Post-installed rebar Installation instructions

Post-installed rebar connection with fischer injection mortars FIS RC II, 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 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 (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 (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), e.g. fischer FVC 35 M or comparable performance data.

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.

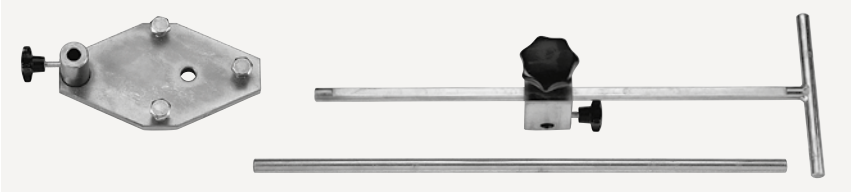

Fig. 3: Drilling aid

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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)

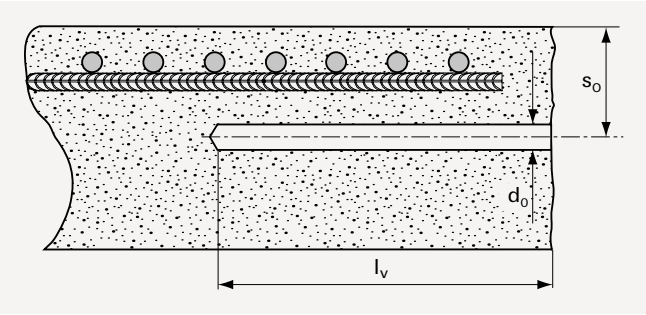

Fig. 4: Anchorage close to the edge of the building component

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, [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

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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.

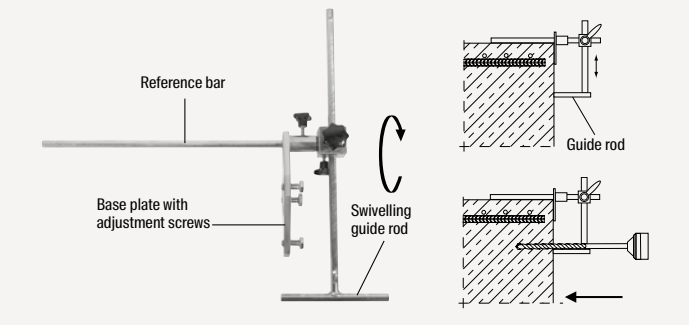
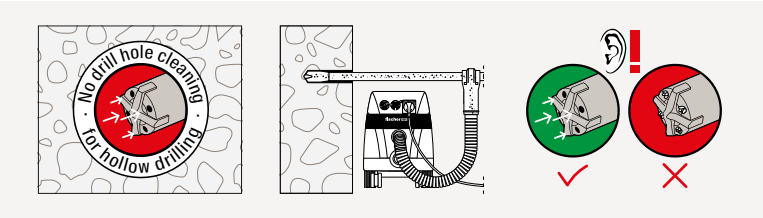


Fig. 5: Drilling aid (Base plate, Reference bar, Guide bar)

2.3 Drilling a hole

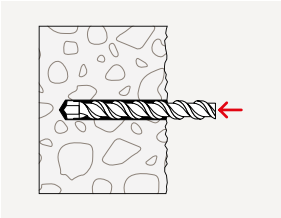
2.3.1 Hollow drilling

Hammer drilling with ETA-regulated hollow drill (e.g. fischer FHD) and extraction using a suitable dust extraction system (e.g. fischer FVC 35 M or similar dust extraction system with comparable performance data). 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.



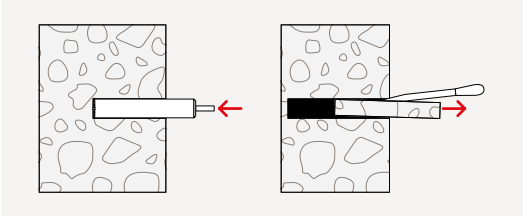
2.3.2 Hammer drilling or pneumatic drilling

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			**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
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.

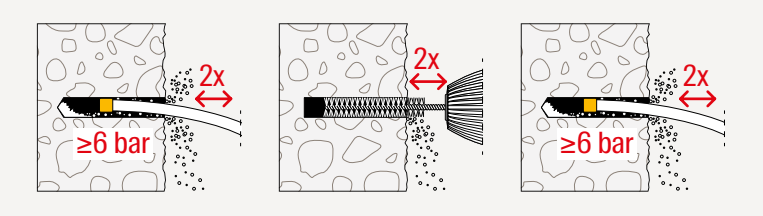
2.4 Roughing up the connecting joint

- 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

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)).

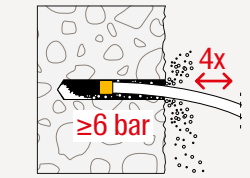
Brush out the drill hole:
Brush out drill hole, extend suitable stainless steel brushes (Tab. 6) with extension in power tool and brush drill hole twice.

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

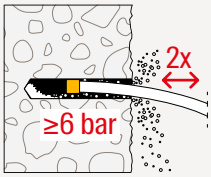
Drill hole by hollow drilling (no further drill hole cleaning necessary), hammer drilling or pneumatic drilling.

Hammer drilling with standard drill bit or pneumatic drilling:

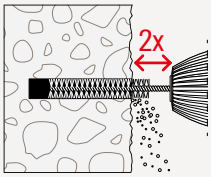


Blow out the drill hole:
Blow out the hole from the bottom of the hole four times with a suitable nozzle attachment (see Tab. 6) and oil-free compressed air (p ≥ 6 bar (0.6 MPa)).

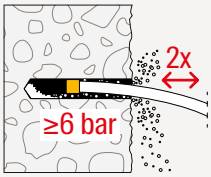
In accordance with EOTA Technical Report TR 069: Post-installed reinforcing bar connections with improved bond-splitting behaviour according to ETA-22/0001.



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)).

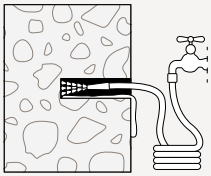


Brush out the drill hole:
Brush out drill hole, extend suitable stainless steel brushes (Tab. 6) with extension in power tool and brush drill hole twice.

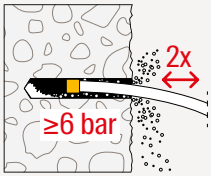


Blow out the drill hole:
Blow out the drill hole from the bottom of the hole twice with a suitable nozzle attachment (see Tab. 6) and oil-free compressed air (p ≥ 6 bar (0.6 MPa)).

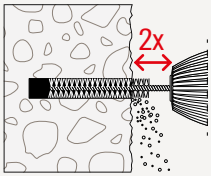
Diamond drilling:



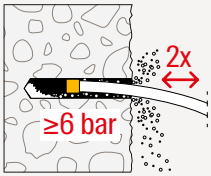
Rinse the drill hole:
Rinse until clear water comes through.



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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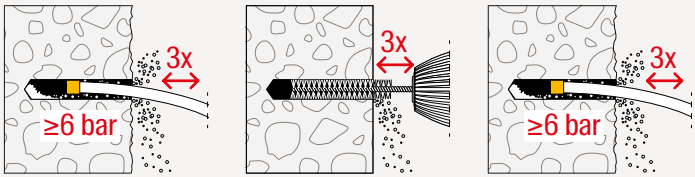
2.5.3 FIS V Plus

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.

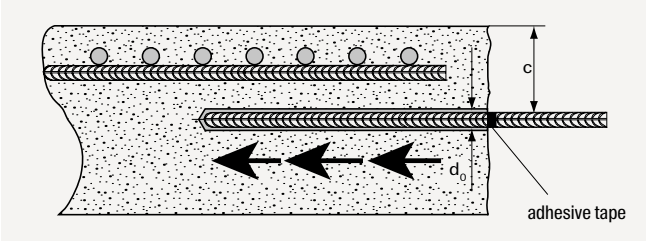


Fig. 6: Checking ease of movement of the reinforcement bar and the drill hole depth

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)**

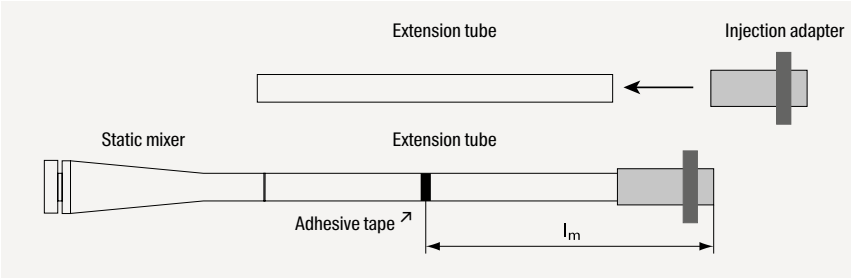


Fig. 7: Preparation of the extension injection system

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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 V Plus) and +30 °C (FIS EM Plus)

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

Table 8.

Base material temperature [°C]	Maximum processing time FIS RC II	Minimum curing time [4] FIS RC II
–10 to 0 [1]	20 min	12 h
> ±0 to +5 [1]	13 min	3 h
> +5 to +10 [1]	9 min	90 min
> +10 to +20	5 min	60 min
> +20 to +30	4 min	45 min
> +30 to +40 [3]	2 min	35 min

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

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

Table 9.

Base material temperature [°C]	Maximum processing time [2] FIS EM Plus	Minimum curing time [4] FIS EM Plus
≥ –5 to ±0 [1]	240 min	200 h
> ±0 to +5 [1]	150 min	90 h
> +5 to +10 [1]	120 min	40 h
> +10 to +20	30 min	18 h
> +20 to +30	14 min	10 h
> +30 to +40 [3]	7 min	5 h

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

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

Table 10.

Temperature in the anchorage base	Maximum working time [2] t_{work}		Minimum curing time [4] t_{cure}	
[°C]	FIS V Plus	FIS VS Plus Low Speed	FIS V Plus	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

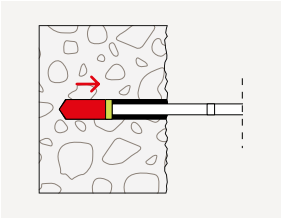
[1] If the temperature in the anchoring base is below +10 °C, the **FIS V Plus** mortar cartridge must be warmed up to +15 °C.
[2] Time from start of filling of mortar to setting and positioning of reinforcement bar.
[3] If the temperature in the anchoring base exceeds +30 °C, the FIS V Plus mortar cartridge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

2.8.4 Processing

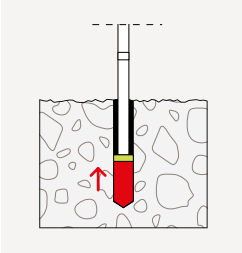
The following equation helps in the planning of the required mortar amounts V_{FIS}:

V_{FIS} = $(d_0^2 - d_s^2) \times 0.95 \times l_v$ [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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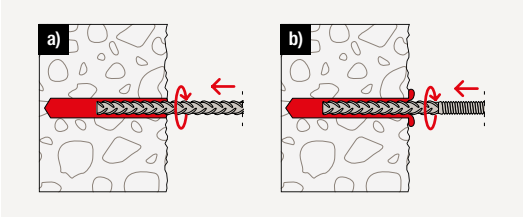
2.8.5 Mortar quantities for selected setting depths

Table 11.

Drill hole depth h_o = Setting depth l/l_{eges} [mm]	Rebar [–]																			
	Ø 8	Ø 8	Ø 10	Ø 10	Ø 12	Ø 12	Ø 14	Ø 16	Ø 20	Ø 22	Ø 24	Ø 25	Ø 25	Ø 26	Ø 28	Ø 30	Ø 32	Ø 34	Ø 36	Ø 40
	Bar diameter d_s [mm]																			
	8	8	10	10	12	12	14	16	20	22	24	25	25	26	28	30	32	34	36	40
	Nominal drill diamete [mm]																			
	10	12	12	14	14	16	18	20	25	30	30	30	35	35	35	40	40	40	45	55
	Standard BEM [mm]																			
	10.35	12.35	12.35	14.35	14.35	16.35	18.35	20.4	25.4	30.4	30.4	30.4	35.5	35.5	35.5	40.6	40.6	40.6	45.6	55.7
	Drill hole depth, min [mm]																			
	80	80	100	100	120	120	140	160	200	220	240	250	250	260	280	300	320	320	320	180
	Drill hole depth, max [mm]																			
	3000	3000	3000	3000	3000	3000	3000	3000	3000	2000	2000	3000	2000	2000	3000	2000	3000	2000	2000	2000
	Mortar volume [ml]																			
100	5	9	5	10																
120	5	11	6	12	7	14														
140	6	12	7	14	8	16	18													
160	7	14	8	16	9	18	21	24												
180	8	16	9	18	11	21	23	27												
200	9	17	10	20	12	23	26	29	45											
220	9	19	11	22	13	25	28	32	49	84										
240	10	21	12	24	14	27	31	35	54	92	73									
250	11	21	13	25	14	28	32	37	56	96	76	65	138							
260	11	22	13	26	15	29	34	38	58	99	79	68	143	132						
280	12	24	14	28	16	32	36	41	63	107	85	73	154	142	116					
300	13	26	15	30	17	34	39	44	67	115	91	78	165	152	124	194				
320	14	27	16	32	18	36	41	47	71	122	97	83	176	162	132	207	173			
340	14	29	17	34	20	38	44	50	76	130	103	88	187	172	140	220	184	145		
350	15	30	18	35	20	39	45	51	78	134	106	91	193	177	145	227	189	149	237	
360	15	31	18	36	21	41	46	53	80	137	109	94	198	182	149	233	195	154	244	
400	17	34	20	40	23	45	51	58	89	153	121	104	220	202	165	259	216	171	271	520
450	19	38	23	45	26	51	58	66	100	172	136	117	247	228	186	291	243	192	305	585
500	21	42	25	50	28	56	64	73	111	191	151	130	275	253	206	324	270	213	339	650
550	23	46	28	55	31	62	70	80	122	210	166	143	302	278	227	356	297	234	373	714
600	25	51	30	60	34	67	77	87	133	229	181	156	330	303	247	388	324	256	407	779
650	27	55	33	65	37	73	83	95	144	248	196	168	357	329	268	421	351	277	440	844
700	29	59	35	70	40	78	89	102	156	267	211	181	385	354	289	453	378	298	474	909
750	31	63	38	75	42	84	96	109	167	286	226	194	412	379	309	485	405	320	508	974
800	33	67	40	80	45	90	102	116	178	305	241	207	440	404	330	518	432	341	542	1039
850	35	71	43	85	48	95	109	123	189	324	256	220	467	430	350	550	459	362	576	1104
900	37	76	45	90	51	101	115	131	200	343	271	233	494	455	371	582	486	383	610	1169
950	39	80	48	95	54	106	121	138	211	362	286	246	522	480	391	615	513	405	643	1234
1000	41	84	50	100	56	112	128	145	222	381	301	259	549	505	412	647	540	426	677	1299
1100	45	92	55	110	62	123	140	160	244	419	331	285	604	556	453	712	594	468	745	1428
1200	49	101	60	120	68	134	153	174	266	457	361	311	659	606	494	776	648	511	813	1558
1300	53	109	65	130	73	145	166	189	288	495	392	336	714	657	535	841	702	553	880	1688
1400	57	117	70	140	79	156	178	203	311	533	422	362	769	707	577	906	756	596	948	1818
1500	61	126	75	150	84	168	191	217	333	571	452	388	824	758	618	970	810	639	1016	1948
1600	66	134	80	160	90	179	204	232	355	609	482	414	879	808	659	1035	864	681	1083	2077
1700	70	142	85	170	96	190	217	246	377	647	512	440	933	859	700	1100	917	724	1151	2207
1800	74	151	90	180	101	201	229	261	399	685	542	466	988	909	741	1164	971	766	1219	2337
1900	78	159	95	190	107	212	242	275	421	723	572	492	1043	960	782	1229	1025	809	1286	2467
2000	82	167	100	200	112	223	255	290	443	761	602	517	1098	1010	823	1294	1079	851	1354	2597
2200	90	184	109	220	124	246	280	319	488			569			906		1187			
2400	98	201	119	240	135	268	306	348	532			621			988		1295			
2600	106	217	129	260	146	290	331	377	576			672			1070		1403			
2800	114	234	139	280	157	312	356	406	621			724			1153		1511			
3000	122	251	149	300	168	335	382	434	665			776			1235		1619			
Surplus considered	20%	20%	20%	20%	15%	15%	15%	15%	15%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%

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.

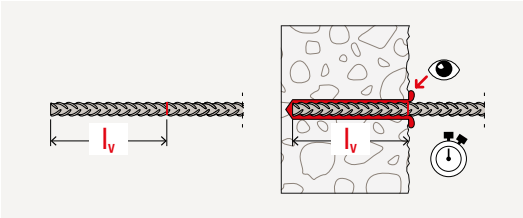
The reinforcement bar is considered to be properly set if:

→ 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
510992	FIS DM S-L 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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