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FAQ Installation of SIMOTICS L-1FN3

Additional Information to the CM and OI

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Question

What do I need to follow when installing 1FN3 built-in linear motors in addition to the Configuration Manual?

Answer

This manual provides additional information about installation of SIMOTICS L-1FN3 built-in linear motors that has not (yet) been included in the current SIMOTICS L-1FN3 Configuration Manual (CM) or the current operating instructions (OI) for SIMOTICS-L 1FN3 linear motors, or which complements the information they already contain.

For basic installation information, follow the 1FN3 CM and the 1FN3 operating instructions.

To fully answer this question, follow the handling instructions and notes listed in this document.

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1 Depths of thread and screw-in depths in the primary section

1 Depths of thread and screw-in depths in the primary section

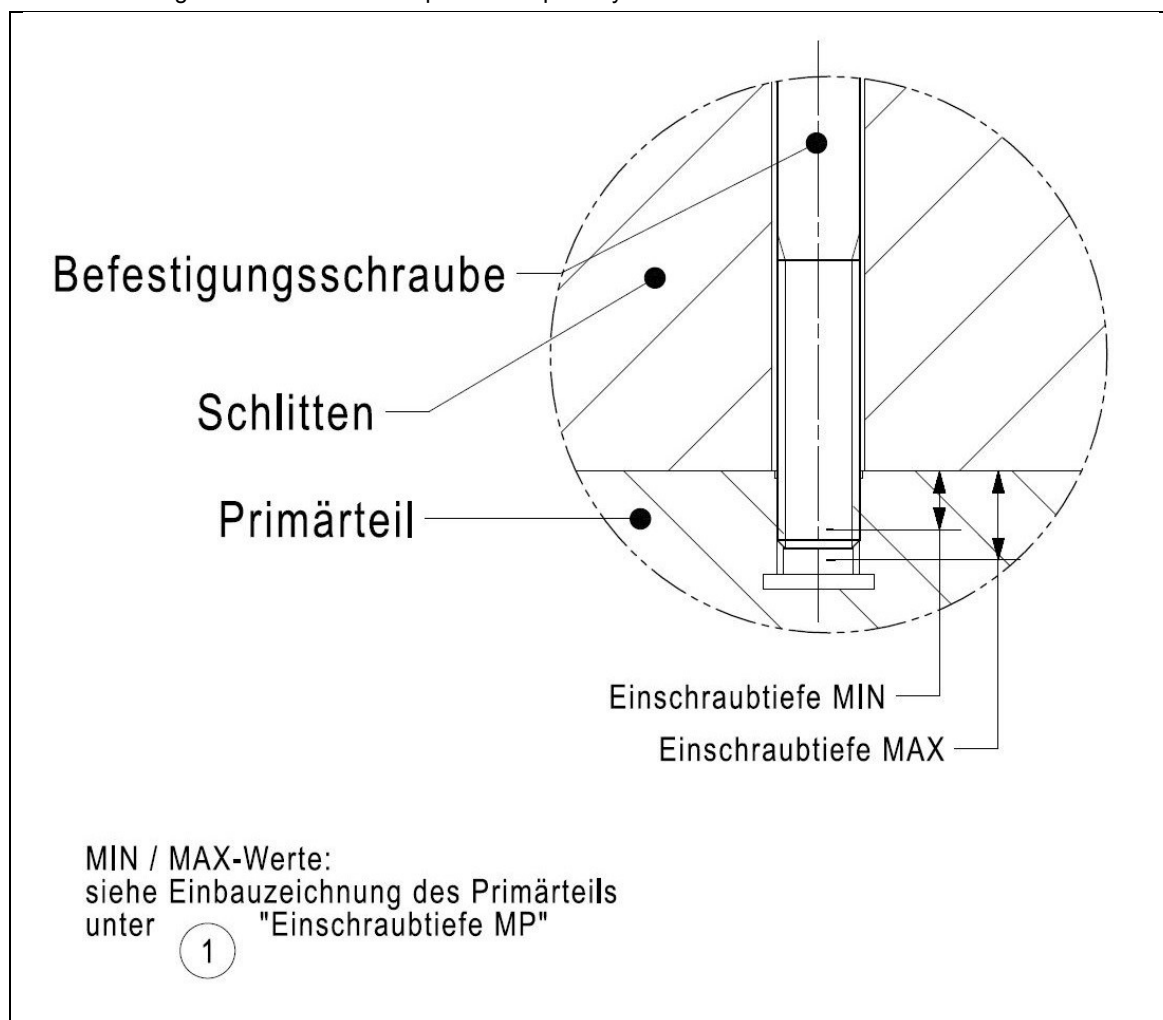
The following figures showing the minimum and maximum permissible reaches of the fixing screws when screwed in place, in each case with and without a precision cooler. This variation allows the machine manufacturer a **tolerance range** when selecting the screw length.

The machine manufacturer is responsible for taking all component tolerances into account and selecting the length of the fixing screws so that:

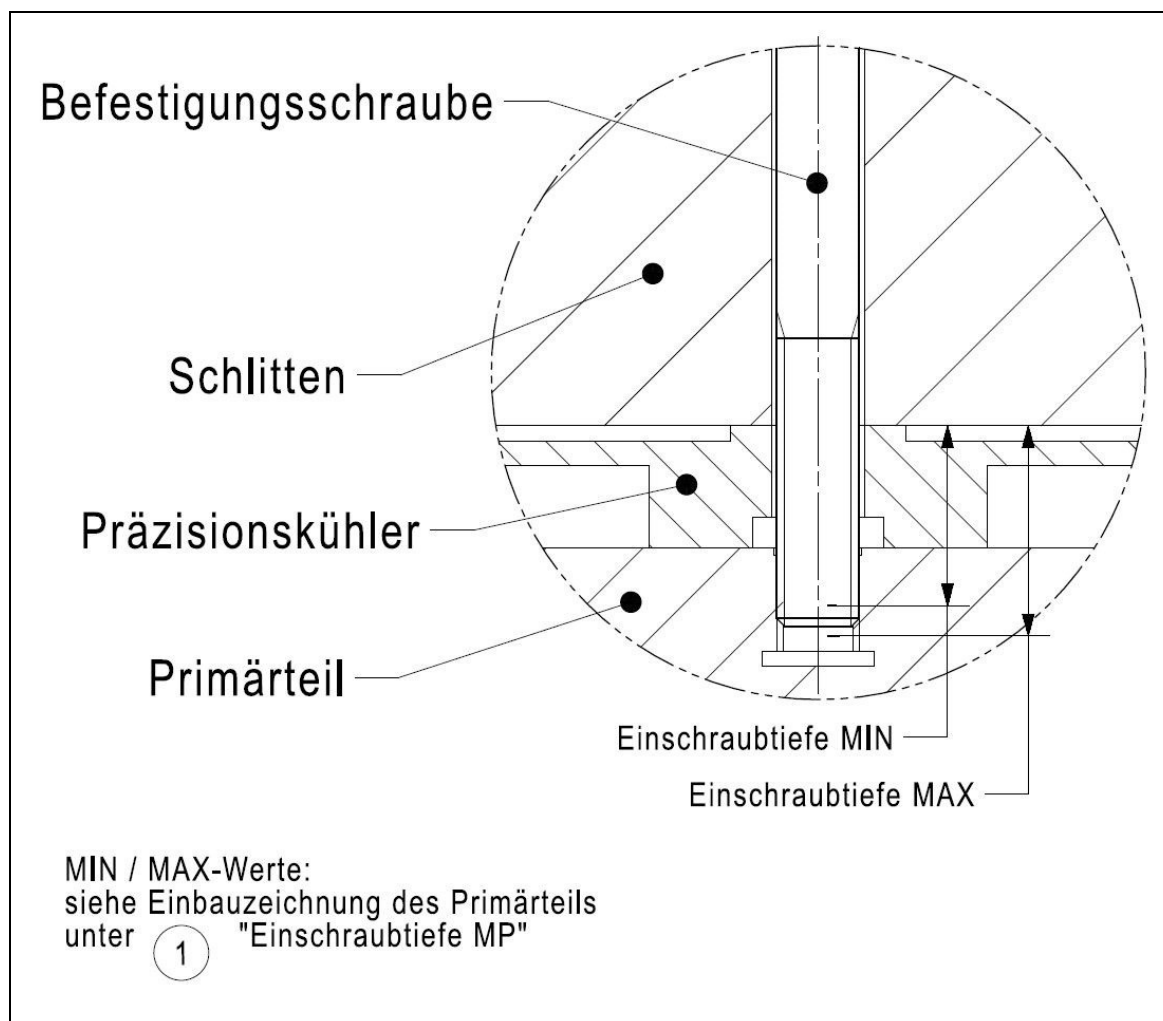
- The reach **does not fall below** the minimum (to prevent them from being torn out), and
- The reach **does not exceed** the maximum (to prevent them touching the bottom of the threaded holes).

The installation drawings for the primary sections can be found in the current CM.

Table 1-1: Diagram of the screw-in depths in the primary section



1 Depths of thread and screw-in depths in the primary section



Befestigungsschraube	fastening screw
Schlitten	Slide
Präzisionskühler	Precision cooler
Primärteil	Primary section
Einschraubtiefe MIN	MIN reach of screw
Einschraubtiefe MAX	MAX reach of screw
MIN / MAX-Werte: Siehe Einbauzeichnung des Primärteils Unter (1) „Einschraubtiefe MP“	MIN / MAX values: See installation drawing for the primary section under (1) “reach of screw MP”

1 Depths of thread and screw-in depths in the primary section

2 Use of stainless steel screws

Standard ferromagnetic steel screws or non-magnetic, corrosion-resistant (stainless) steel screws can be used for mounting the primary and secondary sections of SIMOTICS L-1FN3 linear motors.

Both types of screws have their advantages and disadvantages when used in the 1FN3, as listed below.

Each of the advantages and disadvantages may be important or unimportant depending on the requirements and operating conditions of the particular application.

Therefore no definitive recommendation can be given for particular applications. The machine manufacturer is responsible for assessing whether or not corrosion-resistant screws are to be used in his or her application.

2.1 Advantages of stainless steel screws:

- Stainless steel screws are not subject to corrosion, even if exposed to corrosive media.
- They are easy to handle during installation because they are not subject to magnetic forces.
- Their thermal conductance is substantially lower, so less heat is conducted into the body of the machine.

2.2 Disadvantages of stainless steel screws:

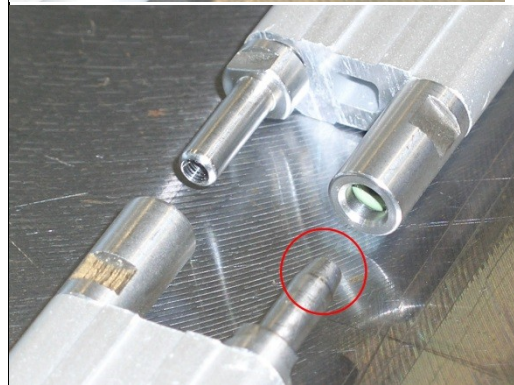
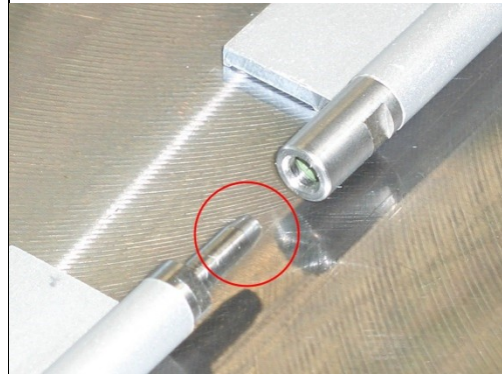
- Stainless steel screws are considerably more expensive, and forward buying involves additional expense.
- Most users are accustomed to using standard screws, and have little experience of using stainless steel screws.
- Stainless steel screws have considerably lower fracture and yield strength limits.
- The combination of stainless steel and aluminum materials leads to contact corrosion in the threaded hole. Countermeasure: Suitable coating of the threads.
- The friction values of stainless steel screws scatter much more widely than those of standard screws, which makes it more difficult to define the tightening torque. The resulting tightening force varies by 50% or more, even if the torque has a high repeat accuracy. Countermeasure: Suitable coating of the threads.

3 Mounting the secondary section cooling

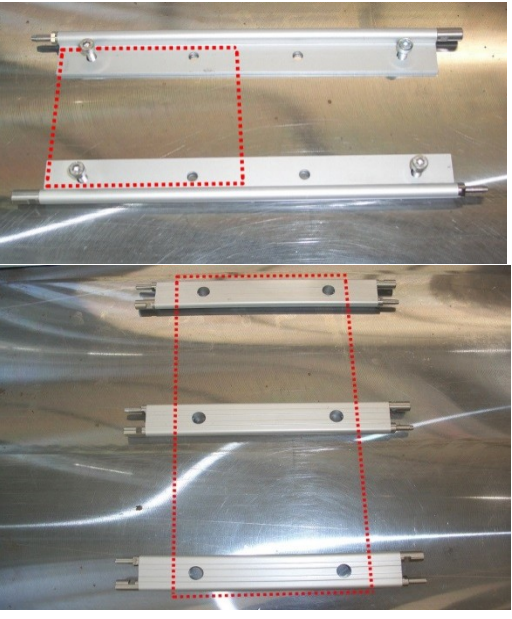
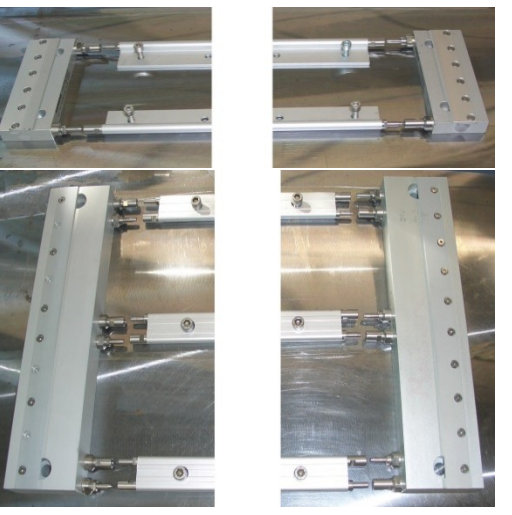
3 Mounting the secondary section cooling

Table 3-1: Steps for installing the secondary section cooling

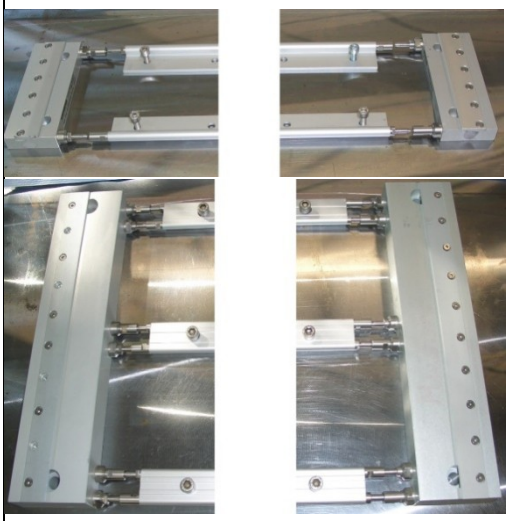
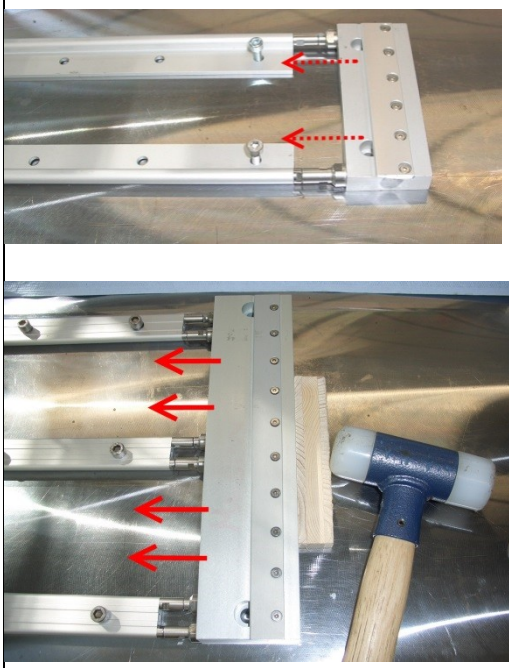
No.	Steps
1	<p>Prepare the heatsink profiles: View of the coupling nipples and coupling sockets. The coupling nipples have a conical nose for entry. Green Viton sealing rings can be seen in the opposite sockets.</p> <p>Frame sizes 1FN3 050 to 1FN3 450: One cooling water duct in each row of profiles</p> <p>Frame sizes 1FN3 600 and 1FN3 900: Two cooling water ducts in each row of profiles</p> <p>Note: To make coupling easier, all coupling nipples should be lubricated with a thin coat of Vaseline.</p>



3 Mounting the secondary section cooling

No.	Steps	
2	<p>Lay heatsink profiles of the required overall length out ready. View of heatsink profile rows. (Area outlined in red: approximate later position of a secondary section segment.)</p> <p>Frame sizes 1FN3050 to 1FN3450: Lay two rows of profiles alongside the secondary sections</p> <p>Frame sizes 1FN3600 and 1FN3900: Place three rows of profiles underneath the secondary sections</p>	
3	<p>Lay end pieces out ready: Assemble the rows of profiles, and provisionally attach screws along the whole length. (This is only to ensure that they are correctly positioned; hand-tightening is sufficient.) Lay out the end pieces ready at each end.</p>	


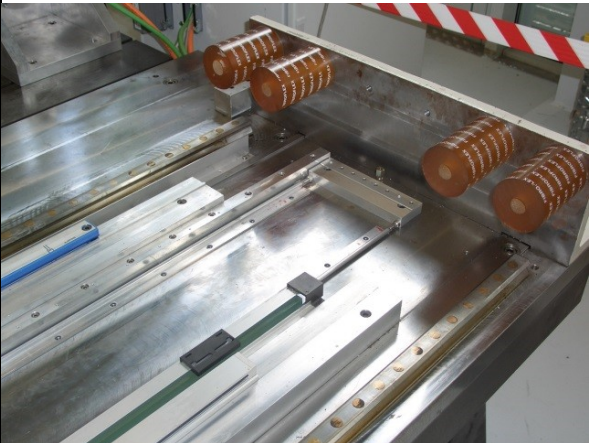

3 Mounting the secondary section cooling

No.	Steps	
3	<p>Align the end pieces: Align the end pieces so that all conical noses of the coupling nipples are inserted about 2 mm into the associated coupling sockets.</p>	
4	<p>Engage the end pieces: Insert the end pieces by hand into their coupled positions. If necessary, drive them in by tapping very cautiously with a hammer at equally spaced intervals across the whole width; place a protective layer, such as a piece of wood, in between hammer and component. The couplings must go in straight without canting! Otherwise the Viton sealing rings in the coupling sockets will be damaged and leak.</p>	



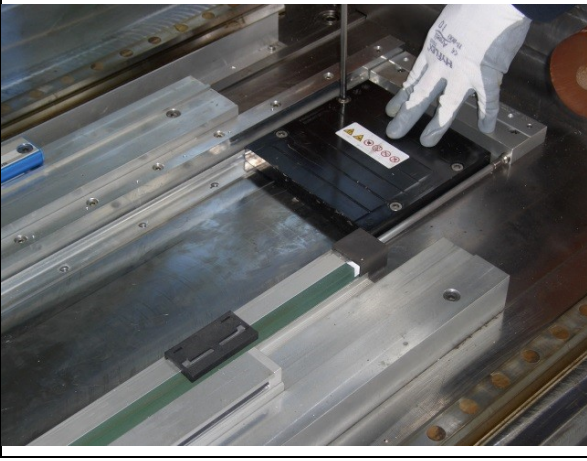
4 Mounting the secondary section segments

4 Mounting the secondary section segments


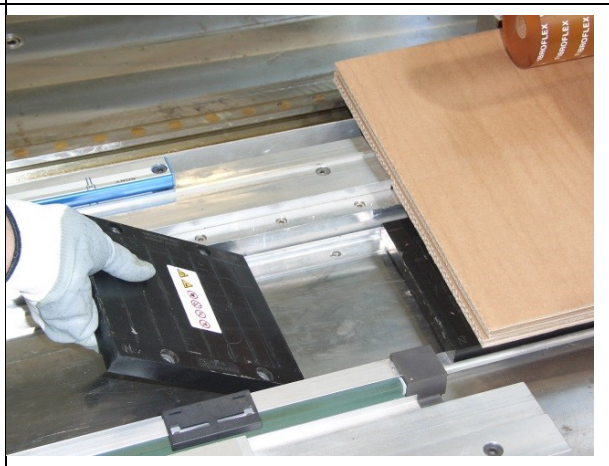
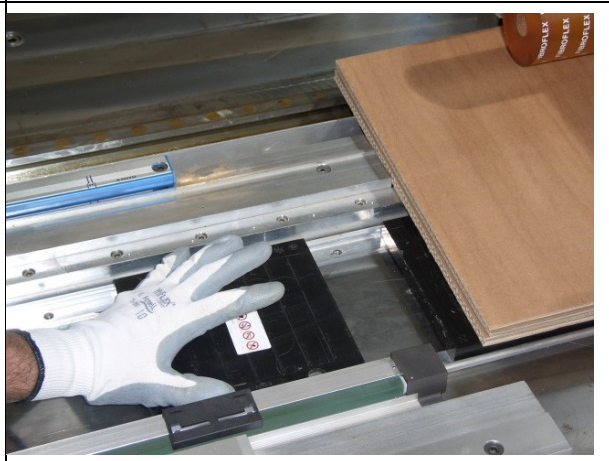
Table 4-1: Steps for the installing the secondary section segments

No.	Steps	
1	<p>Prepare the work equipment:</p> <ul style="list-style-type: none"> - Wear safety shoes. - Cordon off the entire working area with barriers or tapes - Keep electronic and magnetic data storage media and devices (credit cards, watches) out of the working area - Lay the following items out ready on a non-magnetic working surface: - Tool - Fixing screws - Torque wrench - Work gloves (cut-resistant) - Rescue wedge and hammer (both must be non-magnetic) - Secondary section segments (still in their original packaging). 	
2	<p>Prepare the mounting surface:</p> <p>Clean the mounting surface on the machine, and remove all movable objects.</p> <p>The grid of threaded holes must already be present.</p> <p>Heatsink profiles of the secondary section cooling (if provided) must be laid out ready in their intended positions, and prevented from slipping by 2 hand-tightened fixing screws.</p>	
3	<p>Prepare the secondary section:</p> <p>Unpack the first segment of the secondary section:</p> <p>Leave all the other segments in their packaging!</p> <p>Keep the carton boards from the packaging for a later step.</p>	


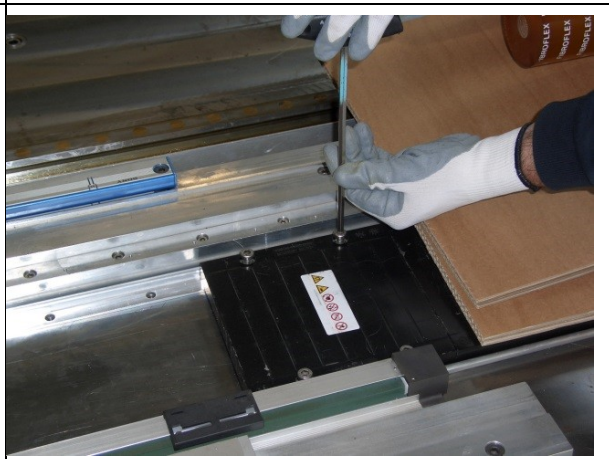
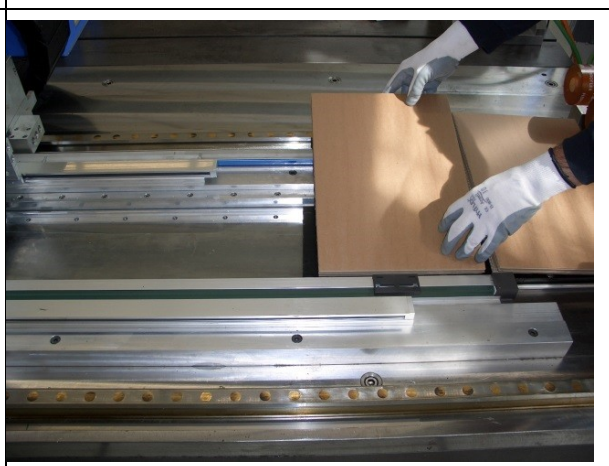
4 Mounting the secondary section segments

4	<p>Insert the secondary section:</p> <p>Lay the secondary section on the mounting surface, aligned as shown in the installation drawing (see operating instructions).</p> <p>Keep one hand on the top surface at all times to prevent the secondary section from accidentally flipping over.</p>	
5	<p>Position the secondary section:</p> <p>Slide the secondary section into the correct position so that the holes in the secondary section are aligned with the threaded holes.</p> <p>Insert fixing screws into all holes.</p>	
6	<p>Fix the secondary section in place:</p> <p>Screw in all the fixing screws completely until the heads of the screws no longer project. Press the secondary section by hand toward the end of the secondary section track so that it is positioned by the threaded shafts of the screws.</p> <p>Now tighten all screws hand tight.</p>	

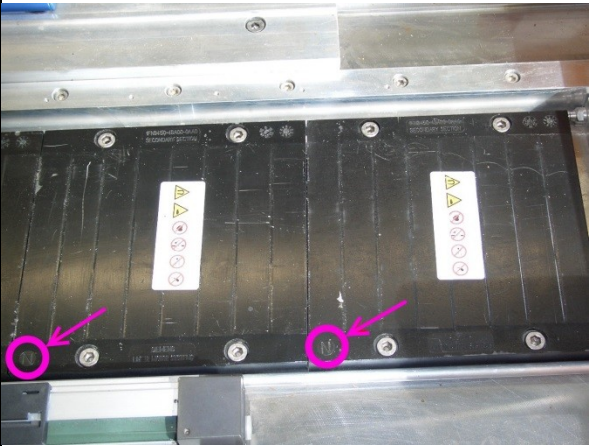

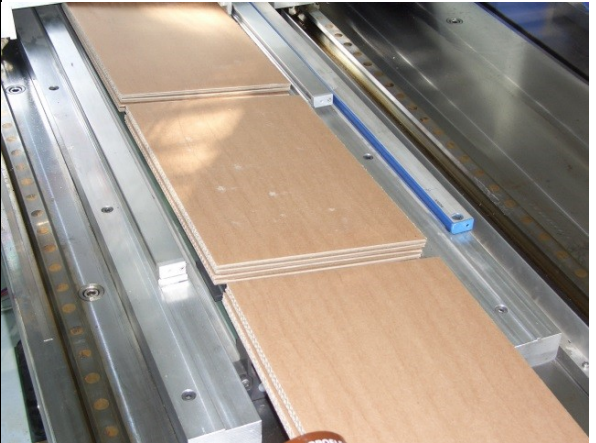
4 Mounting the secondary section segments

<p>7</p>	<p>Cover the secondary section: The secondary section (with its hand-tightened screws) must be protected by a non-magnetic cover at least 2 cm thick. (For example carton boards from the original packaging.)</p>	
<p>8</p>	<p>Next secondary section: Don't unpack the next secondary section until now! Place each subsequent secondary section on the mounting surface at a distance of one hand width from the already fastened sections. Ensure that all the segments have the same magnetic orientation. (The N symbols on the secondary sections all point in the same direction.)</p>	
<p>9</p>	<p>Next secondary section: Hold down the secondary section in a horizontal position, and slide it towards the already fastened secondary section.</p>	

4 Mounting the secondary section segments

<p>10</p>	<p>Next secondary section: If the magnetic orientation is correct, the secondary section is distinctly attracted toward the stop when it reaches a minimum distance of about 20 mm. Be sure to keep hands and fingers out of the intervening gap with!</p>	
<p>11</p>	<p>Next secondary section: Insert all fixing screws. The slightly increased resistance felt when starting to tighten the screws results from them drawing the secondary section into the correct position. Now hand-tighten all screws.</p>	
<p>12</p>	<p>Next secondary section: Cover each subsequent secondary section with a protective cover as soon as it has been fully screwed into place. <u>Do not unpack</u> the next secondary section <u>until this has been done.</u></p>	

4 Mounting the secondary section segments

<p>13</p>	<p>Align secondary section: Mount all the subsequent secondary sections in the same sequence (steps 8 to 12). Ensured without fail that the N symbols on the secondary sections all point in the same direction.</p>	
<p>14</p>	<p>Fasten as defined: Finally tighten all the fixing screws with the specified torque (see table in CM) in the specified order (see operating instructions). The intended gaps between the secondary sections are reached automatically. Caution! Crushing hazard when using a ferromagnetic tool!</p>	
<p>15</p>	<p>Secure the working area: To eliminate hazardous situations after mounting, keep the secondary section track covered with the protective covers until all the other preparatory work has been completed.</p>	

5 Mounting the secondary section cover band

If necessary, the secondary sections of the SIMOTICS L-1FN3 linear motors can be protected from contamination and damage by a band-shaped cover plate ("cover band") or by segmented cover plates.

All parts are available for ordering:

- Multi-piece cover consisting of preformed cover segments.
(See operating instructions for SIMOTICS-L 1FN3 linear motors.)
- One-piece, continuous covering (appropriate length cover band).

If a cover band is used, it is absolutely essential to use an (aluminum) **secondary section end piece** at each end of the secondary section track to fix it in position. If combination end pieces are not specified as part of the secondary section cooling system, at least cover end pieces must be provided.

The two end pieces feature fixing wedges, which are absolutely essential for holding down the cover band.

The cover band is supplied by the factory as a roll and in the exact length required. It is made of corrosion-resistant, semi-magnetic spring steel. It is therefore subject to substantial magnetic forces, which attract it toward the secondary section of the 1FN3 linear motor. As soon as the cover plate lies directly on the secondary section track, the attractive force creates stiction, which makes subsequent precise alignment of the band much more difficult.

Notes on safety The magnetic forces of attraction can set the cover band unexpectedly in fast motion, especially while it is being placed on the secondary section segments. There is a danger of the corners and edges of the band causing crushing and cutting injuries. **Wear safety gloves without fail!**

The material of the cover band has a minimum bending radius of 200 mm. Bending the material to a radius less than this minimum will cause an irreparable kink. The cover band is then unusable. A kink in the cover band projects into the air gap, with the result that it is caught and destroyed by the moving primary section.

Installation work should be carried out by at least two people. It is possible for one person to do the installation work, but this is difficult and requires considerably more effort.

- While one person inserts the cover band into the gap under the machine slide, the second person feeds in the remaining part of the cover band at a suitable angle.
- Especially with axes longer than 4 meters, the band can only be aligned precisely if the central section is also guided by additional persons standing between 1 and 2 meters apart.

A linear axis can be classified by the length of its traversing path as either a:

- Short-path axis (after installation of the machine slide, **at least one** secondary section segment is **no longer accessible** for installation purposes).
- Long-path axis (after installation of the machine slide, **each** secondary section segment is **still accessible** for installation purposes by appropriate positioning of the slide).

As a rule, the cover band has to be mounted on short-path axes before the machine slide is mounted. In this case, the entire fully mounted secondary section track is easily accessible. The simplified installation procedure for the cover band consists of steps 6, 8, 9, 10 and 14 of the following installation instructions (applied analogously).

The following block diagrams are not to scale. The main purpose of the gaps between the secondary section segments is to demarcate the boundaries between the segments.

5 Mounting the secondary section cover band

Fig. 5-1: Diagram of a short-path axis

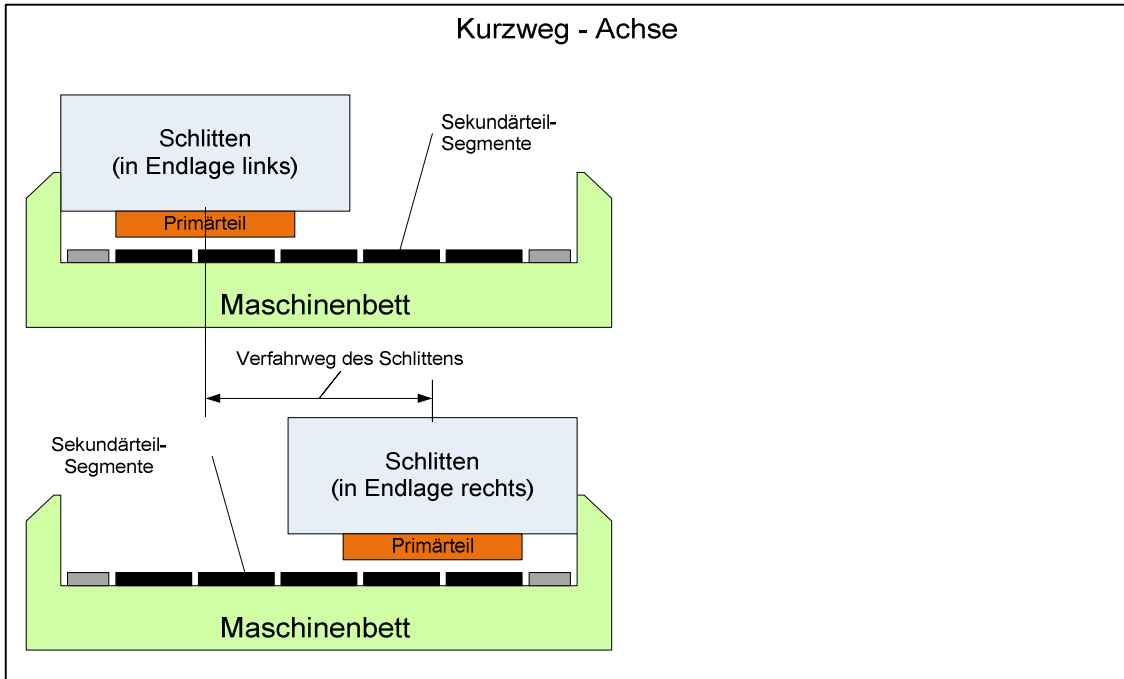
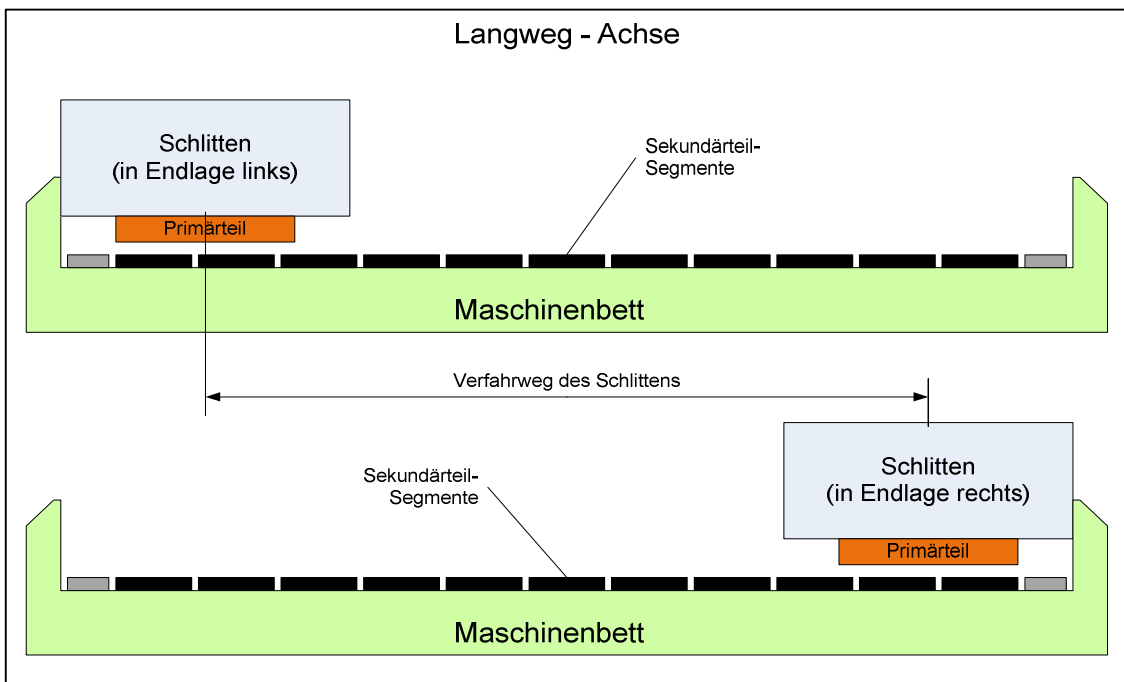



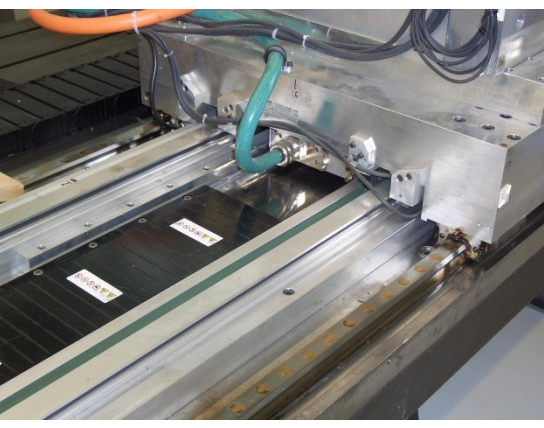
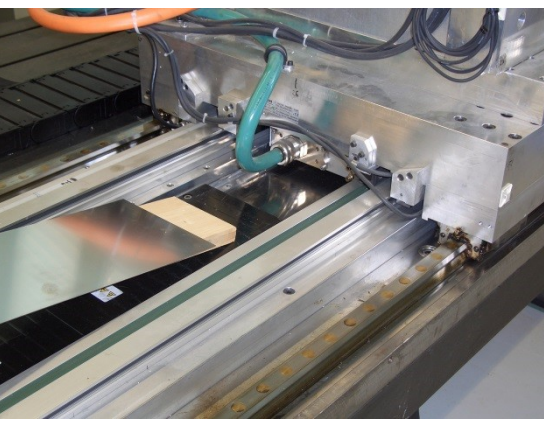
Fig. 5-2: Diagram of a long-path axis



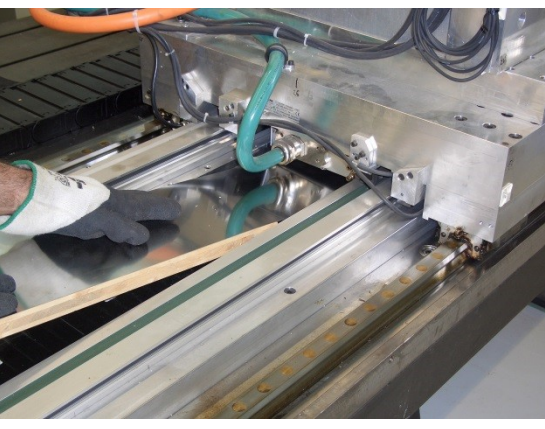

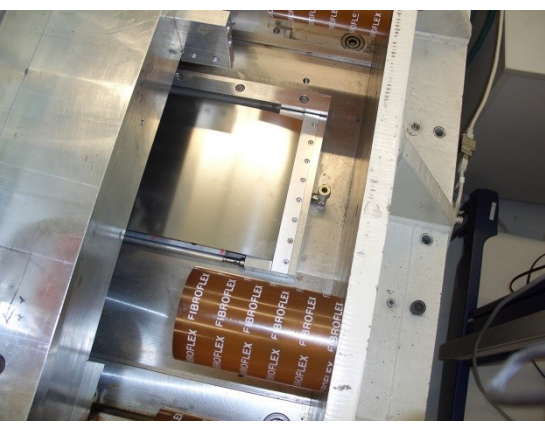
The terms "left-hand end" and "right-hand end" are used in these installation instructions in relation to the secondary section track. The terms can be freely selected by the machine manufacturer, and must be selected from the viewpoint on the more easily accessible side of the machine bed.

5 Mounting the secondary section cover band


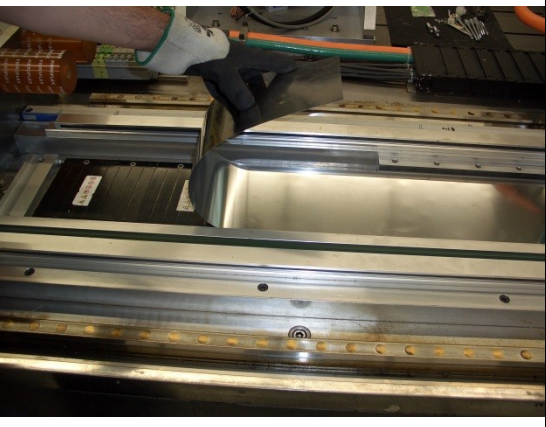
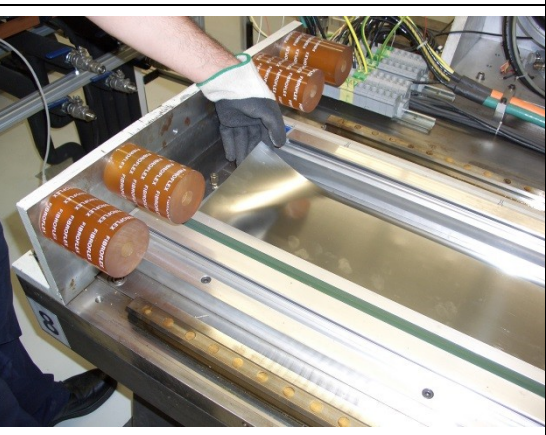
Table 5-1: Steps for installing the secondary section segments

No.	Steps for a long-path axis	
1	<p>Prepare the end pieces:</p> <ul style="list-style-type: none"> - Remove the fixing wedges from the two end pieces. - Place the fixing wedges and their fixing screws to one side. - Lay an insertion guide out ready made of hard, non-magnetic material (preferably wood). 	
2	<p>Prepare the secondary section track: Move the machine slide into the right-hand end position. Starting at the left-hand end of the secondary section track, mount as many secondary section segments as are required to underlay the full length of the machine slide, plus at least one segment length.</p>	
3	<p>Lay the cover band out ready: Notes on safety There is a risk of cutting injuries during all work involving the cover band. Wear safety gloves! Place the insertion guide on the last-mounted segment, and secure it against slipping (if necessary, have it held by a second person), so that it forms a ramp to the gap under the machine slide. Unroll the cover band, and place one end on the insertion guide.</p>	

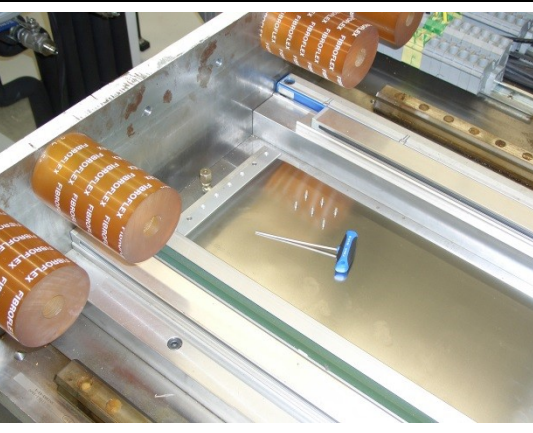
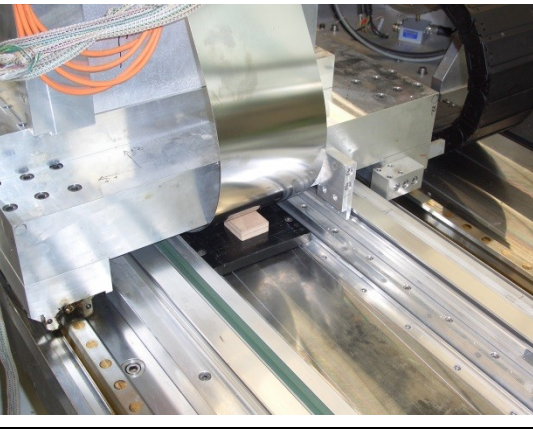
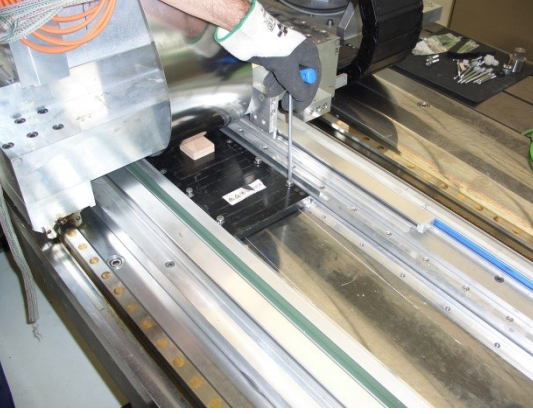
5 Mounting the secondary section cover band

<p>4</p>	<p>Insert the cover band: Slide the cover band down the insertion guide into the gap under the slide, and slide it in until almost its full length has been inserted.</p> <p>Attention: The cover band can only be slid into place because no secondary section segments have been mounted in this position below the slide.</p>	
<p>5</p>	<p>Position the cover band at the right-hand end: Guide the cover band onto the right-hand end piece as soon as it has reached the right-hand end of the machine bed. Align the band in the traversing direction: The threaded holes for the screws that hold the retaining wedge must not be covered. At the same time, align the band centrally, transverse to the traversing direction.</p>	
<p>6</p>	<p>Fixate the right-hand end of the cover band: Place the retaining wedge on the right-hand end piece, hold it down against the spring force, and screw it on with the M3, SW2 fixing screws. Initially, only tighten the screws by hand.</p>	

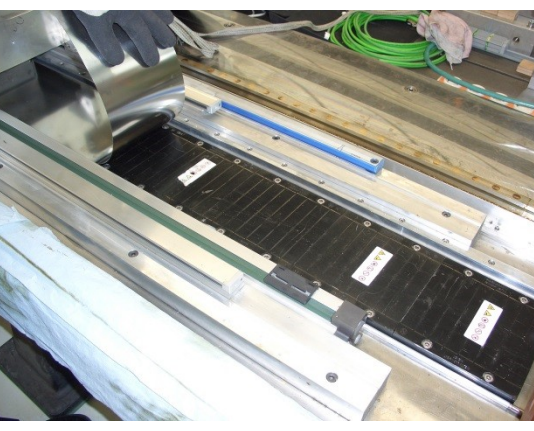

5 Mounting the secondary section cover band

7	<p>Remove the insertion guide: Lift the left-hand end of the cover band off the insertion guide, and bend it upwards with a rolling movement. Remove the insertion guide.</p>	
8	<p>Place the cover plate on the left: Lay the cover band on the secondary section segments by unrolling it from its curved state. Maintain its central and parallel alignment at all times.</p>	
9	<p>Check the alignment: The laid cover band must end directly in front of the threaded holes for the retaining wedge in the left-hand end piece, and it must not be laterally offset. If there is any deviation, the band can be raised again with a rolling movement and realigned.</p>	

5 Mounting the secondary section cover band

10	<p>Fixate the left-hand end of the cover band: Place the retaining wedge on the left-hand end piece, hold it down against the spring force, screw it on with the M3, SW2 fixing screws.</p> <p>Tightening torque: 1.0 Nm</p>	
11	<p>Continue the installation at the right-hand end:</p> <ul style="list-style-type: none"> - Move the machine slide into the left-hand end position. - Release the cover band from the right-hand end piece, and bend it upwards with a rolling movement. - Fixate the cover band in this position. If necessary, insert a wooden wedge to counteract the attraction forces of the secondary section segment. 	
12	<p>Mount the remaining segments: Mount the remaining secondary section segments one after the other up to the right-hand end of the machine bed, and screw them in place with the specified tightening torque.</p>	

5 Mounting the secondary section cover band

13	<p>Lay the right-hand end of the cover band: Lay the cover band on the secondary section segments by unrolling it from its curved state. Maintain the parallel alignment at all times. If there is any deviation, the band can be raised again with a rolling movement and realigned.</p>	 A close-up photograph showing a person's hands unrolling a white, flexible cover band onto a metal secondary section assembly. The assembly consists of several parallel metal rails and a central component. A green cable is visible in the background.
14	<p>Fixate the right-hand end of the cover band: Place the retaining wedge on the right-hand end piece, hold it down against the spring force, fasten with the M3, SW2 fixing screws. Tightening torque: 1.0 Nm</p>	 A close-up photograph showing a person's hands using a screwdriver to fasten a retaining wedge on the right-hand end piece of the secondary section assembly. The wedge is held against a spring force. The assembly is mounted on a metal frame with orange rollers.

6 Mounting the connection cable

6 Mounting the connection cable

Almost all versions of the primary section of the SIMOTICS L-1FN3 built-in linear motor have an integrated terminal panel to which the power cable and signal line, or the combined cable, are connected. This connector is generally made when the customer installs the primary section in the machine.




The mounting procedure illustrated here is mainly with a combined power and signal cable.

The steps also apply analogously to separately routed power cable and signal lines.


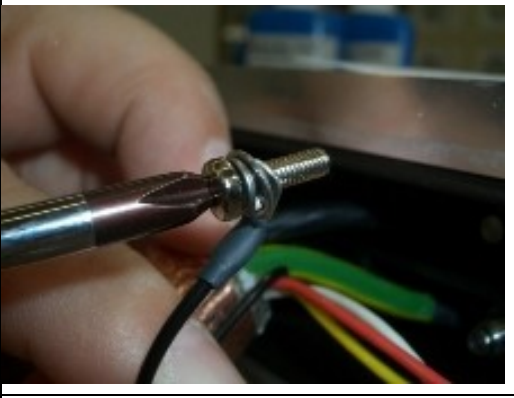

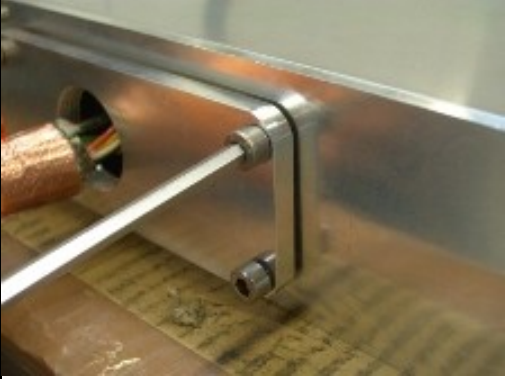
Note:

A (resolvable) thread sealant is not absolutely necessary. Nevertheless, it increases protection against water penetration, and against the threaded joint parting as a result of severe vibration.

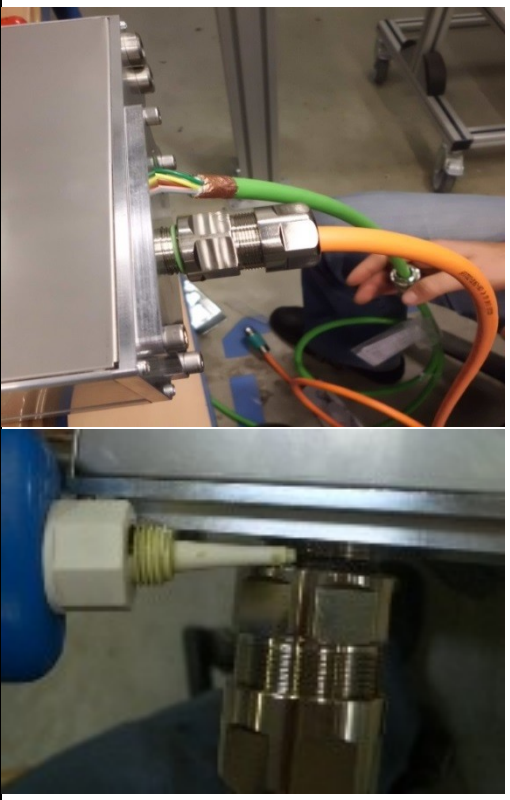
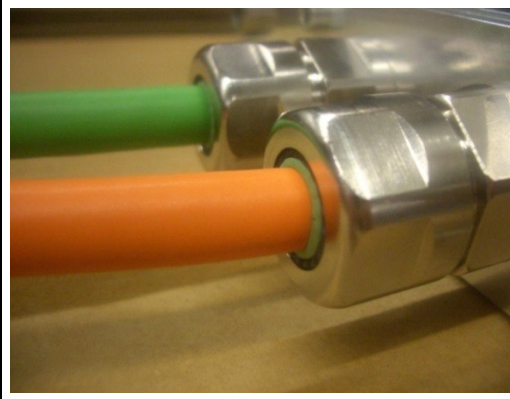
Table 6-1: Steps for installing the connection cables

No.	Steps	
1	Prepare the connection cover: Insert a line of silicon foam into the slot in the connection cover. Note: If the power cable and signal line are routed separately, the sequence of the steps applies correspondingly.	
2	Prepare the power cable: Thread the connection cover onto the prefabricated combination cable, or the power cable and sensor line.	
3	Prepare the power cable conductors: Align the ring cable lugs of the power conductors with the terminal panel. Put the ring cable lugs of phases U, V, W, PE onto their respective threaded pins on the terminal panel.	

6 Mounting the connection cable

No.	Steps							
4	<p>Connect the power cable conductors: Put the washers, spring-lock washers and nuts on the threaded pins, and tighten the nuts. Tightening torque: 6 - 7 Nm</p>							
5	<p>Prepare the sensor conductors: Put the spring-lock washers, washers and ring cable lugs of the sensor conductors on the oval head screws.</p>							
6	<p>Connect the sensor conductors: Mount the sensor conductors on their respective connectors as shown in the drawing, and tighten the screws Tightening torque: 0.6 - 0.8 Nm</p>							
7	<p>Fasten the connection cover: Screw the connection cover to the front panel with the retaining screws provided. Tightening torques: (According to the table in the CM)</p> <table border="1" data-bbox="336 1704 815 1877"> <thead> <tr> <th>Screw size</th> <th>Tightening torque: [Nm]</th> </tr> </thead> <tbody> <tr> <td>M4</td> <td>2.2</td> </tr> <tr> <td>M5</td> <td>3.4</td> </tr> </tbody> </table>	Screw size	Tightening torque: [Nm]	M4	2.2	M5	3.4	
Screw size	Tightening torque: [Nm]							
M4	2.2							
M5	3.4							

6 Mounting the connection cable

No.	Steps													
8	<p>Attach cable gland: Screw the cable gland into the threaded hole in the cover, and tighten as shown in the table below.</p> <table border="1" data-bbox="344 474 842 734"> <thead> <tr> <th data-bbox="344 474 456 600">Nominal size</th> <th data-bbox="459 474 603 600">Width across flats [mm]</th> <th data-bbox="606 474 842 600">Tightening torque: [Nm]</th> </tr> </thead> <tbody> <tr> <td data-bbox="344 604 456 638">M17</td> <td data-bbox="459 604 603 638">19</td> <td data-bbox="606 604 842 638">7.0</td> </tr> <tr> <td data-bbox="344 642 456 676">Size 1</td> <td data-bbox="459 642 603 676">25</td> <td data-bbox="606 642 842 676">16.5</td> </tr> <tr> <td data-bbox="344 680 456 734">Size 1.5</td> <td data-bbox="459 680 603 734">36</td> <td data-bbox="606 680 842 734">33.0</td> </tr> </tbody> </table> <p>ATTENTION: If cable glands without their own seal are used, their threads must be wetted with thread sealant to create adequate seals. (e.g. DELO ML 5249)</p>	Nominal size	Width across flats [mm]	Tightening torque: [Nm]	M17	19	7.0	Size 1	25	16.5	Size 1.5	36	33.0	
Nominal size	Width across flats [mm]	Tightening torque: [Nm]												
M17	19	7.0												
Size 1	25	16.5												
Size 1.5	36	33.0												
9	<p>Fasten the union nut: Tighten the cable gland until the cable seal becomes visible. Criterion for adequate tightening: The seal must not project above the screw connector. Note: If the power cable and signal line are routed separately, the sequence of the steps applies correspondingly.</p>													

7 Angled cable connection

7.1 Connection with angled screw connectors

SIMOTICS L-1FN3 built-in linear motors are fitted as standard with a connector cover that has two threaded holes. The power cable and signal line are connected separately to this cover.

The prefabricated connection cables from SIEMENS already have screw connectors in sizes matching the thread sizes.

M20 x 1.5 for the signal line.

M20 x 1.5 or M32 x 1.5 for the power cable (depending on the cable diameter).

Because of the design, the screw connectors can only be mounted in a straight line – that is in the traversing direction.

If the installation space is so limited that only a 90° angled cable outlet is possible or desired, this can be achieved by using freely rotatable, angled screw connectors. Angled screw connectors must be selected so that their connection thread matches the size of the female thread.

Available from:

PFLITSCH GmbH & Co.KG www.pflitsch.de

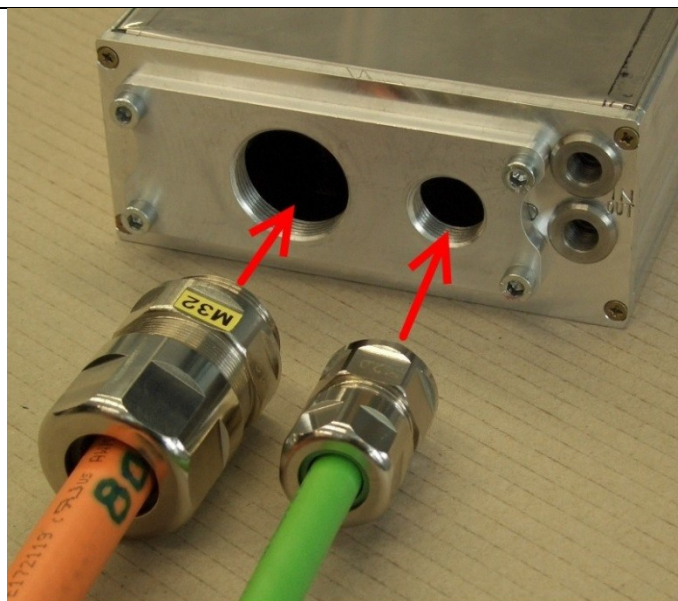
Bracket with coupling outside M20 x 1.5 →inside M20 x 1.5 Article no. 220 EF

Bracket with coupling outside M32 x 1.5 →inside M32 x 1.5 Article no. 232 EF

7 Angled cable connection

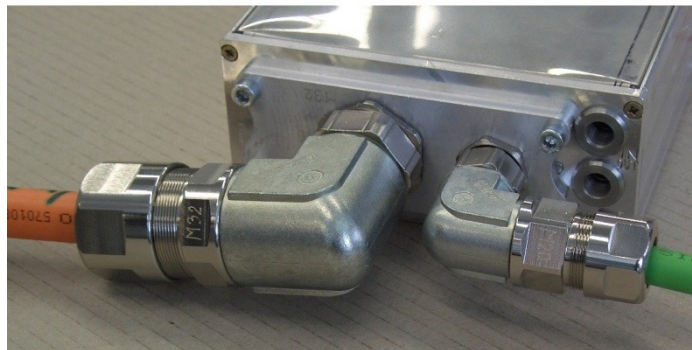
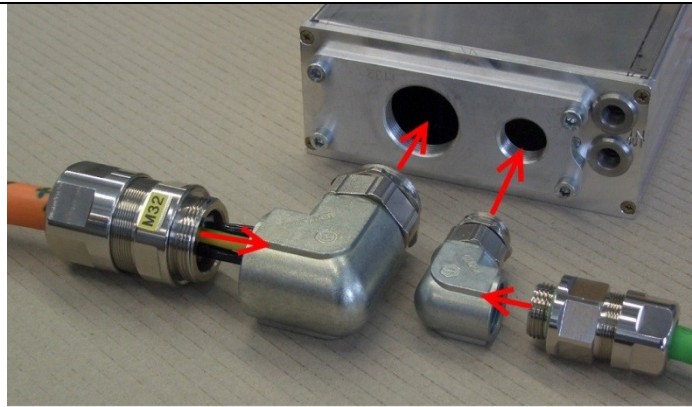
Table 7-1: Angled connector for prefabricated connection cables.

As a rule, the screw connectors are screwed directly (that is in the traversing direction) into the connection cover.



7 Angled cable connection

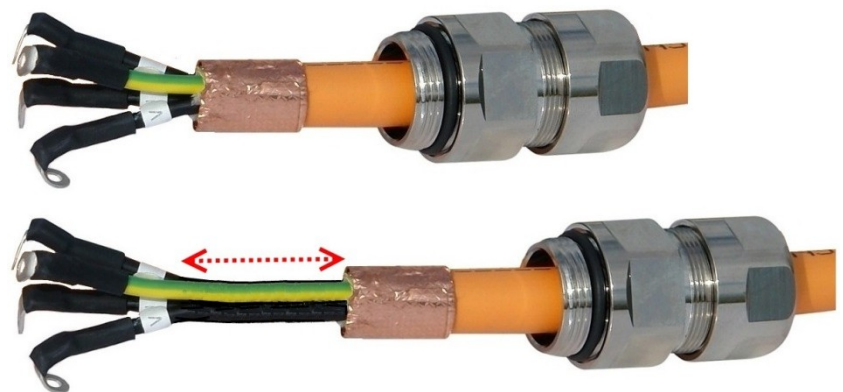
To create a 90° angled connection, angled screw connectors are fitted between the original screw connector and the cover plate.



The following applies to the prefabricated power cable:

Cut back the cable jacket and protective braided shield to expose a length of cable conductor that is long enough for the size of the screw connector:

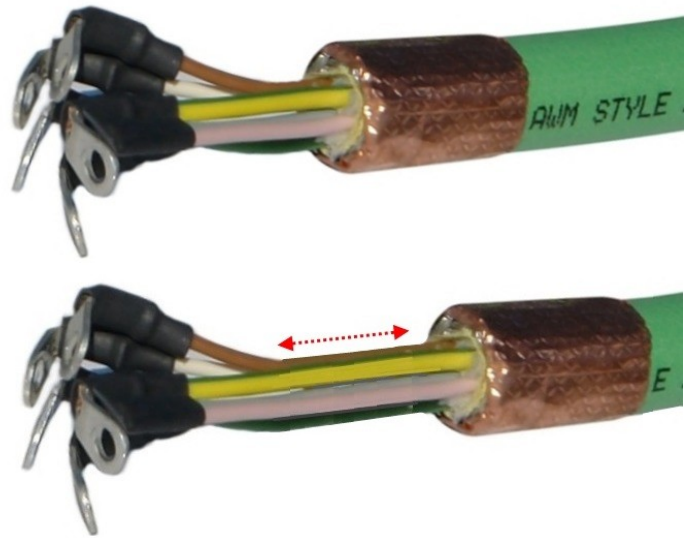
- Approx. 80 mm for M32
- Approx. 60 mm for M20



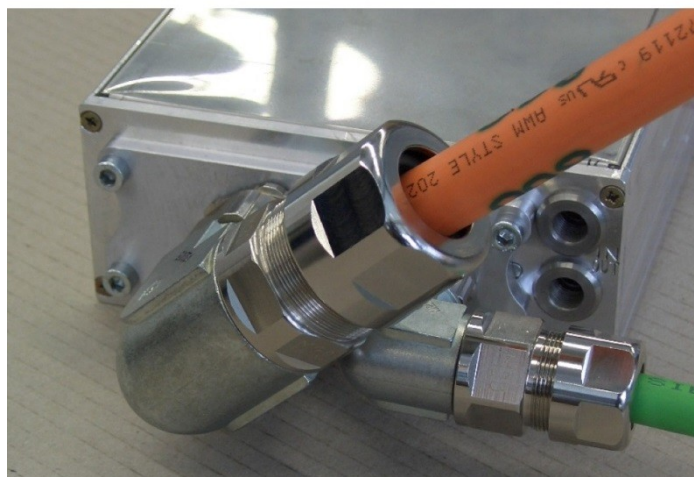
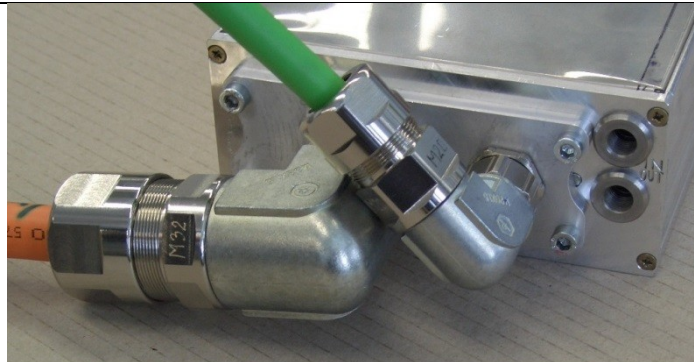
7 Angled cable connection

The same applies to the prefabricated signal line (M20 screw connector):

The cable jacket and protective braided shield must be cut back by 60 mm.



If necessary, the angled screw connectors can be fastened in a rotated position to the extent that the adjacent connection and the cooling system connections permit this arrangement.




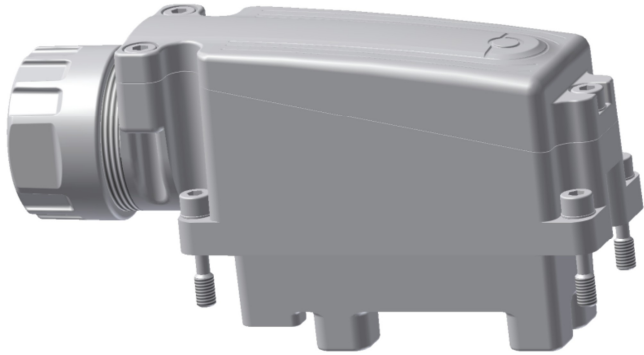
7 Angled cable connection

7.2 Connection via a LIMOTEC 900 angled connector

The angled connector contains a screw connector for a single cable. This means that it is suitable only for a combination cable (power conductors and signal conductors are laid together).

Only one connector size is offered, which is suitable for frame size 1FN3300 to 900 primary sections. It is not suitable for frame size 1FN3050, 100 and 150 primary sections. A LIMOTEC 900 angled connector cannot be used together with the primary section cooling on frame size 1FN3300 primary sections because of their narrow width.

Table 7-2: LIMOTEC 900 angled connector

<p>The LIMOTEC 900 angled connector is mounted directly on the front panel of the primary section instead of the connection cover.</p>	
<p>Manufacturer: INTERCONTEC Produkt GmbH info@intercontec.biz</p> <p>Order No.: S ST N 001 FC 02 45 0400 002</p> <p>The complete equipment requires an additional 4 x 2 mm signal plug sockets, which have to be ordered separately. Order No.: 60.229.11</p>	

8 Cooling system connection

8 Cooling system connection

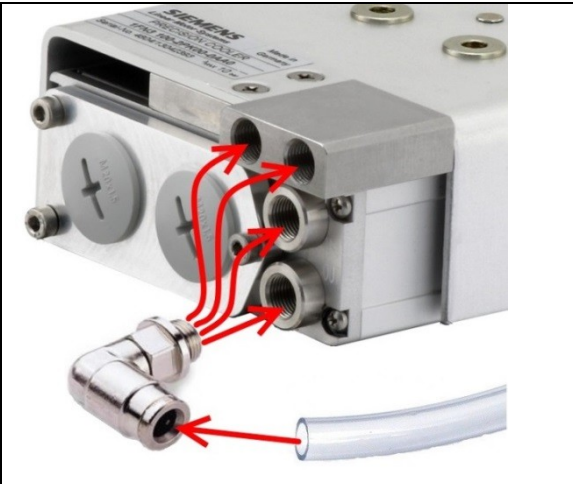
Straight and angled hose push-in fittings are available for quickly connecting the cooling system of the SIMOTICS L-1FN3 linear motor.

The cooling system of the primary section, the precision cooler and the secondary section cooling can all be connected by screw-type fittings (thread type G1/8; hose diameter 6, 8 or 10 mm).

Depending on the mounting situation, a hose infeed with angled push-in fittings or straight push-in fittings or a combination of the two may be most advantageous. Only rotatable versions of the push-in fittings should be selected.

To release the push-in fitting, press the release ring when the push-in-fitting is not under tension (refer also to the push-in fitting product data sheet). Otherwise the interior ring claw cannot be released.

Table 8-1: Illustrated description of possible connection types using push-in fittings.

<p>Cooling system connection with angled screw-type push-in hose fittings</p> <p>Source of supply, e.g. AVS Ing. J. C. Römer GmbH Type 951X4-8F-1/8 (for 8 mm hose)</p>	
<p>Cooling system connection with straight push-in hose fittings</p> <p>Source of supply, e.g. AVS Ing. J. C. Römer GmbH Type 930X4-8F-1/8 (for 8 mm hose)</p>	