KP-38027 - Maintenance Instruction for CONCYCLE® Wind Frequency Converter Systems
This maintenance manual undergoes continuous further development. Woodward SEG reserve the right to changes without prior notice.
1 Preliminary Note

This maintenance manual only applies to CONCYCLE® Wind frequency converter systems delivered by Woodward SEG. This document is relevant for all converter systems used so far as well as topical ones (at IGBT rack construction and NG-03; not for NGx converter types) and replaces all prior instructions. The latter becoming invalid now. Woodward SEG reserve the right to changes to this protocol by publishing separate, type-based instructions.

ATTENTION!
The maintenance of CONCYCLE® Wind frequency converters is only permitted to be done by Woodward SEG personnel or by skilled electricians who were especially trained by Woodward SEG and authorized accordingly at the time maintenance work is done!

Maintenance work on converters with a nominal operating voltage > 1000 V must only be carried out by especially trained personnel who can furnish the required permission for carrying out work on such converters.

Electrical measurements are not permitted to be done by people who are not considered skilled electricians as defined by the BGFE due to their training or previous professional career! Those people are only permitted to do maintenance work under the supervision of a skilled electrician and when the switchgear has been electrically isolated!

Maintenance personnel who has acquired abroad the professional skills for performing work on electrical equipment/utilities and is authorized to work there, has to comply with the prevailing local accident prevention regulations.

DANGER!
For safety reason electrical measurements are not permitted when the converter panel is open or the system is running.

The converter must only be opened when it is switched off and under voltage free working conditions by duly consideration of the relevant safety regulations.

For all maintenance work on the CONCYCLE® Wind converter system please strictly adhere to all notes of this instruction as well as to those indicated on the product itself.

Prior to starting work, the voltage free working condition of the switchgear has to be ensured and maintained for the whole maintenance period (as per EN 50 110-1, DIN VDE 0105-100 and BGV-A3 standards).

The national accident prevention regulation must be unconditionally followed. For Germany BGV-A3 standards apply.
NOTE!
A contractually agreed warranty (liabilities for material deficiencies) does not release the customer or the operator of CONCYCLE® Wind frequency converter systems from the necessity and obligation to precautionary carry out the contractually stipulated maintenance and servicing work commencing from initial start-up.

Only components which were used and released by Woodward SEG (see parts list annexed to the Woodward SEG circuit diagram) must be applied! For further information please contact the Woodward SEG-Service Department.

Note:
As far as required, spare parts have to be ordered well in advance!

All maintenance work to be performed in accordance with the scheduled periods.

All maintenance work must be entered into the WPP logbook.

Failures which were noticed during maintenance must be repaired directly or, if necessary, to be reported to the Woodward SEG-Service Department.

Maintenance work will only be accepted by Woodward SEG on receipt of the completely filled-in maintenance protocol!
2 Signs used for systems and devices

2.1 Warning signs
Electrostatic sensitive devices (ESD)  Warning of electrical power

2.2 Prohibitory signs
Climbing is prohibited for unauthorized people!  Do not switch on!
Prohibited for persons with heart pacemakers!

2.3 Mandatory signs
Wear safety helmet!  Wear protective gloves!
Wear safety harness!

All signs used on converter/vicinity to be strictly followed!
Further regulation signs put up by the constructor of the power plant are mandatory. The signs shown here and their meaning have to be known and must absolutely be followed.
3 Maintenance work

3.1 Data backup prior to maintenance

By means of the CONCYCLE® customer tool the following system information have to be saved and/or recorded during data backup.

1. All data trigger of the previous month stored on the event recorder to be saved
   HR_xxx.dsb / SR_xxx.dsb
2. Formatting the event recorders (HUR and SUR)
3. Generating and saving a relevant data trigger during mains parallel operation under power
   H_customer.dsb / S_customer.dsb (please rename into H_customer_1.dsb and
   S_customer_1.dsb)
4. Saving the HUR / SUR – event counter and operating hour meter
   H_Counter_1.txt (event counter of the HU before maintenance)
   S_Counter_1.txt (event counter of the SU before maintenance)
   OperatingHours_1.txt (Operating hour meter before maintenance)
5. Recording the operating cycles of the circuit breaker
6. Saving the HUR and SUR event lists
   Event_1 evt (Event list before maintenance)

NOTE!
If there is no wind blowing it is sufficient to indicate the trigger last measured when the system was connected to the mains. Trigger files are permitted too.

3.2 Documentation check

When checking the documentation please make sure that a hard copy of all papers needed for maintenance work is available at site.

The following documentation and manuals have always to be found in reach of the switchgear which also applies to the post maintenance time.

1. Provided general documentation (for this, please compare the switchgear recourses number of the type plate with the cover sheet of the switchgear documentation), which contains:
   - Cover sheet (general information on the switchgear
   - Project overview
   - Location overview
   - Parts list
   - Circuit diagram
   - Terminal plan
   - Setting list
   - Mechanical design and constructional drawings

2. Provided transportation and commissioning manuals, containing:
   - Description „Transportation and Commissioning” and “Commissioning Protocol”
   - Declaration of Conformity

3. Manuals
   (XRW1-4, BL 18 and for systems with integrated section switch, the manual of the switch manufacturer is mandatory). For these manuals please see the switchgear documentation; please contact Woodward SEG if you are in need of any more.
3.3 Safety isolation of the system – 5 Safety rules

The procedure outlined hereunder has to be followed during off-load working conditions of the switchgear. For this the equipment is to be isolated by observing the applying safety rules.

![Safety Rules]

5 Safety Rules
1. Isolate from power supply
2. Protect against reclosing
3. Verify the safe isolation from supply
4. Connect to earth and short circuit
5. Provide neighbouring parts under voltage with barriers

3.4. Switching elements and fuse units

3.4.1 Relays and contactors

During each maintenance it must be checked whether contact and connections of control relays and contactors are still tightly fitted.

![Images of assemblies/components]

The above images are examples of assemblies/components where the described maintenance jobs have to be carried out.

Contactors showing defects at the housing or on the contact have to be replaced instantly.

**NOTE!**
When relays with test button, make Finder are installed (this refers to Woodward SEG article numbers 23106, 29273, 29274, 29275 and 29276 only), this test button has to be removed in off-load working conditions. Touching this button at existing control voltage can cause mal operation and faults. The test button can easily be withdrawn.

**NOTE!**
Information on state checks, number of switching cycles and the applying operating hours can be found in the manual of the device. After the stated service life has expired the respective components have to be exchanged.
3.4.2 Alarm contacts

The alarm contacts to be activated individually. By means of a continuity tester and after de-energizing, the function of the alarm sequence is checked.

The above images are examples of assemblies/components where the described maintenance jobs have to be carried out.

3.4.3 Check of the setting values

Fuses, motor protection relay and time relays

The setting values of protective and functional devices to be checked by using the setting list annexed to the circuit diagram or the parts list.

Tight fitting of fuses in the NH fuse strip to be checked and if necessary fuses to be pushed in again.

NOTE!
When NH fuses are used the correct voltage rating class is essential because 500V fuses are not permitted for 660V/690V systems!
3.4.4 Circuit breakers

Maintenance on circuit breakers to be carried out in line with the manufacturer specification. Please note that always the latest manual version is relevant. For circuit breakers with integrated operating cycle counter the number of operating cycles has to be listed in the maintenance protocol.

The above images are examples of assemblies/components where the described maintenance jobs have to be carried out.

**DANGER!**
Conditional on the prevailing operating conditions, the arc chambers and the contact system have to be checked as well. Especially if the CB has opened due to a short circuit, its state has to be re-checked **before** re-closing. Depending on the operational state, but the latest when the number of operating cycles recommended by the manufacturer has been reached, the arc chambers and contact systems have to be replaced.
3.5 Insulation resistance

General

The insulation resistance is measured as dc voltage resistance. It is not so much defined by the thickness of the insulation layer but mainly by the insulation material. Being dependent on length, the insulation resistance will drop in proportion to the increasing cable length.

The measuring instruments used for this purpose should meet the demands of IEC 61557-1. As already specified in the present DIN/VDE standards, also in future the insulation resistance must only be measured with dc voltage. Rating of the measurement voltage has not change with publication of regulation IEC 60364-6-61. For voltages of up to 500 V inclusively, a measured dc voltage of 500 V is required. In system where the nominal voltage is >500 V, measurements have to be taken with a dc test voltage of 1000 V.

For systems with LV generators (Un<1000V) measurement of the insulation resistance has to be done as follows:

Present fuses for the arrester and the stator filter are to be removed. Disconnect the fuses of the generator voltage measurement. Otherwise disconnect all poles of the stator cable in the switchboard and measure the insulation resistance of the stator path.

In accordance to the VDE 1000 Ohm/Volt can be taken as an approximate value. For exact values see the manual of the generator manufacturer. If lower values have been measured against earth, please measure stator cable path and the stator itself separately.

If lower values at the stator terminal are detected please get in touch with the generator manufacturer.

All poles of the rotor cables in the converter switchgear to be disconnected and the insulation resistance of the rotor circuit to be measured. 10MOhm can be taken as guide value. Exact values can be taken from the manual of the generator manufacturer.

If the value of the total circuit to earth is lower than 10Mohm, the rotor and cable-/bus bar system have to be measured separately.

If the values measured at the rotor connection terminal are lower than 10Mohm, the brush room has to be checked and if necessary to be cleaned or repaired.

ATTENTION!
Low insulation values can activate flashovers. Damages at the converter system can be the consequences of this.

At the rotor cable line, too (bus bar system) values of >10Mohm can be expected as a rule. Deviations may indicate a creeping insulation fault.

After the measurement reinstall the fuses of the arrester.
3.6 Electrical plug-in and terminal connections

3.6.1 Electrical plug-in and terminal connections and optical waveguide plug

The plug-in connections have to be checked for their correct fitting. If any of them are not fixed properly, the right position can be restored by pressing the plug in again. Defective plug-in connections have to be replaced instantly!

The above images are examples of assemblies/components where the described maintenance jobs have to be carried out.
3.6.2 Electrical terminal connections

Terminal connections of all clamping points at devices and terminal blocks as well as of the copper bus bar system and the converter are maintenance-free. Dependent on the operational conditions of the CONCYCLE® converter, regular random tests should be carried out by the operator. The tightening torque for loose screw connections can be found in the relevant technical documentation of the device. Conditional on the specific situation/result of the random test (e.g. thermal discoloration), the operator should check all terminal connections for their applying torque. It is recommended to exchange loose washers and not to use them again. To avoid repeated checks on screw connections, the operator should mark those already checked.

The tightening torque stated in the related table refers to unlubricated screw connections. In case a connection of the copper bus bar system is going to be checked or loosened, traces of lubricant and soiling have to be removed first.

The tightening torque can be found in table “Tightening Torques”, under column “Dry”.

The above images are examples of assemblies/components where the described maintenance jobs have to be carried out.

3.6.3 Tightening torque for cable connections and copper screw connections according to DIN 43673

The tightening class for screws and nuts used by Woodward SEG is 8.8 or higher as per ISO 898-1. The corrosion protection is defined as yellow, chromated. Data for unlubricated/dry screw connections can be derived from this.

<table>
<thead>
<tr>
<th>Copper Screw Connections / Cable Connection / Dry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thread</td>
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<tr>
<td>M 4</td>
</tr>
<tr>
<td>M 5</td>
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<tr>
<td>M 6</td>
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<td>M 8</td>
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<td>M 10</td>
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<tr>
<td>M 12</td>
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<tr>
<td>M 16</td>
</tr>
</tbody>
</table>

For copper screw connections two opposite applied spring washers to be used.

After the screw connection is fixed it is to be marked by a **water-proof felt-tip pen** with the appropriate tightening torque listed in above table.

These values do **not** apply for connections to operational equipment here the instructions of the manufacturer have to be followed. The same applies when such devices are exchanged.
3.7 Capacitors

3.7.1 Filter capacitors (DIN VDE 0560)

Among other things, the capacitors are used to filter the harmonics of the CONCYCLE® Wind Frequency Converter reactive power.

**DANGER!**
When checking capacitors the following is mandatory:
- Adherence of the 5 safety rules when operating electrical equipment (BGV-A3)
- Suitable safety facilities and tools have to be used when working on capacitors.
- When the capacitor is activated stepping on the ladder and entering the nacelle of the Wind Power System is strictly prohibited, unless there is a safe escape route.
- The converter is only to be activated when the doors are closed.
- The converter is only to be activated when switched off and potential-free by strictly keeping to the prevailing safety rules.
- For safety reasons the capacitors has to be discharged by using a suitable discharging device.

The following has to be checked:
1. Checking the safe isolation from supply. See 3.7.3 – Discharging Time t\(\geq\) 3 min.
2. Checking if capacitor cans are bulged or damaged.
3. Checking the overpressure valve/-opening at the connecting terminals.
4. Checking the capacity of each individual capacitor (all phases to be measured against each other and then recorded). If a capacitor is not within the tolerance of the indicated nominal capacity it has to be replaced. At deviation of more than 5% Woodward SEG recommend exchange of the capacitor.

<table>
<thead>
<tr>
<th>Delta Connection of the capacitors:</th>
<th>Star connection of the capacitors:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C_{total} = 1,5 \times C_{single})</td>
<td>(C_{total} = 0,5 \times C_{single})</td>
</tr>
</tbody>
</table>

If checks reveal any defects/deficiencies (see items 1-3 above), the capacitor has to be replaced instantly for a new one; the removed capacitor must not be used again.

If power capacitors make EPCOS are being used, please contact Woodward SEG.

To use capacitors of different makes connected to the same fuse strip is not permitted, unless it was rated, tested and released by Woodward SEG.
3.7.2  DC-link circuit capacitors

Visual check of the dc-link circuit capacitors

Please check if any of the following applies:

- Ripped cladding
- Noticeable discoloration close to the connections to the IGBT modules (soot-stained)
- Damaged DC-link circuit connections
- Soiling
- Dampness/Elektrolyt

Soiling has to be removed immediately. If power capacitors have been damaged, the affected power part has to be exchanged without delay.

Discharging time t>10 min. safe isolation from supply

**ATTENTION!**
DC voltage is possible till 1100V.

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IGBT Drawer Method  IGBT Phase Module

The above images are examples of assemblies/components where the described maintenance jobs have to be carried out.

3.7.2.1  Storage

Elektrolytic- and foil capacitors are being used for the DC-link circuits of the power parts.

For high-voltage electrolytic capacitors (applies only for IGBT drawer method) the following has to be considered:
When these capacitors are stored over a long period of time, electrochemical processes still continue inside the electrolytic capacitors, even in a potential-free state, which influence the quality of the dielectric. In case the capacitor voltage is applied in total this can result in an increased leakage current which might cause damage or failure of the capacitors, dependent on the time of the potential-free state and intensity of the voltage.

Without formation procedure the storage of potential-free capacitors is limited to 12 months. After this time the component(s) has (have) to be re-formatted according to the instructions of the manufacturer.

For the formation instructions please contact Woodward SEG.
3.7.3 Check of the discharge unit

DANGER!
As a defective discharge unit is optical not easy to detect, capacitors have to be checked with the utmost caution. A capacitor at full charge can be a great danger for life. It is known from accidents and tests, that in case of a capacitor-discharge via the human body, a critical shock can be caused by an energy-quantity of 0,25 Ws onwards and from 10 Ws on, a danger for life is possible! At a voltage 690 V and a delta connected capacitor with an individual capacity of 55,7 µF the energy-quantity is as follows:

\[
W = \frac{1}{2} \cdot C \cdot U^2 = 0.5 \cdot 1.5 \cdot 55,7 \cdot 10^{-6} \cdot \frac{As}{V} \cdot (690V)^2 = 19.88 Ws
\]

After it is ensured that the connected capacitor is discharged, the discharging unit is to be tested by a multimeter. Normal values are in the 4kOhm (+/-2kOhm) range. In case a different value is shown, the discharge unit has to be replaced.
3.7.4 Check of the capacitor contactor / Inrush current limiter

Example of a capacitor contactor

The above images are examples of assemblies/components where the described maintenance jobs have to be carried out.

The inrush current limiter consists of a resistor circuitry, applying the capacitor to voltage via a leading NO contact. Due to this, the normally high inrush making current of capacitors will be reduced.

When checking the capacitor contactors look out for burnt contacts or defective, kinked resistor wires. Per resistor wire values in a one-figure ohmic range are measured by a multimeter.

Defective contactors have to be exchanged. Defective capacitors may as well be an indication for a damaged contactor.
3.8. Mechanical connections and damage caused by vibration

3.8.1 Mechanical connections

Mechanical connection points, door hinges and latches in particular, are subject for increased wear and tear and must therefore be serviced at regular intervals. The front of the converter must tightly be closed. Defective or missing screws have to be replaced.

The above images are examples of assemblies/components where the described maintenance jobs have to be carried out.
3.8.2 Damages caused by vibration

**ATTENTION!**
Under adverse operating conditions vibration caused damage can occur anywhere in or on the switchgear, and has to be seen to without delay. Proper functioning of the converter has to be restored during maintenance work.

The following parts/details in particular have to be checked, repaired or replaced if necessary:

Outer switchgear area:
- Switchgear fixings at the machine support/support construction as well as stability
- Fixings of the side panels/tops (IP protection class has to be maintained)
- Loose screws to be tightened, missing screws to be replaced
- Electrical components to be fastened

Inner switchgear area:
- Supports and fixings of electrical components
- Strain relief of cables
- All clamped or screwed connections
- Door seals
- Door hinges
- Cable-, core insulation (abrasion wear spots)

The above images are examples of assemblies/components where the described maintenance jobs have to be carried out.
3.9 Over-voltage protection – Type 2 – Arrester

When the over-voltage surge arrester trips, the internal resistance becomes low in respect to the earthing potential and so diverts the over-voltage to the ground.

Overloading condition of a surge arrester is indicated by a change of colour in the control window, e.g. by a colour indicator – yellow, red.

After overloading conditions the surge arrester is to be replaced without delay because it is no longer fully functional.

NOTE!
In some systems proper functioning of the surge arresters is monitored by signal contacts.

Over-voltage surge arresters:

The above images are examples of assemblies/components where the described maintenance jobs have to be carried out.
3.10 Over-voltage protection – Type 1 – Lightning stroke current arrester

Normally lightning stroke current arresters do not have a function control they have to be checked in the time intervals recommended by the manufacturer.

Example: DEHNgap B/n (resistance > 500kOhm → arrester o.k.)

Lightning arrester and overvoltage surge arrester are divided into device classes (SPD – Surge Protection Device). Lightning arresters are classified to Typ1 and overvoltage surge arrester to type 2 and 3. Normally arcing air gaps are used for lightning arresters and because these lighting arrester have no signal they must be checked during the maintenance. This check is valid only for the type 1 arrester. Evaluate the indication pin and the remote signaling contact at type 2.

Work during check:

1) Isolate from power supply/ follow the 5 safety rules
2) Isolate typ 1 arrester by removing the protection
3) Measure and evaluate the arrester in accordance to the image
4) Reclosing the protection

Use an insulation resistance measuring device (adjustment 500V) to measure the arrester. The measure value should be at a range >500kOhm.

![Diagram of DEHNgap B/n with test voltage U = 500 V DC, showing measurement of resistance values and indication of o.k. or replace.]
3.11 Filter pads

The filter-pads have to be checked during each maintenance and be exchanged if damaged or soiled.

It has to be distinguished between the following areas:

**IP54 – Area** = all panels except the line reactor area, when intake air comes from below (perforated plate)

Intake air: The fine filter side to face the inner switchgear
Exhaust air: The rough filter side to face the inner switchgear

**IP2x – Area** (line reactor area)
Rough filter pads have to be used for the line reactor compartment if the intake air comes from below through a perforated plate.
3.12 IGBT-modules

The IGBT modules have a drive electronics connected through optical fibre control cables. These optical fibre control lines must not be soiled and their plugs have to be in good condition, i.e. defective ones must not be used any longer.

The above images are examples of assemblies/components where the described maintenance jobs have to be carried out.

3.13 Cleaning the switchgear

Before re-connection, the switchgear has to be cleaned with adequate utensils (hover, cloths etc.).

No electronic components must be touched during the cleaning procedure, neither by hand nor any utensil. Resulting electrical discharges may damage components. Normally the components are labelled with the sign shown here on the left. Connections of the IGBT power parts are not allowed to be touched without ESD precaution as a rule.

3.14 Safety devices / Touch guard

After all maintenance jobs have been completed it is very important to ensure that the relevant safety devices (Emergency-Off switch / Safety locks / Over-current protection relays etc.) are not damaged and fully functional. Furthermore it is imperative to re-install all components (touch guards) removed for maintenance. Their relevant function has to be carefully checked for warranty purposes (BGV-A3).

3.15 Re-connection of the mains voltage

Under duly consideration of the applying safety measures the mains voltages to be re-connected.

**ATTENTION!**

As outlined at the beginning, electrical measurements and tests with an open converter panel and live electrical components are not permitted for safety reasons.

Thus all following steps must only be carried out with utmost care and by skilled personal, trained by Woodward SEG.

The applying national accident prevention instructions have absolutely to be followed. In Germany this is according to BGV-A3.
3.16 Heating system

For checking the function of the heating system, the hygrometer (humidity) and thermostat (temperature) have to be re-adjusted (see circuit diagram). Based on the values specified in the setting list (circuit diagram), the thermostat and hygrometer are to be checked. If deviations are noticed please adjust them and inform Woodward SEG accordingly. Normally the setting range of the temperature and humidity measuring instruments is interlocked. The procedure how interlocking can be released and then restored again is described in the related technical documentation. Even if access to some heaters is difficult these have to be checked as well, e.g. by measuring the temperature.

**ATTENTION!**
Function of all heating facilities in the switchgear has to be checked. Direct contact with the heaters has strictly to be avoided. **DANGER OF GETTING BURNT!**

The above images are examples of assemblies/components where the described maintenance jobs have to be carried out.

3.16.1 Operation of the heating system – Quick user guide

After the operating voltage (mains voltage) has returned:

If the humidity has exceeded the set value of the hygrometer or the temperature has fallen below the settings at the thermostat, the supply voltage of the battery charger will not be connected and the heating system is activated. The heating function is de-activated as soon the delay time set at the time relay has expired and temperature as well as humidity is within their set limits. Thereafter the supply voltage of the battery charger is re-connected.
3.17 Cooling system

IGBT (air cooled)
If soiled the segments of the heat sink have to be cleaned with a thin brush.

The above images are examples of assemblies/components where the described maintenance jobs have to be carried out.

Panel ventilators / IGBT – Cross current ventilator
Rotation of the ventilators must not be obstructed. If possible, the ventilators are to be controlled by acti-
vating the drying mode or by shortly re-adjusting the thermostats. Should this not be possible, the function
has to be tested before or after maintenance work (during operation of the system).

If the noise of the running ventilator is higher than normal this may also indicate a defect of the device. In
such cases please inform the Woodward SEG Service Department accordingly and note this down in the
Maintenance Protocol.

IGBT (water cooled)
Connection points of the cooling circuit to be checked for corrosion and their degree of tightness. Any
noted leakage or corroded points have to be repaired without delay. For this purpose the cooling agent
has to be drained and disposed of. Then the connection points are to be professionally restored and the
cooling circuit has to be re-filled with fresh cooling agent.

Heat exchanger AIR-AIR
If soiled, the segments of the heat exchanger have to be blown out with compressed air during each
maintenance. Any residues of grease or oil on the segments have to be removed. Segments have to be
cleaned with suds at a temperature of no more than 75°C. If necessary the housing to be dried by using a
hot air blower and than tightly screwed on again.

Heat-exchanger AIR-WATER
Proper function of the condensation water drains has to be checked during each maintenance
3.18 Mains protection relay XN2/XRW

When servicing these facilities (if provided) please refer to the relevant manuals. Checks on settings of the protection- and functional devices always to be carried out on the basis of the setting list annexed to the circuit diagram.

XN2

Test

The key “Test” is used for test tripping of the device. After pressing the key for 5 seconds, the hardware will be checked with both output relays changing into the tripping state and with all trip LEDs flashing.

XRW1-4

Test

After pressing the key <TRIP>, the first half of the software version will be displayed and the other half after pressing the key again. The test trip routine is started by repeated activation of the <TRIP> key. After entry of the password “+ + + +” the message “TRI?” is displayed. By pressing <TRIP> again, all alarm- and tripping relays will be activated successively with a time delay of 1 second. All relays remain acti-vated until manually reset. Thereafter the output relays can be reset to their initial position by pressing the <SELECT/RESET> key. Detailed information can be found in Manual “XRW1-4”, item 7.2 – “Test of Output Relays and LEDs”.

3.19 Batteries – Internal power supply

Batteries are subject to a limited warranty. Their service life varies dependent on application as well as environmental conditions.

The use of sealed lead batteries at more than 20°C reduces their service life expectation considerably.

For re-charging only battery chargers/UPS specified by Woodward SEG are allowed to be used (see circuit diagram/parts list). Reliable charging of functional batteries is only guaranteed by these devices.
3.19.1 24V Buffer Batteries (2x12V)

These batteries serve for supplying the control devices (CSC-HU/CSC-SU) with 24V for a minimum of 1 minute in case the mains voltage supply fails. The trigger files will be saved during this time.

Batteries are subject to special handling instructions:

![Image of battery assembly](image)

The above images are examples of assemblies/components where the described maintenance jobs have to be carried out.

3.19.1.1 Check of the battery charging state

- Check of the charging voltage at the battery charger (e.g. BL18.).
  The value should be about 27.5V. For the exact value please see the related setting list.

  Note:
  The output voltage can be adjusted at the battery charger (see charger Manual)

- Visual check of the batteries: Look out for any damage on the housing, burnt contacts and check tightness of the plug connections (AMP plug).

- **Endurance test:**
  The fuse –F8 must be disconnected with activated converter (at standstill). Voltage to be measured directly at the battery terminals. At least 22V at 10°C till 40°C environmental temperature has to be maintained for 3 minutes.

![Image of battery assembly](image)

The above images are examples of assemblies/components where the described maintenance jobs have to be carried out.
3.19.1.2 Exchange

In order to prevent the battery prematurely failing, it is recommended to exchange batteries every two years (within maintenance intervals) as a precautionary measure.

Batteries are never to be exchanged individually but always as a set. When replacing 12V lead-gel batteries it has to be ensured that Woodward SEG article number KP-36185 is used!

It is important that lead-gel batteries are always installed horizontally.

For lead-fleece (AGM) batteries installation position is optionally.

**ATTENTION!**

Batteries are to be carefully unpacked and if necessary to be cleaned. When installing the sets, check pole direction and connection. Relevant information can be taken from the up-to-date circuit diagram. When connecting the batteries to the dc power supply they have to be free of potential and the polarity must be correct, i.e. battery charger to be switched off and consumers to be disconnected, as well as +pole to be connected to +connection terminal. Valves must not be covered. Then the battery charger is to be switched on and charging procedure to be started.

3.19.1.3 Storage

Batteries are always supplied in charged conditions. If not immediately installed, they have to be stored at a cool, frost-protected and clean place. The best condition for battery sets to be stored is in trickle charge state. Every 6 months the latest the batteries have to be re-charged.

3.20 UPS unit (if UPS delivered by Woodward-SEG)

UPS units have to be checked as follows:

1. Available load capacity – up to max.nominal load – to be switched to the UPS output by connecting the consumers of the operating system of the WPP.
2. Input voltage of the UPS is to be switched off (preceding miniature CB to be switched off as per circuit diagram)
3. Now the UPS has to change into battery operation and supply the consumers for at least 7 minutes
4. Re-connection of the input voltage after 7 minutes
5. UPS changes from battery operation back to mains operation

If the UPS switches off during the test, confer to the UPS failure codes for further procedure. As for discharged batteries para. 3.19.1 applies.

Specific recommendations for different UPS types:

Effekta recommends that fans are replaced after 3 years in operation.

Jovyatlas recommends that fans are replaced after 2 years in operation.

For further information please see the Manual of the respective manufacturer.

3.20.1 Exchange of batteries for UPS with integrated batteries

In order to prevent the UPS to fail at an early stage, the batteries should be replaced every 2 years as a precautionary measure (within the maintenance intervals).

In order to prevent wrong installation position when replacing batteries, it is important that only lead-fleece (AGM) types (Eurobat 10-12 years) are used. Always all of the batteries have to be exchanged and they must be of an identical type.

An exchange of batteries should always be carried out in line with the Manual instructions or after consulting the Woodward SEG Service.
3.20.2 Storage of UPS units with integrated batteries

It is recommended by the manufacturers to re-charge the batteries when they have not been in operation over more than 4 weeks. For this procedure only the UPS has to be connected to the mains. Minimal charging time = 8 hours, recommended are, however, 24 hours.

For other storage requirements please see the Manual of the respective manufacturer.

3.20.3 Storage of UPS units without integrated batteries

For storage requirements please see the Manual of the respective manufacturer.

3.21 Checking and saving of data after maintenance

After maintenance work is completed the following checks have to be carried out. This information can be called off via the CONCYCLE® customer tool.

1. Checking by means of the CONCYCLE® customer tool whether the customer trigger, generated prior to the maintenance, is still on the memory card. If not, please contact the Woodward SEG Service.
2. Generating and saving a customer trigger in mains parallel operation under power.

By using the CONCYCLE® customer tool the following system information is to be saved or recorded:

1. Generating and saving a customer trigger in mains parallel operation under power.
   H_customer.dsb / S_customer.dsb (to be re-named into H_customer_2.dsb and S_customer_2.dsb)
2. Saving the HUR / SUR event counter and operating hour meter
   OperatingHours.txt  (operating hour meter after maintenance)
   H_Counter_2.txt    (event counter of HU after maintenance)
   S_Counter_2.txt    (event counter of SU after maintenance)

NOTE!
If there is no wind blowing it is sufficient to indicate the trigger later when the system was connected to the mains, if necessary also by remote-access.

Check the customer trigger H_customer_2.dsb and S_customer_2.dsb after maintenance:

Check if all measurements in all phases are available and that no vibrations occurs at the dc link voltage and the speed signal. If not, please contact the Woodward SEG service.
4 Data and maintenance protocol

The following 4 pages are to be completely filled-in and then to be sent to Woodward SEG – Service Department either by fax or e-mail within 2 weeks time.

Complete date described in para. 3.1/3.21 is to be sent to Woodward SEG – Service Department by e-mail within 2 weeks time, stating the location and serial number of the converter system as well. The maintenance protocol together with the data described in para. 3.1/3.21 is the precondition for the continuity of the agreed system warranty.

E-Mail: service-kempen@woodward.com

Fax: +49 (0)2152 145-689
### 4.1 Maintenance protocol

Note:
This maintenance protocol is temporary and undergoes continuous further revisions. It is subject to changes without prior notice.

<table>
<thead>
<tr>
<th>Implementation / Result</th>
<th>Notice / Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>o.K./ done</td>
<td></td>
</tr>
<tr>
<td>not o.K. not finished</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System type: Serial Number (SEG Job-No.): Location:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Free of potential – After isolation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check of relays and contacts</td>
</tr>
<tr>
<td>Check of signal contacts</td>
</tr>
<tr>
<td>Check of setting values</td>
</tr>
<tr>
<td>Check of circuit breaker</td>
</tr>
<tr>
<td>Insulation resistance of the stator</td>
</tr>
<tr>
<td>Insulation resistance of the rotor</td>
</tr>
<tr>
<td>Electrical plug-in and terminal connections</td>
</tr>
<tr>
<td>Filter capacitors</td>
</tr>
<tr>
<td>DC capacitors</td>
</tr>
<tr>
<td>Check of capacitor contactors/Inrush current limiter</td>
</tr>
<tr>
<td>Check of mechanical connections</td>
</tr>
<tr>
<td>Check of vibration damage</td>
</tr>
<tr>
<td>Check of over voltage protection – Type 2</td>
</tr>
<tr>
<td>Check of over voltage protection – Type 1</td>
</tr>
<tr>
<td>Check of filter pads</td>
</tr>
<tr>
<td>Check of IGBT-modules</td>
</tr>
<tr>
<td>Cleaning of the system</td>
</tr>
</tbody>
</table>

**Energized – After re-connection**

| Check of heating system | | |
| Check of cooling system | | |
| Check of setting value (XRW, protective devices) | | |
| Check of 24V buffer battery charging | Battery voltage of 22V at 10°C till 40°C environmental temperature for 3 minutes is maintained: Yes/No | |
| Check of UPS battery charging | 7 minutes load under nominal operational conditions is maintained: Yes/No | |
| Check and data back-up after maintenance | | |

Finally
Check of trigger files

Required data as per para. 3.1/3.21 has been sent to Woodward SEG

Date:

Required material/Space left for notes
Declaration

With his signature the technical engineer confirms that the CONCYCLE® Wind Frequency Converter System has been professionally serviced in full accordance with the maintenance instructions.

He further declares that all defects/shortcomings found in the system were removed and that he can give permission the converter system as integrated part of the wind power plant to be operated again without danger to man and machines.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>The wind power plant was put into operation again.</td>
</tr>
<tr>
<td>No</td>
<td>The wind power plant could not be put into operation again.</td>
</tr>
</tbody>
</table>

**Maintenance was carried out on/by**

**Date:**

<table>
<thead>
<tr>
<th>Technical Engineer 1</th>
<th>Signature _____________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name:</td>
<td>(in block letters)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical Engineer 2</th>
<th>Signature _____________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name:</td>
<td>(in block letters)</td>
</tr>
</tbody>
</table>

(Will be filled in by Woodward SEG)

**Confirmation of receipt**

**Date:**

<table>
<thead>
<tr>
<th>Company stamp</th>
<th></th>
</tr>
</thead>
</table>

**Maintenance accepted**

**Maintenance not accepted, because**

________________________________________________________________________________________________________________________________________________

________________________________________________________________________________________________________________________________________________

________________________________________________________________________________________________________________________________________________

Based on the maintenance outcome the contractually agreed warranty can be extended:

yes ☐ no ☐
This description is temporary only and is subject to updating without previous notice.
For any queries please contact us under:

WOODWARD

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