InterDam

# InterDam's perspective on safe tunnel doors.

The safety of people traveling trough tunnels

E-BOOK

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# 1. Introduction

The safety of people travelling through tunnels is to great concern of the owners/ operators of these tunnels. Over the recent years, the evaluation of accidents resulted in more stringent fire safety requirements. Tunnel doors form a critical part of the tunnel safety philosophy.

For tunnel doors, the combination of proven fire resistance, maximum operability and minimal maintenance and cost, is the industry's challenge. This eBook outlines InterDam's approach on the tunnel door industry and will challenge you as an interested reader to join in the discussion to optimize tunnel fire doors in all aspects.

*Figure 1: maintenance on tunnel doors should be brought back to an absolute minimum to minimize "tunnel offline", risk and cost.*

# 2. Challenges in the tunnel fire door industry

The global tunnel fire door industry is strongly divided from a regulatory, client, engineering, supplier and constructor perspective. Most suppliers operate regionally only, as the regulations can differ significantly from country to country. This makes it hard to find economies of scale in the production of tunnel fire doors. Cost savings by suppliers are often found in downgrading the supplied product. E.g., only provide what hard targets the specific project requires, no more. The Fire rating and maximum allowed opening force requirements are met in a laboratory or even only via a factory acceptance test. But what about the softer targets? Low maintenance, easy installation, durability, exchangeability, circularity and opening force during operation time of the tunnel. How can operators assure the required maintenance sequence is met?

## 2.1. Maintenance and CAPEX

Many of the current doors that are supplied in tunnels require frequent maintenance *(figure 1)*. The main reason is that the doors are not designed according to a low maintenance philosophy. For example, dirt and dust are easily allowed into the rolling mechanism of sliding doors and unto the rails, due to the lack of protective covers. From the application of these doors in other stringent environments, like the offshore environment, we have learned that the application of weather hoods and further protective covering can considerably decrease the maintenance interval schedule and associated direct and indirect costs *(figure 2)*.

Another example is to use stainless steel ss316 instead of mild steel as the base material for the door frames and leaves. This for sure increases the CAPEX, as the price for stainless steel is considerably higher than mild steel. However, in regions where Natrium Chlorides (salt) are used in winter times, we recommend the use of ss316 as this material has a long track record withstanding corrosion in very saline environments.

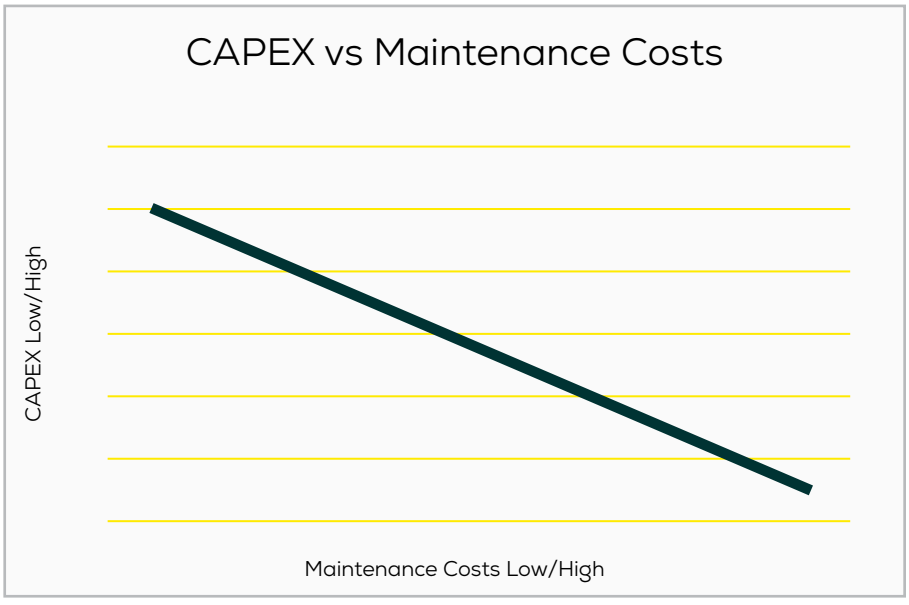


*Figure 2: Capex vs Maintenance cost; low CAPEX could result in high maintenance cost. If the door is designed with minimum maintenance cost, the CAPEX will be higher, but maintenance cost lower.*

## 2.2. CAPEX and Economies of scale

So, we can lower maintenance cost by investing in a more durable product and therefore increasing the CAPEX. But of course, the CAPEX has a limit and should be optimized to get the best value for money. How can we make sure the CAPEX is optimized without compromising quality or longevity?

*Hypothesis:*
Economies of scale can be achieved if doors are designed according to the highest standards. As a standard. If the soft targets are also addressed, this door type could become a widely accepted standard at a lower cost.

Fire curve & Economies of scale:
Different countries and different tunnels prescribe different fire ratings. As there is a considerable difference in temperature and heat flux. The current market standard is to provide fit for purpose solutions that meet these project specific requirements. The problem with this strategy in the market for tunnel doors, which is in numbers on yearly basis not very large, is that it is quite difficult to achieve economies of scale. The current strategy of InterDam, however, is to cut cost by developing a ''global'' standard set of tunnel doors that are tested according to the Mother Of All Curves (MOAC, *figure 2 & 3*).

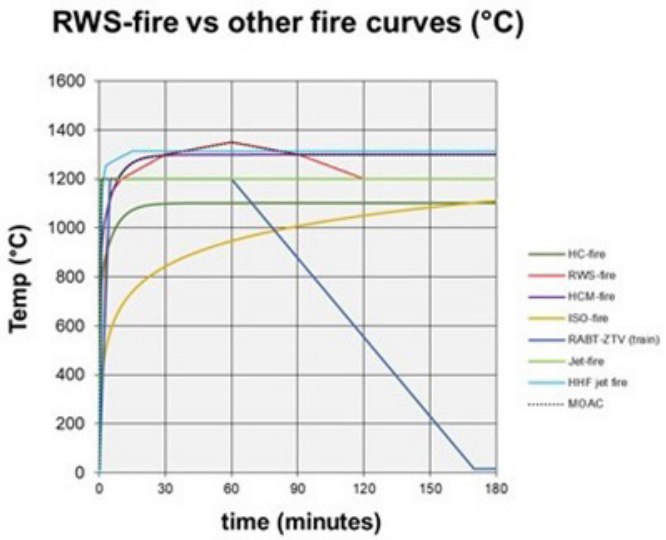


*Figure 3: Temp vs Time on RWS-fire curve vs others, MOAC, Mother Of All Curves covers all curves and is used for testing InterDam doors.*

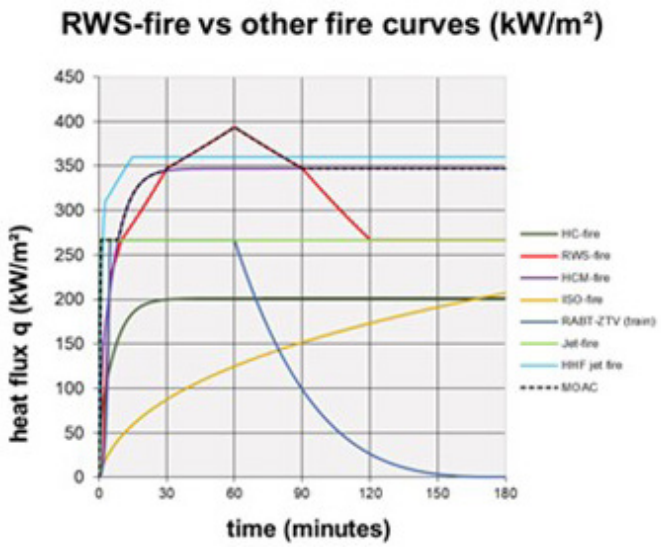


*Figure 4: Heat flux vs time on RWS-fire curve vs others, MOAC, Mother Of All Curves covers all curves and is used for testing InterDam doors.*

Even though this door might be over dimensioned for lower requirements, by standardizing the design as well as production, cost savings are considerable as this allows the doors to be used for all types of tunnel doors, in all regions globally. This will considerably increase the series production of the doors and therefore lower the CAPEX of the doors according to the Economies of scale model *(figure 5)*.

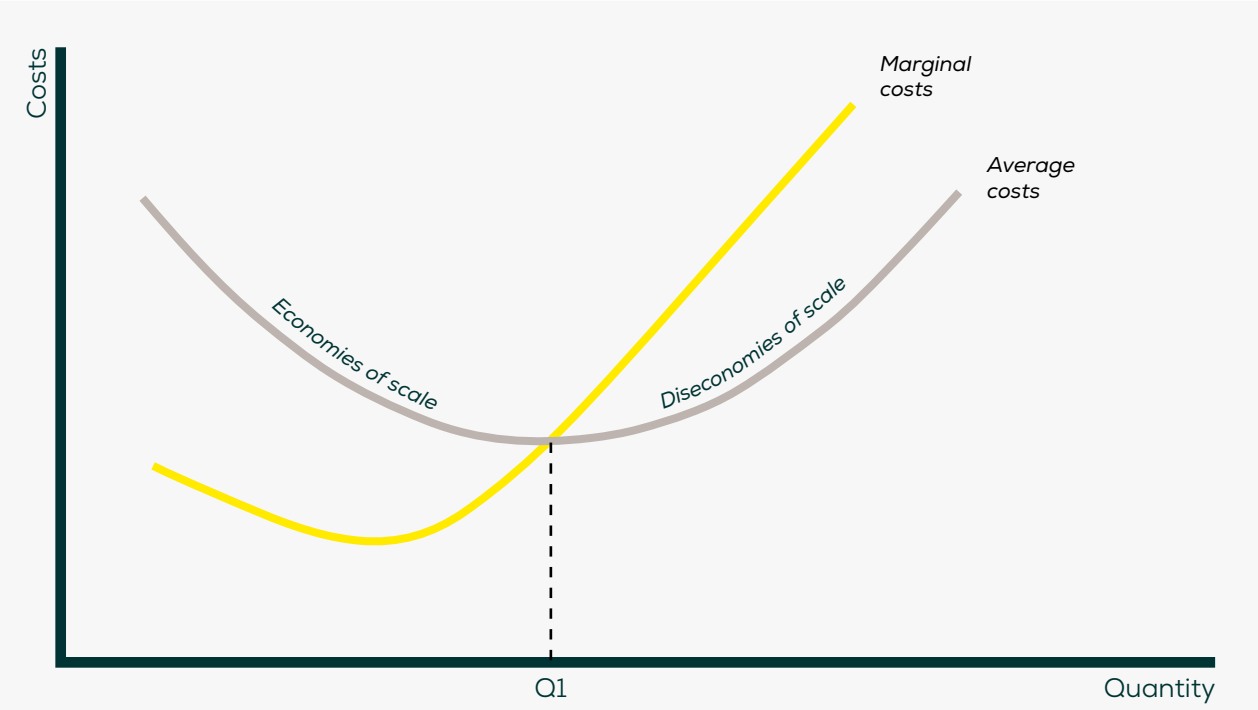


*Figure 5: Economies of scale, semi mass production of "all in" tunnel fire doors will drive cost down due to Economies of scale.*

## 2.3. Fire testing of doors & tunnel safety

In the offshore industry, a fire certificate on doors can only be obtained if the full door including its frame in a representative wall, is successfully tested. Over the past 25 years, InterDam has executed over 50 fire tests. A key takeaway from these tests is that if a door is tested on a smaller scale, or only in parts, the outcome of these partial tests can very well vary from the full-scale test. The main reason is that heat causes materials to increase in length. The longer the material, the greater the length increase. Materials with different properties or different shapes will increase in length differently when heated. This is the main reason for failure during a test.
So, in order to be safe in real life, the doors are to be tested as realistically as possible. As a real live, full package *(figure 6, next page)*.


*Figure 6: InterDam Hinged doors tested at Effectis on fire resistance from both sides at same time.*

## 2.4. Advice for tunnel specialists

For tunnel specialists/owner representatives who wish to make sure the best fit for purpose doors are prescribed, the following points are to be addressed in the technical specification:

1. Fire rating: describe exact requirements (and allow for or better) as per figure 4 and 5);
2. Fire test: confirm doors to be full scale tested (type approved) according to the required fire curve;
3. Openable with a maximum initial force of 100 N at all times during operation life of the door with minimal maintenance (max 2 inspections and 2 cleaning/maintenance runs per year by encapsulating moving parts from tunnel dust. Use of brushes in front of carts in rails for sliding doors. InterDam has designed the ergo latch for easy opening within 100N: Ergo Latch for heavy duty sliding fire doors - YouTube. For hinged doors, openable towards the pressurized escape route, a dedicated pusher can be applied, fit to overcome over 400N of overpressure;
4. Overpressure resistant to 20 kPA +/- 20.000.000 times. Doors including doorframes are designed to withstand this many cycles of overpressure caused by passing trains, trucks or other forms of traffic. If this is applicable for your tunnel, your specification should mention the overpressure and the number of cycles;
5. Gas, water, smoke tightness: gas leakage rate < 3 m3/h @ 100 Pa, weather tight: no leakage from a nozzle of 2 bar overpressure, held at a maximum distance of 1,5 m from the door. smoke tight according to EN 1634-3 class Sa >Sm (2000C)
6. Easy to install, allowing to absorb large main structure (concrete) tolerances;
7. Ss316L for all sheet metal on doors that are installed in tunnels where a corrosive environment is created (Natrium Chloride on winter roads, or other aggressive materials like bird droppings);
8. CO2 footprint: circular materials, durability and longevity of the doors
9. Technical details: check the InterDam Databook doors for all details regarding InterDam doors on www.InterDam.com, or email to 'Tunnels@InterDam.com'.

# InterDam

Your shield in the field.

InterDam is a manufacturer and supplier of fire and blast resistant architectural items. InterDam has the ability to reply to market queries in a flexible way. The aim of InterDam is to create the safest area possible for professionals working in high risk environments, applying straightforward and fully certified products and methods.

The company is certified to ISO9001 with all her products extensively tested and approved by DNV, Lloyd's, ABS and USCG for blast and specific heavy fire ratings A0, A60, H60, H120 and jet fire ratings. All products have relevant type approval certificates from certifying authorities referenced above.

InterDam's products are custom designed to suit different environments such as Oil and Gas platforms and FPSOs, wind energy transformer installations, refineries, petrochemical plants and laboratories. From supply of a standard fire door up to the most complex specific architectural projects, InterDam has all capabilities to support you.

For further details of all InterDam products and services, please visit our website
**www.interdam.com**

Products available from InterDam currently include the following standard and heavy duty items fabricated from galvanized or stainless steel:

- Blast- and fire resistant doors
- Fire resistant walls, welded and bolted types
- Blast resistant walls, welded and bolted types
- Cladding systems, weather tight and/or blast relief
- Spare parts for offshore and onshore fire and blast doors

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