

Order no.	5702-9-			0	
DC-B-013	1				
DC-B-031	2				
2Phase-045	5				
52 mm (2")	1				
Pitch 1 mm / limit switch (mechanical)	0				
Pitch 2 mm / limit switch (mechanical)	1				
Pitch 1 mm / limit switch (Hall effect)	2				
Pitch 2 mm / limit switch (Hall effect)	3				

MA-35 Linear Actuator

Order no. 5702-9-

User Manual

Version: 00.000

Date: 20.04.2016



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1. ABOUT THIS DOCUMENT


All specifications in this user manual refer only to the standard products that are included in the PI miCos catalog. Any special features that are different, in particular special requests from customers, are supplied with the user manual as additional documentation in the form of "Technical Notes".


1.1 Objective and Target Group of this User Manual

- This user manual contains all information required for the intended use of the MA-35.
- Basic knowledge on servo systems, motion control concepts and applicable safety measures is assumed.
- The latest version of the user manual and answers to any questions can be obtained from our customer service department (see chapter 9)

1.2 Symbols and Typographic Conventions

The symbols and typographic conventions used in this manual have the following meanings:

	NOTICE Dangerous situation! If not avoided, the dangerous situation will result in death, injuries or damage to the equipment -> Actions to take to avoid the situation
--	---

	NOTICE Information for easier handling, tricks, tips, etc.
---	--

1.3 Other Applicable Documents

All products and programs from PI miCos mentioned in this documentation are described in separate user manuals.

The latest versions of the user manuals can be obtained from our customer service department (see chapter 9).

2. SAFETY

2.1 Intended Use

The MA-35 is a laboratory device as defined by DIN EN 61010. It is intended for indoor use and use in an environment which is free of dirt, oil, and lubricants.

In accordance with its design, the MA-35 is intended for positioning, adjusting and shifting of loads on one axis at various velocities. The MA-35 can be mounted horizontally or vertically.

The intended use of the MA-35 is only possible in conjunction with suitable electronics. The following options are available:

1. Drive electronics and controller with suitable software
2. Combination device with suitable software

- The electronics are not included in the scope of delivery of the MA-35.
- The electronics must provide the required voltages. To ensure proper performance of the servo-control system, the electronics must be able to read out and process the signals from reference and limit switches, and from the incremental position encoder.

2.2 General Safety Instructions

The MA-35 is built according to state-of-the-art technology and recognized safety standards. Improper use of the MA-35 may result in personal injury and/or damage to the MA-35.

1. Only use the MA-35 for its intended purpose, and only use it if it is in good working order.
2. Read the user manual.
3. Immediately eliminate any faults and malfunctions that are likely to affect safety.

The operator is responsible for the correct installation and operation of the MA-35.

2.2.1 Organizational Measures

User Manual

- Always keep this user manual available when using the MA-35. If the user manual is lost or damaged, contact our customer service department (see chapter 10).
- Add all information from the manufacturer such as supplements or technical notes to the user manual.
- Only use the device on the basis of the complete user manual. If your user manual is incomplete and is therefore missing important information, serious or fatal injury as well as damage to the equipment can result.
- Only install and operate the MA-35 after you have read and understood this user manual.

Personnel Qualification

The MA-35 may only be started up, operated, maintained and cleaned by authorized and appropriately qualified personnel.

2.2.2 Measures during Installation

The MA-35 may be damaged by excessively long screws and wrongly mounted parts.

- When mounting the MA-35, make sure that the mounting screws do not interfere with the stage motion. The screw heads must not protrude from the countersunk holes.
- Only use screws of the correct length for the respective mounting holes.
- Only mount the MA-35 and the loads on the mounting fixtures (holes) intended for this purpose.
- The MA-35 heats up during operation. High temperatures can influence your application.
- Install the MA-35 so that your application is not affected by the dissipating heat.
- Cable extensions can affect the performance of the MP-35 and damage the electronics.
- Only use genuine PI miCos parts to connect the MA-35 to the electronic equipment.
- Do not use cable extensions. If you need longer cables, use cable extensions from PI miCos.
- Avoid short circuiting the lines for motor voltages since this can damage the electronics.

2.2.3 Measures during Start-Up

- Do not put your MA-35 into operation until it is fully mounted and connected.

Your system can be damaged by uncontrolled oscillation of the MA-35. Noise generated during operation of the MA-35 is a typical sign of oscillation.

- Immediately switch off the servo-control system of the affected stage axes.
- Check the settings of the servo-control parameters.

Moving parts attached to devices with motorized stages can accelerate rapidly and generate high forces which can cause injury or damage to equipment.

Unintentional motion of the stage is possible when it is connected to the controller for the first time. Defective software or incorrect operation of the software can also result in unintentional motions.

- Do not place any objects in areas where they can be caught by moving parts.

Collision of a part in motion at the end of the travel range and high accelerations can cause damage to or wear on the mechanical system.

- Ensure that the automatic limit switch halt is supported by the controller, or that it is activated in the controller.
- Do not disable the evaluation of the limit switch signals by the controller.
- Check the function of the limit switches at about 10% to 20% of the maximum velocity.
- In the event of a malfunction of the limit switches, stop motion immediately.
- Ensure that the end of the travel range is approached at low velocity.

Set the control signal so that the moving part does not stop abruptly or try to continue motion at the end of the travel range.

- Determine the maximum velocity for your application.

2.2.4 Measures during Operation

- If noise occurs during operation of the MA-35, check the settings of the servo-control parameters of your controller.

Highest dynamic force and holding force are achieved at a control signal level of 100%; however, during continuous operation the motor/drive may overheat.

- During continuous operation at room temperature, do not exceed a maximum of 90% of the control signal level.
- For continuous operation at other temperatures, observe the maximum permissible duty cycle in relation to the ambient temperature or contact our customer service department for more information (see chapter 9).

2.2.5 Measures during Maintenance

The MA-35 is precision adjusted.

- Do not loosen any sealed screws.

Dirt, oil, lubricants and condensation will render the motor/drive inoperable.

- Keep the motor of the MA-35 free from lubricants.
- Keep the MA-35 free of dirt and condensation.

3. UNPACKING

1. Unpack the MA-35 with care.
2. Compare the contents with the items listed in the contract and the packing list.
3. Inspect the contents for signs of damage. If there is any sign of damage or missing parts, contact PI miCos immediately.
4. Keep all packaging materials in case the product needs to be returned.



WARNING



Risk of suffocation for children. Keep the packaging foil away from children.
Dispose of packaging materials according to environmental regulations.



NOTICE



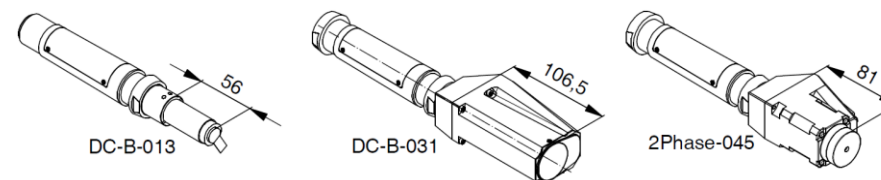
All specifications in this user manual refer only to the standard products that are included in the PI miCos catalog. Any special features that are different, in particular special requests from customers, are supplied with the user manual as additional documentation in the form of "Technical Notes".

4. PRODUCT DESCRIPTION

4.1 Features and Application Area

Our products are designed specifically for use in the laboratory.

4.2 Model Overview



Order no.	5702-9-			0	
DC-B-013		1			
DC-B-031		2			
2Phase-045		5			
52 mm (2")		1			
Pitch 1 mm / limit switch (mechanical)		0			
Pitch 2 mm / limit switch (mechanical)		1			
Pitch 1 mm / limit switch (Hall effect)		2			
Pitch 2 mm / limit switch (Hall effect)		3			

4.3 Product View



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NOTICE



Modifications and servicing on this axis may only be carried out by the manufacturer or persons authorized by the manufacturer. The manufacturer is not liable for damage caused by unauthorized tampering. Unauthorized tampering invalidates the guarantee.

4.4 Safety Instructions



WARNING



After removing the transport lock (if present), watch out for moving parts.

NOTICE



Protect the product against mechanical damage (knocking, shock, ...).
Never start up an axis if you suspect it to be damaged or broken.
Do not disconnect or connect connectors when voltage is present.

WARNING



Risk of squeezing or crushing by moving sliders at the places illustrated.

4.5 Scope of Delivery

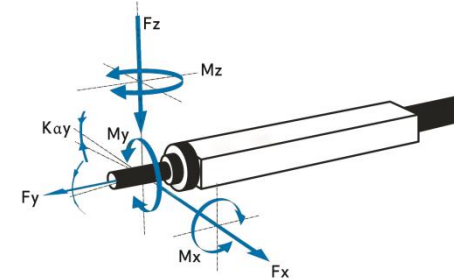
1. Stage according to order.
 - Mounting accessories (screws & pins) in fast-sealing bag.

4.6 Optional Accessories

Obtain more information on optional accessories from our customer service department (chapter 9).

4.7 Technical Features

4.7.1 Load Capacity Data



FACTS

Load characteristics	F _x (N)	F _y (N)	F _z (N)
DC-B-013	10	500	10
DC-B-031	10	200	10
2Phase-045	10	300	10

4.7.2 Motors

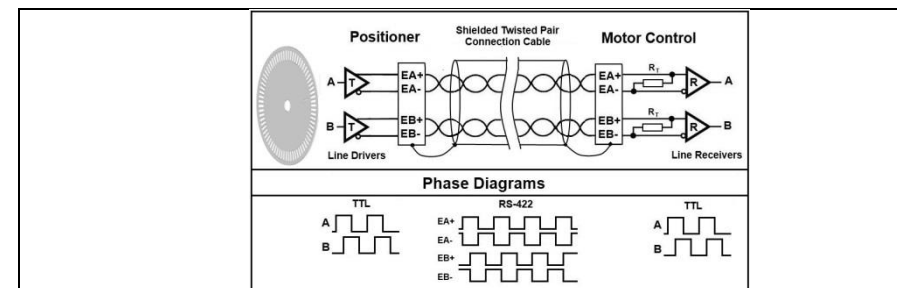
DC-B-013

Motor type		DC brush 2224-024 CR
Nominal voltage	V	24
Max. continuous current	A	0.25
Electrical resistance	Ω	36.6
Electrical inductance	mH	0.8
Torque constant	mNm/A	29.1
Velocity constant	rpm/V	328
n/M slope curve	rpm/mNm	411
No load velocity	rpm	7800
Max. continuous velocity	rpm	5000
Max. continuous velocity at nominal torque	rpm	4800
Inertia	kgm ²	2.71 E-7
Continuous torque	mNm	6.6
Rotary encoder		RE-005 RS422-outputs 2 channel (1)
Gearbox		Low backlash, 22/5
Gear ratio		2401 / 81
Encoder increments (quad counts)	n	2048
with additional line-driver PCB in stage or Sub-D 15-pin connector shell		

RE-005

Rotary magnetic encoder RS-422 quadrature

Encoder type		IE2-512 rotary magnetic MR encoder
Quadrature counts per revolution	n	2048
Signal output		TTL / RS-422 (1)
Channels		2
Supply voltage	VDC	5 +/- 10%
Current consumption, Typical (Vcc = 5 V DC)	mA	30
Frequency range	KHz	160
Code disc inertia	kgm2	9E-9
Operating temperature	°C	-15..85
(1) with additional line-driver PCB in stage or Sub-D 15-pin connector shell		



DC-B-031

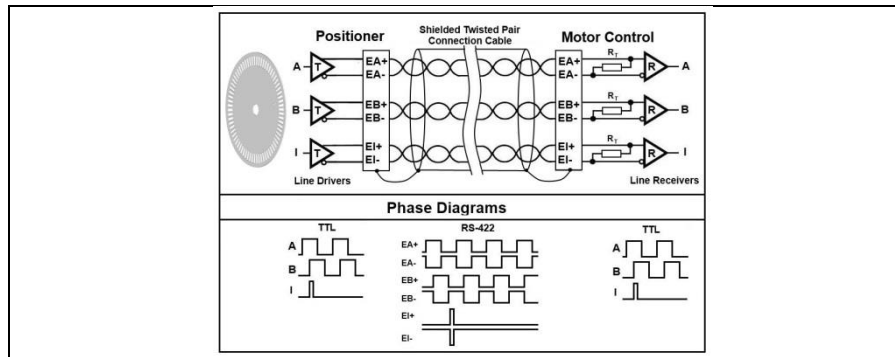
Motor type		DC brush 3557-024 CR
Nominal voltage	V	24
Max. continuous current	A	1.96
Electrical resistance	Ω	2
Electrical inductance	mH	0.27
Torque constant	mNm/A	42.8
Velocity constant	rpm/V	223
n/M slope curve	rpm/mNm	10.4
No load velocity	rpm	5300
Max. continuous velocity at nominal torque	rpm	5000
Inertia	kgm ²	6.4E-6
Continuous torque	mNm	80
Rotary encoder		RE-010 RS422 2-channel + index
Encoder increments (quad counts)	n	2000

RE-010

Rotary optical encoder RS-422 quadrature

Encoder type		HEDL rotary optical encoder
Quadrature counts per revolution	n	2000
Signal output		RS-422
Channels		2 + index
Supply voltage	VDC	4.5..5.5
Current consumption, Typical (Vcc = 5 V DC)	mA	57
Frequency range	KHz	100
Code disc inertia	kgm2	0.5E-7
Operating temperature	°C	-40..100

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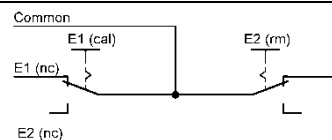
2Phase-045

Motor type		PK-245-01B 2-phase bipolar half coil
Phase current	A	1.2
Step angle	°	1.8
Steps	n	200
Coil resistance	Ω	3.3
Coil inductance	mH	2.8
Holding torque	mNm	320
Inertia	kgm ²	6.8E-6
Weight	kg	0.35

4.7.3 Limit Switch

Mechanical limit switches

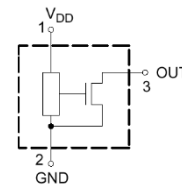
Max. voltage (resistive load)	V	30
Max. current (resistive load)	A	1
Contact type		Normal closed
Max. switch voltage (resistive load)	VDC	3-24
Operations		>5x10 ⁴
Operating temperature	°C	-40 to +85



Hall sensor limit switches, DC motor stages

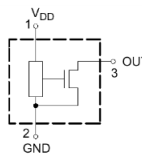
Supply voltage, V _{DD}	V	5 (connected to encoder supply)
Supply current	mA	<5 mA
Output configuration		Open collector
Max. sink current	mA	20
Max. switching voltage (resistive load)	VDC	3-24
Contact type		Normal closed
Output type		npn
Operating temperature	°C	40 to +85

Caution: There is no separate pin for the sensor supply, sensor shares encoder supply!



Hall sensor limit switches, 2SM motor stages

Supply voltage, V _{DD}	V	3.8 .. 24
Supply current	mA	<5 mA
Output configuration		Open collector
Max. sink current	mA	20
Max. switching voltage (resistive load)	VDC	3-24
Contact type		Normal closed
Output type		npn
Operating temperature	°C	40 to +85

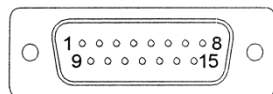


4.7.4 Connector

ST-060

DC motor, Sub-D (m), 15-pin with mechanical switches

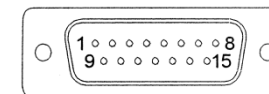
Sub-D (m), 15-pin	Function	
1	EA+	Encoder channel A+
2	EB+	Encoder channel B+
3	EC+	Encoder channel I+
4	EGND	Supply encoder GND
6	M+	DC brush motor +
7	LE2	Limit forward
8	LCOM	Limit common
9	EA-	Encoder channel A-
10	EB-	Encoder channel B-
11	EC-	Encoder channel I-
12	E5V	Encoder supply voltage
14	M-	DC brush motor -
15	LE1	Limit reverse



ST-063

DC motor Sub-D (m), 15-pin with Hall or optical sensors

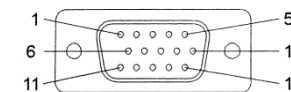
Sub-D (m), 15-pin	Function	
1	EA+	Encoder channel A+
2	EB+	Encoder channel B+
3	EC+	Encoder channel I+
4	EGND	GND supply encoder & sensor limit
6	M+	DC brush motor +
7	LE2	Limit forward
8	nc	
9	EA-	Encoder channel A-
10	EB-	Encoder channel B-
11	EC-	Encoder channel I-
12	E5V	Supply voltage encoder & sensor limit
14	M-	DC brush motor -
15	LE1	Limit reverse



ST-010

2SM motor HD Sub-D (m), 15-pin with mechanical sensors

HD Sub-D (m), 15-pin	Function	
1	MA+	Motor phase A+
2	MA-	Motor phase A-
3	nc	
4	nc	
5	MB+	Motor phase B+
6	MB-	Motor phase B-
7	nc	
8	nc	
9	nc	
10	nc	
11	nc	
12	nc	
13	LE2	Limit forward
14	LE1	Limit reverse
15	LCOM	Limit common



ST-013

2SM motor, HD Sub-D (m), 15-pin with Hall sensors

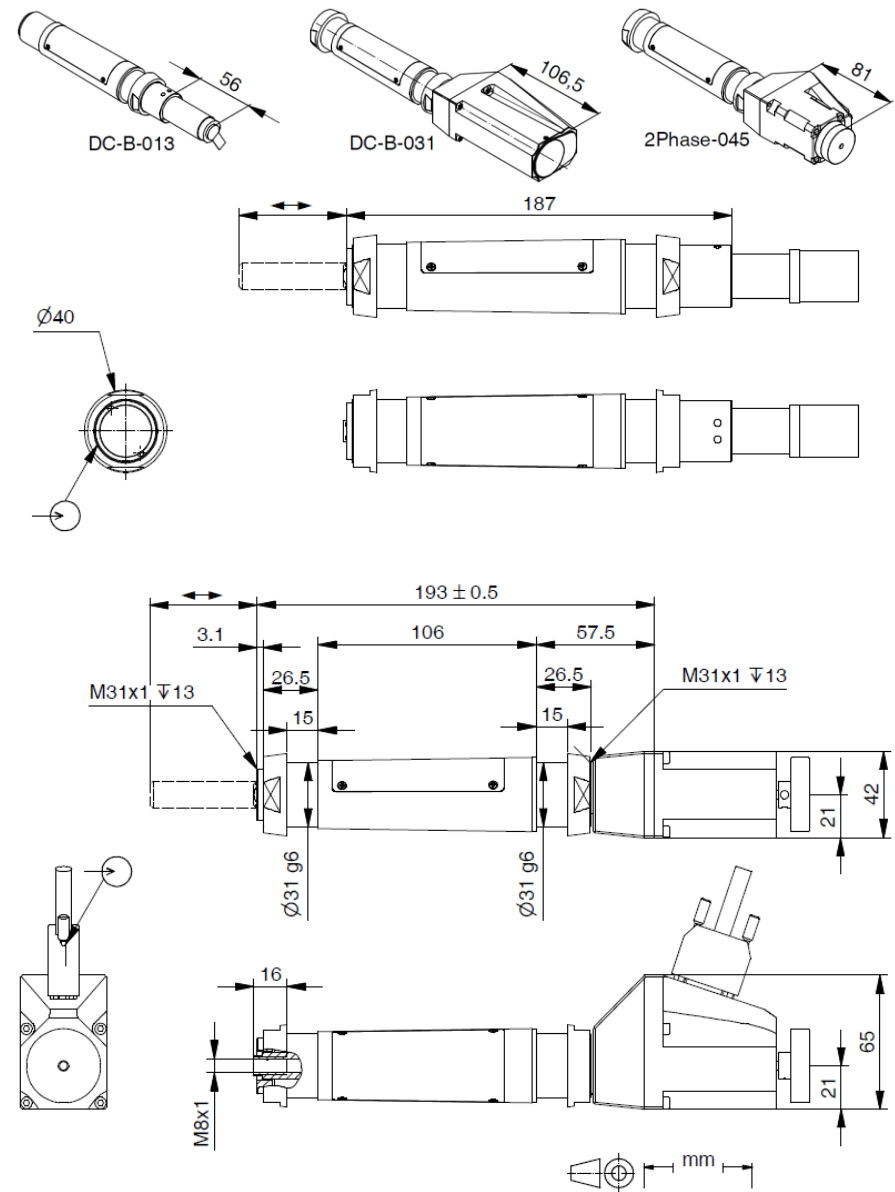
HD Sub-D (m), 15-pin	Function	
1	MA+	Motor phase A+
2	MA-	Motor phase A-
3	nc	
4	nc	
5	MB+	Motor phase B+
6	MB-	Motor phase B-
7	nc	
8	nc	
9	nc	

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10	LVcc	Hall sensor limit supply
11	nc	
12	nc	
13	LE2	Limit forward
14	LE1	Limit reverse
15	LGND	GND sensor limit

4.7.5 Technical Data

TECHNICAL DATA						
Travel range (mm)	52					
Weight (kg)	2					
Motor	DC-B-013		DC-B-031		2Phase-045	
Pitch (mm)	1	2	1	2	1	2
Max. velocity (mm/sec)	2.5	5	50	90	25	45
Typical resolution (μm)	0.1	0.2	0.5	1	0.1	0.2
Calculated resolution (μm)	0.0164726 (RE)	0.0329453 (RE)	0.5(RE)	1(RE)	5(FS)	10(FS)
Bidirectional repeatability (μm)	± 1		± 1		± 1	
Unidirectional repeatability (μm)	0.2		0.5	1.0	0.2	
Nominal current (A)	0.28		1.96		1.2	
Max. operating voltage (V)	24		24			
Accuracy	on request					
Velocity range (mm/sec)	0.001..100					
Material	stainless steel					



4.8 Ambient Conditions

For indoor use only.

- The MA-35 was calibrated at an ambient temperature of 20 °C (+/- 3 °C).
- The permissible operating temperature is between 20 °C and 40 °C.
- The permissible relative humidity is between 20% and 80%.
- Always keep the MA-35 free of dirt, dust and corrosive gases.

5. INSTALLATION

5.1 General Notes on Installation

Requirements

The axis must be screwed onto a surface with an evenness better than 5 µm.

It is necessary to make sure that no dust, dirt or other foreign bodies are between the surface and the axis, otherwise the properties of the axis can be impaired by mechanical tension.

To guarantee the prescribed specifications (see Internet www.pimicos.com), the **evenness of the mounting surface must be better than 5 µm**. (Reference surface of PI miCos measuring granite is 3 µm).

5.2 Mounting the Stage

Requirements

You have read and understood the general notes on installation (see chapter 5.1).

Mounting material

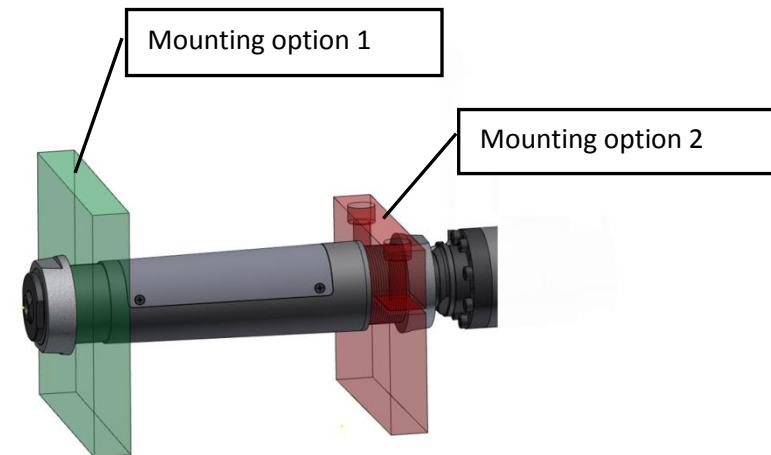
- DIN 912 screws and DIN 6325 dowel pins, m6 tolerance field

Tightening torques of the mounting screws to be used should not have values higher than the following:

- M3 DIN 912 1.5 Nm

- M4 DIN 912 2.0 Nm
- M5 DIN 912 2.5 Nm
- M6 DIN 912 3.0 Nm

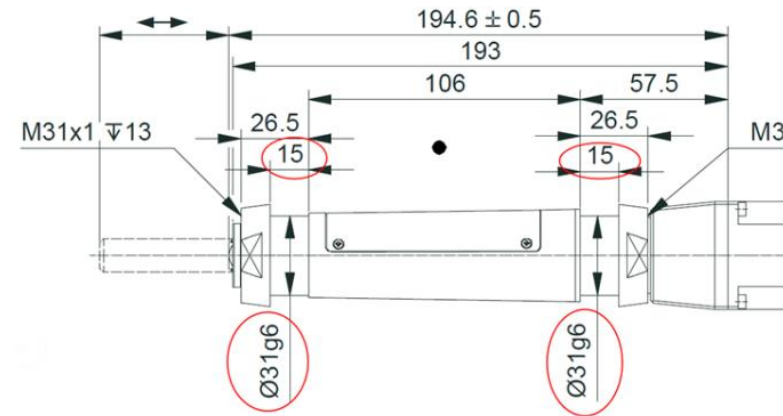
Mounting the MA-35



Mount the stage according to mounting option 1 or 2.

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- Mounting hole in the pusher



5.3 Affixing the Load

Requirements

You have read and understood the general notes on installation (see chapter 5.1).

Mounting material

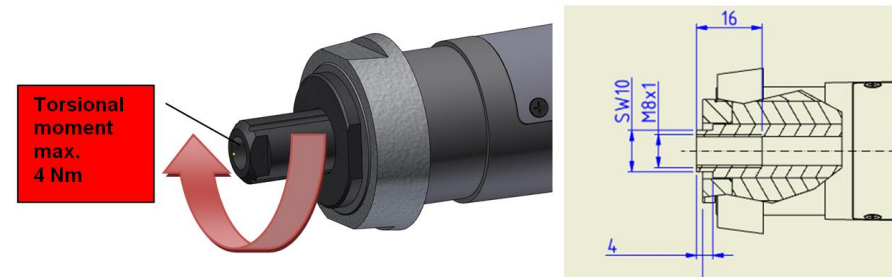
- DIN 912 screws and DIN 6325 dowel pins, m6 tolerance field

Tightening torques of the mounting screws to be used should not have values higher than the following:

- M3 DIN 912 1.5 Nm
- M4 DIN 912 2.0 Nm
- M5 DIN 912 2.5 Nm
- M6 DIN 912 3.0 Nm

Mounting the Additional Part

Mount the additional part with the corresponding screws.



6. START-UP

6.1 General Notes on Start-Up

This stage must be started up with a suitable cable and the associated controllers.

7. MAINTENANCE

Depending on the operating conditions and the period of use of the MA-35, the following maintenance measures are required:

Maintenance Run

The maintenance run is performed to redistribute the existing lubricant on the guidings of the stage.

- To evenly distribute the existing lubricant on the stage guidings, perform a maintenance run across the entire travel range after 500 hours of operation, or after 1 year at the latest.
- If the stage is to be operated continuously in an industrial environment over a small travel (less than 20 percent of the entire travel range), perform a maintenance run across the entire travel range every 5000 motion cycles.

Lubrication

Under laboratory conditions, the guidings of the stage need to be lubricated in exceptional cases only. For continuous industrial use, the lubrication intervals must be defined individually.

- Do not lubricate the guidings of the MA-35 without consulting our customer service department (see chapter 9).
- To lubricate the guidings, follow the instructions specified in the maintenance manual, which you can obtain from our customer service department.

8. TROUBLESHOOTING

If the problem that occurred with your system is not listed in the table above or cannot be solved as described, contact our customer service department (see chapter 9).

9. CUSTOMER SERVICE

For inquiries and orders, contact your PI miCos sales engineer or send us and email (info@pimicos.com).

If you have questions concerning your system, have the following information ready:

1. Product codes and serial numbers of all products in the system
2. Current firmware of the controller (if present)
3. Software version of the driver or the user software (if present)
4. User operating system (if present)

10. OLD EQUIPMENT DISPOSAL

In accordance with EU directive 2002/96/EC (WEEE), as of 13 August 2005, electrical and electronic equipment may not be disposed of in the member states of the EU via the municipal residual waste.

Dispose of your old equipment according to international, national, and local rules and regulations.

In order to fulfil the responsibility as the product manufacturer, PI miCos GmbH undertakes environmentally correct disposal of all old PI miCos equipment made available on the market after 13 August 2005 without charge.

Any old PI miCos equipment can be sent free of charge to the following address:

PI miCos GmbH
Freiburger Strasse 30
79427 Eschbach, Germany
<http://www.pimicos.com>

11. DECLARATION OF CONFORMITY

An EC Declaration of Conformity has been issued for the MA-35 in accordance with the following European directives:

2004/108/EC, EMC Directive
2011/65/EU, RoHS Directive

The applied standards certifying the conformity are listed below.

EMV: EN 61326-1:2013
Safety: EN 61010-1:2010
RoHS: EN 50581:2012