



Installation Manual.

C-Fiber Force Strengthening System
with FRS-L-S NSM CFRP Laminates.





Safety Instructions

Please read the Safety Data Sheets (SDS) and Technical Data Sheets (TDS) before using the products! When working with chemical products, use suitable protective clothing, protective gloves and safety glasses. **IMPORTANT:** Please follow the application instructions, which are included in every package.

Distribution or Copying of this document, as well as exploitation and communication of its contents are prohibited unless otherwise permitted.

Noncompliance leads to a damage claim.

All rights are reserved in the case of patents, utility models or designs. These application instructions were created with care. However, fischerwerke GmbH & Co.KG does not take over any liability for any errors in these application instructions and their consequences. There is also no liability for direct or consequential damage taken from incorrect use of the products.

Performance of construction materials (Epoxy resins) vary with external conditions (e.g. project site conditions such as temperature or humidity).

The suitability of the strengthening kit must be checked and confirmed by the responsible planner. All product names and brand names used belong to the owner, even if not explicitly marked as such. The content is subject to changes.

Content

1. Introduction	4
2. System description	4
3. Products of the fischer C-Fiber Force Strengthening System	5
4. Certification and technical assessments	6
5. Storage conditions	6
6. Recommended equipment	7
7. Health and safety	8
8. Installation steps	10
9. Legal notes	20
10. References	21

1 Introduction

This installation manual describes the safe use of fischer FRS-L-S NSM Near Surface Mounted CFRP Laminates. This document must be used or referred to in conjunction with all relevant Technical Data Sheets (TDS), Safety Data Sheets (SDS) and project specifications. Structural strengthening works shall only be carried out by experienced and trained specialists. For professional product trainings and in case of any questions about our design software REINFORCE-FIX®, please consult the technical team of the national fischer subsidiaries. Note that inadequate choice on the strengthening or retrofitting method, incorrect structural design, inadequate installation might cause significant risks.

2 System description

2.1 Intended use

The primary intended use of the fischer C-Fiber Force Strengthening System with Near Surface Mounted (NSM) CFRP Laminates is the strengthening of reinforced or pre-stressed concrete structures. The fischer C-Fiber Force Strengthening System was developed for safety relevant applications. The design and application of FRS-L-S NSM CFRP Laminates on other base materials such as timber or masonry requires engineering judgement.

The manufacturer strongly recommends the use of the fischer C-Fiber Force Strengthening System as a whole. Combined applications with products from other manufacturers are out of the responsibility range of the fischer group.

2.2 References

This installation manual was written in accordance with the recommendations in ACI 440.2R (2017) and the DAfStb Guideline (Strengthening of concrete members with adhesively bonded reinforcement, Part 3: Execution, 2012)

2.3 Restrictions

This product shall only be used for its intended purpose. Further design details or design information are to be found in the structural design, technical drawings, specifications and risk assessments of the corresponding design engineer or specialist contractor.

3 fischer C-Fiber Force Strengthening System

The primary intended application scope of the fischer C-Fiber Force Strengthening System is to strengthen reinforced or pre-stressed concrete members. The FRS-L-S NSM CFRP Laminates are system components of the fischer C-Fiber Force Strengthening System.

Table 1: Constituents of the fischer C-Fiber Force Strengthening System with corresponding short product descriptions

Product name	Description
FRS-L-S & FRS-L-H FRS-L-S NSM	Pultruded, pre-cured carbon fiber reinforced polymer (CFRP) Laminates for the structural strengthening
FRS-CS	Thixotropic, 2-component epoxy mortar for the installation of CFRP Laminates and steel plates
FRS-W U300 FRS-W U600	Unidirectional Carbon Fiber Fabrics with 300 g/m ² or 600 g/m ² area density
FRS-FC	Unidirectional open end high-strength carbon fiber anchor for optimal end-anchorage of Carbon Fiber Fabrics
FRS-CF	Thixotropic, 2-component epoxy-based saturating resin for the application of FRS-W and FRS-FC
FRS-PC 11	Thixotropic, high-viscosity, low-shrinkage, 3-component epoxy-based concrete repair mortar for reprofiling, surface levelling and for increasing or restoring concrete cover
FRS-BA	2-component, epoxy-based, solvent-free high performance bonding agent for optimal adhesion between different concrete repair mortars and existing concrete as well as corrosion protection for embedded steel reinforcing bars
FRS-CP red FRS-CP grey	Low viscosity, 2-component, epoxy-based corrosion protection primer for exposed steel surfaces as well as embedded steel rebars in two colour versions, red and grey
FRS-SF	Highly UV resistant and water repellent, waterborne protective coating with high durability against environmental exposure for CFRP reinforcement in outdoor applications.
FRS-FP	Waterborne, intumescent coating for CFRP strengthening systems against fire and smoke development
FRS-CA	Universal cleaning agent for the FRS-L-S, FRS-L-H, FRS-L-S NSM CFRP Laminate and tools

4 Certification and technical assessments

The intended use of the fischer C-Fiber Force Strengthening System using Near Surface Mounted CFRP-Laminates is regulated by:

- European Technical Assessment (ETA-24/0281) according to the European Assessment Document (EAD) 160086-01-0301 "Kits for the strengthening of concrete elements by externally bonded and near Surface Mounted CFRP strips".

5 Storage conditions

The materials shall be stored in closed and undamaged original packaging in a dry environment at ambient temperature. Please note the minimum and maximum storage temperature and the shelf life in the corresponding product data sheets (TDS) and product labels.

The FRS-L-S NSM CFRP Laminates shall only be transported in the original packaging or with other adequate protection against mechanical and chemical damage.

6 Recommended equipment

6.1 Equipment, devices, tools and accessories

For the adequate installation of the fischer C-Fiber Force Strengthening System, it is recommended to have the following equipment on site for proper installation:

- Humidity meter
- Equipment for measuring the moisture content of components e.g. concrete moisture meter (CMM)
- Thermometer for air and surface temperatures
- Crack width ruler
- Concrete surface tester to determine the surface unevenness
- Concrete pull-off tester including steel disks with a diameter of 50 mm disc to determine the concrete tensile strength, adequate adhesive for installation
- Diamond core drilling machine and accessories (for concrete pull-off tests)
- Concrete scanner to determine concrete cover and / or position and/or diameter of rebars
- Concrete groove-cutting machine (e.g. diamond slitting machine) to create the slots for NSM Laminate installation
- Weighing scale with suitable weight range and precision
- Equipment for substrate preparation (by caulking, blasting, grinding and for cleaning work)
- Handheld agitator suitable for mixing the chemical products, with a rotation speed (≤ 300 rpm)
- Application equipment (Trowel, spatula, steel brushes, adhesive application device, cleaning cloth, etc.)
- Ruler and visible marker
- Wet film thickness gauge

6.2 Cleaning of tools and accessories

All tools and processing accessories must be cleaned immediately after use with FRS-CA Cleaning Agent or another suitable solvent. Cured materials can only be removed mechanically.

7

Health and safety

7.1 Risk assessment

All health and safety risks must be assessed and adequate countermeasures shall be defined. This includes the very condition of the structure and the resulting risks thereof, the processing of all materials used on site as well as working methods.

All work and working procedures must be carried out in full compliance with the relevant local safety and environmental regulations in force on site.

7.2 Personal safety

During the installation, safety shoes, safety gloves and other suitable skin protection must be always worn. It is strongly recommended to use adequate disposable safety equipment during the processing and application of the materials. Since epoxy adhesives or saturating resins can cause skin irritation, always wear protective gloves e.g. nitrile-based hand gloves when working with them. Unprotected skin must always be covered with protective cream before starting work.

Always wear suitable eye protection during processing, mixing and installation of the products. It is recommended to carry eye wash with you at all times. Always wash hands with suitable soap and clean water after processing the materials.

The work area must be well ventilated, and workers should take regular breaks in the fresh air, to avoid health problems. The developing dust and quartz sand during drilling, grinding or sandblasting the concrete can be hazardous. Avoid the inhalation of concrete dust or CFRP dust. To protect yourself and others, use e.g. vacuum cleaner or other adequate suction techniques. Always wear a dust mask or respirator when grinding concrete or cutting the CFRP Laminate. For detailed health and safety information, see the relevant Safety Data Sheets.

7.3 First aid

If the epoxy mortar-based chemicals come into contact with the eyes or mucous membranes, the contact lenses must be removed and the eyes must be rinsed immediately with clean, warm water for 10–15 min. and a medical doctor should be consulted

If chemicals come into contact with the skin, it must be cleaned immediately and carefully rinsed with clean warm water.

In case an accident happens, despite all the preventive measures, the corresponding SDS must be immediately handed over to the emergency services. This helps the emergency services to select the appropriate medical treatment(s). For detailed health and safety information, refer to the relevant Safety Data Sheet (SDS) of the individual products.



7.4 Waste disposal

Excess materials must not be poured down drains or into water supplies. Waste and packaging must be disposed by specialized waste management companies or partners in accordance with local legislation and official requirements. Furthermore, chemical materials must not be allowed to enter the soil, watercourses, drains or sewers. Chemical waste in uncured form or leaking adhesive must be disposed as hazardous waste.

Waste in the form of cured adhesive can be safely disposed of as normal construction waste in accordance with local legislation. For detailed environmental and safety information, refer to the relevant Safety Data Sheet (SDS).

8 Installation steps

8.1 Preparation works, substrate and environmental conditions

Requirements and preparation



Environmental conditions

- Verify the residual moisture content of the concrete using an adequate device (e.g. CCM).
- The residual moisture content of the concrete shall not exceed max. 4% by weight of concrete grade C30/37 and 3% by weight for concrete grade C35/45, measured with a CM device in accordance with ACI 503.4.
- The residual moisture content of the concrete shall not exceed max. 4% by weight according to the DAFStb Guidelines (Strengthening of concrete members with adhesively bonded reinforcement, Part 3: Execution).
- Verify the permitted temperature range of the member with a thermometer.
- Verify that the chemicals are stored at the permitted storage temperature.
- Underground temperature of the member to be strengthened should be higher than +10 °C and at least 3 K above dew point during and after application throughout the curing time.
- The maximum temperature should not exceed 40 °C and the relative humidity should be below 75 %. Check the humidity with an adequate humidity measurement device.

**Concrete substrate conditions**

Concrete patching / Concrete Reprofiling / crack injection / corrosion inhibition works on the substrate may be necessary prior to the application of the CFRP Laminate if:

- There are defects in the old concrete, such as concrete spalling and pebble nests.
- After the concrete surface preparation, there is unevenness or voids exceeding 2 mm which does not allow flush application of the NSM Laminates into the grooves. The unevenness of the concrete surface shall be verified by concrete surface tester.
- There is insufficient concrete cover. The thickness of the concrete cover of the inner reinforcement shall comply with the valid design rules but at minimum shall be 5 mm more than the groove depth. If this condition is not fulfilled the thickness of the concrete cover shall be elevated. This can be done by using the repair mortar, repair concrete or shotcrete.
- There are cracks of more than 0.01 inch (0.25 mm) and significant depth present². Crack sizes can be measured with a crack width ruler. Care should be taken to seal cracks that may cause infiltration of water.³
- When active corrosion of reinforcement rebars is present

If these conditions are not fulfilled, the thickness of the concrete cover shall be increased by adequate means, methods and materials. Further instructions on the adequate concrete patching can be found in e.g. DAFStb Guideline (Strengthening of concrete members with adhesively bonded reinforcement, Part 3: Execution, 2012); ACI 546R or ICRI 310.2R. Information on treatment of cracks can be found in ACI 224.1R. Information for corrosion inhibition can find in the norm DIN EN 1504-9 principles 7–11.

The concrete surface needs to be dry, oil, dust-free and free of any chemically separating substances.

¹ It's essential to have an intact substrate without damaged or deteriorating concrete prior to installation of FRS-L-S NSM CFRP Laminates. The FRS-L-S NSM CFRP Laminates require an unimpeded bond to the substrate.

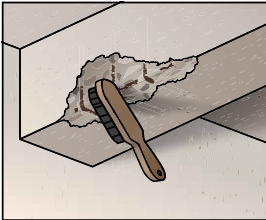
² Cracks > 0.254 mm (10 mils) are an indicator for movements in the structure that may affect the durability of the strengthening system. According to ACI 224.1R.

³ Permanent moisture may affect the durability of the strengthening system.

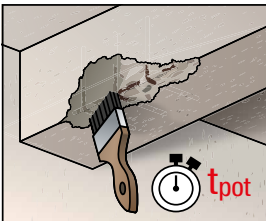
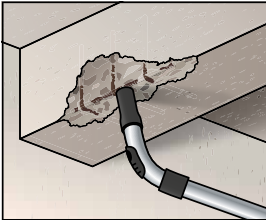
EN 8.2 Concrete repair (optional)

In most cases, concrete repair works on the damaged concrete surface are necessary prior to the CFRP Laminate installation. The concrete repair or concrete patching works shall be carried out by adequate means, methods, and materials, depending on the size of the damage and in accordance with the corresponding design standards. In the following, the concrete repair procedure is described using the components (FRS-PC 11 Epoxy Repair Mortar and FRS-BA Bonding Agent) of the C-Fiber Force Strengthening System.

Concrete repair works (optional)



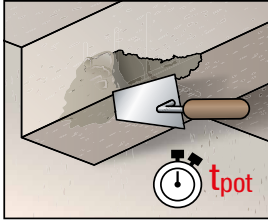
The damaged concrete fracture surface needs to be properly cleaned prior to the application of the concrete patching material or bonding agent. The concrete surface to be repaired or reprofiled must be dry, oil and dust free and the loose concrete parts must be removed. Tools such as steel brush, vacuum cleaner, compressed air might be used to clean the concrete surface.



Apply the fischer FRS-BA Bonding Agent as a thin film layer on the concrete fracture surface using e.g. a brush. For the recommended thickness to be applied and detailed processing information please consult the Technical Data Sheet (TDS) of fischer FRS-BA.

Material consumption: 0.5–0.8 kg/m² FRS-BA is recommended.

Note that the material consumption is dependent on the surface roughness. The thickness of the applied film layer should be, in possible, verified by a wet film thickness gauge.



Apply the fischer FRS-PC 11 Epoxy Repair Mortar wet-in-wet into the concrete cavity with a spatula or trowel, which was beforehand primed with the FRS-BA Bonding Agent. Concrete cavities of 4–30 mm depth can be repaired using the fischer FRS-PC 11 and maximum 500 mm in longitudinal direction of the CFRP strengthening.

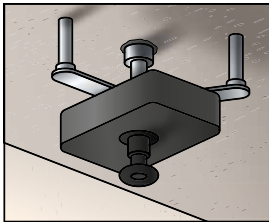
For the detailed processing information such as pot life, hardening times etc., please consult the Technical Data Sheet (TDS) of fischer FRS-PC 11.

The material consumption of concrete repair mortar (FRS-PC 11) is primarily dependent on the size of the concrete cavity and it needs to be estimated prior to the project.

Note that according to DAfStb Guideline “Strengthening of concrete members with bonded reinforcement” and in accordance with the EAD 17-16-0086-03.01, the concrete repair works can be made with one of the following materials:

- Recommended material listed in the Technical Approval of the manufacturer (fischer FRS-PC 11 Epoxy Repair Mortar and FRS-BA Bonding Agent)
- Concrete grout with strength resistance class M3 according to DAfStb Strengthening Guideline
- Concrete according to EN 206-1 in connection with DIN 1045-1
- Shotcrete according to DIN EN 14487-1 in connection with DIN 18551

under consideration of the exposure class. The national regulations must be followed. The choice of the concrete repair material is responsibility of the experienced structural engineer.

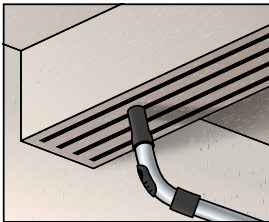
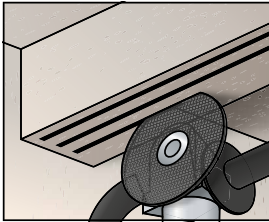


Additional quality instructions

According to the national regulations DAfStb “Strengthening of concrete members with bonded reinforcement” (2012) and according to our recommendation, if concrete repair works are executed prior to the actual CFRP strengthening, concrete pull-off tests must be executed on the repaired/reprofiled concrete surface before the application of the CFRP Laminate (see “Surface testing” below). The detailed procedure of the surface testing procedure is described in a separate manual.

8.3 Installation of the CFRP Laminate on concrete surface

Surface preparation



Grooves for insertion of the NSM CFRP Laminate have to be cut in the concrete using a concrete groove-cutting machine. The thickness of the clear concrete cover has to be 5 mm more than the groove depth. Care must be taken not to cut existing reinforcing steel. The required clear concrete cover of the reinforcing steel needs to be verified beforehand e.g. with a concrete-scanner.

If the structural design and execution are followed by DAFSTB Guideline in conjunction with the corresponding ETA Approval and, the groove dimensions should be within the following tolerance values:

Groove width: $\text{thickness (Laminate)} + 1 \text{ mm} \leq \text{width (slot)} \leq \text{thickness (Laminate)} + 3 \text{ mm}$

Groove depth: $\text{width (Laminate)} + 1 \text{ mm} \leq \text{groove depth} \leq \text{width (Laminate)} + 3 \text{ mm}$

CFRP Laminate NSM	Groove width*	Groove depth
FRS-L-S NSM 20x1.2	2.2–4.2 mm	21–24 mm
FRS-L-S NSM 15x1.4	2.4–4.4 mm	16–19 mm
FRS-L-S NSM 10x1.7	2.7–4.7 mm	11–14 mm

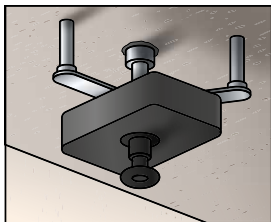
* If the FRS-CS 585 S is intended to be injected into the concrete groove using the FRS-GA injection adapter, the groove width should be greater or equal to 4 mm.

A minimum edge distance of 30 mm from the concrete edge should be kept.

If the design rules of ACI 440.2R are followed during the installation, the minimum groove width should be 3.0 times the thickness of the CFRP Laminate and the groove depth 1.5 times the width of the CFRP Laminate. The spacing between 2 adjacent grooves should be greater than 2 times the groove depth. The minimum edge distance of 4 times the groove depth shall be kept.

Dust and residual loose particles need to be removed from the groove prior to use by compressed air or a vacuum cleaner. The grooves need to be dry.

Surface testing



Prior to application of the CFRP Laminates, the suitability of the concrete surface must be verified through concrete pull-off tests. The concrete surface tensile strength is to be determined using concrete pull-off device. If concrete repair works were performed, the surface tensile strength is to be determined on the reprofiled concrete surface.

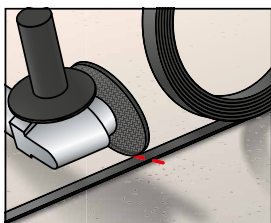
The concrete surface tensile strength must be measured by means of concrete pull-off adhesion testing device according to EN 1542 or according to ASTM C1583/C1583 M after surface preparation.

At least five tests in different locations have to be performed. The number and position of the pull-off tests is the responsibility of the design engineer.

The characteristic mean concrete surface tensile strength must be at least $\geq 1.0 \text{ N/mm}^2$ according to DAIStb Guideline (Strengthening of concrete members with adhesively bonded reinforcement, Part 3: Execution, 2012) or $\geq 1.4 \text{ N/mm}^2$ according to ACI 440.2R (2017). If higher values are used in the structural design, these values have to be verified by concrete pull-off tests.

In case the requirement on the minimum concrete surface tensile strength is not met, the decision on the adequacy of the strengthening method with CFRP Laminates is the responsibility of an experienced structural engineer. The detailed procedure of the surface testing procedure is described in a separate manual.

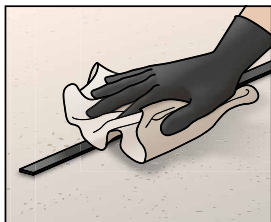
Laminate preparation



Be careful when loosening the packaging straps off the CFRP coil because the uncontrolled uncoiling can cause injuries. The coils are under tension when they are coiled. It is recommended to use a coiler for CFRP Laminates.

The fischer FRS-L-S NSM CFRP Laminates should be cut to the desired length e.g. using an angle grinder or hand saw. The longitudinal splitting of the CFRP Laminate must be avoided.

It is recommended to wear safety mask, safety glasses and safety gloves during cutting the CFRP Laminate.

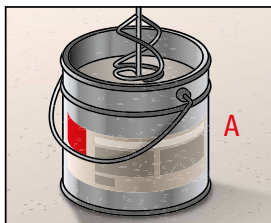


The surface of the fischer FRS-L-S NSM Laminate must be thoroughly cleaned using the fischer FRS-CA cleaning agent or acetone and a soft cloth.

The CFRP Laminate surface shall be completely dry, free of oil, dust and the entire length must be checked for visible damage prior the applications. Don't use damaged CFRP Laminates for example with visible cracks or spalling.

Measures shall be taken to keep the CFRP Laminate surface clean until the very applications.

Installation using the FRS-CS can system

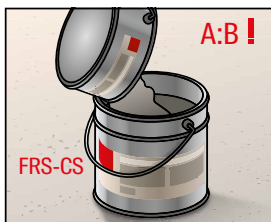


For the installation, either the FRS-CS (can system) or the FRS-CS 585 S injection system should be used.

The 2 components FRS-CS Epoxy Mortar (can system) must be prepared by following the processing steps given the Technical Data Sheet (TDS) of FRS-CS. Note the required mixing ratio, pot life, storage temperature and the proper mixing procedure.

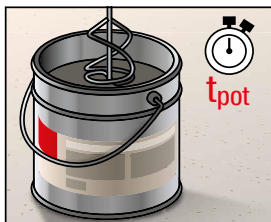
Special care should be taken of the work safety while working with fischer FRS-CS.

If phase separation is observed after opening the can components, the individual can components should be homogenized by stirring them separately, before mixing them. This is especially recommended when partial quantities are taken.



Add component B to component A and mix it (handheld agitator) for 3 min with 300 rpm without air bubbles until a homogeneous and uniform gray tone is achieved.

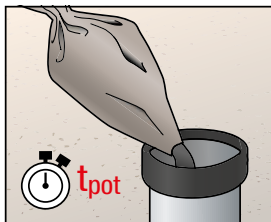
If partial quantities are taken, please pay attention on the correct mixing ratio by weight of component A and component B (4:1). Using weighing scale is recommended for adhere the mixing ratio.

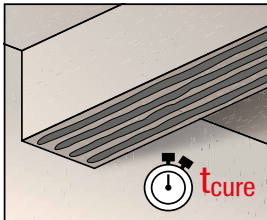
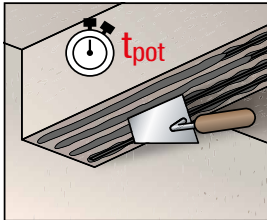
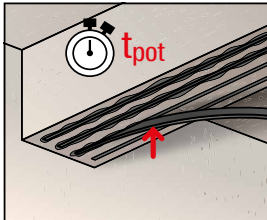
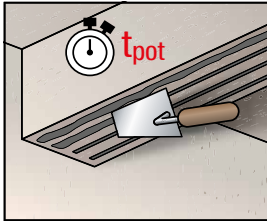
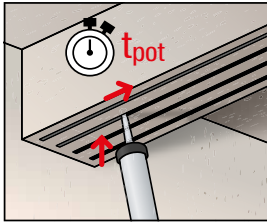


The intended use of FRS-CS is within the temperature range from 10 °C to 40 °C.

The pot life (working time) is 35–40 minutes at 23 °C. The pot life is strongly dependent on the environment temperature and on the material quantity. Precooled material and processing smaller quantities can help to prolong the pot life.

The FRS-CS ready-mix should be filled into a spray bag and pressed into an empty universal 1-component injection cartridge. Using a universal 1-component mortar dispenser. Check the compatibility of the cartridge and the dispenser.





Estimated material consumption of FRS-CS in the concrete grooves

Laminate Width	FRS-CS
10 mm	0.06–0.12 kg/m
15 mm	0.08–0.16 kg/m
20 mm	0.10–0.20 kg/m

The FRS-CS should be injected into the concrete grooves. The grooves are filled starting from the bottom of the groove until mortar excess FRS-CS is visible on the concrete surface. The groove has to be filled completely with FRS-CS without air inclusions.

Note that the actual required quantity is dependent on the concrete surface condition. After exceeding the pot life of FRS-CS, the material should not be used.

Excess FRS-CS can be removed with a trowel.

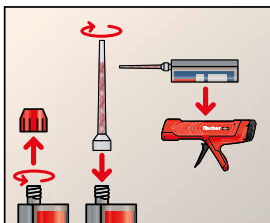
The FRS-L-S NSM CFRP Laminates shall be pressed into the slots upright until complete immersion. Insert only one laminate in one concrete groove.

The FRS-CS is able to hold the own weight of the laminate in overhead applications without additional temporary fixing solutions. Excess FRS-CS can be removed and the surface smoothed with a trowel.

The live loads on the structure are allowed after 48 h curing at 20 °C. Lower temperatures result in longer curing time. The applied the CFRP Laminate should be protected against mechanical and chemical damage, shock, vibration, movements, etc. during the hardening time. If additional protective coating is applied, the uncured adhesive should be sprinkled with sand to improve the adhesion and excess sand has to be removed after curing. Prior to application of further coating systems, the FRS-CS shall be fully cured.

The strength development of the different material parameters as a function of the hardening time is given in the Technical Data Sheet (TDS) of FRS-CS.

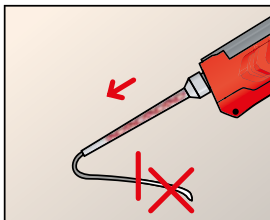
Installation using the FRS-CS 585 S injection system



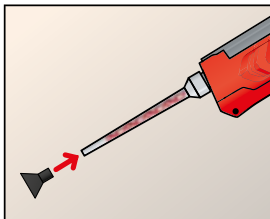
Remove the sealing cap of the FRS-CS 585 S.

Screw on the FIS UMR static mixer
(the spiral in the static mixer must be clearly visible).

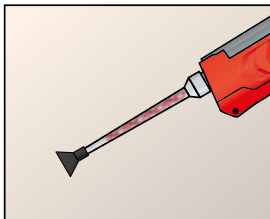
Place the FRS-CS 585 S cartridge into the FIS DM SL dispenser.

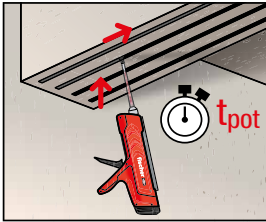


Extrude approximately 10 cm / 4 inch of material out until the resin is evenly grey colour. Do not use the injection mortar that is not uniformly grey.



Put the FRS GA Injection Adapter on the static mixer.





The FRS-CS 585 S should be injected into the concrete grooves.

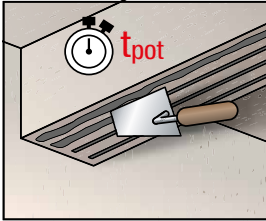
The grooves are filled starting from the bottom of the groove until mortar excess FRS-CS is visible on the concrete surface. The groove has to be filled completely with FRS-CS without air inclusions.

Estimated material consumption of FRS-CS in the concrete grooves

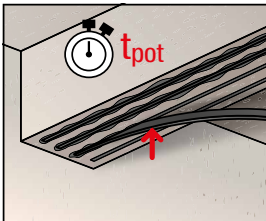
Laminate Width	FRS-CS
10 mm	0.06–0.12 kg/m
15 mm	0.08–0.16 kg/m
20 mm	0.10–0.20 kg/m

Note that the actual required quantity is dependent on the concrete surface condition. After exceeding the pot life of FRS-CS 585 S, the material should not be used.

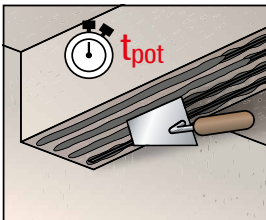
Excess FRS-CS 585 S can be removed with a trowel.



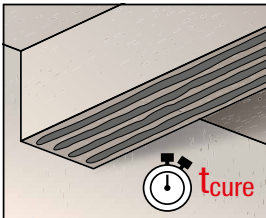
The FRS-L-S NSM CFRP Laminates shall be pressed into the grooves upright until complete immersion. Insert only one laminate in one concrete groove.



The FRS-CS 585 S is able to hold the own weight of the laminate in overhead applications without additional temporary fixing solutions. Excess FRS-CS 585 S can be removed and the surface smoothed with a trowel.



The live loads on the structure are allowed after 48 h curing at 20 °C. Lower temperatures result in longer curing time. The applied the CFRP Laminate should be protected against mechanical and chemical damage, shock, vibration, movements, etc. during the hardening time. If additional protective coating is applied, the uncured adhesive should be sprinkled with sand to improve the adhesion and excess sand has to be removed after curing. Prior to application of further coating systems, the FRS-CS 585 S shall be fully cured.



The strength development of the different material parameters as a function of the hardening time is given in the Technical Data Sheet (TDS) of FRS-CS / FRS-CS 585 S.



The complete embedment of the strips should be ensured by visual inspection.

The concept of the quality inspection plan of the strengthened structure is the duty of the responsible structural engineer, following the national and international regulations, such as AC 178, DafStb-Guideline [2].

8.4 Installation of the CFRP Laminate in masonry or wood

In addition to reinforced concrete, the fischer FRS-L-S NSM CFRP Laminates can also be applied in wood and masonry. Ensure that the masonry structure is suitable for the installation of the fischer FRS-L-S NSM CFRP Laminates. The system can be installed on moderately cracked surface, whereas crumbling bricks and poor substrate quality will compromise the quality and effectiveness of the strengthening system. The responsible specialist engineer must carry out the necessary inspection and calculations, eventually pull-off tests on site to verify the assumptions met during the structural design. Your national fischer subsidiary provides you with consultancy if required. For installation, remove dust completely with oil-free compressed air or vacuum and remove loose masonry parts after milling the slots. In timber members, the grooves needs to be thoroughly cleaned with oil-free compressed air.

9 Legal notes

The above information, in particular the suggestions for processing and use of our products, are based on our knowledge and experience under normal conditions, provided the products have been stored and used properly. Due to the different materials, substrates and deviating working conditions, a guarantee of a work result or liability, from whatever legal relationship, can neither be justified from these instructions nor from verbal advice, unless we are charged with intent or gross negligence in this respect. In this context, the user must prove that he has in writing all knowledge required for a proper and reasonable assessment by fischer, has been communicated to fischer thoroughly and on time. The user must test the products regarding their suitability for the intended use.

The product specifications are subject to change without notice. Third party property rights must be observed. In all other respects, our respective terms and conditions of sale and delivery apply. Always the latest product data sheet (TDS) applies, which should be requested from us.

10

References

[1] ACI 440.2R-17 “Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures”, ACI Committee 440, American Concrete Institute, Farmington Hills, United States of America, **2017**.

[2] DAfStb-Guideline “Strengthening of concrete members with adhesively bonded reinforcement”, W. Finckh, A. Ignatiadis, R. Niedermeier, U. Wiens, K. Zilch, Deutscher Ausschuss für Stahlbeton e. V. – DAfStb, Berlin, Germany, **2012**.

[3] European Technical Assessment (ETA-24/0281), Deutsches Institut für Bautechnik, Berlin, Germany, **2024**.

[4] EAD 160086-01-0301 “Kits for the strengthening of concrete elements by externally bonded and near surface mounted CFRP strips”, European Organization for Technical Assessments, Brussels, Belgium, **2024**.

DIN EN 1504-9 principles 7-11.

[5] ACI PRC-546-14 “Guide to Concrete Repair”, ACI Committee 546, American Concrete Institute, Farmington Hills, United States of America, **2014**.

[6] ICRI 310.2R-2013 “Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair”, International Concrete Repair Institute, Inc., Minnesota, United States of America **2013**.

[7] ACI 224.1R-07 “Causes, Evaluation, and Repair of Cracks in Concrete Structures”, ACI Committee 224, American Concrete Institute, Farmington Hills, United States of America, **2007**.

[8] EN 1504-9:2008 “Products and systems for the protection and repair of concrete structures – Definitions, requirements, quality control and evaluation of conformity – Part 9: General principles for the use of products and systems”, European Committee for Standardization, Brussels, Belgium, **2008**.

[9] EN 206:2013+A2:2021 „Concrete – Specification, performance, production and conformity“, European Committee for Standardization, Brussels, Belgium, **2013**.

[10] DIN 1045-1:2023-08 “Concrete Structures – Part 1: Planning and design”, Deutsches Institut für Normung e. V., Berlin, Germany, **2023**.

[11] EN 14487-1:2022 “Sprayed concrete - Part 1: Definitions, specifications and conformity, European Committee for Standardization”, Brussels, Belgium, **2022**.

[12] DIN 18551:2014-08 “Sprayed concrete - National application rules for series DIN EN 14487 and rules for design of sprayed concrete constructions”, Deutsches Institut für Normung e. V., Berlin, Germany, **2014**.



fischer stands for

Fixing Systems

fischertechnik

Consulting

Electronic Solutions

fischerwerke GmbH & Co.KG

Klaus-Fischer-Straße 1 · 72178 Waldachtal

Germany

P +49 7443 12-0

www.fischer-international.com · structuralretrofitting@fischer.de
