

### What is the Purpose of Adhesive Lined Shrink Boots?

Heat-shrink boots are not watertight unless equipped with factory-installed or user-installed adhesives. When heat is applied to the boot, the adhesive melts and fixes the boot to the adapter and cable jacket to provide the necessary sealing as well as mechanical strain-relief. Hot melt thermoplastic polyamide adhesive is compatible with most cable jackets, economical and easy to install. Glenair hot melt adhesives of this type are available in two temperature ranges: "W1" for -55° to +120°C, and "W2" for -40° to +80°C. But for maximum temperature range and best adhesion epoxy-lined boots are recommended. Glenair Type "R" one-part epoxy precoat provides protection from -75° to +150°C with high strength. **NOTE: This Data sheet summarizes the general performance values, test results and competitive advantages of the Glenair Series 77 adhesives. For unabridged adhesive test data please consult the factory.**

**Table 1: Glenair Series 77 Boots Adhesive Types**

Attribute	W2 Standard Hot Melt Adhesive	W1 High Temperature Hot Melt Adhesive	U Two Part Epoxy Adhesive	R High Performance Epoxy Adhesive
Continuous Operating Temp.	-40° to +80°C	-55° to +105°C	-75° to + 150°C	-75° to +150°C
Resistance to Fuels, Oils & Fluids	Good	Good	Excellent	Excellent
Low Toxicity, Zero Halogen	Yes	Yes	No	Yes

### How is Adhesive Performance Measured?

There are three specifications for adhesives in the heat shrink world, SAE AS5258, VG95343 part 14, 15 and 18, and IEC 62329-3-101 and 102. All three specifications evaluate peel and shear strength for harness test assemblies. **NOTE: All Glenair adhesives and adhesive-lined boots meet or exceed their controlling specifications in every category—with ample safety margins.** While performance values such as dynamic shear, static load, flexibility and peel adhesion may vary from one boot manufacturer to the next, all such products must meet the standards of the controlling specifications to be considered suitable for use in high-reliability applications.

### Are All Adhesives that Satisfy the Controlling Specifications the Same?

Glenair's goal is to win over the market with high-quality products and outstanding customer service. As mentioned, we have designed our boots to meet or exceed all qualification standards with significant safety margins. But passing a test is only part of the story, since how well a boot "sticks" is a complex question that involves the boot material itself, a well-matched adhesive, the adhesive application process, and correct activation and installation by the user.

The most direct method to evaluate boot product design, processing, and installation is to apply a load to the boot-equipped cable at room and elevated temperatures. The load is either applied incrementally until failure mode is reached (dynamic shear) or with a set weight for a set period of time (static load). In other tests, adhesion is measured by peeling the moulded parts from connectors and cables.

Glenair uses adhesive-lined shrink boot products manufactured by Tyco/Raychem and Hellerman as benchmarks in all testing. The VG and SAE qualification standards have essentially been written with quoted values from these organization's (principally Raychem's) own test suite. So when we say our products meet the standards in these controlling specifications, we are also stating categorically they perform competitively to other solutions available today. But this does not mean the products are all the same. Even though they all pass the same tests, in some areas the Glenair adhesive-lined boots outperform competitor products.

### Head-to-Head Comparison of Adhesives

As stated, to provide comparable products and performance, Glenair adhesives are designed to match-up against Raychem and Hellerman boot materials and adhesives. The four Glenair adhesives consist of a high performance two-part epoxy which is described as "U" in the USA and IEC specs, a one-part epoxy described as "R" in the USA and IEC specs and two pre-coated hot melts described as "W1 and W2" in the USA and IEC specs. Manufacturer adhesive codes are explained in the following table:

**Table 2: Glenair and Competitor Adhesive Code Descriptions**

Adhesive Type	Description	Temp Range	Applicable Material	Glenair	Raychem	Hellerman
<b>R</b>	One-part epoxy, pre-coated	-75° to 150° C	Mil. A H Glenair 1 Ray -25,-3 Hell G, B7	"R"	/225	W24
<b>U</b>	Two-part epoxy, user installed	-75° to 150° C	Mil A,B,G,H Glenair 1,2,3 Ray -3,-25,-100 Hell B5, G, H	779-001	S1125	V9500
<b>W1</b>	Pre-coated hot melt wide temp range; low smoke zero hal	-55° to 105° C	Mil. A,B,G,H Glenair 1,2 Ray -3,-25,-100 Hell B5,G,H	"W1"	/86	W8
<b>W2</b>	Pre-coated hot melt; limited temp range	-40° to 80° C	Mil A,B,G Glenair 3 Ray -3,-4 Hell J	"W2"	/42 /180	WM250

### Summary of Glenair Adhesive Materials

To provide comparable products and performance, Glenair adhesives are designed to match-up on a functional basis against Raychem and Hellerman boot materials and adhesives. The following table summarizes the attributes of each Glenair adhesive:

- U:** Glenair two-part epoxy adhesive (type "U") is identical in make-up, performance and packaging to the Tyco/ Raychem (S1125) and Hellerman (V9500) materials. The material is simple to use, very reliable, providing the highest strengths and requires no special installation procedures.
- W1:** Type "W1" is a polyamide hot melt adhesive, pre-coated onto heat shrink boots. The adhesive is versatile and bonds well to a variety of substrates. It possesses good creep resistance at elevated temperatures with excellent bond strengths at low temperature (-55°C to 125°C). The material has good resistance to fuels and oils. It provides excellent resistance to stresses with good peel adhesion. The "W1" adhesive provides a simple reliable technology for Glenair type 1 and 2 boot materials. The material is low smoke, zero halogen and our tests show it provides superior performance to competitor products in both shear strength and peel adhesion—particularly in its adhesion and resistance to flex damage on the cable end.

**W2:** Type "W2" is an EVA hot melt adhesive compatible with our type 3 boot material that provides very high levels of adhesion and sealing. The material has a limited temperature range of -40°C to +80°C and resists oils at room temperature. Our tests demonstrate this adhesive is equivalent in performance to Raychem and Hellerman materials.

**R:** This is Glenair's highest performance pre-coated epoxy adhesive. The adhesive meets required specification levels of AS 5258 and VG 95343 part 18. Like the Raychem /225 adhesive and the Hellerman W24, ***the material requires careful installation using trained operators.*** The adhesive is capable of withstanding high stresses between -75°C and 150°C and prolonged high temperature immersion in fuels and oils. Peel adhesion is very high to a wide range of materials used to manufacture connectors or backshells including aluminium with various types of plating as well as plated and unplated composite thermoplastics. Type "R" can be used on most cable jacket materials including fluorocarbon rubbers, although fluropolymers such as ETFE and PVDF require surface treatment. **Note: The Glenair one part pre-coated adhesive does not match Raychem /225 for peel adhesion but is much better in direct shear and has better handling properties. The material exhibits no cracking on flexing dynamic shear tests confirming its superior flex resistance—particularly on the cable end of the test assembly.**

The following table lists the controlling specifications for type "R", high-performance adhesives:

*Table 3: Specification Requirements for Type "R" Adhesives*

Test	TEMP	SAE AS 5258	VG95343
Dynamic Shear	23 C	300 N	300 N
	100 C	110 N	110 N
Static Load	23 C	20 kgs	20 kgs
	100 C	5 kgs	5 kgs
Sealing Test (1 bar pressure)	23 C		No leaks
Peel Adhesion	23 C	45 N/25mm	60 N/25mm

Again, it bears repeating, the Glenair type "R" adhesive meets all the above requirements with significant safety margins. The material delivers Peel Adhesion test values of 100 N/25mm and Dynamic Shear values of 820 N. The Tyco/Raychem /225 adhesive also tests above the requirement with Peel Adhesion test values of 140 N/25mm but with Dynamic Shear values of only 540 N.

### Conclusion

Glenair has a range of adhesives that meet the published specifications to enable reliable adhesion and long system life. Comparing the four adhesives, the two part "U" epoxies are functionally identical, the W1 hot melt is superior, and the W2 covers the required range and is equivalent.

Glenair's one part pre-coated adhesive ("R") does not match Raychem /225 for peel adhesion but is better in direct shear, has better handling properties, and delivers better flex resistance performance. When installed properly, the material easily meets the "gorilla test" since a peeling force of 100N/25mm (25 lbs) is easily more than a normal person can exert with their fingers. Again, our tests demonstrate the Glenair boot with "R" adhesive is a superior performing product due to its advanced resistance to flex damage such as separation and cracking on the cable-end of the assembly. For complete test result, or a product sample, please contact the factory.