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Indicative Testing Facilities

PROMETHEUS undertakes research and development in fire protection products and fire resistant materials on a contracted and speculative basis. In order to achieve this we need methods of providing early results on trial formulations at low cost. The major restriction on the development of products is the cost of fire and flame testing at professional fire test houses. To accelerate our development work and allow the evaluation of multiple data sets, we design apparatus that allows us to simulate the effects of full scale testing. In all the apparatus described below we provide viewing ports, such that the behaviour of the specimens may be observed under fire conditions.

This apparatus is available to test products of clients who need the facilities of a fire test laboratory without the cost or complications of installation on their premises.

THE RESULTS OBTAINED FROM THIS PROMETHEUS DEVELOPMENT APPARATUS MAY NOT BE USED AS CERTIFICATED RESULTS.
PROMETHEUS DOES NOT COMPETE WITH OFFICIAL FIRE TEST HOUSES AND IS NOT A CERTIFIED LABORATORY.
REPORTS ISSUED BY PROMETHEUS PREDICT WHAT THE RESULT OF FULL SCALE FIRE TESTING WILL BE ON THE BASIS OF THE LABORATORY RESULTS.

Protection From Fire.

Prometheus Developments have therefore designed and constructed a small furnace that will rapidly and repeatedly produce a large number of data points as a laboratory tool and it is pictured below. Fire test behaviour is subject to a good deal of random variation, and there are a considerable number of variables that must be measured on each intumescent formulation variation. It is therefore necessary that the apparatus gives, as far as possible, results equivalent to that which one would expect from the fire test furnaces at any of the test houses, and will produce a large number of data points very quickly, in order to eliminate the effects of error.

The furnace is constructed of mild steel plate on a rigid steel frame, 50 mm of light weight furnace lining is installed over the steel in the form of a board backed up with a fibrous fill.

The device uses a draughted gas burner with bottom extraction of the furnace gases. Therefore, the gas turbulence conditions inside the 0.5m cube, closely correlate to those in full scale fire test furnaces in terms of heat transfer and turbulence conditions.

The fan assisted burner is wired so that the fan may be run independently of the burners. The rapid cooling provided by this lightweight structure, under the influence of the cooling fan allows the furnace to be fired up to four times a day, obtaining eight data points.

- ✓ Few conventional furnaces of fire brick will cool sufficiently quickly for more than one run a day.
- ✓ The furnace will follow both “cellulosic” and “hydrocarbon” temperature curves
- ✓ The performance of the furnace has been "backwards" standardised by firing both passive and active fire protection products against their known performance in full scale tests.

Samples may be tested as either single sided plates backed on to heavy insulating blocks, channel sections similarly mounted or may be three dimensional samples in either column or beam configuration suspended from the removable roof of the furnace. Sections down to an HP/A of 130 may be evaluated. The furnace has a removable side wall. Barrier specimens may be mounted against this wall. Likewise ceiling or floor structures may be mounted in place of the furnace roof. Specimens may be fired in a multitude of configurations as follows :-.

(1) Internally mounted sample plates 200 x 200 x 5 mm. These are mounted in the side specimen apertures, heavily insulated to the rear. Firing a plate in this way is equivalent to firing plates of twice the thickness from both sides. This allows the collection of data on samples fired on realistic heat sinks that accord approximately with the results from full scale furnaces. The panels are small enough for realistic fire test results to be obtained from lab samples as small as 1 litre. Clearly, the one sided panels and their small size fits well with normal panel preparation practised in any paint laboratory. This procedure exactly simulates the test mode of the DIN 4102 Part 8 indicative furnace.

(2) Internally mounted channel sections. 300 mm channel sections may be mounted in a similar manner to the plates. Because these sections are instrumented from the uncoated face, these specimens may be remotely prepared avoiding damage to the thermocouples.

(3) Four sided columns or three sided beams 300 mm long may be fired suspended from the furnace roof. Prometheus has a stock of universal column and beam sections, as well as rectangular and square hollow sections prepared for client use.

(4) A sub frame may be fitted to the roof aperture extending the furnace so that 0.5 m columns, may be fired mounted on the furnace floor.

(5) 200x200mm barrier fire test specimens may be fired in the apertures in the furnace sides.

(6) 600x600mm barrier fire test specimens may be fired mounted in place of the removable furnace side. Fully working model doors in frames have been evaluated in this way.

(7) 600x600mm floor and ceiling structures may be tested by replacing the furnace roof with these structures. A significant number of railway rolling stock floors have been evaluated in this manner.

- This test mode cannot simulate the performance of a full scale wall furnace fire test as so much of the results from that test rely on the integrity of joints and stability of the structure. However, valuable data can be obtained on the performance of small assemblies on the basis of movement and curvature under test conditions rather than structures in this test mode.

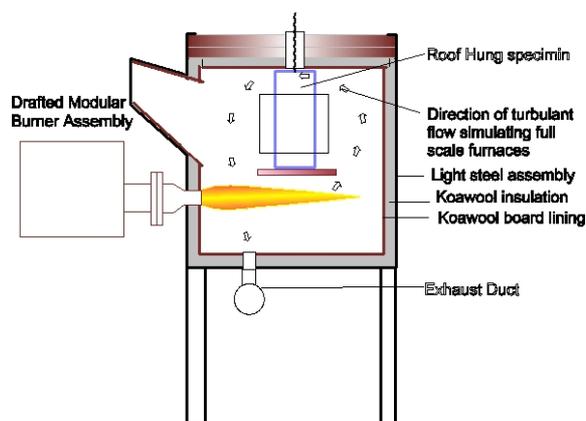
(8) Cable trays and penetration seals may be tested by passing the specimen from side to side of the furnace using the 200 x 200 side apertures.

(9) 150x150x10 plates. As a rapid screening method PD has the designed bespoke plates that can be quickly coated with formulation variations and fired in sets of 8, the thermocouple is positioned 5mm from the hot face and gives an accurate indication of performance. This allows for very rapid screening of formulation variations in the early stages of product development before moving onto larger scale 3 dimensional sections. PD can fire 24 plates in a day.

Thus, we have available the ability to rapidly collect a large number of data points on formulation variations and many simulated structure.

This allows us to simultaneously evaluate a number of interacting variables. Every designer working in the field must have available some form of rapid assessment system. Certainly, the 1.5 metre cube furnace, employing one metre columns, is far too slow and cumbersome to be a development tool, and should be reserved for the final stages of evaluation prior to moving to full scale fire tests.

Figure 1 Prometheus Developments Laboratory Mark1 Fire Test Furnace.
Current furnace design is confidential



An interesting application made available by the existence of this facility, is the evaluation of the durability of intumescent coatings. As the specimen panels are easily small enough to fit most forms of accelerated exposure apparatus, rapid evaluation of the effects of environmental degradation on fire performance can be made with this apparatus.

REACTION TO FIRE

Reaction to fire or flame tests are wide and varied. They are often industry and application specific, Prometheus has a variety of simulators for Reaction to Fire.

1) Single Burning Item (SBI) EN 13823

This reaction to fire test is to become the harmonised European Standard. Unlike the tests it replaces (BS 476 parts 6 and 7, DIN 4102, Epiradiateur) the SBI test requires specimens of significant size. While undertaking work for a client developing flame resistant expanded polystyrene, Prometheus developed a small scale apparatus that mimics the combustion conditions of the full scale SBI. The two 100 x 600 mm specimens are erected as a corner and fired with an un aspirated propane sand burner giving the same area specific heat output as the full scale SBI. Heat output is measured by oxygen depression just as in the full scale apparatus. The apparatus develops it's own Fire Index Gradient (FIGRA) which correlates with the full scale apparatus at $r=0.93$. A nephelometer for smoke emission may be fitted to the output

2) DIN 4102 Brandshaft

Prometheus has a Brandshaft simulator that requires only 100 x 600mm specimens. Past experience has shown that the rating predicted by our simulator accords exactly with the rating received when clients have gone to full scale testing.

3) BS 476 part 6

Prometheus has a full scale version of this rig

4) ASTM E84 flame tunnel

Prometheus has a miniaturised version of this rig as designed by Vandersal, that is commonly used in the USA for development and pre-screening for this very old test. The apparatus is specified as ASTM D 3806. However D 3806 does not include smoke emission. A nephelometer may be attached to this apparatus and standardised against red oak exactly as in the Steiner Tunnel.

Radiant Panel Tests.

Many reaction to fire tests that require exposure to radiant panels only vary in intensity of the radiation, the angle of exposure and exposure time. Any of the following tests may be simulated with our radiant panel rigs standardised against a radiometer.

5) BS 476 part 3

6) BS 476 part 7

7) EN ISO 9239 - ASTM E 648 - ASTM E 970 - NFPA 253

8) ASTM E 162 ASTM D 3675

External Roofing

Surface Flame Spread

Flooring

Motor vehicle requirements

Surface Flame Spread: building materials

Small Flame Test Cabinet

There other small scale flame spread tests specific to the automotive and aerospace industries which are combined in a small flame test cabinet.

These are:-

- 10) FAR 25 appendix F,
- 11) FMV 302,
- 12) UL94, V, H and HB
- 13) EN ISO 11925-2 .
- 14) EN ISO 11612 parameter A
- 15) Additionally the cabinet also contains an ISO 4589 limiting oxygen index (LOI) apparatus.
- 16) A tube burner for EN 50200 testing of cables with detection circuitry is available if required.

Radiant Furnace Tests

- 17) Non flammability test to ISO 1182
- 18) While PD has a ISO EN 5658 rig, this is a cumbersome rig for development. The critical component of the EN 5658 is the CFE parameter. (Critical Flux at Extinguishment). PD has established that this figure can be determined by exposure of small specimens (100 X 200 mm) at controlled irradiance with a pilot burner.

SMOKE AND FUME EMISSION

We have a portable nephelometer that may be attached to either the SBI, DIN 4102 and ASTM E84 rigs to give relative smoke emission data.

Classical Physical Testing.

PD have a standard tensiometer for physical testing and can carry out tensile, flexural, compressive and adhesion tests for clients where, as in the case of composites, achievement of FR properties may compromise structural performance. A tunnel furnace may be installed on this apparatus to evaluate properties at elevated temperatures up to 750°C.

PROCEDURE

Contact should be made with David Aslin at Prometheus to discuss your requirements.

All tests are conducted in total confidence.

Test programmes are tailored to clients' requirements, therefore prices will be quoted according to the clients' particular requirements. For clients evaluating the IIT materials most of the small flame tests will undertaken free of charge.

Advice and comment on the observed and recorded performance can be offered if a report has been commissioned.

Consultancy on improvements is available to any fire test client at our standard consultancy rates.