SFS intec

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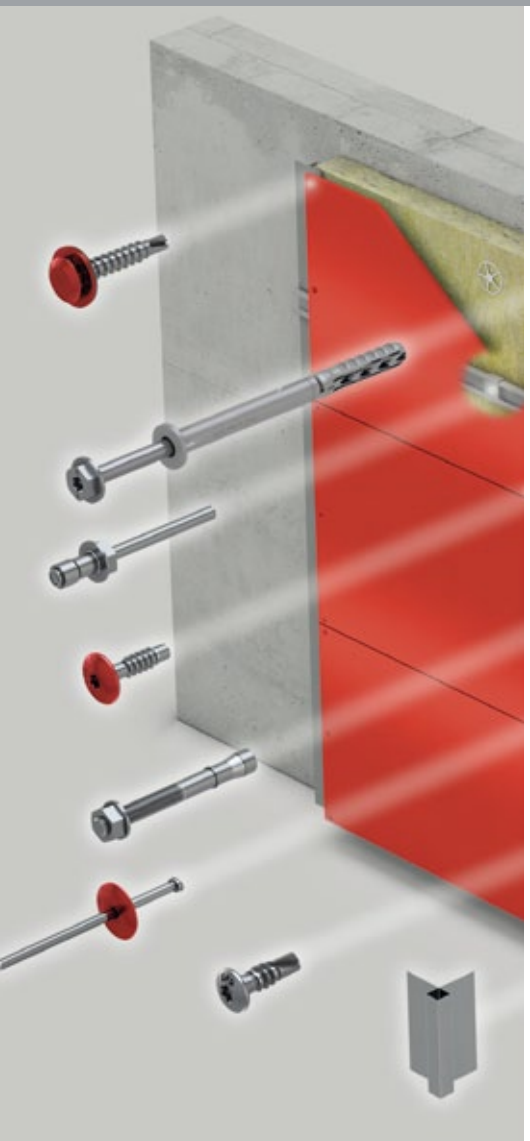
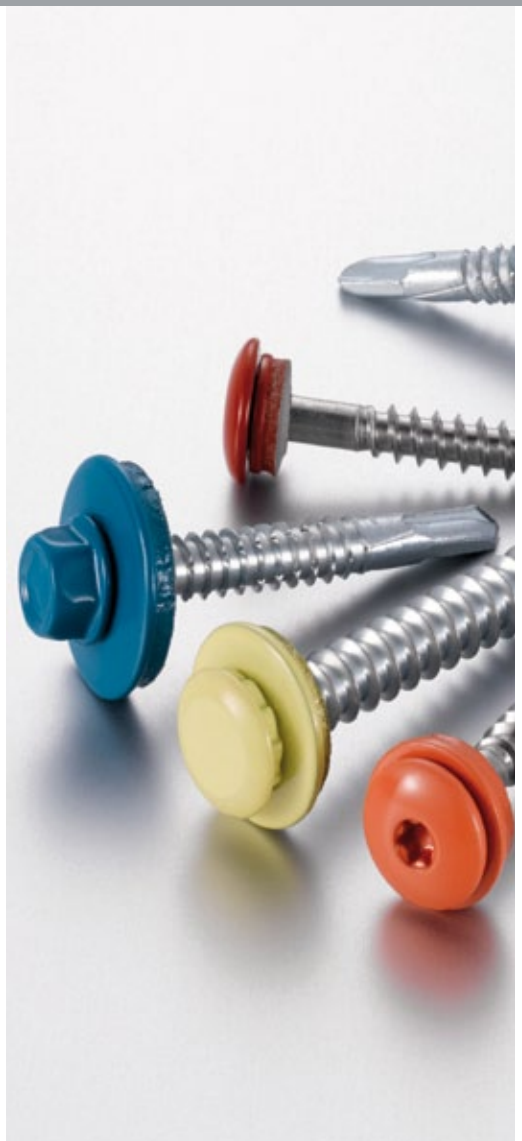
A designer's guide to specifying warranted 316 austenitic stainless steel fasteners and sealants





Welcome to the latest edition of the SFS “A designer’s guide to specifying warranted 316 austenitic stainless steel fasteners and sealants”.

We have revised and updated the publication to reflect changes in our products and services to meet changes in UK construction law. In particular the mandatory use of CE marking for construction materials from 2013 together with the introduction of new EN and revised BS standards which are replacing the old BS versions across all disciplines. For example, for durability standards, we now work to EN 12944 and the 2015 revised edition of BS 7543 and for wind loads, EN 1991 rather than BS 6399.

These new EN standards are in some cases more onerous than the out going BS but have a distinct advantage in that they are recognised Europe-wide, simplifying regulation and cross-border trading at a time when UK constructors are increasingly looking to Europe for business opportunities.

Contents

Introduction to the SFS Group of companies

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The SFS Group of companies, which has its headquarters in Heerbrugg, Switzerland, is one of the worlds leading developers, manufacturers and suppliers of high precision components for a variety of technical industries.

The SFS Group directly employs over 7000 personnel and in 2014 turned over £880million.

Global manufacturing

Global manufacturing

The group manufactures globally, with plants across Europe, North America, Scandinavia and Asia.

Global sales & marketing

Global sales and marketing

Products are supplied into the global market through 70 SFS sales and marketing organisations strategically located in 25 countries.

UK headquarters

The UK headquarters, which includes manufacture, logistics, and sales and marketing, is based in Leeds. Fasteners have been manufactured on this Kirkstall Road site for over 100 years. From this site SFS intec Ltd can offer architects, designers, consulting engineers and cladding envelope contractors a proven commitment to product quality, sound technical solutions and efficient service.

Commitment to investment and innovation

The SFS Group has a philosophy of growing its business by its commitment to reinvesting, to ensure state-of-the-art facilities and, through its extensive research and development department, to continual innovation of new products and services.

Industry associations

SFS intec is actively represented on the technical committees of the leading roofing and cladding associations who seek to encourage best practice and conformance to all relevant regulations.

Section 1 Introduction

The specification of the fastener, despite being such a small component, is critical to the performance of the roofing and cladding system.
The fastener works in close combination with sealing products, therefore the specification of the fastener and sealing products need to be addressed at the early stages of detail design of the project to enable the completed envelope to perform its required function throughout the full term of the system's service and design life.

1.1 Performance criteria

This guide addresses the principle performance criteria of fasteners and sealants, namely;

- Durability (corrosion resistance)
- Weathersealing
- The "Part L" issues of airsealing and thermal bridging
- Aesthetics
- Technical performance

Each particular application will need the various products to comply with at least three of these criteria and often, as with externally exposed fasteners, will require all five. Failure of the products to satisfy these criteria may lead to the inevitable, and sometimes catastrophic, failure of the system or, at the very least, costly remedial works, sometimes even before the project can be handed over to the Client.

This guide will give you the key information needed for you to specify fasteners and associated seals to minimize the risk of system failure.

1.2a Industry associations

The guidance given in this document is generally consistent with publications listed below from these associations, as well as that given within BS5427:Part 1:1996 - the code of practice for the use of profiled sheet for roof and wall cladding on buildings.

NFRC - The National Federation of Roofing Contractors
A guide to good practice, Third Edition 1999 and subsequent Technical Bulletins

- **The Rainscreen Association**

MCRMA - The Metal Cladding and Roofing Manufacturers Association
Design Guides & Technical Papers

EPIC - Engineered Panels In Construction

SPRA - The Single Ply Roofing Association
Single ply - Code of Practice

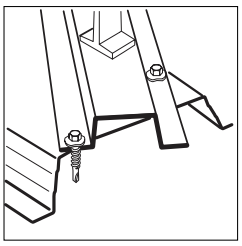
1.2b Partnerships with leading system suppliers

SFS intec also work closely with many of the UK's leading manufacturers of roof and cladding materials keeping up to date with their developments and, in partnership with them, seeking ways to produce more efficient fastening and sealing solutions for their systems.

1.3 Examples of recent innovations

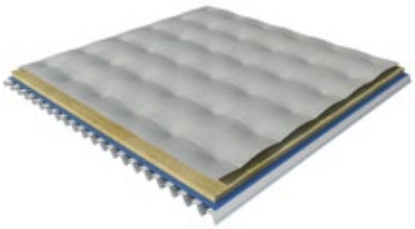
1.3a Development with Kalzip Ltd

Development of SL3 "thick to thin" self drilling fasteners for safe and secure fixing of top hat sections to thin metal decks.



1.3b Development with single ply manufacturers including the Sika Group

Development of *isoweld*® - a revolutionary heat-induction welding system for the securement of single ply membranes in a field pattern rather than in-seam.

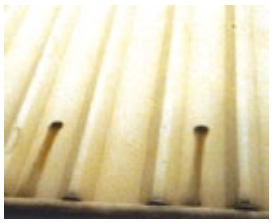


1.3c Development with Kingspan Insulated Panels

Development of a self-coring fastener to eliminate time consuming precoring and backfilling on their Topdek pre-engineered insulated roof membrane system.

Section 2 Durability (corrosion resistance)

- **Definition** - “likely to last”, “remaining useful for long periods”, “resisting wear and decay” Ref; **Oxford Dictionary**



2.1 The problem

If the installer is allowed to use carbon steel fasteners for the external envelope, the inevitable corrosion brought about by exposure to the elements will result in a number of problems; if these are left unattended then ultimate failure of the system is a very real possibility.

2.1a Problems due to corrosion of the head and washer

- Staining of the cladding
- Reduction in pullover performance
- Potential leakage into/through the system
- Increased maintenance and remedial work

2.1b Problems due to corrosion of the shank

- Reduction in tensile performance
- Reduction in shear performance
- Reduction in pullout values
- Staining to interior surfaces

2.1c Problems due to hidden corrosion

Whilst corrosion of exposed heads on the external face of the building and corrosion of the visible shank inside the building are both easily identified, what is considered a much greater structural and security risk is that of corrosion **within** the roofing or cladding system. This would not be visible and would only manifest itself upon ultimate failure of the fastener, which would result in partial, and potentially total, detachment of the system.

Total erosion of a carbon steel fastener shank. Note that this product was originally manufactured with a stainless steel cap formed over the head, which has not corroded to the same extent. The corroded portion was behind the weather sheet and not exposed to the elements.

2.2 Fastener materials

Threaded fasteners for roofing and cladding systems are available in the market place most commonly in two materials, coated carbon steel and stainless steel.

Aluminium threaded fasteners are also available, however their range of application is generally restricted to securing aluminium profiles to timber supports and limited applications of aluminium to aluminium.

2.2a Coated carbon steel

Corrosion of coated carbon steel under Kesternich testing

Carbon steel rapidly corrodes on exposure to humidity. Fasteners in this material are supplied with some form of protective coating, typically metallic or organic, or a combination of the two.
Cadmium has in the past also been used as a protective coating by some fastener manufacturers. However, this is a controlled substance that is hazardous to health and therefore reputable manufacturers who operate recognised Quality and Environmental Management Systems, as well as enforcing Health and Safety Procedures, no longer use cadmium as a protective coating on threaded fasteners.

CR6 and CR3 coatings

Hexavalent chromate [CR6] finishes on zinc plated items are also hazardous and are now banned in some areas of industry across the EU. Trivalent chromate finishes [CR3] are still used in the fastener industry but SFS have not used them for some time.

2.2b Stainless steel

Austenitic stainless steel fasteners

For increased durability (corrosion resistance), fasteners are also manufactured in various grades of stainless steel.

The relative merits of these grades are discussed in greater detail in Section 2.4

Over the following paragraphs in Section 2.3 this guide will explain the limitations of coated carbon steel and the types of “stainless” steels appropriate to roofing and cladding fasteners. We will also examine the different aspects that should be considered in order that the choice, appropriate to the project, can be made between coated carbon or “stainless” steel.

As for the UK construction industry has now moved to mandatory CE marking of building materials from 2013, SFS now uses the methodology found in EN 12944 for assessing building durability. EN12944 is the European standard and has a detailed table of exposure categories. BS7543:2015 can also be used for assessing the durability of the building and its components.

2.3 Limitations of coated carbon steel

2.3a

- Uncoated **carbon steel rapidly corrodes** upon exposure to humidity and polluted environments
- Surface coatings with excellent corrosion resistance can be applied to prolong a fastener's life but they will **only slow down the corrosion** process
- The effectiveness of these coatings can only be gauged after considering the condition **of the coating once the fastener has been applied** within the construction
- These corrosion resistant surface coatings tend to have **poor abrasion resistance**

2.3b Pitched roofing and cladding systems

Coatings on fasteners within most types of metal pitched roofing and cladding systems will inevitably suffer **damage during installation** as the major portion of the shank penetrates the metal weathersheet and purlin.

2.3c New flat roof constructions

There is less risk of coating damage within new "flat" roofing constructions as the fastener is usually applied through less abrasive materials such as the insulation boards and weatherproofing layer(s) - therefore the coatings are more effective, however;

2.3d Refurbishment over flat roofs

There is an increased risk of corrosion of carbon steel as the coating may be abraded as it passes through materials (chippings) within the existing build-up. Additionally there is the probability of increased moisture content within the existing buildup which would accelerate the corrosion rate.

2.3 Keynote summary
Will coated carbon steel satisfy all your requirements?

- **Coating damage reduces fastener life**
- **Corrosion leads to reduced technical performance**
- **Corrosion leads to potential water ingress**
- **Corrosion reduces aesthetic value**
- **Coated carbon steel may be adequate for some less onerous applications - however consider possible change in use during building lifespan**
- **Corrosion of carbon steel fasteners may lead to high consequential damage costs, disruption costs and expensive remedial costs**

Fasteners must have at least an equal life to the proposed roof system

Harry Brearley (1871-1948)- credited with the invention of “rustless steel” in 1913 at Sheffield

SFS 316 austenitic stainless selfdriller

2.4 Types of stainless steel

“Rusting” is regarded by many as a process which is not applicable to stainless steel - this is however incorrect. “Stainless” steel is a generic term covering over 200 different types of alloy which all, to varying degrees, stain-less than carbon steel. Stainless steels can be classified into three main groups;

Austenitic, Ferritic and Martensitic.

2.4a Austenitic stainless steel

- Only grades conforming to BS5427:1996 (see note 1)
- Contains at least 17% chromium
- Contains at least 8% nickel
- Molybdenum may be added for enhanced corrosion resistance
- Non-hardenable (see note 2)
- Non-magnetic (see note 3)
- Low thermal conductivity; 25% of carbon and martensitic stainless steel
- Best known grades are 304 and 316
- Excellent corrosion resistance (see note 4)

These characteristics make austenitic stainless steels the only suitable type for selfdrilling/threadforming fasteners for roofing and cladding.
Note BS EN 10088-2 has introduced a revised steel coding system; the old grade Austenitic 304 is now 1.4301 and Austenitic grade 316 is now 1.4401. Special high performance grade 1.4547 has high Molybdenum content for extra resistance to Chloride attack. [see note 4]

2.4b Ferritic

- Contains at least 12% chromium
- Lower ductility than martensitics and austenitics
- Cannot be hardened
- Susceptible to brittleness

These characteristics make ferritic stainless steels unsuitable for the manufacture of selfdrilling/threadforming fasteners for roofing and cladding.

2.4c Martensitic

- Contains the minimum chromium content of 11%
- Poor corrosion resistance
- Susceptible to stress corrosion
- Can be hardened (at the expense of further stress corrosion risk)
- High thermal conductivity (similar to carbon steel)
- Magnetic
- Modified forms available but stress corrosion considered too great a risk (see 2.4b on page 11)

These characteristics make martensitic stainless steels unsuitable for self drilling/threadforming fasteners for roofing and cladding.

Note 1 - Clause 2.8.3 from BS5427:Part 1:1996 - Code of practice for : The use of profiled sheet for roof and wall cladding on buildings. Part 1: Design.
Note 2 - The threadrolling process hardens the threads sufficiently to threadform but not enough for selfdrilling into mildsteel supports eg purlins and rails. There are special techniques which incorporate a heat treated(hardened) carbon drillpoint to be joined to an austenitic stainless fastener to allow self drilling. These may be referred to as bi-metal fasteners. It is vital that, once installed, all threads within and above the support are austenitic stainless.
Note 3 - Extreme cold forming of austenitic stainless steel wire can impart a small degree of residual magnetism without adversely affecting the materials properties.
Note 4 - It is acknowledged within industry documentation that certain grades of stainless steel, including some austenitic grades, may be at risk of chlorine-induced stress corrosion in conditions which may occur for example, in swimming pool halls. Pool hall design, planned operating and maintenance conditions must be carefully considered by water treatment experts, as well as architects and designers, to minimise any risk. Grades of stainless steel which may be susceptible to chlorine-induced stress corrosion should be limited to those components used in “non safety-critical” applications. Where fasteners are used for structural or safety critical applications, measures should be taken to ensure that a sound and reliable vapour barrier is in place to prevent Chlorine rich condensation from reaching the fasteners in question.
Where this is not practical, then alternative fastener materials such as aluminium or Austenitic stainless steel grade 1.4547 should be considered.

2.4 Other types of “stainless” fasteners

Because of the high technological investment required for the manufacture of bi-metallic austenitic stainless self drilling fasteners, alternative materials and methods of hardening have been introduced by some distributors claiming a performance comparable to bi-metal austenitic grades. Independent tests have highlighted fundamental weaknesses with these alternative stainless products.

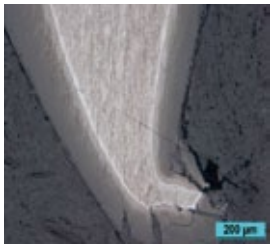
Corrosion of nitrided stainless

2.4a Nitrided stainless fasteners

There is a process available which hardens stainless steel threaded wire, including austenitic grades, sufficiently to enable them to self-drill mild steel without the need to incorporate the hardened carbon steel drillpoint (bi-metallic) element.

However, the process used results in chromium being withdrawn from the surface of the stainless wire which reduces its corrosion resistance. This method is referred to as nitriding.

To reinstate corrosion protection, the fasteners may then be coated with, typically, a zinc/organic coating….similar to the coating applied to carbon steel fasteners.



Non-chrome surface layer on nitrided stainless

It is this coating that provides the corrosion protection and, as described in Section 2.1 & 2.3,
the coating will be inevitably damaged during installation, which would accelerate the corrosion rate and thus provide only temporary corrosion protection.

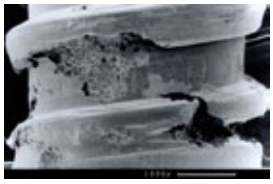
2.4b Modified martensitic stainless fasteners

Whilst martensitic grades of stainless steel fasteners with only 11% chromium are known to have poor corrosion resistance, some aspects of their corrosion performance may be improved by modification of the material involving changing the element mix of their formulation and applying certain manufacturing techniques.

Brittle failure of modified martensitic stainless

One such manufacturing technique involves utilizing a wire with an extremely hard surface (>550HV) which enables them to selfdrill mild steel without the need to incorporate the hardened carbon steel drillpoint (bi-metallic) element.
Suppliers claim this material offers higher resistance to corrosion when subjected to accelerated Kesternich and Saltspray tests - this is subject to the threadforming quality achieved which has been shown to be variable.

Hydrogen and stress corrosion brittleness
However, real-life exposure tests in a number of environmental conditions have shown this type
of fastener material to be subject to stress corrosion and brittleness - this wouldn’t have been evident under Kesternich and Saltspray testing. This type of brittle corrosion is inherent in the hard material and is not necessarily visible to the naked eye.



Stress cracks in modified martensitic stainless

As a result of extensive research work carried out by corrosion experts in Germany, Sweden and the UK on this type of material, SFS intec have been advised that the risks associated with modified martensitic fasteners for roofing and cladding are significant and therefore we continue
to comply with industry guidelines and Standards by manufacturing stainless steel self drillers from austenitic grades using the tried and tested ‘bi-metal’ format.

2.4 Keynote summary

Austenitic stainless steel fasteners, such as grade 316, have been proven over a period exceeding 40 years in environmental conditions worldwide. Austenitic grades are the only type recommended within BS5427:Part :1996.

To enable selfdrilling through mild steel (of up to 14mm thickness), fasteners in these grades are manufactured with a bi-metallic hardened carbon steel drillpoint.

2.5 Coated carbon or austenitic stainless steel? Selection considerations:

In order that a designer or specifier can make the appropriate selection between coated carbon steel or austenitic stainless steel, the following considerations should be addressed;

2.5a System materials
2.5b Design life requirements
2.5c External environment
2.5d Internal environment / building use
2.5e Project-based long term warranty requirements

All these should be considered in the overall risk assessment.

These considerations have been tabulated under Section 2.6 to assist in fastener material selection.

2.5a System materials

2.5a i) Envelope systems

Compatibility with the sheet/system material as well as the purlin/rail will influence the choice between coated carbon steel or austenitic stainless steel fasteners.
Typical materials for the system and support may include;

- Stainless steel
- Coated mild steel
- Aluminium
- Fibre cement
- Cementitious boards
- High pressure laminates
- “Plastics” - GRP, polycarbonates and PVC
- Timber

2.5a ii) Flat roofing systems

It is generally the compatibility of the deck that has a direct influence on the choice between coated carbon steel or austenitic stainless steel fasteners.
Deck types include;

- Coated (galvanized) steel
- Aluminium
- Timber
- “Concrete”

“Old” roof to be overlaid

2.5a iii) Cautionary notes

Refurbishment over existing roof coverings - generally flat roofing.
The insulation type within flat roofing doesn’t generally influence the fastener material, however, on refurbishment, where the existing insulation and weatherproofing is to remain, it is the condition rather than type of the existing buildup which will influence the fastener material choice. If there is dampness within the existing buildup it would be prudent to use austenitic stainless fasteners. Phenolic foam insulation was used on a very small number of flat roof projects some years ago. If it is present beneath a leaking roof, corrosion of galvanised metal components within the build up may occur as aggressive chemicals can leach out of the foam board. **Contact SFS technical department for further information.**

Only grade 1.4401 [316 Grade] stainless steel fasteners should be used to fix through Phenolic foam insulation boards.

2.5a Keynote summary

It has always been good industry practice to use austenitic stainless steel fasteners in combination with aluminium and stainless steel materials to avoid bi-metallic reactions. However, there are many factors that inform the selection of the fastener material in other applications. Using the exposure guidance given in BS EN 12944 [see section 2.6], higher performing grades such as 1.4401 [316 grade] and 1.4547 [A5 grade] should be actively encouraged where the service life of the envelope/waterproofing material is expected to exceed 20 years.

BSI Standards Publication
BS 7543:2015

2.5b Design life requirements

The client or designer should specify the intended design life of the proposed building and its individual building elements, products and components.
Reference may be made to the 2015 revised edition of BS 7543.

As a guide, we give below our interpretation of extracts of BS 7543:2015 relative to fasteners as part of the roofing and cladding envelope.

The client should define the design life of the building in the initial brief, which should reflect the overall requirements. Design life categories for parts are given in Table 1 and categories for effects of failure are given in Table 2. In addition the client might wish to specify the design life for specific assets, for example, the fasteners. An example of reference service lives for specific components is given in Annex D of the standard.

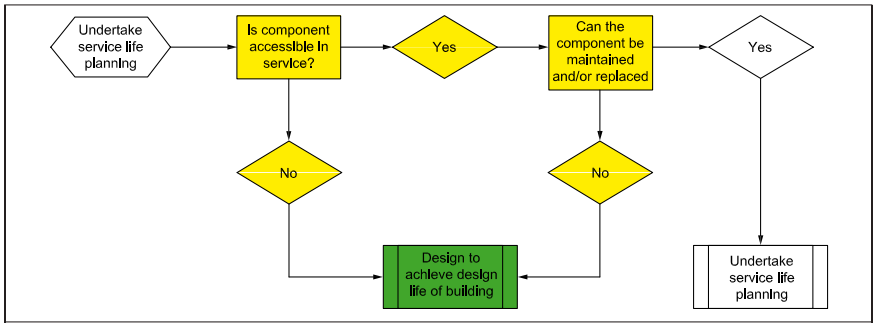
Table 1 - Categories of design life

Category Description	Life
Short-term	Shorter life than the building and readily replaceable
Replaceable	Shorter life than the building and replacement can be envisaged at design stage
Maintainable	Lasts, with periodic treatment, for the life of the building
Lifelong	Lasts for the life of the building

Other than Short-term buildings, typically 10 year design life, carbon steel fasteners are not considered suitable.

This flow chart below, Figure 3 from BS 7543:2015, asks the questions about accessibility of components and also whether they can be maintained or replaced.
If not, then the design has to be based on lasting the life of the building, or, as in the case of fasteners, the life of the material they are fastening.

Figure 3 - Decision process in support of categorization of design life (of fasteners)



2.5b i) Question: Can fasteners and cladding envelope sealants be classed as “replaceable” ?

Non-exposed fasteners and sealing products, both weather and air seals, can often only be accessed by removal of the external weathering sheet. In some cases removal of the weathering sheet in order to access concealed fasteners, within its required design life, may necessitate that it be totally renewed. If fasteners and seals were to degrade within the design life of the system, then installing new fasteners, both exposed and non-exposed, into their existing location would often result in greatly reduced pullout values and therefore present a structural risk (unless a purpose-designed “repair” fastener were used).
As a further example, insulated panel fasteners have enlarged threads under the head to “support” the outer skin and maintain a weatherseal (section 3.3a).
If the fastener prematurely corrodes, then the resulting leakage may damage the sheet around the hole such that simply installing a new fastener may not provide the required levels of sheet support.

Answer - Fasteners and sealing products are not classed as replaceable

2.5b ii) Question: Can fasteners and cladding envelope sealants be classed as “maintainable” ?

As noted above, non-exposed fasteners and seals can only be accessed by removal of the external weathering sheet.
Exposed fasteners may, in theory, have their visible parts “recoated” but this should not be regarded as acceptable at the design stage of a project. Furthermore, applying a new corrosion protective coating to the visible head, providing an appropriate pretreatment can be carried out, as well as being, in most cases, aesthetically unacceptable, would not reinstate corrosion protection to the concealed shank which may also be suffering from corrosion.
Answer - Fasteners and sealing products are not classed as maintainable


Fasteners can be classed as ”high risk” - Categories A-D

Table 2 - Categories of effects of failure

Category	Effect	Life
A	Danger to life (or injury)	Sudden collapse of structure
B	Risk of injury	Loose stair nosing
C	Danger to health	Serious damp penetration
D	Costly repair	Extensive scaffold required. Durability critical component failure (see note below)
E	Costly because repeated	Window fastening replacement
F	Interruption to building use	Heating failure
G	Security compromised	Broken door latch
H	No exception problems	Replacement of light fittings

***Note** - Individual failures can be in two or more categories.*

Many of the buildings where fasteners are used to secure the roofing and cladding envelope have design service life requirements in the range of 25 to 60 years and, as the fasteners are potentially of relatively high risk, typically category A, B, C or D as defined in table 2 above, and they are not considered replaceable or maintainable, they would need to be designed to be lifelong as table 1 (to the service life of the roofing/cladding system)

2.5b Keynote summary

Coated carbon steel fasteners should be considered only for short life, temporary buildings and those in category C1 in the EN 12944 table shown in 2.6 , page 17 of this Guide.

For all other applications, **Austenitic stainless steel fasteners in Grade A2 or A4** is the preferred choice for all other buildings - specifiers should select the appropriate grade to suit the expected exposure and service life using the table above

Weather and air sealing products should match the design life of the roofing or cladding system and the appropriate fastener material.

2.5c External environment

Typical UK atmospheres may be divided as in the following table which should be considered together with the BS EN 12944 table in section 2.5b:

In addition to the climatic conditions present during each season, the local atmospheric conditions in the immediate vicinity of the building are critical in the selection of coated carbon or austenitic stainless steel fasteners.


Marine


Rural

Typical atmospheres may be divided as in the following table;

Marine C5-M	Up to 2km from the sea . High levels of chlorides
Coastal C4	Between 2km and 10km from the sea BS 7543:2015 Clause A.1.3 Coastal regions; Sea fogs or mists might also linger within several miles of coasts. Particular consideration should be given to wind-blown salt atmosphere and how far inland this will impact the design specification.
Industrial C5-I	Atmosphere heavily polluted by sulphur dioxide and other pollutants, typically nitric oxides, chlorine, hydrogen chloride, formic acid, acetic acid, all in the vicinity of corresponding industrial plants.
Urban C3	Densely populated and polluted by sulphur dioxide, also properties adjoining busy motorway junctions or elevated sections which can be exposed to road salt spray in winter.
Rural C2	Smaller towns and villages generally free from atmospheric pollution conducive to corrosion.

Note; Very often these different types of atmosphere overlap, thus presenting an even more aggressive external environment for both the cladding system and its fasteners. For example, there are many marine and coastal areas which are heavily industrialised.

2.5c Keynote summary

The corrosion rate of coated carbon steel fasteners is difficult to predict, however it can be stated with a degree of certainty that;

- **Coated carbon steel fasteners** would corrode when exposed to any of these external environments and the corrosion rate will increase as you move up the table.

- **Austenitic stainless steel fasteners** are durable in all these external environments and should be specified in marine and coastal environments and, in many cases, would be recommended in industrial atmospheres. A4 (316) grade is particularly recommended for industrial and coastal regions where design life requirement exceed 15-20 years.

- **Cladding envelope sealing products** specifications should also be compatible with the design life of the system and its fasteners.

2.5d Internal environment / building use

Some building uses, and the processes they house, can present very onerous internal environmental conditions upon the fasteners and seals.
In such cases, coated carbon steel would not be considered an appropriate fastener material choice.

2.5d i) Building use - "at risk" categories

Due to their general function and internal conditions, austenitic stainless steel fasteners should be considered on the following building categories

- Leisure industry…swimming pools, sports centres, stadia.
- Transport industry…airport terminals and buildings, ferry and dockland facilities, railway buildings
- Water industry…sewage and water treatment works, pumping stations
- Power stations, waste to energy plants
- Manufacturing …paper, pharmaceuticals, chemicals, brick & masonry products, breweries, textiles, food & drink

2.5d ii) Building use - further "at risk" categories

Additionally, there are some other building categories which, even though their internal environment may be non-aggressive, demand that austenitic stainless fasteners be considered. The potential for leakage resulting from corrosion of coated carbon steel may result in damage to expensive/sensitive equipment and could also be extremely disruptive to the running of the business.

- Hygiene, Food processing
- Electronics, computer equipment
- High value goods
- Schools
- Hospitals

2.5d iii) Building use - lower risk categories

Typical building uses where coated carbon steel fasteners have been shown to perform adequately for periods of functional life expectancy up to 25 years and therefore where coated carbon steel could be considered include ;

- Retail
- Distribution
- Manufacturing of "dry" goods such as assembly lines, windows and doors, automotive products, white goods etc.

2.5d Keynote summary

From the above it can be seen that the internal environment / building use has a major influence on the choice of fastener material and that austenitic stainless steel should, in most instances, be specified. Specifying austenitic stainless would also eliminate any future risk if the building use changes.

2.5e Project-based long term warranty requirements

There is an increasing demand by clients and building owners for the performance of products within the building construction and envelope to be warranted. The roofing and cladding industry has responded to these demands and various warranty schemes are now available.

2.5e i) Industry association system based

Warranties are available through a number of industry associations - some warrant workmanship as well as materials. Usually an insurance premium is required to be paid which is a percentage of the envelope contract value.

Tata Steel Panels and Profiles

EUROCLAD
ElitePLUS System

Kingspan.
Insulated Panels

Ultimate Panel

2.5e ii) System suppliers warranty schemes

The principle system supplier may operate warranty schemes for the complete system. So they can eliminate the risk of system failure due to ancillary products, the principle system supplier will specify components to be used in conjunction with their products to make up a total system. Warranties are then obtained from their partner suppliers and installers and a single total system project-specific warranty is then passed to the client.

System supplier warranty schemes do not necessarily require a policy premium to be paid by the client.

SFS intec work closely with the leading system suppliers who specify fasteners and ancillary products such as sealants appropriate to the warranty period required.

2.5e iii) Component suppliers warranties

As an alternative to the warranty schemes above, the client (through the architect/ designer) may wish to specify and obtain separate individual product warranties from all the various suppliers whose components are used or specified within the system, and also the installer if workmanship is to be warranted.

SFS intec project warranty

XL Insurance certificate

2.5e Keynote summary

Project-specific warranty

Clients should be encouraged to obtain warranties which are project-specific, and often upto 30 years - and these should include all components critical to the building envelope. Only austenitic stainless fasteners would be deemed to provide the required level of performance.

Beware, warranties should not be limited to simply supplying more products - the client should seek the re-assurance that the warranty covers **"making good the roof"**. The client should ensure the supplier takes full responsibility within the warranty offered.

Products liability Insurance

The choice of supplier should also be limited by whether their production plants operate Quality and Environmental Management Systems and have certification showing conformance to, for example, ISO 9001:2000 and ISO 14001:1996.

2.6 Exposure and corrosion - selecting the correct product

BS EN 12944 gives guidance on various environmental exposures and associated corrosion risks.
There may be times and locations where the exposure category is higher than expected. For example a lighting column located by an elevated motorway might be considered to be category C3, but when subjected to local conditions such as winter salt spray, might in fact be exposed to category C5-M.

Recommended fastener material to suit EN 12944 exposure categories

Corrosivity Category	C1-very low	C2 - Low	C3 - Medium	C4 - High	C5-I - Very high (industrial)	C5-M - Very high (Marine)	Swimming Pools & Chemical Plants
Examples of typical environments in a temperate climate (informative only)	Interior - Heated buildings with clean atmosphere	Rural areas - low levels of pollution - Unheated buildings where condensation may occur	Urban and industrial areas moderate pollution Coastal area with low salinity - Production rooms with high humidity and some air pollution	Industrial and coastal areas with moderate salinity	Industrial areas with high humidity and aggressive atmosphere. Permanent condensation and high pollution	Coastal and offshore areas with high salinity Permanent condensation and high pollution	Within pool halls and certain chemical processing plants - fasteners that penetrate or are below vcl and exposed to chlorine vapour
Popular Name / EN Name							
A5 1.4547 Max Warranty	✔ 40+	✔ 40+	✔ 40+	✔ 35	✔ 25	✔ 25	✔ 20
A4 - 316 1.4401 Max Warranty	✔ 40+	✔ 40+	✔ 40	✔ 30	✔ 20	✘✔ 15	✘ -
A2 - 304 1.4301 Max Warranty	✔ 30	✔ 25	✔ 20	✘✔ 15	✘✔ 10	✘ -	✘ -

KEY	✔	✔	✘✔	✘
	Suitable but not economic	Recommended	Requires approval	Not suitable

This revised and updated application table simplifies the selection of the appropriate fastener material.

Warranted performance

Stainless steel type 304 austenitic fasteners are warranted for category C1, C2, C3 and, with prior approval, category C4.
Stainless steel type 316 is warranted for all applications up to and including C5-I, and with prior approval, category C5-M.
Stainless steel type 1.4547 is warranted for any swimming pool halls and certain chemical processing plants.
* prior approval is required as applications vary from project to project. It is not possible to cover all possibilities in data sheets and so consultation is required. Therefore, given the complex chemistry involved, users are strongly advised to contact SFS technical department to discuss individual projects in the C5-I and C5-M categories. We would be pleased to advise and develop specifications to suit.

Service life

There are many factors that affect the service life of metal products in construction projects. The service life, unlike the warranty period, is for guidance only and is generally taken to be the useful, practical working life of a product as installed. For fasteners, because there is no maintenance interval [fasteners being considered to be inaccessible and not serviceable once fixed] the useful service life would come to an end when,
for example,

- the building is dismantled or alterations are carried out which require removal of the weather proofing layer and associated fasteners
- the fixing has failed or is so heavily corroded that mechanical failure is imminent
- deterioration of the weather proofing layer becomes too extensive to remain wind and weather tight
- weather penetration of fastener sealing washers has occurred or air leakage is significant.

For carbon steel fasteners, service life in a C1 category may be acceptable, perhaps 15-20 years, but the same product used in say category C3 might start to suffer corrosion within 12 months of installation and be at the end of life and ready for replacement in less than 7 years. In C4 conditions, corrosion might be rapid, with failure within 5 years.

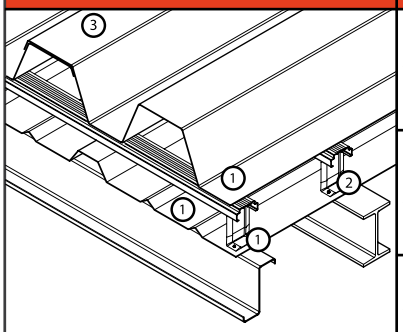
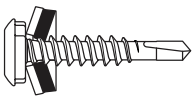
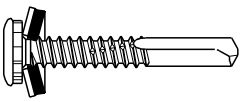
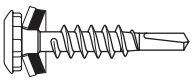
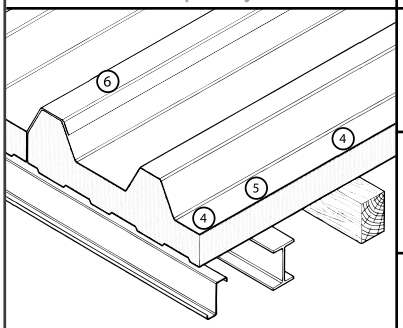
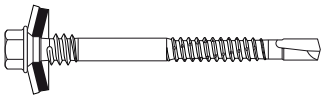
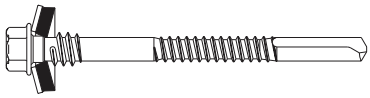
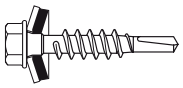
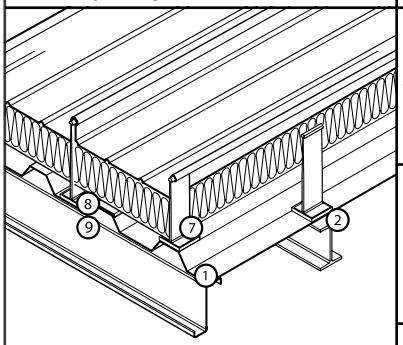
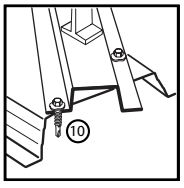
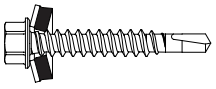
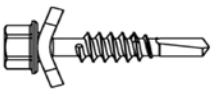
Poor workmanship, incorrect product selection, adverse weather conditions, exposure to industrial or atmospheric pollutants, distance from the sea, winter road-salt spray from adjoining busy roads, accidental damage, alterations to the building, high internal temperatures or humidity levels, interstitial condensation, high radiation levels and incompatible metal components will all affect the service life of the component.

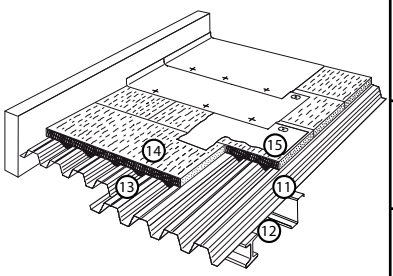
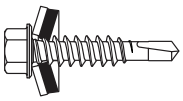
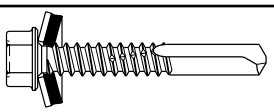
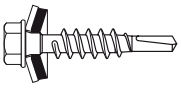
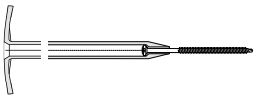
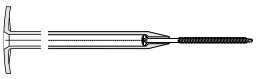
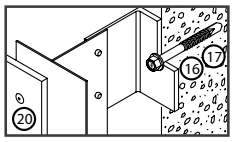
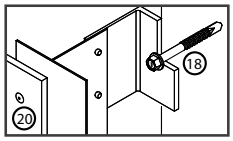
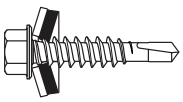
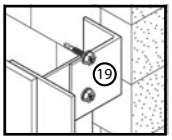
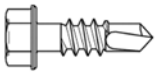
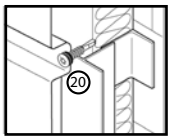
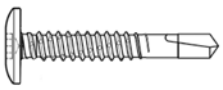
Construction professionals must select an appropriate fastener material that will match the required service life, warranty period and building fabric life given the exposure category that is anticipated. Speculative building projects should be considered to be category C3 as a minimum since occupiers of rented buildings may be from any industry and the impact of their production processes on the fabric will be entirely unpredictable.

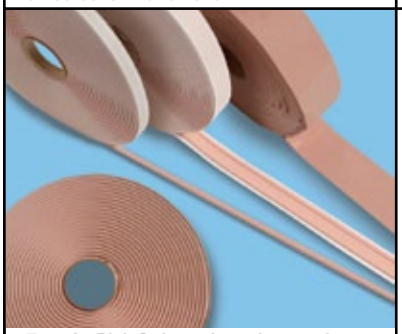
2.7 SFS intec austenitic stainless steel fastener range

Having explained in Section 2 the durability benefits associated with austenitic stainless fasteners, designers can be reassured that austenitic stainless fasteners for virtually all roofing and cladding applications are available in the marketplace.

The tables in this section gives examples of fasteners available relative to the variety of roofing and cladding systems. Unless noted otherwise*, all fasteners shown are manufactured from 316 series austenitic stainless steel. There are many other types available and SFS intec will be pleased to give advice on specific applications on the contact details below or e-mailing details/drawings to gb_technical@sfsintec.biz

APPLICATION	DESCRIPTION	CODE	FASTENER
 Site assembled liner panel systems.	Driller for coldrolled steel with irius® powder coated coloured head where visible.	**SX3/9-L12-S19 -6.0 x 29 x A4 (x colour if applicable)**	 ①
	Driller for hot rolled steel with irius® head.	**SX14/12-L12-S19 -5.5 x 40 x A4 (x colour if applicable)**	 ②
	Driller for clamping/stitching with irius® powder coated coloured head where visible.	**SL2-S-L12-S14 -6.3 x 28 x A4 x colour**	 ③
 Insulated panel systems.	Driller for insulated panels to cold rolled steel with powder coated coloured head.	**SXC5-S19 -5.5 x Length x A4 x colour**	 ④
	Driller for insulated panels to hot rolled steel with powder coated coloured head.	**SXC14-S19 -5.5 x Length x A4 x colour**	 ⑤
	Driller for clamping/stitching with powder coated coloured head.	**SL2-S-S16 -6.3 x 28 x A4 x colour**	 ⑥
  Aluminium standing seam systems.	Driller for securing standing seam system halters to decks with special drive system to eliminate overtorque.	**SDK2-S-377 -6.0 x 35/45**	 ⑦
	Driller for securing standing seam system halters to coldrolled purlins/tophats with special drive system to eliminate overtorque.	**SDK3-S-377 -6.0 x 35/45**	 ⑧
	Driller for securing standing seam system halters to coldrolled purlins/tophats with hexagonal head.	**SX2/18-A16 5.8 x 38 SX2/28-A16-5.8 x 48**	 ⑨
	Driller for securing tophat spacer to steel liner deck.	**SL3/2-5-S -SV16-6 x 27 x A4**	 ⑩

APPLICATION	DESCRIPTION	CODE	FASTENER
 Single ply membrane over insulation on metal deck.	Driller for securing metal decking to coldrolled purlins with hexagonal head.	**SX3/9-S16 -6.0 x 29 x A4**	 11
	Driller for securing metal decking to hotrolled purlins with hexagonal head.	**SX14/12-S16 -5.5 x 40 x A4**	 12
	Driller for clamping/stitching deck sidelaps with hexagonal head.	**SL2-S-S14 -5.5 x 27 x A4**	 13
	Thermally broken fastening system for insulation to metal deck, comprising of a fastener installed through a polyamide "telescope tube".	**Telescope tube R75 x length fastener BS-S-4,8 x length**	 14
	Thermally broken fastening system for inseam fastening of singleply membranes through insulation to metal deck, comprising of a fastener installed through a polyamide "telescope tube".	**Telescope tube R45 x length fastener BS-S-4,8 x length**	 15
  Rainscreens - Bracket to steel framing	316 austenitic steel throughbolt for securing rainscreen bracketry to concrete substrate.	**m1tr- M8, M10 or M12 x Length**	 16
	Nylon plug and 316 austenitic screw for through fixing bracketry to concrete/ masonry substrates.	**MBRK-S4-H18-10 x Length**	 17
	Driller for bracket, thermal pad, board liner into steel framing system.	**SX-S16 x Length x A4**	 18
 Rainscreens - Rail to bracket	Self driller for securing vertical aluminium rails to aluminium brackets.	**SLA5/4-6- S4-6.0 x 19**	 19
 Rainscreens - Panel to rail	Selfdriller for securing aluminium rainscreen panels to aluminium rails and framework over 2.5mm thickness with powder coated low profile coloured head.	**SX3/15-D12 -5,5 x 30 x colour**	 20


Type A+ Pink Strip sealants for metal roofing and cladding

SFS intec has, in consultation with a leading sealant manufacturer, developed a range of weather and air sealants designed exclusively to a specification which enables them to be warranted for periods up to 30 years and thus compatible with the SFS intec austenitic stainless steel fasteners shown above.
The sizes of the strip sealants are as recommended by leading system suppliers and either SFS intec or the appropriate system manufacturer could be consulted for the positioning and size of the strip sealants specific to the chosen system .
The range is supported by test data conducted in accordance with the NFRC Technical Bulletin 36 and is classed as a cross-linked butyl Type A+ and is coloured pink for ease of identification.
Further information with regards weather and air sealing is given in Sections 3.4 & 4.3 of this guide.

6mm x 5mm SFS seal Type A+ pink strip
4mm bead SFS seal Type A+ pink strip
6mm bead SFS seal Type A+ pink strip
8mm bead SFS seal Type A+ pink strip
18mm x 4mm U SFS seal Type A+ pink strip
22mm x 5mm U SFS seal Type A+ pink strip
50mm x 1mm SFS Polyband Type A+ pink strip

Section 3 Weathersealing

3.1a Poor washer design

Loose sealing element not retained under head

Poor quality EPDM showing UV degradation

Exposed fasteners i.e. those which penetrate the external weathering sheet, have to seal the penetration in the sheet for the design life of the roofing and cladding system.
Exposed fasteners are therefore supplied with a sealing washer.
The design of the washer, and in some applications the design of the fastener itself at the sheet interface, is therefore critical to ensure long term performance compatible with the rest of the system.

The total sealing washer design must therefore be resistant to the following;

Environmental conditions

- **General weathering**
- **Water ingress**
- **Acid rain**
- **Ultra-violet rays**
- **Ageing**

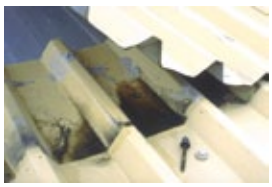
Mechanical loadings

- **Pullover (wind suction)**
- **Abrasion**
- **Splitting**
- **Vibration**
- **Movement (wind/thermal) of sheet**

Site applications

- **Overdriving**
- **Oblique/non-perpendicular driving**

3.1b Poor sealant design



Endlaps and sidelaps on profiled external roofsheets, as well as the external flashings at all junctions, need to be effectively sealed to provide continuity of the weathertight envelope

These sealants have to withstand many of the environmental conditions and mechanical loadings as noted above for the fasteners.

Many of the sealant suppliers are not prepared to give **meaningful** warranties on their standard sealant ranges, such that they could be compatible with a fastener or system warranty of 30 years as referred to under Section 2.5 of this guide.

3.2 The sealing washer solution

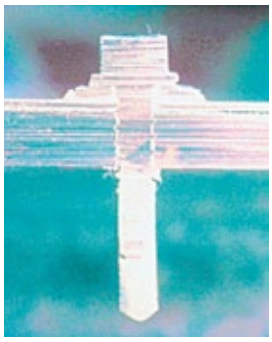
Long-term security

SFS intec has considered all the various performance requirements of the sealing washer, in conjunction with the fastener design relative to the particular type of roofing system, and has engineered weathersealing designs to provide long-term security compatible with the fastener and the material/system being fastened.

3.2a EPDM sealing element

Sealing washers should be specified with an EPDM elastomer (Ethylene Propylene Diene Monomer) as the sealing element. An elastomer is a material which can be repeatedly stretched (and compressed) to at least twice its original length and will then return to its original length immediately the load is released. Due to its overall performance, EPDM is an established material within the fastener and building industries and, in most instances, has replaced neoprene whose limitations include reduced resistance to general weathering, ultra-violet radiation, water and temperature, as well as ageing.

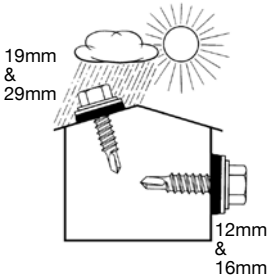
The thickness and hardness of the EPDM should be designed relative to the fastener type and washer diameter, for example where as the normal hardness is 70/80 shore, on clamping and insulated panel fasteners a much softer EPDM with a high recovery from compression value (70%) is used, refer to 3.3a & b.



3.2b Metal backing

To ensure the EPDM compresses evenly and forms a seal against both the sheet and the fastener shank, the EPDM should be vulcanized to a metal backing washer. Merely glueing, as is the practice of some manufacturers, would present a risk of the EPDM delaminating. The problem with loose sealing elements is clearly illustrated on the previous page where, for a number of reasons associated with poor fastener design, the sealing element has “extruded” beyond the head of the fastener and has been destroyed with the result that the seal will no longer be effective.

3.2c Diameters



Sealing washers are available in a wide range of diameters from, typically, 12mm to 29mm.

For primary valley fixing of through-fixed metal **roof** weathersheets and insulated roof panels, 19mm is usually the preferred diameter.

For “plastics” rooflight profiles - typically GRP and polycarbonate, larger diameter washers, typically 29mm, or in some instances crown saddle washers, are recommended.

For **walling** systems and secondary (clamping) fasteners, smaller diameters, typically 12mm-16mm, are used.

3.3 Specialist fastener designs to ensure weathersealing

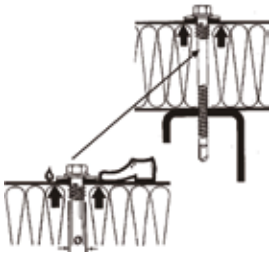
3.3a Insulated panel fasteners

The problem

Factory formed insulated panels, and also site-assembled, by their very nature, have a “non-rigid” section (the insulation core) between the external skin and the supporting purlin. Not all insulated panel fasteners are adequately designed for the application and therefore fail to provide the long-term compression and sealing of the washer leading to water ingress.

Purpose-designed insulated panel fasteners

These are designed with “dual threads”. The lower ones threadform into the purlin and are typically 5.5mm minimum diameter. At the head and washer end of the fastener there is a top thread section of an increased diameter designed to support the outer skin of the panel and thus impart permanent compression of the washer.



Insulated panel fasteners

Top thread performance

This has to be designed to accommodate all positive loading conditions, including concentrated foot loads, whilst maintaining optimum pullover performance of the washers.
Insulated panel fasteners should be designed with a top thread with this overall performance requirement in mind. This may be by having a top thread of c7mm diameter or, if less, then the threadform designs should provide the required support.
Many alternative suppliers have top threads of poor design which are unable to accommodate all these loadings and therefore the support given will inevitably be reduced thus leading to a weatherseal risk.

Thread-free section

For optimum performance, designs should also incorporate a thread-free feature immediately behind and below the washer on insulated panel fasteners.
This enables the weatherskin to be permanently supported thus compressing the EPDM washer. This compression and seal will be maintained even in conditions where the fastener is used to draw the panel back to the support or where fasteners are overdriven. Alternative designs with top threads extending right up to the head present a major risk in both these conditions.

3.3b Clamping fasteners to ensure weathersealing

Clamping fastener

Clamping fasteners are purpose-designed to clamp thin materials together (e.g. sidelaps of profiled metal sheets) and for fixing flashings and closures to profiled metal sheets and to themselves.
Use of inappropriate fasteners may lead to overtorque in which case, not only is weather and air tightness compromised, but also the structural performance of the fastener is lost and components may become detached. Clamping fasteners should incorporate features to ensure structural performance and weathertightness.

- **Reduced diameter drillpoint** - high pullout and clamping forces
- **WRS washer** - thicker and softer with a high recovery from compression value (70%) to ensure a seal over a range of application thinnesses.
- **Thread free (free spin) zone** - to draw and clamp the materials together and to eliminate any weather and air tightness risk associated with over-driving.

3.3c Specialist fasteners designed to prevent overdriving

Overdriving fasteners into thin [<1mm] steel sheet is an increasing problem as building designers select ever thinner sheet material for structural applications. Typical site labour’s practice is to remove depth control devices from powered screwdrivers. This leaves the installer with little control over the setting of the fastener, which happens very rapidly when
it is being driven in at more than 1000rpm. Overdriving crushes the sealing washer so reducing the watertight seal and will easily strip the thread form in steel up to about 2mm thick, leading to immediate fixing failure. In thicker steels, the grip of the thread is not damaged, but the high torque imparted to the fastener will result in very high residual tensile stresses. Overdriving is the most common installation fault observed in the workplace and is caused by lack of training and a belief in “the tighter the better”.
To try to overcome this fixing issue, SFS have engineered a range of products specifically designed to prevent overdriving. The thread free zone mentioned above is one such measure; others include:

- SDK and SOL fasteners, which feature a drive pin that breaks off at a present torque
- SL3 “thick to thin” fasteners designed to clamp thick top hat sections to thin metal decks using a combination of a special sprung washer, deep threads and a free spin zone
- *Irius*® underhead drive system
- TUS system for rainscreen panels

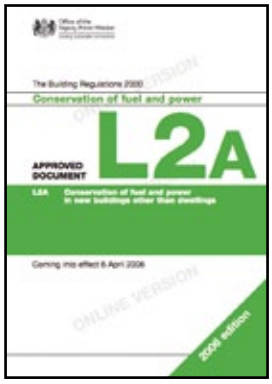
Section 4 The “Part L” issue - Airsealing & thermal bridging

4.1a Overview of April 2002 Part AD-L2A

The changes in the Building Regulations, which became effective in April 2002, sought to address the problems resulting in heat loss through the cladding envelope. Those most relevant to fasteners and sealants resulted in insulation thicknesses in the cladding envelope virtually doubling (U-value reductions) and a reduction in the problem of air-leakage through the system principally by installing additional airseals.
Another contributor to heat loss is thermal bridging through the system. This could be through poor design at junctions and also via metal fasteners which pass through the whole system, particularly on mechanically fastened flat roofing systems where there is typically a higher density of fasteners.

4.1b April 2006 Part AD-L2A England & Wales

Part F2:2006 N. Ireland and Section 6:2007 Scotland (in preparation)



A further enhancement of the Regulations requires the designers to use the National Calculation Methodology (NCM) to determine the energy use of the whole building, including the fabric, lighting, heating, ventilation and cooling systems. The new software calculation tool - the interface for Simplified Building Energy Model (iSBEM v1.2.a) is used within the NCM for buildings other than dwellings.
The target is to further reduce the TER (Target Emission Rate) from the 2002 notional building level by around 24%.

4.1c October 2010 Part AD-L2 England and Wales

Technical Standard J [Scotland] - Overview

The 2010 Approved Documents and Regulations are similar to the 2006 version, however there are many changes to the iSBEM software which models the CO2 output of the building. Most notable are:
* Using a range of notional buildings to model various types of usage [previously ‘one size fits all’] and varying the CO2 reduction levels to suit the notional building types rather than a blanket reduction
* A shift to 3 different lighting layouts for natural light situations - side lit, overhead lit and no light applications
* Retaining the 2006 U value levels as ‘back -stop’ levels
* Focus on reducing cold bridging by adding penalties for poor design of details
* Overall a combined reduction of about 27% in the allowable CO2 level over the 2006 level

The iSBEM calculation now has be submitted at the planning stage and confirmed with an ‘as built’ calculation at the end of the project.

What impact will these changes make on the external cladding envelope?

- U-values -
It is generally felt that, with the new calculation methodology for the buildings CO2 emissions, a further reduction in U-values (ie. increasing insulation thicknesses) of the cladding envelope will only have minimal additional practical impact on the buildings energy efficiency over the changes already implemented in 2002.

- Natural lighting -
On certain types of building, the provision of natural rooflighting may allow a reduction in the usage of electric lighting thus making significant contributions to the buildings energy efficiency. This will usually more than compensate for the higher U-values normally associated with the rooflight element of the roof.

- Cold bridging -
Elimination/reduction in thermal bridges will remain an important design consideration at junctions, interfaces and fasteners.

- Air-tightness -
Increasing air-tightness from the 2002 levels of 10m3/sqm/hr will generally show a greater benefit and a further increase in air-tightness may be chosen by the designer as a significant contributory factor to compliance to the Building Regulations.

The 2010 revision to Part L2A requires allowable air leakage rates to halve to 5m3/m2/hour. This change will bring significant CO2 reductions to typical industrial type building - industry studies have shown reductions in the region of 3 to 4kGs of CO2/m2 when measured against the benchmark 2002 specification using a simple industrial unit layout.

Cold bridging via all-carbon steel fasteners

4.2 Elimination of cold bridges by using thermally broken fasteners

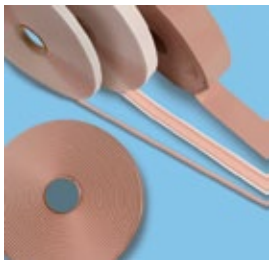
For single ply membrane roofing systems, both the insulation and the membrane may be mechanically fixed. Part L2A, with its’ increasing focus on reducing cold bridging, has led SFS intec to introduce a range of thermally isolated fasteners for these popular roofing systems. Because the metallic fastener element is located deep within the insulation layer, heat flows are significantly reduced over the old style metal plate and screw approach.

As the market leader, SFS intec’s ISO TAK system offers a wide selection of telescopic tubes and high performance fasteners to suit any application including timber, steel and concrete decks. Working in partnership with both the insulation and membrane manufacturers has enabled SFS intec to develop products that offer very high levels of clamp up force to resist wind loads, whilst reducing heat loss by some 10% on typical applications.

4.3 Achieving airtightness with warranted sealants

Generally, to achieve these required levels of airtightness, additional sealing materials have to be included within the system. These seals are usually installed at the inner lining position ie below the insulation…the following section 4.3 gives further information on the specification of the seals.

Tata Steel have published a Technical Paper entitled “Creating an air-tight building envelope Colorcoat® Technical Paper - which gives further useful guidance on achieving air-tightness on built-up and insulated panel systems.



Warranted sealants

There are a number of mechanical and accelerated tests developed by sealant manufacturers for roofing and cladding. The basic tests deem whether the seals are classed as Type A or Type B. The NFRC published Technical Bulletin 36 which gives a summary.
However, there is a need for the seals to be warranted for up to 30 years thus being compatible with the austenitic stainless fasteners and sheet system as referred to in section 2.5.

SFS intec worked closely with a leading sealant manufacturer and developed a high performance butyl strip sealant range for profiled roofing and walling systems. Their performance under all the mechanical and accelerated tests exceeded the basic requirement of a Type A sealant such that SFS intec are able to issue a warranty for up to 30 years. This warranted SFS intec sealant is referred to as Type A+ and is coloured pink for ease of identification.

Thread free zone for weathertight clamping on SFS stitching fasteners

Clamping fasteners (refer to 3.3b)

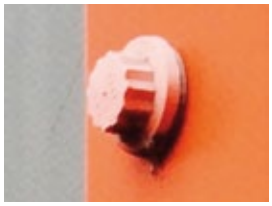
To ensure that the warranted sealants perform effectively within the application, they have to work in combination with the purpose designed clamping fasteners discussed within section 3.3b.

Section 5 Aesthetics by design

Historical background

During the 1970s, the market share for colour-coated cladding materials dramatically increased principally within the industrial and retail building sectors, and today colour-coated cladding represents over 90% of their total market.

Colour-coated materials are also now widely used as part of the cladding envelope on many other building types such as educational, healthcare, residential, leisure and transport-related buildings.



UV fading of moulded heads

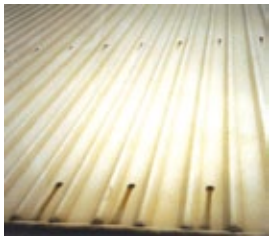
Freedom of design

The range of shapes and profiles to which these coloured materials can be formed has given the architect much freedom of design and great attention is now paid to the aesthetics of construction details and interfaces rather than merely their functional performance. Designers are able to use colour and shape to create aesthetic appeal and impact to attract investors and to support their clients corporate image.

Colouring of fasteners

Where visible fasteners are used to secure these coloured materials, it is, virtually without exception, desirable that the fastener head is permanently coloured.

5.1 The problem



Push fit cap accelerating corrosion

Some contractors may choose to fix the coloured cladding materials with plain hexagonal headed fasteners and then site-apply a push-fit colour cap.

There are many potential problems with this option;

- **i)** Caps may be missed off
- **ii)** Caps may become dislodged after installation
- **iii)** Caps are expensive to replace
- **iv)** The “plastic” may suffer UV degradation
- **v)** The cap may suffer from colour instability
- **vi)** Caps may entrap moisture - leading to corrosion staining
- **vii)** Caps do not offer lifespans matching the cladding
- **viii)** Caps are slow to install

These are problems for both the contractor, who may have to make return visits to replace caps (snagging), and to the building owner who suffers a loss of aesthetic appeal and image and the expense associated with restoring the original intended finish.

5.2 Factory-coloured solutions

To address the many problems associated with push-fit caps, SFS intec has developed ranges of coloured and aesthetically shaped fastening systems which have evolved with the introduction of new cladding materials and profiles. These have been designed with the desires of the specifiers, contractors and building owners taken into consideration.

Painted headform

5.2a The powder coated head solution

Powder coating offers a number of benefits. It is tough, durable and accurately matches the colour of the surrounding weather sheet. It is only very slightly affected by UV light, and so fading or weathering is uncommon. The fastener head remains small and compact and there is no bulky plastic to cause visual intrusion.

Irius® headform

5.2b The “unobtrusive” solution

Where the designer selects a wall cladding material or profile for its high aesthetic appeal, it may be more desirable that the fastening system is unobtrusive and blends in with the cladding.
Some walling systems are designed such that the fasteners are totally concealed, for example, flat or micro-ribbed insulated wall panels are often fixed through their “tongue & groove” joint.

However, there are many walling systems which are visibly fixed and the raised heads of traditional moulded headed fasteners, even though they may offer longterm colour matching, may not meet the aesthetic requirements.

Unobtrusive Irius® at Wales Millennium Centre

Low profile coloured headforms have been developed specifically for applications where the fastener has to fulfil all its normal structural requirements whilst, at the same time, blend in unobtrusively with the cladding.

Coloured Irius® headform

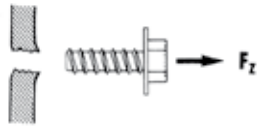
The irius® headform may be powder coated for colour matching purposes and the innovative underhead drive system enables ease of installation whilst also offering a high level of tamper-resistance - aesthetics with security.

Section 6 Technical performance criteria

Apart from durability, weathersealing, airsealing, and aesthetics, fasteners have to be capable of withstanding a wide range of loadings and other performance criteria. These technical performance criteria tend to be specific to the particular type of cladding system and therefore fasteners are designed such as to give optimum performance compatible with the requirements of the particular system.

Typical technical performance criteria which influence fastener design include;

6.1 Pullout and tensile forces
6.2 Pullover resistance
6.3 Concentrated foot loadings
6.4 Dynamic bend resistance
6.5 Unwinding
6.6 Clamping of membrane
6.7 Thermal/cold bridging
6.8 Overdriving resistance
6.9 Clamping & sealing
6.10 Shear performance
6.11 Non-fragility
6.12 Material compatibility
6.13 Windloadings
6.14 Fastener frequencies
6.15 Safety & tooling



6.1 Pullout and tensile resistance

This is the ability of the fasteners threaded connection between the two components to remain intact and resist all axial and tensile loadings.

Selfdrilling fasteners

It is now a widely accepted industry practice that selfdrilling fasteners, which are installed in a single operation, are preferred to tappers, which require the additional predrilling operation.

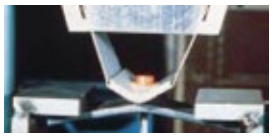
Selfdrillers are now available for the majority of cladding systems for metal support thicknesses up to 14mm.

The benefit of selfdrillers is not limited to the obvious one of timesaving. Selfdrillers also provide more consistent and optimum pullout resistance from the supporting material.
Tappers require the installer to use a non-worn drill of the correct diameter specific to the metal thickness, and to predrill without wobble, otherwise the pullout values achieved will be varied (a high standard deviation) and significantly lower than published data from laboratory testing.


Purpose-designed drillpoints

Selfdrillers are manufactured with their own integral drillpoints which are engineered to efficiently drill and threadform into a predetermined metal thickness, resulting in much more consistent performance thus reflecting published test values.

The drillpoint diameter and length is purpose-designed for a specific range of metal thicknesses.


Pullout testing

To assist the engineer and specifier, SFS intec publishes results of laboratory testing on all fasteners. This includes fastener pullout, showing the mean ultimate failure load and also the standard deviation. This enables the calculation of the standard deviation and the characteristic value as assessed using the method laid down in BS EN 10204: 2004.

6.1a

The SFS intec Technical Value documents present test values for different fasteners. When possible, the results have been evaluated according to the European standards and requirements for the CE mark. For the evaluation, the European Organisation for Technical Approvals (EOTA) has published a guideline1) “Fastening Screws for Metal Members and Sheeting”. Here is a short summary of the guideline regarding the evaluation of characteristic values and one calculation example.

Characteristic Value Rk of a Fastening Capacity

A characteristic value Rk for tension and shear resistance of the fastening is calculated according to the equation 1.

$$R_k = (F_{avg} - k * s) * a \qquad (1)$$

, where
Rk is the characteristic fastening capacity
Favg is the average value of the ultimate failure loads
k is the statistical coefficient according to a sample size n
s is the standard deviation
a is the adjustment coefficient for the test results

6.1a Continued

The adjustment coefficient comes from the equation 2. The purpose of the adjustment is to reduce effects of material property deviation.

$$a = (R_{m,min}/R_{m,obs}) * (t_{min} / t_{obs}) \leq 1 \quad (2)$$

, where $R_{m,min}$ is the minimum tensile strength of a relevant product standard
$R_{m,obs}$ is the actual tensile strength of the test specimen
t_{min} is the minimum thickness according to a relevant product standard
t_{obs} is the actual thickness of the test specimen

Statistical evaluation and k value

The test results are evaluated according to statistical methods. The results are assumed to follow a log-normal distribution. For the evaluation of a 5% fractile value and a confidence level of 75% is chosen according to the EOTA guideline and ISO 12491 : 1997 2). Table 1 shows the statistical factor k according to a sample size normally needed for the tests.

Table 1. k-values for the sample size n.

n = sample size	n = 6	n = 10	n = 12	n = 20
k value	2,34	2,10	2,05	1,93

Note! All calculations, measurements, fasteners and design methods have to be verified by a responsible designer or an engineer, regarding the corresponding structure and load. Please consult your national norms and approvals.

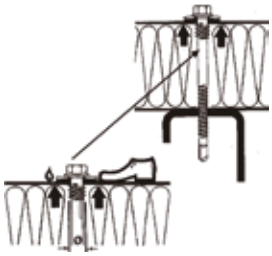
Pullover testing

6.2 Pullover resistance

This is the ability of the fastener to prevent the sheet material failing by pulling over the head of the fastener.

As referred to in Section 3 on weathersealing, resistance to pullover failure of the sheet is influenced by the sheet material thickness and tensile strength in combination with the strength and diameter of the washer.

The fastener supplier specified should be able to provide the engineer with published test results of various washer diameters in various sheet materials and thicknesses.



Sheet support and thread free section on SFS insulated panel fasteners

6.3 Concentrated foot loadings

The two principle applications where foot loadings have to be considered in fastener design are metal faced insulated roof panels and single ply roof membranes over insulation boards.

Insulated roof panels

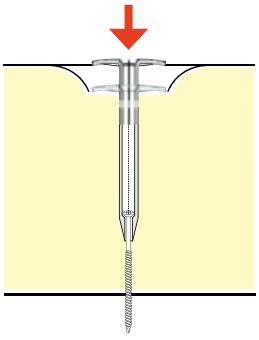
As described in Section 3.3a, the top thread of insulated panel fasteners has to be designed so that it will continue to support the external skin of the panel against the concentrated dynamic loads imparted by foot-traffic.

This may be by having a top thread of c7mm diameter or, if less, then the threadform designs should provide the required support.
Many alternative suppliers have top threads of poor design which are unable to accommodate all these loadings and therefore the support given will inevitably be reduced thus leading to a weatherseal risk.

This enlarged thread also works in combination with the thread-free zone, whose function is also described in Section 3.3a, to ensure both a walkable and weathertight connection.

Single ply membranes over insulation boards

The membrane must be protected against the risk of the insulation and membrane fastener puncturing the membrane as a result of foot traffic causing local compression of the insulation board.
Telescope systems such as the SFS intec Isotak range are automatically “treadfast” as the fastener head is set down towards the bottom of the telescope.
Where old style metal plate and screw systems are used, the screw should have an enlarged thread under the head to engage with the plate washer so as to resist foot traffic loads.



“Treadfast” telescope Isotak

6.4 Dynamic bend resistance

laboratory testing

Where insulated panels are through-fixed, the fasteners are also subject to repetitive bending forces. These forces are typically generated by panel deflections from (wind) loadings and thermal movement. This bending tends to be greater in hot-rolled steel purlins which tend to be less flexible than thinner cold-rolled purlins.

The European Convention for Constructional Steelwork (ECCS) Document 66, Preliminary Recommendations for Sandwich Panels defines a test method to which fastener manufacturers have to be able to demonstrate compliance and advise the maximum allowable deflection relative to steel support and panel thickness.

By 2013, many fasteners for roofing and cladding will feature CE marking in accordance with the European Construction Products Directive. Assessment for CE marking will include a series of tests which will include a bend test similar to the ECCS test outlined above. It is expected that the CE test program will replace the ECCS method in due course.

6.5 Unwinding

high performance drill tip

Pitched roofing systems

Historically, this phenomenon has not been widespread within pitched roofing systems. However, where conditions of potentially high differential movement between the sheet and “lightweight” framing present themselves, caution in the selection of the most appropriate fastener type should be exercised, and SFS intec would welcome being consulted.

Flexible membrane systems to “thin” metal decks

As the wind passes over the flexible membrane an eccentric force passes through the fastener. The SFS ISO TAK system is able to accommodate these dynamic windloads by nature of its “reduced” diameter drillpoint, the tapered lead-in thread section and its shallow thread pitch angle. These features combine to give total thread engagement within the deck and to also provide the optimum pullout from “thin”, 0.63mm minimum, steel decks.

6.6 Clamping of membrane

For in-seam fastening of single ply membranes, telescopic fasteners are designed to resist any sidewards movement of the membrane which could ultimately lead to tearing, slippage and failure of the membrane. SFS intec can offer a variety of fastener and tube designs which, due to their high clamping qualities may allow a 25% increase in the fastener safe working load.

Unless the membrane supplier takes full responsibility for the fastener frequency calculations, confirmation should be sought from the particular membrane supplier that the proposed fastening system and its permissible loadings are appropriate to their membrane.

6.7 Thermal/cold bridging

Cold bridging via all-carbon steel fasteners

Approved Document AD-L2 requires the designer to calculate thermal bridges and consider their effect on both condensation and also heat loss through the building envelope.

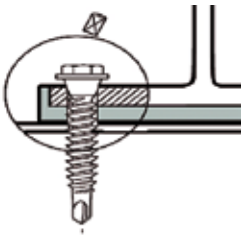
In certain types of roofing and cladding systems, fasteners may add to heat loss depending on their specification.

The thermal conductivity of carbon steel as a fastener material is 60W/mK whereas austenitic stainless is only 17W/mK. Therefore specifying austenitic may allow thinner insulation to be used and still achieve compliance with the Building Regulations.

As an example, in a typical flat roof application with 4 fasteners per sqm, the additional heat loss through 100mm insulation with carbon fasteners exceeds 1.5% compared to only 0.25% with austenitic stainless fasteners. Where coated carbon steel offers sufficient durability, then using a thermally broken telescopic system (see section 4.2) would also allow thinner insulation to be used.

6.8 Overdriving resistance

Overdriving of fasteners may lead to threadstripping within the supporting structure, particularly in “thin” cold rolled sections. “Traditional” designs of selfdrilling threaded fasteners rely upon the installer to take the necessary care not to overdrive, either by use of depth locators on screwguns or experience. For two particular applications where the fastener performance is criticial for the integrity of the system, SFS intec has developed innovative solutions which, by design, cannot be overdriven.



SDK fasteners for standing seam halters

Due to the high expansion rate of aluminium sheets, fasteners securing halters for aluminium standing seam systems, such as KalZip, Euroseam and KeyBemo, often have to withstand very high and repetitive shear/tensile forces. To eliminate the risk of system failure due to overdriven fasteners, the SDK design of fastener is driven via the square peg on the head which is designed to break off when the fastener is tightened to the correct level.

“Thick to thin” applications

On some built-up metal systems, particularly where there is an acoustic and/or high insulation requirement, a “thick” tophat may be installed onto the “thin” liner/deck. Traditionally a rivet would have been used as the risk of overdriving with “standard design” drillers is considered too great. However a rivet is extremely slow to install.

SFS intec developed the selfdrilling fastener shown opposite which combines speed with security - the fastener cannot be overdriven as the specially designed washer flattens within the free-spin zone to accommodate the combined thicknesses of the tophat and liner/deck.

SFS intec clamping fastener

6.9 Clamping & sealing

In Sections 3 and 4 the importance of fasteners with regards weather and air sealing was discussed. SFS intec’s stitching and clamping fasteners are purpose-designed. Behind the soft EPDM washer is an unthreaded (free-spin) zone which enables the two thin sheets to be drawn and clamped together thus compressing the weather or air sealant.

6.10 Shear performance

In some applications fasteners are subjected to a direct shear loading. SFS intec publishes documentation which gives the engineer the shear value of the fastener and also of the fastener in a range of applications.

6.11 Non-fragility

The Advisory Committee for Roofwork (ACR) publish a number of guidance documents which all contribute to the aim of enabling roofwork to be designed and carried out with minimal risk to any personnel who either construct the roof or who subsequently need to traffic a completed roof.

Fastener types and frequencies play a major role in achieving a non-fragile status for metal roof systems and the Red Book - ACR[M]001:2005 details the testing methodology for non-fragility.

Important note: it is now accepted practice to use 5.5mm diameter washered fasteners for roof lining panels rather than 4.8mm non-washered fasteners.
For long term non-fragility beyond the construction phase, **austenitic stainless steel fasteners** would be the recommended choice due to their proven durability.

6.12 Material compatibility

The risk of corrosion of the sheet material due to the fastener and also the fastener due to the material it is fastening into/through has to be considered by the designer.

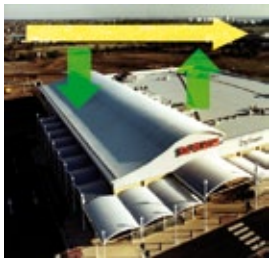
Bi-metallic corrosion

PD6484:1979 - "Commentary on corrosion at bimetallic contacts and its alleviation" may be referred to in order that any risk could be assessed. Consideration must also be made to the relative surface areas of the metals in contact and the moisture content around the connection. Generally, the fastener must be more corrosion-resistant than the material it is fastening into/through. Therefore, it is considered appropriate for austenitic stainless fasteners to be used in combination with aluminium or galvanized steel sheets/supports. Zinc coated carbon steel fasteners should only be considered for galvanized sheets - refer to table in section 2.6.

Corrosion within timber

Timber may be incorporated into the roofing and cladding system as a beam, purlin, spacer, counter batten and/or tiling batten. Timber is a moisture absorbent material and so to prolong the life of timber it may be treated with a preservative. These treatments are typically divided into two types - Organic Solvents (OS) and Copper Chrome Arsenic (CCA) and are covered in BS4072:Part2:1987 and BS5268:Part5:1989.

The CCA treatments, in particular, can be very corrosive to zinc coated carbon steel fasteners and it is therefore recommended that with CCA treatments, and also with OS treatments if the moisture content is likely to be at >15% for prolonged periods, austenitic stainless fasteners be specified.



Wind creates +ve and -ve (suction) loads on roofing and cladding

6.13 Windloadings

The new BS EN 1991 method uses a national annexe to provide wind values for the United Kingdom and this has come into force from January 2011, replacing BS 6399 (and in Ireland CP3). However, EN 1991 produces different values for a given location when compared with the earlier BS 6399 method and so some work has been carried out using a hybrid, taking values from both the BS and EN data and this seems to be the way forward (at spring 2011).

Windload data is often provided by the Engineer, and used by the Contractor and/or the system supplier in the detailed design and specification of the roofing and cladding system.

Where this information is not available, fastener suppliers may be consulted to assist, upon request, and submit windload calculations relevant for the fastening proposals of the roofing and cladding system. Such calculations should be verified by the project engineer.

6.14 Fastener frequencies

SFS intec publishes a wide range of technical performance data on its fasteners.
Generally the published values are the ultimate mean and the standard deviation values. Safety factors have to be applied to these figures to establish the safe working load of the fastener. BS5427:Pt1:1996 Annex B gives guidance on this calculation. SFS intec can help interpret these loads relative to the proposed roofing and cladding system.

There may also be test data compiled by the system manufacturer from which the maximum allowable fastener loads have been determined.

Once all relevant loadings, structural frame details and the proposed roofing and cladding system specification have been established, the fastener supplier may be called upon to work in close co-operation with the relevant party, eg. designer, system supplier, contractor, to determine the fastener frequencies specific to the project.

6.15 Tooling

Sections 6.1 to 6.14 show the wide range of performance criteria fasteners have to be capable of withstanding. These criteria tend to be specific to the particular type of roofing and cladding system and therefore fasteners are designed such as to give optimum performance compatible with the requirements of the particular system. Whilst some fasteners have been designed such that they cannot be mis-installed (refer to 6.8 & 6.9), tooling systems for other fastener types are available which assist the Contractor in terms of both speed and consistency, as well as providing security to the Client.

Section 7 Specification design support

7.1 Fastener and sealant specifications for roofing and cladding

Specification advisory service for architects, designers and consultants
At the early detail design stage of a project, complex and sometimes conflicting requirements can place diverse demands on the fastener and sealants. Consultation with an experienced technical team from the fastener supplier can help you to resolve fastener and sealing issues during the planning stages, working side by side with architects and designers to ensure that performance requirements of the building envelope are met, and the contract specification proceeds without a hitch.

7.1a

Dilapidation and remedial works
Consultants that specialise in surveying properties that are changing hands or are subject to warranty disputes will find the SFS intec technical service to be an invaluable source of advice, built on years of experience.

Assessing and specifying the right products
Every contract is different, and with the increasing number of products on the market, and ever more pressure on your time, just how do you sift through the mass of information available to specify the correct fasteners and sealants.

The answer is to let SFS intec help.

The SFS intec specification team is geared up to working with architects, designers, contractors and structural engineers to provide informed, detailed and reliable specification guidance.

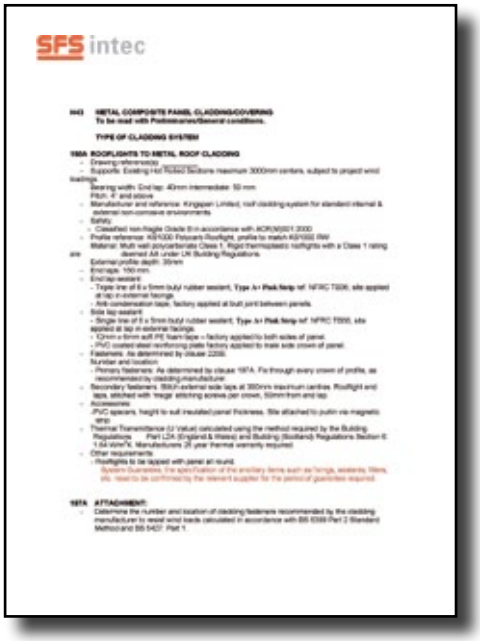
SFS intec can prepare project-specific fastener and sealant specifications for inclusion within tender documentation. These specifications may be in either prescriptive or performance format as adopted by the particular practice.

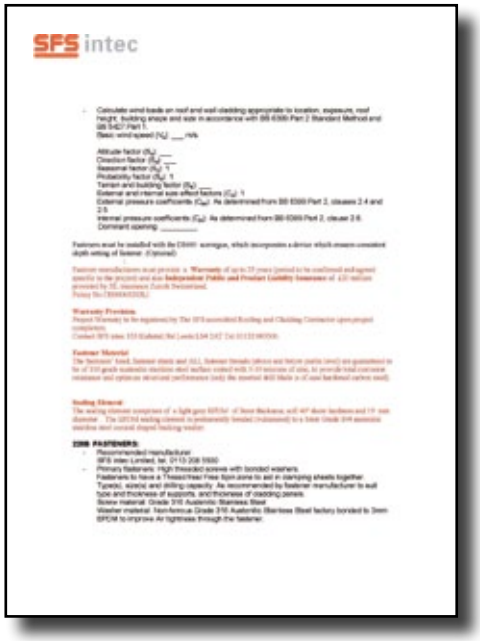
NBS Plus
For those that prescribe to NBS, SFS intec austenitic stainless fasteners and warranted sealants are now listed within NBS Plus, part of the NBS industry standard specification software used by architects, engineers, building surveyors and other construction industry professionals. This means that the technical information and guidance for our products is presented to NBS subscribers, in NBS format, at the point in the specification appropriate to our products. Furthermore you will be able to access our website www.sfsintec.biz/uk through the direct link from NBS Plus to obtain further information. We can also provide guidance for the completion of NBS clauses upon request.
All information found within NBS Plus is updated three times a year ensuring that specifiers have access to our most recent product information.

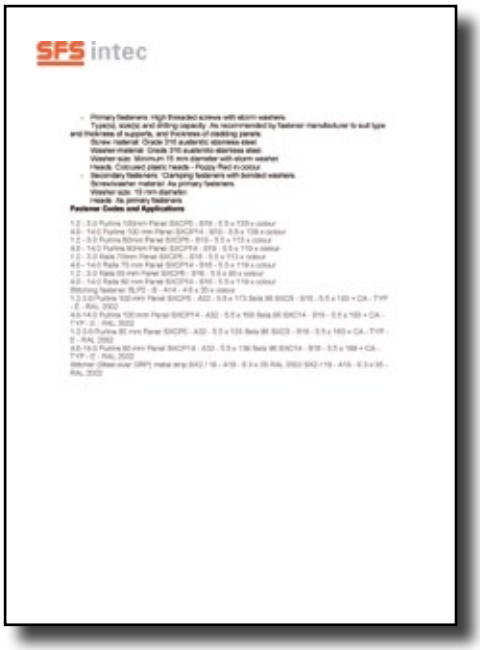
CPD seminars
SFS intec also offer their RIBA-accredited CPD technical seminar which, in conjunction with this guide, helps you to become familiar with issues concerning fasteners and sealants, as well as enabling you to acquire your RIBA CPD points! Contact us on the details below.

7.1a Project-based specification sheets

Examples of the types of project-based specifications for fasteners and sealants are shown below.
By using the codes and descriptions prepared by SFS intec, the specifier has the choice of issuing specifications in either performance, prescriptive or NBS formats.







7.2 Innovative solutions to benefit everyone – from architect through to client

As building design moves forward, architects, designers, and contractors face new challenges and new problems – which must be met with innovative product solutions. At SFS intec we aim to meet – and exceed – your expectations of product performance through constant research and development into practical, effective fasteners and air sealing solutions. Through our close relationship with test houses, research laboratories and manufacturers of roofing and cladding systems, plus our own in-house research into metallurgy, drill technology and corrosion testing, we are able to bring you the most technologically advanced solutions to today's market needs.

Long-term partnerships with roofing system suppliers

Roofing and cladding system manufacturers are constantly improving and developing their products, and SFS intec is matching these developments with new fastener technologies. In the UK and worldwide, SFS intec technical specialists are working in partnership with the market leading system manufacturers in external cladding, insulation systems and roofing systems to bring competitive, high-performance fastener solutions to the market. SFS intec products are endorsed – sometimes exclusively – by many of the UK industry's major systems suppliers such as Tata Steel Panels and Profiles and their Platinum Warranty System – testimony to our commitment to a partnership approach to providing practical, customised solutions for today's competitive market.

Tata Steel and Profiles
Platinum Warranty

Adding value to the project: the SFS intec quality guarantee

In this competitive market, clients are always looking for added value – whether it means a higher level of specification, greater longevity of the building, low maintenance or improved performance. Creating that added value means being able to rely on even the smallest component in the building to support the demand for overall quality.

Recognised worldwide for its commitment to the highest standards of product performance and customer service, SFS intec fastener products and air sealing solutions can play an important part in helping you to deliver customer satisfaction. Throughout the SFS intec organisation, specialised, on-going training ensures that you benefit from an informed, technically aware and experienced team – at all levels. In terms of production, the SFS intec exacting quality assurance system stands up to any international requirement, so you can have complete confidence in the technical values and performance specifications of the products you specify and use.

Quality and environment

SFS intec products and installation systems are manufactured to the highest quality standards, so you can specify with confidence. Since 1987, SFS intec has been certified to ISO 9001. Early in 1996, our main manufacturing plant gained the ISO 14001 environmental standard along with VDA No6. From production through to packaging, we don't just aim to meet quality, environmental and safety requirements – we work to exceed them.

7.3 Achieving results through technical advisory service

Helping you choose the right fastening system

Choosing the right fastening system can be decisive in terms of the longevity and safety of the roof. As well as outlining SFS intec's policy on customer service, fastener product development and cost-effective systems technology, this product selector gives you a clear guide to the most suitable fasteners for different applications within the field of pitched roofing and cladding, making specification quicker and simpler. But if you do need personal advice, please don't hesitate to get in touch with our technical team who can advise you further.

Total technical support from specification to site tests

Incorrect calculations, specification details or installation can lead to costly delays on site. But as the demands on building structures increase, and the variety of options widens, choosing the correct fastener and air sealing solution for the job is becoming more of a testing task. To help you to get things right from start to finish, the SFS intec technical team is committed to providing you with the support you need, including:

- **Expert product specification and air sealing solution advice.**
- **Guidance on choosing a system to meet the specific warranty requirements of your contract.**
- **Training your team in the best use of your chosen system.**
- **Help with calculating fastener quantities and costs.**
- **Informed, reliable technical help whenever you need it throughout the contract.**

7.4 Training

CPD seminars

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On-site training

Precision during installation can be the difference between a secure roof or performance problems. To help you eliminate any risk, SFS intec offers free training in the use of SFS intec onsite fastener installation tools, which are purpose-designed ensuring that consistency of fixing is achieved. Whether you require one of our technical training team to carry out training on-site, or you prefer to visit the technical training centre at our Leeds offices, our expertise is only a phone call away.

Mobile training unit

Features:

- All weather capability - comfortable heated outdoor accommodation for up to 9 people; upto 30 people indoors at your premises
- Hand on demonstrations and videos
- On board power supply
- Full range of SFS tooling systems and products
- Programmes include pitch roofing, flat roofing, cladding, rainscreen and facades, logistics and e-business
- CPD Certificates for attendees

Brings SFS intec to your doorstep...

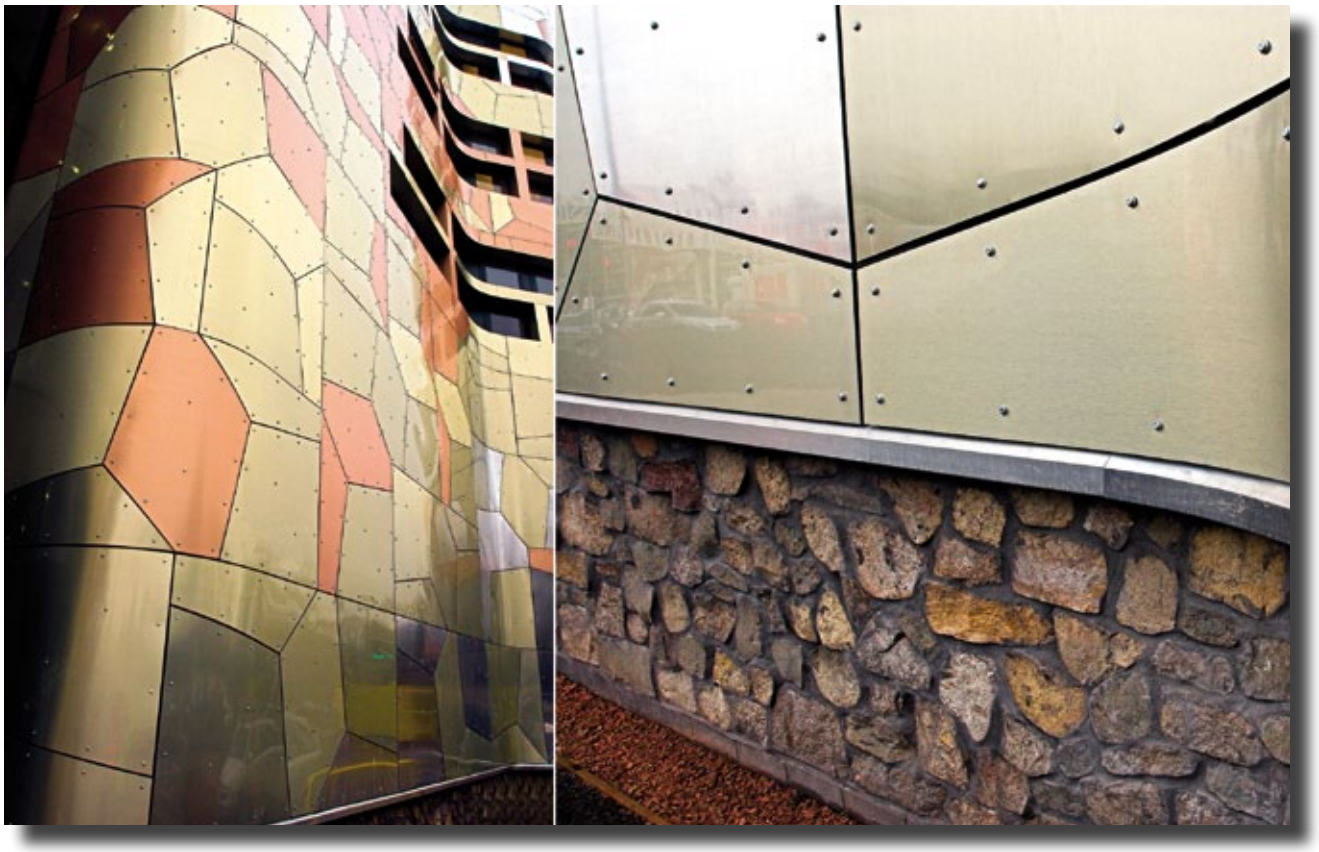
Section 8 Case studies

8.1 First Direct Arena, Leeds

Specialist contractor;	Lakesmere	
Designer;	Populous	
Project requirements;	Durability	Section 2.5b
	Aesthetics	Section 5
	Weather & airsealing	Section 3 & 4
	Technical performance	Section 6
SFS intec products;	Austenitic stainless steel	Section 2.7
	irius® colourheads	Section 5.2b
	Clamping fasteners	Section 3.3, 4.3, 6.9
	Weather & air sealants Type A+	Section 3.4 & 4.3

Section 8 Case studies

8.2 WJEC Building, Cardiff



Specialist contractor;	Severn Insulation	
Designer;	Capita Architecture	
Project requirements;	Durability	**Section 2.5b**
	System suppliers warranty	**Section 2.5e**
	Aesthetics	**Section 5**
	Weather & airsealing	**Section 3 & 4**
	Technical performance	**Section 6**
SFS intec products;	Austenitic stainless steel	**Section 2.7**
	Project-warranty to system supplier	**Section 2.5e ii)**
	irius® colourheads	**Section 5.2b**
	Clamping fasteners	**Section 3.3, 4.3, 6.9**
	Weather & air sealants Type A+	**Section 3.4 & 4.3**

Section 8 Case studies

8.3 Cairngorm Funicular Railway

Specialist contractor;	Abbey Roofing Specialists	
Project requirements;	Durability	Section 2.5b & d
	Component supplier warranty	Section 2.5e
	Aesthetics	Section 5
	Technical performance	Section 6
	Design support	Section 7
SFS intec products;	Austenitic stainless steel	Section 2.7
	SFS project-specific warranty	Section 2.5e iii)
	irius® colourheads	Section 5.2b
	SDK halter fixings	Section 1.3a & 6.8
	Clamping fasteners	Section 3.3, 4.3, 6.9
	Technical & design support	Section 6 & 7

Section 8 Case studies

8.4 ExCel London Phase 2

Specialist contractor;	Hathaway Roofing	
Project requirements;	Durability	Section 2.5b & c
	Component supplier warranty	Section 2.5e
	Aesthetics	Section 5
	Technical performance	Section 6
	Design support	Section 7
SFS intec products;	Austenitic stainless steel	Section 2.7
	SFS project-specific warranty	Section 2.5e iii)
	irius® colourheads	Section 5.2b
	SDK halter fixings	Section 1.3a & 6.8
	Clamping fasteners	Section 3.3, 4.3, 6.9
	Technical & design support	Section 6 & 7

Section 8 Case studies

8.5 Matalan, Kirkby

Specialist contractor;	Longworth	
Designer;	Fletcher-Rae	
Project requirements;	Durability	**Section 2.5b**
	System suppliers warranty	**Section 2.5e**
	Aesthetics	**Section 5**
	Weather & airsealing	**Section 3 & 4**
	Technical performance	**Section 6**
SFS intec products;	Austenitic stainless steel	**Section 2.7**
	irius® colourheads	**Section 5.2b**
	Clamping fasteners	**Section 3.3, 4.3, 6.9**
	Weather & air sealants Type A+	**Section 3.4 & 4.3**

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