

## Technical Brief

### RF and Microwave Connector Care



**Precision Test and Measurement Instrumentation use precision connectors**

**Proper connector care is critical for accurate test and measurement**

## Introduction

One of the most common causes of damage to RF and Microwave test systems, including very expensive test equipment, is by the use of dirty or damaged RF connectors, cables, adaptors and test accessories. These same dirty or damaged connection devices can also result in loss of performance in operational systems and add significant errors to measurement accuracy during testing.

By taking a few simple pre-cautions, and maintaining a strict preventive maintenance policy, you will ensure the highest integrity and performance possible as well as saving money.

## CONSIDERATIONS

Cleanliness    Handling    Gauging    Storage  
Torque    Mating Technique.

### Connector Types

RF connectors come in many types and sizes that primarily relate to their ability to handle the frequency range of the application, the number of expected connect and disconnects, and the precision required. Most of the development of the smaller size connectors, required for performance in the higher GHz and millimeter wave frequency range, was conducted by test equipment measurement companies where the prime consideration is the number of test application connects and disconnects made, while maintaining the good return loss (VSWR) performance required for accurate test results.



## Adapters

The direct mating of connectors of the same type is not always possible. Adaptors are available that convert all of the major types and they demand the same care and pre-cautions as the main connectors.



## Dust Covers

Dust covers are not only good working practice, they are an essential part of maintaining a high integrity RF measurement environment. Dirt is the number one enemy of RF connectors. Dirt on threads and conductor surfaces very quickly destroys the working tolerances and integrity of your connection devices.



## Connector Savers

The main RF input and output connectors of modern test equipment are a major point of potential loss of measurement integrity and a very high cost item for repair or replacement. This connector is often an integral part of an RF module or attenuator assembly. If it gets damaged, or wears out, then the whole assembly must be replaced at very high cost. In a general test laboratory environment this connector is the most common point of continuous connection and disconnection to devices under test. It therefore makes economic sense to protect this point by reducing the number of connections by using an RF connector saver that can be easily and cheaply replaced if it gets worn or damaged.

## Connecting and disconnecting

RF and microwave connectors are precision parts and should be treated with care and respect. They can be very easily damaged by using incorrect methods when mating with their opposite sex. For connectors that have threaded sleeves, you should only rotate the external sleeve and ensure that the inner mating surfaces remain stationary. Never allow the mating surfaces to rotate and rub against each other. If the mating surfaces of the connector are allowed to turn while tightening or loosening, damage or wear can and will occur.

## Connector Cleaning

All RF connections to a test system should be inspected and cleaned at regular intervals. This includes the connectors that are part of a test fixture, component or accessory, such as power sensors, couplers, attenuators, filters, splitters and combiners. Dirt, wear, or damage to any connector in your test system will introduce unknown errors to your measurements and reduce the life of the connection device.

## Recommendations

- Inspect connectors every 20 connections for signs of damage and wear
- Remove any dirt and metal flakes
- Discard and replace damaged or worn connectors

## Visual Inspection: Check for

- Damage and dirt that can significantly degrade repeatability and accuracy
- Gold plated surfaces are especially sensitive to connector damage
- Dents, burrs, metal particles, rough spots, and damaged threads
- Bent or damaged inner conductor
- **Never use a damaged connector**

## Cleaning Tools



## Compressed Air

- Filtered
- Vapor and Oil Free
- < 60 PSI

## Isopropyl Alcohol

**While there are other approved cleaning chemicals, it is safe, inexpensive and highly recommended to primarily use Isopropyl Alcohol**

## Cotton Swabs and Lint Free Cloth

### Cleaning Methods

#### Step 1 Compressed Air:

- Gently blow compressed air over the body and inner surfaces.
- Removes large dirt and metal particles

#### Step 2 Body & Threads:

- Cotton Swab moistened with Isopropyl Alcohol
- Clean outer surfaces only, body and threads
- Do not saturate the swab with Isopropyl Alcohol
- Avoid contact with the inner conductor, if possible

#### Step 2 Inner Surfaces:

- Lint free cloth wrapped around an applicator
- Moisten only
- Do not saturate the cloth with Isopropyl Alcohol
- Gently clean the inner surfaces using inner to outer strokes
- Circular strokes will leave lint on the inner leaves
- Avoid contact with the inner conductor, if possible



#### Step 3 Center Conductor:

- Use **EXTREME** caution
- Moisten cloth with Isopropyl Alcohol
- Very gently clean the center conductor
- **Never apply pressure to center conductor**

## Connector Torque

It is extremely important that RF connectors are not over-tightened as the precision parts are easily damaged. Improper torque can affect measurement accuracy. Torque wrenches are available for most types of connector but some are designed for “finger tight” only. A good rule of thumb for “finger tight” is resistance plus a quarter of a turn.

### **Rules for tightening connectors:**

- Use a Torque Wrench whenever possible
- Tighten using thumb and forefinger only
- Never use wrenches or pliers to tighten a connector
- Use “Soft Jaw” Pliers or Channel Locks to remove “stuck” connectors only



### **Proper storage**

Most damage to connectors and or devices employing RF connectors happens during the period they are not in use. Leaving them on a test bench without dust caps or placing them in a box or bag without protection are the most common causes of dirt and damage.

Expensive devices, like directional couplers, RF bridges, detectors and sensors usually come in a preformed storage box. These boxes are carefully designed to protect the device, and they should always be used when the devices are not in use.

It is also good working practice to keep adaptors in a box with foam cutouts to protect them from dirt and damage. A little thought, care, and discipline here will ensure the integrity and accuracy of your measurements, as well as saving money in the long term.

### **Connector gauging**

There are gauging kits available for each type of connector to insure that the mating surface parameters are maintained to highly accurate specifications. These kits are supplied with detailed operation, calibration and adjustment procedures that should be diligently adhered to. Please refer to the connector manufactures data for more information on connector gauging.

## Do's and Do Not's

### Do:

- Inspect and clean all RF connections at regular intervals (Every 20 connects)
- Store connectors, cables and RF devices in protective cases or foam cutouts
- Use dust covers wherever possible
- Use the correct procedure for mating RF connectors
- Use the correct cleaning tools, materials and procedures
- Gauge connectors at regular intervals (100 connections/6 months)
- Tighten connectors to the correct torque
- Use the correct torque wrench where applicable
- Use the correct connector mating technique
- Use a connector saver wherever possible on high cost items

### Do Not:

- Leave connectors laying on the test bench without protection
- Store them in a box or bag without protection
- Use a damaged or worn connector
- Over-tighten connectors
- Use pliers or wrenches to tighten connections
- Touch the inner conductors
- Allow the conductive surfaces to rotate when mating connectors

## conclusions

- A regular connector cleaning and gauging routine, together with the precautions listed here, will help guarantee the accuracy and integrity of your measurements.
- Connectors and cables are an important consideration in measurement accuracy calculations.
- Dirty connectors will damage the expensive mating connectors installed in your test equipment.
- A clean connector environment could save thousands of dollars over time.

