**GORE-FLIGHT®**
Microwave Assemblies

# Lightweight airframe solution with lowest insertion loss before and after installation

Airframe cable assemblies are exposed to extreme conditions that can compromise their performance — beginning with the challenges of installation and continuing through the rigorous flight conditions that combine rapid temperature and pressure changes with potential contamination from fuels, oils, and fluids. Maintaining signal integrity in these challenging environments is essential to ensuring the reliability of the sophisticated electronic systems in the aircraft. At the same time, the assemblies must be lightweight and durable to improve fuel efficiency and reduce operating costs.

Award-winning GORE-FLIGHT® Microwave Assemblies are lightweight cable solutions that deliver the lowest insertion loss before and after installation, ensuring reliable performance for the life of the system (Table 1). The robust construction of these assemblies reduces total costs by withstanding the challenges of installation, reducing costly production delays, field service frequency, and the need for purchasing replacements. Also, they are lighter weight, which improves fuel efficiency and increases payload.

## Typical Applications

- C5ISR
- Airborne electronic surveillance / countermeasures / jamming
- EW (Electronic Warfare) systems
- RWR (Radar Warning Receiver) systems
- Radar interconnects
- Electronic / signal intelligence
- Navigation / communication systems
- Millimeter wave technologies


## Benefits

- Outstanding signal integrity with lowest insertion loss up to 40 GHz before/after installation
- Lower installation costs due to fewer failures and reduced aircraft production delays
- Improved fuel efficiency and increased payload with lightweight assembly
- Longer system life and reduced downtime due to mechanically robust construction
- Less RF interference among electronic systems due to superior shielding effectiveness
- Proven compliance with stringent industry requirements

These cable assemblies have been qualified to the most stringent specifications for airframe assemblies. Gore controls the entire manufacturing process from purchasing raw materials and creating and applying the proprietary dielectric material, through testing and shipping the final cable assembly. This unsurpassed vertical integration allows Gore the complete control necessary to achieve tight specifications consistently. This process includes testing 100% of the assemblies for vapor leakage, dielectric withstanding voltage, VSWR, insertion loss, impedance, and velocity of propagation — ensuring that every assembly will deliver the highest-quality performance required for today's civil and defense aircraft.

*Together, improving life*

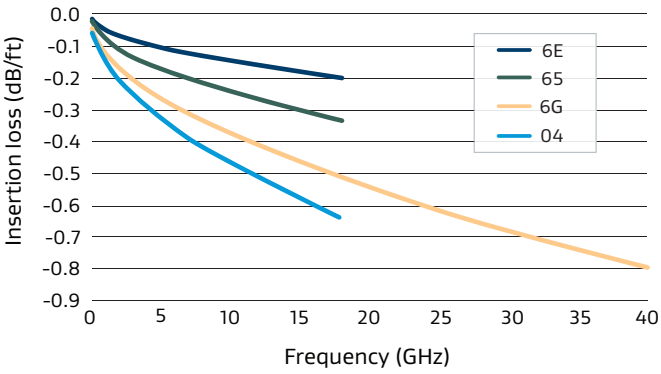
## Rugged Construction for Longer Service Life

GORE-FLIGHT® Microwave Assemblies are engineered with a rugged construction that withstands the challenging environments they encounter throughout an aircraft's service life (Figure 1). The engineered fluoropolymers used in this construction help reduce abrasion caused by routing during installation, and they help maintain stable performance by resisting the effects of vibration and temperature changes during flight.

With a concentrated load resistance that exceeds rigorous requirements, Gore's microwave assemblies prevent the internal core from being compromised and protect against uncontrolled changes in impedance and dielectric constant. At the same time, this rugged construction is lighter than leading competitor assemblies, improving fuel efficiency and increasing payload.

Gore's expanded polytetrafluoroethylene (ePTFE) insulation has the lowest dielectric constant in the industry. In combination with the rugged construction, this allows GORE-FLIGHT Microwave Assemblies to have the lowest insertion loss before and after installation (Figure 2).

**Figure 2: Insertion Loss[a]**

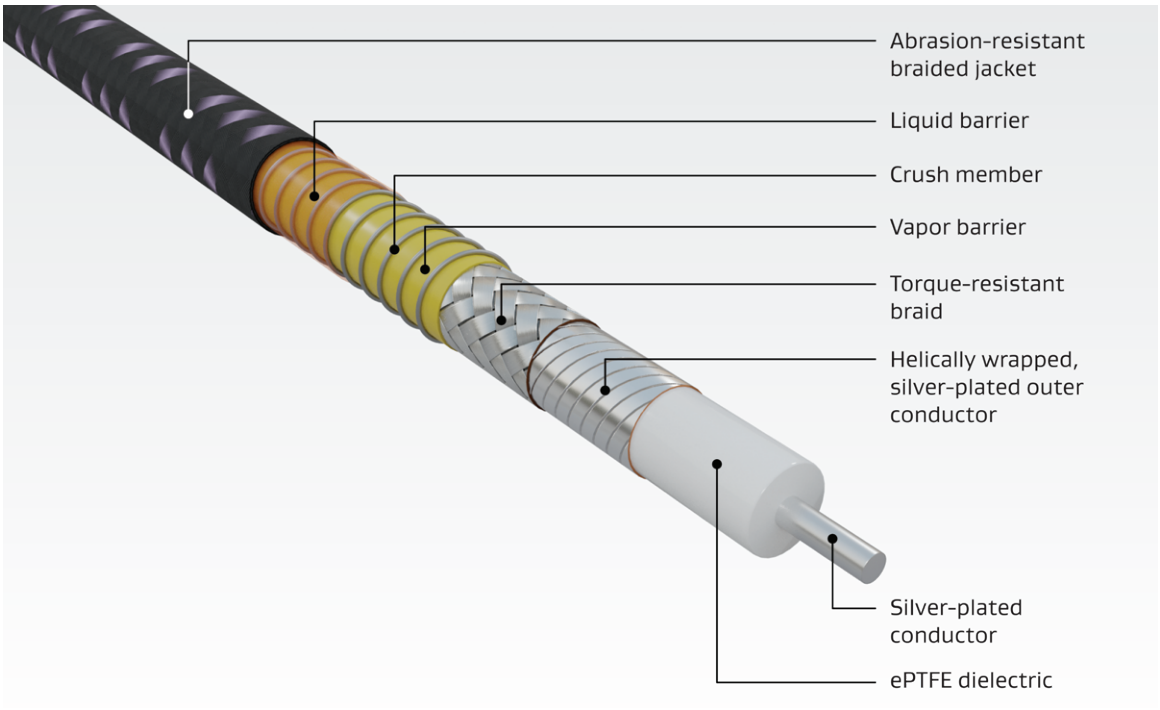



a. Measured assemblies are 10 feet long including straight threaded male connectors.

## Reliable mmWave Performance

Higher frequency mmWave components are being added to electronic warfare (EW) and aircraft survivability equipment (ASE) in today's military aircraft and future fleets. These components and systems require microwave/RF assemblies to operate within Ka-band frequencies from 26 to 40 GHz and V-band frequencies from 40 to 75 GHz. Microwave/RF assemblies are also susceptible to electrical challenges and mechanical stresses due to damage from installation and harsh environmental conditions. Small, rugged GORE-FLIGHT® Microwave Assemblies, Type 6G, is proven to perform reliably up to 40 GHz over the aircraft's lifetime, ensuring mission-critical success and peace of mind.

**Figure 1: Rugged Construction[a]**



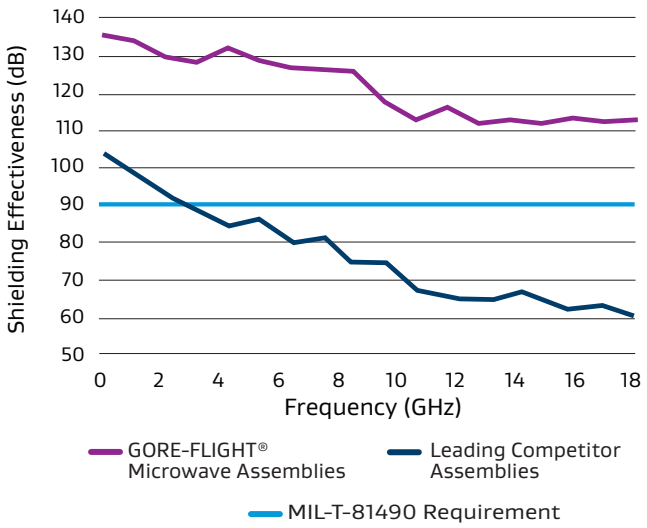

a. Construction for Types 65, 6E and 6G.

## Outstanding EMI Shielding

The MIL-T-81490 standard requires a minimum shielding effectiveness of 90 dB. As the power and frequency requirements increase in today's applications, radiating cable assemblies can interfere with mission-critical systems. These systems can also be susceptible to interference due to inadequate shielding effectiveness.

With proven EMI shielding performance, GORE-FLIGHT® Microwave Assemblies improve signal integrity by reducing RF interference among multiple electronic systems (Figure 3).

**Figure 3: Shielding Effectiveness[a]**




a. Data in this graph reflects Type 6E test results. Results for Type 65 and 6G are similar.

**Table 1: Cable Assembly Properties**

## Electrical

| | Value | | | |
|---|---|---|---|---|
| **Property** | **Type 04** | **Type 65** | **Type 6E** | **Type 6G** |
| Maximum Frequency GHz | 18 | 18 | 18 | 40 |
| Typical VSWR (straight connector) | 1.25:1 | 1.25:1 | 1.25:1 | 1.30:1 |
| Guaranteed VSWR (straight connector) | 1.40:1 | 1.40:1 | 1.40:1 | 1.45:1 |
| Typical Insertion Loss at max frequency dB/ft | 0.633 | 0.342 | 0.198 | 0.795 |
| Guaranteed Insertion Loss at max frequency dB/ft | 0.673 | 0.384 | 0.208 | 0.870 |
| Standard Impedance Ohms | 50 ± 1 | 50 ± 1 | 50 ± 1 | 50 ± 1 |
| Nominal Dielectric Constant | 1.40 | 1.35 | 1.35 | 1.40 |
| Nominal Velocity of Propagation % | 85 | 86 | 86 | 85 |
| Nominal Time Delay ns/in (ns/cm) | 0.103 (0.04) | 0.0984 (0.0387) | 0.0984 (0.0387) | 0.103 (0.04) |
| Shielding Effectiveness through 18 GHz dB | > 90 | > 90 | > 90 | > 90 |

## Mechanical / Environmental

| | Value | | | |
|---|---|---|---|---|
| **Property** | | | | |
| Overall Diameter in (mm) | 0.18 (4.55) | 0.24 (6.1) | 0.35 (8.9) | 0.195 (4.95) |
| Nominal Weight lb/ft (g/m) | 0.027 (41) | 0.040 (60) | 0.084 (125) | 0.033 (49) |
| Minimum Bend Radius in (mm) | 0.5 (12.5) | 1.0 (25.4) | 1.9 (48.3) | 0.75 (19.0) |
| Temperature Range[a] °C | -55 to +125 | -55 to +125 | -55 to +125 | -55 to +125 |
| Concentrated Load lb (MIL-T-81490, paragraph 4.7.18) | > 150 | > 150 | > 150 | > 150 |

a. For applications outside of these temperatures, please contact a Gore representative.

## Proven Performance Through Testing

Gore has designed a simulator to evaluate the stress of installation on microwave airframe assemblies (Figure 4). The simulator has several features that replicate minimum bend radius conditions, routing guides that induce torque, and an abrasive edge to simulate routing across sharp edges or through access holes in the airframe structure (Figure 5).

The simulator enables Gore to evaluate the electrical performance of various cable assemblies after installation. Testing electrical characteristics such as insertion loss and VSWR before and after routing through the simulator verifies whether an assembly can withstand the rigorous challenges of installation — resulting in lower total costs and longer service life.

To evaluate the insertion loss of GORE-FLIGHT® Microwave Assemblies, Gore ran a 10-foot assembly through the simulator for 3 cycles. The results of this simulation demonstrate the importance of testing insertion loss after installation (Table 2).

**Table 2: Insertion Loss After Installation**

| | Value | |
|---|---|---|
| **Property** | **Type 65** | **Type 6E** |
| Typical[a] Insertion Loss at 18 GHz dB/ft | 0.342 | 0.198 |
| Installed[b] Insertion Loss at 18 GHz dB/ft | 0.354 | 0.219 |

a. New out of the box assembly.

b. Performance after routing three times through the installation simulator.

With GORE-FLIGHT® Microwave Assemblies, a fit-and-forget philosophy is now a reality — providing the most cost-effective solution that ensures critical system performance for civil and defense applications.

For more information about the installation simulator, visit **gore.com/simulator**.

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**Figure 4: Installation Simulator**

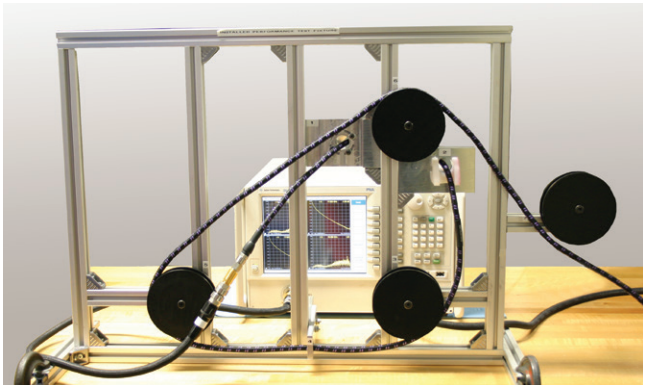


**Figure 5: Abrasive Edge**

## Decades of Proven Heritage

Gore has provided microwave/RF cable assemblies to the aerospace industry since 1976. We offer solutions capable of operating reliably from DC to 110 GHz in the most demanding aircraft and spacecraft environments.

Since 1958, we have been a long-trusted partner to the aerospace and defense industry for wires, cables, sealants, aerospace materials, technical fabrics, and outerwear. Our products have won industry awards and have been used in many applications, including every major defense aircraft.

GORE-FLIGHT® Microwave Assemblies, Type 6G, is proven to perform reliably up to 40 GHz.

## Excellent Signal Integrity for Improved Reliability

GORE-FLIGHT® Microwave Assemblies improve system performance by withstanding the challenges of installation, maintenance activities, and flight conditions. When compared to leading competitor assemblies (Figure 6), Gore's cable assemblies maintain the lowest insertion loss before and after installation (Figure 7) — providing stable and accurate system performance.

Likewise, the VSWR of leading competitor assemblies is less reliable due to impedance changes from damage (Figure 8), while the VSWR for Gore's cable assemblies are well controlled (Figure 9). With this level of performance, GORE-FLIGHT® Microwave Assemblies maintain consistent impedance of 50 ± 1 ohms, eliminating insertion loss stack-up issues when routing through airframe bulkheads.

**Figure 6: Leading Competitor Assemblies Insertion Loss**

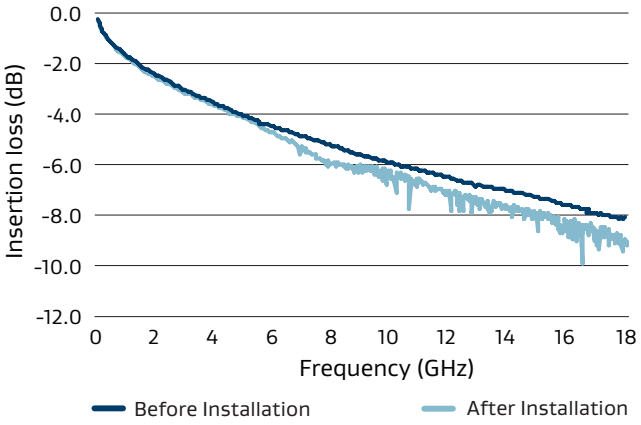



**Figure 7: GORE-FLIGHT® Microwave Assemblies Insertion Loss[a]**

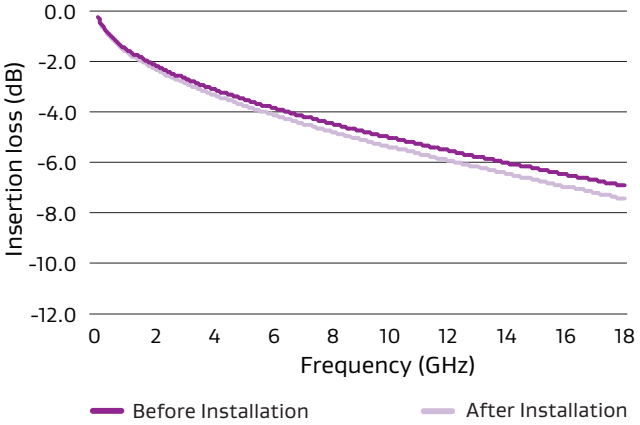



**Figure 8: Leading Competitor Assemblies VSWR**

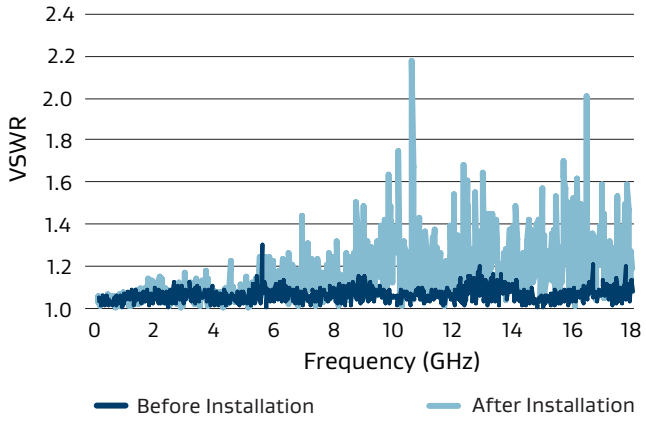
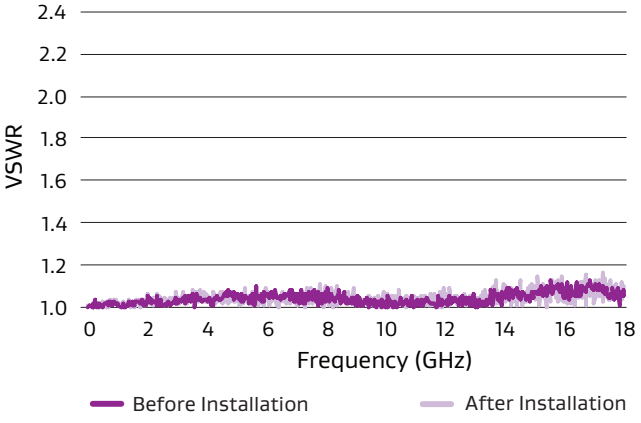



**Figure 9: GORE-FLIGHT® Microwave Assemblies VSWR[a]**




a. Data in this graph reflects Type 6E test results. Results for Type 65 are similar.

## Connector Options

Connectors available for GORE-FLIGHT® Microwave Assemblies are specifically engineered to optimize performance of the assembly (Table 3). Gore also offers an interface that allows the use of replaceable connectors.

**Table 3: Connector Options**

The maximum operating frequency of an assembly is determined as the lowest frequency of either the connectors or the assembly.

| Connector Type | Direct Mount Connector Code | Replaceable End Connector Code | Cable Type Applicability |
|---|---|---|---|
| SMA Straight Male | R01[1] | 701[1] | 04 / 65 / 6E |
| SMA 90° Male | R71[1] | 7V1[1] | 04 / 65 / 6E |
| SMA 45° Male | | 7P1[1] | 04 / 65 / 6E |
| SMA Straight Female | R02 | | 04 / 65 / 6E |
| SMA Bulkhead Female | R42 | | 04 / 65 / 6E |
| SMA Flangemount Female | R52 | | 04 / 65 / 6E |
| TNCA Straight Male | C01[1] | 801[1] | 04 / 65 / 6E |
| TNCA 90° Male | C71[1] | 8V1[1] | 04 / 65 / 6E |
| TNCA 45° Male | | 8P1[1] | 04 / 65 / 6E |
| TNCA Straight Female | | 802 | 04 / 65 / 6E |
| TNCA Bulkhead Female | C42 | 842 | 04 / 65 / 6E |
| TNCA Flangemount Female | C52 | 852 | 04 / 65 / 6E |
| Type N Straight Male | | 901 | 04 / 65 / 6E |
| Type N 90° Male | | 9V1 | 04 / 65 / 6E |
| Type N 45° Male | | 9P1 | 04 / 65 / 6E |
| Type N Straight Female | | 902 | 04 / 65 / 6E |
| Type N Bulkhead Female | | 962 | 04 / 65 / 6E |
| HN Straight Male | | ZJS | 04 / 65 / 6E |
| HN 90° Male | | ZNM | 04 / 65 / 6E |
| HN Bulkhead Female | | ZNL | 04 / 65 / 6E |
| Size 8 Pin Contact BMA[2] | Z8T | | 04 / 65 |
| Size 8 Socket Contact BMA[2] | ZJA | | 04 / 65 |
| Size 8 Pin Contact BMA[3] | Z8T-001 | | 04 / 65 |
| Size 8 Socket Contact BMA[3] | ZY2 | | 04 / 65 |
| Size 8 Pin Contact BMB[2] | ZR3 | | 04 / 65 |
| Size 8 Socket Contact BMB[2] | ZR2 | | 04 / 65 |
| Size 8 Pin Contact BMB[3] | ZR3-001 | | 04 / 65 |
| Size 8 Socket Contact BMB[3] | ZNS | | 04 / 65 |
| M8 Multiport Straight Male | ZXE | ZTC | 04 / 65 / 6E |
| M8 Multiport Straight Female | ZUD | ZTD | 04 / 65 / 6E |
| M8 Multiport 90° Male | | Y1C / Y1D[4] | 04 / 65 / 6E |
| M8 Multiport 90° Female | | Z1C / Z1D[4] | 04 / 65 / 6E |
| M8 Multiport 45° Male | | Z1A / Z1B[4] | 04 / 65 / 6E |
| M8 Multiport 45° Female | | Y1A / Y1B[4] | 04 / 65 / 6E |
| TK Straight Male | | ZVM | 04 / 65 / 6E |
| TK 90° Male | | Y13 | 04 / 65 / 6E |
| TK 45° Male | | ZVN | 04 / 65 / 6E |
| BMB Pin | ZPB | | 04 / 65 |

**Table 3: Connector Options (continued)**

| Connector Type | Direct Mount Connector Code | Replaceable End Connector Code | Cable Type Applicability |
|---|---|---|---|
| SMP Floatmount Socket | ZKY | | 04 |
| SMP Floatmount 90° Socket | ZW2 | | 04 |
| 2.92 mm Straight Male | 0CQ | | 6G |
| 2.92 mm 90° Male | ZQA | | 6G |
| 2.92 mm Straight Female | 0CP | | 6G |
| 2.4 mm Straight Male | 0CJ | | 6G |
| 2.4 mm Straight Female | 0CK | | 6G |

1. Also available in Lock Wire Hole and Self-Locking versions. For Lock Wire version, replace "1" with "L" eg. R01 would be R0L. For Self-Locking version, replace "1" with "S" eg. R01 would be R0S.
2. For use in MIL-DTL-38999 connector systems.
3. For use in ARINC 600 connector systems.
4. Y1B and Y1D are extended versions of Y1A and Y1C connectors respectively. Z1B and Z1D are extended versions of Z1A and Z1C connectors respectively.

## Torque Values

The recommended mating and installation torque values for Gore connector options are provided in Table 4.

**Table 4: Mating/Installation Torque Values**

| Connector | Installation Torque in-lbs (Nm) |
|---|---|
| TNCA[a]<br>TNCA Bulkhead Mount Panel Nut | 23 ± 3 (2.59 ± 0.33)<br>35 ± 5 (3.95 ± 0.56) |
| SMA<br>2.4 mm<br>2.92 mm | 12 – 15 (1.35 – 1.69)<br>12 – 15 (1.35 – 1.69)<br>12 – 15 (1.35 – 1.69) |
| Type N[m]<br>Type N Bulkhead Mount Panel Nut | 23 ± 3 (2.59 ± 0.33)<br>35 ± 5 (3.95 ± 0.56) |
| TK | 19 – 21 (2.15 – 2.37) |
| HN<br>HN Bulkhead Mount Panel Nut | 15 ± 3 (1.69 ± 0.33)<br>35 ± 5 (3.95 ± 0.56) |
| Replaceable Adapter | 45 ± 5 (5.08 ± 0.56) |
| Size 8 – Pin Contact<br>(socket Microwave Interface) | Not applicable |

a. Based on MIL-T-81490 requirements.

## Ordering Information

GORE-FLIGHT® Microwave Assemblies are identified by a 12-character part number. This number designates the cable type, connector types, and assembly length:

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cable Type | | Connector A | | | Connector B | | | Assembly Length | | | |

**Positions 1–2:** Enter 04, 6E, 65 or 6G to identify the specific cable type of GORE-FLIGHT® Microwave Assemblies.

**Positions 3–5 and 6–8:** See Table 3 for the list of connectors available for each cable type. When reading the label, Connector A is on the left-hand side. Additionally, Gore offers an interface that can be used with replaceable connectors (see Table 4).

**Positions 9–12:** The length of the assembly is expressed in inches to the nearest tenth, including zeroes to fill positions if the length is less than three digits. For example, the length of a 24.0-inch assembly is specified as 0240 in the last four digits of the part number.

Build an assembly and request a quote using the **GORE® Microwave/RF Assembly Builder** at **gore.com/rfcablebuilder**. Alternatively, contact a Gore representative at **gore.com/contact**.

Calculate insertion loss, VSWR, and other parameters of Gore's assemblies using the **GORE® Microwave/RF Assembly Calculator** at **tools.gore.com/gmcacalc**.

## Qualification Summary

Engineered to meet the stringent specification requirements of civil and defense aircraft, these assemblies have undergone substantial qualification testing to ensure that they meet the specifications of the most current industry standards (Table 5).

### Table 5: Qualifications for GORE-FLIGHT® Microwave Assemblies

| Examination or Test | Industry Standards | Status |
|---|---|---|
| Design and Construction | MIL-T-81490, Paragraph 4.7.1 | Compliant |
| Markings | MIL-T-81490, Paragraph 4.7.1 | Compliant |
| Workmanship | MIL-T-81490, Paragraph 4.7.1 | Compliant |
| RF Insertion Loss | MIL-T-81490, Paragraph 4.7.3 | Compliant |
| Voltage Standing Wave Ration (VSWR) | MIL-T-81490, Paragraph 4.7.4 | Compliant |
| Impedance | MIL-T-81490, Paragraph 4.7.5 | Compliant |
| Vapor Leakage (Seal) | MIL-STD-202, Method 112E, Paragraph 5, Test Condition C, Procedure IV | Compliant |
| Velocity of Propagation | MIL-T-81490, Paragraph 4.7.7 | Compliant |
| EMI Shielding Effectiveness | EIA-364-66, Mode Stirred Test | Compliant |
| Thermal Shock | MIL-STD-810, Method 503.5, Procedure I-C;<br>MIL-STD-202, Method 107, Test Condition A-1 and B-1 | Compliant |
| Power Handling Capability | MIL-T-81490, Paragraph 4.7.13, Procedure I | Compliant |
| Flexure | MIL-T-81490, Paragraph 4.7.15, Procedure I | Compliant |
| Torque | MIL-T-81490, paragraph 4.7.16, torque requirement of 50 in/lb replaced by ±90° angular displacement | Compliant |
| Tensile Load | MIL-T-81490, Paragraph 4.7.17 | Compliant |
| Concentrated Load | MIL-T-81490, Paragraph 4.7.18, 100 ± 2 lb force<br>Achieved ≥ 150 lb | Compliant |
| Abrasion | MIL-T-81490, Paragraph 4.7.19, Procedure II | Compliant |
| Sand and Dust | MIL-STD-810, Method 510, Procedure I | Compliant |
| Dielectric Withstanding Voltage | MIL-STD-202, Method 301 | Compliant |
| Explosive Atmosphere | MIL-STD-810, Method 511, Procedure I | Compliant |
| Temperature, Humidity, Altitude, Vibration | MIL-STD-810, Method 520, Procedure III with Vibration as per MIL-STD-810, Method 514, Procedure I | Compliant |
| Humidity | Type 04: MIL-STD-810, Method 507<br>Types 6E/65/6G: MIL-STD-810, Method 520, Procedure III | Compliant |
| Vibration | MIL-STD-810, Method 514, Procedure I | Compliant |
| Salt Fog | MIL-STD-810 method 509 | Compliant |
| Chemical Resistance | Type 04: BS3G100, Part 2, Section 3, Subsection 3.12, for Class A<br>Types 6E/65/6G: MIL-STD-810, Method 504 | Compliant |
| Icing/Freezing Rain | MIL-STD-810, Method 521 | Compliant |
| Fungus Resistance | MIL-STD-810, Method 508 | Compliant |
| Drip | MIL-STD-810, Method 506, Procedure III | Compliant |
| Rain & Blowing Rain | MIL-STD-810, Method 506, Procedure I | Compliant |
| Corona Extinction Voltage | MIL-DTL-17, Paragraph 3.7.5 | Compliant |
| Flammability | Type 04: FAR25.853 (a), Appendix F, Part I (b)(7)<br>Types 6E/65/6G: ABD0031, Paragraph 7.1.6; FAR25.853, Appendix F, Part I (b)(7);<br>MIL-STD-202, Method 111 | Compliant |
| Toxicity | Type 04: FAR25.853 (a), Appendix F, Part I (b)(7)<br>Types 6E/65/6G: ABD0031, Paragraph 7.4 | Compliant |
| Smoke Density | Type 04: FAR25.853 (a), Appendix F, Part I (b)(7)<br>Types 6E/65/6G: ABD0031, Paragraph 7.3.5 (AITM 2.0008 B); FAR25.853, Appendix F, Part V | Compliant |
| Impact Shock | MIL-T-81490, Paragraph 4.7.14<br>Type 6E with 1.5 lb<br>Type 65 with 1.0 lb<br>Type 6G with 0.75 lb | Compliant |



**W. L. Gore & Associates, Inc.**
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