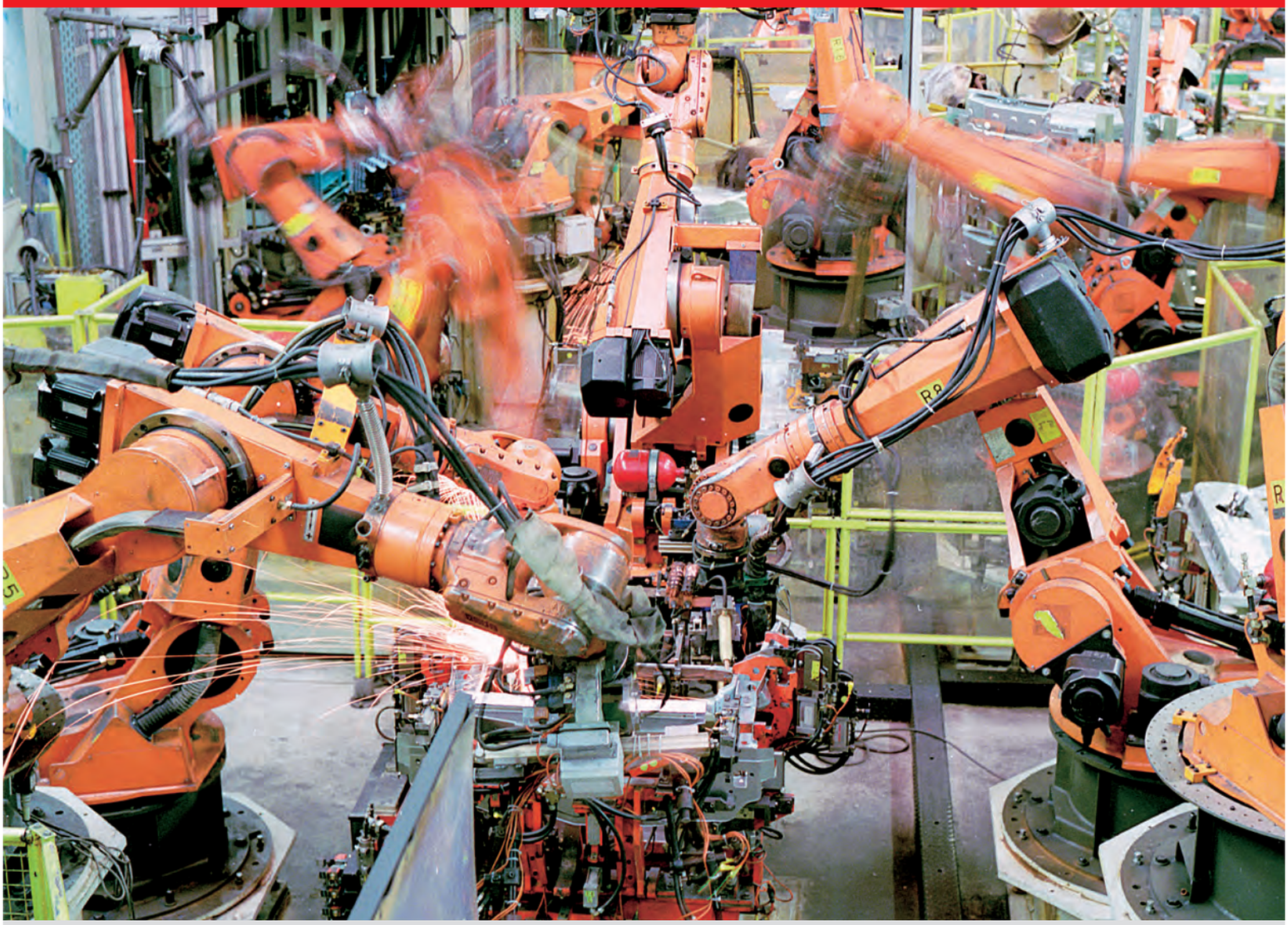


fischer
Fixing solutions for robotics









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 robotics.

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.

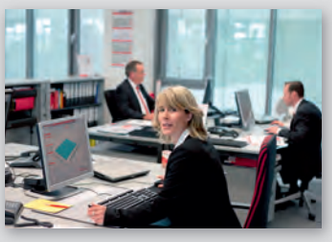
Production

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, such as EC1, EC3 and EC5), 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

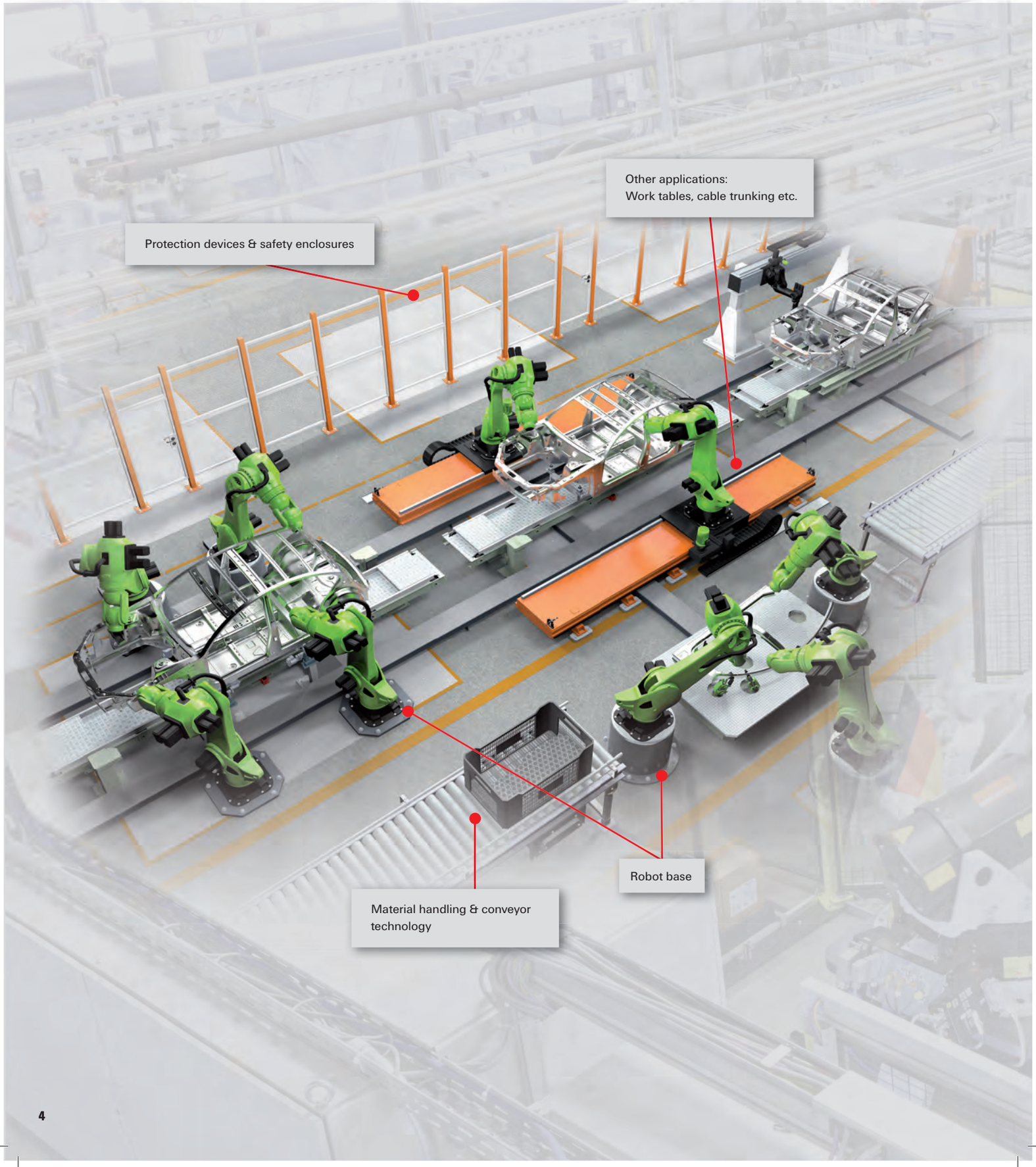
Certifications

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 robotics.



Page



Robot base 10

Fixings for base plates or guide rails for robots have to resist high dynamic loads. Also special requirements for installation, corrosion and shear resistance have to be considered. Due to the required flexibility these fixings are mainly made with post installed anchors.

Page



Protection devices & safety enclosures 12

Impact damage caused by forklift trucks, trolleys or other moving equipment can be avoided by appropriate safety measures like collision protectors for stand-alone robots, protection fences, cable trays or demarcation of pedestrian areas. Mesh guards for protecting employees from machinery, robotic cells or dangerous equipment.

Page



Material handling & conveyor technology 14

Conveyor systems are an economical and highly efficient way to move goods and allow material handling in a facility without the use of manual labour. Systems like gravity, belt or roller conveyers are available in different shapes and lengths and are capable of moving light or heavy duty goods over long distances, buffering between functions and changing vertical or horizontal directions.

Page



Other applications 15

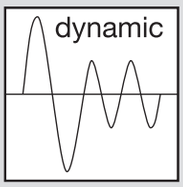
Work tables and cable trunking systems are applications which have to be very flexible in their positioning or change in use during their lifetime. Therefore variable fixings with different requirements such as installation time, removability, spacing or efficiency are required.

Basic knowledge.

Industrial robots are defined as „multi-functional manipulators designed to move materials, parts, tools or specialized devices through various programmed motions". As such, robots provide consistent reliable performance, repetitive accuracy and are able to handle heavy workloads and perform in harsh environments. Once they are programmed they repeat that exact same task 24h a day and for years with high accuracy.

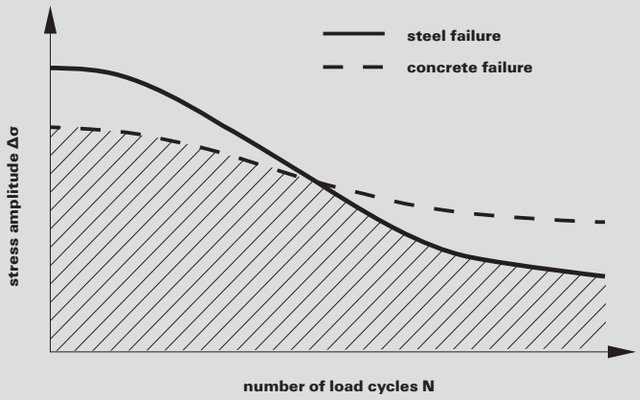
Movement configurations can range from simple arm extension and retraction movements to very complex movements involving body, upper arm, lower arm and wrist movement. Fast accelerations and decelerations of the robot parts cause dynamic forces which must be transferred into the base material to ensure a safe and reliable operation.

General construction approvals cover mainly anchoring systems for static or quasi-static loadings. Fixings used to resist fatigue loading should be prequalified for these types of applications - either by appropriate tests or by a technical approval. Currently, there are no ETA-Approvals or Assessments for dynamic fixings available. The German Institute of Construction Engineering in Berlin (DIBT) issues national German approvals for fastening systems subjected to fatigue loading.



Dynamic/fatigue behaviour

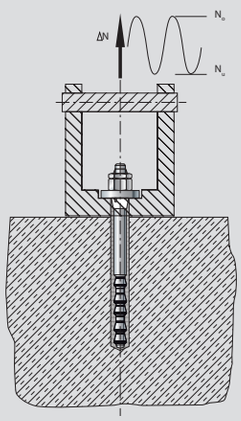
Fatigue occurs without obvious warning and can result in sudden fracture. Fatigue life is influenced by a variety of different factors such as materials (metallurgical structure), surface and/or geometry. Notches and variation in cross section throughout a part leads to stress concentrations where fatigue cracks initiate. In high-cycle fatigue situations, a materials performance is commonly characterized by an S-N curve, also known as a Wöhler curve. This is a graph of the magnitude of a cyclic stress (S) against the logarithmic scale of cycles to failure (N).

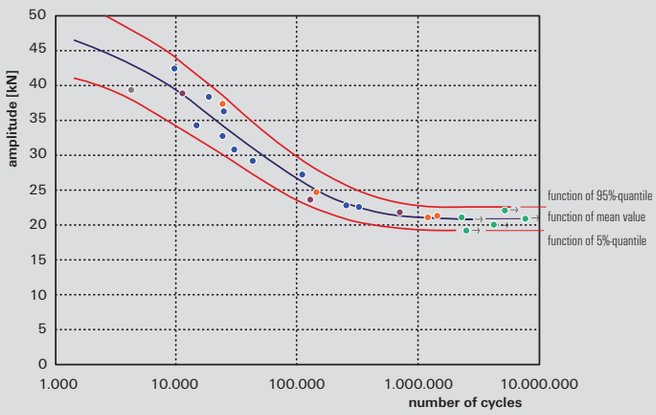


Behaviour of steel

Fatigue is a form of failure that occurs in materials subjected to fluctuating stresses. Under these circumstances it is possible for failure to occur at a stress level considerably lower than the tensile or yield strength for a static load. The fatigue resistance of steel is mainly influenced by the steel grade used, the geometrical shape (notch influence) and the formation of the thread. A rolled thread has a decisive influence on the fatigue endurance. The fatigue strength of a steel anchor is tested with different mean stresses until no failure occurs. This can be assumed to be after reaching more than 2 million load cycles.

Stainless steel grades (316 grades) do not have a pronounced fatigue endurance, which means failure can occur after 2 million load cycles. fischer stainless steel dynamic anchors are manufactured from high corrosion resistance steel grade (1.4529) with higher mechanical properties. The fatigue behavior of this steel type is far better than normal 316 grades and also approved in the respective national German approval for FHBdyn sizes M12 and M16.





Behaviour of concrete

Tests have shown that the fatigue resistance of concrete is reduced by the number of load cycles, but the reduction is significantly lower than steel. It can be assumed that the fatigue resistance is roughly 60% of the static resistance. The compressive strength of the concrete also influences the fatigue resistance - the higher the compressive strength, the higher the fatigue resistance. It is also assumed that this ratio is valid for other concrete failure modes (splitting, blow out, pry-out and concrete edge failure).

Design guide - fatigue

Non static action loads can be distinguished in harmonic, periodic, transient and impulsive actions. In case of harmonic or periodic actions the fatigue resistance is reduced after a certain amount of load cycles. In case of transient or impulsive action the fatigue resistance is not decreased – magnitude and cracks greatly influence the behavior.

Action	Run of the oscillation		Possible cause
harmonic	period T	sinusoidal	Unbalances, tumbling machines
periodic	period T_D	optional, periodical	Regularly abutting parts (e.g. punching machines), rail- and road traffic
transient		optional, nonperiodical	Earthquakes
impulsive		optional, with very short time of influence	Impact, explosion

Dynamic effects

In general fatigue verification should be required, when more than 10^3 load cycles for pulsating loads are expected and in case of alternating shear more than 10 load cycles.
It shall be shown that the value of fatigue action does not exceed the value of fatigue resistance:

$$\Delta E_d \leq \Delta R_d$$

- The design method for fatigue must be compatible to the actual standards for anchors with static actions, e. g. today to ETAG 001, Annex C - Design methods for anchorages or acc. CEN TS 1992-4.
- The fatigue resistances for steel-failure and concrete-failure must be known.
- ΔE_d is given by standards, measurements or experiences.
- Combined tensile and shear actions are acting – interaction!
- Single anchor and anchor groups are possible.
- Combined static and cyclic actions are possible.
- The verification should assume cracked concrete.

General type of verification of the ultimate limit state for steel failure – concrete failure – pull-out failure:

$$(\Delta N_{Ed} / \Delta N_{Rd})^{\alpha} + (\Delta V_{Ed} / \Delta V_{Rd})^{\alpha} \leq 1$$

The verification of the resistance under fatigue loadings consists of both:

- The verification under static loading (static proof)
- The verification under fatigue loading (fatigue proof)

Under static loading the fasteners should be designed according the common Concrete Capacity – Method (CC-Method), for example according ETAG 001, Annex C – Design method for anchorages or CEN/TS 1992-4.

Under fatigue loading the design should be carried out according to the recommendation of the national German building approval or the recommendation from fib or CEN/TS. For fischer FHB dyn anchor two design approaches are possible according the German national approval.

Basic knowledge.

Two design methods are possible

Method I: A "complete" method with the possibility to combine static and fatigue actions for varying number of cycles.

Method II: A simplified method with the assumptions that static and dynamic loads are fatigue actions and only for infinite number of cycles.

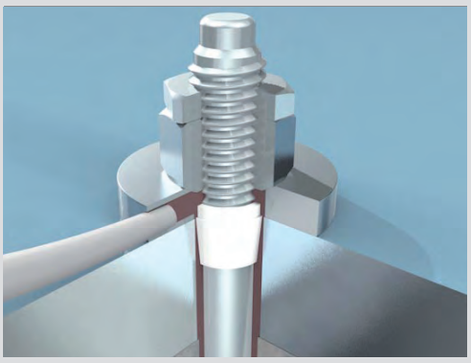
General design rules and considerations

Alternating axial loads on the anchor are not considered, because compression loads are transferred directly from the fixture to the base material.

Anchorages subjected to fatigue shear loading should be designed with no annular gap between the anchors and the baseplate to ensures an even load distribution. This can be achieved while installing the anchor in push through mode – the borehole will be filled with injection mortar and the anchor element will be installed through the drill hole of the baseplate. Once the conical washer rests with its full surface on the baseplate and mortar emerge, the annular gap is fully filled.
In pre-positioned mode - installing the anchor followed by placing the anchor plate - the annular gap can be filled by injecting resin mortar through the drill hole in the conical washer.

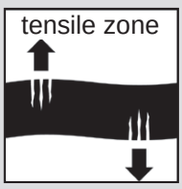
The conical washer also has the function of reducing bending moments on the anchor element. Together with the spherical washer, or alternatively a hexagonal nut with a spherical surface, the bending moments will be reduced if the anchor is installed not square to the substrate.

Loosening of the nut under fatigue loading may be prevented by using lock nuts (see picture) or counter nuts or other suitable means.



Shear loads with lever arm are not permitted because additional bending will be created which reduces the fatigue resistance of the anchor element. This is also the case, if leveling mortar is used below the baseplate. The max. thickness of leveling mortar without creating bending is ≤ d/2 (d = nominal diameter of the fastener) and the compressive strength of the leveling mortar should be ≥ 30N/mm².

The prestressing force has a positive impact on the fatigue resistance of the anchor system. The clamping force induced in the concrete decrease as result of leveling irregularities as well as cracks, creep and relaxation. It is recommended to retighten the anchors after the installation



Cracked concrete

When anchoring in concrete, it is often presumed that tensile cracks are present in the anchoring area that influences the bearing capacity of the fixings. However, it is very complicated, if not impossible, to prove whether the concrete is cracked or non-cracked. For safety reasons, the use of fixings suitable for cracked concrete is recommended. Fixings with an approval according to ETAG 001 for cracked concrete have proved their suitability in cracks and may be used without 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.

Loadbearing behaviour of anchors in steel fibre concrete (SFRC) Industrial floors

Steel Fibre Reinforced Concrete (SFRC) is a modern day composite material in which the concrete's relatively low tensile strength and ductility are counteracted by the inclusion of steel fiber reinforcement. This inclusion produces a material which exhibits the same load bearing capabilities to traditional reinforced concrete. The use of post installed anchors in SFRC has not been regulated at present, unlike traditional concrete where they follow the guidelines and codes as documented in the ETAG 001 or ACI 318-D for standard grades of concrete from C25 to C50.



Tests with resin systems, expansion anchors and concrete screws have been performed in SFRC with a steel content of 25 and 60 kg/m³ by independent institutes to investigate the load bearing capacity and failure mechanism. The series of tests did not show any significant differences between SFRC and normal weight concrete in the failure loads.

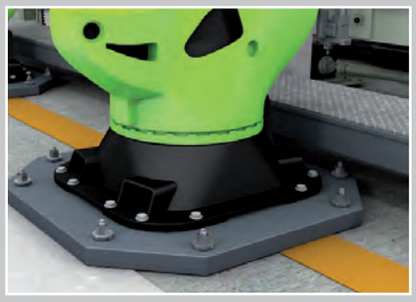
Thus, calculations for applications can be based on a comparable normal weight concrete in line with the stipulations of ETAG 001 Appendix C or TR 029. As there is, however, no building authority approval, it is necessary to get the permission of the authorities or an individual approval by a qualified engineer. The calculation should be carried out for the assumption of cracked concrete with suitable anchor systems. Possible shrinkage cracking is avoided by saw cutting joints into the surface of the slab. The joints should be considered as an edge in the design. Special attention should be paid to the load transfer of the forces applied by the anchor; therefore we recommend carrying out additional proof tests to verify the load bearing capacity of the used anchor system.



Robot base.

Robot pedestals & base plates





Robot guide rails





FHB-A dyn

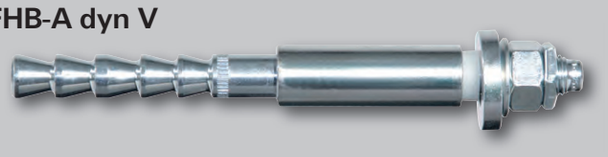








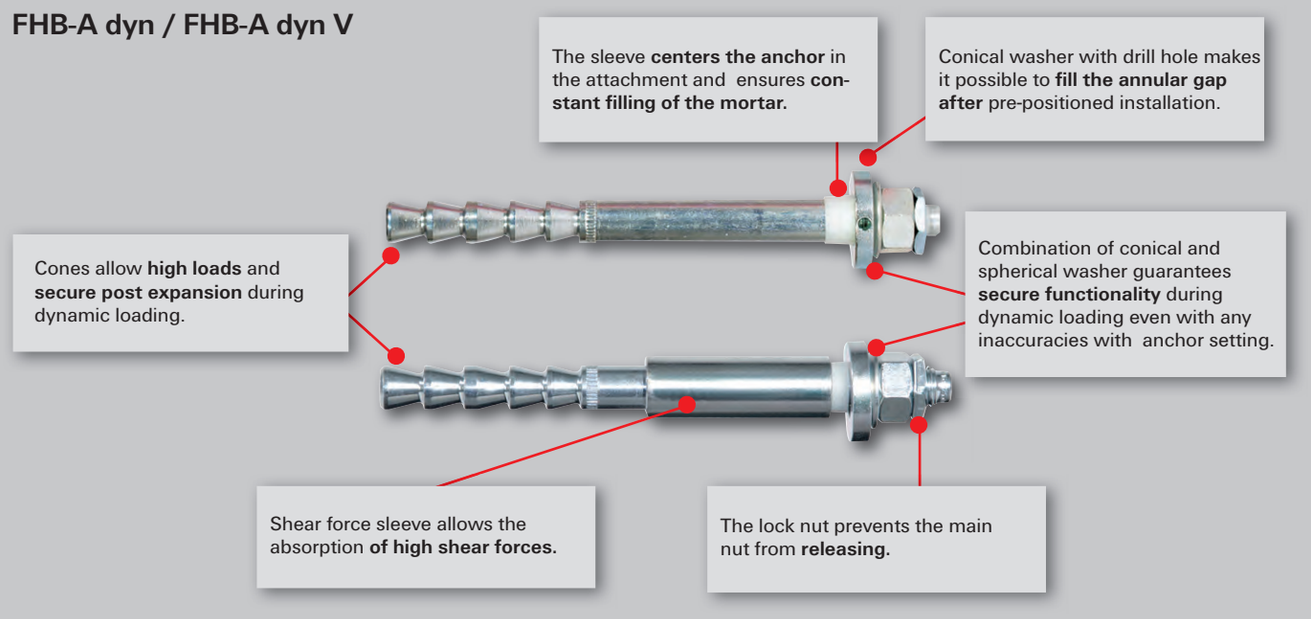
FHB-A dyn V



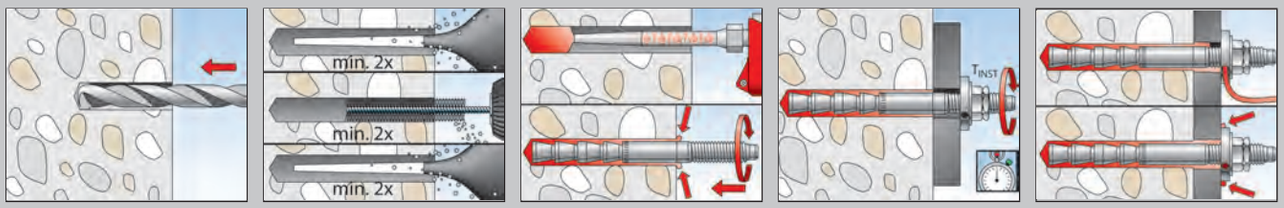


- During the setting process, the injection mortar FIS HB fills the annular gap in the fixture, and ensures optimum load distribution on all anchors. This allows for the absorption of dynamic alternating loads.
- The cone shape of the FHB-A dyn anchor rod ensures a controlled expansion under dynamic stress, thus allowing for use in cracked concrete.
- The anchor rod FHB-A dyn is also available made from highly corrosion-resistant steel. This makes it suitable for use in aggressive atmospheres, for example in tunnels.
- The Highbond anchor dynamic system can achieve even greater shear loads thanks to the additional sleeve of the anchor rod FHB-A dyn V, and therefore provides an increased level of safety.
- The only chemical dynamic system with simple push-through installation but also pre-positioned installation.
- Approved for unlimited load cycles.
- Due to the low expansion forces minimum spacing and edge distances are possible.
- Increased cost effectiveness, especially for series mounting.

FHB-A dyn / FHB-A dyn V



Pre-positioned installation FHB dyn



See for information about push-throught installation: www.fischer.de

The FHB-A dyn is the only chemical dynamic system which can be installed in simple push-through installation but also pre-positioned installation.

Pre-positioned installation

For the filling of the annular gap, which is essential for dynamic usage, we provide the conical washer with a drill hole. Through this hole it's possible to fill the gap with the standard resin mortar.

Push-through installation

The FHB-A dyn can be simply set in push-through installation without any further tools or actions like other bonded anchors.

Accessories for installation


Drills and bits for concrete and masonry


Blow out pump AGB


Cleaning brush BS for concrete


Dispenser DMS


Torque wrench

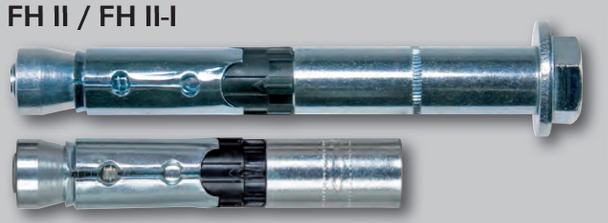
Protection devices & safety enclosures.







FH II / FH II-I



- The optimized geometry reduces the setting energy thus ensuring power-saving installation.
- The anchor design enables different head shapes for fixing points with a sophisticated design.

ETA-07/0025
ETAG 001-2
Option 1 for cracked concrete
seismic performance category C1

ESR-2691
See ICC-ES Evaluation Report at www.icc-es.org

Fire resistance classification R 120

- The international approvals guarantee maximum safety and the best performance. Applications in earthquake regions (Seismic) are also covered by these approvals.
- The detachable bolt connection allows for surface flush removal.

FBN II



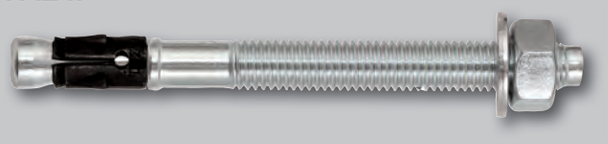
- The standard anchorage depth achieves the maximum load-bearing capacity in non-cracked concrete.
- The reduced anchorage depth reduces the drill hole depth. This minimizes the amount of time needed for drilling and enables less wear on the drill.

ETA-07/0211
ETAG 001-2
Option 7 for non-cracked concrete

Fire resistance classification R 120

- Great flexibility throughout the load range.
- Few hammer blows and the minimal torque slippage allow for a noticeably simpler installation.

FAZ II



- The tried-and-trusted expansion clip makes large load-bearing capacities possible, so fewer fixing points and smaller anchor plates are required.
- The reduced anchorage depths makes considerably shorter drill hole depths possible, so providing a noticeably faster installation.

ETA-05/0069
ETAG 001
Option 1 for cracked concrete
seismic performance category C1, C2

ESR-2948
See ICC-ES Evaluation Report at www.icc-es.org

Fire resistance classification R 120

- Fewer hammer blows and minimal torque slippage ensure safe and easy setting.
- The international approvals guarantee maximum safety and the best performance. Applications in earthquake regions (Seismic) are also covered by these approvals.

Superbond (Anchor rod FIS A /RG M/ RG MI)









- The Superbond system is a combined capsule and injection system for cracked and non-cracked concrete. The injection mortar FIS SB and resin capsule RSB perform the same. This gives the installer maximum flexibility.
- Approved for seismic applications (performance category C2 with FIS SB and C1 for capsule) as well as in waterfilled and diamond drilled holes (capsule only) ensures safety even in extreme conditions.
- Maximum application temperatures of up to +150°C and minimum temperatures of -30°C open up new areas of use for bonded anchors.

More from fischer - Drill bits





See for further information: www.fischer.de

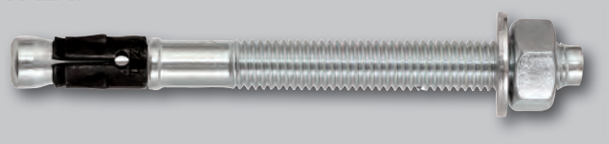
Material handling & conveyor technology.







FAZ II



ETA-05/0069
ETAG 001
Option 1 for cracked concrete
seismic performance category C1, C2

See ICC-ES Evaluation Report at www.icc-es.org
ESR-2948

Fire resistance classification R 120

- The tried-and-trusted expansion clip makes large load-bearing capacities possible, so fewer fixing points and smaller anchor plates are required.
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- Fewer hammer blows and minimal torque slippage ensure safe and easy setting.
- The international approvals guarantee maximum safety and the best performance. Applications in earthquake regions (Seismic) are also covered by these approvals.

FBN II

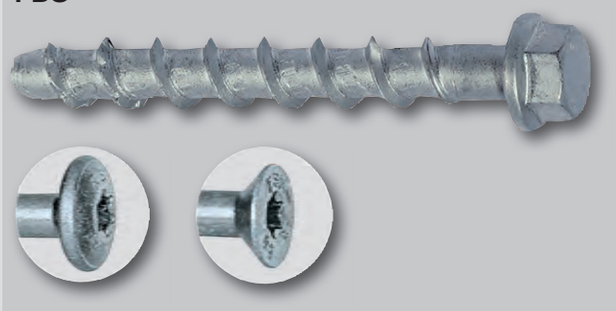


ETA-07/0211
ETAG 001-2
Option 7 for non-cracked concrete

Fire resistance classification R 120

- The standard anchorage depth achieves the maximum load-bearing capacity in non-cracked concrete.
- The reduced anchorage depth reduces the drill hole depth. This minimizes the amount of time needed for drilling and enables less wear on the drill.
- Great flexibility throughout the load range.
- Few hammer blows and the minimal torque slippage allow for a noticeably simpler installation.

FBS



ETA-11/0096
ETAG 001-3
Option 1 for cracked concrete

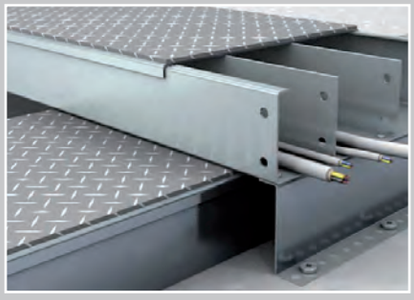
Fire resistance classification R 120

- The self-tapping concrete screw enables a complete dismantling and is ideal for temporary fixings.
- The expansion pressure-free anchoring ensures low edge distances and axial spacings.
- The FBS is installed in a single step, which saves time and money.
- The molded washer allows the usage also for fixtures with larger clearance holes.

Other applications.

Cable trunking systems





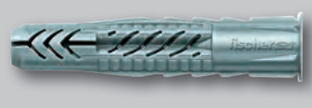
EA II



- The embossed rim prevents the anchor sleeve from slipping, thus ensuring a trouble-free hammerset installation.
- The metric internal thread means that it is possible to use standard screws or threaded rods for the ideal adaptation to suit the intended use.
- The EMS machine setting tool allows for effortless installation, particularly in the case of series installations.
- The embossing that is applied when expanding with the EHS Plus setting tool offers a simple control of the anchoring and provides increased safety.

SX / UX





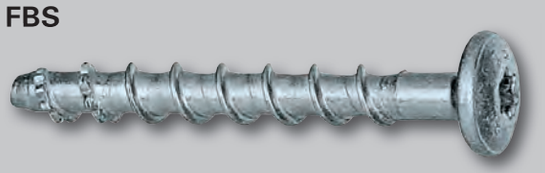
SX

- The 4-way expansion provides the optimum force distribution in the drill hole, and offers high load-bearing capacities in solid and hollow building materials.

UX

- The universal operating principle (knotting or expanding) allows for use in all solid, hollow and board building materials. Thus the UX is the correct choice for unknown base materials.

FBS



- The self-tapping concrete screw enables a complete dismantling and is ideal for temporary fixings.
- The expansion pressure-free anchoring ensures low edge distances and axial spacings.
- The FBS is installed in a single step, which saves time and money.
- The molded washer allows the usage also for fixtures with larger clearance holes.

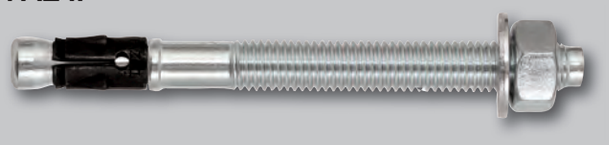
Other applications.

Work tables





FAZ II











- The tried-and-trusted expansion clip makes large load-bearing capacities possible, so fewer fixing points and smaller anchor plates are required.
- The reduced anchorage depths makes considerably shorter drill hole depths possible, so providing a noticeably faster installation.
- Fewer hammer blows and minimal torque slippage ensure safe and easy setting.
- The international approvals guarantee maximum safety and the best performance. Applications in earthquake regions (Seismic) are also covered by these approvals.

FBN II







- The standard anchorage depth achieves the maximum load-bearing capacity in non-cracked concrete.
- The reduced anchorage depth reduces the drill hole depth. This minimizes the amount of time needed for drilling and enables less wear on the drill.
- Great flexibility throughout the load range.
- Few hammer blows and the minimal torque slippage allow for a noticeably simpler installation.

FBS







- The self-tapping concrete screw enables a complete dismantling and is ideal for temporary fixings.
- The expansion pressure-free anchoring ensures low edge distances and axial spacings.
- The FBS is installed in a single step, which saves time and money.
- The molded washer allows the usage also for fixtures with larger clearance holes.

Superbond (Anchor rod FIS A /RG M/ RG MI)





- The Superbond system is a combined capsule and injection system for cracked and non-cracked concrete. The injection mortar FIS SB and resin capsule RSB perform the same. This gives the installer maximum flexibility.
- Approved for seismic applications (performance category C2 with FIS SB and C1 for capsule) as well as in waterfilled and diamond drilled holes (capsule only) ensures safety even in extreme conditions.
- Maximum application temperatures of up to +150°C and minimum temperatures of -30°C open up new areas of use for bonded anchors.

More from fischer - Installation systems





See for further information: www.fischer.de

Overview fischer fixing competence.

Chemical fixings
Resin systems, in the form of cartridge or capsule systems, for fixing of high loads. A secure hold in cracked and non-cracked concrete, natural stone, masonry and aircrete – including reinforcement.

General fixings
A wide range of different nylon and metal anchors with and without screws and hooks. For fastening, assembling and installing lightweight objects in very diverse building materials.

Electrical fixings
E-fix plugs, cable and nail clamps, pipe clips, cable clasps and multi-cable supports. Everything you need for quickly laying cables and conduits.



Frame fixings / Stand-off installation
Frame fixings and nail anchors with screws and different head shapes. For fastening substructures, façades, cable trays, gates, etc. Can be used in concrete, solid brick, perforated brick, natural stone, aircrete and much more.

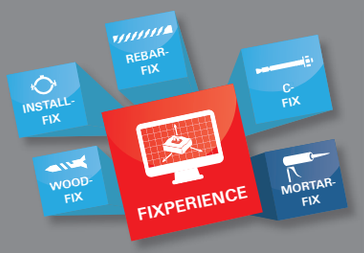


Foams and sealants
Gun foams and quick assembly foams for filling, insulating, sealing, gluing and fixing. Silicones, acrylic building materials and bitumen sealants for grouting, sealing and gluing in diverse applications inside and outside.

Installation systems
Basis for secure guidance and mounting of pipelines within HVAC business. A clever system of universal channels, cantilevers, connection- and construction elements, pipe clamps and accessories in different material qualities and versions for versatile applications.

High performance steel anchors
Cost-effective, easy-to-install anchor bolts for high loads, undercut anchors, sleeve anchors and hammerset anchors. For a wide range of applications in cracked and non-cracked concrete.

fischer FIXPERIENCE.
The new design and information software suite.



- The new modular design program includes engineering software and application modules.
- The software is based on international design standards (ETAG 001 and EC2, such as EC1, 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 3 D 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.
- Design and construction software for demanding applications.

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