Assembly and Operating Manual

MWPG

Miniature changeover parallel gripper

Superior Clamping and Gripping

SCHUNK®

Imprint

Technical changes:

We reserve the right to make alterations for the purpose of technical improvement.

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Dear Customer,

thank you for trusting our products and our family-owned company, the leading technology supplier of robots and production machines.

Our team is always available to answer any questions on this product and other solutions. Ask us questions and challenge us. We will find a solution!

Best regards,

Your SCHUNK team

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1 General

1.1 About this manual

This manual contains important information for a safe and appropriate use of the product.

This manual is an integral part of the product and must be kept accessible for the personnel at all times.

Before starting work, the personnel must have read and understood this operating manual. Prerequisite for safe working is the observance of all safety instructions in this manual.

Illustrations in this manual are provided for basic understanding and may differ from the actual product design.

In addition to these instructions, the documents listed under Applicable documents [▶ 6] are applicable.

1.1.1 Presentation of Warning Labels

To make risks clear, the following signal words and symbols are used for safety notes.

⚠ DANGER

Danger for persons!

Non-observance will inevitably cause irreversible injury or death.

⚠ WARNING

Dangers for persons!

Non-observance can lead to irreversible injury and even death.

⚠ CAUTION

Dangers for persons!

Non-observance can cause minor injuries.

NOTICE

Material damage!

Information about avoiding material damage.

1.1.2 Applicable documents

- General terms of business*
- Catalog data sheet of the purchased product *
- Assembly and operating manuals of the accessories *

The documents marked with an asterisk (*) can be downloaded on our homepage **schunk.com**

1.1.3 Variants

This operating manual applies to the following variations:

- MWPG without gripping force maintenance
- MWPG with gripping force maintenance "O.D. gripping" (AS)
- MWPG with gripping force maintenance "I.D. gripping" (IS)

1.2 Warranty

If the product is used as intended, the warranty is valid for 24 months from the ex-works delivery date under the following conditions:

- Observe the specified maintenance and lubrication intervals
- Observe the ambient conditions and operating conditions

Parts touching the workpiece and wear parts are not included in the warranty.

1.3 Scope of delivery

The scope of delivery includes

- Miniature changeover parallel gripper MWPG in the version ordered
- Assembly and Operating Manual
- Accessory pack

1.3.1 Accessories kit

Content of the accessory pack:

- 2x set-srew M2x2
- 2x pressure spring
- 4x set-screw M2x4
- 2x O-ring 1.78x1.02 (DIN 3771)
- 1x O-ring 1.07x1.27 (DIN 3771) (only for MWPG 20-NS-VK)
- 1x thorn to mount the top jaws
- 1x Allen key SW 0.9

1.4 Accessories

The following accessories, which must be ordered separately, are required for the product:

ID number	Quantity	Designation
0305627	1	Mounting kit, ONS optical sensor
9942698	1	Sleeve for optical sensor
0301390	1	ONS 01 optical sensor, evaluation box
0301391	1	ONS 01-LWL optical sensor, optical fiber
0305623	1	MWK 20 miniature change head
On request	2	Gripper finger

2 Basic safety notes

2.1 Intended use

The product is designed exclusively for gripping and temporarily holding workpieces or objects.

- The product may only be used within the scope of its technical data, Technical data [▶ 16].
- When implementing and operating components in safety-related parts of the control systems, the basic safety principles in accordance with DIN EN ISO 13849-2 apply. The proven safety principles in accordance with DIN EN ISO 13849-2 also apply to categories 1, 2, 3 and 4.
- The product is intended for installation in a machine/system. The applicable guidelines must be observed and complied with.
- The product is intended for industrial and industry-oriented use.
- Appropriate use of the product includes compliance with all instructions in this manual.

2.2 Not intended use

It is not intended use if the product is used, for example, as a pressing tool, stamping tool, lifting gear, guide for tools, cutting tool, clamping device or a drilling tool.

- Any utilization that exceeds or differs from the appropriate use is regarded as misuse.

2.3 Constructional changes

Implementation of structural changes

By conversions, changes, and reworking, e.g. additional threads, holes, or safety devices can impair the functioning or safety of the product or damage it.

- Structural changes should only be made with the written approval of SCHUNK.

2.4 Spare parts

Use of unauthorized spare parts

Using unauthorized spare parts can endanger personnel and damage the product or cause it to malfunction.

- Use only original spare parts or spares authorized by SCHUNK.

2.5 Gripper fingers

Requirements for the gripper fingers

Stored energy within the product creates the risk of serious injuries and significant property damage.

- Arrange the gripper fingers in a way that the product reaches either the position "open" or "closed" in a de-energized state.
- Only exchange the gripper fingers when no residual energy remains in the product.
- Make sure that the product and the top jaws are a sufficient size for the application.

2.6 Ambient conditions and operating conditions

Required ambient conditions and operating conditions

Incorrect ambient and operating conditions can make the product unsafe, leading to the risk of serious injuries, considerable material damage and/or a significant reduction to the product's life span.

- Make sure that the product is used only in the context of its defined application parameters, Technical data [▶ 16].
- Make sure that the product is a sufficient size for the application.
- Make sure that the environment is free from splash water and vapors as well as from abrasion or processing dust. Exceptions are products that are designed especially for contaminated environments.

2.7 Personnel qualification

Inadequate qualifications of the personnel

If the personnel working with the product is not sufficiently qualified, the result may be serious injuries and significant property damage.

- All work may only be performed by qualified personnel.
- Before working with the product, the personnel must have read and understood the complete assembly and operating manual.
- Observe the national safety regulations and rules and general safety instructions.

The following personal qualifications are necessary for the various activities related to the product:

Trained electrician
Due to their technical training, knowledge and experience, trained electricians are able to work on electrical systems, recognize and avoid possible dangers and know the relevant standards and regulations.

Qualified personnel
Due to its technical training, knowledge and experience, qualified personnel is able to perform the delegated tasks, recognize and avoid possible dangers and knows the relevant standards and regulations.

Instructed person
Instructed persons were instructed by the operator about the delegated tasks and possible dangers due to improper behaviour.

Service personnel of the manufacturer
Due to its technical training, knowledge and experience, service personnel of the manufacturer is able to perform the delegated tasks and to recognize and avoid possible dangers.

2.8 Personal protective equipment

Use of personal protective equipment

Personal protective equipment serves to protect staff against danger which may interfere with their health or safety at work.

- When working on and with the product, observe the occupational health and safety regulations and wear the required personal protective equipment.
- Observe the valid safety and accident prevention regulations.
- Wear protective gloves to guard against sharp edges and corners or rough surfaces.
- Wear heat-resistant protective gloves when handling hot surfaces.
- Wear protective gloves and safety goggles when handling hazardous substances.
- Wear close-fitting protective clothing and also wear long hair in a hairnet when dealing with moving components.

2.9 Notes on safe operation

Incorrect handling of the personnel

Incorrect handling and assembly may impair the product's safety and cause serious injuries and considerable material damage.

- Avoid any manner of working that may interfere with the function and operational safety of the product.
- Use the product as intended.
- Observe the safety notes and assembly instructions.
- Do not expose the product to any corrosive media. This does not apply to products that are designed for special environments.
- Eliminate any malfunction immediately.
- Observe the care and maintenance instructions.
- Observe the current safety, accident prevention and environmental protection regulations regarding the product's application field.

2.10 Transport

Handling during transport

Incorrect handling during transport may impair the product's safety and cause serious injuries and considerable material damage.

- When handling heavy weights, use lifting equipment to lift the product and transport it by appropriate means.
- Secure the product against falling during transportation and handling.
- Stand clear of suspended loads.

2.11 Malfunctions

Behavior in case of malfunctions

- Immediately remove the product from operation and report the malfunction to the responsible departments/persons.
- Order appropriately trained personnel to rectify the malfunction.
- Do not recommission the product until the malfunction has been rectified.
- Test the product after a malfunction to establish whether it still functions properly and no increased risks have arisen.

2.12 Disposal

Handling of disposal

The incorrect handling of disposal may impair the product's safety and cause serious injuries as well as considerable material and environmental harm.

- Follow local regulations on dispatching product components for recycling or proper disposal.

2.13 Fundamental dangers

General

- Observe safety distances.
- Never deactivate safety devices.
- Before commissioning the product, take appropriate protective measures to secure the danger zone.
- Disconnect power sources before installation, modification, maintenance, or calibration. Ensure that no residual energy remains in the system.
- If the energy supply is connected, do not move any parts by hand.
- Do not reach into the open mechanism or movement area of the product during operation.

2.13.1 Protection during handling and assembly

Incorrect handling and assembly

Incorrect handling and assembly may impair the product's safety and cause serious injuries and considerable material damage.

- Have all work carried out by appropriately qualified personnel.
- For all work, secure the product against accidental operation.
- Observe the relevant accident prevention rules.
- Use suitable assembly and transport equipment and take precautions to prevent jamming and crushing.

Incorrect lifting of loads

Falling loads may cause serious injuries and even death.

- Stand clear of suspended loads and do not step into their swiveling range.
- Never move loads without supervision.
- Do not leave suspended loads unattended.

2.13.2 Protection during commissioning and operation

Falling or violently ejected components

Falling and violently ejected components can cause serious injuries and even death.

- Take appropriate protective measures to secure the danger zone.
- Never step into the danger zone during operation.

2.13.3 Protection against dangerous movements

Unexpected movements

Residual energy in the system may cause serious injuries while working with the product.

- Switch off the energy supply, ensure that no residual energy remains and secure against inadvertent reactivation.
- Never rely solely on the response of the monitoring function to avert danger. Until the installed monitors become effective, it must be assumed that the drive movement is faulty, with its action being dependent on the control unit and the current operating condition of the drive. Perform maintenance work, modifications, and attachments outside the danger zone defined by the movement range.
- To avoid accidents and/or material damage, human access to the movement range of the machine must be restricted. Limit/prevent accidental access for people in this area due through technical safety measures. The protective cover and protective fence must be rigid enough to withstand the maximum possible movement energy. EMERGENCY STOP switches must be easily and quickly accessible. Before starting up the machine or automated system, check that the EMERGENCY STOP system is working. Prevent operation of the machine if this protective equipment does not function correctly.

2.13.4 Protection against electric shock

Possible electrostatic energy

Components or assembly groups may become electrostatically charged. When the electrostatic charge is touched, the discharge may trigger a shock reaction leading to injuries.

- The operator must ensure that all components and assembly groups are included in the local potential equalisation in accordance with the applicable regulations.
- While paying attention to the actual conditions of the working environment, the potential equalisation must be implemented by a specialist electrician according to the applicable regulations.
- The effectiveness of the potential equalisation must be verified by executing regular safety measurements.

2.14 Notes on particular risks

⚠ DANGER

Risk of fatal injury from suspended loads!

Falling loads can cause serious injuries and even death.

- Stand clear of suspended loads and do not step within their swiveling range.
- Never move loads without supervision.
- Do not leave suspended loads unattended.
- Wear suitable protective equipment.

⚠ WARNING

Risk of injury from objects falling and being ejected!

Falling and ejected objects during operation can lead to serious injury or death.

- Take appropriate protective measures to secure the danger zone.

⚠ WARNING

Risk of injury due to unexpected movements!

If the power supply is switched on or residual energy remains in the system, components can move unexpectedly and cause serious injuries.

- Before starting any work on the product: Switch off the power supply and secure against restarting.
- Make sure, that no residual energy remains in the system.

⚠ WARNING

Risk of injury from crushing and impacts!

Serious injury could occur during the base jaw procedure and when breaking or loosening the gripper fingers.

- Wear suitable protective equipment.
- Do not reach into the open mechanism or the movement area of the product.

⚠ WARNING

Risk of injury from sharp edges and corners!

Sharp edges and corners can cause cuts.

- Use suitable protective equipment.

⚠ WARNING

Risk of injury due to spring forces!

Parts are under spring tension on products which clamp using spring force or which have gripping force maintenance. While disassembling components can move unexpectedly and cause serious injuries.

- Disassemble the product cautiously.
- Make sure that no residual energy remains in the system.

⚠ WARNING

Risk of injury from objects falling during energy supply failure

Products with a mechanical gripping force maintenance can, during energy supply failure, still move independently in the direction specified by the mechanical gripping force maintenance.

- Secure the end positions of the product with SCHUNK SDV-P pressure maintenance valves.

2.14.1 Functional failure due to faulty operation

NOTE

The O-rings of the direct air connections can be solved.

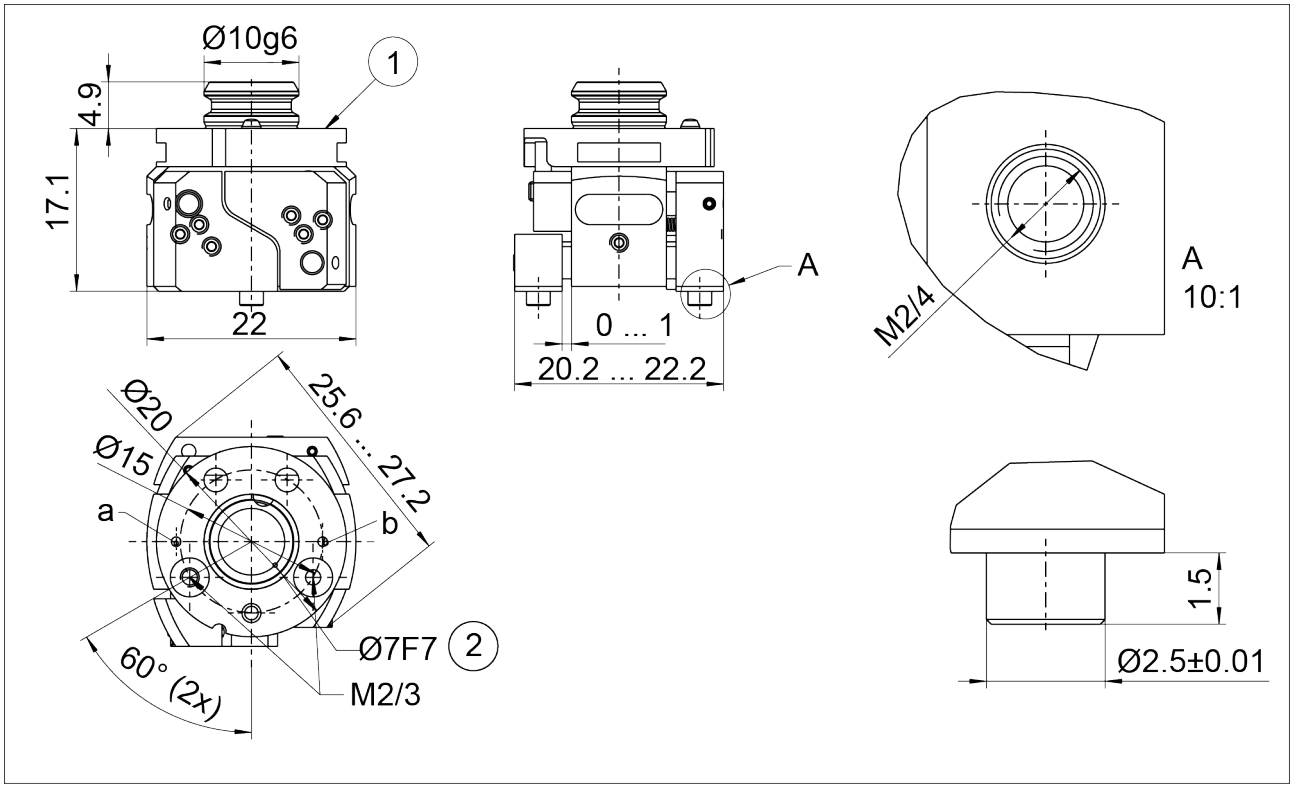
When coupling and uncoupling switch off the energy transfer.

3 Technical data

Size	20
Mechanical operating data	
Weight [kg]	0,026
Dimension	Dimensions [▶ 17]
Max. stroke per finger [mm] (stroke limitation possible)	1
Pressure medium	Compressed air, compressed air quality according to ISO 8573-1:7 4 4
Min. pressure [bar]	3
Max. pressure [bar]	8
Ambient temperature [°C] Min. Max.	 +5 +55
Noise emission [dB(A)]	≤ 70
Operating data for use of MWK 20 miniature change head	
Max. tensile loading [N]	50
Max. static moment [Nm] M_X and M_Y	0,5
Max. static moment M_Z [Nm]	0,2
Locking force [N]	< 15

More technical data is included in the catalog data sheet. Whichever is the latest version.

3.1 Dimensions



Dimensions of the MWPG 20

1	Standard interface complies with DIN 32 565 and ISO 29262, appropriate for the MWK 20 miniature change head
2	Center viewing hole ∅ 7 mm

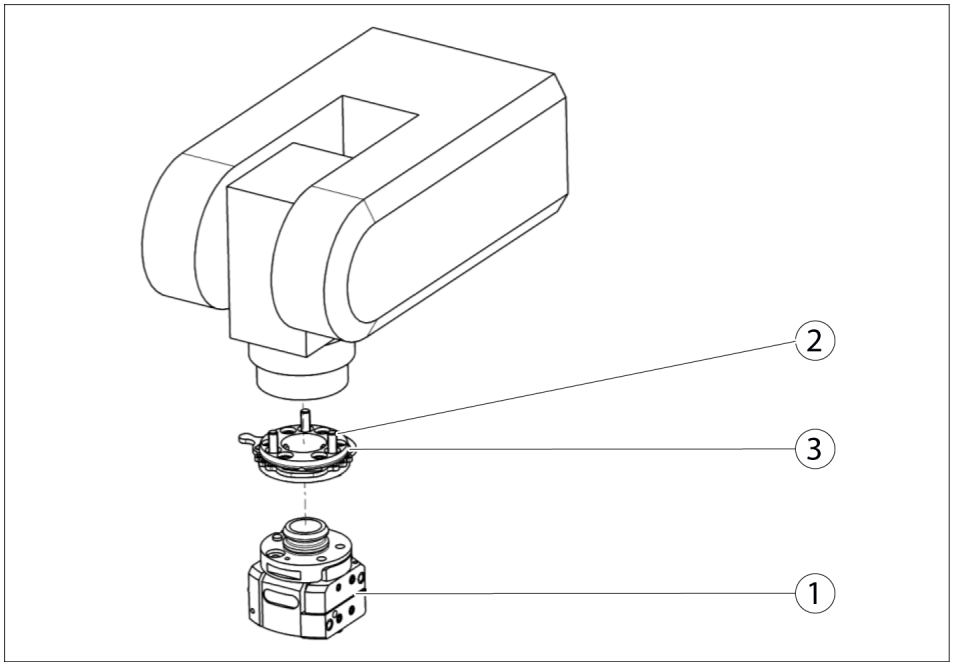
4 Assembly and installation

4.1 Mechanical connection on the MWK miniature change head (standard interface)

⚠ WARNING

Risk of injury when machine/system moves unexpectedly!

- Switch off power supply before assembly and installation.
- Make sure that no residual energy remains in the system.



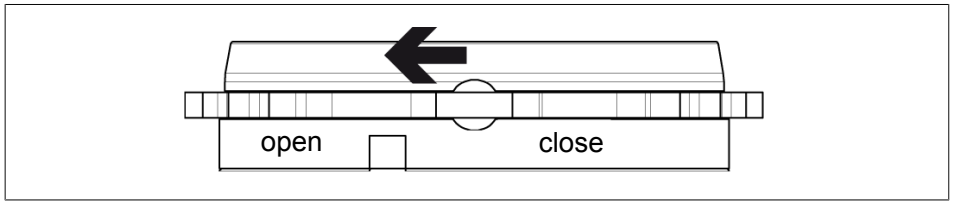
Assembly example with MWK

1	MWPG miniature changeover parallel gripper
2	MWK miniature change head
3	Actuating ring on the MWK

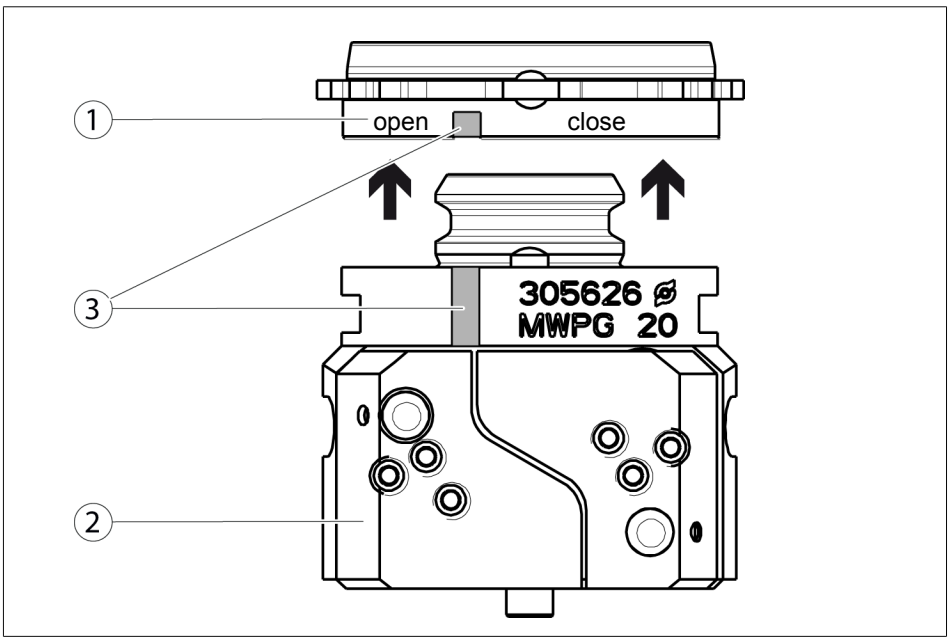
- Miniature change head (MWK) is mounted on the robot.
- All O-rings are inserted at the specified positions in the MWK.

NOTE

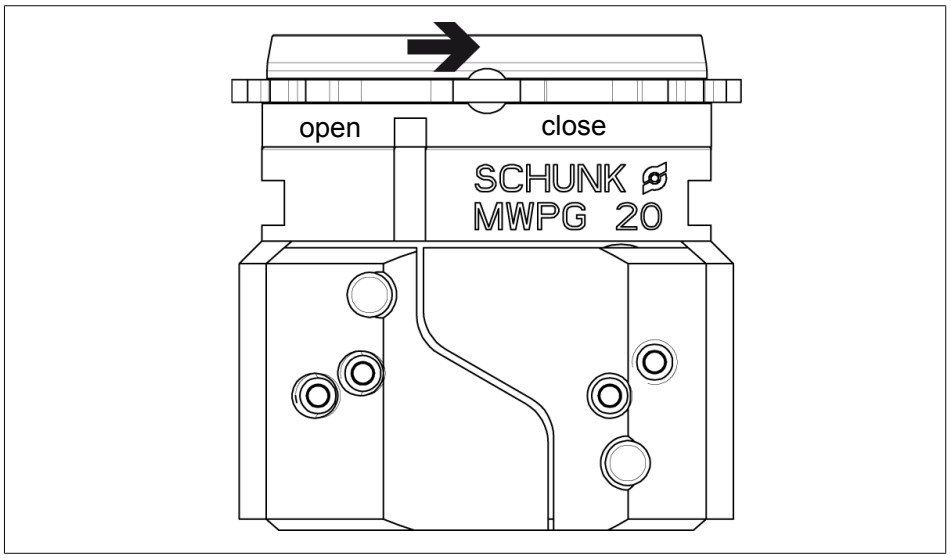
There is more information on the MWK in the operating manual for the miniature change system (MWS).



- Turn the actuating ring of the MWK to the "open" position (arrow).



- Align the MWPG (1) to the MWK (2) in such a way that the milled grooves (3) are aligned to each other.
- Fit the MWPG (1) and the MWK (2) together (arrow).



- Turn the actuating ring of the MWK to the "close" position (arrow).

4.2 Mechanical connection on the customer's adapter plate

⚠ WARNING

Risk of injury when machine/system moves unexpectedly!

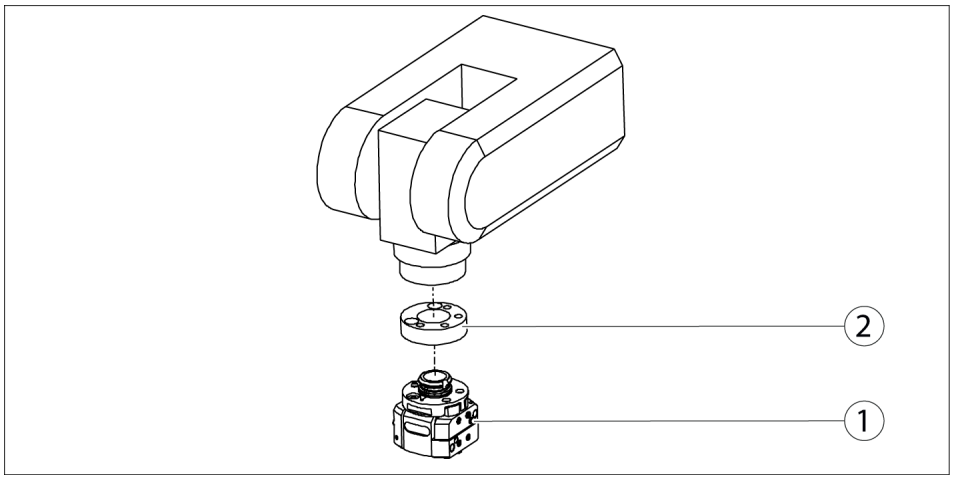
- Switch off power supply before assembly and installation.
- Make sure that no residual energy remains in the system.

Evenness of the mounting surface

The values apply to the whole mounting surface to which the product is mounted.

Requirements for evenness of the mounting surface (Dimensions in mm)

Edge length	Permissible unevenness
< 100	< 0.02
> 100	< 0.05



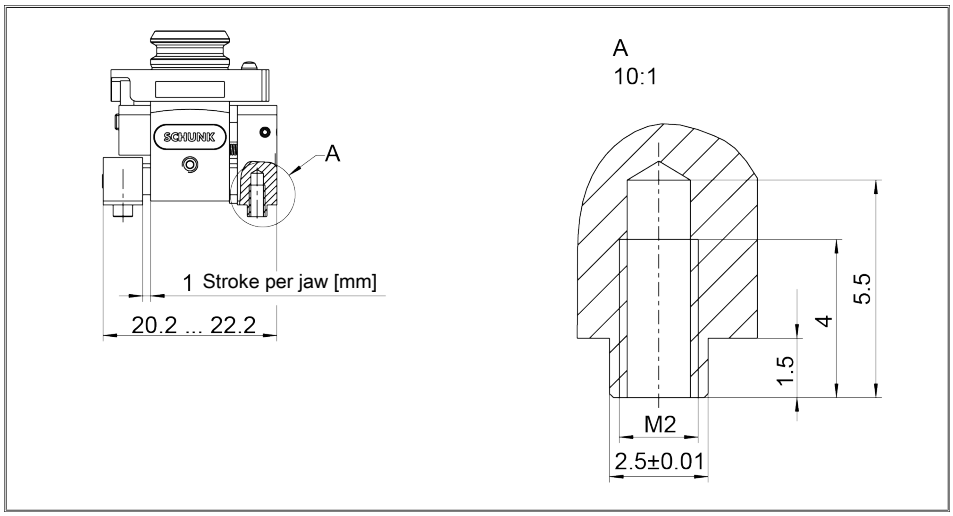
Assembly example

1	MWPG
2	Customer's adapter plate

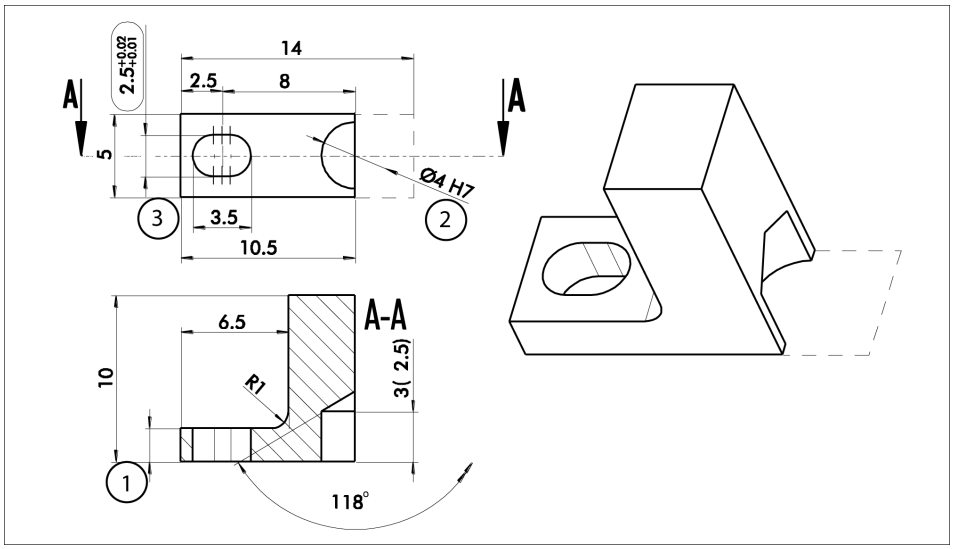
Use an adapter plate with an interface suitable for the MWPG Dimensions [▶ 17].

- ➢ Insert O-rings 1.78 x 1.02 (from the accessory pack) into the adapter plate (2).
- ➢ Fasten the MWPG (1) using two screws (M2) onto the adapter plate (2).
- ➢ Secure the adapter plate (2) on the robot.

4.3 Drawings for production of top jaws



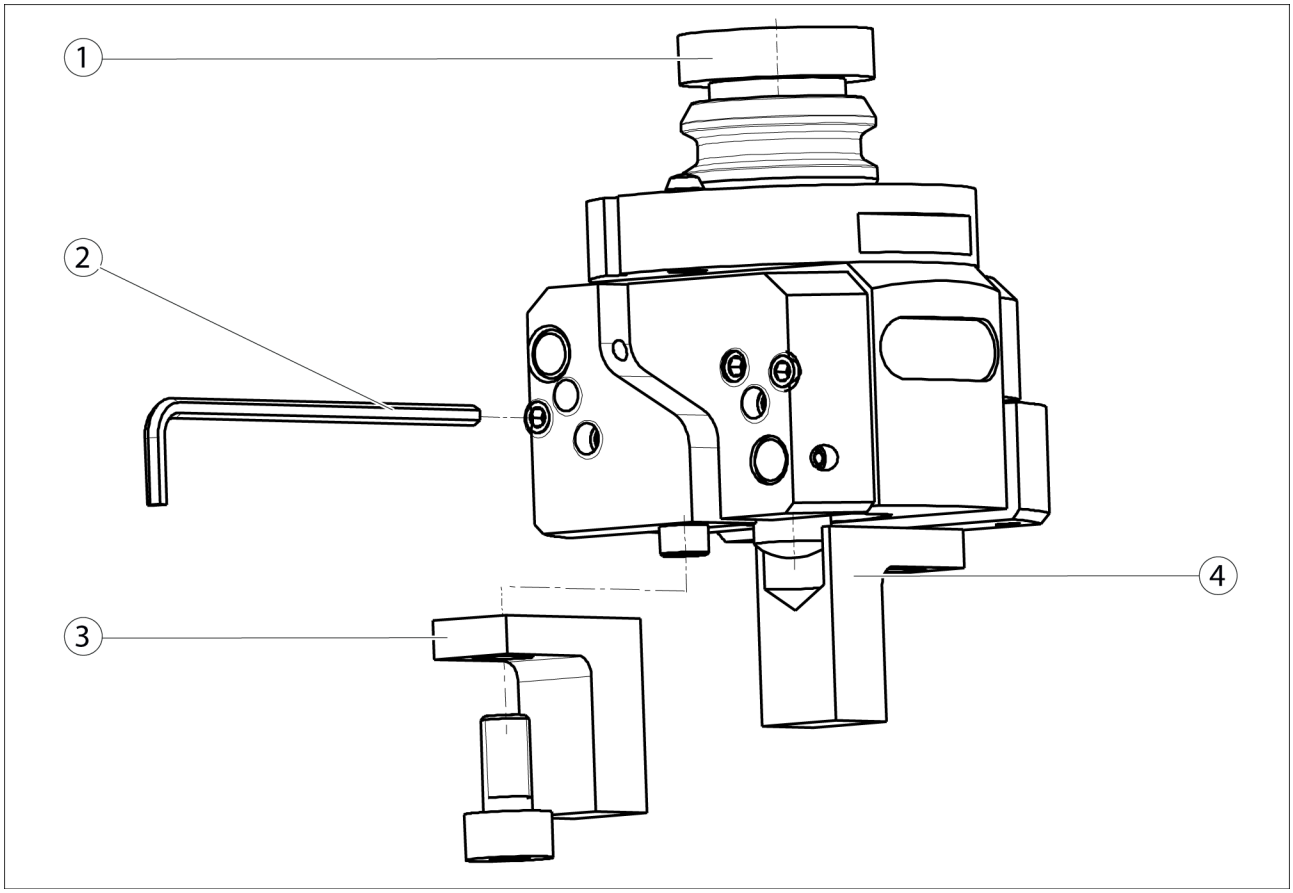
Base jaw dimensions



Dimensions for top jaw

1	original material suitable for the production of Ø4H7
2	If the finger should not be moved, a bore is enough here Ø2.5H7
3	fitting depth

4.4 Assembly of the top jaws



- Set stroke limitation using a hexagon socket wrench, width across flats 0.9 (2).
- Push arbor (1) (from the accessory pack) in the center bore hole of the MWPG as far as it will go.
- Place a top jaw (3) into position and fix it there loosely so that it can still move.
- Align the top jaws (3 and 4) on the arbor (1) and press them together as far as they will go.
- Tighten the fixing screws.

4.5 Pneumatic connection

⚠ WARNING

Risk of injury due to unexpected movements!

If the power supply is switched on or residual energy remains in the system, components can move unexpectedly and cause serious injuries.

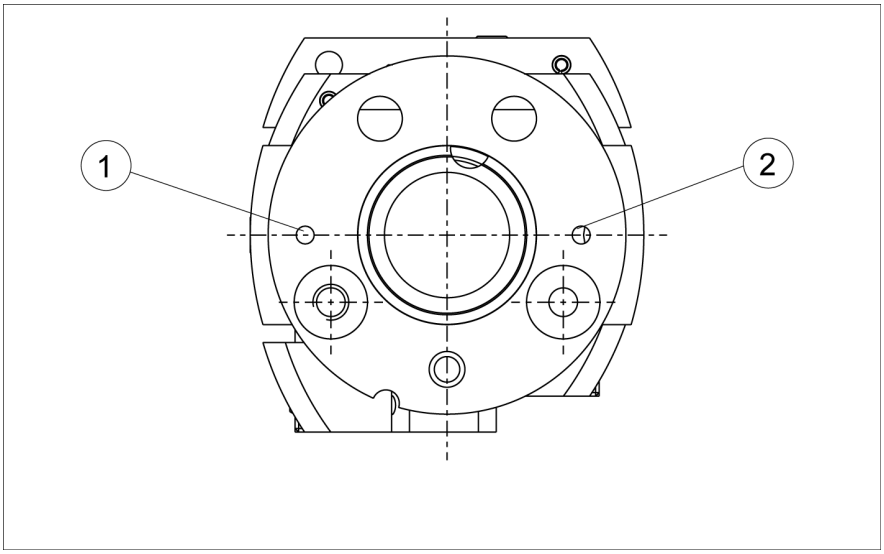
- Before starting any work on the product: Switch off the power supply and secure against restarting.
- Make sure, that no residual energy remains in the system.

NOTE

- Observe the requirements for the compressed air supply, Technical data [▶ 16].
- In case of compressed air loss (cutting off the energy line), the components lose their dynamic effects and do not remain in a secure position. However, the use of a SDV-P pressure maintenance valve is recommended in this case in order to maintain the dynamic effect for some time. Product variants are also offered with mechanical gripping force via springs, which also ensure a minimum clamping force in the event of a pressure drop.

NOTE

- Observe the operating pressure:
  - ⇨ min. 3 bar
  - ⇨ max. 8 bar



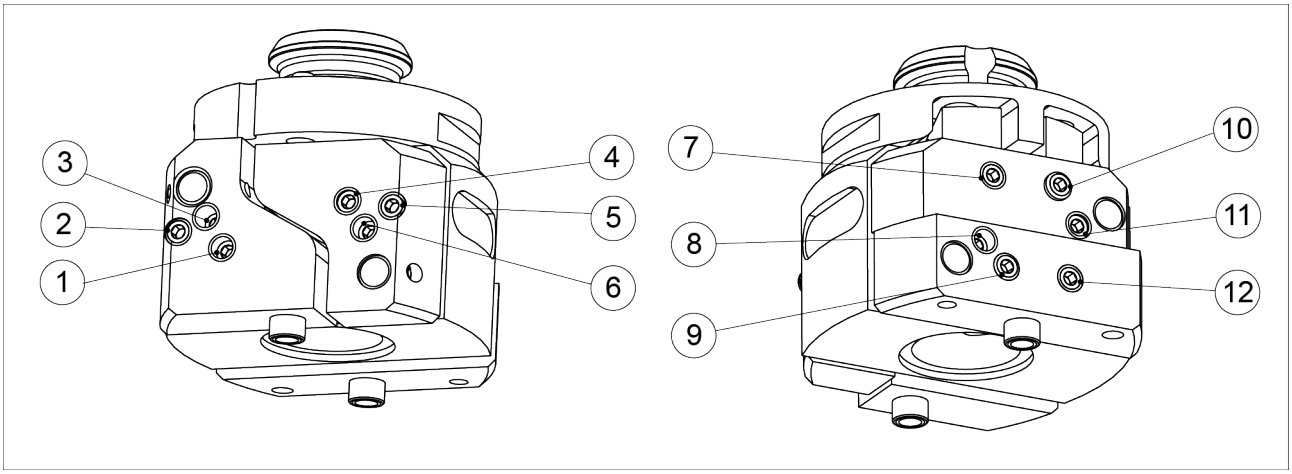
Air connections

1	Open gripper
2	Close gripper

Air is supplied via a hose-free direct connection:

Use O-rings (Ø 1.78 x 1.02 mm) from the accessory kit.

4.6 Setting stroke limitation and springs (maintenance of gripping force)



Item	Note
1 / 4 / 8 / 11	Synchronization (sealing wax, red), **must not be adjusted!**
2	M2x4 set-screw for stroke limitation when closing
12	M2x4 set-screw for stroke limitation when closing In the variant with a fixed jaw and a vacuum channel, a spring is installed at this position to open by spring force.
5	Set-screw M2x4 for stroke limitation when opening
7	Set-screw M2x4 for stroke limitation when opening **Note** In the variant with a fixed jaw and a vacuum channel, a spring is installed at this position to open by spring force and **must not be adjusted.**
3 / 9	Spring and set-screw M2x2 for opening with spring force
6 / 10	Spring and set-screw M2x2 for closing with spring force

4.6.1 Setting stroke limitation

Variant with synchronous or asynchronous finger movement

- Set the set screw (5 / 7) or (2 / 12) of the base jaw using a hexagon socket wrench (width across flats 0.9 mm) to the required stroke limitation.

Variant with fixed jaw and vacuum channel

- Set the set screw (5) of the base jaw using a hexagon socket wrench (width across flats 0.9 mm) to the required stroke limitation.

4.6.2 Setting the springs

NOTE

The springs and set-screws are included in the accessory pack.

Variants with synchronous or asynchronous finger movement

Gripping inside (IS) - open

➢ Insert the springs in each base jaw in bore holes (3 / 9) and apply initial tension with the set-screw out of the accessory pack.

✓ Bore hole (3): set-screw sunk 2.2 mm

✓ Bore hole (9): set-screw projecting by 0.1 mm

Gripping outside (AS) - closed

➢ Insert the springs in each base jaw in bore holes (6 and 10) and apply initial tension with the set-screw out of the accessory pack.

✓ Bore hole (6): set-screw sunk 1.2 mm

✓ Bore hole (10): set-screw projecting by 0.5 mm

Variant with fixed jaw and vacuum channel

➢ Insert the springs in each base jaw in bore holes (9 and 12) and pre-tension the set-screw out of the accessory pack.

✓ Bore hole (9): set-screw projecting by 0.1 mm

✓ Bore hole (12): set-screw projecting by 0.1 mm

4.7 Sensors

The product is prepared for using ONS 01 sensors.

- If you require further information on sensor operation, contact your SCHUNK contact person or download information from our homepage.
- Technical data for the sensors can be found in the data sheets (included in the scope of delivery).

4.7.1 Optical sensor ONS 01

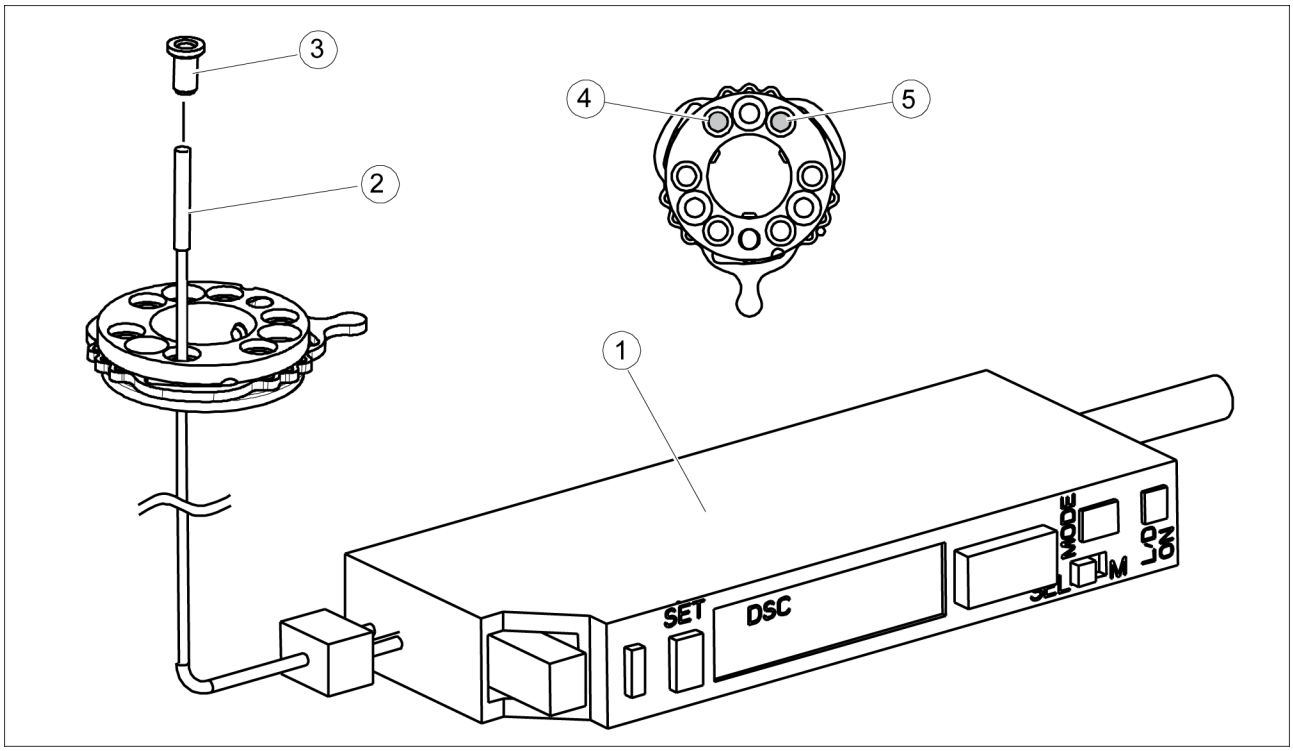
For the proper use of the optical sensor, observe the following:

- Do not pull on the cable of the sensor.
- Do not dangle the sensor from the cable.
- Do not excessively tighten the mounting screw or clips.
- Do not go over the permissible bending radius of the cable (☞ catalog specifications).
- Do not allow the proximity switch to come into contact with hard objects or with chemicals, especially nitric, chromic or sulfuric acid.

NOTICE

Risk of damage to the sensor during assembly! The optical sensors can be sensitive to knocks or movements of the cable.

- Note the sensor's operating manual



Mounting of the ONS 01

Item	Description	ID number
1	ONS Analysis Box	0301390
2	Sensor ONS	0301391
3	Sleeve (in the mounting kit included optical sensor ID no. 0305627)	9942698
4	Optical sensor 2	0301391
5	Optical sensor 1	0301391

The ONS 01 optical sensor with optical fiber and force/torque sensor system controller can be used as an accessory to continuously monitor the base jaw position.

- ➢ Insert the sensor ONS (2) through one of the two openings (4 / 5) in the miniature change head MWK (1).
- ➢ Glue the ONS sensor (2) into the sleeve (3) using Loctite 401.
- ➢ Press the sleeve (3) into the MWK miniature change head (1).

NOTE

The operating manual for the ONS describes how to commission the ONS optical sensor (accessories).

5 Troubleshooting

5.1 Module does not move?

Possible cause	Corrective action
Base jaws jam in housing, e.g. mounting surface is not sufficiently even.	Check the evenness of the mounting surface., Mechanical connection on the MWK miniature change head (standard interface) [▶ 18]
	Loosen the mounting screws of the product and actuate the product again.
Set-screw for the stroke limitation has been screwed in as far as it will go (stroke = 0).	Unscrew the set-screw for the stroke limitation out to the desired stroke position., Setting stroke limitation and springs (maintenance of gripping force) [▶ 24]
Pressure drops below minimum.	Check air supply., Technical data [▶ 16]
Compressed air lines switched.	Check compressed air lines., Pneumatic connection [▶ 23]
Proximity switch defective or set incorrect.	Readjust or change sensor.
Flow control valve closed.	Open the flow control valve.

5.2 The module does not travel through the entire stroke?

Possible cause	Corrective action
Set-screw for the stroke limitation has been screwed in as far as it will go (stroke = 0).	Unscrew the set-screw for the stroke limitation out to the desired stroke position., Setting stroke limitation and springs (maintenance of gripping force) [▶ 24].
Dirt deposits between the base jaws or top jaws.	Clean and if necessary re-lubricate.
Pressure drops below minimum.	Check air supply., Pneumatic connection [▶ 23]
Mounting surface is not sufficiently flat.	Check the evenness of the mounting surface., Mechanical connection on the MWK miniature change head (standard interface) [▶ 18]

5.3 The gripping force drops?

Possible cause	Corrective action
Compressed air can escape.	Check O-rings and replace O-rings if necessary.
Pressure drops below minimum.	Check air supply., Pneumatic connection [▶ 23]

6 Maintenance

6.1 Maintenance and lubrication intervals

The MWPG is maintenance-free.

After 2 million cycles, a visual inspection/function test should be carried out.

Replace the gripper with a new one.

7 Translation of original declaration of incorporation

in terms of the Directive 2006/42/EG, Annex II, Part 1.B of the European Parliament and of the Council on machinery.

Manufacturer/ Distributor	SCHUNK GmbH & Co. KG Spann- und Greiftechnik Bahnhofstr. 106 – 134 D-74348 Lauffen/Neckar

We hereby declare that on the date of the declaration the following partly completed machine complied with all basic safety and health regulations found in the directive 2006/42/EC of the European Parliament and of the Council on machinery. The declaration is rendered invalid if modifications are made to the product.

Product designation:	Miniature changeover parallel gripper / MWPG / pneumatic
ID number	0305626, 0305628, 30058119

The partly completed machine may not be put into operation until conformity of the machine into which the partly completed machine is to be installed with the provisions of the Machinery Directive (2006/42/EC) is confirmed.

Applied harmonized standards, especially:

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

The manufacturer agrees to forward on demand the relevant technical documentation for the partly completed machinery in electronic form to national authorities.

The relevant technical documentation according to Annex VII, Part B, belonging to the partly completed machinery, has been created.

Person authorized to compile the technical documentation:
Robert Leuthner, Address: see manufacturer's address

Signature: see original declaration

Lauffen/Neckar, June 2019

p.p. Ralf Winkler,
Manager for development
of gripping system components

7.1 Annex to Declaration of Incorporation

according 2006/42/EG, Annex II, No. 1 B

1.Description of the essential health and safety requirements pursuant to 2006/42/EC, Annex I that are applicable and that have been fulfilled with:

Product designation	Miniature changeover parallel gripper
Type designation	MWPG
ID number	0305626, 0305628, 30058119

To be provided by the System Integrator for the overall machine			⇓
Fulfilled for the scope of the partly completed machine		⇓	
Not relevant	⇓		

1.1	**Essential Requirements**			
1.1.1	Definitions		X	
1.1.2	Principles of safety integration		X	
1.1.3	Materials and products		X	
1.1.4	Lighting		X	
1.1.5	Design of machinery to facilitate its handling		X	
1.1.6	Ergonomics		X	
1.1.7	Operating positions			X
1.1.8	Seating			X

1.2	**Control Systems**			
1.2.1	Safety and reliability of control systems		X	
1.2.2	Control devices		X	
1.2.3	Starting		X	
1.2.4	Stopping		X	
1.2.4.1	Normal stop		X	
1.2.4.2	Operational stop		X	
1.2.4.3	Emergency stop		X	
1.2.4.4	Assembly of machinery		X	
1.2.5	Selection of control or operating modes		X	
1.2.6	Failure of the power supply			X

1.3	**Protection against mechanical hazards**			
1.3.1	Risk of loss of stability			X
1.3.2	Risk of break-up during operation			X
1.3.3	Risks due to falling or ejected objects			X
1.3.4	Risks due to surfaces, edges or angles		X	
1.3.5	Risks related to combined machinery			X
1.3.6	Risks related to variations in operating conditions			X

1.3	Protection against mechanical hazards			
1.3.7	Risks related to moving parts		X	
1.3.8	Choice of protection against risks arising from moving parts			X
1.3.8.1	Moving transmission parts		X	
1.3.8.2	Moving parts involved in the process			X
1.3.9	Risks of uncontrolled movements			X

1.4	Required characteristics of guards and protective devices			
1.4.1	General requirements			X
1.4.2	Special requirements for guards			X
1.4.2.1	Fixed guards			X
1.4.2.2	Interlocking movable guards			X
1.4.2.3	Adjustable guards restricting access			X
1.4.3	Special requirements for protective devices			X

1.5	Risks due to other hazards			
1.5.1	Electricity supply		X	
1.5.2	Static electricity		X	
1.5.3	Energy supply other than electricity		X	
1.5.4	Errors of fitting		X	
1.5.5	Extreme temperatures			X
1.5.6	Fire			X
1.5.7	Explosion			X
1.5.8	Noise			X
1.5.9	Vibrations			X
1.5.10	Radiation	X		
1.5.11	External radiation	X		
1.5.12	Laser radiation	X		
1.5.13	Emissions of hazardous materials and substances			X
1.5.14	Risk of being trapped in a machine	X		
1.5.15	Risk of slipping, tripping or falling	X		
1.5.16	Lightning			X

1.6	Maintenance			
1.6.1	Machinery maintenance		X	
1.6.2	Access to operating positions and servicing points		X	
1.6.3	Isolation of energy sources		X	
1.6.4	Operator intervention		X	
1.6.5	Cleaning of internal parts		X	

1.7	**Information**			
1.7.1	Information and warnings on the machinery		X	
1.7.1.1	Information and information devices		X	
1.7.1.2	Warning devices		X	
1.7.2	Warning of residual risks		X	
1.7.3	Marking of machinery	X		
1.7.4	Instructions	X		
1.7.4.1	General principles for the drafting of instructions	X		
1.7.4.2	Contents of the instructions	X		
1.7.4.3	Sales literature	X		

	The classification from Annex 1 is to be supplemented from here forward.			
2	Supplementary essential health and safety requirements for certain categories of machinery			X
2.1	Foodstuffs machinery and machinery for cosmetics or pharmaceutical products			X
2.2	Portable hand-held and/or guided machinery			X
2.2.1	Portable fixing and other impact machinery			X
2.3	Machinery for working wood and material with similar physical characteristics			X
3	Supplementary essential health and safety requirements to offset hazards due to the mobility of machinery		X	
4	Supplementary essential health and safety requirements to offset hazards due to lifting operations		X	
5	Supplementary essential health and safety requirements for machinery intended for underground work			X
6	Supplementary essential health and safety requirements for machinery presenting particular hazards due to the lifting of persons		X	