INCH-POUND

MIL-STD-40007(AT)
20 September 1991
SUPERSEDING
(see 6.6)

MILITARY STANDARD

RIVETS, SOLID, INSTALLATION OF

AMSC N/A
FSC 5320

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FOREWORD

1. This military standard is approved for use by the U.S. Army Tank-Automotive Command, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

2. Beneficial Comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: U.S. Army Tank-Automotive Command, ATTN: AMSTA-GDS, Warren, MI 48397-5000, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

3. The purpose of this standard is to provide guidance for the installation and acceptance of solid rivets.

C O N T E N T S

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TABLES

FIGURES

1. SCOPE

1.1 Scope. This standard covers processes for the installation and acceptance of solid rivets.

2. APPLICABLE DOCUMENTS

(This section is not applicable to this standard.)

3. DEFINITIONS

3.1 Positional tolerancing. A positional tolerance defines a zone within which the axis or center plane of a feature is permitted to vary from true (theoretically exact) position. Basic dimensions establish the true position from specified datum features and between interrelated features. 1/

3.2 Recovered materials. "Recovered materials" means materials that have been collected or recovered from solid waste (see 3.2.1).

3.2.1 Solid waste. "Solid waste" means (a) any garbage, refuse, or sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility; and (b) other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining and agricultural operations, and from community activities. It does not include solid or dissolved material in domestic sewage, or solid or dissolved material in irrigation return flows, or industrial discharges which are point sources subject to permits under section 402 of the Clean Water Act, (33 U.S.C. 1342 et seq.), or source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) (Source: Federal Acquisition Regulations, section 23.402).

3.3 Solid rivet. A headed fastening device having a solid shank, designed to have the shank end upset after insertion.

1/ Source: AINSI Y14.5

4. GENERAL REQUIREMENTS

4.1 Equipment. Riveting shall be accomplished by one of the following equipment:

a. Automatic riveting machine.

b. Manual:
   1. Rivet gun and bucking bar.
   2. Squeezer.

4.2 Materials. The rivet material shall be as specified in the applicable engineering drawing and shall include the chemical composition and metal hardness (see 6.2).

4.2.1 Recycled, virgin and reclaimed materials. There are no requirements for the exclusive use of virgin materials. The use of recycled or reclaimed (recovered) materials is acceptable provided that all other requirements of this specification are met (see 3.2).

4.3 Configuration. Rivet size and spacing shall be as specified in the applicable engineering drawing.

5. DETAILED REQUIREMENTS

5.1 Rivet hole size. The required hole sizes for rivets shall be as specified in table I.

TABLE I. Rivet hole size.

Rivet diameter (Inch)	Rivet hole diameter (Inch)	
	Minimum	Maximum
1/16	0.065	0.070
3/32	0.097	0.102
1/8	0.128	0.133
5/32	0.160	0.165
3/16	0.191	0.197
1/4	0.255	0.262
5/16	0.321	0.328
3/8	0.384	0.391

5.2 Hole location.

5.2.1 Positional tolerance. Unless otherwise specified in the engineering drawing, holes shall be located within a positional tolerance of 0.060 inch diameter.

5.2.2 Overlap. When hole location is not specified in the applicable engineering drawing, holes shall be centered on the overlap (see figure 1).

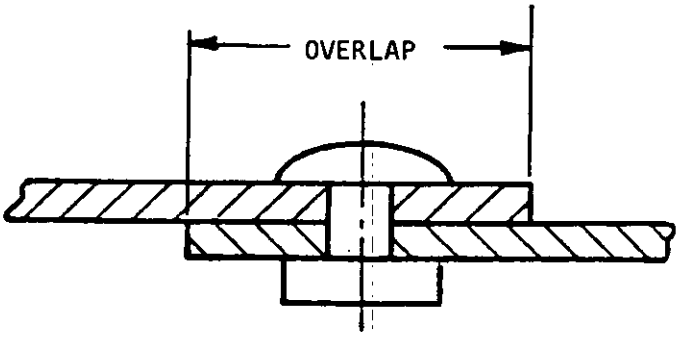


FIGURE 1. Overlap.

5.3 Procedures and operations.

5.3.1 Drilling and piercing. Drilling and piercing operations shall be performed as follows:

a. When a number of sheets are drilled simultaneously, clamp the sheets together securely.
b. Drill the holes normal to the surface of the work.
c. Limit drill pressure to preclude deformation of the surface of the work.
d. Hold the drill steady.
e. Use straight, properly ground drills.
f. When piercing, use tools which produce true and clean holes equivalent to drilled holes.

5.3.2 Countersinking. Countersinking shall be used for all flush riveting and for general usage when the material thickness exceeds dimpling limitations. When practicable, countersinks should be produced with a tool having an automatic-stop countersinking feature. The tool shall be held normal to the surface of the work. The rivet heads, when installed, shall be flush with or not more than 0.010 inch below, the surface of the outer member.

5.3.2.1 Countersinking for 100 degree flush-head rivets:

a. To provide adequate material depth for a 100 degree (°) countersink, the minimum sheet thickness with which flush-head rivets of various sizes may be used shall be as listed in table II.

TABLE II. Sheet and rivet head dimensions - 100(°) flush-head rivets.

Rivet diameter (inch)	Minimum sheet thickness (inch)	Nominal diameter of rivet head (inch)
1/16	0.020	0.111
3/32	0.040	0.176
1/8	0.051	0.222
5/32	0.064	0.284
3/16	0.072	0.351
1/4	0.101	0.474
5/16	0.130	0.578
3/8	0.155	0.693

b. Countersinks and dimples shall conform to table II and figures 2 and 3. When the countersink is in the inner member, the sharp corner shall be removed if the outer member is to be countersunk by dimpling, unless the dimple is to be formed by spinning.
c. Countersinks shall be free from chatter marks and unless otherwise specified shall be concentric with the hole within 0.005 inch diameter.

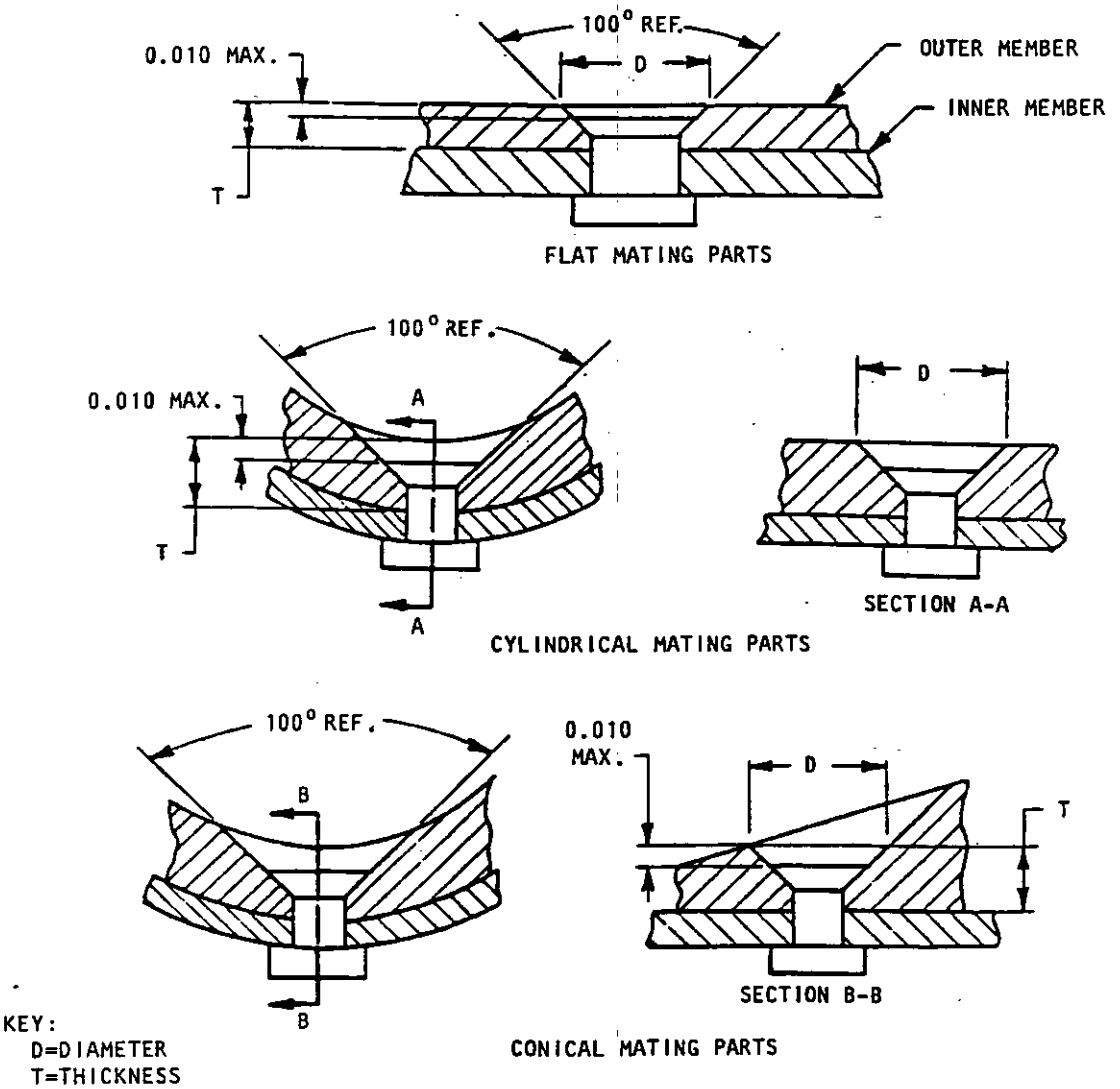
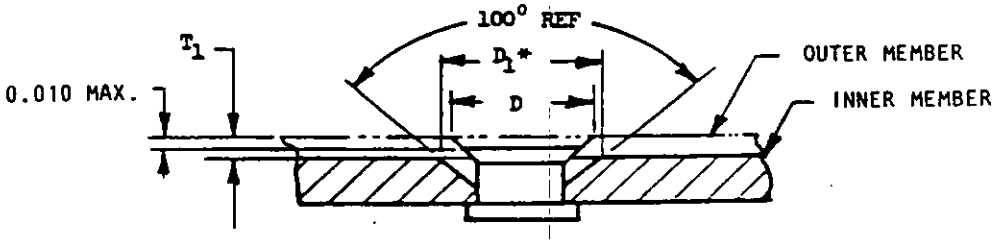


FIGURE 2. Countersinking



* Dimension D_1 is larger than diameter D and is dependent upon the thickness, T_1, of the outer member.

FIGURE 3. Dimpling

5.3.2.2 Foreign material. Prior to installing rivets, remove all chips and foreign material from between the parts.

5.3.3 Riveting. The type of machine or tools used for the riveting shall be determined by the particular work to be done.

5.3.3.1 Automatic riveting machine. This machine automatically makes the holes, dimples, and inserts and drives the rivets.

5.3.3.2 Manual.

5.3.3.2.1 Rivet gun and bucking bar. The rivet is inserted into the hole and the bucking bar is placed on the preformed head of the rivet. The rivet gun is placed on the shank end of the rivet, and repetitive blows are applied until an upset head is formed. Formation of the upset head can be controlled by using the proper impact force of the rivet gun and the proper weight bucking bar (see figure 4a).

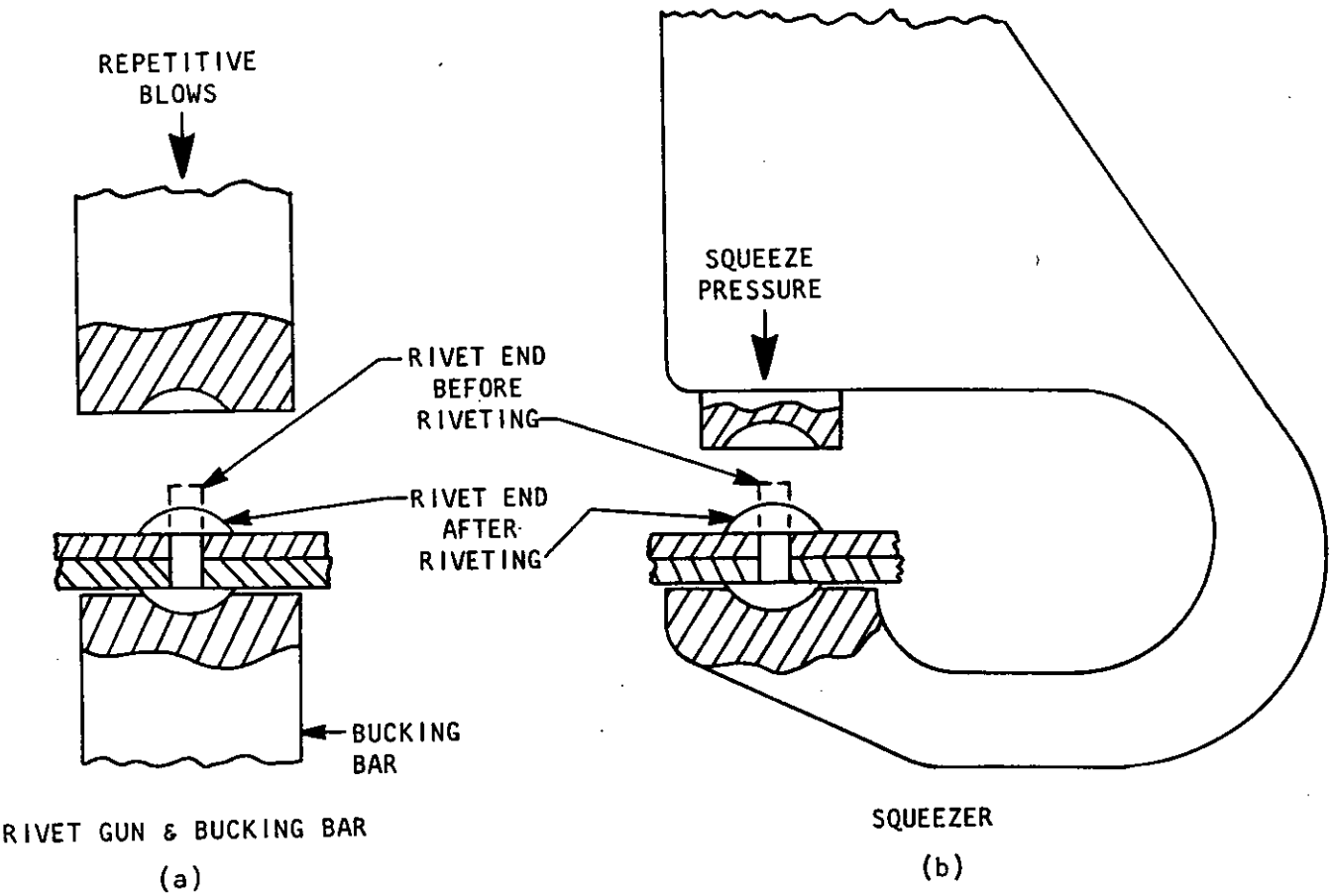


FIGURE 4. Manual riveting.

5.3.3.2.2 Squeezer. The rivet is inserted into the hole and the squeezer is placed over the rivet, with the buck or stationary end on the preformed head of the rivet. Steady pressure is then applied to the shank end of the rivet until an upset head is formed (see figure 4b).

5.3.3.3 Contoured sheets. When riveting contoured sheets, clamp the sheets together, start the drilling and riveting in the center of the sheet and work progressively outward in all directions.

5.3.3.4 Upset head location. Unless otherwise specified in the engineering drawing, the upset head shall be located using the following order of precedence:

a. Against the thicker sheet.
b. Against the harder material.
c. On either side when thickness and hardness are identical.

5.3.3.5 Upset head dimensions. Unless otherwise specified in the engineering drawing, the upset head dimensions shall be as specified in table III.

TABLE III. Upset head dimensions.

Rivet diameter (inch)	Head diameter (inch)		Head height (inch)	
	Minimum	Maximum	Minimum	Maximum
1/16	0.081	0.104	0.021	0.042
3/32	0.122	0.157	0.031	0.062
1/8	0.163	0.208	0.042	0.083
5/32	0.203	0.260	0.052	0.104
3/16	0.245	0.312	0.063	0.125
1/4	0.325	0.416	0.083	0.167
5/16	0.406	0.520	0.104	0.208
3/8	0.487	0.625	0.125	0.250

5.3.3.6 Rivet length. Rivet length shall be as specified in the engineering drawing. In order to meet the upset head requirements of table III, the use of a rivet one size longer or shorter than specified in the engineering drawing is permissible. Any other deviation shall require an engineering order or design approval.

5.4 Inspection.

5.4.1 Upset head faults.

5.4.1.1 Out-of-round heads. Out-of-round heads are acceptable beyond the maximum diameter specified in table III if the minimum diameter requirement is maintained.

5.4.1.2 Tipped and stepped heads. Tipped and stepped heads are caused by misalignment or slippage of tools. Tipped and stepped heads are acceptable if the average thickness is not less than the minimum allowable for that size of rivet, and if they occur on not more than 10 percent of a rivet pattern (see figure 5).

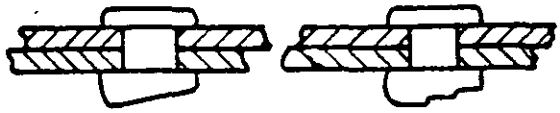


FIGURE 5. Tipped and stepped heads.

5.4.1.3 Clinched or offset heads. Clinched or offset heads are caused by misaligned parts, holes drilled at an angle, and tool slippage or misalignment and shall be cause for rejection (see figure 6).

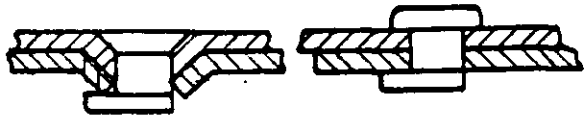


FIGURE 6. Clinched or offset heads.

5.4.1.4 Bell heads. Bell heads can result if the rivet is too long, or the driving blows or the bucking bar too light and shall be cause for rejection (see figure 7).

FIGURE 7. Bell head.

5.4.1.5 Open heads. Open heads are caused by undersized holes and by failure to hold the rivet set normal to the work. The preformed head must be flush seated. A gap of 0.002 inch or greater under the upset head shall be cause for rejection (see figure 8).

FIGURE 8. Open heads.

5.4.1.6 Cracked heads. Cracked heads are caused by overheating during heat treatment of the rivet, excessive cold-working of the rivet, and laps in the rivet wire. A lap crack is acceptable, but a burst crack caused by overheating shall be cause for rejection. More than three non-intersecting cracks caused by excessive cold-working shall be cause for rejection (see figure 9).

FIGURE 9. Cracked heads.

5.4.2 Gap area under heads.

5.4.2.1 Rivets in tubes and cylindrical shapes. Rivets in tubes and cylindrical shapes may have a gap on each side which extends over the curved periphery of the riveted member. Gaps are not permissible along the longitudinal or flat portions of the riveted members (see figure 10).

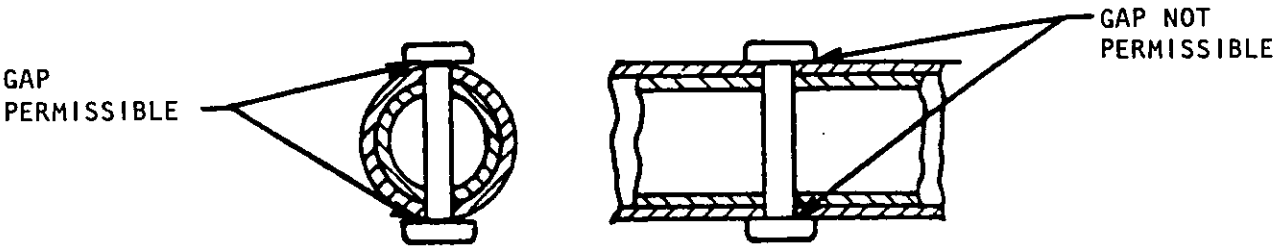


FIGURE 10. Rivets in tubes and cylindrical shapes.

5.4.2.2 Rivets in contoured shapes. Contoured shapes may have gaps under the heads which extend one-third the distance to the shank. The total length of the gap or gaps under the head shall not exceed one-half the head circumference (see figure 11).

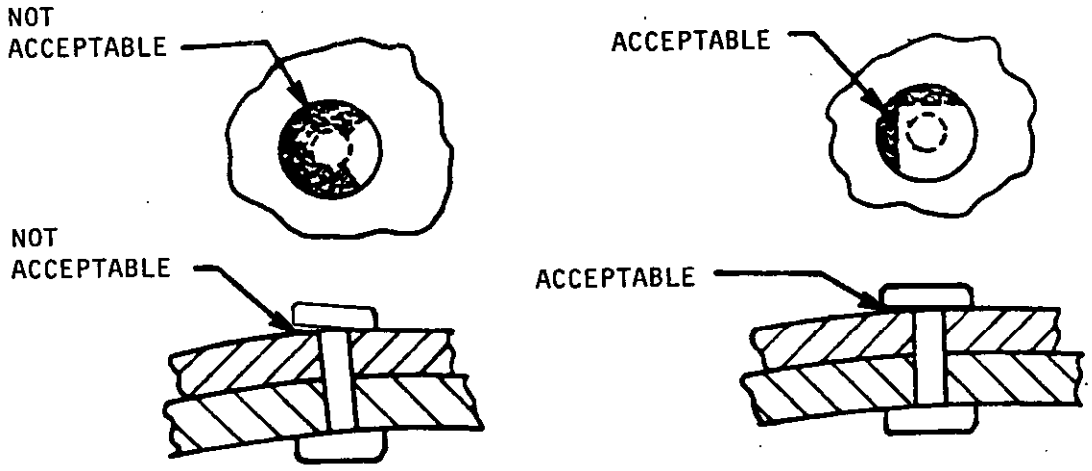


FIGURE 11. Rivets in contoured shapes.

5.4.3 Floating rivets. Floating or loose-flush rivets are caused by the dimple or countersink being too deep, which prevents the rivet from being driven completely tight. The maximum gap allowable on 40 percent of the head circumference is 0.002 inch and is acceptable on not more than 10 percent of a rivet pattern (see figure 12).

FIGURE 12. Floating rivets.

5.4.4 Swelled rivets. Swelled rivets are caused by the separation of the parts during riveting and shall be cause for rejection (see figure 13).

FIGURE 13. Swelled rivets.

5.4.5 Marred surfaces. A cut or ring on the preformed head or the surrounding material caused by the riveting equipment shall be cause for rejection.

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 procedures covered by this standard are intended to ensure the proper installation of solid rivets in the AGT 1500 turbine engine shroud of the M1 tank.

6.2 Rivet material. The rivet must be metallurgically compatible with the metals being riveted together.

6.2.1 Galvanic incompatibility. Metals to be riveted together shall be adequately protected to prevent galvanic corrosion.

6.3 Supersession. This standard supersedes Textron Lycoming Division, Stratford, Connecticut, specification P6255B, dated 26 April 1982.

6.4 Subject term (key word) listing.

Countersinking
Drilling and piercing
Floating rivets
Gap area under heads
Hole location
Marred surfaces
Overlap
Position tolerance
Riveting
Swelled rivets
Upset head faults

Custodian:
Army - AT

Preparing activity:
Army - AT

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