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Synchronous linear motors of

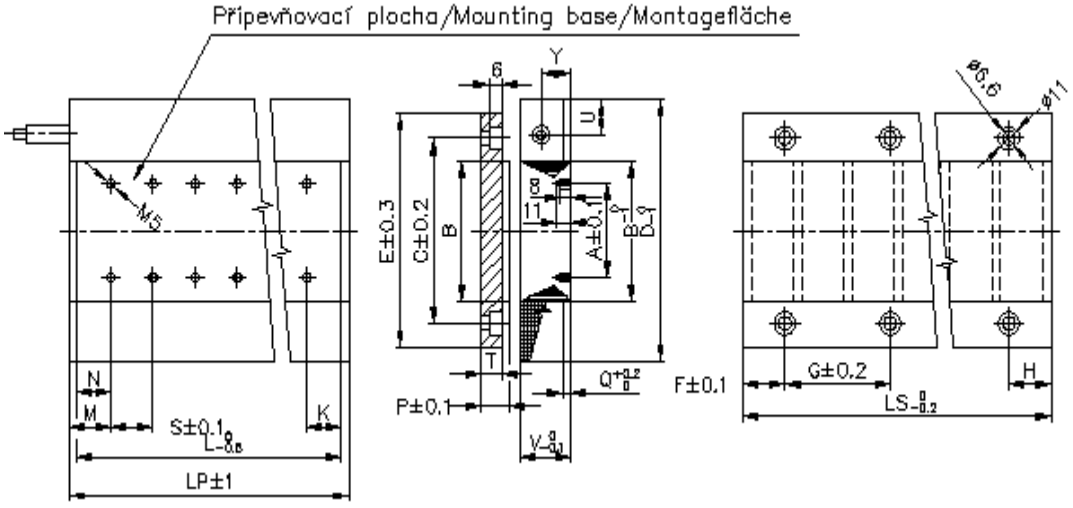
series L3S

Flat linear motors for dynamic drives

Thrust forces	30 ÷ 20 000 N
Thrust speed	0 ÷ 20 m s^{-1}
Air cooling	IC 40
Temperature class	F
Enclosure	IP 55

Issue: March 2005.

♦ Řada L3S ♦ Series L3S ♦ Reihe L3S ♦



Primární díly / Primary parts / Primärteile

Typ / Type / Typ	F_{peak} [N]	A [mm]	B [mm]	D [mm]	L [mm]	L_p [mm]	K [mm]	M [mm]	N [mm]	Q [mm]	S [mm]	V [mm]	δ_{tr}/δ_{el} [mm]	U [mm]	Y [mm]	m [kg]
L3S030P-1215	400	1x16	30	64	184,2	192	17,1	21	17,1	6	75	43,9	0,5/1,0	9	29	2,5
L3S030P-2415	800				360	368	30	34	30							4,8
L3S030P-3615	1200				535,8	544	42,9	47	42,9							7,3
L3S050P-1215	650	1x36	50	84	184,2	192	17,1	21	17,1	6	75	43,9	0,5/1,0	9	29	3,6
L3S050P-2415	1300				360	368	30	34	30							6,9
L3S050P-3615	1950				535,8	544	42,9	47	42,9							10,4
L3S050P-4815	2600				711,6	720	18,3	22,5	18,3							13,9
L3S075P-1215	1000	2x32	75	109	184,2	192	17,1	21	17,1	6	75	43,9	0,5/1,0	9	29	5
L3S075P-2415	2000				360	368	30	34	30							9,6
L3S075P-3615	3000				535,8	544	42,9	47	42,9							14,4
L3S075P-4815	4000				711,6	720	18,3	22,5	18,3							19,2
L3S075P-6015	4900				887,4	896	31,2	35,5	31,2							23,9
L3S100P-1215	1325	2x36	100	134	184,2	192	17,1	21	17,1	6	75	43,9	0,5/1,0	9	29	6,5
L3S100P-2415	2650				360	368	30	34	30							12,5
L3S100P-3615	3970				535,8	544	42,9	47	42,9							18,9
L3S100P-4815	5300				711,6	720	18,3	22,5	18,3							25
L3S100P-6015	6600				887,4	896	31,2	35,5	31,2							31,2
L3S150P-1215	2000	4x32	150	184	184,2	192	17,1	21	17,1	8	75	45,9	0,5/1,0	10	31	9,5
L3S150P-2415	3900				360	368	30	34	30							18
L3S150P-3615	5800				535,8	544	42,9	47	42,9							27
L3S150P-4815	7700				711,6	720	18,3	22,5	18,3							36
L3S150P-6015	9600				887,4	896	31,2	35,5	31,2							45
L3S200P-1215	2700	5x36	200	234	184,2	192	17,1	21	17,1	8	75	45,9	0,5/1,0	10	31	12
L3S200P-2415	5250				360	368	30	34	30							23,5
L3S200P-3615	7800				535,8	544	42,9	47	42,9							35
L3S200P-4815	10350				711,6	720	18,3	22,5	18,3							47
L3S200P-6015	12900				887,4	896	31,2	35,5	31,2							58
L3S250P-1215	3170	6x38	250	284	184,2	192	17,1	21	17,1	8	75	45,9	0,5/1,0	10	31	15
L3S250P-2415	6300				360	368	30	34	30							29
L3S250P-3615	9450				535,8	544	42,9	47	42,9							43
L3S250P-4815	12600				711,6	720	18,3	22,5	18,3							58
L3S250P-6015	15750				887,4	896	31,2	35,5	31,2							72

Sekundární díly / Secondary parts / Sekundärteile

Typ / Type / Typ	B [mm]	C [mm]	E [mm]	F [mm]	G [mm]	H [mm]	Ls [mm]	P [mm]	T [mm]	2p	m [kg]
L3S030S-0416	30	45	60	32	-	32	64	14	8,5	4	0,34
L3S030S-0816					64		128			8	0,68
L3S030S-1616					3x64		256			16	1,36
L3S030S-3216					7x64		512			32	2,72
L3S030S-6416					15x64		1024			64	5,43

Typ / Type / Typ	B [mm]	C [mm]	E [mm]	F [mm]	G [mm]	H [mm]	Ls [mm]	P [mm]	T [mm]	2p	m [kg]
L3S050S-0416	50	65	80	32	-	32	64	14	8,5	4	0,47
L3S050S-0816					64		128			8	0,95
L3S050S-1616					3x64		256			16	1,89
L3S050S-3216					7x64		512			32	3,8
L3S050S-6416					15x64		1024			64	7,58
L3S075S-0416	75	90	105	32	-	32	64	14	8,5	4	0,64
L3S075S-0816					64		128			8	1,28
L3S075S-1616					3x64		256			16	2,56
L3S075S-3216					7x64		512			32	5,12
L3S075S-6416					15x64		1024			64	10,24
L3S100S-0416	100	115	130	32	-	32	64	14	8,5	4	0,8
L3S100S-0816					64		128			8	1,6
L3S100S-1616					3x64		256			16	3,2
L3S100S-3216					7x64		512			32	6,4
L3S100S-6416					15x64		1024			64	12,8
L3S150S-0416	150	165	180	32	-	32	64	14	8,5	4	1,31
L3S150S-0816					64		128			8	2,62
L3S150S-1616					3x64		256			16	5,25
L3S150S-3216					7x64		512			32	10,5
L3S150S-6416					15x64		1024			64	21
L3S200S-0416	200	215	230	32	-	32	64	14	8,5	4	1,7
L3S200S-0816					64		128			8	3,4
L3S200S-1616					3x64		256			16	6,81
L3S200S-3216					7x64		512			32	13,62
L3S200S-6416					15x64		1024			64	27,24
L3S250S-0416	250	270	285	32	-	32	64	14	8,5	4	2,11
L3S250S-0816					64		128			8	4,22
L3S250S-1616					3x64		256			16	8,45
L3S250S-3216					7x64		512			32	16,9

Standardně používané kabely / Standard cables / Standard Kabel

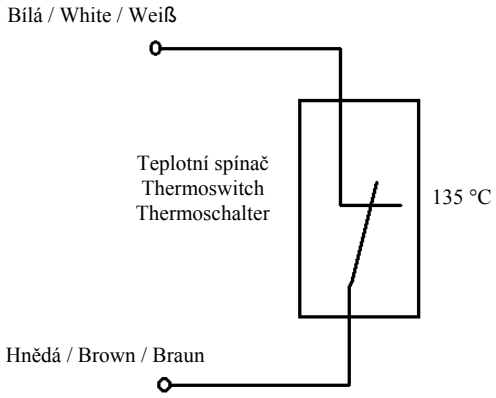
Kabel / Cable / Kabel	30°C*	40°C*	60°C*
4 x 0,75 + 1x (2 x 0,25)	12 A	10,4 A	7,8 A
4 x 1,5 + 1x (2 x 0,5)	18 A	15,5 A	11,7 A
4 x 2,5 + 1x (2 x 0,5)	26 A	24 A	16,8 A
4 x 4 + 1x (2 x 0,5)	42 A	38,5 A	27,5 A

*) – Teplota okolí / Ambient temperature / Umgebungstemperatur

Zapojení / Connection / Schaltung

Měnič / Converter Verstärker	Kabel / Cable Kabel
U	1
V	2
W	3
PE	YG*
TS	Bílá / White / Weiß
TS	Hnědá / Brown / Braun

TS – Teplotní spínač / Thermoswitch / Thermoschalter
YG* – Žlutozelená / Yelow-green / Gelb-grün



Teplotní spínač / Thermoswitch / Thermoschalter

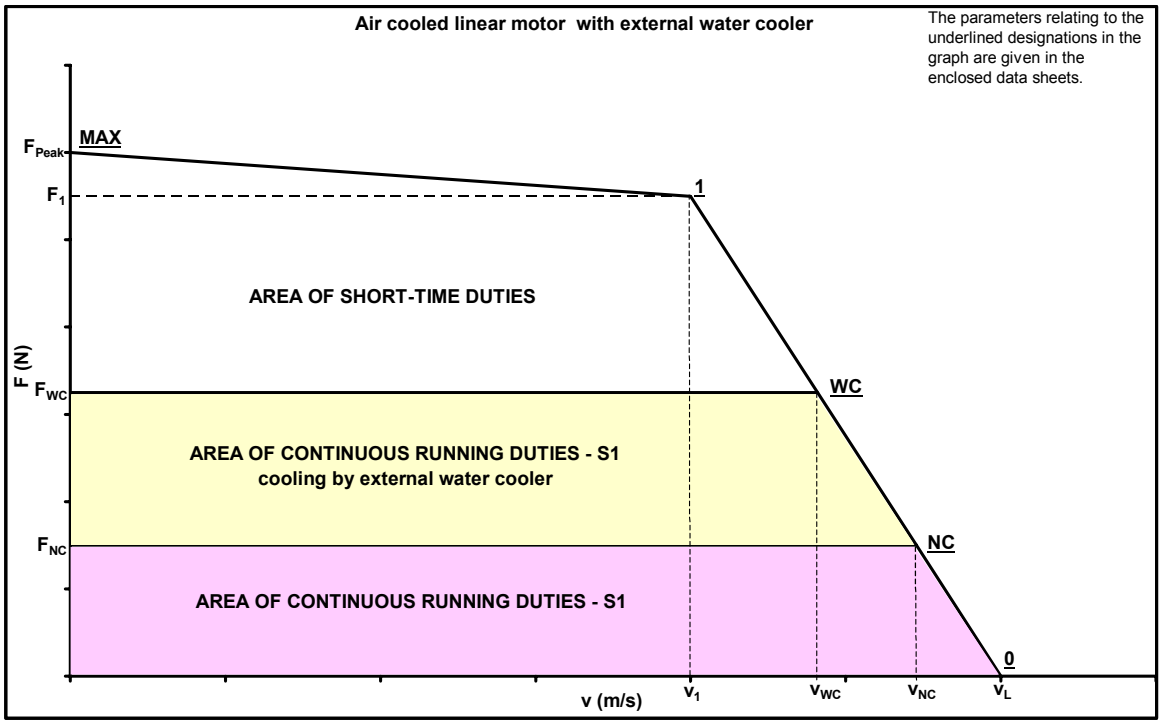
Provedení	Design	Kontaktausführung	Rozpínací / Breake contact / Öffner	
Jmenovité napětí	**Nominal voltage**	**Nennspannung**	250 V_{AC}	500 V_{AC}
Jmenovitý proud	**Nominal current**	**Nennstrom**		
		cosϕ = 1,0	2,5 A	0,75 A
		cosϕ = 0,6	1,6 A	0,5 A
Max. rozpínací proud	**Max.switching current**	**Schaltstrom max.**	7,5 A	2,5 A

Technická data / Technical data / Technische Daten

L3S030P – 250P , U_{DC} = 560

Typ / Type / Typ	F_{peak} [N]	I_{peak} [A]	F_1 [N]	I_1 [A]	v_1 [ms^{-1}]	f_1 [Hz]	ΔP_1 [W]	F_{nc} [N]	I_{nc} [A]	v_{nc} [ms^{-1}]	ΔP_{nc} [W]	F_A [N]	I_{ULT} [A]	k_F [NA^{-1}]	R_{U-V} [Ω]	L_{U-V} [mH]	τ_{el} [ms]
L3S030P-1215-HH	400	8	300	5,6	8,5	265	290	150	2,50	9,5	65	900	11	60	5,48	34	7
L3S030P-2415-HH	800	16	600	11,1	8,5	265	585	300	5,10	9,5	130	1750	23	60	2,74	17	7
L3S030P-3615-HH	1200	25	900	16,6	8,5	265	875	450	7,70	9,5	195	2580	34	60	1,83	11	7
L3S050P-1215-JH	650	8	500	5,6	5,1	159	396	280	2,80	5,6	110	1480	11	100	7,4	55	8,5
L3S050P-2415-JH	1300	16	1000	11,1	5,1	159	792	560	5,70	5,6	220	2880	23	100	3,7	27	8,5
L3S050P-3615-JH	1950	25	1500	16,6	5,1	159	1190	840	8,60	5,6	330	4300	34	100	2,47	18	8,5
L3S050P-4815-JH	2600	32	2000	22,2	5,1	159	1585	1120	11,50	5,6	440	5700	44	100	1,85	14	8,5
L3S075P-1215-NH	1000	8	750	5,6	3,4	106	635	440	3,00	3,7	160	2200	11	150	9,81	79	9,2
L3S075P-2415-NH	2000	16	1500	11,1	3,4	106	1065	880	6,00	3,7	320	4320	23	150	4,9	39	9,2
L3S075P-3615-NH	3000	25	2250	16,6	3,4	106	1575	1320	9,00	3,7	480	6430	34	150	3,27	26	9,2
L3S075P-4815-NH	4000	32	3000	22,2	3,4	106	2100	1760	12,00	3,7	640	8540	44	150	2,45	20	9,2
L3S075P-6015-NH	5000	41	3750	27,8	3,4	106	2685	2200	15,00	3,7	800	10650	57	150	1,96	16	9,2
L3S100P-1215-PH	1325	8	1000	5,6	2,5	78	655	600	3,00	2,7	220	2950	11	200	12,2	105	9,8
L3S100P-2415-PH	2650	16	2000	11,1	2,5	78	1310	1200	6,10	2,7	430	5760	23	200	6,11	52	9,8
L3S100P-3615-PH	3970	25	3000	16,6	2,5	78	1970	1800	9,20	2,7	640	8570	34	200	4,07	35	9,8
L3S100P-4815-PH	5300	32	4000	22,2	2,5	78	2630	2400	12,30	2,7	850	11380	44	200	3,05	26	9,8
L3S100P-6015-PH	6600	41	5000	27,8	2,5	78	3280	3000	15,40	2,7	1100	14200	57	200	2,44	21	9,8
L3S150P-1215-SH	2000	8	1500	5,2	1,6	50	935	900	2,9	1,76	300	4420	11	300	18,2	180	9,9
L3S150P-2415-SH	3900	15	3000	10,4	1,6	50	1845	1800	5,8	1,76	600	8640	20	300	9,13	90	9,9
L3S150P-3615-SH	5800	22	4500	15,6	1,6	50	2780	2700	8,7	1,76	900	12860	30	300	6,08	60	9,9
L3S150P-4815-SH	7700	30	6000	20,7	1,6	50	3685	3600	11,5	1,76	1200	17000	40	300	4,56	45	9,9
L3S150P-6015-SH	9600	37	7500	26,0	1,6	50	4550	4500	14,4	1,76	1500	21300	50	300	3,65	36	9,9
L3S200P-1215-QH	2700	8	2000	5,2	1,2	37,5	1185	1260	3,0	1,31	425	5900	11	400	23,4	240	10,5
L3S200P-2415-QH	5250	15	4000	10,4	1,2	37,5	2370	2520	6,0	1,31	840	11520	20	400	11,70	120	10,5
L3S200P-3615-QH	7800	23	6000	15,5	1,2	37,5	3550	3780	9,1	1,31	1265	17150	30	400	7,80	80	10,5
L3S200P-4815-QH	10350	30	8000	20,7	1,2	37,5	4730	5040	12,1	1,31	1680	22770	40	400	5,85	60	10,5
L3S200P-6015-QH	12900	37	10000	25,9	1,2	37,5	5920	6300	15,1	1,31	2125	28400	50	400	4,68	48	10,5
L3S250P-1215-TH	3170	7	2400	5	1	31,3	1460	1500	2,9	1,09	500	7370	11	500	28,6	300	12
L3S250P-2415-TH	6300	15	4800	9,9	1	31,3	2915	3000	5,7	1,09	1000	14400	20	500	14,3	150	12
L3S250P-3615-TH	9450	21,7	7200	14,9	1	31,3	4370	4500	8,6	1,09	1500	21430	30	500	9,52	100	12
L3S250P-4815-TH	12600	29	9600	19,9	1	31,3	5830	6000	11,5	1,09	2000	28450	40	500	7,14	75	12
L3S250P-6015-TH	15750	36,2	12000	24,8	1	31,3	7280	7500	14,4	1,09	2500	35500	50	500	5,71	60	12

Load characteristic of the type L3S



List of symbols

F_{peak} [N] - highest force developed by the motor (it is used as starting force)

F_1 [N] - max. force by current I_1 and speed v_1

v_1 [m/s] - speed of the motor by current I_1 and force F_1 F_1 ,I_1 and v_1 values determine the transition point of the motor.

F_{NC} [N] - force being developed by the motor continuously at the air cooling by the motor surface and additional cooling area represented by an aluminium plate with the thickness of 10 mm and the cooling surface area three times as large as mechanical interface of the primary part. This additional cooling plate serves for simulating heat removal into the structure of the driven equipment during the tests

F_A [N] - attractive force between the primary and secondary parts of the motor

F_{wc} [N] - force being developed by the motor continuously at the cooling by the additional water cooler

I_{peak} [A] - current corresponding to the force F_{peak}

I_1 [A] - maximum short-time permissible current (r.m.s. value) corresponding to the force F_1

I_{wc} [A] - current corresponding to the force F_{wc}

I_{NC} [A] - current corresponding to the force F_{NC}

R_{u-v} [Ω] - resistance of the motor winding at 20°C

L_{u-v} [mH] - inductance of the winding

τ_{el} [ms] - electromagnetic time constant of the motor

U_{BUS} [V] - DC voltage of intermediate circuit of the frequency inverter for which the motor is intended

k_F [N/A] - force constant

k_E [Vs/m] - voltage constant

k_M [N/√W] - motor constant

v_L [m/s] - theoretical no-load velocity

ΔP_1 [W] - motor losses corresponding to the force F_1 at the winding temperature of 130°C

ΔP_{wc} [W] - motor losses corresponding to the force F_{wc} at the winding temperature of 130°C

ΔP_{NC} [W] - motor losses corresponding to the force F_{NC} at the winding temperature of 130°C

m [kg] - mass of the primary part of the motor

m_{sec} [kg] - mass of the secondary part of the motor

f_1 [Hz] - supply current frequency corresponding to the velocity v_1

I_{ult} [A] - ultimate current, exceeding of which may cause magnet demagnetization

Type key for linear motors

L	3	S		050	P	-	24	15	-	F	L	-	X	0	-	000

Linear

Number of the series

(1 , 2 , 3 , 4)

Type of the motor

Synchronous	S
Induction	A
Reluctance	R

Integrated cooler

Active width

Part of the motor

Primary	P
Secondary	S
Additional cooler	K

Number of slots in primary part

Number of poles in secondary part

Slot pitch of primary part

Pole pitch of secondary part

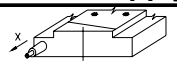
Force constant

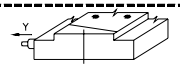
B - 9	H - 60	O - 180	0 - For secondary part and cooler
C - 15	K - 70	P - 200	
D - 25	I - 90	R - 250	
E - 30	J - 100	S - 300	
F - 45	L - 120	U - 350	
G - 50	N - 150	Q - 400	

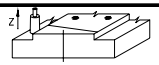
Type of the winding

- N - Winding for U_{DC}=140 V_{DC}
- L - Winding for U_{DC}=330 V_{DC}
- H - Winding for U_{DC} = 560 V_{DC}
- 0 - For secondary part and cooler

Electrical supply

X - 

Y - 

Z - 

- 0 - For secondary part and cooler
- S - Connector

Version

- 0 - Standard
- 1 - Dimensional deviations
- 2 - Electrical deviations
- 3 - Dimensional and electrical deviations

Serial number of the variant

General technical and operating conditions of the motors

Cooling of linear motors

Primary parts:

- series L3S : IC40 i.e. natural cooling by means of motor surface
- series L3SK : IC3W7 i.e. water cooling by means of integrated cooler
- series L3S + cooler : IC3W7 i.e. water cooling by means of additional cooler
- series L3SK + cooler: IC3W7 i.e. water cooling by means of both types of coolers
- Secondary parts: are not cooled

Operating conditions

Linear motors are designed for being used in the environment protected against weather influences defined in the ČSN EN 60721-3-3 standard:

- ambient temperature +5 °C to +40 °C;
- relative air humidity 5 % to 95 %;
- altitude above sea level up to 1000 m;
- For water cooling, it is necessary to use treated water without mechanical impurities. The recommended water hardness is max. 0,7 mmoll/l. If necessary, water softeners are to be used. The recommended cooling water acidity is 6,5 pH to 7,5 pH. The inlet water temperature is +5 °C to +25 °C. The maximum quantity of cooling water is 5 l/min at the pressure drop of 2 hPa. The cooling system is tested at the maximum pressure of 1 MPa.

Other technical data

- Degree of protection of the motor:
  A high degree of protection IP 55 against contact with live parts is reached by embedding the whole winding and the primary motor circuit into protective sealing compound. As the motors are usually delivered as built-in ones, protection against contact with moving parts cannot be ensured.
- Thermal insulation class “F” according to ČSN EN 60034; Part 1 standard, allows the maximum temperature rise of the winding up to 105 K.
- The winding of the standard motor design is three-phase one, either **Y** -connected, without neutral point led out, or **Δ** - connected.
- Thermal protection:
  The winding of the standard motor design is protected by a thermal sensor (break contact) being located in end windings and reacting at the temperature of 135 °C. On customer request also PTC, KTY-84 or resistance thermometers can be used as thermal sensors.
- Connection of the motor to the frequency inverter:
  The winding outlet is made as a standard by flexible cable enabling also supply of the moving primary part. On request the motor winding can be led out to a connector determined by the customer.
- Surface protection:
  The standard machines are painted black. On request of the customer also a paint for food industry or another colour can be used.

Safety rules

The secondary parts of synchronous linear motors are fitted with very strong permanent magnets (Br ≈ 1,2 T). The coercive force of the magnets is stable, independent of machine operating conditions and results in a continuous attractive force acting between the primary and secondary parts (see the attractive force values in data sheets of the particular motors), as well as between the secondary part and any magnetic part in the close vicinity. If these parts are not fixed, they could get move suddenly, unexpectedly and very fast. Their movement ends by a very strong pressure on secondary part. As these forces are not detectable by human senses, they are often underestimated. Magnetic field also

influences sensitive electronic and magnetic devices as watches, mobile phones, floppy discs, magnetic cards, computers and disturbs the colour stability on displays. The influence of magnetic field on healthy human body is harmless. Magnetic field may also influence pacemakers, audio aids and other electronic orthopaedic aids, which may be very dangerous for persons wearing them.

Main precautions :

- Assembly and maintenance must be carried out by at least two trained operators.
- Assembly or maintenance must be always carried out in gloves.
- Warning plates

  ATTENTION: STRONG MAGNETS IN LINEAR DRIVES OF THIS MACHINE !
  STRONG MAGNETIC FIELD !
  HIGH MAGNETIC ATTRACTIVE FORCES !

  must be located on visible places.
- Unfixed magnetic objects, as tools, jigs and parts ready for mounting must not be placed near secondary parts of the linear motor.
- Persons with pacemakers cannot be allowed to work close to the linear drives of this kind.
- For the case of an accident that could occur when working with linear motor at least two solid wedges made of non-magnetic material, and a hammer (approx. 1 kg) must be always at hand. These are the necessary tools for releasing fingers, hand or foot pushed between two magnetic parts.
- Special non-magnetic assembly facilities should be used, if necessary.

Rules for transport and storage:

- Products must be transported and stored in a special non-magnetic packing securing the safe distance (approx. 25 mm) from secondary parts.
- In the course of transporting the machines or their parts with built-in primary and secondary parts their mutual moving must be prevented.
- Store rooms must be protected against weather influence, with the temperature in the range of -5 ÷ +35 °C and at the humidity below 95 %. The rooms must be kept dry and clean.
- The stored magnetic parts must be designated with a warning plate

  ATTENTION ! STRONG MAGNETS !

Notice: The original package secures the demanded safe distance from magnets and warning plates are attached to each part.

Assembly rules:

- The assembly must be always done by two workers at least.
- Any spontaneous movement of the secondary part or primary part of the linear motor along its assembled track must be prevented.
- Secondary parts should be mounted as the very last operation. The package should be removed just before the assembly.
- Before starting the assembly work on the equipment where the secondary parts have been already installed these parts must be provided with a fixed non-magnetic cover securing the safe distance approx. 25 mm from magnets.

Specifications are subject to change without notice.