

A grayscale photograph of an offshore oil rig dominates the background. The rig's complex steel structure, including multiple levels of platforms, ladders, and support beams, is visible against a cloudy sky and the sea. The bottom of the image is partially obscured by a blue banner.

Fire ratings

For fire protective products

Index

Introduction to fire ratings	3
Types of fire	4
Offshore fire ratings	6
Onshore and petrochemical fire ratings	10
Application and materials	11

Introduction to fire ratings

Ever since the discovery of oil, humanity has looked for different ways to obtain this high demand fossil fuel by drilling in harsh environments. Especially the offshore industry has posed difficulties with regards to weather conditions and safety regulations of people and equipment. Certain notable offshore fire disasters have initiated the development of strict rules and regulations for the safety of people and equipment during fire events. One such a disaster was the Piper Alpha disaster in 1988.

Piper Alpha was a large fixed oil production platform in the North Sea, approximately 193 km northeast of Aberdeen, UK. During a shift change, the staff had not been made aware not to use a piece of pipework which had been sealed with a temporary cover and no safety valve. Subsequently, gas leaked out and ignited causing a huge explosion. Within 2 hours most of the platform collapsed into the sea. The devastating results were 167 deaths and a total insured loss of \$3.4 billion.

Some findings leading up to this event were the lack of blast walls, lack of communication, lack of management control on safety system and no proper training.

Some of the lessons drawn from this disaster regarding construction were:

- The need for more partitioning
- The need for strict rules for higher blast and fire ratings;
- Larger separation of processing and accommodation facilities.

A lot has been learned after this disaster but unfortunately, the Piper Alpha disaster was not the last one. In 2010, 22 years after the Piper Alpha disaster, another huge explosion and fire event occurred on the Deepwater Horizon, which was located in the Gulf of Mexico.

The explosion killed 11 workers and injured 17 others. A very recent disaster occurred in a petrochemical plant in Mexico in 2016, April 20th. The probable reason for the fire explosion is a gas leak, which eventually killed 32 workers.

As a result of such fire disasters new and improved rules and regulations were developed and are still developing and evolving.

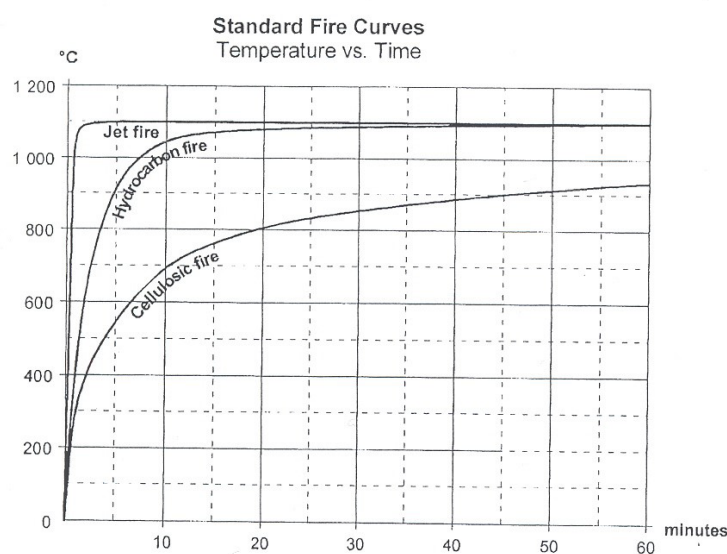
Architectural offshore products such as doors, walls and windows are expected to be rated according to international fire ratings developed by IMO Solas and European Standards.



Types of fire

Fires and flames can have a limitless number of variations regarding growth phase, peak temperature and duration. However, the industry has adopted standard fire curves for different types of fire to allow for benchmarking between fire protection products. There are 3 industry recognized fire types:

- **Cellulosic Fire;**
- **Hydrocarbon Fire;**
- **Jet Fire.**



Cellulosic Fire

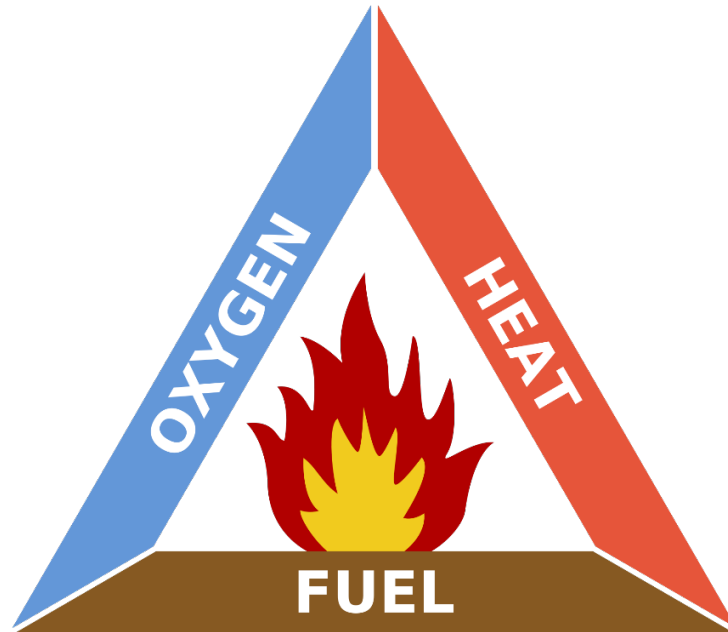
Cellulosic fire is a fire with a fuel source predominantly of cellulose (e.g. plastics, wood, paper, cotton, textiles). A fire involving these materials is relatively slow growing, although its intensity may ultimately reach or exceed that of a hydrocarbon fire. The fire generally remains stable for at least 60 minutes. The standard fire curve of a cellulosic fire reaches 500°C [932°F] within 5 minutes and rises to 945°C [1733°F] over time. Typical radiation value after 5 minutes is 50 kW/m².

Hydrocarbon Fire

Hydrocarbon fire, or pool fire, is a fire fueled by hydrocarbon compounds (oil and gas), having a high flame temperature to 1000°C [1832°F] within 5 minutes, achieved almost instantaneously after ignition. The heat rises to 1100°C [2012°F] shortly thereafter. The fire maintains its stability for at least 120 minutes. A hydrocarbon fire will spread rapidly, burn fiercely and produce a high heat flux. Typical radiation value after 5 minutes is 160 kW/m².

Jet Fire

Jet fires are a particular group of hydrocarbon fuelled fires expelled from an orifice, e.g. leak in pipe or vessel, under pressures of 2 bar or greater. They are the most severe fire scenario, considering the effect of erosion of steel and also the significantly higher rate of burning due to turbulent fuel/air mixing. Typical radiation value after 5 minutes is 320 kW/m².



Offshore fire ratings



The International Maritime Organisation (IMO) is a United Nations organization that is responsible for regulating the maritime industry with regards to safety, environmental concerns, legal matters, technical cooperation, maritime security and the efficiency of shipping. The organization was formally established in 1948 in Geneva and came into force 10 years later (the original name was the Inter-Governmental Maritime Consultative Organization or IMCO, but the name was changed in 1982 to IMO).

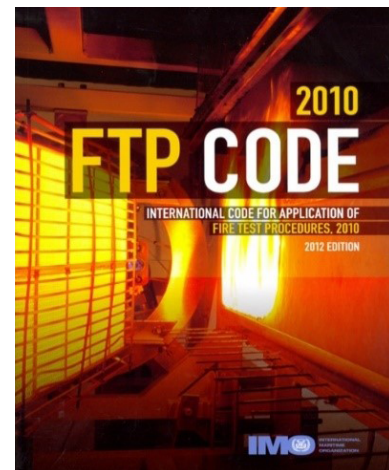
IMO developed the international maritime treaty named “the Safety of Life at Sea” (SOLAS) in order to bring maritime regulations into an international framework. The treaty includes minimum safety standards for ships in terms of construction, equipment and operation.

Fire safety provision onboard all ships is a significant aspect of this treaty. Regulations for fire protection, fire detection and fire extinction are encapsulated under the International Code for the Application of Fire test Procedures (FTP Code).

The FTP Code was implemented in SOLAS in 1996 and entered into force in 1998. The current revised FTP Code 2010 version came into effect on the 1st of July 2012. The FTP Code provides the international requirements for laboratory testing and fire test procedures for products referenced under SOLAS chapter II-2.

The FTP Code includes the following:

- Part 1 Non-combustibility test
- Part 2 Smoke and toxicity test
- Part 3 Test for “A”, “B” and “F” class divisions
- Part 4 Test for fire door control systems
- Part 5 Test for surface flammability
- Part 6 (blank)
- Part 7 Test for vertically supported textiles and films
- Part 8 Test for upholstered furniture
- Part 9 Test for bedding components
- Part 10 Test for fire-restricting materials
- Part 11 Test for fire-resisting divisions of high-speed craft



It also includes annexes on products which may be installed without testing and/or approval and on fire protection materials and required approval test methods.

FTP Code Part 3 - Test for "A", "B" and "F" Class Divisions

Part 3 of the FTP code describes the test procedures for the different fire ratings. Although the fire ratings are normally specified for ships, they have also been used extensively for offshore oil and gas construction specifications. "A", "B" and "F" class divisions for cellulosic fire events have been described in this part.

"A" class divisions are those divisions formed by bulkheads and decks which are constructed of steel or other equivalent material, are suitably stiffened, and are so constructed as to be capable of preventing the passage of smoke and flame to the end of the one-hour standard fire test prescribed in II-2/3.2 of the 1974 SOLAS Convention. They are insulated with approved non-combustible materials such that the average temperature of the unexposed side will not rise more than 140°C above the original temperature, nor will the temperature at any one point, including any joint, rise more than 180°C above the original temperature, within the time listed below:

- Class "A-60" 60 minutes
- Class "A-30" 30 minutes
- Class "A-15" 15 minutes
- Class "A-0" 0 minutes

"B" and "F" class divisions are those divisions formed by bulkheads, decks, ceilings or linings which are so constructed as to be capable of preventing the passage of flame to the end of the first half hour of the standard fire test. They are constructed of approved non-combustible materials.

The average temperature rise of the unexposed side of the insulation will not rise more than 140°C above the original temperature, nor will the temperature at any one point, including any joint, rise more than 225°C above the original temperature, within the time listed below:

- Class "B-15" 15 minutes
- Class "B-0" 0 minutes
- Class "F-15" 15 minutes
- Class "F-0" 0 minutes



“H” and “J” Class divisions

Up to date, there are no internationally recognized hydrocarbon fire test standards. Used standards for hydrocarbon fire test are e.g. the UK Department of Energy Hydrocarbon Time/Temperature Relationship and IMO Resolution MSC.307(88) Performance Criteria. This is accepted as an industry standard, among which all major Notified Bodies (NOBO's) (e.g: LR, DNV-GL, BV, ABS, etc.)

“H” class divisions have to be insulated with non-combustible or equivalent materials such that the unexposed side will not rise more than 140oC above the original temperature, nor will the temperature at any one point, including any joint, rise more than 180oC above the original temperature, within the time listed below:

- Class “H-120” 120 minutes
- Class “H-60” 60 minutes
- Class “H-0” 0 minutes

Unlike the hydrocarbon fire test standard, there are internationally recognized jet fire test standards, like the OTI 95634 *Jet fire resistance test of passive fire protection materials*, and the ISO 22899-1 *Determination of the resistance to Jet Fires of passive fire protection materials*.

These are however not as elaborate and comprehensive as the IMO FTP code, leaving the need for additional specification of both the jet fire characteristics and the required performance of the fire protection materials, of which the most important specifications are:

- Duration of the Jet Fire exposure
- Minimum duration of the insulation performance of the structure
- Maximum temperature rise of the structure.



Fire Integrity

Fire integrity is the basic fire-resisting ability of a product to remain intact during a specified period, i.e., 60 minutes for "A" Class and 30 minutes for "B" Class. The following requirements have to be met for the minimum test duration for the relevant classification, according to the FTP code:

1. There shall be no flaming on the unexposed face
2. There shall be no ignition, i.e. flaming or glowing, of the cotton wool pad when applied in accordance with the relevant paragraphs, or when used to assist evaluation of flaming
3. It shall be not possible to enter the gap gauges into any opening in the specimen

Criteria	A-class	B-class	F-class	H-class	J-Class
Testing duration	60 min	30 min	30 min	120 min	120 min
Insulation temperature rise:					
Average	140°C	140°C	140°C	140°C	140°C
Maximum	180°C	225°C	225°C	180°C	180°C
Radiation value	50 kW/m ²	50 kW/m ²	50 kW/m ²	160 kW/m ²	320 kW/m ²
Class description	0, 15, 30, 60	0, 15	0, 15	0, 60, 120	0, 15, 60

As the fire test procedures for 'A' class, as described in the IMO FTP code are nearly identical to the EN 13501-2, products certified for IMO FTP usually suffice for applications where EN 13501-2 is specified.



Onshore and petrochemical fire ratings

For the onshore and petrochemical industry, the general norm is the European Standard (EN). The rules and regulations for this standard are approved and agreed upon by 3 European Standards Organizations (ESOs), Comité Européen de Normalisation (CEN), Comité Européen de Normalisation Électrotechnique (CENELEC) and European Telecommunications Standards Institute (ETSI).

A European Standard “carries with it the obligation to be implemented at national level by being given the status of a national standard and by withdrawal of any conflicting national standard”. European Standards automatically become a national standard in each of the 33 CEN-CENELEC member countries.

The fire resistance classifications and tests for construction products and building elements for onshore platforms and petrochemical plants are described in the standard EN 13501-2: “Fire classification of construction products and building elements - Part 2: Classification using data from fire resistance tests, excluding ventilation services”.

The test examines the following aspects of fire resistance of the tested product:

- The ability to stop fire and gases in case of one-side fire lade (integrity [E]);
- The ability to reduce the rise of temperature to prevent the movement of a fire and inflammation of materials on protected side, and providing the possibility to safe evacuation, (insulation [I]).

If it is required, the tested product has to prevent the spread of fire during a certain time. The average temperature rise should not be more than 140°C and the maximum temperature rise should not be more than 180 °C, within the time listed below:

- | | | |
|---|--------|-------------|
| • | EI 30 | 30 minutes |
| • | EI 60 | 60 minutes |
| • | EI 90 | 90 minutes |
| • | EI 120 | 120 minutes |

Fire integrity onshore and petrochemical

The assessment of integrity shall generally be made on the basis of the following three aspects:

- cracks or openings in excess of given dimensions;
- ignition of a cotton pad;
- sustained flaming on the unexposed side.

Application and materials

Fire ratings are accredited to different architectural products on offshore platforms, onshore platforms and petrochemical plants. Significant products in designing these structures are doors, walls and windows.

Doors

On each structure, a whole range of doors with various characteristics and properties can be found. The type of rating a door gets depends, among other things, on the location of the door in the construction. "B" and "F" rated doors are generally installed in areas where there are openings in corridors or room partitions, the so-called interior area. For the external part of the platform, "A", "H" and "J" rated doors are installed because they provide a higher level of protection against fire. "H" and "J" rated doors are also applied in internal hazardous areas where the risk of hydrocarbon fire exists, for instance between the oil and gas processing environment and the accommodation area. This is also known as high-level partitioning, where infrastructural products need to be able to withstand more severe fires and explosions. "A" rated doors can be applied everywhere else unless a specific requirement prevails.

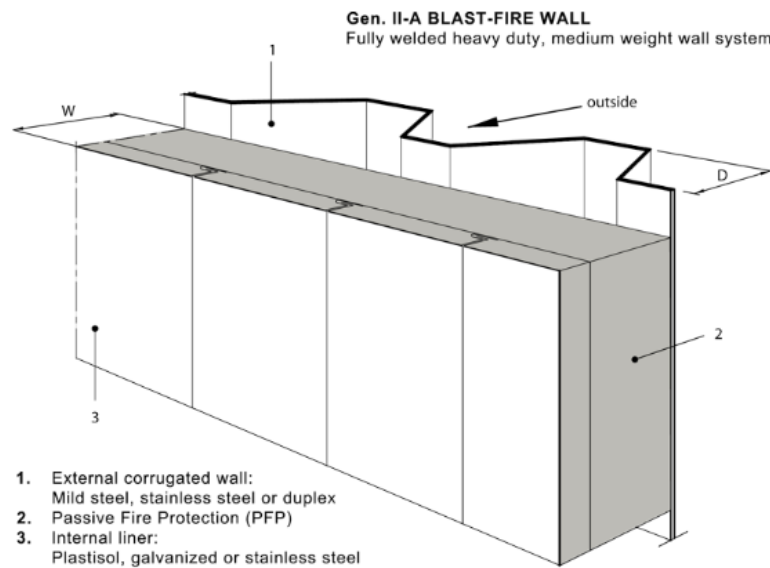
There are specific requirements for fire rated doors. The door leaf and frame have to be constructed of steel or other equivalent material and insulated as necessary to achieve the desired standard of insulation. Fire rated doors usually need to have fire rated seals which commonly are composed of an intumescent material. An intumescent material chemically reacts to heat by expanding, which eventually seals the door edges.

Fire rated doors are insulated with ceramic wool, which is a non-combustible material, made from ceramic materials, like stone. The main fire resistant characteristic of this material is that it has a very high melting point in excess of 1400 C°, therefore it does not allow the spread of flame and it does not produce toxic smoke in the event of a fire.



Walls

Fire rated walls are of equal significance against fire protection as fire rated doors. The fire rated doors are mounted into the walls to form a perfect barrier against fire. "B" and "F" rated walls are positioned in between the corridors and rooms partitions. "A" rated walls are placed around the external parts of the platform to protect against cellulosic fire. "H" and "J" rated walls are applied on the external part and are preferred when there is a high risk of a hydrocarbon fire. "H" and "J" rated walls are also installed in between the oil and gas processing environment and the accommodation area where there is an internal risk of hydrocarbon fires and explosions. For the external part of the wall, the most common materials to use are mild steel, stainless steel, duplex or plastisol. The inner layer of the wall is made of Passive Fire Protection (PFP), which can be, for instance, ceramic wool. The internal liner generally consists of plastisol, galvanized steel or stainless steel.



Windows

Fire rated windows are an indispensable architectural structure on oil platforms. Windows are generally "A", "H" and "J" rated for fire.

The frame and glazing bar of windows are made of mild steel or stainless steel and can be easily welded to fire rated walls.



About van Dam

We design and manufacture fire and blast protective products and solutions to protect personnel and critical equipment. Van Dam B.V. is a market leader in this niche market and our innovative character enables us to stay ahead of the competition by investing in its technologies and anticipating on constant changing safety regulations.

Our organization

We wish to supply a variety of products to the global market from our central organization in the Netherlands with a staff that is highly knowledgeable in fire and explosion proof products and associated products, whereby production activities will take place worldwide. Distributors all over the world are responsible for overseeing and selling a diversity of products on a global basis.

All activities take place from the head office in Moerdijk, the Netherlands, which manages the global production sites and sales network. But also Van Dam ventured into the works setting up Branch offices worldwide. Van Dam B.V. is a genuine project organization, whereby all departments contribute towards the successful completion of a project.

The organization has more than 100 years of experience in projects for international customers who maintain the highest of standards, such as IMO Solas, NORSOK, USCG and many other specifications.

Our organization is fully geared up, and qualified, to face and match the challenges of your complex Design & Build projects.

The Group

Van Dam B.V. is part of Vigians (listed on the Euronext Paris Stock exchange), a leading independent engineering group.

Vigians' activities are focused on the fast growing technological niche market in the nuclear, defense and aerospace industry.

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