1.0 APPLICABILITY

1.1 This standard lists the standard hardware to be used to accomplish Indirect Electrical Bonding using bonding jumpers and straps in accordance with the design requirements of the applicable Engineering Standard Practice.

1.2 Design Standard 42 defines bonding and grounding hardware configurations for DHC-6 and previous aircraft designs.

2.0 DEFINITIONS

2.1 **Grounding** - The process of providing an electrical circuit return path to primary structure. Also the process of providing an electrical connection from the structure or airframe to earth.

2.2 **Electrical Bonding -** The process of electrically connecting two or more conductive objects so that a low resistance path exists between the various conducting surfaces and components.

2.2.1. A **Direct Bond** is formed when two structural members are electrically connected without the use of an auxiliary connector. The bond may be accomplished by the use of metal flow processes such as welding and soldering or, for accessibility and manufacturing reasons, by the application of clamping force to a structural joint by fasteners such as bolts or rivets.

2.2.2. **Indirect Bonding** is accomplished by means of bonding straps or jumpers where it is not possible to create a direct bond due to the distance between mating surfaces, or across a hinged joint.

2.2.3. **Static Bond** - A bond between an otherwise isolated conductive object and the primary structure to prevent accumulation of electrostatic charges caused by gases or fluids in motion.

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SEE ENGINEERING STANDARDS APPROVAL RECORD FOR ORIGINAL SIGNATURES AND CHANGE SUMMARY

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CHECKED	P. LAM
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APPROVED	B. EDWARDS

ELECTRICAL BONDING AND GROUNDING HARDWARE

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3.0 DESIGN REQUIREMENTS

3.1 Methods and Hardware

3.1.1. Refer to Tables 2 to 6 for general arrangement of standard bonding and grounding assembly methods and hardware configurations for various design applications and structural material combinations.

(C) 3.1.2. Tables 2 to 6 define the basic hardware number and, where applicable, the material dash number code. Tables 7 to 10 refer to power feeder lug terminations. Refer to Tables 12 and 13 and DHI Permitted Parts Catalog (specific to the aircraft program the parts are to be used on) for complete part number breakdown of applicable diameter, grip length, etc., as required for the specific design application.

3.1.3. Lockwashers are used under the self-locking attachment nut for **Electrical Grounding** applications, to provide a constant preload on the terminal lug to ensure electrical conductivity, i.e. lockwasher is **not** required for **Electrical Bonding** applications.

3.2 Drawing

3.2.1. Each drawing shall show the following information:

- Schematic of the assembly configuration
- Itemized listing of all hardware comprising the assembly
- Bolt hole size for Type 2 and Type 3 Bonding Methods (ref. Tables 3 and 4) as per Table 1
- Drawing notes as shown in the Design Notes column in the applicable table.

3.3 Torquing of Bonding/Grounding Hardware

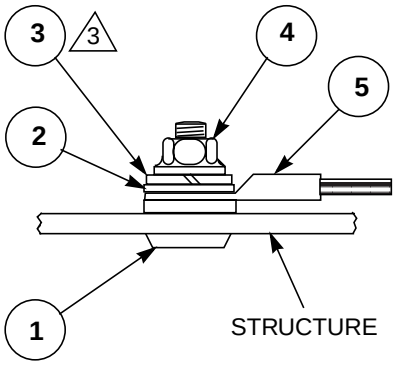
3.3.1. Refer to Table 1 for a listing of applicable torque range values to be used for tightening grounding hardware; bolts, jam nuts and securing nuts as specified herein. NOTE - Torquing is **not** required for electrical bonding applications.

Table 1: BOLT- HOLE SIZES AND TORQUE VALUES

BOLT SIZE	HOLE SIZE	TOLERANCE	TORQUE RANGE
#8	.172	± .003	15 - 20 lb/in
#10	.198		25 - 30 lb/in
1/4	.259		40 - 45 lb/in
5/16	.325		80 - 85 lb/in
3/8	.388		110 - 125 lb/in

(C) PARAGRAPH 3.1.2 REVISED

Table 2: BLIND TERMINAL STUD - TYPE 1

GENERAL ARRANGEMENT	DESIGN NOTES	LIMITATIONS
TERMINAL STUD ASSY  	PREFERRED TYPE FOR GENERAL PURPOSE BONDING AND GROUNDING NOT RECOMMENDED FOR USE WHERE BLIND SIDE OF STUD IS INACCESSIBLE IN SERVICE. REFER TO PPS 2.08 FOR STUD HOLE SIZE **DRAWING NOTES:** > "INSTALL TO PPS 2.08" > "TORQUE NUT (*TORQUE RANGE AS PER TABLE 1*) TO PPS 14.01 - TORQUE INSPECTION NOT REQUIRED" **SEE NOTE 4**	ONLY FOR USE ON ALUMINUM STRUCTURE. STANDARD STUD SIZE = #10 ENGINEERING STANDARDS APPROVAL REQUIRED FOR OTHER SIZES. RESTRICTED TO INTERIOR APPLICATIONS - USE "BOLT/JAM NUT/LOCKNUT ASSY" AS PER TABLE 4 FOR EXTERIOR APPLICATIONS GRIP RANGE - 0.032" - 0.156" **NOTE:** ENGINEERING STANDARDS APPROVAL REQUIRED FOR APPLICATION IN MATERIAL LESS THAN **0.040"** THICKNESS.

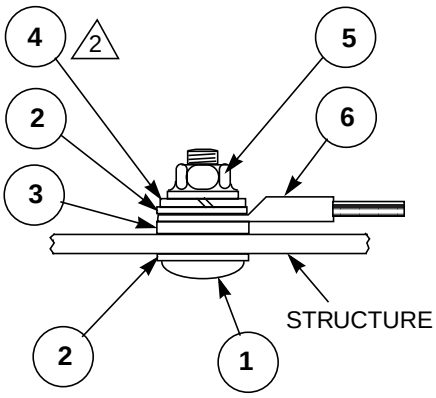
ITEM NO.	DESCRIPTION	STRUCTURE MATERIAL/HARDWARE (NOTE 2)		
		ALUMINUM	STAINLESS STEEL	TITANIUM
1	BLIND TYPE TERMINAL STUD	VNS 192 (NOTE 1)	N/A	N/A
2	LIGHT WASHER - SEE TABLE 7 FOR CODE NO.	NAS1149D(CODE)J		
3	LOCKWASHER - SEE TABLE 7 FOR COMPLETE PART NO.	MS35338-( )		
4	SELF-LOCKING NUT - SEE TABLE 8 FOR COMPLETE PART NO.	MS 21042L( )		
5	BONDING JUMPER	MS 25083-( )		

NOTES:
1. REFER TO PPS 2.08 FOR COMPLETE PART NUMBER BREAKDOWN OF THE TERMINAL STUD.
2. REFER TO THE DHI PERMITTED PARTS CATALOG (PPC) FOR COMPLETE PART NUMBER BREAKDOWN FOR STANDARD HARDWARE.
3. LOCKWASHER NOT REQUIRED FOR ELECTRICAL BONDING APPLICATIONS.
4. TORQUING NOTE NOT REQUIRED FOR ELECTRICAL BONDING APPLICATIONS.

SEE ENGINEERING STANDARDS APPROVAL RECORD FOR ORIGINAL SIGNATURES AND CHANGE SUMMARY

DRAWN	B. EDWARDS	**ELECTRICAL BONDING AND GROUNDING HARDWARE**	**DS 127**
CHECKED	P. LAM		
STRESSED	E. CROMIE		SHEET: 3 OF 11
APPROVED	B. EDWARDS		

Table 3: BOLT/LOCKNUT STUD ASSEMBLY - TYPE 2

GENERAL ARRANGEMENT	DESIGN NOTES	LIMITATIONS
BOLT/LOCKNUT STUD ASSY  	STANDARD CONFIGURATION FOR - ELECTRICAL BONDING, STATIC GROUNDS, POWER RETURN GROUNDS, ETC., WHERE NO RELATIVE MOTION BETWEEN INTER-CONNECTED ASSEMBLIES. REFER TO TABLE 1 FOR BOLT HOLE SIZES AND TOLERANCES. **DRAWING NOTES:** > "BOND TO PPS 9.06" > "TORQUE NUT TO (*TORQUE RANGE AS PER TABLE 1*) TO PPS 14.01 - TORQUE INSPECTION NOT REQUIRED" **SEE NOTE 3**.	CLEAR ACCESS TO BOTH SIDES OF STRUCTURE REQUIRED DURING ASSEMBLY AND IN SERVICE. RESTRICTED TO INTERIOR APPLICATIONS - USE "BOLT/JAM NUT/LOCKNUT ASSY" AS PER TABLE 4FOR EXTERIOR APPLICATIONS.

ITEM NO.	DESCRIPTION	STRUCTURE MATERIAL/HARDWARE (NOTE 1)		
		ALUMINUM	STAINLESS STEEL	TITANIUM
1	SCREW - PAN HEAD CROSS RECESS - #2 - #8 UNC THRD	MS 35206-( )	MS 35206-( )	MS 51957-( )
	SCREW - PAN HEAD CROSS RECESS - #10 - 3/8" UNF THRD	MS 35207-( )	MS 35207-( )	MS 51958-( )
Ⓒ	SCREW- HEX HEAD CRUCIFORM RECESS	NAS1801-( )	NAS1801-( )	
2	LIGHT WASHER - SEE TABLE 10 FOR NAS1149 CODE NO.	NAS1149D(CODE)J	NAS1149F(CODE)P	NAS1149C(CODE)R
3	STANDARD WASHER - SEE TABLE 10 FOR NAS1149 CODE NO.	NAS1149D(CODE)J	NAS1149F(CODE)P	NAS1149C(CODE)R
4	LOCKWASHER - SEE TABLE 10 FOR COMPLETE PART NO.	MS35338-( )	MS35338-( )	MS35338-( )
5	SELF-LOCKING NUT- SEE TABLE 11 FOR COMPLETE PART NO.	MS 21042L( )	MS 21042L( )	MS 21042L( )
6	BONDING JUMPER	MS 25083-( )	MS 25083-( )	MS 25083-( )

NOTES:
1. REFER TO THE DHI PERMITTED PARTS CATALOG (PPC) FOR COMPLETE PART NUMBER BREAKDOWN FOR STANDARD HARDWARE.
2. LOCKWASHER NOT REQUIRED FOR ELECTRICAL BONDING APPLICAIONS.
3. TORQUING NOTE NOT REQUIRED FOR ELECTRICAL BONDING APPLICATIONS

Ⓒ ADDED NAS1801 SCREW

SEE ENGINEERING STANDARDS APPROVAL RECORD FOR ORIGINAL SIGNATURES AND CHANGE SUMMARY

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CHECKED	P. LAM
STRESSED	E. CROMIE
APPROVED	B. EDWARDS

ELECTRICAL BONDING AND GROUNDING HARDWARE

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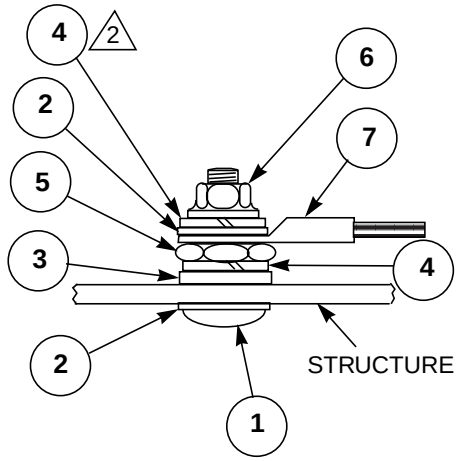
Table 4: BOLT/JAM NUT/LOCKNUT TERMINAL STUD ASSEMBLY - TYPE 3

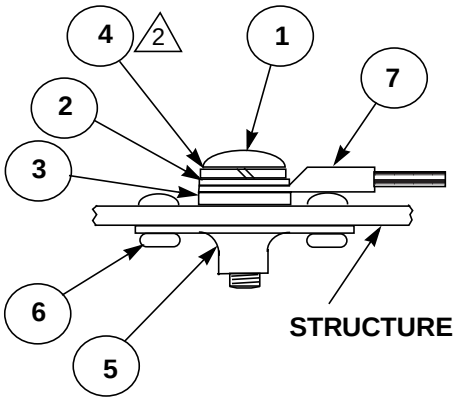
GENERAL ARRANGEMENT	DESIGN NOTES	LIMITATIONS
BOLT/JAM NUT/LOCKNUT TERMINAL STUD ASSY  	STANDARD CONFIGURATION FOR - ELECTRICAL BONDING, STATIC GROUNDS, POWER RETURN GROUNDS, ETC., WHERE RELATIVE MOTION EXISTS BETWEEN INTERCONNECTED ASSEMBLIES AND FOR EXTERIOR APPLICATIONS. REFER TO TABLE 1 FOR BOLT HOLE SIZES AND TOLERANCES. **DRAWING NOTES:** > "BOND TO PPS 9.06" > "TORQUE JAM NUT AND LOCKNUT TO (*TORQUE RANGE AS PER TABLE 1*) TO PPS 14.01 - TORQUE INSPECTION NOT REQUIRED" **SEE NOTE 3.** > "TOUCH UP BOND POINTS WITH F24" - **ONLY WHERE NECESSARY** > "POT WITH DHMS S3.01/B2 SEALANT AS PER PPS 9.06" **FOR EXTERIOR ASSEMBLIES EXPOSED TO WEATHER**	CLEAR ACCESS TO BOTH SIDES OF STRUCTURE REQUIRED DURING ASSEMBLY AND IN SERVICE

ITEM NO.	DESCRIPTION	STRUCTURE MATERIAL/HARDWARE (NOTE 1)		
		ALUMINUM	STAINLESS STEEL	TITANIUM
1	SCREW - PAN HEAD CROSS RECESS - #2 - #8 UNC THREAD	MS 35206- ( )	MS 35206- ( )	MS 51957- ( )
	SCREW - PAN HEAD CROSS RECESS - #10 - 3/8" UNF THREAD	MS 35207- ( )	MS 35207- ( )	MS 51958- ( )
C	SCREW - HEX HEAD CRUCIFORM RECESS	NAS1801-( )	NAS1801-( )	
2	LIGHT WASHER - SEE TABLE 10 FOR NAS1149 CODE NO.	NAS1149D(CODE)J	NAS1149F(CODE)P	NAS1149C(CODE)R
3	STANDARD WASHER - SEE TABLE 10 FOR NAS1149 CODE NO.	NAS1149D(CODE)J	NAS1149F(CODE)P	NAS1149C(CODE)R
4	LOCKWASHER - SEE TABLE 10 FOR COMPLETE PART NO.	MS35338-( )	MS35338-( )	MS35338-( )
5	JAM NUT - SEE TABLE 11 FOR COMPLETE PART NO.	MS 35650-( )	MS 35650-( )	MS 35650-( )
6	SELF-LOCKING NUT - SEE TABLE 11 FOR COMPLETE PART NO.	MS 21042L( )	MS 21042L( )	MS 21042L( )
7	BONDING JUMPER	MS 25083-( )	MS 25083-( )	MS 25083-( )

NOTES:
1. REFER TO THE DHI PERMITTED PARTS CATALOG (PPC) FOR COMPLETE PART NUMBER BREAKDOWN FOR STANDARD HARDWARE.
2. LOCKWASHER NOT REQUIRED UNDER SELF-LOCKING NUT FOR ELECTRICAL BONDING APPLICATIONS.
3. TORQUING NOTE NOT REQUIRED FOR ELECTRICAL BONDING APPLICATIONS.

C ADDED NAS1801 SCREW

Table 5: BOLT/NUTPLATE ASSEMBLY - TYPE 4

GENERAL ARRANGEMENT	DESIGN NOTES	LIMITATIONS
BOLT/NUTPLATE ASSY  	STANDARD CONFIGURATION FOR - ELECTRICAL BONDING, STATIC GROUNDS, POWER RETURN GROUNDS, ETC., WHERE BACK SIDE OF STRUCTURE IS INACCESSIBLE IN SERVICE. REFER TO PPS 2.17 FOR BOLT HOLE SIZE - STANDARD HOLE - NON-FLOATING ANCHOR NUT. **DRAWING NOTES:** > "INSTALL ANCHOR NUT - PPS 2.17" > "BOND TO PPS 9.06" > "TORQUE BOLT TO (*TORQUE RANGE AS PER TABLE 1)* TO PPS 14.01 - TORQUE INSPECTION NOT REQUIRED" **SEE NOTE 3.**	RESTRICTED TO INTERIOR APPLICATIONS

ITEM NO.	DESCRIPTION	STRUCTURE MATERIAL/HARDWARE (NOTE 1)		
		ALUMINUM	STAINLESS STEEL	TITANIUM
1	BOLT - PAN HEAD, CROSS RECESS - #2 - #8 UNC THRD	MS 35206-( )	MS 35206-( )	MS 51957-( )
	BOLT - PAN HEAD, CROSS RECESS - #10 - 3/8" UNF THRD	MS 35207-( )	MS 35207-( )	MS 51958-( )
C	SCREW - HEX HEAD CRUCIFORM RECESS	NAS1801-( )	NAS1801-( )	
2	LIGHT WASHER - SEE TABLE 10 FOR NAS1149 CODE NO.	NAS1149D(CODE)J	NAS1149F(CODE)P	NAS1149C(CODE)R
3	STANDARD WASHER - SEE TABLE 10 FOR NAS1149 CODE NO.	NAS1149D(CODE)J	NAS1149F(CODE)P	NAS1149C(CODE)R
4	LOCKWASHER - SEE TABLE 10 FOR COMPLETE PART NO.	MS35338-( )	MS35338-( )	MS35338-( )
5	NUTPLATE - SELF-LOCKING, TWO LUG	MS 21047L( )	MS 21048-( )	MS21048-( )
6	NUTPLATE RIVET	B0205016AD( )( )	MS 20615-( )( )	MS 20615-( )( )
7	BONDING JUMPER	MS 25083-( )	MS 25083-( )	MS 25083-( )

NOTES:
1. REFER TO THE DHI PERMITTED PARTS CATALOG (PPC) FOR COMPLETE PART NUMBER BREAKDOWN FOR STANDARD HARDWARE.
2. LOCKWASHER NOT REQUIRED FOR ELECTRICAL BONDING APPLICATIONS.
3. TORQUING NOTE NOT REQUIRED FOR ELECTRICAL BONDING APPLICATIONS.

C ADDED NAS1801 SCREW

SEE ENGINEERING STANDARDS APPROVAL RECORD FOR ORIGINAL SIGNATURES AND CHANGE SUMMARY

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STRESSED	E. CROMIE
APPROVED	B. EDWARDS

ELECTRICAL BONDING AND GROUNDING HARDWARE

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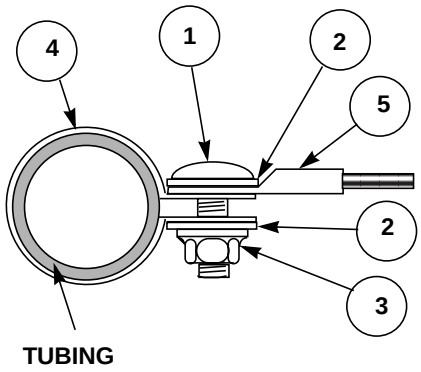
Table 6: BONDING TUBE ASSEMBLIES - TYPE 5

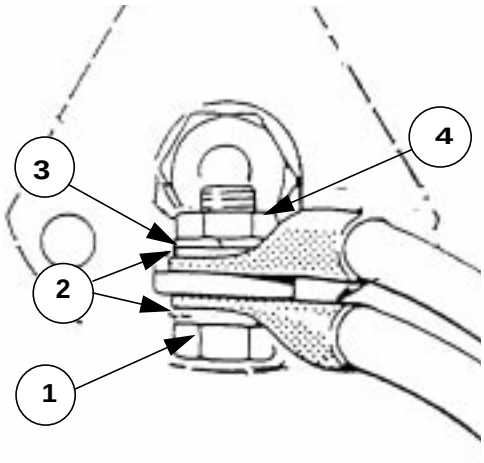
GENERAL ARRANGEMENT	DESIGN NOTES	LIMITATIONS
TUBE ASSY BONDING  	STANDARD CONFIGURATION FOR - ELECTRICAL BONDING FLUID LINE OR ELECTRICAL CONDUIT TUBING **DRAWING NOTES:** >"BOND TO PPS 9.06"	BONDING CLAMP USES #10 SIZE BOLT ONLY.

ITEM NO.	DESCRIPTION		STRUCTURE MATERIAL/HARDWARE (NOTE 1)		
			ALUMINUM	STAINLESS STEEL	TITANIUM
1	SCREW - PAN HEAD, CROSS RECESS - #10 UNF THRD		MS 35207-265	MS 35207-265	MS 35207-265
	SCREW - HEX HEAD CRUCIFORM RECESS		NAS1801-( )	NAS 1801-( )	
2	LIGHT WASHER	UP TO 15/16" TUBE DIA.	NAS 620A10L	NAS 620-10L	NAS620-10L
		1" & UP TUBE DIA.	NAS1149D0316J	NAS1149F0316P	NAS1149F0316P
3	SELF-LOCKING NUT		MS 21042L-3	MS 21042L-3	MS 21042L-3
4	LOOP TYPE BONDING CLAMP		AN 735D( )	AN 735C( )	AN 735C( )
5	BONDING JUMPER		MS 25083-( )	MS 25083-( )	MS 25083-( )

NOTES:
1. REFER TO THE DHI PERMITTED PARTS CATALOG (PPC) FOR COMPLETE PART NUMBER BREAKDOWN FOR STANDARD HARDWARE.

Table 7: POWER FEDDER LUG TERMINATION - TYPE 6

GENERAL ARRANGEMENT

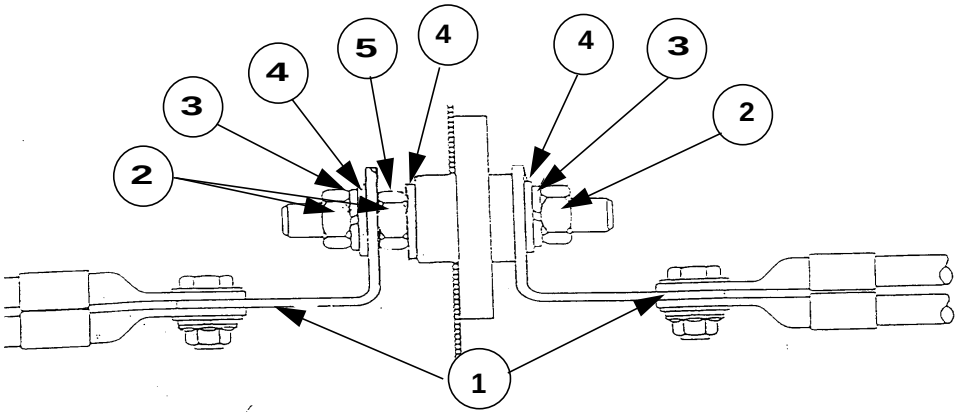


ITEM NO.	DESCRIPTION	STRUCTURE MATERIAL/HARDWARE		
		ALUMINUM	STAINLESS STEEL	TITANIUM
1	BOLT - ALLOY STEEL CAD PLATE	NAS6206-( )		
2	WASHER - CARBON STEEL CAD PLATE (2 REQD)	NAS1070-( )		
3	LOCKWASHER	MS35338-( )		
4	SELF LOCKING NUT	MS21042L( )		

NOTES:
1. REFER TO THE DHI PERMITTED PARTS CATALOG (PPC) FOR COMPLETE PART NUMBER BREAKDOWN FOR STANDARD HARDWARE.

Table 8: POWER FEEDER LUG TERMINATION - TYPE 7

GENERAL ARRANGEMENT

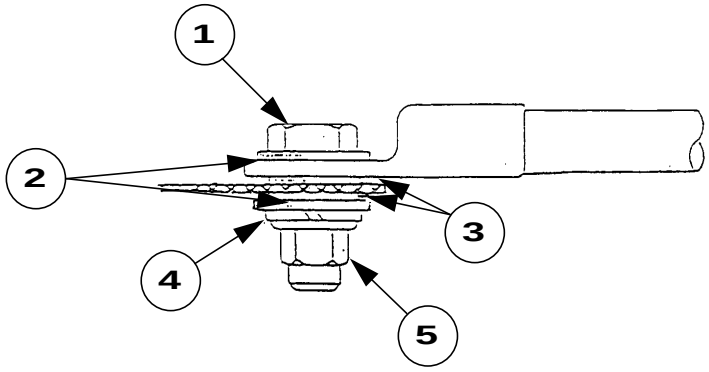


ITEM NO.	DESCRIPTION	STRUCTURE MATERIAL/HARDWARE		
		ALUMINUM	STAINLESS STEEL	TITANIUM
1	SEE TYPE 6 INSTALLATION			
2	NUT, STEEL, CAD PLATED	MS21042L( )		
3	LOCKWASHER	MS35338-( )		
4	WASHER)	NAS1070-( )		
5	NUT	MS35650-( )		

NOTES:
1. REFER TO THE DHI PERMITTED PARTS CATALOG (PPC) FOR COMPLETE PART NUMBER BREAKDOWN FOR STANDARD HARDWARE.

Table 9: POWER FEDDER LUG TERMINATIONS - TYPE 8

GENERAL ARRANGEMENT



ITEM NO.	DESCRIPTION	STRUCTURE MATERIAL/HARDWARE		
		ALUMINUM	STAINLESS STEEL	TITANIUM
1	BOLT, ALLOY STEEL CAD PLATED	NAS6206-( )		
2	WASHER, CARBON STEEL CAD PLATE	NAS1070-( )		
3	FLAT WASHER	CSP192-232		
4	LOCKWASHER)	MS35338-( )		
5	NUT	MS21042L( )		

NOTES:
1. REFER TO THE DHI PERMITTED PARTS CATALOG (PPC) FOR COMPLETE PART NUMBER BREAKDOWN FOR STANDARD HARDWARE.

4.0 REFERENCES

4.1 DHI - PPS 9.06 - Electrical Bonding and Grounding of Aircraft Structures

4.2 DHI - Engineering Standard Practice - ESP 84 - DHC-8 Series 400 EMI/HIRF/LIGHTNING Control Plan

4.3 SAE - Aerospace Recommended Practice - ARP 1870 - Aerospace Systems Electrical Bonding and Grounding for Electromagnetic Compatibility and Safety

STUD BOLT SIZE	LIGHT WASHER.		STANDARD WASHER		LOCKWASHER	
	THICKNESS	NAS1149 CODE No	THICKNESS	NAS1149 CODE No	THICKNESS	MS35338 PART NO.
No. 8	.032	N832	.032	N832	.040	MS35338-42
No. 10	.016	0316	.063	0363	.047	MS35338-43
1/4	.032	0432		0463	.062	MS35338-44
5/16		0532		0563	.078	MS35338-45
3/8		0632		0663	.094	MS35338-46

Table 10: WASHER SIZE CODE/PART NUMBERS

STUD BOLT SIZE	SELF-LOCKING NUT	JAM NUT
No. 8	MS21042L08	MS35650-382
No. 10	MS21042L3	MS35650-302
1/4	MS21042L4	MS35650-3252
5/16	MS21042L5	MS35650-3312
3/8	MS21042L6	MS35650-3382

Table 11: SELF-LOCKING & JAM NUT PART NUMBERS