

The TubeCube TC2.

Instruction and Operators Manual.

Maintenance Plan.



Original manual: Keep for further use!

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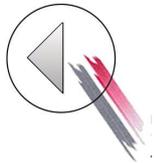
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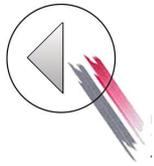
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Foreword

Dear owner, dear operator,

Your safety during the use of this product is our number one priority. Therefore it is necessary for every operator to read this manual and to follow the given instructions and safety regulations.

Furthermore if this manual is well understood then our effort to ensure operational readiness of the TC2 at all times can show its full potential.

This product is a machine according to: Machinery Directive - Directive 2006/42/EC of the European parliament and of the council from May 17th 2006 about machinery, and amending of Directive 95/16/EC (MRL).

This directive determines the structure of the instruction manual according to point: 1.7.4 MRL "General guidelines for the drafting of instruction manuals."

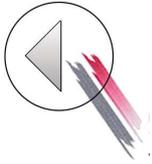
This instruction manual deals with information about safety, transportation, mounting, operation, maintenance and repair of the TC2.

At this point, we would like to sincerely thank you for purchasing our product.

The BSB GmbH & Co KG strives to deliver the best in machinery and Road Rail technology combined with rugged, durable construction to provide an efficient and reliable product for our customers. We are constantly developing our products and invent innovative solutions which are tested under real world conditions to be approved for use. With our experience we can guarantee you a tool that provides high quality and functionality. For your investment you get a product which is accepted by the state of technology and gives you the opportunity to make the best use in practice.

We are interested in your ideas, experiences, suggestions and special requests to ensure our products continued success.

We wish you success during the operation of this quality made product.



1 Introduction

This manual will show you how to work safely with the “TubeCube TC2”. We want to help you get to know and how to effectively use the TC2. We will also give you important advice on how to avoid unnecessary risks during operation.

The TubeCube has been designed and built according to exacting engineering standards and according to recognized safety rules. However, damage or danger for persons or property can always occur and unfortunately it is not possible to avoid all dangers. Accidents and interruptions because of these hazards can be prevented if you follow the given instructions during operation.

ATTENTION!

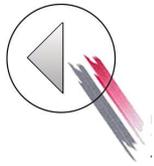
There is a risk of injury and property damage during the transport, operation and maintenance.



Therefore:

- Please read the operating instructions carefully before you transport, operate or maintain the TC2.
 - Please have a look at the operating advice and information, especially the safety rules.
 - Please request a new operating manual from the manufacturer, if you lose or damage your manual.
-

This operating manual only applies to the “TubeCube TC2” as shown on the cover sheet and in the footer. Please compare this data with the information on the nameplate of your own machine.



1.1 General Information

After reading please keep this manual for the whole operating life of the TubeCube TC2 for future reference.

In the event that the TC2 should change owner, the instruction manual must be handed over to the subsequent owner.

All information, illustrations and dimensions of this manual are non-binding. Claims can not be derived from the instruction manual.

Copying or reprinting any or part of this manual is only permitted with the written permission of the manufacturer.

Modification or alteration of the TubeCube TC2 require the written permission of the manufacturer.

The manufacturer shall not be held liable for any unauthorized modifications or changes to the TC2 and the warranty will be void.

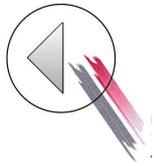
The current warranty conditions are listed in a separate document. You will find this document attached to the TubeCube TC2 documentation. Copies are available on request.

Only original spare parts and fittings which are approved by the manufacturer should be used on the TC2, otherwise the design and characteristics of the TC2, its functionality and safety could be affected.

The manufacturer takes no responsibility in the case of using non-approved parts and can not be held liable.

If you have any problems with the TC2, or the TC2 has any malfunctions, please call us immediately. Together we will find a solution for the problem and the gained experience will aid further development.

Documentation of third party components must be read and understood. The manufacturer of the TC2 takes no responsibility and no liability for the content of third-party documentation.



1.1.1 Explanation of labels and signs

For your better understanding, the following arrangements will be made for the manual:

To highlight important information, the following types of signs will be used:



DANGER!

Indicates an immediate dangerous situation which will lead to death or serious injuries if it is not avoided



WARNING!

indicates an immediate dangerous situation which will lead to death or serious injuries if it is not avoided



CAUTION!

indicates an immediate dangerous situation which will lead to death or serious injuries if it is not avoided



ATTENTION!

indicates an immediate dangerous situation which will lead to property damage or serious injuries if it is not avoided.



contains general hints and useful informations



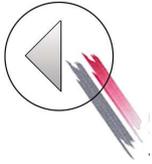
refers to important informations in other sections of the document



2 General safety information

Improper use of this piece of equipment or non-compliance with the operating instructions may result in serious damage to man and machine. Please pay attention to the following points before you mount or operate this piece of equipment :

- Prerequisite for a safe and trouble-free operation of the TC2, is the knowledge of these safety information and general safety rules.
- Read the safety rules carefully before you use the TubeCube TC2, and always comply with the instructions and warnings which are given. Warnings which you will find, at certain places in the text of the following section, must be paid attention to. The manufacturer cannot be held responsible if the notes and warnings are not complied with.
- The operator is responsible for compliance with safety regulations and for the appropriate use of the TubeCube TC2.
- In this respect you operate the TC2 at your own risk. The manufacturer is not liable for damages resulting out of TC2 operation, unless this damage is caused by gross negligence or breach of contract on the part of the manufacturer.
- Although, the TubeCube TC2 fulfils the current technical and safety requirements, you cannot exclude an impairment of the safety of man and machine, due to unforeseeable events or circumstances. Therefore, we explicitly point out that you have to comply with the safety regulations.
- Apart from the information in this manual you have to consider local laws, especially regulations for safety and accident prevention.

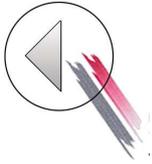


2.1 Safety rules

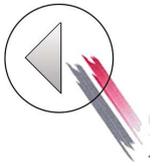
- Any damage to the TubeCube TC2 must be repaired immediately and competently. Contact your dealer or the manufacturer for help.
- The TubeCube TC2 may only be used for the purpose it is designed for.
- Unauthorized persons may not reside in the working area of the machine and the TubeCube TC2.
- Please comply with all safety regulations which apply at the workplace.
- Do not remove any protectors or safeguards. In case of damage or loss they must be replaced immediately.
- When the TubeCube TC2 is mounted or dismounted, make sure that all connections are correctly secured.
- Make sure that during transport or movement, the TubeCube TC2 stands in a secure position and is secured against unintentional movement or contact with the environment.
- Only use original spare parts for replacement. They are available from the manufacturer. If you use non-original spare parts, we cannot guarantee the secure operation of the TubeCube TC2 and will not accept any liability.

In addition to the safety and accident prevention regulations of the trade associations, the following instructions must be observed to prevent injury or property damage:

- The operator is required to inspect the TC2 at least daily and report any visible damage or defects. Any defects could affect the safe working environment.
- The operating company has to ensure that the TubeCube TC2 is only operated in perfect condition.



- Do not disassemble or disable any safety devices on the machine. If you have to remove safety features for maintenance or repair, reattach the safety devices immediately after you finished.
- Do not use substances which are hazardous to health while cleaning the TC2. If this is unavoidable, the operator is responsible to provide adequate protection apparel for cleaning.
- To prevent fire hazard, do not put detergent, paint or other flammable materials near or into the TC2.
- Warning labels, signs and symbols may not be removed or made illegible. You have to replace missing or damaged warning labels, signs or symbols immediately.
- Do not start work if the the TubeCube TC2 is faulty. If errors occur, especially security-related, you have to shut down immediately and initiate repairs.
- You have to shut down any power source to the TubeCube before you repair or clean it. Please ensure that the power source is secured against being switched on again. In case of an attached excavator remove the key for example. Otherwise there is a risk of injury.
- You have to pay attention to the documentation of the supplier in the annex before you operate, repair, disassemble or handle any third party components.
- Access to the control panel should only granted to authorized and qualified persons.
- The excavator operator has to make sure, that he neither endangers others or himself. He has to understand all controlls and functions regarding the TC2, especially its movements during execution of functions.
- **Never** work under suspended loads.
- The manual of the excavator must be complied with.
- In case of an installed quick change adapter pay attention to its manual.
- Absolutely no-one is allowed in the work zone, whilst operating (unless using the manual suspended suction hose).



2.2 Safety signs

In addition to the safety instructions in this manual there are safety and danger signs on the TC2. The following table shows the meaning of these signs.

DANGER!

Risk of serious injury or death because of non-visible safety signs.



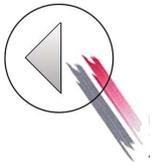
The safety signs show not immediately recognizable hazards. Removed or illegible safety signs can lead to serious injury.

For this reason:

Please pay attention to all safety signs on the TC2 and the attached vehicle.

Do not remove safety signs and make sure that all missing or illegible safety signs are replaced immediately.

Safety sign	Meaning
	Warning tape right/left
	Attention! Power line.
	Attention! High voltage



	It is forbidden to stand in the area!
	Wear hearing protection!
	Wear helmet and safety mask!
	Wear helmet!
	Workstation-specific sound volume emission value!
	Sound power level
	Danger of crushing!

The picture on the following page indicates the specific location of the different signs.

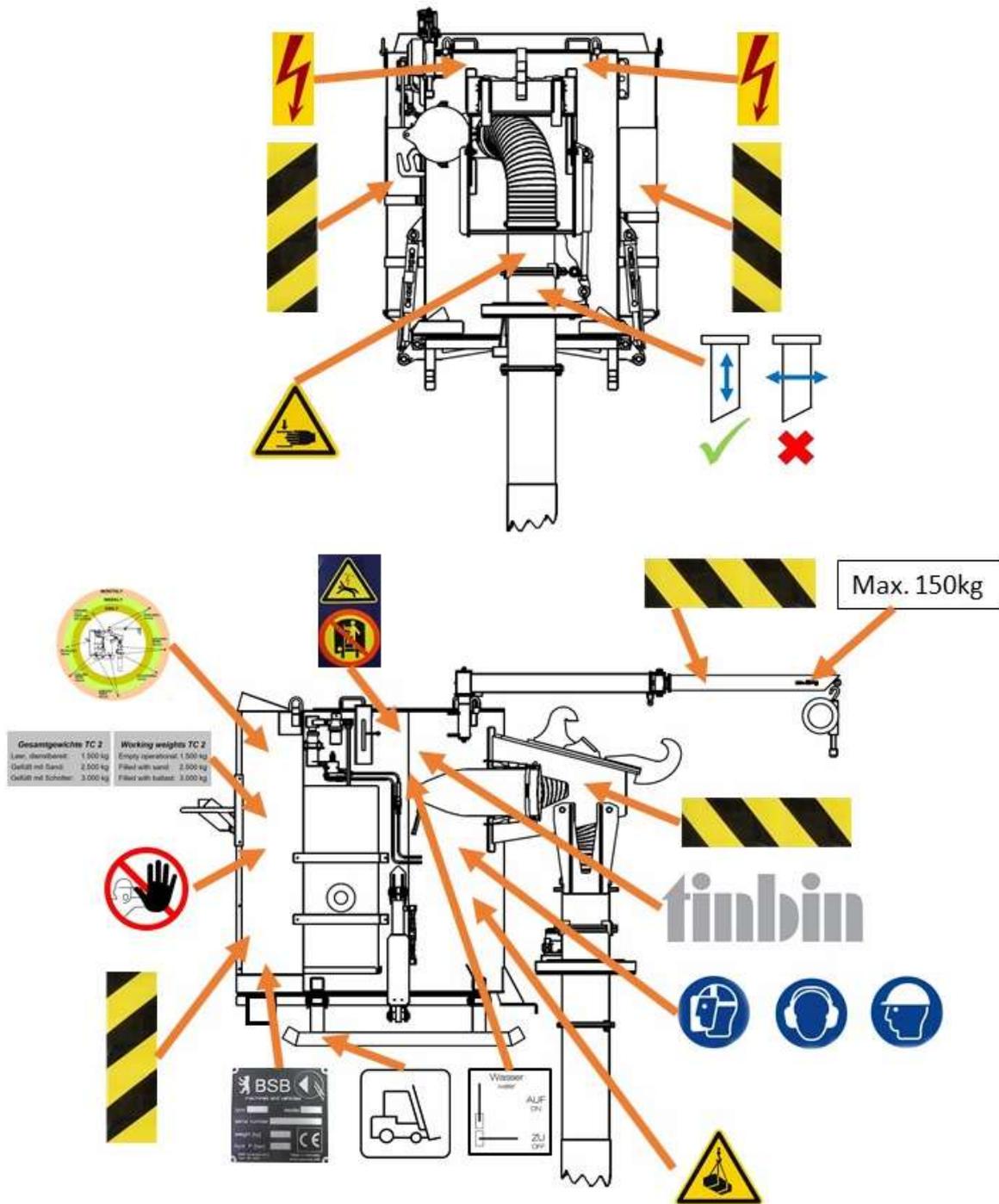
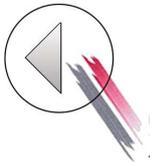


Diagram 1: Locations of safety signs Front Left

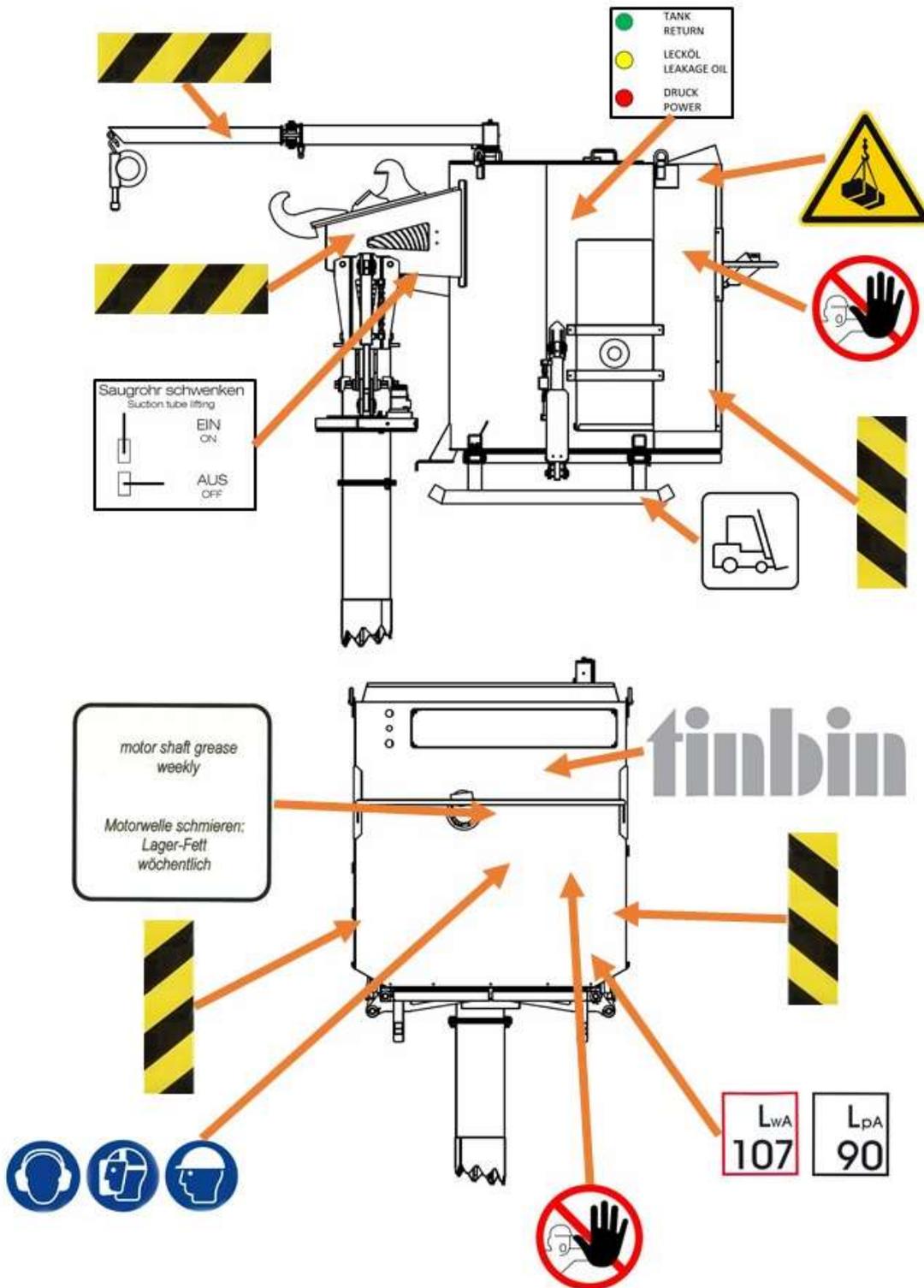
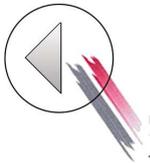
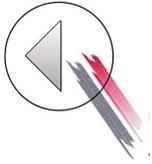


Diagram 2: Locations of safety signs Front Left



2.3 Intended use

The operational safety of the TC2 is only guaranteed through appropriate use. Only use the TC2 for the purpose it was intended.

Please make sure that you use the TC2 as described in the following instruction. Make sure that the TC2 has enough space to work. Pay attention that you lift, move or set the TC2 to the ground with the intended feet. The Lower doors must remain closed! Most importantly you must take note of the permissible weight of the allocated hoisting gear on the TC2. It is allowed to equip the TC2 with accessories and replace or extend existing equipment as long as the above uses and safety regulations are maintained.

The TC2 has to be fixed firmly with the mounting bracket or the load shackle to the host vehicle. The TC2 is designed to operate on an excavator.

IMPORTANT NOTE:

The TC2 is **not** intended to be used as a 'Prime Mover' excavator in hard virgin ground (Like excavator digging bucket). It is intended to be used in a maintenance application like drain cleaning or excavation of loose material (track ballast) where the material type is either soft or already broken up.

In the case of powered rotation of the suction tube (optional extra), the rotation effect is to agitate the material rather than drive down into it with full weight of machine.

Compliance with all information in this manual is part of operation with intended use.

WARNING!



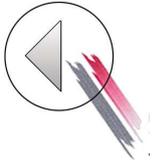
If you don't use the TubeCube TC2 as described in this manual, you risk a dangerous situation and damage to either property or personnel.

Furthermore all warranty claims will be void!

So for this reason:

Only use the TubeCube TC2 as intended!

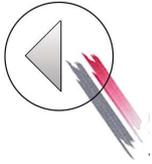
The use of extra hydraulic auxiliary equipment is only covered by intended use if these are approved by the manufacturer.



2.4 Incorrect use

Any use of the TubeCube TC2 which differs from the ones described in Section 2.3 is improper. Following are examples of incorrect uses for the TC2:

- Carrying passengers.
- Lifting of the host vehicle with the aid of the TC2.
- Working with unapproved attachments or devices.
- Operation with a faulty machine or faulty safety features.
- Unauthorized modifications.
- Operation in potentially explosive environments.
- Operation by unqualified personnel.
- None intended operation with an excavator.
- Working the suction tube in a lateral plane (side to side) across the TC2.
- Driving the end of suction tube down into compacted material when using.



2.5 Danger zone

The danger zone is the area in which hazards from the machine present a risk for health or safety. Therefore, no person shall be present in this area during the operation of the TubeCube TC2.



WARNING!

Danger to life because of TubeCube movement!

There is a multitude of possible risks to health and safety in the danger zone.

For this reason:

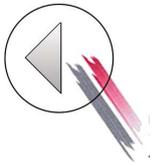
Never use the TubeCube TC2 if persons are present in the danger zone.

Observe the surrounding and press the emergency stop, when persons move into the danger zone.

2.6 Personnel Requirements

Operation of TubeCube is only allowed to people who:

- Are 18 years or older.
- Are physically and mentally fit and able to work with the machine.
- Are well rested and concentrating on the job in hand.
- Are not under the influence of alcohol, narcotics, drugs or other substances.
- Have been instructed by the manufacturer in the operation of the TC2 or completed an equivalent training (e.g. Excavator licence).
- Have training in the fastening of loads and the proper selection and handling of slings
- Are informed of the involved risks
- Read and understood this manual and the manual of equipment which may be included in the delivery.
- Are expected to work reliably and responsibly with the TC2
- Have been chosen by the operator of the host vehicle to use the TC2



3 Product description/ operating principle

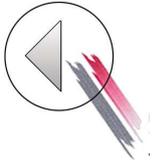
The “TubeCube TC2” is a versatile piece of equipment that uses the principle of air vacuum to excavate various materials and liquids. The intake of the material can either be achieved through an optional fixed tube or a hand guided flexible hose. To loosen up ballast or grown over soil the fixed tube is optionally equipped with a rotary drive, which rotates with approximately 10RPM.

Initially the material arrives in the main body of the machine. Here the coarse material is sifted out. Through air diversion, filtering (via a sieve plate) and air stream deceleration, the air is further cleaned from bigger particles, inside a second chamber. In case of very fine and dry materials a dust suppression water system can optionally be activated. Through high pressure, water is finely dispersed into the dusty air stream and smaller particles are bound. The so treated air is then exhausted by a strong radial fan at the back of the machine.

The fan, which is located in a third separate chamber, is powered by a hydraulic motor. To reduce operating noise the fan chamber is lined with noise dampening material.

3.1 Design characteristics:

- Heavy duty welded steel frame with integrated attachment points.
- Heavy duty sheet metal interior with baffle plates and noise reduction material.
- Pre-equipped dust suppression system powered by hydraulic motor.
- Reinforced mounting plate area suitable for a quick-hitch system (e.g. SMP or Miller)
- The optional heavily reinforced construction for directing material via a steel suction tube (otherwise known as ‘One Man Operation Module’).
- The suction tube has a hydraulically powered rotation for loosening hard soil and gravel.
- The suction hose has a hydraulic ‘swing-out’ function for reducing operating height during lower door emptying.



3.2 Hydraulic system

All hydraulic cylinders are heavy duty in construction and specifically designed for the TubeCube TC2. They are double acting, with check valves and hard-chromed piston rods.

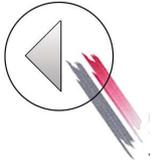
The function of opening and closing the lower doors, the activation of the dust suppression system and the rotation of the suction tube are achieved through an all hydraulic adjustable sequential circuit. The rotation of the suction tube can be isolated by a 2-way ball valve. The system pressure of the sequential circuit is protected, but should not exceed 120 bar to avoid damage to the lower doors.

3.3 Control System

The functions of the hydraulic control system are described in Chapter 8.

Several control variants are installed.

- The simplest variant (1) is installed without one-man operation. There are no valves other than the double-action pressure-relief valve in front of the clamshell cylinders. The double-action pressure-relief valve should be set to between 80 and 120 bar in both circuits.
- A second variant (2) controls one-man operation, allowing the excavator operator to work without assistance. Here, the sequence of movements is controlled by pressure sequence valves. When the discharge flaps close, system pressure increases in the end position of the flap cylinders and the inlet pipe moves into operating position. The dust-control water pump can then be controlled by means of flap closure. Opening the flap to the inlet pipe also operates the 'open flaps' working circuit via the end position of the cylinder.
- A third variant (3) uses a rotating drive that loosens material by moving the suction crown on its vertical axis. The sequential circuit is the same as in the foregoing variants. The rotating drive is operated via a second sequence valve as soon as the inlet pipe forces pressure to build up in the operating position. In order to have enough pressure differential available, in this instance the double-action pressure-relief valve must enable 120 bar. The water pump and the inlet pipe rotation operate in parallel. The water pump can be switched off via a ball cock.
- The fourth variant (4) allows for direction change of the 'suction crown rotation' function. To activate the hydraulic control, the working circuit 'open/close flaps' is switched to the 'rotate inlet pipe' function via a hydraulic 4/2 directional valve. The water pump operates in both rotation directions of the inlet pipe or, optionally, in one rotation direction. This facilitates better control over water supply.
- The last variants (5 and 6) control the sequence electromagnetically. Mechanical switches control the end positions of the cylinders and electromagnetic valves enable the sequential function, as outlined above. To this end, the excavator requires a switchable power circuit. In the event of a circuit failure, the device can be operated



without sequential control as it is not safety-relevant. The advantage of this variant is that it is not dependent on the oil viscosity and the flow rate from the device carrier. The pressure can be reduced to 80 bar. This increases the lifespan of the hydraulic system and the steel construction.

3.4 Slewing drive

The slewing drive is intended to facilitate the alignment of the machine with the material to be suctioned. It enables the machine to be swivelled by 90° in both directions around the vertical axis. Due to the high tilting torques and axial forces, the slewing drive is moved by a non-self-locking worm gear. A brake prevents the drive from running back automatically due to external force. The pressure and volume settings must not be altered. The worms transmit only a certain torque depending on the oil pressure. If the oil volume is too high, the rotary movement will be too fast (difficult to operate) resulting with constant use in the uncontrolled generation of heat in the worm drive. The drive is operated via the flap function (turning the gripper). Depending on customer requirements, the oil flow is diverted to the drive either electrically or mechanically. The brake is released with each activation.

4 Transport / Unpacking

Before working, take personal safety measures e.g. wear protective clothing, gloves and protective shoes.

Only transport, load or unload the TC2 with adequate tools. (Forklift console on the front of the machine, lashing eyes at the top). Ensure sufficient lifting capacity (machine weight see name plate)

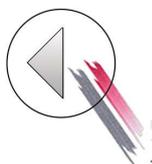
Only transport TC2 whilst doors are closed and it is secured against tilting.

When unloading the TubeCube TC2 put it on a flat, stable surface and secure it against tilting.

Examine following points after each transport:

- Check if the TC2 has been damaged during transit
- Check if parts are missing (see spare parts list).
- Check if any parts have loosened up (screws, axles, fuses, etc.).
- Check if the hydraulic system is leaking

If you notice any defects during the above performed tasks, please contact your dealership immediately.



5 Mounting

Before mounting the TC2, it is to be checked for damages and defects. If, according to your best judgement, defects relevant to safety can be determined, it is necessary to contact the workshop or the manufacturer. The machine should not be used without approval of a competent person. The following areas should be examined:

• Welding seams	- For cracks
• Hoses/pressure elements	- For damages/leaks
• Cylinders	- For damages/leaks
• Valves and screw connections	- For leaks and proper operation
• Load hooks/shackles/sling gear	- For damage
• Blockages in the suction tube	

The TubeCube is designed to be attached to the dipper arm instead of a bucket. The excavator needs, a minimum of 5 services and one of these must be a separate drain directly to tank from the fan motor with no back pressure.

The attachment is designed for excavators with a **minimum of 16t operating weight** and an **engine power of at least 75kW**.

The following hydraulic parameters are required:

1. Oil supply for axial piston motor/fan

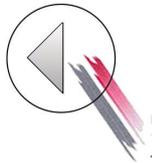
Oil stream	$120 \frac{l}{min}$
Operating pressure	280bar
Required hydraulic power	min 55kW
Separate leak oil connection	max. back pressure 2.5bar (ideally 0bar)

A double acting circuit is usable or – if existing – a hydraulic breaker/hammer circuit.

2. Oil supply for lower doors cylinders, water pump and rotating suction crown

Oil stream	approx. $30 \frac{l}{min}$ - $40 \frac{l}{min}$
Operating pressure	120bar

For the auxiliary functions of the TC2, the slew function for turning the excavator is usable. The TubeCube is factory fitted with pressure limiting valves set to 125bar, which will prevent an overload of the system, independent from the excavator type.



The TC2 is suitably supplied by most general hydraulic systems. High flow combined with medium to high pressure is the optimum.

The TubeCube TC2 is meant for attachment to the dipper arm in place of normal digging equipment. In the case of free rotation, then suspension from the dipper arm is possible via integrated eyelets which can be used with suitable chains and swivel hooks. These can be obtained from the BSB distribution department.

The hydraulic connection is made with hoses and quick couplings. High tech hydraulic connections to the host vehicle via quick coupling plate systems like Likufix can also be ordered and installed at the manufacturing plant.

5.1 Connection

Connect the pipes required for the specific function to the excavator shaft. Always observe the connection instructions on the device (See 5. Installation).

Always work in a clean environment when connecting the hydraulic system. Dirt can damage your hydraulic system!

To operate the slewing drive and for variant 5, an electric connection to the excavator is necessary. Variant five requires two electrical circuits. The circuits will be wired following consultation with the customer.

Once connected, test the functions and deactivation of the slewing drive. Test the movement of the pipes to ensure that connections cannot be broken off. We are unable to perform type-specific test runs at our site.

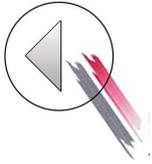
5.2 Technical Data

Service weight of the host vehicle :	≥ 16t
Pump Flow Rate:	$120 \frac{l}{min}$
Motor rated power of the host vehicle :	≥ 75kW
Suction capacity of the radial ventilator:	approx. 12.000m ³ /h
Suction head of the radial ventilator:	ca. 900mm H ² O / 1,3Psi
Power requirements for main fan:	≥ 55kW
Volume of the storage tank:	max. 0,75m ³



Dead weight ¹ :	1.300kg
Suction depth without extension:	1.500mm
Suction depth with suction crown :	700 mm
Operating voltage for electrically controlled version:	24 VDC

¹ Water for the dust suppression system and quick coupling plates have to be taken into account additionally



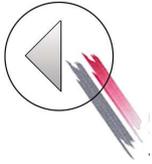
Ordering note

Regarding the connection of standrad version of TC2

To ensure compatibility with your host vehicle, following are the specification for our hydraulic hoses:

- **Union Nut M36x2 with taper (Hermeto 25S)** for the hydraulic motor of the radial fan (for both couplings on "hammer pressure line" and "Hammer feedback")
- **Union Nut M26x1,5 with taper (Hermeto 18L)** for the hydraulic motor "leaking oil line"
- **Union Nut M16x1,5 with taper (Hermeto 10L)** for lower doors and suction crown swivel (on connection "turn tool")

We hold hoses in these specification in stock. But if desired we can provide different sizes and specifications.



6 Operation

The TC2 is well suited for difficult excavation work, e.g. the excavation required for the repair of municipal systems. (water, electricity, etc.) The soil can be removed fast and easy without inflicting any damage. Digging without damage!

When operating close to supply lines you still need to work carefully with the suction crown. Optional heavy duty plastic caps to replace the hardox steel tube are available upon request.

Before starting work you have to carefully position the TC2. If using the hand held suction hose it is advisable to set the TC2 on the ground.

You can either work with the handguided suction hose with suction crown and guide bracket or with the optional “one man operation module” from the excavator. For this purpose the TC2 has a fixed, hinged suction tube. The hydraulic sequential circuit swings the suction tube to the side before the lower doors are opened. You can also disable the rotation of the suction tube with a hydraulic hand lever.



ATTENTION!

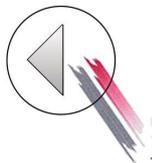
Standing under suspended load is forbidden. The TC2 has a highly mobile suction hose. In any case it is advised to work afar from the main body to reduce the risk of accident.

During operation of the “one man module” you have to make sure that nobody is in the working area.

The machine is ready for operation once the main fan is powered on. Through the suction crown the soil will be transported into the main reservoir. Ensure that the position of the suction crown always allows for a little air flow. Otherwise no material will be transported. Do not fully submerge the crown.

Please note: For dry materials, you can activate the built-in water spray system. For this purpose you have to keep rotating the suction crown which will automatically power the water-pump. The pump draws water from the two attached tanks and sprays water through nozzles into the air stream. The water droplets catch the dust particles and dust formation is effectively prevented. The water system can be disabled through a ball valve on the machine. The system should only be activated when necessary. Make sure not to run the water reservoirs dry. The system runs best when fully charged.

For semi-dry and moist materials the water system is not necessary and can be disabled.



To make operating the hand guided hose easier the hose can be suspended from a foldable arm and a spring balancer like the old TC1. To reach greater depths, extended suction tubes are available.

Attention: when working on defective gas, electric and water lines heightened awareness is advised.

Although the main fan is equipped with increased spark protection, specific health protection information VBG ZH 1/200, VBG 50 has to be complied with.

Once the main body is full the suction power decreases rapidly. Work with the machine must then be stopped.

To empty the material the TubeCube must be carried by the host vehicle to the dumping site. The lower doors, on the bottom of the machine, can be opened in a controlled way at will. **Before the lower doors are closed make sure that the sealing surfaces are clean.**

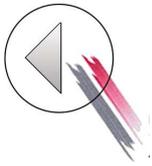
Operation of the TubeCube TC2 can then be resumed.

6.1 Operator obligations

Besides the safety-instructions in this manual, you will have to comply with local safety, accident prevention and environmental-protection regulations.

The following applies in particular:

- Personnel who will work with TubeCube TC2 must be carefully selected by the operator (see Section 2.6, page 14)
- Every person who will handle the TubeCube TC2 is obliged to read and comply with this manual. They have to be trained in the dangers during operation of attachment machinery and of the working environment.
- In accordance with operational circumstances appropriate personal protective equipment has to be chosen, supplied and worn.
- If a risk or non-compliance with the regulations is determined, immediate measurements have to be taken to act against this.
- The operator has to ensure that the workplace is tidy and well organized.
- The operator must read the section describing 'Intended Use' and also 'Incorrect Use'. Section 2.3 and 2.4. Pages 13 and 14



7 Maintenance

The TC2 is designed to reduce maintenance intervals. It is sufficient to grease the lower door joints, joints of the hydraulic pistons and the bearing of the main fan once a month with commercial bearing grease. In case of very high workload and high temperatures the main fan bearing should be greased once a week. Use bearing grease KP2K-30 according to DIN 51825. The manufacturer recommends the use of “FAG Arcanol-Multi 2” bearing grease.

After opening the lower doors you can easily clean the fan housing and sealing surfaces. Clean sealing surfaces on the lower doors are especially important regarding consistent suction power. For convenient and safe access you can tilt the bucket ram as shown in the picture below. This way you can inspect and clean the seals without standing under suspended load. For safety reasons it is advisable to turn off the excavator during this work.

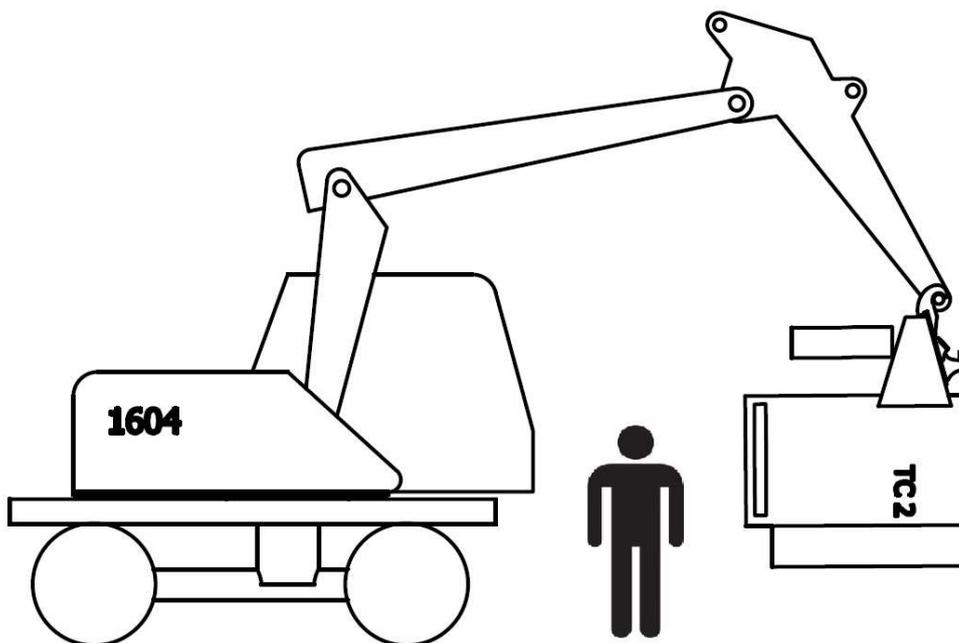
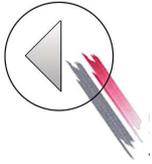


Diagram 3: Cleaning of TC2

Separate maintenance booklets for the manual spring balancer have to be followed (see separate operating manual for balancer).

Adjustment of the sequential hydraulic circuit for lower doors and suction crown

The following functions depend very much on the temperature and condition of the hydraulic oil and the condition of the valves. Please note that optimal functions require optimal conditions.



Movement sequences during the opening of the lower doors:

1. Suction tube swings out and away to the side.
2. Lower doors open

Movement sequences during the closing of the lower doors:

1. Lower doors are closed
2. Suction tube swings back in downward facing position.

This sequence is facilitated by two sequential valves. See hydraulic diagram "lower doors, suction crown and water pump". (Page 28)

These two valves are factory set before shipping and usually don't require any tuning.

Basics for the adjustment of the sequence valves:

Tightening of the adjustment screw leads to:

- Higher output pressure.
- Longer intervals between the steps of the sequence.
- Lower movement speed of the subsequent connected components.

Adjustment for opening the lower doors:

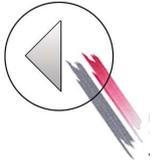
Adjustment screw of the forward pressure limitation valve (No. 2) is used for tuning the sequence of suction tube and lower doors movement. (Tightening: longer interval but reduced movement speed).

Acceleration of door movement by tightening adjustment screw on V1 of pressure limitation valve (No. 1).

Adjustment for opening the lower doors:

Adjustment screw of rear pressure limitation valve (No. 3) is used for tuning the sequence of suction tube and lower doors movement.

You can reduce the 'swing away' speed of the suction crown by tightening the adjustment screw.

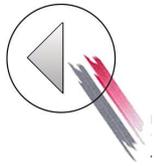


Water pump:

The water pump is powered by a hydraulic motor that is supplied by the oil flow of the “close lower doors function”. The flow rate should not exceed 18 l/min during operation. Depending on the installed nozzles, the water pump delivers 17-20l/min at 5-18bar. You can reduce the water pressure with a pressure limitation valve on the pump by loosening the screw. We recommend that you regularly clean the water filter attached to the pump. On each tank is a big side opening for easy cleaning. This system works best with full water reservoirs. Keep them charged up.

The water pump should not be run dry. If the pump air locks by running dry, you can open up the top cover of the pump and fill it with water to restore functionality. Once you see water in the water filter it should be filled enough, a check valve in the suction line of the pump prevents backflow.

To prevent damage due to frost, drain the water system when temperatures drop below 4°C.

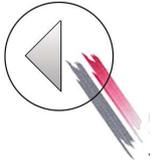


7.1 Service instructions

Serial	Activity	Daily	Monthly	Yearly	Every 6 Years
1	Perform a general check for damage and faults, repair if necessary	*	*	*	*
2	Check hoses, bolts and screw connections for secure fit and possible damage.	*	*	*	*
3	Check supporting structure for security and damage.	*	*	*	*
4	Operate the fan as a functional test and allow it to run down.	*	*	*	*
5	Visual check hydraulic system for damage and leaks.	*	*	*	*
6	Inspect warning decals for condition replace as required.	*	*	*	*
7	Clean gaskets and sealing surfaces.	*	*	*	*
8	Check safety equipment	*	*	*	*
9	Lubricate fan bearings.		*	*	*
10	Lubricate lower door bearings		*	*	*
11	Lubricate crown swivel bearing.		*	*	*
12	Lubricate rotation drive.		*	*	*
13	Annual inspection			*	*
14	Replace all hydraulic hoses.				*

Depending on the level of pollution in the atmosphere or the type of environmental influences, lubrication can be required daily or weekly, to be determined by the operator.

Use bearing grease KP2K-30 according to DIN 51825. The manufacturer recommends the use of "FAG Arcanol-Multi 2" bearing grease.



BSB Saugbagger & Zweiwegetechnik. Stefan Mattes GmbH & Co KG. Zur Alten Börse 49

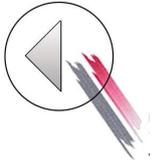
D-12681 Berlin / Germany

7.2 Pre delivery inspection for a TubeCube TC2.

Before the first operation perform the following steps.

Step	Activity	Check
1	Perform a general check for damage and faults, repair if necessary.	
2	Check hoses, bolts and screw connections for secure fit and possible damage.	
3	Check supporting structure.	
4	Inspect warning decals for condition, replace as required.	
5	Check safety equipment.	
6	If necessary drain hydraulic system, flush and refill with adequate hydraulic fluid. The TC2 comes factory filled with "ADDINOL Ecosynth Super HEES 46 S"	
7	Visual check hydraulic system for damage and leaks.	
8	Operate the fan as a functional test and allow it to run down.	

Date, Signature

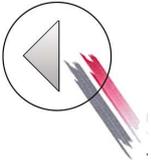


8 Mode of action, sequential hydraulic circuit

All functions, except for the main fan control, are operated by the slew circuit function of the excavator. To execute these functions it is necessary to hold over the lever or **hold down the button** while the TubeCube sequentially runs through its steps. If the lever is operated in the opposite direction the TC will sequentially reverse the actions. The main fan is controlled via the hydraulic breaker / hammer circuit and can be switched on and off at any time.

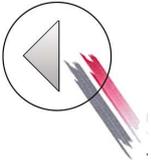
With closed lower doors and suction tube in lowered position there are two possible functions.

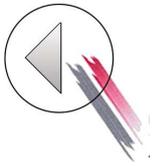
- If the slew function of the excavator is operated in one direction the suction tube will swing to the side and afterwards the lower doors will be opened. This is the standard mode for emptying the TC2.
 - A check valve (RSV) prevents the suction tube swinging out during opening of the lower doors. The suction tube only swings out in one way.
- If the swing out function is then operated in the reverse direction the lower doors will close, the suction tube will swing back and start to rotate. While the crown rotates the water pump of the dust suppression system is running.
 - During the closing of the lower doors, sequence valve (1) controls the moment at which the suction tube (S) starts to swing back into position.
 - Because the operating pressure would not be adequate to operate the stop valve at the suction tube (H) and simultaneously rotate this tube and powering the water pump these functions are separated through sequence valve (2)
 - The hydraulic throttle (D) in front of the suction tube drive guarantees the necessary operating pressure for the water pump
- Loosening (Unscrewing) of the adjustment screw on sequence valve (1) leads to the simultaneous closing of the lower doors and swivel of the suction crown. Tightening will separate the functions more and lower the operating speed. If the valve is tightened too much a part of the hydraulic flow will be bypassed by pressure limitation valve (DBV) and only the lower doors will close.
- Loosening of sequence valve (2) will result in the simultaneous activation of suction tube swing out and rotation. Because the pressure is not adequate, stop valve (H) is not activated and the tube will not swing. An over tightening will result in a loss of water pump power and suction tube rotation.



- Further opening of throttle (D1) causes the water pump to stop; closing will lead to a reduced rotating speed of the suction crown and increased power of the water pump.
- Throttle (D2) guarantees a steady pressure for operating stop valve (H)



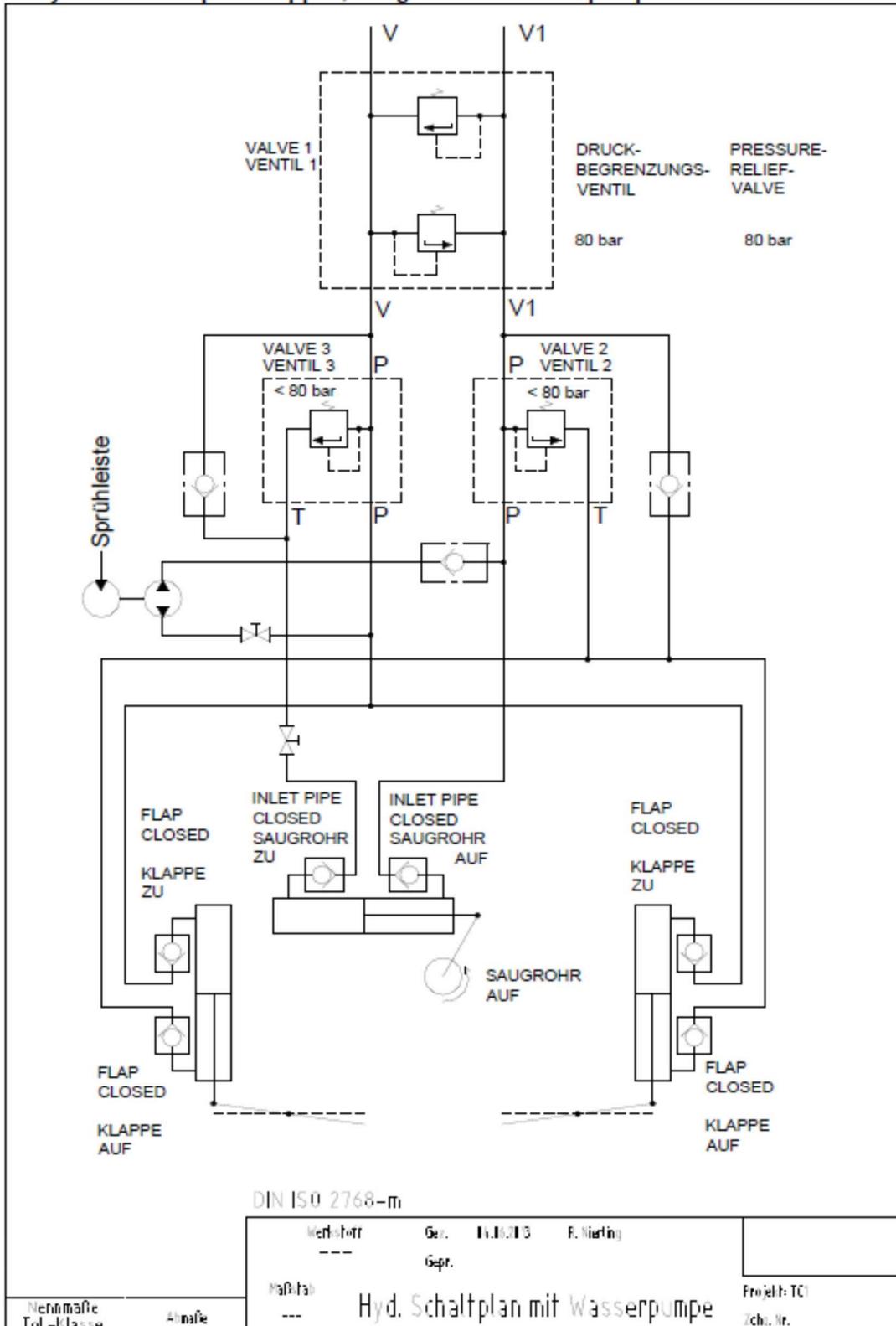


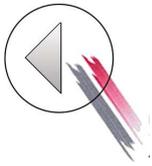


9 Annex – Circuit Diagrams

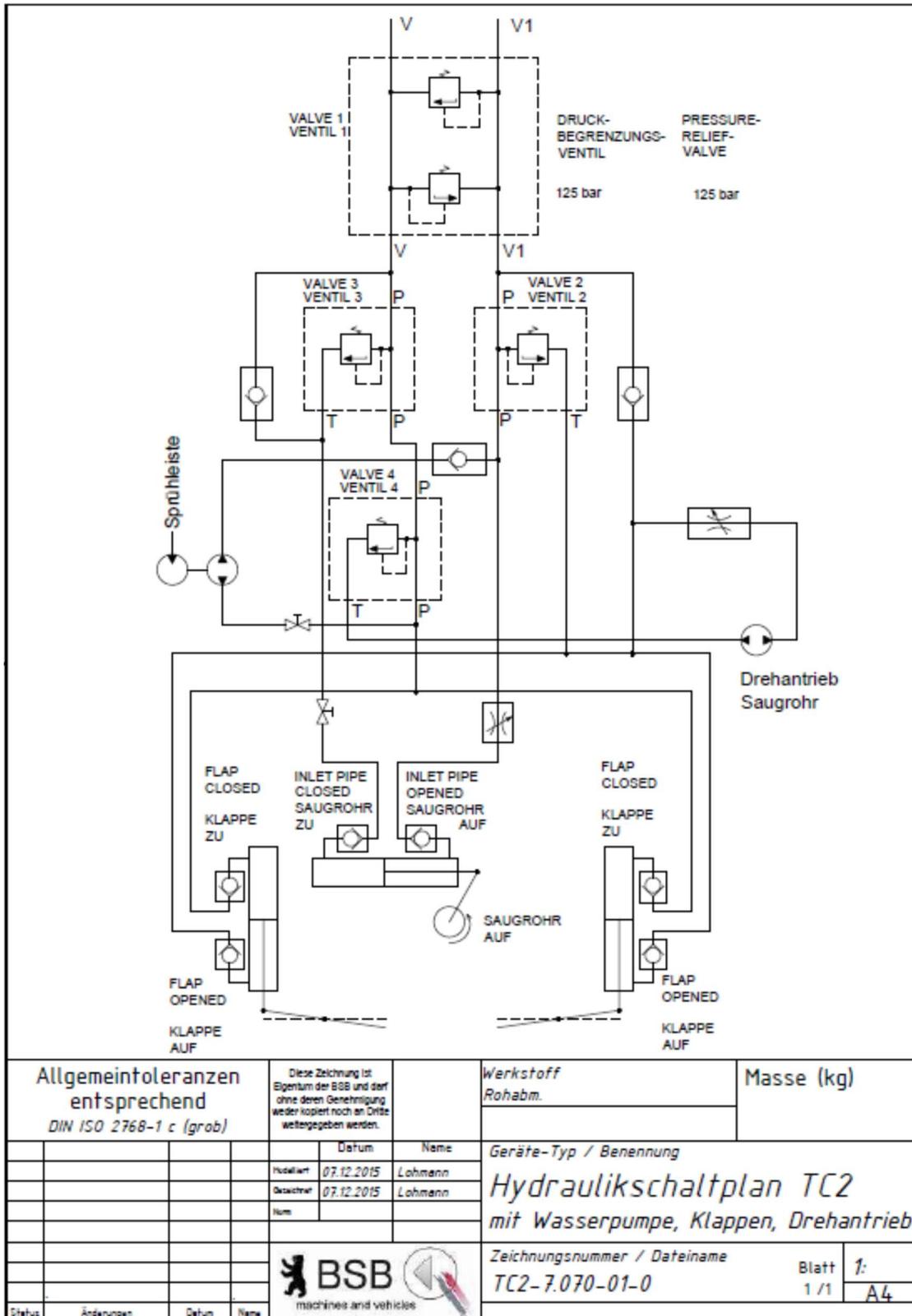
9.1 Variant 2

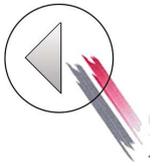
Hydraulischschaltplan Klappen, Saugrohr und Wasserpumpe



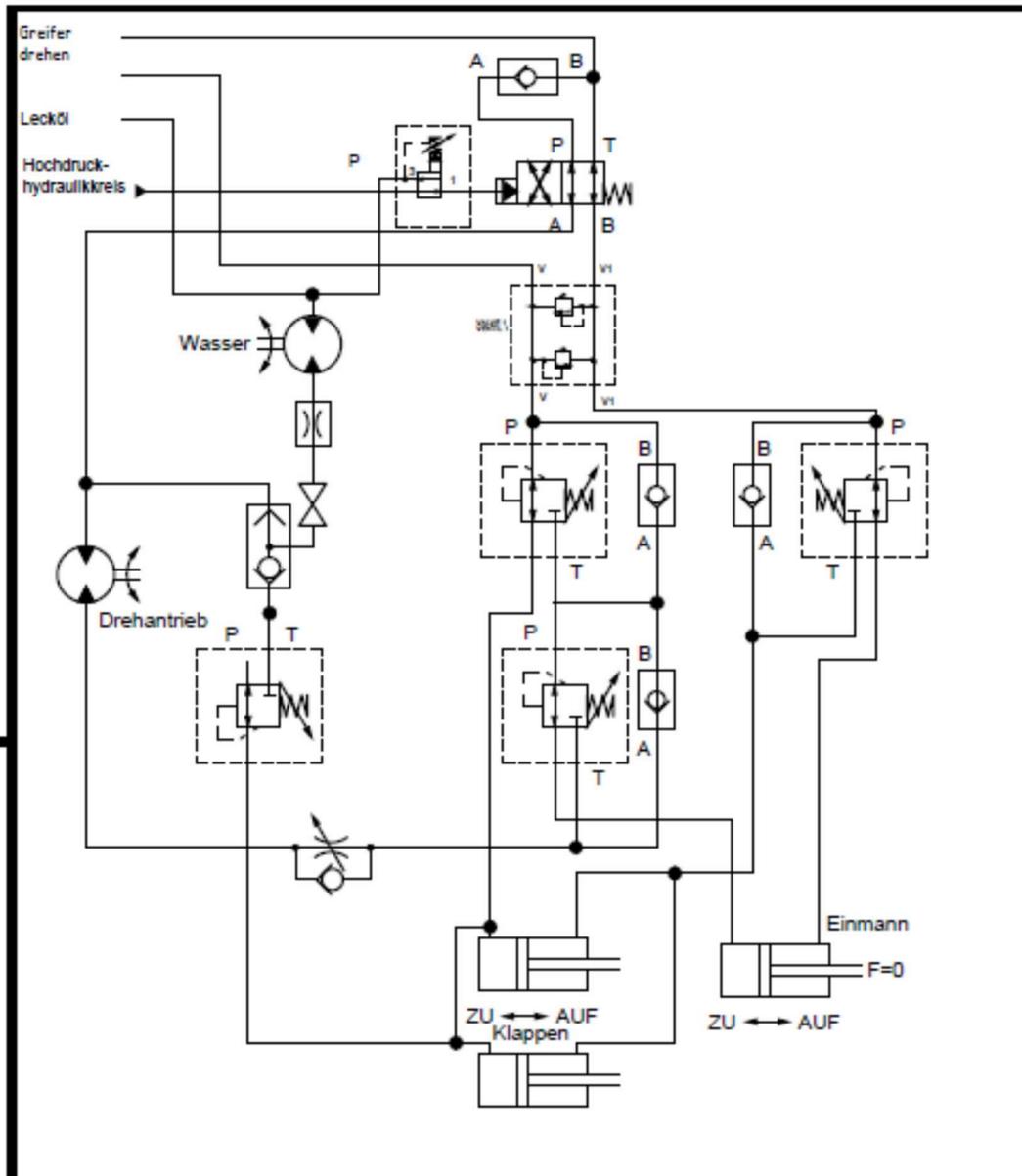


9.2 Variant 3

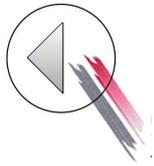




9.3 Variant 4

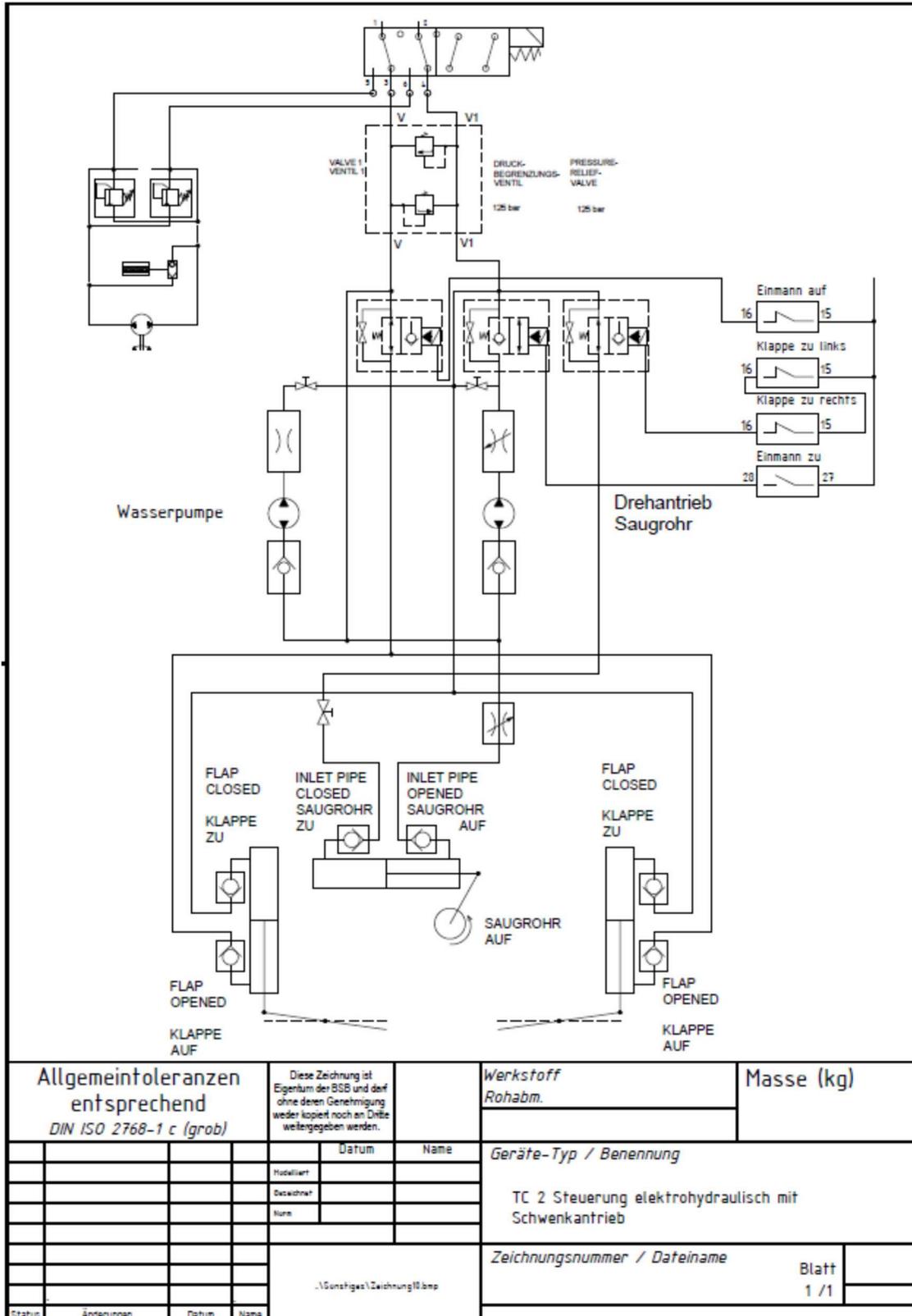


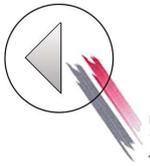
Allgemeintoleranzen entsprechend DIN ISO 2768-1 c (grub)		Diese Zeichnung ist Eigentum der SGG und darf ohne deren Genehmigung weder kopiert noch an Dritte weitergegeben werden.		Werkstoff Rohabm.	Masse (kg)
		Hersteller	Kunde	Geräte-Typ / Benennung	
		27.01.2016	Lohmann	Hydraulikschaltplan TC2 mit Drehantrieb links - rechts	
		27.01.2016	Lohmann		
				Zeichnungsnummer / Dateiname	
				TC2-7.080-01-0	
				Blatt	1:
				1 / 1	A4
A. Kroschel hinzü		08.04.16 U.D.		..Sonstige/Zeichnungsleg.	
Stafus	Änderungen	Datum	Name		



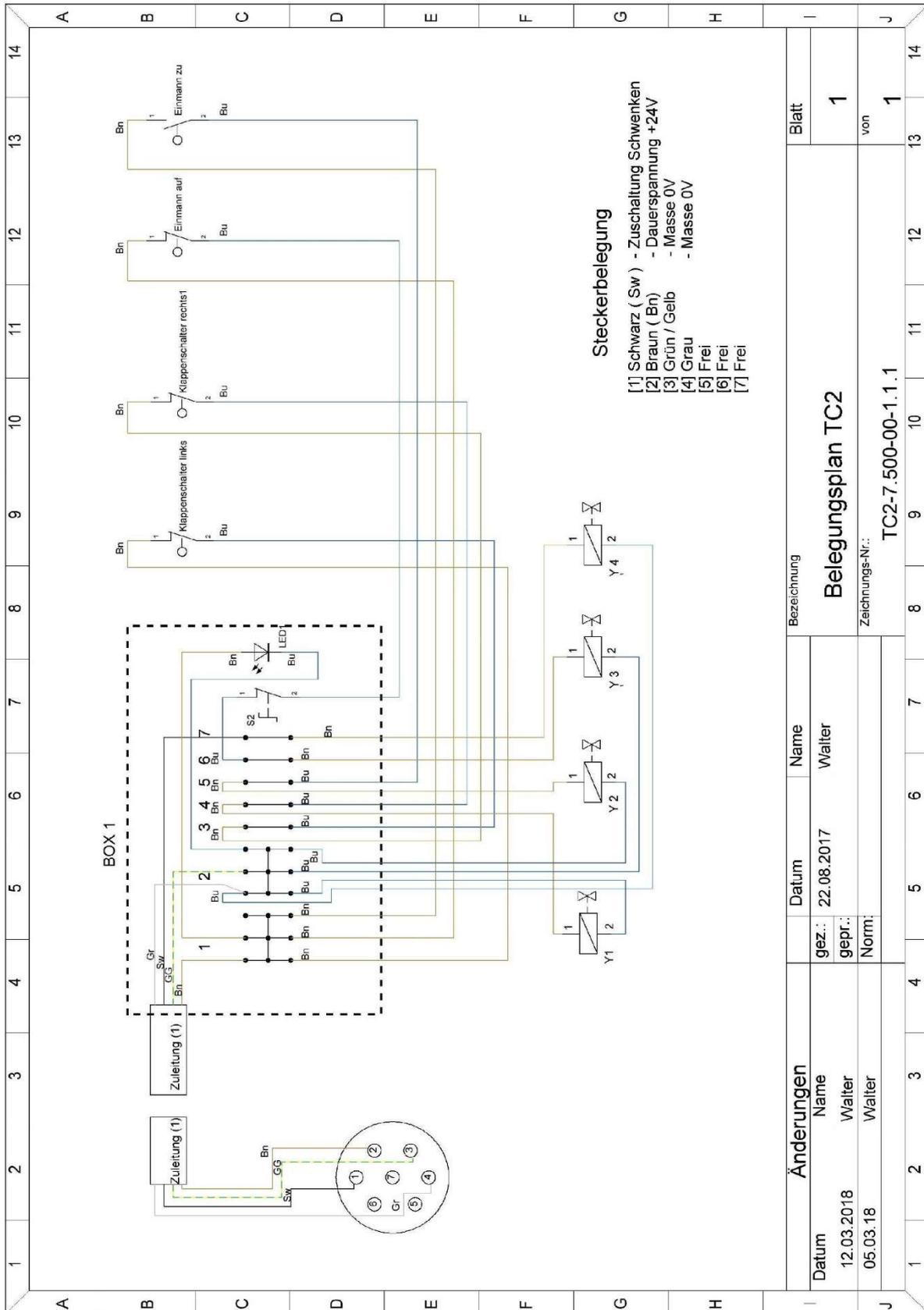
9.4 Variant 5

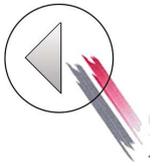
9.4.1 Circuit Diagram



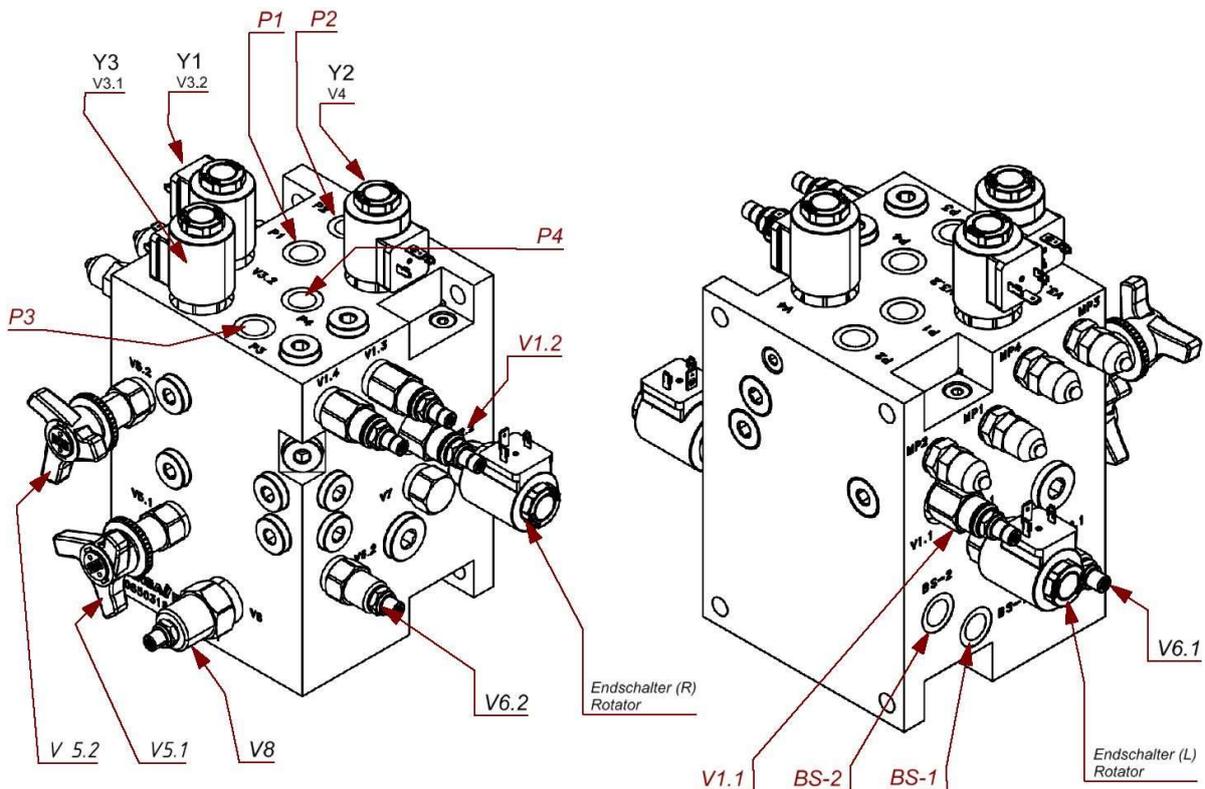


9.4.2 Pin Assignment Plan

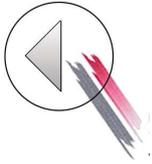




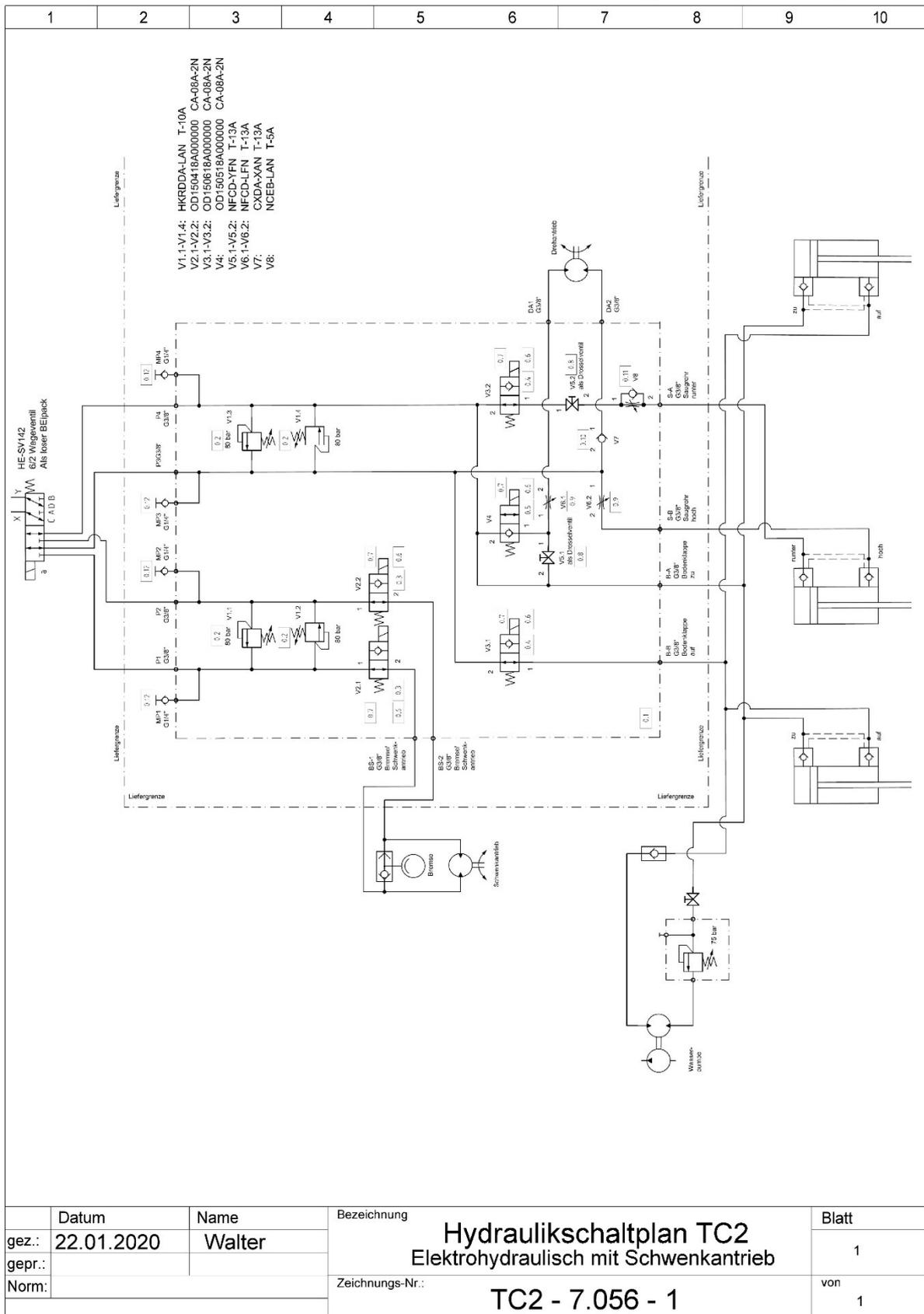
9.5 Variant 6



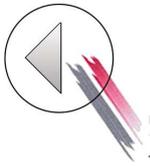
- The flaps are operated using the functional gripper (direction dependent). The ventilator is operated via the hammer function.
- By means of sequential control, on opening the suction crown high, the end switch (one-man open) and the open flap function are released by the valve (V3.1).
- Once the flaps are closed, the suction crown moves into the operating position.
- In flap close mode, the flat limit switch operates the valve (V3.2) currentless, returns to the normal position and releases the flow of oil to close the inlet pipe (S). If the inlet pipe is closed, the end switch (one-man closed) is operated and via valve (V4) releases the function “rotate inlet pipe”.
- The closing speed of the inlet pipe can be set via the flow control (V8).
- The opening speed of the inlet pipe can be set via the flow control (V6.2).
- The adjustable flow control valve (V6.1) in the oil engine supply line (rotate inlet pipe), creates the preload pressure for the water engine at no load.
- Are check valves (V7) in the oil circuit open flaps prevents the rotation of the inlet pipe when opening the discharge flaps. The inlet pipe rotate on one side only.
- If the flap function of the one-man is not required, it can be disabled with the valve (5.2).
- If the drive unit does not supply power, the flap functions run simultaneously. The rotate inlet pipe function is enabled by opening the valve (5.1)



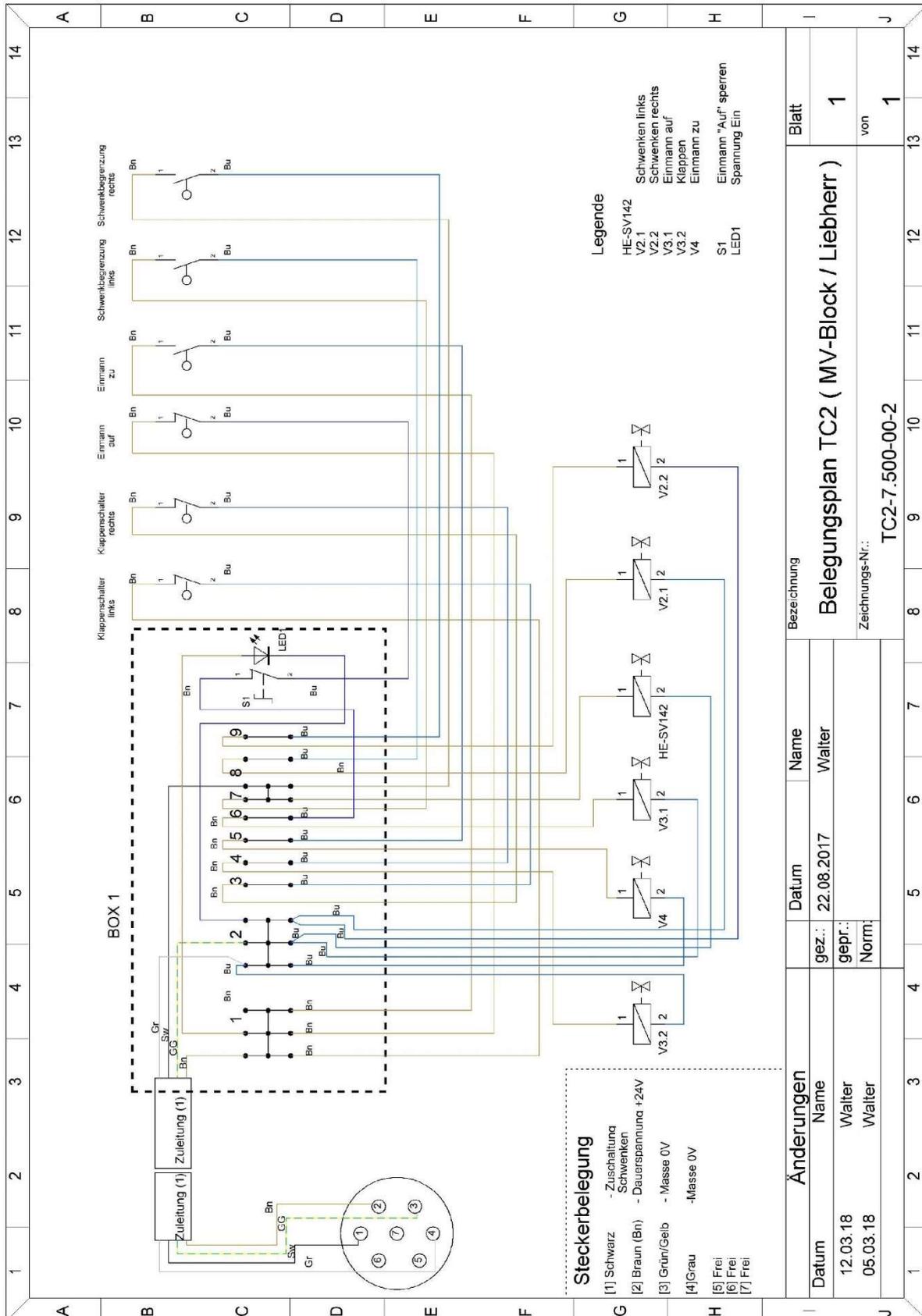
9.5.1 Circuit Diagram

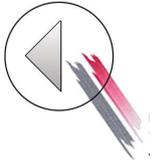


	Datum	Name	Bezeichnung	Blatt
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gepr.:				von
Norm:			Zeichnungs-Nr.: TC2 - 7.056 - 1	1



9.5.2 Pin Assignment Plan





9.6 Variant 6.1 (SPS)

In variant 6.1, the signal output is equivalent to variant 6, but the control system is different. When initiating the hydraulic flaps open mode, the basic function remains the same, but with a 1-second-delay in the sequential control. This provides more time to stop between steps.

There is also a one second delay when closing the flaps. The water pump operation is new. There are two options: switching on the water pump in alternate or direct operation if suction hose rotation is not required.

In normal operation there are 2 types of operation:

- 1) inlet pipe rotation
- 2) inlet pipe rotation + water supply

Operating mode can be switched via the close flaps function. To switch between the operating modes, briefly stop the hydraulic activation of the function then reactivate it. Operation with water is signalled by a blue indicator light "water" during operation.

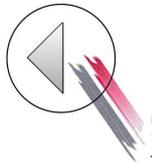
If suction hose rotation is switched off using the "rotating drive lock" switch, the "water" indicator light remains illuminated.

Rotator operation can also be operated as in variant 6. It is signalled with a green indicator light "rotator".

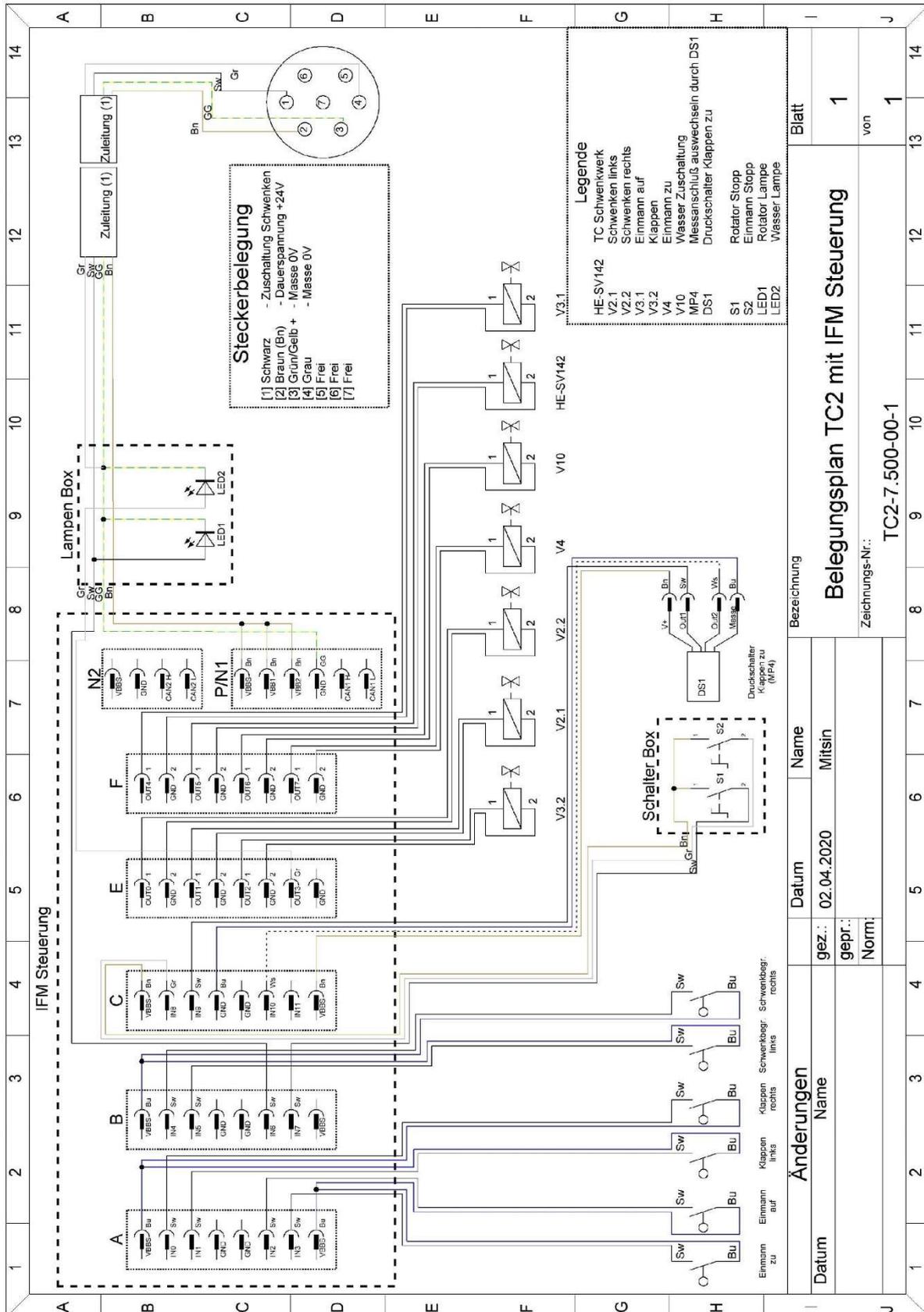
To prevent damage to the water pump caused by an empty water tank,

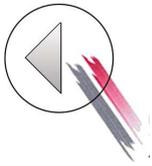
The machine has an integrated water level control, which prevents the pump from being activated when the tank is empty. As soon as an empty water tank is detected, the "water" indicator light flashes.



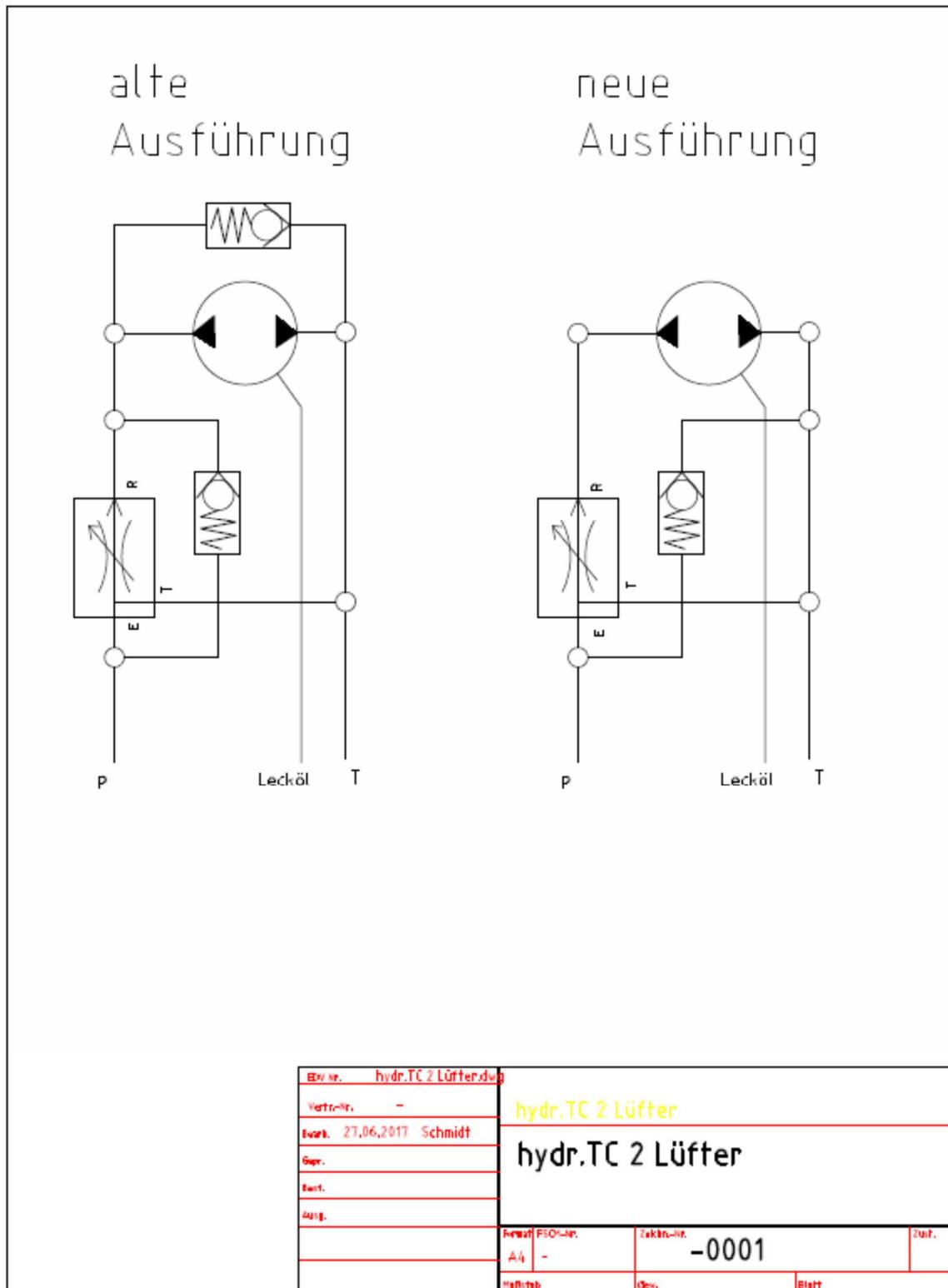


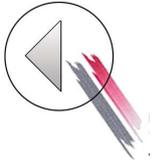
9.6.1 Terminal Connection Diagram Variant 6.1





9.7 Hydraulic Circuit Diagram Hydromotor





10 Disposal

Disposal of the TubeCube TC2 after its lifetime, is only permitted to qualified personnel. The manufacturer takes no liability for damages which are the result of inappropriate disposal.

During all handling of TC2 it is of the utmost importance to not cause any unnecessary environmental impact. Oil and grease residues are to be removed after maintenance work is finished. Leaking fluids are to be collected. If the oil system has to be drained make sure that enough containers are available.

All contaminations and oily residues have to be disposed of environmentally friendly and in accordance with local environmental protection laws.