Operating Instructions for Powder Coating Booth Control Unit

Automatic

CAUTION!
Do not put the coating system into operation before the safety instructions in this handbook have been studied thoroughly!
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1 Safety rules for Electrostatic powder coating

1. This equipment can be dangerous when it is not operated according to the recommendations in these Operating Instructions.

2. The equipment must also be operated according to the local regulations where it is set up.

3. The Operating Instructions for running the powder recovery equipment, the reciprocator, and all other attached plant must be carefully observed.

4. All electrically conductive parts, which are within a distance of 5 m of the coating position, and especially the workpieces must be grounded.

5. The floor of the coating area must be electrically conductive (normal concrete is generally conductive).

6. The operating personnel must wear electrically conductive footwear (e.g. Leather soles).

7. A good metallic connection between the gun control unit, the coating booth, and the conveyor or the workpiece hooks is a precondition.

8. The power cables, and powder supply hoses to the gun must be laid out so that they are well protected from mechanical damage.

9. The powder coating equipment must only be switched on after the booth is in operation. If the booth stops, the powder coating equipment must also switch off.

10. The grounding of all conductive parts is to be checked at least once a week.

11. The ground leakage resistance of the contact point for each workpiece can be maximum 1 MOhm. The construction of the workpieces, and workpiece hangers must ensure that the workpieces remain grounded. NOTE: Because workpieces are grounded through metal hooks, it is important that these hooks are cleaned regularly, in order to inhibit the formation of an insulating coating of melted powder.

12. When cleaning the gun, and changing the nozzles the control unit must be switched off.
2 General operation

2.1 Automatic equipment with PLC and Operator Panel

The Operator Panel is a display and operation field, through which all the data and control commands for the automatic coating equipment are input. The process control and process display simplifies operation. Activity messages give an overview and a check. All functions of the coating equipment can be controlled, and monitored through the Operator Panel.

- Because of the process display incorrect input is eliminated.
- The operator is guided clearly through the process.
- Variable data can be called up or changed.
- Greater flexibility, simple adaptation to new values.
- Activity messages appear on the Text display, which are helpful to the operator, e. g. when looking for errors.
- Also legible in poor lighting conditions.
- IP 65 type protection.
- Available in different languages.

The communication and operating unit is built into the door of the PLC control cabinet. All Masks and commands are stored directly in the Operator Panel. The PLC control deals only with actual control functions.

The Operator Panel is a communications terminal based on an LCD display screen. Process control, and process display give the operator an overview and control over the whole coating procedure. Incorrect input is practically hundred percent eliminated. Only valid keys appear on the display and are released.
Display: The operation masks are shown on the display screen
Function keys: The machine can be operated with the Function keys F1 - F8
Alarm display: The alarm display is active if a fault is present
3 Mask descriptions

3.1 Operation masks

The operation masks generally have the following structure:

```
M02 conveyor STOP = 0.00 m/min 1/1

** MAIN MODE **

powder mode
AUTO MANUAL clean REF serv

Conveyor speed
```

*Line 1-3:* Title line, Mask description (Upper case letters)
*Line 4-8:* Menu positions, information and Parameters (Variable)

**Conveyor speed:** Shows the actual speed of the conveyor.
3.2 SYSTEM START

After the coating equipment is switched on with the Main switch, and the key switch, the control (PLC) and the OP 17 are switched on. After an internal test of the OP 17 the SYSTEM START Mask appears.

**SYSTEM START (Mask 1)**

The following functions are possible in the Main:

- **Project language switching**: German, English, and a third language as an option (Customer request) are possible. After switching the language the OP needs a moment to initialize.

- The Main menu can be entered by pressing the F7 key. 
  See Chapter 3.3 Main menu

- EXIT DISPLAY: The key „ESC“ changes to the last display (Tree structure).

Before pressing Key F7, to enter the next display, it is recommended to switch on the Control unit with Key switch.

**Control unit ON means:**
The fans are switched on and the booth lighting is switched on.
The pre-fluidizing starts to loosen up the powder in the powder hopper.
The Filter cleaning and the Sieve machine are also switched on. Switching on of equipment like PRC 3, APS 2, and the optional Fresh powder system follows. The run-up of the plant takes a little longer than half a minute.

**Control unit OFF means:**
The parts of the plant described and the Control unit ON are switched off independent of the momentary selected display. It is recommended when switching off the Control unit also to change to the System start display.
3.3 Main menu

When changing to the Main menu, the whole plant is switched on. That means, the reciprocator and guns are supplied with current.

**MAIN MENU Mask 2**

![Main menu menu](image)

The following functions are possible in the Main menu:

**Operating mode selection:** Manual See Chapter 3.5 Manual Operation

Automatic See Chapter 3.4 Automatic

Cleaning See Chapter 3.7 Cleaning

Service See Chapter 3.10 Service

**Reference Travel** (Initializing) of the reciprocator: The plant should be initialized before the automatic mode can be switched to. The plant will otherwise not start in the automatic mode and an error message will appear. The Reference travel of the reciprocators can also be release individually directly in manual operation on each PRC 3.
3.4 Automatic

By pressing the Function key F1 the plant is switched to automatic operation. The axes remain at rest. The plant waits for the next part to enter into the Object recognition and then travels through the program set.

**AUTOMATIC OPERATION Mask 7**

<table>
<thead>
<tr>
<th>M07 conveyor STDP = 0.00 m/min</th>
<th>1/1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AUTOMATIC</strong></td>
<td></td>
</tr>
<tr>
<td>opt1 = 2</td>
<td>object = 1</td>
</tr>
</tbody>
</table>

**X-axis**

**MANUAL**

**diag**

**Opti**: The OptiTronic program can be changed here. The parameter of the programs 1-255 are managed on the OptiTronic equipment.

**Object**: A maximum of 50 different objects can be selected with this key. The following data per object number are stored in memory: Program number of the guns, Program number of the horizontal axis and a Program number of the vertical axis per reciprocator. They are first actualized with the key Load, then loaded into the equipment.

**Remote**: If the Remote function (Remote control) is switched ON, the OptiTronic equipment (Gun control equipment) is controlled by the PLC, when OFF the values for the OptiTronic equipment itself can be manually changed.

**Manual**: See Chapter 3.5 Manual Operation

**Load**: The data from the PLC is actualized on the display and the data is loaded onto the corresponding equipment. Necessary at a change of object.

**Save**: The data is written on the display on the PLC and saved and the object number set.

**Axes**: By selecting Stroke mode a further mask is entered: Automatic Stroke mode is described further below. See Chapter 3.6.1 Automatic stroke Mode

**Diag**: A further mask (Diagnosis) is entered here, where Alarm messages, and Inputs/Outputs can be checked. See Chapter 3.8 Diagnosis
3.5 Manual Operation

Switches the plant to the manual operating mode. The booth runs as in automatic operating mode. The rest of the plant (Axes and guns) are released, so that the plant operator can operate the plant himself. The operating control switches to the manual operation mask.

**MANUAL OPERATION Mask 5**

<table>
<thead>
<tr>
<th>AUTO</th>
<th>guns</th>
<th>axis</th>
<th>conveyor</th>
<th>diag</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The same plant parts are displayed as with Automatic operation. Additional functions compared with automatic operation are:

**Auto:** See Chapter 3.4 Automatic

**Guns On/Off:** The guns can be switched on and off.

**Load:** The data is actualized by the PLC on the display and the data is loaded on the appropriate equipment. Necessary for change of object.

**Save:** The data is written from the display to the PLC and saved and the set object number.

**Axes:** A further display appears when the Stroke mode is selected: Stroke mode Manual operation are described further below.

See Chapter 3.6.2 Stroke Mode Manual Operation

**Conveyor 0/1:** The chain drive can be switched on and off.

**Diag:** A further display (Diagnosis) where Alarm messages, Inputs, and Outputs can be checked.

See Chapter 3.8 Diagnosis
3.6 Automatic and Manual Operation

3.6.1 Stroke Mode Automatic

**STROKE MODE AUTOMATIC Mask 15**

<table>
<thead>
<tr>
<th>M15</th>
<th>conveyor STDP = 0.00 m/min</th>
<th>1/1</th>
</tr>
</thead>
</table>

**X-AXIS**

<table>
<thead>
<tr>
<th>Z-A = 0</th>
<th>Z-B = 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-A = 0</td>
<td>X-B = 0</td>
</tr>
<tr>
<td>Offset A = 0</td>
<td>Offset B = 0</td>
</tr>
</tbody>
</table>

**Z axes:** A maximum of 20 different program numbers of the axes can be set here. The parameter of the program must be input directly in the position regulator. At a 0 the axes are at rest, otherwise they run through the set program, but only when an object has been recognized by the Light grid.

**X axes:** A maximum of 30 different program numbers for the axes can be set here. The parameter of the corresponding program must be input directly in the position regulator. If there is a 0 in it, the axes are controlled through the Light grid, otherwise they travel to the corresponding position of the axes number.

**Offset X axes:** In Automatic operation the position can be shifted in the range +/- 30 here.

**Diag:** A further display (Diagnosis) is entered where Alarm messages, Inputs and Outputs can be checked. *See Chapter 3.8 Diagnosis*
3.6.2 Stroke Mode Manual Operation

**STROKE MODE MANUAL OPERATION** Mask 14

<table>
<thead>
<tr>
<th>Z-Axis</th>
<th>X-Axis</th>
<th>Diag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z-A = 0</td>
<td>Z-B = 0</td>
<td>diag</td>
</tr>
<tr>
<td>X-A = 0</td>
<td>X-B = 0</td>
<td></td>
</tr>
</tbody>
</table>

Z axes: A maximum of 20 different program numbers axes can be set here. The parameter of the corresponding program must be input directly in the position regulator. At a 0 the axes are at rest, otherwise they travel through the set program as soon as a program number is input.

X axes: The reciprocator can be made to travel completely in or out in the X direction with these keys.

Diag: A further display (Diagnosis) is entered here, where Alarm messages, Inputs and Outputs can be checked. See Chapter 3.8 Diagnosis.
3.7 Cleaning

**CLEANING MODE Mask 4**

<table>
<thead>
<tr>
<th>Mode</th>
<th>conveyor STOP = 0.00 m/min</th>
<th>1/1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>CLEANING</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>guns OUTSIDE</th>
<th>guns INSIDE</th>
<th>BOOTH</th>
<th>diag</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>F2</td>
<td>F3</td>
<td>F4</td>
</tr>
<tr>
<td>F5</td>
<td>F6</td>
<td>F7</td>
<td>F8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OFF</td>
<td></td>
</tr>
</tbody>
</table>

The fresh powder supply is switched off during the cleaning operation. (The powder hopper is supplied with sufficient recovered powder because of the return of the backed-up powder from the booth).

**Clean Guns EXTERNALLY**: All guns are moved completely into the booth (PRC Program number 63), then each Station travels out of the booth, for individual automatic cleaning of the gun tubes, during this blowing off (PRC Program number 60).

**Clean Guns INTERNALLY**: All axes travel into the booth to the cleaning position (PRC Program number 62), then the release, from the Powder Centre control, is given to start the internal cleaning of the guns.

**BOOTH ON/OFF**: Ring rinsing is only on Cylinder booths: Ring rinsing is switched on and off with this key. The booth funnel is cleaned continuously when "BOOTH ON" is displayed.

**Diag**: A further display (Diagnosis) is entered here where Alarm messages, Inputs and Outputs can be checked. See Chapter 3.8 Diagnosis.
3.8 Diagnosis

During this operation faults can appear. The faults are displayed directly. The small LED display and the Fault lamp blink. All Fault messages are acknowledged with the Key „ACK“. If the cause of the fault is not eliminated the messages are always present. The small LED display illuminated and the Fault lamp still blinks. Independent of all this, the causes of the faults must be eliminated.

**DIAGNOSIS** Mask 40

Already acknowledged messages are no longer visible and are only indicated by small LED display and the Fault lamp that they are still present. By pressing the key „Diag“ and afterwards „Alarm“ the message area is entered, where the faults appear, if one is still present. There are complete messages stored in the Message buffer.

- **Alarm**: The actual Alarm messages are listed here.
- **Message Buffer** See Chapter 3.9 Message Buffer
- **I/O**: Inputs, Outputs can be checked. See Chapter 4.24.2 PLC Test Inputs and Outputs

**Caution**: when exiting the message area to return to where you started, otherwise another Operating mode can be selected.

Following fault messages can occur:

- **Motor protection NOK**: A fuse or a Motor protection switch has blown. It is recommended to call an electrician to eliminate the cause of the fault.
- **Fire protection NOK**: Emergency Stop or Fire protection actuated (See Fire protection documentation)
- **Switch cabinet temperature NOK**: The thermostat in the Switch cabinet reports over-temperature. It is recommended to call an electrician to eliminate the cause of the fault.
- **Grounding control NOK** (See Fire protection documentation)
- **Booth doors are not open**: The booth doors should be open in the coating operation. One of the door end switches reports not open.
- **Fan - Over-pressure**: Too much air is sucked from the Booth.
- **Fan - Under-pressure**: Too little air is sucked from the Booth.

**PLC Battery EMPTY**: When the battery of the PLC is empty, then this message is created. As long as the main power is present (Mains switch on) the program in the
PLC remains in the memory. As soon as the plant is switched off the program is lost. The complete program with must be reprogrammed with a programming device or it is read in with an EPROM (if present). **ATTENTION:** Data, formulae and parameters can deviate from the plant and must be input again.

**Control distance overstepped:** The control distance set is overstepped, which means, the Light grid is permanently covered and no longer switches.

**Axis not ready:** Axis does not react or is not initialized (Reference point travel).

**Conveyor stopped, Danger of collision:** Doors are not open and the Light grid had detected an object.

**Booth doors are still open:** The doors should be closed in the Cleaning mode.

**Axis not at Reference point:** Axes are not initialized.

**EMERGENCY STOP:**
At an Emergency Stop the whole plant (except the Operator panel and PLC) is switched off. A serious fault has occurred and further coating is not possible.
3.9 **Message Buffer**

History: The last 24 Messages are stored here and can be called up.

Date/Time: The actual date and time are checked here and if necessary, changed.

Delete History: All messages stored in History can be deleted here. This is however, only possible when a password is given.
3.10 Service

Some functions can be used in the Service mask which are foreseen for maintenance work and Start-Up. All monitoring is switched off in these operating modes.

SERVICE Mode Mask 6

The booth is switched off, and the conveyor is released.

Set-Up: See Chapter 3.10.4 Set-Up

Axes test: See Chapter 3.10.1 Axes test

Gun test: See Chapter 3.10.2 Gun test

Encoder test: Scaling of the Incremental Pulse Generator of the Chain conveyor. See Chapter 3.10.3 Encoder Test

Diag: A further display (Diagnosis) is entered here where Alarm messages, and Inputs and Outputs can be checked. See Chapter 3.8 Diagnosis
3.10.1 Axes test
If this operating mode is selected, only the axes power is switched on. The Axes can be set manually. The Axes test Mask is active.

**AXES TEST Mask 11**

**TEST AXIS**

3.10.2 Gun test
Gun test: The high-voltage of the guns can be measured with this function. All the guns are switched on, the air supply to the guns is, however, switched off. Now the ITW Gema Service engineer can measure the High-voltage value of the guns.

**GUNS TEST Mask 12**

**TEST GUNS**
3.10.3 Encoder Test

**ENCODER TEST** Mask 13

- **M11** service 1/1
- **TEST ENCODER**
- **counter**: 0

<table>
<thead>
<tr>
<th>start</th>
<th>stop</th>
<th>reset</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Start: Starts the Conveyor counter
Stop: Stops the Conveyor counter
Reset: Resets the Incremental Pulse Generator to 0.

If this operating mode is selected, only the axes power is switched on.
A measured distance is defined on the conveyor to calibrate the Incremental Pulse Generator. It is advantageous to take the distances of a number of hanger spaces in range of between 5 and 10 m. Set the corresponding PRC 3 Parameter 10 (PRC 3 AC) or Parameter 12 (PRC 3 DC) to the required pulse length. The counter is started at the beginning of the measured distance, with the conveyor running, and stopped again at the end.

Parameter 8 (PRC 3 AC) or Parameter 10 (PRC 3 DC) are calculated according to the following formula:

\[
\text{New parameter} = \frac{(\text{Old parameter}) \times (\text{Counter reading after Stop}) \times \text{Pulse length}}{\text{Measured distance}}
\]
### 3.10.4 Set-Up

#### SET-UP Mask 20

<table>
<thead>
<tr>
<th>Axis</th>
<th>Guns</th>
<th>Light Grille</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Gema)</td>
<td></td>
<td>(Gema)</td>
</tr>
<tr>
<td>M2 0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SETUP**

- Set-Up General Data and Options activated: See Mask 3.10.5
- Set-Up Axes: See Chapter 3.10.6 Set-Up Axes
- Set-Up Guns: See Chapter 3.10.7 Set-Up Guns
- Set-Up Object: See Chapter 3.10.8 Set-Up Object
- Set-Up Light grid: See Chapter 3.10.9 Set-Up Light grid
3.10.5 Set-Up General Data

** GENERAL **

M21 SetUp 1/15

MINimal pulse time 3.00 [s]
delay GUNS ON 4.00 [s]
delay AXIS ON 4.00 [s]

** GENERAL **

impulse HORN ON 1.00 [s]
impulse HORN OFF 2.00 [s]

** GENERAL **

Booth

mteors STARTET 5.00 [s]
PRESSURE messages 30.00 [s]
sieve cleaning ON 5.00 [s]
sieve cleaning OFF 30.00 [s]

** GENERAL **

Booth

ring main tubing DELAY 5.00 [s]
sieve machine_1 10.00 [s]
sieve machine_2 10.00 [s]
These parameters can only be changed with Password. Changes may only be made by ITW Gema Service Personnel.
These parameters can only be changed with a password. Changes may only be made by ITW Gema Service Personnel.
3.10.6 Set-Up Axes

**SET-UP AXES Mask 22**

**AXIS**

FIRST axis: 1 START code POS. [no] [pulse] [no] [no]

AXIS 1 0 0 0

LAST axis: 4

These parameters can only be changed with a password. Changes may only be made by ITW Gema Service Personnel.
3.10.7 Set-Up Guns

**SET-UP GUNS Mask 27**

<table>
<thead>
<tr>
<th>M24</th>
<th>SetUp</th>
<th>1/1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>GUNS</strong></td>
<td></td>
</tr>
</tbody>
</table>

**FIRST gun:** 1  START code  POS.
[no] [pulse] [no] [no]

**GUN**
1  0  0  0

**LAST gun:** 16

These parameters can only be changed with a password. Changes may only be made by ITW Gema Service Personnel.
3.10.8 Set-Up Object

** OBJEKT **

start
offset: extension:
station A 25 [pulse] 20 [pulse]
station B 25 [pulse] 20 [pulse]

** OBJEKT **

start
offset: extension:
HEIGHT-1 20 [pulse] 15 [pulse]
HEIGHT-2 20 [pulse] 15 [pulse]
GUNS 20 [pulse] 10 [pulse]

** OBJEKT **

KONTROL distance 500 [pulse]
KONTROL counter 0 [pulse]

** OBJEKT **

guns RINSING distance 0 [pulse]
blank/out 0 [pulse]
gap 100 [pulse]

These parameters can only be changed with a password. Changes may only be made by ITW Gema Service Personnel.
### 3.10.9 Set-Up Light grid

**SET-UP LIGHT GRID** Mask 27

<table>
<thead>
<tr>
<th>Beam</th>
<th>Position</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-axis A</td>
<td>1 [no]</td>
<td>0 [no]</td>
</tr>
<tr>
<td>X-axis B</td>
<td>1 [no]</td>
<td>0 [no]</td>
</tr>
<tr>
<td>Z-axis</td>
<td>1 [no]</td>
<td>0 [no]</td>
</tr>
</tbody>
</table>

Segmentation: 11111111 00000000

<table>
<thead>
<tr>
<th>P1</th>
<th>P2</th>
<th>P3</th>
<th>P4</th>
<th>P5</th>
<th>P6</th>
<th>P7</th>
<th>P8</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>X2</td>
<td>X3</td>
<td>X4</td>
<td>X5</td>
<td>X6</td>
<td>X7</td>
<td>X8</td>
</tr>
</tbody>
</table>

---

**SET-UP LIGHT GRID**

Segment 8......1

| Guns group 1 | 00000000 |
| Guns group 2 | 00000000 |
| Guns group 3 | 00000000 |
| Guns group 4 | 00000000 |

<table>
<thead>
<tr>
<th>P1</th>
<th>P2</th>
<th>P3</th>
<th>P4</th>
<th>P5</th>
<th>P6</th>
<th>P7</th>
<th>P8</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>X2</td>
<td>X3</td>
<td>X4</td>
<td>X5</td>
<td>X6</td>
<td>X7</td>
<td>X8</td>
</tr>
</tbody>
</table>

---

**SET-UP LIGHT GRID**

Segment 8......1

| Guns group 5 | 00000000 |
| Guns group 6 | 00000000 |
| Guns group 7 | 00000000 |
| Guns group 8 | 00000000 |

<table>
<thead>
<tr>
<th>P1</th>
<th>P2</th>
<th>P3</th>
<th>P4</th>
<th>P5</th>
<th>P6</th>
<th>P7</th>
<th>P8</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>X2</td>
<td>X3</td>
<td>X4</td>
<td>X5</td>
<td>X6</td>
<td>X7</td>
<td>X8</td>
</tr>
</tbody>
</table>

These parameters can only be changed with Password. Changes may only be made by ITW Gema Service Personnel.
4 Configuration Level

4.1 System

**SYSTEM Mask 10**

The following functions are possible here:

**Download (Transfer):** It is branched in the Transfer display to load new OP 17 Software.

**Password:** It is branched in the Password display.

**Edit Password:** Further passwords can be given or the Superuser password can be changed with the Password level 9. It is called up in a System display.

**Logout:** The set password level can be reset to 0. If no input is made after 10 minutes the password level is automatically set to 0.

The Superuser Password (Level 9) is pre-set by ITW Gema.

**I/O:** Inputs and Outputs can be checked. See Chapter 4.24.2 PLC Test Inputs and Outputs
4.2 PLC Test Inputs and Outputs

PLC TEST Mask 42, 43

The Inputs and Outputs can be checked if the I/O is selected through the Menu Diagnosis. The Inputs and Outputs can be checked if the I/O is selected through the Menu System. In addition the outputs can be controlled. In this Test mode all other program segments are skipped (not processed) and all outputs can be set individually.
Documentation OP17 Operator Panel

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