DE HAVILLAND AIRCRAFT OF CANADA LIMITED

BOMBARDIER

Toronto Site

PPS 2.20 - Installation of Bolts and Screws

Issue 21
- This standard supersedes PPS 2.20, Issue 20.
- Vertical lines in the left hand margin indicate technical changes over the previous issue.
- Direct PPS related questions to christie.chung@dehavilland.com or (416) 375-7641.
- This PPS is effective as of the distribution date.

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

Issue 21 - 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.

- Specified this is a jointly owned PPS by both De Havilland Aircraft of Canada Limited and Bombardier Inc.
- Specified “MRB” (Material Review Board) to include DHC/BA MRB and DHC/BA delegated MRB.
- Corrected final hole tolerance typo for 7/16" nominal thread size (was 70.467" corrected to 0.467"). See Table I.
- Deleted part number NAS4402 as superseded by part number NAS7402; deleted part number NAS4403 as superseded by part number NAS7403; deleted part number NAS4404 as superseded by part number NAS7404; deleted part number NAS4405 as superseded by part number NAS7405; deleted part number NAS4406 as superseded by part number NAS7406; deleted part number NAS4407 as superseded by part number NAS7407; deleted part number NAS4703 as superseded by part number NAS8603; deleted part number NAS4704 as superseded by part number NAS8604; deleted part number NAS4705 as superseded by part number NAS8605; deleted part number NAS4707 as superseded by part number NAS8607; deleted part number NAS4705 as superseded by part number NAS8605; deleted part number NAS4706 as superseded by part number NAS8606; deleted part number NAS4803 as superseded by part number NAS8703; deleted part number NAS4804 as superseded by part number NAS8704 as per EO7336. See Table II.
- Replaced DSC 228-* part number with superseding B0203073-* part number as per Supersession List EO7336 (with the exception of DSC228-16). See Table IV.
- Specified Torque Code A for B0203072 barrel nut (DSC 228-16 barrel nut superseded by B0203072-16S). See Table IV.
- Replaced DSC 71-* part number with superseding B0203025-* part number as per Supersession List EO7336.
- Specified Torque Code C for MS20004 bolt. See Table IV.
- Deleted use of all F1 zinc chromate primer according to PPS 34.02. Where F1 zinc chromate primer is specified, apply F19 Type 2 primer according to PPS 34.08.

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1 SCOPE

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for the installation of bolts and screws (except wood screws, sheet metal screws and self-tapping screws).

1.1.1 This PPS complements the engineering drawings that specify its use as an authorized instruction. The procedure specified in this PPS shall 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.

2 HAZARDOUS MATERIALS

2.1 Before receipt at De Havilland Canada (DHC) or Bombardier Toronto (BA), all materials shall be approved and assigned Material Safety Data Sheet (MSDS) numbers by the DHC/BA 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 DHC/BA Environment, Health and Safety Department.

3 REFERENCES

3.1 Engineering Order (E.O.) 7336 - DM9010.05 Supersession List.

3.2 PPS 1.01 - Dimpling Aluminum Alloys.

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

3.4 PPS 1.09 - Drilling and Reaming.

3.5 PPS 1.33 - Countersinking for Flush Head Fasteners.

3.6 PPS 2.17 - Installation of Anchor Nuts.

3.7 PPS 2.65 - Salvage of Oversize Holes using Acres Sleeves.

3.8 PPS 9.04 - Assembly and Installation of Electrical and Electronic Wire Assemblies

3.9 PPS 13.06 - Use of Screwdrivers for the Installation of Aircraft Screws and Bolts.

3.10 PPS 13.26 - General Subcontractor Provisions.

3.11 PPS 14.01 - Torquing & Tightening.

3.12 PPS 14.04 - Installation of Preload Indicating (PLI) Washers.

3.13 PPS 16.01 - Application of Hard and Soft Film (F13) Corrosion Preventive Compound.

3.14 PPS 18.01 - Limitations on Shearing, Blanking and Punching Aluminum and Magnesium Alloy Sheet.

3.15 PPS 18.04 - Limitations on Shearing and Punching Titanium Alloy.

3.16 PPS 19.01 - Safetying Devices.

3.17 PPS 21.21 - General Sealing Practices.

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

4 MATERIALS AND EQUIPMENT

4.1 Materials

4.1.1 Bolts, screws, nuts, washers and lockwashers as specified on the engineering drawing.

4.1.2 MIL-G-23827 grease or Shell Oil Co. Aeroshell grease No. 7.

4.2 Equipment

4.2.1 GO/NO-GO gauge or other hole measuring gauge.

4.2.2 Suitable hole measurement equipment (e.g., vernier caliper, hole micrometer, etc.).

5 PROCEDURE

5.1 General

5.1.1 For the purposes of this PPS, the term “MRB” (Material Review Board) is considered to include DHC/BA MRB and DHC/BA delegated MRB.

5.1.2 For the purposes of this standard the term fastener is used to include both bolts and screws unless specific reference is made.

5.2 Preparation of Work

5.2.1 Carry out all drilling operations according to PPS 1.09.

5.2.2 When punching aluminum and titanium alloys, ensure that the limitations of PPS 18.01 and PPS 18.04, respectively, are not exceeded.

5.2.3 If specified on the engineering drawing, carry out spot facing to the diameter and depth specified. Prime all spot faced and counterbored areas using F19 epoxy primer according to PPS 34.08.

5.2.4 For protruding fastener heads to be installed in close tolerance holes, if a washer is not to be installed under the head, chamfer (0.020" x 45°) the edges of the hole to accommodate the fastener head fillet radius (see Figure 1).

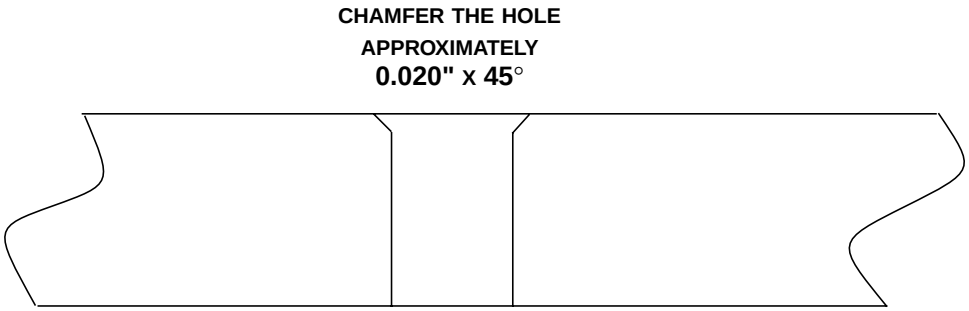


FIGURE 1 - CHAMFERING OF CLOSE TOLERANCE HOLES

5.2.5 If dimpling is specified, dimple according to PPS 1.01 or PPS 1.07 before drilling to final size according to PPS 1.09.

5.2.6 If countersinking is specified, countersink according to PPS 1.33. If the engineering drawing does not specify a countersink diameter, refer to Table II for the recommended countersink diameter; the countersink diameters listed in Table II are for reference only, prepare the countersink so that the flushness requirements of paragraph 6.3 are met. If the engineering drawing specifies a countersink diameter without a tolerance, refer to Liaison Engineering for the tolerance. Countersink close tolerance holes after pre-drilling, and before drilling to final size. Prepare countersinks extending through more than one sheet simultaneously to ensure proper alignment of the holes. After countersinking, prime countersinks with F19 Type 2 epoxy-polyamide primer according to PPS 34.08.

5.2.7 If the engineering drawing specifies a close tolerance hole (i.e., the hole diameter tolerance is 0.003" or less), pre-drill the hole and countersink (if specified) before drilling to final size. Refer to PPS 1.09 for pre-drill sizes.

5.2.8 Prepare anchor nut screw holes according to PPS 2.17.

5.2.9 If the engineering drawing does not specify a hole tolerance but specifies only a drill size, or a final hole size without a tolerance, refer to the first section of Table I for the hole dimensions. If the engineering drawing does not specify a hole tolerance, drill size or a final hole size without a tolerance but specifies only a fastener size, refer to the second section of Table I for the hole dimensions.

TABLE I - HOLE PREPARATION DATA

SPECIFIED FINAL DRILL OR HOLE SIZE	FINAL HOLE TOLERANCE (Note 1)		SPECIFIED FINAL DRILL OR HOLE SIZE	FINAL HOLE TOLERANCE (Note 1)
#51 (0.0670")	0.066" - 0.071"		P (0.3230")	0.322" - 0.329"
#46 (0.0810")	0.080" - 0.085"		V (0.3770")	0.3760" - 0.3830"
#42 (0.0935")	0.092" - 0.097"		W (0.3860")	0.385" - 0.392"
#36 (0.1065")	0.105" - 0.110"		7/16" (0.4375")	0.4365" - 0.4435"
#31) (0.1200")	0.119" - 0.124"		29/64" (0.4531")	0.452" - 0.459"
#29 (0.1360")	0.135" - 0.141"		1/2"(0.5000")	0.4990" - 0.5060"
#26 (0.1470")	0.146" - 0.152"		33/64" (0.5156")	0.514" - 0.523"
#19 (0.1660")	0.1650" - 0.1710"		9/16" (0.5625")	0.5615" - 0.5705"
#17 (0.1730")	0.172" - 0.178"		37/64" (0.5781")	0.577" - 0.586"
#11 (0.1910")	0.1900" - 0.1960"		5/8" (0.6250")	0.6240" - 0.6330"
#9 (0.1960")	0.195" - 0.201"		41/64" (0.6406")	0.639" - 0.648"
E (0.2500")	0.2490" - 0.2550"		3/4" (0.7500")	0.7490" - 0.7580"
F (0.2570")	0.256" - 0.263"		49/64" (0.7656")	0.764" - 0.772"
5/16" (0.3125")	0.3115" - 0.3185"			

Note 1. The hole size tolerances shown above are applicable only if the engineering drawing specifies a drill size or the equivalent final hole size (in brackets). If the engineering drawing specifies min/max hole dimensions, they take precedence over the tolerances shown. If the engineering drawing specifies a hole size (without a tolerance) not shown above, refer to PPS 1.09 for the hole tolerance.

NOMINAL FASTENER THREAD SIZE	FINAL HOLE TOLERANCE (Note 2)		NOMINAL FASTENER THREAD SIZE	FINAL HOLE TOLERANCE (Note 2)
#4	0.115" - 0.125"		7/16"	0.467" - 0.479"
#6	0.141" - 0.151"		1/2"	0.529" - 0.541"
#8	0.192" - 0.203"		9/16"	0.591" - 0.610"
#10	0.218" - 0.229"		5/8"	0.653" - 0.672"
1/4"	0.279" - 0.291"		3/4"	0.778" - 0.797"
5/16"	0.342" - 0.354"		7/8"	0.903" - 0.922"
3/8"	0.404" - 0.416"		1"	1.028" - 1.047"

Note 2. The hole size tolerances shown immediately above are applicable only if the engineering drawing specifies a fastener size but does not specify the hole tolerance or the final drill or fastener hole size. If the engineering drawing specifies min/max hole dimensions, they take precedence over the tolerances shown in this table.

TABLE II - COUNTERSINKING DATA

NOMINAL THREAD DIAMETER	RECOMMENDED COUNTERSINK DIAMETER (Notes 1 & 2)	
	FLUSH HEAD FASTENERS (Note 3)	REDUCED FLUSH HEAD FASTENERS (Note 4)
#0 (0.0600")	0.119" - 0.125"	n/a
#1 (0.0730")	0.149" - 0.155"	n/a
#2 (0.0860")	0.172" - 0.179"	n/a
#3 (0.0990")	0.199" - 0.206"	n/a
#4 (0.1120")	0.225" - 0.233"	n/a
#5 (0.1250")	0.252" - 0.260"	n/a
#6 (0.1380")	0.279" - 0.288"	n/a
#8 (0.1640")	0.332" - 0.341"	0.257" - 0.267"
#10 (0.1900")	0.385" - 0.395"	0.303" - 0.313"
1/4" (0.2500")	0.507" - 0.517"	0.397" - 0.407"
5/16" (0.3125")	0.635" - 0.645"	0.477" - 0.487"
3/8" (0.3750")	0.762" - 0.772"	0.564" - 0.574"
7/16" (0.4375")	0.890" - 0.900"	0.672" - 0.682"
1/2" (0.5000")	1.017" - 1.028"	0.755" - 0.766"
9/16" (0.5625")	1.145" - 1.156"	0.838" - 0.849"
5/8" (0.6250")	1.272" - 1.284"	0.925" - 0.937"

Note 1. The recommended countersink diameters listed in this table are not applicable if the engineering drawing specifies a required countersink diameter. The countersink diameters listed in this table are for reference only, prepare the countersink so that the flushness requirements of paragraph 6.3 are met.

Note 2. In general, use a 100° countersink. However, for AN505 and AN510 fasteners, use an 82° countersink.

Note 3. Flush head fasteners: AN505, AN507, AN509, AN510, MS24693, MS24694, NAS333 - NAS340, NAS514, NAS1203 - NAS1207, NAS4104 - NAS4416, NAS4204 - NAS4216, NAS4304 - NAS4316, NAS4401, NAS4408 - NAS4416, NAS4500 - NAS4516, NAS5600 - NAS5606, NAS5700 - NAS5706, NAS5800 - NAS5806 and NAS7103 - NAS7116, NAS7203 - NAS 7216, NAS7400 - NAS7416, NAS7500 - NAS7516 and CSP 318.

Note 4. Reduced head fasteners: NAS4708 - NAS4716, NAS4805 - NAS4816, NAS4903 - NAS4916, NAS8602 - NAS8616 and NAS8702 - NAS8716.

5.2.10 On a sample basis, check at random (across the entire pattern) the number of holes specified in Table III for conformance to the hole limit requirements of the engineering drawing or Table I, as applicable, 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.

5.2.10.1 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 caliper, hole micrometer, etc.) to determine the minor and major diameters of the hole. The minor and major diameters of the hole shall 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 III - HOLE SIZE VERIFICATION SAMPLE REQUIREMENTS

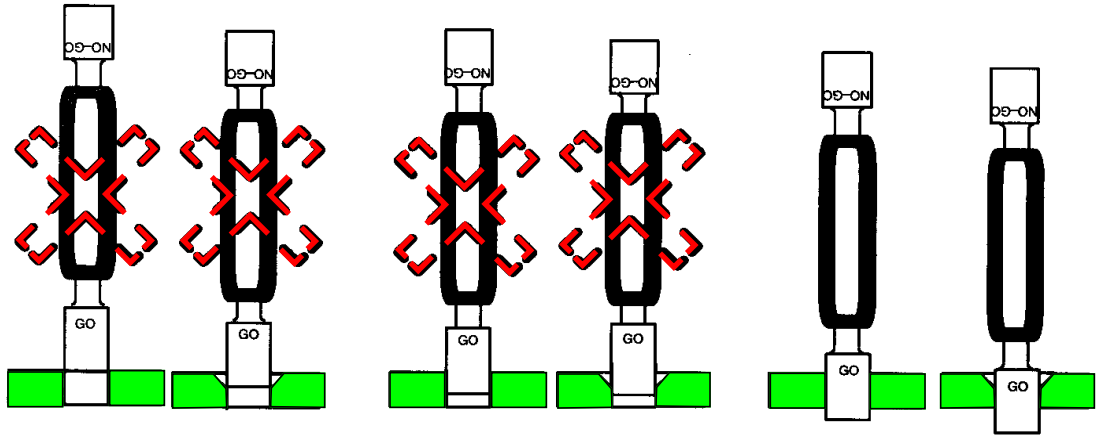
NUMBER OF HOLES IN PATTERN	REQUIRED SAMPLE SIZE
5 or less	all
6 - 50	5
51 - 90	7
91 - 150	11
151 - 280	13
281 - 500	16
more than 500	19

5.3 Use of GO/NO-GO Gauges

5.3.1 Check selected fastener holes for conformance to the requirements of the engineering drawing or Table I as applicable 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.

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

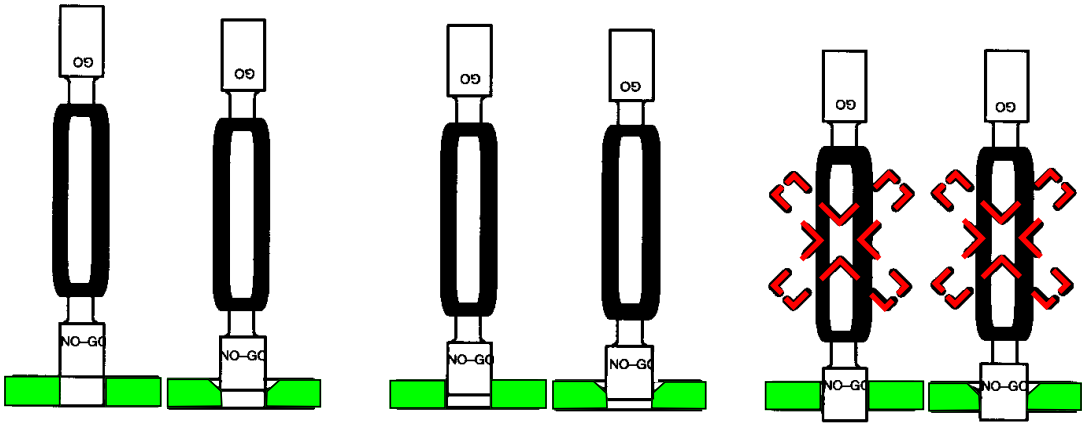


Does not go in.
UNDERSIZE HOLE

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 Preparation of Fasteners

5.4.1 Except as noted in paragraph 5.4.1.1 and paragraph 5.4.1.2, apply a coating of F13 Grade 2 corrosion preventive compound according to PPS 16.01 to the **shanks** of bolts used for the following applications. Take care to ensure that the compound does not come into contact with bearing races and moving parts.

- All externally used hex head and 12 point bolts.
- All internally used bolts which pass through major components (i.e., main frames, engine mounts, wing and tailplane attachment fittings, etc.).
- All bolts passing through roller bearings.

5.4.1.1 Do not apply corrosion preventive compound to bolt **shanks** which are to be sealed during assembly.

5.4.1.2 Lubricate bolt **shanks** which act as shafts in rotating joints with MIL-G-23827 grease or Aeroshell grease No. 7.

5.4.2 Do not add any form of lubricant (e.g., bee's wax, etc.) to fastener **threads**. If binding of a screw or bolt is encountered during installation, replace the fastener; if the problem persists, contact MRB for a disposition.

5.5 Bolt Head Location

5.5.1 If fastener installation as shown on the engineering drawing is not possible, refer to MRB for a disposition.

5.5.2 If the engineering drawing does not specify the fastener head and nut locations in relation to the assembly, install the head up or forward, as applicable.

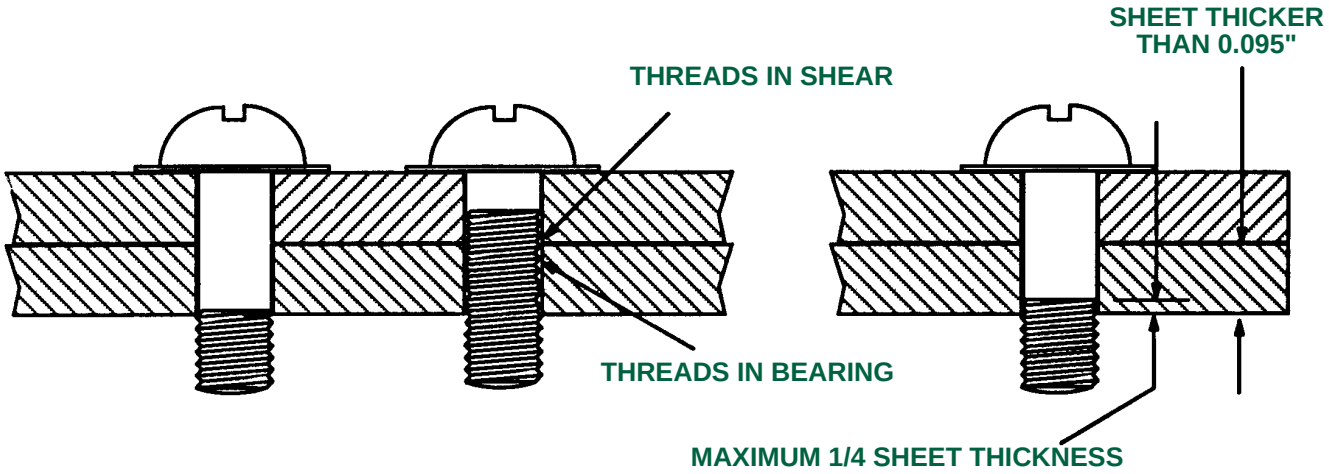
5.6 Shank Length

5.6.1 In general, it is **not** acceptable for fasteners to have threads in bearing or shear (see Figure 3-A). However, for fasteners used for structural purposes other than primary structure, it is acceptable to have a maximum of two threads in bearing, provided that the sheet thickness is greater than 0.095" and the threads in bearing do not exceed 1/4 of the sheet thickness (see Figure 3-B).

5.6.2 Except as noted below, fasteners of the same specification having a grip length **1/8"** longer or shorter than the fastener called out on the engineering drawing may be used to ensure that the grip length requirements are met. Many fasteners have grip lengths in increments of 1/16" and therefore, in those cases, a fastener of the same specification up to **2** sizes longer or shorter may be used, if necessary.

- If a specific bolt length is called out in an attach pattern of bolts (as used on doors, accessories, removable panels and equipment items) MRB written authorization (e.g., via fastpath RNC) is required to change the bolt grip length.
- If a specific bolt length is called out by a drawing note, MRB written authorization (e.g., via fastpath RNC) is required to change the bolt grip length.
- For bolts to be fastened into a closed receptacle (e.g., barrel nuts, capped nuts, heli-coils, tapped holes) in which visual verification of bolt protrusion through the nut or thread engagement is not possible, MRB written authorization (e.g., via fastpath RNC) is required to change the bolt grip length.

5.6.3 If required, washers under the fastener head may be replaced with thinner washers according to section 5.7.



ACCEPTABLE **NOT ACCEPTABLE**

ACCEPTABLE
(only on structure other than primary over 0.095" thick)

Figure 3-A **Figure 3-B**

FIGURE 3 - THREADS IN BEARING AND SHEAR

5.7 Use of Washers

5.7.1 Except as noted below, thinner washers or additional washers may be used as necessary provided all other requirements of this standard are met. If thinner washers or additional washers are required, use washers of the same type, diameter, material and finish as those specified on the engineering drawing.

- MRB written approval (e.g., via fastpath RNC) is required to change washers used on assemblies with Preload Indicating (PLI) washers or electrical bonding jumper installations.
- It is not acceptable to use other washers in contact with sealing washers such as Dyna-Seal (DSC 31), Lock-O-Seal or NAS 1598.
- Unless otherwise specified by the engineering drawing, for primary structure the minimum acceptable washer thickness is 0.032".
- If a torque value is specified for a fastener, use of a thinner washer is not acceptable.

5.7.2 Washers totalling an additional thickness of 0.062" may be added. Use the minimum number of washers needed to make the required thickness. NAS1149 washers are available, depending on size, in a variety of thicknesses (e.g., 0.016", 0.032", etc.). MS20002 and MS20002C (countersunk) washers are only available in 0.062" thickness.

5.7.3 Use MS20002C washers under protruding fastener heads to accommodate the bolt head fillet radius. Use plain type (MS20002) washers between MS20002C washers and the part surface, or washers added under the nut.

5.7.4 Always place the washer beneath the nut or fastener head, whichever is to be rotated for tightening.

5.7.5 Use an NAS1149 washer between any lockwasher and the surface of the work.

5.7.6 If the specified fastener length is deemed to be incorrect for a particular assembly, refer to MRB for corrective action.

5.8 Use of Self-Locking Nuts

5.8.1 **DO NOT** use non-castellated self-locking nuts having plastic or fibre inserts on bolts or screws with cotter pinning holes in the threaded portion.

5.8.2 **DO NOT** tap self-locking nuts.

5.8.3 If it is necessary to remove a self-locking nut after installation, the self-locking nut shall be replaced. It is not acceptable to re-use self locking nuts as the self-locking feature will be degraded by removal.

5.9 Starting, Tightening and Torquing

5.9.1 Start all fasteners by hand. Discard bolts, screws and nuts with imperfect threads. If binding of a screw or bolt is encountered during installation, replace the fastener; if the problem persists, refer to MRB for disposition. **DO NOT** add any form of lubricant (e.g., bee's wax, etc.) to fastener **threads**.

5.9.2 The threads of self-locking nuts should only allow the engagement of bolts or screws by hand up to the self-locking device. Discard nuts which permit bolts or screws to pass through the self-locking portion by hand tightening.

5.9.3 When tightening a nut and bolt combination, if possible run down the nut on the bolt (i.e., do not tighten the bolt while holding the nut). If required, it is acceptable use a wrench on the head of the fastener to prevent it from turning during tightening. For circumstances where it is not possible to run down the nut on the bolt (e.g., anchor nuts), it is acceptable to tighten the bolt.

5.9.4 Tighten fastener assemblies with Preload Indicating (PLI) washers according to PPS 14.04.

5.9.5 If a torque value is specified on the engineering drawing or Engineering Order (EO), carry out torquing to the value specified according to PPS 14.01.

5.9.6 Except as noted in paragraph 5.9.6.1, if a torque value is **not** specified by the engineering drawing or EO, use a suitable wrench to tighten the fastener until the fastener head and the base of the nut rest against the parts being tightened and resistance increases sharply, then tighten a further 1/4 turn. Alternatively, if a torque value is **not** specified by the engineering drawing or EO, it is also acceptable to use a torque wrench set to the value specified in Table V to install the fastener (refer to Table IV for the torque code) according to PPS 14.01. If a torque value is not specified by the engineering drawing or EO, identification of torqued fasteners with tamper proof sealant is not required.

5.9.6.1 For MS3320 circuit breakers, torque the attachment screws to the torque values specified in PPS 9.04 according to PPS 14.01.

5.9.7 Tighten faying surface sealed parts at least twice within the assembly life of the sealant, allowing a minimum time of 5 minutes between tightening operations.

5.9.8 Ensure that fastener threads do not bottom in blind tapped holes and that nuts do not bottom on the shank of the fastener. Add additional washers according to section 5.7, if necessary.

5.9.9 When using screwdrivers, refer to PPS 13.06 for instructions on their proper use.

TABLE IV - TORQUE CODE DETERMINATION

BOLTS OR SCREWS	TORQUE CODE
AN525	F
BACB30US	A
BACB30UU	D
MS20004	C
MS21250	B
MS24693	F
MS24694	F
MS35206	F
MS35207	F
MS51957	F
MS51958	F
NAS517	F
NAS1801	F
NAS1802	F
NAS1953 - NAS1970	D
NAS6203 - NAS6220	D
NAS6303 - NAS6320	D
NAS6603 - NAS6620	C
NAS6703 - NAS6720	C
NAS7402 - NAS7416	D
NAS7502 - NAS7516	D
NAS7702 - NAS7706	D
NAS7802 - NAS7806	D
NAS8602 - NAS8616	E
NAS8702 - NAS8716	E

NUTS	TORQUE CODE
Anchor Nuts, All	C
B0203010	C
B0203011	D
B02040XX Standoffs	C
B0204033	C
B0203025	A
DSC97	B
DSC203	C
B0203072	A
B0203073	A
Gang Channels, All	C
Helicoils	C
MS14144	C
MS14145	D
MS21042	C
MS21043	C
MS21225	C
NAS577	B
NAS679	C
NAS1291	C
NAS1727	C
NAS1804	B

TABLE V - TORQUING OF FASTENERS

THREAD SIZE \ TORQUE CODE	TORQUE (IN-LBS)					
	A	B	C	D	E	F
0.0860 (#2-56)	---	---	3.4 - 4.5	2.5 - 4.5	---	---
0.1120 (#4-40)	---	---	6 - 8	6 - 8	---	---
0.1380 (#6-32)	---	---	12 - 15	12 - 15	---	---
0.1640 (#8-32)	---	---	15 - 20	15 - 17	10 - 18	---
0.1900 (#10-32)	70 - 100	30 - 35	25 - 35	18 - 25	18 - 25	10 - 16
0.2500 (1/4-28)	90 - 125	65 - 100	50 - 80	30 - 50	30 - 40	15 - 21
0.3125 (5/16-24)	180 - 250	130 - 200	100 - 150	60 - 95	60 - 70	30 - 36
0.3750 (3/8-24)	300 - 500	220 - 410	160 -240	95 - 160	95 - 105	40 - 46
0.4375 (7/16-20)	510 - 840	370 - 690	250 - 350	220 - 280	150 - 170	60 - 70
0.5000 (1/2-20)	870 - 1300	630 - 1070	480 - 790	290 - 510	220 - 245	75 - 85
0.5625 (9/16-18)	1300 - 1800	1000 - 1470	800 - 1150	480 - 850	290 - 325	85 - 95
0.6250 (5/8-18)	1900 - 2300	1400 - 1900	1100 - 1500	660 - 980	395 - 435	96 - 106
0.7500 (3/4-16)	3300 - 4300	2400 - 3500	2300 - 3000	1300 - 2000	645 - 720	150 -165

Note 1. Refer to Table IV for the torque code for each particular nut. When the nut and bolt have a different torque code, torque to the lower torque (e.g., if the bolt is a torque code A and the nut is a torque code B, use torque code B).
Note 2. The torque values specified herein are not applicable if the engineering drawing or EO specifies a different torque value.

5.10 Safetying

5.10.1 If specified on the engineering drawing, carry out safetying of bolts, screws or nuts according to PPS 19.01.

5.11 Enlarged Holes, Dimples or Countersinks

5.11.1 Only if authorized in writing by an MRB disposition, use Acres sleeves to salvage parts with oversize holes.

5.11.2 MRB written approval is required if the use of the next size fastener becomes necessary in order to salvage parts with oversize holes, countersinks or dimples.

5.12 Sealing

5.12.1 If sealing of fasteners is specified on the engineering drawing, carry out sealing according to PPS 21.21, using the sealant specified on the engineering drawing.

5.13 Re-Use of Bolts and Screws

5.13.1 Bolts and screws which have been removed in conjunction with rework and/or repair activities can be re-used as long as there is no damage/deformation of the recess, shank, threads or finish.

6 REQUIREMENTS

6.1 A small gap (sheet separation) of 0.001" to 0.010" shall exist between sheets if a dimpled sheet nests in another dimple or in a countersink (see Figure 4).

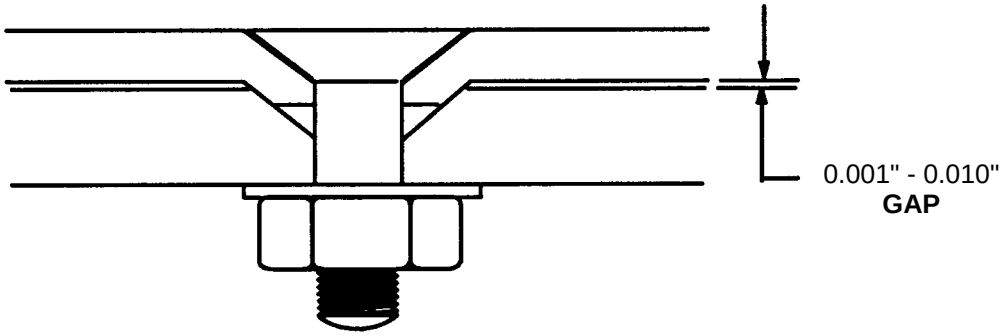


FIGURE 4 - DIMPLED SHEET SEPARATION

6.2 The threaded end of the fastener shall protrude beyond the nut a minimum of the full round or chamfer. In the case of flat end fasteners, the threaded end shall protrude a minimum of 1/32" or 1 1/2 threads (see Figure 5).

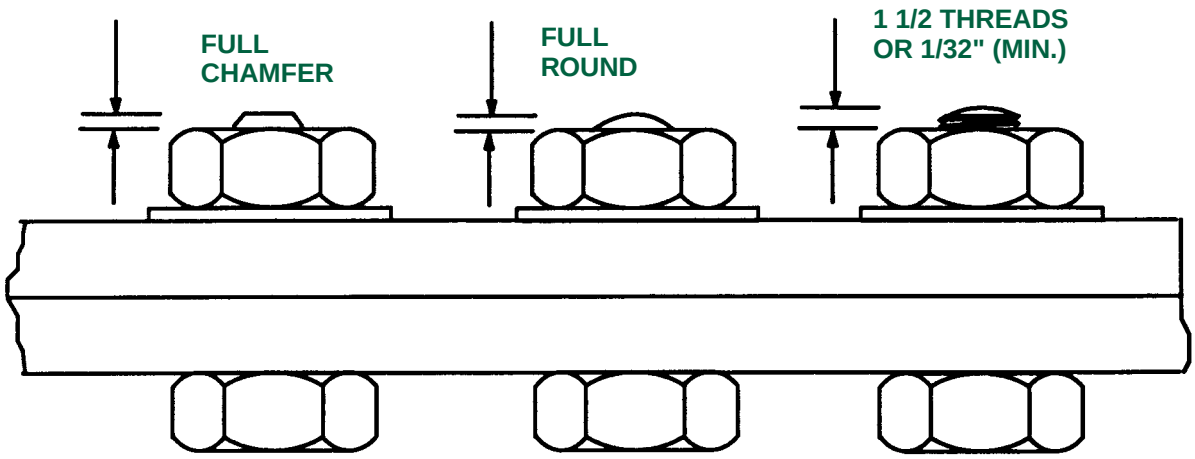


FIGURE 5 - REQUIRED BOLT PROTRUSION THROUGH NUT

6.3 In general, installed flush head fastener heads shall be within ± 0.010" of flush with the surrounding material surface (see Figure 6). If projecting fastener heads could interfere with adjacent moving parts, the heads shall be flush to 0.010" below the surface. If the engineering drawing specifies a required countersink diameter, refer to Liaison Engineering for disposition if the fastener head is not within ± 0.010" of flush.

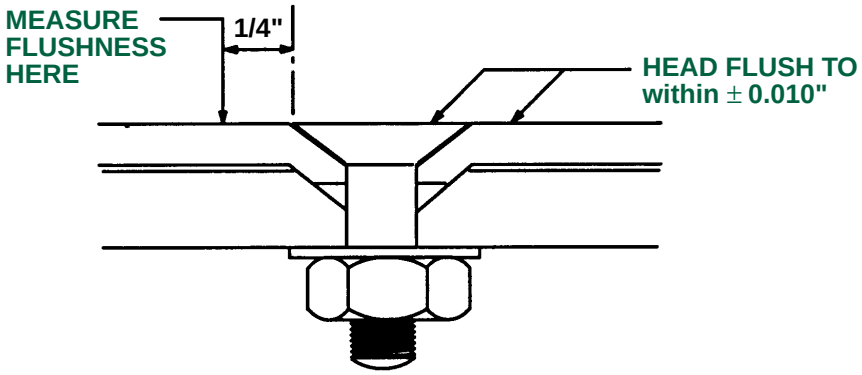
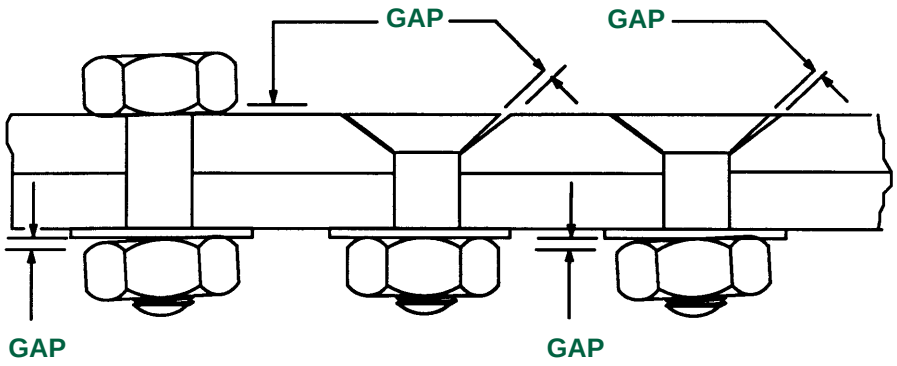


FIGURE 6 - MEASUREMENT OF HEAD FLUSHNESS

6.4 In general, a gap under one side of the fastener head or nut, as shown in Figure 7, is acceptable if the applicable feeler gauge does not touch the shank of the fastener. However, if the engineering drawing specifies torquing according to PPS 14.01, or if Preload Indicating (PLI) washers are used, no gap is permissible under the fastener head or nut.



MAXIMUM ACCEPTABLE GAP (NOTE 1)	0.004" for fastener sizes up to 5/16"
	0.006" for fastener sizes 3/8" to 9/16"
	0.008" for fastener sizes 5/8" and greater
Note 1 - There shall be no gap if torquing according to PPS 14.01 is specified or PLI washers are used.	

FIGURE 7 - GAPS UNDER HEAD OF BOLT AND NUT

7 BOMBARDIER TORONTO SAFETY PRECAUTIONS

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

7.2 Observe standard plant safety precautions when performing the procedure specified herein.

7.3 Avoid ingestion of any primers, lubricants or sealants specified herein. Wash hands before eating or smoking after handling primers, lubricants, sealants or sealed assemblies. If ingestion has occurred, obtain medical attention immediately.

7.4 Refer to the specified PPS's for any additional safety precautions.

8 PERSONNEL REQUIREMENTS

8.1 Personnel responsible for installation of bolts and screws shall have a good working knowledge of the applicable procedure and requirements as specified herein and shall have exhibited their competency to their supervisor.