# Compliance Wrist

## FM-80-P
## FM-100-P
## FM-125-P
## FM-160-P
## FM-200-P
## FM-250-P
## FM-300-P




Version 2.0 Last revision November 2012

Dear customer,

Thank you for the confidence that you have placed in our company by purchasing an IPR compliance wrist.

Every compliance wrist is fully assembled in the plant and is subject to an individual test. This includes examining their complete proper functioning and safe working.

These instructions illustrate how the compliance wrist is set up and operates. In addition, all the main details for assembly, commissioning and maintenance are clearly arranged.

Please carefully read through the contents.

Do directly contact us if any of your questions are not answered in these instructions. We are at the following address.

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Translation of Original Assembly Instructions

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# 1. General

## 1.1. Information on these instructions

These instructions enable the compliance wrist to be safely and effectively handled. These instructions form part of the machine and should be kept close to it so that the personnel responsible can easily access them.

The personnel involved must have carefully read through these instructions and understood them before beginning any work. Keeping to all the safety and handling pointers in these instructions is the basis on which work is done safely.

Also applying are any local health & safety regulations and the general safety conditions where the machine is used.

Illustrations in these instructions are there to assist in basic understanding; they may deviate somewhat from the actual design.

Also follow the generally valid, statutory and other binding regulations of European and national legislation as well as the accident prevention and environmental protection provisions in force in your country.

## 1.2. Terms of the guarantee

The terms of the guarantee can be found in the manufacturer's general terms & conditions of business. Please turn to our Customer Service (for contact data see cover) if any matters are not clear.

# 2. Safety

This section provides an overview on all the important safety aspects for the protecting people and for reliable, no-trouble operations. Further task-related safety instructions are included in the sections on the individual service life phases.

## 2.1. Symbol explanations

Safety instructions are identified by symbols in these instructions. The safety instructions are introduced by signalling words expressing the degree of hazard involved.

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|---|---|
|  | **CAUTION!**<br>Points to a **possible** dangerous situation which - if not avoided - may result in either minor or slight injuries. |
|  | **NOTE!**<br>Points to a **possible** dangerous situation which - if not avoided - may result in either material or ecological damage. |
|  | This symbol brings useful tips and recommendations to one's notice as well as information on efficient, no-trouble operations. |

## 2.2. Intended use

Compliance wrists are tried and tested components for compensating tolerances at assembly, palletizing and loading and unloading parts in machine tools and workpiece carriers.

Compliance wrists are not ready-to-use machines as envisaged under the EU Machinery Directive. They are solely for fitting/attaching to robots and handling equipment.

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|  | **NOTE!**<br>You must use this compliance wrist exclusively in accordance with the operating conditions and performance specifications established in theses instructions. |

## 2.3. Inappropriate use

Any other use or one going beyond that described in the "Intended Use" chapter is deemed to be inappropriate and will void all warranty or guarantee claims.

It is the owner - and not the manufacturer - who accepts liability for damage resulting from this.

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|  | **NOTE!**<br>The compliance wrist must not be used in any explosive environment. |

## 2.4. General risks

The compliance wrist was state-of-the-art manufactured at the time of delivery. Even so, dangers could still proceed from it if the safety information listed here in these instructions is not followed. The personnel involved must have carefully read through these instructions and understood them before beginning any work.

- The instructions must always be available for all users where the compliance wrist is deployed.
- These instructions are also to accompany the compliance wrist if it is handed over to third parties.
- Do not delve into moving components or handle them during on-going operations.
- Never open protective covers under ongoing operations.
- Only authorized specialist personnel - outside the danger zone - are allowed to carry out any work such as assembly, commissioning, operating, dismantling and maintenance.
- Before any work is begun on the compliance wrist, the energy supply needs to be disconnected and the line system relieved of pressure. Secure the system against being unintentionally reactivated for the duration of the work.
- Ensure during commissioning that all pneumatic connections are either allocated or firmly closed.

## 2.5. Owner obligations

Together with the safety instructions in these instructions, the valid safety, accident prevention and environmental protection regulations in force where the compliance wrist is used must be adhered to.

As part of his obligation to exercise due car, the owner is to ensure that:

- The compliance wrist is used as intended
- During the entire period of use of the compliance wrist a check is to be made on whether his operating instructions comply with the ongoing status of the standards & codes and, if necessary, he is to adapt them.
- The responsibilities for installation, operation, fault rectification, maintenance and cleaning are clearly settled and laid down.
- All those dealing with the compliance wrist have both read these instructions and understood them. In addition, he has to regularly train the personnel involved and inform them as to hazards/risks.

## 2.6. Requirements placed on the personnel

The variety of tasks described in these instructions place differing requirements on the qualifications of those performing these tasks.

Only appropriate specialist personnel or a duly instructed person under the supervision of specialist personnel are allowed to carry out any work such as assembly, commissioning, operating, dismantling and maintenance.

In view of his technical training, knowledge, experience and knowledge of the relevant standards and regulations, the specialist is in a position to perform the work he has been entrusted with and - on his own - to recognize/avoid any hazards.

# 3. Specifications

(Please refer to the ongoing catalogue or the internet for specifications of the individual compliance wrists.)

## 3.1. General basic data

| | |
|---|---|
| Min. operating pressure: | 3,5 bar |
| Max. operating pressure: | 8 bar |
| Temperature range: | 5 ℃ to 80 ℃ (higher if request ed) |
| Drive: | Pneumatic |
| Material: | Casing of high-strength aluminium hard-coated/ partly hardened steel |
| | Operating parts hardened tool-steel |
| Tolerance particulars | |
| Thread: | +/− 0.1 mm |
| Alignment pin drill hole: | +/− 0.02 mm |
| Elastomers: | Polymer materials with high elasticity |
| Shore hardness: | A unit of measurement for the “stiffness” of an elastomer |

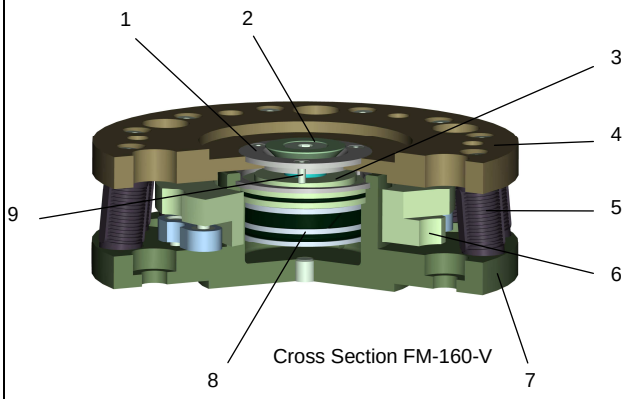
## 3.2. Operating conditions

The working environment is not to contain any dirt, dust, spray or vapours. The machine is to be used at temperatures between 10 ℃ and 40 ℃.

The maximum (non-condensing) relative air humidity is to be between 10% and 70%.

# 4. Setup and function

## 4.1. Overview




Cross Section FM-160-V

| | | | |
|---|---|---|---|
| 1 | Cone Inset | 6 | Torsion Protection (Option V) |
| 2 | Locking Cone | 7 | Robot Side |
| 3 | Sealing Part | 8 | Piston |
| 4 | Tool side | 9 | Piston Rod |
| 5 | Elastomer | | |

## 4.2. Brief description

The position compensation is made possible through specially developed elastomer elements. If a position offset occurs, the workpiece to be inserted will be moved automatically by the resulting reaction forces in sucha way that jamming and wedging of the part is prevented. Depending on the chamfer present, positioning misalignments of up to +/-3 mm and angular misalignments of upto 2 degrees can be compensatec.

The compensation takes place horizontally in the x-y plane and about the x-y-z axis for angular compensation. After extension, the elements returns back into the starting position through self-centering.

**FM-P: pneumatic cylinder**

The shift can be locked by an integrated pneumatic cylinder. This alternative must be used at the time of short cycles, of great masses of gripping device and part and in all the operations of horizontal or inclined insertion.

Depending on the requirements, compliance wrists are supplied with a different number of elastomer elements and different Shore hardnesses of the elastomer material.

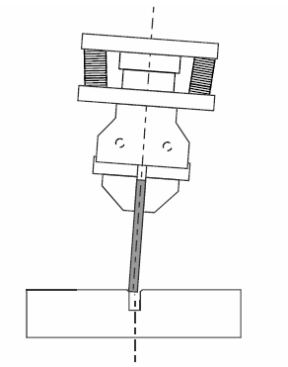
**Compensation function**

The compliance wrist FM is a positioning aid that makes possible positioning deviations of the robot tool by means of specially developed elastomer elements.

If a positioning offset occurs, the occurring reactive forces automatically move the workpiece to be inserted such that jamming and tilting of the joining member is prevented.

**Initial position:**

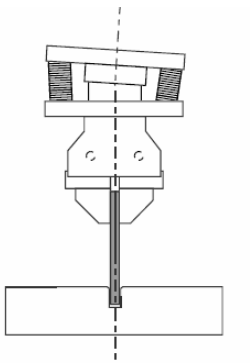
The robot approaches the insertion operation. The workpiece is not vertical to the joining member.



**Position compensation by the compliance wrist:**

The insertion operation has been carried out.

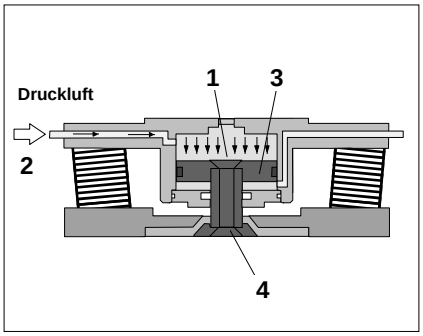
Due to the compensation movement of the compliance wrist FM, the workpiece axis was aligned to the joining member.



In the main body of the compliance wrist FM-P, there is a double-action pneumatic cylinder (1) that is used to release or lock the FM's compensation movement.

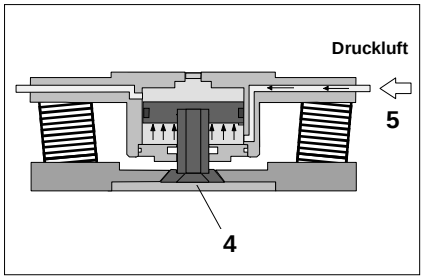
**Unlocked condition**

Compressed air to the “Unlocked” compressed air connection (2) pushes the piston (3) with the locking mushroom (4) outwards such that shifting or rotating of the tool flange is made possible relative to the robot flange.




**Locked condition**

Compressed air to the “Locked” compressed air connection (5) forces the robot flange through the “inclined plane” of the locking mushroom (4) into the centred position. The locking force is dependent on the air pressure.




In the FM's locked condition, the tool flange and the robot flange form a rigid unit.

The compliance wrist is controlled by means of a provided 5/2 way pneumatic valve that is controlled by the robot control provided by the customer or a separate PLC.

## 5. Transport, packing, storage

### 5.1. Transport

Immediately check on the delivery when received as to completeness and any transportation damage.

Proceed as follows if there are signs of external damage:

- Do not accept the delivery or only under reservation.
- Note down the extent of damage on the transportation documents or on the forwarder's delivery note.
- Initiate the complaint procedure.

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|  | Object to any shortcoming as soon as it is discovered. Claims for damages can only be filed within the valid time spans as set aside for complaints. |

Transportation temperature −20 °C to 65 °C.

Protect against external impact (jolt, blow, vibration)

### 5.2. Packing

The packing is to be such as to protect the components up to the assembly stage from transportation damage, corrosion and other kinds of damage. Thus, the packing is to be left intact and only removed just before actual assembly.

Only recyclable materials are used for the packing.

Dispose of packaging materials in accordance with the respectively valid statutory regulations and local requirements.

### 5.3. Storage

Store packs under the following conditions:

- Do not store outdoors.
- Store at a dry and dust-free location.
- Do not expose to corrosive media.
- Protect from direct sunlight.
- Avoid mechanical shocks.
- Temperature for storage: 15 °C to 35 °C
- Relative air humidity: max. 60%.
- In cases of storage exceeding 3 months, regularly check on the general condition of all the parts and packing. If need be, either recondition the conservation protection or renew it.

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|  | There may also be information on the packs themselves extending beyond the requirements set out here. They are to be correspondingly kept to. |

## 6. Assembly and commissioning

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|  | **CAUTION!**<br>Before assembling the compliance wrist, the energy supply needs to be disconnected and the line system relieved of pressure.<br>Make a note of the safety instructions and general hazards listed on Page 2. |

### 6.1. Assembly

The assembly drill holes and pneumatic connections can be taken from our ongoing catalogue and/or the Internet.

The compliance wrist must only be fastened at the threads provided for the purpose. If needed, make an appropriate adapter flange or purchase it from the manufacturer.

Tighten the assembly bolts with thread locking adhesive (e.g. Loctite 4052) or with Schnorr/Nord lock washers, as appropriate.

Only mount the compliance wrist on the robot and the tool with a suitable adapter flange!

You can order an adapter flange for the respective robot type from IPR!

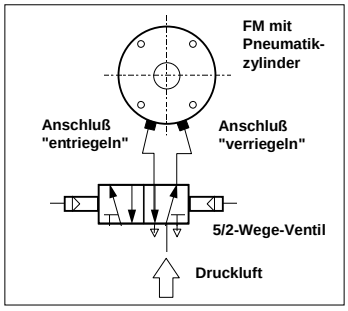
When mounting the tool on the compliance wrist, observe the information in the operating or assembly instructions of the respective tool manufacturer.

**Fasten the compliance wrist on the flange (robot, adapter flange)**

- For the number and size of the pins and fastening bolts of the corresponding FM model, refer to the current catalogue or the Internet
- Have ready the pins and fastening screws
- Insert the pins in the pinholes
- Use (Loctite 243) thread locking adhesive to secure the screw connections
- Place the compliance wrist FM on the adapter flange and screw it tight (tighten the screws with the tightening torque that is necessary for the thread type)

**Pneumatic system**

- Provide a 5/2 way pneumatic valve onsite
- Provide compressed air at 3.5 – 8 bar




- Install the compressed air lines on the robot side
- Follow the instructions provided by the robot manufacturer
- Location and size of the FM's compressed air connections in the connection plan of the corresponding size
- Connect the compressed air hoses to the compressed air ports on the body with push-on connectors

**Programming locking and unlocking**

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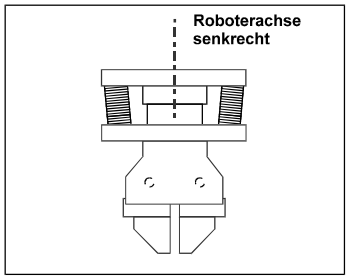
|  | The robot control must only be programmed by qualified responsible specialists! |

The compliance wrist's compensation function is only possible in the horizontal direction.

This means that you must only lock and unlock the compliance wrist when the robot axis (axis of the tool flange) is vertical!

The compliance wrist must be locked In all other positions of the robot axis and while the robot is running.




| | |
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|  | **NOTE!**<br>If you unlock the FM when the robot axis is not vertical, the compliance wrist is damaged! |

## 6.2. Commissioning

- Check threaded unions and push-on connectors for firm seating
- Check freedom of movement of the electrical cables and pneumatic hoses for possible damaging edges
- Check the air pressure
- Carry out assembly work in “Teach Mode” only
- No persons may be present in the danger area
- Secure robot against being unintentionally switched on
- Determine the overload threshold value
- Inspect again the technical protection measures of the robot system
- Check the robot's performance specifications with regard to the handling capacity and the payload
- Start up the compliance wrist
- Observe the safety information
- Carry out functional testing at all program stages
- Check that the change between locking and unlocking is appropriate to the program
- If necessary, reprogram the robot

# 7. Malfunctions

The compliance wrist no longer carries out the compensation movement

- Remove foreign bodies
- Get the manufacturer to service elastomers that have swelled or are brittle
- Get the manufacturer to service elastomers that have hairline cracks on them

The compliance wrist does not lock or unlock

- Switch on compressed air or increase air pressure
- Check the pneumatic valve
- Check the compressed air lines
- Check the compressed air wiring

Air flowing out of compliance wrist

- Get the manufacturer to service it

## 8. Maintenance and repairs

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|  | **NOTE!**<br>Make a note of the safety instructions and general hazards listed on Page 2. |

### 8.1. Cleaning and upkeep

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|  | **NOTE!**<br>Corrosive cleaning agents could damage the compliance wrist seals and result in them ageing more rapidly. |

Make a note of the following when cleaning and maintaining compliance wrists:

- se protective caps and the like to firmly close all the openings
- Check that all connections are tight
- Use a metal cleaner
- Remove any coarse dirt and keep components such as sensors clean

### 8.2. Maintenance

To retain compliance wrist functions, we recommend carrying out the following maintenance steps at least once a year:

- Clean the compliance wrist
- Check the function of the compliance wrist; if necessary, get the manufacturer to service it
- Check the compliance wrist for external deformations, damage and wear; if necessary, get the manufacturer to service it
- Inspect the elastomers for cracks, brittleness or deformations; if necessary, get the manufacturer to service them (You must replace brittle or swelled elastomers and ones with hairline cracks)

### 8.3. Corrective maintenance

The manufacturer provides you with a comprehensive repair service for compliance wrists.

To guarantee correct functioning, corrective maintenance work may only be carried out by the manufacturer.

IPR accepts absolutely no responsibility in the case of accidents at work due to maintenance work carried out on your own initiative!

## 9. Dismantling, Decommissioning, Disposal

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|  | **VORSICHT!**<br>Bei der Demontage des Fügemechanismus muss die Energieversorgung abgeschaltet und das Leitungssystem druckentlastet sein.<br>Sicherheitshinweise und allgemeine Gefahren auf Seite 2 beachten. |

### 9.1. Dismantling

At the end of its useful life, the compliance wrist must be dismantled and disposed of in an environmentally friendly manner.

Properly clean sub-assemblies and components and disassemble them with consideration given to the prevailing local health & safety and environmental protection provisions.

### 9.2. Decommissioning

You carry out decommissioning in the reverse order to commissioning.

- Any compliance wrist malfunctioning must be corrected before decommissioning
- The compliance wrist must be cleaned
- Shut down briefly only with the robot axis in the vertical position

### 9.3. Disposal

Pass on disassembled parts for recycling if no arrangements have been made for returning them or disposal:

- Turn metals into scrap
- Hand in plastic elements for recycling
- Sort the rest of the components by material properties and dispose of accordingly

## 10. Accessories

(For information on individual compliance wrists, please refer to the current catalogue or the Internet)