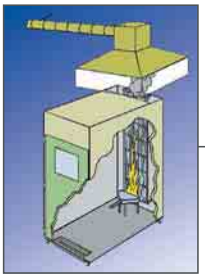
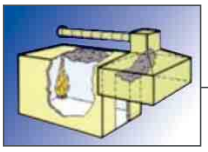
Flexibility with FTT Calorimeters

FTT calorimeters are designed to have interchangeable modules that give our clients maximum operational or upgrade flexibility. A variety of analysers can be housed within our systems and the major components themselves can also have multi-use. The small entry level Mass Loss Calorimeters (ISO 13927 and ISO 17554) can be used as a spare calorimeter furnace model, extended to measure smoke in accordance with ISO 5660-2 or developed further to become a full Cone Calorimeter. The analysis systems of the Dual Cone Calorimeter can be transported to large calorimeters within minutes. Almost all ducted rigs like the IEC 60332-3 can be readily converted to large calorimeters by use of the rack from a Dual Cone Calorimeter and a duct insert which FTT provide. The latter houses all necessary gas sampling, temperature and mass flow probes.



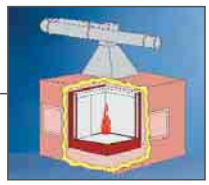
IEC 60332-3 cable testing rig
Readily converted to enable heat release from cable tray tests to be measured.



ISO 9705 Room Corner test
Used extensively to measure the heat release from wall lining materials.

Furniture calorimeter
Used to measure heat release and mass loss from furniture.

Duct Insert
Fitted into exhaust ducts of dynamic test methods. This houses gas temperature and mass flow probes and smoke measuring hardware.



EN 13823
The SBI test method used extensively in Europe to test construction products.

Principle of measurement

This technique is based on the empirical observation that heat released by burning materials is directly proportional to the quantity of oxygen used in the combustion process. Most fuels were found to generate 13.1 x 10^3 kJ/kg of oxygen consumed. Measurement of the precise concentrations of oxygen in the exhaust duct and the volumetric flow of air gives the rate of oxygen consumption from which the heat release rates can be calculated. In the Cone Calorimeter the rate of heat released is given by:

$$\dot{q} = (13.1 \times 10^3)\ 1.10C \sqrt{\frac{\Delta P}{T_e}}\ \frac{(0.2095 - X_{O_2})}{(1.105 - 1.5\ X_{O_2})}$$

Where $\dot{q}$ = Rate of heat release (kW)
C = Orifice plate coefficient ($kg^{1/2} \cdot m^{1/2} \cdot K^{1/2}$)
ΔP = Pressure drop across the orifice plate (Pa)
T_e = Gas temperature at the orifice plate (K)
X_{O_2} = Measured mole fraction of O_2 in the exhaust air (no units)

Modelling with Calorimeter data

Early work carried out in the USA and Sweden showed how successful the Cone Calorimeter was in generating good input data for models.

After the EUREFIC project demonstrated excellent prediction of Room Corner (ISO 9705) performance for wall lining materials from Cone Calorimeter data the European Commission funded several large multi-lab research projects to develop models for prediction of the performance of finished construction products from small scale calorimeter tests. These include the CBUF (Combustion Behaviour of Upholstered Furniture) project for furniture, the FIPEC (Fire Performance of Electric Cables) project for electric cables and the FIRESTAR project for railway rolling-stock.

FTT now supplies Cone Calorimeters that enable materials and products to be tested both in accordance with product standards and with novel developments for advanced research studies. We also produce a range of larger calorimeters that enable products of all sizes to be tested full scale. FTT researchers continue to cooperate with the worlds leading research teams who are using bench scale calorimetry and flame-spread data to predict fire development rates.

FTT's contribution to the development of calorimetery

In the mid 1980's FTT directors worked with Dr. Vytenis Babrauskas (who invented the Cone Calorimeter) and other colleagues to help develop international test standards based upon it. They also designed European prototypes and Stanton Redcroft's commercial Cone Calorimeter. Since 1989 FTT has been the worlds leading manufacturer of full scale calorimeters (e.g. Furniture Calorimeter and the ISO 9705 Room Corner test). The introduction of the FTT Cone Calorimeter in 1993 offered a new generation commercial instrument to the market at approximately half the price of the then current commercial systems. This brought calorimetry into the budgetary reach of most laboratories and FTT subsequently supplied the major sector of this market. FTT later launched the new Cone 2000 and the Dual Cone 2000. Throughout this period FTT scientists and engineers led several calorimetry research projects and contributed extensively to International, European, ASTM and British Standardisation groups.

The FTT group have supplied more than 300 Cone Calorimeters to customers in more than 40 countries. Our specialist calorimetry design engineers ensure our products integrate new developments, our production engineers are the world's most experienced cone builders and our team of specialist service engineers ensure that FTT calorimeters are promptly maintained on all 5 continents.

Applications

Most leading fire research groups now use cone calorimeters both as a prime source of data on properties of materials and as a source of input data to models used for predicting the fire behaviour of finished products. International standards have been published describing the equipment and several national standardisation bodies have now published product standards for use of the Cone Calorimeter in assessing performances of finished products.

- Furniture (ASTM E 1474)
- Wall lining materials (ASTM E 1740)
- Prison mattresses (ASTM F 1550)
- Electric Cables (ASTM D 6113)
- Railway rolling-stock applications (BS 6853)
- Maritime applications (IMO)

Technical Specification

TRUNCATED CONICAL HEATER	
Element	5kW electrical heating element
Heat flux	Up to 100kW/m^2
Heat Shield	Placed between the cone heater and specimen

SPECIMEN HOLDER AND WEIGHING DEVICE	
Specimen holder	A square pan 106mm x 106mm at the top, and a height of 25mm, constructed from stainless steel
Retainer edge frame	A stainless steel frame with inside dimension 111mm x 111mm, and opening of 94mm x 94mm.
Sample size	100mm x 100mm
Sample thickness	Up to 50mm
Balance sensitivity	< 0.1g
Load capacity	Up to 5.0kg

EXHAUST GAS SYSTEM WITH FLOW MEASURING INSTRUMENTATION	
Duct diameter	114mm
Nominal exhaust flow rate	24 l/s
Orifice plate	Internal diameter 57mm located in chimney to measure duct flow
Sampling ring	685mm from the hood, contains 12 small holes with a diameter of 2.2mm
Gas sampling apparatus	Incorporates a pump, soot filter, cold trap, moisture and CO_2 removal traps when CO_2 analyser is not fitted
Cold trap	Operate at 0 – 4°C

IGNITION CIRCUIT	
Spark igniter	Spark gap of 3.0mm located 13mm above the centre of the specimen

CALIBRATION BURNER	
Construction	A tube with a 500mm^2 square orifice covered with wire gauze

INSTRUMENTATION FOR OXYGEN AND GAS ANALYSIS	
Oxygen analyser	Paramagnetic type with a range of 0-25% Oxygen
Carbon dioxide (optional)	Non-dispersive infrared type with a range of 0-10%
Carbon monoxide (optional)	Non-dispersive infrared with a range of 0-1%

SMOKE DENSITY MEASUREMENT	
Light source	0.5mW Helium-Neon laser beam
Detector	Silicon photodiode

DATA COLLECTION AND ANALYSIS SYSTEM	
Resolution	20 bits
Recording time	Once every second
Storage	Raw data recorded for each test is stored and can be retrieved

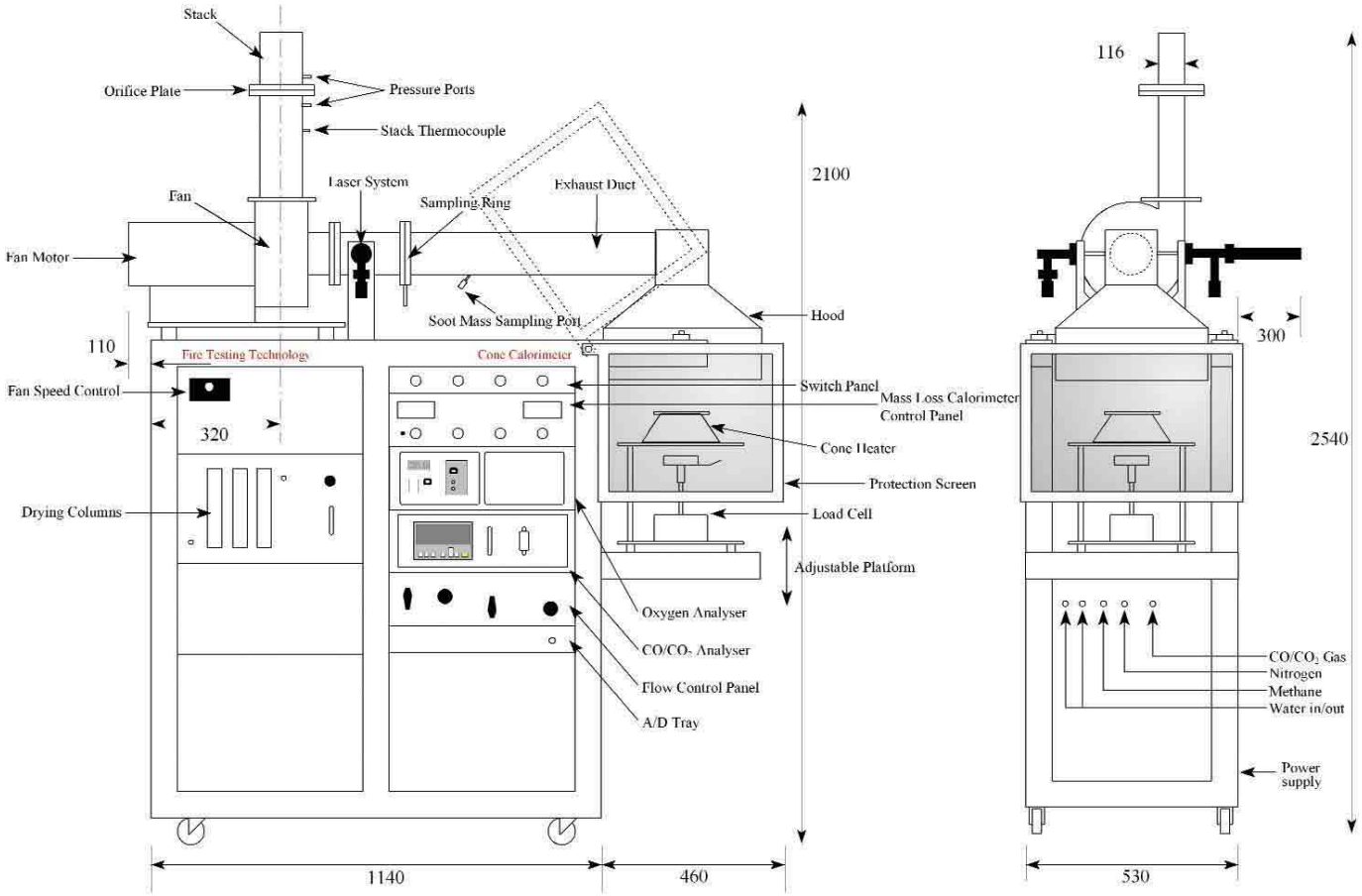
Due to the continuous development policy of FTT technical changes could be made without prior notice.

SERVICE REQUIREMENTS	
Electric	230VAC, 30A, 50/60 Hz. Single Phase
Water	250 kPa (35 psi)
Exhaust Extraction	250-500 l/s
Standard Gases	Oxygen-free Nitrogen, Methane (UHP99.5%)
Optional	CO 0.85%, CO_2 8.5%

Schematic Diagram

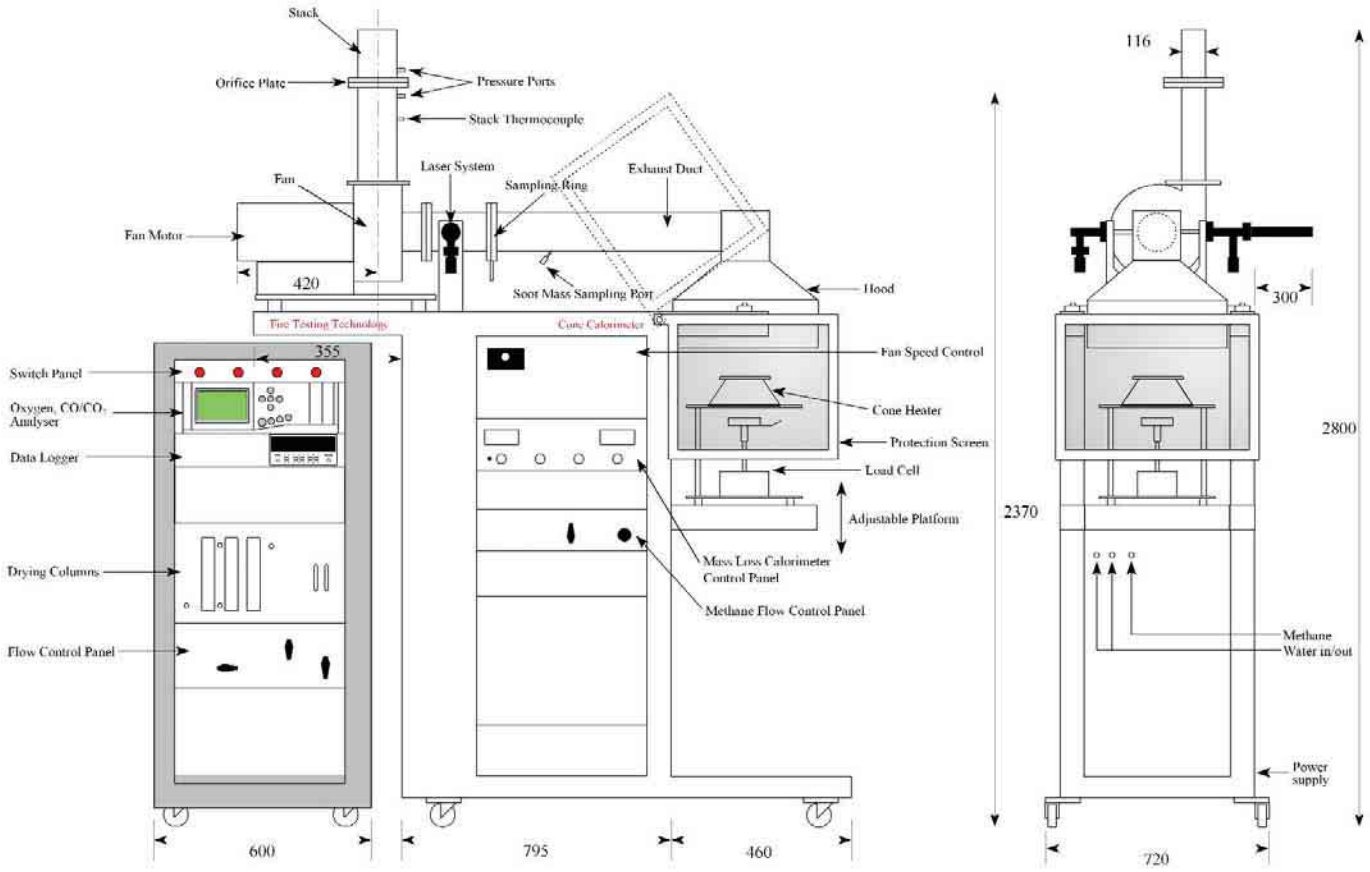
Standard Cone Calorimeter

Not to Scale – Dimensions in mm



Dual Analysis Cone Calorimeter

Not to Scale – Dimensions in mm



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