8	1480	1480	1685	1685	2215	2215	2525	2525	2525	2525
1/4 (-8)	-3	(2)	1725	(2)	1880	(2)	2170	(2)	2360	(2)	2985
	-4	1620	2000	1775	2175	1820	2560	2135	2770	2995	3390
	-5	1860	2165	2020	2365	2165	2950	2530	3180	3360	3795
	-6	2100	2305	2270	2520	2525	3350	2945	3610	3735	4085
	-7	2340	2450	2520	2675	2870	3740	3340	4015	4055	4300
	-8	2615	2615	2765	2825	3215	3920	3745	4390	4390	4390
	-9	2615	2615	2925	2925	3565	3920	4140	4390	4390	4390
	-10	2615	2615	2925	2925	3920	3920	4390	4390	4390	4390
Reference Shear Strength Level	-----	50 KSI	50 KSI	50 KSI	50 KSI	75 KSI	75 KSI	75 KSI	75 KSI	75 KSI	75 KSI

(1) For rivet grips greater than those listed, use highest value shown for the diameter, class and type.
(2) Parts too short to be tested.

TABLE V

MINIMUM TENSILE STRENGTH VALUES (LBS)							
Rivet Diameter	CR3214 CR3224	CR3212 CR3213 CR3222 CR3223	CR3242 CR3243 CR3245 CR3246 CR3252 CR3253 CR3255	CR3522 CR3523	CR3552 CR3553 CR3555 CR3556	CR3852 CR3853	CR3524
1/8 (-4)	250	285	345	400	490	570	360
5/32 (-5)	390	445	530	635	740	860	555
3/16 (-6)	560	635	710	890	1000	1160	800
1/4 (-8)	1000	1125	1260	1570	1755	2030	1410

NOTE: 4-1, 5-1, 5-2, 6-1 AND 6-2 rivets are too short to test.

TABLE VI

MINIMUM THIN SHEET PULL THRU LOADS (lbs.)						
Rivet Diameter	2024-T3 Aluminum Sheet Types B, E			6Al-4V Ti Sheet Type M, C		
	Thickness	Load		Thickness	Load	
		NOM	OS		NOM	OS
1/8 (-4)	.025	160	180	.020	250	280
5/32(-5)	.032	220	260	.025	360	430
3/16(-6)	.040	315	375	.032	570	680
1/4(-8)	.050	400	480	.040	1000	1060

TABLE VII

SPINDLE RETENTION LOAD			
Rivet Diameter	Column A Minimum Axial Push-Out (lbs.) Installed Condition		Column B Minimum Axial Push-Out (lbs.) Uninstalled Condition
	Types B & E	Types M & C	All Types
1/8 (-4)	125	150	10
5/32 (-5)	200	250	10
3/16 (-6)	290	450	10
1/4 (-8)	380	750	10

TABLE VIII

Spindle Flushness Limits (Inch) All Types, Styles & Classes		
Rivet Diameter	A Max. (Above)	B Max. (Below)
1/8 (-4)	0.010	0.015
5/32 (-5)	0.010	0.020
3/16 (-6)	0.010	0.020
1/4 (-8)	0.015	0.025

NOTE: 1) Collar (locking element) to be flush with top surface of rivet head within ±005. Slight collar flash permissible .010 Max. from top of rivet head, provided the flash is not so sharp and/or rigid as to be a safety concern.

TABLE IX

FATIGUE TEST LOAD (lbs.)						
Rivet Diameter	Rivet Grip Dash No.	Style A Hole Size	Style B Hole Size	Sheet Thickness "T" (Inches)	Maximum Load Per Specimen (lbs.)	
		±.0005	± .0005	± .002	B, & E	M & C
1/8 (-4)	-2	.130	.144	.063	440	610
5/32 (-5)	-3	.162	.178	.080	700	970
3/16 (-6)	-3	.194	.207	.090	945	1310
1/4 (-8)	-4	.259	.273	.125	1190	1650

TABLE X

QUALIFICATION TESTS

TEST	REQUIREMENT PARAGRAPH	METHOD PARAGRAPH	NUMBER OF SAMPLES	NUMBER OF DEFECTS ALLOWED
Examination	3.3.1, 3.3.2, 3.3.5, 3.3.6, 3.3.7	4.3.3, 4.4.1, 4.4.2	All Qualification Samples	0
Shear Strength	3.4.1	4.5.1	5 pieces each lot submitted	0
Tensile Strength	3.4.2	4.5.2	5 pieces each dia. and class submitted	0
Tensile Strength in Thin Sheet	3.4.3	4.5.3	3 pieces each lot submitted	0
Spindle Retention	3.4.4	4.5.5	6 pieces each lot submitted	0
Fatigue Strength	3.4.6	4.5.4	3 Fatigue Specimens each dia. and class submitted	0
Installation	3.4.7	4.5.7	20 pieces each lot submitted	1/Lot ②
Shank Expansion	3.4.5	4.5.6	3 Class 1 pieces each lot submitted	0

NOTES:

1) Grip lengths and diameters to be tested will be specified by the activity requesting qualification. Unless otherwise specified, number of grip lengths to be tested shall be three (3) of one diameter and two (2) of each additional diameter.
②Failure rate (unacceptable spindle flushness) greater than 5%, or any splits shall be cause for rejection during qualification testing.

TABLE XI

QUALITY CONFORMANCE TESTS

TEST	REQUIREMENT PARAGRAPH	METHOD PARAGRAPH	SAMPLE (MIL-STD-105)	ACCEPTANCE LIMITS (%AQL)
Examination	3.3.1, 3.3.4, 3.3.5, 3.3.6, 3.3.7	4.3.3	S-3	4.0
Installation a) Split Sleeve b) Spindle Protrusion	3.3.2, 3.3.10	4.5.7	S-3	4.0
Shear Strength	3.4.1	4.5.1	S-1	0 defective
Tensile Strength	3.4.2	4.5.2	S-1	0 defective
Spindle Retention	3.4.4	4.5.5	S-1	0 defective

Sampling:

Samples shall be selected at random, in accordance with MIL-STD-105, Inspection Level and Acceptance Quality Level (AQL), as specified in TABLE I and TABLE XI. Identical sample items may be used for any of the tests, provided selection of random samples is maintained and known characteristics of the samples are not used to influence the integrity of the test results.

CherryMax® Head Markings

TABLE XII

Part No.	Head Style	Rivet Material	Stem Material	Rivet Diameter	Head Markings
CR 3212 Nominal	MS20426 CSK.	5056	8740	ALL	
CR 3213 Nominal	MS20470 UNIV.	5056	8740	ALL	
CR 3222 Nominal	MS20426 CSK.	5056	15–7	ALL	
CR 3223 Nominal	MS20470 UNIV.	5056	15–7	ALL	
CR 3522 Nominal	MS20426 CSK.	MONEL			
CR 3523 Nominal	MS20470 UNIV.	MONEL	15–7	ALL	
CR 3242 Oversize	MS20426 CSK.	5056	8740	ALL	
CR 3243 Oversize	MS20470 UNIV.	5056	8740	ALL	
CR 3252 Oversize	MS20426 CSK.	5056	8740	ALL	
CR3253 Oversize	MS20470 UNIV.	5056	15–7	ALL	
CR 3552 Oversize	MS20426 CSK.	MONEL	15–7	ALL	
CR 3553 Oversize	MS20470 UNIV.	MONEL	15–7	ALL	
CR 3214 Nominal	NAS1097 CSK.	5056	8740	-4 & -5	
CR 3214 Nominal	NAS1097 CSK.	5056	8740	-6 & -8	
CR 3224 Nominal	NAS1097 CSK.	5056	15–7	-4 & -5	
CR 3224 Nominal	NAS1097 CSK.	5056	15–7	-6 & -8	
CR 3524 Nominal	NAS1097 CSK.	MONEL	15–7	-4 & -5	
CR 3524 Nominal	NAS1097 CSK.	MONEL	15–7	-6 & -8	
CR 3245 Oversize	UNISINK	5056	8740	ALL	
CR 3255 Oversize	UNISINK	5056	15–7	ALL	
CR 3555 Oversize	UNISINK	MONEL	15–7	ALL	
CR 3852 Oversize	MS20426 CSK.	INCO	INCO	ALL	
CR 3853 Oversize	MS20470 UNIV.	INCO	INCO	ALL	
CR 3246 Oversize	120 CSK.	5056	8740	ALL	
CR 3556 Oversize	120 CSK.	MONEL	15–7	ALL	

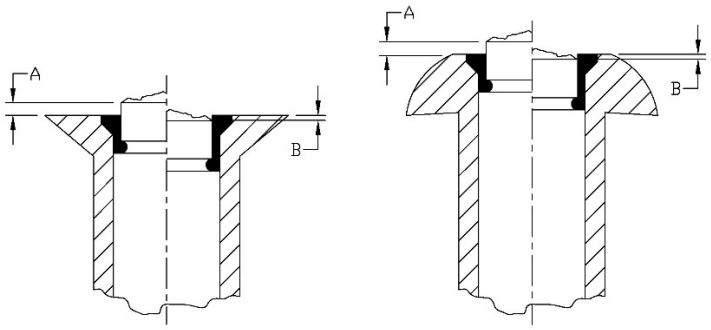

Figure 1

INSTALLED SPINDLE AND COLLAR FLUSHNESS

NOTE: Locking element shall be flush with top surface of rivet head within ±.005. Slight element flash permissible .010 maximum from top of rivet head.

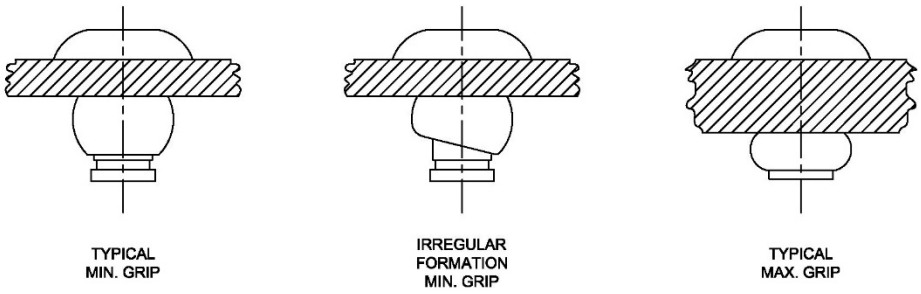

Figure 2

ACCEPTABLE BLIND HEAD FORMATION

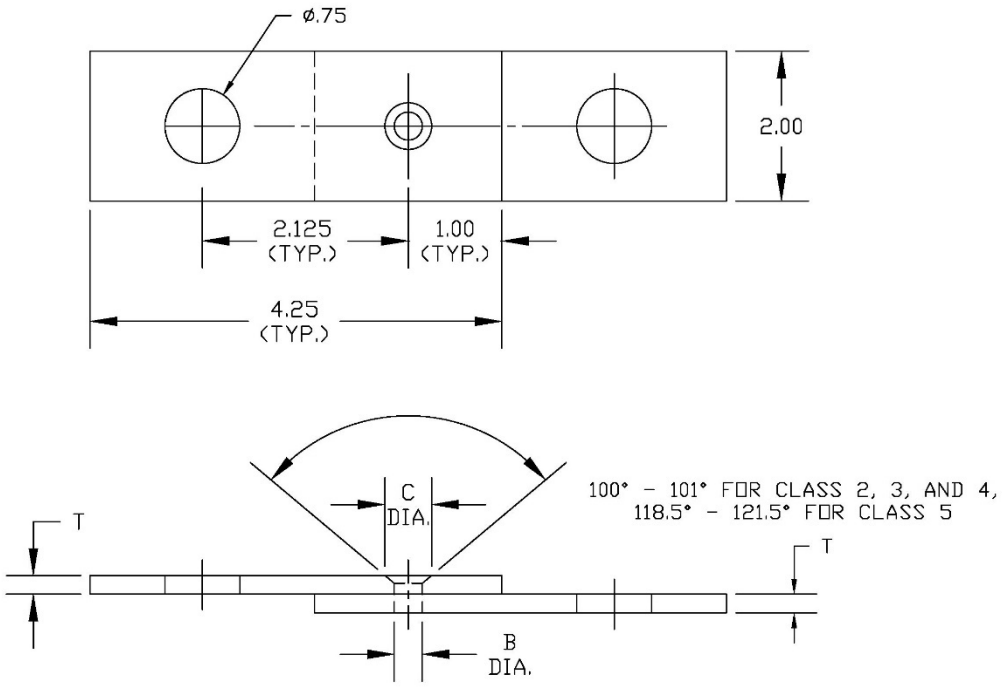

Figure 3

TYPE	CLASS	(-4) 1/8" Diameter		(-5) 5/32 Diameter		(-6) 3/16" Diameter		(-8) 1/4" Diameter	
		B ±0005	C ±003	B ±0005	C ±.003	B ±0005	C ±003	B ±0005	C ±.003
Type A	Class 1	0.130	---	0.162	---	0.194	---	0.258	---
	Class 2	0.130	0.225	0.162	0.286	0.194	0.353	0.258	0.476
	Class 3	0.130	0.192	0.162	0.243	0.194	0.299	0.258	0.392
Type B	Class 1	0.144	---	0.178	---	0.207	---	0.273	---
	Class 2	0.144	0.225	0.178	0.286	0.207	0.353	0.273	0.476
	Class 4	0.144	0.170	0.178	0.213	0.207	0.255	---	---
	Class 5	0.144	0.272	0.178	0.314	0.207	0.350	---	---

SHEAR STRENGTH TEST SPECIMEN

NOTES:
1) Holes to be square with both faces.
2) Countersink and cylindrical holes to be concentric.
3) Material: Alloy Steel Rc46 Min.
4) All dimensions in inches.
5) "T" Thickness shall be 1/2 the maximum grip of the rivet being tested.
6) Coupon dimensions not affecting test results are optional.

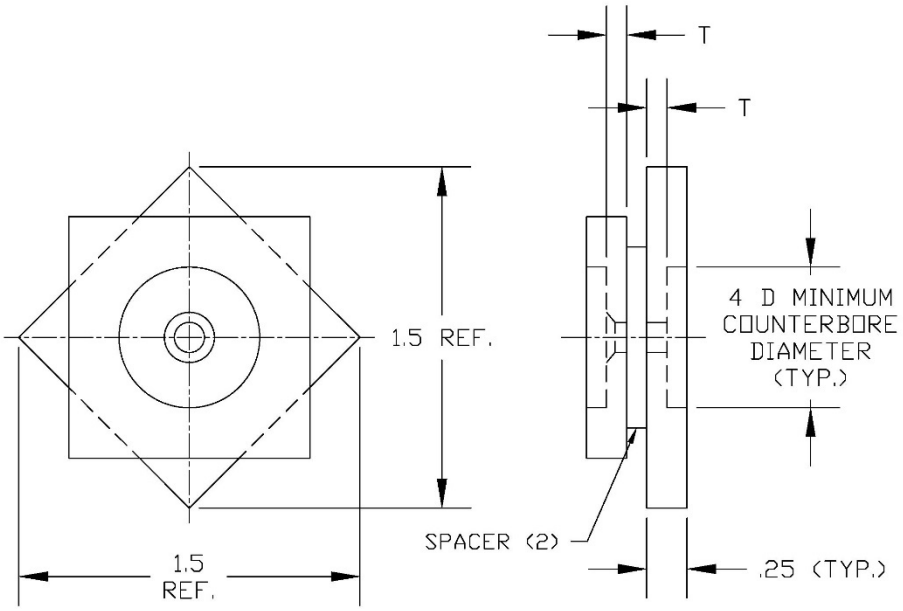

Figure 4

RIVET DIAMETER	"T" DIMENSION MINIMUM
1/8 (-4)	.063
5/32 (-5)	.078
3/16 (-6)	.094
1/4 (-8)	.125

TENSION SPECIMEN

NOTES:
1) Material: Alloy Steel Rc46 Min.
2) Hole preparation per Figure 3.
3) Spacer thickness as necessary to obtain maximum grip for rivet tested.
4) Dimension in inches.
5) Coupon dimensions not affecting test results are optional.

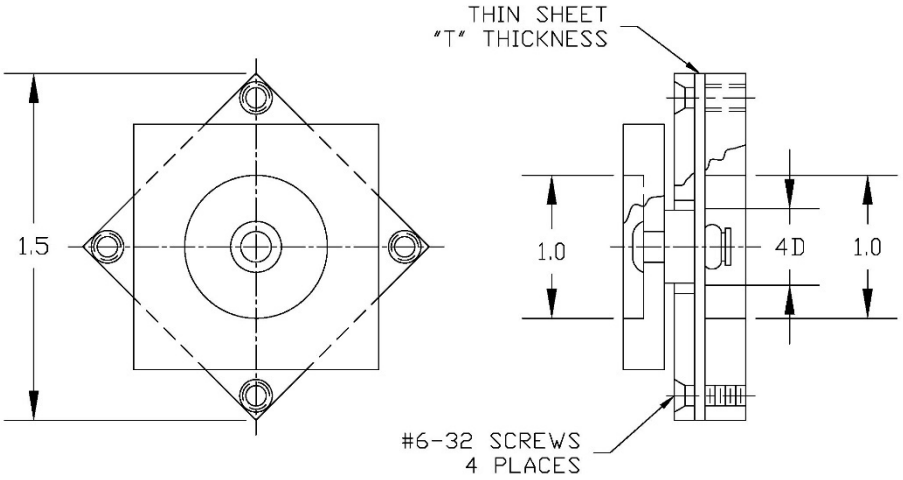

Figure 5

THIN SHEET PULL-THRU SPECIMEN

NOTES:

1) Material: Type B & E Rivets=2024-T3 Clad Aluminum.
   Type M & C Rivets=6Al-4V Titanium.
2) Hole Preparation - See Figure 3.
3) "T" Thickness (See TABLE VI) Selected to produce blind head "pull thru".
4) Dimensions in Inches.
5) Coupon dimensions not affecting test results are optional.

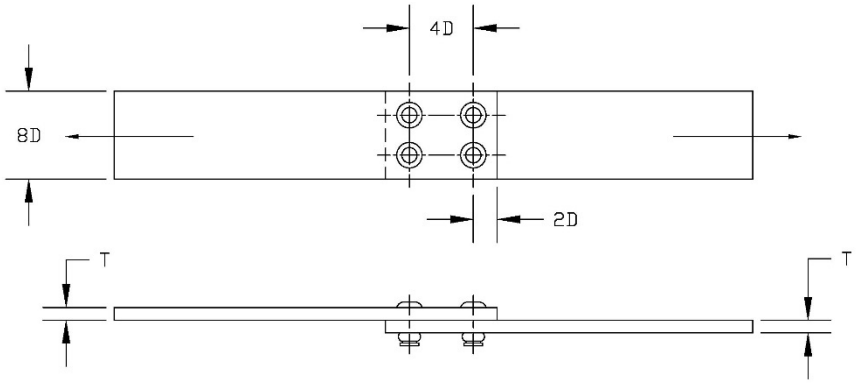

Figure 6

FATIGUE SPECIMEN

NOTES:

1) Material: Type B, and E Rivets - 2024-T3 Clad Aluminum Alloy Sheet – M&C 6AL-4V
2) Hole preparation - See Figure 3
3) "T" Thickness to be in accordance with TABLE IXfor specific rivet being tested.
4) Coupon dimensions not affecting test results are optional.

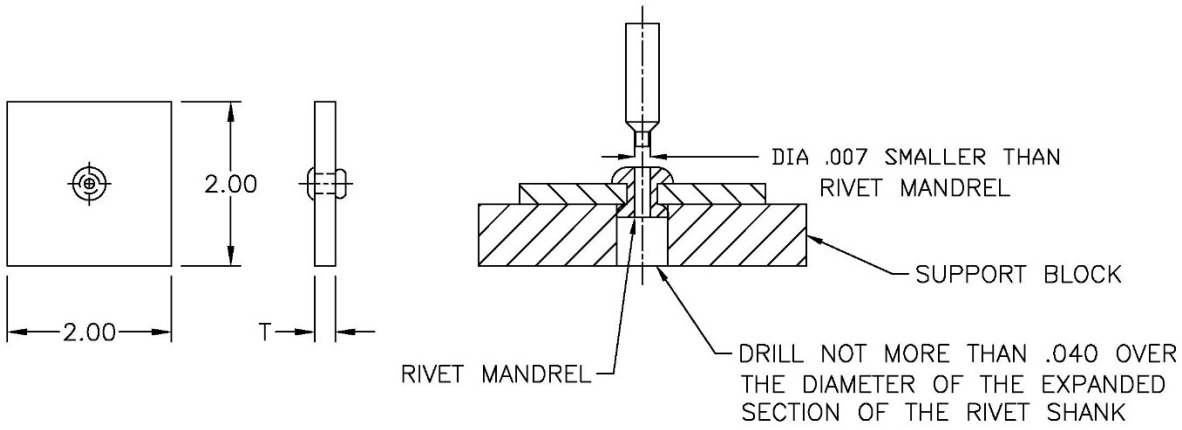

Figure 7

Nominal Rivet Diameter	Style A Hole Dia. ±.0005	Style B Hole Dia. ±.0005
1/8 (-4)	.132	.146
5/32 (-5)	.164	.180
3/16 (-6)	.196	.209
1/4 (-8)	.261	.275

SPINDLE RETENTION TEST

NOTES:
1) Dimension in inches.
2) Countersunk dimensions to be same as Figure 3.
3) "T" to be in accordance with manufacturer's recommended grip length for rivets being tested.
4) Coupon dimensions not affecting test results are optional.

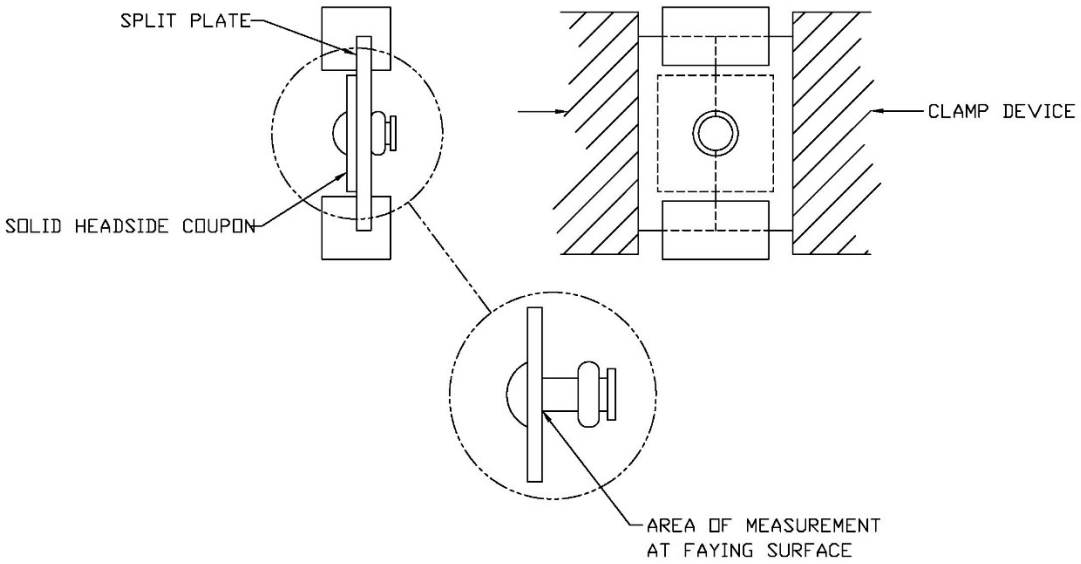

Figure 8

Nominal Rivet Diameter	Rivet Grip Dash No.	Headside Coupon			Split Plate			Total Grip
		Thickness ±.002	Hole Size ±.0005		Thickness ±.001	Hole Size +.0005 -.0000		
			Style A	Style B		Style A	Style B	
1/8 (-4)	-2	.063	.1315	.1455	.062	.1325	.1465	.125
5/32 (-5)	-3	.080	.1635	.1795	.078	.1645	.1805	.158
3/16 (-6)	-3	.090	.1955	.2085	.094	.1965	.2095	.184
1/4 (-8)	-4	.125	.2605	.2745	.125	.2615	.2755	.250

SHANK EXPANSION COUPON

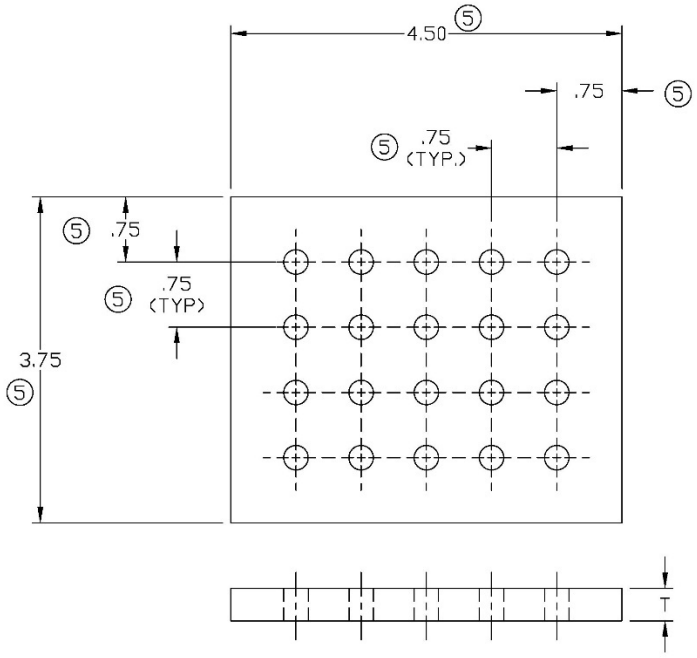

Figure 9

Rivet Diameter	Hole Diameter ±.0005 Minimum Grip		Hole Diameter ±.0005 Maximum Grip	
	Style A	Style B	Style A	Style B
1/8 (-4)	.132	.146	.129	.143
5/32 (-5)	.164	.180	.160	.176
3/16 (-6)	.196	.209	.192	.205
1/4 (-8)	.261	.275	.256	.271

SPECIMEN FOR INSTALLATION TEST

NOTES:

1) "T" - Sheet Thickness. For each specific grip length of appropriate size under evaluation, installation tests shall be conducted at total grip (T) conforming to minimum and maximum grip as indicated in applicable standard. One-half of required tests shall be in min. grip-max. hole, and one-half in max. grip-min. hole.
2) Material: Rivet Types B & E = Alloy Steel or 7075-T6 Aluminum Alloy or 2024-T3 Aluminum. Rivet Types M & C = Alloy Steel RC46 Min.
3) Dimensions in inches.
4) See Figure 3 for countersink dimensions.
5) Dimension values are optional.