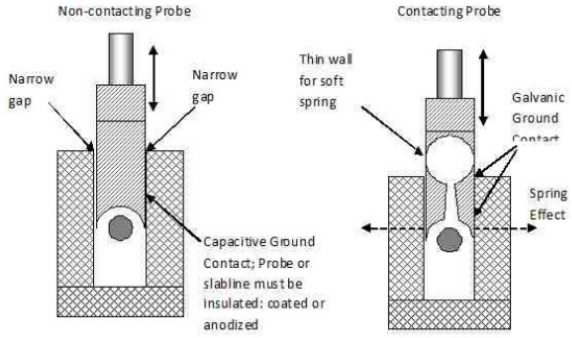
Contacting versus Non-contacting Tuner Probes (Slugs)

There is some controversy in vendor's literature about the advantages and shortcomings of various tuner probe designs.

In slide-screw tuners, as used today, two types of probes are typical:
1. Contacting probes
2. Non-contacting probes.

The difference is the type of ground contact between the probe and the slabline (the probes never touch the center conductor, of course...).

The figure below illustrates the difference:



The differences can be summarized as follows:
1. Non-contacting probes require a higher manufacturing precision in slabline tolerances. It is therefore more difficult to make very long (low frequency) tuners (>250MHz).
2. Non-contacting probes allow microphonism (effect of vibration on RF response), because the probes are free hanging in the slabline (fmax <50GHz).
3. Non-contacting probes do not stress the axis movement, and allow good RF repeatability with lower axis robustness.
4. It is claimed that there is no wear and tear compared to contacting probes.
5. The probe and/or the slabline must be dielectrically coated or anodized, meaning in fact that one of them must be made of Aluminum.

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6. Contacting probes allow higher, resonance-free, instantaneous bandwidth (fmax<65GHz).

7. Contacting probes demand lower tolerances in slabline manufacturing, thus allowing longer slablines and lower frequency tuners (100MHz).
8. No coating or anodizing of either probes or slablines is needed.
9. Contacting probes do not allow microphonism.
10. Contacting probes require a better and more robust design of the vertical axis, due to stress created by the friction of the probe with the slabline walls.
11. Wear and tear happens only when the tuner is misaligned - typically used Brass/Be versus Aluminum friction is self-lubricating.

At Focus we have been experimenting with both Contacting and non-Contacting probes. Due to operational advantages (2, 9), anodization and large bandwidth requirements, the preferred technique is of Contacting probes, even though non-Contacting probes would allow for 3-5dB better repeatability (55 instead of 50-52dB) at Gamma=0.9. In our experience both 50 or 55dB repeatability (0.3% to 0.18%) is fully sufficient for load pull and noise measurement applications.