L7 Series
High Efficiency Linear Motors

We pioneer motion

SCHAEFFLER

The L7 series – The benchmark for efficiency and power density

For many years, Schaeffler Industrial Drives has supplied water-cooled, iron core linear motors of the L1 series with peak forces of up to 5,171 N. With the new L7 series, we are expanding our range of linear motors with peak forces of up to 24,300 N. This means that Schaeffler linear direct drives can now be used much more widely in handling systems and the main axes of machine tools.

By combining a highly compact cooling system with an optimised coil system, we have been able to achieve

- a reduction in power loss of up to 50% with the same drive force or
- an increase in nominal force of up to 40% with the same power loss compared to the current benchmark.

This series of linear motors enables a significant reduction in operating costs and a considerable increase in productivity. The L7 motor demonstrates its strengths particularly in the case of oscillating motion, where high acceleration is required and the motor is continuously heated. The high acceleration capability reduces the cycle times and the energy reserves ensure high contour accuracy of the workpiece. As power loss is minimal, less heat is introduced into the machine bed.

Customer benefits

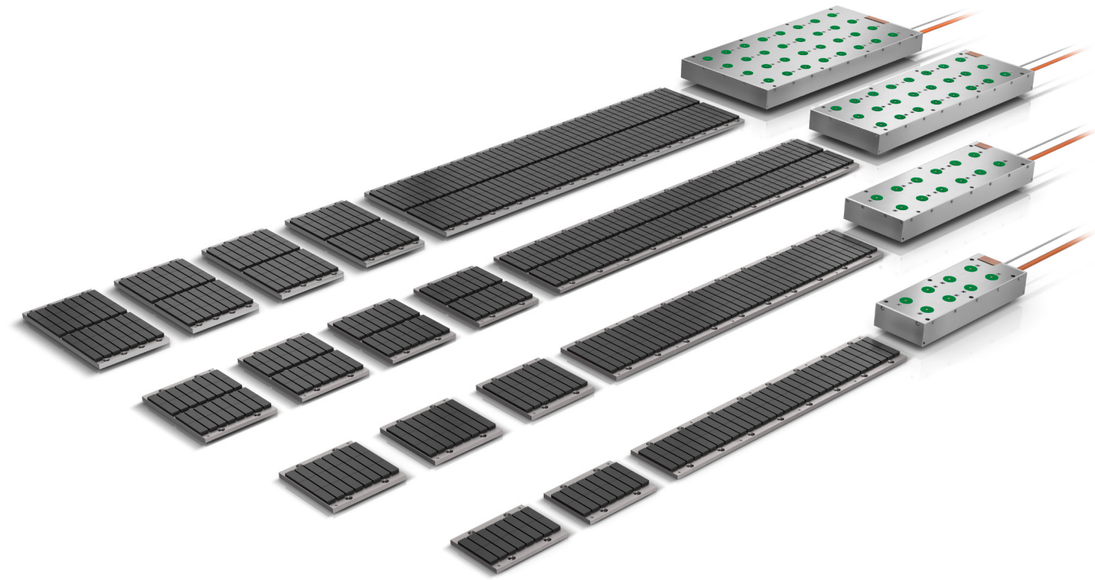
- high productivity
- low unit costs
- low CO_2 emissions
- higher machine accuracy

Features

- highly efficient linear motor with water cooling system
- primary parts available in four widths and three lengths
- up to 800 V dielectric strength
- optionally available with secondary part encapsulation, secondary part cooling system, secondary part cover
- primary part certified to IP65

Applications

- milling machines
- turning machines
- laser machining
- surface and profile grinding machines
- centreless grinding machines
- out-of-round machining
- oscillation machining
- HSC axes
- PCB drilling machines



The perfect motor configuration for every task

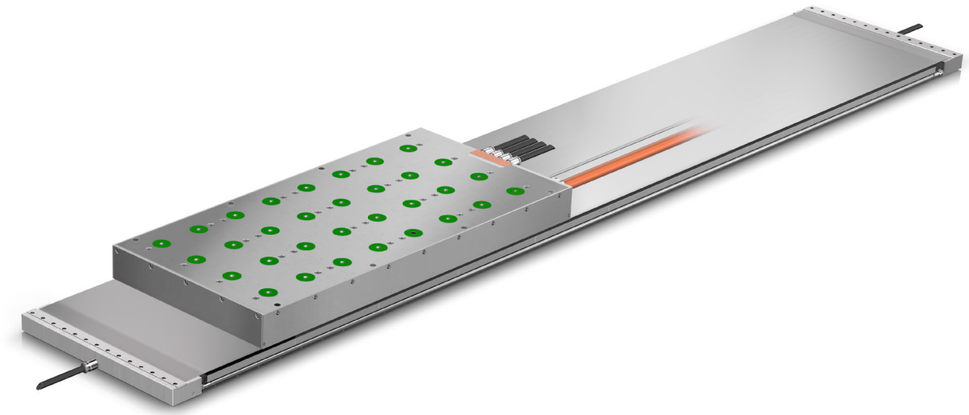
Our L7 series of linear motors comprises twelve motor sizes, divided into the four secondary part widths 100, 150, 200 and 300 mm and into the three primary part lengths 350, 500 and 650 mm. A secondary part cooling system is available for applications which are particularly sensitive to heat.

Robust and durable

Highly effective protection against mechanical influences is available for the secondary parts of the L7 series of linear motors in the form of an optional cover plate, which allows particles generated during production, such as swarf, to be easily removed. Encapsulated secondary parts, which are also available as an option, provide excellent protection against liquids, whilst a reinforced insulation system ensures that the linear motors are optimally prepared for future electrical requirements. These options allow the L7 series of linear motors to offer extensive durability and reliability. The motors also meet the requirements of the Ecodesign Directive (2009/125/EC).

Keeping the temperature in check

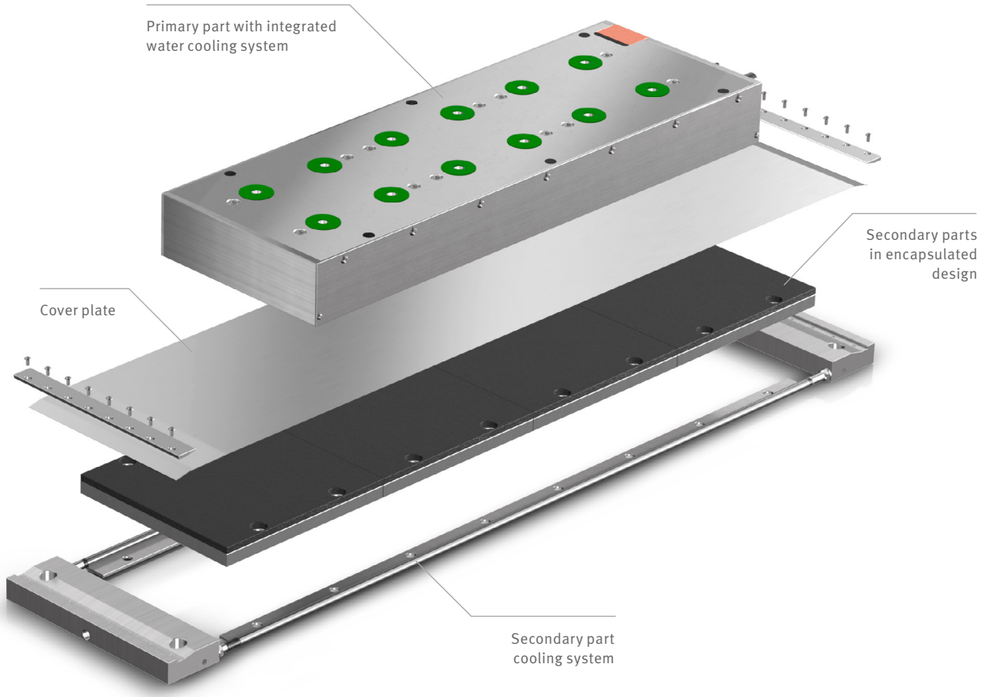
The L7 series of linear motors was developed specifically with machine tool applications in mind, such as high speed cutting (HSC), high performance cutting (HPC) and various grinding applications.
Sizeable feed forces must be generated with maximum efficiency and the resulting power loss dissipated with a high degree of efficiency in order to minimise the introduction of heat into the machine structure or adjacent construction.
The L7 series of motors therefore comes with a cooling circuit for the primary part, which is also available as an optional extra for the secondary part. The cooling circuit for the primary part absorbs the majority of the heat flow and dissipates it into the cooling medium.
The secondary part cooling system absorbs and dissipates the residual radiant and convection heat from the underside of the primary part. This renders the complex process of installing cooling ducts in the machine bed, which has the effect of weakening the structure, unnecessary.



In order to minimise thermally induced changes to the machine geometry, the L7 motor comprehensively supports the following measures:

- **Thermal insulation:** Special spacer elements create an air gap above the primary part, which insulates the linear motor thermally from the screw mounting surface.
- **Homogeneous temperature distribution:** Thermally and symmetrically constructed primary parts and a main cooling system produced to a special design enable optimum homogeneous distribution of the temperature.
- **Active temperature control as a complete system:** The secondary parts are optionally available with a cooling facility and can be easily incorporated into the existing cooling system of the primary part.

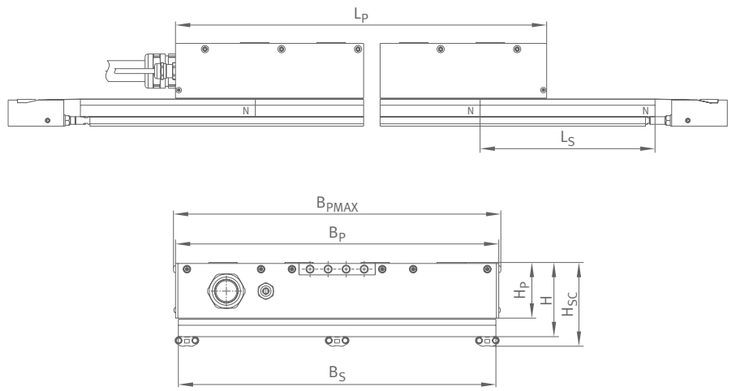
Motor components at a glance

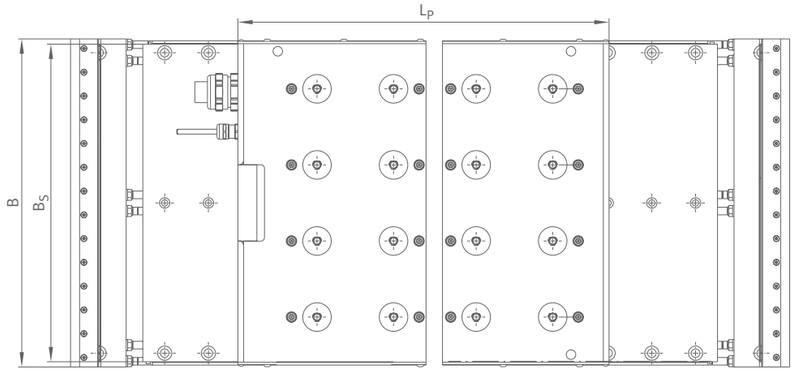


Performance data

Size				350-100	500-100	650-100	350-150	500-150	650-150	350-200	500-200	650-200	350-300	500-300	650-300
Winding				Z1.9H	Z2.8H	Z2.7H	Z1.9H	Z2.8H	Z2.7H	Z2.8H	Z2.8H	Z3.8H	Z2.8H	Z2.8H	Z3.8H
Forces	Ultimate force (1 s) at $I_{u\,eff}$	F_u	N	4432	6648	8864	6648	9972	13296	8864	13296	17728	13296	19944	26593
	Peak force at $I_{p\,eff}$	F_p	N	4052	6078	8104	6078	9117	12157	8104	12157	16209	12157	18235	24313
	Continuous force (cooled) at Icw eff $I_{cw\,eff}$	F_{cw}	N	1813	2700	3638	2760	4111	5539	3727	5535	7385	5667	8415	11229
	Continuous force (not cooled) at $I_{c\,eff}$	F_c	N	661	951	1258	961	1380	1824	1253	1794	2346	1838	2629	3437
	Stall force (cooled) at $I_{sw\,eff}$	F_{sw}	N	1288	1918	2584	1832	2727	3674	2473	4000	5336	3759	5580	7444
	Cogging force at I = 0	F_{cog}	N	8.10	12.16	16.21	12.16	18.23	24.31	16.21	24.31	32.42	24.31	36.47	48.63
Velocities	Limiting velocity at $I_{p\,eff}$ and U_{DCL} = 600 V	v_{lp600}	m/s	1.95	1.90	1.40	1.36	1.36	0.98	1.36	0.92	1.20	0.88	0.56	0.76
	Limiting velocity at $I_{cw\,eff}$ and U_{DCL} = 600 V	v_{lw600}	m/s	4.53	4.48	3.34	3.08	3.09	2.29	3.11	2.20	2.79	2.04	1.42	1.82
	Limiting velocity at $I_{p\,eff}$ and U_{DCL} = 300 V	v_{lp300}	m/s	0.82	0.80	0.54	0.51	0.51	0.30	0.53	0.28	0.44	0.27	0.03	0.20
	Limiting velocity at $I_{cw\,eff}$ and U_{DCL} = 300 V	v_{lw300}	m/s	2.08	2.06	1.51	1.38	1.38	0.99	1.40	0.95	1.24	0.88	0.58	0.78
Currents	Effective ultimate current (1 s)	$I_{u\,eff}$	A	65.6	98.4	99.7	65.6	98.4	99.7	90.8	98.4	163.2	90.8	98.4	163.2
	Effective peak current	$I_{p\,eff}$	A	52.5	78.7	79.7	52.5	78.7	79.7	72.7	78.7	130.5	72.7	78.7	130.5
	Effective continuous current (cooled)	$I_{cw\,eff}$	A	17.3	25.7	26.3	17.5	26.1	26.7	24.6	26.3	43.7	24.9	26.7	44.3
	Effective continuous current (not cooled)	$I_{c\,eff}$	A	6.17	8.87	8.91	5.97	8.58	8.61	8.09	8.37	13.61	7.91	8.17	13.29
	Effective stall current (cooled)	$I_{sw\,eff}$	A	12.2	18.2	18.6	11.6	17.2	17.6	16.2	19.0	31.5	16.4	17.6	29.2
Power losses	Power loss at F_p	P_{lp}	W	7267	10900	14128	9663	14495	18788	12648	19085	25222	17414	26275	34725
	Power loss at F_{cw}	P_{lw}	W	1052	1556	2059	1442	2131	2821	1935	2861	3787	2738	4047	5357
	Power loss at F_c	P_{lc}	W	134	185	236	168	231	294	210	289	367	277	379	482
Electrical characteristic values	DC link voltage	U_{DCL}	V	800	800	800	800	800	800	800	800	800	800	800	800
	Electrical resistance, phase to phase	R_{20}	Ω	1.76	1.17	1.48	2.34	1.56	1.97	1.60	2.05	0.99	2.20	2.82	1.36
	Inductance, phase to phase	L	mH	29.69	20.39	26.51	40.38	26.92	35.00	29.62	37.84	18.36	42.88	54.78	26.57
	Back EMF constant, phase to phase	$k_{\hat{u}}$	V/(m/s)	87.7	87.7	115.5	131.5	131.5	173.2	126.7	175.4	141.1	190.0	263.1	211.6
General characteristic values	Pole pair width	$2\tau_p$		46	46	46	46	46	46	46	46	46	46	46	46
	Motor constant (20 °C)	k_m	N/√W	66.1	81.0	94.9	86.0	105.4	123.4	100.3	122.4	142.0	128.2	156.5	181.5
	Force constant	k_f	N/A	107.2	107.2	141.2	160.8	160.8	211.7	154.9	214.4	172.4	232.3	321.6	258.7
	Motor temperature switch-off threshold	ϑ_{PTC}	°C	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0	110.0
	Attraction force	F_a	N	6205	9307	12410	9307	13961	18615	12410	18615	24820	18615	27922	37230
Cooling conditions (water as reference medium at supply temperature of 20°C)	Recommended volume flow rate	dV/dt	l/min	4.0	4.5	5.0	4.0	4.5	5.0	4.5	5.5	6.0	11.0	12.0	13.0
	Cooling water temperature difference	$\Delta\vartheta$	K	3.8	5.0	5.9	5.2	6.8	8.1	6.2	7.5	9.1	3.6	4.8	5.9
	Pressure drop	Δp	bar	0.3	0.4	0.6	0.5	0.8	1.2	0.7	1.4	2.0	0.8	1.3	1.9

Geometric data





Size				350-100	500-100	650-100	350-150	500-150	650-150	350-200	500-200	650-200	350-300	500-300	650-300
Winding				**Z1.9H**	**Z2.8H**	**Z2.7H**	**Z1.9H**	**Z2.8H**	**Z2.7H**	**Z2.8H**	**Z2.8H**	**Z3.8H**	**Z2.8H**	**Z2.8H**	**Z3.8H**
Primary part	Length	L_P	mm	384	545	706	384	545	706	384	545	706	384	545	706
	Width	B_P	mm	140	140	140	187	187	187	247	247	247	340	340	340
	Height	H_P	mm	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5	58.5
	Maximum width	B_{PMAX}	mm	144,4	144.4	144.4	191.4	191.4	191.4	251.4	251.4	251.4	344.4	344.4	344.4
	Cooling water connection	TS_{PC}		2 x G1/8“	2 x G1/8“	2 x G1/8“	2 x G1/8“	2 x G1/8“	2 x G1/8“	2 x G1/8“	2 x G1/8“	2 x G1/8“	4 x G1/8“	4x G1/8“	4x G1/8“
	Mass	m_P	kg	ca. 14	ca. 20	ca. 26	ca. 20	ca. 28	ca. 36	ca. 27	ca. 39	ca. 50	ca. 39	ca. 55	ca. 72
Secondary part	Length	L_S	mm		184			184			184			184	
	Width	B_S	mm		134			180			240			334	
	Height, variant: without encapsulation	H_S	mm		16			18			16			18	
	Height, variant: encapsulated	H_{SP}	mm		16.3			18.3			16.3			18.3	
Motor installation dimensions	Width with secondary part cooling system	B	mm		155			201			251			345	
	Height without secondary part cooling system	H	mm		76			78			76			78	
	Height with secondary part cooling system	H_{SC}	mm		79			81			86			88	

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