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Section C – Mechanics

Part 3: Machine tools and special machines, robotics

The following delivery specifications of Wieland-Werke AG form part of the contract.
Any deviating specifications are to be agreed upon between the supplier/contractor and Wieland, and documented.

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1. Machine tools and special machines

The following points have to be fulfilled for the delivery release and acceptance of a machine/plant:

1.1 Geometric report

The geometric report is a requirement for the delivery release.
For plants and machinery built according to own designs or Wieland designs, a geometric report on the individual parts must be supplied for the main construction elements such as machine frames, central shafts etc. according to the purchaser's specifications. In this report, toleranced dimensions are recorded with their actual dimension, dimensions corresponding to the general tolerances in accordance with DIN are marked as within tolerance or above/below tolerance, and, if deviations are found, they are immediately submitted for approval. The axes, machining surfaces etc. relevant for the function must be measured and recorded in the assembled state for (preliminary) commissioning.

1.2 Capability studies

As part of the delivery approval, a short-term capability study is carried out using previously agreed production parts. If VDMA guidelines exist for the machine type in question, these must be applied.

1.2.1 Machine capability study

The machine capability study on production equipment for series production is a requirement for delivery approval.
In the normal case, 50 consecutively manufactured production parts are divided into 10 samples of 5 parts each, and recorded in the chronological sequence in which they were taken, in order for example to identify any trends. Since with only 50 consecutively produced parts the actual operational spread is often not fully captured, the result of a short-term capability study should be assessed in light of the future process. Furthermore, the 50 measured values are used to assess the distribution shape.
To classify a machine as capable in a provisional machine capability study, the machine capability index must be $c_{mk} \geq 1.67$.

1.2.2 Preliminary process capability study

To carry out this study, at least 20 samples, of at least 3 parts, are taken at equal time intervals. To increase the informative value of this study, however, the aim should be to use 25 samples of 5 parts each.
To classify a process as quality capable in a provisional process capability study, the process capability index must be $c_{pk} \geq 1.67$.

1.3 Granting of delivery release and acceptance

The delivery release can be granted when the conditions relating to the above points have been fulfilled and the remaining deficiencies identified have been dealt with.
Acceptance can take place when the conditions relating to the above points have been fulfilled. Likewise, the documentation must be available in the agreed form and all other acceptance criteria must be fulfilled in accordance with the order or specification.

2. Robotics

2.1 Manufacturer selection

Robot make and type are to be agreed with Wieland. Preferably the make

- Yaskawa Motoman

is to be used.

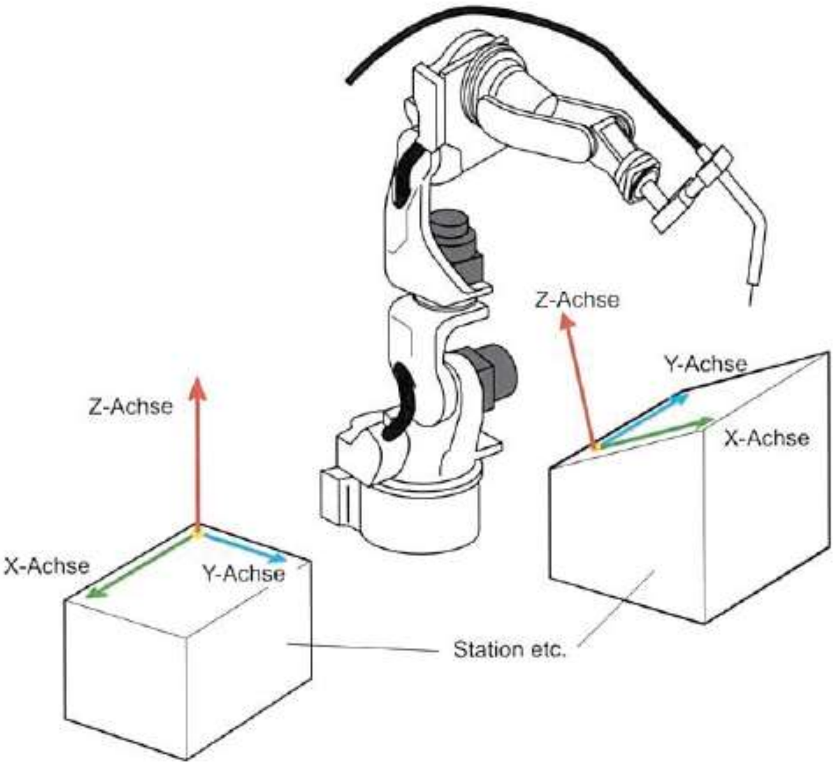
2.2 Collaborative robots

Only by agreement and with the approval of Wieland.

2.3 Coordinate systems

2.3.1 User coordinate system

If the machine/automation consists of several stations that are not mechanically connected to each other, a user coordinate system must be created for each station that is approached by the robot. The stations for which this is required shall be determined together with Wieland.

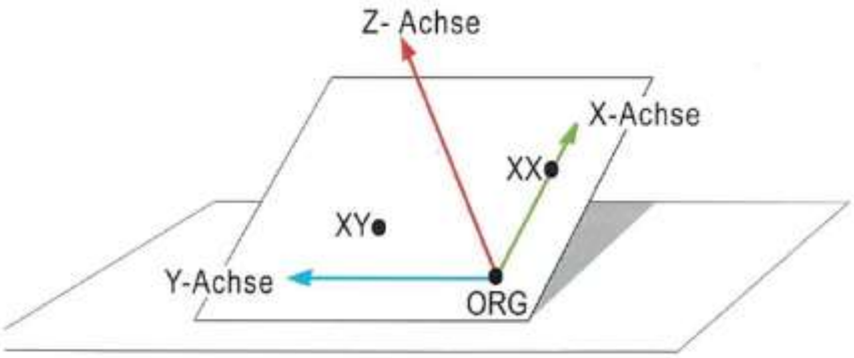


Legend:

DE	EN
X-Achse	X-axis
Y-Achse	Y-axis
Z-Achse	Z-axis

A reference surface must be attached to each of these stations, on which the point of origin and the spatial orientation of the axes are marked.

The reference points are calibrated by means of a setting master with a tip/cone that can be mounted on the robot arm (gripper). The setting master must be supplied.



Definitionspunkte der Anwenderkoordinaten

Punkt	Definition	Bedeutung
ORG	Ursprungspunkt	Legt fest, an welcher Stelle das Koordinatensystem den Ursprung hat.
XX	Punkt auf der X-Achse	Legt die Ausrichtung der X-Achse im Bezug zum ORG fest.
XY	Punkt auf der XY-Ebene	Legt fest, in welcher Ebene rechtwinklig zu der festgelegten X-Achse die Y-Achse und Z- Achse definiert werden.

Legend:

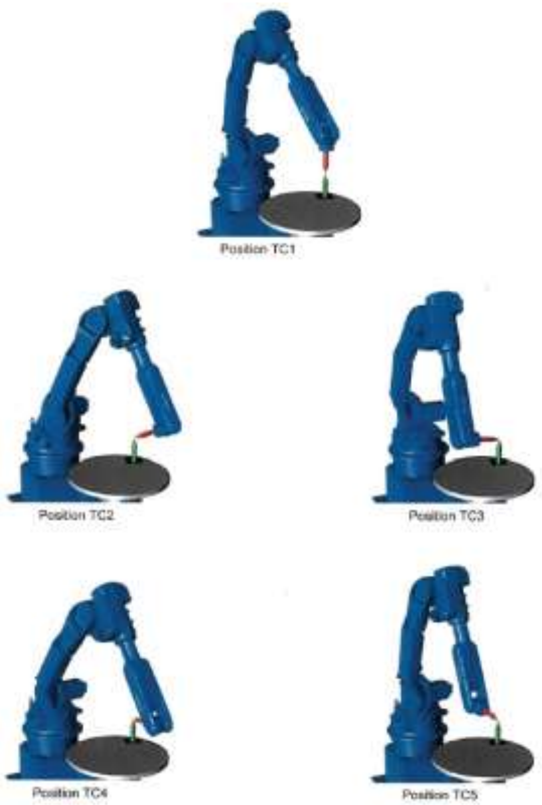
DE	**EN**
Z-Achse	Z-axis
X-Achse	X-axis
Y-Achse	Y-axis
Definitionspunkte der Anwenderkoordinaten	Definition points of user coordinates
Punkt	Point
Definition	Definition
Bedeutung	Meaning
ORG	ORG
Ursprungspunkt	Point of origin
Legt fest, an welcher Stelle das Koordinatensystem den Ursprung hat.	Defines the point from which the coordinate system originates.
XX	XX
Punkt auf der X-Achse	Point on the X-axis
Legt die Ausrichtung der X-Achse im Bezug zum ORG fest.	Defines the orientation of the X-axis in relation to the ORG.
XY	XY
Punkt auf der XY-Ebene	Point on the XY plane
Legt fest, in welcher Ebene rechtwinklig zu der festgelegten X-Achse die Y-Achse und Z-Achse definiert werden.	Defines the plane at right angles to the defined X-axis in which the Y-axis and Z-axis are defined.

The calibration procedure and the orientation of the user coordinate systems must be documented. It must be possible, based on this documentation, to check the calibrated reference points and, for example, to recalibrate the reference points if the machine is moved. The programs for automatically approaching / checking the reference points must also be supplied.

The robot movements must be programmed in the user coordinate system of the respective station.

2.3.2 Tool coordinate system

If different tools are used on the robot, the Tool Control Point (TCP) for each tool must be created in a tool file. This can be done by entering it manually or by determining the TCP with the robot using the 5-point method. This also applies if the robot application requires precise path or speed behaviour at the TCP (e.g. welding, gluing).



2.4 Programming

Robot programs are to be created using the standard programming environment; no high-level programming language is allowed. Explanatory comments should be included in the programs, where the programming interface allows this.

The robot programs should be programmed in a structured way for all agreed workpieces. For the robot sequence which is the same for all workpieces, <u>one</u> basic program should be created, which moves to the basic positions.

For the workpiece-specific sequences, one subprogram should be created for each workpiece, starting from the respective home position.
Each subprogram is given a header, which contains general data and settings. The robot programs must be named in a way that corresponds to the workpiece designation.

An automatic return to the home position must be possible.
Programs for automatic retraction to the home position after a program abort or fault as well as programs for moving to maintenance positions (setup/repair) must be created.

2.5 Collision detection

Automatic collision detection must be implemented to prevent damage to the robot, gripper or other involved components.

2.6 Limiting robot movements

If axis limitations are required, the use of software-based safety range limitation (e.g. Functional Safety Unit FSU with Yaskawa) is preferable to a solution with mechanical stops or limit switches.

2.7 Installation

Any sensors or actuators attached to the robot must always be connected by means of a pluggable connector.
Cable carriers (energy chains), cables and hoses must be installed on the robot in such a way that damage/wear caused by friction or collision is prevented both on the robot and on the energy supply lines. If this is only possible to a limited extent, appropriate measures should be taken when programming the axis movements.

2.8 Environmental influences

Suitable measures must be taken to protect the robot from process-related environmental influences (chips, dust, radiation, liquids, sparks, welding spatter, etc.) Where robot protection covers are used, ASP-Balg is the preferred manufacturer.

2.9 Training

Training/instruction of operating and maintenance personnel is part of the scope of supply.

2.10 Documentation

A complete data backup of the robot programs must be supplied on data media. All of the robot’s reference systems are to be documented by means of drawings, images and descriptions. The procedure for checking and correcting the reference systems must be supplied (see 2.3 Coordinate systems).
Interface signals to a higher-level control system must be documented.
The manufacturer’s operating instructions and programming instructions must be supplied in paper form. The remaining complete manufacturer’s documentation on data carriers.

2.11 Standards and regulations

It is the supplier’s responsibility to proceed according to the applicable standards and regulations concerning his machinery/equipment. Some standards are listed here by way of example:

- DIN EN ISO 10218 parts 1+2 – Safety requirements for industrial robots
- DGUV Information 209-074 – Industrial robots