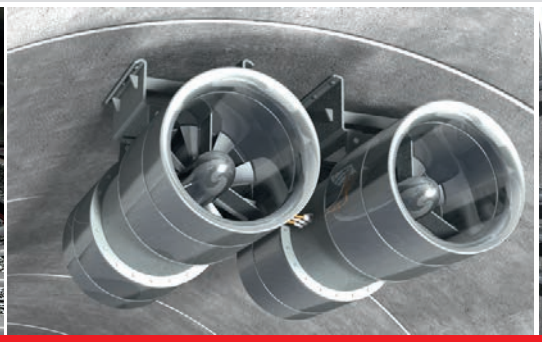


fischer
Fixing solutions in tunnels









fischer

innovative solutions



A brand and its promise to perform

fischer
innovative solutions

Customers who choose fischer get more than just a range of secure fixing products. Our goal is to ensure that we always offer our customers the best solutions with real added value.



In addition to innovative and outstanding products, this primarily includes user-oriented advice and benefit-oriented services. fischer is a leading brand in which engineering experts throughout the world place their trust.

Global presence

With more than 40 national subsidiaries and more than 100 importers, fischer has a global network with a strong presence. The advantages for you as a project customer are clear. There'll always be a competent technical or sales partner in your vicinity and a high level of product availability is also guaranteed.



Customer advice

Our technical support service provides cost-effective, legally compliant advice for all questions relating to fastening systems. Services that you can access include test installations, pull-out tests, individual designs, comparative calculations, and the development of special solutions. Around the world, more than 130 engineers support you with their concentrated fastening expertise. We're happy to give you advice – at our fischer Academy, at your office or at the construction site itself.

Products

We offer you a wide range of fastening solutions from the fields of chemical resins, steel and plastics. We cover a very broad application spectrum with our standard products as well as project-based solutions and customer-specific special developments. All of these are based on our know-how and experience gleaned during more than 60 years in anchoring technology. You can depend on it.



Services for tunnel construction.

Research & development



We have our own research and development teams for chemical resins, steel and plastics. This allows our own research results, market trends and customer requirements to be quickly embraced and converted into market-ready products. In addition to the capability and quality of our products, safe and fast installation is also vital. This pays off by saving you time, money and labour.

Production

With research and development, tool-making, special machine construction and production facilities for chemistry, steel and plastics, the entire production process of our products takes place in-house. Our quality management system is certified in accordance with DIN EN ISO 9001.



Through the fischer Process System (fPS), we continuously optimise our processes and adapt flexibly to customer requirements. In this way, we ensure that you can rely on innovative products with a constantly high level of quality.

Design software



Our new modular design software suite is called „Fixperience". It offers safe and reliable design along with top processing comfort.

The relevant design standards (ETAG 001 and EC2), national application documents and extensive choice of all conventional load and measurement units make the software suitable for international use. A free „live update" is available at all times at: www.fischer.de/fixperience

Certifications

We don't compromise on the safety of our products. We take part in the leading international, standard-setting councils in the fastening technology sector, thus contributing our knowledge to their work. Many of our products are characterised by thorough, up-to-date, international approvals, technical certifications and expert reports. For you, this means safety that you can rely on.

The environment

We actively consider the aspect of sustainable construction. Our environmental management system is certified in accordance with DIN EN ISO 14001. A growing number of our products have an Environmental Product Declaration (EPD) from the Bauen und Umwelt e.V. (IBU) institute, which constitutes the data basis for an ecological building evaluation. And our greenline product range is already based on more than 50% sustainable raw materials – certified in accordance with DIN CERTCO/TÜV Rheinland.

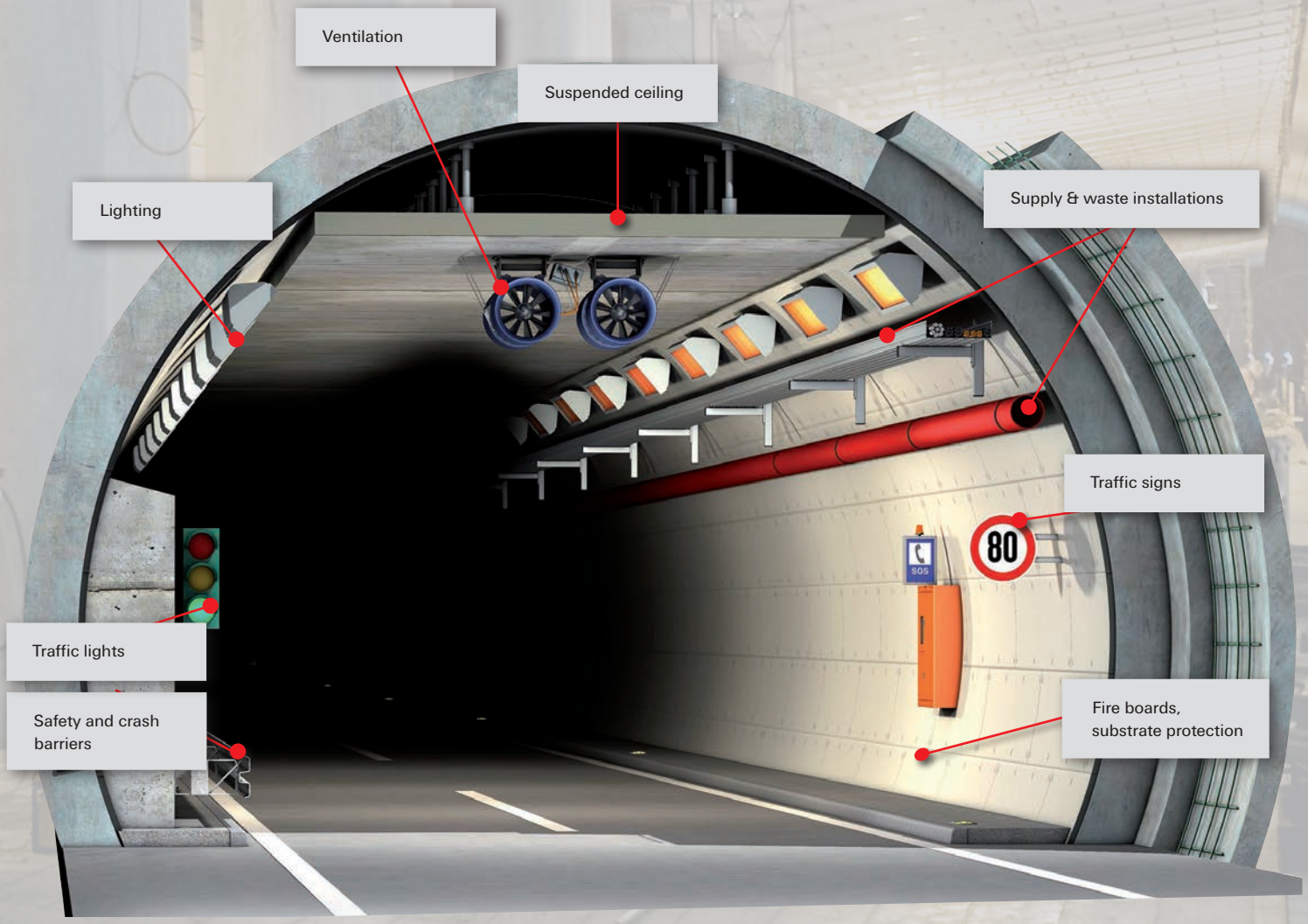
Solutions for rail and road tunnels.

Special requirements for fixings in tunnels:

- Long maintenance-free design life
- Preventing structural damage during fire
- Resisting fire
- Safety even in case of seismic influences

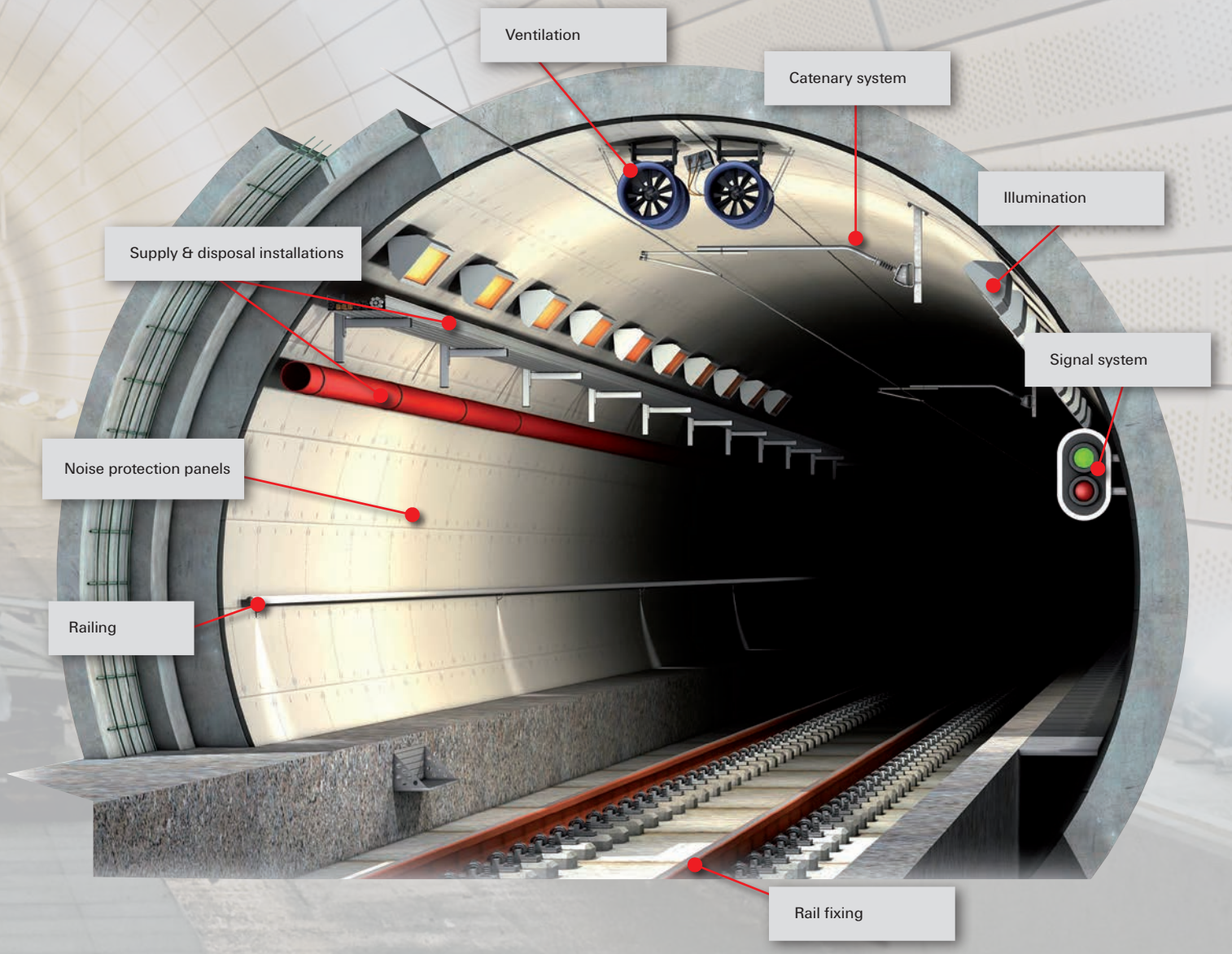
fischer offers:

- Long-life products and systems made of materials such as stainless steel and of high-corrosion steel
- Products which are able to resist fire/ seismic/ dynamic or shock loads



Content

	Page		Page
Fire protection	6	Ventilation / smoke extraction	12
Electrical installations / illumination	8	Structural design and steel works	13
Power supply – Catenary system and 3rd rail	9	Other equipment and installations	14
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Fire protection.



Sprayed Coating





FNA II



Standard nail head with or without washer - t_{fix} 5 to max 20 mm



Washer – Standard size 7,5 x 30 x 1,5 mm in steel grade according to the FNA II



Spacer – standard sizes for mesh distance to the concrete of 13 mm or 18 mm as standard

ULTRACUT FBS II 6



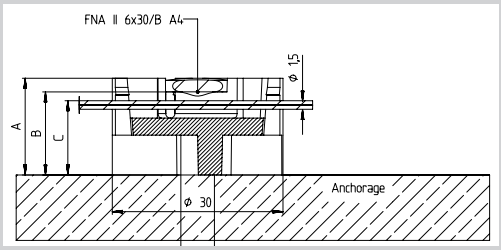
Application:

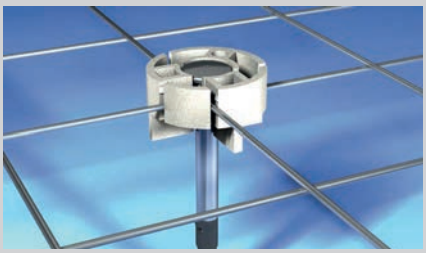
Fixing of bent or flat reinforcement mesh for sprayed fire protection coating.

Round or rectangular washers according to system requirements for preformed mesh with FNA II or FBS 6.

FNA II with nail head in combination with the patented spacer for flat mesh (wire 1.5 mm). Spacing mesh to concrete surface 13 mm or 18 mm.

Special Products





Art.-No. Spacer	Art. Description	Wire ø [mm]	A [mm]	B [mm]	C [mm]	Coverage [mm]	air-placed concrete [mm]	FNA II
502724	**30x22/18**	1,5	22	20	18	> 17	> 35	6/20
504533	**30x17/13**	1,5	17	15	13	> 17	> 30	6/15
min height	**30x12/8**	1,5	12	10	8	> 17	> 15	6/10

Further dimensions on request.

Fire protection.



Board Systems





FNA II



FNAII M6



Standard nail head with or without washer – usable length up to 125 mm

FNA II RB



detachable nail head with washer – usable length up to 125 mm

Accessories





setting / setting tool

ULTRACUT FBS II 6



Application:

Fixing of board materials with or without backing strips with total fixture thickness of up to 120 mm.

Standard embedment depth of only 30mm (drill depth of 35 mm / red. 30 mm).

FNA II RB with nail head, detachable nail head, thread nut, or as an alternative the FBS 6.

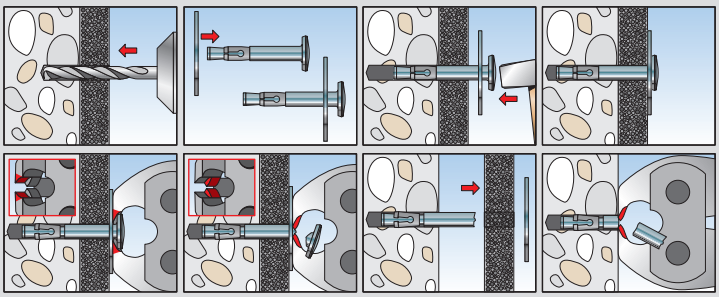
Concrete screw FBS 6 with up to 45 mm fixture thickness if the risk of unscrewing by vibration / alterneting deflection of the board is not given.

Other dimensions for all products on request.

Removable Board Version - FNA II RB

The latest version of the FNA II combines the advantages of the easy to install nail head version and a removable solution. Just cut the head, remove the board, cut the rest of the bolt close to the concrete surface, twist the board and fix it again.

NEW



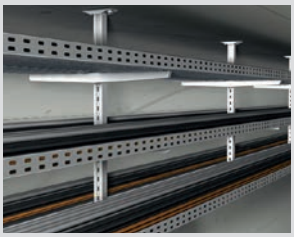


Electrical installations / illumination.



Electrification





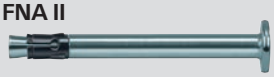
FAZ II



FBN II



FNA II



EA II



RG M





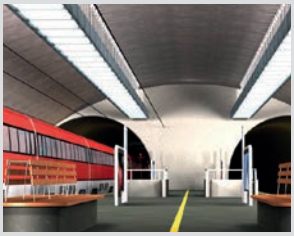
with RM or FIS V

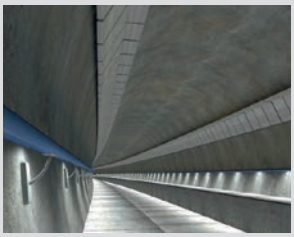
Application:

Ductwork for cables or heavy cable trays, using drop-in, through bolt anchors all load requirements can be covered.

Alternatively with bonded anchors, higher loads and smaller edge distances can be achieved.

Lighting





Ultracut FBS II



FH II



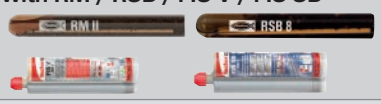
FZA / FZEA



RG M / RG M I



with RM / RSB / FIS V / FIS SB



FHB II



Application:

Emergency lighting or heavy suspended flood lights, whatever your requirements are, with fastest curing bonded anchors, undercut anchors or mechanical anchors fischer can offer the most efficient solution for your application.

Power supply – Catenary system and 3rd rail.



Overhead systems

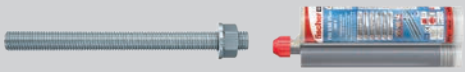




FHB II with FIS HB



FIS A with FIS EM Plus



RG M with RM II or RSB



FZA



Application:

Overhead conductor rail and standard catenary systems are often executed as stand-off installations with high load and safety standards.

With the fischer bonded anchor range highest loads can be transferred, even with limited drill depth due to layers of watertight membranes in the wall structure.

The undercut system of the FZA offers highest safety even in cracked concrete.

3rd rail systems





Ultracut FBS II



FH II



FZA / FZEA



RG M / RG M I
with RM / RSB / FIS V / FIS SB



FHB II



Application:

If fixed on the wall of a tunnel or in a station or outside on a slab track or sleeper, we can assist you to design the most economical fixing solution.

For threaded rods installed with our epoxy resin FIS EM Plus we can provide electric insulated solutions.

Rail fixing - track.



Metro rail

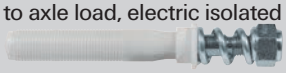




fischer rail anchor RA M22x220
axle load, electric isolated



fischer rail anchor RA M22x270
to axle load, electric isolated



fischer rail anchor RA M22x310
to axle load, electric isolated



Three componant mortar

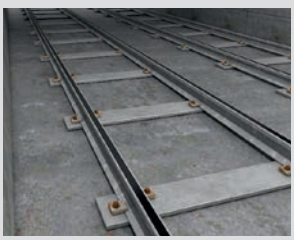


Application:

Light rails for tramways fixed on a slab track are a typical application of the fischer rail anchor RA M 22x270. The three component mortar, based on epoxy resin is guaranteed not to shrink, and supports under the high loaded rail base plates.

Light rail systems & temporary systems





FIS A



FIS EM Plus



Ultracut FBS II – for temporary installations during construction



Application:

In longer tunnels commonly used rail systems for material transports creates challenging boundary conditions for the fixing: high safety, fast installation easy to removal. The fischer FBS covers all these demands.

Safety.



Quelle: Hugentobler Spezialleuchten AG

Safety & emergency systems





FBN II



EA II



RG M / RSB / SB / FIS V / FIS EM Plus



FAZ II



SXR / SXRL



Application:

For fixing of emergency exit doors, signs, emergency illumination, video surveillance systems, sensors, detectors, speakers and much more, depending on load, required fire resistance and product lifecycle, fischer offers a wide range of solutions covering different local standards.

Passenger control & restraint systems





FAZ II



FHB II



Ultracut FBS II



RG M / RSB / SB / FIS V / FIS EM Plus



Application:

Often underestimated but important for operational safety, fixings in stainless steel quality can offer long-term maintenance free utilization of screen doors, automatic barriers or even simple fences.

Ventilation / smoke extraction.



Ventilation & smoke extraction





FHB dynamic with FIS HB



FZA



RG M with RM, RSB



FIS A with FIS V, FIS EM Plus or FIS SB



FAZ II



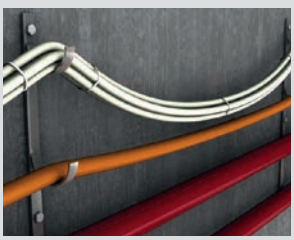
Application:

Ceiling or wall mounted fans are, due to their dimensions and proximity to the passing heavy goods vehicle traffic, usually exposed to dynamic loads. For such cases the FHB dynamic is the right choice.

Fire traps, smaller fans, and fans not exposed to dynamic loads can be also fixed with standard bonded anchors or undercut anchors.

Temporary supply

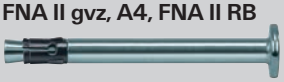




Ultracut FBS II



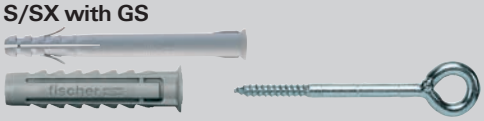
FNA II gvz, A4, FNA II RB



EA II



S/SX with GS



Application:

Temporary air ducts, cables and pipes for ventilation, illumination, water supply and evacuation can be fixed with zinc-plated fixings according to their load requirements.

Long tunnels with high coverage may also necessitate a special cooling system.

Structural design and steel works.



Structural applications





FIS EM Plus



FIS V



FIS SB - Superbond



FZA



Customised shear bolts



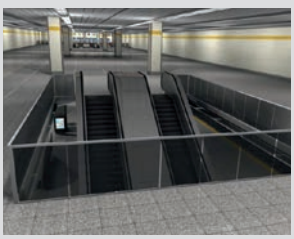
Application:

If high loads according to anchor or rebar theory have to be resisted, with FIS EM Plus, FIS V or the new FIS SB, requirements according to ETA or ICC can be fulfilled.

Heavy suspended ceilings, wall protections, curbs or separation walls – with bonded or undercut systems in different steel grades and with fire approvals, advanced solutions are available.

Walkway and guard rails





FAZ II



FH II



FZA / FZEA



FHB II



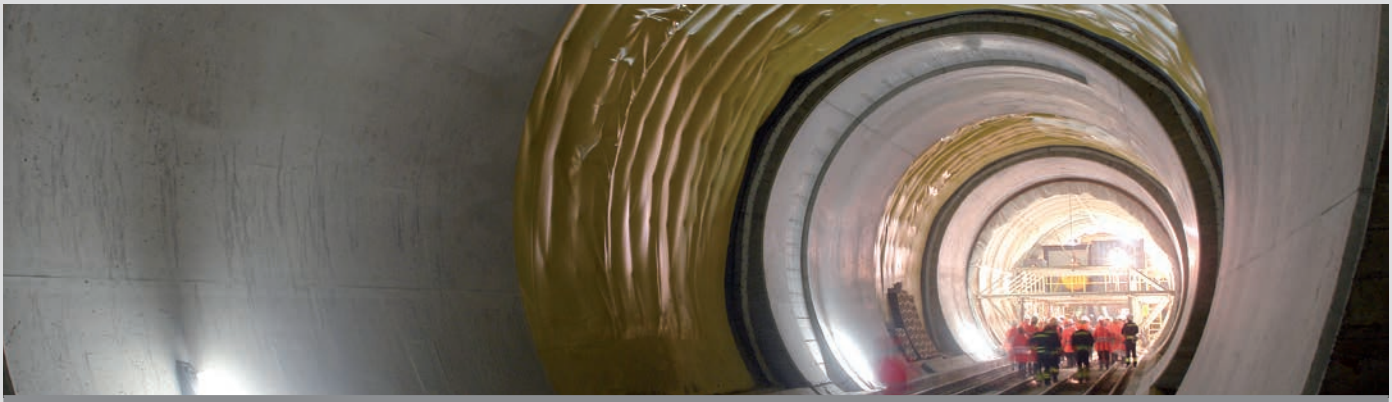
RG M with RM or FIS V



Application:

Emergency or maintenance walkways, combined with staircases and ladders, whenever steel structures have to be fixed to concrete, bolt or undercut anchors are standard. But also bonded anchors are used for extreme loads or requirements for sealed, water tight drill-holes.

Other equipment and installations.



Light suspended ceilings and noise absorbers





FBS 6



FNA II



EA II



SXR / SXRL



Application:

Special requirements given by board and stone materials of soundproofing systems which are installed on walls or used as suspended ceiling, can be covered with approved and tested fixing solutions.

Wall cladding

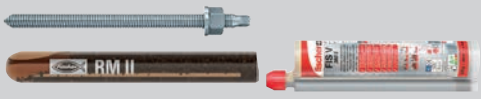




FAZ II



RG M



FBN II



SXR / SXRL

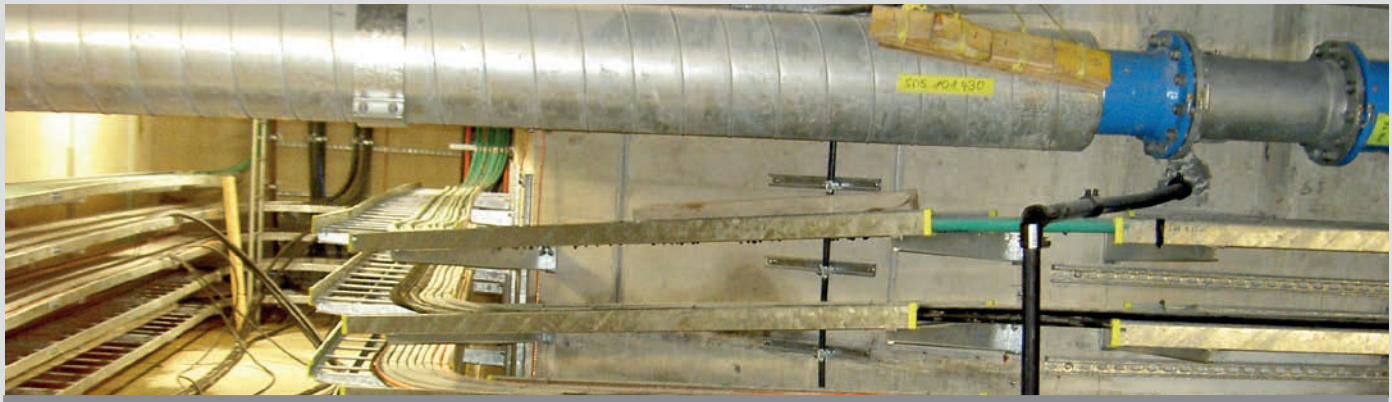


Application:

Whatever material is used for cladding the walls in stations, we have the adequate fixing solution for the cladding itself and substructure if required.

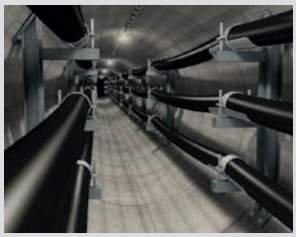
With the fischer ACT system fischer offers a service and maintenance friendly solution for claddings with natural and artificial stone, HPL, ceramic and glass.

Supply and service tunnels.



Cables and Pipes





FBN II



FAZ II



EA II



FZA



RG M + Patrone



Application:

River underpass, historic city centres or runways and taxi ways at the airport, supply and service tunnels usually have special requests regarding fire proofing and fire resistance of related fixings.

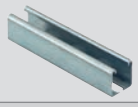
With our fire rated steel, chemical and even nylon fixing range we offer solutions for all different types of fire tests, up to Hydrocarbon and RWS fire curves.

Installation system SaMontec





FUS channel



Pipe clamp



Angle bracket UWS



FCAM massive console



Application:

In service tunnels the pipes and cables will be guided by pipeclamps and cable trays which are installed on channel systems. These channel systems are suitable for customized solutions and individual installations by a wide range of different products.

Depending on the conditions the products are available in all kind of materials and coatings for the prevailing environments (fire, corrosion).

Product specifications and accessories.

Product overview	connection thread M	material			method of operation			type of installation			relevant approvals for use in tunnels								dy-namic
		galvanized steel	stainless steel e.g. A4	high corrosion resitant steel e.g. 1.4529	interlocking	adhesive	expansive	push-through installation	pre - positioned	internal thread	CE	Z-Zulassung	ESR-2948	Shock approval by the Federal Office for Civil Defense, Bonn.	RWS	Fire resistance classification R 120	ZTV		dynamic
Zykon anchor FZA	6-16	✔	✔	✔	✔				✔	✔	✔			✔		✔		✔	
Zykon hammerset anchro FZEA II	8-12	✔	✔	✔	✔				✔	✔	✔			✔		✔			
Bolt anchor FAZ II	8-24	✔	✔	✔			✔	✔			✔		✔	✔		✔	✔	✔	
High performance anchor FH II	6-24	✔	✔				✔	✔		✔	✔		✔	✔		✔		✔	
Bolt anchor FBN II	6-20	✔	✔				✔	✔			✔					✔			
Nail anchor FNA II	6-8	✔	✔	✔			✔	✔			✔				✔	✔	✔		
Highbond anchor FHB II	10-24	✔	✔	✔		✔	✔	✔	✔		✔					✔	✔		
Dynamic highbond anchor FHB dyn	12-24	✔		✔		✔	✔	✔	✔			✔		✔		✔			✔
FIS EM Plus + FIS A	8-30	✔	✔	✔		✔		✔	✔	✔	✔		✔			✔		✔	
Superbond - System FSB	8-30	✔	✔	✔		✔		✔	✔	✔	✔		✔			✔		✔	
Ultracut FBS II	8-14	✔	✔		✔			✔			✔					✔			

Helpful accessories




Clips




Electric isolated fixing points

Clips for overhead installation

Clip	Anchor rod	Drilling diameter [mm]	Length of anchor rod [mm]	Material
8-12	**M8-M12**	12-14	up to 1000	PBT
16	**M16**	18	up to 1000	PBT
20-24	**M20, M22,M24**	24-28	up to 1000	PBT
27	**M27**	30	up to 1000	spring steel
30	**M30**	35	up to 1000	spring steel

Accessories for electric isolated fixing points

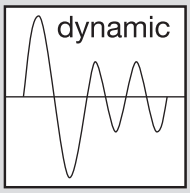
Article	Anchor rod	Drilling diameter [mm]	Pacing [pz]	Art.-No
ACD M 8	**M8**	14	500	071359
ACD M 10	**M10**	16	500	071360
ACD M 12	**M12**	18	500	557240
ACD M 16	**M16**	22	500	571093
ACD M 20	**M20**	25	500	071094
ACD M 24	**M24**	30	500	557241
ACD M 27	**M27**	32	200	571095
ACD M 30	**M30**	35	200	071096
ACD M 33	**M33**	40	100	071097

Basic knowledge.

Cracked concrete



When anchoring in concrete, it is almost presumed that cracks are present in the anchoring area that influences the bearing capacity of the fixings. It is difficult to define all temporary and permanent load cases and to determine if the concrete is cracked or non-cracked. For safety reasons, the use of fixings suitable for cracked concrete is generally recommended for engineers, designers and specifiers. Fixings with an approval according to ETAG 001 for cracked concrete have proved their suitability in cracks and may be used without any restriction in the tensile and compressive zones of concrete members. Fixings suitable for cracked concrete are also checked and approved according to American standards. These "evaluation reports" are prepared according to ACI 318.



Dynamic/fatigue behaviour

The general building authority approved by the German Institute of Construction Engineering in Berlin (DIBt) and the European Technical Approvals (ETA) are generally exclusively for anchoring of static and predominantly static loads. However, in contrast to these current approvals, in practice a number of dynamic effects occur, e.g. increasing and alternating stresses in case of a lot applications in a road tunnel. The main focus in this case is on, e.g. jet vans, overhead sign structures, etc. The applications are influenced by heavy traffic generating compression and sucktion action on interior components.

The fischer Highbond anchor FHB dyn is approved for dynamic loads. The approval applies to anchoring of dynamic loads with unlimited numbers of load cycles, for tension and for shear loads. In addition, the FHB dyn is manufactured in anchor size M16 of high corrosion-resistant steel, material no.1.4529.

Tests have shown that this material - in contrast to the usual standard stainless steel types in the corrosion resistance class III, e.g. A4, steel grade AISI 316- is suitable not only for use in humid internal and external conditions, but also for dynamic loads.

Corrosion

Corrosion is a chemical reaction in which metal is decomposed. The lower quality of the metal ("electrochemical potential"), the material will be even more damaged. In this process it is either converted into flaking rust or worn away in places. These two types of corrosions can be differentiated here. The most frequent types of corrosion in fixings and anchors include:

Surface corrosion

In this case, the metal corrodes relatively uniformly over the entire surface or over a part of the surface. An example of this is the invisible rusting due to condensation of a screw in the transition area from anchor plate to hole. The result: The connection which appears completely intact from the outside fails abruptly.

Contact corrosion

If metals with different quality contact each other in a conductive medium, the less noble metal always corrodes (the anode). As a consequence, stainless steel is usually not endangered. What is decisive, are the surface ratios of the two types of metal: the greater the surface area of the higher quality metal in comparison to the lower quality materials is, the greater the corrosion becomes.

For example, if large stainless steel sheets are screwed with galvanised screws, the screws will be highly attacked within a very short time. In contrast, using stainless steel screws for galvanised sheets is not critical.

Stress corrosion cracking

In case of sustained tensile loads, also A4, grade 316 material can be attacked by stress corrosion cracking. In this process, a crack develops due to mechanical stresses and chemical processes (chromium depletion), which grows under sustainded tensile loads in aggressive conditions and thus prepares a path for progressive corrosion.

For example, it occurs with A4 steel in an atmosphere with chemical pollution like road tunnels containing carbon monoxides, deicing materials, etc. Generally stress corrosion cracking is not visible with fixings and usually leads to sudden failure of the anchoring and the construction.

Basic knowledge.

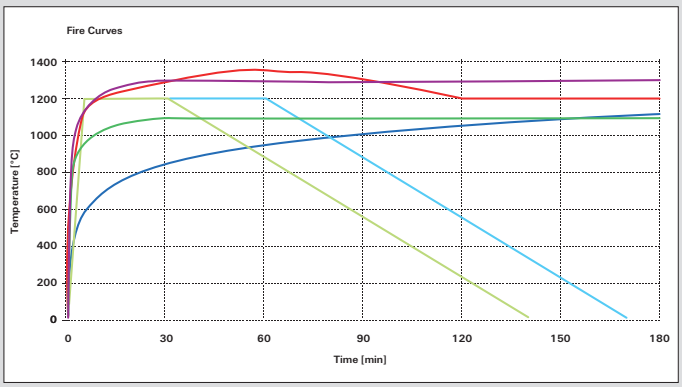


Fire resistance

Systems like cable trays, ventilation or utility systems are tested not only for fire resistance, but also for functional capabilities in the case of fire (e.g. supply lines to sprinkler systems, fire protection boards, etc.). The fire resistance duration of these systems is specified for the application in tunnels according special developed tunnel fire curves.
Actually there are different tunnel fire curves available and it depends to the country and the standard which is set in the tunnel project. The RAB/ZTV (Germany) tunnel fire curve increase to 1200°C within 5 minutes. Anchor approved for the RAB/ZTV curve are the FAZ II, FHB II and FHB dyn, M16 in material 1.4529.

With a higher temperature stress the Rijkswaterstaat (Netherlands) tunnel fire curve attacks the systems with their fixing elements. For this fire curve with a maximum temperature of 1350°C fire board and spray systems with FNA II are checked with a realistic proof. The last one popular tunnel fire curve is the Hydrocarbon curve. This curve is based on the assumption of a tunnel fire causing with combustible liquids, e.g. petrol, chemicals, etc. with 1100°C during a very long time. In some areas of a tunnel project which are not affected by the traffic itself other fire curves can be decisive.

For example in Germany the Standard Temperature Time fire curve (ETK), based on German standard DIN 4102 and ISO 834. For applications according the requirements to this kind of fire curves there are many fischer products available in the fischer range.



Temperature Curves:
- RWS, RijksWaterStaat, NL
- HCM, Modified HydroCarbon, Fr
- HC, HydroCarbonEurocode 1
- RABAT-ZTV (train), G
- RABAT-ZTV(car), G
- ISO-834, Cellulostic, Buildings



References.

Metro Milan



Challenge

The project ML5 has been developed according to the requirements of the Milan Metro. fischer was the only player capable of providing all required subsystems for the rail fastening solution. fischer has provided engineering and technical support both on and off site throughout the full project period.

Solution

fischer has provided technical products for more than 35,000 rails attachment plates, in particular Rail Anchor M22x270 - 75,000 pcs and 4,800 cartridges of FIS EM Plus 1500. All works have been executed on time and all testing was successful.

Hatfield tunnel UK



Challenge

Challenge on this project was to comply with stringent Highway Agency Design Manual BD 78/99 and Interim Advice Note 104/07. For the subcontractor, it was important that fischer offered a comprehensive package: advance and fully tested products backed up with a proactive technical support offering not only design consultancy but also site support with installation trainings and suitability site testing in accordance to BS5080 and vigorous IAN 104/07.

Solution

fischer was specified and used on all applications in this tunnel, fixing passive fire protection, M&E services, polyvision wall cladding and tunnel ventilation. FNA II 6x30/30 A4 nail anchor was specified because it was tested as part of the passive fire protection system and RWS fire tests were already available for FNA anchor in conjunction with the specified passive fire protection boards. For fixing jet fans FHB dyn M16x125/50C anchors were used because of its dynamic approval.

Gotthard Base tunnel



Challenge

Long-term safety and minimized maintenance requirements for decades, this was the main requirement of the project owner for the installation of the catenary system. At the same time the system supplier asked for an easy to install, economic solution with adjustable stand-off installation, high loads and limited drill-hole depth.

Solution

FIS A M16 to M30 made of high corrosion resistant steel (1.4529) together with FIS EM Plus was used for about 40,000 fixing points of the catenary system. A systematic quality control with hundreds of successful pull-out tests was established. The heavy installation of the complete catenary system was over- head. Therefore fischer developed and deli-vered installation clips in nylon and steel, to prevent the heavy anchor bolt slipping out by proper weight, during the curing time of the chemical mortar.

Mont Blanc tunnel



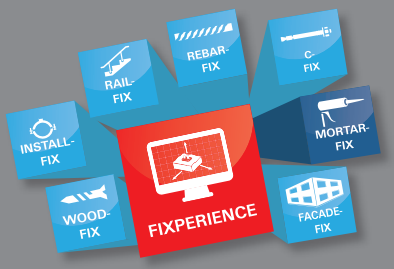
Challenge

After the disastrous fire in 1999 the single tube tunnel with only one lane in each direction was completely refurbished and modernised. In the 11.6 km long tunnel also the tunnel ventilation systems had to be updated. Of course this applies also for the fixings of the 76 tunnel fans. New technical specifications with dynamic loads, high resistance to corrosion and latest standards for fire resistance had to be fulfilled.

Solution

In spite of the defined standards and based on latest state of the art know how, fischer decided to propose an alternative technical solution with anchors for dynamic loads and high corrosion resistance, the FHB Dyn 16x125/110 C. With the French certifying body CETU the needs in case of fire have been approved.

fischer FIXPERIENCE
The design and information software suite



- The modular design program includes engineering software and application modules.
- The software is based on international design standards (ETAG 001, EC1, EC2, EC3 and EC5), including the national application documents. All common force and measurement units are available.
- Incorrect input will be recognized and the software gives tips to get a correct result. This ensures a safe and reliable design every time.
- The graphical display can easily be rotated through 360°, panned, tilted or zoomed as required.
- The 3D display gives a detailed and realistic image.
- The "live update" feature helps to keep the program up to date ensuring you are always working with the latest version.
- Free download and updates at www.fischer.de/fixperience-en

Our service to you



We are available to you at any time as a reliable partner to offer technical support and advice:

- Our products range from chemical resin systems to steel anchors through to nylon anchors.
- Competence and innovation through own research, development and production.
- Global presence and active sales service in over 100 countries.
- Qualified technical consulting for economical and compliant fastening solutions. Also on-site at the construction site if requested.
- Training sessions, some with accreditation, at your premises or at the fischer academy.
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