fischer

Post-installed rebar Installation instructions

Post-installed rebar connection with fischer injection mortars
FIS RC II, FIS RC II Low Speed, FIS EM Plus or FIS V Plus

Safety instructions

Before use, read and review the installation

instructions and the SDS (Safety Data Sheet).

Then working with injection mortar, wear suitable protective clothing, protective gloves and protective goggles!

Important:
For detailed information on installation, refer to instruction manual provided with the package of the product.

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1 Description of the system

1.1 Injection mortar FIS RC II, FIS RC II Low Speed, FIS EM Plus and FIS V Plus

The fischer FIS injection mortars are used for “post-installed” rebars as anchorages or lapped bars in the construction of reinforced concrete or for rebar anchors FRA as lapped bars only.

The post-installed rebar connections can be made with the injection mortars FIS RC II, FIS RC II Low Speed (ETA-22/0502), FIS EM Plus (ETA-17/1056) or FIS V Plus (ETA-20/0728) (Fig. 1).

Fig. 1: Injection mortar FIS RC II, FIS RC II Low Speed (360 ml | 825 ml), FIS EM Plus (390 ml | 585 ml | 1500 ml), FIS V Plus (360 ml | 825 ml)

1.2 FIS-Rebar case

The system includes the FIS-rebar case, containing the most important accessory components which are required for proper installation of the above mentioned connections (Fig. 2)

Fig. 2:
FIS-rebar case

1.3 Required tools and equipments

In addition to fischer injection mortar, FIS-rebar case and the reinforcement bars to be post-installed, the following tools and equipment are also required:

- Hammer drill, pneumatic drill or diamond drill.
- Battery-operated screw driver or drilling machine (for drill hole brushing).
- SDS plus or SDS max drill bit, hollow drill bit, pneumatic drill bit or diamond core bit according to the required drill hole geometry.
- Compressor for oil-free compressed air with p ≥ 6 bar (0.6 MPa).
- fischer professional dispenser (manual, battery-operated or pneumatic).
- Extension tube for static mixer, ø 9 mm or ø 15 mm.
- Additional static mixers.
- fischer scabbeling tool for roughing up the connecting joint.
- Suitable protective clothing, safety goggles and protective gloves in accordance with EN 374 (e.g. butyl rubber, fluorocarbon rubber, nitrile rubber - with FIS EM Plus penetration time > 120 min).
- Dust extraction system (when using hollow drills).

1.4 Drilling aid

In compliance with the Design Engineer a drilling aid (Fig. 3) must be used as a guide to create the drill hole, if e. g. the hole is to be drilled close to the edge of the concrete building component or exactly parallel to existing reinforcement.

The drilling position, drill hole diameter selection, drill depth and the decision about the use of a drilling aid shall be made by the Design Engineer and must be complied with. Discrepancies must be clarified with the Design Engineer before construction.

The individual steps in creating a post-installed rebar connection are described in detail in sections 2.1 to 2.11.

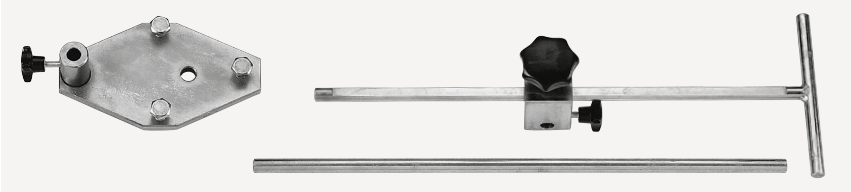

Fig. 3: Drilling aid

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2 Process for post-installed rebar connection

2.1 Marking the drilling position

- The person carrying out the work must ensure that if the anchorage is close to a free edge (Fig. 4) the minimum concrete cover $\mathbf{c_{min}}$ (Tab. 1) and minimum spacing $\mathbf{min\ a_s}$ (Eq. 1) of the reinforcement bars to be installed are observed.
- The minimum drilling distances $\mathbf{min\ s_o}$ (Eq. 2) are the result of $\mathbf{c_{min}}$ and may be calculated for the respective bar diameter $\mathbf{d_s}$ and drilling depths.
- For minimum spacing min $\mathbf{a_s}$ of the post-installed reinforcement bars the following equation applies:
  $\mathbf{min\ a_s \geq 5\ d_s\ (and \geq 50\ mm)}$ (Eq. 1)
- The following applies for minimal edge distance of the free edge:
  $\mathbf{min\ s_o = c + d_s/2}$ (Eq. 2)

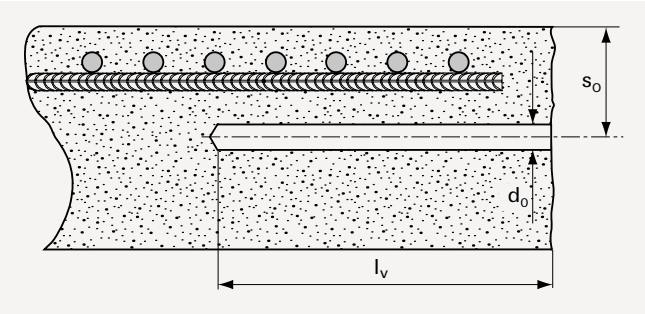


Fig. 4: Anchorage close to the edge of the building component

2.1.1 Minimum concrete cover c_{min} depending on setting depths l_v

Table 1.

Drilling method	Nominal diameter of the reinforcing bar d_s [mm]	Minimum concrete cover c_{min} [mm]	
		Without drilling aid	With drilling aid
Hammer drilling with standard drill, Hammer drilling with hollow drill, Diamond drilling	< 25	30 mm + 0.06 $l_v \geq 2\ d_s$	30 mm + 0.02 $l_v \geq 2\ d_s$
	≥ 25	40 mm + 0.06 $l_v \geq 2\ d_s$	40 mm + 0.02 $l_v \geq 2\ d_s$
Compressed air drilling	< 25	50 mm + 0.08 l_v	50 mm + 0.02 l_v
	≥ 25	60 mm + 0.08 $l_v \geq 2\ d_s$	60 mm + 0.02 $l_v \geq 2\ d_s$

For fischer rebar anchor FRA, $l_{e,ges}$ instead of l_v

2.1.2 Minimum edge distance min s_o for selected setting depths l_v

Table 2.

		Setting depth l_v [mm]																							
		80	100	120	140	160	200	250	280	300	320	400	500	600	700	800	900	1000	1200	1400	1600	1800	2000
Rebar-ø d_s [mm]	Drilling method	Minimum edge distance of the bore min s_o [mm]																					
8	Hammer drilling without drilling aid	39	40	41	42	44	46	49	51	52	53	58	64	70	76	82	88	94	106	118	130	142	
	Compressed air drilling without drilling aid	60	62	64	65	67	70	74	76	78	80	86	94	102	110	118	126	134	150	166	182	198	
	Hammer drilling with drilling aid	36	36	36	37	37	38	39	40	40	40	42	44	46	48	50	52	54	58	62	66	70	
	Compressed air drilling with drilling aid	56	56	56	57	57	58	59	60	60	60	62	64	66	68	70	72	74	78	82	86	90	
10	Hammer drilling without drilling aid		41	42	43	45	47	50	52	53	54	59	65	71	77	83	89	95	107	119	131	143	
	Compressed air drilling without drilling aid		63	65	66	68	71	75	77	79	81	87	95	103	111	119	127	135	151	167	183	199	
	Hammer drilling with drilling aid		37	37	38	38	39	40	41	41	41	43	45	47	49	51	53	55	59	63	67	71	
	Compressed air drilling with drilling aid		57	57	58	58	59	60	61	61	61	63	65	67	69	71	73	75	79	83	87	91	
12	Hammer drilling without drilling aid			43	44	46	48	51	53	54	55	60	66	72	78	84	90	96	108	120	132	144	
	Compressed air drilling without drilling aid			66	67	69	72	76	78	80	82	88	96	104	112	120	128	136	152	168	184	200	
	Hammer drilling with drilling aid			38	39	39	40	41	42	42	42	44	46	48	50	52	54	56	60	64	68	72	
	Compressed air drilling with drilling aid			58	59	59	60	61	62	62	62	64	66	68	70	72	74	76	80	84	88	92	
14	Hammer drilling without drilling aid				45	47	49	52	54	55	56	61	67	73	79	85	91	97	109	121	133	145	
	Compressed air drilling without drilling aid				68	70	73	77	79	81	83	89	97	105	113	121	129	137	153	169	185	201	
	Hammer drilling with drilling aid				40	40	41	42	43	43	43	45	47	49	51	53	55	57	61	65	69	73	
	Compressed air drilling with drilling aid				60	60	61	62	63	63	63	65	67	69	71	73	75	77	81	85	89	93	
16	Hammer drilling without drilling aid					48	50	53	55	56	57	62	68	74	80	86	92	98	110	122	134	146	
	Compressed air drilling without drilling aid					71	74	78	80	82	84	90	98	106	114	122	130	138	154	170	186	202	
	Hammer drilling with drilling aid					40	41	42	43	43	43	45	47	49	51	53	55	57	61	65	69	73	
	Compressed air drilling with drilling aid					61	62	63	64	64	64	66	68	70	72	74	76	78	82	86	90	94	
20	Hammer drilling without drilling aid						52	55	57	58	59	64	70	76	82	88	94	100	112	124	136	148	
	Compressed air drilling without drilling aid						76	80	82	84	86	92	100	108	116	124	132	140	156	172	188	204	
	Hammer drilling with drilling aid						50	50	50	50	50	50	50	52	54	56	58	60	64	68	72	76	
	Compressed air drilling with drilling aid						64	65	66	66	66	68	70	72	74	76	78	80	84	88	92	96	
25	Hammer drilling without drilling aid							68	69	71	72	77	83	89	95	101	107	113	125	137	149	161	173
	Compressed air drilling without drilling aid							93	95	97	98	105	113	121	129	137	145	153	169	185	201	217	233
	Hammer drilling with drilling aid							63	63	63	63	63	63	65	67	69	71	73	77	81	85	89	93
	Compressed air drilling with drilling aid							78	78	79	79	81	83	85	87	89	91	93	97	101	105	109	113
28	Hammer drilling without drilling aid								71	72	73	78	84	90	96	102	108	114	126	138	150	162	174
	Compressed air drilling without drilling aid								96	98	100	106	114	122	130	138	146	154	170	186	202	218	234
	Hammer drilling with drilling aid								70	70	70	70	70	70	70	70	72	74	78	82	86	90	94
	Compressed air drilling with drilling aid								80	80	80	82	84	86	88	90	92	94	98	102	106	110	114
32	Hammer drilling without drilling aid										75	80	86	92	98	104	110	116	128	140	152	164	176
	Compressed air drilling without drilling aid										102	108	116	124	132	140	148	156	172	188	204	220	236
	Hammer drilling with drilling aid										80	80	80	80	80	80	80	80	80	84	88	92	96
	Compressed air drilling with drilling aid										82	84	86	88	90	92	94	96	100	104	108	112	116
40	Hammer drilling without drilling aid											84	90	96	102	108	114	120	132	144	156	168	180
	Compressed air drilling without drilling aid											112	120	128	136	144	152	160	176	192	208	224	240
	Hammer drilling with drilling aid											100	100	100	100	100	100	100	100	100	100	100	100
	Compressed air drilling with drilling aid											88	90	92	94	96	98	100	104	108	112	116	120

For fischer rebar anchor FRA, $l_{e,ges}$ instead of l_v

2.2 Fixing the drilling aid

- For lapped joints always ensure that drilling is parallel to the existing reinforcement and thus parallel to a reference surface.
- When using a drilling aid it must first be fixed with an anchor.
- Afterwards the base plate must be aligned in such a way that the reference bar is parallel to the concrete surface.
- Finally, the swivelling guide bar must be aligned in such a way that it is in close proximity to the drill hole marking and can thus be used as a visual aid for parallel drilling.

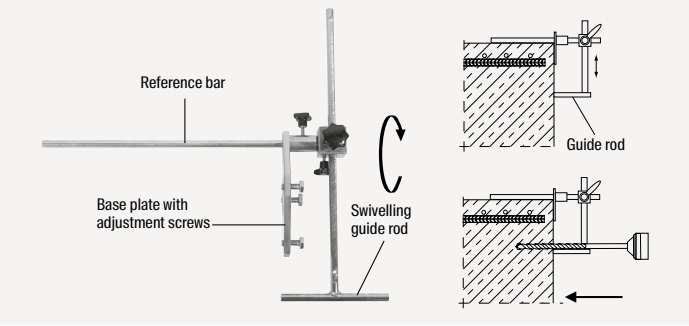
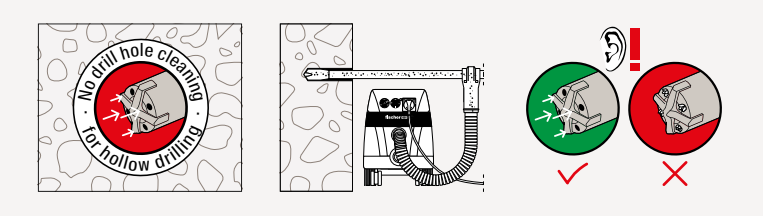


Fig. 5: Drilling aid (Base plate, Reference bar, Guide bar)

2.3 Drilling a hole

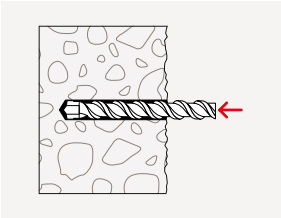
2.3.1 Hollow drilling

Hammer drilling with ETA-regulated hollow drill (e.g. fischer FHD) and extraction using a suitable dust extraction system. The dust extraction system must be set to maximum power and must extract the drilling dust constantly during the entire drilling process. The correct function of the dust extraction system must be checked before, during and after each drilling operation. A further cleaning of the drill hole is not necessary for drilled holes with hollow drills. For drill holes with a setting depth $\mathbf{l_v > 25\ cm}$, pre-drill to a depth of at least 15 cm using a short drill bit is recommeneded. After completion of the pre-drilling, the concrete surface should be roughened up according to the specifications of the planning engineer (see chapter 2.4). The maximum setting depth $\mathbf{l_{v,max}}$, $\mathbf{l_{e,ges,max}}$ (max. drill hole depth) can be found in Tab. 3 - 5.



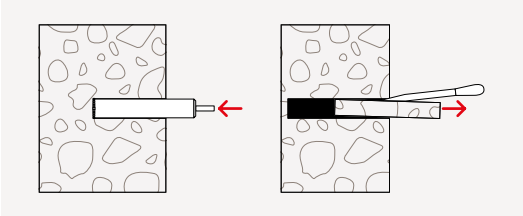
2.3.2 Hammer drilling or pneumatic drilling

For drill holes with a setting depth l_v **> 25 cm**, 15 cm must first be pre-drilled with a short drill bit.
It is recommended after pre-drilling to rough up the concrete surface in line with the specifications of the planning engineers (see section 2.4).
The maximum setting depth $l_{v,max}/l_{e,ges,max}$ (maximum drill hole depth) can be taken from Tab. 3 - 5.



2.3.3 Diamond drilling

The diamond drilling method may only be used when using the injection mortar FIS EM Plus.
The maximum setting depth $l_{v,max}/l_{e,ges,max}$ (max. drill hole depth) can be found in Tab. 3 - 5.
After drilling, the drilled concrete core must be broken and removed. For diamond drilled holes a special cleaning procedure must be followed. (see chapter 2.5.2).



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2.3.4 Maximum setting depth with cartridges and dispenser assignment for post-installed rebar connection

Table 3.

Injection mortar FIS RC II / FIS RC II Low Speed			**360 ml**		**825 ml**
Dispenser			Hand	Battery & Pneumatic	Battery & Pneumatic
Rebar-ø	Drill hole-ø	Drill-cutting-ø	Maximum setting depth		
d_s [mm]	**d_0 [mm]**	**d_{cut} [mm]**	**$l_{v,max}/l_{e,ges,max}$ [mm]**		
8	10 / 12 [1]	≤ 10.5 / ≤ 12.5	1000	1000	1800
10	12 / 14 [1]	≤ 12.5 / ≤ 14.5			
12 / FRA 12 (HCR)	14 / 16 [1]	≤ 14.5 / ≤ 16.5		1200	
14	18	≤ 18.5			
16 / FRA 16 (HCR)	20	≤ 20.55		1500	
18 / 20 / FRA 20 (HCR)	25	≤ 25.55	700	1300	
22 / 24	30	≤ 30.55			
25 / FRA 24 (HCR)	30 / 35 [1]	≤ 30.55 / ≤ 35.7		1000	2000
28	35	≤ 35.7		700	
30 / 32	40	≤ 40.7			$T_i > 0$ °C: 1500 $T_i \leq 0$ °C: 2000
40	55	≤ 55,7			1300
Minimum concrete temperature			-10 °C		
Maximum concrete temperature			+40 °C		

[1] Both diameters are possible.

Table 4.

Injection mortar FIS EM Plus			**390 ml**	**585 ml**	**390 ml**	**585 ml**	**1500 ml**
Dispenser			Hand		Battery & Pneumatic		Pneumatic
Rebar-ø	Drill hole-ø	Drill-cutting-ø	Maximum setting depth				
d_s [mm]	**d_0 [mm]**	**d_{cut} [mm]**	**$l_{v,max}/l_{e,ges,max}$ [mm]**				
8	10 / 12 [1]	≤ 10.5 / ≤ 12.5	1000		1000		1800
10	12 / 14 [1]	≤ 12.5 / ≤ 14.5					
12 / FRA 12	14 / 16 [1]	≤ 14.5 / ≤ 16.5			1200		
14	18	≤ 18.5					
16 / FRA 16	20	≤ 20.55			1500		
20 / FRA 20	25	≤ 25.55	700		1300		
22 / 24	30	≤ 30.55			1000		2000
25 / FRA 24	30 / 35 [1]	≤ 30.55 / ≤ 35.7					
26 / 28	35	≤ 35.7	500		700		
30 / 32 / 34	40	≤ 40.7	–		500		
36	45	≤ 45.7					
40	55	≤ 55.7					
Minimum concrete temperature			-5 °C				
Maximum concrete temperature			+40 °C				

[1] Both diameters are possible.

Table 5.

Injection mortar FIS V Plus			**360 ml**		**825 ml**
Dispenser			Hand	Battery & Pneumatic	Battery & Pneumatic
Rebar-ø	Drill hole-ø	Drill-cutting-ø	Maximum setting depth		
d_s [mm]	**d_0 [mm]**	**d_{cut} [mm]**	**$l_{v,max}$ / $l_{e,ges,max}$ [mm]**		
8	10 / 12 [1]	≤ 10.5 / ≤ 12.5	1000	1000	1800
10	12 / 14 [1]	≤ 12.5 / ≤ 14.5			
12 / FRA 12	14 / 16 [1]	≤ 14.5 / ≤ 16.5		1200	
14	18	≤ 18.5			
16 / FRA 16	20	≤ 20.55		1500	
20 / FRA 20	25	≤ 25.55	700	1300	
25 / FRA 24	30 / 35 [1]	≤ 30.55 / ≤ 35.7		1000	2000
28	35	≤ 35.7	500	700	
Minimum concrete temperature			±0 °C		
Maximum concrete temperature			+40 °C		

[1] Both diameters are possible.

2.3.5 Installation accessories

Table 6.

Rebar-ø	**Drill hole-ø**	**Compressed air nozzle-ø**	**Cleaning brush for drill-ø**	**Extension tube-ø**	**Colour of the Injection adapter**
d_s [mm]	**d_0 [mm]**	**[mm]**	**d_b [mm]**	**[mm]**	
8 [1]	10	–	11.0	9 [2]	–
8 / 10 [1]	12	11	12.5	9 [2]	transparent
10 / 12 / FRA 12 [1]	14	11	15.0	9 [2]	blue
12 / FRA 12 [1]	16	15	17.0	9 [2]	red
14	18	15	19.0	9 [2] or 15	yellow
16 / FRA 16	20	19	21.5	9 [2] or 15	green
20 / FRA 20	25	19	26.5	9 [2] or 15	black
22 / 24 / 25 / FRA 24	30	28	32.0	9 [2] or 15	grey
25 / 26 / 28 / FRA 24	35	28	37.0	9 [2] or 15	brown
30 / 32 / 34	40	38	42.0	9 [2] or 15	red
36	45	38	47.0	9 [2] or 15	yellow
40	55	38	58.0	9 [2] or 15	transparent

[1] Both diameters possible.
The larger drill diameters are particularly recommended for greater anchorage depths.

[2] For the 360 ml and 390 ml cartridge, use the ø 9 mm extension.
The corresponding maximum setting depths can be found in Tab. 3-5.

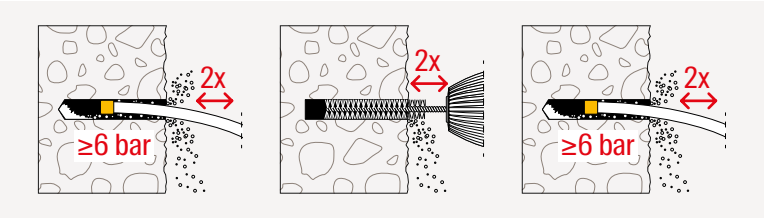
2.4 Roughing up the connecting joint

- In compliance with the Design Engineer the connecting joint (existing concrete surface) must be at least roughed up to the extent that the aggregates are visible before pouring the new building component. For this purpose, e.g. the fischer scrabbling tool with SDS-Max can be used. Other possibilities are, for example, high-pressure water jetting.
- It is advisable that the connecting joints roughened up after pre-drilling as the set bars may impede access to the surface).
- In the case of a carbonated surface of the existing concrete structure, the carbonated layer must be removed in the area of the post-installed rebar connection with the diameter of ø +60 mm prior to the installation of the new rebar. The depth of the concrete to be removed must be at least the minimum concrete cover for the respective environmental conditions according to EN 1992-1-1. This is not applicable for new and non-carbonated concrete and if the building components are in a dry conditions.

2.5 Drill hole cleaning

2.5.1 FIS RC II, FIS RC II Low Speed

Drill hole by hollow drilling (no further drill hole cleaning necessary), hammer drilling with standard drill bit or hollow drill bit or pneumatic drilling.



Blow out the drill hole:
Blow out the drill hole from the bottom of the hole twice with a suitable nozzle attachment (see Tab. 6) and oil-free compressed air (p ≥ 6 bar (0.6 MPa)).

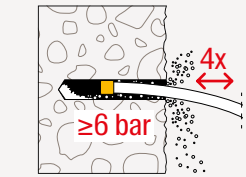
Brush out the drill hole:
Brush out drill hole, extend suitable stainless steel brushes (Tab. 6) with extension in power tool and brush drill hole twice.

Blow out the drill hole:
Blow out the drill hole from the bottom of the hole twice with a suitable nozzle attachment (see Tab.6) and oil-free compressed air (p ≥ 6 bar (0.6 MPa)).

2.5.2 FIS EM Plus

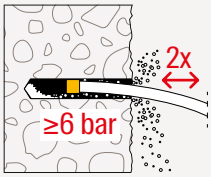
Drill hole by hollow drilling (no further drill hole cleaning necessary), hammer drilling or pneumatic drilling.

Hammer drilling with standard drill bit or pneumatic drilling:

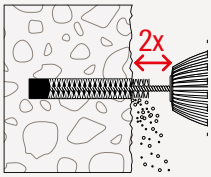


Blow out the drill hole:
Blow out the hole from the bottom of the hole four times with a suitable nozzle attachment (see Tab. 6) and oil-free compressed air (p ≥ 6 bar (0.6 MPa)).

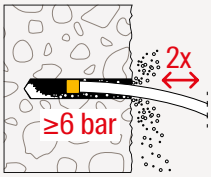
In accordance with EOTA Technical Report TR 069: Post-installed reinforcing bar connections with improved bond-splitting behaviour according to ETA-22/0001.



Blow out the drill hole:
Blow out the drill hole from the bottom of the hole twice with a suitable nozzle attachment (see Tab. 6) and oil-free compressed air (p ≥ 6 bar (0.6 MPa)).

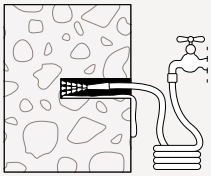


Brush out the drill hole:
Brush out drill hole, extend suitable stainless steel brushes (Tab. 6) with extension in power tool and brush drill hole twice.

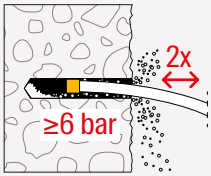


Blow out the drill hole:
Blow out the drill hole from the bottom of the hole twice with a suitable nozzle attachment (see Tab. 6) and oil-free compressed air (p ≥ 6 bar (0.6 MPa)).

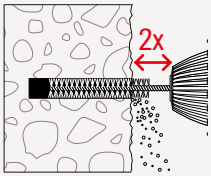
Diamond drilling:



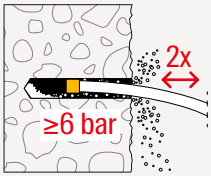
Rinse the drill hole:
Rinse until clear water comes through.



Blow out the drill hole:
Blow out the drill hole from the bottom of the hole twice with a suitable nozzle attachment (see Tab. 6) and oil-free compressed air (p ≥ 6 bar (0.6 MPa)).



Brush out the drill hole:
Brush out drill hole, extend suitable stainless steel brushes (Tab. 6) with extension in power tool and brush drill hole twice.



Blow out the drill hole:
Blow out the drill hole from the bottom of the hole twice with a suitable nozzle attachment (see Tab. 6) and oil-free compressed air (p ≥ 6 bar (0.6 MPa)).

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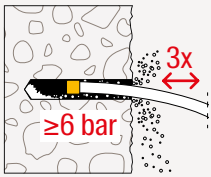
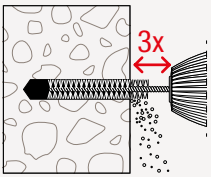
2.5.3 FIS V Plus

Drill hole creation by hollow drilling (no further drill hole cleaning necessary), hammer drilling or pneumatic drilling (diamond drilling not permitted).



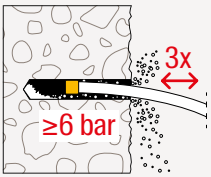
Blow out the drill hole:

Blow out the drill hole from the bottom of the hole three times with a suitable nozzle attachment (see Tab. 6) and oil-free compressed air (p ≥ 6 bar (0.6 MPa)).



Brush out the drill hole:

Brush out drill hole, extend suitable stainless steel brushes (Tab. 6) with extension in power tool and brush drill hole three times.



Blow out the drill hole:

Blow out the drill hole from the bottom of the hole three times with a suitable nozzle attachment (see Tab. 6) and oil-free compressed air (p ≥ 6 bar (0.6 MPa)).

2.6 Marking and checking setting depth on reinforcement bar

- The setting depth l_v specified by the planning engineer must be marked with adhesive tape on the reinforcement bar.
- For testing purposes, the marked reinforcement bar is inserted into the cleaned drill hole to the bottom of the drill hole and turned at the same time, thus checking ease of movement of the reinforcement bar and the drill hole depth (Fig. 6).
- Any ridges on the edge of the bars that hinder ease of movement must be removed.

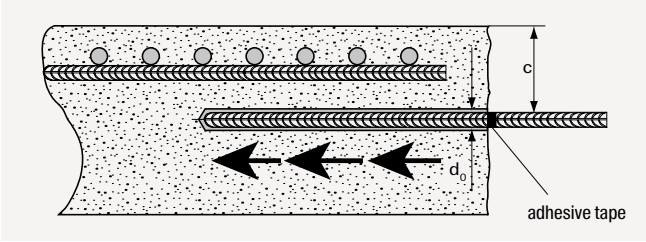


Fig. 6: Checking ease of movement of the reinforcement bar and the drill hole depth

2.7 Preparation of the extension injection system

- The static mixers must be extended with appropriate extension tubes (ø 9 mm or ø 15 mm). The extension tube of ø 9 mm fit the small static mixer FIS MR Plus. The FIS UMR static mixers for the 585 ml or 1500 ml cartridge and FIS JMR for 825 ml cartridge can be fitted with the extension tube ø 9 mm (plugged in inside) and ø 15 mm (plugged on outside).
- Choose an extension tube that is about 200 mm longer than the drill hole depth.
- The specified injection adapter can be attached to the end of the extension tube facing the drill hole. This allows filling which is even and free from air bubbles. Select the correct injection adapter from Tab.le 6.
- Finally, the length of injection l_m is marked with adhesive tape on the extension tube as per Fig. 7
- Tab. 7 specifies the values for l_m. The following formula can also be applied instead of the Tab. values on the safe side: **l_m = 1/3 x drill hole depth (l_v)**

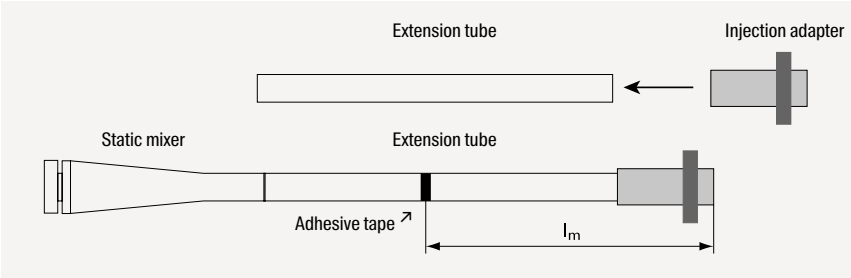


Fig. 7: Preparation of the extension injection system

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2.7.1 Marking length l_m depending on setting depth l_v or $l_{e,ges}$

Table 7:

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Drill hole depth h_o = Setting depth l_v/$l_{e,ges}$ [mm]	Bar diameter d_s [mm]																				
	8	8	10	10	FRA12 12	FRA12 12	14	FRA16 16	18	FRA20 20	22	24	FRA24 25	FRA24 25	26	28	30	32	34	36	40
	Nominal drill diameter d_0 [mm]																				
	10	12	12	14	14	16	18	20	25	25	30	30	30	35	35	35	40	40	40	45	55
	Marking length l_m [mm]																				
80	45	27																			
100	57	33	63	41																	
120	68	40	76	49	82	57															
140	80	47	89	58	95	67	74														
160	91	53	101	66	109	76	84	91													
180	102	60	114	74	123	86	95	102	76												
200	114	67	127	82	136	95	105	114	84	114											
220	125	73	139	91	150	105	116	125	93	125	98										
240	136	80	152	99	164	114	126	136	101	136	107	136									
250	142	83	158	103	170	119	131	142	106	142	111	142	158	103							
260	148	87	165	107	177	124	137	148	110	148	116	148	165	107	120						
280	159	93	177	115	191	133	147	159	118	159	125	159	177	115	129	159					
300	170	100	190	124	204	143	158	170	127	170	134	170	190	124	139	170	143				
320	182	107	203	132	218	152	168	182	135	182	143	182	203	132	148	182	152	182			
340	193	113	215	140	232	162	179	193	144	193	151	193	215	140	157	193	162	193	227		
350	199	117	222	144	239	166	184	199	148	199	156	199	222	144	162	199	166	199	233		
360	204	120	228	148	245	171	189	204	152	204	160	204	228	148	166	204	171	204	240	204	
380	216	127	241	157	259	181	200	216	160	216	169	216	241	157	176	216	181	216	253	216	
400	227	133	253	165	273	190	210	227	169	227	178	227	253	165	185	227	190	227	267	227	174
450	256	150	285	186	307	214	237	256	190	256	200	256	285	186	208	256	214	256	300	256	196
500	284	167	317	206	341	238	263	284	211	284	223	284	317	206	231	284	238	284	334	284	217
550	312	183	348	227	375	261	289	312	232	312	245	312	348	227	254	312	261	312	367	312	239
600	341	200	380	247	409	285	316	341	253	341	267	341	380	247	277	341	285	341	400	341	261
650	369	217	412	268	443	309	342	369	274	369	289	369	412	268	300	369	309	369	434	369	283
700	398	233	443	289	477	333	368	398	295	398	312	398	443	289	324	398	333	398	467	398	304
750	426	250	475	309	511	356	394	426	317	426	334	426	475	309	347	426	356	426	500	426	326
800	454	267	507	330	545	380	421	454	338	454	356	454	507	330	370	454	380	454	534	454	348
850	483	283	538	350	579	404	447	483	359	483	379	483	538	350	393	483	404	483	567	483	370
900	511	300	570	371	613	428	473	511	380	511	401	511	570	371	416	511	428	511	600	511	391
950	540	317	602	392	648	451	500	540	401	540	423	540	602	392	439	540	451	540	634	540	413
1000	568	333	633	412	682	475	526	568	422	568	445	568	633	412	462	568	475	568	667	568	435
1050	596	350	665	433	716	499	552	596	443	596	468	596	665	433	485	596	499	596	700	596	456
1100	625	367	697	453	750	523	579	625	464	625	490	625	697	453	508	625	523	625	734	625	478
1150	653	383	728	474	784	546	605	653	485	653	512	653	728	474	532	653	546	653	767	653	500
1200	682	400	760	495	818	570	631	682	506	682	534	682	760	495	555	682	570	682	800	682	522
1250	710	417	792	515	852	594	657	710	528	710	557	710	792	515	578	710	594	710	834	710	543
1300	738	433	823	536	886	618	684	738	549	738	579	738	823	536	601	738	618	738	867	738	565
1350	767	450	855	557	920	641	710	767	570	767	601	767	855	557	624	767	641	767	900	767	587
1400	795	467	887	577	954	665	736	795	591	795	623	795	887	577	647	795	665	795	934	795	609
1450	824	483	918	598	988	689	763	824	612	824	646	824	918	598	670	824	689	824	967	824	630
1500	852	500	950	618	1022	713	789	852	633	852	668	852	950	618	693	852	713	852	1001	852	652
1550	880	517	982	639	1057	736	815	880	654	880	690	880	982	639	716	880	736	880	1034	880	674
1600	909	533	1013	660	1091	760	841	909	675	909	713	909	1013	660	740	909	760	909	1067	909	696
1650	937	550	1045	680	1125	784	868	937	696	937	735	937	1045	680	763	937	784	937	1101	937	717
1700	966	567	1077	701	1159	808	894	966	718	966	757	966	1077	701	786	966	808	966	1134	966	739
1750	994	583	1108	721	1193	831	920	994	739	994	779	994	1108	721	809	994	831	994	1167	994	761
1800	1022	600	1140	742	1227	855	947	1022	760	1022	802	1022	1140	742	832	1022	855	1022	1201	1022	782
1850											824	1051	1172	763	855	1051	879	1051	1234	1051	804
1900											846	1079	1203	783	878	1079	903	1079	1267	1079	826
1950											868	1108	1235	804	901	1108	926	1108	1301	1108	848
2000											891	1136	1267	824	924	1136	950	1136	1334	1136	869

2.8 Filling the drill hole

The effects of temperature must be considered for both storage and processing time of the injection mortar:

Storage temperature of the cartridge:
+5 °C to +25 °C (FIS RC II, FIS RC II Low Speed, FIS V Plus) and +30 °C (FIS EM Plus)

2.8.1 Processing and curing time of the injection mortar FIS RC II, FIS RC II Low Speed

Table 8.

Temperature in the anchorage base	Maximum working time [1] t_{work}		Minimum curing time [2] t_{cure}	
[°C]	FIS RC II	FIS RC II Low Speed	FIS RC II	FIS RC II Low Speed
–10 to –5	20 min [3]	–	12 h	–
≥ –5 to ±0	20 min [3]	40 min	12 h	5 d
> ±0 to +5	13 min [3]	30 min	3 h	48 h
> +5 to +10	9 min [3]	20 min	90 min	24 h
> +10 to +20	5 min	13 min	60 min	120 min
> +20 to +30	4 min	9 min	45 min	60 min
> +30 to +40	2 min [4]	7 min	35 min	45 min

[1] Maximum time from the beginning of the injection to rebar / fischer rebar anchor FRA setting and positioning.
[2] For wet concrete the curing time must be doubled.
[3] If the temperature in the concrete falls below +10 °C the cartridge must be warmed up to +15 °C.
[4] If the temperature in the concrete exceeds +30 °C the cartridge must be cooled down to +15 °C up to +20 °C.

2.8.2 Processing and curing times of the injection mortar FIS EM Plus

Table 9.

Temperature in the anchorage base [°C]	Maximum working time [1] t_{work} FIS EM Plus	Initial curing time [2] $t_{cure, ini}$ FIS EM Plus	Minimum curing time [3] t_{cure} FIS EM Plus
≥ –5 to ±0	240 min [4]	62 h	200 h
> ±0 to +5	150 min [4]	39 h	90 h
> +5 to +10	120 min [4]	25 h	40 h
> +10 to +15	30 min	16 h	18 h
> +15 to +20	23 min	11 h	18 h
> +20 to +25	14 min	7 h	10 h
> +25 to +30	10 min	5 h	10 h
> +30 to +35	7 min [5]	3,5 h	5 h
> +35 to +40	5 min [5]	2,5 h	5 h

1) Maximum time from the beginning of the injection to rebar / fischer rebar anchor FRA setting and positioning.
2) After the initial curing time $t_{cure, ini}$ is reached, the initial bond strength is achieved and allows further processing.
3) For wet concrete the curing time must be doubled.
4) If the temperature in the concrete falls below +10 °C the cartridge must be warmed up to +15 °C.
5) If the temperature in the concrete exceeds +30 °C the cartridge must be cooled down to +15 °C up to +20 °C.

2.8.3 Processing and curing times of the injection mortar FIS V Plus

Table 10.

Temperature in the anchorage base [°C]	Maximum working time [2] t_{work} FIS V Plus	Maximum working time [2] t_{work} FIS VS Plus Low Speed	Minimum curing time [4] t_{cure} FIS V Plus	Minimum curing time [4] t_{cure} FIS VS Plus Low Speed
±0 to +5 [1]	13 min	–	3 h	6 h
> +5 to +10 [1]	9 min	20 min	90 min	3 h
> +10 to +20	5 min	10 min	60 min	2 h
> +20 to +30	4 min	6 min	45 min	60 min
> +30 to +40 [3]	2 min	4 min	35 min	60 min

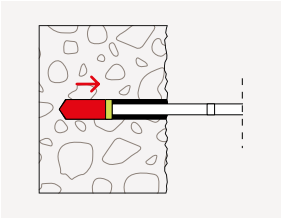
1) If the temperature in the anchoring base is below +10 °C, the **FIS V Plus** mortar cartridge must be warmed up to +15 °C.
2) Time from start of filling of mortar to setting and positioning of reinforcement bar.
3) If the temperature in the anchoring base exceeds +30 °C, the FIS V Plus mortar cartridge must be cooled down to +15 °C to 20°C.
4) In wet concrete, the curing times must be doubled.

2.8.4 Processing

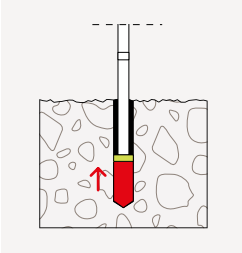
The following equation helps in the planning of the required mortar amounts V_{FIS}:

$$V_{FIS} = (d_0^2 - d_s^2) \times 0.95 \times l_v \text{ [ml]}$$

d_0 = Drilling diameter in [mm] (see Tab. 3 to 5)
d_s = Reinforcing bar diameter in [mm]
l_v = Setting depth in [mm]



Horizontal filling:
Gently guide the dispenser - do not pull



Vertical filling:
Hold the weight of the dispenser

- Attach the static mixer to the cartridge and place it in the dispenser.
- Operate the dispenser until the dispensed mortar is an even tone of grey.
- Attach extension tube and extrude mortar until it reaches the end of the extension tube.
- Insert extension tube and injection adapter right down to the bottom of the drill hole and extrude the mortar. Injecting mortar in water-filled drill holes is not permitted.
- Slowly pull back the dispenser while filling – following the pressure acting on the injection adapter - do not pull.
- Stop the process when the tape (marking l_m) on the injection extension tube appears above the concrete surface.

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2.8.5 Mortar quantities for selected setting depths

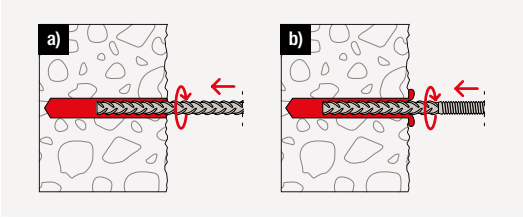
Table 11.

Drill hole depth h_o = Setting depth $l_v/l_{v,ges}$ [mm]	Reinforced anchor-bar diameter d_s [mm]																				
					FRA M12			FRA M16		FRA M20			FRA M24								
	ø 8	ø 8	ø 10	ø 10	ø 12	ø 12	ø 14	ø 16	ø 18	ø 20	ø 22	ø 24	ø 25	ø 25	ø 26	ø 28	ø 30	ø 32	ø 34	ø 36	ø 40
	Drillhole diameter d_o [mm]																				
	10	12	12	14	14	16	18	20	25	25	30	30	30	35	35	35	40	40	40	45	55
	Quantities in [ml]																				
100	5	8	5	9																	
120	6	10	6	11	7	13															
140	7	11	7	13	8	15	18														
160	8	13	8	14	9	17	21	22	Lower limit of the anchoring depth (approximately 10 x ø)												
180	9	14	9	16	10	19	23	25	51												
200	10	16	10	18	12	21	26	28	57	42											
220	11	18	11	20	13	23	28	30	62	46	86										
240	12	19	12	22	14	25	31	33	68	50	94	73									
250	13	20	13	23	15	26	32	34	71	53	98	76	65	138							
280	14	22	14	25	16	30	36	39	79	59	109	85	73	155	145	116					
300	15	24	15	27	17	32	39	41	85	63	117	91	78	166	155	124	198				
320	16	26	16	29	19	34	41	44	91	67	125	97	83	177	166	133	211	174			
340	17	27	17	31	20	36	44	47	96	71	133	103	88	188	176	141	224	185	142		
350	18	28	18	32	20	37	45	48	99	74	137	106	91	193	181	145	231	190	146	240	
360	18	29	18	32	21	38	46	50	102	76	141	110	94	199	186	149	238	196	150	247	
400	20	32	20	36	23	42	51	55	113	84	156	122	104	221	207	166	264	218	167	274	537
450	23	36	23	41	26	47	58	62	128	95	176	137	117	248	233	186	297	245	188	309	604
500	25	40	25	45	29	53	64	69	142	105	195	152	130	276	259	207	330	272	209	343	671
550	28	44	28	50	32	58	71	76	156	116	215	167	143	304	285	228	363	299	230	377	738
600	30	48	30	54	35	63	77	83	170	126	235	183	156	331	311	249	396	326	251	411	806
650	33	52	33	59	38	69	84	89	184	137	254	198	169	359	337	269	429	353	271	446	873
700	35	56	35	63	41	74	90	96	198	147	274	213	182	386	363	290	462	381	292	480	940
750	38	60	38	68	44	79	96	103	213	158	293	228	195	414	388	311	495	408	313	514	1007
800	40	64	40	72	46	84	103	110	227	168	313	243	208	442	414	331	528	435	334	549	1074
850	43	68	43	77	49	90	109	117	241	179	332	259	221	469	440	352	561	462	355	583	1141
900	45	72	45	81	52	95	116	124	255	189	352	274	234	497	466	373	594	489	376	617	1208
950	48	76	48	86	55	100	122	131	269	200	371	289	247	524	492	394	627	517	397	651	1275
1000	50	80	50	90	58	106	129	138	283	210	391	304	260	552	518	414	660	544	418	686	1343
1100	55	88	55	99	64	116	141	151	312	231	430	335	286	607	570	456	726	598	459	754	1477
1200	60	96	60	108	70	127	154	165	340	252	469	365	312	662	621	497	792	653	501	823	1611
1300	65	104	65	117	75	137	167	179	368	273	508	395	338	718	673	539	858	707	543	891	1745
1400	70	112	70	126	81	148	180	193	397	294	547	426	364	773	725	580	924	761	585	960	1880
1500	75	120	75	135	87	158	193	206	425	315	586	456	390	828	777	621	990	816	626	1029	2014
1600	80	128	80	144	93	169	206	220	453	336	625	487	416	883	829	663	1056	870	668	1097	2148
1700	85	136	85	153	99	179	219	234	482	357	665	517	442	938	880	704	1122	924	710	1166	2282
1800	90	144	90	162	104	190	231	248	510	378	704	548	468	994	932	746	1188	979	752	1234	2417
1900	Upper limit of injection possibility (see ETA-REBAR)										743	578	494	1049	984	787	1254	1033	794	1303	2551
2000											782	608	520	1104	1036	829	1320	1088	835	1371	2685
Add*	**20%**	**20%**	**20%**	**20%**	**15%**	**15%**	**15%**	**15%**	**15%**	**10%**	**10%**	**10%**	**10%**	**10%**	**10%**	**10%**	**10%**	**10%**	**10%**	**10%**	**10%**

* Additional mortar for multiple drill holes: The values in the table include the percentage as an addition for the required mortar, which is needed to fill several static mixer and extension tubes for multiple holes.

2.9 Inserting the reinforcement bar

- After filling in the mortar remove the extension tube from the drill hole.
- The prepared reinforcement bar must be inserted using force and by turning into the filled drill hole up to the setting depth marking. This may need to carried out quickly at high temperatures.



Under strong pressure and simultaneous rotation, the reinforcement bar (a) or the fischer rebar anchor FRA (b) is inserted into the drill hole.
After the curing time, the anchored bar can be loaded.

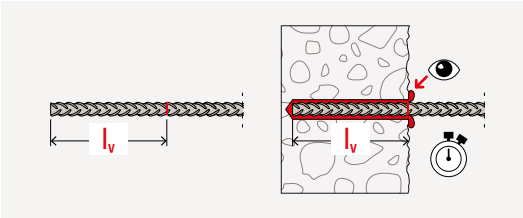
The reinforcement bar is considered to be properly set if:

→ the reinforcement bar does not spring back.

→ no bursting of air bubbles occurs.

→ excess mortar appears outside the drill hole.

→ the setting depth mark of the rebar is flush with the concrete surface.



2.10 Curing of the mortar

See processing and curing times Tab. 8-10.

- The reinforcement bar must not be moved until the mortar is cured.
- The curing time depends on the temperature in the building component and starts at the end of the processing time.

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3 Additional accessories

Supplementary accessories FIS-rebar case

Table 12.

Article-No.	Description
001490	Cleaning brush for drill-ø 12 mm
001491	Cleaning brush for drill-ø 14 mm
001492	Cleaning brush for drill-ø 16 mm
001493	Cleaning brush for drill-ø 18 mm
001494	Cleaning brush for drill-ø 20 mm
001495	Cleaning brush for drill-ø 25 mm
090063	Cleaning brush for drill-ø 30 mm
090071	Cleaning brush for drill-ø 35 mm
505061	Cleaning brush for drill-ø 40 mm
506254	Cleaning brush for drill-ø 45 mm
505062	Cleaning brush for drill-ø 55 mm
001497	Injection adapter for drill-ø 12 Natural (ø 9)
001498	Injection adapter for drill-ø 14 Blue (ø 9)
001499	Injection adapter for drill-ø 16 Rot (ø 9)
001483	Injection adapter for drill-ø 18 Yellow (ø 9)
001506	Injection adapter for drill-ø 20 Green (ø 9)
001508	Injection adapter for drill-ø 20 Green (ø 15)
001507	Injection adapter for drill-ø 25 Black (ø 9)
001509	Injection adapter for drill-ø 25 Black (ø 15)
090689	Injection adapter for drill-ø 30 Grey (ø 9)
090700	Injection adapter for drill-ø 30 Grey (ø 15)
090699	Injection adapter for drill-ø 35 Brown (ø 9)
090701	Injection adapter for drill-ø 35 Brown (ø 15)
505077	Injection adapter for drill-ø 40 Red (ø 9)
505079	Injection adapter for drill-ø 40 Red (ø 15)
508909	Injection adapter for drill-ø 45 Yellow (ø 9)
508910	Injection adapter for drill-ø 45 Yellow (ø 15)
505078	Injection adapter for drill-ø 55 Natural (ø 9)

Article-No.	Description
505080	Injection adapter for drill-ø 55 Natural (ø 15)
511956	Compressed air nozzle ø 12 – ø 15
511957	Compressed air nozzle ø 16 – ø 19
511958	Compressed air nozzle ø 20 – ø 25
511959	Compressed air nozzle ø 30 – ø 35
511960	Compressed air nozzle ø 40 – ø 55
508791	Extension rod for brush set
530332	SDS adapter with internal thread M8
019684	Template for checking brush wear
519527	Compressed-air cleaning hose
048983	FIS extension tube ø 9 mm
530800	FIS extension tube ø 15 mm
001253	SDS max scabbeling tool
090819	Drilling aid
520593	Static mixer FIS UMR
545853	Static mixer FIS MR Plus
567522	Static mixer FIS JMR 825
563337	FIS DM S Pro Manual dispenser for 360 ml - and 390 ml cartridges
058000	FIS AM Manual dispenser for 360 ml - and 390 ml-cartridges
577080	FIS DM SL Pro Manual dispenser for 585 ml - cartridges
563241	FIS AM S-XL Manual dispenser for 825 ml - cartridges
558955	FIS DB S Pro Battery operated dispenser for 360 ml - and 390 ml-cartridges
562004	FIS DB S-L Pro Battery operated dispenser for 585 ml - and 825 ml-cartridges
58027	FIS AP pneumatic dispenser for 360 ml - and 390 ml-cartridges
511125	FIS DP S-L pneumatic dispenser for 585 ml - cartridges
512401	FIS DP S-XL pneumatic dispenser for 1500 ml - cartridges

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These installation instructions have been prepared with care. However, fischerwerke GmbH & Co. KG accepts no liability for any errors in these installation instructions and their consequences. Nor is any liability accepted for direct or consequential damage resulting from incorrect use of the products.

Construction materials (anchoring base) as well as external conditions (e.g. ambient conditions such as temperature, humidity) vary greatly. The current condition of the anchoring base and its suitability must therefore be checked by the installer. If there is any doubt about the condition of the anchoring base (e.g. about the strength), the responsible design engineer must be consulted.

fischer stands for

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203868 (04) · 12/2025 [hös] · V-MB · Printed in Germany