Workmanship Standards

Electrical / Mechanical

2-1027 Revision 21

February 8, 2021

Last Update By: Terry Davis and Ed Gayron

Note: IPC-A-610 (Current Revision) is a supplement to this Standard.

Contents

SECTION 1 - SOLDERLESS CONNECTIONS

1.1 Terminal Lugs

1.1.1 PIDG Faston Terminals

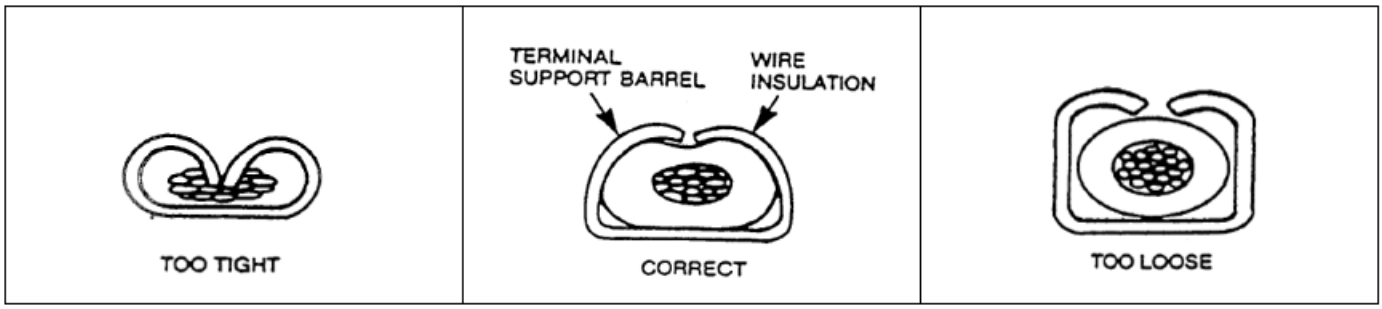


Figure 1-1

Figure 1-1 illustrates, in cross section, three examples of crimped insulation barrels on open barrel terminals. The crimp on the left is too tight, piercing through the insulation, penetrating and damaging the wire strands, and creating a possible trouble spot. In the center is the desired crimp providing adequate support without damage to either insulation or wire. On the right a crimp that is too loose, providing little or no support for the wire.

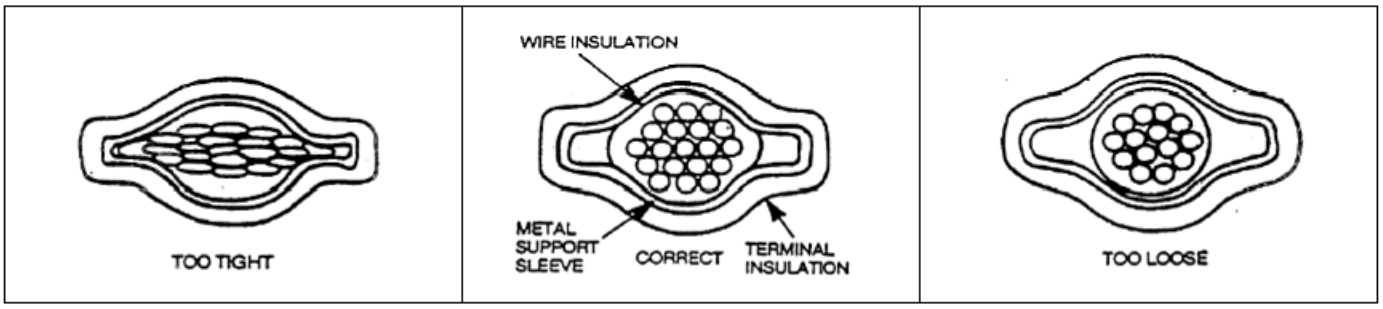


Figure 1-2

Figure 1-2 Illustrates, in cross section, three examples of closed barrel insulation crimps. The crimp on the left is too tight, damaging the wire insulation and possible breaking wire strands or reducing circular mil area by wire extrusion. In the center is the desired crimp, providing adequate support without damage to either the insulation or the wire. On the right is a crimp that is too loose, providing little or no support for the wire.

Mechanical Inspection. The tensile strength of the mechanical connection of the wire and the crimped contact shall meet the minimum requirements specified in table 1-1 below.

WIRE SIZE	MINIMUM TENSILE STRENGTH (lbs.)
22	10
20	16
18	20
16	30
14	50
12	70
10	80

TABLE 1-1

NOTE: ***The above table was taken from U.L. 486 Specification.***

PIDG - Faston Terminal

Visually Inspect for the following:

1. Terminals must not be deformed, especially at the mouth of the tab receptacle.
2. Wire strands must be flush with or extend no more than 1/32” past the receptacle end of wire barrel.
3. Wire insulation must be inside insulation barrel (support).
4. Terminal insulation must not be cut or damaged during crimping.
5. Bellmouth must be visible, as below.
6. See Figure 1-3.

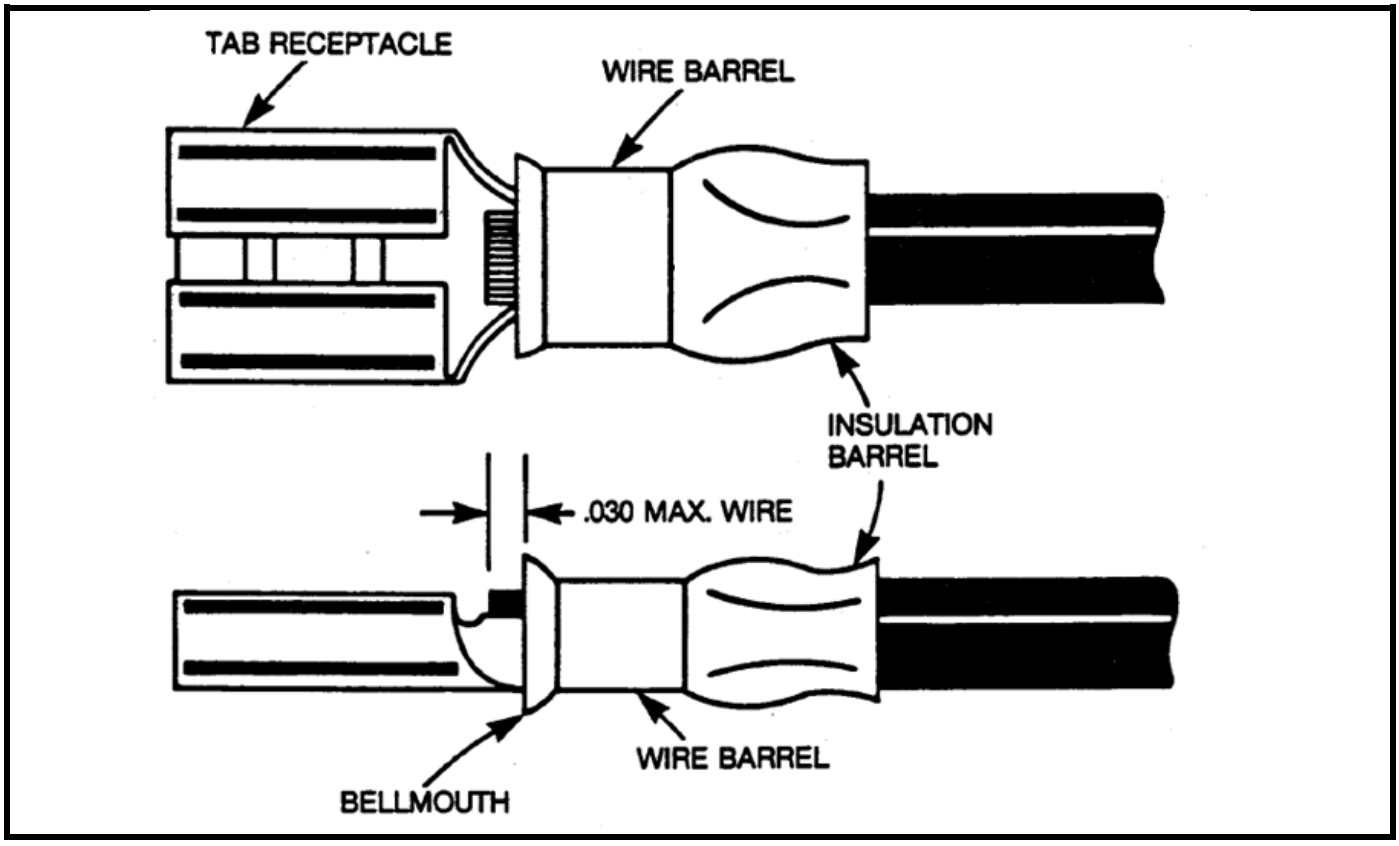


Figure 1-3

1.1.2 Plastic-Grip Terminals (Loose Piece or Tape Mounted)

Visually inspect for the following:

1. Wire must be visible at contact end of wire barrel but shall not interfere with attachment hardware.
2. Bellmouth must be visible as shown below. (See Figure 1-4)
3. Wire insulation must be inside insulation barrel (support).
4. Dot code shall be in accordance with instructional material packaged with the crimp tooling dies. An additional dot code appears on terminals crimped with interchangeable crimping dies.

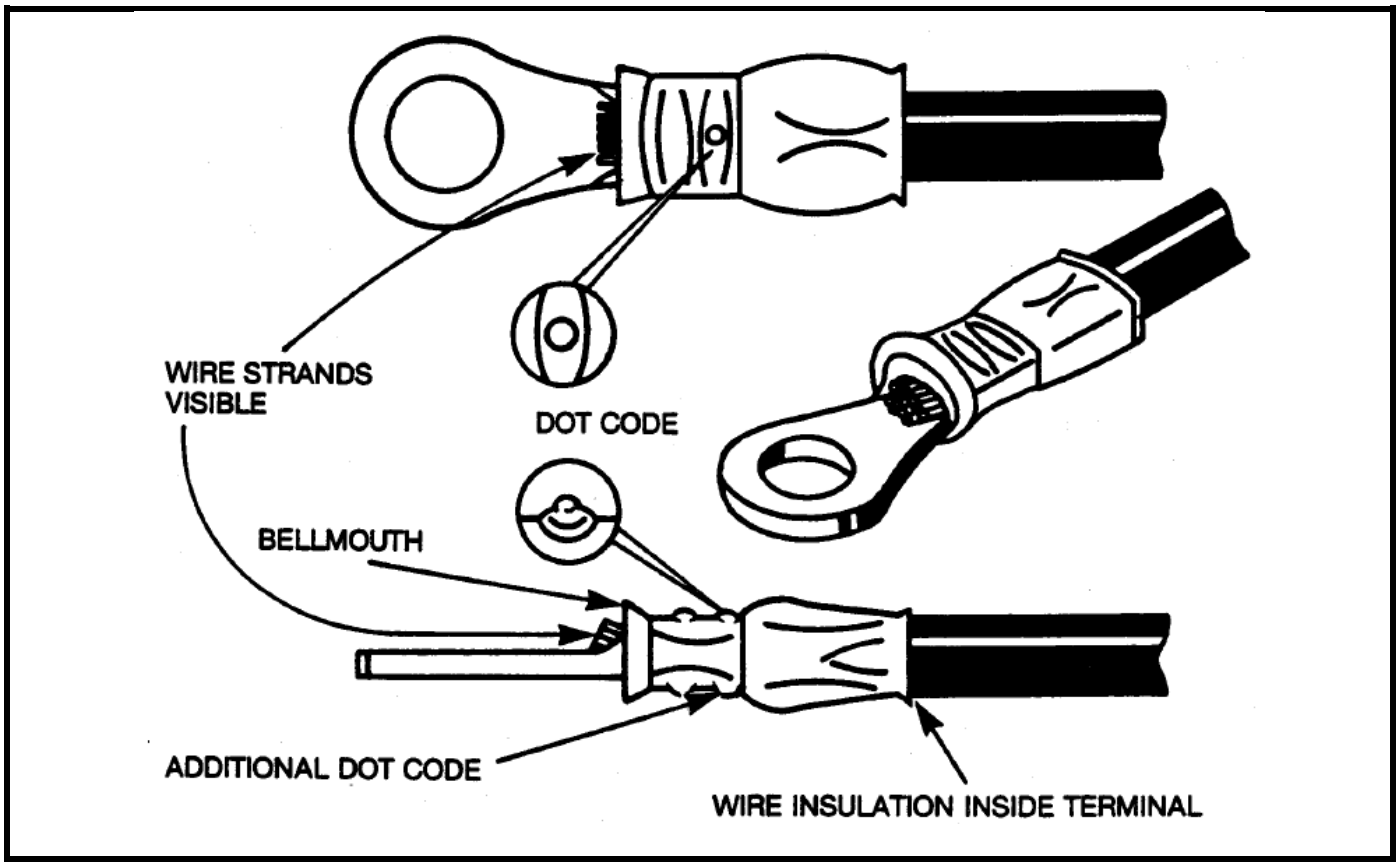


Figure 1-4

1.1.3 MP Type XI Contacts

Visually Inspect for the following:

1. Contacts must not be damaged or deformed.
2. Wire strands shall be flush with or extend up to .040” past contact end of wire barrel.
3. Wire strands and insulation must be visible between wire and insulation barrel.
4. Wire barrel seam must be completely closed.
5. All wire strands must be within wire barrel.
6. See Figure 1-5.

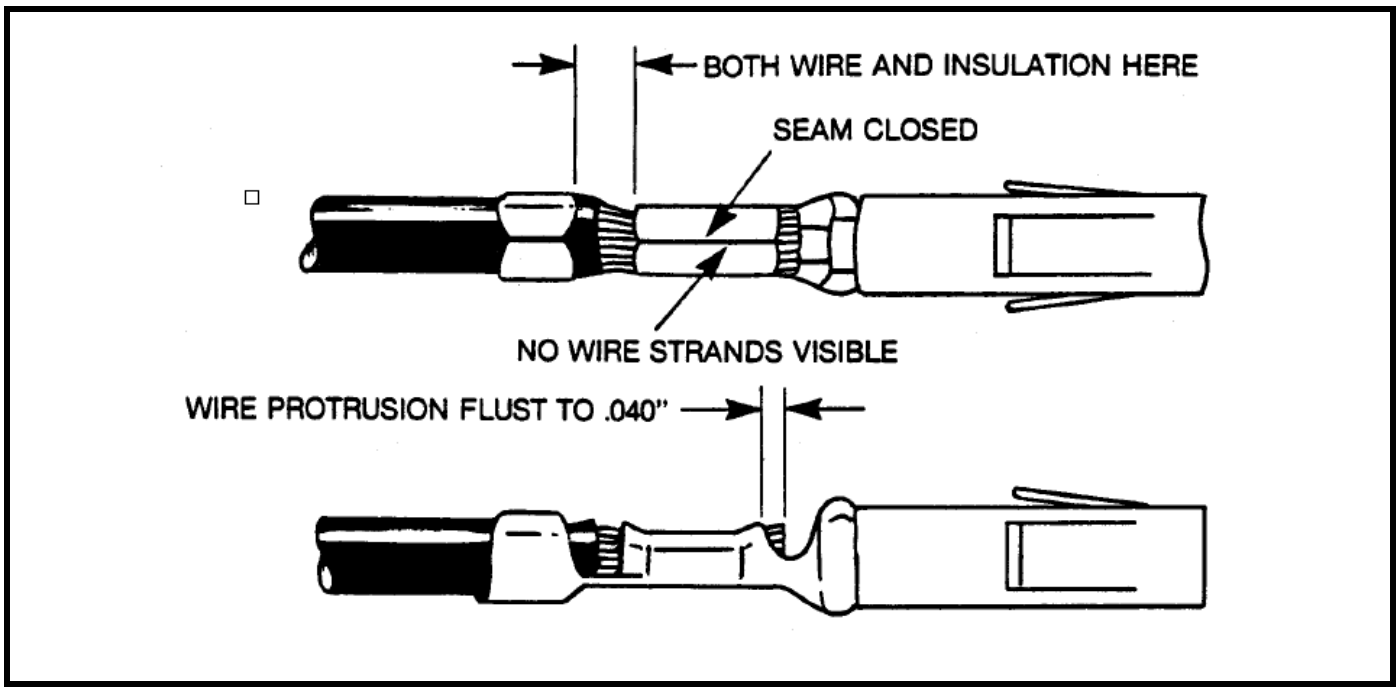


Figure 1-5

1.1.4 AMP Modu Contacts ("F" Crimp)

Visually inspect for the following:

1. Box portion of contact must not be damaged.
2. Wire strands must be flush with or extend up .030" past contact end of wire barrel.
3. Both insulation and wire strands must be visible between wire and insulation barrels.
4. See Figure 1-6.

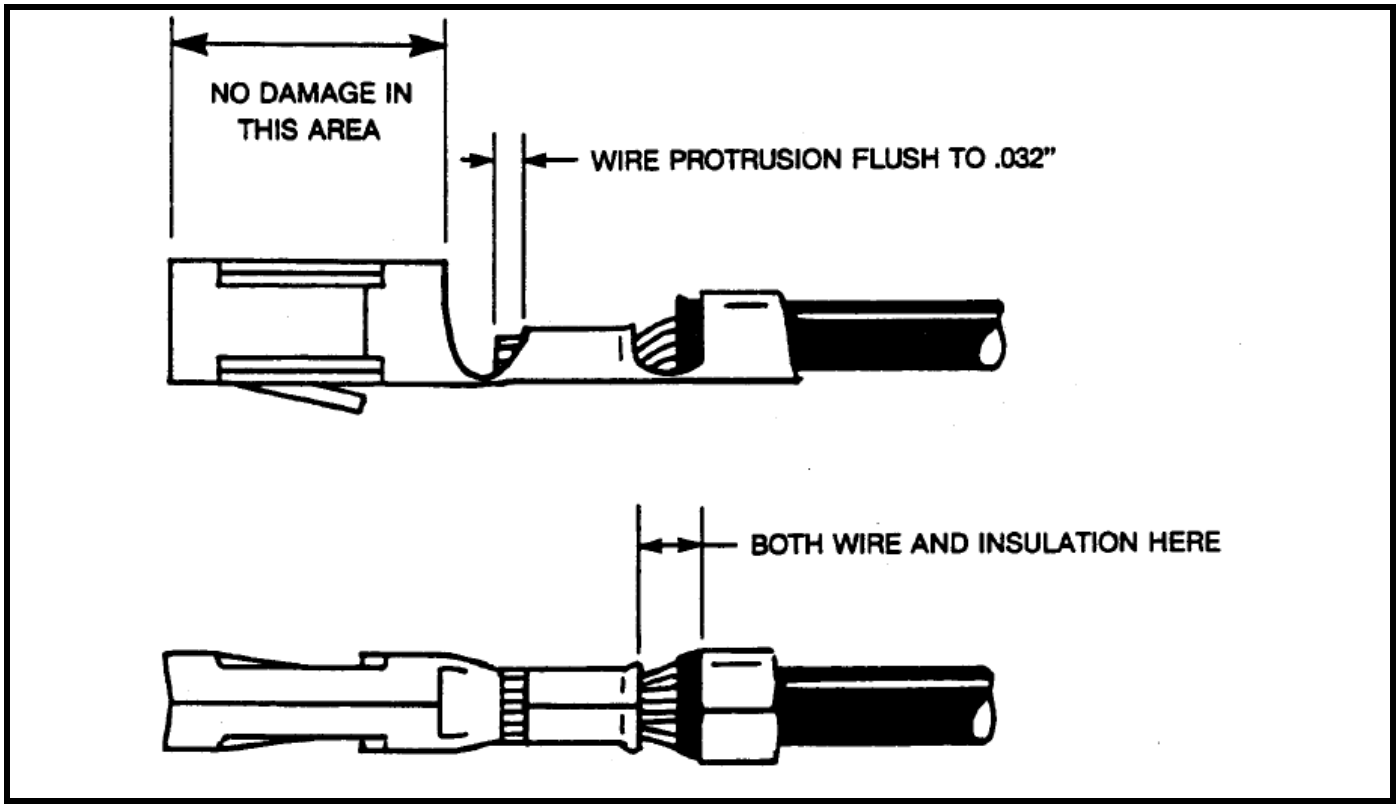


Figure 1-6

1.1.5 Solistrand Terminals & Splices

Visually inspect for the following:

1. Wire insulation must not be inside terminal or splice.
2. For terminals and parallel splices, crimp must be centered between wire stop (sight inspection holes) and end of splice (on both halves).
3. For terminals, wire ends must be flush with or extend beyond tongue end of wire barrel but shall not interfere with attachment hardware.
4. For butt splices, wire ends must be visible inside sight inspection holes (when supplied).
5. For parallel splices, wire ends must be flush with or extend beyond, both ends of splice.
6. See Figure 1-7.

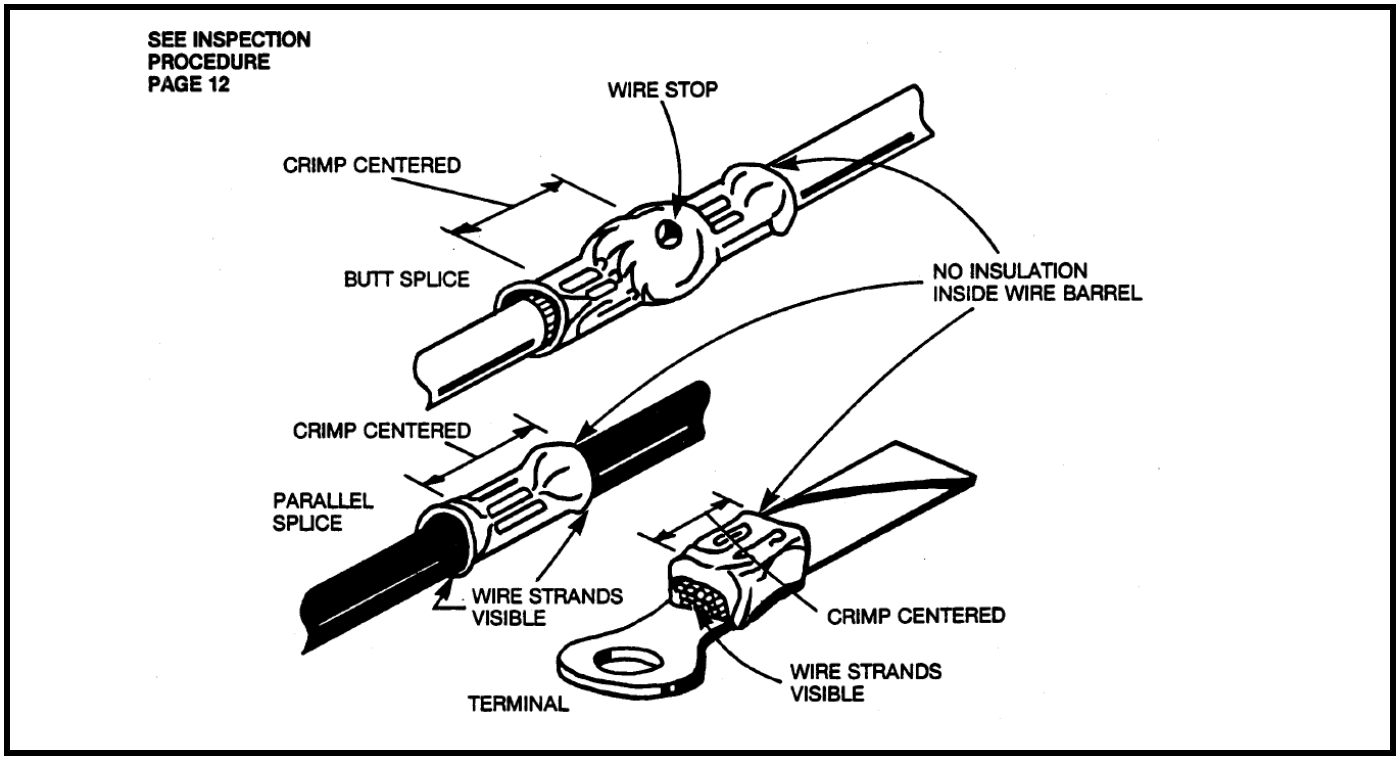


Figure 1-7

1.1.6 Faston Terminals

Visually inspect for the following:

1. Wire strands must be visible at contact end of wire but should not extend more than .031".
2. Both insulation and wire strands must be visible between wire barrel and insulation barrel.
3. Bellmouth required at wire end of wire barrel. Sight bellmouth is permissible at contact end of wire barrel.
4. See Figure 1-8.

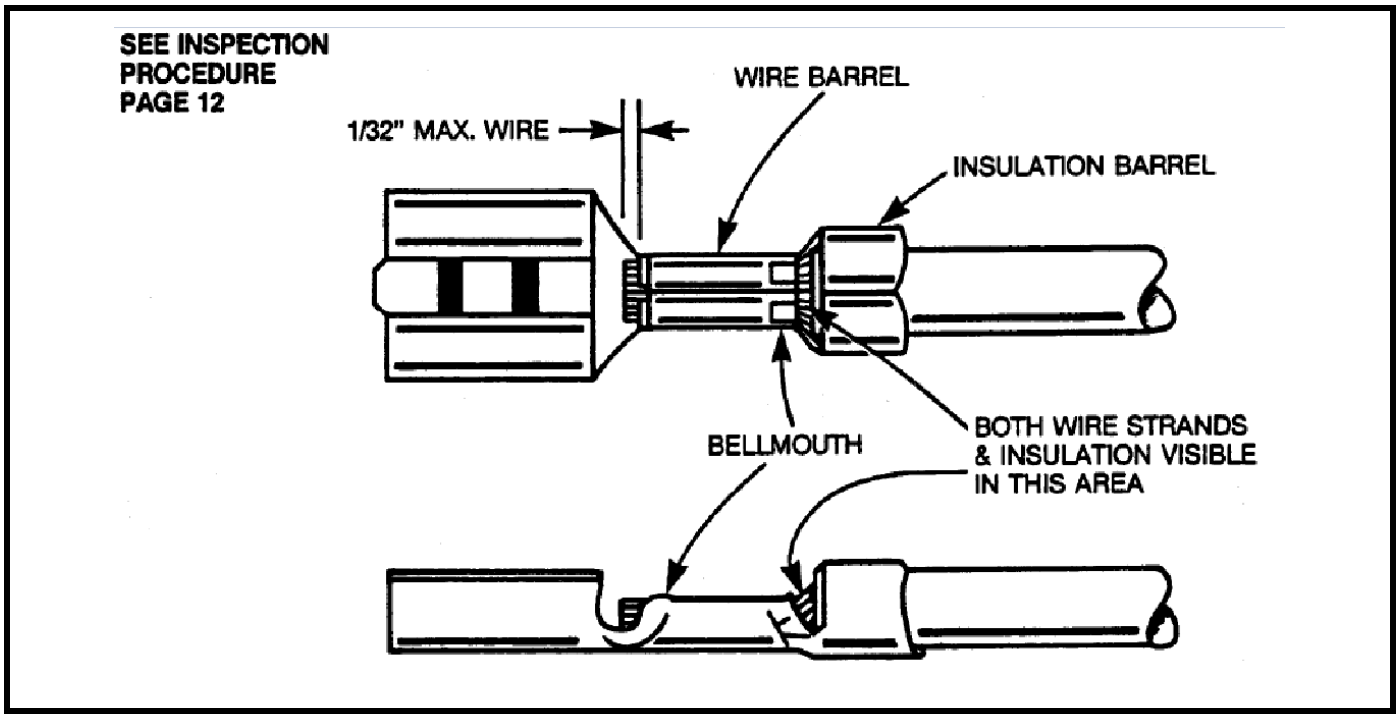


Figure 1-8

1.1.7 Open Barrel Spade Terminals

Visually inspect for the following:

1. Bellmouth at wire end of wire barrel must be .020" minimum to .040" maximum, (crimp height, micrometer or dial caliper may be used to measure this dimension). Slight bellmouth is permissible at contact end of wire barrel.
2. Wire strands must be visible at contact end of wire barrel but shall not extend more than .031"
3. Both insulation and wire strands must be visible between wire and insulation barrels.
4. See Figure 1-9.

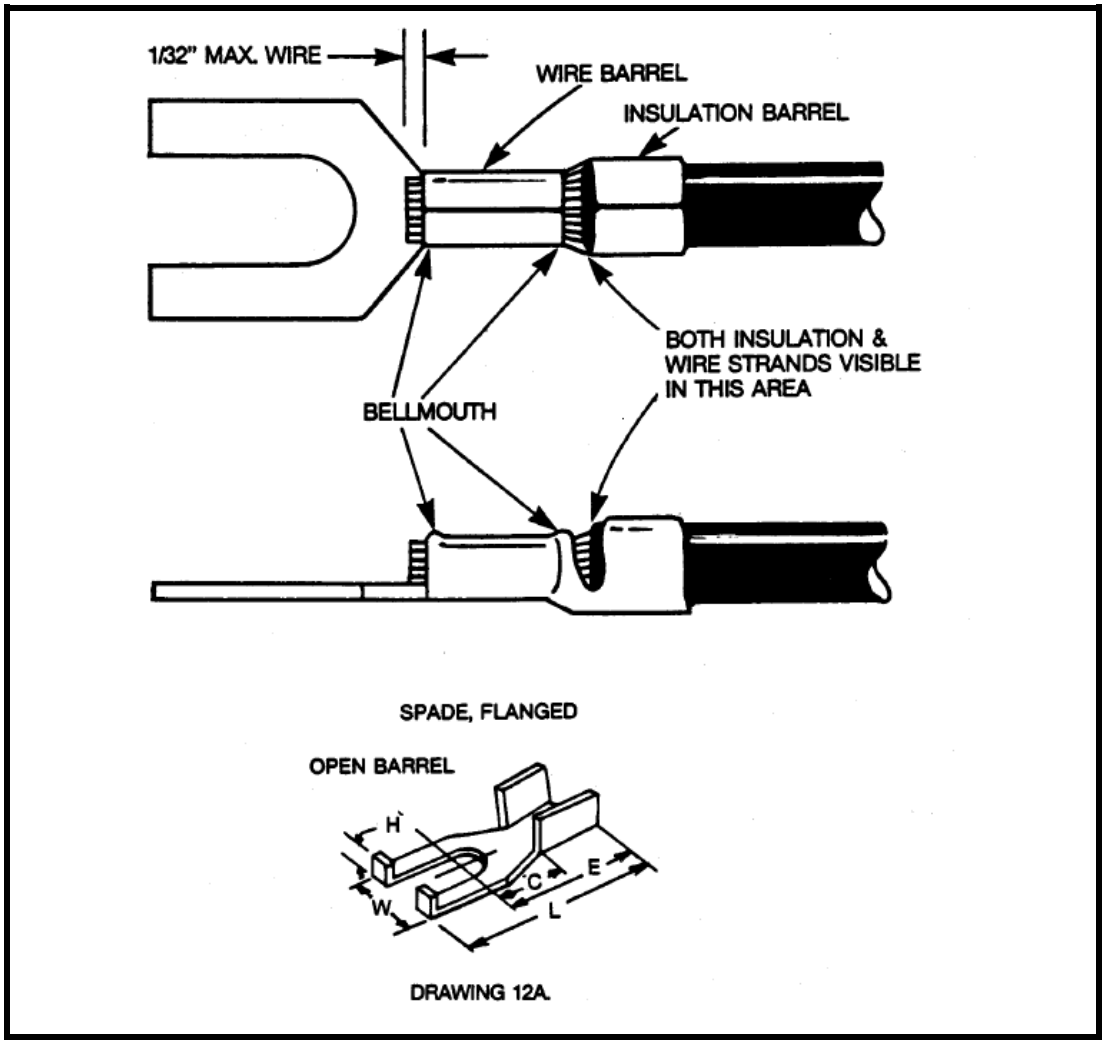


Figure 1-9

1.1.8 AMP Type III (+) Contacts

Visually inspect for the following:

1. Contacts shall not be damaged.
2. Wire strands and insulation must be visible between wire barrel and insulation barrel.
3. Wire strands shall be flush with or extend up to .032” past contact end of wire barrel.
4. See Figure 1-10.

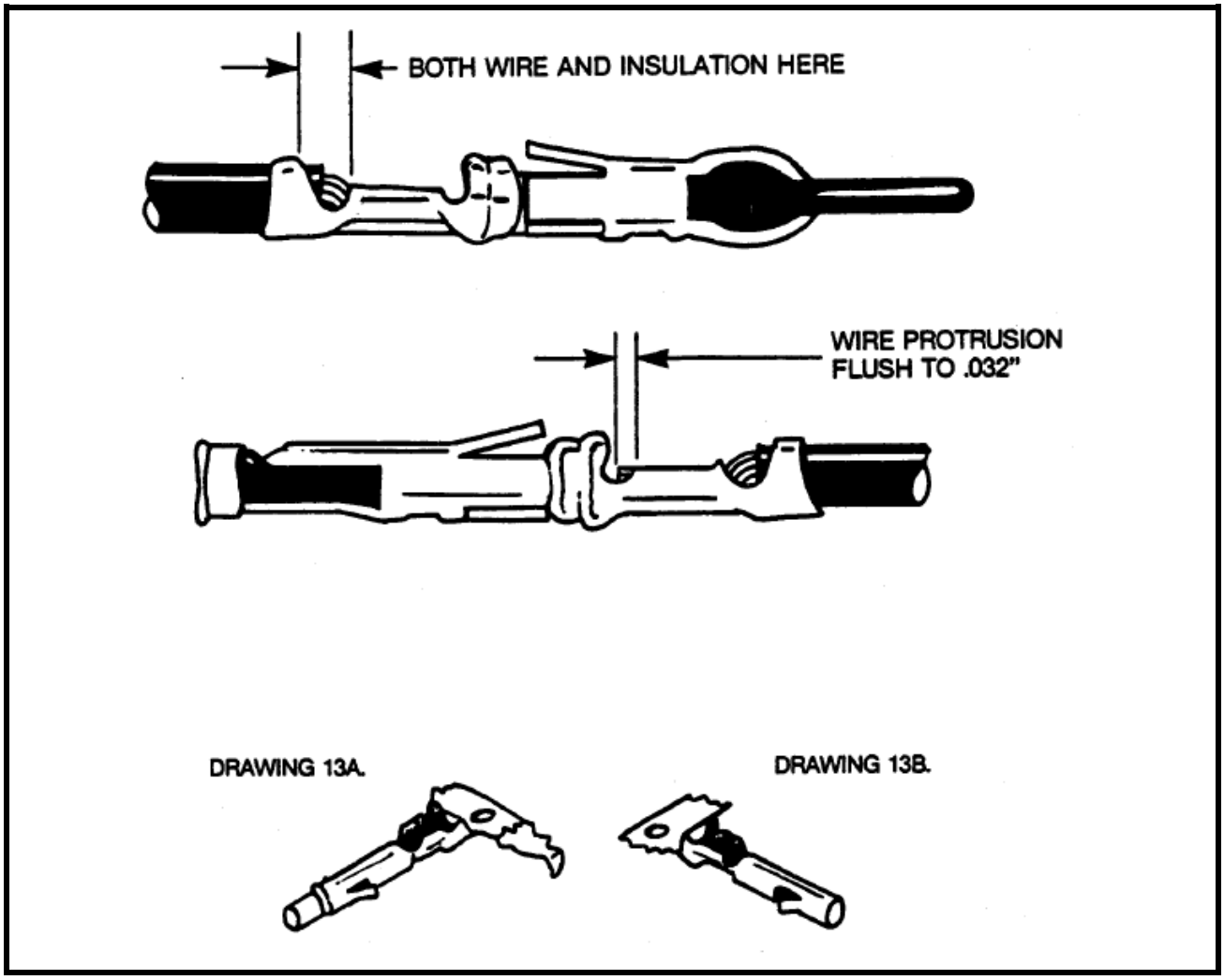


Figure 1-10

1.1.9 AMP Modified Fork Contacts

Visually inspect for the following:

1. Contacts must not be damaged or deformed.
2. Wire strands shall be flush with or extend up to .015” past, contact end of wire barrel.
3. Wire strands and insulation must be visible between wire and insulation barrels.
4. Wire barrel seam must be completely closed.
5. All wire strands must be within wire barrel.
6. See Figure 1-11.

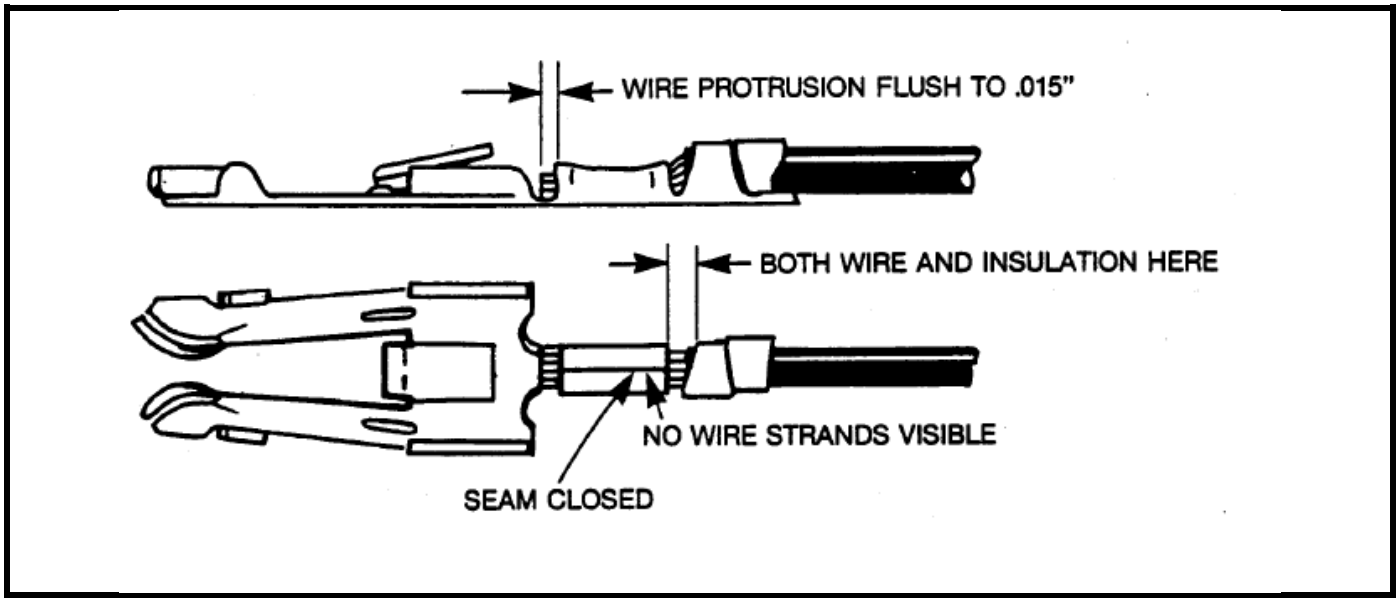


Figure 1-11

1.1.10 AMP Leaf Contacts

Visually inspect for the following:

1. Wire strands and insulation must be visible between wire and insulation barrels.
2. Wire strands shall be flush with or extend up to a maximum of .010" past, the contact end of wire barrel.
3. The locking lance and anti-tangle strap shall not be damaged or deformed.
4. When crimped in hand tool, the following crimp code will be visible:
   4.1. One Dot-crimped in the 22-20 AWG crimp section.
   4.2. Two Dots-crimped in the 18-22 AWG crimp section.
5. See Figure 1-12.

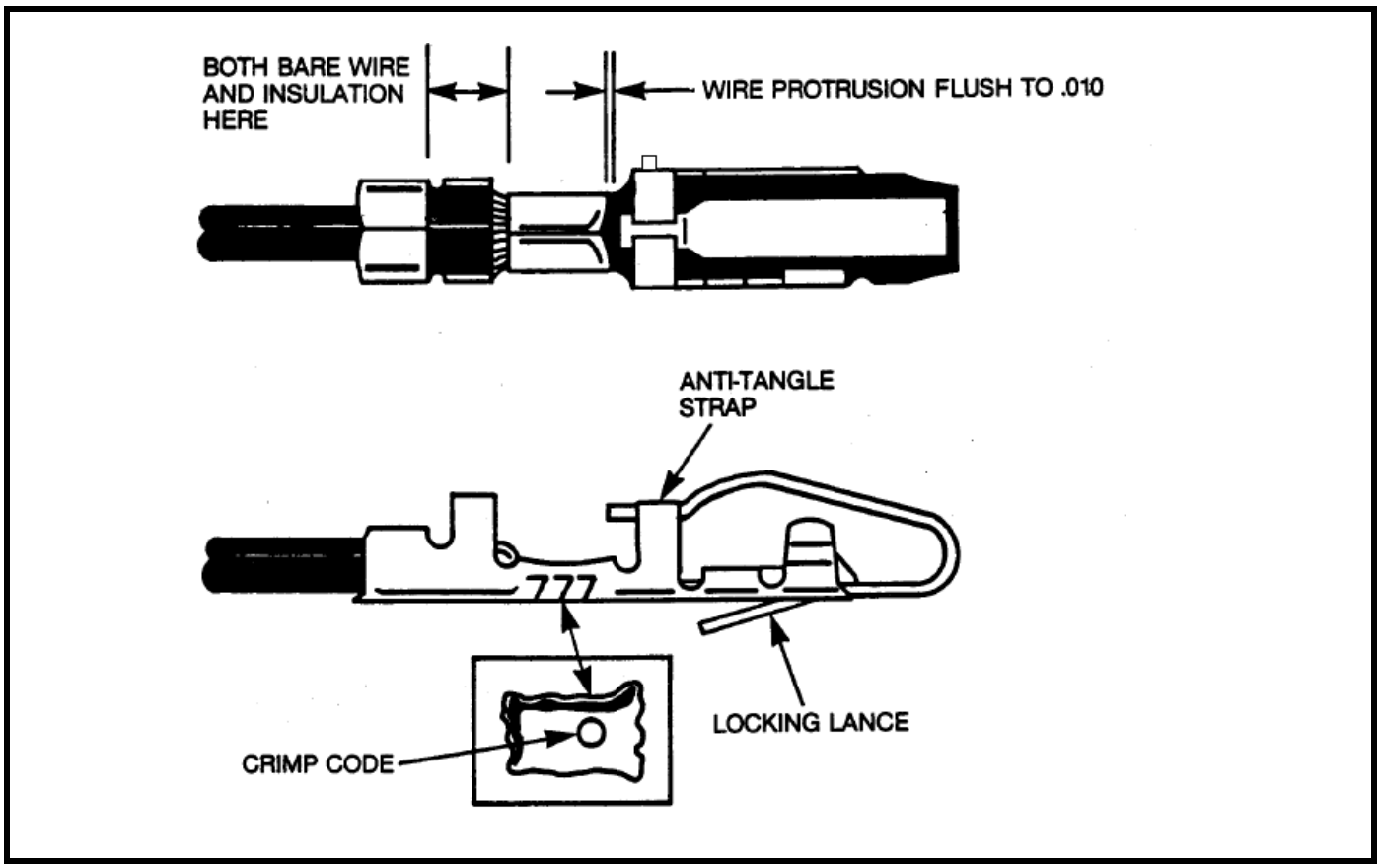


Figure 1-12

1.1.11 AMP Tablok Terminals

Visually inspect for the following:

1. Wire strands and insulation must be visible between wire and insulation barrels.
2. Wire barrel tab #1 must be through tab slot in bottom of terminal, formed against bottom of barrel, indented deeply in position and locked by at least one full locking lance. When only one lance is effective, the other lance must be firmly embedded against edge of tab.
3. Wire barrel tab#2 must extend under full width of locking lances.
4. Wire barrel shoulder must rest against wire barrel area adjacent to slot.
5. Wire shall be visible at front end of wire barrel, never recessed by more than .031", and never extending beyond the cut off tab by more than .010".

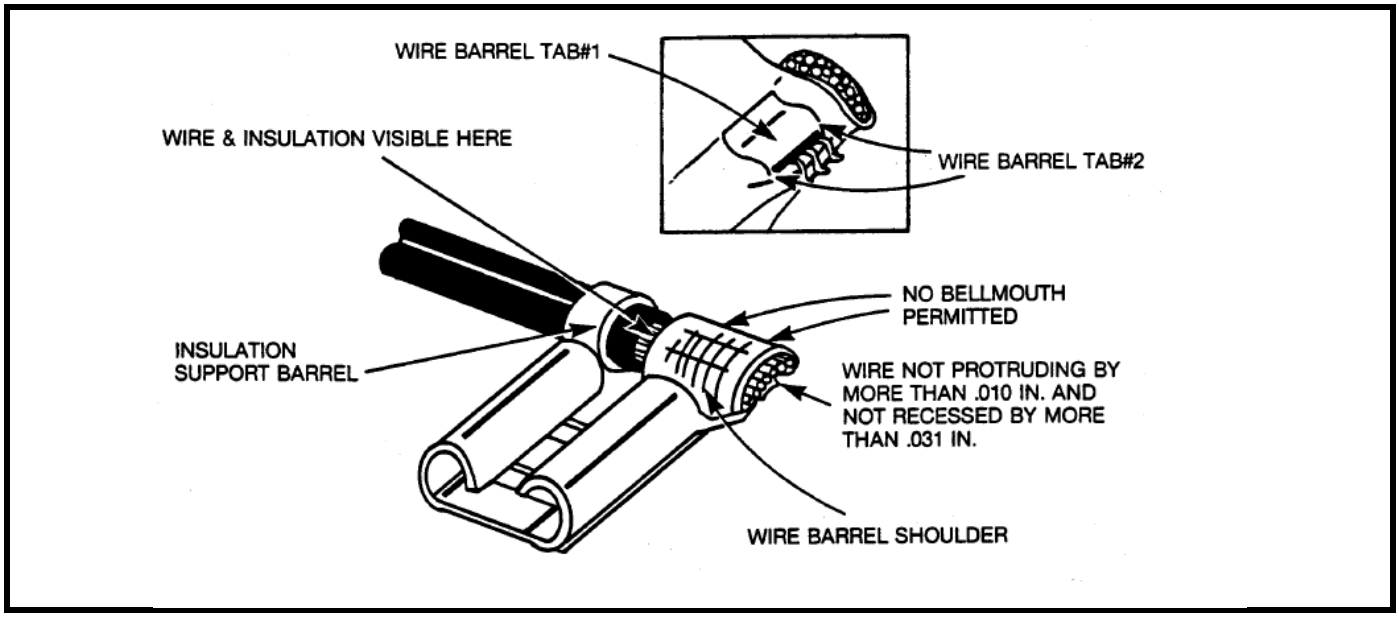


Figure 1-13

6. Insulation support barrel must be formed over insulation to prevent flexing of wire at rear of wire barrel. Wire and insulation barrels must be in alignment after crimping.
7. No bellmouth is permissible at either end of wire barrel.
8. Hair line fractures at ends of tab slot are permissible but must NOT extend more than half the distance between slot and terminal edge.
9. See Figure 1-13 above.

1.1.12 AMP Twin Leaf Contacts

Visually inspect for the following:

1. Wire strands and insulation must be visible between wire and insulation barrels.
2. Wire strands must be flush with or extend no more than .015” past, the contact and of wire barrel.
3. Locking lance and contact stop must not be deformed after crimping.
4. See Figure 1-14.

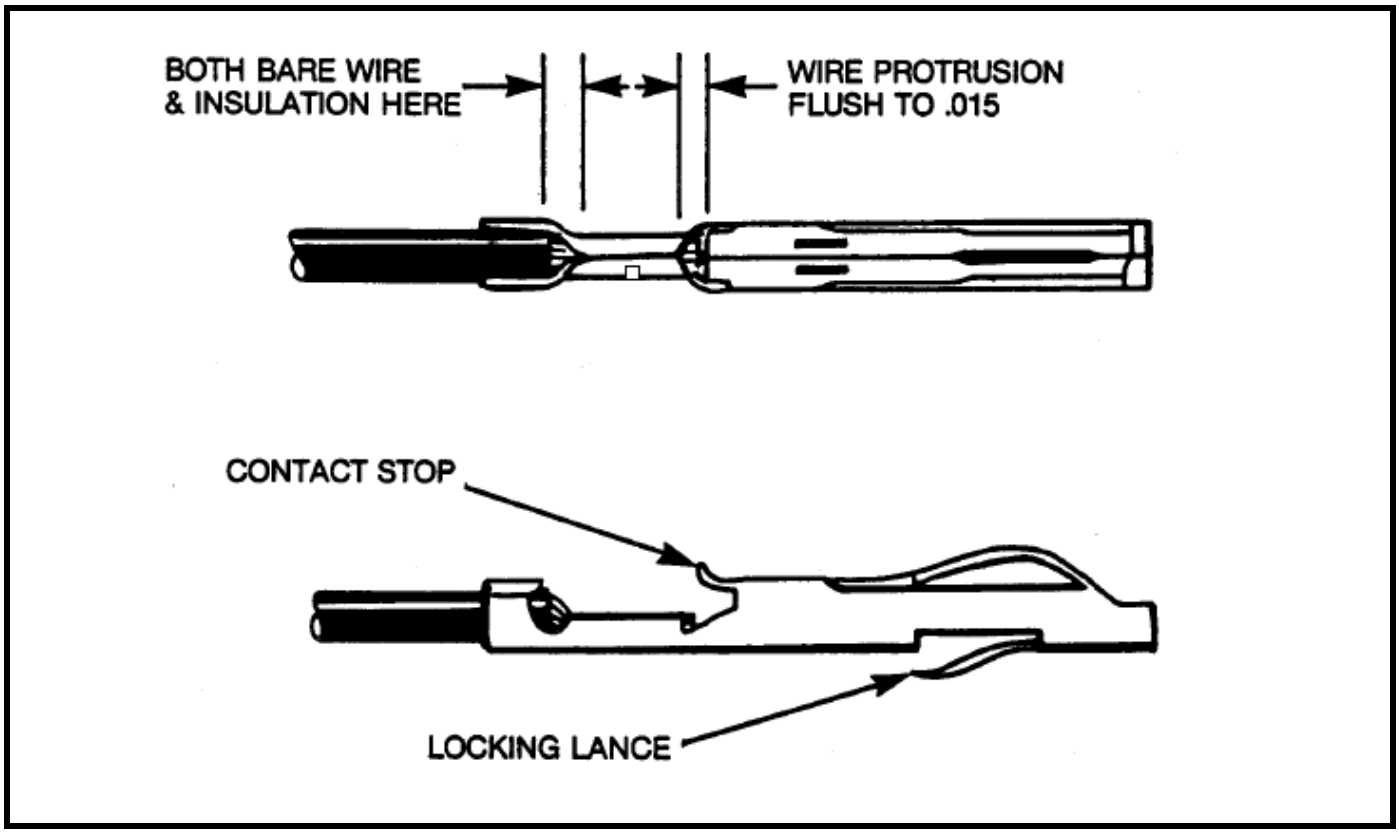


Figure 1-14

1.1.13 Universal Mate "N" Lok Contacts

Visually inspect for the following:

1. Contacts must be straight and cylindrical in shape.
2. Locking lances must not be damaged or deformed.
3. Both insulation and wire strands must be visible between wire and insulation barrels.
4. Wire strands must be visible at contact end of wire barrel.
5. Bellmouth must be visible at both ends of wire barrel. (NOTE: Applies to both male and female contacts)
6. See Figure 1-15.

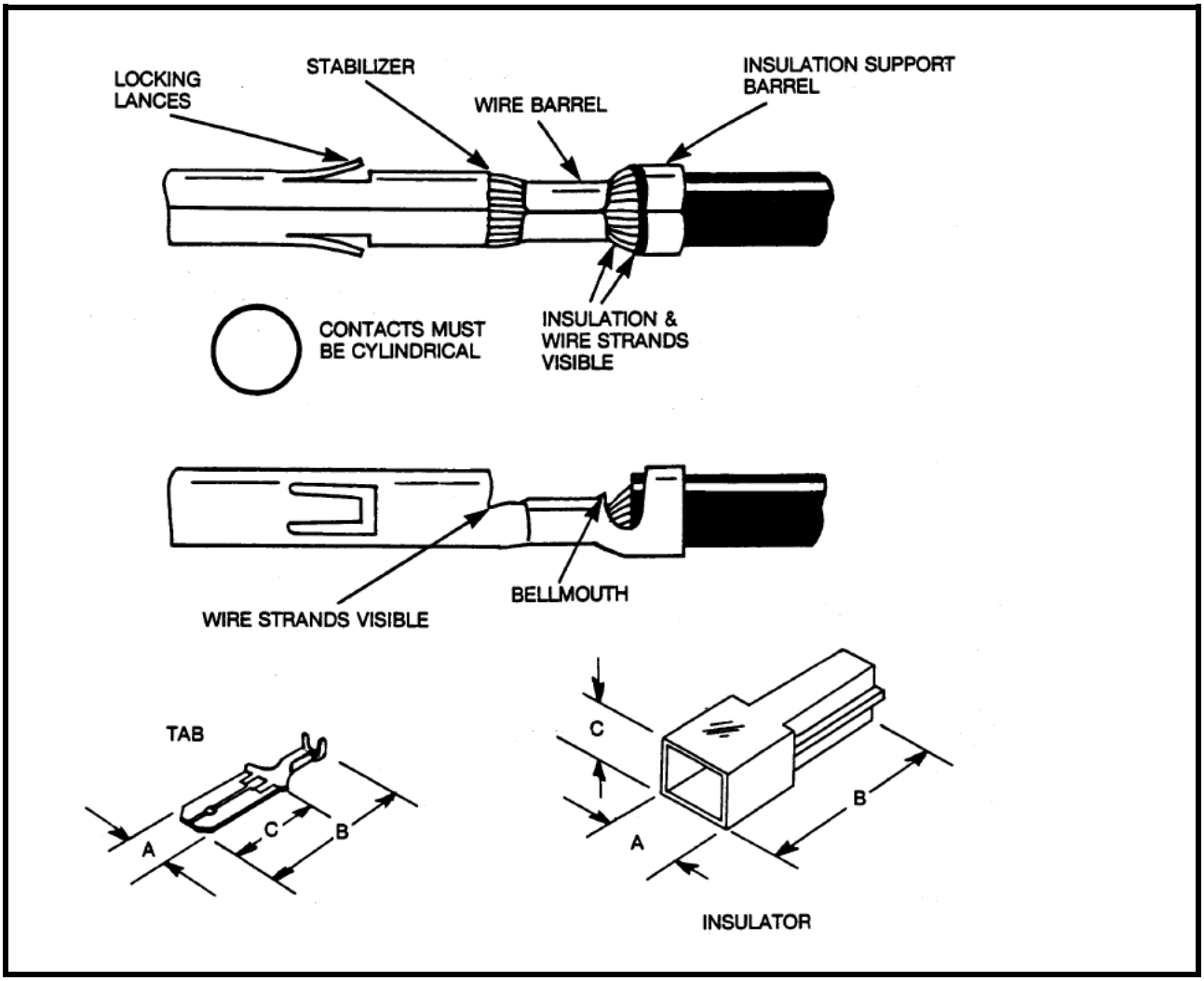


Figure 1-15

1.1.14 Termi-Point Clips (For .031 X .062 Posts)

Visually inspect for the following:

1. Wire strands must be visible.
2. Clips must not interfere with each other.
3. Complete length of clip curls must be in contact with the post.
4. Distance between connector or panel and “wire end” of clip must be equal to or greater than the wire insulation diameter.
5. See Figure 1-16.

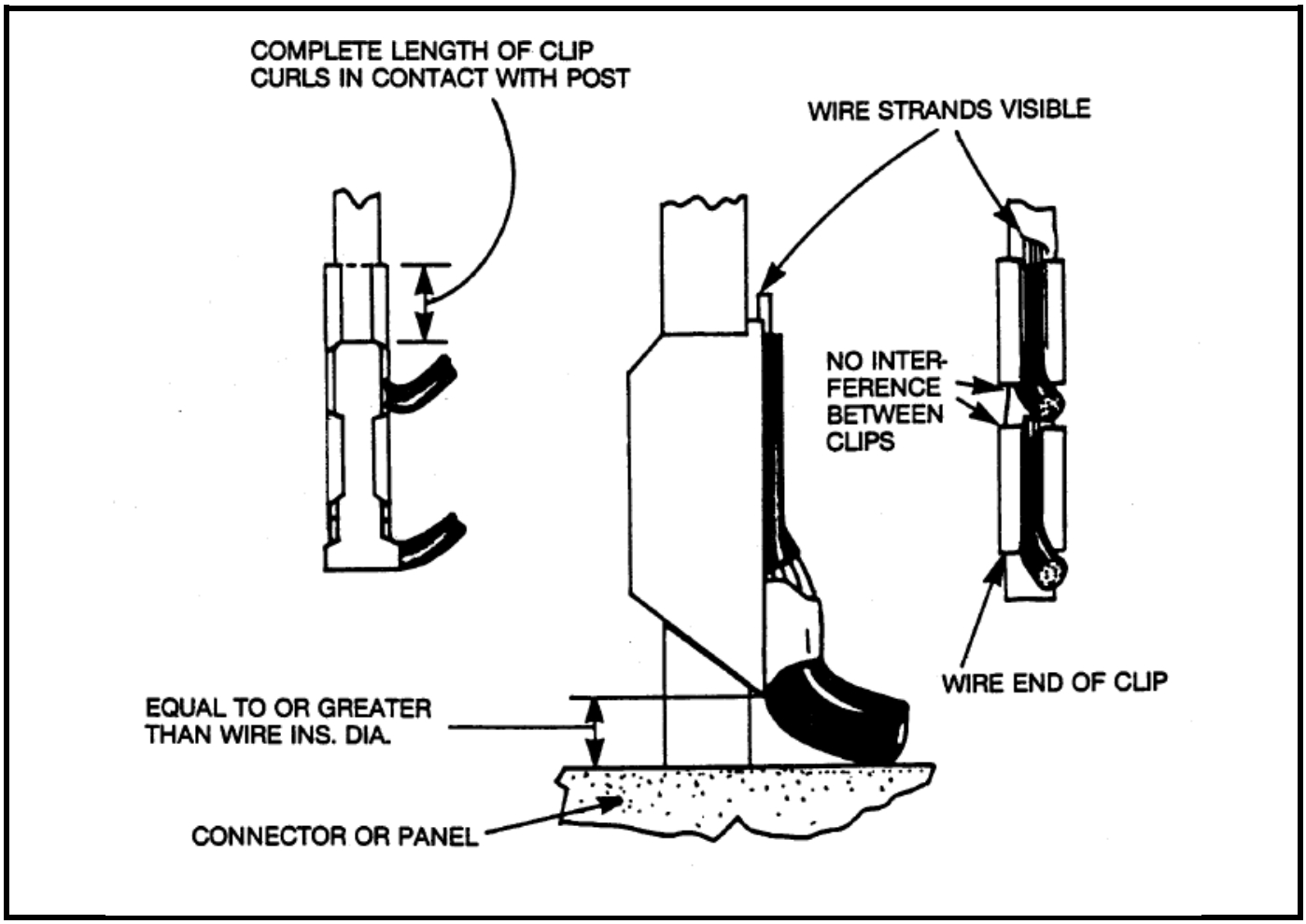


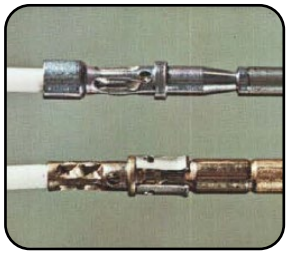
Figure 1-16

1.2 Solderless Connections

1.2.1 Crimped Pins

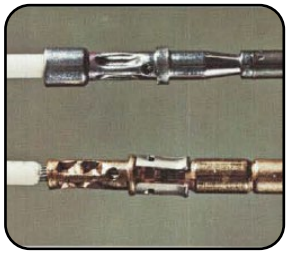
MAGNIFICATION 5X

PREFERRED



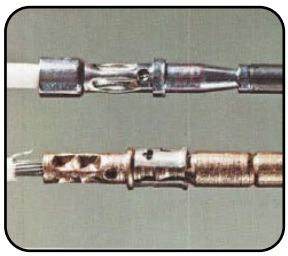
1. Top Pin: (With insulation support well) Insulation has been inserted to the depth of the insulation support well.
2. Bottom Pin: (W/O insulation support well) Insulation has been stripped evenly & neatly & butts on the rear of the contact.
3. Conductors have bottomed in the support wells & are visible through the inspection hole.
4. Crimping indents are well formed & properly positioned.

ACCEPTABLE



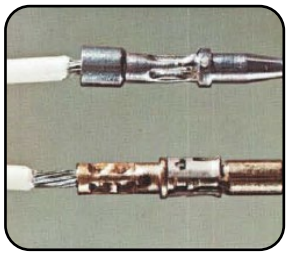
1. Top Pin: (With insulation support well) insulated conductor does not bottom on insulation support well but is within 1/32 inch of the bottom of the well.
2. Bottom Pin: (W/O insulation support well) Exposed bare wire length does not exceed 1/32 inch from the rear of the contact.
3. Conductor is visible through inspection hole.

REJECT



1. Top Pin: (With insulation support well) Insulation not fully seated in support well.
2. Bottom Pin: (W/O insulation support well) Exposed bare wire exceeds 1/32 inch from the rear of the contact crimp barrel.
3. Conductor is visible through inspection hole.

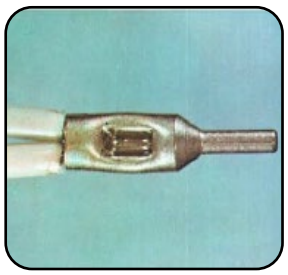
REJECT



1. Top Pin: (With insulation support well) Bare wire visible outside support well.
2. Bottom Pin: (W/O insulation support well) Excess insulation strip. Exposed bare wire exceeds 1/32 inch maximumfrom rear of contact crimp barrel.
3. Conductors have not bottomed in the support well & are not visible through inspection hole.
4. Top Pin: Crimping indents too low.

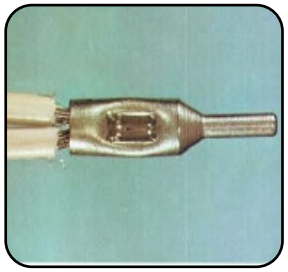
1.2.2 Multiwire

MAGNIFICATION 5X



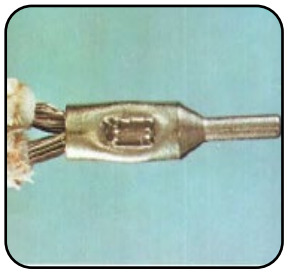
PREFERRED

1. Insulation has been stripped evenly & terminates flush with the rear of the contact barrel.
2. Conductors are bottomed in the support well.
3. Crimp indent is well formed & centered.
4. Crimp does not affect barrel.



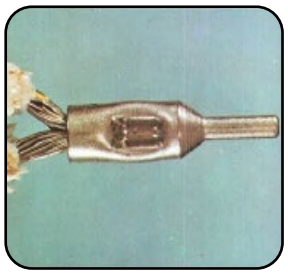
ACCEPTABLE

1. Insulation terminates within 1/32 inch of the rear of the contact barrel.
2. Insulation trim is slightly uneven.
3. Crimp indent is well formed & centered.
4. Crimp does not affect barrel.



REJECT

1. Exposed bare wire exceeds 1/32 inch from rear of the contact barrel.
2. Birdcaging on top wire is not acceptable.



REJECT

1. Exposed bare wire exceeds maximum tolerance specified above.
2. Conductors are not bottomed in the barrel.
3. Crimp indent is too low.
4. Frayed insulation.

1.2.3 Shielding Ferrules

NOTE: Administer pull test to ground lead to assure solid connection.

MAGNIFICATION 5X

PREFERRED

1. Ground wire insulation terminates inside ferrule insulation & is approximately 1/16 inch back from the metal crimp barrel.
2. Crimp indents are centered in the metal crimp barrel & are fully formed.
3. Shield & ground conductors cut-off flush with end of ferrule.
4. Filler (braided shield) added as required to fill crimp barrel tightly prior to crimping.

ACCEPTABLE

1. Ground wire insulation contacts but is not under crimp barrel
2. Shield & ground wire conductors do not exceed 1/16 inch beyond end of ferrule.

ACCEPTABLE MINIMUM

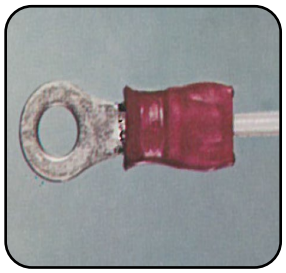
1. Ground wire insulation is recessed inside ferrule insulation at least 1/16 inch.
2. Shield & ground wire conductors are slightly recessed from end of ferrule insulation, however, all conductors extend beyond metal crimp barrel.

REJECT

1. Ground wire insulation is not under ferrule insulation, bare conductor showing.
2. Crimp indent improperlly located on barrel. Too close to end of crimp barrel.
3. Crimp indent not fully formed, too shallow.
4. Shield & ground wire conductors are recessed inside the metal crimp barrel.

1.2.4 Terminal Lugs

MAGNIFICATION 5X



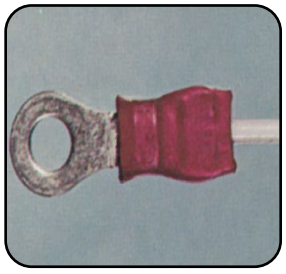
PREFERRED

1.a) Barrel crimping indent is well formed and properly positioned.

b) Wire insulation grip impression is well formed and provides proper support without crushing the insulation.

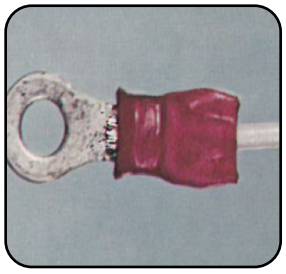
c) Correct crimp tool jaws used, indicated by (1) dot in barrel crimp (red lug).

2. End of bare conductor protrudes through crimp barrel approximately 1/32 inch.



ACCEPTABLE

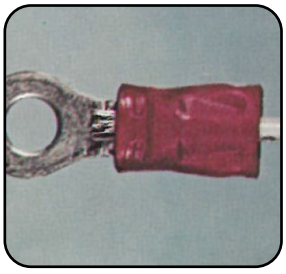
1. Bare conductor protrudes through crimp barrel the minimum distance. (Flush with crimp barrel)



ACCEPTABLE MINIMUM

1. Bare conductor protrudes through crimp barrel the maximum distance but does not exceed 1/16 inch.

REJECT



1. a) Barrel crimping indent is only partially located over the lug barrel. Lug was not fully inserted into the crimp jaws.

b) Incorrect crimp tool jaws used (indicated by two (2) dots in barrel crimp for blue lug). Insufficient prewssure applied.

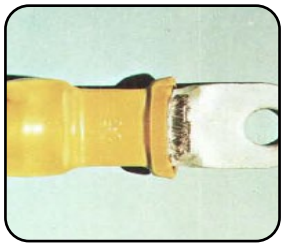
c) Wire insulation grip pressure is insufficient to provide proper gripping of the insulation.

2) Bare conductor protrudes through crimp barrel in excess of 1/16 inch.

1.2.5 Terminal Lugs - Multiwire

MAGNIFICATION 5X

PREFERRED

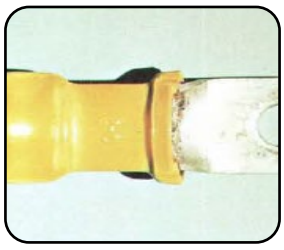


Multiple conductors in a single conductor installations due to the tendency of one or more conductors to "crawl" during crimping operation.

1. Barrel crimping indent is smoothly formed and positioned to securely clamp both conductors.

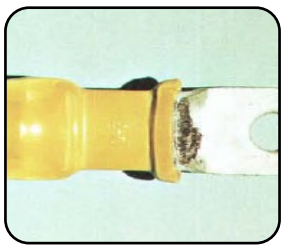
2. Wire Insulation impression is evenly formed and provides support without crushing insulation.

3. End of bare conductors protrude through crimp barrel approximately 1/32 to 1/8 inch depending on lug size and crimp tool recommended stop setting.



ACCEPTABLE

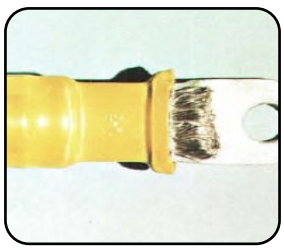
1. Bare conductors are flush with end of the crimp barrel and both are securely clamped by the crimping barrel.



ACCEPTABLE MINIMUM

1. Bare conductors are trimmed unevely; however, all strands protrude through the crimp barrel and no strands extend onto the lug tongue flat.

2. Bare conductors not extending through the crimp barrel are rejectable.



REJECT

1. Bare conductors protrude through crimp barrel and extend onto the lug tongue flat.

2. Wire insulation grip indent is insufficient to provide proper gripping of the insulation.

1.3 Cable and Harness Wiring Connectors

1.3.1 Hardface Dielectric

MAGNIFICATION 6X

PREFERRED

1. The dielectric and insert cavities are intact without visible damage such as chipping, crazing, cracks or wear.

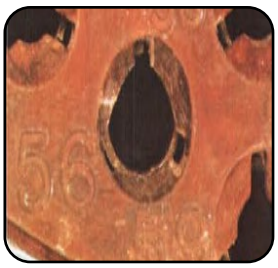
ACCEPTABLE

1. Insert cavity shows major scrape marks and slight crazing at the edges of the flanges.

ACCEPTABLE MINIMUM

1. Insert target hole shows evidence of slight wear. Edges of flage are chipped; however, the contact release sleeve is not exposed.

NOTE: Acceptable only on connectors after inprocess assembly or test.



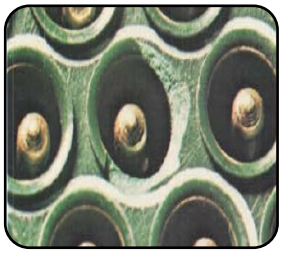
REJECT

1. Insert target hole is oversize and "out of round".
2. Flanges have been chipped or broken exposing the contact release sleeve.

MAGNIFICATION 6X

PREFERRED

1. Dielectric is intact without evidence of chipping, cracks or other damage.

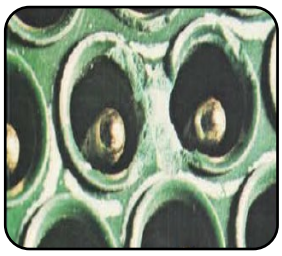


ACCEPTABLE

1. Chipping extends around the seal perimeter and into the cavity. Dielectric has not been chipped between seals.
2. Chipping does not extend from any seal to outer shell.

ACCEPTABLE MINIMUM

1. Total seal has been chipped off but dielectric between seals is intact.
2. Chipping does not extend from one seal to the outer diameter of any adjacent seal.

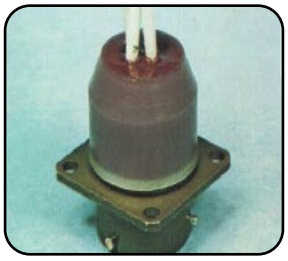


REJECT

1. Chipping extends from seal to the outside diameter of the adjacent seal.
2. Two chips on adjacent seals are potential leakage paths.

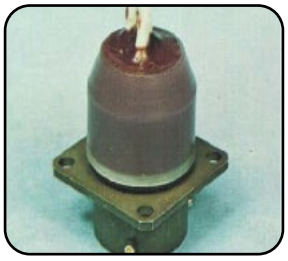
1.3.2 Potting

ACTUAL SIZE



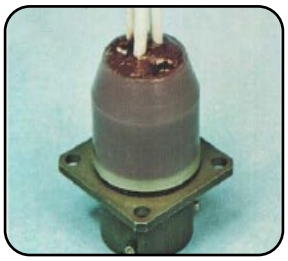
PREFERRED

1. Compound is smooth, uniform in color and even with the top of potting boot.
2. Wires and adjacent surfaces are free of spatter.
3. Wires centered in boot.



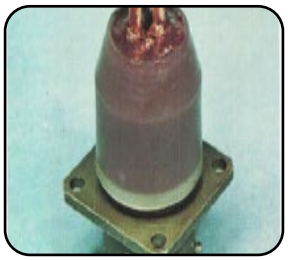
ACCEPTABLE

1. Small spatters of compound are firmly anchored to wire insulation.
2. Compound build-up around wires does not exceed 1/8 inch above top of potting boot.
3. Small surface voids are less than 1/16 inch in diameter.



ACCEPTABLE MINIMUM

1. Voids exceed 1/16 inch in diameter but do not expose connector surfaces or connector contacts.
2. Amount of potting compound in boot is minimum but exceeds height of solder cups by at least 1/4 inch.



REJECT

1. Compound has "feathered" on the wire insulation and has not been removed.
2. Compound has color streaks indicating improper mixing with curing agent.
3. Amount of compound in potting boot is below minimum.
4. Voids in compound expose solder or connector contacts.

1.3.3 Potting Compound

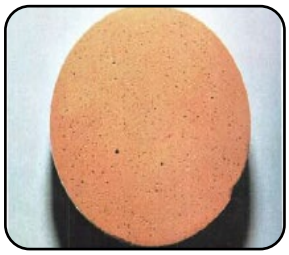
NOTE: When sectioning sample of synthetic rubber compound is required, sections shall be compared with following standards for acceptance criteria.

ACTUAL SIZE

PREFERRED

1. Compound is uniform in color without streaks, tackiness or other evidence of improper mixing.

2. Texture of compound is uniform and shows no voids or other evidence of air entrapment.



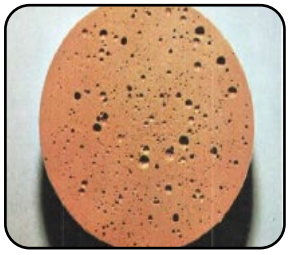
ACCEPTABLE

1. Texture is grainy and there are isolated small holes; however, there is no evidence of air entrapment or void areas.

ACCEPTABLE MINIMUM

1. Section shows numerous small holes which are less than 1/16 inch in diameter; however, they do not interlock and the surface is firm.

2. Environmental sealing protection is adequate.



REJECT

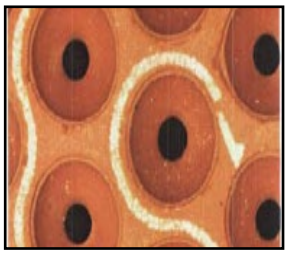
1. Compound shows numerous holes and voids in excess of 1/16 inch diameter.

2. Surface is spongy and the environmental sealing protection is questionable.

3. Discoloration and spongy areas are indicative of improper mixing of compound.

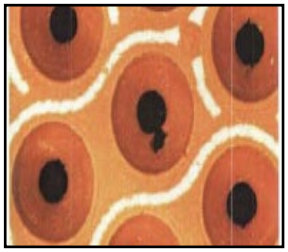
1.3.4 Resilient Dielectric

MAGNIFICATION 6X



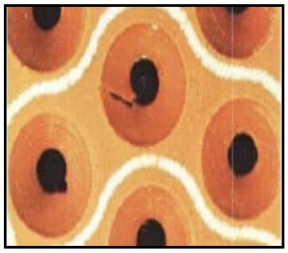
PREFERRED

1. Dielectric is intact, without evidence of plugging, cracks, cuts, chips or other damage.



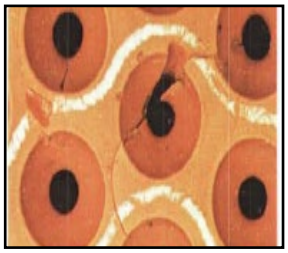
ACCEPTABLE

1. Small plug has been cleanly cut out by insertion/extraction tool without damage to dielectric between cups.
2. Small chips at interface of cup and dielectric face do not extend to adjacent cups.



ACCEPTABLE MINIMUM

1. Cut made by insertion/extraction tool extends only to interface of cup and dielectric face. Dielectric face between cups is undamaged.



REJECT

1. Large plug and chip have been cut out of cup area and extends into dielectric face.
2. Cuts and tears in dielectric extend beyond cup diameters and interconnect adjacent cups.

1.3.5 Shell Finish

NOTE: The following standards apply only to assembled and installed MIL type electrical connectors.

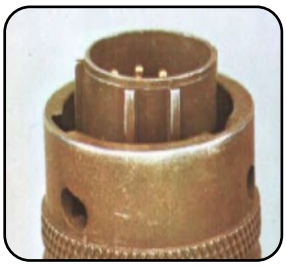
MAGNIFICATION 3X

PREFERRED

1. Shell surface is clean and unmarked.
2. Nomenclature and/or identification is neat and legible.

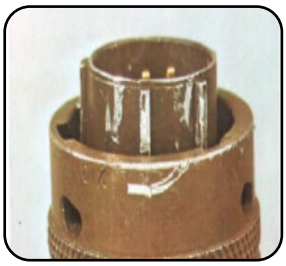
ACCEPTABLE

1. Minor surface marks and abrasions do not penetrate the protective finishes or deface markings.



ACCEPTABLE MINIMUM

1. Positioning keys or keyways that show surface scuff marks or that have the base metal exposed on the radius, as a result of normal wear or shop environment are acceptable providing key or keyway dimensions are not changed or the base material mutilated.



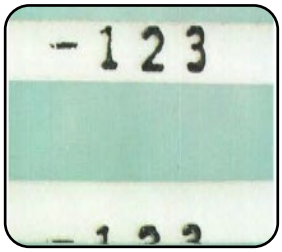
REJECT

1. Shell and positioning keys are mutilated and contain deep scratches and burrs.
2. Key width and height have been reduced by abrasions and scraping.

1.4 Wire Preparation – Identification Marking

NOTE: Top wire, front view of markings. Bottom wire, side view of markings.

MAGNIFICATION 6X



PREFERRED

1. Markings are sharp, legible and unblurred.
2. Insulation has not been indented or deformed by marking die.

ACCEPTABLE

1. Markings are slightly "feather edged"; however, they are clear and legible.
2. Slight indentations caused by marking die do not perforate or damage the insulation.

ACCEPTABLE MINIMUM

1. Marking is heavy; however, characters are legible and unblurred.
2. Insulation has evidence of die forming and indentation; however, it has not been perforated. No evidence of burning or other damage.

REJECT

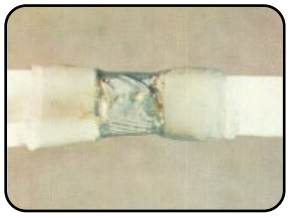
1. Marking characters are blurred and malformed.
2. Marking die has perforated, flattened and burned the wire insulation.

1.5 Solder Coverage – Solder Sleeve

MAGNIFICATION 5X

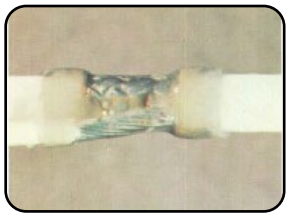
PREFERRED

1. Good even solder flow. Original solder ring is no longer discernible.
2. Smooth, concave, solder fillet visible between shield and jumper. Shield and jumper lead strands are tinned and are clearly discernible.
3. Sleeve and wire insulation shows no discoloration due to excessive heat.



ACCEPTABLE

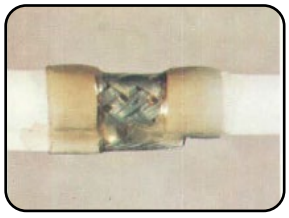
1. Solder flow is minimum. Heavy (maximum) fillet has formed between the shield and jumper. Shield and jumper strands are discernible. Joint indicates minimum but adequate heat applied.
2. Exposed bare wire (strip length) on shield and jumper is not less than 3/16 inch.



ACCEPTABLE MINIMUM

1. Solder flow is maximum. Light (minimum) fillet has formed between shield and jumper. Joint indicates maximum heat applied.
2. Exposed bare wire (strip length) on shield and jumper does not exceed 1/4 inch.
3. Plastic sleeve is slightly discolored but not burned or charred.

NOTE: Solder pooling may occur along the jacket insulation provided there is a definite solder fillet between the shield mass and the jumper wire conductor.



REJECT

1. Solder flow is excessive. Fillet between shield and jumper is not sufficient. Joint indicates excessive heat applied.
2. Jumper wire bridges stripped suface on shield, preventing wire to wire contact.
3. Plastic sleeve is charred by excess heat.

"Solder Sleeve" is a Raychem Corporation Registered Trademark.

1.6 Ribbon Cable – Surface Flaws

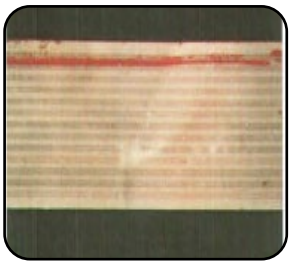
MAGNIFICATION 1X

PREFERRED

1. Ribbon cable free of any defects.

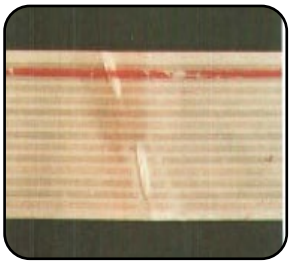
ACCEPTABLE

1. Random marks on surface; no insulation damage.



REJECT

1. Evidence of separation or delamination.

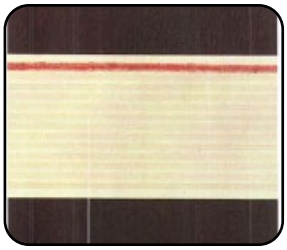


REJECT

1. Severe separation and delamination; profile of conductor not visible.

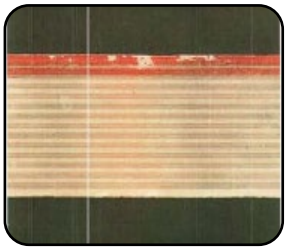
1.6.1 Edge Damage

MAGNIFICATION 1X



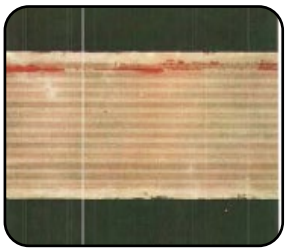
PREFERRED

1. Ribbon cable free of any defects.



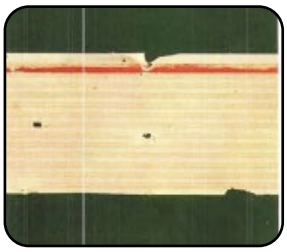
ACCEPTABLE

1. Edge of ribbon cable shows evidence of nicks; however, insulation of the conductors has been maintained.



ACCEPTABLE MINIMUM

1. Ragged edges along the ribbon cable. Conductors not exposed.



REJECT

1. Insulation cut along cable; delamination present and copper exposed.

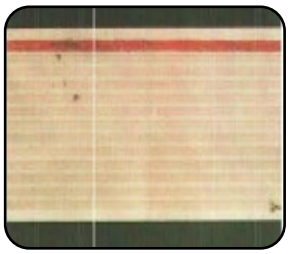
NOTES: ANY exposure of copper is rejectable. There are no "ACCEPTABLE" or "ACCEPTABLE MINIMUM" standards for this condition.

1.6.2 Creases

MAGNIFICATION 1X

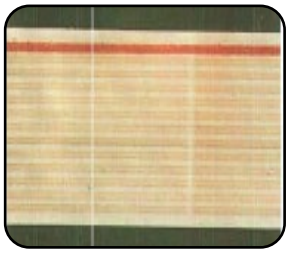
PREFERRED

1. Ribbon cable free of any defects.



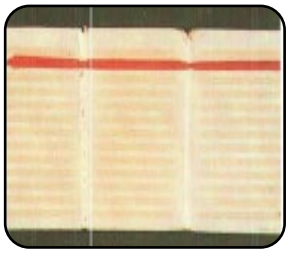
ACCEPTABLE

1. Surface indicates cable folded, with no permanent mark.



ACCEPTABLE MINIMUM

1. More severe crease of cable; white line caused by retardant material. Some indentation in insulation.



REJECT

1. Severe crease across part or all conductors; insulation is indented and copper expanded.

1.6.3 Dents

MAGNIFICATION 1X

PREFERRED

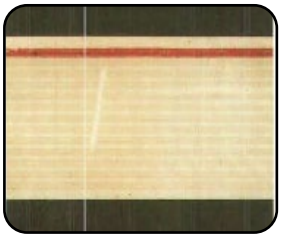
1. Ribbon cable free of any defects.

ACCEPTABLE

1. Surface indicates contact in an area longer than a dig but insulation is not broken.

ACCEPTABLE MINIMUM

1. Indentation in insulation longer than a dig. Insulation is not broken.

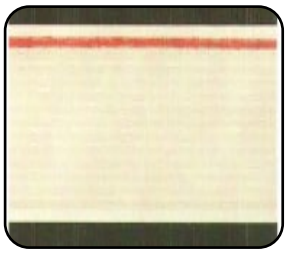


REJECT

1. Indentation broken; dent may, in fact, bridge conductors; copper subject to contamination.

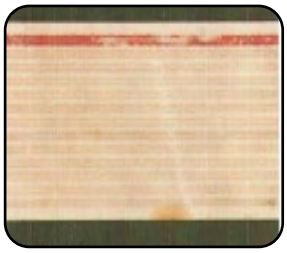
1.6.4 Scratches

MAGNIFICATION 1X



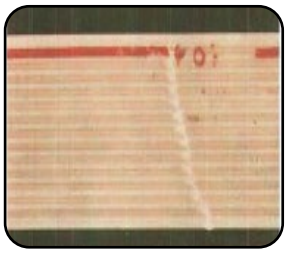
PREFERRED

1. Ribbon Cable free of any defects.



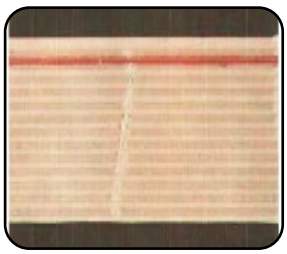
ACCEPTABLE

1. Surface indication due to slight pressure applied by contact. Insulation is not damaged.



ACCEPTABLE MINIMUM

1. Profile of conductors appears irregular due to increased pressure and retardant material. Indentation in insulation.



REJECT

1. Indentations deep with broken insulation. Copper may be exposed to environment.

1.6.5 Digs

MAGNIFICATION 1X

PREFERRED

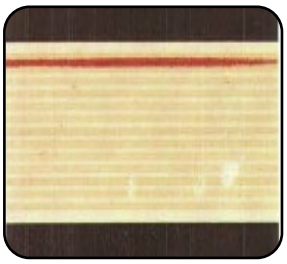
1. Ribbon cable free of any defects.

ACCEPTABLE

1. Surface indicates contact but insulation not broken.

ACCEPTABLE MINIMUM

1. Indentation in insulation causing exposure of white retardant material.



REJECT

1. Deep indentations deforming copper conductors and revealing white retardant material.

SECTION 2 - FABRICATION

2.1 Perpendicularity of Holes

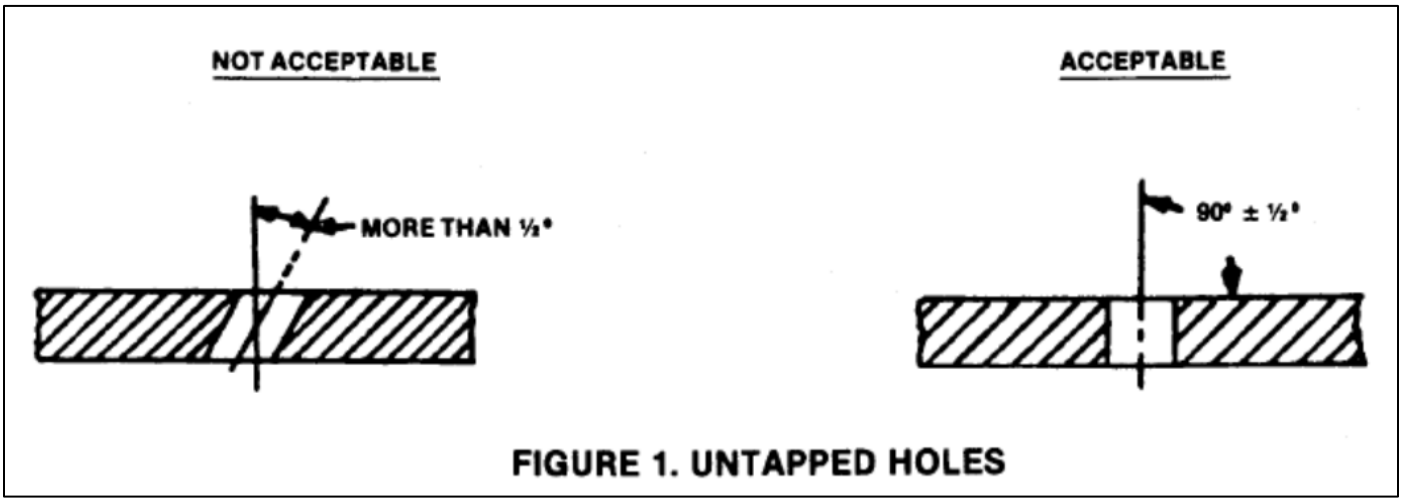


FIGURE 1. UNTAPPED HOLES

NOT ACCEPTABLE

A. Perpendicularity of a hole to a surface.

ACCEPTABLE

A. Perpendicularity of a hole to a surface does not exceed 1/2° in any direction.

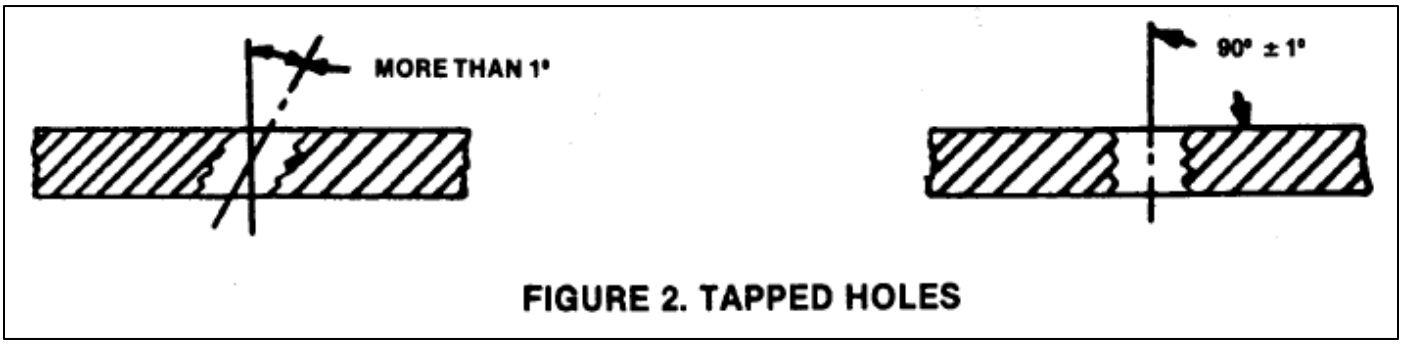


FIGURE 2. TAPPED HOLES

NOT ACCEPTABLE

A. Perpendicularity of a hole to a surface exceeds 1°.

ACCEPTABLE

A. Perpendicularity of a hole to a surface does not exceed 1° in any direction.

2.2 Dimensioning

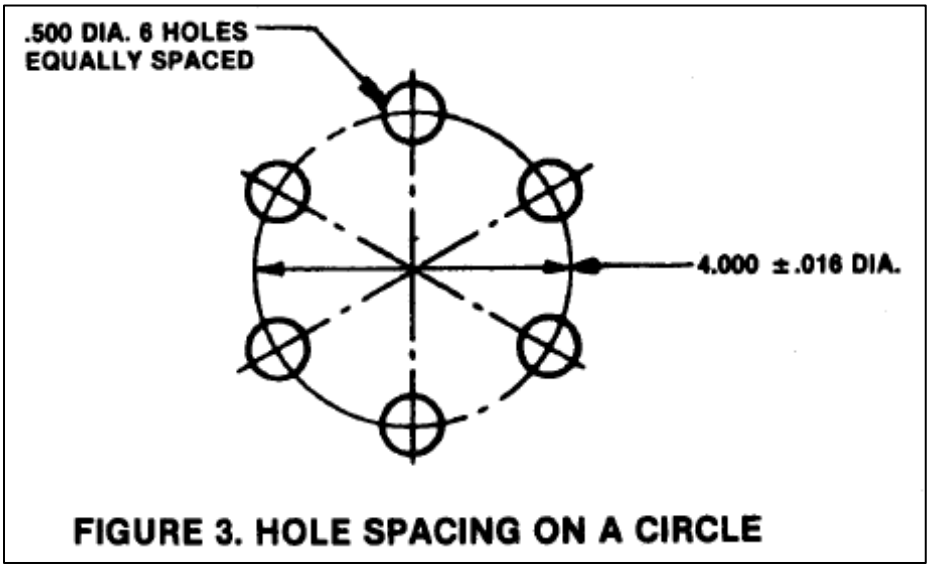


FIGURE 3. HOLE SPACING ON A CIRCLE

As shown on drawing: Deviation of each hole, from its true location not to exceed ¼ of tolerance (¼ of .032 = .008) on diameter of circle.

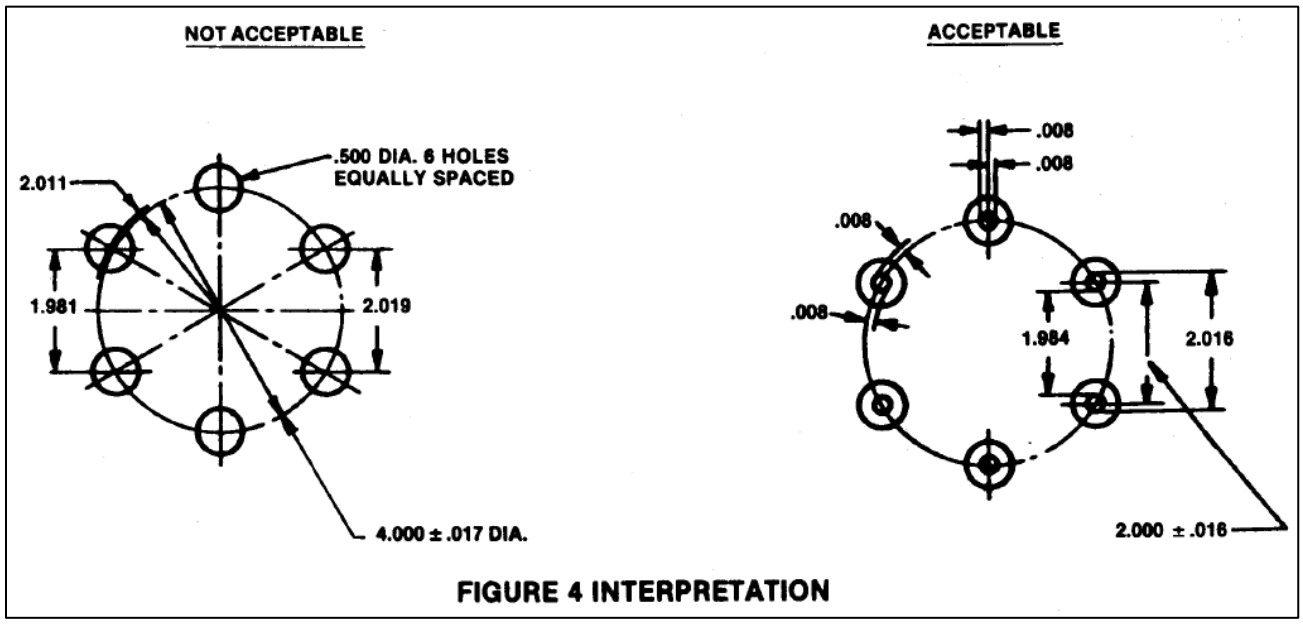


FIGURE 4 INTERPRETATION

NOT ACCEPTABLE

A. Location and radius exceed permissible deviation of .008 from true location.

ACCEPTABLE

A. Hole location and radius within the .008 allowable deviation.

Dimensioning

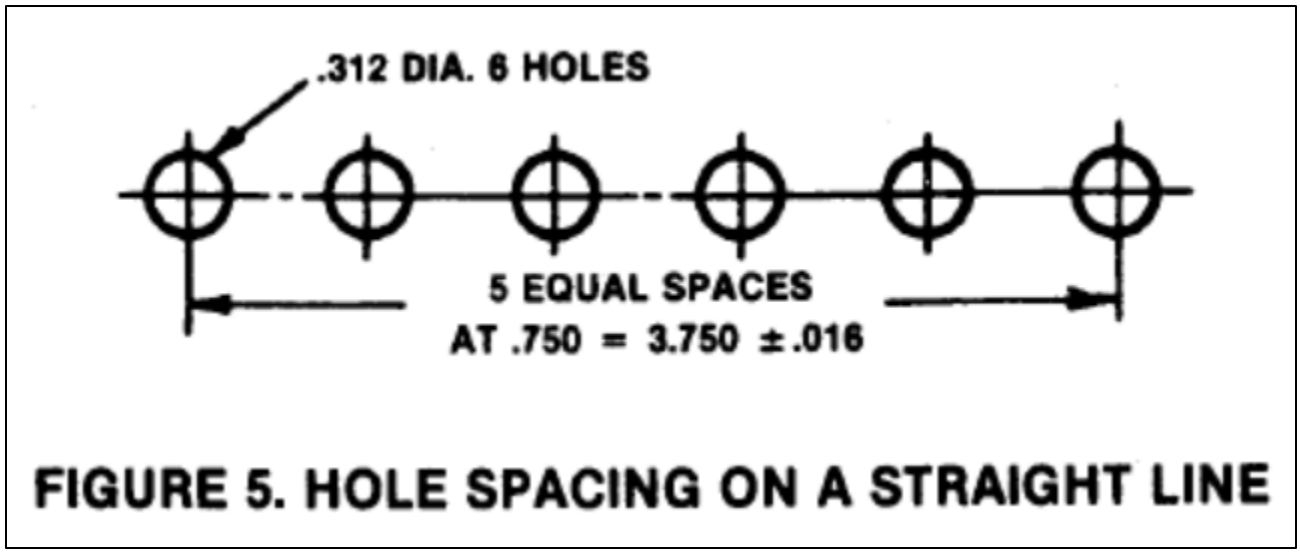


FIGURE 5. HOLE SPACING ON A STRAIGHT LINE

As shown on drawing: Deviation of each hole, from its true location not to exceed ¼ of total tolerance (¼ of .032 = .008) on the overall dimension.

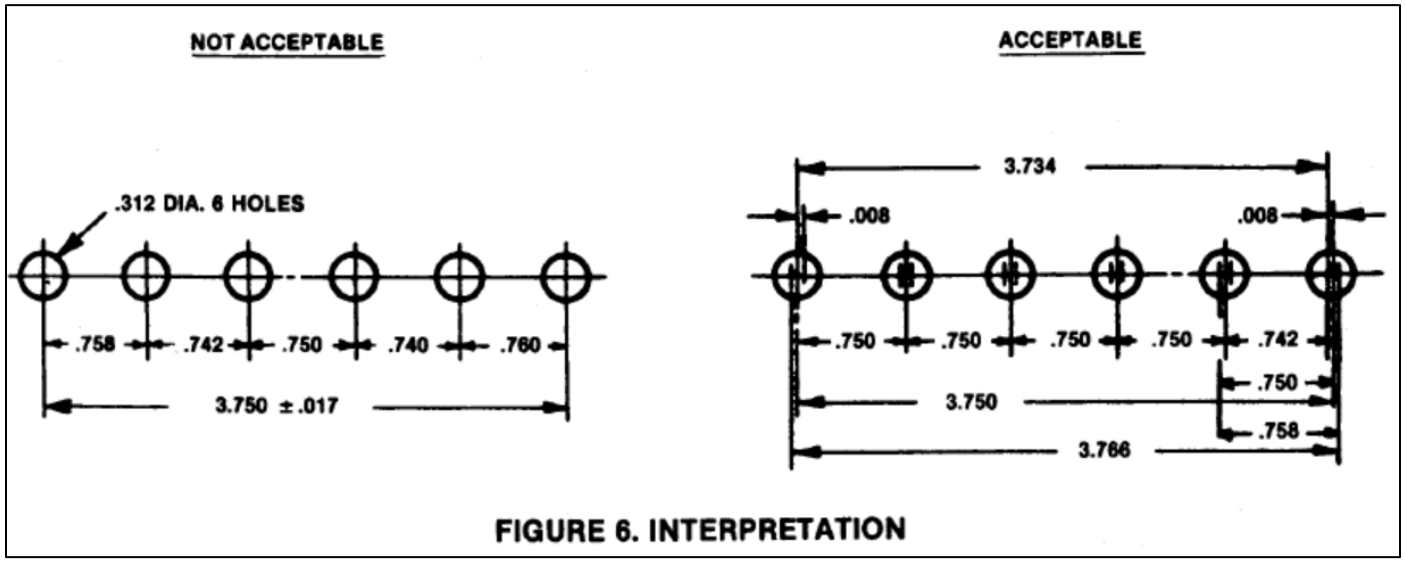


FIGURE 6. INTERPRETATION

NOT ACCEPTABLE

A. Hole center deviates more than .008 from true location on some holes.

ACCEPTABLE

A. Hole centers within .008 of true location.

Dimensioning

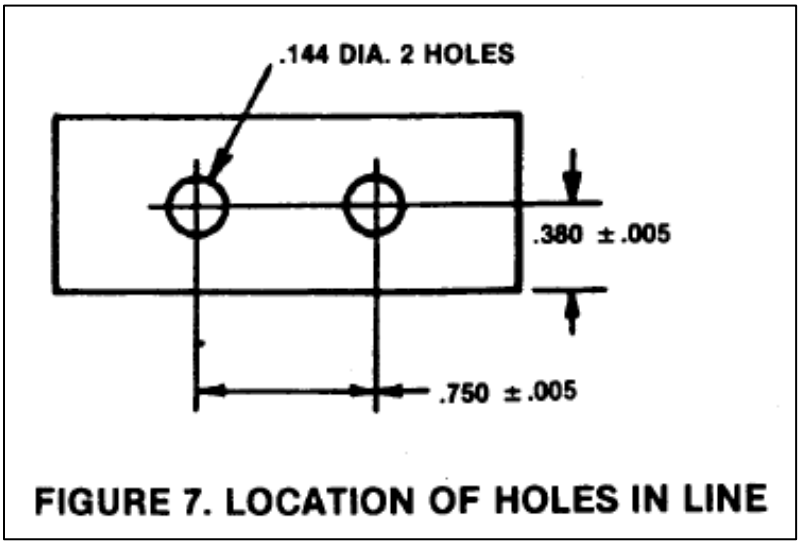


FIGURE 7. LOCATION OF HOLES IN LINE

As shown on drawing: Deviation of hole from its true location not to exceed ¼ of total tolerance (¼ of .010 = .0025) on the spacing dimension.

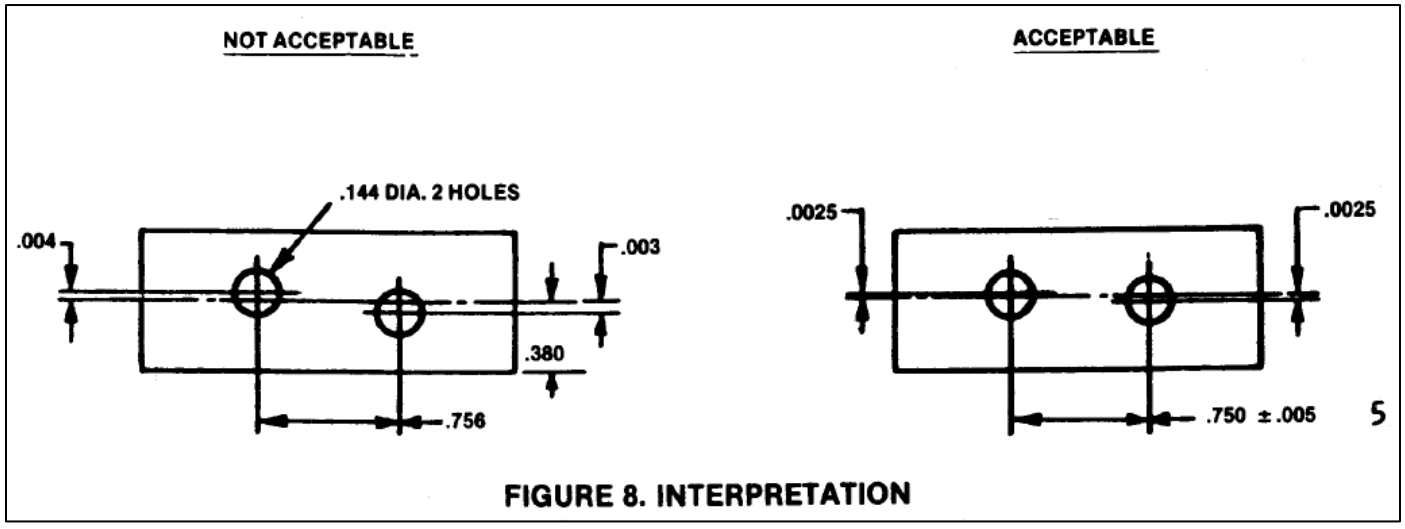


FIGURE 8. INTERPRETATION

NOT ACCEPTABLE

A. Deviation from true location exceeds .0025.

ACCEPTABLE

A. Deviation within .0025 of true location.

2.3 Machined and Sheet Metal Parts

2.3.1 Drilled Hole Tolerances

The following hole tolerances, standard for holes drilled with a drilling machine using suitable jigs and fixtures will apply except in those cases where design dictates greater or lesser accuracy.

Drilled Hole Tolerances

Hole Diameter	Tolerance
0.0135 thru 0.125	+0.004 -0.001
0.126 thru 0.250	+0.005 -0.001
0.251 thru 0.500	+0.006 -0.001
0.501 thru 0.750	+0.008 -0.001
0.751 thru 1.000	+0.010 -0.001
1.001 thru 2.000	+0.012 -0.001

2.3.2 Parallelism and Squareness

NOTE: Machines surfaces shown parallel shall be parallel within a rate of 0.0005 inch per linear inch. Machined surfaces shall be square (90°) within a rate of 0.0005 inch per linear inch. For both parallelism and squareness, the rate of 0.0005 per lineal inch also applies for any dimension less than an inch.

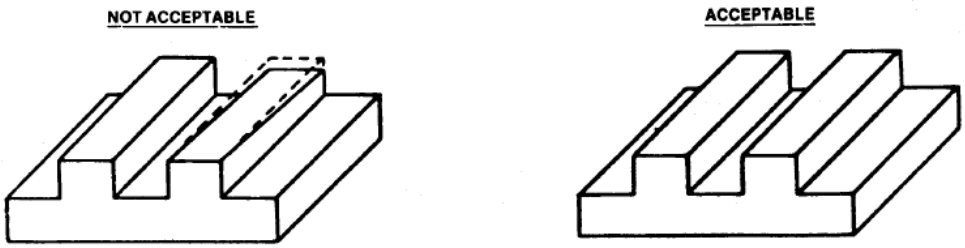


FIGURE 1. PARALLELISM BETWEEN MILLED SURFACES

NOT ACCEPTABLE

A. Milled surfaces not parallel within variation.

ACCEPTABLE

A. Milled surfaces are parallel within variation.

FIGURE 2. PARALLELISM OF GROUND SURFACES

NOT ACCEPTABLE

A. Ground surfaces not parallel.

ACCEPTABLE

A. Ground surfaces parallel.

2.3.3 Unmatched Surfaces of Parts

(MADE FROM BAR, ROD, SHAPES OR TUBE STOCK)

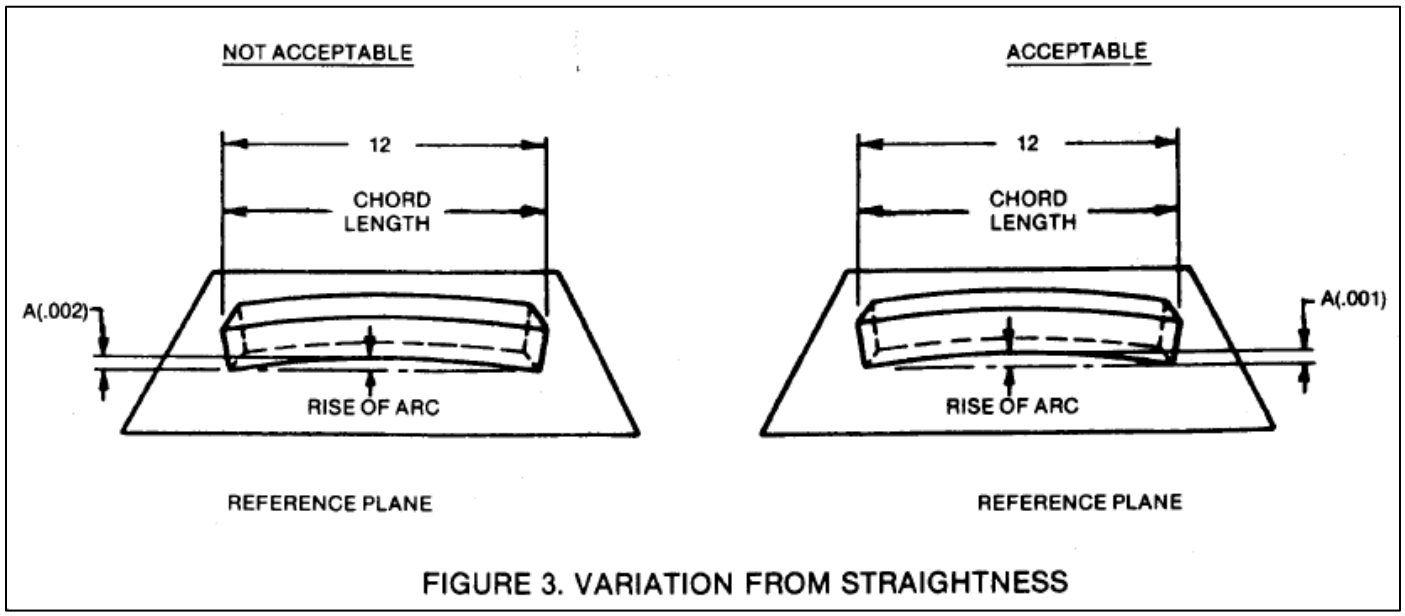


FIGURE 3. VARIATION FROM STRAIGHTNESS

NOT ACCEPTABLE

A. Rise of arc in excess of allowable variation shown in Table 1.

ACCEPTABLE

A. Rise of arc within allowable variation shown in Table 1.

TABLE 1. VARIATIONS FROM STRAIGHTNESS (IN INCHES)

Chord Length in Inches	Up To 12	Over 12 to 24 Inclusive	Over 24 to 36 Inclusive	Over 36 to 48 Inclusive	Over 48
Max Deviation "A" per Inch of length	.001	.0015	.002	.003	.004

2.4 Machining

2.4.1 Runout

NOTE: The total indicated runout on any diameter with respect to any other concentric diameter shall not exceed twice the smallest tolerance of the diameters involved.

Smallest tolerance of diameters ± .0005
Total tolerance = .001

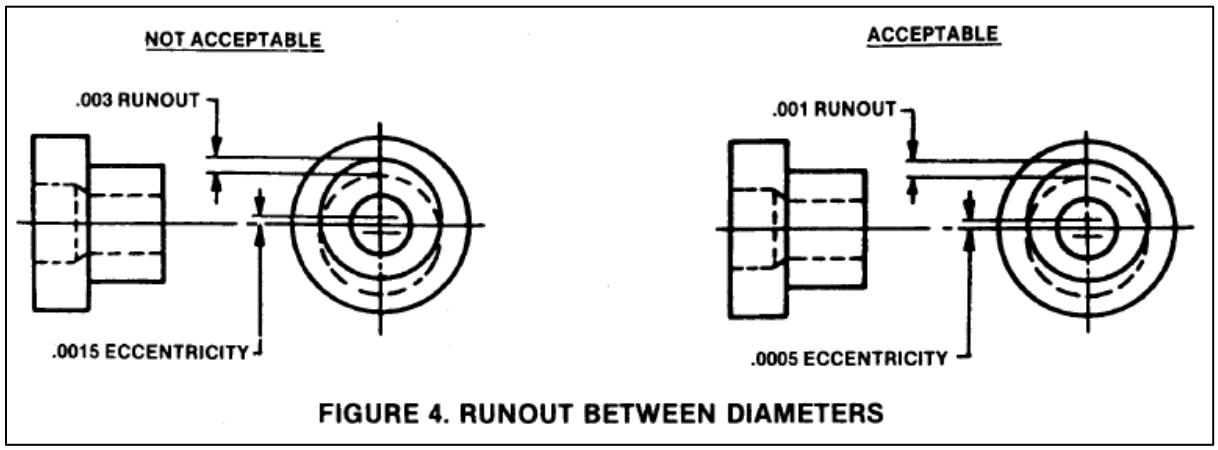


FIGURE 4. RUNOUT BETWEEN DIAMETERS

NOT ACCEPTABLE

A. Runout exceeds twice the tolerance.

ACCEPTABLE

A. Runout does not exceed twice the smallest tolerance.

NOTE: The total indicated runout on any face, with respect to axis or outside diameter, shall not exceed .003 per inch of face diameter.

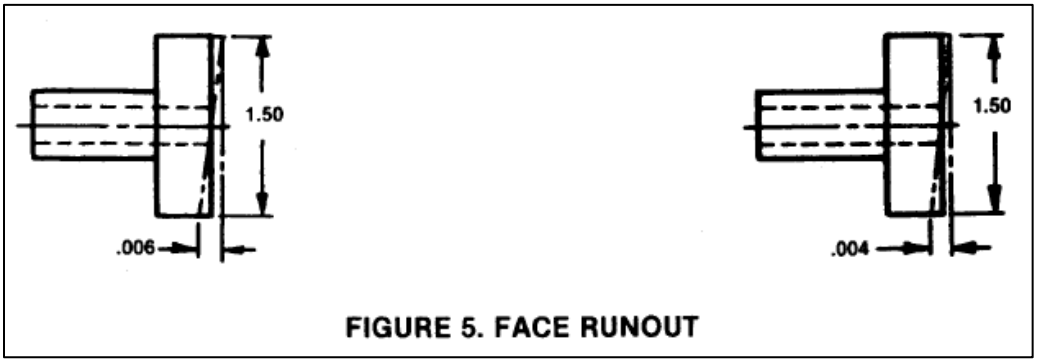


FIGURE 5. FACE RUNOUT

NOT ACCEPTABLE

A. Face runout exceeds .003 inch per inch of face diameter.

ACCEPTABLE

A. Runout does not exceed .003 inch per inch of face diameter.

2.4.2 Inside Radius of Turned Parts

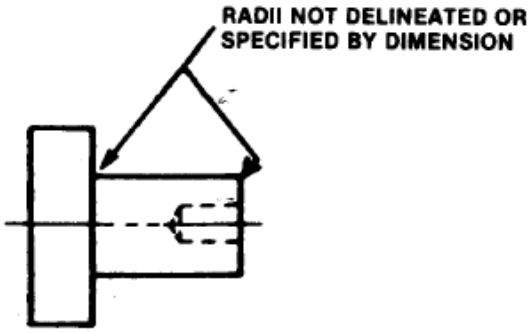


FIGURE 6. PART AS DELINEATED ON DRAWING

FIGURE 7. PART AS MANUFACTURED

NOT ACCEPTABLE

A. Radius in corner exceeds .010.
B. Radius of outside corner exceeds 0.15.

ACCEPTABLE

A. Radius in corner .010 or less.
B. Radius of outside corner no greater than .015 or no less than .005.

2.4.3 Screw Machine Cut-Off

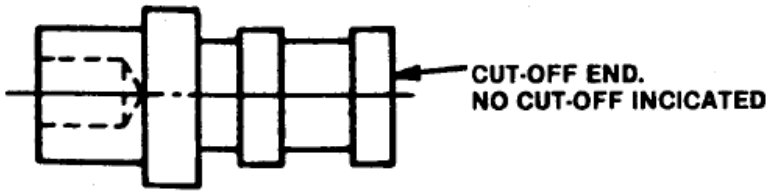


FIGURE 8. PART AS DELINEATED ON DRAWING

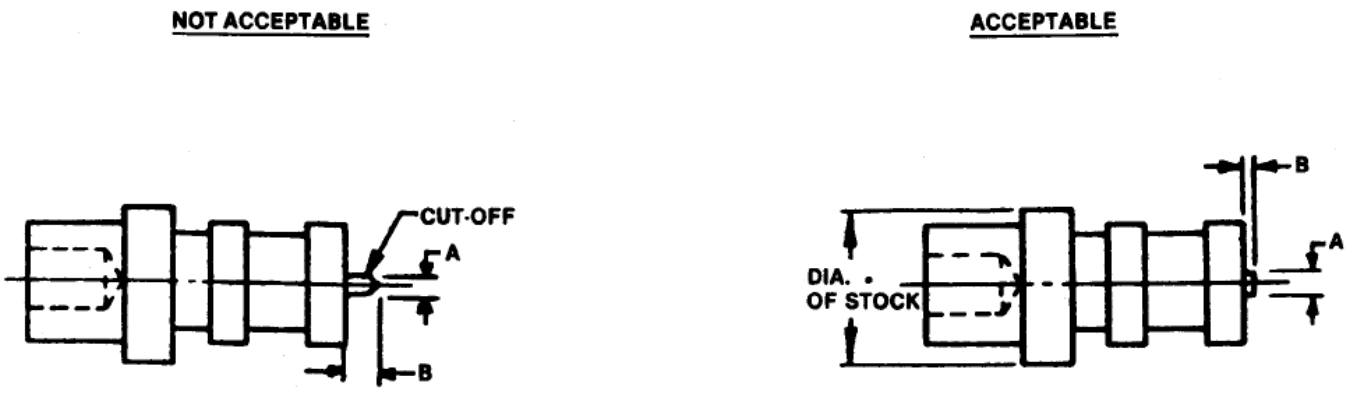


FIGURE 9. PART AS MANUFACTURED

NOT ACCEPTABLE

A. Size of cut-off exceeds .005 on dimensions A and B.

ACCEPTABLE

A. Size of cut-off does not exceed .005 on dimensions A and B.

2.4.4 Threaded Parts – External Thread

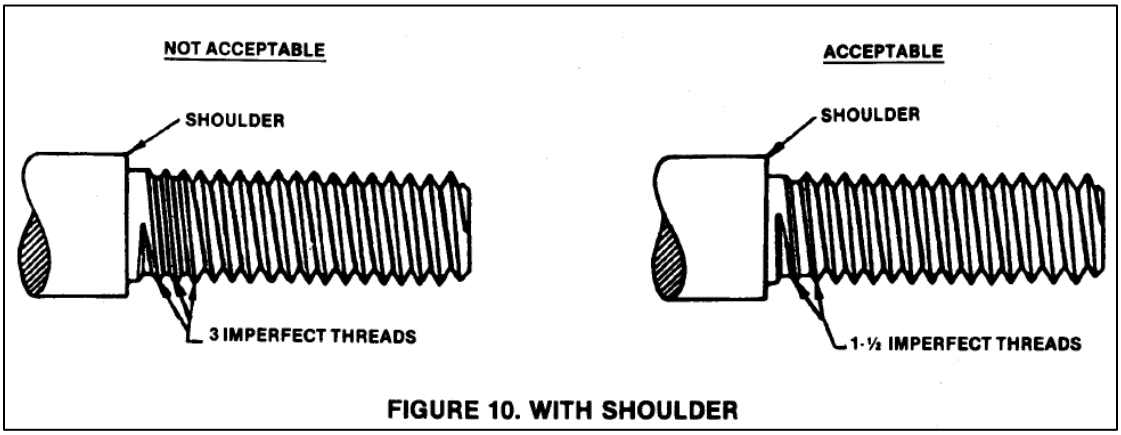


FIGURE 10. WITH SHOULDER

NOT ACCEPTABLE

A. More than the last 1-1/2 threads of an externally threaded part threaded imperfectly.
B. Wrong class of thread.

ACCEPTABLE

A. Complete threads shall extend to within 1-1/2 threads of the shoulder.
B. Right class of thread.

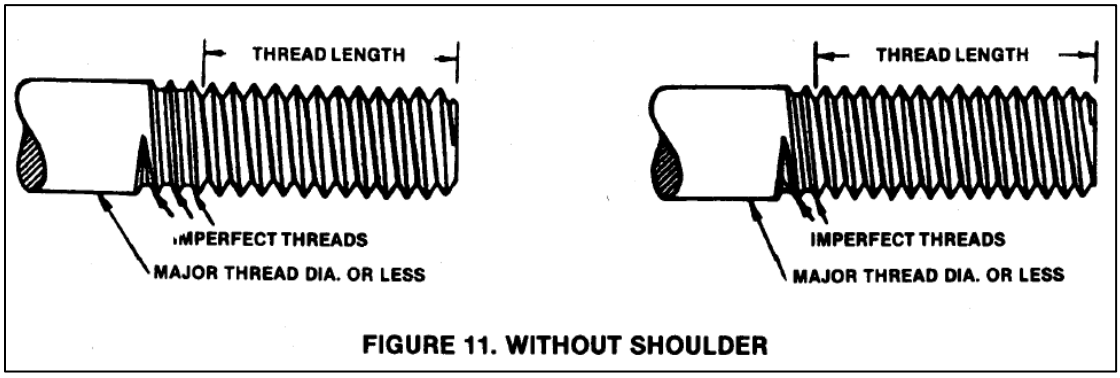


FIGURE 11. WITHOUT SHOULDER

NOT ACCEPTABLE

A. Imperfect threads located within the specified minimum thread length.
B. Wrong class of thread.

ACCEPTABLE

A. No imperfect threads located within specified thread length. Maximum of 1-1/2 imperfect threads for thread runout.
B. Right class of thread.

2.4.5 Threaded Parts – Internal Thread

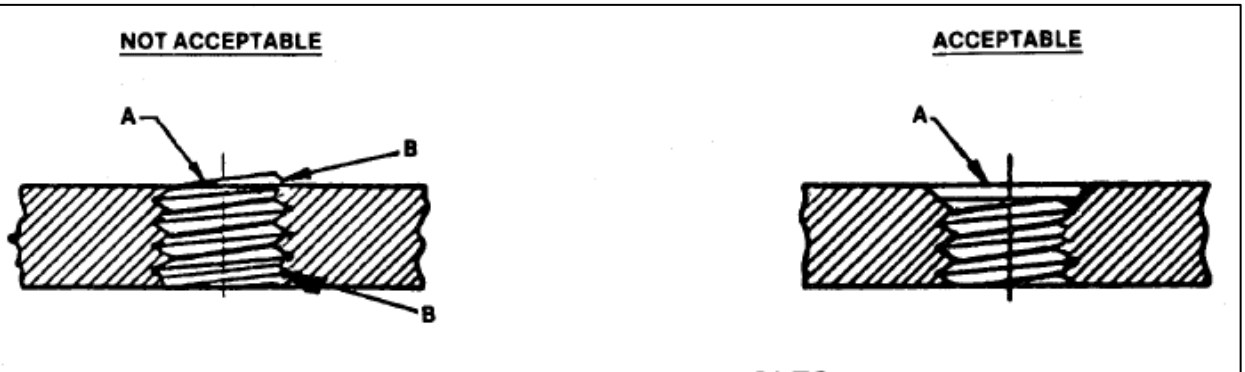


FIGURE 12. THROUGH HOLES

NOT ACCEPTABLE

A. Wrong class of thread.
B. One or more imperfect threads. Thread rises above surface or burr on edge of hole.
C. Chamfer omitted.

ACCEPTABLE

A. Right class of thread.
B. No imperfect threads. No threads rise above surface. No burr on edge of hole.
C. Initial thread chamfered.

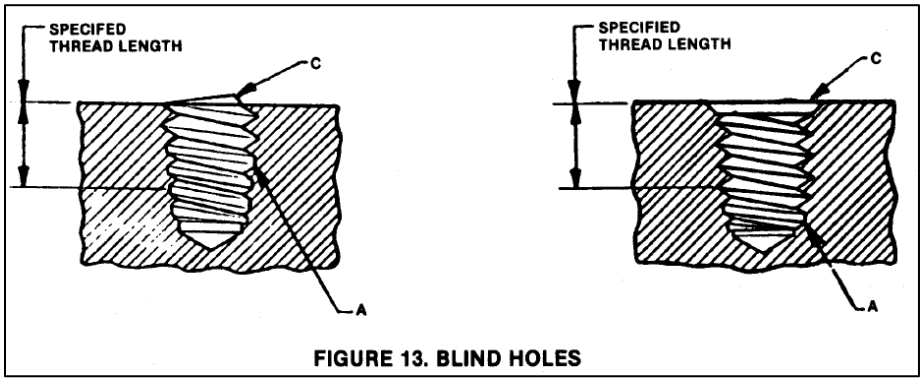


FIGURE 13. BLIND HOLES

NOT ACCEPTABLE

A. Imperfect threads located within the specified minimum thread length.
B. Wrong class of thread.
C. Thread rises above surface or burr on edge of hole.
D. Chamfer omitted.

ACCEPTABLE

A. No imperfect threads located within specified thread length.
B. Right class of thread.
C. No threads rise above surface. No burr on edge of hole.
D. Initial thread chamfered.

2.5 Sheet Metal
2.5.1 Flatness

NOTE: Variation from flatness is measured by laying parts or panels on surface plate with convex side up and measuring the maximum rise. No clamps or weights shall be used.

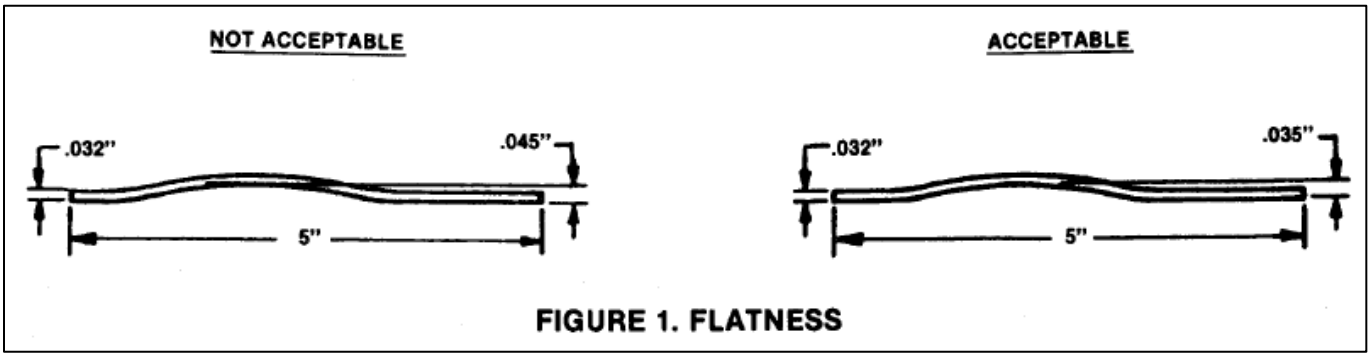


FIGURE 1. FLATNESS

NOT ACCEPTABLE

A. Variation from flatness exceeds the allowable limit shown in Table 1.

ACCEPTABLE

A. Variation from flatness within allowable limits shown in Table 1.

TABLE 1. VARIATION FROM FLATNESS

SHEET METAL THICKNESS	MAXIMUM DIMENSIONS OF SHEET METAL PARTS				
	UP TO 3	3 TO 10	10 TO 24	24 TO 48	48 & OVER
	MAXIMUM VARIATION FROM FLATNESS (INCHES)				
.016 to .040	.015	.040	.080	.160	----
Over .040 to .093	.010	.030	.055	.110	.130
Over .093 to .189	.008	.025	.040	.080	.130
NOTE: In any one part, waves not exceeding above values shall be permissible.					

2.5.2 Shearing

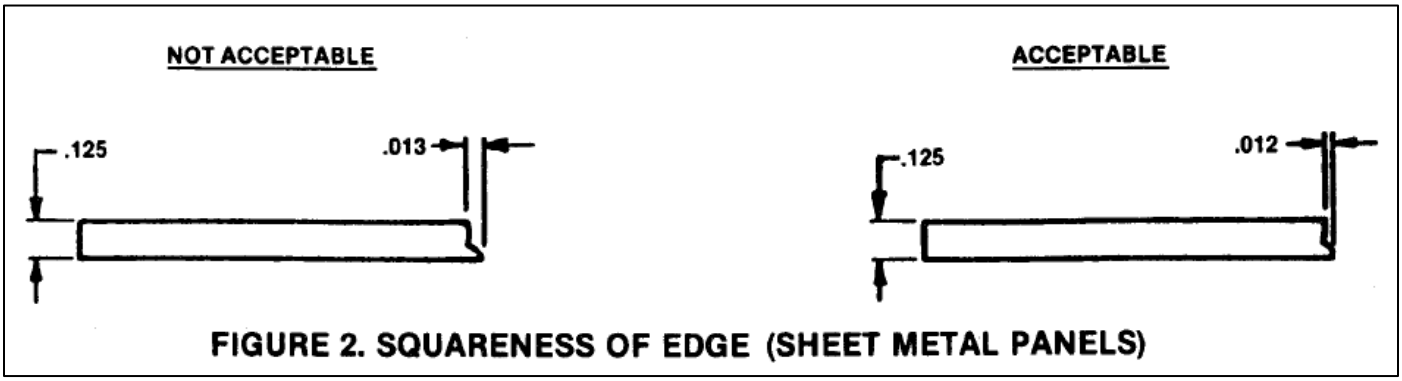


FIGURE 2. SQUARENESS OF EDGE (SHEET METAL PANELS)

NOT ACCEPTABLE

A. Variation from squareness of edge exceeds allowable limit shown in Table II.

ACCEPTABLE

A. Variation from squareness of edge within allowable limit shown in Table II.

TABLE II. VARIATION FROM SQUARENESS OF EDGE (INCHES)

MATERIAL THICKNESS	TO .015	OVER .015 TO .032	OVER .032 TO .083	OVER .083 TO .125	OVER .125 TO .250
MAXIMUM PERMISSIBLE	.004	.006	.008	.012	.020

2.5.3 Squareness of Sides

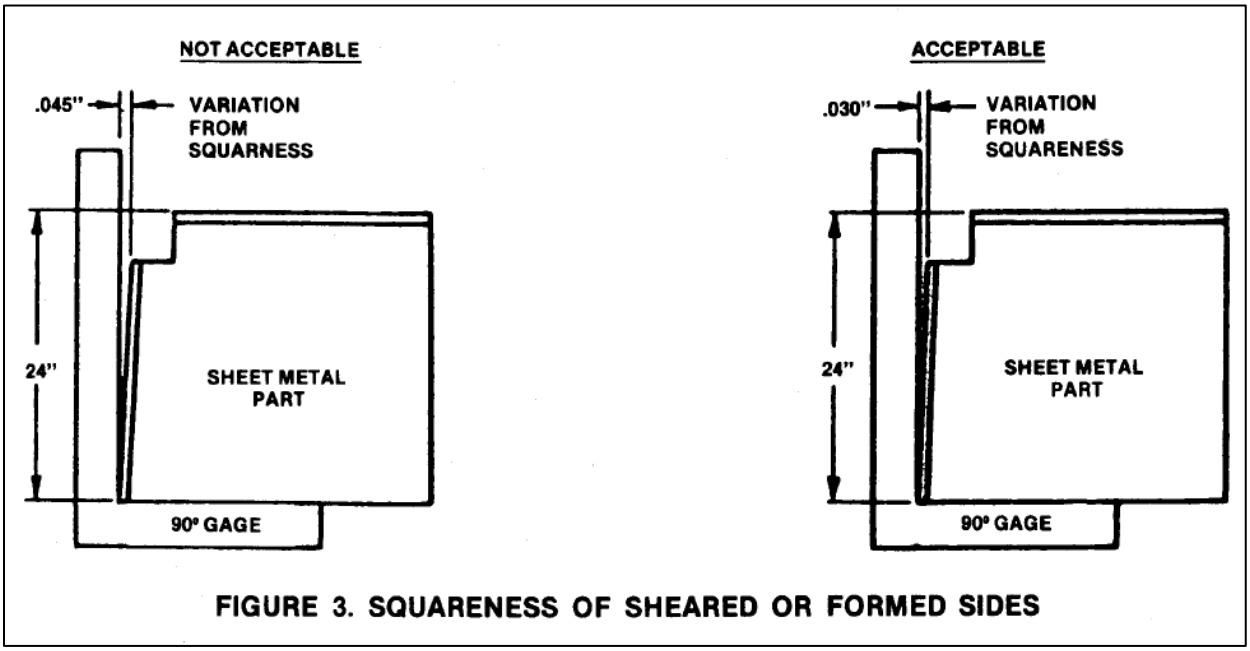


FIGURE 3. SQUARENESS OF SHEARED OR FORMED SIDES

NOT ACCEPTABLE

A. Variation from squareness between sheared and formed edges exceeds .020 inch per linear foot.
B. Variation from squareness between two edges exceeds limits in Table III.

ACCEPTABLE

A. Variation from squareness between sheared and formed edges within .020 inch per linear foot.
B. Variation from squareness between two edges within limits established in Table III.

TABLE III. MAXIMUM VARIATION IN SQUARENESS IN INCHES PER LINEAR FOOT

BETWEEN	SHEARED EDGE	FORMED EDGE
SHEARED EDGE	.015	.020
FORMED EDGE	.020	.015

2.5.4 Bending

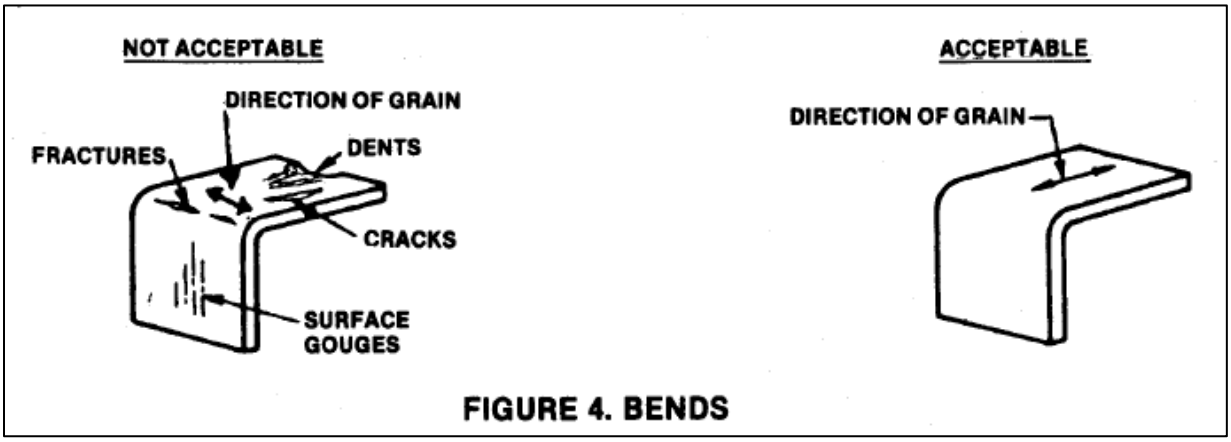


FIGURE 4. BENDS

NOT ACCEPTABLE

A. Fracture at bend.
B. Raw material or finished part containing gouges, dents and cracks.
C. Bend is parallel with direction of grain.

ACCEPTABLE

A. Absence of fracture at bends.
B. Flat portion of sheet metal free from surface defects, such as cracks, dents and gouges.
C. Bend at right angle to direction of grain or at a favorable compromise with respect to multiple bends.

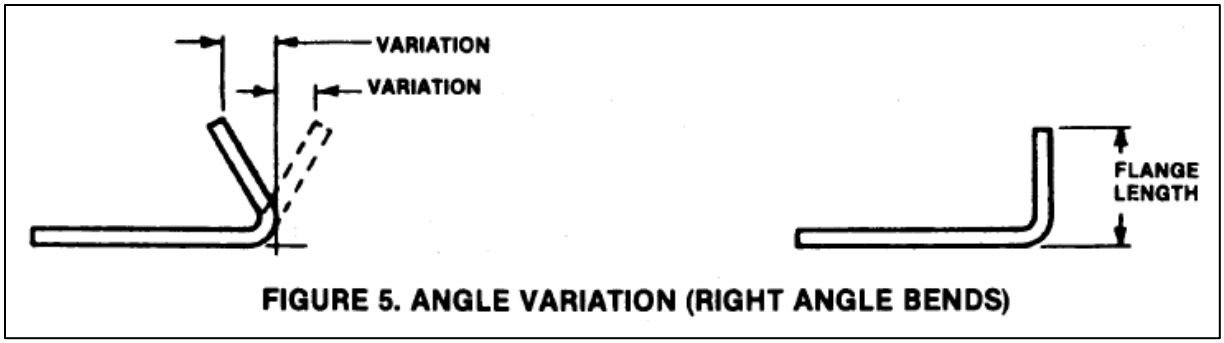


FIGURE 5. ANGLE VARIATION (RIGHT ANGLE BENDS)

NOT ACCEPTABLE

A. Variation exceeds limits established for forming. (See Table IV.)

ACCEPTABLE

A. Variation from right angle does not exceed values listed in Table IV.

TABLE IV. FLANGE ANGLE VARIATION (IN INCHES)

FLANGE LENGTH		VARIATION MAXIMUM
OVER	UP TO AND INCLUDING	
---	.50	.010
.50	1.50	.020
1.50	6.00	.031
6.00	---	Add .031 per foot

2.5.6 Corner and Edge Condition

NOTES:

1. All sheet metal parts shall be free from burrs and loose metal chips that may result in possible interference in assembly or injury to personnel. Burrs are defined as excessive displacements of metal caused by cutting tools. A minimum displacement of metal results when tools are sharp and properly set up.
2. Any burr on sheet metal parts, in addition to the preceding requirement, shall not exceed 10% of the thickness of the stock up to and including .060 inch. For stock thicknesses over .060 inch, burrs shall not be greater than .006 inch. There shall be no machining burrs on screw machine parts. The chamfer or radius incurred in the removal of burrs shall not exceed .015 inch.

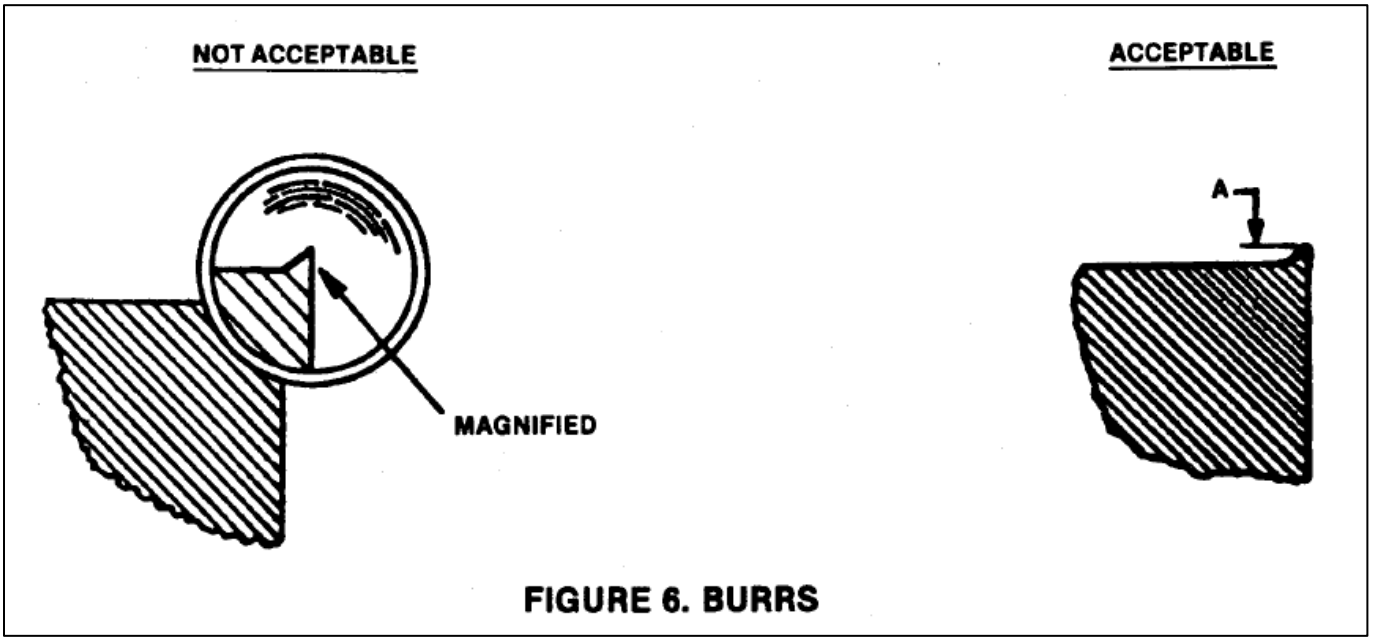


FIGURE 6. BURRS

NOT ACCEPTABLE

A. Parts with burrs. Metal displacement exceeds limits specified in note 2 above.

ACCEPTABLE

A. Displacement of metal within limits specified in note 2 above.

2.5.7 Corner and Edge Condition

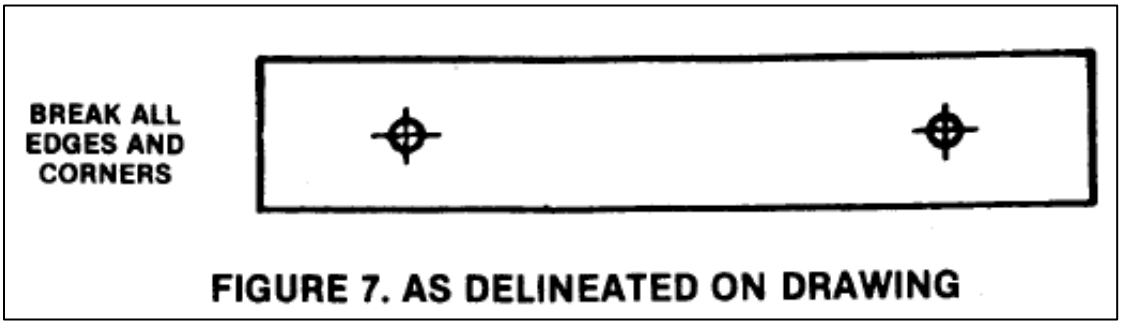


FIGURE 7. AS DELINEATED ON DRAWING

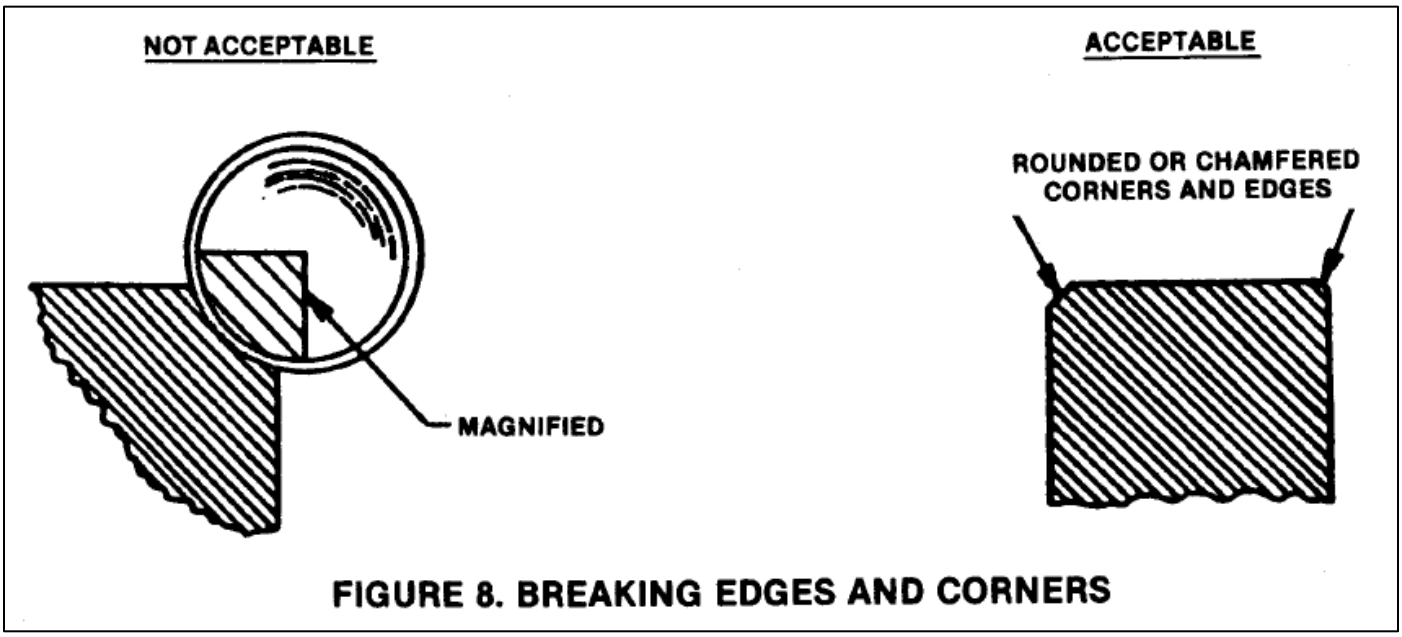


FIGURE 8. BREAKING EDGES AND CORNERS

NOT ACCEPTABLE

A. Parts with sharp corners.
B. Tooling marks on parts so that a secondary smoothing operating is required prior to applying finish.

ACCEPTABLE

A. Edges and corners of parts have a small but definite rounding or break.
B. Minimum tool marks so that secondary smoothing operation is not required.
C. Chamber or radius shall not exceed .015 or 10% of the material thickness whichever is smaller.

SECTION 3 - SOLDER/FLUX AND CLEANING

General

Analogic uses a variety of solder types in the manufacture of their products. The use of both lead and lead-free solder is acceptable depending on the requirements set forth in the product specific documentation available in Agile.

Lead free solder must be used when specified by product specific documentation. Each specific solder metallurgic composition/flux must have a formal, documented validation approved prior to initial use.

Where lead solder or lead flux-cored wire solder are used they will have a tin/lead ratio of 63/37%. There are four types of lead solder/flux that are authorized for use in the manufacture of Analogic product: rosin mildly activated solder (RMA), rosin solder (R), "No Clean" and organically activated solder (OA). The use of rosin activated solder (RA), rosin super activated solder (RSA), and inorganic (acid/halide) flux are prohibited from all Manufacturing operations. Each specific solder type/flux must have a formal documented validated approved prior to initial use.

Completed boards or secondary operations, touch-up, rework or repair will be thoroughly cleaned of solder splash, flux or any other foreign material, except as noted below.

Engineering or Management will determine the compatibility of products/components with the various solder/flux and cleaning methods. Solder/flux and cleaning requirements specific to components/ products will be identified by Engineering and included in product documentation. The soldering process shall meet or exceed the requirements of IPC-SF-818 Class 2, General Industrial or Class 3, High Reliability for life support items and military electronic equipment.

Wave/Flow Soldering (lead)

Wave/flow soldering machines designed for lead solder will have a tin/lead ratio of 63/37% and using only organically activated (OA) or "No-Clean" flux. The solder and flux will be periodically checked for contamination and replaced as necessary. Post-solder cleaning of organically activated flux will utilize and automated aqueous cleaning process. Each manufacturing area will operate and maintain their aqueous cleaning equipment using the Department's operational procedures.

Wave/Flow Soldering (lead free)

Wave/flow soldering machines designed for lead free solder will use organically activated (OA) or "No-Clean" flux which is compatible with the type of lead-free solder being used. The solder and flux will be periodically checked for contamination and replaced as necessary. Post-solder cleaning of organically activated flux will utilize and automated aqueous cleaning process. Each manufacturing area will operate and maintain their aqueous cleaning equipment using the Department's operational procedures.

Hand Soldering Using Organically Activated (OA) Flux

Secondary operations, touch-up, rework, or repair may be performed using organically activated liquid flux or organically activated cored solder. Post-solder cleaning of organically activated flux will utilize and automated aqueous cleaning equipment using the Department's operational procedures.

Hand Soldering Using Rosin Mildly Activated (RMA) Flux

Secondary operations, touch-up, rework, or repair may be performed using mildly activated liquid flux or mildly activated rosin cored solder. Post-solder cleaning of rosin mildly activated flux will us a solvent and brush to loosen the flux residue. The use of lint-free tissues, swabs or compressed air may be used to improve cleaning effectiveness. Isopropyl alcohol or other approved solvents shall be used. Repeat cleaning until all areas are free of any flux residue.

Hand Soldering Using Rosin (R) Flux

Secondary operations, touch-up, rework, or repair may be performed using rosin liquid flux or rosin cored solder. Post-solder cleaning of rosin flux requires the same procedure as used above for RMA flux.

Hand Soldering Using "No-Clean" Flux

Secondary operations, touch-up, rework, or repair may be performed using "No-Clean" cored solder. Post-solder cleaning of "No-Clean" flux is not required. Minimal residues remaining on the soldering area are acceptable.

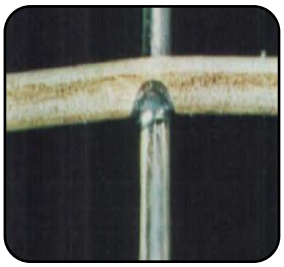
Post Cleaning – Cleanliness Verification

Cleanliness verification may be required on various products after the cleaning process. This will depend on the product type and various technical requirements as outlined by the engineering and manufacturing documentation. Monograph test, surface insulation resistance test, electrical tests, or other methods may be used as directed for validating the process.

SECTION 4 - WELDED MODULES

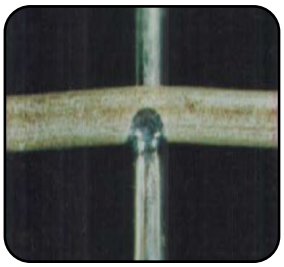
4.1 Discolorations

MAGNIFICATION 20X



PREFERRED

1. No discoloration in weld area.
2. No evidence of excessive heat.



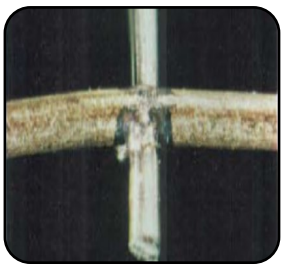
ACCEPTABLE

1. Narrow band of discoloration within area.

NOTE: This discoloration is normal on conductors having a thin outer metallic coat such as a hot tin dipped copper, gold flash Domet or Kovar. A light blue-green color is acceptable.

ACCEPTABLE

1. Approximately 75% of weld area has discolored but weld shows no evidence of other defects detrimental to the quality of the weld.

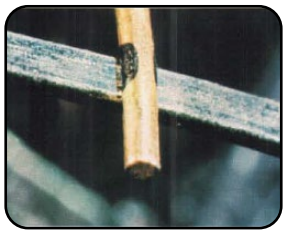


NOT ACCEPTABLE

1. Weld area is totally discolored as indicated by the blackend or burned weld area.

4.2 Mash – Flattening

MAGNIFICATION 20X

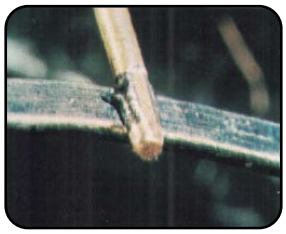


PREFERRED

1. No evidence of mash or deformation of the conductors.

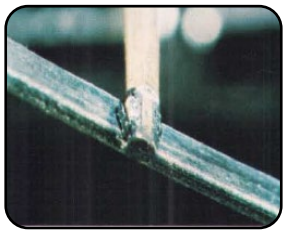
ACCEPTABLE

1. Some evidence of pressure resulting in flattening of conductors does not exceed 30 percent of the original diameter of the conductor.



ACCEPTABLE

1. Evidence of heat resulting in mash does not exceed 30 percent of the original diameter of the conductor.



NOT ACCEPTABLE

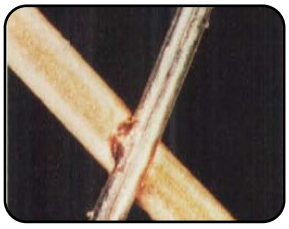
1. Excessive mash results in diameter of the conductor being reduced in excess of 30 percent.
2. Weld area is burned and fusion has not occured.

4.3 Metal Expulsion

MAGNIFICATION 20X

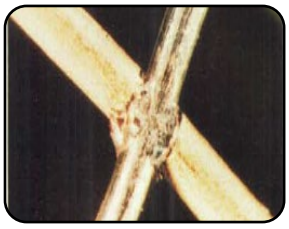
PREFERRED

1. Conductors have completely fused, without evidence of spitting, cracking or loose particles being expelled from weld area.



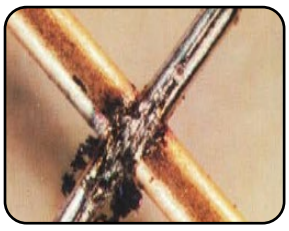
ACCEPTABLE

1. Molten metal has been expelled from one side of weld area. Metal is firmly anchored to conductor.



ACCEPTABLE

1. Molten metal expulsion is evident; however, expelled metal balls and protrusions are firmly anchored. No voids appear within the weld area.

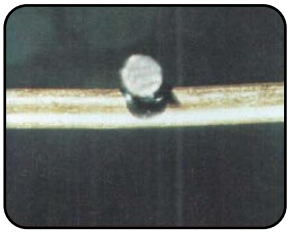


NOT ACCEPTABLE

1. Weld area contains heat craters, cracks nd burned areas.
2. Expelled metal is excessive, with loose particles, slag, surface metal and burn through.

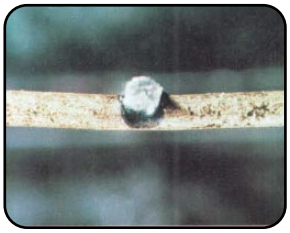
4.4 Penetration

MAGNIFICATION 20X



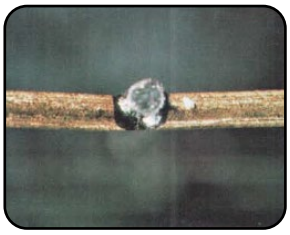
PREFERRED

1. Conductors have fused properly and penetration is 10 percent to 15 percent of the conductors' diameter.



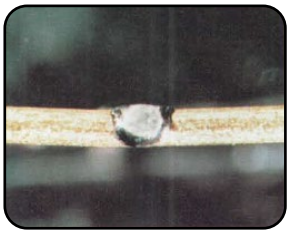
ACCEPTABLE

1. Penetration of conductors is approximately 40 percent (average). Weld area is not mashed or otherwise deformed.



ACCEPTABLE

1. Penetration of conductors is maximum, 75 percent; however, weld area is well formed without spits, burns or other defects detrimental to the quality of the weld.



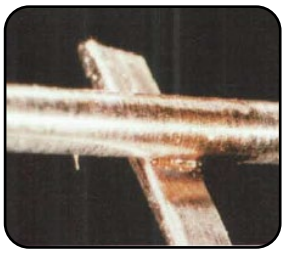
NOT ACCEPTABLE

1. Penetration is over 75 percent of the conductor diameter.

NOTE: This condition is extremely critical in as much as one or both conductors are burned through, producing a mechanically weak connection and potential failure.

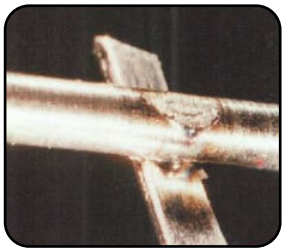
4.5 Tip Melt

MAGNIFICATION 20X



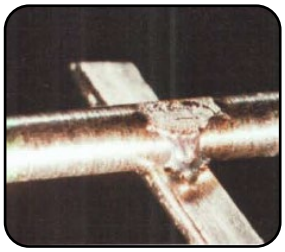
PREFERRED

1. No evidence of tip or surface melting.
2. No deformation of conductor.



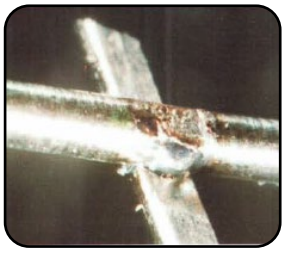
ACCEPTABLE

1. Some evidence of conductor melting; however, depth of melted away area is less than 10 percent of the diameter of the conductor.



ACCEPTABLE

1. No more than 10 percent of the diameter of the conductor is melted away.
2. Melted metal is firmly attached, with no loose particles.



NOT ACCEPTABLE

1. Tip or surface melt exceeds 10 percent of the diameter of the conductor.
2. Loose particle potential.
3. Heat discoloration.

SECTION 5 - ADHESIVE BONDING

5.1 Adhesion

METHOD: Adhesion shall be determined by inserting the point of metal probe between the adhesive and metal to force separation and observing the action under the microscope.

MAGNIFICATION 10X

PREFERRED

CLASS 1 ADHESION

1. When probe insertion is attempted, adhesive cannot be separated from the metal without damage to the metal itself.

ACCEPTABLE

CLASS 1 ADHESION

1. When probe is inserted, no air or separation precedes point of probe, and metal is marked and scratched by the probe.

ACCEPTABLE MINIMUM

CLASS 2 ADHESION

1. Less force is required to insert probe and a small area of air or separation between the metal and adhesive precedes the point of probe.

NOT ACCEPTABLE

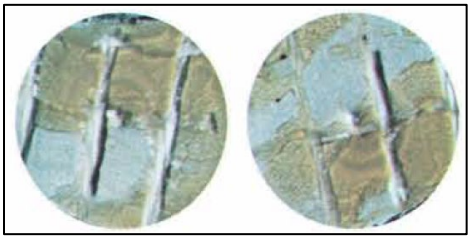
CLASS 3 ADHESION

1. Probe is easily inserted.
2. Adhesive layer separates easily from the metal over an area considerably wider than the width of the probe.
3. Pieces of adhesive may be lifted from the metal surface.

5.2 Cohesion

METHOD: Cohesion shall be determined by examining the glue line under the microscope and comparing to the following standards.

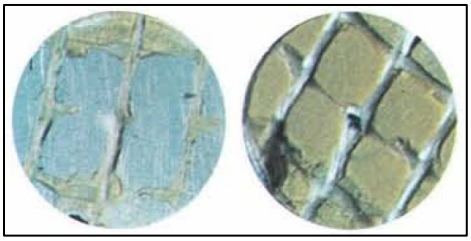
MAGNIFICATION 5X



PREFERRED

CLASS 1 ADHESION

1. No evidence of cohesive break between the adhesive interfaces (adhesive film-spray coat).
2. Break has occurred within the adhesive, as indicated by both halves of the button being completely covered with adhesive whose surfaces have a rough, torn appearance.



ACCEPTABLE MINIMUM

CLASS 2 COHESION

1. Small localized areas lack cohesion at the adhesive interfaces, as indicated by the variation of colors and glossy hollows and mounds

ACCEPTABLE MINIMUM

CLASS 2 COHESION

1. Localized cohesive failure at the adhesive interfaces is indicated by random color variations with glossy, molded appearance; however, the cohesion failure represents less than 50 percent of the total area of the button.

NOT ACCEPTABLE

CLASS 3 COHESION

1. General cohesion failure is evidenced by a clean separation of the adhesive film from the sprayed prime coat of adhesive on the metal in an area greater than 50 percent of the total area of the button.
2. Mating surfaces show a molded, pressed image without adherence of one surface to the other.

5.3 Contact

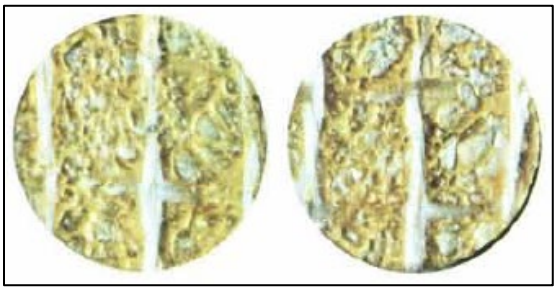
METHOD: Degree of contact between bonded surfaces shall be determined by examination of the glue line under the microscope.

MAGNIFICATION 5X

PREFERRED

CLASS 1 CONTACT

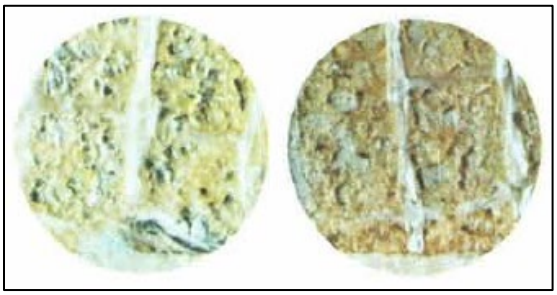
1. Adhesive surface reflects a completely covered, even surface indicating contact was maintained throughout the glue line.
2. No evidence of shrinkage voids or cracks.



ACCEPTABLE MINIMUM

CLASS 2 CONTACT

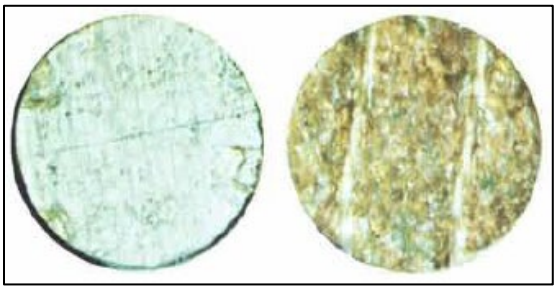
1. Glue line shows evidence of only minor shrinkage voids and cracks, indicating contact was sufficient.



ACCEPTABLE MINIMUM

CLASS 2 CONTACT

1. Glue line shows areas of “No Contact”; however, these areas are less than 50 percent of the total button area and it is not indicated that the “No Contact” extends beyond the periphery of the button.



NOT ACCEPTABLE

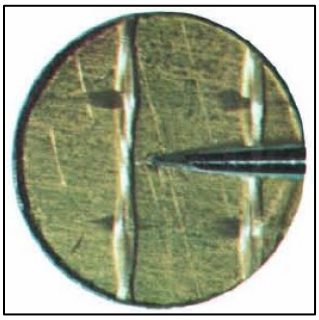
CLASS 3 CONTACT

1. Adhesive surface has a glossy, uneven appearance.
2. “No Contact” exists over an area in excess of 50 percent of the total button area and extends beyond the periphery of the button.

5.4 Degree of Cure

METHOD: Degree of cure or harness shall be determined by inserting the probe into the adhesive, applying pressure, and observing the action under the microscope.

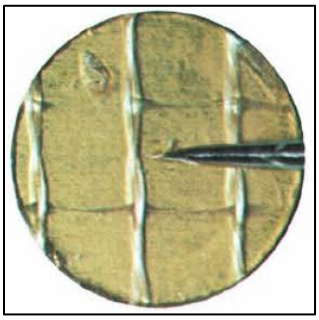
MAGNIFICATION 10X



PREFERRED

CLASS 1 CURE

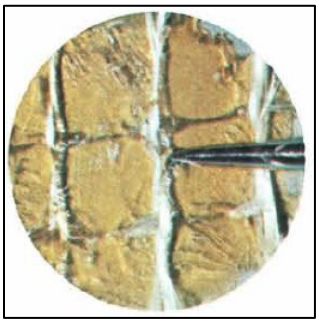
1. Glue lines are hard and show no elastic recovery when pressure is applied.



ACCEPTABLE

CLASS 1 CURE

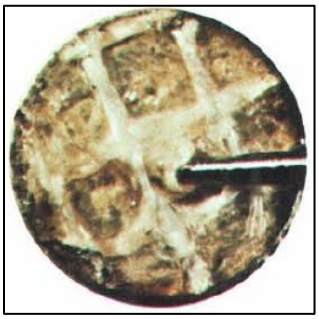
1. Glue lines are moderately hard and tough and show only slight elastic recovery after deformation by the probe.
2. Considerable pressure is required to deform the adhesive.



ACCEPTABLE MINIMUM

CLASS 2 CURE

1. Glue lines are tough and firm and exhibit some elastic recovery of the adhesive after deformation by the probe.



NOT ACCEPTABLE

CLASS 3 CURE

1. Glue lines are soft and flexible. They show yielding and recovery of the adhesive after the probe is applied and removed.
2. Only slight pressure is required to deform the adhesive.

5.5 Porosity

METHOD: Degree of porosity shall be determined by examining glue line under the microscope for bubbles and comparing the appearances to the following standards.

MAGINIFICATION 10X

PREFERRED

CLASS 1 POROSITY

1. Glue line is solid and clear in appearance, without bubbles or other evidence of porosity.

ACCEPTABLE

CLASS 1 POROSITY

1. Glue line is solid and clear, with random, small, well-separated bubbles.

ACCEPTABLE MINIMUM

CLASS 2 POROSITY

1. Glue line exhibits multiple bubbles; however, they are not adjacent to or overlapping one another.

NOT ACCEPTABLE

CLASS 3 POROSITY

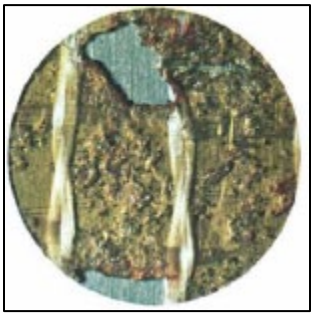
1. Glue line exhibits multiple bubbles adjacent to and overlapping one another.
2. Porosity is extreme, as indicated by a frothy, irregular surface.

5.6 Voids

METHOD: Microscopic examination of the glue line shall be made to determine the void condition.

MAGNIFICATION 10X

PREFERRED
CLASS 1 VOIDS:
Adhesives surface is solid and clear in appearance, without voids.



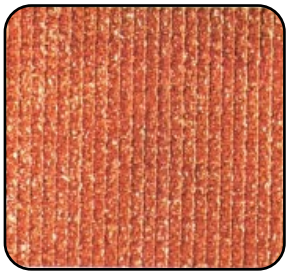
ACCEPTABLE MINIMUM
CLASS 2 VOIDS:
Small, isolated voids occur in a random pattern.

ACCEPTABLE MINIMUM
CLASS 2 VOIDS:
Multiple voids in the glue line do not exceed 50 percent of the total button area.

NOT ACCEPTABLE
CLASS 3 VOIDS:
Void areas exceed 50 percent of the total button area and extend beyond the periphery of the button.

5.7 Film Application

ACTUAL SIZE

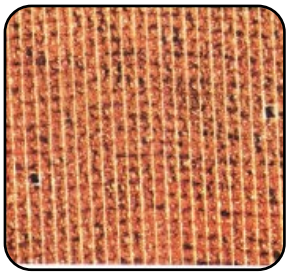


PREFERRED

1. Film has been firmly and evenly pressed onto the precoat part, without evidence of wrinkles, folds or foreign material.
2. Surface texture, color and weave are uniform without evidence of holes or tears.

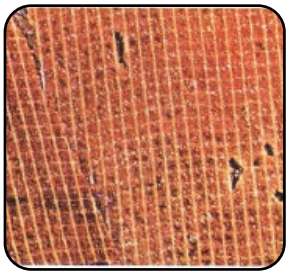
ACCEPTABLE

1. Small surface indentations are less than 1/8 inch in diameter and do not penetrate through the film.



ACCEPTABLE MINIMUM

1. Small random holes which penetrate the film are not in excess of 1/8 inch in diameter and there are not more than two holes per square inch.



NOT ACCEPTABLE

1. Surface is irregular, with overlapping wrinkles and folds.
2. Foreign matter is embedded in film.
3. Holes through film exceed 1/8 inch in diameter and/or there are more than two holes per square inch.

5.8 Liquid Coat Application

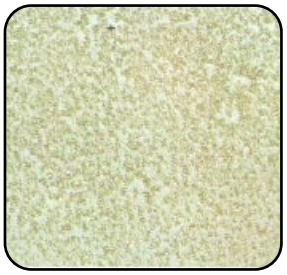
ACTUAL SIZE

PREFERRED

1. Coating is uniform in color, density and surface texture.
2. Coating surface has a smooth, wet appearance.
3. Coating thickness is average (0.002 inch approx).

ACCEPTABLE

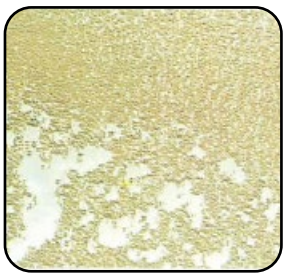
1. Coating thickness is minimum (0.001 inch), and has a thin translucent appearance; however, both color and texture are uniform.



ACCEPTABLE MINIMUM

1. Coating thickness is maximum (0.003 inch) and has a heavy, slightly opaque apperance.
2. Coating has a slight "blushing" appearance.

NOTE: If "blush" does not clear within 10 minutes, the coating must be rejected.



NOT ACCEPTABLE

1. Coating has an uneven surface appearance, with some areas built up in excess of 0.003 inch and thin areas built up less than 0.001 inch.
2. Color and surface texture are not uniform.
3. "Cobwebbing" or "blushing" are also prevalent.

SECTION 6 - FASTENER & FASTENER ASSEMBLIES

6.1 Screws, Machine and Cap

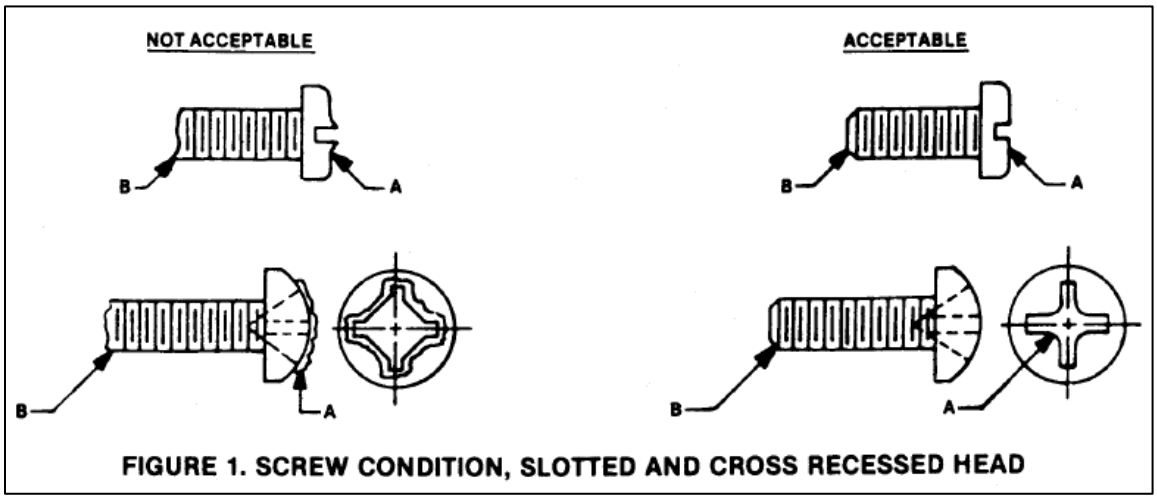


FIGURE 1. SCREW CONDITION, SLOTTED AND CROSS RECESSED HEAD

NOT ACCEPTABLE

A. Head marred or burred from use of improper driver or excessive torque.
B. Threads damaged or length reworked by cut off.

ACCEPTABLE

A. Head and driving recess not marred or burred.
B. Threads & lead thread not cut or damaged.

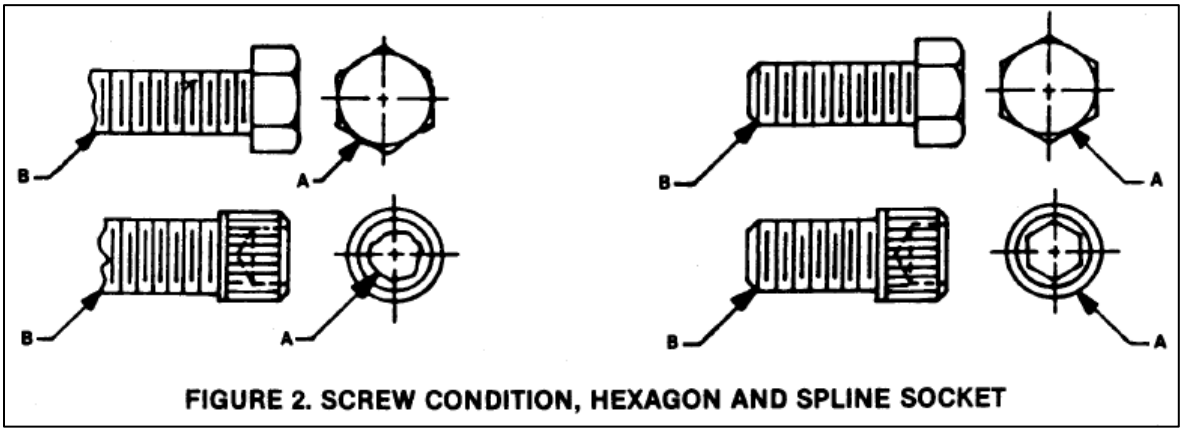


FIGURE 2. SCREW CONDITION, HEXAGON AND SPLINE SOCKET

NOT ACCEPTABLE

A. Head marred, burred or rounded from use of improper driver or excessive torque.
B. Threads damaged or length reworked by cut off.

ACCEPTABLE

A. Head and driving recess not marred, burred or rounded.
B. Threads and lead not cut or damaged.

6.2 Threaded Fastener Assemblies

6.2.1 Washers for Screws in Tapped Holes

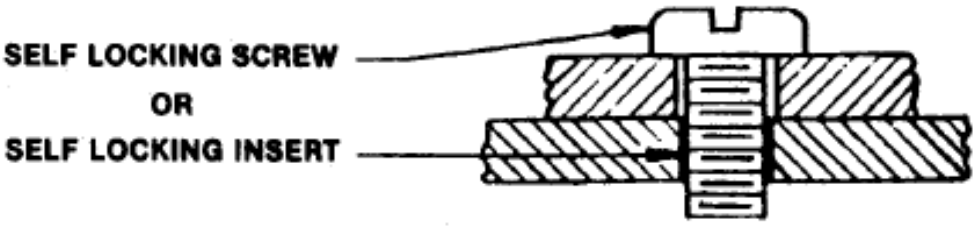


FIGURE 3. NO WASHER REQUIRED WHEN;

A. The hole is provided with a self-locking insert or
B. The screw is of the self-locking variety and
C. The upper layer of material is steel and not painted.

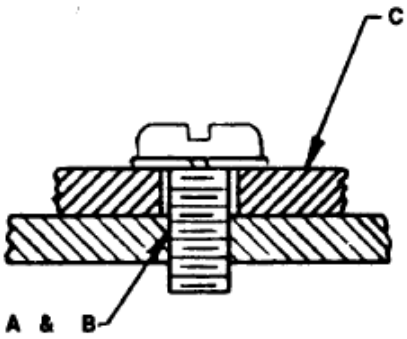


FIGURE 4. HELICAL LOCK WASHER ONLY REQUIRED WHEN;

A. The hole is not provided with a self-locking insert or
B. The screw is not of the self-locking variety and
C. The upper layer of material is steel.

Washers for Screws in Tapped Holes (continued)

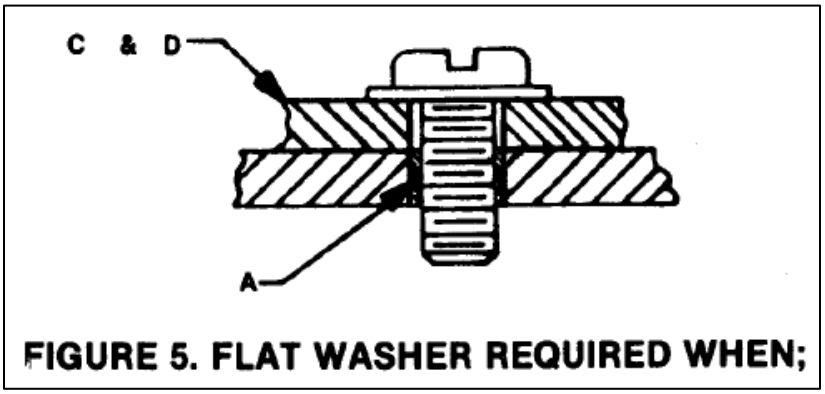


FIGURE 5. FLAT WASHER REQUIRED WHEN;

A. The tapped hole is provided with a self-locking insert or
B. The screw is of the self-locking variety and
C. The upper layer of material has an exposed painted surface.
D. The upper layer is aluminum, magnesium or other soft compressible material or
E. The upper layer of material has an enlarged or elongated hole.

Washers for Screws in Tapped Holes (continued)

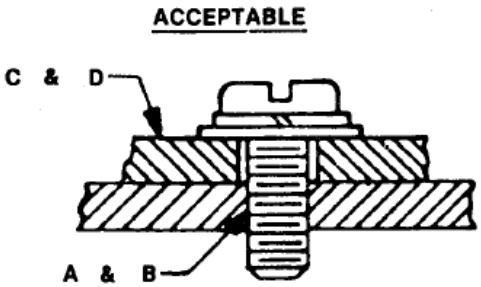


FIGURE 6. FLAT AND HELICAL LOCK WASHER REQUIRED WHEN;

A. The tapped hole is not provided with a self-locking insert or
B. The screw is not of the self-locking variety or
C. The upper layer of material has an exposed painted surface.
D. The upper layer of aluminum, magnesium or other soft compressible material or
E. The upper layer has an enlarged or elongated hole.

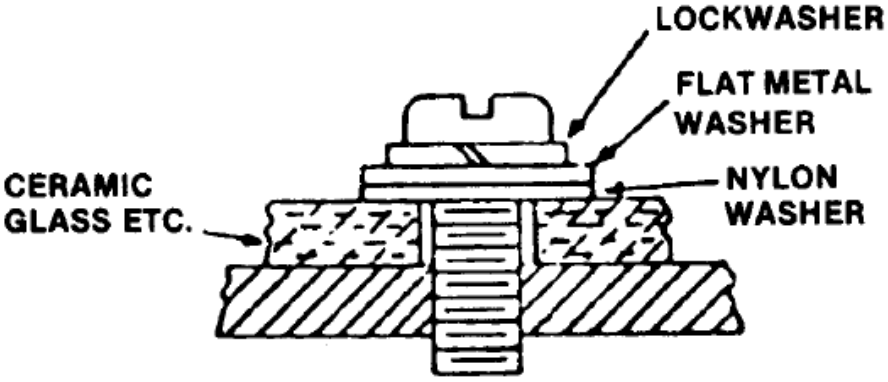


FIGURE 7. NYLON WASHER REQUIRED WHEN'

A. Between ceramic, glass or other brittle material and a flat washer and
B. Any other suitable locking device.

6.2.2 Washers in Screw and Nut Combinations

NOTE: The following criteria is restricted to the use of washers under the nut only in screw and nut assemblies. The criteria for washers under the screw head of such assemblies is covered in figures 3,5 and 7.

ACCEPTABLE

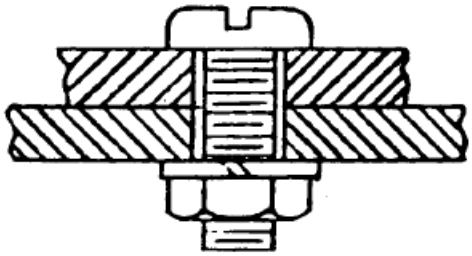


FIGURE 8. HELICAL LOCK WASHER UNDER NUT REQUIRED WHEN;

A. Both layers of material being fastened are steel and are not painted.

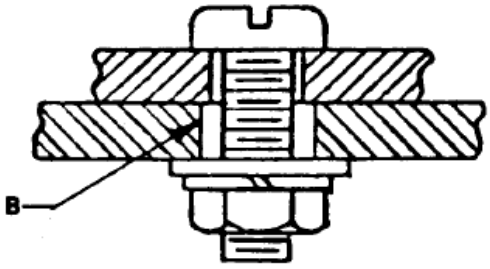


FIGURE 9. HELICAL AND FLAT WASHER UNDER NUT REQUIRED WHEN;

A. The bottom layer of material is aluminum, magnesium or other soft compressible material or
B. The bottom layer has an enlarged or elongated hole or
C. Top layer is unpainted steel.

Washers in Screw and Nut Combinations (continued)

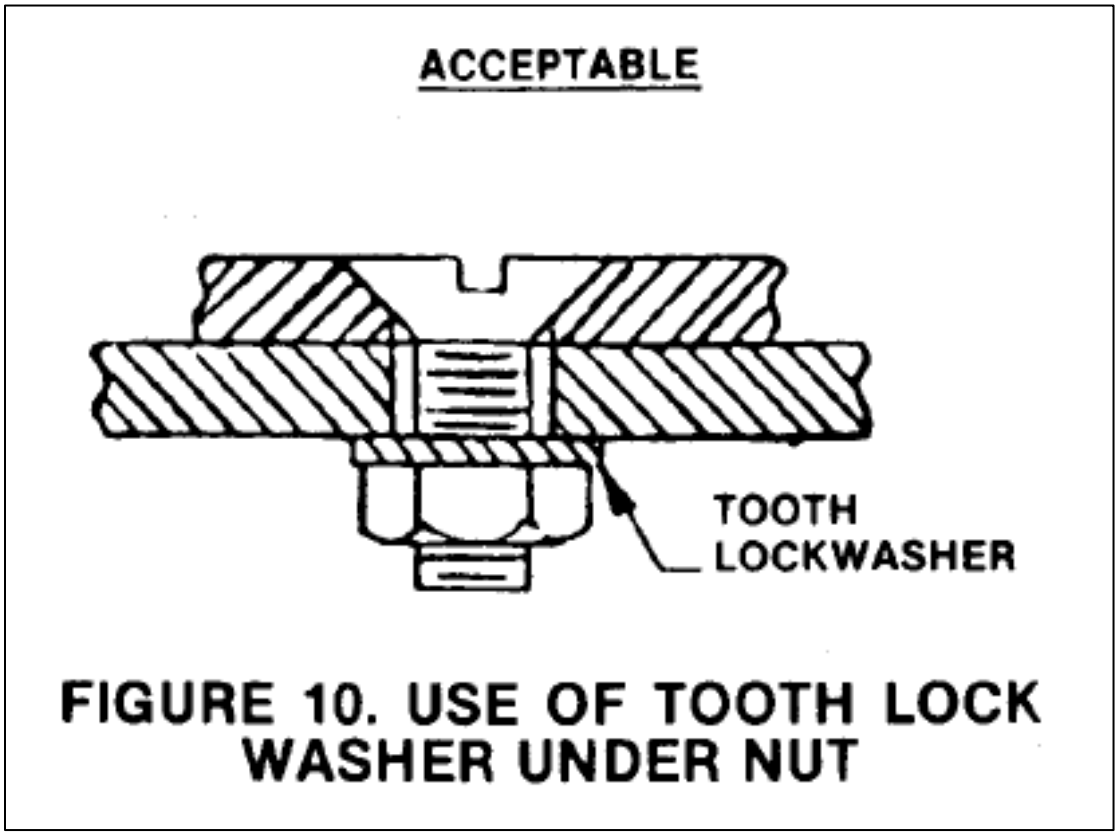


FIGURE 10. USE OF TOOTH LOCK WASHER UNDER NUT

A. External tooth washer used to establish grounding connection and
B. Where security of assembly is critical.
C. Internal tooth washer may be used only where it is invisible such as to secure a shaft where it will be covered by a knob.

6.2.3 Flat Head Screws

NOTE: Flathead screws shall not require fitting selectively to flushness limits listed below. The dimpled or countersunk holes shall be such that screws within tolerances will never exceed these limits.

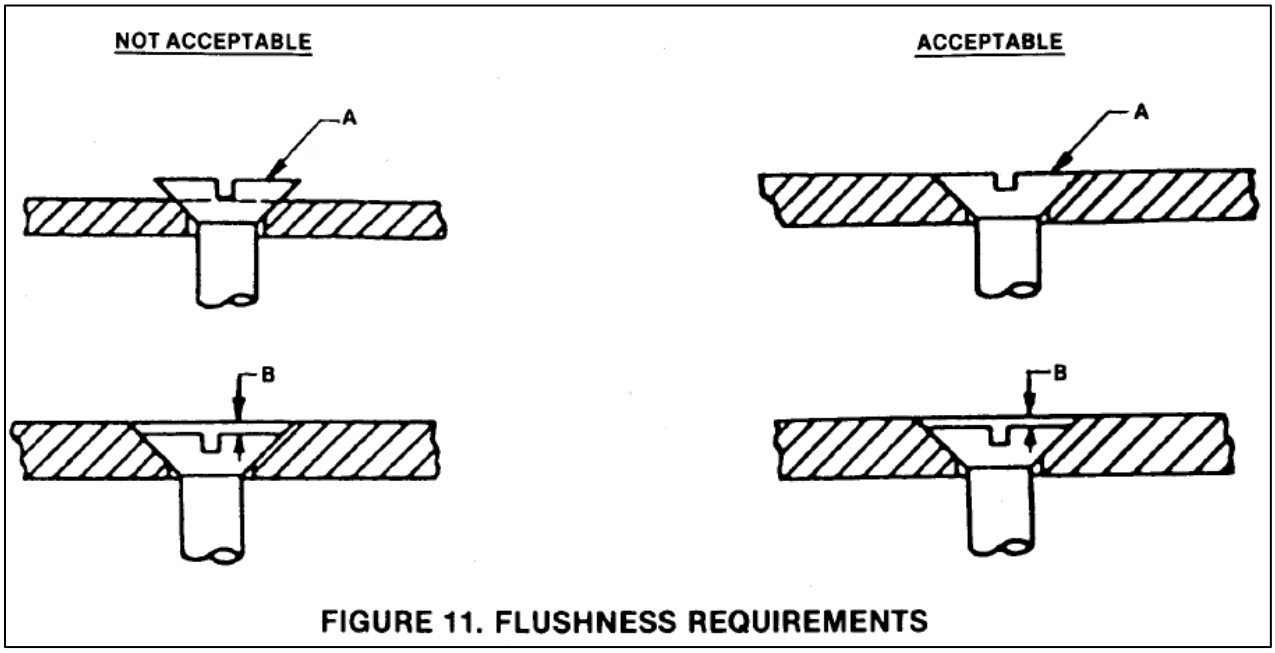


FIGURE 11. FLUSHNESS REQUIREMENTS

NOT ACCEPTABLE

A. Head protrudes above surface.
B. Countersunk diameter too large. Head depression greater than .010 inch.

ACCEPTABLE

A. No head protrusion.
B. Head depression slush to .010 inch under flush.
C. No selective fitting or shaving.

6.2.4 Threaded Fastener – Permissible Thread Extension

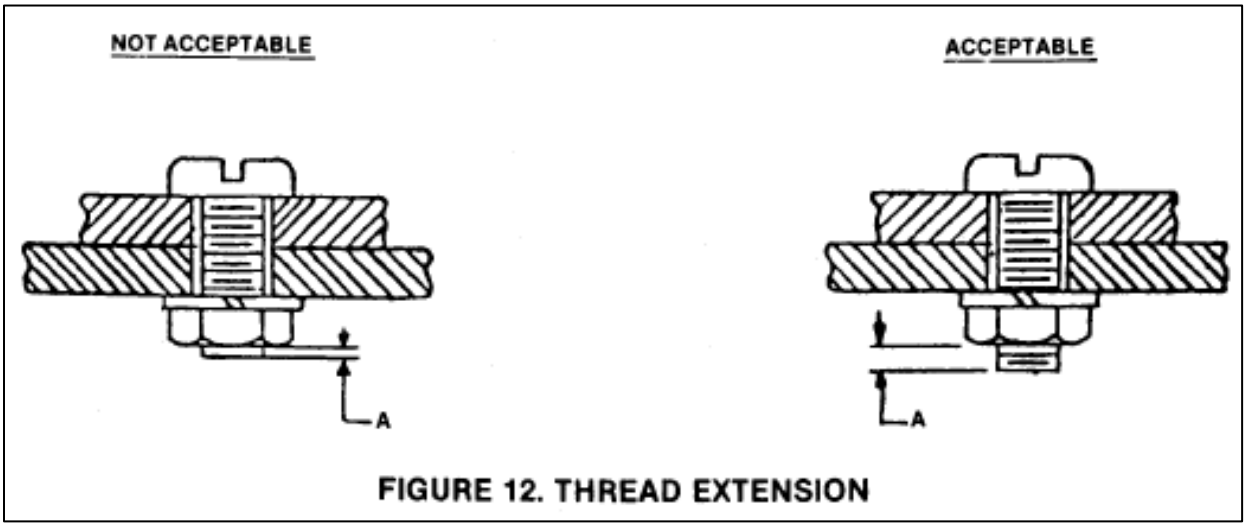


FIGURE 12. THREAD EXTENSION

NOT ACCEPTABLE

A. Thread extensions greater or less than limits allowed in Table I.

ACCEPTABLE

A. Thread extension within limits allowed in Table I.

TABLE I. PERMISSIBLE THREAD EXTENSION

SCREW LENGTH	"A" MIN	"A" MAX
Up to 1 Inch	1 – ½ Threads	1 – ½ Threads + 1/8 Inch
Over 1 Inch	1 – ½ Threads	1 – ½ Threads + ¼ Inch

6.2.5 Threaded Engagement in Blind Tapped Holes

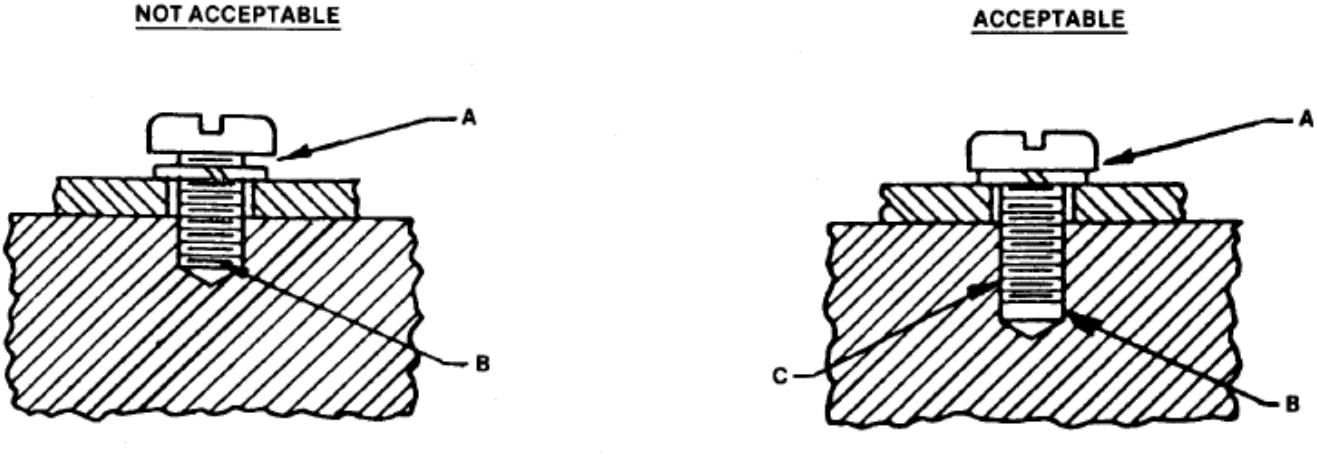


FIGURE 13. THREAD ENGAGEMENT

NOT ACCEPTABLE

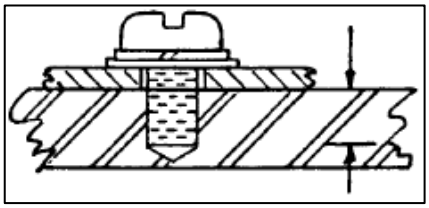
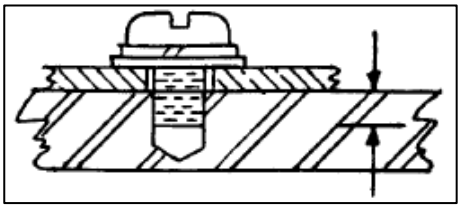
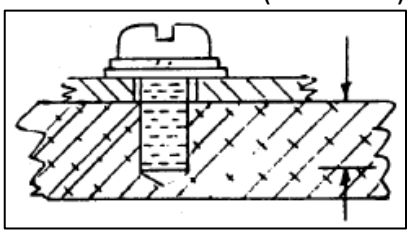
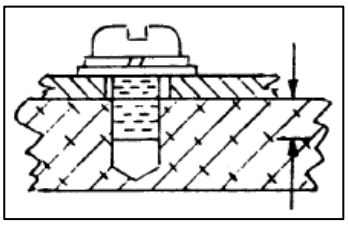
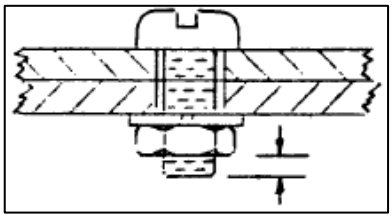
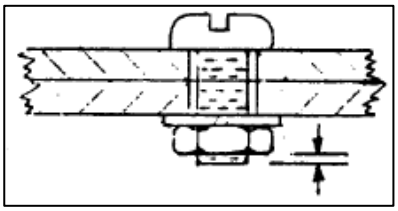
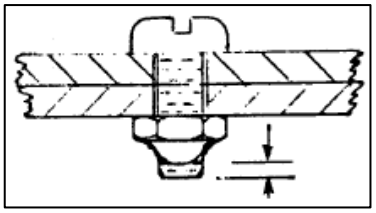
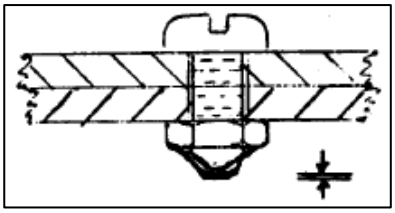
A. Screw has bottomed in tapped hole so that screw does not secure pars.
B. Lead threads of screw stripped due to forced engagement of last two threads in tapped hole which are imperfect threads in most blind tapped holes.
C. Screw engagement in tapped material less than the nominal diameter of the screw.

ACCEPTABLE

A. Screw head is bearing against parts to be fastened.
B. Screw has not bottomed or engaged imperfect threads in bottom of tapped hole.
C. Screw engages tapped material for a length at least equal to the nominal diameter of the screw.

6.3 MECHANICAL FASTENERS

6.3.1 Threaded Engagement – Projection

	ACCEPTABLE	REJECT
THREAD ENGAGEMENT Tapped holes in hard brass or steel.	 Thread engagement is one time the screw diameter (minimum).	 Thread engagement is less than one time the screw diameter.
Tapped holes in aluminum, magnesium or other soft metals.	 Thread engagement is one- and one-half times screw diameter (minimum).	 Thread engagement is less than one- and one-half times screw diameter.
THREAD PROJECTION Non-lock type nut.	 Minimum: At least 1 – ½ threads through nut. Maximum: Limited by next larger standard bolt/screw length.	 Less than 1- ½ threads through nut.
Lock Type nut.	 Minimum: At least 1- ½ threads through locking device of nut. Maximum: Limited by next larger standard bolt/screw length.	 Less than 1- ½ threads through locking device of nut.

MECHANICAL FASTENERS

6.3.2 Self-Locking Nuts

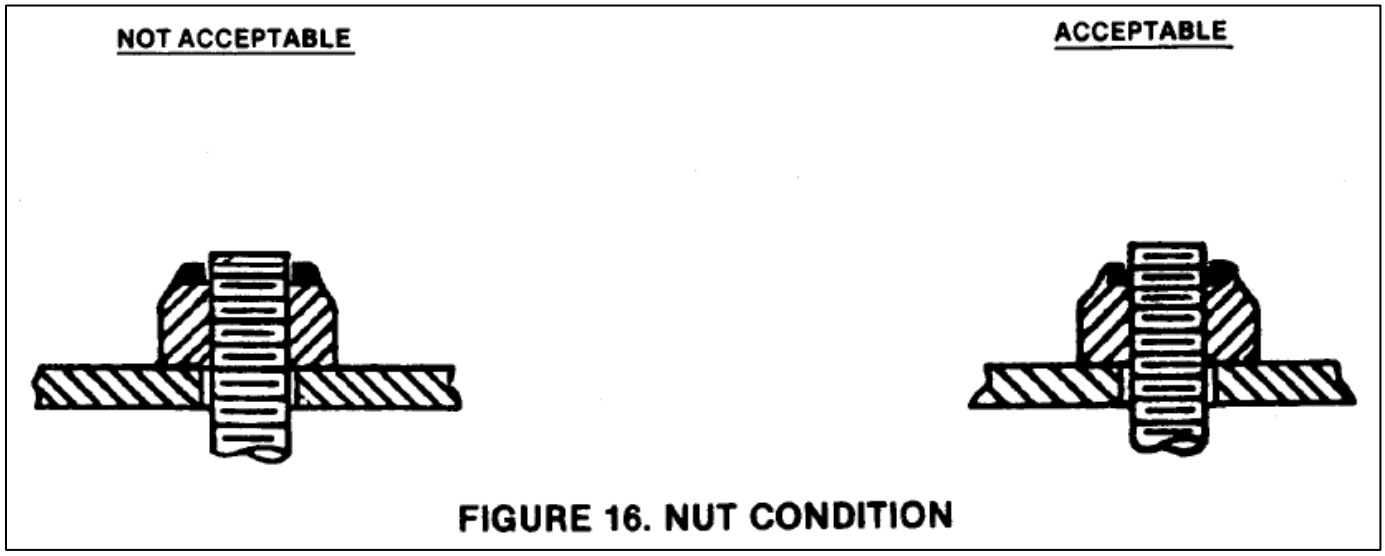


FIGURE 16. NUT CONDITION

NOT ACCEPTABLE

A. Locking element reworked or reprocessed.
B. Nut can be loosened by fingers when not seated indicating nut has been tapped or too frequently re-used.

ACCEPTABLE

A. Nut has not been reworked or reprocessed (including plating) by other than nut manufacturer.
B. Nut running and locking torque is within the prescribed limits and cannot be turned without a wrench.

MECHANICAL FASTENERS

6.3.3 Tightness of Hardware

DEFINITION OF TIGHT

Because of the many variables affecting hand tightening, “tight” is defined as meaning the screw cannot be appreciably tightened further without damage to the threads or material.

TORQUE TABLE

Because of the many variables involved to determine absolute torque values, the following table indicates approximate torque values as applied to stainless steel machine screws. Torque values shown are based on bolt and nut material being the same.

MECHANICAL FASTENERS

Tightness of Hardware

TORQUE VALUES FOR THREADED FASTENERS OF VARIOUS MATERIALS FOR RIGID (METAL TO METAL) JOINTS.

BOLT SIZE		ALUMINUM 2024-T4	BRASS	MONEL	SILICON BRONZE	LOW CARBON STEEL	STAINLESS STEEL 302 – 303	STAINLESS STEEL 316
METRIC	AM.NAT.							
TORQUE VALUES IN OUNCE-INCHES								
---	0-80	8-9	10-11	14-16	13-14	12-14	10-12	14-15
---	1-64	14-15	18-20	25-28	22-25	22-25	18-21	24-27
---	1-72	15-16	18-21	27-30	24-27	23-26	20-22	26-29
M2	2-56	19-22	29-32	37-40	34-37	32-35	35-40	37-42
M2.5	3-56	22-24	32-34	40-42	38-40	36-38	40-42	42-44
TORQUE VALUES IN POUND-INCHES								
---	4-40	3	4	5	4-5	4-5	5	5-6
M3	5-40	3-4	5-6	6-8	6-7	6-7	6-8	7-8
M3.5	6-32	5	7-8	9-10	8-9	8-9	9-10	9-10
M4	8-32	10-11	15-16	18-20	17-18	16-18	18-20	19-21
M5	10-24	12-14	17-19	23-26	19-21	19-21	20-23	21-24
---	10-32	17-19	23-26	31-35	26-29	27-30	28-32	30-33
M6	¼-20	41-46	55-62	77-85	62-69	58-65	68-75	71-79
---	¼-28	51-57	69-77	95-106	78-87	81-90	85-94	89-99
M8	5/16-18	72-80	96-107	134-149	111-123	116-129	119-132	124-138
---	5/16-24	77-86	104-116	144-160	118-131	125-139	128-142	132-147
M10	3/8-16	129-143	173-192	239-266	197-219	191-212	212-236	222-247
---	3/8-24	141-157	191-212	265-294	216-240	209-232	233-259	244-271
M12	7/16-14	210-235	285-315	400-440	325-360	315-350	350-390	365-400

MECHANICAL FASTENERS

Tightness of Hardware

TORQUE VALUES FOR THREADED FASTENERS OF VARIOUS MATERIALS FOR USE IN GASKETED JOINT WITH GASKETS HAVING A HARDNESS OF LESS THAN 40 SHOR DUROMETER "A" RUBBER

BOLT SIZE		ALUMINUM 2024-T4	BRASS	MONEL	SILICON BRONZE	LOW CARBON STEEL	STAINLESS STEEL 302-303	STAINLESS STEEL 316
METRIC	AM. NAT.							
TORQUE VALUES IN OUNCE-INCHES								
….	0-80	5-6	6-7	9-10	8-9	8-9	7-9	9-10
….	1-64	9-10	12-13	16-18	14-16	14-16	12-14	16-18
….	1-72	10-11	12-14	18-20	16-18	15-17	13-14	17-19
M2	2-56	12-14	19-21	24-26	22-24	21-23	23-26	24-27
M2.5	3-56	16-18	22-24	26-28	24-26	24-26	26-28	28-30
TORQUE VALUES IN POUND-INCHES								
….	4-40	2	2-3	3	3	3	3	3-4
M3	5-40	2-3	3-4	3-4	3-4	3-4	4	5
M3.5	6-32	3	5	5	5-6	5-6	6	6-7
M4	8-32	6-7	10	12-13	11-12	10-13	13-14	12-13
M5	10-24	8-9	11-12	15-17	12-14	12-14	13-15	14-16
….	10-32	11-13	15-17	20-23	17-19	17-19	18-21	19-22
M6	¼-20	27-30	36-40	50-55	40-45	38-42	44-49	46-51
….	¼-28	33-37	45-50	62-69	51-56	52-58	55-61	58-64
M8	5/16-18	47-52	62-70	87-97	72-80	75-84	77-86	81-90
….	5/16-24	50-56	68-75	94-104	77-85	81-90	83-92	86-96
M10	3/8-16	84-93	112-125	155-173	128-142	124-138	138-153	144-160
….	3/8-24	92-102	124-138	172-191	140-156	136-151	151-168	159-176
M12		134-148	180-200	240-270	200-220	200-220	220-240	230-250

Torque Values are expressed in inch pounds
THREADED MATERIAL

Screw Size	L/D*	(St) Steel			(Al) Aluminum			Magnesium			(Br) Brass			(Plastic) Phenolic		
Bolt Mat%		Al	Br	St	Al	Br	St	Al	Br	St	Al	Br	St	Al	Br	St
	0.5	0.5	0.5	1.0	0.5	0.5	0.5	0.18	0.18	0.18	0.25	0.26	0.26	0.09	0.09	0.09
0-80	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.36	0.36	0.36	0.45	0.54	0.54	0.18	0.18	0.18
	1.5	0.5	0.5	1.0	0.5	0.5	0.5	0.54	0.54	0.54	0.65	0.75	0.75	0.27	0.27	0.27
	0.5	0.7	0.7	1.5	0.7	0.7	0.7	0.7	0.30	0.36	0.37	0.45	0.45	0.16	0.16	0.16
1-64	1.0	0.7	0.7	1.5	0.7	0.7	0.7	0.7	0.55	0.55	0.75	0.85	0.85	0.32	0.32	0.32
	1.5	0.8	0.8	1.75	0.8	0.8	0.8	0.8	0.85	0.85	0.75	0.85	0.85	0.48	0.48	0.48
	0.5	1.0	1.0	2.25	1.0	1.0	1.0	0.42	0.42	0.42	0.6	0.7	0 .7	0.20	0.20	0.20
2-56	1.0	1.0	1.0	2.25	1.0	1.0	1.0	0.82	0.82	0.82	1.2	1.4	1.4	0.41	0.41	0.41
	1.5	1.3	1.3	3.0	1.3	1.3	1.3	1.2	1.2	1.2	1.2	1.4	1.4	0.61	0.61	0.61
	0.5	1.6	1.6	3.5	1.6	1.6	1.6	0.7	0.7	0.7	1.0	1.1	1.1	0.32	0.32	0.32
3-48	1.0	1.6	1.6	3.5	1.6	1.6	1.6	1.3	1.3	1.3	2.0	2.2	2.2	0.65	0.65	0.65
	1.5	2.0	2.0	4.3	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.2	2.2	1.0	1.0	1.0
	0.5	2.2	2.2	4.75	2.2	2.2	2.2	0.9	0.9	0.9	1.3	1.4	1.4	0.4	0.4	0.4
4-40	1.0	2.2	2.2	4.75	2.2	2.2	2.2	1.7	1.7	1.7	2.5	2.8	2.8	0.8	0.8	0.8
	1.5	2.6	2.6	5.75	2.6	2.6	2.6	2.8	2.8	2.8	2.5	2.8	2.8	1.0	1.0	1.0
	0.5	3.2	3.2	7.0	3.2	3.2	3.2	1.4	1.4	1.4	2.0	2.0	2.0	0.6	0.6	0.6
5-40	1.0	3.2	3.2	7.0	3.2	3.2	3.2	2.5	2.5	2.5	3.7	4.0	4.0	1.2	1.2	1.2
	1.5	3.6	3.6	8.0	3.6	3.6	3.6	3.9	3.9	3.9	3.7	4.0	4.0	1.5	1.5	1.5
	0.5	4.0	4.0	8.75	4.0	4.0	4.0	1.6	1.6	1.6	2.4	2.6	2.6	0.8	0.8	0.8
6-32	1.0	4.0	4.0	8.75	4.0	4.0	4.0	3.2	3.2	3.2	4.8	5.3	5.3	1.6	1.6	1.6
	1.5	4.5	4.5	10.0	4.5	4.5	4.5	4.8	4.8	4.8	4.8	5.3	5.3	1.8	1.9	1.8
	0.5	8.1	8.1	18.0	8.1	8.1	8.1	3.2	3.2	3.2	4.7	5.0	5.0	1.6	1.6	1.6
8-32	1.0	8.1	8.1	18.0	8.1	8.1	8.1	6.5	6.5	6.5	9.5	10.0	10.0	3.2	3.2	3.2
	1.5	9.0	9.0	20.0	9.0	9.0	9.0	9.6	9.6	9.6	9.5	10.0	10.0	4.0	4.0	4.0
	0.5	10.0	10.0	23.0	10.0	10.0	10.0	4.2	4.2	4.2	6.0	7.0	7.0	2.1	2.1	2.1
10-24	1.0	10.0	10.0	23.0	10.0	10.0	10.0	8.4	8.4	8.4	12.0	13.0	13.0	4.2	4.2	4.2
	1.5	12.0	12.0	26.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	13.0	13.0	5.0	5.0	5.0
	0.5	36.0	36.0	80.0	36.0	36.0	36.0	15.0	15.0	15.0	25.0	27.0	27.0	8.0	8.0	8.0
1/4-20	1.0	36.0	36.0	80.0	36.0	36.0	36.0	29.0	29.0	29.0	45.0	55.0	55.0	15.0	15.0	15.0
	1.5	36.0	36.0	80.0	36.0	36.0	36.0	45.0	45.0	45.0	45.0	55.0	55.0	23.0	23.0	23.0
	0.5	64.0	64.0	140.0	64.0	64.0	64.0	26.0	26.0	26.0	37.0	42.0	42.0	13.0	13.0	13.0
5/16-18	1.0	64.0	64.0	140.0	64.0	64.0	64.0	51.0	51.0	51.0	75.0	85.0	85.0	25.0	25.0	25.0
	1.5	64.0	64.0	140.0	64.0	64.0	64.0	75.0	75.0	75.0	75.0	85.0	85.0	38.0	38.0	38.0
	0.5	110.0	110.0	250.0	110.0	110.0	110.0	46.0	46.0	46.0	70.0	75.0	75.0	22.0	22.0	22.0
3/8-16	1.0	110.0	110.0	250.0	110.0	110.0	110.0	91.0	91.0	91.0	135.0	150.0	150.0	45.0	45.0	45.0
	1.5	110.0	110.0	250.0	110.0	110.0	110.0	137.0	137.0	137.0	135.0	150.0	150.0	65.0	65.0	65.0

*Values for L/D are for length of third engagement to nominal bolt diameter. Bolt diameters are with or without plating.

MECHANICAL FASTENERS

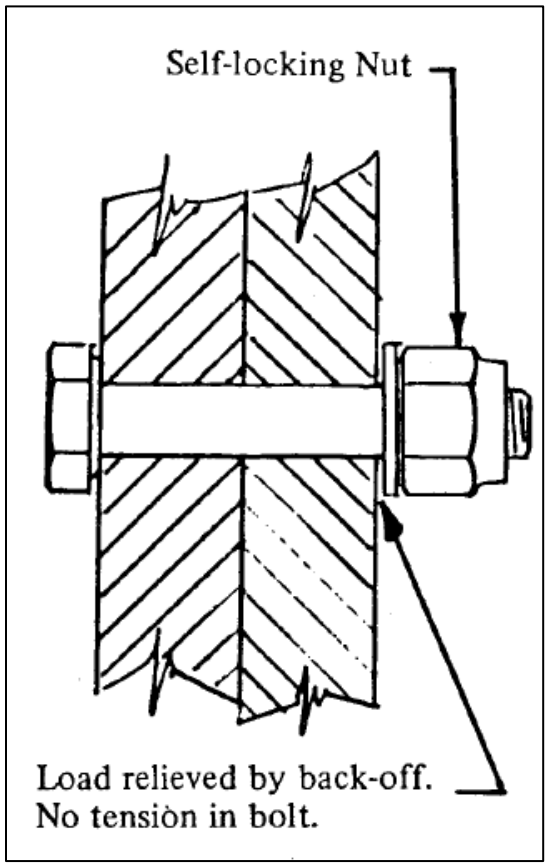
6.3.4 Reuse of Self-Locking Devices

Repeated removal of self-locking nuts and bolts may reduce the holding power of these devices. Reusability shall be on the basis of meeting minimum breakaway torque requirements as specified.

Minimum Breakaway Torque

The torque required to start removal of the nut, bolt, or screw. The locking element shall be the only factor restraining the fastener when measuring this torque.

1. Remove any induced specified torque by backing off nut, or threaded screw type fastener from assembled surface one full turn. See sketch.
2. Measure minimum breakaway torque and reject locking fastener if value is less than indicated in table.



Torque
(At room temperature in inch-pounds)

Thread Sizes; Nut, Bolt or Screw	Minimum Breakaway Torque
No. 4-40 UNC-3B	0.5
No. 6-32 UNC-3B	1.0
No. 8-32 UNC-3B	1.5
No. 10-32 UNF-3B	2.0
¼ -28 UNF-3B	3.5
5/16 -24 UNF-3B	6.5
3/8 -24 UNF-3B	9.5
7/16 -20 UNF-3B	14.0
½ -20 UNF-3B	18.0
9/16-18 UNF-3B	24.0
5/8 -18 UNF-3B	32.0
¾ -16 UNF-3B	50.0
7/8-14 UNF-3B	70.0
1-12 UNF-3B	92.0
1-1/8-12 UNF-3B	117.0
1-1/4-12 UNF-3B	143.0

6.4 FASTENERS & FASTENER ASSEMBLIES

6.4.1 Clinch Nuts – Press in Type

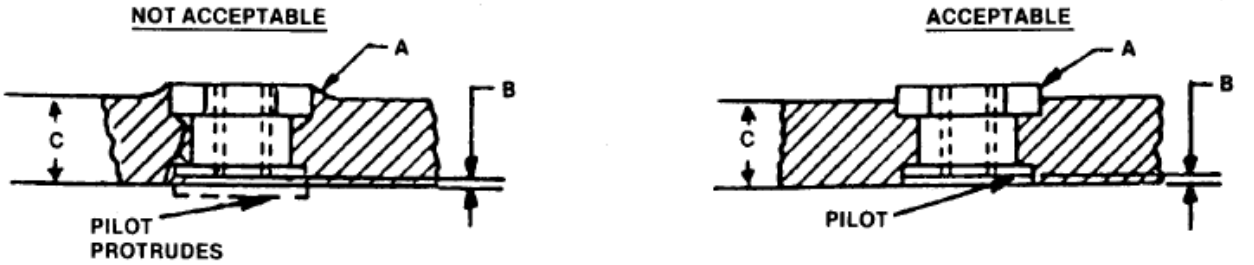


FIGURE 17. PRESSED INSULATION

NOT ACCEPTABLE

A. Nut loose. Panel deformed.
B. More than .010 inch below flush or protrudes beyond panel surface.
C. Length of nut incorrect for panel thickness in which it is installed.

ACCEPTABLE

A. Nut tight. Panel not deformed.
B. Unless otherwise specified nuts of this type shall be installed with pilot flush to .010 inch below flush.
C. Nut size permits panel to be equal to or thicker than minimum requirements of nut.
D. Head may be installed flush with panel surface.

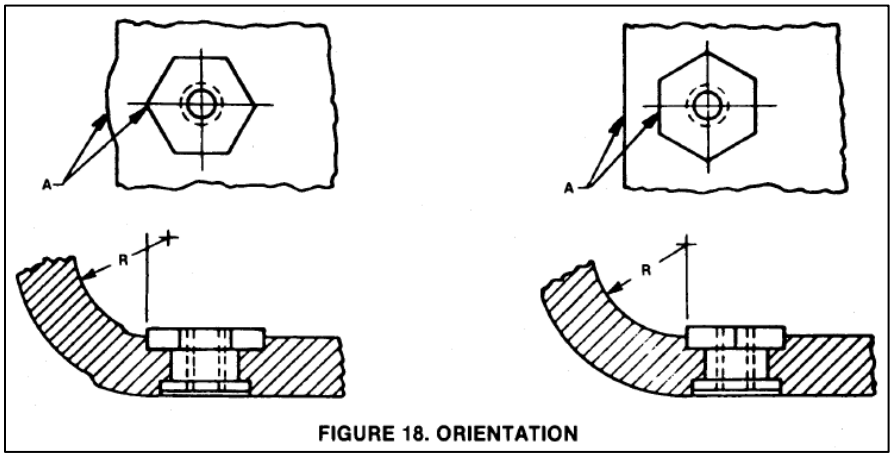


FIGURE 18. ORIENTATION

NOT ACCEPTABLE

A. Nut installed too close to bend or edge or corner of hex faces edge or bend causing deformation.

ACCEPTABLE

A. Nut oriented so that hex flat is parallel to the bend or edge when nut is installed close to the bend or edge.

6.4.2 Clinch Nuts – Press in Types

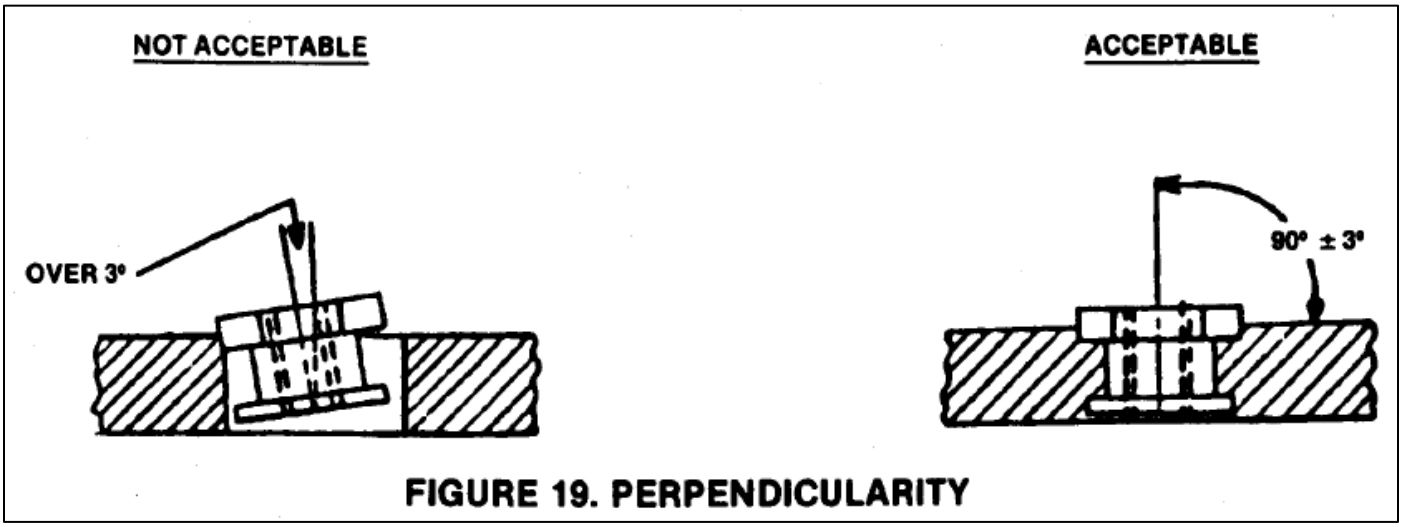


FIGURE 19. PERPENDICULARITY

NOT ACCEPTABLE

A. Nonparallel surface used to install nut. Threads are not perpendicular to panel.

ACCEPTABLE

A. Threads perpendicular with mounting surface.

6.4.3 Clinch Nuts – Flared Type

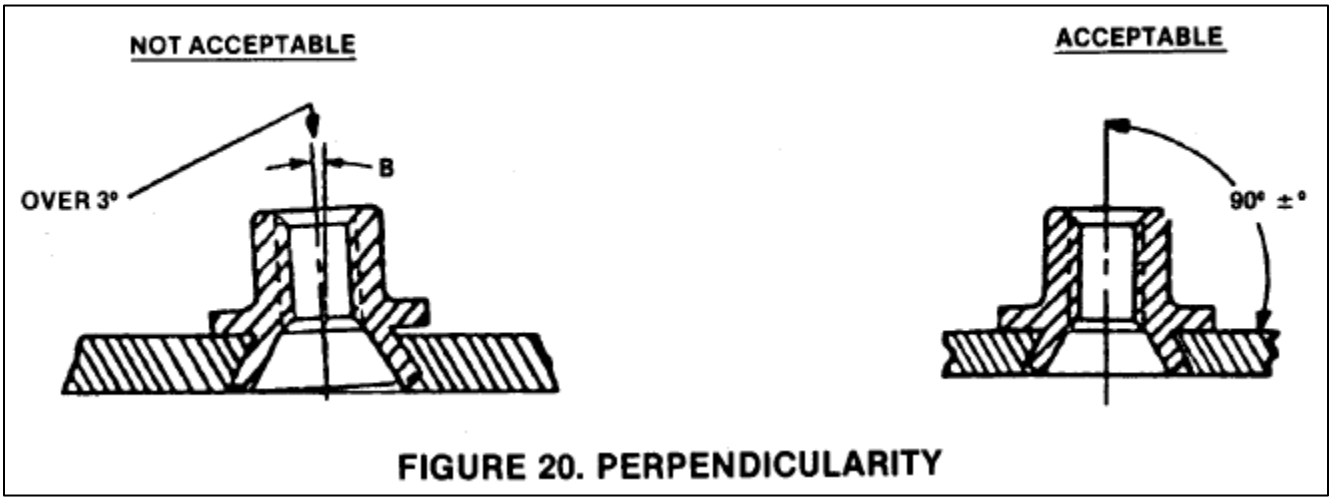


FIGURE 20. PERPENDICULARITY

NOT ACCEPTABLE

A. Uneven surfaces used in mounting nut.
B. Axis from the perpendicular exceeds 3°.

ACCEPTABLE

A. Parallel mounting surfaces used to mount nut so that shoulder rests against panel entire circumference of shoulder.
B. Threads perpendicular to surface within 90° ± 3°.

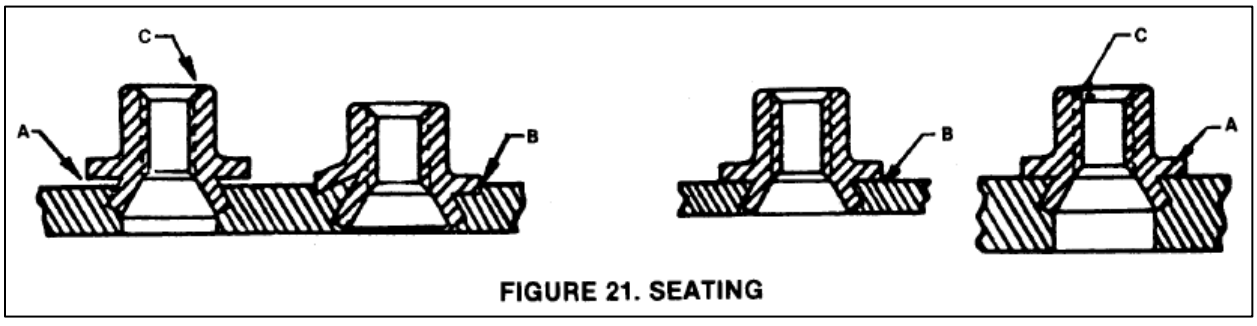


FIGURE 21. SEATING

NOT ACCEPTABLE

A. Nut incompletely seated.
B. Excessive pressure used to seat nut prior to flaring shank.
C. Damaged threads.

ACCEPTABLE

A. Nut properly seated prior to flaring shank.
B. Shoulder pressed against panel but is not imbedded.
C. No damaged threads.

6.4.4 Clinch Nuts – Flared Type

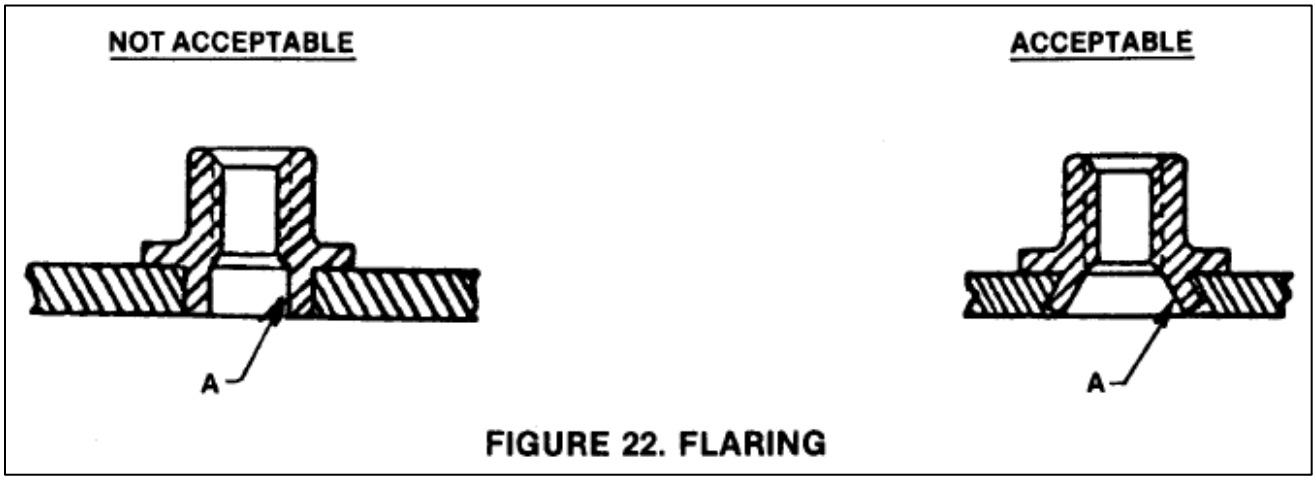


FIGURE 22. FLARING

NOT ACCEPTABLE

A. Shank not flared.

ACCEPTABLE

A. Shank flared to approximate original mounting hole in panel.

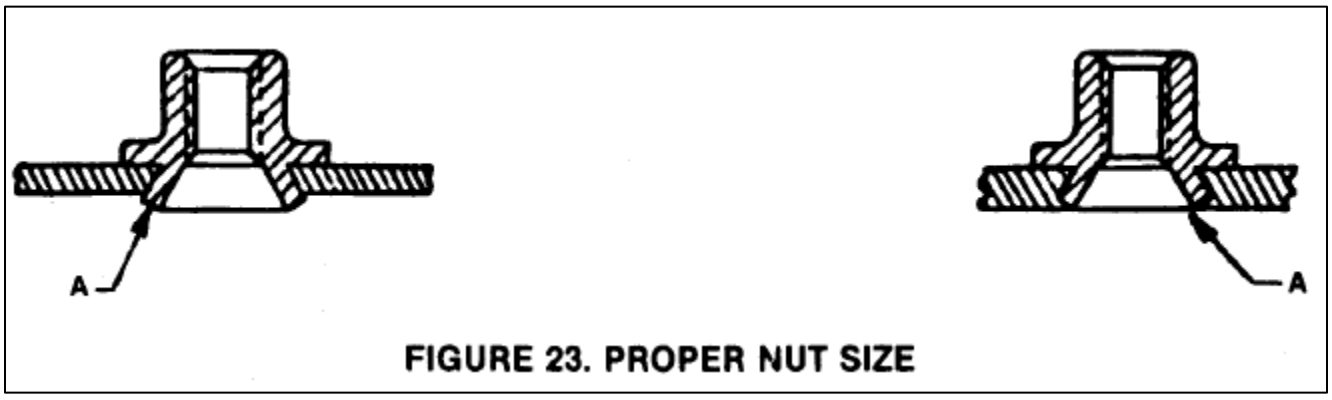


FIGURE 23. PROPER NUT SIZE

NOT ACCEPTABLE

A. Shank protrudes through sheet indicating incorrect clinch nut used.

ACCEPTABLE

A. Proper nut size for panel thickness used so that shank is completely within mounting hole.

6.4.5 Clinch Nuts – Knurled Shoulder Type

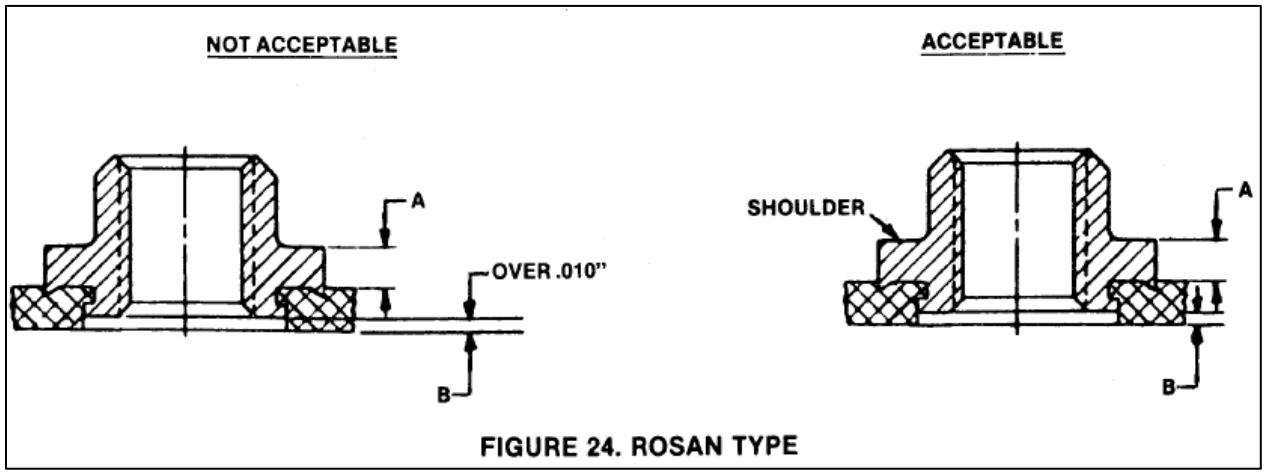


FIGURE 24. ROSAN TYPE

NOT ACCEPTABLE

Insufficient or excessive pressure applied causing embedment of shoulder in panel to a greater or lesser degree than prescribed in Table III.
Pilot extends beyond or is more than .010 inch below being flush with surface panel.

ACCEPTABLE

Sufficient pressure applied to embed shoulder in panel so that A dimension is within range shown in Table III.
Pilot may be flush to .010 inch below flush with surface of panel.

TABLE III. PILOT FLUSHNESS LIMITS

THREAD SIZE	A		THREAD SIZE	A	
	MIN.	MAX.		MIN.	MAX.
No. 2-56	.030	.050	No. 10-32	.030	.050
No. 4-40	.030	.050	¼-20	.045	.065
No. 6-32	.030	.050	5/16-18	.055	.075
No. 8-32	.030	.050	3/8-16	.070	.085

6.4.6 Threaded Studs

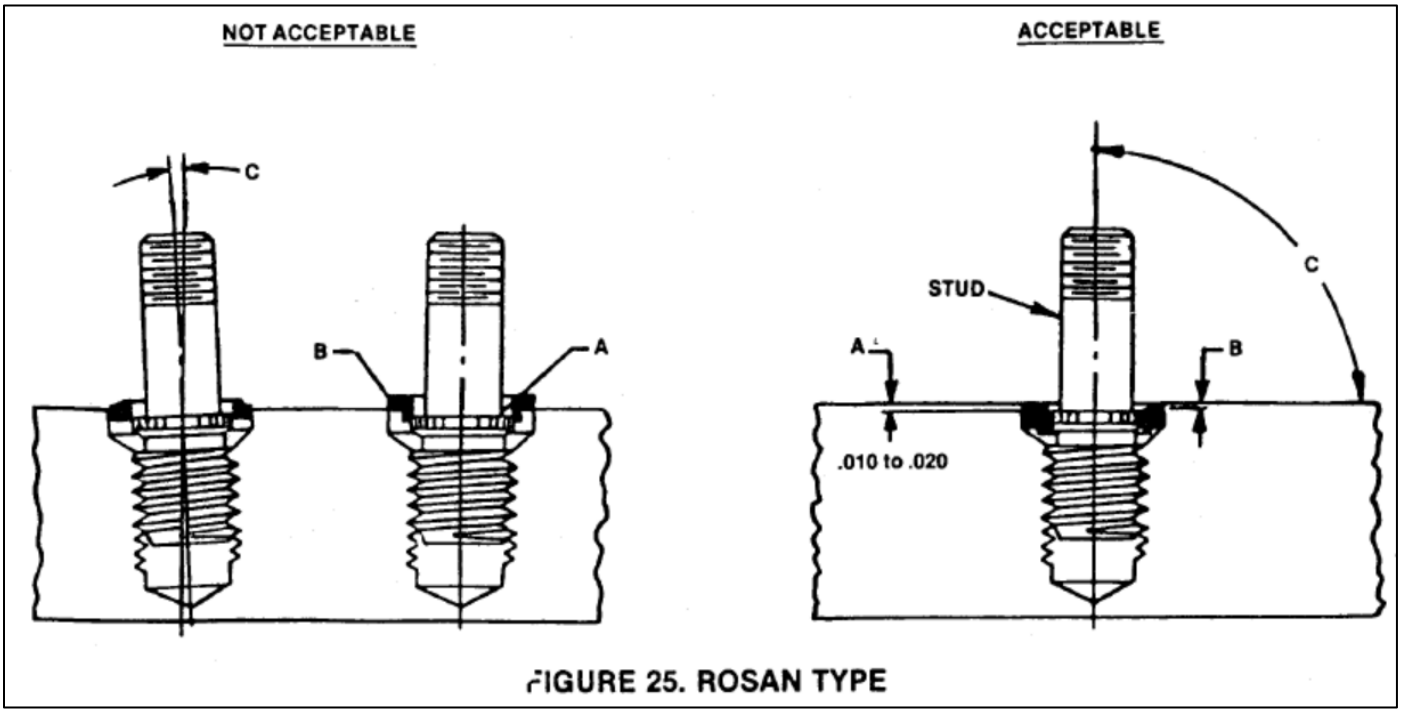


FIGURE 25. ROSAN TYPE

NOT ACCEPTABLE

A. Stud incorrectly installed.
B. Lock ring not properly seated.
C. Assembly not perpendicular to base material within 90° ± 3°.

ACCEPTABLE

A. Stud installed with top of surface .010 inch to .020 inch below surface.
B. Lock ring installed with top flush to .010 inch below flush.
C. Assembly installed perpendicular to base material within 90° ± 3°.

6.4.7 Inserts in Molded and Die Cast Materials

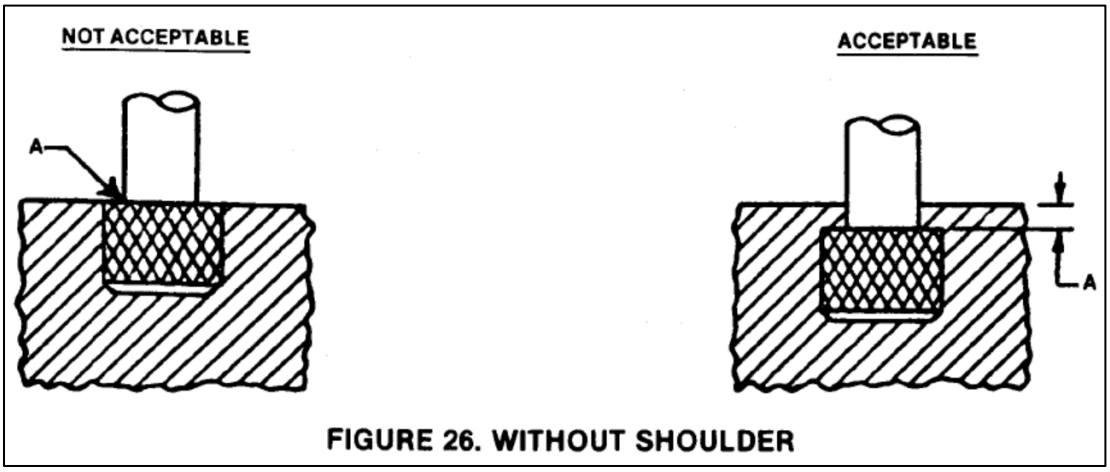


FIGURE 26. WITHOUT SHOULDER

NOT ACCEPTABLE

A. Knurled or gripping surface flush or above surface.

ACCEPTABLE

A. Knurled or gripping surface in a minimum of .003 inch below surface.

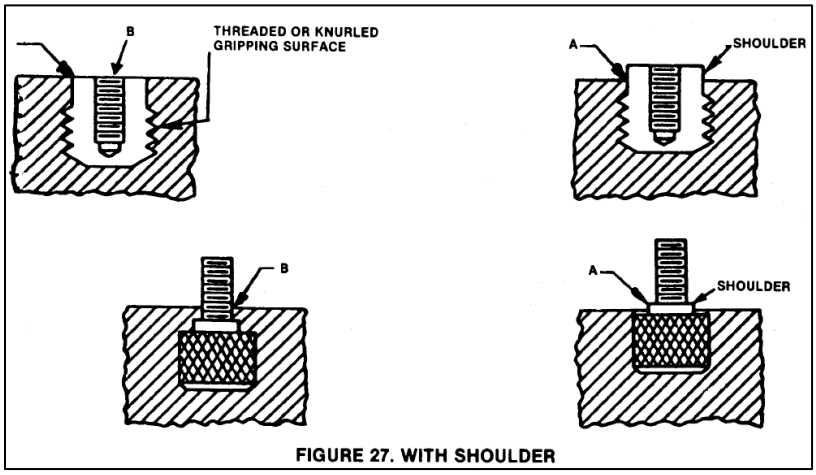


FIGURE 27. WITH SHOULDER

NOT ACCEPTABLE

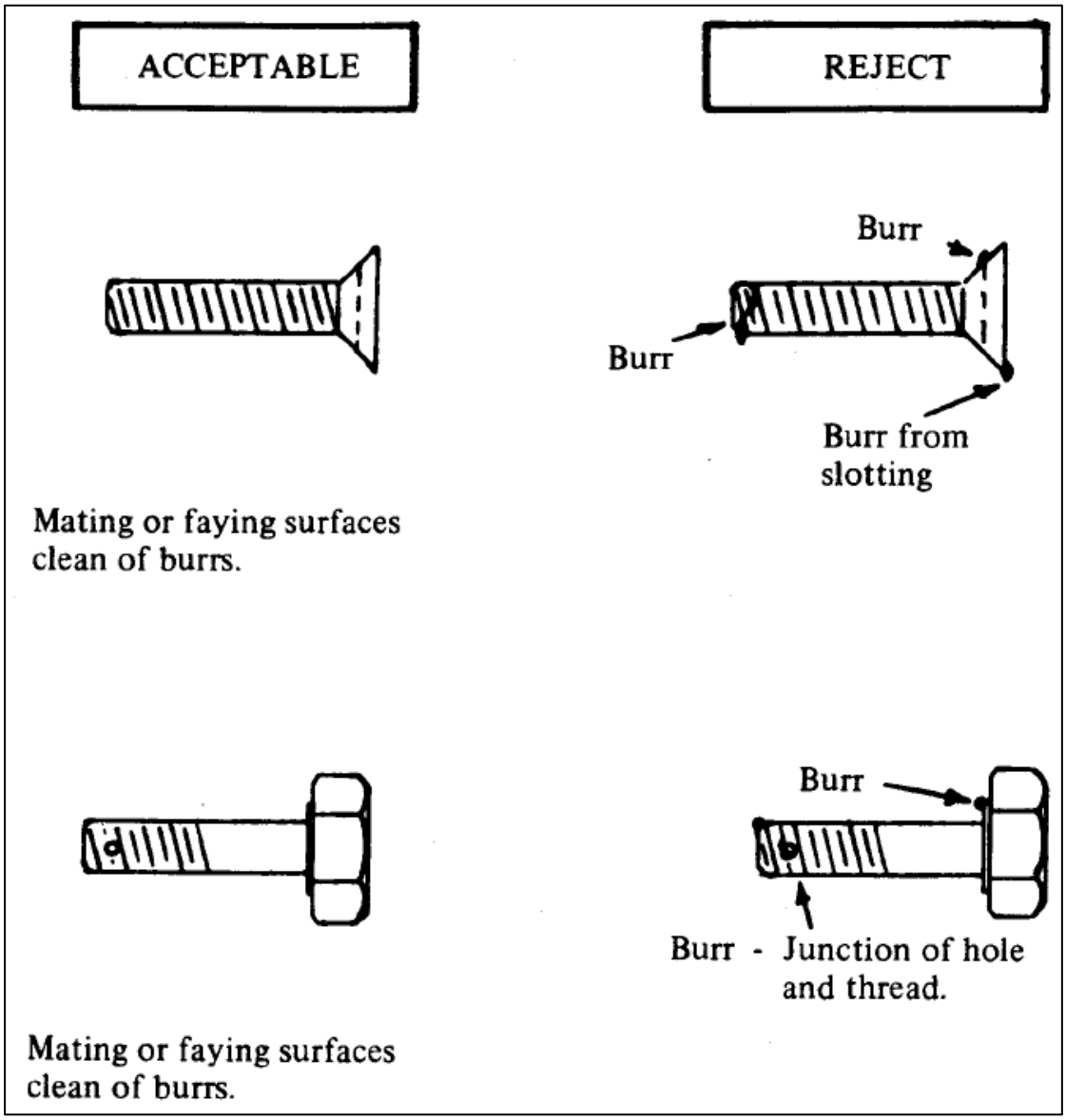
A. Internally threaded insert flush or below flush with surface.
B. Molded material in threads.

ACCEPTABLE

A. Insert located above surface so that shoulder will restrict flow of molded material into threads.
B. No molded material in threads.

6.4.8 Burrs

Burrs – Screws/Bolts



6.5 Dissimilar Metals

1. Dissimilar metals shall not be used in intimate contact unless suitably protected against electrolytic corrosion. When it is necessary that any combination of such dissimilar metals (see chart) be assembled, an interposing material compatible to each shall be used.

GROUPING OF METALS			
Group 1	**Group 2**	**Group 3**	**Group 4**
Magnesium Alloys Most Anodic	Aluminum Aluminum Alloys Zinc Cadmium Tin Stainless Steel	Zinc Cadmium Steel Lead Tin Stainless Steel	Copper & its Alloys Nickel & its Alloys Chromium Stainless Steel Gold Most Cathodic

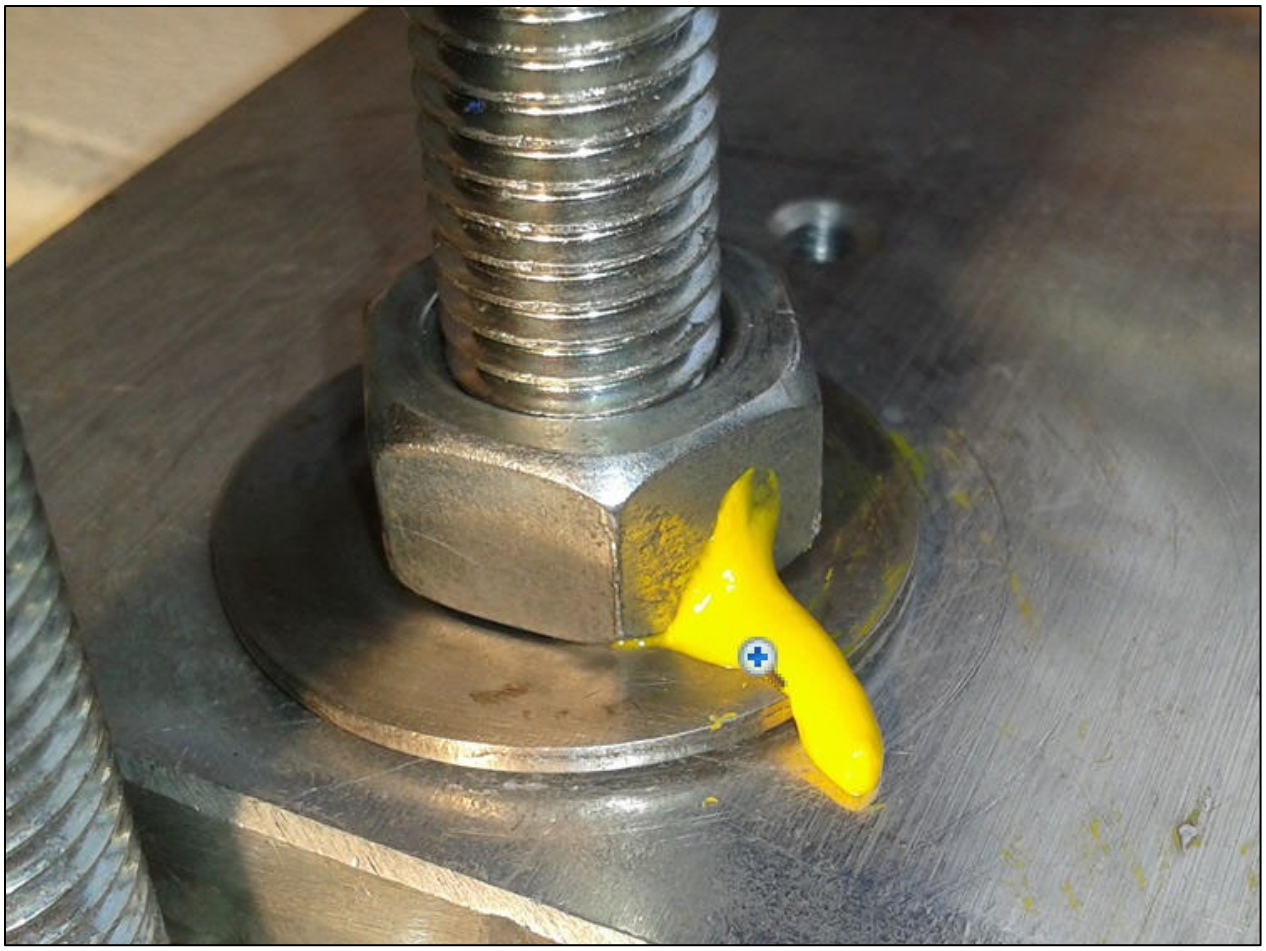
2. Contact between a member of any one group and another member of the same group shall be considered as similar. Contact between a member of one group and a member of any other group shall be considered as dissimilar, except for zinc and cadmium, as listed in Groups 2 and 3, and for tin and stainless steel as listed in Groups 2, 3 and 4.

3. Where reference is made to a metal in a particular group, the reference applies to the metal on the surface of the part; that is, zinc means zinc castings, as well as zinc electroplate, zinc hot-dip, or zinc metal spray.

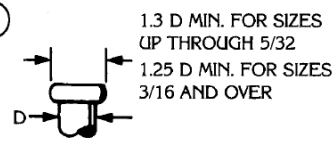
4. Different metals in contact, even though similar, shall be employed in assemblies in such manner that the smaller is cathodic or protected and the larger part is anodic or corroded.

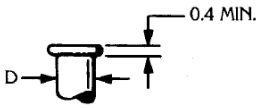
6.6 Proper Application of Torque Seal

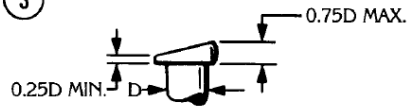
As illustrated in the picture below, torque seal must be applied so that it forms a solid plane from the fastener to the fixed portion of the assembly. This is done in a manner that will indicate if the fastener has been moved after the torque seal was applied.

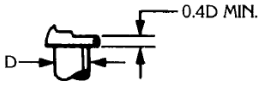


6.7 Rivets and Eyelets

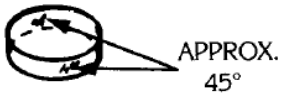
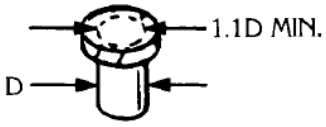
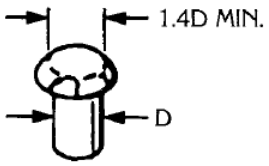
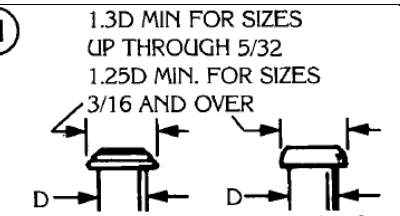
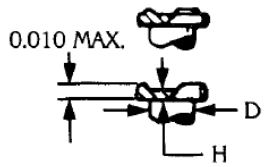
<table>
<tr><th>CONDITION</th><th colspan="4">ACCEPTABLE LIMITS</th></tr>
<tr><td rowspan="5">(1)
 

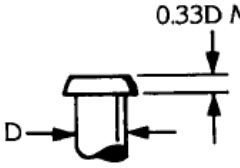
MINIMUM DRIVEN HEAD DIAMETER</td><td>RIVET SIZE</td><td>MINIMUM DIA.</td><td>RIVET SIZE</td><td>MINIMUM DIA.</td></tr>
<tr><td>1/16</td><td>0.081</td><td>3/16</td><td>0.235</td></tr>
<tr><td>3/32</td><td>0.122</td><td>¼</td><td>0.312</td></tr>
<tr><td>1/8</td><td>0.163</td><td>5/16</td><td>0.390</td></tr>
<tr><td>5/32</td><td>0.202</td><td>3/8</td><td>0.470</td></tr>
<tr><td rowspan="5">(2)
 

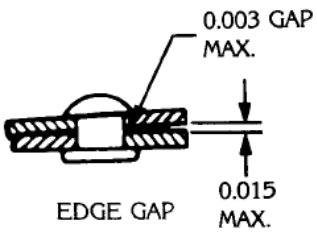
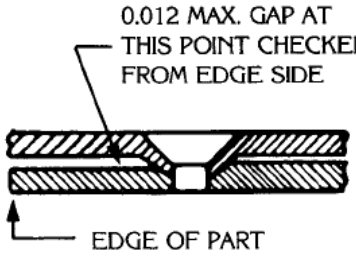
MINIMUM DRIVEN HEAD HEIGHT</td><td>RIVET SIZE</td><td>MINIMUM DIA.</td><td>RIVET SIZE</td><td>MINIMUM DIA.</td></tr>
<tr><td>1/16</td><td>0.025</td><td>3/16</td><td>0.075</td></tr>
<tr><td>3/32</td><td>0.038</td><td>¼</td><td>0.100</td></tr>
<tr><td>1/8</td><td>0.050</td><td>5/16</td><td>0.135</td></tr>
<tr><td>5/32</td><td>0.062</td><td>3/8</td><td>0.150</td></tr>
<tr><td>(3)
 

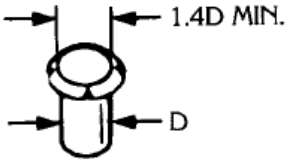
BEVELED DRIVEN HEAD</td><td colspan="4">A. THE AVERAGE OF THE MINIMUM & THE MAXIMUM HEAD HEIGHTS SHALL NOT BE LESS THAN 0.4D (SEE CONDITION 2).
B. THE MINIMUM HEAD HEIGHT AT ANY POINT SHALL BE 0.25D; THE MAXIMUM, .075D.</td></tr>
<tr><td>(4)
 
OFFSET DRIVEN HEAD</td><td colspan="4">A. THE HEAD MAY BE TANGENT TO THE SHANK EXCEPT THAT NO PORTION OF THE HOLE, THE DEBURRED SURFACE OR THE BELL MOUTH OF THE DIMPLE SHALL BE VISIBLE.</td></tr>
<tr><td>(5)
 

STEPPED DRIVEN HEAD</td><td colspan="4">A. MINIMUM THICKNESS SHALL BE 0.4D.
B. HEAD IS ACCEPTABLE WITH HIGH PART REMOVED.</td></tr>
<tr><td>(6)
 
BELL DRIVEN HEAD</td><td colspan="4">RIVET IS INCOMPLETELY DRIVEN & DOES NOT FILL HOLE. MUST BE REDRIVEN OR REPLACED.</td></tr>
<tr><td>(7)
 
VERTICAL CRACKS DRIVEN HEAD
(245 ONLY)</td><td colspan="4">A. VERTICAL OR BURST CRACKS ARE USUALLY CAUSED BY OVER HEAT-TREATING. THIS TYPE RIVET IS WEAK & BRITTLE & SOULD BE REJECTED.
B. LAP OR SEAM CRACKS SHOULD NOT BE CONFUSED WITH CRACKS CAUSED BY DRIVING. THE FORMER MAY BE IDENTIFIED BY THEIR SMOOTH DULL FINISH.</td></tr>
</table>

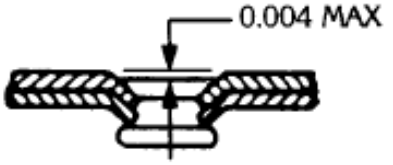
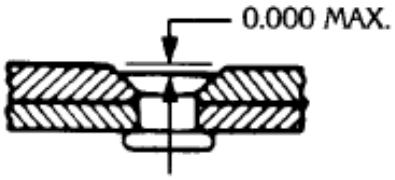
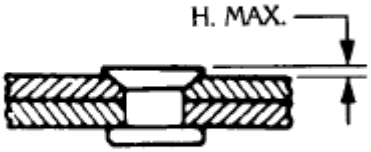
CONDITION	ACCEPTABLE LIMITS
8  PARALLEL DIAGONAL CRACKS – DRIVEN HEAD	THIS CONDITION IS OFTEN INDICATIVE OF A PARTIAL SHEAR CONDITION ACROSS THE WHOLE HEAD. RIVET IS NOT ACCEPTABLE.
9  DIAGONAL CRACKS – DRIVEN HEAD	A. ACCEPTABLE CRACKS ARE APPRIXIMATELY RADIAL (VIEWING TOP OF HEAD). NO CRACK SHALL EXTEND INTO AN AREA WITH A DIAMETER LESS THAN 1.1D. B. TWO OR MORE CRACKS SHALL NOT INTERSECT. THIS FORMS A POTENTIAL CAUSE FOR A PORTION OF THE HEAD TO CHIP OFF. C. FIVE OR MORE CRACKS ARE NOT ACCEPTABLE. D. 24S RIVETS WHICH HAVE AGED TOO LONG WILL USUALLY CRACK SEVERELY – THEY ARE NOT ACCEPTABLE.
10  CRACKED MANUFACTURED HEAD	A. CRACKS IN THE MANUFACTURED HEAD (EXCEPT 24S RIVETS) ARE ACCEPTABLE PROVIDED NO PORTION ENTERS INTO AN AREA CIRCUSCRIBED BY A 1.4D DIAMETER CIRCLE. B. NO CRACKS ARE ACCEPTABLE IN MANUFACTURED HEAD OF A 24S RIVET. (RACKING USUALLY INDICATES OVER-HEAT-TREATMENT).
11  STEPPED OR TRUNCATED CONICAL DRIVEN HEAD	ACCEPTABLE ON 3/16 AND LARGER DIAMETER RIVETS. REDUCE THE TENDENCY OF LARGER RIVETS TO CRACK.
12  MISSHAPEN DRIVEN HEAD	ACCEPTABLE SO LONG AS LIMITS OF MNINIMUM HEAD DIAMETER & MINIMU HEAD HEIGHT (SEE CONDITIONS 1 & 2) ARE MET.
13  PUNCH RING – DRIVEN HEAD	A. PUNCH RINGS EVEN WITH OR ABOVE THE SURFACE OF THE RIVET (MADE WITH AN AUTOMATIC RIVETING MACHINE) ARE ACCEPTABLE. B. PUNCH RINGS BELOW THE SURFACE OF THE HEAD FLAT ARE ACCEPTABLE PROVIDING THE DEPTH DOES NOT EXCEED 0.010 & MIN. H IS 0.4D.

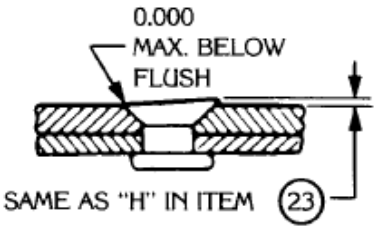
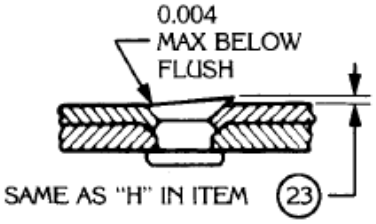
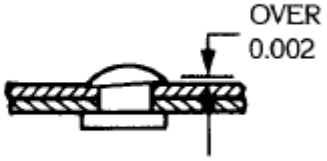
<table>
<tr><th>CONDITION</th><th colspan="4">ACCEPTABLE LIMITS</th></tr>
<tr><td rowspan="5">(14)
 

FLATTENED MFGD. HEAD</td><td>RIVET SIZE</td><td>MINIMUM HEIGHT</td><td>RIVET SIZE</td><td>MINIMUM HEIGHT</td></tr>
<tr><td>1/16</td><td>0.021</td><td>3/16</td><td>0.062</td></tr>
<tr><td>3/32</td><td>0.031</td><td>¼</td><td>0.083</td></tr>
<tr><td>1/8</td><td>0.041</td><td>5/16</td><td>0.104</td></tr>
<tr><td>5/32</td><td>0.052</td><td>3/8</td><td>0.125</td></tr>
<tr><td>(15)
 
</td><td colspan="4">A. NO GAP IS PERMISSIBLE ON PRESSURE RETAINING ASSEMBLIES.
B. THE GAP AT THE OPEN EDGE OF THE JOINT IS ACCEPTABLE IF IT IS 0.015 OR LESS (WITHIN TWO RIVET DIAMETERS OF EITHER SIDE OF THE RIVET).
C. THE MAX. PERMISSIBLE GAP AT THE RIVET SHANK IS 0.003.</td></tr>
<tr><td>(16)
 
</td><td colspan="4">A DIMPLE SHALL NEST INTO A MACHINE COUNTERSINK OR ANOTHER DIMPLE WITHIN THE LIMITS GIVEN IN FIGURE 2 EXCEPT AS FOLLOWS.

A. ON AN EDGE ROW OF RIVETS, A MAX. GAP AT THE DIMPLE OF 0.012 IS PERMISSIBLE FROM THE EDGE SIDE ONLY. THE GAP AT THE DIMPLE ON THE OTHER THREE SIDES OF THE RIVET SHALL NOT EXCEED 0.008 AS SPECIFIED IN FIGURE 2.</td></tr>
<tr><td>(17)
 

MACHINE PINCHED HEAD</td><td colspan="4">CAUSED BY THE GRIPPING DOGS ON AUTOMATIC RIVETING MACHINES. ACCEPTABLE PROVIDING RIVET HEAD IS FIRMLY SEATED & DEFORMATION DOES NOT EWNTER INTO AN AREA HAVING A DIAMETER OF 1.4D.</td></tr>
<tr><td>(18)
 
CUTS OR DINGS IN SHEET CAUSED BY RIVET SET OR BUCKING BAR</td><td colspan="4">MAY BE CAUSE FOR REJECTION OF THE ASSEMBLY.</td></tr>
<tr><td>(19)
CRACKING OR DEFORMATION OF SHEET ADJACENT TO RIVET CAUSED BY OVER-DRIVING RIVET</td><td colspan="4">MAY BE CAUSE FOR REJECTION.</td></tr>
</table>

20  DRIVEN HEAD REVERSED	PROTRUDING HEAD TYPE RIVETS MAY HAVE DRIVEN HEAD FORMED INTO DIMPLE OR COUNTERSINK. ACCEPTABILITY LIMITS FOR THE DRIVEN HEAD SHALL BE THE SAME AS FOR THE EQUIVALENT MANUFACTURED HEAD (COUNTERSUNK TYPE).
21  MFG'D. HEAD RECESSION – DIMPLED TOP SHEET	RIVET IS NOT ACCEPTABLE IF HEAD FLAT IS MORE THAN 0.004 BELOW SHEET SURFACE (WHERE TOP SHEET IS DIMPLED).
22  MFG'D. HEAD RECESSION – COUNTERSUNK TOP SHEET	RIVET IS NOT ACCEPTABLE IF ANY PART OF HEAD FLAT IS BELOW SURFACE UNLESS SPECIFICALLY NOTED OTHERWISE ON THE CONTOUR SMOOTHNESS DRAWING (WHERE TOP SHEET IS COUNTERSUNK).
23  MFG'D HEAD PROTRUSION	RIVET IS NOT ACCEPTABLE IF HEAD PROTRUDES MORE THAN "H" DIMENSION IN FOLLOWING CHART: RIVET SIZE / H (BEFORE SHAVING) 3/32 — 0.010 1/8 — 0.010 5/32 — 0.010 3/16 — 0.010 1/4 — 0.015 5/16 — 0.020 3/8 — 0.020 THIS IS A STRUCTURAL REQUIREMENT. FOR ACTUAL FLUSHING LIMITS SEE APPLICABLE PROCESS SPECIFICATION ON AERODYNAMIC CONTOURS.

CONDITION	ACCEPTABLE LIMITS
(24)  NOT ACCEPTABLE  ACCEPTABLE PARTIALLY OPEN COUNTERSINK	RIVET IS NOT ACCEPTABLE IF PARTIAL OPENING EXISTS TO RIVET SHANK. NOTE: FLAT EDGES OR ROUNDED EDGES ON RIVET HEAD CREATE A CONDITION WHICH RESEMBLES THE ABOVE; HOWEVER, IF RIVET HEAD IS TIGHT & OPENING DOES NOT EXTEND TO SHANK, RIVET IS ACCEPTABLE. THESE LIMITS APPLY TO BOTH MACHINE COUNTERSUNK & DIMPLED JOINTS.
(25)  MACHINE COUNTERSUNK TILTED FLUSH RIVET	RIVET IS ACCEPTABLE PRIVIDING NO PART OF HEAD FALLS BELOW FLUSH, MAX. H DOES NOT EXCEED LIMITS & DIFFERENTIAL BETWEEN HIGH & LOW PORTION DOES NOT EXCEED 0.010.
(26)  DIMPLE TILTED FLUSH RIVET	RIVET IS ACCEPTABLE PROVIDING NO PART OF HEAD FALLS MORE THAN 0.004 BELOW FLUSH, MAX. H DOES NOT EXCEED LIMITS & DIFFERENTIAL BETWEEN HIGH & LOW PORTION DOES NOT EXCEED 0.010.
(27)  TILTED MANUFACTURED HEAD	UNACCEPTABLE IF 0.002 FEELER GAGE CAN BE INSERTED TO SHANK, RESTRIKE TO CORRECT. NO TILT ACCEPTABLE ON PRESSURE RETAINING ASSEMBLIES.

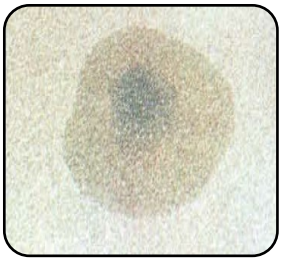
6.8 MACHINED & SHEET METAL PARTS

6.8.1 Aluminum Wettability Test – Abrasive Cleaning

ACTUAL SIZE

PREFERRED

1. Water drop test indicates an even spread of the water with complete wetting of the surface. No water is visible above surface grain.

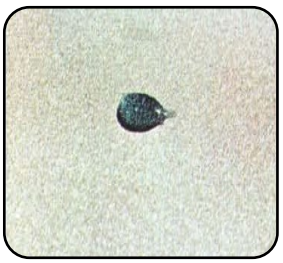


ACCEPTABLE

1. Water drop indicates less spread. Surface is completely wetted and spread is even.

ACCEPTABLE MINIMUM

1. Water drop indicates minimum spread. Water is visible above surface; however, the wetting action is adequate and water has not beaded on surface.

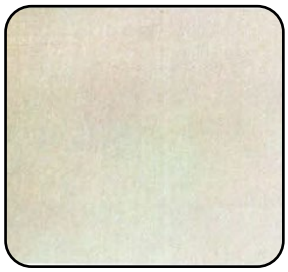


NOT ACCEPTABLE

1. Surface has failed to wet. Water drop has beaded on surface, without spreading, indicating surface is contaminated.

6.8.2 Aluminum Wettability Test – Chemical Cleaning

ACTUAL SIZE



PREFERRED

1. **Spray or Dip Test:** Surface is completely wetted & the water has spread evenly without evidence of water-break or beading.

NOT ACCEPTABLE

1. **Spray or Dip Test:** Surface has failed to wet evenly. Water-break or beading has occurred indicating the surface is contaminated.

ACCEPTABLE MINIMUM

1. **Alternate Water Drop Test:** Water-Drop indicates minimum spread; however, the wetting action is adequate & water drop has not beaded on surface.

NOT ACCEPTABLE

Alternate Water-Drop Test: Surface has failed to wet. Water drop has beaded on surface, without spreading, indicating surface is contaminated.

6.8.3 Drilled Hole Tolerances

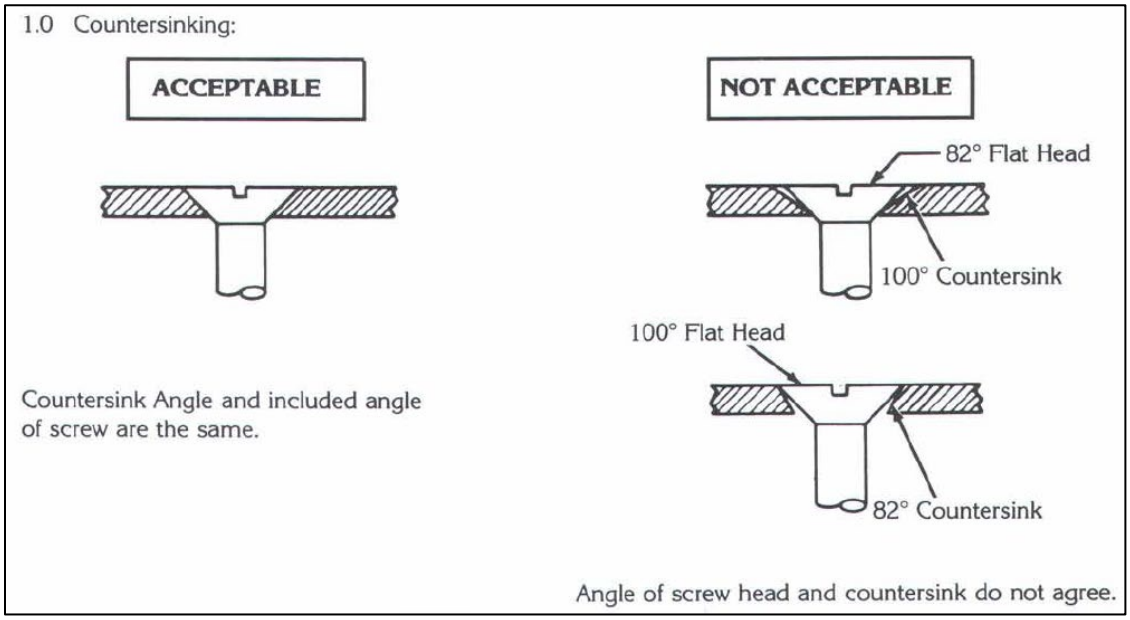
The following hole tolerances, standard for holes drilled with a drilling machine using suitable jigs and fixtures, will apply except in those cases where design dictates greater or lesser accuracy.

Drilled Hole Tolerances

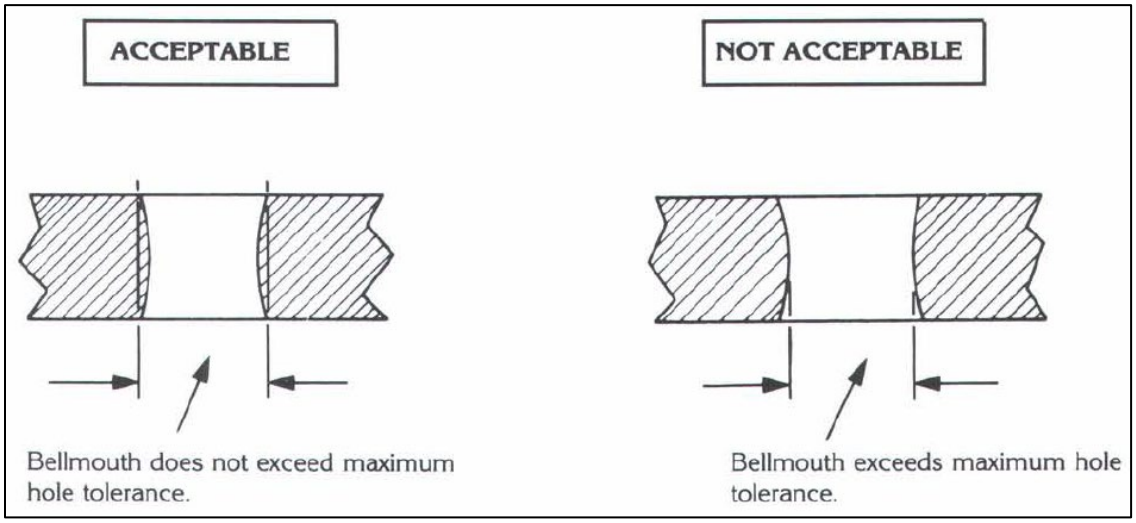
Hole Diameter	Tolerance
0.0135 thru 0.125	+0.004 -0.001
0.126 thru 0.250	+0.005 -0.001
0.251 thru 0.500	+0.006 -0.001
0.501 thru 0.750	+0.008 - 0.001
0.751 thru 1.000	+0.010 -0.001
1.001 thru 2.000	+0.012 -0.001

6.8.4 Drilling and Countersinking

1. Countersinking



2. Drilling – Bellmouth holes can be caused by hand drilling.

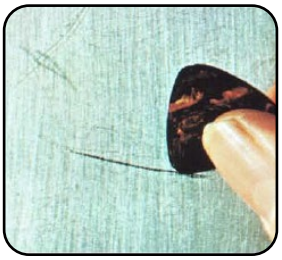


6.8.5 Skin – Surface Condition

ACTUAL SIZE

PREFERRED

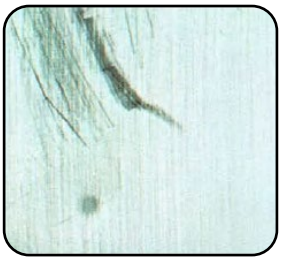
1. Skin surface is smooth and even, without waviness, dents, abrasion or other visible defects.
2. Skin assembly is straight along any longitudinal line or specified element.



ACCEPTABLE

1. Minor scratches, gouges or pits are not detectable by feel with the scratch detection tool.

NOTE: Scratch detection tool (plastic pick) should be held approximately 45 degrees to skin surface with the small radius against skin & slid along over the suspected area to "feel" scratch.



ACCEPTABLE MINIMUM

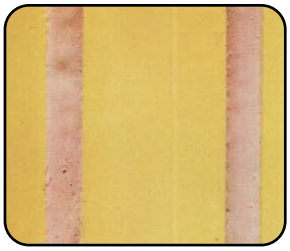
1. Minor scuff marks and abrasions are visible only by reflected light and have no measurable dimensional characteristics.
2. Small surface wave or dent does not break the skin surface nor does it exceed 0.006 inch in dpeth in any one inch length when measured along a longitudinal line.

NOT ACCEPTABLE

1. Scratches, gouges or pits are detectable by feel with the scratch detection tool.
2. Surface wave or dent exceeds 0.006 inch in depth for any one inch in length when measured along a longitudinal line.
3. Straightness of the outside contour along a longitudinal line exceeds 0.015 inch overall.

6.9 SEALANTS

ACTUAL SIZE



PREFERRED

1. Uniform fillet free of surface irregularities. No evidence of peeling or lifting. No sealant in undesignated areas.
2. Sealant is continuous, evenly distributed & uniform in color.

NOT ACCEPTABLE

1. Small tool mark in surface.
2. Small amount of sealant in undesignated area caused by irregular fillet.

ACCEPTABLE MINIMUM

1. Small surface irregularities do not reduce thickness to less than 1/16 inch.
2. Slight color difference caused by patching or rework is acceptable.

NOTE: Color difference caused by failure of nonconductive sealant to cover conductive sealant shall be cause for rejection.

NOT ACCEPTABLE

1. Excess sealant in undesignated areas.
2. Uneven distribution of sealant, fillet not uniform. Thickness reduced in areas to less than 1/16 inch.
3. Voids & incomplete coverage, potential source of leakage.
4. Evidence of peeling & lifting of sealant.
5. Very poor quality throughout.

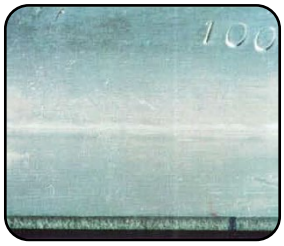
SECTION 7 -WELDING

7.1 Fusion Weld

B.1.1 Burn through

NOTE: All pictures on this page have been taken from the side opposite the weldment for fillet welds.

MAGNIFICATION 5X



PREFERRED

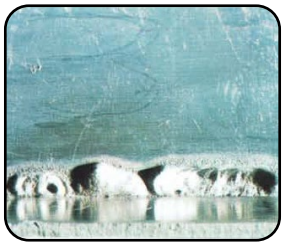
1. No evidence of "burn-through." Parent metal is clean & bright.

ACCEPTABLE

1. Slight discoloration of parent metal. Weld metal has not completely penetrated parent metal.

ACCEPTABLE

1. Slight bulge of parent metal. Weld metal has not completely penetrated or burned through parent metal.

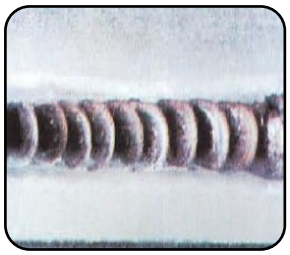


NOT ACCEPTABLE

1. Weld metal has burned through parent metal causing craters, fissures & distortions in parent metal.

Fusion Weld
7.1.2 Crater

MAGNIFICATION 5X

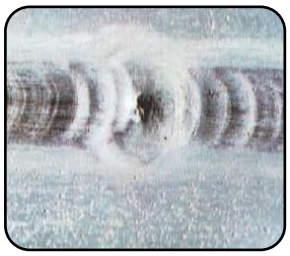


PREFERRED

1. No visible weld defects. Weld craters have been properly filled and faired into adjacent weld beads.

ACCEPTABLE

1. Small clean crater does not exceed 1/10 the thickness of the parent metal in depth or 1X the weld bead in width.



ACCEPTABLE

1. Crater has pitted area in bottom without evidence of burn through, cracks or inclusions.

NOTE: Class IV & V welds: Crater cracks which are confined totally within the crater are acceptable.

NOT ACCEPTABLE

1. Crater has cracked the base metal and/or weld metal.
2. Depth of crater exceeds 1/10 the thickness of the parent metal.
3. Width of the crater is greater than the width of the weld bead.

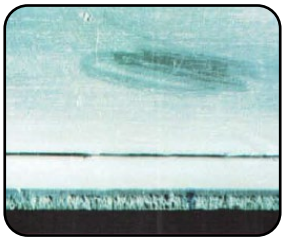
Fusion Weld

7.1.3 Fillet Fit-Up

MAGNIFICATION 5X

PREFERRED

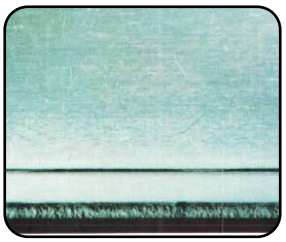
1. Welded details have a tight fit-up without measurable separation or shifting of the root face.



ACCEPTABLE

1. Welded details have shifted slightly but root opening is not greater than 1/32 inch.

ACCEPTABLE



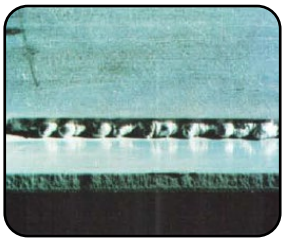
1. Root opening does not exceed the following tolerances for the thickness specified:

(a) Up to 1/8 inch = 1/32 root opening permitted.

(b) Over 1/8 to 3/8 inch = 1/16 root opening permitted.

(c) Over 3/8 inch = 1/8 root opening permitted.

(d) All metals on automatic equipment = 10 percent of material thickness but not to exceed 0.010 inch.



NOT ACCEPTABLE

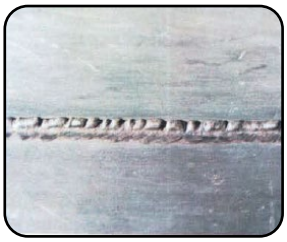
1. Root opening exceeds tolerances specified above.

Fusion Weld

7.1.4 Penetration

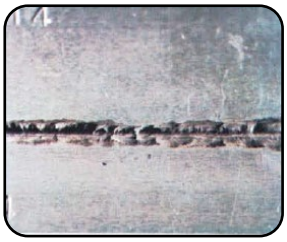
NOTE: All pictures on this page, except bottom photograph (right portion) have been taken from the opposite side of the weldment

MAGNIFICATION 5X



PREFERRED

1. Penetration is 100 percent without visible defects.



ACCEPTABLE

1. Incomplete penetration (or imperfect fusion) is acceptable when the greatest summation end to end of all dfect lines do not exceed the following:

a. Class III & IV welds: 1/3T in any weld length of 6T

b. Class V welds: 3/4T in any weld length of 6T.

NOTE: T = Nominal base material thickness.

ACCEPTABLE

1. Weld metal has completely penetrated joint. Shallow line center of penetrated metal indicates that penetrated metal has not solidified to produce a uniform contour on the top surface.

NOTE: This is an appearance item only & does not affect weld quality.

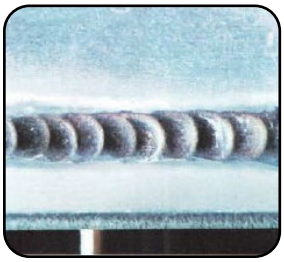
NOT ACCEPTABLE

1. Left portion of photograph: Indicates that weld metal has failed to penetrate butt joint.

2. Right portion of photograph: Indicates that weld metal may have failed to fuse with parent metal, as evidenced by apparent overlap & irregular edge of weld bead.

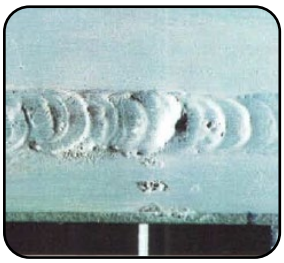
Fusion Weld
7.1.5 Porosity

MAGNIFICATION 5X



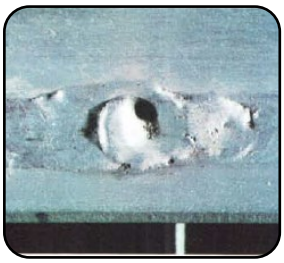
PREFERRED

1. Weld is free of surface defects.



ACCEPTABLE

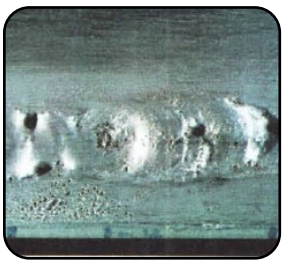
1. Shallow surface void does not exceed a diameter of 2/3 X the thickness of the parent metal or a depth of over 0.05 X the thickness of the parent metal.



ACCEPTABLE

1. Surface porosity diameters, in combination, do not exceed 0.100 inch per lineal inch of weld or 10 percent of the surface area of a lineal inch of weld, whichever is greater.

NOTE: Internal porosity shall be determined by radiographic examination if required by specification. In such cases, overall porosity shall be determined by Quality in accordance with the applicable radiographic standard.



NOT ACCEPTABLE

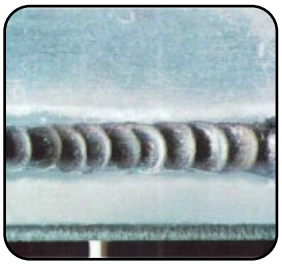
1. Surface porosity diameters, in combinations, exceed 0.100 inch per lineal inch of weld or 10 percent of the surface area of a lineal inch of weld.

NOTE: Inclusions (all types) shall be considered the same as porosity except that angular type inclusions are not acceptable in any size.

Fusion Weld

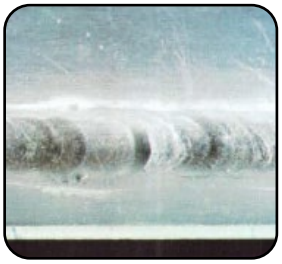
7.1.6 Undercut

MAGNIFICATION 5X



PREFERRED

1. Weldment is free of visible defects, with no evidence of undercutting.



ACCEPTABLE

1. Undercut depth does not exceed 1/10 of the thickness of the parent metal.

ACCEPTABLE

1. Undercut does not exceed 1 inch in length. Multiple undercuts are not closer than 4 inches to each other as measured from the end of one to the adjacent end of the next one.

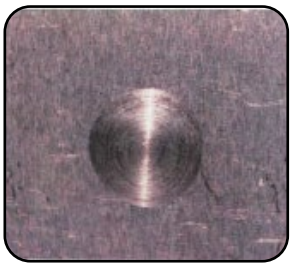
NOT ACCEPTABLE

1. Undercut depth exceeds 1/10 of the thickness of the parent metal.
2. Undercut exceeds 1 inch in length.
3. Multiple undercuts are closer than 4 inches.

7.2 Spot Weld

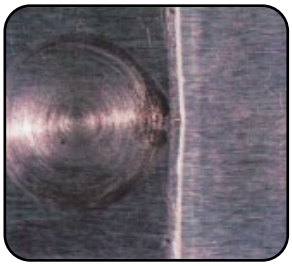
7.2.1 Edge Bulge

MAGNIFICATION 5X



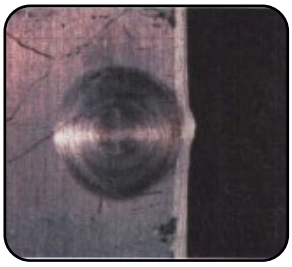
PREFERRED

1. Weld is free of visible defects. No evidence of edge bulge.
2. Edge distance conforms to engineering dimensions.



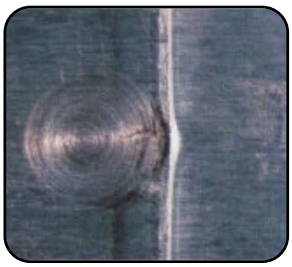
ACCEPTABLE

1. Slight edge bulge does not affect weld quality.
2. Sheet may be "Dressed" to assure fit-up to mating part.



ACCEPTABLE MINIMUM

1. Edge bulge does not affect weld quality and does not interfere with mating part.
2. Edge distance is minimum but is within engineering dimension for specific application.



NOT ACCEPTABLE

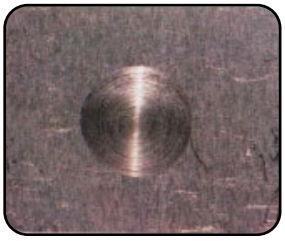
1. Edge bulge is excessive and has caused both the weld and the base metal to crack.

NOTE: Class "C" welds: Features containing random welds with excessive edge bulge will be acceptable provided the defective welds do not exceed 10 percent of the total welds. No additional repairs permitted.

Spot Weld

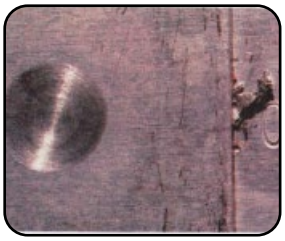
7.2.2 Metal Expulsion

MAGNIFICATION 5X



PREFERRED

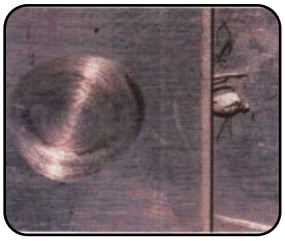
1. Weld is free of visible defects. No evidence of splits, surface flash or metal expulsion.



ACCEPTABLE

1. Small spits have not affected weld area or caused sheet separation & can be easily removed.

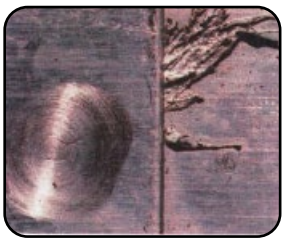
ACCEPTABLE



1. Small, firmly anchored, spits have not affected weld or caused separation of sheets. Acceptable without repair on random welds on the same feature as follows:
Class A - 3 percent (No additional repair)
Class B - 5 percent (5 percent additional repair)
Class C - 10 percent (10 percent additional repair)

2. Expelled metal must be dislodged prior to acceptance.

NOT ACCEPTABLE



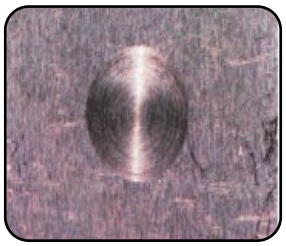
1. Excess metal has been expelled which has caused the weld to be deformed as evidenced by excessive indentation and surface cracks.

NOTE: Class C welds: Features containing random welds with excessive metal expulsion will be acceptable provided the defective welds do not exceed 5 percent of the total welds, an additional 5 percent will be acceptable with repairs. Expelled metal must be dislodged prior to acceptance.

Spot Weld

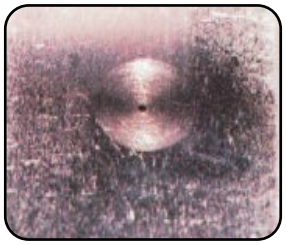
7.2.3 Pits and Blown Spots

MAGNIFICATION 5X



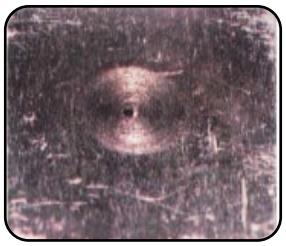
PREFERRED

1. Weld is free of visible defects, with no evidence of pits or blown spots.



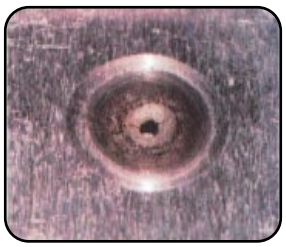
ACCEPTABLE

1. Small surface pit or blown spot less than 1/32 inch in diameter & less than 0.005 inch deep.



ACCEPTABLE

1. Blown spot or pit is less than 1/16 inch in diameter. Acceptable without repair on random welds on the same feature as follows:
Class A - 3 percent (2 percent additional repairs permitted)
Class B - 5 percent (5 percent additional repairs permitted)
Class C - 10 percent (10 percent additional repairs permitted).



NOT ACCEPTABLE

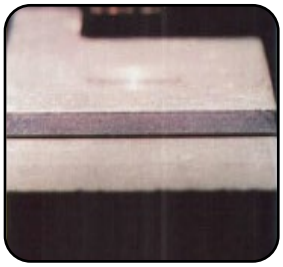
1. Blown spot or pit is in excess of 1/16 inch. Weld contains cracks and burned metal.

NOTE: Class "C" welds: Features containing random welds with excessive pits and blown spots will be acceptable provided the defective welds do not exceed 10 percent of th total welds. An additional 5 percent defective welds will be acceptable with repairs.

Spot Weld

7.2.4 Sheet Separation

MAGNIFICATION 5X

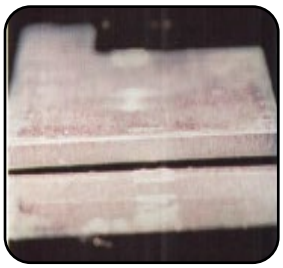


PREFERRED

1. Sheet fit-up is uniform with no visible separation.

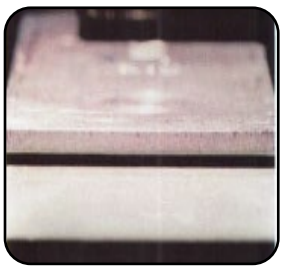
ACCEPTABLE

1. Sheet separation, as measured at a distance from the edge of the weld approximately equal to half the diameter of the electrode indentation, does not exceed 10 percent of the thickness of the two sheets or the following dimensions, whichever is greater:
a) 0.005 inch for Class A welds (Group "a" materials).
b) 0.006 inch for Class A welds (Group "b" & "c" materials).
c) 0.003 inch for Class A welds in foil thickness materials (for all metals).



ACCEPTABLE

1. Sheet spearation does not exceed 15 percent of the thickness of the two sheets joined, or 0.006 inch, whichever is greater for Class B & C welds (for all metals).



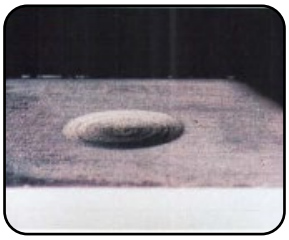
NOT ACCEPTABLE

1. Sheet separation exceeds the acceptance limits established above.
NOTE: Features containing random welds with excessive sheet spearation will be acceptable provided the defective welds do not exceed the following percentages:
Class A - 3 percent (No additional repairs permitted)
Class B - 5 percent (No additional repairs permitted)
Class C - 10 percent (No additional repairs permitted)

Spot Weld

7.2.5 Tip Indentation

MAGNIFICATION 5X



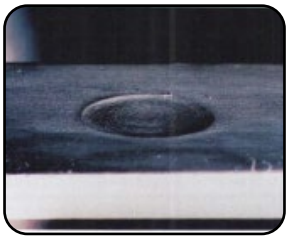
PREFERRED

1. Weld is free of visible defects. No evidence of tip indentation or weld deformation.

ACCEPTABLE

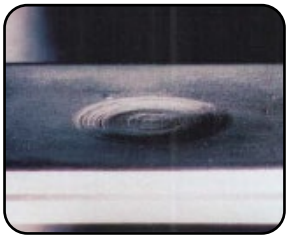
1. Slight tip indentation does not affect weld quality or aerodynamic characteristics (less than 0.004 inch).
2. Tip indentation is less than 0.005 inch for all other applications.

ACCEPTABLE



1. Tip indentation is maximum but within the following tolerances:
Class A&B Welds (for other than foil thickness) 10 percent or 0.005 inch, whichever is greater.
Class A&B Welds (for foil thickness) 30 percent.
Class C Welds (for other than foil thicnesses) 20 percent or 0.005 inch, whichever is greater.
Class C welds (for foil thicknesses) 40 percent.
NOTE: The above percentages are of the thickness of the sheet in which indentation occurs.

NOT ACCEPTABLE



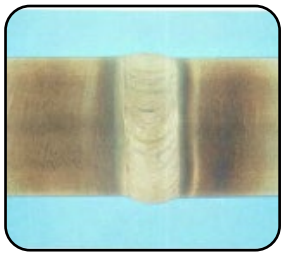
1. Tip indentation exceeds the acceptable limits established above.

NOTE: Features containing random welds with excessive indentation will be acceptable provided that defective welds do not exceed the following percentages of total welds.
Class A welds - 5 percent (No additional repairs permitted).
Class B&C welds - 10 percent (No additional repairs permitted).

7.3 Tube Weld

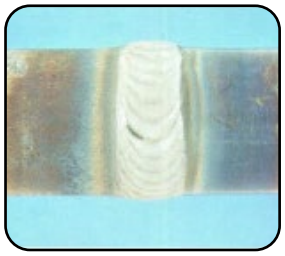
7.3.1 Bead Defects

MAGNIFICATION 4X



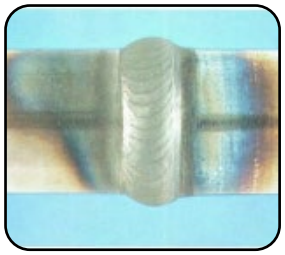
PREFERRED

1. Complete fusion.
2. No weld bead discontinuties
3. No evidence of contamination.



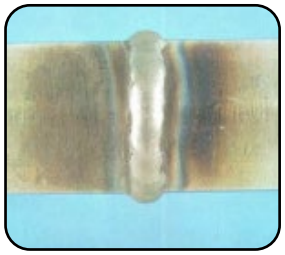
ACCEPTABLE

1. Weld bead is wider than preferred.
2. More tube discoloration than preferred.



ACCEPTABLE MINIMUM

1. Incomplete melting of flare.
2. Complete fusion.
3. No weld bead discontinuities.



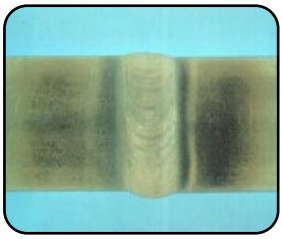
NOT ACCEPTABLE

1. Weld bead width and thickness are indicative of a lack of fusion and penetration.

Tube Weld

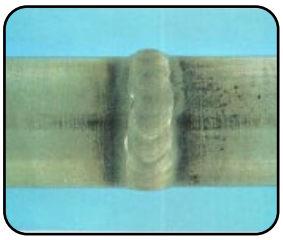
7.3.2 Contamination & Lack of Fusion

MAGNIFICATION 4X



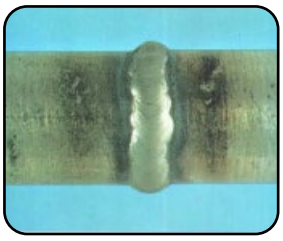
PREFERRED

1. Complete fusions.
2. No weld bead discontinuties.
3. No evidence of contamination.



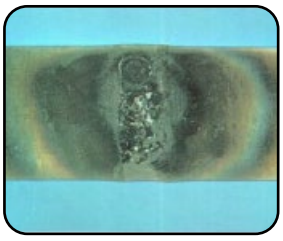
ACCEPTABLE

1. Weld interface with parent metal is less smooth than preferred.
2. Surface oxide discoloration is present adjacent to weld.
3. No visual evidence of excessive contamination.



NOT ACCEPTABLE

1. Surface of weld interface with parent metal indicates a lack of fusion and weld bead uniformity.



NOT ACCEPTABLE

1. Loose scale on weld bead and adjacent to weld is a specific indication of excessive contamination and lack of proper temperature control.

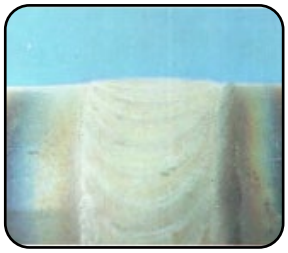
Tube Weld

7.3.4 Undercutting

MAGNIFICATION 10X

PREFERRED

1. Complete fusion.
2. No weld bead discontinuities.
3. No undercutting.

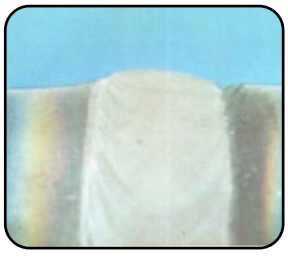


ACCEPTABLE

1. Undercutting depth and length are visible but well within specification maximum allowance.

ACCEPTABLE MINIMUM

1. Undercutting depth and length are the maximum allowed by specifications.

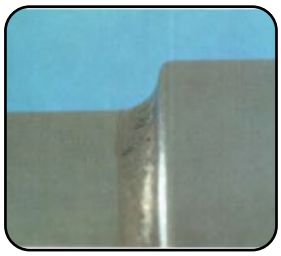


NOT ACCEPTABLE

1. Depth and length of undercutting exceeds maximum allowed by specifications.

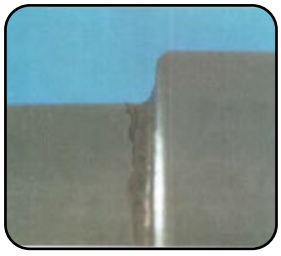
Tube Weld

7.3.5 Induction Brazing Undercutting



PREFERRED

1. No undercutting of either the tube or the fitting.
2. Alloy flow is complete.

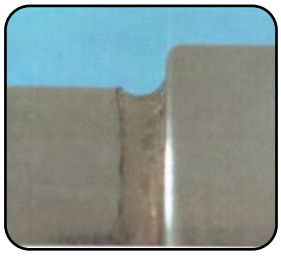


ACCEPTABLE

1. Slight undercutting of the tube.

ACCEPTABLE MINIMUM

1. Undercutting approahes the specification maximum allowance.



NOT ACCEPTABLE

1. Tube undercutting exceeds the specification maximum allowance.

GLOSSARY

B

Base Metal – The metal comprising the conductor, but not including protective finish and solderable coatings.

Bent Lead – A lead that is bent either at an approximate 45-degree angle, or when used with offset lands, is formed to be in direct contact with the land.

Bifurcated Contact – A connector contact (usually a flat spring) which is slotted lengthwise to provide additional, independently-operated points of contact.

Bifurcated (Split) – A terminal containing a slot or split in which wires or leads are placed before soldering.

Birdcage – Disarrangement of the original wire lay, usually due to reverse twisting.

Bridging, Electrical – The formation of a conductive path between conductors (short).

C

Chemical Stripping – The process of removing enamel insulation from wire using compounds specifically formulated for dissolving and removing enamel.

Clinched-Wire Through Connection – A connection made by a wire which is passed through a hole in a printed board, and subsequently formed, or clinched, in contact with the conductive pattern on each side of the board, and soldered.

Cold – The solder usually appears dull and crystalline but may be shiny and smooth. It has a stacked or piled-up appearance and shows signs of improper flow or wetting action. A cold solder connection often has a definite line of demarcation, rather than the smooth, continuing fillet of the preferred connection. In most cases, the cause can be traced to an improper wattage soldering iron or inadequately cleaned surfaces to be soldered.

Cold Solder Connection – Unsatisfactory connection resulting from nonwetting and exhibiting an abrupt rise of the solder from the surface being soldered.

Cold Solder Joint – A solder connection exhibiting poor wetting and a grayish, porous appearance due to insufficient heat inadequate cleaning prior to soldering, or to excessive impurities in the solder solution.

Component – A part, assembly or combination of parts, subassemblies or assemblies mounted together to perform a design function.

Component Installation – When installing components, the following items must be acceptable. The component must have correct lead bend radius, clearance, center, support, orientation, marking properly located and visible.

Component Lead – The solid or stranded wire formed conductor that extends from a component and serves as a mechanical or electrical connection or both.

Component Side – That side of the printed board on which most of the components will be mounted.

Conductor Integrity – Conductors shall not be cut, nicked or broken stretch or scraped.

Conformal Coating – An insulating protective coating, which conforms to the configuration of the object coated, applied to the completed board assembly.

Contact Spacing – The distance between the centerlines of adjacent contact area.

Cracking – A condition consisting of breaks in metallic or nonmetallic coatings or both that extend through to an underlying surface.

Crazing – An internal condition occurring in the laminated base material in which the glass fibers are separated from the resin at the weave intersections. This condition manifests itself in the form of connected white spots or “crosses”

below the surface and the base material and is usually related to mechanically induced stress.
Crazing (Conformal Coating) – A network of fine cracks on the surface or within the conformal coating.

D

Delamination – A separation between plies within the base material or between the base material and the conductive foil or both.
Device – An individual electrical element, usually in an independent body, which cannot be further reduced without destroying its stated function.
Dewetting – A condition which results when motion solder has coated a surface and then receded leaving irregularly shaped mounds of solder separated by areas covered with a thin solder film; base metal is not exposed.
Disturbed – The solder has a dull, porous and crystalline appearing surface. It may also, under magnify, revealing any cracks or fractures. Movement of the parts during the critical plastic phase, just before solidification, will cause this type of defect.
Double-Sided Board – A printed board with a conductive pattern on both sides.
Double Tinned – The tinning process repeated. This is one technique to remove gold plating from leads of components.
Dual In-Line Package (DIP) – A component which terminates in two straight rows of pins or lead wires.

E

Edge-Board Connector A connector designed specifically for making removable and reliable interconnections between the edge board contacts on the edge of a printed board and external wiring.
Edge-Board Contacts – A series of contacts printed on or near any edge of a printed board and intended for mating with an edge-board connector.
Edge Definition – The fidelity of reproduction of a pattern edge relative to the production master.
Edge Spacing – The distance of a pattern components, or both, from the edges of the printed board.
Excessive – The contour of the component lead or wire being joined is completely obscured; the solder has overflowed beyond the confines of the area being soldered. Excessive solder could contribute to wicking.

F

Fiber Exposure – A condition in which reinforcing fibers within the base material are exposed in machined, abraded or chemically-attacked areas.
Fillet – A blending or rounding of intersecting conductors or leads which eliminate sharp corners. Also, build-up of solder around a component lead.
Flat Cable – A cable with two or more parallel, round or flat conductors in the same plane encapsulated by an insulating material.
Flexible Printed Circuit – A random arrangement of printed circuit and components utilizing flexible base materials with or without flexible cover layers.
Flexible Printed Wiring – A random arrangement of printed wiring utilizing flexible base material with or without flexible cover layers.
Flux – A chemically active compound that is capable of promoting the wetting of metals with solder.
Foreign Material – Particles of material located on, but different than, the lead material or coating.

H

Hole Location – The dimensional location of the center of a hole.
Hole Pattern – The arrangement of all holes in a printed board.
Hook Terminal – A terminal formed in a hook shape.

I

Inclusions – Foreign particles that penetrate the surface of the base metal, tin lead plating, or soldered area (Source: MIL-STD-429).

Insufficient – The component or wire leads show exposed lead or copper material and absence of a solder fillet between the terminal and leads being soldered.

Insulation Clearance – Insulations shall be free of charring, burning or damage that would affect electrical operations.

L

Land – A portion of a conductive pattern usually, but not exclusively, used for the connection or attachment or both components.

Lead – A length of wire used for electrical interconnection.

M

Mealing – A condition at the interface of the conformal coating and base material in the form of discrete spots or patches, which reveals a separation of the conformal coating from the surface of the printed board, or from the surface of attached components, or from both.

Measling – An internal condition occurring in laminated base material in which the glass fibers are separated from the resin at the weave intersection. This condition manifests itself in the form of discrete white spots or "crosses" below the surface of the base material and is usually related to thermally induced stress.

Mechanical Wrap – The securing of a wire or the lead of a component around a terminal prior to the soldering operation.

Misregistration – The lack of dimensional conformity between successively produced features or patterns.

N

Nick – A cut in the wire that exposes basic metal.

Nonwetting – A condition whereby a surface has contacted molten solder, but the solder has not adhered to all of the surfaces; base metal remains exposed.

O

Overhang – Overhang is the increase in conductor width, caused by plating build-up (Source: MIL-STD-429).

Overheated – The solder has a chalky, dull, or crystalline appearance and shows evidence of coarse grain porosity or pitting. An overheated solder connection is caused by excessive heat being applied during the initial soldering operation, or from repeated efforts to repair a connection that will not flow or wet properly because of contamination.

P

Pad – See "Land."

Part Lead – A part lead is a solid or stranded wire that serves as a connection and in some cases, as mechanical support for small electronic parts or assemblies.

Perforated or Pierced Terminal – A terminal containing a hole through which leads, or wires are placed before soldering.

Pinholes – Small holes occurring as imperfections which penetrate entirely through a layer of material.

Pits – Pits are holes occurring as imperfections which do not penetrate entirely through the metal foil.

Plate-Through-Hole – A plated-through-hole is an interfacial or interlayer connection formed by deposition of conductive material on the sides of a hole through the base.

Porosity – A condition of a solder coating with a spongy appearing, uneven surface which contain a concentration of small pinholes and pits.

Preferred – The solder is smooth, bright and feathered-out to a thin edge, indicating proper flow and wetting action. No bare lead material is exposed within the solder connection, and there are no sharp protrusions or evidence of

contamination (embedded foreign matter). The contour of the component lead wire is visible.
Printed Board – The general term for completely processed printed circuit or printed wiring configurations. It includes rigid or flexible, single, double, and multilayer boards.
Printed Board Assembly – An assembly of several printed circuit assemblies or printed wiring assemblies, or both.
Printed Circuit – A conductive pattern comprised of printed components, printed wiring, or a combination thereof, all formed in a predetermined design and intended to be attached to a common base.
Printed Circuit Assembly – A printed wiring board on which separately manufactured components and parts have been added.
Printed Circuit Board – A part manufactured from rigid base material upon which completely processed printed circuit has been formed.
Printed Wring Assembly – A printed wiring board on which separately manufactured components and parts have been added.
Printed-Wiring Board – A part manufactured from rigid base material upon which processed printed wiring has been formed.

R

Reflow Soldering – A process of joining parts by tinning the mating surfaces, plating them together, heating until the solder fuses, and allowing to cool in the joined position.
Registration – The degree of conformity of the position of a pattern, or a portion thereof, with its intended position or with that of any other conductor layer of a board.
Repair – Approved operations performed on a nonconforming article to place the article in a usable condition.
Resistance Soldering – A method of soldering in which a current is passed through and heats the soldering area by contact with one or more electrodes.
Rework – The reprocessing of articles or material that will make the articles or material conform to the drawings, specification, or contract.
Right-Angle Edge Connector – A connector which terminates conductors at the edge of a printed board, while bringing the terminations out at right angles to the plane of the board conductors.
Rosin – A rosin solder connection has practically the same appearance as a cold solder connection but shows evidence of having rosin entrapped within the connection, separating the surfaces to be joined. This type of defective solder connection is caused by insufficient heat being applied, or by oxidized surfaces.

S

Scored – Marks, incisions, or notching's on the individual conductor strands or a solid conductor that has reduced its diameter.
Scratch – A scratch is a relatively long and narrow furrow or groove, usually shallow, on a surface caused by marking or rasping the surface with something pointed or sharp.
Slivers – Icicles nubs, and spikes which are undesirable protrusions from a soldered connection.
Solder – A fusible metallic alloy used to join metal surfaces at a temperature below the melting temperature of the metals being joined.
Solder Cup – A hollow, cylindrical terminal, open on one end to accommodate one or more leads or wires.
Solder Joints – The connection of similar or dissimilar metals by applying molten solder, with no fusion of the basic metals.
Solder Plugs – Cores of solder in plated-through holes of a printed board.
Solder Side – The side of a printed board which is opposite to the component side.
Solderability – The property of a metal to be wetted by solder.
Soldered Connection – A soldered a connection is an electrical connection which employs solder

for bonding two or more metals with an alloy (solder).

Soldering – A process of joining metallic surfaces with solder, without the melting of the base material.

Solderless Wrap – A method of connecting a solid wire to a square, rectangular, or V-shaped terminal by tightly wrapping the wire around the terminal with a special tool.

Stress Loop – The forming of a slight curve in the leads of components to avoid stress between terminations.

Stress Relief – A predetermined amount of slack to relieve tension in component or lead wires.

Surface Mounting – The electrical connection of components to the surface of a conductive pattern without utilizing component holes.

Swaged Leads – Component lead wires which extend through the printed board and are flattened, or swaged, so as to secure the component to the board during manufacturing operations.

T

Terminal – A terminal is a tie-point device used for the purpose of making electrical connections. Solder type terminals in common use include turret, bifurcated (slotted), hook, eye, tab, & solder cups.

Turret Terminal – A round post-type grooved stud around which wires, or leads are snugly hooked before soldering. The turret terminal may have either spacing shoulders or grooves for positioning the wires or leads.

U

Unsoldered Connection – An unsoldered connection is a major defect that would cause mission failure. One hundred (100) percent inspection of all soldered connections is mandatory.

W

Wave Soldering – A process wherein printed boards are brought in contact with the surface of continuously flowing and circulating solder.

Weave Exposure – A surface condition of base material in which the unbroken fibers of woven glass cloth are not completely covered by resin.

Weave Texture – A surface condition of base material in which a wave pattern of glass cloth is apparent although the unbroken fibers of the woven cloth are completely covered with resin.

Wetting – The formation of a relatively uniform, smooth, unbroken and adherent film of solder to a base material.

Wicking – Capillary absorption of liquid along the fibers of the base material.

Workmanship Standards – Workmanship standards are photographs, models, actual hardware, or other similar items to demonstrate acceptable characteristics to inspectors and operators during fabrication and assembly.