

MICRO COMBUSTION CALORIMETER

FEATURES

The Micro Combustion Calorimeter was developed by the Federal Aviation Administration (FAA) to offer industry a research tool to assist the FAA in its mandate to dramatically improve the fire safety of aircraft materials. The tester is becoming a mainstay in research laboratories due to its ability to obtain meaningful test data with a sample size in the range of 0.5 Mg to 50 mg. The instrument has been validated by a national consensus organisation ASTM International and is now the subject of an ASTM standards publication, designated D7309.

Micro Combustion Calorimetry (MCC), sometimes referred to as Pyrolysis-combustion flow calorimetry (PCFC), measures the rate at which the heat of combustion of fuel gases are released by a solid during controlled pyrolysis in an inert gas stream. The fuel gases are mixed with excess oxygen and combusted (oxidised) at high temperature, and the instantaneous heat of combustion of the flowing gas stream is measured by oxygen consumption calorimetry.

The new flammability test method quickly and easily measures the combustibility of plastics, wood and textiles etc. Only a few milligrams of sample are needed and results are obtained in minutes, instead of hours or days of analysis. The test apparatus shown above, provides a wealth of information on the fire hazard of a material, including the following:

Fire Load:

This is the amount of heat released by the plastic during burning (heat of combustion). The heat of combustion is one indicator of fire hazard.

Ignition Temperature:

The temperature at which the plastic ignites is important for fire safety. Plastics that ignite at a high temperature are heat resistant and tend to burn slowly in a fire, providing more time for occupants to escape from a confined space.

Heat Release Rate:

The best single predictor of the fire hazard of a plastic is its heat release rate in flaming combustion. However, heat release rate is difficult to quantify because it depends on fire size (heating rate), sample thickness, and the amount of oxygen available for combustion. The MCC instrumentation eliminates this uncertainty by using controlled heating and excess oxygen to measure a specific heat release rate (W/g), that depends only on the material being tested and the heating rate. Data shown in figure 1, is compared to heat release rates of plastics in a cone calorimeter, to those



Image for information only

SPECIFICATIONS

ASTM D7309



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measured in the MCC at a comparable heating rate. Dividing the specific heat release rate of the material by the heating rate used in the test (K/s), gives a flammability parameter with the units (J/g-K) and significance of a heat release capacity (HRC), which is a good predictor of flammability.

Flame Resistance:

Flame resistance is the ability of a plastic to withstand a brief exposure to a small flame (e.g., a Bunsen burner) without continuing to burn. The Underwriters Laboratory (UL94) test for flammability of plastics and the Limiting Oxygen Index (LOI) test are the two most common flame resistance tests.

The heat release capacity measured in the MCC instrument is an excellent predictor of the results of these tests.

Figures 2 and 3 above, compare standardised flammability tests results (LOI or UL 94) to the heat release capacity (HRC) measured in the MCC instrument for a wide range of plastics. For the materials tested, three regimes of flammability can be distinguished from HRC data:

Flammable:

Plastics with heat release capacities above 400 J/g-K will continue to burn after a brief exposure to a small flame as indicated by a LOI below 21% in Figure 2, or UL 94 HB rating in Figure 3. These plastics are unsuitable for use in electrical equipment, consumer electronics, and public transportation.

Self-Extinguishing:

Plastics with heat release capacities below about 300 J/g-K burn slowly or not at all after brief exposure to a small flame, as indicated by a LOI above 21% in Figure 2, or a UL 94 V rating as Figure 3. These plastics are approved for electrical/electronic equipment and public ground transportation but not commercial aircraft.

Non-Ignitable:

Plastics with heat release capacities below 150 J/g-K do not ignite after brief exposure to a small flame (UL 94 V0 or LOI > 35%) and usually pass strict Federal Aviation Administration (FAA) requirements for fire and flammability of materials used in commercial aircraft cabins.

The instrument is commercially manufactured under license by the FAA to use the FAA patented technology. Concept have a continuing working relationship with Dr. Richard E Lyon and the FAA, who are the inventors of the Microscale calorimetry technique, which makes for a unique and very effective technical support resource for end users.

The technical advantages and features of the MCC instrument

- The MCC has excellent repeatability, reproducibility AND an almost identical correlation with the FAA built micro-calorimeters.
- The MCC control and calculation software are two separate applications. This enables analysing of results on the user's office PC or laptop, outside of the laboratory, as well as on the MCC workstation.
- The file structure/format of the MCC test files are completely 100% compatible with the data calculation software used by the FAA at the FAA Hughes Technical Centre in Atlantic City, NJ.
- Easily selectable Pyrolysis mode – Anaerobic Pyrolysis mode(nc), where oxygen is blended with the specimen effluents before entering the combustor. Or Aerobic Pyrolysis mode(hc) where oxygen is blended with Nitrogen before flowing into the Pyrolyzer.
- Intelligent temperature control modules, providing precise, controlled pyrolyzer heating rate over a temperature range between ambient and 1000°C and an accurately regulated Combustor temperature range between ambient and 1000°C.
- Sample Heating Rate: 0 – 10 K/s.
- High performance Kanthal A-1 heater elements ensure maximum temperatures are effortlessly achieved and in addition, the superior high quality alloy provides a lifespan of at least twice that of NiChrome elements.
- Mass flow controllers and mass flow meters used in the MCC are “calibration flow quality” instruments for high accuracy and calibration rather than commercial grade meters.
- Gas Flow Rate: 50 to 200 cm³/min, response time of <0.1 s, sensitivity of 0.1 % of full scale, repeatability to ±0.2 % of full scale and an accuracy of ±1 % of full scale deflection.
- Gas Composition: 0 – 100% Oxygen range (O₂); balance Nitrogen (N₂).
- Oxygen sensor range of 0 – 100%, response time of <6 s for 90 % deflection, a sensitivity of <0.1 % and a linearity of ± 1% of full scale at constant temperature and pressure.
- Sample size: 0.5 – 50 mg (milligrams).
- Detection Limit: 5 mW.
- Repeatability: ± 2% (10 mg specimen).

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Figure 1

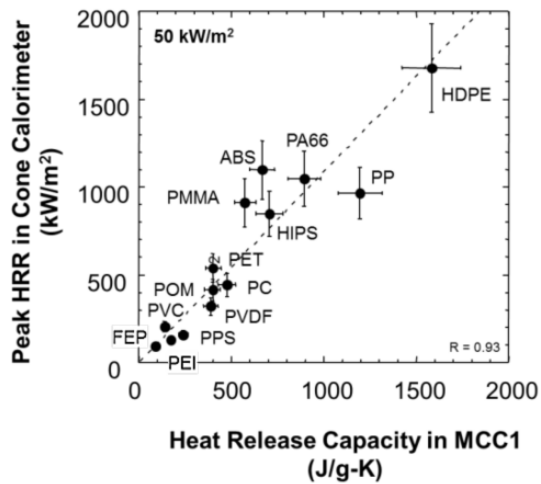


Figure 2

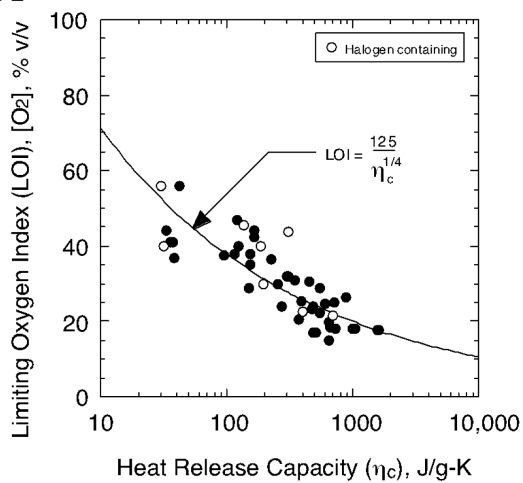
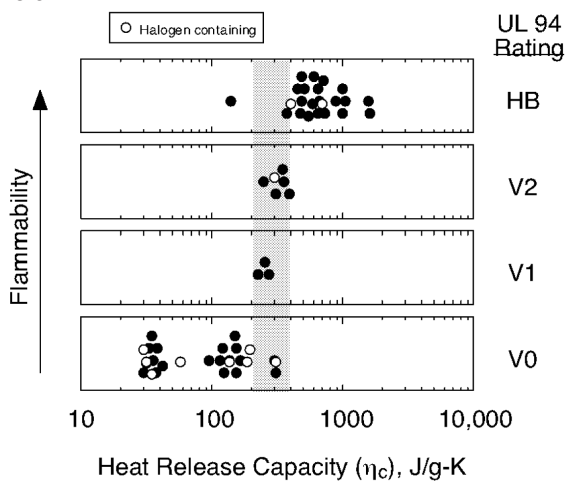


Figure 3





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The Micro Combustion Calorimeter data outputs include:

Heat of Combustion (Fire Load)

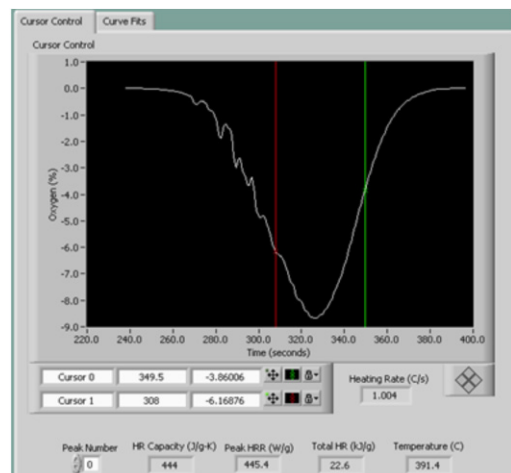
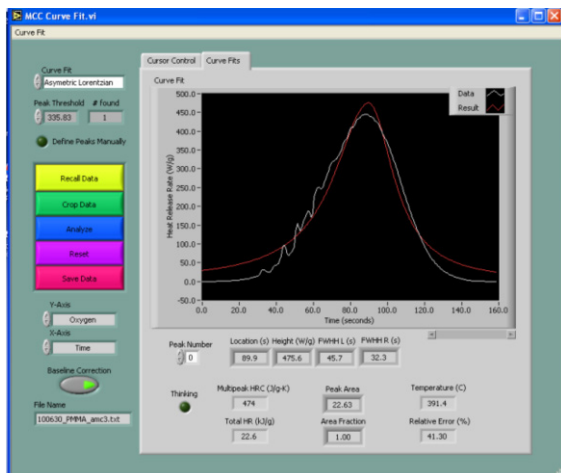
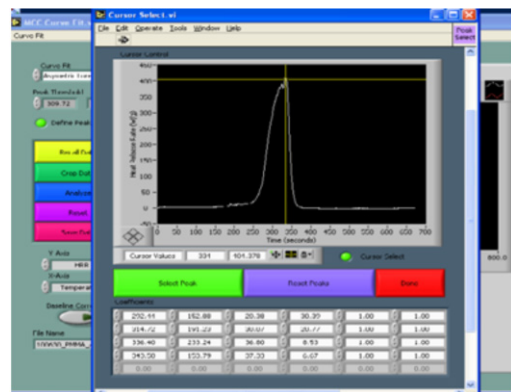
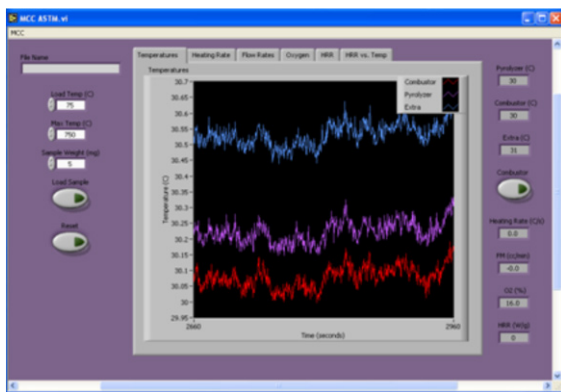
Ignition Temperature

Heat Release Rate

Heat Release Capacity

Flame Resistance

The instrument includes operation, analysis and calibration software and is complete and ready to run tests after connection to compressed air, oxygen, nitrogen, a small exhaust system and after attaching to the computer.





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TECHNICAL DATA

Electrical:

230 volts AC 50 Hz. Power - 7200 Watts

Ambient Temperature:

Operating 10°C to 35°C

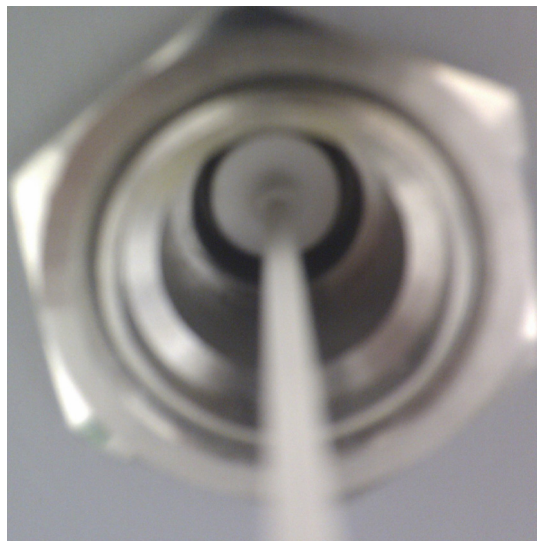
Dimensions:

Instrument - 254mm (W) x 1068mm x (H) x 558mm (D).

With Computer - 1068mm (W) x 610mm (D)

Weight:

39 Kg



SERVICES REQUIRED

Gas Supplies:

Nitrogen gas: 99.9% pure. Pressure: 20 – 25 PSI.

Flow: 80cc/m, 100cc/m maximum, 6mm Swagelok Fitting.

Oxygen Gas: 99.9% pure. Pressure: 20 – 25 PSI.

Flow: 20cc/m, 50cc/m maximum, 6 mm Swagelok Fitting.

Compressed Air (oil and water free): Pressure: 60 PSI.

6 mm Swagelok Fitting.

Fume extraction:

Customer supplied - 5nl/s, 6 mm Swagelok Fitting.