

MIL-N-45938
30 September 1971

MILITARY SPECIFICATION

NUT, PLAIN, CLINCH AND NUT, SELF-LOCKING, CLINCH GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification covers the requirements for nuts which are permanently attached to a structure by pressing the nut shank or collar into a single hole. Anti-rotation and push-out resistance results from cold flow of the structure material into the shank or collar of the nut, or the flaring over of the nut shank.

1.2 Classification. Types and sizes of clinch nuts shall be as specified on the applicable specification sheets and MS21331.

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

Federal

- QQ-A-225/5 - Aluminum Alloy Bar, Rod and Wire; Rolled, Drawn or Cold Finished, 2017.
- QQ-A-225/6 - Aluminum Alloy Bar, Rod and Wire; Rolled, Drawn or Cold Finished, 2024.
- QQ-P-35 - Passivation Treatments for Austenitic, Ferritic and Martensitic Corrosion-Resisting Steel (Fastening Devices).
- QQ-P-416 - Plating, Cadmium (Electrodeposited).
- QQ-S-365 - Silver Plating, Electrodeposited; General Requirements For.
- PPP-H-1581 - Hardware (Fasteners and Related Items), Packaging and Packing for Shipment and Storage of.

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Military

- MIL-I-6866 - Inspection, Penetrant Method of.
- MIL-I-6868 - Inspection Process, Magnetic Particle.
- MIL-S-7742 - Screw Threads, Standard, Optimum Selected Series:
General Specification for.
- MIL-A-8625 - Anodic Coatings, for Aluminum and Aluminum Alloys.
- MIL-S-8879 - Screw Threads, Controlled Radius Root with Increased
Minor Diameter; General Specification for.
- MIL-L-8937 - Lubricant, Solid Film, Heat Cured.
- MIL-I-17214 - Indicator, Permeability; Low-Mu (Go-No Go).
- MIL-L-23398 - Lubricant, Solid Film, Air Drying.
- MIL-N-25027 - Nut, Self-Locking, 250°F, 450°F, and 800°F, 125 KSI
FTU, 60 KSI FTU, and 30 KSI FTU.

(See supplement 1 for list of applicable specification sheets.)

STANDARDS

Federal

FED. STD. NO. 66 - Steel: Chemical Composition and Hardenability.

Military

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-1312 - Fasteners, Test Methods.
- MS21331 - Nut, Plain, Clinch.

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitations for bid or request for proposal shall apply.

American National Standards Institute (ANSI) Standard.

ANSI B46.1 - Surface Texture

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, N. Y., N. Y. 10018.)

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National Bureau of Standards.Handbook H28 - Screw-Thread Standards for Federal Services

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.)

Aerospace Material Specification.

AMS 5734 - Steel Bars, Forgings and Tubing, Corrosion and Heat Resistant

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., Two Pennsylvania Plaza, New York, N. Y. 10001.)

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheets.

3.2 Material. Clinch nuts shall be made from the following materials, as specified in the applicable specification sheet and MS21331.

3.2.1 Carbon and alloy steel. Carbon and alloy steel shall be in accordance with Fed. Std. No. 66 and shall meet all the requirements specified herein.

3.2.2 Corrosion-resisting steel. Corrosion-resisting steel shall be AISI 303 in accordance with Fed. Std. No. 66. When specified in the applicable specification sheet, corrosion-resisting steel shall be A-286 in accordance with AMS 5734.

3.2.2.1 Magnetic permeability. Corrosion-resisting steel shall have a magnetic permeability of 2.0 max (air = 1.0) for a field strength of $H = 200$ oersteds when tested using an indicator in accordance with MIL-I-17214.

3.2.3 Aluminum alloy. Aluminum alloy shall be 2017-T4 in accordance with QQ-A-225/5 or 2024-T4 in accordance with QQ-A-225/6.

3.2.4 Non-metallic insert. The non-metallic insert used in self-locking nuts shall be nylon.

3.3 Protective finish.

3.3.1 Cadmium plating. Carbon and alloy steel nuts shall be cadmium plated in accordance with QQ-P-416, Type II, Class 3.

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3.3.1.1 Hydrogen embrittlement. Cadmium plated alloy steel nuts and cadmium plated, heat treated carbon steel nuts shall be subjected to an embrittlement relief treatment within 4 hours after plating, conducted in accordance with QQ-P-416.

3.3.2 Passivation. Corrosion-resisting steel (303) nuts shall be passivated in accordance with QQ-P-35.

3.3.3 Silver plating. Corrosion-resisting steel (A-286) nuts shall be silver plated in accordance with QQ-S-365, Type II, Grade B, 0.0002 thick.

3.3.4 Lubricant. Alloy steel nuts shall have a supplementary solid film lubricant coating in accordance with MIL-L-8937 or MIL-L-23398. When specified on the applicable specification sheet, corrosion-resisting steel nuts shall have a supplementary solid film lubricant coating in accordance with MIL-L-8937 or MIL-L-23398. Lubricant shall be required on all-metal lock nuts only.

3.4 Design and construction. Clinch nuts shall be of one-piece construction. (Nuts with permanently attached non-metallic inserts are considered as one-piece). Clinch nuts shall have a countersunk entry on both sides, except for elliptically offset lock nuts and nuts with non-metallic inserts, which shall only be required to have the countersink on the entry side. When properly installed in a predrilled or punched hole in sheet material, the clinch portion of the nut shall provide a positive, permanent attachment to the sheet without damaging or affecting the threads. The locking device shall not operate by means of separate movement from the installation and shall not depend upon pressure on the bearing surface for locking action.

3.4.1 Dimensions. Dimensions and tolerances shall be as specified on the applicable specification sheet and MS21331 and shall apply after plating and prior to supplemental lubrication.

3.4.2 Threads. Unless otherwise specified, threads shall be in accordance with Handbook H28. When specified on the applicable specification sheet, threads shall be in accordance with MIL-S-7742 or MIL-S-8879.

3.4.2.1 Thread start. Self-locking nuts with locking feature incorporated and without lubricant shall allow a "Go" plug gage to enter the nut a minimum of $3/4$ turn before engagement of the locking feature. When lubricant prevents use of standard gages, the nut shall permit free rotational (finger torqued) bolt engagement of at least $3/4$ turn.

3.5 Mechanical requirements.

3.5.1 Push-out. Push-out values for installed clinch nuts shall not be less than the values specified in the applicable specification sheet.

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3.5.2 Torque-out. Torque-out values for installed clinch nuts shall not be less than the values specified in the applicable specification sheet.

3.5.3 Vibration. Self-locking clinch nuts shall withstand the vibration test specified in 4.5.6.

3.5.4 Locking-torque. Self-locking clinch nuts shall meet the locking-torque requirements specified in MIL-N-25027.

3.5.5 Stress embrittlement. Alloy steel clinch nuts, that are heat treated Rockwell C46 and above, shall be tested for stress embrittlement in accordance with 4.5.5.

3.5.6 Surface roughness. The surface roughness of all external surfaces, except knurling, shall not exceed 125 microinches (RHR) as specified in ANSI B46.1.

3.6 Installation. Clinch nuts shall be installed as specified in the applicable specification sheet. Installation forces shall be exerted between parallel faces so that the nut will be installed squarely and the proper embedment of knurled surfaces will result in proper displacement of structure material. Sufficient support shall be provided the structure material during clinching to prevent its collapse.

Self-clinching nuts shall be attached to the structure by pressing and imbedding a knurled or hexagonal configuration into the structure to provide anti-rotation, thereby displacing structure material into the shank undercut to provide push-out resistance. Self-clinching nuts must always be harder than the structure material to obtain proper displacement.

Swage-clinching nuts shall be installed by pressing the nut in a hole sized to produce an interference fit and thereby cause the knurl to broach into the structure to provide anti-rotation. Push-out resistance is developed by flaring the shank into a countersink on the opposite structure side or rolling the shank over on the opposite side.

3.7 Metallurgical properties.

3.7.1 Discontinuities. Clinch nuts shall not contain discontinuities such as laps, seams and inclusions which equal or exceed the limitations specified herein. Care must be exercised not to confuse cracks with discontinuities. When visual inspection discloses discontinuities which show cause for further examination, magnetic particle or penetrant inspection, as applicable, shall be as specified in 4.5.8, for size .190 and larger.

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3.7.1.1 Laps and seams. Clinch nuts may possess laps and seams. The depth shall not exceed the values specified in Table I.

3.7.1.2 Inclusions. Small inclusions in parts of the clinch nuts which are not indicative of unsatisfactory quality, shall not be cause for rejection. The depth shall not exceed the values specified in Table I.

TABLE I

DISCONTINUITY LIMITS

NOM. SIZE	DEPTH LIMIT (INCH)	
	SHEET METAL	BAR STOCK
.060	.004	.008
.086	.004	.008
.112	.004	.008
.138	.005	.010
.164	.005	.010
.190	.005	.010
.250	.005	.010
.3125	.005	.010
.375	.006	.011
.500	.008	.012

3.7.2 Cracks. Clinch nuts shall be free from cracks in any direction or location.

3.8 Workmanship. Clinch nuts shall be free of burrs, flaws and other similar defects, and shall be free of corrosion and surface contamination.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Inspection lot. A lot shall consist of completed clinch nuts which are of the same part number, produced by the same manufacturer under essentially the same conditions, and submitted for acceptance at one time.

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4.3 Sampling for lot inspection.

4.3.1 Sampling for examination. A random sample of clinch nuts shall be taken from each lot in accordance with MIL-STD-105, Inspection Level I. The Acceptable Quality Level (AQL) shall be as specified in Table II.

4.3.2 Sampling for tests. Sampling for tests (installation, push-out, torque-out, stress embrittlement and vibration) shall be in accordance with MIL-STD-105, Inspection Level S-1. The AQL shall be 2.5 percent defective.

4.3.2.1 Sampling for test of locking-torque. Sampling for test of locking-torque shall be in accordance with MIL-STD-105, Inspection Level S-2. The AQL shall be 2.5 percent defective.

4.3.3 Sampling for protective coating. Sampling for text of protective coatings shall be in accordance with the applicable specification of 3.3.

4.3.4 Sampling for packaging and packing. Sampling for examination and test of packaging and packing shall be in accordance with PPP-H-1581.

4.4 Examination. Each clinch nut taken as specified in 4.3.1 shall be examined to verify conformance with this specification. Examination shall be conducted in accordance with Table II. Each nut containing a defect shall be rejected and if the number of defective nuts exceed the acceptance number, the lot represented by the sample shall be rejected.

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TABLE II

Classification of Defects

<u>Categories</u>	<u>Defects</u>	<u>Inspection Method</u>
Critical	None defined	
Major A	AQL = 1.0 percent defective	
101	Self-locking element missing, if required	Visual
102	Material, not as specified (3.2)	Visual
Major B	AQL = 2.5 percent defective	
103	Dimensions, not as specified (3.4.1)	* SIE
104	Threads, not as specified (3.4.2)	SIE
105	Thread start (3.4.2.1)	SIE
Minor	AQL = 4.0 percent defective	
201	Magnetic permeability (3.2.2.1)	See 3.2.2.1
202	Protective coating, missing or incomplete (3.3)	Visual
203	Surface roughness (3.5.6)	SIE
204	Discontinuities (3.7.1)	Visual & SIE
205	Workmanship (3.8)	Visual

* SIE = Standard Inspection Equipment

4.5 Tests.

4.5.1 Test panels. Test panels shall be of suitable thickness and hardness for the nut being tested, as specified in the applicable specification sheet.

4.5.2 Installation test. Samples taken as specified in 4.3.2 shall be installed in test panels specified in the applicable specification sheet. Installation shall be in accordance with 3.6. Properly installed samples shall be visually inspected under 10 diameters magnification. Evidence of cocking, looseness, splits or cracks shall be cause for rejection. When applicable, depth of embedment shall be measured using standard inspection equipment.

4.5.3 Push-out test. Samples taken as specified in 4.3.2 shall be installed in test panels specified in the applicable specification sheet. Installation shall be in accordance with 3.6. A mating test screw or bolt shall be engaged in the nut. The push-out load shall be steadily applied to the test screw or bolt directly in line with the axis of the nut thread (see figure 1). Sufficient support shall be provided for the

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test panel to prevent its collapse. Failure of the clinch nuts to withstand the push-out loads specified on the applicable specification sheet without loosening, cracking or thread damage shall be cause for rejection.

APPLIED LOAD

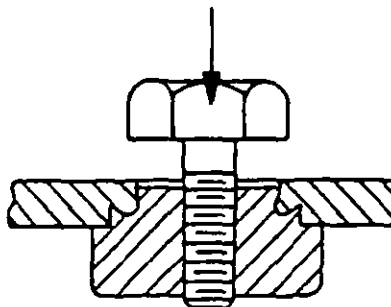


FIGURE 1
Push out test

4.5.4 Torque-out test. Samples taken as specified in 4.3.2 shall be installed in test panels specified in the applicable specification sheet. Installation shall be in accordance with 3.6. A mating test screw, bolt or torque stud shall be engaged in the nut and shall be provided with a shoulder, whose diameter is less than the diameter of the mounting hole, to seat against the base of the nut. The threads of the test screw, bolt or torque stud shall extend through the nut sufficiently to accept a check nut. The check nut shall be torqued against the top of the nut being tested to resist the counter-clockwise torque-out test. Torque shall be applied with a torque measuring device to the engaged screw, bolt or torque stud; first in a clockwise direction and then in a counter-clockwise direction. Failure of the clinch nuts to withstand the torque-out loads specified on the applicable specification sheet without loosening, turning or thread damage shall be cause for rejection.

4.5.5 Stress embrittlement test. Alloy steel clinch nuts that are heat treated to Rockwell C46 and above shall be subjected to a stress embrittlement test. Samples taken as specified in 4.3.2 shall be installed in test panels specified in the applicable specification sheet. Installation shall be in accordance with 3.6. A mating test bolt shall be engaged in the nut and torqued to the values specified in Table III. The assembly shall be stored at room ambient temperature for 48 hours. After 48 hours the nut, while still assembled as initially torqued, shall be visually examined for cracks and minimum breakaway torque shall be determined. Nuts with lower breakaway torque than specified in Table III shall be sectioned and examined under 10 diameters magnification. The presence of any crack shall cause rejection of the represented lot.

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TABLE III
STRESS EMBRITTLEMENT TORQUE VALUES

NOM. SIZE	INSTALLATION TORQUE IN.-LB	BREAKAWAY TORQUE-MIN IN.-LB
.164	23	2.0
.190	46	2.5
.250	115	5.0
.3125	260	8.0
.375	320	12.0

4.5.5.1 Embrittlement relief test. When specified (see 6.2), the following test may be performed in lieu of the test described in 4.5.5. When specified (see 6.2), cadmium plated, heat treated carbon steel nuts shall be subjected to the following test.

Samples taken as specified in 4.3.2 shall be installed in test panels specified in the applicable specification sheet. Installation shall be in accordance with 3.6 and, without any clamping action, shall be stored for 48 hours at room ambient temperature. After 48 hours the nut shall be examined for looseness and cracks. Then the nut shall be lightly tapped on the side to see if it will break loose. Any evidence of loosening or cracks shall cause rejection of the represented lot.

4.5.6 Vibration test. Samples taken as specified in 4.3.2 (self-locking clinch nuts only) shall be vibration tested in accordance with test 7 of MIL-STD-1312. The clinch nuts shall be assembled in accordance with figure 1 of test 7, MIL-STD-1312, with mating bolts and torque values as specified in Table IV. The mating bolts shall then be removed and reinstalled to this torque four additional times before being vibrated.

TABLE IV
VIBRATION TORQUE VALUES

NOM. SIZE	TORQUE IN.-LB
.190	36
.250	60
.3125	120
.375	160
.4375	200
.500	300

Determination shall be made throughout the test to guarantee that the assembly is traversing the entire length of the slots in the test fixture.

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The test shall be run for 30,000 cycles except that it shall be stopped prior to the completion of the 30,000 cycles if a nut becomes disassembled from the bolt. The nut shall then be examined for cracks under 10 diameters magnification.

Nuts shall be considered to have failed the vibration test under the following conditions. Any one nut failure shall cause rejection of the represented lot.

(a) If any structural failure, such as broken segments, locking inserts falling out or cracks occur during the test, provided failure is not the result of failure of the bolt.

(b) If any nut comes completely off the bolt or can be turned completely on or off the bolt with the fingers during or after completion of 30,000 cycles.

(c) If relative rotation between any nut and bolt exceeds 360° .

4.5.6.1 Vibration tests on nuts smaller than size .190 are not required, provided that size .190 and larger nuts of the same type and design of locking device have satisfactorily passed the vibration test.

4.5.7 Locking-torque test. Samples taken as specified in 4.3.2.1 shall be subjected to a locking torque test (self-locking clinch nuts only). The test shall be conducted as specified in MIL-N-25027 to determine conformance to 3.5.4.

4.5.8 Discontinuities. Magnetic particle inspection performed in accordance with MIL-I-6868 for carbon and alloy steel and penetrant particle inspection performed in accordance with MIL-I-6866 for corrosion-resisting steel, shall be used to determine the presence of cracks and discontinuities such as laps, seams and inclusions. Magnetic or penetrant particle indications alone shall not be cause for rejection. If indications are considered cause for rejection, the samples taken from that lot shall be examined under 10 diameters magnification to determine conformance to 3.7.

4.5.9 Protective coating. Examination and test of protective coating shall be in accordance with the applicable specification 3.3.

4.5.10 Packaging and packing. Examination and test of packaging and packing shall be in accordance with PPP-H-1581.

5. PREPARATION FOR DELIVERY

5.1 Preservation and packaging. Preservation and packaging shall be level A or C, as specified (see 6.2), in accordance with PPP-H-1581.

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5.2 Packing. Packing shall be level A, B or C, as specified (see 6.2), in accordance with PPP-H-1581.

5.3 Marking. Marking of unit packages and shipping containers shall be in accordance with PPP-H-1581.

6. NOTES

6.1 Intended use. Clinch nuts covered by this specification are intended as permanent or captive type nuts installed into the parent structure by compression, swaging or flaring. Clinch nuts are intended to provide a more durable thread for disassembly and assembly in secondary and non-structural applications.

6.2 Ordering data. Procurement documents should specify the following:

- (a) Title, number and date of this general specification.
- (b) Title, number and date of applicable specification sheet or Military Standard.
- (c) Applicable part number.
- (d) Embrittlement relief test, if required (4.5.5.1).
- (e) Selection of applicable levels of packaging and packing (5.1 and 5.2).

6.3 Clinch nuts should not be used in magnesium parent material.

6.4 Definitions.

6.4.1 Crack. A crack is a clean crystalline break passing through the grain or grain boundary without the inclusion of foreign elements.

6.4.2 Lap. A lap is a surface defect appearing as a seam, caused by folding over of metal fins or sharp corners and then rolling or forging them into the surface, but not welding them.

6.4.3 Seam. A seam is an unwelded fold or lap which appears as an opening in the raw material as received from the source.

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6.4.4 Inclusions. Inclusions are non-metallic materials in a solid metallic matrix.

Custodians:

Army - WC

Navy - OS

Air Force - None

Preparing activity:

Army - WC

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Reviewer activities:

Army - AV, MU

Navy - None

Air Force - None

DSA-IS

User activities:

Army - AT, EL, GL, ME

Navy - AS, MC, SH

Air Force - None