BOMBARDIER

Toronto Site

PROPRIETARY INFORMATION

PPS 2.38

PRODUCTION PROCESS STANDARD

Fluid Tight Installation of Solid Rivets

Issue 16
- This standard supersedes PPS 2.38, Issue 15.
- 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.

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	Quality	

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

Issue 16 - 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 General Procedure section to avoid repetitiveness throughout the PPS.
- Revised term “head thickness” with “head height” throughout.
- Modified note 1 in Table III (i.e., Deleted the term “Reference” from table title and the note).
- Deleted the term “recommended” from paragraph 5.6.4 regarding the shop head maximum height.
- Revised note 2 in Table VI and deleted the statement “The countersink diameter dimensions specified in this table are for reference only”.
- Added new paragraph 7.1 to safety precautions section.
- Specified to refer PPS 1.14 for the safety precautions when using rivet guns.

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1 Scope

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for the installation of solid rivets (see Table I) in fluid tight applications (e.g., integral fuel tanks). For non-fluid tight installation of solid rivets, refer to PPS 2.01.

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.

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 EO 7336 - BM9010.05 Supersession List.

3.2 PPS 1.09 - Drilling and Reaming.

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

3.4 PPS 1.14 - Use of Pneumatic Rivet Guns.

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

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

3.7 PPS 1.33 - Countersinking for Flush Head Fasteners.

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

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

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

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

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

3.13 PPS 21.21 - General Sealing Practices.

3.14 PPS 27.05 - Manual Edge Finishing.

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

4 Materials and Equipment

4.1 Materials

4.1.1 Solid rivets as specified on the engineering drawing or substitute rivets specified or permitted by EO 7336 or SREO's (see Table I). Refer to Figure 1 for examples of rivet part number break down.

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

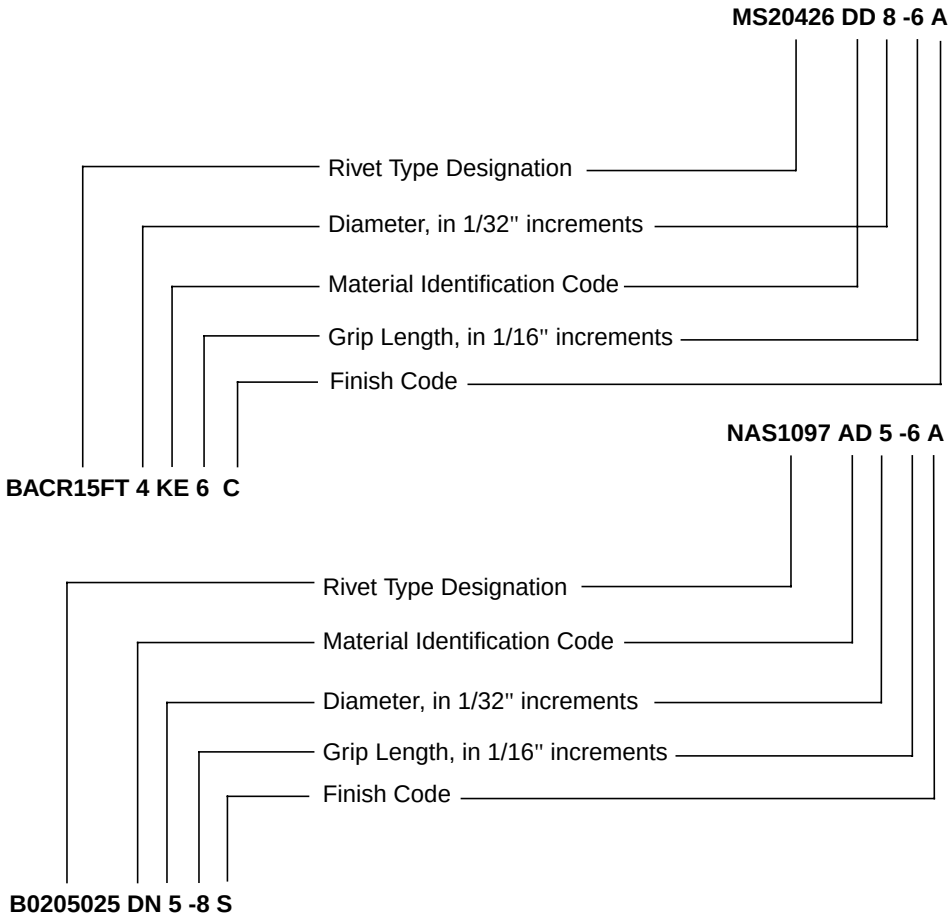


Figure 1 - Sample Part Number Breakdowns

TABLE I - SOLID RIVETS FOR FLUID TIGHT INSTALLATIONS (NOTES 1, 2 & 3)

MS AND NAS RIVETS SUPERSEDED BY CSP RIVETS	CSP AND SHORTS SB RIVETS SUPERSEDED BY BACR RIVETS	BACR RIVETS SUPERSEDED BY BOMBARDIER B RIVETS	BOMBARDIER B RIVETS SUPERSEDING MS, NAS, CSP, BACR AND SB RIVETS (Note 4)
MS20426ADJ4#-#	CSP320ADJ4#-#	BACR15BA#AD#C	B0205017AD#-#S
MS20426DDJ4#-#	CSP320DDJ4#-#	BACR15BA#DD#C	B0205017DD#-#S
			B0205017DN#-#S
			B0205017KE#-#S
		BACR15BA#KE#C	B0205017KE#-#S
MS20470ADJ4#-#	CSP374ADJ4#-#	BACR15BB#AD#C	B0205016AD#-#S
MS20470DDJ4#-#	CSP374DDJ4#-#	BACR15BB#DD#C	B0205016DD#-#S
			B0205016DN#-#S
			B0205016KE#-#S
		BACR15FT#KE#C	B0205016KE#-#S
NAS1097ADJ4#-#	CSP372ADJ4#-#	BACR15CE#AD#C	B0205018AD#-#S
NAS1097DDJ4#-#	CSP372DDJ4#-#	BACR15CE#DD#C	B0205018DD#-#S
			B0205018DN#-#S
			B0205018KE#-#S
		BACR15CE#KE#C	B0205018KE#-#S
---	SB0205001AD#-#S	BACR15BA#AD#C	B0205017AD#-#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 visa versa.
Note 2. At Bombardier Toronto, install the rivets specified on the work order or assembly manual. If the rivet specified on the work order or assembly manual is not available, contact Bombardier Toronto Material Logistics. Do not substitute rivets as specified herein without Methods approval.
Note 3. Refer to Table V for a listing of oversize Bombardier B rivets.
Note 4. In place of DD rivets, it is acceptable to make the following substitutions: For automatic installation, it is acceptable to substitute the appropriate KE rivet; for manual installation, it is acceptable to substitute the appropriate DN rivet (e.g., if use of a B0205017DD#-#S rivet is specified, it is acceptable to manually install a B0205017DN#-#S rivet).

4.2 Equipment

4.2.1 Refer to referenced PPS's for hole preparation and rivet installation equipment required.

4.2.2 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.

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

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 Fluid tight riveting requires that rivet shank expansion during installation must completely fill and seal the hole. To achieve this, it is necessary to install rivets in high quality, close tolerance holes. With the exception of the hole tolerance requirements, fluid tight installation of solid rivets is performed in the same manner as described in PPS 2.01 for standard installation of solid rivets.

5.1.3 Solid rivets are identified on the engineering drawing as normal stress rivets or critical stress rivets. Refer to PPS 2.62 for identification symbols.

5.1.4 Rivets manufactured from 2024 aluminum alloy (DD rivets) must be heat treated and maintained in refrigerated storage according to PPS 30.03 until installed.

5.2 Hole Preparation

5.2.1 Refer to Table II for the final hole sizes required. When preparing holes, maintain the minimum edge distance according to PPS 1.09. When preparing the final hole, any of the following methods may be employed:

- Drill using standard drillmotors and double margin drills 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.
- Drill or drill/countersink using automatic drill riveters according to PPS 1.20, PPS 1.41 or PPS 1.43.

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

RIVET NOMINAL DIAMETER	RECOMMENDED DRILL SIZE (NOTE 1)	REQUIRED FINAL HOLE SIZE
-4 (1/8")	0.128"	0.127" - 0.130"
-5 (5/32")	0.159"	0.159" - 0.162"
-6 (3/16")	0.191"	0.190" - 0.193"
-8 (1/4")	0.253"	0.253" - 0.256"
Note 1. Ensure final hole size requirements are met.		

5.2.2 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.

5.2.3 See Table III for the countersink diameter requirements for flush head fasteners.

TABLE III - COUNTERSINK DIAMETERS

HEAD STYLE	FASTENER	COUNTERSINK DIAMETER (NOTE 1)			
		-4 (1/8")	-5 (5/32")	-6 (3/16")	-8 (1/4")
Flush Head	B0205017	0.208" - 0.218"	0.273" - 0.283"	0.336" - 0.346"	0.459" - 0.469"
	BACR15BA	0.211" - 0.221"	0.273" - 0.283"	0.339" - 0.349"	0.463" - 0.473"
	MS 20426	0.207" - 0.217"	0.268" - 0.278"	0.335" - 0.345"	0.458" - 0.468"
Reduced Flush Head	B0205018	0.180" - 0.185"	0.231" - 0.236"	0.287" - 0.292"	0.380" - 0.385"
	BACR15CE	0.181" - 0.186"	0.234" - 0.239"	0.284" - 0.289"	0.382" - 0.387"
	NAS 1097	0.179" - 0.184"	0.231" - 0.236"	0.288" - 0.293"	0.381" - 0.386"

Note 1. Install rivets so that the head protrusion limits specified in Table VIII are met.

5.2.4 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 IV 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.

5.2.4.1 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 IV - HOLE SIZE VERIFICATION SAMPLE REQUIREMENTS

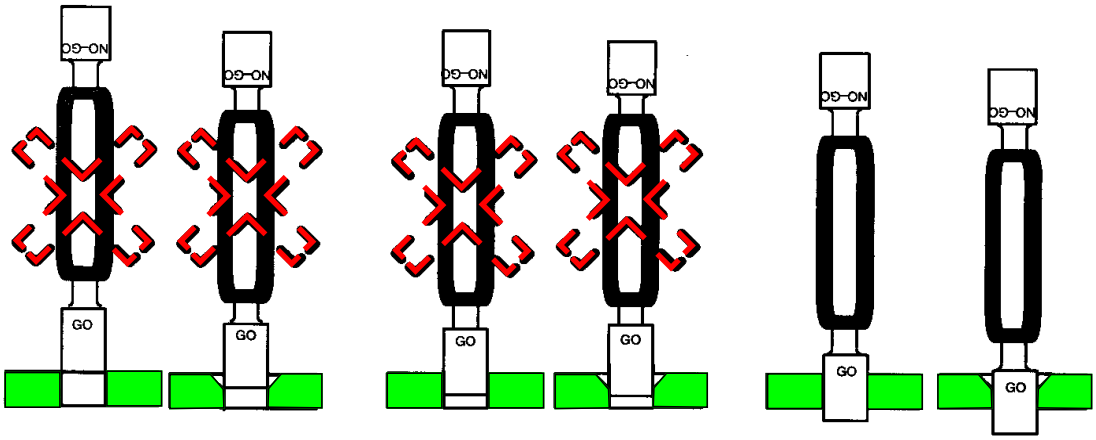
NUMBER OF HOLES IN PATTERN	REQUIRED SAMPLE SIZE
5 or less	all
6 - 50	5
51 - 90	7
91 - 150	11
151 - 280	13
281 - 500	16
more than 500	19

5.3 Use of GO/NO-GO Gauges

5.3.1 Check selected fastener holes for conformance to the requirements of Table II using the applicable go/no-go gauge as follows (see Figure 2):

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 II.

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.

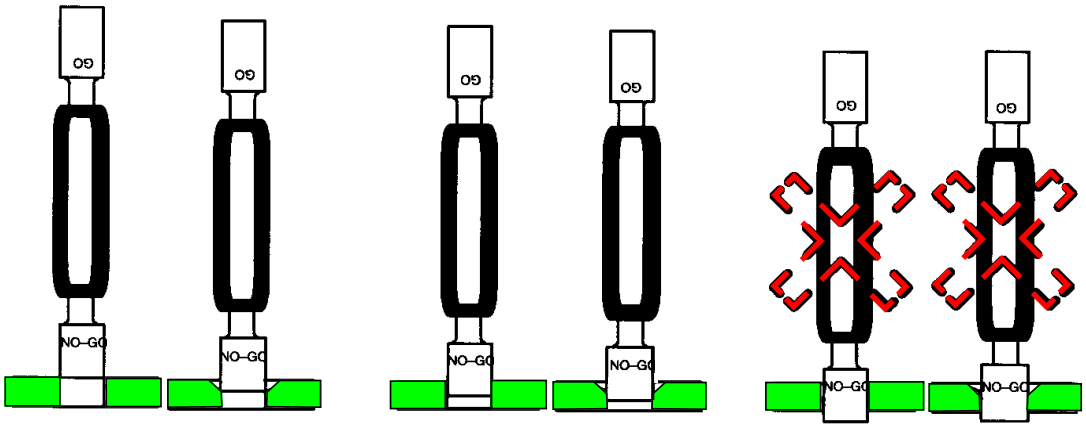


DOES NOT GO IN
UNDERSIZE HOLE

GOES ONLY PARTIALLY IN
UNDERSIZE HOLE

GOES IN COMPLETELY
ACCEPTABLE

USE OF GO END



DOES NOT GO IN
ACCEPTABLE

GOES ONLY PARTIALLY IN
ACCEPTABLE

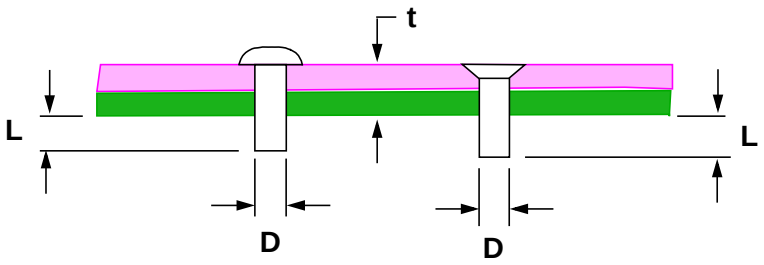
GOES IN COMPLETELY
OVERSIZE HOLE

USE OF NO-GO END

Figure 2 - 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 VII. As a general rule, the length of the undriven rivet should be 1.25 to 1.5 times the nominal rivet shank diameter plus the thickness of the material into which the rivet is to be installed (see Figure 3).



D = nominal rivet shank diameter
t = stackup thickness
L = undriven rivet length **protrusion**, L = 1.25D to 1.5D
t + L = Required rivet length

Figure 3 - 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 curved parts without excessive gaps.

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, 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 a rivet gun.
- 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.

5.6.2 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 superseded wet installed CSP, MS or NAS rivets, it is acceptable to install the rivets without sealant.

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

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 above 0.005" and less than 0.010" to a protrusion of 0.000" - 0.0035" using a depth controlled rivet shaver (see equipment section, paragraph 4.2.3) 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) 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.

5.8.2 When replacing leaking rivets in Lear 45 aircraft fuel tanks, wet install the replacement rivet with DHMS S3.06 Type I Class C-80 sealant, mixed according to PPS 21.20 and applied according to PPS 21.21.

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 V 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 VI according to section 5.2.

TABLE V - OVERSIZE RIVETS

ORIGINAL/INSTALLED RIVET	REPAIR OVERSIZE RIVET
B0205016	B0205024
B0205017	B0205025
B0205018	B0205026
BACR15BA	B0205025
BACR15BB	B0205024
BACR15CE	B0205026
BACR15FT	B0205024

ORIGINAL/INSTALLED RIVET	REPAIR OVERSIZE RIVET
CSP320	B0205025
CSP372	B0205026
CSP374	B0205024
MS20426	B0205025
MS20470	B0205024
NAS1097	B0205026

TABLE VI - HOLE SIZES AND COUNTERSINK DIAMETERS FOR OVERSIZE RIVETS

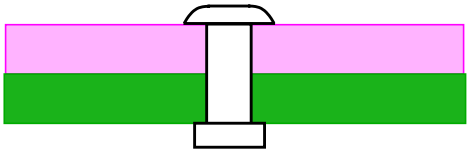
RIVET DASH NUMBER (Note 1)	RECOMMENDED DRILL SIZE	FINAL HOLE SIZE (B0205024, B0205025 & B0205026 rivets)	COUNTERSINK DIAMETER (NOTE 2)	
			B0205025	B0205026
-4	#27 (0.1440")	0.143" - 0.146"	0.224" - 0.234"	0.196" - 0.201"
-5	#16 (0.1770")	0.176" - 0.179"	0.285" - 0.295"	0.247" - 0.252"
-6	#5 (0.2055")	0.205" - 0.208"	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.
Note 2. Install rivets so that the head protrusion limits specified in Table VIII are met.

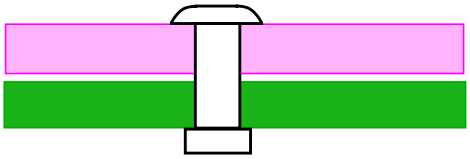
6 Requirements

6.1 Production Parts

6.1.1 The sheets must be drawn up tightly:

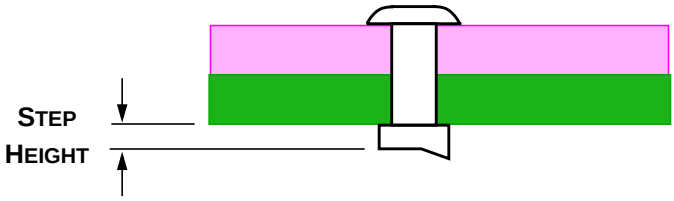


Proper Installation



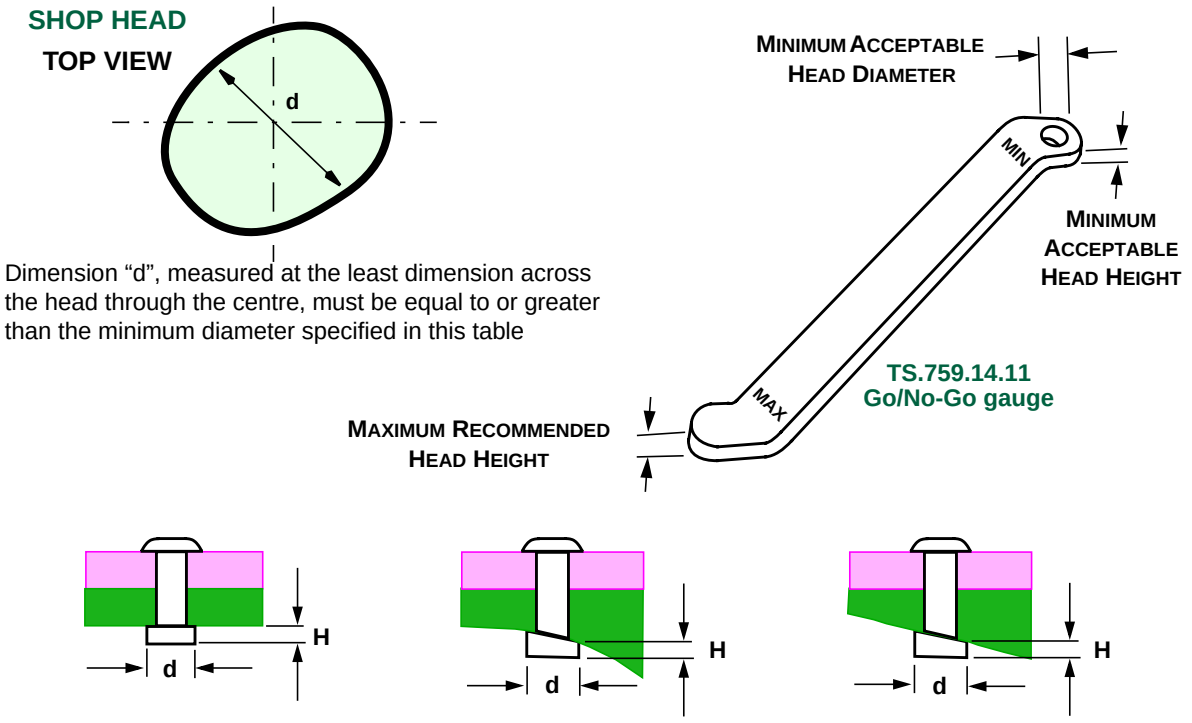
Gap Between Sheets
UNACCEPTABLE

6.1.2 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 VII, the rivet must be replaced.



6.1.3 Shop formed heads must meet the requirements specified in Table VII. 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 VII.

TABLE VII - SHOP FORMED HEAD DIMENSIONAL REQUIREMENTS

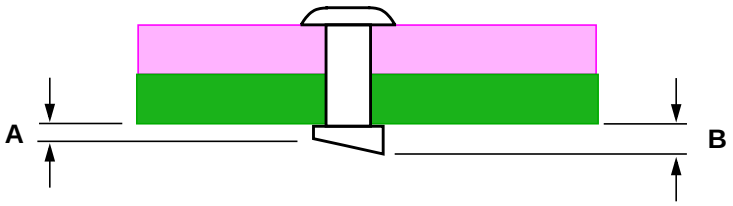


NOMINAL RIVET DIAMETER	HEAD DIAMETER “d”		HEAD HEIGHT “H”	GO/NO-GO GAUGE TS.759.14.11 (Note 2)	
	7050 AL (KE) RIVETS	ALL RIVETS EXCEPT 7050 AL (KE) RIVETS	ALL RIVETS INCLUDING 7050 AL (KE) RIVETS	ALL RIVETS EXCEPT 7050 AL (KE) RIVETS	7050 AL (KE) RIVETS
-4 (1/8")	0.177" - 0.208"	0.165" - 0.196"	0.050" - 0.080"	MK 1	MK 5
-5 (5/32")	0.218" - 0.249"	0.203" - 0.234"	0.062" - 0.100"	MK 2	MK 6
-6 (3/16")	0.263" - 0.294"	0.245" - 0.276"	0.075" - 0.120"	MK 3	MK 7
-8 (1/4")	0.350" - 0.400"	0.325" - 0.375"	0.100" - 0.160"	MK 4	MK 8

Note 1. Exceeding the maximum recommended head height “H” is acceptable. However, excessive button height adds unnecessary weight and should be avoided.

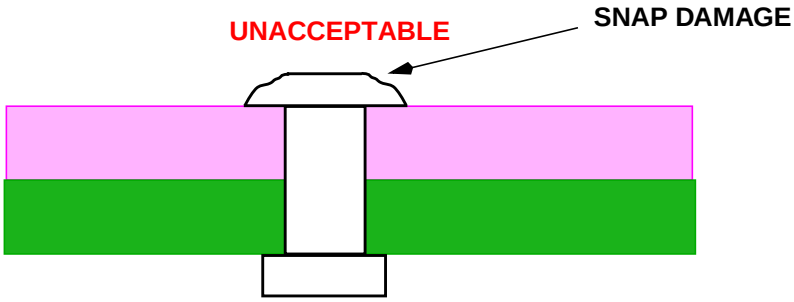
Note 2. The TS.759.14.11 Go/No-Go gauge can be used for checking shop formed heads which are approximately symmetrical in diameter. For shop formed heads which are not approximately symmetrical in diameter, check the minimum head diameter using suitable alternative measurement equipment capable of measuring the least dimension across the head through the centre.

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

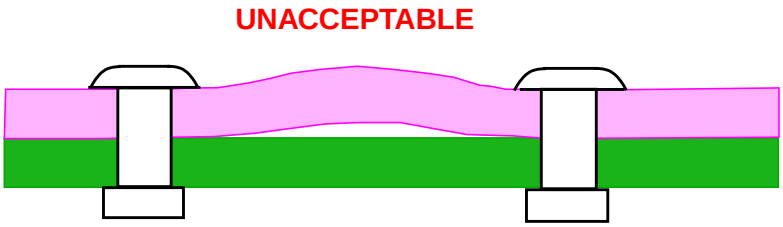


$$\text{Mean Height} = \frac{(A + B)}{2}$$

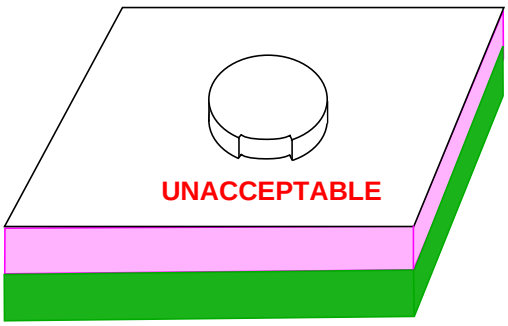
6.1.5 If the manufactured head of the rivet has been damaged by the installation tooling (e.g., snap was too small), as shown below, the rivet must be replaced.



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

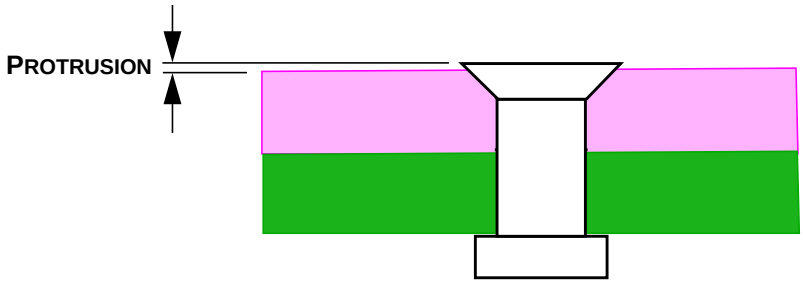


6.1.7 If the circumference or face of a rivet head shows evidence of a segment being sheared out (e.g., as shown below), the rivet must be replaced.



6.1.8 Refer to Table VIII for the limitations on flush head rivet protrusion above the surface of the part, before and after shaving, as applicable.

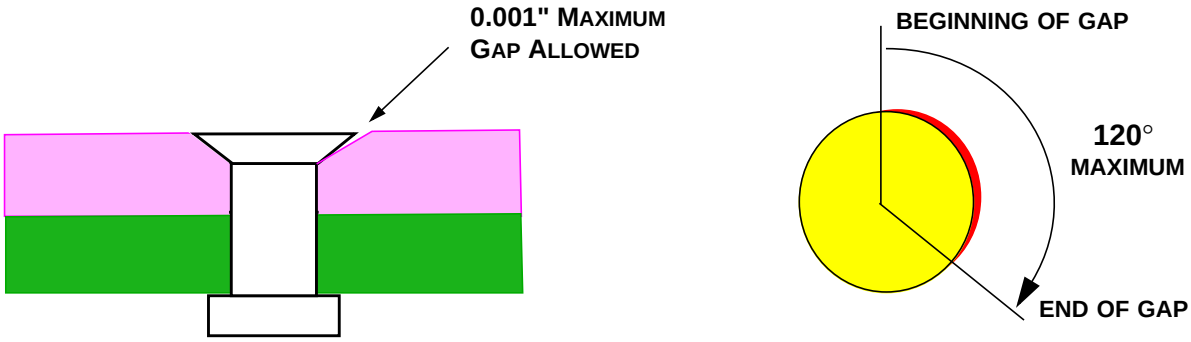
TABLE VIII - FLUSH HEAD RIVET PROTRUSION LIMITS



RIVET TYPE	INSTALLATION METHOD	INSTALLATION AREA	PROTRUSION LIMITS	
			PROTRUSION AT INSTALLATION (NOTE 1)	FINAL PROTRUSION (NOTE 2)
Reduced Flush Head Rivets	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)

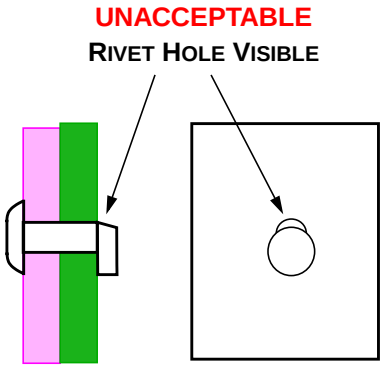
Note 1. The “Protrusion at Installation” dimensions are the limits on the flush rivet head above the part surface as installed before any shaving.
Note 2. The “Final Protrusion” dimensions are the limits on the flush head above the part surface after shaving, if necessary or permitted.
Note 3. If shaving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

6.1.9 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.



6.1.10 Replaced leaking rivets in Lear 45 aircraft fuel tanks, must have been wet installed with DHMS S3.06 Type I Class C-80 sealant, mixed according to PPS 21.20 and applied according to PPS 21.21.

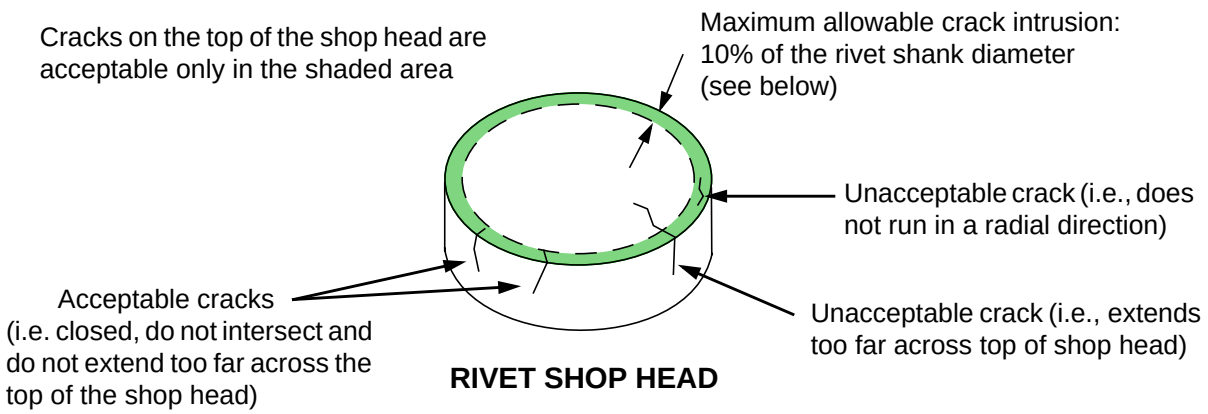
6.1.11 If the rivet hole is visible beyond the periphery of an eccentric shop head (as shown below), the rivet must be replaced. If the rivet hole is **not** visible beyond the periphery of an eccentric shop head, visibly eccentric rivets are acceptable only if the number of such rivets does not exceed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



6.1.12 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:

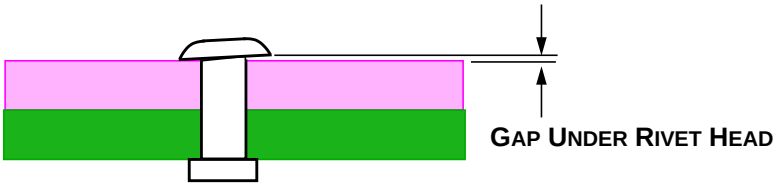
- The crack must be closed.
- The crack must run in a radial direction (i.e., from the edge of the rivet head towards the centre).
- The crack must not intersect with any other cracks or run in a direction such that it may intersect with another crack.
- The visible part of the crack must not extend more than 1/10th of the rivet shank diameter toward the centre of the rivet head (see Table IX).

TABLE IX - MAXIMUM ALLOWABLE CRACK INTRUSION



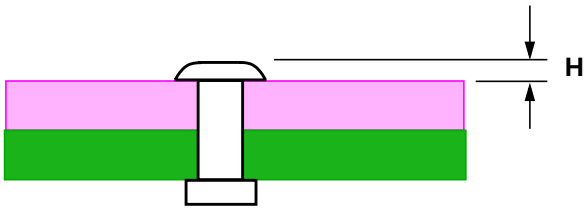
RIVET SIZE	-4 (1/8")	-5 (5/32")	-6 (3/16")	-8 (1/4")
MAXIMUM ALLOWABLE CRACK INTRUSION	0.0125"	0.0156"	0.0188"	0.025"

6.1.13 A gap under a manufactured protruding head is only acceptable on one side of the head and it must not be possible for a 0.002" feeler gauge to contact the rivet shank or move freely when slipped back and forth in a straight line perpendicular to the axis of the rivet shank. If the gap extends all around the head or it is possible for a 0.002" feeler gauge to contact the rivet shank or move freely when slipped back and forth in a straight line perpendicular to the axis of the rivet shank, the rivet must be replaced.



6.1.14 For universal and modified universal head rivets, if the flattened head height of the manufactured protruding head is less than the minimum dimension specified in Table X, the rivet must be replaced.

TABLE X - LIMITATIONS ON MANUFACTURED HEAD DEFORMATION



NOMINAL RIVET DIAMETER	MINIMUM ACCEPTABLE HEIGHT 'H' FOR FLATTENED PROTRUDING HEADS
-4 (1/8")	0.050"
-5 (5/32")	0.062"
-6 (3/16")	0.075"
-8 (1/4")	0.100"

6.2 Automatic Drill Riveter Test Pieces

6.2.1 Check test pieces prepared according to PPS 1.20, PPS 1.41 or PPS 1.43 to ensure that the following requirements are met:

- The interference measured across the rivet diameter at the "seal plane" (see Figure 4) must be 0.001" to 0.006". Make the measurement approximately 0.020" from the base of the shop head as shown in the Figure 4.
- Ensure rivets installed in test pieces meet requirements of section 6.1.
- Angularity - Holes and countersinks must be normal (perpendicular) to the surface within 2 degrees.
- Circumferential scratches in the rivet holes must not exceed 1/16" or 10% of the part thickness, whichever is smaller.
- Helical scratches in the rivet holes must not exceed 1/16" or 25% of the part thickness, whichever is smaller.
- Longitudinal scratches in rivet holes must not exceed 50 percent of the length of the hole in any one part. The scratch must not start or end within 1/16" or 25% of the part thickness (whichever is smaller) from the surface of the part.
- The surface roughness of the drilled hole must not exceed 125 R_a.

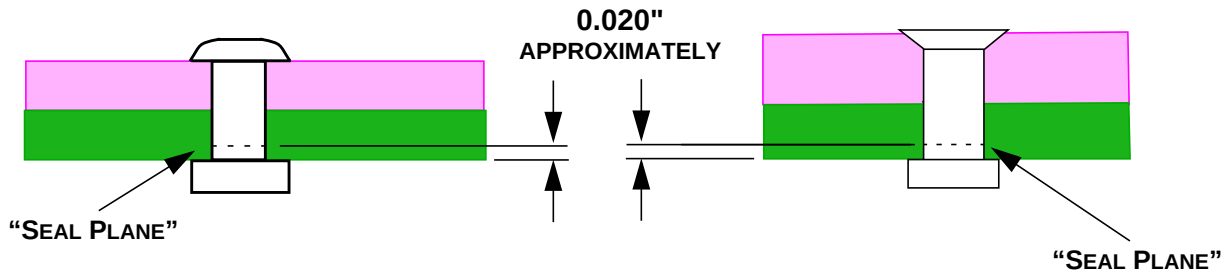


Figure 4 - Rivet Interference Seal Planes

7 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 fluid tight 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.