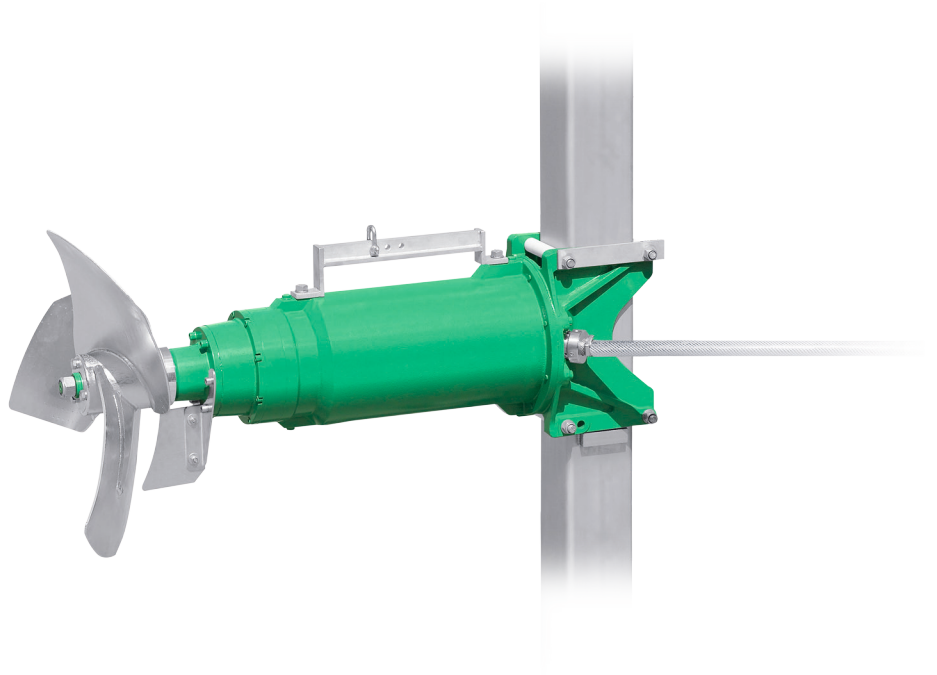


Submersible motor agitators

Optimix 3G 250-270

for biogas and liquid manure containers



**Operating instructions
and spare parts list**

Original edition (GER)

Contents

1	General	4
	To the operating personnel	4
	Other applicable documents	4
	Storage	4
2	Safety	4
	Fundamental safety instructions	5
3	Intended use	7
	Misuse	7
	Liability exclusions	7
4	Structure and function	8
5	Scope of supply	9
	Standard model with motor support	9
	Accessories (optional)	9
6	Type plate	9
7	Technical data	10
8	Assembly of the submersible motor agitator	11
	Before installation	11
	Conditions for assembly	11
	Mounting the agitator mast with the control unit	12
	Mounting the submersible motor agitator	12
	Finishing the agitator installation	12
	Connect the power supply	12
	After completed installation	13
9	Stirring operation	14
	Prerequisites	14
	Adjusting the agitating position	15
10	Faults and troubleshooting	16

11	Inspection and maintenance	18
	Servicing Plan	18
	Before maintenance work	19
	Inspection work	19
	Tightening torques	19
	Wear-related maintenance work	19
	Replacement of the shaft sealing rings	20
	Oil change	20
	Replacement of the propeller	20
12	Proof of maintenance and service	21
13	Spare parts and ordering	22
	Assembly of the submersible motor	22
	Assembly planetary gear	24
	Assembly of the bearing flange	26
14	Installation of the suspension mounting frame EV5	26
	General and prerequisites	26
	Installation of the work platform and swivel boom	26
	Installation of the guide tube and cable guide	26
	Structure of the cable clip	27
	Structure of the suspension mounting frame EV5	28
15	Installation of the gastight operating unit (MGD)	30
	General and prerequisites	30
	Installation of the guide mount and guide tube	30
	Installation of the cable guide	31
	Structure of the built-in mast with gastight operating unit	32
16	Biogas safety information (three-substance diagram)	34
17	Permit for potentially explosive areas	35
18	Excerpt from the Accident Prevention Regulations (UVV 2.8)	36
19	Checklist for initial commissioning	38
20	EU declaration of conformity	39

1 General

To the operating personnel

These operating instructions provide information regarding safety, design, function, operation and maintenance of Optimix submersible motor agitators, type 3G. Following the instructions carefully will ensure long, trouble-free and safe operation.

Other applicable documents

- Accident Prevention Regulations and Safety Information (Appendices)

Storage

The operating instructions (incl. the jointly applicable documents) must always be kept readily available near the propeller agitator!

2 Safety

Prohibiting, warning, mandatory and information signs

Excerpt from the health and safety protection labelling in accordance with the Accident Prevention Regulations (BGV A 8 / DIN 4844):

	Unauthorized access forbidden!		Warning – risk of falling!
	Fire, naked light and smoking forbidden!		Warning of automatic starting!
	Access forbidden, risk of falling through!		Use respiratory protection!
	Reaching in forbidden!		Use a body harness!
	Warning of a dangerous area!		Use eye and ear protection!
	Warning of potentially explosive atmosphere!		Use protective gloves!
	Warning of dangerous voltage!		Follow the instructions for use!

Fundamental safety instructions

The safety information serves to avoid danger to persons, damage to the agitator and detrimental effects on the environment. It is mandatory for all users to read these safety instructions and always to adhere to them.



Danger of injury due to improperly secured parts!

If necessary, use suitable hoisting equipment designed to accommodate the weight and shape of the agitator and accessories (e. g. excavator, crane).

Persons must not remain under the load whilst lifting, transporting and lowering the device.

Never leave the load unattended when it is in a raised condition. Do not reach under the agitator when lifting or lowering it.

Never grasp moving parts!



Danger of injury due to impacts! Wear a safety helmet!

Danger of injury due to falling parts! Wear safety shoes!

Danger of injury due to sharp edged metal parts! Wear safety gloves!



Warning of potentially explosive and flammable atmospheres!

Gases can escape from the fermenter, which may be toxic, inflammable and potentially explosive!

Assembly and maintenance work on explosion-protected machines shall be carried out by suitably qualified persons observing the Operational Safety Act (BetrSichV corresponds with 1999/92/EC) as well as the safety and maintenance information in these operating instructions. Danger of explosion due to lightning strike!

When carrying out maintenance work on container openings, make sure that no potentially explosive atmosphere exists for the entire duration of the work!

Work influencing explosion protection must only be carried out by appropriately trained or proficient specialists. The permit (see Chapter 2 Safety Information) must be completed before any work on the agitator is performed and must be signed by the person responsible. If the work is not carried out by SUMA, it must be performed by a trained service technician and approved. The technician must provide written confirmation and attach a certificate mark to the machine. This confirmation must be filed in the operator's explosion protection documentation and shall be presented upon request.

Danger of explosion due to lightning strike!

Increased explosion hazard!

- *Gas may escape when opening or dismantling the agitator.*
- *MAKE ABSOLUTELY SURE to keep all sources of ignition (e.g. naked flames, hot heat sources, tools prone to sparking, electrical equipment without explosion protection) away from potentially explosive areas (Ex zones)!*
- *ONLY USE non-sparking tools (also applies to drills, bits, core drills, chisels, etc.)! Welding work, burning work and work generating sparks must UNDER NO CIRCUMSTANCES be carried out within Ex zones!*
- *Do not smoke and do not use naked flames, mobile phones or other ignition sources in the vicinity of the biogas system.*
- *Provide sufficient ventilation for the fermenter during assembly and maintenance work. Observe the regulations for the biogas system!*
- *Secure the plant against being accessed and operated by unauthorised persons*



Hazard due to dangerous voltage!

Any work on electrical equipment may ONLY be carried out by a qualified electrician.



Danger of injury

Please observe the relevant accident prevention regulations for agricultural biogas systems, the Operational Safety Act (BetrSichV) and other technical regulations as well as the safety instructions.

Supplementary to the operating instructions, the generally applicable and local regulations governing the prevention of accidents, work safety and environmental protection must be made available and observed.

Persons who are under the influence of alcohol, drugs or medicines must not transport, install, commission, operate or repair the to propeller agitator.

The operating personnel must be at least 18 years old.

Ensure that the operating personnel are instructed regularly in all relevant questions of work safety and environmental protection and that they are acquainted with and observe these operating instructions and the safety instructions contained in them.

Pay attention to the warning and instruction signs attached to the propeller agitator. Also make sure that these are not removed UNDER ANY CIRCUMSTANCES and that they remain LEGIBLE.

NEVER switch on the device if it is not properly and fully assembled, or when there are persons within the danger zone.

During mounting and maintenance work, keep persons and animals away from the fermenter and the working area of the device. Pay particular attention to children playing!

Never leave the machine unattended during assembly and maintenance work.

Before working in the fermenter, on and in the vicinity of the propeller agitator and on the electrical equipment:

- *MAKE ABSOLUTELY SURE to switch off the machine at the mains switch and to secure it against being accidentally switched on again by means of a padlock (remove the key) and affix a corresponding warning sign.*
- *MAKE ABSOLUTELY SURE TO WEAR personal safety equipment (safety belt, safety rope, gas warning device, respiratory equipment, safety shoes, protective gloves etc.)!*

The submersible agitator must not be put into operation without the safety / protective equipment fitted by the manufacturer or installed on site.

Faults in the agitator must be rectified without delay. Do not alter or convert the propeller agitator, otherwise the declaration of conformity and the operating licence will be void.

When changing defective components, make sure to only use original spare parts with identical electrical and mechanical data, as otherwise neither the safety, function nor explosion protection can be maintained.

All safety devices, seals, attachments as well as electrical connections and cables must be inspected regularly for perfect condition.

For warranty details, please refer to our General Terms and Conditions of Delivery or your contract documents.



Danger of environmental damage due to oils, lubricants and cleaning agents!

These materials may on no account be allowed to enter the soil, water, sewer or fermenter. Hazardous materials, as well as containers and cloths contaminated by these MUST be stored and transported in suitable containers and disposed of in accordance with regulations!

Suitable personal protective equipment is to be used when handling hazardous materials.

3 Intended use

The agitators of type Optimix are designed to be installed in fermenters of agricultural biogas plants and normal liquid manure containers and are used for the agitation of liquid manure, liquid manure with co-substrates (e.g. renewable raw materials) and similar biological liquids. For the intended use a square tube is necessary as a mounting device (for attachment); an electrical controller is required for operation if necessary.



Notice

The agitators of type Optimix are a component of the agitation facility (a unit consisting of container, control unit, agitator, items of equipment, etc.) within the meaning of the machinery directive 2006/42/EU and thus represent an incomplete machine.



Danger of explosion!

The Optimix submersible motor-driven agitators are approved according to the explosion protection directive 94/9/EU for use in Ex zone 2, as well as outside Ex zones. Operation of the unit in Ex zone 0 or 1 is not permissible. If necessary, it is to be guaranteed by the customer that unintentional operation in an impermissible Ex zone is reliably prevented. If an Ex zone 0 or 1 is present above the substrate due to the installation situation/plant, it must be ensured by means of suitable safety device(s) that, in case of emergency, all poles of the voltage and current supply to the agitator are disconnected.

Operation of the agitator is only permitted when the propeller is fully submersed. The substrate to be agitated must be in fluid state, the dry matter content (DMC) must not exceed 12%, the temperature must be within a range of 5 °C to max. 60 °C and it must have a pH-value between 6.5 and 8.2.

Misuse

The agitator may be installed, operated and serviced exclusively in accordance with the specifications in this operating manual. Any other use is considered to be misuse, in particular if

- use is not in accordance with the declaration of conformity,
- the agitator, mast, support or control unit are not ready for operation or have been modified,
- the agitator is not suitable for the substrate to be agitated,
- there are foreign bodies in the substrate, e.g. cords, plastic straps, foils, wood, ropes, chains.

The user or operator of the agitator is responsible for all damage resulting from inappropriate use.

Liability exclusions

Liability for personal injuries and damage to property and the environment is excluded in particular in the case of:

- inappropriate transport, installation, commissioning, operation or maintenance;
- use with defective or improperly attached safety devices;
- disregarding the instructions in the operation manual;
- unauthorised intervention or structural modification;
- insufficient monitoring of parts that are subject to wear,
- improperly performed maintenance;
- use other than for the intended purpose;
- influence of foreign objects.

Corrosion caused by electro-chemical reactions (e.g. pH value, copper sulphate, hydrogen sulphide), by stray current (e.g. inadequate/incorrect earthing) or by microbial influences (e.g. bacteria, algae, fungi) does not represent a defect (reason for complaint).

4 Structure and function

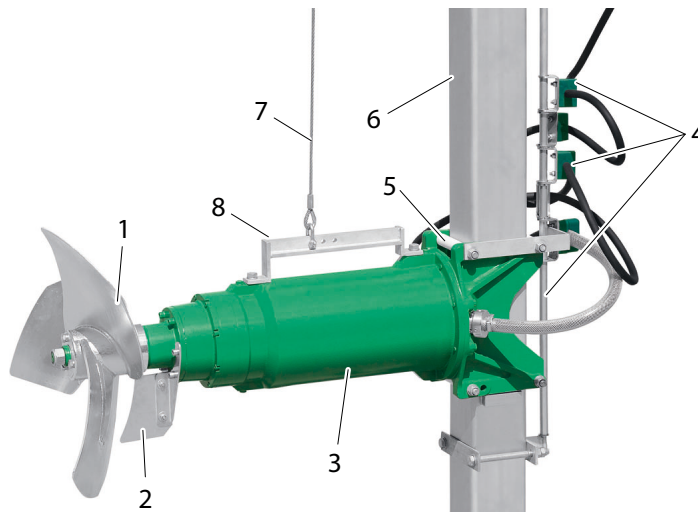


Figure 1: Optimix 3G with cable guide linkage (standard version)

- | | |
|--|---------------------------------------|
| 1 Propeller | 5 4-roller guide |
| 2 Scraper | 6 Sliding mast (optional) |
| 3 Submersible motor | 7 Stainless steel rope (optional) |
| 4 Cable guide linkage, complete (optional) | 8 Retaining bracket for hauling cable |

The submersible motor agitator serves for mixing renewable raw materials (RRM), liquid manure and similar substrates. The electro-motor driven submersible agitator is designed for submersion operations in potentially explosive environments of Ex zone 2 and complies with Directive 94/9 EC.

The submersible agitator can be attached to most sliding masts measuring 150 x 150 mm by means of the guide unit that is flange-mounted to the motor housing. A retaining bracket is fitted to the submersible motor (6) for attaching the hauling cable for the height adjustment. Due to the 4-roller guide on the guide unit, the agitator can be raised and lowered on the square mast virtually without friction, even if the linkage of the hauling cable is attached somewhat at an angle. The guide unit is designed as standard for a 150 x 150 mm square sliding mast; it can also be used for a 120 x 120 mm or 100 x 100 mm sliding mast by exchanging the rollers.

The connecting cable is stress-relieved directly at the cable gland, which is pressed pressure-tight to the cable. Depending upon requirements, the cable can then be guided either by cable clips on the hauling rope or by cable guide linkage at the rear of the sliding mast.

The geared motor with guide unit is manufactured from nodular cast iron (GGG40) and painted; the propeller is galvanised. The submersible agitator is manufactured in a modular design; electric submersible motor with a generously dimensioned planetary gear and flanged bearing unit for absorbing the agitating forces. The conical shaft in the bearing unit is tempered, mounted by two angular roller bearings in an oil bath and sealed against the agitating substrate by a mechanical seal made of SiC/SiC that is independent of the direction of rotation.

5 Scope of supply

The scope of supply may differ from the illustration on the front page!

Standard version

Description	Quantity
Optimix 3G, complete (with propeller, 10 m connecting cable, without switch)	1

Accessories (optional)*

Description	Quantity
Start-up control (manual switch, soft start,...)	1
Screened connecting cable in a custom length	1
Cable guide linkage, complete.	1
Cable clip for attaching to the hauling rope	1
Different installation kits with sliding mast for biogas or liquid manure containers	1
Stainless steel propellers or hardened steel propellers	1

*see also our currently valid sales lists.



Notice

The submersible motor propeller is delivered without the switch box.

Safety and monitoring equipment (e.g. EMERGENCY-STOP and start-up control) shall be provided for on site and can be optionally ordered as an accessory.

6 Type plate

The type plate of the agitator is mounted at the cable outlet on the motor, bearing the following information:

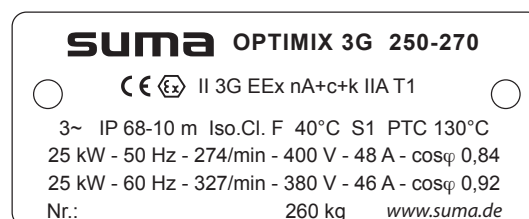


Figure 2: Optimix 3G 250-270 type plate

7 Technical data

Optimix type	3G 250 - 270
Manufacturer	SUMA Rührtechnik GmbH Martinszeller Str. 21 DE 87477 Sulzberg
Rated power	25 kW
Rated voltage	400 VΔ
Frequency	50 Hz
Rated speed (electric)	1,465 rpm
Rated current	48 AΔ
Starting current I_A/I_N	7.8
Power factor cos φ	0.84
Insulation class	F
Temperature sensor	PTC 130°C
Operating mode	S1 (100 % ED) - maximum of 6 starting procedures per hour
Activation	Soft start / frequency converter
Cable length	10 m or optionally up to 50 m
Protection class	IP 68 - 10 m
Gear transmission ratio	5.35
Sound pressure level	< 72 dB (A)
Area of application	5°C ... 60°C pH 6.5 ... 8.2 TS < 12%
Ignition protection type	Ex II 3G Ex nA+c+k IIA T1
Propeller	MS 850
Weight including Motor support	260 kg
Dimensions incl. Guide unit mm	1,230 x 850 x 850

8 Assembly of the submersible motor agitator

General



Danger of personal injury and damage to property and the environment!

It is essential to follow the safety instructions in chapter 2 Safety.

The submersible motor agitator Optimix 3G is designed in such a way that it can be installed and dismantled from outside. The geared motor is intended for submersion operations up to a filling level of 10 m, for which it is designed according to its protection class IP68. The maximum ambient temperature for the operation of the geared motor must be at least 5 °C and at the most 60 °C.

Attention must also be paid during assembly that enough space is available around the propeller for faultless agitator operation. The adjustment possibility can be limited on site if required, in order to prevent contact of the propeller with the floor wall or roof of the machine.

Before installation



Warning of potentially explosive and flammable atmospheres!

Before installing the propeller agitator, make sure that no potentially explosive atmosphere exists for the entire duration of the work. Before working in potentially explosive areas, a permit (see Appendix *Safety information*) must be filled in and signed by a responsible person.



Danger of injury due to improperly secured parts!

- *Use suitable hoisting equipment designed to accommodate the weight and shape of the propeller agitator (e. g. excavator, crane).*
- *Persons must not remain under the load whilst lifting, transporting and lowering the propeller agitator.*
- *Never leave the load unattended when it is in a raised condition.*
- *Do not reach under the agitator when lifting or lowering it.*
- *Never grasp moving parts!*

Conditions for assembly

- The static and dynamic design of the container and the sliding mast with the adjustment equipment must be suitable for use with the submersible motor agitator.
- Depending on the installation situation, a work platform may be required for the operation of the agitator.
- Before drilling holes and making openings, the container wall must be checked for clamping and heating elements and similar.
- The container must be emptied or the substrate must be sufficiently lowered, ventilated and cleaned.

Mounting the agitator mast with the control unit

- Mount the agitator mast with the support according to the manufacturer's instructions.
- Check the function of the mast.

Mounting the submersible motor agitator



Caution! Danger of damage to the device

When introducing, assembling and attaching the agitator to the sliding mast, avoid contact of the propeller or damage to the connecting cable..

- Open the rear sliding rollers on the motor support,
- Suspend the Optimix securely on the motor support and lift it in the container onto the sliding mast, Attach the sliding rollers and secure them so that they can still be rotated.
- Fasten the hauling cable to the motor support.
- Test the lifting and pivoting functions of the submersible agitator and limit them if necessary.
- Attach appropriate cable guide, making sure that the cable support is suitable for the cable diameter and that it does not impermissibly constrict the cable.

Finishing the agitator installation

- Inspect the agitator for damage,
- Check the bolted connections with a torque wrench.
(see Tightening torques in Chapter 10).
- Align the agitator in the desired position.

Connect the power supply



Hazard due to dangerous voltage!

Any work on electrical equipment may **ONLY** be carried out by a qualified electrician.

The cable must be sufficiently dimensioned.

Ensure by potential equalisation that no different earthing potentials and potential equalisation flows exist between the bodies of the operating equipment.

Creating electrical connections

The electrical connection must be made by a specialist in accordance with the valid safety and accident prevention regulations. Relevant assembly and operating regulations (e. f. for cable cross-sections, fuses, protective conductor connection) must be taken into account. In potentially explosive areas, only approved screw connections and terminal boxes may be used.

The motor is to be protected against overloading and impermissible heating up and must be completely disconnected from the voltage supply in the case of tripping. Impermissible heating up of the submersible motor must likewise be prevented in the operational case that it is not submersed in the substrate.

The following combination is necessary for the electrical protection of the motor:

- motor protection switch with phase-failure protection, and
- temperature monitoring by means of the PTC temperature sensor built into the motor.



Caution!

A maximum test voltage of 2.5 V may be applied to the temperature sensors integrated in the winding of the electric motor (PTC / thermistor) for the 'thermal machine protection (TMS)'.

Never apply the control voltage of 230 V.

The Optimix type-3G submersible motors are suitable for a 3-pole start by means of soft start or frequency converter or direct start-up.



Warning of potentially explosive and flammable atmospheres!

If the submersible motor is used in accordance with its suitability for a potentially explosive area, then it may only be controlled by a frequency converter if this frequency converter is suitable for the operation of motors in an Ex zone.

The Optimix 3G is equipped with a special microbe-resistant screened cable 4x10 + 4x1 mm² for the electrical connection. The connecting wires bear numbers or colour codes (acc. to DIN 47100). Cores 4 and 5 are signal lines for the PTC temperature sensor; cores 6 and 7 are not used at present.

Notice: The screening is not attached inside the motor and is suitable for insulation monitoring.

Designation	No.	Color
U1	1	black
V1	2	brown
W1	3	grey
PE		yellow-green
T1 (max. 2,5 V)	4	black
T2 (max. 2,5 V)	5	black
-	6	black
-	7	black

Figure 3: Colour code of cable identification)

Connecting the submersible motor

- Check whether the electrical data of the agitator and control unit match.
- Connect the supply cable to the motor in clockwise direction.

Check the direction of rotation of the motor

- By briefly starting the motor (trial operation) check the direction of rotation. Clockwise rotation should mean that the propeller has the correct rotational direction, but please check this to make sure. Looking at the front of the propeller, the rotation must be in clockwise direction.

Earthing the electric agitator

Ensure by potential equalisation that no different earthing potentials and potential equalisation flows exist between the bodies of the operating equipment.

- Ensure adequate earthing of the propeller agitator (potential equalisation): connect the earth conductor provided by the customer to the yellow-green PE conductor of the agitator.

After completed installation

- Test the function of the motor circuit breaker.
- Check the proper assembly of the potential equalisation between the fermenter / container, agitator and distributor.

9 Stirring operation



Danger of personal injury and damage to property and the environment!

It is essential to follow the safety instructions in chapter 2 Safety.

Prerequisites

- The propeller must not be blocked by solid deposits.
- The propeller must always be fully submersed in the substrate during agitating. If necessary, a suitable monitoring facility must be installed on site.

During operation, pay attention to unusual noises and vibrations (e. g. caused by loose parts, damage to the motor, gear unit, bearing or shaft, vortex formation etc.).

The Optimix is equipped as standard for operation in one rotational direction, in clockwise direction (to the right), viewed from the propeller to the motor. A reversal of the direction of rotation, e.g. in order to free the propeller from vortices, is only permitted briefly up to 5 minutes.

Operation of the propeller is only allowed in immaculate and fully functional condition.

The agitator may not be operated under any circumstances if

- maintenance and service work is being carried out,
- the agitator is damaged, or there is a suspicion that damage may be caused during operation,
- the sliding mast or the hauling cable fixture are not properly fastened or do not have the necessary strength quality for safe operation,
- the propeller is not or not fully submersed in the substrate.

If damage to or deterioration of the agitator or the fixing parts or the supply lines are discovered, or if non-hazardous operation is not guaranteed for some other reason, the agitator must be taken out of service immediately or, if applicable, must on no account be taken into service.

Foreign bodies in the stirring medium, such as twine, string and plastic tapes can cause imbalance of the propeller, which in turn can lead to a higher load on the bearings or to material fatigue. These foreign bodies can also cause early failure of the mechanical seal.

General



Notice

Vibration strengths $v_{\text{eff}} \leq 3.5 \text{ mm/s}$ are normal during agitator operation. In the event of deviation from normal operation – e.g. increased temperatures, loud noises or vibration – the agitator should be switched off and checked for damage in case of doubt.

Adjusting the agitating position



Caution! Danger of damage to the device

Adjusting and changing the agitating position by lateral swinging or height adjustment may take place only when the agitator is stationary.

Make absolutely sure that the hauling cable is always kept taut so that the cable cannot come into contact with the propeller. Never work with a damaged hauling cable.

As the substrate to be agitated (particularly co-ferments) can be very different in its composition, a binding statement as regards optimal agitation cannot be made. How often and how long the agitator must run depends on the consistency of the substrate.

Based on experience, the best agitation results for avoiding floating layers is achieved, when the agitator is laterally swivelled to the left by approx. 45° and the top edge of the propeller is about 20 to 30 cm below the filling level. In case of thick floating layers, it is recommended to not process these in continuous operation but at intervals.

If several agitators exist, it is often recommendable to start them fairly simultaneously, in order to quickly achieve a rotary movement in the container; after this, the additional agitator can usually be deactivated. All agitators shall mix in one direction, not in opposite to one another.

A non-homogenous substrate often results from an insufficient agitator capacity, e.g. due to worn propellers or from the poor flow capability of the substrate due to a too high dry matter content (%TS).
See Chap. 10 *Faults and troubleshooting*.

10 Faults and troubleshooting



Danger of personal injury and damage to property and the environment!

It is essential to follow the safety instructions in chapter 2 Safety.

Fault	Possible cause	Remedial action
No function	Motor or gear unit defective	Replace the geared motor or repair it (have it repaired).
	The RCCB has triggered	Check the connecting cable, replace if necessary (have replaced); dismantle the agitator and check for leak tightness (have checked); check circuit breaker.
	Motor circuit breaker has triggered	Switch the circuit breaker back to operating position, check cause if necessary (have checked);
	Safety switching device has triggered	Release control circuit, check cause if necessary.
	Control unit or electrical connection defective	Check the design of the control unit, repair the control unit or the electrical connection (or have them repaired).
	Propeller is blocked	Release the blockage by reversing the rotational direction.
	One or more phases missing	Check fuses, terminal box, power cable and motor connection.
Stirring power is too weak	Propeller worn	Determine wear on the basis of the power consumption and replace the propeller if necessary.
	Stirring time too short, breaks between too long.	Increase agitation intervals; optimise agitating position.
	Dry matter content of the substrate is too high.	Check substrate quantity, composition and solids content and dilute or reduce the addition of solids if necessary.
Motor burnt out	Motor circuit breaker incorrectly connected or adjusted	Replace motor (have replaced) and correctly adjust the circuit breaker.
	Motor incorrectly connected	Replace motor (have replaced) and connect correctly.
	Connecting cable is damaged	Replace the connecting cable (or have it replaced); determine the cause (or have it determined).

Fault	Possible cause	Remedial action
Electro-motor overloaded	Density of the substrate is too high.	Check the quantity, composition and solid content of the substrate and dilute it if necessary. Exchange the propeller.
	Poor cooling	Dry matter content of the substrate is too high Lower the substrate temperature, replace the propeller if necessary (or have it replaced).
	Substrate is clinging to the motor housing	Dry matter content of the substrate is too high, dilute it if necessary; Check the agitation performance (or have it checked)
	Bearing defective.	Check the function / bearing; repair it (or have it repaired) if necessary.
	Voltage too low during operation	Check connecting cable (cross-section and length) supply voltage, power consumption.
	Foreign materials have wrapped themselves around the propeller	Remove foreign materials, possibly by briefly reversing the rotational direction.
Propeller agitator runs unevenly	Propeller is damaged or distorted.	Replace the propeller (or have it replaced). Check the installation situation and remove any foreign bodies if necessary
	Foreign materials have wrapped themselves around the propeller	Remove foreign materials, possibly by briefly reversing the rotational direction.
	Corrosion on the propeller	Determine the cause of the corrosion (or have it determined) and rectify it.
Strange drumming noises on the agitator.	Propeller is catching the scraper	Check propeller bearing, replace if necessary, readjust scraper
Unusual operating noises	Loose parts	Retighten all nuts, bolts and screws
	Damage to the agitator	Call SUMA Customer Service or your dealer for assistance; if necessary, dismount the agitator and check it (or have this done).
Corrosion	Stray current corrosion	Ensure potential equalisation, if necessary attach a sacrificial anode, repair or replace damaged parts (or have them repaired or replaced).
	Electro-chemical corrosion Contact corrosion	Check the concentration of foreign matter (silage liquid, copper sulphates,...), avoid foreign matter, attach a sacrificial anode if necessary, repair or replace damaged parts (or have them repaired or replaced).
	Micro-biological corrosion	Check for possibly increased microbial load (silage additives,...). Repair or replace damaged parts (or have them repaired or replaced).

11 Inspection and maintenance



Danger of personal injury and damage to property and the environment!

It is essential to follow the safety instructions in chapter 2 *Safety*.



Warning of potentially explosive and flammable atmospheres!

Before dismantling the propeller agitator, make sure that no potentially explosive atmosphere exists for the entire duration of the work. Before working in potentially explosive areas, a permit (see Appendix *Safety information*) must be filled in and signed by a responsible person.

Servicing Plan

Component	Checking	Check	Operating resources / remark
Propeller agitator	Function	Daily during operation	Also observe whether any unusual noises or vibrations occur.
	Damage and corrosion	At least 2,000 operating hours per year	Repair (have repairs done) if necessary. Replace defective parts (have them replaced).
Sliding mast with support	Function	Daily during operation	Visual inspection, if necessary swivel the agitator
	Corrosion and firm seating	At least 2,000 operating hours per year	Repair (have repairs done) if necessary. Replace defective parts (have them replaced).
Hauling cable and cable guide	Damage	Upon each use, at least monthly	Visual inspection, if necessary lower and lift the agitator.
Connecting cable and cable guide	Damage, impermissible buckling	At least 2,000 operating hours per year	Visual inspection, if necessary, replace defective parts (have replaced).
Propeller	Damage and wear	As required, at least on a yearly basis	Replace if necessary
Planetary gear	Oil change	2,000 operating hours, at least every 2 years	See under <i>Changing the gear oil</i> .
	Replace bearing		See under <i>Replacement of the bearings</i>
Bearing head	Oil change	2,000 operating hours, at least every 2 years	See under <i>Changing the gear oil</i> .
	Replace bearing		See under <i>Replacement of the bearings</i>

Before maintenance work

- If the propeller agitator has to be dismantled for maintenance work, **SUFFICIENTLY** reduce the filling level in the fermenter!

Inspection work

Mechanical connections

- All mechanical connections must be secured against self-loosening. The propeller and moving parts must be checked regularly for free running and firm seating.

Tightening torques (for bolts in Nm)

- So that screws can maintain the stipulated tension force achieved by screwing in, the screws must only be tightened to the maximum permissible torque rating. If exceeded, the screw may be elongated and the tension force is lost.
- The following recommendation for tightening torques are calculated at an average friction coefficient of $\mu_{ges}=0,14$. Additional lubrication substantially changes the friction coefficient, so that tightening torques are reduced.

Bolt	M8	M10	M12	M14	M16	M20	M24
Quality A2/A4-70							
$\mu=0.10$	16	32	55	88	134	262	451
$\mu=0.14$	20	40	69	111	171	334	574
Quality 8.8 galvanised							
$\mu=0.10$	21	43	73	117	180	363	625
$\mu=0.14$	27	54	93	148	230	464	798

Cleaning

- The agitator and the propeller should be inspected and freed of wrapped or adhering matter at regular intervals, but at least once per year.

Corrosion

- Since the composition of the agitating medium can vary widely and may also be aggressive and abrasive, the agitator must be checked once a year for corrosion and wear as a precaution. If necessary the damaged areas are to be repaired by a suitable silicone-based protective coating.

Corrosion caused by the contractor can usually be prevented; well-known causes according to experience are:

- electro-chemical reaction (e.g. low pH value/acids or copper sulphate in the agitating substrate),
- stray current corrosion (e.g. potential equalisation current due to inadequate earthing),
- microbe-induced corrosion (e.g. increased microbe content due to additives in the animal fodder).



Notice

The inspection work according to BGV A3 is to be carried out.

Wear-related maintenance work

All moving parts, in particular bearings, shaft sealing rings and propellers, are subject to wear, which is dependent on the running time, the loading level and the operating conditions. Since operating conditions can be very different, the following are only recommendations for precautionary replacement.

Replacement of the bearings

In order to ensure trouble-free operation, all bearings must be replaced before reaching their rated service life in L_h (operating hours):

Service life L_{h10} in hours (h)	Motor bearing :	Planetary bearing:	Propeller bearing:
3G 250-270	(2 x 6208.C3): 40,000 h	(3 x K25x35x30): 70,000 h	(2 x 32009X): 45,000 h

Exchanging the shaft seals

The service life of dynamically loaded shaft sealing rings cannot be determined with greater precision, therefore a precautionary exchange of all shaft seals [one in the motor (page 25, item 10) and one in the planetary gear (page 26, item 27) – see also chapter 12 *Spare parts and orders*] is recommended after 8,000 hours of operation at the most.

Oil change

An oil change in the planetary gear and in the bearing head must be carried out at the latest every 2,000 operating hours or at least every two years. The oil should be drained immediately after stopping the agitator, whilst still in a warm condition. 1.5 litres in the planetary gear and 0.2 litres of gear oil in the bearing head are required for re-filling. Gear oil in accordance with SAE 85W-140 / API GL-5 is recommended.

The propeller must be dismantled to drain off the oil in the bearing head.

An oil change in the motor interior is not necessary, since the oil predominantly serves to cool the built-in motor.



Notice

If the old oil in the gearbox or in the bearing head is in a very dirty condition, then these should be rinsed out before refilling with new oil. To do this, fill with the necessary quantity and operate the agitator briefly (up to 3 minutes), drain off the rinsing liquid completely and fill with a suitable gear oil.

The rinsing fluid can be a thin gear oil, a mixture of gear oil and diesel or only diesel. When using diesel as the rinsing fluid, the agitator must not be operated for more than 1 minute.



Caution

The interior of the Optimix with the motor winding may not be rinsed under any circumstances with another liquid, as otherwise the insulation of the motor and the connecting cable could be damaged.

All moving parts are subject to wear, which is dependent on the running time, the loading level and the operating conditions. Since operating conditions can be very different, the following are only recommendations.

Oil batches	Motor housings	Planetary gear	Bearing flange
3G 250-270	3.0 litre AGIP OTE 68	1.5 litre SAE 85W140 / API GL-5	0.2 litre SAE 85W140 / API GL-5

Replacement of the propeller

Wear is dependent on the running time and the substrate that is present. Since the power or current consumption decreases with wear, we recommend that the propeller be replaced before the no-load current is reached (= current load in the non-submersed condition). The conical spring washer (special lock washers) should be replaced at the same time. Take care when replacing that the mounting surfaces are clean.

After replacing the propeller, the scraper must be readjusted so that there is a gap of 1 to 3 mm between the scraper blade and the edge of the propeller at both ends.

[illegible]

13 Spare parts and ordering

Structure of the Optimix complete with motor support

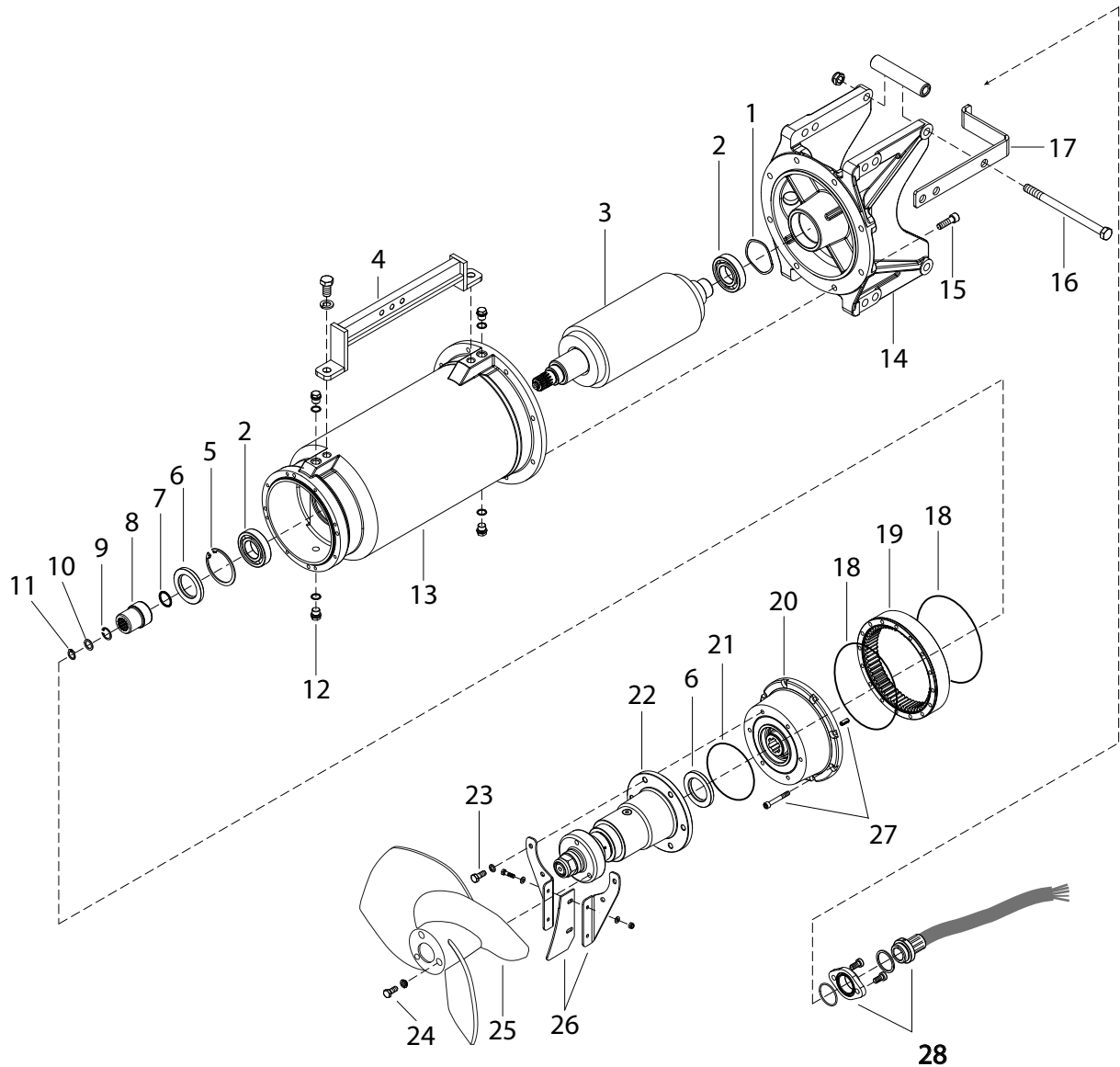
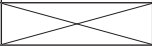
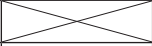


Figure 4: Structure of the Optimix with guide unit

Structure of the Optimix complete with motor support

Item	Part no.	Quantity	Designation	Remarks
1	64810	1	Wave spring washer	KAS 80
2	63810	2	Ball bearing	6208.C3
3	108408	1	Built-in motor 25 kW	EAY 160L/4D-11
4	110389	1	Retaining bracket	
	105692	2	Hex-head bolt	M16x30 DIN933 A2
	110688	2	Spring washer	Ø16 DIN 127 A2
5	62510	1	Retaining ring	J80 DIN 472
6	61310	2	Shaft sealing ring	50x80x10 BA

Item	Part no.	Quantity	Designation	Remarks
7	109228	1	O-ring	Ø30x3 NBR
8	109638	1	Profile bushing	65.2129.4
9	114529	1	Retaining ring	J26 DIN 472
10	114531	1	Support disk	17x24x1.5
11	114533	1	Retaining ring	AS16 DIN 471
12	106002	4	Sealing plug	M16x1.5 DIN 910 A4
	106384	4	Sealing ring	Ø16xØ20x1.5 DIN 7603 Cu
13		1	Cup-shaped housing	01.0180.0
14	109662	1	Guide unit flange housing	
15	109749	8	Hex-head bolt	M12x45 DIN 912 A2
	105008	8	Spring washer	Ø12 DIN 7980 A2
16	109753	4	Hex-head bolt	M16x230 DIN 931 A2
	104596	4	Securing nut	M16 DIN 985 A2
	110032	4	POM roller	Ø30x150
17	110320	1	Retainer for cable guidance on the mast	optional
18	114503	2	O-ring	Ø194x2 NBR
19	114535	1	Internal gear, 61 teeth	41.0068.3
20		1	Pinion cage, complete	
21	60140	1	O-ring	Ø128x2 NBR
22	110198	1	Bearing flange F9, complete	
23	100274	6	Hexagon socket screw	M10x30 DIN 912 A2
	100262	6	Spring washer	Ø10 DIN 7980 A2
24	103026	3	Hex-head bolt	M12 x 30 DIN 933 A2
	41366	3	Special spring lock washer	Ø12 A2
25	*	1	Propeller MS 850	
26	103718	1	Scraper holder, left	V2A
	100570	1	Scraper holder, right	V2A
	113065	1	Scraper plate	V2A
	100298	2	Hex-head bolt	M8 x 25 DIN 933 A2
	100458	4	Washer	Ø 8.4 DIN 9021 A2
	106377	2	Securing nut	M8 DIN 985 A2
27	109751	8	Hexagon socket screw	M8x65 DIN 912 A2
	106435	8	Spring washers	Ø8 DIN 7980 A2
	107569	4	Clamping sleeve	Ø8x20
28	100507	1	O-ring	Ø35x2 Viton
	110862	1	Locking ring	
	100555	1	Sealing ring	Ø32xØ38x2 DIN 7603 Cu
	111278	1	Cable gland	
	64500	2	Hex-head bolt	M8x20 DIN 912 A2
	106435	2	Spring washer	Ø8 DIN 7980 A2

* Propeller: zinc-coated, hardened or V2A (see supply note)

Structure of the planetary gear

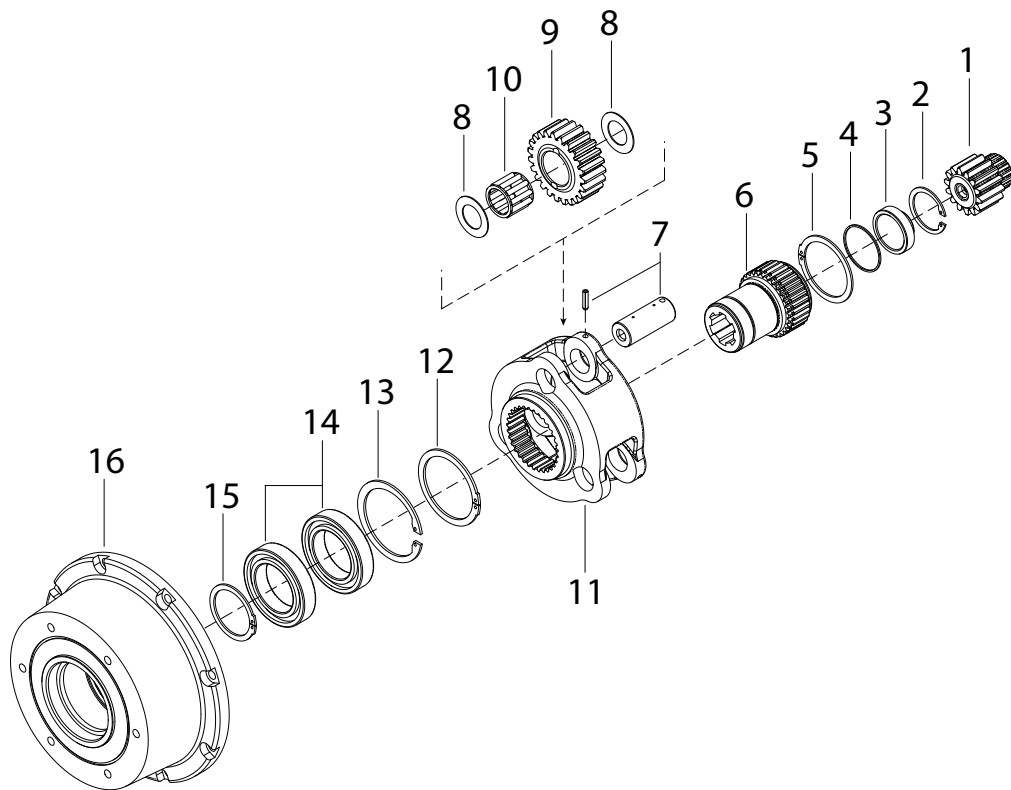


Figure 5: Assembly planetary gear

Item	Part no.	Quantity	Designation	Remarks
1	114537	1	Sun gear, 14 teeth	37.0887.4
2	114539	1	Retaining ring	J45 DIN 472
3	114544	1	Contact washer	66.0679.4
4	110425	1	O-ring	Ø45x2 Viton
5	100338	1	Retaining ring	A60 DIN 471
6	114540	1	Profile bushing	65.2128.3
7	114548	3	Planetary pin	64.0353.4
	114542	3	Clamping sleeve	Ø5x20
8	114550	6	Axial washer	AS2542 DIN 5405
9	114552	3	Planet gear, 23 teeth	38.0999.4
10	114554	3	Needle roller cage	K25x35X30
11	114556	1	Planet carrier	20.0187.2
12	114558	1	Retaining ring	A68 DIN 471
13	62510	1	Retaining ring	J80 DIN 472
14	114560	2	Deep-groove ball bearing	6010 DIN 625
15	114562	1	Retaining ring	A50 DIN 471

Structure of bearing flange F9

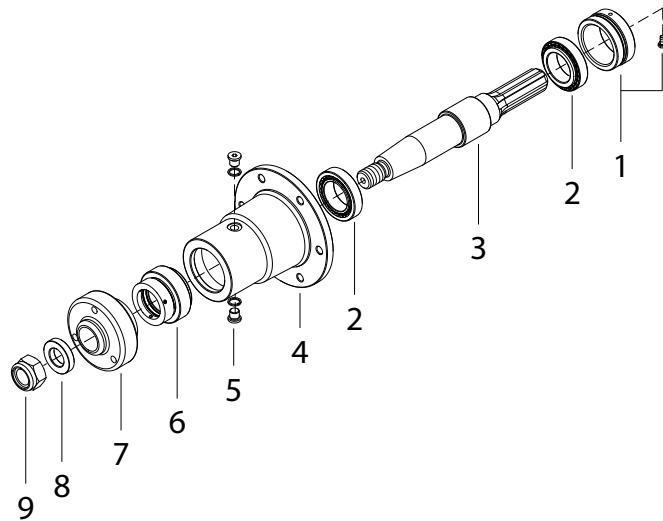


Figure 6: Assembly bearing flange F9 with propeller mounting

Item	Part no.	Quantity	Designation	Remarks
1	107679	1	Threaded ring	
	100391	1	Hex-head bolt	M6x12 DIN 933 galv.
2	106024	2	Taper roller bearing	32009-A DIN 720
3	110403	1	Conical shaft Ø45	
4	107665	1	Bearing flange F9	
5	100273	2	Sealing plug	M14 DIN 908 A2
	100553	2	Sealing ring	Ø14 x Ø18 x 1.5 DIN 7603 CU
6	114519	1	Mechanical seal	Ø 45 - SiC / SiC cpl.
7	107667	1	Propeller hub	
9	107677	1	Washer	Ø50xØ28x12 V2A
10	61600	1	Securing nut	M27 DIN 985 A2

14 Installation of the suspension mounting frame EV5

General



Danger of personal injury and damage to property and the environment!

It is essential to follow the safety instructions in chapter 2 *Safety*.

All installation work is to be carried out by a qualified specialist.

The rope winch manufacturer's instructions are to be followed.

Prerequisites

The static and dynamic design of the container must be suitable for the installation of the suspension mounting frame, as well as for use in combination with the submersible motor-driven agitator.

Installation of the work platform (option)

The work platform has a clearance depth of 80 cm and a clearance width of 120 cm and has a maximum permissible load of 500 kg.

- Fix the retaining brackets (item 14) by means of the spacers (item 16) horizontally to the container wall at a distance of approx. 40 cm from the top edge of the container. The spacers ensure that there is a suitable width for the subsequent suspension of the work platform.
- Remove the spacer and attach it to the work platform at the bottom as a safety device to prevent stepping through.
- Suspend the work platform in the retaining brackets and secure the lower contact points by means of pegs.

Installation of the swivel boom



Notice

It is advantageous to install the swivel boom to the right - in the ratio $\frac{3}{4}$ to $\frac{1}{4}$ - or with approx. 30 cm clearance between boom and platform. This allows more freedom of movement on the work platform and the submersible motor can be removed more easily.

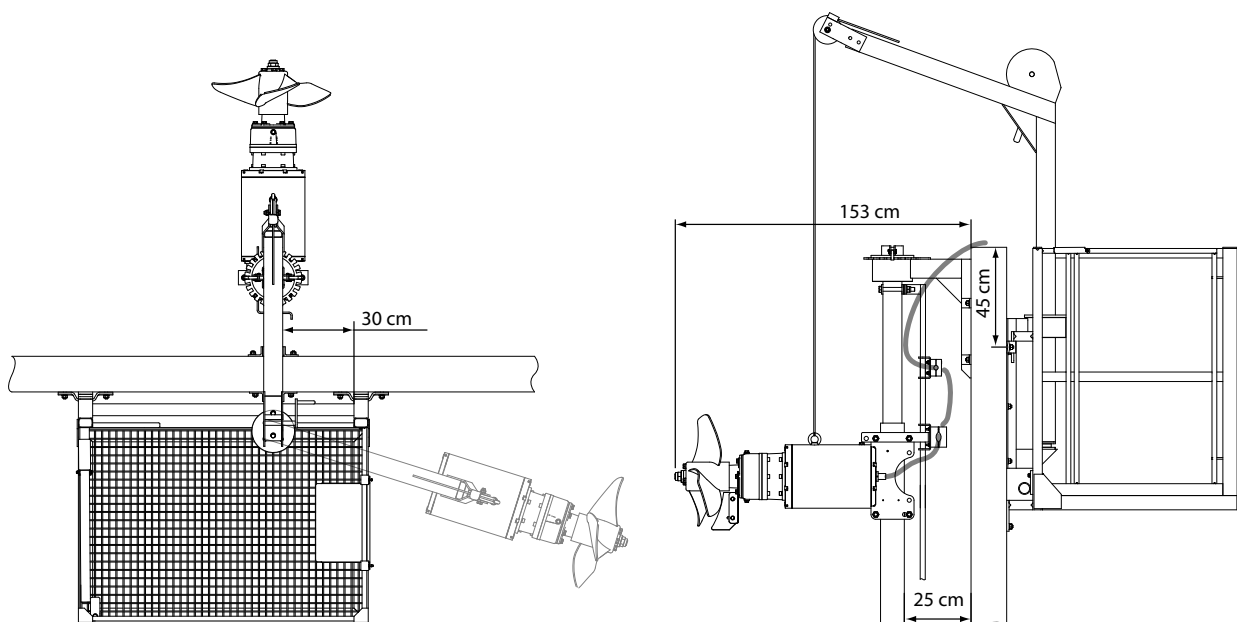


Figure 7: Adjustment of work platform, Optimix and swivel boom

- Mount the swivel support (item 12), at a distance of approx. 36 cm to the top edge of the container and opposite the wall bracket (item 3).
- Insert the PVC blank and feed in the swivelling boom; attach the locknut to the threaded pin without torque.

Installation of the guide tube with wall bracket

Under certain circumstances it may be necessary to adapt the length of the guide tube to the container height.

- Mount the wall bracket (item 3) approx. 6 cm from the top edge of the container.
- Feed in the square tube with floor support through the wall bracket, attach the PVC blank and then align the square tube perpendicularly.
- Attach the swivel lock (item 1).

Installation of the cable guide (option)

Under certain circumstances it may be necessary to adapt the length of the linkage of the cable guide.

- Attach the cable guide linkage to the rear of the square tube, so that clamping is positioned below the depth stop on the floor support at the bottom and directly under the swivel bushing of the wall bracket at the top.
- Fasten the sliding holder on the submersible motor cable at a max. distance of 2 m.

Structure of the cable clip (instead of the cable guide)

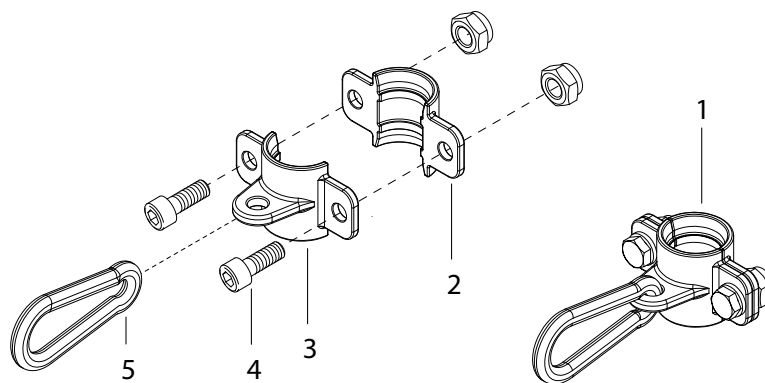


Figure 8: Cable clip

Item	Part no.	Quantity	Designation	Remarks
1	113840	1	Cable clip, complete	for cable Ø26 mm, 1.4571
2	113852	1	Clip lower part	for cable Ø26 mm, 1.4571
3	113854	1	Clip upper part	for cable Ø26 mm, 1.4571
4	108167	2	Hexagon socket screw	M6x16 DIN 912 A4
	100316	2	Securing nut	M6 DIN 985 A4
5	107617	1	Snap hook	Ø5x50 A4



Notice

The cable clip is intended exclusively for the Optimix connecting cable Ø 26 mm and can be easily attached to the hauling rope with the snap hook. Mounting spacing on the cable about 100 cm.

Suspending the submersible motor on the square tube

- Attach the cable clips with a maximum spacing of 1.2 m, if no cable guide is present.
- Suspend the submersible motor on the square tube and attach the hauling rope from the swivel boom.
- Check the safe operation of the submersible agitator.

Structure of EV5 with cable guide and work platform

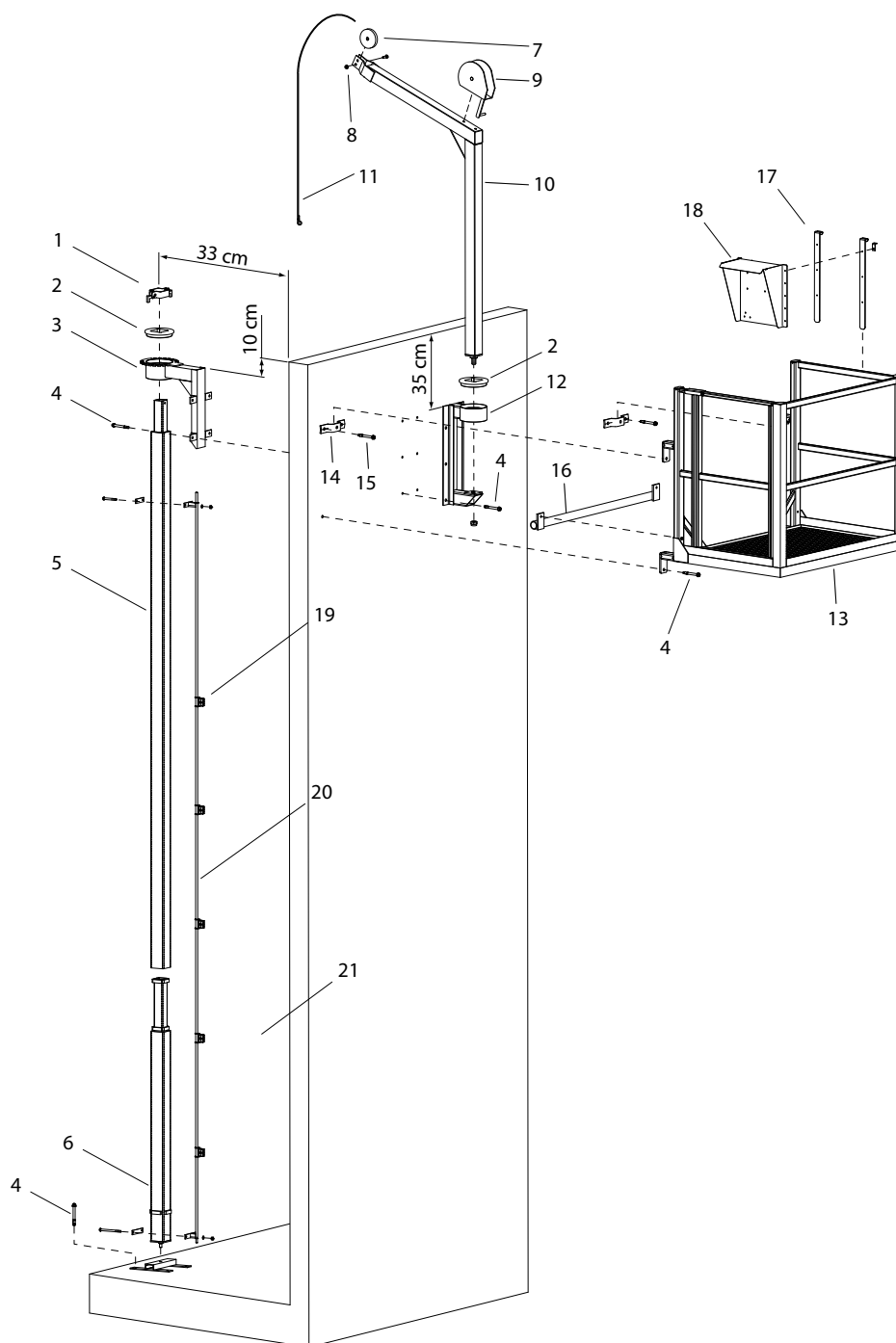


Figure 9: Structure of EV5 suspension mounting frame with cable guide and work platform

Structure of EV5 with cable guide and work platform

Item	Part no.	Quantity	Designation	Remarks
1	104835	1	Locking unit	for EV5, V2A
2	39522	2	PVC swivel bushing 80	for square tube 80x80
3	104449	1	Wall bracket EV5	V2A
4	100306	12	Anchor bolt	M12/15-110 A4
5	110158	1	Guide tube 150 x 150 x 4	V4A (1.4571)
6	110569	1	Support bracket 150 x 150 x 4	V4A (1.4571)
	110162	1	Base frame 150 x 150	V2A (1.4301)
7	110247	1	Pulley	PVC
8	114231	1	Hex-head bolt	M12x60 DIN 931 A2
	100263	2	Washer	Ø13.5 DIN 125 A2
	103311	1	Securing nut	M12 DIN 985 A2
9	39504	1	Rope winch LB 650 without rope	galvanised
	100395	2	Hex-head bolt	M10 x 25 DIN 933 galv.
	104435	4	Washer	Ø10.5 DIN 125 galv.
	100422	2	Securing nut	M10 DIN 985 galv.
10	103346	1	Boom for EV5	for external side of container
11	39506	1	Steel rope	Ø 6 mm – 10 m, 1.4401
12	104487	1	Wall bracket EV5, external	for boom
	100312	1	Securing nut	M24 DIN 985 A2
13	39601	1	Work platform for concrete container	80 x 120 cm, galvanised
14	107518	2	Retaining bracket	for work platform, galvanised
15	69792	6	Anchor bolt	M12/30-110 galv.
16	103325	1	Kick plate	for work platform, galvanised
	100374	2	Hex-head bolt	M8 x 60 DIN 931 galv.
	100326	2	Washer	Ø8.4 DIN 125 galv.
	103373	2	Securing nut	M8 DIN 985 galv.
17	104431	2	Retainer for protective hood	40 x 5 x 600, galvanised
	114219	1	Fixing bracket for retainer	3x20x45
	100447	5	Fillister head screw	M5x12 DIN 7985 galv.
	100448	1	Fillister head screw	M5x16 DIN 7985 galv.
	100459	1	Washer	Ø 5.3 DIN 9021 galv.
	106506	6	Hexagonal nut	M5 DIN 934 galv.
18	100647	1	Rain hood	for switch, 1.4301
19	102317	1	Cable guide unit	for 6.0 m container, V4A
20	39132	4	Cable clip 90	for cable guide unit
21	105559	1	Cable clip 110	for cable guide unit

15 Installation of the gastight operating unit (MGD)

General



Danger of personal injury and damage to property and the environment!

It is essential to follow the safety instructions in chapter 2 *Safety*.

All installation work is to be carried out by a qualified specialist.

The rope winch manufacturer's instructions are to be followed.

Prerequisites

The static and dynamic design of the container must be suitable for the installation of the suspension mounting frame, as well as for use in combination with the submersible motor-driven agitator. The container must be empty and suitable for an installation. The position of the operating unit is to be specified before the installation. In selecting the position, the function, operation and possible maintenance are to be taken into account as well as possible restrictions due to tensioning belts, unevenness and interfering points.

During the installation, the permissible tightening torques for bolts are to be observed. The permissible tightening torques for the anchor bolts can be taken from the packing.

Installation of the work platform (option)

The optional work platform can be installed in accordance with the instructions on page 26 (EV5 assembly).

Installation of the guide mount and guide tube



Notice

Depending on the container height and the position of the tapping drill holes, it may be necessary to adapt the length of the guide tube and the length of the cable guide.

Two tapping drill holes, to be provided by the customer, are necessary for the installation of the gastight operating unit.

- One tapping drill hole Ø60 mm is to be made at least 30 cm from the top edge of the container; a drill hole is likewise necessary for the cable entry and should be at around the same height and at least 30 cm to the side, with a diameter of minimum 30 mm and maximum 60 mm.
- Temporarily fasten the guide mount using two anchor bolts, with the guide tube aligned centrally in the tapping drill hole, and drill the remaining fixing holes.
- Insert the PVC swivel bushing at the top and then determine the overall height from the top edge of the swivel bushing to the floor of the container. Compare the overall height to the overall length of the unit consisting of the square tube with support bracket and base frame; if necessary the square tube must be shortened from below to fit.
- Determine the vertical reference point for the mounting position of the base frame and fasten the base frame to the support bracket.
- Temporarily remove the guide mount, push the square tube onto the support bracket and fit the guide mount again, fasten with all anchor bolts and insert the PVC swivel bushing.
- Attach the angle rails for the lateral bracing and fasten the support bracket with anchor bolts.
- Push the adjusting shaft into the guide mount.
- Install the feed-through bracket and rope winch mount. Depending upon needs and rope length, the rope winch mount can also be located further below. **CAUTION:** There must be no insulating materials between the wall and mounting parts.
- Push the turning wheel from the outside onto the adjusting shaft; it may be necessary to push the adjusting shaft somewhat to the rear in order to do this.
- Insert the turnstile (without crown gear) from above into the guide tube. After that, mount the curved crown gear on the turnstile. **CAUTION:** Align the guide tube first so that the lowering stops are aligned laterally at the bottom on the support bracket.

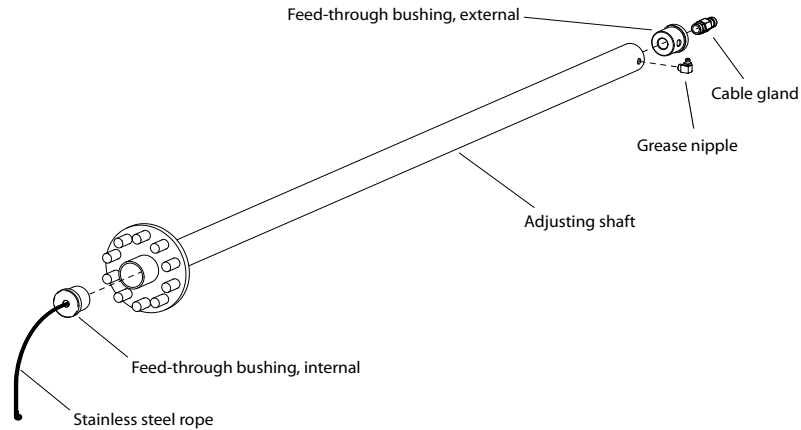


Figure 10: Structure of the adjusting shaft with rope feed-through

- Feed the stainless steel rope over the pulley on the turnstile and through the adjusting shaft. Fill the adjusting shaft at the far end with a cartridge of grease (400 g), feed the end of the rope through the feed-through bushing and close the open end of the adjusting shaft with the feed-through bushing.
- After that, feed the stainless steel rope over the pulley and fasten it in the rope winch.

Installation of the cable guide

Under certain circumstances it may be necessary to adapt the length of the linkage of the cable guide (9.2).

- Attach the cable guide linkage to the rear of the square tube, so that clamping is positioned below the depth stop on the floor support at the bottom and directly under the swivel bushing of the wall bracket at the top.
- Attach the oval holder in the compulsory guide and fasten it with the fabric hose; attach the remaining sliding holders to the submersible motor cable at distances of 2 m and insert into the cable guide linkage.
- Feed the connecting cable through the second tapping drill hole and seal the cable outlet tightly with the connection plate including the cable gland.

Suspending the submersible motor on the square tube

- Attach the cable clips with a maximum spacing of 1.2 m, if no cable guide is present.
- Suspend the submersible motor on the square tube, attach the stainless steel rope and tension it. **CAUTION:** Do not overtighten the fixing bolts of the submersible motor, as otherwise the sliding guide can jam on the square tube.

It is advantageous to move the submersible motor completely up and down twice using the rope winch. After that, lock the screws on the feed-through bushing without play. If necessary, lubricate the rope seal using a grease gun.

- Check the safe operation and direction of rotation of the submersible agitator. Check the torque of all bolted connections before starting up.

Structure of the built-in mast with gastight adjusting device (MGD)

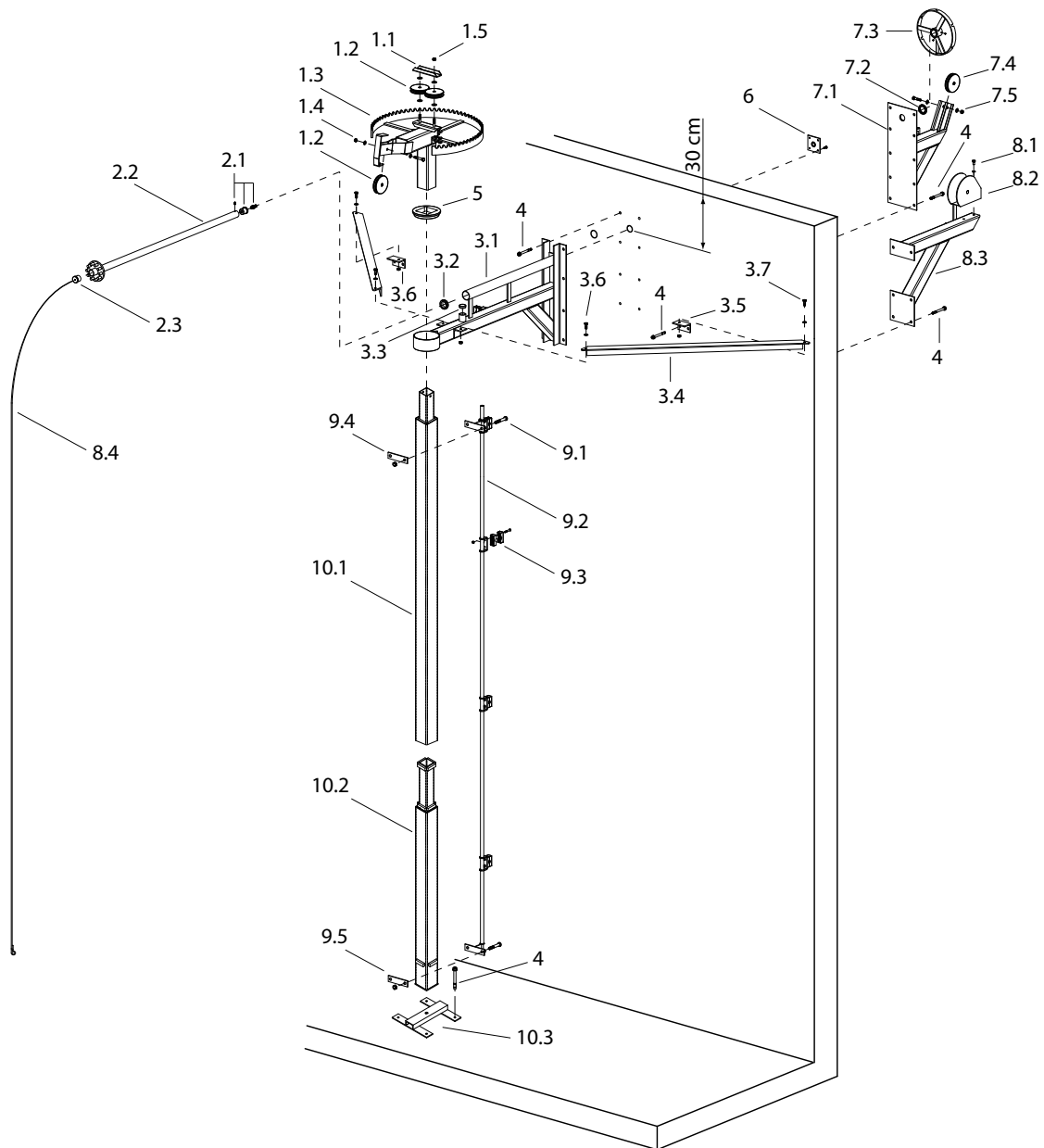


Figure 11: Structure of operating device MGD with cable guide

Structure of EV5 with cable guide and work platform

Item	Part no.	Quantity	Designation	Remarks
1.1	102251	1	Clamping rail	V4A (1.4571)
1.2	102249	3	Pulley	PVC
1.3	102245	1	Turnstile, complete MGD	V4A (1.4571)
1.4	100290	1	Hex-head bolt	M12 x 60 DIN 931 A4
	100314	1	Securing nut	M12 DIN 985 A4
	100267	2	Washer	Ø13 DIN 125 A4
1.5	100290	2	Hexagonal bolt DIN 931 - M12 x 60 - A4	M12 x 60 DIN 931 A4
	100314	2	Securing nut	M12 DIN 985 A4
	100267	4	Washer	Ø13 DIN 125 A4

Item	Part no.	Quantity	Designation	Remarks
2.1	102335	1	Outer bushing	
2.2	102353	1	Adjusting shaft MGD	V4A (1.4571)
2.3	102337	1	Inner bushing	
3.1	102261	1	Guide mount, complete MGD	V4A (1.4571)
3.2	102339	1	Sliding bushing	POM
3.3	102283	1	Sliding cover MGD	POM
3.4	102233	2	Angle rail MGD	V4A (1.4571)
3.5	102235	1	Support bracket, right MGD	V4A (1.4571)
3.6	102237	1	Support bracket, left MGD	V4A (1.4571)
3.7	100290	2	Hex-head bolt	M12 x 60 DIN 931 A4
	100314	2	Securing nut	M12 DIN 985 A4
	100267	2	Washer	Ø13 DIN 125 A4
4	100306	32	Anchor bolt	M12/15 x 110 A4
5	39524	1	Swivel bushing 100	PVC
6	112864	1	Mounting plate	V4A (1.4571)
	112729	1	Cable gland	M32
	112742	1	Nut for cable gland	M32
	69795	4	Anchor bolt	M8/15 x 80 A4
7.1	110216	1	Feed-through bracket MGD 120	V2A (1.4301)
7.2	104861	1	Shaft sealing ring	40x62x8 BA
7.3	102351	1	Turning wheel MGD	V2A (1.4301)
	106131	1	Stud bolt	M6 x 10 DIN 916 A2
7.4	110247	1	Pulley, complete	
7.5	114231	1	Hex-head bolt	M12 x 60 DIN 931 A2
	100311	1	Securing nut	M12 DIN 985 A2
	100263	2	Washer 125 - A17 - A2	Ø13 DIN 125 A2
8.1	100291	2	Hex-head bolt	M10 x 25 DIN 933 A2
	100303	2	Nut	M10 DIN 934 A2
	100262	2	Washer	Ø10.5 DIN 125 A2
8.2	110573	1	Rope winch LB 1200	without rope
8.3	102293	1	Rope winch mount MGD	V2A (1.4301)
8.4	103517	1	HK-Niro steel wire rope with thimble at one end	Ø 8.0 mm - 14 m (1.4401)
9.1	105077	2	Hex-head bolt	M16 x150 DIN 931 A4
	100315	2	Securing nut	M16 DIN 985 A4
	103032	2	Washer	Ø17 DIN 125 A4
9.2	111941	1	Cable guide unit	V4A (1.4571)
9.3	39132	6	Cable clip 90	Quantity = container depth minus 2
	105559	1	Cable clip 110	for cable guide unit
	114649	1	Slider, long	oval cable clips
9.4	103628	1	Clamping rail EV5 100	
9.5	114751	1	Clamping rail EV5 150	
10.1	110158	1	Guide tube 150 x 150 x 4 - 6 m	V4A (1.4571)
10.2	110569	1	Support bracket 150 x 150 x 4 - 2 m	V4A (1.4571)
10.3	110162	1	Base frame 150 x 150	V2A (1.4301)

16 Biogas – Safety information



Biogas characterisation

Biogas is a colourless fermentation gas which is insoluble in water and which is produced by the anaerobic decomposition of biomass, such as liquid manure, sewage sludge or biowaste. In general, it contains between 40 % and 75 % methane and between 20 % and 50 % carbon dioxide, in addition to hydrogen sulphide as a trace gas in concentrations of 10 ppm up to maximum 1 % (generally 0.01 % – 0.4 %), depending on the fermented material. Biogas may also contain various esters, organic sulphur compounds, alkyl benzenes and ammonia (up to 30 ppm) in addition to hydrogen, nitrogen and carbon monoxide, and sometimes may contain suspended matter.

Biogas must be identified with the symbols Xn (harmful to health) and R 20 (harmful to health on inhalation) from a hydrogen sulphide concentration of 200 ppm upwards. No classification on the basis of the hydrogen sulphide content is foreseen below this concentration. Nevertheless, gas mixtures containing hydrogen sulphide are harmful even below the mandatory identification content: consequently, even 50 ppm hydrogen sulphide content causes irritation to the eyes and respiratory tracts. Severe poisoning with the risk of unconsciousness and death can be anticipated from a concentration of 700 ppm (0.07 %) upwards.

The ignition temperature of biogas is around 700 °C (methane: 595 °C), the lower explosive limit is approx. 6 % by volume biogas (methane: 4.4 % by volume) and the upper explosive limit is approx. 12 % by volume biogas (methane: 16.5 % by volume).

Three substance diagram

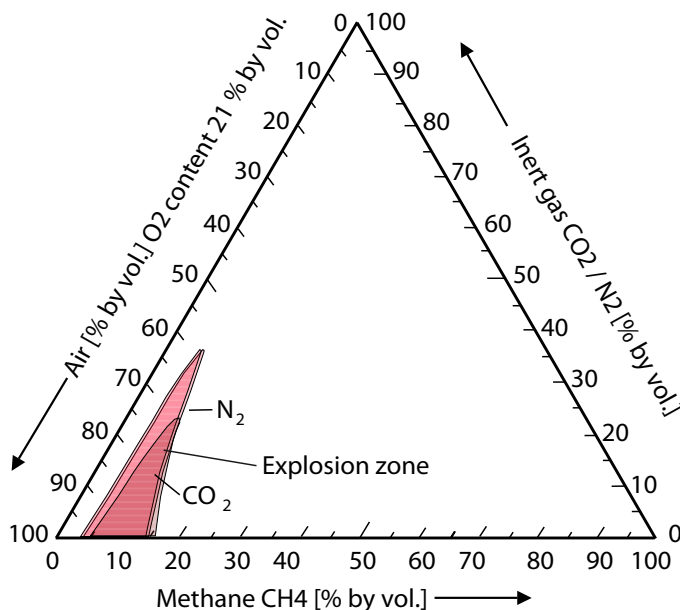


Figure 12: Three substance diagram for the methane/air/CO₂-N₂ mixture explosive zone
(according to Tabasaran / Rettenberger (UBA – research report 12/1982, no. 10302207 part 1))

Biogas is somewhat lighter than air and forms a potentially explosive atmosphere with air. Increased risk of explosion can be anticipated in the presence of sources of ignition, such as hot surfaces, naked flames, mechanically/electrically produced sparks, electrostatic discharges and lightning strikes.

When heated/combusted, the biogas produces hazardous gases (e.g. carbon monoxide, sulphur dioxide, sulphur trioxide and formaldehyde).

The material resistance is greatly dependent on the trace gas content, e.g. hydrogen sulphide.

Depending on the concentration, temperature and humidity, hydrogen sulphide attacks most metals and plastics. Stainless steels of grade 1.4301 (AISI 304) are resistant to a certain extent and stainless steels of grade 1.4571 (316) are largely resistant, as are plastics such as PE, PTFE, PP or polyisobutylene.

17 Permit for work in potentially explosive areas

Mark the applicable with a cross. Strike through the non-applicable parts in marked lines.

Permission for welding, burning and other work that generates sparks, for drilling, grinding, hammering and mortising work, and for the employment of devices that are not explosion-proof.

A

1. Client: Building: Tel.: Foreman:
2. Place and type of work
3. Permission from o'clock, until o'clock, for the time
4. For workplace/company Building Foreman

B

Dangerous places in the vicinity

of the workplace, buildings, apparatuses etc.	Responsible person	Building	Telephone
1.			
2.			
3.			
4.			

C

Safety measures

to be carried out by: done ☐

1. Examination of pipes and apparatuses in the vicinity of the workplace for leaks ☐
2. Fire extinguishers and other safety measures
 - a. Provision of fire fighting water, fire extinguishers at the workplace ☐
 - b. Connect fire brigade hose ☐
 - c. Appoint safety supervisors ☐
☐ Contractor ☐ Member of staff ☐ Supervisor ☐ Fireman
 - d. Elimination of inflammable materials, vapours, gases or dust deposits ☐
 - e. ☐
3. Marking of the workplace (road, railway track etc.)
 - a. By means of red flags (20 m on both sides of the workplace) ☐
 - b. By means of signs (e.g. fire work on pipe bridge) ☐
 - c. Cordoning off, bypass for tank trucks, blockage for railway vehicles ☐
4. Securing the vicinity against welding sparks
 - a. Covering the neighbouring lines ☐
 - b. Erect protective wall, protect roof cladding, possibly keep damp ☐
 - c. Stop work when there is train traffic ☐
 - d. Maintain a minimum distance to flammable tankers, tank farms etc. of m ☐
 - e. Cover or seal pipe penetrations, gratings, light shafts and sewer manholes ☐
 - f. ☐
5. For work in and on containers, apparatuses, pits, pipelines, on removed plant parts, in confined rooms etc. additional measures for:
 - a. Permission to drive in No. from ☐
 - b. Work permit No. from ☐
 - c. Safety certificate for electrical equipment No. from ☐
 - d. ☐
6.
 - a. Report daily before commencing work in the case of B 1, 2, 3, 4. ☐
 - b. Report the end of work daily in the case of B 1, 2, 3, 4. ☐
7.
 - a. Marked safety measures checked by (name) ☐
 - b. Workplace checked after completion of the work by (name) ☐

D

Agreement of the responsibilities for the dangerous places

Beginning of work reported on: to:
For B 1 measures C number
For B 2 measures C number
For B 3 measures C number
For B 4 measures C number

Permit issued

Date

Signature of the works manager

18 Extract from the German regulations for the prevention of accidents with regard to liquid manure storage, pits, sewers and wells (VSG 2.8)

§ 1 Basic principles

This accident prevention regulation applies to the storage of liquid manure as well as for the erection, the setting-up and the operation of pits, sewers and wells.

Performance directive for § 1

1. Pits include, for example, containers, foil-lined ground basins for liquid manure storage (lagoons), basins and other depressions.
2. Watering and drainage channels are not sewers in this sense.
3. Wells include, for example, well chambers, inspection manholes, rainwater catchment basins, water basins, street-side basins.

§ 2 Prevention of falling in

The entrepreneur must ensure that

1. pits, sewers and wells are secured against persons falling in by means of protection devices or covers. If these are not deeper than 1 m, other safety measures are sufficient.
2. foil-lined ground basins and rainwater catchment basins are equipped with aids for climbing out for people who have fallen in.

Performance directive for No. 1

1. Open slurry and liquid manure pits, foil-lined ground basins and rainwater catchment basins are as a rule secured against falling in if they have a closed, impassable safety device with a height of 1.80 m and a 30 cm high kerb exists at removal and agitation points.
2. Another safety measure is a flat slope, for example.
3. Foils and similar covers are not considered to be protection against the falling in of persons.
4. You are referred to the accident prevention regulations 'Workplaces, physical structures and facilities' (VSG 2.1) and the state building regulations.

Performance directive for No. 2

The following are considered to be aids for climbing out, e.g. steps, ladders or rescue routes made of tyres tied together with polyester ropes. The distance between the aids for climbing out should not exceed 20 m.

§ 3 Openings

The entrepreneur must ensure that

1. persons cannot fall into the removal, entrance or similar openings
2. receiving basins sunk into the ground are covered or protected by non-slip gratings that can bear the weight of a vehicle if necessary,
3. pits with receiving facilities, into which the loads of vehicles or transport containers are emptied, are provided with a base and a parapet; it may be possible to open or move the parapet at the filling place, but not to remove it,
4. pits, sewers and wells that are normally climbed into must be equipped with devices that enable climbing inside without danger. The openings must be dimensioned so that the rescue of accident victims is possible.
5. suitable tools are used for the safe removal and refitting of manhole covers.

Performance directive for No. 1

The opening can be secured, for example, by a non-slip grating which, if necessary, is capable of bearing the weight of a vehicle. Opened well chambers and inspection manholes can be secured e.g. by suitable cordoning-off measures.

Performance directive for No. 4

1. Safe entering is possible e.g. via ladders, manhole steps and insertable support rods at the entrances. The opening width should be at least 80 cm. You are referred to the accident prevention regulations 'Workplaces, physical structures and facilities' (VSG 2.1).
2. With regard to the openings in closed liquid manure containers, you are referred to DIN 11 622-1 'Silage silos and liquid manure containers; dimensioning, execution, composition; general requirements'.

Performance directive for No. 5

Suitable tools are, for example, cover jacks.

§ 4 Entering and rescuing accident victims

(1) The entrepreneur must ensure that

1. only persons who are aware of the associated dangers climb into pits, sewers and wells,
2. the necessary aids for securing the persons entering are kept near to the entrance area and that the secured persons are familiar with the handling of the aids.

Performance directive for paragraph 1 no. 1

There is a danger of asphyxiation, poisoning, fire or explosion in pits, sewers and wells due to

- biological processes (fermentation, rotting), in particular in the case of a damp and rotten substrate or if pits and sewers contain faeces,
- defective supply lines (natural gas),
- chemical reactions.

(2) Before entering and during the stay in pits, sewers and wells, it must be ensured that

- there is no danger of poisoning,
- there is sufficient breathing air,
- operating equipment is reliably secured against being switched on.

Performance directive for paragraph 2

Sufficient breathing air is to be determined e.g. by the examination of the atmosphere with an appropriate measuring instrument; it can also be manufactured by the adequate exchange of air (air supply and exhaust).

(3) Entering is permissible only if a second person above ground is within the range of vision. The person entering is to be secured in such a way that his rescue is possible at any time.

(4) The entering of liquid manure pits is permissible only if the person entering is roped up and the rope is anchored outside the liquid manure pit and the person entering is secured by two further persons.

Performance directive for paragraph 4

The same safety measures may also be necessary in the case of deep liquid manure channels.

- (5) Entering in order to rescue accident victims is permissible only if the person entering is secured in such a way that he can leave the danger area himself at any time and uses suitable breathing aids.

Performance directive for paragraph 5

1. The requirement for the protection of the person entering is to be regarded as fulfilled, if
 - one person secures the person entering with roping and rescue lifting equipment (tripod) in connection with rescue belts and safety ropes,
 - two further persons secure the person entering with a rope that is firmly anchored outside.
2. Breathing aids are, for example, breathing apparatus that is independent of the environment atmosphere, such as
 - oxygen self rescuer (oxygen-fed escape hood),
 - fresh air suction hose devices.

- (6) Open flames are not permitted.

§ 5 Containers and ducts for animal faeces

- (1) The entrepreneur must ensure that

1. noxious gases from pits and ducts in the open air are prevented by suitable measures from flowing into buildings,
2. closed pits have non-closable ventilation openings to the open air on the opposite sides,
3. noxious gases in pits and ducts in buildings are exhausted by suitable means,
4. ducts must be designed such that unnecessary dispersion of the faeces is avoided.
5. operating consoles of stirring, pumping and rinsing equipment must be installed above ground.
6. closed rooms in which operating consoles are located must not have openings into containers and ducts.
7. operating instructions are permanently attached to the operating consoles,
8. above-ground containers that have to be ascended to for operation are equipped with ladders and work platforms.

Performance directive for paragraph 1 no. 1

1. The noxious gases include in particular hydrogen sulphide, methane, ammonia and carbon dioxide.
2. Suitable measures are, for example, siphons, evaporating shafts and tightly closing valves or rubber aprons in the ducts between pits and buildings, whose function is checked at regular intervals.

Performance directive for paragraph 1 no. 2

With regard to the openings, you are referred to DIN 11 622-1 'Silage silos and liquid manure containers; dimensioning, execution, composition; general requirements'.

Performance directive for paragraph 1 no. 3

Suitable measures and equipment for ensuring the extraction of noxious gases are, for example

- opening of doors, gates and windows,
- stable ventilators, which extract the gases immediately above the floor,
- positive air pressure systems in sealed stables, in which the positive pressure forces the gases via exhaust ducts into the outside air.

Performance directive for paragraph 1 no. 8

With regard to the vertical ladders and work platforms, you are referred to DIN EN ISO 14122 'Safety of machines, fixed entrances to mechanical plants'.

- (2) Agitating, pumping and rinsing equipment in buildings may only be switched on if the forced extraction of the noxious gases is ensured. The extracted gases must not endanger persons.

Performance directive for paragraph 2

1. The requirement is considered to be fulfilled in the case of self-activating agitating, pumping and rinsing equipment if the facility for the extraction of the noxious gases switches on compulsorily upon the start-up of the agitating, pumping and rinsing equipment and switches off only after completion of the work process. In all other respects you are referred to the performance directive for paragraph 1 number 3.
2. Endangerment of persons is not to be expected if the extracted gases are released into the outside air at a minimum height of 2 m above the ground.

§ 6 Removal of animal faeces from pits and ducts

- (1) Smoking and naked flames are not permitted in the immediate vicinity of removal openings during stirring and removal of faeces; sparks are to be avoided.
- (2) During stirring and removal of faeces, persons and animals may only remain in buildings in which open containers and ducts are located if sufficient ventilation is ensured.

Performance directive

You are referred to § 5 paragraph 1 number 3 including the performance directive.

§ 7 Warning signs

The entrepreneur must ensure that warning signs indicating the dangers due to gases are attached in clearly visible places at the openings of pits and ducts.

Performance directive

1. Examples of the wording of warning signs:

- | | | |
|--|--|--|
| • At removal, exhaust and entrance openings: | 'Caution! Danger of poisoning!' | 'Caution! Danger of explosion!' |
| • At access openings: | 'Entry only if ventilation is switched on' | 'Attach a rope to yourself before entry' |
| • In the door or gate area of stables: | 'Remaining in the building during the agitation and removal of liquid manure is deadly dangerous.' | |

2. You are referred to the accident prevention regulation 'Health and safety protection marking' (VSG 1.5).

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19 Check list for commissioning



NOTICE

In accordance with the Equipment and Product Safety Act (GPSG), technical working materials (machines, facilities) may first be commissioned after asserting the conformity with the Machine Guideline 2006/42/EC. This means that the conformity with the Guideline 2006/42/EC must be asserted for commissioning technical working materials that are modified, installed on-site and/or joined with external parts.

Operator	
Address	
Postcode/ place:	
Telephone	
Machine	
Type/no.	
Date	

Pos.	Assessment guideline for commissioning*	Yes	Remark:
1	Are all documents (declaration of conformity, operating instructions) complete, available in the respective language and accessible?	☐	
2	Is the intended use possible according to the documents (declaration of conformity, operating instructions)?	☐	
3	Were all safety and installation instructions in the operating instructions observed/implemented?	☐	
4	Installation was properly performed and checked (torques, seals, attachments)?	☐	
5	Is there sufficient protection against mechanical hazards like squashing, shearing, cutting, catching, drawing in, hitting and friction?	☐	
6	Is there sufficient protection against electric hazards like short circuit, overload, error statuses, touching live parts and electrostatic charge?	☐	
7	Is there sufficient protection against noise, vibrations, heat and hazardous substances?	☐	
8	Is safe, proper and risk-free operation/handling possible (if applicable, in a test operation)?	☐	
9	Were all sources of ignition removed from and/or avoided in the range of the agitator?	☐	

* Depending on the extent and the hazard potential of the technical facility, an extensive assessment procedure may be required for commissioning.

Responsible for installation/assembly:	Responsible for electric installations:	Responsible for commissioning:

20 EC declaration of conformity

Declaration of conformity within the meaning of the directive 94/9/EC

Manufacturer SUMA Rührtechnik GmbH, Martinszeller Str. 21, 87477 Sulzberg / Germany

Product designation: **Optimix 3G 250-270**

Product description: The agitators of type **Optimix 3G** are designed to be installed in fermenters of agricultural biogas plants and normal liquid manure containers and are used for the agitation of liquid manure, liquid manure with co-substrates (e.g. renewable raw materials) and similar biological liquids.

We hereby we declare on our sole responsibility that the SUMA agitators of the type **Optimix 3G** comply with the health and safety requirements, for use as intended according to the directive mentioned:

Harmonised standards applied:

EN ISO 12100-1	EN 13463-1	EN 13463-8	EN 60079-14	EN 50495
EN ISO 12100-2	EN 13463-5	EN 60079-0	EN 60079-15	

Other applied Directives (each in the currently valid version):

2006/42/EG	2006/95/EG
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The identification plates of the devices contain the following information   II 3G EEx nA+c+k IIA T1

This declaration of conformity applies only to devices and accessories made by SUMA if

- the specifications in the operating instructions are complied with in every particular and
- the agitators are operated in the composition and with the accessories designed by SUMA.

In connection with the container, the agitator with suspension device (guide/support linkage) results in an agitating device (machine) whose conformity is to be determined before start-up.

If alterations, installation into or combination with other machines, devices or components take place, then commissioning is prohibited until such time as the conformity of the end product to Directives 94/9/EC and 2006/42/EC has been confirmed.

This declaration is not a guarantee of properties within the context of product liability laws.

Authorised representative of SUMA Rührtechnik GmbH
for the compilation of all the

Technical documentation:

Carsten Gülker
(Dipl.-Ing.) (Engineering graduate)

Sulzberg, 4th January 2011



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