BOMBARDIER

Toronto Site

PROPRIETARY INFORMATION

PPS 2.01

PRODUCTION PROCESS STANDARD

Installation of Solid Rivets

Issue 31
- This standard supersedes PPS 2.01, Issue 30.
- Vertical lines in the left hand margin indicate technical changes over the previous issue.
- Direct PPS related questions to christie.chung@aero.bombardier.com or (416) 375-7641.
- This PPS is effective as of the distribution date.

Signed original on file. Validation of paper prints is the responsibility of the user.

Prepared By:	(Christie Chung)	July 19, 2018
	PPS Group	
Approved By:	(Stephen Mabee)	July 20, 2018
	Materials Technology	
	(Davor Filipovic)	July 20, 2018
	Quality	

Issue 31 - Summary of Changes (over the previous issue)

The following summaries are not detailed and are intended only to assist in alerting PPS users to changes which may affect them; refer to the applicable sections of this PPS for detailed procedure and requirements.

- Defined the term “MRB” in the Gereral Procedure section to avoid repetitiveness throughout the PPS.
- Revised term “head thickness” with “head height” throughout.
- Modified note 1 in Table 5 (i.e., Deleted mentioning countersinks; Clarified that drill size is recommended provided that final hole size requirements of Table 4 are met).
- Modified note 1 in Table 6 to clarify that drills and drill/countersinks for use with Spacematic or Q-Matic Dirllmotors are recommended provided that Table 4 or Table 9 requirements are met.
- Deleted the term “recommended” from Table 7, Table 8, Table 9, paragraph 5.2.4, and paragraph 5.6.5.
- Clarified that drills or drill/countersink are recommended provided that final hole/countersink size are met as specified in Table 4 or Table 9.

Table of Contents

Sections **Page**

Tables

Table of Contents

Tables **Page**

Figures

1 Scope

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for the installation of solid rivets in aircraft structures. For fluid tight installation of solid rivets, refer to PPS 2.38.

1.1.1 This PPS complements the engineering drawings that specify its use as an authorized instruction. The procedure specified in this PPS must be followed to ensure compliance with all applicable specifications. In general, if this PPS conflicts with the engineering drawing, follow the engineering drawing. The requirements specified in this PPS are necessary to fulfil the engineering design and reliability objectives.

1.1.2 Refer to PPS 13.26 for the subcontractor provisions applicable to this PPS.

1.1.3 Procedure or requirements specified in a Bombardier BAPS, MPS, LES or P. Spec. do not supersede the procedure or requirements specified in this PPS.

1.1.4 Refer to Table 1 for a listing of the solid rivets covered in this PPS. Refer to Table 2 for a listing of solid rivets which have been superseded.

TABLE 1 - SOLID RIVETS IN USE

FASTENER	DESCRIPTION
B0205013M	Flush head, Monel
B0205015M	Reduced flush head, Monel
B0205016AD	Protruding head, 2117
B0205016DD	Protruding head, 2024 (Note 1)
B0205016DN	Protruding head, 2017
B0205016KE	Protruding head, 7050
B0205017AD	Flush head, 2117
B0205017DD	Flush head, 2024 (Note 1)
B0205017DN	Flush head, 2017
B0205017KE	Flush head, 7050
B0205018AD	Reduced flush head, 2117
B0205018DD	Reduced flush head, 2024 (Note 1)
B0205018DN	Reduced flush head, 2017
B0205018KE	Reduced flush head, 7050

FASTENER	DESCRIPTION
B0205024DN	Protruding head, 1/64" oversize, 2017
B0205025DN	Flush head, 1/64" oversize, 2017
B0205026DN	Reduced flush head, 1/64" oversize, 2017
MS20426A	Flush head, 1100
MS20426B	Flush head, 5056
MS20427M	Flush head, Monel
MS20470A	Protruding “Universal” head, 1100
MS20470B	Protruding head, 5056
MS20470E	Protruding “Universal” head, 7050
MS20613C	Protruding “Universal” head, CRES
MS20615M	Protruding “Universal” head, Monel
NAS1097B	Reduced flush head “shear type”, 5056
NAS 1200M	Reduced flush head, Monel

Note 1. In place of DD rivets, it is acceptable to substitute the equivalent KE rivet (automatic installation) or DN rivet (manual installation).

Flush Head Reduced Flush Head Protruding Head

TABLE 2 - SUPERSEDED SOLID RIVETS (NOTE 1)

SUPERSEDED FASTENER	SUPERSEDING BACR15 FASTENER	SUPERSEDING BOMBARDIER FASTENER
BACR15BA#AD#C	n/a	B0205017AD#-#S
BACR15BA#DD#C	n/a	B0205017DD#-#S (Note 2)
BACR15BA#KE#C	n/a	B0205017KE#-#S
BACR15BB#AD#C	n/a	B0205016AD#-#S
BACR15BB#DD#C	n/a	B0205016DD#-#S (Note 2)
BACR15CE#AD#C	n/a	B0205018AD#-#S
BACR15CE#DD#C	n/a	B0205018DD#-#S (Note 2)
BACR15FT#KE#	n/a	B0205016KE#-#S
CSP310AD	BACR15BA#AD#C	B0205017AD#-#S
CSP362AD	BACR15BA#AD#C	B0205017AD#-#S
CSP362DD	BACR15BA#DD#C	B0205017DD#-#S (Note 2)
CSP371AD	BACR15CE#AD#C	B0205018AD#-#S
MS20426AD	BACR15BA#AD#C	B0205017AD#-#S
MS20426DD	BACR15BA#DD#C	B0205017DD#-#S (Note 2)
MS20470AD	BACR15BB#AD#C	B0205016AD#-#S
MS20470DD	BACR15BB#DD#C	B0205016DD#-#S (Note 2)
NAS1097AD	BACR15CE#AD#C	B0205018AD#-#S
NAS1097DD	BACR15CE#DD#C	B0205018DD#-#S (Note 2)‘
SB0205001AD#-#S	BACR15BA#AD#C	B0205017AD#-#S
SB0205001E#-#S	BACR15BA#KE#C	B0205017KE#-#S

Note 1. Fasteners are superseded by the new item when stock of the old fastener is depleted. Old and new are **not** interchangeable. The superseding fastener can be used in place of the old fastener but not vice versa.

Note 2. In place of B0205016DD, B0205017DD and B0205018DD rivets, it is acceptable to substitute the equivalent KE rivet (automatic installation) or DN rivet (manual installation).

Flush Head Reduced Flush Head Protruding Head

2 Hazardous Materials

2.1 Before receipt at Bombardier Toronto, all materials must be approved and assigned Material Safety Data Sheet (MSDS) numbers by the Bombardier Toronto Environment, Health and Safety Department. Refer to the manufacturer’s MSDS for specific safety data on any of the materials specified in this PPS. If the MSDS is not available, contact the Bombardier Toronto Environment, Health and Safety Department.

3 References

3.1 Unless a specific issue is indicated, the issue of the reference documents specified in this section in effect at the time of manufacture shall form a part of this specification to the extent indicated herein.

3.1.1 PPS 1.01 - Dimpling Aluminum Alloys.

3.1.2 PPS 1.07 - Dimpling Ferrous, Nickel and Titanium Alloys.

3.1.3 PPS 1.09 - Drilling and Reaming.

3.1.4 PPS 1.12 - Use of Rivet Squeezers (Portable and Stationary).

3.1.5 PPS 1.14 - Use of Pneumatic Rivet Guns.

3.1.6 PPS 1.20 - Set-Up & Operation of the APS Model 705 Automatic Drill Riveter.

3.1.7 PPS 1.31 - Drill/Countersinking for Flush Head Fasteners.

3.1.8 PPS 1.33 - Countersinking for Flush Head Fasteners.

3.1.9 PPS 1.37 - Set-Up and Operation of Portable Automatic Drillmotors.

3.1.10 PPS 1.41 - Set-Up and Operation of the Craco Automatic Drill Riveter.

3.1.11 PPS 1.43 - Set-Up & Operation of Drivmatic Drill Riveters.

3.1.12 PPS 1.48 - Set-Up and Operation of Rivet Shavers.

3.1.13 PPS 2.62 - Index of Fastener Symbols and Codes.

3.1.14 PPS 13.26 - General Subcontractor Provisions.

3.1.15 PPS 21.20 - Mixing and Handling Two-Part Sealants.

3.1.16 PPS 21.21 - General Sealing Practices.

3.1.17 PPS 27.05 - Manual Edge Finishing.

3.1.18 PPS 30.03 - Heat Treatment and Control of 2024 (DD) Rivets.

3.1.19 PPS 34.02 - Application of Alkyd Zinc Chromate Primer (F1).

3.1.20 PPS 34.08 - Application of Epoxy-Polyamide Primer (F19 & F45)

4 Materials and Equipment

4.1 Materials

4.1.1 Unless otherwise specified in this section, use only the materials specified. Use of superseding or alternative materials is not allowed.

4.1.2 Solid rivets as specified on the engineering drawing or substitute rivets specified or permitted by EO 7336 or SREO's.

4.1.3 DHMS S3.06 Type I, Class C-80 sealant.

4.2 Equipment

4.2.1 Plug gauges (e.g., Frank Cox Sales Ltd. P#####). Each plug gauge used at Bombardier Toronto has a distinct Bombardier Toronto inventory number. Plug sizes are marked on the gauge ends.

4.2.2 Depth controlled rivet shavers. Use steel cutters for shaving aluminum rivets and carbide cutters for shaving Monel and CRES rivets.

4.2.3 Electromagnetic riveter, hand held (e.g., Electroimpact Inc. HH-50). Hand held electromagnetic riveters must be capable of properly forming the rivet head as specified herein without adversely affecting the rivet properties or aircraft structure.

5 Procedure

5.1 General

5.1.1 For the purposes of this PPS, the term "MRB" (Material Review Board) is considered to include Bombardier Toronto MRB and Bombardier Toronto delegated MRB.

5.1.2 Solid rivets to be installed in DASH 8 aircraft are identified on the engineering drawing as normal stress rivets or critical stress rivets. Refer to PPS 2.62 for identification symbols.

5.1.3 Rivets manufactured from 2024 aluminum alloy (DD) rivets must be heat treated and then maintained in refrigerated storage according to PPS 30.03 until installed. This is necessary because before heat treatment, the DD rivets are so hard that the shop head will crack when driving the rivets. When solution heat treated, the DD rivet material becomes soft enough for the rivet to be driven without cracking. Unless maintained in refrigerated storage after heat treatment, DD rivets will quickly age harden and again be too hard to be driven without cracking.

5.1.4 Like most rivets other than DD rivets, the material properties of KE and DN rivets allow them to be driven without special heat treatment, and in fact, heat treatment before installation would have a detrimental effect on the final strength of KE and DN rivets. Therefore, although KE rivets may be substituted for DD rivets for automatic installation and DN rivets may be substituted for manual installation, do **not** heat treat KE or DN rivets before installation. Also, since refrigeration is only necessary to delay age hardening after solution heat treatment, refrigerated storage of KE and DN rivets is **not** necessary.

5.1.5 For Bombardier Toronto operators, install the rivets specified on the work order, assembly manual or RNC. If the rivet specified on the work order or assembly manual is not available, contact Work and Material Planning (WMP). Do not use substitute rivets (as allowed by an Engineering approved EO or SREO) without Methods approval.

5.1.6 Refer to Figure 1 for examples of rivet part number break down.

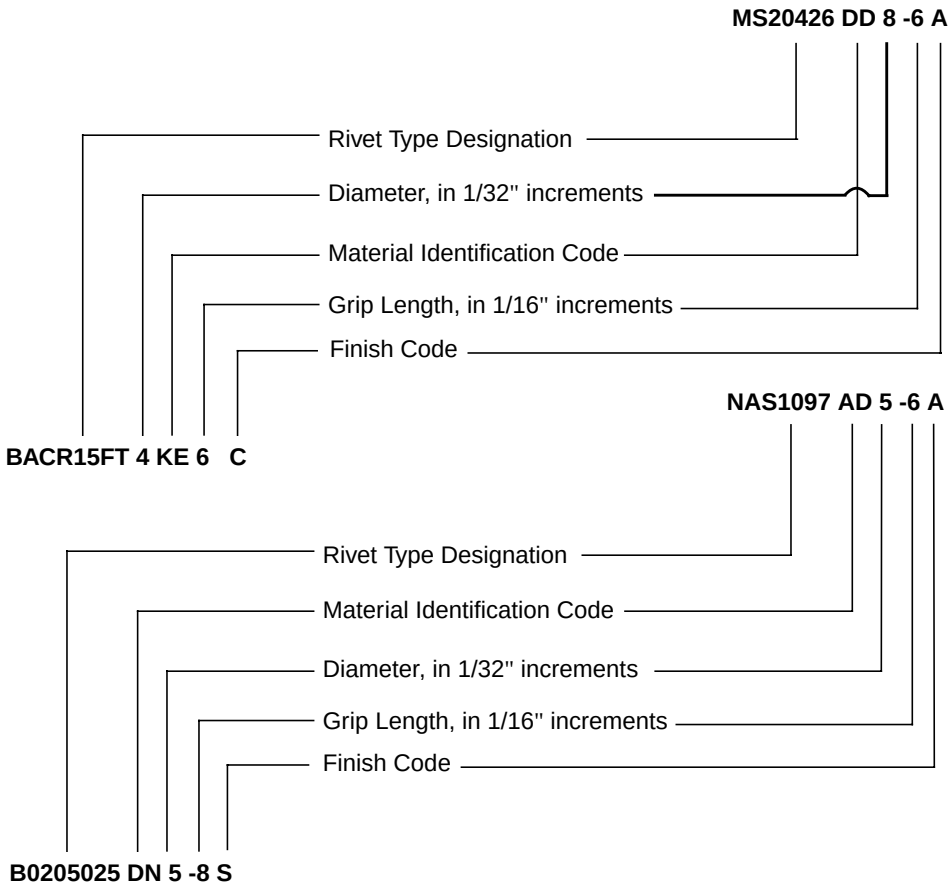


Figure 1 - Sample Part Number Breakdowns

5.2 Hole Preparation

5.2.1 If dimpling is specified by the engineering drawing or assembly manual, prepare and dimple rivet holes as follows:

Step 1. For reduced flush head rivets (as referenced in Table 1), pre-drill the rivet holes according to Table 3.

Step 2. For rivets other than reduced flush head rivets (as referenced in Table 1), drill the hole to final size as specified in paragraph 5.2.2.

Step 3. Dimple rivet holes according to either PPS 1.01 or PPS 1.07, as applicable.

Step 4. For reduced flush head rivets (as referenced in Table 1), drill the hole to final size as specified in paragraph 5.2.2.

TABLE 3 - PRE-DRILL FOR DIMPLING (NOTE 1)

RIVET NOMINAL DIAMETER	PRE-DRILL FOR DIMPLING (Note 2)
-4 (1/8")	#40
-5 (5/32")	#30
-6 (3/16")	#20
-8 (1/4")	#2

Note 1. This table is applicable to B0205018, BACR15CE, NAS1097 and NAS1200 rivets only.
Note 2. It is acceptable to use equivalent metric drills and countersinks provided that hole sizes are verified using gauges/equipment calibrated in inches.

5.2.2 Refer to Table 4 for the final hole sizes required. When preparing holes, maintain the minimum edge distance according to PPS 1.09. Except as noted in paragraph 5.2.1, when preparing the final hole, any of the following methods may be employed:

- Drill using standard drillmotors and drills (see Table 5) according to PPS 1.09.
- For flush head rivets, drill/countersink according to PPS 1.31 or countersink according to PPS 1.33.
- Drill using Spacematic or Q-matic drillmotors and drills or drill/countersinks according to PPS 1.37 (refer to Table 6 for a listing of recommended drills and drill/countersinks).
- Drill or drill/countersink using automatic drill riveters according to PPS 1.20, PPS 1.41 or PPS 1.43, as applicable.

TABLE 4 - FINAL HOLE DATA (ALL RIVETS EXCEPT OVERSIZE)

RIVET NOMINAL DIAMETER	REQUIRED FINAL HOLE SIZE
-2 (1/16")	0.066" - 0.071"
-3 (3/32")	0.098" - 0.102"
-4 (1/8")	0.128" - 0.133"
-5 (5/32")	0.159" - 0.166"
-6 (3/16")	0.190" - 0.196"
-7 (7/32")	0.221" - 0.228"
-8 (1/4")	0.253" - 0.263"
-10 (5/16")	0.317" - 0.323"
-12 (3/8")	0.378" - 0.387"

TABLE 5 - HOLE PREPARATION USING A STANDARD DRILLMOTOR AND DRILLS

RIVET NOMINAL DIAMETER	RECOMMENDED DRILL SIZE (Note 1)
-2 (1/16")	#51 (0.0670")
-3 (3/32")	#40 (0.0980")
-4 (1/8")	#30 (0.1285") or 0.128"
-5 (5/32")	#21 (0.159")
-6 (3/16")	#11 (0.1910") or 0.190"
-7 (7/32")	#2 (0.2210")
-8 (1/4")	F (0.2570") or 0.253"
-10 (5/16")	O (0.3160")
-12 (3/8")	V (0.3770")

Note 1. It is acceptable to use equivalent metric drills provided that hole sizes are verified using gauges/equipment calibrated in inches. Ensure Table 4 final hole size requirements are met.

TABLE 6 - RECOMMENDED DRILLS AND DRILL/COUNTERSINKS FOR USE WITH SPACEMATIC OR Q-MATIC DRILLMOTORS

RIVET NOMINAL DIAMETER	DRILL SIZE	DRILL/COUNTERSINK	DRILL
-2 (1/16")	0.0670"	n/a	n/a
-3 (3/32")	0.0980"	n/a	n/a
-4 (1/8")	0.128"	TS.514.43.11 MK 2	TS.514.41.11 MK 1
-5 (5/32")	0.159"	TS.514.43.11 MK 3	TS.514.41.11 MK 9
-6 (3/16")	0.190"	TS.514.43.11 MK 7	TS.514.41.11 MK 12
-7 (7/32")	0.2210"	n/a	n/a
-8 (1/4")	0.253"	TS.514.53.11 MK 3 (Note 2)	TS.514.41.11 MK 10
-10 (5/16")	0.3160"	n/a	n/a
-12 (3/8")	0.3860"	n/a	n/a

Note 1. It is acceptable to use equivalent metric drills or drill/countersinks provided that hole sizes are verified using gauges/equipment calibrated in inches. Ensure Table 4 or Table 9 requirements are met, as applicable.

Note 2. For -8 (1/4") diameter reduced flush head rivets (as referenced in Table 1), use a TS.514.41.11 MK 10 drill to produce the fastener hole and then manually countersink according to PPS 1.33.

5.2.3 For MS20613 and MS20615 rivets, after final drilling, chamfer the hole edge 0.010" - 0.020" on the sheet against which the manufactured head will seat according to PPS 27.05.

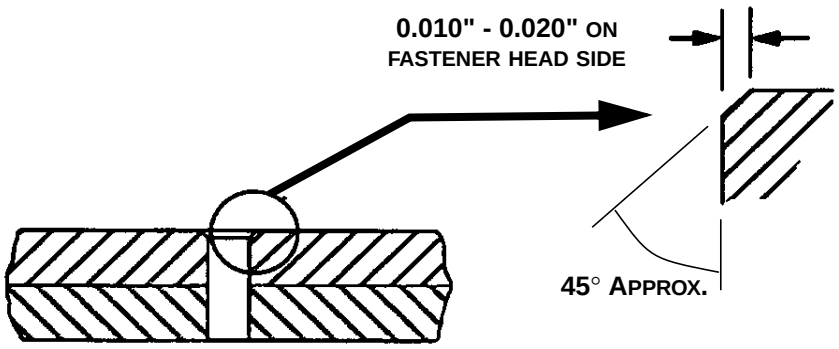


Figure 2 - Chamfer for Proper Seating of the Manufactured Head of MS20613 and MS20615 Rivets

5.2.4 For installation of flush head fasteners, refer to Table 7 (BACR rivets), Table 8 (NAS or MS rivets) or Table 9 (Bombardier 'B' rivets) for the countersink diameter. Install flush head rivets so that the flush head protrusion limits specified in Table 16 are met.

TABLE 7 - COUNTERSINK DIAMETERS FOR BACR15 RIVETS

RIVET NOMINAL DIAMETER	COUNTERSINK DIAMETER (Note 2)		
	BACR15BA	BACR15CE	BACR15CE SUB-COUNTERSINK
-3 (3/32")	0.165" - 0.175"	0.134" - 0.139"	n/a
-4 (1/8")	0.211" - 0.221"	0.181" - 0.186"	0.203" - 0.208"
-5 (5/32")	0.273" - 0.283"	0.234" - 0.239"	0.248" - 0.253"
-6 (3/16")	0.339" - 0.349"	0.284" - 0.289"	0.297" - 0.302"
-8 (1/4")	0.463" - 0.473"	0.382" - 0.387"	n/a

Note 1. Refer to Table 16 for flush head protrusion limits.
Note 2. Use the sub-countersink diameter when a dimple will nest into the countersink.

TABLE 8 - COUNTERSINK DIAMETERS FOR NAS AND MS RIVETS

RIVET NOMINAL DIAMETER	COUNTERSINK DIAMETER (Note 2)			
	NAS 1097 & NAS 1200	NAS 1097 & NAS 1200 SUB-COUNTERSINK	MS 20426	MS 20427
-2 (1/16")	n/a	n/a	0.096" - 0.106"	0.113" - 0.123"
-3 (3/32")	0.132" - 0.137"	n/a	0.161" - 0.171"	0.168" - 0.178"
-4 (1/8")	0.179" - 0.184"	0.203" - 0.208"	0.207" - 0.217"	0.214" - 0.224"
-5 (5/32")	0.231" - 0.236"	0.248" - 0.253"	0.268" - 0.278"	0.276" - 0.286"
-6 (3/16")	0.288" - 0.293"	0.297" - 0.302"	0.335" - 0.345"	0.343" - 0.353"
-7 (7/32")	n/a	n/a	0.397" - 0.407"	0.404" - 0.414"
-8 (1/4")	0.381" - 0.386"	0.390" - 0.395"	0.458" - 0.468"	0.467" - 0.477"

Note 1. Refer to Table 16 for flush head protrusion limits.
Note 2. For NAS 1097 and NAS 1200 rivets, use the sub-countersink diameter when a dimple will nest into the countersink.

TABLE 9 - COUNTERSINK DIAMETERS FOR BOMBARDIER B RIVETS

RIVET NOMINAL DIAMETER	COUNTERSINK DIAMETER			
	B0205013	B0205015	B0205017	B0205018
-2 (1/16")	0.095" - 0.105"	n/a	0.097" - 0.107"	n/a
-3 (3/32")	0.157" - 0.167"	0.131" - 0.136"	0.162" - 0.172"	0.132" - 0.137"
-4 (1/8")	0.206" - 0.216"	0.179" - 0.184"	0.208" - 0.218"	0.180" - 0.185"
-5 (5/32")	0.268" - 0.278"	0.230" - 0.235"	0.273" - 0.283"	0.231" - 0.236"
-6 (3/16")	0.335" - 0.345"	0.286" - 0.291"	0.336" - 0.346"	0.287" - 0.292"
-7 (7/32")	n/a	n/a	0.398" - 0.408"	n/a
-8 (1/4")	0.457" - 0.467"	0.379" - 0.384"	0.459" - 0.469"	0.380" - 0.385"
-10 (5/16")	n/a	n/a	0.547" - 0.557"	n/a
-12 (3/8")	n/a	n/a	0.677" - 0.687"	n/a

Note 1. Refer to Table 16 for flush head protrusion limits.

5.2.5 If a rivet is to be flush on both sides, countersink the hole for the shop head to the size specified on the engineering drawing. If the countersink diameter for the shop head is not specified on the engineering drawing, countersink the hole to the dimensions for a NAS1097 manufactured head (see Table 8).

5.2.6 Except for assemblies riveted using automatic drill riveting equipment, after drilling the rivet hole, remove the standing burr from the exit side according to PPS 27.05.

5.2.7 Except when installing aluminum alloy rivets, prime countersinks with F1 zinc chromate primer according to PPS 34.02 or F19 Type 2 epoxy-polyamide primer according to PPS 34.08. It is not necessary to prime the countersink for installation of aluminum alloy rivets.

5.2.8 Except for rivets installed using an automatic drill/riveter, on a sample basis check at random (across the entire pattern) the number of holes specified in Table 10 for conformance to the hole limit requirements, using a go/no-go gauge or other hole measuring gauge. If any oversize holes are found in the sample, check every hole in the pattern. Refer all oversize holes to MRB for disposition.

5.2.8.1 While checking holes using a GO/NO-GO gauge or other hole measuring gauge, also check visually for hole ovality. For holes with a visually evident oval or out of round shape, check the hole diameter at several positions using suitable hole measurement equipment (e.g., vernier calliper, hole micrometer, etc.) to determine the minor and major diameters of the hole. The minor and major diameters of the hole must be within the minimum and maximum hole diameter tolerances, respectively. If the minor or major diameters of any oval hole in the sample are not within the minimum and maximum hole diameter tolerance, check every hole in the pattern for conformance to the hole limit requirements and visually for ovality as specified herein. Refer all non-conforming holes to MRB for disposition.

TABLE 10 - HOLE SIZE VERIFICATION SAMPLE REQUIREMENTS

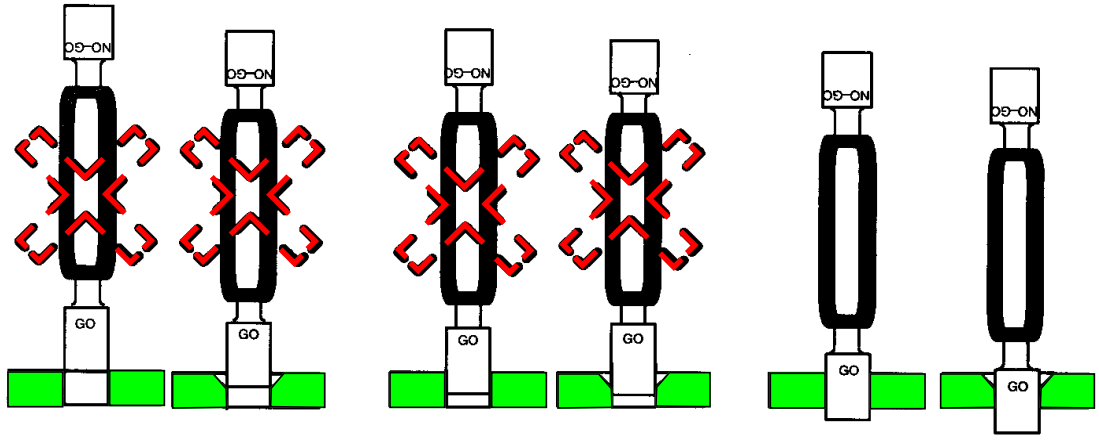
NUMBER OF HOLES IN PATTERN	REQUIRED SAMPLE SIZE
5 or less	all
6 - 50	5
51 - 90	7
91 - 150	11
151 - 280	13
281 - 500	16
more than 500	19

5.3 Use of GO/NO-GO Gauges

5.3.1 Check selected fastener holes for conformance to the requirements of Table 4 using the applicable go/no-go gauge as follows (see Figure 3):

Step 1. Taking care not to force or rotate the go/no-go gauge, lightly insert the go end of the gauge into the fastener hole. If the go end of the gauge goes in only partially or does not go into the hole at all, the hole is **undersize**. Open undersize holes to the final diameter specified in Table 4.

Step 2. Lightly insert the no-go end of the plug gauge in the fastener hole. If the gauge goes completely into the hole, the hole is **oversize**; oversize holes are not acceptable and must be referred to MRB for disposition.

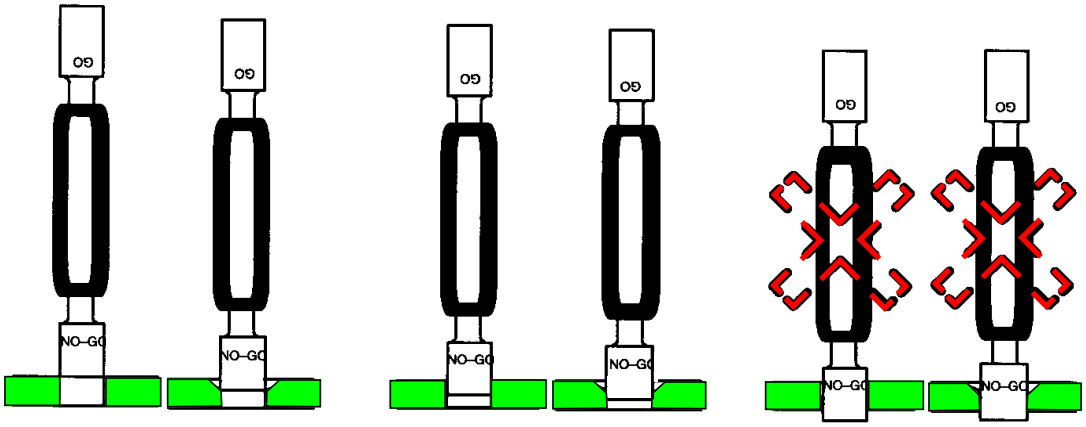


DOES NOT GO IN
UNDERSIZE HOLE

GOES ONLY PARTIALLY IN
UNDERSIZE HOLE

GOES IN COMPLETELY
ACCEPTABLE

USE OF GO END



DOES NOT GO IN
ACCEPTABLE

GOES ONLY PARTIALLY IN
ACCEPTABLE

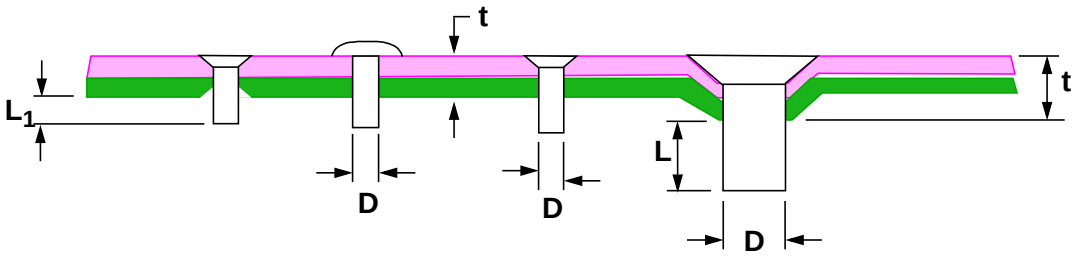
GOES IN COMPLETELY
OVERSIZE HOLE

USE OF NO-GO END

Figure 3 - Use of GO/NO-GO Gauges

5.4 Determination of Required Rivet Length

5.4.1 If the engineering drawing, work order or assembly manual does not specify the rivet grip length or if the specified length does not form satisfactory shop heads, select the rivet length which forms a shop head meeting the requirements specified in Table 14. As a general rule, for standard installations, the length of the un-driven rivet should be 1.25 to 1.5 times the nominal rivet shank diameter (D) plus the thickness of the material into which the rivet is to be installed (see Figure 4). For double flush installations, the length of the un-driven rivet should be 0.75D to 1.0D plus the thickness of the material into which the rivet is to be installed.



D = nominal rivet shank diameter.
t = stackup thickness.
L = un-driven rivet length protrusion. L = 1.25D to 1.5D.
L_1 = un-driven rivet length protrusion (double flush installation). L_1 = 0.75D to 1D;
Required rivet grip length = t + L (or t + L_1 for double flush installation).

Figure 4 - Determining Required Rivet Length

5.5 Assembly of Parts for Riveting

5.5.1 Assemble parts for riveting or drill riveting as follows:

Step 1. Correctly position the parts to be riveted and mate the curved parts without excessive gaps. Ensure dimples nest in each other or in their countersinks with a small gap or sheet separation, as shown in Figure 5.

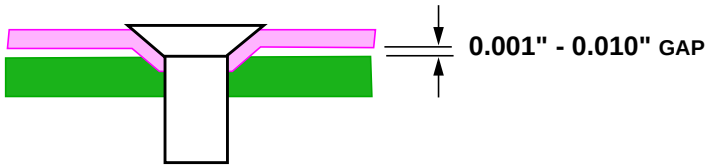


Figure 5 - Sheet Separation for Nested Dimples

Step 2. Except when using automatic drill riveting equipment, clamp the assemblies with Cleco type temporary fasteners or tack rivet every fourth to sixth rivet hole.

5.6 Riveting Operations

5.6.1 Install rivets using squeeze riveters according to PPS 1.12 or automatic drill riveters according to PPS 1.20, PPS 1.41 or PPS 1.43. If the requirements of PPS 1.20, PPS 1.41 or PPS 1.43 are met, use of numerically controlled (NC) automatic drill riveters is acceptable.

5.6.1.1 Except as noted below, percussion riveting using a pneumatic rivet gun according to PPS 1.14 is also acceptable if squeeze riveting or automatic drill riveting is not possible.

- For 7050 (KE) aluminum alloy rivets, no more than 10% of the rivets used to join 2 components may be installed using a rivet gun. Refer to MRB for approval if more than 10% of the rivets used to join 2 components must be installed using percussion riveting.
- For 7050 (KE) aluminum alloy rivets, no more than 2 adjacent rivets may be installed using a rivet gun. MRB approval is needed if more than 2 adjacent 7050 (KE) aluminum alloy rivets must be installed using a rivet gun.
- On the Lear 45 wing, all 7050 (KE) aluminum alloy rivets up to and including 5/32" in diameter may be installed using a rivet gun even if the above restrictions are violated.

5.6.1.2 For installation of rivets up to 3/16" in diameter, use of a hand held electromagnetic riveter (see Equipment section, paragraph 4.2.3), operated according to the manufacturers instructions, is also acceptable.

5.6.1.3 For installation of rivets, use of alternative equipment, operated according to the manufacturers instructions, is acceptable provided that it is capable of properly forming the rivet head to meet requirements specified herein without adversely affecting the rivet properties or aircraft structure.

5.6.2 If riveting dissimilar materials (i.e., stainless steel and aluminum or titanium and aluminum), wet assemble the rivets using DHMS S3.06 Type I, Class C-80 sealant, mixed according to PPS 21.20 and applied according to PPS 21.21.

5.6.3 Except when riveting dissimilar materials, when BACR15 or Bombardier ‘B’ rivets are used to replace wet installed MS20426, MS20470 or NAS1097 rivets, it is acceptable to install the rivets without sealant.

5.6.4 Except as noted in paragraph 5.6.4.1, it is extremely important that riveted flush head rivets **protrude** at least 0.0005" above the part surface **before shaving**. If the rivet protrusion is less than 0.0005", the countersink diameter may be too large for installation of the specified rivet and proper pre-load of the joint may not be achieved. Therefore, ensure there is sufficient protrusion of each rivet in the countersink **before** riveting.

5.6.4.1 If, **and only if**, rivets are installed using an automatic riveter and the anvil used to seat the rivet is smaller than the head of the rivet, the minimum acceptable protrusion above the parts surface before shaving is 0.000". If the rivet head is installed below flush, it will be necessary to refer to MRB for disposition (i.e., authorization to install an oversize rivet or fastener).

5.6.5 To prevent cracks in rivet heads when forming, maintain the shop head height as close as possible to the minimum diameter specified in Table 14 and recommended maximum height specified in Table 13.

5.7 Shaving of Installed Flush Head Rivets

5.7.1 Except as noted in paragraph 5.7.1.1 or paragraph 5.7.1.2, flush head rivets that protrude **0.0005" - 0.005"** do **not** require shaving. Shave flush head rivets which protrude 0.005" - 0.010" to a protrusion of 0.000" - 0.0035" using a depth controlled rivet shaver (see equipment section, paragraph 4.2.2) according to PPS 1.48. Rivets which protrude over 0.010" are not acceptable and must be replaced (check the countersink diameter before installing another rivet).

5.7.1.1 Flush head rivets (including reduced flush head rivets as referenced in Table 1) installed in visibility areas (e.g., exterior aircraft skin which will be painted) must protrude no more than 0.0035" above the part surface. Shave flush head rivets (other than reduced flush head rivets) that protrude more than 0.0035" above the part surface to a protrusion of 0.000" - 0.0035" using a depth controlled rivet shaver according to PPS 1.48.

5.7.1.2 **Do not** shave reduced flush head rivets. Reduced flush head rivets that protrude more than specified above are **not** acceptable and must be replaced (check the countersink diameter before installing another rivet).

5.8 Removing Rivets

5.8.1 If necessary, remove rivets as follows:

Step 1. Use a drill of the same diameter as the rivet shank to drill through the head a distance equal to the rivet head height. If possible, drill out the rivet from the manufactured head side since it is centred with more accuracy than the shop head. Also, the identification symbol on AD rivets can be used as a guide for the drill.

Step 2. Carefully pry off the rivet head using a straight punch.

Step 3. While supporting the sheet on the opposite side to prevent dimpling around the rivet hole, drive out the rivet shank using a small punch.

5.9 Installation of Oversize Rivets

5.9.1 Oversize rivets may be used to salvage slightly oversize holes or oversize countersinks (oversize flush head 'B' rivets have a nominal 1/64" oversize shank **and** head) only if authorized in writing by MRB. Install oversize rivets as follows:

Step 1. Select the oversize rivet from Table 11 for the corresponding original size rivet. Use the same grip length as would be used for the standard size rivet.

Step 2. Open the hole and countersink diameters to the values specified in Table 12 according to section 5.2.

TABLE 11 - OVERSIZE RIVETS

ORIGINAL/INSTALLED RIVET	REPAIR OVERSIZE RIVET
B0205016	B0205024
B0205017	B0205025
B0205018	B0205026
BACR15BA	B0205025
BACR15BB	B0205024
BACR15CE	B0205026
CSP310	B0205025
CSP320	B0205025

ORIGINAL/INSTALLED RIVET	REPAIR OVERSIZE RIVET
CSP362	B0205025
CSP371	B0205026
CSP372	B0205026
CSP374	B0205024
CSP391	B0205026
MS20426	B0205025
MS20470	B0205024
NAS1097	B0205026

TABLE 12 - HOLE SIZES AND COUNTERSINK DIAMETERS FOR OVERSIZE RIVETS

RIVET DASH NUMBER (Note 1)	RECOMMENDED DRILL SIZE	FINAL HOLE SIZE (B0205024, B0205025 & B0205026 rivets)	B0205025 COUNTERSINK DIAMETER	B0205026 COUNTERSINK DIAMETER
-4	#27 (0.1440")	0.143" - 0.148"	0.224" - 0.234"	0.196" - 0.201"
-5	#16 (0.1770")	0.176" - 0.181"	0.285" - 0.295"	0.247" - 0.252"
-6	#5 (0.2055")	0.205" - 0.211"	0.351" - 0.361"	0.302" - 0.307"

Note 1. The nominal diameter for a particular dash number of an oversize rivet is 1/64" larger than that of the corresponding standard rivet.

6 Requirements

6.1 It is unacceptable for the sheets to bulge between the rivets (e.g., as shown below).

UNACCEPTABLE

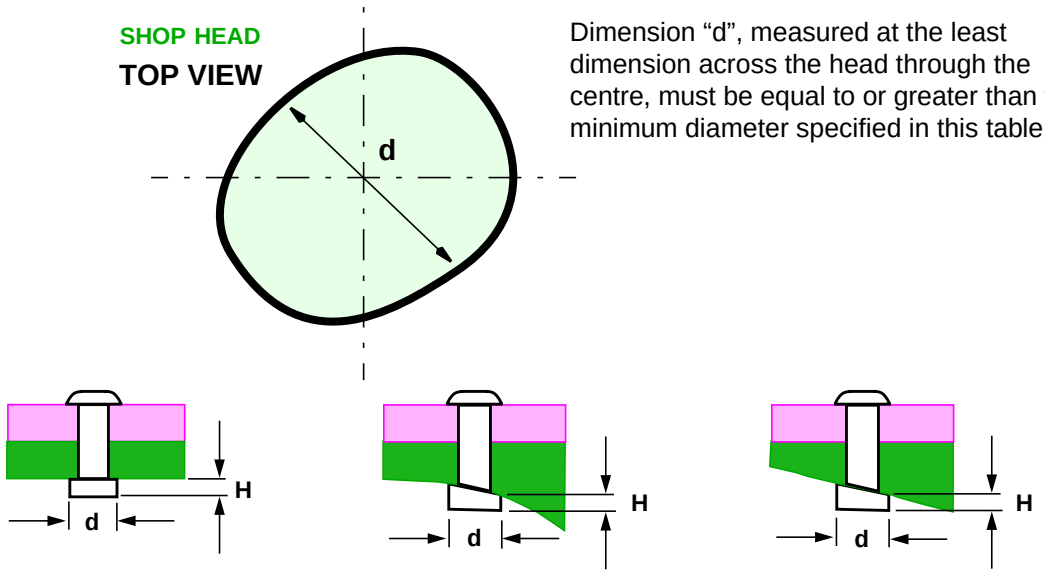
6.2 Although excessive button height or diameter adds unnecessary weight and should be avoided, exceeding the **maximum** recommended head height and/or diameter specified in Table 13 is acceptable.

TABLE 13 - RECOMMENDED SHOP FORMED HEAD DIMENSIONAL LIMITATIONS

NOMINAL RIVET DIAMETER	MAXIMUM RECOMMENDED HEAD DIAMETER		MAXIMUM RECOMMENDED HEAD HEIGHT
	7050 Al (KE) RIVETS	ALL RIVETS EXCEPT 7050 Al (KE) RIVETS	ALL RIVETS INCLUDING 7050 Al (KE) RIVETS
-2 (1/16")	n/a	0.094"	0.040"
-3 (3/32")	0.163"	0.153"	0.060"
-4 (1/8")	0.208"	0.196"	0.080"
-5 (5/32")	0.249"	0.234"	0.100"
-6 (3/16")	0.294"	0.276"	0.120"
-7 (7/32")	n/a	0.329"	0.140"
-8 (1/4")	0.400"	0.375"	0.160"
-10 (5/16")	n/a	0.470"	0.200"
-12 (3/8")	n/a	0.563"	0.210"

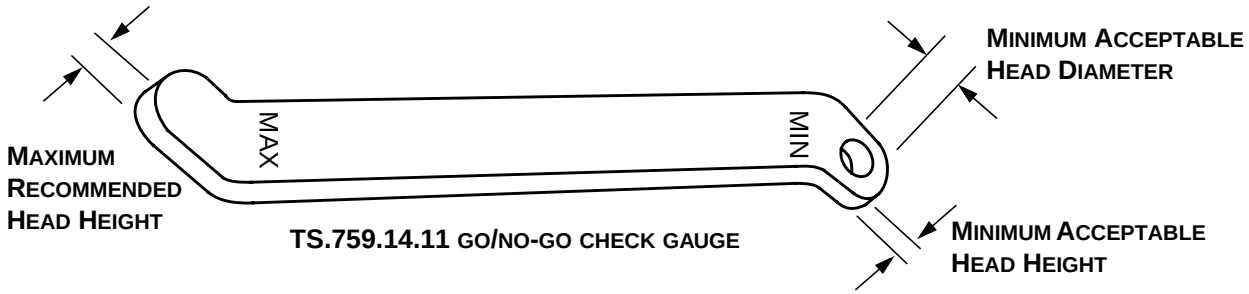
6.3 Shop formed heads must meet the **minimum** height and diameter requirements specified in Table 14. Shop formed heads which are not approximately symmetrical in diameter are acceptable provided that the least dimension across the head through the centre is equal to or greater than the minimum diameter specified in Table 14.

TABLE 14 - SHOP FORMED HEAD DIMENSIONAL REQUIREMENTS



Dimension “d”, measured at the least dimension across the head through the centre, must be equal to or greater than the minimum diameter specified in this table

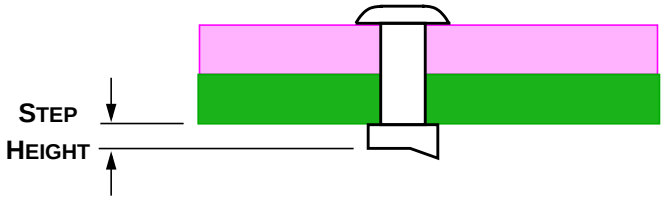
NOMINAL RIVET DIAMETER	MINIMUM REQUIRED HEAD DIAMETER “d”		MINIMUM REQUIRED HEAD HEIGHT “H”	GO/NO-GO GAUGE TS.759.14.11 (see Figure 6)	
	7050 Al (KE) RIVETS	ALL RIVETS EXCEPT 7050 Al (KE) RIVETS	ALL RIVETS INCLUDING 7050 Al (KE) RIVETS	ALL RIVETS EXCEPT 7050 Al (KE) RIVETS	7050 Al (KE) RIVETS
-2 (1/16")	n/a	0.081"	0.025"	n/a	n/a
-3 (3/32")	0.132"	0.122"	0.038"	n/a	n/a
-4 (1/8")	0.177"	0.165"	0.050"	MK 1	MK 5
-5 (5/32")	0.218"	0.203"	0.062"	MK 2	MK 6
-6 (3/16")	0.263"	0.245"	0.075"	MK 3	MK 7
-7 (7/32")	n/a	0.285"	0.085"	n/a	n/a
-8 (1/4")	0.350"	0.325"	0.100"	MK 4	MK 8
-10 (5/16")	n/a	0.406"	0.125"	n/a	n/a
-12 (3/8")	n/a	0.488"	0.150"	n/a	n/a



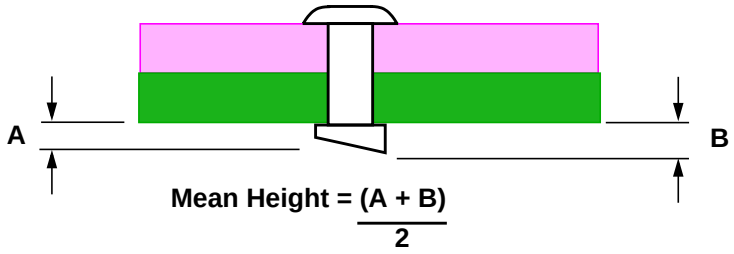
Note: For shop formed heads which are **not** approximately symmetrical in diameter, check the minimum head diameter using suitable alternative measurement equipment capable of measuring the least dimension across the head through the centre.

Figure 6 - TS.759.14.11 GO/NO-GO Check Gauge for Shop Head Dimensions

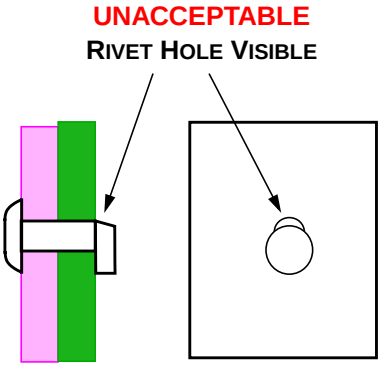
6.4 If the height of a stepped portion, if any, of a shop head (as shown below) is less than the minimum height specified in Table 14, the rivet must be replaced.



6.5 If the mean (average) height of a sloped shop head (see the following figure) is less than the minimum specified in Table 14, the rivet must be replaced.



6.6 If the rivet hole is visible beyond the periphery of an eccentric shop head (as shown below), the rivet must be replaced. If the rivet hole is **not** visible beyond the periphery of an eccentric shop head, visibly eccentric rivets are acceptable only if the number of such rivets does not exceed 10% of the pattern and are not adjacent to one another.



6.7 For protruding head rivets, if the flattened head height of the manufactured protruding head as shown below is less than the minimum dimension specified in Table 15, the rivet must be replaced.

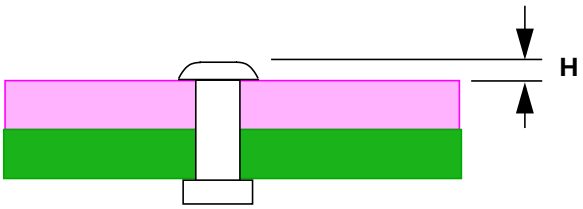


TABLE 15 - LIMITATIONS ON MANUFACTURED HEAD DEFORMATION

NOMINAL RIVET DIAMETER	'H' MINIMUM
-2 (1/16")	0.025"
-3 (3/32")	0.038"
-4 (1/8")	0.050"
-5 (5/32")	0.062"
-6 (3/16")	0.075"

NOMINAL RIVET DIAMETER	'H' MINIMUM
-7 (7/32")	0.085"
-8 (1/4")	0.100"
-10 (5/16")	0.125"
-12 (3/8")	0.153"

6.8 Refer to Table 16 for the limitations on flush head rivet protrusion above the surface of the part as shown below, before and after shaving, as applicable.

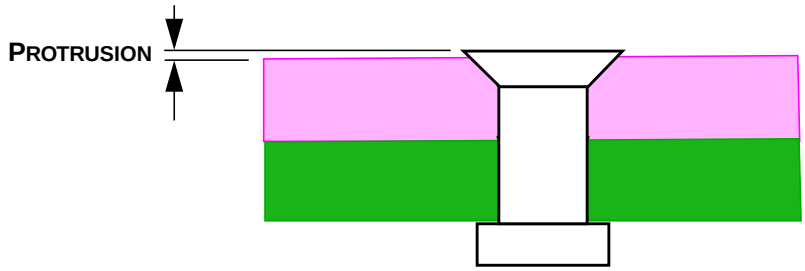
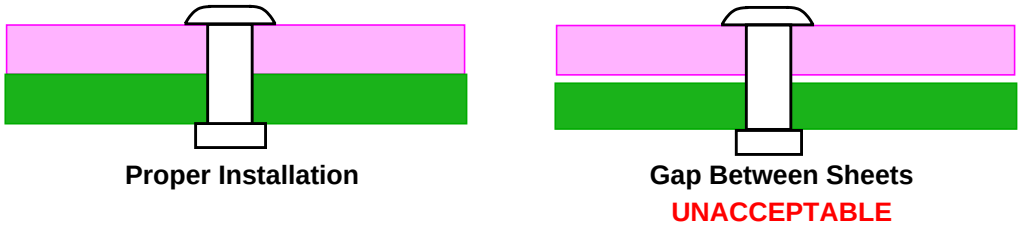


TABLE 16 - FLUSH HEAD RIVET PROTRUSION LIMITS

RIVET TYPE	INSTALLATION METHOD	INSTALLATION AREA	PROTRUSION LIMITS	
			PROTRUSION AT INSTALLATION (Note 1)	FINAL PROTRUSION (Note 2)
Reduced Flush Head Rivets (as referenced in Table 1)	Installed using an automatic riveter and the anvil used to seat the rivet was smaller than the head of the rivet.	Visibility area	0.000" - 0.0035"	Shaving of reduced flush head rivets is not permitted. If the rivet protrusion is excessive, the rivet must be removed and replaced.
		Not a visibility area	0.000" - 0.005"	
	Not installed using an automatic riveter equipped with a rivet seating anvil smaller than the head of the rivet.	Visibility area	0.0005" - 0.0035"	
		Not a visibility area	0.0005" - 0.005"	
Flush Head Rivets **other than** Reduced Flush Head	Installed using an automatic riveter and the anvil used to seat the rivet was smaller than the head of the rivet.	Visibility area	0.000" - 0.010"	0.000" - 0.0035"
		Not a visibility area	0.000" - 0.010"	0.000" - 0.005" (Note 3)
	Not installed using an automatic riveter equipped with a rivet seating anvil smaller than the head of the rivet.	Visibility area	0.0005" - 0.010"	0.0005" - 0.0035" (Note 3)
		Not a visibility area	0.0005" - 0.010"	0.0005" - 0.005" (Note 3)

Note 1. The “Protrusion at Installation” dimensions are the limits on the flush rivet head above the part surface as installed before any shaving.
Note 2. The “Final Protrusion” dimensions are the limits on the flush head above the part surface after shaving, if necessary or permitted.
Note 3. If shaving of flush head rivets was required as specified in paragraph 5.7.1, the final protrusion should be 0.000" - 0.0035".

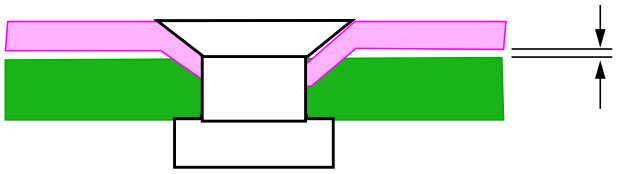
6.9 Except when a dimpled sheet nests into another dimple or into a countersink, the sheets must be drawn up tightly as shown:



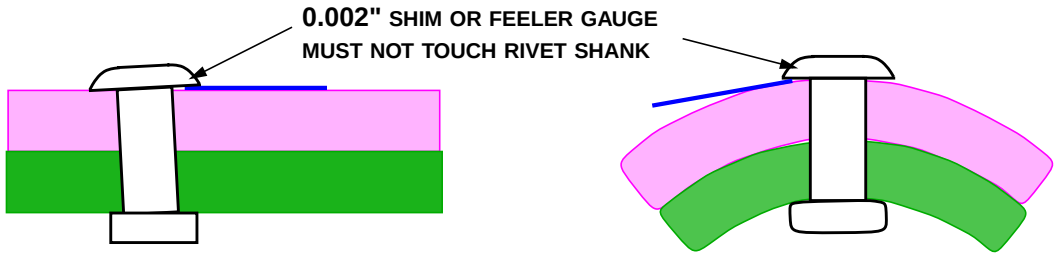
Proper Installation

Gap Between Sheets
UNACCEPTABLE

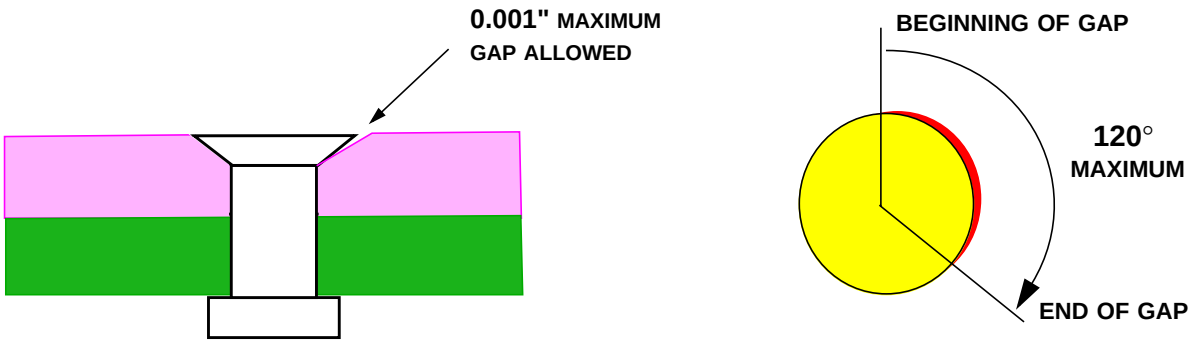
6.10 When a dimpled sheet nests into another dimple or into a countersink, there must be a small gap or sheet separation of 0.001" - 0.010" between the sheets as shown:



6.11 Protruding manufactured heads on flat or curved surfaces must be seated such that a 0.002" shim or feeler gauge cannot touch the shank of the rivet. On curved surfaces do not attempt to shape the manufactured head to match the surface curvature.

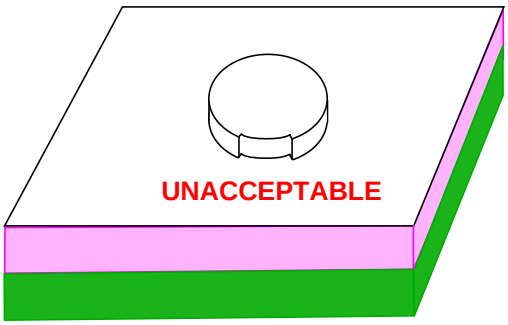


6.12 For flush head rivets, any gap under the head must be less than 0.002" without extending to the shank of the rivet and the bearing surface must extend at least 240° around the circumference of the rivet head. Therefore, if it is possible to either (a) insert the edge of a 0.002" feeler gauge into a gap, (b) a gap extends to the shank of the rivet, or (c) if a visible gap extends more than 120°, the rivet must be replaced and the countersink diameter checked.



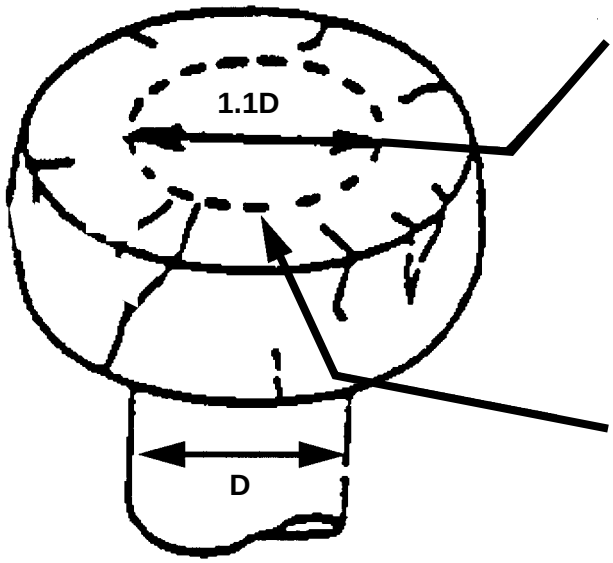
6.13 It is **not** necessary that rivet head markings be visible **after** installation (obliteration of the head marking during installation of the rivet is often unavoidable depending on the rivet material and the type of installation tooling used and is acceptable).

6.14 If the circumference or face of a rivet head shows evidence of a segment being sheared out (as shown below), the rivet must be replaced.



6.15 Except as specified below, if there are any cracks in the shop head, the rivet must be replaced. Cracks which meet **all** of the following characteristics are acceptable:

- The crack must be closed.
- The crack must run in a radial direction (i.e., from the edge of the rivet head towards the centre).
- The crack must not intersect with any other cracks or run in a direction such that it may intersect with another crack.
- The rivet head must have a minimum crack free surface diameter equal to 1.1 times the rivet shank diameter (see Table 17).



1.1 times the rivet shank diameter (see below)

RIVET SIZE	CRACK FREE DIA.
-2 (1/16")	0.069"
-3 (3/32")	0.103"
-4 (1/8")	0.138"
-5 (5/32")	0.172"

RIVET SIZE	CRACK FREE DIA.
-6 (3/16")	0.206"
-7 (7/32")	0.241"
-8 (1/4")	0.275"
-10 (5/16")	0.344"
-12 (3/8")	0.413"

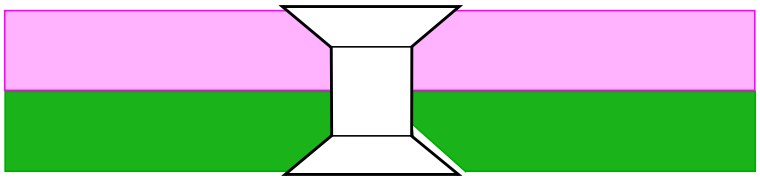
MAXIMUM ACCEPTABLE CRACK PENETRATION DEPTH FROM PERIPHERY OF RIVET (SEE TABLE 17)

TABLE 17 - MAXIMUM ACCEPTABLE CRACK PENETRATION INTO SHOP HEAD

MEASURED SHOP HEAD DIAMETER									MAXIMUM ACCEPTABLE CRACK PENETRATION
-2 (1/16")	-3 (3/32")	-4 (1/8")	-5 (5/32")	-6 (3/16")	-7 (7/32")	-8 (1/4")	-10 (5/16")	-12 (3/8")	
0.081"	---	---	---	---	---	---	---	---	0.006"
0.085"	---	---	---	---	---	---	---	---	0.008"
0.089"	0.123"	---	---	---	---	---	---	---	0.010"
0.093"	0.127"	---	---	---	---	---	---	---	0.012"
0.097"	0.131"	0.166"	---	---	---	---	---	---	0.014"
0.101"	0.135"	0.170"	0.204"	---	---	---	---	---	0.016"
	0.139"	0.174"	0.208"	---	---	---	---	---	0.018"
	0.143"	0.178"	0.212"	0.246"	---	---	---	---	0.020"
	0.147"	0.182"	0.216"	0.250"	0.285"	---	---	---	0.022"
	0.151"	0.186"	0.220"	0.254"	0.289"	---	---	---	0.024"
	0.155"	0.190"	0.224"	0.258"	0.293"	0.327"	---	---	0.026"
	0.159"	0.194"	0.228"	0.262"	0.297"	0.331"	---	---	0.028"
	0.163"	0.198"	0.232"	0.266"	0.301"	0.335"	---	---	0.030"
	0.167"	0.202"	0.236"	0.270"	0.305"	0.339"	0.408"	---	0.032"
	0.171"	0.206"	0.240"	0.274"	0.309"	0.343"	0.412"	---	0.034"
		0.210"	0.244"	0.278"	0.313"	0.347"	0.416"	---	0.036"
		0.214"	0.248"	0.282"	0.317"	0.351"	0.420"	0.489"	0.038"
		0.218"	0.252"	0.286"	0.321"	0.355"	0.424"	0.493"	0.040"
			0.256"	0.290"	0.325"	0.359"	0.428"	0.497"	0.042"
				0.294"	0.329"	0.363"	0.432"	0.501"	0.044"
				0.298"	0.333"	0.367"	0.436"	0.505"	0.046"
				0.302"	0.337"	0.371"	0.440"	0.509"	0.048"
				0.306"	0.341"	0.375"	0.444"	0.513"	0.050"
				0.310"	0.345"	0.379"	0.448"	0.517"	0.052"
						0.383"	0.452"	0.521"	0.054"
						0.387"	0.456"	0.525"	0.056"
						0.391"	0.460"	0.529"	0.058"
						0.395"	0.464"	0.533"	0.060"
						0.399"	0.468"	0.537"	0.062"
						0.403"	0.472"	0.541"	0.064"
						0.407"	0.476"	0.545"	0.066"
						0.411"	0.480"	0.549"	0.068"
						0.415"	0.484"	0.553"	0.070"
						0.419"	0.488"	0.557"	0.072"
						0.423"	0.492"	0.561"	0.074"
								0.565"	0.076"
								0.569"	0.078"
								0.573"	0.080"
								0.577"	0.082"
								0.581"	0.084"

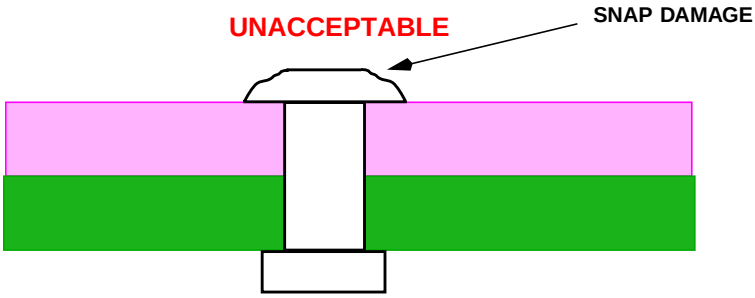
Interpolate between values as required.
For example: for a -6 rivet with a measured head diameter of 0.280", the maximum acceptable crack penetration would be 0.037" (i.e., since 0.280" is exactly in the middle between 0.278" and 0.282", then the maximum crack is exactly in the middle of the maximum crack for 0.278" which is 0.036" and the maximum crack for 0.282" which is 0.0038").

6.16 For double flush applications, if the **shop formed** head does not entirely fill the countersink, as shown below, the rivet must be replaced.



UNACCEPTABLE
There must be no gap between the structure and a **flush shop formed** head.

6.17 If the manufactured head of the rivet has been damaged by the installation tooling (e.g., snap was too small), as shown below, the rivet must be replaced.



7 BOMBARDIER TORONTO SAFETY PRECAUTIONS

7.1 The safety precautions specified herein are specific to Bombardier Toronto to meet Canadian Federal and Provincial government environmental, health and safety regulations. It is strongly recommended that subcontractors consider these safety precautions; however, subcontractors are responsible for ensuring that their own environmental, health and safety precautions satisfy the appropriate local government regulations.

7.2 Observe general shop safety precautions when performing the procedure specified herein.

7.3 When using riveting guns, observe the safety precautions specified in PPS 1.14.

8 Personnel Requirements

8.1 Personnel responsible for the installation of solid rivets must have a good working knowledge of the procedure and requirements as specified herein and must have exhibited their competency to their supervisor.