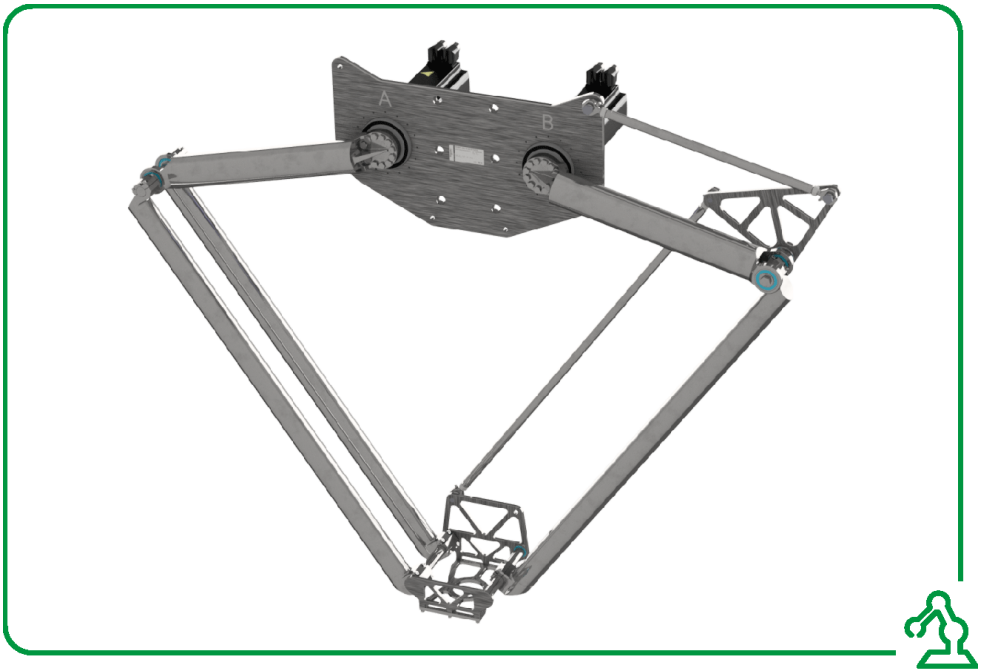
Operating Manual
Robot T-Series

(Original Document)

12/2017



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The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Schneider Electric nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein. If you have any suggestions for improvements or amendments or have found errors in this publication, please notify us.

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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

Table of Contents

Safety Information

Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

NOTICE is used to address practices not related to physical injury.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

About the Book

At a Glance

Document Scope

This manual is to help you use the capabilities of the robot safely and properly.

Follow the instructions within this manual to help:

- Reduce risks
- Reduce repair costs and downtime of the robot
- Increase the service life of the robot
- Increase the reliability of the robot

Validity Note

The technical characteristics of the devices described in this document also appear online. To access this information online:

Step	Action
1	Go to the Schneider Electric home page *www.schneider-electric.com*.
2	In the **Search** box type the reference of a product or the name of a product range. ● Do not include blank spaces in the reference or product range. ● To get information on grouping similar modules, use asterisks (*).
3	If you entered a reference, go to the **Product Datasheets** search results and click on the reference that interests you. If you entered the name of a product range, go to the **Product Ranges** search results and click on the product range that interests you.
4	If more than one reference appears in the **Products** search results, click on the reference that interests you.
5	Depending on the size of your screen, you may need to scroll down to see the data sheet.
6	To save or print a data sheet as a .pdf file, click **Download XXX product datasheet**.

The characteristics that are presented in this manual should be the same as those characteristics that appear online. In line with our policy of constant improvement, we may revise content over time to improve clarity and accuracy. If you see a difference between the manual and online information, use the online information as your reference.

For product compliance and environmental information (RoHS, REACH, PEP, EOLI, etc.), go to *www.schneider-electric.com/green-premium*.

Related Documents

Title of Documentation	Reference Number
MH3 Servo motor Motor Manual	*0198441114042 (EN)* *0198441114041 (GER)*
Lexium 52 Hardware Guide	*EIO0000001347 (EN)* *EIO0000001348 (GER)*
Lexium 62 Hardware Guide	*EIO0000001349 (EN)* *EIO0000001350 (GER)*
Lexium 62 ILM Hardware Guide	*EIO0000001351 (EN)* *EIO0000001352 (GER)*
SchneiderElectricRobotics Library Guide (only available in the online help)	EIO0000002236 (EN) EIO0000002237 (GER)

You can download these technical publications and other technical information from our website at https://www.schneider-electric.com/en/download

Terminology Derived from Standards

The technical terms, terminology, symbols and the corresponding descriptions in this manual, or that appear in or on the products themselves, are generally derived from the terms or definitions of international standards.

In the area of functional safety systems, drives and general automation, this may include, but is not limited to, terms such as *safety*, *safety function*, *safe state*, *fault*, *fault reset*, *malfunction*, *failure*, *error*, *error message*, *dangerous*, etc.

Among others, these standards include:

Standard	Description
EN 61131-2:2007	Programmable controllers, part 2: Equipment requirements and tests.
ISO 13849-1:2008	Safety of machinery: Safety related parts of control systems. General principles for design.
EN 61496-1:2013	Safety of machinery: Electro-sensitive protective equipment. Part 1: General requirements and tests.
ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN 60204-1:2006	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN 1088:2008 ISO 14119:2013	Safety of machinery - Interlocking devices associated with guards - Principles for design and selection
ISO 13850:2006	Safety of machinery - Emergency stop - Principles for design
EN/IEC 62061:2005	Safety of machinery - Functional safety of safety-related electrical, electronic, and electronic programmable control systems

Standard	Description
IEC 61508-1:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: General requirements.
IEC 61508-2:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Requirements for electrical/electronic/programmable electronic safety-related systems.
IEC 61508-3:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Software requirements.
IEC 61784-3:2008	Digital data communication for measurement and control: Functional safety field buses.
2006/42/EC	Machinery Directive
2014/30/EU	Electromagnetic Compatibility Directive
2014/35/EU	Low Voltage Directive

In addition, terms used in the present document may tangentially be used as they are derived from other standards such as:

Standard	Description
IEC 60034 series	Rotating electrical machines
IEC 61800 series	Adjustable speed electrical power drive systems
IEC 61158 series	Digital data communications for measurement and control – Fieldbus for use in industrial control systems

Finally, the term *zone of operation* may be used in conjunction with the description of specific hazards, and is defined as it is for a *hazard zone* or *danger zone* in the *Machinery Directive* (*2006/42/EC*) and *ISO 12100:2010*.

NOTE: The aforementioned standards may or may not apply to the specific products cited in the present documentation. For more information concerning the individual standards applicable to the products described herein, see the characteristics tables for those product references.

Dual Dimensions

Dimensions are indicated in metric system and U.S. customary units system. The U.S. dimensions are given in parentheses, for example 8.4 mm (0.33 in).

NOTE: The given values in parentheses are rounded and for reference only.

Chapter 1
Specific Safety Information

What Is in This Chapter?

This chapter contains the following topics:

Proper Use

Overview

This section contains information regarding the operation of the robot. Qualified personnel *(see page 16)* working with the robot must read and observe this information. The robot was built in compliance with the recognized technical safety regulations.

Installation

The T-Series robot is intended to be installed in a machine or assembled with other components to form a machine or system.

Provide for Protective Measures

Before installing the device, provide appropriate protective devices in compliance with local and national standards. Do not commission components without appropriate protective devices. After installation, commissioning, or repair, test the protective devices used.

Perform a risk evaluation concerning the specific use before operating the product and take appropriate security measures.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Ensure that a risk assessment is conducted and respected according to EN/ISO 12100 during the design of your machine.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

If circumstances occur that affect the safety or cause changes to the operating behavior of the robot, then immediately shut down the robot and contact your local Schneider Electric service representative.

Use Original Equipment Only

Use only the accessories and mounting parts specified in the documentation and only third-party devices or components that have been expressly approved by Schneider Electric. Only modify the robot in the manner intended and described in this documentation, and other documentation concerning any other associated equipment.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Only use software and hardware components approved by Schneider Electric for use with this equipment.
- Update your application program every time you change the physical hardware configuration.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Misuse

The robot is not suitable for the manipulation of living organisms or explosive materials, nor is it suitable for impact activities.

Incompatible Environments

The components must not be used in the following environments:

- Hazardous (explosive) atmospheres
- Mobile, movable, or floating systems
- Life support systems
- Domestic appliances
- Underground
- Highly saline environments (refer to *Technical Data* *(see page 35)* for materials used)
- Environments with increased radioactive radiation

This equipment has been designed to operate outside of any hazardous location. Only install this equipment in zones known to be free of a hazardous atmosphere.

⚠ DANGER

POTENTIAL FOR EXPLOSION

Install and use this equipment in non-hazardous locations only.

Failure to follow these instructions will result in death or serious injury.

Installation and Operating Conditions

Only use the components in accordance with the installation and operating conditions described in this documentation. The operating conditions at the installation location must be inspected and maintained in accordance with the required technical data (performance data and ambient conditions). Commissioning is prohibited until the usable machine or system in which the T-Series product is installed is in accordance to the applicable local regulations and standards.

Service Life

The expected service life of the robot as partially completed machinery is 15 years.

Qualification of Personnel

Target Audience for This Manual

This documentation is intended for users having the following knowledge:

- Advanced knowledge in mechanical engineering
- Advanced knowledge in electrical engineering
- Qualified person
- System engineer
- Knowledge of the robot control system and the construction

Qualified Person

Electrical and mechanical equipment must be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material. A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and the installation, and has received safety training to recognize and avoid the hazards involved.

The qualified personnel must be able to detect possible hazards that may arise from parametrization, changing parameter values and generally from mechanical, electrical, or electronic equipment. The qualified personnel must be familiar with the standards, provisions, and regulations for the prevention of industrial accidents, which they must observe when working on the drive system.

Product Related Information

Overview

The equipment described herein must be used in accordance with the application-specific risk analysis that you are to perform along with verification of all applicable standards. Pay attention in conforming to any safety information, different electrical requirements, and normative standards that would apply to your application of the information contained in the present manual.

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires.
- Place a "Do Not Turn On" or equivalent hazard label on all power switches and lock them in the non-energized position.
- Wait 15 minutes to allow the residual energy of the DC bus capacitors to discharge.
- Measure the voltage on the DC bus with a properly rated voltage sensing device and verify that the voltage is less than 42.4 Vdc.
- Do not assume that the DC bus is voltage-free when the DC bus LED is off.
- Block the motor shaft to prevent rotation prior to performing any type of work on the drive system.
- Do not create a short-circuit across the DC bus terminals or the DC bus capacitors.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Perform an in-depth risk analysis to determine the appropriate safety integrity level for your specific application, based on all the applicable standards.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and overtravel stop, power outage, and restart.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines.(1)
- Each implementation of this equipment must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

(1) for additional information, refer to NEMA ICS 1.1 (latest edition), “Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control” and to NEMA ICS 7.1 (latest edition), “Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems” or their equivalent governing your particular location.

Emergency Stop

The robot mechanics are not supplied with external brakes nor an emergency stop switch to trigger the external brakes.

⚠ WARNING

ENTRAPMENT BY ROBOT MECHANICS

- Provide means for ensuring that the motors can be put into a voltage-free state with any internal holding brake or external service brake released.
- Make available those means such that the robot mechanics can be manually moved by a single person within reach of the zone of operation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The opening of the brakes may cause the robot to sag.

⚠ WARNING
SAGGING OF THE ROBOT Ensure that release of the motor brakes poses no additional risks in the zone of operation. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

NOTE: Provide separation devices for all infeed energies. It must be possible to secure the separation devices in de-energized position, for example, by locking.

Noise Protection

The noise level of the mechanics depends on the basic cycle and the payload, as well as on further application-specific accessory parts. Be aware of the fact that noise emissions multiply when several mechanics are in use at the same time. If noise emissions reach a value of more than 70 dBA, wear ear protectors.

⚠ CAUTION
NOISE EMISSIONS OF THE ROBOT MECHANICS ● Wear ear protectors in accordance with the locally applicable regulations. ● Attach a sign on the robot mechanics if the noise emissions reach an excessive value. **Failure to follow these instructions can result in injury or equipment damage.**

NOTE: Attach the following symbol where it can easily be seen on the robot mechanics.

Emissions

Grease emissions on or at the gearbox may be an indication of a damaged robot.

NOTICE
INOPERABLE EQUIPMENT INDICATED BY GEARBOX GREASE EMISSIONS ● Verify the mechanics before and during use. ● Shut down the mechanics immediately if necessary. **Failure to follow these instructions can result in equipment damage.**

Attachments or Modifications

If different products are transported by the robot mechanics, then the product pickup must be consequently modified. For this reason, it is possible to build different product pickups (tool mounting) onto the flange. In doing so, ensure that the articulation movement is not restricted and/or that no motion errors can result from the modifications. Attachments and rebuilds may not influence the operation of the protective devices in any way and all EMERGENCY STOP buttons must be accessible all the time.

⚠ WARNING
UNINTENDED MACHINE OPERATION ● Do not drill into or modify the articulated arms. ● Do not modify the cable set. ● Do not modify the mounting plate. ● Do not modify the components of movable mechanics. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

Options for Moving the Robot Without Drive Energy

The robot mechanics are not equipped with a security frame.

NOTE: Take appropriate security measures concerning the specific use before operating the robot.

⚠ WARNING
SAGGING OF THE ROBOT Ensure that release of the motor brakes poses no additional risks in the zone of operation. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

If the equipment is with power, perform the following steps:

Step	Action
1	Switch the robot into a torque-free state.
2	Manually hold the robot in position.
3	Open the motor brakes. **NOTE:** The function for opening the brakes as well as for torque-free switching of the motors is not included within the scope of supply. Implement the same as a component part of the design of the electrical equipment.
4	Manually move the robot. **NOTE:** A greater force could be necessary because the motor and gearbox may pose resistance to movement.
5	Close the brakes.

If the equipment is without power, perform the following steps:

Step	Action
1	Disconnect the motor cables from the motors.
2	Apply an external 24 V supply to the appropriate connection points to release the motor brakes, if necessary.
3	Release the external brakes engaged by the functional safety system of the robot.
4	Manually move the robot. **NOTE:** A greater force could be necessary because the motor and gearbox may pose resistance to movement.
5	Remove the external current to close the brakes.
6	Reconnect the motor cables to the motor.

Residual Risks

Overview

Risks arising from the robot have been reduced. However a residual risk remains since the robot is moved and operated with electrical voltage and electrical currents.

If activities involve residual risks, a safety message is made at the appropriate points. This includes potential hazards that may arise, their possible consequences, and describes preventive measures to avoid the hazards.

Electrical Parts

⚠ ⚠ DANGER

ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Operate electrical components only with a connected protective ground (earth) cable.
- After the installation, verify the secure connection of the protective ground (earth) cable to all electrical devices to ensure that connection complies with the connection diagram.
- Before enabling the device, cover the live components to prevent contact.
- Do not touch the electrical connection points of the components when the module is energized.
- Provide protection against indirect contact (EN 50178).
- Connect and disconnect cables and terminals only after you have verified that the power has been removed from the system.
- Insulate the unused conductors on both ends of the motor cable.

Failure to follow these instructions will result in death or serious injury.

Assembly and Handling

⚠ WARNING

CRUSHING, SHEARING, CUTTING AND HITTING DURING HANDLING

- Observe the general construction and safety regulations for handling and assembly.
- Use appropriate mounting and transport equipment and use appropriate tools.
- Prevent clamping and crushing by taking appropriate precautions.
- Cover edges and angles to protect against cutting damage.
- Wear suitable protective clothing (for example, protective goggles, protective boots, protective gloves).

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Robot Motion

Parts of the mechanics can move at high speeds. In such cases, the payload weight, additionally installed tools, and shifts in the center of gravity of the moving parts contribute to the total energy of the forces generated.

Motion sequences can occur when operating with robot mechanics, which allow operational staff to make misjudgments. For safety considerations (according to EN ISO 13849-1), consider the controller and the brakes as non-safety-related elements. Ensure that necessary protective measures are implemented.

The safety standards and directives for the respective country where the equipment is in use define which protective measures are appropriate. Additionally, the system engineer who is responsible for the integration of the robot mechanics must evaluate which measures have to be taken.

NOTE: The configuration of the robot mechanics, the Tool Center Point (TCP) velocity, as well as the additional payload have an effect on the total energy, which can potentially be a source of damage and injury.

⚠ WARNING

CRUSHING, SHEARING, CUTTING AND IMPACT INJURY

- The robot must be operated only within a frame.
- Open or enter the frame for cleaning and maintenance purposes only.
- Design the frame such that it withstands an impact by the robot and that it resists ejected parts from escaping the zone of operation.
- Design the frame such that the robot is safely deactivated as soon as a person enters the zone of operation of the robot.
- All barriers, protective doors, contact mats, light barriers, and so on, must be configured correctly and enabled whenever the robot mechanics are under power.
- Define the clearance distance to the zone of operation of the robot such that operational staff do not have access to, nor can be enclosed in, the robot mechanics zone of operation.
- Design the frame to account for the maximum possible travel paths of the robot, that is, the maximum path until the hardware safety system limits (safety fence, and so on) as well as the additional run-on paths, in case of a power interruption.

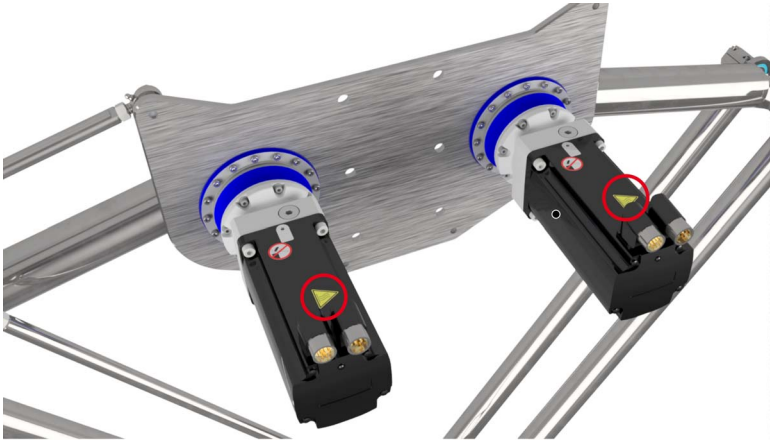
Failure to follow these instructions can result in death, serious injury, or equipment damage.

For detailed information about travel path and power loss, refer to *Run-on Motions of the Robot for Risk Analysis* *(see page 76)*.

Hot Surfaces

The metal surfaces of the product may exceed 85 °C (185 °F) during operation.

The following graphic presents the hot surface labels on the robot.



⚠ WARNING
HOT SURFACES ● Avoid unprotected contact with hot surfaces. ● Do not allow flammable or heat-sensitive parts in the immediate vicinity of hot surfaces. ● Verify that the heat dissipation is sufficient by performing a test run under maximum load conditions. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

Hazardous Movements

There can be different sources of hazardous movements:

- No, or incorrect, homing of the drive
- Wiring or cabling errors
- Errors in the application program
- Component errors
- Error in the measured value and signal transmitter

NOTE: Provide for personal safety by primary equipment monitoring or measures. Do not rely only on the internal monitoring of the drive components. Adapt the monitoring or other arrangements and measures to the specific conditions of the installation in accordance with a hazard and risk analysis.

⚠ DANGER

UNAVAILABLE OR INADEQUATE PROTECTION DEVICE(S)

- Prevent entry to a zone of operation with, for example, protective fencing, mesh guards, protective coverings, or light barriers.
- Dimension the protective devices properly and do not remove them.
- Do not make any modifications that can degrade, incapacitate, or in any way invalidate protection devices.
- Bring the drives and the motors they control to a stop before accessing the drives or entering the zone of operation.
- Protect existing workstations and operating terminals against unauthorized operation.
- Position emergency stop switches so that they are easily accessible and can be reached quickly.
- Validate the functionality of emergency stop equipment before start-up and during maintenance periods.
- Prevent unintentional start-up by disconnecting the power connection of the drives using the emergency stop circuit or using an appropriate lock-out tag-out sequence.
- Validate the system and installation before the initial start-up.
- Avoid operating high-frequency, remote control, and radio devices close to the system electronics and their feed lines.
- Perform, if necessary, a special electromagnetic compatibility (EMC) verification of the system.

Failure to follow these instructions will result in death or serious injury.

Drive systems may perform unanticipated movements because of incorrect wiring, incorrect settings, incorrect data, or other errors.

⚠ WARNING

UNINTENDED MOVEMENT OR MACHINE OPERATION

- Carefully install the wiring in accordance with the EMC requirements.
- Do not operate the product with undetermined settings and data.
- Perform comprehensive commissioning tests that include verification of configuration settings and data that determine position and movement.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Hanging Loads

The robot is capable of suspending heavy loads.

⚠ WARNING
HANGING LOADS Do not stand under hanging loads. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

Chapter 2
System Overview

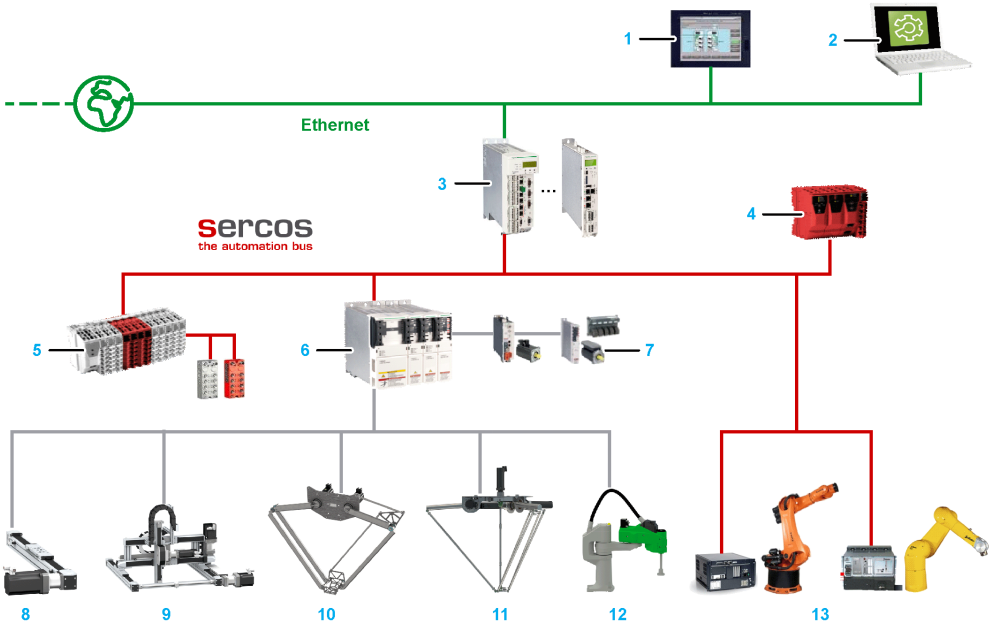
What Is in This Chapter?

This chapter contains the following topics:

Product Overview T-Series

Overview

The control system consists of several components, depending on its application. The following graphic presents an example of a PacDrive 3 system.

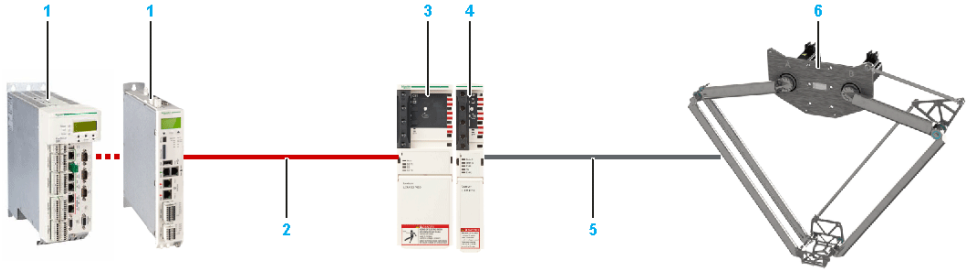


1 Magelis HMI
2 SoMachine Motion
3 Motion Controller
4 Safety Controller
5 I/O
6 Drives
7 Motors
8 Linear Axes
9 Cartesian Robots
10 Delta 2 Robots (T-Series)
11 Delta 3 Robots (P-Series)
12 SCARA Robots (S-Series)
13 Articulated Robots

For more information about the several components, refer to the corresponding product manuals (for example, *Lexium 52 Hardware Guide*, *Lexium 62 Hardware Guide* or *Lexium 62 ILM Hardware Guide*).

System Architecture

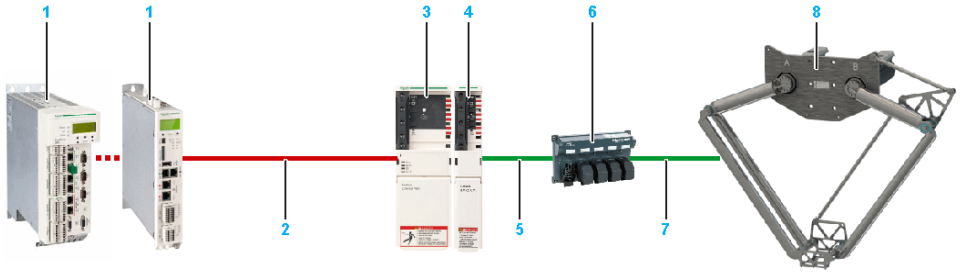
The following graphic presents an example of a system architecture for T-Series robots for MH3 motors.



Number	Device name	Quantity	Device type	Comment
1	Controller	1	LMC•00C…LMC•01C	Logic Motion Controller
2	Sercos cable	3	VW3E5001R	Sercos cable; the cable length depends on the distance between controller and cabinet.
3	Power supply	1	LXM62PD84A11000	Lexium 62 Power Supply
4	Double drive	1	Double drive: LXM62DD27B21000	Lexium 62 Drive Module
5	Motor cable for connection of drive and motor	2	VW3E1143R•••	PacDrive 3 motor cable; the cable length depends on the distance between cabinet and robot.
	Feedback cable for connection of drive and motor	2	VW3E2094R•••	
6	T-Series robot	1	(1)	

(1) The device type depends on the robot reference and its characteristics. For further information refer to *Type Code* *(see page 33)*.

The following graphic presents an example of a system architecture for T-Series robots for ILM motors.



Number	Device name	Quantity	Device type	Comment
1	Controller	1	LMC•00C…LMC•01C	Logic Motion Controller
2	Sercos cable	3	VW3E5001R	Sercos cable; the cable length depends on the distance between controller and cabinet.
3	Power supply	1	LXM62PD84A11000	Lexium 62 Power Supply
4	Connection module	1	ILM62CMD20A000	Lexium 62 Connection Module
5	Cable for connection of connection module and distribution box	2	VW3E1•••R•••	Hybrid cable; the cable length depends on the distance between the cabinet and the robot. Various connector plugs are available.
6	Distribution box	1	ILM62DB4A000	Lexium 62 Distribution Box
7	Cable for connection of distribution box and motor	2	VW3E1•••R•••	Hybrid cable; the cable length depends on the distance between the cabinet and the robot. Various connector plugs are available.
8	T-Series robot	1	(1)	

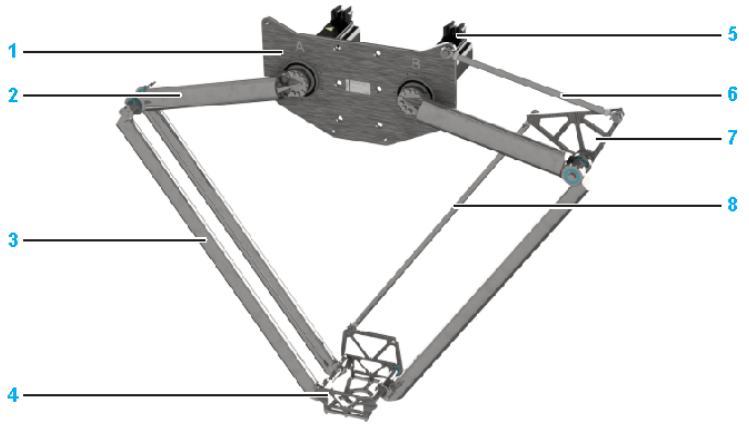
(1) The device type depends on the robot reference and its characteristics. For further information refer to *Type Code (see page 33)*.

System Performance

System performance for a robotic application (including enough performance overhead for additional application components):

PacDrive LMC	Sercos cycle time 1 ms		Sercos cycle time 2 ms	
	Simple control (1)	Control with velocity control (1)	Simple control (1)	Control with velocity control (1)
PacDrive LMC101	2	–	2	1
PacDrive LMC106	2	–	2	1
PacDrive LMC201	2	–	2	1
PacDrive LMC212	2	–	4	1
PacDrive LMC216	2	–	4	1
PacDrive LMC400	3	1	4	2
PacDrive LMC402	8	4	8	8
PacDrive LMC600	6	2	12	4
PacDrive LMC802	11	4	22	8
(1) Number of controllable robots (two axes per robot)				

Components Overview



1 Mounting plate
2 Upper arm
3 Lower arm
4 Parallel plate
5 Motor/gearbox
6 Parallel linkage rod short
7 Lever parallel linkage
8 Parallel linkage rod long

Characteristics of the T-Series Robot

The T-Series robot provides the following features:

- Stainless steel Delta 2 robot equipped by an automation platform
- Few references covering large performance
- Pre-assembled and ready to connect
- No calibration at customer site and automatic re-calibration without tools
- Compact foot print
- Fast replacement of replacement equipment

Type Code for T-Series Robots

Presentation

	Type			Model		Characteristics										
Digit:	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12
Example:	V	R	K	T	3	L	0	R	N	C	0	0	0	0	0

Robot Kinematics

VRK

Robot / Product Type

T2	2 axis Delta 800 mm (31.5 in)
T3	2 axis Delta 1000 mm (39 in)
T5	2 axis Delta 1500 mm (59 in)
TX	Parts for T-Series robots. For example: replacement equipment.

Sub Type

L0	ILM motors (T2; T3; T5)
M0	MH3 motors (T2; T3; T5)
M1	MH3 motors heavy duty (T2; T3; T5)
WM	Without motors (T2; T3; T5)
YY	Replacement equipment set

Option

R	Rotational axis installed
F	Fixed, no rotational axis installed
C	Customized version
Y	Replacement equipment (replacement equipment for customized editions = C)

Variant

NC	Normal, Compact (T2; T3; T5)
YY	Replacement equipment

Revision

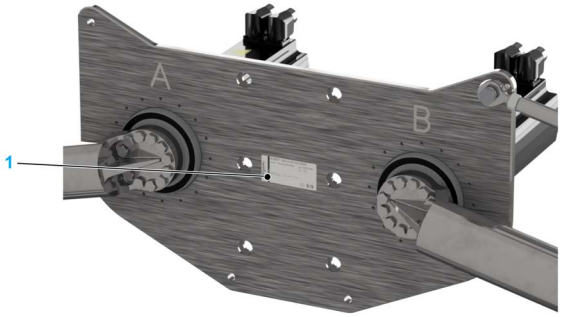
00	S00 (T2; T3; T5)

Miscellaneous

000	Without options

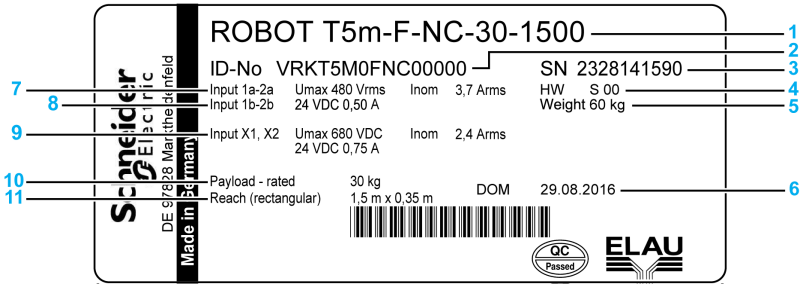
Type Plate

Position of the Type Plate



1 Type Plate

Description of the Type Plate



1 Device name
2 Type code
3 Serial number
4 Hardware code
5 Weight of the robot
6 Date of manufacture
7 Voltage and current of the main axis motors
8 Voltage and current of the brakes
9 Voltage and current of all motors and brakes
10 Nominal load
11 Radius working area

Chapter 3
Technical Data

What Is in This Chapter?

This chapter contains the following sections:

Section 3.1
Ambient Conditions

Ambient Conditions

Overview

Procedure	Parameter	Unit	Value
Operation(1)	**Classes 3K3**, **3Z12**, **3Z2**, **3B2**, **3C1**, **3M7** (according to IEC/EN 60721-3-3)		
	Ambient temperature	°C (°F)	+5…+40 (+41…+104)(2)
	Condensation	–	prohibited
	Formation of ice	–	prohibited
	Relative humidity	%	5…85
Transport	**Set of class combinations IE21** (according to IEC/EN 60721-3-2)(3)		
	Ambient temperature	°C (°F)	-20…+70 (-4…+158)
	Condensation	–	prohibited
	Precipitation	–	prohibited
	Formation of ice	–	prohibited
	Other liquid	–	prohibited
	Wetness	–	prohibited
	Relative humidity	%	< 75

(1) Installation altitude without power reduction < 1000 m (3281 ft).
(2) Power reduction for T-Series Compact versions with ILM motors at ambient temperatures exceeding +25 °C (+77 °F). Power reduction depends on the application. If some severities of parameters deviate from the specified ambient conditions, contact your local Schneider Electric service representative for more information.
(3) All parameters conform to the specified class except for the ambient temperature which is limited by other components of the system.

Procedure	Parameter	Unit	Value
Long-term storage in transport packaging	**Class 1K3** (according to IEC/EN 60721-3-1)(3)		
	Ambient temperature	°C (°F)	0…+40 °C (+32…+104 °F)
	Condensation	–	prohibited
	Precipitation	–	prohibited
	Formation of ice	–	prohibited
	Other liquid	–	prohibited
	Relative humidity	%	5…95
	Maximum storage period	years	2

(1) Installation altitude without power reduction < 1000 m (3281 ft).
(2) Power reduction for T-Series Compact versions with ILM motors at ambient temperatures exceeding +25 °C (+77 °F). Power reduction depends on the application. If some severities of parameters deviate from the specified ambient conditions, contact your local Schneider Electric service representative for more information.
(3) All parameters conform to the specified class except for the ambient temperature which is limited by other components of the system.

Section 3.2
Mechanical and Electrical Data of T-Series

What Is in This Section?

This section contains the following topics:

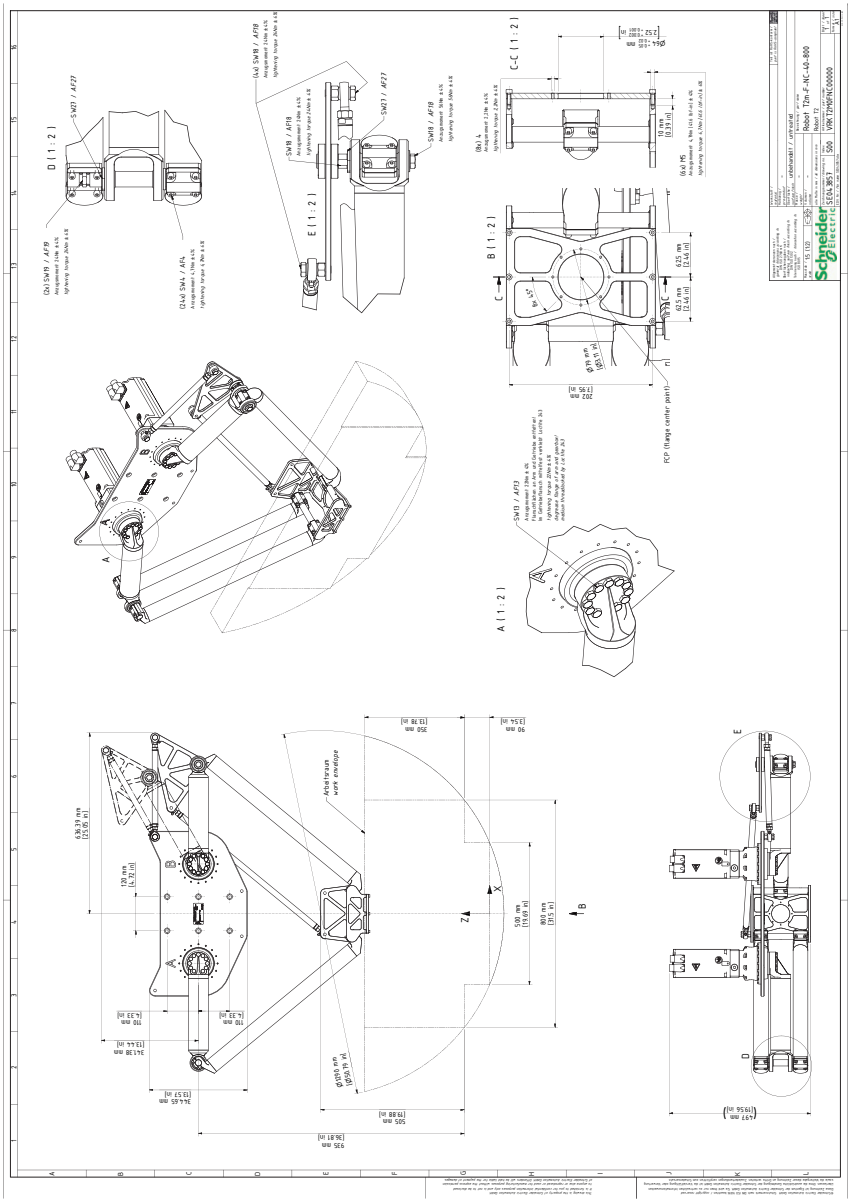
Robot VRKT2•••NC

Mechanical and Electrical Data

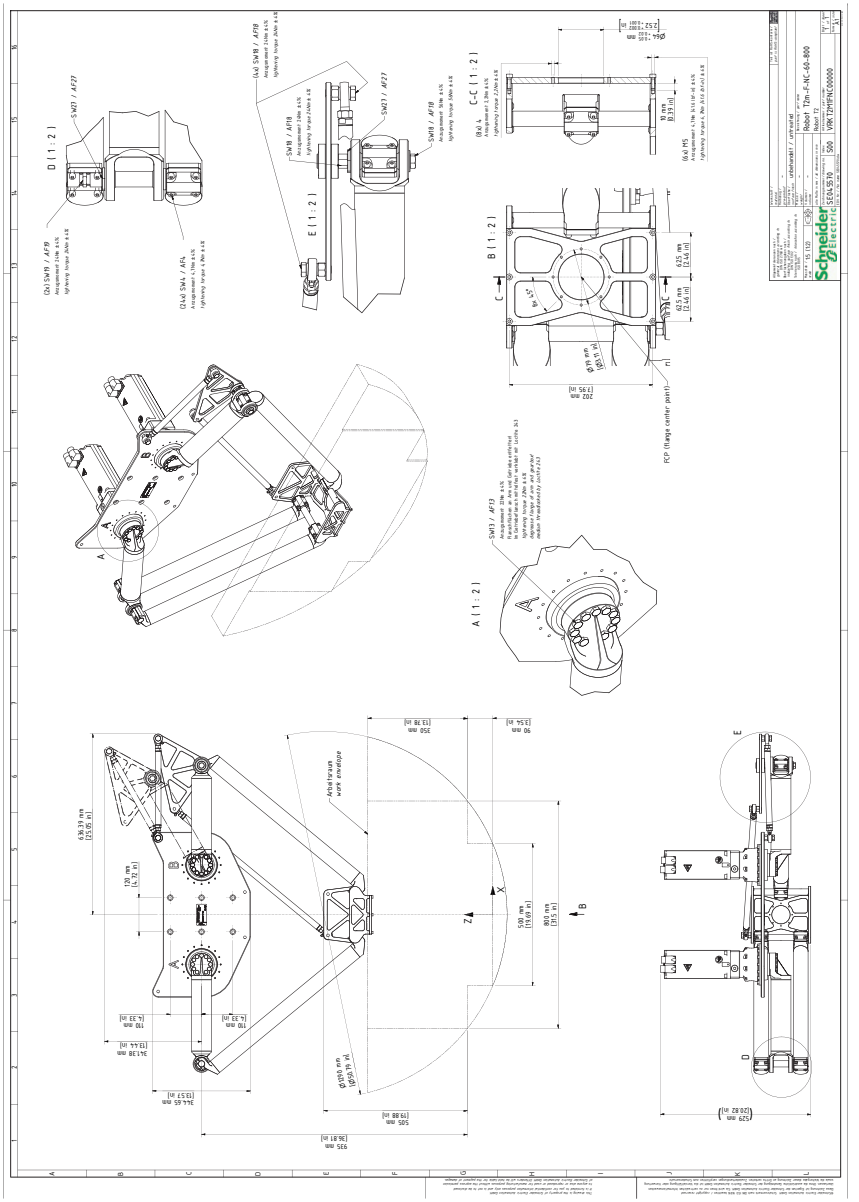
Category	Parameter	Unit	VRKT2M0 FNC00000	VRKT2M1 FNC00000	VRKT2L0 FNC00000
General data	Rated load	kg (lb)	10 (22)		
	Maximum load	kg (lb)	40 (88)(2)	60 (132)(2)	40 (88)(2)
	Maximum velocity	m/s (ft/s)	5.8 (19)	5.5 (18)	5.8 (19)
	Maximum acceleration(1) for 1 kg (2.2 lb)	m/s^2 (ft/s^2)	60 (197)	37 (121)	60 (197)
	Maximum acceleration(1) for 10 kg (22 lb)	m/s^2 (ft/s^2)	53 (174)	33 (108)	53 (174)
	Maximum acceleration(1) for over 10 kg (22 lb)	m/s^2 (ft/s^2)	(2)		
	Number of axes	–	2		
	Position repeatability (ISO 9283)	mm (in)	Position: 0.1 (0.0039)		
Electrical data	Mains voltage - 3-phase	Vac	maximum 480(3)		
	Control voltage (with brake)	Vdc	+24 (-10…+6%)		+24 (-20…+25%)
	Motor main axes	–	MH31002P02F2200	MH31003P02F2200	ILM1003P02F0000
	Power consumption for a typical Pick & Place cycle with 15 kg (33 lb)	kW (hp)	0.65 (0.87)		
Mechanical data	Installation type	–	Ceiling installation		
	Protection class for moving parts	–	IP64		
	Basic protection class	–	IP64		
Working area	Height	mm (in)	350 (13.8) / 440 (17.3)		
	Width	mm (in)	800 (31.5)		
Weight	–	kg (lb)	56 (123)	60 (132)	64 (141)
Noise level	–	dB(A)	< 70		
Material	External casing	–	Stainless steel 1.4301, steel, aluminum, FPM, EPDM		
		–	Stainless		

(1) For a load fitted centrally underneath the flange and a distance of maximum 100 mm (3.9 in) between flange and mass center of gravity.
(2) Loads are subject to restrictions that are application-specific. For more information, contact your local Schneider Electric service representative.
(3) For further information, refer to *Lexium 52 Hardware Guide* or *Lexium 62 Hardware Guide*. The maximum 480 Vac is the mains voltage of the Lexium 52 Drive or the Lexium 62 Power Supply.

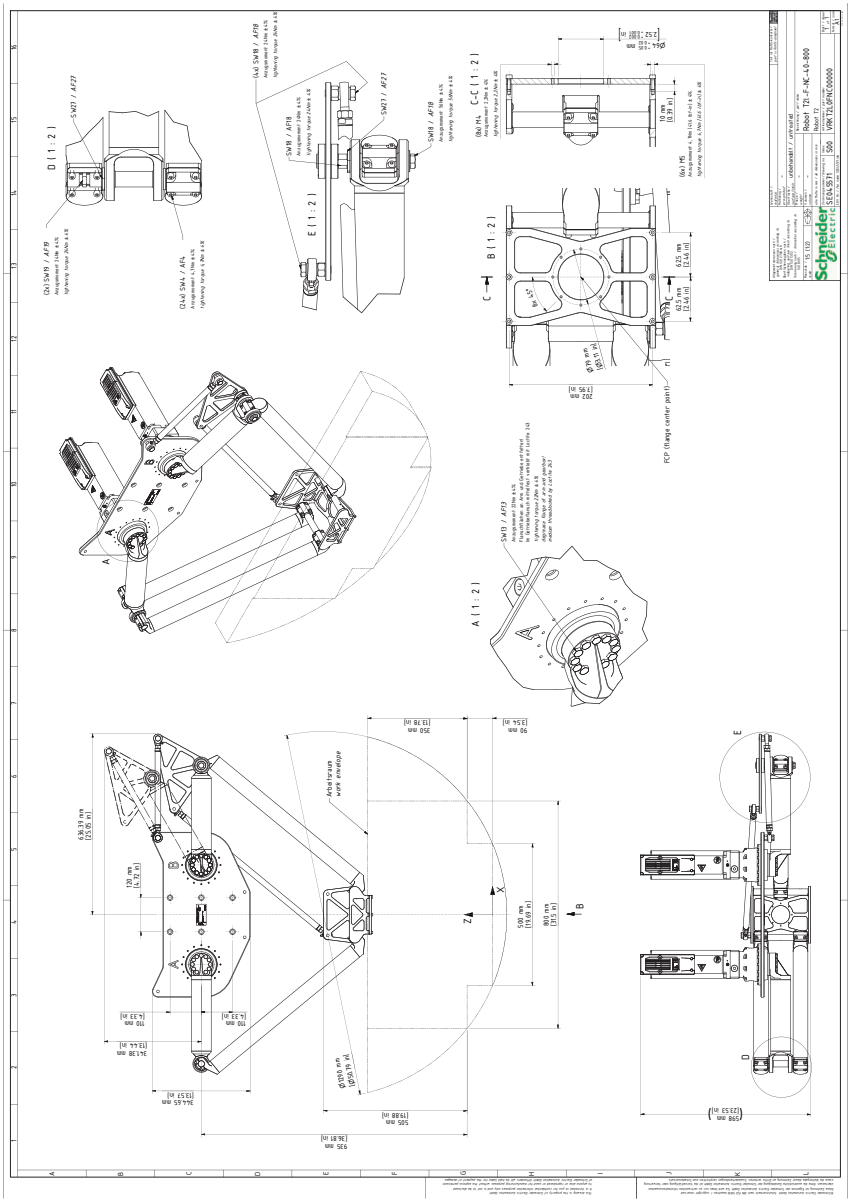
Dimensional Drawing VRKT2M0FNC00000



Dimensional Drawing VRKT2M1FNC00000



Dimensional Drawing VRKT2L0FNC00000



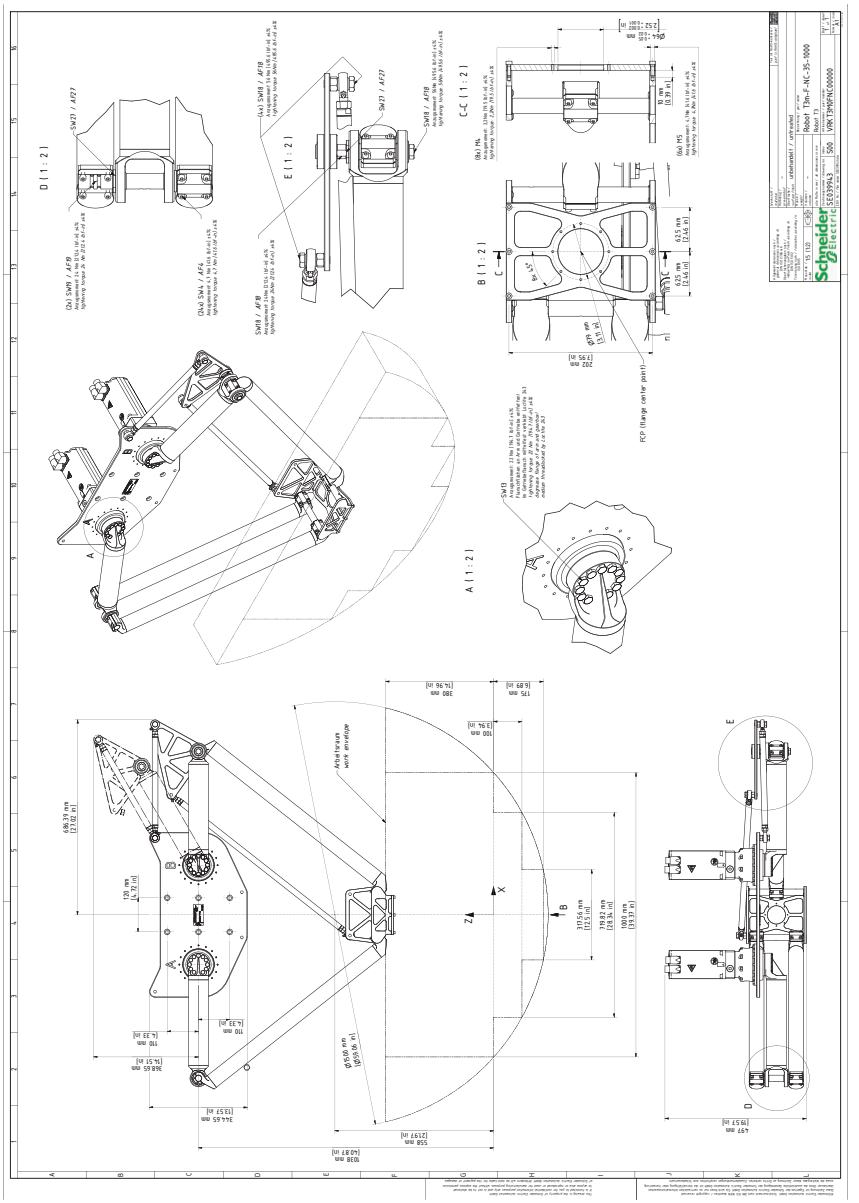
Robot VRKT3•••NC

Mechanical and Electrical Data

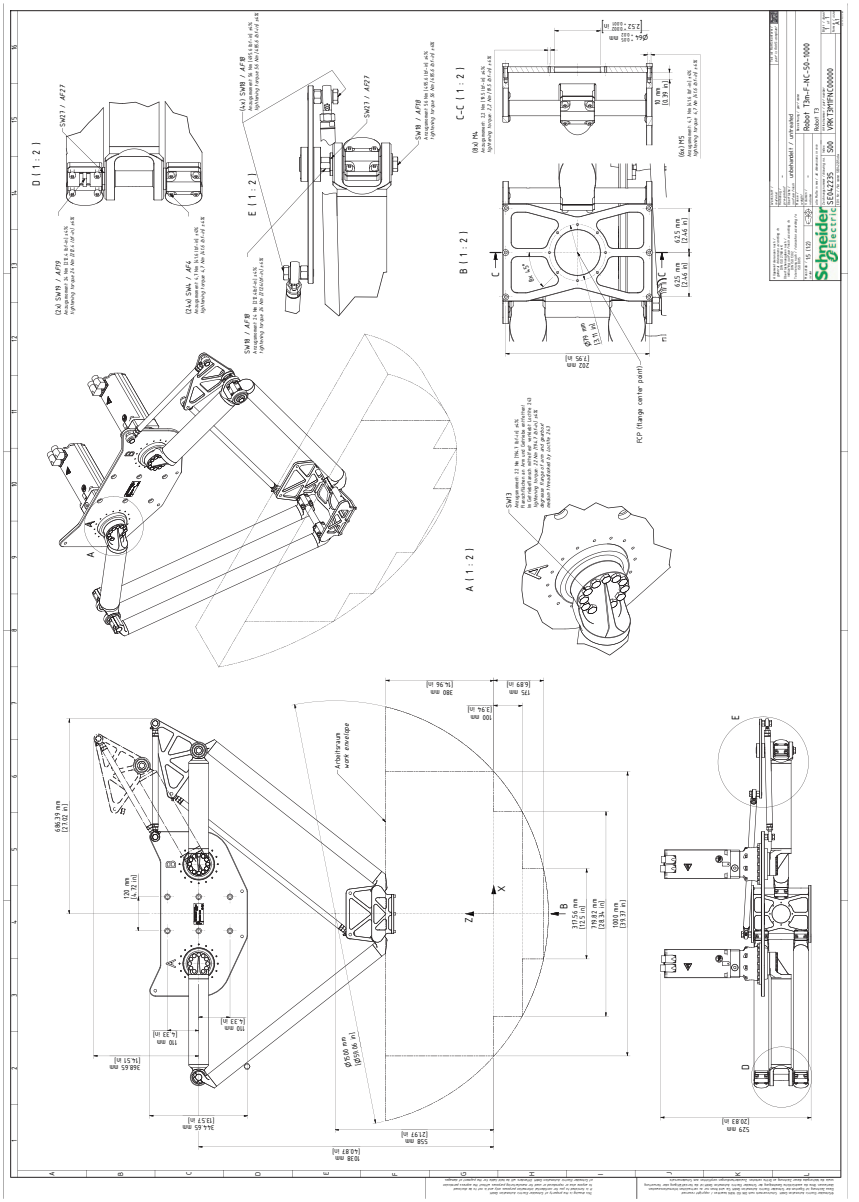
Category	Parameter	Unit	VRKT3M0 FNC00000	VRKT3M1 FNC00000	VRKT3L0 FNC00000
General data	Rated load	kg (lb)	10 (22)		
	Maximum load	kg (lb)	35 (77)(2)	50 (110)(2)	35 (77)(2)
	Maximum velocity	m/s (ft/s)	6 (19.7)	5.8 (19)	6 (19.7)
	Maximum acceleration(1) for 1 kg (2.2 lb)	m/s^2 (ft/s^2)	62 (203)	55 (180)	62 (203)
	Maximum acceleration(1) for 10 kg (22 lb)	m/s^2 (ft/s^2)	41 (135)	38 (125)	41 (135)
	Maximum acceleration(1) for over 10 kg (22 lb)	m/s^2 (ft/s^2)	(2)		
	Number of axes	–	2		
	Position repeatability (ISO 9283)	mm (in)	Position: 0.1 (0.0039)		
Electrical data	Mains voltage - 3-phase	Vac	maximum 480(3)		
	Control voltage (with brake)	Vdc	+24 (-10…+6%)		+24 (-20…+25%)
	Motor main axes	–	MH31002 P02F2200	MH31003 P02F2200	ILM1003P 02F0000
	Power consumption for a typical Pick & Place cycle with 15 kg (33 lb)	kW (hp)	0.65 (0.87)		
Mechanical data	Installation type	–	Ceiling installation		
	Protection class for moving parts	–	IP64		
	Basic protection class	–	IP64		
Working area	Height	mm (in)	380 (15) / 555 (22)		
	Width	mm (in)	1000 (39)		
Weight	–	kg (lb)	60 (132)	65 (143)	65 (143)
Noise level	–	dB(A)	< 70		
Material	External casing	–	Stainless steel 1.4301, steel, aluminum, FPM, EPDM		
		–	Stainless		

(1) For a load fitted centrally underneath the flange and a distance of maximum 100 mm (3.9 in) between flange and mass center of gravity.
(2) Loads are subject to restrictions that are application-specific. For more information, contact your local Schneider Electric service representative.
(3) For further information, refer to *Lexium 52 Hardware Guide* or *Lexium 62 Hardware Guide*. The maximum 480 Vac is the mains voltage of the Lexium 52 Drive or the Lexium 62 Power Supply.

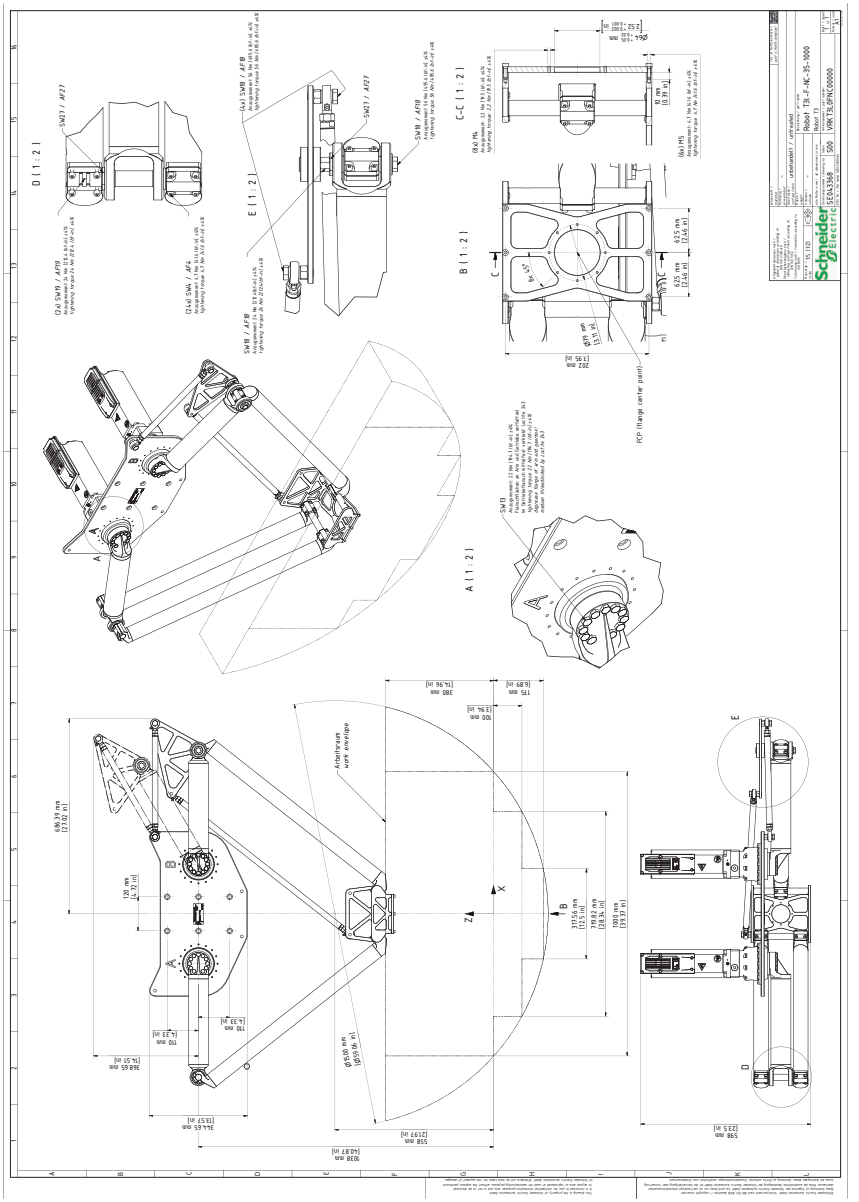
Dimensional Drawing VRKT3M0FNC00000



Dimensional Drawing VRKT3M1FNC00000



Dimensional Drawing VRKT3L0FNC00000



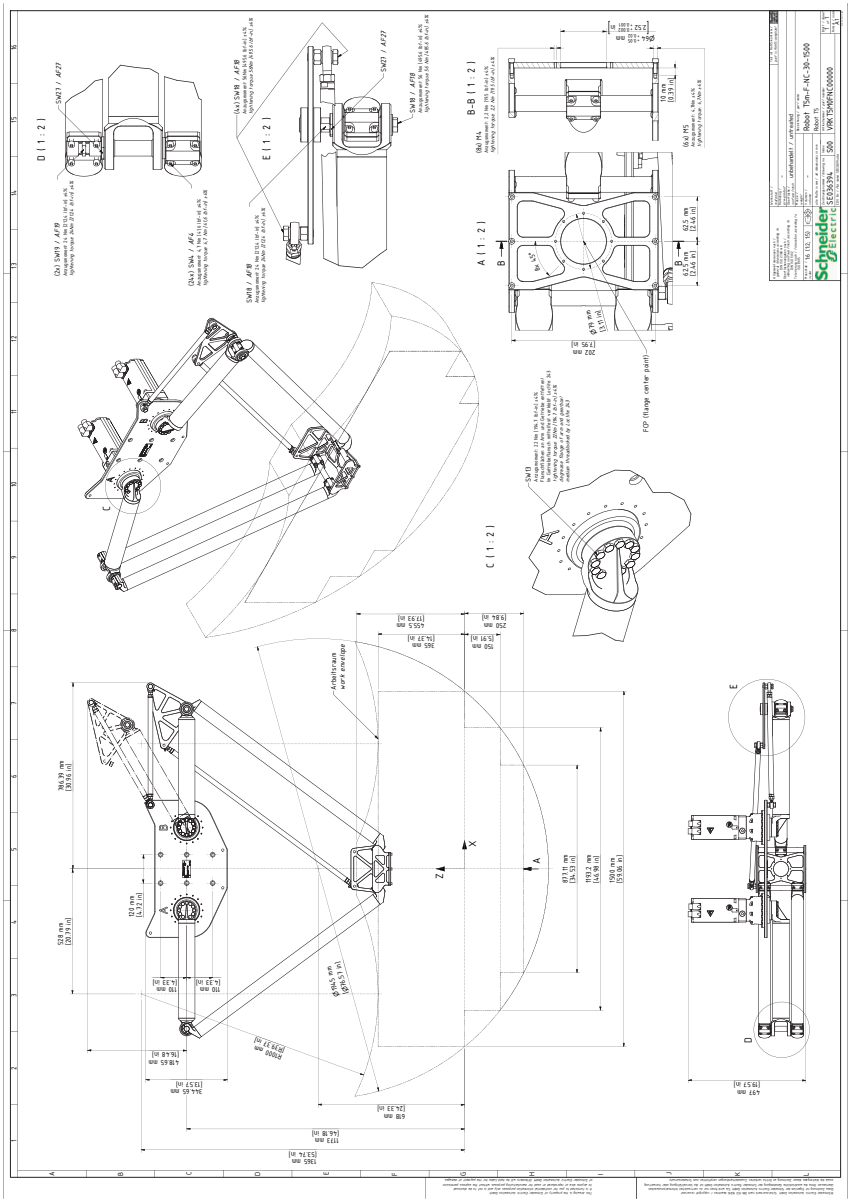
Robot VRKT5•••NC

Mechanical and Electrical Data

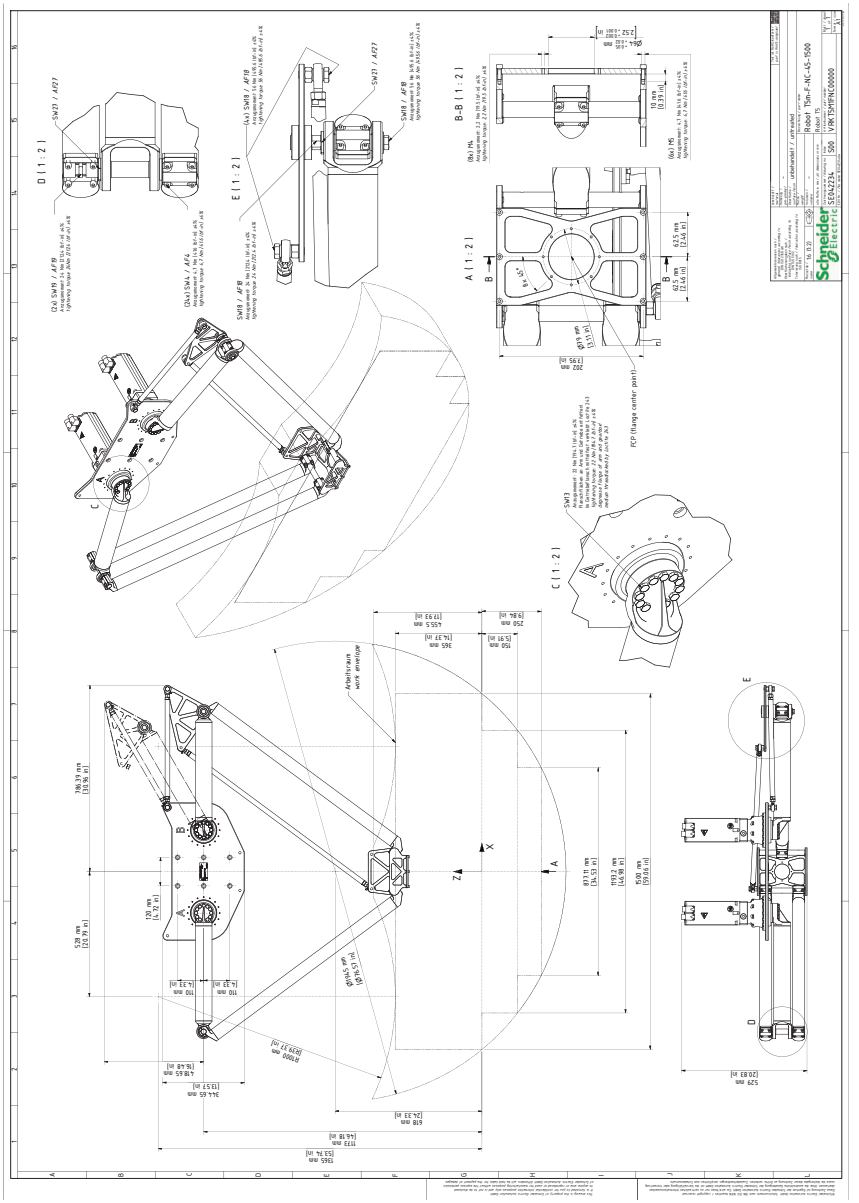
Category	Parameter	Unit	VRKT5M0 FNC00000	VRKT5M1 FNC00000	VRKT5L0 FNC00000
General data	Rated load	kg (lb)	10 (22)		
	Maximum load	kg (lb)	30 (66)(2)	45 (99)(2)	30 (66)(2)
	Maximum velocity	m/s (ft/s)	6.8 (22.3)	7.3 (24)	6.8 (22.3)
	Maximum acceleration(1) for 1 kg (2.2 lb)	m/s^2 (ft/s^2)	58 (190)	64 (210)	58 (190)
	Maximum acceleration(1) for 10 kg (22 lb)	m/s^2 (ft/s^2)	48 (157)	57 (187)	48 (157)
	Maximum acceleration(1) for over 10 kg (22 lb)	m/s^2 (ft/s^2)	(2)		
	Number of axes	–	2		
	Position repeatability (ISO 9283)	mm (in)	Position: 0.1 mm (0.0039 in)		
Electrical data	Mains voltage - 3-phase	Vac	maximum 480(3)		
	Control voltage (with brake)	Vdc	+24 (-10…+6%)		+24 (-20…+25%)
	Motor main axes	–	MH31002 P02F2200	MH31003 P02F2200	ILM1003P 02F0000
	Power consumption for a typical pick-and-place cycle with 15 kg (33 lb)	kW (hp)	0.65 (0.87)		
Mechanical data	Installation type	–	Ceiling installation		
	Protection class for moving parts	–	IP64		
	Basic protection class	–	IP64		
Working area	Height	mm (in)	365 (14.4) / 615 (24)		
	Diameter	mm (in)	1500 (59)		
Weight	–	kg (lb)	60 (132)	65 (143)	65 (143)
Noise level	–	dB(A)	< 70		
Material	External casing	–	Stainless steel 1.4301, steel, aluminum, FPM, EPDM		
		–	Stainless		

(1) For a load fitted centrally underneath the flange and a distance of maximum 100 mm (3.9 in) between flange and mass center of gravity.
(2) Loads are subject to restrictions that are application-specific. For more information, contact your local Schneider Electric service representative.
(3) For further information, refer to *Lexium 52 Hardware Guide* or *Lexium 62 Hardware Guide*. The maximum 480 Vac is the mains voltage of the Lexium 52 Drive or the Lexium 62 Power Supply.

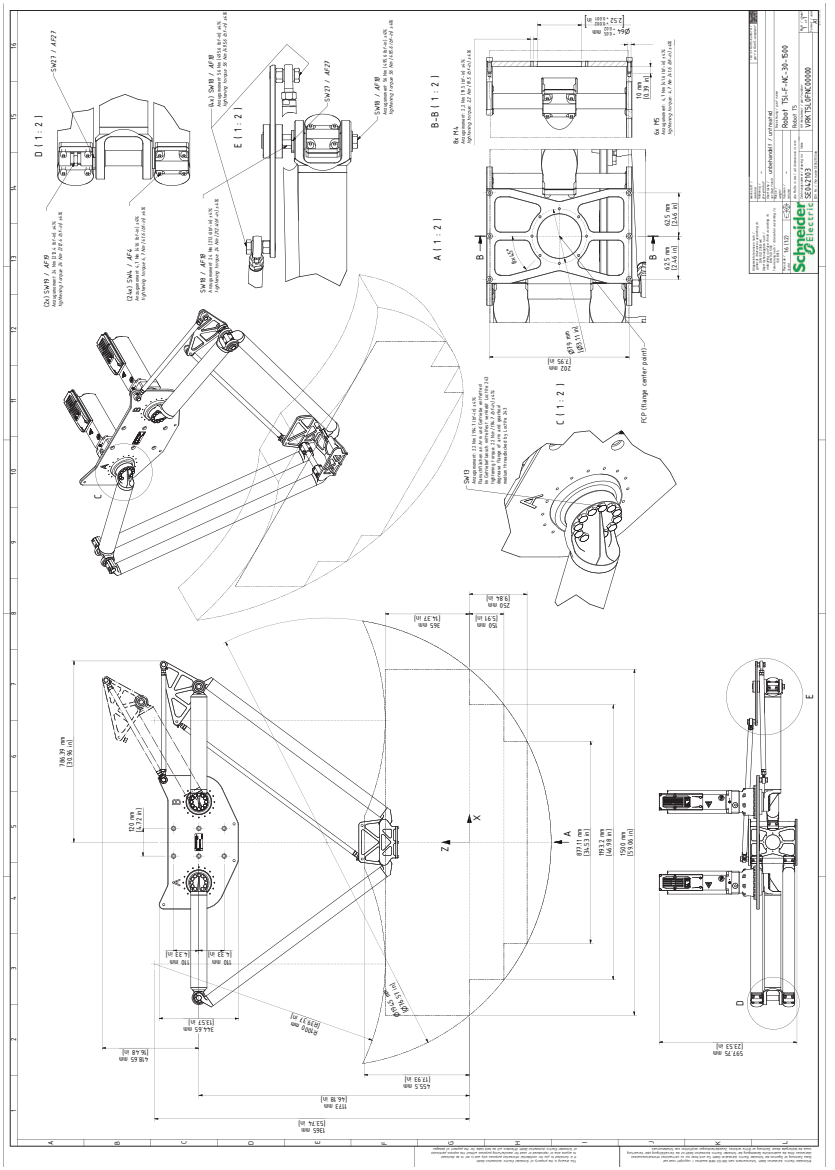
Dimensional Drawing VRKT5M0FNC00000



Dimensional Drawing VRKT5M1FNC00000

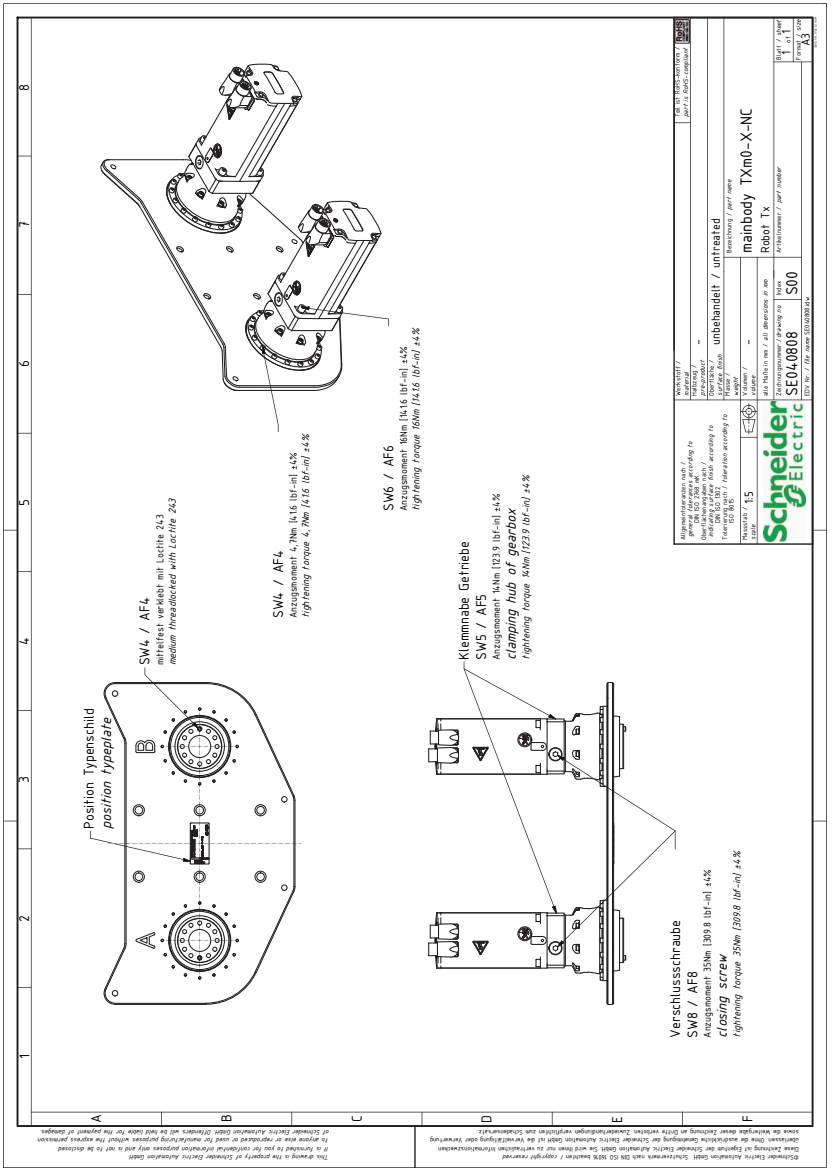


Dimensional Drawing VRKT5L0FNC00000

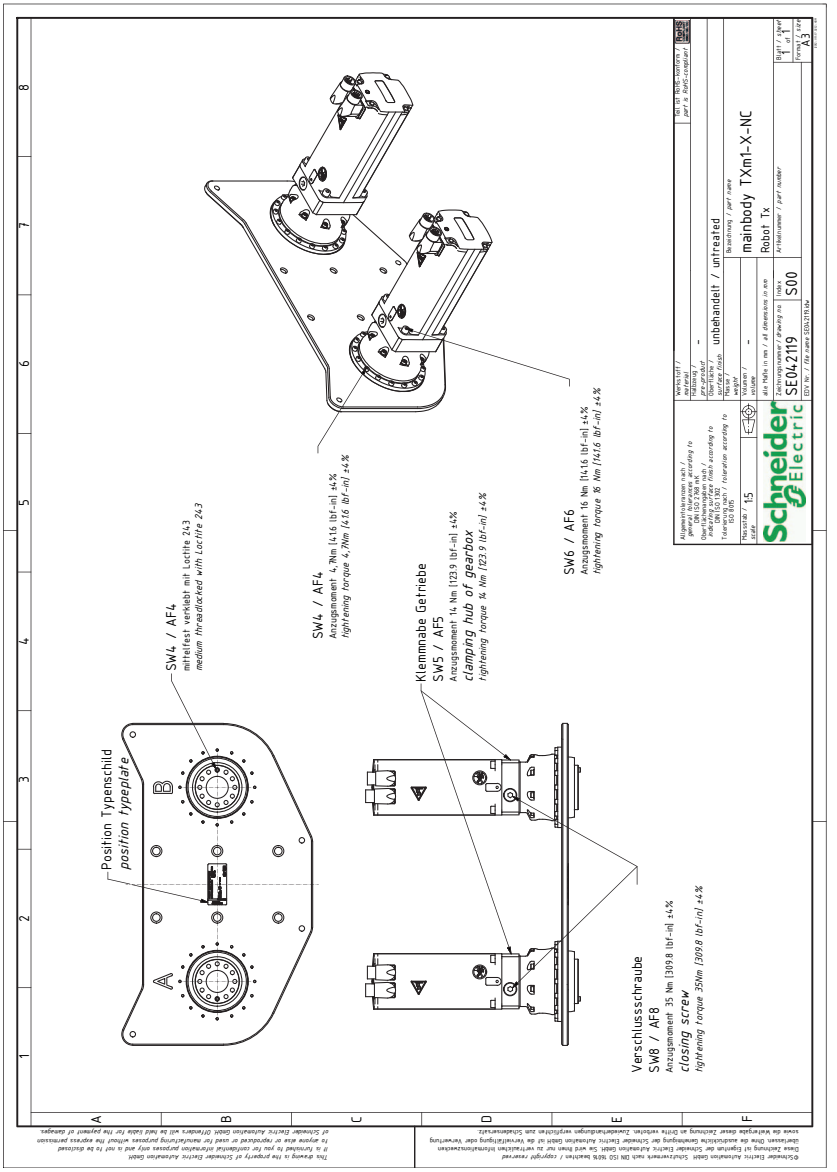


Main Body

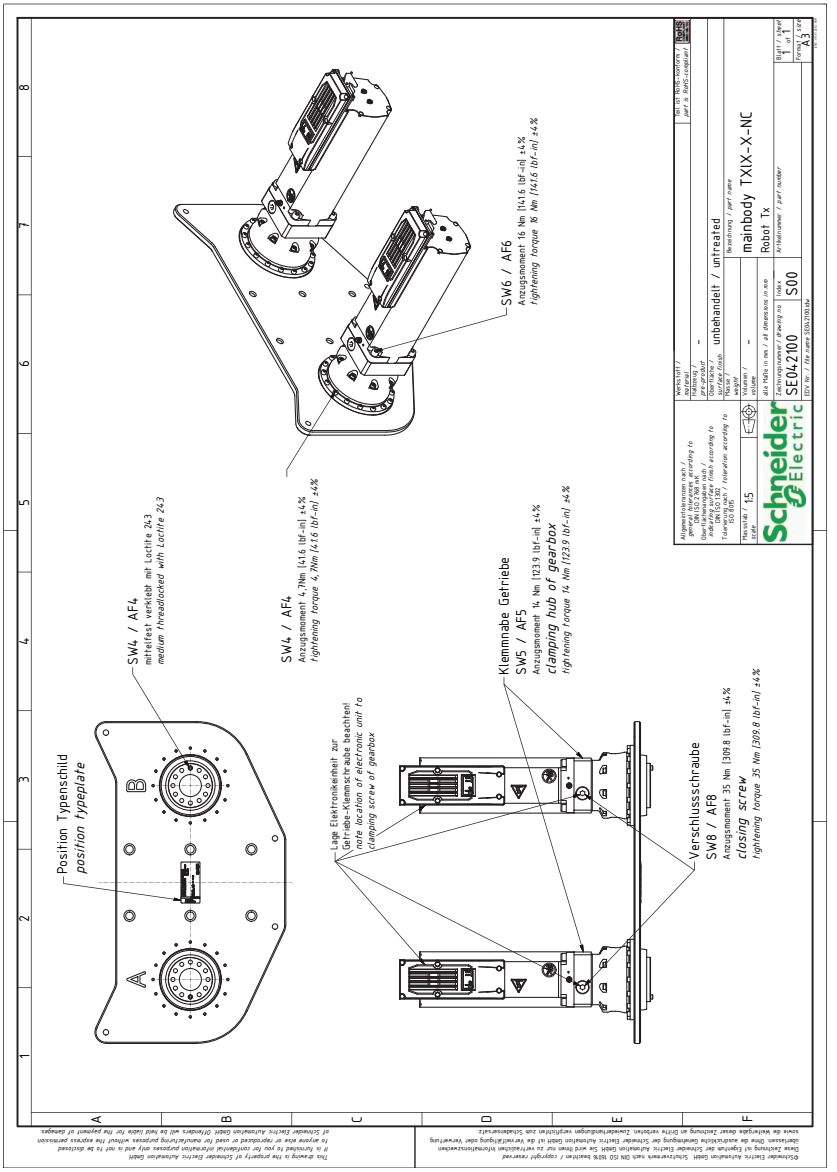
Detail Drawing of Main Body Robot VRKT•M0•NC



Detail Drawing of Main Body VRKT•M1•NC

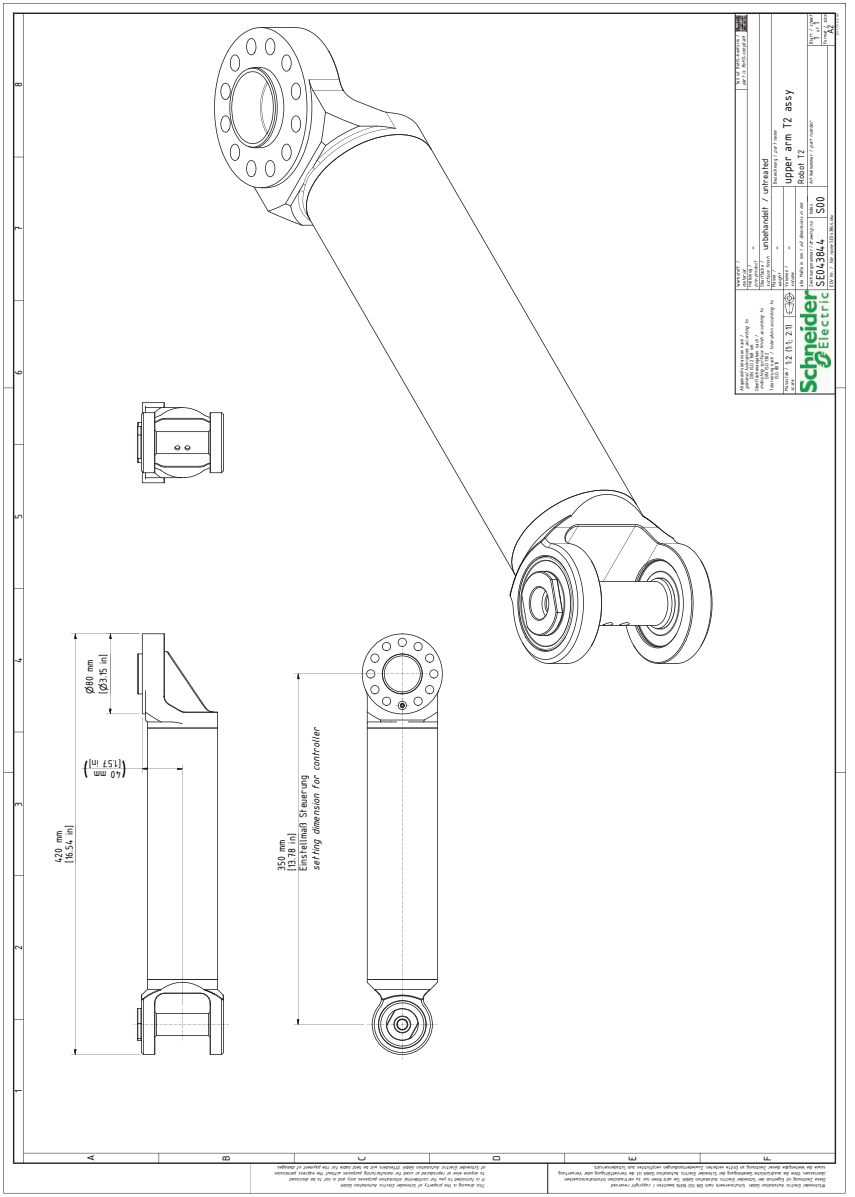


Detail Drawing of Main Body VRKT•L••NC

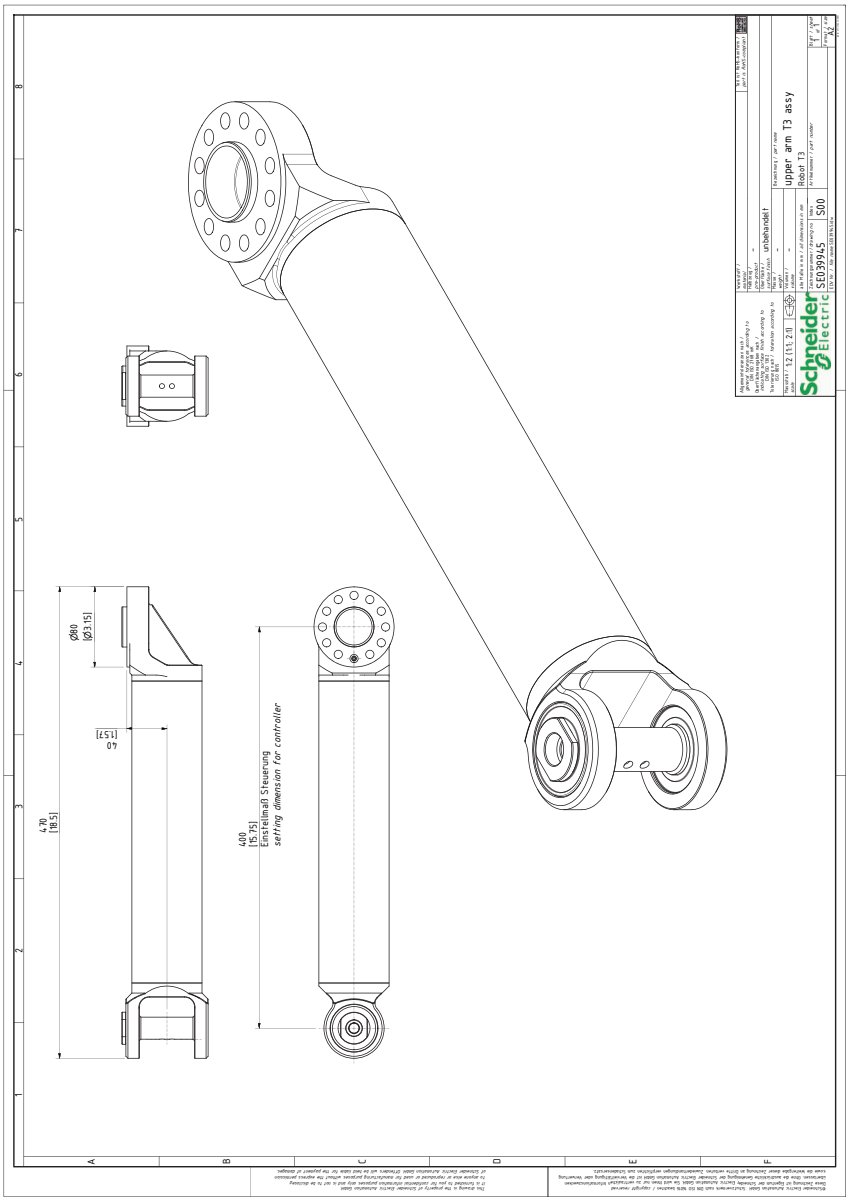


Upper Arm

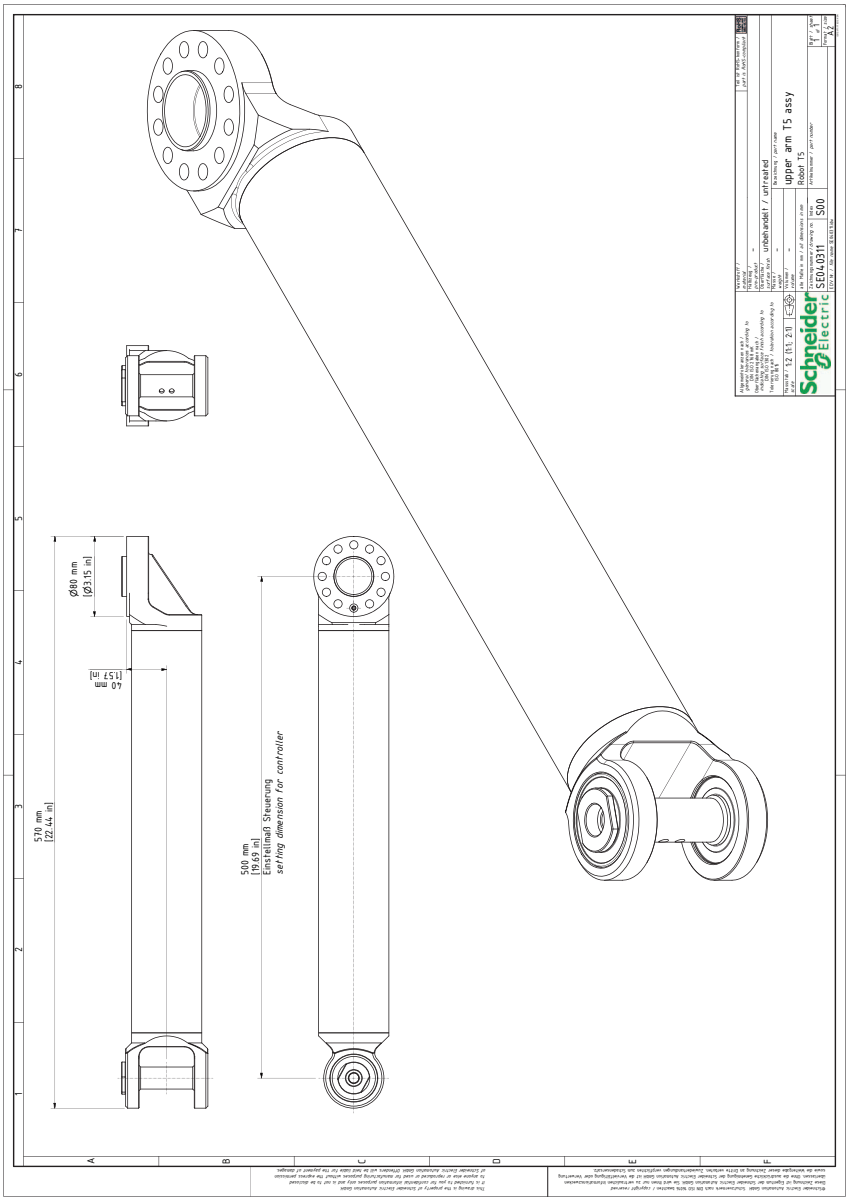
Detail Drawing of Upper Arm T2



Detail Drawing of Upper Arm T3

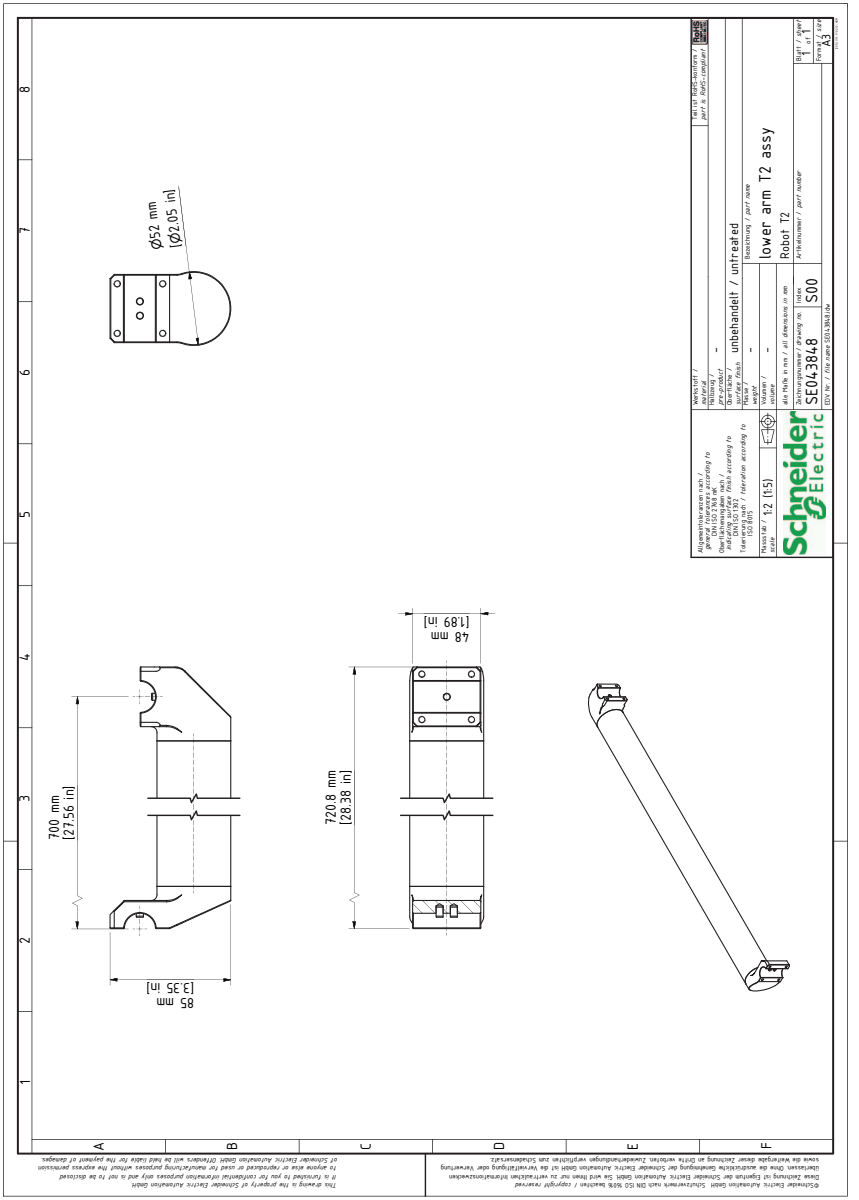


Detail Drawing of Upper Arm T5

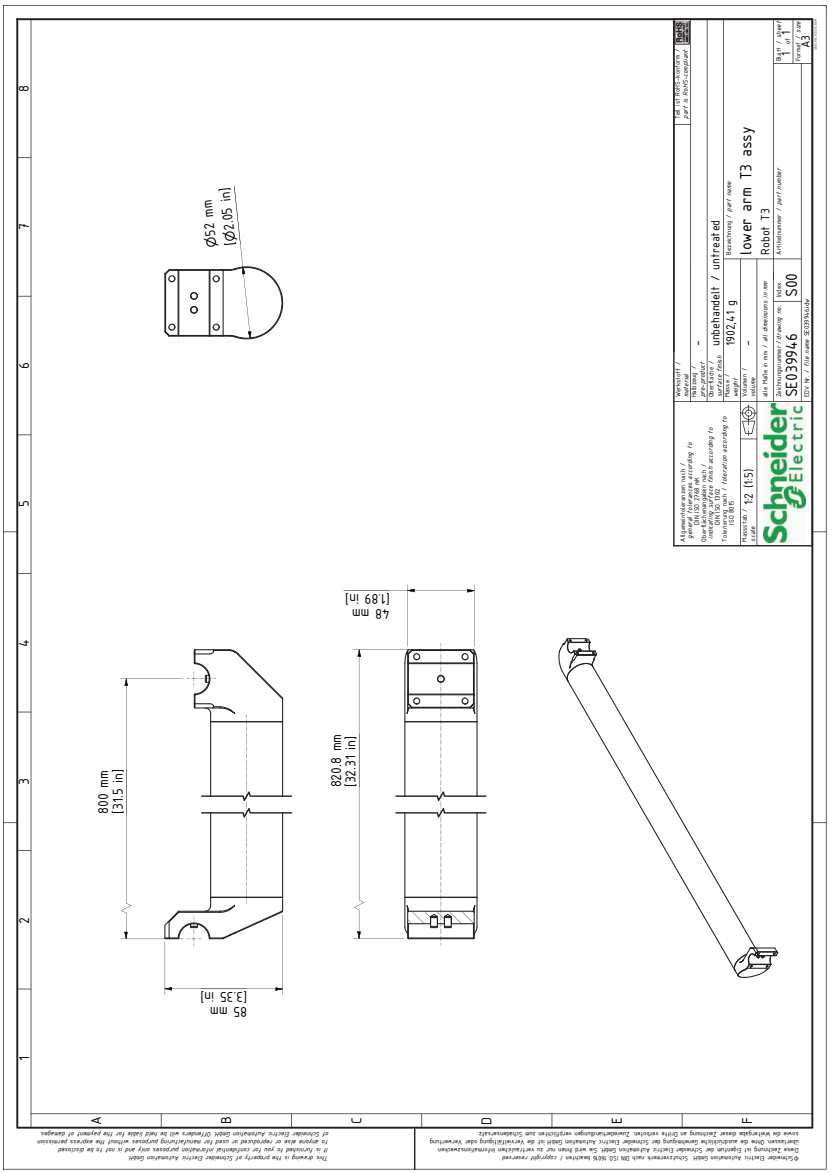


Lower Arm

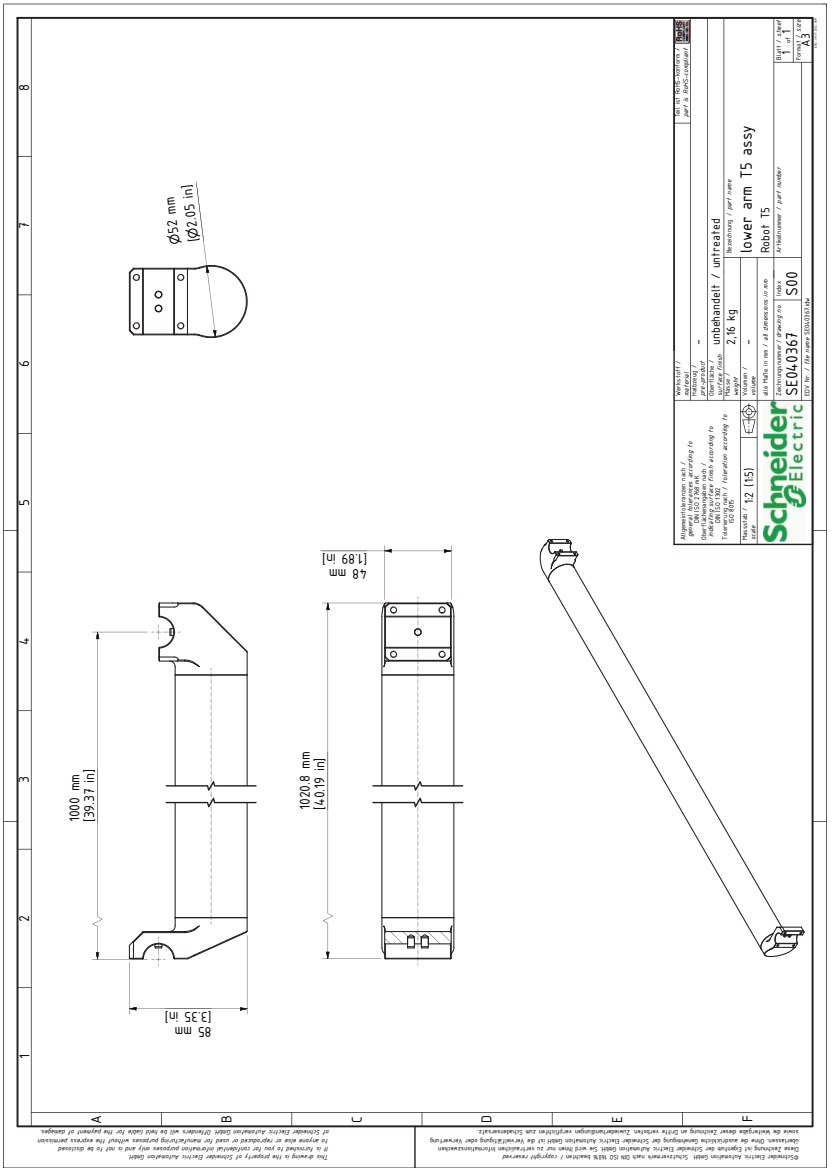
Detail Drawing of Lower Arm T2



Detail Drawing of Lower Arm T3

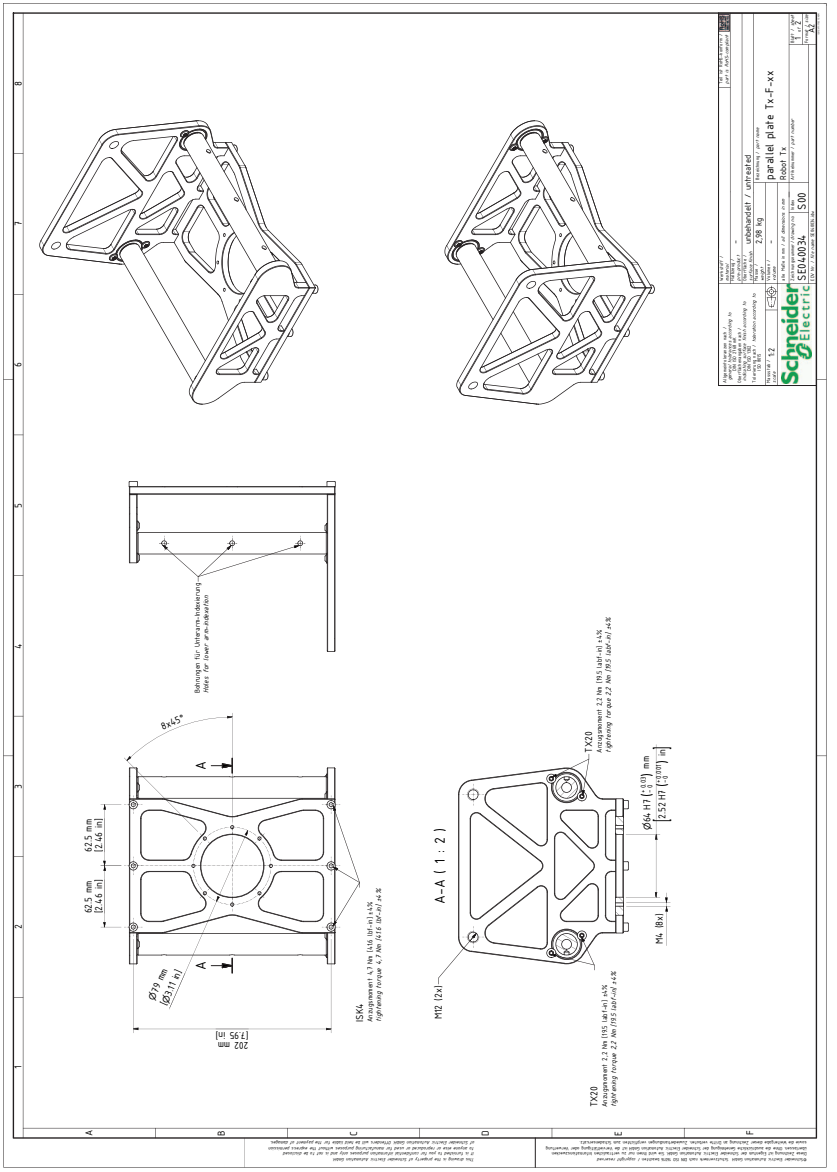


Detail Drawing of Lower Arm T5



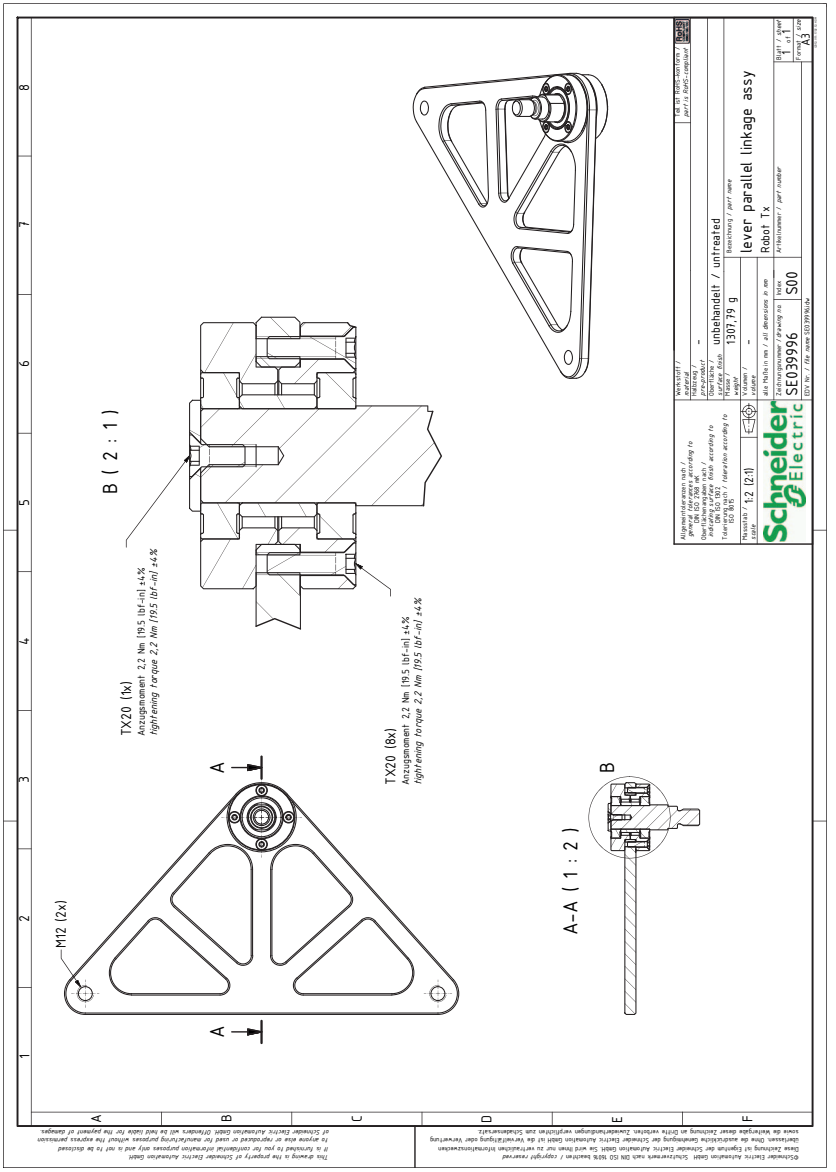
Parallel Plate

Detail Drawing of Parallel Plate T-Series



Lever Parallel Linkage

Detail Drawing of Lever Parallel Linkage T-Series



Section 3.3
Electrical Connections

Electrical Connections

Electrical Connections VRKT•M•

Connection power P30 (size 1): Connection power, brake, and temperature sensor

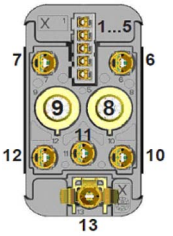
Representation	Pin	Designation	Meaning	Range
	1	W	Performance	3 x 0...480 Vac
	2	PE	Protective ground (earth) cable	–
	3	U	Performance	3 x 0...480 Vac
	4	V	Performance	3 x 0...480 Vac
	A	Brake +	Brake	24 Vdc
	B	Brake -	Brake	0 Vdc
	C	PTC	Temperature sensor	–
	D	PTC	Temperature sensor	–

Encoder Connection: Encoder SKS/SKM-36

Representation	Pin	Designation	Meaning	Range
	1	REF COS	Reference signal Cosinus	–
	2	RS 485 +	Parameter channel +	–
	3	–	–	–
	4	–	–	–
	5	SIN	Sinusoidal trace	–
	6	REF SIN	Reference signal sine	–
	7	RS 485 -	Parameter channel -	–
	8	COS	Cosine track	–
	9	–	–	–
	10	GND	Supply Voltage	DC 0 V
	11	–	–	–
	12	U_s	Supply Voltage	DC 7...12 V

Electrical Connections VRKT•L•

Connector Lexium 62 ILM Servo Module

Representation	Pin	Designation	Meaning
	1	IE_sig	Inverter Enable (differential signal)
	2	IE_ref	
	3	Brake	Braking signal
	4	N.C.	–
	5	N.C.	–
	6	24 V	Control voltage 24 V
	7	0 V	Control voltage 0 V
	8.1	Rx+	Sercos port 1 - Input (not assigned for daisy chain wiring)
	8.2	Tx-	Sercos port 1 - Output (not assigned for daisy chain wiring)
	8.3	Rx-	Sercos port 1 - Input (not assigned for daisy chain wiring)
	8.4	Tx+	Sercos port 1 - Output (not assigned for daisy chain wiring)
	9.1	Rx+	Sercos port 2 - Input (not assigned for daisy chain wiring)
	9.2	Tx-	Sercos port 2 - Output (not assigned in the case of daisy chain wiring)
	9.3	Rx-	Sercos port 2 - Input (not assigned for daisy chain wiring)
	9.4	Tx+	Sercos port 2 - Output (not assigned in the case of daisy chain wiring)
	10	DC -	DC bus voltage -
	11	Shield	Shielded connector
	12	DC +	DC bus voltage +
	13	PE	Protective ground (earth) cable

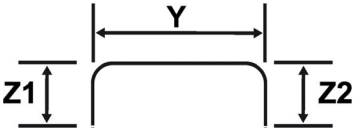
Section 3.4
Performance Data

What Is in This Section?

This section contains the following topics:

Typical Cycle Time

Robot Path (pick-place-pick):

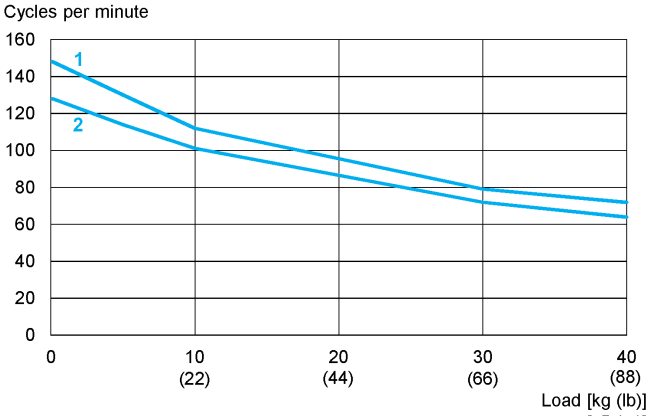


Cycle Times of Robot VRKT2M0 / VRKT2L0

Measurements performed with PacDrive 3 and using the `SchneiderElectricRobotics` library, ambient temperature 20 °C (68 °F).

Path Z1 x Y x Z2 in mm (in)	Load in kg (lb)	Cycle time(1) in s	Cycles per minute
25 x 305 x 25 (1.0 x 12.0 x 1.0)	0.1 (0.22)	0.405	148
	5.0 (11.0)(2)	0.462	130
	10.0 (22.0)(2)	0.536	112
	30.0 (66.1)(2)	0.759	79
	40.0 (88.2)(2)	0.833	72
70 x 400 x 70 (2.8 x 15.7 x 2.8)	0.1 (0.22)	0.469	128
	5.0 (11.0)(2)	0.526	114
	10.0 (22.0)(2)	0.594	101
	30.0 (66.1)(2)	0.833	72
	40.0 (88.2)(2)	0.938	64

(1) Cycle times contain the motion back and forth. A position is considered as reached if the robot remains permanently in a window of +/-0.25 mm (0.0098 in) around the target position.
(2) Loads up to 40 kg. Heavier payloads upon request. If required, contact your local Schneider Electric service representative.



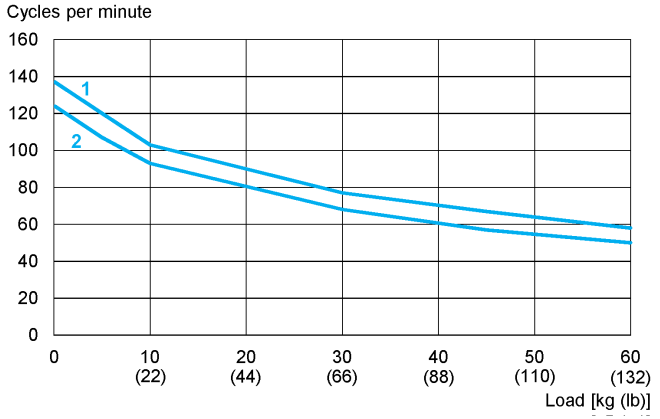
1 25 x 305 x 25 (1.0 x 12.0 x 1.0)
2 70 x 400 x 70 (2.8 x 15.7 x 2.8)

Cycle Times of Robot VRKT2M1

Measurements performed with PacDrive 3 and using the `SchneiderElectricRobotics` library, ambient temperature 20 °C (68 °F).

Path Z1 x Y x Z2 in mm (in)	Load in kg (lb)	Cycle time(1) in s	Cycles per minute
25 x 305 x 25 (1.0 x 12.0 x 1.0)	0.1 (0.22)	0.438	137
	5.0 (11.0)(2)	0.500	120
	10.0 (22.0)(2)	0.583	103
	30.0 (66.1)(2)	0.779	77
	45.0 (99.2)(2)	0.896	67
	60.0 (132.3)(2)	1.034	58
70 x 400 x 70 (2.8 x 15.7 x 2.8)	0.1 (0.22)	0.484	124
	5.0 (11.0)(2)	0.560	107
	10.0 (22.0)(2)	0.680	93
	30.0 (66.1)(2)	0.880	68
	45.0 (99.2)(2)	1.060	57
	60.0 (132.3)(2)	1.200	50

(1) Cycle times contain the motion back and forth. A position is considered as reached if the robot remains permanently in a window of +/-0.25 mm (0.0098 in) around the target position.
(2) Loads up to 60 kg. Heavier payloads upon request. If required, contact your local Schneider Electric service representative.



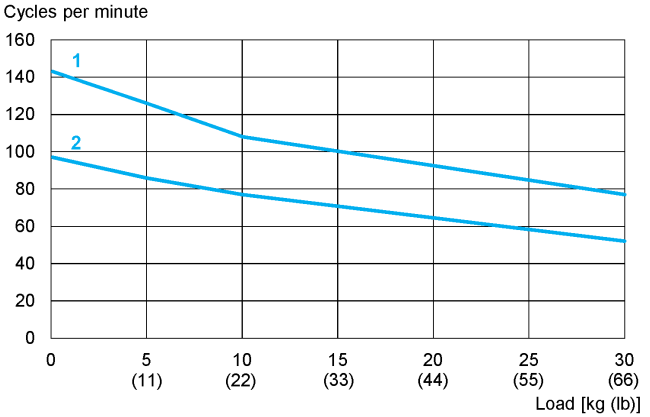
1 25 x 305 x 25 (1.0 x 12.0 x 1.0)
2 70 x 400 x 70 (2.8 x 15.7 x 2.8)

Cycle Times of Robot VRKT3M0 / VRKT3L0

Measurements performed with PacDrive 3 and using the `SchneiderElectricRobotics` library, ambient temperature 20 °C (68 °F).

Path Z1 x Y x Z2 in mm (in)	Load in kg (lb)	Cycle time(1) in s	Cycles per minute
25 x 305 x 25 (1.0 x 12.0 x 1.0)	0.1 (0.22)	0.419	143
	5.0 (11.0)(2)	0.478	126
	10.0 (22.0)(2)	0.558	108
	30.0 (66.1)(2)	0.778	77
70 x 400 x 70 (2.8 x 15.7 x 2.8)	0.1 (0.22)	0.479	125
	5.0 (11.0)(2)	0.538	112
	10.0 (22.0)(2)	0.619	97
	30.0 (66.1)(2)	0.858	70
90 x 700 x 90 (3.5 x 27.6 x 3.5)	0.1 (0.22)	0.618	97
	5.0 (11)(2)	0.698	86
	10.0 (22.0)(2)	0.778	77
	30.0 (66.1)(2)	1.158	52

(1) Cycle times contain the motion back and forth. A position is considered as reached if the robot remains permanently in a window of +/-0.25 mm (0.0098 in) around the target position.
(2) Loads up to 35 kg. Heavier payloads upon request. If required, contact your local Schneider Electric service representative.



1 25 x 305 x 25 (1.0 x 12.0 x 1.0)
2 90 x 700 x 90 (3.5 x 27.6 x 3.5)

Cycle Times of Robot VRKT3M1

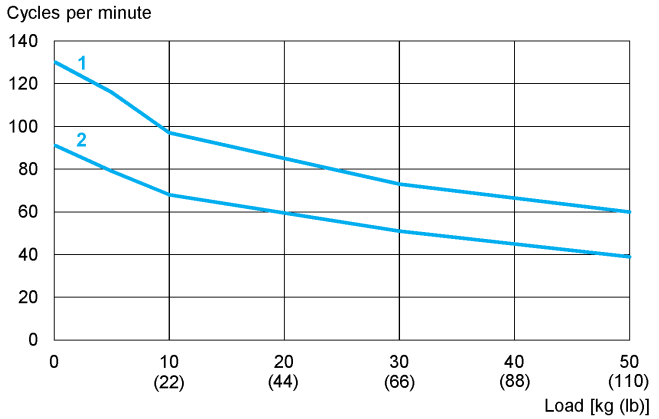
Measurements performed with PacDrive 3 and using the `SchneiderElectricRobotics` library, ambient temperature 20 °C (68 °F).

Path Z1 x Y x Z2 in mm (in)	Load in kg (lb)	Cycle time(1) in s	Cycles per minute
25 x 305 x 25 (1.0 x 12.0 x 1.0)	0.1 (0.22)	0.460	130
	5.0 (11.0)(2)	0.519	116
	10.0 (22.0)(2)	0.619	97
	30.0 (66.1)(2)	0.818	73
	50.0 (110.2)(2)	0.998	60
70 x 400 x 70 (2.8 x 15.7 x 2.8)	0.1 (0.22)	0.518	116
	5.0 (11.0)(2)	0.578	104
	10.0 (22.0)(2)	0.738	81
	30.0 (66.1)(2)	0.979	61
	50.0 (110.2)(2)	1.158	52

(1) Cycle times contain the motion back and forth. A position is considered as reached if the robot remains permanently in a window of +/-0.25 mm (0.0098 in) around the target position.
(2) Loads up to 50 kg. Heavier payloads upon request. If required, contact your local Schneider Electric service representative.

Path Z1 x Y x Z2 in mm (in)	Load in kg (lb)	Cycle time(1) in s	Cycles per minute
90 x 700 x 90 (3.5 x 27.6 x 3.5)	0.1 (0.22)	0.659	91
	5.0 (11.0)(2)	0.758	79
	10.0 (22.0)(2)	0.878	68
	30.0 (66.1)(2)	1.178	51
	50.0 (110.2)(2)	1.538	39

(1) Cycle times contain the motion back and forth. A position is considered as reached if the robot remains permanently in a window of +/-0.25 mm (0.0098 in) around the target position.
(2) Loads up to 50 kg. Heavier payloads upon request. If required, contact your local Schneider Electric service representative.



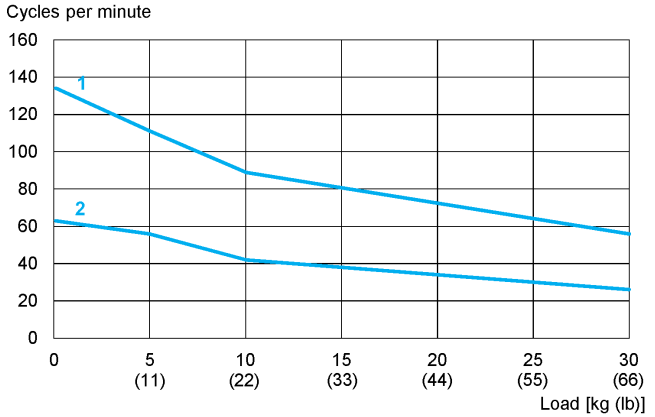
1 25 x 305 x 25 (1.0 x 12.0 x 1.0)
2 90 x 700 x 90 (3.5 x 27.6 x 3.5)

Cycle Times of Robot VRKT5M0 / VRKT5L0

Measurements performed with PacDrive 3 and using the `SchneiderElectricRobotics` library, ambient temperature 20 °C (68 °F).

Path Z1 x Y x Z2 in mm (in)	Load in kg (lb)	Cycle time(1) in s	Cycles per minute
25 x 305 x 25 (1.0 x 12.0 x 1.0)	0.1 (0.22)	0.448	134
	5.0 (11.0)(2)	0.541	111
	10.0 (22.0)(2)	0.675	89
	30.0 (66.1)(2)	1.077	56
70 x 400 x 70 (2.8 x 15.7 x 2.8)	0.1 (0.22)	0.555	108
	5.0 (11.0)(2)	0.593	101
	10.0 (22.0)(2)	0.862	70
	30.0 (66.1)(2)	1.168	51
90 x 700 x 90 (3.5 x 27.6 x 3.5)	0.1 (0.22)	0.658	91
	5.0 (11.0)(2)	0.798	75
	10.0 (22.0)(2)	0.991	61
	30.0 (66.1)(2)	1.828	33
110 x 1300 x 110 (4.3 x 51.2 x 4.3)	0.1 (0.22)	0.950	63
	5.0 (11.0)(2)	1.076	56
	10.0 (22.0)(2)	1.418	42
	30.0 (66.1)(2)	2.275	26

(1) Cycle times contain the motion back and forth. A position is considered as reached if the robot remains permanently in a window of +/-0.25 mm (0.0098 in) around the target position.
(2) Loads up to 30 kg. Heavier payloads upon request. If required, contact your local Schneider Electric service representative.



1 25 x 305 x 25 (1.0 x 12.0 x 1.0)
2 110 x 1300 x 110 (4.3 x 51.2 x 4.3)

Cycle Times of Robot VRKT5M1

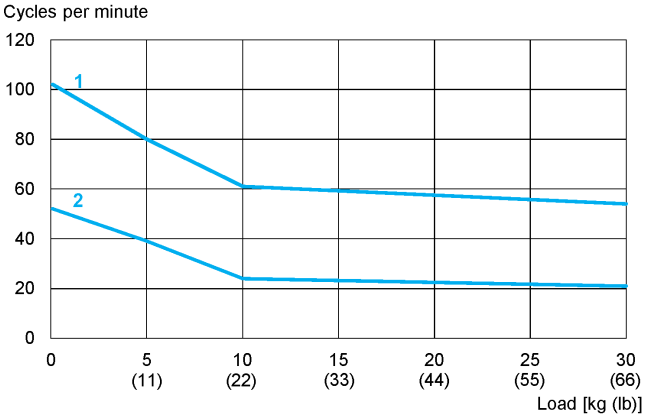
Measurements performed with PacDrive 3 and using the `SchneiderElectricRobotics` library, ambient temperature 20 °C (68 °F).

Path Z1 x Y x Z2 in mm (in)	Load in kg (lb)	Cycle time(1) in s	Cycles per minute
25 x 305 x 25 (1.0 x 12.0 x 1.0)	5.0 (11.0)(2)	0.581	102
	10.0 (22.0)(2)	0.752	80
	30.0 (66.1)(2)	0.980	61
	40.0 (88.2)(2)	1.102	54
70 x 400 x 70 (2.8 x 15.7 x 2.8)	5.0 (11.0)(2)	0.682	88
	10.0 (22.0)(2)	0.998	60
	30.0 (66.1)(2)	1.153	52
	40.0 (88.2)(2)	1.253	48
90 x 700 x 90 (3.5 x 27.6 x 3.5)	5.0 (11.0)(2)	0.893	67
	10.0 (22.0)(2)	1.092	55
	30.0 (66.1)(2)	1.575	38
	40.0 (88.2)(2)	1.875	32

(1) Cycle times contain the motion back and forth. A position is considered as reached if the robot remains permanently in a window of +/-0.25 mm (0.0098 in) around the target position.
(2) Loads up to 45 kg. Heavier payloads upon request. If required, contact your local Schneider Electric service representative.

Path Z1 x Y x Z2 in mm (in)	Load in kg (lb)	Cycle time(1) in s	Cycles per minute
110 x 1300 x 110 (4.3 x 51.2 x 4.3)	5.0 (11.0)(2)	1.157	52
	10.0 (22.0)(2)	1.535	39
	30.0 (66.1)(2)	2.504	24
	40.0 (88.2)(2)	2.859	21

(1) Cycle times contain the motion back and forth. A position is considered as reached if the robot remains permanently in a window of +/-0.25 mm (0.0098 in) around the target position.
(2) Loads up to 45 kg. Heavier payloads upon request. If required, contact your local Schneider Electric service representative.



1 25 x 305 x 25 (1.0 x 12.0 x 1.0)
2 110 x 1300 x 110 (4.3 x 51.2 x 4.3)

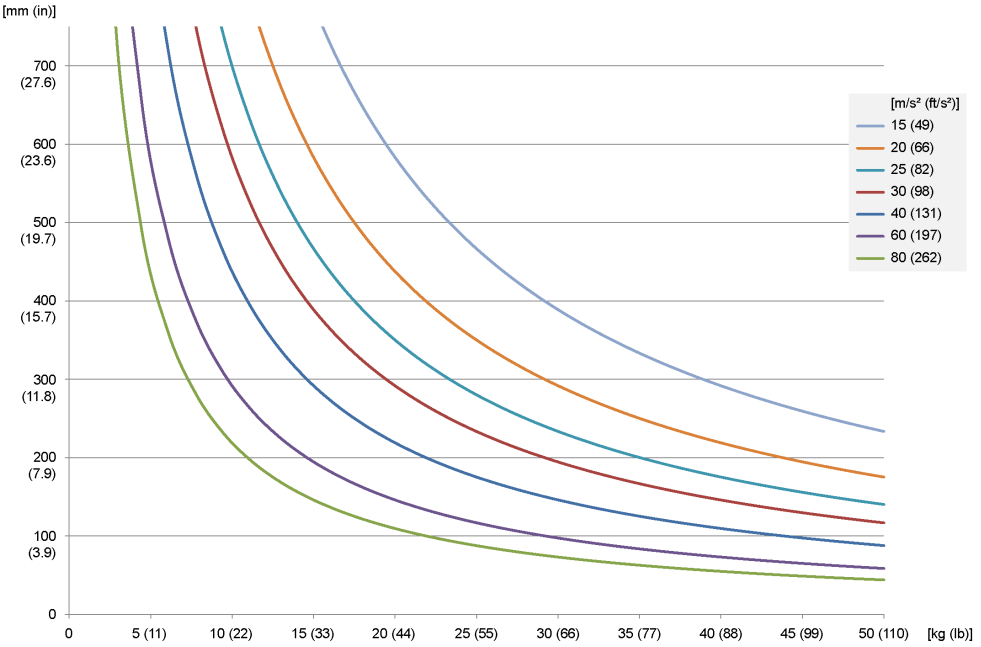
Load Capacity Diagram

Overview

The load diagram shows the maximum permissible distance of the mass center of gravity from the Flange Center Point (FCP) for a given acceleration relative to the mass. For detailed information, refer to the respective dimensional drawing in *Mechanical and Electrical Data* (*see page 38*).

Maximum Tilting Torque (Vertical Distance from the FCP)

The loading capacity of the T-Series robots is limited by the maximum tilting torque at the FCP. The following diagram shows the possible vertical distance of the mass center of gravity of the payload relative to the mass and the required maximum acceleration.



A maximum tilting torque of 175 Nm (1549 lbf-in) is to be observed at the FCP:

Tilting torque [Nm (lbf-in)] = payload [kg (lb)] x maximum acceleration [m/s^2 (ft/s^2)] x distance from the FCP [m (in)]

Section 3.5
Design of the Robot Frame

Design of the Robot Frame

System Requirements

Use the T-Series robots for ceiling mounting. In the case of special applications with an angularly suspended robot system, contact your local Schneider Electric service representative.

- Delta-2 robots of the T-Series reach their highest level of performance and accuracy in the center of the working area.
- Position the robot such that the movements to be executed are located as closely as possible to the center of the work envelope.
- When determining the suspension height of the robot, observe the overall height of the tool (gripper, suction cup, and so on).
- For the design of the robot frame, account for possibly varying tool heights. Possibly design the robot suspension in a height-adjustable manner.

The precision of the robot in the application is also determined by the frame. Deformations of the frame cause imprecisions on the Tool Center Point (TCP).

General Requirements Regarding the Frame

The frame must not only withstand the constant forces and torques stated below, but also have sufficient stiffness so that the deformations and vibrations which occur do not lead to any major deviations on the TCP. Ensure a sufficient transverse bracing in the frame.

The forces and torques to be taken up by the frame during normal operation:

Parameter	Value
Static load	approximately 1.2 kN (270 lbf)
Dynamic load	approximately 10 kN (2248 lbf) in any direction
Dynamic torque	approximately 10000 Nm (88507 lbf-in)

Fasten the robot with six screws of property class 8.8 or greater, or A2-70 or greater.

For further information, refer to the respective dimensional drawing in *Mechanical and Electrical Data* *(see page 38)*.

NOTE: The configuration of the robot mechanics, the TCP velocity, as well as the additional payload have an effect on the total energy, which can potentially cause damage.

⚠ WARNING

CRUSHING, SHEARING, CUTTING AND IMPACT INJURY

- The robot must be operated only within a frame.
- Open or enter the frame for cleaning and maintenance purposes only.
- Design the frame such that it withstands an impact by the robot and that it resists ejected parts from escaping the zone of operation.
- Design the frame such that the robot is safely deactivated as soon as a person enters the zone of operation of the robot.
- All barriers, protective doors, contact mats, light barriers, and so on, must be configured correctly and enabled whenever the robot mechanics are under power.
- Define the clearance distance to the zone of operation of the robot such that operational staff do not have access to, nor can be enclosed in, the robot mechanics zone of operation.
- Design the frame to account for the maximum possible travel paths of the robot, that is, the maximum path until the hardware safety system limits (safety fence, and so on) as well as the additional run-on paths, in case of a power interruption.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

For further information about travel path and power loss, refer to *Run-on Motions of the Robot for Risk Analysis* *(see page 76)*.

Interference Contours in the Frame

Depending on the robot type, a sufficient freedom of movement of the upper and lower arms must be ensured during the construction of the robot frame. Take into account the required space for the movement of the parallel linkage system.

For further information, refer to the respective dimensional drawing in *Mechanical and Electrical Data* *(see page 38)*.

For detailed information about the interference areas caused by upper and lower arm motions, refer to the 3D-CAD data on the Schneider Electric homepage (www.schneider-electric.com) or contact your local Schneider Electric service representative.

Section 3.6
Run-On Motions of the Robot for Risk Analysis

Run-On Motions of the Robot for Risk Analysis

Overview

What is measured is the time from the application of a stop signal to the standstill of the robot. This measurement is carried out for various different loads and velocities (measurement according to ISO 10218-1).

⚠ WARNING

BREAKDOWN OF THE INTERNAL MOTOR HOLDING BRAKE

- Do not consider the internal motor holding brake to be a functional safety device.
- Take into account a possible breakdown of the internal motor holding brake during the safety analysis.
- Take into account that the internal motor holding brake of the robot only withstands a limited number of brake operations.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

If there is a power outage of the control system, the brakes are applied and the robot mechanics leave the planned trajectory.

⚠ WARNING

LEAVING THE PLANNED TRAJECTORY OF THE ROBOT MECHANICS

- Use the buffering of the 24 V supply (UPS) in order to enable a controlled stop of the mechanics in accordance with stop category 1 by making use of the stored residual mechanical and electrical energy.
- Use a synchronous stop on the path to avoid collisions with obstacles.
- Observe the extension of the run-on path while performing your risk analysis.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

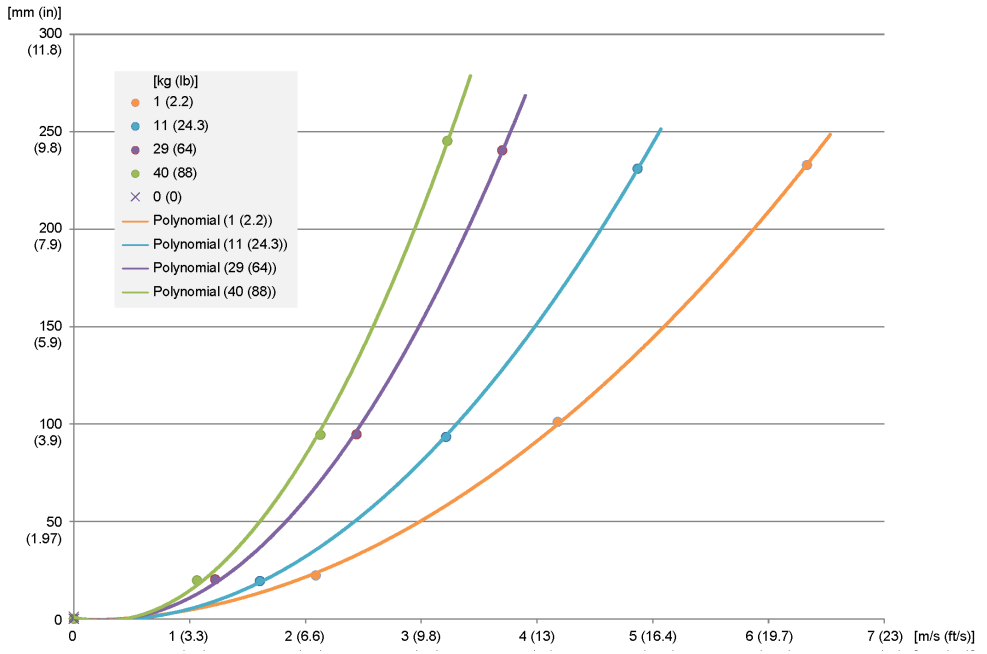
Stop Function Categories

The following table presents the product-related stop function categories according to IEC 60204-1:

Stop function category	Definition	Corresponds to
0	Stopping by immediate removal of power to the machine actuators (for example, an uncontrolled stop).	An uncontrolled stop (stopping of machine motion by removing electrical power to the machine actuators).
1	A controlled stop with power available to the machine actuators to achieve the stop and then removal of power when the stop is achieved.	An controlled stop (stopping of machine motion with power to the machine actuators maintained during the stopping process).

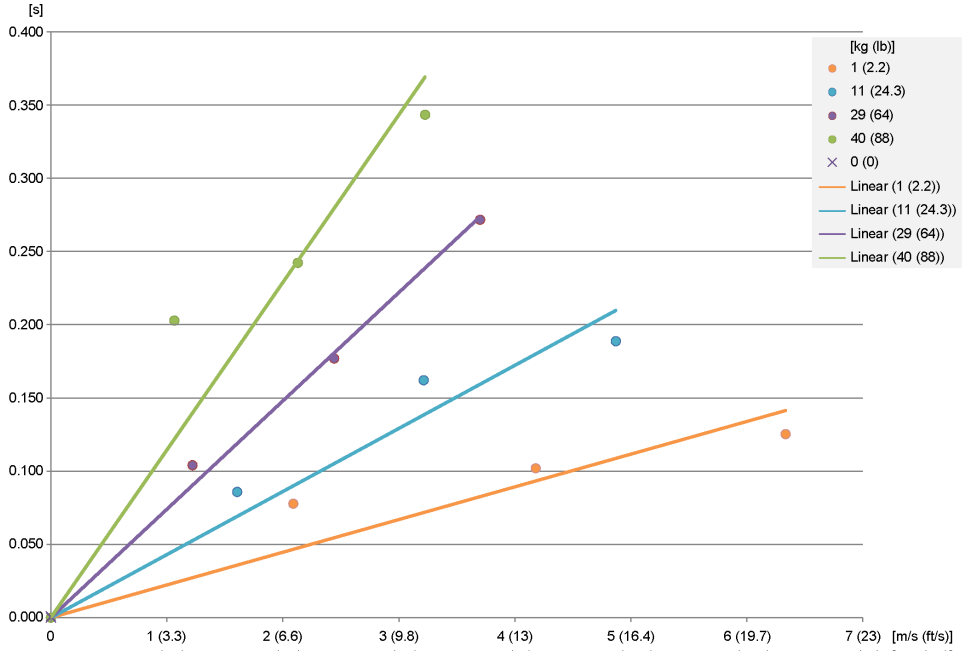
Run-On Path Robot VRKT2M0

Run-on path robot VRKT2M0 for stop category 0:



For further information, refer to IEC 60204-1 (does not depend on performance, stop with holding brake only).

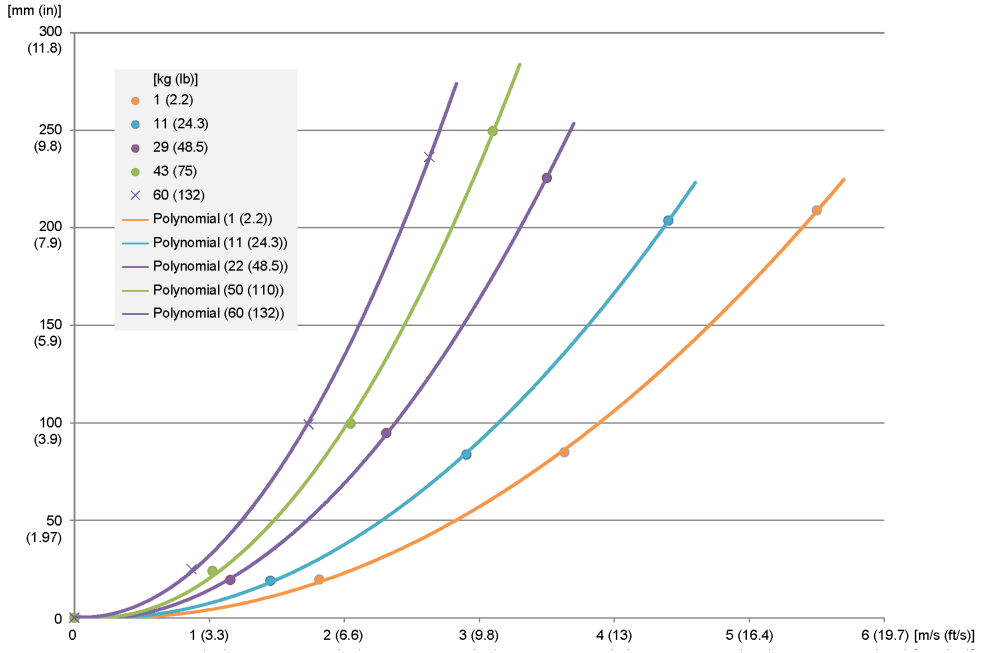
Stopping time robot VRKT2M0 for stop category 0:



For further information, refer to IEC 60204-1 (does not depend on performance, stop with holding brake only).

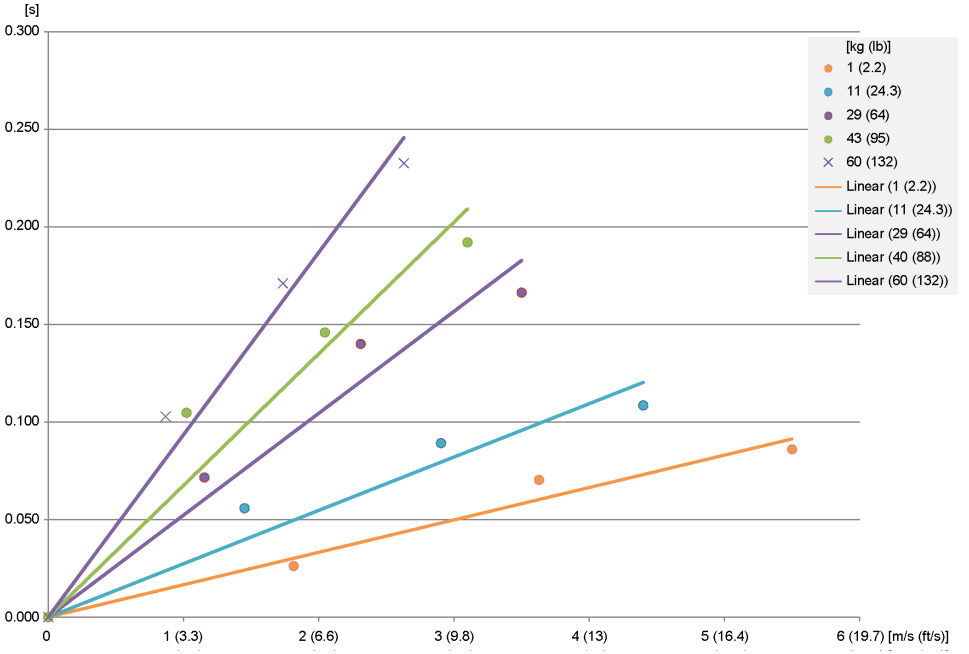
Run-On Path Robot VRKT2M1 and Robot VRKT2L0

Run-on path robot VRKT2M1 and robot VRKT2L0 for stop category 0:



For further information, refer to IEC 60204-1 (does not depend on performance, stop with holding brake only).

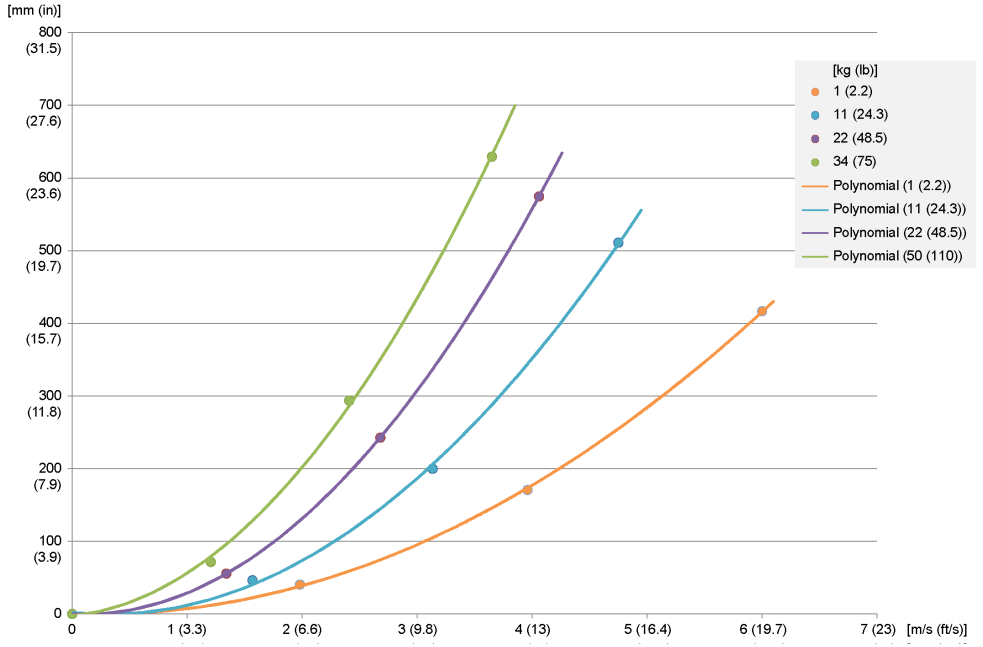
Stopping time robot VRKT2M1 and robot VRKT2L0 for stop category 0:



For further information, refer to IEC 60204-1 (does not depend on performance, stop with holding brake only).

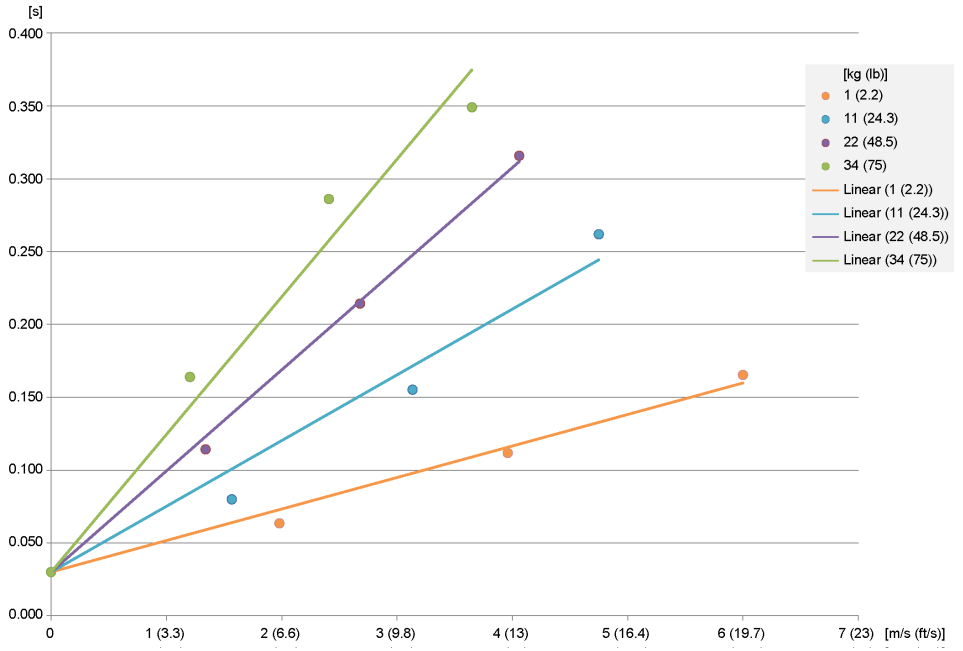
Run-On Path Robot VRKT3M0

Run-on path robot VRKT3M0 for stop category 0:



For further information, refer to IEC 60204-1 (does not depend on performance, stop with holding brake only).

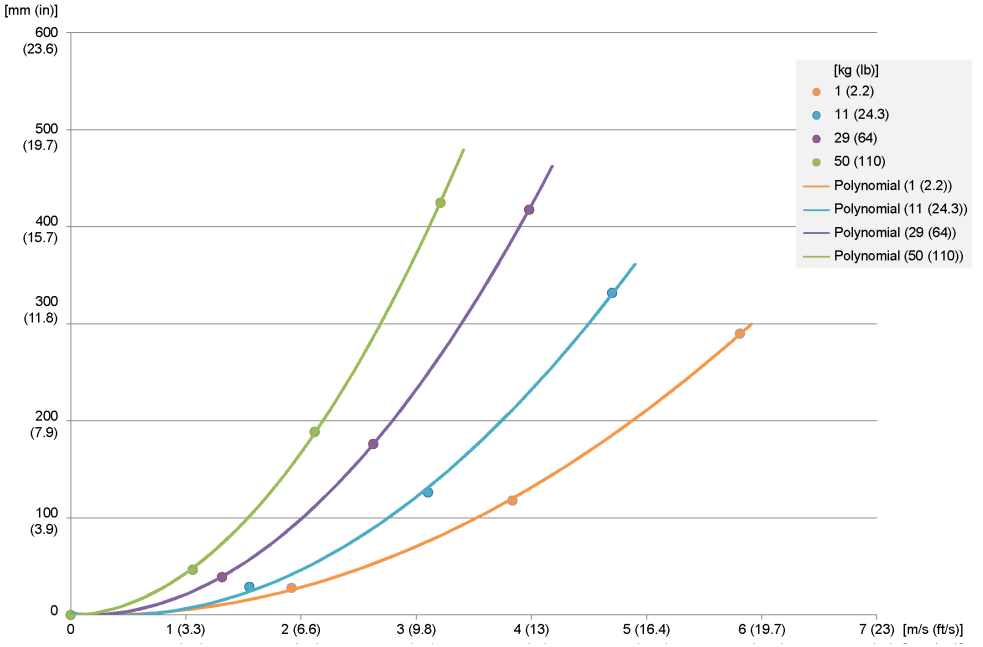
Stopping time robot VRKT3M0 for stop category 0:



For further information, refer to IEC 60204-1 (does not depend on performance, stop with holding brake only).

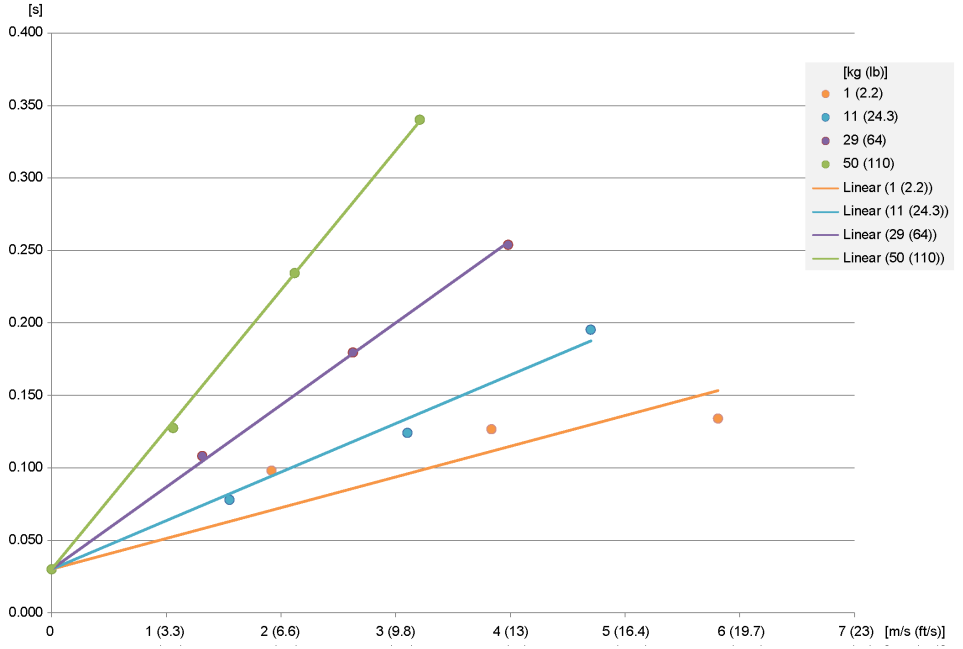
Run-On Path Robot VRKT3M1 and Robot VRKT3L0

Run-on path robot VRKT3M1 and robot VRKT3L0 for stop category 0:



For further information, refer to IEC 60204-1 (does not depend on performance, stop with holding brake only).

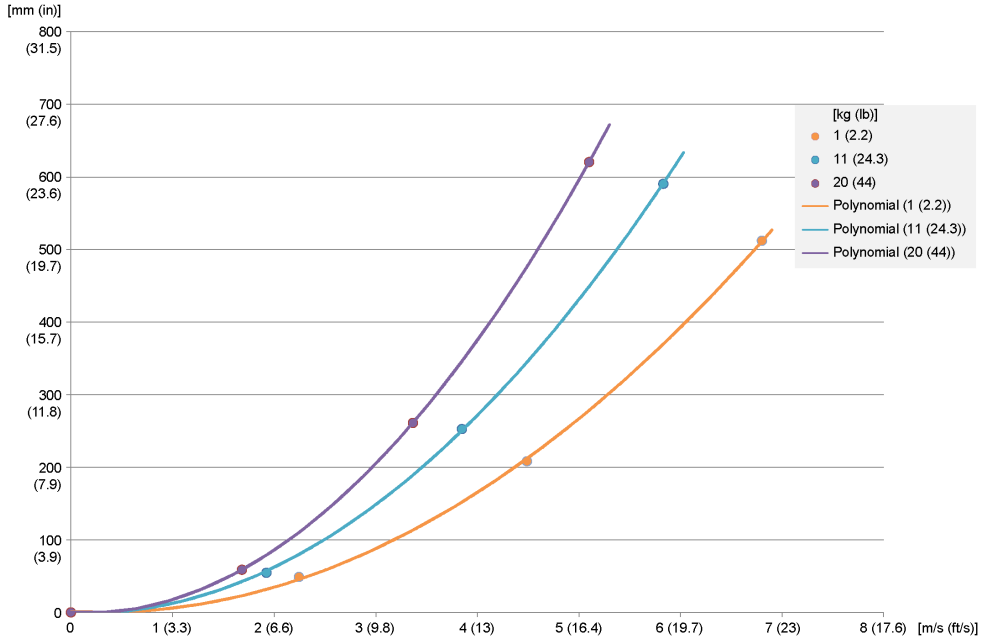
Stopping time robot VRKT3M1 and robot VRKT3L0 for stop category 0:



For further information, refer to IEC 60204-1 (does not depend on performance, stop with holding brake only).

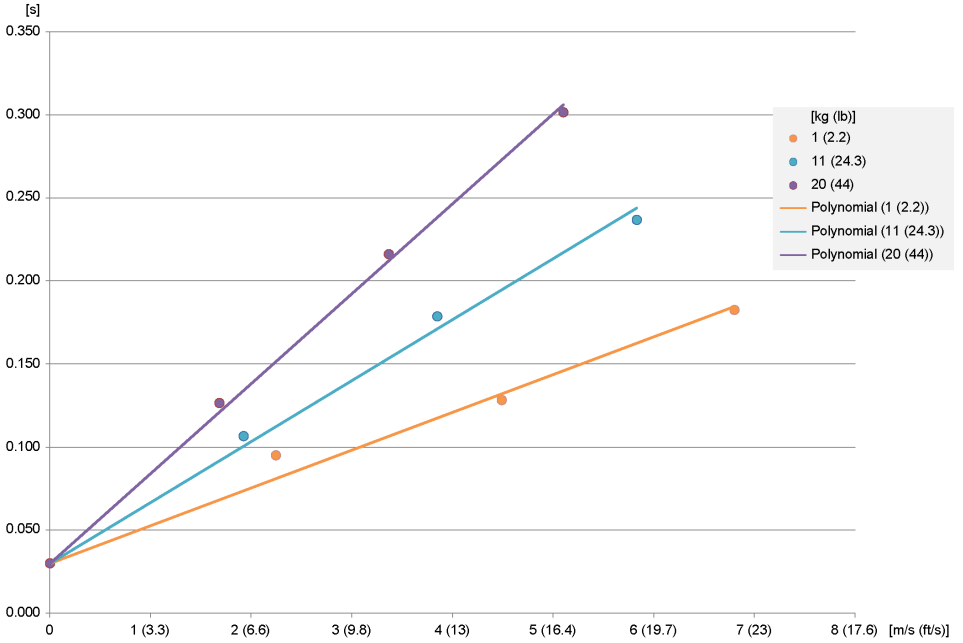
Run-On Path Robot VRKT5M0

Run-on path robot VRKT5M0 for stop category 0:



For further information, refer to IEC 60204-1 (does not depend on performance, stop with holding brake only).

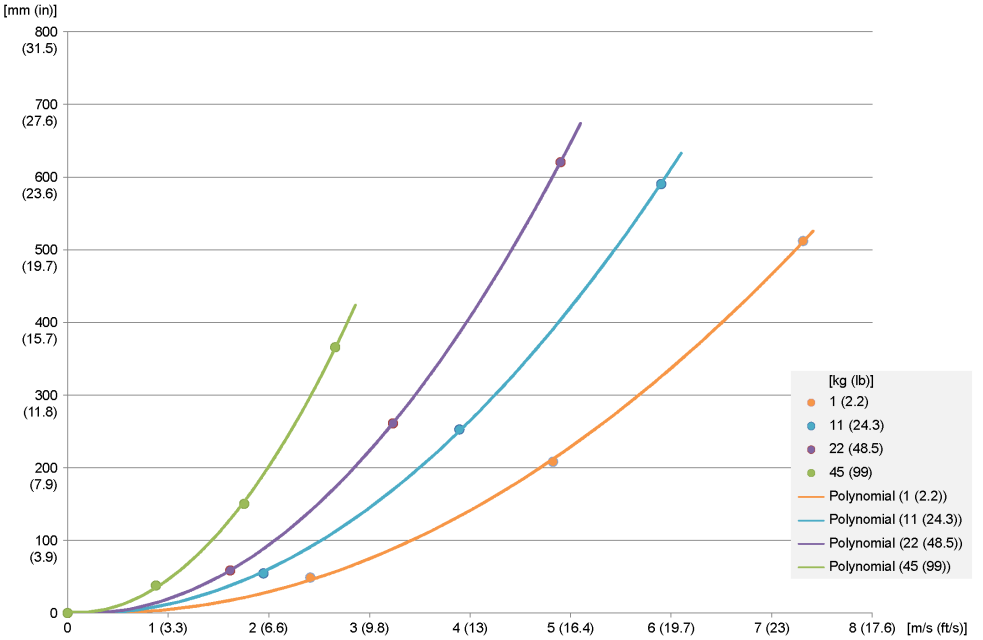
Stopping time robot VRKT5M0 for stop category 0:



For further information, refer to IEC 60204-1 (does not depend on performance, stop with holding brake only).

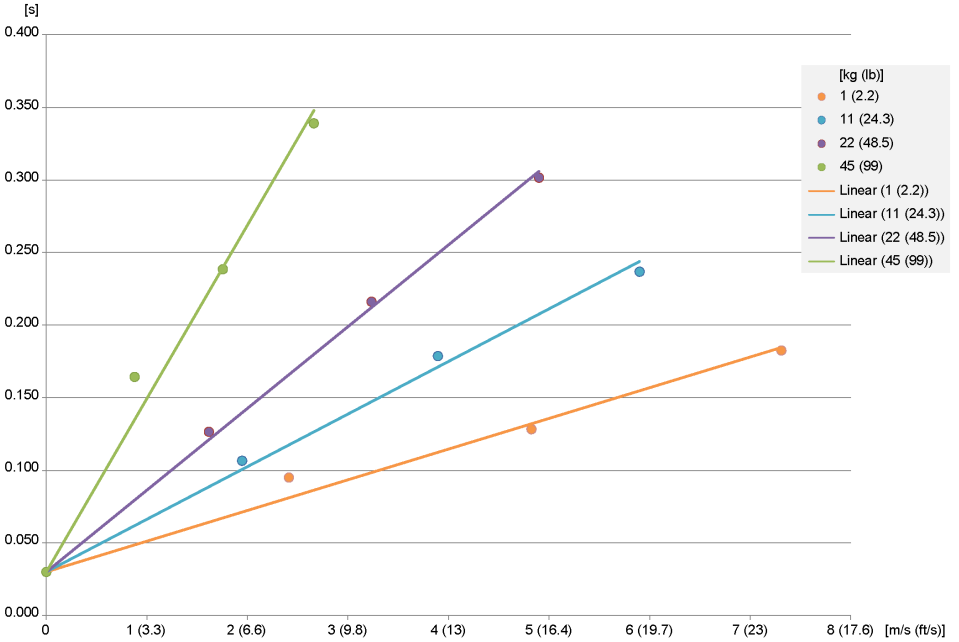
Run-On Path Robot VRKT5M1 and Robot VRKT5L0

Run-on path robot VRKT5M1 and robot VRKT5L0 for stop category 0:



For further information, refer to IEC 60204-1 (does not depend on performance, stop with holding brake only).

Stopping time robot VRKT5M1 and robot VRKT5L0 for stop category 0:



For further information, refer to IEC 60204-1 (does not depend on performance, stop with holding brake only).

Section 3.7
Motor and Gearbox

Motor and Gearbox

Motor

For more information about the motor, refer to the corresponding motor manual.

Gearbox

For more information about the gearbox, refer to the corresponding gearbox manual.

Chapter 4
Transport and Commissioning

What Is in This Chapter?

This chapter contains the following sections:

Section 4.1
Transport and Unpacking

What Is in This Section?

This section contains the following topics:

Transport and Storage

Transport Conditions

The T-Series products must be handled with care. Shocks and impacts may damage the product. Damage may lead to reduced running accuracy, reduced service life, or to inoperable equipment.

The product is pre-assembled before transport.

NOTE: Before unpacking and installing the T-Series product, make sure that the lifting capacity of the lifting devices (forklift truck and crane) is sufficient to lift the product. You can find the total weight of your equipment on the container or in the transport documents.

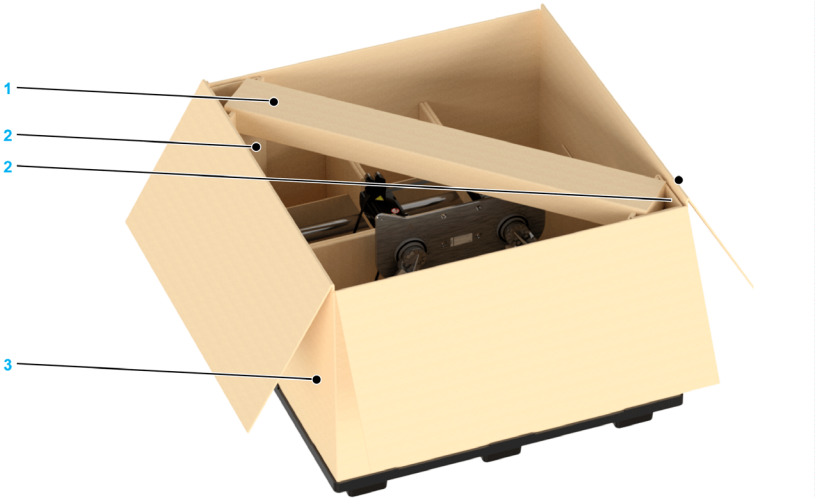
Storage

The T-Series product can be stored inside the packaging or unpacked. In both cases, ensure that it is stored in a sheltered and dry place. Avoid humidity which can have corrosive effects on the product.

NOTE: When stored unpacked, the T-Series product needs to be on a level surface.

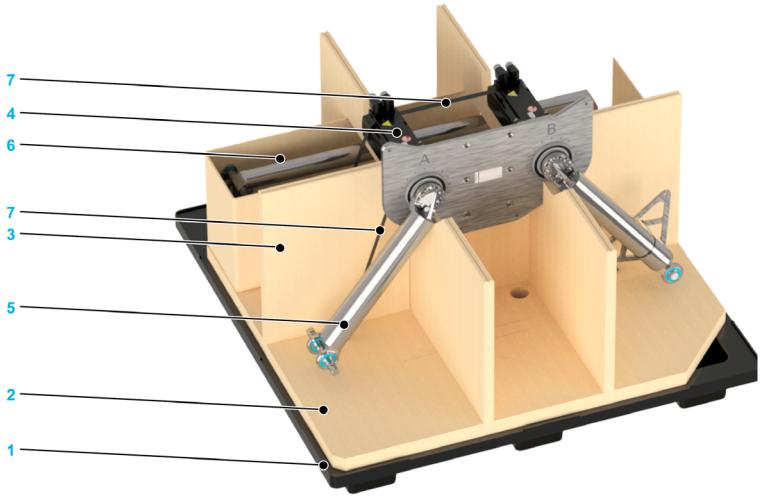
Unpacking

Removing the Outer Carton



Step	Action
1	Remove lashing straps.
2	Open the outer carton on the top side and remove the accessories box (1).
3	Remove both triangular supports (2).
4	Lift up and remove the outer carton (3).

Presentation of the Robot Packaging



The packaging consists of an ISO plastic pallet (1) of 120 x 120 cm (47 x 47 in).

This pallet comprises a base carton (2).

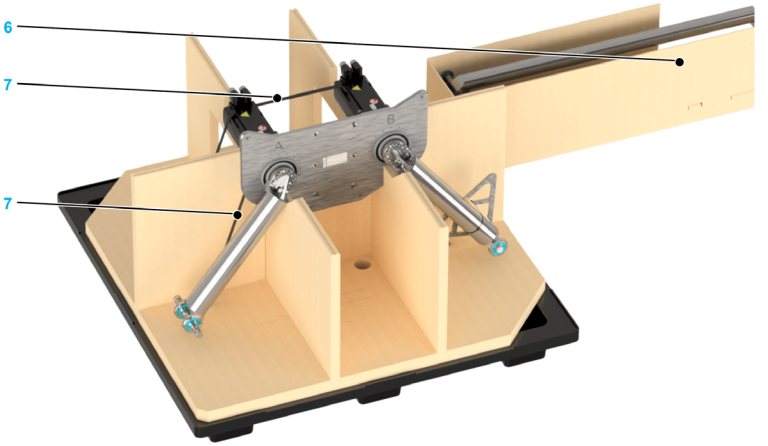
The robot with its mounting plate sits on a carton block (3), so that the motors or motor covers (4) are suspended above the base carton.

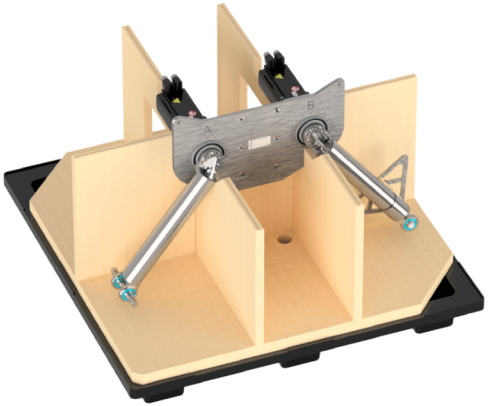
In delivery condition, the upper arms of the robot (5) are in a transportation position.

Lower arms with parallel plate are placed in the lower arm box (6).

The robot is fixed by lashing straps (7).

Preparing the Robot for Installation

Step	Action
1	Slide out the lower arm box (6) to the left or right and verify for transport damage. 
2	Remove the robot fixing lashing straps (7).
3	Verify the robot for transport damage.

Step	Action
4	Open the accessories box and verify all included parts for transport damage. It must contain: ● 1x parallel linkage rod long ● 1x parallel linkage rod short ● 3x half shell for lower arm fixing ● 12x screw for half shell (M5 x 16) ● 1x documentation DVD  **Result:** The robot is now prepared for installation.

NOTE: In case of transport damage, contact your Schneider Electric representative.

For information about the disposal of the packaging, refer to *Disposal* *(see page 181)*.

Section 4.2
Mechanical Installation

What Is in This Section?

This section contains the following topics:

Information About Installation

Overview

Proceed with care during the following steps in order to help to prevent the following points:

- Injuries and material damage
- Incorrect installation and programming of components
- Incorrect operation of components
- Use of non-authorized cables or modified components

For further Information, refer to *Specific Safety Information* *(see page 13)*.

Mounting the Robot

Overview

There are two ways of proceeding for handling and mounting of the robot. Study both ways of proceeding and determine which one is appropriate for your environment.

Installing by Forklift Truck

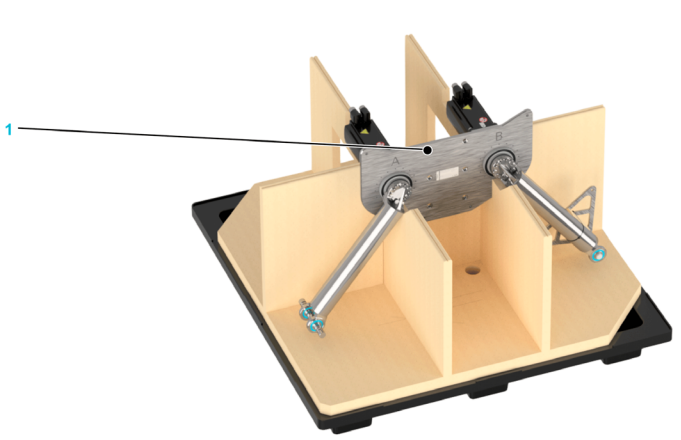
⚠ WARNING

FALLING LOADS

- Drive slowly and carefully with the forklift truck.
- Do not carry out any sudden steering movements.
- Exercise care when initiating height adjustments of the forklift truck loading platform.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Step	Action
1	Using a forklift truck, lift robot and pallet into the frame. 

Step	Action
2	Bolt down the robot into the frame using the six integrated screw holes (M12) (1). Use a tightening torque of 56 Nm (496 lbf-in) and screws of property class 8.8 or greater, or A2-70 or greater.  1 **Result:** The robot has now been mounted on the stand such that it can carry loads.
3	Remove the carton block, base carton, and plastic pallet from the robot.

For information about the disposal of the packaging, refer to *Disposal* *(see page 181)*.

Installing by Crane

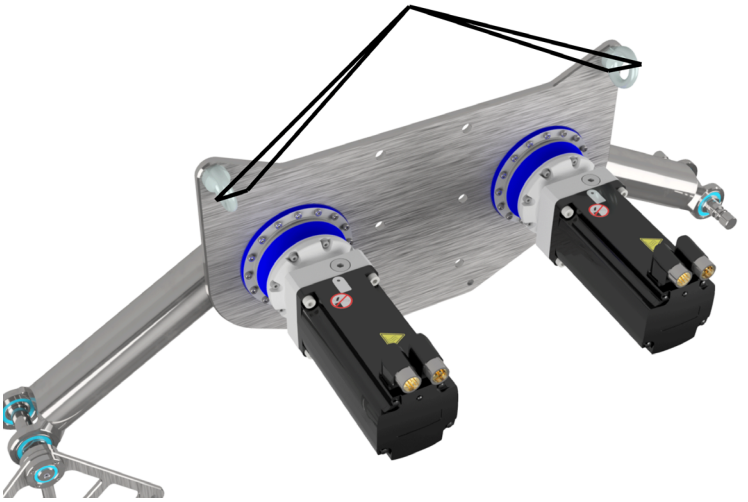
NOTE: The motors cannot carry the weight of the robot.

⚠ WARNING

FALLING HEAVY LOAD

- Attach lifting lugs to the mounting plate only.
- Do not attach lifting lugs to the upper arms or the motors.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Step	Action
1	Pull two lifting lugs to crane eyes at the mounting plate. 
2	Using the crane, carefully lift the robot into the frame.
3	Bolt down the robot into the frame using the six integrated screw holes (M12). Use a tightening torque of 56 Nm (496 lbf-in) and screws of property class 8.8 or greater, or A2-70 or greater.

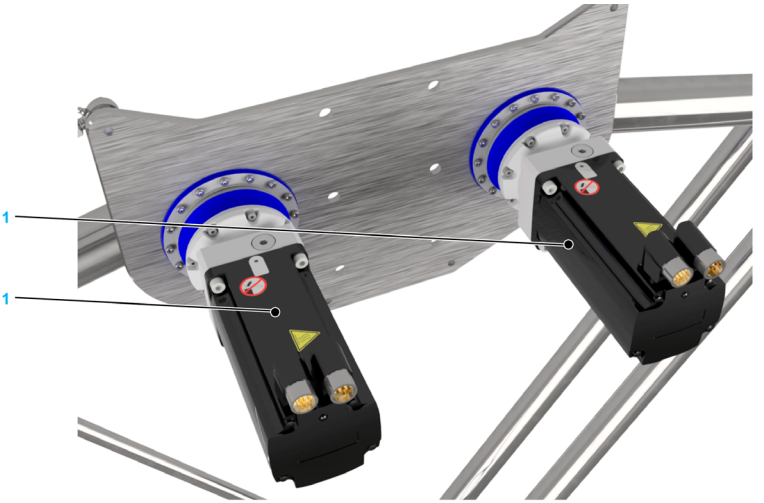
Section 4.3
Electrical Installation

What Is in This Section?

This section contains the following topics:

Cabling the VRKT•M••NC

Cabling the Robot

Step	Action
1	Feed the two encoder cables to the motors (1). Verify for a correct routing and fixing of the cables to prevent any collision of cables and moving parts. 
2	Feed the two power cables to the motors (1). Verify for the routing and fixing of the cables to prevent any collision of cables and moving parts. **NOTE:** For equipment that you are supplying that is not described in the present document, consult the documentation for those products.
3	Bolt encoder and motor supply cables as described in the *MH3 Servo motor Motor Manual*.
4	Couple the DC buses of the servo amplifiers so that braking motors can feed back their power to the accelerating motors in the case of an on-path stop of the robot. **NOTE:** Due to the coupling of the DC buses, the existing energy suffices in many cases for an on-path stop of the robot. In case of a breakdown of the 24 Vdc supply, this measure of the feedback does not take effect.

⚠ ⚠ DANGER

LOOSE WIRING OR CABLING CAUSES ELECTRIC SHOCK

Tighten wiring or cabling connections in conformance with the torque specifications.

Failure to follow these instructions will result in death or serious injury.

NOTICE
INCORRECT PAIRING OF MOTOR AND ENCODER CABLES Label the motor and associated encoder cables according to their pairing. **Failure to follow these instructions can result in equipment damage.**

For further information, refer to *Lexium 62 Hardware Guide* or *Lexium 52 Hardware Guide*.

Grounding the Robot

NOTE: When grounding the robot, use cables that comply with the applicable local standards, for example, cables that conform to NEC 70 / NFPA 79 in the USA.

Step	Action
1	Bolt the ground cables to the ground connections (1) of robot motors (symbol IEC 60417 - 5019) (tightening torque: 2.9 Nm (25.7 lbf-in). 

⚠ ⚠ DANGER

ELECTRIC SHOCK DUE TO IMPROPER GROUNDING

- Ground robot components in accordance with local standards and regulations at a single, central point.
- Verify whether the motors are connected to the central ground.

Failure to follow these instructions will result in death or serious injury.

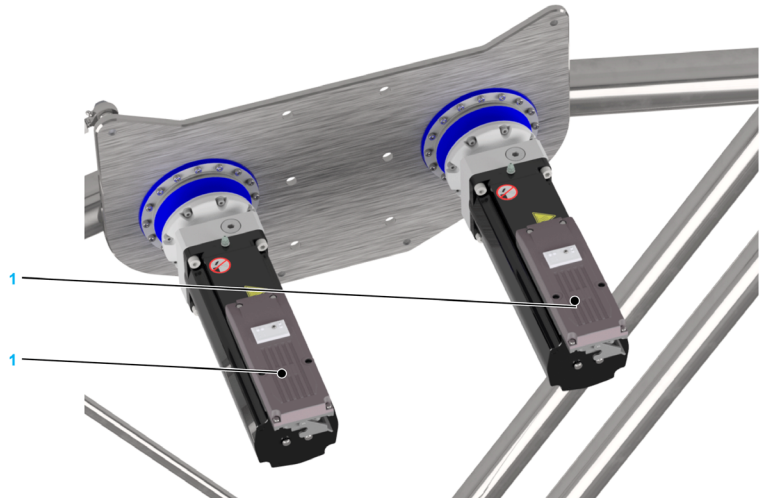
Multipoint grounding is permissible if connections are made to an equipotential ground plane dimensioned to help avoid cable shield damage in the event of power system short-circuit currents.

Reducing Risks Around the Robot

Step	Action
1	Install external safety-related devices in accordance to local regulations and standards.
2	When designing the safety-related devices, assume that the robot cannot be stopped by internal logic and must necessarily be stopped by the external safety-related devices. **NOTE:** More information about the circuitry of emergency stop and additional protection elements is contained in the document *Lexium 52 Hardware Guide* or *Lexium 62 Hardware Guide* or *Lexium 62 ILM Hardware Guide*.

Cabling the VRKT•L••NC

Cabling the Robot

Step	Action
1	For each of the two main motors (1), guide a hybrid cable from a Distribution Box ILM62DB and connect them to the motors.  **NOTE:** For equipment that you are supplying that is not described in the present document, consult the documentation for those products.

⚠ ⚠ DANGER

LOOSE WIRING OR CABLING CAUSES ELECTRIC SHOCK

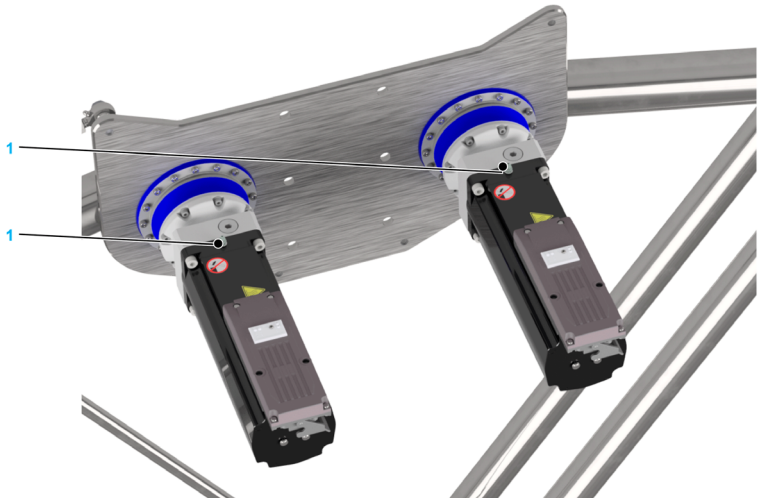
Tighten wiring or cabling connections in conformance with the torque specifications.

Failure to follow these instructions will result in death or serious injury.

For further information, refer to *Lexium 62 Hardware Guide* or *Lexium 52 Hardware Guide*.

Grounding the Robot

NOTE: When grounding the robot, use cables that comply with the applicable local standards, for example, cables that conform to NEC 70 / NFPA 79 in the USA.

Step	Action
1	Bolt the ground cables to the ground connections (1) of the robot motors (symbol IEC 60417 - 5019) (tightening torque: 2.9 Nm (25.7 lbf-in). 

⚠ ⚠ DANGER

ELECTRIC SHOCK DUE TO IMPROPER GROUNDING

- Ground robot components in accordance with local standards and regulations at a single, central point.
- Verify whether the motors are connected to the central ground.

Failure to follow these instructions will result in death or serious injury.

Multipoint grounding is permissible if connections are made to an equipotential ground plane dimensioned to help avoid cable shield damage in the event of power system short-circuit currents.

Reducing Risks Around the Robot

Step	Action
1	Install external safety-related devices in accordance to local regulations and standards.

Step	Action
2	When designing the safety-related devices, assume that the robot cannot be stopped by internal logic and must necessarily be stopped by the external safety-related devices. **NOTE:** More information about the circuitry of emergency stop and additional protection elements is contained in the document *Lexium 52 Hardware Guide* or *Lexium 62 Hardware Guide* or *Lexium 62 ILM Hardware Guide*.

Section 4.4
Initial Start-Up

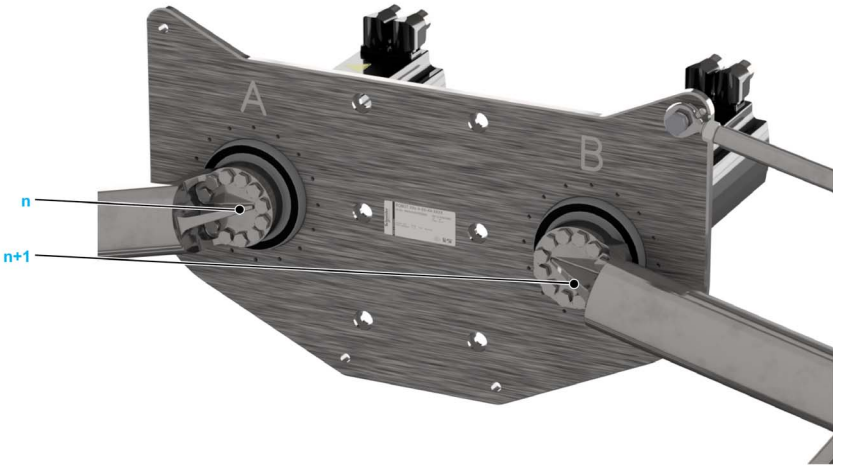
What Is in This Section?

This section contains the following topics:

Allocation of the Sercos Addresses

Presentation

Allocate the Sercos addresses of the servo amplifiers on the two main axes in ascending order and from left to right, as also shown by engraved letters on the mounting plate.



Parametrization of the Robot Mechanics

Parametrization of the Robot Mechanics by Means of the `SchneiderElectricRobotics` Library

Use the `SchneiderElectricRobotics` library for operating the T-Series robots. The `SchneiderElectricRobotics` library facilitates the parametrization and increases the possible payload, the accuracy, and the performance of the system.

For further information about using the `SchneiderElectricRobotics` library, refer to *SchneiderElectricRobotics Library Guide* in the *SoMachine Motion online help*.

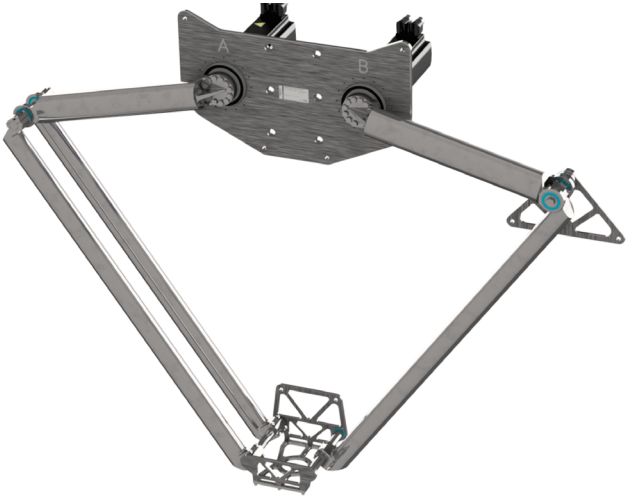
Manual Parametrization of the Robot Mechanics

Depending on the application, individual values may or must be adapted or optimized. This must be effected relative to the payload, path, permissible tracking deviation, and so on.

Mounting the Lower Arms with Parallel Plate

Overview

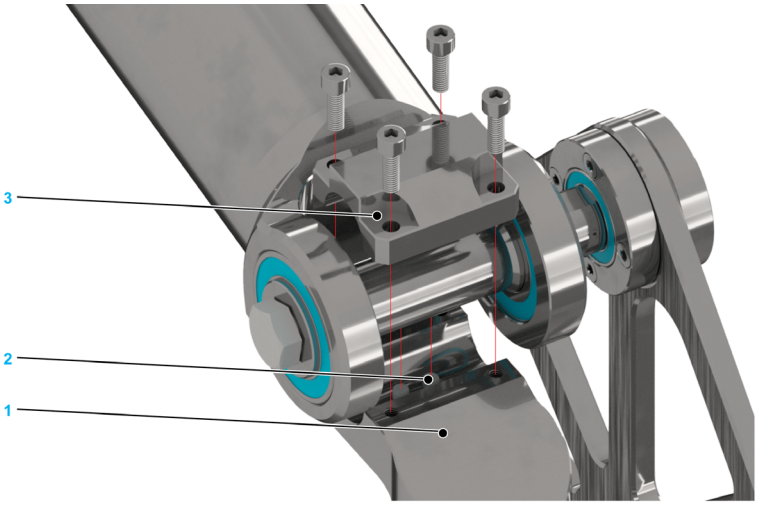
In the following procedures, the single lower arm with parallel plate is mounted to the right side and the double lower arm is mounted to the left side of the T-Series robot (see following figure). Alternatively, you can switch the mounting sides of the single lower arm with parallel plate and the double lower arm.



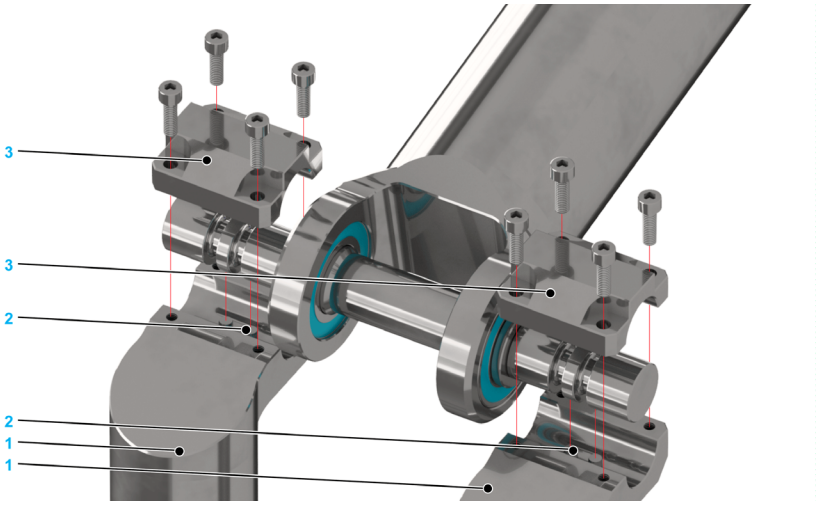
For further information on changing the mounting sides, your local Schneider Electric service representative.

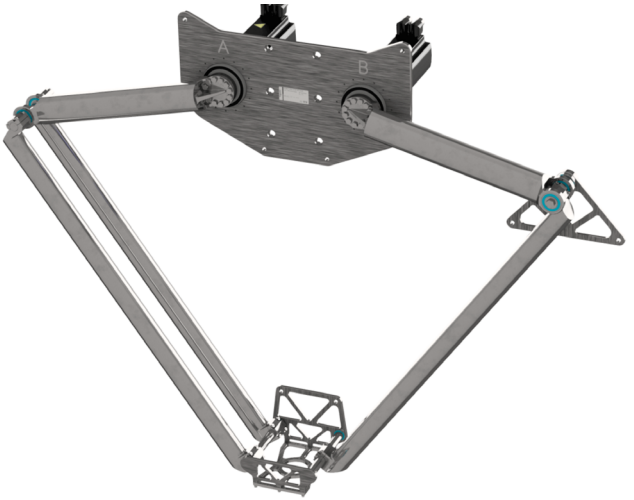
Mounting the Single Lower Arm with Parallel Plate

Step	Action
1	Verify that the premounted combination of lower arms and parallel plate show no visible signs of transport damage. **NOTE:** If there are visible signs of transport damage, then replace the parts.

Step	Action
2	Push the single lower arm (1) with its upper end to the mid of the upper arm. 
3	Verify that the two pins (2) of the lower arm are fitting correctly into the upper arm shaft.
4	Mount a half shell to fix lower arm by attaching four screws (M5 x 16) to the half shell (3), tightening torque 4.7 Nm (42 lbf-in).

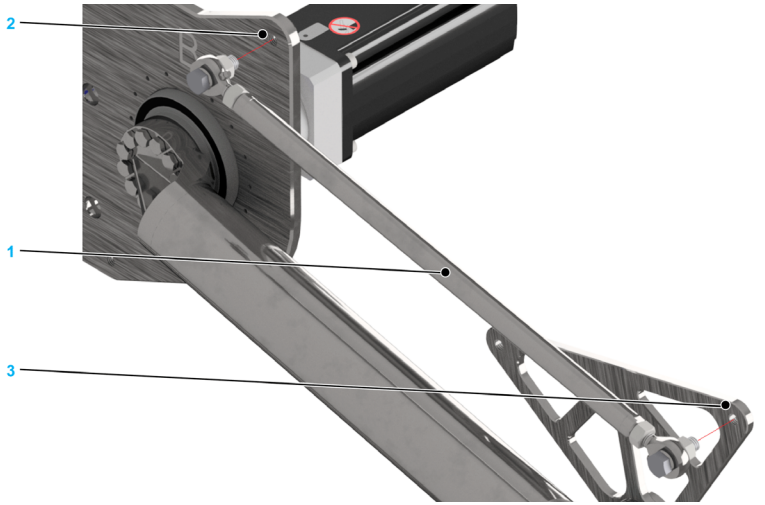
Mounting Double Lower Arms with Parallel Plate

Step	Action
1	Push both lower arms (1) with their upper ends to the left and right of the upper arm. 
2	Verify that the two pins (2) of both lower arms are fitting correctly into the upper arm shaft.
3	Mount two half shells to fix lower arms by attaching four screws (M5 x 16) to each half shell (3), tightening torque 4.7 Nm (42 lbf-in).

Step	Action
4	Verify that the robot configuration corresponds to the following graphic.  **NOTE:** Alternatively, the mounting sides of the single lower arm and the double lower arm can be switched.

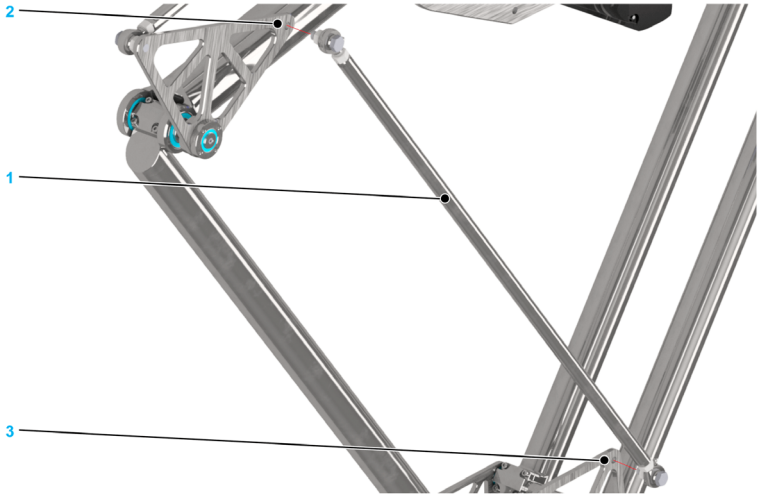
Mounting the Rods for Parallel Linkage

Mounting the Upper Parallel Rod

Step	Action
1	Verify that the short rod shows no visible signs of transport damage. **NOTE:** If there are visible signs of transport damage, then replace the part.
2	Screw both ends of the short rod (1) to the shown positions of mounting plate (2) and lever parallel linkage (3). 
3	Verify the position of the lever parallel linkage (3).

Mounting the Lower Parallel Rod

Step	Action
1	Verify that the long rod shows no visible signs of transport damage. **NOTE:** If there are visible signs of transport damage, then replace the part.

Step	Action
2	Screw both ends of the long rod (1) to the shown positions of lever parallel linkage (2) and parallel plate (3). 
3	Verify the position of the parallel plate (3).

Setting the Monitoring

Operating Library

Use the `SchneiderElectricRobotics` library for operating the T-Series robots.

Software Limits for Working Area

For definition of application-specific software limits, refer to *SoMachine Motion online help*.

Verify Brake Voltage

Verify the brake voltage as an incorrect voltage may cause premature wear of the brakes.

For further information, observe the respective operating instructions of the motors:

- VRKT•M•: *MH3 Servo motor Motor Manual*
- VRKT•L•: *Lexium 62 ILM Hardware Guide*

Testing Additional Protective Devices

- Verify the emergency stop, operator protective device, and device for releasing the brakes.
- Comply with the relevant standards, design the protective devices such that the robot is stopped without leaving the path (Safe Stop 1 (SS1), synchronous).

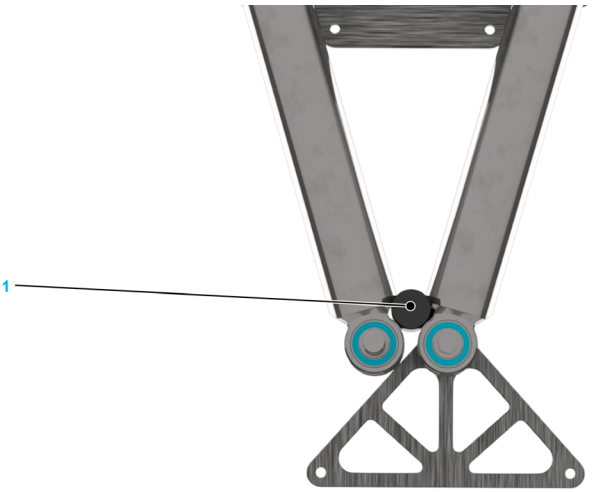
For further information, refer to *Lexium 52 Hardware Guide* or *Lexium 62 Hardware Guide*.

Verify the Monitoring

- Slowly move the robot beyond the limits of the preset work envelope in order to verify whether this is prevented by the preset monitoring.
- Individually move the upper arms beyond the maximum/minimum angles in order to verify whether this is prevented by the preset monitoring.

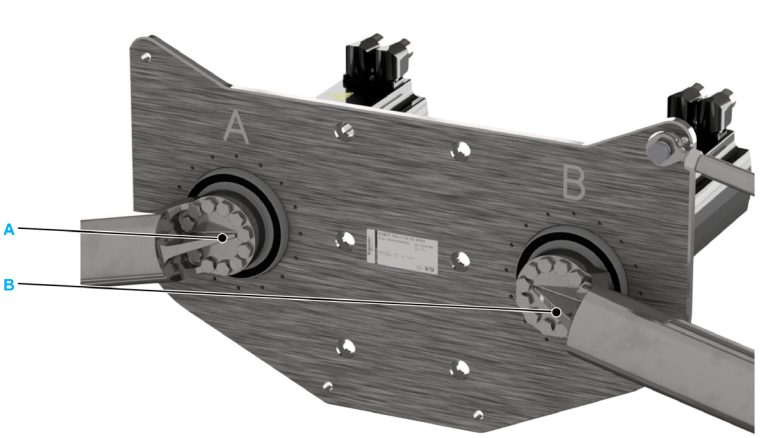
Verifying the Installation

Verifying the Calibration

Step	Action
1	Mount the calibration tool (1) to one of the upper arms. 
2	Open brakes.
3	Rotate both upper arms carefully inwards until the calibration tool contacts both arms as shown (calibration position).
4	Verify that the angle of both upper arms indicated is: ● For T2: -114.31° (+/-0.1°) ● For T3: -110.75° (+/-0.1°) ● For T5: -106.12° (+/-0.1°) For further information, refer to *Calibration of the Robot Mechanics* *(see page 161)*.
5	Move the arms outward again until they are in a horizontal position (motor position approximately 0°).

Verifying the Motor Direction of Rotation

Step	Action
1	Slowly move upper arms by hand upwards and downwards.
2	Verify whether the direction of rotation is correct. Upwards movement means increasing angle, downwards movement decreasing angle at both arms.

Step	Action
3	Verify whether the parameterized motor moves and the motors A and B are arranged as in the following graphic. 

For further information, refer to *Allocation of the Sercos Adresses* *(see page 111)*.

Example: Parameters for Manual Jogging of the Two Main Axes

```
//Set motion parameter for movements of all robot axes
stRobotInterface.iq_ifManual.SetParameter(
i_etComponent              := ROB.ET_RobotComponent.AxisAll,
i_lrMaxVelocity            := 1.0,
i_lrMaxAcceleration        := 10.0,
i_lrMaxDeceleration        := 0,
i_lrRamp                   := 50.0,
i_lrMaxDistance            := 0.0,
q_etDiag                   => etDiag,
q_etDiagExt                => etDiagExtRM,
q_sMsg                     => sMsgBuffer);
```

Verifying the Coordinate System of the Robot

Step	Action
1	Manually move the robot slowly in the direction of an axis of the coordinate system.
2	Verify whether the robot moves in a straight line in the direction of the axis.
3	Verify whether the robot moves in a straight line in a positive or negative direction of the coordinate system.
4	Repeat the process for all axes of the coordinate system.

For example parameters for manual jogging within the cartesian coordinate system, refer to *Example: Parameters for Manual Jogging of the Two Main Axes* *(see page 121)*.

In case the robot does not move in a straight line on the path, proceed as follows:

Step	Action
1	Select the robot type when using the `SchneiderElectricRobotics` library.
2	When not using the `SchneiderElectricRobotics` library, verify the correct parametrization of the transformation and the axes.
3	Verify calibration again *(see page 120)*.
4	Verify the direction of rotation of the drives *(see page 120)*.
5	Carry out a calibration of the robot *(see page 160)* if required.

In case the robot moves along a straight line but not in the direction of the required coordinate system, proceed as follows:

Step	Action
1	Verify the definition of the coordinate system on the transformation.
2	Verify the definition of the motors in the correct sequence *(see page 120)*.

Start-Up

Overview

When the robot is operated for the first time, there is a risk of unintended equipment operation caused by possible wiring errors or unsuitable parameters.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Verify that the robot is properly fastened so it cannot come loose even in the case of fast acceleration.
- Take all necessary measures to ensure that the moving parts of the robot cannot move in an unanticipated way.
- Verify that a working button for emergency stop is within reach of the zone of operation.
- Verify that the system is free and ready for the movement before starting the system.
- Run initial tests at reduced velocity.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

If the motor power supply is disabled unintentionally, for example as a result of power outage, errors or functions, the motor is no longer decelerated in a controlled way.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Verify that movements without braking effect cannot cause injuries or equipment damage.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The metal surfaces of the product may exceed 85 °C (185 °F) during operation.

⚠ WARNING

HOT SURFACES

- Avoid unprotected contact with hot surfaces.
- Do not allow flammable or heat-sensitive parts in the immediate vicinity of hot surfaces.
- Verify that the heat dissipation is sufficient by performing a test run under maximum load conditions.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTE: Perform a start-up in case of an already configured robot when it is used under modified operating conditions. For more information, refer to *Specific Safety Information* *(see page 13)*.

Commissioning Procedure

Step	Action
1	Verify the installation. For more information, refer to *Verifying the Installation* *(see page 120)*.
2	Comply with the instructions provided in the manual of the motor used and in the manual of the drives used.
3	Verify that the loads conform to appropriate, specified payloads for the robot and the machine it contains before operating the product.
4	Limit the maximum torque of the motor in accordance with the maximum driving torque of the robot.
5	Perform initial tests at reduced velocity.
6	Verify that the ambient conditions conform to the appropriate, specified environments for the robot and the machine it contains. For details, refer to *Ambient Conditions* *(see page 36)*.

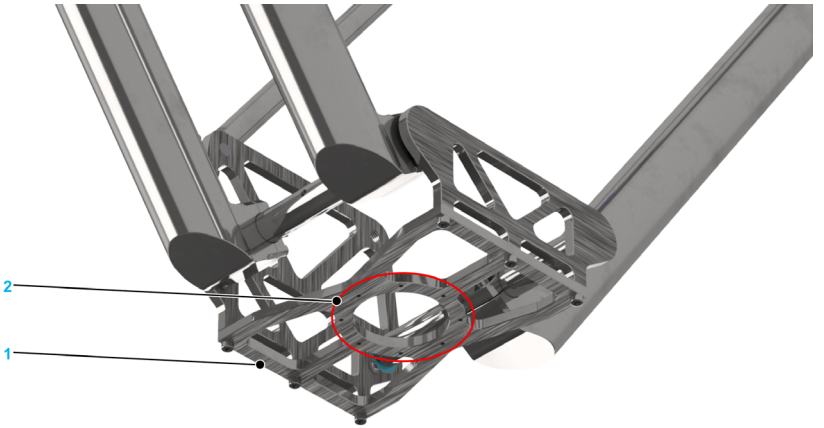
Section 4.5
Mounting the Payload

What Is in This Section?

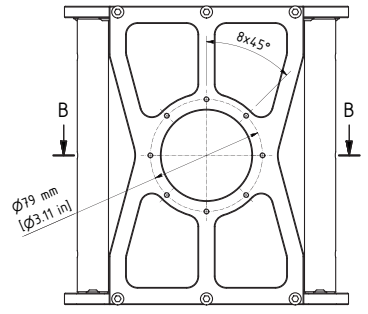
This section contains the following topics:

Mounting the Gripper

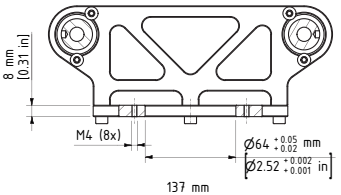
Mounting the Gripper

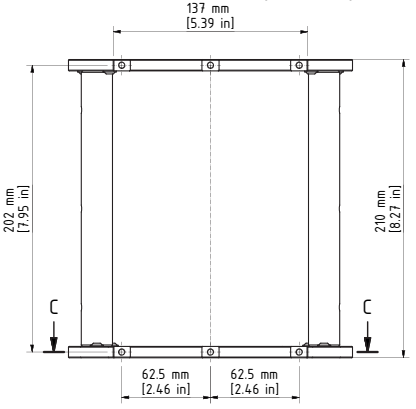
Step	Action
1	Bolt down the gripper to the bolt-on points provided for this purpose on the parallel plate (1): ● Pitch circle diameter 79 mm (3.1 in): 8 x M4 (2), tightening torque: 1.8 Nm (16 lbf-in); property class of the screws 8.8 or greater or A4-80 or greater.  **NOTE:** ● Observe the permissible weights and distances. For further information, refer to *Mechanical and Electrical Data* *(see page 38)*. ● The maximum tilting torque at the parallel plate is 175 Nm (1549 lbf-in). For further information, refer to *Load Capacity Diagram* *(see page 73)*.

Flange Dimensions for T-Series Robots

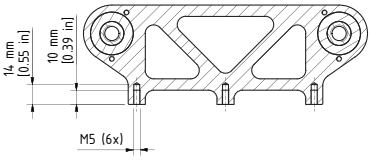


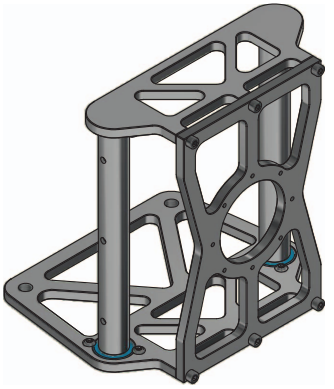
B-B (1 : 2)

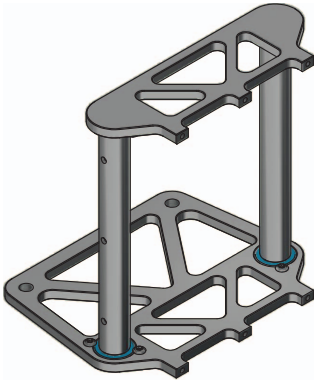




C-C (1 : 2)





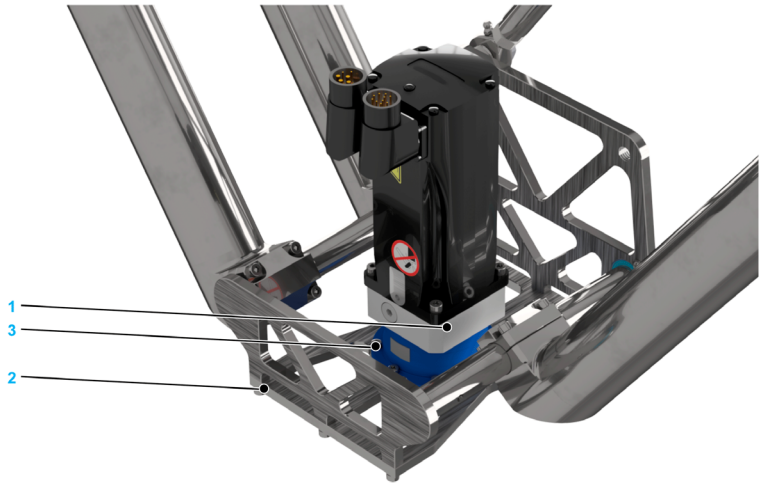


Mounting a Rotational Drive Unit

Overview

You can mount a gearbox/motor combination at the bolt-on points for the gripper. This unit could be used for rotating an attached gripper or drive mechanical components inside an end-effector system. The appropriate combination of motor and gearbox has to be determined according to the application specifications. The mounting flange is compatible to many commonly used gearboxes.

Mounting a Rotational Drive Unit

Step	Action
1	Bolt down the gearbox (1) to the bolt-on points provided for this purpose on the parallel plate (2). ● Pitch circle diameter 79 mm (3.1 in): 8 x M4 (3), tightening torque: 1.8 Nm (16 lbf-in); property class of the screws 8.8 or greater or A4-80 or greater.  **NOTE:** ● Observe the permissible weights and distances. For further information, refer to *Mechanical and Electrical Data* *(see page 38)*. ● The maximum tilting torque at the parallel plate is 175 Nm (1549 lbf-in). For further information, refer to *Load Capacity Diagram* *(see page 73)*.
2	Ground the gearbox/motor combination in accordance with local standards and regulations at a single, central point. **NOTE:** When grounding the robot, use cables that comply with the applicable local standards, for example, cables that conform to NEC 70 / NFPA 79 in the USA.

⚠ ⚠ DANGER

ELECTRIC SHOCK DUE TO IMPROPER GROUNDING

- Ground robot components in accordance with local standards and regulations at a single, central point.
- Verify whether the motors are connected to the central ground.

Failure to follow these instructions will result in death or serious injury.

Multipoint grounding is permissible if connections are made to an equipotential ground plane dimensioned to help avoid cable shield damage in the event of power system short-circuit currents.

Supply of the Gripper

Feeding the Media to the Gripper

Feed in the media line from cables, hoses, and so on, via the upper and lower arms to the parallel plate.

NOTE: Ensure that additional loads on the upper and lower arms are minimal. Distribute additional loads to different arms, if possible. As far as possible, attach the additional loads to the lower arms in such a way that a distorting of the arms due to dynamic forces is avoided as much as possible.

NOTICE
HIGH WEAR AND/OR DAMAGED BEARINGS Distribute loads to lower arms in a way that minimizes the rotational forces on the arms. **Failure to follow these instructions can result in equipment damage.**

Chapter 5
Maintenance and Repair

What Is in This Chapter?

This chapter contains the following sections:

Section 5.1
Maintenance, Repair, and Cleaning

What Is in This Section?

This section contains the following topics:

General Information About Maintenance, Repair, and Cleaning

Overview

The use and application of the information contained herein require expertise in the design and programming of automated control systems. Only you, the user, machine builder or integrator, can be aware of all the conditions and factors present during installation and setup, operation, repair, and maintenance of the machine or process.

You must also consider any applicable standards and/or regulations with respect to grounding of all equipment. Verify compliance with any safety information, different electrical requirements, and normative standards that apply to your machine or process in the use of this equipment.

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires.
- Place a "Do Not Turn On" or equivalent hazard label on all power switches and lock them in the non-energized position.
- Wait 15 minutes to allow the residual energy of the DC bus capacitors to discharge.
- Measure the voltage on the DC bus with a properly rated voltage sensing device and verify that the voltage is less than 42.4 Vdc.
- Do not assume that the DC bus is voltage-free when the DC bus LED is off.
- Block the motor shaft to prevent rotation prior to performing any type of work on the drive system.
- Do not create a short-circuit across the DC bus terminals or the DC bus capacitors.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

Failure to follow these instructions will result in death or serious injury.

Servicing

In case of issues which cannot be resolved, contact your local Schneider Electric service representative with the following information:

- Type plate information (type, identification number, serial number, DOM, and so on)
- Detailed description of the issue
- Previous and associated circumstances

Maintenance Plan

Overview

The maintenance intervals may have to be adapted to the greatly varying service lives depending on the application.

For procedures to replace the different parts, refer to *Replacing Parts* *(see page 145)*.

Maintenance Schedule

Interval	Action
Every 150 hours of operation or weekly	• Verify robot by visual inspection for any damage or missing parts. Especially moving parts and parts at risk for collisions like grippers, upper arms, lower arms, parallel plate, or parallel linkage rods. • Replace arms or parallel linkage rods if these are bent or dented. • Clean robot mechanics.
Every 1000 hours of operation or every three months	• Verify all moving parts for bolted connections. • Verify output shaft sealing of gearboxes for deposits of dirt and clean.
Every 3000 hours of operation or every six months	• Verify the arm-bearings and replace them if necessary. • Verify the parallel plate bearings and replace them if necessary.
Annually	• Verify the parallel rod system and replace or lubricate the ball ends of the parallel rods with a grease gun, if necessary.
Annually or after an uncontrolled stop (stop category 0)	• Verify the brake function during operation. For further information, refer to the corresponding motor manual.
Every 20000 hours of operation	• Replace main gearboxes and motors.
Every 40000 hours of operation	• Replace upper arms.
Every 1000 emergency stop situations	• Replace upper arms.

NOTE: The gearbox and the bearings have been lubricated for life.

Maintaining the Upper Arm Bearings

Maintaining the Upper Arm Bearings

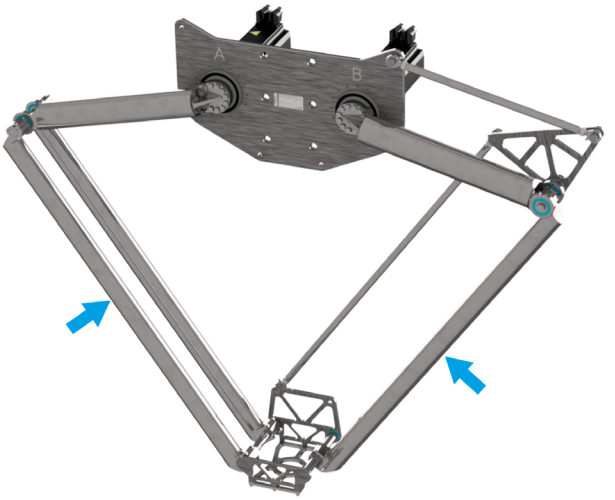
Periodically verify and replace upper arms with mounted ball bearings in accordance with the maintenance schedule *(see page 134)*.

Small amounts of grease at the ball bearings do not constitute damage. Carefully remove deposits at the bearing seals using a lint-free cloth.

NOTICE
DAMAGED BEARINGS ● Use a lint-free cloth for cleaning. ● Do not clean dry deposits using compressed air. ● Do not use solvents such as trichloroethylene, tetrachloromethane, or hydrocarbons nor sharp-edged objects, emery cloth, or emery paper. ● Minimize the mechanical impacts when cleaning. **Failure to follow these instructions can result in equipment damage.**

Verifying the Wear of the Upper Arm Bearings

Step	Action
1	**NOTE:** Do **not** remove the robot arm for this verification. Move both robot upper arms in a horizontal position.

Step	Action
2	Test the bearings for backlash by pushing and pulling the lower arms perpendicular to the robot working plane (apply about 30 N (6.7 lbf) at the middle of the lower arm). **NOTE:** When testing, differentiate between the real backlash of the system as opposed to the resistance of the components to movement. 
3	Replace the upper arm with mounted ball bearings if the noticed backlash exceeds the needs of your application. For further information, refer to *Replacing the Upper Arms* *(see page 154)*.

Maintaining the Parallel Plate Bearings

Maintaining the Parallel Plate Bearings

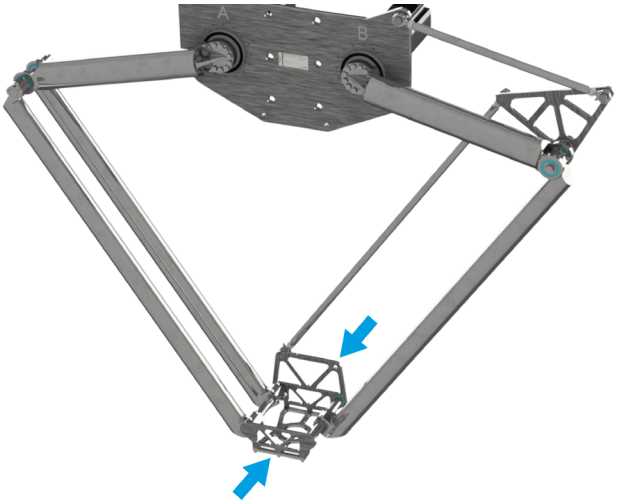
Periodically verify and replace the parallel plate bearings in accordance with the maintenance schedule *(see page 134)*.

Small amounts of grease at the ball bearings do not constitute damage. Carefully remove deposits at the bearing seals using a lint-free cloth.

NOTICE
DAMAGED BEARINGS ● Use a lint-free cloth for cleaning. ● Do not clean dry deposits using compressed air. ● Do not use solvents such as trichloroethylene, tetrachloromethane, or hydrocarbons nor sharp-edged objects, emery cloth, or emery paper. ● Minimize the mechanical impacts when cleaning. **Failure to follow these instructions can result in equipment damage.**

Verifying the Wear of the Parallel Plate Bearings

Step	Action
1	**NOTE:** Do **not** remove the robot arm for this verification. Move both robot upper arms in a horizontal position.

Step	Action
2	Test the bearings for backlash by pushing, pulling and tilting the parallel plate (apply about 10 N (2.25 lbf) in the middle of the parallel plate). **NOTE:** When testing, differentiate between the real backlash of the system as opposed to the resistance of the components to movement. 
3	Replace the parallel plate bearings if the noticed backlash exceeds the needs of your application. For further information, refer to *Replacing the Parallel Plate Bearings* *(see page 151)*.

Maintaining the Parallel Rod System

Maintaining the Parallel Rod System

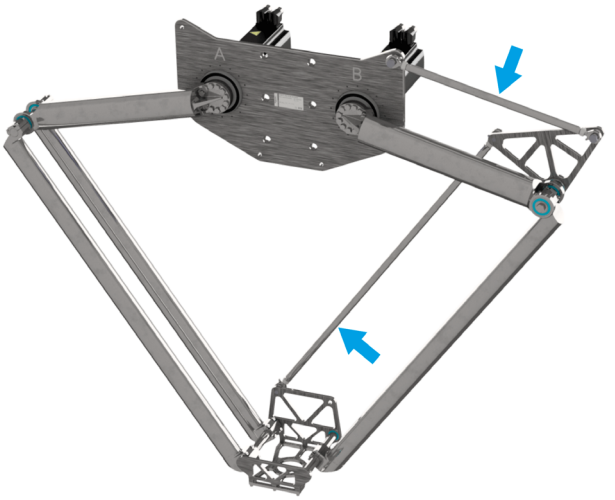
Periodically verify and replace the parallel rods in accordance with the maintenance schedule *(see page 134)*.

Small amounts of grease at the ball end bearings do not constitute damage. Carefully remove deposits at the bearing seals using a lint-free cloth.

NOTICE
DAMAGED BEARINGS ● Use a lint-free cloth for cleaning. ● Do not clean dry deposits using compressed air. ● Do not use solvents such as trichloroethylene, tetrachloromethane, or hydrocarbons nor sharp-edged objects, emery cloth, or emery paper. ● Minimize the mechanical impacts when cleaning. **Failure to follow these instructions can result in equipment damage.**

Verifying the Wear of the Parallel Rod Ball End Bearings

Step	Action
1	**NOTE:** Do **not** remove the robot arm for this verification. Move both robot upper arms in a horizontal position.

Step	Action
2	Test the bearings for backlash by pushing and pulling both parallel rods perpendicular to the robot working plane (apply about 30 N (6.7 lbf) at the middle of the rods). **NOTE:** When testing, differentiate between the real backlash of the system as opposed to the resistance of the components to movement. 
3	Replace the parallel rod if the noticed backlash exceeds the needs of your application. For further information, refer to *Replacing the Parallel Rods (see page 153)*.

Lubricating the Parallel Rod System

Step	Action
1	Use aluminum-complex-soap grease, approved according to USDA H1. Temperature range: -45…+120 °C (-49…+248 °F)
2	Apply grease by using a grease gun to the grease nipple, DIN 71412 H1 (minimum size 12).

Maintaining the Motor

Overview

For information about maintaining the motor, refer to the corresponding motor manual.

Maintaining the Gearbox

Maintaining the Gearbox

Step	Action
1	In accordance with the maintenance schedule *(see page 134)*, periodically verify the gearbox by visual inspection for leakages and deposits of dirt on the gearbox output shaft sealing.
2	Carefully remove deposits.
3	In case of a leakage, contact your local Schneider Electric service representative.
4	To clean the gearbox, use lint-free cloths.

NOTICE

DAMAGED GEARBOXES

- Use lint-free cloth for cleaning.
- Do not clean dry deposits using compressed air.
- Do not use solvents such as trichloroethylene, tetrachloromethane, or hydrocarbons nor sharp-edged objects, emery cloth, or emery paper.
- Minimize the mechanical impacts when cleaning.

Failure to follow these instructions can result in equipment damage.

Cleaning

Overview

Care must be taken with cleaning products as some active agents may have deleterious effects on plastics and stainless steel.

NOTICE
CORROSION CAUSED BY CLEANING AGENTS ● Carry out a compatibility test in relation to the cleaning agent and the component affected before using a cleaning agent. ● Do not use alkaline detergent in the interior of the mechanics. ● Do not use any chloride-containing cleaning agents. ● Do not use any sulphuric acid containing detergent. **Failure to follow these instructions can result in equipment damage.**

For more information about the material properties of your components, refer to *Mechanical and Electrical Data* *(see page 38)*.

NOTE: Depending on the operating conditions and requirements, cleaning may be necessary on a more frequent basis.

Cleaning the Robot

Step	Action
1	Use cleaning processes appropriate to the degree of protection *(see page 38)* of the robot.
2	Allow the cleaning agent to act for a short time.
3	Thoroughly rinse the robot with water.
4	Clean robots on a weekly basis in order to help to avoid that abrasions accumulate and pass into production.

Cleaning the Bearings of Moving Parts

NOTE: Particularly in the first hours of operation, a slight sweating of the bearings may occur. This is a result of the manufacturing process and does not constitute damage on the bearings.

Only clean the bearings and seals by wiping with a lint-free cloth or wash-down at low pressure. For further information, refer to *Maintaining the Upper Arm Bearings* *(see page 135)*, *Maintaining the Parallel Plate Bearings* *(see page 137)* and *Maintaining the Parallel Rod System* *(see page 139)*.

Cleaning the Gearbox

NOTE: Particularly in the first hours of operation, a slight sweating of the gearboxes may occur. This is a result of the manufacturing process and does not constitute damage on the gearboxes.

Only clean the gearbox flanges and seals by using wiping with lint-free clothes or wash-down at low pressure. For further information, refer to *Maintaining the Gearbox* *(see page 141)*.

Repairing After Collisions

Overview

Components may be damaged as a result of a collision.

⚠ WARNING

FALLING OR EJECTED PARTS

- Thoroughly inspect all components of the robot and all components attached to the robot, including the motor and the gearbox, for damage after a collision.
- Do not use the robot if any of the components are damaged or suspected to be damaged.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Verifying the Robot After a Collision

NOTICE

COLLISION OF COMPONENTS

Replace upper arms, lower arms and/or parallel rods if dents or cracks are observed or otherwise detected.

Failure to follow these instructions can result in equipment damage.

Step	Action
1	Verify the components for completeness. If any components are missing, locate the same and remove them from the surrounding machinery.
2	Replace damaged or missing components.
3	Verify the upper arms, lower arms and parallel rods for visible dents or cracks. Dents reduce the strength of the arms and may cause component breakdown.
4	Verify calibration *(see page 160)* by moving the upper arms to the calibration tool. **NOTE:** If the tolerance requirements for calibration are not met, then replace the upper arms.
5	Verify the lower arms and the parallel rods for straightness.
6	Release the brakes and move the robot manually to verify the ease of operation.
7	Close the brakes and verify that there is small backlash in the gearboxes and no cracking noises.

In case of other repairs beyond those described in the present document, contact your local Schneider Electric service representative.

Section 5.2
Replacing Parts

What Is in This Section?

This section contains the following topics:

Information About Replacing Parts

Overview

The use and application of the information contained herein require expertise in the design and programming of automated control systems. Only you, the user, machine builder or integrator, can be aware of all the conditions and factors present during installation and setup, operation, repair, and maintenance of the machine or process.

You must also consider any applicable standards and/or regulations with respect to grounding of all equipment. Verify compliance with any safety information, different electrical requirements, and normative standards that apply to your machine or process in the use of this equipment.

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires.
- Place a "Do Not Turn On" or equivalent hazard label on all power switches and lock them in the non-energized position.
- Wait 15 minutes to allow the residual energy of the DC bus capacitors to discharge.
- Measure the voltage on the DC bus with a properly rated voltage sensing device and verify that the voltage is less than 42.4 Vdc.
- Do not assume that the DC bus is voltage-free when the DC bus LED is off.
- Block the motor shaft to prevent rotation prior to performing any type of work on the drive system.
- Do not create a short-circuit across the DC bus terminals or the DC bus capacitors.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

Failure to follow these instructions will result in death or serious injury.

The robot heats up significantly when subjected to heavy loads and/or high performances.

The metal surfaces of the robot may exceed 85 °C (185 °F) during operation.

For further information, refer to *Hot Surfaces* *(see page 24)*.

⚠ WARNING

HOT SURFACES

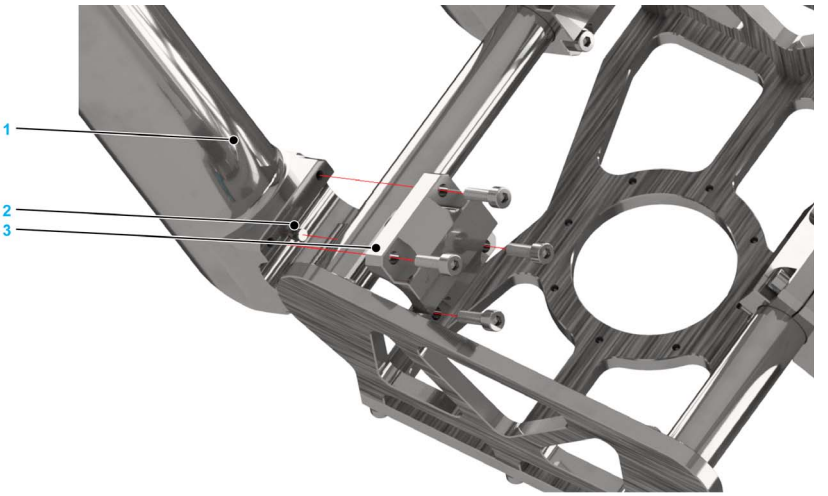
- Avoid unprotected contact with hot surfaces.
- Do not allow flammable or heat-sensitive parts in the immediate vicinity of hot surfaces.
- Verify that the heat dissipation is sufficient by performing a test run under maximum load conditions.

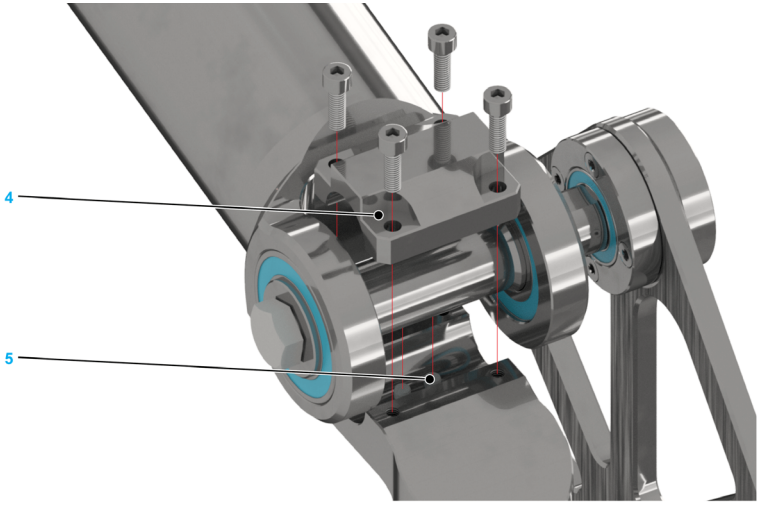
Failure to follow these instructions can result in death, serious injury, or equipment damage.

Replacing the Lower Arms

Replacing the Upper Lower Arms

⚠ WARNING
FALLING HEAVY LOAD Secure in place the parallel plate and lower arm when loosening and removing the bolts. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

Step	Action
1	Carefully remove the lower half shell (3) of the lower arm (1) by removing the four screws at the shell.  **NOTE:** Take care about the indexing bolts (2) of the lower arm.

Step	Action
2	Carefully remove the upper half shell (4) of the lower arm by removing the four screws at the shell.  **NOTE:** Take care about the indexing bolts (5) of the lower arm.
3	Replace the lower arm and mount the shells in reverse order.

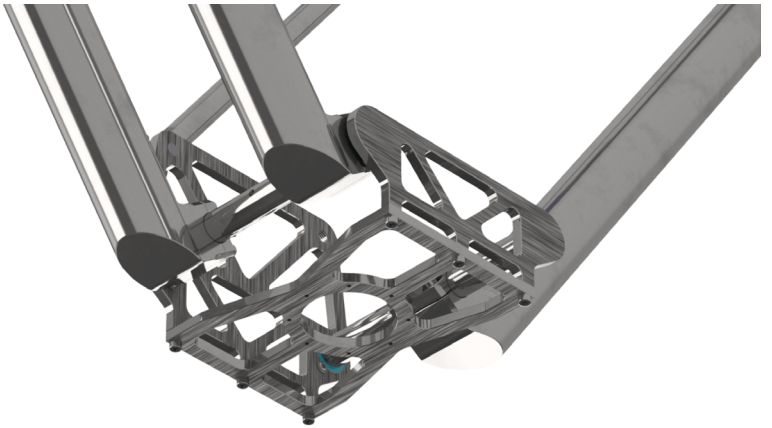
For further information, refer to *Mounting the Lower Arms with Parallel Plate (see page 113)*.

Replacing the Parallel Plate

Replacing the Parallel Plate

Replacing the Parallel Plate

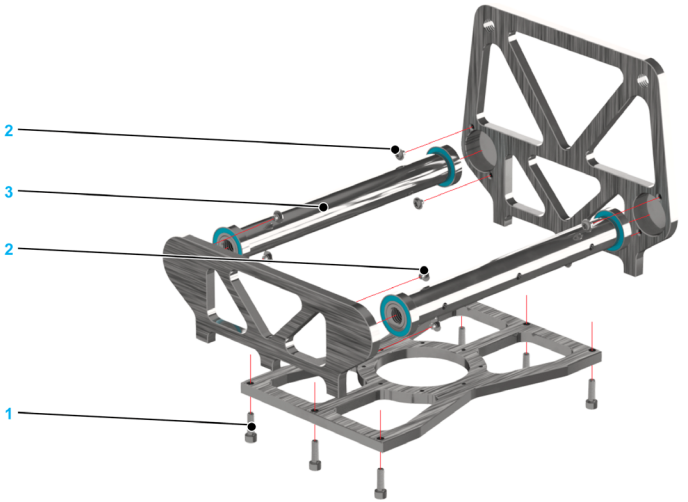
⚠ WARNING
FALLING HEAVY LOAD Secure in place the parallel plate and lower arm when loosening and removing the bolts. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

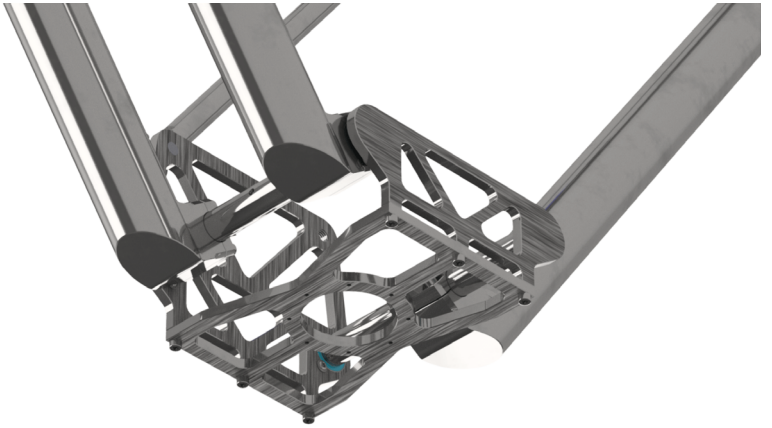
Step	Action
1	Remove the parallel rod by unscrewing it from the parallel plate. For further information, refer to *Replacing the Parallel Rods (see page 153)*.
2	Remove the lower half shells of the lower arms. For further information, refer to *Replacing the Lower Arms (see page 148)*.
3	Fit the new parallel plate with the lower arms.
4	When mounting the parallel plate, ensure that the parallel plate has the same orientation as before.
5	Remount the parallel rod. For further information, refer to *Replacing the Parallel Rods (see page 153)* and *Replacing the Lower Arms (see page 148)*
6	After mounting the parallel plate, move the robot slowly and verify the position of the particular articulation devices. 

Replacing the Parallel Plate Bearings

Replacing the Parallel Plate Bearings

⚠ WARNING
FALLING HEAVY LOAD Secure in place the parallel plate and lower arm when loosening and removing the bolts. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

Step	Action
1	Remove the parallel rod by unscrewing it from the parallel plate. For further information, refer to *Replacing the Parallel Rods (see page 153)*.
2	Remove the lower half shells of the lower arms. For further information, refer to *Replacing the Lower Arms (see page 148)*.
3	Remove the six screws (1) on the bottom of the parallel plate and also remove the eight axle fixings (2) at the bearings. 
4	Mount the new shaft with bearing (3).
5	Fit the parallel plate with lower arms.
6	When mounting the parallel plate, ensure that the parallel plate has the same orientation as before.
7	Remount the parallel rod.

Step	Action
8	After mounting the parallel plate, move the robot slowly and verify the position of the particular articulation devices. 

Replacing the Parallel Rods

Replacing the Parallel Rods

Replacing the Parallel Rods

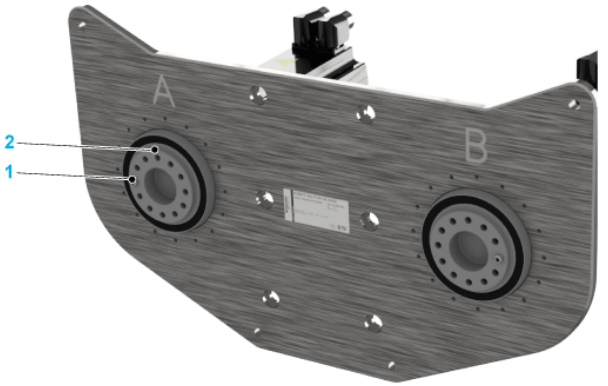
⚠ WARNING
FALLING HEAVY LOAD Secure in place the parallel plate and lower arm when loosening and removing the bolts. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

Step	Action
1	Remove the parallel rod by unscrewing both ends.
2	Fit the new parallel plate rod. For further information, refer to *Mounting the Rods for Parallel Linkage* *(see page 100)*.
3	After mounting a new parallel rod, first move slowly and verify the position of the particular articulation devices.

Replacing the Upper Arms

Replacing the Upper Arms

⚠ WARNING
FALLING HEAVY UPPER ARM Secure in place the upper arm when loosening and removing the bolts. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

Step	Action
1	Remove the parallel plate and the lower arms. For further information, refer to *Replacing the Parallel Plate (see page 150)* and *Replacing the Lower Arms (see page 148)*.
2	Undo the bolts on the upper arm.
3	Pull off the upper arm.
4	Verify whether the threaded pin (1) is in the hole of the gearbox. If there is no threaded pin, insert a new threaded pin at the position (1). 
5	Verify whether the flange surfaces of the gearbox (2) and of the upper arm are free from grease and oil. If necessary, remove grease and oil residues from the upper arm and/or gearbox flange.
6	Bolt down the new upper arm to the gearbox - tightening torque: 22 Nm (195 lbf-in). For more information about stud torques, bolt locking devices and installation notes, refer to the respective dimensional drawing in *Mechanical and Electrical Data (see page 38)*. To reorder the screws, contact your local Schneider Electric service representative.
7	Calibrate the robot mechanics. For further information, refer to Calibration *(see page 160)*.

Step	Action
8	Refit the parallel plate and the lower arms. For further information, refer to *Replacing the Parallel Plate (see page 150)* and *Replacing the Lower Arms (see page 148)*.

NOTICE

INOPERABILITY OF UPPER ARM

Remove all grease and oil residues from the gearbox flange and the upper arm.

Failure to follow these instructions can result in equipment damage.

NOTICE

COLLISION OF COMPONENTS

- Only use the bolts that are prescribed by Schneider Electric.
- Perform a calibration procedure of the robot mechanics after replacement of an upper arm, motor, or gearbox.

Failure to follow these instructions can result in equipment damage.

Replacing the Motor or Gearbox on Main Axis

Overview

The use and application of the information contained herein require expertise in the design and programming of automated control systems. Only you, the user, machine builder or integrator, can be aware of all the conditions and factors present during installation and setup, operation, repair, and maintenance of the machine or process.

You must also consider any applicable standards and/or regulations with respect to grounding of all equipment. Verify compliance with any safety information, different electrical requirements, and normative standards that apply to your machine or process in the use of this equipment.

⚠ ⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires.
- Place a "Do Not Turn On" or equivalent hazard label on all power switches and lock them in the non-energized position.
- Wait 15 minutes to allow the residual energy of the DC bus capacitors to discharge.
- Measure the voltage on the DC bus with a properly rated voltage sensing device and verify that the voltage is less than 42.4 Vdc.
- Do not assume that the DC bus is voltage-free when the DC bus LED is off.
- Block the motor shaft to prevent rotation prior to performing any type of work on the drive system.
- Do not create a short-circuit across the DC bus terminals or the DC bus capacitors.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

Failure to follow these instructions will result in death or serious injury.

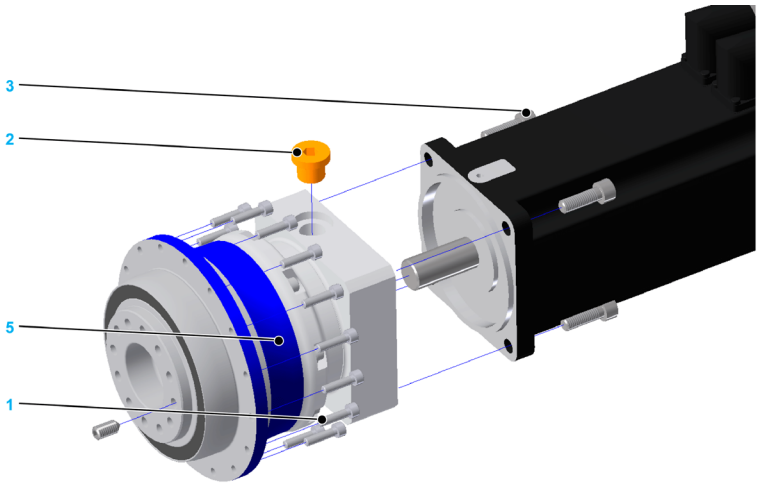
Procedure Overview

Perform the following procedures to replace the motor or gearbox on main axis:

- Removing the motor or gearbox *(see page 157)*
- Mounting the new motor or gearbox *(see page 158)*

Removing the Motor or Gearbox

⚠ WARNING
FALLING HEAVY LOAD Support the motor and gearbox while removing. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

Step	Action
1	Remove the upper arm. Fur further information, refer to *Replacing the Upper Arms* *(see page 154)*.
2	For VRKT•M• robots: Undo the cable bolting of the two motor supply cables and disconnect cables. For VRKT•L• robots: Slightly lift up the locking latch of the hybrid cable and then disconnect the cable.
3	Undo the ground strap to the motor.
4	Remove the ground cable.
5	Undo the 16 bolts (1) by means of which the gearbox is bolted to the mounting plate. 
6	Carefully withdraw the motor and gearbox (5) from the mounting plate in rearward direction. **NOTE:** Do not tilt transmission and do not damage the alignment hole at the mounting plate.
7	Remove the plug screw (2) on the gearbox flange.
8	Remove the four mounting bolts (3) on the motor which connect the motor to the gearbox.

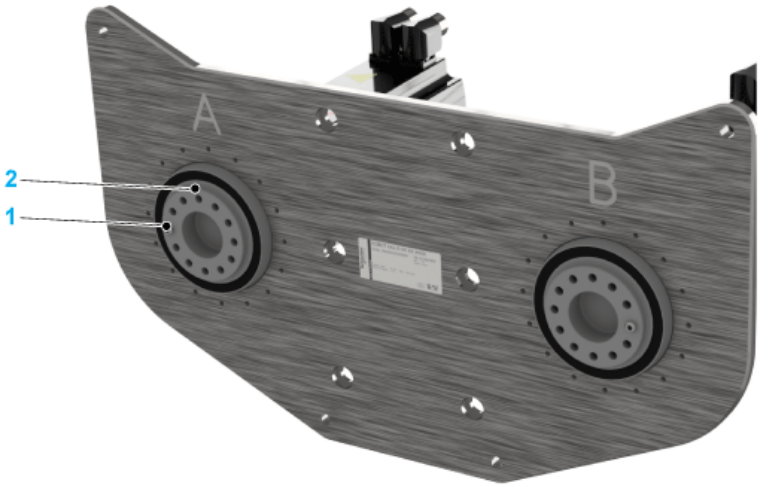
Step	Action
9	Carefully rotate the motor until the screw on the clamping flange appears in the aperture of the plug screw.
10	Loosen the screw in the clamping flange.
11	Withdraw motor carefully from the gearbox.

Mounting the New Motor or Gearbox

NOTE: Ensure that the gearbox and the mounting plate are of the same temperature, as otherwise - in the case of a temperature difference - the gearbox may not fit into the aperture provided.

NOTICE
DISTORTION OF MOTOR AND GEARBOX ● Only bolt down motor and gearbox with all components at the same ambient temperature. ● Only bolt down motor and gearbox in vertical position. **Failure to follow these instructions can result in equipment damage.**

Step	Action
1	Bolt down the motor to the gearbox according to the specifications of the manufacturer supplied with the gearbox. Tightening torques: ● Clamping hub: 14 Nm (124 lbf-in) ● Motor screws: 16 Nm (142 lbf-in)
2	Insert the plug screw into the gearbox flange.
3	Fit the motor/gearbox combination into the robot mounting plate in the orientation specified. For further information, refer to the respective detail drawing in *Mechanical and Electrical Data (see page 38)*.
4	Bolt down the gearbox to the mounting plate - tightening torque: 4.7 Nm (42 lbf-in).
5	Attach the ground strap to the motor - tightening torque: 2.9 Nm (25.7 lbf-in). For further information about motor assembly, refer to: ● VRKT•M•: *MH3 Servo motor Motor Manual* ● VRKT•L•: *Lexium 62 ILM Hardware Guide*
6	Refit motor supply cables and lock in position.

Step	Action
7	In the case of a new gearbox, mount threaded pin (1) as shown in the following graphic. For further information, refer to the respective detail drawing in *Mechanical and Electrical Data (see page 38)*. 
8	Mount the upper arm. For further information, refer to *Replacing the Upper Arms (see page 154)*.
9	Calibrate the robot mechanics. For further information, refer to *Calibration (see page 160)*.
10	Mount the parallel plate and the lower arms. For further information, refer to *Replacing the Parallel Plate (see page 150)* and *Replacing the Lower Arms (see page 148)*.

NOTICE

COLLISION OF COMPONENTS

Perform a calibration procedure of the robot mechanics after replacement of an upper arm, motor, or gearbox.

Failure to follow these instructions can result in equipment damage.

Section 5.3
Calibration

What Is in This Section?

This section contains the following topics:

Calibration of the Robot Mechanics

Overview

The robot has been calibrated in the factory and the data/positions of the axes can be read from the motor encoders. A further alignment is not necessary. However, in a service case, calibration via the control panel may become necessary in order to restore the intended operation.

Carry Out Calibration

Carry out calibration in the following cases:

- Following the replacement of a component (motor, gearbox, upper arm).
- Following deletion or overwriting of the calibration data.

Calibrating the robot mechanics must be carried out by Schneider Electric personnel or appropriately qualified personnel only, as this requires an expert level of knowledge of the PacDrive System.

For this purpose, the `SchneiderElectricRobotics` library contains an interface that has the necessary modes and parameters.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Calibrating the robot mechanics must be carried out by appropriately qualified personnel only.
- Conduct the calibration procedures exactly in the manner and in the order described in the present documentation.
- Use the `SchneiderElectricRobotics` library in conjunction of the calibration of robot mechanics.

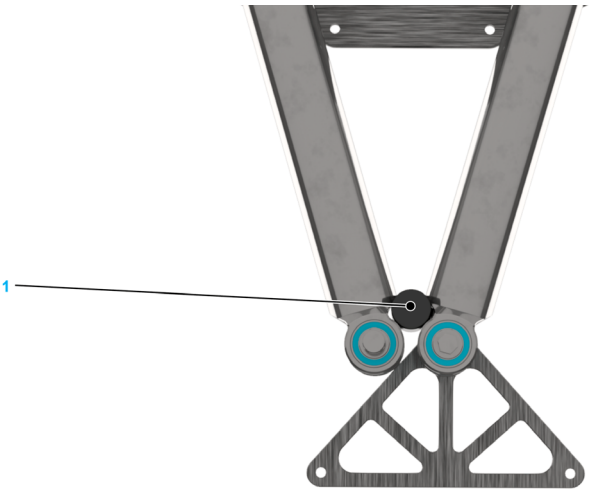
Failure to follow these instructions can result in death, serious injury, or equipment damage.

Calibrating the Main Axes

Preparing the Robot Mechanics for a Calibration Movement

Step	Action
1	Remove the lower arms and the parallel plate. For further information, refer to *Replacing the Lower Arms (see page 148)* and *Replacing the Parallel Plate (see page 150)*.
2	Mount the calibration tool to one of the robot upper arms.
3	Release the brakes.

Calibrating the Main Axes

Step	Action
1	Manually move both upper arms to the calibration position so that both arms touch the calibration tool (1). 
2	Close the brakes.
3	To execute calibration, refer to the Calibration procedure in the *SchneiderElectricRobotics Library Guide*, Chapter *Using SchneiderElectricRobotics, TSeries*.
4	After calibration, move upper arms to a convenient position for lower arm mounting or use calibration mode `MoveToMountPosition` of `SchneiderElectricRobotics` library.
5	Remove the calibration tool.

Step	Action
6	Fit lower arms and parallel plate. For further information, refer to *Replacing the Lower Arms (see page 148)* and *Replacing the Parallel Plate (see page 150)*. **Result:** The robot is calibrated now.

Chapter 6
Replacement Equipment

What Is in This Chapter?

This chapter contains the following topics:

Replacement Equipment Inventory

Overview

Keeping a stock of important components helps ensure that the equipment is ready for operation at all times. Only replace devices with identical types to help ensure compatibility.

Indicate the following information on the replacement equipment order, which can be found on the logistic type plate *(see page 34)*:

Parameter	Example value	Position on type plate
Item name:	Robot T5m-F-NC-35-1500	First line
Item number:	VRKT5M0FNC00000	ID-No
Hardware revision:	S00	HW

Replacement Equipment Stock for T-Series Robots

When using the T-Series robots in a production environment, consider keeping the following replacement equipment packages in stock:

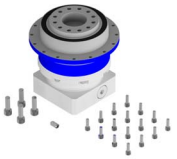
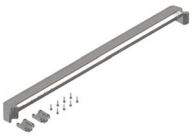
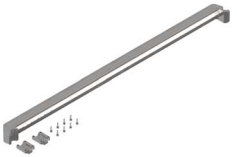
Item number	Item name	Number*		
		T2	T3	T5
VRKT2YYYYY00002	Primary arm with bearings	(1)**	0	0
VRKT3YYYYY00002		0	(1)**	0
VRKT5YYYYY00002		0	0	(1)**
VRKTXYYYYY00003	Gearbox main axis	(1)**	(1)**	(1)**
VRKT2YYYYY00004	Secondary arm - set of two	(1)**	0	0
VRKT3YYYYY00004		0	(1)**	0
VRKT5YYYYY00004		0	0	(1)**
VRKTXYYYYY00006	Shaft parallel plate with bearings	1 (2)**	1 (2)**	1 (2)**
VRKT2YYYYY00007	Parallel linkage rod long	(1)**	0	0
VRKT3YYYYY00007		0	(1)**	0
VRKT5YYYYY00007		0	0	(1)**
VRKT2YYYYY00008	Parallel linkage rod short	(1)**	0	0
VRKT3YYYYY00008		0	(1)**	0
VRKT5YYYYY00008		0	0	(1)**
VRKTXYYYYY00009	Lever parallel linkage	(1)**	(1)**	(1)**
VRKTXYYYYY00010	Bearing parallel linkage	1	1	1

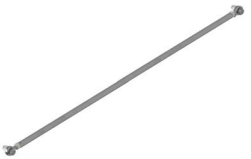
* In the case of multiple robots increase number accordingly.
** Only if there are increased requirements on the availability of the machine.

Replacement Equipment of the T-Series Robots

Replacement Equipment

Item no.	Item description and content	To be used for...
VRKTXYYYYY00001 	Calibration tool: ● 1x calibration tool	All
VRKT2YYYYY00002 	Primary arm with bearings and bolts: ● 1x primary arm complete ● 1x indexing bolt gearing ● 11x screw primary arm	VRKT2•••NC
VRKT3YYYYY00002 	Primary arm with bearings and bolts: ● 1x primary arm complete ● 1x indexing bolt gearing ● 11x screw primary arm	VRKT3•••NC
VRKT5YYYYY00002 	Primary arm with bearings and bolts: ● 1x primary arm complete ● 1x indexing bolt gearing ● 11x screw primary arm	VRKT5•••NC

Item no.	Item description and content	To be used for...
VRKTXYYYYY00003 	Main gearbox with fasteners and indexing bolt: ● 1x gearbox main axis ● 16x screw gearbox/mounting plate ● 4x screw motor/gearbox ● 1x indexing bolt gearbox	All
VRKT2YYYYY00004 	Secondary arm with half shells and fasteners: ● 1x secondary arm complete ● 2x half shell ● 8x screw half shell	VRKT2•••NC
VRKT3YYYYY00004 	Secondary arm with half shells and fasteners: ● 1x secondary arm complete ● 2x half shell ● 8x screw half shell	VRKT3•••NC
VRKT5YYYYY00004 	Secondary arm with half shells and fasteners: ● 1x secondary arm complete ● 2x half shell ● 8x screw half shell	VRKT5•••NC
VRKTXYYYYY00005 	Parallel plate with bearings and shafts: ● 1x parallel plate complete	All

Item no.	Item description and content	To be used for...
VRKTXYYYYY00006 	Two shafts parallel plate with bearings: ● 2x shaft complete with mounted bearings	All
VRKT2YYYYY00007 	Parallel linkage rod long with fasteners: ● 1x linkage rod complete	VRKT2•••NC
VRKT3YYYYY00007 	Parallel linkage rod long with fasteners: ● 1x linkage rod complete	VRKT3•••NC
VRKT5YYYYY00007 	Parallel linkage rod long with fasteners: ● 1x linkage rod complete	VRKT5•••NC
VRKT2YYYYY00008 	Parallel linkage rod short with fasteners: ● 1x linkage rod complete	VRKT2•••NC

Item no.	Item description and content	To be used for...
VRKT3YYYYY00008 	Parallel linkage rod short with fasteners: ● 1x linkage rod complete	VRKT3•••NC
VRKT5YYYYY00008 	Parallel linkage rod short with fasteners: ● 1x linkage rod complete	VRKT5•••NC
VRKTXYYYYY00009 	Lever parallel linkage with bearings: ● 1x lever with shaft and bearings	All
VRKTXYYYYY00010 	Bearing parallel linkage: ● 2x shell with mounted bearings ● 8x screw for shell	All
VRKTXYYYYY00011 	Set fasteners primary arm: ● 11x screw primary arm	All

Item no.	Item description and content	To be used for...
VRKTXYYYYY00012 	Set of mounting shafts secondary arm: ● 2x mounting shaft secondary arm ● 1x distance ring	All
MH31002P02F2200 	PacDrive motor for main axis, MH3 ● 1x motor	VRKT•M0•NC
MH31003P02F2200 	PacDrive motor for main axis, MH3 ● 1x motor	VRKT•M1•NC
ILM1003P02F0000 	PacDrive motor for main axis, Lexium 62 ILM ● 1x motor	VRKT•L••NC

Chapter 7
Troubleshooting

Troubleshooting

Overview

Malfunction	Probable cause	Solution
Trouble with components.	End of component life cycle.	Note the maintenance plan *(see page 134)*.
Rattling noise.	Screw joints came loose.	Verify and tighten the screw joints if necessary.
Oil beads up at new gearbox.	Initial oozing of the new gearbox.	Clean the gearbox dry *(see page 142)*.
Grease at new ball bearing.	Initial oozing of the new bearings.	Clean the ball bearing dry *(see page 142)*.
Extensive position deviation after motor replacement.	Robot is not calibrated.	Calibrate the robot *(see page 160)*.
	Incorrect motor replacement.	Mount the motor correctly *(see page 156)*.

Appendices

What Is in This Appendix?

The appendix contains the following chapters:

Appendix A
Further Information About the Manufacturer

What Is in This Chapter?

This chapter contains the following topics:

Contact Addresses

Schneider Electric Automation GmbH

Schneiderplatz 1

97828 Marktheidenfeld, Germany

Phone: +49 (0) 9391 / 606 - 0

Fax: +49 (0) 9391 / 606 - 4000

Email: info-marktheidenfeld@schneider-electric.com

Internet: *www.schneider-electric.com*

Machine Solution Service

Schneiderplatz 1

97828 Marktheidenfeld, Germany

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Fax: +49 (0) 9391 / 606 - 4000

Email: automation.support.de@schneider-electric.com

Internet: *www.schneider-electric.com*

Additional Contact Addresses

See the homepage for additional contact addresses:

www.schneider-electric.com

Product Training Courses

Product Training Courses

Schneider Electric offers a number of product training courses.

The Schneider Electric training instructors will help you take advantage of the extensive possibilities offered by the system.

See the website (*www.schneider-electric.com*) for further information and the seminar schedule.

Appendix B
Disposal

Disposal

Information on the Disposal of Schneider Electric Products

The robot is delivered on a recyclable ISO plastic pallet. Further packaging comprises cartons and films.

NOTE: The components consist of different materials, which can be reused and must be disposed of separately. Do not return the packaging to the manufacturer.

Dispose of the packaging in accordance with the relevant national regulations.

Dispose of the packaging at the disposal sites provided for this purpose.

Dispose of robot in accordance with the applicable national regulations.

NOTE: The gearbox units contain lubricants whose disposal may be subject to local, regional, or national regulations apart from the packaging.

Appendix C
Declaration of Incorporation

Declaration of Incorporation

Overview

Declaration of Incorporation

According to EC directive 2006/42/EC on machinery (Annex II B)
Document number / Month.Year: RBA2016001.01 / 10.2017
- Original Language -

We: Schneider Electric Automation GmbH
Subsidiary of Schneider Electric SE (FR 92500 Rueil-Malmaison)

Schneiderplatz 1
97828 Marktheidenfeld
Germany

herewith declare, that the partly completed machinery described below:

Trademark:	Schneider Electric
Product, Type, Function:	Robot
Models:	T-Series
Serial Number:	YYZZXXXXXX (YY: Year+10, e.g. 26 = 2016; ZZ: Supplier Code; XXXXXX = cont. number)

with the following references

Reference	Description
VRKT2M****00***	T2 with MH3 motor
VRKT2L****00***	T2 with ILM motor
VRKT2WM***00***	T2 without motors
VRKT3M****00***	T3 with MH3 motor
VRKT3L****00**	T3 with ILM motor
VRKT3WM***00***	T3 without motors
VRKT5M****00***	T5 with MH3 motor
VRKT5L****00***	T5 with ILM motor
VRKT5WM***00***	T5 without motors

* are any letters or numbers not affecting the conformity of the product

is complying with all essential requirements of the Machinery Directive 2006/42/EC, as far as the scope of delivery allows. Additional we declare that the relevant technical documentation is compiled in accordance with part B of Annex VII.

Directive	Fulfilled Requirements	Harmonized Standard
DIRECTIVE 2006/42/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2006 on machinery, and amending Directive 95/16/EC	1.1.2, 1.1.3, 1.1.5, 1.3.2, 1.3.4, 1.3.7, 1.5.1, 1.5.4, 1.5.5, 1.5.6, 1.5.7, 1.5.8, 1.5.10, 1.5.13, 1.6.1, 1.7.1, 1.7.2, 1.7.3, 1.7.4	**EN ISO 10218-1:2011** Robots and robotic devices - Safety requirements for industrial robots - Part 1: Robots

We commit to transmit, in response to a reasoned request by the market surveillance authorities, relevant documents on the partly completed machinery by our documentation department. The method of transmission shall be electronic.

Name and address of the person authorised to compile the technical documentation:
Rainer Ritschel, Schneider Electric Automation GmbH, Schneiderplatz 1, 97828 Marktheidenfeld - Germany

The partly completed machinery must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of Directive 2006/42/EC on Machinery, where appropriate, and until the EC Declaration of Conformity according to Annex II A is issued.

Schneider Electric Automation GmbH
Schneiderplatz 1
97828 Marktheidenfeld
Telefon: 09391 606-0

Issued at: Marktheidenfeld - Germany, 20th October 2017

i.A. Michael Schweizer
Machine Solutions Certification Manager

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