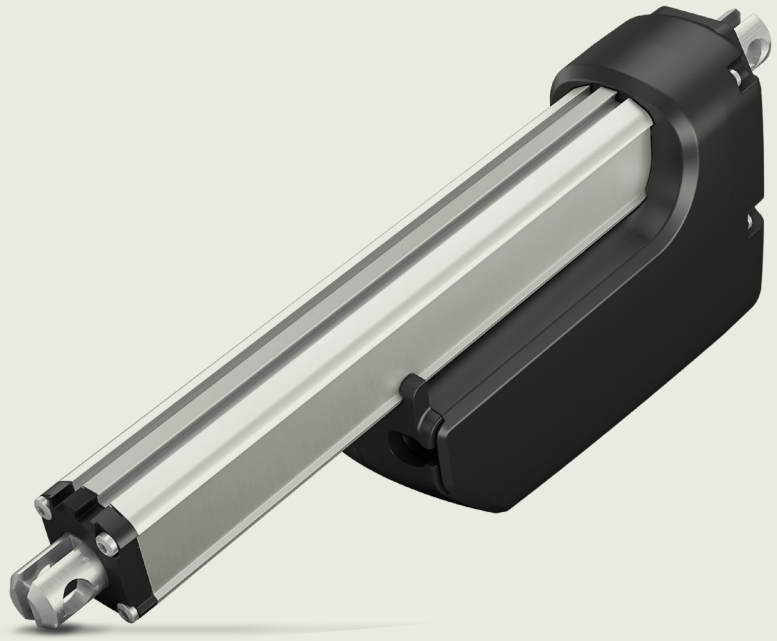
Linear Actuator LA33

Data Sheet



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Revision overview

Edition 16

Document aligned to match LA36, LA37, LA76 and LA77	
Safety instructions added	Page 4-5
Stroke lengths updated	Page 6
Safety factor added to Features	Page 6
Options in general updated	Page 6
Ordering Example updated with new IC types	Page 9
Old IC types removed	Page 9, 31
Technical Specifications updated with Gear/Ratio, Hall resolution, End-play and 48 V	Page 14
Current curves updated	Page 15 - 17
Current Limits and Current Cut-off added	Page 19
Mounting Guidelines added	Page 20-21
Principle drawing text added illustrations	page 20 & 28
Built-in dimensions for Zero Point added	Page 23
Keep a clearing text updated	Page 23
Option ‘4’ added to piston rod eyes	Page 25
‘All dimensions are in mm’ text added	Page 23 - 26
Cables updated	Page 29 - 31
Electrical installation text updated	Page 32
Specified that only actuators with platform “0” needs fuses	Page 32
Manual Hand Crank text updated	Page 41
DOC for I/O added	Page 50
CAN bus J1939 changed to CAN SAE J1939	(all over document)
UKCA documents removed	
All Connection Diagrams and I/O Specs are removed from the SBU They can be found in the respective Interface User Manuals	

Edition 15

B10 added	Page 12-14

Edition 14

Spindle dependent end-play values added	Page 7
Fast gear added	Page 5, 7-11, 23
Plastic gears added	Page 12
Ordering example updated with 48 V motor type, 0-point, gear and IC options	Page 12-13
48 V motor added	Page 5, 7, 11, 23
Connection diagrams layout changed	Page 25-83
I/O Specifications layout changed	Page 26-85

Introduction

The actuator LA33 combines compact design and high power in a solution fit for use in industrial settings and for demanding applications that require customised interfaces, faster, silent operation or to work in rough and extreme environments.

Safety instructions

Please read this safety information carefully.

Be aware of the following three symbols throughout the user manual:

Warning!
Failing to follow these instructions can cause accidents resulting in serious personal injury.

Recommendations
Failing to follow these instructions can result in the actuator suffering damage or being ruined.

Additional information
Usage tips or additional information that is important in connection with the use of the actuator.

Furthermore, ensure that all staff who are to connect, mount, or use the actuator are in possession of the necessary information and that they have access to this user manual.

Persons who do not have the necessary experience or knowledge of the product/products must not use the product/products. Besides, persons with reduced physical or mental abilities must not use the product/products, unless they are under surveillance or they have been thoroughly instructed in the use of the apparatus by a person who is responsible for the safety of these persons.

Moreover, children must be under surveillance to ensure that they do not play with the product.

Before you start mounting/dismounting, ensure that the following points are observed:

- The actuator is not in operation.
- The actuator is free from loads that could be released during this work.

Before you put the actuator into operation, check the following:

- The actuator is correctly mounted as indicated in the relevant user instructions.
- The equipment can be freely moved over the actuator's whole working area.
- The actuator is connected to a mains electricity supply/transformer with the correct voltage and which is dimensioned and adapted to the actuator in question.
- Ensure that the voltage applied matches to the voltage specified on the actuator label.
- Ensure that the connection bolts can withstand the wear.
- Ensure that the connection bolts are secured safely.

During operation, please be aware of the following:

- Listen for unusual sounds and watch out for uneven running. Stop the actuator immediately if anything unusual is observed.
- Only use the actuator within the specified working limits.
- Do not step on or kick the actuator.

When the equipment is not in use:

- Switch off the mains supply in order to prevent unintentional operation.
- Check regularly for extraordinary wear.

Classification

The equipment is not suitable for use in the presence of a flammable anaesthetic mixture with air or with oxygen or nitrous oxide.

Warnings

- Do not sideload the actuator.
- When mounting the actuator in the application ensure that the bolts can withstand the wear and that they are secured safely.
- If irregularities are observed, the actuator must be replaced.

Recommendations

- Do not place load on the actuator housing.
- Prevent impact or blows, or any other form of stress to the housing.
- Ensure that the duty cycle and the usage temperatures for the actuators are respected.
- Ensure that the cable cannot be squeezed, pulled or subjected to any other stress.
- Furthermore, it will be good practice to ensure that the actuator is fully retracted in the “normal” position. The reason is that there will be a vacuum inside the actuator if it is extended which over time can lead to water entering the actuator.

Features

- Maximum load from 500 N - 5,000 N depending on gear ratio and spindle pitch
- Maximum. speed up to 70 mm/sec. depending on load and spindle pitch
- Stroke length (switch) from 35 to 1000 mm
- Stroke length (Zero Point) from 75 mm to 1000 mm
- Heavy duty aluminium housing for harsh conditions
- Highly efficient acme thread spindle
- Safety factor 2: The actuator has been certified to withstand static loads that are twice the magnitude of its dynamic load capacity without sustaining damage.
- Protection class: IP66 for outdoor use (dynamic), furthermore the actuator can be washed down by a high pressure cleaner (IP69K – static)
- Hand crank for manual operation
- Integrated brake, high self-lock ability
- Endplay – 2.5 mm maximum
- Non rotating piston rod eye
- Built-in endstop switches
- Noise level: 73 dB (A) measuring method DS/EN ISO 8746 actuator not loaded
  70 dB (A) measuring method DS/EN ISO 8746 actuator not loaded (Plastic gear)
- Self-lock (with shorted power cables)

Options in general

- 12, 24 or 48 VDC permanent magnetic motor
- Exchangeable cables in different lengths
- Adjustable magnetic sensors for Endstop Reached signals (code no. 1017031)
- Hall effect sensor
- Endstop Reached Signals
- IC options including:
  - I/O
  - LIN bus communication
  - CAN SAE J1939
  - CANopen
  - Parallel Controller with CAN SAE J1939 and CANopen
  - Analogue or digital feedback for precise positioning
  - Proportional control
- Specific interface user manuals are available at the TECHLINE webpage containing both Connection Diagrams and I/O Specifications
- PC configuration tool (BusLink or Actuator Connect™)

Usage

- Duty cycle at 600 mm stroke is maximum. 20% (4 min. drive and 16 min. rest)
- Duty cycle, with plastic gear, at 400 mm stroke is maximum. 10% (2 min. drive and 18 min. rest)
- Ambient operating temperature: -40 °C (reduced load) to +85 °C (reduced duty cycle)
  -For plastic gear options: -10 °C to 40 °C
- Ambient operating temperature at full performance from +5 °C to +40 °C
- Storage temperature: -55 °C to +105 °C

Ordering example

33 090 200 0A 0A 3 B 1 A = 1 1 B C 2 A 4 2 0 0 0 0

Actuator Type	33	=	LA33			
Spindle Type	**090**	=	9 mm	200	=	20 mm
	150	=	15 mm			
Stroke length	**200**	=	length in mm (50-955)			
Safety	00	=	None	**0A**	=	Safety nut (Push only)
Feedback	00	=	None	0F	=	PWM
	0A	=	Analogue feedback (Hall potentiometer)	0K	=	Single Hall
Platform	0	=	Standard			
	3	=	IC (Integrated Controller)			
Motor Type	A	=	12 VDC	J	=	48 VDC
	B	=	24 VDC			
Endstop	0	=	Power switch	2	=	Zero Point (Platform 3 - IC)
	1	=	Signal switch (Platform 3 - IC)			
IP	**A**	=	IP66			
Colour	**=**	=	Dark Olivish Grey NCS S7000-N			
Back Fixture	**1**	=	Ø 12.2 hole, slotted	A	=	12.2 hole, slotted, AISI 304
	2	=	Ø 12.2 hole, slotted - 90°	B	=	12.2 hole, slotted, AISI 304 - 90°
	3	=	Ø 12.9 hole, slotted	C	=	12.9 hole, slotted, AISI 304
	4	=	Ø 12.9 hole, slotted - 90°	D	=	12.9 hole, slotted, AISI 304 - 90°
	5	=	M12 X 1.75, male adaptor			
Piston Rod Eye	**1**	=	Ø 12.2 hole, slotted	A	=	Ø 12.2 hole, slotted, AISI 304
	2	=	Ø 12.9 hole, slotted	B	=	Ø 12.9 hole, slotted, AISI 304
	4	=	M8, female adapter, AISI 303	C	=	Ball eye ø10H7, AISI 304
	5	=	M12 X 1.75, male adaptor	D	=	Ball eye ø12H7, AISI 304
				X	=	Special
Gear	A	=	Ratio 1:67	1	=	Ratio 1:67 (Plastic gear)
	B	=	Ratio 1:39	2	=	Ratio 1:39 (Plastic gear)
	C	=	Ratio 1:16	3	=	Ratio 1:16 (Plastic gear)

Plug type	0	=	No plug			
	C	=	Flying leads (Signal cable with FASTIN FASTON AMP)			
	H	=	Deutsch			
	K	=	AMP Super Seal			
	7	=	AMP Super Seal moulded			
	9	=	Deutsch moulded	X	=	Special
Cable	0	=	No cable	A	=	1.5 m power 90°
	1	=	1.5 m power	B	=	5 m power 90°
	2	=	5 m power	C	=	1.5 m power and 1.5 m signal 90°
	3	=	1.5 m power and 1.5 m signal	D	=	5 m power and 5 m signal 90°
	4	=	5 m power and 5 m signal			
	5	=	1.5 m Y-cable, power and signal in one			
	6	=	5 m Y-cable, power and signal in one			
				X	=	Special
Endstop Reached output* In/Out	**A**	=	A_HIGH / A_HIGH	N	=	LOW / LOW
	B	=	A_LOW / A_HIGH			
	C	=	A_HIGH / A_LOW			
	D	=	A_LOW / A_LOW	X	=	Special
Feedback Level	0	=	None (IC w/o feedback)	3	=	0.5 - 4.5 V
	1	=	0 V - VCC (Single Hall)	**4**	=	4 - 20 mA
	2	=	0-10 V	X	=	Special

* A_High is active high and A_LOW is active low. HIGH is constant high and LOW is constant low.

Active high: The signal goes from low to high, when the endstop is reached.

Active low: The signal goes from high to low, when the endstop is reached.

Low: The signal stays low at all times.

IC Type

6-pin

Endstop switch principle

0 = None IC - (standard actuator)
6 = LIN bus
7 = CAN SAE J1939
8 = CANopen
X = Special

9-pin

Zero Point

B = I/O Basic
C = I/O Customised
F = I/O Full
Q* = Modbus RTU
S* = IO-Link

Zero Point with split power supply

E* = Ethernet/IP
G = CAN SAE J1939
H = CANopen
P* = Profinet
T* = Modbus TCP/IP
X = Special

Not used **0** = N/A

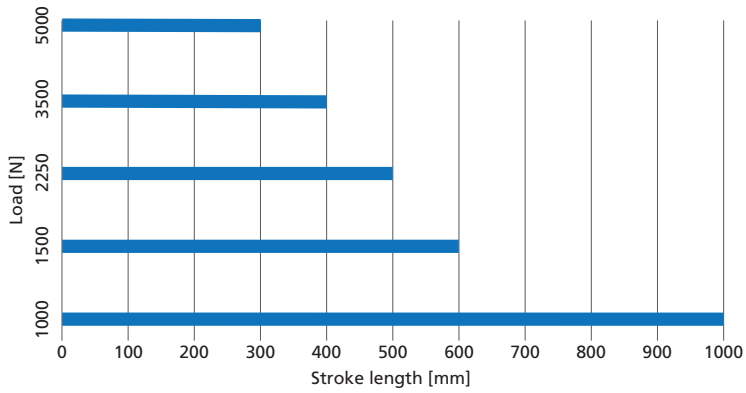
Parallel **0** = The system is Not Parallel

2-8 = Numbers of actuators in Parallel

BID **000** = Stroke up to 300 mm = stroke + 160 mm (165 mm for Zero point)
000 = Stroke from 301 mm = stroke + 210 mm (215 mm for Zero point)

* Actuators with these platforms comes with the specific signal cables that coresponds to the specifc IC-Type.

Load vs. stroke length



- For applications operating only in pull the limitations are 600 mm stroke and 5,000 N load
- 1000 mm with maximum 1000 N in push and 1500 N in pull available as special item. (For plastic gears there is no difference between push and pull loads).

Technical specifications:

12V motor:

Load max. [N]	Self-lock max. [N]	Spindle Pitch (mm) /Gear	Gear/ Ratio	Hall Rersolu-tion [mm/ count]	End-play in [mm]	*Typical speed [mm/s[		Standard Stroke length [mm] in steps of 50 mm	*Typical Amp. [A]	
						No load	Full load		No load	Full load
500	500	20	C 1:16	0,56	2.5	68	52	100-600	5.0	12
1500	1500	20	B 1:39	0,56	2.5	34	24	100-600	2.0	10
2250	2250	15	B 1:39	0,42	1.25	23	15	100-500**	2.8	10
3500	3500	15	A 1:67	0,26	1.25	15	9	100-400**	2.8	10
5000	5000	9	A 1:67	0,15	1.0	9	6	100-300**	2.8	10

24V motor:

Load max. [N]	Self-lock max. [N]	Spindle Pitch (mm) /Gear	Gear/ Ratio	Hall Rersolu-tion [mm/ count]	End-play in [mm]	*Typical speed [mm/s]		Standard Stroke length [mm] in steps of 50 mm	*Typical Amp. [A]	
						No load	Full load		No load	Full load
500	500	20	C 1:16	0,56	2.5	80	72	100-600	3	7
1500	1500	20	B 1:39	0,56	2.5	35	30	100-600	1.8	6.5
2250	2250	15	B 1:39	0,42	1.25	25	21	100-500**	1.8	6.6
3500	3500	15	A 1:67	0,26	1.25	15	13	100-400**	1.8	7.0
5000	5000	9	A 1:67	0,15	1.0	9	7	100-300**	1.8	6.5

48 V Motor:

Load max. [N]	Self-lock max. [N]	Spindle Pitch (mm) /Gear	Gear/ Ratio	Hall Rersolu-tion [mm/ count]	End-play in [mm]	*Typical speed [mm/s]		Standard Stroke length [mm] in steps of 50 mm	*Typical Amp. [A]	
						No load	Full load		No load	Full load
500	500	20	C 1:16	0,56	2.5	80	72	100-600	0.9	3.5
1500	1500	20	B 1:39	0,56	2.5	35	30	100-600	0.9	3.2
2250	2250	15	B 1:39	0,42	1.25	25	21	100-500**	0.9	3.3
3500	3500	15	A 1:67	0,26	1.25	15	13	100-400**	0.9	3.5
5000	5000	9	A 1:67	0,15	1.0	9	7	100-300**	0.9	3.2

See Current limits and Current cut-offs for availability of voltage

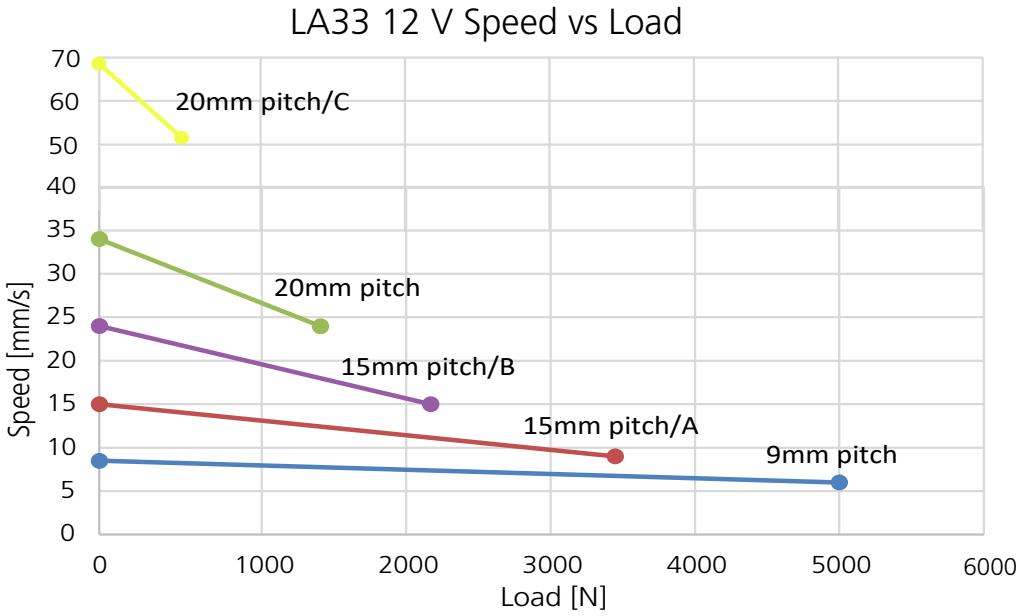
* The typical values can have a variation of ± 20% on the current values and ± 10% on the speed values. Measurements are made with an actuator in connection with a stable power supply and an ambient temperature at 20 °C.

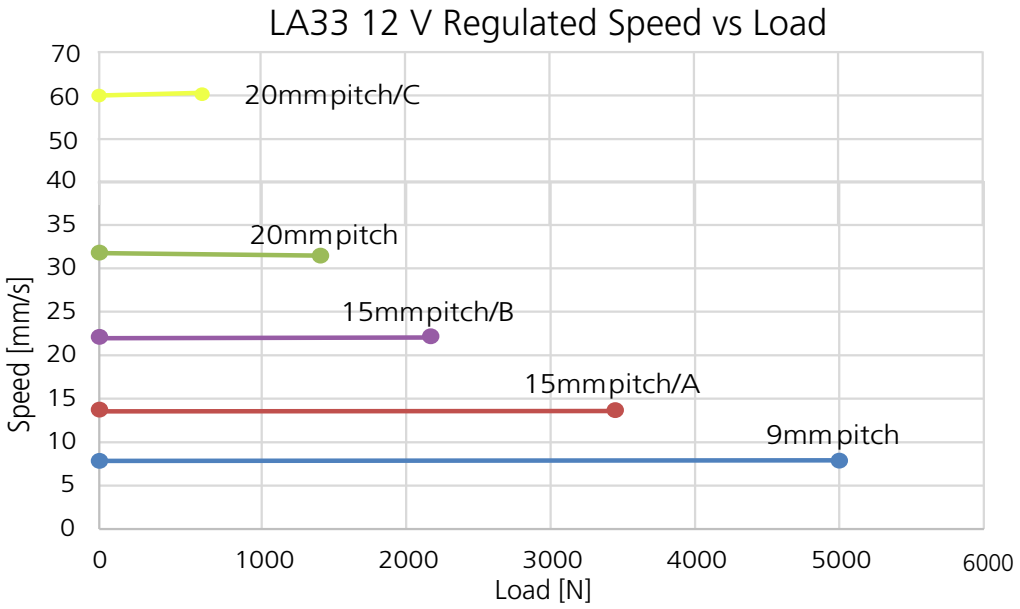
** There are limitations on the stroke length if you need full load, please see "Load vs. stroke length" on the previous page.

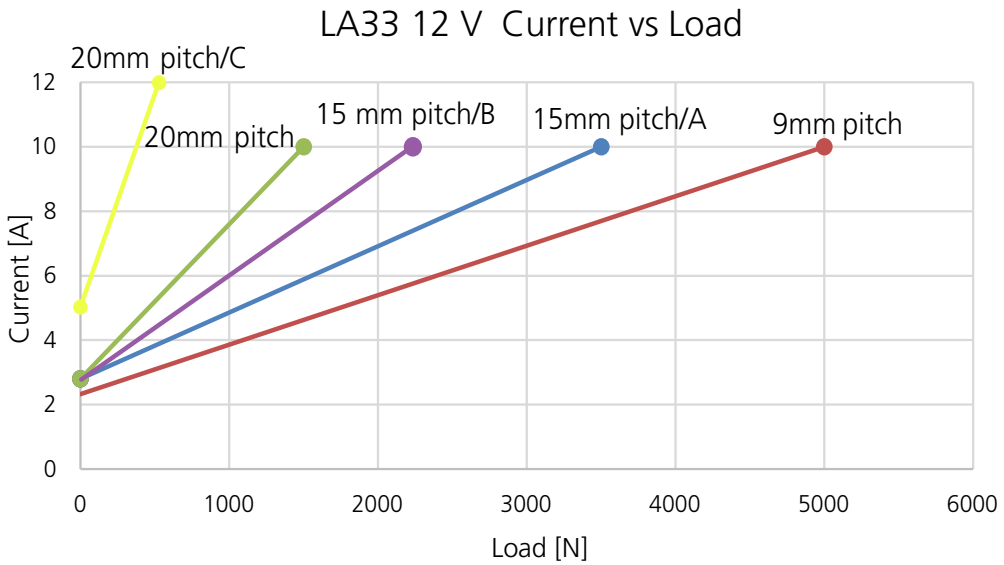
Please note that all actuators featuring 'LIN bus', 'CAN SAE J1939', 'CANopen', 'MODBUS', 'I/O' will run at a regulated speed, which is typically around 80% of the Typical speed at no load.

Speed and current curves 12 V

The values below are typical values and made with a stable power supply and an ambient temperature of 20˚ C.

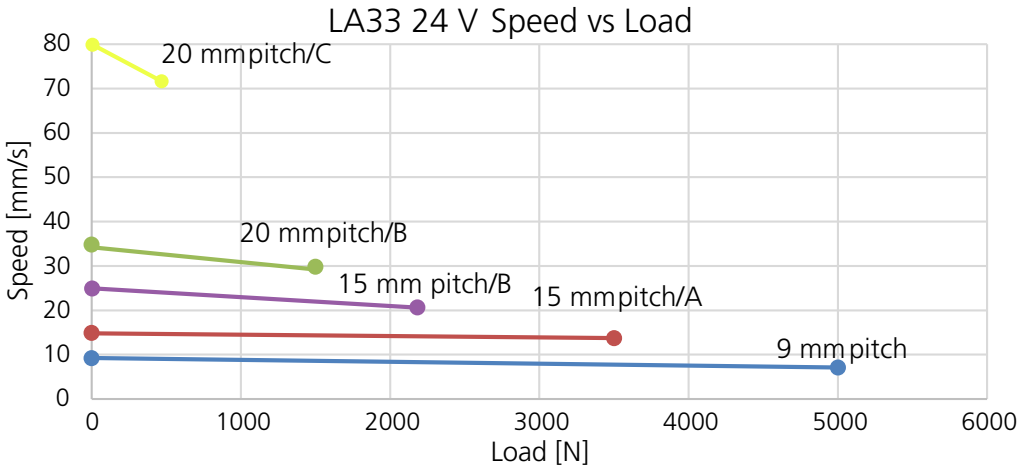


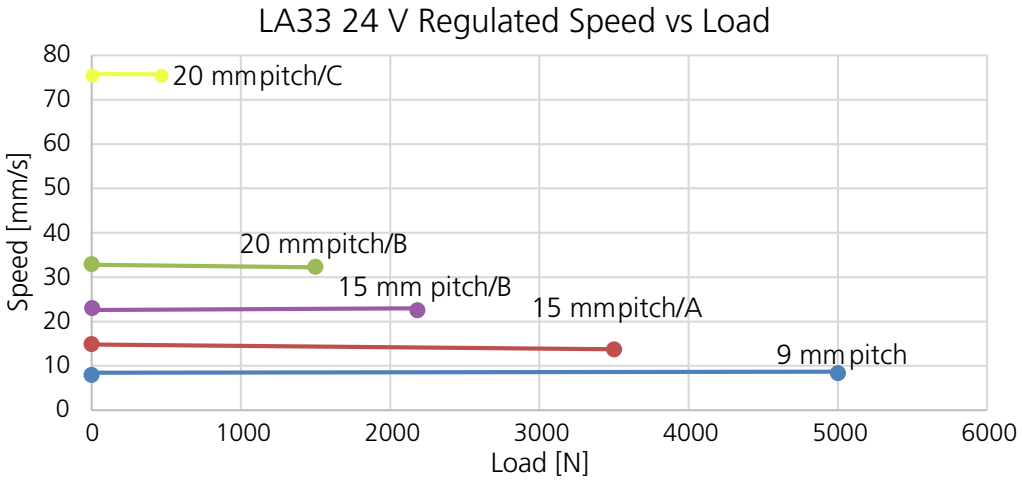


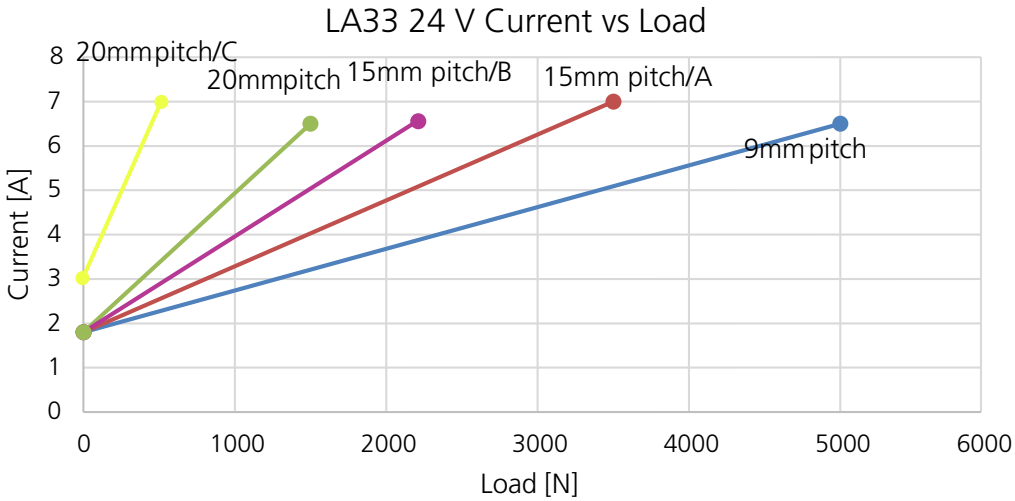


Speed and current curves 24 V

The values below are typical values and made with a stable power supply and an ambient temperature of 20˚ C. The performance is reduced at low temperatures (below -5° C).

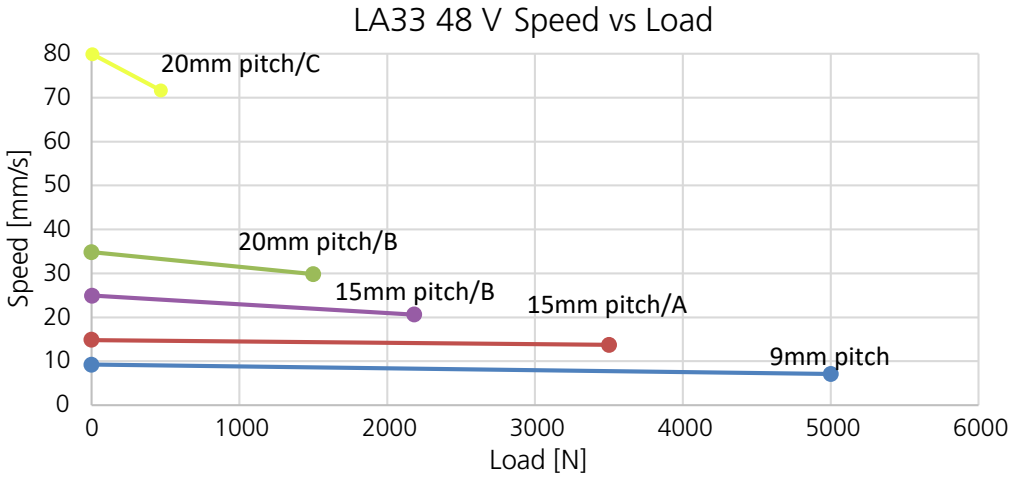


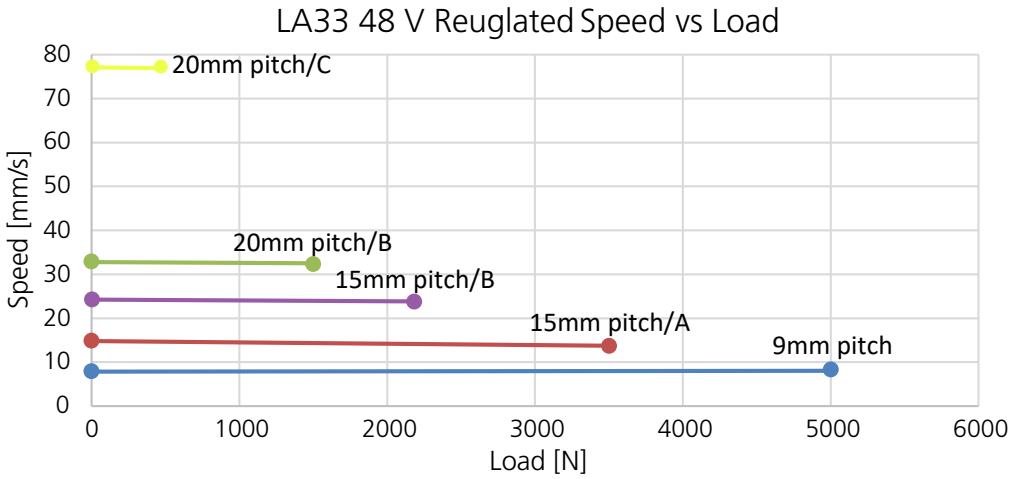


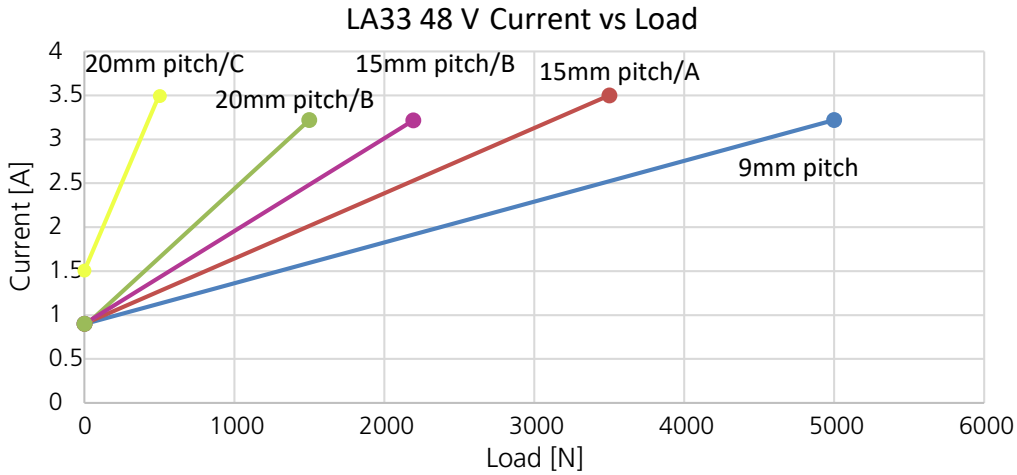


Speed and current curves 48 V

The values below are typical values and made with a stable power supply and an ambient temperature of 20˚ C. The performance is reduced at low temperatures (below -5° C).







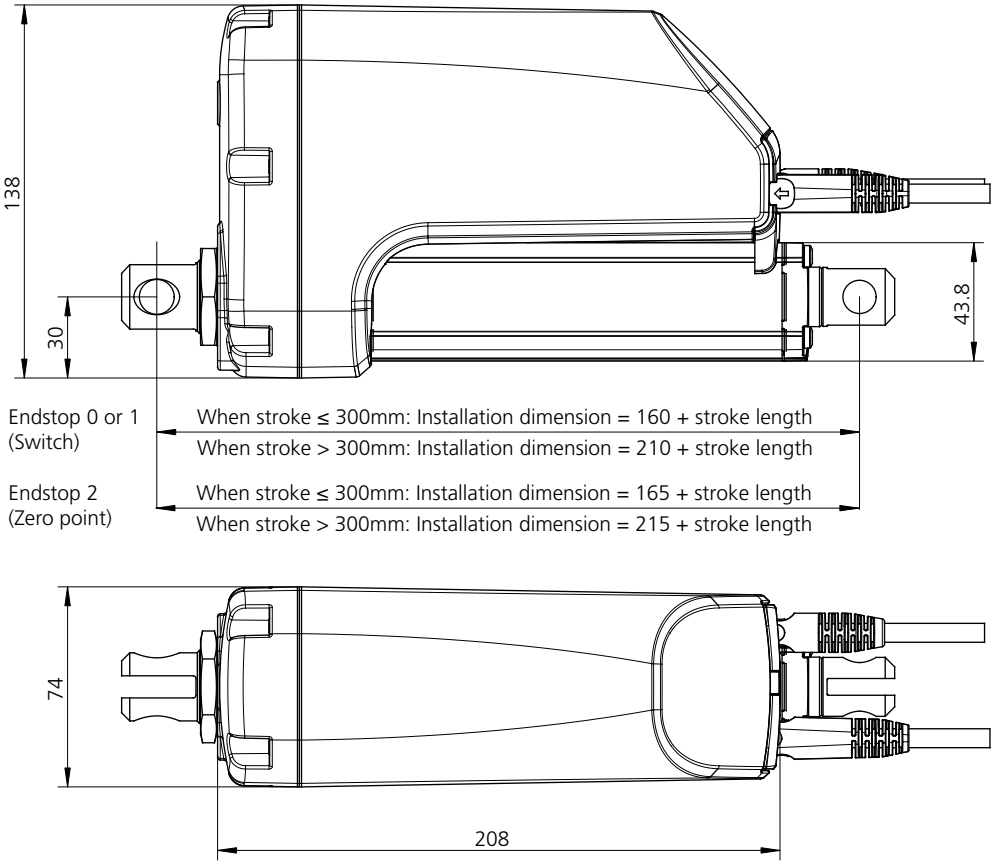
Stroke and built-in tolerances:

Endstop options	Descriptions	Stroke tolerance	Example for 200mm stroke	BID tolerance	Example for 360mm BID
All	With built-in limit switches or Integrated Controller	+/-2mm	198 to 202mm	+/- 4mm	356 to 364mm

Built-in dimensions:

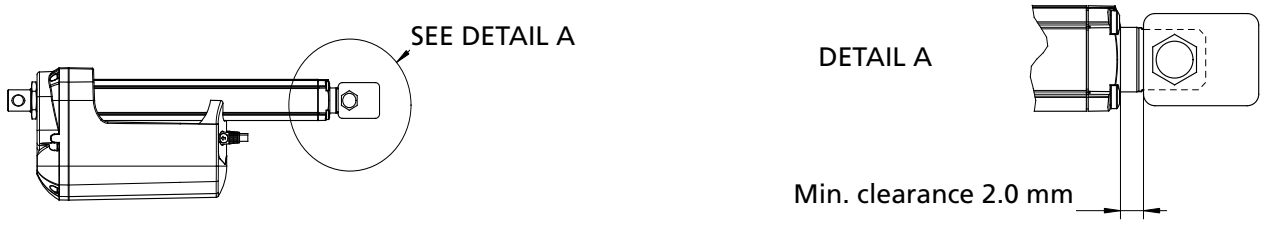
	Piston rod	"1 and A" / to the centre of the hole		"2 and B" / to the centre of the hole		"5" / from the surface		"C and D" / to the centre of the hole	
Back fixture		Stroke < = 300	Stroke > 300	Stroke < = 300	Stroke > 300	Stroke < = 300	Stroke > 300	Stroke < = 300	Stroke > 300
Endstop 0 or 1 (Switch)		160	210	160	210	157*	207*	171	221
Endstop 2 (Zero Point)		165	215	165	215	162*	212*	176	226

* These built-in dimensions are measured according to the illustration below. All dimensions are in mm.



Keep a clearance when mounting a bracket

When mounting a custom bracket on the moving part of the actuator, please observe the minimum clearance between bracket and cylinder top when fully retracted. This will prevent jamming and destruction of the actuator drive train.



With Zero point the minimum stroke is 75 mm
The Zero point initialisation zone is located between 35-70 mm going from the most inward position.

The movement passing the zone has to be stable for the initialisation to succeed - also no virtual limits can be set in the initialisation zone.

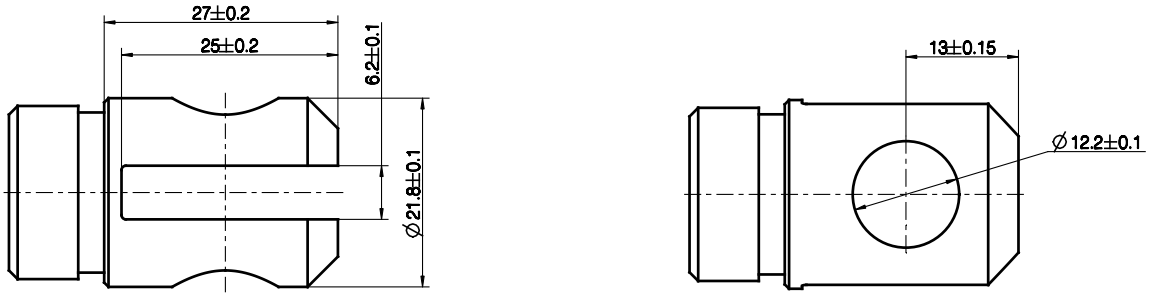
Piston Rod Eyes:

All dimensions are in mm..

Option "1" and "A"

Piston 0331036, Zinc coated steel

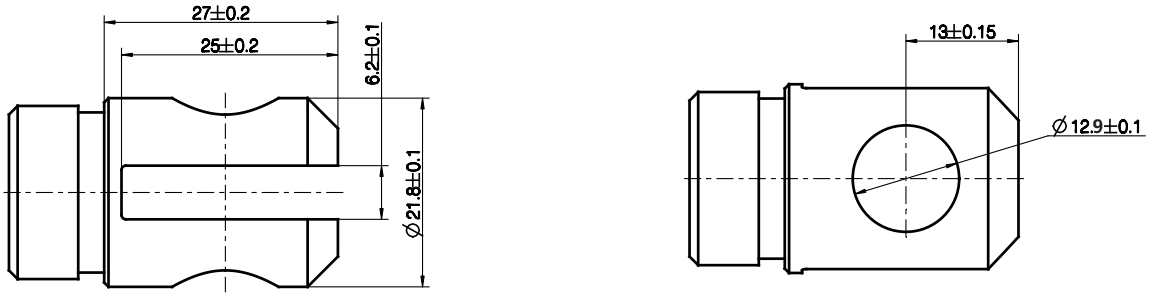
Piston 0331140, Stainless steel AISI 304



Option "2" and "B"

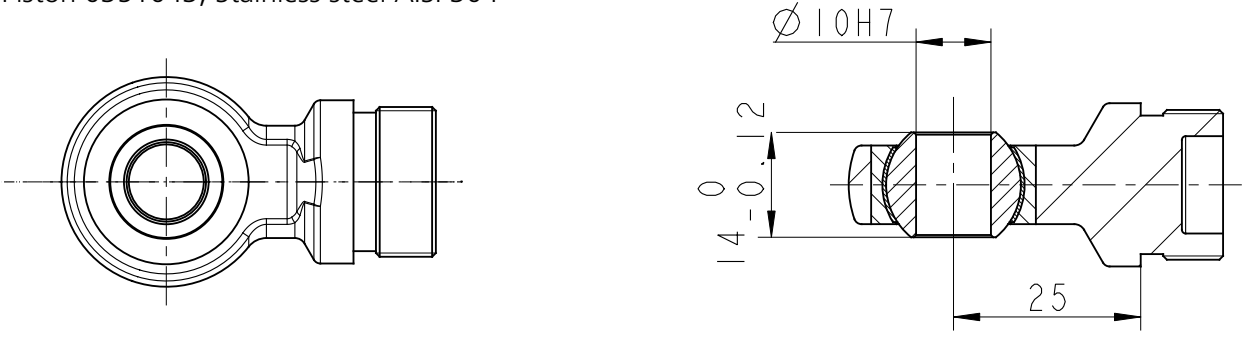
Piston 0331014, Zinc coated steel

Piston 0331139, Stainless steel AISI 304



Option "C"

Piston 0351043, Stainless steel AISI 304



The Piston Rod Eye is only allowed to turn 0 - 180 degrees

Piston Rod Eyes:

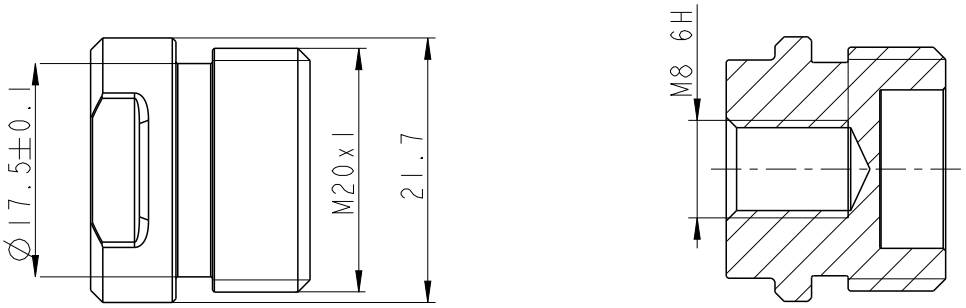
All dimensions are in mm.

Option "D"

Piston 0351035, Stainless steel AISI 304

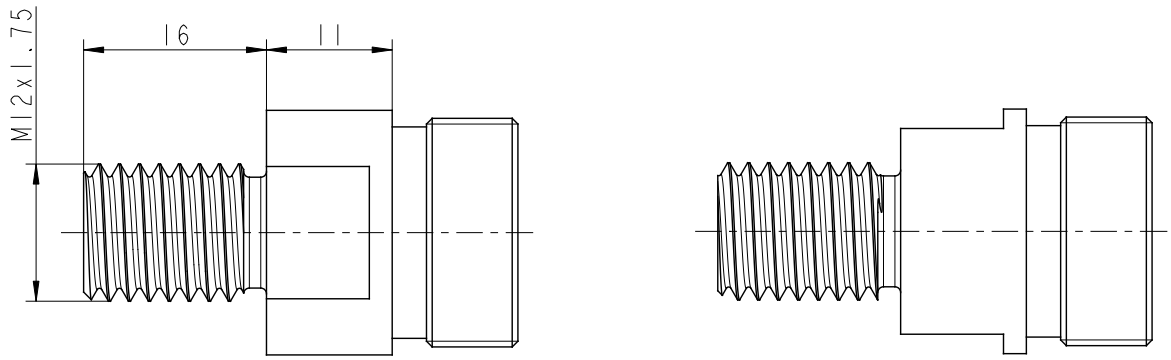
Option “4”

Piston 0331177, Stainless steel AISI 303



Option "5"

Piston 0231094, Stainless steel AISI 304



The Piston Rod Eye is only allowed to turn 0 - 180 degrees

Back fixtures:

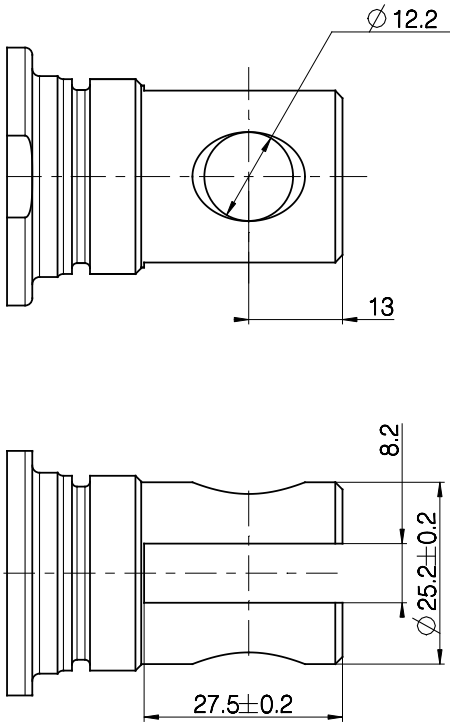
All dimensions are in mm.

Option "1" and "2"

LINAK P/N: 0331160, Zink coated steel

Option "A" and "B"

LINAK P/N: 0331158, Stainless steel AISI 304

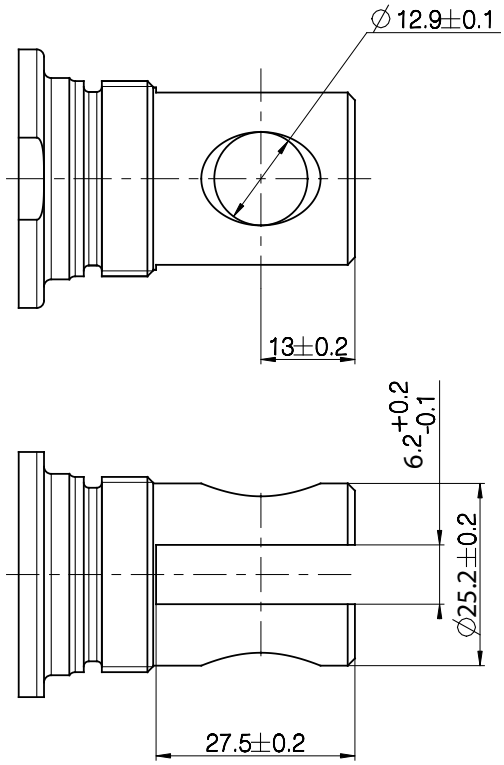


Option "3"

LINAK P/N: 0331159, Zink coated steel

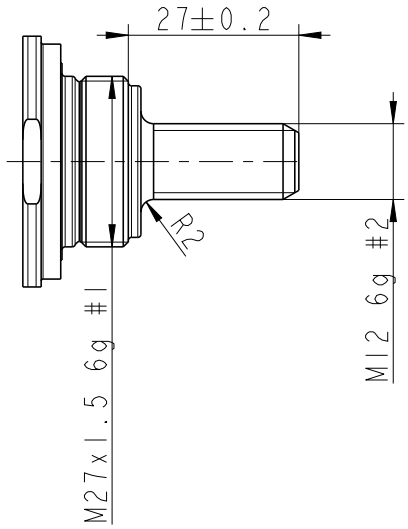
Option "C" and "D"

LINAK P/N: 0331157, Stainless steel AISI 304



Option "5"

LINAK P/N: 0331110, Stainless steel AISI 303



Back fixture orientation:

"0" Degrees

"90" Degrees

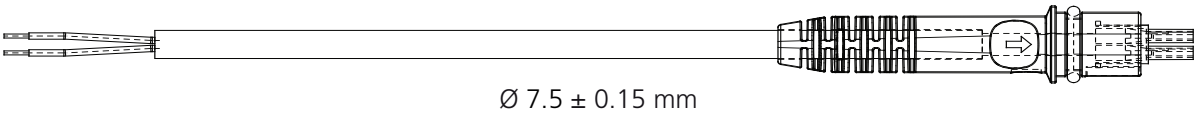
NB. All with tolerance of ± 4 °

Cables

Power cable dimensions

LINAK® P/N 0367046

Colour	Outer dimensions	Core mm²	AWG*
Brown	Ø2.8 mm	2.0	14
Blue	Ø2.8 mm	2.0	14

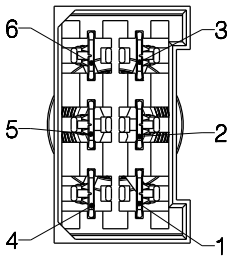


Ø 7.5 ± 0.15 mm

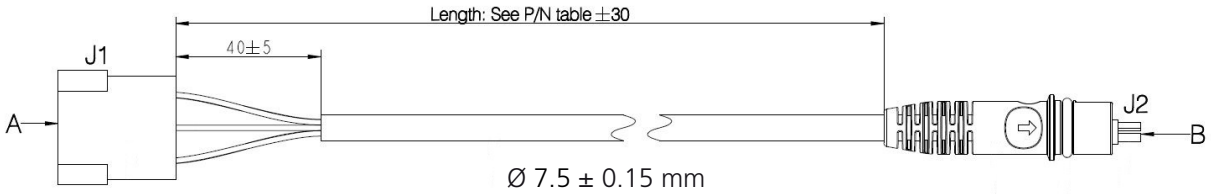
6-pin Signal cable dimensions

LINAK P/N 0367049

Colour	Outer dimensions	Core mm²	AWG*
Violet	Ø1.5 mm	0.5	20
Black	Ø1.5 mm	0.5	20
Red	Ø1.5 mm	0.5	20
Yellow	Ø1.5 mm	0.5	20
Green	Ø1.5 mm	0.5	20
White	Ø1.5 mm	0.5	20



Rear view

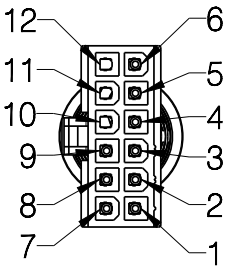


Ø 7.5 ± 0.15 mm

9-pin Signal cable dimensions

LINAK P/N 0368543

Colour	Outer dimensions	Core mm²	AWG*	Pin
Orange	Ø1.5 mm	0.5	20	5
Black	Ø1.5 mm	0.5	20	1
Red	Ø1.5 mm	0.5	20	2
Light Blue	Ø1.5 mm	0.5	20	6
Yellow	Ø1.5 mm	0.5	20	3
Green	Ø1.5 mm	0.5	20	4
Grey	Ø1.5 mm	0.5	20	0
Violet	Ø1.5 mm	0.5	20	7
White	Ø1.5 mm	0.5	20	8



Front view

*AWG: American Wire Gauge

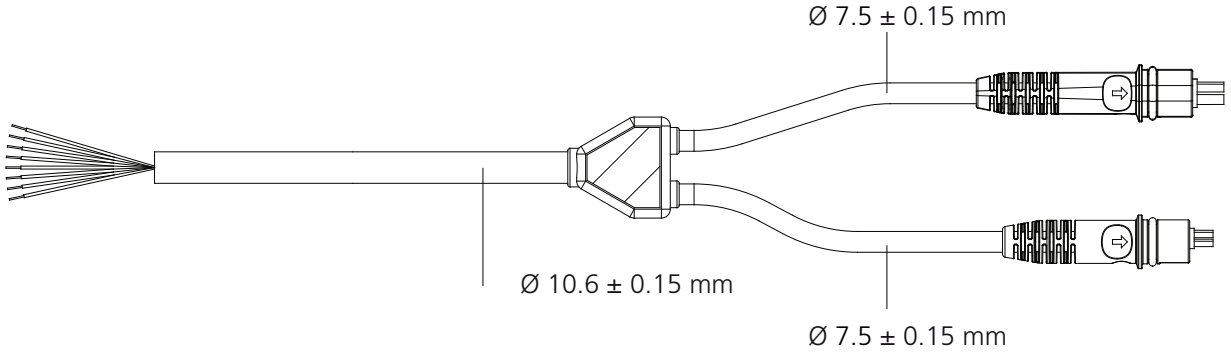
Cables

Y-cable dimensions

LINAK® P/N 0367020

Colour	Outer dimensions	Core mm²	AWG	Pin*
Brown	Ø2.8 mm	2.0	14	2
Blue	Ø2.8 mm	2.0	14	1
Red	Ø1.5 mm	0.5	20	4
Black	Ø1.5 mm	0.5	20	3
Yellow	Ø1.5 mm	0.5	20	7
Green	Ø1.5 mm	0.5	20	8
White	Ø1.5 mm	0.5	20	5
Violet	Ø1.5 mm	0.5	20	6

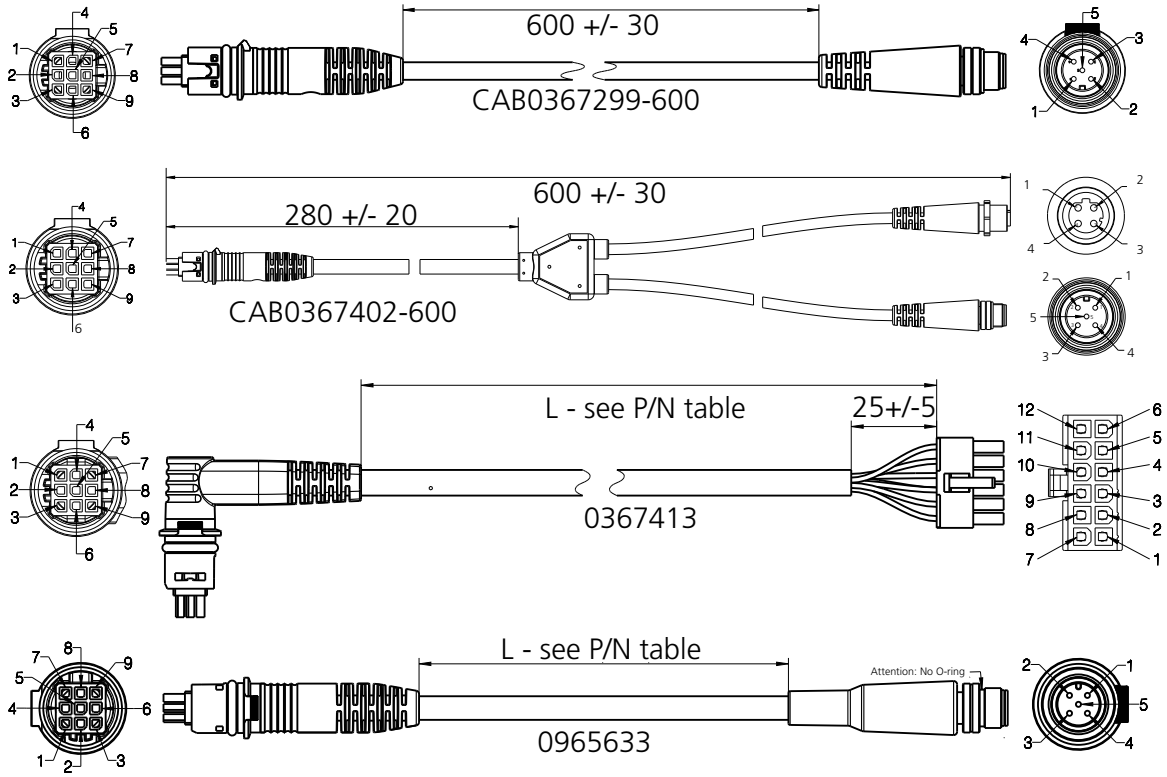
* Pin connections are the same for both AMP and Deutsch connectors



Cable P/N Table					
LINAK P/N	**Cable type**	**# Wires**	**mm²**	**AWG****	**Length in mm**
0367006	Power cable with AMP	2	2.0	14	200
CAB0367046-0400	Power cable	2	2.0	14	400
CAB0367046-0600	Power cable	2	2.0	14	600
CAB0367046-1500	Power cable	2	2.0	14	1,500
CAB0367046-5000	Power cable	2	2.0	14	5,000
CAB0367049-0600	Signal cable	6	0.5	20	600
CAB0367049-1500	Signal cable	6	0.5	20	1,500
CAB0367049-2000	Signal cable	6	0.5	20	2,000
CAB0367049-3000	Signal cable	6	0.5	20	3,000
CAB0367049-5000	Signal cable	6	0.5	20	5,000
CAB0368543-1500	Signal cable	9	0.5	20	1,500
CAB0368543-5000	Signal cable	9	0.5	20	5,000
CAB0367020-1500	Y-Cable Signal and Power	6 2	0.5 2.0	20 14	1,500
CAB0367020-5000	Y-Cable Signal and Power	6 2	0.5 2.0	20 14	5,000
0367430-XXXX	Y-Cable Signal and Power	9 2	0.5 2.0	20 14	1,500 5,000

Cable P/N Table					
CAB0367299-600	Signal cable for IO-Link	9	0.5	20	600
CAB0367402-600	Signal Y-cable for Ethernet	9	0.5	20	600
0367413-XXXX	Signal cable w. 90° plug	9	0.5	20	1,500 5,000
0965633-XXXX	Signal cable for Modbus	9	0.5	20	100 & 1,000

**AWG: American Wire Gauge



Cable kit article numbers

Buslink® cable kits				
System	**Article no.**	**Pins**	**Including**	**Colour**
CAN SAE J1939 / CANopen with 6 pins	0367997	6	(Adapter + USB2Lin)	Green

Actuator Connect™ cable kits				
System	**Article no.**	**Pins**	**Including**	**Colour**
I/O: Basic, Customised and Full & CAN SAE J1939 / CANopen with 9 pins	0367996	9	(Adapter + USB2Lin)	Grey

Latest versions of Actuator Connect® can be downloaded at the LINAK/TECHLINE page.

Electrical installation:

To ensure maximum self-locking ability, for standard actuators without IC, please be sure that the motor is shorted when stopped. Actuators with integrated controller provide this feature, as long as the actuator is powered.

When using soft stop on a DC-motor, a short peak of higher voltage will be sent back towards the power supply. It is important when selecting the power supply that it does not turn off the output, when this backwards load dump occurs.

Manual hand crank:

The manual hand crank can be used in the case of power failure and is only intended for emergency use.

The cover over the Allen key socket must be unscrewed before the Allen key can be inserted and the hand crank operated.

Hand crank torque: 6-8 Nm

Hand crank rpm: Max. 65

- The power supply has to be disconnected during manual operation
- If the actuator is operated as a hand crank, it must only be operated by hand, otherwise there is a potential risk of overloading and hereby damaging the actuator
  - do NOT use power tools for the hand crank!
- After using the hand crank the ingress protection will be lower
  - even if the cover is proberly mounted
- Actuators with absolute positioning must be initialised after use of the manual hand crank, because their positioning will be displaced when the power is disconnected.
- After using the hand crank, always return the actuator to the most inward position. Failing to do so can damage the actuator and/or the application it is used for

Environmental tests

Degrees of protection	EN60529 - IP66	IP6X - Dust: Dust-tight, No ingress of dust Actuator is not activated
	EN60529 - IP66	IPX6 - Water: Ingress of water in quantities causing harmful effects is not allowed Duration: 100 litres per minute in 3 minutes Actuator is not activated
	DIN40050 - IP69K	IPX9K: High pressure cleaner Temperature: +80°C Water pressure: 80-100 bar Water flow: 14-16 l/minute Duration: 30 sec. each at 4 different angles 0°, 30°, 60° and 90° Actuator is not activated Ingress of water in quantities causing harmful effects is not allowed

Environmental tests – Mechanical:

Test	Specification	Comment
Mechanical Shock (Handling) - Drop test		3 drops on 6 faces onto a concrete floor Drop height: 500 mm on all faces
Vibration Random	The specification is based on ISO 16750-3:2012(E) Test VII and should therefore be performed according to IEC 60068-2-64, random vibration. The PSD level is increased in the frequency range from 10 to 400[Hz]	Random vibration: From 10Hz to 2000 Hz Duration: 32 h/axis Acceleration: 6.9 [g_{rms}]

Environmental tests – Electrical:

Standard	Specification	FOCUS ON
EN/IEC 60204-1:2006 + A1:2009 + AC:2010	Safety of machinery - Electrical equipment of machines - Part 1: General requirements	• INDUSTRIAL AUTOMATION
EN/IEC 61000-6-1: 2007	Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity for residential, commercial and light industrial environments	• INDUSTRIAL AUTOMATION
EN/IEC 61000-6-2: 2005 + AC:2005	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments	• INDUSTRIAL AUTOMATION
EN/IEC 61000-6-3: 2007 + A1:2011 + AC:2012	Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments	• INDUSTRIAL AUTOMATION
EN/IEC 61000-6-4: 2007 + A1:2011	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards: Emission standard for industrial environments	• INDUSTRIAL AUTOMATION
ISO 16750-2:2012	Environmental conditions and testing for electrical and electronic equipment - Part 2: Electrical loads	• ROAD VEHICLES
ISO 7637-2:2011	Electrical disturbances from conduction and coupling - Part 2: Electrical transient conduction along supply lines only	• ROAD VEHICLES
ISO 7637-3:2007	Electrical disturbances from conduction and coupling - Part 3: Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines	• ROAD VEHICLES
CISPR 25 IEC:2008	Radio disturbance characteristics – Limits and methods of measurement for the protection of on-board receivers	• VEHICLE, BOATS AND INTERNAL COMBUSTION ENGINES
ISO 11452-1, 2, 4		

All electrical tests are conducted and radiated emission (EMC) tests.

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