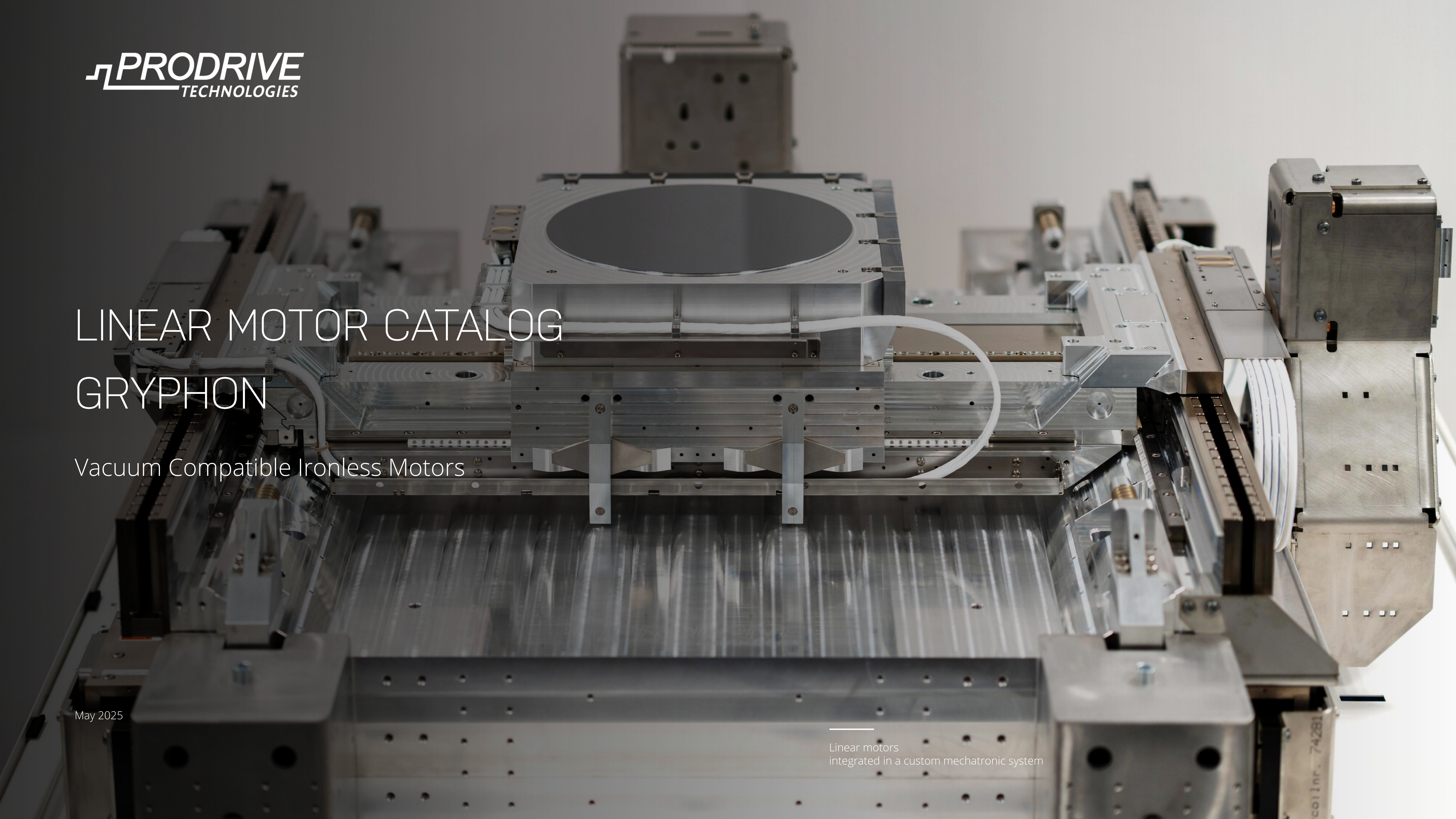


LINEAR MOTOR CATALOG
GRYPHON

Vacuum Compatible Ironless Motors

May 2025

Linear motors
integrated in a custom mechatronic system

TABLE OF CONTENTS

CREATING MEANINGFUL TECHNOLOGIES THAT MAKE THE WORLD WORK

Knowledge

Engineering excellence is the driving force behind linear motor innovation in both design and manufacturing. Prodrive has a highly skilled group of (electro-)mechanical engineers capable of customizing linear motor technology towards your needs.

Quality

Quality is in the DNA of Prodrive Technologies. With a long history in electronics manufacturing, Prodrive continues in the area of linear motor manufacturing with the same philosophy and processes, setting a new standard within the linear motor market.

Automation

Design for manufacturing is key to reduce cost and guarantee quality. Winding, assembly, vacuum potting and magnet gluing are highly automated processes which guarantees a constant quality at minimum cost.

Time to market

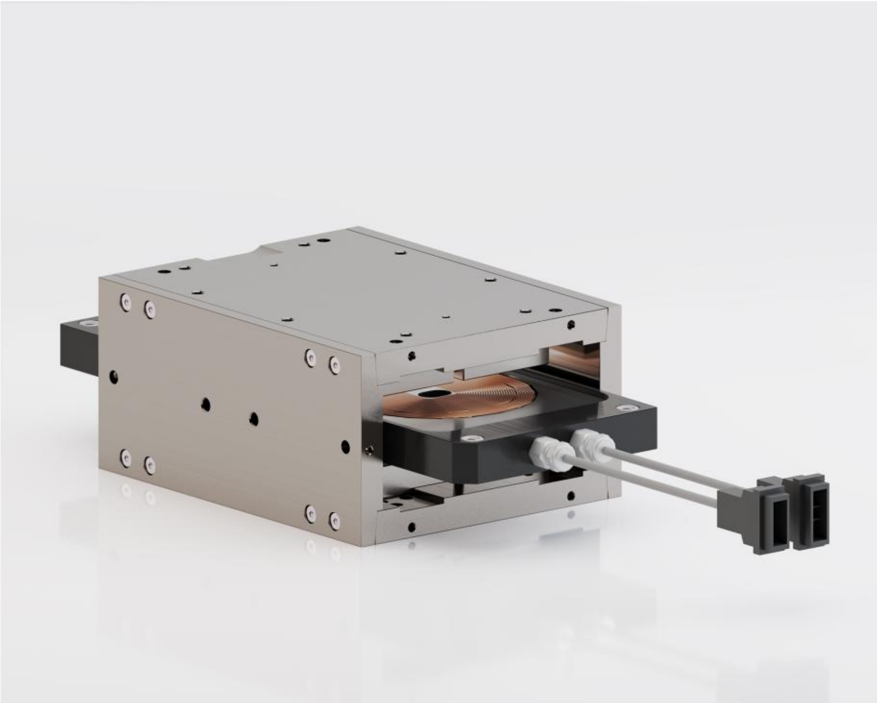
Due to the agility of Prodrive Technologies' large development department, customization can be performed in a very short time, providing a short time to market for challenging mechatronic applications.

Prodrive Technologies HQ Campus, The Netherlands

OVERVIEW

Gryphon

The Gryphon is a cost-effective solution for vacuum-compatible ironless linear motors. These motors also contain multiple features providing magnetic shielding.



Iris

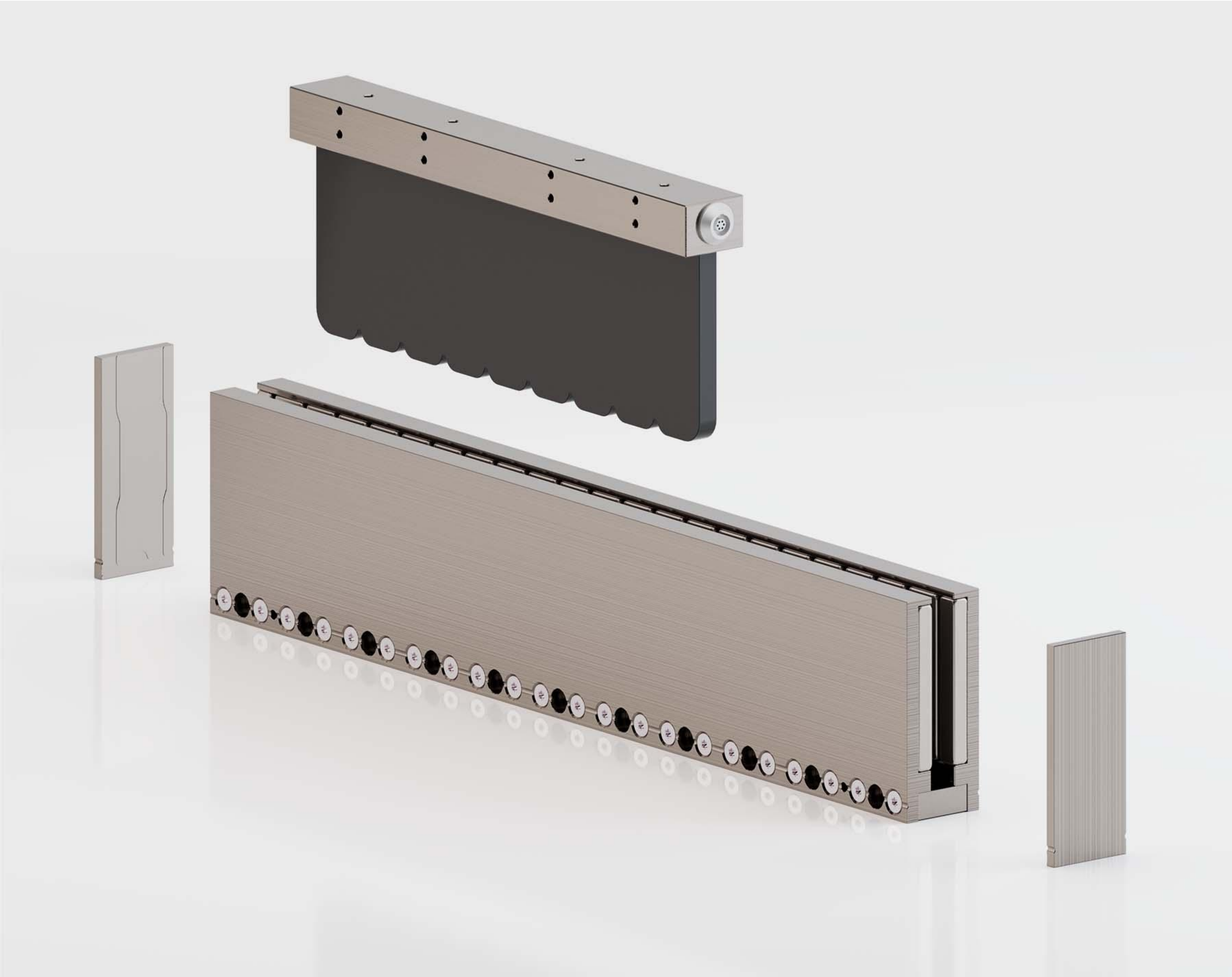
For short stroke applications requiring a relatively large displacement in three directions, the Iris line provides a high force density with zero attraction forces in a rectangular form factor.

GRYPHON LINE

The Gryphon line offers a cost-effective solution for vacuum-compatible ironless linear motors. These motors also contain features providing magnetic shielding.

Gryphon line in medium and large configuration

FEATURES



Gryphon magnet yoke and coil unit

Gryphon-CU-M-09-C-C

- Connector
- Winding configuration (C)
- # of coils
- Size (M / L)
- Coil unit

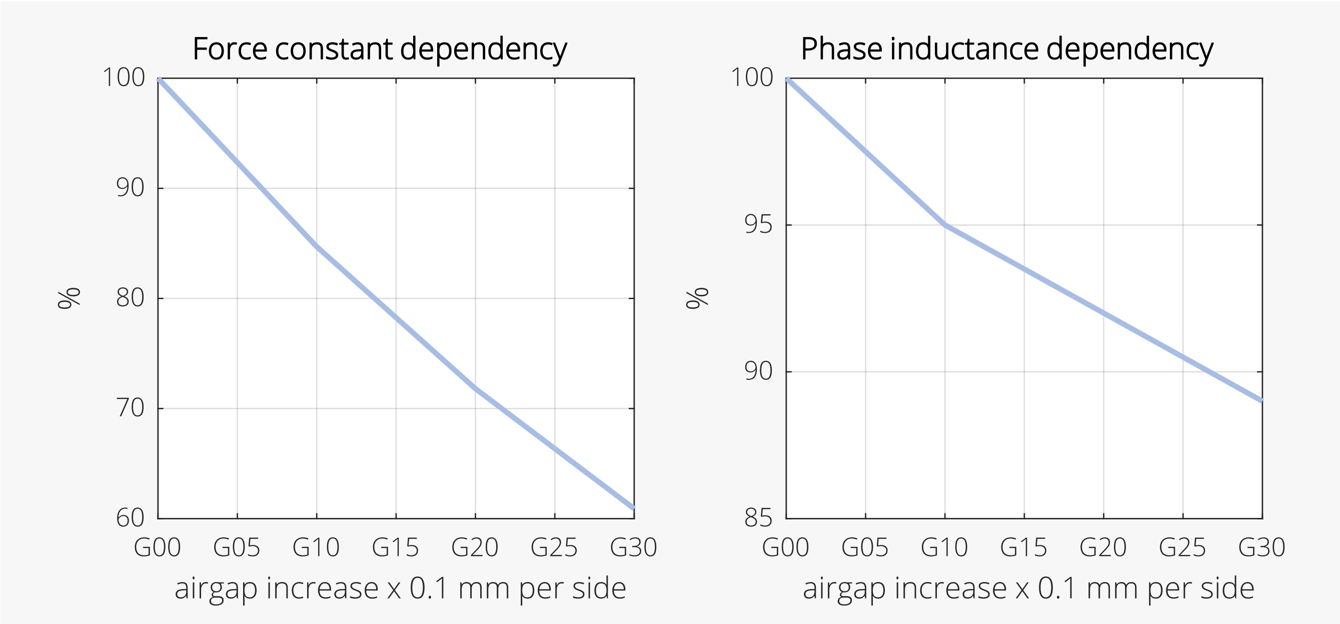
Gryphon-MY-M-12-FX-G00

- Additional airgap x 0.1 mm on each side
- End plates (X, L, R, B)
- Half pole location (C, D, E, F)
- # of poles
- Size (M / L)
- Magnet yoke

- Magnet yokes and coil units are made of low outgassing materials
- Coil units have a temperature sensor (PT1000)
- Coil units have a vacuum compatible connector
- Magnet yokes can be butted together making the stroke length flexible
- Magnet yokes can be selected with larger airgaps to allow higher installation tolerances
- Magnet yokes have optional half poles at the end to improve magnetic shielding
- Magnet yokes have optional end plates to further enhance magnetic shielding
- The IP rating of coil units is IP4X

PERFORMANCE SPECIFICATIONS

	Parameter	Symbol	Unit	T_{coil} (°C)	CU-M-09	CU-L-12
	Winding configuration	-	-	-	C	C
Electromechanical	Peak force	F_p	N	20	269	414
	Continuous force, interface at 20°C	F_c	N	50	161	249
	Attraction force (I = 0)	F_{att}	N	-	0	0
	Motor constant	S	N^2/W	20	566	1330
	Force constant	K_f	N/A_{rms}	-	54	83
	Maximum velocity (F = 0)	v_m	m/s	-	2.3	1.5
	Maximum velocity (F = F_p)	v_i	m/s	20	1.8	1.2
Electrical	Maximum dc bus voltage	V_{dc}	V	-	100	100
	Phase resistance	$R_{ph,20}$	Ohm	20	1.7	1.7
	Phase inductance	L_{ph}	mH	20	2.3	2.6
	Peak line emf constant	$K_{e,ll,p}$	Vs/m	-	44	68
	Maximum rms current	I_p	A_{rms}	20	5.0	5.0
	Continuous rms current	I_c	A_{rms}	50	3.0	3.0
Thermal	Continuous dissipation	$P_{d,c}$	W	50	51	52
	Thermal resistance, coils to interface	$R_{th,i}$	K/W	-	0.37	0.19
	Thermal time constant, interface at 20°C	τ_{th}	s	-	627	541



Airgap dependency M-size

Notes

- Specifications are based upon a magnet temperature of 20°C
- Specifications consider complete overlap of coil unit/magnet yoke
- Specifications consider sinusoidal q-axis commutation
- Velocity specifications are based on the maximum bus voltage
- Specifications consider a magnet yoke with nominal airgap (G00)
- See 'definitions' section at the end of the catalog for more details

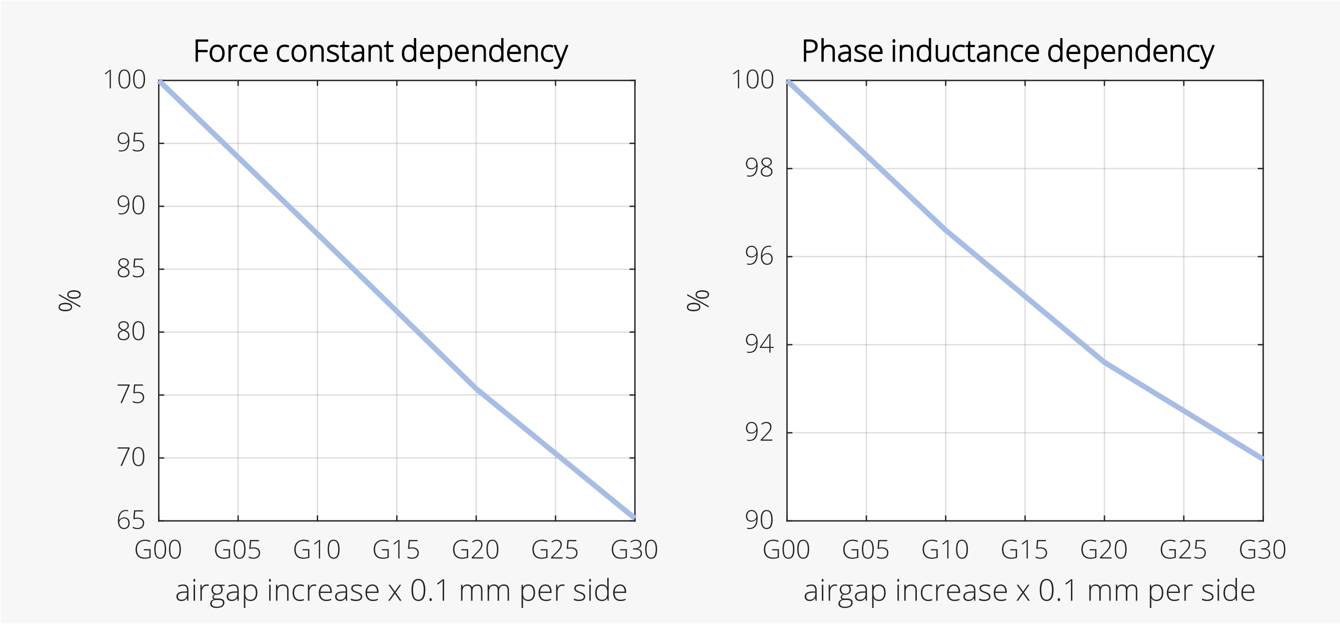
Product marking / approvals

Power/PTC Interface:

Connector: LEMO HGG.1B.306.CLLP

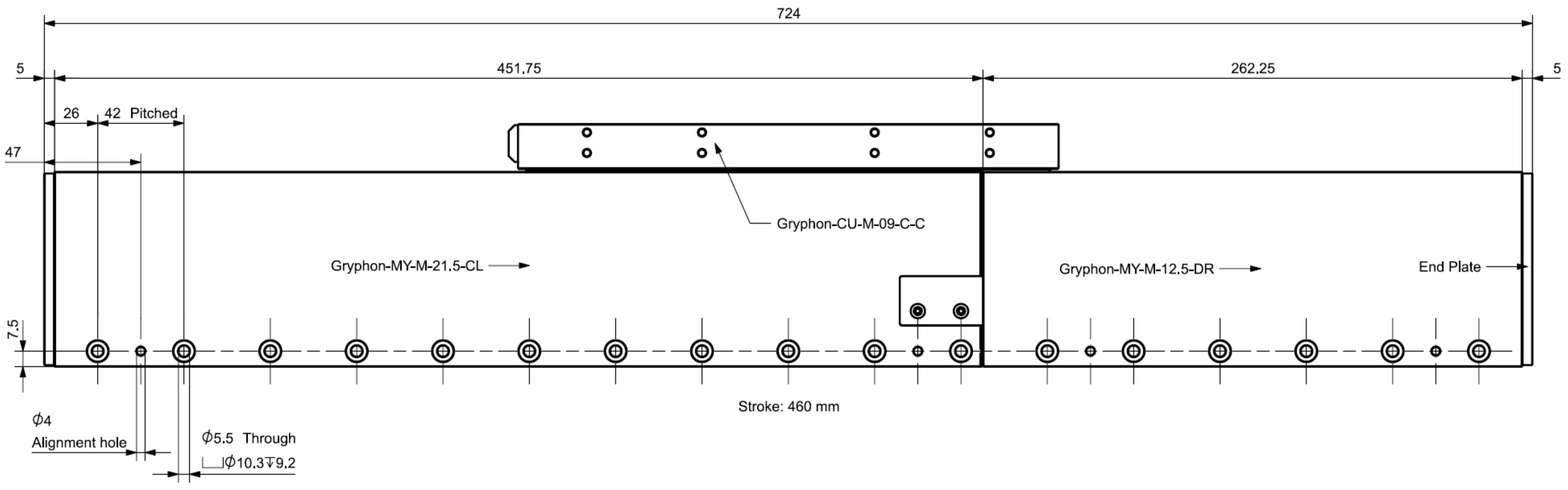
- Phase U (Pin 1)
- Phase V (Pin 2)
- Phase W (Pin 3)
- PE (Pin 4)
- PT1000 (Pin 5)
- PT1000 (Pin 6)

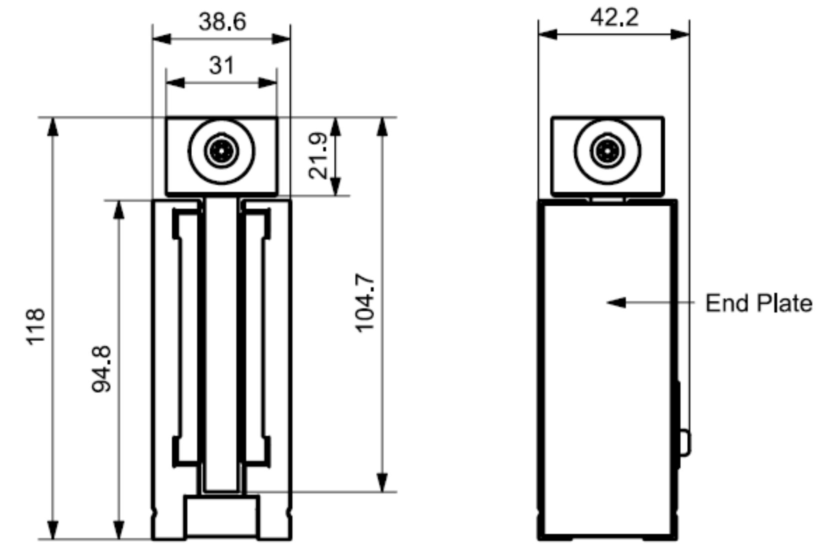
Electrical interfaces

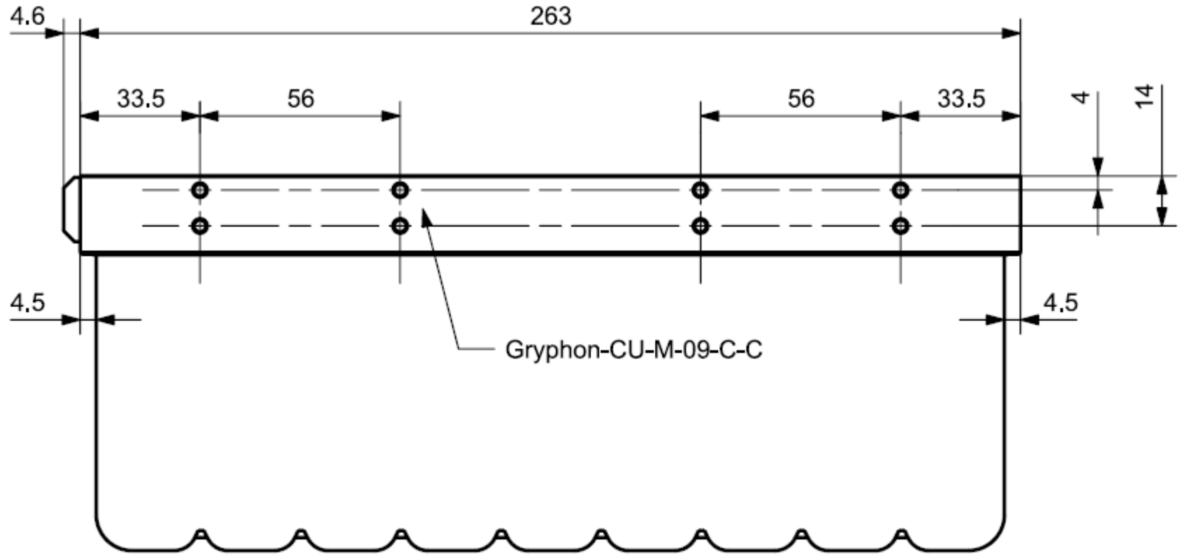


Airgap dependency L-size

GRYPHON-M MECHANICAL SPECIFICATIONS



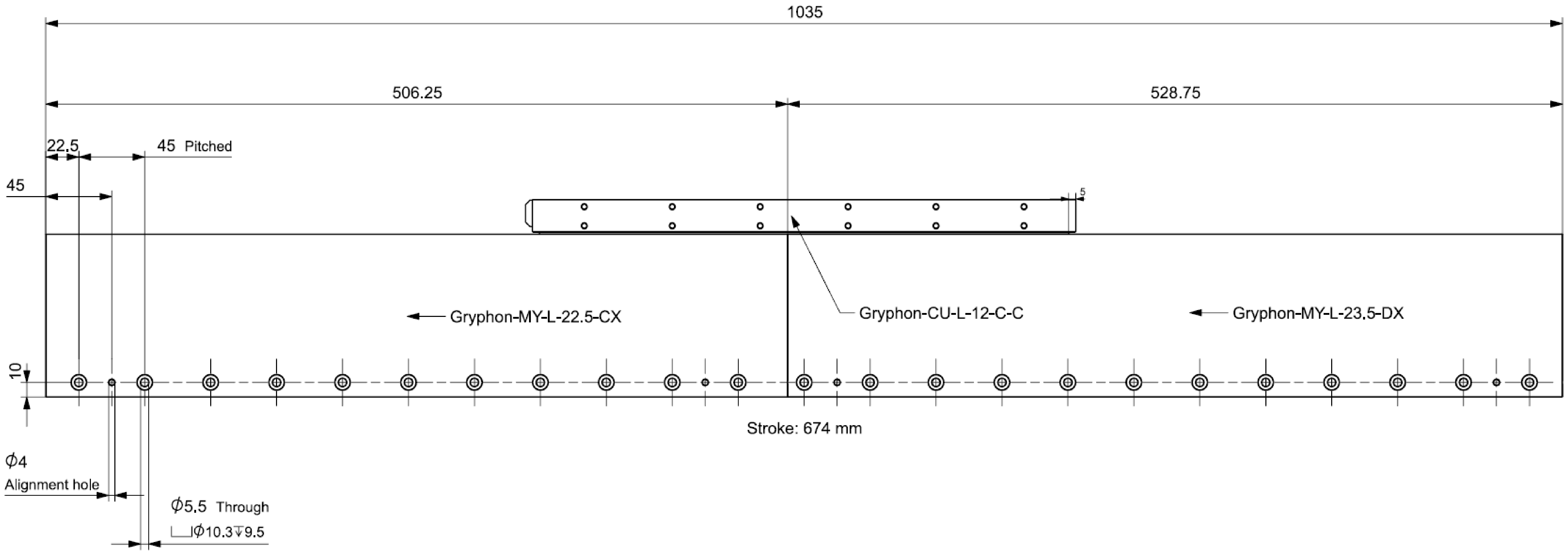


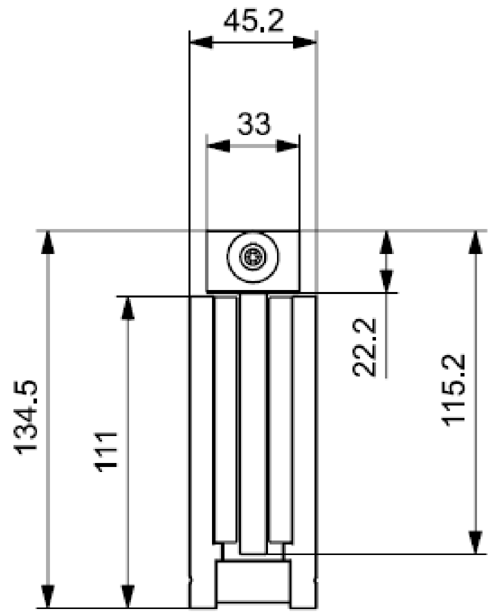


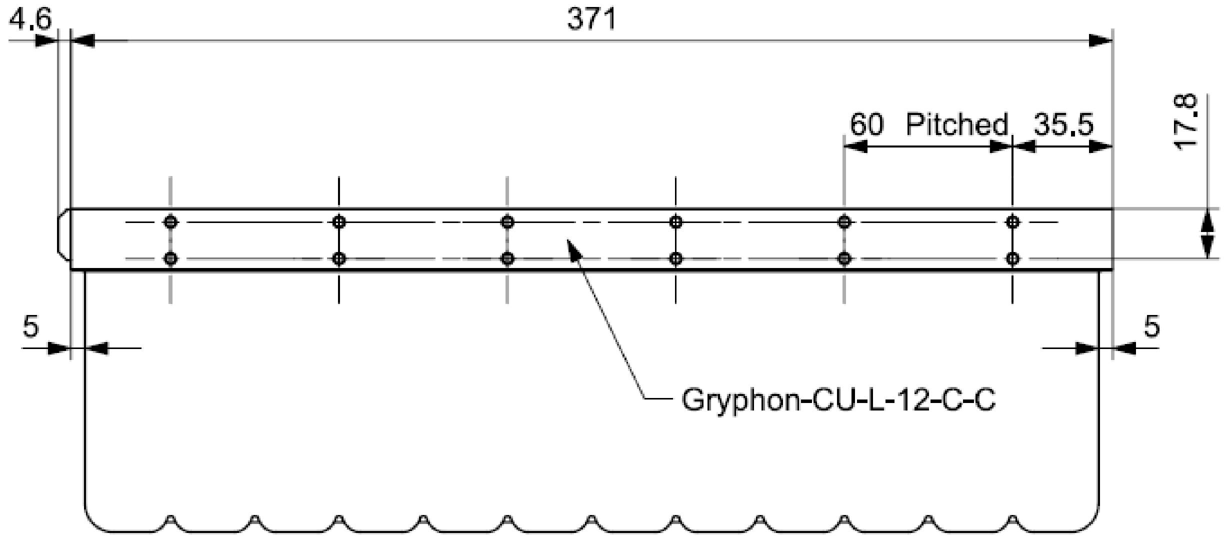
	Parameter	Symbol	Unit	MY-M-12.5-DR	MY-M-21.5-CL
Magnet Yokes	Number of poles	N_p	-	12.5	21.5
	Pole pitch (N-N)	$2\tau_p$	mm	42	42
	Mass	M_{my}	kg	5.2	8.8

	Parameter	Symbol	Unit	CU-M-09
Coil Units	Number of coils	N_{coil}	-	9
	Coil pitch	τ_{coil}	mm	28
	Mass	M_{cu}	kg	1.4

GRYPHON-L MECHANICAL SPECIFICATIONS



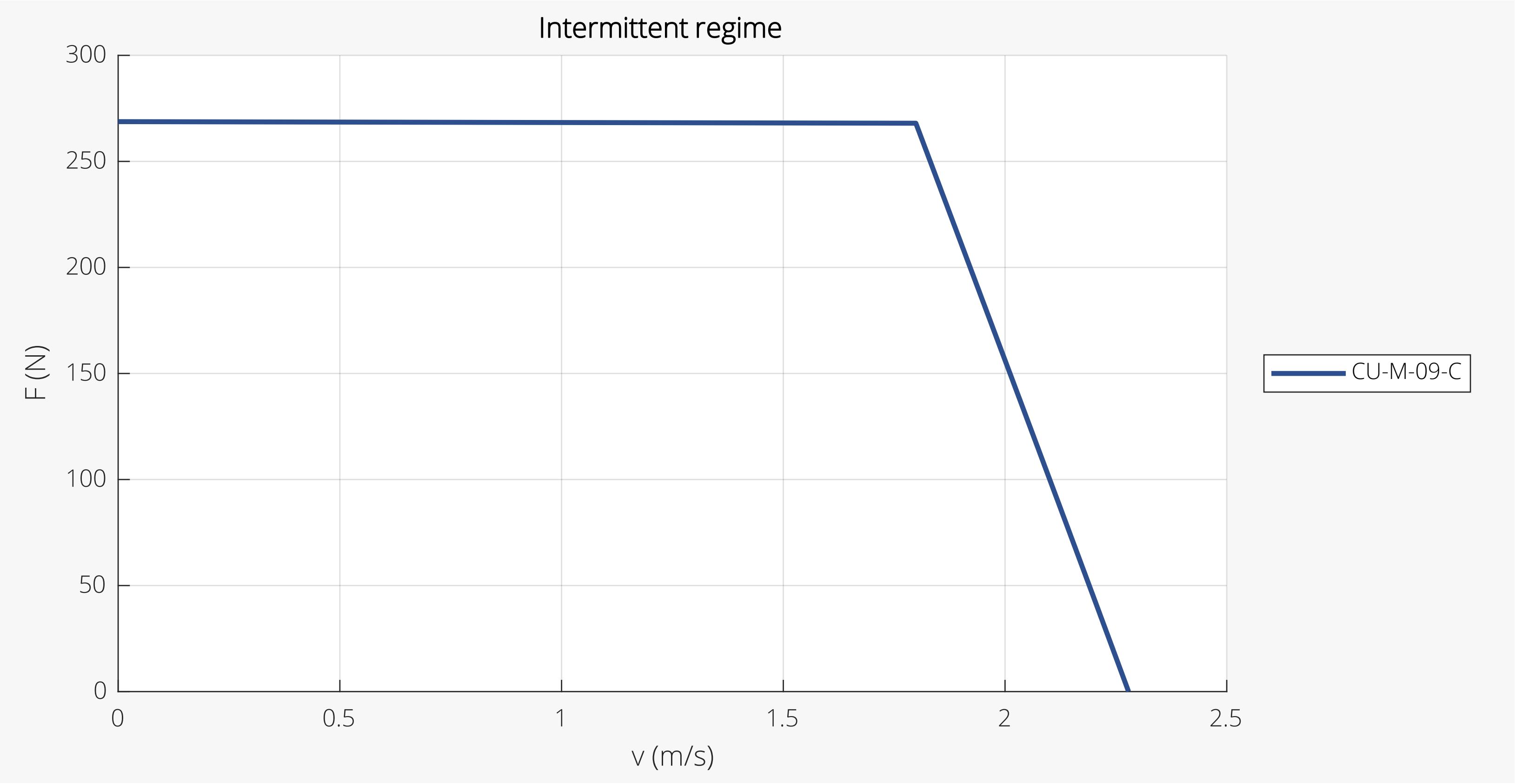




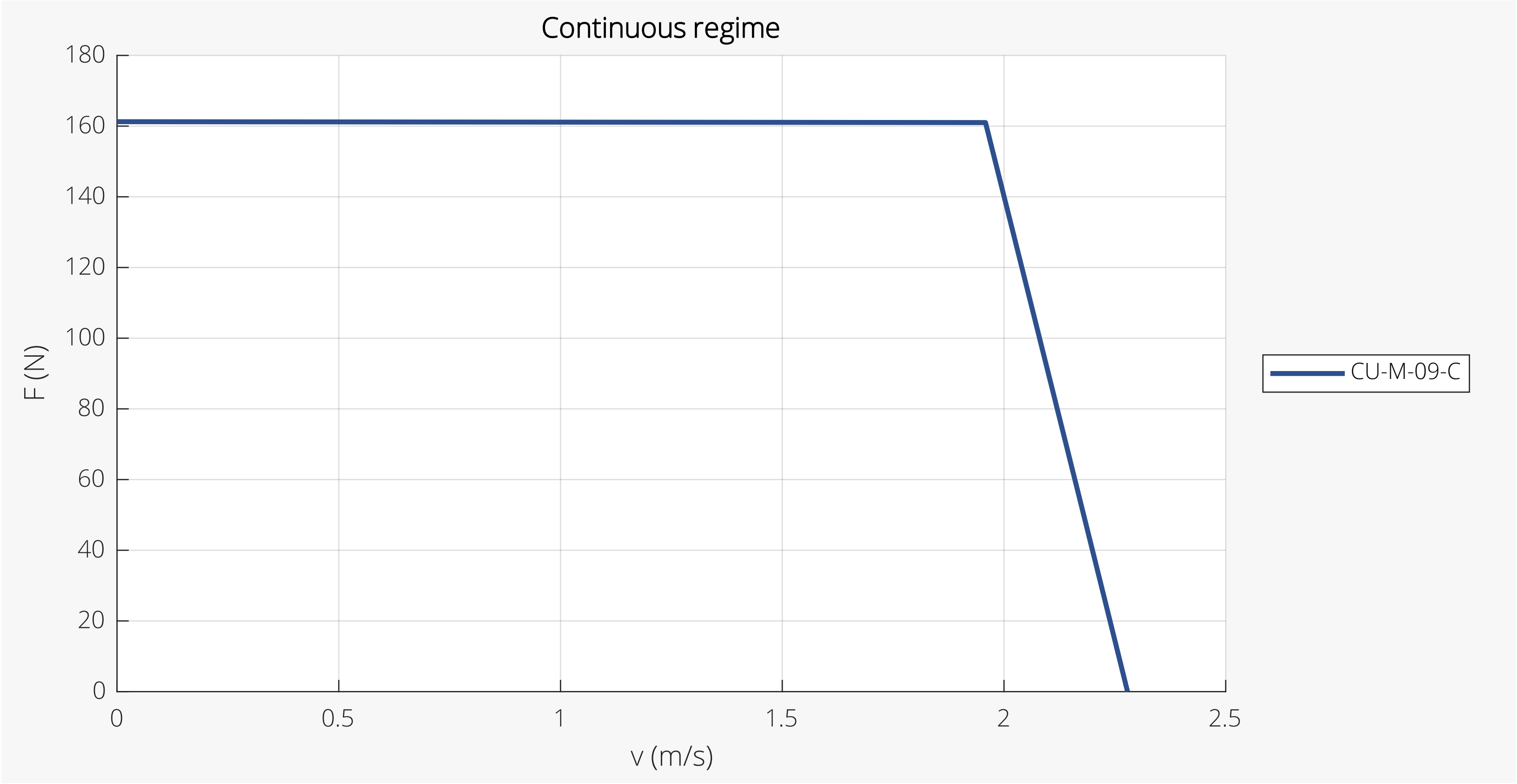
	Parameter	Symbol	Unit	MY-L-22.5-CX	MY-L-23.5-DX
Magnet Yokes	Number of poles	N_p	-	22.5	23.5
	Pole pitch (N-N)	$2\tau_p$	mm	45	45
	Mass	M_{my}	kg	14.0	14.6

	Parameter	Symbol	Unit	CU-L-12
Coil Units	Number of coils	N_{coil}	-	12
	Coil pitch	τ_{coil}	mm	30
	Mass	M_{cu}	kg	2.4

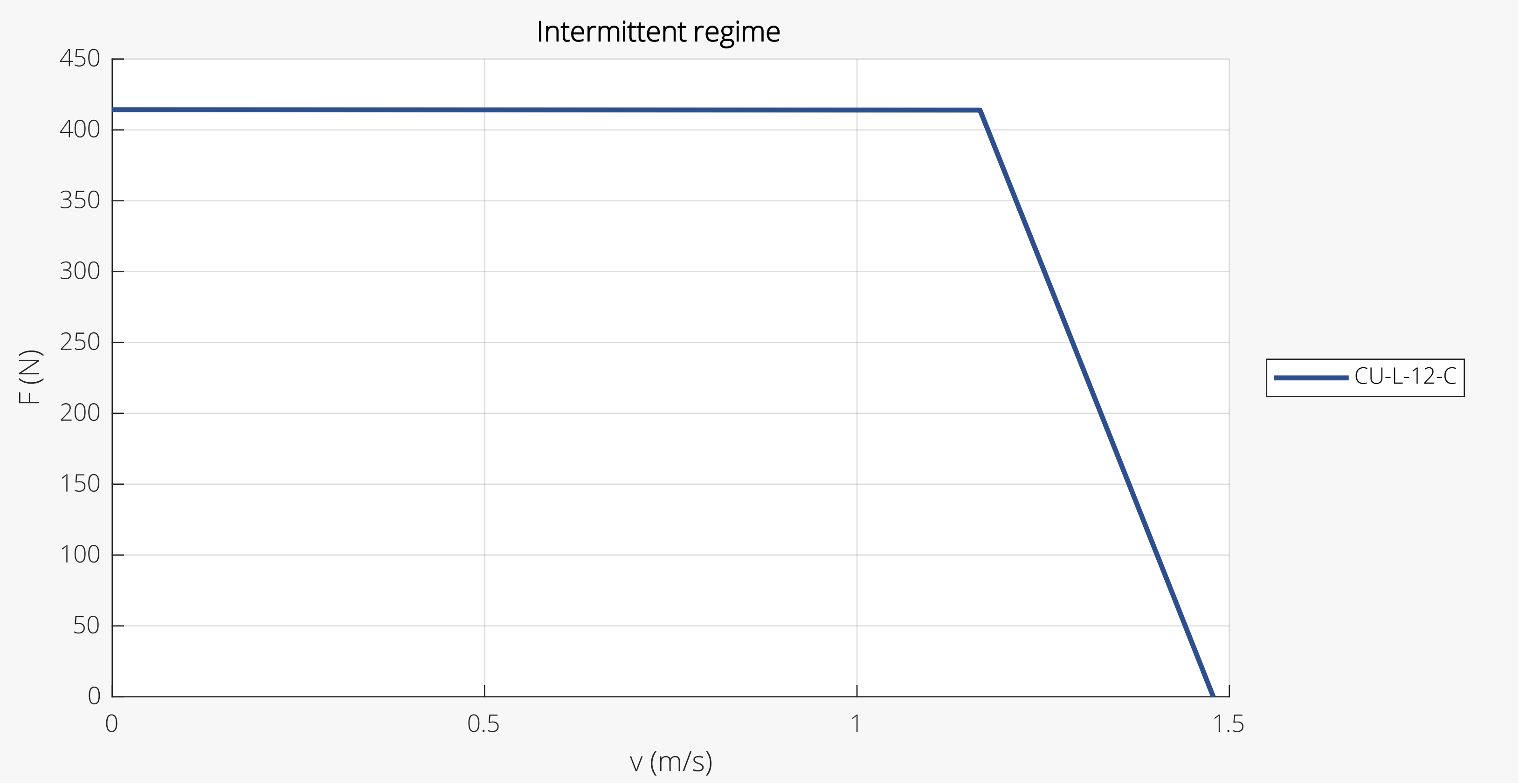
FORCE-VELOCITY DIAGRAMS



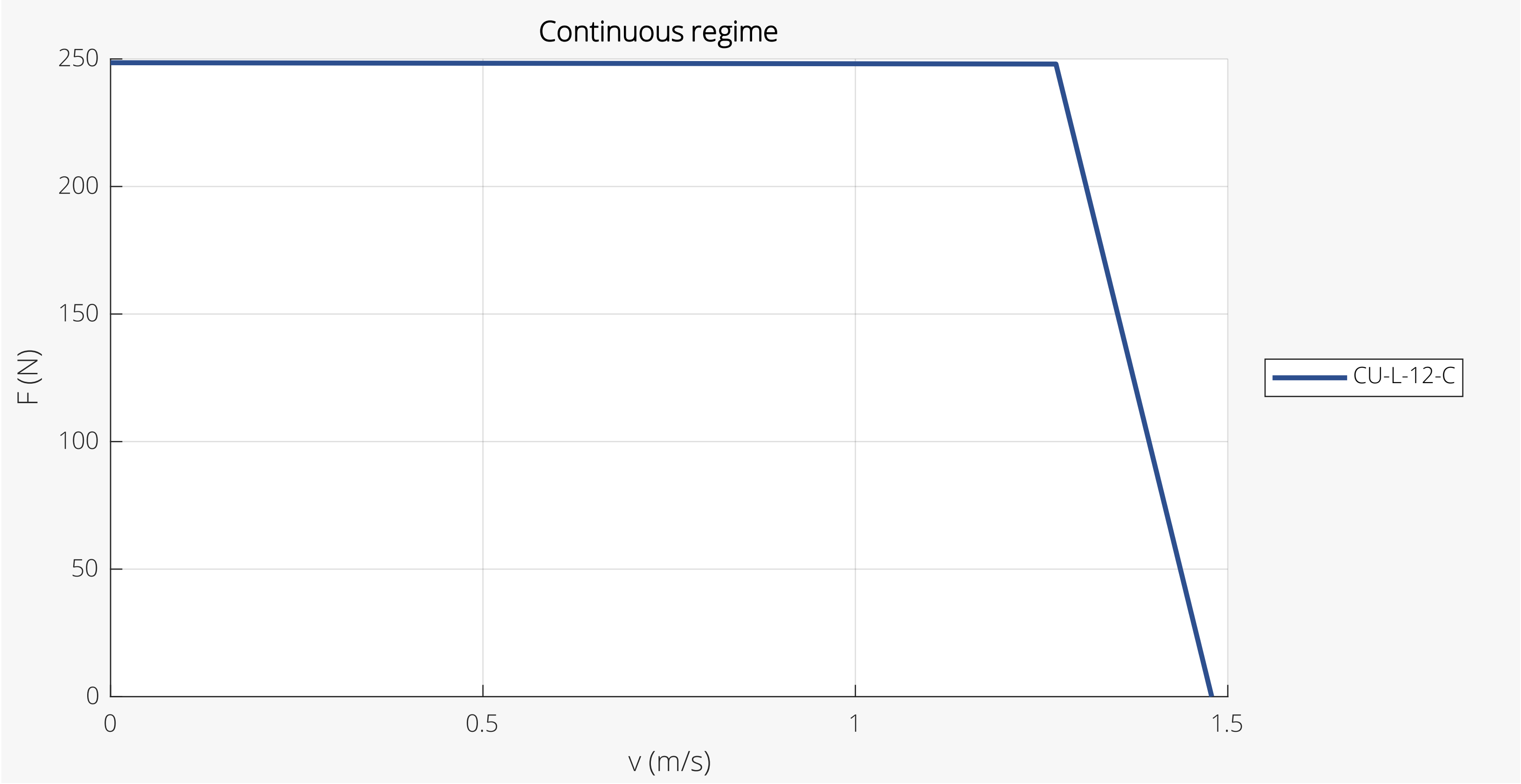
Force-Velocity Diagrams Gryphon-M Intermittent Regime



Force-Velocity Diagrams Gryphon-M Continuous Regime



Force-Velocity Diagrams Gryphon-L Intermittent Regime

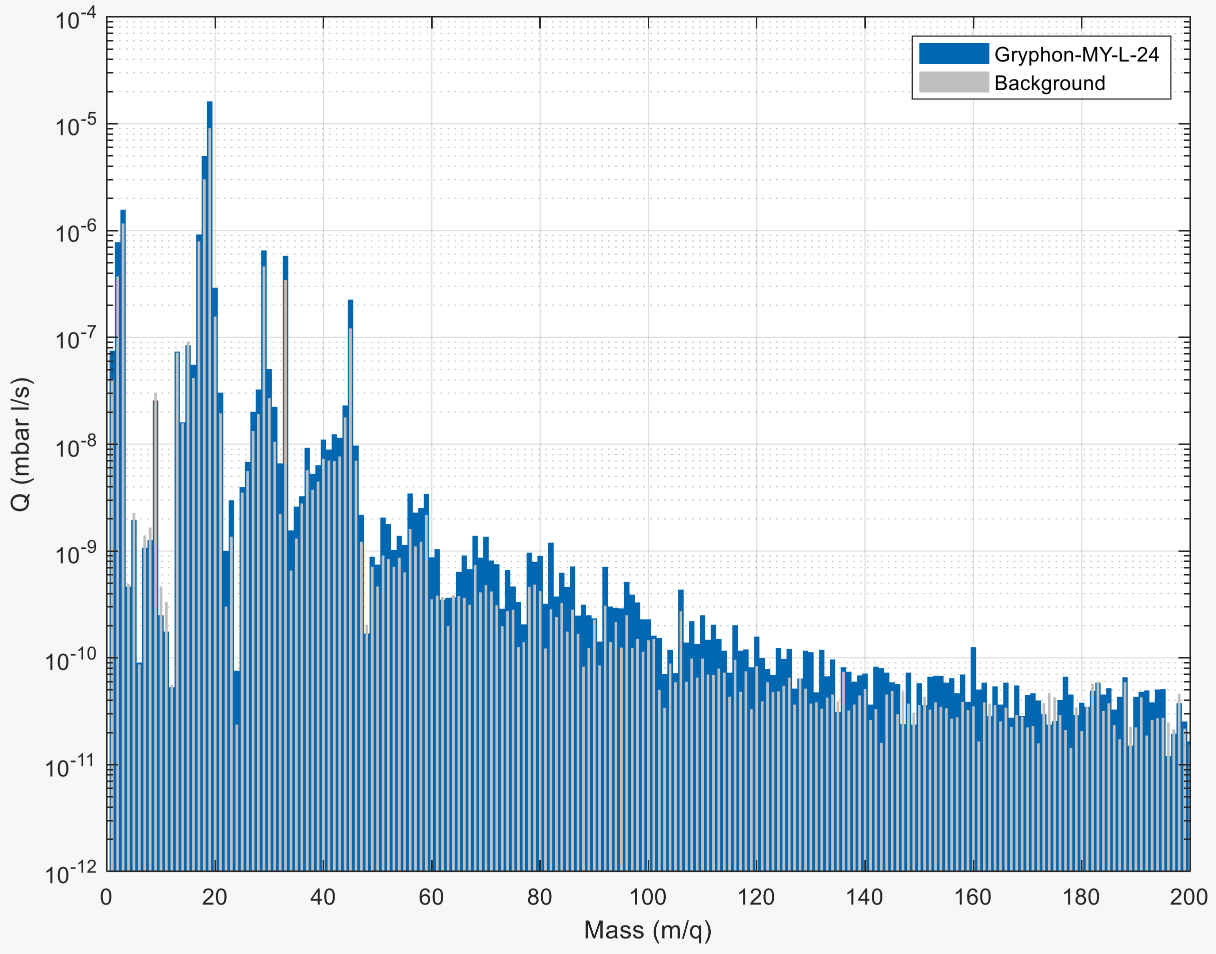


Force-Velocity Diagrams Gryphon-L Continuous Regime

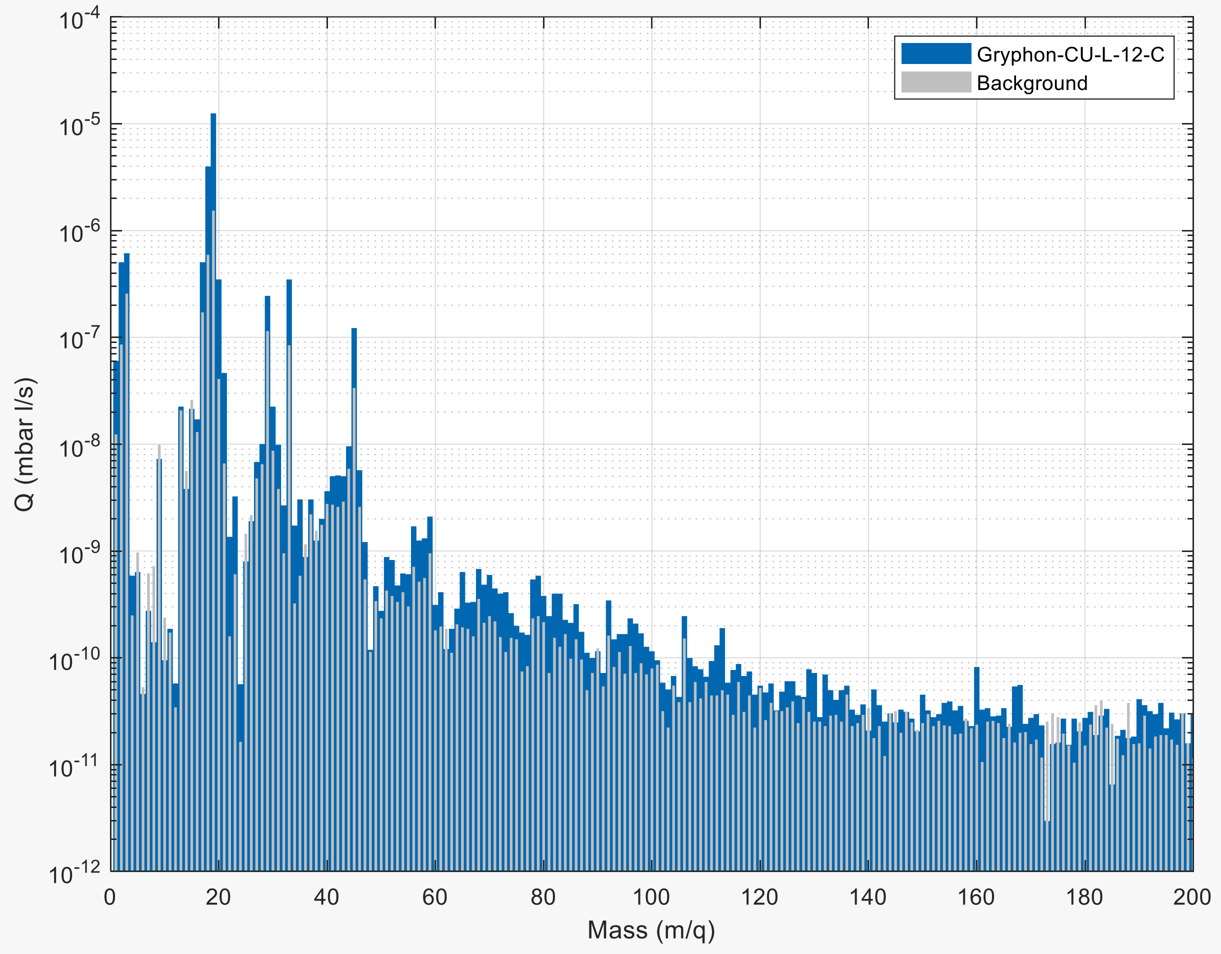
OUTGASSING MEASUREMENTS

The outgassing measurement results below are obtained after bakeout of the magnet yoke segments and coil units. Results are obtained at room temperature, 10 hours after TMP start. Vacuum level 1e-7 mbar (1e-5 Pa or 7.5e-8 Torr).

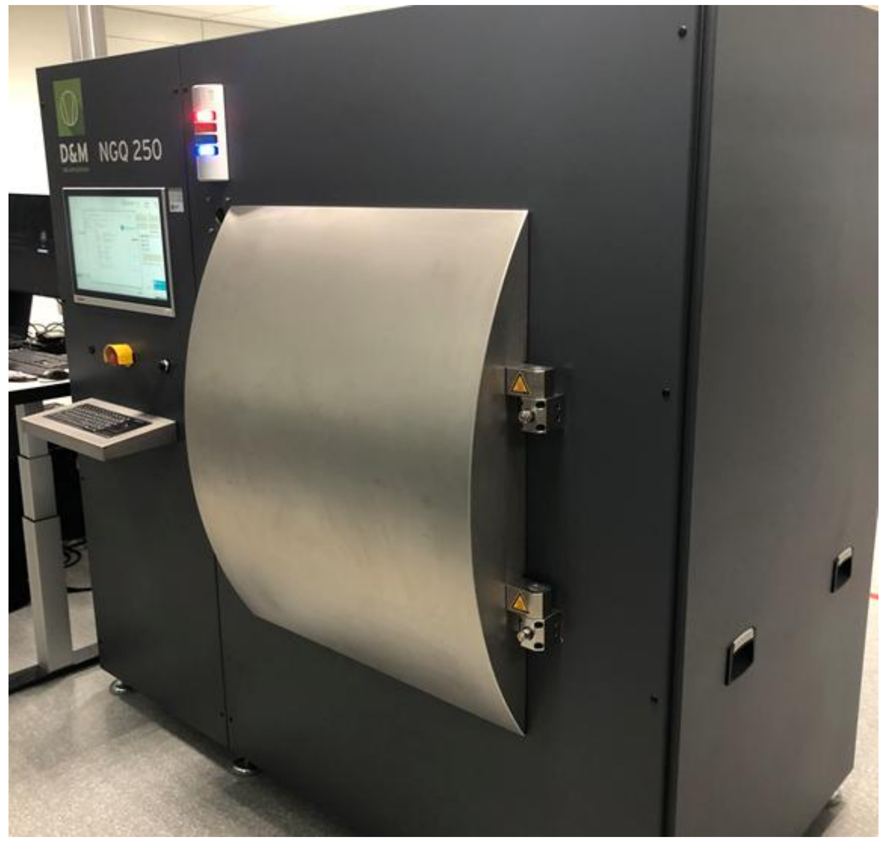
Gryphon-MY-L-23.5



Gryphon-CU-L-12-C



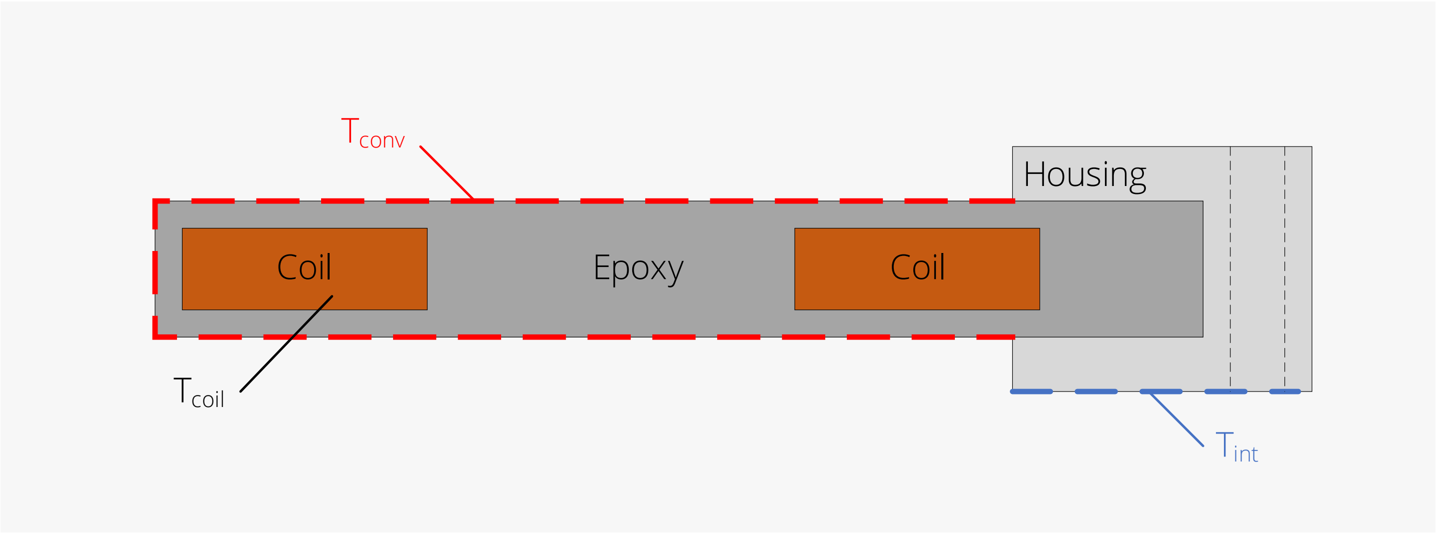
Outgassing measurements



Top picture: In-house RGA equipment
Bottom Picture: In-house bake out equipment

DEFINITIONS

Parameter	Symbol / Equation	Unit	Remarks
Coil temperature	T_{coil}	°C	Average temperature over the complete coil volume
Interface temperature	T_{int}	°C	Average temperature over the complete interface surface
Convective surface temperature	T_{conv}	°C	Average temperature over the complete convective surface
Thermal resistance	$R_{th,i}$	K/W	From average coil temperature to average interface temperature
Thermal resistance	$R_{th,c}$	K/W	From average coil temperature to average convective surface temperature
Thermal time constant	τ_{th}	s	The time to reach 63.7% of the steady state temperature considering T_{int} = 20°C



Gryphon temperature definitions

The achievable continuous force is strongly dependent on the cooling conditions available in the application.

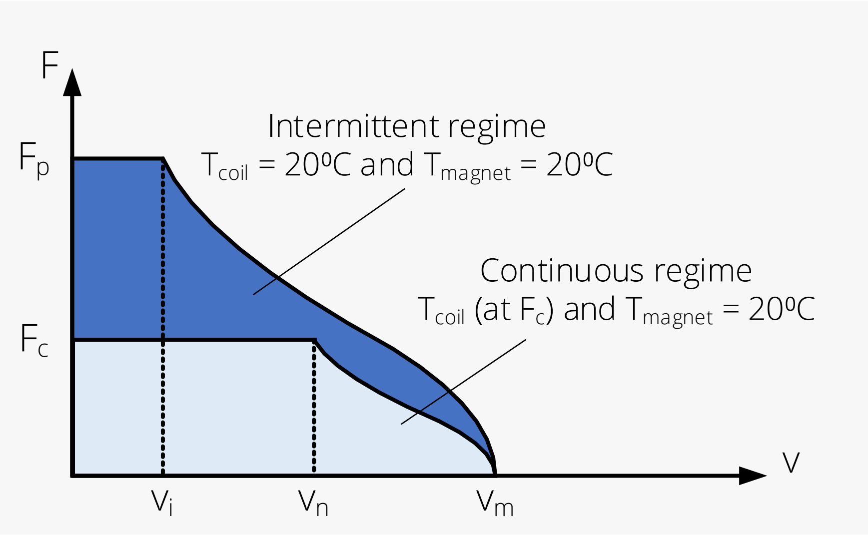
Depending on the situation (vacuum environment, natural convection, forced convection or other), the thermal resistances of the coil unit ($R_{th,i}$ and $R_{th,c}$) should be combined with the thermal resistances of the cooling interfaces to determine the overall thermal resistance (R_{th}).

This overall thermal resistance provides the maximum dissipated power and continuous force.

Please contact us for any support in selecting the optimal product for your application.

DEFINITIONS

Description	Equation	Unit	Remarks
Phase resistance at T_{coil}	$R_{ph} = R_{ph,20}\left(1+0.0039(T_{coil}-20)\right)$	Ohm	
Force constant at no load	$K_f = \sqrt{3/2}\, K_{e,ll,p}$	N/A_{rms}	
Continuous dissipation	$P_{d,c} = (T_{coil}-T_{int})/R_{th,i}$	W	Only copper losses are considered. This catalog considers T_{int} = 20ºC and only heat dissipation towards the interface.
Peak dissipation	$P_{d,p} = C_{th}\alpha_T$	W	α_T is mentioned at the peak force specification. C_{th} is the heat capacitance of the coils only and not specified seperately in the catalog.
Continuous rms current	$I_c = \min\left(\sqrt{\frac{P_{d,c}}{3R_{ph}}}, \frac{V_{dc}}{\sqrt{6}R_{ph}}\right)$	A_{rms}	Limited either by continuous dissipation or dc voltage and resistance or connector ratings (if applicable).
Peak rms current	$I_p = \min\left(\sqrt{\frac{P_{d,p}}{3R_{ph,20}}}, \frac{V_{dc}}{\sqrt{6}R_{ph,20}}\right)$	A_{rms}	Limited either by peak dissipation or dc voltage and resistance or connector ratings (if applicable).
Continuous force	$F_c = K_f I_c$	N	
Peak force	$F_p = K_f I_p$	N	
Steepness	$S = \frac{K_f^2}{3R_{ph,20}}$	N^2/W	
Maximum velocity (F = 0)	$v_m = \frac{V_{dc}}{K_{e,ll,p}}$	m/s	
Maximum velocity (F = F_p)	$v_i = \left(\tau_p\sqrt{6\tau_p^2K_f^2V_{dc}^2+54\pi^2\left(L_{ph}^2I_p^2V_{dc}^2-6L_{ph}^2R_{ph,20}^2I_p^4\right)}-6\tau_p^2K_fR_{ph,20}I_p\right)\left(2\tau_p^2K_f^2+18\pi^2L_{ph}^2I_p^2\right)^{-1}$	m/s	
Maximum velocity (F = F_c)	$v_n = \left(\tau_p\sqrt{6\tau_p^2K_f^2V_{dc}^2+54\pi^2\left(L_{ph}^2I_c^2V_{dc}^2-6L_{ph}^2R_{ph}^2I_p^4\right)}-6\tau_p^2K_fR_{ph}I_c\right)\left(2\tau_p^2K_f^2+18\pi^2L_{ph}^2I_c^2\right)^{-1}$	m/s	



Force-velocity curves

CUSTOM SOLUTIONS

Design

Prodrive Technologies offers specialized mechatronic and actuator design including magnetic, mechanical and thermal design competences. We have extensive experience in magnetic shielding design and design for high-vacuum.

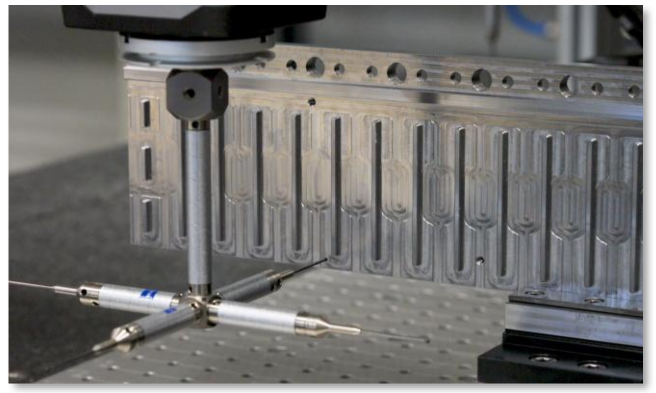
Manufacturing

We provide in-house automated and semi-automated manufacturing technologies located in the Netherlands, which enable high flexibility and customizability in product design. Competences include milling and coordinate measurement, magnet plate assembly, and coil unit assembly and testing.

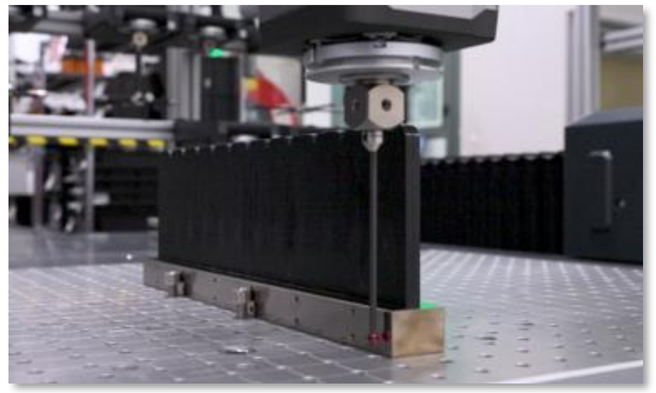
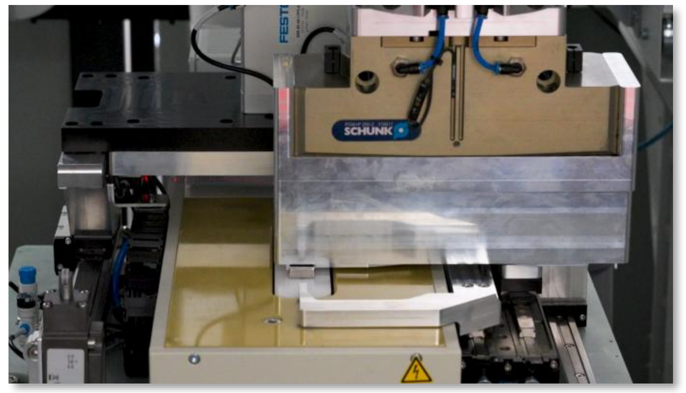
Customization

Backed by our design and manufacturing competences, we can provide customized motor and actuator solutions of (high-vacuum) coreless linear motors, iron core linear motors, and other linear motor or actuator types. We support the process from requirements definition, design, and qualification through manufacturing and lifecycle management.

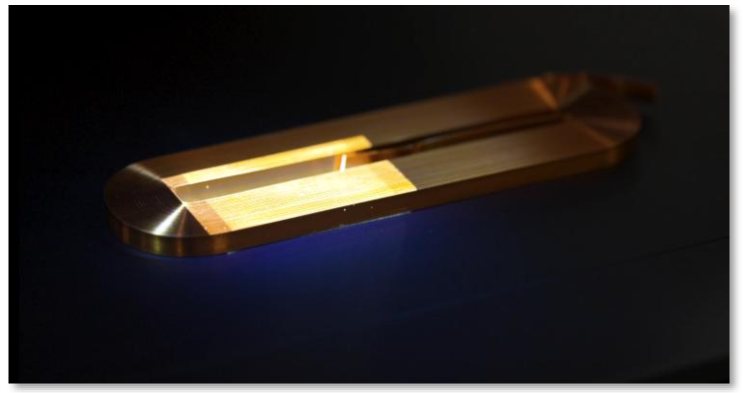
Contact us to enquire about the possibilities to provide the best solution for your application.

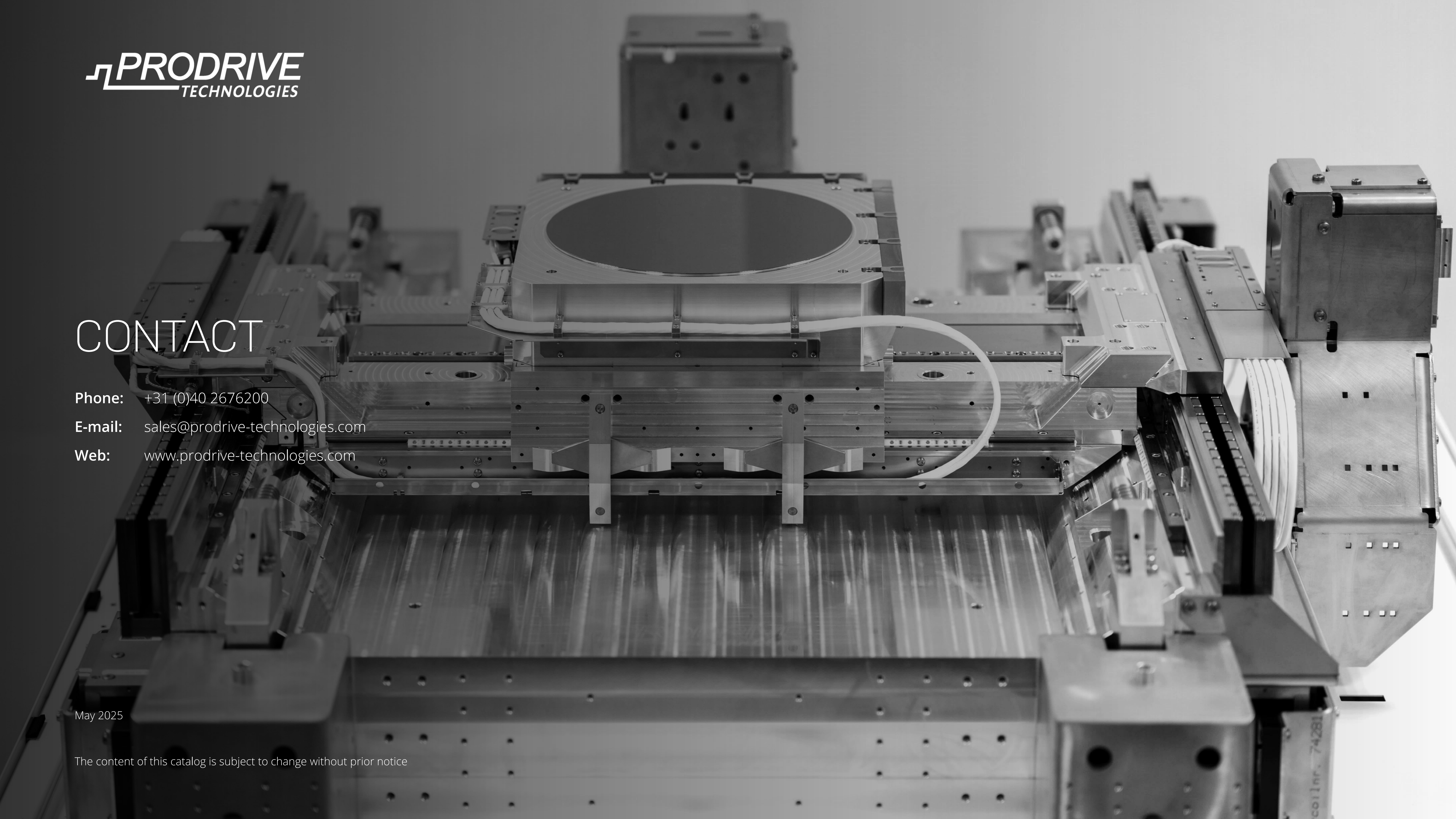








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May 2025