

Linear Actuator LA77

Data Sheet



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Preface

Dear User,

We are delighted that you have chosen a LINAK® product.

LINAK systems are high-tech products based on many years of experience in the manufacture and development of actuators, lifting columns, desk frames, electric control boxes, controls, batteries, accessories and chargers.

This User Manual does not address the end user. It is intended as a source of information for the equipment or system manufacturer only, and it will tell you how to install, use and maintain your LINAK electronics. The manufacturer of the end product has the responsibility to provide a User Manual, where relevant safety information from this manual is passed on to the end user.

We are convinced that your LINAK product/system will give you many years of problem-free operation.

Before our products leave the factory, they undergo both function and quality testing. Should you, nevertheless, experience problems with your product/system, you are always welcome to contact your supplier.

LINAK subsidiaries and some distributors situated all over the world have authorised service centres, which are always ready to help you. Locate your local contact information on the back page.

LINAK provides a warranty on all products. (See warranty section).

This warranty, however, is subject to correct use in accordance with the specifications, maintenance being done correctly, and any repairs being carried out at a service centre, which is authorised to repair LINAK products.

Changes in installation and use of LINAK systems can affect their operation and durability. The products may only be opened by authorised personnel.

This User Manual has been written based on the present technical knowledge. LINAK reserves the right to carry out technical modifications and keeps the associated information updated.

LINAK A/S

Terms of use

LINAK® takes great care in providing accurate and up-to-date information on its products. However, the user is responsible for determining the suitability of LINAK products for a specific application.

Due to continual development, LINAK products are subject to frequent modifications and changes. LINAK reserves the rights to conduct modifications, updates, and changes without any prior notice. For the same reason, LINAK cannot guarantee the correctness and actual status of imprinted information on its products.

LINAK uses its best efforts to fulfil orders. However, for the reasons mentioned above, LINAK cannot guarantee availability of any particular product at any given time. LINAK reserves the right to discontinue the sale of any product displayed on its website or listed in its catalogues or in other written material created and produced by LINAK, LINAK subsidiaries, or LINAK affiliates.

All sales are subject to the 'Standard Terms of Sale and Delivery for LINAK A/S' available on LINAK websites.

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Introduction

Powerful electric linear actuator designed to handle high loads and demanding environments. It delivers long-lasting reliability as well as a wide choice of industrial control interfaces.

Safety instructions

Please read this safety information carefully.

Be aware of the following three symbols throughout the document:



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 document.

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.
- Do not sideload the actuator.
- 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 cable cover is mounted correctly. Use 3.5 Nm torque.
- Ensure that the duty cycle and the usage temperatures for LA77 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

- Protection class: IP66 for outdoor use (dynamic). Furthermore, the actuator can be washed down by a high pressure cleaner (IP69K - static)
- Highly efficient acme thread spindle
- Static holding load up to 45 kN in push and pull
- Dynamic wind stress loads 15 kN push/pull 100,000 times
- Hand crank for manual operation
- Integrated brake, high self-lock ability
- Endplay - 2 mm max.
- Non-rotating piston rod eye
- Noise level: 76 dB (A). Measuring method: DS/EN ISO 8746 (actuator not loaded)
- Built-in Zero Point initialisation
- Heavy duty aluminium housing for harsh conditions
- Hall effect sensor for precise positioning
- Current monitoring

Options in general

- 24 / 48 V DC Brushless motor
- Load from 10,000 N - 15,000 N
- Max. speed 7 mm/sec. depending on load and spindle pitch
- Stroke length from 100 mm to 600 mm
- Back fixture turnable in steps of 30 degrees
- Different back fixtures and piston rod eyes
- Exchangeable cables in different lengths
- Analogue or digital feedback for precise positioning
- Endstop reached signals
- IC options (see specific platform manuals at the [TECHLINE webpage](#) for Connection Diagrams and I/O Specifications) including:
 - I/O
 - Ethernet/IP
 - Modbus TCP/IP
 - Modbus RTU
 - IO-Link
 - CAN bus
 - CANopen
- PC configuration tool (Actuator Connect™ and BusLink)



For more information about I/O, please see the [I/O interface user manual](#)

Usage

- Duty cycle for actuators with a 0-600 mm stroke length is 10%
- Duty cycle for actuators with a 601-1,000 mm stroke length (special item) is 5%
- Ambient operating temperature:
 - Full performance from +5°C to +40°C
 - 25°C to +65°C for IECEx/ATEX T135
 - 30°C (reduced load 50%) to + 85°C (reduced duty cycle 10%)
 - 40°C (no load)
- Storage temperature:
 - 40 °C to +70 °C
 - Actuator is not activated/connected. -40°C to +85°C for 72 hours
 - 55°C to +105°C for 24 hours for Integrated Control platform
- Acclimatization before usage.
- Relative humidity:
 - Full performance from 20 % to 80 % - non-condensing
 - (Actuator is not activated/connected)
- Cyclic state:
 - 93 % to 98 % - non-condensing +25°C to +55°C for 12 hours
- Steady state:
 - 93 % to 95 % - non-condensing +40°C for 56 Days
- Atmospheric pressure:
 - 700 to 1060 hPa
- Meters above sea level:
 - Max. 3000 meters

Ordering example

77 080 200 0 H B3 2 6 = 6 1 2 H 3 XXXX A C S 0 0 0

Actuator type 77 = LA77

Spindle type 025 = 2.5 mm

080 = 8 mm

Stroke length 200 = XXX Length in mm (50-999)

AXX = 10XX Length in mm (1.000-1.099)

Safety 0 = No safety nut

Feedback 0 = No Feedback
H = Dual Hall

9 = Hall Potentiometer, 2-wire
K = Single Hall
X = Special

Platform

9-pin

Zero Point

B3 = I/O Basic
C3 = I/O Customised
F3 = I/O Full
B7 = CAN bus (J1939)
B8 = CANopen
0B = IO-Link
14 = Modbus RTU

Zero Point with split supply

A7 = CAN bus (J1939)
A8 = CANopen
0E = Modbus TCP/IP
2E = EtherNet/IP

XX = Special

Motor type 2 = 24 V BLDC

4 = 48 V BLDC

IP B = IP66 - Long Life - Reinforced house

6 = IP66 - Reinforced house

Reed = = Brushless motor

Colour 6 = Dark Olivish Grey NCS S7000-N

X = Special

Back fixture 1 = 0 °

2 = 90°

X = Special

Piston rod eye 2 = Solid

6 = Ball eye

4 = Male Adapter (Outer thread)

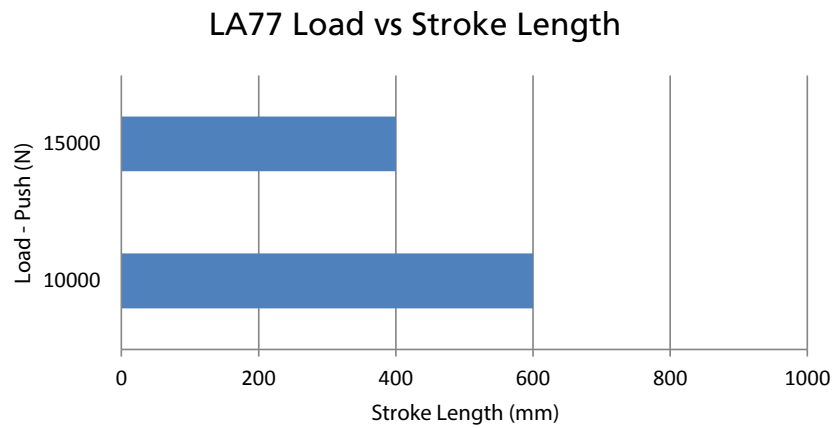
X = Special

Gear H = Ratio 1:46

Ordering example

Brake	1	= Push	3	= Push/Pull
	2	= Pull	4	= None
Built-in dimension	xxxx	= Measured in mm		
Endstop reached output	A	= A_HIGH / A_HIGH	J	= A_HIGH / LOW
	B	= A_LOW / A_HIGH	K	= A_LOW / LOW
	C	= A_HIGH / A_LOW	L	= A_HIGH / HIGH
	D	= A_LOW / A_LOW	M	= A_LOW / HIGH
	E	= LOW / A_HIGH	N	= LOW / LOW
	F	= HIGH / A_HIGH	O	= HIGH / LOW
	G	= LOW / A_LOW	P	= LOW / HIGH
	H	= HIGH / A_LOW	Q	= HIGH / HIGH
			X	= Special
Plug type	0	= No plug (when no cable is chosen)	H	= AMP
	J	= Deutsch	K	= AMP Super Seal
	9	= Deutsch - Moulded	7	= AMP Super Seal - Moulded
	C	= Flying leads	U	= Power cable UL1203 USA
	E	= M12 Ethernet Y-cable	M	= M12 Modbus cable
	L	= M12 IO-Link cable	X	= Special
Cable	0	= No cable selected	S	= Straight cable
			X	= Special
Parallel mode	0	= Not parallel	2-8	= Critical parallel (number of actuators in the parallel system)
SW config.	0	= Standard software	X	= Special software
Not used	0	= Not used		

Load vs stroke length



LA77 is available with stroke lengths from 601 to 1,000 mm as special item. Please note:

- For applications that only operate in pull - the limitations are 1,000 mm stroke with both 10,000 and 15,000 N load
- Safety factor 2

Technical specifications

24 V

Load max. (N)	Self-lock min. (N)	Pitch (mm/spindle rev.)	Hall Resolution mm/count	Endplay (mm)	Typical speed (mm/s)		Regulated speed (mm/s)	Standard stroke lengths (mm)	Typical amp. (A)	
					No load	Full load			No load	Full load
15000	20000	2.5	0.034	2	3.0	3.0	2.4	100-400	2.0	10.0
10000	20000	2.5	0.034	2	3.0	3.0	2.4	400-600	2.0	8.0
10000	15000	8.0	0.110	2	7.0	7.0	5.6	100-600	2.0	11.0

48 V

Load max. (N)	Self-lock min. (N)	Pitch (mm/spindle rev.)	Hall Resolution mm/count	Endplay (mm)	Typical speed (mm/s)		Regulated speed (mm/s)	Standard stroke lengths (mm)	Typical amp. (A)	
					No load	Full load			No load	Full load
15000	20000	2.5	0.034	2	3.0	3.0	2.4	100-400	1.1	5.5
10000	20000	2.5	0.034	2	3.0	3.0	2.4	400-600	1.1	5.5
10000	15000	8.0	0.110	2	7.0	7.0	5.6	100-600	1.1	6.0

- When using soft stop on a BLDC-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.



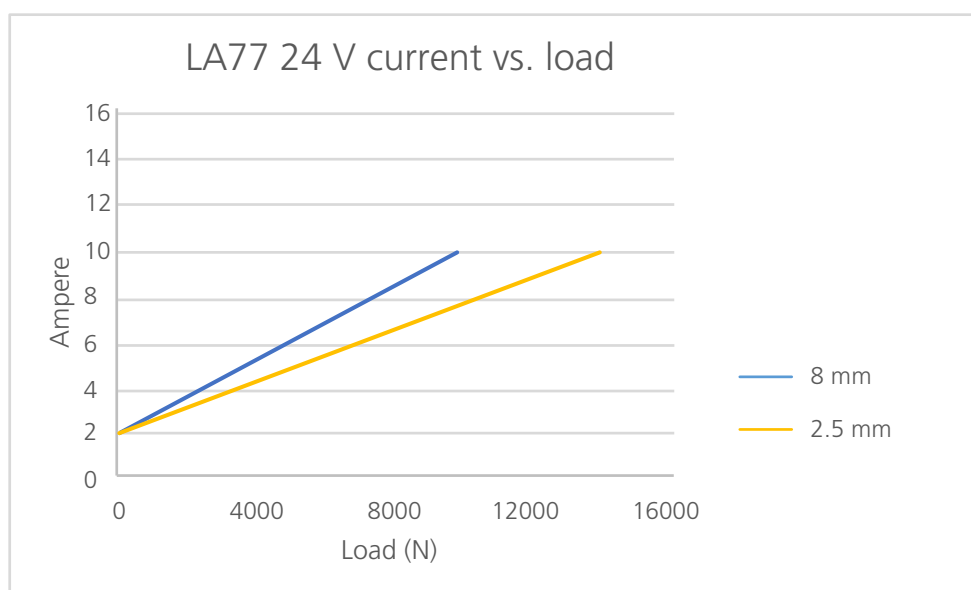
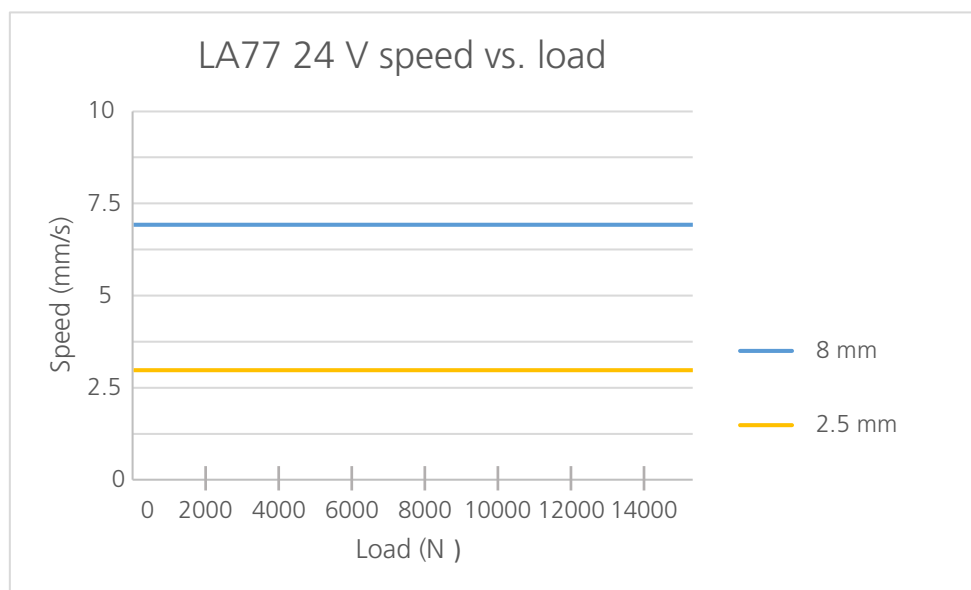
A Hall pulse consists of two Hall counts. A Hall count occurs every time the signal changes state (high to low or vice versa).



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

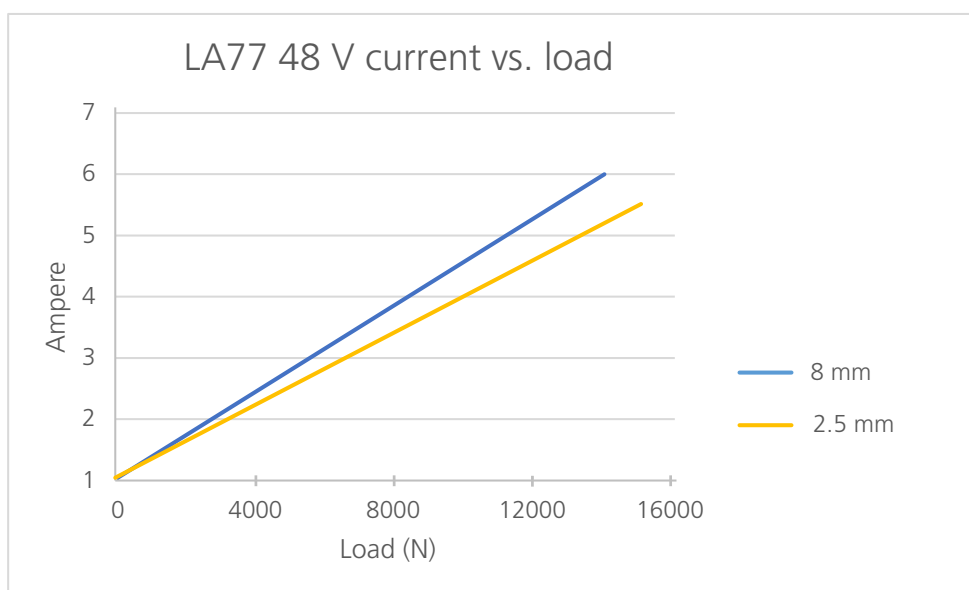
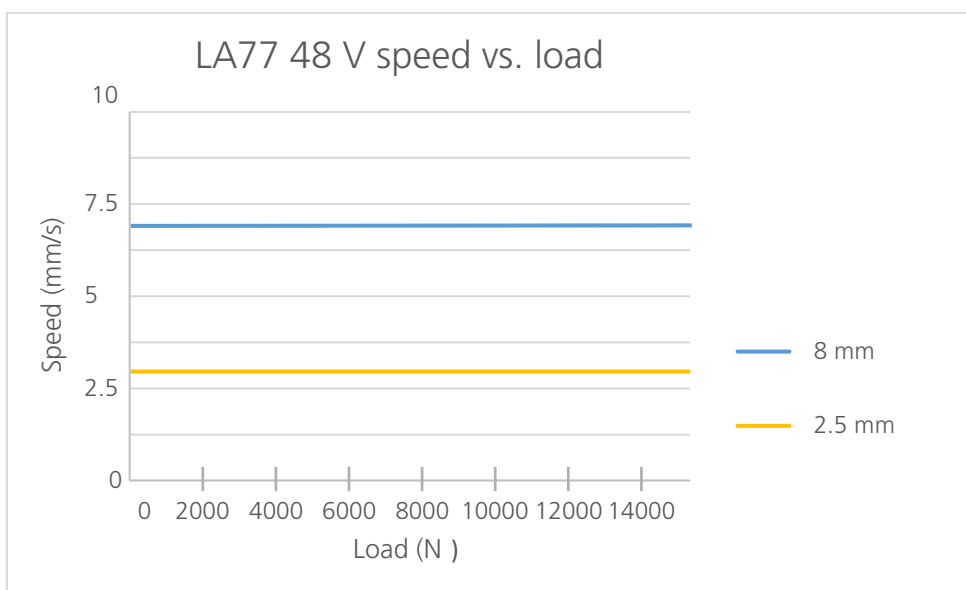
Speed and current curves

The typical values below are made with a stable power supply of 24 V DC and an ambient temperature of 20°C.



Speed and current curves

The typical values below are made with a stable power supply of 48 V DC and an ambient temperature of 20°C.



Current limits

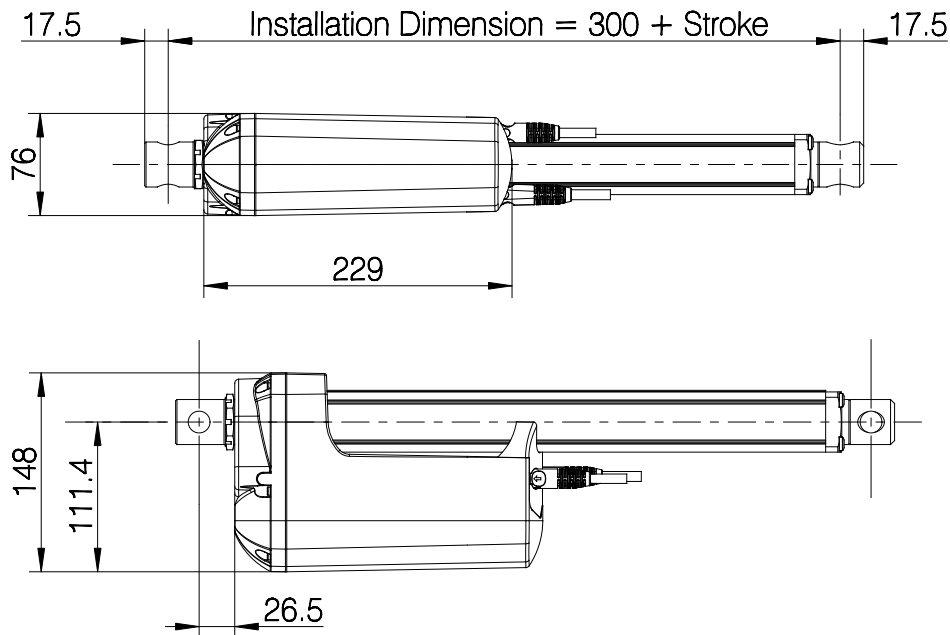
Platform	Movement	24 V	48 V	Temperature
All	Outwards	14 A	10 A	Above
	Inwards	14 A	10 A	
	Reference temperature 0°C			Below
	Outwards	26 A	13 A	
	Inwards	26 A	13 A	

Stroke and built-in tolerances

Platform	Stroke tolerance	Example for 200 mm stroke	BID tolerance	Example for 200 mm BID
All	+/- 2 mm	198 to 202 mm	+/- 2 mm	198 to 202 mm

Built-in dimensions

All dimensions are in mm

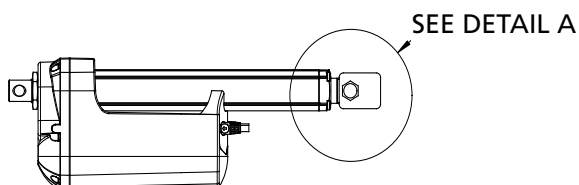


The above dimensions apply for all LA77 piston rod eyes and back fixtures.

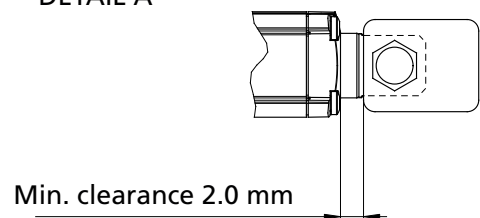
Keep a clearance when mounting a bracket



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.



DETAIL A



With Zero Point the minimum stroke is 70 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.

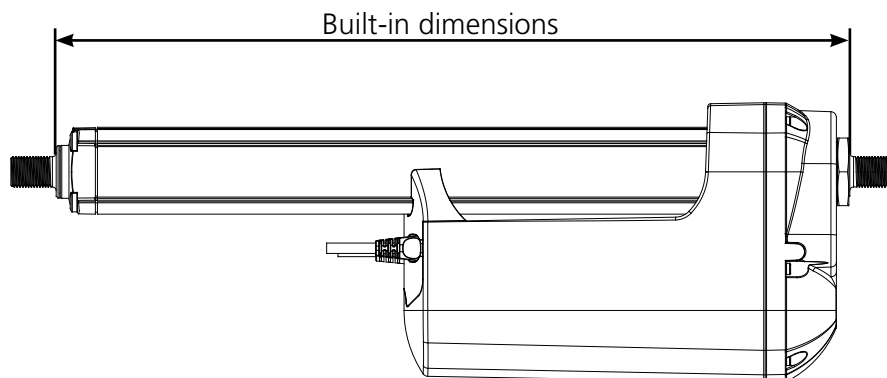
Built-in dimensions

All dimensions are in mm

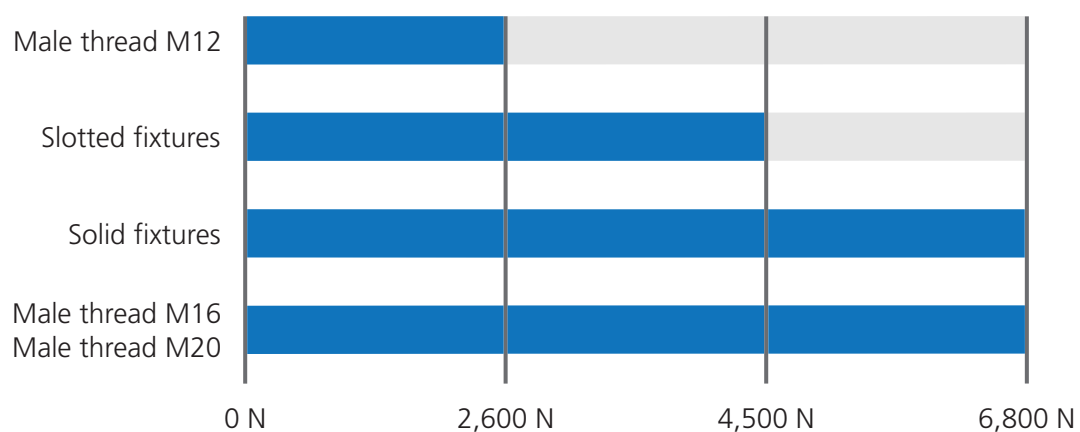
The built-in dimension depends on the chosen safety option and stroke length(s).

	Piston rod	Ball eye Ø20 H7 / to the centre of the hole	Ball eye Ø19.2 / to the centre of the hole	Solid Ø16.2 mm / to the centre of the hole	Solid Ø19.2 mm / to the centre of the hole	Male adapter M16 X 1.5 / from the surface	Male adapter M20 X 1.5/ from the surface
Back fixture		Stroke from 100 to 600	Stroke from 100 to 600	Stroke from 100 to 600	Stroke from 100 to 600	Stroke from 100 to 600	Stroke from 100 to 600
Solid Ø16.2 mm (0° and 90°) / to the centre of the hole		316 + stroke	316 + stroke	300 + stroke	300 + stroke	287 + stroke	287 + stroke
Solid Ø19.2 mm (0° and 90°) / to the centre of the hole		316 + stroke	316 + stroke	300 + stroke	300 + stroke	287 + stroke	287 + stroke
Male adapter M20 / from the surface		297 + stroke	297 + stroke	281 + stroke	281 + stroke	267 + stroke*	267 + stroke*

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



Durability for piston rod eyes and back fixtures

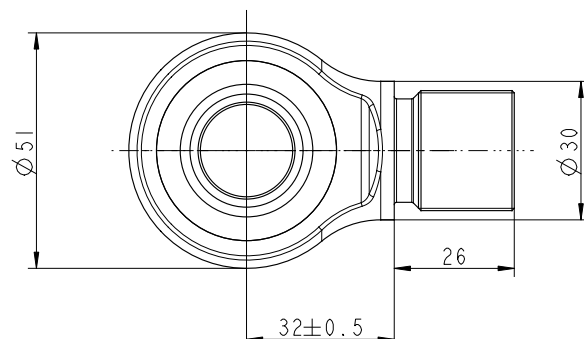


Blue = Full Lifetime
Grey = Reduced lifetime

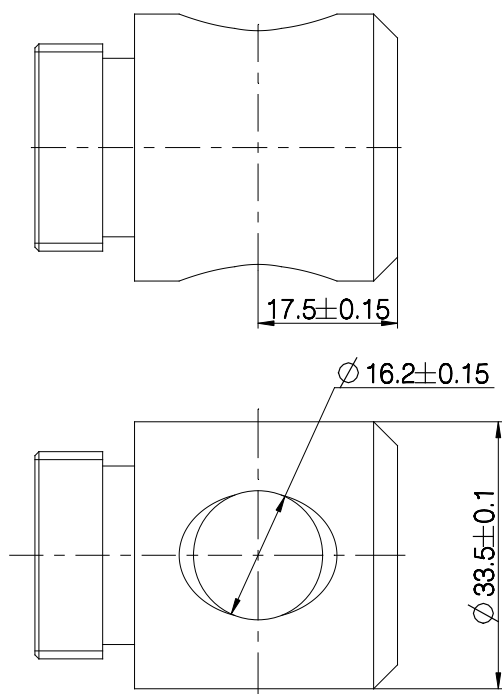
(If e.g. a Male thread M12 is used with an actuator with a larger load than 2,600 N and a Slotted fixture is used with an actuator with a larger load than 4,500 N their lifetime will be shorter than if the other fixtures are chosen).

Piston rod eyes

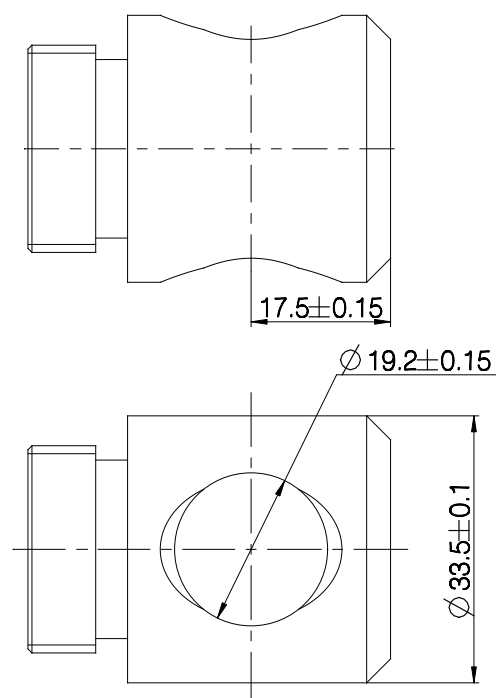
Option "0&1"
 LINAK P/N: 0361568
 AISI 304



Option "2"
 LINAK P/N: 0361387
 Free-cutting steel galvanised surface



Option "3"
 LINAK P/N: 0361393
 Free-cutting steel galvanised surface



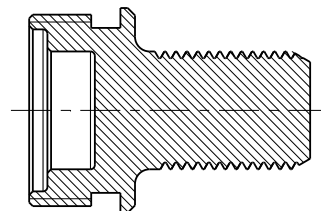
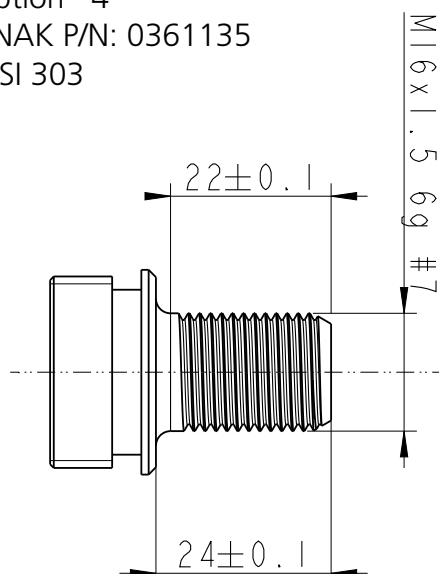
The piston rod eye is only allowed to turn 0 - 90 degrees.

Piston rod eyes

Option "4"

LINAK P/N: 0361135

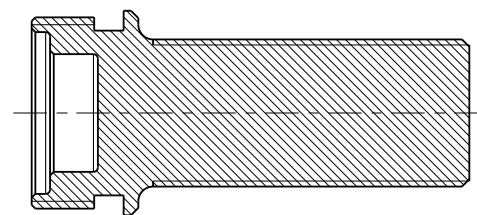
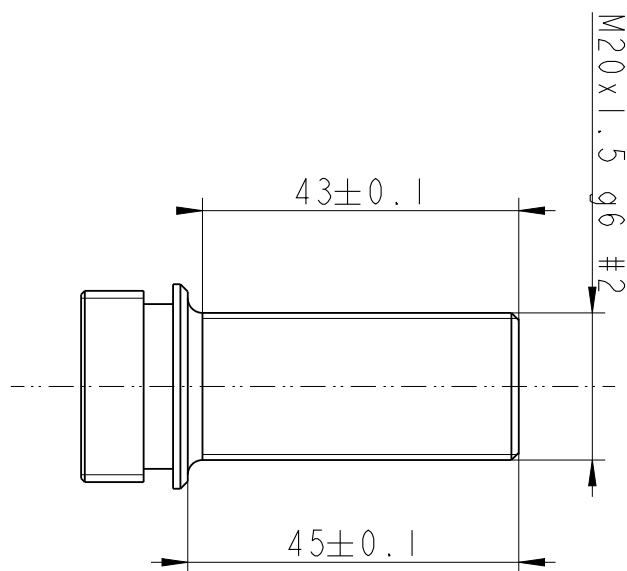
AISI 303



Option "5"

LINAK P/N: 0771044

AISI 303



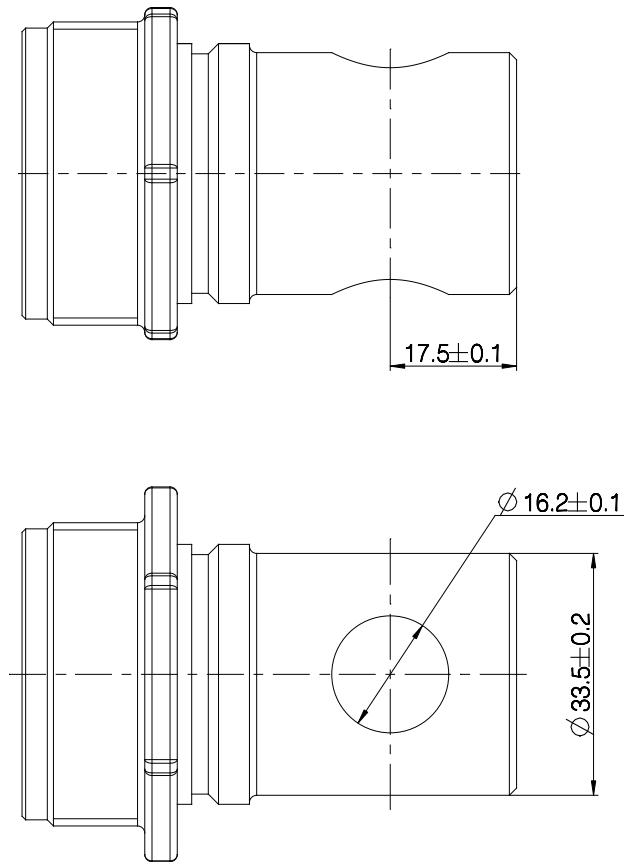
The piston rod eye is only allowed to turn 0 - 90 degrees.

Back fixtures

Option "1&2"

LINAK P/N: 0771019

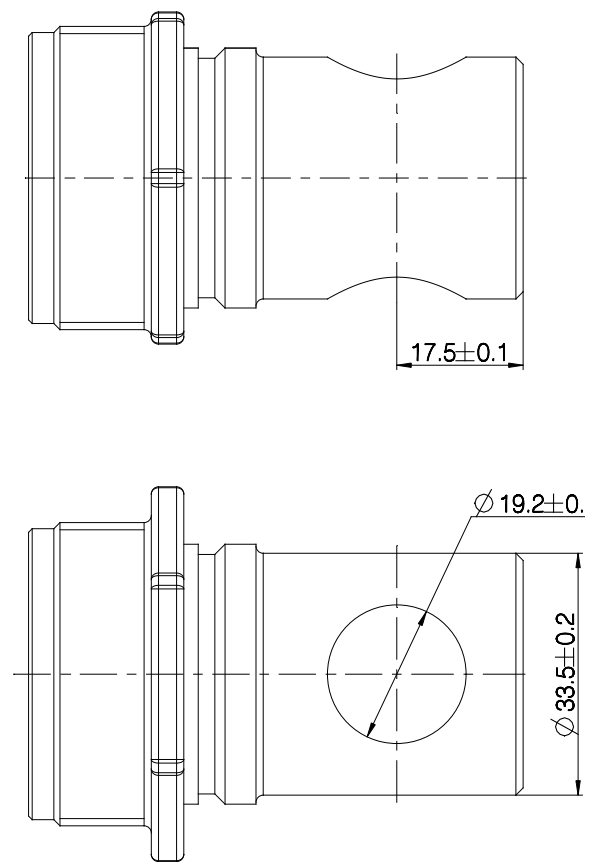
Free-cutting steel galvanised surface



Option "3&4"

LINAK P/N: 0771040

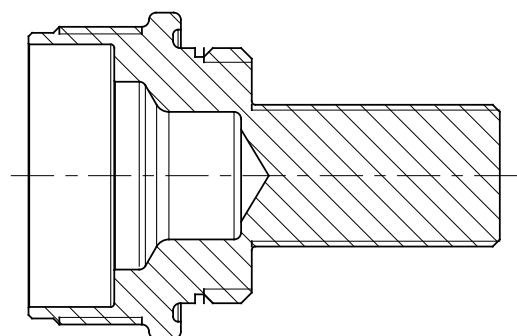
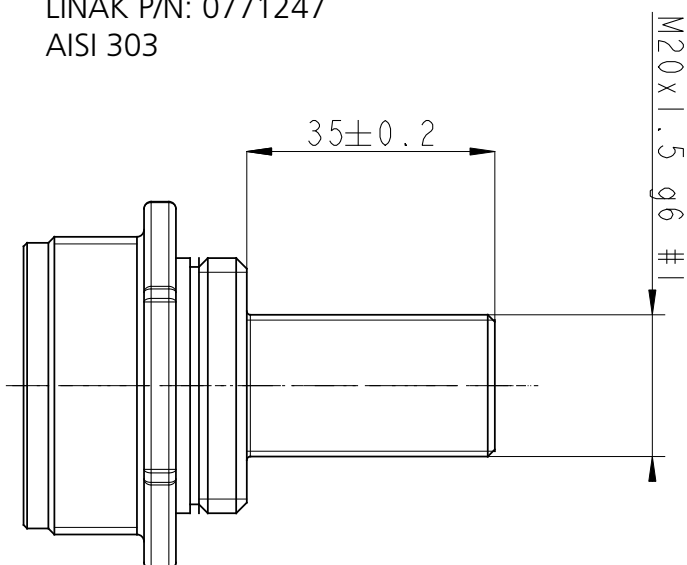
Free-cutting steel galvanised surface



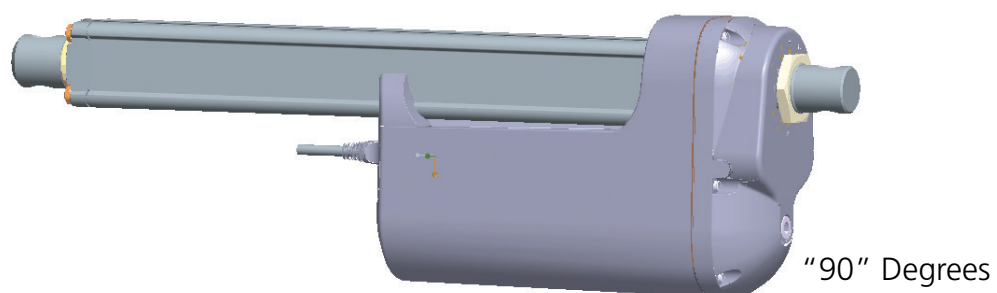
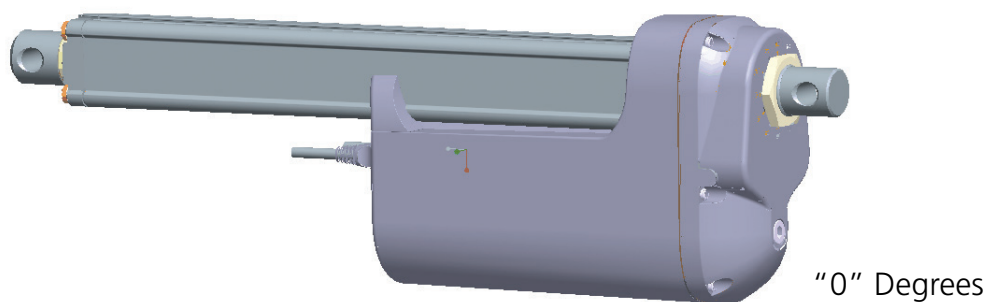
Option "5"

LINAK P/N: 0771247

AISI 303

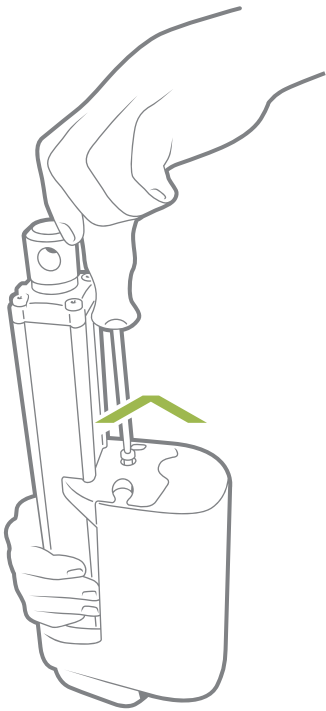


Back fixture orientation

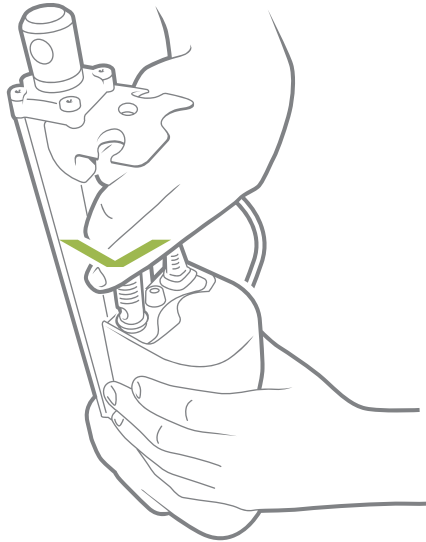


NB. Both with tolerance of $\pm 4^\circ$

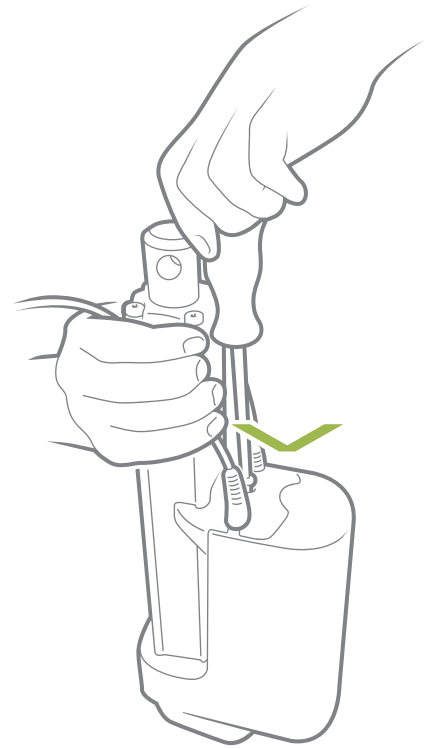
Cable mounting



1. Unscrew the cover and remove the two blind plugs.



2. Plug in the power cable and/or the signal cable.



3. Slide the cover onto the actuator.

The torque of the cover screw is approx. 3.5 ± 0.3 Nm

TORX 25IP



When changing the cables on a LINAK® actuator, it is important that this is done carefully, in order to protect the plugs and pins. Before the new cable is mounted, we recommend that the socket is greased with Vaseline®, to keep the high IP protection and ensure an easy mounting. Please be sure that the plug is in the right location and fully pressed in before the cable lid is mounted.

Remove the tinned cable end when the cable end is mechanically connected. The tinned end is only to be used when a soldered connection is made.

Please note that if the cables are mounted and dismantled more than 3 times, the plugs can be damaged. Therefore, we recommend that such cables are discarded and replaced. Also note that the cables should not be used for carrying the actuator.

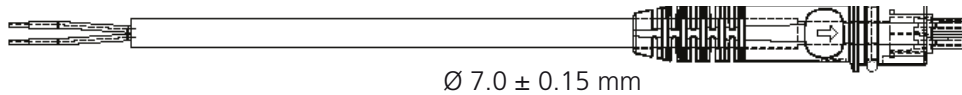
We recommend taking some precaution and designing the wire connection in a way, where the cable end is kept inside a closed, protected area to guarantee the high IP protection.

Cables

Power cable dimensions

LINAK® P/N 0367046

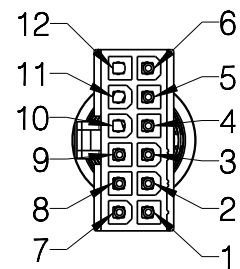
Colour	Outer dimensions	Core mm ²	AWG
Brown	Ø2.8 mm	2.0	14
Blue	Ø2.8 mm	2.0	14



9-pin Signal cable dimensions

LINAK P/N 0368543

Colour	Outer dimensions	Core mm ²	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



Cable kit article numbers

Actuator Connect™ cable kits					
	Platform	Article no.	Connection	Includes	Colour
B3	I/O Basic	0367996	Signal-power + RJ45	(Adapter + USB2Lin)	Grey
C3	I/O Customised				
F3	I/O Full				
B7	CAN bus (J1939)				
B8	CANopen				
0B	IO-Link				
14	Modbus RTU				
A7	CAN bus (J1939)				
A8	CANopen				
2E	EtherNet/IP				
0E	Modbus TCP/IP				



The latest version of Actuator Connect can be downloaded at the [LINAK/TECHLINE](#) page.

Manual hand crank

The manual hand crank can be used in the case of a 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

Piston rod movement per turn: Gear H = 4.0 mm



- 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 thereby damaging the actuator. Do NOT use power tools to operate the hand crank!
- After using the hand crank, the ingress protection IP66 cannot be maintained.
- After using the hand crank, always return the actuator to the most inward position. Failing to do so can damage the actuator or the application it is used for.
- 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.

Environmental tests - Climatic

Test	Specification	Comment
Cold test	EN60068-2-1 (Ab)	Storage at low temperature: Temperature: -40°C Duration: 72 h Not connected Tested at room temperature
	EN60068-2-1 (Ad)	Storage at low temperature: Temperature: -30°C Duration: 2 h Actuator is not activated/connected Tested at low temperature
Dry heat	EN60068-2-2 (Bb)	Storage at high temperature: Temperature: +90°C Duration: 72 h Actuator is not activated/connected Tested at room temperature
	EN60068-2-2 (Bd)	Storage at high temperature: Temperature: +70°C Duration: 1000 h Actuator is not activated/connected Tested at high temperature Operating at high temperature: Temperature: +60°C Int. max. 17% Duration: 700 h Actuator is activated Tested at high temperature
Change of temperature	EN60068-2-14 (Na)	Rapid change of temperature: High temperature: +100°C in 60 minutes Low temperature: -30°C in 60 minutes Transition time: <10 seconds Duration: 100 cycles Actuator is not activated/connected Tested at room temperature
	EN60068-2-14 (Nb)	Controlled change of temperature: Temperature change 5°C pr. minute High temperature: +70°C in 60 minutes Low temperature: -30°C in 30 minutes 130 minutes per cycle Duration: 1,000 cycles (90 days) Actuator is not activated/connected Tested at 250, 500 and 1,000 cycles at low and high temperatures.

Environmental tests - Climatic

Damp heat	EN60068-2-30 (Db)	<p>Damp heat, cyclic:</p> <p>Relative humidity: 93-98%</p> <p>High temperature: +55°C in 12 hours</p> <p>Low temperature: +25°C in 12 hours</p> <p>Duration: 21 cycles * 24 hours</p> <p>Actuator is not activated/connected</p> <p>Tested within 1 hour after condensation, after upper temperature has been reached.</p>
	EN60068-2-3 (Ca)	<p>Damp heat, steady state:</p> <p>Relative humidity: 93-95%</p> <p>Temperature: +40 ± 2°C</p> <p>Duration: 56 days</p> <p>Actuator is not activated/connected</p> <p>Tested within one hour after exposure.</p>
Salt spray test		Actuators are tested for corrosion resistance at 500 hours salt spray test.
Degrees of protection IPX6 static		<p>IPX6 static:</p> <p>Actuators are tested for water ingress according to IPX6, without movement.</p> <p>IPX4 dynamic:</p> <p>Actuators are tested in rainy conditions with movement.</p> <p>IP6X:</p> <p>Actuators are tested for dust sealing properties according to IP6X.</p>
Chemicals	BS7691 / 96 hours	<p>Diesel 100%</p> <p>Hydraulic oil 100%</p> <p>Ethylene Glucol 50%</p> <p>Urea Nitrogen saturated solution</p> <p>Liquid lime 10% (Super- Cal)</p> <p>NPK Fertilizer (NPK 16-4-12) saturated</p> <p>Tested for corrosion.</p>
Climate test with Modbus PCB		Actuators with Modbus PCB are tested with 10.000 N load at temperatures of +5°C and +40°C.
Climate test with Hall PCB		Actuators with Hall PCB are tested with 15.000 N load at temperatures of -30°C and +70°C.

Environmental tests - Mechanical

Test	Specification	Comment
Free fall		<u>Free fall from all sides:</u> Height of fall: 0.4 meter onto steel. Actuator not activated/connected.
Vibration	EN60068-2-36 (Fdb) EN 60068-2-6 (Fc)	<u>Random vibration:</u> Short time test: 6.29 g RMS Actuator is not connected Long time test: 7.21 g RMS Actuator is not connected Duration: 2 hours in each direction <u>Sinus vibration:</u> Frequency 5-25Hz: Amplitude = 3.3 mm pp Frequency 25-200Hz: Acceleration 4 g Number of directions: 3 (X-Z-Y) Duration: 2 hours in each direction Actuator is not activated.
Bump	EN60068-2-29 (Eb)	<u>Bump test:</u> Level: 40 g Duration: 6 milliseconds Number of bumps: 500 shocks in each of 6 directions. Actuator is not connected.
Shock	EN60068-2-27 (Ea)	<u>Shock test:</u> Level: 100g Duration: 6 milliseconds Number of bumps: 3 shocks in each of 6 directions. Actuator is not connected.
Static load		Static push and pull tests of basic actuators with 500, 750 and 1000mm strokes.
Dynamic load		Dynamic push/pull tests of the actuator.
Self-locking test		Self-locking tests at dynamic and static load.
Abuse test		Tests at 100% duty cycle until damage.
Lifetime test		Lifetime tests performed at combined loads in push and pull situations.

Environmental tests - Electrical

Test	Specification	Comment
Power supply	ASAE EP455 (1990)	Operating voltages +10 V - +16 V Overvoltage +26 (V) / 5 min. Reverse polarity -26 (V) / 5 min. Short circuit to ground 16 (V) / 5 min. Short circuit to supply 16 (V) / 5 min.
HF-immunity	EN61000-6-2	Level: 30 V/m. at 26 MHz – 1000 mHz 80% 1 KHz
Emmision	EN61000-6-4	Level is inside limits for 12 V motor
Insulation test		Level: 500 VAC/25-100 hz for 1 minute
Automotive transients	ISO 7677	Load dump test only accepted on motor power connection.
Current and speed		Actuators with loads of 0 N, 7.500 N and 15.000 N are tested at -30°C, +20°C and 70°C



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

Contacts

FACTORIES

Denmark - Headquarters
LINAK A/S
Phone: +45 73 15 15 15
Fax: +45 74 45 80 48
Fax (Sales): +45 73 15 16 13
Web: www.linak.com

China
LINAK (Shenzhen) Actuator Systems, Ltd.
Phone: +86 755 8610 6656
Phone: +86 755 8610 6990
Web: www.linak.cn

Slovakia
LINAK Slovakia s.r.o.
Phone: +421 51 7563 444
Web: www.linak.sk

Thailand
LINAK APAC Ltd.
Phone: +66 33 265 400
Web: www.linak.com

USA
LINAK U.S. Inc.
Americas Headquarters
Phone: +1 502 253 5595
Fax: +1 502 253 5596
Web: www.linak-us.com
www.linak-latinamerica.com

SUBSIDIARIES

Australia
LINAK Australia Pty. Ltd
Phone: +61 3 8796 9777
Fax: +61 3 8796 9778
E-mail: sales@linak.com.au
Web: www.linak.com.au

Austria
LINAK Zweigniederlassung - Österreich (Wien)
Phone: +43 (1) 890 7446
Fax: +43 (1) 890 744615
E-mail: info@linak.de
Web: www.linak.at - www.linak.hu

Belgium
LINAK Actuator-Systems NV/SA
(Belgium & Luxembourg)
Phone: +32 (0)9 230 01 09
E-mail: beinfo@linak.be
Web: www.linak.be - www.fr.linak.be

Brazil
LINAK Do Brasil Comércio De Atuadores Ltda.
Phone: +55 (11) 2832 7070
Fax: +55 (11) 2832 7060
E-mail: info@linak.com.br
Web: www.linak.com.br

Canada
LINAK Canada Inc.
Phone: +1 502 253 5595
Fax: +1 416 255 7720
E-mail: info@linak.ca
Web: www.linak-us.com

Czech Republic
LINAK C&S s.r.o.
Phone: +42 058 174 1814
Fax: +42 058 170 2452
E-mail: info@linak.cz
Web: www.linak.cz - www.linak.sk

Denmark - International
LINAK International
Phone: +45 73 15 15 15
E-mail: info@linak.com
Web: www.linak.com

Denmark - Sales
LINAK Danmark A/S
Phone: +45 86 80 36 11
Fax: +45 86 82 90 51
E-mail: linak@linak-silkeborg.dk
Web: www.linak.dk

Finland
LINAK OY
Phone: +358 10 841 8700
E-mail: linak@linak.fi
Web: www.linak.fi

France
LINAK France E.U.R.L
Phone: +33 (0) 2 41 36 34 34
Fax: +33 (0) 2 41 36 35 00
E-mail: linak@linak.fr
Web: www.linak.fr

Germany
LINAK GmbH
Phone: +49 6043 9655 0
Fax: +49 6043 9655 60
E-mail: info@linak.de
Web: www.linak.de

India
LINAK A/S India Liaison Office
Phone: +91 120 4531797
Fax: +91 120 4786428
E-mail: info@linak.in
Web: www.linak.in

Ireland
LINAK UK Limited (Ireland)
Phone: +44 (0)121 544 2211
Fax: +44 (0)121 544 2552
+44 (0)796 855 1606 (UK Mobile)
+35 387 634 6554 (Rep.of Ireland Mobile)
E-mail: sales@linak.co.uk
Web: www.linak.co.uk

Italy
LINAK ITALIA S.r.l.
Phone: +39 02 48 46 33 66
Fax: +39 02 48 46 82 52
E-mail: info@linak.it
Web: www.linak.it

Japan
LINAK K.K.
Phone: 81-45-533-0802
Fax: 81-45-533-0803
E-mail: linak@linak.jp
Web: www.linak.jp

Malaysia
LINAK Actuators Sdn. Bhd.
Phone: +60 4 210 6500
Fax: +60 4 226 8901
E-mail: info@linak-asia.com
Web: www.linak.my

Netherlands
LINAK Actuator-Systems B.V.
Phone: +31 76 5 42 44 40 /
+31 76 200 11 10
E-mail: info@linak.nl
Web: www.linak.nl

New Zealand
LINAK New Zealand Ltd
Phone: +64 9580 2071
Fax: +64 9580 2072
E-mail: nzsales@linak.com.au
Web: www.linak.com.au

Norway
LINAK Norge AS
Phone: +47 32 82 90 90
E-mail: info@linak.no
Web: www.linak.no

Poland
LINAK Polska
LINAK Danmark A/S (Spółka Akcyjna)
Phone: +48 22 295 09 70 /
+48 22 295 09 71
E-mail: info@linak.pl
Web: www.linak.pl

Republic of Korea
LINAK Korea Ltd.
Phone: +82 2 6231 1515
Fax: +82 2 6231 1516
E-mail: info@linak.kr
Web: www.linak.kr

Slovakia
LINAK Slovakia S.R.O.
Phone: +421 51 7563 444
Web: www.linak.sk

Spain
LINAK Actuadores, S.L.u
Phone: +34 93 588 27 77
Fax: +34 93 588 27 85
E-mail: esma@linak.es
Web: www.linak.es

Sweden
LINAK Scandinavia AB
Phone: +46 8 732 20 00
Fax: +46 8 732 20 50
E-mail: info@linak.se
Web: www.linak.se

Switzerland
LINAK AG
Phone: +41 43 388 31 88
Fax: +41 43 388 31 87
E-mail: info@linak.ch
Web: www.linak.ch - www.fr.linak.ch
www.it.linak.ch

Taiwan
LINAK (Shenzhen) Actuator systems Ltd.
Taiwan Representative office
Phone: +886 2 272 90068
Fax: +886 2 272 90096
E-mail: sales@linak.com.tw
Web: www.linak.com.tw

Turkey
LINAK İth. İhr. San. ve Tic. A.Ş.
Phone: +90 312 4726338
Fax: +90 312 4726635
E-mail: info@linak.com.tr
Web: www.linak.com.tr

United Kingdom
LINAK UK Limited
Phone: +44 (0)121 544 2211
Fax: +44 (0)121 544 2552
E-mail: sales@linak.co.uk
Web: www.linak.co.uk

DISTRIBUTORS

Argentina
Novotec Argentina SRL
Phone: 011-4303-8989 / 8900
Fax: 011-4032-0184
E-mail: info@novotecargentina.com
Web: www.novotecargentina.com

Colombia
MEM Ltda
Phone: +[57] (1) 334-7666
Fax: +[57] (1) 282-1684
E-mail: servicioalcliente@memltda.com.co
Web: www.mem.net.co

India
Mechatronics Control Equipments India Pvt Ltd
Phone: +91-44-28558484, 85
E-mail: bala@mechatronicscontrol.com
Web: www.mechatronicscontrol.com

Indonesia
PT. Himalaya Everest Jaya
Phone: +6 221 544 8956 /+6 221 544 8965
Fax: +6 221 619 1925
Fax (Sales): +6 221 619 4658
E-mail: hejplastic-div@centrin.net.id
Web: www.hej.co.id

Israel
NetivTech LTD
Phone: +972 55-2266-535
Fax: +972 2-9900-560
Email: info@NetivTech.com
Web: www.netivtech.com

Singapore
Servo Dynamics Pte Ltd
Phone: +65 6844 0288
Fax: +65 6844 0070
E-mail: servodynamics@servo.com.sg

South Africa
Industrial Specialised Applications CC
Phone: +27 011 466 0346
E-mail: gartht@isagroup.co.za
Web: www.isaza.co.za

United Arab Emirates
Mechatronics
Phone: +971 4 267 4311
Fax: +971 4 267 4312
E-mail: mechtron@emirates.net.ae

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