Established in 1938, Carbolite has become a leading international manufacturer of quality thermal equipment, producing a wide range of models for quality control, specialised research, pilot plant and production processes.

In particular the furnaces and ovens designed for coal and coke testing and iron ore evaluation, have become established as the standard equipment used in coal laboratories, power plants and steelworks throughout the world.

The range includes bench top laboratory models for routine testing and large pilot plant scale products, some of which are unique to Carbolite, such as the variable width hearth moving wall coking oven which can be found in coal research facilities as well as large steel producing plants around the world.

Carbolite operates a quality management system and has obtained accreditation to ISO 9001. In addition all products carry the CE mark which indicates compliance with all relevant European safety directives, i.e. low voltage directive and electromagnetic compatibility directive.

All products are also manufactured in compliance with the relevant safety standards to BS EN 61010-1:1993 and 61010-2-010:1995.

Where applicable the specialist range of ovens and furnaces also conforms to international standards and other defined test procedures, including ASTM, BS, JIS, DIN and ISO.

Our team of installation and commissioning engineers is supported by trained technicians from our world-wide network of distributors who also ensure availability of critical spare components and consumables.

Laboratory products

Ashing Furnaces

The OAF furnaces are designed for ashing coal samples and have a maximum operating temperature of 1100°C. The OAF 11/1 has a large floor area which allows many samples to be accommodated and because of the low chamber height, the air flow is held close over the samples to promote burning. The traditional muffle heated chamber is extremely durable, giving good resistance to abrasion and to vapour attack. Good air flow is ensured by natural convection through a tall chimney and provides 4-5 air changes per minute. The inlet air is pre-heated before it enters the heated chamber ensuring that crucibles located near the inlet are not chilled.

A larger unit OAF 11/2 provides twice the capacity in an upper and lower chamber.

A three term microprocessor controller with a digital readout is fitted as standard and programming...
facilities can be incorporated as an option. Both furnaces comply with the following industry standards: BS 1016, Part 4, ISO 344 & 1171, ASTM D2361, D2795 & D3174

**VOLATILE MATTER FURNACES** Two models are available to meet the different test methods of ISO 562 and ASTM D3175.

The model VMF 10/6 meets the requirements of ISO 562 and is a chamber furnace with a maximum temperature of 1000°C. Chamber size is 100 x 200 x 210 mm (HWD) and external dimensions of 655 x 435 x 610 mm (HWD). Powerful open spiral heating elements, supported in lightweight ceramic fibre insulation give fast heating. A sophisticated algorithm in the digital temperature controller ensures fast recovery of temperature after loading the samples - less than 4 minutes to return to 900°C ± 10°C. The uniform zone of 80 x 160 x 160 mm (HWD) is within ± 10°C measured at 900°C.

The furnace available to meet the ASTM standard is a top loading furnace to accept a single crucible which is suspended into the vertical work tube of 50 mm diameter x 100 mm depth. A control thermocouple is placed directly under the crucible and the furnace is offered with a choice of digital PID temperature controllers. External dimensions are 330 x 410 x 300 mm (HWD).

**MINIMUM FREE SPACE OVEN** (MFS)
The oven is available as a single chamber or a multiple unit with four separate chambers. It is designed for the determination of moisture in coal by drying in a nitrogen atmosphere, as described in BS 1016: Part 104. The oven measures the flow of nitrogen which is required to pass through the chamber at approximately 15 oven volumes per hour. Inner chamber dimensions are 25 x 195 x 290 mm (HWD). A choice of digital PID temperature controllers is available and desiccators are an optional extra.

**SWELLING NUMBER INDEX (SNF)**
A top loading furnace has been designed for use in the test for the determination of the crucible swelling number of coal samples as described in BS 1016: Part 107 and ISO 501.

Maximum temperature is 900°C and chamber dimensions of 55 mm diameter x 85 mm deep. A choice of digital PID temperature controllers is available with overtemperature protection as an optional extra.

**COAL ASH FUSIBILITY FURNACE**
Carbolite has a range of furnaces which conforms to ASTM D1857-68 and BS 1016: Part 113 to determine the precise fusion stages required in the standard test.

The CAF/Video model with a maximum operating temperature of 1550°C can accommodate up to 12 sample cones with ease at a single loading. The advantage of lightweight insulation allows fast cooling, and up to 36 samples can be processed in a day with little supervision. The video system enables the test to be observed and recorded and a digital temperature reading, date and batch number are displayed on the screen and tape. The test cycle

**Minimum Free Space Oven (MFS/1).**
can be pre-set, including automatic gas switching which minimises operator supervision.

A new digital imaging version is also available allowing digital pictures to be viewed more quickly and monitoring can be performed remotely via a PC.

For laboratories where a small number of samples are processed a manual version is available which requires visual observation of the sample via a telescope. Model type CAF 16/38 has a maximum temperature of 1600°C.

Detailed specifications are available and special versions can be manufactured up to 1700°C.

SULPHUR & CHLORINE CONTENT
Combustion tube furnaces with a maximum operating temperature of 1400°C are designed for sulphur and chlorine content tests in accordance with BS 1016: Part 6 & 7; ASTM D3177-75; ISO 351 & 609. These models accept work tubes of 38 mm with a heated length of 180 mm.

Single, two or four tube versions are available.

CARBON AND HYDROGEN CONTENT TESTS
The above furnace with the addition of an auxiliary heater is offered as a single or twin tube furnace for this test.

Other, less frequently used furnaces are manufactured to special order and include the Gray King coke test furnace, Leibig (low temperature) method for determination of carbon and hydrogen in coal.
pilot plant equipment

The following products comprise the range of larger units and are separately detailed on individual specification data sheets.

MOVING WALL COKING TEST OVEN The oven rated at 1250°C is designed for testing suitably granulated and graded coals for coking under accurately controlled conditions. The oven is designed to allow pressure generated during the coking to be exerted against a fixed wall on one side of the chamber and a moving wall on the other. This pressure is measured by a load transducer actuated by the moving wall. The recommended width of the oven is 455 mm with a nominal charge weight of 255 (kg-dry basis). Other widths are available requiring additional hearth plates and doors.

Many optional extras are often requested, including charge hoppers and trolleys, quench carts, discharge ram, etc. A separate control cabinet houses all instrumentation.

COKING TEST OVENS Two standard carbonisation ovens are included in the range to coke coal or coal blends under controlled conditions. The CTO/15 has a capacity of 7 kg with a typical cycle time of 1.5 hours and a maximum operating temperature of 1300°C. A larger unit - CTO/500 has a capacity of 227 kg and a maximum operating temperature of 1250°C with a maximum rate of rise of temperature from 750°C up to 1250°C of 20°C per hour.

SOLE HEATED OVENS Both single and double chamber versions are included in the range and are designed to measure the expansion and contraction of coal and coal blends when heated under a constant load. Maximum operating temperature is
1000°C. VERTICALLY SPLIT COKING OVEN
The furnace is designed to measure wall pressure during coking and also the temperature at the centre of the charge and variation in charge height during coking. The results obtained will be an approximate average of the larger scale moving wall coking oven but not an accurate simulation.

IRON ORE TESTING
Various test standards are used in the testing of iron ores.

Carbolite has manufactured furnace test rigs for many of these procedures and all are fully documented on comprehensive specification data sheets. Please request further information.

They include:
- Determination of reducibility of iron ores according to ISO 4695: 1995 (E) - JISM 8713 - ASTM/E 1071-89.
- Low temperature disintegration test - method using cold tumbling after static reduction according to ISO 4696: 1984 (E).
- Determination of relative free swelling index according to ISO 4698: 1994 (E).
- Determination of reduction properties under load according to ISO 7992: 1992(E)
- Linder Test. Low temperature breakdown test of iron ore, generally in accordance with ISO 4697. Iron ore pellets are placed into a heat resistant rotating tube and subjected to a tumbling action whilst heated in a reducing atmosphere. The samples are then subjected to a stove analysis to determine the degree of disintegration.

NB: when requesting quotations for reducibility test equipment, it is essential to specify the standard to which you are working.

COKE REACTIVITY TEST EQUIPMENT
Carbolite produces furnace test rigs according to the method defined by the ASTM D 5341-93a. Within this standard there are two tests:
- Coke strength after reduction (CSR)
- Coke reactivity index (CRI)

Again it is important to specify the exact standard required especially because of variations with other national standards.

COAL DRYING OVENS Two models suitable for testing as defined by BS and ASTM methods are:
- Model CDLT which conforms to BS 1017: Parts 1 & 2 and ASTM 3320. Model CDHT conforms to BS 1016: Parts 1 & 2 and ASTM 2961.
NEW HORIZONS IN TEMPERATURE TECHNOLOGY

carbon, coke & iron ore testing furnaces