# FIRETEX® FX RANGE

## INTUMESCENT PROTECTION FOR STEEL FRAMED CAR PARKS

FROM SPEC TO PROTECT

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# FIRE PROTECTING STEEL FRAMED CAR PARKS WITH INTUMESCENT COATINGS

**While there are typical designs for car parks, like most buildings these may vary significantly as can the environmental conditions. At one end of the spectrum are open car parks with no roof cover while at the other end are car parks located under a water tight building.**

For fire protection coatings the environmental extremes encountered in car parks, and other open sided buildings, mean that it is often not possible to have a one size fits all solution to the specification. Particularly onerous for intumescent products are open deck car parks and underground car parks where water, road salt and grit can cause conditions that are very severe.

In common with most structures that require a coating specification, steel frame car parks are often defined in terms of a corrosivity environment in accordance with ISO 12944/EN 16623. The challenge is that these are broad based categories which do not really consider the specific requirement of intumescent fire protection coatings. Despite this ISO 12944/EN 16623 could better define the actual environment encountered in different types of car park and similar open structures, if more consideration were given to the parts of the standard that deal with issues such as local micro-environments and special cases.

Fire protection coatings are specified for the safety of life as well as building integrity in the event of a fire. They are expected to remain effective over the defined service life, and so it is essential that the correct environment is recognised in order that the most appropriate specification is identified.

This document attempts to identify a number of typical car park types, the likely environmental conditions and the most appropriate specification type in the opinion of Sherwin-Williams, however, it is clear that many projects will need to be considered on an individual basis due to the wide variation of conditions that can be encountered.

# ISO 12944/EN 16623 AND DEFINING THE ENVIRONMENTAL CONDITIONS

**In common with most structures that require a coating specification there is a tendency for steel frame car parks to be defined in terms of a corrosivity environment in accordance with ISO 12944/EN 16623. While this is understandable for ease of definition it is technically incorrect for a number of reasons:**

- ISO 12944/EN 16623 environmental classifications are based on the corrosion rate of carbon steel or zinc panels. Given that in many cases the actual corrosion rate is unknown, the standard also provides descriptive examples to help the specifier visualise the typical environment for corrosion protection. It is important to remember though that these descriptive examples are informative and do not cover all possible environmental conditions.
- In addition to these environmental classifications, ISO 12944/EN 16623 identifies the need to consider micro-environments which can modify the main defined environment. This aspect of ISO 12944/EN 16623 is often overlooked by a specifier but in many cases the micro-environment can be fundamental to the correct definition of the environment.
- ISO 12944/EN 16623 does not directly apply to the specification and use of intumescent fire protection coatings, the main role of which is not corrosion protection but the insulation of steel in the event of a fire. In many cases the micro-environment is fundamental to the correct specification of an intumescent coating.

## ISO 12944/EN 16623 ENVIRONMENTAL CLASSIFICATIONS IN MORE DETAIL

Environmental classifications according to ISO 12944 Part 2, Clause 5, Table 1 and EN 16623.

| Corrosivity category | Examples of typical environments in a temperate climate (informative only) | |
|---|---|---|
| | Exterior | Interior |
| C1 Very low | N/A | Heated buildings with clean atmospheres, e.g. offices, shops, schools, hotels. |
| Z2 | N/A | Humidity lower than 85%, and excluding temperatures below 0ºC. |
| C2 Low | Atmospheres with low level of pollution. Mostly rural areas. | Unheated buildings where condensation may occur, e.g. depots, sports halls. |
| Z1 | N/A | Humidity equal to or higher than 85%, but excluding temperatures below 0ºC. |
| C3 Medium | Urban and industrial atmospheres, moderate sulphur dioxide pollution. Coastal areas with low salinity. | Production rooms with high humidity and some air pollution, e.g. food-processing plants, laundries, breweries, dairies. |
| Y | | Including temperatures below 0ºC, but no exposure to rain, and limited or casual exposure to UV. |
| C4 High | Industrial areas and coastal areas with moderate salinity. | Chemical plants, swimming pools, coastal ship and boatyards. |
| X | Exposed to weather. | N/A |
| C5 | Industrial areas with high humidity and aggressive atmosphere/ coastal areas with high salinity. | Buildings or areas with almost permanent condensation and with high pollution. |
| N/A | N/A | N/A |

The importance of the micro-environment in correct specification is recognised in ISO 12944 by the following definition:

### MICRO-ENVIRONMENT

The environment at the interface between a constituent element of a structure and its surroundings. The micro-environment is one of the decisive factors in the assessment of corrosion stresses.

In addition to highlighting the importance of the micro-environment, ISO 12944 Part 2 also discusses Special cases. These are defined in Clause 4.3 as follows:

### SPECIAL CASES

For the selection of a protective paint system, special stresses to which a structure is subjected and special situations in which a structure is located shall also be taken into account. Both the design as well as the use of the structure may lead to corrosion stresses not taken into consideration in the classification system given in clause 5. Examples of such special cases are given in Annex B which goes on to say...

"The effect of corrosion stresses due to the climate inside the building can be considerably intensified by the use to which the building is put, and these stresses should be dealt with as special stresses (see clause B.2)."

"In cases where surfaces are wetted by electrolytes, even if such wetting is only temporary (for example in the case of saturated building materials), particularly stringent corrosion requirements are necessary."

### B.2 SPECIAL STRESSES

Special stresses, for the purposes of ISO 12944/EN 16623, are stresses which cause a significant increase in corrosion and/or which make higher demands on the performance of protective paint systems. Owing to the diversity of such stresses, only a selected number of examples can be presented here.

The following stresses are amongst those identified as examples in Annex B.2:

### B.2.3 STRESSES DUE TO CONDENSATION

If the temperature at the surface of a structure remains below the dew point for several days, the condensation produced will represent a particularly high corrosion stress, especially if such condensation may be expected to recur at regular intervals.

### B.2.5 INCREASED CORROSION DUE TO COMBINATIONS OF STRESSES

Corrosion may develop more quickly on surfaces exposed simultaneously to mechanical and chemical stresses. This applies particularly to steel structures near roads on which grit and salt have been spread.

Passing vehicles will splash salty water and throw up grit on to parts of such structures. The surface is then exposed to corrosion stresses from the salt and at the same time to mechanical stresses due to the impact of grit. Other parts of the structure will be wetted by salt spray.

# ISO 12944/EN 16623 ENVIRONMENTAL CLASSIFICATION AND INTUMESCENT COATINGS

**What is clear from the above information is that ISO 12944/EN 16623 cannot define in five environmental classes, all of the potential environmental stresses that a coating system may be exposed to during its service life.**

This is recognised in the standard which highlights the need to examine each exposure environment and take into account where appropriate, other fundamental factors such as micro-environments and special stresses.

It is inadequate to try to classify the environment in car parks and other open sided buildings by considering only the location of that building. The variable conditions encountered in these buildings demand that more time and consideration is given to recognising the fact that micro-environments and special conditions will have an impact on the classification, even to the extent that different areas of the building may require different environmental classifications.

In addition it should not be overlooked that ISO 12944/EN 16623 is intended to define the environmental classification for corrosion protection, not for intumescent fire protection.

Intumescent coatings differ from corrosion protection coatings due to the inclusion of fire reactive compounds. Depending on the formulation these compounds may be susceptible to leaching out due to excessive water exposure, especially if incorrectly sealed. Thus when considering the specification of intumescent coatings it is essential to consider not only the general ISO 12944/EN 16623 classification but also the micro-environment and in particular the potential for continual water exposure.

# CAR PARK ENVIRONMENTAL CONSIDERATIONS

**While there are typical designs for car parks, like most buildings they can vary significantly, depending on client requirement, site limitations, size, etc.**

From a coating and fire protection perspective the extremes of environments present in a car park, or other similar open sided building, can be polar opposites. At one end of the spectrum are open car parks with no roof cover; while at the other end of the spectrum are car parks under a water tight building and with only one open side for access/egress.

Many car park designs, especially those with open decks and sides, present micro-environment conditions that can be far more severe than the overall environmental definition given to the structure as a whole.

For example with open deck car parks the steelwork along the outer perimeter, behind louvres, mesh panels and at the entrance and exits can experience continual running water long after rainfall has ceased – this extended soaking differs and is more onerous than normal external exposure. Incorrectly sealed floor slabs can lead to water penetration such that beams and columns located in internal areas are constantly wet. Poor drainage of the floors and decks can also lead to pools of water collecting at the base of columns, effectively presenting an immersion environment.

Open decks and access ramps are often gritted in winter which provides a saline corrosive atmosphere that would not otherwise be expected given the building location e.g. an inland town centre car park.

In many of the above examples, the main structure might be classified as C2 or C3 in accordance with ISO 12944 and Z1 or Y in accordance with EN 16623. The lack of recognition of micro-climates and the fact that the ISO standard does not consider intumescent coatings, may mean that environmental classification is completely inadequate for some or all areas of the structure.

Not unsurprisingly therefore, it is difficult to have a one size fits all solution to the specification of fire protection in this type of building and it is our recommendation that greater consideration is given to the above issues.

# FIRETEX® INTUMESCENT SPECIFICATIONS FOR CAR PARKS AND OPEN SIDED BUILDINGS

**Given all the various comments above regarding correct environmental classification it is impossible for Sherwin-Williams to provide a standard specification to suit all such environments, and indeed it is highly likely that more than one specification will be required for different areas of the same building depending on design.**

Similarly it is impossible for Sherwin-Williams to know at the design stage what micro-environments or special cases may coexist in any given building envelope. Thus it is incumbent on the client, architect or main contractor to correctly define not only the general environment but also any micro-environment or special case that might induce additional environmental stresses.

However we do accept that in many cases the client, architect or main contractor may also not be aware of the detailed building environment at the early stages of the tender process but may require typical fire protection specifications for budget purposes. In order to help with this process several typical specifications are presented for typical car park designs and locations within those buildings. It must be stressed, however, that it is the responsibility of the client, architect or main contractor to effectively define the various environmental conditions within the car park or open sided building prior to project award.

Where a more detailed specification is required then Sherwin-Williams are prepared to work with the client, architect or main contractor to help correctly identify the localised conditions and advise the most appropriate specification for the anticipated service life.

# TYPICAL CAR PARK DESIGNS AND FIRETEX® SPECIFICATIONS

**Given the wide variation in design of such buildings this document provides recommendations for the use of FIRETEX® products for the fire protection of steelwork as well as the expected life to first major maintenance (LTFMM). These guidelines assume that the steelwork has previously been abrasive blast cleaned to Sa 2½ and protected with an appropriate primer.**

Car parks have been grouped into various types for the purpose of simplification of typical specification. These specifications may also be suitable for other open sided buildings.

## OPEN DECK CAR PARKS – EXTERNAL AND INTERIOR EXPOSED STEEL

The following will require an epoxy or MMA intumescent specification which will provide longer durabilty for:

- Steelwork at the outer perimeter, behind louvres or mesh panels, at the entrance and exit points.
- Internal ramp steelwork that is subjected to water soaking from above.
- Beams and columns that are subjected to water soaking due to floor slabs that are not water-tight for any reason.
- Columns subjected to water soaking due to poor drainage or pools of run-off water collecting at the base of columns for any reason.
- Any steelwork in the proximity of water splashing from vehicular traffic whether gritted or not.
- Beams connected to the external steelwork that project into the building and are subjected to soaking due to channelled water. It is not possible to change from epoxy to thin film intumescent part way along a beam; therefore the epoxy must be taken to the first interior grid line.

## OPEN DECK CAR PARKS – INTERIOR STEEL. WATER TIGHT CONDITIONS

Where steelwork is remote from the perimeter, and other conditions as noted above, and where no running or pooling water is present during the life of the coating system and the environment is classified as no more than C4 per ISO 12944 or X as per EN 16623 then solvent based thin film intumescent can be used with appropriate sealer coat.

## COVERED CAR PARKS – EXTERNAL EXPOSED STEEL

This type of car park would be typified by one located under a building such as a supermarket where the outer perimeter steel is ‘built over’ and so is exposed to normal weathering conditions and not subjected to constant running water as is often encountered in open deck car parks. Typically these environments would be classified as C4 per ISO 12944or X as per EN 16623 then solvent based thin film intumescent can be used with appropriate sealer coat. Sherwin-Williams would therefore recomend the use of FIRETEX FX6002 MMA for better durability.

Typical perimeter steel detail that would be subjected to normal weathering conditions.

# COVERED CAR PARKS – INTERIOR STEEL. WATER-TIGHT CONDITIONS

This is probably the most difficult environment to describe and to specify for, due to the fact that there can be such large variation in the exposure conditions of interior steel from one car park design to another. In some car parks the interior steel can be in an environment that is almost like that of a fully enclosed building (C2/Z1), while in other cases the environment can be between that defined by C3 and C4. The main criteria are the extent of condensation and weathering that the intumescent is exposed to.

In all cases the building shall be water tight and no liability for water damage shall be accepted by Sherwin-Williams. If it cannot be assured that the building will be water tight then the epoxy specification shall be used.

Subject to the above criteria steelwork that is remote from the perimeter and water tight, then either water based thin film specification or a solvent based thin film specification can be considered as follows:

- For small car parks where the interior steel is less than 10 m from the perimeter and/or heavy condensation can be expected at any time during the year, then this environment would most likely fall within the ISO 12944/EN 16623 category of C3 interior or even C4 interior. In both cases solvent based specifications FP4 or FP5 would be appropriate. Of course one can always upgrade to the more robust epoxy specification FP6.
- For large car parks classified as no worse than ISO 12944/EN 16623 C2/EN 16623 Z1 and where the interior steel is more than 10 m from an external wall or externally exposed access ramp, and where the environment is dry and well ventilated by either natural air flow or forced extraction; then a water based intumescent specification may be used (FP1). This is fundamentally dependent on the building being water tight with no pooled or running water no matter how this occurs. Columns shall not be subjected to impact damage and any coating defects be repaired immediately. Of course one can always upgrade to the next more robust specification.

If pools of water can collect at the base of columns for example via snow melt from cars, then the most suitable specification would be the epoxy system FP6. In fact for such conditions or for mechanical damage resistance, for example from shopping trolleys or car doors, it may be appropriate to use a combination specification of epoxy on the columns and either water based or solvent based thin film intumescent on the beams.

Typical supermarket car park interior steel. Many metres from potential external weathering and in a dry well venitlated environment. Assumes building is water tight.

# BASEMENT AND UNDERGROUND CAR PARKS

In general the comments made above for covered car parks will apply to underground car parks but these can present quite different environments depending on size, ventilation, access/egress ramp design and drainage. For example some underground car parks sit below a water tight building envelope while others sit below concrete paved areas, concourses and similar environments that may not be water tight. In many cases underground car parks have walls that are constructed from sheet piling that may or may not be fully water tight.

Typical extreme examples are small poorly ventilated car parks with a down ramp that is poorly drained leading to large volumes of water being carried into the interior. Such a car park will exhibit high levels of humidity and condensation in cold weather as well as road salt and grit damage to steel located close to the ramp and the access zone. This would lead to a classification at best of C3/Y and at worst C5 due to salt water and grit contamination.

Conversely a large well ventilated basement car park with fume extraction that is well drained and with a covered down ramp protected from the elements will be much drier and present a less onerous environment. It is possible that this environment may be classified as C2/Z1 or C3/Y.

In the majority of cases for basement car parks the most appropriate specification would be thin film solvent based FIRETEX FX6002 MMA and in more extreme cases the epoxy specification FP6 or FIRETEX FX6002 MMA. On rare occasions it may be possible to consider a water based option but this would depend on the client specifying the environment as well ventilated and controlled C1 or C2 and also guaranteeing a water tight envelope. It is also likely that if water based intumescent was considered appropriate it would only be used on beams or on columns that do not sit on the floor and hence would not suffer from water exposure. In these cases such a car park would probably be better considered as a covered car park (see above) rather than an underground car park.

In all cases it is assumed that the roof and any sheet piling walls are water tight. If not then the epoxy intumescent specification shall be used.

# SUMMARY

**ISO 12944/EN 16623 environmental conditions relate to the corrosion protection of steel not to the use of intumescent fire protection. It is essential that where ISO 12944/EN 16623 is used to define an environment for use with intumescent coatings, particularly in car parks and other open structures that attention is paid to the effect of micro-environments and special cases as defined in the standard.**

Particularly onerous for intumescent products are open deck car parks and underground car parks where water, road salt and grit can cause conditions that are very severe.

Car park designs vary significantly and there is no one size fits all solution and it is highly likely that more than one intumescent specification will be required for different environmental zones within the building envelope.

With the exception of the epoxy intumescent specification FP6/FIRETEX FX6002 MMA all other specifications assume that the building is presented in a water tight condition and will remain so during the expected coating life. Failure to adequately top coat and seal thin film intumescent fire protection coatings will result in premature breakdown. It is also essential that intumescent coatings systems are inspected and repaired prior to building hand over and regularly during the building life.

**Fire protection is specified for the safety of life as well as building integrity in the event of a fire. It is expected to remain effective over the defined service life of the specification and Sherwin-Williams will always give best advice with this fundamental function in mind.**

# FIRETEX® FX RANGE

## INTUMESCENT PROTECTION FOR STEEL FRAMED CAR PARKS

### THE SHERWIN-WILLIAMS DIFFERENCE

Sherwin-Williams Protective & Marine delivers world-class industry subject matter expertise, unparalleled technical and specification service, and unmatched regional commercial team support to our customers around the globe. Our broad portfolio of high-performance coatings and systems that excel at combating corrosion helps customers achieve smarter, time-tested asset protection. We serve a wide array of markets across our rapidly growing international distribution footprint, including oil and gas, water and wastewater, bridge and highway, steel fabrication, flooring, food and beverage, rail and power, marine and passive fire protection.

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SHERWIN-WILLIAMS®

protectiveemea.sherwin-williams.com
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**United Kingdom:**
+44 (0)1204 556420
sales.uk@sherwin.com

**Europe and Africa:**
+44 (0)1204 556454
sales.uk@sherwin.com

**Middle East:**
+971 4 8840200
sales.me@sherwin.com

**India:**
+91 9871900878
pmsales.india@sherwin.com