KAWA GmbH

Leiterplattentechnik / Industrievertretung

ATOTECH

Equipment manual

UNIPLATE CP+ Cu6 Ip2

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1 Introduction

1.1 Legal notice

1. Limitation of liability

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1.3 General information

ATOTECH is one of the world's leading suppliers of chemical installations and production systems for the printed circuit board (PCB) and surface treatment industries. These production systems are developed for various process technologies and customer-specifically optimized to meet individual production requirements.

1.4 Information on system documentation

This operating manual provides important instructions for handling the system. Compliance with all indicated safety instructions is required for safe operation.

Also comply with applicable local accident prevention regulations and general safety provisions relevant to the scope of system operation.

Carefully read the operating manual before starting any activities on the system. This operating manual is an integral part of the system and should be stored near the system, so that it is readily accessible to personnel at any time.

The operating manual must accompany the system should it be transferred to a third party.

The standard flow direction is from the left-hand side to the right-hand side, as viewed from the operator side. Illustrations contained in this documentation relate to the standard flow direction. If the flow direction is from the right-hand side to the left-hand side, and illustrations are used for reference, attention must be paid to the fact that these illustrations should be symmetrical to the system. The feed side of the system is in this case on the right-hand side. Note: Illustrations contained in this system documentation are not true to scale for reasons of reproduction on a monitor or printer, for instance.

1.4.1 Structure of the documentation

This documentation is

- target-group-focused
- broken down according to types of information
- modular
- hierarchically structured

Target group focus

Documents are organized so that a given target group receives only the documents it actually needs. This means that each target group will only work with target-group-relevant information.

Break-down according to types of information

The documentation is broken down according to types of information, so that information can be quickly found.

Modular organization

This documentation comprises individual modules, so that information can be easily and quickly updated in the event of revisions.

Hierarchical structure

The consistent technical approach to providing information gives a clear overview of the complex system technology. The hierarchical structuring into modules and components facilitates navigation through the online documentation.

1.4.2 Target groups

This documentation is split into target groups by design and purpose. A given target group receives only the information required for completing the target-group-specific task. Hence information overload is avoided.

Target group	Definition
Operating personnel	Operating personnel operate the system. Operators are qualified technical personnel with basic knowledge of system technology, and mechanical, electrical and process engineering applications. Training in safety and health at work is required.
Maintenance personnel	Maintenance personnel carry out routine maintenance tasks and eliminate minor faults. Maintenance personnel are qualified technical personnel with knowledge of system technology, and mechanical, electrical and process engineering applications. Training in safety and health is required.
Service personnel	Service personnel have expert knowledge in mechanical, electrical, and process engineering applications, as well as hardware and software systems. Service personnel support the owner's maintenance personnel as needed in maintenance tasks and fault elimination measures. All of the tasks not explicitly assigned to maintenance personnel should be exclusively carried out by service personnel. Service personnel also complete all tasks involving installation and startup.

1.4.3 Types of Information

This documentation is divided into the following types of information:

- Editorial notes
- Safety
- Operation
- Technical description
- Maintenance/Inspection

Editorial notes

Editorial notes provide directions and instructions for handling the system documentation.

Safety

Important information involving the safe handling of the system is given here. Strict compliance with safety instructions is mandatory.

Operation

The operating manual contains all of the information necessary to ensure smooth operation of your system.

Technical description

The technical description contains all technical details applicable to your system.

Maintenance/Inspection

Documents on maintenance and inspection tasks provide information on how and when to perform maintenance tasks on your system or system components.

Repair

Documents on repair tasks are only relevant to service personnel. You are receiving these documents so that your system documentation is complete.

1.5 Revision

The revision status is used to record certain modification states relevant to this document. This ensures that a complete overview and revision history is available resulting from, e.g., system retrofits.

Revision

Date	Version	Chapter	Comments
18.11.2013	Draft V1.0		

1.6 Information on installing the system

Project management plans and monitors system installation processes from the time the system is delivered to final acceptance of the system in collaboration with the customer.

ATOTECH personnel carry out these processes as a rule (systematic approach: mechanical, electrical, software, chemical, and service support even during production). ATOTECH has supervisory authority (and the professional expertise) during installation procedures.

1.7 Intended use of the system

This horizontal production system from ATOTECH is solely intended for processing PCBs (or foils). The system has been built using the latest technology and design principles. Operate the system only in accordance with its intended use. The owner must comply with startup, operation, maintenance, and servicing specifications prescribed by ATOTECH to achieve proper operation. The operational safety of the supplied system is only guaranteed if the system is used as intended. The manufacturer assumes no liability for any damage caused by using the system for any other purpose.

1.8 Warranty and liability

The "General Terms and Conditions of Sales and Delivery" for the system apply. These are furnished to the owner at the time the contract is concluded. Product liability or warranty claims involving physical injury or material damage are excluded if these are attributable to one or several of the following causes:

- Non-intended use of the system
- Improper operation or maintenance of the system
- Operating the system with defective safety devices or improperly fitted or non-functioning safety devices and protective equipment.
- Failure to comply with instructions given in this documentation concerning the startup, operation, maintenance and setup of the system.
- Failure to comply with instructions provided by system signage concerning "prohibition, warning, and command signs".
- If chemical solutions and recipes used in the individual modules differ from those specified on delivery of the product.
- Use of the system (equipment and chemicals) for any other purpose than agreed.
- Violation of any of the directions given in this system documentation and in "Material Safety Data Sheets" (MSDS).
- Deployment of untrained personnel
- Unauthorized structural modifications to the system
- Inadequate inspection and maintenance of system components subject to wear
- Improperly performed repair work
- Use of unapproved replacement parts
- Disasters caused by foreign objects and acts of nature

Should a customer intend to use the system in any other manner than specified, he/she will be under obligation to obtain written consent from ATOTECH beforehand.

	INFORMATION
i	**Disclaimer of liability arising from improper use** ATOTECH assumes no liability for accidents, damage, or defective products attributable to improper use; i.e., use beyond the scope stipulated and fixed in writing in the contract.

2 Declaration of Conformity

ATOTECH

CE

EC - Declaration of Conformity

Atotech Deutschland GmbH Feucht Plant
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We confirm that the equipment, as described below, complies with the basic requirements for Health and Safety according to the quoted EC-Regulations.

This declaration confirms compliance with the quoted regulations, but does not guarantee specific properties. The declaration becomes invalid if the equipment is used for purposes other than for which it was designed, and if any changes are made to the equipment which have not been approved by the manufacturer.

The health and safety recommendations included in the Technical Documentation, delivered with the equipment, are to be followed.

Product:	**UNIPLATE**
Equipment Type:	CP Cu6 IP2 UTS-XL L/R 1,0m/min.
Customer:	
Project Number:	52-1009-01
Year of Manufacture:	2014
Applied EC-Regulations:	Machinery (2006/42/EC) Electromagnetic Compatibility (2004/108/EC) Low Voltage Regulation (2006/95/EC)
Applied harmonised standards:	DIN EN ISO 12100-1 und – 2 DIN EN ISO 13850 DIN EN ISO 13857 DIN EN 349 DIN EN 60 204 (id. VDE 0113) DIN EN 61 000-6-4 (id. VDE 0839 T 6-4) DIN EN 61 000-6-2 (id. VDE 0839 T 6-2) DIN EN ISO 13849-1

signed at Feucht, 24.03.2014

ppa. S. Naser
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i.V. C. Schwarting
(Project Management EQ-EL)

FF2603E04

3 Safety instructions

3.1 Safety in general

The basic precondition for safe and fault-free operation of the plant is a knowledge of the safety instructions and the safety specifications.

This operating manual contains all the instructions necessary to operate the plant safely.

The safety instructions as well as the plant signage in terms of the "prohibition, warning and commandment notices" must be followed by all persons working on the plant.

In addition, the locally applicable rules and safety regulations for accident prevention must be followed.

If the safety specifications are ignored, in extreme cases, danger to the life and limb of the user as well as damage to the plant may result.

The plant is state-of-the-art in construction and built in keeping with the safety-related regulations.

3.2 Responsibilities of the owner/operator

The owner/operator undertakes to allow only such persons to work on the ATOTECH plant, who:

- are familiar with the basic regulations concerning industrial safety and accident prevention, and who have been trained to handle the machine.
- have read and understood the chapter on safety and the warning signs in this operating manual,
- are familiar with the plant signage with regard to the "Prohibition, warning and commandment notices".

Other obligations of the owner/operator:

- That there is compliance with the maintenance intervals as described in this operating manual.
- All safety devices are regularly checked for correct working and completeness.
- Providing the required protective equipment to the personnel.
- Ensuring that the preparation conditions required in this operating manual are fulfilled before initial commissioning or re-commissioning of the plant.
- Attention is regularly paid to the safety-conscious working of the personnel (knowledge passing and knowledge refreshing).
- Non-compliance with the safety regulations has to be prevented through suitable measures.

Organisational measures

- The owner/operator must make the necessary personal protection equipment (protective clothing etc.) available.

- Regularly check the operational capability of all the existing safety devices.
- Repair them if required. Personnel qualifications and training. The operations, maintenance, inspection and assembly personnel must have the corresponding qualification for this work.
- The customer's personnel will be provided instruction and training according to the requirement and the operation, especially if the customer does not yet have a similar plant and is not yet familiar with the operation of the plant.
- Personnel in training should only work on the system under the supervision of an experienced person.
- The responsibilities and tasks of the personnel for the operation, tooling, maintenance and upkeep must be clearly defined.

The owner/operator undertakes to allow only qualified personnel to work on the plant.

PROHIBITION

Unauthorized persons who do not fulfil the requirements described are not familiar with the dangers in the working area.

a) Keep unauthorized persons away from the work area.
b) In case of doubt, talk to the persons and ask them to leave the work area.
c) Interrupt the work for as long as there are unauthorized persons in the work area.

Informal safety measures:

The operating manual must always be kept at the plant. Supplementary to the operating manual, the generally applicable as well as the local regulations for accident prevention and environment protection must be made available and followed.

All the safety instructions and danger notices at the plant must be kept in legible condition.

Obligations of the personnel

All persons assigned to work on the machine must undertake, prior to starting work,

- to comply with the basic industrial safety and accident prevention guidelines
- to read the chapter on safety and the warning notices in this documentation and to act accordingly.

Structural changes (spare parts)

- In case of any dismantling, reconstruction or modification of the plant, you are earnestly urged to contact ATOTECH first. Otherwise, warranty and liability entitlements in case of harm to persons or damage to property are excluded.
- No changes, attachments or modifications may be made to the plant without the previous consent of the manufacturer. This also applies to welding on load-bearing parts.

- Plant parts that are not in an impeccable state must be exchanged immediately.
- Use only original spare and wear parts. With externally sourced parts, it is not possible to ensure that they are designed and manufactured in a manner suitable for the load and safety requirements. Installing externally sourced parts is not permitted.

3.2.1 Operating personnel

Qualified personnel

... are in a position, thanks to their educational qualifications, knowledge and experience, as well as familiarity with the relevant regulations, to carry out the work entrusted to them and to independently recognise possible dangers

Skilled electricians

... are able, thanks to their educational qualifications, knowledge and experience, as well as knowledge of the relevant standards and regulations, to carry out work on electrical plants and to independently recognise possible dangers. The skilled electrician is specially trained for the work environment in which he has to work and is familiar with the relevant standards and regulations.

In Germany, the skilled electrician must fulfil the requirements of the accident prevention regulations BGV A3 (e.g. electrical fitter, foreman). In other countries, the corresponding local regulations apply.

Trained Person

... was instructed in handling the plant in a training session by the manufacturer and advised as to the possible dangers in case of incorrect conduct.

Instructed Person

... was advised in an instruction session by the owner/operator about the tasks entrusted to him or her and the possible dangers in case of incorrect conduct.

Permitted Person

Only persons from whom it can be expected that will they carry out their work reliably are permitted as operations personnel. Persons whose ability to react to situations has been affected, e.g. by the use of drugs, alcohol or medication are not permitted.

When selecting personnel, follow the age-specific and profession-specific regulations applicable at the location of use.

3.3 Safety symbols

3.3.1 Reading the safety instructions

The safety instructions in this operating manual have been generated in accordance with the "SAFE" schema.

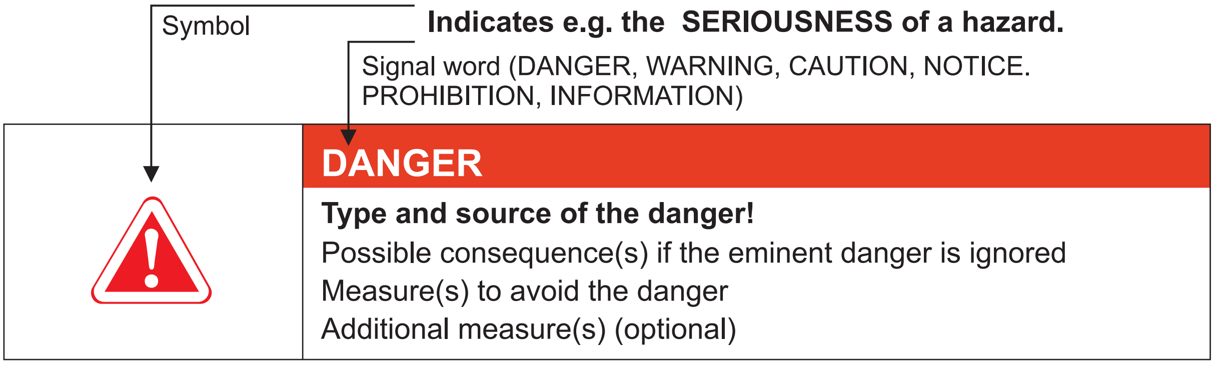
S,- Describes the "SERIOUSNESS" of a hazard.

A,- Describes the "TYPE" of hazard.

F,- Describes the "CONSEQUENCES" if the eminent danger is ignored.

E,- Describes how to "ESCAPE" from this danger.

The following graphic shows how the safety instructions in this operating manual are to be read and understood.



Description of the symbols

3.3.2 General safety instructions

	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, may result in death or serious injury.

	CAUTION
	Caution Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

	NOTICE
	Notice Indicates a situation which, if not avoided, may lead to faulty products or to production downtime.

	PROHIBITION
	Prohibition Indicates general prohibited actions.

	INFORMATION
	Information Indicates information and tips how to utilize the equipment best.

3.4 Plant signage

Plant designation

Plant signboard

Every ATOTECH horizontal production plant has a type nameplate fitted on the front side of the inflow and outflow module.

There is another type nameplate on the switch cabinet of the plant.

Module designation

Module signage

Every module carries one signboard on the front and rear side. The signboard shows the running position number and the module designation. The signboards on the front side of each module are fitted centrally 60 mm below the upper tank edge on signboard supports. On the rear side of each module, the signboards are fitted according to the space conditions. The position number, module designation and language correspond to the marking in the R&I scheme.

3.5 Preventive safety measures

Protective devices

	NOTICE
!	**Protective Devices** Prior to every time that the plant is started, all the protective devices must be properly fitted and fully functional. Protective devices may only be removed after standstill and subsequent securing of the plant from getting switched on again.

Emergency stop button

Emergency stop switches are fitted on the plant at different places at the prescribed distances (red button with a yellow background).

	NOTICE
!	**Emergency stop button getting triggered interrupts the control voltage of the plant.** All the circuit breakers for drives and pumps get disconnected. (The 24-Volt control voltage for input signals remains in place).

Plant control

- Do not make program changes to the software under any circumstances.
- Change the password at least every 3 months. In-house regulations on password assignment must be generated and followed.
- Only instructed personnel may operate/ control the plant.

Safety measures during normal operation

The plant may only be operated when all the protective devices are fully functional.

Before commissioning the plant, it has to be ensured that nobody can be endangered by normal operation.

At least once per shift, the system must be checked for outwardly recognisable defects and the function of all the safety devices.

Inspection of the plant in normal operations

- Functions over and above the input of goods data are password-protected.
- Carry out a visual inspection of the safety devices every time before switching on the plant.
- Operate the plant only if all protective gear is fully functional.
- Before switching on the plant, ensure that nobody can be endangered by the plant getting started up.
- At least once per shift, check the system for exterior defects and the function of the safety devices.
- Report if any chemicals are discharged. Remove and dispose of the chemicals (in liquid or solid form) immediately in accordance with the factory-internal specifications.

Maintenance and upkeep

- Carry out the prescribed setting, servicing, and inspection tasks according to schedule. Coordinate the maintenance and repair work in time.
- During any maintenance, inspection and repair work, render the plant or the respective plant part inoperative and secure them against unexpectedly getting switched on again. (Close the main switch pull out the key, put up a warning notice or a warning board against it getting switched on again, etc).
- When replacing large assemblies, fasten and secure them carefully to hoists.
- Check threaded connections that have been loosened for firm seating.
- Upon completion of the maintenance work, check the safety devices for correct working.

Cleaning and disposal

- Handle and dispose of used materials in a proper and professional manner.

4 Description of the unit

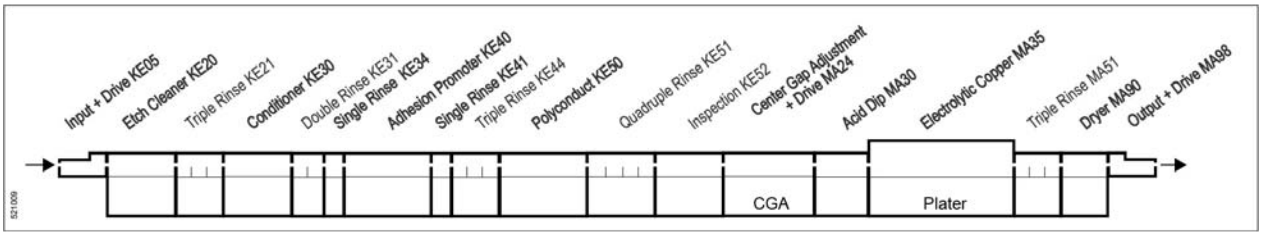
4.1 Technical Data (at delivery status)

Description	Data
Line Data:	
Line type	UNIPLATE Seleo CP-Cu6 InPulse2, UTS-XL
Transport direction	Left – Right (L – R)
Line length	23.765 m (from input to output module)
Line width	1.435 m (without periphery)
Conveyor width	700 mm
Working height	965 m
Weight (total weight unloaded line, included periphery equipment)	
Net weight of the Plater (without external equipment)	
Transport system	UTS-XL
Rated transport speed	1.0 m/min
Electrical Values	
Voltage/ Frequency	380/220 V (+/- 5%) / 50 Hz
System (Network)	TN-S
Nominal Current	235 A
Water Supply	
Cooling water	3 bar, DN50 (15°C)
DI-water	3 bar, DN50
Compressed Air	
Pressurized air oil free	6 bar DN15
Compressed air volume during operation (max.)	10.0 m³/h
Compressed air volume during maintenance (max.)	6.6 m³/h
Exhaust	(Process and dryer must have a separate exhaust system)
Process exhaust requirement	2,200 m³/h
Dryer exhaust	600 m³/h
Negative exhaust pressure (suction performance)	–400 Pa to –800 Pa
Exhaust gas temperature	max. 65°C
Panel Specification	
Panel material	FR4

Description	Data
Panel width	min. 355 mm / max. 535 mm
Panel length	min. 360 mm / max. 610 mm
Panel thickness total	min. 0.5 mm / max. 2.4 mm
Cu-Clad thickness	0.005 mm to 0.018 mm
Through hole diameter	0.1 mm to 6.3 mm
Blind micro via diameter	0.1 mm to 0.3 mm
Blind micro via depth	0.075 mm to 0.1 mm
Plater	
Clamp type	Lift-up pin clamp
Clamp drive	Stainless steel
Environmental Conditions	
Recommended room temperature	20°C – 25°C
Room temperature (max.)	35°C
Room temperature (min.)	15°C
Relative humidity (max.)	Max. 80% at 20°C and max. 50% at 35°C respectively

4.2 Line configuration and module function

Process Steps



Schematic diagram of the Line Process Modules

Summary of Modules

Module	Module Name
KE05	Input and Drive
KE20	Etch Cleaner
KE21, KE31, KE34, KE41, KE44, KE51, MA51	Rinses
KE30	Conditioner
KE40	Adhesion Promoter
KE50	Polyconduct
MA24	Center Gap Adjustment and Drive

Module	Module Name
MA30	Acid Dip
MA35	Electrolytic Copper (Plater)
MA90	Dryer
MA98	Output and Drive

Seleo CP Plus

Seleo CP Plus is a conductive polymer based direct metallization process. It is cyanide and formaldehyde free.

Input and Drive

This module belongs to the group of handling modules (contrary to Rinse modules and chemically active modules in the line).

- The motor in this module drives the first section* of the transport system, i.e. all the gears and conveyor rollers belonging to it, not just in this module, but also in the following ones.
  [*Depending on the length of the entire line, there are several transport sections and drive motors in the line. In the lay-out diagram (see P&I diagram ‘52nnnnRL1’) the length of the transport sections are specified].
- The light barrier in this module detects whether a panel is at the mounting position of the light barrier or not (gap = no panel).
- The drive motor is employed with an encoder. It delivers the pulses for panel tracking. Together with the light barrier, the encoder is the other essential sensor for panel tracking.
- Encoder: The number of pulses per time interval (i.e. per revolution) is also used to check the actual speed of the motor.
- The drive motor is driven via frequency inverter (see electrical wiring diagram).
- The emergency stop switch stops all functions in the entire line, i.e. all digital outputs for pumps, heaters, drive motors, etc..

Etch Cleaner

Cleaning and micro roughening of copper surfaces to ensure an optimum copper to copper adhesion. This module removes copper smear and nail heading.

Rinses

Functions of the rinse module:

- removes chemicals from the surface of the PCBs
- prevents the transfer of chemicals in the next module

- stops the chemical process of the previous module

Conditioner

This module prepares the glass fibers and resin for an optimum attack of the Adhesion Promoter in the subsequent step by wetting, cleaning and conditioning.

Adhesion Promoter

This module is applied to form a thin, densely packed manganese dioxide (MnO_2) layer to initiate polymer formation on the pre-conditioned surfaces (resin & glass fibers).

CAUTION

Hot module

The surface of the Adhesion Promoter module might be hot. Don’t touch.

Polycontact

Acid catalyzed formation of conductive polymer on MnO_2 surfaces.

Center Gap Adjustment and Drive

This module belongs to the group of panel handling modules (contrary to Rinse modules and chemically active modules in the line). It gives the option to inspect panels prior of being processed in the Acid Dip module and the subsequent Plater.

- The light barriers in this module detect whether a panel is at the mounting position of the light barrier or not (gap = no panel).
  The light barriers are part of the panel tracking system of the entire line.
- In case that the light barrier near the outlet wall of this module is the last one before the anodes of the Plater, this light barrier has a number of software functions attached to it, such as panel tracking and current control of pulse devices.
  Correct function of the panel tracking system is essential for the quality of copper deposition in the Plater.

NOTICE

Important instruction for operators:

Do **not move a PCB** while it is under the last panel tracking sensor before the Plater.

This would lead to fault messages and faulty PCBs.

- **Spraying and wetting:**
  For surface wetting of the PCBs, a spray is installed (see also P&I diagram).

Commissioning:

a) The overall flow quantity of DI water can be set by a manually adjustable valve.

b) The actual flow quantity must be within range and is monitored by two flow switches (S36.1 and S36.2). In the commissioning phase, the adequate range of flow quantity (between maximum and minimum limit) must be set.

c) Furthermore, the spray intensity from top onto the surface of the panel and the intensity of flow from below can be set by two respective adjustable valves.

During production:

If the panels are not equally wetted across the whole width, check the holes in the spray pipe (top side).

- The used up water is drained in a drain pipe.

Acid Dip

The chemistry in this module is used for wetting and activating the surface prior of the plating process.

Plater

In the Plater module electrolytic copper reverse pulse plating occurs in a horizontal mode with inert anodes. The copper replenishment system uses redox technology and a Redumat.

Dryer

This module helps to make the panels dry in the through holes and vias as well as on the surface. Four blow bars deliver the air which is supplied with a given temperature and pressure. Each blow bar has 3 rows of holes in it.

Output and Drive

Like the Input module, this Output module belongs to the group of panel handling modules (contrary to Rinse modules and chemically active modules in the line).

- The motor drives the last section of the transport system* with all the gears and conveyor rollers belonging to it, not just in this module, but also in the previous ones.
  [*Depending on the length of the entire line, there are several transport sections and drive motors in the line. In the lay-out diagram (see P&I diagram ‘52nnnnRL1’) the length of the transport sections are specified].
- Panel and gap detection:
  The light barrier (S14.#) in this module detects whether a panel is at the mounting position of the light barrier or not.
- Encoder (S13.#):
  a) The drive motor is employed with an encoder. It delivers the pulses for panel tracking. Together with the light barrier, the encoder is the other essential sensor for panel tracking.

b) The number of pulses per time interval (i.e. per revolution, etc.) are also used to check the actual speed of the motor.

- The drive motor is controlled and supplied via frequency inverter (see electrical wiring diagram). The frequency of the motor current determines the speed of the panel movement.
- The emergency stop switch safely disconnects all pumps, heaters, drive motors, etc.. All bus system output functions of the entire line are switched off.
- A discharge brush takes the electric charge away (to ground), if the PCB has been electrically charged while being processed in the preceding modules.
- Water (if carried over) is drained in a drain pipe.

5 Installation and start-up

Before and whilst unpacking the unit please check if any damages were caused during transport (especially loose parts, dents, scratches etc.).

The freight service has to be informed of any damages immediately.

Please check the packing material very carefully before disposing it. There might be still any small parts in it.

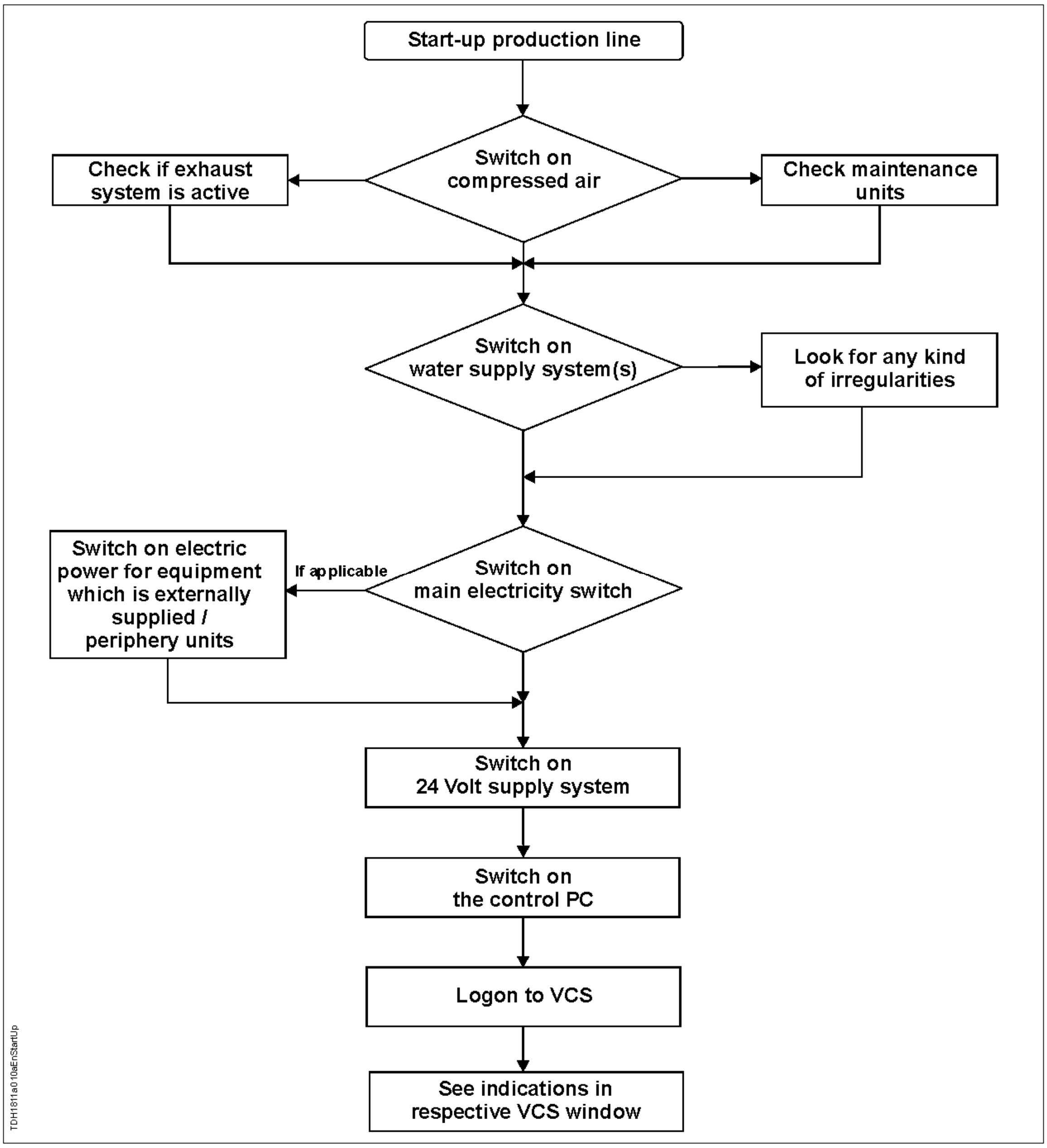
To work on any claim we need details about defects (e.g. photo).

The unit has to be transported and stored in operating position only. This is to protect from any damages. If this is not being observed there will be no guarantee.

All work on the unit may be performed by skilled personnel only. All relevant safety- and environment protection regulations must be observed.

5.1 Start-up production line

- Attend to all aspects in the safety chapter of this manual and your company safety policy. Make sure that nobody else is at risk if switching on electric power, air and water supplies.



Start-up production line, flowchart

- Related sources of information
  - Safety chapter in this Atotech manual and safety notes in sub-suppliers' manuals
  - Company Policy: Standard Operation Procedure, etc.
  - Schematic in P&I, showing the basic supplies of air and water (graphical overview)
  - VCS user guide: 'Getting started', 'Line controls', 'Fault messages List', etc.

Is the exhaust system active? Check air suction at inlets of Rinse module.
[Notice: Electrical power supply of exhaust air blower doesn't belong to the Atotech system; it is an external system, which must run all the time as long as a chemical solution is in one (or more) of the module tanks].

- Switch on compressed air and check maintenance unit (oil-free, sufficient pressure, maintenance unit adequately adjusted and not overfilled with condensed liquid)
  - Switch on water supply system(s)
  - Walk around the entire production plant and look for any kind of irregularities
  - Switch on mains electricity switch at first electrical cabinet '+F1'.

    Note: We assume here, that switch-gear inside the cabinet is not switched off.
- If applicable: Switch on electric power for equipment which is externally supplied (not via Atotech main switch, for example air blower for Electroless Copper module)
- Switch on 24 Volt supply system (green button with indication lights at PC cabinet or next to it)
- Main power switch of control PC (inside of PC cabinet)
- After automatic PC start (first operating system, then project by 'fastview' icon), the user logs on to 'VCS' (user management)
- Are all filter covers closed? Don't switch on pumps prior of this check!
- See indications in respective VCS window and in Fault message window:
  - Are all main supplies switched on (valves open)? Sufficient pressure?
  - Are protective shields in place (no cover switch alarm) ?
  - Are all maintenance switches in ON-position
  - Are all peripheral devices ready for operation (no fault message) etc.
  - Press F9 key (just once every 5 seconds) and attend to displayed fault messages.
  - Again, walk around the entire production plant and look for any kind of irregularities
  - Switch tool from 'Manual' mode of operation to 'Heat-up' mode;
    Attend to messages in VCS, if any;
    Again, walk around the entire production plant and look for any kind of irregularities.
- After bath temperatures have reached their set temperature values; switch from 'Heat-up' mode to 'Automatic' mode of operation;
  Again, attend to messages in VCS, if any;
  Again, walk around the entire production plant and look for any kind of irregularities. Again press F9 key (just once every 5 seconds) and attend to remaining displayed fault messages.
- Trouble shooting:
  - Highlight the displayed fault message,
  - make use of function key combination Ctrl+F1,
  - read trouble shooting table to find cause (hints).

6 Function and Operation

6.1 Handling of the line in general

Whether it is

- in Manual mode of the line or in stand-by,
- during production,
- before a long break, or
- after the break, when production is resumed again,

in any case, the line must be correctly operated, observed, cleaned and maintained to prevent faults.

With different professional background and experience, people are conscious about a smaller or higher number of aspects, but might oversee some other points.

All people, who are regularly or temporarily working at the line, like process engineers, production engineers, equipment engineers, operators, maintenance people, etc. ought to work hand in hand and share their knowledge and experience to get the highest benefit (yield, throughput, etc.) from the line.

- In this chapter there are some general descriptions which are relevant for the handling and observation of the line to keep it as a whole in an appropriate condition. Closely related chapters are 'VCS' and the individual tasks in the maintenance plan.
- Furthermore links are made to other descriptions in other chapters, which are important, when the production is stopped for several days (or weeks) and resumed after that.

See also

🗎 Cleaning of the module (or tank) and Make-Up procedure [➙ 102]

🗎 Methods of how to inspect the exhaust system [➙ 56]

🗎 Maintenance schedule (order by time) [➙ 332]

6.1.1 Continuous running of exhaust system

WARNING

Exhaust system is out of operation

The exhaust system must be permanently in operation, independent, whether in automatic mode, heat-up mode or manual mode of operation.

➢ Safety of operators

a) If there is any sign of insufficient suction, check the exhaust system immediately!

b) If it fails to operate, production must be stopped, the line must be switched to manual mode and the heating system must remain switched off.

c) Chemical solutions in the modules must be drained, if required by the respective safety standards and regulations.

See also

- 060020 Check for proper function of exhaust system [→ 329]
- 060021 Check function of exhaust system visually [→ 330]
- Methods of how to inspect the exhaust system [→ 56]

6.1.2 Signal lamp and status of the line

- Green flashing light:
  The line is in heat-up mode.
- Green steady light:
  All automatic functions of the line are switched on.
- Yellow flashing light:
  There has been at least one new warning signal, which has not yet been acknowledged by the operator.
  Every new warning signal generates a new flashing of the yellow lamp.
- Yellow steady light:
  There has been at least one new warning signal.
  All warning signals have been acknowledged by the operator.
- Red flashing light:
  There has been at least one new alarm signal, which has not yet been acknowledged by the operator.
  Every new alarm signal generates a new flashing of the red lamp.

- **Red steady light:**
  There has been at least one alarm signal.
  All alarm signals have been acknowledged by the operator.
  - Additional to the luminous indications, an acoustical alarm signal will sound.
  - Simultaneously a red colored error message appears in the Fault message window of the PC monitor.

After the generation of a (fault) message on the PC monitor, the operator confirms the recognition of the fault message by pressing the F9 key.

a) Pressing the F9 key once will switch off the acoustical alarm signal.
b) Assuming that the cause for the fault has been identified and remedied, pressing the F9 key a second time will remove the fault message from the active Fault Message list.

	NOTICE
!	**Risk of Damage** Don't press the F9 button frequently! First once, then wait a few seconds; Then again once with a few seconds patience, then see and read the remaining message(s)!

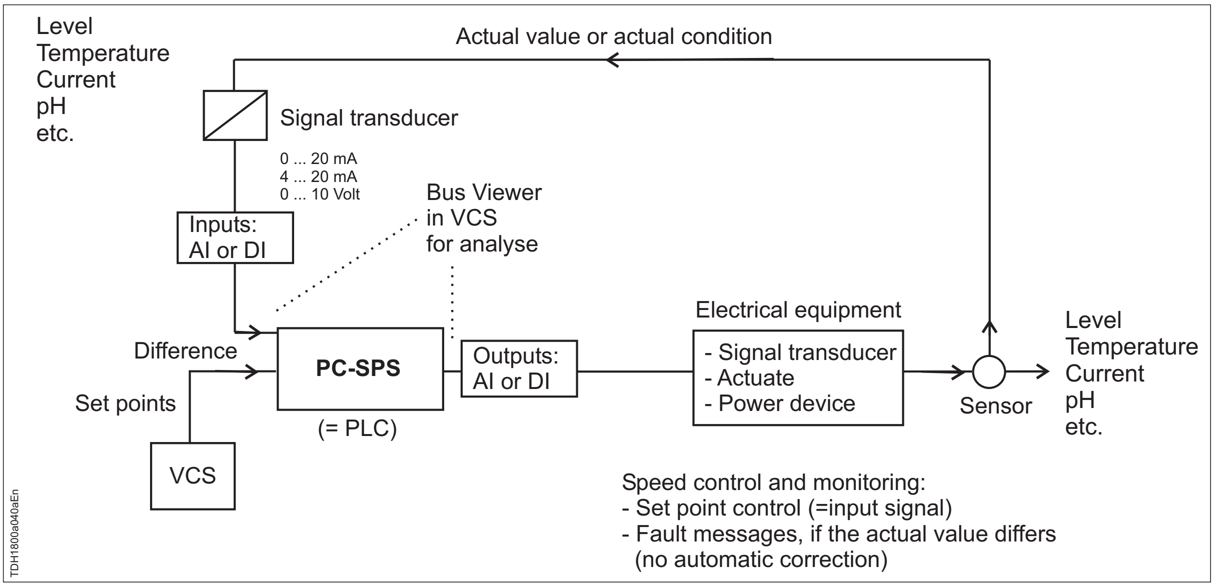
6.1.3 Categories and examples of how (automatic) functions are monitored

It is helpful - and especially for trouble shooting necessary - to have a profound understanding, in which way the sensors monitor the line in conjunction to the software logic and what is left to be monitored and inspected by personnel.

This description serves as a general introduction; It categorizes the major functions in the line with regard to their complexity of automatic control, from fully automated functions to other functions without any sensor and PC control.

	Example	Type of Monitoring	Reaction by PLC and Personnel in case of a fault
A1 A2 A3	Level Temperature Anode currents	Analogue measurement of the physical quantity; Automatic closed loop control system with adjustable set points and warning and alarm ranges.	Automatic software controlled reactions to maintain the set point: The programmed logic of the PLC automatically corrects definite deviations from the set-point by giving respective output signals.
B1	Flow rate in pump circuits with frequency controlled pumps	Measurement of analogue value and display in VCS; Setting of limits for alarms (no set point).	Analogue flow measurement; Fault message in VCS, if the expected flow rate is not reached. No analogue output signal for the correction of the flow rate; Exchange of the filter instead, etc.
B2	Speed of the conveyor system	Detection (counting) of digital input signals per time	If the drive motor (synchronously running by frequency) fails to rotate or the encoder is

	Example	Type of Monitoring	Reaction by PLC and Personnel in case of a fault
			broken, maintenance personnel is alerted to execute trouble shooting.
B3	Torque of the clamp drive motor in the Plater	Measurement of analogue value and display in VCS; Setting of limits for alarms (no set point).	The intention is to protect the belt. Analogue torque measurement and fault message(s) in case of faults; No automatic correction, i.e. just switching off the motor.
C1	Position of cover switch (closed or not)	Detective switch; digital response signal	Fault message in VCS; The pumps in the module will be switched off; No automatic correction.
C2	Minimum flow and pressure detection	Detective switch; Digital response signal	Fault message in VCS; The respective pump will be switched of; No automatic correction.
C3	Flow rate of dosing	Detective switch; Digital response signal	Fault message in VCS; The respective pump will be switched of; No automatic correction.
D1	Exhaust system	Maintenance schedule	No message in VCS; No monitoring by sensor; No PLC reaction. See preventive maintenance tasks!
D2	Pressure at the filter	Operators observe the gauges at the filters	No message in VCS; No monitoring by sensor; No PLC reaction; Preventive maintenance task!
D3	Heating cartridges	No monitoring of the individual currents; Indirect side effects in case of a fault	No message in VCS; No PLC reaction; The heat-up phase takes longer than usual, if some heating cartridges are worn out.



Applications of the 'Closed Loop Control System' in ATOTECH Horizontal lines

Related descriptions:

- On-line help messages in VCS
- Electrical wiring diagram

See also

- Level Control: Level sensors and set-points [→ 109]
- Temperature Control [→ 122]
- Pressure switches and flow monitoring [→ 66]
- Analogue measurement of the flow quantity [→ 68]
- The torque monitoring system [→ 164]

6.1.4 Working on Opened Modules

WARNING

Risk of injury

Working on opened modules is generally not permitted, if the drive (transport system, conveyor) is running.

The detector switch at the opened cover automatically turns off the module pumps to avoid danger of splashing, but it does not turn off the drive.

Exceptionally (for example in maintenance mode, during test or after a panel jam) it may be necessary to open the glass cover and to carry out some work while the drive is running.

WARNING

Risk of injury

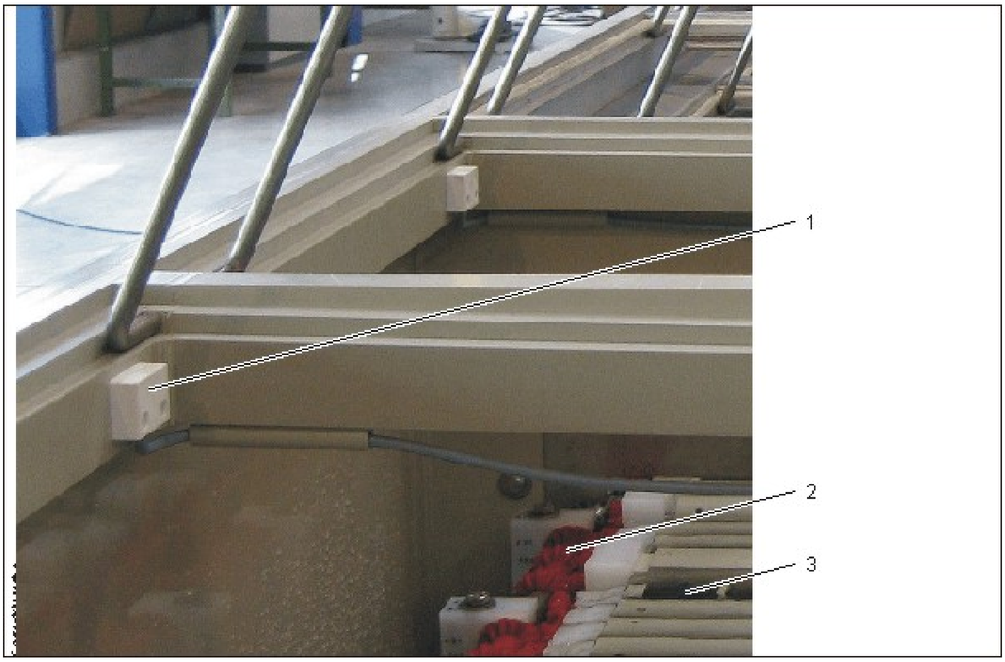
Be careful and keep away from the moving gears of the transport system.

Only instructed personnel are allowed to work on the open line.

It is not permitted to take away safety interlockings!

Related safety instructions:

- Take care of reliable and safe support of the opened cover!
- Wear protective goggles and gloves to avoid danger of being etched by chemicals!
- Wear close fitting clothes to avoid danger of being drawn into the drive!
- Be cautious when working at hot modules (risk of burns)!



Opened Cover

1	Cover Switch	3	Liquid in module (may be hot and/or etching)
2	Transport system (dependent on Drive		

Related Topics:

- VCS Fault message

See also

🗎 020184 Check cover switches [→ 302]

🗎 Rinses [→ 140]

🗎 Handling of the line in general [→ 32]

6.1.5 InPulse Cu Modules and breaks of production

The Uniplate line is designed for high process capacity with a high throughput.

The chemistry is actually very stable. But, due to a high concentration of iron and copper salt together with a high concentration of sulphuric acid there is a high risk of crystallisation.

Short term breaks

In case of short term shut down (i.e. about 8 hours to 2 days) carry out the following steps:

- Switch line to manual mode
- Rinse off the anodes of the Plater module with DI-water. Take care that all electrolyte has been washed off of the anodes. Pay attention to the maintenance instruction 043060.

Long term breaks

In case of long term breaks (i.e longer than 2 days) cristallization has to be prevented by carrying out the following steps.

	NOTICE
!	**Risk of crystallization at room temperature below 20°C!** In this case carry out the same steps as for long term break of production.

1. Switch line to manual mode.
2. Rinse off the working area of the module with DI-water. Do not forget to clean the clamps carefully. Pay attention to the maintenance instruction 043060.
3. Close the manual valves in the transfer pipes from Redumat to module and from module to Redumat.
4. Dump about half of the solution in the Redumat and rinse off the Redumat (dissolving area) with DI-water.
5. Refill the Redumat with DI-water up to the normal level.
6. Open the valves again.
7. Switch on the transfer pumps from Redumat to module for about 15 seconds.
8. Set the Plater temperature control to 25°C and leave the filter pump running.

Before putting the line into operation again carry out following steps:

1. Replace filter cartridges and filter bags.
2. Set the temperature control to the regular production value.
3. After working temperature is reached, start all circulation pumps
4. Check the function of all components and the level situation.
5. After 30 minutes of circulation take a bath sample and carry out analysis of inorganic and organic bath components.
6. Add chemistry if necessary.
7. Start dummy plating for about one hour and check the deposition quality with a test panel.
8. Start production after having reassured that chemistry and plating performance are in range.

See also

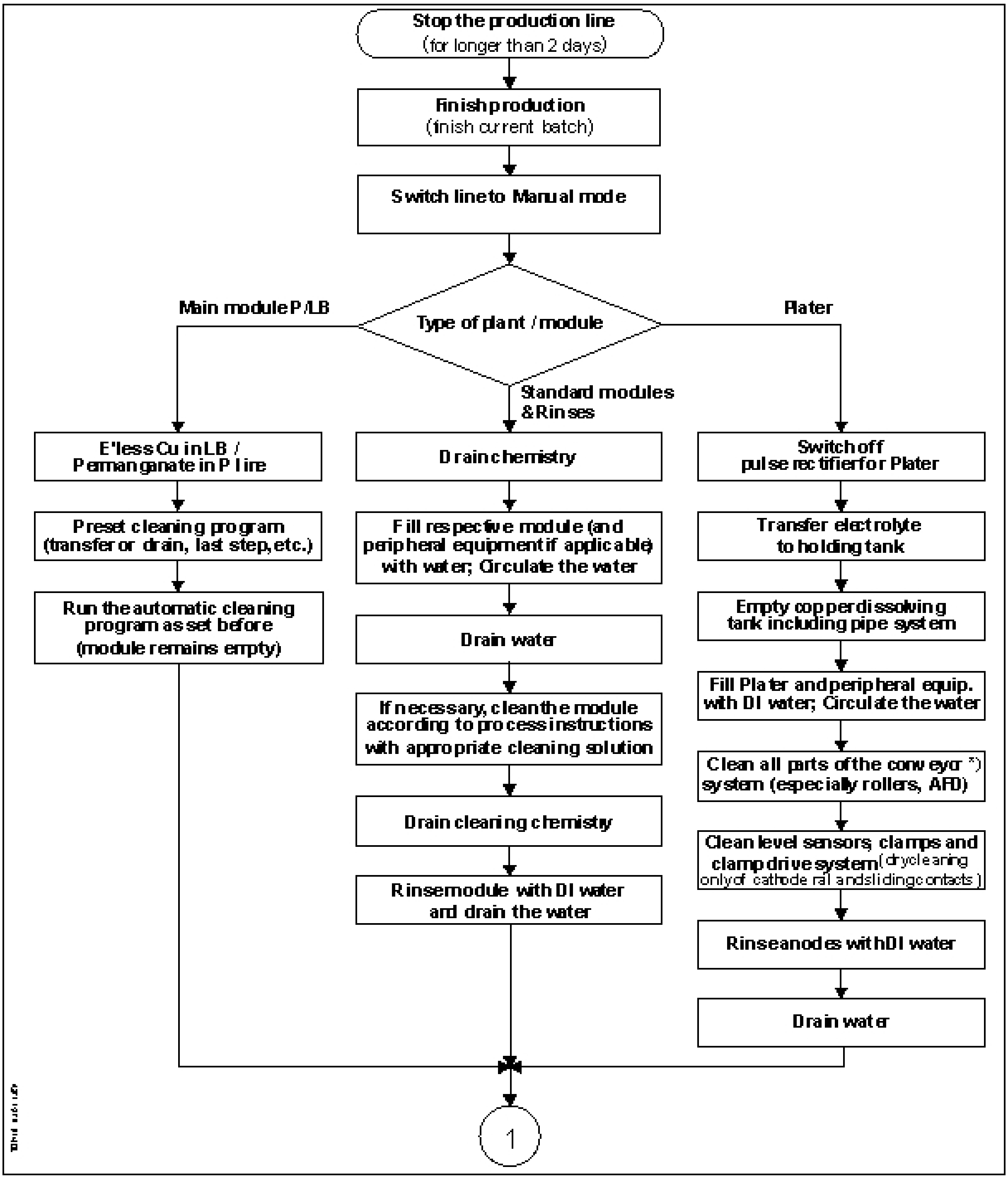
- Plater [→ 159]
- 043060 Rinse Inert Anode Segments and Plater Parts with DI water [→ 323]

6.1.6 Stop of production for several days, cleaning and restart of the whole line

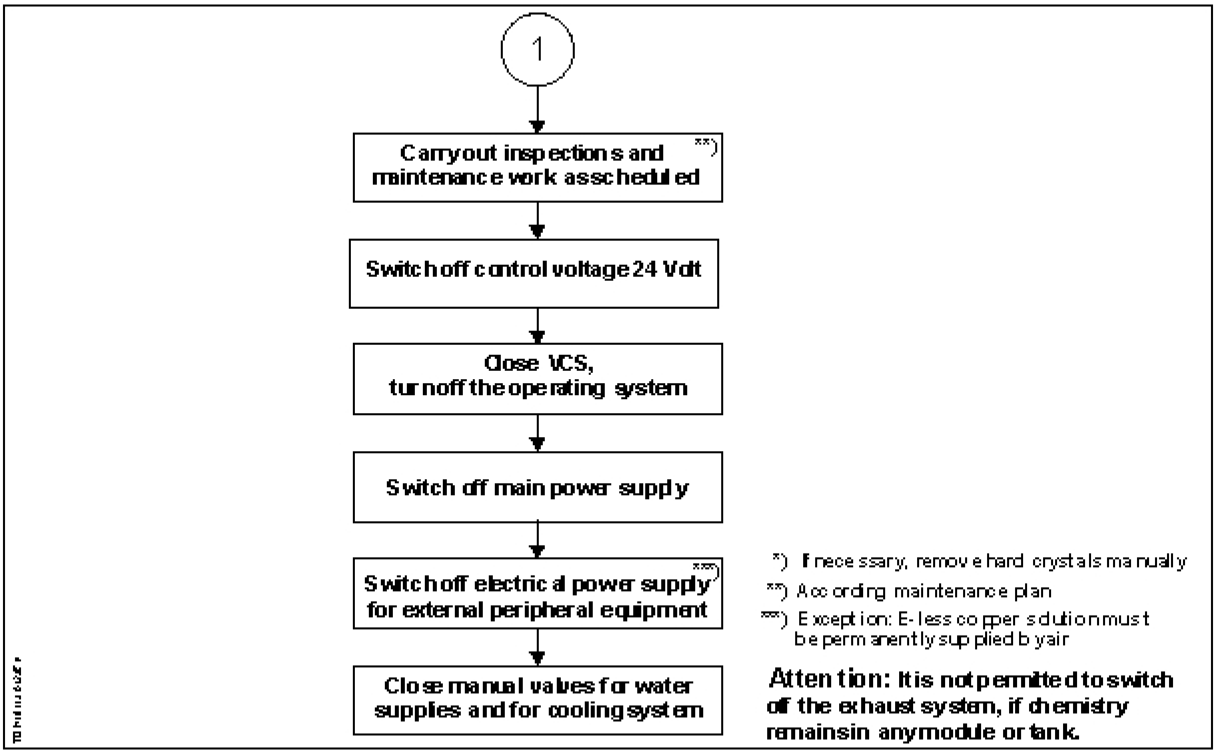
In case that an ATOTECH horizontal line is stopped for more than two or three days, the line has to be completely cleaned to avoid restarting problems after such a long break of production. This is strongly recommended for a number of reasons such as a loss of quality of the bath chemistry (process reliability) as well as the cleanliness and function of the equipment, especially with regard to conveyor system and sensors.

Summary and central point:

	NOTICE
!	**Risk of damage** The better the line is cleaned and inspected before the break (holidays, etc.), the smaller is the risk of faults when production is resumed several days later. If this effort is made before the production break, it will save a lot of time (meaning also costs) afterwards.



Schematic representation part 1



Schematic representation part 2

List of instructions:

The following instructions shall serve as a guideline and reminder of the most essential steps. They include cross references to other maintenance tasks and related documentation.

1. Finish production early enough to have sufficient time left for the cleaning and inspection of all modules and of the complete peripheral equipment. About 8 hrs. should be appropriate depending on the line type, the available manpower and the experience of maintenance personnel.
2. Normally the chemistry is drained from all modules of the horizontal line and all peripheral tanks. However, it might be reasonable to make exceptions: Considering the life time of the bath and the cost for a new make-up, the process and production engineers have to make a decision as to which chemistry shall be stored where, either remain in the module of the line or be transferred to an holding tank, if not disposed of.
3. In lines with Permanganate module, run the automatic cleaning program. Clean holding tank afterwards, if the Permanganate solution is disposed of. Set the options in VCS accordingly before starting the cleaning program.
4. In parallel, run the automatic cleaning program in the Electroless copper module (in case of LB sub line installed) or Adhesion promoter (in case of CP sub line installed).
5. Drain and clean all other active modules and peripheral equipment.
   If necessary, refer to the experience of other process engineers, the ‘Technical Data sheets’ and ‘Material Safety Data Sheets’ for all chemistries and to the description in the equipment documentation (e.g. ‘Cleaning of the module (or tank) and Make-Up procedure’).

6. Execute all (or at least a large part of) maintenance tasks according to the maintenance schedule included in the Equipment documentation. Daily, weekly and monthly tasks have to be executed. Which of the other tasks are to be executed (every 3 months, 6 months, annually) depends on the company internal maintenance schedule.
7. If a Plater is part of the horizontal production line, first of all a decision is to be made:

   - Either the solution shall be drained and disposed of (followed by a new Make-up after the break) or

   - the solution shall be transferred to a holding tank (and be transferred back to the Plater when restarting production) or

   - a fraction of the solution is drained. The anodes and all parts of the conveyor system in the Plater are to be thoroughly cleaned with DI water. This, of course, will dilute the solution to some extent which, on the other hand, has the advantage of reducing the risk of strong crystallization. It must also be considered that the temperature of the solution shall never fall below 20 to 25°C to avoid crystallization. Therefore it may be necessary to leave the circulation pump running (in manual mode) and to activate the heating system after the temperature set point has been set accordingly.
8. In any of the three cases mentioned, the anodes in the Plater have to be cleaned with DI water, as well as the rollers and all moving parts. Perform all daily, weekly and monthly maintenance tasks for the Plater. Which of the other maintenance tasks are to be executed (with a 3 month, 6 month or annual interval) depends on the company internal maintenance schedule. It is also recommended to inspect the holes in the AFD masks, if a pair of AFDs is installed (Task No. 043090).
9. Making a decision for any of the first two cases has the advantage, that the cleaning of the Plater with DI water can be performed more thoroughly without running the risk of solution dilution.

	NOTICE
	**Risk of damage** It would have a negative impact on the life time of anodes, if the anodes are not rinsed. Highly concentrated acidic solution on the surface of the anode mesh due to the drying process, would cause damages to the Iridium oxide layer.

10. Going away from the Plater and coming back to general instructions: For safety reasons, the control PC shall remain ‘ON’ and the operating system in ‘Manual’ mode, should some modules and tanks of the line not be empty.
11. This applies also for the exhaust system and other devices or functional systems, which are not powered via the ATOTECH main supply switch (example: Air supply in Electroless Copper Module). It is not permitted to switch off the exhaust system, if chemistry remains in any module or tank.
12. After the break, carry out remaining maintenance tasks (those which could not be finished before the break due to lack of time or parts, etc.). As long as the line is empty, many inspections are more easy to be executed.

13. For production restart, process engineers finally take care of the ‘Make-up’ procedure, after all equipment maintenance tasks have been executed.

See also related descriptions:

- Maintenance schedule (see equipment documentation)
- Make-Up: ‘Cleaning of the module (or tank) and Make-Up procedure’
- Cleaning of Platers with inert anodes
- ‘Technical Data sheets’ (process related information)

6.2 Functional units and components along the line

6.2.1 Maintenance for handling devices

See also

🗎 Handling [→ 288]

6.2.2 Drive system / drive shaft

The drive system consists of

- drive motors and electric supplies including frequency inverters,
- drive shaft along the entire production line together with gears, couplings and set collars,
- conveyor system with rollers, wheel axles, fluid delivery elements, etc.

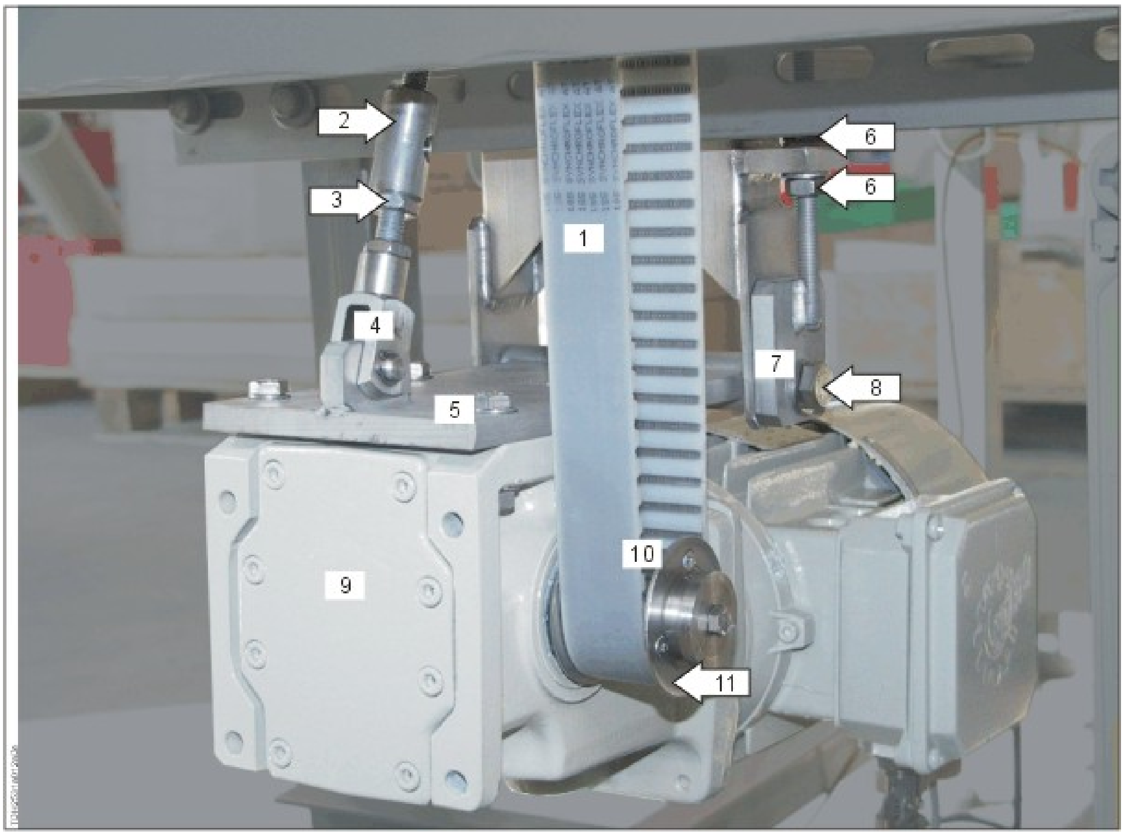
Details of it are represented in the project specific Atotech Electronic Parts Catalog.

See also

🗎 020101 Inspection / Replacement of Multiple Bearing Inserts (MBIs) [→ 296]
🗎 020120 Check the conveyor system: Smooth rotation of components [→ 297]
🗎 020125 Check all the parts of the transport system [→ 298]

6.2.2.1 Axle alignment and belt tension

Part designation



Drive Motor

1	Drive belt	7	Tension element for axle alignment
2	Turnbuckle	8	Screw for motor block adjustment
3	Fixing nut for turnbuckle	9	Gear motor
4	Tension element for belt adjustment	10	Synchronizing disk
5	Motor console	11	Flanged wheel
6	Fixing nuts for axle alignment		

CAUTION

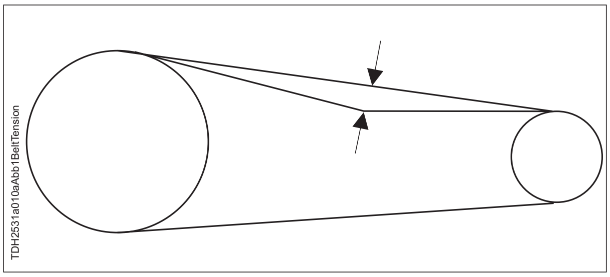
Risk of injury

Before starting the adjustment work make sure that nobody can switch on the drive motor while you carry out the work.

If you start the motor for testing your adjustment work, make sure that nobody else is in danger of getting injured.

Check the belt tension:

The belt should move between 5–10 mm when pressed with the fingers.



Check belt tension

Tools needed for the adjustment work:

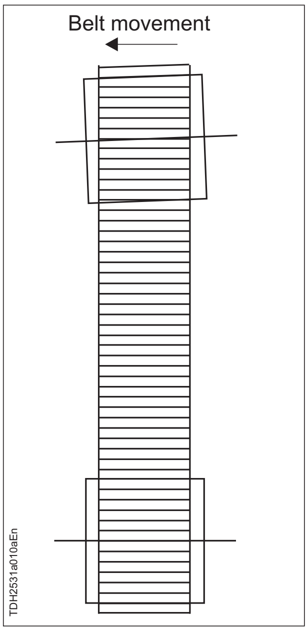
- Fork wrenches, ring wrench or hexagon socket wrench, 19 mm
- Fork wrench 17 mm
- Tension rod d=8 mm, ca. 200 mm long for the adjustment of the turnbuckle

Counter measure when the belt runs against a flanged wheel

The wear of the drive belt increases by running against a flanged wheel and rubbing at it. The gear axle with synchronizing disc must be aligned in that way, that the drive belt does not run against a flanged wheel.

Adjustment work:

a) Loosen the two motor block adjustment screws (8)
b) Loosen and turn the two fixing nuts (6) in order to align the gear box axle
c) Tighten the two nuts (6), check the belt tension and start the drive motor to test the alignment.



Adaptation and correction of the distance of axes if belt is moving sideways

1	Belt movement

After the axle of the gear box with synchronizing disc is aligned, the belt tension must be checked and adjusted.

Adjustment of the belt tension

a) Loosen the turnbuckle fixing nut (3) and the two screws for motor block (8, left and right)
b) Insert the tension rod into the turnbuckle (2)
c) Move the motor downwards by rotating the turnbuckle with the tension rod
d) After the belt tension is correct, retighten the fixing nut (3) and the screws for motor block adjustment (8).

6.2.2.2 Color marking for distinction of flooding elements

Color marking for distinction of flooding elements

The metallic parts used in the ATOTECH conveyor system (UTS) are made of titanium, stainless steel or Hastelloy

NOTICE

Different chemical resistance of module parts

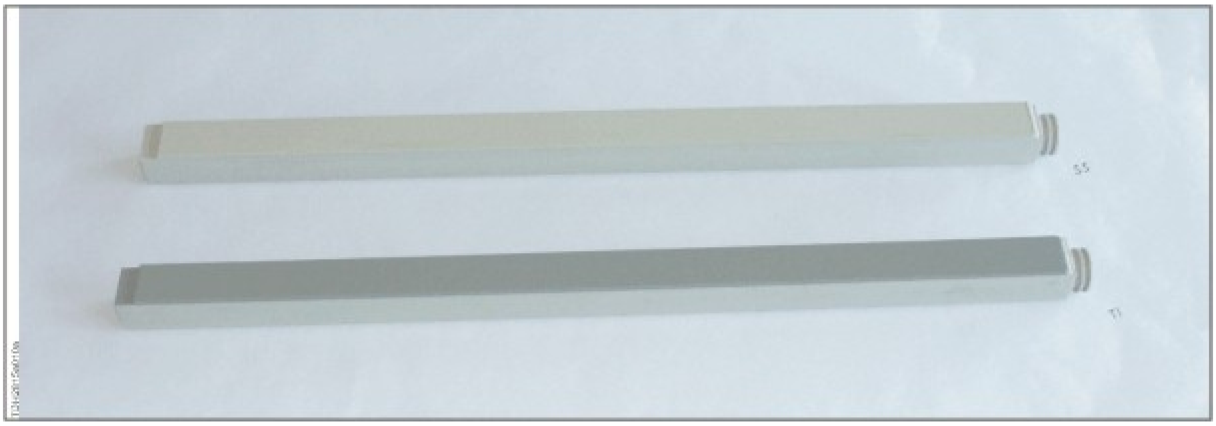
It is not permitted to use wrong parts (metal and material other than specified) in the various modules because of the different chemical resistance.

The correct type of metal to be used in the various types of modules of the line is specified in the module table in the P&I diagram.

Not just axle bolts and set screws of the conveyor system are made of different metals, but also certain parts inside flooding elements (SFDs, AFDs, etc.).

Color marking for distinction:

The color at the back of the flooding element is the indicator for the type of metal used inside of it.



Back of flooding elements (different colors outside = different metals inside)

	Metallic parts in a module	Color of the back of the flooding element
1	Stainless Steel (SS)	PP material, standard beige-to-gray
2	Titanium	PP material, dark gray
3	Hastelloy (in Glass etch module of the Permanganate process)	PPN material, almost white (not shown in the photo)

6.2.2.3 Bearing brackets

The bearing brackets right next to the drive belts (in drive modules) are worn out quicker than others due to the regular pulling force of the belt.

To avoid bending of the drive axes downward, these bearing brackets must be replaced by new ones annually.

This is applicable for all modules with a drive motor for the roller drive system.

See also

🗎 010060 Replace bearing brackets next to drive belts [➔ 289]

6.2.3 Light barriers for panel detection and panel tracking

Generally light barriers are used for the detection of the PCBs (position of leading etches, rear edges and gaps in the line / sub line) and for panel counting.

They are installed in the Input and Output modules of the production line as well as in other handling modules (like the Center Gap Adjuster if a Plater is part of the line).

Further light barriers may be installed in other modules (optional). In the P&I diagram as well as in the electrical wiring diagram, all the installed light barriers in the various modules are designated by the code S14.n.

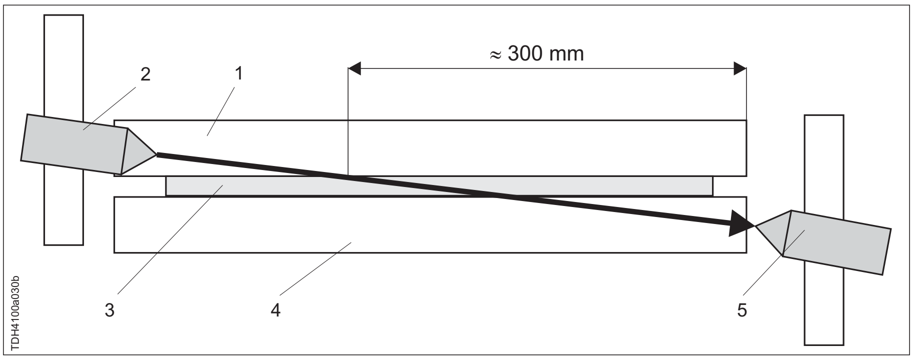
ATOTECH is using light barriers made with a Teflon coating against chemical attack.

Function:

A light beam is sent from the emitter to the receiver. The panel interrupts the light beam to generate an ‘ON’ signal (digital input signal to the bus and control PC).

At the amplifier, the light intensity is adjusted to make a clear distinction between Gap and PCB (Gap = light to the receiver and PCB = dark at the receiver).

Mechanical fixing:



Light barrier adjustment (schematic)

1	Upper roller	4	Lower roller
2	Emitter	5	Receiver
3	Board		

As shown in the schematic, the light beam between emitter and receiver is sloping, crossing the horizontal conveyor area. On reaching the conveyor area, the light beam is either reflected by the PCB or passes on to the receiver.

The adjustment of the light barriers must be such a way that they reliably detect even the smallest specified panel width (for example 350 mm). The light beam sent by the transmitter must hit the receiver (be directed straight to it). Safe and tight mechanical fixing of the light barrier is therefore important.

	NOTICE
!	**Improper adjustments of light barriers** Improper adjustments of the light barriers may cause severe damage to equipment and panels (caused by panel crash and wrong panel tracking).

Panel tracking

Concept:

For panel tracking the light barriers work in conjunction with encoders which are installed at the drive motor. While the light barriers detect the edges of the moving panels, the encoder creates regular pulses (several pulses per revolution of the motor) which are used to inform the control PC how far a panel has moved forward. The panel feed per pulse is entered as parameter into the software. The number of pulses is then a measure how far a panel has moved forward.

Missing panels:

The line specific distances between two light barriers are further parameters in the software which are important for panel tracking.

If a panel is expected to arrive at the next light barrier and does not come, the software logic will generate a fault message.

In other words it means that the On/Off pattern generated by the Panels/Gaps at the first light barrier is checked again at the following light barriers of the line. If the next pattern is different to the previously recorded one, a fault message is generated (missing panel, panel too long etc.).

Fault messages:

If some panels are missing (by default three), the conveyor of the line will be stopped. If nobody took out the panels, there might be a panel crash due to a conveyor problem. Other possible causes for such a fault message are listed up in a fault message window by highlighting the fault message and pressing the CTRL+F1 button combination.

See also

- Electrical wiring diagram of the production line
- Sub supplier ‘Keyence’,
  PS-201 (= light barrier) and
  PS2-61(P) (= photo electric sensor)
- CGA
- Positioner

6.2.4 Water supply

6.2.4.1 Specification closed system cooling water

To avoid deposits and corrosion closed system cooling-water should correspond to the following standard values. Deviation from these values must be approved by Process Engineering.

Parameter	Unit	Value
Piping temperature	°C	< 60
Appearance		Colorless and Clear or only lightly clouded, without sediments
Material in suspension	mg/l	< 30
pH value at 25°C		7 - 8,5
Conductivity at 25°C	µs/cm	< 2000 *
Ks8.2 (p value)	mmol/l	< 1
Ks4.3 (m value)	mmol/l	1 - 6 **
Alkaline earths (hardness)	mmol/l	< 9
Free carbon dioxide	mg/l	< 3

Parameter	Unit	Value
Chlorides	mg/l	< 300
Algae growth		Not allowed
Chlorine at max. dosing rate	mg/l	1 – 2

Changed values for use with soft water:

Parameter	Unit	Value
pH value at 25°C		8 - 9,5
Ks8.2 (p value)	mmol/l	< 3
Ks4.3 (m value)	mmol/l	< 25

* When corrosion resistant materials are used for the whole circulation system or when using appropriate corrosion inhibitors up to 3000 µS/cm and chlorine concentration up to 500 mg/l.

** Upper limit value when using polymere phospate. When using organo-phosphates or phosphonic acids, a Ks4.3 of up to 10 mmol/l is possible, depending on the actual chemicals and concentrations used.

See also

060050 Replace the water of the cooler station [→ 330]

6.2.4.2 Specification water types

Parameter	Units	City Water	Softened Water	Rev. Osmosis	DI Water
Temperature	°C	10 – 25	10 – 25	10 – 25	10 – 25
pH Value		6,5 – 8,0	6,5 – 8,0	6,5 – 8,0	5,3 – 7,5
Hardness	°dH	< 10	< 1	< 0,01	< 0,01
	CaCO3 mg/l	179	17,9	<0,01	<0,01
COD	mg/l	< 5	< 5	< 5	< 5
TOC	mg/l	< 5	< 5	<1	<1
Conductivity	µS/cm	< 800	< 1000	< 60	< 10
Free Chlorine	mg/l	< 0,3	< 0,3	< 0,03	< 0,03
Number of Colonies	Col /ml	< 20	< 20	< 20	< 20
Cations:					
Ca	mg/l	< 70	< 5	< 5	< 1
Mg	mg/l	< 15	< 1	< 0,100	< 0,100
Cu, Al, Zn, Sn	mg/l	< 0,5	< 0,5	< 0,100	< 0,100
Ni, Mn, Cr	mg/l	< 0,5	< 0,5	< 0,020	< 0,020
Fe, Pb	mg/l	< 0,2	< 0,2	< 0,020	< 0,020
NH4+	mg/l	< 0,5	< 0,5	< 0,03	< 0,02

Anions:					
Sulfate	mg/l	< 120	< 120	< 1	< 1
Chloride	mg/l	< 100	< 100	< 1	< 1
Nitrate	mg/l	< 10	< 10	< 1	< 0,5
Phosphate	mg/l	< 2	< 2	< 1	< 0,5
Silicate	mg/l	< 10	< 10	< 1,5	< 5
Flouride	mg/l	< 1	< 1	< 0,5	< 0,5

Value 0 = below detection limit

NOTICE

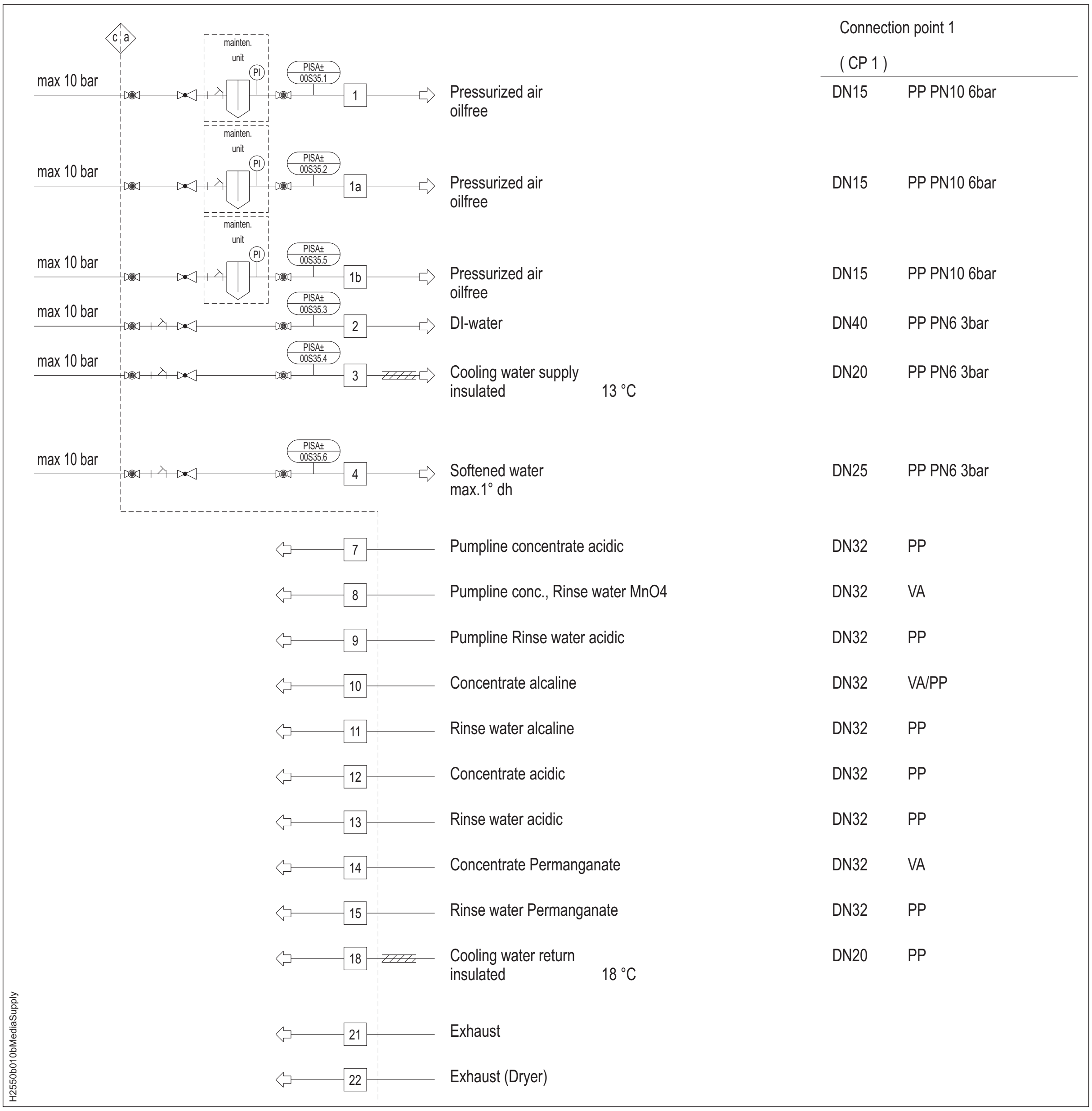
Circulated water

Circulated water is not permitted

6.2.5 Connection point, main supplies, drainage pipes

Main supplies (compressed air, water) and drainage lines of used chemicals are specified and schematically represented in one of the P&I diagrams.

The schematic below serves just as an example for illustration:



Example of supply and drainage pipes as shown in P&I schematics

For project specific information, please attend the respective P&I diagram of your production line following the path:

> Process overview and modules > P&I Diagram

Compressed air [1] [1a] [1b] etc.:

- Without sufficient air (quality), the pneumatic valves and cylinders are at risk to cause troubles (malfunctions in the respective modules).
- Adjustment of required pressure at the maintenance units
- Pressure minimum monitoring by the control PLC
- Air quality: it must be oil free

Types of water

- Without sufficient water (quality), the process quality may be affected: risk of defects at produced panels!

- [2] DI water
- [3] Cold water supply for cooling system in the modules
- [4] Other type of water as agreed by contract (line configuration)
- Pressure minimum monitoring by the control PLC to detect insufficient supply immediately

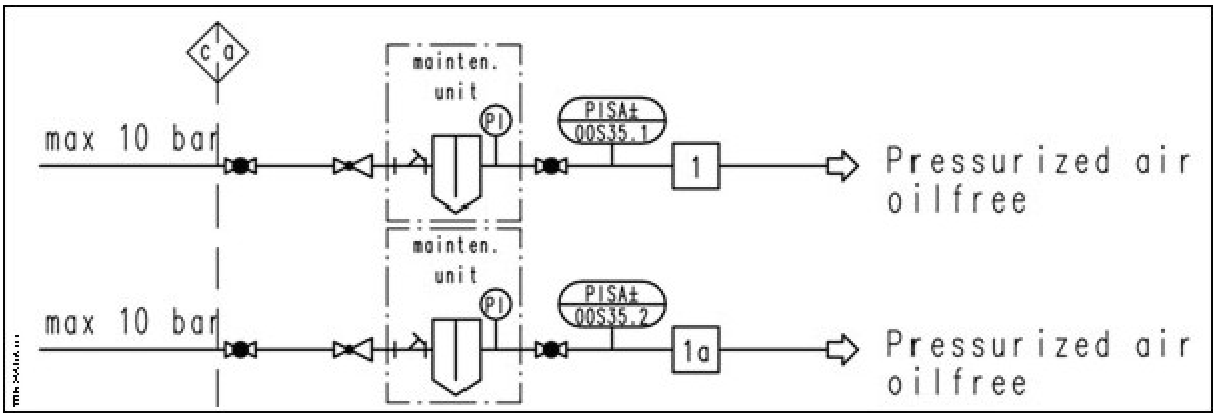
Pipe system at the point of transition Atotech | Customer:

- The numbers in the square field represent the pipe system of the line
- The drainage system must match (modules, pipes, tanks).
  Pipes should be marked according to house internal regulations.
- 'DNXX' specifies the inside diameter of the pipes
- PP, VA etc. for the pipe material

6.2.6 Compressed air system

Compressed air belongs to the basic supply systems (besides water and electricity).

Without sufficient air (quantity, pressure, quality), production is not possible. Respective faults must be avoided. The customer provides compressed air with sufficient pressure as stated in the P&I diagram.



Example of P&I schematic with two compressed air supply sub-lines [1] and [1a] (for illustration)

The schematic above is next explained from left to right:

- The acceptable maximum pressure from supplier side is mentioned in the P&I schematics (for example 10 bar) and defined with respect to the appropriate pressure reduction device (e.g. pressure regulators, maintenance units).
- The ‹c|a› line represents the interface between customer | atotech
- With respect to number of supply lines (in parallel), the compressed air supply system is line-specifically different: depending on compressed air consumption (number of valves, handling modules, etc.), the air supply system is split up into two, three of four pipe systems.
- Besides manually operated valves, each air supply line is equipped with a pressure regulator, a maintenance unit and a pressure monitoring switch S35.#.
- A code is applied to identify the compressed-air lines, such as:

Code	Pneumatic line (supplying which instruments)	Pressure for pneumatic instruments
[1]	General supply pressure	6 bar (common)
[1a]	Instrumentation pressure Handling	6 bar (other pneumatic instrument)
[1b]	Other instrumentation pressure	x bar (specific pneumatic instrument)

- The general supply pressure line [1] is used for commonly used pneumatic equipment such as solenoid valves and pneumatic cylinders. If several compressed air supply lines are installed [1a], [1b], etc., these acronyms serve as ‘link’ (line connection within the P&I schematics) representing the respective pneumatic line of a module.

Related topics:

- Project specific P&I diagram
- Maintenance instructions in Atotech equipment manual and part suppliers’ manual
- Electrical wiring diagram (with layout of pneumatic parts in sub distribution boxes)
- Electronic parts catalog (start via etk.exe file) with sub-supplier manuals

6.2.7 Exhaust system

i	INFORMATION
	Proper functioning of the exhaust system For reasons of process quality and on-the-job safety, it must be checked at regular intervals whether the exhaust system is continuously running. If chemistry is in the production plant, suction must take place. If there is any sign of improper suction, check the exhaust system immediately more thoroughly!

The aim of the exhaust system description below is to explain the correlations and to provide criteria for monitoring and checking the exhaust system.

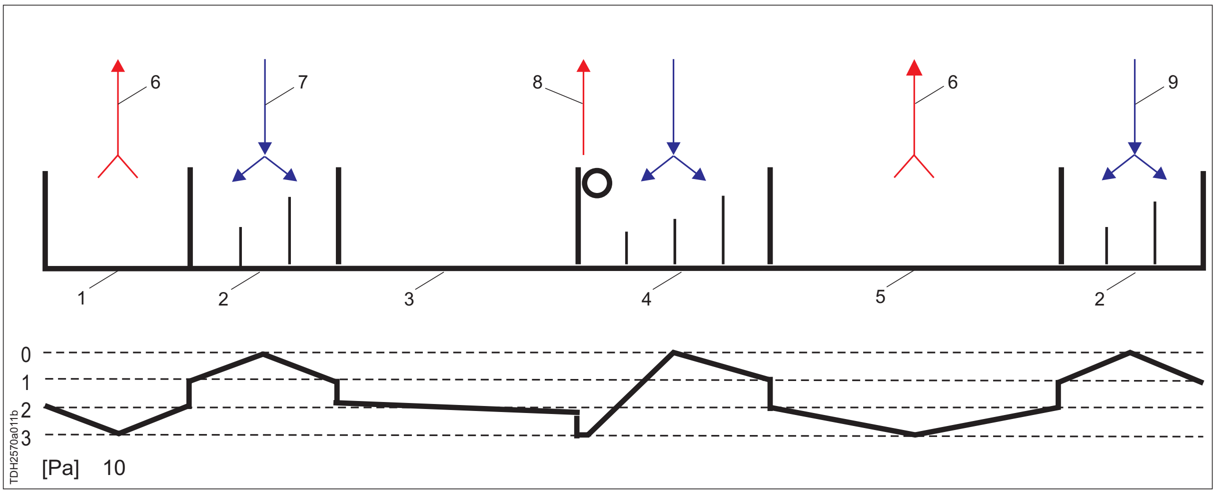
See also

🗎 Exhaust system in the Plater [→ 159]

6.2.7.1 Airflow

There are apertures on the top sides of the rinse modules on the maintenance side of the line.

These apertures are the ambient air inlets and must therefore **not** be covered.



Example of the exhaust air flow in ATOTECH systems (principle)

1	Active module	6	Exhaust air
2	Triple Rinse	7	Fresh air input
3	Conditioner	8	Exhaust slit
4	Pre-rinse cascade	9	Fresh air input
5	Conductor	10	Suction pressure

As the piping of the exhaust system is connected to the active modules, the air is drawn in this direction.

The vacuum in the active modules is relatively small (range: 1 - 3 Pa). During commissioning, the ATOTECH staff adjusts this suction pressure as required for the specific module by using orifice discs.

The diameter of the orifice discs and the pressure values at the measuring points are recorded for each active module.

6.2.7.2 Important general notes

	CAUTION
	Vapour of an active module The vapour of an active module mustn't escape into the ambient air (for example, if the top cover is opened).

	NOTICE
	Vapour of an active module The vapour of an active module mustn't flow to the neighbouring active modules.

In the P&I diagram, the exhaust pipe system has the reference number [21]. The flow rates in the exhaust pipes (module pipes and main pipe) are defined to be adequate to the size of the module (neither to low nor to high). The flow speed in the exhaust pipes is 8 to 10 m/s (to give an orientation).

The nominal diameters of the exhaust pipes are specified in the project-specific P&I diagram (DN 32, DN50, DN80, etc).

INFORMATION

Measurements during line commissioning
During line commissioning measurements are taken at the defined points (at the Atotech-customer interface connection, etc.). Orifice discs (installed in the pipes of active modules) are used to set the module-specific flow rates (speed in pipes, low pressure inside modules).
The results are recorded in the sheet ‘Record of Exhaust Settings’. These records are to be used for reference to check the exhaust system in future.

If the suction effect is too high (for example if there is no orifice disc installed),

- the system unnecessarily removes condensate, thus increasing the consumption of chemicals and
- it removes too much energy (especially from the high temperture modules), thus prolonging the heat-up time for such modules unnecessarily.

Note: Exhaust system modifications and risks by interdependences

- The exhaust conditions inside of the modules strongly depend on the total exhaust air flow rate (at main connection point and at exhaust blower). If the conditions applicable for the total volume of exhaust air are changed – as it is the case if other production plants are added to the entire exhaust system or if the exhaust system is modified or repaired –, this is very likely to affect the low pressure and process quality in the active modules.
- Conversely, any modification to an individual active module (especially to modules with a high exhaust volume and the pertaining exhaust pipes with orifice discs) can have an effect on the process in other modules as the total fume volume equals the sums of the partial flow rates.

6.2.7.3 Methods of how to inspect the exhaust system

Depending on factors such as flow rate in the exhaust pipe system, low pressure inside modules and practical feasibility of checks and measurements, the methods of how to inspect the exhaust system vary.

At different measurement points and also depending on the status of the production line (production, stand-by, heat-up, manual), adequate methods of inspection and measurement must be applied. Some methods are very simple, others are more accurate.

	INFORMATION
i	**Exhaust system** The exhaust system must be checked regularly (a) according to maintenance schedule (b) always when the exhaust system is modified in any way The functioning of the exhaust system has an influence on flow quantity in the exhaust pipes and on the low pressure situation (strength of suction) inside modules.

Checking the degree of ambient air flow into Rinse modules:

There are apertures for air inlet at Rinse modules (at the rear side of the line).

Always prior of opening the lids of a module (and at least once per shift) make a short and simple test:

► Use a piece of light cloth (paper, tissue) to check whether there is suction of air into the aperture, i.e. air flow into the Rinse module. (Due to the suction by the main exhaust blower in is flowing on to the adjacent active modules).

This inspection method has the advantage that no measurement tools are needed. It can be applied at any time (status of the line) and does not need a trained specialist.
(Note: If installed, the air knife system must first be switched off when making this test).

Checking the temperature of covers on top of some rinse modules:

This inspection method is also very simple, is however just suitable where a Rinse module is next to an active modules with high operating temperature.

In general the air is flowing from the rinse module to the next active modules. The in-going air is at room temperature, it is heated up in the active modules. Considering the regular direction of flow, the temperature in the rinse module should be closer to the room temperature than to the temperature of the hot module.

► By touching the glass cover of a Rinse module (cautiously), you get an indication whether the (hot) air is flowing the right direction (not backwards). If the cover of the Rinse module is unusually hot (almost as hot as the adjacent active module), the exhaust system is most likely not extracting enough hot air.

Direction and speed of air flow (use of smoke sticks):

The use of smoke sticks is a method, which makes the direction and speed of air flow visible. This type of air flow monitoring can be carried out in stand-by mode of the line (and is, module dependant, also possible during production).

The vapors should move at a speed of 0.2 - 0.5m per 10 seconds. The vapor movement is better visible in warm and moist modules. In cold modules, it is less easily to be seen.

With regard to the recommended smoke sticks, please contact a trained process engineer, your regional ATOTECH office or the BTT in Berlin ATOTECH Berlin.

► Air flow monitoring with smoke generation should be executed
- latest every three months,
- when new parts are added to the exhaust system or when repair work or modifications were carried out at he exhaust system,
- according to process specific instructions.

Low pressure inside active modules (measured by a special manometer):

Atotech staff personnel applies this accurate method when commissioning the line.

At the rear side of each active module there are two holes, usually closed up by an R1/2” screw. Taking the screws out, the threaded holes are used for connecting the low pressure manometer (the characteristic feature of it, is the slanted pipe with red liquid inside of it). The red liquid level is an indicator for the strength of suction inside of the module.

The required low pressure value must be between 1 to 3 Pa (module specific also more closely specified by aspects such as temperature und type of exhaust vapor).

► The value is set and adapted by means of the orifice discs in the exhaust pipe at the rear side of active modules.

► The measured low pressure values (1 to 3 Pa) are recorded together with the diameter of the orifice discs (in the exhaust system protocol sheet).

► Decide upon where to put the records (a copy of protocol) for later reference.

Velocity of air flow inside exhaust pipes:

This method is suitable when flow rate and speed of the air in exhaust pipes is sufficiently high for using an air flow meter (vane anemometer).
R3/4” holes in the exhaust pipes serve as provision for fixing the vane anemometer.

► The flow speed in the exhaust pipe is adjusted by fitting orifice plates of appropriate diameters.

► The velocity of the exhaust air is measured
- at the Atotech/customer interface,
- at the Dryer module
- and, if part of the line, at the Plater module).

► The measured velocity is recorded in the exhaust pipe protocol together with the respective diameter of the pipe (and orifice disc in module pipe).

The pipe diameter and the velocity may be used to compute the flow rate (in m3/h) at the individual measuring points.
Formula: Flow rate (in m^3/h) = Average Flow speed x Pipe diameter.

Regarding the flow speed, it must be considered, that it is higher in the center of the pipe than near to the pipe wall.
► The point of measurement (of vane rotation) must be in the center of the pipe.

Two sets of records, in case that an air knife system is employed:

In some lines (with slimmed rollers) there is an air knife system employed to prevent drag-out of chemistry. This installation (if switched on) changes completely the pressure and flow situation in the modules and in the pipes of the exhaust system due to the extra input of air (pressed into the system by the air knife compressor).

► Protocols (of measured values and employed orifice discs) must be made for both phases of operation:

- Air knife system OFF

- Air knife system ON

See also

🗎 060020 Check for proper function of exhaust system [➙ 329]

🗎 060021 Check function of exhaust system visually [➙ 330]

🗎 Exhaust system in the Plater [➙ 159]

🗎 Control parameters [➙ 265]

6.2.8 Electrical and Bus System

6.2.8.1 Code numbers used in wiring diagrams

The two main sections in the electrical diagram file(s) are:

- Wiring diagram for power circuit with control circuit (module orientated order)
- I/O Section with information on the bus system (slave orientated order).

There are cross references between both sections. In case of a fault it is very important for electrical engineers and electricians to find a certain part or wiring terminal quickly. Therefore some exercise is needed beforehand.

The following lists shall assist the process of getting familiar with the electrical wiring diagrams.

6.2.8.2 Wiring diagram

The sections in the electrical diagram files are numbered in the following order.

Each section consists of pages in ascending order.

Number	Module / Section in Wiring diagram	Subdivision of section
		See page numbering in the right-hand bottom corner
=00	System	Power supply for the line, 24V DC supply for the line,

Number	Module / Section in Wiring diagram	Subdivision of section
		AC Control Circuit (if installed)
=00	System	Power supply for the line, 24V DC supply for the line, AC Control Circuit (if installed)
=__04	Loader	
=__05	Input	
....		
....	Modules in ascending order (with gaps in the sequence)	Power circuit, digital inputs and digital outputs, analog inputs and analog outputs
....		
=__85	Dryer	

= I/O	BUS section	Subdivision of bus section
Overview Nodes / Slaves	Lists with type of module, location where mounted, reference to other page, specification of supplier	See page numbering in the right-hand bottom corner
PC card	Displays overview with the nodes that are used and connections to PC card(s)	
Layouts SB	Displays layout of all the sub distribution boards	
Details Nodes / Slaves 3 122	Layout of slave components, Wiring of bus and power modules List of connected wires	- Slaves or nodes in ascending order (with gaps in the sequence possible)

6.2.8.3 Code numbers related to BUS section

= I/O	BUS section of electrical diagram
-A1.29.5	This module is addressed Via PC Bus Card 1, slave number 29, position 5
DO	Digital Output Module,
AI	Analogue Input Module
=43/3,2	See also section 43 (module 43), page 3, current path 2
+SB43 +ZV43	Mounted in Subdistribution board 43
TM-E-4DI	Digital input module, 4 signal channels, Siemens specification

6.2.8.4 Abbreviations

EA IO	(German: Eingang / Ausgang) Input / Output (related to BUS System)
ZV JB	 Junction Box, Subdistribution board
PE	Protective Earth
gnge	green-yellow wire (protective earth)
br	brown

6.2.8.5 Labeling electrical components

Label	Description
A	Special input/output units
B	Sensors
C	Capacitors
E	Heaters, lamps, etc.
F	Fuses, protective devices
G	Generators, frequency converters
H	Signal devices (optical, acoustical)
K	Contactors
L	Inductive components, coils
M	Motors
Q	Switch gear (power circuit)
R	Resistors
S	Switches, push button switch (control circuits)
T	Transformers
X	Terminal blocks, plugs, point of connection
Y	Electrically operated mechanical devices, electromagnetic valves
W	Wires, cables, transmission equipment

Labeling of electrical components

6.2.8.6 Example

Example		Explanation
=00 / 2,3	 =00 2 3	This line or diagram is continued ... .. in the power supply section on page 2 path number 3
/ 6,4	 / 6 4	This line or diagram is continued in this same section (module) on page 6 current path number 4
+ ZV 05	+ ZV 05	Location: This component is placed the junction box number 05
- X24	- X 24	The wire is connected to (electrical part) terminal block number 24
- W 1443	- W 1 44 3	part, device, wire power circuit module counter

Example of Code numbers and letters

6.2.8.7 Color code wires

- Three phase power supply:Neutral wire à blue, 3 Live wires à black, Protective Earth à green yellow
- AC Control circuit:
  Live and neutral wires both in red
- DC wires:
  + 24Volt à blue wires, zero potential à gray wires
- Wires of specific electrical parts or appliances:
  See wiring diagram or OEM documentation

6.2.9 The importance of good electric connections

Poor electric contacts, like loose cable connections, not only lead to malfunctions, but cause also the development of heat at the contact points.
In extreme cases this may even lead to self-ignition of components.

WARNING

Poor electric contacts

Fire hazard and danger of getting burns!

Care must be taken to ensure that each and every electric connection is tightened up thoroughly after it was disconnected. This is especially important for high current connection points.

► Always carry out the following checks, particularly after any repair work, but also at regular intervals.

- Are the contact points tight?
- Are the cables damaged or corroreded?
- Is there abnormal heat development?
- Is the material showing any changes of color as a result of excessive temperatures?

Additional measures for large surface and high current connections:

- Clean and smoothen the contact surfaces with emery paper
- Use contact grease (however not too much, contact grease should never end up in the bath)

See also

Redumat and Copper Dissolving Tank [→ 256]

Plater [→ 159]

6.2.10 Uninterrupted 24 Volt power supply for the control PC and the Bus system (UPS)

Bus system and VCS (Visualization and Control System) are powered by an uninterrupted 24 Volt power supply unit consisting of

- 1 to 3 MCS Power supply units (Murr Elektronik) for regular operation,
- 1 RDCUSV20S Power DC-UPS Module (Michael Riedel) serving as buffer in case of power failure.

UPS: Uninterrupted Power Supply

The task of the UPS device is to switch over from the regular 24 Volt power supply unit (Murr Electronik, 3phase/ 24 Volt DC) to the buffer battery without interruption in order to protect the computer controlled system from data loss and file corruption.

After mains power failure the data base is shut down immediately by VCS. The battery in the UPS Module keeps 24V/20A up to approximately 5 minutes. (The buffer time depends on the actually available battery load capacity.) In this time the cause of power failure has to be eliminated.

UPS unit in the control cabinet

Circuit diagram of UPS internal configuration

The UPS is equipped with three status indicating LED lights. A circuit diagram of the internal configuration of the UPS is found on the left side of chassis.

- Red light is ‘ON’:
  Battery is being charged.
- Green light is ‘ON’:
  Ready for operation.
- Yellow light is ‘ON’:
  Mains power failure: UPS is operating. The bus gets a ‘0’ - signal via the isolated contact integrated in

the unit. A fault message (No. 11509) is transmitted to the control system. Power is kept up to 5 min max depending on battery load capacity.

The UPS is switched off by actuating the power circuit breaker for the regular 24V supply.

	NOTICE
!	**Risk of data crash** In case of repair work at the UPS: Before disconnecting 24V power supply, shut down PLC and VCS to protect data and file system.

Related topics:

- VCS Fault messages
- Electric wiring diagram

6.3 Functional units and components in the modules

6.3.1 Pumps and pump circuits (classification)

The line is employed with numerous pumps and pump circuits. This introduction shall help to give an overview and to make distinctions in different respects.

	INFORMATION
i	**Functionality of a pump circuit** If you want to study a pump circuit with respect to a certain purpose, we recommend - to look first at the project-specific P&I diagram (to a certain module), - compare then the schematic of a pump circuit to the installation itself and the respective VCS-H process control window.

With regard to function we can distinguish the following groups of pump circuits:

1. Pumps for **bath circulation** in an active module, running in stand-by mode and needed to start the heating elements (more precisely the automatic temperature control).
   This pump circuit may also be used for fine filtration of the chemistry of a module.
2. Pumps for **fluid delivery for panel treatment**, feeding fluid delivery devices (different types of FDDs) or spray systems.
3. a) **Dosing pumps** for the replenishment of chemistry to maintain the required bath concentration.
   b) **Barrel pumps** are used for Make-up and transfer the chemistry by a distinctly higher flow rate than the Dosing pumps.

4. **Transfer pumps:** They transfer the medium from one tank to another, for example
   - during production from a module to an external tank, or
   - during an automatic (or semi-automatic) cleaning program.
5. **Other function-specific (and module-specific) pump circuits,** such as
   - spraying (cleaning) of rollers and/or gears of transport system, etc.
   - agitation (for example for clamp stripping in the Copper module)
   - flow quantity compensation (additional tray flooding in UTS-xs transport system)
   - etc.
6. For **water supply**, the pump is generally line-external (i.e. not delivered by ATOTECH). In such water circuits, pneumatically operated valves switch on/off the flow of water.

Information about pumps and components belonging to a pump circuit

- P&I diagram
- Electrical wiring diagram
- Identification plate at the pump
- Sub-supplier manual (see the electronic parts catalogue ETK)

See also

🗎 020160 Clean ventilation grid of pump motors [→ 300]

🗎 020180 Inspection of monitoring devices [→ 300]

🗎 Exchanging magnetic centrifugal pumps [→ 353]

6.3.2 Pressure switches and flow monitoring

6.3.2.1 Pressure switch (at filter unit)

Some pump circuits are monitored by a digital pressure minimum switch mounted at the filter unit.

It delivers an ‘On’ signal to the bus system under regular working condition and reports a fault to the control PC if the pressure is below the set minimum.

The main reason for installation of this pressure minimum switch is the protection of pumps against running dry (without solution).

This option is applied if, for example, immersion pumps are installed (like in the Plater).

Manometer with pressure minimum switch and signal cable

If the actual pressure is insufficient, the related fault message appears on screen.

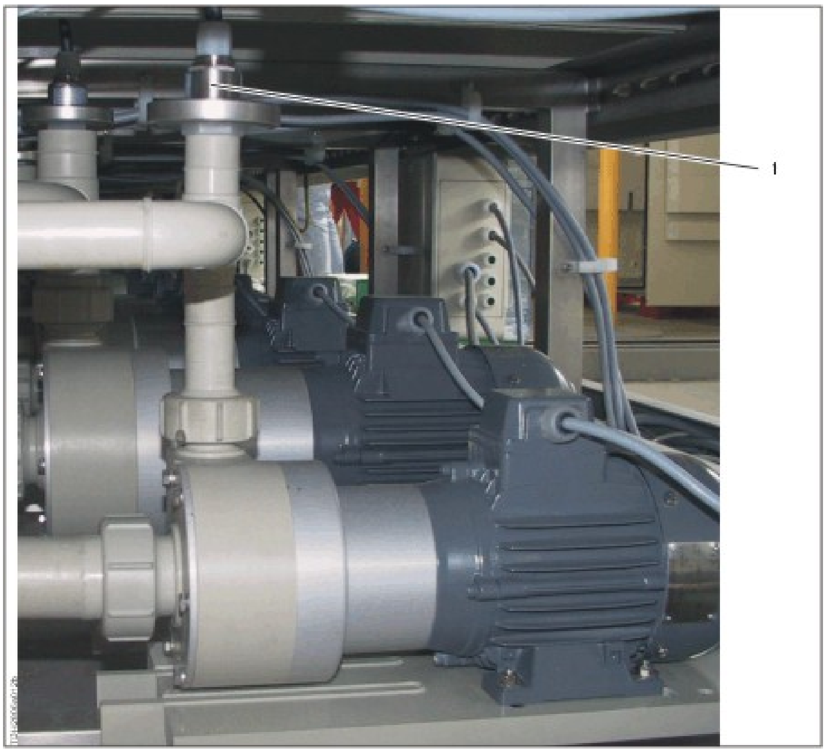
By highlighting the fault message and pressing the key combination ‘Ctrl+F1’ (Online help function) a list of possible causes and corrective measures is displayed on the VCS screen.

6.3.2.2 Pressure switch at pumps

The pumps installed under the modules are protected against running without liquid by a pressure minimum guard (digital sensor).

Indirectly this pressure guard serves also to detect an insufficient flow quantity for fluid elements and spray nozzles.

The disc-shaped pressure guard is mounted directly at the delivery side of the pump. It delivers an ‘On’ signal to the bus system under regular working condition.



Pressure guard

1	Digital pressure guard

The threshold value of the pressure sensor is set by the manufacturer.

If the actual pressure is insufficient, the related fault message appears on screen:

Examples:

‘401 Pump (number) stopped because of pressure minimum’.

‘508 Alarm! Transfer pump stopped because of pressure minimum’.

By highlighting the fault message and pressing the key combination ‘Ctrl+F1’ (Online help function) a list of possible causes and corrective measures is displayed on the VCS screen.

6.3.2.3 Analogue measurement of the flow quantity

In Atotech production lines pump circuits are monitored by one of the following options:

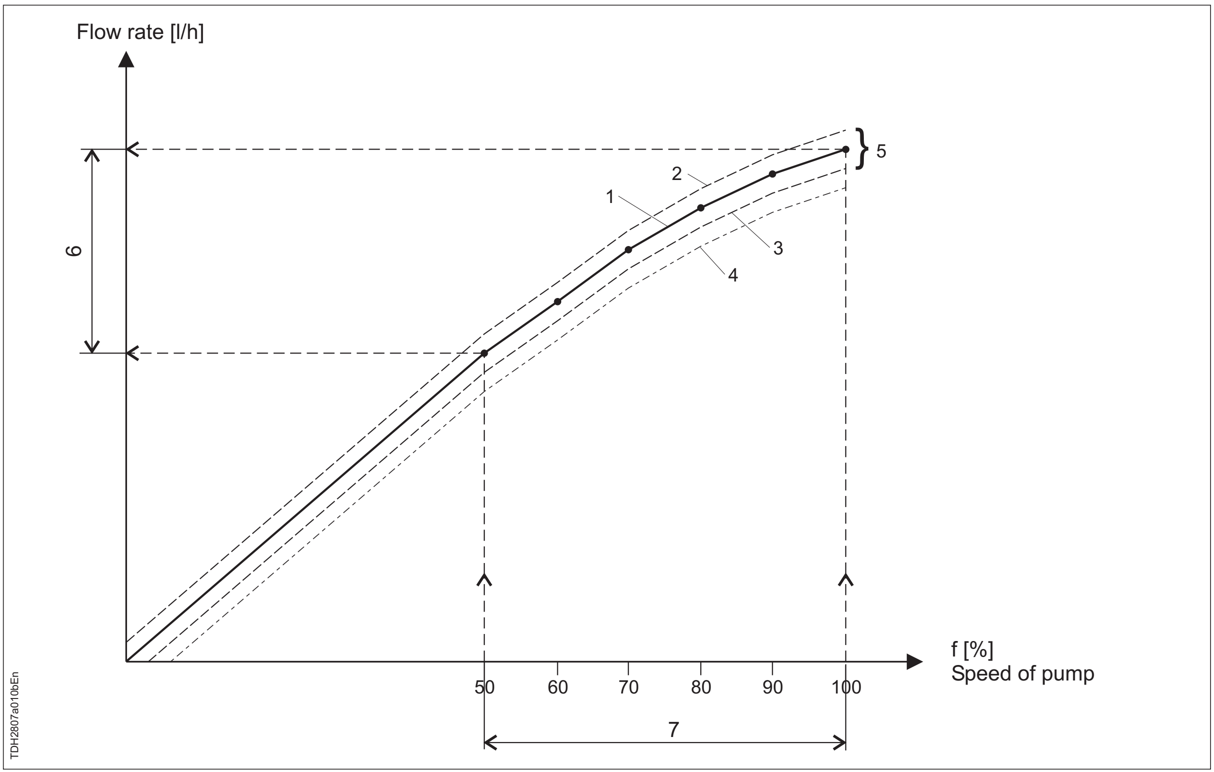
- Digital flow rate minimum detection (by S36 switch) or
- digital pressure minimum detection (by S35 switch) or
- analog flow rate measurement (by B36 sensor) or
- analog pressure measurement (by B35 sensor).

This description is about analog flow rate measurement (by B36.# sensors). Please refer to P&I diagram, electrical diagram and/or the part designation label –B36.# to see whether an analog flow measurement check is applied in a certain pump circuit.

The advantages of running pumps by frequency converters and measuring the actual flow quantity in the respective pump circuit by a flow rate sensor (with Atotech designation B36.#) are as follows:

- Possibility to reduce the flow rate with regard to safe transport of foils (thin PCBs) in horizontal production plants (prevention of panel jam)
- Possibility to adjust the flow rate to the preferred value with regard to panel thickness and panel treatment (fluid dynamics and impact on processed PCB).
- Automatic detection of clogged filters due to reduced flow rate and respective message for operators
- Protection of the pump against being damaged by preventing an operation without liquid flow (suction side of pump must not be blocked).

If a pump is frequency controlled, the flow rate in the pump circuit depends on the supplied frequency. In order to measure the actual flow rate, an analogue flow transmitter is installed. The AI-signal delivered by the B36 flow rate sensor is used by the control PC to display the actual flow quantity (in the respective process control window in VCS).



Flow rate characteristic depending in the speed (frequency) of the pump

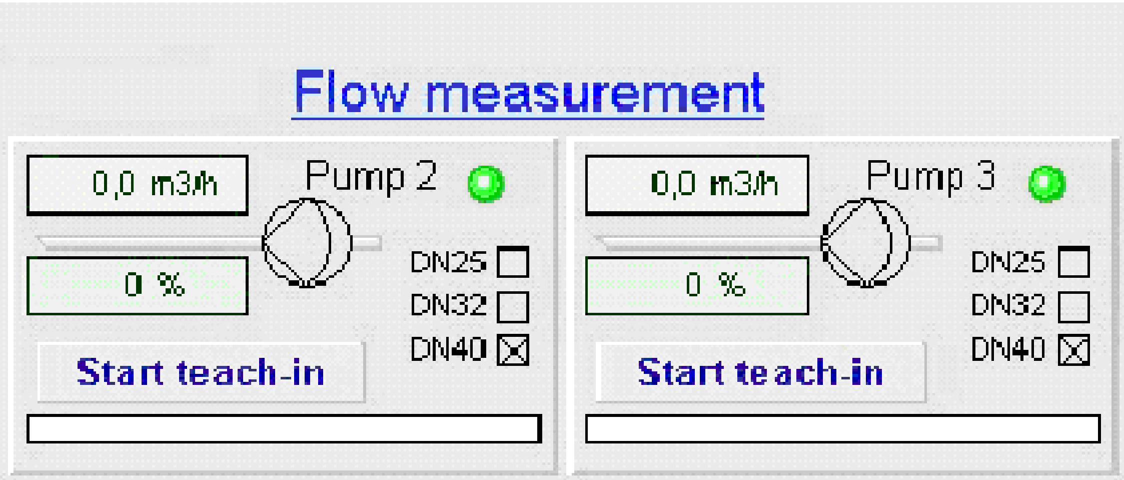
1	Taught-in reference characteristic	5	Regular range of operation
2	Upper warning limit	6	Resulting flow rate
3	Lower warning limit	7	Teach-in procedure: Automatic frequency variation
4	Alarm minimum limit		

As shown in the flow rate characteristic above, the reference flow rate curve and the warning / alarm limits above and below are frequency dependent. After correct teach-in, the PLC has the record of expected flow rate / of irregular flow rate for the whole range of frequencies.

If the actual flow rate is getting below or above the defined range, an alarm message will be generated to alert the operator. The range between the upper and lower flow rate limit is defined by percentage parameters in the PLC block (they are entered by Atotech commissioning personnel at line commissioning).

Teach-in function:

For illustration purposes we show a randomly selected window ‘Flow measurement’ extracted from VCS (as an example).



Extract from VCS: Flow measurement window with the ‘Start teach-in’ button

INFORMATION

Teach-in function

After correct execution during commissioning of the production plant: There is no need (and no permission!) to click the teach-in button (an exception would be a modification of parts in the pump circuit).

Prior to running the teach-in function, the commissioning engineer must be sure about optimum condition of the entire pump circuit equipment (clean filter, etc.).

The teach-in function must not be applied, if the filter is clogged or if any other cause might reduce the flow quantity.

NOTICE

No filter in the filter housing

On the other hand it is not permitted to start a pump, if there is no filter in the filter housing!

After having clicked the ‘Teach-In’ button of a pump, the PLC will automatically

- vary the pump frequency automatically up and down (several times) and

- record the measured flow quantity values (at specified points of the characteristic: Flow quantity versus frequency).

After that flow rate measurement procedure, the recorded values are used by the control system as frequency-dependant reference values for fault detection (such as ‘filter clogged’).

Fault message generation:

If, for example, a filter gets clogged and the flow quantity is reduced, the system will generate the warning / alarm message, if the deviation from the recorded reference value is bigger than the percentage, entered in the PLC block during line commissioning.

6.3.3 Setting and selection of pump frequencies dependent on panel thickness and flexibility of foils and PCBs

All pumps, which supply the Fluid Delivery Devices (FDDs, such as SFDs, HFDs, AFDs, ASFDs, etc.) with chemical solution or water, are frequency inverter controlled, i.e. all these pumps can run with variable pressure and flow quantity.

By this design / feature, the UNIPLATE lines are able to process panels of different thicknesses and flexibility ranges. Both, process requirements and transport reliability can be achieved.

Influencing factors on stability / flexibility of foils:

- Thin boards have a higher flexibility, thicker boards are more rigid
- Besides the total panel thickness, the portion of the copper clad is another essential factor for the stability of bards (copper clad = copper layer which is laminated on the base material). The thinner the copper clad, the more flexible is the board.
- Type of base material
- Copper clad with or without pattern (= space and line structure)
- etc.

Summary:

The fluid pressure onto the board has to be adapted dependent on the panel specific flexibility, in order to get both, the expected process quality and transport reliability. Therefore frequency inverters are installed in the modules of the line.

- The nominal pump frequency is the electric network frequency (50Hz/60Hz). This frequency is generally set, if the panel thickness is bigger than 0.3mm.
- Thin and flexible boards have to be processed with a gentle fluid pressure, i.e. with lower pump frequencies.
- Thicker or more rigid boards have to be processed with a higher fluid pressure, i.e. with higher pump frequencies.

If thin and relatively flexible boards are processed with pump frequencies which are too high, there is the risk of panel jam.

On the contrary: If thick and rigid panels (e. g. high aspect ratio boards) are processed with pump frequencies which are too low, the fluid pressure may be insufficient for a successful drill hole treatment, especially in long through holes.

	NOTICE
	Pump frequencies It is important to set the correct pump frequencies appropriate for the individual type of panel in the commissioning phase. Test runs must be executed.

Commissioning of the line and aspects of frequency setting

- The possible frequency range is from 20 to 60 Hz for the inverter controlled pump circuits.
- During line commissioning it has to be found out which pump frequency is to be used for which type of board (test runs).
- The tests have to be carried out not just with water in the modules, but also with chemistry (because of the density/viscosity of the liquid different to water).
- In a number of modules splash-free flow of the solution is required, i.e. the flow quantity into a tray and the return flow must be balanced. This is another aspect for frequency setting.
- Note: It is possible (and sometimes even necessary), that we need to set different frequencies in different modules and pump circuits for reaching optimum results.
  (Furthermore, in a module such as the Plater, pump frequencies of upper and lower pump groups may need to be set slightly different to avoid scratches).
- After successfully passing the transport tests, the required pump frequencies are to be saved in a specific recipe (= set of machine parameters, such as speed, etc., including the frequencies). This specific recipe is then the appropriate one for the specified board type.

Production and operation:

	INFORMATION
i	**Specific recipe** If a job is about to be loaded, the operators just select the appropriate part from the parts library (in VCS-H job administration). The recipe is attached to the selected part. This way, the correct frequency parameters will be automatically assigned.

New/Different panels:

	NOTICE
!	**Panel types with different flexibility** In the course of the months/years after commissioning new panel types with different or unknown flexibility may come into process. In this case further test runs are obligatory to find out and optimize the required frequency parameters. The results have to be saved in a new recipe. New recipes are to be distributed throughout all concerned work teams in order to pass on all essential information on the specific processes.

6.3.4 Fluid Delivery Devices – Introduction

Flooding Devices (FDs), also named Fluid Delivery Devices (FDDs), are part of the conveyor system in horizontal production lines. They are designed as bars with different types of exit apertures (slots, bore holes, cone-shaped holes and nozzles). They transmit the chemical solution (or water) of a module with adequate pressure and flow quantity. This way the holes and the surfaces of the processed panels (PCBs, foils) are treated as intended with regard to process quality.

The various types of FDs which are installed in the various ATOTECH horizontal lines may be classified by type, materials and shape.

- Classification by type (such as TSFDs, THFDs,TCFDs, AFDs, Flood bars, etc.); These types are essentially different with regard to shape of outlet aperture (slots, bore holes, cone-shaped holes, nozzles, gap) flow quantity, impact pressure and impact velocity;
  Examples of FDs (meaning of acronym):
  - TSFDs are FDs with Slots and Teeth (teeth for better transport reliability)
  - THFDs are FDs with Holes and Teeth (teeth for better transport reliability)
- Classification by materials (such as PP, PVC, stainless steel, etc.) depending on kind of chemistry used in a module;

- Classification by shape and dimensions, depending on the various conveyor systems (T1, T3, T4, UTS-s, UTS-XL, UTS-xs, TTS).

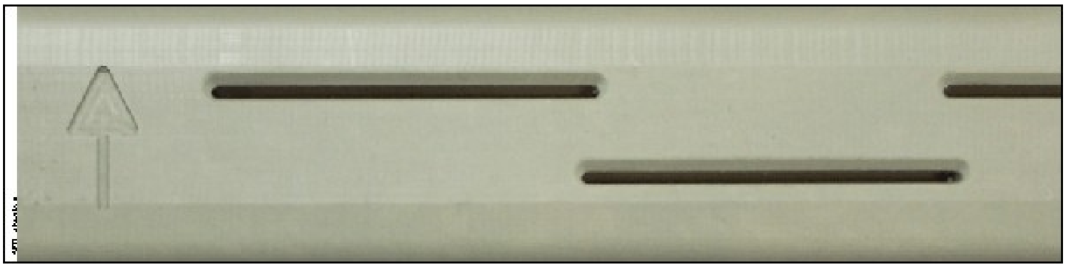
Project and module specific information about FDs

- To get a first overview about the design of the conveyor system including the specified type of FD (and pump circuit), please refer to the **project specific P&I diagram**. In the P&I diagram it is also symbolized whether a tray is installed in the module, which keeps the PCB completely immersed inside solution while processed.
- The correct order number for FDs can be taken from the **Electronic Parts Catalogue** (application 'etk.exe' of a → specific line, → in a specific module at its → specific position in the conveyor system). The respective brief FD-description contains, amongst others, abbreviations about the material of the FD (PP, SS, PVC, etc.).
- Should a team of specialists reach a conclusion, that the type of an FD at a certain position shall be changed, please update the house internal records and inform Atotech Feucht in Germany about such modifications (including the regional Atotech office).
- Flow rate to and from Flood tray, level in Flood trays, return flow control:
  For panel transport reliability of thin foils, the feed flow is automatically controlled (by software parameter settings in the commissioning phase).

6.3.4.1 SFD: Slot Fluid Delivery Device

This is the most common type of fluid delivery devices installed in Atotech horizontal lines since the so called UTS transport system was introduced. The slots in the SFD bar are arranged in two rows.

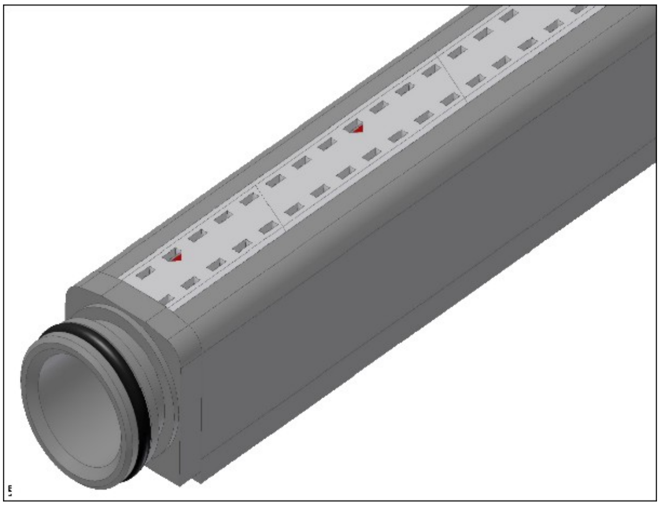
When mounting SFDs, consider the marks for transport direction: The SFD has a 45° chamfer at the front edge to avoid panel jam. The transport direction of PCBs is marked by an arrow on top/bottom side of the SFD.



SFD: Slots with chamfer at front side; Arrow, to mark the direction of transport

In comparison to other FDDs (AFDs and Flood bars), outlet pressure and flow quantity of SFDs are in the middle range of the respective pump characteristic.

6.3.4.2 AFD: Advanced Fluid Delivery Device



AFD with two rows of fine flat jet nozzles

The main visible feature of AFDs are the fine jet nozzles arranged in two rows (in clued segments).

In comparison to other FDs, the stream velocity and impact pressure (on the processed PCB) is higher compared to large-size outlet apertures (due to the tiny outlet area of the nozzles). The respective flow quantity is in the lower range of the pump characteristic.

The relatively high pressure and high outlet velocity together with the special flat shape of the spray jet, is used to blow out entrapped air from Micro Blind Vias in PCBs (for example).

NOTICE

Operating instruction and maintenance of AFDs:

- In order to prevent crystallization and blockage of the small nozzles, the AFDs must be rinsed / cleaned by DI water prior of a long-time standstill of the line (example: a full day and two nights break).
- Make sure to have always a clean filter inserted in the AFD pump circuits. If this is ignored by mistake, the small nozzles might get easily blocked. Without inserted filter, the respective pump mustn't be started.
- Other instructions and information: See equipment manual, use the 'Search'-function, type 'AFD' and read related topics.

When removing and remounting AFDs, the top AFD and bottom AFD mustn't be mixed up.

Furthermore, in case of exchange between different Atotech lines, the direction of transport must also be considered, since the direction of the outgoing jets of the two rows of nozzles is unequal (one row with perpendicular spray direction to the conveyor plane / the other slanted).

6.3.5 Filters

See also

🗎 020010 Check the pressure indication at the filter units [→ 289]

6.3.5.1 Quick-exchange filters

Quick exchange filters are mounted in most active modules and in the rinses of the line.

They are installed between the pump and the flooding element in the respective cycle.

The filter inserts are easy to exchange.

Specifications and Details

The filter specifications (Filter dimensions, flow volume, material) are provided on the one hand in the P&I diagram and on the other hand in the parts catalogue included in the documentation.

Representation and identification of pump cycles

The Atotech identification of any filter pump (e.g. /M03.2) is identical:

- in the P&I diagram
- in the control system
- directly at the pump

Pressure indicator and filter exchange

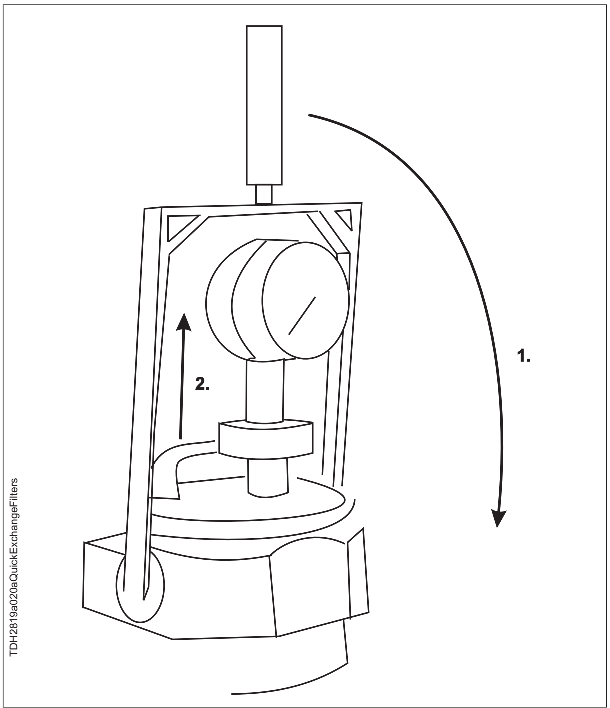
A short sight at the manometer is enough to find out whether a filter exchange is necessary or not. The examination criteria is whether and by how much the pressure indicator deviates from the set mark.

For this purpose it is necessary that, when the first commissioning of the line is made (with the module-specific bath solution in the module and new or cleaned filter inserts), the mark at all manometers is set in accordance with the pointer position.

By this, the normal operation pressure in the filter is pre-defined.

With increasing contamination the volume of flow in the filter diminishes, whereas the pressure inside the filter (at the pump side) increases.

If the indicated value deviates by +/- 30% from the normal operation value (with a new filter bag), it is necessary to replace the filter bag.



Quick exchange filter, removing of the filter insert

WARNING

Risk of severe injuries by splashing chemicals

Before replacing the filter, always switch off the pump connected to the corresponding cycle! For this purpose, maintenance switches are mounted at the filter unit (or nearby).

When replacing the filter always observe the directions for the handling of acids and alkaline solutions!

Re-assembly of the filter insert:

Push the lever in order to press the filter insert upward until it is pressed in completely against the stopper. Only in this case you can switch on the pump again.

a) In order to switch on the pump again it is necessary not only to switch On the maintenance switch, but also to push the reset button F9 at the control PC.

The case may occur that even after replacing the filter, the pressure indicated does not correspond to the mark set at the manometer.

This may have following causes:

- The mark at the manometer was not set correctly at the beginning.
- Incrustations or obstructions have an adverse effect on the volume flow of the liquid circuit and therefore on the pressure indicator.
- In exceptional situations the pump may be damaged, so that it is no longer able to work at full capacity.

See also

🗎 020010 Check the pressure indication at the filter units [➔ 289]

6.3.5.2 By-pass filtration, filter units with cartridge filters inside

Contrarily to the quick exchange filter units which are installed between the pump and flooding element in the liquid circuit, cartridge filters are mounted as “By-pass”-system (‚By-Pass-Filtration‘) for fine filtration purposes .

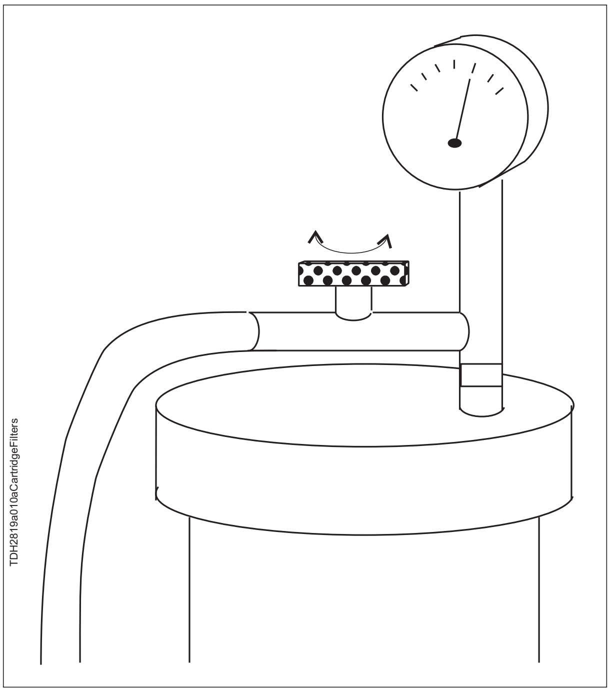
A pump circuit with cartridge filters is just used for

- bath circulation and
- fine filtration of the bath
- (and not for the direct board treatment).

Generally the pump used for the ‚By-Pass-Filtration‘ is also used for bath circulation purposes in the Heat-up or ‚Stand-by‘ mode. By this the bath liquid is fine filtered not only during production.

Air release

In order to release air from the filter housing, the air release valve at the filter has to be kept slightly opened. A slight amount of solution is then visible, permanently flowing back to the module in the transparent tube.



Air release valve and transparent tube at filter unit with cartridge filters inside

Specifications and Details

The filter specification is documented in the P&I-Diagram and in the parts list of the documentation. You may also contact the Atotech regional office.

Further details about the cartridge filters (assembly, single parts, etc.) are provided in the manufacturer's documentation.

Representation and identification of pump circuits

By having a look in the P&I Diagram and on the VCS screen, you can easily distinguish the pump circuits with cartridge filters (in the different active modules of the line) from the circuits with flooding elements.

The ATO identification tag (e.g. /M03.1) is identical in the P&I Diagram, in the PC control system and directly at the pump.

See also

🗎 020010 Check the pressure indication at the filter units [➔ 289]

6.3.5.3 Leaching/Cleaning PP-filter Inserts

Prior of first use the filter material must be cleaned.

	CAUTION
	Working with chemical contaminated parts Inspection and adjustment work is only to be carried out by trained personnel wearing appropriate protective clothing!

- Material:PP 111 SP, fabric, white, free of spinning oil

	CAUTION
	Working with chemicals The health and safety regulations for the use of acids and alkalines must be followed.

- Cleaning filter inserts when already in use:

a) Use DI water only or attend to chemical cleaning instructions.

b) Rinse filter for a while until PP material is clean.

c) Use only original filter inserts with the correct size.

d) Check gaskets for damage when changing filter inserts and replaced if necessary.

For further cleaning instructions (initial use of filters) contact the Atotech regional office or the BTT in Berlin.

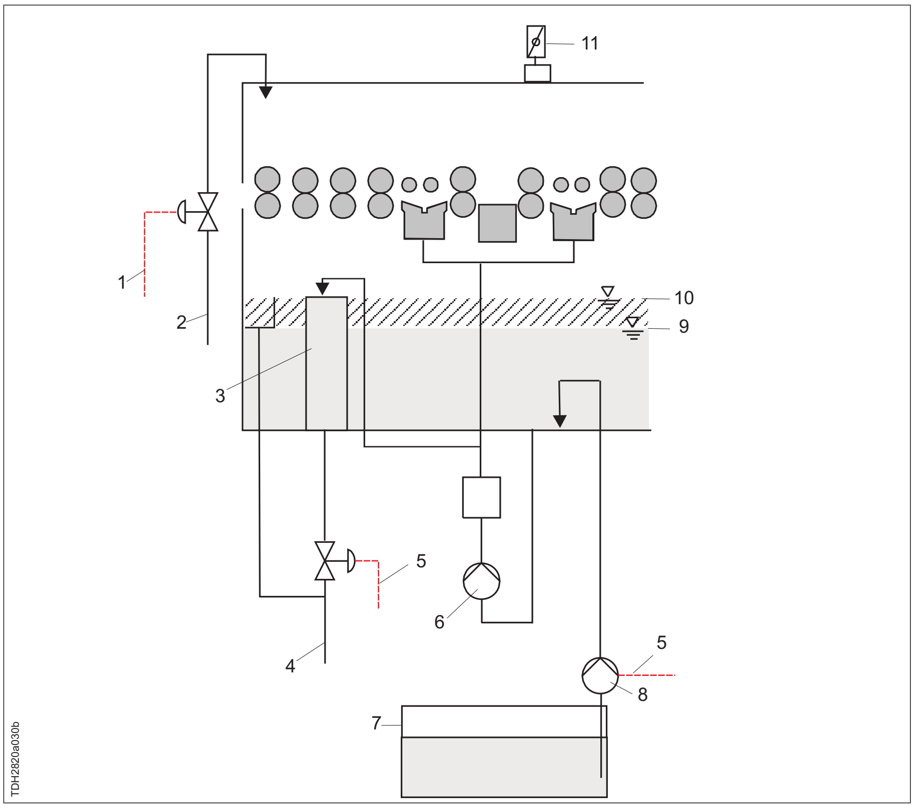
6.3.6 Dosing

The purpose of the automatic replenishment of chemistry is to compensate the changes of bath composition (concentrations) caused by consumption (chemical reactions), drag-out (into Rinse module), evaporation (into exhaust system) and input of external particles (dirt, dust, etc.) The latter influence ought to be minimized (cleanliness of work).

The main parts of the dosing system are as follows:

- Dosing station with dosing tanks and dosing pumps (see sub supplier documentation)
- Transfer pipes from the dosing tank to the modules of production plant with flow check sensor S04.# and injection unit (installed at the plant module, see also P&I)
- Dosing chemistry (see Technical Data Sheets, TDS)

The set-up is shown in the following schematic:



Schematic of dosing system

1	Signal for DI water addition	7	Dosing tank
2	Di water supply	8	Dosing pump
3	Feed & Bleed container	9	Set-point level (pumps ON)
4	Return flow (bleed, overflow)	10	Level (pumps OFF)
5	PLC-Signals (On/Off)	11	Exhaust air
6	Pump for Flooding Device		

In case a dosing pump is enabled and there is no flow detected (by flow check sensor S04.#), the control system will generate a respective fault message.

The dosed volume per dosing cycle is defined by the two parameters
- ‘Dosing pump flow rate (as calibrated and entered)’ multiplied by
- ‘Running time of dosing pump (generally 30 seconds)’.

- Other parameters which are closely related to dosing (Make-up, dosing equivalent, bleed, etc,) are set during line commissioning by process engineers.

The dosing pump must be calibrated in regular intervals according to house-internal quality standards.

- For a comprehensive understanding of the dosing system of a module, please inspect the respective parts (directly at the production plant), refer to the line specific P&I diagram, the respective control windows in VCS (including VCS-Help file), the Technical Data Sheets for the chemistry in modules (TDS) and the electrical wiring diagrams (of sub-supplier and Atotech).

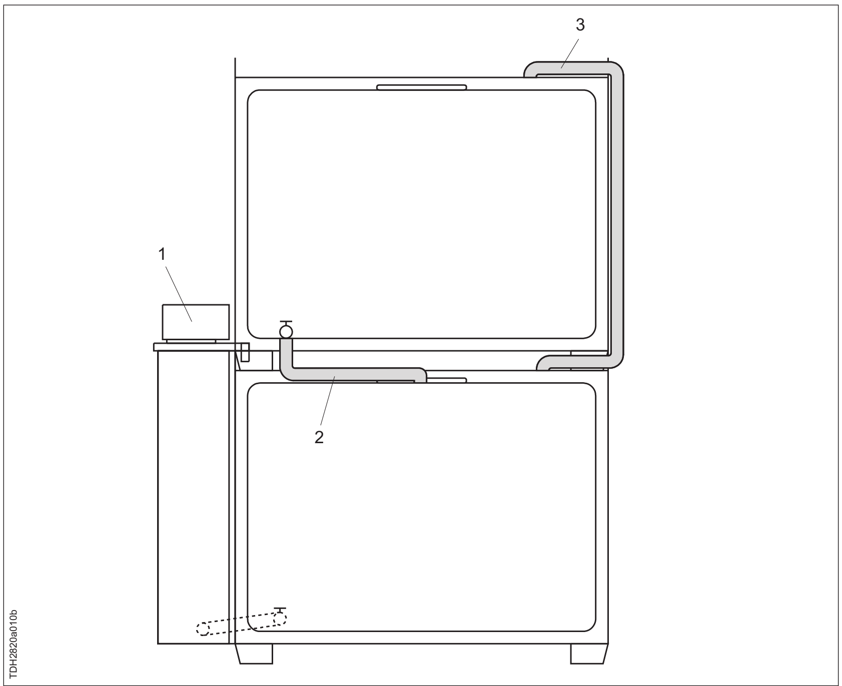
6.3.6.1 Refilling of dosing tanks

When transferring from the upper into the lower returnable tank., the venting and deairing tubes must be permanently connected.

	WARNING
	Evaporation of chemical gases If the tube is not fixed properly, chemical gases evaporate from the lower tank to the environment.

Inspection and adjustment work is only to be carried out by trained personnel with regard to the safety instructions.

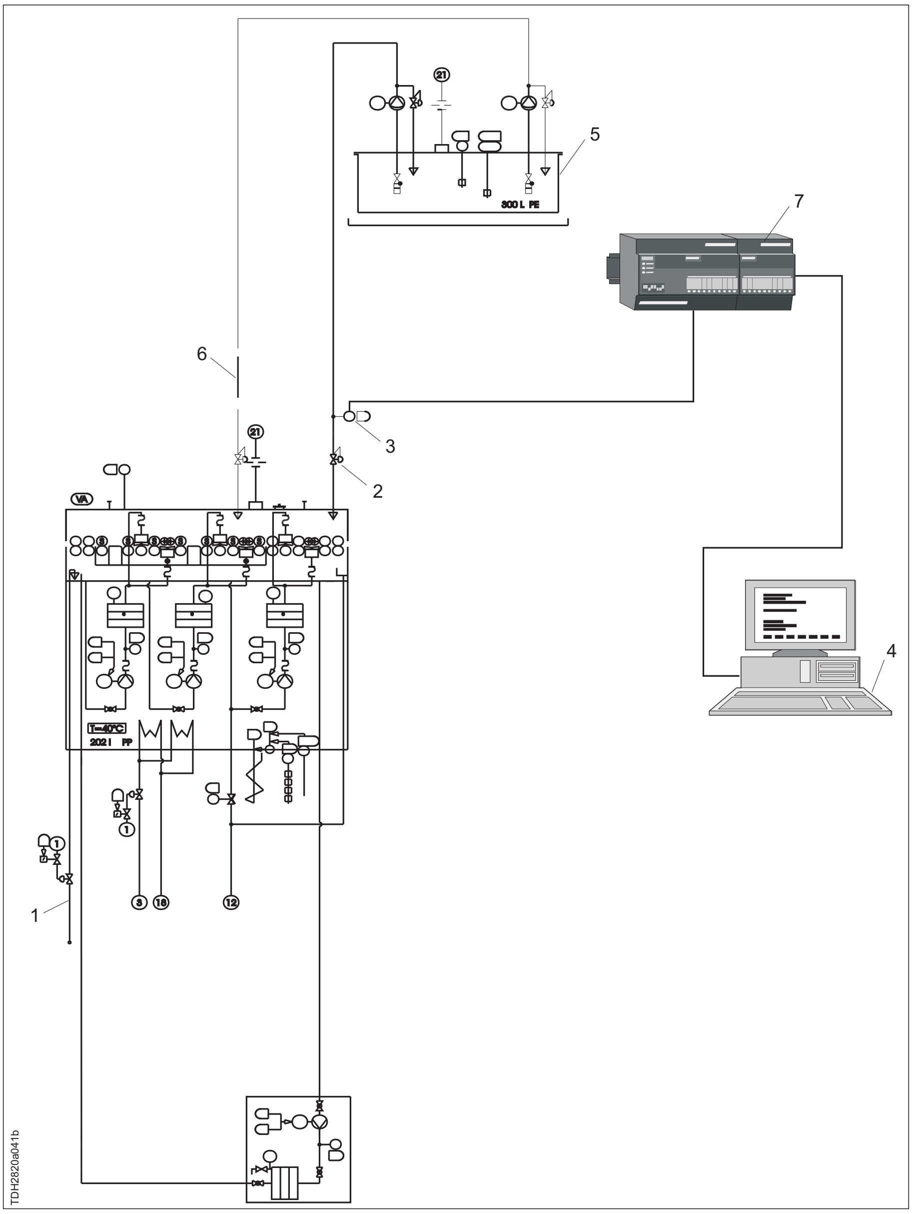
a) Refer also to the safety data sheet!



Returnable tank with filling and air exchange tubes

1	Dosing tank	3	Dearing
2	Filling		

6.3.6.2 Flow monitoring



Scheme of dosing monitoring

1	Di water supply	5	Dosing pump
2	Pressure retaining valve	6	Flexible dosing pipe (0.5 - 0.8 bar pressure)
3	Digital flow sensor	7	Bus system
4	PC PLC		

The digital flow sensor (3) monitors whether the solution is flowing or not, when the pump is running.

6.3.6.3 Flow monitoring of the dosing streams

Flow monitoring switches (designated by ‘S04.#’ and mounted at the rear side of the module) are parts, which belong to the pipe work of the dosing system of active modules.

The flow monitoring switch has a

- **safety function** (distinctly reducing the risk of people getting affected by uncontrolled flow of chemistry) as well as a
- PCB **process quality function** (with regard to the reliability of chemistry replenishment according to panel throughput).

Principle of fault message generation:

While the dosing pump is running (mounted at the dosing tank), the chemistry must go through the respective flow monitoring switch (mounted at the module). If this is not the case, operators are informed by a fault message.

Possible causes: problem at dosing pump; dosing tube (pipe) connected in a wrong way or not fixed at all; dosing monitoring switch faulty.

Note: fault messages mustn't be ignored by operators!

Types of flow monitoring switches (distinguished by function principles)

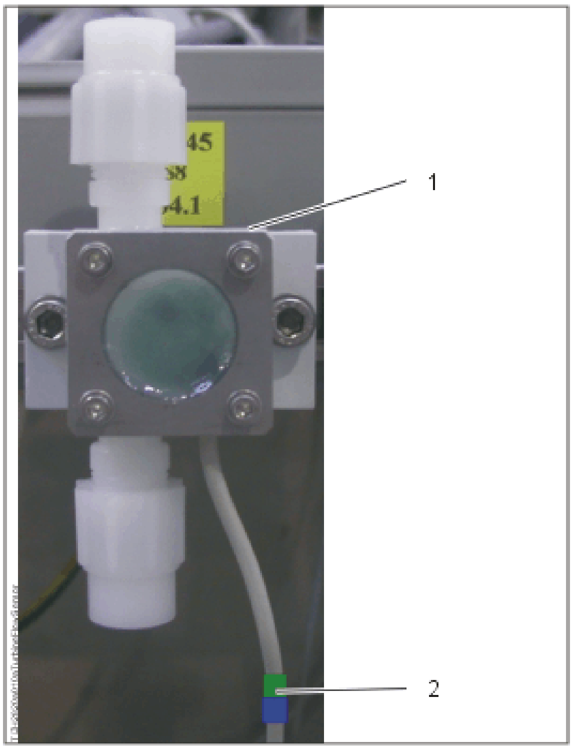
Depending on dosing chemistries for the different module, we make use of

- **Turbine flow monitoring switch:** This type of flow monitoring switch is expected to deliver pulses while the dosing pump is enabled (= response control).
  (by the way: in case the pump is OFF, the LED at the turbine flow detector may be illuminated or not; this has no meaning control PC evaluation).
- **Caloric switches** (detecting temperature differences, which are then evaluated)
- **Flap-type flow detectors** (On/Off switches just as used till middle of 2008).

Information about the installed type of flow monitoring switch and the respective sealing material can be obtained from the commonly used sources of information, namely
- the P&I diagram (flow switch S04.#),
- directly at the line (see further description with image below)
- as well as the parts catalogue (ETK).

Turbine flow detectors

Besides sealing material, the flow range is another aspect which must be distinguished.



Turbine flow detector marked with two color rings (example in the photo: green / blue)

1	IDs for placing orders: The ID (identification number or part number) is imprinted on the mounting plate of the flow detector. Besides that, it can be found in the Electronic Parts Catalog (start file --> 'etk.exe'; then search in the folder for --> 'pipe work assembly' for terms such as --> Flow meter, FPM, EPDM, Halar).
2	Color marks: The signal wire of the turbine flow detectors is marked with two colored rings, one ring to indicate the sealing material, the other one is for the range of flow quantity. - Green / **blue** rings mean FPM (viton) / **5 to 55** liter/hr, - Green / **red** rings mean FPM (viton) / **55 to 130** liter/hr, - Black / **blue** ring combination means EPDM / **5 to 55** liter/hr, - Black / **red** ring combination means EPDM / **55 to 130** liter/hr.

Caloric flow switches

Caloric flow switches are mainly installed in Stannatech lines (since middle of 2008).

Principle of flow detection:

As we know, the dosing pump is switched on and off in intervals. The liquid in the caloric flow switch is continuously warmed up (electric energy input). Two temperature sensors in the caloric flow switch monitor the respective temperatures (indirectly also the temperature difference between them).
If the dosing pump starts, the liquid is moved. This leads to a lower temperature (especially for the fist sensor) as well as a temperature difference between the two sensors.

In short (and somewhat simplified): the PLC expects a changed temperature pattern, while the dosing pump is running. If this expected change is not verified, a fault message is generated.

Related documentation

Information about the type of flow monitoring switch (stainless steel vs. PTFE) as installed for a specific dosing stream can be obtained
- from the P&I,
- directly at the flow detector (see imprinted ID on the mounting plate)
- as well as in the parts catalogue (ETK).

Since there is just one flow range from 5 to 130 l/hr (contrary to the turbine flow detector), there is (for caloric flow detectors) no distinction by color marking necessary.

WARNING

Dosing tube under pressure! Wear safety goggles

If you need to perform work at the dosing system, first release the pressure in the dosing tube/pipe (to be done at the dosing pump).

Context: For accurate dosing, a pressure retaining valve in the injection unit, keeps the pressure high even if the dosing pump is switched off.

This applies for each and every tube (from the dosing pump to the injection unit at the rear side of the module).

See also

020186 Check flow switch for dosing [→ 302]

6.3.7 Feed & Bleed System

6.3.7.1 General

The Feed & Bleed System serves the purpose of refreshing the bath in order to extend the usability of the bath (to put off new make-up of the bath).

This is done by draining a certain quantity of the bath (= Bleed) and adding an equal quantity (= Feed). This may be considered a partial new make-up.

The chemicals are added by the automatic dosing system, the water by the automatic level control system.

Feed & Bleed System

1	Input tube from pump	3	Feed & Bleed pot
2	Level sensor		

6.3.7.2 Influencing factors on the bleed quantity

Influencing factors are:

- Volume of the bleed tank (defined during construction)
- Valve opening time for emptying the bleed tank. It is set during line commissioning and adjustable at the process control panel.
- Frequency of valve openings which in turn is determined by the throughput parameter.
  The throughput parameter has to be entered at the process control panel (module specific parameter). It determines how many m^2 of panels have to go through the line before the valve opens again. The smaller the throughput parameter, the more frequently the valves opens.

6.3.7.3 Filling of the bleed tank

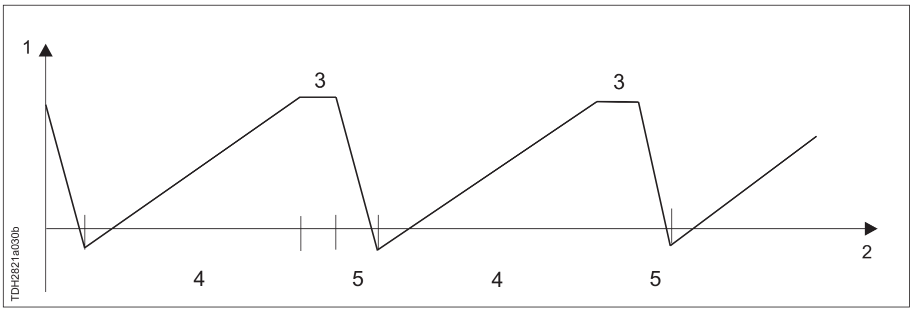
In most active modules there is a bleed tank whose volume is defined module specifically (e.g. 1.5 or 2 liters).

It can be seen from the P&I diagram from which pump circuit (e.g. for flood bars) a pipe branches off to fill the bleed tank.

The upper edge of the bleed tank, which is open at the top, is above the bath liquid level (when pumps are off).

Due to the pump pressure the bleed tank is overflowing. This ensures that it is filled to the top edge at each bleeding cycle.

The pump flow rate during filling is low compared to the draining flow rate. This means it takes more time for filling than for draining (see saw tooth diagram below).



Saw tooth diagram, filling and emptying of the bleed tank

1	Volume	4	Filling
2	Time	5	Emptying
3	Overflow		

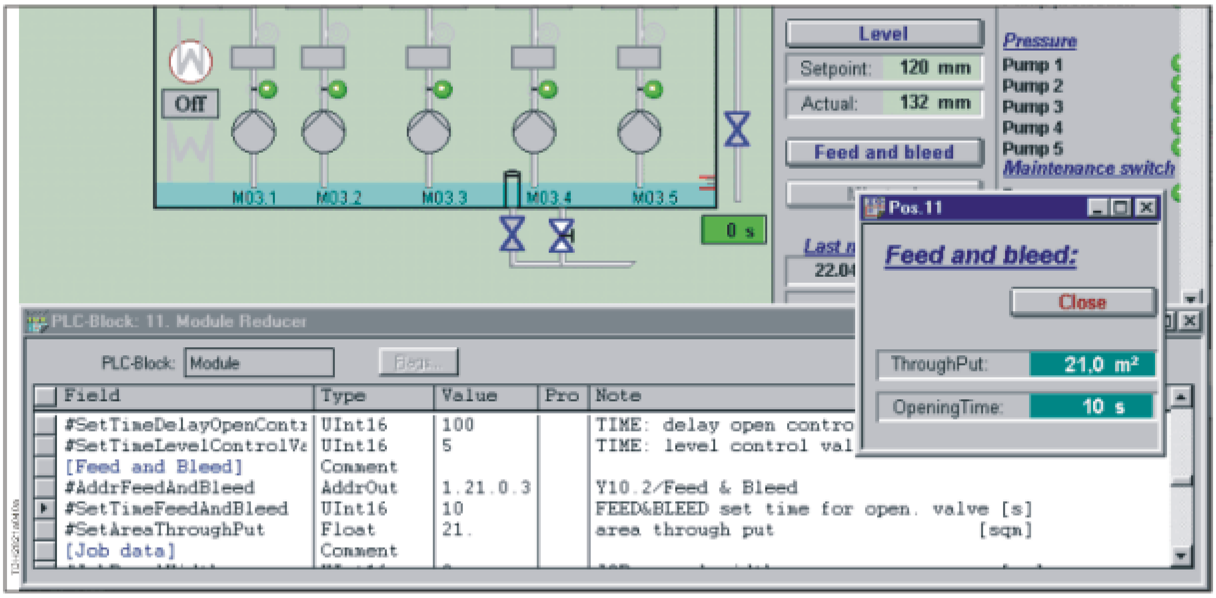
6.3.7.4 Parameters for valve opening and bleed quantity

In the picture below, the throughput parameter is set at 21 m^2 in this example.

The opening time for draining the bleed tank is 10 seconds.

If for a certain charge, 420 m^2 were processed, the valve has opened 20 times for 10 seconds each.

Together with the quantity in the bleed tank, the total bleed quantity can be calculated.



Example for feed and bleed setting at the process control panel

The opening time of the magnetic valve is set during line commissioning in such a way that the bleed tank is running empty during this time.

With this setting, the bleed quantity is calculated as follows:

- volume of bleed tank multiplied by

- ratio total throughput / throughput parameter.

If the valve opening time is shorter, the bleed quantity can be calculated as follows:

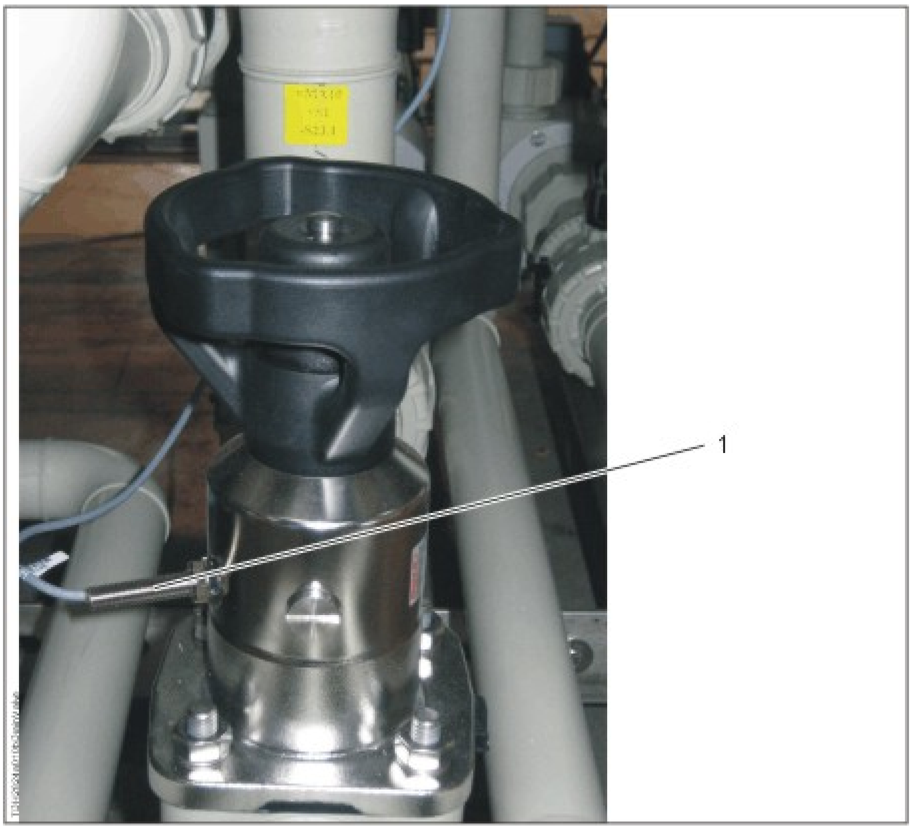
- valve opening time x bleed flow rate multiplied by
- ratio total throughput / throughput parameter.

6.3.8 Manual drain valves at active modules

Introduction

Generally active modules and peripheral units are equipped with one or more manual drain valves. Turning the wheel clockwise direction closes the valve, turning it anticlockwise direction opens it.

The valve is opened to discharge solution from the module. For starting the makeup procedure the drain valve has to be closed **completely**.



Drain valve with [1] position indicator switch equipped with green LED

A detector switch (proximity initiator) equipped with a green LED actuates an electric signal:

- If the valve is closed, the green LED is illuminated. Makeup and cleaning processes are enabled by VCS.
- If the valve is open, the green LED is dark. Makeup and cleaning processes are suspended by VCS.

Software Monitoring

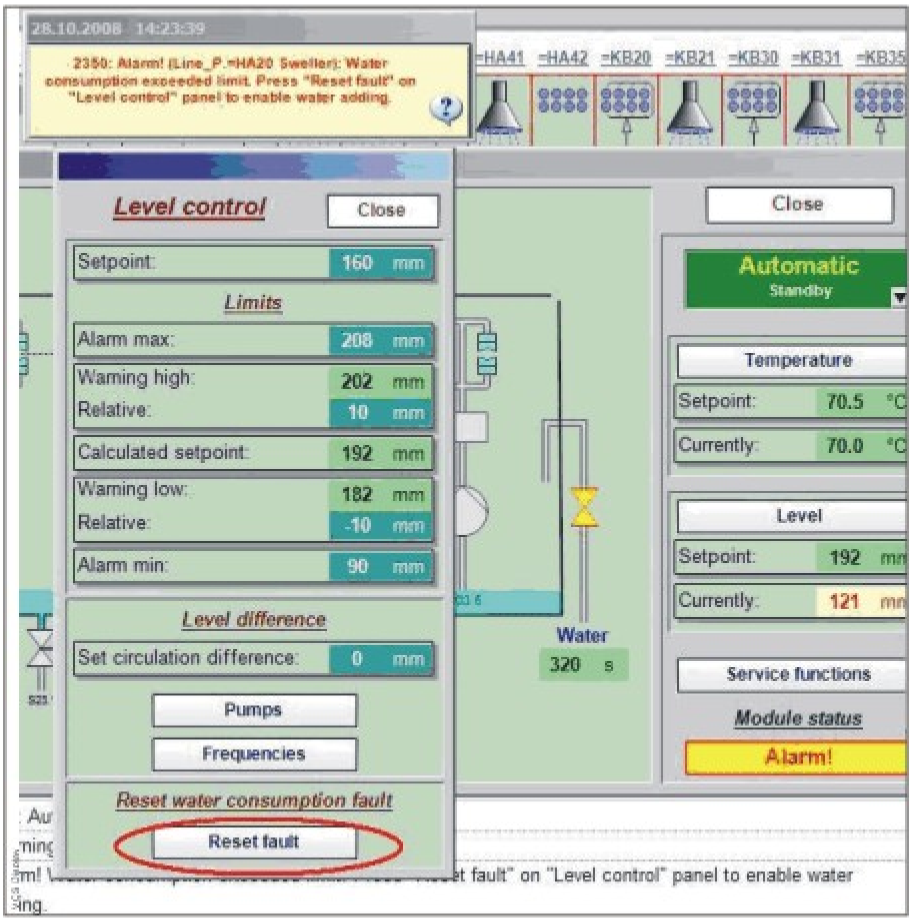
The valve status is monitored by VCS. If the drain valve is not reliably closed because of a worn out membrane, fluid may drip out. In active modules a decreasing level of chemical solution usually is filled up with water. Thus a drain valve leak leads to chemicals dilution. The VCS counts the seconds of water valve opening within a certain period and compares it to a preset maximum value of water consumption referring to this period. If the actual time of water valve opening exceeds the limit a fault message is generated in VCS. In this case the tightness of valve has to be checked manually.

Exceptions: For modules with a Feed & Bleed function there is allowance to increase the water consumption limit by up to 20%. To avoid temperature drop down in hot modules there is a possibility of periodical water adding by adjusting time setpoints (usual value: 10s of water adding every 5min).

NOTICE

Faulty operation

To enhance process stability by avoiding a faulty operation of the line a fault reset in order to enable more water adding only can be carried out by users with **high level rights.** (such as e.g. to disable parameters)



VCS – Display with fault message and 'Fault Reset' – button

Checking valve status

To check the valve status, the green LED on the position indicator switch has to be observed: If the green LED is illuminated, the valve is closed.If the green LED is not illuminated, the valve is open.

As the valve membrane is a wear part, the drain valve has to be regularly checked more thoroughly: A worn out membrane may lead to a "Close" – signal in VCS, while the valve actually is not closed completely.

Checking and maintenance procedures

- **Prior to filling modules after each production stop:**
  Check tightness of valve closing after each time of valve use. The handwheel has to be screwed up hand-tight (single hand finger-tight fastening)
- **Monthly check on empty module:**
  Check hysteresis between VCS-message “Valve Open” and span of handwheel rotation in opening direction. The average span can range from 20 to 40 degrees.
- **Annual check and maintenance (Line is not working):**
  Remove valve fitting and do a leakage test. If the membrane is worn out, water will drip out of valve. If there is a leakage, the valve has to be replaced by a new one. Refer to parts catalogue.

Safety instructions

DANGER

Danger of life by jerking parts being loosened under pressure

It is not allowed to maintain or disassemble valves during line operation!

Before working on valves it is obligatory to always shut all pressure down!

WARNING

Risk of severe injuries by being etched by chemicals

It is not allowed to maintain or disassemble valves during line operation!

Always wear safety goggles and gloves when working on drain valves at active modules!

Only water is permitted to use for leakage tests!

NOTICE

Risk of damage on drain valve

Operations on drain valves only should be carried out by qualified and well trained personnel.

Otherwise the valve could be damaged seriously.

CAUTION

Risk of damage on drain valve:

Operations on drain valves only should be carried out by qualified and well trained personnel.

Otherwise the valve could be damaged seriously.

Related sources of information:

- Electrical wiring diagram
- P&I schematics
- Parts catalogue (key words to search for: ‘Drain valve’, ‘-S23.1’)

- Supplier's documentation (GEMÜ 653/654)
- VCS-H fault message file (online fault messages)

See also

Cleaning program [→ 128]

Make-up Program [→ 99]

6.3.9 The Ultrasonic system

Purpose

The ultrasonic system in ATOTECH horizontal lines is installed in modules to remove smallest particles from the processed boards and / or to prompt the expulsion of gas bubbles entrapped in micro blind vias (in upper side of PCBs).

Main parts

The ultrasonic system consists of an array of ultrasonic generators located in the switch cabinet. Each ultrasonic generator supplies one or two ultrasonic transducers. The system is connected to the VCS system and operated via the line control panel.

Ultrasonic transducers

The ultrasonic transducers are integrated in the conveyor of the module. The illustration below shows the mechanical installation of the ultrasonic transducer in the flood tray.

[1] Ultrasonic transducer integrated in conveyor of module (line not operating!)

The ultrasonic transducer is a wear part. Thus the whole ultrasonic system and its environment have to be inspected carefully prior to line operation. Maintenance has to be done regularly according to the maintenance schedule.

The normal ultrasonic cleaning process effects cavitation which leads to corrosion in the long term. To minimize corrosion and to elongate lifetime of the transducer, the polished wave transmitting area of the transducer surface needs to be treated with great care. It is also necessary to inspect the neighboring rollers for possible scratches regularly.

	NOTICE
	Wrong treatment of the US transducers In order to reach the maximum service time of transducers, the surface of the US transducers must be treated extremely carefully (no scratches). Never use liquid cleaners or sprays to clean the surface. Only use a damp cloth.

In no way it is allowed to run the ultrasonic system when there is no solution in the module.

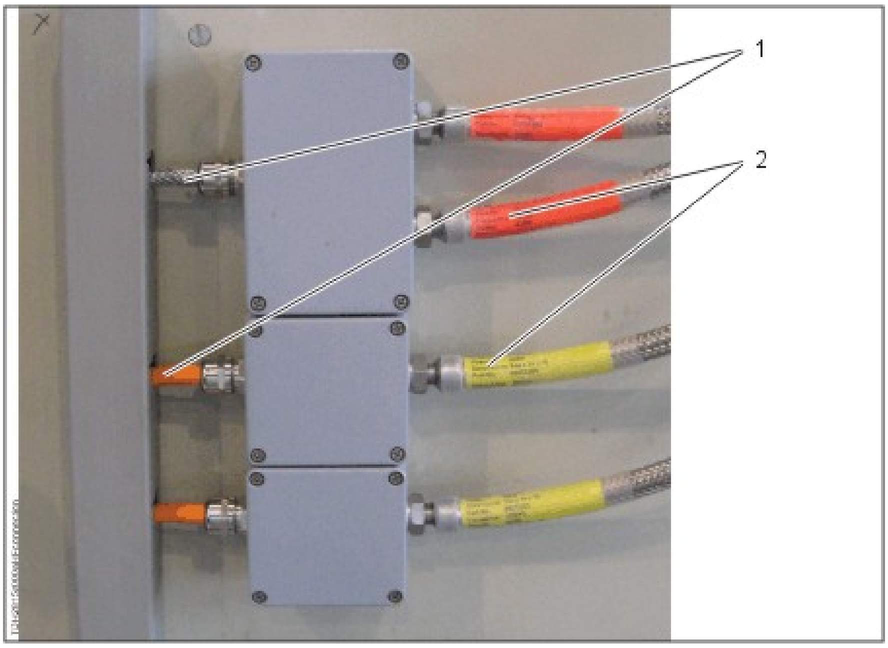
Therefore all level minimum switches of the module have to be checked for proper function after every repair or maintenance work and according to the maintenance schedule following the corresponding maintenance instruction.

Prior to operation of the ultrasonic system it has to be verified that the transducers are completely immersed into the bath (minimum immersion depth 10mm). It is recommended to attend to all related messages in VCS.

	NOTICE
	Risk of damaging the ultrasonic transducers by dry run Prior to operation of the ultrasonic system: - Make sure that the transducers are completely immersed into the solution! - Check the solution level before switching on the ultrasonic system! - Regular functional checks of the level minimum switches are obligatory (see maintenance instructions).

If a transducer is worn out, it has to be replaced by a new one.

HF - Connection box



HF – connection boxes connecting transducer(s) to generator

1	US – generator cable	2	US – transducer cable

The ultrasonic transducer(s) are connected to the supplying generator using a high frequency (HF) connection box. The cable markings on the transducer cables give information about the type, power output, frequency, and serial number of the connected transducer. At the connection socket inside the connection box, resistance and capacity measurements can be carried out in order to check the functionality of the ultrasonic transducer(s). See the related service instruction.

⚠	**DANGER**
	Danger of electric shock Only skilled electricians are allowed to do service and installation works! During performance of service and repair works the ultrasonic generator has to be disconnected from mains completely!

Ultrasonic generator

US-generators as aligned in the switch cabinet

The ultrasonic generator supplying one or two ultrasonic transducers is arranged with other generators in an array of generators connected to a specified power supply. The ultrasonic generators are controlled via VCS during operation. For service tasks a handheld control panel can be plugged in the front connector of the ultrasonic generator.

Handheld control panel for ultrasonic generator

For operation of the handheld control panel, look up the operation's manual of the supplier.

NOTICE

Risk of damaging the ultrasonic system and / or the processed product

- All settings are done during commissioning phase and it is not recommended to change them.
- The handheld control panel only is used for service and troubleshooting tasks when the ultrasonic system is out of order.
- Only skilled technical personnel are allowed to do service and troubleshooting tasks using the handheld control panel.

Power settings and operation

The US-generator output power value is set as a parameter in the program recipe as percentage of the maximum output power. **The default value is 80%.**

For sensitive foils this parameter is set to a smaller value in the concerning job administration recipe. In VCS, the ultrasonic system can be switched off for each module.

Automatic control of the ultrasonic system and displayed information in VCS:

- Selection of appropriate recipe: Automatic application of output power set value.
- Job loading: The US output power set value is sent to the US generators.
- During production: The actual value of US output power is displayed in VCS in the respective module control window in a separate popup window (e.g. sweller, permanganate etc.)
- Breakdown of US system: Digital signal from US generator to VCS switches off the US system and generates a fault message. The loader is stopped.
- Loader stop: The fault message appears in Job report. The remaining PCBs in the line will be tagged (i.e. mentioned in the report).
- Level lower than minimum value: Switching off US generator. Note: A blocked float ring of a level sensor can cause the same effect!
- Pumps not running: Level will be low, the US generator is switched off.

Related topics

- P&I diagram
- Electrical wiring diagram
- Electronic Parts catalogue (ETK)
- VCS-H Fault messages 11677 to 11684
- Sub-supplier’s manual (Weber Ultrasonic)

See also

020020 Inspect the bath level in fluid trays [→ 292]

020125 Check all the parts of the transport system [→ 298]

020181 Check digital level switches [→ 301]

020220 Inspect all the rollers adjacent to and below the ultrasonic transducers [→ 303]

6.3.9.1 Troubleshooting the Ultrasonic system

Purpose of this instruction

This manual shall give a brief overview for methods of troubleshooting the ultrasonic system.

External reasons of US – system breakdown

The flood tray level is not sufficient due to following reasons:

- The pumps are not running
- The float ring level sensor is blocked, defective or mal-adjusted
- There are leakages in the module equipment (including peripheral units and supply piping)

First it is necessary to examine the possible faults mentioned above to isolate a fault of the ultrasonic system itself. Attend to P & I schematic examining external faults.

Defects of the US-system

Ultrasonic generators and transducers (oscillators) are high frequency components and thus influence each other when connected. Methodic steps are necessary to isolate the malfunction.

NOTICE

Faults in the module

Before examining the ultrasonic system itself, it is necessary to safely exclude the possibility of faults in the module which effects a breakdown of the ultrasonic system. Take into account that ultrasonic components work with high frequency and thus influence each other.

VCS fault messages

In VCS, a number of fault messages are related to the ultrasonic system. Before taking any measures it is essential to follow the explanations given along with the appearing fault messages. Use the VCS-H Faults manual.

The most important fault messages related to the ultrasonic hardware are:

- 11680 Ultrasonic: No reference signal
- 11681 Ultrasonic: Temperature
- 11682 Ultrasonic: A-protection

If one of these messages appears, it is in either case necessary to examine the ultrasonic equipment for malfunction. This works can be carried out by skilled electricians only, because there is danger of electric shock.

An exemplary instruction for troubleshooting the ultrasonic system is given below.

For more information about ultrasonic system error messages look up the instructions given in the manuals of the sub-supplier (Weber).

Troubleshooting the ultrasonic system: Exemplary description

DANGER

Supply voltage of ultrasonic generators is up to 400V

- Only skilled electricians are allowed to do service and repair works!

- During performance of service and repair works: When disassembling parts of the US- system the ultrasonic generator has to be disconnected from mains completely!

Check for generator fault

A: Message “A-protection” or “No RF signal”

- Open the respective field of the switch cabinet (according to the electric wiring diagram of the line).
- Plug in the Weber handheld control panel to look up the error messages.
- Unscrew the transducer connection on the rear side of the generator housing. See illustration below.
- If the error message is still displayed after transducer disconnection, the generator is defective
- If the error message is no longer displayed either the transducer or the power supply of the generator is faulty.

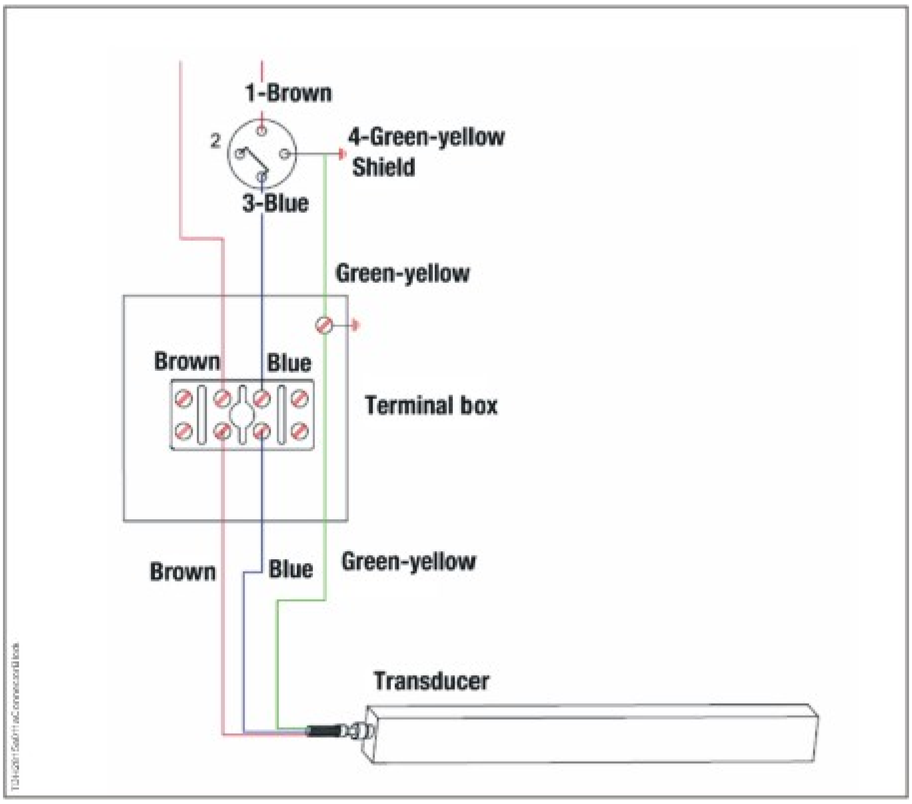
Transducer connectors on rear side of US-generator rack

B: Message “Temperature”

- After opening the respective field of the switch cabinet, check the ultrasonic generator fan. After switching on mains power, it should start running briefly without unusual noises.
- Check the generator’s ventilation slits for being blocked and remove the blockings if necessary **(mains power switched off!)**.
- Check the airflow to and from the generator.
- If the fan is working and airflow is sufficient switch on mains power again and check the generator function without the transducers connected (use handheld control panel).
- If the generator is o.k., check the transducers. See instruction below.

Check for transducer fault

- Switch off the power of the respective US system
- Open the connection box between transducer and generator cable (rear side of module)
- On the terminal block in the box, measure the ohmic resistance between the brown and the blue wire of the transducer. Expected value: ≈ 2,2 MΩ
- Change the polarity and repeat measuring the ohmic resistance. The value has to be equal to the first measured value up to 2 points right to the comma (using a digital instrument).
- If there is an obvious difference between the two measured values, the transducer is broken and has to be changed.



Connector block between transducer and generator (Source: Operations Manual Weber)

NOTICE

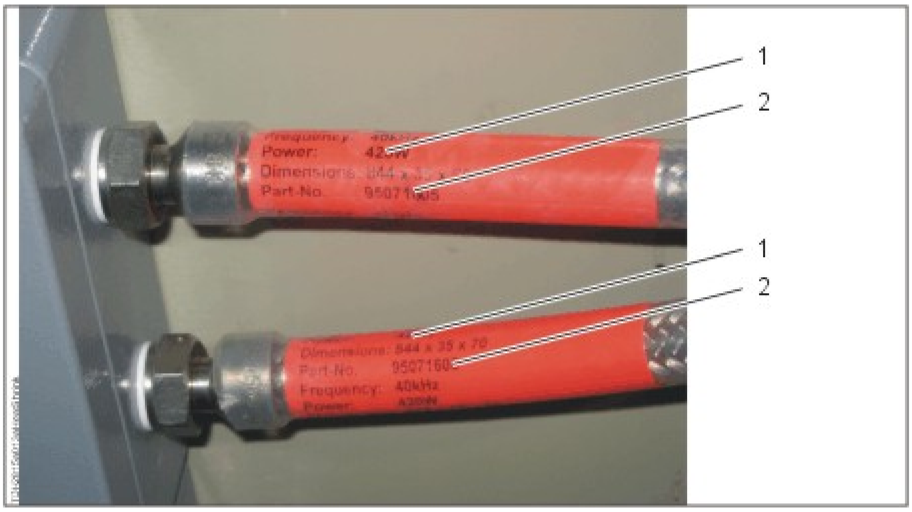
Defective transducer

If the ultrasonic system is working but the results of ultrasonic treatment are not satisfactory, the transducer may be defective because of mechanical wear out or partial malfunction of the oscillating elements inside the transducer. Observe the maintenance schedule.

Important information

If a part of the ultrasonic system is defective and has to be changed, it is very important that the ordered spare part is compatible. **Always pass at least the line number and the component code or part number of the wear part along with your orders and specific questions to ATOTECH.** The illustrations below show where the essential information is located on the ultrasonic components.

[1] Module code [2] component code and [3] serial number of Weber US-generator



[1] Technical data and [2] part number on heat shrink tube on US-transducer cable

For further information see the P&I schematic, the electric wiring diagram or the sub-supplier's documentation (Weber).

6.3.10 Make-up Program

The bath content is subject to an aging process, dependent on parameters such as through put (m^2), time, turnover, etc. Therefore the bath is due to be drained and completely renewed within certain intervals.

With the automatic Make-Up logic, being provided in the control system, we save the time and effort for having to make-up the bath manually.

Design of the Make-Up program

The logic of the Make-Up program and the type of pumps used, are determined by the following factors:

- Type of module (or Make-Up tank)
- Bath volume of module (or Make-Up tank)
- Number of bath components
- Make-Up quantities, concentration of bath components
- Make-Up sequence of bath components

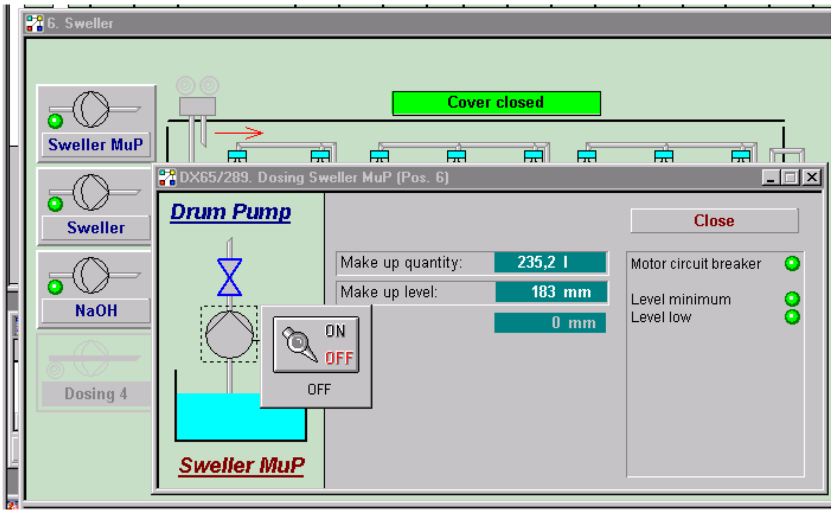
In principle we have to distinguish level controlled Make-Up from volume controlled Make-Up:

- Make-Up with level controlled barrel pumps, being activated in the first phase of the automatic Make-Up program.
  They have a comparatively high flow rate.
  The Make-Up volume is defined by level set-points (in mm).
- Make-Up with volume controlled dosing pumps, being activated in the final phase of the automatic Make-Up program.
  They have a comparatively low flow rate.
  The Make-Up volume is entered directly in liters.

6.3.10.1 Make-Up parameters in VCS

Level controlled automatic Make-Up using drum pumps

- In VCS you recognize level-controlled drum pumps at the acronym **MuP** (for Make-Up Pump - in contrary to the volume controlled dosing pumps).
- The parameter 'Make up quantity' is included merely for the sake of getting it recorded in the data base and dosing reports.
- The parameter 'Make up level' is controlling the pump. When the level is reached this pump is switched off and the next 'Make-Up' step is automatically activated.
- Manual activation of the drum pump by mouse click is not needed for the automatic Make-up program. Switching the pump on and off this way can be done for maintenance purposes (e.g. when working with water instead of chemicals).

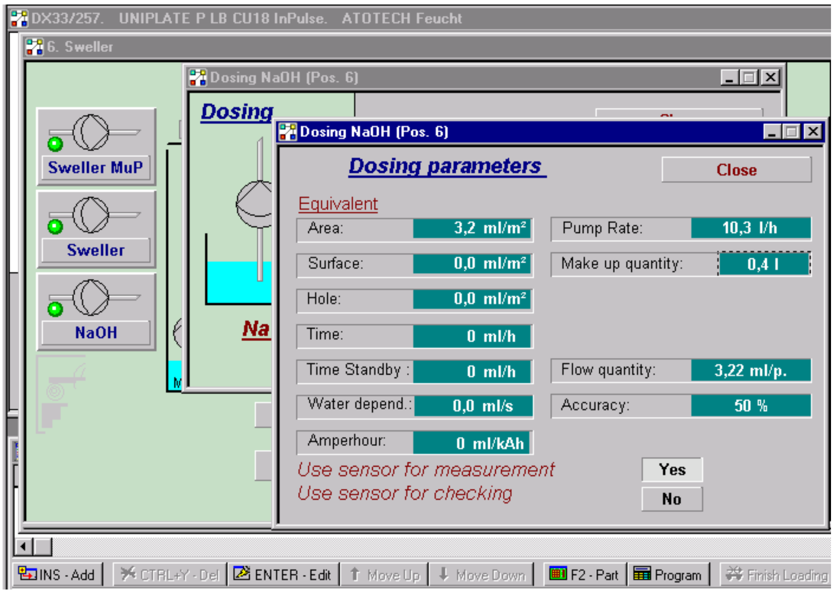


'Make up quantity' and 'Make up level' parameters for level controlled Make-Up pumps in VCS

	NOTICE
!	**Unauthorized operator** It is not permitted to modify these parameters without being authorized for it. The correct ratio of bath components and the bath concentrations depend on this Make-Up level setting.

Volume controlled automatic Make-Up, use of dosing pumps

- The excerpt from VCS below serves as an example of a process control window with two dosing pumps and one drum pump. The control windows for the dosing pumps contain two essential parameters for volume controlled Make-Up:
  The 'Pump Rate' and the 'Make up quantity'.
- In the cell for 'Pump Rate' you enter the actual flow rate (= calibration of the pump).
- The cell for 'Make up quantity' contains the volume that is added, when the automatic Make-Up program is running.
- The control system calculates the running time of this specific pump by division of the 'Make up quantity' (volume) by the pump rate.
- Volume controlled pumps start, when the logic of the Make-Up program enables the activation. This happens when the level controlled part of the complete Make-Up logic is already executed. With delay parameters in the PLC block, it is possible to shift the start of the dosing pumps.



'Make up quantity' and 'Pump Rate' parameters for volume controlled Make-Up pumps in VCS

	NOTICE
	Unauthorized operator It is not permitted to modify these parameters without being authorized for it. In case of volume controlled Make-up, the correct ratio of bath components and the bath concentrations depend on the 'Make up quantity' setting.

6.3.10.2 Cleaning of the module (or tank) and Make-Up procedure

a) Observe the process instructions, the Technical Data Sheets and Material Safety Data Sheets of the bath components! Clean and rinse the module according to regulations!

b) When Make-Up is running, the line is in manual mode of operation. Leave a message at the control PC for other operators, to inform them, that Make-Up is carried out.

c) Make sure that the drainage system is ready to take up the solutions being about to be drained.

d) Open the drain valve and empty the module completely.

e) Check and clean the parts in the module before you start with the make-up procedure!

- Conveyor system (rollers and gears)
- Floodbars
- Spray jets
- PP filter inserts
- Sieves at the solution drainage holes
- Remove incrustations from the level sensor. Check calibration.
- Take away the pressure in the dosing pipe system and remove incrustations at the dosing injection assembly (with pressure retaining valve) and at the dosing flow rate minimum switch.

	NOTICE
	Installation When the dosing injection assembly is installed again, the inscription „TOP“ must be on top of the injection assembly! This ensures the correct spray direction into the bath and not upward to the glass cover.

a) After cleaning and inspection of parts, close the drain valve of the module completely. The automatic Make-Up can not start, if the drain valve is left open.
In case of a fault indication ‘Drain valve open’, take also into consideration, that the position sensor at the drain valve might be faulty itself.

b) Check level and volume settings of all pumps that are part of the Make-Up program.

c) In order to start the make-up program, press the button “Start Make-Up” in VCS in the module control window. The message “Make-Up running” appears on the monitor.

d) Do not start any pump by mouse click, while the automatic Make-Up program is running.

e) Observe the automatic running of Make-Up process at the line and the check the messages at the PC monitor.

f) In case of a fault (like Make-Up tank or dosing tank empty, low level protection for Make-Up pump, etc.), highlight the fault message and open the on-line help file with the key combination Ctrl+F1 to get hints of possible faults and the respective remedy actions.

- The message “Make-Up finished” appears on the monitor when the Make-Up program is completed.
- The date and time, when the (last) automatic Make-Up was carried out, is registered in the data base and will be displayed in the dosing reports.

6.3.10.3 Make-Up pumps (drum pumps) controlled by level setting

Level controlled Make-Up pumps, are used for comparatively large Make-Up volumes. The flow rate is generally in the range of 500 to 1000 l/h. Make-Up volume and Make-Up flow rate determine the Make-Up time for a chemical component.

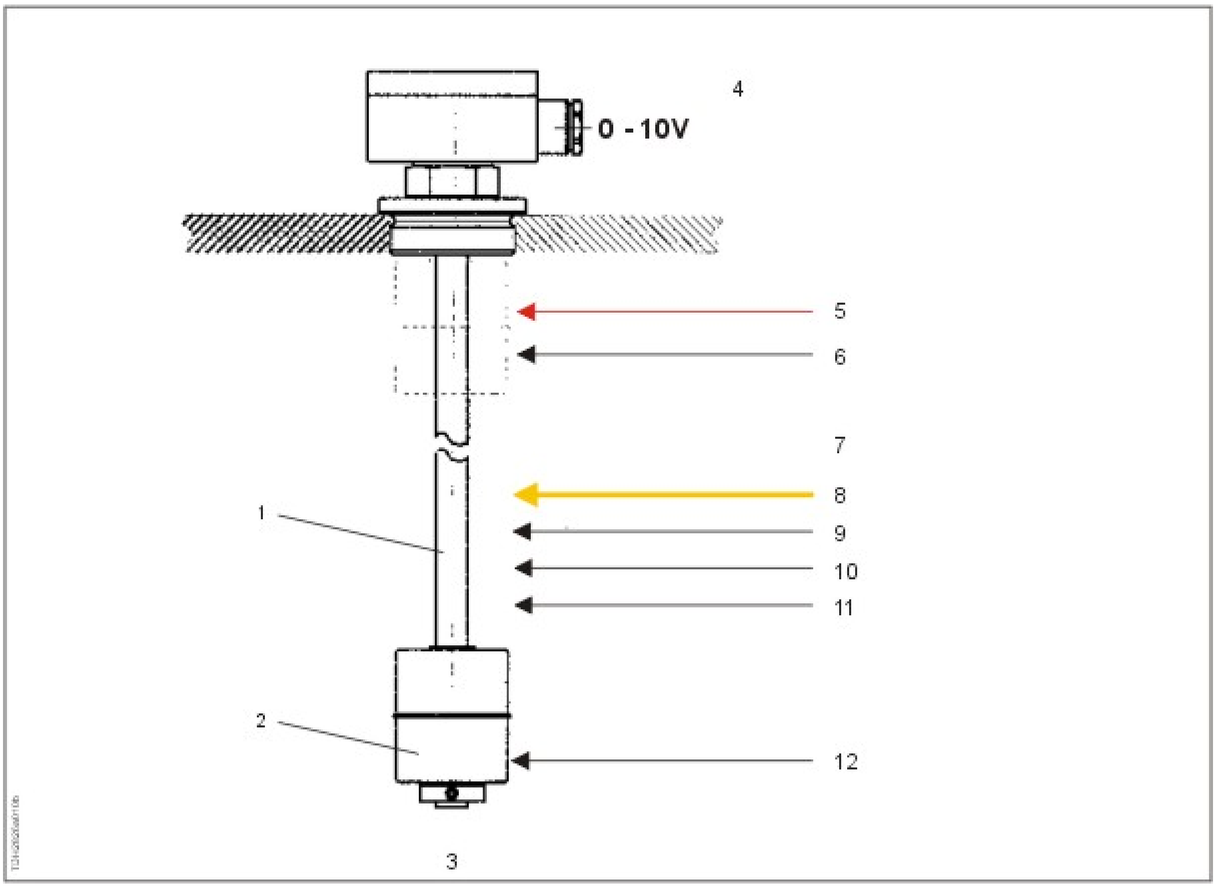
When the automatic Make-Up program is started,

- the individual program steps are controlled by the program logic in conjunction with the analogue level sensor and the level set-points.
- Both, the inflow of water (via the valve), and the start and stop of the Make-Up pumps of the respective bath components depend on the level setting.
- The Make-Up volume can’t be directly entered in the control PC. The level parameters are the control parameters instead. Please take into consideration that volume increase and level increase are not directly proportional to each other when the module is filled, due to the design of the module and the shape of parts in a module.

The Make-Up level parameters are set in the PLC-Data block of the respective module (or tank):

- LEVEL A (mm): Make-Up water (the water valve closes and the first Make-Up pump starts)
- LEVEL B (mm): Make-Up of the first bath component after water
- LEVEL C (mm): Make-Up of the second bath component after water
- LEVEL D (mm): Start of circulating pump on

In the real application one, two, three or all of the above mentioned steps are necessary, activated and executed; Other steps are skipped, using flags and parameters in the software.
If, for example, Level B and C are both set to zero, the logic of the program jumps directly from step A to volume controlled Make-Up (= activation of dosing pumps) after the water input and the start of the circulation pump (step D).



Level controlled Make-Up, Set points in PLC block

1	Analogue Level Sensor	7	Pump + heating ON when required
2	Float ring	8	Set Level Make Up Medium 3
3	Set Level Diff. Circ. On Off = difference between pumps ON/OFF	9	Set Level Make Up Medium 2
4	Starting conditions for autom. make-up program: - Operation mode of line: “Manual Mode” - Module is to be empty - Drain valve closed	10	Set Level Make Up Medium 1
5	Level Alarm Max.	11	Set Level Make Up Water (DI-water-valve)
6	Level Warning High	12	Level Module Empty (start condition)

6.3.10.4 Logic of the automatic level controlled Make-Up

In general the logic of the automatic Make-Up program activates:

- first the water inlet valve,
- then the level controlled pumps, one after the other (if applied), and
- afterwards volume controlled pumps. The control system has the option, to build two groups of dosing pumps and also to use delay parameters to start the dosing pumps with time shift. (See also separate description with regard to volume controlled pumps).
- The complete logic is engineered for all types of automatic programs and modules. To adapt the program to the module specific application, some individual steps of the logic are often skipped and the required ones are activated. This is done at line commissioning.

More general information regarding the logic of the program

- It is possible to run the automatic Make-Up program in several modules at the same time in parallel.
- The module(s), and specifically the level sensor(s), must be inspected and cleaned prior to the start of the automatic Make-Up program
- The drain valve(s) of the module(s) must be closed before the start of the automatic Make-Up program
- To enable the start of the Make-Up program, the level sensor must deliver the '*ModuleEmpty*' message to the PC. In case the module is actually empty and a fault message appears, saying that Make-up cannot start, because the module was not empty, the sensor and the PLC block parameter must be checked
- In case that a fault message interrupts the progress of the automatic Make-Up program (e.g. Make-Up tank is empty, pump is switched off for pump protection), you must first solve the problem. After that, you quit the fault (F9 function key) and the program will continue at that step, where it was interrupted.
- Pumps in the respective module must remain switched off, when the level controlled part of the automatic Make-Up program is running, because of the actual level difference when pumps are switched on and off. If this instruction is ignored, the whole Make-Up procedure is not performed correctly (volume too big, concentration out of range, etc.).

PLC block parameters

	NOTICE
!	**Wrong parameters and levels** At line commissioning, Atotech personnel activates the right parameters and sets the correct levels in the PLC block (accessible with 'Super user' rights, using Ctrl+D function key combination). The correct levels must not be modified afterwards without consultation of the responsible process engineers. Alterations would influence the ratio of volumes of individual components and the bath concentrations.

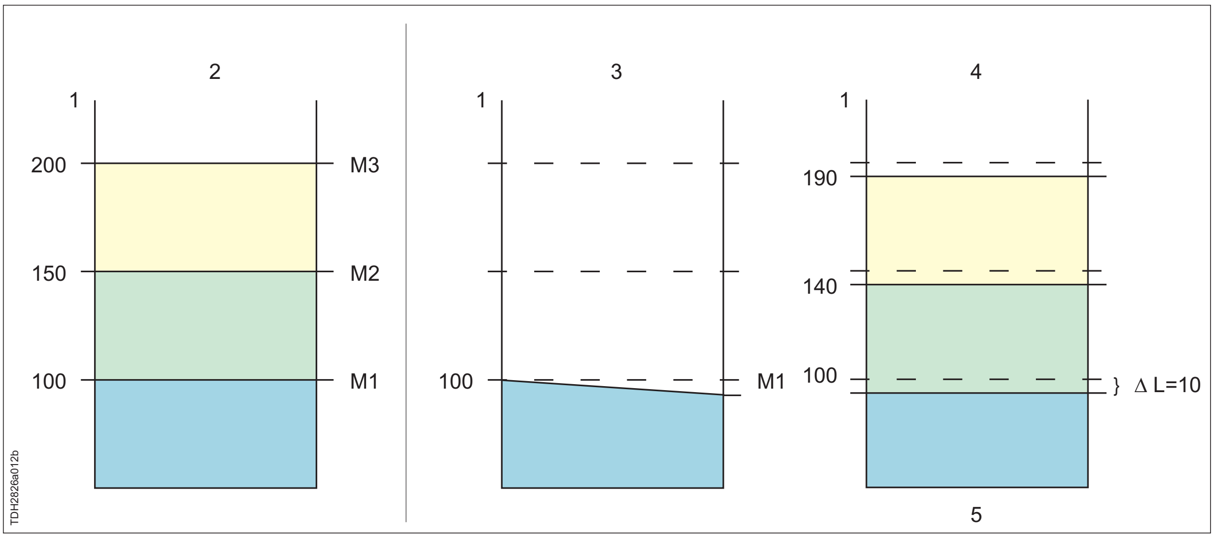
The PLC block parameters are as follows:

[Level]

- *#SetLevelMakeUpWater* (mm) for closing the valve and starting the first pump.
- *#SetLevelMakeUpMedium1* (mm)
- *#SetLevelMakeUpMedium2* (mm)
- *#SetLevelMakeUpCircPump* (mm) for the start of the circulating pump.

Start of the circulation pump

Generally, the circulation pump shall start not before the last level controlled Make-Up pump has stopped. i.e., the parameter for starting the circulation pump is to be set high enough to achieve this.



Level difference due to start of the circulation pump

1	level	5	due to pump circulation
2	without circulation	M	Medium
3	start of pump circulation	DL	Level difference
4	with circulation		

If, for any important reason, it is required that the circulation pump must start already before the last level controlled Make-Up pump has stopped, we must consider this, by lowering the level parameters.

This is essential for the following reason:

When the solution reaches the value #SetLevelMakeUpCircPump, the pump starts and the actual fluid level in the sump is reduced (to some extent) due to the circulation.

If this level reduction (or level difference) is not negligibly small, those level parameters which are not yet reached in the rest of the automatic program, must be reduced by that level difference.

When the Make-Up is finished and the circulation pump stops finally, the actual level will rise by the level difference and reach the 'AllPumpsOff' set point.

6.3.10.5 Make-Up pumps (dosing pumps) controlled by volume

Dosing pumps are primarily used for the replenishment of solution, but they are often also used for Make-Up.

This is applied when the flow rate of the dosing pump is sufficient. Then there is no need to install a separate drum pump to reduce the Make-Up time.

In general, the logic of the automatic Make-Up program activates

- first the water inlet valve,
- then the level controlled pumps, one after the other (if applicable), and
- afterwards volume controlled pumps (the control system has the option, to build two groups of dosing pumps and also to use delay parameters to start the dosing pumps with time shift).
- If the solution must be heated up to a certain temperature during Make-Up, this is part of the Make-Up logic and can be activated by software specialists.
- Individual steps of the complete logic are often skipped in module and bath specific applications.

In case of volume controlled Make-Up:

- The Make-Up quantity (in liter) is to be entered in the control system.
- The control system calculates automatically the running time of the pump, on the basis of Make-Up quantity and flow rate.

It is necessary, that the flow rate of the pump (in liters per hour) is calibrated and entered in the control system correctly.

Nominal versus actual flow rate: The nominal flow rate of the pump is specified in the P&I diagram and can also be read directly from name plate of the dosing pump. The nominal value serves as orientation, but it may not be entered as actual value in the VCS control system. The actual flow rate must be determined by measurement, which generally differs from the nominal flow rate to some extent.

Distinction of volume controlled Make-Up pumps and required parameter setting

Application A): The pump is used as dosing pump and **not** as Make-Up pump, the pump capacity is rather small (e.g. 7,5 l/h).

Required (and not required) parameters:

a) Calibrate the pump and enter the actual flow rate value (l/hrs.)
b) Enter the dosing equivalent in the dosing control panel
c) The Make-Up quantity is ‘zero’.

Application B): The pump is used as dosing pump and also as Make-Up pump, the pump capacity is approximately 25 l/h.

Required parameters:

a) At line commissioning, Atotech software specialists set flags in the PLC block, to include the pump in the automatic Make-Up program
b) Calibrate the pump and enter actual flow rate value (l/hrs.)
c) Enter the dosing equivalent in the dosing control window
d) The Make-Up quantity is to be set in liters

Application C): The pump is used as Make-Up pump, but not as dosing pump. The pump capacity is in the range of about 50 – 200 l/h.

Required (and not required) parameters:

a) At line commissioning, Atotech software specialists set flags in the PLC block, to include the pump in the automatic Make-Up program
b) Calibrate the pump and enter the actual flow rate value (l/hrs.)
c) All the dosing equivalent values are set to ‘zero’
d) The Make-Up volume is to be set (in liters)

NOTICE

Wrong parameters

At line commissioning, Atotech personnel activates the right parameters to run the dosing pumps automatically and process engineers set the correct volumes.

The volume setting must not be modified afterwards without consultation of the responsible process engineers. Alterations would influence the ratio of individual bath components and the bath concentrations.

6.3.10.6 Overview, various Make-Up applications

The design of Atotech Horizontal Lines varies to a large extend. Some of the manifold options listed below are chosen and applied for the best customer-orientated solution.

Make-Up variants in the modules of the line and in peripheral tanks

- Automatic Make-Up in the module (standard for all standard active modules).
- Automatic Make-Up parallel in the module and in external tanks.
- Automatic Make-Up in the holding tank.
- Half-automatic Make-Up in the holding tank (line-specific). Step-by-step control of pumps, either by electrical push buttons or by mouse click at the control PC.

Make-Up of cleaning solution

- Manual Make-Up of the cleaning solution in the cleaning tank (standard).
- Automatic Make-Up in the cleaning tank (line-specific).
- Automatic Make-Up in the module during the cleaning program (only in case that no cleaning tank is available, line-specific).

Half-automatic Make-Up of dosing components

Step-by-step control of pumps, either by electrical push buttons or by mouse click at the control PC.

- In Make-Up tanks (line-specific)
- In the holding tank (line-specific)

6.3.11 Level Control: Level sensors and set-points

6.3.11.1 Level Minimum and other level parameters in active modules

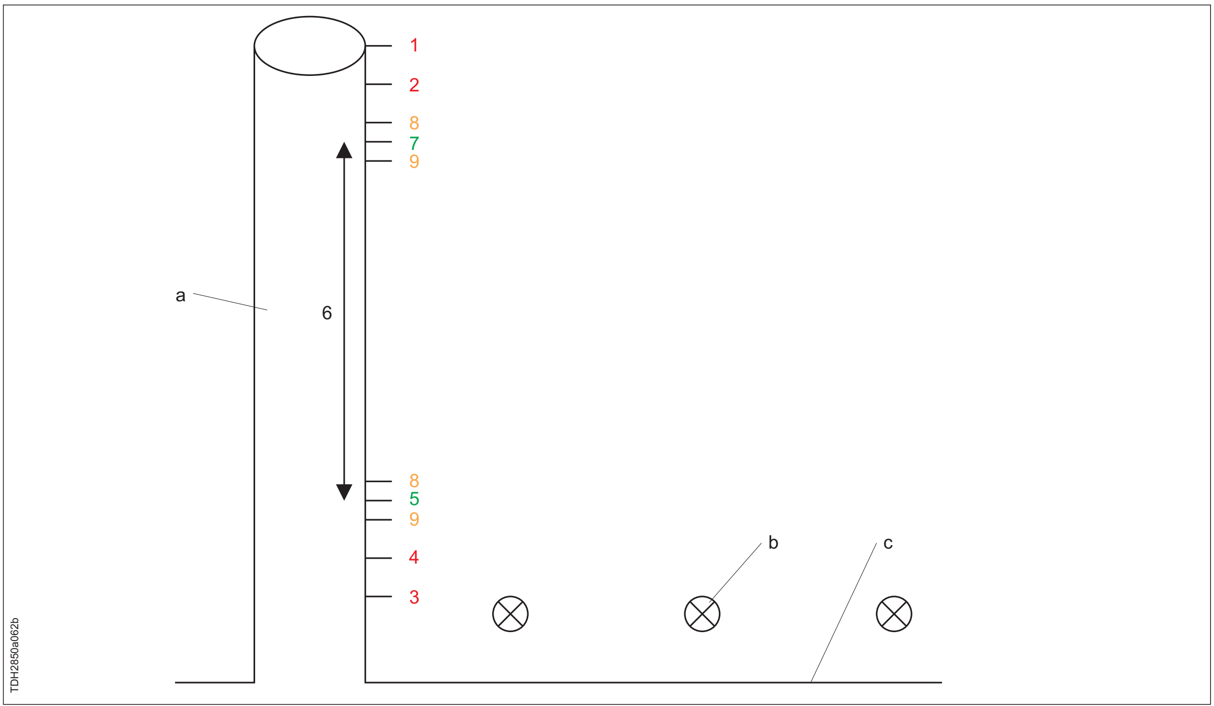
The heating elements in an active module must always be completely covered when all the pumps are running! The bath level must be at least 10 to 15 mm above the top edge of the heating elements.

NOTICE

Level Minimum Alarm

It is not permitted to lower the Level Minimum Alarm parameter in the control system!

The control system must switch off all the heating elements and all the pumps in the respective module, when the actual level should by any fault get too low!



Level parameters between top edge of flow pipe and heating elements in active modules

1	Upper edge of the overflow pipe	6	Level difference
2	Level maximum alarm	7	All pumps off
3	Upper edge of the heating elements	a	Overflow pipe in active module
4	Level minimum alarm	b	heating element
5	All pumps running	c	bottom of module

Absolute level values and level limits by construction

1. Upper edge of the overflow pipe. This height is a value fixed by construction.
2. Alarm Level Maximum: It must be at least 4 to 6 mm less than Level 1.
   A higher level than this would cause overflow of solution into the drainage system.
3. Level of the top edge of the heating elements. The solution just covers the heating elements completely.
   This height is also a value fixed by the construction.
4. Alarm Level Minimum: It must be at least 10 to 12 mm higher than Level 3.
   This parameter is essential for prevention of damage to the equipment!
   If the actual value is getting lower than this value, the PLC switches off the pumps and heating elements in the respective module.

List of level values as example

- The modules are different by construction as well as solution volumes.
- The table of values below merely serves as an example to illustrate the interdependence of parameters.
  The real nominal values for all the different types of modules are set by the responsible process engineer!

- The numbers in the first column relate to the graphic above and also the description below this table.

No.	Parameters	Absolute values	Relative values	Defined or set by
1	Height of upper edge of overflow pipe	280		Construction
2	**LevelAlarmMax**	**275**		**Commissioning**
8	WarningMaxStandby	254	4	Calculated
	HystereseWaterStop	252	2	Calculated
7	LevelControlStandby	250		Calculated
	HystereseWaterAdd	248	2	Calculated
9	WarningMinStandby	246	- 4	Calculated
6	DiffCirculationPumpsOn		70	Commissioning
8	WarningLevelMaximumAllPumpsON	184	4	Commissioning
	HystereseWaterStop	182	2	Calculated
5	**LevelControlAllPumpsOn**	**180**		**Commissioning**
	HystereseWaterAdd	178	2	Calculated
9	WarningLevelMinimumAllPumpsON	176	- 4	Commissioning
4	AlarmMinPumpAndHeatProtection	172		Commissioning
3	Height of upper edge of heating elements	160		Construction

Table with a set of level parameters to illustrate their interdependence

Level values related to the set-point level:

1. Level set-point when all the pumps are running. This level must be at least 5 mm higher than Level 4 and **at least** 16 mm higher than Level 3. 20 mm to 25 mm above the heating elements (Level 3) is recommended, if possible with regard to volume and top edge of flow pipe.
2. Difference of level when
   - a) all pumps are off and
   - b) all pumps are running:

   (a) and (b) is to be measured at commissioning, the difference is then to be calculated and correctly entered in the respective VCS process control window of each active module.
3. Calculated set-point level, when the line is in stand-by mode (all the pumps are off, besides circulation pump):

It is automatically calculated by the control system by adding difference 6 to Level 5.

This level is also the target level, that must be reached at the end of the Make-up program.

4. Warning Level Maximum:

   For example set to + 4 mm relative to Level 7 or 5, depending on the On/Off state of pumps.

   Level 7 plus this value 8 must be less than Level 2 (Alarm Maximum).

5. Warning Level Minimum:

   Set to minus 4 mm relative to Level 7 or 5, depending on the On/Off state of pumps.

   Level 5 minus this value 9 must be bigger than Level 4 (Alarm Minimum).

NOTICE

Altering setting values

After correct commissioning, the values must not be altered, because they are interdependent and essential for safety and prevention of damage!

6.3.11.2 Actual set points depending on the modes of operation

Different medium levels due to pump activation

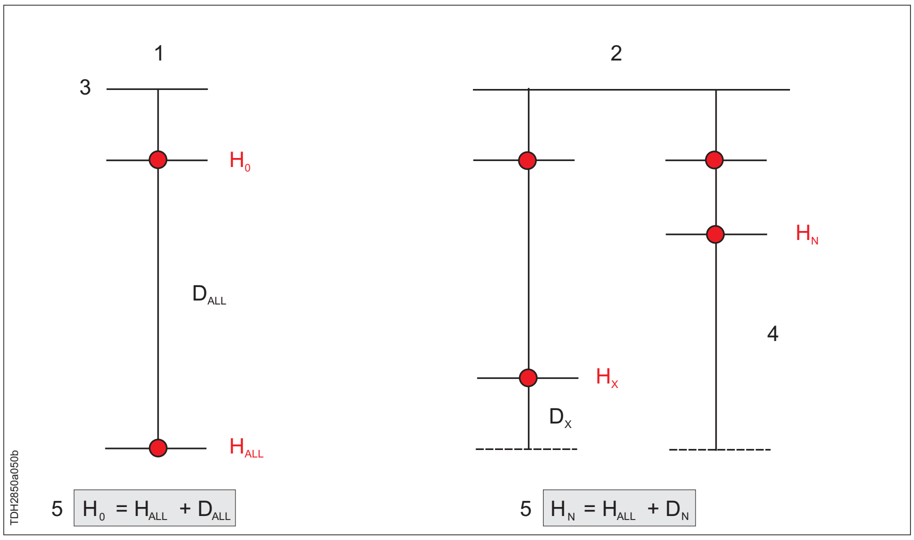
The sump level of active modules is changing from low level to high level and vice versa. We get automatically a

- low level when all the pumps are on
- a higher sump level during heat-up mode or if there are no panels in the line (only one or a few pumps are on for liquid circulation)
- highest sump level when all the pumps are off.

This effect happens due to the amount of liquid inside the pipes, Floodbars, etc. when the liquid is circulating.

Actual set point levels

- The actual set point level varies depending on the mode of operation (heat-up, stand-by, production) and the
- number of pumps activated during production.



Calculation of level

1	Stand-by mode	4	D_N = sum of D_X
2	Production with some pumps not used	5	Level
3	Off		

Level H_{OFF}:	no production, all pumps are off, high sump level
Level H_0:	no production, heat-up or stand-by mode, one pump (or a few) is switched on the for circulation of electrolyte in the sump
Level H_{ALL}:	production is running with all pumps switched on
Level H_X:	production is running with a specific pump X not in use
Level H_N:	production is running with a certain number of pumps N not used
$D_{ALL} = H_0 - H_{ALL}$	Level difference between stand-by mode (pumps off) and running production (all pumps switched on). It is defined in the PLC-Block as ‘SetLevelDiffCircOnOff’
D_X	Level difference of one individual pump not running.
D_N	Level difference when N pumps are not used for production (sum of D_X)

Definition of level and differences

With H_{ALL}, D_{ALL} and D_X as given values the actual set point levels H_0 and H_N are automatically calculated by the following equations:

Level H_0 = Level H_{ALL} + D_{ALL} (level in stand-by or heat-up mode).

Level H_N = Level H_{ALL} + D_N (production with N pumps off).

Automatic level control during stand-by and heat-up mode

Example: With

- a set point of 120 mm for production (for example) and
- a “Diff. Circulation” value of 30 mm (for example) the

level during **stand-by or heat-up mode** is calculated and automatically kept on 150 mm.

When changing to **automatic mode** of operation for production the level will reach 120 mm as soon as the elements in the pump circuits are filled with medium.

Automatic level control is taking place in automatic mode - both during production and in stand-by mode.

Hysteresis value and warning level values are related to the actual set point level.

Level setting via specific Job Administration programs

The adequate level in a specific module for a specific production job can also be entered via Job Administration.

The program must be designed accordingly during line commissioning. This is executed by ATOTECH line commissioning specialists.

6.3.11.2.1 Different medium levels due to pump activation

The sump level of active modules is changing from low level to high level and vice versa. We get automatically a

- low level when all the pumps are on
- a higher sump level during heat-up mode or if there are no panels in the line (only one or a few pumps are on for liquid circulation)
- highest sump level when all the pumps are off.

This effect happens due to the amount of liquid inside the pipes, Floodbars, etc. when the liquid is circulating.

6.3.11.2.2 Actual set point levels

- The actual set point level varies depending on the mode of operation (heat-up, stand-by, production) and the
- number of pumps activated during production.

Definition of level and differences

With H_{ALL}, D_{ALL} and D_X as given values the actual set point levels H_0 and H_N are automatically calculated by the following equations:

Level H_0 = Level H_{ALL} + D_{ALL} (level in stand-by or heat-up mode).

Level H_N = Level H_{ALL} + D_N (production with N pumps off).

6.3.11.2.3 Automatic level control during stand-by and heat-up mode

Example: With

- a set point of 120 mm for production (for example) and

- a “Diff. Circulation” value of 30 mm (for example) the

level during **stand-by or heat-up mode** is calculated and automatically kept on 150 mm.

When changing to **automatic mode** of operation for production the level will reach 120 mm as soon as the elements in the pump circuits are filled with medium.

Automatic level control is taking place in automatic mode - both during production and in stand-by mode.

Hysteresis value and warning level values are related to the actual set point level.

6.3.11.2.4 Level setting via specific Job Administration programs

The adequate level in a specific module for a specific production job can also be entered via Job Administration.

The program must be designed accordingly during line commissioning. This is executed by ATOTECH line commissioning specialists.

6.3.11.3 Level sensor with float ring

The electric wiring diagram displays that the level sensor has three leads. Two leads are used for its power supply (10V). The third lead is used to transfer the voltage level that is depending upon the float position (0 to 10V). (See also the color code for the leads and their connection to the conversion module in the electrical wiring diagram).

Inside the submerge tube of the level sensor there is a line of reed relays and a chain of resistors which work as a voltage divider. The relays are activated by the magnetic field of the float ring. Thus a part of the total DC voltage is transferred to the voltage-variable lead.

Level sensor with floater

There are different level sensors installed within the various modules of your ATOTECH-line. Important specification information includes:

- Fitting length
- Measuring length and resolution
- Material of the submerge tube and the float ring
- Resistance of the sensor in kΩ
- Length of the connection cable

For additional information see also spare part chapter of ATOTECH documentation and suppliers' documentation.

The measuring length corresponds to the motion value of the float ring along the submerge tube. The resolution depends on the measuring length and the number of resistors within the chain. The closer the chain of resistors inside the submerge tube the finer is the resolution.

6.3.11.4 Microwave level sensor (ifm)

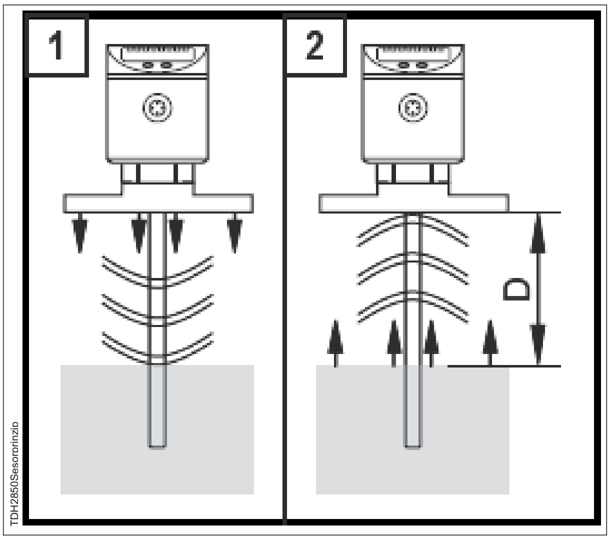
Installation in modules of the line

Microwave level sensor mounted on top of the module with help of a flange plate

Principle of operation

The sensor head sends electro-magnetic impulses (micro-waves) along the partly submerged rod of the level sensor. The micro-waves are reflected by the medium.

The longer the distance to the medium, the longer the time of impulse reflection. A long time of impulse reflection represents a low level, a shorter time of impulse reflection represents a higher level.



Principle of sensor operation

Commissioning

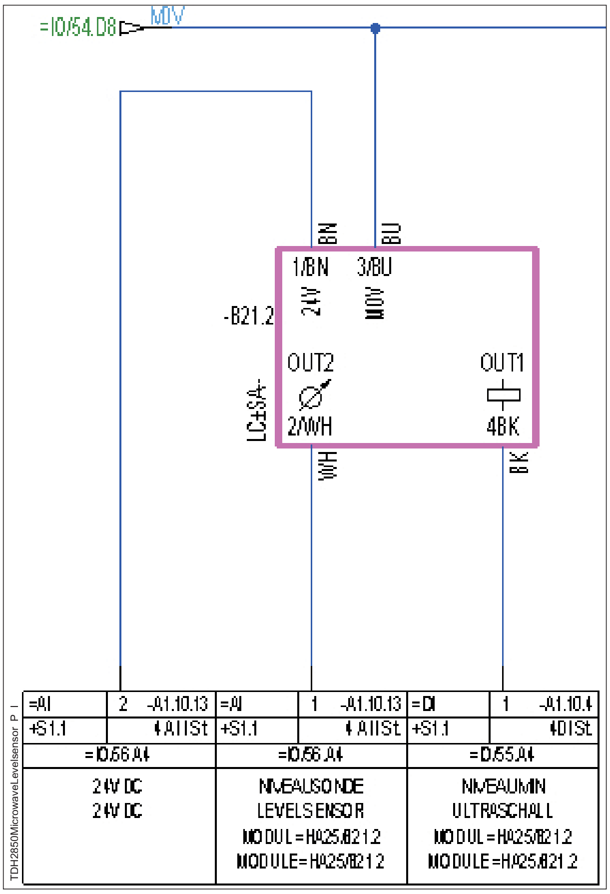
The working mode of the sensor is set on a display on the sensor head.

An important parameter is the length of the probe which has to be entered in the sensor display. See the supplier's documentation for more information.

Electrical connections

The level sensor has four leads. Two leads are used for its power supply (24V). The third lead is used to transfer the analog input signal that is depending on the length of the uncovered sensor (0 to 10V or 4 to 20mA). The fourth lead can be used for an additional relay contact serving as a minimum switch.

The component code of the sensor in P&I and electric wiring diagram is B21.#.



Exemplary representation of the Microwave-guided analog level sensor in the electrical wiring diagram

Further sources of information

- P&I schematic (line-specific)
- Electrical wiring diagram (line-specific)
- Supplier's manual (ifm)
- Parts catalogue (etk.exe)

6.3.11.5 Automatic level control

Two kinds of automatic level control (closed loop controls) must be distinguished:

1. Automatic level control in the sump of an active module
   a) without production, when the pumps are 'Off' and
   b) during production, when the pumps are running.
2. Automatic level control in the flood tray during production = 'Working level control'.
   The 'Working level control' is mainly used in plants with the UTS-xs transport system (since 2008).

Level measurement is carried out by using analog level sensors (B21.# component designation).

Digital level switches (S20.#, S24.# component designation) detect limit levels (stops, warnings, alarms, etc.).

See also

🗎 Cross reference to other sources of information [→ 119]

🗎 Level Minimum and other level parameters in active modules [→ 109]

🗎 Actual set points depending on the modes of operation [→ 112]

🗎 Level sensor with float ring [→ 115]

🗎 Microwave level sensor (ifm) [→ 116]

6.3.11.6 Cross reference to other sources of information

You may also refer to:

- P & I diagram: Display functional information of the line (process type, module type, pumps and instruments).
- Electric wiring diagrams: Display detailed electrical information for each module and its instruments (how the electrical components are connected).
- Supplier's information of the measurement chain components:
  - Level sensor: Fitting length, measuring length, resolution, order code, manufacturer, etc.
  - Analog input module: Electrical inputs and outputs, resolution, order code, manufacturer, etc.

In the P&I diagram the level sensor is marked out by B 21.#, which is the ATOTECH code for line components.

6.3.12 Safety switch S24.1 (level minimum)

The S24.1 (S24.# in general) is a safety device for switching off the heating system of the respective module if the level is too low (risk of excessive heat and fire).

The S24.1 triggered power interruption takes place not just by software but **also by hardware (via relay K24.1)**.

- The S24.# has two switching contacts (one contact is for hardware switch off, the other one delivers the digital input for software control).
  K24.1 is the respective relay, switching off the contactors for heating elements.
- Software logic (and test criterion in manual mode of operation):
  If the float ring is pressed down for test purposes, the S24.1 must switch off all the heating elements in the module. The pumps are also switched off.
  Check whether the related fault messages are generated.
  This check belongs to the function checks of sensors in the production line.
- Prior of a new make-up, the cleanliness of sensors/switches and their adequate functions must be checked.
- Logic in case of fault during production:
  If the S24.1 switches off the heating system, the control PC stops the Loader (not the drive).
- The level switch has a fixed length and a fixed mounting height (i.e. height adjustment is not possible and not necessary). That means that switch-point level for minimum alarm is fixed by construction.
- Commissioners must make sure, (a) that the switch-point is not too low.
  The switch-point (alarm level) must be at least 15 mm above the highest point of the highest heating element. (risk of equipment damage by over-heat, if ignored!).
  Secondly (b), they ensure, that the switch-point is not too high: For process safety, the switch-point height must be below the basic set-point level (= all pumps are running at 50Hz/60Hz).
  If, by mistake, the length of the S24.1 is not adequate and the alarm generation occurs either at a level too low (a) or if too high (b), it must be reported back to the ATOTECH mechanical engineering department in Feucht.
- For spare part ordering, the ID number must be correct (tank specifically, the exchanged part must have same length).

Related documentation:

- Electrical wiring diagram of the respective module
- VCS-H fault messages (on-line information for operators)

See also

🗎 020180 Inspection of monitoring devices [→ 300]

🗎 020181 Check digital level switches [→ 301]

6.3.13 Cover Switches

Active modules and rinses are equipped with a magnetic detector cover switch. If a module is opened, the detector transmits a fault signal to VCS.

If the cover is opened when the pumps are running, the control PC will react automatically and switch off the pumps.

This protects operators from process chemicals splashing over.

Meanwhile the drive is not switched off and the transport system is still running. This makes it necessary to take preventive safety measures when operating the line while one or more modules are opened.

PROHIBITION

Working on opened modules

Working on opened modules is generally not permitted, if the drive (transport system, conveyor) is running.

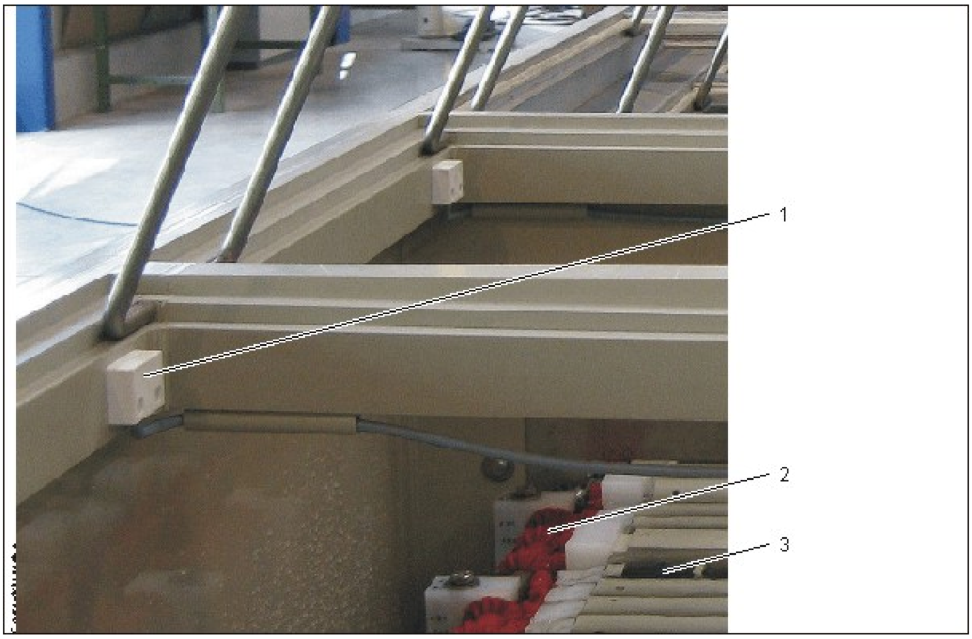
WARNING

Risk of injury

Be careful and keep away from the moving gears of the transport system.

Only instructed personnel are allowed to work on the open line.

It is not permitted to take away safety interlockings!



Opened Cover

1	Cover Switch	3	Liquid in module (may be hot and/or etching)
2	Transport system (dependent on Drive		

Related Topics:

- VCS –H Fault messages

See also

- 020184 Check cover switches [→ 302]
- Rinses [→ 140]
- Handling of the line in general [→ 32]

6.3.14 Temperature Control

Heating elements E16.# and temperature sensors B16.# are installed in active modules of the production plant and also in external tanks (if required).

The usually required and applied temperature of the solution in a module or tank is (in the engineering phase) specified in the P&I diagram: See table in bottom-left-hand-side corner with module specific values.

If process engineers decide to go way from this specification, they must share such a decision with colleagues and make records about this change (including the reasons for it).

- The optimum temperature (for process results and/or with respect to prevention of equipment damage) is set in VCS.
- The actual temperature is detected by the temperature sensor (Atotech code B16.#).
- The range between upper and lower temperature limit (first for a warning message, then for an alarm) is also set in the respective VCS control window.

Safety note to all operators, technicians and engineers, working at VCS controlled ATOTECH production plants!

	NOTICE
!	**Risk of fire or property damage** It is not permitted to take out the PLC address of the temperature sensors in the VCS control system. This would disrupt the automatic switch-off function of the heating system.

Technicians and Engineers must case-specifically distinguish different features.

- In most cases of installation, the temperature is automatically kept constant during production (automatic closed loop control system). The heating system is automatically switched on if the actual temperature is below the set value.
  The cooling system is automatically switched on if the actual temperature is above the set value.
- In other cases the temperature is just monitored (no automatic temperature control possible). A fault message is given if the actual temperature is out of range.

- If a temperature limiter A18.# is part of the installation (S18.# connected to A18.# and relays switching off the ‘Direct starter’, see electrical wiring diagram), it must be checked in regular intervals whether the temperature limit is correctly set at A18.#) and whether hardware safety switching it is still working as intended (switching off the heating system if the temperature is too high).

Further sources of information (project and module specific):

- P&I diagram

- Electrical wiring diagram

- Atotech Parts Catalog (sub-suppliers’ manuals)

6.3.14.1 Checks and actions for trouble shooting

► **Checking the displayed value in VCS**

The actual temperature value as displayed in VCS can be checked by comparison with a calibrated thermometer (chemistry resistant, if executed in the chemistry). Please notice that the thermometer has to be immersed right next to the Pt 100 into the liquid of the according module.

The test may also be performed with water outside the module.

► **Checking the resistance of a Pt100 which is not connected**

The resistance value between to wires of the Pt100 is measured with an ohmmeter. These measured values should comply with the reference table (°Celsius <--> resistance in Ohm). The measured values may also be compared between different Pt100 sensors.

► **Checking the BusValues of several working points**

The following check requires more knowledge and experience (training). Somebody must have access rights to the BusViewer in VCS.

The Bus value (digital increments) rises and decreases proportionally with the temperature change.

From the electrical diagram you obtain the node, the address and the channel for the analog level signal.

Knowing the address, the bus values (digital increments) can be viewed in the VCS menu (sub menu → PLC → Bus Viewer).

If you put the Pt100 in different containers with liquid of different temperatures, several working points can be checked.

You record (for several working points)
- actual temperature of the liquid (and displayed temperature in VCS) and

- Bus value

From these results, the parameters ‘TemperatureFactor’ and ‘TemperatureOffset’ can be calculated.

For comparison you may also seek advice from software engineers (colleagues) and get information about correct parameters (factor, offset) in other cases of installation.

► **Replacement of AI-Bus module**

As it can be seen in the electrical wiring diagram, the Pt100 is connected to an AI-Bus terminal (for conversion of analog input signal to digital increments). If there is no reasonable temperature display, the AI-Bus terminal may be defect. Replacement of the AI-Bus module is advised, if other possible causes (wrong wiring, defect Pt100, no ‘Factor’ and ‘Offset’ parameter yet) can be excluded.

6.3.14.2 The temperature sensor Pt100 and table of reference

The thermometer sensor Pt100 has 4 leads. The connection to its bus terminal is shown in the electric wiring diagram.

The resistance thermometer (Pt 100) detects the temperature of the liquid.

With rising temperature the resistance value of the Pt 100 increases (see reference table, i.g. 0° ↔ 100Ω, 26° ↔ 110Ω, 40° ↔ 115 Ω, 80° ↔ 130 Ω).

The table is useful to check the function of the Pt 100 (resistance test).

Resistance of Pt 100 in 1°C steps

°C	Ohm	Ohm/K	°C	Ohm	Ohm/K	°C	Ohm	Ohm/K
-10	96,09	0,39	0	100,00	0,39	10	103,90	0,39
-9	96,48	0,39	1	100,39	0,39	11	104,29	0,39
-8	96,87	0,39	2	100,78	0,39	12	104,68	0,39
-7	97,26	0,39	3	101,17	0,39	13	105,07	0,39
-6	97,65	0,39	4	101,56	0,39	14	105,46	0,39
-5	98,04	0,40	5	101,95	0,39	15	105,85	0,39
-4	98,44	0,39	6	102,34	0,39	16	106,24	0,39
-3	98,83	0,39	7	102,73	0,39	17	106,63	0,39
-2	99,22	0,39	8	103,12	0,39	18	107,02	0,38
-1	99,61	0,39	9	103,51	0,39	19	107,40	0,39

°C	Ohm	Ohm/K	°C	Ohm	Ohm/K	°C	Ohm	Ohm/K
20	107,79	0,39	30	111,67	0,39	40	115,54	0,39
21	106,18	0,39	31	112,06	0,39	41	115,93	0,38
22	108,57	0,39	32	112,45	0,38	42	116,31	0,39
23	108,96	0,39	33	112,83	0,39	43	116,70	0,38
24	109,35	0,38	34	113,22	0,39	44	117,08	0,39
25	109,73	0,39	35	113,61	0,38	45	117,47	0,38
26	110,12	0,39	36	113,99	0,39	46	117,85	0,39

°C	Ohm	Ohm/K	°C	Ohm	Ohm/K	°C	Ohm	Ohm/K
27	110,51	0,39	37	114,38	0,39	47	118,24	0,38
28	110,90	0,38	38	114,77	0,38	48	118,62	0,39
29	111,26	0,39	39	115,15	0,39	49	119,01	0,39

°C	Ohm	Ohm/K	°C	Ohm	Ohm/K	°C	Ohm	Ohm/K
50	119,40	0,38	60	123,24	0,38	70	127,07	0,38
51	119,78	0,38	61	123,62	0,39	71	127,45	0,39
52	120,16	0,39	62	124,01	0,38	72	127,84	0,38
53	120,55	0,38	63	124,39	0,38	73	128,22	0,38
54	120,93	0,39	64	124,77	0,39	74	128,60	0,38
55	121,32	0,38	65	125,16	0,38	75	128,96	0,39
56	121,70	0,39	66	125,54	0,38	76	129,37	0,38
57	122,09	0,38	67	125,92	0,39	77	129,75	0,38
58	122,47	0,39	68	126,31	0,38	78	130,13	0,38
59	122,96	0,38	69	126,69	0,38	79	130,51	0,38

°C	Ohm	Ohm/K	°C	Ohm	Ohm/K	°C	Ohm	Ohm/K
80	130,89	0,38	90	134,70	0,38	100	138,50	0,38
81	131,27	0,39	91	135,08	0,38	101	138,88	0,38
82	131,56	0,38	92	135,46	0,38	102	139,26	0,38
83	132,04	0,38	93	135,84	0,38	103	139,64	0,38
84	132,42	0,38	94	136,22	0,38	104	140,02	0,37
85	132,80	0,38	95	136,60	0,38	105	140,39	0,38
86	133,18	0,38	96	136,98	0,38	106	140,77	0,38
87	133,56	0,38	97	137,36	0,38	107	141,15	0,38
88	133,94	0,38	98	137,74	0,38	108	141,53	0,38
89	134,32	0,38	99	138,12	0,38	109	141,91	0,38

°C	Ohm	Ohm/K
110	142,29	0,37
111	142,66	0,38
112	143,04	0,38
113	143,42	0,38

°C	Ohm	Ohm/K
114	143,80	0,37
115	144,17	0,38
116	144,55	0,38
117	144,93	0,38
118	145,31	0,37
119	145,68	0,38
120	146,06	0,38

6.3.15 Calibration of probes or sensors in VCS

Probes or sensors for the analog measurement of physical quantities ‘Y’ (like pH value, conductivity of the solution, level of the bath, temperature etc.) must be calibrated once in while according to process specific requirements.

Provided that the hardware of the measurement system (the electrical components) is properly working, calibration of software parameters is necessary, if the real value is distinctly different from the value displayed in VCS.

In any case of measurement and monitoring of analog input signals, we can assume a linear characteristic according to the formula:
Y = m*X + b; whereby m = ‘Gain’ or ‘Factor’, b = ‘Offset’ and X = BusValue.

Software calibration means, that the parameters ‘Factor’ b and ‘Offset’ m must be checked and fine-tuned, if an alternative and reliable measurement method leads to the result, that the displayed value Y is not accurate enough.

In principle the steps are as follows (details to the single steps are specifically described for the different measurement systems, like pH or conductivity meter, etc.):

1. Exercise 1 (for preparation): Find out the address of the measurement system either in the electrical wiring diagram (module orientated order) or in VCS (if you have the required access rights).
2. Exercise 2 (for preparation): In the VCS menu, click the ‘BusViewer’ and read the respective analogue BusValue X. Write it down together with the displayed value Y for reference later on.
3. Exercise 3 (for preparation): Find out the present values for ‘Offset’ and ‘Factor’ of the linear characteristic making use of the ‘PLC Explorer’.
4. Prepare two solutions for calibration or (in other words) define the two working points A and B (Y_A and Y_B). The values Y_A and $Y_B$must be reliable ones, i.e. measured by a standardized, trustworthy and practical method independent of VCS and the components of the ATOTECH line.
5. Plan and prepare the practical test situations A and B to find out (X_A , Y_A) and (X_B ,Y_B).
6. Execute step A of the test to find out the Busvalue X_A. Compare the displayed value Y_{AD} with the real value Y_{AR}. Write down Y_{AR}, Y_{AD}, X_A.

7. Execute step B of the test to find out the Busvalue X_B: Compare the displayed value Y_{BD} with the real value Y_{BR}. Write down Y_{BR}, Y_{BD}, X_B.
8. If the displayed values Y_{AD} and Y_{BD} do not significantly differ from the real values Y_{AR} and Y_{BR} , there is no need to change the values for ‘Offset’ and ‘Factor’. Otherwise calculation and calibration must be executed.
9. Calculation (if required): Entering the values (Y_A , X_A) and (Y_B , X_B) into the two equations
   (A) $Y_A = m*X_A + b$ and (B) $Y_B = m*X_B + b$ you can calculate m and b.
   Before going on to the next step, check whether your calculation is correct and the result resonable.
10. Overwrite the former values for ‘Offset’ b and ‘Factor’ m (in the ‘PLC parameter Explorer’) with the new calculated ones.
11. Finally check your new calibration by reading the actual display and by comparison with the real condition of the solution.

This description is a general one applicable for all types of analogue input sensors (measurement of temperature, level, pressure, flow rate, probes, etc.). Generally two working points must be defined for accurate calibration.

However in practice, the calibration method can often be simplified, knowing one of the two specified working points (A or B) by considering specific properties of the measurement system. Then the calibration of one working point is enough (= just adjustment of the display next to the set-point by tuning of the ‘Offset’, leaving the ‘Factor’ constant).

- In case of the pH measurement (if installed): Important is the accuracy especially at the set-point and not so much at other ranges (entire range 0 to 14). For a pH value Y_A=0, the BusValue X_A is also zero (i.e. the Offset remains ‘0’). The second working point is the maximum value (Y_B = 14, X_B= 27648). If the display at the set-point is not accurate enough, the ‘Offset’ can be slightly fine-tuned (away from the default value 0), but the ‘Factor’ remains unchanged.
- Level sensors are calibrated by just adjusting the ‘Offset’, because their overall measuring range is not changing in the course of time. That means, that the ‘Factor’ remains unchanged. If ‘Offset’ and ‘Factor’ are once correctly set and the hardware installation is not changed, there will be no need for calibration any more afterwards.
- The accuracy of the temperature is especially important at its set-point (just at one point). For all the installed temperature sensors ‘PT100’ in the line, there is a common ‘SetTempFactor’ in the Global PLC block. If the display of the actual temperature must be adjusted, this can easily be done by ‘Offset’ adjustment, one or a few degrees up or down (as the only parameter), after the bath is heated up to its set-point temperature.

If a person needs to familiarize himself with the calibration of analog sensors by tuning software parameters, it is recommended to read also other descriptions (like calibration of pH meter, level sensors, etc.) to get a comprehensive understanding of the topic. To arrange a brief training session at a VCS-H control PC may be beneficial.

See also

- Level Control: Level sensors and set-points [→ 109]
- 020180 Inspection of monitoring devices [→ 300]

6.3.16 Cleaning program

A fully automated cleaning program is installed in

- the Permanganate module (P-line)
- the Electroless copper module (LB-line) and
- the Adhesion Promoter (CP-line).

The single cleaning steps are represented clearly in the VCS control system.

6.3.16.1 General

The cleaning program enables you to clean the modules either fully automatically or manually controlled. The line must be in the ‘manual mode’ when running the cleaning program.

By clicking the screen box "Cleaning" at the control PC a flow diagram of the modules, tanks and units that are involved is displayed.

When running the program the location of the chemicals is displayed permanently.

It is made visible in which containers the chemicals (e.g. Permanganate solution, DI water or cleaning solution) are during the individual steps.

In message display boxes you get information about the:

- current cleaning step
- notes and
- (may be) fault messages

6.3.16.2 Checking the starting conditions of the cleaning program

- Is the line in manual mode?
- Is there no fault message indicated?
- Is the temperature of the Permanganate solution within the range set in the software? (customer specific limit settings and corresponding interlocking in the control).
- Is the holding tank empty?
- Can the concentrate be released into the disposal system?
- Is there enough cleaning solution (with the required concentration) in the container for the cleaning solution?

- Is the electrical supply of the Oxamat cells switched off (because the line is in manual mode of operation).
- Have a look at spray jets during the cleaning process:
  - The spray jets must spray evenly.
  - Look for possible blockages of single jets.
  - If necessary remove blocked jets and blow out their holes with compressed air.

6.3.16.3 Operation Modes of Cleaning Programs

Automatic Cleaning

- all steps are running automatically

Manual cleaning

- step by step cleaning following the “cleaning program” list
- logic order of steps is controlled by PLC

Maintenance Mode

- only for test purposes of devices after repairing
- only for superusers

NOTICE

Maintenance Mode

Never use this mode if chemicals are in the modules or tanks.

6.3.16.4 Automatic cleaning

INFORMATION

A condition for starting this cleaning program is that the line or rather the special part of the line is in manual mode (mode F10).

Procedure:

a) Select the control window "Cleaning” in the process screen of the module.
b) Select button "Automatic Cleaning”.

- The automatic cleaning process of the cleaning program is started now running.

The relaying to the next step is carried out after completion of the previous step automatically.

Interruptions:

a) Stop the program by pressing the key "Suspend Cleaning".
b) By resetting the button the program continues in the same process step.

If by mistake the button "Automatic cleaning" is released during the cleaning process (in any step N), the program is reset back to its beginning.

The continuation of the program (in the correct step N) is then carried out by clicking the button “Manual cleaning” and selecting here the button of the corresponding step N.

Hereafter there is the possibility to continue in the manually controlled mode or to switch to the automatic cleaning mode again. (The manually controlled cleaning program is explained in detail in the following section).

6.3.16.5 Manual cleaning mode

	INFORMATION
i	A condition for starting this cleaning program is that the line or rather the special part of the line is in manual mode (mode F10).

Purpose:

For special purposes all steps of the cleaning program may be selected also manually. This offers the option to run a customized cleaning program (e.g. other duration times than in the automatic cleaning program).

Proceedings:

a) First click on the button "Manual Cleaning" and then click on the button "Cleaning Program".
b) Then each individual cleaning step of the cleaning program has to be activated by mouse click. This is the main difference to the fully automatic cleaning mode.

Interruptions:

Each step (button pushed) that was selected manually can be switched off by clicking on the corresponding function key. The same step may be restarted by clicking the function key again.

In addition, the program can be stopped by clicking the button “Suspend cleaning”. When the button is reset (“Continue Cleaning”) the program continues.

Interlocking:

It is not possible to execute steps out of the correct order! A compulsory sequence of the steps is defined in the control system to avoid dangerous irregularities!

The interlockings in the manual cleaning process are like those of the automatic process. The interlocking and the messages depend also on the position of the medium (in which container is which medium at a certain cleaning step).

Change to automatic mode:

The cleaning program can be switched from manual mode into automatic mode in any step.

The program will be switched over to the automatic mode by clicking the button "Automatic cleaning" when the "Manual cleaning" button is currently activated.

	NOTICE
	Wrong displayed tank Check if the medium is really in the displayed tank!

6.3.16.5.1 Starting a single step in "Manual Cleaning"

	INFORMATION
	A condition for starting this cleaning program is that the line or rather the special part of the line is in manual mode (mode F10).

Procedure:

a) Click on the control panel of the total process flow on *"Cleaning".*

b) Select the production mode *"Manual Cleaning*".

c) Open the table with the cleaning steps.

Activate a step:

By clicking the button ON/OFF in the row "Step" in the cleaning table a step could be activated or not.

a) Select the necessary step.

b) Activate the desired step (step on control panel ON).

- Step is activated and the LED control lamp (in row "Active") is green.

Is the selected step finished the cleaning program stops. The next step must be reselected and started.

Is in the manual mode a step selected which is locked the stroke ON goes out at once and on the control panel the OFF button appears automatically.

Interrupt manual cleaning:

By selecting the button "Stop Cleaning" a step could be interrupted every time. A step is also interrupted if the button for the manual (or automatic) mode is switched off. A manual selected step can be switched off by reclicking on the according functional button.

6.3.16.6 Maintenance mode

	NOTICE
	Risk of mal-operation No software interlocking! Danger of mal-operation! Only to be used by qualified staff with access authorization!

The maintenance mode serves only for the test of units (pumps and valves) for example for inspections during line commissioning!

Cleaning must not at all be executed with the maintenance mode activated! Mal-operations due to improper proceedings and ignorance of the specified step sequence include the danger of overfilling and loss of the bath, e.g.!

There are no interlockings in force which prevent mal-operations (opposite to the automatic and manual cleaning process)!

a) Before operating any pumps and valves always double-check that the chemicals are actually in the same tank as it is indicated at the screen!

The ATOTECH labels of the function units in the VCS flow diagram, in the P&I diagram and at the Atotech line must be identical to avoid mistakes.

6.3.16.7 Visualization of the medium transfer

The cleaning program stores in which tank which medium is filled.

Example:

Is a solution pumped from the module to the holding tank, the software stores internal that the holding tank is now filled with solution. With starting the medium transfer a ”control flag“ is set. This flag is reset if the level switch in the holding tank is in the lower normal position and the lag time oft the transfer pump has passed.

The visualization of the medium transfer is active in all of the three operating modes:

- Automatic cleaning
- Manual cleaning (manual selection of steps)
- Maintenance cleaning (pass word protected; not for regular cleaning mode authorized)

For example, if a filled tank is drained off using the stop valve by hand with a separate barrel pump or something similar the control flag remains set. This means that according to the software the tank is still filled!

a) Therefore do not start the cleaning program before the tank is refilled (again by hand)!

This situation would create an error by starting the cleaning program.

a) Therefore never drain off the tanks uncontrolled but only using the cleaning program.

Only the cleaning program “Automatic or Manual Cleaning” controls the sequences of steps and prevents with a visualization of the medium transfer a overflow or an operating error.

	NOTICE
	Uncontrolled drained off tanks If one ore more tanks were drained off uncontrolled and the stored actual visualization does not match with the reality, the visualization needs an adjustment. In this case contact a specialist from ATOTECH to adjust the control flags! Without the adjustments the cleaning program is not working properly.

6.3.16.8 Explanation of the displayed layout in the VCS cleaning program

- Selected operating mode in the cleaning program.
  - “Automatic mode”,
  - “Manual mode”,
  - “Maintenance mode”
- Actual cleaning step with displayed number of the step.
- Pass time in seconds.
  - Cleaning time,
  - rinse time,
  - waiting time (reaction time)
- Position of the valves.
  - blue: valve is open;
  - white: valve is locked
- Operating mode of pumps.
  - lighted symbol in light blue: pump is active
  - lighted symbol in gray: pump is not active
- Display of actual flow direction of every cleaning step.
  - blue lighted pipeline: active step
- Information and fault messages.
  - Cleaning program was interrupted (motor safety switch activated,...)
  - This medium transfer is not allowed.
  - Temperature for medium transfer too high or too low.
  - Tank is full.

– Level (min. or max.) of holding or cleaning tank reached.

6.3.16.9 Required input conditions in single steps

The required signal inputs for the control system are:

- Tank empty:
  The digital level switch is in the bottom position and the delay time of the pump has passed.
- Filling a module via solenoid valve or by pump activation:
  This is a level controlled action. The next step is only activated after the set level is reached. This leads to a closing of the valve or the stop of the transfer pump.
- Module empty:
  The level sensor is in the bottom position and the delay time of the transfer pump has passed.
- Transfer from tank to module:
  The pump stops if the level in the module is reached or if the tank is empty.The respective signals are delivered by the level sensor in the target module or the tank (level minimum plus time delay).

6.3.16.10 Safety locks of the VCS

The index criteria in the VCS for the next cleaning step concerning the emptying of the tank or by medium transfer are:

- The level sensor of the tank which should be emptied has to be in the lower stop position and the lag time has passed.

	INFORMATION
i	Are these conditions not fulfilled the cleaning program stops!

- Overfill protection:
  Is the overfill limit (level alarm maximum) during filling reached, the transfer pump will stop and the cleaning program will be set in alarm mode.
- Low level protection:
  Is the level minimum during the medium transfer for example from cleaner to module reached, the pump and the cleaning program will stop.

6.3.16.11 Adjustment of the cleaner and rinse water level in the module

Cleaner level:

The cleaner level has to be 5 to 10 mm over the neutral level of the module.

Reason: Dissolving of incrustations on the inner side of the module.

Rinse water level:

The level of the rinse water has to be about 5 to 10 mm over the cleaner level.

Reason: Complete removal of cleaner residuals from the inner side of the module.

Example:

- Actual level in the module: 300 mm (Floodbar pumps OFF)
- Set level of the cleaner: 310 mm
- Set level of the rinse water: 320 mm

6.3.17 Damages by chemical overconcentration

6.3.17.1 Prevention of damages caused by chemical overconcentration

All materials which are used in the individual process modules have been tested and are resistant against the chemical solution mixtures within the prescribed concentration ranges.

NOTICE

Serious equipment damages and reduced lifespan of equipment parts!

a) Do not add any chemical solutions, if you are not sure about the maximal permitted quantities! In case of any doubt please contact the responsible Process Engineer or the local Atotech support.

b) Do not exceed the concentrations listed in the Process Manual.

The table below shows the maximal permitted concentrations per liter of standard cleaning solution made up and mixed in an external tank. For any other solution concentrations please refer to the acc. BTT Process Manual.

Etch Cleaner Securiganth HS Make-Up per liter	Volume [ml]	Density [g/cm³]
DI water	960	---
Sulfuric acid 50 % w/w	25	1,40
Hydrogen peroxide 35% w/w	15	1,13

Permitted concentrations for standard cleaning solution

Chemical overconcentrations attack or dissolve materials or make them porous.

Especially solutions which contain sulfuric acid must not exceed the permitted limits as this can lead at higher concentrations to partial dissolving and weakening of the materials. That will lead easily to leakages, an early wear-out of parts, massive corrosion or total failures.

Examples:

1. “PVX”, which is used as bearing material in Sweller, Permanganate and Adhesion Promoter will be dissolved and weakened by overconcentration. Early wear-out will be the consequence.
2. Sealing materials like EPDM will also be attacked by chemical overconcentrations. Leakages, damages by corrosion and sensor failures will be the consequences.

NOTICE

Danger of Overconcentration

a) Do not pour any chemical solution or cleaning solution component (especially high concentrated sulphuric acids) from a canister directly into the modules over drive parts, gear wheels bevel gears or bearing bushes.

⇨ Parts of the equipment will be attacked, dissolved, weakened or softened. Serious equipment damages!

NOTICE

Danger of panel jams, break-down of bevel gears, jerky run of drives and serious damage

a) Do not operate the line with worn out bearing bushes or if the wear-out limit is undercut.

⇨ Otherwise panel jams between rinses and active modules will occur.

⇨ Bevel gears will run out of the center point and break down.

⇨ Increased driving forces will cause jerky run of drives.

6.3.17.2 Make-up of cleaning solution

➢ Make-up of the cleaning solution in an external make-up tank.

a) Transfer the DI-water into the tank.

b) Circulate the DI-water to prevent local overconcentration.

c) Transfer the chemical solutions one-by-one.

d) Circulate the solution during filling-in the chemicals in the tank.
e) Transfer the cleaning solution into the according module.
f) Circulate the solution during transfer to prevent local overconcentrations.

	INFORMATION
i	**Maximal permitted quantities of chemicals used for stripper/cleaning solutions** The permitted quantity of chemical solution per liter find in the Process Manual of BTT. a) Calculate the correct quantity of chemicals you have to add in dependence on the module volume (the module specific tank volumes please see in legend of P&I Diagram, part of the Documentation).

g) Rinse the module, pump circuit, pipework and all equipment parts well with DI water after cleaning with cleaning solution.

	NOTICE
!	**Equipment damages** a) Do not leave-out any rinsing step by DI-water

	PROHIBITION
	Shortening of rinsing times It is not permitted to shorten the rinsing times in automatic cleaning programs.

6.3.18 DI water spray pipes in Handling modules (wetting)

For surface wetting of the PCBs, a DI water spray is employed (see also P&I diagram).

Commissioning:

a) The overall flow quantity of DI water can be set by a manually adjustable valve.

b) The actual flow quantity must be within range and is monitored by two flow switches (S36.1 and S36.2). In the commissioning phase, the adequate range of flow quantity must be set (maximum and minimum limit).

c) Furthermore, the spray intensity (from top and from below) can be set by two manually adjustable valves. The spray intensity from top and from below must be balanced (equal impact on the surfaces of the PCB) to avoid panel jam in case that jobs with thin foils are processed.

Inspection and maintenance:

If the panels are not equally wetted across the whole width, check the holes in the spray pipe (top side).

6.4 Seleo CP

6.4.1 Polyconduct module

In the Polyconduct module the boards are coated with an electrically conductive organic layer.

6.4.2 Cooling of the Polyconduct module

The Polyconduct module is equipped with an external cooling unit. A circulation pump (M02.1) is pumping the solution from the module tank to the external cooling unit and from there via a three cartridges filter back into the module. The external cooling unit has connection with the cooling water supply of the customer.

INFORMATION

External cooling unit

For supply requirements see technical data of the line. See also the OEM cooler documentation.

6.4.3 Operating instructions - specific for the Seleo CP line

NOTICE

Adhesion Promoter

The automatic cleaning program must be carried out at least every second week.

It must be also performed prior to a plant standstill of a few hours, for example if the worn out bearing inserts must be replaced. The solution is then kept in the holding tank!

a) Consult the process engineer or the regional Atotech office, if advice is required.

⇨ If the running of the cleaning program is delayed, the wear of the gears in the drive system is getting too strong!

	WARNING
	Evaporation of Thiophene from the Polyconduct module Thiophene gases generated in Polyconduct module must be sucked reliably and continuously! A flow sensor installed in the exhaust line checks whether exhaust performance is sufficient or not. Glass covers of the module must be kept closed! Without proper function of the exhaust system, operation of the Seleo CP line is not permitted! In case of a failure of the exhaust system, production is not permitted. Otherwise there is the danger of evaporation of Thiophene gases.

	INFORMATION
	The proper function of the exhaust system of line must be observed and checked.

See also

Exhaust system [→ 54]

6.4.4 Dosing in the Rinse module before the Polyconduct module

The Rinse protects the bath from drag-in of contaminations and keeps the pH-value stable.

Water addition and replenishment of pH corrective solution take place by different logical principles.

Water addition

Contrary to other rinse modules, the water is not continuously running during production. A valve opens and closes in intervals. In a way, the water is ‘dosed’, however not by a dosing pump but by a water valve.

Reference volume of water:

The volume of water added: V_{REF} = flow rate of water * time of valve being open.
Theoretical example: V_{REF} = 60l/h * 30 sec = 0.5 liter.

This volume is also the definition of the so-called ‘reference volume’.

The flow rate must be calibrated. Please note: Any change of water pressure is an influencing factor on the flow rate.

Consumption and replenishment:

The required fresh water for replenishment depends on

- average width of PCB at inlet sensor of the line
- speed of job
- area dosing equivalent for water replenishment
- time of production

With these four factors the control PC calculates (integrates) a mathematically accumulating volume which represents the ‘consumed’ water (= volume which needs to be replenished).

Automatic opening and closing of the water valve:

The water valve will open when the mathematically accumulated volume is becoming bigger than the reference volume (see definition above).

The valve will close after the set time (PLC block parameter). The flow rate (as entered in VCS) and this set time define the reference volume, which is added per flow cycle.

The mathematical volume integration is tooth-shaped over time. The volume to be replenished increases when PCBs enter the line, it decreases when the output signal for the valve is ‘ON’.

Related topics:

Latest dosing component data sheets of the Atotech BTT-PTH team

6.5 Rinses

Functions of the rinse module:

- removes chemicals from the surface of the PCBs
- prevents the transfer of chemicals in the next module
- stops the chemical process of the previous module

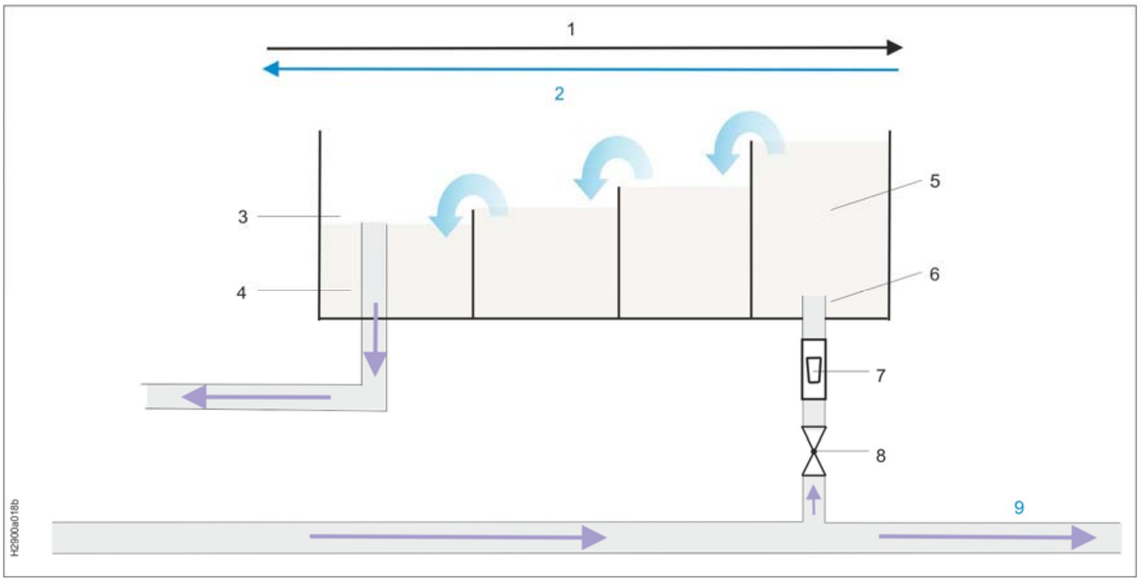
6.5.1 Water flow and parts of the pump circuit

Principle:

There are two circuits in the rinse module which will be briefly described.

1. Water inlet and overflow

The rinse module consists of several chambers which are divided by walls at different height (see schematic).



Schematic for a 4-cascade Rinse

1	Panel transport direction	6	Inlet
2	Water flow direction	7	Flow meter
3	First chamber	8	Magnetic valve
4	Overflow pipe	9	Next rinse module
5	Last chamber		

A magnetic valve mounted in the inlet pipe is automatically opened when the first panel of a job approaches the rinse in a specified distance. This magnetic valve controls the water inlet for the rinse module.

The water flows through the flow meter. The operator can read the flow rate, the PC detects minimum or maximum flow rate.

When the last chamber is filled the water flows over to the previous chamber. The direction of water flow is opposite to the conveyor direction. This process continues to the first cabinet. The water is drained off trough the overflow pipe.

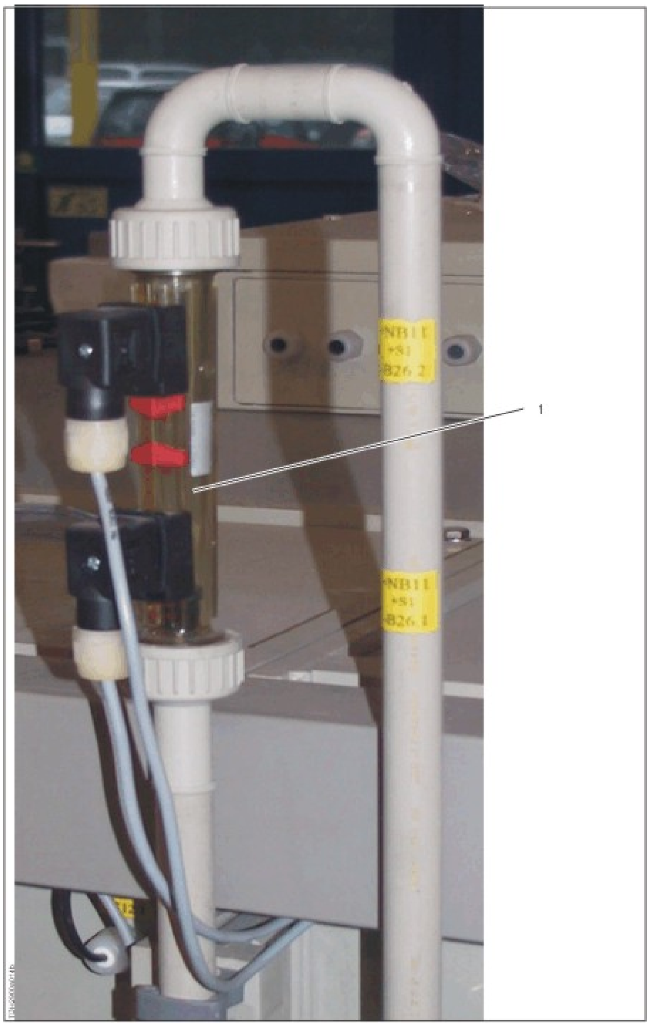
2. Parts of the pump circuit

- From the pump
- To the strainer or filter
- To the Floodbars and spray nozzles
- To the PCBs
- Into the chambers
- Through the sieve
- Back to the pump

6.5.2 Components

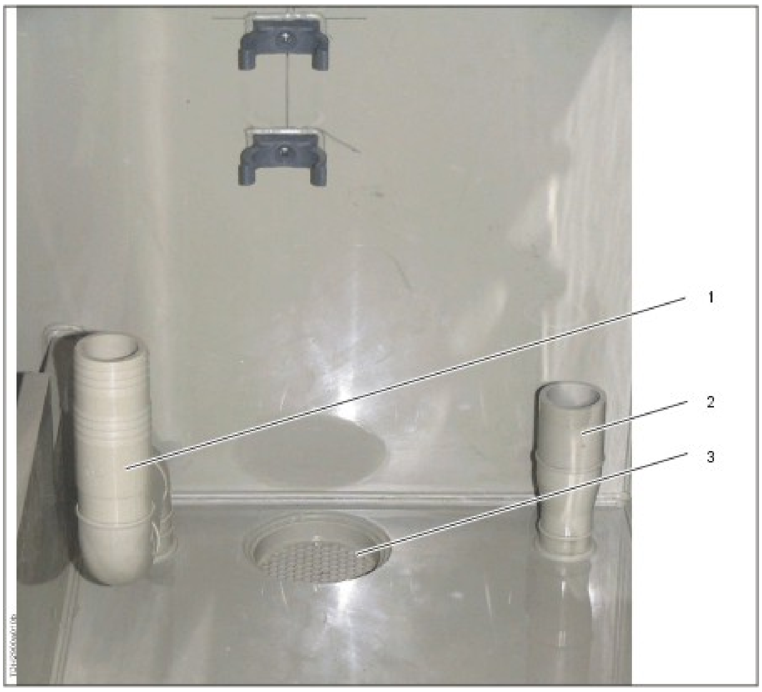
Cover switch actuates an alarm when the magnetical effect is interrupted

1	Cover switch



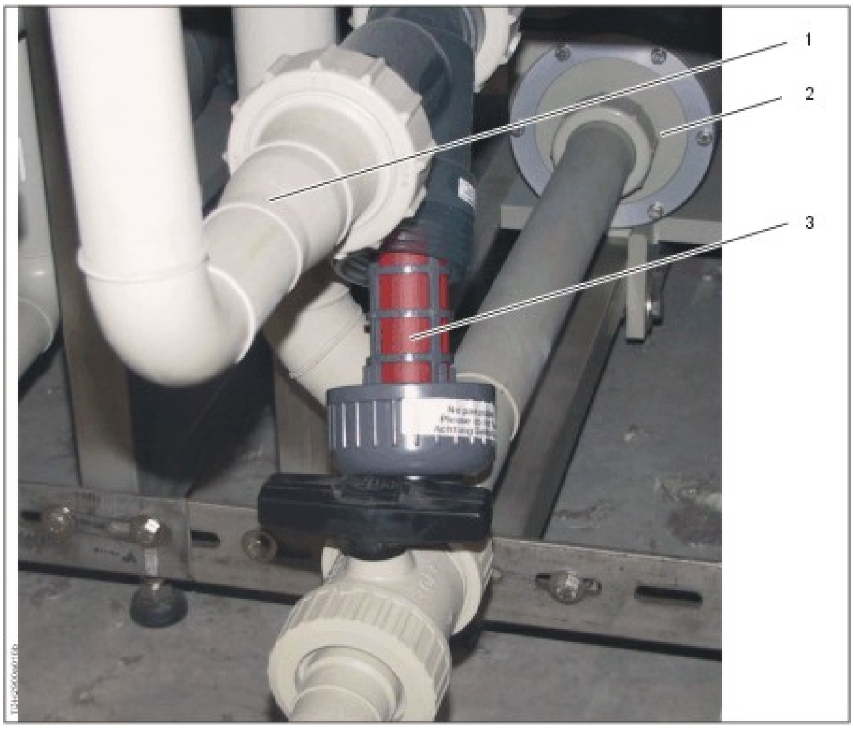
Flow meter monitors flow rate

1	Flowmeter



Sight in a chamber of the rinse module

1	Pipework at the pressure side of the pump	3	Sieve at the suction side of the pump
2	Overflow pipe		



Strainer filters the water

1	Pipework	3	Strainer
2	Pump		

6.5.3 Digital flow quantity monitoring

The flow of DI water to all the rinse modules is monitored by means of a flow meter. (supplier GEMUE, Plastic Flowmeter with limit switches).

Principle: The cone-shaped float element can move freely in the metering tube. It is lifted by the running water and indicates the actual flow quantity visually (transparent metering tube).

Monitoring the actual flow quantity: The minimum and maximum limit sensor can be shifted up and down at the metering tube for adjustment. The adjustment is relevant for the detection of the flow quantity (being too low or too strong) and for the automatic fault message generation by the computer.

Setting the manual valve: The manually controlled valve in line with the flow meter is used to set the water flow quantity for the rinse module.

Flowmeter

1	Flowmeter

6.5.4 Monitoring of the cover position, flow quantity and pump pressure

- Cover switch:
  The Opened/Closed position of the cover switches is monitored by a cover switch.
  If the cover is opened when the pumps are running, the control PC would react automatically and switch off the pumps.
  This protects operators and prevents chemicals splashing over.
- Flow meter:
  The cone-shaped float element can move freely in the metering tube. It is lifted by the running water and indicates the actual flow quantity visually (through the transparent metering tube).
  The flow meter actuates an alarm signal at the control PC, when the water supply is too high or too low, for example if a manual valve is not adjusted correctly.
- Pressure switch:
  The pumps installed under the rinse module are protected against running without liquid by a pressure minimum switch.
  Indirectly this pressure switch serves also to detect an insufficient flow quantity for fluid elements and spray nozzles.
  The disc-shaped pressure switch is mounted in the pipe-work directly at the pressure side of the pump. Under regular working conditions it delivers an 'On' signal to the bus system.

See also

🗎 Pressure switch (at filter unit) [→ 66]

🗎 Pressure switch at pumps [→ 67]

🗎 020184 Check cover switches [→ 302]

6.5.5 Maintenance

See also

🗎 020010 Check the pressure indication at the filter units [→ 289]

6.5.6 Further sources

For more information you may also relate to:

- Electronic parts catalog
- Electric wiring diagram
- Process control window in VCS

6.5.7 Level minimum switches in Rinse modules with heating system

The two types of level minimum switches S24.# and S20.#

In Rinse cascades employed with heating elements (so-called 'Hot Rinse Modules'), there are two different types of level minimum switches installed, labeled by the acronyms S24.# and S20.#. Both types of level switches serve to protect the equipment against over-temperature.

By the combination of the two level switches in one cascade, equipment safety is enhanced (even beyond the common safety regulations). This way the risk is prevented, that the heating system is (or remains) switched on while it is not immersed in water (which could cause excessive temperatures or even fire).

Though the main purpose is preliminary the same for S24.# and S20.#, the adjustment and the logic attached to the two types of level minimum switches is different.

Level minimum switch S24.#:

Purpose: Safety protection for switching off the heating system of the whole Rinse module, not just by software but **also by hardware**.

- The S24.n has two switching contacts (one for hardware switch off, the other one as digital input for software control)
- Software logic and test: The S24.n must switch off all the heating elements in the module (the pumps must continue running, if the float ring is pressed down).
- The level switch has a fixed length, a fixed mounting height (i.e. height adjustment is not possible and not necessary) and a fixed height of switching. For spare part ordering, the ID number must be correct (module specific).
- Commissioners must make sure, (a) that the switch-point is not too low. The switch height must be at least 15 mm above the highest point of the highest heating element. (risk of equipment damage by over-heat, if ignored !).
  Secondly (b) they ensure, that the switch-point is not too high: For process safety, the switch-point height must be at least 15 mm below the overflow level to the next cascade.
  If, by mistake, the switching occurs either too low (a) or too high (b), it must be reported back to the ATOTECH mechanical engineering department.
- Logic in case of fault during production: If, in case of a fault, the S24.n switches off the heating system, a running job can be finished, even if the temperature is getting less; This means that the control PC stops the Loader (not the drive).
  Note: Since the pumps are not stopped, a drag-out of chemistry into the next active module after the Rinse does not occur.

Level minimum switch S20.n:

Purpose: Equipment protection **by software in the respective cascade**

- Contrary to the S24.n, the S20.n has just one switching contact (delivering a digital input signal for software control).
- Software logic and test: The S20.n must switch off just the heating elements in the respective cascade of the Rinse module. Again the pumps continue running, if the float ring is pressed down.
- Height adjustment of this type of level switch is possible and must be executed when the line is commissioned.
- Commissioners must adjust the switching height such a way, that the switching occurs about 15 mm (12 to 20 mm) above the highest point of the highest heating element in the cascade.
- Logic in case of a fault during production: A running job can be finished, even if the temperature in this one cascade is getting less (i.e. automatic Loader stop and no drive stop).

Protection of pumps by their respective flow minimum switches:

- In Rinse modules, neither the S20.n nor the S24.n is supposed to switch off pumps. As generally in all the Rinse modules, the pumps are protected by their respective flow switches (or pressure switches).
- If one out of three pumps in the three Rinse cascades is switched off or fails due to flow minimum, just the Loader is stopped (i.e. not the drive of the line, the panels continue moving).
- If all the pumps of a Rinse module fail simultaneously, the drive must be stopped. This way drag-out of chemistry into the next active module is prevented. However this case is practically rather unlikely.

Related documentation:

- Electrical wiring diagram of the respective Rinse module
- P&I diagram
- VCS-H fault messages (on-line information for operators)

6.6 Gap Adjustment with a Cross Drive CGA

6.6.1 Purpose and functions of the CGA

The Center Gap Adjuster (CGA) fulfills the following main tasks:

- Lateral alignment of Printed Circuit Boards (clamp side edge alignment of the PCBs in relation to clamp contacts)
- Adjustment of close distance between two subsequent panels (by default 10 +/- mm) for a maximum PCB throughput.

There are also other functions attached to the light and panel tracking sensors in the CGA:

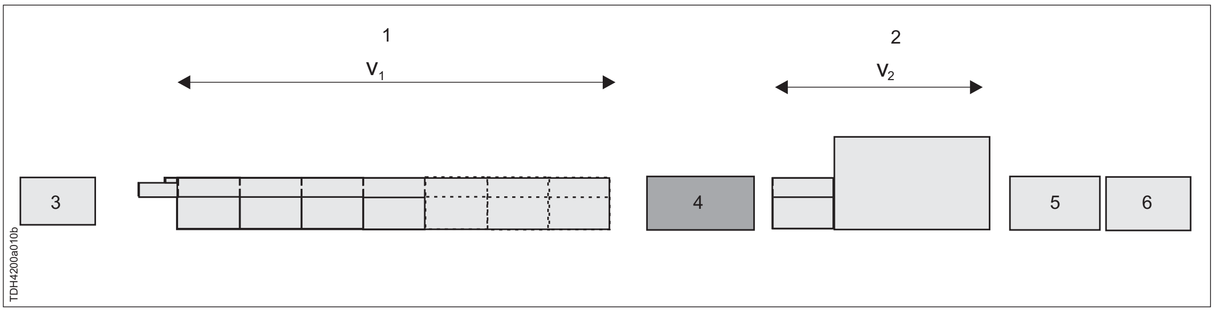
- Signal delivery for the automatic control of function in the Plater, like control of anode currents
- Panel tracking: Comparison of actual panel positions with fictional panel position and detection of missing panels
- Measurement of the actual length of each PCB.

6.6.2 Speed ratio of sub-lines and size of gaps between adjacent PCBs

The gap between two adjacent PCBs in the Plater module is set to 10 mm by default.

In the modules of the pretreatment sub-line, the gap between two PCBs is always bigger than in the Plater. This prevents overlapping of panels and panel crash.

A larger gap is achieved by running sub-lines with different speed set-points.



Schematic of two sub-lines with speed ratio v1 > v2

1	Pretreatment line	4	Gap Adjustment
2	Plater	5	Output
3	Loader	6	Unload

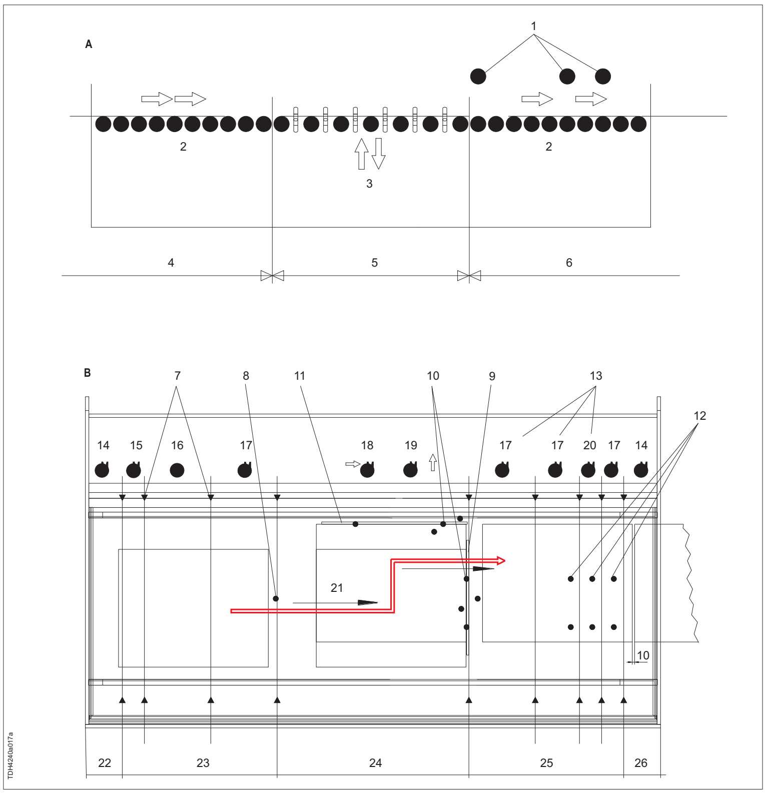
- Drive speed ratio to be maintained:
  $v_1 > v_2$ (whereby v_2 at least 5% smaller than v_1)
- The distance D_1 between the two leading edges of adjacent PCBs (determined by two sequential lay-down signals from the control PC to the Loader) is calculated by the formula:
  $D_1 = D_2 * (v_1/v_2)$, whereby distance D_2 = board length L_{PCB} of actual job + gapG_2
- The gap G_1 in the pretreatment line is then: $G_1 = D_1 - L_{PCB}$

	NOTICE
!	**Different speed set points of several platers in series** Overlapping of panels, panel crash and defective platers! ➢ The speed set points v2 for the several platers in a line are different. a) Set the speed v2 equal for each plater of the line.

6.6.3 The ATOTECH Cross Drive CGA

This type of CGA can be divided in 3 sections with 3 main functions:

- Inlet section for PCB acceleration
- Middle section for the alignment of the PCB (clamp side alignment)
- Outlet section for gap adjustment (10 mm by default)



Side and Top view of the ATOTECH Cross Drive CGA

A	Side view	13	Drive motors (n individual DC motors, one for each drive partition plus two three-phase motors for the adjacent conveyor segments)
1	Liftable rollers	14	Conveyor Drive
2	Cylindrical transport rollers	15	Drive 1
3	Ball-type transport rollers forward/cross	16	Drive 2
4	Inlet section for acceleration	17	Drive …
5	Middle section for clamp side alignment	18	Drive 4a
6	Outlet section for gap adjustment	19	Drives 4b+4c
B	Top view	20	Drive n
7	Light barriers, installed between two drive partitions	21	Direction of transport
8	Laser sensor for ‚waiting', if a preceding PCB is still in the middle section of the CGA	22	Input
9	Center alignment sheet for pre-alignment of the arriving PCBs	23	Acceleration
10	Laser sensors for panel detection and two signal sensors for the response control of the pneumatic cylinder	24	Clamp side alignment
11	Side alignment sheet for the alignment of the PCBs in line with the row of clamps in the Plater module	25	Gap adjustment
12	Laser sensors for panel and gap detection (for gap adjustment)	26	Output

Sequence of operation

Inlet (or first) section:

1. As soon as the PCB is completely inside the first section of the CGA, it is accelerated to reach the middle section as quick as possible (to get time for the following adjustment procedure).
2. If there is still a preceding panel in the next CGA section, the panel behind is made to wait at the ‘waiting line’ (transition between first and second section).

Middle (or second) section:

1. The incoming PCB is accelerated and moved towards the center alignment sheet (mounted perpendicular to the transport direction) for the pre-alignment of the arriving PCB.
2. As soon as the PCB is detected, stopped and pre-aligned at this center alignment sheet, the cross-way roller system is lifted.
3. Driven by two parallel motors, the PCB moves on ball-type rollers perpendicular to the transport direction towards the clamp side alignment sheet.
4. At arrival, the clamp side edge of the PCB is aligned.
5. After the PCB is aligned, the cross-way drive system is lowered,
the two alignment sheets are lifted and
the PCB is conveyed by transport rollers in forward direction to the third section of the CGA.
6. As soon as the middle section is empty, the next PCB moves in.

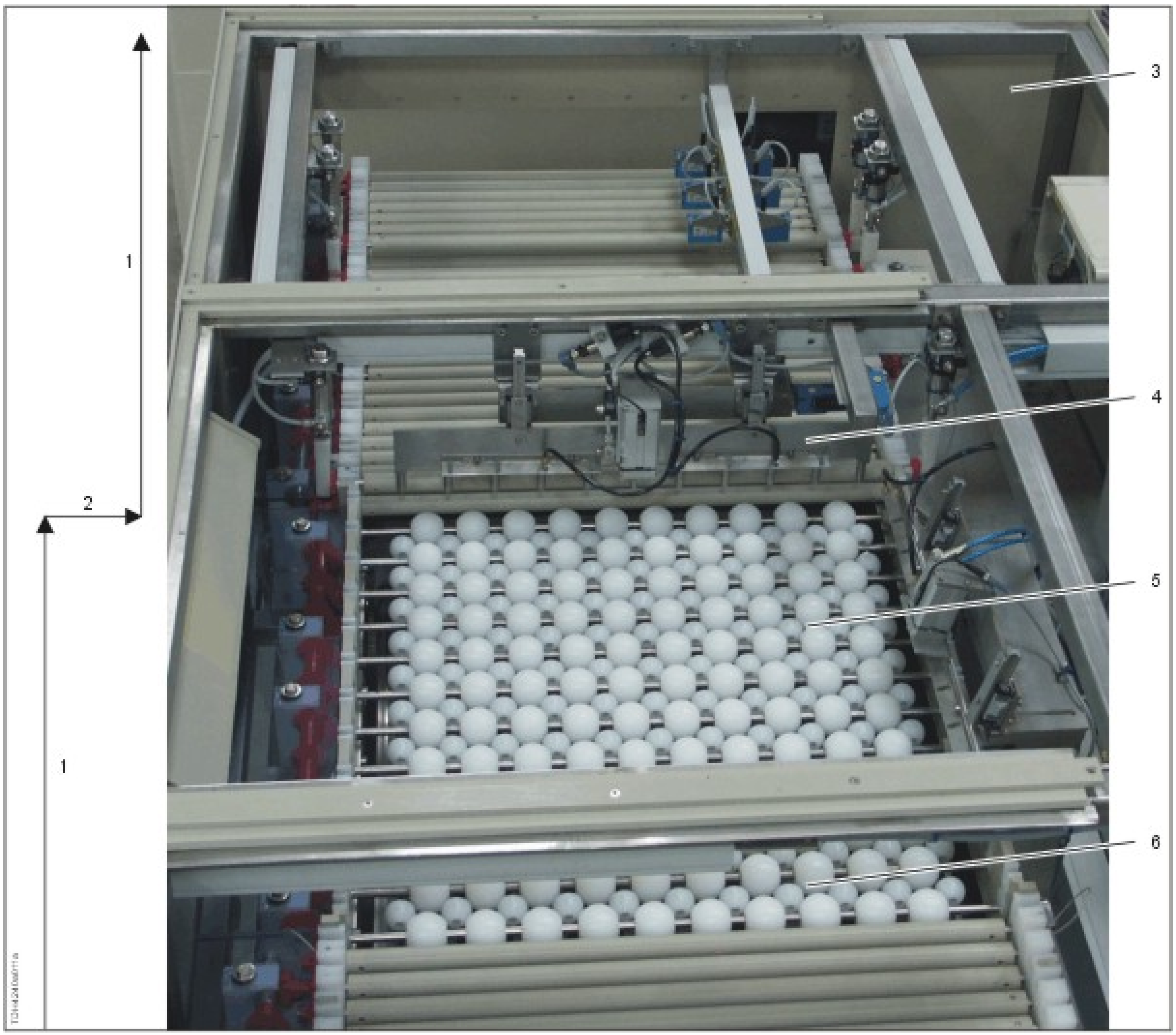
Third / Outlet section

1. In the third section the 10 mm gap between the PCBs is realized by making use of three pairs of laser sensors, that measure the distance between PCBs.
2. Depending on the measured gap, the drive motors of the individual drive partitions under the PCB are speeded up for a calculated time which is needed to shorten the gap to the set 10 mm. All this is automatically performed (by the application of the “Closed Loop Control Principle”).

6.6.4 Photos, main parts and sensors

This ATOTECH Center Gap Adjuster is manufactured since the year 2006. It is made to convey thinnest foils in accordance with the project specific line specifications. The main steps of panel movement are as follows:

1. Acceleration of incoming PCBs in the first section of this CGA
2. Leading edge and clamp side adjustment in the second section
3. Gap adjustment (of 10 mm by default) between PCBs in the outlet section

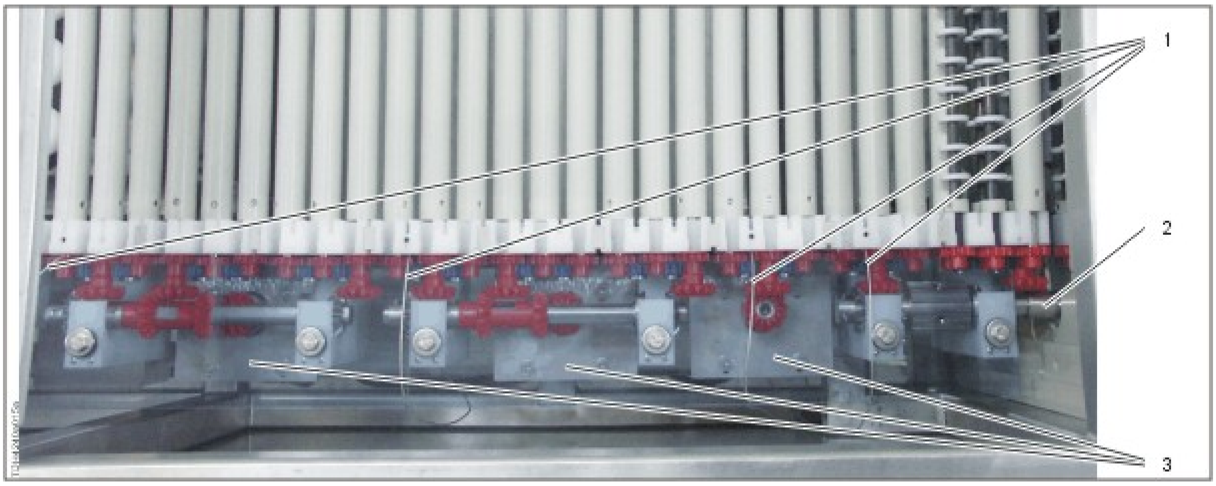


Center Gap Adjuster – Top view on second and third section

1	Forward	4	Front stop sheet for leading edge adjustment
2	Sideward	5	Second section with forward and sideward ball-type conveyor system
3	Outlet partition for the gap adjustment between two PCBs	6	Outlet side of the first section with roller conveyor system and light barriers

Center Gap Adjuster – Operation buttons, Leading edge stop, clamp side adjustment

1	Light sensor to slow down the sideward movement	5	Ball-type conveyor for forward transport to the leading-edge-adjustment-stop
2	Pair of sensors to stop the sideward movement	6	Ball-type conveyor for the sideward transport towards the clamp side
3	Clamp side edge stop sheet	7	Leading edge stop sheet
4	First stop light sensor (to make the PCB waiting till the preceding PCB moves out of this section)	8	Switches and push buttons for the control of the individual functions of the CGA



Center Gap Adjuster – First section: Acceleration and first stop

1	Four light barriers to detect the PCBs, their leading and trailing edges and the respective gaps	3	Several separately controlled conveyor partitions driven by DC motors
2	Drive axis of preceding drive segment drive by a three-phase motor and frequency inverter		

Altogether there are 10 drive partitions in forward direction. The speed adjustment of the individual motors is automatically calculated and executed.

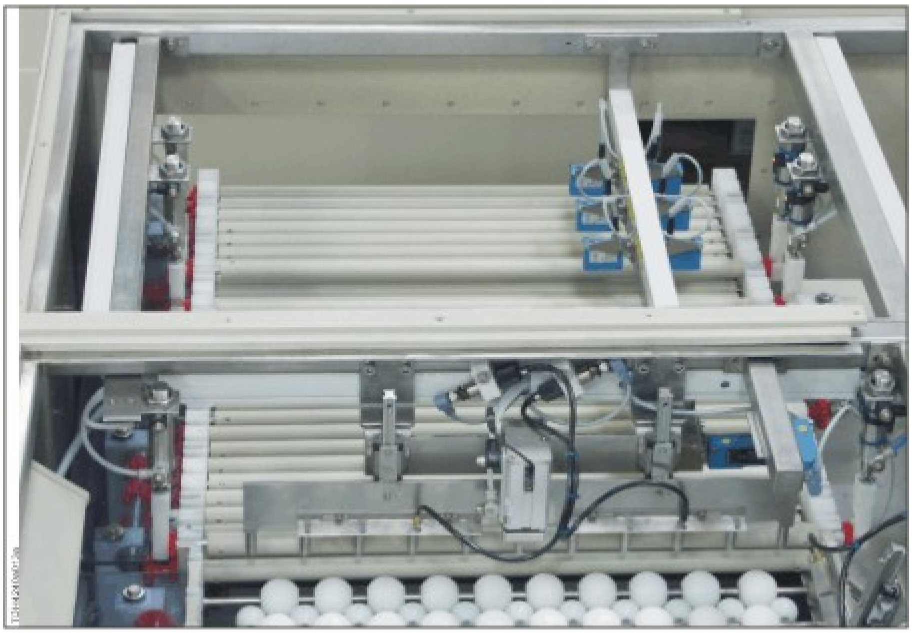
The first partition (which consists of two bearing inserts) is driven by the three-phase motor. This motor drives also the conveyor of the preceding modules.

Three DC supplied motors are installed in the first section of the CGA (for the acceleration and the stop for waiting).

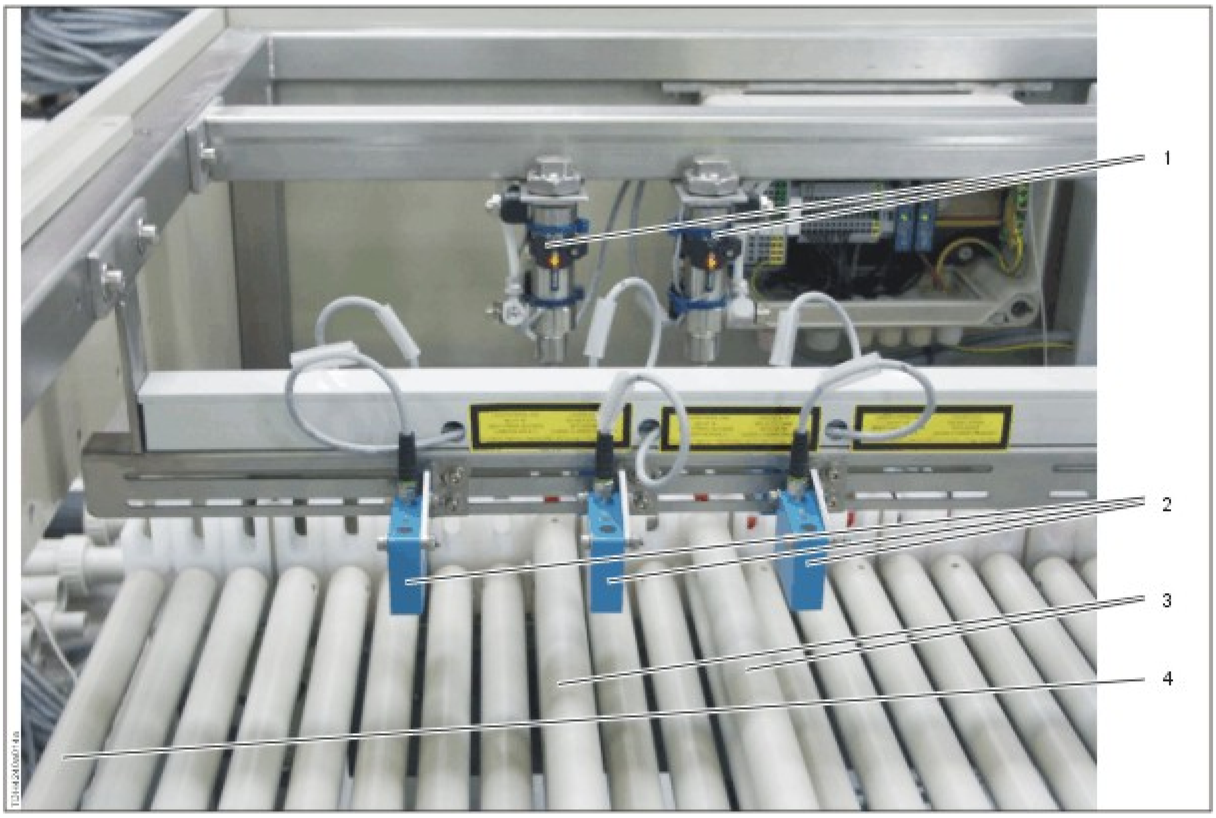
One DC supplied motor drives the ball-type conveyor in the second section of the CGA. Another DC motor in this section drives the ball-type conveyor of the cross drive unit.

Four further DC supplied motors drive the rollers in the last section of the CGA for gap adjustment.

The last motor is again a three-phase motor, which is controlled by a frequency inverter. This motor drives also the conveyor of the next module and to the Plater module.



Transition from second to third section of the CGA



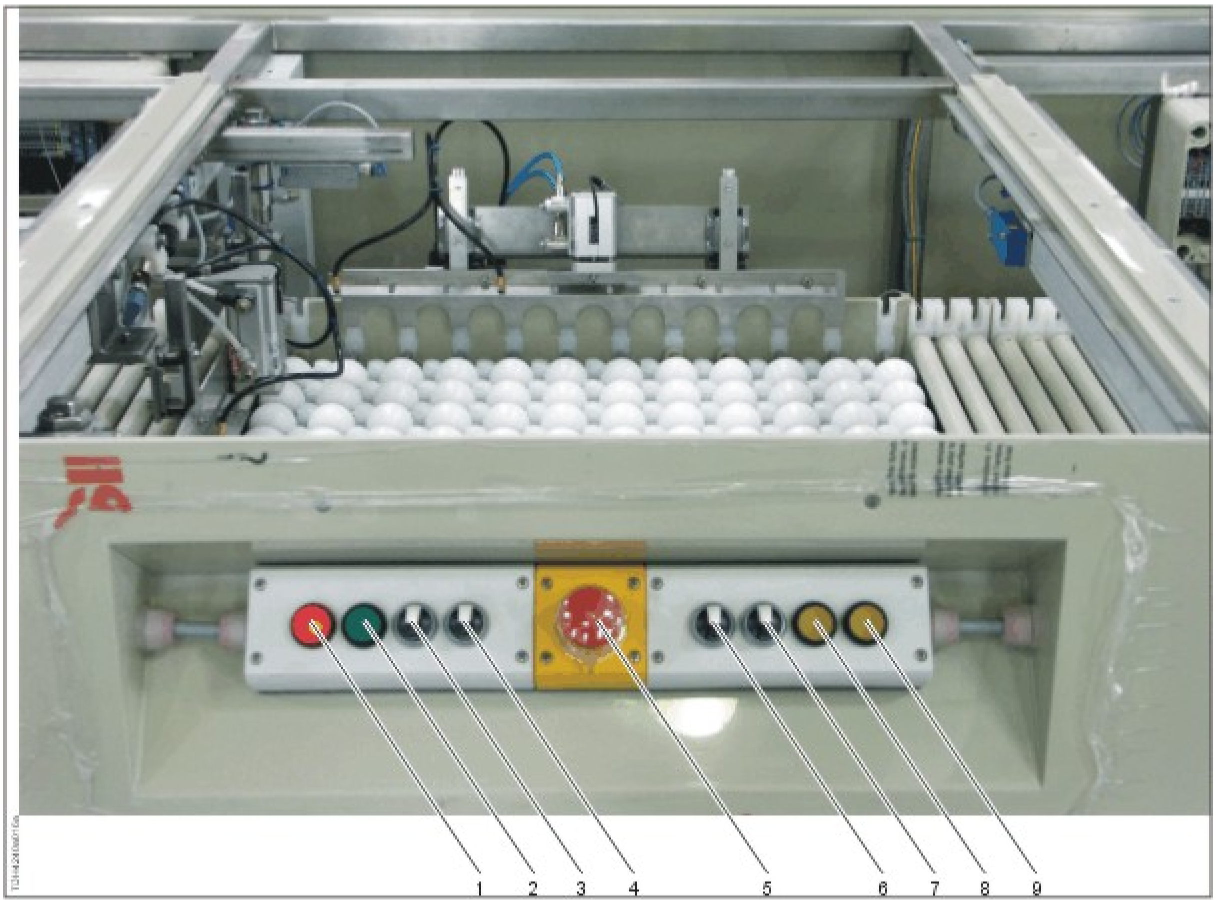
Gap adjustment in outlet section of the CGA

1	Pneumatic cylinders to lift the upper rollers	3	Upper rollers to be lifted if there is no panel
2	Three pairs of reflection-type sensors for the measurement of gaps between PCBs	4	Outlet side towards the Plater module

Three pairs of sensor are arranged in series to measure the gap between two PCBs. DC motors speed up the rear drive partitions to reduce the gap. The front drive partition conveys the PCBs to the Plater after the 10 mm gap is adjusted.

Upper rollers are lifted if there is a gap underneath. After the leading edge of a PCB is under a lifted upper roller, this roller will be automatically lowered. This function supports safe and reliable transport.

6.6.5 Control buttons and switches for operation



Center Gap Adjuster – Operation buttons and switches

1	Red illuminated button: For 'Off' and for 'Fault' indication	6	Clamp side stop sheet: Turn left to lift it; Turn clockwise to lower it.
2	Green button: 'On' / 'Mode' / 'Reset' Switch between 'Manual' and 'Automatic' mode of operation; State indication: Flashing and continues light respectively.	7	Front stop sheet: Turn left to lift it; Turn clockwise to lower it.
3	Cross drive unit: Turn left to lift it; Turn clockwise to lower it.	8	All forward drive motors: Press for 'On' or 'Off'.
4	Cross drive conveyor balls: Turn left for 'Forward'; Turn clockwise for 'Reverse'.	9	Upper rollers: Press for 'Up' or 'Down'.
5	Emergency button for the entire line Press in case of emergency, Lift and lock, before 'Reset'.		

1. Red button with illumination for fault indication:
   - Don't press during production!
   - If the red light is continuously lit and the green light is off, the CGA is entirely switched off.

- In manual Mode or Stand-by situation of the line:
  Push to switch off all the functions of the CGA, for example for safety reasons, when carrying out repair work.
- If the green button is illuminated and the red light is flashing , two categories of faults may be distinguished:
  a) Missing supplies, i.e. an electrical circuit breaker is tripped or no sufficient air pressure, etc.
  b) Over-time occurrences, like 'Panel too long' or response control of cylinders (i.e. any of the cylinders does not reach the expected position within the expected time).

2. Green push button with illumination for mode indication:
   - Don't press during production (while the green light is continuously lit)!
   - Push for switching ON the CGA, if the red light is continuously lit and the green light is off.
   - Push for 'RESET', if there is a fault (red light flashing). Press just once to see whether the indicated fault has gone. Don't press several times behind each other without observation of the lights in between.
   - Push for the change to the Automatic mode, if the green light is flashing!
   - Push for the change back to the Manual mode, if the green light is continuously lit!
   - If there is no fault indicated, you change to the other mode by pressing this button (Automatic to Manual and vice versa).
   - However it is not possible to switch to the Automatic mode, if any panel is in the CGA or if any of the light barriers or light sensors is activated, this way pretending a 'Panel-in-the-CGA' situation.
   - All cylinders go automatically in their home position, if the mode is changed from 'Manual' to 'Automatic'.

a) If the CGA is in manual mode and you want to continue with production, first remove all the PCBs inside the CGA. Just afterwards you may switch to the automatic mode (by pressing the flashing green button) to resume production.

1. Three position switch to lift / lower the cross drive unit in manual mode:
   - In manual mode (green light flashing):
     Turn this switch left side to lift the cross drive unit and turn it clockwise to lower it.
   - No digital input signal in the center position
   - If the green light is continuously lit, there will be no reaction, if the switch is turned any side (software interlocking).
2. Three position switch to start the cross drive (rotation of the small conveyor balls) in manual mode:
   - Turn left for 'Forward' movement towards the clamp side.
   - Turn clockwise for 'Reverse' movement.
   - In Automatic mode (continuous green light status): The activation of this switch leads to no reaction in this case (software interlocking).

3. Emergency button for the entire line
   - Press in case of emergency to stop all outputs (drive motors, pumps heating, etc.)!
   - To resume production, lift and turn (lock) this button, before software 'Reset'.
4. Three position switch to lift / lower the clamp side stop sheet (just in manual mode):
   - In manual mode (green light flashing):
     To lift the clamp side stop sheet, turn this switch left side. Turn it clockwise to lower the stop sheet.
   - If the green light is continuously lit, there will be no reaction, if the switch is turned (software interlocking).
   - There is no digital input signal in the center position of the switch.
5. Three position switch to lift / lower front side stop sheet the in manual mode:
   - In manual mode (green light flashing):
     To lift the front side stop sheet, turn this switch left side. Turn it clockwise to lower the stop sheet.
   - If the green light is continuously lit, there will be no reaction, if this switch is turned (software interlocking).
   - There is no digital input signal in the center position of the switch.
6. Yellow push button for all the forward drive motors:
   - Push this button to switch On / Off all the 8 DC motors for the forward movement. (The three-phase motors and the cross drive motor are not activated by this button).
   - The yellow light indicates the On / Off status of the DC motors.
   - If the green light (second button) is continuously lit there will be no reaction, if this button is pressed (software interlocking).
7. Yellow push button for the three upper rollers:
   - Push this button to activate all the 6 cylinders (3 pairs) to lift / to lower the 3 upper rollers.
   - The yellow light indicates the Up / Down status.
   - If the green light (second button) is continuously lit, there will be no reaction, if this button is pressed (software interlocking).

6.6.6 Inspection and Maintenance

U1: Daily: In normal conditions no additional down time necessary!

- Check sensors of transport system and clean if necessary.
- Check function of CGA by observation during run.

U2: Weekly: CGA together with plater maintenance

- Full functional check and cleaning the CGA
- General Module / Device inspection and examination CGA

U3: Monthly: CGA together with plater maintenance

- General cleaning and functional test of CGA.
- Replacement of wearing parts in case of need.

6.7 Plater

See also

- The importance of good electric connections [→ 62]
- InPulse Cu Modules and breaks of production [→ 37]
- 043060 Rinse Inert Anode Segments and Plater Parts with DI water [→ 323]

6.7.1 Standard functions and components

6.7.1.1 Exhaust system in the Plater

This topic is in close conjunction with the general description of the exhaust system in horizontal Atotech lines.

Here we specify

- the exhaust volume of the Plater
- the velocity of air flow in the exhaust pipes and
- relate to maintenance tasks that are essential for the proper ventilation in the Plater.

Exhaust volumes:

The exhaust volume of one Plater amounts to approx. 500 m^3/h x 2 pipes = 1000 m^3/h.
This value is used for the power rating of a complete exhaust system in horizontal Atotech lines.
(For the sake of comparison we mention also a few values for other modules):
Approx. 200 m^3/h for each exhaust pipe of the drier modules and about 100, 50 or 20 m^3/h for active modules depending on the module size, the operating temperature and the installed orifice discs).

Velocity of air flow in the two exhaust pipes of the Plater:

R3/4" apertures have been provided in the exhaust pipes, allowing a vane meter to be fixed. The rotational speed of the vane meter is directly proportional to the flow quantity.

Atotech commissioning personnel measure the velocity of the exhaust air and record the values together with the diameter of the exhaust pipe.
Adjustments made by Atotech's commissioning personnel (for example the use of orifices) must not be changed.

The rated values are as follows:

Approximately 8m/s velocity of air flow
in an exhaust pipe of 160mm diameter
corresponds with a flow quantity of 500 m³/h.

Maintenance tasks

a) Inspection and cleaning of slots in the exhaust duct
b) Cleaning the entire exhaust duct
c) Checking the exhaust system of the line

These maintenance tasks are very essential for the proper ventilation of Plater.
If the duct and its slots are not free of sediments the exhaust system is blocked. Vapor could escape into the room. Various malfunctions of the Plater can occur.

See also

- Exhaust system [→ 54]
- 060020 Check for proper function of exhaust system [→ 329]
- 060021 Check function of exhaust system visually [→ 330]

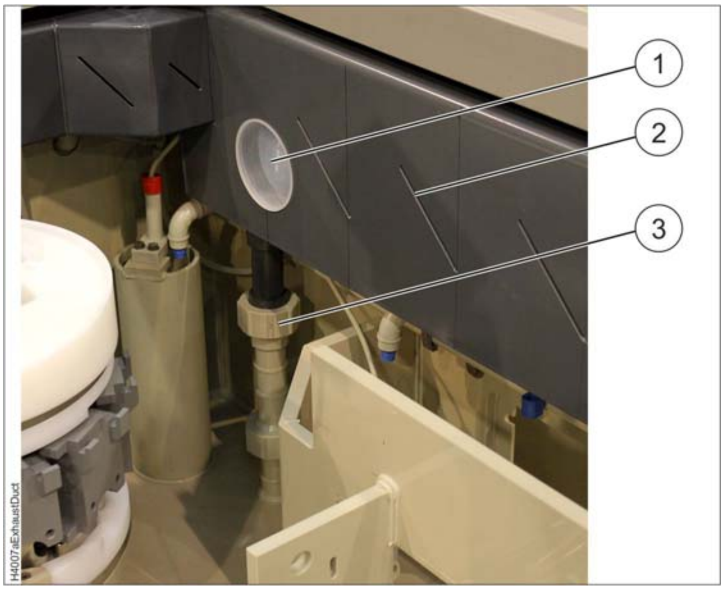
6.7.1.1.1 Cleaning the exhaust duct of the Plater

The plater is equipped with an exhaust duct going around the upper edge of the module. The exhaust duct is sloped in direction to the drain pipes of the duct. The drain pipes are located on both ends of the plater and locked by manual ball valves. These valves are opened for cleaning the duct from deposits. Between the air extraction slots sealable circular openings are aligned regularly on the duct serving as inlets for water rinsing hoses.

With the exhaust air sucked in condensate may crystallize and lead to depositions. So the function of the exhaust duct has to be checked regularly. The deposits of crystallized condensate have to be removed weekly by means of a sponge and DI - water.

	NOTICE
	Risk of damaging the product! Damaged panels! ➢ With crystallized condensate deposits contaminated process solution a) Never flush the duct with a DI-water gun!

In addition to the sealable circular openings aligned in regular intervals on the duct surface extra-big sealable openings above the duct drain pipes serve for cleaning purposes. When the production is stopped and the line is switched into manual mode, the Plater duct has to be cleaned from deposits at least every three months. The ball valve in the drain pipe is opened manually and the duct is rinsed with DI - water by putting a hose into one of the openings in order to remove the deposits drawn into the duct. The extra-big openings above the drain pipes serve as openings for taking out deposits manually to avoid blocking of the pipe and to observe reliable draining.



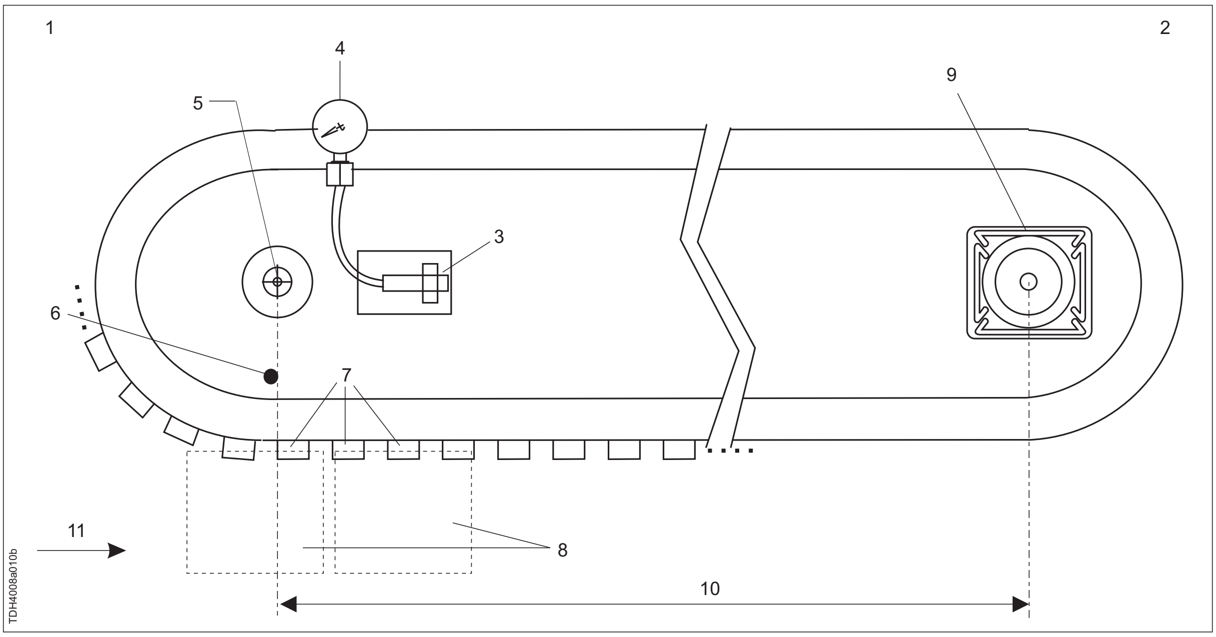
Exhaust duct with [1] circular sealable opening, [2] air extraction slots and [3] drain pipe

6.7.1.2 Clamp drive

See also

🗎 030090 Check clamp drive belt (belt tension and wear) [→ 311]

6.7.1.2.1 Clamp drive system and tensile force at the belt



Schematic representation of the clamp drive

1	Input side: Indication and adjustment of the belt tension	7	Clamps
2	Output side - Drive motor	8	Boards
3	Belt tension adjustment	9	Clamp drive motor and torque monitoring
4	Force gauge	10	Nominal distance between axes
5	Bolt with internal to thread	11	Transport direction
6	Air blowing to open clamps (optional)		

Indication and adjustment of the belt tension:

At the inlet side of the Plater module, the belt tension is measured by a force gauge.

NOTICE

Wrong belt tension

The belt tension must be checked regularly because it is important for maintaining the smooth running of the clamps and for the reliable transition of PCBs from the rollers to the clamps.

The tensile force can be seen at the inlet side of the Plater by having a look to the force indicator. The pointer must be in the green range. The belt tension must be kept as follows:

Bottom limit	Regular range under operation	Upper limit
2.5 kN	3.0 to 5.5 kN (green range)	6.0 kN

If the belt stretches slightly (due to temperature and time in use), the tension is getting less. If the force indication gets too low, the tension must be adjusted (see ‘3’ in the schematic above). The result of this adjustment will be, that the drive axes move apart by a few mm to maintain the required tension.

NOTICE

Wrong belt tension

The distance between the two axis of the clamp drive system must be measured before and after the adjustment of the belt tension.

Distance of drive axes:

Types of Platers and the respective distances of drive axes	Plater with clamp lifting mechanism	Plater with the Double-Cam-Clamps
Nominal value (new belt)	6240 mm	6180 mm
Maximum extension due to adjustments	13 mm	13 mm
Distance, which makes the exchange of the belt necessary	6253 mm	6193 mm
Completely overstretched belt	6260 mm	6200 mm

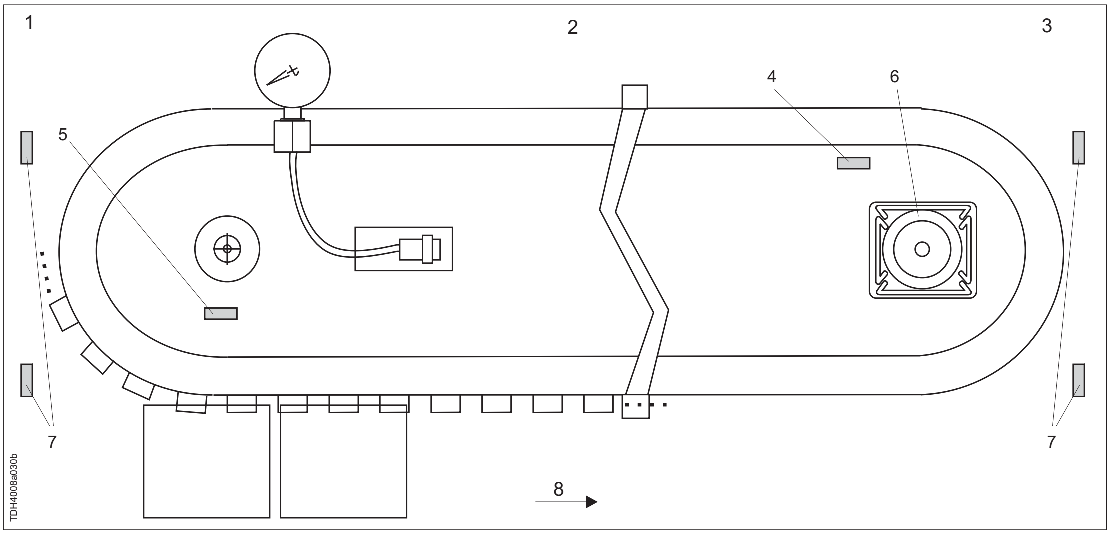
Torque of drive system:

The drive torque caused by friction in the clamp drive system is continuously monitored to protect the belt from getting damaged. When the drive motor is running it exerts an additional force on the belt. The actually measured torque in Nm is indicated in the respective window at the VCS screen of the control PC (see separate description).

See also

- The torque of the clamp drive system [→ 165]
- 030010 Check belt tension of clamp drive by reading tensile force [→ 305]

6.7.1.2.2 Schematic, clamp drive sensors



Clamp drive sensors

1	Input side	5	Sensor to detect the position of the clamp
2	L/R module	6	Torque monitoring
3	Output side	7	Digital level switches
4	Sensor to detect if the clamps are closed - they must be open to allow metal stripping	8	Transport direction

6.7.1.2.3 Clamp drive maintenance

See also

- 030010 Check belt tension of clamp drive by reading tensile force [→ 305]
- 030050 Check function of cleaning systems for clamp belt and input-/output rollers [→ 309]
- 030090 Check clamp drive belt (belt tension and wear) [→ 311]
- 030100 Change clamp drive belt [→ 312]

6.7.1.3 The torque monitoring system

The actual torque of the clamp drive system of a copper Plater is always monitored. To avoid damage to the copper Plater the clamp drive must stop automatically when the alarm level is exceeded.

This document describes the signal chain from the force sensor to the torque indication in the Visualization and Control System.

For your complete information refer also to:

- the pictures to illustrate the mechanical construction (available on request)
- the ATOTECH electrical wiring diagram and
- the documentation of our sub supplier.

6.7.1.3.1 The torque of the clamp drive system

The actual torque of the clamp drive system of the Plater is continuously monitored and the value displayed in VCS-H.

The torque monitoring system serves:

- to protect the drive belt from excessive belt tension and tearing in case of the clamp holding blocks getting completely stuck in the guide rails or in case of strong friction of the blocks in the rails.
- to recognize in increased torque relative the initial installation at commissioning.

The actual value of the clamp drive torque is measured by the force detection sensor which is mounted next to the clamp drive motor. Via signal transducer and bus system, the actual value is transferred to the control PC and displayed on the VCS screen.

Setting of warning and alarm values in VCS:

Common and regular values (measured, no set-point)	Warning value in VCS	Alarm value in VCS (automatic switching OFF of the drive)
This value may vary in the range from 150 to 400 Nm. This is a Plater-specific result due to the varying friction/clearance of the 216 clamp holding blocks in the clamp drive rails.	400 Nm	450 Nm in general; Exceptionally, just for finishing a production batch, also 10 to 20% higher. Higher values involve the risk of belt damage!

If the actually measured torque value is getting distinctly beyond the regular torque, VCS will generate

- first a warning message (to inform the operator)
- and secondly an alarm; The alarm will stop the drive automatically, which belongs to the most serious category of faults. However, the drive stop is necessary to protect the belt from over-stretching and tearing apart.

NOTICE

Friction

The first counteraction to reduce friction is to spray water into the clamp guide rails and to inspect the spray nozzle. (See also the related descriptions under ‘Cleaning the drive belt’ and the maintenance task No. 030050).

	NOTICE
!	**Changing the setting of warning and alarm values** It is not permitted to change the setting of the warning and alarm values without having the required knowledge and authority. This would involve the risk of causing a drive stop or even belt damage. Never ignore warning messages! Even if the drive is not automatically switched off by the warning, the unusually high torque must be given attention to.

Background information: Why the wide range of regular torque values?

- The actual value of the torque depends to large extent on the clearance / friction of the 216 clamp holding blocks in the clamp guide rails (in the upper and bottom RCH1000 rails). Because this clearance can never be absolutely equal in all the existing Platers, the actually measured torque value may also be different from one Plater to the other.
- The manufacturing of guide rails (and order numbers) may also be different. Some Platers are designed for thin foils, other Platers are for the transport of thicker panels. In Platers for thin foils, the clearance is reduced to a minimum. This helps to stabilize the movement of the clamp contacts. On the other hand the torque might be somewhat higher.

See also

Clamp drive [→ 161]
030050 Check function of cleaning systems for clamp belt and input-/output rollers [→ 309]

6.7.1.3.2 The tensile force sensor at the drive motor

The torque measurement device of the clamp drive monitors the adjacent torque value by means of the tensile force sensor.

Clamp drive motor with tensile force sensor

1	Cardan joint and shaft	4b	Joint with 65 mm bolt
2	Direction of rotation	5	Moveable joint
3	Tensile force sensor	6	Bottom mounting plate
4a	Joint with 55 mm bolt fixed to ground plate		

Note: The picture shown here is applicable in Right-To-Left lines only.

In Left-to-Right lines the position of the two joints (moveable, fixed) is interchanged.

	INFORMATION
i	**R-L lines** Direction of panel transport: The above illustration is only relevant for R-L lines (in L-R lines the position of the two stud bolts would be interchanged.) In general, with the motor running a tensile force (and no pressure) has to be applied onto the sensor.

Structure and function description

The stud (4a) is screwed into the base plate (6). The second (longer) stud is screwed into the bar below the bottom plate. The bar is tightly screwed to the motor housing, however, it is movable in relation to the bottom plate.

The motor is mounted to the bottom plate in such a way that it can rotate.
With clamp drive running, a tensile force is applied onto the sensor via the bar (5)-stud (4b) linkage.

Signal chain

There is a linear relationship between the electrical output signal transmitted by the tensile force sensor and this tensile force.

The actual torque value is sent via a signal transmitter to the control system.

The control system evaluates this signal. If the torque value is too high the control switches off the drive motor to prevent the drive belt from damages.

CAUTION

Rotation of the gear motor

In case of repair or maintenance work you must ensure that the motor cannot be switched on while the tensile force sensor is not fixed to the two bolts.

Only with the tensile force sensor it is possible to avoid that the gear motor inserted in the bottom plate rotates on the motor shaft.

6.7.1.3.3 Offset calibration VCS

Which data transmission bus is installed at your line – Can Bus or Profibus?

- Find parameter SetTorqueOffset in the PLC Data Block.
- For that open the control panels for --> 44/51/61 Platers --> Drive --> Torque and use function keys Ctrl+D.
- Then scroll for SetTorqueOffset parameter and adjust it, if necessary.

The values for the torque sensor in the PLC-Data-Block are as follows:

- Gain (remains fixed):
  - for CAN Bus: 0.4415
  - for Profibus 0.0511

- Offset (default value):
  - for CAN Bus 1060
  - for Profibus 706
- The offset value is adjusted for each clamp-drive-system separately during line commissioning. The calibration is carried out during line commissioning by ATOTECH technicians.

Procedure:

- Safety instruction:
- Interrupt power supply for clamp drive motor and make sure that nobody can switch on unexpectedly.
- In order to get a defined zero torque operating point ensure that no force is applied at the sensor. This is possible by taking off one side of the sensor from its vertical bolt. It is strongly recommended to loosen the nut of that joint that is fixed to the ground plate and not the nut for the longer joint with the moveable lever. Make use of a second spanner to keep the joint bolt tight in the plate.
- Remove also the fan cover and turn the motor fan by hand a few turns so that you can lift the previously loosened side of the sensor.

CAUTION

Rotation of the gear motor
Make sure that nobody can start the clamp drive motor when the force sensor or one of its two joint bolts is removed. Only with the fixed sensor rotation of the motor housing is prevented and mechanical damage avoided.

- Without applied force at the sensor the displayed torque value at the VCS screen should be about “0” Nm. If that is not the case the PLC parameter SetTorqueOffset must be set higher or lower so that “0” Nm is displayed after the new value is entered.

6.7.1.3.4 Check disconnected sensor

With the signal adapter LAC disconnected you can check the sensor by means of a multi-tester.

Resistance test:

The expected resistance between white and red wire is 350 +/- 400 between blue and black (supply wires) 400 +/- 200.

If the measured resistance values differ considerably the sensor is defect.

Zero point check:

What is the output signal at a supply voltage of 9 Volt and no tensile force applied?

Procedure:

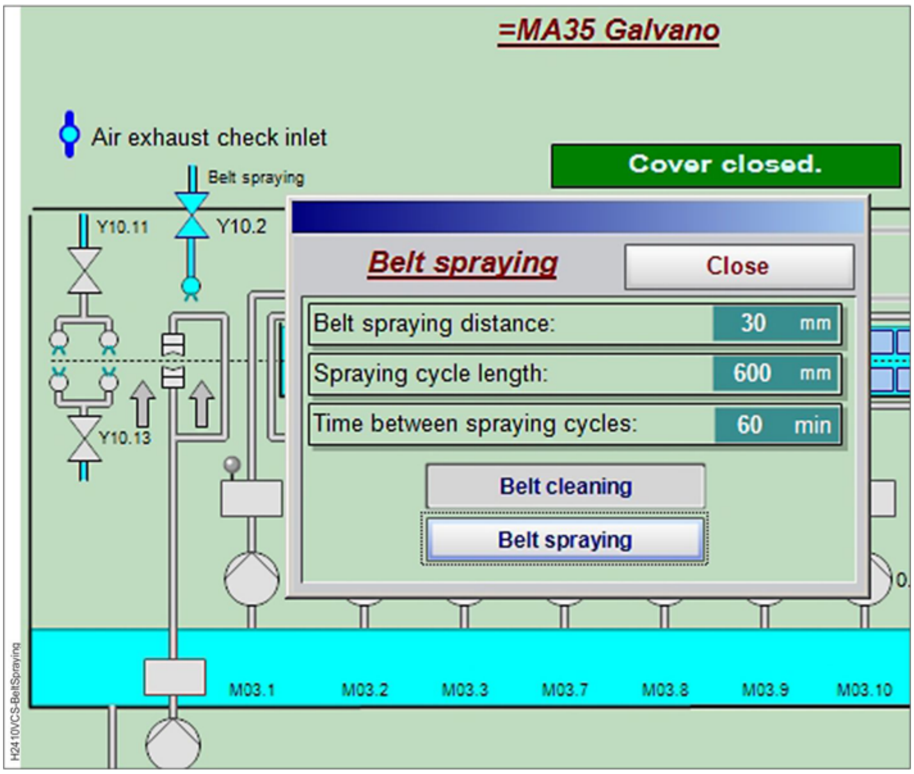
- Unscrew M12 nut to disconnect one sensor joint. Use 9-Volt battery and apply this voltage between the blue (+) and black (-) supply wires.
- Then check the voltage between white (-) and red (+) wire.
- If the voltage is higher than 1 mV the sensor cannot be used any more.

6.7.1.4 Cleaning the drive belt

6.7.1.4.1 Spraying length and frequency

The valve is actuated periodically on the basis of length specifications. Three distances are stored in the control system:

- Belt length or revolution distance (e.g. above 12 m)
- Cycle distance:
  This value (e.g. 600 mm) is comprised of the spraying distance and the waiting distance and defines the valve opening frequency per revolution.
- Sprayed distance:
  Distance that is sprayed per valve opening (e.g. 60 mm). In the example selected below (values of 60 and 600), this also means that the valve is open for 10% of the time required for one revolution. (distance ratio = sprayed distance / cycle distance).



Extract from VCS screen

Explanation of the picture:

- “Belt cleaning” is used for continuous belt spraying for one revolution of the clamp belt.
- “Belt spraying” is used for spraying the belt at regular intervals in the automatic mode.
- Restart time (e.g. 60 min):
  During production in the automatic mode, the subsequent revolution with interval spraying is started after the time specified.

6.7.1.4.2 Spray parameters in the automatic mode

The valve opening frequency is defined by:

- the time specified (e.g. once every hour, a revolution with spraying is started).
- the ratio of the sprayed distance and the cycle distance (e.g. 10%).

The valve opening time per spraying revolution is computed from the belt length (according to the revolution distance), divided by the speed of the clamps and multiplied by the distance ratio.

Assuming a revolution time of, for example, 10 min. and a distance ratio of 10%, the spraying time would be 1 minute per spraying revolution.

6.7.1.4.3 Belt cleaning in the manual mode

Purpose:

Cleaning of the belt

- before longer breaks in operation, carried out immediately after production has ended
- when necessary due to heavy incrustations or
- to check the spray system for proper functioning.

Execution:

Press the “Belt cleaning” button in the manual mode while the clamp drive is running.

Function:

The valve is then permanently (i.e. not cyclically) open for one revolution. After that revolution, VCS releases the “Belt cleaning” button automatically. The belt revolution time is equal to the belt length divided by the set speed.

The “Belt cleaning” button can be released by mouse click prematurely; then the valve is closed immediately.

6.7.1.4.4 Torque reduction in the heating mode

When switching to the heat-up mode.

The following devices are switched on:

- the circulation pump in the sump,
- the heater of the copper module and
- the drives (clamp drive and roller drive).

Start-up revolution:

The belt is then sprayed for one revolution according to the set cycle and spraying distances. Thus, the increased start-up torque is reduced even before production starts.

Circumventing incorrect alarm messages:

The torque threshold at which the clamp drive is stopped due to an excessively high torque is increased by 100 Nm during the start-up revolution. In this way, the drive is prevented from being switched off simply because of the higher start-up torque as a result of a longer period of shut-down. Even with the increased torque threshold, there is sufficient safety margin to protect the drive belt against damage due to overload.

6.7.1.4.5 Maintenance

Check function:

Check the spraying system for proper functioning at regular intervals. Make sure that the cathode rail is always free of moisture!!

The water pressure must be sufficient, but not be too high.

If necessary, adjust the direction of the water jet, replace the spray nozzle, or adjust the spraying pressure (via the flow rate)!

Water flow rate, electrolyte dilution, level increase:

Example: At a pressure of 2 bar, the water flow rate at the spray nozzle is 0.63 liters per minute (nominal values). These values can be used to compute the water addition per hour or day.

- If the DI water feed to the bath is too high:
- Check the function and the opening times of the valves for belt cleaning, roller spraying and water feed!
- If the clamp guide pieces are excessively incrusted, remove the dirt or incrustation by spraying the belt manually using a DI water spraying hose! This will also result in a dilution of the bath.

See also

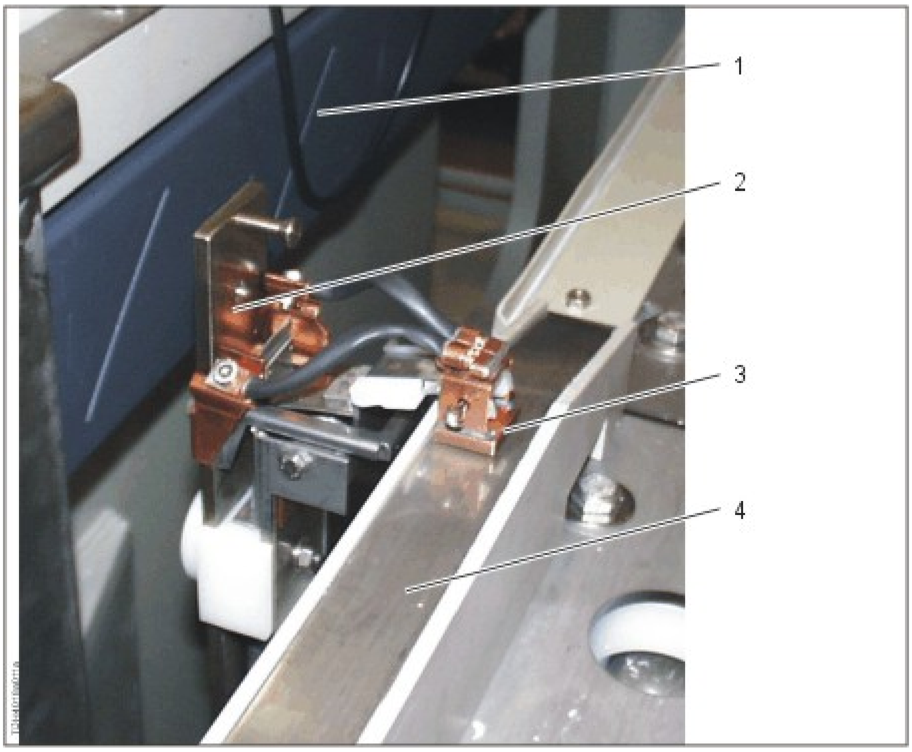
030050 Check function of cleaning systems for clamp belt and input-/output rollers [→ 309]

6.7.1.5 Clamp stripping

6.7.1.5.1 Introduction

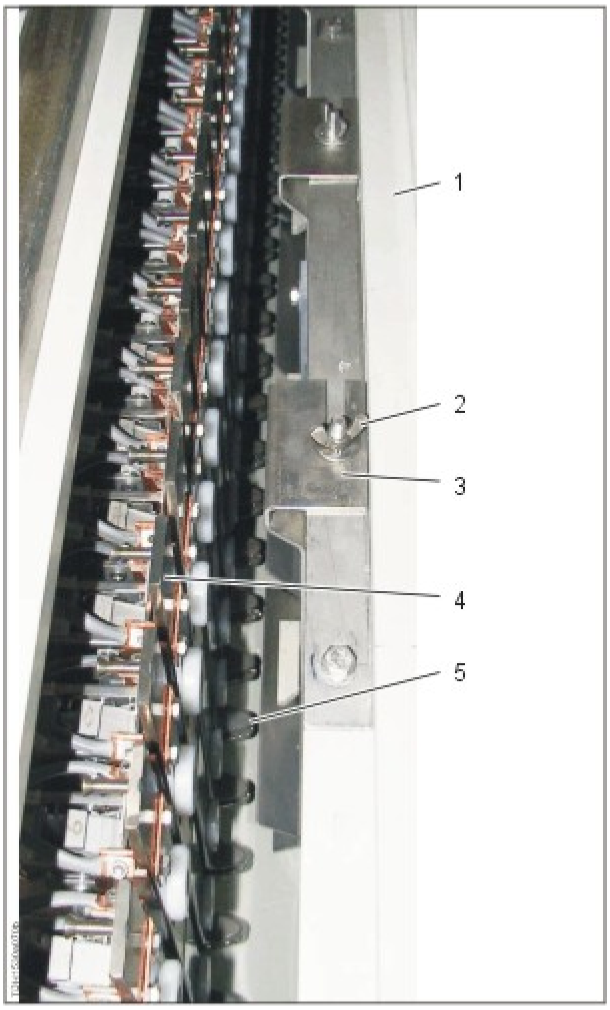
The clamp contacts must be stripped (made free of copper accumulations).

This is achieved as they move back from the output side of the Plater to the input side in the stripping section of the Plater (at the rear side of it).



Anode rail of the stripping section of the Plater

1	Exhaust duct at the rear side of the Plater	3	Sliding contact of clamp
2	Clamp	4	Anode rail of stripping section



Stripping section at the rear side of the Plater, cathodically connected titanum sheets fixed by winged nuts

1	Rear side of the Plater	4	Clamps at stripping section
2	Winged nuts to fix the metal sheets	5	Clamp contacts
3	Cathodically connected metal sheets		

The anode rail and an array of cathode sheets are connected to a voltage controlled rectifier (see separate description for the setting of the rectifier voltage).

The cathodically connected sheets and the clamp contacts must be inspected regularly (see maintenance tasks No. 030060 and 030070).

The clamps are kept open for stripping. This happens mechanically (latch mechanism) before the clamps enter the stripping section. Unopened clamps are registered by an inductive vicinity sensor. A fault message will be displayed on the control screen if the latch mechanism fails to work properly.

Solution agitation to enhance the stripping efficiency is deployed by an extra pump circuit for stripping (see also P&I diagram of Plater).

See also

- 030060 Check clamp contacts for residue-free metal stripping [→ 309]
- 030070 Check degree of metal deposition on stripping sheets [→ 310]

6.7.1.5.2 Stripping of clamp contacts (3 rectifiers)

This description is applicable for the stripping of
- plastic shielded clamps with rectangular stripe contacts
- used in Platers with three stripper sections (three rectifiers and three separate cathodic connections).
Especially the voltage set-points differ in other types of stripping systems.
It covers the following topics:

- Setting of voltages, observation of actual currents
- Weekly exchange of the whole set of cathode sheets if necessary
  (= preventive maintenance task No. 030070
- Inspection of the clamp contacts by the operator (= preventive maintenance task No. 030060)

a) Setting of voltages, observation of currents and copper accumulation

Stripping should neither take place too slow nor too quick. Almost the whole array of cathodic metal sheets shall be equally covered with copper (after some days of production).

- If the clamp contacts are not copper-free (not stripped well) and the last metal sheets are also covered with accumulated copper, either some clamps are not in good condition or the set voltage might be too low.
- If only the edges of the clamp contacts are copper-free (while patches of copper remain on the clamp) and just a few metal sheets in the first part of the stripping section have accumulated copper, the voltage is probably set too high.

In direction of clamp movement in the stripping section, we distinguish three sections. For achieving the main objective (well stripped clamp contacts) there are two other objectives for proper stripping adjustment.

	First section	Middle section	Last section
Default voltage at Plater	0.6 Volt	1.2 Volt	3.0 Volt
Objective 1: Copper distribution on the array of metal sheets	Copper deposition on the cathodic sheets equally distributed; (Check after several days of production)	Copper deposition on the cathodic sheets equally distributed; (Check after several days of production)	Thickness of copper on the metal sheets coat getting less; No copper deposition on the last one, two or three metal sheets
Objective 2: Actual current distribution	$I_1 \leq I_2$ Example 12 A Appr. 40% of $(I_1 + I_2 + I_3)$	$I_2 = (1.2 \text{ to } 1.3) * I_1$ Example 15 A Appr. 50% of $(I_1 + I_2 + I_3)$	$I_3 = (0.2 \text{ to } 0.3) * I_1$ Example 3 A Appr. 10% of $(I_1 + I_2 + I_3)$
Final voltage at Plater	To be adjusted according to objectives 1 and 2	To be adjusted according to objectives 1 and 2	To be adjusted according to objectives 1 and 2

a) After commissioning, when the production starts to run continuously, observe whether the two objectives are met. If not, set the present voltage settings higher or lower. This correction, however, makes only sense, if the clamps are in good condition.
b) When the appropriate voltage set-points are found, they should be recorded and not changed any more. It is not the task of operators to change voltage set-points every other day or week.
c) Note that there is a voltage loss from the rectifier to the Plater. The voltage at the output terminals of the rectifier is higher than at the Plater (between anode rail and cathode sheets).

b) Check degree of copper accumulation on the cathode sheets

See preventive maintenance task No. 030070

c) Removal of copper at clamp contacts (regular maintenance):

See preventive maintenance task 030060

Operators execute this preventive maintenance task through the maintenance window (once daily or up to weekly) depending on the individual situation in the Plater module and the condition of the clamps.

If not executed, the copper deposition around the clamp contacts might get too strong. Easy removal of the copper on the clamp would not be possible any more.

NOTICE

Damaged clamps

Damaged clamps must be replaced! The stripping system can not strip clamps fully if their shielding is damaged or if there is too much copper under the clamp shieldings.

INFORMATION

Never let the copper grow too much! Carry out the preventive maintenance task No. 030060 regularly.

The need for this maintenance action can be minimized if

- the clamps are well maintained and not damaged
- the stripping system is adjusted well and working properly

d) Trouble shooting after insufficient automatic rectifier stripping

In case of insufficient automatic stripping of the clamp contacts refer to the separately described list of check points.

See also

🗎 030060 Check clamp contacts for residue-free metal stripping [→ 309]

🗎 030070 Check degree of metal deposition on stripping sheets [➔ 310]

6.7.1.5.3 Stripping of clamp contacts, trouble shooting

In case of insufficient automatic stripping of the clamps:

1. If the shielding of a clamp is damaged, it must be removed and replaced. Any damage at the clamp itself is generally the first cause for too much copper building up around the clamp contacts.
2. Make a distinction: Are just a few clamps not stripped well or all of them?
   In the first case attend to the clamp and not to the stripping system.
   In the latter case give attention to both systems, clamp and stripping system.
3. Inspect the stripping rail (anode rail) at the rear side of the Plater (as well as the cathode rail at the anode side of the clamp drive system): Are both rails clean and dry? Are the sliding contacts of the moving clamps in good contact to the rails? Are they in good condition? Inspect the sliding contacts with low speed of the clamp drive system (e.g. 0.5m/min). Use a hand lamp for better inspection.
4. Inspect the array of the cathodic metal sheets (at the rear side of the Plater) and the electric connections to the metal stripe, which is serving as connection between the metal sheets and the negative pole of the rectifier:
   Are all the winged nuts tight to make a good and low-resistive contact?
   Is any of the contacts unclean or corroded?
5. Check the distribution of the thickness of the accumulated copper on the titanium sheets after several days of production? How is the thickness of copper on the individual sheets distributed along the array of cathode sheets?
   If necessary, re-adjust the voltage set-points according to the separately described instruction!

Other points, which, though rather rare, should also be considered:

1. At the PCB side of the Plater: Do the clamps completely close? How does the clamp contact print on the PCBs look like, when the clamps leave the Plater?
   (Remember that only a well maintained clamp can be stripped well).
2. The clamps must be kept open in the stripping section of the Plater. This is made mechanically by the latch mechanism. Are they actually kept open? Is the inductive vicinity sensor actuated by the passing-by clamps?
3. Is the actual stripper rectifier voltage really as indicated in VCS?
   What is the actual stripping voltage between clamp (anode rail) and metal sheets?
   How much does it differ from the voltage at rectifier output terminals?
   Which of the two voltage values is indicated in VCS?
4. Was there recently any change with regard to the anode shielding (constructional modifications) in the anode area of the Plater?
5. Was there recently any change with regard to the stripper pump circuit? This pump circuit is moving the solution in the stripping section of the Plater against direction of clamp movement.

6. Was there recently any change with regard to the composition of the electrolyte?
   Are Brightener and Leveller in the correct range?

6.7.1.5.4 Cleaning Stripping Sheets - Cathode Sheets -

CAUTION

Working with chemicals

All safety precautions and handling procedures concerning strong acid or alkaline solutions must be carefully observed. While handling with such solutions safety glasses and protective clothing must be worn.

Pre-requisites

The stripping sheets are required as a cathode for stripping plated copper on clamp contacts in a Uniplate copper plating system from ATOTECH. The stripping sheets are made of titanium.

Under certain production conditions (especially low Fe^{3+} -content of plating electrolyte) the plated copper on the stripping sheets could build-up by time. The cathodically connected titanium sheets have to be replaced and stripped when the copper accumulation reaches several mm up to a maximum of 5 mm. Therefore it is recommended to have a second set of copper-free titanium sheets ready for exchange.

Cleaning Stripping Sheets

To clean the stripping sheets from plated copper following procedure is recommended:

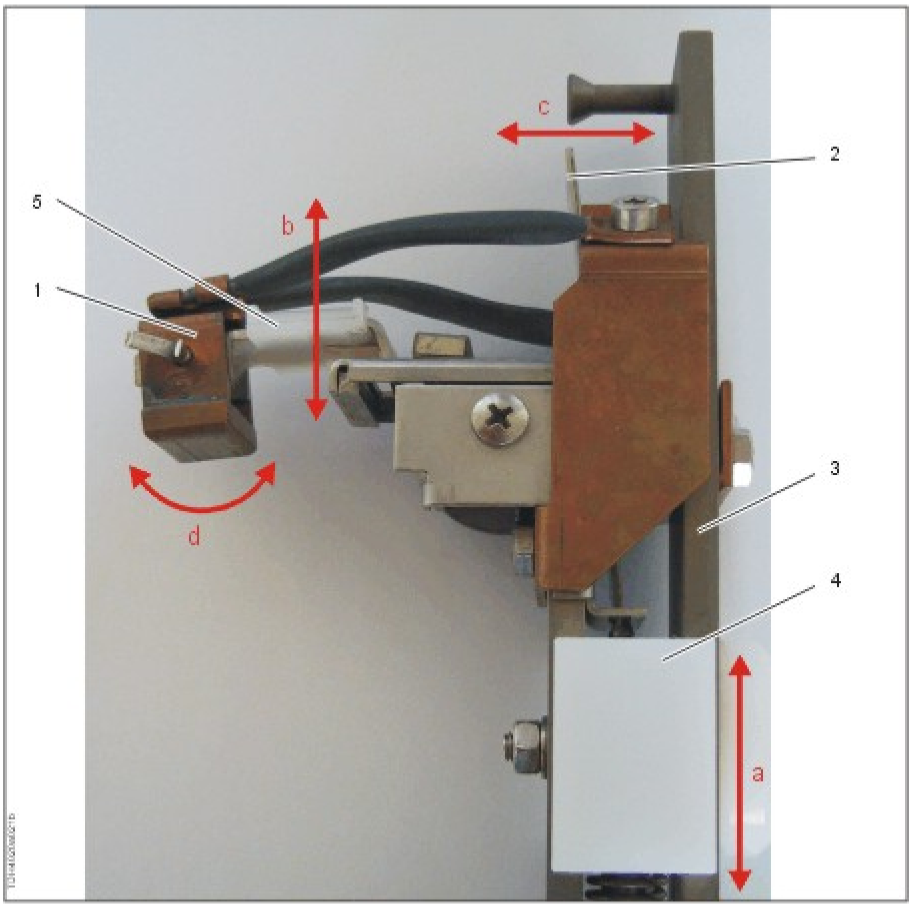
- Put the sheets into the by-pass section of a copper etching system used in PCB-production (NH_3- or $FeCl_3$-/$CuCl_2$-etchants)
- Control the progress in copper stripping from the titanium-sheets every 30 minutes.
- Etching time 1-2 hours (depending on plated copper thickness and convection intensity of the copper etchant around the copper sheets).
- After successful strip-off of plated copper from the titanium sheets rinse the sheets properly in city-water (alternatively softened water).
- Neutralize/leach the titanium sheet for 5 minutes in 5vol% H_2SO_4-solution followed by DI-water rinse.
- Reinstall the sheets in the Uniplate system when required.

6.7.1.6 Clamp with lift-up pin

6.7.1.6.1 Clamp inspection

When a clamp is recognized as faulty, it is possible to drive the affected clamp to the maintenance window for replacement and repair.

Check moveable parts:



Checking of clamps

1	Sliding contact	4	Support for clamp arm
2	Catch plate	5	Sliding contact lever
3	Moveable clamp arm		

- The moveable clamp arm (3) must be moveable inside the two clamp supports (movement a). There must be enough space (play) for the moveable clamp part inside the two support blocks.
- The catch plate of the latching mechanism (movement c) must move easily forward and backward by its own weight. The function of the latching mechanism is to hold the clamp open when required. Otherwise it must fall back by its own weight to allow the clamp contacts to close and to grip the panels.
- Check function of the torque spring and sliding contact lever:
  The sliding contact lever (5) is to be lifted by hand (movement b) from its bottom to its top limit. The torque spring moves it back down. Check for any irregular friction!

Check the tension of the torque spring (for pressing the sliding contact down on the copper rail).
Compare with the tension of sliding contact levers in new clamps. See also maintenance task 030180.

- The sliding contact (1) must be moveable easily around the split-pin (movement d).

Contact points and metal stripping:

- See maintenance task No. 030060.

Check closing performance of upper and lower clamp contact:

- Their surfaces must be
  - metallically clean for a good electric contact with the PCB's
  - congruent (closing without side-way offset)
  - parallel (for a full-surface contact)
  - right-angled (related to the vertical mounting surface)

Maintenance of sliding contacts:

- It is absolutely essential that the sliding contacts make a good electric contact to the cathode rail in the plating area and to the anode rail in the stripping area.
  Regarding this observe the following maintenance instructions carefully:
  No. 030040, 030100, 030170, 030180, 030181 and 030182!

Mounting of clamps to the belt:

- Regarding clamp exchange see maintenance tasks No. 030181 and 030182.

Play of clamp guide blocks:

- The clamps must move easily in the RCH1000 rails. The vertical gap between the stainless steel clamp guide block and the RCH1000 guide rails should be 0.2 - 0.4 mm on the operator side and about 0.5 mm in the stripping area.

See also

🗎 030040 Remove abrasion dust from sliding contacts in clamp drive area [→ 306]

🗎 030100 Change clamp drive belt [→ 312]

🗎 030170 Check sliding contact of clamps visually [→ 313]

🗎 030180 Check clamps, sliding contacts, spring tension and replace clamps if necessary [→ 314]

🗎 030181 Exchange of individual clamps (at the maintenance window) [→ 315]

🗎 030182 Exchange of a larger number of clamps [→ 316]

6.7.1.6.2 Exchange of sliding contact

The sliding contacts are wear parts. Initially the thickness of the sliding piece (made of Cu graphite) is 6 mm.

If there is just a thickness of 3.5 mm left, the sliding contacts must be replaced (i.e. after 2.5 mm of abrasion, also if just one-sided, which is generally at the rear / dome side).

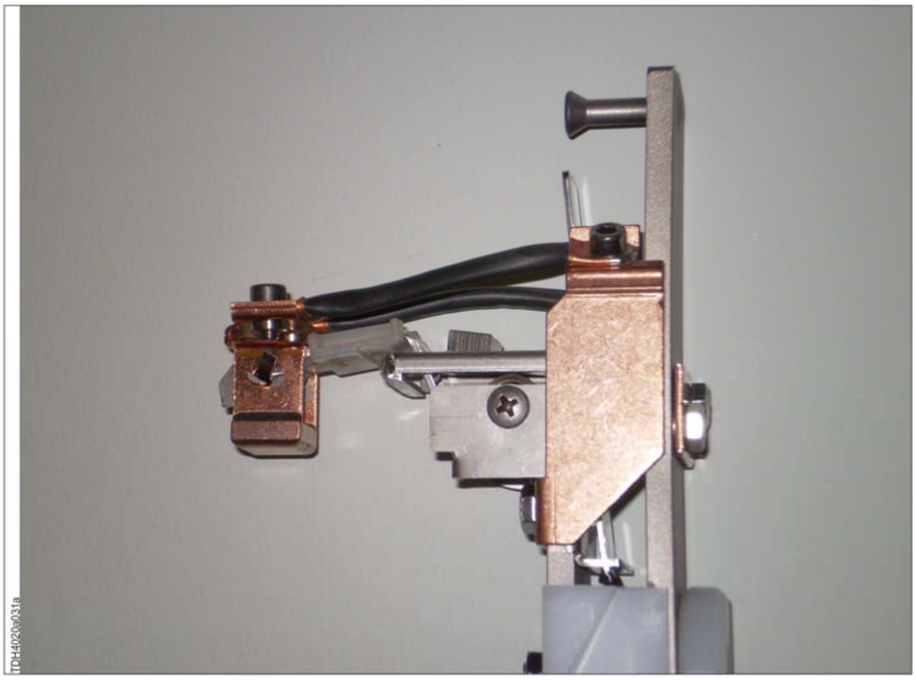
(If this is ignored, the soldered copper bow will soon cause scratches in the cathode rail).

	INFORMATION
	Use genuine parts only!

The sliding contacts can be replaced individually or together with the pair of insulated copper wires. Both, the state of sliding contacts as well as the state of the pair of cables must be given attention to.

Any small damage to the insulation of the cables is a reason to replace them, because corrosion and overheating will soon increase if their insulation is slightly damaged.

1. Removal of the worn-out sliding contact unit



Sliding contacts and two cables with cable lugs (screwed contacts)

a) Unscrew the two hexagon socket screws

b) Remove split-pin

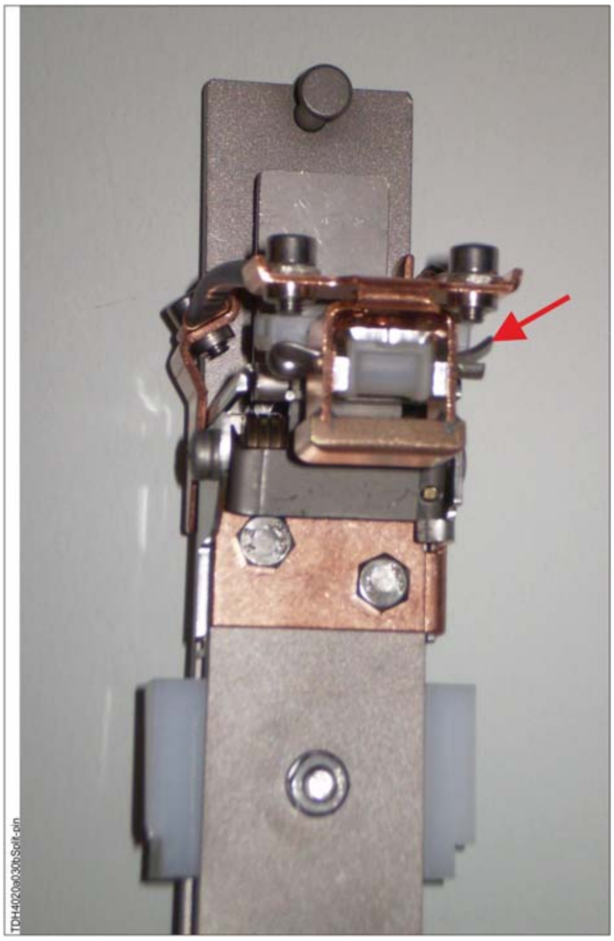
1. Clean the contact surfaces thoroughly

a) Make use of a fine metallic brush and/or fine emery paper (Scotch-Brite, etc.) to clean the electric contact area thoroughly till the surface is metallically clean and shiny.
A good electric contact is very essential for good plating results!

1. Mounting of the sliding contact and bending of grooved split-pin

a) Fix the sliding contact with split-pin

- It is enough to bend just the longer split-pin arm (with groove for bending).



Adequately bent split-pin

a) Bend split-pin as shown in the picture – not too much and not to little.

- The groove in the longer pin part makes it easier to bend it at the right spot.
- The use of genuine ATOTECH parts is relevant for good current conductivity
- After being bent, the split-pin must be moveable (about 1mm forward and backward).
- The sliding contact must be turnable easily around the split-pin. This is very important to ensure a good contact to the cathode rail during production.

1. **Tightening of the hexagon socket screws with a torque wrench**

a) Adjust torque wrench to 2.5 Nm

b) Make sure that there is a good electric contact between terminal lugs and the previously cleaned copper contact surfaces

c) When tightening the hexagon socket screws prevent rotation of terminal lugs

The service time (in month) of sliding contacts is rather wide spread and can't be defined precisely. Influences are

- Maintenance and observation of the state of cathode rail
- Maintenance and function of the exhaust system
- Speed of production
- Current load by current density

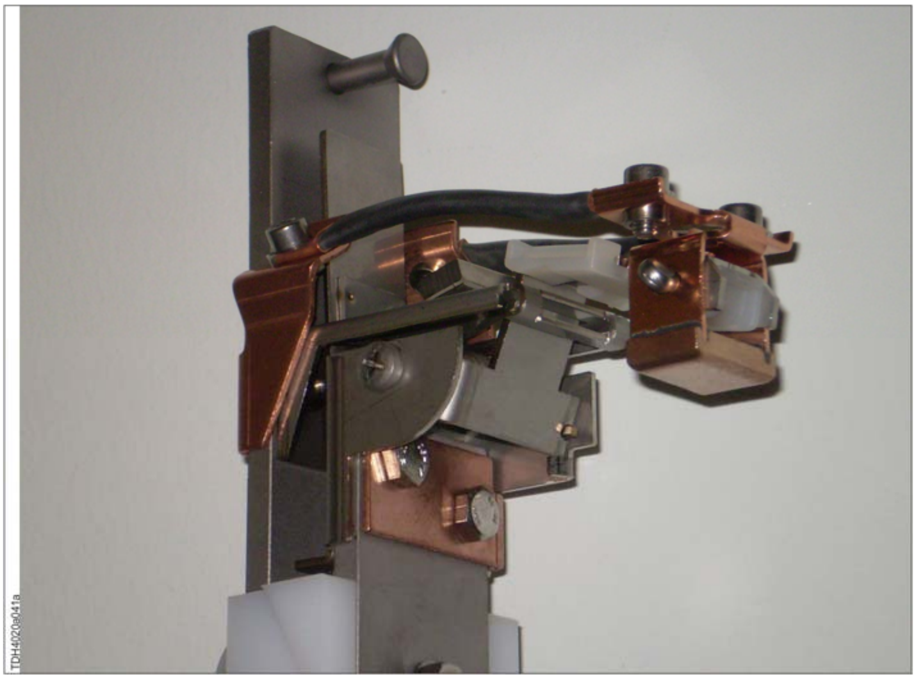
- No overheating caused by poor contacts
- Dedication to clamp maintenance in general
- Etc.

For these reasons a thorough check of the sliding contacts is to be performed about 3 to 4 times per year. Based on such assessments, an action plan must be made when to replace the sliding contacts altogether.

See also

🗎 030180 Check clamps, sliding contacts, spring tension and replace clamps if necessary [→ 314]

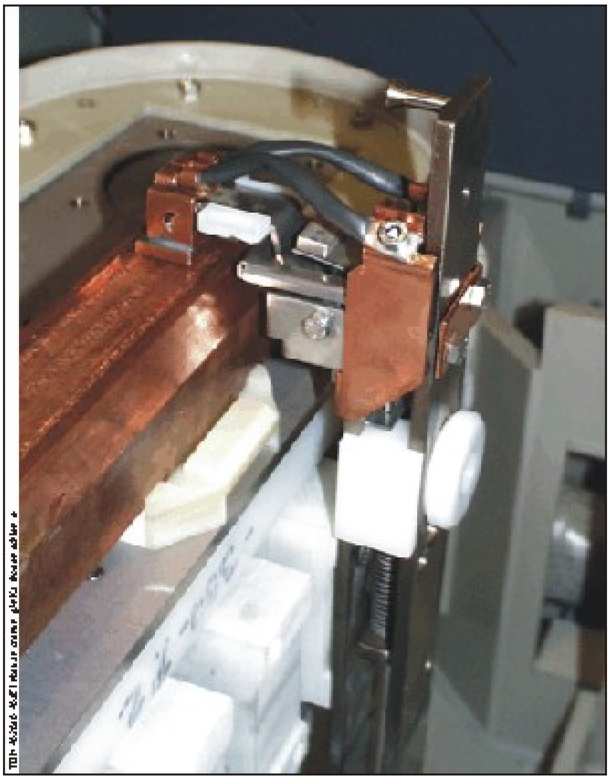
6.7.1.6.3 Photos of completely assembled sliding contact



Clamp contact mechanism and Cu-graphite contact piece

Check function of clamps:

- Moveability
  - of front clamp arm inside upper and lower supports
  - of sliding contact around split-pin
  - of latching mechanism with torque spring and catch plate
- Are all the Cu-graphite contact pieces sliding well on the cathode rail?
- Refer also to documents on clamp maintenance and repair work for further details.



Sliding contact, sliding performance on cathode rail

See also

- Clamp inspection [→ 179]
- 030041 Inspect cathode rail and make it metallically clean [→ 307]

6.7.1.6.4 Maximum clamp current

The actual current of a clamp is determined by the actually set pulse parameters of a job and the width of the panels in the Plater.

A simplified equation to estimate the clamp current is:
Clamp current = 2 x Current density x 0.6 dm x Width of the PCB

(‘2’ for top and bottom side, ‘current density’ must be the heat-effective one, 0.6 dm is the distance from one clamp to the next).

- The clamp current is not measured. (Note: The current and voltage values which are displayed in VCS are taken at the Pulse Devices). For this reason it is most important to carry out preventive maintenance thoroughly (cathode rail maintenance, inspection of clamps, exhaust system of the Plater).

The critical points of the clamp (with regard to the maximum current) are the spots where current transfer takes place.

    - Cathode rail and sliding contacts of the clamps
    - Clamp contacts to PCBs
    - Thickness of copper clad on the PCB

- The maximum current load of a clamp depends furthermore on the type of clamp (Type of clamp contacts to PCB as well as type of sliding contacts on cathode rail).

    - In case there is a plan to chance production parameters in comparison to previous jobs, it is recommended to first seek advice from regional service bureau (a) or from the BTT-PP in Berlin (b) or from the Plater specialists in Feucht (c).

Such a new situations could be:

- The copper clad is extremely thin (for example below 5 micron). This could require a distinctly reduced current density to prevent damage to the copper clad and indirectly to the clamp contacts.
- In case of same type of PCBs: A change of pulse parameters makes the whole set of parameters stronger (resulting in more heat development)
- The chemistry is more aggressive (etching away copper from the PCB near to the clamp contacts).

An assessment whether or not (or how far) the clamp or the PCB is at risk of getting damaged can just be made, if all the factors are known, which have an influence. It is not useful to fix a single value (such as 100 Amps effective current) for all the different situations.

The factors which have an influence on the maximum current of the clamp are numerous and can be grouped in the following way:

- Type of Plater and type of clamp used in that Plater
- Thoroughness of execution of the preventive maintenance
- Type of PCB (thickness of copper clad, width of PCB, type of applied process, etc.)
- Type of chemistry used for the job (process).

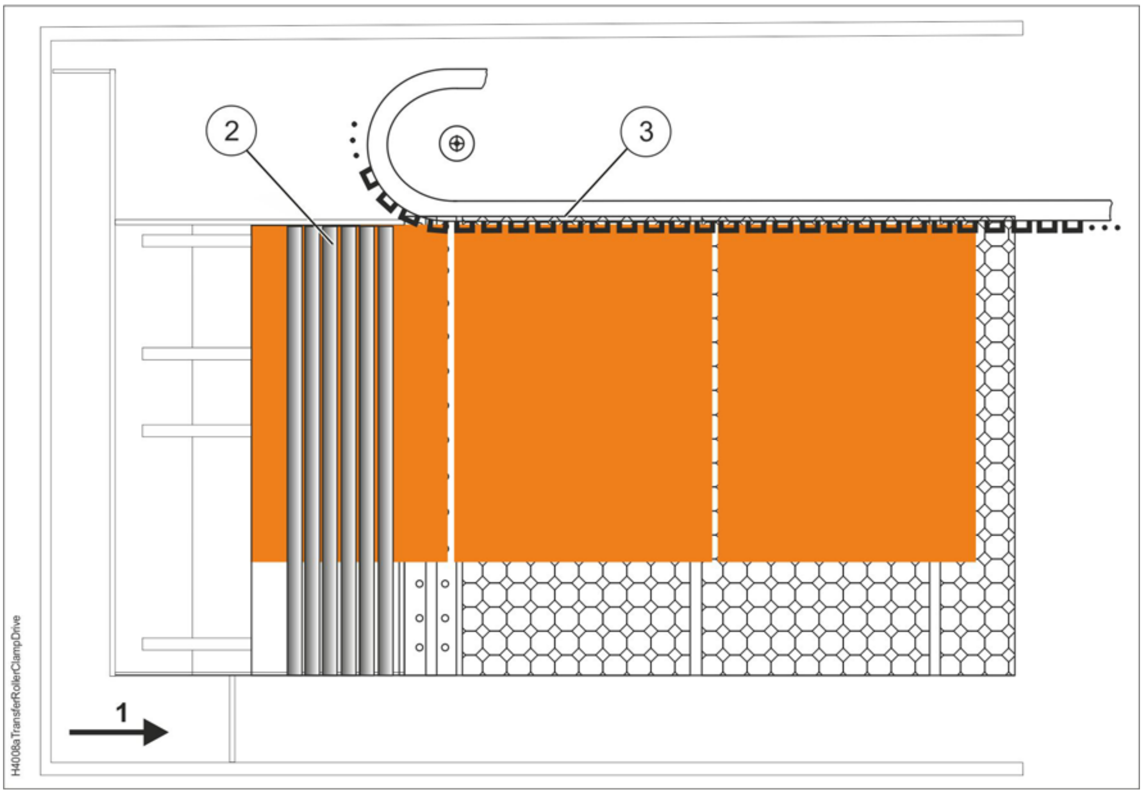
Case specific it may be necessary to reduce pulse parameters (current density, reverse time) in order to prevent an overload of the clamp or an overload of the copper clad on the PCB (resulting in overheat and damage).

6.7.1.7 Conveyor and clamp drive system, transfer of PCBs

The printed circuit boards (PCBs) are conveyed from the Centre Gap Adjuster (or Positioner) into the Plater module by the roller transport system.

In the Plater the PCBs are transferred to the clamp drive system. The clamps are mounted on the clamp drive belt. They grip the PCBs and carry them forward. The clamps not only serve as a main part of the transport system, they also make the electrical contact to the PCBs for electroplating.

	NOTICE
	Panel crash The transfer of PCBs from the roller conveyor system to the clamps is a critical subject, which needs careful attention, when doing commissioning and repair work. Mal-adjustments of alignment assemblies can easily lead to a panel crash. When carrying out repair work (removing certain parts) it is most essential to fix everything in the same way as it was fixed before.



Transfer from roller to clamp drive

1	Transport direction	2	Roller drive
3	Clamp drive system		

The first clamping position is approx. 489 mm from the outside edge of the module (in direction of transport).

The recommended minimum board length for a reliable transfer of PCBs to the clamps is specified in the P&I diagram (generally about 305 mm).

It is essential that the two drive systems are adjusted to each other to provide a smooth and straight transfer of PCBs between them. This applies not only for the transfer of PCBs into the Plater, but also for the output side of the Plater.

In principle, adjustments are made in three dimensions:

- Vertical adjustment (working height) in the Plater module:
  - Standard height of both roller drive and clamp drive system must match,
  - bearing inserts must be in proper condition (wearing not more than 0.5 mm).
- Forward orientation in direction of transport:
  - Speed of the roller drive related to clamp drive must be equal,
  - alignment of the rollers for exact forward movement in direction of transport, no skewing of rollers
- Lateral shift and alignment at clamp side:
  For getting well positioned clamping points on the PCBs at their margin, the adjustments are made in
  - the Center Gap Adjuster
  - and in the Positioner module, if there are several Platers installed in the line.

	NOTICE
!	**Panel crash** All this adjustments are made and tested during commissioning of the line. Give attention not to change them, when doing repair work.

In the Handling module which is preceding the Plater Module (Centre Gap Adjuster or Positioner), sensors check the clamp side edge alignment of the outgoing PCB to confirm that the boards are about to enter the Copper module correctly positioned. A fault message is generated if this is not the case.

6.7.1.8 How to take out the Plater windows

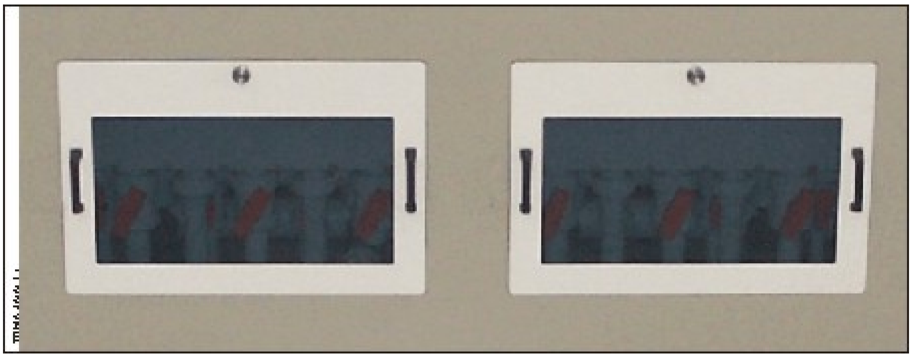
In the past there were a number of cases that the inner frame of the window broke apart, if the window was pulled out with force.

To avoid this, please consider this instruction:

Release air pressure completely (a) and shake the window prior of pulling it out (b)!

a) To release the pressure in the compressed air sealing system completely:

► Press the button 'Open window' (compressed air 'OFF') in VCS-H.



Plater windows, one screw, two handles

b) At the window which shall be opened:

► Unscrew the screw

► Don’t pull out the window immediately!

Holding it at the two handles, first shake the window side-ways in all directions, left and right ↔, up and down ↕, clockwise and counter-clockwise ⟳ (if still sticking to the window frame, the sealing tubes are loosened this way)

► Finally pull the window out with care, still with shaking movements,. first slant it slightly at its upper side, then lift it. Don’t pull out straight and with heave force. Rather repeat shaking action in all direction and pull then again gently (at upper side first).

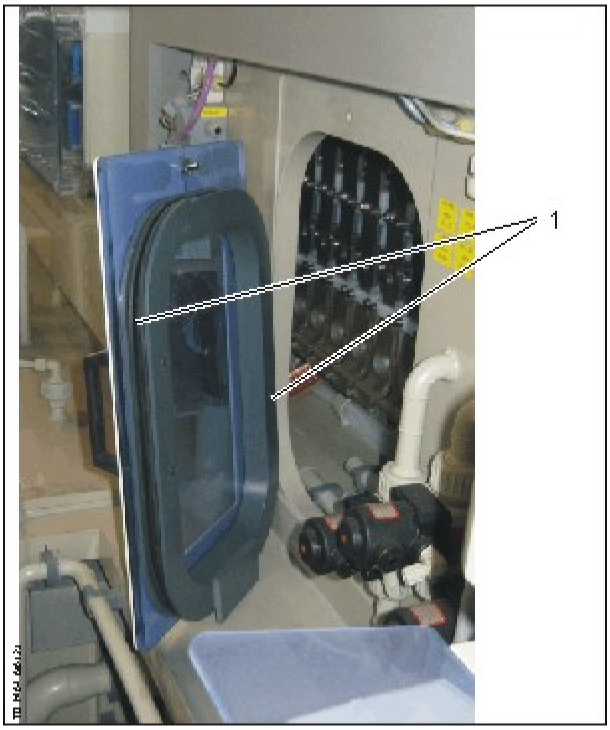
When outside:

► Handle the Plater windows with care and place them safely.

Keeping parts clean, fixing the window:

► Cleanliness of work: Wipe off any debris and dirt

► Make sure not to damage the black rubber tube



Inspection window of Plater opened

1	Clean window frame, Clean rubber tube gently if dirty.		

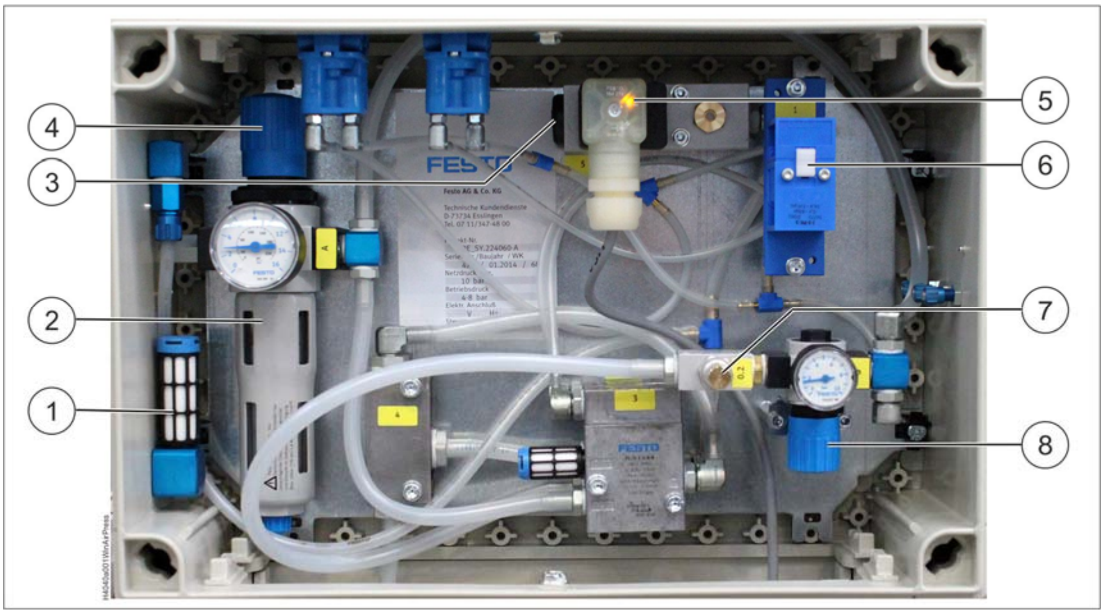
6.7.1.9 Window air pressure control

The windows in the Plater module are sealed by compressed air. The air pipes and the rubber rings in the Plater windows must be free of air leakage. If there is air leakage and subsequently loss of pressure in the pneumatic pipe system (which would lead to leakage of solution), the pressure monitoring system (the transducer in the pneumatic unit) must generate an alarm message at the control PC.

NOTICE

Loss of solution

The alarm at the control PC must switch off the pumps in the Plater before strong loss of solution through the windows can occur.



The 'FESTO' pneumatic control unit

1	Silencer (air release)	5	LED indication (DI signal to the control PC)
2	Condensate bleed	6	On / Off switch
3	Adjustment of switch point	7	Throttle to adjust the flow rate of air (pipe system fill up time)
4	Input pressure control and air filter	8	Output pressure control = seal pressure for windows

NOTICE

Damaged rubber rings

Windows with damaged rubber rings inside the frame (i.e. air leakage) must be replaced.

	NOTICE
	Risk that window frames might brake It is not allowed to set the air pressure higher than permitted, because there is the risk that the window frame(s), which holds the rubber ring, might break.

Principle of the monitoring function:

The pressure transducer switch in the pneumatic control unit recognizes a drop of pressure, if the air flow (air leakage) is too high. An increase of leakage causes a higher loss of pressure. If the switch point is reached, the voltage signal changes from ‘1’ to ‘0’. The control PC generates a fault message and switches of the pumps in the Plater and the rectifiers. (Note that minor air leakages can not be detected by the pressure transducer switch).

- The pneumatic system to seal the windows must always be correctly set up in order to operate reliably. This is done during line commissioning. Those settings should not be changed without instruction from ATOTECH engineers.
- The system pressure (inside the pneumatic unit) is set at the bigger pressure regulator to 3.5 bar. The production line as a whole is to be supplied by 6 bar.
- The pressure for the window seal system is set at the smaller pressure regulator to 1.3 bar (range 1.2 to 1.5 bar). Higher pressure would involve the risk of window frames to crack.
- Filling time for the air seals:
  The time between starting the filling operation (by switching "On") and the change of the diode light should be 20 ± 5 seconds. If the time is outside this range adjust the throttle screw accordingly. Either increase or reduce the rate of air flow.

Hint how to open the windows

► Release air pressure (press respective button)

► Wait for 30 sec. to have the air completely released

► Open screw of window

► Take out window without exerting exessive force (risk of cracking)

Further related information:

- Fault message in VCS „ .. Window open“.
- Electrical wiring diagram of the Plater module

See also

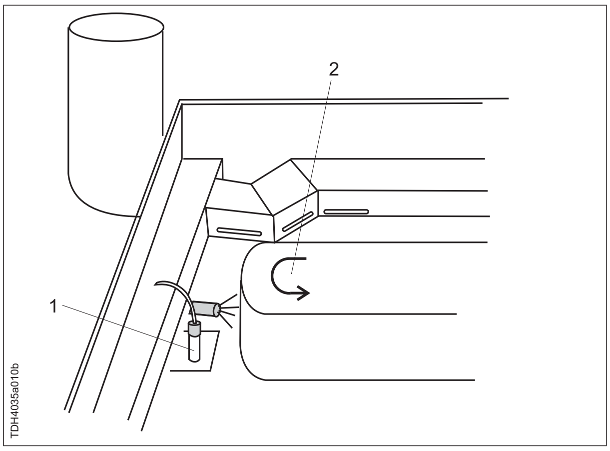
🗎 030030 Check input/output rollers and sealing lips in the Plater [➔ 306]

🗎 030220 Check monitoring of window sealing system [➔ 316]

6.7.1.10 Level minimum monitoring

The level switches for level minimum are mounted in the input and output area of the Plater.

Their purpose is to monitor the bath level in the anode area.



Level switch

1	Level switch for level minimum	2	Clamp drive (input side)

The upper anodes must always be covered with electrolyte when the rectifier is switched on. If the bath level drops below the upper edge of the upper anodes a fault message is generated by this level switch.

With the level too low the rectifier and the pump for electrolyte circulation in the metal stripping area will switch of.

The two level switches (one in the input area the second in the output area) must be adjusted accordingly during plant commissioning and in case they have to be removed for maintenance or repair work.

i	**INFORMATION**
	Refer also to fault message “40 working level minimum”.

6.7.1.11 Roller spraying system

The Plater is equipped with a roller spraying system at the input and output side.

!	**NOTICE**
	Risk of damaged panels The input and output rollers in the Plater have to remain free from crystallisation to prevent damage on the surface of the boards.

This roller spraying system cleans the input and output rollers with DI water over an pre-adjusted time interval, and removes crystallisation of the electrolyte.

Spray intervals in automatic operation:

- There is one spray interval when the pumps are switched on or off (when the bath level raises or decreases).
- After the pump for the bath circulation is running, the water valves are automatically switched on and off (parameters for waiting time and spraying time).

Manual operation:

For inspection purposes and for additional cleaning operations the corresponding valve at the input and output side of the Plater can be switched on / off at the control PC.

Spray quantity:

The nominal value of spray quantity per nozzle is 1 litre per minute (at a pressure of 2 bars). This corresponds to 6 litres per minute or 360 litres per hour when 3 nozzles and two spraying devices are in operation. Furthermore, the spray quantity is decisively influenced by the spraying interval (percentage = spray time / waiting time + spray time).

Maintenance:

Observe the spraying characteristics so as to clean the nozzles as soon as necessary or try to find out the reason for a possible fault if it is out of function.

6.7.1.12 Carbon treatment of the electrolyte

General information and preparation

Whether it is necessary to clean the electrolyte by means of activated carbon depends on the Total Organic Content (TOC). The decision is to be made by process engineers in consultation with the production management.

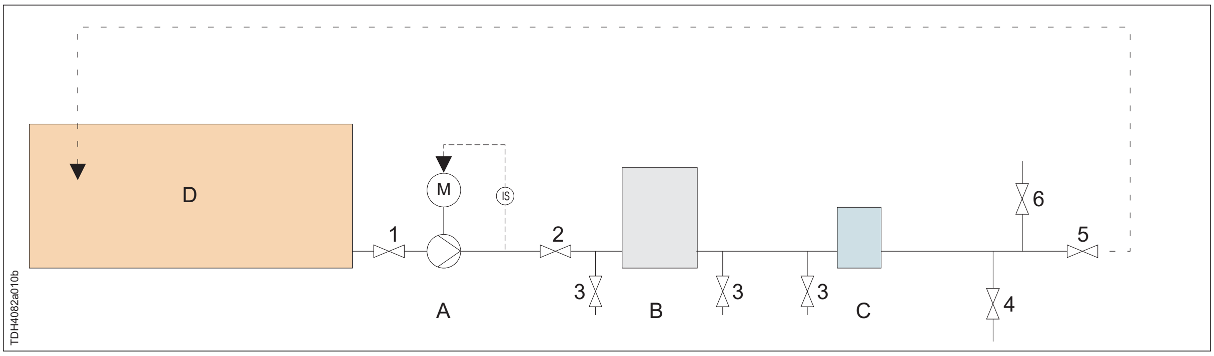
It is recommended to carry out the carbon treatment at TOC of 2,5 g/l and higher. This could be between once in 3 month to once a year.

Another indicator that points out the need for this preventive maintenance action is copper deposition at parts in the Plater.

Cleaning circuit with electrolyte remaining in the Plater

In case that there is no Holding Tank installed or a transfer to it not necessary, the solution can be cleaned while remaining in the Plater.

The following schematic represents a part from the P&I diagram. The carbon treatment circuit includes the Plater (opposite to the Holding Tank as the other option).



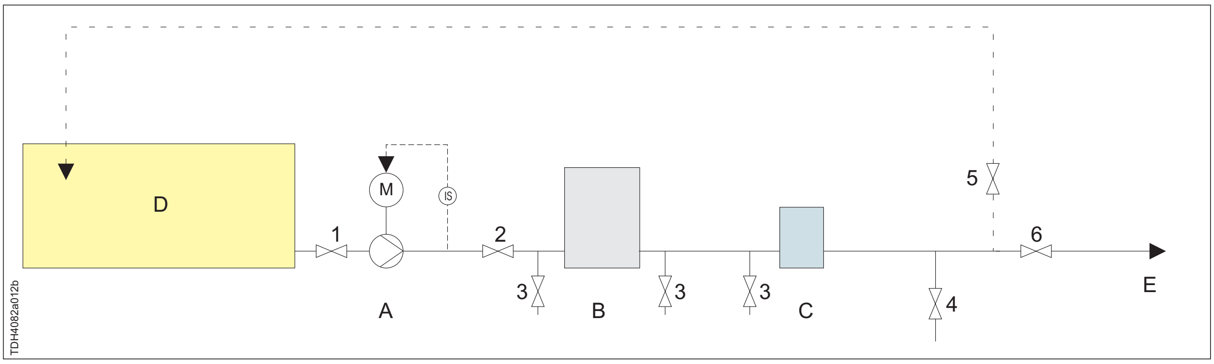
Schematic of flow circuit through Plater

A	Centrifugal pump	C	Cartridge filter
B	Activated carbon filter	D	Plater

Cleaning circuit with electrolyte in the Holding Tank

Cleaning of the electrolyte in the Holding Tank can be carried out at the same time when maintenance or repair work in the Plater is done and the electrolyte is transferred for this reason anyway.

The following schematic represents a part from the P&I diagram. The carbon treatment circuit includes the Holding Tank (opposite to the Plater as the other option).



Schematic of the cleaning circuit through the Holding Tank

A	Centrifugal pump	D	Holding tank
B	Activated carbon filter	E	to the Plater
C	Cartridge filter		

Type of activated carbon to be used

We recommend to use activated carbon of type „Hydraffin DG 47“, available from Atotech Feucht, order No. 08590218.

i	**INFORMATION**
	In any case use granulated active carbon material according to specification, and not carbon powder!

Important general instructions

	INFORMATION
i	To prevent that manual valves are set wrongly or automatic valves are mal-activated by mouse click, it is important and necessary to make yourself familiar with - the designation of the electrical parts (in VCS, P&I, at the real installation), - the representation of the pipe work in the P&I diagram and in the VCS process window, - the pipe work directly at the plant (Plater, Holding Tank, filter units).

	NOTICE
!	**Pump activation** The lids of the filter units must be closed and tightly locked before pump activation!

	NOTICE
!	**Risk of damaged pump** The centrifugal pump must not run longer than five seconds without liquid!

- The centrifugal pump must not run longer than one minute against a completely closed valve or flow obstruction! Regarding this, crosscheck with the supplier (OEM) documentation for the installed pump (Sager&Mack).
- When the pump is running, never close a valve at the suction side.
  At pressure side, alteration of manual valve settings should be made gradually and not suddenly.
  As far as pneumatically controlled valves are concerned, stop first the pump and then close the valve.
  Before you start the pump, first open the valve and then start the pump.
- Check continuously the activated carbon filter unit for leakage.
- The purpose of the PP cartridge filters is to hold back carbon particles. It must be ensured that carbon particles won't come in the Plater or Holding Tank while activated carbon treatment is carried out!
- Clean filter units and rinse pumps and filter units after the carbon treatment is finished.

Preparation – Filling of filter bags with active carbon

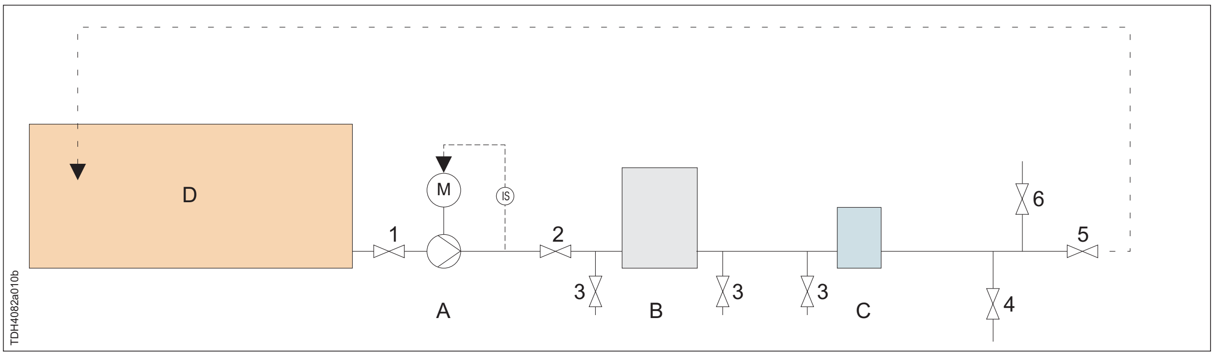
a) The filter units and piping must be checked for cleanliness. If necessary clean and rinse with DI water. Drain off the water through the valves represented as valve 3 in the schematic.
b) Fill about 12 kg active carbon of the required specification into the filter bags (2 sets, in total 4 bags, are delivered with the active carbon treatment unit), close them up with an acid resistant ribbon.

c) Put the bags into the two filter housings.
Be aware, that both slopes of the filter bags are on the top, otherwise it will be difficult to remove the bags after the treatment is finished!

Equipment status prior to start

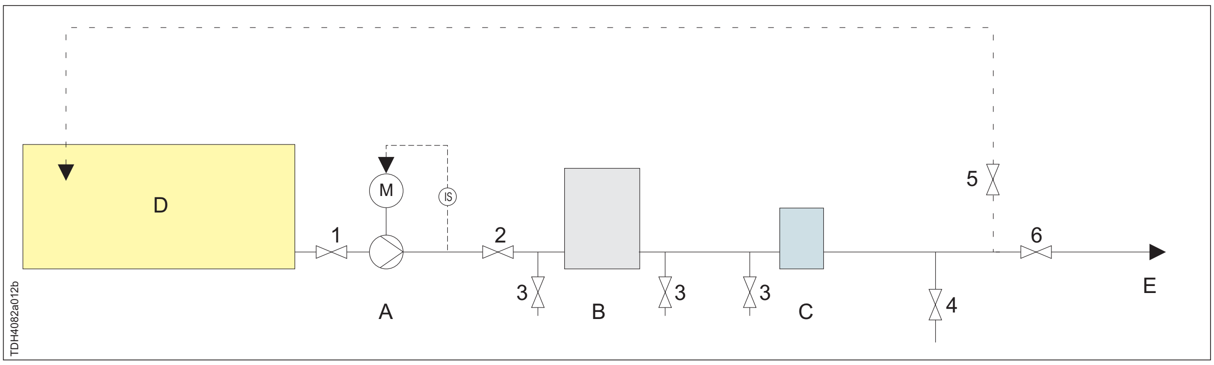
- The pore size of the filters used in the cartridge filter unit must not be bigger than 10 µm (ideal: 1 µm).
- The filter unit and the cartridges are clean. Make sure that the filter unit is closed tight and that the sealing is not damaged.
- The carbon filter unit is filled with new activated carbon and the lid tightly closed.
- The line is in 'manual mode' of operation and must remain in this mode.
A notice at the control PC informs operators that the electrolyte cleaning with activated carbon is ongoing.

6.7.1.12.1 Cleaning steps



Schematic of flow circuit through Plater

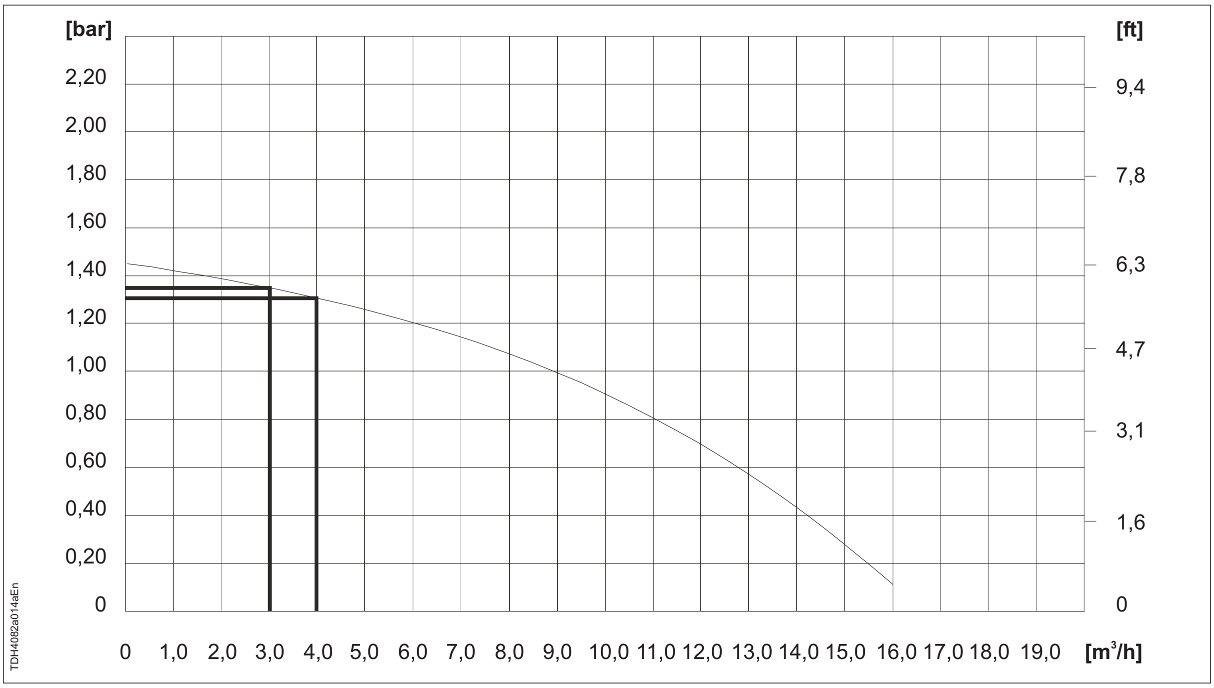
A	Centrifugal pump	C	Cartridge filter
B	Activated carbon filter	D	Plater



Schematic of the cleaning circuit through the Holding Tank

A	Centrifugal pump	D	Holding tank
B	Activated carbon filter	E	to the Plater
C	Cartridge filter		

1. First of all, make yourself familiar with the position of the valves in the real pipe installation. Please note, that the valve designation in the schematic above (Valve 1 to 6) is only used here to illustrate the description.
   View also the VCS process control window to find where pneumatically controlled valves and the pump must be clicked.
   Before starting the pump, first carry out the next steps.
2. Open all the valves on the suction side of the pump (in the schematic represented as valve 1) and its pressure side (see schematic, valve 2).
3. Wait at least 30 seconds, until the piping system is filled with solution. The pump must never run without liquid. Check the filter system for leakage.
4. Set the valve at the pump pressure side (valve 2) to be about one third open. Valve 5 is closed. Open one of the valves represented as valve 3 slightly, to allow air release and catch the first liters of electrolyte in a container.
5. The pump must not run for more than a maximum time of five seconds without liquid to avoid damage! Before starting the pump ensure that all the valves at the suction side are open. For test purposes stop the pump again after 3 seconds. If there is no pressure increase and liquid flow yet 3 seconds after having started the pump, check whether the supply on the pump suction side is unblocked (valve open, etc.).
   Start the pump again, if the liquid flow and pressure was rising as expected within the first seconds.
6. To verify that no carbon particles pass the cartridge filter, and reach the Plater, take out a sample of solution at the valve 4 and examine for carbon particles.
   If preparation work was not performed well and particles are detected, the filter inserts must be removed and the filter type must be checked. The filter and piping must be rinsed with DI-water. Drain off the water through the sample valve 4.
   Afterwards refit the cartridges, clean the seals and close the filter tightly.
   It must be ensured that carbon particles won’t come in the Plater!
7. See the pressure-flow rate characteristic below: The appropriate working range is at 3 to 4 m3/h (about 60 l/min at 1,3 bar).
   To adjust the flow rate accordingly, close all the sample valves, open valve 5, click on valves and then the pump for starting the circulation and adjust the valve on the pump pressure side (valve 2).



Pressure vs. volume rate for a centrifugal pump

8. The activated carbon treatment takes about 5 hours. The reduction of TOC should be checked within this time. It might be necessary to replace the bags with activated carbon by new ones when the carbon is saturated with organic.
9. Switch off the pump and close all valves.
10. Open valves 3 and 4 to take away pressure in the filter units, then open the filter units and take out the activated carbon bags and the cartridge filters. Dispose of the activated carbon.
11. Either you can continue with the next step or you put new carbon bags in the filter unit and go back to the previous steps continuing with carbon treatment.
12. After the carbon treatment is finally finished clean the filter units. The seals have to be cleaned and the filter unit tightly closed.
13. Rinse the pump, pipework and filter units to prevent crystallization. This is necessary due to the relatively long period to the next carbon treatment maintenance action.
    How it can be executed the best way varies strongly between all types of installation.
    In principle the rinse circuit includes a container with rinse water, the pump, the filter units (for rinsing without carbon and PP cartridges). Valves must be set accordingly to build the closed circulation loop.
    Remember that this type of pump must not run dry and also not run against a closed valve at the pressure side for more than one or two minutes!
14. After rinsing, it is advised to put new cartridge filters. The cartridges must be fitted correctly, i.e. ensure that the sealing at the cartridge ends fit correctly.
    The cover seal must be cleaned and the cover must be tightly closed.
15. Finally all valves must be tightly closed, including the valves for taking samples (3 and 4).

6.7.1.12.2 Cleaning of the transfer pump and pipe work

After finishing the electrolyte treatment, i.e. when the electrolyte has been pumped back from the holding tank to the module, all pipes and the transfer pump have to be cleaned with DI water to avoid crystallization. These sediments would damage parts inside of the pump and can cause breakdown or malfunctions at the next cleaning cycle. Rinsing is necessary due to the relatively long time till the carbon treatment is carried out next (operation only once in 3 month to once a year).

How to proceed:

a) Fill holding tank with DI water (approx. 300 l).
b) Set valves to make a closed circuit: Pump through Holding tank and back.
c) Switch on transfer pump for circulation and rinse for 5 to 10 minutes.
d) Dispose of DI water

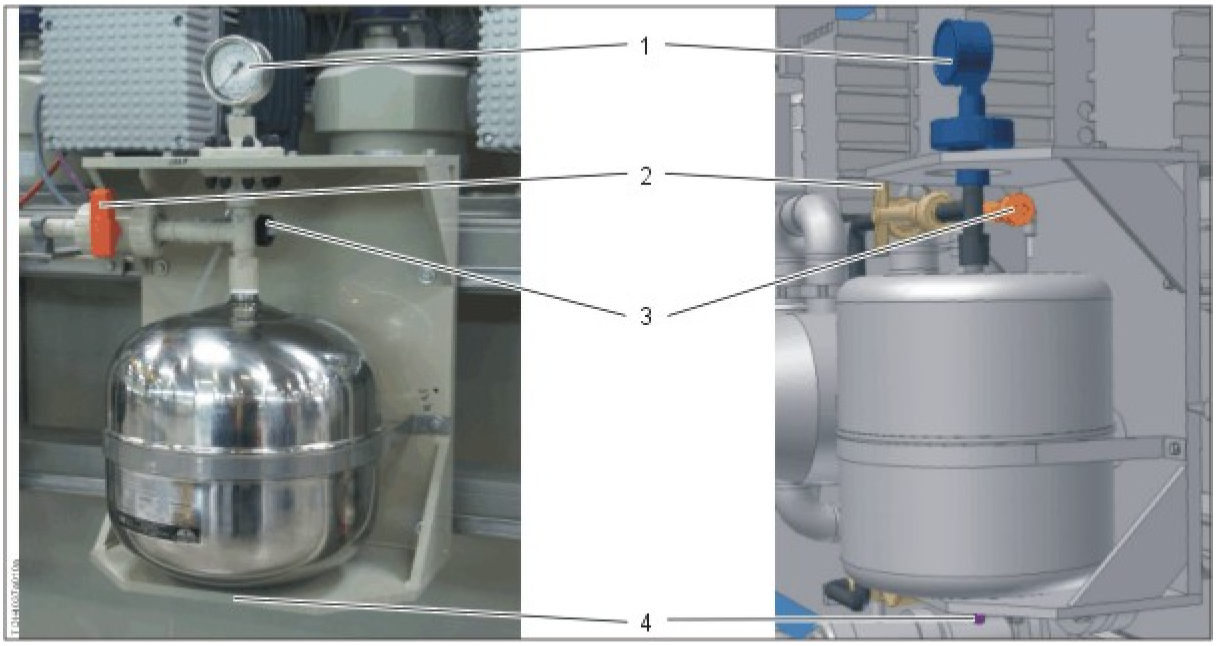
6.7.1.13 Plater – Cooling Water - Pressure Compensation Vessel

NOTICE

Cracks and leakages

The pressure compensation vessel is a safety device. It helps to prevent the development of cracks and subsequently of leakages, not only of cooling water into the bath, but also - more important – of chemical solution into the cooling water system.
The risk that the water pipe system might get a crack at any spot by over-pressure is distinctly reduced by a properly working pressure compensation vessel!

The regular water pressure is between 2 and 5 bar (maximum limit 6 bar). If the pressure indication at the gauge is out of this range, execute the instructions given below.



Pressure compensation vessel for the cooling water in the Plater

1	Pressure gauge	3	Air and/or pressure release valve
2	Manual valve (open at regular operation)	4	Gas pressure retention valve

Principle of operation:

In the center of the vessel there is a horizontally fixed and expandable membrane. It separates the cooling water from a compressible gas (the cooling water top side / Nitrogen* gas or Air* at the bottom side).

(* Nitrogen is used by the manufacturer 'ZILMET' as more suitable than *Air, because it is a comparatively sluggish gas and penetration and loss of pressure through the membrane is less. However refilling is also possible with air. The essential point is, that the gas/air pressure is kept in the required range. See also the maintenance instruction below.)

The system inherent fluctuation of temperature in the cooling water goes together with fluctuation of pressure. The pressure increase (caused by an increase of temperature) is compensated by the volume of gas (Nitrogen or Air) in the vessel, since gas is compressible (contrary to water).

This means, that the membrane is stretched down/up if the water temperature and pressure in the pipe system increases/decreases.
(Note: To measure the pressure of the gas, we first must get rid of the water pressure on the top side of the membrane. See also the maintenance instruction below).

Regular operation:

For cooling the solution in the Plater, two valves are automatically opened to let the cooling water flow through the cooling system in the Plater. At this moment the indicated water pressure at the vessel is relatively low (the membrane is pressed by the gas to some extent to the upper side of the vessel).

After the bath is cooled down (actual temperature equal or slightly smaller than the set temperature), the two valves are automatically closed.

Now the water is gradually warming up in the cooling pipe system. This means also that the volume of the water between the two closed valves is expanding. This expansion is now compensated by the compression of the gas in the bottom half of the vessel. Cracks in the pipe system are prevented, if a sufficient volume (and counter pressure) of gas is in the vessel.

Maintenance (6 month): Check the gas pressure in the expansion vessel

As a rule the correct pressure of the gas P_{GAS} is about 3 to 4 bar. It is to be set in relation to the water pressure of the cooling system (project- and Plater-specific).
Since the water pressure is fluctuating, it should be related to the specific water pressure P_{FLOW}, when the cooling water is flowing or just after the two valves have closed.
P_{GAS} should be about 20% higher than P_{FLOW}
($P_{GAS} = 1.2 \times P_{FLOW}$).

If the pressure of the gas is too low, the compressible gas volume is too small.
If it is too high, the membrane is made too hard to perform the required pressure compensation.

Checking firstly the pressure of the water:

1. The regular case should be like this: While the 2 valves are closed and therefore the temperature of the cooling water is increasing, the water pressure indication will increase. It is not supposed to reach more than 6 bar (upper limit).
2. Should the water pressure rise to values as high as 6, 7 or 8 bar or even higher, then this must be regarded as a fault indication.
   Possible causes: No gas in the vessel or membrane defect, etc..
3. Should the indicated water pressure be zero or below 2 bar (bottom limit) and not rise beyond this bottom limit, then the water pipe system is most probably cracked at any spot (assuming that the cooling system is working well and that the manometer is not defect). In this case the cause of the problem must be found !

Checking the pressure of the gas:

1. Close the manually operated valve (Pos. 2, see picture above) and open the pressure release valve (3), this way taking away the water pressure at the top of the membrane in the vessel.
2. At the bottom of the vessel first unscrew the protective cap. Then open **briefly** the Gas Pressure Retention Valve (4). If gas/air is coming out, we can continue with the next step. If water is coming out, the membrane is defect. Then the vessel must be replaced (See description below for this latter case).
3. Press a gas manometer against the valve (in the same manner as the air pressure of a car tire is measured) and read the indicated pressure.
   If the measured pressure is a) in the range as specified above and
   b) later on during production the water pressure will fluctuate in the range as described above, then the pressure compensation system is set correctly and the vessel can fulfill its safety function.

However, air* must be refilled, if the pressure of the gas P_{GAS} is less than P_{FLOW}.(= water pressure, when the cooling water is flowing or just after the valves have closed).

* Nitrogen is used by the manufacturer 'ZILMET' rather than air, because it is a comparatively sluggish gas and penetration and loss of pressure through the membrane is less. However refilling with Air* is also possible The essential point is that the gas/air pressure is kept in the required range.

New vessel in case of a defect membrane

Since the vessel must be seen as a safety device, it is not permitted to run production if there is no air / gas in the vessel or if the membrane is defect.

The ZILMET vessel delivered by ATOTECH is made of stainless steel because of corrosion resistance. In case that a new, genuine vessel (manufacturer 'ZILMET') is not on stock, you may bridge the delivery time by using a commonly used expansion vessel of the same or similar specification (especially with regard to volume and maximum pressure).

For a few days or weeks, the criteria corrosion resistance can be neglected, however, as soon as the ZILMET vessel has arrived, it must be installed to replace the intermediately used auxiliary vessel.

See also

🗎 030280 Attend to the pressure at (and in) the pressure compensation vessel [→ 319]

6.7.2 Cu InPulse2

Atotech Inpulse2 Platers have a number of advantages over the Atotech Inpulse1 Platers, mainly the capability of plating thin foils with thin copper clad.

The schematic below shows a cross-section of an Inpulse2 Plater.

The cabinets with the Pulse Devices inside are positioned sideways to the Plater and not on top of it, leaving space for more easy Plater maintenance.

The main parts of the Plater are marked by color in this schematic.

Features

- Optimized solution flow: Frequency controlled pumps, use of spray nozzles, returning flow quantity adjustable by manually operated valves.
- Minimized distance between anodes and circuit boards
- No anode shielding required
- Possibility to control and monitor 112 independent electric circuits individually: 112 Pulse Generators for 2 times 14 anodes times 4 anode segments each
- Exact calculation and control of anode currents: This is executed individually for each anode segment, depending on the overlapping area of PCB and anode segment

- Due to the individual current control of the Pulse Devices and anode segments, we can process PCBs with different job parameters simultaneously in a Plater. The required gap between two jobs is less than one meter
- No dummy boards required between two jobs
- No clamp blowing mechanism required, however as option still available: If there are no PCBs to be clamped (presence of gaps), the clamps needn’t be kept open. The electric field lines are concentrated just between the PCBs and the anodes. Besides that, the clamp contacts are wider than the 10 mm gap between two PCBs
- Guided fluid circulation results in a reduced oxygen drag-in and therefore a reduced Redumat capacity
- Widened contact area of clamp contacts (rectangular shape instead of circular pin)

6.7.2.1 Pulse shaped current and radiation

	WARNING **Electromagnetic radiation! Risk for people with heart pacemaker!** Stay away at least 5 m.

**For people who have a heart pacemaker implanted, it is not permitted to stay or work next to the Pulse Plater (InPulse1 or InPulse2) or go in the forbidden area
(5 meter vicinity to Plater, Pulse Device cabinets and connecting cables).**

Context:

The pulse shaped current is supplied by the pulse devices (installed in cabinets).
It is transferred to the anodes in the Plater via cables. The pulse shaped current in cables is emitting electromagnetic radiation of high frequency. The closer a person is next to an active supply cable, the higher is the risk of influence on a person with a weak heart.

Further general notes:

- Conformity with EMC regulations is given: Protection of machines and people against electromagnetic radiation according to regulations of the Association of Electrical Engineers.
- Measures to reduce the inductivity and radiation: Parallel laying (twisting) of the two supply cables (+ / -) of each and every anode segment.
- Radiation is kept within the required limits for healthy people.
  Nevertheless: Very close to the cables, the limits may sometimes be reached or even exceeded.
- Do not stay close to the supply cables and cable connecting joints during production for a long time without need.

6.7.2.2 Dummy Panels in InPulse2 Plater systems

The discussion, whether dummy panels are needed in InPulse2 Platers or not, will arise from case to case. This description serves as a guideline, of how progress can be made.

a) Generally there are no dummy panels needed in InPulse2 Platers.

Technological background: The distance between anodes and PCBs is close, with the effect of concentrating the electric field just where the panels are moving. By means of the panel tracking system and PLC logic, the anode currents are automatically set (real-time control).

a) If measurements show, that the surface distribution of a first and a last panel of a job (batch) is not sufficiently even, one dummy panel each side, at the beginning and at the end of a job (batch), must be used.
b) These two dummy panels must be of the same specification as the production PCBs (same width, length, copper clad thickness, fine line structure, etc.).

This last instruction must be applied, especially if the copper clad is rather thin.
If it will be ignored, it may happen, that the surface distribution of the first and last production panel of a batch (i.e. adjacent to the dummy panels) is not in the specified range (for example, because of the different side-to side conductivity due to the different copper clad of the adjacent dummy/production panel situation).

a) An analysis of the specific situation (type of panels, production parameters, etc.) can probably lead to a case-specific solution. If measurements show, that the plated thickness at defined points on the first and last PCB (or dummy panels) are out of the acceptable range, please contact ATOTECH for finding possible causes and adequate counter-measures.

In a common approach it may well be possible to find a solution with the objective, to make the use of dummies obsolete. (It may be sufficient, just to fine-tune one or the other production or machine parameter).

a) However, in order to make progress - based on facts rather than assumptions -, the test conditions, the results and their evaluation must be described and shared.

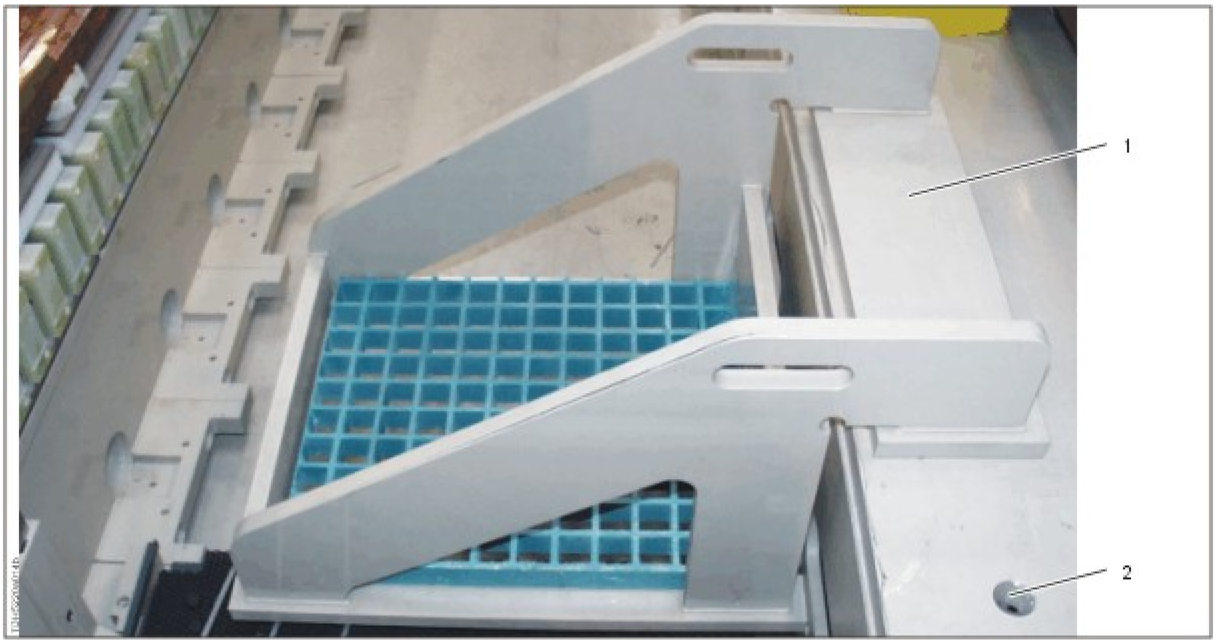
This effort can well pay out, if the counter-measures are finally successful and therefore the use of dummy panels may not be necessary any more.

6.7.2.3 Access boards for maintenance work

i	INFORMATION
	For work inside the Plater, maintenance personnel mustn’t step directly on the foil guide plates at the anodes.

The picture below shows the type of access board constructions that are used for the Inpulse2 Plater generation.

The access board constructions are hooked in the peg holes at the operator side of the Plater.



Access board constructions for maintenance work in the InPulse2 Plater generation

1	Maintenance access board	2	Peg hole

This type of access boards is designed for both directions of transport:

- Right-To-Left (R-L) as well as

- Left-To-Right (L-R);

this is in contrary to the Inpulse1 Platers

6.7.2.4 Fluid delivery and working level above anodes

The bath level above the anodes

During production, when the Pulse Generators are active, the solution must cover the upper anodes completely and reliably.

> **NOTICE**
>
> **Bath level in the anode area**
>
> The bath in the anode area should not be above the anode frames. The level must be a few mm below the upper edges of the anode frames so that the anode frames are still visible.

With this rule we meet the following requirements:

- The solution (turbulence, splashes) shall not reach the cathode rail causing troubles with regard to the current flow of the clamps, also minimzing the cathode rail maintenance.
- Besides that the level in the sump must be below the bottom edge of the windows of the Plater, when all pumps are switched off

The level above the anodes adjusts itself as a result of

- the flow rate of the fluid being fed to the anode area (by all pumps except M03.6) and
- the flow rate of the fluid returning back to the sump (adjusted
  a) by manually operated valves and
  b) by three holes at the rear side of the Plater in the intermediate floor at the end of the stripping section)

The valve position influences the return flow back to the sump. The level is raised by closing the valve and is lowered by opening it. The proper adjustment is done during line commissioning.

Fluid delivery by pumps

The spray system above and below the anodes is supplied by eight frequency controlled pumps. Altogether there are eleven pumps installed.

Pump designations	Purpose
Pumps M03.2 and M03.3	Supply of upper spray nozzles at the input side of the Plater
Pumps M03.4 and M03.5	Supply of upper spray nozzles at the output side of the Plater
Pumps M03.7 and M03.8	Supply of bottom spray nozzles at the input side of the Plater
Pumps M03.9 and M03.10	Supply of bottom spray nozzles at the output side of the Plater
Pump M03.6	Circulation of solution in the sump and filtering of solution, also running in the heat-up phase
Pump M03.1	For solution flow in the stripping area for agitation, this way improving the clamp stripping performance with direction of flow against direction of clamp movement towards drive motor side
Pump M03.11	Supply of the pair of AFDs (Advanced Fluid Device) at the input side of the Plater

The appropriate frequency of the pumps is adjusted during line commissioning. Any change of frequency would change the flow quantity and the fluid level above the anodes.

Setting of valves for the fluid return flow

Manual valve for the adjustment of fluid return flow during line commissioning

1	Manual valve

The manual valves at the window side are for flow control in conjunction with the pump frequency. The pump frequency and the return flow valves are adjusted once during commissioning.

As a general rule, the valve adjustment should not be changed, after they were properly adjusted.

Thin foils and reduction of flow rate:

Smaller pump frequencies than the nominal one (e.g. 35 or 40 Hz instead of 50 Hz) are just useful and appropriate, if thin foils are processed in order to ensure a safe and reliable transport of the foils through the Plater.

Atotech software commissioning personnel design in the VCS system one or several Job Administration Programs, especially for the production of thin foils, which after that, are used by the operators for thin material jobs. Pump frequency parameters are part of such a list of program parameters.

If a job of high pump frequency is followed by a job of distinctly smaller frequency, the level in the anode area would also be distinctly less (may be even 50 to 100 mm) if there are no appropriate counter measures to reduce the return flow adequately.

For this case there are

- firstly, three holes at the rear side of the Plater in the intermediate floor at the end of the stripping section, which can be closed to rise the bath level or opened to lower it.
- secondly, manually operated valves at the window side of the Plater installed in the fluid return pipes. They are adjusted during commissioning for the commonly used category of Job Administration Programs (with regard to thickness PCBs and frequency of pumps).

i	**INFORMATION**
	In case that the fluid level above the anode mesh is not sufficient (due to a lower pump frequency for the sake of safe transport), then the second of the three holes in the stripping area should be closed as the first counter measure. Please remember to correct this modification after this category of jobs with the low frequency is completely processed (prior to running other jobs with higher frequencies).

In case that the first counter measure (closing of fluid return holes with lids) is not sufficient to raise the level to the required level, the second measure could be, to partly close the manual valves at the window side.

However, it is strongly advised to mark first the initial valve setting, so that the alteration is later on reversible with little effort.

!	**NOTICE**
	Bath level in the anode area The operators must reverse any alteration, immediately after the one category of jobs is completely processed. The operators must also inspect the bath level above the anodes, each time when any valve setting was changed.

In principle, the change of valve settings should be avoided as far as possible, not only because of the working time necessary, but also because of other possible effects, like the influence on the flow rate from clamp to window side above and below the produced PCBs.

i	**INFORMATION**
	Alterations are therefore not recommended without prior consultation of Atotech personnel.

See also

🗎 Level minimum monitoring [→ 191]

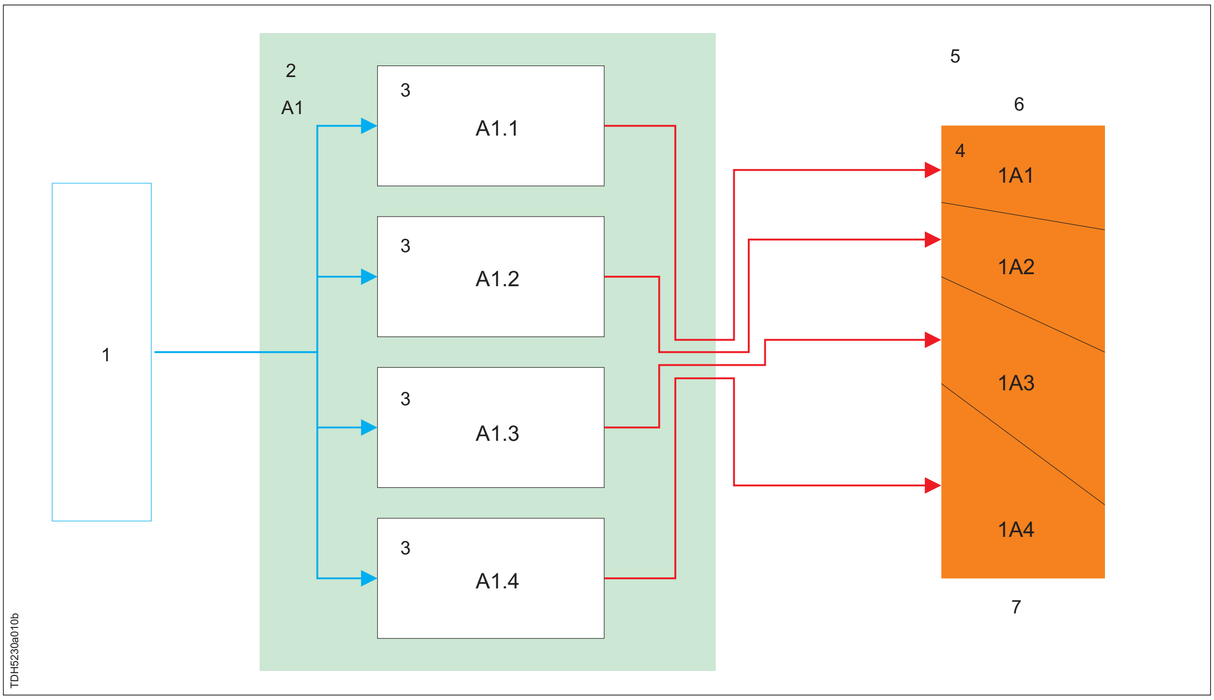
6.7.2.5 Electrical Design

6.7.2.5.1 Pulse Devices and Pulse Generators

A Pulse Device ‘PD’ contains 4 Pulse Generators for the supply of 4 anode segments (in one anode basket). Altogether there are 28 anode baskets in the InPulse2 Plater, 14 above the clamped panels (working area) and 14 below of them.

Each Pulse Device has its own power supply with separate circuit breakers.

The Pulse Generators deliver forward | reverse pulses.



Schematic of the electrical power supply for an anode basket wit 4 anode segments

1	Main power supply	5	Schematic of an anode basket in the Plater
2	Pulse Device in el. cabinets	6	Clamp side in the Plater
3	Pulse generators	7	Window side in the Plater
4	Clamp side anode segment		

Design of anode segments:

This design ensures optimized surface distribution.

At clamp side: Anode segments designated as 1A1 to 14A1 and 1B1 to 14B1, relatively small area, supplied by less electrical current (same current density).

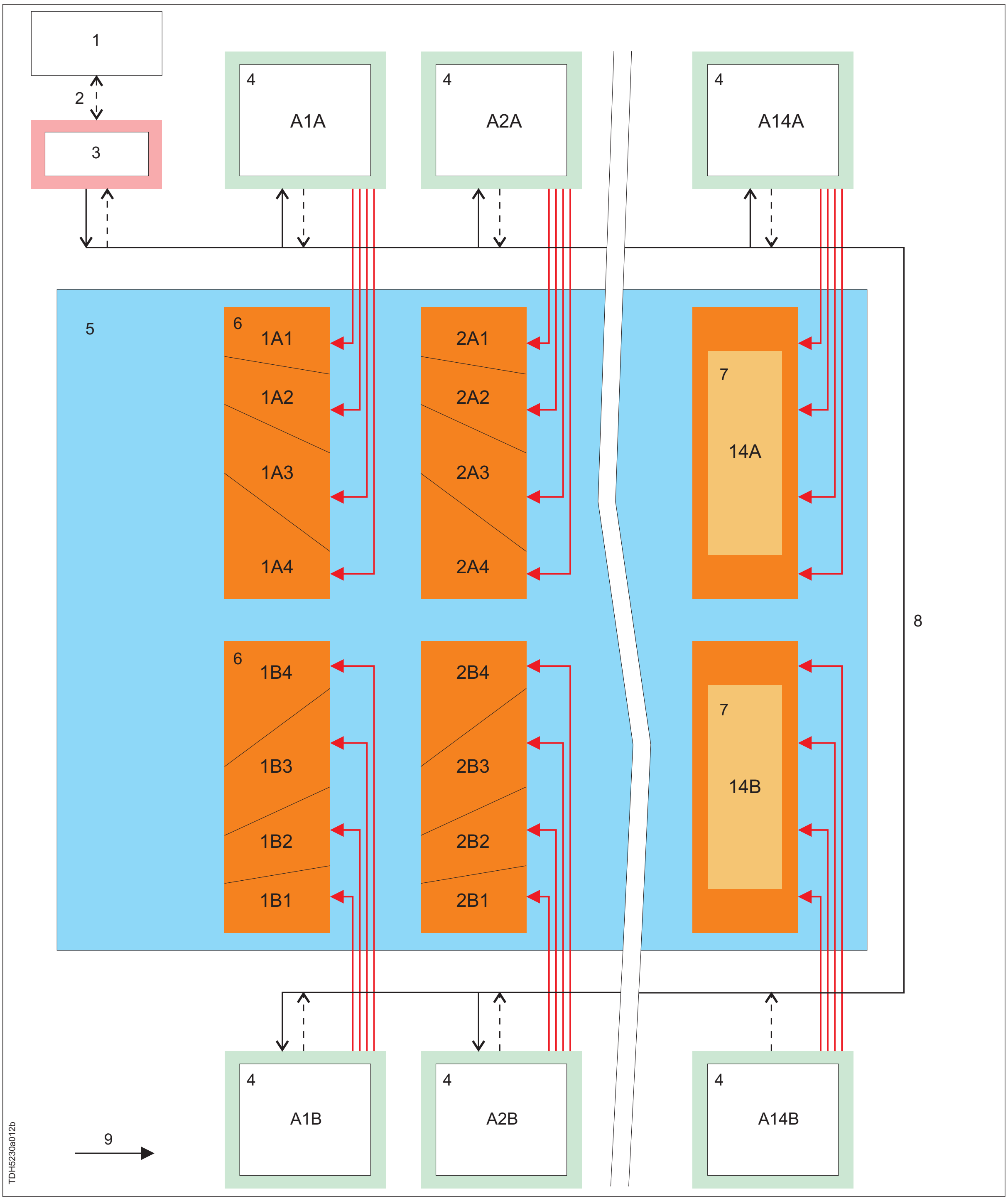
At window side: Anode segments designated as 1A4 to 14A4 and 1B4 to 14B4, relatively large area, supplied by more electrical current (same current density).

Pulse shape of pulse devices (current vs. time):

For a pair of quadruple anodes (pair of baskets above and below), the pulse shapes are identical, only the phase shift for the top anode and the bottom anode may differ (by 180°).

6.7.2.5.2 Pulse Devices and Anodes in the Plater

See schematic below: For each Plater there are 28 Pulse Devices ‘PDs’, 14 for the upper anodes and 14 for the lower ones. The PDs are placed in a row of electrical cabinets next to the Plater.



Pulse switch gear (in electrical cabinets) and anode designations

1	Power supply	6	Segmented anodes
2	Connection cable	7	Non segmented anode (only if installed)
3	PC (Visualization & Control System and PLC)	8	Bus system (signal exchange)
4	Pulse Devices	9	Transport direction
5	Schematic of Plater		

The cabinets for the Pulse Devices are equipped with a water cooling system. Connections for a water cooling system are installed at each electric cabinet on the bottom rear side.

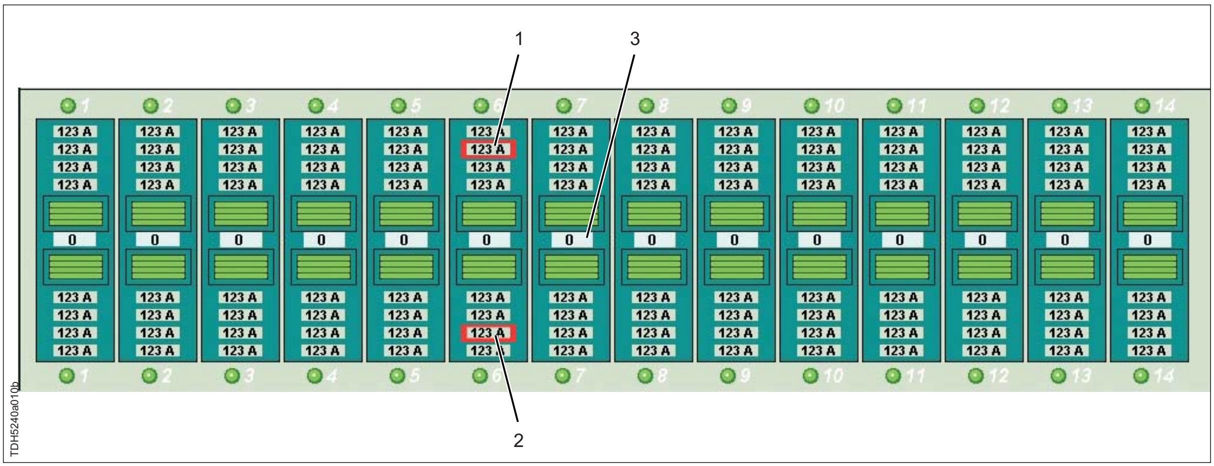
The Pulse Devices are intrinsically safe, i.e. they protect themselves from possible over-current and over-voltages.

At the computer (with VCS installed) we control all the Pulse Generators (individual control as well as synchronization of pulse shapes and monitoring them). It is, for example, possible to switch each Pulse Device individually from pulsing current mode (AC-mode) to direct current mode (DC-mode) or to apply so-called CDA-Factors (current density adjustment for optimization of surface distribution).

6.7.2.6 Visualization and Control System (VCS)

6.7.2.6.1 Display of the average anode currents

Current calculation and monitoring is continuously executed for each anode segment (anodes A1 to A14 and B1 to B14, with four segments each).



Current display in VCS, actual average current of each anode segment

1	Anode segment A6.3	3	Job no.
2	Anode segment B6.3		

This process overview window in VCS gives the possibility to view the average current of the anode segments for observation and analysis (altogether 112 values, 14 anodes above, 14 anodes below, 4 anode segments per anode).

The operator can easily recognize

- actual gaps between jobs in the Plater (no current flow through a pair of upper and lower anodes)
- actual position of the leading or the last PCB of a job (increase and decrease of current at a pair of anode segments adjacent to the gap)
- the actual currents for the upper and lower anode twin segments (for example, segment A6.3 in comparison with B6.3)

Definition of current values:

The definition of the entire ‘average’ current value I_{Avg} is to be distinguished from ‘peak’ values, as well as from ‘average reverse’ and ‘average forward’ values

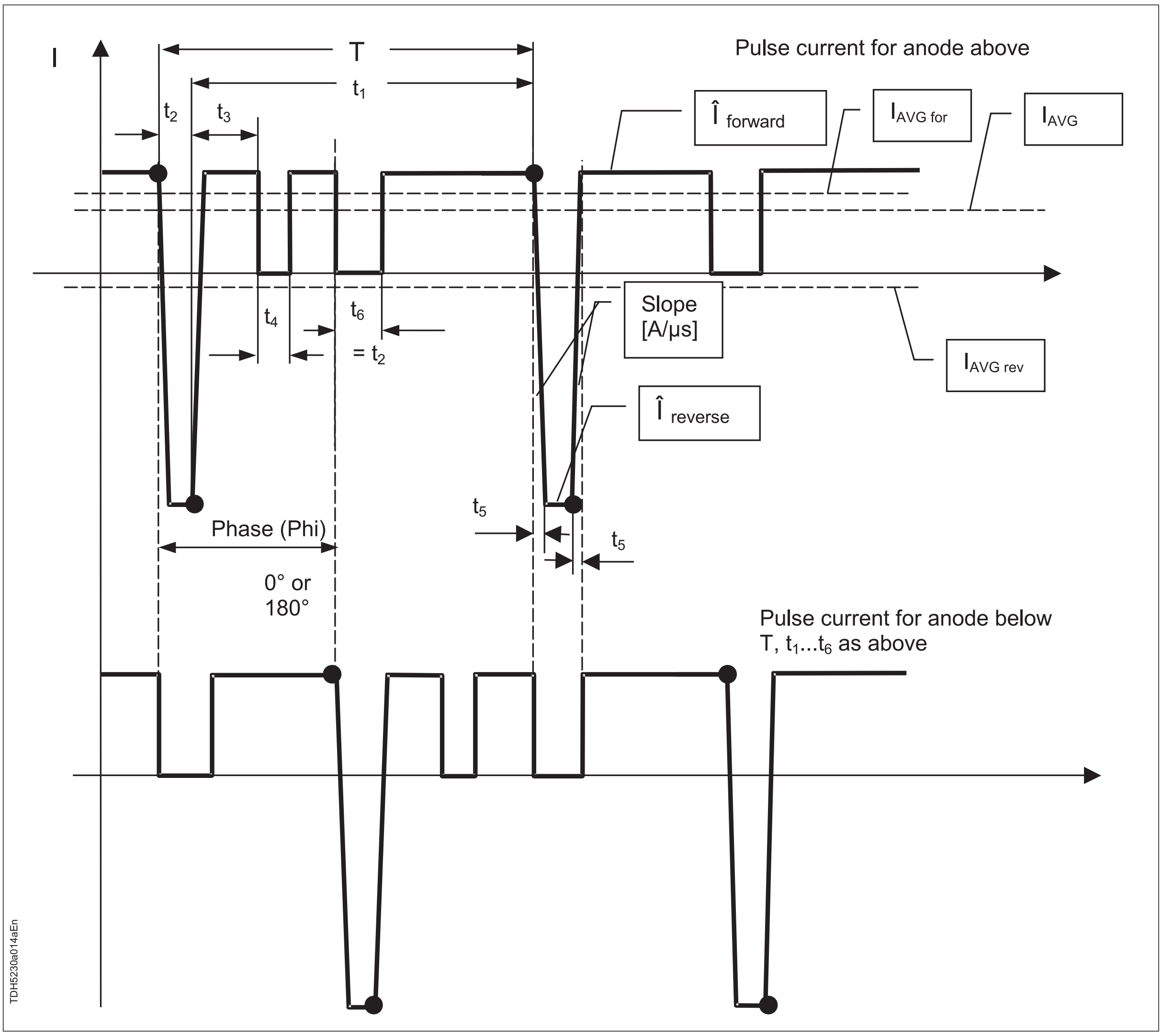
($I_{Avg} = I_{Avg\ For} - I_{Avg\ Rev}$).

I_{Avg} is obviously (by definition) less than ‘average forward’ value $I_{Avg\ For}$ and also less than the forward peak value.

See also

- Pulse shape, current and time parameters [→ 211]
- Display of anode currents for observation and analysis [→ 216]
- Display of the Pulse Device voltages for observation and analysis [→ 217]

6.7.2.6.2 Pulse shape, current and time parameters



Pulse shape, current and time parameters

The current shape is designed and defined at the control PC in VCS-Job-administration.

It is essential to understand the definition of each current and time parameter for the designation of each pulse shape.

Meaning of letters for the design of a pulse in the VCS

T → Periodical time (time between begin of two reverse pulses)

t_1 → Forward pulse time (plating time)

t_2 → Reverse pulse time (etching time)

t_3 → Start time of forward pulse break

t_4 → Forward pulse break time (duration of the pulse break)

t_5 → Pulse raising and falling time for 500 A (dependent on slope S = 500 A/t_5).
The higher this time the less the slope S (in Amps/microseconds).

t_6 → Forced pulse break time ($t_6 = t_2$ during phase shifted reverse pulse)

S → Slope (pulse gradient in Amperes per microseconds,
relation with t5: S = 500 Amps/t_5)

Phi → Phase shift (between current reverse pulses for top and bottom anodes; 0° or 180°)

$\hat{I}_{Forward}$ → Peak current forward

$\hat{I}_{Reverse}$ → Peak current reverse

I_{Avg} → Periodical average current ($I_{Avg} = I_{Avg\ for} - I_{Avg\ Rev}$)

I_{AvgFor} → Forward average current (plating effect)

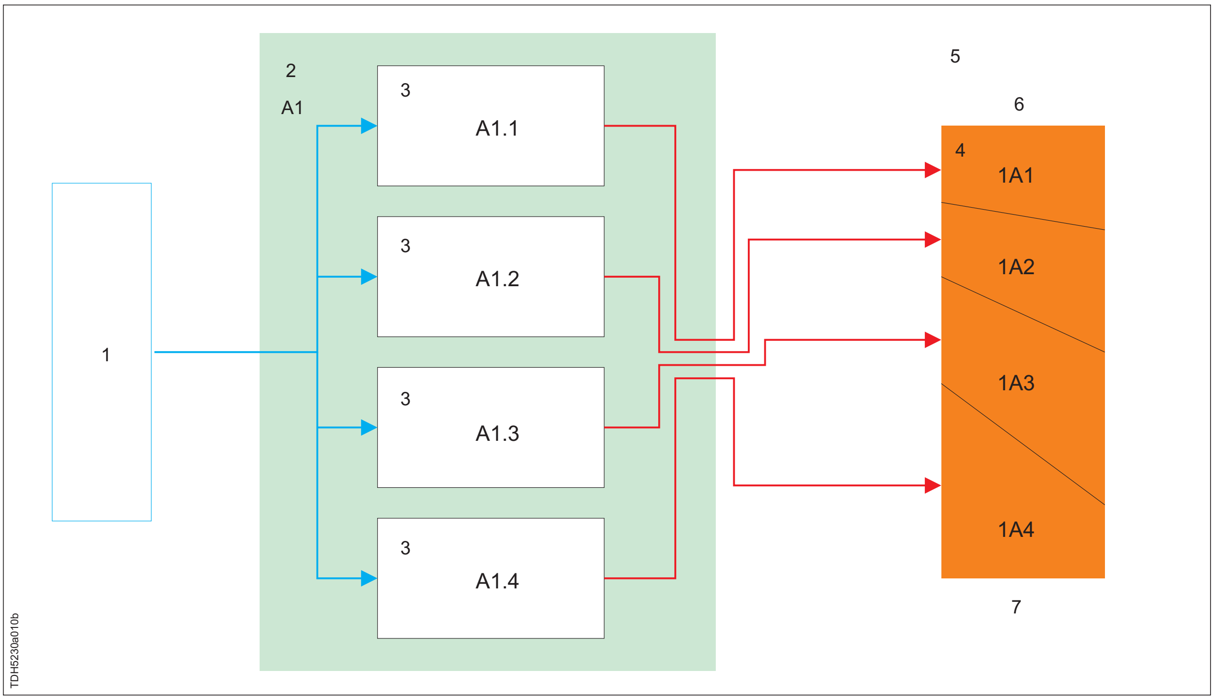
I_{AvgRev} → Reverse average current (etching effect)

$I_{Avg\ AnodeLoad}$ → Anode load average current ($I_{Avg\ AnodeLoad} = I_{Avg\ for} + I_{Avg\ Rev}$)

6.7.2.6.3 Permanent refreshing of current set-points

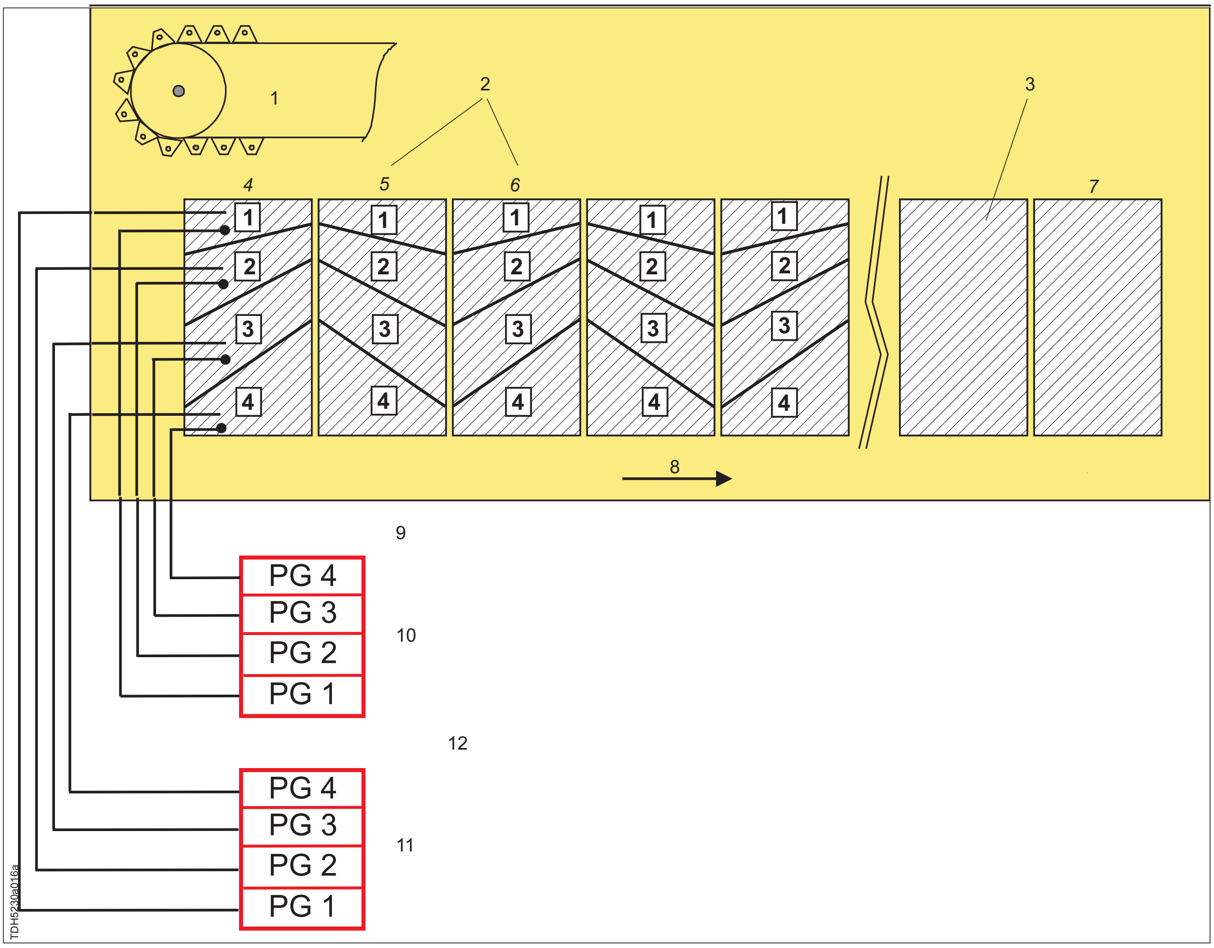
A Pulse Device (PD) is a set of four Pulse Generators (PGs) for the supply of four anode segments. The PGs deliver forward and reverse pulses, either to quadruple segmented anodes (‘Quattro Anodes’) or to anodes without segments (‘Uno-Anodes’).

The PDs for the supply of all the 14 pairs of anodes (pair = top & bottom) in an InPulse2 Plater are installed in 7 electrical cabinets (peripheral equipment).



Pulse Device A1, Pulse Generators A1.n, Quadruple segmented anode

1	Main power supply	5	First segmented anode 1A
2	Pulse Device A1	6	Clamp side
3	Pulse Generator	7	Window side
4	Anode segment		



Individually controllable current supply of quadruple segmented anodes in a Plater with InPulse2 technology

1	Clamp drive	7	Anode 14
2	Anodes 1 to n: “Quattro" Anodes (segmented)	8	Transport
3	Anodes (n + 1) to 14: "Uno" - Anodes (not segmented)	9	“Pulse Generator” for anode segment 4
4	Anode 1	10	“Pulse Device” for anode 1 above
5	Anode 2	11	“Pulse Device” for anode 1 below
6	Anode 3	12	(PG1 ... PG4 are individually controllable)

The current setpoints of the Pulse Generators (PGs) are permanently recalculated for getting the required current density at the moving board and its respective pair of anode segments.

This demands permanent data exchange between control PC and PGs.

Data output to PGs:

Each Pulse Generator is individually controlled from the central VCS computer through an Interface PLC.

In the list of job parameters (job administration feature in VCS), the setpoints are individually determined for each Pulse Generator.

The central control PC transfers the job specific parameters (current setpoints, pulse parameters, etc.) together with the requested synchronizing signals through the bus system (fiber optical cable) to the Interface PLC. The Interface PLC controls the Pulse Generators.

This data output is permanently updated, based on the continually changing panel area between a pair of anode segments. With each signal update, new current setpoints are set for each Pulse Generator.

Data input from PGs:

The actual current and voltage values of the anode segments are measured by the Pulse Generators; the results are transferred through the Interface PLC to the central PLC and then displayed at the VCS-computer.

Production with several jobs in a Plater:

In one Plater there may be up to three different jobs with different or equal types of PCBs and production parameters and with different or equal setpoints and actual values respectively.

Moving PCBs and gap positions

At any instant of time, the moving PCBs have to be plated with the job specific current density.

While a series of PCBs (= ‘job’), followed by a gap and later on followed by the next job are transported through the Plater, the plated area between a certain pair of anode segments (positioned above and below the moving PCB) is continuously changing.

The cell current delivered to each anode segment is therefore continuously recalculated and automatically readjusted, depending on the continuously changing position of the PCBs.

Importance of the panel tracking function for accurate current setpoints and plating of boards:

The panel tracking function of the control system delivers the required data to the PC-PLC (and VCS).

The panel tracking data is taken from

a) the job parameters (size of PCBs, current densities, shape of pulse current)

b) the light barriers (installed in modules which are before the Plater)

c) the pulses from the running clamp drive motor.

This received panel tracking data is used for the re-calculation of current setpoints at every other instant of time.

The partial distance of the pulse signal (which is delivered by a sensor in the clamp drive motor) correlates to a resolution of about 1 mm. In other words it means, that the simulated PCBs (= simulated change of areas between anodes) move on in mm-steps.

The recalculation of the current setpoints depends essentially on this simulated step-by-step movement of the areas of the PCBs.

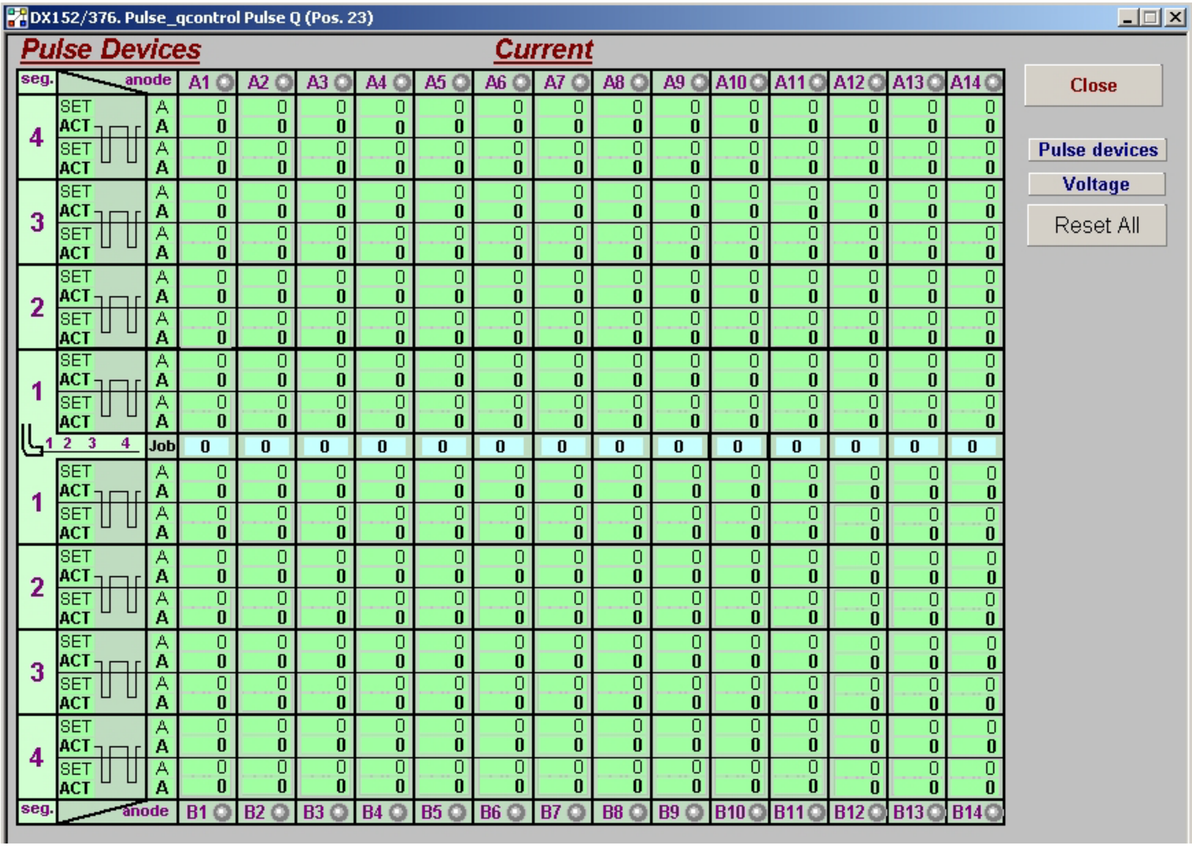
The simulated movement is verified by light barriers which are installed along the line. Fault messages are generated if the actual movement of PCBs differs from the simulated movement.

6.7.2.6.4 Display of anode currents for observation and analysis

VCS refreshes continuously the display of values of

- the calculated current set-points (SET) for both, forward phase (peak value) and reverse phase (peak value)
- the actually measured currents (ACT), forward and reverse, both values separately

Calculation and monitoring is automatically executed for each anode segment (anodes A1 to A14 and B1 to B14, with four segments 1,2,3,4; whereby segment 1 is at the clamp and segment 4 at the window side).



Current display in VCS, current set-point of Pulse Devices and actual current of anode segments

This extract from VCS gives the possibility to view the currents of the anode segments (altogether 448 values) for observation and analysis. The operator can easily recognize

- gaps between jobs in the Plater (no anode current)
- actual position of the leading or the last PCB of a job (increase and decrease of current at a pair of anode segments)
- currents for upper and lower anode twin segments (for example current of A6.3 in comparison with current B6.3)
- actual current ratio (forward to reverse) of a single anode segment
- possible causes for warning and alarm messages, for example, differences between set-point and actual current of an anode segment

See also

🗎 Display of the average anode currents [➔ 210]

🗎 Display of the Pulse Device voltages for observation and analysis [➔ 217]

6.7.2.6.5 Display of the Pulse Device voltages for observation and analysis

The design of the electric circuits (independent and individual control of anode segment currents) gives the possibility to control and monitor 112 independent electric circuits individually
(112 Pulse Generators for 2x14 anodes with 4 anode segments each).

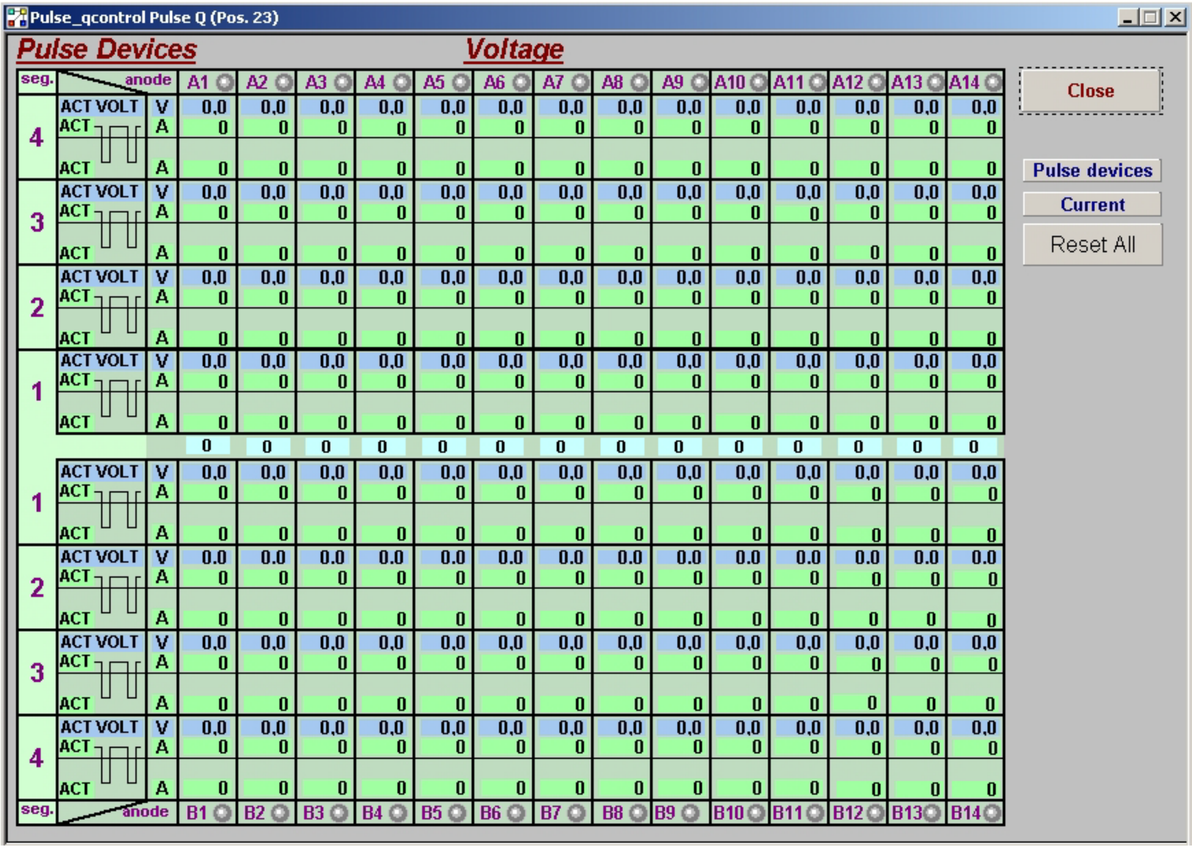
The voltage of a Pulse Generator adjusts itself automatically depending on the required current and a given total resistance of the complete electric circuit.

- Current setpoint: The current required from of a Pulse Generator depends on
  the current density of the active job,
  the pulse shape parameters of that job,
  the position of PCBs, overlapping partly or fully with a pair of anode segments
- Total resistance: In case of a poor conductivity at any spot on the current path from the Pulse Generator to the anode segments, the voltage increases as a result of the increased resistance.

The cause for a Pulse Generator voltage being above the warning or alarm level is in most cases an increased resistance, for example a poor electric contact, in the current path.

Update of values in the VCS 'Voltage' window

- the actual voltage (forward phase) in relation to the currents of an anode segment
- the actually measured currents (ACT, forward phase peak value and reverse phase peak value)
- of each anode segment (anodes A1 to A14 and B1 to B14, segments 1,2,3,4, segment 1 is close to the clamp, segment 4 next to the window side)



Voltage display of Pulse Generators in VCS related to the actual current of anode segments

This extract from VCS gives the possibility to view the pulse generator voltages in relation to the anode segment currents for observation and analysis.

The operator can easily recognize

- possible causes for warning and alarm messages, for example, a high voltage due to an increase of resistance of an individual Pulse Generator circuit (=anode segment circuit).
- voltages and currents for upper and lower anode twin segments (for example for comparison of the third anode segments, A6.3 and B6.3, in mounting position 6)
- actual current ratio forward to reverse of a single anode segment
- gaps between jobs in the Plater (no current flow)
- actual position of the leading or the last panels of a job (increase or decrease of current values as a result of PCB overlapping at a pair of anode segments)

See also

- Display of the average anode currents [→ 210]
- Display of anode currents for observation and analysis [→ 216]
- Permanent refreshing of current set-points [→ 212]

6.7.2.6.6 Possible set-point ranges and steps in VCS

Pulse times

Forward pulse time t_1	10 ms ... 500 ms in 1 ms steps
Reverse t_2	0.4 ms ... 25 ms in 0,1 ms steps

Ratio of pulse times

T / t_2	T / t2 ≥ 10; free adjustable within range of current and charging.

Slope

Slope S (instead of t_5)	0.2 A/µs ... 2.5 A/µs in 0.1 A/µs steps
Slope S for Uno anodes	0.8 A/µs ... 10.0 A/µs in 0.1 A/µs steps

Interruption of Î forward

Start time of forward pulse break t_3	10 ms ... 500 ms in 1 ms steps
Forward pulse break time t_4 (duration of the pulse break)	0.64 ms ... 25 ms in 0.1 ms steps

Phase shift between Pulse Generators (anodes) above and below.

Only at 180° there is a forced pulse break time t_6 of $\hat{I}_{forward}$ exactly at that time of the corresponding anode has its reverse pulse. Forced break $t_6 \approx t_2$.	two fixed phase shifts: 0° and 180° for T ≥ 20 ms (at T = 10 ms no phase shift)

Disable anode segment 4	in one step

Set-points for current control:

for the peak current foreward $\hat{I}_{forw}$.	one place after decimal point
for the peak current $\hat{I}_{reverse}$.	one place after decimal point

6.7.2.6.7 Data transfer

The time for whole data transfer of all analogue values between interface and the 28 Pulse Devices with their maximal 112 Pulse Generators of each Plater in both directions is not more than 300 ms for:

Refreshing of all current set-points and current actual values:

If, for example, the actual ramp has a time difference of 300 ms, the values in VCS are refreshed in less than 4 seconds.

6.7.2.7 Removal and reinstallation of anode units

This description contains a number of photos for illustration and part designation. The sequence of pictures is in order of anode removal. The sequence for reinstallation would be in reverse order.

On the one hand the steps for removal and reinstallation are briefly summarized, on the other hand they are also illustrated for part designation.

See also

- Disassembly of anode meshes [→ 238]
- 030100 Change clamp drive belt [→ 312]

6.7.2.7.1 Introduction, preparation, general guide lines

The removal and reinstallation of the lower anode units may be subdivided in four main steps; the steps 2 and 3 can be omitted, if just the upper anodes have to be taken out.

1. Removal of the upper anode units
2. Removal of the lower anode units
3. Reinstallation of the lower anode units
4. Reinstallation of the upper anode units

It is comparatively easy to remove just the upper anode units and reinstall them afterwards again (steps 1 and 4).
However, the steps 2 and 3 are more fiddly; they also involve the risk that the original height adjustment is mal-adjusted. This could later on be a cause for scratches on the processed PCBs or even lead to crashes in the Plater.

Tools:

- Standard tool box with spanners and socket wrenches
- One or several maintenance step-on boards for work inside the Plater
- Self-made rod (with 8 mm thread and handle) for lifting the bottom anodes at the window side
- Torque wrench for tightening the countersunk nuts which hold the perforated plates of the anode units

A few general rules

CAUTION

Unexpected switch on of the line

Always when carrying out maintenance or repair work at the Uniplate equipment, switch the line to manual mode of operation and take appropriate measures to make sure that nobody can unexpectedly switch on the drive or other functions (press the emergency stop button, place a sign that repair work is going on, close the VCS application, etc.).

- Prior to the removal of parts give full attention to details, how they are fitted and adjusted. This helps to avoid troubles later on during and after reinstallation.
- Make especially sure not to change any setting with regard to the height of the lower and upper anode units:
  - The bottom anodes are resting on the four pins for level adjustment. If they are turned the height adjustment of the bottom anode units and the original transport height would be changed
  - The distance between lower and upper anodes is set by
    (a) distance pieces, mounted in the frame of the bottom anode unit at the window side and by
    (b) distance rods at the clamp side, fixed at the carrier bar of the upper anode unit)
- Mind that no tools or small parts, like nuts, seals, screws etc. fall down and get lost in the electrolyte

NOTICE

Maintenance step-on boards

Don't step on the perforated foil guide plates of the anode units! Use the maintenance step-on boards for work inside the Plater after the upper anodes are taken out!

6.7.2.7.2 Steps for the removal of the upper anode units (summary)

a) See also the series of photos with part designations. It is meant as a help for a better understanding of this brief list of steps here.
b) Switch off the equipment and take appropriate measures to make sure that nobody can switch on unexpectedly.
c) Remove the glass and PP covers on top of the Plater.
d) Spray the anode area, where you are going to work with DI water. Mind the quantity of water, not to dilute the solution to much.

	NOTICE
!	**Wet cathode rail** Water or solution must not splash onto the cathode rail! The cathode rail must always be absolutely dry for good current conductivity!

	NOTICE
!	**Added DI water** Added DI water is diluting the electrolyte! Do not overfill the module!

e) Disconnect electrical cables and mind the way they were connected; they have to be fixed later on again in the same way (color, inclined position) .
f) Open pipe connection (PVC union nut) and mind the O-ring (it should not get lost).
g) See position number in the anode carrying bar for reinstallation later on.
h) First lift the upper anode unit a few centimeters at both sides and then move it out carefully to prevent any damage.
i) Place the anode unit down on the floor. Make sure not to bend or damage the clamp side edge of anode mesh.
j) Check the PCB supporting ball bearings whether they easily turn.
k) Check if the screws in the perforated foil guide plates are tight and fully countersunk. After being tightened, they must be flush! Jutting out screws or burs could cause scratches on the surface of the processed PCBs.
l) In case that a countersunk screw is found to be loose, tighten it with a torque wrench adjusted to about 3 Nm (range 3 + 0,5 Nm).
m) Mind the completeness of small parts (screws, nuts, seals) and tools.

6.7.2.7.3 Taking out the upper anode units (photos)

Disconnect pressure sensor from fluid container

1	Pressure sensor	3	Coupling for pressure connection
2	Air tube	4	Fluid container for pressure transmission

The cable connection from the Pulse Rectifier to the four anode segments mustn’t be mixed up.

i	**INFORMATION**
	Mixed up cables If you ignore the colour code of the cables, the according anode segment will be supplied with the wrong current value from the pulse rectifier. Plating thickness and throwing power will be negatively influenced.

a) The union of the spray supply pipe must be opened next, then the anode unit can be lifted and taken out. Don’t loose or damage the O-ring seal.

Supply cables removed from upper anode unit, pipe union still fixed

1	Union nut of the spray system supply pipe	3	Points of connection for anode supply cables from the Pulse Devices
2	Spray tubes with nozzles of the upper anode unit		

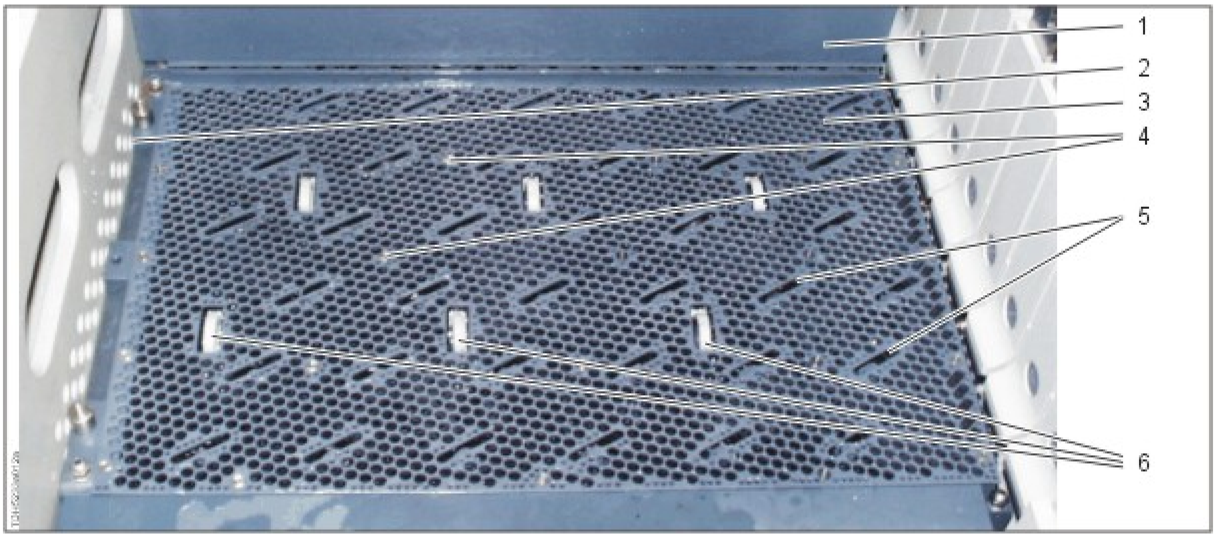
NOTICE

Risk of changing the distance of the anodes

Don’t open a nut at the height adjustment rods! This would involve the risk of changing the distance between upper and lower anodes and could cause a panel crash when production will start!

The height of bottom contact surface of the clamps is referred to as the transport height in the Plater.

The top edges of the ball bearings can be considered as the actual PCB transport height. It must be 0.0 to 0.5 mm below the bottom contact area of the clamp.



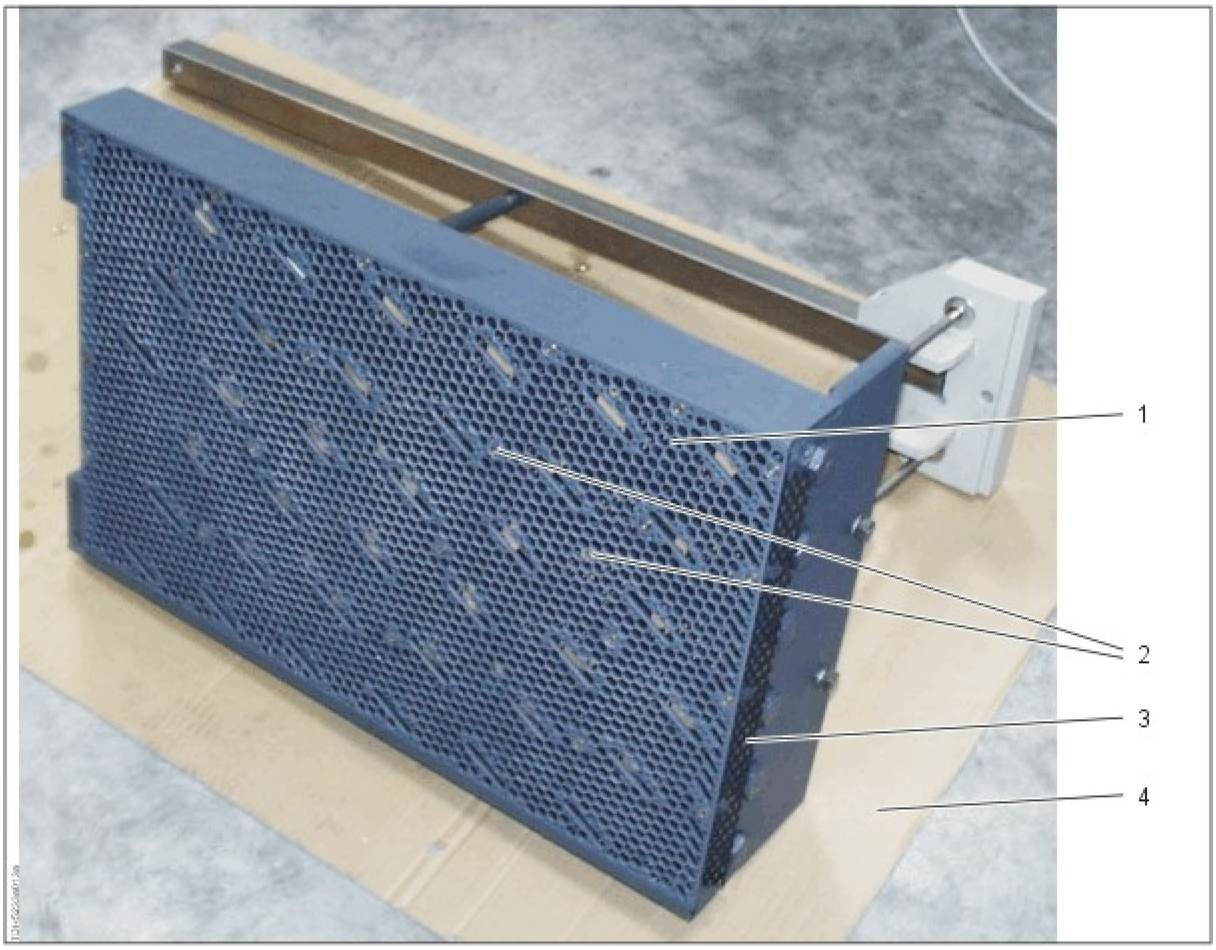
Upper anode unit removed, view on bottom anode unit inside Plater

1	Frame of the upper anode unit	4	Countersunk screws for fixing the foil guide plates (torque: 3 + 0.5 Nm)
2	Fluid return holes at window side	5	Slots with spray nozzles behind
3	Perforated foil guide plate of bottom anode unit	6	PCB supporting ball bearings

a) Place the anode unit down on the floor as shown in the photo. Make sure not to bend or damage the cranked clamp side edge of anode mesh.

b) Check if the screws in the perforated foil guide plates are tight and fully countersunk. They must be flush to prevent panel crash!

c) In case that a countersunk screw is found to be loose, tighten it with a torque wrench adjusted to about 3 Nm (range 3 + 0,5 Nm).



Proper placement of the upper anode unit on the floor

1	Perforated foil guide plate of upper anode unit	3	Cranked anode mesh at the clamp side
2	Countersunk screws for fixing the foil guide plates (torque: 3 + 0.5 Nm)	4	Clean base on the floor

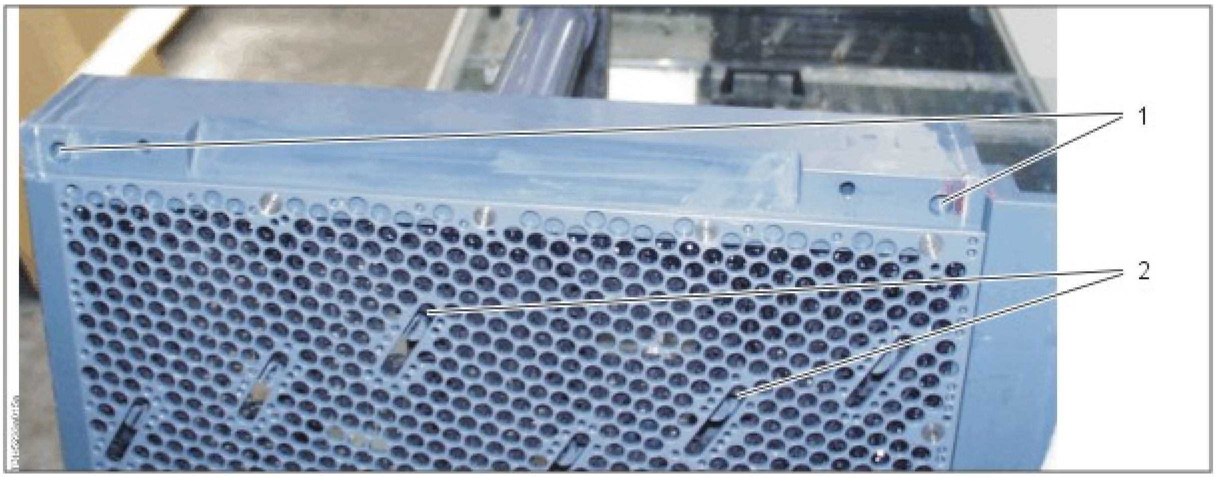
NOTICE

Damaged panels

Jutting out screws or burs could cause scratches on the surface of the processed PCBs or even cause board crashes in the Plater.

Mind the O-ring, when removing or remounting the anode unit

1	Main pipe of spray system	3	O ring as seal
2	Union piece for one of the upper anode segments	4	Peg hole, provided for mounting the maintenance step-on board



Upper anode segment removed and lifted

1	Two fitting holes for correct positioning at reinstallation	2	Spray nozzles behind slots (same angle)

See also

- Steps for taking out the lower anode units (summary) [→ 228]
- Steps for reinstallation of upper anode units (summary) [→ 238]

6.7.2.7.4 Steps for taking out the lower anode units (summary)

a) See also the series of photos with part designations. Those illustrations shall be a help for a better understanding of the steps listed up here.

b) - Use maintenance step-on board. Don't step on the perforated foil guide plates of the bottom anode units!
- It is recommended that two people work together. For one person it could be difficult to take out the anode units.

c) Take away the air pressure for the window sealing system, take out the window and remove pipe connection of the anode fluid delivery pipe behind of the fluid return pipes.
It is recommended to have the electrolyte first transferred to a holding tank.
Make sure that no pipe fittings will fall into the sump.

d) Remove at least 10 clamps for the removal of one bottom anode unit (for quick exchange clamps use spanner, 17 mm width, relatively short handle)

e) Remove the four counter nuts at the four corners of the bottom anode frame

f) Screw an auxiliary rod with 8 mm thread (self-made tool for lifting the bottom anode unit) into the hole with 8 mm thread.

g) Lift bottom anode unit at both sides simultaneously and make sure not to bend the four adjustment rods. It is advised that two people work together.

h) Position the bottom anode unit vertically for disconnection of the cable. Keep in mind the way in which the cables wire fixed (color and inclined position). This is important for reinstallation later on. There is little space between the floor and the bottom anodes.

i) Don't change the setting of the four adjustment screws on which the anode unit was based and fixed. This could save extra work and time for readjustment of the height of the anodes with relation to the transport height reference area.

j) Mind the position number of the removed anode units for correct order of reinstallation later on.

k) Place the anode unit safely down on the floor. Make sure not to bend or damage any part, especially the clamp side edge of the anode mesh.

6.7.2.7.5 Taking out the bottom anode units (photos)

a) In order to gain the necessary space for lifting later on the bottom anode units, we must first remove at least 10 clamps. This gap in the clamp drive can be driven to the required position by manually switching on the clamp drive.

b) Use maintenance tray(s) as step-on board / tool tray. Don't step on the perforated foil guide plates of the bottom anode units.

c) Mind that no tools or parts, like nuts, seals, screws etc. fall down and get lost in the bath or under the anodes. Any foreign material, like dirt, grease, oil, etc. mustn't end up in the bath (and spoil it).

View on bottom anode in the Plater with clamps removed

1	Frame of the upper anode unit	4	Countersunk screws for fixing the foil guide plates (torque: 3 + 0.5 Nm)
2	Perforated foil guide plate on top of anode meshes	5	Slots of spray system
3	PCB supporting ball bearings (their top points are a few tenth of mm below the transport height)		

d) Remove the four nuts at the four corners of the bottom anode frame

Nuts for fixing the bottom anodes with13 mm spanner

1	Distance pieces which determine the distance between top and bottom anodes	3	One of four nuts to be unscrewed
2	Hole with 8 mm thread for mounting an auxiliary rod to lift the bottom anode segment		

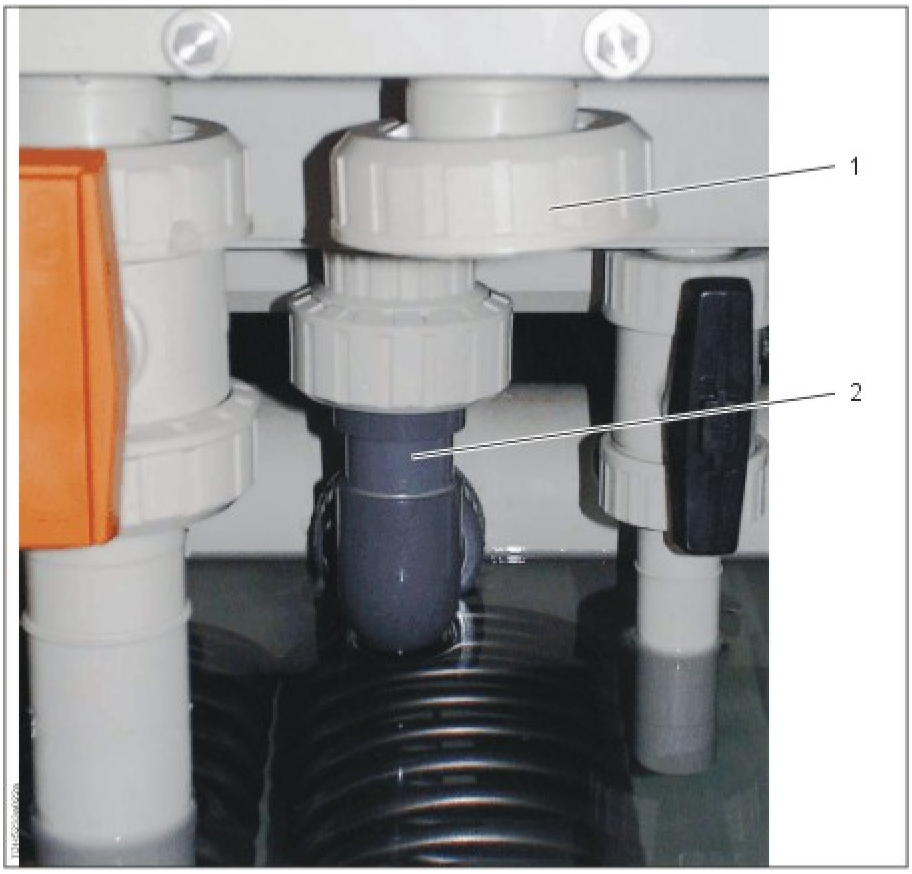
For removal of the bottom anode units: Unscrewing the four nuts which holds them tight For reinstallation: Tightening the nut again (no precise torque defined)

1	One of four nuts to be unscrewed

e) For the removal of the bottom anode unit, the pipe union below the intermediate PP-floor is to be removed.

f) To go for that, first take away the air pressure for the window sealing system. Then take out the window.

g) It would be advantageous to have drained (stored) some of the solution in the sump of the Plater, to lower the solution level for easier access.

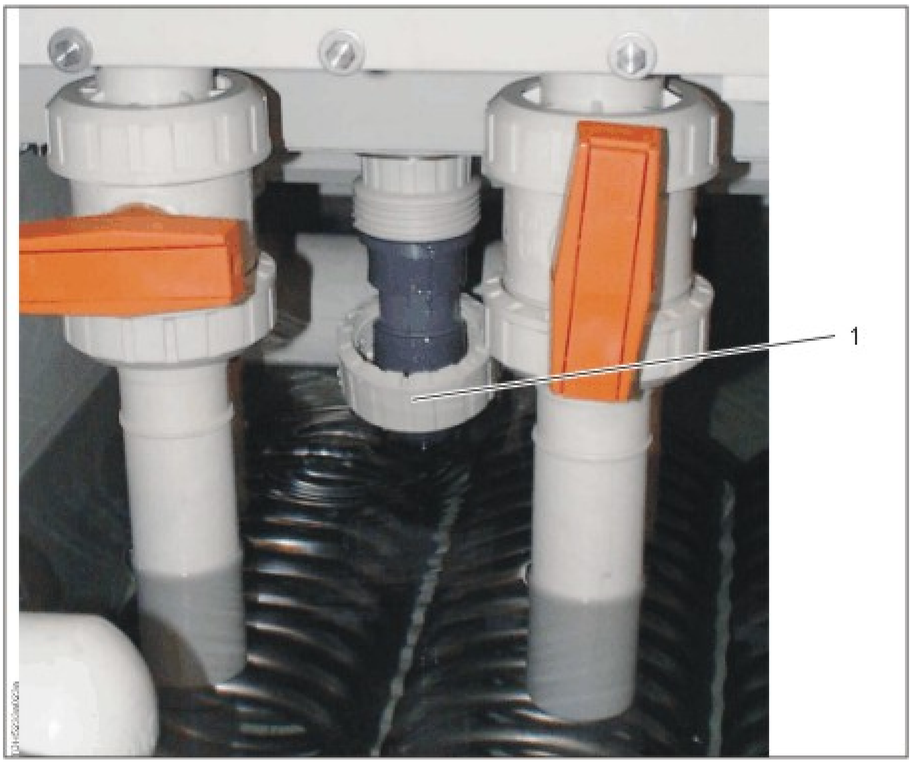


Union of fluid return pipe still fixed

1	Pipe with manually adjustable valve for fluid return (already removed for getting access to the pipe behind)	2	Pipe for fluid delivery to spray system of the bottom anodes

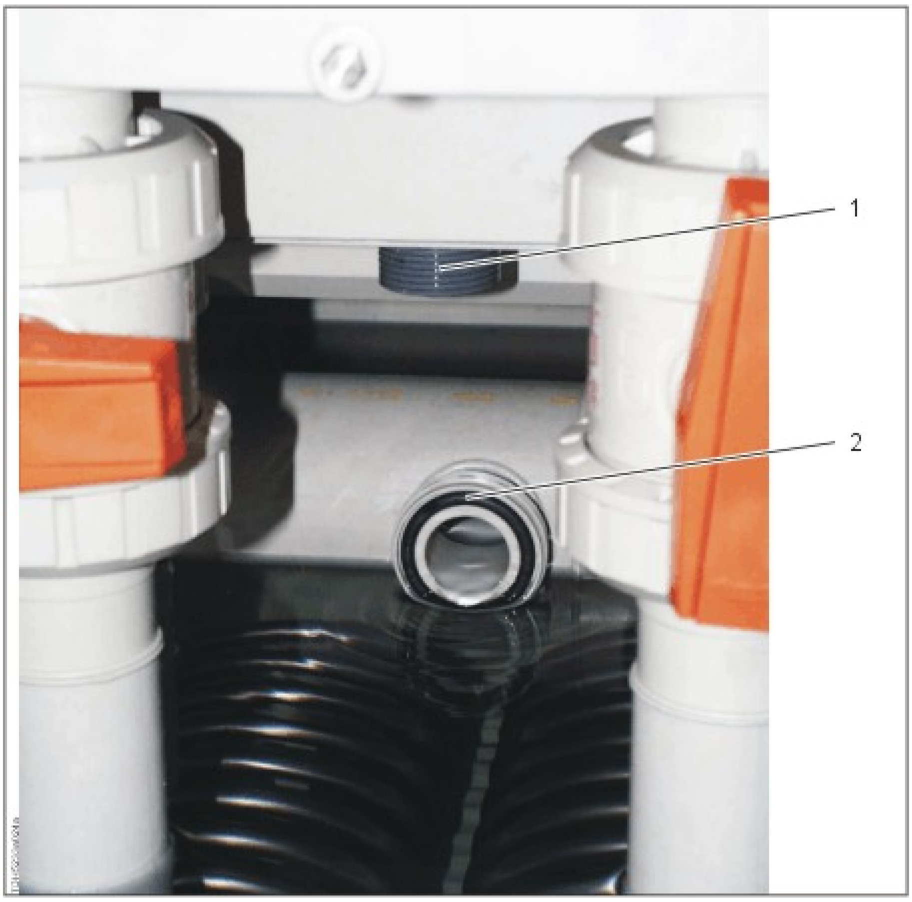
h) Next loosen and remove the pipe connection of the respective anode fluid supply pipe behind of the fluid return pipes.

i) Make sure that no pipe fittings and seals will fall into the sump. (Once more the general instruction: Mind that no tools or parts, like nuts, seals, screws etc. fall down and get lost. Any foreign material, like dirt, grease, oil, etc. mustn't end up in the bath and spoil it.)



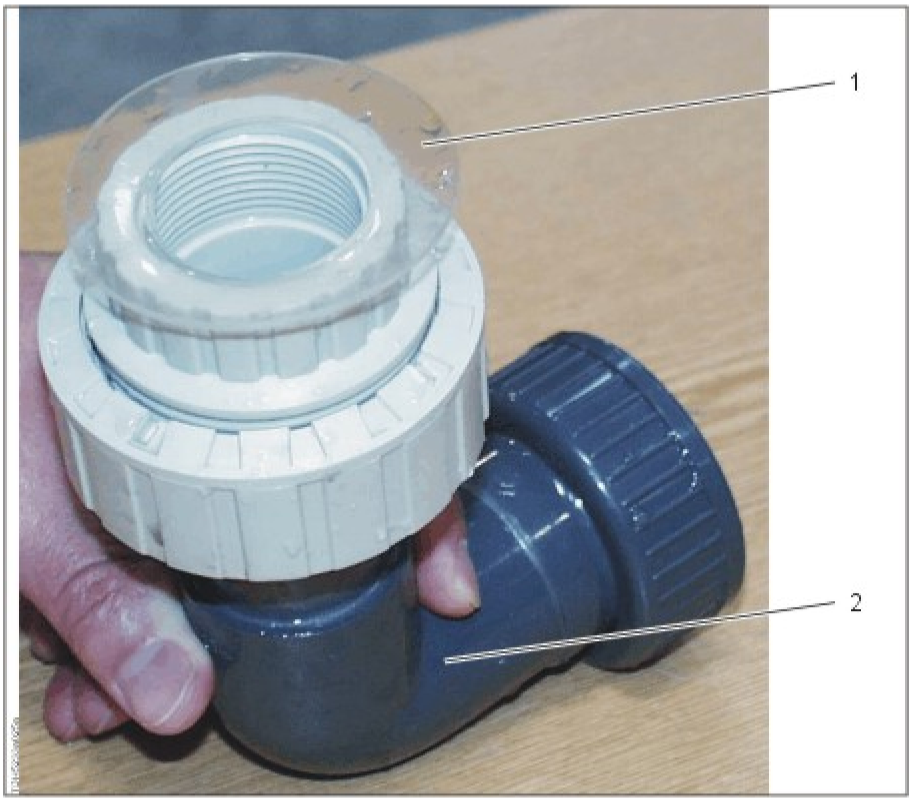
Union nut loosened

1	Union nut



Elbow pipe fitting removed, O-ring still in main distribution pipe

1	Penetrating pipe of bottom anode unit	2	O-Ring as seal



Elbow pipe fitting together with seals removed

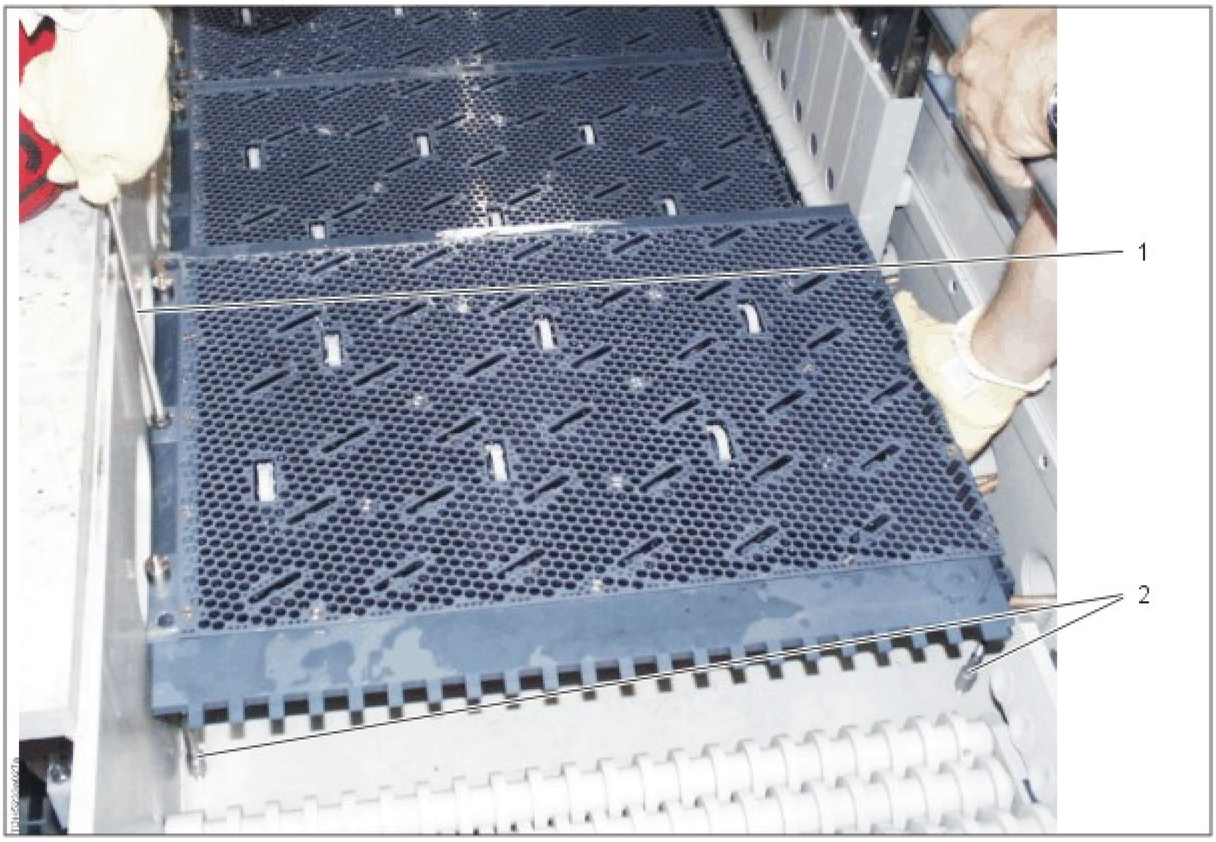
1	Seal below intermediate floor	2	Elbow pipe fitting removed

j) Going back into the anode area: Screw an auxiliary rod with 8 mm thread (self-made tool for lifting the bottom anode unit) into the hole with 8 mm thread as shown in the next picture.

Auxiliary rod screwed in a threaded hole at the window side of the anode unit

1	Auxiliary rod	2	8 mm thread

k) Lift bottom anode unit at both sides simultaneously and make sure not to bend the four base height adjustment bolts. At least two people work together.



Removal/Refitting of bottom anode unit by means of an auxiliary rod

1	Auxiliary rod	2	Base bolts for height adjustment

l) Position the bottom anode unit vertically for disconnection/reconnection of the four cables. Keep in mind the way in which the cables wire fixed (color and inclined position). This is important for reinstallation later on, because there is little space between the intermediate floor board and the bottom anodes.

m) Position the bottom anode unit vertically for disconnection/reconnection of the four cables. Keep in mind the way in which the cables wire fixed (color and inclined position). This is important for reinstallation later on, because there is little space between the intermediate floor board and the bottom anodes.

Bottom anode unit lifted for disconnection (later on reconnection) of the electric supply cables

n) For reconnection later on: The black colored insulation mustn't show any kind of cracks. Furthermore this part of the cables mustn't be bent . Avoid any tensile stress.

o) Don't change the setting of the four height adjustment bolts on which the anode unit was based and will be later fixed. This saves extra work and time (no need for readjustment of the height of the anodes with relation to the clamp contacts).

The reference height of the transport plane is the bottom surface of a clamped PCB or, in other words, the height of the bottom contact of the clamp.

Adjustment near the window side: The top of the (white) ball bearing rollers is adjusted to be level with the reference height (=bottom contact of the clamp).

Adjustment at the clamp side: The top of the ball bearing rollers is 0.3 to 0.5 mm below the reference height.

Base bolts on which the anode units are resting (for height adjustment)

1	Fluid return holes back to the sump	3	Base bolt and nut to fix the bottom anode unit
2	Distance piece (distance between upper and bottom anode frame)	4	Base bolt for the height adjustment of bottom anode units

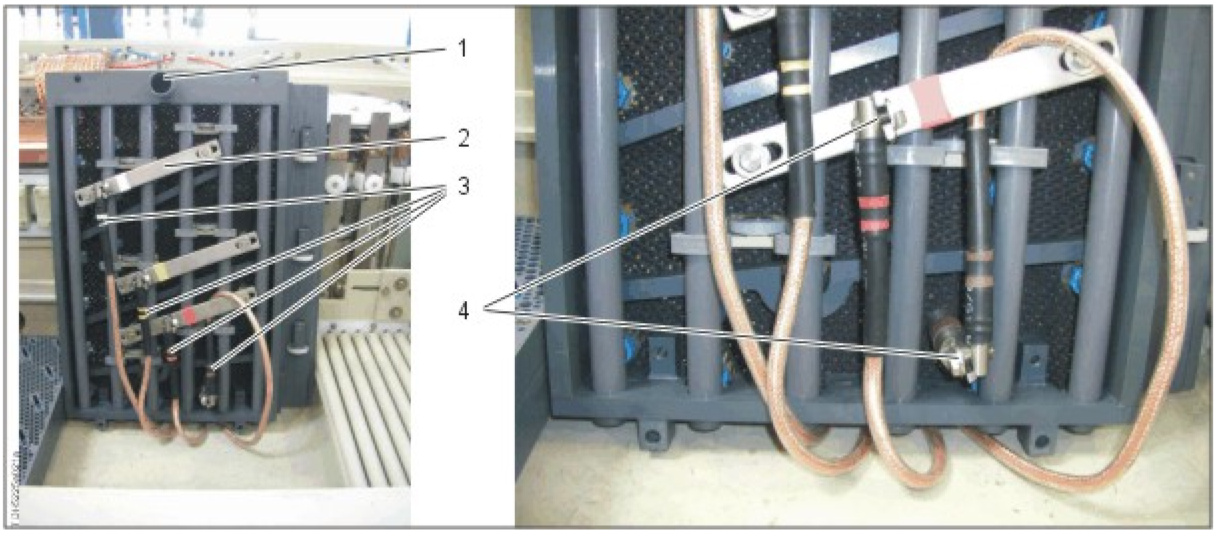
a) Important! When fixing the bottom anode cables later on, use the genuine bolt 'Nord-lock' bolt securing washers only and attend to the separate description of how to use them in a professional way.

For reinstallation you can refer to a separate list of instructions in conjunction with the photos above (in reverse order).

6.7.2.7.6 Reinstallation of the bottom anode units

a) Preparation: For a better understanding of this summary you may first read the closely related description about the removal of the anode units (several photos for illustration).

b) Preparation: Attend also to the information about the ‘Nord-lock’ bolt securing washers in the Plater. This special pairs of washers must be used for adequately fixing the bottom anode cables (applied in Platers built since early 2007).
c) Use maintenance step-on board(s) inside of the Plater. Don’t step on the perforated foil guide plates of the bottom anode units!
Furthermore don’t step on the transport rollers at the input side / output side of the Plater.
d) The numbers of the anode units are in ascending order in direction of transport. Don’t change the sequence of the anode units in their continuous order. Attend to the position numbers 1 to 14 imprinted in the frame of the anode unit (the anode frame types 1/ and 2\ are changing).
e) Put the bottom anode unit inside of the Plater, position it vertically at the clamp side to carry out the next steps (connection of the four cables).



Bottom anode unit

1	Pipe for fluid supply	3	Color marking (brown, red, yellow, white from clamp to window side)
2	Bridge bar for current supply	4	Connection of the 4 cables with 4 pairs of special securing washers

f) Don’t mix up the four cables (colors) for the supply of the four anode segments.
g) Inspect and clean the electrical contact surfaces of the cable terminals and the anode unit contact from any dirt or oxidation layer.
h) When fixing the bottom anode cables, use the genuine bolt ‘Nord-lock’ bolt securing washers only and attend to the separate description of how to use them in a professional way.
i) Consider also that there is little space between the intermediate PP floor of the Plater and the bottom anode units. Lay the cables straight as illustrated (with regard to direction of the black insulation sleeves, inclination of the cable contacts and terminals, nuts and pairs of washers).
If the cable ends with black insulation sleeves were bent, it would involve the risk of electrolyte penetration. This must be avoided.
j) Make absolutely sure that the connections are tight. Good electric contacts are absolutely essential for good conductivity and current flow.

k) The black colored insulation sleeves mustn't show any kind of cracks. Furthermore this part of the cables mustn't be bent to avoid any tensile stress.

	NOTICE
	Penetration of electrolyte would lead to corrosion, to troubles during production and to a major break time for repair work. Give utmost attention when fixing the four cables. The cable connections must be made in a professional manner (layers of cables, black insulation sleeves, cleanliness of the terminal contacts, torque). When fixing the bottom anode cables, use the genuine bolt 'Nord-lock' bolt securing washers only and attend to the separate description of how to use this pair of securing washers in a professional way.

a) Prior of placing the anode frame down (after the cables are properly laid and tightened) screw an auxiliary rod with M8 mm thread (self-made tool for lifting and lowering the bottom anode unit) into the hole with M8 mm thread.
b) Put the bottom anode unit at both sides simultaneously down and make sure not to bend the four adjustment bolts, on which the anode unit is based.
c) Unscrew the auxiliary rod and gently tighten the 4 nuts on the bolts (= preliminary fixing of anode units)

The reference height is the bottom surface of a clamped PCB or, in other words, the height of the bottom contact of the clamp.
Near the window side: The top of the (white) ball bearing rollers is adjusted to be level with the reference height (=bottom contact of the clamp).
At the clamp side: The top side of the ball bearing rollers is 0.3 to 0.5 mm below the reference height.

a) Check the height adjustment of the reinstalled bottom anode unit with relation to the standard height of the transport plane: The height of the ball bearings in the anode unit is adjusted with reference to the clamp contacts (as defined above).
   - If just a few bottom anode units were removed, we can use the setting of the adjacent anode units as reference: Use a spirit level and place it on top of the PCB supporting ball bearings. If necessary readjust the adjustment bolts on which the anode unit is mounted. This way we make sure that the transport area as horizontally absolutely level and that its height is correct.
   - If all the bottom anode units were removed, this adjustment must be checked later on a second time after the Plater solution was heated up (material extension depending on different temperatures plays a role which can't be neglected).
b) Finally check whether all the four counter nuts (screwed on the adjustment rods at the corners) of the bottom anode frames are tight.
c) Safe panel transport is important: Take any precautions and make sure that there isn't any cause for any panel jam in the Plater later on (like edges, debris, dirt, scratches).

d) In case that a countersunk screw in any of the perforated foil guide plates is found to be loose, tighten it with a torque wrench adjusted to 3 Nm (range 3 + 0,5 Nm).
e) Through the removed window of the Plater: Fix and tighten the pipe fittings of the fluid supply pipes and fluid return pipes. Make sure not to forget the sealing between pipe and the intermediate PP floor of the Plater. Make sure that no parts will fall down into the sump and get lost there.
f) Fix the clamps and tighten them according to instruction.
- If the clamps are fixed by two countersunk screws, use torque wrench. The two countersunk screws M8x20 for mounting the clamps are to be tightened with a torque of 10 Nm.
- If you use the clamps with the quick-exchange mechanism (Plater specific as option), don't use excessive force when tightening the quick-exchange clamp by a spanner!
g) Continue the reassembly by putting back the upper anode units (separate description).

6.7.2.7.7 Steps for reinstallation of upper anode units (summary)

a) Check if the screws in the perforated foil guide plates are tight and fully countersunk. They must be flush! Jutting out screws could cause scratches on the surface of the processed PCBs.
b) In case that a countersunk screw is found to be loose, tighten it with a torque wrench adjusted to about 3 Nm (range 3 + 0,5 Nm).
c) Check the easy-running of the PCB supporting ball bearings. This is valid for ball bearing in both anode units, top and bottom.
d) See position number in the top side of the supporting bar. The numbers of the anode units are in ascending order in direction of transport. It is not permitted to change the sequence in continuous order.
e) Clean the surface on which the anode unit is resting. When putting the upper anode unit in place (see locating pins and holes), move it carefully to prevent any damage.
f) Connect electrical cables thoroughly and in the correct way as they were previously fixed (with regard to color marking, slanted direction, nuts and washers, contact area for good current transition, etc.).
Make absolutely sure that the connections are tight. Good electric contacts are very essential for good conductivity and current flow.
g) Fix and tighten pipe connection, attend to O-ring (it mustn't be forgotten, if damaged take a new one of the same material and specification).
h) After the Plater is heated up again, run the first job with a few dummy PCBs before you resume production.

6.7.2.8 Disassembly and assembly of anode meshes

6.7.2.8.1 Disassembly of anode meshes

Related topics:

- Need for the replacement of worn-out anodes

	CAUTION
	Working with chemicals and chemically contaminated parts Wear gloves and safety goggles! Before you start disassembling the anode units, clean the anode units and their frames thoroughly with DI-water (but not with high pressure jets).

	INFORMATION
	Treat the meshed anode sheets with care. Do not scratch or damage the anode coating not to shorten the anode life time.

See also

Removal and reinstallation of anode units [→ 220]

030100 Change clamp drive belt [→ 312]

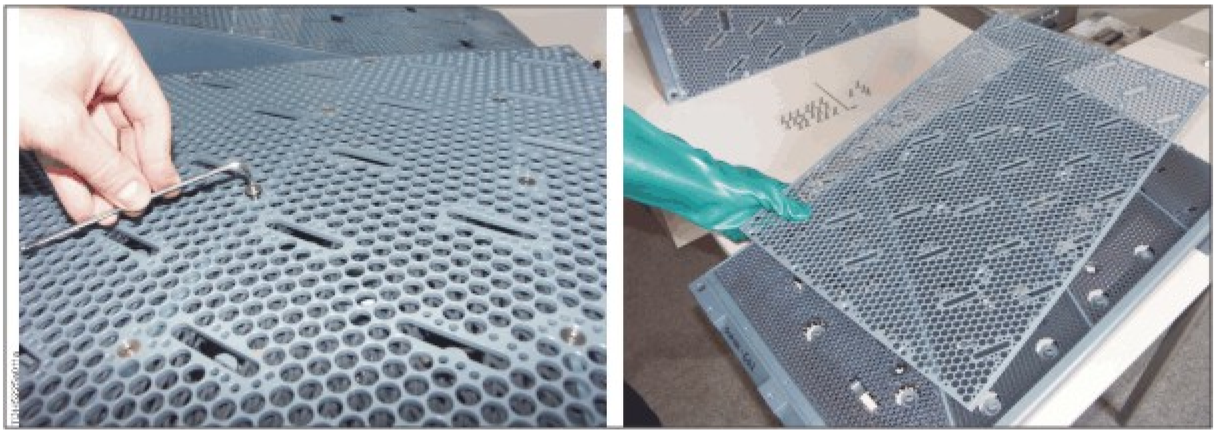
6.7.2.8.1.1 Disassembly

1. Unscrew theTi-M8x20 hexagon head screws of connection bars (bridging bars from bolt to bolt). Don’t loose the Titanium shims placed under the screws.

Removal of connection bars

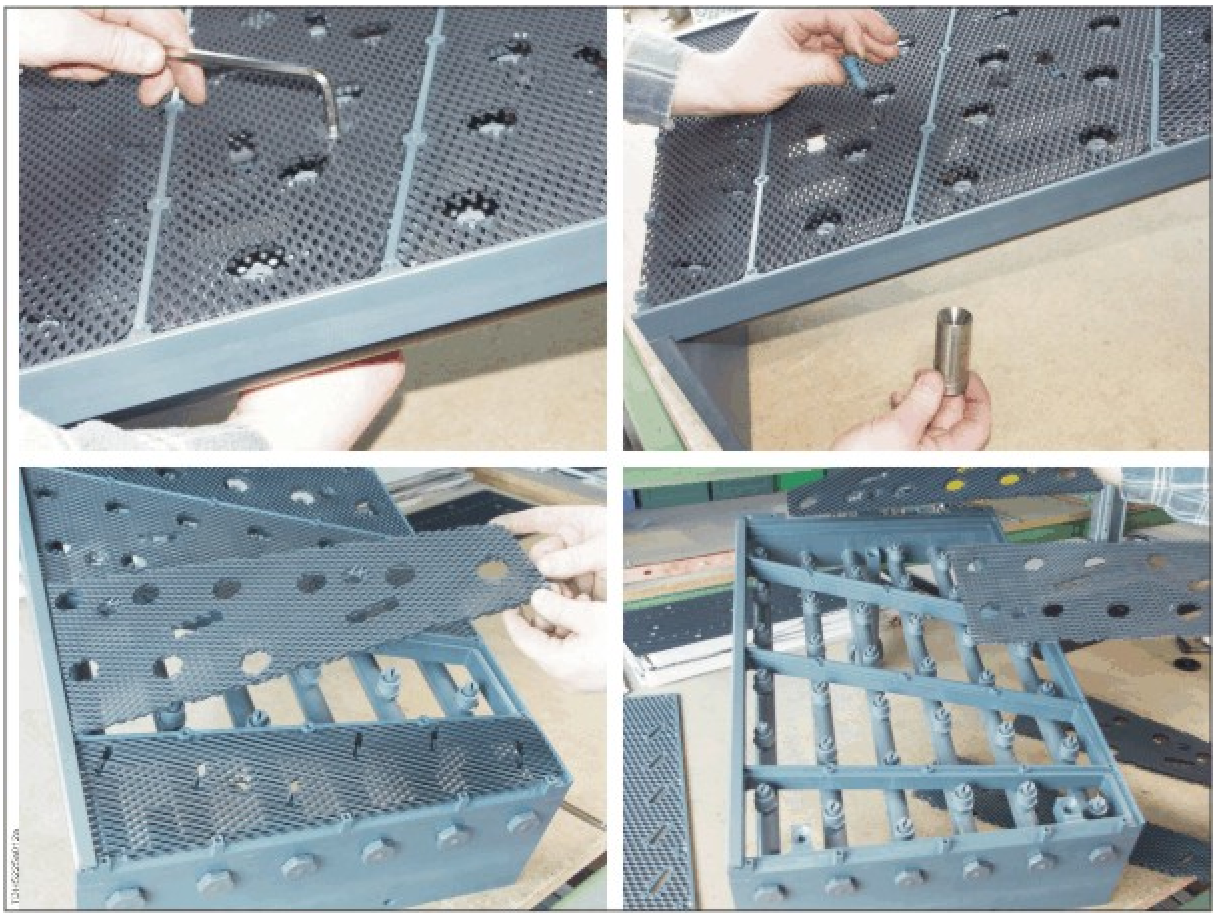
1	M8x20 hexagon head screw	3	For anode cable connection
2	Titanium shim (placed like a washer under the screws)	4	Connection bars (bridges on bolts)

2. Unscrew the Ti-countersunk head screws (size M5) of the foil guide plates.



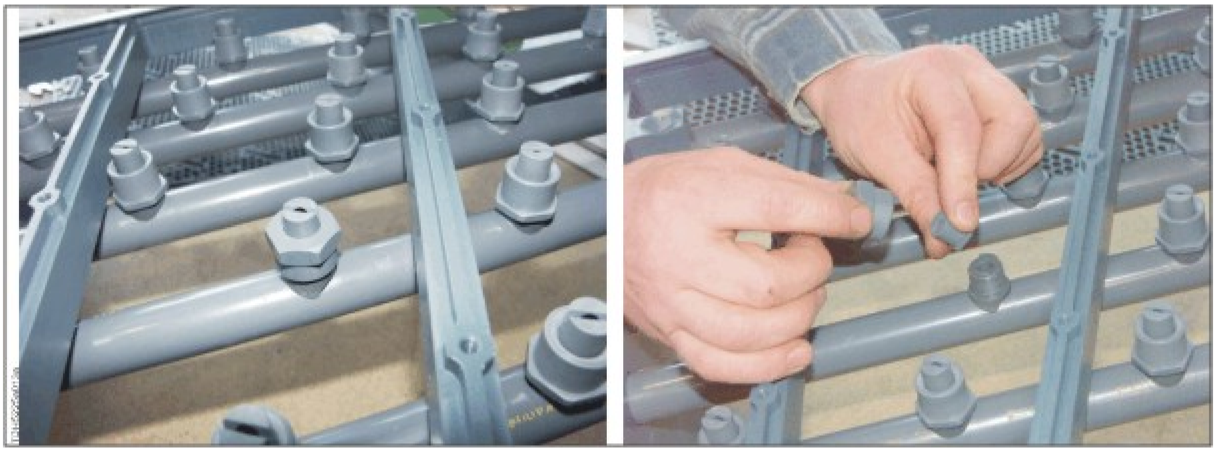
Removal of foil guide plates

3. Unscrew the countersunk head screws M8x30 which fix the distance bolts. Undo the screws with care. Check the threads and clean them carefully from residues or crystallizations by help of a brush if required.
   Important: Don`t use any lubricants or oil (this would spoil later on the electrolyte of the bath)! Then take out the anode meshes from the frame.



Removal of distance bolt and anode meshes

4. Check the spray nozzles: Are they blocked? Any damage?



Inspection of spray nozzles

5. Reassembly of nozzles:
   Fastening of the PVC union nuts by a torque wrench with 3 Nm (treat the thread gently).
   Keep the angle position of the nozzle apertures (slots). Later on it must be congruent with the apertures (slots) in the foil guide plates.

Reassembly of nozzles by a torque wrench (3 Nm)

6.7.2.8.1.2 Types and number of anode meshes in a Plater

In a Plater module there are 14 anode units above the PCBs (upper position),
plus 14 anode units below (bottom anodes in the Plater).

Two types of anode units:

First of all, we distinguish two types of anode units indicated here by 1/ and 2\. The slashes shall relate to the alternating inclination of the anode segment partition walls.

- Mounted at sequential position numbers 1,3, to 13: Anode unit type 1/
- Mounted at sequential position numbers 2,4, to 14: Anode unit type 2\

Four different sets of anode meshes:

Secondly, each anode unit is partitioned in 4 segments fitted with 2 sets of anode meshes each, A and B.
The sets A and B can be distinguished as follows:

Set A (4 pieces of meshed metal sheets):	Set B (4 pieces of meshed metal sheets):
Smaller holes with 26 mm diameter	Bigger holes with 32 mm diameter
Set A pieces are fitted first (underneath in the anode frame), followed by mesh type B	Set B pieces are fitted on top of set A pieces (top position in the anode frame)
Mounted next to the spray pipes (more distant to PCBs)	Mounted next to the foil guide plates (closer to PCBs)
The smallest sheet (in the segment at the clamp side) is cranked	The smallest sheet (in the segment at the clamp side) is straight (not cranked)
Mesh pattern orientated perpendicular to transport direction the at clamp side segment and elongated parallel to transport direction in the three other anode segments	Mesh pattern elongated parallel to transport direction at the clamp side segment and perpendicular (at a 90° angle) to transport direction in the three other anode segments

Actually there are four sets of mesh types: A/, A\, B/ and B\; The direction of inclination of the anode segments is indicated by slashes / and \ for both mesh types A and B.

This leads to 4 identification numbers (4 sets of anode meshes with 4 pieces each for the four the anode segments).

In one anode unit there are 2 sets or 8 anode sheets assembled, either set A/ together with set B/ or, A\ together with B\.

Assembly inside the Plater:

The anode mesh sets A/, A\, B/ and B\ are installed 14 times each in one Plater:
14 sets * [(A/ + B/) + (A\ +B\)].

The sequential numbers of the anode units are imprinted in each of the 28 anode units (14 anode units above and 14 below, see PVC frames).

Which set of anode meshes has to be installed at which position in a Plater can be seen in the following overview chart.

Anode unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Type of anode unit	1/	2\	1/	2\	1/	2\	1/	2\	1/	2\	1/	2\	1/	2\
Mesh sets above	**A/** **B/**	A\ B\	**A/** **B/**	A\ B\	**A/** **B/**	A\ B\	**A/** **B/**	A\ B\	**A/** **B/**	A\ B\	**A/** **B/**	A\ B\	**A/** **B/**	A\ B\
PCBs														
Mesh sets below	B\ A\	**B/** **A/**	B\ A\	**B/** **A/**	B\ A\	**B/** **A/**	B\ A\	**B/** **A/**	B\ A\	**B/** **A/**	B\ A\	**B/** **A/**	B\ A\	**B/** **A/**

Make sure not to mix up the types of anode meshes and their positions:
There are: (4 types of sets) * (4 anode sheets each) * (14 anode positions) = 224 anode sheets in a Plater.

6.7.2.8.2 Reassembly of anode meshes

Related topics:

- Disassembly of InPulse2 anode units, removal of meshed anode sheets
- Types and number of anode meshes in a Plater
- Removal and refitting of InPulse2 anode units

	INFORMATION
i	Treat the meshed anode sheets with care. Do not scratch or damage the anode coating not to shorten the anode life time.

	INFORMATION
i	Do not use any lubricants. Any organic substances would contaminate the electrolyte.

See also

Disassembly of anode meshes [→ 238]

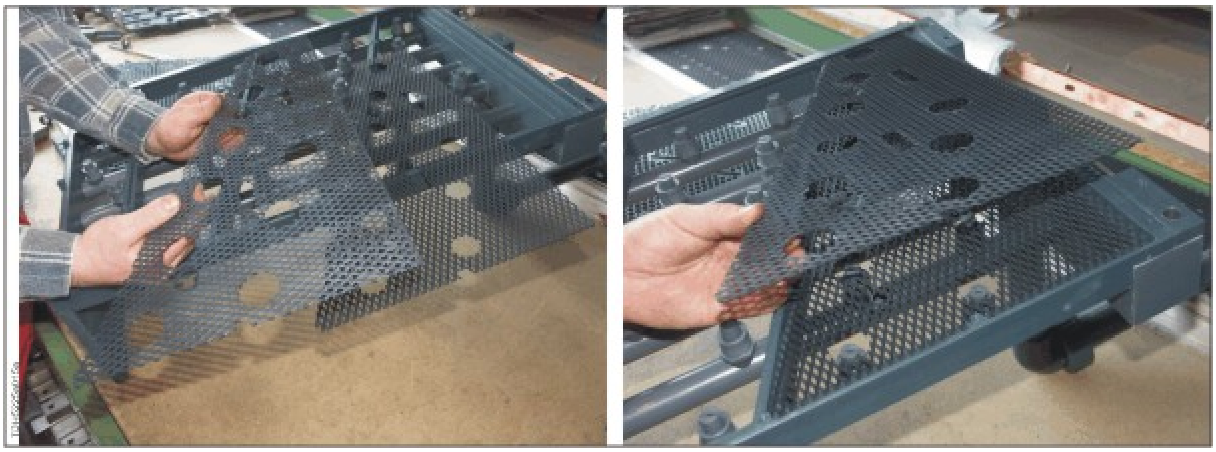
Types and number of anode meshes in a Plater [→ 241]

Removal and reinstallation of anode units [→ 220]

6.7.2.8.2.1 Reassembly - step by step

1. Fit the new anode meshes in their correct position, as described separately.

- Distinguish the 4 types of sets (A/ together with B/ in one unit and A\ together with B\ other units)
- Mind the position of the anode sheets in the anode unit (set B on top of set A)
- Mind the position of anode units in the Plater (14 position, upper and lower side).



Anode mesh type B to be mounted on top of mesh type A (larger holes on top of smaller holes)

In the illustrated example, the fourth anode segment is fitted with two sheets (type A and type B) of different orientation of the meshed wire structure.

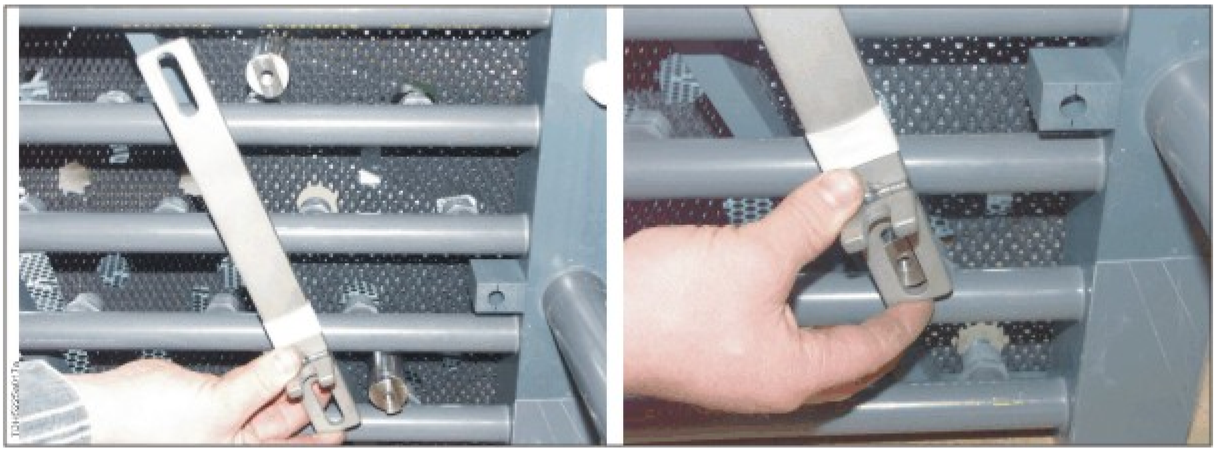
In this fourth anode segment (as well as in the second and third anode segment), the structure of the bottom sheet A is in direction of transport, whereas the structure of the upper sheet B is from the clamp side to the window side of the Plater.

2. Mount the distance bolts with the Titanium countersunk head screws M8x30.

Mounting of distance bolts

At this stage just fasten the bolts slightly. Later on you must turn the bolts to adjust them to the angle orientation of the slot in the connection bars.

3. Align the pins of the distance bolts that they fit easily in the slot of the connection bars.



Alignment of distance bolts and mounting of bridging bars

Avoid distortions and deformations. Align pins of bolts and connection bars thoroughly.

a) Fasten now the distance bolts (Titanium countersunk head screws M8x30) with a torque of 15 Nm by using of a torque wrench.

NOTICE

Insufficient electric connection

If you feel any blockage during fastening the distance bolts, don`t use force. This would lead to an insufficient electric connection. In this case rather check for proper fit of the meshes in the frame and check screws, bolts and mesh for possible deformations caused by improper fastening. Clean the threads of bolt and screws thoroughly and replace them by new ones if the threads are damaged.

4. Refit the foil guide plates and fasten the Ti-countersunk head screws (size M5) with a torque of $2^{(+1)}$ Nm.

Refitting of foil guide plates, tightening of screws with torque wrench

NOTICE

Scratches on the panels

Make sure, that all the screws are flush not to get scratches on the PCBs later on at production.

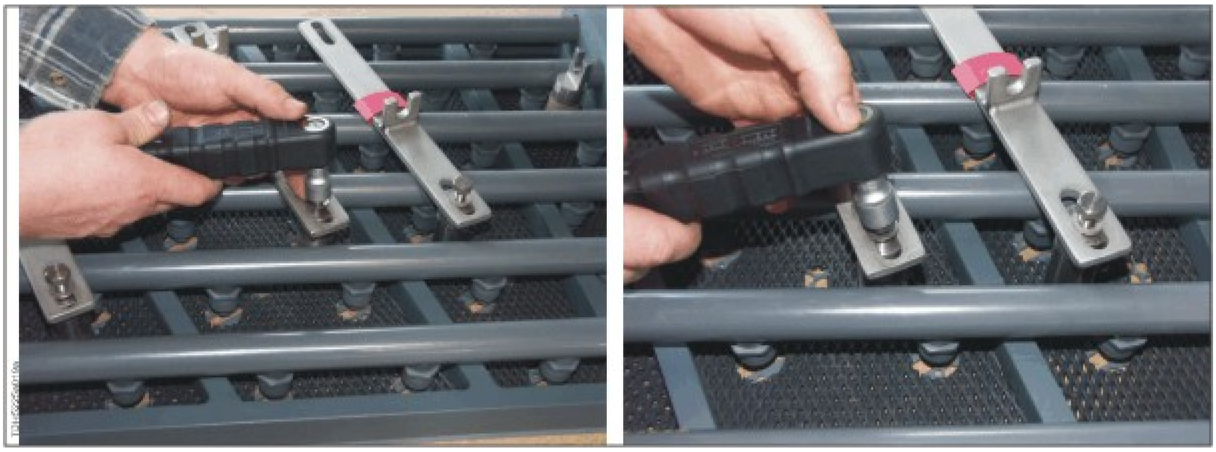
INFORMATION

Mind the orientation of the slots for fluid delivery (angle orientation like that of nozzles).

5. Mind the color marking of the connection bars, fasten the bars to the distance bolts

The color designation of the bars (as well as cables) is as follows:

At anode segment 1(clamp side):	Brown color (exception Uno-Anodes).
At anode segment 2:	Red color
At anode segment 3:	Yellow color
At anode segment 4 (window side):	White color



Fixing the color-marked connection bars to distance bolts with a defined torque

a) Place the Titanium shims between connection bar and screws.

b) Fasten the Ti-M8x20 hexagon head screws with a nominal torque of 15 Nm.

> **NOTICE**
>
> **High voltage**
>
> A correct and tight fit of these electrical connections is very important for a good and loss-free current conductivity. High voltage fault messages would appear if the connections are not properly made.

> **NOTICE**
>
> **Mixed colours**
>
> Make sure not to mix the colours! This would lead to serious malfunctions! The voltage and current ratings of the Pulse Generators must match the ratings of the anode segments.

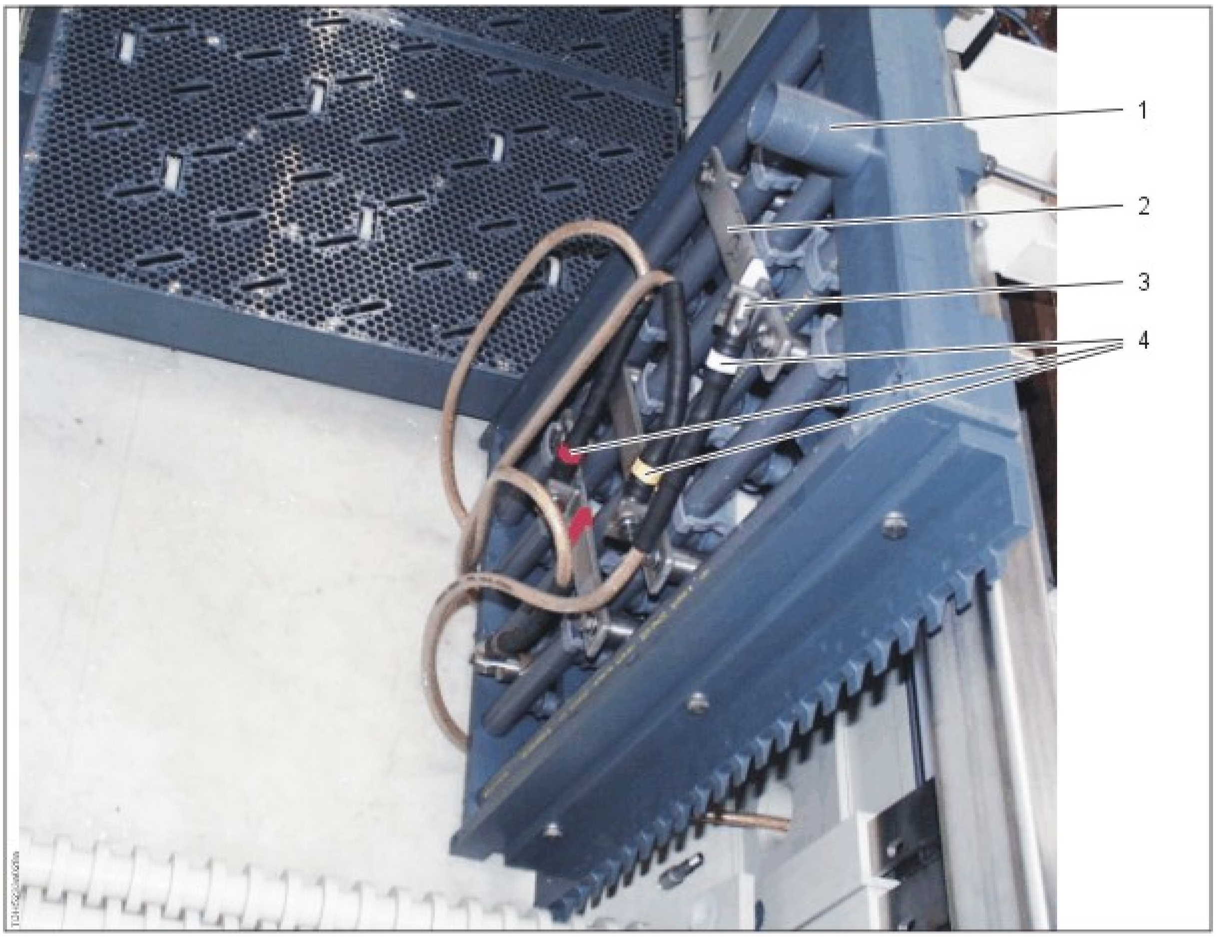
6. Connect the supply cables to the assembled anode units in the Plater module

The cables between the Pulse Devices and anode units are colour-marked with the same colors as the connection bars (brown, red, yellow, white, from clamp to window side). This helps to avoid wrong cable connections.

a) Fasten the color-marked electrical supply cables to the respective color-marked anode segment. Make sure not to mix the cables! This would lead to serious malfunctions!

b) The cable connections have to be fastened by a torque wrench adjusted to 15 Nm.

c) The arrangement of the cable connections must be at a 90° angle to the contact piece of the connection bar. This way the contact area between contact piece and cable terminal is maximum.



Connection of cables to anode units

1	Pipe for fluid delivery	3	Connection of anode cables
2	Bridge bar for current supply	4	Color marking

	NOTICE
!	**Mixed cables** Make sure not to mix the cables! This would lead to serious malfunctions! The voltage and current ratings of the Pulse Generators must match the ratings of the anode segments.

Summary:

- Fit the new anode meshes in their correct position, as described separately.
- Mount the distance bolts with the Titanium countersunk head screws M8x30.
- Align the pins of the distance bolts that they fit easily in the slot of the connection bars.
- Fasten now the distance bolts (Titanium countersunk head screws M8x30) with a torque of 15 Nm by using of a torque wrench.
- Refit the foil guide plates and fasten the Ti-countersunk head screws (size M5) with a torque of 2 $^{(+1)}$ Nm.

- Mind the colour marking of the connection bars, fasten the bars to the distance bolts
- Connect the supply cables to the assembled anode units in the Plater module

Related topic:

Concerning the re-installation of anode units in the Plater please, please refer to the separate description.

6.7.2.9 Pre-contacting system in Ip2-Platers with current monitoring

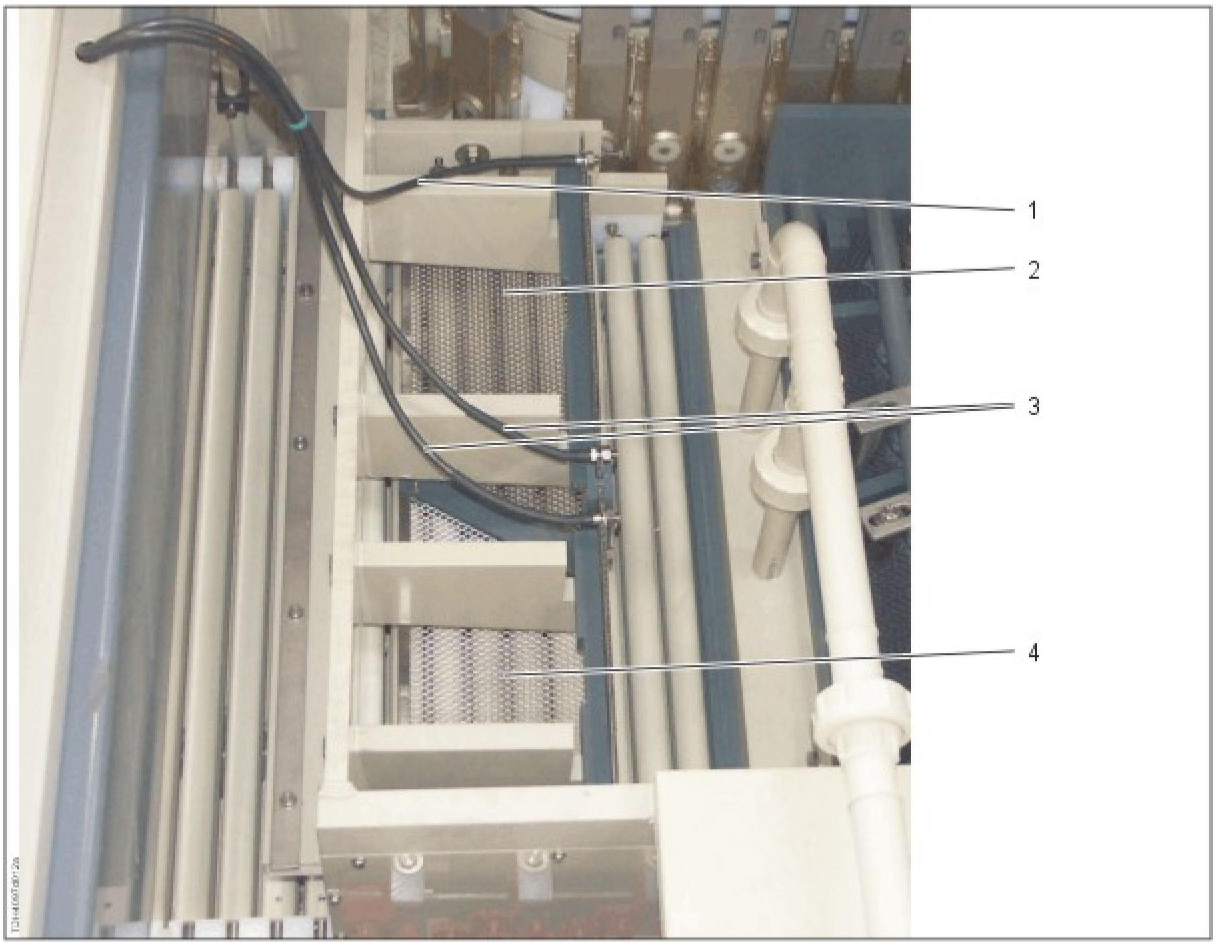
See also

030271 Inspect the rectangular titanium mesh (pre-contacting system) [→ 318]

6.7.2.9.1 Introduction

The pre-contacting system is installed at the input side of the Plater. Its function is to influence the potential of PCBs (which are about to enter the anode plating area, but which are not yet clamped) in such a way, that the etching effects at the leading edges of these PCBs are minimized to negligible minimum.

An insulated 16mm² copper wire connects the rectangular pre-contacting mesh with the cathode rail. The influence on the potential of the incoming PCBs goes together with a current flow from the first anode(s) - via the electrolyte, the rectangular pre-contacting mesh, the wire and an array of milliOhm resistors - to the cathode rail.



Two pieces of pre-contact meshes linked via cables to resistors

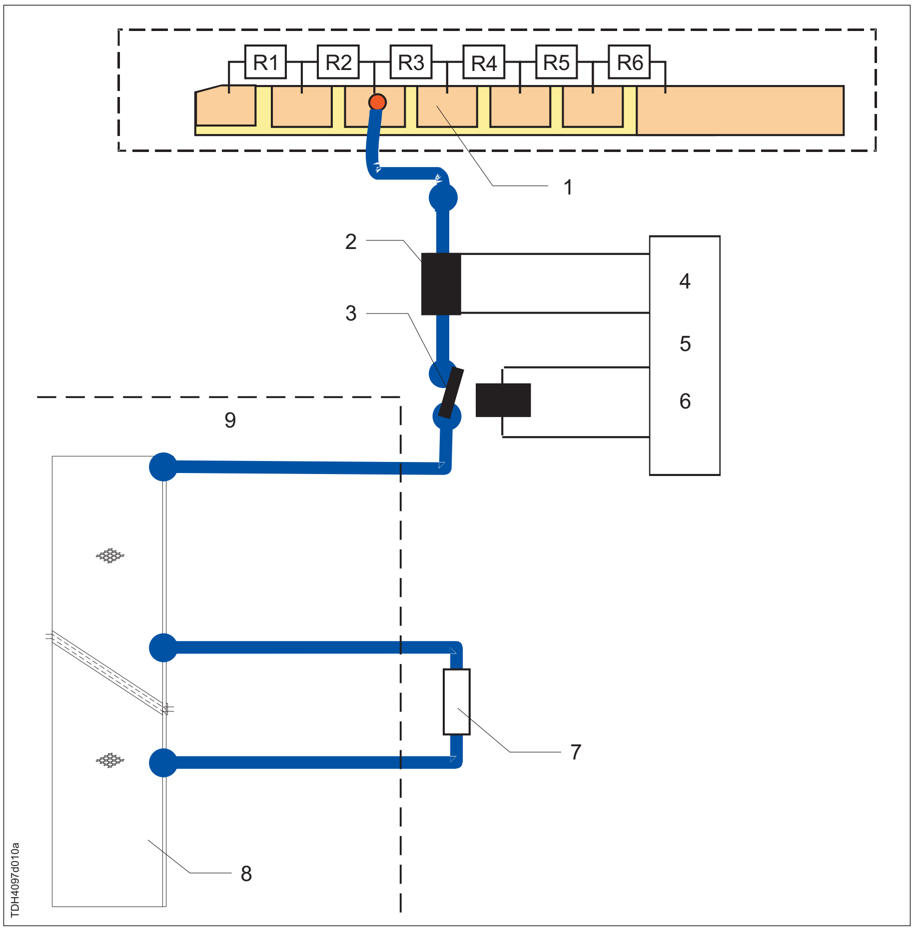
1	Wire to cathode rail	3	Pair of wires to resistor
2	Pre-Contact mesh at clamp side	4	Pre-Contact mesh at window side

6.7.2.9.2 Two Pre-contact Meshes

In order to get an optimum compensation of the potentials between the panels and to balance the differences from clamp to window side, the pre-contact mesh is segmented into two pieces. One part is mounted at the window side, the other part at the clamp side. These two pieces are interconnected with a resistor of 1,4 Ohm, that is mounted in a distribution box at the rear side of the Plater (see picture 2).

The pre-contacting current is accumulative from the window side to the clamp side of the Plater.

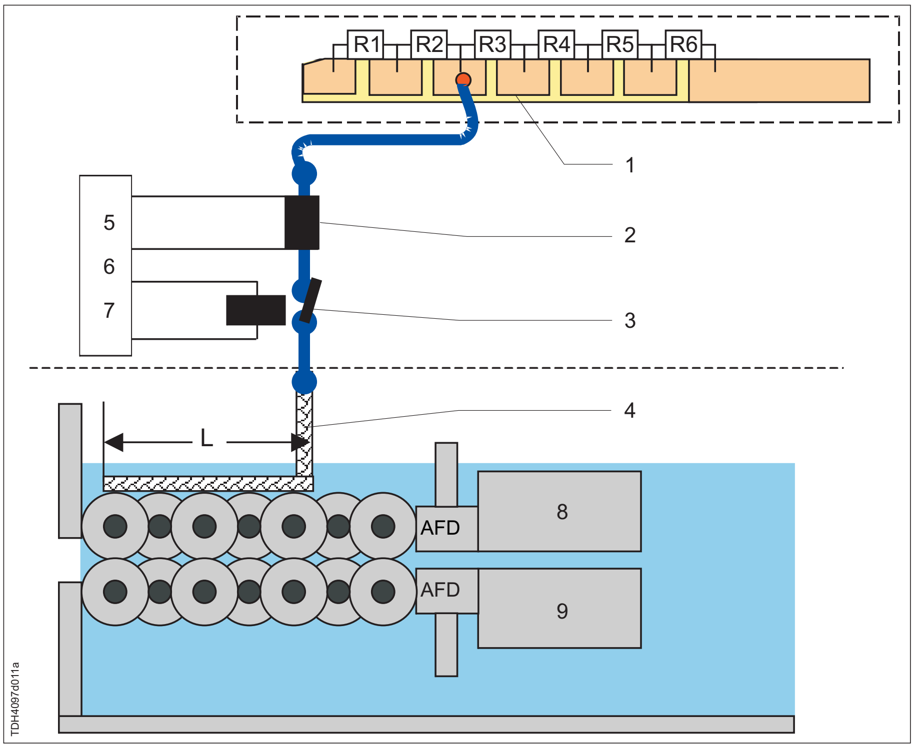
That means that the current through the 1.4 Ohm resistor (between the two meshes) must be distinctly less than the current in the wire to the cathode rail. Electricians can verify this by current measurement with a clamp-on ammeter.



Resistor connection between clamp side mesh and window side mesh

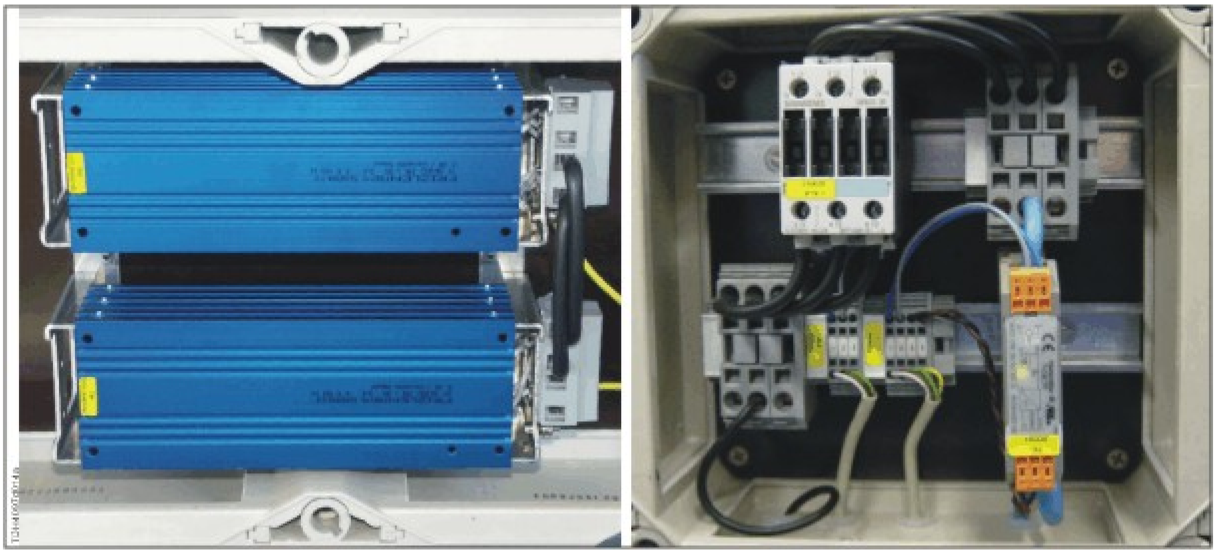
1	Segmented cathode rail	6	Digital output signal
2	Current transducer	7	Resistor combination 1.4 Ohm
3	Contactor	8	Precontact mesh
4	Analogue input signal	9	Inside the Plater
5	Logic in VCS		

6.7.2.9.3 Sketch for the illustration of components



Connection between the Pre-contact mesh and the cathode rail, monitored and controlled by the PC

1	Segmented cathode rail	6	Logic in VCS
2	Current transducer	7	Digital output signal
3	Contactor	8	First anode above
4	Pre-contact mesh	9	First anode below
5	Analogue input signal		



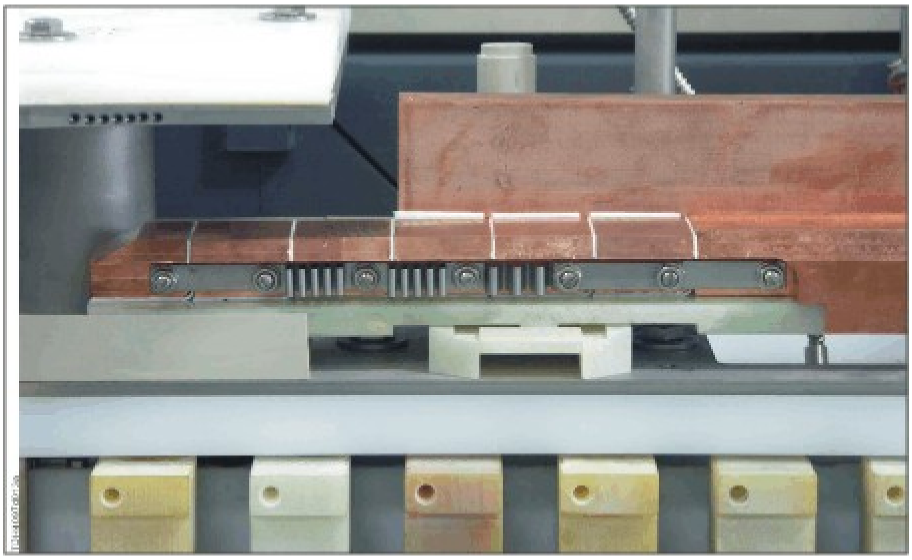
Pre-contacting system: Electrical parts mounted at the rear side of the Plater

1	1.4 Ohm resistor combination	3	Contactor
2	Current transducer		

Pre-contact segments in the cathode rail and array of resistors

The first part of the cathode rail is segmented. The isolated segments in the cathode rail are bridged by six resistors. The resistor values used in Ip2-Platers are as follows:

Resistor	R1	R2	R3	R4	R5	R6
[mΩ]	4	16	16	10	1	1



Segmented part of the cathode rail with six resistors

6.7.2.9.4 Current monitoring system

The current measurement chain consists of the following main components:

- A transducer which is converting the current into an analogue current signal in the range between 4 to 20 mA.
- The analog input module (AI) that is converting the 4 to 20 mA signal into digital values that enable the VCS to calculate, evaluate and display the current values.
- A contactor that is interrupting the current flow to the cathode rail, if the current exceeds the adjusted high alarm level.
- The digital output module that is activating the contactor if the high alarm level is exceeded.

The wiring of these parts of the measurement chain can be seen in the electrical wiring diagram.

Monitoring of the current in the connection wire:

For the proper function of the pre-contacting system it is important that

- the current flow is not interrupted (good electric contacts, no broken resistor in the chain of resistors at the cathode rail)
- an over-current is avoided, which can cause overheat and damage components.

The amount of current that is flowing in this connecting wire is largely in the range between 1 to 20 Amps. The actual amount of current depends on the actually running job, the kind of produced boards and the selected program parameters (assuming the correct function of the system, of course).

However, considering any malfunction of the system, like incorrect panel tracking, etc. this current could exceed even 100 Amps. This could destroy the resistors.

The current monitoring components together with software parameters help to detect faulty situations, either

- a poor electric contact (alarm minimum 0.3 Amps, warning minimum 1 Amps) or
- an over-current (default warning 20 Amps, default Alarm high 25 Amps)

When the 'Alarm high' is reached, the current flow is interrupted automatically by the contactor device. To allow the resistors to cool off (after an increase of temperature due to high current), the system will be deactivated for 2 minutes (default value).

Please note: These proposed default values must be fine-tuned, depending on the specific range of products during the commissioning phase of the line and in the first months of production.

6.7.2.10 AFDs in the Plater

A pair of AFDs is mounted at the input side of the Plater. It supports the transport of thin foils.

INFORMATION

Transportproblems for thin foils

The AFDs are not properly set. Transportproblems for thin foils will occur.

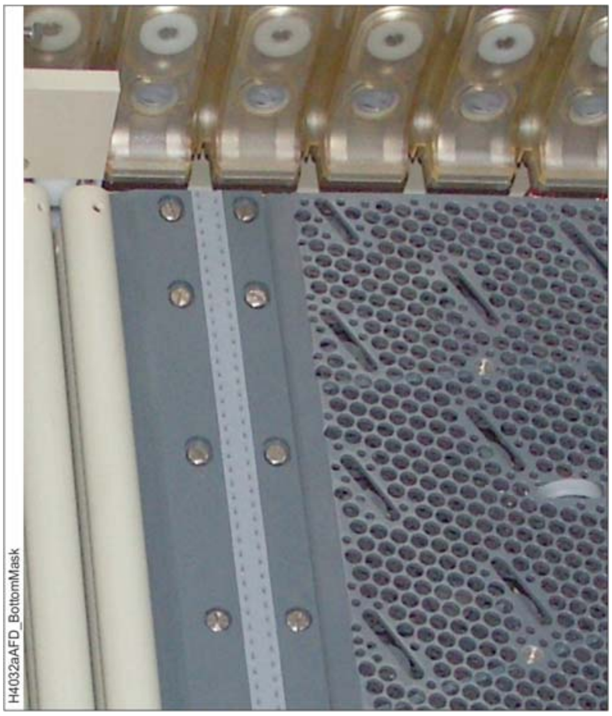
Intended purpose

The AFDs remove entrapped air in vias, blind vias and micro blind vias. They serve for surface treatment at the walls of bore holes to cause a better plating quality.

Distance of AFD masks to transport level

The AFDs are fixed at the first pair of anode baskets. Therefore the mounting height of the AFDs is given by the mounting height of the first anode baskets.

- **Lower AFD mask:**
  The surface is about 3 mm below the transport level of the panels. This distance is fixed by construction and can't be altered.



Lower AFD maskfixed to the first anode basket

- Upper AFD mask:
  The distance to the transport level depends on the different thicknesses of panels and the different production lines (UTS-s, UTS-xs and UTS-XL lines). The maximum panel thickness allowed for processing in the production line is specified in the P&I diagram.
  - In UTS-s and UTS-xs production lines the distance above the transport level is about 3 mm to 3.5 mm.
  - In UTS-XL production lines the distance depends on the mounting height of upper AFD baskets;
    Example:
    If the PVC surface of the upper Anode basket is 8 mm above the transport plane, the AFD mask surface is about 7.5 to 7 mm above the transport level.

Difference between upper and lower AFD mask

The chamfer at the upper AFD mask helps to prevent that lower AFD masks are mixed up with upper ones while maintenance work is carried out.

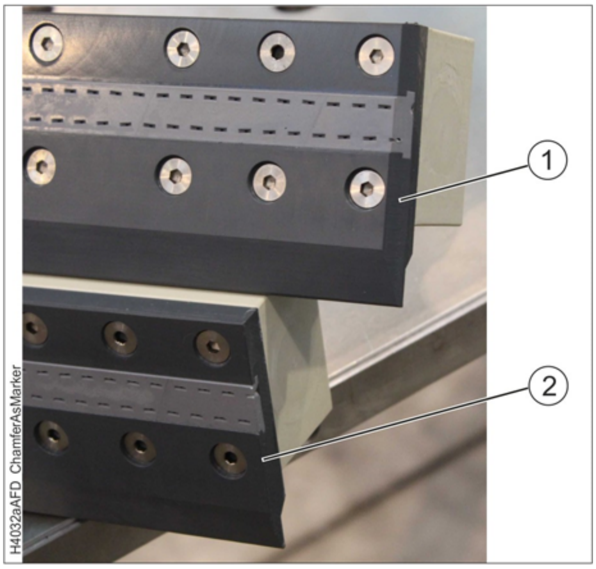
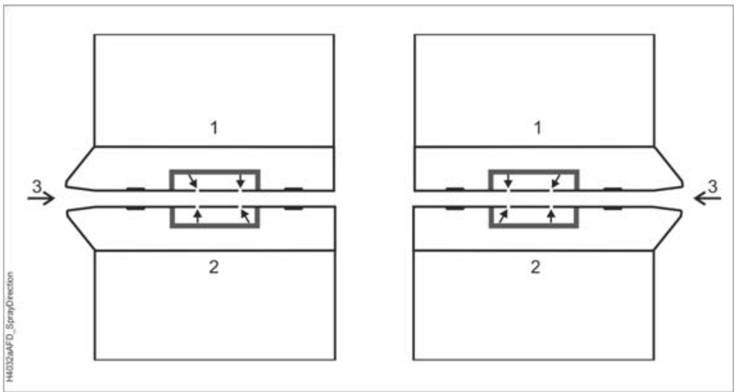


Illustration of chamfer at upper AFD mask (as marker)

	NOTICE
!	**Risk of panel jam, especially for thin material** It is not permitted to mount AFD masks with chamfer at the bottom AFD bar.

The direction of spraying beams (vertical or slightly slanted) is relevant for reliable transport of thin foils. Other factors are pump frquency, resulting flow rate and impact pressure, etc; (See related description: Setting and selection of pump frequencies dependent on panel thickness and flexibility of foils and PCBs)

Illustration of spray beams



Spray direction of AFD beams in L-R lines (left side schematic) and in R-L lines (right side schematic)

AFD mask without chamfer (see photo above)	AFD mask with chamfer (see photo above
As a result, the first row of AFD nozzles will spray vertically upward, the second row of nozzles will spray slightly slanted against direction of transport	As a result, the first row of AFD nozzles will spray slightly slanted in direction of transport, the second row of nozzles sprays vertically downward.

See also

043090 Inspect AFD masks and clean single holes if necessary [→ 326]

6.7.3 Redumat and Copper Dissolving Tank

See also

🗎 The importance of good electric connections [➔ 62]

6.7.3.1 Safety Instructions

CAUTION

Working with chemicals and chemically contaminated parts

For splash protection the anode box must be secured when opened. The pipe that is placed across the anode box serves this purpose.

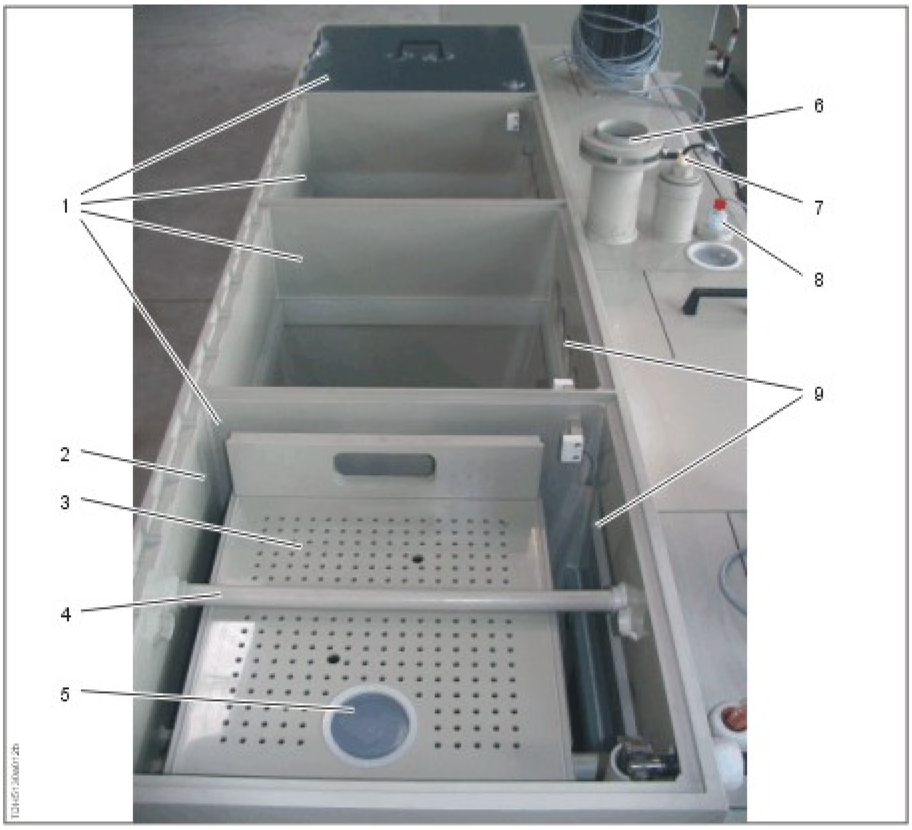
When maintenance work is carried out, the pipe is jammed below the box to hold it open securely.

The safety regulations on work with acids have to be always observed (safety goggles, protective clothing etc.).

6.7.3.2 Compartments and part designation

Copper replenishment takes place in the Copper Dissolving Tank. It is made of 5 compartments. One of the compartments is the Redumat compartment.

On top of the four copper containing compartments are the overflow apertures to the rear side compartment.



Top view of Redumat compartment and three Copper Dissolving compartments

1	Four copper dissolving compartments	6	Exhaust pipe
2	Top view on Redumat compartment	7	Analogue level sensor for level control
3	Anode box with oxygen release holes	8	Digital level switch for overflow protection
4	Pipe across anode box to hold it fixed	9	Overflow apertures the rear side compartment
5	Inspection hole		

6.7.3.3 Copper Dissolving Tank

Due to the insoluble anodes in the Plater the plated-out copper is to be replenished. This is achieved in the copper dissolving tank (which may be considered as Cu-ion generator).

The copper dissolving tank is installed externally (outside of the Plater) for easy maintenance.

The solution is pumped from the Plater to the copper dissolving tank (by the first transfer pump) and back to the Plater by a second pump (which is frequency controlled).

The copper is dissolved, when the electrolyte passes the Cu-Pellets in the four compartments.

The main chemical reactions in the copper dissolving tank are:

- Anode:
  $Fe^{2+} - e^{-} \rightarrow Fe^{3+}$
- Cathode:
  $Cu^{2+} + 2e^{-} \rightarrow Cu^{0}$

- General:
  $Cu^0 + 2\ Fe^{3+} \rightarrow Cu^{2+} + 2\ Fe^{2+}$
- (Cu^0 = metallic copper, Fe^{3+}/ Fe^{2+} = iron ions as redox-medium)

6.7.3.4 Fluid circulation

Please confer also to the P&I diagram to get an overview over the pipe work and the components that are installed.

Solution transfer from and back to the Plater

One transfer pump moves the solution from the Plater to the Copper Dissolving Tank. In the Copper Dissolving Tank the copper is replenished.

A second transfer pump moves the copper enriched solution back to the Plater. This pump is frequency controlled. Together with the analogue level sensor it is automatically controlling the solution level in the Copper Dissolving Tank.

Circulation for copper pellet dissolution

Two circulation pumps press the solution from the bottom of the four copper dissolving compartments to the top. The solution crosses over to the rear side compartment via overflow apertures.

It is then partly transferred back to the Plater and partly it is sucked again by one of circulation pumps.

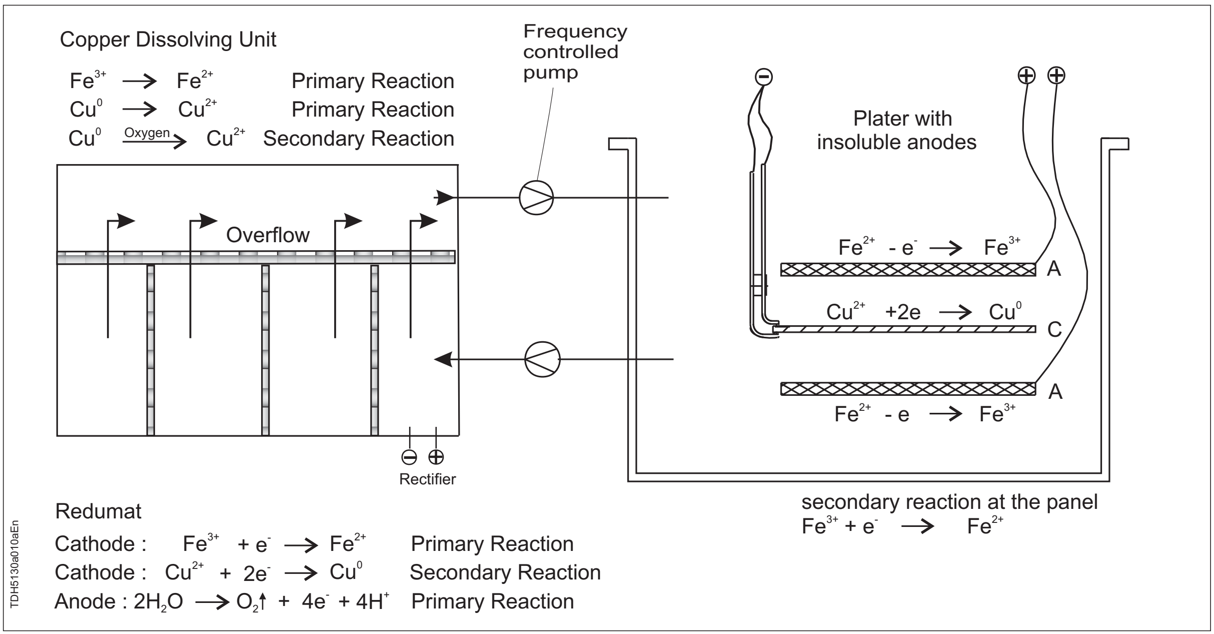
In the Redumat compartment the solution passes the following parts from the bottom to the top:

- the punched plate at the bottom
- the cathode titanium mesh
- the copper pellets (dissolving them continuously)
- the diaphragm in the anode box
- the anode mesh in the anode box
- the cross-over aperture on top

See also

- Compartments and part designation [→ 256]
- Chemical reactions in the Plater, Copper Dissolving Tank and Redumat [→ 259]
- Redumat [→ 259]

6.7.3.5 Chemical reactions in the Plater, Copper Dissolving Tank and Redumat



Schematic of fluid circulation and chemical reactions

6.7.3.6 Redumat

Without the rectifier of the Redumat being switched on, the copper content of the bath would raise daily by about one gram/liter.

The purpose of the Redumat is to keep the copper content constant.

After bath analysis the rectifier current is to be set accordingly (e.g. 150 A).

Anode box in the Redumat compartment

The chemical reactions in the Redumat compartment are the following:

- **Anode:**

  $6\ H_2O \rightarrow O_2 + 4\ e^- + 4\ H_3O^+$ (principal reaction, oxygen development)

$Fe^{2+} \rightarrow Fe^{3+} + e^-$ (secondary reaction, by constructive measures minimized)

The principal reaction at the anode (reduction of the oxygen concentration in the solution) becomes more dominant, the higher the current density is.

This is achieved by the comparatively small anode surface in comparison to the relatively large, negatively polarized copper pellet surface.

- Cathode:

  $Fe^{3+} + e^- \rightarrow Fe^{2+}$ (principal reaction)

  $Cu^{2+} + 2\ e^- \rightarrow Cu^0$ (secondary reaction)

  The principal reaction is the desired one. It becomes more dominant the lower the current density is. Therefore the cathode (in conjunction with the copper pellets) is constructed having a large surface.

6.7.3.7 Further sources of information

For more information on the Copper Dissolving Tank and Redumat you may also relate to:

- the P&I diagram
- the electric wiring diagram files
- the process control window in VCS
- the spare part list in the Atotech documentation
- the OEM (Original Equipment Manufacturers) documentation (for filters, pumps etc.).

See also

🗎 Copper replenishment and other maintenance task [➔ 260]

6.7.3.8 Copper replenishment and other maintenance task

See also

🗎 043011 Refill Cu-dissolving tank [➔ 319]

🗎 043031 Check diaphragms and exchange them if necessary [➔ 321]

🗎 043041 Read voltage display of Redumat rectifier [➔ 322]

🗎 043081 Cleaning of the dissolving tank (2nd generation of Redumat) [➔ 324]

🗎 043082 Inspection/replacement of the meshed anode grid [➔ 325]

6.7.3.9 Possible faults, when the voltage rises to a higher level than usual

a) In case that the rectifier voltage rises beyond the initially set warning level and you can’t run the Redumat anymore with a current of 190 A as maximum set point, please check ....

- the height of copper pellets (may be refilling of the tank is necessary)
- the cable connections (no corrosion, tight contact for good conductivity, quality of cable insulation, cable core not chemically attacked)
- the diaphragm (may be, it became blocked an therefore resistive)
- the actual life time of the anode mesh (usually the life time is between 18 to 24 month)

Theoretical context:

Any kind of increase of resistance in the whole electric circuit leads to an increase of voltage, because the current is set and therefore fixed. By applying Ohms Law this means, that the actual voltage is proportional to the actual resistance.

See also

Copper replenishment and other maintenance task [→ 260]

6.8 Dryer

6.8.1 Main features of the Dryer Module

In order to dry the PCBs completely, in the through holes and vias as well as on the surface, the air is supplied with a given temperature and pressure.
The air is delivered through 4 blow bars, each blow bar with 3 rows of holes in it.

<table>
<tr><td rowspan="2"></td><td>CAUTION</td></tr>
<tr><td>Hot compressed air
The surface of the Dryer module might be hot. Don’t touch.</td></tr>
</table>

Two compressors in the bottom compartment:
The two frequency controlled compressors (supplier Elmo) are installed in the bottom compartment of the module to save space (not sideways next to the line).

One compressor supplies the two bottom blow bars, the other one the two upper blow bars (see also P&I diagram).

A cooling fan keeps the ambient temperature of the two compressors at about 40 to 45°C.

Automatic temperature control by frequency variation:
The temperature of the compressed air is automatically controlled and kept at a given set-point.

The air is compressed as it passes through the blowing bars; as a result heat is generated, i.e. pressure and friction cause the temperature increase, there is no additional heat unit.
The energy is delivered by the electrical power supply of the compressor.

The actual temperature value is influenced by factors like the motor frequency of the compressor, environmental temperature, job parameters, exhaust system, cleanliness of the filter, etc.. The automatic control system continuously counteracts and neutralizes these influences. It is balancing deviations from the set-point value by an increase and decrease of the compressor frequency.

Automatic pressure control by flow rate variation:

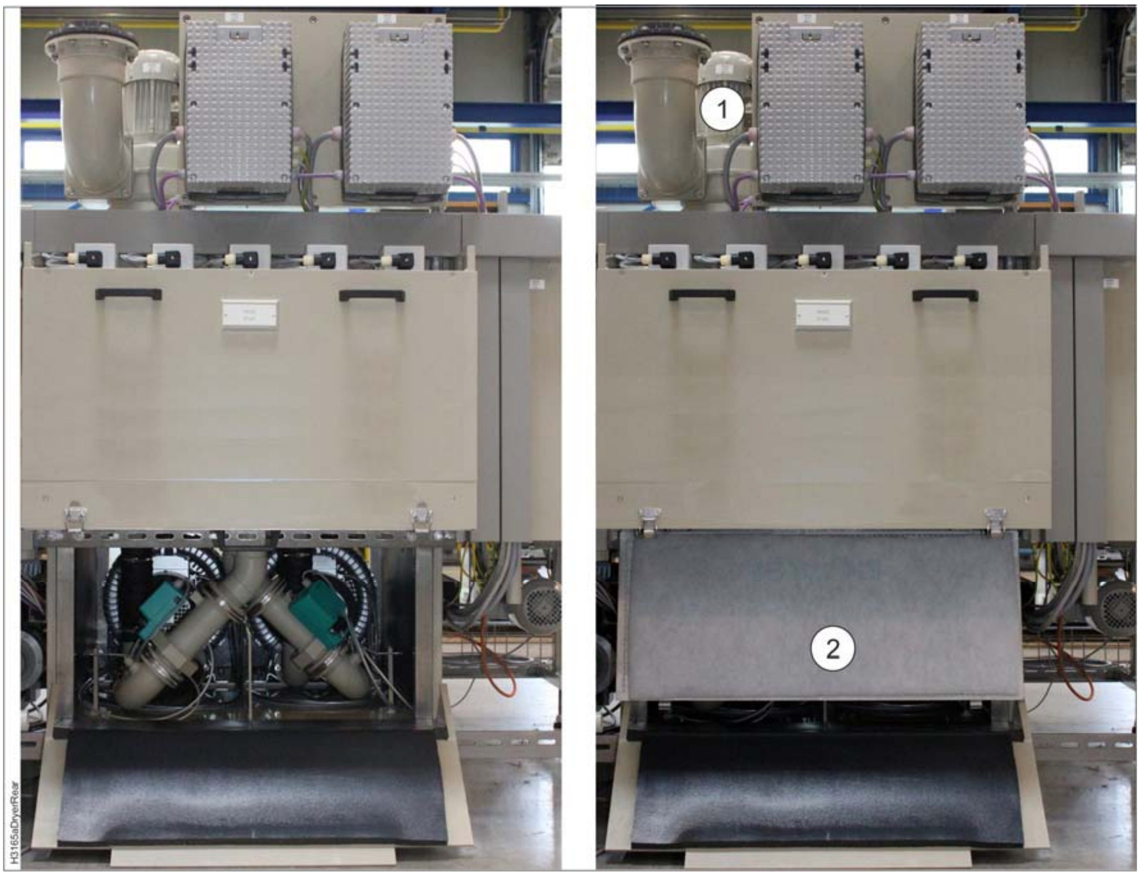
The pressure of the air in the blow bars is automatically controlled and kept at a given set-point.

The flap angle in the valve (supplied by Joventa) is automatically varied. The flap opens in order to increase the pressure and closes in order to reduce it.

Exhaust system:

The Dryer module has its own exhaust system, i.e. it is not linked to the exhaust system of the other modules of the line.
The use of a exhaust blower ensures a defined flow of exhaust air.

6.8.2 Photos and main parts

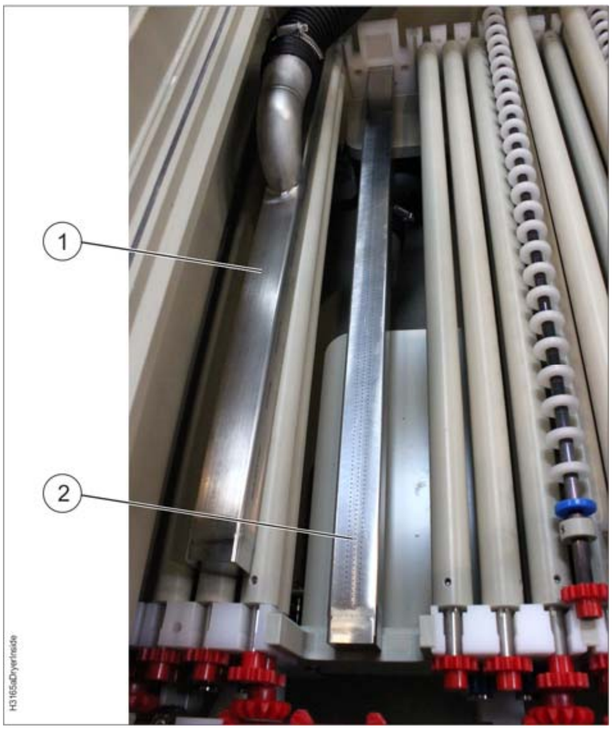


Open filter at maintenance side of the Dryer module

1	Exhaust blower	2	Air filter

Pressure Pipe

1	Connection for pressure detection	3	Upper blow bar
2	Temperature sensor cable		



Dryer inside

1	Upper blow bar (lifted out for cleaning or maintenance)	2	Lower blowbar with 3 rows of holes

View into the bottom compartment of the Dryer module

1	Compressor	2	Motor activated valve for flow rate and pressure control

Primary parts in the Dryer module

- Air Filter (ambient air input) at rear side
- Two pairs of blow bars, each bar with small holes in three rows
- Two compressors, one for the two bottom blow bars, the other one for the two upper blow bars
- Each compressor is controlled by a frequency inverter (supplier Nordac)
- Flow and pressure control valve (Joventa) at the pressure side of each compressor
- Exhaust blower, installed in the exhaust pipe, to blow out the humid air from the upper compartment (Exhaust volume 400 m³/h – 600 m³/h). Its speed is frequency controlled and depends on the pressure measurement in the upper compartment of the Dryer module
- Cooling fan in the bottom compartment, controlled by a temperature sensor
- Acoustic insulation of the bottom compartment for noise suppression
- Altogether 5 temperature sensors:
  - Two sensors to control the temperature in the pipe towards the upper / lower blow bars,
  - a third one, to detect the temperature in the bottom compartment
  - and two further ones, to prevent excessive temperatures at the output pipes of the two compressors (for hardware controlled switching off in case of over-temperature)
- Altogether 3 pressure sensors:
  2 pressure sensors to control the pressure in the pipe towards the upper / lower blow bars by an automatic angle variation of the Joventa valve flap and a third one to control the low pressure in the upper compartment and the speed of the exhaust blower.

6.8.3 Control parameters

The two compressors in the bottom compartment of the Dryer module are temperature-frequency controlled. The control system varies automatically both, the frequency of the compressors and the flap-position of the so-called “Butterfly Valves” depending on the temperature difference between actual and set-point value. This way, the temperature is kept constant at the given set-point value.

For the automatic temperature control, we use the sensors B16.1 and B16.2, which are located in the pressure side pipe of each compressor (point of measurement between ‘Butterfly Control Valve’ and Blow Bars).

Temperature set-point, warning and alarm limits (default values)

Parameter	Value	Reaction of control system
Set-point Temperature by default	65 - 70 °C	Comparison of actual value with set-point value
Temperature Warning High	+3°C	Fault message and horn actuation
Temperature Alarm Max	+5 °C	Message, horn, Stop of Loader, stop frequency inverter and compressors
Temperature Warning Low	-3 °C	Message, horn
Temperature Alarm Min	-5 °C	Message, horn, stop of Loader

INFORMATION

Warning limits

The (upper/lower) warning limits are relative to the set-point value, a few °C higher or lower.

NOTICE

Set-point temperature

It is not permitted to set the set-point temperature higher than 70°C!

The temperature of the PP material inside of the Dryer module must not exceed the maximum temperature of 70°C.

Safety protection:

- At an excess temperature higher than ‘Temperature Alarm Maximum’, the compressors will be switched off automatically.
- Atotech commissioning personnel sets the additional protective PLC-parameter ‘SetTempModuleOverheat’ to 80°C (absolute value, not relative).

Pressure in the blow bars

Pressure sensors:

The pressure sensor, which detects the actual pressure in the blow bars, is mounted in the pipe between butterfly valve and the blow bars. It is connected to an analogue input bus module. See also electrical wiring diagram.

One pressure sensor is used for the pressure detection in the first pair of blow bars, the second one for the second pair blow bars.

Pressure range and set-points:

The pressure set-point can be in the range between 50 mbar up to approximately 185 mbar.

Since the optimum pressure is dependant on panel thickness (transport reliability), the set-points are entered into the Batch Control program (recipe). The table below is an adjustment recommendation for the different panel thicknesses. Note: The individual panel flexibility depends not only on the absolute thickness but also on the copper clad thickness! If required, according test runs have to be carried out to find out the optimum pressure values for the individual panel types.

The maximum possible pressure value to be entered is 200mbar. At this value the system is running at its upper design limit. With regard to lifetime and equipment safety it would be better to refrain from adjusting this maximum pressure value.

Thickness of PCB	Nominal pressure set-points
for thickness >50 µm to 100 µm	60 - 70mbar
for thickness >100 µm to 250 µm	75 - 100mbar
for thickness >250 µm to 400 µm	100 - 140mbar
for thickness >400 µm	150 - 185 mbar

Automatic flap angle variation:

If we set the pressure to a high value (e. g. 185 mbar), the automatic control (PLC) opens the 'Butterfly Valve' (flap angle moves to approximately 90 degree position).

At pressure set-points between maximum and minimum pressure, the flap angle in the valve is automatically adjusted by the control PC.

The actual flap angle is always displayed at the VCS process control window.

Pressure in the working area, control of exhaust blower

A third pressure sensor (supplier Greisinger) detects the actual pressure in the working area of the Dryer module (= blow bar and conveyor area and exhaust area).

The speed of the exhaust blower varies PC controlled in order to keep the pressure at the given set-point.

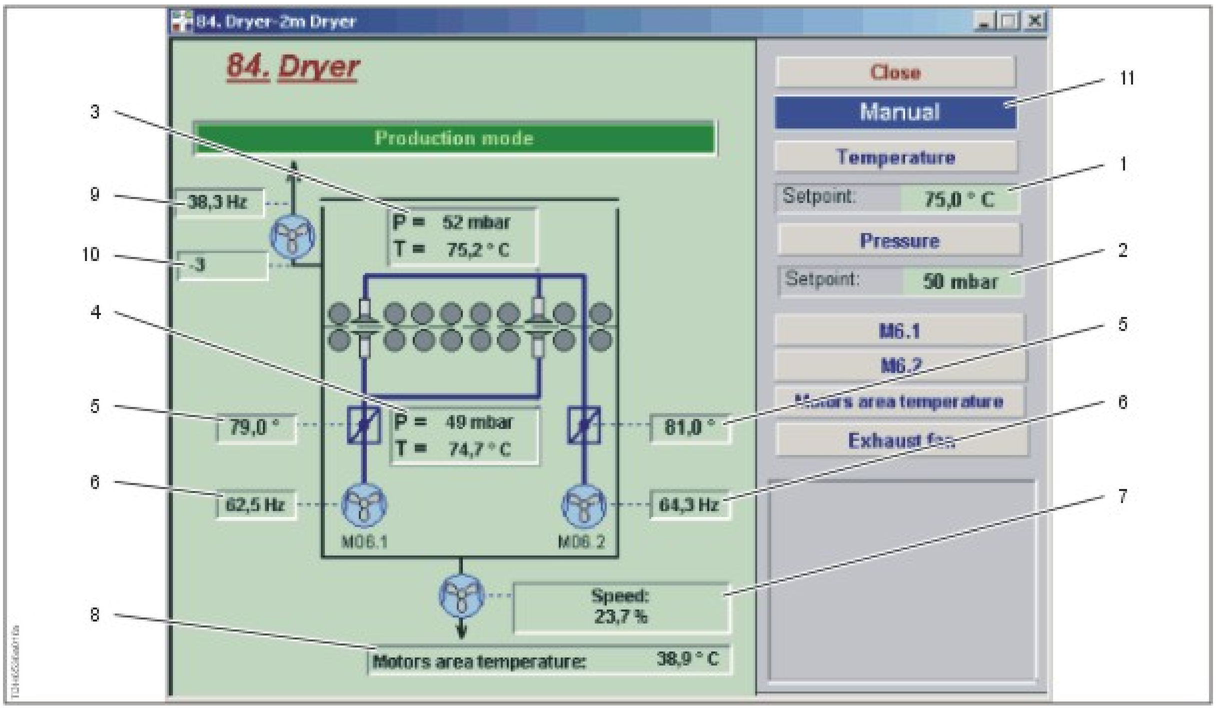
Set-point value for exhaust: -2 Pa (between –1 Pa to –5 Pa)

The set-point value, being in the negative range, ensures that some air is sucked from the adjacent modules into the Dryer module and not blown sideways (towards adjacent modules). Furthermore it ensures that the humid air is sucked-out from the dryer chamber to ensure an optimum drying process.

In other words this setting means, that the flow rate being sucked by the exhaust blower is slightly more, than the air input through the filter at the rear side of the module.

	NOTICE
!	**Risk of panel damage** It is not permitted to operate the Dryer without exhaust blower running. Risk if drying process not sufficient!

Process control window (extract from VCS)



Extract from VCS, Process control window of the Dryer module

1	Temperature set-point	7	Speed of the cooling fan in %
2	Pressure set-point	8	Actual temperature in compressor compartment
3	Actual values of pressure and temperature in upper blow bars	9	Actual frequency of the exhaust blower
4	Actual values of pressure and temperature in lower blow bars	10	Actual pressure in the working area
5	Flap angles of the two butterfly valves	11	Display of the mode of operation of the Dryer module
6	Actual frequencies of the two compressors		

Different types of Heat-up phases

To make the heat-up system of the Dryer module both, faster and more economical, the control logic is not exactly the same if PCBs are in the Dryer module or not.

We distinguish

- Pre-heating phase:
  No PCBs in the line, fixed flap angle for butterfly valve, no automatic pressure control
- Active heating phase:
  PCBs are in the line, but the leading PCB of the job has not yet reached the cross-over position, that defines the ‘Production mode of the Dryer module’.
- ‘Production mode’ of the Dryer module:
  This mode means that a PCB is already inside the Dryer module, or the first PCB of a job is coming closer and just a certain distance away from the Dryer module.

Fixed flap angle: The flap angle of the Butterfly valve can be set to a fixed angle, which is just relevant

- in the Pre-heating phase (no panels in the line) and
- in the Active heating phase - as long as panels have not reached the cross-over point.

A reduced and fixed flap angle reduces the flow rate (which is sucked by the compressors) and reduces energy consumption. The pressure control in the blow bars is disabled in these phases.

Ventilation fans for temperature control in the compressor compartments

The compressor compartment of the Dryer module is somewhat cooled by ventilation fans (supplier ‘Papst’) to prevent overheating of the two compressor engines and extend their working ranges.

The speed of the two fans is PC controlled in order to keep the ambient air temperature in the compressor compartment for the two compressor engines at a given set-point.

NOTICE

Risk of compressor damage

It is not permitted to operate the Dryer if the ventlation fans are not running, defective or switched off (this may happen especially in Manual Line Mode, while panel tests are made or in case of maintenance, if all aggregates are switched on by manual command).

- By default the set-point is 40°C. (Any higher set-point would limit the pressure range in which the automatic pressure control loop can operate).

The actual value of the ambient compressor temperature is detected by a temperature sensor [Pt100].

- Temperature warning high: 46°C

- Temperature alarm maximum: 50°C
- Default set-point during heat-up: 45°C

Actual display of the fan speeds:

The actual speed of the fans is indicated as percentage (0 – 100%).

Low percentage means that the fan is running at a relatively low speed. In such a situation there is little flow rate required to keep the temperature in the compressor compartment constant.

High percentage means that the fan is running at a relatively high speed. There is a high flow rate required to keep the temperature in the compressor compartment at the given set-point.

At 100% speed and flow rate, the temperature control at the given temperature set-point is at its upper limit. A slight increase of the temperature (set-point for compressor compartment) is appropriate to slow down the cooling fans somewhat.

See also

🗎 Temperature Control [→ 122]

6.8.4 Preventive Maintenance

Filter check and cleaning:
When the filter is contaminated and therefore partially blocked the air throughput is reduced.

Therefore the fine filter must be cleaned at regular intervals depending on the degree of contamination.

See also

🗎 Photos and main parts [→ 262]

🗎 085010 Clean filter of the Dryer [→ 327]

6.8.5 Further sources of information

For more information on the Dryer module you may also relate to:

- the electric wiring diagram files in the electric cabinet
- the process control window in VCS

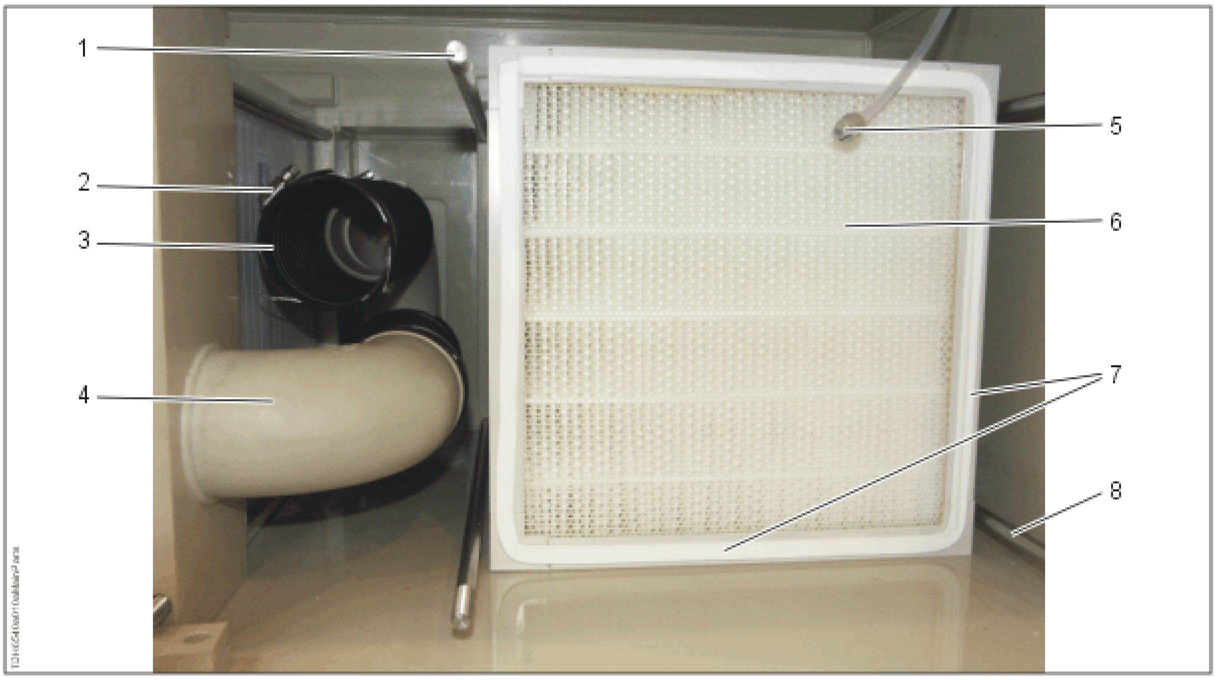
6.8.6 HEPA-Filter in the Dryer module

HEPA is the acronym for 'High Efficiency Particulate Arresting'.

Particulate in the air is caught in the HEPA filter prior of the compressed air being used for drying the PCB (especially relevant for fine line technology).

Depending on the degree of air contamination in the production hall, the HEPA filter must be replaced by a new one sooner or later if it is (fully) congested.

Photo to illustrate main HEPA filter parts in the Dryer module



View into the opened bottom compartment of the Dryer module (here with the holding frame of the HEPA filter already removed)

1	Rod for tightening the holding frame	5	Pressure measurement pipe, measurement point A of the signal transducer
2	Fastening ring to fix and tighten the supply pipe	6	HEPA Filter box
3	Supply pipe from compressor to HEPA filter (for the opened section of the Dryer module)	7	Sealing ring to prevent sideway air suction (here white color, commonly however black)
4	Supply pipe from compressor to HEPA filter for the other section of the Dryer module)	8	Rod for tightening the holding frame

Air Flow (sequence of involved parts)

See the P&I diagram to follow up the direction of air flow:

- Input air filter (pre-filter mat)
- Frequency controlled compressor(s)
- Actuator(s) for pressure, temperature and flow control
- HEPA Filter(s) (pressure monitoring across)
- Air blow bars with many small holes (two twins, top and bottom)

Replacement of the two filters (need to do):

Since it is neither possible nor reasonable to define a fixed interval for replacement in weeks or month, the VCS software monitors the pressure loss across the HEPA filter (which is indirectly an indicator for the degree of reduced flow of air) if the filter gets congested.

If the input of air into the Dryer module is not sufficient any more and the pressure loss across the HEPA filter is getting too high, the two HEPA filter boxes must be replaced.

The VCS software generates a warning (alarm) message, if the pressure loss across the HEPA filter is higher than regular (regular range from 1 to 6 mbar).

- Warning: If the pressure loss is equal or more than 6 mbar (default value), VCS generates a 'Warning' message: "Increased loss of pressure: The HEPA filter needs to be replaced soon"
- If the pressure loss is equal or more than 9 mbar (default value), VCS generates an 'Alarm' message: "Loss of pressure too high: The HEPA filter needs to be replaced. The drying process in the Dryer module is likely to be not sufficient any more".

Replacement of the two filters (actions):

a) Remove the rear side cover (open 4 hinges)
b) Unscrew the 4 black screws
c) Loosen the fastening ring (fixed around the feed pipe connection).
d) Take off the pressure measurement pipe from the front side holding frame
e) Pull back the HEPA Filter holding frame
f) Replace the old HEPA filter by a new one. It is recommended to replace both of them.
g) Always before re-installation of the HEPA filter: Clean the 2 Sealing rings at the rear side and front side as well as the areas against which the sealing rings are pressed.
h) After re-installation: Check the indicated pressure loss at the respective VCS control window (whether it is now less than about 2 mbar).
i) Check that there are two spare filters in stock for the next replacement if necessary.

Hint with regard to Pre-Filter and extension of service time:

Clean and replace the Pre-filter (positioned bottom side below the HEPA filter) rather sooner than later (weekly, monthly, depending on condition) in order to extent the service time of the HEPA filter!

6.9 Trouble shooting / fault messages

For immediate and professional response to any kind of detected faults, VCS offers Online Help messages. The context sensitive help function makes it possible to identify causes of a fault without unnecessary delay.

The alarm management system indicates the kind and location of a fault in the production line and offers a troubleshooting guide to give advice in solving problems.

This will be helpful to reduce the time to restart production to a minimum.

Fault Messages List

The **Fault Messages** list displays the active fault messages, warnings, and notifications received from the equipment in the chronological order.

2/2/2005 2:31:34 PM		7601	Warning! (Line.=HA20 Sweller.Sweller): Dosing tank level low.
2/2/2005 2:31:34 PM		11003	Alarm! (Line.=HA20 Sweller.Sweller): Circuit breaker fused.
2/2/2005 2:31:34 PM		7001	Alarm! (Line.=HA20 Sweller.NaOH): Dosing tank level minimum.
2/2/2005 2:31:34 PM		7601	Warning! (Line.=HA20 Sweller.NaOH): Dosing tank level low.
2/2/2005 2:31:34 PM		7604	Warning! (Line.=HA20 Sweller.NaOH): Dosing tank level high.
2/2/2005 2:31:34 PM		7304	Alarm! (Line.=HA20 Sweller.NaOH): Dosing tank level maximum.
2/2/2005 2:31:34 PM		11003	Alarm! (Line.=HA20 Sweller.NaOH): Circuit breaker fused.

The first column shows the date and time when a message appears, the second column shows the message alarm class icon, the third column displays the message ID number, the fourth column contains the message text with the message alarm class (alarm, warning, information) and the line module and device where the fault occurred.

If the line works properly, the **Fault Messages** list is empty. New alarm and error messages appear in red, new warning messages appear in brown. To execute "Reset Alarm", press **F9** once. All messages in the window turn to gray. New messages, appearing after the last **Reset Alarm** command execution, are highlighted. A message disappears from the list only if the fault causing the message is gone, and the **Reset Alarm** command is executed after that.

If there is not enough space for all messages in the window, then as many messages as possible are shown. A scroll bar appears at the right border of the list and is used to scroll up and down through the entire **Fault Messages** list.

For immediate response to any kind of detected faults, VCS offers the online Fault messages help. To open a fault message help file, it is necessary to highlight (select) the fault message that is on-screen in the active fault messages window and press function keys **Ctrl+F1.** The opened file provides detailed information on the background and context of the fault. It enables taking corrective measures quickly.

Extract out of the VCS-H_Help.pdf / VCS-H_Help.chm file

To open a fault message help file:

a) Highlight (select) the fault message in the ‘Fault Message List’

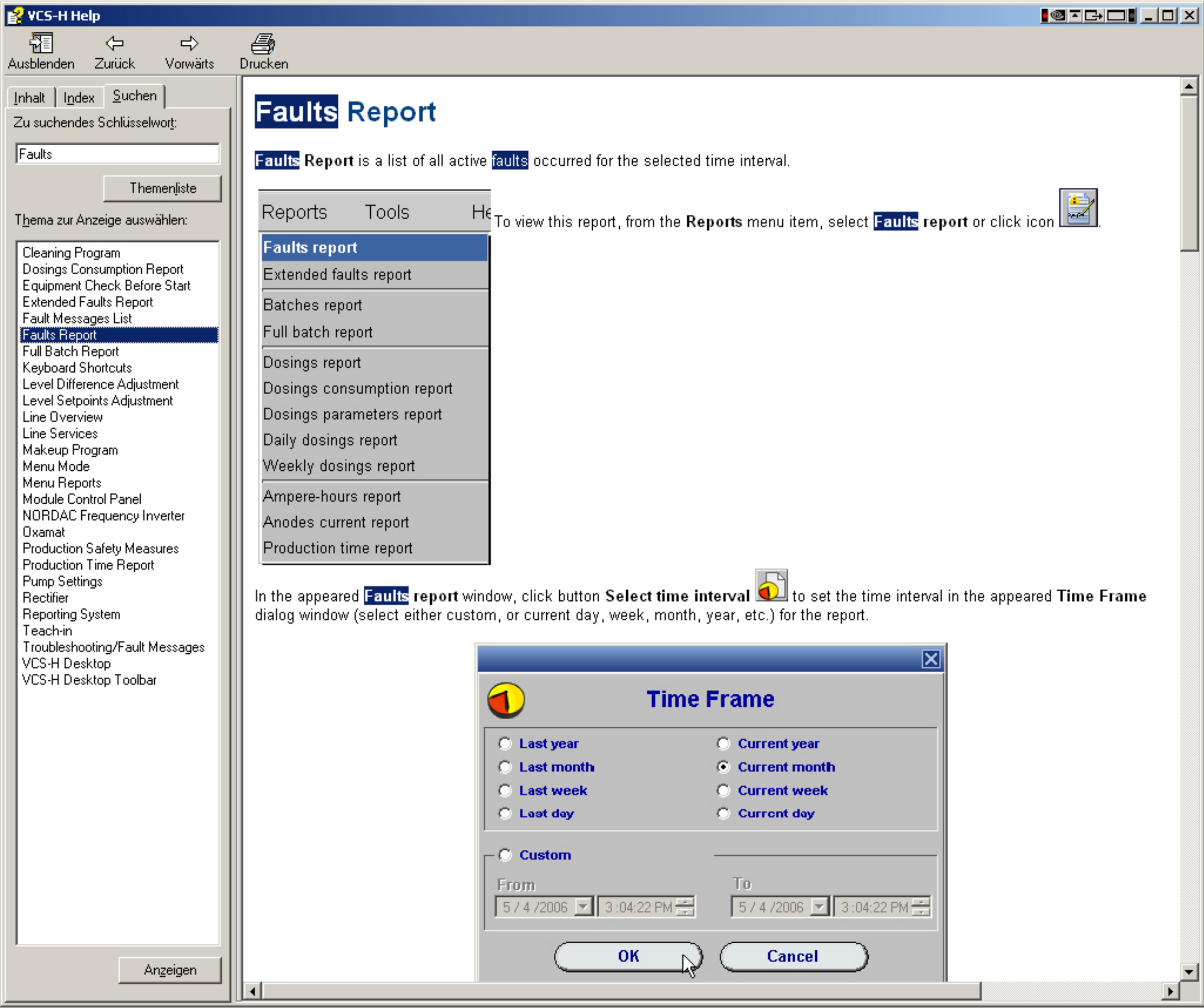
b) Press the function key combination Ctrl+F1

A help file will then be opened that provides detailed information on the background and context of the fault. It enables you to take corrective measures quickly.

You may also contact Support@visutechsystem.by for further clarification and support if required.

If you wish to read more about topics related to ‘Fault reports’ etc., you may open the file VCS-H_Help.chm on the control PC (or a copy of it saved anywhere else).

To give an example, we entered the word ‘fault’ for Search and opened one the appearing files (example ‘Faults Report’).



Extract out of VCS-H_Help.chm

This extract is just an example of how information can quickly and easily be obtained in the VCS-H_Help file.

6.9.1 Signal lamp and status of the line

In case of a malfunction an acoustical alarm signal will sound.

An fault message will appear in VCS (red color).

- Green flashing light:
  The line is in heat-up mode.
- Green steady light:
  All automatic functions of the line are switched on.
- Yellow flashing light:
  There has been at least one new warning signal, which has not yet been acknowledged by the operator. Every new warning signal generates a new flashing of the lamp.

- **Yellow steady light:**
  There has been at least one new warning signal.
  All warning signals have been acknowledged by the operator.
- **Red flashing light:**
  There has been at least one new alarm signal, which has not yet been acknowledged by the operator.
  Every new alarm signal generates a new flashing of the lamp.
- **Red steady light:**
  There has been at least one alarm signal.
  All alarm signals have been acknowledged by the operator.

6.9.2 Confirming fault messages (F9 key)

After the generation of a fault message, the operator confirms the recognition of the fault message by pressing the F9 key. Pressing the F9 key once will disable the acoustical alarm signal.

Assuming that the cause for the fault has been corrected, pressing the F9 key a second time will remove the fault message from the monitor.

6.9.3 Alarm Management System in the MANUAL mode of operation

	INFORMATION
i	Contrary to the Automatic mode of operation, the logic which creates a message is different in the Manual mode of operation.

- Drive System:
  Be aware about the speed relation in the two, three (or more) sublines line.
  The drives are not interlocked by control system. They must be switched on one by one, considering the individul drive speeds and the position of the panels in the line. If panels are in the line, start to switch on the last subline first and the first subline last.
- If a Plater is part of the line, consider that board jams in the Plater can cause major damage to the system (clamps, clamp shieldings, anodes, etc.).
- Temperature monitoring in the Manual mode: No warning signal, only a message is displayed on the monitor.
- Water supply: No monitoring of the water supply to the rinse modules (min. and max. flow through the flow sensors).
- Drain valves in active modules: No magnetic valve position monitoring.

The different logic in Manual mode mainly serves the purpose of making tests without being blocked by software interlockings (which, on the other hand, are very important for being part of the logic during production).

6.9.4 Access to a fault message help file

Generally the fault messages that appear, are created on-screen in different ways:

1. inside the Active Fault Message Window (at the bottom of the VCS main window)
2. by creating a fault message report (see VCS menu)

To get a selected fault message help file, press the function keys Ctrl+F1, after the fault message is on-screen and selected.

It is recommended to make use of the options mentioned, not only at the PC for running the production, but also by installing and using the VCS- Demo version on an office PC.

Inside the Active Fault Message Window you can

- highlight the fault message
- press the function keys Ctrl+F1

and the fault related trouble shooting guide will appear on-screen.

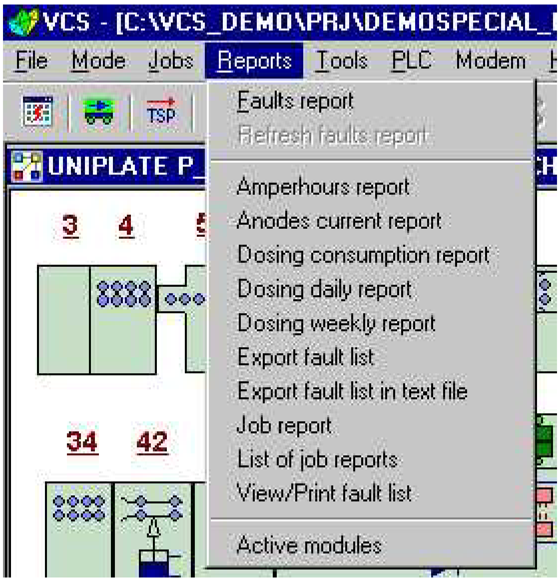
6.9.4.1 Fault messages in the Active Fault Message Window

Inside the Active Fault Message Window you can

- highlight the fault message
- press the function keys Ctrl+F1

and the fault related trouble shooting guide will appear on-screen.

6.9.4.2 Generation of a fault message report



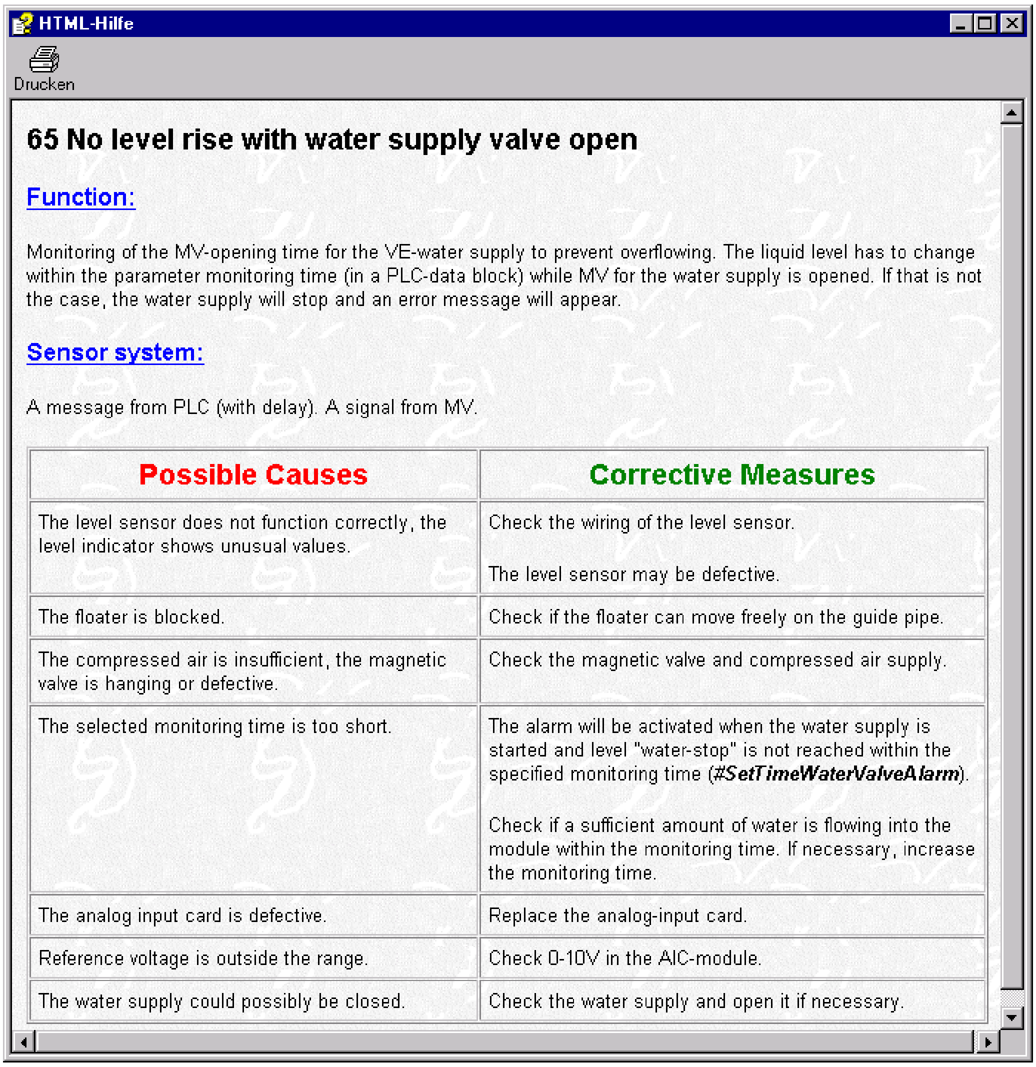
Fault reports or fault lists display fault messages which appeared in the past in a certain period of time.

However, there are no links to a fault message help file. Therefore the Ctrl+F1 function key combination can not work inside a fault report.

6.9.5 Structure of the fault message help files

Content and structure of the fault message help files

The structure of the fault message help files is uniform. Below you see an example illustrating its structure, followed by descriptions of the content of fault message help files in general.



65 No level rise with water supply valve open

Function:

Monitoring of the MV-opening time for the VE-water supply to prevent overflowing. The liquid level has to change within the parameter monitoring time (in a PLC-data block) while MV for the water supply is opened. If that is not the case, the water supply will stop and an error message will appear.

Sensor system:

A message from PLC (with delay). A signal from MV.

Possible Causes	Corrective Measures
The level sensor does not function correctly, the level indicator shows unusual values.	Check the wiring of the level sensor. The level sensor may be defective.
The floater is blocked.	Check if the floater can move freely on the guide pipe.
The compressed air is insufficient, the magnetic valve is hanging or defective.	Check the magnetic valve and compressed air supply.
The selected monitoring time is too short.	The alarm will be activated when the water supply is started and level "water-stop" is not reached within the specified monitoring time (***#SetTimeWaterValveAlarm***). Check if a sufficient amount of water is flowing into the module within the monitoring time. If necessary, increase the monitoring time.
The analog input card is defective.	Replace the analog-input card.
Reference voltage is outside the range.	Check 0-10V in the AIC-module.
The water supply could possibly be closed.	Check the water supply and open it if necessary.

Number and headline of a fault message help file

Number and headline are inseparable, i.e. both together form one entity. They are displayed in the fault message window and fault message reports. The number serves as counter and reference number for administrative purposes. The headline briefly describes the content of a fault message .

Function:

The purpose of a device and its operation is briefly explained to provide you with the context in relation to possible causes and corrective measures.

Sensor, sensor system, logic:

This section gives the sensor or sensor combination that triggered the fault message.

The fault message may also be generated by a subroutine of the control program, if the line conditions deviate from the ones expected normally.

Guide lines:

Possible Causes	Corrective Measures
cause 1	.....
cause 2	
....	

6.9.6 Faults, related messages and their consequences triggered by the control system

The significance of fault messages, generated by the automatic control system, varies; some faults are serious and the message requires immediate action by an operator, others are just messages for the operator’s information.

Faults are prompted in various ways by the automatic control system (drive stop, loader stop, warning messages, etc.). To reduce or avoid the probability that the product quality is affected they are grouped as below:

Drive stop:

The most critical faults are those causing a drive stop (excl. the ones causing personal injury). It must be prevented by all possible means. In case of its occurrence quick action by the operator(s) is important. The actions depend on the individual incident.

Loader stop:

Some faults will trigger a loader stop. In this case production of PCBs continues until the last remaining panel in the line has passed the Unloader module. The longer it takes ot fix the fault the larger will be the panel gap.

Panels which leave the line after a loader stop must be checked for faults individually.

Continuous production in spite of faults:

In case of a low probability for a fault message to result in a product defect, processing of the current job will not be interrupted by the control system (e.g. no loader stop even though one of the several pumps installed in the module does not work).

As long as such a type of fault occurs, the control system automatically records which panels are concerned and may be affected in quality.

Checking the job report will reveal which panels may be faulty and which fault message it is related to (on the basis of the consecutive numbering of the panels). The panels identified as faulty can therefore be selected and examined individually.

Information and warning messages:

A further type of message provides the operators with information as to whether intervention is necessary or attention must be paid towards a particular function.

However, there is no risk that the product quality is affected.

Examples:

- Production cannot be started because a peripheral device is not switched on. As soon as the control system detects that a device does not transmit any release signal, the operator receives a corresponding notice.
- The temperature or the bath level do not correspond to the set value, but do not differ to such an extend that a device has to be switched off (or even the loader and drive have to be stopped). The production parameters are within the warning range but not within the alarm range.
  The operator receives a notice which draws his attention to the corresponding function.
  The fault may possibly be automatically eliminated by the control system. However, in case of a function fault the warning message may also lead to an alarm message.

Information about normal operating status

Example: “Make up program is active”.

Messages of this type do merely inform the operator about a current operating status. There is no reason to intervene in any way.

6.9.7 Faults, related messages

The significance of fault messages, generated by the automatic control system, varies; some faults are serious and the message requires immediate action by an operator, others are just messages for the operator’s information.

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7 VCS-H System control - Line operation

VCS-H is the acronym for 'Visualization and Control System for Horizontal Lines'. Operators control the production line from the control PC (switch on/off individual functions) and receive at the operation windows messages from the numerous sensors in the line.

Online Help Information

- During production:
  Give always attention to the fault messages in the bottom pane of the VCS-H control window. This helps to pin-point a fault quickly and to take adequate counteraction without delay.
  For opening the Fault Message Help Information, highlight a fault message in the Fault Messages Pane and press then the 'Ctrl + F1' key combination.

In the commissioning phase and in manual mode of the Line:
Besides attending to fault messages, extensive information about line operation and process control windows is provided in the VCS-H help file (VCS-H Help) which can be opened via the menu.

7.1 Batch Administration

Purpose

The **Batch Administration** menu allows the user to create a new batch, to edit, delete or to move down or up a batch in the batch administration list, furthermore to monitor a job in the line, to start or stop a job, and to define recipes or parts.

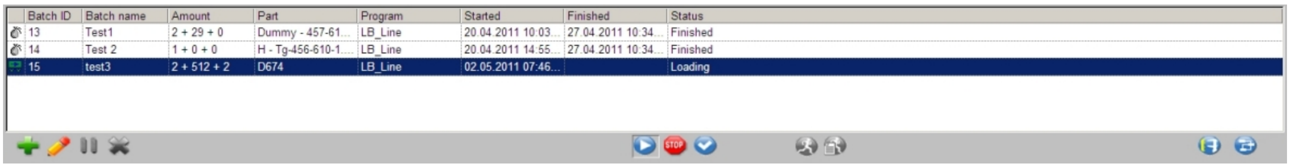
Note that in the overview of the line window, dummy panels are highlighted in gray, production panels - in brown, the last panel of the batch - in green.

Batch Administration window

The "Batch Administration" window provides the following data:

- **Status** displays the status of a batch in the production line. The status is marked by the following special symbols:
  - ( ) a batch is running in the line
  - ( ) a batch is waiting in the loader
  - ( ) a finished batch.
- **Batch ID** displays the batch ID
- **Batch name** displays the batch name
- **Amount** displays the numbers of panels in the batch. The panels sequence is the following: dummies before + work panels + dummies after

- **Part** displays the part name of a batch
- **Program** displays the program name of a batch
- **Started** displays the time and day when the batch starts
- **Finished** displays the time and day when the batch finishes
- **Waiting distance** displays a waiting distance between the batches in the list.



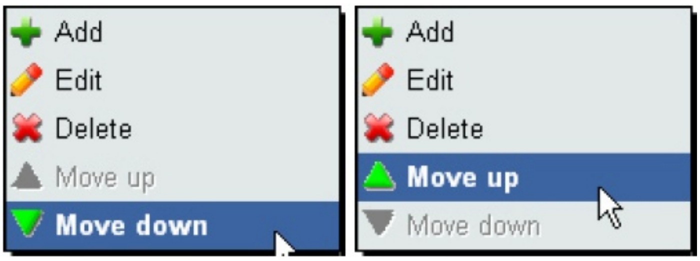
In the Batch Administration window a list of all created batches is displayed. The first column indicates the status of a batch in the production line.

Batch Administration menu

For the batch manipulation in the list, use the buttons in the lower part of the window. (NOTE: The executable functions depend on the user privileges.)

- Click on the ( ) button to add a new batch into the list. This command is also available from the right-click into the batch list.
- Click on the ( ) button to edit the selected batch in the list. This command is also available from the right-click into the batch list.
- Click the ( ) button to delete the selected batch in the list. This command is also available from the right-click into the batch list.
- To change the running order of the batches, it is necessary to select a batch and the corresponding command from the right-click menu **Move down** or **Move up**.

NOTE: The production always starts with the first batch at the top in the batch list.



Move down or move up.

- When button **Force loading** ( ) is used, automatic load of panels will be continued without respect to any occurring alarms. Makes sense only for dummy production or tests, or if the production quality under a certain alarm condition is only temporarily agreed by the responsible line engineer. A reminder will be displayed in the messages list of the screen, and this action will be recorded.
- Button **Stop loading** ( ) is used, when a batch is loading but it is necessary to stop this process. This batch will be stopped, and the loader will be ready to start loading the next one if it exists in the batch list.

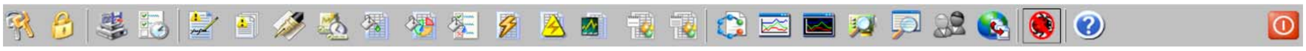
- Button **Complete batch** ( ) is used when it is necessary to finish the loading batch prior to the last panel at any time. After activating this button, the loader will stop immediately. The remaining panels in the loader will not be counted to this batch and do not belong to this batch any more. The remaining panels can now be removed from the loader or processed with new, different parameters by entering a new batch in the job list.

  Caution:

  If no new batch is entered, these panels will be processed with the parameters of the following batch of the job list, if another batch has been there already entered.

- Use button **Recipes** ( ) to view, create, edit or delete parameters of the corresponding program.
- Use button **Parts** ( ) to view, create, edit or delete parameters of the corresponding part.

Selection via toolbar



The meaning of each icon is self explaining (Mouse over-button effect).

7.2 Create a new job in VCS

Purpose

Use this procedure to create a new job with the “Batch Editor” window.

Background

If a new job is to be loaded (with a number of specified panels), the respective data is to be entered into VCS. The sequence of jobs in the Job Administration window must be the same as the queue to be processed (queue of jobs at Loader module).

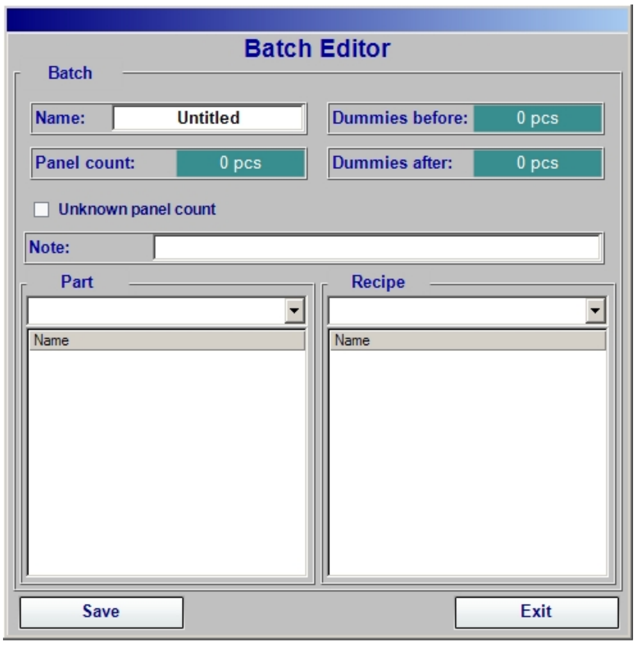
Following values can be defined in the “Batch Editor” window:

- Batch name
- Number of production panels
- Number of dummies before and after production panels
- Note (optional).
- Predefined Part dimensions and Recipe parameters are selected (by pull-down menu)

Procedure

1. Click ( ) button on the left side, lower part of the main VCS window to open the “Batch Editor” window.

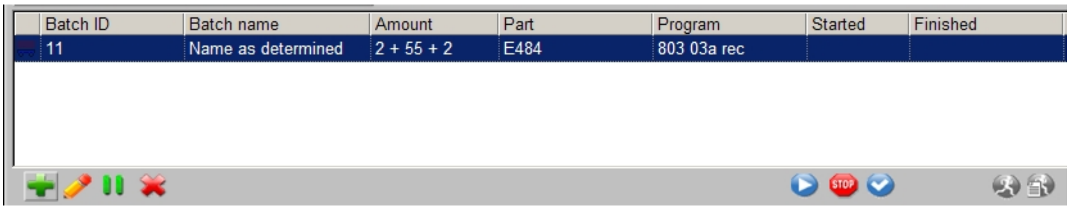
   Result: The “Batch Editor” window opens.



Batch Editor Window (no entries yet)

2. Type the **Name** of the new batch, enter the **Panel count** (number of production panels) if the number is known. Then enter the number of dummies before and after production panels (if required).
3. From the pull-down menu **Part** select the corresponding part parameter.
4. From the pull-down menu **Recipe** select the corresponding program (with machine parameters).
5. Click the **Save** button to create the new job, or click **Exit** to close the batch editor window without save.

   Result: After save, the new created job appears in the "**Batch Administration list**" window.



"Batch Administration" list window (example: one job is highlighted)

End of Steps

7.3 Edit / Delete an existent job in VCS

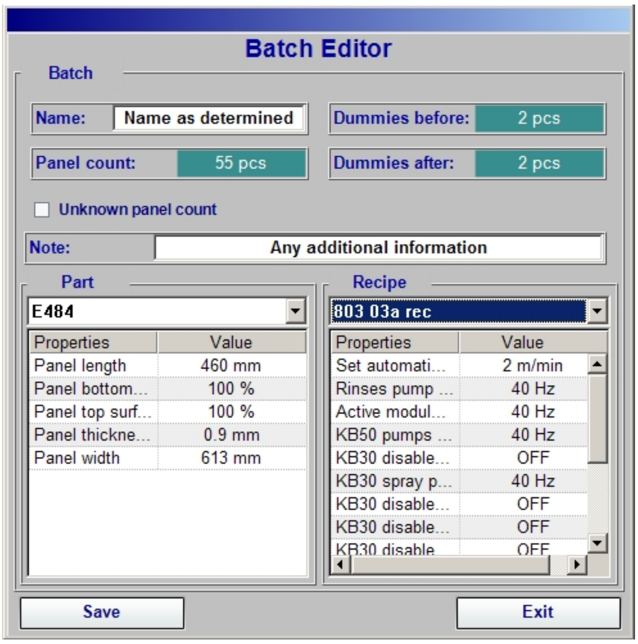
Purpose

Use this procedure to edit or delete an existent job with the "Batch Editor" window.

Procedure

1. Select one of the existing **Batches** you want to edit from the "Batch Administration list".
2. Click () button on the left side, lower part of the main VCS window (or right-click on the selected batch) to open the "Batch Editor" window (with the selected job information).

Result: The “Batch Editor” window opens.



Batch Editor Window (entries to be edit)

3. Enter (edit) the new data in the “Batch Editor” window.
4. Click the **Save** button to save the modifications, or click **Exit** to close the batch editor window without save.

   (End of edit procedure)

5. If you want to delete an existent job from the “Batch Administration” list, select first the batch to be deleted.
6. Then click the () button to delete the selected batch.
7. **Result:**

   A confirmation window appears. Click **Yes** to confirm.

   The deleted batch disappears from the “Batch Administration” list window.

End of Steps

7.4 Log on, Log off

Purpose

Use this procedure to log on to VCS or to log off.

Background

The system provides user management and password authentication to prevent unauthorized access to the system. The system supports different user security classes. Each user has his own password and owns permissions assigned by the **User management** administrator. For logging on to the VCS an access password is required.

Procedure

1. Select from the main pull down menu **Log on** or click on the () button from the toolbar to obtain the "Logon" dialog window.

   Result: The "**Logon"** dialog window opens and the system perform a user login and password verification.

Logon dialog window

2. Enter your **User Name** and **Password**. Then click **OK** to confirm.

   Result: You are now logged-in with your permissions.

End of Steps (Logon procedure)

1. Select from the pull down menu **Log off** or click on the () button from the toolbar.

   Result: You are now logged-off. (The "**Logon"** dialog window opens).

Logon dialog window

2. Click **Exit** to close this window.

   Result: The "**Logon"** dialog window disappears.

End of Steps (Logoff procedure)

Documents

🗎 VCS-H Help (resources/pdf/VCS-H_Help--901397003.pdf)

8 Preventive Maintenance

8.1 Maintenance numbers code

The code for reference numbers contains some information about the kind maintenance work and to which line section the work belongs to.

This code is of good help to make cross references, to find corresponding maintenance work and to administrate the updates and revisions.

The reference number consists of six digits (e.g. 0 2005 0) in the format: k llll m.

- k (first digit) identification of new, completely revised versions
- llll identification of line section or process
- m (last digit) designed to differentiate more precisely the different maintenance tasks, if necessary.
- from 0 1000 0 = Maintenance work related to handling devices and panel transport
- from 0 2000 0 = Maintenance work at the Pretreatment section of the line.
  Further diversification of specifically process-related maintenance work
  - 0 2500 0 = BondFilm (2501 – 2599)
  - 0 2600 0 = CP (2601 – 2699)
  - 0 2700 0 = LB (2701 – 2799)
  - 0 2800 0 = NP (2801 – 2899)
  - 0 2900 0 = P (2901 – 2999)
- from 0 3000 0 = for any type of Plater in general
- from 0 4000 0 = specifically for copper Plater with soluble anode material
- from 0 4100 0 = specifically for Tin Plater (soluble anode material)
- from 0 4300 0 = for INERT - Plater
- from 0 4600 0 = for Cu-Ip1 and Cu-Ip2
- from 0 5000 0 = not yet specified
- from 0 6000 0 = Additional devices (coolers, rectifiers, exhaust air system, peripheral devices, ...)
- from 0 7000 0
  - 0 7000 0 = for Stannatech (7000 – 7199)
  - 0 7300 0 = for E'less Nickel (7300 – 7399)
- from 0 8500 0 = for Dryer modules

8.2 Order by modules / process / devices

8.2.1 Handling

8.2.1.1 010010 Check sensors of transport system

- Period: shift
- Mode of operation: ‘Manual’

	NOTICE
	Interrupted light beam Only to be done during manual operation, as during automatic operation, faults would be caused and alarms created when the light beam of light barrier is interrupted.

a) Check the light sensors and light barriers by interrupting the light beam with the hand or a panel.

b) Observe the LED through the window of the sub-distribution box (red and green LED both must be on when a panel is fully reliably detected).

c) Check sensor for proper fit, clean with a cloth if necessary.

For further information see also supplier's (OEM) documentation.

8.2.2 Drive

See also

020101 Inspection / Replacement of Multiple Bearing Inserts (MBIs) [→ 296]

020120 Check the conveyor system: Smooth rotation of components [→ 297]

8.2.2.1 010041 Check belt tension and axle alignment

- Period: 400 hrs.
- Mode of operation: ‘Manual’

The belt is wearing out quicker in case it runs sideways against the flange of the toothed drive wheel.

a) If that is the case the axle of the toothed wheel must be aligned to be parallel to the axle of the conveyor shaft.

b) Check also the tension of belt by pressing together with the hand (1.0 - 1.5 cm allowance) and adjust nuts, if necessary.

See also

🗎 Axle alignment and belt tension [➙ 43]

8.2.2.2 010050 Maintenance of drive motors

- Period: 6 month
- Mode of operation: Inspection in automatic mode of operation, repair (if necessary) in manual mode

a) According to the supplier's documentation (Original Equipment Manufacturers, OEM) the stored drive motors (in stock as spare part) are to be turned upside down in order to cover those gear wheels and bearings that were not covered until then.

b) Drive motors installed in the line are to maintained according to the supplier's documentation after 10 000 working hours or 2 years.

For further information see also OEM documentation.

8.2.2.3 010060 Replace bearing brackets next to drive belts

- Period: annually
- Mode of operation: 'Manual'

The bearing brackets right next to the drive belts are getting worn out quicker than others due to the continuous pulling force of the belt.

a) To avoid bending of the drive axes downward replace these bearing brackets left and right of the belt annually.

See also

🗎 Bearing brackets [➙ 47]

8.2.3 Modules and components

8.2.3.1 020010 Check the pressure indication at the filter units

- Period: Each shift, regularly
- Mode of operation: Observation in 'Automatic mode', exchange of filters in 'Manual mode' or 'Heat-up mode'

Give regularly attention to the indicated pressure at the manometer mounted at filter units: Compare the actual pointer position with initially set mark(s). This is one simple way to detect any irregularities in the respective pump circuit.

Setting of markers (to be initially done in the commissioning phase):

- The regular pressure value must be found with the chemical solution in the module. There is little use to do this with water (different viscosity).

  ► Insert a new (already leached) filter material (filter bag or cartridges)

  ► Switch on the pump and note down the frequency (if the pump is driven by a frequency inverter)

  ► Read the respective indicated pressure value at the gauge and write it down for later reference.

  ► Set the marker at the pressure gauge (using the shift-able marker or set a mark in any other way)

  ► Repeat the last steps with other commonly used frequencies (if there are different ones in different Job Administration Recipes)

  To execute this procedure has a higher relevance, if there is no flow sensor B36.# or pressure sensor B35.# installed in the respective pump circuit (i.e. no analog flow rate measurement or automatic pressure control at FD and respective fault message in VCS if a filter is clogged).

	INFORMATION
i	**Pressure loss in filters** With increasing clogging of the filter material (cartridge or bag), the pressure loss across the filter material is increasing.

Regular checks after marks are set (daily routine work)

If the indication (the pointer position) deviates distinctly from the initially marked value (for example 30 % up or down), there is most probably need to exchange the filter inserts (filter bag or filter cartridges). This rule is valid especially for pump circuits in which the pump is always running by one frequency only.

However, having in mind the whole pump circuit and the different designs, there are a few more aspects to be considered. As long as the frequency of pumps is not changed, the pressure indication may be used as an indicator for filter exchange. However in many productions lines (for thin material processes) the pump frequency is not constant.

Different jobs may be run with different pump frequencies, which have a strong influence on the indicated pressure.

Different concepts (software algorithms) of how frequencies are set:

- If the pump is driven by different frequencies as set in the job administration recipes (and a flow sensor B36.# measures the flow rate), the regular working point changes: A lower frequency of pump means less pressure in the pump circuit and also at the pressure gauge.
- If automatic pressure control at Fluid Delivery bars is installed (B35.#), it involves an automatic change of frequencies (due to clogging of filters).

  If a pump circuit is equipped with a B35.# pressure sensor or B36.# flow rate sensor and if the filter is clogged, messages to alert the operator are generated in VCS.

Pointer position irregular, possible causes and trouble shooting actions

- Blocked filters lead (in most cases) to a pressure increase (dependant on filter design).
  → Blocked filter inserts must be replaced because they reduce flow rate and pressure at the fluid delivery element (AFD, SFD, etc.), which is a risk for process quality.
- If there are no filter inserts in the housing or if there is leakage through the filter material without filtration, the pressure indication is less than regular (in most cases, dependant on filter design).
  → Use correct filter material only! → Fix filter material properly.
  → Risk of blocking spray nozzles or AFDs (if part of the pump circuit installation and if pumps are switched on without filter in the filter housing).
  → Never switch on a pump if there is no filter material in the filter housing!
- → Inspect also the sealing at the filter unit, when changing the filter inserts.
  → Replace sealing, if worn out or damaged.
- Rather seldom causes for an irregular pressure could be a blocked or leaking pipe or the malfunction of a pump.
  → Consider all aspects of the pump circuit, not just the filter insert.

The indicated pressure varies by a number of factors

- Applied software algorithm (pressure control, flow monitoring, etc.)
- Adjusted pump frequency in Hz (different control parameters)
- Actual filter clogging / contamination
- Degree of blockage and crystallization of flooding device
- Used medium type (density of liquid)
- Rated power of pump and respective pump performance
- Filter type and diameter (5 µm, 10 µm, 25 µm, 50 µm, 100 µm,)
- Type of flooding device (TCFD, SFD, AFD, …) after filter
- Arrangement of pipe work and respective flow resistance

Pressure values at pressure gauges (2 tests as examples)

Used medium: City water; Filter fineness: 50 µm;

Example 1* of a common pump circuit		Example 2** of another pump circuit	
Frequency	Pressure	Frequency	Pressure
30 Hz	0.07 bar	30 Hz	0.40 bar
40 Hz	0.21 bar	35 Hz	0.60 bar
50 Hz	0.37 bar	40 Hz	0.70 bar
		45 Hz	0.90 bar
		50 Hz	1.20 bar

* Power rate of pump: 1.5 kW; Type of Flooding Device: TCFD (example 1)

** Power rate of pump: 4.0 kW; Spray pipe system with spray nozzles (example 2)

See also

- Filters [→ 76]
- Pressure switch (at filter unit) [→ 66]
- Analogue measurement of the flow quantity [→ 68]

8.2.3.2 020020 Inspect the bath level in fluid trays

- Period: 100 hrs.
- Mode of operation: ‘Automatic mode’

Visual inspection at modules with fluid trays:

During operation with activated pumps the flood trays must be filled at least up to the middle of the upper transport rollers.

a) If the height of the flood bath is not sufficient, check preliminary the distance between bulk head and roller. Adjust distance to approx. 0.2 - 0.5 mm.

Other possible faults:
The level adjusts itself as result of incoming solution and return flow.

a) In general the whole flow circuit from

- the pump(s) to the fluid tray and
- the return flow back to the sump

must be checked. In case the level is too low either the solution input is too low or the return flow too much. This principal distinction leads to further possible causes (malfunction of pump; blocked filter, wrong orifices, etc.)

8.2.3.3 020060 Inspection for irregularities

- Period: shift
- Mode of operation: ‘Automatic mode’

Operators are supposed to walk along the production line, inspect and observe parts visually and develop a sense for irregularities, such as noise and leakages.

This kind of observation can be done during production (interference into functions are not supposed to be made during this kind of inspection).

► Check immersion pumps: vibrations, imbalance, noise, rattling, defective bearings!

► Check compressors: vibrations, imbalance, noise, rattling, defective bearings!

► Are there any cover plates removed? Put them back in place!

► Check for any kind of liquid leakages of tanks, pipes, pipe connections!

► How well was the last external cleaning executed (maintenance task 020080)?

► Check for any kind of compressed air leakages!

► Check air pressure indication at compressed air supply units and level of condensed liquid in collecting glass!

► Check pressure indication of manometers (position of pointer relative to previously set marks)!

► Are there irregularities of conveyor system: jerky movement of rollers, gears, etc.!

If necessary, maintenance personnel must be called to carry out repair work at a suitable time as soon as possible (next job, next break of production).

► At peripheral stations and devices: are there any alarm signals (light indicators, acoustical signals, etc.)

See also

🗎 020010 Check the pressure indication at the filter units [➔ 289]

🗎 020080 Keeping modules and plant components clean [➔ 294]

🗎 020120 Check the conveyor system: Smooth rotation of components [➔ 297]

🗎 020200 Check air release at the filter units [➔ 303]

🗎 030020 Check windows of Plater for leaks [➔ 305]

8.2.3.4 020070 Check piping for leaks

- Period: shift
- Mode of operation: ‘Automatic mode’

a) Visual check of all piping for safe operation and leaking.

	CAUTION
	Etching chemicals Leaking fluids may be etching chemicals!

8.2.3.5 020080 Keeping modules and plant components clean

- Period: Weekly;
  Weekly cleaning is a minimum standard for a cleaning interval. Cleaning should be done regularly, according to a house internal schedule,
  i.e. immediately (situation dependant), daily, weekly, monthly,
  and especially in conjunction with production downtime and long breaks of production.
- Mode of operation: Partly ‘Automatic’, mainly ‘Manual’ mode;
  - In Automatic mode: For routine cleaning tasks during production, if and as long as there is no risk of injury or damage or of causing faults, which could disturb the production process;
  - Manual mode: For thorough cleaning action.

General guide lines to have a good cleaning concept implemented:

- Regular cleaning of the production line in adequate intervals is necessary for
  - people’s safety,
  - reliability of plant functions of plant components,
  - service time of parts (the longer, the better),
  - process and product quality,
  - thus cost management
  - and last not least, style and reputation.
- Preventive actions to reduce the need for cleaning:
  Make arrangements not to spoil chemistry, catch dripping solution when taking samples, etc..
- A clean production line gives and leaves a good impression:
  The earlier and more often cleaning is executed, the easier it is to remove sediments. Management ought to make arrangements and quality checks accordingly.
- The cleaning concept:
  - Instruction and training of all personnel working on the line.
  - Provision of adequate tools, materials, and accessories for line cleaning
  - Regular and close supervision as well as quality checks immediately after all cleaning actions.

	NOTICE
	Cleaning the module Chemicals, in the liquid state and as solid deposition or dust, must be cleaned and disposed of in regular intervals (immediately, per shift, daily, etc.) according to chemistry related safety standards and company internal regulations. This measure serves to avoid troubles during production, helps to extend the service time of mechanical and electrical parts and is an important safety measure to prevent heat development (or even fire) due to unforeseeable chemical reactions.

The following list gives hints for supervision and training of cleaning personnel:

a) Personnel working at the line must wear safety clothing, gloves, and goggles!

b) People must be instructed how to handle chemicals (for example, permitted and forbidden combinations of solutions, crystals, depositions).

c) Trained and skilled personnel must supervise untrained personnel whether (or not and how well) they abide by the existing regulations. If necessary, new regulations must be decided upon, documented and distributed.

d) Different modules, different chemistries: What can be mixed, what not? Clear instructions of how cleaning material and chemicals must be disposed of are essential.

e) Cables in cable trays and ducts must never be wetted, neither by water and especially not by cleaning chemistry. Protective sheaths of cables must remain in good shape. Both, mechanical as well as chemical attack of electric cables must be prevented.

f) Remove dirt and chemical residues on the outside of the individual modules or production line components spot by spot: It is not permitted to flush down dirt and crystals. Scratch them off with appropriate tools and use vacuum cleaner right there on the spot.
Dirt must be **removed** (i.e. picked up, vacuum cleaned, soaked up, adequately disposed of) and not flushed down or blown into corners!

g) When scratching away sediments, line parts must not be mechanically damaged: The cleaning tool (sponge, brush, wood, plastic, metal) must be soft in comparison to the part and material which is cleaned.

h) The use of cleaning chemistry is permitted just locally and with good care in order to prevent corrosion of parts: Soak up the applied cleaning chemistry immediately after its application, using adequate soaking material, special cloth or special wool.

i) During cleaning actions, check for possible irregularities such as leaks, loose connections, noise etc.. If you are not supposed to fix loosened parts yourself, report to the maintenance crew.

j) For getting conscious about more details about ‘What shall be cleaned in which way’, use the search function in the equipment manual:
Open the compiled help file of your equipment manual, select the ‘Search’ tab and type then in the term

‘clean’ or ‘cleaning’. As a result you will find many descriptions and details of how specific parts of the line must be cleaned.

See also

Stop of production for several days, cleaning and restart of the whole line [→ 39]

020070 Check piping for leaks [→ 293]

8.2.3.6 020101 Inspection / Replacement of Multiple Bearing Inserts (MBIs)

- Period: 2000 hrs.
- Mode of operation: ‘Manual’

Validity of this maintenance instruction:

This maintenance description is applicable for ATOTECH horizontal lines with the UTS-s and UTS-XL transport system.

(For the so-called Floodbars installed in former transport systems, like T1 or T4, there are separate and completely different adjustment and maintenance descriptions).

Standard roller height:

The contact points of two vertically aligned rollers (top and bottom twin rollers) running in unworn holes of the ‘Multiple Bearing Inserts’ define the standard roller height (or standard transport plane).

In the course of time, this plane gradually lowers and becomes to a certain extent uneven due to the wear in the holes of the ‘Multiple Bearing Inserts’ (MBIs). This unevenness in the conveyor plane may lead to transport problems and must therefore be kept to a minimum.

Wear limit:

If the holes in the MBIs are worn out by 0.5 mm / 1 mm (for UTS-s / UTS-XL respectively), the MBIs must be replaced.*

[* In case of UTS-s transport system and the so-called ‘hot’ modules made of stainless steel: Just the bushes inside of the MBIs must be replaced, not the MBIs as a whole].

Context:

- A bigger wear than stated above involves the risk of jerky movements of the rollers.
- In the UTS-s conveyer system the bottom inversion gears (inversion of direction of rotation) may be overloaded and crack.

- The driving cogwheel is on the drive shaft, the driven one belongs to the conveyor unit: The two jointly active (and beveled) cogwheels engage less, if the bore holes in the MBI are not round any more.

Service life of the MBIs [*bushes in the MBIs]:

In modules running with less than 50°C, 8000 up to 16000 working hrs. can be assumed, however, a check should be carried out earlier (after 4000 hrs.).

A more frequent check-up (after 2000 hrs.) is preliminary necessary in modules with a higher operation temperature (modules made of stainless steel) and where crystallization occurs relatively strong.

Procedure of checking the degree of wear:

a) Take out one or two complete conveyor units. Disassemble the removed conveyor unit to inspect the holes in this MBI. Make an analysis of how much they are deformed:
Measure the diameter of the bore holes, compare with the diameter of an unworn MBI (*or inner diameter of a bush) and consider the wear limit rule as stated above.
b) Never change a single MBI or just a few of them. Always agree on an action plan and replace all the MBIs in a module. The transport plane must be even (not bumpy) for a safe and reliable transport.
c) When changing the MBIs, also check the cogwheels and replace them if worn out.
d) In case you come to the result, that the replacement of the inserts (MBIs / bushes*) is not yet necessary, it is recommended to record the presently measured values of hole deformation and decide on the next date for check-up.

See also

🗎 020120 Check the conveyor system: Smooth rotation of components [➔ 297]

🗎 020125 Check all the parts of the transport system [➔ 298]

8.2.3.7 020120 Check the conveyor system: Smooth rotation of components

- Period: Daily
- Mode of operation: Inspection in Automatic mode of operation, replacement (if necessary) in Manual mode

The check-up is necessary in principle at all modules, but most of all at modules with a higher operation temperature (higher than 50°C) and where crystallization occurs stronger (stronger than in Rinse modules, for example).

Inspection of the cogwheels in the transport system:

Cogwheels are wear parts, just as the Multiple Bearing Inserts (MBIs) mounted in the side rails of the conveyor system.

a) For safe transport of the PCBs all the way through the conveyor system, any jerky movement must be given immediate attention (latest before the next job will be started).
b) Compare new and worn cogwheels to see the difference clearly: Along the curved flank of a tooth, where two adjacent gear wheels engage, the degree of wear is strongest in the course of time.

Possible reasons for a jerky movement of transport components:

- Crystallization of cogwheels, bearings or rollers, especially after breaks of production (requires cleaning)
- Worn out teeth of the cogwheels (requires replacement)
- The engagement of the upper spur gears is too little: This may occur, if thicker panels than specified are produced.
- Have a look to the engagement of two bevel gears (depending on distance sleeves on the transport axis and the condition of the holes or bushes in the MBIs).
- There is an irregular friction anywhere in the conveyor unit (requires observation, testing and probably dismantling of a conveyor unit). For more details, see also the description of the whole conveyor system.
- Are the couplings of transport axes or the set collars loose?
- Worn out bearing bore holes in the MBIs:
  The degree of wearing of the bore holes in the Multiple Bearing Insert (MBI) can be checked by removing and dismantling a complete conveyor unit (only in manual mode, of course).
  The wearing of the bore holes (or bushes) should be not more than **0.5 to 0.6 mm**.
  If the wear is stronger, the risk, that the bottom change gears are overloaded, is increasing. By checking one or two MBIs, conclusions can be made about the condition of bore holes of other MBIs in the module.
  For more details, see also the description of the whole UTS conveyor system.
- Several aspects mentioned above accumulate.

See also

020101 Inspection / Replacement of Multiple Bearing Inserts (MBIs) [→ 296]

020125 Check all the parts of the transport system [→ 298]

8.2.3.8 020125 Check all the parts of the transport system

- Period: Monthly
- Mode of operation: Manual mode

For safe transport of the PCBs all the way through the conveyor system, any jerky movement must be prevented. Operators and mechanics must work together to identify risks and to take adequate preventive steps.

The following list is a summary of check points. If you are not yet familiar with the individual parts, their function and adjustments, read first the illustrated description of the transport system (drive system + conveyor system).

General rules:

- Frictions must reduced and prevented
- The clearances must be adequate (not too much, not too little)
- Expansion by heat plays an important role (in some modules)
- Use genuine parts only as specified for each module.

Attend to any possible cause and irregularity:

a) The set screws in the couplings of the transport axis along the line are not tight. Check all of them. Identify and record which one are troublesome. Consult operators for identification.
b) The screws of set collars are not tight. Check all of them. Leave enough clearance for axial movement but not to much. Relate to specification. See link below.
c) Do not use any wrong metallic parts if you replace worn-out ones by new ones (distinguish chemistry and module specific requirements).
d) Transducer bars of ultrasonic system.
e) Give attention to the separate description about the distance of transport shafts (12mm / 3mm).
f) Attend to worn-out teeth of the cogwheels (requires replacement).
g) Check the axial clearance of rollers (friction against MBIs in side rails).
h) Have a look to the engagement of two bevel gears (depending on distance sleeves on the transport axis and the condition of the holes or bushes in the MBIs).
i) After removal of the transport axis of a module: Check for an irregular friction within the conveyor unit (requires observation, testing and probably dismantling of a conveyor unit). For more details, see also the description of the whole transport system.
j) Worn out bearing bore holes in the MBIs:
The degree of wearing of the bore holes in the Multiple Bearing Insert (MBI) can be checked by removing and dismantling a complete conveyor unit (only in manual mode, of course).
The wearing of the bore holes (or bushes) should be not more than **0.5 to 0.6 mm**.
If the wear is stronger, the risk, that the bottom change gears are overloaded, is increasing. By checking one or two MBIs, conclusions can be made about the condition of bore holes of other MBIs in the module.
For more details, you may refer to the description of the whole transport system.

See also

- Drive system / drive shaft [→ 43]
- 020101 Inspection / Replacement of Multiple Bearing Inserts (MBIs) [→ 296]
- 020120 Check the conveyor system: Smooth rotation of components [→ 297]

8.2.3.9 020140 Check dosing system (quality control specified by customer)

- Period: e.g. 3 month (or according to quality control specified by customer)
- Mode of operation: Inspection in automatic mode of operation, repair (if necessary) in manual mode

If the analysis of the baths indicates that the automatic dosing systems does not function properly, find out the cause and take corrective measures.

For further instructions see also chapter "Fault Messages" in documentation.

See also

🗎 Trouble shooting / fault messages [→ 271]

8.2.3.10 020160 Clean ventilation grid of pump motors

- Period: annually
- Mode of operation: Inspection in automatic mode of operation, repair (if necessary) in manual mode

► Check ventilation grid of the pump motor and clean it If necessary.

8.2.3.11 020180 Inspection of monitoring devices

- Period: 3 month or in accordance with customer's quality control measures
- Mode of operation: ‘Manual’

This maintenance task is related to devices such as:

- Level sensors and switches
- Temperature sensors
- Cover switches
- Flow sensors
- Probes

Procedure:

a) Activate sensor/monitoring device and observe message at control system monitor. Check also system response and evaluate reaction.
b) Distinguish which checks can be carried out in production/manual mode.
c) Read and evaluate displays in the control system.
d) Visual inspection for damages and incrustation.
e) **Observe safety regulations!**

For further information see also ATOTECH documentation to the related topics.

If necessary, readjustment of respective monitoring devices by qualified service personnel.

See also

🗎 020181 Check digital level switches [→ 301]

🗎 020182 Check analog level sensors [→ 301]

🗎 020183 Check temperature sensor Pt 100 [→ 302]

🗎 020184 Check cover switches [→ 302]

🗎 020185 Check flow switch (cone-shaped float) [→ 302]

🗎 020186 Check flow switch for dosing [→ 302]

🗎 Safety switch S24.1 (level minimum) [→ 120]

🗎 Calibration of probes or sensors in VCS [→ 126]

8.2.3.12 020181 Check digital level switches

- Period: 3 month or in accordance with customer's quality control measures
- Mode of operation: 'Manual'

► Move float ring at level switch up and down to observe whether respective fault message appears and response takes place (e.g. pump off).

This has to be carried out:

- especially at all safety level switches S24.# in all modules with a heating system
- at all S20.# level switches (in trays and tanks, etc.).

(If a Plater is part of your production line: the rectifiers are only activated if the level is above the upper anodes).

Sensors and monitoring switches must be cleaned always when a make-up is made in a module.

It is recommended to carry out a function test at the same time.

See also

🗎 Safety switch S24.1 (level minimum) [→ 120]

8.2.3.13 020182 Check analog level sensors

- Period: 3 month or in accordance with customer's quality control measures
- Mode of operation: 'Manual'

a) Measure bath level of module and compare to displayed value at the control system.
b) Please keep in mind that the bottom of the module is inclined. The position of the level sensor mounted from the outer edge of the module has to be taken into consideration. To achieve correct measuring

results, the measuring rod has to be inserted into the bath with the same distance as the level sensor is mounted away from the outer edge.

8.2.3.14 020183 Check temperature sensor Pt 100

- Period: 3 month or in accordance with customer's quality control measures
- Mode of operation: ‘Manual’

a) Measure bath temperature and compare to the displayed value at the control system.

Procedure:

a) Insert thermometer (with digital display if available) close to temperature sensor (Pt 100).

8.2.3.15 020184 Check cover switches

- Period: 3 month or in accordance with customer's quality control measures
- Mode of operation: ‘Manual’

a) Check proper signal transmission by opening and closing the cover.
b) Check if message "Cover open" appears in fault message window at control system.

8.2.3.16 020185 Check flow switch (cone-shaped float)

- Period: 3 month or in accordance with customer's quality control measures
- Mode of operation: ‘Manual’

a) Check visually if the cone floats freely and for correct position of Max./Min. set points.

8.2.3.17 020186 Check flow switch for dosing

- Period: 3 month or in accordance with customer's quality control measures
- Mode of operation: ‘Manual’

► Check visually for contamination, incrustation, leakage.

See also

- Flow monitoring [→ 82]
- Dosing [→ 79]
- Flow monitoring of the dosing streams [→ 82]

8.2.3.18 020190 Check spray pipes and spray nozzles for cleaning purposes

- Period: 200 hrs.
- Mode of operation: ‘Manual’

a) Check spray pipes and spray nozzles during cleaning operation.

The spray nozzles must spray evenly.

a) Check for possible clogging of individual spray nozzles.
b) If necessary, remove clogged nozzles and clean them with compressed air.

8.2.3.19 020200 Check air release at the filter units

- Period: weekly
- Mode of operation: ‘Automatic mode’

To ensure proper air release from the filter, its valve must be kept slightly open.

In the transparent pipe you can see some solution flowing back into the module.

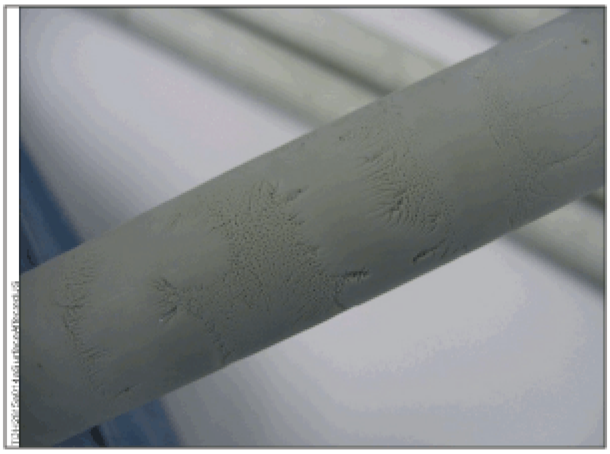
See also

By-pass filtration, filter units with cartridge filters inside [→ 78]

8.2.3.20 020220 Inspect all the rollers adjacent to and below the ultrasonic transducers

- Mode of operation: Manual
- Period: 6 month (or earlier in conjunction with other maintenance actions)

Exposed to the effects of ultrasonic, the surface of rollers may become unsmooth.



Example of roller surface affected by ultrasonic treatment

a) If necessary, polish or replace the rollers adjacent to or below the ultrasonic transducers, to prevent scratches or dents on the surface of boards.

See also (related topics):

- Ultrasonic generators: Output power to be set at the control PC

8.2.4 CP-Process

8.2.4.1 026010 Carry out cleaning program of Adhesion Promoter module

- Period: weekly
- Mode of operation: ‘Manual’

At the PC control desk start automatic cleaning mode or manual cleaning mode.

The control PC displays the single steps and the status of the cleaning program.

The cleaning program should also be carried out before longer breaks (for example in case of a holiday without production).

For further information see also instructions for operators in ATOTECH documentation.

See also

🗎 Cleaning program [→ 128]

8.2.4.2 026040 Calibrate pH sensor

- Period: daily or weekly as required
- Mode of operation: Inspection in automatic mode of operation, repair (if necessary) in manual mode

To be done according to separate instruction (regional ATOTECH service center).

8.2.4.3 026050 Inspect the sealing under the glass covers and replace them, if required

- Period: 1 month (or 1 week, in conjunction with the cleaning program)
- Mode of operation: ‘Manual’

The sealing cords under the glass covers in modules with a high operation temperature (above 50° Celsius) are wearing out quicker than in other modules.

Check the quality of the sealing cords after each running of the automatic cleaning program prior of resuming production.

If damaged, they must be replaced to prevent loss of heat energy and to avoid that the glass covers crack (if they lie on the steel frame).

8.2.5 Plater - all types

8.2.5.1 030010 Check belt tension of clamp drive by reading tensile force

- Period: shift
- Mode of operation: ‘Automatic mode’

The tensile force of the clamp drive belt can be checked visually by reading the indicator mounted at the input side of the Plater. The tension should be in the green range (3.0 to 5.5 kN).

Immediate intervention is necessary if the tension indication is in the white range.

a) If the indicator is in the red range the adjustment of belt tension should be carried out soon.
b) The distance between axes (nominal value 6240mm) is to be measured before and after tightening of the belt.

See also

🗎 Clamp drive system and tensile force at the belt [→ 162]

8.2.5.2 030020 Check windows of Plater for leaks

- Period: shift
- Mode of operation: ‘Automatic mode’

The windows in the Plater module are sealed by air. If there is any leakage during production, possible causes must be found (see links to further descriptions below).

a) As a routine, check the windows of the Plater for leaks while the pumps are running.
b) Report to the maintenance team if there is any leakage.

NOTICE

Braking window frames

Windows with damaged sealing (air leakage) must be replaced. It is not allowed to set the air pressure in the pneumatic control window higher than permitted, because there is the risk, that the window frame(s) might break, which holds the rubber ring.

See also

030220 Check monitoring of window sealing system [→ 316]

Window air pressure control [→ 188]

8.2.5.3 030030 Check input/output rollers and sealing lips in the Plater

- Period: 400 hrs.
- Mode of operation: Inspection in automatic mode of operation, repair (if necessary) in manual mode

a) Remove covers of the Plater and check the input and output rollers visually.

b) Check also if the PTFE seals touch the rollers densely in order to minimize the flow of solution from the working section to the input or output section of the Plater.

See also

Roller spraying system [→ 191]

8.2.5.4 030040 Remove abrasion dust from sliding contacts in clamp drive area

- Period: 100 hrs.
- Mode of operation: ‘Manual’

NOTICE

Non proper function of clamps

This maintenance task is very essential for the proper function of clamps and its current conductivity.

a) Remove abrasion from sliding contacts in the clamp drive area with a vacuum cleaner.

b) Remove PP lid casing and vacuum cathode bars, dome as well as RCH-1000 area (deflection dome).

c) See also maintenance tasks: No. 30100 [→ 312], 30170 [→ 313], 30180 [→ 314], 30181 [→ 315] and 30182 [→ 316].

Only for Platers with soluble anodes: Can be carried out at the same time as anode maintenance (when filling the baskets).

8.2.5.5 030041 Inspect cathode rail and make it metallically clean

- Period: Monthly
  (Inspection already after about 100 to 200 working hours. The best time of execution is, when the cleaning program in the PTH line section is running in order minimize the downtime of the line)
- Mode of operation: 'Manual'

To carry out this maintenance action is of highest importance to prevent troubles arising later on during production time. It is necessary to be executed in order to achieve evenly distributed current flow through all the closed clamps, which is a key condition for good surface distribution.
We also prevent damage at the clamps; cathode rail and sliding contacts remain in good state, their pairs of cables are not overheated, the prospective lifetime of the clamps is extended.

Background information and context: Abrasion dust on the cathode rail is normal as well as a dry, thin, black film on the contact surface of the rail (coming from small carbon inclusion in the sliding contacts of the clamp). The abrasion dust must be removed several times in a month (weekly) by means of a vacuum cleaner.

However, it is an irregular state, to have any kind of moisture on the rail, which leads to hardened corns or black incrustations (cakings, resulting from the combination of abrasion dust, moisture and heat).
A possible reason for such incrustations might be an insufficiently working exhaust system of the Plater. Other reasons might be poor pipe connections or condensing liquid at the cathode rail.

Remember: Development of dust on the cathode rail is normal, any moisture and hardened incrustation is irregular!

Preparation:

- Man power: 2 people for this task, but 3 or 4, if other maintenance tasks are carried out at the same time, like clamp contact inspection at the maintenance window
- Tools: Standard toolbox, hand lamp, small mirror

a) Keep abrasive sponge pads in stock (for example 'Scotch' pads, degree of smoothness about 150 to 250, thickness about 5 to 10 mm).

b) Cut a number of pieces to proper size (width 24 ± 3 mm, proper length across three clamp contacts would be about 210 mm).

	NOTICE
	Fallen sponge pads in the Plater solution Make sure that the sponge pads don't fall in the Plater solution (they should not come into the pump circuits).

CAUTION

Risk of injury

Be careful when switching on the clamp drive, make sure that nobody is in danger of getting injured.

Don’t squeeze your fingers, when lifting the sliding contacts of the clamp while the clamp drive is running.

Execution:

a) Remove covers on Plater to get access to the cathode rail
b) Is the cathode rail wet? In this case find the reason (leakages in pipe work, blocked exhaust system, etc). Don’t ignore such faults. It would subsequently lead to clamp and plating problems.
c) At the control PC, set slow speed (0.5 m/min) for the Plater section of the line.
d) Switch on the clamp drive. Be careful when switching on the clamp drive, make sure that nobody is in danger of getting injured.
e) You may interrupt the clamp movement at the On/Off switch mounted directly at the Plater.
f) Clean away dust on the cathode rail with vacuum cleaner (see also weekly maintenance task 030040)
g) Stop the clamp drive and inspect the contact surface of the rail. Are there hardened corns (‘baked’ incrustations) on it?
h) In this case the incrustations must be removed by a hard, sharp-edged piece of plastic material (like PP etc.).
i) If necessary (because of metallically unclean contact surface) fix the previously cut abrasive sponge pieces under the sliding contacts of some clamps.
   Three to five abrasive sponge pieces might well be enough, however this depends largely on the condition of the rail and the sliding contacts.
j) Switch on the clamp drive again (you may interrupt the clamp movement at the On/Off switch at the Plater).
k) By use of the vacuum cleaner, catch dirt and dust next to the abrasive pieces, especially when they reach the end of the rail.
l) Collect abrasive sponge pieces and discard them if worn out. Make sure that no pieces fall in the electrolyte.
m) Check the cathode rail again and repeat the above steps another time if necessary.
n) Inspect the surface of the sliding contacts with a hand lamp and small mirror (maintenance tasks 030170 and 030180). If the cathode rail was metallically clean, i.e. without incrustations caused by moisture, abrasions and heat, you may just check a few sliding contacts. However, if the cathode rail was not free of incrustations, the condition of all the sliding contacts (216 clamps) must be checked whether metallically clean.

See also

- 030040 Remove abrasion dust from sliding contacts in clamp drive area [→ 306]
- 030170 Check sliding contact of clamps visually [→ 313]
- 030180 Check clamps, sliding contacts, spring tension and replace clamps if necessary [→ 314]
- Exhaust system in the Plater [→ 159]

8.2.5.6 030050 Check function of cleaning systems for clamp belt and input-/output rollers

- Period: monthly
- Mode of operation: 'Automatic mode'

a) Activate pressure valves by mouse click at the control system and check at the Plater correct position, proper function and spray characteristic of the spray nozzles.

See also

- Cleaning the drive belt [→ 170]

8.2.5.7 030060 Check clamp contacts for residue-free metal stripping

- Period: 100 hrs.
- Mode of operation: 'Automatic mode'

a) Check clamps for residue-free metal stripping at the clamp contacts.

Procedure:

a) It is advisable to select a low speed (e.g. 0.5 m/min) and to observe the clamps through the inspection window at the module inlet or outlet.
b) Copper accumulations have to be removed from the clamp contacts.
c) To stop the respective clamps at the inspection window, press the button "clamp drive stop".

NOTICE

Damaged clamps
Do not use metallic or sharp-edged objects such as screw drivers, knives or others! Best results are achieved by using a soft material such as a finger with glove or wood.

The clamp contacts have to be absolutely free of copper to prevent new copper deposits from accumulating quickly.

See also

🗎 030070 Check degree of metal deposition on stripping sheets [➙ 310]

🗎 Clamp stripping [➙ 173]

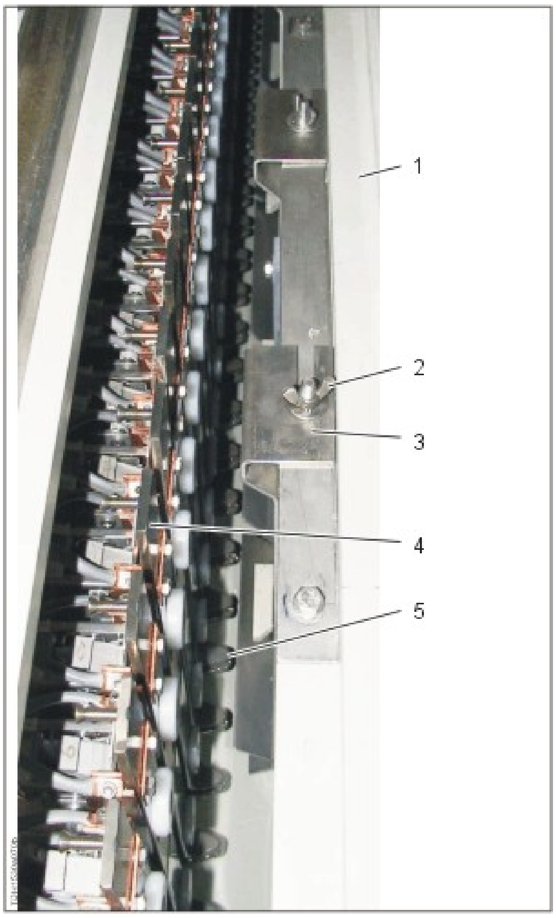
8.2.5.8 030070 Check degree of metal deposition on stripping sheets

030070 Check the degree of copper accumulation on the array of cathode sheets

- Period: 100 hrs.
- Mode of operation: ‘Manual’

The cathodically connected titanium sheets have to be replaced and stripped when the Copper accumulation reaches several mm up to a maximum of 5 mm.

Preparation: It is recommended to have a second set of copper-free metal sheets ready for exchange.



Stripping section at the rear side of the Plater, stripping sheets fixed by winged nuts

1	Rear side of the Plater	4	Clamps at stripping section
2	Winged nuts to fix the metal sheets	5	Clamp contacts
3	Cathodically connected metal sheets		

Procedure of cathode sheet exchange:

a) Take PP covers above stripping section away (at rear side of the Plater)
b) Loosen the winged nuts, which connect the cathode sheets
c) Remove the sheets one after the other and check degree of copper accumulation
d) Re-mount the previously stripped copper-free metal sheets.
   Prior to re-mount: Check the sheets whether clean and planar (not bent). Do not use bent and dirty sheets. Sheets and clamps mustn't get in contact with each other.
e) Strip off the accumulated copper in a separate container with appropriate copper stripping solution and store the sheets for the next exchange action.

NOTICE

Damaged parts

- Tighten winged screws properly!
- Check electrical supply cables for tight fit! Corroded contacts must be cleaned!
- Inform the Head of the Maintenance department, if anything is damaged!
- Make sure that all the sheets are re-mounted!
- The thickness of copper on the sheets is continously growing. Sheets and clamps mustn't get in contact with each other! Make sure to execute the next exhange of clamps not too late!

See also

Clamp stripping [→ 173]

030060 Check clamp contacts for residue-free metal stripping [→ 309]

The importance of good electric connections [→ 62]

8.2.5.9 030080 Check the conveyor gears/bevel gears in the Plater

- Period: 800 hrs .
- Mode of operation: 'Manual'

a) Activation of drive with open window and observation of shafts, bevel gears and axles.
b) Visual check for obvious defects, as worn-down teeth, loose coupling parts.

8.2.5.10 030090 Check clamp drive belt (belt tension and wear)

- Period: 2000 hrs.
- Mode of operation: 'Manual'

Check drive belt for wear and damages.

Visual check of belt for cracks. If necessary, use flashlight.

If necessary, increase belt tension. Check axle distance before and after adjustment of the belt tension.

See also

- Clamp drive [→ 161]
- 030010 Check belt tension of clamp drive by reading tensile force [→ 305]
- 030041 Inspect cathode rail and make it metallically clean [→ 307]
- 030100 Change clamp drive belt [→ 312]

8.2.5.11 030100 Change clamp drive belt

- Period: 15000 hrs.
- Mode of operation: ‘Manual’

This comparatively complex maintenance task is normally carried out by ATOTECH service personnel (maintenance contract).

It takes 20 to 24 hours per Plater (for 3 maintenance mechanics) depending on the repair work needed.

In preparation, the following steps may be carried out by the customer himself after consultation with ATOTECH's Service & Installation Department:

a) Drain and clean Plater:

> **NOTICE**
>
> **Damaged parts**
>
> Follow respective cleaning instructions for different types of Platers (inert or soluble anodes).

b) Remove windows, anode baskets and/or anode segments.

c) Remove spray pipes and spray pipe supports.

d) Put step-boards into module.

> **NOTICE**
>
> **Damaged rollers**
>
> Do not step onto input/output rollers!

See also

- Clamp drive [→ 161]

8.2.5.12 030110 Read current and voltage values of rectifiers

- Period: shift
- Mode of operation: ‘Automatic mode’

Observe current and voltage displays at the VCS control system in regular intervals (see process control window "Rectifier").

The purpose of this task is to get familiar with the regular displays and to recognize significant changes. Taking records may help the service and maintenance staff to draw the right conclusions and take corrective measures quickly.

Higher voltage values than usual result from an increasing total resistance (the rectifier keeps the current constant). A higher resistance is the result of a current path interruption at a certain point (e.g. connection).

By reading the anode currents in VCS, current path interruptions can be recognized promptly.

See also

🗎 The importance of good electric connections [→ 62]

8.2.5.13 030170 Check sliding contact of clamps visually

- Period: 100 hrs.
- Mode of operation: ‘Manual’

For current conductivity, good contact between cathode rail / stripping rail and clamp sliding contacts is essential.

a) Avoid improper sliding contact, incrustations of the sliding contacts and grooves in the rails by keeping the rails clean and dry. If rails are wet, find out the cause for moisture (condensed liquids, proper functioning of exhaust system etc.).

Procedure of visual check:

a) Remove PP cover at one end of the Plater and check contacts (dry, clean, without incrustation, slightly dusty, not worn out, no mechanical irregularities).

Checking for mechanical irregularities:

a) Inspect opening and closing mechanism with clamps moving at low speed.

> **INFORMATION**
>
> Observe safety regulations! Do not touch moving parts! Visual check of the sliding contacts may be carried out in conjunction with maintenance task No. 030060 (check clamping points for residue-free metal stripping).

Other maintenance tasks with regard to clamps see:

- No. 030040 [→ 306] (Remove abrasion dust)

- No. 030180 [➞ 314] (Check sliding contacts)
- No. 030100 [➞ 312] (general Plater maintenance)
- Documentation on 'Clamps [➞ 179]' in the chapter 'Maintenance and Adjustment Information'

See also

030060 Check clamp contacts for residue-free metal stripping [➞ 309]

8.2.5.14 030180 Check clamps, sliding contacts, spring tension and replace clamps if necessary

- Period: 2000 hrs.
- Mode of operation: 'Manual'

Sliding contacts of clamps are wear parts.

a) Check for wear and good sliding contact at the cathode rail and metal stripping rail.

Metallic sliding pieces must be clean (with some dust) and without incrustation. The rails also must be dry, clean and smooth so that a good current transfer from the clamp to the rail is ensured.

Procedure:

a) Run clamp drive (do not touch moving parts) and check visually the following functions of clamps: close sliding contact to rails, opening and closing mechanism at the deflection domes.
b) Furthermore check clamp cable conditions, functioning of latching mechanism in order to keep clamp open, blower nozzle, as well as sensors.
c) The drive must be stopped in order to check the contact pressure of metallic sliding pieces by lifting them with the finger.

Is the torque spring still in good condition?
In order to check the surface of the sliding contacts a mirror and lamp may be useful.

See also

Clamp inspection [➞ 179]

030040 Remove abrasion dust from sliding contacts in clamp drive area [➞ 306]

030100 Change clamp drive belt [➞ 312]

030170 Check sliding contact of clamps visually [➞ 313]

030181 Exchange of individual clamps (at the maintenance window) [➞ 315]

030182 Exchange of a larger number of clamps [➞ 316]

Exchange of sliding contact [➞ 180]

8.2.5.15 030181 Exchange of individual clamps (at the maintenance window)

- Period: 400 hrs.
- Mode of operation: 'Manual'

Exchange of individual clamps may best be carried out through the maintenance window. (The alternative option is described in maintenance task No. 030182, replacement of 10 or more clamps after taking out some upper anodes first).

a) Procedure:
Use the start/stop bush buttons for the clamp drive to move the defective clamps to the maintenance window where you can unscrew the clamps.

b) Use the torx-key to unscrew the two countersunk screws M8x20 that hold the clamp.

	CAUTION
	Squeezed fingers If the clamp contacts are not closed, the spring of the clamp is under tension! Don't hold the clamp with the fingers between the clamp contacts! Fingers between the open clamp contacts could get squeezed should the latching mechanism of the clamp be released.

	INFORMATION
	Mounting of the clamps: The two countersunk screws M8x20 for mounting the clamps are to be tightened with a torque of 10 Nm.

Other maintenance tasks for clamps

See also

- 030040 Remove abrasion dust from sliding contacts in clamp drive area [→ 306]
- 030100 Change clamp drive belt [→ 312]
- 030170 Check sliding contact of clamps visually [→ 313]
- 030180 Check clamps, sliding contacts, spring tension and replace clamps if necessary [→ 314]
- 030182 Exchange of a larger number of clamps [→ 316]
- Clamp with lift-up pin [→ 179]

8.2.5.16 030182 Exchange of a larger number of clamps

- Period: 2000 operating hours
- Mode of operation: ‘Manual’

For this maintenance action we refer also to the more detailed description: ‘Disassembly of the upper anode segments’.

Here is a brief summary of that description:

a) Bring the shieldings back in their home position (if installed)
b) Remove two glass covers and PP cover of the dome at the input or output side of the Plater.
c) Switch off the compressed air and open the respective windows.
d) Loosen pipe connections of spray bars and unscrew the electric contact to the upper anode baskets.
e) Carefully lift the assembly of carrier bar and upper anode.
f) Use the start/stop push buttons for the clamp drive to move the defective clamps to the position where you can unscrew the clamps.
g) Use the torx-key to unscrew the two countersunk screws M8x20 that hold the clamp to the clamp belt.

i	INFORMATION
	Mounting of clamps The two countersunk screws M8x20 are to be tightened with a torque of 10 Nm. Reassemble in reverse sequence.

Related maintenance description:

See also

- 030040 Remove abrasion dust from sliding contacts in clamp drive area [→ 306]
- 030100 Change clamp drive belt [→ 312]
- 030170 Check sliding contact of clamps visually [→ 313]
- 030180 Check clamps, sliding contacts, spring tension and replace clamps if necessary [→ 314]
- 030181 Exchange of individual clamps (at the maintenance window) [→ 315]
- Clamp with lift-up pin [→ 179]

8.2.5.17 030220 Check monitoring of window sealing system

- Period: 3 month
- Mode of operation: ‘Manual’

General introduction:

The windows in the Plater module are sealed by air pressure. The air pipes and the rubber rings in the Plater windows must be free of air leakage. If there is air leakage and loss of pressure in the pneumatic pipe system (which subsequently would lead to leakage of solution), the pressure monitoring system (the transducer in the pneumatic unit) must generate an alarm message at the control PC.

	NOTICE
!	**Loss of solution** The alarm at the control PC must switch off the pumps in the Plater before strong loss of solution through the windows can occur. (Minor air leakage can not be detected by the pressure transducer switch).

The LED in the 'FESTO' pneumatic control unit indicates 'High' pressure (= regular pressure as required)

The purpose of this maintenance task is to check the proper function of the pressure monitoring system (FESTO unit, pressure transducer, electrical wiring, bus system, PLC, VCS window).

Procedure:

a) The production line is switched into manual mode (the pumps are off, no solution in the anode area). The pneumatic control system for the Plater windows is switched on so that so windows are tight.

b) Then slightly open one of the window screws (do not unscrew completely) in order to release some air and to lower the pressure in the air pipe system somewhat.

c) A fault message must appear at the control PC when the window screw is slightly opened (and the pressure is lowered). If no fault message appears, the setting of the adjustable screws in the FESTO air control unit must be checked.
(Generally this adjustments are made at commissioning. Don't change settings without need).

d) For trouble shooting and for checking the set points, please relate to further descriptions or contact ATOTECH equipment commissioners, if the expected fault message (and help description with possible causes and corrective measures) doesn't appear.

e) Final test: Slightly open that window screw which is the last one in the air distribution system in order to intentionally cause the fault message. (Generally the last window of the pneumatic pipe system is at the inlet side of the Plater).

See also

🗎 030020 Check windows of Plater for leaks [→ 305]

🗎 Window air pressure control [→ 188]

8.2.5.18 030230 Check function of monitoring devices (see also 0 2018 0)

- Period: 3 month
- Mode of operation: 'Manual'

Check sensors of Plater as described in maintenance task No. 020180 [➔ 300] and in the respective sections of the ATOTECH documentation.

8.2.5.19 030240 Clean drive motor, speed control sensor and torque measuring device

- Period: monthly
- Mode of operation: Inspection in automatic mode of operation, cleaning (if necessary) in manual mode

a) Clean drive motor and torque measurement sensor in case of contamination with electrolyte in order to avoid subsequent damages.

8.2.5.20 030271 Inspect the rectangular titanium mesh (pre-contacting system)

- Frequency: Weekly (or daily if necessary)
- Mode of operation: Manual

If there is too much copper accumulation on the rectangular titanium mesh you must remove it (like stripping of stripping sheets in stripping section).

	CAUTION
	Working with chemicals and chemical contaminated parts Wear safety goggles, gloves and appropriate clothing

	NOTICE
	Copper corrosion Do not damage the insulation of the 16 mm² wire to avoid copper corrosion afterwards.

Procedure:

a) Loosen the cable connection screws, take out the two titanium meshes and strip them in a container with stripping solution

b) After the copper is stripped reinstall the rectangular titanium meshes.

c) Make sure that the screws are tight and that the 16mm² wire connection is made well.

d) Perform continuity test with an Ohm-meter:
A good electric contact of the 16mm² wire is essential for the proper function of the pre-contacting system. A continuity test with the Ohmmeter from the titanium mesh to the cathode rail (beyond the last resistor) is therefore recommended after each disconnection of the wire to make sure that all the contacts are made well.

The expected resistance from the window side to the cathode rail is between 1 to 2 Ohm (1.4 Ohm resistor between the two meshes plus negligibly small values in the milliohm range).
Prior of making the continuity test, the sliding contacts of the first five or six clamps must be lifted and electrically isolated from the cathode rail. The sliding contacts shall not bridge the isolating material between the six precontacting copper pieces when the continuity test is made.

8.2.5.21 030280 Attend to the pressure at (and in) the pressure compensation vessel

- Period: Weekly
- Mode of operation: ‘Automatic’

NOTICE

Devellopement of cracks and leakages
The pressure compensation vessel is a safety device. It helps to prevent the development of cracks and subsequently of leakages, not only of cooling water into the bath, but also – and even more important – of chemical solution into the cooling water system. The risk that the water pipe system might get a crack at any spot by over-pressure is distinctly reduced by a properly working pressure compensation vessel!

a) Observe regularly the indicated water pressure whether not below 2 bar or higher than 5 bar (highest limit 6 bar). Note that there is pressure variation depending on the temperature of the cooling water in the pipes.
b) If required, refill air (or Nitrogen gas): Measure the gas / air pressure at least every 6 month.

See also

Plater – Cooling Water - Pressure Compensation Vessel [→ 198]

8.2.6 Plater - InPlate/InPulse

8.2.6.1 043011 Refill Cu-dissolving tank

- Period: daily
- Mode of operation: ‘Automatic mode’

Copper replenishment should be carried out during production, when all the pumps in the Plater are running. (In manual mode of operation it could cause overfill alarm in the Plater).

Instructions for refill

CAUTION

Working with chemical contaminated parts

Wear protective glasses and clothes.

Whenever the anode box is lifted, use the secure pipe across the Redumat compartment to fix the anode box securely opened. Otherwise there is the risk of splashing fluid, when the box falls down.

a) **Lower the fluid level first!**
   Before the Cu dissolving tank is refilled, the button “Refill Copper” in the VCS control panel of the copper dissolving unit has to be pressed in order to lower the fluid level in the compartments of the dissolving unit.
   After the “Ready for Refill” message has appeared on-screen, the covers of the dissolving tank can be opened without danger and without causing alarm.
   Notice: Don`t forget to release the “Refill Copper” – button, when copper replenishment is finished!
b) Check the copper height once a day (or after 20 hrs. of production). The actual filling height should not be less than 80% of the maximum filling height. This ensures a constant dissolving rate and avoids increase of rectifier voltage. The maximum filling height is the middle of the PPN bar in the compartment.
c) Insert the securing pipe to hold the anode box open
d) Copper ramifications and peaks that formed themselves on the surface of the copper pellets must be smashed with a rod. A continued growth up to the diaphragm and anode would cause a short circuit and damage to the equipment.
e) Check also condition of the diaphragm and clean or replace if necessary.

Type of pellets: The four compartments of the Cu dissolving tank have to be filled with adequate anode pellets (phosphor free Cu-pellets, recommended size 8 x 15 mm).

NOTICE

Refilling copper

After refilling the copper surface has to be flat and even. The filling height mustn’t be higher than the middle of the PPN-bar marking. Any peaks or conglomeration of Cu-pellets higher than the PPN-bar, may easily lead to a short circuit between copper and anode (risk of copper penetration through the diaphragm).

Never remove any of the distance bars! They ensure a sufficient distance between copper and anode. The distance between copper and diaphragm must not be less than approximately 50 mm.

a) After the copper replenishment is carried out, release the control button “copper replenishment” in VCS. The working level in the copper dissolving tank will then automatically adjust itself.

8.2.6.2 043031 Check diaphragms and exchange them if necessary

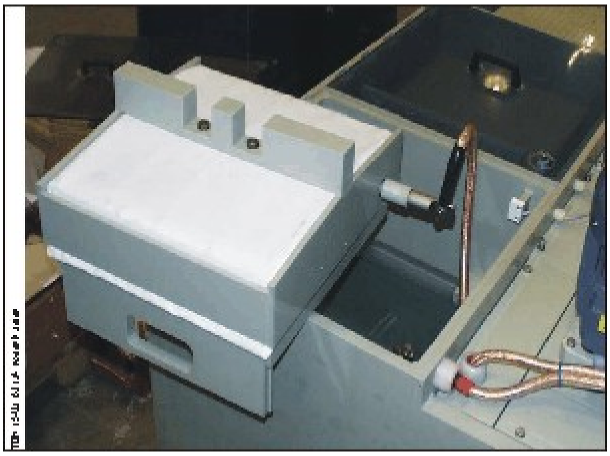
- Period: weekly, visual control after 200 operating hours
- Mode of operation: Inspection possible during production, however the redumat must be switched off

a) Check diaphragm (copper deposition, contamination, damages) and replace it by cleaned diaphragms if its condition is poor.

The line can produce without the Redumat rectifier being switched on. Substantial or quick changes of the bath concentrations will not occur (e.g. within one or two hours).

Procedure:

a) Click the button ‘Copper Replenishment’ in the VCS process control window of the copper dissolving tank to switch off the Redumat.
b) Lift the anode box and turn it around.



Anode box lifted and turned upside down

a) Inspect the diaphragm and replace it if necessary.
b) For the diaphragm exchange remove its holding frame from the anode box. Use gloves! Wear protective clothing!

Removing holding frame for diaphragm

Removal of diaphragm

Before you put the anode box back make sure that the electric connections are tight.

See also

- The importance of good electric connections [→ 62]
- 043011 Refill Cu-dissolving tank [→ 319]

8.2.6.3 043041 Read voltage display of Redumat rectifier

- Period: daily
- Mode of operation: ‘Automatic mode’

a) Pay attention the actual voltage value of the Redumat rectifiers (displayed in the VCS control window). It can be useful to write them down and compare them later, in order to be able to notice any possible changes in the course of time.

It is not necessary to take any precautionary maintenance measures concerning the anodes.

If the actual rectifier voltage is getting higher as usual, a warning and fault message will appear.

If there are no other contact resistances causing the increase of the rectifier voltage in the electric circuit (common causes are: corrosion, loose electrical connections), the voltage rise may be caused by an increase of the resistance of the coated anodes.

	NOTICE
!	**Correct electric contacting** Pay attention to correct electric contacting when ending repair work ! No excessive heat development should occur!

See also

🗎 043082 Inspection/replacement of the meshed anode grid [➔ 325]

🗎 The importance of good electric connections [➔ 62]

8.2.6.4 043060 Rinse Inert Anode Segments and Plater Parts with DI water

- Period: Monthly
- Mode of operation: ‘Manual’

	NOTICE
!	**Clamp Drive and sliding contacts** Do never use water or pressure jet cleaner for cleaning of clamp drive area and sliding contacts. For these upper parts apply dry cleaning only!

	NOTICE
!	**Inert anodes** With regard to the lifetime of the coated inert anode segments, they have to be rinsed regularly with DI water, especially if there is a break of production of more than one shift. Dried acidic sediments are harmful to the coating of the anode meshes. Do not use cleaning agent! The coating of the inert anode meshes may be attacked and partly destructed! Therefore use DI water only!

	CAUTION
⚠	**Working with chemical contaminated parts** Wear safety glothes and protective goggles!

a) Rinse off any residue and crystallized CuSO4 from the anode surfaces by a gentle water beam. Do not clean Anode segments with high pressure! Adjust a moderate pressure (water pipe pressure) in order to avoid damaging or tearing off the coating of the anode meshes!
b) Remove tightly hardened residues carefully only by hand (wear safety gloves!) and/or a piece of softened wedge wood. Never use any sharp tools like screwdrivers, pair of pliers, knife etc. to remove crystallization or tight residues. Again this involves the risk of damaging the anode coating!
c) Do not let run the Plater pumps unnecessarily if there is no production. Needless contact between electrolyte and anode coating is not favorable for the anode lifetime.

	NOTICE
!	**Other parts** Machine cleaning with pressure jet cleaner is practical for drive parts, rollers, module tank, etc.

d) If necessary, clean also Plater parts like AFD, pre-contacting mesh (if installed), roller surfaces at inlet and outlet, bevel- and spur gears, level switches, the anode connections and the automatic shielding mechanism (not installed in InPulse2 Platers) from crystallized CuSO4 residues.

	NOTICE
!	**Consultation of the process engineer** The input of water influences the bath concentration.

e) After water input, the tank level may be over the set-level. Drain off electrolyte until the correct level set-point is reached again.
f) Check bath concentration and add Leveler, Brightener and Make-Up solution as a result of analysis if required.

See also

- 043081 Cleaning of the dissolving tank (2nd generation of Redumat) [→ 324]
- 030041 Inspect cathode rail and make it metallically clean [→ 307]
- InPulse Cu Modules and breaks of production [→ 37]
- Plater [→ 159]

8.2.6.5 043081 Cleaning of the dissolving tank (2nd generation of Redumat)

- Period: annually
- Mode of operation: Manual operation

When cleaning the Plater, clean also the Dissolving Tank. Use with DI water only.

For rinsing the tank it is not necessary to take out the Cu-pellets. They may remain inside the tank.

Additionally, if required:

Take out the diaphragms and replace them by cleaned diaphragms.

For that purpose, unscrew the bolt connections and proceed as explained in maintenance instruction No. 043031 [→ 321].

8.2.6.6 043082 Inspection/replacement of the meshed anode grid

- Period: as required by a rising voltage level
- Mode of operation: ‘Manual mode’

Fault pattern:

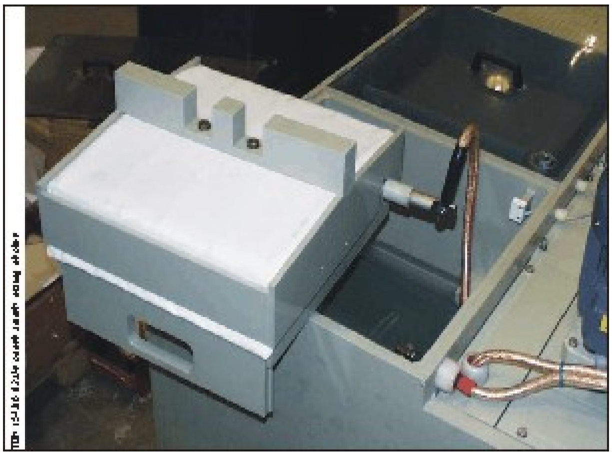
The required current (maximum 200 A) can’t be delivered any more by the rectifier without over-voltage alarm!

The set current (which should normally amount between 150 A and 180 A) cannot be maintained by the rectifier. The situation worsens steadily. Even at low current rates the over-voltage warning and alarm is generated.

You may reduce the current rate in steps. If the rectifier voltage still rises to its maximum it is most likely that the anode mesh is worn out.

Procedure to replace the anode mesh:

a) Switch the redumat off.
b) Open the cover of the respective Redumat section (where the fault appears) and lift the anode box.



Anode box lifted and turned upside down

a) Remove the front panel of the anode box.
b) Remove the diaphragm holding frame. Inspect the diaphragm bag and replace it later on by a new one if necessary.
c) Loosen the electric connection from the anode mesh and take off the old mesh.
d) Insert the new mesh and tighten the electric connection (Attention: Electric heat is building up when connections are not tight!).

e) Fix all the parts and put the anode box back again.

See also

🗎 The importance of good electric connections [➔ 62]

8.2.6.7 043090 Inspect AFD masks and clean single holes if necessary

- Period: Weekly to monthly, depending on the results of the previous inspections
- Mode of operation: 'Manual'

Relevance:

- InPulse1 and InPulse2 Platers
- PCBs with blind vias and/or high aspect ratios

Automatic monitoring of possible deviations of the flow rate:

The flow rate of the upper and lower AFDs in the Plater is permanently monitored by two analogue flow sensors. If the flow rate changes in comparison to the initial fault-free setting, the control system generates a fault message.

- Warning message: Deviation of about ± 10% relative to fault-free setting
- Alarm message with pump stop: Deviation of ± 20%.

If a warning message is generated during continuous production, the filter is probably the first cause. If, however, a warning message is generated while the first PCB of a job is about to enter the Plater, a fraction of the holes in the AFD masks is probably blocked.

i	INFORMATION
	The risk, that copper crystals block the holes rises considerably, if the copper content of the bath is relatively high and when the bath is cooling down.

Preventive maintenance in addition to the automatic monitoring:

Maintenance personal must give attention to the individual holes in the AFD masks, whether free (not blocked). A small number of holes being blocked can not be detected by the automatic monitoring of the flow rate.

Therefore inspect the holes

- always, when warning or alarm messages indicate a reduced flow and the filter can be excluded as the other main cause.
- always after breaks of production of more than 6 hrs. This time may be defined longer/shorter, if the results of several inspections justify/demand it.

- at least once a month, if there are no long breaks of production or no warning messages. However, it is recommended to execute this maintenance task weekly, for example, while the cleaning program is running in modules of the Uniplate pretreatment line.
- always, whenever the upper anodes have to be taken out for any other maintenance reasons, like annual Plater maintenance, belt exchange, panel crashes, etc..

⚠	CAUTION
	Working with chemicals Observe carefully all the regulations on working with chemical solutions! Wear safety goggles, gloves and protective clothing!

Procedure for the removal, inspection and cleaning of the AFD masks:

a) Remove upper AFD (whole AFD unit together with supply pipes)
b) Rinse it at an appropriate place
c) Unscrew the AFD-mask of this removed AFD unit (outside of the Plater)
d) Rinse the bottom AFD inside of the Plater
e) Unscrew the bottom AFD-mask (the lower AFD body remains fixed in the Plater)
f) Inspect all the holes in the two masks, whether free (view against any source of light)
g) If blocked, clean the individual holes with a needle or pin of proper thickness
h) Rinse the masks and inspect the holes once more
i) Fix the masks again (first the pair of screws in the middle of the AFD bar, finally the outside pairs of screws)
j) Mount the upper AFD unit and, when switching on the pump, make sure that there is no leakage at the pipe work joints.

8.2.7 Dryer

8.2.7.1 085010 Clean filter of the Dryer

- Period: 100 hrs.
- Mode of operation: Automatic

When the filter is contaminated and therefore partially blocked the air throughput is reduced. Therefore the fine filter must be cleaned at regular intervals depending on the degree of contamination.

Cleaning instructions:

a) Blow through with compressed air
b) Wash with a weak soap solution and rinse well with water

	CAUTION
	Compressed air Wear safety glasses to avoid risk of eye injury. Never aim the compressed air towards the body!

8.2.8 Periphery

8.2.8.1 060010 Attend to the water cooler station

- Period: weekly
- Mode of operation: 'Automatic mode'

The water cooling station (also named Lahn-Cooler, because Lahn is the supplier company) is installed to cool both, all the rectifier cabinets and also the cathode rail in the Plater (=2 secondary water cycles in case of InPulse2 Platers).

The two respective pumps start, if PCBs enter the Plater and stop, if the Plater (or Plater sub-line) is empty.

Water specification and water level:

The water level in the cooler station must be sufficiently high.

- Check the water level (see inspection glass). If necessary, refill with soft city water.
- Check for leaks, if water is lost frequently.

	NOTICE
	Wrong water For refill, use soft city water, hardness range below 7°dH (1.3 mmol/liter), no recycled water, no DI water*.

* For KIMO pulse devices however, the distinctly different instruction 060051 is applicable

With regard to the water cooling system, consider also
- the instructions in the rectifier supplier manual,
- the specification of closed loop cooling water.

The adequate water temperature (set-point and deviations):

By default, the set-point specified by ATOTECH is **27°C**, however project specifically (considering the ambient room temperature, the humidity in the factory hall, the make of the rectifiers / pulse devices) the optimum setting may vary:
Practical experience and observation of the system are important (signs of condensation, prober function of electronic parts, exhaust system of the Plater).

The set-point …
a) … mustn't be too low, to avoid condensation on the cathode rail in the Plater as well as in the rectifier cabinets and
b) … mustn't be too high, to get sufficient cooling of parts (no over-temperature fault messages).

It is recommended to make records about the proper settings, if different from the specified default set-point. Reasons for changing the set-point after commissioning should be written down and shared with colleagues.

Remarks to the required water temperature of the cathode rail:

a) Condensation must be avoided: For the cathode rail alone, an inlet water temperature between 30 to 35°C would be sufficient for cooling. Since the actual temperature set-point is generally somewhat lower, it must be stated and underlined, that the Plater exhaust system - from the inlet slots in the exhaust duct to extraction pipes - mustn't be blocked. The exhaust flow must remain properly adjusted. The correct function of the exhaust system in the Plater is important to have enough air extraction and sufficiently low humidity in the Plater.

b) The temperature of the cathode rail is monitored by 2 PT100 temperature sensors. The warning value should be set to 45 or 50°C, but not higher.

Remarks to the rectifier temperature:

- See the respective equipment manual of the supplier.
- The cabinets must remain closed!

Related information material:

- Pipe and Installation diagram (P&I)
- Electrical wiring diagram (functional unit =CC11, etc.)
- In VCS-H: The respective Window for Visualization and Control

See also

🗎 060050 Replace the water of the cooler station [→ 330]

🗎 Specification closed system cooling water [→ 49]

8.2.8.2 060020 Check for proper function of exhaust system

- Period: 6 month
- Mode of operation: 'Manual'

The general working condition of the complete exhaust system is to be checked by a specialist in order to prevent people from inhaling of dangerous vapors.

a) Use fume sticks for the generation of fume and observe its flow from the inlet port at rinse modules to the neighboring active modules. Make sure that no air is driven sideways between two active modules crossing a rinse module in between.

b) The measurement of the low pressure may be done through openings in the rear side of the active modules.
c) Remove chemical deposits from exhaust slits to maintain the air flow quantity adjusted upon commissioning (adjusted by means of orifices at a given low pressure).

See also

- Exhaust system [➙ 54]

8.2.8.3 060021 Check function of exhaust system visually

- Period: weekly
- Mode of operation: 'Automatic mode'

a) For safety reasons and for keeping the quality of production at high standards, it is essential to give regular attention to the proper function of the exhaust system.

See also

- Exhaust system [➙ 54]

8.2.8.4 060040 Maintenance of rectifiers

- Period: annually
- Mode of operation: 'Manual'

For further information see also suppliers' documentation.

a) Check cabinet inside, vacuum if necessary and in case of moisture/water find out the cause for it.

8.2.8.5 060050 Replace the water of the cooler station

- Period: 6 month
- Mode of operation: 'Manual'

Relevance: In case of InPulse2 Platers and pe Pulse Devices
(however for KIMO Pulse Devices see different instruction 060051)

Replacement of cooling water in the water cooler station (Lahn Cooler):

a) Every 6 month:
   Drain used water and replace with fresh water.
   For more information, please refer to the closely related maintenance instruction 060010.

See also

- Water supply [➙ 49]
- 060010 Attend to the water cooler station [➙ 328]

🗎 Specification closed system cooling water [→ 49]

8.2.8.6 060070 Observe air supply system

- Period: weekly
- Mode of operation: ‘Automatic mode’

The supplied compressed air must be dry, free of oil and the air pressure must be sufficient.

In case you observe condensate developing in the filter bowl of a filter unit with pressure regulator make sure that the condensate is drained in good time (open bleed screw, see sub suppliers' documentation).

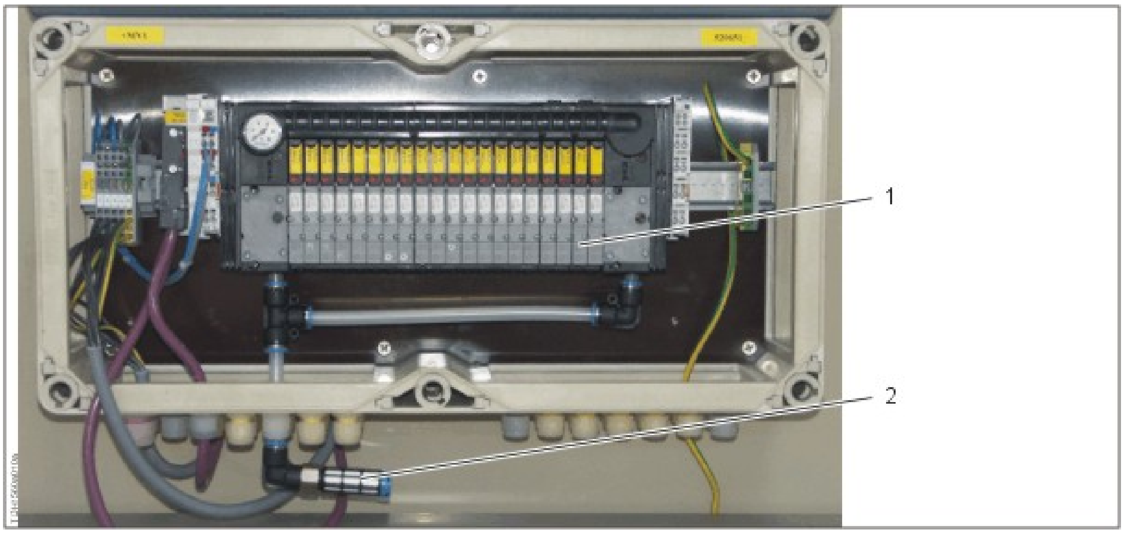
a) If the condensate is developing too quick find out the reason (preparatory treatment of compressed air).

b) Clean also the filter cartridge or replace it, if heavily contaminated.

For further information see also fault message 118 related to compressed air supply system.

8.2.8.7 060090 Clean/Replace the silencers of the pneumatic system

- Period: 6 month (more often if the quality of air is/was not sufficiently good)
- Mode of operation: ‘Automatic mode’



Silencer at pneumatic unit with a series of solenoid valves

1	Solenoid valves	2	Silencer

Sufficient and properly directed flow of air through the solenoid valves in the pneumatic unit needs – amongst others - clean silencers.

a) Check in regular intervals the cleanliness of the silencers.

See also the operating instructions of the sub supplier of the pneumatic system of the solenoid valves.

See also:

- Buerkert MA6524 Operating instructions

8.3 Maintenance schedule (order by time)

8.3.1 Shift

See also

- 010010 Check sensors of transport system [→ 288]
- 020010 Check the pressure indication at the filter units [→ 289]
- 020060 Inspection for irregularities [→ 292]
- 020070 Check piping for leaks [→ 293]
- 030010 Check belt tension of clamp drive by reading tensile force [→ 305]
- 030020 Check windows of Plater for leaks [→ 305]
- 030110 Read current and voltage values of rectifiers [→ 313]

8.3.2 Daily

See also

- 020120 Check the conveyor system: Smooth rotation of components [→ 297]
- 020125 Check all the parts of the transport system [→ 298]
- 026040 Calibrate pH sensor [→ 304]
- 043011 Refill Cu-dissolving tank [→ 319]
- 043041 Read voltage display of Redumat rectifier [→ 322]

8.3.3 Weekly

See also

- 020020 Inspect the bath level in fluid trays [→ 292]
- 020080 Keeping modules and plant components clean [→ 294]
- 020190 Check spray pipes and spray nozzles for cleaning purposes [→ 303]
- 020200 Check air release at the filter units [→ 303]
- 026010 Carry out cleaning program of Adhesion Promoter module [→ 304]
- 030040 Remove abrasion dust from sliding contacts in clamp drive area [→ 306]
- 030060 Check clamp contacts for residue-free metal stripping [→ 309]
- 030070 Check degree of metal deposition on stripping sheets [→ 310]

- 030170 Check sliding contact of clamps visually [→ 313]
- 030271 Inspect the rectangular titanium mesh (pre-contacting system) [→ 318]
- 030280 Attend to the pressure at (and in) the pressure compensation vessel [→ 319]
- 043031 Check diaphragms and exchange them if necessary [→ 321]
- 043090 Inspect AFD masks and clean single holes if necessary [→ 326]
- 060010 Attend to the water cooler station [→ 328]
- 060021 Check function of exhaust system visually [→ 330]
- 060070 Observe air supply system [→ 331]
- 085010 Clean filter of the Dryer [→ 327]

8.3.4 Monthly

See also

- 010041 Check belt tension and axle alignment [→ 288]
- 026050 Inspect the sealing under the glass covers and replace them, if required [→ 304]
- 030030 Check input/output rollers and sealing lips in the Plater [→ 306]
- 030041 Inspect cathode rail and make it metallically clean [→ 307]
- 030050 Check function of cleaning systems for clamp belt and input-/output rollers [→ 309]
- 030080 Check the conveyor gears/bevel gears in the Plater [→ 311]
- 030181 Exchange of individual clamps (at the maintenance window) [→ 315]
- 030240 Clean drive motor, speed control sensor and torque measuring device [→ 318]
- 043060 Rinse Inert Anode Segments and Plater Parts with DI water [→ 323]

8.3.5 3 month

See also

- 020101 Inspection / Replacement of Multiple Bearing Inserts (MBIs) [→ 296]
- 020140 Check dosing system (quality control specified by customer) [→ 300]
- 020180 Inspection of monitoring devices [→ 300]
- 020181 Check digital level switches [→ 301]
- 020182 Check analog level sensors [→ 301]
- 020183 Check temperature sensor Pt 100 [→ 302]
- 020184 Check cover switches [→ 302]

- 020185 Check flow switch (cone-shaped float) [→ 302]
- 020186 Check flow switch for dosing [→ 302]
- 030220 Check monitoring of window sealing system [→ 316]
- 030230 Check function of monitoring devices (see also 0 2018 0) [→ 317]
- 043082 Inspection/replacement of the meshed anode grid [→ 325]

8.3.6 6 month

See also

- 010050 Maintenance of drive motors [→ 289]
- 020220 Inspect all the rollers adjacent to and below the ultrasonic transducers [→ 303]
- 030090 Check clamp drive belt (belt tension and wear) [→ 311]
- 030180 Check clamps, sliding contacts, spring tension and replace clamps if necessary [→ 314]
- 030182 Exchange of a larger number of clamps [→ 316]
- 060020 Check for proper function of exhaust system [→ 329]
- 060050 Replace the water of the cooler station [→ 330]
- 060090 Clean/Replace the silencers of the pneumatic system [→ 331]

8.3.7 Annually

See also

- 010060 Replace bearing brackets next to drive belts [→ 289]
- 020160 Clean ventilation grid of pump motors [→ 300]
- 030100 Change clamp drive belt [→ 312]
- 043081 Cleaning of the dissolving tank (2nd generation of Redumat) [→ 324]
- 060040 Maintenance of rectifiers [→ 330]

9 Spare parts and wearing parts

9.1 Identification of mechanical spare parts

In ATOTECH lines a mechanical part is identified by:

- Project number (520xxxnn)
- Type of line
- Customer
- Designation of module or peripheral unit
- Part number

Finding parts by using ATOTECH Parts Catalog

The DVD-version of the equipment documentation provides software to view the mechanical design and identify parts by their part number. The application "Electronics Parts Catalog (etk.exe)" gives detailed information about spare parts of the line.

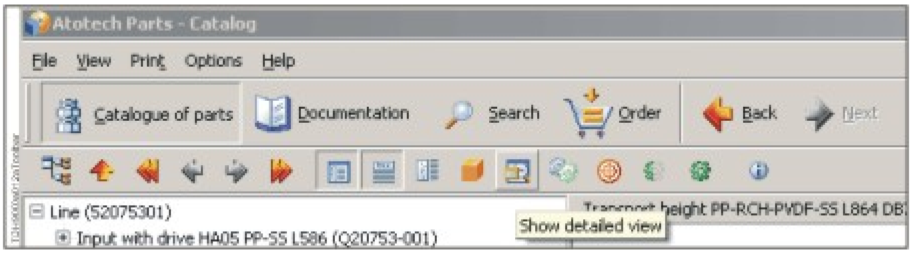
i	INFORMATION
	Part numbers are only attached to parts which are likely to wear out during regular operation and thus have to be exchanged. If the lifetime of a part is likely to be as long as the lifetime of the whole module or peripheral unit it is built in, it is not considered as a spare part.

Features of Electronics Parts Catalog

- 3D - constructions with animation functions
- 2D - constructions with position numbers
- Parts database with search function
- Call function for OEM (sub-suppliers') – documentations
- etc.

Features of Electronics Parts Catalog

Icons in toolbar



Icons in toolbar

The function of the different icons is explained by quick info tags.

3D - construction

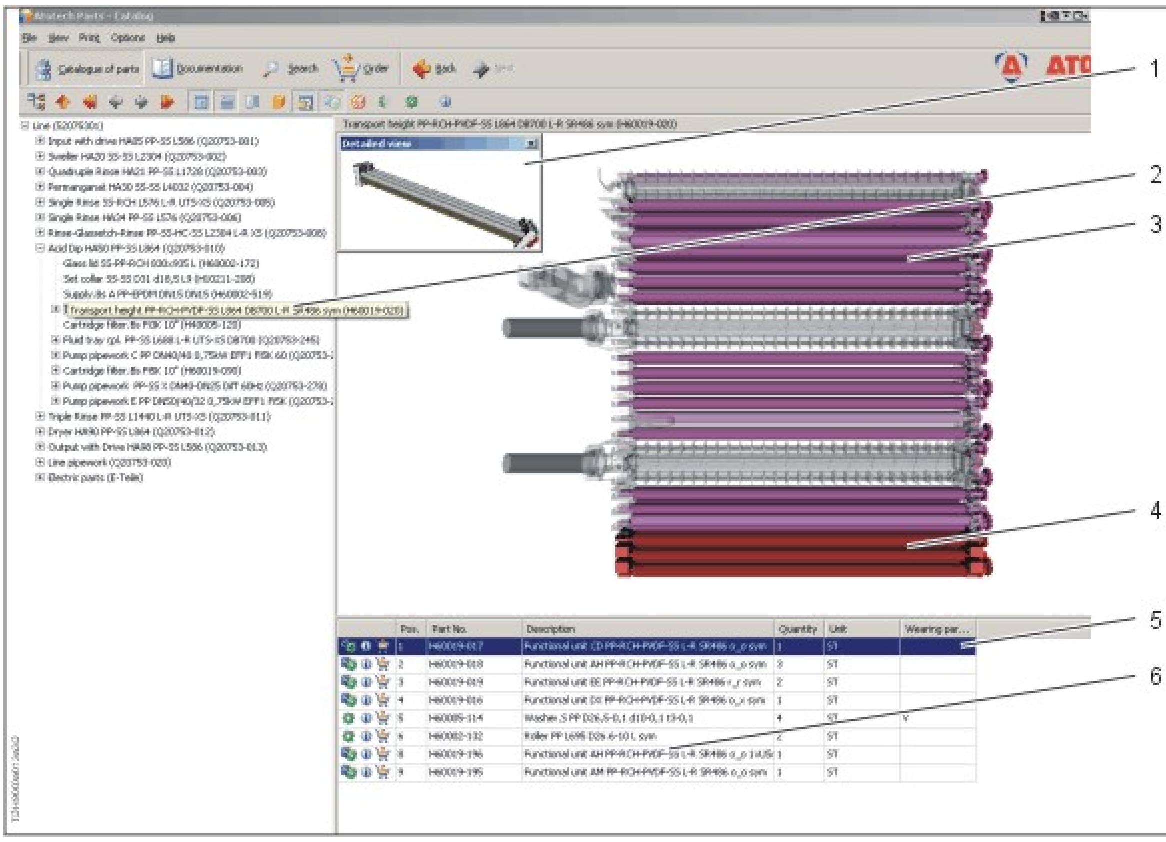


Illustration 3D - construction

1	Detailed view of highlighted part	4	Selected part in 3D – view (highlighted)
2	Directory tree of module sub-assemblies	5	Selected part in database
3	3D - view of module sub-assembly	6	Database of represented parts

Illustration displays the 3D - construction window, where the module and its sub-assemblies are shown as selected in the directory on the left side of the window. The bottom part of the window contains an extract of the parts database. The selected part is highlighted in the construction as well as in the database extract.

Virtual disassembling of parts consisting of more than one single part

In the left field of the parts database icons allow the call of further functions:

Icons: [1] parts icon [2] information icon

	INFORMATION
i	**Part symbol** The part symbol represents part number and part designation. If it consists of more than one part, the selected part consists of more than one part. Double clicking on the double part symbol allows going to the detailed view of the corresponding subparts. Double-clicking on the single part symbol highlights the selected part.

Zooming details of 3D - view

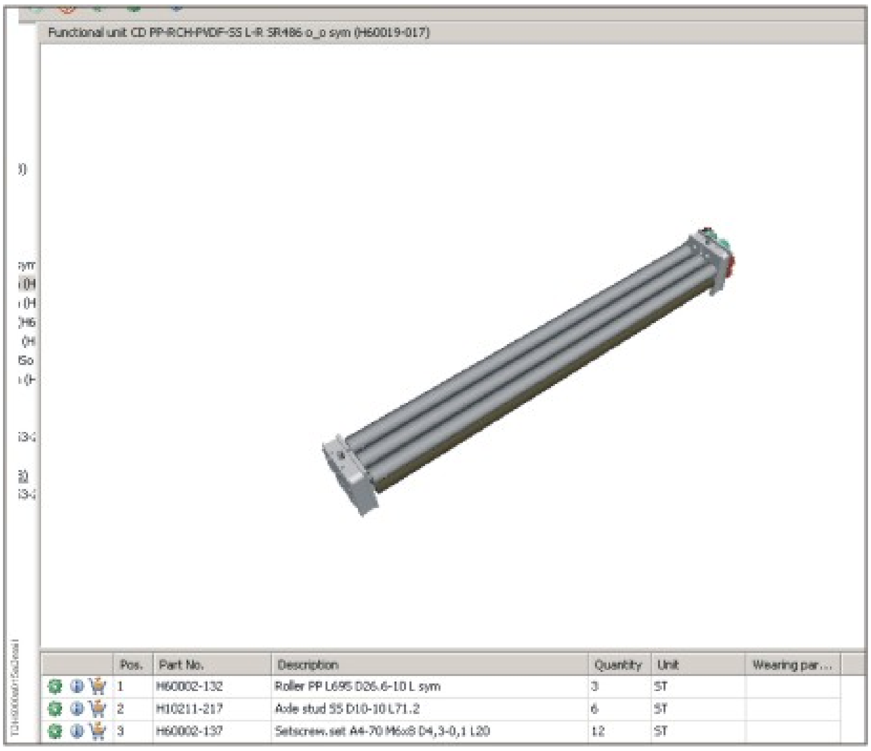


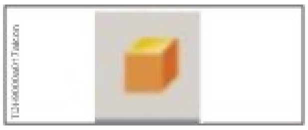
Illustration B Detail of 3D - construction

Double-clicking on a part icon representing more than one part opens a more detailed view of the construction. Illustration B shows a 3D - construction of the part that was extracted from the unit shown in illustration A, where this part is highlighted in red (appearing in the left upper corner of the screen as “detailed view” in the same illustration). The parts database extract shows the components of the displayed construction.

As long as a part consists of more than one component, this action can be repeated.

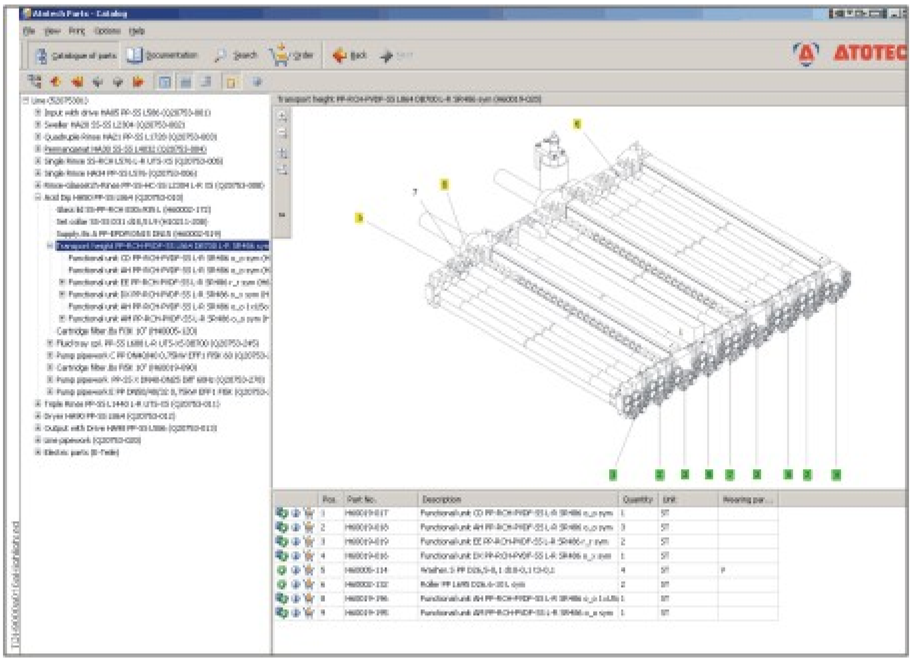
- **Switching to 2D view**

A click on the cubic icon in the toolbar switches between 3D- and 2D – view.



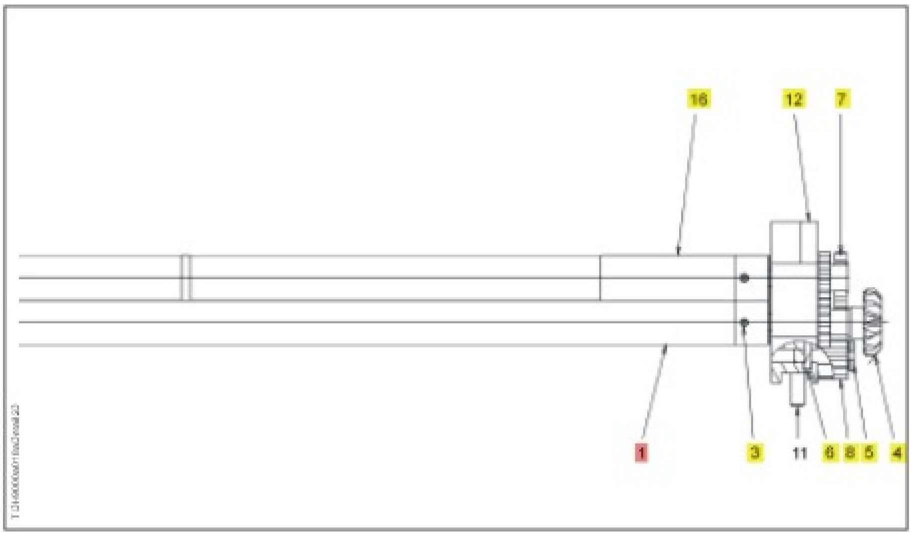
Cubic icon to switch between 2D and 3D

The 2D - view shows the mechanical drawing of the selected object including position numbers for all parts contained in it. If the position number is highlighted yellow, the respective part is a single spare part. If the position number is highlighted green, the respective part is an assembly of two or more parts which have separate part numbers themselves. If the position number is not highlighted at all, the respective part is no regular spare part, because it is unlikely to wear out or break.



2D – construction

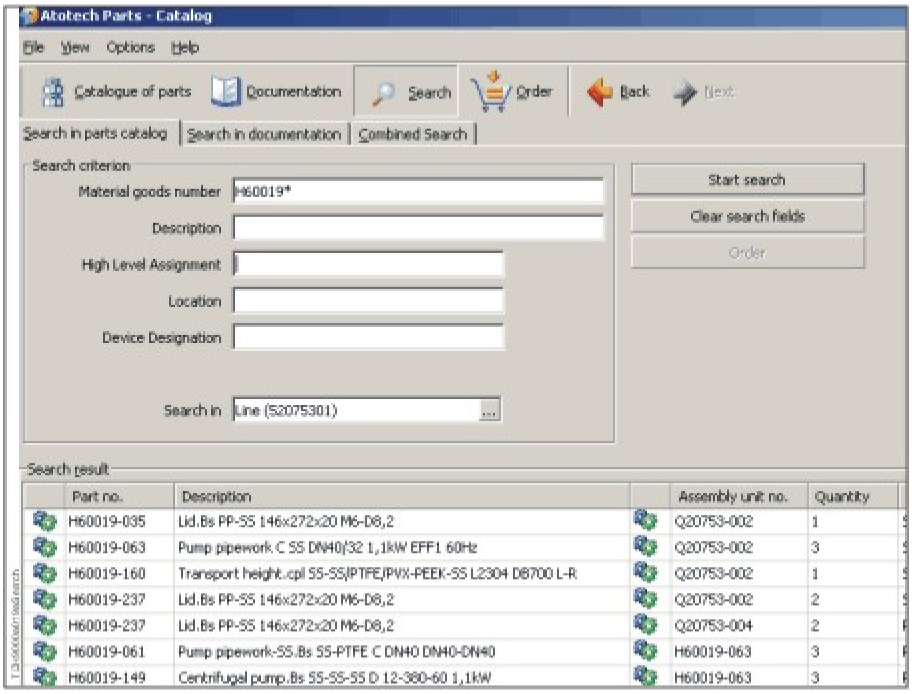
When a single part is selected, the position number is highlighted red.



Details of 2D - construction

Use of search function

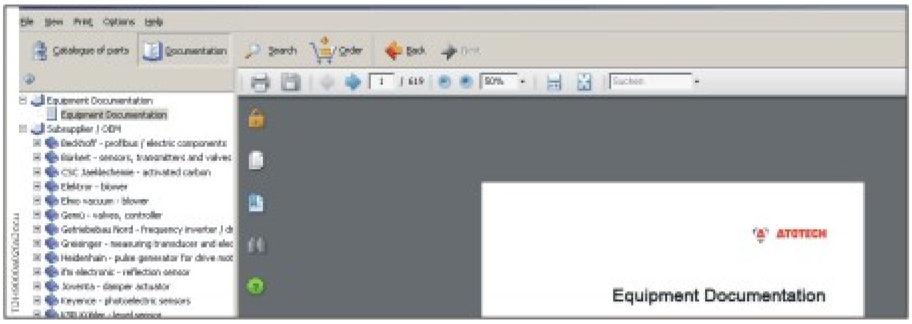
The Electronic Parts Catalog provides several search functions:



Search window of Electronic Parts Catalog

Calling the documentation

The Electronic Parts Catalog provides the possibility of looking up the ATOTECH equipment documentation as well as all sub-supplier’s (OEM) documentations.

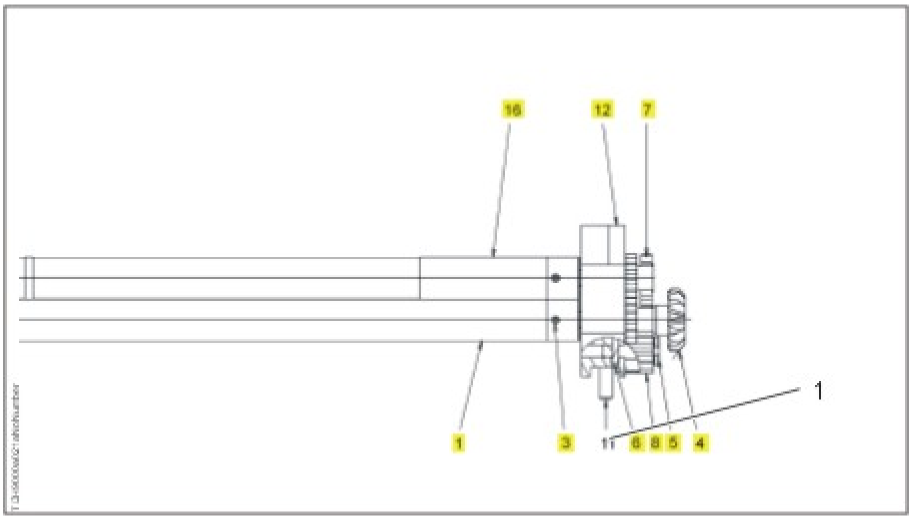


Documentation window

All searches can be done in the catalog as well as in all technical documentations.

Finding parts without a part number

As an exception parts can be assembled in the line, that don't have a public ATOTECH spare part number. This is because some parts normally need not to be changed because they don't wear out.



Position number of a part without a part number [1]

If the unusual case appears that a part is searched for which is not in the parts list, the following measures can be taken:

The 2D - view shows all parts of a unit including those parts which have no ATOTECH spare part number. The position numbers of parts not having a part number are not highlighted in any color.

Parts without numbers are to be ordered by passing following information:

- Description of the part and its function(s)
- Line number (520xxnn)
- Module code (High Level Assignment, e.g. =HA50)

Optional:

- 2D - cutout with position number
- Photograph of the part
- If available: Dimensions and technical data

9.2 Identification of electrical spare parts

The ATOTECH component designation code for electrical components

In ATOTECH lines an electrical part is identified by:

- Project number (520xxxnn)
- Module / Function (= …..)
- Location (+ …..)

- Electrical part designation (- ……).

Example: The designation 520xxxnn =HA25 +S3 -12.1 provides a definite identification of the sought-after component.

- The line number “520xxxnn” identifies distinctly the line where the component is assembled.
- The designation “=HA25” is a coded module name from which ATOTECH gets information about the module function and the process it is used in.
- The designation “+S3” is a coded name for the switch cabinet or junction box where the component is assembled.
- The component code consists of
  - 1. the standard component designation by letters, e.g. “-S” for “switch”
  - 2. the ATOTECH function code, e.g. “12.#” for “cover switch”

A detailed description of component and function code is given in the equipemt documentation.

The ATOTECH designation code is used for all kind of printed and software documentation and has to be located on each component itself as a yellow label.

Places of ATOTECH electrical component designation code:

- P&I schematic
- Electrical wiring diagram
- Control software (VCS)
- Component code labeling

Identification of part number using documentation software

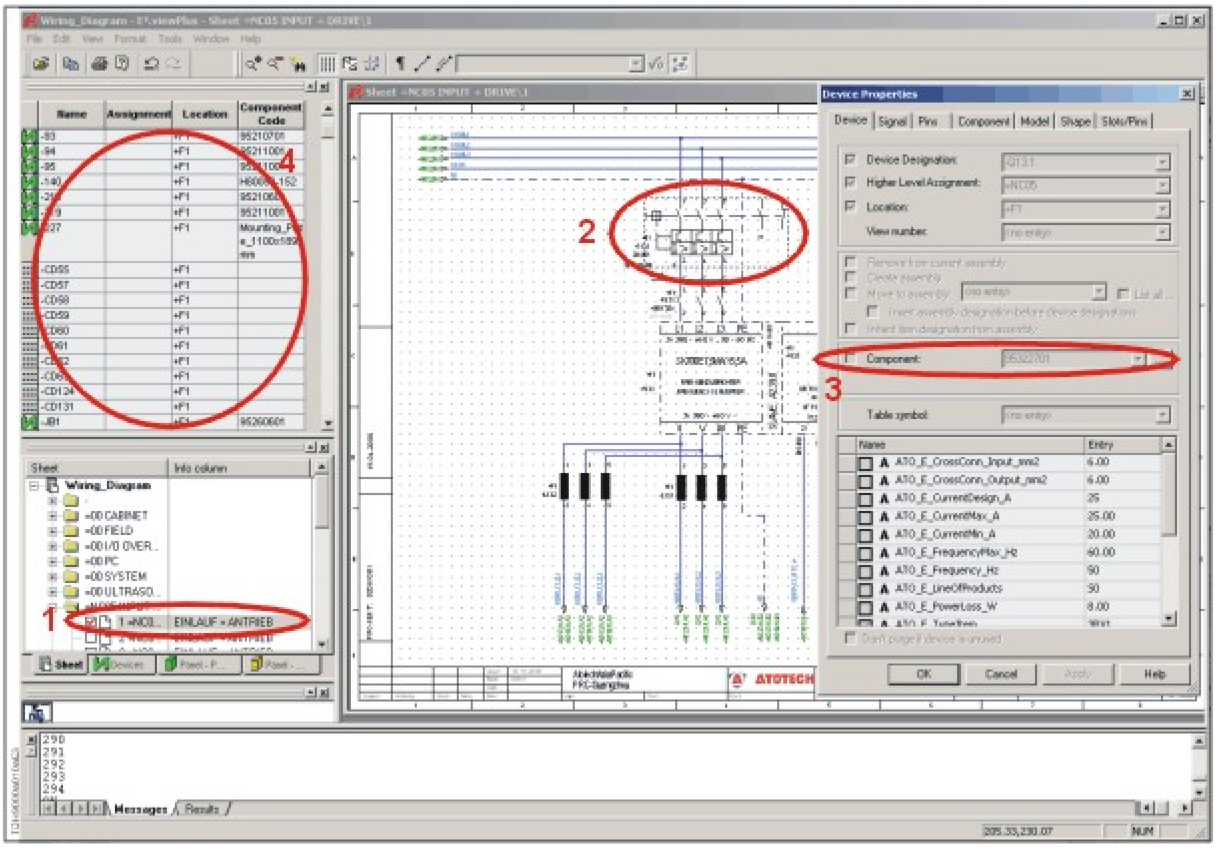
Part numbers in E3 viewer

The DVD-version of the equipment documentation provides software to read the electric wiring diagram in the computer. The software application “E3 Viewer” gives detailed information about all electric components used in the line.

To find an existing part number, start E3. The default view shows three windows:

- Main window displaying selected diagram sheet
- Project window providing several search functions
- Output window displaying messages and commands

In the “View” menu more windows can be selected, e.g. a component table like shown below on the left side of the illustration:



Screen of E3-viewer: [1] process window, [2] diagram in main window, [3] properties popup window [4] component table

Example:

- ► Select a diagram page in the process window
- ► Right-click on the desired component (here: circuit breaker) to activate the context menu
- ► Select “Properties” from the context menu
- ► In the pop up window see the component number

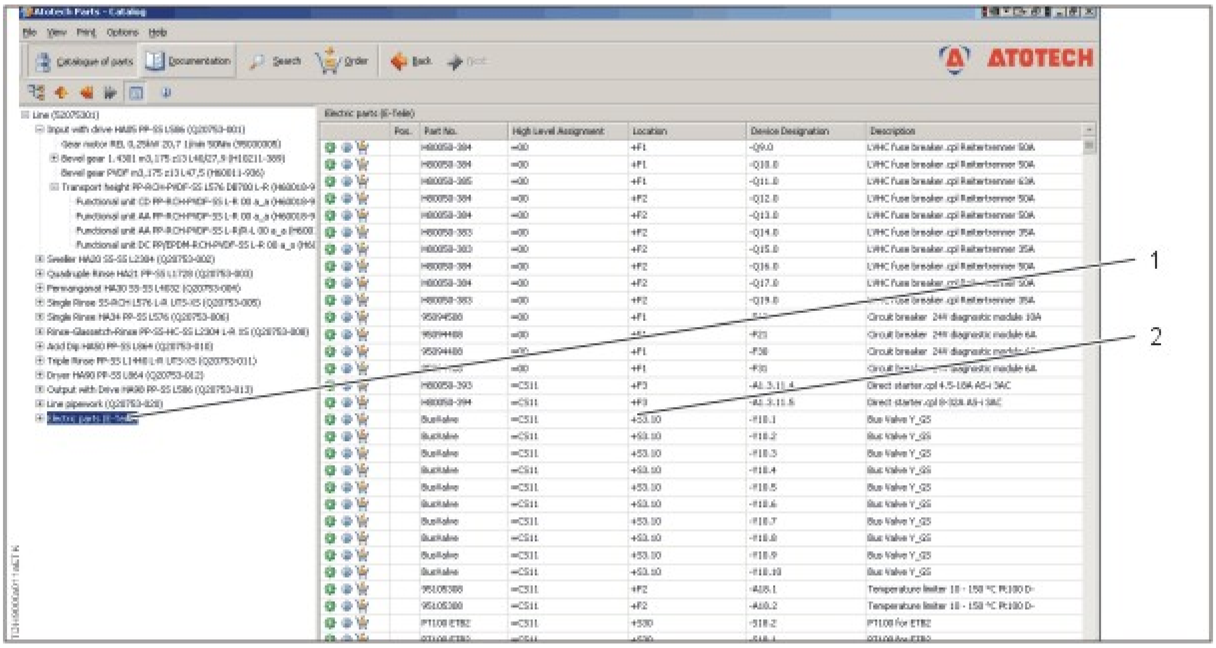
Alternative search methods (dependant on existing information):

- Double-click in a field of the component table
- Click the “Devices”-flag beneath the process window

Part numbers in Electronics parts catalog

The Electronics parts catalog is designed to help to identify parts. The features provided in the software are

- material parts list
- 3-D-models with detailed part designations
- Function for calling OEM-documentations
- Various search-functions
- Electric components can be found under a specific item: “Electrical parts” in the material parts list.



Electrical parts list in Electronic Parts Catalog: Left [1] Parts file, [2] Parts list

Select the desired part from the electrical parts list by double-clicking on it. The software shows the corresponding parts number(s).

Use the search function for “=” – “+” - , and “-“ – codes.

Identification of parts without distinct part number

As an exeption parts can be assembled in the line which don’t have an ATOTECH parts number. This often applies to peripheral units. Besides the module and component codes these parts can be identified by reading the type nameplate attached on the part itself.

On the nameplate following informations are given:

- Manufacturer (sub-supplier)
- Model number
- Serial number
- Technical data of the device

The line number in combination with the information on the device nameplate makes it possible to identify the desired part when passed to ATOTECH along with orders or service requests.

9.3 Freight back to Feucht location

Do you wish to send a shipment to ATOTECH Feucht?

VARIATION 1

1. Prepare the shipment ready for dispatch
2. Specify the shipment conditions with the forwarding agency

3. The forwarder has to pick up the shipment
4. Transmit the shipping documents (proforma invoice, packing list, delivery note, freight documents) by fax to a.m. faxnumber immediately upon shipment.

Please do not forget to mention the recipient in charge you are dealing with at our company.

VARIATION 2

If you choose this variation we will also be pleased to help you!

1. Prepare the shipment ready for dispatch
2. Send an advice note „ready for shipment“ to the a.m. faxnumber.
3. Transmit the shipping documents (proforma invoice, packing list, delivery note, freight documents) by fax to a.m. faxnumber immediately.
4. We will hire the forwarding agency and instruct them to pick up the shipment at your place. Thus you won’t have any further hassle.

If you choose this variation it is also very important that you indicate the person in charge you are dealing with in Feucht. Please indicate also the exact loading address and loading time in the advice note.

9.4 You order - we ship

We advise almost every shipment all over the world at the time of dispatch. The advice note consists of all shipping details.

With these details you are able to locate your shipment immediately. A smooth flow of information is guaranteed so that you are able to have the shipment at your further disposal according to the Just-In-Time principle.

If there should arise problems or if you have further questions the Logistics-Service-Team of ATOTECH Feucht will be pleased to help you.

Your contact person:	ATOTECH FEUCHT Mr. Axel Tuengerthal Import-Export Manager Tel.: ++49-9128-725-393 Fax.:++49-9128-725-451

9.5 Ordering spare parts after expiry of the warranty

The spare parts and anodes department is in charge of handling offers, orders, deliveries and invoicing.

Spare parts and anode department	
e-mail address	spares.feucht@atotech.com
	Fax: +49/9128/725-255

10 OEM-Documentation

For the sub-supplier’s OEM documentation please see the Parts Catalog.

11 Service

11.1Exchange of devices, repairs

Exchange of (broken) parts requires knowledge, skills and experience. Parts and devices which are commonly installed in pipe or tube systems are the various types of pumps, valves, filters, flow detectors, flow sensors, pressure regulators, fluid delivery devices and spray racks, etc.

This description gives hints and instructions of what must be taken into consideration while this kind of repair work is planned and carried out.

11.1.1 Introductory notes

- In order to get a quick overview of components which are part of the pipe system of a pump circuit / a water supply pipe system / the compressed air system
  ► please refer first to the P&I diagram and compare real pipe work installation (the zone where a part is broken and must be repaired) with the P&I schematic.
- Repair work must only be started after the maintenance person / team is fully conscious about possible risks:
  ► Attend to the general safety chapter of this equipment manual, the document ‘Safety first’ below and the house-internal safety policy, where the production plant is installed.
  ► In complex cases of repair work, a special team (assigned to this work) must perform a case specific risk assessment prior of starting with the repair work.
- Besides having the adequate tools, skills and training, a case specific analysis (acquiring detailed knowledge) is beneficial and necessary,
  – not just for safety and risk prevention, but
  – also for professional and efficient performance of repair work.
  ► For this objective, you ought to (or must in case of doubts) refer to all related sources of available information
  → chemistry and process instructions,
  → electrical wiring diagram,
  → parts catalog,
  → VCS control windows and related descriptions,
  → system descriptions in this manual,
  → part-specific manuals of sub-suppliers.
- From Atotech’s side, the descriptions are written to the best of our knowledge. Feedback from the field about practical feasibility and optimization of execution is very welcome.

11.1.2 Safety first

- Attend to all aspects in the safety chapter of this manual and comply with your company safety policy.
- Prior of switching off power supplies (electricity, compressed air, water) make sure that no production takes place any more (no panels in modules) and that nobody is performing any kind of work which requires these supplies.
- Most maintenance tasks can't or shouldn't be done alone. Operators, equipment technicians and process engineers must work together, give each other assistance, advice and guidance. Experience ought to be shared, open issues (how to do this or that) addressed to find the optimum hands-on procedure.
- Make sure that nobody else is at risk if switching on/off electric power, air and water. The more people are at the tool, the more attention must be paid to this aspect!
- In order to separate power supply of functions **in the entire tool** (for actuators such as pumps, heating elements, cylinder activation), press one off the 'Emergency Stop'-buttons and make sure that nobody else is reversing this safety measure (comply with Lock-out & Tag-out rules). Doing this, it is not necessary to open the electric cabinet for selective power separation.
- In order to shorten a maintenance interval, **different tasks may be carried out in different modules in parallel**. For example, one module is in Service mode for a new Make-up, in another module, the automatic cleaning program is running (also switched to Service mode) and in a third module mechanical maintenance is carried out (Manual mode required!).
  In this case, the main supplies can't be interrupted for the entire production plant. To disconnect electrical power of the 'third' module, trained electricians must disconnect the correct switch-gear in the electric cabinet (see separate list of instructions).
- In case of maintenance work at Loader and Unloader module, it may be necessary to switch off the compressed air and to release air pressure.
- To close compressed air supply is obligatory, if maintenance work is carried out inside the Loader and Unloader module (see separate description) and in general, if parts of the pneumatic system must be taken out / replaced.
- This is strongly recommended as a redundant safety measure also for other maintenance actions.
- If air pressure is needed for tests to be executed, keep away from parts which are moved by those cylinders.
- If any pipe connections are to be opened, make sure that there is no remaining pressure and that it is not possible to switch on the respective pump or valve (or actuator in general).
- Attend to all warnings, hints and information which is directly printed on a device (besides manuals of sub-suppliers)

11.1.3 How to disable output signal of a single module in VCS

To disable output signals of a module in a VCS process control window is easy; however, note, that this is not a sufficient safety measure.

- From VCS: Disable output signals of singled out module shown

Extract from VCS windows

► Check whether actuators (pumps, heaters, cylinders, etc.) are really disabled.

► For safety purposes, switching off the right hardware devices must be done additionally, if you must perform work inside of a module.

11.1.4 Switching off electrical power supply in switch-gear cabinets for execution of maintenance at specific modules

For specific maintenance task it is necessary and obligatory to safely disconnect actuators in one or several modules, so that work at them can be executed safely without switching off the main supplies (water, air, electricity).
[The steps to switch off the entire tool altogether are separately listed. See chapter “Handling of the tool in general”].

- In order to separate power supply of functions in one or a few single modules (for actuators such as pumps, heating elements, cylinder activation), only trained electricians are permitted to open the electrical cabinets.
- Attend to all warnings, hints and information which are directly printed on a device (besides information provided in manuals of sub-suppliers).
- Are you authorized to separate power for all actuators in this module?
  Who else must be informed and know about the execution of this maintenance task(s)?
- From VCS:
  - Switch entire production plant to Manual mode or selectively just one or several modules
  - Disable output signals of modules (where actuators shall be disabled and maintenance work must be executed). This software based disabling action is recommended as a redundant measure besides hardware-based power separation.
- Opening of doors of electrical cabinet
  - Attend to all aspects in the safety chapter of this manual and comply with your company safety policy.

- In order to shorten a maintenance interval, different tasks may be carried out in different modules in parallel.
  For example, one module is in Service mode for a new Make-up; in another module, the Automatic Cleaning Program is running (also switched to Service mode); in a third module mechanical inspection and maintenance is carried out (Manual mode required!).
  In this case, the main supplies (water, air, electricity) can't be disconnected.
  To disconnect electrical power of the 'third' module only, trained electricians must disconnect the correct switch-gear in the electric cabinet.

- Refer to electrical wiring diagram: For different kind of maintenance tasks, you must decide which of the power supplies (switch-gear) are to be disconnected:
  - Direct starters (supplying the respective actuators, such as pumps and heaters, etc.)
  - Respective 'Ground Fault Circuit Interrupters' in main cabinet +F1 (see respective pages of three-phase power distribution in chapter =00 in electrical wiring diagram)
  - Respective power separator switch (with NH-fuse inside) in main cabinet +F1 (Note: To open the power separator (and to take out the NH-fuse) is just allowed after power is disconnected by the respective 'Ground Fault Circuit Interrupter'.
- Comply with 'Lock-out & Tag-out' rules per company policy
- Maintenance switches are installed for some pumps and stirrers in tanks. Make use of them, if you perform work near-by.

11.1.5 Exchange of components installed in pipe systems (valves, sensors, etc.)

Pipe systems (filled by water, chemical solutions, compressed air or gases) may be under pressure, not just during production, but also if the production plant is switched to 'Manual' mode, even if a pump is not running.

Prior of dismounting of components (such as pressure sensors, flow meters, valves and pumps etc.) observe the following safety instructions:

WARNING

Pressure in the pipe system

Prior of opening a pipe connection, make sure beyond any doubt that there is no pressure any more in the pipe system (or a section of it)!

The repair work will take some time. Make sure that in this phase nobody else can switch on the respective pump or valve. Lock out and tag out the pressure supply device (pump, valve) according to company safety policy.

Process engineers inform other personnel (mechanics, electricians, equipment technicians) about chemistry-specific possible risks (prevention of accidents, personnel safety equipment, first aid, etc.).

Besides these introductory instructions above, observe as well all the other safety instructions for operators, in the maintenance chapter and in the general safety chapter of the equipment manual.

CAUTION

Working with chemicals

Observe all safety instructions with respect to the specific chemical solution in the pipe!

In order to take out a component installed in a pipe system in a professional manner (with regard to safety, function and efficiency),

► a case specific analysis is required and necessary directly at the place of installation.

The following questions shall serve as a guide to conduct this analysis. To clarify open questions, thoroughly inspect the pipe installation and refer to the related sources of information (such as P&I diagram, VCS, parts catalog, manuals, process instructions, etc.).

► Based on a thorough analysis you must be sure that nothing shall go wrong (no accident, efficient repair).

Essential questions for analysis:

- What is the flow direction, if the pump were running? Which pipes (including branches) are installed between pump and the part to be removed? Mark those pipes to be sure not to mix up any pipes!
- Which ones are the next valves with respect to the device to be taken out?
  - Valves at the pressure side of the broken part?
  - Valves at the opposite side (further on, after the broken part)?
  - Which type of valves are relevant (manually operated ones, PC controlled ones)?
- To clarify such question it may be necessary (and is recommended) to make use of the P&I diagram and compare the actual installation with the representation in the P&I diagram.

- The respective process control window in VCS may also be beneficial to discover aspects of pipe installation and parts involved.
- Which branches belong to the pump circuit / tube system? Is it possible to block the flow by valves in all branches? Which type of liquid and how much it can flow back (by gravity) even if all relevant and installed valves are closed (flow blocked in all branches).
- Which risk is involved, if one or the other relevant valve for this repair were is not tight (not blocking liquid flow fully)?
  - Is it adequate (and in which way possible) to take away pressure in an additional way (to take multiple safety measures), for example temporary measures such as
  - installation of an extra secondary valve, or
  - a temporary pipe blockage by a sealed dead end cover?
- Multiple safety measures against unwanted leakage / drainage / bursting of pipes must be taken into consideration, especially
  - if risk assessment requires it,
  - if parts look 'out of age' and may not be reliably working any more,
  - If a repair takes long and is complex,
  - if many people are involved.
- Decisions must be made:
  - Drainage of solution in tank (Yes / No / Not applicable / Later)
  - Rinsing of pipe system with water prior of opening it (Yes / No / How)?
- How much liquid will flow out if a pipe is opened?
  - Is a tank connected which will be drained by gravity (directly / indirectly), if a pipe connection is opened?
  - In which way can the volume of escaping solution be minimized?
  - Estimate volume in all the relevant pipes to all the next valves (more than just two if there are branches).
  - What is the best way to catch the chemistry / the rinse water?
    Which container / drip pan is adequate to catch the escaping volume?
  - If a container under the pipe system to be opened can't catch all the escaping liquid, it must be simultaneously sucked away by a barrel pump into another tank.
    Caution: Never mix different chemistries! Risk of explosion!
- If a pipe connection is to be opened to take out a device, the respective sealing my get damaged. Are the correct types of sealing (material, size) available?
- If a sensor needs to be exchanged:
  - What exactly is the function of that sensor?

  - Which work is to be done by experts of another profession (electricians, software technicians, process engineers)?
  - Which company is the manufacturer / sub-supplier? Refer to sub-supplier manual (safety, installation, maintenance).
- All people, who are regularly or temporarily working at the production plant, ought to work hand in hand and share their knowledge and experience. Record your experiences and safe them for later reference, if a similar work is to be carried out again.

See also

🗎 Safety first [→ 348]

11.1.6 Pressure release in dosing tubes

Chemicals are transferred from the Dosing tank to the respective module or tank.

Dosing pump (mounted at dosing station), dosing tubes, flow detector and injection unit with pressure retaining valve (commonly mounted at the rear side of the module) are the main parts in the dosing tube system.

The pressure retaining valve maintains pressure in the tube even if the dosing pump is switched off. The pressure retaining valve is installed for dosing accuracy.

	WARNING
⚠	**Dosing tube under pressure!** If you need to perform work at the dosing system, first release the pressure in the dosing tube/pipe (to be done at the dosing pump). This must be observed for each and every tube.

11.1.7 Exchanging magnetic centrifugal pumps

General Information

Scope of application

This safety-related description is valid for mounting and dismounting of magnetic centrifugal pumps installed in UNIPLATE lines.

Situations of Mounting, Purpose, Labeling:

Magnetic centrifugal pumps are used for following purposes:

- Feeding pumps for flooding elements in all process modules of Uniplate and Horizon lines.
- External filtering stations

- Transfer pumps
- Agitation of fluid in the sump
- By-pass-filtration

From the P&I schematics for this line one can get purpose and ATOTECH-labeling (e.g. /-M03.2) of each pump of the system.

Identical labeling is used for the electric wiring diagram the Visualization&Control System (VCS-H).

The meaning of the ATOTECH-labeling (of their single letters and numbers) is described separately in the line documentation.

Further sources of information about the pump circuit and the related units:

- P&I schematics
- Electric wiring diagram
- Display of VCS-H
- ATOTECH documentation of line (description of symbols of the P&I schematics)
- Sub-suppliers documentation for the related devices (Pumps:Sager&Mack, Frequency Inverter:Lenze)

They should be used along with this document to answer possible questions about the particular situation of mounting or about the purpose of a part of the pump circuit.

Arrangement of pump access piping and lock valves:

All magnetic centrifugal pumps are mounted by means of standardized fittings in the piping system.

Manual lock valves at the suction side of the pump allow the dismounting of pumps without draining the respective module.

(At filtering stations and transfer pumps manual lock valves are installed at the suction side **as well as** at the pressure side. This design prevents flowing back and escaping of remaining media during pump exchange).

11.1.7.1 Instruction of mounting and dismounting magnetic centrifugal pumps along with safety instructions

The particular steps will be described showcase for pumps equipped with a frequency inverter that feed flooding elements and are equipped with only one manual valve at the suction side.

The mounting and dismounting of transfer pumps and magnetic centrifugal pumps in external filtering stations is performed in corresponding steps analogically.

Showcase example: Dismounting and Mounting of a pump for flooding elements

Valid for all items:

	CAUTION
	Risk of injury by splashing acidic solutions Wear acidic resistant protective clothing! Wear chemical splash safety goggles!

1. Switch line (line part) to manual operation
(VCS Control: Mode F10, old lines: Siemens S5 Control: Mode F12)

2. Operator panel and part of line has to be marked with information board: "Attention!" Do not switch on! Work on module (Name, Nr.XX)!"

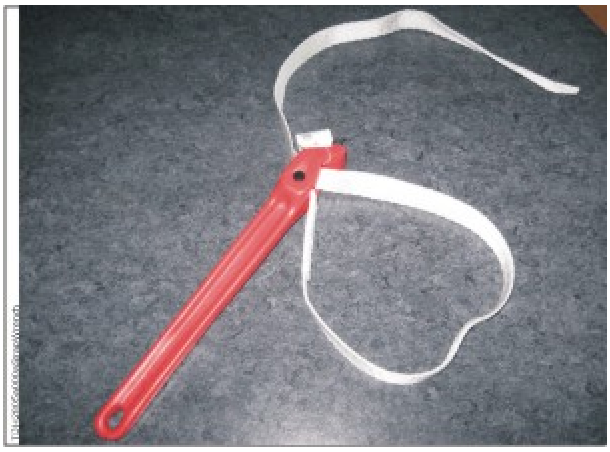
3. Maintenance switch of the respective pump on module rear side (red torque switch, Labeling Q0X.n with number of respective pump) has to be switched off. Consequently the pump is separated from power supply. The maintenance switch has to be marked with an information board too.

Valid for item 4 to 7:

	CAUTION
	Working with chemicals Wear acid-resistant protective gloves!

4. Remove front facing with paying attention to the sharp edges at the lower side.

5. Apply tools and auxiliary means:
-- plastic acid-proof collecting tray (height not exceeding 80mm), minimum capacity 6l
-- standard tool trolley
-- hand lamp or torch to illuminate work space
-- acid-resistant cleaning rag
-- strap wrench



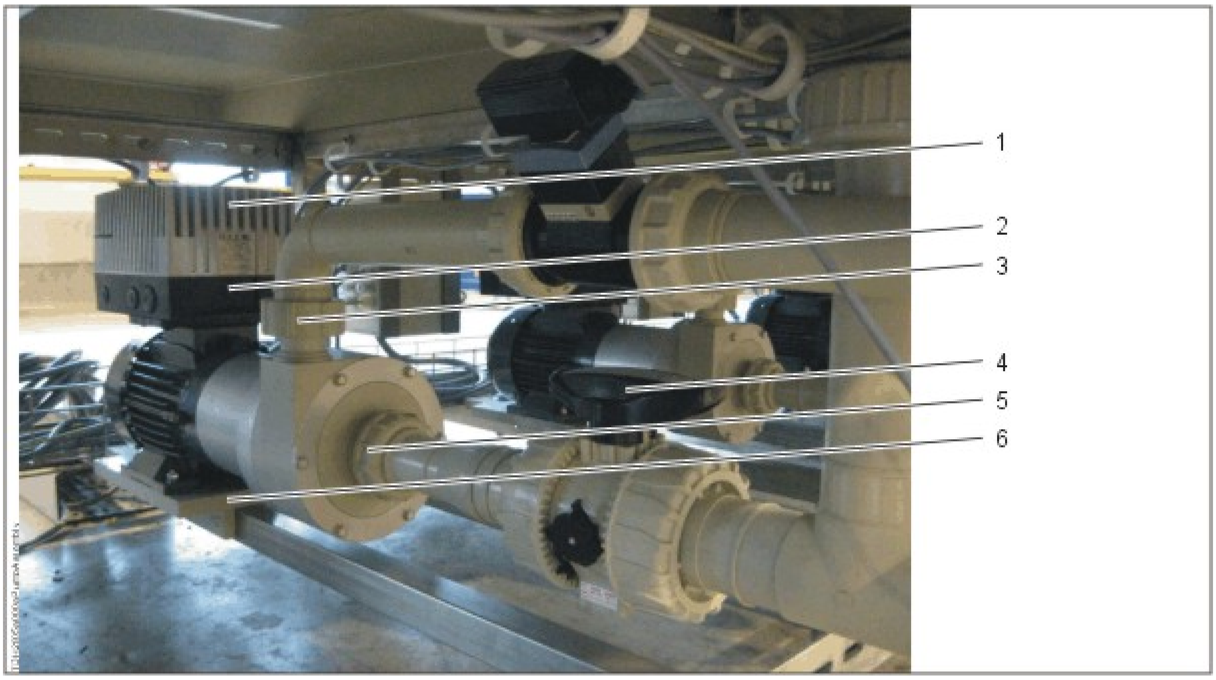
Strap wrench

Valid for item 6:

	NOTICE
!	**Risk of valve fracture!** Don’t use force!

6. The manual lock valve (label XX V 1/2/3…) at suction side of pump has to be carefully brought in blocking position (blocking position = at right angles to flow direction). In case of the valve being rough-running, cautiously spray the valve with water and dissolve the incrustations, afterwards wipe with a rag.

7. Place the collecting tray below the pump, so that fittings on suction and pressure side are placed above



Pump assembly with valve and piping (rear view of line)

1	Frequency inverter head	4	Manual lock valve
2	Frequency inverter foot	5	Lock nut suction side
3	Lock nut pressure side	6	Mounting plate on steel supporter

Valid for item 8 and 9:

	WARNING
⚠	**Electric shock** Don’t work live-line! Use insulated tools! If the maintenance technician has no instruction and permission for connecting and disconnecting electrical wires according to current regulations electrical works have to be carried out by a certified electrician or a person instructed for electrical works.

	NOTICE
	Risk of motor damage by inverted rotational direction Don’t change phase sequence! Don’t remove or change Y- or delta bridges on the motor connection board!

	NOTICE
	Risk of motor damage Keep the motor terminal block in a dry and safe place. Be careful not to loose small parts like screws and washers.

8. Disassemble frequency inverter (FI) head:

--Remove the FI head using a 4mm hex (Allen) key. For key positioning see picture below.

--Place it on a dry and safe place e.g. tool trolley.

9. Disassemble FI foot:

--Take out the bus function module.

--Unscrew the motor terminal block.

--Remove motor earth wire.

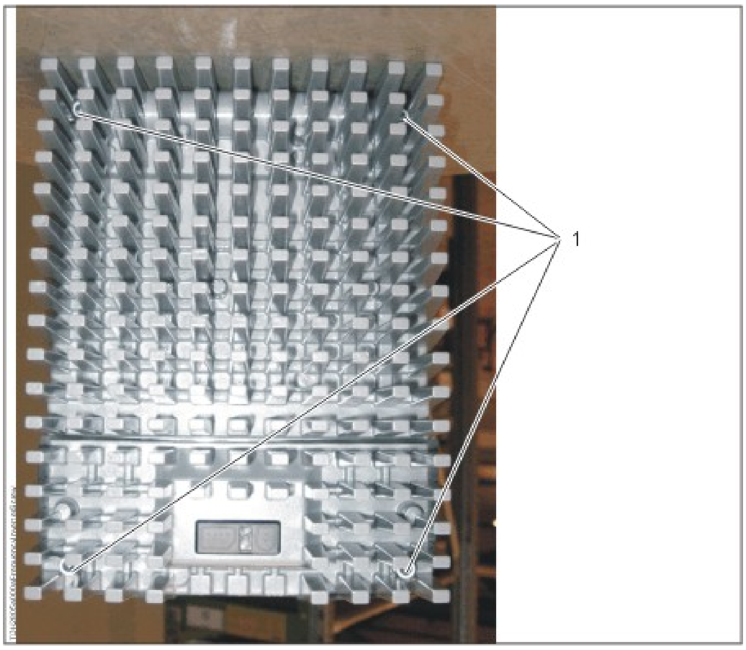
--Unscrew the power supply terminal block.

--Unscrew the foot mounting panel that links FI foot to motor connection board.

--Feed motor terminal block through opening of foot mounting panel.

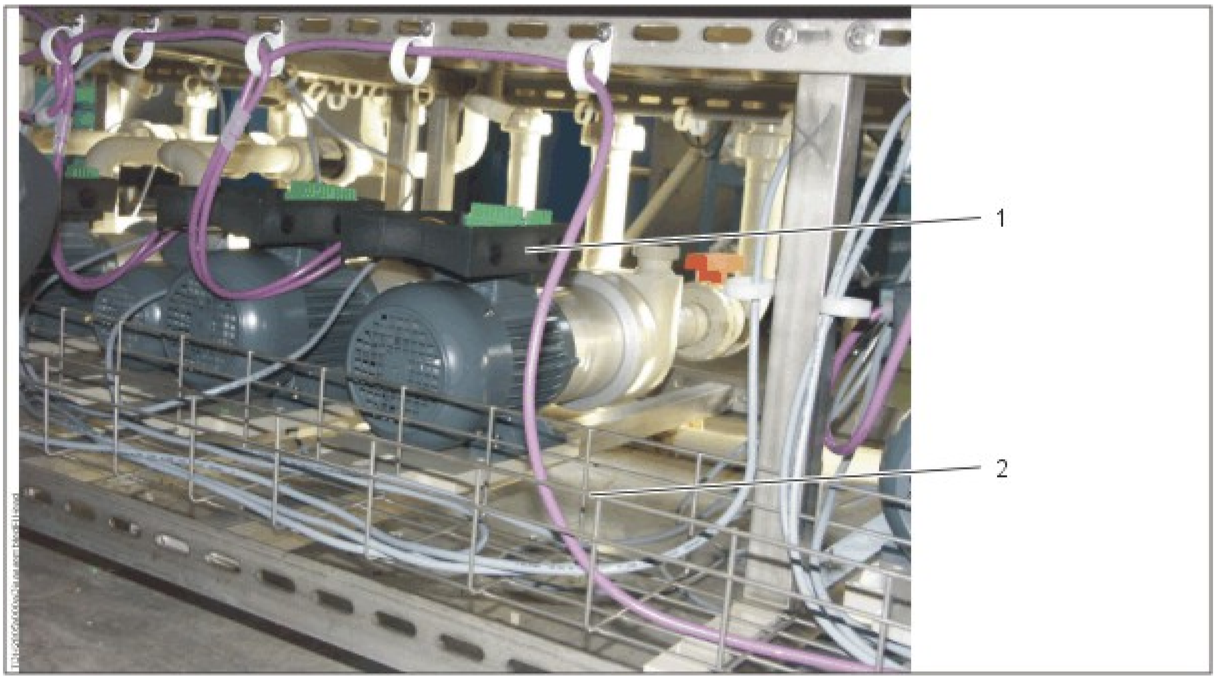
--Disconnect motor phase wires from the motor connection board.

--Carefully remove FI foot from pump and place it in the cable tray in front of line.



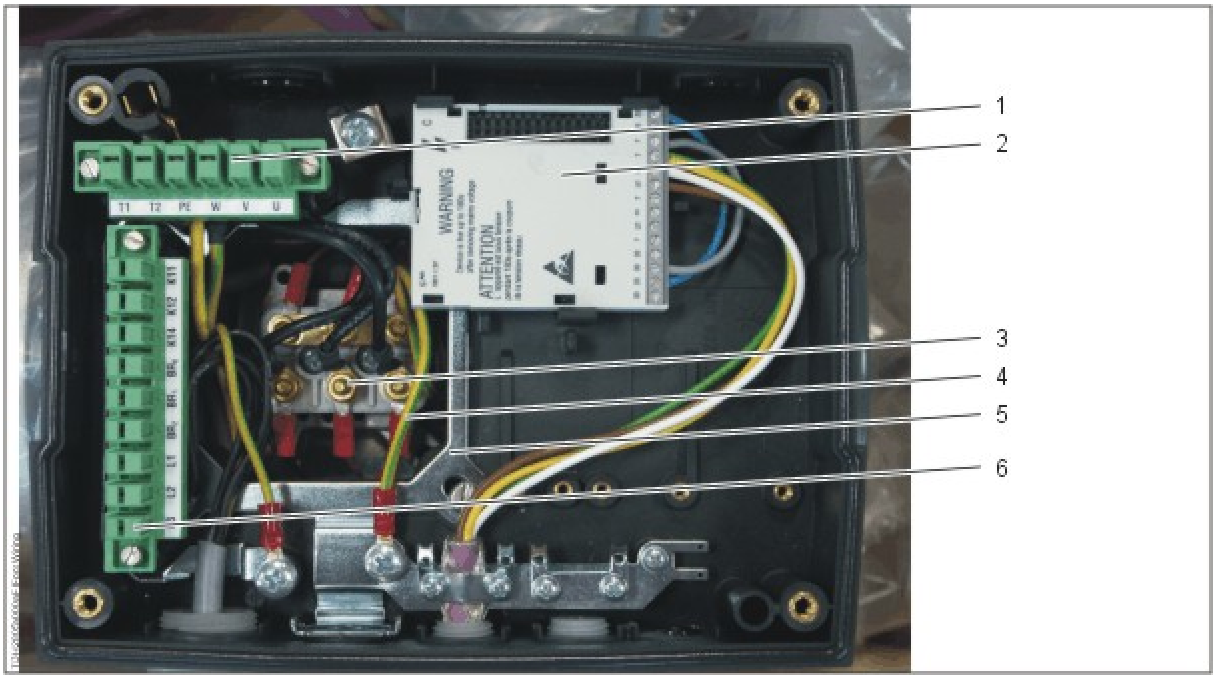
Frequency inverter head

1	FI head fixing screws		



Pump with disassembled Frequency inverter head

1	Frequency inverter foot	2	Cable tray



Frequency Inverter foot wiring

1	Motor terminal block	4	Motor earth wire
2	Bus function module	5	Foot mounting panel
3	Motor connection board	6	Power terminal block

Valid for item 10-13:

	CAUTION
	Working with chemicals Wear acid-resistant protective gloves!

	CAUTION
	Working with chemicals Liquid remainders from the pipe at pressure side (about 2 liters) are flowing back and leak from the fitting. Wear acid-resistant protective gloves!

10. Arrange plastic tray below the rack with pump piping placed directly above the tray.
Loosen pipe fittings at suction and pressure side of the pump. If it is not possible to loosen the fitting manually wearing protective gloves, use a strap wrench.
Push back the lock nuts on the piping. Let remaining liquids drip completely out of piping into the plastic tray placed below. Remove remains of chemicals on pipe, pump, and fitting.

11. Loosen attachment bolts of mounting plate placed on steel supporter in the rack using a wrench or a ratchet lever.

12. Carefully raise the pump from the metal support, move it sideways and then lift it out of rack towards the front of casing.

13. Prepare the new pump for assembly:
Verify accurate power indication in kW and of material type of impeller. See also P&I-schematics, order number in parts catalogue of the Atotech documentation, and sub-supplier's documentation (Sager&Mack).

Valid for item 14 and 15:

	NOTICE
	Risk of motor damage by inverted rotational direction Don't change phase sequence! Don't remove or change Y- or delta bridges on the motor connection board!

	NOTICE
	Risk of motor damage by intrusion of water or acidic solutions! Be careful about seal of FI head and foot!

	INFORMATION
	When you are mounting FI foot on motor connection box, carefully feed the motor terminal block through the openings of the seals, fixing brackets, and FI foot base opening.

14. Assemble FI foot on new pump:
--Remove cover of the motor connection box
--Connect the motor phase wires to the motor connection board
--Apply lower FI foot seal, foot bracket, and upper foot seal in correct order
--Check correct fit of seals and bracket
--Connect the FI foot to the motor connection box by fixing the foot mounting panel

15. Reassemble FI foot wiring:
--Reassemble the motor terminal block
--Reconnect earth wire
--Reassemble the power terminal block
--Snap in the bus function module

Valid for item 16 and 17:

	NOTICE
	Risk of leaks in pump assembly Don’t damage fittings or seals!

16. Check the seals on the fittings and replace them if necessary. Align the pump in the rack, so that fittings of pump and piping become congruent.Tighten lock nuts. Fix the mounting plate on the support by tightening the attachment bolts.

Valid for item 17:

	NOTICE
	Risk of screw fracture: If using a power screwdriver: Don’t tighten the screws with a torque higher tha 3,4Nm! See the FI sub-supplier’s documentation (Lenze)

17. Reassemble FI head using hex key.

18. Carefully bring the manual lock valve into discharging position again (parallel to flow direction in pipe).

19. Turn on maintenance switch.

Valid for item 20:

	WARNING
	Risk of serious injuries by etching liquids and moving parts! Do tracing of pump screwings only during pump standstill!

Valid for item 20-25:

	CAUTION
	Working with chemicals Wear acid-resistant protective gloves!

Valid for item 20 and 21:

	NOTICE
	Wrong software parameters As the pump type of replacement pump is identical to the dismounted one, normally there is no need for changing any software parameters. But doing the test run probably makes it necessary to refer to the sub-supplier's manual of FI in order to check the appropriate function of interaction between FI and pump.

20. Check for leaks and carry out a test run of the pump:
Dry up all liquid remains with a rag. Switch on maintenance switch.
Turn on respective pump at control PC in manual operation mode.
Test instructions:
--check rotational direction
--check tightness of seals at suction and pressure side; trace with care by means of a strap wrench if necessary.
If tracing of the screwing is not successful the o-seals have to be replaced.

21. Further and more specific instructions for operation, safety and review according to the used pump type are found in the related data sheet of the sub-supplier's documentation (Lenze, Sager&Mack)

22. Remove contaminations and remains of chemicals from pump casing and piping.

23. Remove plastic tray below and deliver the rest of liquids to disposal. Alternative: Remove liquids using a vacuum cleaner adequate for acidic liquids before moving the tray forward.

24. Watch the regular operation of flooding elements through the glass lid.

25. Replace the PP front facing.

26. Remove the information boards from the line.

27. Record the repair in the line log (date, time, module number, pump number, device number of new pump.

28. Release line for operation again (inform responsible personnel).

11.1.8 Prevention of risks by heavy weight to be lifted

Heavy weights must either be lifted
- by several persons (using adequate auxiliary means) or
- by a crane or cable winch or by other suitable auxiliary means (lever, rollers, ropes)
- or be first shifted sideways (without being lifted) and lifted then by a crane.

Context and risk:

Due to higher weights (which are not permitted to be lifted by one person, refer to house-internal safety policy) and conditions such as restricted clearance and access, a person
- may injure his back bone,
- loose balance (with the risk of injuries), or
- drop components (falling on his/her feet, resulting in damage of parts).

If a crane (or cable winch) is not available, two-person-lifting or several-person-lifting is, for example, required for

- Heavy pumps
- Compressor in Dryer module
- Clamp belt in the Plater module
- etc.

If a heavy assembly unit / device needs to be handed over and carried on, again, several-person-carrying is required, of course.

► Apply instructions per company policy (hands-on training)!

► Exact procedures should be established by experienced personnel;

► Case specific experiences ought to be recorded (making photos with comments, video clips) and shared with less experienced personnel.

12 Appendix

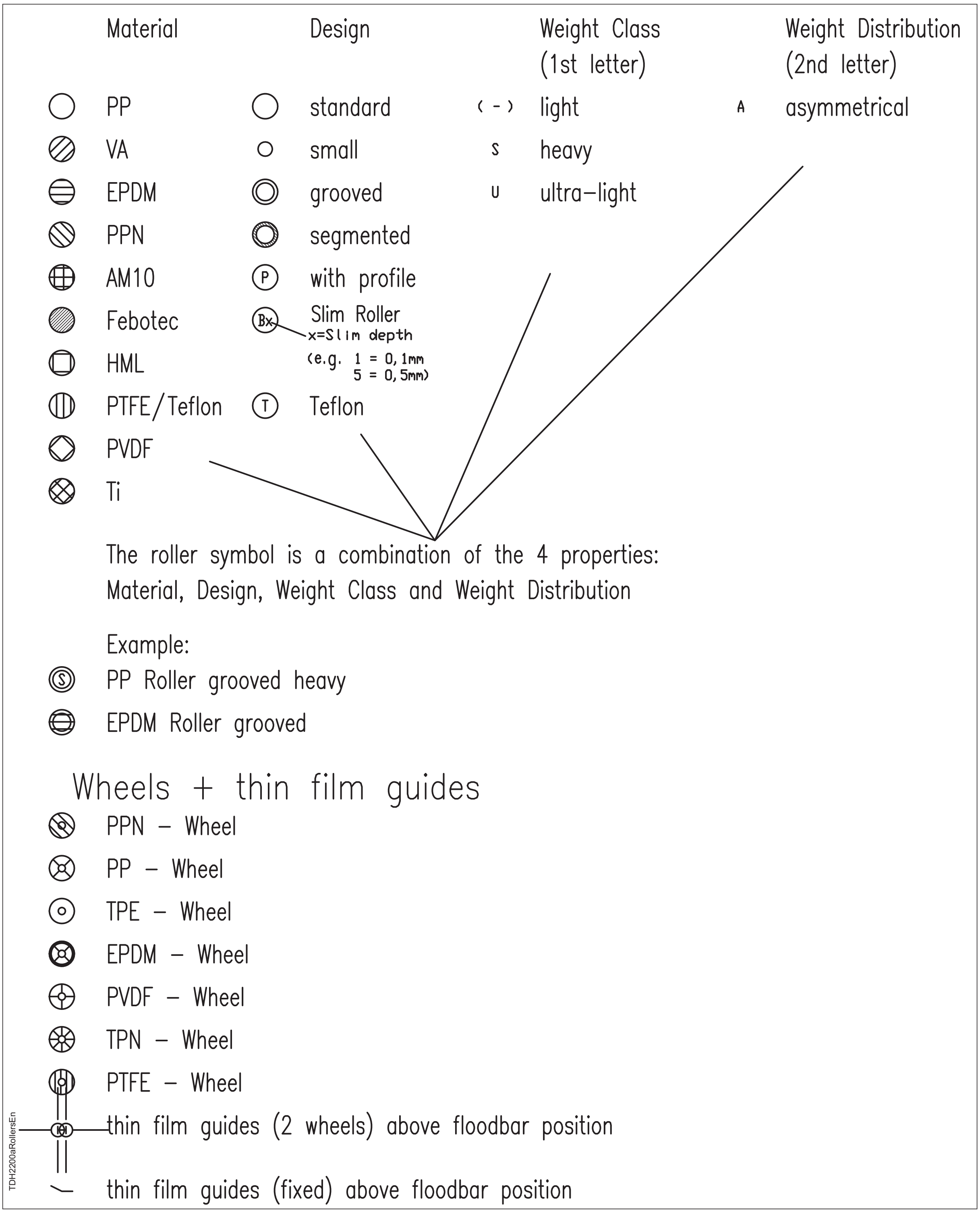
12.1P&I Diagram

Click here to open the P&I Diagram:

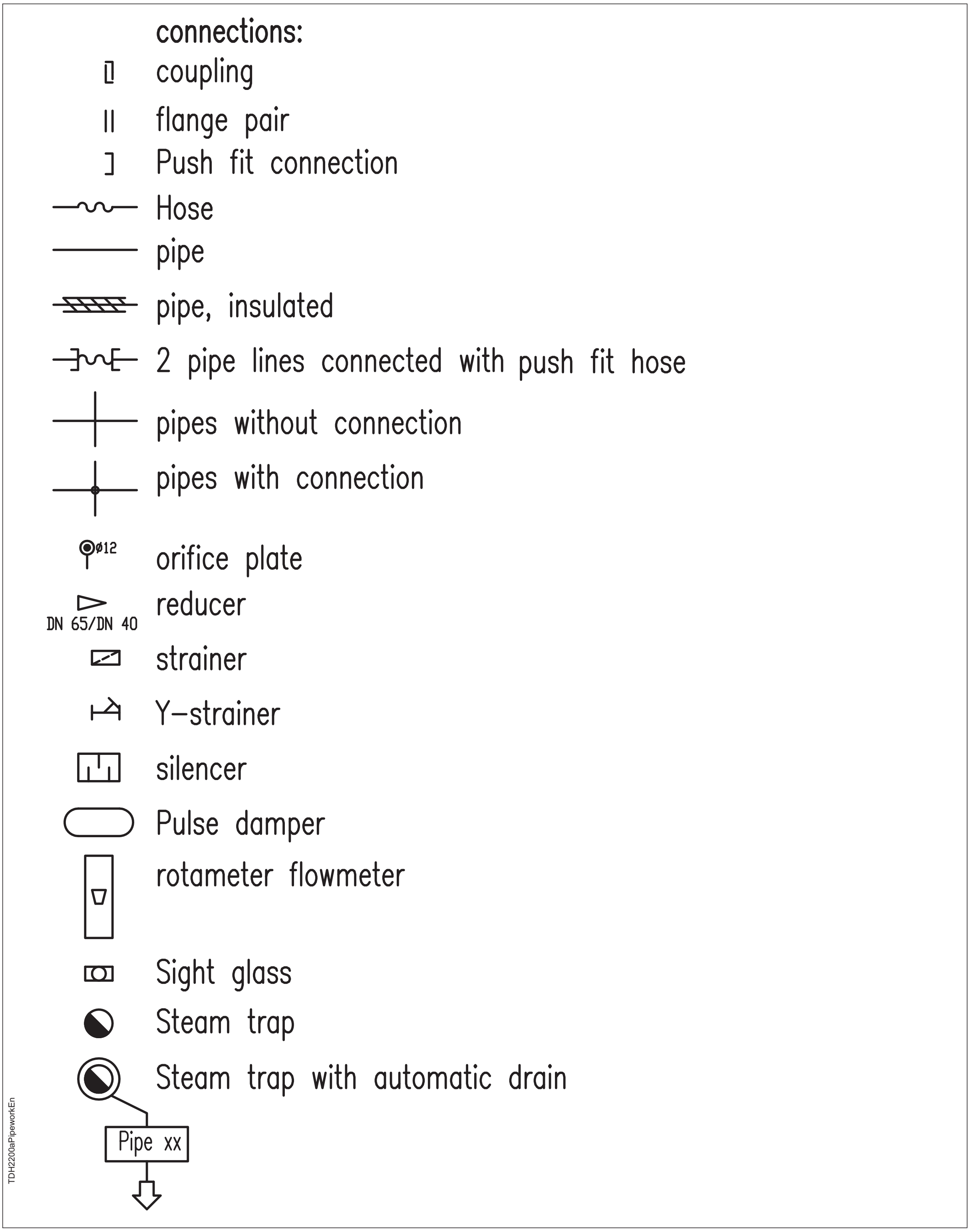
P&I Diagram

12.1.1 Explanation of P&I Symbols and electrical components

12.1.1.1 Rollers, wheels and pipe work components

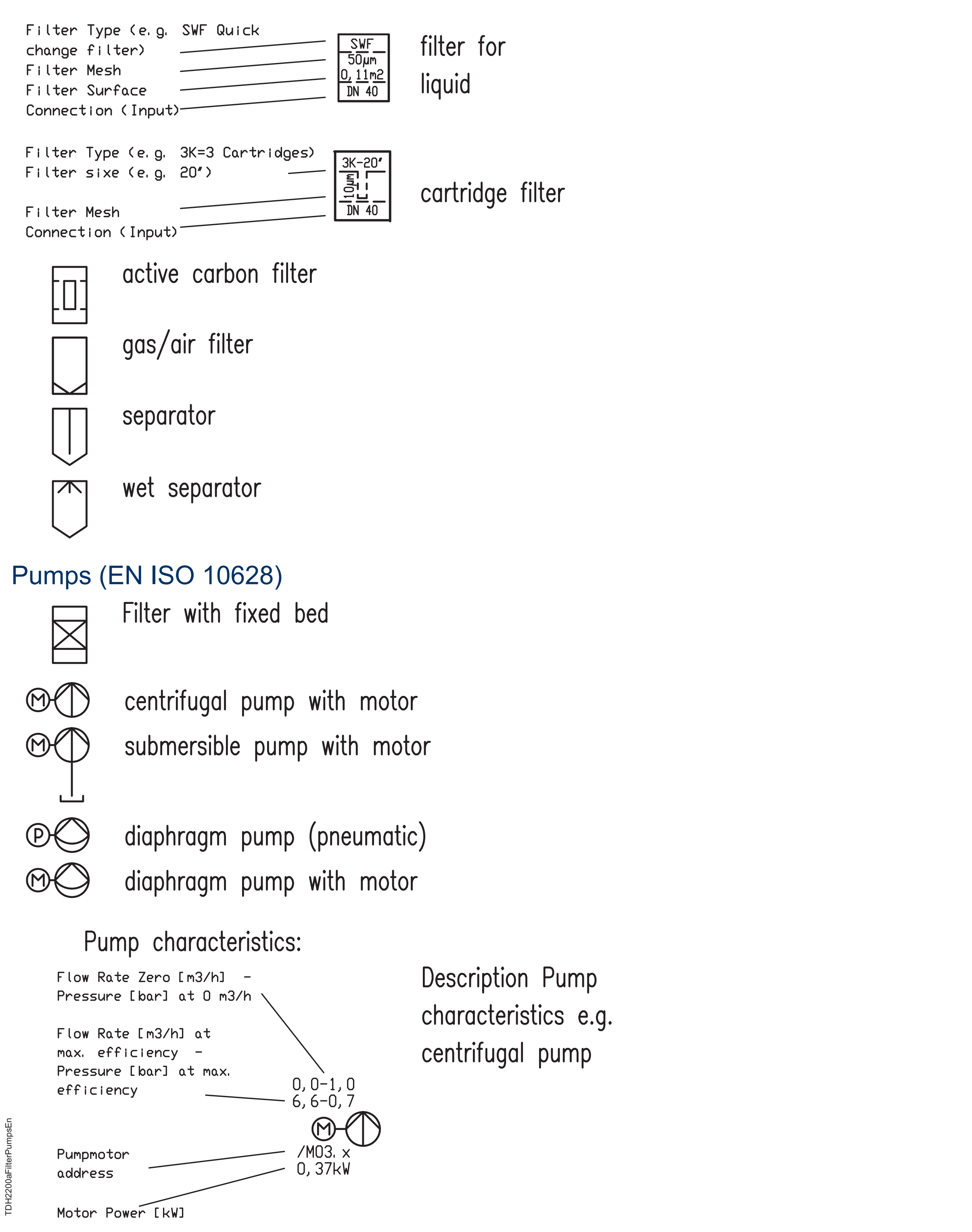


P&I Symbols of rollers and wheels



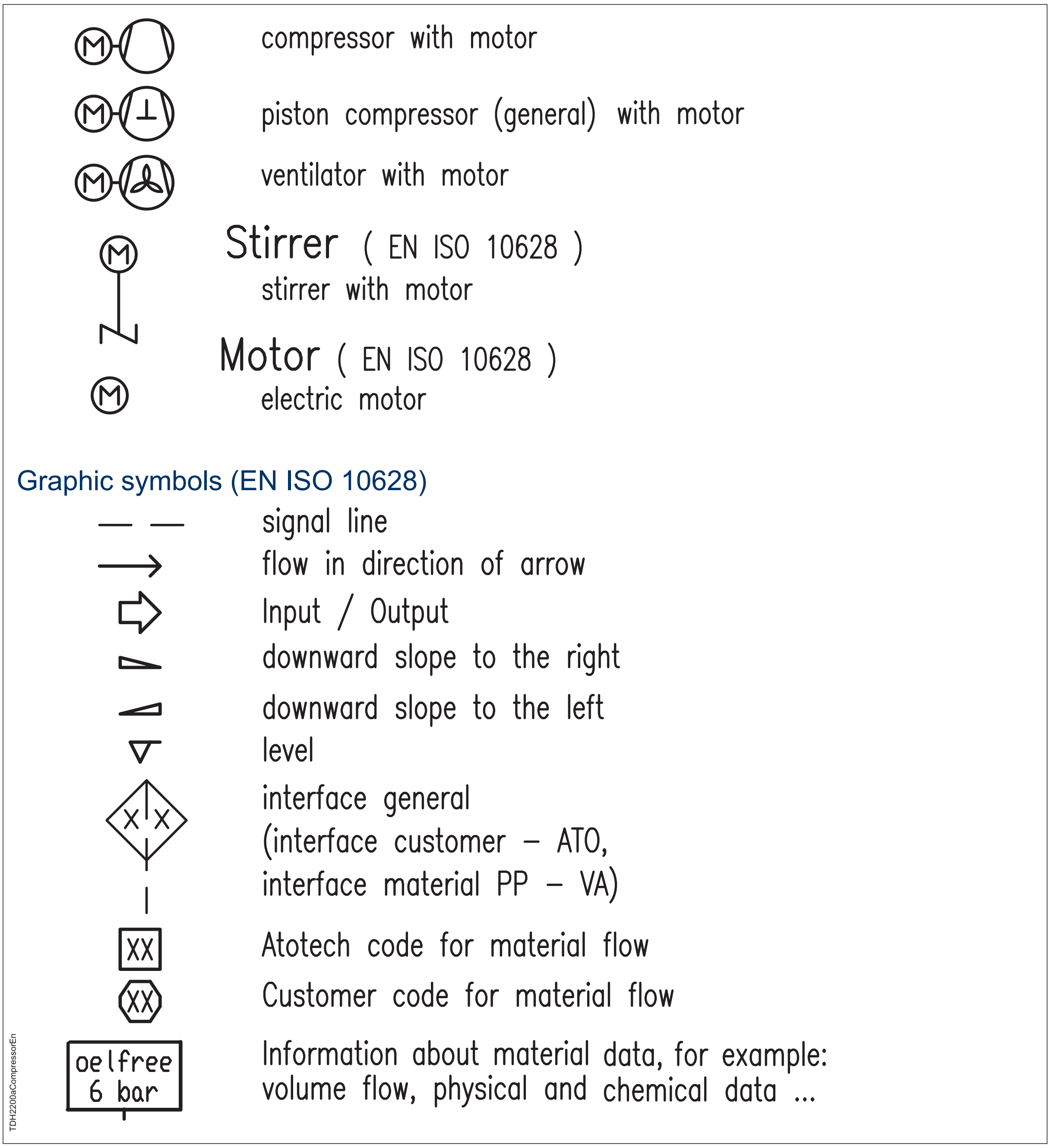
P&I Symbols of pipe work components

12.1.1.2 Filter and Pumps



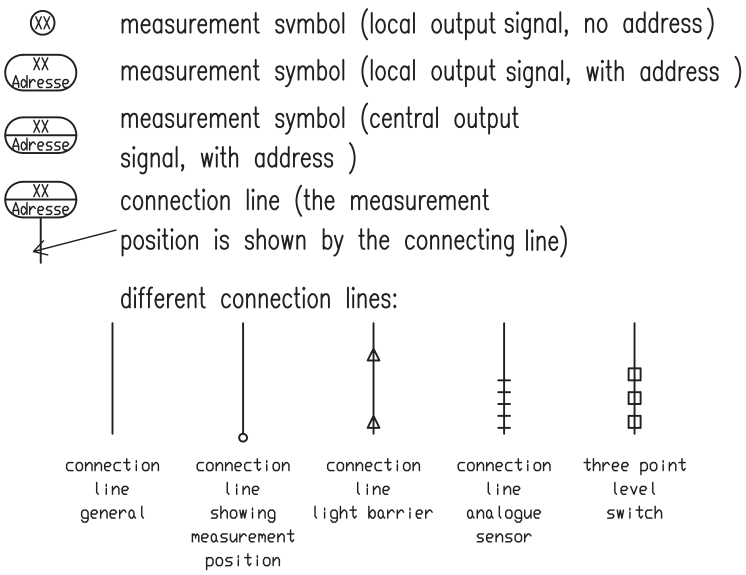
P&I Symbols of filter and pumps

12.1.1.3 Compressor and ventilator



P&I Symbols of compressor and ventilator

12.1.1.4 Instrumentation and control



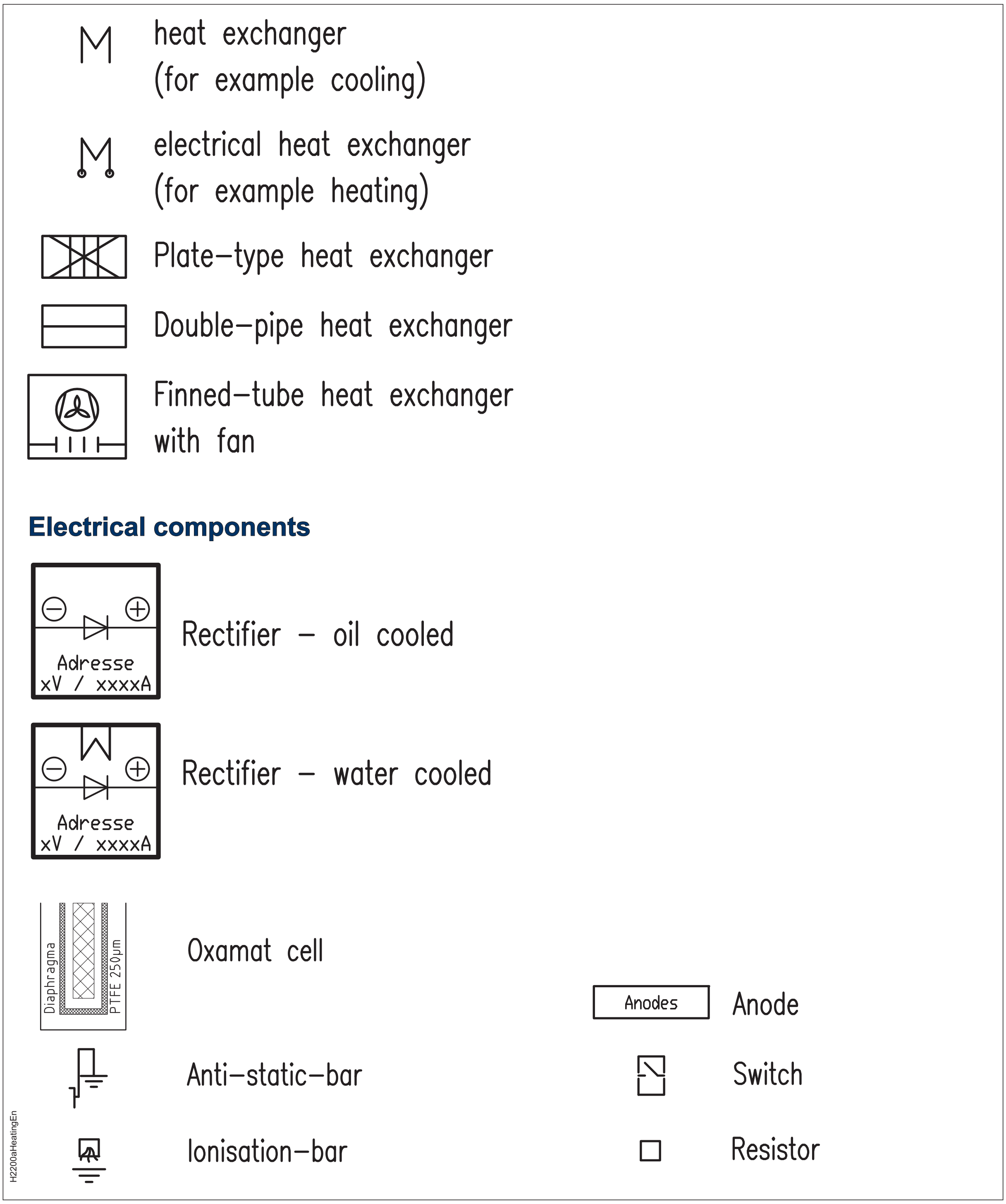
I + C code letters (DIN 19227 Part 1):	
1st letter:Extension	
	A: Alarm
	C: Control
D: Density	D: Difference
E: Electrical value	F: Sensor only
F: Flow	F: Ratio
G: Distance, length, position	
H: Manual	
	I: Indication
K: Time	
L: Level	
P: Pressure	
Q: Material property (pH, Conductivity, Concentration)	Q: Sum
	R: Registration
S: Speed, Rotation speed, Frequency	S: Switch
T: Temperature	
	Z: Limit function
	+: upper limit
	−: lower limit

PI Example: Manometer with pressure indication
(P = Pressure , I = Indication)

TDH1000aInstrumentationEn

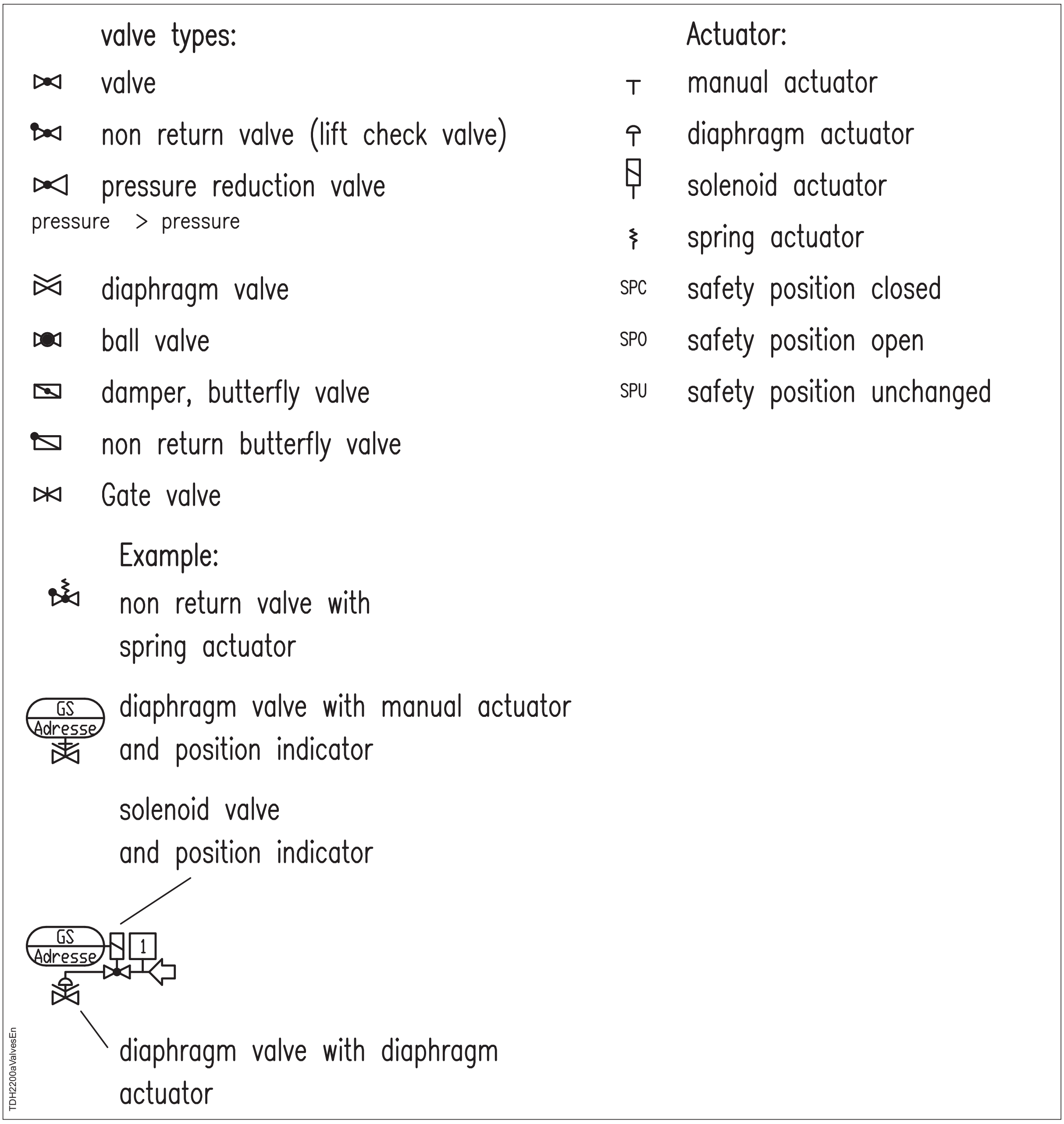
P&I Symbols of instrumentation and control

12.1.1.5 Heating and cooling



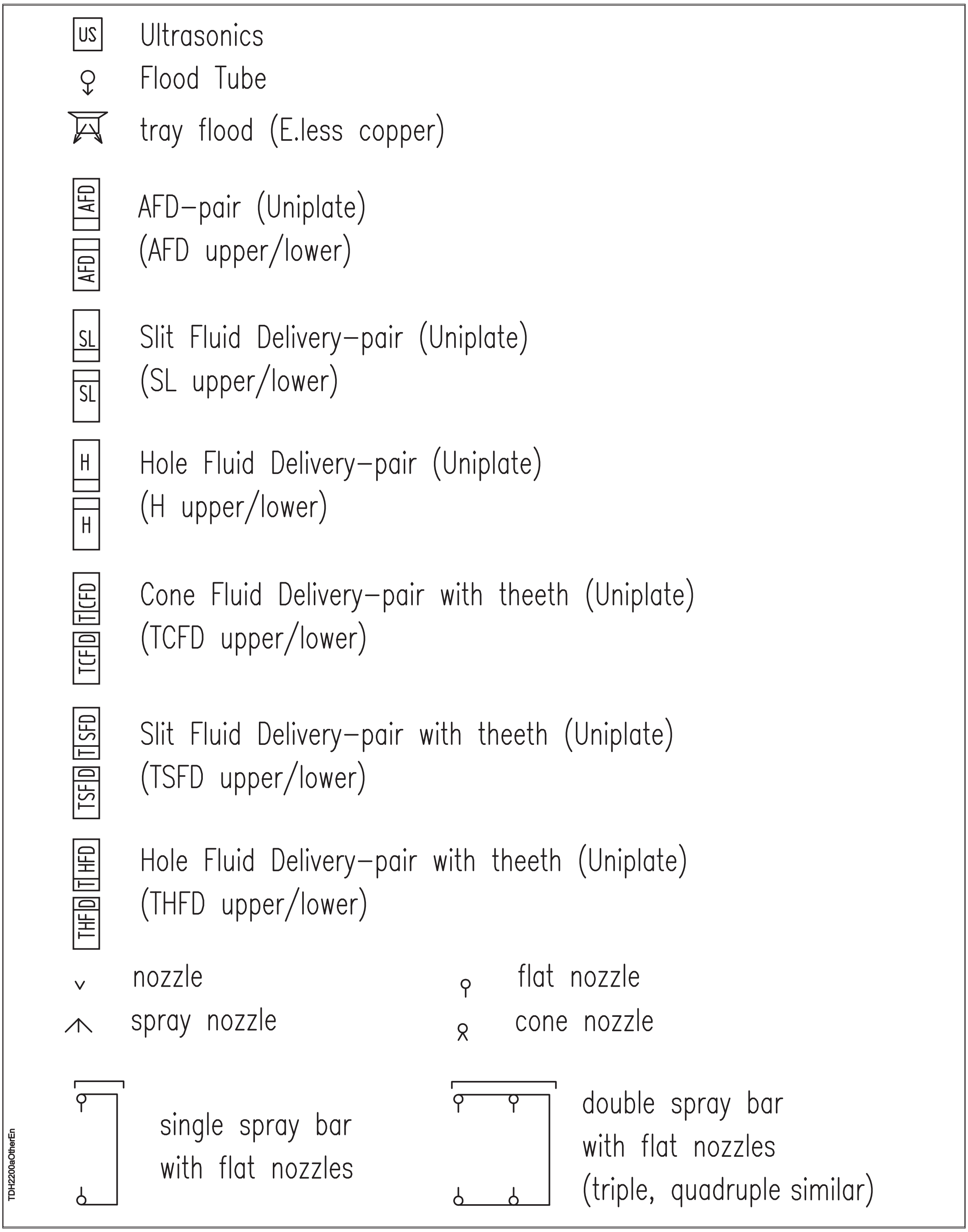
P&I Symbols of heating and cooling

12.1.1.6 Valves



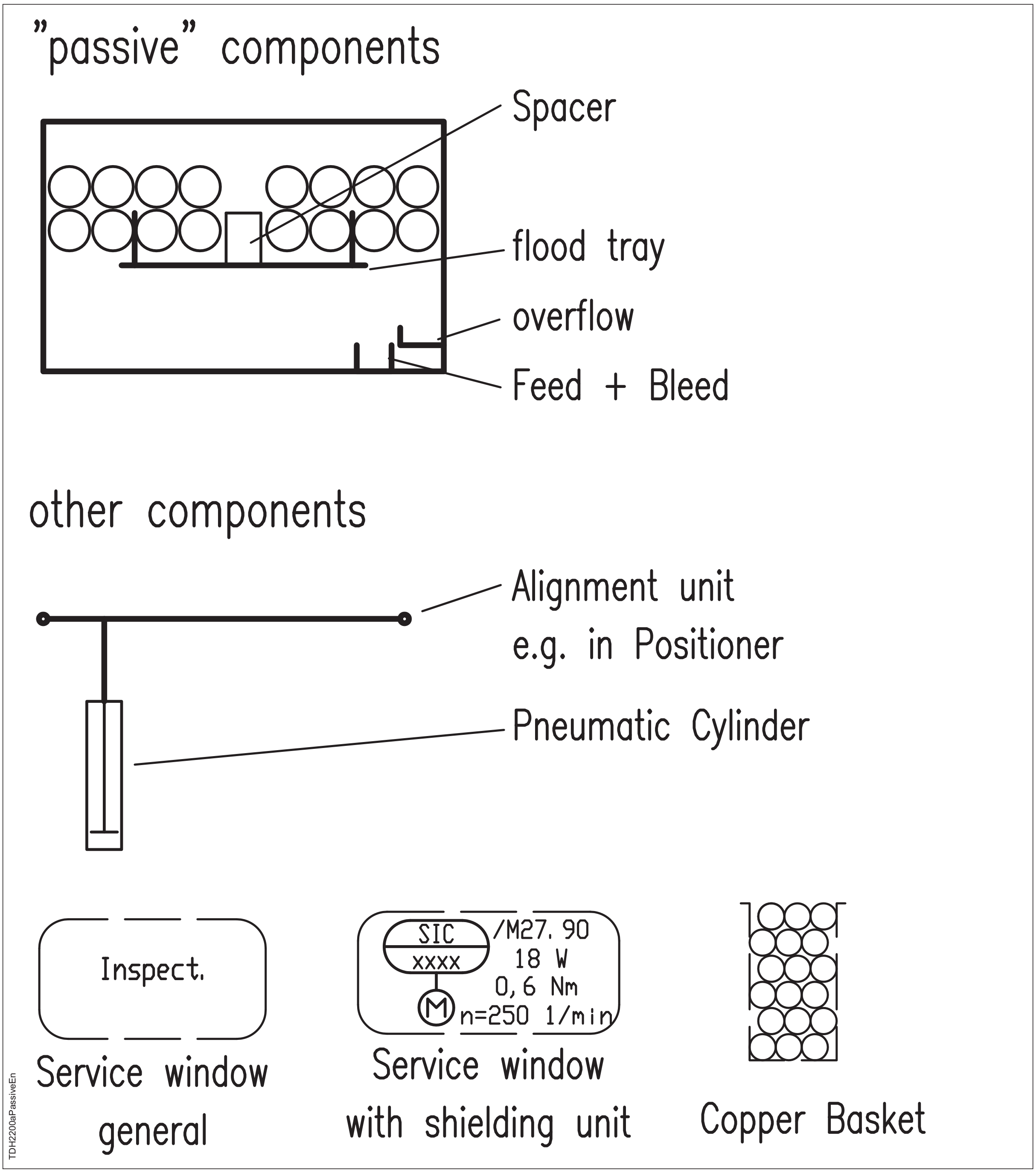
P&I Symbols of valves

12.1.1.7 Other components



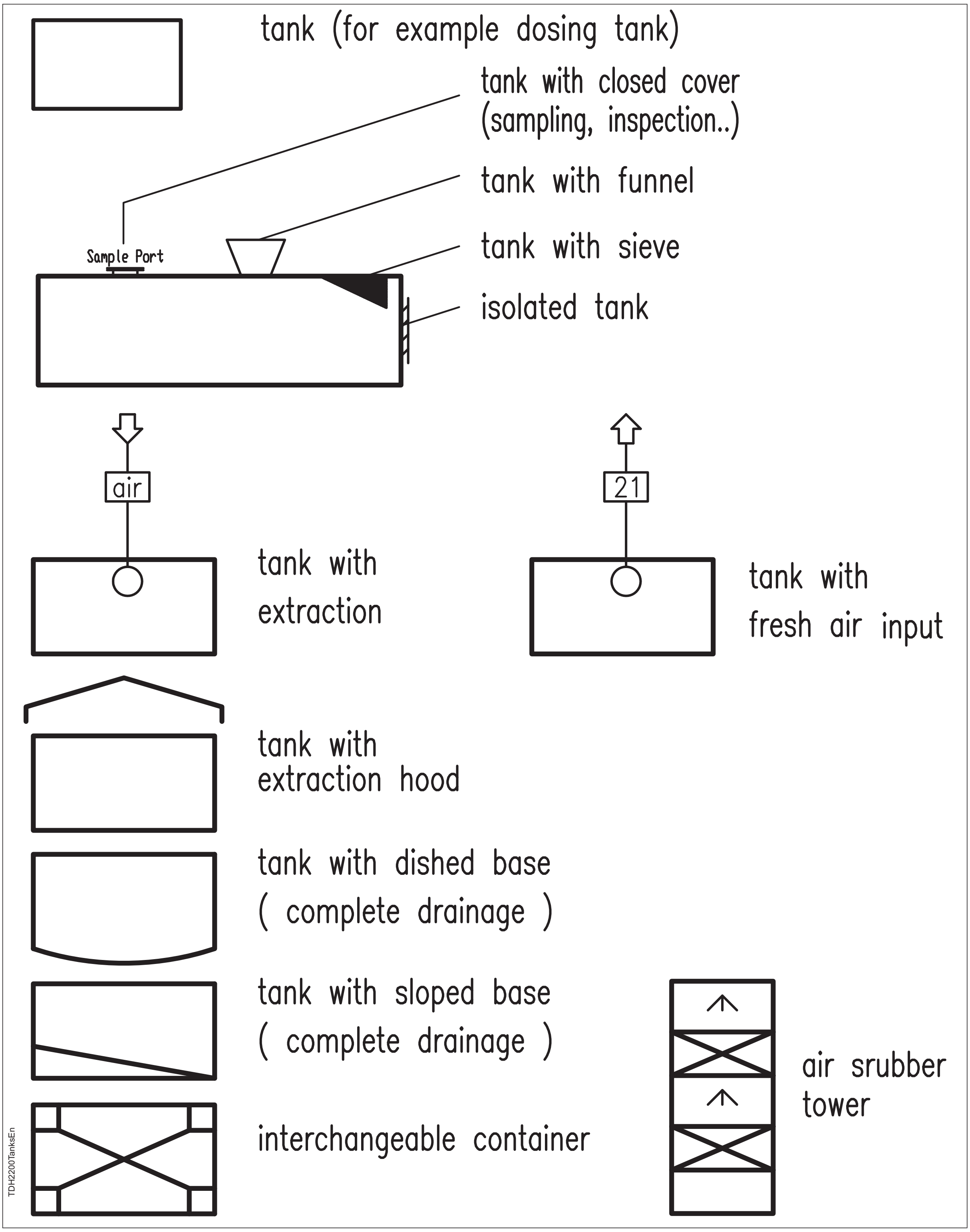
P&I Symbols of other components

12.1.1.8 Passive components



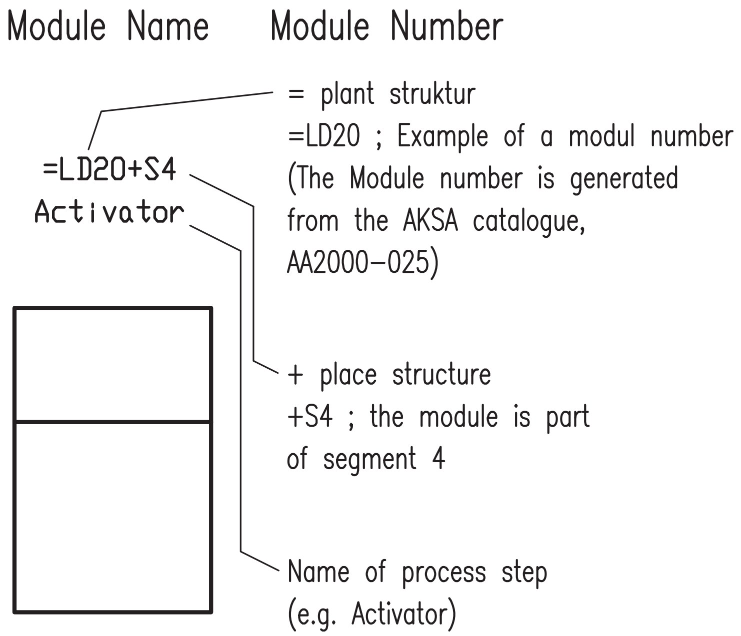
Passive components

12.1.1.9 Tanks



P&I Symbols of tanks

12.1.1.10 General abbreviations and Abbreviations for materials



Abbreviations general

a	Atotech
c	Customer
CP	Connection Point
DN	Nominal diameter
FU	Frequency converter
PN	Rated pressure
RT	Room Temperature
SWF	Quick change filter
US	Ultrasonics
SL	Slot Mask
AFD	Advanced Fluid Delivery

Abbreviations material

CFK	Carbon reinforced glass fibre
EPDM	Etylen-Propylen-Kautschuk
FPM	Fluor-Kohlenwasserstoff-Polymerisat (Viton)
GFK	Glas fibre
PE	Polyethylene
PP	Polypropylene
PPN	Polypropylene-Natural
PTFE	Polytetraflourethylen
PVDF	Polyvinylidenflourid (or Vinyliden-Polyflourid)
Ti	Titanium
TPE	Thermoplastic Polyme
VA	SS (Stainless Steel)

TDH2200aAbbreviationsEn

Abbriviations

12.1.1.11 Electrical components

The installed electrical components are designated by a specific Atotech code. For distinct identification, the designation of a specific component must be identical

- in the P&I diagram,
- the electrical wiring diagrams,
- the control software (VCS) and
- at the installed component itself (labels at the production line).

At first, two examples are made for initial explanation:

Example A:
HA05 / M13.1

HA05 /: The component is installed in the line module HA05

M is used for motors, transport, movement, etc.

13: for function (13 = related to drive)

.1: counter (first motor in this module)

Example B:
HA20 / S12.3

HA20 /: The component is installed in the line module HA20

S stands for switch (or On/Off signal)

12: for function (12 = cover switch)

.3: counter (third cover switch in this module

Module code:

HA20 or HA05 are examples of coded names for modules in ATOTECH horizontal lines. The module code serves, amongst others, as a defined reference system for computerized documentation (like parts lists, etc.).

This code classifies modules with regard to different kinds of process sequences and equipment groups.

Within a single project (= production plant) the module classification and identification by this code is self-explaining by merely having a look to the P&I diagram or Lay-out diagram of your Atotech line.

Component code:

The second part (like /M13.1 or /S12.3) of the whole code needs a bit more explanation (and some exercise) for comprehensive understanding:

Firstly, electrical components are classified by letters (grouped according to the German national standard DIN 40719, part 2). The most common designating letters are as follows:

A	Amplifiers, electronic cards for conversion of electronic signals; specifically in Atotech lines: Anodes and Pulse switches
B	Sensors which generate an analogue signal from a non-electrical input, like flow, pressure, temperature, level, force, etc.
E	Components for heat and light generation, like heating coils and lamps
M	Motors for the drive system, for pumps, for agitation, etc.
S	Switches, generation of digital signals
Y	Electrically operated mechanical devices (magnetic valves, etc.)

Function code:

In conjunction with such designating letters as above, Atotech uses (secondly) numbers for a certain function of the electrical component in the production line (e.g./M02 or /M06, different numbers representing different functions on line).

Counting numbers:

#: This sign represents the space for the counting number in case of several components of the same type in one module, if there are four counting numbers (e.g. /S14.####), this means that the coordinates of the component are given in the component designation.

Component group	Atotech Code	Equipment component and its function in the Atotech plant
Q	01:#	One master maintenance switch for all pumps in a specific module
M	02.#	Circulation/Transfer pump (Sump-, tank circulation, stripping pump, Oxamat pump, internal Redumat circulation pump, ...)
Q	02.#	Maintenance switch for above mentioned pump
M	03.#	Feed pump (Flood-Bar pump, AFD-pump, pump for spray bars, ...)
Q	03.#	Maintenance switch for above mentioned pump
M	04.#	Dosing pump, combined dosing and make-up pump [time/quantity controlled]
S	04.#	Digital flow switch for dosing flow check
B	04.#	Analogue flow switch for dosing flow check
M	05.#	Stirrer, mixer, propeller mixer, mixing drum
Q	05.#	Maintenance switch for stirrer, mixer, propeller mixer, mixing drum
M	06.#	Side Channel Blower (dryer, air injection LB, ...)
M	07.#	Cooling fan, fans in general, air extraction fan (e. g. exhaust fan of dryer, ...)
S	09.#	Filter monitoring (housing closed / open)
A	09.#	Copper probe (just in the Electroless Copper module of the LB process subline)
Y	10.#	Electromagnetic valves for the supply of water, also ‘Feed and Bleed’ valve, to be distinguished from Y45.# for the control of pneumatic cylinders
G	11.##	Ultrasonic devices (oscillators in general)
S	12.#	Detection of the cover switch position (closed/opened)
M	13.#	Drive motors for the conveyor, also clamp drive system, CGA
S	13.#	Sensor for the generation of a uniform digital signal from the running drive system

		used for speed monitoring, length and distance measurement, etc.
S	14.#	Sensor for On/Off-signals from the moving PCB for panel tracking, like light barriers or light sensors
S	15.#	Limit switch, indication of end (home) positions
E, M	16.#	Components for the heating (cooling) system
Y	16.#	Automatically controlled valve for the supply of cooling water (or of hot water)
B	16.#	Temperature sensor for closed-loop temperature control or analogue temperature measurement
S	17.#	Light sensor or light barrier for the detection of PCBs (digital signal)
S	18.#	Hardware operated safety device to prevent over-temperature
A	19.#	Rectifier
S	20.#	Level switch (digital signal for level control)
B	21.#	Level Sensor (analogue signal for level control)
M	22.#	Vibrator (only in vertical plants)
S	23.#	Monitoring the closed/open position of drain valves
M	23.#	Motor driven drain valve, actuated by an output signal
S	24.#	Level safety protection, actuated by hardware rather than software program
M	27.#	Motor for the Automatic Shielding system in some kinds of Plater modules
S	27.#	Encoder for the Automatic Shielding system in the Plater
M,Y,S	28.#	Make-Up Pump
B	31.#	Redox probe, e.g. in NP Conductor module
B	33.#	PH probe
B	34.#	Conductivity probe (water conductivity, etc.)
S	35.#	Digital pressure switch in pump circuits (e.g. minimum pressure for pump protection), pressure gauge with digital output signal, also digital monitoring of required air pressure
B	35.#	Analogue pressure sensor in compressor circuits or pump circuits
S	36.#	Digital flow switch for pump circuit, water supply check and air flow (exhaust)
B	36.#	Analogue flow sensor for pump circuit, water supply check and air flow (exhaust)
S	40.#	Emergency stop button to stop the whole line (output signals disabled)
B	40.#	Analogue tensile force measurement of the torque of the clamp drive system in the Plater
S	41.#	Digital signal detection of running clamp drive system in the Plater module
S	42.#	Safety Cover switch (Personenschutz)
Y	45.#	Valve for the control of pneumatic cylinders
S	45.#	Position indication of pneumatic cylinder (limit switch)
M	50.#	Motor actuated valve, automatically controlled by an analogue output signal
M	70.#	Pump for solution transfer to another tank or module
Y	70.#	Automatically controlled valve activated in conjunction with the solution transfer pump to direct the solution as required

#: Space for the counting number in case of several components of the same type in one module

12.2VCS-H Help

Click here to open the VCS-H Help:

VCS-H Help

12.3VCS-H Faults

Click here to open the description of the VCS-H Faults:

VCS-H Faults

13 Glossary

A		
ACFD TCFD		’Advanced Cone Flooding Device’: Flooding Device with four parallel rows of conically shaped outlet holes; There are different types (ID numbers) of ACFDs for lines with different direction of panel transport. Since 2010, these types of FDs have Teeth for higher transport reliability (ACFD →TCFD).
AFD		‘Advanced Flooding Device’: Flooding Device with two parallel rows of micro-jet nozzles; There are different types of AFDs for lines with different direction of panel transport.
Ancolyzer		Software program used in peripheral control stations placed directly at the line for automatic and detailed chemical analysis.
Air knife		→ACFD bar used as a blowing device in modules wit touch-less transport system, preventing drag-out of chemicals into the neighboring module (Rinse module) by blowing the liquids off the PCB surface.
ASFD TSFD		‘Advanced Slotted Flooding Device’: Fluid delivery bar with higher number of slots compared to →SFD; There are different types (ID numbers) of ASFDs / TSFDs for lines with different direction of panel transport. Since 2010 these types of FDs have Teeth for higher transport reliability (ASFD →TSFD).
Automatic level control		An analog level sensor and actuators (i.e. water valve, controlled by →PLC) automatically keep the fluid level constant as set in →VCS.
B		
Batch		Pack of equal type of panels processed in the production line with same →Recipe
Bevel gear		A gear wheel (with cone-shaped teethes) for transmission of driving force to conveyor units (contrary to spur gear)
BMV		‘Blind Micro Via’: Micro hole designed as blind hole in PCB (contrary to through hole)
BondFilm		→STT– Process: Surface treatment technology process bringing adhesive materials onto the panel surface (for production of Multilayer boards)
BTT		Business Technology Team: →BTT-PTH, →BTT-PP, →BTT-SF, →BTT-STT; Defined fields of application at ATOTECH headquarter in Berlin, responsible for developing, designing, starting-up and servicing ATOTECH lines and process chemicals.
BTT-PP		Business Technology Team for Panel & Pattern Plating processes
BTT-PTH		Business Technology Team for Plating Through Hole processes
BTT-SF		Business Technology Team for Selective Finishing processes
BTT-STT		Business Technology Team for Surface Treatment Technology processes
Bulkhead		Mechanical sheet (dam) of at the end of flood trays to prevent liquid loss keeping the level in the flood tray high above the top side of the processed PCBs.
By-pass-Filtration		Pump circuit with cartridge filters serving only for bath circulation and fine filtration of bath liquids; see →Cartridge filter.

C		
Calmed modules		Modules with special design features in →UTS-xs transport system for very thin →PCBs and foils with by means of special equipment design: no splashing, no overflow, control of flow rate and fluid pressure in active modules and in Rinse modules.
Cartridge filter		Filter with a number of cartridges for fine filtration (contrary to filters with filter fleece material held by a basket in the filter housing)
CDA		Current Density Adjustment: Factor used in Platers to optimize the surface distribution of copper deposition
CFD and TCFD		'Cone Fluid Delivery Device': Flooding Device with conically shaped outlet holes, aligned in three or four parallel rows. Since 2010, these types of FDs have Teeth for higher transport reliability (CFD →TCFD).
CGA		'Center Gap Adjustment': Modul before Plater for linear adjustment of →PCBs to ensure equal gaps (of 10 mm) between panels inside the Plater module.
D		
Debug		Clearing up faults in software applications
Dummy panels		Panels at beginning and end of a job not belonging to the processed panels for bath activation and start-up of rectifier in the electroplating processes
E		
E´less		Abbreviation for Electroless
EPDM		Ethylene-Propylene-Terpolymere, Ethylen-Propylen-Elastomer
ETK (etk.exe)		Abbreviation for 'Electronic Parts Catalog': A double click on the 'etk.exe' file will open the equipment parts catalog (used since 2007)
F		
FDD or _FD		'Fluid Delivery Device': Fluid delivery element in general, term used for all types like →AFD, →ASFD, →ACFD, →HFD, →SFD, →CFD, →Floodbar, →TSFD, →TCFD, →THFD, →SFD,
Febotec		Commercial brand name, here used for rubber coat on rollers in the conveyor system in handling modules
Feed & Bleed		Automatically controlled refreshment of the bath, lengthening bath lifetime. A certain volume amount of bath is drained (=Bleed) and the drained amount is replaced by fresh dosing chemicals (= Feed).
Floodbar		Fluid delivery element with high flow rate and rather low panel treatment pressure, which was used in transport systems → T1 to T4 (not any mor used in current lines with UTS transport system)
Flood tray		Tray in modules below the conveyor system holding the chemical liquid for panel processing while the fluid delivery pumps are running
Fluid delivery pump		Pump delivering fluids to the panel process area, i.e. to the flood tray (contrary to circulation pumps which serve for bath agitation inside of the sump)
Frequency inverter		Unit for controlling drive speed or pump speed: the mains frequency (50Hz/60Hz) is inverted to a range from 20 to 50Hz/60Hz for speed control

		of the drive system or for pump flow rate control.
H		
Heat-up pump		Circulation pump for bath agitation in the module sump: this pump must be started prior of switching on the automatic temperature control (heat-up/cooling)
HEPA filter		=High Efficiency Particulate Arresting: Air filter catching very small dust particles
HFD / THFD		'Hole Fluid Delivery Device': Fluid delivery bars with two parallel rows of holes preliminarily used in the Sweller module (P-Process) and E'less copper module (LB-Process). Since 2010, these types of FDs have Teeth for higher transport reliability (HFD →THFD).
High Aspect Ratio Board		Boards with high thickness and small hole diameters (AR = Aspect Ratio = Thickness : Diameter for example 40 : 1)
J		
Job report		List generated by →VCS (see menu bar), containing information about a previous job. The data is stored in the database of the control PC; export is possible.
L		
LB Process		'Low Build' Process for making drill hole walls conductive by chemical Cu-deposition (=electro-less copper process) →PTH
M		
Magnetically driven pump		Centrifugal pump used for fluid delivery, fluid transfer and fluid circulation; the rotation of the motor is coupled with the impeller of the pump by magnetic force; Different make compared to →submerged pumps
MBI		'Multiple Bearing Insert' in the → Side rail for holding conveyor units with rollers and FDDs
MBV		Micro Blind Vias. → BMV
MSDS		Material Safety Data Sheet: If chemistry is shipped, stored and used safety instructions and handling instructions must be observed.
MTBF		'Mean Time Between Failure': statistical value for the frequency of serious faults during production.
O		
Oxamat		Peripheral unit for regeneration of Permanganate bath used in production lines (→P Process)
P		
P&I Schematic		Piping and Instrumentation schematic (flow chart) containing all functional units, component codes, tables of used materials and process chemistry (German abreviation: R&I)

PCB		Printed Circuit Board (processed panel in the production line)
PEEK		Polyetheretherketone (material used for gears in the Sweller module)
P Process		'Permanganate' Process for drill hole cleaning in →PCBs, prior of the PTH-Process
Plating		Copper deposition increasing the copper thickness in drill holes and on surfaces of PCBs using an electrolytic process (with rectifiers)
PP		Polypropylene, or Panel & Pattern Plating on →PCBs
PPN		Polypropylene natural (Pure PP without other inclusions); material used in the Electroless Copper Module (→LB-Process)
PLC		Programmable Logic Control
Prepreg		Pre-impregnated sheet material (glass fibre immersed with resin)
PTFE		Polytetrafluorethylene (Teflon): material used in high temperature modules etc.
PTH		'Plating Through Hole': LB Process, CP process, NP (processes for making a conductive surface inside bore holes after drilling, cleaning and etching)
PVDF		Polyvinylidenfluoride: material of numerous parts, such as gears, etc.
Q		
Quick exchange filter		Filter which can be opened relatively quickly by a lever (no screws to be opened and tightened)
R		
Recipe		Parameter list for a job, such as speed, frequency and many other set-points for equipment control; Thin foils are processed by different parameters than thick boards, to give an example. The adequate recipe for parts (foils, PCBs, boards, panels) is set up by engineers, operators just select a complete recipe (by instruction)
Redumat		A peripheral unit for keeping the copper concentration in a Plater solution constant. Process engineers can set the current set-point accordingly.
Resin		Basic material (between fiber glass texture) used for circuit board production
P&I Schematic		Piping and Instrumentation diagram containing all equipment functional units and component codes of a production line; If a new project is planned, the P&I is the basis of the main technical features.
S		
SBU		Sequential Build Up
SF		'Selective Finishing': For a tin layer on copper lines, the →Stannatech process is applied
SFD / TSFD		Fluid Delivery Devices with Slots, aligned in two parallel rows. Since 2010, these types of FDs have Teeth for higher transport reliability (SFD →TSFD). Regarding transport direction, SFD / TSFD are marked for correct installation (slots have a chamfered edge at one side).
Shunt		Low resistance resistor for current measurement (used in rectifiers, etc.)

Side rail		The conveyor system his fixed between side rails for insertion of 'Multiple Bearing Inserts' →MBIs (being part of conveyor units)
Stannatech		Product name for ATOTECH's immersion tin process, belonging to the BTT Selective Finishing
SS		Stainless Steel (in German language VA): Metallic parts are made of stainless steel, Titanium or Hastelloy; For the chemistry in a module, the respective metal is specified. Parts which are made of different metal must be stored in different boxes and mustn't be mixed up.
STT		Surface Treatment Technology: For a bonding layer on foils, the Bondfilm process is applied (just to mention one example)
Submerged pump		Pump being immersed in fluid, the motor is distinctly above the fluid; Different make compared to →magnetically coupled pumps
Sump		Space in the module where the fluid volume is contained if the fluid delivery pumps are off; For heat-up, the fluid is agitated in the sump by switching on the circulation pump
T		
T1 (…T4)		Formerly used transport system for panels like T1 (thick →PCBs), T3 (BondFilm), or T4 (thin →PCBs)
TCFD, THFD, TSFD		Different types of **F**looding **D**evices with **T**eethes (overlapping with wheels in the respective conveyor unit) designed for improved reliability of panel transport
TDS		'Technical Data-Sheets' provide chemical specifications and instructions with regard to specific modules of the production line
Ti		Titanium; Metallic parts are made of stainless steel SS; Titanium or Hastelloy; For a chemistry in a module, the respective metal is specified. Parts which are made of different metal must be stored in different boxes and mustn't be mixed up
TPE		Thermoplastic Elastomeres
Transport direction		Transport direction of panels seen from operating side of the line; R→L means from Right to Left, L→R from Left to Right
U		
UTS		Universal-Transport-Systems: →UTS-s, →UTS-xs, →UTS-XL for PCBs and foils of different thickness ranges
UTS-xs		Universal-Transport-System for ultra-thin foils
UTS-s		Universal-Transport-System for thin boards (0.1 mm to 2.4 mm)
UTS-XL		Universal-Transport-System for thick boards
V		
VCS		The VCS (Visualization and Control System) controls the production process and monitors the equipment
VDE		(Verband Deutscher Elektrotechniker) German association of electrical engineering (similar to e.g. UL in USA), publishing safety instructions

W		
Working level		Fluid level in →Flood tray (to be distinguished from fluid level in the →Sump)

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