ATX LABS TECH BRIEF

COGNITIVE ERGONOMICS AND ITS APPLICATION TO MICROWAVE INTERFACE GAGING

This Technique Results in an Enhanced Cognitive Interface for the Gaging of Microwave Connectors Providing the User with Immediate Reference to Compliance Data

Cognitive Ergonomics is a term reserved for a body of techniques that are designed to clarify and make more efficient the use of a product or procedure. Common examples include the computer keyboard that uses a cluster of keys that are organized to reflect frequency of use, as well as the graphic interface on a device like an Iphone that uses icon based navigation. There is ample patent art in both these areas. Perhaps the simplest example is the use of red and green bands on a boiler dial, instantly alerting the user to conditions relating to danger and safety.

There are a number of legacy techniques that have enjoyed a somewhat static corner of technology based on relatively dated platforms.

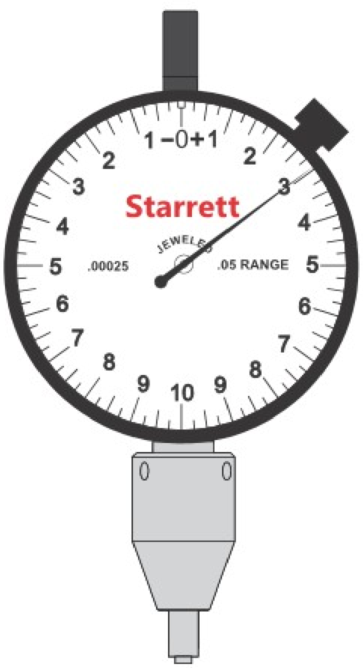

Figure 1

One of the more interesting ones, in terms the opportunity to provide improvements, is the manner in which microwave connectors – from 1.85mm to 7mm – are "gaged" for the determination of interface compliance relative to Standards like IEEE287, MIL-C-39012 and MIL-STD-348. Gaging is motivated by the recognition that the failure to do so may lead to breakage of the center pin on the female connector, or to reduced performance at the connector boundary due to pin and socket misalignment related to the gap between the front plane of a socket and the shoulder of a male pin. A microwave gage is simply a depth indicator in which a fixed part of the gage sits on the outer conductor of the connector, and a movable portion of the gage sits on the front plane of the inner conductor, thereby transmitting a grade difference to the indicator's dial face.

The common legacy technique is to employ a shop indicator based on the ASME B89.1.10-2003 Standard – which provides a framework for everything from the dial size and color to the meaning of the dial's indicia. An example of a common shop dial is given in the first figure.

While having the virtue of familiarity on a shop floor, there is nothing about the legacy art that favors its use in a microwave culture where very specific dimension and tolerance zones are called for. Herein is described a richer ergonomic interface that takes advantage of all the real estate on a dial indicator to promote a better and quicker understanding of compliance – or non compliance – relative to virtually any compliance standard. .

The ordinary interface of a sexed microwave connector is based on the connector being an extension of the TEM transmission line to which it is attached, and the critical dimensions of sexed connectors that are "gaged" are always based on the grade difference between the center pin's shoulder or front plane (an extension of the center conductor) and the outer coaxial body's mating or reference plane plane, (an extension of the coaxial braid). The latter is referred to as the "reference plane" since it is the zero grade reference for the measurement.

Figure 2 is representative of the features being gaged. The illustration shows the sectional view of 1.85mm/2.4mm male and female connectors along with tabular data on their compliant recession specs relative to three standards as well as common industry practice for precision connectors.

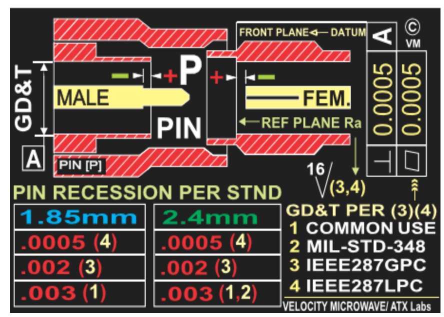

Figure 2

In the Standards mentioned above, it is the call out of this grade difference between reference plane and pin that is the subject of compliance. The following improvements in cognition available to the process of gaging fall into several categories.

The first feature of note is based on the recognition that the various Standards, as well as different sections within the same Standard, have different specifications for the grade difference. For example, MIL-STD-348 calls for a recession of up to 10 mils (0.01) of the male or female SMA pin relative to the reference plane, yet in another section designated for SMA "test" connectors, the compliant recession is reduced to 3 mils (0.003). 1.85mm, 2.4mm, 2.92mm and 3.5mm all have different recession specs depending on the Standard in question. Type N varies across the different standards as well and also within the

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same standard depending on the classification of use.

Thus there is an unmistakable opportunity to make compliance

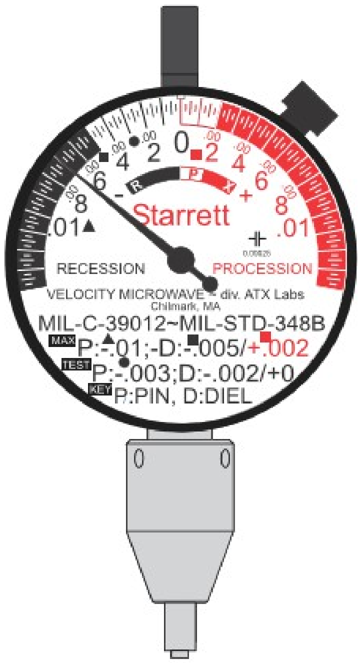

Figure 3

awareness an integral part of the gaging experience without having to look up the specifications called out by a standard. Figure 3 illustrates an example of one of the gage faces developed by ATX for the SMA connector in order to illustrate compliance.

Gage face ergonomic enrichment is also extremely useful for Type N gaging where the legacy master gage that zeroes the instrument is physically machined to match the procession and recession of the actual standard. This makes it virtually impossible to translate between standards on the fly – further necessitating a number of master gages machined differently to match all standards. ATX Labs uses a proprietary bushing that is cut – not to a specific standard – but rather to match the non-coplanar reference plane on both the male and female. This not only makes possible standards invariant gaging, but

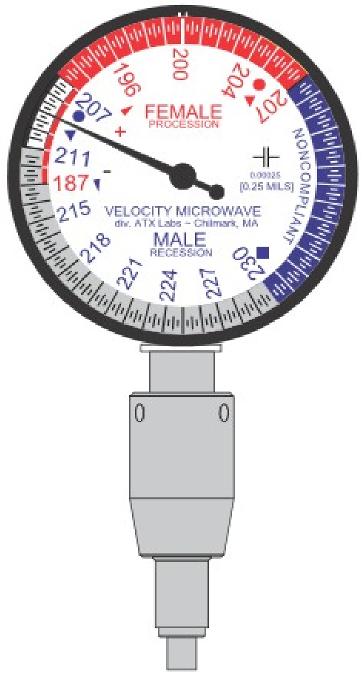

Figure 4

allows the creation of an ergonomic interface that provides compliance information for all standards in the form of literal dial face indicia reflecting actual recession and

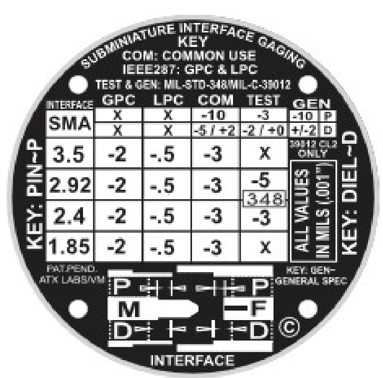

Figure 5

procession values, as illustrated in the fourth figure.

Another useful piece of real estate is on the back of the common AGD2 or AGD1 dial indicator (normally flat for gaging applications) which can provide all relevant Standards information as a way of reinforcing or further clarifying the dial face. Figure 5 illustrates one of the custom metal backs used by ATX to provide a summary of relevant recession specs for the sub-miniature family of connectors consisting of SMA, 2.92mm, 3.5mm, 2.4mm and 1.85mm. Other backs (not illustrated) exist for combined families that include Type N.

ATX Labs manufactures a suite of microwave gages that employ a combination of custom, ergonomically enhanced back plates and fascia to illustrate Standard's compliance for the common microwave connectors. This enhancement is dedicated to the principles that clarity improves compliance, and that compliance has a direct influence on connector life – and therefore indirectly on the life of any component terminated by a connector. Sustainability of a test assembly, as well as anything that connects to an assembly, is supported by frequent gaging as a red flag condition of potential trouble.

This work was done by Victor R. Spelman and Emily Milstein of ATX Labs, Vineyard Haven Massachusetts.