

Glass Insert Selection Guide for GC and GC-MS

# GC/GC-MS Glass Insert/Liner Selection Guide



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## 1-1. Glass Inserts/Liners

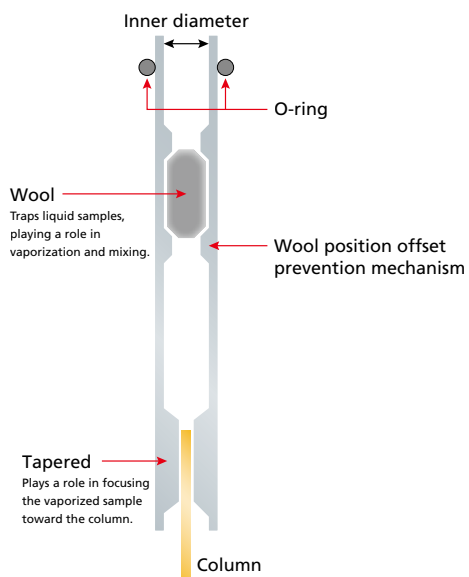
In a gas chromatograph, the sample is injected into the column via the injection unit. A glass insert / liner is used to vaporize the sample more efficiently, and to inject the vaporized sample into the column with no unnecessary dispersion. Additionally, using a glass insert reduces the extent to which contaminants such as high boiling point compounds from the sample contaminate the injection unit. Accordingly, selecting a glass insert appropriate for the objective heightens the accuracy of analysis and leads to more reliable results.

When selecting a glass insert, various selection standards are used depending on the application. For example, the following cases can be cited as selection standards for glass inserts.

- What type of injection unit is used? What sample injection method is used during analysis?
- Is the glass insert filled with wool (glass wool)? What shape is the glass insert?
- What are the dimensions of the glass insert?
- Is surface treatment of the glass insert necessary?

Glass inserts with a variety of specifications are commercially available to suit these varied selection criteria, so selecting a glass insert can be daunting.

This selection guide describes how to select an appropriate glass insert for the objective/application as well as points to consider in accordance with elements of the glass insert configuration. Additionally, this guide introduces glass inserts appropriate for your Shimadzu GC system.



Schematic Diagram of the Glass Insert and O-Ring



Element	Parameter	Explanation	Role
Wool	Position	Wool position within the glass insert	Controls the vaporization point
	Amount of filler	Weight of the wool	Controls the vaporization efficiency
Inner Diameter	Inner diameter	Inner diameter of the glass insert	Impact on the delivery rate of the vaporized components
	Capacity	Internal volume of the glass insert	Impact on the upper limit of the injection volume
Shape	Wool position offset prevention mechanism	Protrusion within the glass insert on the order of 1 mm	Prevents offset of the wool position
	Tapered	A narrowing of the inner diameter at the bottom of the glass insert on the order of 1 mm	Focuses the vaporized sample toward the column tip
Surface Treatment		Chemical treatment of the surface of the glass insert	Impact on adsorption and degradation of compounds

## 1-2. Sample Injection Unit/Injection Method

The glass insert is designed in accordance with the sample injection method. This section introduces typical sample injection unit and injection methods.

Select a glass insert suited to the sample injection unit and injection method being used.

Sample Injection Unit	Injection Method	Glass Insert	Target Sample	Sample Injection	Compatible Columns
SPL	Split	Split glass insert, Split/Splitless glass insert	Medium to high-concentration samples	The sample is instantaneously vaporized, and some of it is injected into the column.	0.1 mm to 0.53 mm capillary columns
	Splitless	Splitless glass insert, Split/Splitless glass insert	Low-concentration samples	The sample is vaporized, and a large portion of it is injected into the column.	0.1 mm to 0.53 mm capillary columns (Wide diameter columns are more suitable)
WBI	Full volume injection (Direct)	Splitless glass insert/WBI glass insert	No concentration restriction	The sample is instantaneously vaporized, and the full amount is injected into the column.	0.53 mm capillary columns
OCI	Full volume injection (Direct)	OCI glass insert	Samples with a wide range of boiling points, and samples with ultra-high boiling points	The entire sample solution is injected into the column before vaporization.	0.25 mm to 0.53 mm capillary columns
PTV	Heated split	PTV glass insert	Medium to high-concentration samples prone to thermal decomposition, and samples with a wide range of boiling points	A heating program is used to vaporize the compounds in the sample in order of boiling point. A portion is then injected into the column.	0.1 mm to 0.53 mm capillary columns
	Heated splitless	PTV glass insert	Low-concentration samples prone to thermal decomposition, and samples with a wide range of boiling points	A heating program is used to vaporize the compounds in the sample in order of boiling point. A large portion is then injected into the column.	0.1 mm to 0.53 mm capillary columns (Wide diameter columns are more suitable)
SINJ/DINJ	Full volume injection (Direct)	Packed glass insert	No concentration restriction	The sample is instantaneously vaporized, and the full amount is injected into the column.	Packed Columns

Refer to the following for details on the types of sample injection unit.

[Details](#) 

# Glass Insert Selection



## 2-1. Glass Inserts by GC Model/Sample Injection Unit

This section introduces frequently used, general-purpose glass inserts for each GC model, sample injection unit, and injection method. If you are having difficulty making a selection, it is recommended that you start by selecting from the following lineup. The full glass insert list is provided in Chapter 4, so use that in combination with this section.

### Nexis GC-2030

GCMS-QP2020 NX  
GCMS-TQ8040 NX  
GCMS-TQ8050 NX

### Brevis GC-2050



GC-2030



GC-2050

### SPL (Split)

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature	
1		227-35007-01	5	✓	95	4.9	3.4	863	Inactivation treatment	350°C	<div style="background-color: #0070C0; color: white; padding: 2px;">General purpose item</div> <div style="background-color: #FFC000; color: white; padding: 2px;">Standard accessory</div>

### SPL (Splitless)

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature	
19		227-35008-01	5	✓	95	5	3.4	654	Inactivation treatment	350°C	<div style="background-color: #0070C0; color: white; padding: 2px;">General purpose item</div> <div style="background-color: #FFC000; color: white; padding: 2px;">Standard accessory</div>

### WBI (Full Volume Injection)

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature	
19		227-35008-01	5	✓	95	5	3.4	654	Inactivation treatment	350°C	<div style="background-color: #0070C0; color: white; padding: 2px;">General purpose item</div> <div style="background-color: #FFC000; color: white; padding: 2px;">Standard accessory</div>

## Nexis GC-2030

GCMS-QP2020 NX  
GCMS-TQ8040 NX  
GCMS-TQ8050 NX

## Brevis GC-2050



GC-2030

GC-2050

### SINJ+WBC Attachment (WBC Full Volume Injection)

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (µL)	Surface Treatment	Heat Resistant Temperature
34		221-38107-02	1	---	126	4.8	3.4	870	None	450°C

### OCI-2030 Insert (Metal)

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (µL)	Surface Treatment	Heat Resistant Temperature
25		221-49298-91	1	---	103	2	1	81	None	450°C

Note: Cannot be used with the OCI-2030 NX.

### Simple OCI Insert

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (µL)	Surface Treatment	Heat Resistant Temperature
27		221-49381-02	1	---	95	3.5	0.8	48	Inactivation treatment (Silanizing treatment)	350°C

Note: Cannot be used with the OCI-2030 NX.

### OCI-2030 NX Insert (Metal)

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (µL)	Surface Treatment	Heat Resistant Temperature
28		221-85694	1	---	11.5	-	-	-	None	450°C

Note: Note: This can only be used with the OCI-2030. This cannot be used with OCI-2030 NX.

### PTV (Heated Split/Heated Splitless)

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (µL)	Surface Treatment	Heat Resistant Temperature
30		221-49300	1	---	95	3.5	1.5	168	None	450°C

General purpose item  
Standard accessory

### SINJ (Packed Column Full Volume Injection)

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (µL)	Surface Treatment	Heat Resistant Temperature
32		221-80902	1	---	93	5	3.4	726	None	450°C

Standard accessory

## GC-2010 series

GCMS-QP2010 SE  
GCMS-QP2020  
GCMS-TQ8050/8040/8030



GC-2010

### SPL (Split)

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature	
1		227-35007-01	5	✓	95	4.9	3.4	863	Inactivation treatment	400°C	General purpose item
2		221-41444-01	1	---	95	4.9	3.4	863	None	450°C	Standard accessory
21		225-20803-01	5	✓	95	5	3.5	914	Inactivation treatment	350°C	

- 227-35007-01 can be used with the GC-2010 series. The wool filling position differs from the recommended position for the 2010 series. If it is used in the default position, the form is such that as with the GC-2030, the tip of the syringe needle will enter the wool.
- 221-41444-01 is a standard accessory for the GC-2010 unit.
- 225-20803-01 has a history of being recommended for GCMS with the GC-2010 series.

### SPL (Splitless)/WBI (Full Volume Injection)

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature	
19		227-35008-01	5	✓	95	5	3.4	654	Inactivation treatment	400°C	General purpose item
20		221-48335-01	1	---	95	5	3.4	654	None	450°C	Standard accessory
6		221-48876-03	5	✓	95	5	3.4	654	Inactivation treatment	350°C	

- 227-35008-01 can be used with the GC-2010 series.
- 221-48335-01 is a standard accessory for the GC-2010 unit.
- 221-48876-03 has a history of being recommended for GCMS with the GC-2010 series.

### OCI Insert (Metal)

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature
25		221-49298-91	1	---	103	2	1	81	None	450°C

### Simple OCI Insert

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature
27		221-49381-02	1	---	95	3.5	0.8	48	Inactivation treatment (Silanizing treatment)	350°C

### PTV (Heated Split/Heated Splitless)

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature	
30		221-49300	1	---	95	3.5	1.5	168	None	450°C	General purpose item Standard accessory

## GC-2014 series



GC-2014/GC-2014s/GC-2014c

### SPL (Split)

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature	
1		227-35007-01	5	8.5	95	4.9	3.4	863	Inactivation treatment	350°C	General purpose item
3		221-41444 221-41444-84	1 5	---	95	5	3.4	863	None	450°C	Standard accessory

- 227-35007-01 can be used with the GC-2014 series. The wool filling position differs from the recommended position for the 2014 series.
- 221-41444 is a standard accessory for the GC-2014 unit. It is not wool filled.

### SPL (Splitless)/WBI (Full Volume Injection)

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature	
19		227-35008-01	5	✓	95	5	3.4	654	Inactivation treatment	400°C	General purpose item
20		221-48335-01	1	---	95	5	3.4	654	None	450°C	Standard accessory

- 227-35008-01 can be used with the GC-2014 series.
- 221-48335-01 is a standard accessory for the GC-2014 unit. It is not wool filled.

### SINJ/DINJ+WBC Attachment (WBC Full Volume Injection)

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature
33		221-38107	1	---	139	4.8	3.4	988	None	450°C

### SINJ/DINJ (Dia. 3.2 mm Packed Column Full Volume Injection Method)

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature	
37		221-14093 221-14093-84	1 5	---	139	4.4 (Tip 2.9)	3.5	1104	None	450°C	Standard accessory

- 221-14093 and 14093-84 are used for glass-packed or SUS-packed columns with a diameter of 3.0 to 3.4mm.

### SINJ/DINJ (Dia. 2.6 mm Packed Column Full Volume Injection Method)

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature	
38		221-14094 221-14094-84	1 5	---	139	4.4 (Tip 2.3)	3.4	825	None	450°C	Standard accessory

- 221-14094 and 14094-84 are used for glass-packed columns with a diameter of 2.4 to 2.8mm.



## GC-2025



GC-2025

### SPL (Split)

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature	
1		227-35007-01	5	8.5	95	5	3.4	863	Inactivation treatment	350°C	General purpose item
3		221-41444 221-41444-84	1 5	---	95	5	3.4	863	None	450°C	Standard accessory

- 227-35007-01 can be used with the GC-2025. The wool filling position differs from the recommended position for the 2025. If it is used in the default position, the form is such that as with the GC-2030, the tip of the syringe needle will enter the wool.
- 221-41444 is a standard accessory for the GC-2025 unit. It is not wool filled.

### SPL (Splitless)/WBI (Full Volume Injection)

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature	
19		227-35008-01	5	✓	95	5	3.4	654	Inactivation treatment	400°C	General purpose item
20		221-48335-01	1	---	95	5	3.4	654	None	450°C	Standard accessory

- 227-35008-01 is a wool filled glass insert that can be used with the GC-2025 series.
- 221-48335-01 is a standard accessory for the GC-2025 unit. It is not wool filled.

## HS-10



HS-10

With the HS-10 headspace sampler, the transfer line is connected to the GC SPL injection port. The sample is injected from the HS to the GC.

The HS-10 glass insert is used for the SPL.

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature
40		227-35014-01	1	---	95	5	1.2	107	Inactivation treatment	350°C

Shimadzu HS-20 series Headspace sampler has a short transfer line design that reduces carryover and enables highly sensitive analysis.

A glass insert is not required for HS-20 series because a column can be connected to them without going through a injection units such as SPL.

## 2-2. Glass Insert Selection by Application

### SPME/SPME Arrow Analysis

The solid phase micro extraction (SPME) method concentrates volatile components in SPME fibers, for sample loading into GC and GCMS systems. Analysis can be performed by the AOC-6000 Plus multi-functional autosampler system.

Refer also to C146-E424 "Smart SPME Fibers and Arrow Selection Guide".

[Brochure](#)



AOC-6000 Plus

Favorably shaped peaks can be obtained by selecting the optimal GC injection port glass insert for the Smart SPME fibers or Smart SPME Arrow. If an ordinary glass insert for liquid injection is used when using Smart SPME fibers, the bandwidth for low boiling point compounds widens, leading to wider peak shapes. For this reason, with the SPME method, use glass inserts with as narrow an inner diameter as possible to obtain sharp peaks.

### SPME

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature
18		221-75196	5	---	95	5	0.8	48	None	350°C

When using Smart SPME fibers, select a glass insert with a narrow 0.8 mm inner diameter for SPME.

### SPME Arrow

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature
41		227-35327-03	3	---	95	5	1.3	126	None	350°C
42		227-35328-03	3	---	95	5	1.7	216	None	350°C

· When using Smart SPME Arrow with an outer diameter of 1.1 mm, use glass inserts for SPME Arrow with an inner diameter of 1.3 or 1.7 mm.

· When using Smart SPME Arrow with an outer diameter of 1.5 mm, use glass inserts for SPME Arrow with an inner diameter of 1.7 mm.

### Aqueous Solvent Analysis



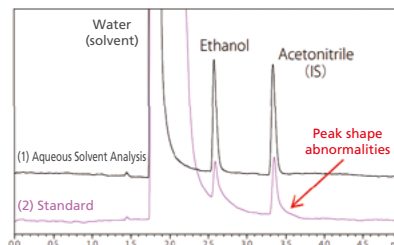
### GC-2030/GC-2050/GC-2010 series/GC-2014 series/GC-2025

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature
39		227-35015-01	5	✓	95	5	3.4	863	Inactivation treatment	400°C

227-35015-01 is a glass insert for aqueous solvent analysis. The shape, wool amount, and wool filling position are optimized, enabling stable sample vaporization and good repeatability.

Application News (01-00328) introduces examples of the use of glass inserts for aqueous solvent analysis.

[Application](#)



Measurement Results for a Standard Solution for Alcohol Concentration Measurements (TCD)

## SPL (Split/Splitless)



### GC-2030/GC-2050/GC-2010 series/GC-2014 series/GC-2025

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature
8		227-35016-01	5	✓	95	5	3.5	847	Inactivation treatment	350°C

The 227-35016-01 split/splitless glass insert can accommodate two injection methods with one. This insert, with its high wool content, is suitable for the analysis of relatively stable compounds. Delicate compounds like pesticides may be prone to accelerated degradation. If you cannot get good analysis results with this split/splitless glass insert, the 227-35007-01 split insert and the 227-35008-01 splitless insert, which are better optimized for each injection method, are recommended.

- The lower taper of this insert may pose resistance issues, especially when high split flow rates are configured, particularly when using large-diameter columns.
- This insert, with its high wool content, is well-suited for relatively stable compounds. Delicate compounds like pesticides may be prone to accelerated degradation.
- This insert has wool located in the upper part, which results in poor transition for relatively high-boiling compounds.



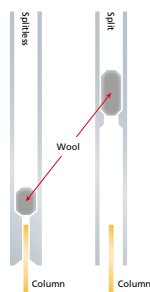
This section describes glass insert selection methods.

## Selecting the Glass Insert Wool

Wool is used inside the glass insert when performing SPL, WBI, and PTV analysis. The wool traps the liquid sample injected into the glass insert, promoting efficient vaporization. The two main wool substances are hard glass and quartz glass. This section describes the role of the wool, and cautions when filling the glass insert with wool.

### Wool Filling Position

In many cases, the liquid sample is vaporized at the wool surface or within the wool plug. In other words, the wool position is the site at which the sample vaporizes, so controlling the position of the wool controls the timing of the sample vaporization.



**In splitless analysis with a smaller flowrate of the carrier gas and direct analysis, the glass insert is generally filled with wool all the way to the bottom.**

If the vaporization site is too far away from the column inlet, it will take time for the vaporized sample to reach the column inlet, which can cause reduced sensitivity and peak shape problems. Additionally, there is a risk that the vaporized sample will spill over the top of the glass insert, leading to reversed flow or deviation from the septum purge flowrate. Caution is necessary when injecting 3  $\mu\text{L}$  or more of the sample.

In split analysis with a larger total flowrate of the carrier gas, the top of the glass insert is generally filled with wool.

If the top is filled with wool, the syringe needle tip and the top edge of the wool tend to be in close proximity or contact. As a result, when the liquid sample is injected, the direction of scatter of the liquid from the syringe needle tip is uniform, leading to improved repeatability of area values.

### Wool Filling Position

The amount of wool filling differs depending on the vaporization chamber and the injection method, but is generally between 2 mg and 20 mg.

The liquid sample is vaporized by the heat provided not only by the carrier gas but also by the filled wool. In particular, if the inside of the glass insert is not filled with wool, the liquid sample will not vaporize sufficiently, and repeatability will drop. The amount of heat provided by the wool changes depending on the amount of wool filler, so adjust the amount of wool filler if you are concerned about repeatability during liquid sample analysis.

**In split analysis, the amount of wool filler must be increased to improve the sample vaporization efficiency.**

The greater the amount of wool filler, the more efficient the sample vaporization, but this can also cause adsorption and degradation depending on the compound.

In splitless analysis, in which the sample retention time within the glass insert is long, if the amount of wool filler is large, excessive heat might be applied to the sample, which can cause sample adsorption or degradation. When increasing the amount of wool filler, be careful of adsorption and degradation of compounds in the sample. **With splitless analysis and direct analysis in pursuit of sensitivity, when analyzing target compounds that are comparatively prone to adsorption and degradation, it is recommended that you reduce the amount of wool filling for the analysis.**

## Recommended Filling Position and Amount of Filler for Each Model

If purchasing a glass insert with no wool, and then filling the wool yourself, pay attention while filling to the amount and position of the wool. For details on the recommended wool amount and position, refer to the instruction manual and maintenance help for the applicable instrument.

GC Model	Sample Injection Unit	Injection Method	Recommended Amount of Wool	Recommended Wool Position
GC-2030 GC-2050 (SPL)	SPL	Split	10 mg	22 mm from the top surface
		Splitless/Full volume injection	4 mg	67 mm from the top surface (Filled to the tapered bottom)
GC-2014	SPL	Heated split/Heated splitless	1 to 2 mg	22 mm from the top surface
		Split	10 mg	20 mm from the top surface
GC-2025 (SPL) GC-2010 series (SPL)	SPL	Splitless/Full volume injection	2 mg	67 mm from the top surface (Filled to the tapered bottom)
		Split	10 mg	25 mm from the top surface
GC-2010 series	PTV	Heated split/Heated splitless	1 to 2 mg	25 mm from the top surface

Note: The optimal wool position and amount of wool may differ depending on the sample, the measured components, and the injection volume. The above-mentioned are generally recommended values.

In split analysis, it is advisable to pack the upper surface of the wool as flat as possible, as this improves reproducibility. When injecting samples, having the upper surface of the wool as flat as possible is beneficial because it ensures stable sample vaporization, especially when the wool is in close proximity to the syringe tip.

## Other Roles of the Wool

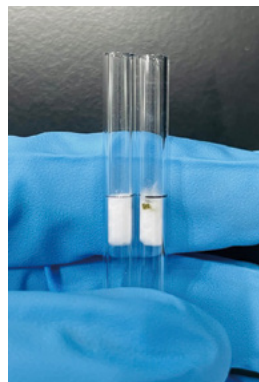
### Trapping Nonvolatile Components

During analysis, as the number of injections increases, so too does the possibility that various nonvolatile components will be injected and accumulate within the sample injection unit.

- Nonvolatile components from the sample
- Contaminants and specks of silicon from the septum
- Metal powder from the syringe

When a large amount of nonvolatile components accumulate, this may have an impact on the analysis results.

Trapping as many of these nonvolatile components as possible with the wool, and reducing column contamination from nonvolatile components, leads to more reliable analysis results. Additionally, trapping nonvolatile components with the wool helps reduce the frequency of replacing columns and the frequency of maintenance for the GC system as a whole.



### Mixing

Filling the glass insert with wool promotes mixing of the sample after vaporization with the carrier gas, reducing discrimination\* during sample vaporization.

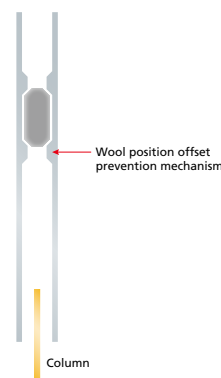
\* Note: Discrimination refers to a structural change that occurs when using a chromatograph to analyze mixed samples containing components with a range of boiling points from low to high.

## Selecting the Shape of the Glass Insert

This section describes the role of the various shapes of glass inserts, as well as points to consider when selecting the shape.

### Wool Position Offset Prevention Mechanism

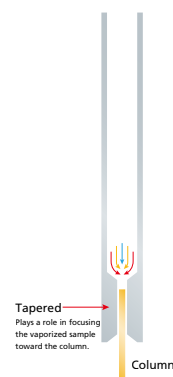
When there is a sudden pressure change in sample injection unit, such as during septum replacement, the wool position is sometimes offset, worsening the repeatability of the analysis results. To prevent wool position offset, some glass inserts are shaped with a protrusion. Using a glass insert with a wool position offset prevention mechanism should provide analysis results with more stable repeatability.



### Tapered Structure

A tapered part is one in which the inner diameter of the glass insert quickly narrows from the top down, from a position at the bottom of the glass inserter (in proximity to the column inlet).

A tapered structure plays a role in focusing the injection of the vaporized sample toward the column. This structure is often used in glass inserts for splitless and direct analysis. In these analyses, in which the total flowrate of the carrier gas is small, the delivery rate of the vaporized sample within the glass insert is slowed. For this reason, using a tapered structure helps the vaporized sample to collect at the column inlet more efficiently.



## Selecting the Inner Diameter of the Glass Insert

This section describes how to select the inner diameter of the glass insert in accordance with the analysis conditions.

### Inner Diameter

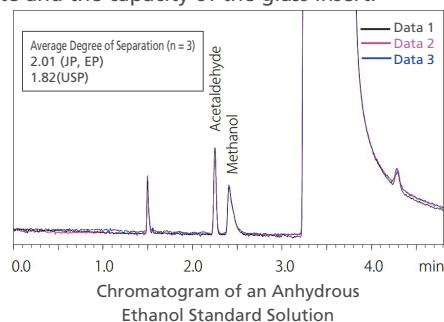
The inner diameter of the glass insert has an impact on the sample delivery rate and the capacity of the glass insert.

This section focuses on describing the impact on the sample delivery rate.

(Capacity is described in the next section.)

In almost all liquid sample analysis, a thicker inner diameter of glass insert is appropriate. When the carrier gas passes through the glass insert, if the glass insert has a narrow inner diameter, the linear velocity will increase. Liquid samples take some time to vaporize, and the volume expands considerably, so the use of glass inserts with extremely narrow inner diameters should be avoided.

However, when analyzing some samples containing low boiling point components, the peak bandwidth tends to spread, so a fast delivery rate is required. For this sort of analysis, a glass insert with a comparatively narrow inner diameter is suitable.



Application



## Capacity

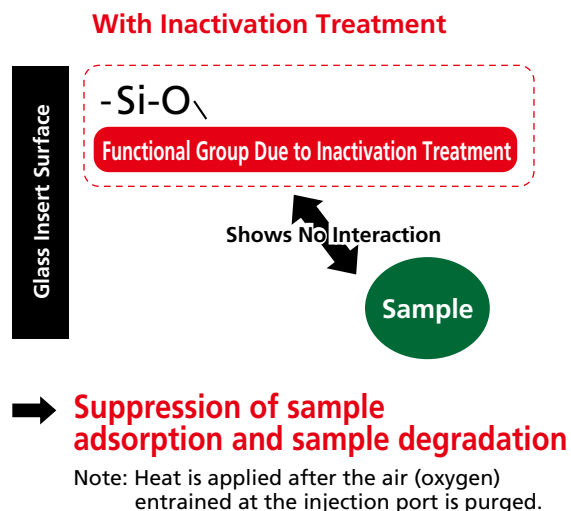
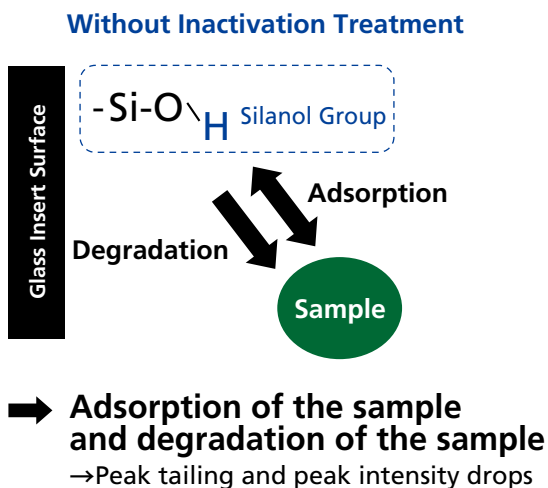
The internal capacity of a glass insert is calculated as  $(\text{Inner diameter of the glass insert}/2)^2 \times \pi \times \text{Length of the glass insert}$ . The capacity of a GC glass insert is generally about 100 to 900  $\mu\text{L}$ . Select a suitable glass insert in accordance with the vaporization volume of the sample for analysis. The following table shows the vaporization volume (at 250 °C and 140 kPa) of typical sample solvents utilized in analysis.

Solvent Type	1 $\mu\text{L}$ Injection Volume	2 $\mu\text{L}$ Injection Volume
Isooctane	110	220
n-Hexane	140	280
Toluene	170	340
Ethyl Acetate	185	370
Acetone	245	490
Dichloromethane	285	570
Carbon Disulfide	300	600
Acetonitrile	350	700
Methanol	450	900
Water	1010	2020

## Surface Treatment of Glass Inserts

Samples make direct contact with the inner walls of glass inserts, so if a sample contains compounds prone to degradation, problems such as peak tailing and drops in peak intensity sometimes occur. In this case, the use of a glass insert and wool treated to inactivate the surface is recommended. Note that the heat resistance of inactivated glass inserts is at maximum approximately 350 °C. The heat resistance of glass inserts without inactivation treatment is at maximum approximately 450 °C.

### Example



## All Glass Insert List



This is a list of the glass inserts provided by Shimadzu. Information on compatible GC instruments is also noted. The same ID numbers used in the section list in Chapter 2 are used in this table.

## 4-1. List of Glass Inserts and Compatible Instruments

★...Standard accessory ●...Described as a recommended item in Chapter 2 ✓...Can be used

\*1 Special order for glass column + pTCD

\*2 Special order for glass column + packed detector other than a TCD

\*3 It can be used by remodeling the GC unit SPL to WBI with WBI Modification Kit 221-74660-41.

\*4 Connections to systems other than the GC-2010, GC-2014, or GC-2030 series are handled by special order.

ID	Figure	P/N	Quantity	Wool Filling	Category	GC-2030	GC-2050	GC-2010 series	GC-2025	GC-2014 series
1		227-35007-01	5	✓	SPL (Split)	★●	★●	●	●	●
2		221-41444-01	1		SPL (Split)	✓	✓	★●	✓	✓
3		221-41444 221-41444-84	1 5		SPL (Split)	✓	✓	✓	★●	★
4		221-75193	5	✓	SPL (Split)	✓	✓	✓	✓	✓
5		221-48876-02	5		SPL (Splitless)	✓	✓	✓	✓	✓
6		221-48876-03	5	✓	SPL (Splitless)	✓	✓	★●	✓	✓
7		221-48876-05	5		SPL (Splitless)	✓	✓	✓	✓	✓
8		227-35016-01	5	✓	SPL (Split / Splitless)	★●	★●	●	●	●
9		221-41544 221-41544-84	1 5		SPL (Split / Splitless)	✓	✓	✓	✓	✓
10		221-41544-05	5		SPL (Split / Splitless)	✓	✓	✓	✓	✓
11		221-75187	5	✓	SPL (Split / Splitless)	✓	✓	✓	✓	✓
12		221-75188	5	✓	SPL (Split / Splitless)	✓	✓	✓	✓	✓
13		221-75189	5	✓	SPL (Split / Splitless)	✓	✓	✓	✓	✓
14		221-75190	5		SPL (Split / Splitless)	✓	✓	✓	✓	✓
15		221-75192	5		SPL (Split / Splitless)	✓	✓	✓	✓	✓
16		221-75194	5		SPL (Split / Splitless)	✓	✓	✓	✓	✓



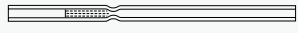

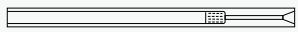
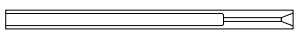


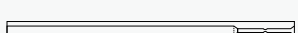
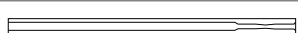


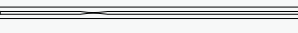









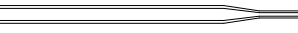





★...Standard accessory   ●...Described as a recommended item in Chapter 2   ✓...Can be used

\*1 Special order for glass column + pTCD

\*2 Special order for glass column + packed detector other than a TCD

\*3 It can be used by remodeling the GC unit SPL to WBI with 221-74660-41 WBI Modification Kit.

\*4 Connections to systems other than the GC-2010, GC-2014, or GC-2030 series are handled by special order.

ID	Figure	P/N	Quantity	Wool Filling	Category	GC-2030	GC-2050	GC-2010 series	GC-2025	GC-2014 series
17		221-75195	5	✓	SPL (Split / Splitless)	✓	✓	✓	✓	✓
18		221-75196	5		SPME	✓	✓	✓	✓	✓
19		227-35008-01	5	✓	SPL/WBI (Splitless, Full Volume Injection)	★●	★●	✓	✓	✓
20		221-48335-01	1		SPL/WBI (Splitless, Full Volume Injection)	✓	✓	★●	★●	★●
21		225-20803-01	5	✓	SPL/WBI (Splitless, Full Volume Injection)	✓	✓	★●	✓	✓
22		221-75197	5	✓	SPL/WBI (Splitless, Full Volume Injection)	✓	✓	✓	✓	✓
23		221-41599 221-41599-84	1 5		WBI (Full Volume Injection)	✓		✓	✓	✓
24		221-41599-05	5		WBI (Full Volume Injection)	✓		✓	* 3	✓
25		221-49298-91	1		OCI	★●		★●		
26		221-49381-01	1		Simple OCI	✓		✓		
27		221-49381-02	1		Simple OCI	●		●		
28		221-85694	1		OCI	★●				
29		225-08184	1		PTV/OCI	✓		★		
30		221-49300	1		PTV	★●		★●		
31		221-74830-09	5	✓	PTV	✓		✓		
32		221-80902	1		SINJ (Packed Column Full Volume Injection)	★●				
33		221-38107	1		SINJ/DINJ (WBC Full Volume Injection)					★●
34		221-38107-02	1		SINJ/DINJ (WBC Full Volume Injection)	★●				
35		221-48993	1		SPL/WBI (Packed Column Full Volume Injection Method)			✓ * 1		
36		221-48886	1		SPL/WBI (Packed Column Full Volume Injection Method)			✓ * 2		
37		221-14093 221-14093-84	1 5		SINJ/DINJ (Packed Column Full Volume Injection Method)					★●
38		221-14094 221-14094-84	1 5		SINJ/DINJ (Packed Column Full Volume Injection Method)					★●
39		227-35015-01	5	✓	Aqueous Solvent Analysis	✓	✓	✓	✓	✓
40		227-35014-01	1		HS-10	★		★	* 4	★
41		227-35327-03	3		AOC-6000 Plus SPME arrow	★	★	★		
42		227-35328-03	3		AOC-6000 Plus SPME arrow	★	★	★		

Standard Accessories for the GC-17A ver. 1-3, the GC-1700, and the GC-18A

ID	P/N	Category
3	221-41444 221-41444-84 (5 pc)	SPL (Split)
9	221-41544 221-41544-84 (5 pc)	SPL (Splitless)
23	221-41599 221-41599-84 (5 pc)	WBI (Full Volume Injection)
100	221-41484	Packed Column Full Volume Injection

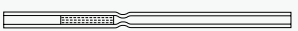
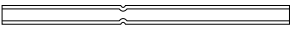
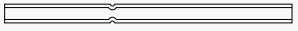

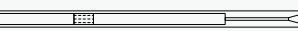

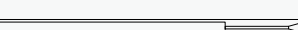










Standard Accessories for the GC-14A/B

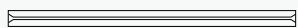
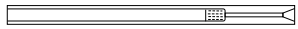
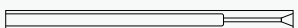


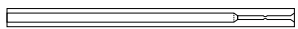





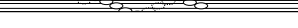




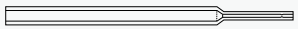


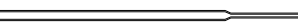


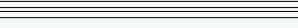


ID	P/N	Category
101	221-32574-01	SPL (Split) without taper
102	221-32544-01	SPL (Split) with taper
103	221-32544	SPL (Splitless)
104	221-38151-04	Septum purge unit (Full Volume Injection)
33	221-38107	WBC attachment (Full Volume Injection)
105	221-32998-01	CLH (Injection unit)
106	221-33000	CLH (Detector)
37	221-14093 221-14093-84 (5 pc)	Dia. 3.2 mm packed Full Volume Injection
38	221-14094 221-14094-84 (5 pc)	Dia. 2.6 mm packed Full Volume Injection

Standard Accessories for the GC-8A

ID	P/N	Category
107	221-25822-03	SPL (Split)
108	221-25944-03	SPL (Splitless)
109	221-39148	WBC attachment (Full Volume Injection)
110	221-18384-04	CLH (Injection unit)
111	221-18756-02	CLH (Detector)

## 4-2. Glass Insert Information

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature
1		227-35007-01	5	✓	95	4.9	3.4	863	Inactivation treatment	350°C
2		221-41444-01	1		95	4.9	3.4	863	None	450°C
3		221-41444 221-41444-84	1 5		95	5	3.4	863	None	450°C
4		221-75193	5	✓	95	5	3.4	863	Inactivation treatment	350°C
5		221-48876-02	5	✓	95	5	3.4	654	Inactivation treatment	350°C
6		221-48876-03	5	✓	95	5	3.4	654	Inactivation treatment	350°C
7		221-48876-05	5		95	5	3.4	654	Inactivation treatment	350°C
8		227-35016-01	5	✓	95	5	3.5	847	Inactivation treatment	350°C
9		221-41544 221-41544-84	1 5		95	5	2.6	504	None	450°C
10		221-41544-05	5		95	5	2.6	504	Inactivation treatment	350°C
11		221-75187	5	✓	95	5	3.4	799	Inactivation treatment	350°C
12		221-75188	5	✓	94.5	5	3.4	858	Inactivation treatment	350°C
13		221-75189	5	✓	95	5	3.4	863	Inactivation treatment	350°C
14		221-75190	5		95	5	3.3	813	Inactivation treatment	350°C
15		221-75192	5		95	5	3.5	847	Inactivation treatment	350°C
16		221-75194	5		95	5	3.4	863	Inactivation treatment	350°C
17		221-75195	5	✓	95	5	3.4	863	Inactivation treatment	350°C

ID	Figure	P/N	Quantity	Wool Filling	Length (mm)	Outer Diameter (mm)	Inner Diameter (mm)	Capacity (μL)	Surface Treatment	Heat Resistant Temperature
18		221-75196	5		95	5	0.8	48	Inactivation treatment	350°C
19		227-35008-01	5	✓	95	5	3.4	654	Inactivation treatment	350°C
20		221-48335-01	1		95	5	3.4	654	None	450°C
21		225-20803-01	5	✓	95	5	3.5	914	Inactivation treatment	350°C
22		221-75197	5	✓	95	5	3.3	599	Inactivation treatment	350°C
23		221-41599 221-41599-84	1 5		95	5	2.6	504	None	450°C
24		221-41599-05	5		95	5	2.6	504	Inactivation treatment	350°C
25		221-49298-91	1		103	2	1	81	None	450°C
26		221-49381-01	1		95	3.5	0.8	48	None	450°C
27		221-49381-02	1		95	3.5	0.8	48	Inactivation treatment (Silanizing treatment)	350°C
28		221-85694	1		11.5	-	-	-	None	450°C
29		225-08184	1		95	3.5	1.5	131	None	450°C
30		221-49300	1		95	3.5	1.5	168	None	450°C
31		221-74830-09	5	✓	95	3.5	2.5	466	Inactivation treatment	350°C
32		221-80902	1		93	5	3.4	726	None	450°C
33		221-38107	1		139	4.8	3.4	988	None	450°C
34		221-38107-02	1		126	4.8	3.4	870	None	450°C
35		221-48993	1		87	5	3.4	590	None	450°C
36		221-48886	1		87	5	3.4	672	None	450°C
37		221-14093 221-14093-84	1 5		139	4.4 (Tip 2.9)	3.5	1104	None	450°C
38		221-14094 221-14094-84	1 5		139	4.4 (Tip 2.3)	3.4	825	None	450°C
39		227-35015-01	5	✓	95	4.8	3.4	863	Inactivation treatment	400°C
40		227-35014-01	1		95	5	1.2	107	Inactivation treatment	350°C
41		227-35327-03	3		95	5	1.3	126	None	350°C
42		227-35328-03	3		95	5	1.7	216	None	350°C



This section introduces the glass insert accessories provided by Shimadzu.

## O-Ring

ID	Part Name	P/N	Quantity	Sample Injection Unit	Remarks
201	O-Ring, 4D, P5	227-35005-01	10	SPL/WBI	Maximum usage temperature: 450 °C
202	O-Ring, K8900 High Temperature Applications	036-11544-01	1		High temperature, low bleed type, maximum usage temperature: 450 °C This is suitable O-ring for FPD and other high-sensitivity analyses, because it limits the appearance of ghost peaks resulting from O-rings when the injection port temperature is increased.
203	O-Ring, 4D, P3	036-11352-01	1	OCI/PTV	Maximum usage temperature: 450 °C
204	O-Ring, K8900, P3 High Temperature Applications	036-11544-02	1		High temperature, low bleed type, maximum usage temperature: 450 °C This is suitable O-ring for FPD and other high-sensitivity analyses, because it limits the appearance of ghost peaks resulting from O-rings when the injection port temperature is increased.

Standard accessory



Image of O-Ring (ID201)

## Graphite O-ring

ID	Part Name	P/N	Quantity	Remarks
205	Split Graphite	221-48393-91	4	It cannot be applied to GC-2030 and GC-2050. For high temperatures, SPL (Split), temperatures of 300 to 450 °C
206	Splitless/WBI Graphite	221-47222-91	4	It cannot be applied to GC-2030 and GC-2050. For high temperatures, SPL (Splitless)/WBI, temperatures of 300 to 450 °C



Image of graphite O-Ring (ID205)

## Ferrule

ID	Part Name	P/N	Quantity	Applicable Instruments
207	Graphite	221-46403-92	4	GC-17A/1700/18A
208	Graphite	221-75182	10	GC-14A/B

Standard accessory



Image of Ferrule (ID207)

## Wool

ID	Part Name	P/N	Quantity	Applicable Instruments
209	Inactivated Glass Wool (2 g)	221-48600	1	GC-2010 series GC-2014 series GC-2025
210	Silica (quartz) wool, not inactivated (2 g)	201-47616-01	1	GC-17A/1700/ 18A/14A/B



P/N : 221-48600



P/N : 201-47616-01

## Silica Beads Shimmerite Q

ID	Part Name	P/N	Quantity
211	Silica Beads Shimmerite Q (25 mL)	670-10458-73	1



## Wool Filling Kit

ID	Part Name	P/N	Quantity
212	Wool Filling Kit for Glass Inserts	227-35030-01	1

This is a kit for filling wool into glass inserts that are not filled with wool. This kit allows you to increase the flatness of the top end of the wool, improving reproducibility.



## Inlet Liner Removal Tool

ID	Part Name	P/N	Quantity
213	Inlet Liner Removal Tool	227-35032-01	1

The Inlet Liner Removal Tool is designed to simplify the removal of gas chromatography (GC) inlet liners.









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