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1. General

The following remarks refer to complete systems containing quick-closing valves with electric actuation as well as corresponding control cabinets (short designation AW/FSV-E System). The main perspective of this operating instruction is the application on board of sea-going vessels.

Rules and approvals:

- DNV GL (complete system)
- RINA Registro Italiano Navale (complete system)
- RMRS Russian Maritime Register of Shipping (valves in the context of this system)
- LRS Lloyd's Register of Shipping (valves in the context of this system)

Please refer to the references to the respectively relevant rules and conditions in the corresponding type approval certificates.

1.1. Marks

Quick-closing valves are marked with the following information in delivery status:

- Manufacturer (plate at handwheel)
- Type no. (label)
- Body material (cast)
- Pressure class (cast)
- Nominal bore (cast)
- Batch no. and foundry sign (cast)
- Direction of flow (cast)

Operating Instruction

Electric Quick-Closing Valve Systems

1.2. Tightness of Quick-Closing Valves

For design reasons, quick-closing valves with metal trim have a slight leakage at the seat. A leakage rate „D“ according to EN 12266-1:2003 (P12) is guaranteed by means of a 100% pressure test of the produced valves. For the body, a full pressure tightness and burst strength is guaranteed in accordance with EN 12266-1:2003 (P10/P11) depending on the respective pressure class.

Soft-sealed quick-closing valves have got a lower leakage rate, due to conceptual reasons. ARMATUREN-WOLFF fits soft-sealed quick-closing valves with different elastomer materials, depending on customer requirements and the operating conditions of the plant.

Attention: Soft-sealed quick-closing valves may not be used at storage and service tanks with a capacity of more than 500 liters!

All ARMATUREN-WOLFF products are tested with regards to correct function as well as possible damage and leakages. Before installation, the valves should undergo an additional sight inspection procedure, and before system start-up, the tightness of the plants and systems is to be verified.

1.3. Medium

Before installation and start-up of the plant it is to be verified that valve materials are suitable for the medium. In case of doubt the manufacturer will be glad to approve the adequacy of the chosen materials.

Unsuitable combinations of medium and valve materials may lead to leakages at the valve seat. Dangerous kinds of medium may not get into the environment.

For assembly, we use lubricants on mineral oil basis. Please note that these can get in contact with the medium, if no special measures are undertaken against this effect. Lubricants and auxiliary liquids may theoretically get into the medium and cause pollution or provoke unintended chemical reactions.

1.4. Ambient and Medium Temperature

Quick-closing valves from ARMATUREN-WOLFF are not sensitive against changing ambient temperatures. In case the ambient temperature should drop far below 0°C or rise clearly above 55°C (valves; rated temperature at valve actuator > 70°C) or 45°C (control cabinet), suitable measures should be undertaken to cool the electrical components. If appropriate, electrical components should be isolated against heat impact from outside as well as from the valve body.

The medium temperature can be up to 140°C, if it is higher than 70°C, the actuator has to be isolated from valve body heat radiation!

Attention: Valves which are intended for use with different media at different operating temperatures (in particular, HFO and MGO/MDO, e.g.), special conditions apply and must be taken into respect for a specific layout of the stem sealing arrangement!

Please contact ARMATUREN-WOLFF in such cases for possible technical advice.

Due to the process controlled charge and discharge cycle, electrical control cabinet are sensitive against frequent and high changes of the ambient temperature. If the ambient temperature changes often by more than 10K within short times, so that the components of the control cabinet cannot adapt evenly to the new temperature level, an option for the active modification of the charge current should be taken into consideration. Otherwise, the accumulators risk to gas out. If this option should be required, it has to be mentioned with the order.

1.5. Vibrations

Quick-closing valves and control cabinets are insensitive against weak shocks and vibrations below 0,7g. In case it should not be possible to limit the local vibrations under below this value, quick-closing valves should be isolated from the pipeline. For this purpose, ARMATUREN-WOLFF offers special vibration dampers.

1.6. Pipe Tensions

Pipelines and pipeline systems have to be installed in such way that no tensions from expansion and temperature may have impact on the valve. This can theoretically even lead to breaks in the valve, causing danger from medium spills. ARMATUREN-WOLFF offers suitable expansion joints for this purpose.

1.7. Protection during Storage and Transport

All protection devices for transport and storage have to be removed before installation. If the equipment is not installed directly after delivery, the following measures should be taken care for:

- Storage in a dry place, protected from environmental impact
- Optimum storage temperature is 5°C to 40°C
- Protection against dust and dirt impact
- The valves should be protected against strong heat and cold impact.

The contact push between the two batteries must not be closed (pushed in) before the actual system start-up!

2. Technical Data

2.1. Valves

Operation mode:	Closed-circuit principle, 100% duty ratio
Power consumption:	7,5 Watts/valve (single solenoid) 12,0 Watts/valve (double solenoid)
Voltage supply:	24 V DC
Ambient temperature:	0 - 55°C
Medium temperature:	up to 140°C, if > 70°C, the actuator has to be isolated from valve body heat radiation!
Protection class:	IP 55 { (single solenoid) (double solenoid) acc. to DIN EN 60529 (higher protection classes on special request)

2.2. Control Cabinet

Power consumption:	max. ≈ 270 W (depending on specific conditions)
Voltage supply:	115 - 230 V AC, 47 - 63 Hz, additionally parallel 24 V DC (external power supply)
Ambient temperature:	0 - 45°C Optimum range (for battery lifetime): 0 - 25°C
Protection class:	IP 22 acc. to DIN EN 60529 (higher protection classes on special request, however not higher than IP 44)

Operating Instruction Electric Quick-Closing Valve Systems

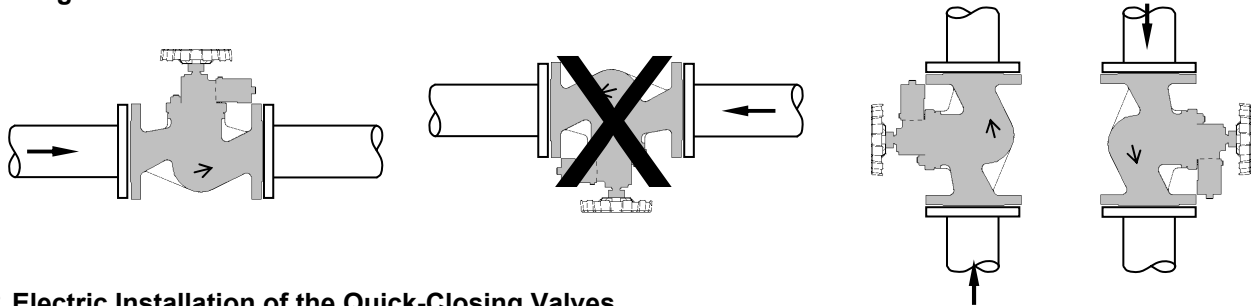
3. Installation

3.1. Instructions for the Installation of Valves into the Pipeline

Lever, switches, actuator, etc. may never be used in order to lift the valve. Quick-closing valves should be protected against falling down, after removal of the packing material.

During the installation it has to be made sure that trim and sealing surfaces are not damaged.

Quick-closing valves must always be installed in such way that the medium inlet is above the cone (direction of flow = closing direction). **In horizontal pipelines, the valve may not be installed with a downward-showing bonnet!**

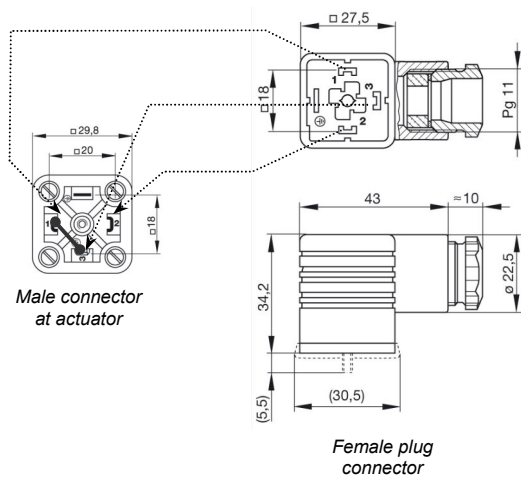


3.2. Electric Installation of the Quick-Closing Valves

The valve solenoids are connected by means of rectangular angle plug connectors. In standard execution, the actuators are fitted with cable glands Pg11 (for cable diameters 6 - 9 mm) – different plugs available on request.

Every solenoid is connected with a three wire cable. Two of these leads are used for the supply of the solenoid, whereas the third is used to connect the supervision conductor. Depending on the specific installation situation, suitable measures have to be defined in order to minimize the risk of damaging the plug or the actuator.

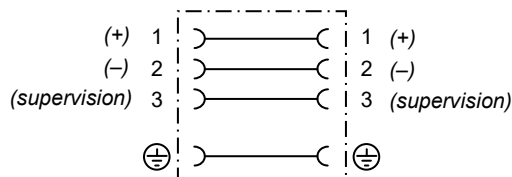
Connection scheme (general):



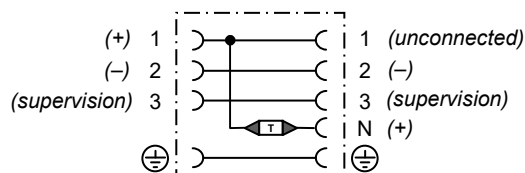
**Contacts
of valve connector**

- 1 (+)
- 2 (-)
- 3 (feedback conductor)

Terminal pattern (*plug connector without thermal link*):



Terminal pattern (*plug connector with thermal link*):



Operating Instruction Electric Quick-Closing Valve Systems

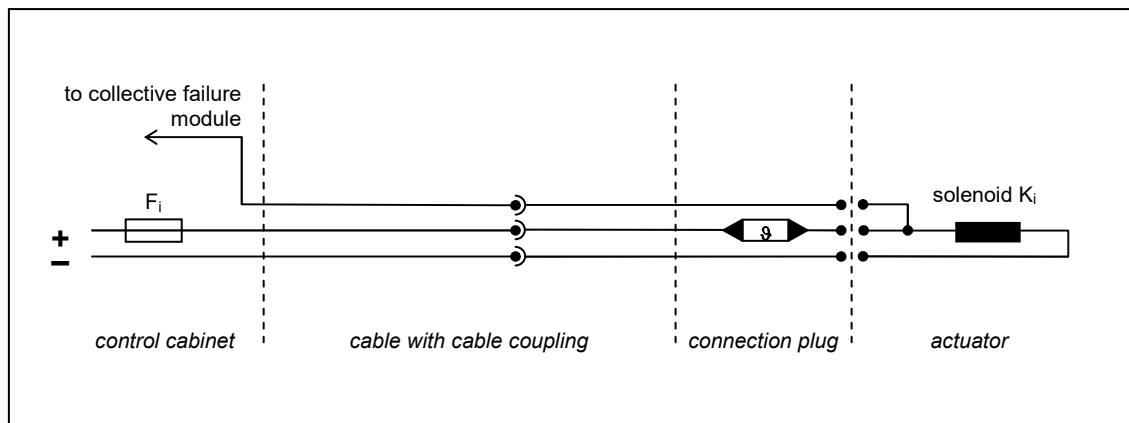
Application in accordance to Lloyd's Register:

In order to comply with the relevant Lloyd's Register rules and regulations the following additional provisions have to be taken into respect:

- Quick-closing valves generally have to be equipped with a thermal link in order to make sure that under impact of fire the valve will take its safest position, i.e. is guaranteed to close.
- The connection cables have to be equipped with a cable coupling, which is placed in a safe distance to the valve. In case of an extreme impact of heat, and subsequent closure of the valve, the actuator can be replaced very easily, then, in order to reestablish full functionality and unrestricted ship operation.
- For this purpose, a sufficient number of replacement actuators with fitted cable and coupling half have to be kept on stock on board.

Suitable cable couplings are available upon request at ARMATUREN-WOLFF, whereas a specific type is not mandatory.

Under these provisions, the connection diagram of an electric quick-closing valve is as follows:



Requirements for control cable:

Cores:	min. $3 \times 1,0 \text{ mm}^2$
Diameter:	according to applied plug connector, see above
Approval:	type approved ship cable for category 2 (unshielded)
Temperature resistance:	permanently min. 65°C
Conductor material, max. length:	The regulations of the classification society with regards to the maximum allowable voltage drop have to be observed.

In case of doubt, ARMATUREN-WOLFF is readily prepared to verify the suitability of a specific cable. If requested, we are also able to supply suitable control cables along with the main equipment and to fit these with plug connectors as well labels.

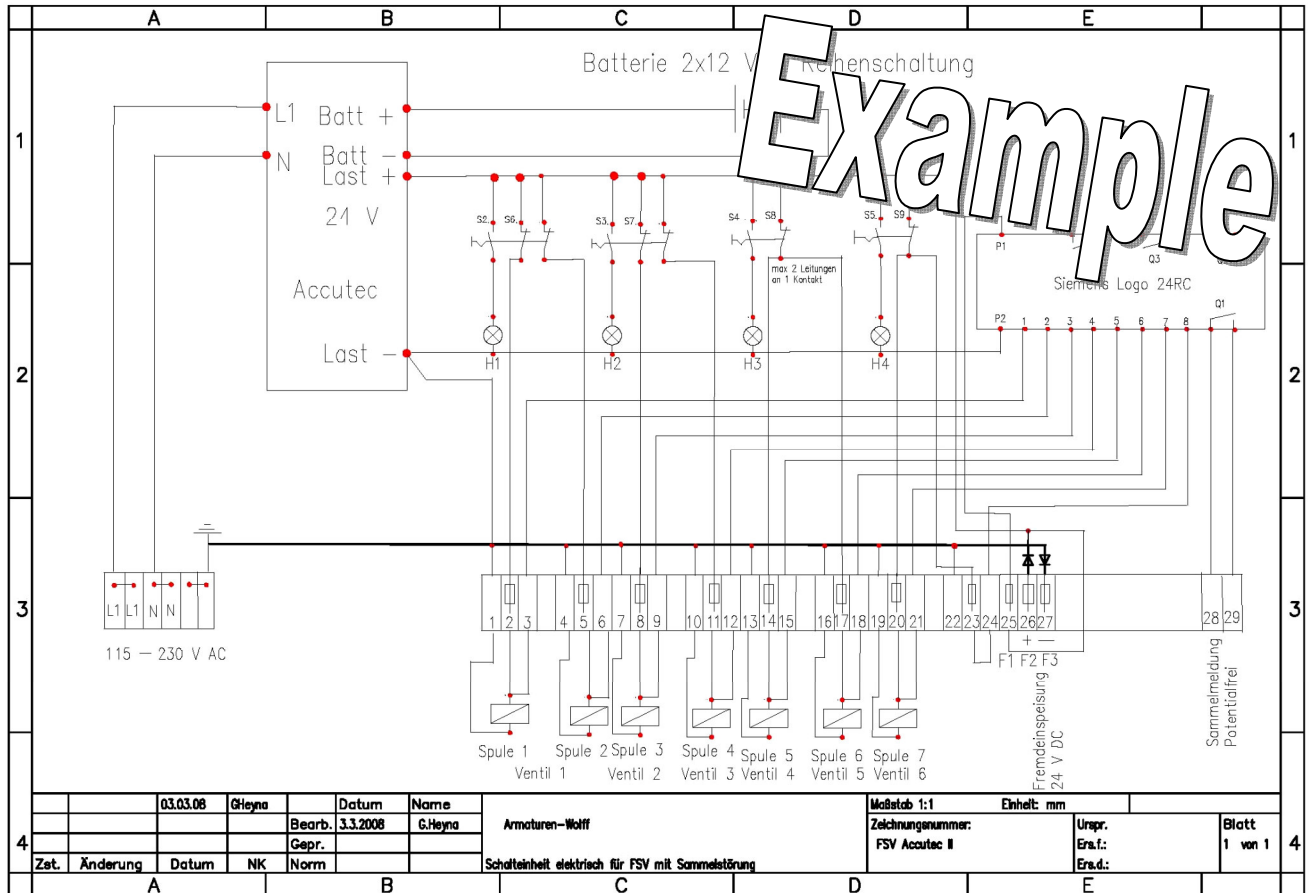
Where valves with double solenoids are installed, suitable measures shall be undertaken to minimize the risk of a damage to both control cables at the same time (examples: local separation, additional mechanic protection, separate cable ways). Depending on the specific situation, if suitable, the angle connectors should be fitted with an additional protection, in order to minimize the risk of damage or separation from the actuator. **It must be observed in general that water impact from outside has to be avoided. In particular the kinds of impact which do not correspond to the protection class under section 2.1 (e.g. strong water jet) have to be prevented!**

Before switching on the power supply, correct cable connection shall imperatively be double-checked.

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3.3. Installation of the Control Cabinet

Attention: The following circuit diagram merely serves as example, since in a specific case the number of release switches, the number and grouping of valves, the type of battery-buffered direct current supply unit as well as the number of ports for the collective fault alarm module can differ. Consequently, the numbers of the clamps for the external power supply 24V as well as the collective fault alarm may be different.



Voltage Supply

In general, both the main power supply of 115 – 230 V AC (clamps no. L1/N/⊕) **and** the direct (parallel) external power supply of 24 V DC (in the depicted example, clamps no. 26/27) have to be connected! The electrical connections may only be made in voltage-free state, the mains switch must be turned off and the contact bridge between the two batteries has to remain interrupted (as delivered)!

Supervision Wires

The supervision of the system is generally realized with potential free contacts, which work either as normally closed (NC) or as normally opened (NO) contacts.

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The following contacts imperatively have to be connected and lead to a permanently staffed place:

Supervision	Contacts	Function
Main power supply available	AkkuTEC module (I/O no. 6/7)	NC (closed, opens in case of failure)
Battery OK	AkkuTEC module (I/O no. 8/9)	NC (closed, opens in case of failure)
Power supply of all valve solenoids OK	Collective fault alarm (clamps in the example circuit diagram no. 28/29)	NC (closed, opens in case of failure)

For the purpose of an easier handling, these contacts are connected to the terminal block as well – clamp numbers according to circuit diagram in the specific case.

These supervisions also have to be connected to the alarm system inside the engine room in such way, that a failure is indicated both optically and acoustically as a „general machinery alarm“ in the engine room control room as well as at the light calling columns in the engine room.

In addition to this, the following supervision options are possible:

Supervision	Contacts	Function
Main power supply available	AkkuTEC module (USB-Port)	DCD active
Battery OK	AkkuTEC module (USB-Port)	CTS active
Main power supply interrupted	AkkuTEC module (I/O no. 5/7)	NO (open, closes in case of failure)
Power supply of the valve solenoids	Collective fault alarm module	NC (closed, opens in case of failure) or NO (open, closes in case of failure)
	(This component is a programmable logic module and therefore programmable in a flexible way with regards to its reaction to different single kinds of failure – please refer to the separate operating instruction, available on request)	

Remarks about Grouping of Quick-Closing Valves

The quick-closing valves are generally arranged in groups by ARMATUREN-WOLFF through electrical connections inside the control cabinet. Changing of this arrangement requires the approval from ARMATUREN-WOLFF. It has to be taken into respect that each switch can have a maximum of three contacts, which can each connect to a maximum of two solenoids (therefore max. 6 solenoids per release switch).

In the example circuit diagram above, the switches S6 and S7 control each two separate, electrically independent contacts. At the switches S8 and S9 the connection of two wires to one contact is demonstrated.

To be observed:

Valves installed at fuel oil day tanks for the supply of main engine and generators, if those valves are installed without redundancy, have to be equipped with a double solenoid actuator (in the example scheme, this is the case with valve no. 1, connected with the clamps no. 1/2/3 and 4/5/6). The solenoids of this kind of actuator have each got a sufficient holding force to keep the valve open even in case of a failure at one solenoid.

It is not acceptable to connect groups of more than one valve of this kind to one switch; this is only acceptable for double solenoid valves of the *same plant unit* (for instance, inlet and outlet of the same engine)!
The two solenoids of one actuator may not be connected to the same contact.

In general, each solenoid has to be connected with a separate cable in accordance with the a.m. provisions. In order to connect single solenoid actuators which are placed in short distance to each others and which are grouped under the same release switch, it is possible to use an appropriate multiple core cable from the control cabinet to a central distribution point. This main control cable shall have three separate conductors for each solenoid, i.e. in case of three valves, for instance, nine single conductors. The requirements described under section 3.2 with regards to core diameter, approval, temperature resistance and maximum voltage drop are valid in analogy for the main control cable.

System Start-up and Shut-down

For start-up, the contact plug between the two batteries has to be closed (by pushing in), the power supply has to be switched on and the mains switch inside the control cabinet has to be turned on.

For shut-down of the control cabinet, the contact plug between the two batteries must be interrupted (by pulling out), in order to prevent a deep discharge (and a damage) of the accumulators! Additionally, the mains switch has to be turned off.

4. Operation

4.1. Operation of the Quick-Closing Valves

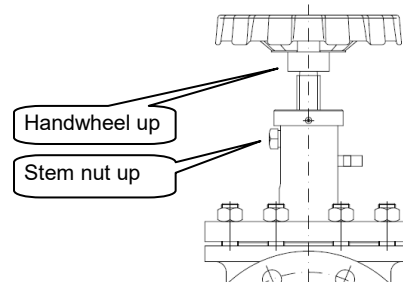
Opening of the Valve

After release, the valve can be reset according to the following procedure:

1. Make sure the voltage supply of the actuator is switched on.
2. Turn the handwheel to the right (clockwise) until resistance.
3. Pull the lever of the actuator;
the tappet of the actuator will be moved out and held in that position.
4. Turn the handwheel to the left (counter-clockwise) until a slight resistance is noticed.

Now the valve is operational in its home position with pre-compressed spring.

Operational, opened valve:



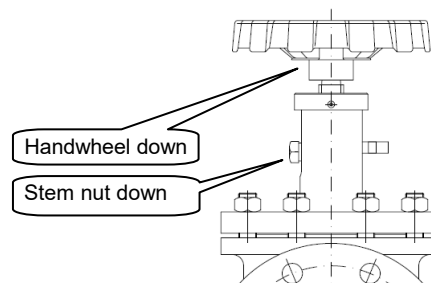
If the valve is required to be fixed in open position without the power supply being switched on, there is a fixing pin available at the actuator. This pin is inserted into the corresponding hole in the actuator while the actuator lever is pulled. **ATTENTION: In this situation the valve cannot be released any more!** As delivered, there is one fixing pin available at every valve, where it should be kept also after installation.

Closing of the Valve

The valve is closed by interruption of the power supply, which loosens the fixing device by the actuator and allows the pre-compressed spring to quickly close the valve.

When the power is switched on, the valve can also be closed manually by means of the handwheel like a regular globe valve.

Valve after release (closed):



4.2. Operation of the Control Cabinet

Release

In order to release a valve or a group of valves, turn the corresponding release switch. This interrupts the power supply of the respective valves and makes the valves close under spring force.

During the actuation of the release switch, its internal signal lamp will burn red. The interruption of the circuit is recorded by the collective fault alarm module, thereby creating a failure alarm.

Displays

During normal operation (i.e. main power supply available 230V, all valves under voltage) the LEDs at the front of the AkkuTEC module burn with green light:

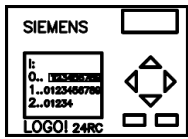
Ua	○	(supply voltage 24 V DC available at the clamps)
Netz OK	○	(main power supply available)
Batt OK	○	(battery OK)

In case of a respective failure, the corresponding LEDs will go out, in case of a strongly fatigued battery, the LED „Batt OK“ is blinking (regularly tested every 60 seconds).

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On the display of the collective failure alarm module it can be seen for which solenoids or control lines voltage supply is available and working.



There, a figure with black background signifies working and uninterrupted voltage supply, whereas a figure with light background means that the corresponding circuit is interrupted.

Example:

123456789

all control lines OK, line or solenoid no. 3 interrupted

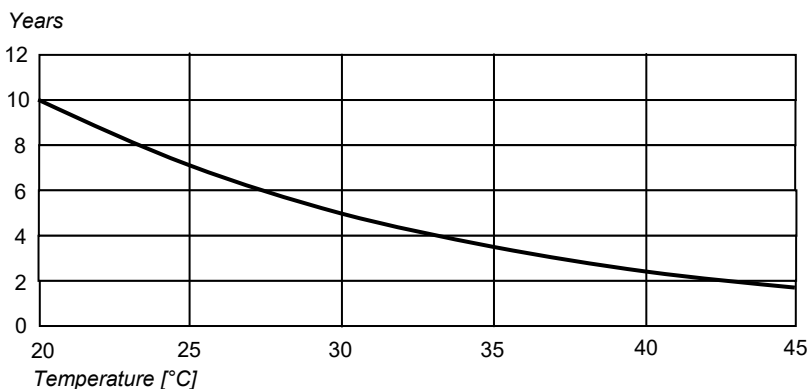
The display is always in several lines, even if the number of supervised solenoids is eight or less.

On the inside of the control cabinet door, there is a table showing the relation between the collective fault alarm module and the clamps on the terminal block. For example, line 0/number 3 in the display of the collective fault alarm module may correspond to the clamps 7/8/9 on the terminal block.

5. Maintenance

5.1. Maintenance of the Control Cabinet

For technical reasons, the accumulators installed inside the control cabinet suffer from a natural deterioration with growing age, whereas speed depends on the prevailing environmental conditions. Mainly the ambient temperature of the control cabinet has got a major impact on the deterioration, in consequence of which the installed accumulators can be expected to work without defect in accordance with the following function:



For this reason it is advisable to define a maintenance plan, according to which a battery test is performed after a period of 1,5 years for the first time, and then in regular periods of maximum 6 months. In order to do so, the operation on battery power is enforced by an interruption of the main external power supply (115-230 V) as well as the parallel direct external power supply of 24 V by turning off the mains switch inside the control cabinet, and the measurement of the time during which the valves stay open. If this time should drop below 90 minutes, the accumulators must be replaced.

Appropriate batteries are available at ARMATUREN-WOLFF – please note the exact product descriptions in accordance with section 5.3.

Additionally, a process-controlled, automatic battery test ensures the storage capacity of the batteries during normal operation. If the capacity of the accumulators should not be available in consequence of strong fatigue, this is shown by a red burning LED at the front of the AkkuTEC module. Also, the corresponding supervision contact is switched according to section 3.3. In this case, the batteries must be replaced immediately.

This way, the batteries are made sure to always have a sufficient capacity for a minimum alimentation time of one hour.

In regular periods of maximum 6 months, an extensive function test should be performed, including the release of all connected valve groups.

Exchanging the Batteries

Do make sure the mains switch inside the control cabinet is turned off and the connection between the batteries is interrupted (contact plug pulled out). Accumulators may never be exchanged under voltage!

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5.2. Maintenance of the Quick-closing Valves

In normal operation, our quick-closing valves are maintenance free. It has to be made sure, however, that movable parts are kept free from dirt. In regular intervals, which should be defined by the operator and should not exceed six months, the valves should undergo a function test during which also possible dirt is removed.

The actuator solenoids have been laid out for a permanent operation (100% duty ratio) at the above specified operating conditions. Under the influence of external impact, the electrical components can however suffer from an increased fatigue. For this reason, we recommend to apply suitable measures of predictive maintenance and to regularly determine the current fatigue status of the solenoids (for example, measurement of the heat development and/or power consumption under identical conditions, optical inspection), so that the valves are made sure at all times not to close in an uncontrolled way and without a warning.

5.3. Recommended Spare Parts per Quick-Closing Valves Plant

Description	Recommended permanently available quantity on board	Article no.
Accumulator, 12 V, 12 Ah	2	000-101150 (1 ea.)
Valve actuator (single solenoid), DN 15-50, 24 V DC, 7,5 W, Pg11	(t.b.d. acc. to specific case)	000-109438
Valve actuator (single solenoid), DN 65-150, 24 V DC, 7,5 W, Pg11	(t.b.d. acc. to specific case)	000-109437
Valve actuator (double solenoid), DN 15-50, 24 V DC, 12,0 W, Pg11	(t.b.d. acc. to specific case)	000-109704
Valve actuator (double solenoid), DN 65-150, 24 V DC, 12,0 W, Pg11	(t.b.d. acc. to specific case)	000-109705
Electric fuse DIN, 5x20 mm, 0,8 A	10	000-101151 (10 pcs.)
Valve plug, regular type (separate)	-	000-100308
Valve plug with thermal link	-	000-109745
Cable coupling (acc. LRS)	(t.b.d. acc. to specific case)	000-110009

For all components a dry and dust-free storage at a temperature of 0 – 50°C has to be observed (ideal: 5 – 40°C).

6. Safety Remarks

- The operating instruction has to be observed in an obligatory way, the implementation of maintenance actions is to be recorded. In case of noncompliance, all guarantees and liabilities are reserved!
- Sharp edges and flashes can cause injuries. Handle parts with care.
- Quick-closing valves may only be installed, connected and taken into service by appropriately instructed personnel.
- Maintenance personnel must be informed about the dangers related to disassembling and mounting of quick-closing valves as well as electric and machinery installations.
- At all work at a valve installed in a pipeline it has to be made sure that the plant is not under pressure and not medium can escape from the pipeline.
- Never reach into spring-loaded open valves or electrical installations under electrical power, since an unintended touch of conductors or release of the valve can cause serious injuries.
- For the separation of the external power supply, there is a mains power switch installed for the interruption of the main power supply (115 – 230 V AC) as well as the direct external power supply (24 V DC). In order to separate the system from all voltage supply (required for system shut-down), the contact plug between the batteries has to be pulled out.
- **The electric installation as well as a change of the batteries may only be done in a voltage-free situation.** Never loosen electrical contacts during operation! Electrical connections may only be installed in a voltage-free state!
- The contacts of the accumulators may not be switched! Never short-circuit the batteries! Danger of electric arc!
- Verify the correctness of the contacts before first system start-up!
- Never combine new and old batteries or batteries of different types. When not genuine parts are used for replacement, guarantees and liabilities become void.