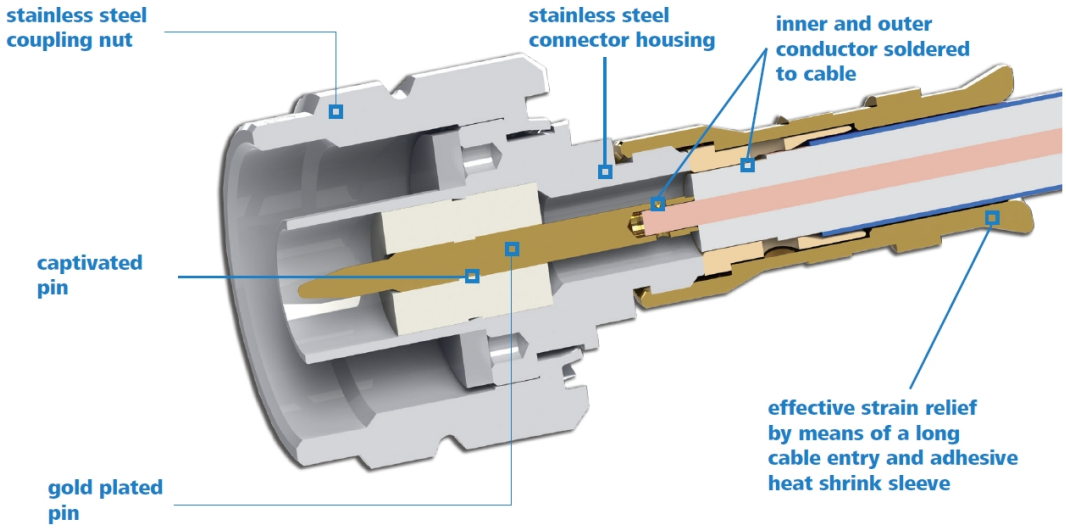
Influence of the test cables on the measurement results

High frequency measuring technology is one of the most demanding fields in telecommunications. Manufacturers of high-quality test and measuring equipment take enormous efforts to ensure that system-related measurement errors are kept to a minimum. Not only the measuring devices themselves but also all the measuring accessories used must work precisely, reliably, and with reproducible results. However, the influence of the test cables on the measurement results is often underestimated.

Measurements can only be as accurate as the measuring devices used. The electronic components are selected according to the strictest quality demands, devices are calibrated regularly and the ambient conditions of the laboratory and measuring benches are kept within defined limits. The measuring accessories are also subject to strict requirements. Nevertheless, the influence of test cables on the accuracy, reliability and reproducibility of the measurement results is not always given sufficient consideration. All too often, low-cost test cables or even standard cable assemblies are used instead of special, high-quality test cables. The result: measuring results which are not exactly reproducible and, therefore, not sufficiently reliable. But what is it that distinguishes a high-quality test cable from conventional rf cables?

Characteristics of high-quality test cables

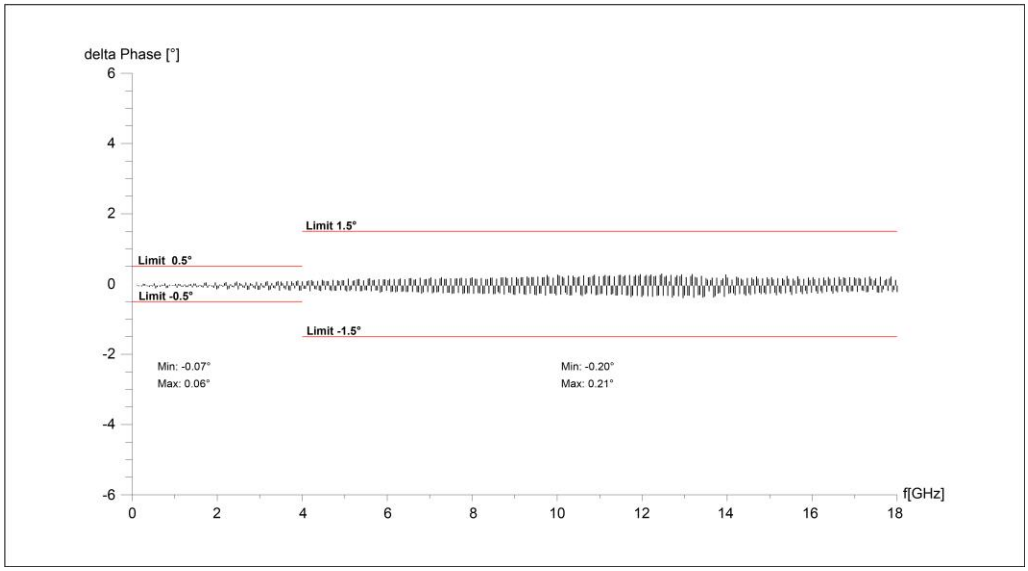
Test cables must be designed for much higher mating- cycles as well as increased bending loads, and at the same time have much tighter tolerances than conventional cables. The design and choice of material, both for the connector and the cable, are decisive.
Stainless steel connector bodies and coupling-nuts, together with gold-plated, captivated inner conductors, guarantee long life and high-precision, as well as long-term stable dimensions at minimum tolerances. The inner and outer contacts of the connector should be soldered to the conductors of the coaxial cable to ensure maximum low-loss, low-reflection signal transition.



TestLine Connector Design

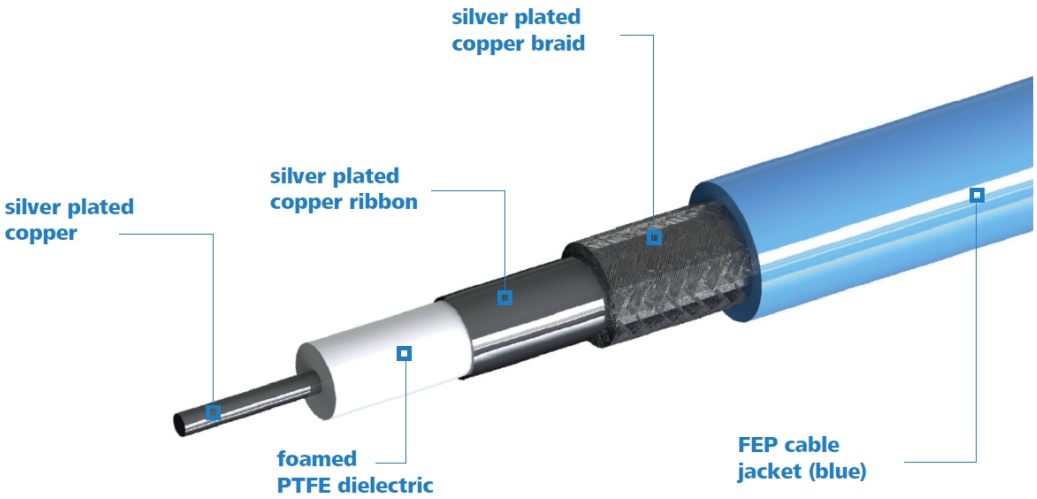
However, excellent connectors alone are not enough. The cable itself must also meet higher demands. For example, test cables are moved more often than conventional coaxial cables.

The cable geometry and the electrical length changes every time the cable is bent and this is reflected in the phase relation between transmitted and received signals. Mechanical changes to the inner conductor, dielectric and outer conductor change the phasing of the signal with regard to the calibrated zero point, as well as its amplitude. The bending stress on the cable, therefore, directly influences the accuracy and reproducibility of the measurement results. The mechanical changes, especially with poor quality cables, are significant and in part irreversible.



Phase change of Telegärtner TestLine cables under bending stress of 90° and a bending radius of 60 mm.

A special cable structure is the solution. An rf-optimised design and carefully selected materials such as silver-plated conductors, foamed PFTE dielectric and an FEP cable sheath enable the production of flexible but nevertheless robust test cables of highest quality. Permanent monitoring during production, product-optimised processes, and continuous quality assurance controls are indispensable.



TestLine Cable Construction

RF transitions are particularly critical

In addition to phase and amplitude stability, the return loss is the third critical variable in the development of rf test cables. Wherever the measurement signal encounters even the slightest non-uniformity – e.g. when mechanical stress alters the geometry of the transmission path or when the materials used change – the impedance jumps and, therefore, frequency- dependent signal reflections are the result. Transitions from one cable to another are in this regard particularly problematical. Where test cables which can be used up to 11 GHz (N-plug) or up to 18 GHz (SMA) are concerned, the return loss and its stability have an influence on the accuracy and the reproducibility of the measurement results.

Synergies for precision

In addition to innovative connector design and cable assembly, self-developed procedures in production and quality assurance are necessary to guarantee high-quality test cables. Each and every TestLine test cable from Telegärtner comes, therefore, complete with a detailed test report.

Research, development, design, production and quality assurance are united at a central location in Germany. This leads to synergies which make such a high level of quality level. Today, "Made in Germany" still stands for quality, long life and reliability. After all, those constantly involved in test and measurement need to be able to rely on their equipment.

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