Accessories and protection devices for on-load tap-changers
Assortment 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.

ABB makes no warranty or representation and assumes no liability for the accuracy of the information in this document or for the use of such information. All information in this document is subject to change without notice.
Recommended practices

ABB recommends careful consideration of the following factors for maintenance work on safety devices:

■ Before you start any work, make sure that the personnel doing the job have read and fully understood the documents 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.

WARNING, CAUTION and NOTE

<table>
<thead>
<tr>
<th>WARNING</th>
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<tbody>
<tr>
<td>A WARNING provides information that, if disregarded, could cause injury or death.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
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<tbody>
<tr>
<td>A CAUTION provides information that, if disregarded, could cause damage to the equipment.</td>
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</table>

NOTE: A NOTE provides additional information to assist in carrying out the work described.

During drying of the transformer

<table>
<thead>
<tr>
<th>CAUTION</th>
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<tbody>
<tr>
<td>The protection sensors must not be included during the drying process of the transformers, as this risks damaging the apparatus or negatively affecting the function.</td>
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Insulation test of cables

<table>
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<tr>
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<td>If the protection devices are not disconnected during insulation testing of signal cables the following procedure applies:</td>
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- Insulation test 1500-2000 V AC for 1 minute. Prior to the test, all contacts (NO, NC and C) must be connected. At voltage levels < 1500 V AC, testing can be carried out between open contacts.
- Leak-tracing/insulation test 500-2000 V DC. Prior to the test, all contacts (NO, NC and C) must be connected. When testing at a voltage level ≤ of 500 V DC, leak-tracing can be carried out between open contacts.

<table>
<thead>
<tr>
<th>CAUTION</th>
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<tbody>
<tr>
<td>If national or local standards require insulation testing that exceeds the specified parameters, it is recommended that the supplier is contacted before testing is carried out. Otherwise, the product’s function may be affected.</td>
</tr>
</tbody>
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1. Introduction

Standard IEC 60214-1 requires that at least one protection device is supplied with the tap-changer. The device must detect any faults related to the tap-changer as quickly as possible. Sensors detect faults by reacting to high pressure pulses or oil flows that are created in the event of internal failure in the tap-changer.

Fig. 1 schematically shows the position of the sensors on the tap-changer in relation to the transformer and expansion tank.

**NOTE:** If the transformer is painted after the sensors are installed, all ventilation holes on the sensors must be protected.

**NOTE:** All sensors are supplied based on the selection made on the order form.

The sensors are designated their own position on each tap-changer. Figs. 2-7 show where the sensors are to be placed on the relevant tap-changer type.

*Fig. 1. Main parts, on-load tap-changer type UC.*
1.1 Position of the sensors on tap-changers, type UBB

Fig. 2 shows the top section on tap-changer type UBB where the respective position of the sensors are marked. Alternative positions apply to positions A, B and C.

Fig. 2. Top section of on-load tap-changer type UBB.
1.2 Position of the sensors on tap-changers, type UZ

Fig. 3 and 4 show tap-changers type UZE and UZF and where the different sensors are to be placed. In contrast to other tap-changers, the sensors on the UZ types must be placed in the designated position. This is so that all sensors have room on the tank without affecting the function of the tap-changer or sensors negatively.

The insertion depth in the UZ tank is strictly regulated with regard to the electrical fields inside the tap-changer.

Valve for oil filling and filtration (when ordered)
Pressure relief device
Dehydrating of one-way breather
Oil level indicator (with or without alarm)
Thermoswitch housing (when ordered)
Pressure relay
Valve for oil filling, draining and filtration

*Fig. 3. Tank of on-load tap-changer type UZE.*

Valve for oil filling and filtration (when ordered)
Pressure relief device (when ordered)
Flange for oil conservator
Thermoswitch housing (when ordered)
Pressure relay
Valve for oil filling, draining and filtration

*Fig. 4. Tank of on-load tap-changer type UZF.*
1.3 Position of the sensors on tap-changers, type UC

Fig. 5, 6 and 7 show top section on tap-changer type UC and the position of the sensors. Flanges A, B and C are optional valves where inlet tubes and other accessories can be connected.

Fig. 5. Top section of on-load tap-changer type UCG.

Fig. 6. Top section of on-load tap-changer type UCL.
Fig. 7. Top section of on-load tap-changer type UCC/UCD.
2. Pressure relay

2.1 General

ABB on-load tap-changers are supplied with a pressure relay as standard. If connected correctly, the pressure relay trips the transformer main circuit breakers in the event of overpressure inside the OLTC.

It is recommended to connect the pressure relay in the trip circuit of the power supply during testing of the transformer.

![Fig. 8. Pressure relay. Original fit to the left and retrofit part to the right.](image)

2.2 Ratings

<table>
<thead>
<tr>
<th>Auxiliary power</th>
<th>5 A at 125 V AC resistive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 A at 250 V AC resistive</td>
</tr>
<tr>
<td></td>
<td>0.6 A at 125 V DC resistive</td>
</tr>
<tr>
<td></td>
<td>0.15 A at 125 V DC, L/R = 40 ms</td>
</tr>
<tr>
<td>Temperature</td>
<td>Ambient -40 °C to 80 °C</td>
</tr>
</tbody>
</table>

2.3 Before work

**WARNING**

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

Disconnect all power sources before any work is carried out. Check that the power is disconnected by using a voltmeter.

Do not take the transformer into service after a pressure relay trip without carrying out a careful inspection of the on-load tap-changer. An authorized service technician must check all moving contacts and transition resistors as well as other vital parts. Disregarding this instruction may cause severe damage to the on-load tap-changer and the transformer.
The pressure relay is a calibrated safety instrument. It must be handled with care at all times.

### 2.4 Installation

1. Check that the pressure relay is properly fitted to the quick coupling. If not, secure the pressure relay by applying 25 Nm to the coupling.

2. Check that the relay setting corresponds with tap-changer type and the height of the conservator according to table 1.

**NOTE:** Make sure the OLTC is not filled with oil before removing the flange.

#### Table 1. Set-point of the pressure relay.

<table>
<thead>
<tr>
<th>OLTC type</th>
<th>Vertical distance to conservator tank</th>
<th>50 kPa</th>
<th>100 kPa</th>
<th>150 kPa</th>
<th>200 kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>UZ</td>
<td>H &lt; 4 m</td>
<td>4 m &lt; H &lt; 7 m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UB</td>
<td>H &lt; 7 m</td>
<td>7 m &lt; H &lt; 12 m</td>
<td>12 m &lt; H &lt; 17 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UC</td>
<td>H &lt; 7 m</td>
<td>7 m &lt; H &lt; 14 m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UC GSU (^1)</td>
<td>H &lt; 4 m</td>
<td>4 m &lt; H &lt; 7 m (^2)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) GSU = Generator Step Up application.

2) GSU Transformer with converter tank above ≥ 7 m please contact ABB.

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![Fig. 9. Installation.](accessories_0011)
3. Remove the cover from the flange at the indicated position (Figs. 2-7) and install the pressure relay. Make sure that the gasket is correctly fitted.

4. Remove the top cover from the pressure relay by unscrewing the two screws on the top cover. The screws are secured and stay in place if the cover is turned upside down.

5. Connect the cables to the bottom row on the terminal block. Fig. 9.

6. Perform commissioning check described in section 2.5.

2.5 Check at commissioning

**WARNING**
Before any work is started, make sure the power is disconnected.

**Tools**
- Screwdriver 5 mm and 10 mm
- Buzzer
- 500 V DC power unit/insulation tester

2.5.1 Insulation test

**CAUTION**
If the protection devices are not disconnected during insulation testing of signal cables the following procedure applies:

- **Insulation test 1500-2000 V AC for 1 minute.** Prior to the test, all contacts (NO, NC and C) must be connected. At voltage levels < 1500 V AC, testing can be carried out between open contacts.

- **Leak-tracing/insulation testing 500-2000 V DC.** Prior to the test, all contacts (NO, NC and C) must be connected. When testing at a voltage level ≤ of 500 V DC, leak-tracing can be carried out between open contacts.

If national or local standards require testing that exceeds the specified parameters, it is recommended that ABB is consulted before testing is carried out. Otherwise, the product’s function may be affected.

The leakage current test is performed to verify that there is sufficient insulation to earth. All contacts NO, NC and C must be connected during the test. The test must not be performed between each contact to earth.

1. Connect all inputs and outputs (NO, NC and C).
2. Then power with 500 V DC for a maximum of 1 minute.
3. If the pressure relay shows the result < 100 MΩ it must be replaced. See chapter 2.7.
4. If no faults are indicated, continue with the function test.
2.5.2 Function testing

**NOTE:** When function testing the pressure relay, observe caution when the pressure relay’s valve is set to test mode, as there is a risk that a small amount of oil will flow out of the valve.

1. Turn the handle on the valve 90° to the test position. See Fig. 10.
2. Connect an air pump with manometer to the test tap on the pressure relay. The air pump must be able to generate the pressure that the pressure relay is set to.

*Fig. 10. Test mode.*
3. Connect a buzzer to the terminal outputs according to Fig. 11. Test one output at a time.
   - output 61 (NO) with 62 (C) carry out point 4 and 5
   - output 63 (NC) with 62 (C) carry out point 4 and 5
   - output 64 (NO) with 65 (C) carry out point 4 and 5
   - output 66 (NC) with 65 (C) carry out point 4 and 5

Fig. 11. Terminal output.

4. Apply the pressure shown by the pressure relay setting and register whether the switch gives a signal or not. Permitted deviation ± 10 %.

5. Note whether the signal disappears/recurs (NO or NC) when the pressure drops below the setting level. See Table 1.

6. If the pressure relay acts correctly, connect the cables from the control cabinet and reinstall the cover on the pressure relay. Ensure that all gaskets are correctly positioned.

7. Remove the air pump and refit the cover to the test output.

8. Set the valve handle back to service position. Fig. 12.

9. Switch on the power.

Fig. 12.
2.6 Service and trouble-shooting

If the pressure relay has tripped, the tap-changer and/or transformer must be inspected thoroughly. Any faults must be repaired before the transformer resumes operation.

If both tap-changer and transformer work correctly, test the pressure relay according to chapter 2.5.2.

2.7 Replacing the pressure relay

**CAUTION**

_It is not permitted to replace the microswitch or in any other way change the pressure relay settings. If the preset settings are in any way manipulated, this will impair the function of the pressure relay._

If the pressure relay fails to pass the insulation test and/or the function test, the pressure relay must be replaced. This is done without dismounting the valve, and only the pressure relay is replaced.

**Tools required**

- Spanner (30 mm)
- Screwdriver 5 mm and 10 mm

**Spare parts required**

- Pressure relay
- O-ring (17.1 x 1.6 mm)

**WARNING**

_Be aware of the risk of slipping caused by oil spillage, when working on the transformer cover._

1. Set the three-way valve handle in test position (see Fig. 10)
2. Disconnect the cable from the bottom row of the terminal connection and open the cable gland. Pull the cable out through the cable gland.
3. Loosen the quick coupling and remove the pressure relay and the old O-ring inside the quick coupling.

4. Fit the new O-ring (17.1 x 1.6 mm) delivered together with the new pressure relay.

5. Mount the new pressure relay. Tightening torque approximately 20-25 Nm. The cable gland should point 180° opposite the valve handle.

6. Connect the cables.

7. Tighten the cable gland, max 4-5 Nm.

8. Carry out the test procedure according to section 2.5.2.

*Fig. 14. Replacement of pressure relay.*
3. Oil flow relay

3.1 General

The on-load tap-changer may be equipped with an oil flow relay. In the event of overpressure, the oil flow relay responds with a signal that trips the transformer main circuit breakers or gives an alarm.

3.2 Ratings

Voltage
AC 12 V to 250 V
DC 12 V to 250 V

Current
AC 0.05 A to 2 A \( \cos \delta \geq 0.4 \)
DC 0.05 A to 2 A, \( \tau = L/R \leq 40 \text{ ms} \)

3.3 Before work

**WARNING**

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

Disconnect all power sources before any work is carried out. Check that the power is disconnected by using a voltmeter.

Do not take the transformer into service after an oil flow relay trip without carrying out a careful inspection of the on-load tap-changer. An authorized service technician should carry out an inspection of all moving contacts and transition resistors as well as other vital parts. Disregarding this instruction may cause severe damage to the on-load tap-changer and the transformer.
CAUTION
The oil flow relay is a calibrated safety instrument. It must be handled with care and protected against mechanical damage.

3.4 Installation

CAUTION

Never connect two or more tap-changers to the same oil flow relay as this can cause false trip signals.

Pipes must be routed so that oil cannot flow between tap-changers without first passing the conservator.

NOTE: The transformer manufacturer arranges the pipe routing between the conservator and tap-changer device on which the oil flow relay is to be placed.

NOTE: Pipe bends must be avoided as far as is possible to obtain a free flow and prevent air bubbles in the system.

1. The oil flow relay must be positioned on the pipe up to the conservator, as close to the tap-changer as possible.

2. The angle of the pipe and oil flow relay up to the conservator must be between 2° and 4° to prevent air bubbles getting stuck in the pipe.

3. Note the arrows that indicate the direction of flow of the oil flow relay; the arrow should point towards the conservator. Fig. 16.

Fig. 16. Close up of flow direction arrow
4. Make sure that the transport protection on the flanges are removed before the relay is installed on the pipes.

5. Connect the signal cable through the cable gland and connect to the terminal. Tighten the cable union to 4-5 Nm.

6. The cable gland that is not used must have a plug.

3.5 Check at commissioning

**WARNING**

Before any work is started, make sure the power is disconnected.

**Tools**

- Screwdriver 5 mm
- 500 V DC power unit/insulation tester
- Buzzer

3.5.1 Insulation test

The leakage current test is performed to verify that there is sufficient insulation to earth. The test must be performed with all contacts NO, NC and C connected.

1. Start by unscrewing the screws on the cover and removing the cover. If the test is performed from inside the control room, the cover for the oil flow relay does not need to be removed.

2. Connect all inputs and outputs (NO, NC and C).

3. Then power with 500 VDC for a maximum of 1 minute.

4. If the oil flow relay shows the result < 100 MΩ it must be replaced, see section 5.4.

5. If no faults are indicated, continue with function test 3.5.2.
3.5.2 Function testing

The test is performed to ensure that the relay works as it should before the transformer is energized.

1. Remove the cover from the oil flow relay.
2. Unscrew the cover for the test button.
3. Open the cover on the observation hatch so that the lever bridge is visible inside the switch.

Connect a buzzer to the terminal outputs according to the description. Test one output at a time. Repeat the test procedure until all NO / NC contacts have been tested individually. Figs. 18 and 19 show two different switch combinations.

**1 Normally-Open contact and 1 Change-over contact.**
- output 23 (NO) with 24 (C) carry out points 5 - 7.
- output 12 (NC) with 14 (C) carry out points 5 - 7.
- output 11 (NO) with 14 (C) carry out points 5 - 7.

*Fig. 17. Lever bridge*
Fig. 18. 1 NO and 1 change-over contact.

2 Normally-Open contacts
- output 13 (NO) with 14 (C) carry out points 5 - 7.
- output 23 (NO) with 24 (C) carry out points 5 - 7.

Fig. 19. 2 NO contacts.

4. Depress the test button.
5. Note two things:
   - that the signal is correct for the connection made.
   - that the lever bridge inside the switch changes position.
6. Reset the lever bridge to operating mode by turning the test button. If correctly reset the signal disappears/reappears (depending on connection NO or NC).
7. When all signals function as they should, screw the cover back into place.
8. Check that the lever bridge is in operating mode by turning the test button anticlockwise. Do not depress the test button.

**NOTE:** Permitted deviation from the setting is ±15 %.

9. Close the cover for the observation hatch and fit the cover for the test button back into place.
10. Then power the oil flow relay.
11. If the oil flow relay is defective, it must be replaced. Continue with chapter 3.7.
3.6 Service and trouble-shooting

Trouble-shooting the oil flow relay is carried out in the same way as when commissioning according to chapter 3.5.

**CAUTION**

*If the transformer is operated after the oil flow relay has deployed, without opening the tap-changer and making a thorough inspection of the active part and rectifying any faults, this can cause serious damage to the tap-changer and transformer.*

3.7 Replacing oil flow relay

**Tools**

- Oil container/oil drum
- Pump with connection to drain cock on the tap-changer.
- Spanners for disassembling the switch with.

**Procedure**

**CAUTION**

*Note the risk of slipping as oil can leak out from the pipe and onto the transformer cover.*

*Note that the direction of flow must be from the tap-changer to the expansion tank. See the arrow on the switch.*

1. Close the shut-off valve on the pipe to the conservator.
2. Drain oil through the designated valve on the tap-changer. When the oil level has dropped below the oil flow relay, stop draining. It is not necessary to drain the entire tap-changer of oil.
3. Then unscrew the oil flow relay and install the new relay. All gaskets should be replaced. Check that all gaskets are correctly positioned and that all transport protection is removed.
4. Perform tests on the new relay according to chapter 3.5. Wait to perform point 10 until the oil has been pumped back in.
5. Once the new relay has been tested according to 3.5 and no faults have been detected, the amount of oil that was drained from the tap-changer must be refilled. Follow the instructions in the respective tap-changer's installation instructions.
6. After the oil has been pumped back, check that the oil flow relay is in operating mode by turning the test button anticlockwise once.
4. Pressure relief device (PRD)

4.1 General

The on-load tap-changer may be equipped with a pressure relief device (PRD). In the event of overpressure the pressure relief device gives an alarm signal. The pressure relief device is not intended to be the sole protective device on the on-load tap-changer, but should be used together with a pressure relay and/or oil flow relay.

Fig. 20. Pressure relief device Ø 130 mm

Fig. 21. Pressure relief device Ø 50 mm. (The picture showing option with two micro-switches).
4.2 Ratings

Model 208 / 213:
AC 15 A at 125 V, 250 V and 480 V
DC 0.5 A at 125 V, non-inductive
DC 0.25 A at 250 V, non-inductive

Model 206:
AC 6 A at 120 V
AC 3 A at 240 V
DC 0.55 A at 125 V, non-inductive
DC 0.27 A at 250 V, non-inductive

4.3 Before work

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

Disconnect all power sources before any work is carried out. Check that the power is disconnected by using a voltmeter.

Do not take the transformer into service after a pressure relief alarm without carrying out a careful inspection of the on-load tap-changer. An authorized service technician should carry out an inspection of all moving contacts and transition resistors as well as other vital parts before re-commissioning the transformer. Disregarding this instruction may cause severe damage to the on-load tap-changer and transformer.

**CAUTION**
The pressure relief device is a calibrated instrument. It must be handled with care and protected against mechanical damage.

4.4 Installation

**WARNING**
Be aware of the risk of slipping caused by oil spillage, when working on the transformer cover.

1. Remove the protective cover or any previous relief valve from the designated place on the tap-changer. See Figs. 2-7.
2. Install the pressure relief device and ensure that the gasket is correctly positioned.
3. Connect the cable to the junction box.
4.5 Check at commissioning

**WARNING**
Before any work is started, make sure the power is disconnected.

**Tools**
- Screwdriver 5 mm
- 500 V DC Power unit/Megger
- Buzzer/Multimeter

4.5.1 Insulation test
The leakage current test is performed to verify that there is sufficient insulation to earth. The test must be performed with all contacts NO, NC and C connected.
1. Bridge all inputs and outputs (NO, NC and C).
2. Then power with 500 V DC for a maximum of 1 minute.
3. If the pressure relief valve shows the result < 100 MΩ it must be replaced, see section 4.3.
4. If no faults are indicated, continue with function test 4.5.2.

4.5.2 Function test
1. Connect a buzzer or multimeter to one input/output at a time.
2. a) Pressure relief device diameter 130 mm: Depress the test lever that is positioned under the cover just by the junction box. See Fig. 22.
   b) Pressure relief device diameter 50 mm: Press the trigger, see Fig. 23.
3. Note that the signal you get is correct based on the connection diagram.
4. Reset the test lever at Ø 130 mm by pressing the test lever upwards. If correctly reset the signal disappears/reappears depending on connection NO or NC. At Ø 50 mm the switches reset themselves.
5. Repeat the test procedure until all inputs and outputs have been tested individually.
6. When all signals function as they should, fit the cover for the terminal terminals back into place.
7. If the pressure relief device is defective, it must be replaced. Continue with section 4.3.

![Test lever under the cover](image.png)

*Fig. 22. Directions of test at Ø130 mm.*
4.6 Trouble-shooting

**NOTE:** If the pressure relief device has deployed, the indication pin must be in the raised position.

Follow the instructions in chapter 4.5.2.

4.7 Replacing

1. If the pressure relief valve is deemed faulty, it must be replaced. When replacing the pressure relief device, follow the description in chapter 4.3 and 4.5.

2. A faulty device must be returned to ABB.
5. Oil level indicator

5.1 General
The oil level indicator is used as a supplement to other sensors, primarily on tap-changer type UZ.

![Fig. 25.](accessories_0027)

5.2 Ratings
- AC 15 A at 125 V, 250 V and 480 V
- DC 0.5 A at 125 V, non-inductive
- DC 0.25 A at 250 V, non-inductive

5.3 Before work

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

Disconnect all power sources before any work is carried out. Check that the power is disconnected by using a voltmeter.

**CAUTION**
The oil level indicator is a calibrated monitoring instrument. It must be handled with care and protected against mechanical damage.

5.4 Installation
1. Install the oil level indicator in the designated place according to chapter 1.
2. Note the insertion depth on the float when installing on tap-changer type UZ.
3. Connect the signal cables to the terminal box.
4. Check the function by carefully moving the float up and down according to Fig. 25.
5.5 Check at commissioning

**WARNING**

Before any work is started, make sure the power is disconnected.

**Tools**
- Screwdriver 5 mm
- 500 V DC Power unit/Megger
- Buzzer/Multimeter

5.5.1 Insulation test

The leakage current test is performed to verify that there is sufficient insulation to earth. The test must be performed with all contacts NO, NC and C connected.

1. Connect all inputs and outputs (NO, NC and C).
2. Then power with 500 V DC for a maximum of 1 minute.
3. If the oil level indicator shows the result < 100 MΩ it must be replaced.

**Fig. 26.**
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