

# Furnaces for Precious Metals

**Ideal for  
Smelting &  
Assaying**



Cupellation Furnace  
CF 24



Crucible Furnace  
SCF 4

# Cupellation Furnaces – for the assay of precious metals

**Carbolite Gero cupellation furnaces are designed for testing using the cupellation, or fire assay test, method to ISO 11426:2014, a standard test method used to determine their purity.**

The test method produces hazardous vapours. When used within a suitable fume management system, the cupellation furnaces are designed to handle the vapours without exposing the operator to these hazards. The design of the cupellation furnace range ensures protection from the corrosive environment which would damage a conventional furnace.

## Standard features

- Maximum operating temperature: 1200 °C
- Variable airflow is preheated before entering the work chamber
- Silicon carbide heating elements protected by silicon carbide tiles
- Fumes are extracted through an insulated exhaust duct
- Removable container collects condensed lead



CF 24

## Technical data

Model	Max temp (°C)	Maximum continuous operating temp (°C)	Dimensions: Internal H x W x D (mm)	Dimensions: External H x W x D (mm)	Charge capacity of no. 8 cupels	Charge capacity of no. 6 cupels	Max power (W)	Thermocouple type	Power supply		
									Volt	Phase	Ampere per phase
CF 15	1200	1200	125 x 215 x 270	1050 x 950 x 1070 (Bench-mounted) 225 x 600 x 380 (Separate control module)	15	24	9000	R	200 – 240	Single phase	68
									380 – 415	3 phase + N	23
									200 – 240	3 phase delta	40
CF 24	1200	1200	200 x 250 x 340	2050 x 1000 x 1200 (Floor-standing)	24	32	13000	R	200 – 240	Single phase	87
									380 – 415	3 phase + N	28
									200 – 240	3 phase delta	50
CF 60	1200	1200	250 x 400 x 600	2230 x 1120 x 1435 (Floor-standing)	60	90	31000	R	380 – 415	3 phase + N	59
									200 – 240	3 phase delta	103
									440	3 phase + N	59

# Crucible Furnaces – for the smelting of precious metal



SCF 4

The Carbolite Gero range of robust top loading crucible furnaces are specifically designed for the smelting of precious metals and have gained in international reputation for close temperature uniformity, low heat loss and maximum fume control.

The furnaces are robustly constructed from heavy gauge hollow steel section and zinc coated sheet steel panels. Silicon carbide heating elements surround the chamber sides and are protected by silicon carbide tiles. The hearth is constructed from refractory bricks and silicon carbide tiles. The SCF 1 has a single chamber, all other models have twin chambers with separate lids.

### Standard features

- Maximum operating temperature: 1400 °C
- Single or multiple crucible models
- Silicon carbide heating elements protected by silicon carbide tiles
- Silicon carbide tiles also protect insulation from fluxes

### Technical data

Model	Max temp (°C)	Max continuous operating temp (°C)	Dimensions excluding handles: External H x W x D (mm)	Dimensions: Each chamber H x W x D (mm)	Dimensions: Control module H x W x D (mm)	Charge capacity	Thermocouple type	Max power (W)
SCF 1	1400	1350	850 x 905 x 905	440 x 285 x 285	630 x 600 x 490	-	R	15000
SCF 4	1400	1350	990 x 1230 x 1040	200 x 245 x 500	630 x 600 x 490	4 crucibles 120 x 180 (OD x H mm)	R	15000
SCF 8	1400	1350	1025 x 1350 x 1300	200 x 245 x 760	630 x 600 x 490	8 crucibles 120 x 180 (OD x H mm)	R	21000
SCF 24	1400	1350	990 x 1230 x 1040	200 x 245 x 500	630 x 600 x 490	24 crucibles 79 x 97 (OD x H mm)	R	15000
SCF 48	1400	1350	1025 x 1350 x 1300	200 x 245 x 760	630 x 600 x 490	48 crucibles 79 x 97 (OD x H mm)	R	21000

# Recycling and assessing precious metals

**Global demand for precious metals continues to soar, whether for jewellery or for use in industrial applications. While gold and silver have been used for thousands of years in jewellery, more recently precious metals are performing useful and specialist functions in chemical processes, electronics manufacturing, aerospace and automotive systems, eg catalytic converters. Carbolite Gero equipment is used throughout the world both for recycling these relatively rare commodities and for assessing their purity. Two key processes in the precious metals market are smelting and cupellation**

## Smelting

Smelting is the separation of precious metal from non-metallic impurities. When bulk ores are involved very large installations are required using heat and chemical reducing agents to decompose the ore, drive off other elements such as gases or slag and leave only the metal behind. When the process involves pre-used materials – for example, catalytic converters or jewellery – the equipment is smaller in scale but involves the same principles in order to ensure a high-quality end material.

Precious metals recovery is a typical use of smelting. In a catalytic converter exhaust gases pass through a ceramic honeycomb which is coated with a fine layer of palladium group metals (PGMs). This contains platinum ore, typically two to three orders of magnitude richer than the mined ore. During the recycling process the honeycomb ceramic is crushed into a powder and fed into the furnace. Up to 98% of PGMs may be recovered.

For recycling purposes the raw material to be assayed is typically ground into powder form before being placed in crucibles where it is melted with lead oxide and a suitable flux at 1200°C. In its molten state the lead combines with the precious metal and the impurities form a slag which can be easily removed when the sample cools. A cupellation furnace is

then used to remove the lead, leading to further treatment to ascertain the precious metal content.

**Carbolite Gero's SCF furnaces are specifically designed to provide the temperatures required for smelting, while withstanding the gases given off by the process.** High-performance silicon carbide elements are fitted which allow continuous operation up to 1350°C. In addition, furnace chambers are lined with silicon carbide tiles which protect the elements and the insulation with hard-wearing insulating brick providing a solid hearth.

Material is processed in ceramic crucibles of various sizes, and **the SCF range includes five models to suit different customers' requirements.** The smallest model is a single-chamber unit, while the other four have twin chambers. The hinged chamber lids keep the hot face insulation away from the operator and also incorporate chimneys to vent fumes. Furnace temperature is regulated by a three-term microprocessor-based controller, and a 24-hour seven-day time switch allows the equipment to be switched on automatically without an operator being present.

## Assaying

Accurate analysis is routinely carried out to determine the precious metal content in a wide variety of different materials. This is particularly important for fineness determination for the hallmarking of precious metals for jewellery use. The precious metal concentration in different materials can vary widely from amounts measured in parts per million (ppm) for car catalysts or powdered ore samples to almost 100% in jewellery alloys or bullion bars.

Determining the precious metal content of gold, silver and platinum is fundamental to the jewellery industry and is particularly important for those valuing, buying or selling scrap gold or second-hand material. While X-ray fluorescence (XRF) spectrometry is more accurate than in the past and can provide reliable results, there remains a number of drawbacks including the initial purchasing expense. **For gold and silver the most accurate and preferred method still remains the traditional cupellation process.**

The cupellation of gold is a refining process in which all other elements are eradicated leaving only pure gold. For assaying gold by cupellation,

small samples are accurately weighed and wrapped in lead with a pre-determined quantity of silver to assist with the collection of gold and the removal of base metals. The wrapped samples are placed on porous blocks, known as cupels, and heated to 1100°C in a furnace resulting in the cupels absorbing the lead and any base metals as oxides.

A pure gold and silver bead is left behind which is then boiled in nitric acid, dissolving the silver and leaving a residue of fine gold. When the weight of the residue is compared with the original sample the gold content by weight can be calculated.

The assay of gold alloys by cupellation is the standard method used by the UK Assay Offices and a reference method laid down by the International Hallmarking Convention in accordance with ISO 11426 : 2014 and ASTM E1335 – 08. **The Carbolite Gero furnaces designed for this process have a reputation for close temperature uniformity, low heat loss and maximum fume control.**