An Improved Instrumentation/Industrial Compression Fitting

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**Bringing analytical performance to worldwide standard fitting design;
The double ferrule compression fitting**

1. INTRODUCTION

The well known double ferrule assembly has a “swaging” action, i.e. it compresses the tube in at some points and increases tube outside diameter beyond those points, as shown in Figure 1. This design has worked well for industrial applications such as high pressure systems and/or when there is a high level of vibration. The oversize section of the tube beyond the front ferrule makes it very difficult to eject the fitting even if the nut loosens over time. With this safe assembly these types of fitting are universally used in process plants today.

The general acceptance of this design and its easy availability have led analytical system designers to adopt it into analytical instruments and sampling systems. This design has worked well for many early analytical systems with the available instrument detection limits.

However by today’s standards such fitting designs are problematic for instrument manufacturers, system integrators and sampling system builders.

2. DEAD VOLUME

One of the major drawbacks being the dead volume.

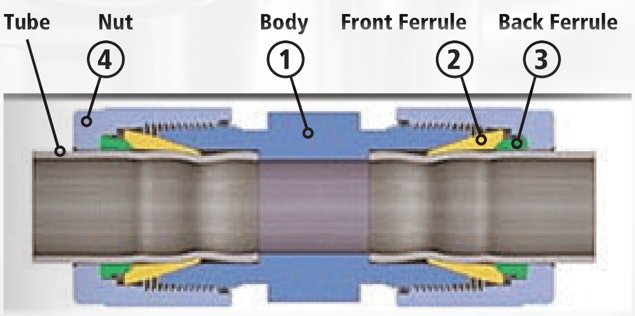

Figure 1: Typical double ferrule fitting.

Indeed, problems caused by dead volumes are much more subtle, sometimes these situations are confused with leaks. In fact, dead volumes may be thought as virtual leaks.

Here are some real situations that have happened to many of us. To explain this, refer to Figure 2, which shows the simplest gas chromatographic configuration. Lets select a very common GC application, where the carrier is helium, the column is based on a 1/8”OD molecular sieve and the detector is a helium ionisation type. Such a configuration is used for permanent gas measurements. On both ends of the column, there is a double ferrule type column end fitting.

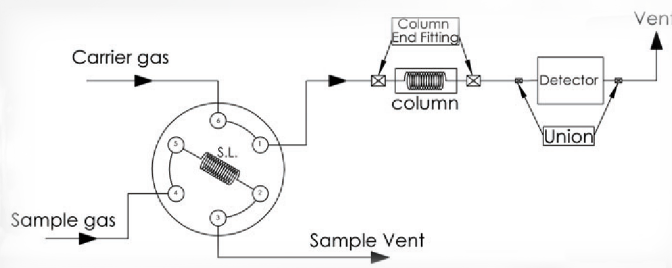

Figure 2: Simple GC configuration

After the system starts, helium is passed through and the column is regenerated to purge away any contaminants. Figure 3 shows the detector signal after system stabilisation.

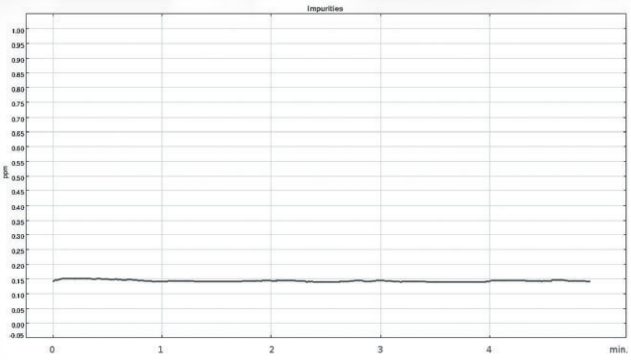

Figure 3: Stabilized detector signal after start-up

Figure 4 shows the same signal when carrier flow is decreased and then restored. When carrier flow is decreased, the signal increases due to dead volume accumulated gas diffusing back into the carrier. This increases the impurity level into the detector, hence increasing the signal.

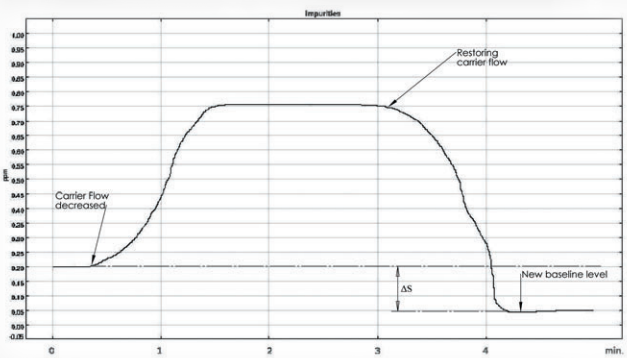

Figure 4: Effect of flow variation over signal

Restoring the flow dilutes the impurity level into the carrier gas, so signal goes down. As can be observed on Figure 4, the signal is now lower compared to the beginning of the trend. This is due to the fact that there is less contaminant entrapped in the dead volume. Varying system flow or pressure is an excellent method for finding leaks into a gas chromatographic system.

Looking at the signal trend of Figure 4, it would lead you to think that there is leaks and air diffusion into the system. The normal reaction would be to retighten fittings until the signal goes down.

By retightening the fittings, the ferrules are pushed forward and tubing OD increases once again, decreasing dead volumes. This causes the entrapped contaminant to be forced back into the carrier gas and detector.

The signal shown in Figure 5 is typical of such a situation. Varying the flow or pressure to recheck for leaks would again generate a signal similar to Figure 4, but with less amplitude. Once more, with the best of intentions, someone observing this would retighten further the fittings, thinking that there are leaks. Since there are also unions and other fittings at various points in the system, it makes the problem even worse! Eventually, while attempting to resolve these virtual leaks, fittings will become overtightened, and real leaks will be generated.

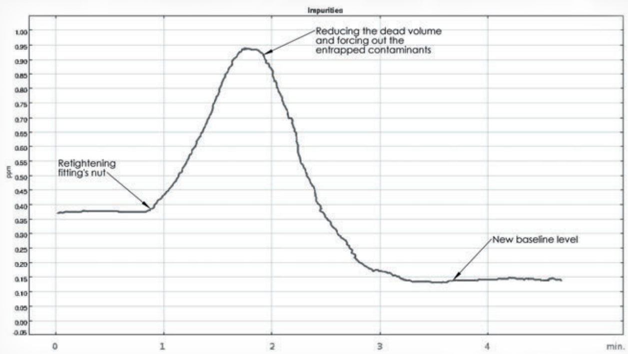

Figure 5: Effect of retightening a double ferrules fitting

3. GC SYSTEM ERRATIC WORKING BEHAVIOUR CAUSED BY DEAD VOLUME

Another erratic result can appear when injecting a relatively large sample volume. Injecting such a large volume suddenly reduces system pressure, generating a «ghost» peak. This results from trapped contaminants in dead volume diffusing back into the carrier. The larger the tubing size or higher the system sensitivity, the worse the problem.

As a former process GC manufacturer, we have experienced these problems many times before. Colleagues in the field have reported similar system issues.

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4. OUR DESIGN

Combine analytical performance and robustness of legacy industrial design, with improve leak detection capability while maintainimg existing system compatibility.

As an improvement to the universal industrial double ferrule fitting design, we have patented the LipLOK design. This design uses two seal points, the first being the 'coated sealing ring' which is compression fitted to the tube end. Having the seal point placed here allows minimum loss of analytical performance. This fitting is similar to the VCR™ fitting but has less dead volume in the flowpath. This analytical grade seal performance is achieved between the tube end and the sealing ring feature using a very low torque- almost finger tight.

The double ferrule design provides the second level of sealing, which resists the effects of vibration and protects against ejection of the tube from the fitting. This is achieved without transferring excessive force to the sealing ring.

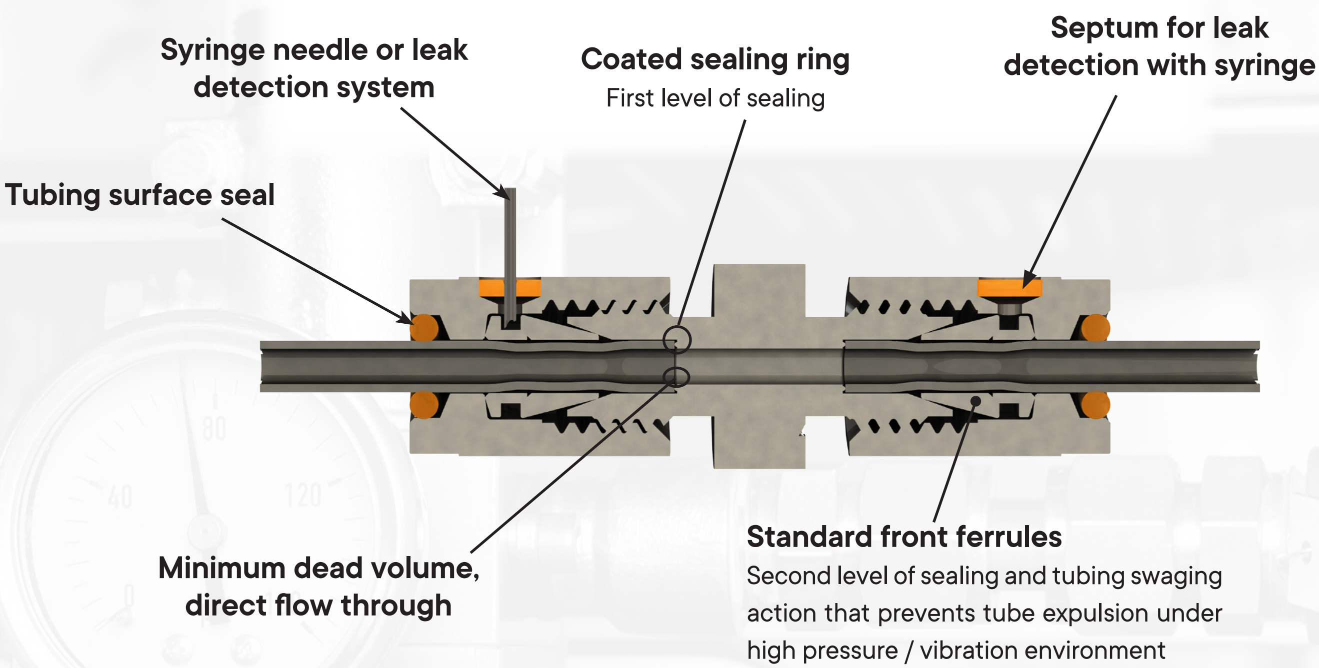

Figure 6

FEATURES & BENEFITS

- ☐ No dead volume effect
- ☐ Better sealing integrity
- ☐ Lower torque
- ☐ Sniffing hole through the nut having a septum, for leak detection purpose

There is now a surface seal added to the fitting nut and a seal or septum in the sniffing hole. Any leak developing inside the fitting will be forced to accumulate in the leak chamber space. The pressure will built up in this chamber until a value where it will go through or around the septum. Inserting the needle of a sniffer or leak detection apparatus allow sensitive leak detection since the leak is concentrated into this chamber. This is shown in figure 7.

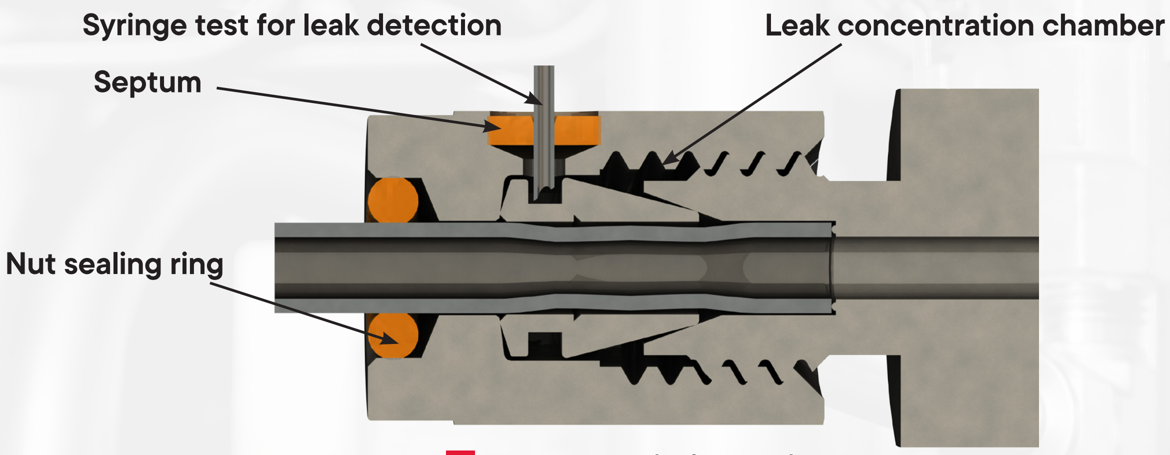

Figure 7, Leak Flow Path

Figure 8 shows the combined effect on the assembly torque of the sealing ring and the double ferrule. Only a very low torque is required to make a tight connection at the sealing ring feature. Tests have demonstrated that a finger tight torque will seal. However, high pressures require a more robust hold on the tubing. This is achieved by the swaging action of the ferrules.

Additionally, the sealing ring keeps the pressure exerted by the fluid inside the tube and not in the fitting body. Consequently when a fitting is properly mated, the front ferrule is not exposed to process pressure.

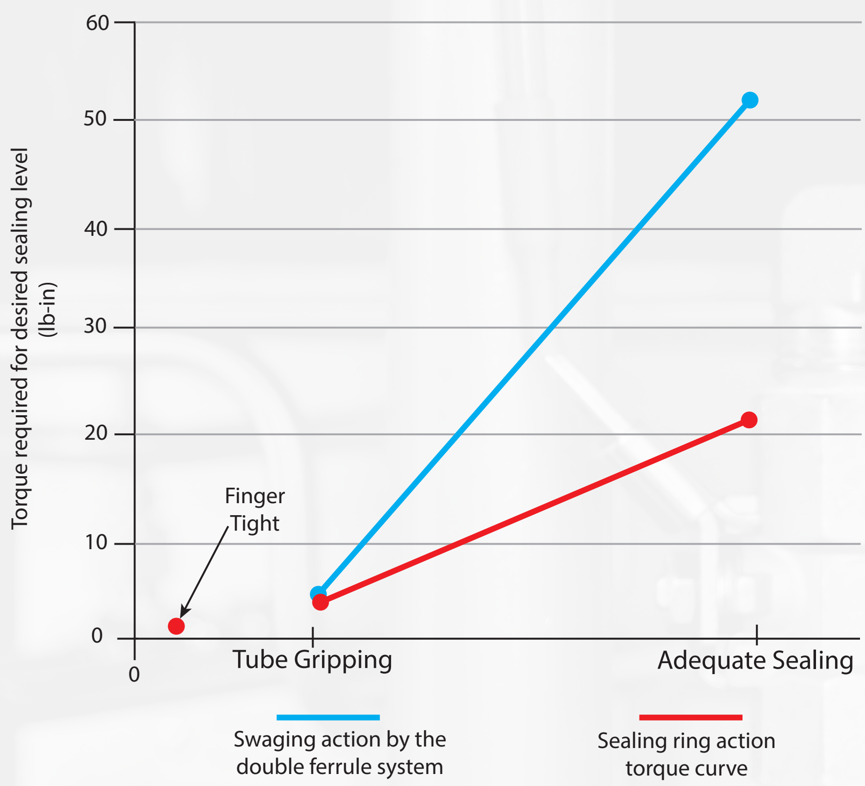

Figure 8, Torquing Value

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