

Title	OTH95 477: 348: Assessing the Uniformity of the Interim Jet Fire Test Procedure
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Executive Summary	<p>In December 1993, the United Kingdom Health and Safety Executive (HSE) made available a report [1] entitled "Interim Jet Fire Test for Determining the Effectiveness of Passive Fire Protection Materials". The Interim Jet Fire Test (IJFT) procedure described in the report was based on a test pioneered by the Norwegian Fire Research Laboratory (SINTEF NBL), which involved a sonic release of propane vapour of 0.3 kgs, directed at a flat test specimen constructed in the form of an open fronted steel box, 1.5 m wide, 1.5 m high and 0.5 m deep. Although the dimensions of the test specimen were small compared with those typical of items of structure and plant and the release rate of the gas was substantially less than that which might occur in practice, the nature and characteristics of the propane jet fire had been shown to be similar to full scale jet fires involving sonic releases of natural gas of 2 to 3 kgs carried out by British Gas and Shell Research at the Spadeadam Test Facility. The size of the IJFT facility allows tests to be carried out economically either indoors or outdoors in an area protected from the environment, and is therefore attractive as a standard test procedure.</p> <p>The IJFT procedure identifies three configurations of test specimen to test passive fire protection (pfp) material. The first configuration is designed to test panel materials that can stand alone or be used to protect a substrate. The panel material is used to form the rear wall of the test specimen. The second configuration is designed to represent a coating material applied to flat panels. In this case, the coating material is used to protect the inside surfaces of the test specimen. The third configuration is designed to represent the application of a coating material to a structural section such as an I-beam. In this case, a vertical central web is included in the test specimen, welded to the rear wall and positioned edge on to the jet fire. The coating material again covers the inside surfaces of the test specimen in addition to the web.</p> <p>However, before the IJFT procedure can be adopted as an entirely appropriate test method for pfp materials designed to protect against jet fires, one essential requirement was to assess the uniformity of the results from nominally identical tests carried out at different test laboratories</p> <p><b>OBJECTIVE</b></p> <p>This report contains the results from a programme of tests carried out at three different test laboratories in accordance with the UFT procedure. The purpose of the work was to assess the uniformity of the results obtained from the IJFT between the test laboratories.</p> <p><b>OUTLINE</b></p> <p>The generic type of pfp material selected to coat the test specimens was an epoxy intumescent. Epoxy intumescent was chosen since such material is used extensively for fire protection and can be vulnerable to jet fire attack. Consequently such material is suitable material for assessing the IJFT procedure. Two different proprietary epoxy intumescent were selected to ensure that the results from the tests were not material specific. The manufacturers of these materials were approached and both agreed to supply the material free of charge.</p> <p>The configuration of the test specimen employed in these tests was the test specimen with the central web. This was selected since the central web provided the opportunity of testing the application of an epoxy intumescent on an edge feature, which is considered a particularly vulnerable arrangement under the</p>

conditions experienced in a jet fire.

The duration of the tests was selected to be one hour. One manufacturer was asked to provide pfp material which was designed to protect the test specimen for one hour and remain intact for this duration. The other manufacturer was asked to provide pfp material which was designed to provide protection for 40 minutes but would be expected to be damaged at the end of a one hour test. This would allow the assessment of the uniformity of the IJET procedure for materials which survive and for materials which fail in the test.

Three test laboratories were selected to carry out the tests and they were SINTEF NBL, in Trondheim, Norway, the Southwest Research Institute (SwRI) in San Antonio, Texas, USA and the HSE's test facility at Buxton in Derbyshire, UK. Each test laboratory tested two test specimens, one protected by the first pfp material and the other protected by the second pfp material. Thus, six test specimens were manufactured and tested.

## **CONCLUSIONS**

### **Test Specimens**

The test specimens were manufactured in accordance with the engineering drawing provided at the rear of this report. They were coated with pfp material in accordance with the manufacturer's specification or where the application of the pfp material differed from the specification, the difference was approved by the manufacturer's representative who was present during the application. The application was undertaken in a manner which ensured that the pfp material on the test specimens was as uniform as reasonably practical. It is therefore concluded that the test specimens and pfp material were as uniform as could be reasonably expected.

### **Test Procedure**

The three test laboratories carried out the tests on the test specimens generally in accordance with the IJFT procedure. At SwRI no protection was installed around the sides or across the top of the specimen and rear box. There was no evidence of the flames passing around the sides or top of the specimen, however it was not possible to determine whether or not radiation from the flames incident upon the rear box was significant since appropriate measurements were not made. Some minor changes and additions were made to the IJFT procedure, namely

- a) the method of installing thermocouples in the central web,
- b) the attachment of thermocouple to the rear wall, and
- c) the provision of engineering drawings.

These changes and additions are considered to have improved the IJFT procedure. It is concluded that the IJFT procedure is a workable procedure which can be used by test laboratories to carry out jet fire testing.

The test reports issued by the test laboratories vary in content and presentation and consideration should be given to ensuring more uniformity in the reporting of the results.

### **Testing Indoors v Outdoors**

From the testing carried out at Buxton, it would appear that there are particular problems in undertaking IJFT tests outdoors which are not present when the IJFT's are carried out indoors. A number of suggestions have been made in an attempt to account for the differences in the jet fire witnessed at Buxton. It is concluded that further work is necessary to investigate the design of test enclosures used for IJIT's

undertaken outdoors.

Performance of pfp Material on Rear Wall The condition of the char and the temperatures measured on the rear wall of the test specimens showed that there was a high level of uniformity in the results from the three test laboratories. It is therefore concluded that the IJFT procedure provides a uniform test for the rear wall of test specimens.

**Performance- of the pfp Material on the Central Web**

The condition of the char and the temperatures measured on the central web of the test specimens showed that there was not a high level of uniformity in the results from the three test laboratories. IJFT Procedure

It is recommended that the following changes be made to the IJFT procedure:-

- a) full engineering drawings should replace the diagrams in the procedure
- b) the methods outlined in this report to attach the thermocouples to the rear wall should be adopted
- c) stainless steel sheathed thermocouples should be used in the central web
- d) a report format should be included
- e) the IJFT procedure should insist that the report from the test laboratory should contain a section on the measurement and control of the propane flow rate.

**Outdoor Testing**

It is recommended that further work be undertaken to investigate the design of test enclosures to be used outdoors. This work should determine an optimum size, shape, orientation, construction material and ventilation procedure for the test enclosure,

**Application of pfp Material to the Rear Wall**

From the observations made during the IJFT's carried out at the three test laboratories, the pfp material applied to the rear wall of the test specimens responded uniformly. Therefore it appears that the IJIT procedure may be appropriate for the testing of pfp materials in such a configuration. However, further consideration should be given to the performance of the pfp material during an IJFT compared to its performance in a jet fire representative of that which might occur in practice.

**Application of pfp Material to the Central Web**

From the observations made during the IJFT's carried out at the three test laboratories, the pfp material applied to the central web of the test specimens did not respond uniformly. Therefore further consideration needs to be given to the IJFT procedure which may include:

- a) the design of the test specimen
- b) the configuration of the test specimen and test set-up
- c) the orientation and arrangement of the jet fire

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