On-load tap-changers, type UZE and UZF
Installation and commissioning guide
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

WARNING

Unused transformer oil is harmful. Fumes from unused warm oil may irritate the respiratory organs and the eyes. After long and repeated contact with transformer oil, skin becomes very dry.

Used tap-changer oil from diverter switch housings and selector switch housings contains harmful substances. Fumes are irritating to the respiratory organs and the eyes and are highly flammable. Used transformer oil may well be carcinogenic.

Avoid contact with the oil and use oil-tight protective gloves when handling the oil.

First aid:
Skin contact: Wash your hands. Use skin cream to counteract drying.
In the eyes: Rinse your eyes in clean water.
Swallowing: Drink water or milk. Avoid vomiting. Call a doctor.

Collect used oil in oil drums.

Waste and clean-up: Should be absorbed by an absorber. Treat it as hazardous to the environment.

In the event of fire: Any fires should be extinguished with powder, foam or carbonic acid extinguishing agents.

WARNING

The motor-drive mechanism must not be installed in an explosive atmosphere. The electrical equipment creates sparks that can cause an explosion.

WARNING

Before any work is carried out on the tap-changer: Make sure that the transformer is disconnected and that grounding is properly conducted. Obtain a signed certificate from the engineer in charge.
WARNING

Before carrying out work on the tap-changer, put the LOCAL/REMOTE switch on the motor-drive mechanism to position 0. It is also advisable to shut the door of the motor-drive mechanism and padlock it when work is carried out on the tap-changer. The key should be kept by the operator. This is done to avoid an unexpected start of the motor-drive mechanism.

WARNING

Before starting any work inside the motor-drive mechanism, the auxiliary power must be switched off.

NOTE: The motor, contactors and heating element may be energized from separate sources.

During drying of the transformer

CAUTION

The tap-changer must not be included in the vapour phase drying process of the transformer. For permissible pressure and temperature at the rear during drying process, see chapter 3.

Mounting of gaskets

CAUTION

Sealing surfaces and gaskets must be clean and undamaged. Diametrically opposed bolts in sealing joints must be tightened alternately several times, beginning with a low tightening torque and finally with the recommended tightening torque as described in section 1.8.

During oil filling

WARNING

When oil that has been used in a diverter switch housing is pumped out, grounded conducting tubes and hoses should be used to avoid the risk of explosion due to the gases produced by arcs during service.

CAUTION

Do not fill the tap-changer with oil if the transformer tank is under vacuum and the tap-changer is not.

CAUTION

Do not fill the transformer tank with oil if the tap-changer is under vacuum and the transformer tank is not.

CAUTION

The oil level in the oil conservator of the tap-changer should never be above the oil level in the oil conservator of the transformer.

After oil filling

CAUTION

Do not energize the transformer earlier than three hours after oil filling at atmospheric pressure. This waiting period is needed to allow air bubbles to dissipate.
During service

WARNING

Small amounts of explosive gases might come out from the breathing devices (dehydrating breather or one-way breather). Make sure that no open fire, hot surfaces or sparks occur in the immediate surroundings of the breathing devices.

WARNING

If a failure in power supply occurs during operation, the operation will be completed when the power returns.

WARNING

The hand crank must not be inserted during electrical operation.

WARNING

If the tap-changer is not in its exact position and the hand crank is pulled out, the motor-drive mechanism will start and go to the exact position if the power supply is on.

CAUTION

After a pressure relay trip, follow the instructions in the chapter “Pressure relay” in the Repair guide.

CAUTION

The pressure relay is a calibrated monitoring instrument. It must be handled with care and protected against careless handling or any kind of mechanical damage.
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1. Introduction

The on-tank concept of on-load tap-changer, realized by ABB in the UZ range, is unique. The design offers advantages in installation and maintenance. The whole device is delivered installed in a tank that is simply mounted onto the transformer tank together with the motor-drive mechanism.

In the event of a tap-changer being delivered without a tank, the transformer manufacturer will supply the tank. Appendix A includes a welding and mounting instruction.

It is easy to access all parts of the tap-changer for maintenance and repair. After draining the oil, you simply unbolt and open the front cover to access any part you may need to inspect or replace.

UZE requires the transformer conductors to be accessed from the rear of the tap-changer.

UZF has an inclined rear wall and a top cover that is removable to provide access to the transformer conductors.

**WARNING**

The cover for access to conductors on top of UZF tank may be opened after draining the transformer main tank.

UZE models are available for use without a separate oil conservator, for example, when used on sealed tank transformers.

---

**Fig. 1. General arrangement of on-load tap-changer.**
1.3 Oil
The oil quality should be IEC 60296-LCSET -30° (former Class II). The oil should have an electrical withstand of at least 40 kV, measured in a 2.5 mm gap, according to IEC 60156. New oil should have a water content below 15 ppm and have been handled and stored according to IEC 60422 point 10.

Table 1. Weight of oil in kg.

<table>
<thead>
<tr>
<th>Type designation</th>
<th>Tap-changer with separate conservator (The oil for the conservator is not included.)</th>
<th>Tap-changer with expansion volume in the tank</th>
</tr>
</thead>
<tbody>
<tr>
<td>200/...</td>
<td>500</td>
<td>450</td>
</tr>
<tr>
<td>250/...</td>
<td>500</td>
<td>450</td>
</tr>
<tr>
<td>380/...</td>
<td>950</td>
<td>880</td>
</tr>
<tr>
<td>550/...</td>
<td>1250</td>
<td>1150</td>
</tr>
<tr>
<td>650/...</td>
<td>1250</td>
<td>1150</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type designation</th>
<th>Tap-changer with separate conservator (The oil for the conservator is not included.)</th>
<th>Tap-changer with expansion volume in the tank</th>
</tr>
</thead>
<tbody>
<tr>
<td>200/...</td>
<td>400</td>
<td>430</td>
</tr>
<tr>
<td>250/...</td>
<td>400</td>
<td>430</td>
</tr>
<tr>
<td>380/...</td>
<td>750</td>
<td>800</td>
</tr>
<tr>
<td>550/...</td>
<td>1050</td>
<td>1120</td>
</tr>
<tr>
<td>650/...</td>
<td>1050</td>
<td>1120</td>
</tr>
</tbody>
</table>

⚠️ WARNING

Do not energize the transformer until oil has been filled as per chapter 6, Oil filling, in this manual.
1.4 Oil conservator

The tap-changer has to be connected to an oil conservator, except when it is an UZE with expansion volume in the tank. ABB recommends the use of a separate conservator for the tap-changer with both oil and air side separated from the main conservator of the transformer.

The volume of the conservator should be such that there is oil left in the conservator even at the lowest oil temperature expected and such that no flooding can occur at the highest oil temperature expected.

A suitable dimension of the tube for connection to the conservator is an inner diameter of approximately 20 mm. The tube should be inclined at least 3° to avoid gas cushions in the tube. A valve in the connection to the conservator is recommended.

The conservator must be equipped with a breathing device that does not allow moist air into the conservator and that allows the gas from the arcs to disappear. We recommend that the breather for the tap-changer should be bigger than normally used for that amount of oil, as the tap-changer is breathing more frequently because of the gas produced at each tap-changer operation.

The conservator should also be equipped with an oil level indicator, and an alarm contact for low oil level is recommended.
1.5 Filter unit for continuous oil filtration
If the tap-changer should have an oil filter unit for continuous oil filtration from ABB, installation and commissioning instructions can be found in the oil filter unit manual, delivered with the oil filter unit.

1.6 Weights
Table 2 contains the approximate weights of all the models in the UZ range of tap-changers. The weight of the motor-drive mechanism is approximately 110 kg, and is included in the overall weight.

Table 2. Weights for UZ tap-changers in kg.

<table>
<thead>
<tr>
<th>Tap-changer type designation</th>
<th>Tap-changer with tank without oil</th>
<th>Insert without motor-drive mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>UZE.N, UZE.T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>200/...</td>
<td>700</td>
<td>220</td>
</tr>
<tr>
<td>250/...</td>
<td>700</td>
<td>220</td>
</tr>
<tr>
<td>380/...</td>
<td>930</td>
<td>270</td>
</tr>
<tr>
<td>550/...</td>
<td>1100</td>
<td>340</td>
</tr>
<tr>
<td>650/...</td>
<td>1100</td>
<td>340</td>
</tr>
<tr>
<td>UZF.N, UZF.T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>200/...</td>
<td>720</td>
<td>220</td>
</tr>
<tr>
<td>250/...</td>
<td>720</td>
<td>220</td>
</tr>
<tr>
<td>380/...</td>
<td>900</td>
<td>270</td>
</tr>
<tr>
<td>550/...</td>
<td>1100</td>
<td>340</td>
</tr>
<tr>
<td>650/...</td>
<td>1100</td>
<td>340</td>
</tr>
</tbody>
</table>

1.7 Tightening torque
The following tightening torques are recommended unless otherwise stated in this installation guide:

<table>
<thead>
<tr>
<th>Size</th>
<th>Torque</th>
<th>±10 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>M6</td>
<td>10 Nm</td>
<td>(7.4 lbf x ft)</td>
</tr>
<tr>
<td>M8</td>
<td>24.5 Nm</td>
<td>(18 lbf x ft)</td>
</tr>
<tr>
<td>M10</td>
<td>49 Nm</td>
<td>(36 lbf x ft)</td>
</tr>
<tr>
<td>M12</td>
<td>84 Nm</td>
<td>(62 lbf x ft)</td>
</tr>
</tbody>
</table>

Welded stud bolts:
M12 42 Nm (31 lbf x ft)

1.8 Pressure relay and other protection devices
In case the tap-changers is equipped with pressure relay or any other protection devices, instructions for functional check and replacement are available in the assortment guide, 1ZSC000562-AAD.
2.1 Unpacking
Check that the package is free from transport damage. Open the cover of the transport box. Remove the supporting blocks of wood. If the package is damaged a careful investigation must be carried out.

Lift the tap-changer, using the lifting eyes on the top.

2.2 Inspection upon receiving
1. Check that there is no visible damage.
2. Open the door of the cabinet of the motor-drive mechanism and check that the motor-drive mechanism is free from damage.
3. If transport damage is found, and it is adjudged that correct operation of the tap-changer is not possible, a damage report should be sent to the insurance company. It is also recommended that photographs be taken of the damaged details. Mark the photos with the serial number of the tap-changer and send them to ABB for comments.
4. Check that the quantity delivered, the type designation and the serial number agree with the delivery documents, e.g. the packing list or ABB’s ordering acknowledgement. The serial number is stamped on the rating plate.
5. Remove the drying agent (placed according to Fig. 5), before the tap-changer is taken into service.
6. If the packing material seems to be wet (e.g. the plastic is coated with moisture), the tap-changer must be dried at least 24 hours at a temperature of max. 70 °C (158 °F) before it is fitted to the transformer. See chapter 3, Drying.

2.3 Temporary storage before assembly
If the tap-changer is not to be installed on the transformer immediately, once the delivery has been approved the tap-changer must be kept warm and dry. Let the unit be kept in its plastic enclosure and leave the drying agent until assembly.

![Fig. 5. Inspection on receipt](image-url)
3. Drying

Drying of the tap-changer is normally not required, see section 2.2, step 6.

The following temperatures and pressures between the tap-changer tank and the transformer tank are allowed when drying:

<table>
<thead>
<tr>
<th>Pressure</th>
<th>Standard tap-changer</th>
<th>Tap-changer with reinforced barrier</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Up to 115 °C (239 °F) on the transformer side. Up to 90 °C (194 °F) inside the tank.</td>
<td>Up to 115 °C (239 °F) on the transformer side. Up to 90 °C (194 °F) inside the tank.</td>
</tr>
<tr>
<td>Up to 100 kPa</td>
<td>Up to 60 °C (140 °F).</td>
<td>Up to 90 °C (194 °F).</td>
</tr>
<tr>
<td>100–150 kPa</td>
<td>Not allowed.</td>
<td>Up to 60 °C (140 °F).</td>
</tr>
</tbody>
</table>

The temperature inside the motor drive cabinet must not exceed 70 °C (158 °F).

During or after drying the tap-changer must not be operated until it has been filled with oil. The motor-drive mechanism should not be included in a vacuum process, as the process would remove the grease necessary for operation.
4. Installation on the transformer

**CAUTION**

The tap-changer must not be included in the drying process of the transformer.

The tap-changer is either bolted or welded to the transformer tank, see section 4.1.

---

In the event of the tap-changer being delivered without a tank, the transformer manufacturer has to make the tank and mount it onto the transformer tank; or make the tap-changer tank integrated with the transformer tank. Appendix A includes a welding and mounting instruction. In this case, continue with section 4.2 directly.

---

4.1 Attaching the tap-changer to the transformer

4.1.1 Welding

For welding the tap-changer to the transformer tank, use fillet weld with a $\geq 4$ mm (Fig. 6).

4.1.2 Bolting

A set of cork-rubber gaskets is provided to seal against the transformer tank.

When you install the tap-changer, the gasket should be glued as described below.

Tighten the bolts by approximately 90 Nm torque.

Ensure that the surfaces being in contact with the gaskets are clean and free from grease and oil.

After cleaning, stick the gaskets to the transformer tank flange (Fig. 7) with ABB glue 1234 0016-608, by brushing glue on both the gasket and the flange.

---

**Fig. 6. Welding detail.**
After spreading the glue let it dry at room temperature for a minimum of 10 minutes and a maximum of 30 minutes.

Keep the gaskets in the correct position by using clamping blocks for a minimum of 3 hours.

Glue the inner gasket bands only, both to the tap-changer flange side and to the transformer-tank flange side.

The required amount of glue (ABB 1234 0016-608) is 0.5 kg.

Do not glue gaskets at temperatures below 0 °C (32 °F).

**ABB glue 1234 0016-608 is a contact adhesive of nitrile rubber base.**

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**Fig. 7. Gluing the gasket.**
4.1.3 Assembly of accessories
All details which have been removed for the transport are specified on the packing list. The openings on the tap-changer are then sealed by transport covers.

1. Remove the transport covers.
2. Check the O-rings. Make sure they are pressed into the bottom of the groove on the flanges.
3. Assemble the accessories. Tightening torque for the nuts as per section 1.7.

4.1.4 Retightening
When a gasket is subjected to the pressure from the flange bolts it will change its shape or settle. This reduces the pressure on the bolts, making them loose.

The settling effect will increase at higher temperatures. For this reason retightening is required.

Retighten one day after assembly. Retighten again after the transformer has been in service for about two weeks to let the gaskets settle at service temperature. The retightening torque should again be approximately 90 Nm.

Retighten the dome nuts with 42 Nm before oil filling. See section 5.1.

4.2 Connection of the regulating winding of the transformer
On UZE the winding has to be connected from the rear.

On both UZE and UZF the cable lugs can be either crimped or brazed. The free distance between the cable lugs for adjacent contacts must be at least 7 mm. Tightening torque is 38 Nm. For star point design, attach the neutral connection as shown in Fig. 8 and the connection diagram.

On UZF the top cover is intended to be used when connecting the transformer’s regulating winding leads to the tap-changer terminals.

Remove the cover and connect the leads. Tightening torque is 38 Nm for the cable lugs. For star-point design, attach the neutral connection as shown in Fig. 8 and the connection diagram. Bolt on the cover. Tightening torque is 42 Nm for the dome nuts.

If the oil conservator is to be installed on the top of the tap-changer, connect the regulating winding leads before installing the oil conservator.

Fig. 8. Assembly of the neutral connection.
4.3 Connection to the oil conservator
See Fig. 9.

Remove the transport cover from the flange for the oil conservator. Check that the O-ring is in place on the flange and connect the pipe to the oil conservator.

In cases where the oil conservator is installed directly on the top of the tap-changer, install the oil conservator directly on the flange with the connection sealed by an O-ring that is left on the flange when the transport cover is removed. After that, the other bracket of the conservator is mounted to the tank.

For UZ with normal barrier, the oil level difference between tap-changer and transformer should be a maximum of 1.2 m. For a reinforced barrier, the oil level difference may be 8 m.

Fig. 9. Attachment flange for oil conservator.
5. Oil filling

5.1 Retightening
Before oil filling, the front cover and the connection cover on UZF should be retightened. Tightening torque 42 Nm. The welded stud bolts should not be over-tightened.

Retighten again after the transformer has been in service for about two weeks, to let the gaskets settle at service temperature.

5.2 Filling methods and restrictions
Oil filling can be carried out at atmospheric pressure or under vacuum. The wall between the tap-changer and the transformer tank is designed to withstand vacuum on one side and atmospheric pressure on the other side. Having vacuum on one side and the pressure of an oil column on the other side is not permitted.

UZE can be delivered with an oil expansion volume in the top section of the tank. The design of UZF does not allow an oil expansion volume in the tank. Instead, UZF can be delivered with a built-on oil conservator. See also Figs. 2, 3 and 4.

Oil filling may be carried out in different ways depending on what the transformer manufacturer considers convenient, as long as the above rules are complied with and the tap-changer is filled with oil to the correct level.

The methods below are recommended, and if they are followed in detail no pressure limits will be exceeded.

5.2.1 Filling at atmospheric pressure
1. Open the conservator valve, if any.
2. Dismantle the pipe to the breather. Or, if simpler, remove the air relief valve (one way breather) or the dehydrating breather.
3. Connect the pump to the oil valve on the tap-changer tank. For dimension see the dimension drawing. Open the valve and pump in oil to the correct level shown on the oil level indicator. For correct oil level see section 5.3.
4. Shut the oil valve and disconnect the pump.
5. Reassemble the pipe or the breather. The connections must be airtight; therefore use sealing tape on the threads and O-rings in the flanges.

**CAUTION**
Do not energize the transformer earlier than three hours after oil filling in atmospheric pressure. This waiting period is needed to allow air bubbles to disappear.

5.2.2 Filling under vacuum
Oil filling under vacuum is not necessary. If it is to be carried out, the tap-changer and the transformer tank should be put under vacuum simultaneously.

It is assumed that a vacuum-proof conservator is in use.

1. Open the conservator valve, if any.
2. Dismantle the pipe to the breather, or, if simpler, remove the air relief valve or the dehydrating breather.
3. Connect the transformer to the conservator for the tap-changer.
4. Apply vacuum.
5. Connect the oil filling equipment to the oil valve on the tap-changer tank. Open the valve and let oil into the tank until the correct level is shown on the oil level indicator. For correct oil level see section 5.3.
6. Shut the oil valve and disconnect the filling equipment.
7. When filling of the transformer is completed disconnect the vacuum pump and let air into the conservator or expansion volume.
8. Reassemble the pipe or the breather. The connections must be airtight; therefore use sealing tape on the threads and O-rings in the flanges.

5.3 Correct oil level
If possible, the oil levels of the oil conservators of the transformer tank and the tap-changer should be the same. The oil level of the oil conservator of the tap-changer should in no case be higher than the oil level of the transformer oil conservator.

At +20 °C (68 °F), oil is filled to the level where the pointer of the oil level indicator points half-way between MIN and MAX.

For other temperatures than +20 °C (68 °F), proceed as follows:

- For every 13 °C (23 °F) increase of temperature, adjust the oil level upwards a tenth of the scale range of the oil level indicator.
- For every 13 °C (23 °F) decrease of temperature, adjust the oil level downwards a tenth of the scale range of the oil level indicator.
6. Electrical connection and testing

6.1 General
Before the transformer is energized, tests have to be carried out to make sure that all mechanical and electrical connections are correct, and to check the proper functioning of the motor-drive mechanism and the tap-changer.

When testing the transformer, the tap-changer can be operated either by the hand crank or electrically. When operating electrically the drive mechanism is connected as per section 6.2.

6.2 Connecting and testing
For bolted-on design, connect the earthing terminal on the tap-changer to the transformer tank.

Connect the motor supply and the control supply to the correct terminals in the motor-drive mechanism as shown by the circuit diagram supplied with the tap-changer.

Operate the motor-drive mechanism by means of the hand crank to one of the positions in the middle of the range, but not in a through position (= a position with a letter suffix).

Turn the control selector-switch to position LOCAL. Then give an impulse for RAISE operation. If the phase sequence (three-phase supply) is wrong, the motor-drive mechanism will start in LOWER direction. The motor-drive mechanism will stop when it has made approximately half of the complete operation and it will operate back and forth without the tap-changer changing position until the protective motor switch is turned to position “0”. If the phase sequence is wrong, reverse two of the motor supply cables in order to get the correct sequence.

6.3 Electrical tests on transformer
Acceptance tests on the transformer or commissioning can now be performed.

6.4 After energizing

WARNING
The transformer should in no case be energized with an end stop out of order.

6.5 Resistance measurement
If there are any problems with to high resistance during measurement of the transformer, the tap-changer should be operated 10 cycles over all positions to clean the contacts.

Another cause for problems at resistance measurement may be too low measuring current. We recommend a measuring current of at least 50 A.
7. Transport

CAUTION

The motor-drive mechanism must be protected against condensation. Energize the heater when power is available. When not, put drying agent inside the motor-drive cabinet and seal the vents.

7.1 Oil level during transport
The following adjustment of the oil level must be carried out when the tap-changer is to be transported.

CAUTION

Take care to avoid ingestion of moist air when oil is drained. If the ambient air is moist, let incoming air pass through a dehydrating breather with slow air flow to obtain proper dehydration.

7.1.1 Transformer filled with oil
Conservator mounted
The tap-changer should be filled with oil and connected to its conservator.

Conservator dismounted
Drain about 20 % of the oil from the tap-changer. Oil weights according to section 1.3.

Close the opening to the conservator with a transport cover.

UZE with oil expansion volume in the tank
The tap-changer should be filled with oil.

7.1.2 Transformer drained
Conservator mounted
Drain the oil from the tap-changer. Keep the connections to the conservator.

Conservator dismounted
Drain the oil from the tap-changer. Close the opening to the conservator with a transport cover.

UZE with oil expansion volume in the tank
Drain the oil from the tap-changer.
This section describes tasks to be carried out when the transformer is being installed and tested on site.

**CAUTION**

The motor-drive mechanism must be protected against condensation. Energize the heater when power is available. When not available, put drying agent inside the motor-drive cabinet and seal the vents.

8.1 Reassembly
Reassemble the conservator and all other accessories which may have been dismantled for the transport. Remember the O-rings in the flanges.

8.2 Oil filling
See chapter 5.

8.2.1 Dehydrating breather
If the breather has an oil trap, fill oil to the marked level.

8.3 Electrical connection and testing
Do all wiring work and perform the appropriate tests as described in chapter 6.

8.3.1 Motor protection
The function of the protective motor switch should be checked. For three-phase AC motors, remove one of the phase fuses and check the function time of the protective motor switch by a RAISE or LOWER operation. The protective motor switch should release within 60 seconds at a current setting equal to the rated current of the motor at the actual voltage.

If the protective motor switch does not trip within 60 seconds, adjust the current setting. Repeat the test when the motor is cold.

8.3.2 Counter
Check that the counter functions upon RAISE and LOWER operations.

8.3.3 Position transmitter and other multi-position switches
Check the function of the position transmitter and other multi-position switches.

8.3.4 Light
Check that the light is switched on when the door is opened and goes out when the door is closed.

8.3.5 Heater
Switch off all power supplies and feel by hand that the heater has been warmed up during earlier tests. Switch on the power afterwards.

Check that the air vents are open.

Remove the drying agent used during transport.

8.3.6 Pressure relay and other protection devices
Check the function according to instruction 1ZSC000562-AAD.

8.4 Putting into operation
Put the LOCAL/REMOTE switch to REMOTE. Reset the drag hands.

Make sure that no tools or foreign objects are left in the motor drive cabinet. Close the door.
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