

White Paper

HBB Series

High Power Quick Release Connectors



1. PURPOSE

This document will present the Smiths Interconnect HBB connector range with a leading competitor's 38999 style product, comparison included.

2. DESCRIPTION

Shell Size 17 - 300A, Shell Size 21 - 500A

- Circular connector combining high current handling capability with small size and exceptional performance in harsh environments.
- Suitable for applications requiring transmission of high currents (up to 500A) including aerospace; defence field equipment (e.g. mobile weapon and radar systems); internal combustion, hybrid, electric and alternative energy vehicles, aviation, transportation, industrial and oil & gas markets.
- Safety Protection: including a safety interlock with full finger protection on pin and socket contacts.
- Tactile 'push mate' mating provides confirmation of full mate preventing "attached not locked" condition.
- Robust aluminium metal shell fully sealed to IP67 and featuring 360° EMI/RFI shielding.
- Smiths Interconnect Hyperboloid contact offering high reliability and excellent integrity.

3. BACKGROUND

- High current, high power connectors such as the Smiths Interconnect HBB range are intended for use as high power connectors in a variety of applications, including military and commercial transport. As such a wide ranging performance requirement is imposed on this connector range to ensure its compliance with the environments in which it may be installed.
- The connectors are expected to be mated and unmated regularly in close proximity to neighbouring devices, in harsh environments and in a variety of temperatures and ambient lighting conditions

4. Competitor Comparison

Comparison of against a competitive MIL-DTL-38999 style product.

A. Summary

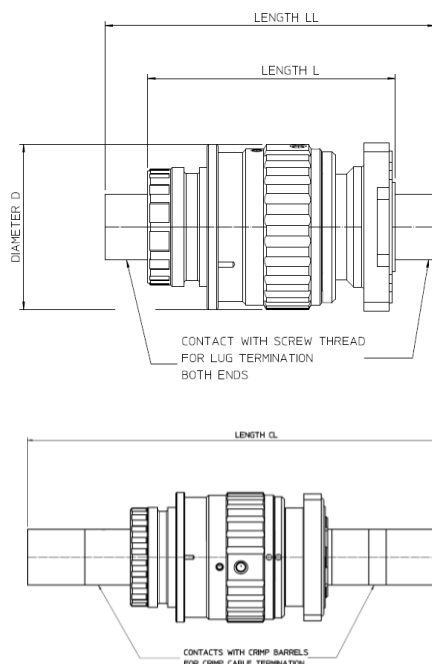
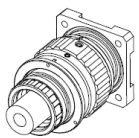
- Following the tests described below, it is clear that the HBB connector range is up to 50% lighter than competition, can be deployed 4% more closely together, requires up to 50% less axial force to assemble and separate with zero applied mating torque and has 34% lower contact resistance than a similar 38999 style connector assembly.
- Declared life expectancy shows HBB connectors can endure 5000 mating cycles.
- 38999 style connectors can survive only 500 mating cycles.

B. Test Results & Capabilities

Mass; Assembled Connector Pair	Overall Dimensions, Mated Pair; (See p6)
HBB Size 17 (#17) 300A; 181.0g	Length L; Shell Rear Surface – Shell Rear Surface; 56mm, Overall Diameter D; 37.5mm
HBB-Size 21 (#21); 500A; 363.4g	Length L; Shell Rear Surface – Shell Rear Surface; 70mm, Overall Diameter D; 45.5mm
38999 (300) style (#21); 368.0g	Length L; Shell Rear Surface – Shell Rear Surface; 75mm, Overall Diameter; 40mm
38999 (500) style (#23); 511.5g	Length L; Shell Rear Surface – Shell Rear Surface; 81mm, Overall Diameter; 43.5mm

C. Competitor Comparison – Dimensions

▪ Length & Diameter



Length L; Shell Rear to Shell Rear.

HBB 300 #17; 56mm

HBB 500 #21; 70mm

38999 #21; 75mm

38999 #23; 81mm

Length LL; Screw thread end surface to Screw thread end surface.

HBB #17; 83.5mm

HBB #21; 105.5mm

38999 #21; 115.5mm

38999 #23; 128.0mm

Length CL; Crimp barrel end surface to Crimp barrel end surface.

HBB #17; 127.6mm

HBB #21; 142.1mm

38999 #21; 115.64mm

38999 #23; 138.29mm

Diameter D

HBB #17; Ø 37.5mm.

HBB #21; Ø 45.5mm.

38999 #21; Ø 41.15mm.

38999 #23; Ø 44.12mm.

▪ Connector Spacing & Density

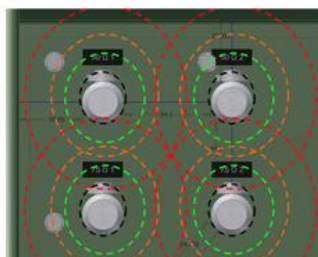
An excerpt from a leading human factors and ergonomics guidelines manual is shown below:

Dimensions of typical panel layouts are shown on the following page.

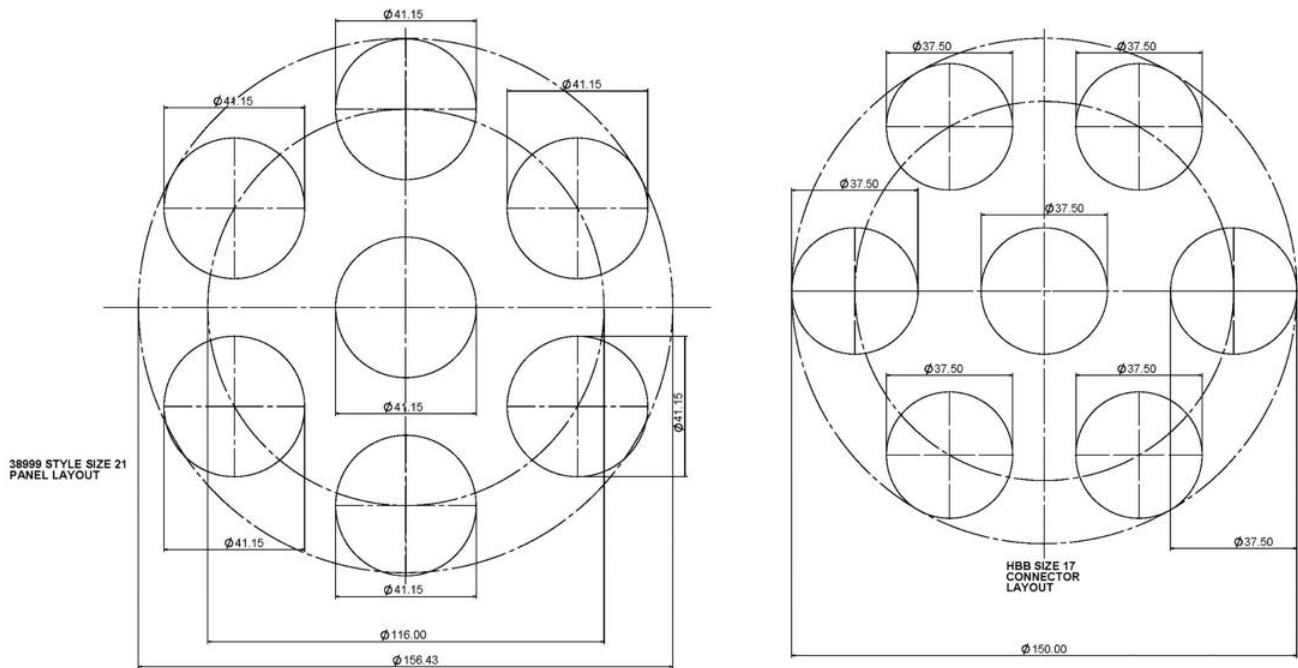
• **Minimum connector spacing** – The clearance space between a connector and any other obstruction shall be at least:

- 25 mm (1 in) when operated with bare fingers.
- 32 mm (1.25 in) when operated with gloved fingers.
- 64 mm (2.5 in) if high force operation is required.
- 75 mm (3 in) when operated with mittened hands.
- Clearance should permit a rotation of at least 270°.

- Outer Edge of connector
- 25mm from outer edge
- 32mm from outer edge
- 75mm from outer edge



Panel Layouts



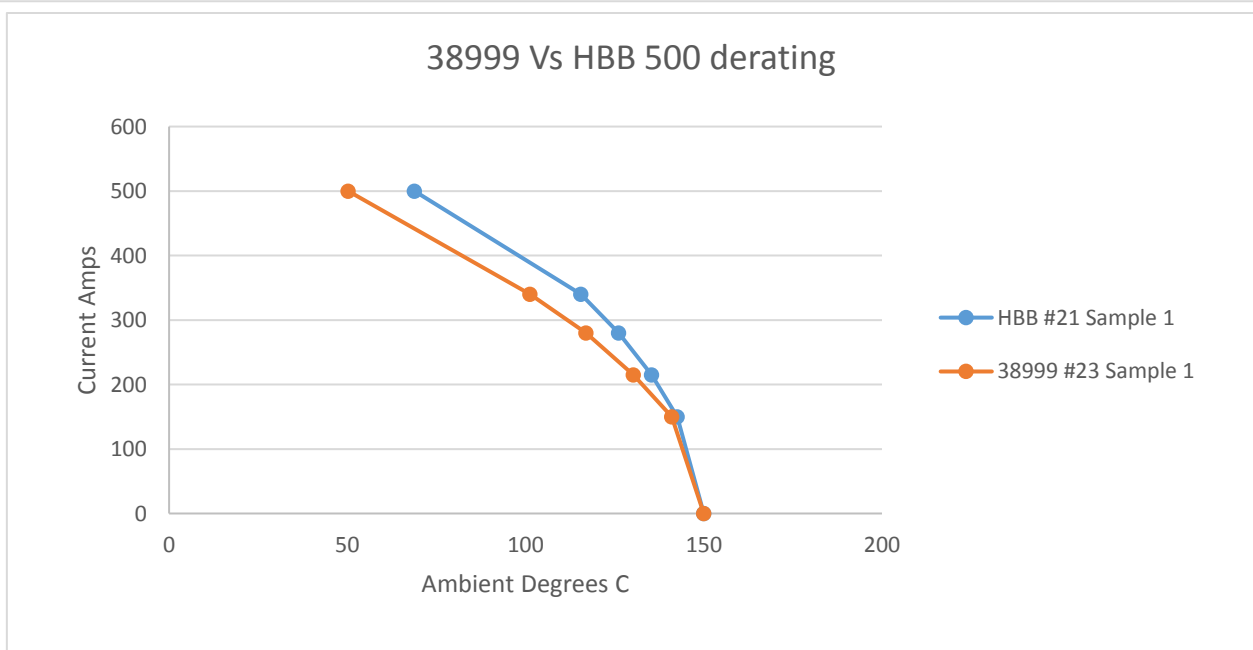
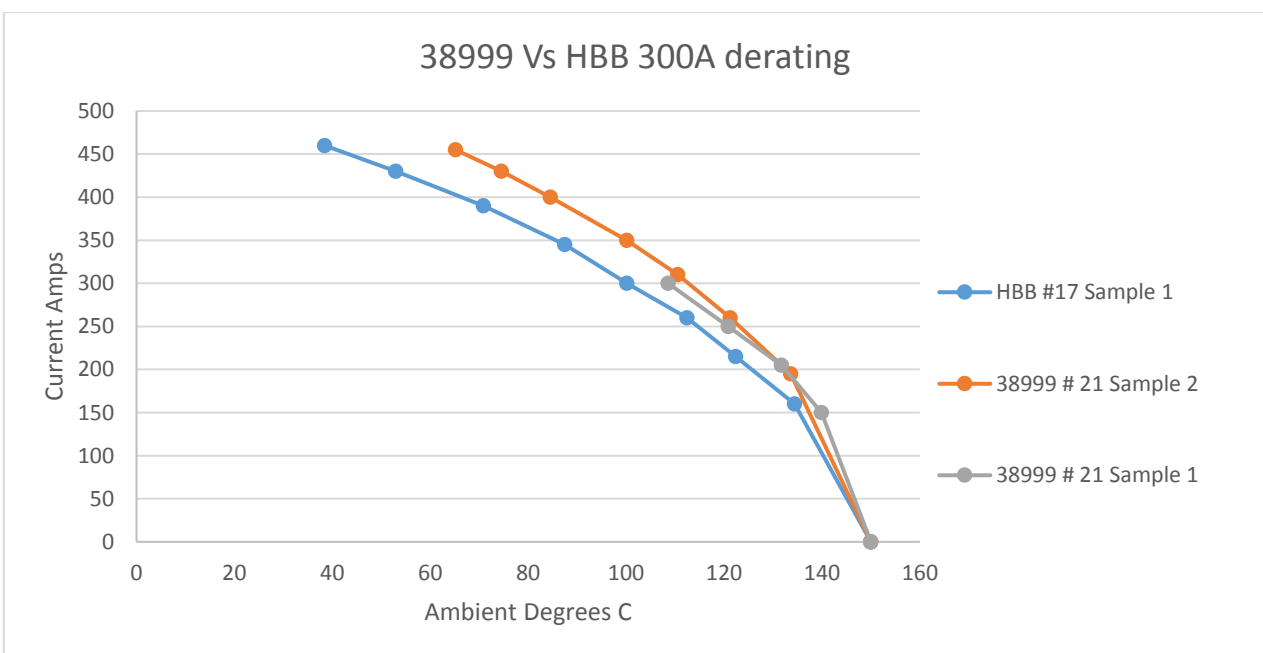
**Comparison of layouts of 7 x 300A assemblies
38999 size 21, HBB size 17**

Mating/Separation

- HBB Connectors are assembled using a straight push procedure to full mate which offers a tactical click for fail safe engagement. Separation is achieved by a straight pull after an approximate 20° twist of the locking ring, engagement takes around one second.
- The 38999 style connectors use an initial straight push followed by a full turn of a locking ring to achieve the fully mated condition, approximately five seconds. In reverse, separation requires a full 360° rotation of the locking ring before the straight pull.
- The HBB #21 connectors assemble and separate with generally lower forces than the competition, reducing effort and fatigue.
- Full assembly of HBB connectors is confirmed by the alignment of red dots on the plugs and receptacles. Full assembly of 38999 style connectors is confirmed when a red band around the receptacle shell is covered by the plug locking ring at the end of the rotation action.
- This shows that HBB connectors can be located in closer proximity to other connectors and devices, can be assembled and separated quicker than competitor's product with a fail safe engagement mechanism and are easier to confirm as fully assembled than a 38999 style assembly.

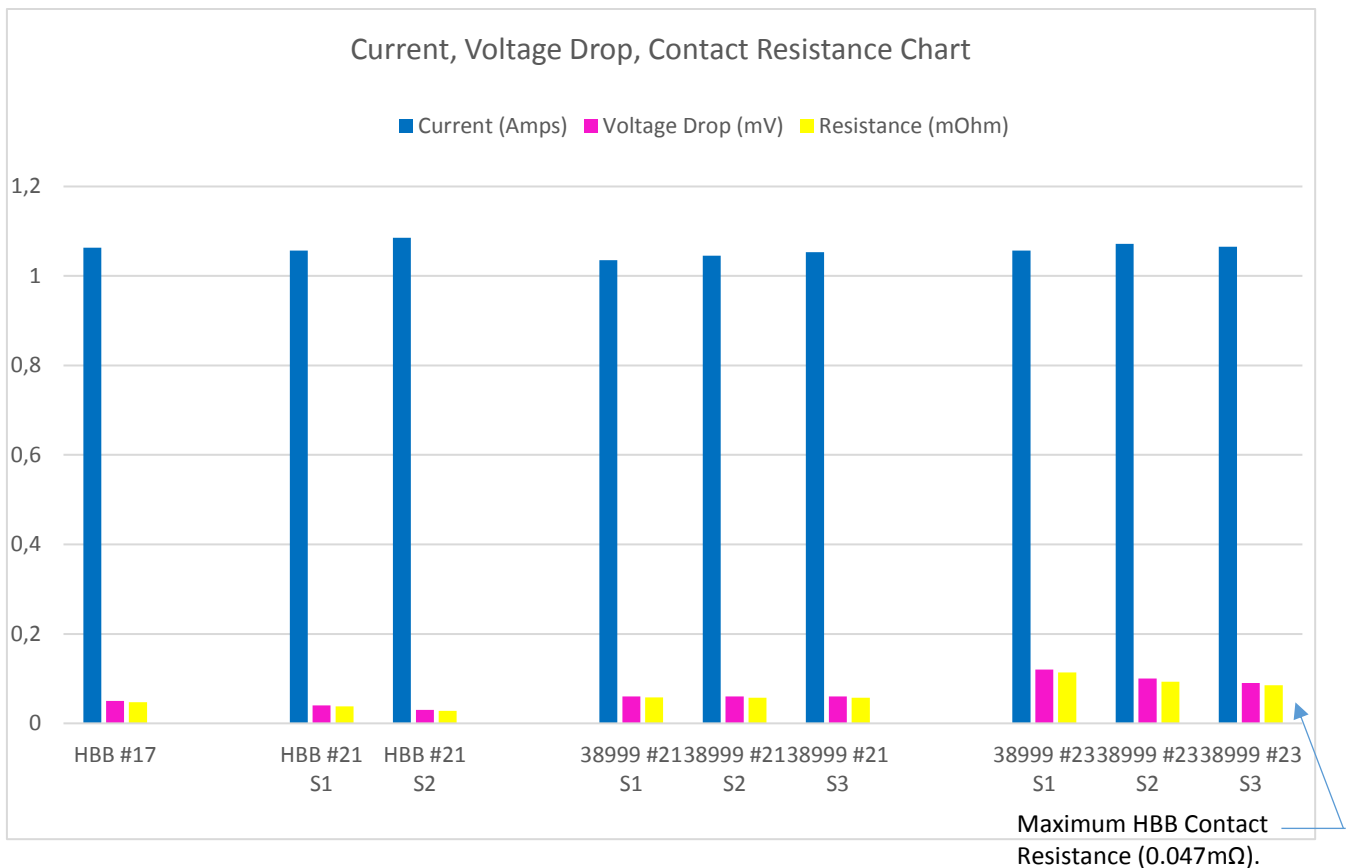
▪ **High Current, High Temperature**

- At increased ambient temperature, the chart below shows the derating curves for Smiths HBB #17 (300A) and #21 (500A) ranges in comparison with the competitor 38999 style 300A and 500A products.
- The charts show that in the comparison tests, the HBB connectors comply with the Smiths rating convention of measured current at 100°C ambient at 300A and 500A. The 38999 standard connectors comply at the 300A comparison but at the 500A tests the 38999 standard connectors would not be rated as high as 500A with the Smiths rating convention.



▪ Contact Resistance

All connectors were assembled and tested for overall contact resistance. While the results were occasionally unpredictable, they showed the HBB #21 and #17 series connectors held consistently lower resistance than the competition. This means the HBB has reduced losses in heat and transmission performance in comparison with 38999 style products.



▪ Vibration at Power

- All connectors were tested with vibration along 2 axes; parallel with the overall connector axis and normal to the connector axis according to MIL-DTL-38999 & EIA-364-28.
- Connectors are required to survive 90 minutes vibration without any resonance, disassembly or electrical discontinuities in excess of 1 microsecond throughout.
- All connectors passed all the above criteria except that the 38999 style 500A assembly showed resonance between 1.8kHz and 2.0kHz and the test was aborted after 18 minutes.

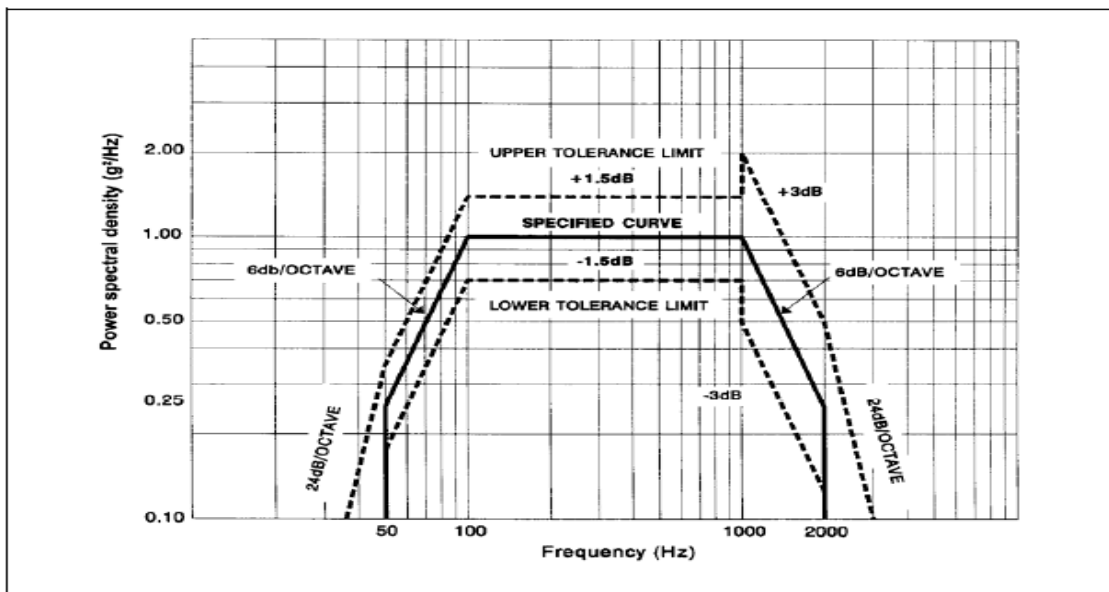


Figure 4 - Test condition V, random vibration test-curve envelope (see table 2).

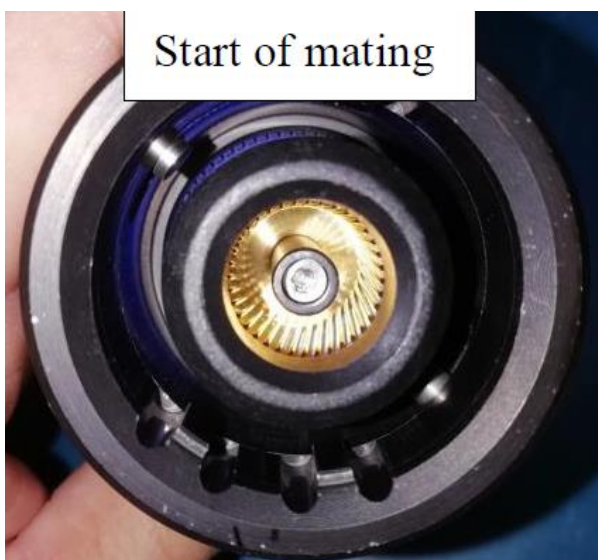
Table 2 - Values for test condition V ¹⁾

Test condition letter	Power spectral density, g ² /Hz	Overall rms g
A	0.02	5.35
B	0.04	7.56
C	0.06	9.26
D	0.1	11.95
E	0.2	16.91
F	0.3	20.71
G	0.4	23.91
H	0.6	29.28
I	Superseded by Test condition letter J	
J	1.0	37.80
K	1.5	46.30

1) For duration of test; see 4.2.2.

▪ Durability

- The contacts of the HBB and the 38999 style assemblies were tested to 5000 mating cycles. Insertion and extraction forces were recorded and contact resistance was measured throughout and all forces and resistances were within limits at the start and finish of the test.
- HBB connector shell assemblies have been tested to 5000 mating cycles elsewhere without failure or damage.
- The 38999 style connector shell assemblies are specified to withstand 500 mating cycles.
- Pictures below show HBB 500A Plug connector before and after durability test.



5. Conclusions

- On all tests and comparisons, the HBB connectors are smaller, lighter and can be mounted more densely (closer together) than the nearest competitor product allowing for greater power density in a smaller space envelope.
- HBB connectors are faster and easier to assemble together (mate) and disassemble (un-mate), offer a fail safe and a rapid verification engagement mechanism than the nearest competitor product which translates to ease of maintainability and serviceability in the field.
- HBB assemblies can survive 5000 mating cycles, the nearest competitor is rated with a life of only 500 mating cycles, producing a 10x increase in service life.

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