GEA Cleaning Technology

Orbital cleaner_TSG

Operating instruction (Translation from the original language)

430BAL010370EN_16

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1 General Information

1.1 Information on the Document

The present Operating Instructions are part of the user information for the product. The Operating Instructions contain all the information you need to transport, install, commission, operate and carry out maintenance for the product.

1.1.1 Binding Character of These Operating Instructions

These Operating Instructions contain the manufacturer's instructions to the operator of the product and to all persons who work on or use the product regarding the procedures to follow.

Carefully read these Operating Instructions before starting any work on or using the product. Your personal safety and the safety of the product can only be ensured if you act as described in the Operating Instructions.

Store the Operating Instructions in such a way that they are accessible to the operator and the operating staff during the entire life cycle of the product. When the location is changed or the product is sold make sure you also provide the Operating Instructions.

1.1.2 Notes on the Illustrations

The illustrations in these Operating Instructions show the product in a simplified form. The actual design of the product can differ from the illustration. For detailed views and dimensions of the product please refer to the design documents.

1.1.3 Symbols and Highlighting

In these Operating Instructions, important information is highlighted by symbols or special formatting. The following examples illustrate the most important types of highlighting.

Danger

Warning: Fatal Injuries

Failure to observe the warning can result in serious damage to health, or even death.

► The arrow identifies a precautionary measure you have to take to avoid the hazard.

Warning: Explosions

Failure to observe the warning can result in severe explosions.

► The arrow identifies a precautionary measure you have to take to avoid the hazard.

⚠ Warning!

Warning: Serious Injuries

Failure to observe the warning can result in serious damage to health.

► The arrow identifies a precautionary measure you have to take to avoid the hazard.

⚠ Caution!

Warning: Injuries

Failure to observe the warning can result in minor or moderate damage to health.

► The arrow identifies a precautionary measure you have to take to avoid the hazard.

Notice

Warning: Damage to Property

Failure to observe the warning can result in serious damage to the component or in the vicinity of the component.

► The arrow identifies a precautionary measure you have to take to avoid the hazard.

Carry out the following steps: = Start of a set of instructions.

1. First step in a sequence of operations.
2. Second step in a sequence of operations.

   → Result of the previous operation.

→ The operation is complete, the goal has been achieved.

Hint!

Further useful information.

1.2 Manufacturer address

GEA Tuchenhagen GmbH
Am Industriepark 2-10
21514 Büchen

1.3 Contact

Tel.:+49 4155 49-0
Fax:+49 4155 49-2035

flowcomponents@gea.com
www.gea.com

1.4 EC Declaration of Integration for Partially Completed Machines

Einbauerklärung
Declaration of Incorporation

im Sinne der EG-Maschinenrichtlinie 2006/42/EG
as defined by Machinery Directive 2006/42/EC

Hiermit erklären wir, dass es sich bei dieser Lieferung um die nachfolgend bezeichnete - jedoch unvollständige - Maschine handelt und dass ihre Inbetriebnahme solange untersagt ist, bis festgestellt wurde, dass die Maschine, in die diese Maschine eingebaut werden soll, den Bestimmungen der EG-Maschinenrichtlinie entspricht.

We herewith declare that this consignment contains the subsequently described - but incomplete - machine and that commissioning is suspended until it is established that the machine in which the machine concerned will be installed conforms to the regulations of the EC-Machine Directive

Wir erklären, dass die hier beschriebene unvollständige Maschine den "grundlegenden Sicherheits- und Gesundheitsschutzanforderungen" aus Anhang I, Abschnitt 1. und Abschnitt 2.1 erfüllt. Die technischen Unterlagen wurden gemäß Anhang VII, Teil B erstellt. Auf begründetes Verlangen werden die Unterlagen einzelstaatlichen Stellen zur Verfügung gestellt.

We declare that the subsequently described incomplete machine fulfills the "Essential Health and Safety Requirements" from Annex I part 1. and part 2.1. The technical documentation is compiled in accordance to part B of Annex VII. In response to reasoned request the relevant information will be transmitted to the national authorities.

Bei einer nicht mit uns abgestimmten Änderung an der Maschine verliert diese Erklärung ihre Gültigkeit.

This declaration becomes invalid in case of alterations at the machine which have not been agreed with us.

Bezeichnung der Maschine / Machine´s designation:	Cyclone, Twister, Typhoon, Tempest, Tornado, Tornado 4
Maschinentyp: Machine type:	GEA Orbitalreiniger GEA orbital cleaner
Einschlägige EG-Richtlinien: Relevant EC-Directives:	2006/42/EG 2006/42/EC
Angewendete harmonisierte Normen: Applicable, harmonized standards:	DIN EN ISO 12100 DIN EN ISO 12100

Büchen, 18.04.2016

Franz Bürmann
Geschäftsführer/Managing Director

i.V. Südel
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Flow Components

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Fig.1

1.5 Translated copy of the EU - Declaration of incorporation in accordance with the EC Machine Directive 2006/42/EC

Manufacturer:	**GEA Tuchenhagen GmbH** **Am Industriepark 2-10** **21514 Büchen**

We herewith declare that this consignment contains the subsequently identified but incomplete, and that putting into service is not permitted until it has been established that the machinery into which this machine is to be incorporated is in conformity with the provisions of the EC Machinery Directive.

Designation:	Cyclone, Twister, Typhoon, Tempest, Tornado, Tornado 4
Type:	GEA Orbital cleaner

Relevant EC directives:	2006/42/EC	EC Machinery Directive
Applicable harmonized standards, in particular:	EN ISO 12100	

Remarks:

- This declaration will become invalid if any alterations are made to the machine which have not been agreed with us
- We declare that the incomplete machine identified here complies with the "Essential Health and Safety Requirements" defined in Annex I, section 1 and section 2.1. The technical documentation is compiled in accordance with Annex VII, part B. In response to a reasoned request the relevant information will be transmitted to the appropriate national authorities.

Person authorised for compilation and handover of technical documentation:	**GEA Tuchenhagen GmbH** **CE Documentation Officer** **Am Industriepark 2-10** **21514 Büchen, Germany**

Büchen, 18.04. 2016

Franz Bürmann Managing Director	i.V. Matthias Südel Head of Engineering

2 Safety

2.1 Intended use

The orbital cleaner Cyclone, Twister, Typhoon, Tempest and Tornado are designed for the cleaning of tanks and containers. This cleaner are designed for the installation and operation at any angle. Using the device for any other purpose is considered contrary to its designated use.

Hint!

The manufacturer will not accept any liability for damage resulting from any use of the cleaner which is not in accordance with its designated use. The risk of such misuse lies entirely with the operator of the facility.

2.1.1 Requirements for operation

The prerequisite for reliable and safe operation of the component is proper transportation and storage as well as professional installation and assembly. Operating the unit within the limits of its designated use also involves adhering to the operating, inspection and maintenance instructions.

2.1.2 Improper operating conditions

The operational reliability of the cleaner cannot be ensured under improper operating conditions. Therefore avoid improper operating conditions.

Operating the cleaner is not permitted if

- Persons or objects are in the danger zone.
- Safety devices are not working or were removed.
- Malfunctions have been detected on the cleaner.
- Damage has been detected on the cleaner.
- Maintenance intervals have been exceeded.

2.2 Operator’s Duty of Care

In your capacity as operator of the facility you bear a particular responsibility for the proper and safe handling of the cleaner in your facility. Only use the cleaner when it is in perfect condition to prevent danger to persons and property.

These Operating Instructions contain the information you and your staff need for the safe and reliable operation during the entire service life of the cleaner. Be sure to read these Operating Instructions carefully and ensure that the measures described here are observed.

The operator's duty of care includes planning the necessary safety measures and monitoring that these measures are observed. The following principles apply:

- Only allow qualified staff to work on the cleaner.
- The operating company must authorize personnel to carry out the relevant tasks.

- Working areas and the entire environment of the cleaner must be neat and clean.
- Personnel must wear suitable work clothing and personal protective equipment. As the operating company must ensure that work clothing and personal protective equipment are used.
- Inform personnel regarding any properties of the product which might pose a health risk and the preventative measures to be taken.
- Have a qualified first-aid representative on call during the operation. This person must be able to initiate any necessary first-aid measures in case of an emergency.
- Clearly define processes, lines of authority and responsibilities associated with the cleaner. Everybody must know what to do in case of an emergency. Instruct the staff in this respect at regular intervals.
- The signs relating to the cleaner must always be complete and legible. Check, clean and replace the signs as necessary at regular intervals.
- Observe the Technical Data specified and the limits of use!

Hint!

Carry out regular checks. This way you can ensure that these measures are actually observed.

2.3 Subsequent changes

You should never make any technical modifications to the cleaner. Otherwise you will have to undergo a new conformity process in accordance with the EC Machinery Directive on your own.

In general, only original spare parts supplied by GEA Tuchenhagen GmbH should be installed. This ensures the reliable and economical operation of the cleaner. Using spare parts from third-party suppliers will invalidate any and all warranty claims.

2.4 General safety instructions and dangers

The cleaner is operationally reliable. It was built according to state-of-the-art science and technology.

Nevertheless, the cleaner can pose dangers, especially if

- the cleaner is not used in accordance with its intended use,
- the cleaner is not used correctly,
- the cleaner is operated under impermissible operating conditions.

2.4.1 Principles for safe operation

Dangerous situations during operation can be avoided by safety-conscious and proactive behaviour of the personnel.

To ensure the safe operation of the cleaner the following principles apply:

- The Operating Instructions must be kept ready to hand and accessible for everyone at the cleaner's place of use. They must be complete and in clearly legible form.
- Only use the cleaner for its intended use.
- The cleaner must be functional and in good working order. Check the condition of the cleaner before starting work and at regular intervals.
- Wear tight-fitting work clothing for all work on the cleaner.
- Ensure that nobody can get hurt on the parts of the cleaner.
- Immediately report any faults or noticeable changes on the cleaner to the person responsible.
- Never touch the pipes and the cleaner when these components are hot! Avoid opening the cleaner, unless the process units have been emptied and depressurised.
- Observe the accident prevention regulations and all local regulations.

2.4.2 Environmental Protection

Harm to the environment can be avoided by safety-conscious and proactive behaviour of the staff.

For environmental protection the following principles apply:

- Substances harmful to the environment must not be discharged into the ground or the sewage system.
- Always observe the pertinent regulations relating to waste avoidance, disposal and utilization.
- Substances harmful to the environment must be collected and stored in suitable containers. Clearly mark the containers.
- Dispose of lubricants as hazardous waste.

2.5 Supplementary Regulations

In addition to the instructions in this documentation the following also has to be observed:

- pertinent accident prevention regulations,
- generally accepted safety rules,
- national regulations applicable in the country of use,
- work and safety instructions applicable in the facility,
- installation and operating regulations for use in potentially explosive areas.
- For use in Ex-protected areas, special safety and operating instructions apply. For this purpose, GEA supplies a separate ATEX supplementary operating manual, which must be observed.

2.6 Qualification of personnel

This section contains information about the qualifications that staff working on the cleaner must have.

Operating and maintenance personnel must

- have the necessary qualification to carry out their tasks,
- be instructed with regard to possible dangers,
- know and observe the safety instructions given in the documentation.

Only allow qualified electricians to carry out work on the electrical equipment or have a qualified electrician supervise the work.

Only allow specially trained personnel to carry out work on an explosion-protected system. When working on explosion-protected equipment observe the standards DIN EN 60079-14 for gases and DIN EN 50281-1-2 for dusts.

The following minimum qualifications are required:

- Vocational training as a skilled worker who can work on the cleaner independently.
- Sufficient instruction to work on the cleaner under the supervision and direction of a qualified specialist.

Each member of staff must meet the following requirements to be allowed to work on the cleaner:

- Personal suitability for the respective task.
- Sufficient professional qualification for the respective task.
- Instructed with regard to the function of the cleaner.
- Instructed with regard to the operating sequences of the cleaner.
- Familiar with the safety devices and their function.
- Familiar with these Operating Instructions, especially with the safety instructions and the information which is relevant for the task on hand.
- Familiar with the basic regulations with regard to occupational health and safety and accident prevention.

For work to be carried out on the cleaner the following user groups are distinguished:

User groups	
Staff	**Qualifications**
Operating personnel	Adequate instruction and sound knowledge in the following areas: • Function of the cleaner • Operating sequences of the cleaner • What to do in case of an emergency • Lines of authority and responsibilities with respect to the task
Maintenance personnel	Adequate instruction as well as sound knowledge of the design and function of the cleaner. Sound knowledge in the following areas: • Mechanical equipment • Electrical equipment • Pneumatic system Authorization with regard to safety engineering standards to carry out the following tasks: • Setting devices into operation • Earthing of devices • Marking of devices The relevant certificates of qualification must be submitted before work can be carried out on ATEX certified machines.

2.7 Safety equipment

2.7.1 Signage

Dangerous points on the cleaner are indicated by warning signs, prohibition signs and mandatory signs.

The signs and notes on the cleaner must always be legible. Any illegible signs must be replaced immediately.

Signs on the cleaner	
Sign	**Meaning**
 Fig.2	General hazard warning
 Fig.3	Warning Crushing
 Fig.4	Explosive atmosphere hazard warning

2.8 Residual dangers

Dangerous situations can be avoided by safety-conscious and proactive behaviour of the personnel and by wearing personal protective equipment.

Residual dangers on the cleaner and measures		
Danger	**Cause**	**Measure**
Danger to life	Inadvertent switch-on of the cleaner	Effectively disconnect all components, effectively prevent switch-on.
Risk of injury	Danger presented by moving or sharp-edged parts	The operator must exercise caution and prudence. For all work: • Wear suitable work clothing. • Never operate the machine if the cover panels are not correctly fitted. • Never open the cover panels during the operation. • Never reach into openings. As a precautionary measure, wear personal protective equipment in the vicinity of the cleaner: • Protective gloves • Safety shoes

2.9 Danger zones

Transport, installation

Do not set the cleaner down on the rotating (lower) housing. Store the cleaner in horizontal position and secure it against rolling away to the side.

Commissioning

Please observe the following notes:

- When installing the cleaner, secure it against tipping and twisting and secure all fixing points correctly.
- Only set the cleaner into operation in closed vessels.

Operation

Please observe the following notes:

- Provide suitable protective measures to ensure that the cleaner cannot be set into operation outside of the vessel.
- In the event of faults, stop all media supplies immediately.
- Check the installation situation to ensure that the cleaner is not in contact with other parts and that rotation cannot be obstructed.
- Do not allow the maximum cleaning pressure and the maximum cleaning temperature to be exceeded.
- Vessels, tanks and road tankers etc. must be grounded by suitable means.

Maintenance

Please observe the following notes:

- Close all media supply lines and ensure that no hot or aggressive media are applied to or are in the cleaner.
- Never set the cleaner down on the rotating housing.
- Do not attempt to turn the nozzles by hand.
- Do not use the rotating housing as a tool contact point for installation or removal.

3 Description

3.1 Design

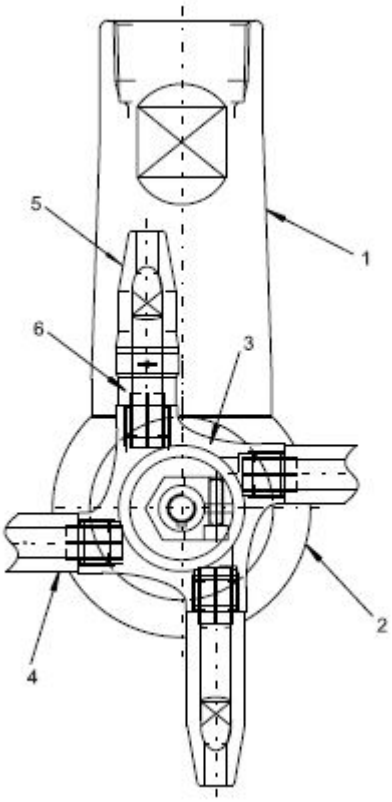

Fig.5: Sample orbital cleaner

Design	
No.	**Designation**
1	Static (upper) housing
2	Rotating (lower) housing
3	Nozzle carrier
4	Nozzle
5	Self-cleaning nozzle
6	Nozzle sleeve

3.2 Functional description

The principle of operation of the Orbital Cleaner is based on two horizontally and vertically rotating axes, as shown in the following diagram.

Fig.6

- Hygienic design
- No ball bearings
- Slim, compact construction
- Intensive cleaning through directed streams
- Long service life
- Maintenance friendly
- Drive happens through the cleaning medium
- Low number of components (same spare parts for orbital cleaner Typhoon, Tempest, Tornado)

4 Transport and storage

4.1 Storage conditions

Store the cleaner in a dry place and ensure it is not subjected to vibration and is protected from external influence.

Storage temperature +5...+40 °C

4.2 Transport

For transport, the following principles apply:

- Only use suitable lifting gear and slings for transporting package units/ cleaners.
- Observe the pictograms on the package.
- Handle the cleaner with care to avoid damage caused by impact or careless loading and unloading. The outside synthetic materials are susceptible to breaking.
- Only allow qualified staff to transport the cleaner.
- Movable parts must be properly secured.
- Only use approved, fully functional load lifting devices and lifting accessories which are suitable for the intended purpose. Observe the maximum load-bearing capacities.
- Under no circumstances should anyone stand under a suspended load.
- Take care when transporting the cleaner. Do not grip sensitive parts of the unit to lift or push the unit or to support yourself. Avoid jerky movements when putting down the unit.
- Do not set the orbital cleaner down on the rotating (lower) housing. Store the orbital cleaner in the horizontal position and secure the cleaner against rolling away to the side.

4.2.1 Scope of supply

On receipt of the cleaner, check whether

- the details on the type plate correspond to the data in the order and delivery documents,
- the equipment is complete and all components are in good order.

5 Technical data

5.1 Identification

The marking on the cleaner is used for the clear identification of the cleaner.

Hint!

Cleaners for use in explosive atmospheres (ATEX) have a different marking, which is explained in the associated ATEX Operating Instructions.

Fig.7

The label contains the following characteristics:

Characteristics of the cleaner	
Type code	e.g. TY-TSG-0-4x4.5-BSP-1"-2-1-2- //A
Part number	4660-4969-117
Serial number	1438612-0010-001 The serial number is composed of: order confirmation number - item number - consecutive number.

5.2 Cyclone:

Technical specifications – Cyclone	
Term	**Description**
Standard materials	Stainless steel, C-PTFE or PTFE
Standard connection	Inner threads 3/4" BSP/NPT // 1"PinFix / 3/4" BSPT / 3/4" NPS
Working temperature	max. 95 °C (203 °F)
Ambient temperature	max. 140 °C (284 °F), max. 30 min
Operational system pressure	4...10 bar (58...145 psi)
Tank opening	min. Ø 77 mm (3 inch)
Nozzle specifications	360° spray pattern Four nozzles with 3 mm / 4 mm bore

5.3 Twister:

Technical specifications – Twister	
Term	**Description**
Standard materials	Stainless steel, C-PTFE, PTFE
Standard connection	Inner threads 3/4" BSP/NPT // 1"PinFix / 3/4" BSPT / 3/4" NPS
Working temperature	max. 95 °C (203 °F)
Ambient temperature	max. 140 °C (284 °F), max. 30 min
Operational system pressure	4...10 bar (58...145 psi)
Tank opening	min. Ø 100 mm (3.94 inch)
Nozzle specifications	360° spray pattern Four nozzles with 3 mm / 4 mm bore

5.4 Typhoon

Technical specifications – Typhoon	
Term	**Description**
Standard materials	Stainless steel, C-PTFE, PTFE
Standard connection	Inner threads 1" BSP/NPT // 1"PinFix / 1" BSPT / 1" NPS
Working temperature	max. 95 °C (203 °F)
Ambient temperature	max. 140 °C (284 °F), max. 30 min
Operational system pressure	4...10 bar (58...145 psi)
Tank opening	min. Ø 130 mm (5.12 inch)
Nozzle specifications	360° spray pattern Four nozzles with 3 mm / 4.5 mm / 6 mm bore

5.5 Tempest

Technical specifications – Tempest	
Term	**Description**
Standard materials	Stainless steel, C-PTFE, PTFE
Standard connection	Inner threads 1.5" BSP/NPT // 1.5"PinFix / 1.5" BSPT / 1.5" NPS
Working temperature	max. 95 °C (203 °F)
Ambient temperature	max. 140 °C (284 °F), max. 30 min
Operational system pressure	4...10 bar (58...145 psi)

Technical specifications – Tempest	
Term	**Description**
Tank opening	min. Ø 210 mm (8.27 inch)
Nozzle specifications	360° spray pattern Four nozzles with 7 mm / 8 mm bore

5.6 Tornado

Technical specifications – Tornado	
Term	**Description**
Standard materials	Stainless steel, C-PTFE, PTFE
Standard connection	Inner thread: 1.5" BSP/NPT // 1.5"PinFix / 1.5" BSPT / 1.5" NPS
Working temperature	max. 95 °C (203 °F)
Ambient temperature	max. 140 °C (284 °F), max. 30 min
Operational system pressure	4...10 bar (58...145 psi)
Tank opening	min. Ø 220 mm (8.66 inch)
Nozzle specifications	360° spray pattern Two nozzles with 11 mm bore

5.7 Tornado 4

Technical specifications – Tornado 4	
Term	**Description**
Standard materials	Stainless steel, C-PTFE, PTFE
Standard connection	Inner thread: 2" BSP/NPT // 2.5"PinFix / 2" BSPT / 2" NPS
Working temperature	max. 95 °C (203 °F)
Ambient temperature	max. 140 °C (284 °F), max. 30 min
Operational system pressure	4...10 bar (58...145 psi)
Tank opening	min. Ø 250 mm (9.84 inch)
Nozzle specifications	360° spray pattern Four nozzles with 8 mm / 9 mm / 10 mm / 11 mm / 12 mm bore

5.8 Resistance and permitted operating temperature of the sealing materials

The resistance and permitted operating temperature of the sealing materials depend on the type and temperature of the medium conveyed. The exposure time can adversely affect the service life of the seals. The sealing materials comply with the regulations of FDA 21 CFR 177.2600 or FDA 21 CFR 177.1550.

The maximum operating temperature is defined by the sealing type and its mechanical load.

Resistance:

- + = good resistance
- o = reduced resistance
- – = no resistance

Sealing resistance / permitted operating temperature			
Medium	**Maximum operating temperatures**	**Sealing material**	
		PTFE	**C-PTFE**
Alkalis up to 3%	up to 80 °C (176°F)	+	+
Alkalis up to 5%	up to 40 °C (104°F)	+	+
Alkalis up to 5%	up to 80 °C (176° F)	+	+
Alkalis more than 5%		+	+
Inorganic acids up to 3%**	up to 80 °C (176°F)	+	+
Inorganic acids up to 5%**	up to 80 °C (176°F)	+	+
Inorganic acids up to 5%**	up to 100 °C (212°F)	+	+
Water	up to 80 °C (176°F)	+	+
Steam	up to 135 °C (275° F)	+	+
Steam, approx. 30 min	up to 150 °C (320°F)	+	+
Fuels/hydrocarbons		+	+
Product with a fat content of max. 35%		+	+
Product with a fat content of more than 35%		+	+
Oils		+	+
** Inorganic acids are, e.g. carbonic acid, nitric acid and sulphuric acid			

Sealing material - temperature resistance	
Sealing material	**General temperature resistance***
PTFE	-40…+260°C (-40...500 °F)
C-PTFE	-40…+260°C (-40...500 °F)
* The general resistance of the material does not correspond to the maximum operating temperature	

5.9 Tool

Tools used for several construction types	
Tools	**Material no.**
Scribe D 1/8"	414-001
Cotter pin driver	4660-0652-000
Socket wrench insert adjustable 1-30 mm	408-172
Torque wrench 1-5 Nm	4660-9000-000
Torque wrench 10-60 Nm	4660-9000-100
Mounting tool / hexagon socket bit 2.5 mm	4660-9042-020

Cyclone	
Tools	**Material no.**
Mounting tool / bush CyTw	4660-9063-010
Mounting tool / bevel gear wheel Tw	4660-4830-010
Mounting tool / nozzle carrier Cy	4660-4820-050
Mounting tool / hexagon socket bit 2 mm	4660-9032-020
Assembly	4660-9012-020

Twister	
Tools	**Material no.**
Mounting tool / bushes CyTw	4660-9063-010
Mounting tool / bevel gear wheel Tw	4660-4830-010
Mounting tool / nozzle carrier Cy	4660-4820-040
Mounting tool / hexagon socket bit 2 mm	4660-9032-020

Typhoon Low Profile	
Tools	**Material no.**
Mounting tool / bushes TyTeTo	4660-9062-010
Mounting tool / bevel gear wheel TyTe	4660-4820-010
Assembly tool / nozzle carrier TyLP	4660-4820-030
Mounting tool / hexagon socket bit 2 mm	4660-9032-020
Mounting tool / hexagon socket bit 4 mm	4660-9052-020
Mounting tool / slot screwdriver bit	4660-9022-020

Typhoon, Tempest, Tornado	
Tools	**Material no.**
Mounting tool / bushes TyTeTo	4660-9062-010
Mounting tool / bevel gear wheel TyTe	4660-4820-010
Mounting tool / nozzle carrier TyTe	4660-4820-020
Mounting tool / hexagon socket bit 2 mm	4660-9032-020
Mounting tool / hexagon socket bit 4 mm	4660-9052-020

Tornado 4	
Tools	**Material no.**
Mounting tool / bushes TyTeTo	4660-9062-010
Mounting tool / bevel gear wheel To4	4660-4840-010
Mounting tool / nozzle carrier TyTe	4660-4820-020
Mounting tool / hexagon socket bit 4 mm	4660-9052-020

5.10 Weights

Size	Weight [kg]
Cyclone	2.0
Twister	2.0
Typhoon Low Profile	2.8
Typhoon	2.8
Tempest	3.9
Tornado	3.1
Tornado 4	4.6

6 Assembly and installation

6.1 Safety notes

Hazardous situations during installation can be avoided by safety-conscious and proactive behaviour of the personnel.

For installation, the following principles apply:

- Only properly qualified staff is allowed to install, assemble and set the cleaner into operation.
- Ensure that adequate working and traffic areas are available at the place of installation.
- Observe the maximum load-bearing capacity of the installation surface.
- Observe the transport instructions and markings on the part(s) to be transported.
- Remove any nails protruding from transport crates immediately after opening the crate.
- Under no circumstances should anyone stand under a suspended load.
- During assembly, the cleaner's safety devices might not be working effectively.
- Reliably secure sections of the plant which have already been connected against inadvertently being switched on.

6.2 Notes on installation

Observe the following points before installing the cleaner:

- Switch off the power circuit and protect it from unauthorized switch-on.
- Protect the supply pump for CIP medium against unauthorized switch-on.
- Shut off the cleaning medium supply line and secure the line against being opened. There must not be any chemical cleaning medium in the supply line.
- Make sure that there are no foreign objects in the system.
- Clean (rinse) the cleaning medium supply line before connecting the orbital cleaner.
- The electrical installation must be in accordance with the requirements of EN 60079-14 in areas with explosive gas atmosphere and in accordance with the requirements of EN 61241-4 in areas with explosive dust atmosphere.

6.3 Preassembly

The orbital cleaner is already pre-assembled. Long nozzles are disassembled for packaging reasons and must be assembled.

Carry out the following steps:

1. Insert the cotter pin driver (SP 1) through the drainage bore in the rotating (lower) housing.

Fig.8

2. Turn the drive shaft (18) using the gap in the inlet until the cotter pin driver (SP 1) can be inserted into the hole in the output shaft (8). The cotter pin driver (SP 1) blocks the movement of the output shaft (8).

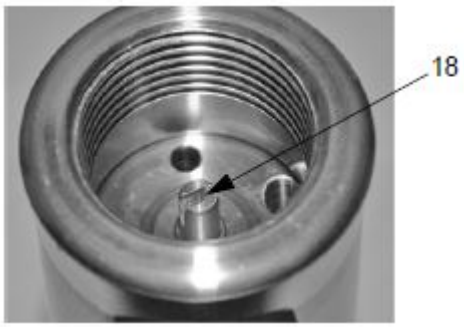

Fig.9

3. Clamp the rotating housing in a vice as shown. Then remove the nozzle carrier with the aid of the tool.

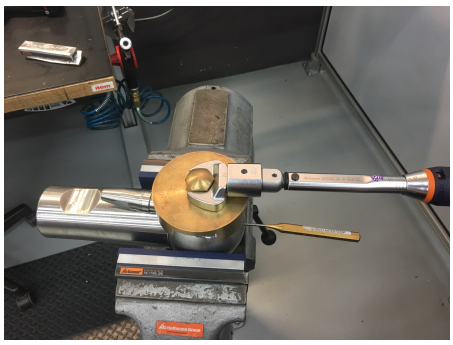

Fig.10

Hint!

Do not remove the bevel gear and leave the cotter pin driver in the drainage hole.

4. Clamp the nozzle carrier, as shown, in a vice and screw in the nozzles with inserted flow guides into the nozzle carrier. Subsequently tighten with torque.

   Torque, see Section 9.4.1, Page 46.

Fig.11

5. Check if the wedge lock washers (37) are correctly positioned in the rotating bevel gear. To this end, both disks must be one above the other so that the larger teeth lie on top of each other.

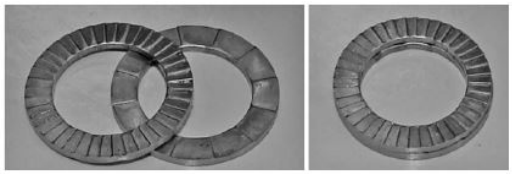

Fig.12

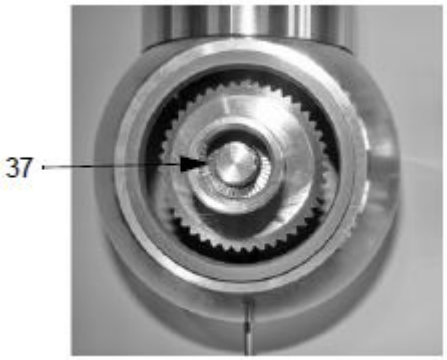

Fig.13

6. Clamp the rotating housing in a vice as shown and block the output shaft (8) with a cotter pin driver. Subsequently tighten the nozzle carrier with the aid of the torque wrench to the defined torque. Torques, see Section 9.4.1, Page 46.

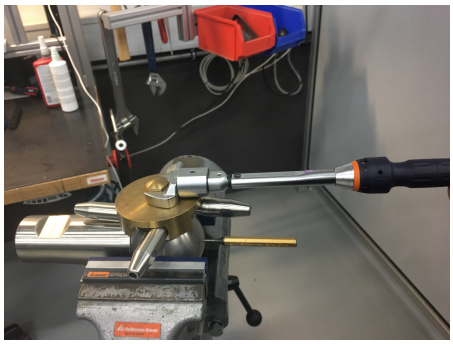

Fig.14

→ The assembly of the orbital cleaner has been completed.

6.4 Installation

Prerequisite

- We generally recommend that a 500 µm filter/strainer should be installed in the CIP supply line at the tank cleaner to prevent blockage or damage resulting from foreign particles. It is the customer‘s responsibility to ensure the suitability of the strainer/filter retention rating for this particular application.
- The cleaner must have a suitable pipe connection for this.
- The user must ensure a loss-proof lead connection into the tank. GEA offers suitable adapters and other accessories such as protective cages.

Notice

Danger when screwing the cleaner to the fixed pipe via the rotating (lower) housing

Doing so will cause damage to the gears inside the cleaner or jamming of the mechanism

► Screw the upper static housing (1) to the pipe (0).

Carry out the following steps:

1. Hold the upper static housing (1) and carefully screw it onto the pipe (0) until it is hand-tight.
2. Use a strap wrench/adjustable spanner on the upper static housing or a suitably sized spanner on the spanner flats provided to screw the cleaner to the pipe.

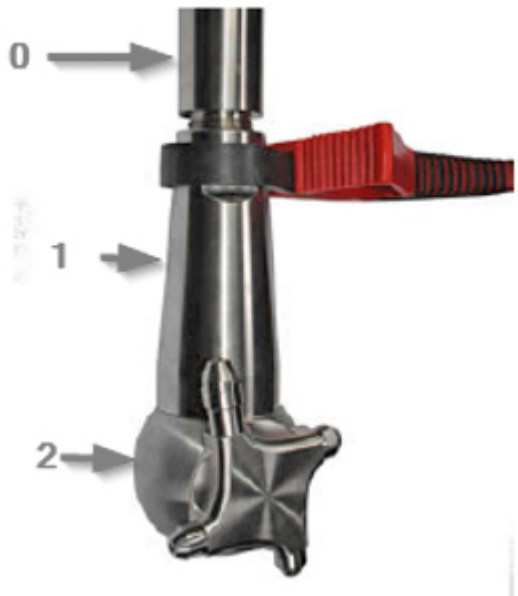

Fig.15

→ Done.

6.5 Removing

Remove in reverse sequence of installation.

⚠ Caution!

Hot surface of the cleaner

Danger of burns.

► Allow the cleaner to cool before removing it.

⚠ Caution!

Hot and aggressive liquids can be discharged from the cleaner.

Danger of injury.

► Completely drain the cleaner before removing it.

Notice

Danger when unscrewing the cleaner via the rotating (lower) housing

Doing so will cause damage to the gears inside the cleaner or jamming of the mechanism

► Use the upper static housing as contact point for the tool.

Carry out the following steps:

1. Use a strap wrench/adjustable spanner on the upper static housing or a suitably sized spanner on the spanner flats provided to unscrew the cleaner from the pipe.

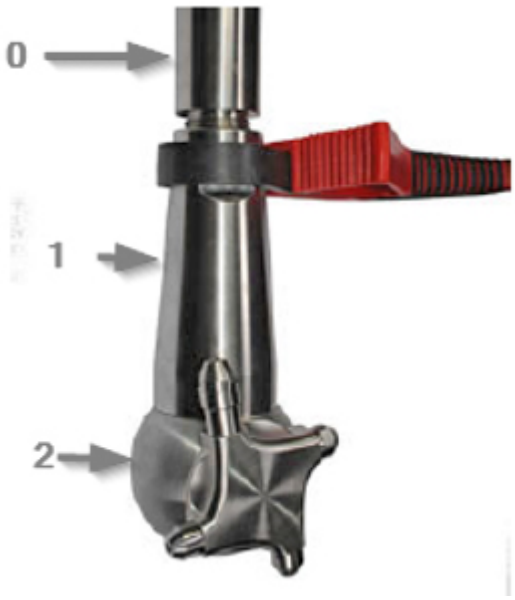

Fig.16

2. Support the rotating housing (2) and carefully unscrew the upper static housing (1) by hand until the cleaner comes free from the inlet pipe.

→ Done.

7 Start-up

7.1 Safety precautions

Initial commissioning

For initial commissioning, the following principles apply:

- The cleaner must be completely assembled and correctly adjusted. All screw connections must be securely tightened.
- Reliably secure machine parts which have already been connected against inadvertently being switched on.
- After each change of the cleaner by the customer, the residual risks must be re-evaluated.

Commissioning

For commissioning, the following principles apply:

- Only allow properly qualified staff to set the cleaner into operation.
- Make sure all connections are properly established.
- There should be no persons in the area around the tank for health and safety reasons. The area must be clear to avoid possible accidents / injuries.
- Remove any liquids that have escaped without leaving residues. Do not leave any residues of leaking liquid on or inside the cleaner.

7.2 Commissioning

Prerequisite:

- Avoid water hammers in the supply pipe.

⚠ Caution!

Hot and aggressive liquids are discharged from the cleaner!

Risk of injury

► Make sure nobody stands in the area of action of the nozzles.
► The cleaner may only be operated in a container intended for this purpose.

Carry out the following steps:

1. Connect the cleaner and set it into operation.

- Done.

Hint!

Noise generated when the cleaning jets hit the tank wall can cause discomfort and stress in the immediate vicinity.

8 Operation and control

8.1 Safety notes

Dangerous situations during operation can be avoided by safety-conscious and proactive behaviour of the personnel.

For operation, the following principles apply:

- Monitor the cleaner during the operation.
- Safety devices must not be changed, removed or taken out of service. Check all safety devices at regular intervals.
- All guards and hoods must be fitted as intended.
- The place of installation of the cleaner must be adequately ventilated at all times.
- Structural alterations of the cleaner are not permitted. Immediately report any changes on the cleaner to the person responsible.
- Always keep danger zones clear. Do not leave any objects in the danger zone. Only allow persons to enter the danger zone when the machine is de-energized.
- Regularly check that all emergency stop devices are working correctly.

8.2 Operating conditions

The cleaner is driven by the cleaning liquid flowing through it at a suitable pressure and flow rate. It is essential that the cleaner is supplied with cleaning liquid at the correct pressure and flow rate for effective operation. The requirements are specified in the tables below.

The specified pressure is the pressure required at the cleaning head and not at the pump.

Cyclone

Operating flow rate and pressure requirements for cleaner, Cyclone – 3 mm nozzles								
Required flow rate	[m^3/h]	2.5	2.8	3.1	3.3	3.5	3.7	4.0
	[l/min]	42	47	51	55	59	62	66
	[USgpm]	11.1	12.4	13.5	14.5	15.6	16.4	17.4
Required pressure	[bar]	4.0	5.0	6.0	7.0	8.0	9.0	10.0
	[psi]	58.0	72.5	87.0	101.5	116.0	130.5	145.0

Operating flow rate and pressure requirements for cleaner, Cyclone – 4 mm nozzles								
Required flow rate	[m^3/h]	4.0	4.5	4.9	5.2	5.6	5.9	6.2
	[l/min]	67	75	82	87	93	98	103
	[USgpm]	17.7	19.8	21.7	23.0	24.6	25.9	27.2

Operating flow rate and pressure requirements for cleaner, Cyclone – 4 mm nozzles								
Required pressure	[bar]	4.0	5.0	6.0	7.0	8.0	9.0	10.0
	[psi]	58.0	72.5	87.0	101.5	116.0	130.5	145.0

Twister

Operating flow rate and pressure requirements for cleaner, Twister – 3 mm nozzles								
Required flow rate	[m^3/h]	2.7	2.9	3.2	3.4	3.6	3.8	4.1
	[l/min]	45	49	54	57	60	64	68
	[USgpm]	11.9	12.9	14.3	15.1	15.9	16.9	18.0
Required pressure	[bar]	4.0	5.0	6.0	7.0	8.0	9.0	10.0
	[psi]	58.0	72.5	87.0	101.5	116.0	130.5	145.0

Operating flow rate and pressure requirements for cleaner, Twister – 4 mm nozzles								
Required flow rate	[m^3/h]	3.9	4.3	4.7	5.0	5.3	5.6	5.8
	[l/min]	65	72	78	84	88	93	97
	[USgpm]	17.2	19.0	20.6	22.2	23.2	24.6	25.6
Required pressure	[bar]	4.0	5.0	6.0	7.0	8.0	9.0	10.0
	[psi]	58.0	72.5	87.0	101.5	116.0	130.5	145.0

Typhoon

Operating flow rate and pressure requirements for cleaner, Typhoon – 3 mm nozzles					
Required flow rate	[m^3/h]	2.9	3.4	4.0	4.4
	[l/min]	48.0	57.0	66.0	73.0
	[USgpm]	12.7	15.1	17.4	19.3
Required pressure	[bar]	4.0	6.0	8.0	10.0
	[psi]	58.0	87.0	116.0	145.0

Operating flow rate and pressure requirements for cleaner, Typhoon – 4.5 mm nozzles								
Required flow rate	[m^3/h]	5.6	6.2	6.7	6.9	7.1	7.3	7.6
	[l/min]	93.3	103.3	111.7	115.0	118.3	121.7	126.7
	[USgpm]	24.7	27.3	29.5	30.4	31.3	32.1	33.5
Required pressure	[bar]	4.0	5.0	6.0	7.0	8.0	9.0	10.0
	[psi]	58.0	72.5	87.0	101.5	116.0	130.5	145.0

Operating flow rate and pressure requirements for cleaner, Typhoon – 6.0 mm nozzles								
Required flow rate	[m^3/h]	7.4	8.2	8.9	9.6	10.0	10.3	10.5
	[l/min]	123.3	136.7	148.3	160.0	166.7	170.8	175.0
	[USgpm]	32.6	36.1	39.2	42.3	44.0	45.1	46.2
Required pressure	[bar]	4.0	5.0	6.0	7.0	8.0	9.0	10.0
	[psi]	58.0	72.5	87.0	101.5	116.0	130.5	145.0

Tempest

Operating flow rate and pressure requirements for cleaner, Tempest– 7 mm nozzles								
Required flow rate	[m^3/h]	12.0	13.7	15.3	16.7	18.0	18.6	19.2
	[l/min]	200	227.5	255.0	277.5	300.0	310.0	320.0
	[USgpm]	52.8	60.1	67.4	73.3	79.3	81.9	84.5
Required pressure	[bar]	4.0	5.0	6.0	7.0	8.0	9.0	10.0
	[psi]	58.0	72.5	87.0	101.5	116.0	130.5	145.0

Operating flow rate and pressure requirements for cleaner, Tempest– 8 mm nozzles								
Required flow rate	[m^3/h]	13.5	15.8	18.0	19.5	21.0	22.2	23.4
	[l/min]	225.0	262.5	300.0	325.0	350.0	370.0	390.0
	[USgpm]	59.4	69.3	79.3	85.9	92.5	97.7	103.0
Required pressure	[bar]	4.0	5.0	6.0	7.0	8.0	9.0	10.0
	[psi]	58.0	72.5	87.0	101.5	116.0	130.5	145.0

Tornado

Operating flow rate and pressure requirements for cleaner, Tornado – 11 mm nozzles								
Required flow rate	[m^3/h]	14.6	15.4	16.1	18.3	20.4	21.6	22.7
	[l/min]	243.3	255.8	268.3	304.2	340.0	359.2	378.3
	[USgpm]	64.3	67.6	70.9	80.4	89.8	94.9	99.9
Required pressure	[bar]	4.0	5.0	6.0	7.0	8.0	9.0	10.0
	[psi]	58.0	72.5	87.0	101.5	116.0	130.5	145.0

Tornado 4

Operating flow rate and pressure requirements for cleaner, Tornado 4– 8 mm nozzles					
Required flow rate	[m^3/h]	14.2	16.9	19.2	21.3
	[l/min]	236.0	282.0	320.0	355.0
	[USgpm]	62.3	74.5	84.5	93.8

Operating flow rate and pressure requirements for cleaner, Tornado 4– 8 mm nozzles					
Required pressure	[bar]	4.0	6.0	8.0	10.0
	[psi]	58.0	87.0	116.0	145.0

Operating flow rate and pressure requirements for cleaner, Tornado 4– 9 mm nozzles					
Required flow rate	[m^3/h]	17.0	21.0	23.8	26.5
	[l/min]	284.0	350.0	397.0	442.0
	[USgpm]	75.0	92.5	104.9	116.8
Required pressure	[bar]	4.0	6.0	8.0	10.0
	[psi]	58.0	87.0	116.0	145.0

Operating flow rate and pressure requirements for cleaner, Tornado 4– 10 mm nozzles					
Required flow rate	[m^3/h]	20.7	25.4	29.5	33.1
	[l/min]	345.0	424.0	492.0	551.0
	[USgpm]	91.1	112.0	130.0	145.6
Required pressure	[bar]	4.0	6.0	8.0	10.0
	[psi]	58.0	87.0	116.0	145.0

Operating flow rate and pressure requirements for cleaner, Tornado 4– 11 mm nozzles					
Required flow rate	[m^3/h]	27.6	34.1	38.4	43.2
	[l/min]	460.0	568.0	640.0	720.0
	[USgpm]	121.5	150.1	169.1	190.2
Required pressure	[bar]	4.0	6.0	8.0	10.0
	[psi]	58.0	87.0	116.0	145.0

Operating flow rate and pressure requirements for cleaner, Tornado 4– 12 mm nozzles					
Required flow rate	[m^3/h]	29.9	37.0	42.3	47.4
	[l/min]	499.0	617.0	705.0	790.0
	[USgpm]	131.8	163.0	186.2	208.7
Required pressure	[bar]	4.0	6.0	8.0	10.0
	[psi]	58.0	87.0	116.0	145.0

Hint!

The cleaner may only be operated at a maximum pressure of 10 bar (145 psi). Higher pressures can destroy the cleaner.

9 Maintenance

9.1 Safety notes

Maintenance and repair

For maintenance and repair, the following principles apply:

- Observe the intervals specified in the maintenance schedule.
- Only allow qualified staff to carry out maintenance or repair work on the cleaner.
- Before starting any maintenance or repair work, the cleaner must be switched off and secured against being switched back on. Work may only be started once any residual energy has been discharged.
- Block access for unauthorized persons. Put up notice signs which draw attention to the maintenance or repair work going on.
- Do not climb on the cleaner. Use suitable access aids and working platforms.
- Wear suitable protective clothing.
- Only use suitable and undamaged tools to carry out maintenance work.
- When replacing parts only use approved, fully functional load lifting devices and lifting accessories which are suitable for the intended purpose.
- Before setting the unit back into operation refit all safety devices as originally provided in the factory. Then check that all safety devices are working correctly.
- Check pipes are firmly secured, also check for leaks and damage.
- Check that all emergency stop devices are working correctly.

Disassembly

For disassembly, the following principles apply:

- Only allow qualified staff to disassemble the cleaner.
- Before starting disassembly, the cleaner must be switched off and secured against being switched back on. Work may only be started once any residual energy has been discharged.
- Disconnect all power and utility lines.
- Markings, e.g. on lines, must not be removed.
- Do not climb on the cleaner. Use suitable access aids and working platforms.
- Mark the lines (if unmarked) prior to disassembly to ensure they are not confused when re-assembling.
- Protect open line ends with blind plugs against ingress of dirt.
- Pack sensitive parts separately.

9.2 Maintenance intervals

The practical maintenance intervals can only be determined by the user since they depend on the operating conditions, for instance:

- type and temperature of the cleaning solution,
- ambient conditions.

Maintenance intervals	
Applications	**Maintenance intervals (guideline values)**
Inspection	175 hours of operation
Maintenance	500 hours of operation

9.3 Disassembly

9.3.1 Dismantling the rotating (lower) housing

Requirement:

- The cleaner must have been removed and completely drained and must have cooled down.

Unscrew the nozzle carrier

Carry out the following steps:

1. Insert the cotter pin driver (SP 1) through the drainage bore in the rotating housing.

Fig.17

2. Turn the drive shaft (18) using the gap in the inlet until the cotter pin driver (SP 1) can be inserted into the hole in the output shaft (8). The cotter pin driver (SP 1) blocks the movement of the output shaft (8).

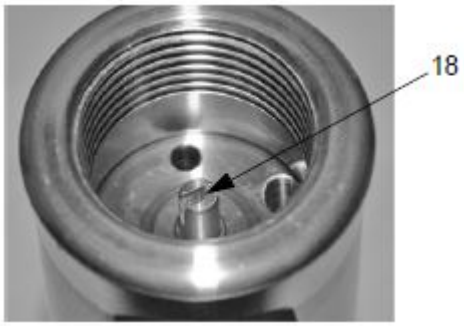

Fig.18

3. Remove the nozzle carrier (3).

   → Typhoon, Tempest, Tornado, Tornado 4: Clamp the rotating housing (2) in a vice as shown. Release the nozzle carrier (3) with a soft-faced hammer.

   → Cyclone: Clamp the rotating housing (2) in a vice as shown. Loosen the nozzle carrier (3) with a large adjustable wrench.

   → Twister: Clamp the rotating housing (2) in a vice as shown. Release the nozzle carrier (3) with a soft-faced hammer.

4. Loosen the nozzle carrier by turning counter-clockwise and remove.

Fig.19

5. If necessary, as not urgently required for maintenance: Disassemble all nozzles (4, 5) with a suitable wrench in anti-clockwise direction. If needed, also remove all nozzle inserts (7).

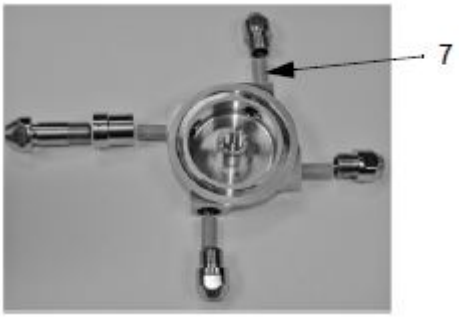

Fig.20

→ Unscrew the nozzle carrier.

Remove the nozzle carrier sealing washer

Carry out the following steps:

1. Remove the sealing washer (10).

Fig.21

→ Nozzle carrier sealing washer is removed.

Removal of the bevel gear

Carry out the following steps:

1. Carefully remove the bevel gear (11) - it should be easy to lift off with the lock washers (37).

Fig.22

! Residue build up of the cleaner may make the bevel gear difficult to remove.

In this case, carry out the following steps:

Clamp the bevel gear in the vice as shown and carefully release it from the cleaner with a blow with the soft-face hammer.

Fig.23

→ Bevel gear is now removed.

Removal of the lock washers.

Carry out the following steps:

1. Remove the lock washers (37). No special tools are required for this.

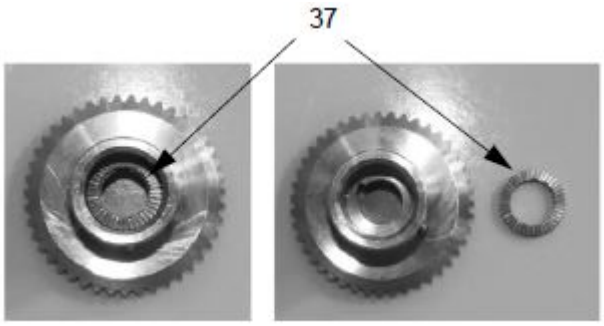

Fig.24

→ The lock washers are removed.

Removal of the retaining plate and shaft

Carry out the following steps:

1. Remove the 4 cylinder head screws (25) and remove the retaining plate (9) from the drive shaft (8).

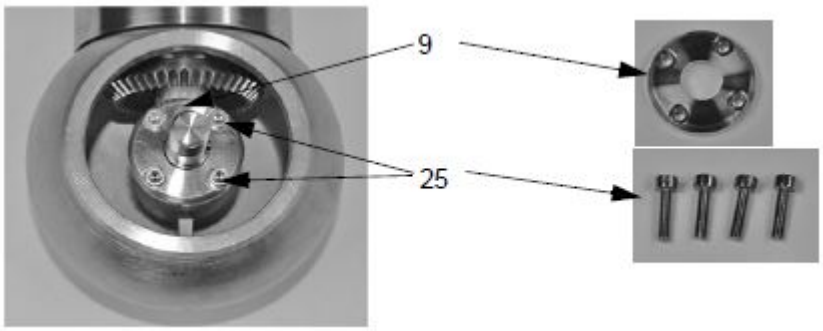

Fig.25

2. Remove the drive shaft (8) and the thrust washer (28). No tools are required for this. Remove the feather key (29) from the shaft if it is damaged.

Fig.26

→ Retaining plate and shaft are removed.

Loosening the set screw

Carry out the following steps:

1. Use a 2.5 mm hex wrench to loosen the set screw (26).
   → Cyclone/Twister/Typhoon/Tempest/Tornado: The set screw (26) is found in the in the upper-middle of the rotating housing (2)

→ Tornado 4: The set screw (26) is found in the in the upper-central portion of the rotating housing (2)

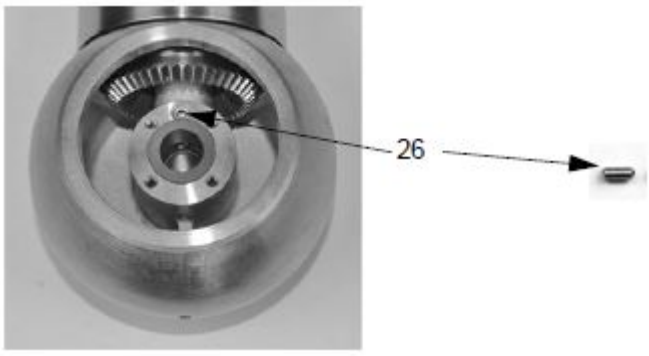

Fig.27

→ The set screw is removed.

9.3.2 Separate static (upper) and rotating (lower) housing

Carry out the following steps:

1. Clamp the rotating housing (2) in a soft-jawed vice.
2. With a large adjustable spanner unscrew the static housing (1) in clockwise direction until the static housing separates from the rotating housing.

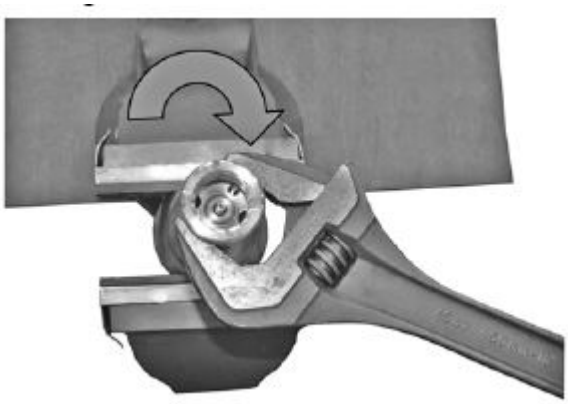

Fig.28

3. Remove the second sealing ring (10) from the rotating housing.

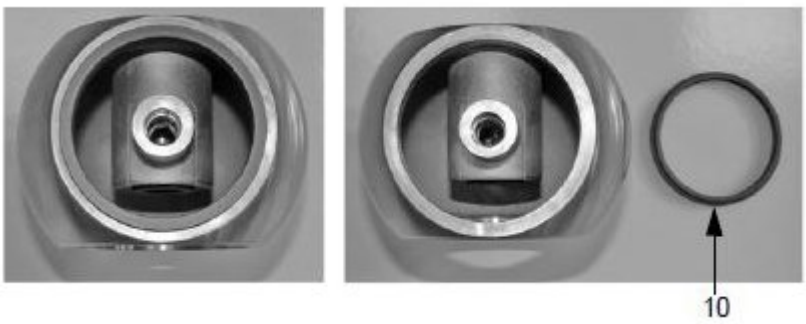

Fig.29

→ Static and rotating housing are separated.

9.3.3 Removal of the shaft bearing

Carry out the following steps:

1. Use the curved scriber (SP 1) to remove both bearing inserts (22, 24) from the rotating housing.

   Note: This step can also be done after the removal of the set screw.

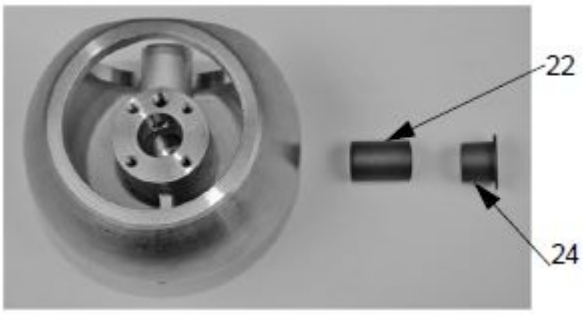

Fig.30

→ The shaft bearing is removed.

9.3.4 Remove individual parts from static (upper) housing

Carry out the following steps:

1. Clamp the designated spanner flats of the static housing with a soft-padded vice.

Fig.31

2. Carefully pry open and remove the circlip (30) with a small screwdriver.
3. Using the bevel gear tool (SP 3), carefully unscrew the bevel gear (12) in a counter-clockwise direction.

Fig.32

4. Remove the plain bearing (35) from the centre of the bevel gear (12). It should be easily removed.

Fig.33

5. Remove the drive wheel (13) from the static housing. No tool is required for this, it should easily lift out. The small bushing (14) remains in the drive wheel.

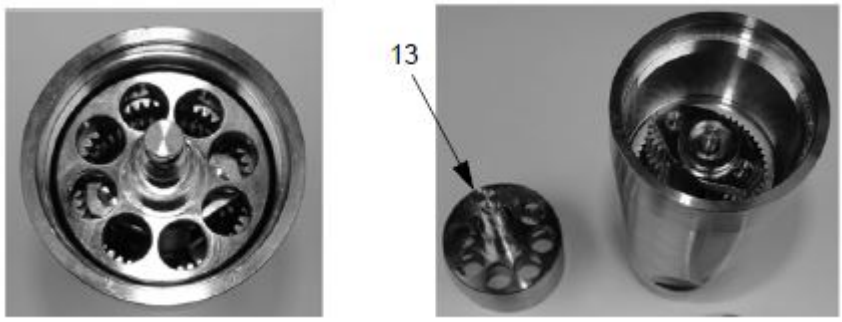

Fig.34

6. Remove the remains of the drive bushing (14) from the drive wheel.

Fig.35

7. Take the planetary gear out of the static housing (1). No tool is required for this, the parts should easily lift out.

Fig.36

8. Remove the drive shaft assembly (18, 19, 27). No tool is required for this, the parts should easily lift out.

Fig.37

9. Remove the bushing (21) from the drive (20). To do this, push out the socket with the pin punch driver from the upper inlet downwards.

Fig.38

→ The individual parts are removed from the static housing.

9.3.5 Disassembly of the planetary gear

Carry out the following steps:

1. Use the pin punch driver (SP2) to remove the bushings (23) from the ring carrier unit. The bushings may remain in the drive shaft assembly and then no longer need to be removed from the ring carrier unit.

Fig.39

2. Remove the spring-lock washer (36).

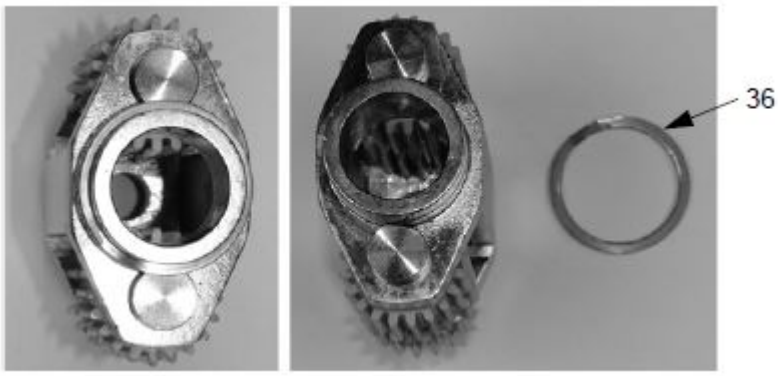

Fig.40

3. Pull out the spindles (15).

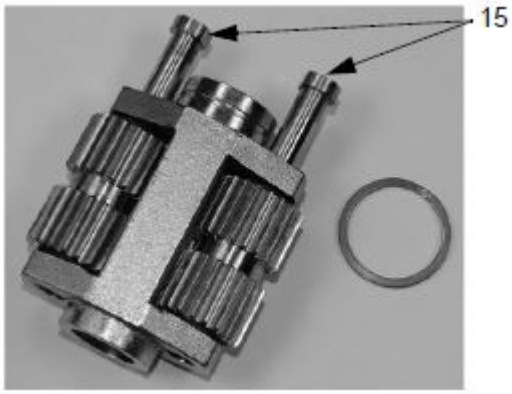

Fig.41

4. Remove the planet gears (32, 33) from the carrier (16) and the bushes (34) from the planetary gears.

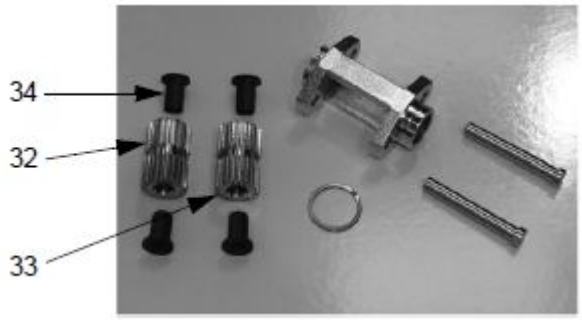

Fig.42

Example Typhoon:

Fig.43

→ The planetary gear is disassembled.

→ The cleaner is now disassembled.

9.4 Installation

9.4.1 Torque of the cleaner components

When mounting the components of the cleaner, install according to the torques given in the table.

Torque			
Pos.-Nr	**Term**		**(Nm)**
3	Nozzle support		
	Cyclone:	M8	20
	Twister:	M8	20
	Typhoon Low Profile:	M10	30
	Typhoon/Tempest/Tornado:	M10	30
	Tornado 4:	M10	35
4	Nozzle		
	Cyclone:		2

Torque			
Pos.-Nr	**Term**		**(Nm)**
	Twister: Typhoon Low Profile: Typhoon: Tempest: Tornado: Tornado 4:		10 5 15 20 25 30
25	First tighten Allen screws	M3	1.3
26	Threaded pin	M5	3.5
27	Threaded pin	M5	3.5

9.4.2 Installing the drive shaft assembly

Carry out the following steps:

1. Place bushing (21) on slotted end of drive shaft assembly with a gap. The flange end first.

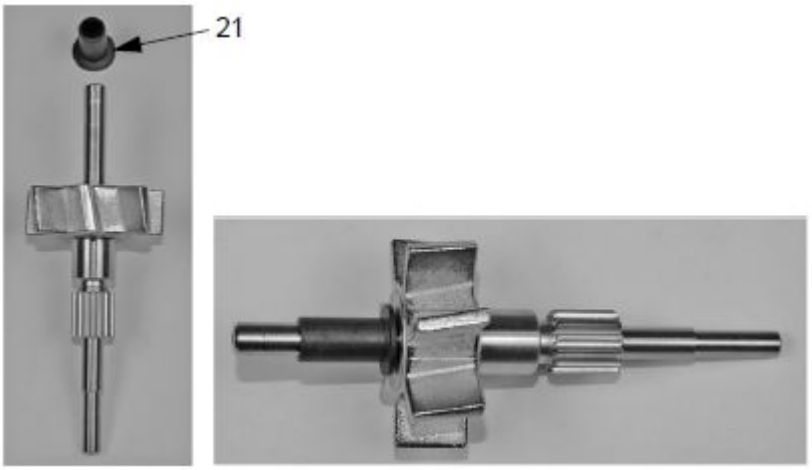

Fig.44

2. Insert the drive shaft assembly into the central bore of the drive in the upper static housing. Check that the bushing is firmly seated in the hole.

Fig.45

→ The drive shaft assembly is installed.

9.4.3 Assemble the planetary gear

At the head of each spindle (15) on one side a smooth contact surface is located. These contact surfaces must be fitted to the top of the carrier unit so that the spindles and planetary gears are aligned correctly before installing the retaining ring.

Carry out the following steps:

1. Insert the planetary gear bushings (34) into the planetary gears.

Fig.46

2. Mount the planetary gears (32/33) and spindles (15) so that the flat sides of the spindle heads (A) are fitted to the top of the carrier unit.

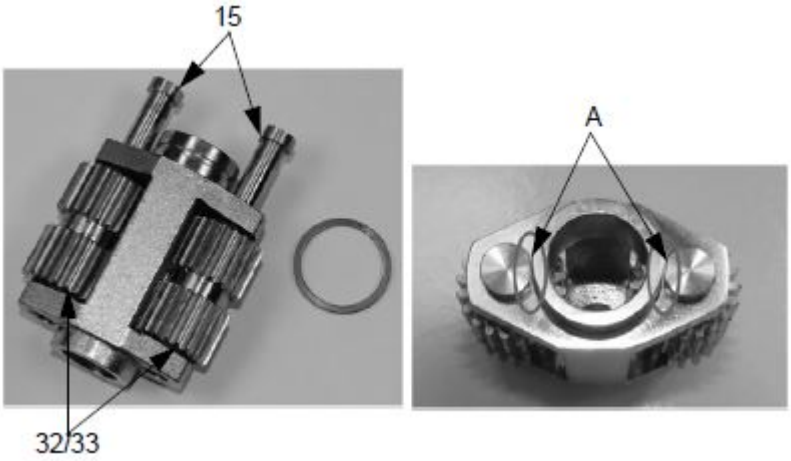

Fig.47

3. Insert the retaining ring (36) into the groove provided.

Fig.48

4. Press the bushings (23) into the “retaining ring end” of the carrier unit.

   ! Pay attention that the flat sides of the bushings are seated directly above the carrier unit.

Fig.49

→ The planetary gear is assembled.

9.4.4 Planetary gear installation

Carry out the following steps:

1. Slide the planet gear over the end of the drive shaft and replace it in the static (upper) housing. Insert the end with the bushings first. The assembly should be easily inserted.

   ! Make sure that the planet gears engage with the gear in the static housing.

Fig.50

! The assembly should be seated loosely and be able to be turned freely by hand.

2. Press the drive bushing (14) firmly into the hole in the centre of the round drive wheel (13).

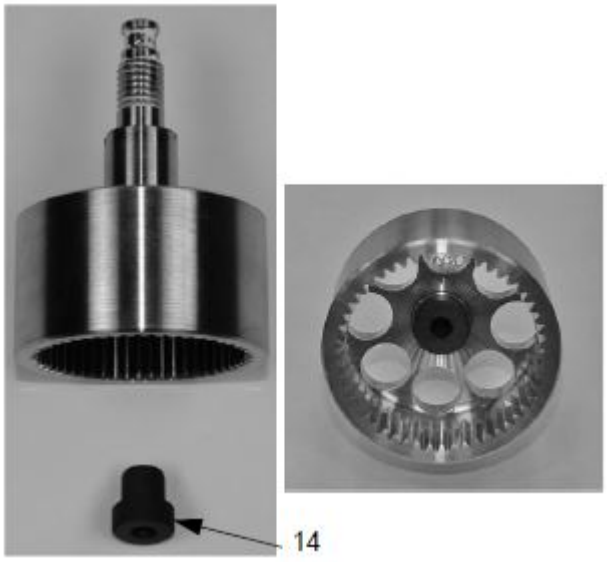

Fig.51

3. Slide the drive wheel (13) over the drive shaft into the static housing onto the planetary gear. The gear bushing (14) should slide over the end of the drive shaft so that the planetary gears align.

Fig.52

→ The drive wheel unit is now fixed and can no longer be turned freely by hand.

→ Planetary gear is installed.

9.4.5 Installation of the slide bearing

Carry out the following steps:

1. Slide the slide bearing (35) down into the bevel gear (12). No tool is required for this step

   ! Make sure that the slide bearing is seated flat against the bevel gear.

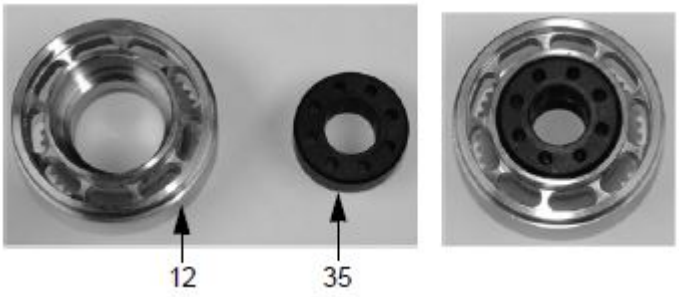

Fig.53

→ The slide bearing is installed.

9.4.6 Installation of the bevel gear in the static (upper) housing

Carry out the following steps:

1. Push the assembly with the end of the bearing over the protruding spindle. As soon as the two screw threads are slightly in contact, carefully tighten clockwise.

Fig.54

2. Clamp the designated spanner flats of the static housing with a soft-padded vice. Using a bevel gear tool (SP3), tighten the assembly into the housing until hand tight.

   → Typhoon, Tempest, Tornado, Tornado 4:

   → Cyclone/Twister:

→ The bevel gear is installed in the static housing.

9.4.7 Installation of the retaining ring in the static (upper) housing

Carry out the following steps:

1. Thread the retaining ring (30) back into the groove and press into position.

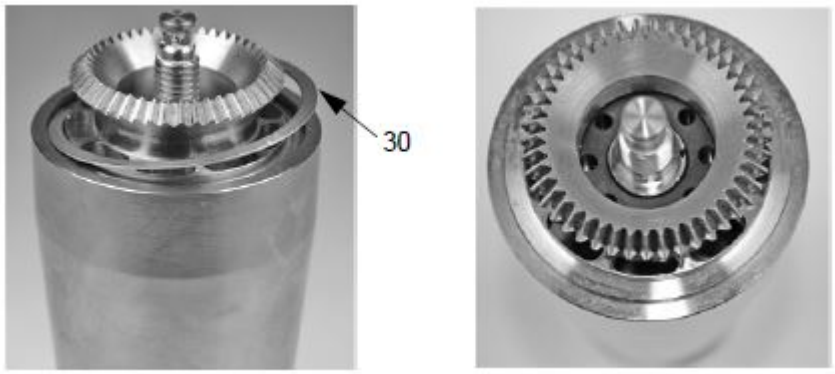

Fig.55

→ The retaining ring is installed in the static housing.

9.4.8 Installation of the shaft bushings in the rotating (lower) housing

Carry out the following steps:

1. Insert the bushing (24) into the large hole in the centre of the rotating housing and press in with the special tool (SP 6) until it stops.

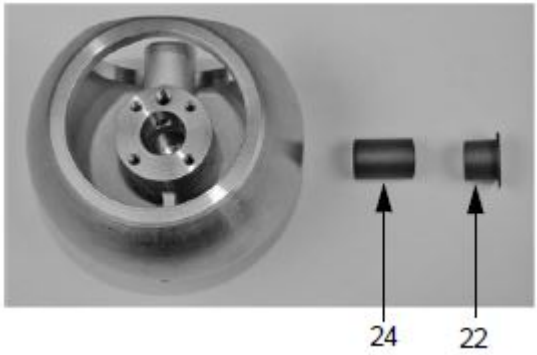

Fig.56

2. Insert bushing (22) with flange end upwards into the same hole. No tool is required for this step.

→ The shaft bushings is installed in the rotating housing.

9.4.9 Assembly static (upper) and rotating (lower) housing

Requirement:

- Before assembling, test if the drive shaft (18) can rotate across the gap.

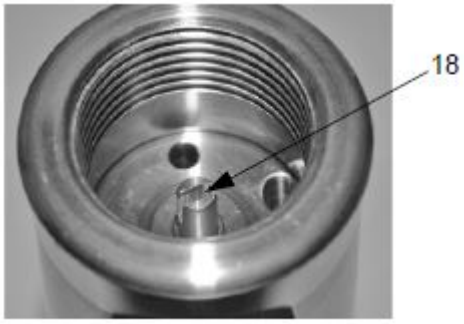

Fig.57

Carry out the following steps:

1. Place retaining ring (10) in the groove on the front side of the rotating housing.

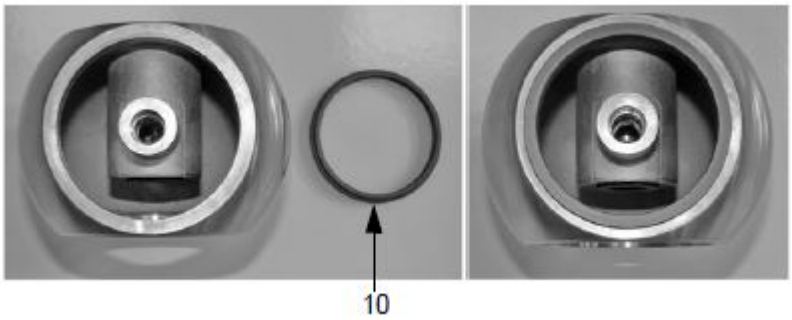

Fig.58

2. Engage the left-hand thread of the driven gear (13) protruding from the static bevel gear (12) into the corresponding threaded hole in the rotating housing (2).

   Carefully tighten by hand in a counter-clockwise direction.

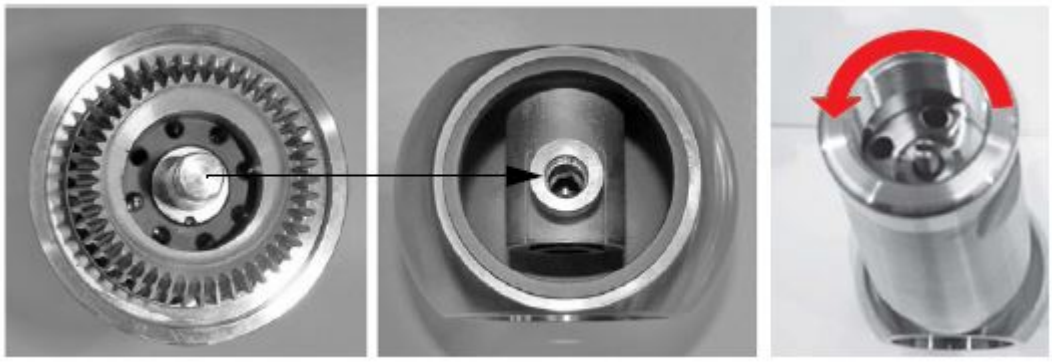

Fig.59

3. Clamp the rotating housing in a vice with padded jaws and attach an adjustable wrench to the upper housing. Tighten counter-clockwise.

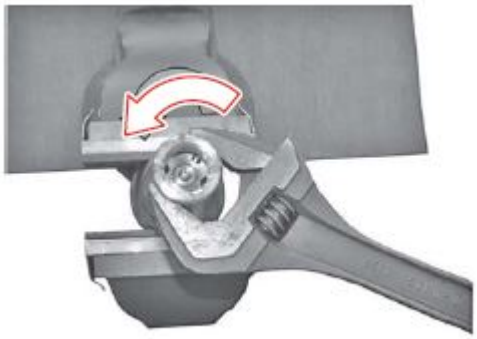

Fig.60

4. Remove from the vice and insert the set screw (26) into the middle upper hole in the rotating housing. Tighten with an Allen key (2.5 mm), see torque Section 9.4.1, Page 46.

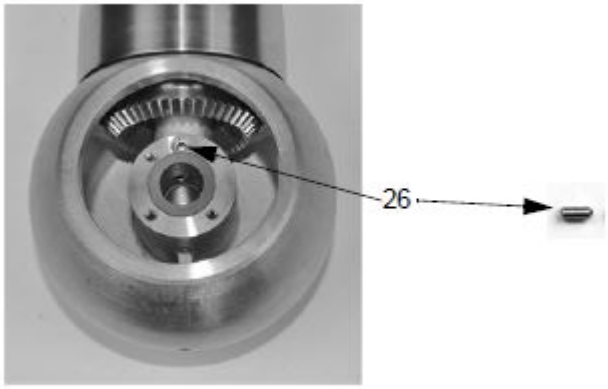

Fig.61

→ Static and rotating housing are assembled.

9.4.10 Mounting the nozzle carrier

Requirement:

- Make sure that key (29) is in groove on the spindle shaft.

Mounting the shaft and retaining plate

Carry out the following steps:

1. Insert the output shaft (8) into the hole with the bushing. Make sure the smooth end is inserted first and the threaded end protrudes. The feather key should be oriented upwards as shown in the picture. This facilitates later insertion of the pin driver.

   Note: When the shaft is inserted, air is displaced in the bore, giving the impression of an air cushion.

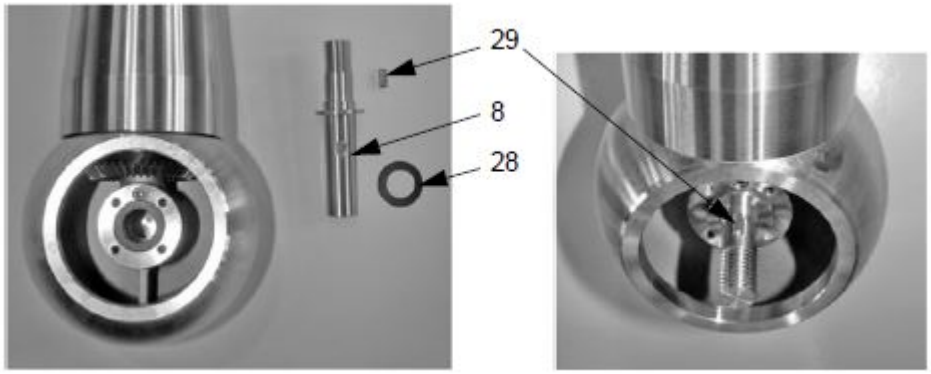

Fig.62

2. Push the pressure lock washer (28) over the shaft end.

Fig.63

3. Place the retaining plate (9) onto the shaft and secure with 4 cylinder head screws (25). Tighten with an Allen key (2.5 mm), see torque Section 9.4.1, Page 46.

Fig.64

→ The shaft and retaining plate are mounted.

Installing the bevel gear and retaining ring

Carry out the following steps:

1. Insert the cotter pin driver (SP 1) in through the opening in the floor of the rotating (lower) housing (2).

Fig.65

2. Slide the feather key groove of the bevel gear (11) over the corresponding feather key (29) of the shaft.

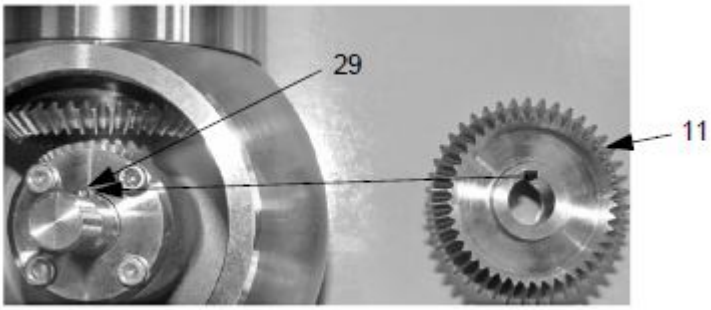

Fig.66

3. Insert the retaining ring (10) into the rotating housing (2).

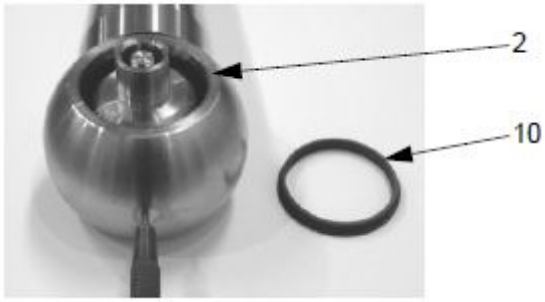

Fig.67

→ The bevel gear and retaining ring are installed.

Installing the fit-lock washers

Carry out the following steps:

1. The fix-lock washers (37) must be installed as a pair. To do this, place both discs one above the other so that the larger teeth lie on top of each other.

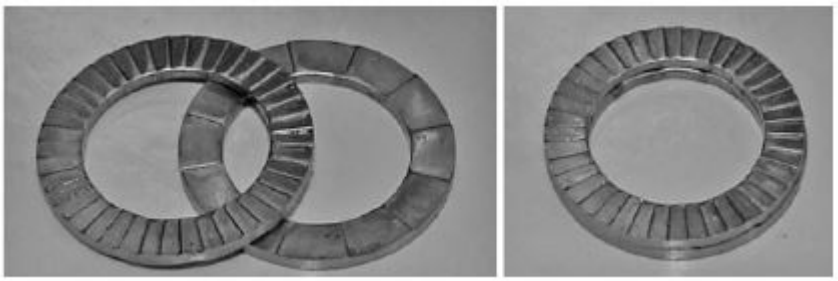

Fig.68

2. Insert the fit-lock washers (37) over the end of the shaft into the bevel gear (11).

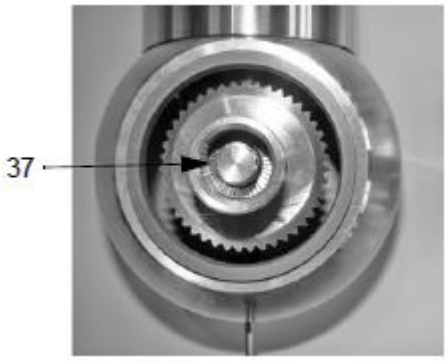

Fig.69

→ The fix-lock washers are installed.

Mounting the nozzle carrier

Carry out the following steps:

1. The self-cleaning nozzles (5) of the orbital cleaners Twister, Typhoon, Tempest, Tornado and Tornado 4 are mounted in the same way:

   Slide the nozzle sleeve (6) onto the nozzle. The hole in the sleeve does not have to line up with the hole in the nozzle.

   ! Does not apply for Cyclone.

Fig.70

2. Insert nozzle inserts (7) into all nozzles.

Fig.71

3. Screw standard nozzles (4) clockwise into the nozzle carrier (3) and tighten, see torque Section 9.4.1, Page 46.

   For required tools, see Section 5.9, Page 23.

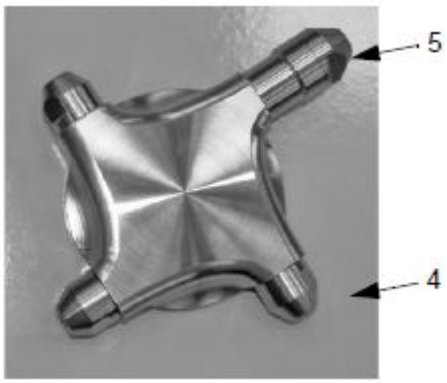

Fig.72

4. Screw the self-cleaning nozzle (5) loosely onto the nozzle holder by hand.
5. Check that the nozzle (4), (5) have been correctly installed.

Fig.73

6. Reinstall the nozzle carrier (3). To do this, let the screw thread on the shaft engage into the corresponding screw thread in the nozzle carrier. Carefully tighten by hand in a clockwise direction.

Fig.74

7. Clamp the rotating housing in a vice as shown and block the output shaft with a cotter pin driver. Then, as shown, tighten the nozzle carrier with the aid of the torque wrench to the defined torque.

   For proper torque, see Section 9.4.1, Page 46.

Fig.75

Fig.76

Fig.77

8. Turn the nozzle sleeve until the small hole (A) points towards the tank cleaner. In this position, tighten the nozzle sleeve by tightening the nozzle with a suitable tool on the wrench flats (B), see Torque Section 9.4.1, Page 46.

   ! Does not apply for Cyclone.

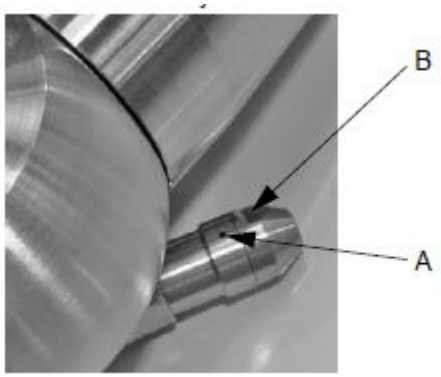

Fig.78

   → The nozzle carrier is installed.

→ The cleaner is assembled again.

9.4.11 Check the assembly

Check the orientation of the planet gears on the fully assembled unit.

Carry out the following steps:

1. Turn the drive shaft with a flat-blade screwdriver.

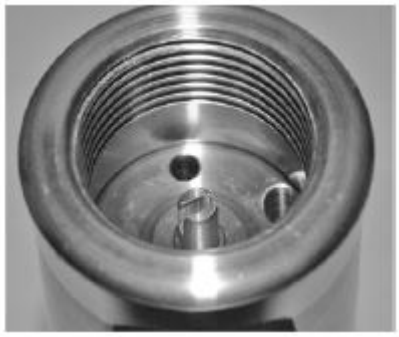

Fig.79

→ When properly installed, the drive shaft should rotate freely, without resistance or snagging.

If resistance is detected, the planetary gears are likely to have been misaligned during assembly.

Do not use the cleaner until it has been dismantled and reinstalled with properly aligned wheels.

2. Now test the cleaner under suitable conditions.

→ The installation is now tested.

10 Alarms

10.1 Malfunctions and remedies

In the event of malfunctions immediately deactivate the cleaner and secure it against inadvertent reactivation. Malfunctions may only be remedied by qualified staff, who must observe the safety instructions.

11 Decommissioning

11.1 Safety notes

For shutting down, the following principles apply:

- For longer periods of standstill, observe the storage conditions, see Chapter 4, Page 18.

11.2 Disposal

11.2.1 General notes

Dispose of the cleaner in an environmentally friendly manner. Observe the statutory waste disposal regulations applicable at the place of installation.

Separate the different materials and dispose of them correctly sorted. Also observe the instructions regarding disposal in the operating instructions for the individual components.

12 Spare parts list - orbital cleaner TSG-CTTTTT

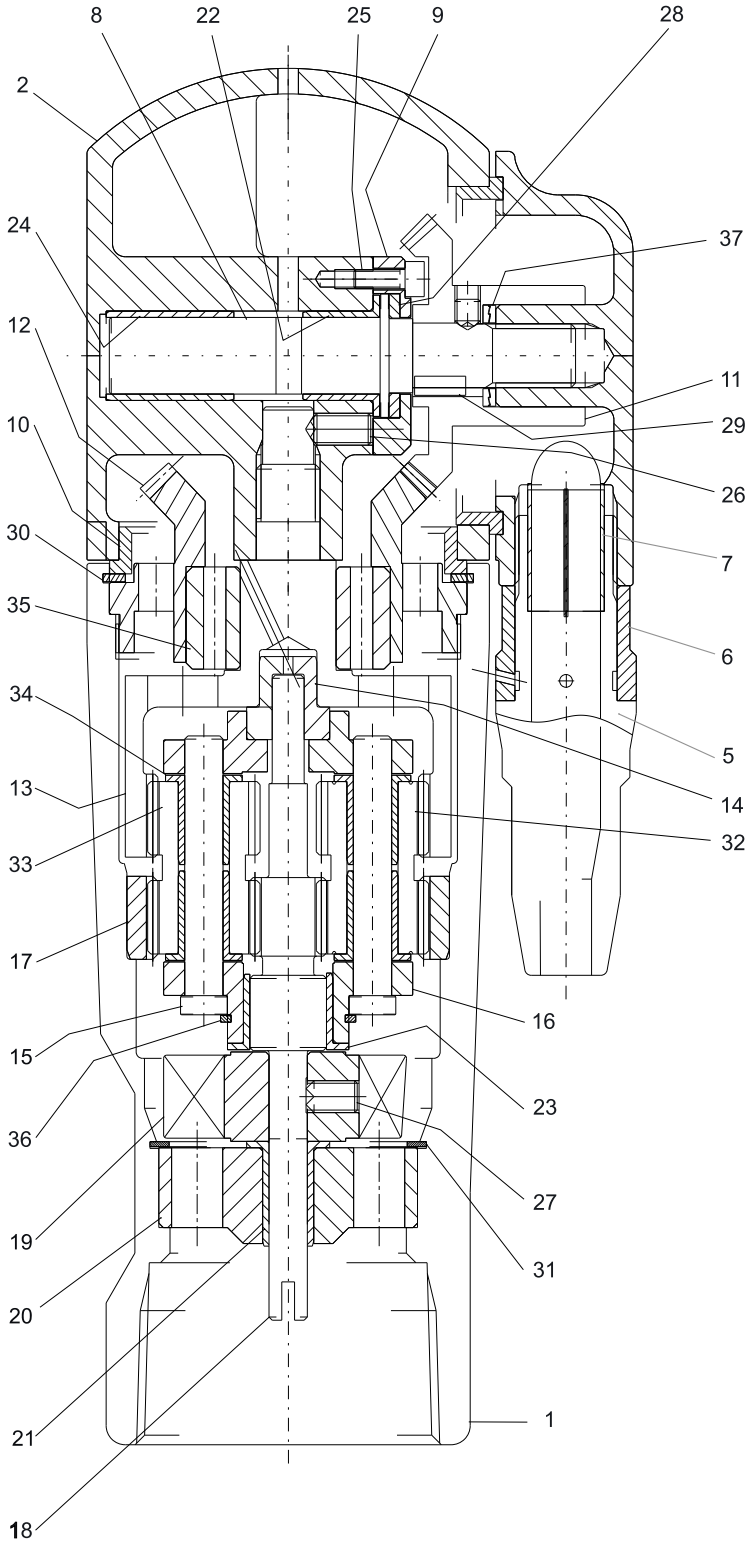

Fig.80

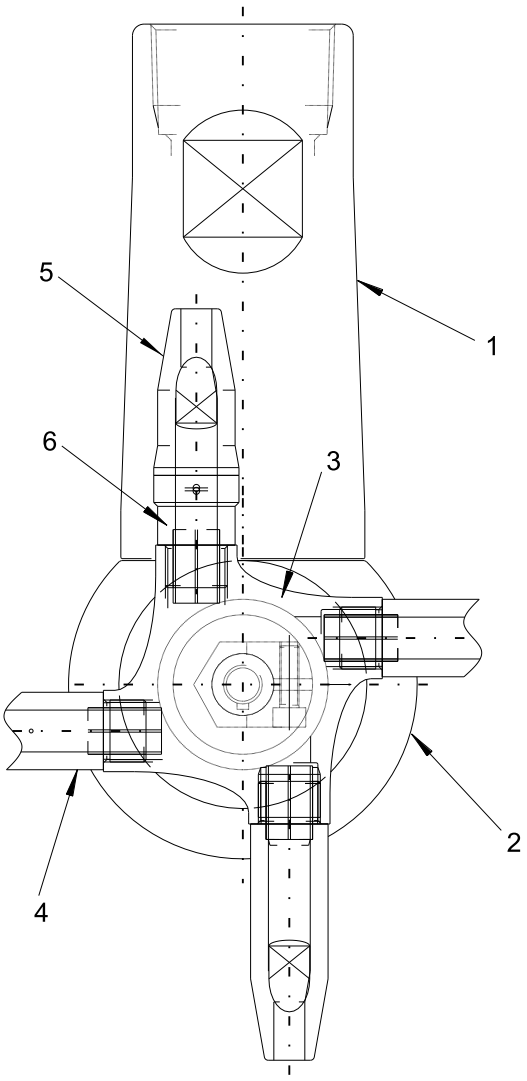

Fig.81

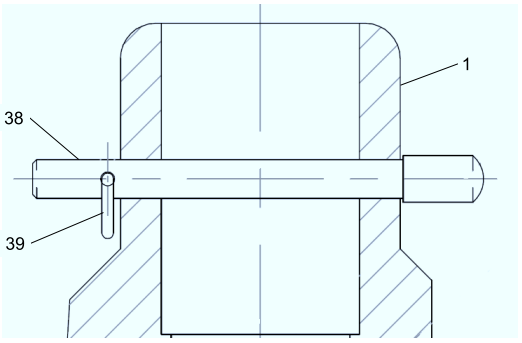

Fig.82

Cyclone				
Item	**Quantity**	**Designation**	**Material**	**Material no.**
1	1	Upper housing BSP	1.4404/316L	4660-8819-112
		Upper housing NPT	1.4404/316L	4660-8819-111
		Upper housing PIN FIX	1.4404/316L	4660-8819-110
2	1	Lower housing	1.4404/316L	4660-8218-020
3	1	Nozzle carrier	1.4404/316L	4660-4229-001
4	4	Nozzle 3 mm	1.4404/316L	4660-8287-001
		Nozzle 4 mm	1.4404/316L	4660-8288-001
7	4	Stream straightener	1.4404/316L	4660-4268-000
8	1	Shaft	1.4404/316L	4660-8287-020
9	1	Keep plate	1.4404/316L	4660-8287-030
10*	2	Seal ring	C-PTFE	4660-4218-050
		Seal ring	PTFE	4660-4218-030
11	1	Bevel gear wheel rotating	1.4404/316L	4660-8383-020
12	1	Bevel gear wheel static	1.4404/316L	4660-8383-030
13	1	Drive gear	1.4404/316L	4660-8251-030
14*	1	Bush (drive gear)	C-PTFE	4660-4260-030
		Bush (drive gear)	PTFE	4660-4260-040
15	2	Spindle	1.4404/316L	4660-8287-040
16	1	Planet gear carrier	1.4404/316L	4660-8268-000
17	1	Internal gear	1.4404/316L	4660-8280-000
18	1	Drive shaft	1.4404/316L	4660-4221-020
19	1	Rotor	1.4404/316L	4660-8216-000
20	1	Actuator 3 mm	1.4404/316L	4660-4721-030
		Actuator 4 mm	1.4404/316L	4660-4721-020
21*	1	Bush (drive)	C-PTFE	4660-4260-090
		Bush (drive)	PTFE	4660-4260-110
22*	1	Bush (drive shaft)	C-PTFE	4660-4238-020
		Bush (drive shaft)	PTFE	4660-4238-030
23*	1	Bush (carrier)	C-PTFE	4660-4260-050
		Bush (carrier)	PTFE	4660-4260-080
24*	1	Bush (smooth)	C-PTFE	4660-4238-040
		Bush (smooth)	PTFE	4660-4238-050
25*	4	Cylinder head screw	A4	4660-8221-020
26*	1	Set screw	A4	4660-4784-010
27	1	Set screw	A4	4660-4784-010
28*	1	Pressure disk	C-PTFE	4660-4220-040
		Pressure disk	PTFE	4660-4220-050
29	1	Feather key	1.4571	4660-8261-010
30	1	Retaining ring	1.4401	4660-8383-011
31	1	Retaining ring	1.4401	4660-4721-021
32	1	Planet gear (even)	318S13	4660-8210-080
33	1	Planet gear (odd)	318S13	4660-8210-090

Cyclone				
Item	**Quantity**	**Designation**	**Material**	**Material no.**
34*	4	Bush (planet gear)	C-PTFE	4660-0466-020
		Bush (planet gear)	PTFE	4660-0466-030
35*	1	Plain bearing	C-PTFE	4660-0517-110
		Plain bearing	PTFE	4660-0517-120
36	1	Retaining ring	1.4401	4660-7361-020
37*	1	Wedge lock washer	1.4404	4660-5810-019
38	1	Pin 1"	1.4404/316L	4660-4264-010
39	1	R-clip	1.4401	4660-4274-010
* Wear parts are included in the wear parts set.				

Twister TSG				
Item	**Quantity**	**Designation**	**Material**	**Material no.**
1	1	Upper housing BSP	1.4404/316L	4660-8819-112
		Upper housing NPT	1.4404/316L	4660-8819-111
		Upper housing PIN FIX	1.4404/316L	4660-8819-110
2	1	Lower housing	1.4404/316L	4660-8218-020
3	1	Nozzle carrier	1.4404/316L	4660-4229-000
4	3	Nozzle 3 mm	1.4404/316L	4660-8287-000
		Nozzle 4 mm	1.4404/316L	4660-8288-000
5	1	Self-cleaning nozzle 3 mm	1.4404/316L	4660-4288-000
		Self-cleaning nozzle 4 mm	1.4404/316L	4660-4289-000
6	1	Nozzle sleeve	1.4404/316L	4660-4258-000
7	4	Stream straightener	1.4404/316L	4660-4268-000
8	1	Shaft	1.4404/316L	4660-8287-020
9	1	Keep plate	1.4404/316L	4660-8287-030
10*	2	Seal ring	C-PTFE	4660-4218-050
		Seal ring	PTFE	4660-4218-030
11	1	Bevel gear wheel rotating	1.4404/316L	4660-8383-020
12	1	Bevel gear wheel static	1.4404/316L	4660-8383-030
13	1	Drive gear	1.4404/316L	4660-8251-030
14	1	Bush (drive gear)	C-PTFE	4660-4260-030
		Bush (drive gear)	PTFE	4660-4260-040
15	2	Spindle	1.4404/316L	4660-8287-040
16	1	Planet gear carrier	1.4404/316L	4660-8268-000
17	1	Internal gear	1.4404/316L	4660-8280-000
18	1	Drive shaft	1.4404/316L	4660-4221-020
19	1	Rotor	1.4404/316L	4660-8216-000
20	1	Actuator 3 mm	1.4404/316L	4660-4721-030
		Actuator 4 mm	1.4404/316L	4660-4721-020
21*	1	Bush (drive)	C-PTFE	4660-4260-090
		Bush (drive)	PTFE	4660-4260-110
22*	1	Bush (drive shaft)	C-PTFE	4660-4238-020
		Bush (drive shaft)	PTFE	4660-4238-030
23*	1	Bush (carrier)	C-PTFE	4660-4260-050
		Bush (carrier)	PTFE	4660-4260-080
24*	1	Bush (smooth)	C-PTFE	4660-4238-040
		Bush (smooth)	PTFE	4660-4238-050
25*	4	Cylinder head screw	A4	4660-8221-020
26*	1	Set screw	A4	4660-4784-010
27	1	Set screw	A4	4660-4784-010
28*	1	Pressure disk	C-PTFE	4660-4220-040
		Pressure disk	PTFE	4660-4220-050
29	1	Feather key	1.4571	4660-8261-010
30	1	Retaining ring	A4	4660-8383-011

Twister TSG				
Item	**Quantity**	**Designation**	**Material**	**Material no.**
31	1	Retaining ring	A4	4660-4721-021
32	1	Planet gear (even)	318S13	4660-8210-080
33	1	Planet gear (odd)	318S13	4660-8210-090
34*	4	Bush (planet gear)	C-PTFE	4660-0466-020
		Bush (planet gear)	PTFE	4660-0466-030
35*	1	Plain bearing	C-PTFE	4660-0517-110
		Plain bearing	PTFE	4660-0517-120
36	1	Retaining ring	1.4401	4660-7361-020
37*	1	Wedge lock washer	1.4404	4660-5810-019
38	1	Pin 1"	1.4404/316L	4660-4264-010
39	1	R-clip	1.4401	4660-4274-010
* Wear parts are included in the wear parts set.				

Typhoon TSG				
Item	**Quantity**	**Designation**	**Material**	**Material no.**
1	1	Upper housing BSP	1.4404/316L	4660-4210-010
		Upper housing NPT	1.4404/316L	4660-4210-040
		Upper housing PIN FIX	1.4404/316L	4660-4250-410
2	1	Lower housing	1.4404/316L	4660-8230-610
3	1	Nozzle carrier	1.4404/316L	4660-4220-010
4	3	Nozzle 3 mm	1.4404/316L	4660-4250-011
		Nozzle 4.5 mm	1.4404/316L	4660-4250-010
		Nozzle 6 mm	1.4404/316L	4660-4250-012
5	1	Self-cleaning nozzle 3 mm	1.4404/316L	4660-4241-011
		Self-cleaning nozzle 4.5 mm	1.4404/316L	4660-4241-010
		Self-cleaning nozzle 6 mm	1.4404/316L	4660-4241-012
6	1	Nozzle sleeve	1.4404/316L	4660-4251-010
7	1	Stream straightener	1.4404/316L	4660-4260-120
8	1	Shaft	1.4404/316L	4660-8230-010
9	1	Keep plate	1.4404/316L	4660-8240-010
10*	2	Seal ring	C-PTFE	4660-4210-030
		Seal ring	PTFE	4660-8210-020
11	1	Bevel gear wheel rotating	1.4404/316L	4660-0485-010
12	1	Bevel gear wheel static	1.4404/316L	4660-8232-010
13	1	Drive gear	1.4404/316L	4660-8250-010
14*	1	Bush (drive gear)	C-PTFE	4660-8210-030
		Bush (drive gear)	PTFE	4660-4210-020
15	2	Spindle	1.4404/316L	4660-8282-010
16	1	Planet gear carrier	1.4404/316L	4660-8260-600
17	1	Internal gear	1.4404/316L	4660-8270-010
18	1	Drive shaft	1.4404/316L	4660-4221-010
19	1	Rotor	1.4404/316L	4660-8211-000
20	1	Actuator 3 mm	1.4404/316L	4660-4231-011
		Actuator 4.5 mm	1.4404/316L	4660-4231-010
		Actuator 6 mm	1.4404/316L	4660-4231-012
21*	1	Bush (drive)	C-PTFE	4660-8220-030
		Bush (drive)	PTFE	4660-4220-020
22*	1	Bush (drive shaft)	C-PTFE	4660-8230-030
		Bush (drive shaft)	PTFE	4660-4230-020
23*	1	Bush (carrier)	C-PTFE	4660-8230-030
		Bush (carrier)	PTFE	4660-4230-020
24*	1	Bush (smooth)	C-PTFE	4660-8240-030
		Bush (smooth)	PTFE	4660-4240-020
25*	4	Cylinder head screw	A4	4660-8221-020
26*	1	Set screw	A4	4660-8241-010
27	1	Set screw	A4	4660-8251-010
28*	1	Pressure disk	C-PTFE	4660-4220-030

Typhoon TSG				
Item	**Quantity**	**Designation**	**Material**	**Material no.**
		Pressure disk	PTFE	4660-4250-020
29	1	Feather key	1.4571	4660-8261-010
30	1	Retaining ring	1.4401	4660-8271-010
31	1	Retaining ring	1.4401	4660-8281-010
32	1	Planet gear (even)	318S13	4660-0465-010
33	1	Planet gear (odd)	318S13	4660-0475-010
34*	4	Bush (planet gear)	C-PTFE	4660-0455-030
		Bush (planet gear)	PTFE	4660-0464-020
35*	1	Plain bearing	C-PTFE	4660-8250-030
		Plain bearing	PTFE	4660-4270-020
36	1	Retaining ring	1.4401	4660-8242-010
37*	1	Wedge lock washer	1.4404	4660-5811-010
38	1	Pin 1”	1.4404/316L	4660-4264-010
39	1	R-clip	1.4401	4660-4274-010
* Wear parts are included in the wear parts set.				

Tempest TSG				
Item	**Quantity**	**Designation**	**Material**	**Material no.**
1	1	Upper housing BSP	1.4404/316L	4660-8212-010
		Upper housing NPT	1.4404/316L	4660-8212-020
		Upper housing PIN FIX	1.4404/316L	4660-8212-040
2	1	Lower housing	1.4404/316L	4660-8230-610
3	1	Nozzle carrier	1.4404/316L	4660-4283-010
4	3	Nozzle 7 mm	1.4404/316L	4660-4214-010
		Nozzle 8 mm	1.4404/316L	4660-4214-011
5	1	Self-cleaning nozzle 7 mm	1.4404/316L	4660-4244-010
		Self-cleaning nozzle 8 mm	1.4404/316L	4660-4244-011
6	1	Nozzle sleeve	1.4404/316L	4660-4254-010
7	4	Stream straightener	1.4404/316L	4660-4224-120
8	1	Shaft	1.4404/316L	4660-8230-010
9	1	Keep plate	1.4404/316L	4660-8240-010
10*	2	Seal ring	C-PTFE	4660-4210-030
		Seal ring	PTFE	4660-8210-020
11	1	Bevel gear wheel rotating	1.4404/316L	4660-0485-010
12	1	Bevel gear wheel static	1.4404/316L	4660-8232-010
13	1	Drive gear	1.4404/316L	4660-8250-010
14*	1	Bush (drive gear)	C-PTFE	4660-8210-030
		Bush (drive gear)	PTFE	4660-4210-020
15	2	Spindle	1.4404/316L	4660-8282-010
16	1	Planet gear carrier	1.4404/316L	4660-8260-600
17	1	Internal gear	1.4404/316L	4660-8270-010
18	1	Drive shaft	1.4404/316L	4660-4221-010
19	1	Rotor	1.4404/316L	4660-8211-000
20	1	Actuator 7 mm	1.4404/316L	4660-4234-010
		Actuator 8 mm	1.4404/316L	4660-4234-020
21*	1	Bush (drive)	C-PTFE	4660-8220-030
		Bush (drive)	PTFE	4660-4220-020
22*	1	Bush (drive shaft)	C-PTFE	4660-8230-030
		Bush (drive shaft)	PTFE	4660-4230-020
23*	1	Bush (carrier)	C-PTFE	4660-8230-030
		Bush (carrier)	PTFE	4660-4230-020
24*	1	Bush (smooth)	C-PTFE	4660-8240-030
		Bush (smooth)	PTFE	4660-4240-020
25*	4	Cylinder head screw	A4	4660-8221-020
26*	1	Set screw	A4	4660-8241-010
27	1	Set screw	A4	4660-8251-010
28*	1	Pressure disk	C-PTFE	4660-4220-030
		Pressure disk	PTFE	4660-4250-020
29	1	Feather key	1.4571	4660-8261-010
30	1	Retaining ring	1.4401	4660-8271-010

Tempest TSG				
Item	**Quantity**	**Designation**	**Material**	**Material no.**
31	1	Retaining ring	1.4401	4660-8281-010
32	1	Planet gear (even)	318S13	4660-0465-010
33	1	Planet gear (odd)	318S13	4660-0475-010
34*	4	Bush (planet gear)	C-PTFE	4660-0455-030
		Bush (planet gear)	PTFE	4660-0464-020
35*	1	Plain bearing	C-PTFE	4660-8250-030
		Plain bearing	PTFE	4660-4270-020
36	1	Retaining ring	1.4401	4660-8242-010
37*	1	Wedge lock washer	1.4404	4660-5811-011
38	1	Pin 1.5"	1.4404/316L	4660-4264-030
39	1	R-clip	1.4401	4660-4274-010
* Wear parts are included in the wear parts set.				

Tornado TSG				
Item	**Quantity**	**Designation**	**Material**	**Material no.**
1	1	Upper housing BSP	1.4404/316L	4660-8212-010
		Upper housing NPT	1.4404/316L	4660-8212-020
		Upper housing PIN FIX	1.4404/316L	4660-8212-040
2	1	Lower housing	1.4404/316L	4660-8230-610
3	1	Nozzle carrier	1.4404/316L	4660-8252-010
4	1	Nozzle 11 mm	1.4404/316L	4660-8272-010
5	1	Self-cleaning nozzle 11 mm	1.4404/316L	4660-4284-010
6	1	Nozzle sleeve	1.4404/316L	4660-4215-010
7	2	Stream straightener	1.4404/316L	4660-8262-010
8	1	Shaft	1.4404/316L	4660-8230-010
9	1	Keep plate	1.4404/316L	4660-8240-010
10*	2	Seal ring	C-PTFE	4660-4210-030
		Seal ring	PTFE	4660-8210-020
11	1	Bevel gear wheel rotating	1.4404/316L	4660-0485-010
12	1	Bevel gear wheel static	1.4404/316L	4660-8232-010
13	1	Drive gear	1.4404/316L	4660-8250-010
14*	1	Bush (drive gear)	C-PTFE	4660-8210-030
		Bush (drive gear)	PTFE	4660-4210-020
15	2	Spindle	1.4404/316L	4660-8282-010
16	1	Planet gear carrier	1.4404/316L	4660-8260-600
17	1	Internal gear	1.4404/316L	4660-8270-010
18	1	Drive shaft	1.4404/316L	4660-4221-010
19	1	Rotor	1.4404/316L	4660-8211-000
20	1	Actuator 11 mm	1.4404/316L	4660-4234-020
21*	1	Bush (drive)	C-PTFE	4660-8220-030
		Bush (drive)	PTFE	4660-4220-020
22*	1	Bush (drive shaft)	C-PTFE	4660-8230-030
		Bush (drive shaft)	PTFE	4660-4230-020
23*	1	Bush (carrier)	C-PTFE	4660-8230-030
		Bush (carrier)	PTFE	4660-4230-020
24*	1	Bush (smooth)	C-PTFE	4660-8240-030
		Bush (smooth)	PTFE	4660-4240-020
25*	4	Cylinder head screw	A4	4660-8221-020
26*	1	Set screw	A4	4660-8241-010
27	1	Set screw	A4	4660-8251-010
28*	1	Pressure disk	C-PTFE	4660-4220-030
		Pressure disk	PTFE	4660-4250-020
29	1	Feather key	1.4571	4660-8261-010
30	1	Retaining ring	1.4401	4660-8271-010
31	1	Retaining ring	1.4401	4660-8281-010
32	1	Planet gear (even)	318S13	4660-0465-010
33	1	Planet gear (odd)	318S13	4660-0475-010

Tornado TSG				
Item	**Quantity**	**Designation**	**Material**	**Material no.**
34*	4	Bush (planet gear)	C-PTFE	4660-0455-030
		Bush (planet gear)	PTFE	4660-0464-020
35*	1	Plain bearing	C-PTFE	4660-8250-030
		Plain bearing	PTFE	4660-4270-020
36	1	Retaining ring	1.4401	4660-8242-010
37*	1	Wedge lock washer	1.4404	4660-5811-011
38	1	Pin 1.5"	1.4404/316L	4660-4264-030
39	1	R-clip	1.4401	4660-4274-010
* Wear parts are included in the wear parts set.				

Tornado 4 TSG				
Item	**Quantity**	**Designation**	**Material**	**Material no.**
1	1	Upper housing BSP	1.4404/316L	4660-0662-000
		Upper housing NPT	1.4404/316L	4660-0662-010
		Upper housing PIN FIX	1.4404/316L	4660-0662-001
2	1	Lower housing	1.4404/316L	4660-8229-610
3	1	Nozzle carrier	1.4404/316L	4660-0471-000
4	3	Nozzle 8 mm	1.4404/316L	4660-0481-000
		Nozzle 9 mm	1.4404/316L	4660-0481-020
		Nozzle 10 mm	1.4404/316L	4660-0481-010
		Nozzle 11 mm	1.4404/316L	4660-0481-030
		Nozzle 12 mm	1.4404/316L	4660-0481-040
5	1	Self-cleaning nozzle 8 mm	1.4404/316L	4660-0412-000
		Self-cleaning nozzle 9 mm	1.4404/316L	4660-0412-020
		Self-cleaning nozzle 10 mm	1.4404/316L	4660-0412-010
		Self-cleaning nozzle 11 mm	1.4404/316L	4660-0412-030
		Self-cleaning nozzle 12 mm	1.4404/316L	4660-0412-040
6	1	Nozzle sleeve	1.4404/316L	4660-0422-000
7	4	Stream straightener	1.4404/316L	4660-0682-000
8	1	Shaft	1.4404/316L	4660-0613-000
9	1	Keep plate	1.4404/316L	4660-8240-010
10*	2	Seal ring	C-PTFE	4660-4210-050
		Seal ring	PTFE	4660-4210-051
11	1	Bevel gear wheel rotating	1.4404/316L	4660-0416-000
12	1	Bevel gear wheel static	1.4404/316L	4660-0426-000
13	1	Drive gear	1.4404/316L	4660-0436-000
14*	1	Bush (drive gear)	C-PTFE	4660-8210-030
		Bush (drive gear)	PTFE	4660-4210-020
15	2	Spindle	1.4404/316L	4660-8282-010
16	1	Planet gear carrier	1.4404/316L	4660-8260-610
17	1	Internal gear	1.4404/316L	4660-8270-010
18	1	Drive shaft	1.4404/316L	4660-4221-010
19	1	Rotor	1.4404/316L	4660-8211-000
20	1	Actuator 8 mm	1.4404/316L	4660-0623-001
		Actuator 9 mm	1.4404/316L	4660-0623-001
		Actuator 10 mm	1.4404/316L	4660-0623-002
		Actuator 11 mm	1.4404/316L	4660-0623-000
		Actuator 12 mm	1.4404/316L	4660-0623-000
21*	1	Bush (drive)	C-PTFE	4660-8220-030
		Bush (drive)	PTFE	4660-4220-020
22*	1	Bush (drive shaft)	C-PTFE	4660-8230-030
		Bush (drive shaft)	PTFE	4660-4230-020
23*	1	Bush (carrier)	C-PTFE	4660-8230-030
		Bush (carrier)	PTFE	4660-4230-020

Tornado 4 TSG				
Item	**Quantity**	**Designation**	**Material**	**Material no.**
24*	1	Bush (smooth)	C-PTFE	4660-8240-030
		Bush (smooth)	PTFE	4660-4240-020
25*	4	Cylinder head screw	A4	4660-8221-020
26*	1	Set screw	A4	4660-8241-010
27	1	Set screw	A4	4660-8251-010
28*	1	Pressure disk	C-PTFE	4660-4220-030
		Pressure disk	PTFE	4660-4250-020
29	1	Feather key	1.4571	4660-8261-010
30	1	Retaining ring	1.4401	4660-0633-000
31	1	Retaining ring	1.4401	4660-0643-000
32	1	Planet gear (even)	318S13	4660-0465-010
33	1	Planet gear (odd)	318S13	4660-0475-010
34*	4	Bush (planet gear)	C-PTFE	4660-0455-030
		Bush (planet gear)	PTFE	4660-0464-020
35*	1	Plain bearing	C-PTFE	4660-0551-030
		Plain bearing	PTFE	4660-0551-031
36	1	Retaining ring	1.4401	4660-8242-010
37*	1	Wedge lock washer	1.4404	4660-5810-022
38	1	Pin 2.5”	1.4404/316L	4660-4264-020
39	1	R-clip	1.4401	4660-4274-010
* Wear parts are included in the wear parts set.				

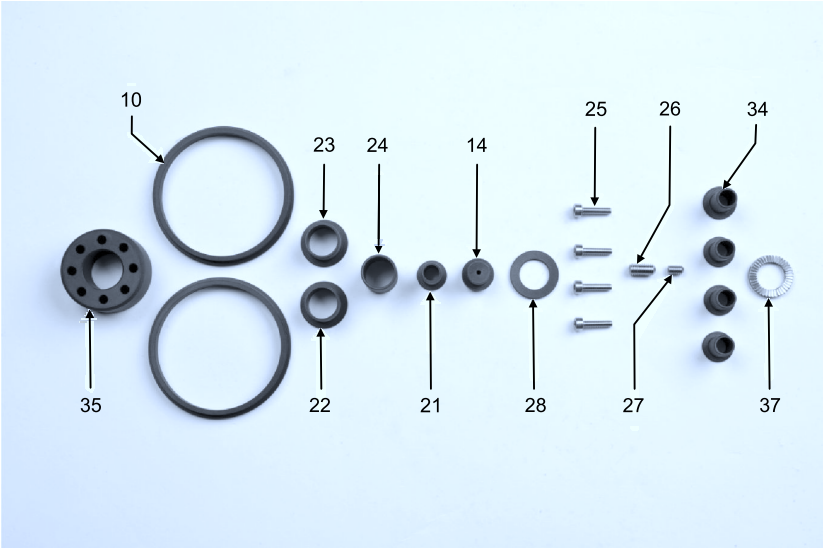

Fig.83: Wear parts set TSG

Table wear parts set		
Cleaner type	**Material**	**Material no.**
Cyclone / Twister TSG	C-PTFE	4660-4050-888
	PTFE	4660-4051-888
Typhoon/Tempest/Tornado TSK/TSG*	C-PTFE	4660-4013-888
	PTFE	4660-4014-888
Tornado 4	C-PTFE	4660-4980-888
	PTFE	4660-4981-888
* Contains screw M5x16 for TPB version		

13 Appendix

13.1 Lists

13.1.1 Abbreviations and terms

Abbreviation	Explanation
ATEX	ATEX is a widely used synonym for the European Union ATEX directives. The designation ATEX is derived from the abbreviation of the French ATmosphère EXplosive.
BS	British Standard
bar	Unit of measurement of pressure [bar] All pressure data expressed in [bar/psi] is assumed to be gauge pressure [barg/psig] unless explicitly specified otherwise.
BSP	British Standard Pipe Thread
approx.	approximately
°C	Unit of measurement of temperature [degree Celsius]
C-PTFE	Carbonated polytetrafluoroethylene
DN	DIN nominal width
DIN	German standard issued by DIN (Deutsches Institut für Normung e.V., German Institute for Standardization)
EN	European Standard
°F	Unit of measurement of temperature [degree Fahrenheit]
h	Unit of measurement of time [hour]
ISO	International standard of the International Organisation for Standardisation
kg	Unit of measurement of weight [kilogram]
l	Unit of measurement of volume [litre]
min.	minimum
max.	maximum
mm	Unit of measurement of length [millimetre]
mm	Unit of measurement of length [micrometre]
M	Metric
NPT	National Pipe Thread
Nm	Unit of measurement of work [newton metre] TORQUE SPECIFICATION: 1 Nm = 0.737 lbft Pound-Force (lb) + Feet (ft)
PA	Polyamide
PEEK	Polyether ether ketone

Abbreviation	Explanation
C-PEEK	Polyether ether ketone containing carbon
PTFE	Polytetrafluoroethylene
psi	Anglo-American unit of measurement for pressure [pound-force per square inch] All pressure data expressed in [bar/psi] is assumed to be gauge pressure [barg/psig] unless explicitly specified otherwise.
SW	Indicates the size of spanners [width across flats]
Inch	Unit of measurement of length in the Anglo-American language area
Inch OD	Tube measurement according to British Standard (BS), outside diameter
Inch IPS	American pipe measurement, iron pipe size

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