



1600°C Coal Ash Fusibility Test Furnace



CAF 16/75/3508P1

Introduction

When Carbolite first introduced a Coal Ash Fusibility Test Furnace (CAF), it revolutionized coal sample testing where time and accuracy are both critical. Previously, an operator's time was dedicated to the continuous monitoring of a test with only one or two samples. The CAF furnace allows up to twelve samples to be tested at a time, and continuous image recording allows laboratory technicians to carry out other tasks while the test is in progress. The current CAF design provides for the capture of test images via computer, and assures end users both an accurate and rapid analysis of the tests. The computerized system automatically generates a test report once the relevant fusion temperatures have been identified by quickly scrolling through the stored images.

Coal Ash Fusibility Testing

At high temperatures, the heat from burning coal is often sufficient to melt its own ash which when cooled solidifies into clinker.

In industrial coal burning applications, clinkers can be extremely large and can cause both disposal problems and operation downtime. Coal ash fusibility testing is therefore required by users to determine the ash fusibility characteristics of the fuel.

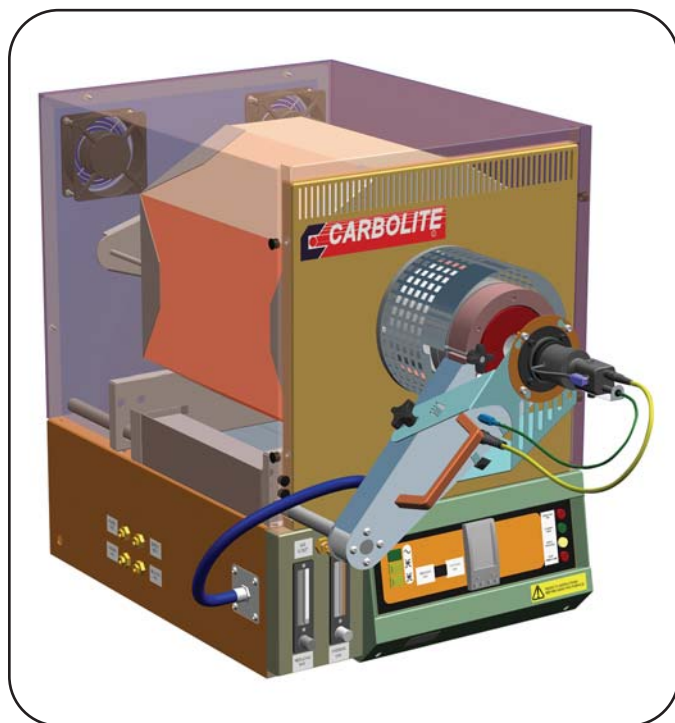
The published standards require that the ash fusion temperature is measured and recorded at 4 points - the initial rounding of the cone tip, when the cone has softened, when melted to a hemisphere and finally when it flows into a puddle.

The Furnace

The Coal Ash Fusibility Furnace is designed to heat coal ash samples up to a maximum temperature of 1600°C in a controlled atmosphere and visually record the fusion of the samples for analysis.

The furnace work tube is sealed and has a "fail safe" gas control system for safety when testing with toxic and flammable gases. A sliding and rotating door mechanism provides unrestricted access to the work tube, allowing easy loading and unloading of the test samples using the sample loading tool provided. The large diameter work tube can accept up to 12 samples at any one time. The use of lightweight insulation allows the furnace to cool quickly, permitting multiple tests to be completed during the day.

The start and finish temperatures can be pre-set and the rate of temperature rise is adjustable within the parameters of the relevant published standards. Independent over-temperature protection is provided by a separate temperature controller using its own thermocouple and contactor to override the heating circuit.



Coal Ash Fusibility Test Furnace

Furnace Model	Max. Temp. (°C)	Work Tube Inside Diameter Inches (mm)	Tube Material	Maximum Number Samples	TC Type	Max Power (kW)	Furnace Voltage	External Dimensions *			Shipping Weight (lb.)	
								Height	Width	Inches (mm) Depth		Overall Depth
CAF 16/75	1600	3.00 (79)	Mullite	12	R	7.0	208/240	27.50 (700)	20.00 (505)	25.50 (650)	38.25 (970)	162

Specify voltage at time of order.

* Furnace only, additional bench space will be required for computer.

Furnace operates on single phase voltage.



General Features

- Maximum operating temperature of 1600°C.
- Carbolite CAF furnace meets all relevant international and U.S. standards in testing method for fusibility of coal and coke ash.
- Test 12 samples at one time.
- Multiple built in safety features assures operator safety.
- Furnace incorporates 3" ID mullite work tube.
- Efficient loading and unloading of samples with sample loading tool.
- Use of lightweight ceramic fiber insulation allows the furnace to cool quickly, permitting multiple tests to be completed during the day.
- Carbolite 3508P1 programmable temperature control allows the start and finish temperatures to be pre-set, and the rate of temperature rise is adjustable.
- Fan and convective cooling provides low outer case temperature.
- Furnace is fitted with an independent over-temperature protection control as standard.
- Long-life free radiating silicon carbide heating elements provide excellent chamber uniformity.
- Power to the heating elements is controlled by thyristor based solid state relays.

Gas Controls

A "fail-safe" gas system is incorporated into the furnace. Oxidizing or reducing gases are automatically introduced into the work tube during a coal ash fusibility test. The flow rate and required atmosphere are controlled from individual flowmeters mounted on the front of the furnace. There are two gas options available with the CAF furnace. The gas option should be specified at time of order.

Reducing gas 60% (V/V) CO + 40% (V/V) CO₂
 Oxidizing gas Air
 Purge gas N₂

or

Reducing gas 50% (V/V) H₂ + 50% (V/V) CO₂
 Oxidizing gas CO₂
 Purge gas CO₂ (for use with H₂)

To ensure operator safety, the following features are included:

- Safety purge of the work tube prior to and after carrying out a coal ash fusibility test.
- "Purge Gas Failure" audible and visual alarm.
- Safety purge of work tube in the event of a power failure during a test.
- Test in progress indicator to warn the operator that oxidizing or reducing gases are present within the work tube.
- "Gas Tight" work tube.

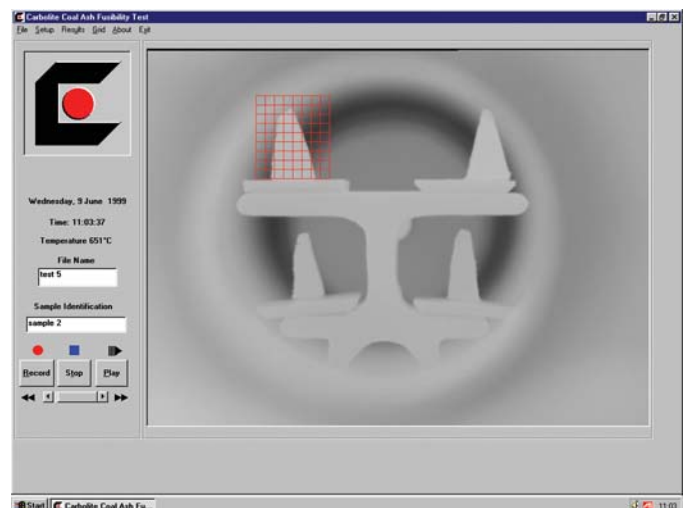


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Image Recording

An image from the video camera is captured at specified time and temperature intervals and stored on computer in sequence order, including date, time, a batch identifier and the temperature at the point of capture. A real time image of the samples is displayed on the computer monitor throughout the test. The precise stages of fusion are then determined by quickly and accurately scrolling through the stored images to the required point and recording the deformation temperature using the automatic results feature in the software. To ensure accurate comparison of sample height and width, a grid overlay feature is provided in the software. The scale of the grid is adjustable and can easily be moved on the screen to analyze each sample in turn.

A results print out can be generated using the test software. Also, the results and their associated images can be easily imported into a Windows based word processor and spreadsheet software package. Tests can be stored on a computer disc for future analysis. High density storage media and drive are provided to allow compact and secure archiving of test data.





200°C to 1400° Laboratory Coal and Coke Testing Furnaces



SNF

Swelling Number Index Furnace

The Carbolite SNF furnace is designed for the "Standard Test Method for Free-Swelling Index of Coal", as described in ASTM Standard D720-91. The results of this test may be used as an indication of the caking characteristic of the coal when burned as a fuel. This furnace is rated for 900°C and incorporates an 85 mm deep x 55 mm diameter chamber. A crucible containing the coal sample is lowered into the chamber for the test. The control thermocouple, projecting in from the bottom of the chamber, is in close proximity to the sample, assuring precise temperature control throughout the test. The furnace control system incorporates a precise PID digital temperature controller.



MFS/1

Minimum Free Space Oven

The Carbolite MFS/1 Oven is designed for the "Standard Test Method for Moisture in the Analysis Sample of Coal and Coke", as described in ASTM Standard D-3173-00. This 200°C oven has a chamber size of 25 mm H x 195 mm W x 290 mm D. Nitrogen, introduced in the rear of furnace, is preheated before entering the chamber. The oven incorporates two flowmeters to monitor the gas input and output. An exhaust change-over valve allows the output flowmeter to be by-passed during operation, thus preventing the build-up of condensation in the flowmeter. The oven control system incorporates a precise PID digital temperature controller.

Sulfur and Chlorine Content Test Furnace

The Carbolite CFM 14/1 and CFM 14/2 furnaces are designed for the "Standard Test Methods for Sulfur in the Analysis Sample of Coal and Coke Using High Temperature Tube Furnace Combustion Methods", as described in ASTM Standard D4239-04. Chlorine content of coal can also be determined in appropriate tests. This 1400°C combustion tube furnace is offered in both a single and double tube version. The furnace has a 180 mm heated length, and is designed to accept 32 mm OD x 25mm ID tubes. Tubes are not included with furnace but are available from Carbolite. The recommended tube length is 750 mm. The furnace control system incorporates a precise PID digital temperature controller.



CFM 14/2

Carbon and Hydrogen Content Test Furnace

The Carbolite CFM 14/1 AUX and CFM 14/2 AUX Combustion Tube furnaces are of the same design as the CFM furnaces described above, except the furnace is provided with an auxiliary heater necessary for the test.

Volatile Matter Furnace

The Carbolite Model VMF/ASTM Furnace is designed for the "Standard Test Method for Volatile Matter in the Analysis Sample of Coal and Coke", as described in ASTM Standard D3175-02. This test method determines the percentage of gaseous products, exclusive of moisture vapor, in the analysis sample which are released under the specific conditions of the test. This furnace is very similar in design to the previously described and pictured SNF furnace. The furnace is rated for 1000°C and incorporates a 100 mm deep x 50 mm diameter chamber. A single crucible with sample is suspended into the chamber during the test. The furnace control system incorporates a precise PID digital temperature control.

Coal Ashing Furnace

The Carbolite Model AAF 11/7 Furnace is designed specifically for the "Standard Test Method for Ash in the Analysis Sample of Coal and Coke from Coal", as described in ASTM Standard D-3174-00. See further description and specification of furnace on pages 14 and 15.



Thermal Products for Coal, Coke and Iron Ore Testing

Carbolite offers a comprehensive line of furnace and oven products specifically designed for pilot plant applications in the testing of coal, coke and iron ore to meet specified regulatory standards. Carbolite's extensive experience in both the design/manufacturing and installation of these products worldwide, has established Carbolite's reputation as the number one source for such equipment.

Coke Reactivity Test Furnace

Carbolite produces a furnace system specifically designed to carry out testing defined by ASTM D5341-93a, Method for Measuring Coke Reactivity Index (CRI) and Coke Strength after Reaction (CSR). The CRI test specifies that a dry coke sample of designated size and origin is reacted with CO₂ gas in a retort at a specific temperature and length of time. Precisely measured weight change during the reaction is used to calculate the CRI. The CSR test determines the strength of the sample and is carried out after reduction in a mechanical tumbler.



Moving Wall Coking Test Oven

This specialty test oven 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.



Please Note: When inquiring about any of the aforementioned products, it is critical to define the specific ASTM or international test standard the product will be used for.

Sole Heated Oven

This coal testing system is designed to measure the expansion and contraction of coal and coal blends during carbonization per the standard test described in ASTM-2014-71. A known thickness of coal is heated from the bottom while pressure is applied to the top surface. The test concludes after final measurement of the coal thickness. A single or double chamber version is available.



Iron Ore Testing Furnaces

Carbolite provides furnaces that are specifically designed to meet regulatory standards related to iron ore. A common system sold is for determination of reducibility of iron ores as specified in regulation ASTM/E 1071-89. Carbolite offers several other systems designed

for such tests as Low Temperature Disintegration test, Determination of Relative Free Swelling Index test, Determination of Reduction Properties Under Load test and the Linder test.

Coking Test Ovens

In addition to the previously identified coal and coke related furnace products, Carbolite offers a Capacity Coking Test Oven, which is designed to carbonize 7 kgs. (15 lbs.) of crushed coal blends for comparative testing in a laboratory. A large number of samples can be processed rapidly and accurately in order to assess which are suitable for subsequent large scale testing. Carbolite also offers a small scale Vertically Split Coking Oven. This unit is designed to measure the charge center gas pressure and the pressure exerted on the fixed wall during coking. One wall is mounted on pivots allowing it to move under pressure which is then measured by a load cell mounted between the moving wall and the oven frame.