

**Material and Performance Requirements of Aluminum and Steel Bodied Open and Closed End Blind Rivets****FOREWORD:**

During the November 2005 update, revisions were made to WG 101, WG 102 and WG 103. These standards specified a 3 micrometre zinc finish on the mandrels. Although only zinc was specified, Suppliers of these products were typically applying a Hexavalent chromate treatment. The use of Hexavalent chromate treatments is prohibited in accordance with the Restricted Substance Management Standard, WSS-M99P9999-A1. In order to recognize industry practice the standards were revised to permit subsequent treatments (passivates, lubricants etc.).

Apart from the inclusion of this Foreword, the only change to WG 950 was to include a statement "Mandrels are exempt from the electroplating restriction of WSS-M99A3-A." Some mandrels do exceed the 390HV threshold, however this has never given rise to an embrittlement issue.

During the April 2006 update section 3.4 was revised to allow uncoated mandrels for aluminum closed end rivets.

1. **SCOPE:** This standard covers the material, shear strength, tensile strength, mandrel breakload and mandrel retention requirements of aluminum and steel bodied open and closed end blind rivets in nominal diameters 2.4, 3.2, 4.0, 4.8, and 6.4.

1.1 REFERENCES:

ISO 468	Surface roughness
SAE J492	Rivets and riveting
SAE J454 5056	General data on wrought aluminum alloys
WSD-M1A283-B2,B3,B4,B5,B6,B47,B48,B49,B53,B57	Steel, cross reference for standard parts

2. **GENERAL:** The various rivet types, their body/mandrel and other design feature combinations are shown in Table 1.

The load to disassemble the mandrel from the body before the product has been assembled in a panel shall not be less than 10N for all types of rivet and mandrel combinations. After assembly, as described in Figure 4 the push-out load for the retained section of mandrel must not be less than 20N for all types of rivet and mandrel combination.

3. **MATERIAL:** The material for the bodies and mandrels of blind rivets is shown below.

3.1 Aluminum (Al) bodies shall be manufactured from Aluminum Alloy SAE J1086 UNS A95052, A95056A, A95154A, A95251 or A95754.

3.2 The material for mild steel (MS) bodies shall be in accordance with WSD-M1A283-B3/B4/B5/B6/B47/B48/B49/B53 or B57.

3.3 Stainless steel (SS) bodies shall be manufactured from Austenitic stainless steel - 300 series.

3.4 The material for carbon steel (CS) mandrels shall be any low carbon steel that meets the requirements of Clause 6. The mandrel shall be zinc coated for open end rivets and steel closed end rivets, and uncoated for aluminum closed end rivets.

3.5 Stainless steel (SS) mandrels shall be manufactured from Austenitic stainless steel 300 series for open end rivets or 400 series for closed end rivets.

4. **SHEAR STRENGTH:** The shear strengths for the various body/mandrel and design feature combinations covered by this standard shall be in accordance with Table 2 when tested using a test plate as described in Figure 1.

5. **TENSILE STRENGTH:** The tensile strengths for the various body/mandrel and design feature combinations covered by this standard shall be in accordance with Table 2 when tested using a test plate as described in Figure 2.



6. **MANDREL BREAKLOAD:** The mandrel breakloads for the various body/mandrel and design feature combinations covered by this standard shall be in accordance with Table 3 when tested using a test rig as described in Figure 3. Mandrels are exempt from the electroplating restriction of WSS-M99A3-A.
7. **TEST PLATE:** The test plates shall be steel hardened and tempered to 530HV min. The surface roughness of mating faces shall be in the range N2 to N5 when tested in accordance with ISO 468.

Table 1 - Rivet types

Design Feature	Rivet Type															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Domed Head	*		*		*		*		*		*		*		*	
Countersunk Head		*		*		*		*		*		*		*		*
Open End	*	*			*	*			*	*			*	*		
Closed End			*	*			*	*			*	*			*	*
Body Material ¹⁾	A	Al	Al	Al	M	M	M	M	Al	Al	Al	Al	SS	SS	SS	SS
Mandrel Material ¹⁾	C	C	C	C	C	C	C	C	SS	SS	SS	SS	SS	SS	SS	SS

- 1) For material coding details (i.e. Al, CS, MS and SS) See Clause 3.

Table 2 - Shear strength (N) and tensile strength (N)

Performance	Body Dia. Nom.	Rivet Type															
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Minimum Shear Strength (N)	2.4	310				580				310							
	3.2	530		1100		1160		1150		530		1100		1870		2100	
	4.0	850		1600		1650		1700		850		1600		2800		3300	
	4.8	1160		2200		2400		2400		1160		2200		3900		4300	
	6.4	2050				3750				2050							
Minimum Tensile Strength (N)	2.4	360				760				360							
	3.2	670		1450		1380		1200		670		1540		2000		2200	
	4.0	1020		2200		2090		1850		1020		2200		3110		4000	
	4.8	1420		3100		3020		2800		1420		3100		4400		4400	
	6.4	2490				4000				2490							

Table 3 - Mandrel breakload (kN)

Mandrel Breakload	Body Dia. Nom.	Rivet Type															
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
	2.4	0.78	1.22	1.160	1.600	1.140	1.300	1.330	2.220	2.50	2.55						
	3.2	1.82	3.5	2.670	3.560	22.90	26.90	2.890	4.230	3.30	3.35						
	4.0	3	5	3.340	4.450	3.200	3.780	5.120	6.450	4.10	4.15						
	4.8	4	7.6	5.120	6.450	4.620	5.380	6.230	8.450	4.90	4.95						
	6.4	8	10.76	8.670	10.500	8.000	10.760	13.300	16.000	6.55	6.60						