cyltronic

Electric cylinder CTC

Operating instructions EN

CE

flexibility ***in motion***

1 General information

1.1 Document version

20220804 Operating Instructions CTC EN (replaces previous versions)

1.2 Manufacturer information

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Thank you for your confidence in our product. We recommend reading the entire operating instructions before commissioning.

Installation and commissioning may only be carried out by qualified personnel with appropriate qualifications in accordance with these operating instructions.

1.3 Device assignment

These instructions apply to the following devices:

Cyltronic electric cylinder:

- Type CTC

1.4 Scope of delivery

The scope of delivery includes only the electric cylinder, all accessories must be purchased separately.

2 Table of contents

3 Safety information

3.1.1 Local safety regulations

Before using this product, make sure that it complies with all local safety regulations. Take all necessary safety precautions to ensure proper operating function during and after the period of use. You may also add additional external protective features or structures to the product as needed. Restrict access to hazardous areas appropriately.

3.1.2 Accident risk

Do not remove any parts from the product or attempt to open it, for example by loosening screws or other components.

3.1.3 Modification

No modifications may be made to the product. Modifications may cause the product to malfunction and void any warranty claims.

3.1.4 Qualified personnel

Installation, commissioning, as well as maintenance and disassembly may only be performed by qualified personnel. The personnel must be familiar with the installation of mechatronic drives.

3.2 Intended use

The product is an incomplete machine in the sense of the Machinery Directive (Directive 2006/42/EC) and is intended for installation in a complete machine. This must not be put into operation until it has been established that the machine into which this partly completed machine is to be incorporated complies with the provisions of Directive 2006/42/EC.

The electric cylinder is to be used for linear movements of payloads or as a drive with the use of separate guides.

This product can be used in applications of various fields; therefore, the responsibility of the specific application passes to the user. The application or performance limits as well as the environmental or boundary conditions are described in chapter 6 "Technical data ".

The risks associated with improper use lie solely with the user. No liability is accepted for damage resulting from improper use.

3.3 Foreseeable misuse

The product must not be used to transport or move people and animals. For example, the product must not be used for lifting suspended loads when direct failure may result in injury to a human being.

3.4 Safety instructions

3.4.1 General hazards

This product is built according to the current state of the art and is safe to operate. However, hazards may arise from the machine if it is not used by trained or at least instructed personnel, or if it is used improperly or for purposes other than those for which it is intended.

3.4.2 Warnings, notes

Warnings, notes and residual risks are identified by symbols in these operating instructions. It is essential to follow the instructions in order to avoid accidents, personal injury and damage to property.

Consider markings on the product.

Before mounting, installation and maintenance units: Switch off the power supply, check that no voltage is present and secure against being switched on again.

DANGER	
	...indicates a hazardous situation which, if not avoided, could result in death or serious injury.

WARNING	
	...indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION	
	...indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTE	
	...points out useful tips and work recommendations, which, however, have no influence on the safety and health of the personnel.

IMPORTANT	
	...indicates a possible harmful situation, which can lead to property damage if not avoided.

3.4.3 Residual risks

CAUTION	
	During operation, the product can become hot without affecting its function. The surface temperature can reach temperatures of up to reach 100 °C. Do not touch the product under any circumstances during operation and in the cooling phase after shutdown. Attach protective measures against contact at temperatures above 60 °C and contact duration of more than 1s. Ensure that no temperature-sensitive parts or objects are in contact with or attached to the product.

3.4.4 Product-specific warnings and notes

CAUTION	
	Depending on the operating conditions (speed, load, etc.), increased surface temperatures may occur on the product in the area of the drive. Touching the product during operation can cause minor burns. Do not touch the product during operation. During maintenance and repair work, make sure that the product has cooled down before starting work.

NOTE	
	The noise pattern does not necessarily indicate the service life of the cylinder. Different noise patterns may occur depending on the production process.

4 Transport, handling, storage

Lift the cylinder by the housing only. Weight acc. to chapter 6 Technical data Note The cylinder must not be held by the trust tube only, as this may result in damage. The trust tube must be fixed and kept free of load during transport. Torques on the trust tube must generally be avoided.

5 Functional description

The CTC electric cylinder is primarily used as a replacement for pneumatic cylinders. The CTC series functions as an electromechanical spindle drive for linear movements and is essentially controlled, regulated and evaluated like a pneumatic cylinder.

The main components are the integrated synchronous servomotor, the spindle drive and the integrated electronics.

All components are located in the cylinder housing. The retraction and extension speed as well as the force limitation can be continuously adjusted via rotary knobs directly on the housing.

5.1 Structure

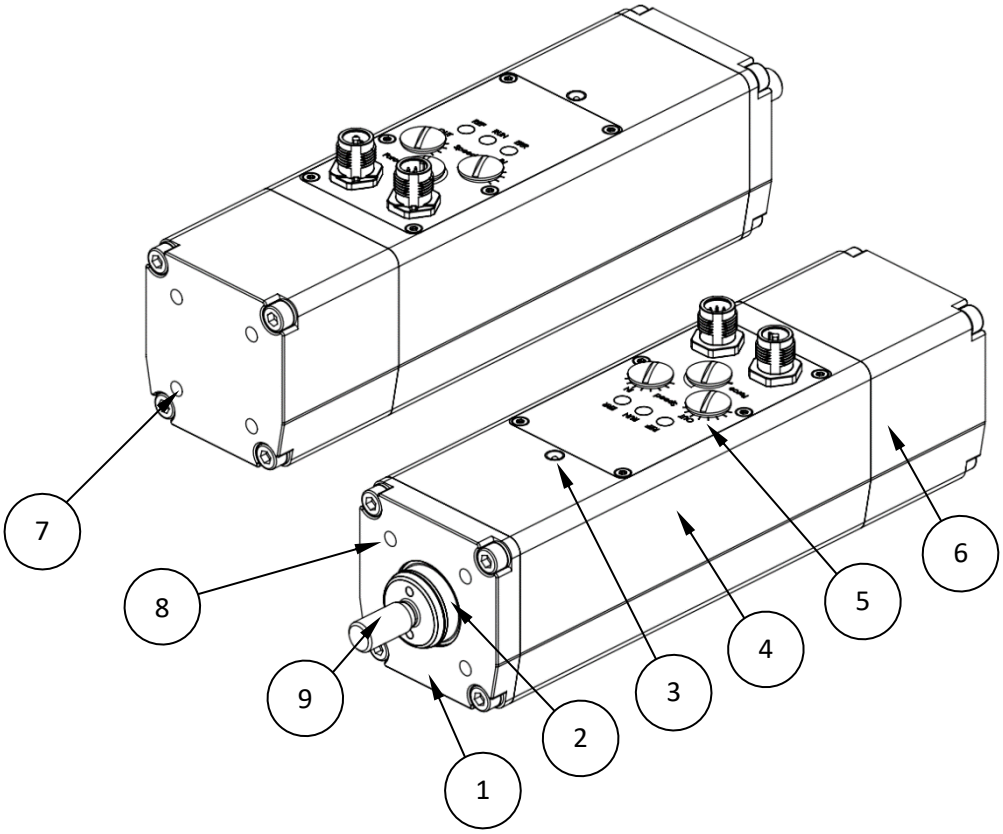


FIGURE 1: STRUCTURE

No.	Designation
1	Front cover
2	Thrust tube
3	Grease nipple
4	Profile housing
5	Control panel, connections, display
6	Rear cover
7	Rear standard threads for mounting and fixing accessories
8	Front standard threads for mounting and fixing accessories
9	Thrust tube rods threaded attachment for mounting and fixing accessories

5.2 Control panel, connections, display

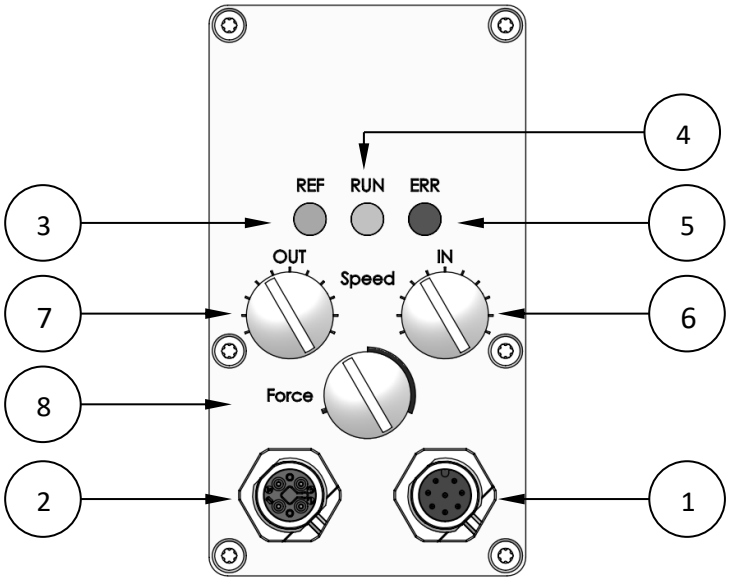


FIGURE 2: CONTROL PANEL

No.	Designation	Property
1	Connection for signal (M12 8-pin)	A-coded
2	Connection for power (M12 4-pin)	T-coded
3	LED display REF (orange)	Lights: Reference run required.
4	LED display RUN (green)	Lights: Ready for operation / In operation
5	LED indicator ERR (red)	Lights: Error / not ready for operation Flashes: Error code see chapter 12.1
6	Rotary knob for setting the retraction speed (under the screw plug)	+ clockwise - Counterclockwise
7	Rotary knob for setting the extension speed (under the screw plug)	+ clockwise - Counterclockwise
8	Rotary knob for setting the force (under the screw plug)	+ clockwise - Counterclockwise

IMPORTANT	
	The scale on the rotary knob for setting the force only gives an indication of the continuous range and the peak force. An excessively long duty cycle with operation above the continuous range can lead to overheating. The unit has an internal temperature monitor which initiates a stop as soon as the temperature limit value is exceeded. However, damage due to overheating cannot be prevented.

5.2.1 Set speed / force

The knobs for speed and force adjustment are exposed with a flathead screwdriver, by removing the screw plugs:

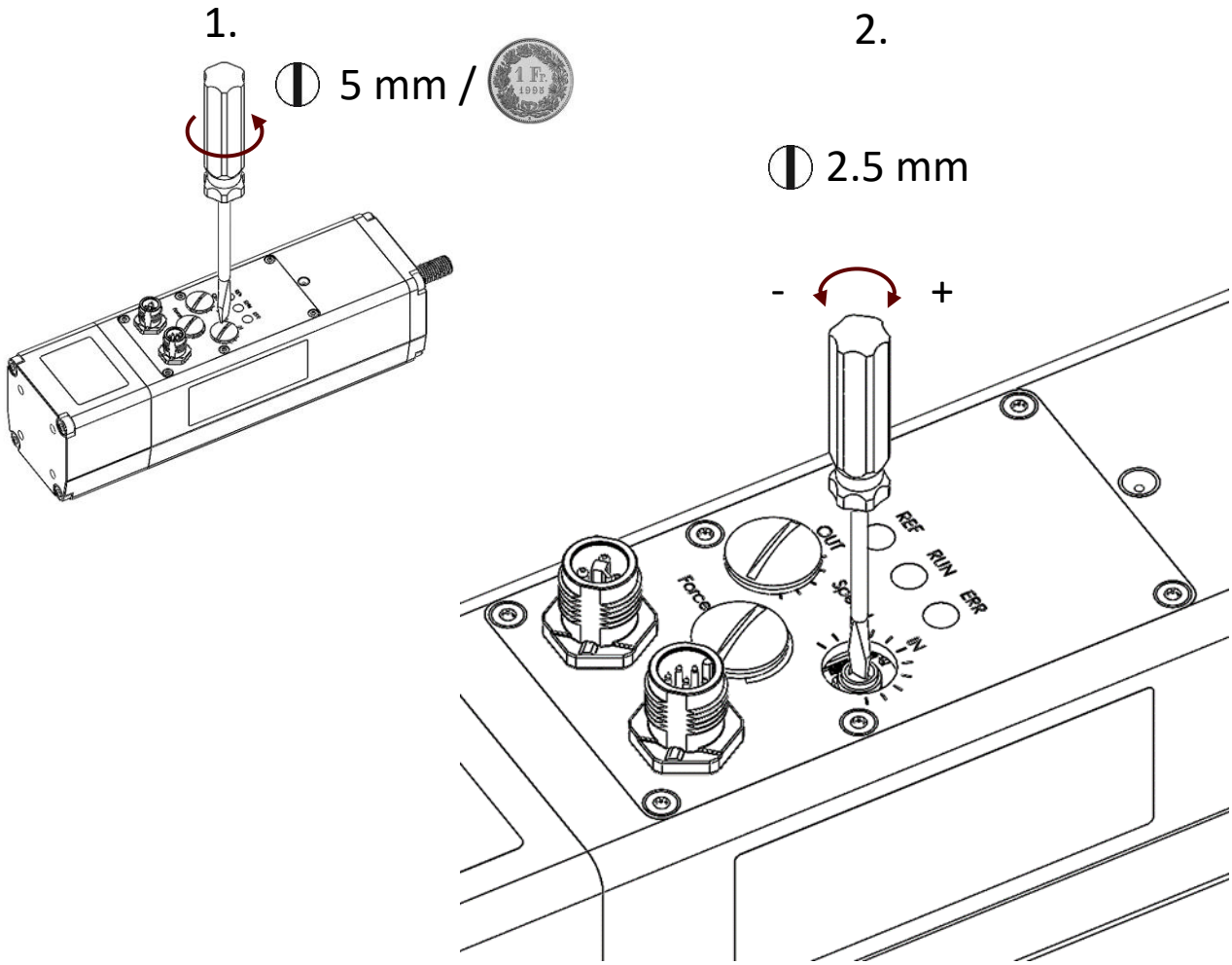


FIGURE 3: SET SPEED / FORCE

The retraction and extension speed as well as the force limitation are set via the rotary knobs (higher clockwise, lower counterclockwise).

IMPORTANT	
	Turn the knobs for force and speed carefully (approx. 0.5-1 Ncm). Do not turn beyond the end positions, as this may cause damage to the product.

IMPORTANT	
	The screw plugs may only be removed when the ambient humidity is below 90%. To avoid damage to the seal, tighten the screw plugs carefully when closing (approx. 2-5 Ncm).

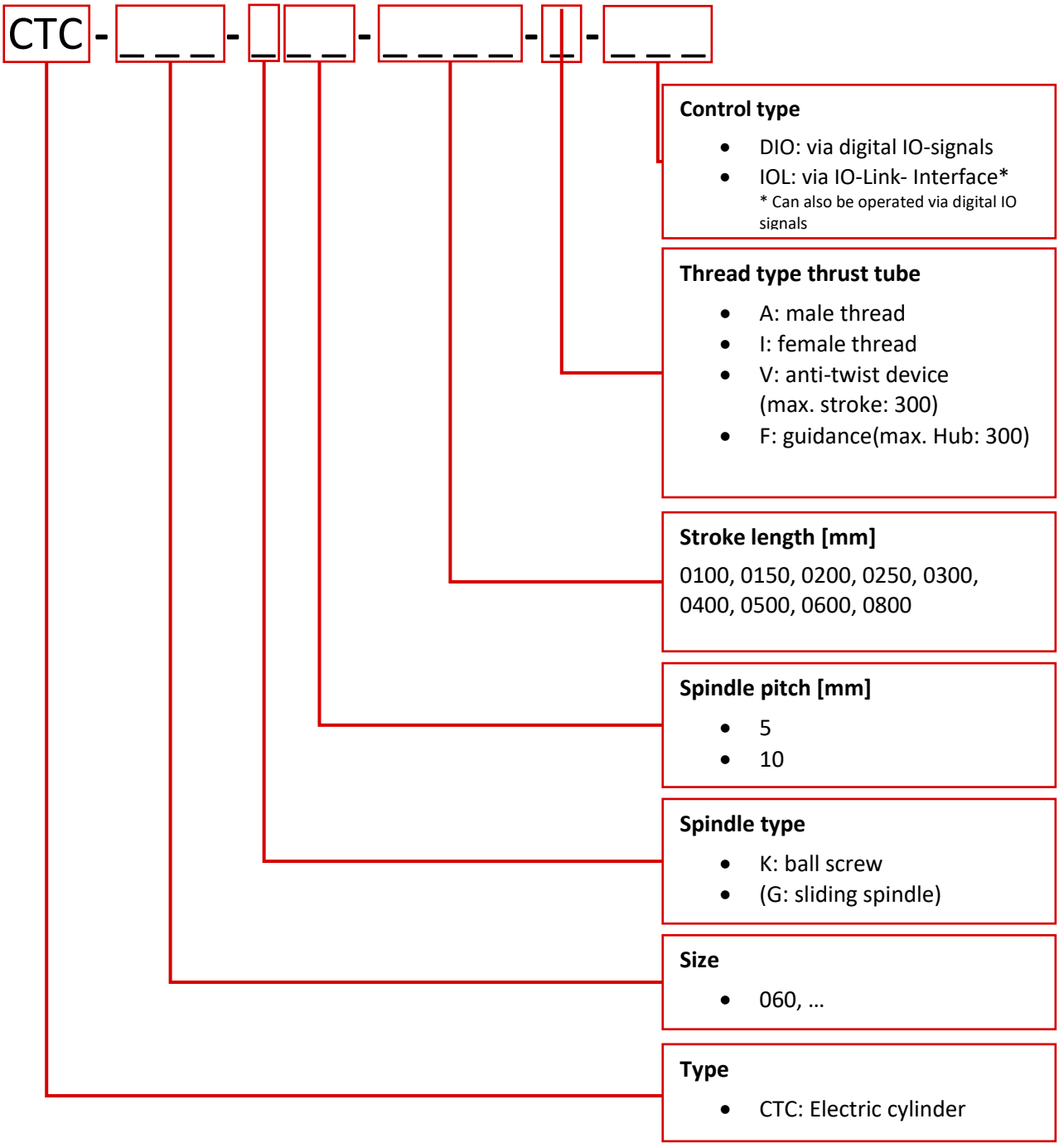
6 Technical data

Size		CTC-60	
Spindle pitch	[mm/rev]	5	10
Spindle type		Ball screw	
Mounting position		any	
Ambient temperature	[°C]	0...+40	
Storage temperature	[°C]	-20...+60	
Protection class		IP65 according to EN 60529 (At a standstill)	
Relative humidity	[%]	0...90 (non-condensing)	
Max. Feed force (peak)	[N]	800	400
Max. Feed force (continuous operation)	[N]	400	200
Max. Speed **In 24V operation** **In 48V operation**	 [mm/s] [mm/s]	 150 300	 300 600
Max. Acceleration	$[m/s]^2$	15	15

Materials	
Housing, cover	Aluminium colorless anodized
Thrust tube	Aluminium, hard anodized
Seals	NBR / EPDM
Thread attachment	Stainless steel
Screws	Steel Galvanized
Spindle	heat-treated steel
Spindle nut	Roller bearing steel
Covers knobs	Stainless steel
Grease nipple	Steel Galvanized
Connector fittings	Zinc nickel plated

Weight (+/- 10%)		
For 100 mm stroke	[g]	1670
Per 10mm stroke additionally	[g]	45
moving mass / 10 mm stroke	[g]	5.85

6.1 Configuration key

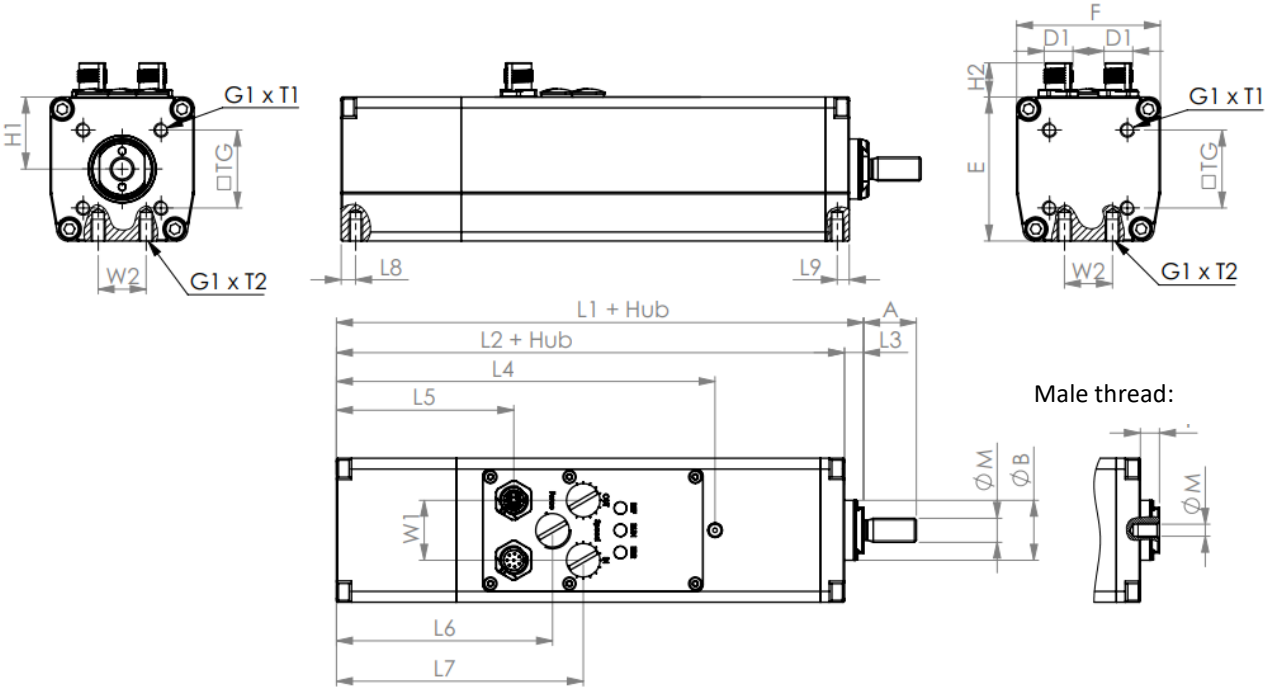


Example: CTC-060-K10-0100-A-DIO

6.2 Dimensions

The basic dimensions are based on ISO 15552.

The connection and accessory dimensions fully comply with ISO 15552.



With anti-twist device:

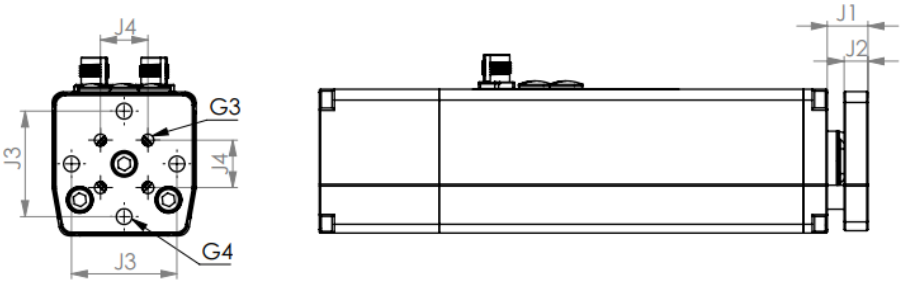


FIGURE 4: DIMENSIONS

	L1*	L2*	L3	L4	L5	L6	L7	L8	L9	H1	H2	D1
CTC-060	120	112	8	158	74	90	103	6	5	30	14.3	M12

	TG**	G1	T1	T2	A	B	E	F	I	M	W1	W2
CTC-060	32.5	M6	12	9	22	25	60	60	9	12	25	20

	J1	J2	J3	J4	J5	G3	G4					
CTC-060	17	10	44	19.8	58	M6	6.6					

All dimensions in mm.

* Stroke-dependent dimensions

** Thread for version with anti-rotation lock only on rear side of housing

6.2.1 Supplementary dimensions for CTC-___-___-____-F

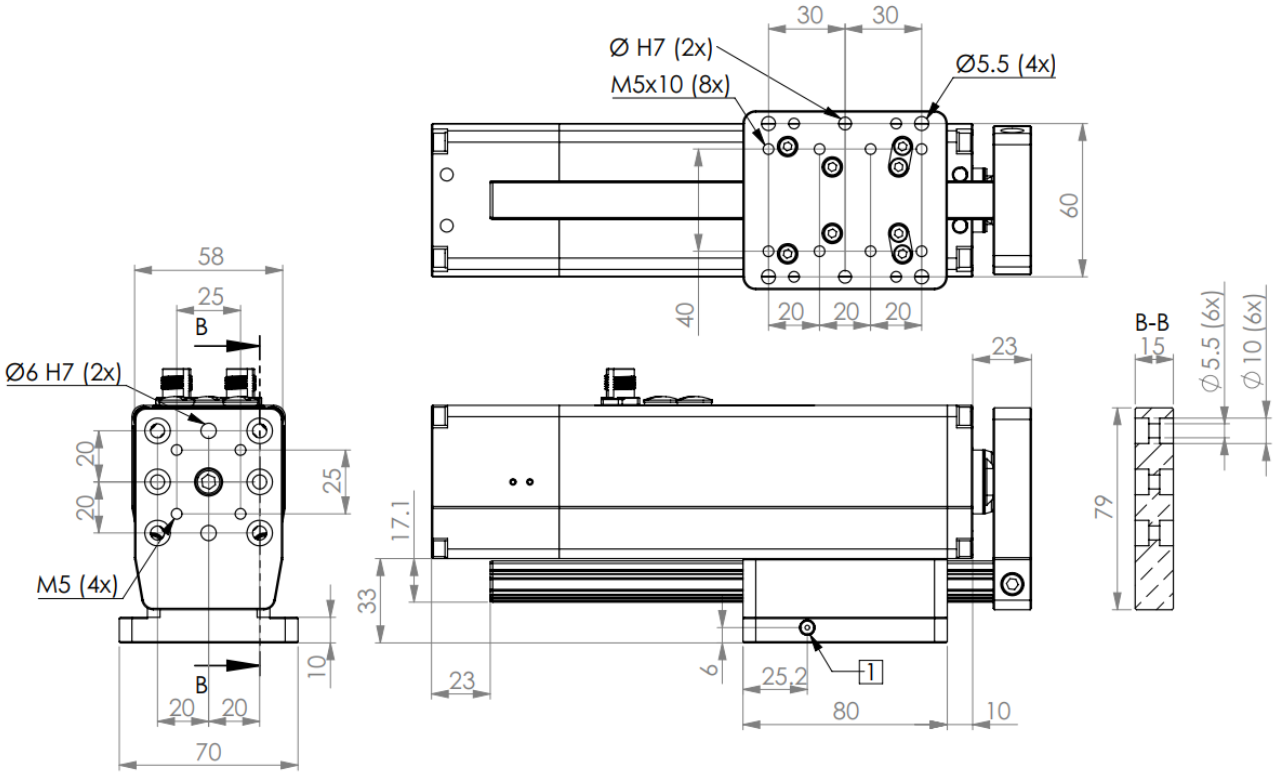


FIGURE 5: DIMENSIONS CTC-___-___-____-F

[1] Conical grease nipple for lubricating the guide (both sides)

6.3 Characteristics / Design

6.3.1 Feed force F as a function of feed rate v

The force-velocity curves provide information about the continuous load (corresponds to a duty cycle of 100%) and the maximum available force / feed rate (peak). If an operating point is above the RMS line, continuous operation is not possible. The load must be reduced accordingly, otherwise overheating of the actuator must be expected. The internal temperature monitoring withdraws the operational readiness from the cylinder and puts the cylinder into an error state (ERR LED flashing pattern see: Chapter 12.1).

If continuous operation is desired (100% duty cycle, all individual operating points must be below the peak line and the averaged effective load (F_{RMS}) must be below the RMS line. The curves shown below are valid for an ambient temperature of 20° C.

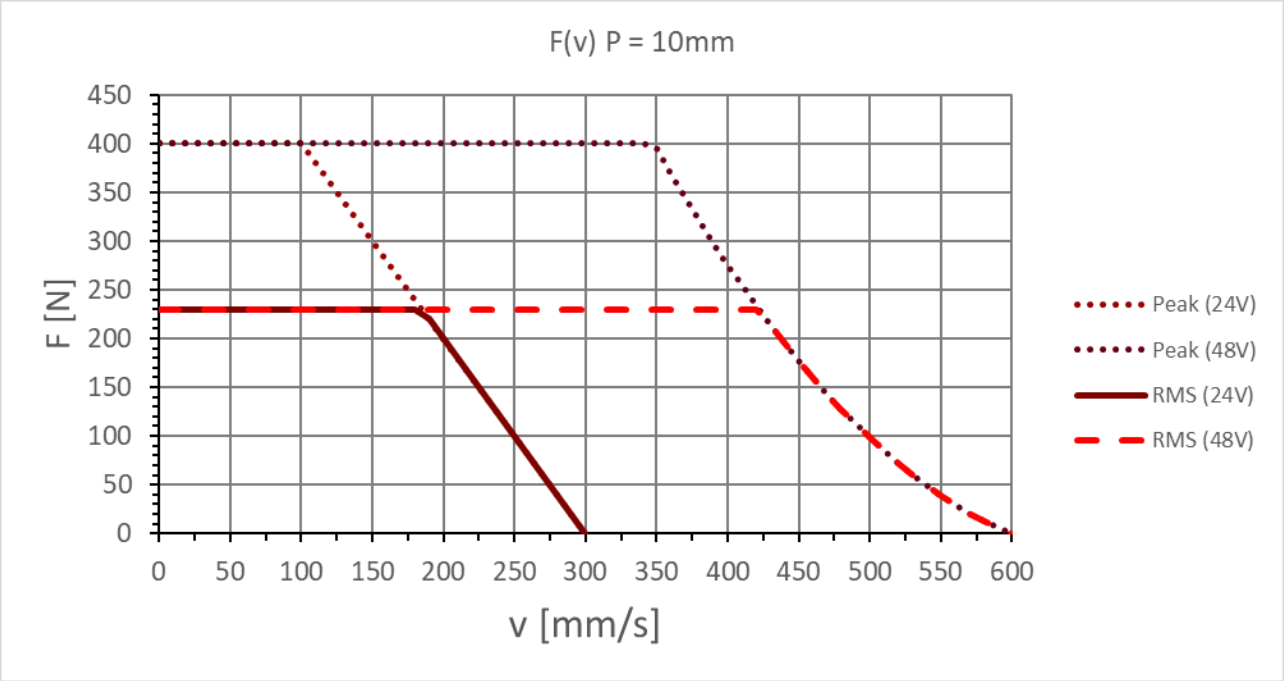


FIGURE 6: FORCE / SPEED CHARACTERISTIC 10MM SPINDLE PITCH

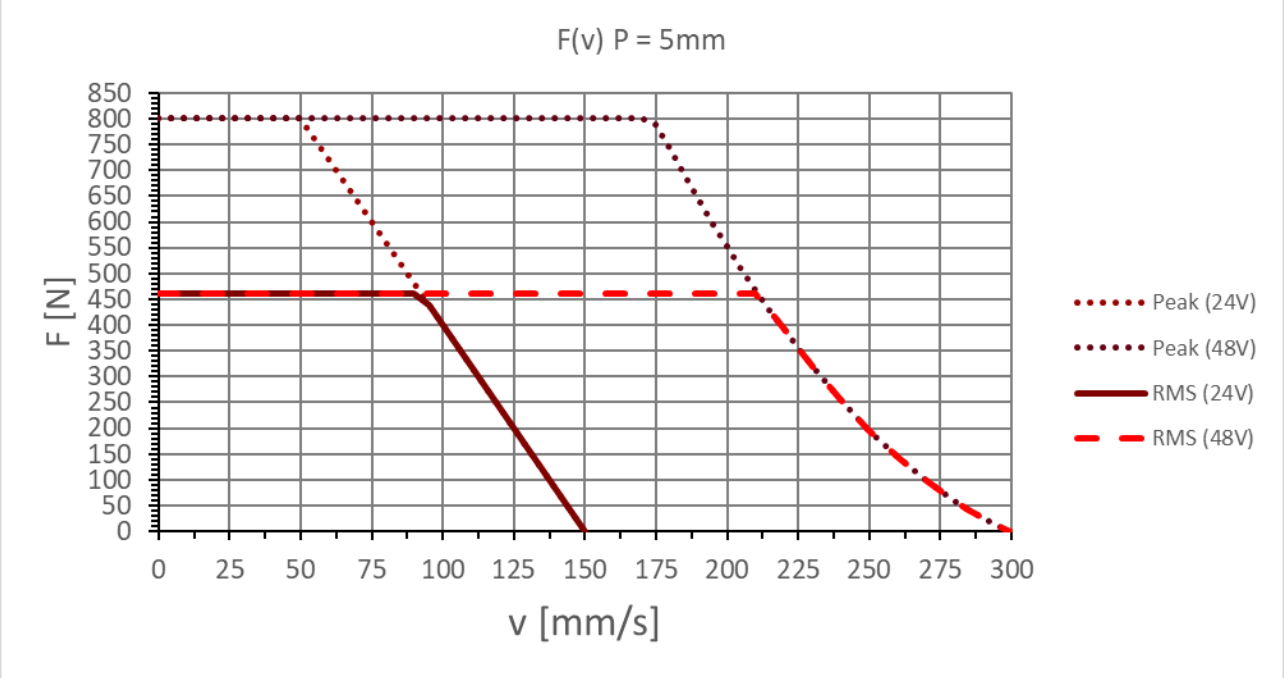


FIGURE 7: FORCE / SPEED CHARACTERISTIC 5MM SPINDLE PITCH

A stroke movement is typically divided into the following chapter:

- b: Accelerate
- c: Run at constant speed
- v: decelerate
- h: Hold / Pause

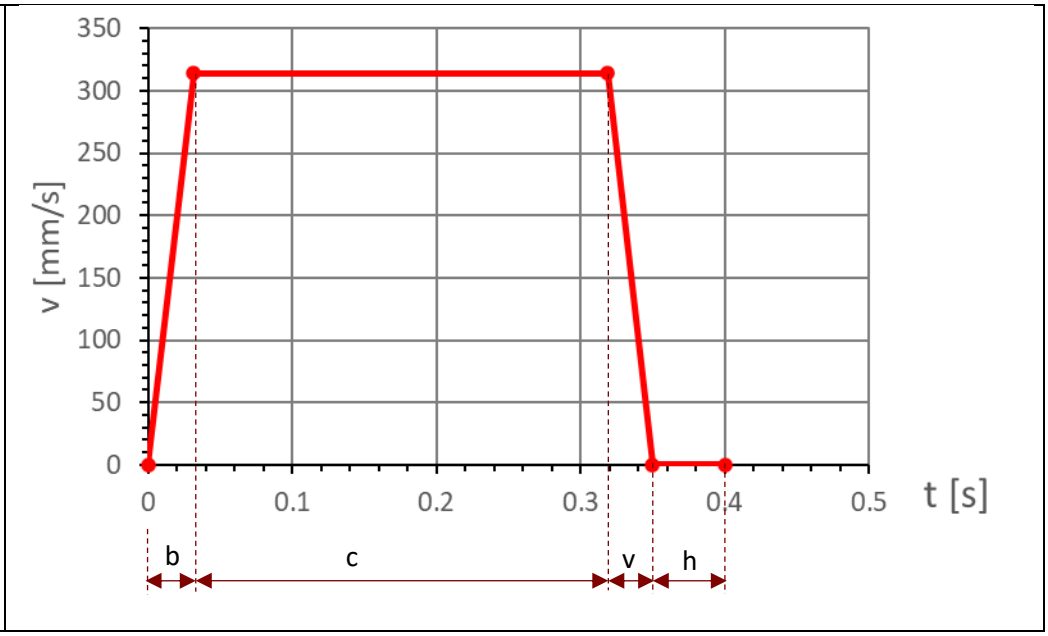


FIGURE 8: V-T DIAGRAM OF A TYPICAL STROKE MOVEMENT

The effective load must be calculated for each chapter. If the averaged effective load is above the RMS line, continuous operation is not possible. The peak curve indicates the load possible for a short time, although this cannot always be operated permanently for thermal reasons. The load during acceleration or deceleration can be above the RMS curve but must be below the peak curve so that the desired stroke time can be achieved.

NOTE	
	Under certain circumstances, the control must be deactivated at high loads (see chapter 7.2) Deactivating the control is only possible in bistable and omnistable mode.

6.3.1.1 Mean effective load (RMS)

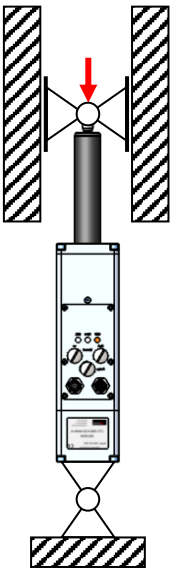
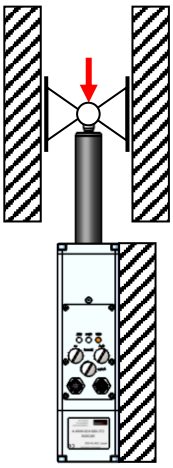
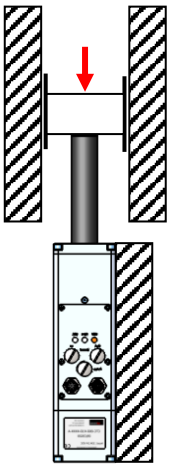
The average effective load (RMS) is calculated using the following formula:

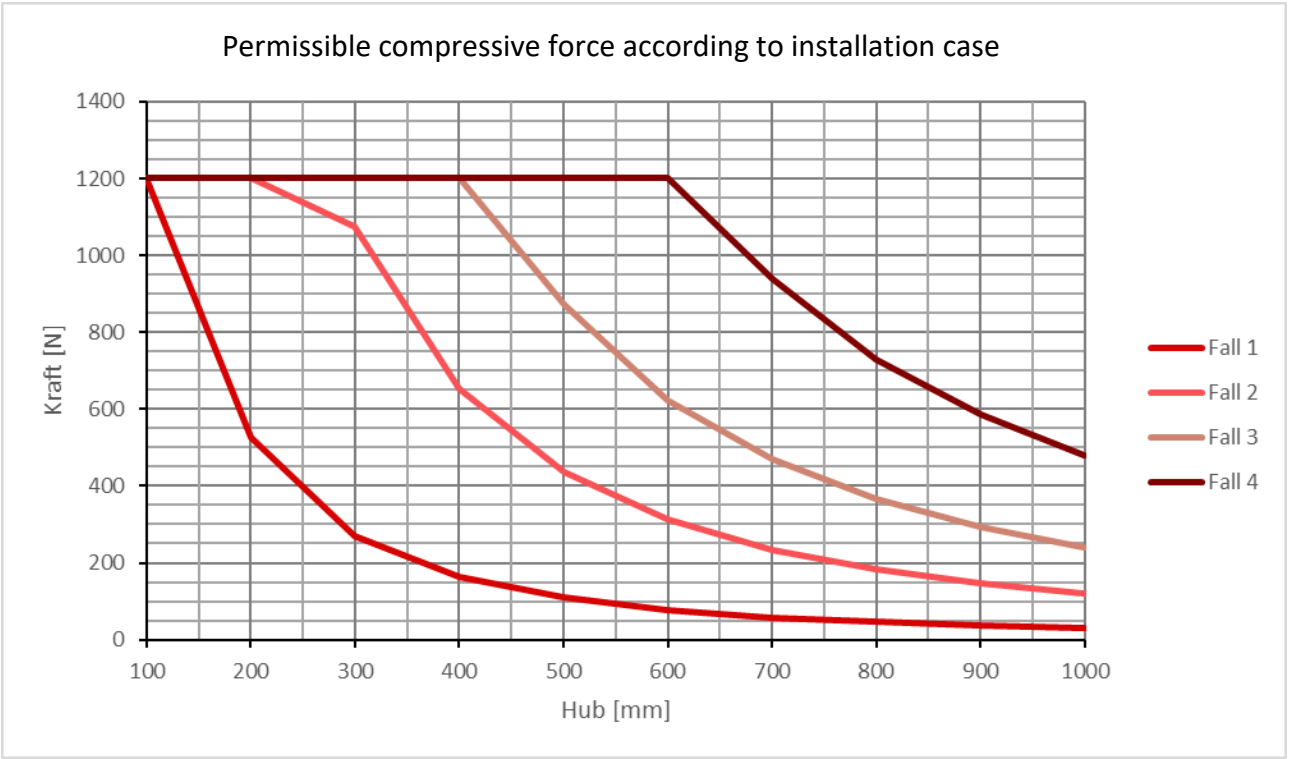
$$F_{RMS} = \sqrt{\frac{1}{t_{tot}} \cdot (t_b \cdot {F_b}^2 + t_c \cdot {F_c}^2 + t_v \cdot {F_v}^2 + t_h \cdot {F_h}^2)}$$ Average effective load in N

$t_b = \frac{v_{max}}{1000 * a_b}$	Acceleration time in s
$t_v = \frac{v_{max}}{1000 * a_v}$	Deceleration time in s
$t_c = \frac{s - \frac{v_{max}(t_b + t_v)}{2}}{v_{max}}$	Time for constant speed in s
t_h	Time for hold / pause in s
$t_{hub} = t_b + t_c + t_v$	Time for total stroke movement in s
$t_{tot} = t_b + t_c + t_v + t_h$	Time for total movement (incl. pause / hold) in s
$F_b = m \cdot a_b + m \cdot g \cdot \sin(\alpha)$	max. occurring load during acceleration in N
$F_c = m \cdot g \cdot \sin(\alpha)$	max. occurring load during constant speed in N
$F_v = m \cdot a_v + m \cdot g \cdot \sin(\alpha)$	max. occurring load during deceleration in N
$F_h = m \cdot g \cdot \sin(\alpha)$	max. occurring load during hold in N (for pause F_h = 0)
$v_b = \frac{v_{max}}{2}$	average velocity during acceleration in mm/s
$v_v = \frac{v_{max}}{2}$	average velocity during deceleration in mm/s
v_{max}	occurring velocity in mm/s
m	Mass in kg
s	Stroke in mm
a_b	in m/s² (for rough design 10 m/s²)
a_v	in m/s² (for rough design 10 m/s²)
g	acceleration due to gravity 9.81 m/s² (for simplicity 10 m/s²)
α	Mounting position (e.g., vertical: α = 90°, horizontal: α = 0°)

6.3.2 Permissible compressive force according to installation case

Compressive forces represent a buckling hazard and must be limited depending on the installation case.

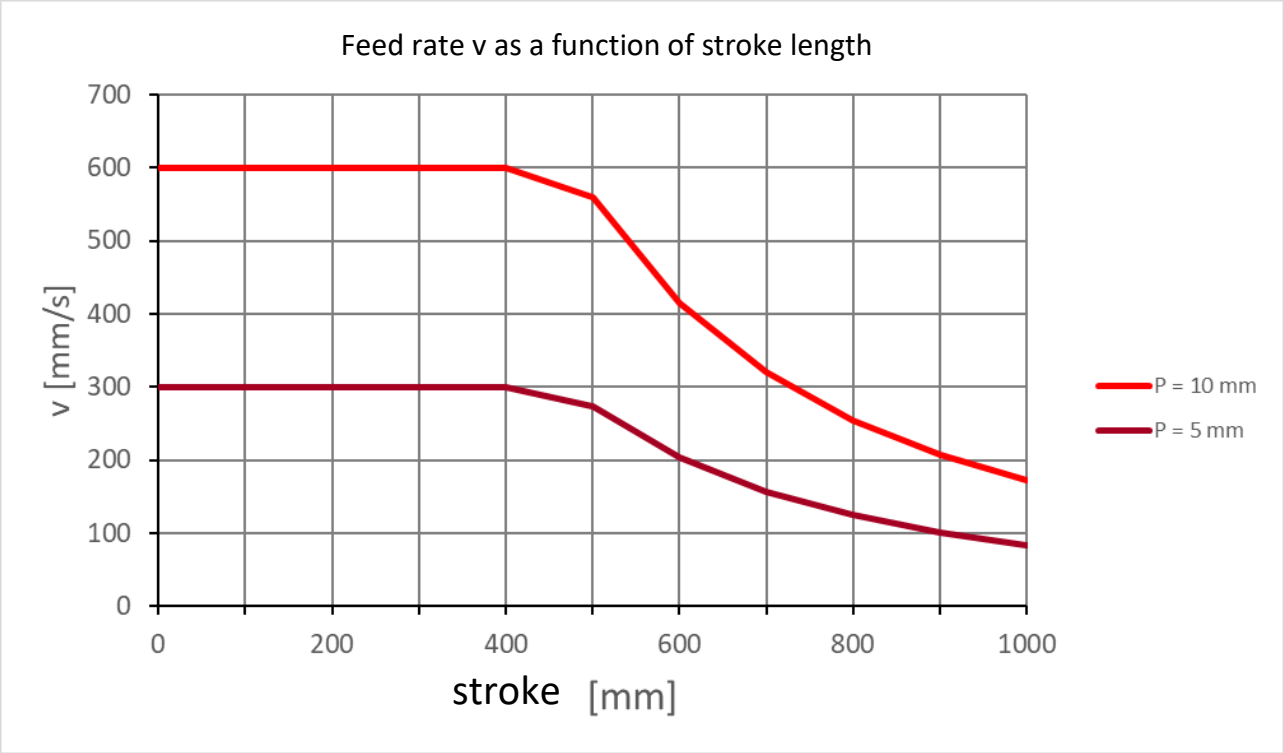
Case 1	Case 2	Case 3	Case 4
Cylinder fixed (rear and front), thrust tube not guided	Cylinder hinged (rear or front), thrust tube hinged and guided	Cylinder fixed, thrust tube hinged and guided	Cylinder fixed, (rear or front), thrust tube guided (not hinged)
			



6.3.3 Feed rate v as a function of stroke length

Due to the larger bearing distances with longer strokes, the maximum spindle speed must be reduced accordingly. This also corresponds to a reduction in the feed rate.

The maximum feed rate depends on the spindle pitch P:

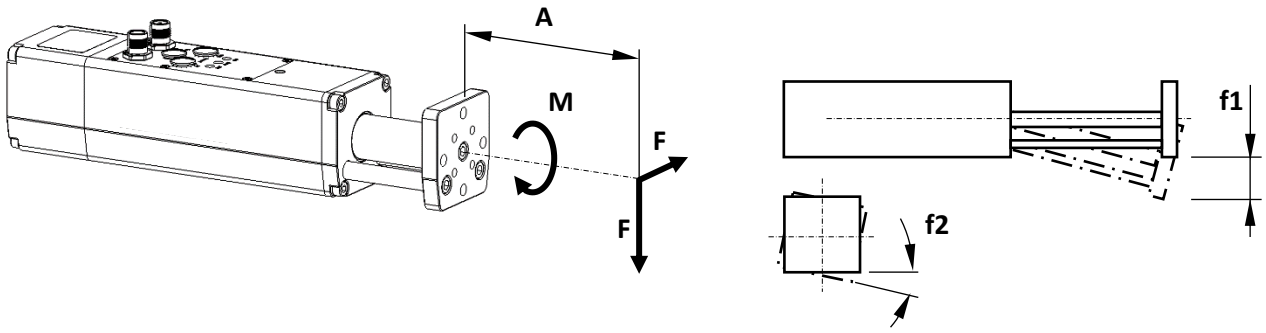


6.3.4 Transversal load for CTC-K__-____-A / CTC-K__-____-I

Transverse load on the thrust tube (version CTC-K__-____-**A** / CTC-K__-____-**I**) are not permitted and lead to a reduction in service life.

IMPORTANT	
	During installation, care must be taken to install the unit in its specified location without distortion or axial misalignment.

6.3.5 Permissible moment load M and transversal load F for CTC-K__-____-V

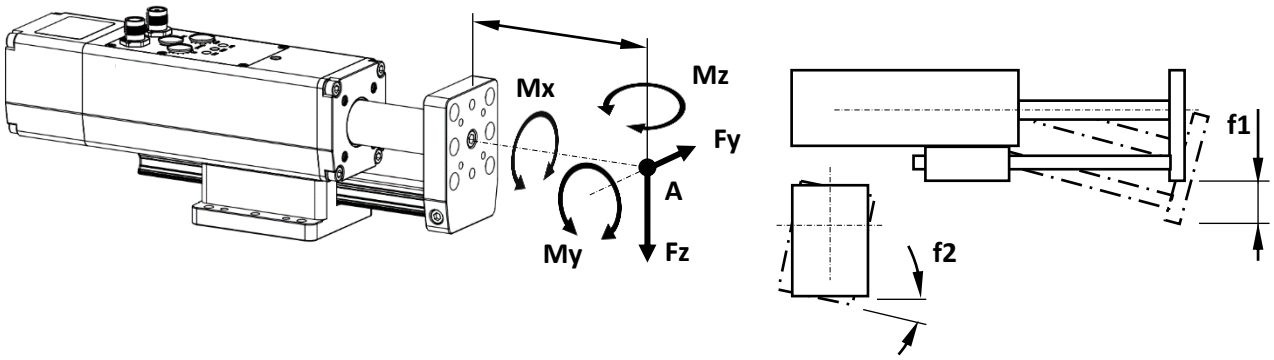


A: point of load: 20mm (center of endplate)
F: transversal load F
M: moment load M
f1: total deflection of endplate (due to bearing clearance and transverse load)
f2: total torsion of endplate (due to bearing clearance and moment load)

stroke	F [N]	M [Nm]	f1* [mm]	f2* [°]
100	29.96	1.26	0.20	0.07
150	12.45	0.75	0.35	0.12
200	6.31	0.54	0.40	0.16
250	3.63	0.45	0.45	0.19
300	2.28	0.40	0.50	0.152

*in new condition

6.3.6 Permissible moment load M and transversal load F for CTC-K__-____-F



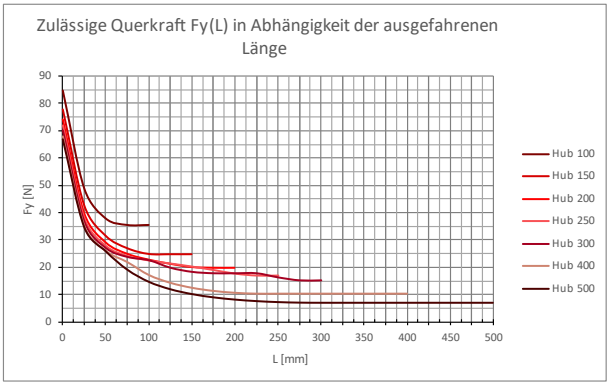
A: Force application point: (centered end plate)

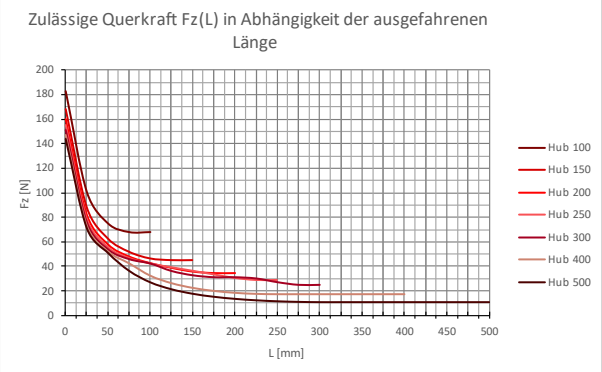
F_n: transversal load F

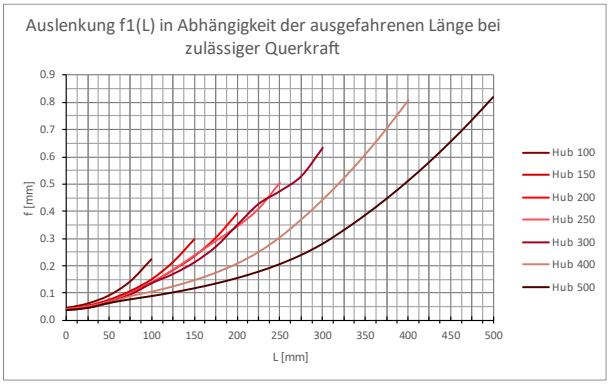
M_n: Moment load M

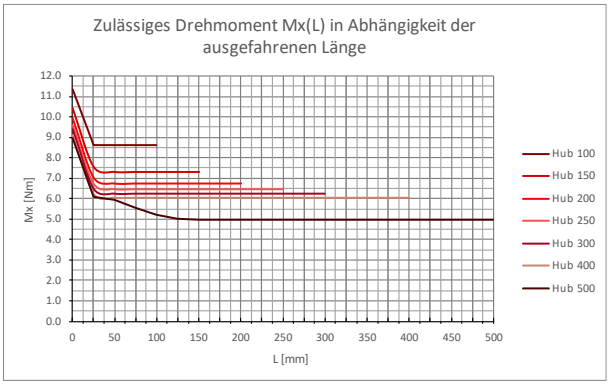
f1: Summed deflection f of the end plate (due to bearing clearance and transcersal load)

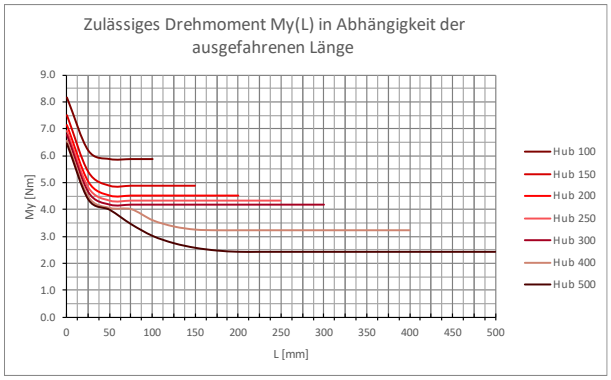
f2: Summed torsion of the end plate (due to bearing clearance and moment load)

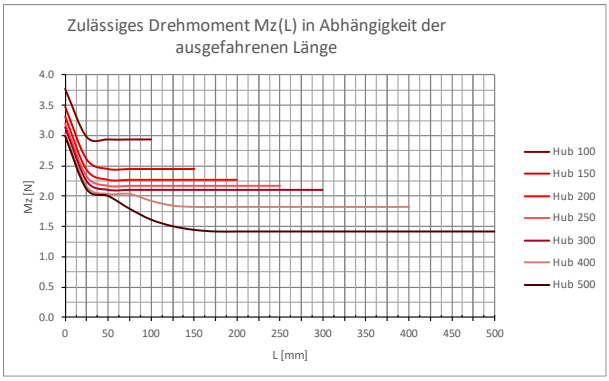


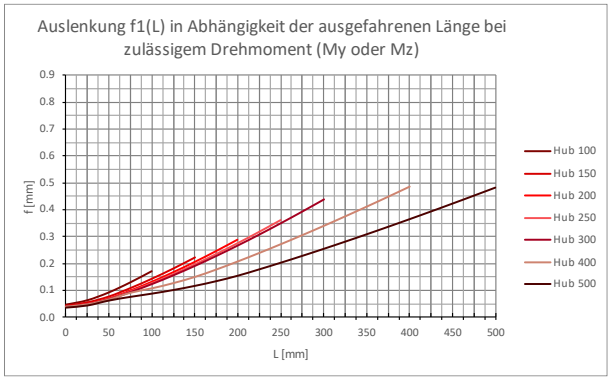


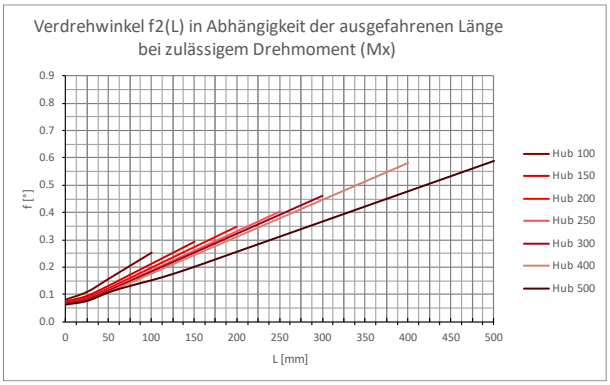












Superposition factor fv

If several of the above-mentioned forces and moments act simultaneously, the following equation must also be fulfilled in addition to compliance with the listed maximum loads:

$$f_v = \frac{|F_y|}{F_{y\,max}} + \frac{|F_z|}{F_{z\,max}} + \frac{|M_x|}{M_{x\,max}} + \frac{|M_y|}{M_{y\,max}} + \frac{|M_z|}{M_{z\,max}} \leq 1$$

F_n / M_n = dynamic values

6.3.7 Generator / brake operation

IMPORTANT	
	Overvoltage can occur in the device and in the power supply unit during generator/brake operation. To avoid damage to other devices in the same voltage circuit due to overvoltage, the use of a braking resistor (braking chopper) is recommended.

A brake chopper is connected to the DC link. When a set limit voltage is reached, it transfers the excess power to a braking resistor and thus effectively limits the voltage in the DC link. Suitable braking resistors (braking choppers) are available on request.

7 Operating modes

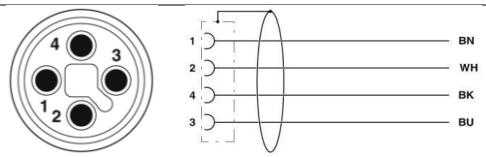
The cylinder can be controlled in two different operating modes. Mode 1 for monostable control and mode 2 for bistable control. **Mode 1** is the factory default state**. To** switch the operating modes, see chapter 7.3.

7.1 Mode 1: Monostable (& Omnistable)

7.1.1 Omnistable

In omni-stable mode, a stroke can be interrupted at any position. If neither a signal for retraction nor extension is detected, the cylinder stops and remains in control in the position reached. For a force-free state, the control can be interrupted (with DI Force-free).

7.1.1.1 Signal assignment Mode: Omnistable

Power	Signal
Plug M12x1, 4-pole T-coded according to EN 61076-2-11	**Plug M12x1, 8-pin** A-coded according to EN 61076-2-101 (Shielded cables are recommended)
	

Pin assignment Digital I/O

Pin	Color	Function	Pin	Color	Function
1	BN	Power voltage 24V-48V ± 15% (max. 10A) At 48V the use of a brake chopper is recommended.	**1**	WH	DO Ready
2	WH	Functional earth (FE)	**2**	BN	Logic voltage 24V ± 15% (max. 500mA)
3	BU	GND 0V	**3**	GN	DO is extended
4	BK	reserved, do not connect	**4**	YE	DO is retracted
			5	GY	DI Retract*
			6	PK	DI Extend*
			7	BU	GND 0V
			8	RD	DI Teach / Reset / Powerless

7.1.1.2 Truth Table Mode: Omnistable

Command	DI Extend	DI Retract	DI Teach	Comment
Cylinder brakes and stops in regulation	0	0	0	
Retract	0	1	0	
Extend	1	0	0	
Teach run: Start with retracted	0	1	1	The cylinder moves slowly to both end stops, starting with retraction, and teaches the new stroke.
Teach run: Start with extension	1	0	1	The cylinder moves slowly to both end stops, starting with the extension, and teaches the new stroke.
undefined	1	1	0	A movement can be executed, this condition must be avoided!
undefined	1	1	1	A movement can be executed, this condition must be avoided!
Reset / powerless	0	0	1	- Control is deactivated, actuator goes into a powerless state, but remains ready for operation - Acknowledge errors

7.1.2 Monostable, normally retracted

Corresponds to a control and behavior as in the operation of a pneumatic cylinder with a monostable pneumatic valve. In which the cylinder is hosed so that it retracts when the valve is in the rest position.

7.1.2.1 Signal assignment Mode: monostable, normally retracted

Signal connector assignment	Pin	Color	Function
Plug M12x1, 8-pin A-coded according to EN 61076-2-101 (shielded cables are recommended)	**1**	WH	DO Ready
	2	BN	Logic voltage 24V ± 15% (max. 500mA)
	3	GN	DO is extended
	**4**	YE	DO is retracted
	5	GY	**Logic voltage 24V (max. 500mA)**
	6	PK	**DI Extend**
	7	BU	GND 0V
	8	RD	DI Teach / Reset

7.1.2.2 Truth table mode: monostable, normally retracted

Command	DI Extend	DI Teach	Comment
Extend	1	0	
Retract	0	0	
Teach run: **Start with Retract**	0	1	The cylinder moves slowly to both end stops, starting with retraction, and teaches the new stroke.
undefined	1	1	Undefined state, this state must be avoided!

7.1.3 Monostable, normally extended

Corresponds to control and behavior as in the operation of a pneumatic cylinder with a monostable pneumatic valve. In which the cylinder is hosed so that it extends when the valve is in the rest position.

7.1.3.1 Signal assignment Mode: monostable, normally extended

Signal connector assignment	Pin	Color	Function
Plug M12x1, 8-pin A-coded according to EN 61076-2-101 (Shielded cables are recommended)	**1**	WH	DO Ready
	2	BN	Logic voltage 24V ± 15% (max. 500mA)
	3	GN	DO is extended
	**4**	YE	DO is retracted
	5	GY	**DI Retract**
	6	PK	**Logic voltage 24V (max. 500mA)**
	7	BU	GND 0V
	8	RD	DI Teach / Reset

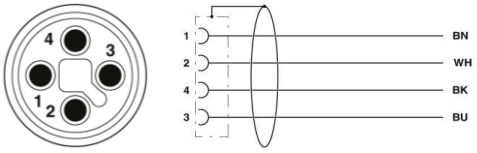
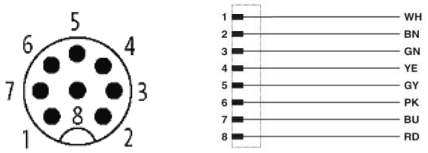
7.1.3.2 Truth table mode: monostable, normally extended

Command	DI Retract	DI Teach	Comment
Extend	0	0	
Retract	1	0	
Teach run: **Start with extension**	0	1	The cylinder moves slowly to both end stops, starting with the extension, and teaches the new stroke.
undefined	1	1	Undefined state, this state must be avoided!

7.2 Mode 2: Bistable

Corresponds to control and behavior as in the operation of a pneumatic cylinder with a bistable pneumatic valve. If a run command is initiated, the cylinder runs the entire (taught-in) stroke, even if the signal drops. The cylinder remains in control in the corresponding end position until the counter signal is received. For a force-free state, the control can be interrupted (with DI Force-free).

7.2.1.1 Signal assignment Mode: Bistable

Power	Signal
Plug M12x1, 4-pole T-coded according to EN 61076-2-11	**Plug M12x1, 8-pin** A-coded according to EN 61076-2-101 (Shielded cables are recommended)
	

Pin assignment Digital I/O

Pin	Color	Function	Pin	Color	Function
1	BN	Power voltage 24V-48V ± 15% (max. 10A) At 48V the use of a brake chopper is recommended.	**1**	WH	DO Ready
2	WH	Functional earth (FE)	**2**	BN	Logic voltage 24V ± 15% (max. 500mA)
3	BU	GND 0V	**3**	GN	DO is extended
4	BK	reserved, do not connect	**4**	YE	DO is retracted
			5	GY	DI Retract
			6	PK	DI Extend
			7	BU	GND 0V
			8	RD	DI Teach / Reset / Powerless

7.2.1.2 Truth Table Mode: Bistable

Command	DI Extend	DI Retract	DI Teach	Comment
Extend	1	0	0	
set	0	0	0	Exit command remains active
Retract	0	1	0	
set	0	0	0	Retract command remains active
stops	1	1	0	
set	0	0	0	Stand command remains active
Reset / powerless	0	0	1	- Control is deactivated, actuator goes into a powerless state, but remains ready for operation - Acknowledge errors
Teach run: **Start with extension**	1	0	1	Cylinder moves slowly to both end stops starting with extension and teaches the new stroke.
Teach run: **Start with retract**	0	1	1	Cylinder moves slowly to both end stops starting with Retract and teaches the new stroke.
stops	1	1	1	Not allowed (programming mode can be reached accidentally)

7.3 Switching the operating modes

Perform the following steps to switch to another operating mode.

1. Disconnect the power and logic voltage supply
2. Connect the logic power supply and immediately activate the signals "DI Retract", "DI Extend" as well as "DI Teach".
3. The signals under point 2. must remain active for 3 seconds. As soon as the device is in programming mode, the LED display "REF" flashes with 2 Hz, deactivate the 3 signals.
4. To switch to another mode, switch the "DI Teach" signal on and off once:
    a. Blinking pattern for **mode 1 (mono-/omni-stable)**: LED "RUN" blinks **once**, then 1 s pause, ...
    b. Flashing pattern for **mode 2 (bistable)**: LED "RUN" flashes **twice**, then 1 s pause, ...
5. To confirm and exit the programming mode, disconnect the logic power supply

NOTE	
	Switching the operating modes is only possible when no power voltage is applied.

8 Installation, assembly

The simplest method of mounting is via the front and bottom mounting threads in the rear and front covers.

8.1 Tightening torques of screws

Cylinder size	Tightening torque for fastening holes at the front and at the bottom	Tightening torque For push tube attachments
CTC-060	4.8 max. Nm (+/- 10%)	20 max. Nm (+/- 10%)

WARNING	
	Failure to comply with the specifications may result in a failure of the bolted joint, which, depending on the situation, may result in serious injuries

WARNING	
	The internal ball screw is not self-locking! It must always be ensured, especially when the electric lifting cylinder is in a vertical position, that the thrust tube is secured against moving out!

WARNING	
	The internal end stops of the electric cylinder must not be approached under any circumstances during operation. The cylinder may only be moved to the internal end positions with minimum force and very slowly (max. 2% of the nominal speed during setup operation and only to determine the end positions or for relubrication. The service life of the electric cylinder is strongly dependent on the extent to which its performance has been exhausted and whether - even if only briefly - inadmissible operating inadmissible operating conditions have occurred.

IMPORTANT	
	The cylinder must be mounted free of stress and distortion. The cylinder must always be installed as a pendulum support. Lateral forces on the cylinder and the thrust tube considerably reduce the service life of the cylinder and must be avoided.

IMPORTANT	
	The thrust tube must not be loaded with a torque. When mounting accessories on the thrust tube, always use the appropriate lock nut for tightening / applying counteracting force.cc

8.2 Connecting signal and power supply

Connect the cables according to the operating mode (see chapter 7). Depending on the mode (see chapter 7.1.1), inputs 5 or 6 are wired to the 24V power supply

DANGER	
	The connection of the electrical lines may only be carried out by qualified personnel.

IMPORTANT	
	To avoid interference with other components in the 24V mains / 48V mains, the power voltage supply of the cylinder must be connected to a separate power supply unit or to a mains filter. Several cylinders can be operated on the same power supply unit.

IMPORTANT	
	The signal power supply must not exceed 24V DC. A range of 24-48V DC is permissible for the power voltage supply, but in this case the signal voltage supply must be provided by a separate 24V power supply unit.

8.3 Commissioning

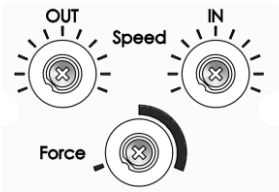
IMPORTANT	
	To prevent damage to the microprocessor, the "DI Retract", "DI Extend" and "DI Teach" signals must not be switched until the logic power supply is connected.

1. The Force and speed are to be set to the smallest position via the rotary knobs (Attention: Do not turn the rotary knobs out beyond the stop!)
2. Connect the power and control connection
3. Optional: Place the cylinder in such a way that the trust tube can move without obstruction and load during extension and retraction.
4. Perform a function check according to chapter 8.4.

8.4 Function control

First carry out all points according to chapters 8.2 and 8.3 through.

1. By signal input on "DI Extend" or "DI Retract", the cylinder starts to move at a reduced reference speed (reference run according to chapter 8.5)
2. The cylinder automatically moves to the corresponding end position and then stops.
3. Press the opposite signal ("DI retract" or "DI extend") to move the cylinder to the other end position. The cylinder now moves at the working speed.
4. Optional: Install the cylinder in its final mounting position.
5. If the cylinder does not perform the full stroke when installed, but is operated with external end stops, perform a teach run according to chapter 8.6 to teach in the new stroke.

	If the potentiometer is set to the black area, care must be taken that the maximum force is not applied at 100% for a duty cycle. On the other hand, the cylinder will heat up and the internal temperature monitoring will put the cylinder into an error state ("DO Ready" = 0).

8.5 Reference run

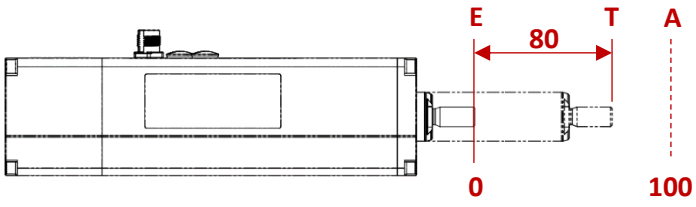
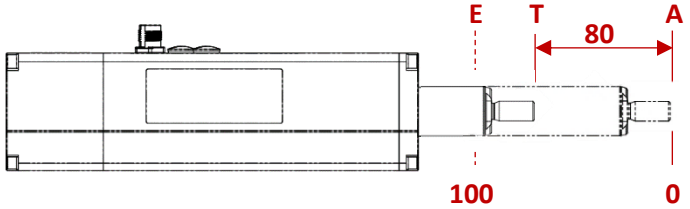
The reference run is used to move the cylinder slowly to an end position and to reference it there (set 0-position).

A reference run is always necessary when the logic voltage has been disconnected from the cylinder. A disconnection of the power voltage, on the other hand, does not require a new reference run.

A reference run is performed automatically as soon as a logic voltage is applied and a signal for retraction or extension is present. If the cylinder is already in the corresponding end position, no movement is performed, and the cylinder is referenced directly.

The reference run differs from the teach-in run in that a new stroke is taught in during the teach-in run. During the reference run, on the other hand, only the start position of the stroke is determined.

This request is represented by the simultaneous illumination of the "REF" and "RUN" LEDs.

Process	**Image representation of the run range after reference run (nominal stroke: 100mm)**
Referencing with a taught-in stroke of 80mm with reference run to the inner stop (E)	
Referencing with a taught-in stroke of 80mm with reference run to the outer stop (A)	

8.6 Teach run

The teach-in run is used to teach-in a new stroke length (or external stops that are shorter than the nominal stroke). As a rule, the teach-in run only has to be performed once during initial startup or when replacing the cylinder. The cylinder moves at slow speed in the specified direction until an end stop is detected by setting a force threshold. The direction of movement is then changed until the second end stop has been detected by means of a force threshold.

The teach-in run is always initiated in combination by the two signals "DI Teach" and the "DI Retract" or the "DI Extend".

"DI Teach" and "DI Extend" → Teach run starting with Extend*.

"DI Teach" and "DI Retracted" → Teach run starting with Retracted*.

*Possible teach run initiations may differ depending on the operating modes, see truth tables in chapter 7 Operating modes.

Procedure Teach run:

1. Mount the cylinder in the intended installation location
2. Commissioning according to chapter 8.3 perform
3. Execute signal combination for teach-in operation:
    a. "DI Teach" and "DI Extend" → Teach run starting with Extend
    b. "DI Teach" and "DI Retracted" → Teach run starting with Retracted.
4. Cylinder extends/retracts slowly to the internal or external end stop
5. Cylinder changes direction of movement and moves to the opposite end stop
6. Cylinder automatically saves the new stroke length.
    a. Green LED (RUN) lights up.
    b. Signal "DO cylinder is extended" or "DO cylinder is retracted" becomes active
7. Teach run completed

NOTE	
	After successful teach-in run, the cylinder brakes before the end stops and remains in position at the end stops. The applied force of the cylinder only corresponds to the force required to hold the end position.

WARNING	
	Using external stops without performing a teach-in run can lead to high wear and damage to the spindle. In addition, too much power is called up because the cylinder always tries to reach the programmed end positions with the maximum set force (force threshold).

9 Maintenance and care

9.1 Maintenance plan

When	What	Action
After commissioning	Spindle	The cylinder is supplied lubricated from the factory. However, if the cylinder lies longer than 1 year in stock by the customer, it must be relubricated, see **9.2 Relubrication**
According to mileage ran	Spindle	Regreasing the spindle, see **9.2 Relubrication**
Annual	Electric cylinder	Check for visible damage (external) Contact Cyltronic AG in the event of visible damage or damage caused externally.
Annual	Mounting fastener	Check screw tightening torques, see **assembly tightening torques chapter 8.1**
All operating500 hours	Relubrication	Lubricate according to chapter 9.2 perform.

9.2 Relubrication

The electric cylinder is lubricated from the factory. Relubrication of the spindle must be carried out at the latest after operating 500 hours (guide value). The relubrication interval may be reduced depending on the application and depends on the operating conditions (series, pitch, speed, acceleration, loads, etc.) and the ambient conditions (e.g., temperature). Environmental influences such as high loads, shocks and vibrations shorten the lubrication intervals. In short-stroke applications, a lubrication run must be performed after a maximum of 1 million motion cycles.

One lubrication run means that 4x one complete stroke is performed over the entire nominal stroke range of the cylinder.

Normal operating conditions:

- Average speed: 0.5 x vmax
- No shocks and vibrations
- Load ratio F/F_{max}: 20

	Spindle	Interval	Lubricant quantity
CTC-060	K12x5	250 Km / 500 operating hours *	1.2 cm^3 / Grease stroke
	K12x10	500 Km / 500 operating hours *	1.2 cm^3 / Grease stroke

* For vertical installation, increase the lubricant quantity by 50%.

9.2.1 Relubrication of the spindle

Make a grease stroke in the retracted position. Then move the thrust tube into lubrication position for the spindle by extending it. This is reached when the distance from the front cover to the threaded attachment is at least 108mm (see Figure 9). If necessary, remove external mechanical limitations. Relubrication may only be carried out in this position (3 grease strokes). Lubrication in horizontal position (grease nipple on top) is recommended. Then move the thrust tube **slowly** back and forth 4-6 times (lubrication stroke) so that the grease can be distributed on the spindle. Then repeat both (3 grease strokes + 4-6 lubrication strokes).

Lubricant: A food-grade grease is recommended (e.g., Fuchs Cassida Grease EPS 2).

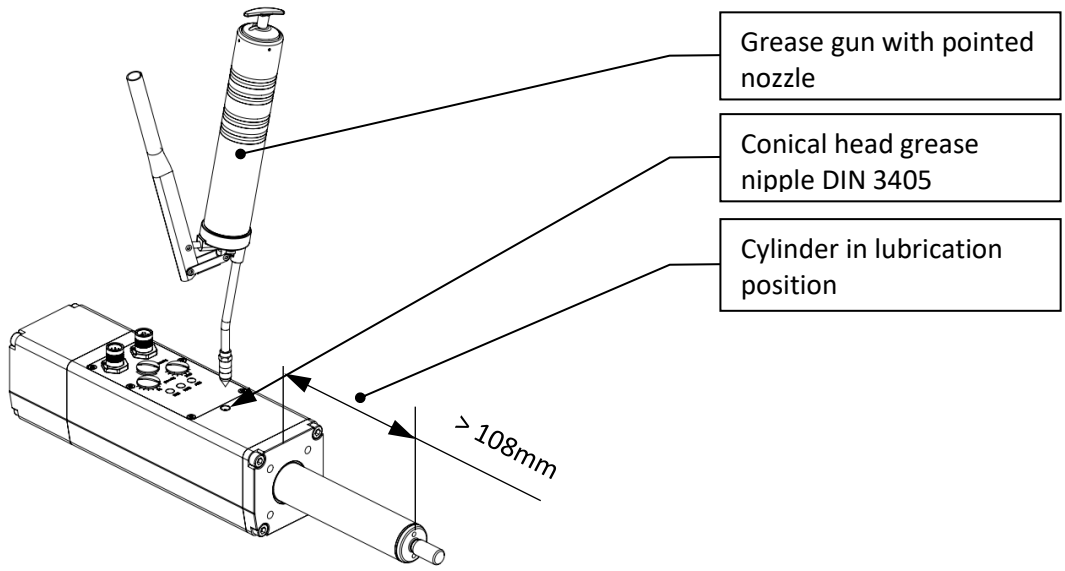


FIGURE 9: LUBRICATION POSITION

IMPORTANT	
	For optimum relubrication, it is recommended that the cylinder be placed in a horizontal position (cf. Figure 9: Lubrication position) so that the grease nipple points upwards. Lubrication in a vertical position is possible.

9.2.2 Relubrication for linear guide (only for CTC-___-___-____-F)

Relubrication of the linear guide can be performed in any position of the slide via the lubrication port [1].

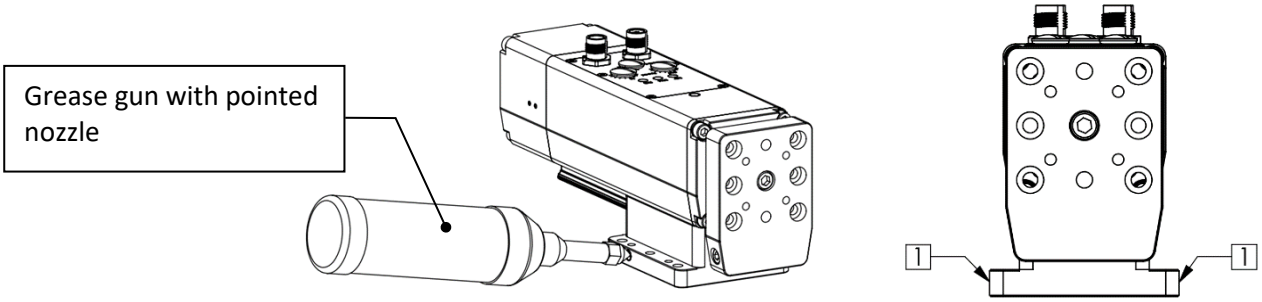


FIGURE 10: RELUBRICATION OF LINEAR GUIDE FOR CTC-___-___-____-F

Lubricant quantity linear guide

	Intervall	Schmierstoffmenge
CTC-060-_-F	2000 Km / 1000 Betriebsstunden	0.2 cm^3 / Schmierstoss

9.3 Cleaning

IMPORTANT	
	Before cleaning, make sure that the screw plugs are correctly tightened. Cleaning of the product may only be carried out when it is at a standstill. Direct directing of strong jets of water at the grease nipple must be avoided and may cause damage. Submersion of the product is not permitted. The product must be in dry condition before restarting after cleaning.

10 Removal and repair

In the event of damage or defect, the entire unit must be returned to Cyltronic AG. The repair may only be carried out by Cyltronic AG trained personnel.

11 Disposal

Dispose of the device properly according to the prevailing legal regulations or return it to Cyltronic AG.

12 Troubleshooting

IMPORTANT	
	Do not attempt to open the cylinder or remove individual parts. Improper disassembly may result in damage. Any warranty claims will be forfeited.

Malfunction	Possible cause	Remedy / further measures
Reversing backlash too large	Torque arm defective / worn	Contact Cyltronic or your Cyltronic dealer.
Strong retracting noise	Torque support or spindle defective / worn out	Contact Cyltronic or your Cyltronic dealer.
Thrust tube cannot be moved by hand	Spindle nut wedged too tightly with stop	1. Electrically extend / retract 2. Increase force potentiometer 3. Contact Cyltronic or your Cyltronic dealer.
Thrust tube cannot be moved electrically	- Spindle nut wedged too tightly with stop - Force set too low	1. Increase force potentiometer 2. Contact Cyltronic or your Cyltronic dealer.
Thrust tube can be rotated	- Torque arm defective / worn - Connection between thrust tube and recirculating ball nut has loosened.	Contact Cyltronic or your Cyltronic dealer.

12.1 Error codes

Faults are indicated by the flashing pattern of the red LED on the device. If a fault occurs, the respective flashing pattern is repeated continuously with a pause of 1s. Faults can be acknowledged with the Teach command.

Blink / light pattern	Error Code	Possible cause	Remedy
LED red lights constantly (after teach or reference run)	Voltage dip during teach or reference run, teach or reference run could not be completed	The power supply delivers less current than the actuator requires. Force setting too high.	-Reduction of the force by means of potentiometer -test by a new run command whether sufficient reduction has been made, if not-> repeat -If the force should then no longer be sufficient, a voltage supply with a higher output current must be used.
LED flashes red: **1x, Pause, 1x, ...**	Power voltage too high	- Overvoltage generated by braking loads	- Checking the power supply - Speed reduction - Installation of a braking resistor
LED flashes red: **2x, pause, 2x, ...**	Temperature too high	Overload of the device	Allow the device to cool down. If the error occurs again, reduce the switch-on time.
LED flashes red: **3x, pause, 3x, ...**	Error current	Current internally too high	Indicates a defect in an internal electronic component. If the error occurs repeatedly or cannot be acknowledged, contact Cyltronic.
LED flashes red: **4x, pause, 4x, ...**	Internal error	Internal error	Indicates a defect in an internal electronic component. If the error occurs repeatedly or cannot be acknowledged, contact Cyltronic.
LED flashes red: **5x, pause, 5x, ...**	Signal voltage too high	- Overvoltage generated by braking loads - Overvoltage caused by another device in the 24V intermediate circuit	- Checking the signal power supply - If necessary, install a separate power supply unit for the signal voltage supply.
LED flashes red: **6x, pause, 6x, ...**	Signal voltage too low		- Checking the signal power supply

13 Appendix

13.1 Dimensioning example

A load of 15 kg is to be lifted vertically by 100mm at a maximum speed of 200 mm/s and held for 10 seconds. A value of 8 mm/s is [2]selected for the acceleration / deceleration.

The holding time is: $t_h = 10s$

The times for acceleration / deceleration are calculated as follows:

$$t_b = \frac{v_{max}}{1000 \cdot a_b} = \frac{200\ mm/s}{1000\ mm/m * 8\ m/s^2} = 0.025\ s$$

$$t_v = \frac{v_{max}}{1000 \cdot a_v} = \frac{200\ mm/s}{1000\ mm/m * 8\ m/s^2} = 0.025\ s$$

The time for run at constant speed is:

$$t_c = \frac{s - \frac{v_{max}(t_b + t_v)}{2}}{v_{max}} = \frac{100\ mm - \frac{200\ mm/s \cdot (0.025\ s + 0.025\ s)}{2}}{200\ mm/s} = 0.475s$$

The time for the entire movement including holding is:

$$t_{tot} = t_b + t_c + t_v + t_h = 0.025s + 0.475s + 0.025s + 10.525s$$

The average speed during acceleration / deceleration is:

$$v_b = v_v = \frac{v_{max}}{2} = \frac{200\ mm/s}{2} = 100\ mm/s$$

The loads during the individual sections are:

$$F_b = m \cdot a_b + m \cdot g \cdot \sin(\alpha) = 15\ kg \cdot 8\ m/s^2 + 15\ kg \cdot 10\ m/s^2 \cdot \sin(90°) = 270\ N$$

$$F_v = m \cdot a_b + m \cdot g \cdot \sin(\alpha) = 15\ kg \cdot 8\ m/s^2 + 15\ kg \cdot 10\ m/s^2 \cdot \sin(90°) = 270\ N$$

$$F_c = m \cdot g \cdot \sin(\alpha) = 15\ kg \cdot 9.81\ m/s^2 \cdot \sin(90°) = 150\ N$$

$$F_h = m \cdot g \cdot \sin(\alpha) = 15\ kg \cdot 9.81\ m/s^2 \cdot \sin(90°) = 150\ N$$

The average effective load F_{RMS} is calculated as follows:

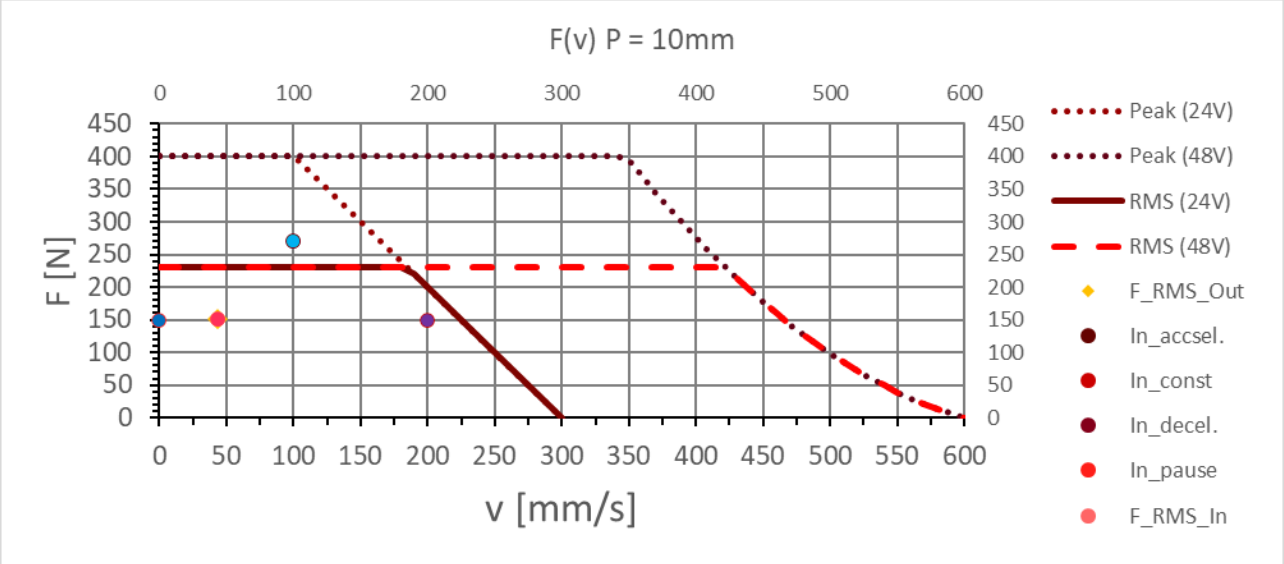
$$F_{RMS} = \sqrt{\frac{1}{t_{tot}} \cdot (t_b \cdot {F_b}^2 + t_c \cdot {F_c}^2 + t_v \cdot {F_v}^2 + t_h \cdot {F_h}^2)}$$

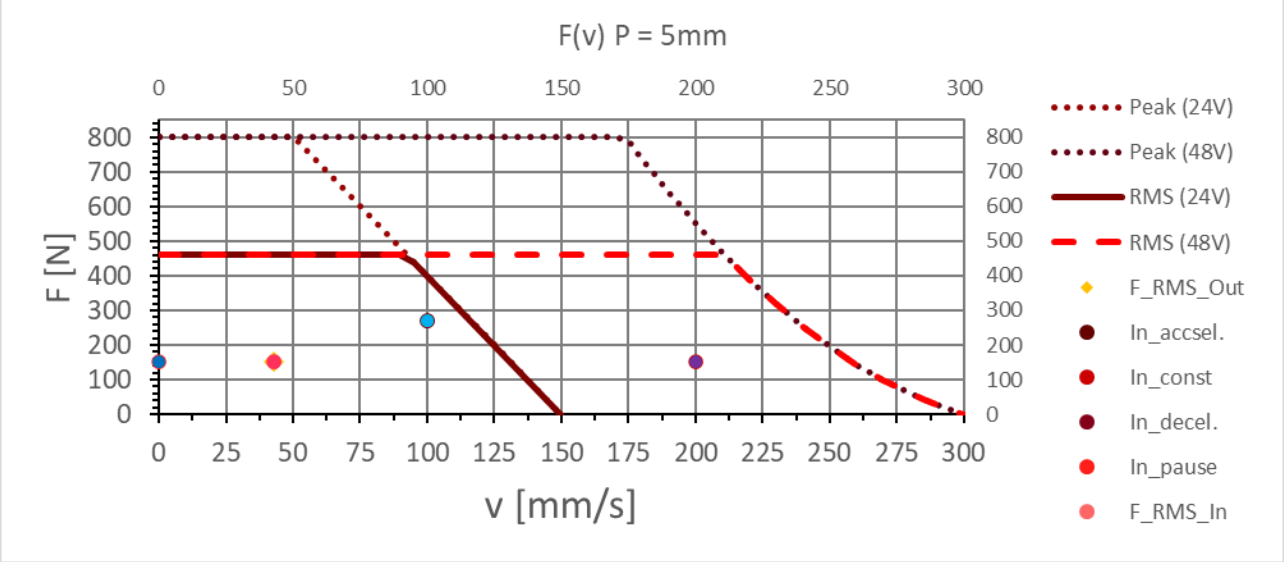
$$= \sqrt{\frac{1}{10.525s} \cdot (0.025s \cdot 270N^2 + 0.475 \cdot 150N^2 + 0.025s \cdot 270N^2 + 10s \cdot 150N^2)} = \mathbf{150.796\ N}$$

The following points must now be considered for the evaluation

Operating point	Load in N	Speed In mm/s	Evaluation
Accelerate	270	100	Operating point is below the peak line Operating point→ permissible
constant Speed	150	200	Operating point is below the peak line Operating point→ permissible
Deceleration	270	100	Operating point is below the peak line Operating point→ permissible
Hold	150	0	Operating point is below the peak line Operating point→ permissible
F_{RMS}	150.796	-	Load is below the RMS line → Operating point permissible

If the points are retracted in the respective F(v) diagrams, it becomes apparent that the 10mm spindle pitch is suitable for the selected application. The "acceleration" operating point is above the RMS curve, but still below the peak curve. The 5mm spindle pitch would also be conceivable for the set conditions, but here a 48V power supply is needed to achieve the desired feed rate. (Operating point above the 47V RMS line).





13.2 Declaration of incorporation

Declaration of incorporation CTC-060

in the sense of the Machinery Directive 2006/42/EC, Annex II, 1.B for partly completed machinery

The manufacturer:

Cyltronic AG
Technoparkstrasse 2
CH-8406 Winterthur

Confirms that the said product

Product name:	Cyltronic electric cylinder
Type designation:	CTC-060
Trade name:	CTC-060
Year of manufacture:	from 05/2021
Function:	Electromechanical extension and retraction of the thrust tube to generate a linear motion

meets the requirements of an **incomplete machine** according to the EC Machinery Directive 2006/42/EC.

The following essential requirements of the Machinery Directive 2006/42/EC according to Annex I are applied and fulfilled:

Appendix I, Paragraph: 1, 1.1.2, 1.1.3, 1.1.5, 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.7, 1.5.1, 1.5.2, 1.5.4, 1.5.8, 1.6.1, 1.7.1, 1.7.1.1

Standard	Title	Edition
DIN EN ISO 12100	Safety of machinery - General principles for design - Risk assessment and risk reduction	12100:2010

It also declares that the specific technical documentation has been prepared in accordance with Annex VII, Part B.

It is expressly declared that the **incomplete machinery** complies with all relevant provisions of the following EC Directives:

2011/65/EU Directive 2011/65/EU of the European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

Cyltronic AG undertakes to transmit the technical documentation on the partly completed machinery in electronic form to the national authorities upon justified request.

Person established in the Community authorized to compile the relevant technical documentation:

Jeremias Wehrli
Cyltronic AG
Technoparkstrasse 2
CH-8406 Winterthur

Commissioning is prohibited until the machine into which this incomplete machine is installed is installed complies with the provisions of EC Directive 2006/42/EC.

Before being placed on the market, this must comply with the CE directives, including documentation.

Winterthur / 20.05.2022 (Ort/Datum)

J. Wehrli (Unterschrift)

Jeremias Wehrli
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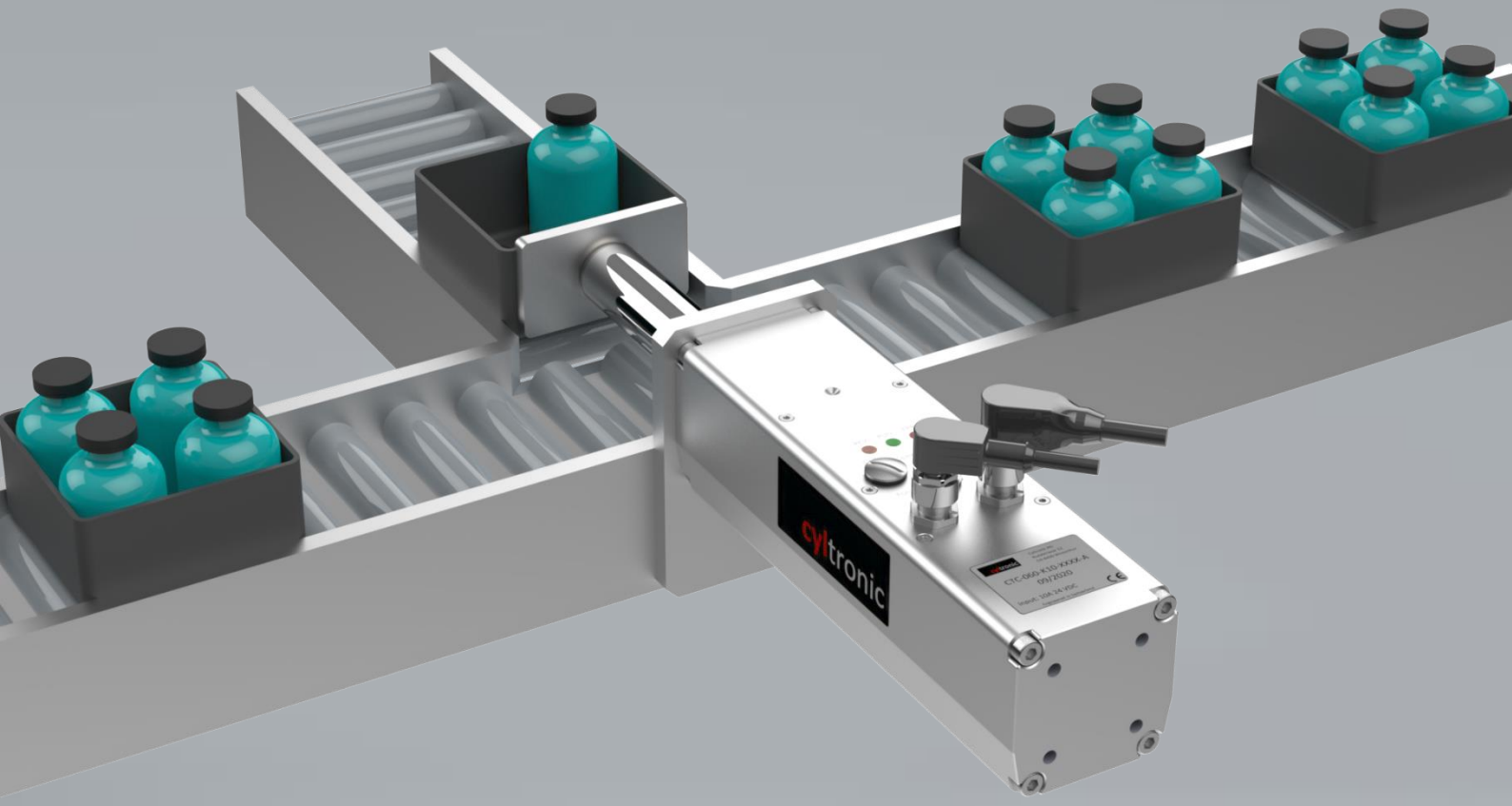
13.3 List of Figures



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flexibility in motion

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