Oil filter unit, type OLU, for on-load tap-changers
Manual
**Original instruction**

The information provided in this document is intended to be general and does not cover all possible applications. Any specific application not covered should be referred directly to ABB, or its authorized representative.

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Recommended practices
ABB recommends careful consideration of the following factors when installing on-load tap-changers:

Before you install or commission a unit, make sure that the personnel doing the job have read and fully understood the installation and commissioning guide provided with the unit.

To avoid damaging the unit, never exceed the operating limits stated in delivery documents and on rating plates.

Do not alter or modify a unit without first consulting ABB.

Follow local and international wiring regulations at all times.

Use only factory authorized replacement parts and procedures.

Safety precautions
The following warnings and notes are used in the manual:

**WARNING**
WARNING indicates an imminently hazardous situation, which if not avoided will result in death or serious injury. This signal word is to be limited to the most extreme situations.

WARNING also indicates a potentially hazardous situation, which if not avoided could result in death or serious injury.

**CAUTION**
CAUTION indicates a potentially hazardous situation, which if not avoided may result in minor or moderate injury. It may also be used to alert of unsafe practices.
CAUTION may also indicate property-damage-only hazards.

**INFO** provides additional information to assist in carrying out the work described and to provide trouble-free operation.

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**WARNING**
Almost all types of oil are potential threats to the environment and as such they should not be drained into ordinary sewers and "dumped" in nature. Always check that all oil carrying components are sealed and tight before operating the oil filter unit.

**WARNING**
Be aware that oil spillage on the floor around the filter unit is a safety risk!

**WARNING**
Used filter elements very often contain harmful substances separated from the oil. Always pack and seal used elements thoroughly until they can be disposed of in accordance with local regulations.

**WARNING**
Switch off the electrical power supply to the filter unit when carrying out maintenance.

**WARNING**
The oil filter unit may be hot. Be careful!

**CAUTION**
Do not expose the filter unit to ambient temperatures higher than 60 °C (140 °F) as this may harm electrical wires, hoses and other rubber or synthetic components!

**CAUTION**
The fluid temperature inside the filter unit must never exceed 110 °C (230 °F). Higher fluid temperatures may cause damage to the seals and packings on and in the filter unit.
1. General information

This manual gives information for one oil filter unit. In case of two or more units on the same transformer, all procedures are the same for each one of the units.

1.1 Advantages with an oil filter unit
All on-load tap-changers manufactured by ABB are designed and tested for service in transformer oil without any kind of filtration. Filtration of oil is necessary only when normal maintenance is carried out.

However, filtering gives the following advantages:
• Dielectric strength in the oil is maintained high, important in line end applications.
• Eliminates risk for depositing “sludge” in electrically highly stressed areas.
• Filtration reduces mechanical wear, which is beneficial in applications with high operation frequency.
• It simplifies maintenance since no cleaning and no further oil filtration is necessary. This is also important from a health point of view for the service staff and it also shortens the transformer outage time.

1.2 The oil filter unit
See Fig. 1.

The oil filter unit and the filter cartridge are delivered by ABB. The on-load tap-changer is also prepared for connection to the oil filter unit. The oil filter unit allows continuous service of the transformer during filtration. The filter unit consists of a filter base, one or two filter housings, an electric motor, a pump, an electric connection box, a sample valve and two threaded connections.

There is also a pressure switch that could be used by the customer. The switch changes state when the pressure in the filter is such that a filter cartridge replacement is necessary. This switch does not stop the motor, it only gives information about the filter status.

As an option, a flow switch can be mounted at the oil filter unit outlet. The switch changes state when the oil flow through the filter unit is approximately half of the nominal oil flow. This switch does not stop the motor, it only tells if there is an oil flow or not.

The motor/pump unit is a sealed unit and must not be disassembled. It is mounted on the filter house. The oil pump is a screw type pump.

The filter cartridge is delivered separately and it must be mounted in the filter housing by the customer before starting the oil filter unit.

There is also a pressure gauge which measures the pressure in the oil filter. At a certain pressure level, a filter cartridge replacement is necessary.

Each of the filter housings contains a lid with O-ring sealing.

The oil inlet connection is placed at the oil strainer. The oil outlet connection is the port at the oil flow switch placed at the bottom of the filter housing.

The tubes for connection between the oil filter unit and the on-load tap-changer are not included in the delivery of the oil filter unit.

1.2.1 Y-strainer
See Fig. 1.

The oil pump in the filter unit will be damaged if big particles (such as welding sparks, dirt from grinding processes or sealing agent) are allowed to enter the pump. To prevent that, a strainer (pos. 26) with a mesh width of 0.5 mm is delivered with the oil filter unit. This strainer is mounted at the inlet port of the oil pump.

When the oil filter unit has been running for a while, e.g. two months, the strainer must be cleaned from particles. The cleaning should be repeated at every exchange of filter cartridge, or if, for some reason the oil pipes have been dismantled.
1. Auxiliary switch
2. Motor protective switch
3. Pressure switch
4, 5. Pump/motor unit
6. Pressure gauge
7. Filtration element
8. Shunt release
9. Filter housing
10. Connection box
11. Drain plug
12. Lid
13. Y-strainer
14. Flow switch (option)
15. Air vent and oil sample point, dirty oil
16. Wall bracket

Oil inlet G ¾" male acc. to ISO 228-1
Coupling part for flexible hose mounted.

Oil outlet G ¾" male acc. to ISO 228-1
Coupling part for flexible hose mounted.

Cable glands
2 pcs. M20 cable 8-13 mm
4 pcs. M16 cable 5-9 mm
Free space for exchange of filtration element

1) Flow switch is an option.

N.B. 2 pcs of flexible PTFE-hose with flange for O-ring sealing delivered with the oil filter and must be mounted by the customer, according to the included instructions.
1. Auxiliary switch  
2. Motor protective switch  
3. Pressure switch  
4, 5. Pump/motor unit  
6. Pressure gauge  
7. Filtration element  
9. Shunt release  
20. Filter housing  
21. Connection box  
24. Drain plug  
25. Lid  
26. Y-strainer  
27. Flow switch (option)  
28. Air vent and oil sample point, dirty oil  
29. Wall bracket  

- Oil inlet G ¾” male acc. to ISO 228-1  
- Coupling part for flexible hose mounted.  
- Oil outlet G ¾” male acc. to ISO 228-1  
- Coupling part for flexible hose mounted.  

Cable glands  
2 pcs. M20 cable 8-13 mm  
4 pcs. M16 cable 5-9 mm
N.B. 2 pcs of flexible PTFE-hose with flange for O-ring sealing delivered with the oil filter and must be mounted by the customer, according to the included instructions.

1) Flow switch is an option.
1. Oil inlet G ¾" male acc. to ISO 228-1
2. Coupling part for flexible hose mounted.
3. Oil outlet G ¾" male acc. to ISO 228-1
4. Coupling part for flexible hose mounted.

1. Auxiliary switch
2. Motor protective switch
3. Pressure switch
4, 5. Pump/motor unit
6. Pressure gauge
7. Filtration element
9. Shunt release
20. Filter housing
21. Connection box
24. Drain plug
25. Lid
26. Y-strainer
27. Flow switch (option)
28. Air vent and oil sample point, dirty oil
29. Wall bracket

Cable glands
2 pcs. M20 cable 8-13 mm
4 pcs. M16 cable 5-9 mm

Oil inlet G ¼" male acc. to ISO 228-1
Coupling part for flexible hose mounted.

Oil outlet G ¼" male acc. to ISO 228-1
Coupling part for flexible hose mounted.

05 Oil filter unit OLU2D.
N.B. 2 pcs of flexible PTFE-hose with flange for O-ring sealing delivered with the oil filter and must be mounted by the customer, according to the included instructions.

1) Flow switch is an option.
Delivered unmounted

Flexible hose of PTFE with one braided layer of stainless steel wire
Min. bend radius 135 mm
Temp. range: -50 °C to +150 °C
1. Auxiliary switch
2. Protective motor switch
3. Pressure switch
5. Motor
9. Shunt release
27. Flow switch (option)

Circuit diagram for oil filter unit with single phase motor.
1. Auxiliary switch
2. Protective motor switch
3. Pressure switch
5. Motor
9. Shunt release
27. Flow switch (option)

09 Circuit diagram for oil filter unit with 3-phase motor.
On-load tap-changer type UC with oil filter unit.
OIL FILTER UNIT TYPE OLU MANUAL

Tube from oil filter outlet, min ½"

Flow switch as an option

Valve

From filter

To filter

View show UCG

View show UCL

11 On-load tap-changer type UC with oil filter unit.
12 On-load tap-changer type UZ with oil filter unit.

13 On-load tap-changer type UBB with oil filter unit.
1.3 Electric equipment
See Figs. 8 and 9.

All motor control equipments are installed in a connection box.

The oil filter unit needs an electric power supply to the motor. This power supply should be connected to the motor protective switch in the connection box.

The pressure switch has three electric connections. The signal from this switch is recommended to be used in a control room as an indication for the need of filter cartridge replacement.

The flow switch (optional) has three electric connections. The signal from this switch is recommended to be used in a control room as an indication that the motor/pump unit is pumping sufficient of oil in the right direction.

It is recommended to connect the “low level contact” signal from the oil level indicator on the conservator, so it trips the motor protective switch by the trip coil in case of low oil level in the conservator due to leakage in the oil filter circuit or some other cause.

The motor protective switch has a status indication contact which shows if the motor circuit breaker is off or on. This contact is recommended to be connected in a way that makes a trip immediately visible in the control room.

Since the oil filter is working continuously, no other electrical components are necessary.

1.4 Oil filter circuit
See Figs. 10-13.

In the oil filter inlet port and outlet port respectively, there is mounted one half of a swivelling fitting for the supplied flexible PTFE hose. The PTFE hose must be used for connecting the oil filter unit to the pipe system. It is essential to do so to reduce noise and vibrations and also to avoid excess forces from the pipe system. It is not allowed to connect the pipe system directly to the oil filter ports, without using the flexible PTFE hose.

The oil filter unit should be placed lower than the return connection of the on-load tap-changer.

The oil filtering circuit is nearly the same for all different types of ABB on-load tap-changers. The only difference is the connection to the on-load tap-changers. The oil filter unit inlet tube is connected to the UC and UZ types of on-load tap-changers by flanges on the oil valves. On UB type of on-load tap-changers, the oil filter unit inlet tube is connected to a flange on a tube in the centre of the cover. No valve is mounted.

All flanges for the oil filter unit inlet tube have dimensions according to Figs. 14 and 15.

The oil filter unit inlet tube shall have a valve near the oil filter unit to make it possible to shut off the oil flow in case of filter cartridge replacement, repair work, etc.

The oil filter unit outlet tube for the UB and UC types of on-load tap-changers shall be connected to the free flange on the head of the on-load tap-changer. Dimensions are according to Fig. 14. The position of this free flange may vary, depending on where the pressure relay and the tube to the conservator are connected.

WARNING

Make sure that the oil filter unit outlet tube is not connected to the OLTC transformer main tank flange.
The oil filter unit outlet tube for the UZ type of on-load tap-changers is connected to a flange on the top of the UZ-tank, see Fig. 12. This flange has dimensions according to Fig. 15. The exact position is shown on the dimension drawing for the on-load tap-changer.

The oil filter unit outlet tube shall have a valve near the oil filter unit to make it possible to shut off the oil flow in case of filter cartridge replacement, repair work, etc.

It is recommended to install a valve in a T-piece in the inlet pipe close to the Y-strainer, see Fig. 10. This valve may be used for draining or filling the conservator.

1.5 Continuous oil filtration
The oil filter unit is working according to the continuous operation principle. Thus the filtration runs continuously with a low and smooth flow rate, giving the best filtration result. This gives a number of advantages:

- Narrower pipes might be used.
- No change in flow rate eliminates release of already trapped particles.
- Reduced risk of foam or gas bubbles.
- Moisture removal works even if the on-load tap-changer is not operating.
- This method requires very little control equipment. The necessary components are placed in the electric control box.
- Maximum power needed is approximately 370 W per unit. The average power consumption during a life cycle of the oil filter unit is considerably lower.

1.6 Filtration medium
The oil filter unit should only be used for filtering transformer oil according to IEC 60296. For other media, please consult ABB.
1.7 Service temperature
The ambient temperature may vary between -40˚C to +60˚C (-40˚F to +140˚F).

Normal operating range for the filtered oil is from 0˚C to +100˚C (+32˚F to 212˚F).

An oil filter unit with a new filter cartridge can be started with an oil temperature down to -25˚C (-13˚F) provided the viscosity is 1000 cSt or lower.

If the filter cartridge has been in service for a while and a pressure drop has been built up, the pressure switch may give alarm when starting at low oil temperatures. This can be avoided by letting the transformer oil be warmed up to at least 0˚C (32˚F) before the oil filter unit is switched on. The pressure switch will give signal until the warm oil from the on-load tap-changer has come into the oil filter unit.

If the pressure switch is still giving signal after half an hour, wait until the transformer oil has become even warmer and then start again.

If the transformer is subjected to many starts in very low temperature (e.g. spare transformers), make sure that the filter cartridge is changed frequently.

If the service conditions are such that the ambient temperature is very low (often and during long periods below -10˚C (-14˚F), the oil temperature of the transformer is low and the inlet tube is long (>3m), the oil filter unit inlet tube should be heat insulated.

1.8 Filter cartridge replacement interval
See section 5.2 Maintenance.

1.9 Leakage in the oil filter unit circuit
There is always a risk of leakage in an oil circuit, with a too low oil level in the on-load tap-changer housing as a result. This risk can be reduced by using an oil level indicator, with alarm contacts for low level, on the conservator. The signal should be used to give an alarm in the control room, and to trip the motor protective switch of the oil filter unit, by activating the shunt release coil. See the wiring diagrams in Figs. 8 and 9.

1.10 Oil level in the on-load tap-changer

• Approx. 20 liters for oil filter unit with 1 filter cartridge.
• Approx. 40 liters for oil filter unit with 2 filter cartridges.
• Approx. 80 liters for oil filter unit with 4 filter cartridges.

1.11 Ordering data
When ordering an oil filter unit the following must be given:
• The motor voltage
• The voltage for the trip coil of the motor circuit breaker.

1.12 Spare parts
Avoid ordering spare filter cartridges until they are needed. They can not be stored for more than 24 months without reduced water removing capacity. See also chapter 7.
### 1.13 Technical specifications

#### 1.13.1 Technical specification for common parts of an oil filter unit

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil pump</td>
<td>Settima screw pump</td>
</tr>
<tr>
<td></td>
<td>Flow rate: 250-300 l/h (67-80 gph)</td>
</tr>
<tr>
<td></td>
<td>Over-pressure valve: Opening pressure 5.0 bar</td>
</tr>
<tr>
<td>Filter cartridge</td>
<td>Type: 50 NVD</td>
</tr>
<tr>
<td></td>
<td>Material: Cellulose</td>
</tr>
<tr>
<td></td>
<td>Specially dried for water absorption</td>
</tr>
<tr>
<td></td>
<td>Filtering grade: 3 µm absolute</td>
</tr>
<tr>
<td></td>
<td>Typically pressure drop at 20 °C temperature and new filter cartridge: &lt;0.1 bar</td>
</tr>
<tr>
<td></td>
<td>Max. storage time: 24 months, with undamaged package</td>
</tr>
<tr>
<td>Pressure switch</td>
<td>GEMS PS41</td>
</tr>
<tr>
<td></td>
<td>Adjusted value: 4 bar</td>
</tr>
<tr>
<td></td>
<td>Max. voltage: 230 V AC, 24 V DC</td>
</tr>
<tr>
<td>Contact rating</td>
<td>Max. current: Res. load 5 A</td>
</tr>
<tr>
<td></td>
<td>Ind. load 3 A at 28 V</td>
</tr>
<tr>
<td></td>
<td>Protection class: IP67 with 2 meter flying lead</td>
</tr>
<tr>
<td>Flow switch (option)</td>
<td>DKM-1</td>
</tr>
<tr>
<td></td>
<td>Adjusted value: Approximately 125 l/h (33 gph)</td>
</tr>
<tr>
<td>Contact rating</td>
<td>Max. load 250 V, 1.5 A, 50 VA (min. load 3 VA)</td>
</tr>
<tr>
<td></td>
<td>Reed contacts are very sensitive to overload and must be protected against</td>
</tr>
<tr>
<td></td>
<td>Inductive, Capacitive or Resistive overload. A common way to protect is to</td>
</tr>
<tr>
<td></td>
<td>use a RC-circuit. Protection class: IP67 with 2 meter flying lead</td>
</tr>
<tr>
<td>Electric connection box</td>
<td>2 cable glands M20, cable diameter 8-13 mm</td>
</tr>
<tr>
<td></td>
<td>4 cable glands M16, cable diameter 5-9 mm</td>
</tr>
<tr>
<td></td>
<td>Max. 2 x 2.5 mm² wire on each terminal.</td>
</tr>
<tr>
<td>Noise</td>
<td>&lt;70 dB (A) acc. to ISO 4412</td>
</tr>
<tr>
<td>Connecting tubes</td>
<td>Min. ¾”</td>
</tr>
<tr>
<td>Connections for oil</td>
<td>Male G ¾” acc. to ISO 228-1</td>
</tr>
<tr>
<td>Material</td>
<td>Stainless steel, painted carbon steel.</td>
</tr>
<tr>
<td>Colour</td>
<td>RAL 7032</td>
</tr>
</tbody>
</table>

#### 1.13.2 Motor specification for oil filter unit with 1 cartridge type OLU1C50NV

<table>
<thead>
<tr>
<th>Motor</th>
<th>ABB article number for a complete oil filter unit with motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type: 1-phase, squirrel-cage</td>
<td>1ZSC027410-AAA (without flow switch)</td>
</tr>
<tr>
<td>Data: 110 V/0.37 kW, 50/60 Hz</td>
<td>1ZSC003676-AAA (flow switch included)</td>
</tr>
<tr>
<td>Speed: 1370-1660 rpm</td>
<td></td>
</tr>
<tr>
<td>Protection class: IP55</td>
<td></td>
</tr>
<tr>
<td>Type: 1-phase, squirrel-cage</td>
<td>1ZSC027410-AAB (without flow switch)</td>
</tr>
<tr>
<td>Data: 230 V/0.37 kW, 50/60 Hz</td>
<td>1ZSC003676-AAB (flow switch included)</td>
</tr>
<tr>
<td>Speed: 1370-1660 rpm</td>
<td></td>
</tr>
<tr>
<td>Protection class: IP55</td>
<td></td>
</tr>
<tr>
<td>Type: 3-phase, squirrel-cage</td>
<td>1ZSC027410-AAC (without flow switch)</td>
</tr>
<tr>
<td>Data: 500 V/0.37 kW, 50/60 Hz</td>
<td>1ZSC003676-AAC (flow switch included)</td>
</tr>
<tr>
<td>Speed: 1370-1660 rpm</td>
<td></td>
</tr>
<tr>
<td>Protection class: IP55</td>
<td></td>
</tr>
<tr>
<td>Type: 3-phase, squirrel-cage</td>
<td>1ZSC027410-AAD (without flow switch)</td>
</tr>
<tr>
<td>Data: 208-277 V/0.37 kW, 50/60 Hz</td>
<td>1ZSC003676-AAD (flow switch included)</td>
</tr>
<tr>
<td>Speed: 1370-1660 rpm</td>
<td></td>
</tr>
<tr>
<td>Protection class: IP55</td>
<td></td>
</tr>
<tr>
<td>Type: 3-phase, squirrel-cage</td>
<td>1ZSC027410-AAE (without flow switch)</td>
</tr>
<tr>
<td>Data: 360-480 V/0.37 kW, 50/60 Hz</td>
<td>1ZSC003676-AAE (flow switch included)</td>
</tr>
<tr>
<td>Speed: 1370-1660 rpm</td>
<td></td>
</tr>
<tr>
<td>Protection class: IP55</td>
<td></td>
</tr>
</tbody>
</table>
1.13.3 Motor specification for oil filter unit with 2 cartridges type OLU1D50NV

<table>
<thead>
<tr>
<th>Motor</th>
<th>ABB article number for a complete oil filter unit with motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type: 1-phase, squirrel-cage</td>
<td>1ZSC027410-AAF (without flow switch)</td>
</tr>
<tr>
<td>Data: 110 V/0.37 kW, 50/60 Hz</td>
<td>1ZSC003676-AAF (flow switch included)</td>
</tr>
<tr>
<td>Speed: 1370-1660 rpm</td>
<td></td>
</tr>
<tr>
<td>Protection class: IP55</td>
<td></td>
</tr>
<tr>
<td>Type: 1-phase, squirrel-cage</td>
<td>1ZSC027410-AAG (without flow switch)</td>
</tr>
<tr>
<td>Data: 230 V/0.37 kW, 50/60 Hz</td>
<td>1ZSC003676-AAG (flow switch included)</td>
</tr>
<tr>
<td>Speed: 1370-1660 rpm</td>
<td></td>
</tr>
<tr>
<td>Protection class: IP55</td>
<td></td>
</tr>
<tr>
<td>Type: 3-phase, squirrel-cage</td>
<td>1ZSC027410-AAH (without flow switch)</td>
</tr>
<tr>
<td>Data: 500 V/0.37 kW, 50/60 Hz</td>
<td>1ZSC003676-AAH (flow switch included)</td>
</tr>
<tr>
<td>Speed: 1370-1660 rpm</td>
<td></td>
</tr>
<tr>
<td>Protection class: IP55</td>
<td></td>
</tr>
<tr>
<td>Type: 3-phase, squirrel-cage</td>
<td>1ZSC027410-AAJ (without flow switch)</td>
</tr>
<tr>
<td>Data: 208-277 V/0.37 kW, 50/60 Hz</td>
<td>1ZSC003676-AAJ (flow switch included)</td>
</tr>
<tr>
<td>Speed: 1370-1660 rpm</td>
<td></td>
</tr>
<tr>
<td>Protection class: IP55</td>
<td></td>
</tr>
<tr>
<td>Type: 3-phase, squirrel-cage</td>
<td>1ZSC027410-AAK (without flow switch)</td>
</tr>
<tr>
<td>Data: 360-480 V/0.37 kW, 50/60 Hz</td>
<td>1ZSC003676-AAK (flow switch included)</td>
</tr>
<tr>
<td>Speed: 1370-1660 rpm</td>
<td></td>
</tr>
<tr>
<td>Protection class: IP55</td>
<td></td>
</tr>
</tbody>
</table>

1.13.4 Motor specification for oil filter unit with 4 cartridges type OLU2D50NV

<table>
<thead>
<tr>
<th>Motor</th>
<th>ABB article number for a complete oil filter unit with motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type: 1-phase, squirrel-cage</td>
<td>1ZSC027410-AAL (without flow switch)</td>
</tr>
<tr>
<td>Data: 110 V/0.37 kW, 50/60 Hz</td>
<td>1ZSC003676-AAL (flow switch included)</td>
</tr>
<tr>
<td>Speed: 1370-1660 rpm</td>
<td></td>
</tr>
<tr>
<td>Protection class: IP55</td>
<td></td>
</tr>
<tr>
<td>Type: 1-phase, squirrel-cage</td>
<td>1ZSC027410-AAM (without flow switch)</td>
</tr>
<tr>
<td>Data: 230 V/0.37 kW, 50/60 Hz</td>
<td>1ZSC003676-AAM (flow switch included)</td>
</tr>
<tr>
<td>Speed: 1370-1660 rpm</td>
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<tr>
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<td>1ZSC003676-AAN (flow switch included)</td>
</tr>
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<td>Protection class: IP55</td>
<td></td>
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<tr>
<td>Type: 3-phase, squirrel-cage</td>
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<td>Data: 360-480 V/0.37 kW, 50/60 Hz</td>
<td>1ZSC003676-AAAR (flow switch included)</td>
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<tr>
<td>Protection class: IP55</td>
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</table>
2. Installation

2.1 General
The oil filter unit should be mounted at ground level to enable maintenance and repair work without de-energizing the transformer and to avoid gas collection.

Figs. 10-13 shows the valves that are recommended to use in the oil circuit.

A special bracket plate has to be placed on the transformer. Dimensions for fixing screw joints, see Fig. 2.

For the UC-types of on-load tap-changers up to three units should be mounted one for each of on-load tap-changer.

2.2 Tools
- Normal set of hand tools
- Small pipe wrench

2.3 Material
- A bucket, oil resistant
- Cleaning paper
- Lubrication for stainless steel connections

2.4 Weight
- Approximately 40 kg for oil filter unit with 1 filter cartridge (OLU1C)
- Approximately 80 kg for oil filter unit with 2 filter cartridges (OLU1D)
- Approximately 160 kg for oil filter unit with 4 filter cartridges (OLU2D)

2.5 Receiving
2.5.1 Unpacking
Check that the package is undamaged.

Normally the filter units are delivered in boxes of wooden material. Therefore only the assembly screws should be removed.

Lifting of the box should be carried out with a lifting device. Avoid manually heavy lifting.

2.6 Mounting
Mounting may be carried out after mounting of the on-load tap-changer in the transformer factory or at commissioning on site.

A clearance of 500 mm is necessary above the filter housing to enable exchange of filter cartridges. The filter unit should be mounted on a vibration free surface. In case of vibrations, vibration absorbing rubber feet should be used. The pressure gauge should be visible and easy to read. The sample valves should be easily accessible.

2.5.2 Inspection on receipt
Check that the oil filter unit, the pressure gauge, the pressure switch, the flow switch (optional) and the Y-strainer are undamaged. If transport damage is found, and it is judged that correct operation of the oil filter unit is not possible, a damage report should be sent to the insurance company. It is also recommended that photographs are taken of the damaged details. Mark the photos with ABB’s reference number and the serial number of the oil filter unit, and send them to ABB for comments.

2.5.3 Temporary storage before assembly
If the oil filter unit is not to be assembled immediately once the delivery has been approved, keep the oil filter unit and the filter cartridge in the delivery package.

CAUTION
The package of the filter cartridge must not be opened! The special package ensures maintained water absorption capacity of the filter cartridge.
2.6.1 Plumbing

**CAUTION**

Do not open the filter cartridge package at this stage.

Plumbing is recommended to be carried out after oil filling of the on-load tap-changer.

Start by mounting the oil filter unit to a bracket plate on the transformer. Manufacture an inlet tube and an outlet tube as recommended in Figs. 10-13, depending on which type of on-load tap-changer the filter unit is to be connected to. For dimensions of connecting flanges, see section 1.4 or the dimension drawing delivered with the on-load tap-changer.

**CAUTION**

Remove the plastic plugs from the inlet and outlet connections before installation.

Make sure that the tubes are clean before connection to the on-load tap-changer. Make sure that all O-rings are in place before connecting the flanges.

**WARNING**

Do not mix up inlet and outlet ports on oil filter unit or on the on-load tap-changer. The filtration will be poor, and in worst case, a flashover may occur in the on-load tap-changer.

The connection points are shown in Figs. 10-13.

- UCG and UCL have vertical flanges instead of horizontal as shown in Fig. 11 (UCC). Connect the inlet tube to the valve with flange. The outlet tube from the oil filter unit is connected to any one of the free flanges, except to the one connected to the transformer tank.
- For UBB on-load tap-changers there is a flange connection without a valve in the centre of the cover.
- On UZ-type of on-load tap-changers there is a special flange for oil filter unit outlet tube, see the dimension drawing delivered together with the on-load tap-changer or Fig. 12 in this manual.

Try to keep the tubes short and with as few joints and bends as possible. If the tubes are longer than 5 meters, increase the tube diameter to 3/4 ".

When the transformer will be operating on sites where the temperature frequently falls below -10˚C (+14˚ F), it is recommended to heat insulate the inlet tube.

When the oil filter unit has been running for a while, e.g. two months, the Y-strainer must be cleaned from particles. The cleaning should be repeated at every exchange of filter cartridge, or if, for some reason the oil pipes have been dismantled.

2.6.2 Electrical connection

**WARNING**

Make sure that the voltage is properly switched off before starting wiring work!

Only qualified personnel should attempt installation of electrical equipment.

Make sure that the available voltage and frequency is in accordance with the rating of the electric motor.

Connect the motor supply to the electric connection box as shown in the wiring diagram in Figs. 8 and 9 in this manual.

The pressure switch and the flow switch (optional) should be connected to give information to the control room if pressure is over its limit or if oil flow is below its limit.

It is also recommended to use an oil level indicator with a contact for low oil level in the conservator, and to connect it so a trip from that contact will switch off the motor protective switch to the oil filter unit, and to give an alarm in the control room. See the wiring diagrams in Figs. 8 and 9.

Make sure that the motor has correct rotation direction by comparing the rotation of the fan with the arrow on the motor.

**WARNING**

If the rotation direction is wrong, the cleaning of the oil will be poor, and in worst case, a flashover may occur in the on-load tap-changer.
3. Commissioning

Make sure that all valves are closed. See Figs. 10-13.

1. Dismantle the filter housing lid (item 25) by loosening the 6 nuts. (See Fig. 19.)
2. Dismantle the filter cartridge assembly bolt with seal, spring and washers. (See Fig. 20.)
3. Inspect the O-ring at filter housing and replace it if necessary. (See Fig. 23.)
4. Take the new filter element out of the plastic bag. Check “use by date”. Throw the plastic bag, together with the silica gel in a dedicated place. (See Fig. 24.)

5. Check that an O-ring is fitted to the base of filter cartridge. (See Fig. 25.)
6. Place the new filter cartridge on to the filter housing center pipe and carefully lower the cartridge into the filter housing (item 20). (See Fig. 26.)
7. Remount the filter cartridge assembly bolt with seal, spring and washers, max. torque 15 Nm. (See Fig. 27.)
8. Remount the filter housing lid (item 25) and tighten the 6 nuts, max. torque 15 Nm. (See Figs. 29 and 30.)
9. For mounting of filter cartridges in the second filter housing, repeat step 1 – 8.
10. Open the inlet and outlet valves.
11. Open the air vent valve, and the plug on the second filter housing (item 28) and remove all air from the filter housing, close valve and plug when no more air comes out.
12. Fill up conservator with oil if necessary.
13. Start the filter unit.
14. Check that no leaks have occurred.
4. Transportation

The oil filter unit may be transported mounted on the transformer, provided that it is properly fixed. If the unit should be dismounted before transportation, proceed as follows and prepare the on-load tap-changer as stated in the applicable guide.

If the oil filter unit has been oil filled, drain as follows:
1. Shut all valves. Drain all oil from the filter housing (item 20). The bucket may be emptied several times before the draining is completed.
2. Dismount the tubes. Keep the O-rings, the screws, nuts and the washers.

**CAUTION**

Oil will pour out from the tubes when they are loosened. Prepare for taking care of that oil!

The sealing in the flange of the on-load tap-changer work with “rubber excess” which makes the O-rings looking somewhat damaged, but they can be reused provided that they are left in their positions or refitted in the same positions as they had earlier.

3. Mount the covers on the return flange of the on-load tap-changers.
   For UBB tap-changers: Mount a cover on the flange for the inlet tube.
4. Remove all wirings.

**WARNING**

Make sure that the voltage is properly switched off before starting wiring work!

The oil filter unit is transported in its delivery package which can be reused.

Remounting at site is done by using appropriate parts according to section 2.6.

Restart the oil filter unit by using appropriate parts according to section 3.
5. Maintenance

The oil filter unit is maintained during the annual inspection of the on-load tap-changer and during the normal maintenance of the on-load tap-changer.

The maintenance needed is replacement of the oil filter cartridge when necessary and to clean the strainer. The cleaning should be repeated at every exchange of oil filter cartridge, or if, for some reason the oil pipes have been dismantled.

When a new oil filter unit has been running for a while, e.g. two months, the strainer must be cleaned from particles.

During the annual inspection of the on-load tap-changer, check for abnormal noise, heat or vibrations from the oil filter motor/pump unit. If an oil flow switch is mounted, also check that it does not give an alarm signal.

The motor and pump is a sealed unit and must be replaced as one unit.

5.1 Tools
• Normal set of hand tools
• Bucket (oil resistant)

5.2 Material
Spare filter cartridge. For ordering, see chapter 7 Spare parts list.

5.3 Annual inspection
During the annual inspection of the on-load tap-changer, the pressure gauge is read. Note the reading so the change from year to year can be seen.

If the pressure is close to 4 bar or more, the filter cartridge should be replaced.

The pressure increase goes faster at the end of filter cartridge lifetime.

If moisture is suspected to have come into the on-load tap-changer compartment, the filter cartridge should be replaced.

Also check for leakages. All leakages should be repaired.

5.4 Maintenance
The filter cartridge should be replaced every 2 years, even if the pressure is lower than 4 bar.

For on-load tap-changers with a high switching frequency, e.g. furnace transformers, the filter cartridge is replaced when the pressure drop is 4 bar or more, or if moisture is suspected to have come into the on-load tap-changer compartment.
5.5 Filter cartridge replacement

A filter cartridge replacement could be performed without turning off other systems.

The filter cartridge must be replaced when there is a pressure drop of 4 bar over the filter cartridge. (At normal service temperature)

- Do not break the sealed package of the new filter cartridge until immediately before installation.

1. Stop the motor of the oil filter unit by switching off the power. (See Fig. 16.)
2. Close the valves in the inlet and outlet tubes.
3. Check that there is no pressure applied to the oil filter unit when the work is started. The pressure gauge pointer should be close to 0 bar. (See Fig. 17.)
4. Remove the draining plug (item 24) at the bottom of the oil filter housing, use an 8 mm allen key or a 27 mm spanner. (See Fig. 18.)
5. Open the air vent valve (item 28), wait till all oil is drained.
6. Dismantle the filter housing lid (item 25) by loosening the 6 nuts. (See Fig. 19.)

- 16 Switch off the electric power to the motor.
- 17 Close the inlet and outlet valves and check that the pressure is off.
- 18 Unscrew the drain plug and empty out the oil.
- 19 Unscrew the nuts and remove the lid.
7. Dismantle the filter cartridge assembly bolt with seal, spring and washers. (See Fig. 20.)
8. Pull the filter cartridge/s (item 7) out of the filter housing (item 20). Use the handle on top of the filter cartridge. Place them in a suitable vessel. (See Fig. 21)
9. Clean the Y-strainer (item 26) at the oil pump inlet port
10. Clean the inside of the filter housing and the lid if necessary. (See Fig. 22)
11. Inspect the O-ring at filter housing and replace it if necessary. (See Fig. 23)

12. Take the new filter element out of the plastic bag. Check "use by date". Throw the plastic bag, together with the silica gel in a dedicated place. (See Fig. 24)

- Remove the package of silica gel from the new filter cartridges before installation.

13. Check that an O-ring is fitted to the base of filter cartridge. (See Fig. 25)

14. Place the new filter cartridge on to the filter housing center pipe and carefully lower the cartridge into the filter housing (item 20). (See Fig. 26)

- 23 Inspect the O-ring and replace it if necessary.

- 24 Take the new cartridge box and check "use by date".

- 25 Check that the O-ring is fitted to the base of the cartridge.

- 26 Place the cartridge carefully in the housing by using the plastic handle.
15. Remount the filter cartridge assembly bolt with seal, spring and washers, max. torque is 15 Nm. (See Fig. 27)
16. When the new filter cartridge is in place, mount the draining plug (item 24) back, use an 8 mm allen key or a 27 mm spanner. (See Fig. 28)
17. Remount the filter housing lid (item 25) and tighten the 6 nuts, max. torque is 15 Nm. (See Figs. 29 and 30)
18. For replacement of filter cartridges in the second filter housing, repeat steps 6 – 17.
19. Open the inlet and outlet valves.
20. Open the air vent valve and the plug on the second filter housing (item 28). Remove all air from the filter housing, close valve and plug when no more air comes out.
21. Fill up conservator with oil if necessary.
22. Start the filter unit.
23. Check that no leaks have occurred.

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**CAUTION**

A used filter cartridge is a hazardous waste and has to be handled according to local instructions.

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27 Fit the cartridge screw assembly with seal and washers.

28 Fit a new drain plug. A new sealing is included in the cartridge box.

29 Fit the lid to the filter housings.

30 Tighten the filter lid bolts.
Besides replacement of filter cartridge, no repair work is needed. However, after long time in service the ball bearings in the motor may be worn or the pumping capacity of the oil pump has become too low.

The motor/pump unit may also be damaged due to over-voltage. The motor and pump is a sealed unit and must be replaced as one unit.

6.1 Replacement of pump/motor unit
For ordering spare motor/pump unit, see chapter 7, Spare parts list.

6.1.1 Tools
Normal set of hand tools.

6.1.2 Material
• Motor/pump unit
• Sealing ring for draining plug
• Bucket, oil resistant

6.1.3 Dismounting
1. Switch off the oil filter unit.
2. Close the valves in the tubes on both sides of the oil filter unit.
3. Put a bucket under the draining plug (item 24) at the bottom of the filter housing. Drain the filter housing completely.

**WARNING**
Make sure that the voltage is properly switched off before starting wiring work!

4. Disconnect the electric power supply cable from the motor/pump unit.
5. Disconnect the pipe from the Y-strainer and the pipe between pump and filter housing.
6. Unscrew the four screws retaining the motor/pump unit to the filter housing clamp and lift off the motor/pump unit. Take care of the screws and the washers.
7. Disconnect the Y-strainer from the motor/pump unit.

6.1.4 Remounting
1. Reconnect the Y-strainer to the motor/pump unit.
2. Remount the draining plug, use a new sealing.
3. Put the motor/pump unit in place on the filter housing clamp.
4. Mount and tighten the four screws with washers.
5. Remount the pipes to the motor/pump unit.

**WARNING**
Make sure that the voltage is properly switched off before starting wiring work!

6. Reconnect the electrical power supply to the motor.
7. Make a quick start and stop of the motor and check the direction of rotation. The direction is shown with an arrow on the motor.

**CAUTION**
If the rotation direction is wrong, the cleaning of the oil will be poor, and in worst case, a flashover may occur in the on-load tap-changer.

8. If necessary, change the rotation direction by changing place of two phases.
9. Open the valves in the tubes on both sides of the oil filter unit.
10. Fill up the filter housing with oil.
11. Open the air valve on top of the lid (item 28) until all air is evacuated.
12. Check that no leaks have occurred.
13. Make a final check of the rotation direction of the motor by closing the valve on the outlet tube slowly. The pressure gauge should show increasing pressure.
14. If not, change the rotation direction as described earlier and check again.
15. Open the valve fully afterwards.
6.1.5 Filling up small amount of oil in the oil conservator

When changing oil filter cartridges or motor/pump unit, there will be a loss of oil in the conservator. Before the oil level goes so low than an alarm from the oil level indicator occurs it is necessary to fill up oil in the conservator. It can be done with help of the oil filter pump.

1. Stop the oil filter unit by switching off the electric power.
2. Close the valves in the inlet and outlet tubes of the oil filter unit.
3. Connect a clean oil resistant suction hose to the drain/fill valve and put the free end in a drum with oil of proper quality and amount, keep the hose as short as possible. The drain/fill valve is the one mounted between the Y-strainer and the shut off valve in the oil filter unit inlet pipe, see Fig. 10.
4. Open the valve in the oil filter unit outlet pipe and open the drain/fill valve.
5. Start the oil pump.
6. Fill up oil to the correct level in the conservator.
7. Open the valve in the inlet pipe and close the drain/fill valve.
8. Remove the suction hose and remount the plug to the drain/fill valve again.
9. If you have difficulties to make the pump suction oil from the drum, it may help to shut off the oil pump and to open the valve in the inlet pipe for a short while so a small amount of oil from the on-load tap-changer can fill up the suction hose.
10. Then start the oil pump and close the valve in the inlet pipe. When doing so you must have strict control of the oil level in the conservator and in the oil drum.
7. Spare parts list

7.1 Introduction
This spare parts list has been compiled to help you with procurement of spares. To obtain trouble-free deliveries you should note a few things which are explained in the following text.

The breakdown level and general contents of this list have been worked out to cover normal customer requests. Our spare part department will assist if you require any specific item that is not included in the list.

7.2 Oil filter unit serial number
The rating plate on the oil filter unit shows the serial number of the device you are ordering spares for. It is important to have this information, because the manufacture of parts gradually changes as materials and manufacturing technology improves.

ABB makes every effort to supply spares that should fit your requirements. Some parts of later manufacture than those you are replacing may need some adaptation to fit into your device. Our spare part department needs to know the serial number to supply exactly what you require.

7.3 Item number
Item numbers are shown in Fig. 1 and in the list.

7.4 Name of item
The name should be specified when ordering to make sure the right type of item is ordered.

7.5 Quantity
The figures given represent the number of items that are fitted to one oil filter unit.

7.6 Remarks
Information of the content and reference to Fig. 1.

7.7 General arrangement
The general arrangement of an oil filter unit is shown in Fig. 1.

7.8 Standard spare parts
Standard spare parts for the oil filter unit are filter cartridge, O-ring for the lid and motor/pump unit.

7.9 Special spare parts
If you need parts other than those in the list, our staff will be happy to assist you. Please use Fig. 1 as a reference when discussing your requirements. As usual, the serial number is essential for ordering.

7.10 Spare parts list for oil filter unit
See Fig. 1.

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<th>Item</th>
<th>Name of item</th>
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<td>Auxiliary switch, motor protector</td>
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<td>1SAM201901R1001</td>
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<tr>
<td>2</td>
<td>Motor protective switch</td>
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<td>Dependent of motor data</td>
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<td>3</td>
<td>Pressure switch</td>
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<td>4</td>
<td>Motor/pump assembly unit</td>
<td>1</td>
<td>Dependent of motor data</td>
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<td>Pressure gauge</td>
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<td>Shunt release</td>
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<td>Wall bracket</td>
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<td>Capacitor bracket</td>
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8. Recycling

8.1 Introduction
The following instructions should only be seen as recommendations for environmentally sound disposal of machines. It is the customer’s responsibility to ensure that local regulations are followed.

8.2 Recycling of packaging material
Once the oil filter unit has arrived on site, the packaging material will need to be removed.
- Any wood packaging can be burned. For some countries, the packaging used for shipping by sea is made of impregnated wood that must be recycled according to local regulations.
- Plastic wrappings can be recycled.

8.3 Scrapping and destruction
The end user has to, when the equipment has served its time, take care to the current practice and local regulations for scrapping and destruction.

8.4 Approximate material content
The material used in manufacturing of the oil filter unit is mainly stainless steel and carbon steel. Also a minor part of, among others, copper, plastics and rubber are included.

8.5 Hazardous waste
The oil from the filter unit is a hazardous waste and has to be handled according to local instructions.