International

EXPLOSION RESISTANCE OF

PASSIVE FIRE PROTECTION - CHARTEK® 7

1. Introduction

The effect of explosion loading on structural elements and bulkheads to which passive fire protection materials have been applied, and the potential damage of the passive fire protection material by explosion, is a key factor requiring consideration in selection of passive fire protection materials.

As early as 1983 Norwegian offshore operators, in association with technical institutes and test laboratories formulated a programme for experimental test work into the effect of explosion loading on structures and passive fireproofing materials. In 1984, a programme of actual and simulated explosion testing was organised by the Norwegian Scientific Institute, SINTEF, with actual explosion tests being conducted by the Christian Michelsen's Institute in Bergen.

The aim of the test programme was to show the effect of explosion loading on various types of passive fire protection materials, applied to both structural members and plate. Additionally, it was designed to draw comparison between actual explosion loading in a test situation and simulated explosions using shapes and plates with hydraulic rams.

International's Chartek® 3 product was involved in that programme. The results on Chartek® 3 demonstrated Chartek®'s ability to withstand the affects of explosion, as indeed did further testing in 1991 at the Fire Research, Cardington, UK laboratories.

Similarly, Chartek® 7 has been demonstrated by explosion testing at Cardington to be able to withstand varying levels of blast overpressure and deflection.

2. Explosion and Fire – The Problem

A fire protection system can be rendered worthless if an explosion precedes a fire, which is a very likely scenario where hydrocarbons are being extracted, processed and transported. The consequence of an explosion to the passive fire protection system can be damage to that system. Typically, damage can be cracking of the passive fire protection, opening of joints, delamination and, in some cases, complete removal of the passive fire protection material. Actual explosion testing demonstrates a passive fire protection material's ability to withstand a blast overpressure and the associate deflections.

While the danger of explosions are clearly recognised there is no national or international standard that addresses the testing of structural members or components that are required to be exposed to blast and survive.

3. Explosion Testing of Chartek® 7

An explosion test programme on Chartek® 7 was carried out at the Building Research Establishment Ltd/Fire Research Station – BRE/FRS on 24 April 1997. These tests examined the performance of the Chartek® under a range of dynamic pressure loads.

3.1. Test Specimen

3.1.1. Passive Fire Protection System

The passive fire protection system consisted of 8mm Chartek® 7 reinforced with HK-1 fibre mesh at mid thickness of the Chartek®.

3.1.2. Substrate

The Chartek® 7 was applied to one side of a 2m x 1m steel plate. The steel plate was 6mm thick. A 50mm x 50mm x 8mm ordinary steel angle was welded along the four edges of the external face of the plate. The top and bottom stiffeners were drilled to allow the test specimen to be anchored to the front of the blast chamber. The two sides were unrestrained.

3.2. Test Results

The BRE/FRS summarised the series of test results as follows:

Average Pressure (max) (kpa)	***Time to Pmax (ms)***	***Net Central Displacement (mm)***	***Permanent Displacement (mm)***
151.0	412	72	38

Observations: No significant damage to the panel was reported.
No debonding or delamination of the coating was reported.

3.3. Conclusions

Chartek® 7 was shown, by dynamic testing, to be capable of withstanding, without loss of integrity, explosion pressures up to 1.51 bar and deflections up to 72mm in a span of 2m.