Choosing the Ideal Ferrule for Your GC Application

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Abstract
A range of ferrules are available to connect a GC column to the inlet and detector interface. Here, the relative merits of each type of ferrule are assessed to aid in selecting the best ferrule for an application.

Introduction

Ferrules are an important and often overlooked part of a GC system. Their role is two-fold: primarily, to provide a leak free connection between the column and the inlet/detector, and secondarily, to hold the column securely in the GC system and ensure that it is correctly positioned in the inlet/detector. If a leak-tight seal is not created, air and water can enter the column and cause rapid degradation of the column stationary phase, which results in high baselines and short column lifetimes. Air and water may also enter the mass spectrometer detector, if used, and cause rapid oxidation of the components, reducing sensitivity, maintenance intervals, and instrument lifespan. In addition, if a column is not inserted to the correct depth, sample transfer onto and off the column will be compromised, leading to poor peak shape and sensitivity.

It is important that an appropriately sized ferrule be used for a column. If a ferrule made for a 0.53 mm column is used on a 0.25 mm column, a poor seal will be made, causing leaks and poor instrument performance.

Most GC systems are fitted with 100% graphite ferrules on the inlet/detector unless the system has an MS detector, in which case, 15% graphite/85% Vespel® ferrules are supplied on the MS. This means most customers are not aware of the other ferrule options available. Thermo Scientific™ provides several types of ferrules that are suited to different applications, each of which are discussed in this guide.

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100% Graphite Ferrules

100% graphite ferrules (Figure 1) are suitable for most interfaces and are supplied as standard on a new GC instrument. This means they are the most common type of ferrule used for GC analysis. Graphite is porous to oxygen; therefore, these ferrules must not be used on MS detector interfaces. (This is not a problem at the inlet as any oxygen is removed through the split line.) They provide a "soft" seal around the column and may be re-used by sliding them along the column before column trimming and then re-positioning and re-tightening them. No tightening is necessary after installation, as the ferrules do not shrink on heating.

Because 100% graphite ferrules are soft in nature, they are prone to plugging the interface with graphite fragments, which build up over time. This can result in the column becoming partially or fully blocked and lead to poor peak shape. Thermo Scientific provides a range of alternative products that do not suffer the same drawbacks as graphite ferrules, these are detailed in the following sections.

15% Graphite/85% Vespel Ferrules

15% graphite/85% Vespel ferrules are usually supplied with a new GC-MS instrument to connect the column to the MS detector, although they may be used for all other interfaces. The 15% graphite/85% Vespel ferrules are used at the MS interface as they are non-porous to oxygen, thus prohibiting oxygen from entering the MS. Unlike 100% graphite ferrules, they are not re-useable. However, they can be removed without breaking or shortening the column.

15% graphite/85% Vespel ferrules must be re-tightened after initial temperature cycles because they shrink slightly at high temperature, which leads to small leaks. After re-tightening, a good seal is formed for the life of the connection. Care must be taken not to over-tighten the connection, as this can damage transfer lines and crack the ferrule, leading to leaks.

Figure 1: 15% graphite/85% Vespel ferrules

SilTite Metal Ferrules

Thermo Scientific SilTite™ metal ferrules (Figure 2) are similar to the 15% graphite/85% Vespel ferrules, except they are made from metal and are suitable for MS detectors and Thermo Scientific TRACE™ 1300/1310 and Agilent® split/splitless (SSL) injectors. They are not available for Thermo Scientific TRACE ULTRA SSL injectors. They require the use of SilTite nuts made from the same material as the ferrule. Both parts have the same thermal expansion coefficient to form a reliable, permanent seal that does not need re-tightening.

The disadvantage of these ferrules over 15% graphite/85% Vespel ferrules is that the ferrule cannot be removed from the column once tightened. This means if it is incorrectly positioned, the column must be cut before another ferrule can be attached. This makes them more suitable for use on the detector end of a system where column re-positioning is less frequent.

If the column is to be removed for storage, capping the column end with a Thermo Scientific Capillary Column End Cap (p/n 260EC111) instead of a septum allows the ferrule to remained attached and no trimming is required before re-installation.

Figure 2: SilTite metal ferrules

Finger Tite Connectors

Thermo Scientific Finger Tite Connectors (Figure 3) are similar to the SilTite ferrules and permanently attach to the column. They feature inlet and detector interface adapters and a custom nut enabling the ferrule to be tightened by hand without tools. They are available for Thermo Scientific and Agilent SSL inlets, MS detectors and flame ionization detectors (FID). Ferrules are available only for columns up to 0.32 mm internal diameter.

The advantage of this system is that the column can be removed by hand without cooling the inlet/detector port (however, the oven must still be cooled). This is possible as the nut is designed so that it does not get too hot to touch. A supplied tool is used to attach the ferrule to the column, and the column is tightened in the SSL/FID by hand.

These ferrules are particularly advantageous in high throughput laboratories where downtime must be avoided. They enable columns to be changed or maintained while injector/detectors are hot, thus reducing the risk of burns to the operator. Additionally, they will not plug the inlet with graphite and do not require re-tightening.

As with SilTite ferrules, capping the column with a Capillary Column End Cap (p/n 260EC111) for storage means that the column can be re-installed without the need to trim the ends as would be required if capped with a septum.

Figure 3: Finger Tite connectors

Quick Column Change (QCC) Kits

The QCC devices use 100% graphite ferrules similar to those described in Section 1 that share the same merits and disadvantages. Where the QCC device differs is in the use of a specially designed nut that can be tightened by hand without the need for tools. This is advantageous as it prevents the operator from over-tightening the ferrule leading to inlet/detector port blocking. Unlike with Finger Tite connectors, the injector/detector port must be cooled to prevent burning the operator, but the ferrule may be re-used by sliding it along the column and re-tightening it.

The QCC device is available for Thermo Scientific and Agilent split/splitless inlets, FIDs, and thermal conductivity detectors (TCD). For Agilent systems, an inlet port adapter is required along with different ferrules (included in the QCC kits).

Summary

To quickly select the most appropriate ferrule for your GC system, refer to Table 1 below. For a summary of the properties of the different ferrules shown in this guide, refer to Table 2 below.

	100% Graphite	15% Graphite / 85% Vespel	SilTite	Finger Tite	QCC
Suitable for Thermo Scientific TRACE ULTRA SSL Injector	x	x		x	x
Suitable for Thermo Scientific TRACE 1300/1310 & Agilent SSL Injectors	x	x	x	x	x
Suitable for Thermo Scientific TRACE ULTRA non-MS detectors	x	x		x	x
Suitable for Thermo Scientific TRACE 1300/1310 & Agilent non-MS detectors	x	x		x	x
Suitable for all Thermo Scientific & Agilent MS detectors		x	x	x	
Suitable for Thermo Scientific PTV Injector	x	x			

Table 1: Ferrule instrument compatibility table

	100% Graphite	15% Graphite / 85% Vespel	SilTite	Finger Tite	QCC
Re-useable	x				x
Removable from column after use	x	x			x
Can be touched when hot				x	
Requires re-tightening		x			
Porous to oxygen	x				x

Table 2: Ferrule properties table

The main points about each ferrule are summarized below to aid in selecting the best one for an application.

100% Graphite Ferrules

- Most commonly used ferrule for GC interfaces
- Suitable for most inlets/detectors, not suitable for MS detector interfaces
- Particularly useful for inlets/detectors requiring frequent column maintenance and/or column changing
- Prone to plugging interface with graphite if ferrule is over-tightened

15% Graphite/85% Vespel Ferrules

- Most commonly used ferrule for MS detectors, but suitable for all interfaces
- Must be re-tightened after initial temperature cycles
- Care must be taken not to over-tighten and damage the ferrule and potentially damage the transfer line

SilTite Metal Ferrules

- Available for Thermo Scientific TRACE 1300/1310 and Agilent SSL inlets and all Thermo Scientific and Agilent GC/MS detector interfaces
- Most useful on GC/MS interface. Form a leak tight seal the first time without the need for re-tightening
- Cannot be removed from column once attached, column must be cut to remove the ferrule

Finger Tite Connectors

- Available for Thermo Scientific and Agilent SSL inlets and FID and GC/MS detector interfaces
- Form a leak tight seal first time without the need for re-tightening
- Column can be removed from port by hand while hot, which gives reduced instrument downtime
- As no tools are required, columns installed in a GC/MS interface are less prone to damage from dropped spanners

QCC Kits

- Available for Thermo Scientific and Agilent SSL inlets and FID and TCD detector interfaces
- Use 100% graphite ferrules
- Column can be installed and removed by hand without the need for spanners
- Inlet/detector must be cooled before maintenance
- Reduces the possibility of over-tightening ferrules leading to less injector/detector port plugging from graphite build-up

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