Live Tank Circuit Breakers
Buyer’s Guide -
Section BLG operating mechanism
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ABB is the supplier of cutting edge technology

Our task is to help our customers to a more reliable power grid and sustainable society at large. This is why we always strive for the leading position in research and development. ABB has all the experience necessary for successful development of power transmission technology.

This Buyer’s Guide concerns one of our true specialty areas – high voltage circuit breakers – an area in which we are constantly striving to improve product performance that delivers real customer value. What has pushed development forward has been the capability to increase availability at our customers’ installations by supplying reliable high voltage equipment.

Development is a team effort
Our development team consists of highly qualified and experienced technicians with expert knowledge in, for example, plasma physics, materials physics, gas dynamics, mechanics and high voltage technology. We also collaborate with others with expert knowledge and skills, both at ABB and externally.

An important aspect of development work is our close dialog with customers, which enables us to find out about their experiences. Customers who demand more of our products give us the best platforms to realize new innovations.

Thought leadership
Our design work with constant improvements and simplification of our products have resulted in: 550 kV circuit breakers without grading capacitors; the Motor Drive with a servo motor system that accurately controls and monitors the contact operation and the LTB D1 and E1 circuit breakers with MSD operating mechanism that provide fast and simple installation at site.

Other milestones:
- 80 kA with only two breaking chambers per pole
- The DCB concept that enables smarter, safer and greener substations
- Excellent earthquake performance suitable for seismic regions
- The eco-efficient CO₂ circuit breaker LTA

New technology requires careful testing.
ABB’s high power laboratory is among the world’s most modern and best equipped labs for switchgear technology, with facilities for testing circuit breakers with rated voltages of up to 1200 kV and breaking currents of up to 80 kA.
## Live Tank Circuit Breakers

ABB has a complete portfolio and well proven technology for high voltage circuit breakers used in a number of applications.

<table>
<thead>
<tr>
<th>Standards</th>
<th>LTB D1 72.5 – 170</th>
<th>LTB E1 72.5 – 245</th>
<th>LTB E2 362 – 550</th>
<th>LTB E4 800</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>72.5 – 170 kV</td>
<td>72.5 – 245 kV</td>
<td>362 – 550 kV</td>
<td>800 kV</td>
</tr>
<tr>
<td>Rated current</td>
<td>up to 3150 A</td>
<td>up to 4000 A</td>
<td>up to 4000 A</td>
<td>up to 4000 A</td>
</tr>
<tr>
<td>Circuit-breaking capacity</td>
<td>up to 40 kA</td>
<td>up to 50 kA</td>
<td>up to 50 kA</td>
<td>up to 50 kA</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-30 – +40 ºC</td>
<td>-30 – +40 ºC</td>
<td>-30 – +40 ºC</td>
<td>-30 – +40 ºC</td>
</tr>
</tbody>
</table>

The circuit breakers can also be supplied for ambient temperatures down to -60 or up to +70 ºC.

<table>
<thead>
<tr>
<th>Standards</th>
<th>HPL 72.5 – 300</th>
<th>HPL 362 – 550</th>
<th>HPL 800</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>72.5 – 300 kV</td>
<td>362 – 550 kV</td>
<td>800 kV (*)</td>
</tr>
<tr>
<td>Rated current</td>
<td>up to 4000 A</td>
<td>up to 4000 A</td>
<td>up to 4000 A</td>
</tr>
<tr>
<td>Circuit-breaking capacity</td>
<td>up to 80 kA</td>
<td>up to 80 kA</td>
<td>up to 80 kA</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-30 – +40 ºC</td>
<td>-30 – +40 ºC</td>
<td>-30 – +40 ºC</td>
</tr>
</tbody>
</table>

(*) Up to 1200 kV on request

The circuit breakers can also be supplied for ambient temperatures down to -60 or up to +70 ºC.
As a complement to the basic versions of our circuit breakers, which are primarily designed for conventional substation solutions, there is a disconnecting circuit breaker configuration with the disconnecting function integrated into the breaking chamber. A safe interlocking system, composite insulators and a motor-driven grounding switch provide personal safety.

<table>
<thead>
<tr>
<th>DCB LTB 72.5</th>
<th>DCB LTB 145</th>
<th>DCB HPL 170-300</th>
<th>DCB 362-550</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standards</td>
<td>IEC</td>
<td>IEC</td>
<td>IEC</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>72.5 kV</td>
<td>145 kV</td>
<td>170 - 300 kV</td>
</tr>
<tr>
<td>Rated current</td>
<td>up to 3150 A</td>
<td>up to 3150 A</td>
<td>up to 4000 A</td>
</tr>
<tr>
<td>Circuit-breaking capacity</td>
<td>up to 40 kA</td>
<td>up to 40 kA</td>
<td>up to 50 kA</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-30 – +40 ºC</td>
<td>-30 – +40 ºC</td>
<td>-30 – +40 ºC</td>
</tr>
</tbody>
</table>

The disconnecting circuit breakers can also be supplied for other data on request.
For more information about DCBs, please see Application Guide 1HSM 9543 23-03en
Installations with ABB Live Tank Circuit Breakers

LTB 420 E2 with current transformer IMB. Installation in Denmark.

Substation in Oman with desert climate. ABB equipment with LTB 145.

Disconnecting circuit breaker LTB DCB for 72.5 kV installed at a windfarm in Sweden.

Disconnecting circuit breaker HPL DCB for 420 kV installed in a switching station in Sweden.

Disconnecting circuit breaker LTB DCB for 145 kV with the operating mechanism Motor Drive installed at refurbishment in Norway.

1100 kV by-pass switch in series compensation installation in China.
ABB has over a century of experience in developing, testing and manufacturing high voltage circuit breakers. Through the years, our circuit breakers have acquired a reputation for high reliability and long life in all climates and in all parts of the world.

Our apparatus are manufactured in a workshop where we continuously are working with improvements regarding quality, work environment, environment and safety.

### Product range

<table>
<thead>
<tr>
<th>Product range</th>
<th>Type</th>
<th>Maximum rated voltage (kV)</th>
<th>Maximum rated current (A)</th>
<th>Maximum rated breaking current (kA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit Breaker LTB</td>
<td>LTB D1/B</td>
<td>170</td>
<td>3150</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>LTB E1</td>
<td>245</td>
<td>4000</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>LTB E2</td>
<td>550</td>
<td>4000</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>LTB E4</td>
<td>800</td>
<td>4000</td>
<td>50</td>
</tr>
<tr>
<td>Circuit Breaker HPL</td>
<td>HPL B1</td>
<td>300</td>
<td>5000</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>HPL B2</td>
<td>550</td>
<td>5000</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>HPL B4</td>
<td>800 (*)</td>
<td>4000</td>
<td>80</td>
</tr>
</tbody>
</table>

*) Up to 1200 kV on request

Other data and/or special applications not covered in this Buyer’s Guide will be quoted on request.

### How to interpret the type designations

The circuit breaker type designations are for simplicity reasons not always given in full in this document. The product portfolio basically consists of three product groups:

- LTB xxxD1/B (a single-unit circuit breaker)
- LTB xxxEy (a single-, two- or four-unit circuit breaker)
- HPL xxxBy (a single-, two- or four-unit circuit breaker)

Circuit breakers of type LTB are SF₆ gas circuit breaker of self-blast design while circuits-breakers of type HPL are SF₆ puffer circuit breakers.

In the full type designation xxx indicates the rated voltage and y indicates number of series connected breaking units per pole. In this document where the circuit breakers are described in general the voltage designations as well as the number of series connected breaking units are omitted.

### Other informations

For information about Compact air insulated HV switchgear solutions with Disconnecting Circuit Breaker, please see separate Application Guide.

Catalogue publication 1HSM 9543 23-03 en.

Further information about controlled switching applications and Switchsync™ controllers is found in Controlled Switching, Buyer’s Guide/Application Guide.

Catalogue publication 1HSM 9543 22-01en.

Information about the new CO₂ insulated high voltage circuit breaker LTA is found in brochure 1HSM 9543 21-06en.
Introduction

Demands on the reliability of power transmission networks are increasing continuously. As such, today many customers strongly focus on the reliability and maintenance requirements of system equipment.

Circuit breakers are the last link in a chain of apparatus that form the protection equipment for a power supply system. Within a few milliseconds an operating mechanism must supply the energy needed to transform the circuit breaker from a perfect conductor to a perfect insulator. A failure in the operating mechanism often means a failure in the total breaking operation. Thus, operating mechanisms play a major role of the reliability of the circuit breaker and, thereby, of the total power supply system.

In addition, capacitor bank and reactor switching applications, which impose added requirements on operational endurance, are becoming more common.

In an international investigation it was shown that eighty percent (80%) of all failures in high voltage circuit breakers originated in the operating mechanism. Therefore, to achieve highest operational reliability, circuit breakers should be equipped with highly reliable operating mechanisms.

With over 55,000 BLG operating mechanisms delivered, ABB is confident that the design is one of the most reliable on the market.

The design ensures a high degree of total reliability and minimal need for maintenance for the operating mechanism and, thus, the circuit breaker as a whole.

Applications

The BLG spring operating mechanisms are used for the following types of circuit breaker:

- HPL B
- LTB E1 (three-pole operated)
- LTB E2
- LTB E4

Design features

The closing springs in the mechanism generate the required driving force to close the breaker and charge the opening spring.

The opening springs are part of the circuit breaker’s link system and placed underneath the mechanism housing. This means that the mechanical energy needed for the vital opening operation is always stored in the opening spring when the circuit breaker is in closed position. In other words, a closed breaker is always prepared for immediate opening.

A universal motor(s) drive(s) the spring charging gear, which automatically charges the closing springs immediately after each closing operation. The springs are kept in the charged state by a latch that is released when the breaker is being closed. This enables rapid reclosing of the breaker after a dead time interval of 0.3 s.

The principle of the operating mechanism can be briefly described as follows: an endless chain links a cam disc and a set of springs. The chain, which is in two loops and runs over a motor-driven sprocket, transmits energy when the springs are being charged and drives the cam disc around when the circuit breaker is to be closed. During its rotation the cam disc actuates a link that converts the rotating motion into a linear motion.

The trip and closing latches are identical, fast acting and vibration proof.
A damping device is included to retard the motion of the contact system in the end positions.

The auxiliary equipment is characterized by the following:

- Robust auxiliary contacts and limit switches
- Mechanical indication of charged, partly charged or discharged closing spring.
- All electrical wiring used for external connections is brought to terminal blocks.

Consistent operating times for all environmental conditions which make the circuit breaker suitable for controlled switching.

**Interlocking against unintentional operation**

Interlocking is achieved partly electrically and partly mechanically. Electrical interlocking is achieved by having the circuits of the operation coils connected through the auxiliary contacts of the operating mechanism. In addition, the closing coil is connected through a limit switch that is controlled by the position of the spring bridge. In this way the closing circuit is only closed when the breaker is in the open position and the closing springs are fully charged.

Based on the above interlocking design, the following operations are not possible when in service:

- Closing operation when the breaker is already closed (i.e. a “blind” stroke)
- Closing operation during an opening operation

**BLG housing**

- Corrosion resistant housing of painted aluminum of 2 mm thickness.
- Front and back doors equipped with doorstops and provisions for padlock on door handles.
- Insulated doors and walls for low energy consumption and low noise level.

**Panels**

Below the front door there is a panel, with a transparent shutter, that may be equipped differently, depending on customer specific requirements. As a standard, the following equipment is included on the control panel:

- Local open / close switch
- Local / remote / disconnect selector switch
- Electromechanical operations counter – non-resettable
- Mechanical spring charge indicator – visible through the transparent shutter

Behind the rear door of the operating mechanism housing there is an interface panel containing all necessary terminal blocks for customer connections. As a standard, the following equipment is included:

- Standard terminal blocks of compression type (in which a bare wire is compressed between two metallic plates in the terminal)
- Interlocking for hand spring charging
- Control equipment – such as relays, MCBs, contactors etc.
- Auxiliary contacts

On the backside of the rear door there is a compartment for documents with instruction manual and final drawings. A hand crank is also attached.

**Central Control Cubicle (CCC)**

When the circuit breaker is single-pole operated a Central Control Cubicle (CCC) is used when the circuit breaker is locally three-pole operated. The CCC will be delivered by ABB or arranged by the customer, from case to case. We are open for discussions how to arrange the solution.
Closed position
In the normal service position of the circuit breaker (B), the contacts are in closed position, with closing- (5) and opening spring (A) charged.

The breaker is kept in the closed position by the opening latch (1), which takes up the force from the charged opening spring.

The mechanism is now ready to open upon an opening command and can carry out a complete fast auto-reclosing (0 - 0.3 s - CO) cycle.

Opening operation
When the breaker is being opened, the latch (1) is released by the tripping coil.

The opening spring (A) pulls the breaker (B) towards the open position. The operating lever (2) moves to the right and finally rests against the cam disc (3).

The motion of the contact system is damped towards the end of the stroke by an oil-filled damping device (4).
**Closing operation**

When the breaker is being closed, the closing latch (6) is released by the closing coil.

The sprocket (7) is locked to prevent rotation where upon the operating energy in the closing springs is transferred via section (8) of the endless chain to the sprocket (11) belonging to the cam disc (3).

The cam disc then pushes the operating lever (2) towards the left where it is locked in its end position by the tripping latch (1).

The last part of the rotation of the cam disc is damped by the damping device (9) and a locking latch on the sprocket (11) again takes up the initial position against the closing latch (6).

**Charging of the closing springs**

The breaker has closed; the motor starts and drives the sprocket (7).

The sprocket (11) belonging to the cam disc (3), has its catch locked against the closing latch (6), whereupon the sections of the chain (8) raise the spring bridge (10).

The closing springs (5) are thereby charged and the mechanism again takes up its normal operating position.
The design of BLG is a well-proven technology (more than 55,000 units are in service). This proven technology is efficiently combined with modern manufacturing methods. This ensures a high degree of total reliability for the circuit breaker and a minimal need of maintenance. Mechanical life tests have been performed with 10,000 operations.

BLG is the answer to the demands of today and tomorrow and designed for widely shifting conditions, from polar to desert climate.

### Brief performance data

<table>
<thead>
<tr>
<th>Installation</th>
<th>Outdoor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>Spring operated</td>
</tr>
<tr>
<td>For circuit breaker</td>
<td>LTB E1 (Three-pole operated)</td>
</tr>
<tr>
<td></td>
<td>LTB E2</td>
</tr>
<tr>
<td></td>
<td>LTB E4</td>
</tr>
<tr>
<td></td>
<td>HPL B</td>
</tr>
<tr>
<td>Service conditions:</td>
<td>-55 °C to +40 °C</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>(Other on request)</td>
</tr>
</tbody>
</table>

BLG Spring Operating Mechanism
Technical information

Material
The housing is made of corrosion resistant, painted aluminum.
Front and back doors are equipped with doorstops and pad lock provisions on door handles.
The doors and walls are insulated for low heat energy consumption and low noise level.

Rating plates
A rating plate, which includes data for the circuit breaker, is placed on the side of the cabinet.
The rating plate is made of stainless steel with engraved text.

Instructions
With each delivery of circuit breakers, there is an extensive product manual that will guide the user how to handle the apparatus during its lifetime. Instructions, product manual, circuit diagram and other documents are placed in a compartment inside the back door of the operating mechanism.

Transport
BLG is normally packed and transported in a separate seaworthy wooden box.

Arrival inspection - Unpacking
Please check the contents and packaging with regard to transport damage immediately on arrival. In the event of any material missing or damage to the goods, contact ABB for advice, before further handling of the goods takes place. Any damage should be documented (photographed).
The operating mechanism must be lifted using the lifting eyes on top of the cabinet. Slings must not be placed around the cabinet when lifting.

All packing material can be recycled.

Storage
The operating mechanism shall preferably be stored indoors in a dry building. When stored outdoors the internal heater should be used to prevent condensation.

If it is planned to store the unit, an external connection to the internal heater is provided.

Tools
Special tools for assembling and service are placed on the backside of the rear door.

Maintenance
The maintenance requirements are small, as BLG is designed for a service life of more than 30 years. Normally it is sufficient with ocular inspection every 1–2 years. Preventive inspection is recommended after 15 years or 5 000 operations. A more detailed check is recommended after 30 years of service or 10 000 operations.

Overhaul and repair work must be performed by authorized personnel only.
The instructions in the manual for operation and maintenance should be observed. This ensures a continued problem-free operation.

Disposal
The disposal should be carried out in accordance with local legal provisions.
The metals used in BLG can be recycled.
BLG
Electrical functions

The principle function of the mechanism’s electrical components is shown in the elementary diagram on next page.

Closing circuit
The closing coil (Y3) can be activated electrically by means of local or remote control. When the circuit breaker is in closed position, the closing circuit is interrupted by the auxiliary contact (BG).

Tripping circuits
The mechanism is provided with two independent trip coils (Y1 and Y2). The mechanism can be operated electrically through local or remote control. With the circuit breaker in the open position, the tripping circuits are interrupted by the auxiliary contact (BG).

Interlocks
The contact on the density switch (BD) actuates the auxiliary relays (K9, K10), which block the operating impulse if the density of the SF₆ gas is too low. The antipumping relay (K3) blocks any remaining closing impulse after the breaker has completed a closing operation.

The density of the SF₆ gas and condition of the operating mechanism is monitored electrically, given the following (remote) indications:
- Topping up of SF₆ gas is recommended (alarm level)
- Density of the SF₆ gas is too low (blocking level)
- Indication of charged springs

Heater circuits
The operating mechanism is provided with an anti-condensation heater.

To ensure reliable operation at low temperatures the mechanism is provided with a thermostat-controlled heater unit (BT1, E2).

Alternatively, in climatic conditions with high humidity, the mechanism can be provided with moisture detector.

Terminal blocks
The terminal blocks are the user’s interface to the control circuits and connect the internal wiring.

Standard terminal blocks are compression type in which a bare wire end is compressed between two metallic plates in the terminal.

Circuits for supply to control, motor and AC auxiliaries are normally connected to 6 mm² disconnectable terminals. (Entrelec M6/8.STA)

The signal circuits are connected to 4 mm² through-terminals. (Entrelec M4/6)

All terminals can be protected with a transparent cover.

Internal wiring
The cabling in the operating mechanism is normally carried out with PVC-insulated cables.

The dimensions are 2.5 mm² for motor-circuits and 1.5 mm² for control- and auxiliary-circuits.
### Electrical functions

#### Control circuits
- **BD**: Signal contact of density switch
- **BG**: Auxiliary contact
- **BT1**: Thermostat
- **BW**: Limit switch
- **E1, E2**: Heater
- **F1, F1.1**: Direct-on-line motor starter (MCB)
- **F2**: Miniature circuit breaker, AC auxiliary circuit
- **K3**: Anti-pumping relay
- **K9, K10**: Interlocking relay, trip, close

**SPO** = Single-pole operated  
**TPO** = Three-pole operated

#### Circuit diagram

The circuit diagram shows the operating mechanism when the circuit breaker is in normal service condition, i.e., pressurized, closing spring charged, in closed position, in motor charging position, and with the selector switch in remote position.

Two motors are used in the BLG when larger spring energy is required.

**N** = Neutral  
**L** = Live
**Motor**

Universal motor\(^*\) for 110 – 125 or 220 – 250 V, AC or DC

<table>
<thead>
<tr>
<th>Rated voltage</th>
<th>Starting current peak value (max)</th>
<th>Normal Current at DC (approximately)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>110</td>
<td>20 - 40 **</td>
<td>12 - 30 ***</td>
</tr>
<tr>
<td>220</td>
<td>10 - 30 **</td>
<td>6 - 15 ***</td>
</tr>
</tbody>
</table>

* Please note that the motor contactor is either AC or DC type.
** Depending on power source. Peak value during first 0.1 s is in general 3 times charge current.
*** Depending on spring setup.

**Spring charging time**

\[ \leq 15 \text{ s} \]

**Operating coils**

<table>
<thead>
<tr>
<th>Operating coils</th>
<th>Rated voltage</th>
<th>Power consumption (approximately)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>V (DC)</td>
<td>W</td>
</tr>
<tr>
<td>Closing</td>
<td>110 - 125</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>220 - 250</td>
<td></td>
</tr>
<tr>
<td>Tripping</td>
<td>110 - 125</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>220 - 250</td>
<td></td>
</tr>
</tbody>
</table>

**Auxiliary contacts**

<table>
<thead>
<tr>
<th>Rated voltage</th>
<th>Rated current</th>
<th>Making current</th>
<th>Breaking current</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>V</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>110</td>
<td>25</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>220</td>
<td>25</td>
<td>10</td>
<td>2</td>
</tr>
</tbody>
</table>

The operating mechanism normally includes 9 NO and 11 NC spare auxiliary contacts.
If TCS is provided the operating mechanism normally includes 9 NO and 9 NC spare auxiliary contacts.

**Heating elements**

<table>
<thead>
<tr>
<th>Rated voltage</th>
<th>Power consumption at -40 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Continuously connected</td>
</tr>
<tr>
<td>V (AC)</td>
<td>W</td>
</tr>
<tr>
<td>110 - 127</td>
<td>70</td>
</tr>
<tr>
<td>220 - 254</td>
<td>70</td>
</tr>
</tbody>
</table>

\(^{*)}\) 2 x 140 W for -55 °C

The voltage range for motor, control and auxiliaries fulfills the requirements according to IEC and ANSI C37 standards.

Other ratings for motor, coils, auxiliary contacts and heating elements can be provided.
BLG

Design data

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions (mm)</td>
<td>682 x 760 x 1747</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>465</td>
</tr>
<tr>
<td>Material of housing</td>
<td>Aluminium</td>
</tr>
<tr>
<td>Thickness (mm)</td>
<td>2</td>
</tr>
<tr>
<td>Color</td>
<td>Grey, RAL 7032</td>
</tr>
<tr>
<td>Temperature range (°C)</td>
<td>-55 to +40</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>As per IEC 60529: IP 55</td>
</tr>
<tr>
<td>Terminal blocks</td>
<td>Supply, motor and AC circuits, disconnectable 6 mm² block.</td>
</tr>
<tr>
<td></td>
<td>Signal circuits through 4 mm² block.</td>
</tr>
<tr>
<td>Cable connection (mm)</td>
<td>Size FL 33: 102 x 306</td>
</tr>
<tr>
<td>Earthing clamp</td>
<td>For conductors with maximum 13 mm diameter</td>
</tr>
<tr>
<td>Internal cable</td>
<td>Motor circuits 2.5 mm² PVC-insulated cable.</td>
</tr>
<tr>
<td></td>
<td>Otherwise 1.5 mm² PVC-insulated cable.</td>
</tr>
</tbody>
</table>

BLG

Front View

Side View

Bottom View

Cable Entry Flange (FL 33)
BLG
Design data

Optional equipment
- Manual mechanical trip push-button -
  Inside or outside cubicle
- Additional auxiliary contacts - 6 NO + 6 NC
- Trip circuit supervision
- Internal light with door switch
- Socket outlet
- Position indicating lights
- Extra heater - Moisture detector control
- Provision for key interlock (Castell, Fortress or Kirk)
- Extra closing coil
- Lockable operating switches
- Protective cover for terminal block

Tests
The BLG mechanism has together with the corresponding circuit breaker, passed type tests in accordance with applicable IEC and ANSI standards.

Mechanical life tests have been performed with 10,000 operations.

Before delivery each operating mechanism together with the corresponding circuit breaker has to pass routine tests according to current standards.

For each circuit breaker together with its operating mechanism a routine test report is issued showing the actual test result.

Recommended spare parts for BLG
Applicable for circuit breakers for frequent switching duty, e.g. switching capacitor- or reactor-banks.

- Catchgear with closing coil (or separate coil)
- Catchgear with tripping coils (or separate coil)
- Heater
- Motor with driving unit
- Motor contactor
- Auxiliary relays
Quality control and testing

Quality
ABB High Voltage Products in Ludvika has an advanced quality management system for development, design, manufacturing, testing, sales and after sales service as well as for environmental standards, and is certified by Bureau Veritas Certification for ISO 9001 and ISO 14001.

Testing resources
ABB has the facilities for carrying out development tests, type tests and routine tests on the circuit breakers. The laboratories for testing are located in Ludvika close to the factories and the offices for development, design and planning.

With these testing resources ABB is in the forefront in developing new and safe products for the 21st century.

Type tests
The High Power Laboratory is owned by ABB and has facilities for high power tests, temperature rise tests and mechanical tests. It is also accredited by SWEDAC (Swedish Board for Technical Accreditation).

In the STRI AB laboratory, mainly high voltage tests, environmental and special long time duration tests are carried out.

In both laboratories tests in accordance with the requirements stipulated in the international standards IEEE and IEC can be performed. It is also possible to carry out special tests specified by our customers.

The High Power Laboratory as well as STRI has status of independent laboratory and both are members of SATS (Scandinavian Association for Testing of Electric Power Equipment), which in turn is a member of STL (Short Circuit Testing Liaison).

STL provides a forum for international collaboration between testing organizations.

Routine tests
The routine tests are part of the process of producing the circuit breakers and are always performed with the same test procedures, irrespective whether or not the tests are witnessed by the client’s representative.

The circuit breaker pole or poles are tested together with the corresponding operating mechanism.

For single-pole operated circuit breakers type HPL B and LTB E, the routine tests are always individually performed for each pole.

Circuit breakers type LTB D and three-pole operated circuit breakers type HPL and LTB E are always routine tested as complete three-phase units.

In general, the routine tests are performed according to IEC or ANSI/IEEE standards.

The main routine tests steps with respect to IEC, IEEE and ABB standards are summarized in the table below.

The entire routine tests for each circuit breaker is documented in a detailed routine test report, generated by the computerized testing system. After verification by the ABB certified test supervisor, this report is provided to the customer as part of the order documentation.

<table>
<thead>
<tr>
<th>Summary of routine tests</th>
<th>IEC</th>
<th>IEEE</th>
<th>ABB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nameplate and design check</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Resistance measurement (Components in auxiliary and control circuits)</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Function check of auxiliary and control circuits</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Mechanical operating test</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Resistance measurement (Main circuit)</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Dielectric test (Auxiliary and control circuit)</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Overpressure test</td>
<td>N/A</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Dielectric test (Main circuit)</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Tightness test</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Description
A summary description of the ABB production and routine tests process is provided in the brochure 1HSM 9543 21-03. A detailed description of the routine tests is given in the document 1HSB 4154 09-646.
Processes and support

The circuit breaker organization is process-oriented with focus on deliveries to customers. The process is continuously optimized with respect to time and quality.

Sales and Order handling
In order to assure that the deliveries fulfill the requirements in the Purchase Order (P.O.) special attention is focused on:

- Assuring the hand over of the P.O. from the Sales to the Order department.
- Order clarification, assuring the particular tasks of order, order design, purchasing and production departments.
- Possible order modifications.

The tools to monitor the orders are continuously improved in order to give our customers the best possible service.

Supply management and Purchasing
The circuit breaker unit has well defined processes for selection and approval of suppliers.

Special attention is addressed to audits at the suppliers plant, the manufacturing, Inspection and Test Plan (ITP) and the On Time Delivery (OTD) monitoring.

The suppliers are evaluated continuously with respect to quality and ODT.

Production and Assembly
All employees are trained and certified with respect to their responsibilities.

Inspections and test plans together with inspection records and control cards have been prepared for all circuit breakers in order to assure that all activities and the assembly are performed according to the specification.

Service and Spares
The circuit breaker unit takes care of the customer’s requirements with respect to service and spare parts. Certified traveling service engineers are available at the plant in Ludvika. Also, in order to be able to assist our customers as fast as possible, local service centers are established in several parts of the world.

In case of emergencies a 24-hour telephone support is available (ph.: +46 70 3505350).

By calling this number customers will get in touch with one of our representatives for immediate consultation and action planning.

Research and Development
The R&D process is utilizing a project management model with well-defined gates in order to assure that all customer requirements and technical issues are addressed.
As a minimum the following information is required and can preferably be copied and sent along with your inquiry.

### PROJECT DATA
- End customer
- Name of project
- Standard / Customer specification
- Number of circuit breakers
- Delivery time

### APPLICATION
- Line
- Transformer
- Reactor banks
- Capacitor banks
- Other service duty
- Number of operations per year

### SYSTEM PARAMETERS
- Rated voltage
- Rated frequency
- Rated normal current
- Maximum breaking current
- LiWL (Lightning impulse 1.2/50 μs)
- SiWL (Switching impulse 25/2500 μs, for $U_{in} \geq 300$ kV)
- Power frequency withstand voltage
- Grounded / Ungrounded neutral

### AMBIENT CONDITIONS
- Ambient temperature (max - min)
- Altitude (m.a.s.l.)
- Earthquake withstand requirements

### BASIC MECHANICAL PARAMETERS
- Three-pole / Single-pole operation
- Preinsertion resistors (PIR) for line circuit breakers
- Type of high voltage terminal (IEC/NEMA/DIN)
- Insulator material (porcelain or composite)
- Insulator color
  - Porcelain: brown or gray
  - Composite: only gray
- Minimum creepage distance mm or mm/kV
- Phase distance (center-to-center)
- Support structure (height)
As a minimum the following information is required and can preferably be copied and sent along with your inquiry.

<table>
<thead>
<tr>
<th>OPTIONAL MECHANICAL PARAMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bursting discs</td>
</tr>
<tr>
<td>Bracket for CT</td>
</tr>
<tr>
<td>Primary connections CB – CT</td>
</tr>
<tr>
<td>Manual trip</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DATA FOR OPERATING MECHANISM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control voltage (Coils and relays)</td>
</tr>
<tr>
<td>Motor voltage</td>
</tr>
<tr>
<td>AC-voltage (heaters, etc.)</td>
</tr>
<tr>
<td>Number of free auxiliary contacts</td>
</tr>
<tr>
<td>Special requirements</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ACCESSORIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF₆ gas for pressurizing</td>
</tr>
<tr>
<td>Gas filling equipment</td>
</tr>
<tr>
<td>Controlled Switching (Switchsync™)</td>
</tr>
<tr>
<td>Condition monitoring (OLM)</td>
</tr>
<tr>
<td>Test equipment</td>
</tr>
<tr>
<td>- SA10</td>
</tr>
<tr>
<td>- Programma</td>
</tr>
<tr>
<td>Tools</td>
</tr>
<tr>
<td>Spare parts</td>
</tr>
</tbody>
</table>

NOTE! For information regarding the parameters asked for see chapter “Explanation”.