ORMAZABAL
velatia

Vacuum circuit-breaker

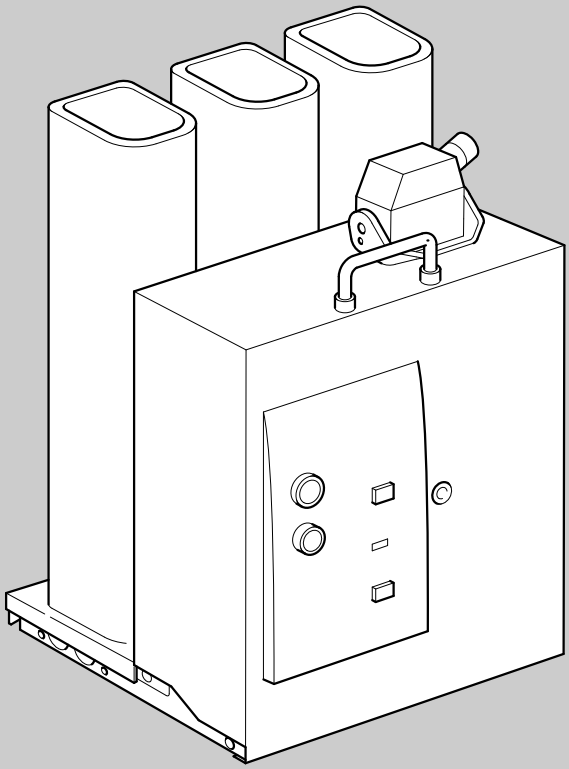
Type NVL

12 kV, ...2500 A, ...31.5 kA

17.5 kV, ...2500 A, ...31.5 kA

24 kV, ...1250 A, ...25 kA

OPERATING INSTRUCTIONS



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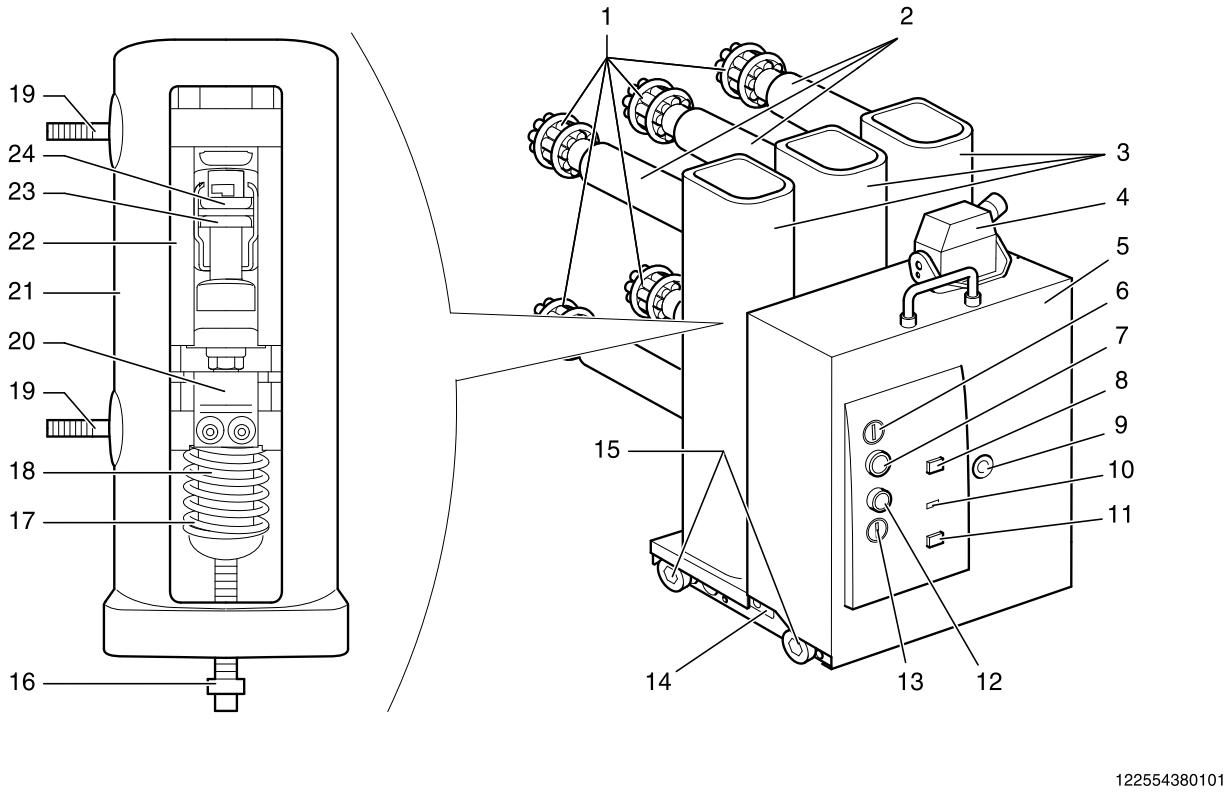
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Fig. 1

1	Isolating contacts (optional)
2	Contact arms (optional)
3	Breaker poles
4	Plug-in connector for control and record leads
5	Outer casing
6	Lock to lock the push-button ON (optional)
7	Push-button ON (I)
8	Indication for spring accumulator (tensioned - relieved)
9	Manual winding up of spring accumulator
10	Operations counter
11	Position indicator (O= OFF, I=ON)
12	Push-button OFF (O)
13	Lock to lock the push-button OFF (optional)
14	Earth terminal
15	Trolley rollers (optional)
16	Insulating switchstick
17	Pole insulation spring
18	Impact sleeve with internal contact pressure spring
19	Upper or lower connection
20	Flexible connector
21	Insulating enclosure
22	Vacuum interrupter chamber
23	Movable switching contact
24	Fixed switching contact

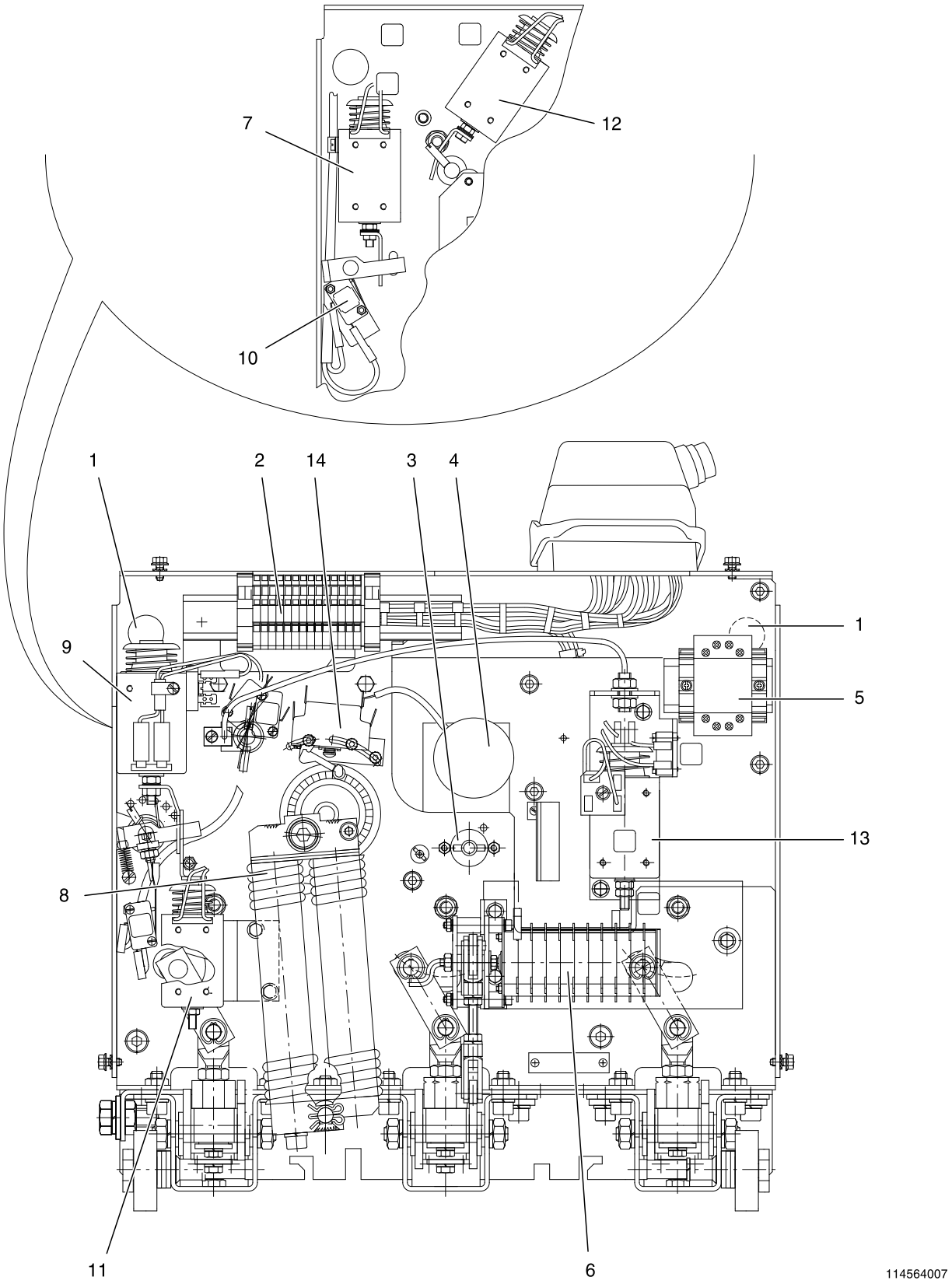

Fig. 2

1	Transport suspension
2	Terminal strip
3	Manual wind-up
4	Stored energy spring mechanism motor
5	Anti-pumping relay
6	Auxiliary switch
7	1. trip element OFF
8	Closing spring
9	2. trip element OFF
10	Fleeting contact switch message OFF
11	3. trip element OFF
12	Trip element ON
13	Electric closing lock-out
14	Control switch for motor drive and spring accumulator

1 General

1.1 Liability and warranty

All information and notes concerning operation and maintenance of the circuit-breaker are provided under due consideration of our present experience and to the best of our knowledge.
This manual describes the standard circuit-breaker NVL.

All technical information and data contained in these operating instructions are up to date at the day of printing. We reserve the right for technical changes in course of further development without changing these instructions.

No claims can therefore be raised on the basis of the information and descriptions in these instructions.

We will not assume liability for damage or malfunctions resulting from operating errors, non-observance of these operating instructions or unprofessional repairs.

Genuine spare parts have been specially designed and tested for NVL-circuit-breaker.

It is recommended to use only spare parts and accessories supplied by us. We would like to make explicitly clear, that any spare parts and accessories not supplied by us need our approval.

The installation and use of other products may have a negative effect on design specific characteristics of the circuit-breaker and thereby impair the safety for man, circuit-breaker or other property.

For damage resulting from the use of spare parts and accessories not approved by us any liability is excluded.

Any unauthorized conversions and changes to the circuit-breaker are prohibited for safety reasons and cause the exclusion of any liability by the manufacturer for any resulting damage.

1.2 Service information

Any technical inquiries concerning NVL-circuit-breakers should be addressed to our customer service department.

Should you encounter any difficulties with our equipment, please contact the manufacturing plant.
The address of tze manufacturing plant can be found on the last page of these operating instructions.

2 Safety regulations

2.1 Intended use

Vacuum circuit-breakers of product range NVL are prefabricated, type approved switchgear. They can be used for a rated current of up to 2500 A and a rated operating voltage of up to 24 kV (observe optional assembly).

Each circuit-breaker is individually tested in the factory according to IEC 62271-100 and DIN VDE 0670 part 1000, together with the control of the order related equipment, and is thereby checked for correct assembly and function.

Circuit-breakers of type NVL are used in metal encased, modular switchgear panels for accessible switchgear rooms, according to IEC 62271-200.

The circuit-breaker must only be serviced and repaired by authorized persons, who have been instructed or trained accordingly.

These operating instructions must be read before the installation and commissioning of the circuit-breaker. All measures and notes mentioned in the operating instructions must be fully complied with during installation, commissioning and during operation.

Each person involved in the installation, commissioning, operation, maintenance and repair of the unit must have read and understood these operating instructions, especially the chapter with safety regulations and any other notes on safety.

We recommend that the user/owner requests a written confirmation.

Only the exact knowledge of these operating instructions helps to avoid operating errors and ensures trouble-free operation.

The general safety and accident prevention instruction issued by the legislator and possible regulations of the insurer, which may be different from country to country, must be strictly observed when operating and servicing the circuit-breaker.

This operating manual is part of the circuit-breaker. When passing on the circuit-breaker (relocation, selling or similar) the operating manual must also be handed over.

2.2 Notes on radiation protection

One physical characteristic of vacuum insulation is the possibility of X-ray emission when the contact-break distance is open.

Vacuum switchgear chambers are therefore subject to the regulations of the X-ray directive of the Federal Republic of Germany (presently valid as amended on 8th of January 1987).

The vacuum interrupter chambers installed in the vacuum circuit-breakers have been type approved acc. to §8 of the X-ray directive (RöV) of the Federal Republic of Germany as amended on 8th of January 1987 (BGBL.I S.114). It meets the requirements of the RöV up to the max. value of the rated power frequency withstand voltage (testing voltage acc. to IEC or VDE) specified in the technical data.

Please contact the manufacturer for any further information.

2.3 Explanation of symbols and notes

Observe these notes and exercise extreme care in such cases. Hand out all notes on health and safety also to all persons who are involved in work with the circuit-breaker. Besides the notes in these operating instructions you must also comply with the generally valid safety and accident prevention instructions (e.g. DIN EN 50110, VDE 0105 Part 100, BGV A3).

Symbols on health and safety

In these operating instructions you will meet this symbol with all notes on health and safety which highlight possible dangers for the health and life of persons.

Warning against electrical voltage

This special health and safety symbol warns against dangers caused by electrical voltage.

Attention!

Attention note

In these operating instructions this note highlights all subjects needing particular attention in order to comply with guidelines, instructions and the correct work sequence, thereby avoiding damage and destruction of the circuit-breaker.

2.4 General notes on safety

The circuit-breaker has been designed and manufactured according to the latest technical standard and with due consideration of all safety regulations.

However, dangers for persons and property may arise from the circuit-breaker, if it is used incorrectly by untrained personnel or for purposes it is not intended for and if it is manipulated or the safety regulations are disregarded. Each person involved in the installation, commissioning, operation or servicing of the circuit-breaker must therefore have read and understood these instructions.

During operation of this electric switchgear certain components are inevitably charged with dangerous electrical voltage and mechanical parts, even remote controlled ones, may perform rapid movements.
The non-observance of the warnings can therefore lead to bodily injury or material damage.

2.4.1 Operation

When operating the circuit-breaker the responsibilities must be clearly specified and complied with, so that no unclear competences regarding safety will arise.

Before commissioning and after service work or modifications the circuit-breaker must be inspected by qualified personnel for safe working condition.

Before starting operation all persons within the danger zone around the circuit-breaker must be warned and asked to leave this area or to remove any objects. Access to the control elements must be assured.

The user must operate the circuit-breaker only in perfect condition.

Any changes impairing the safety must immediately be reported to the next higher responsible person.

Changes to the circuit-breaker are only permitted in coordination with manufacturer and under the supervision of expert personnel.

Experts are persons who, due to their professional education and experience, have sufficient knowledge in the field of electro technology and are acquainted with the relevant accident prevention instructions, guidelines (BGV A3) and the generally accepted technical rules and regulations (e.g. VDE-regulations, IEC-standards, DIN-standards).

2.4.2 Safety installations

Safety installations must not be modified, dismantled or made ineffective. Unprotected parts of the circuit-breaker can cause fatal injuries.

All safety installations, such as covers, must always be fully functional and correctly in place. Operation of the circuit-breaker with faulty safety installations is not permitted.

2.4.3 Auxiliary devices for operation and repair

If any auxiliary devices and tools are required for operation, maintenance or repair of the circuit-breaker, these must be in safe condition and should be used in a safe way.

Any unnecessary and endangering use of auxiliary devices and tools on the circuit-breaker is not permitted.

2.4.4 Statutory accident prevention instructions

Apart from these notes on prevention of accidents and the notes attached to the circuit-breaker the locally valid accident prevention instructions must also be observed.

3 Transport and installation

3.1 Safety notes for transport

1. Lifting tackle must only be used at points on the circuit-breaker specially specified for this purpose.
2. Ropes, chains or other lifting tackle must be fitted with safety hooks.
3. Do not use any torn or worn ropes.
4. Ropes and chains must be free of knots.
5. Ropes and chains must not touch any sharp edges.
6. Use only lifting tackle with sufficient load bearing capacity (weight of circuit-breaker see Chap. 7.2 or rating plate).
7. Use only lifting gear with sufficient load bearing capacity (weight of circuit-breaker see Chap. 7.2 or rating plate).
8. Do not lift loads over persons.

3.2 Transport and unloading

The circuit-breaker is preferably shipped fastened on a wooden pallet and covered with cardboard or packed in export boxes.

If the circuit-breaker is delivered in a switchgear panel, it is in isolated position in the switch room.

Packaging for oversea transport:

Packaging according to country specific requirements or as specified by the customer.

Outside packaging: Wooden boxes are used as standard

Internal packaging: Desiccant bags inserted in the packaging foil.

Observe the instructions for use of the desiccant bags acc. to DIN 55 473.

The following applies:

– Colour indicator blue: Content dry
– Colour indicator pink: Content damp (relative humidity, e.g. higher than 40%)
– Replace the desiccant
– Correct dimensioning of the desiccant ensures a stability of six months.

For transport or intermediate storage you should generally use the original packaging and secure the circuit-breaker in the same way as it has been secured upon delivery.

During transport comply with the warning and safety notes on circuit-breaker and packaging.

When unloading observe the notes on safety (see Chap. 3.1) and the applicable accident prevention instructions.

Unloading must only be performed by experienced persons who are fully familiar with the lifting gear. Observe the permissible hoisting weight of lifting tackle and lifting gear (forklift truck, crane).

For transport and intermediate storage the circuit-breaker must be switched off (position indicator on "0") and the closing spring relieved (spring accumulator indicator on symbol "Relieved").

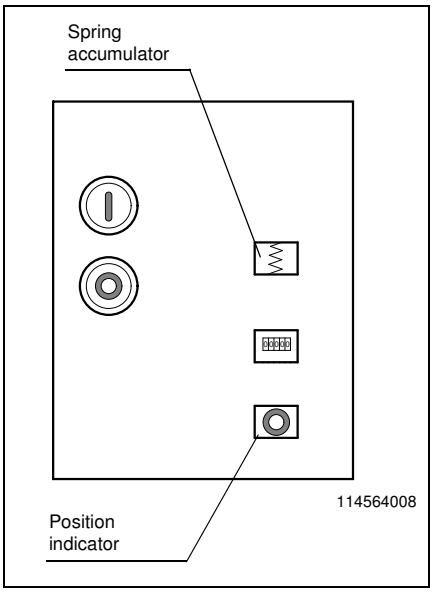

Fig. 3

3.3 Arrival and unpacking of goods

Upon arrival check the vacuum circuit-breaker immediately for any signs of transport damage:

- **Externally visible damage** must be confirmed by the driver on the freight documents. For actuarial reasons damages must be reported in writing to the delivering forwarding agent within a period of 3 days (!).
- **Hidden damage** can only be detected after removing the packaging material. Claims for transport damage detected at a later date **can only be accepted by us** within one week.
- Remove the tightening straps. The vacuum circuit-breaker is then unsecured.

The circuit-breaker must be lifted by the locating bores ∅ 23, on the back wall of the circuit-breaker (Fig. 4), provided for this purpose.

For circuit-breakers with a rated current higher than 1600 A the transport device, supplied for this purpose, should be used.

During transport care must be taken to avoid damage and soiling.

Attention!

The breaker poles must not be mechanically strained during transport and when loading and unloading. The circuit-breaker must not be lifted and transported by the breaker poles.

Upon delivery check the vacuum circuit-breaker for correctness and completeness. The manufacturing numbers on delivery note and vacuum circuit-breaker rating plate (Fig. 5) must be identical.

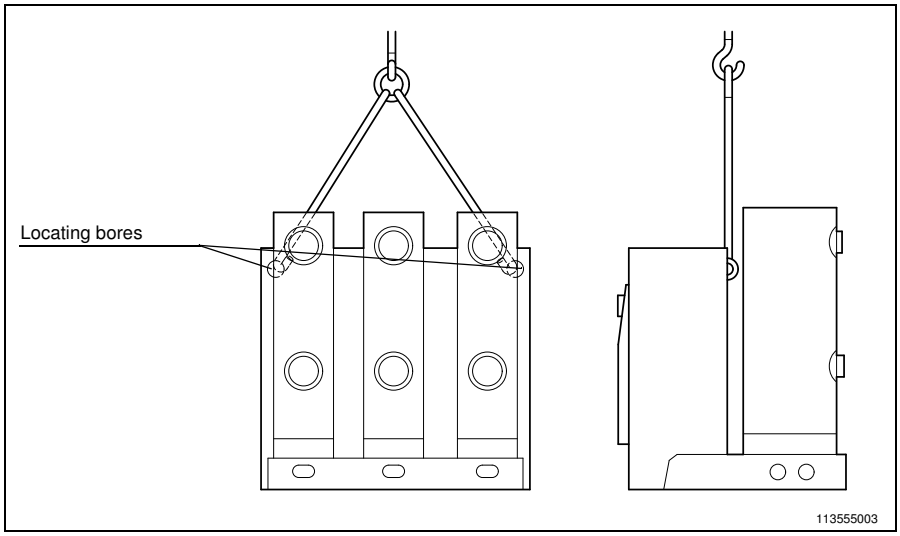

Fig. 4

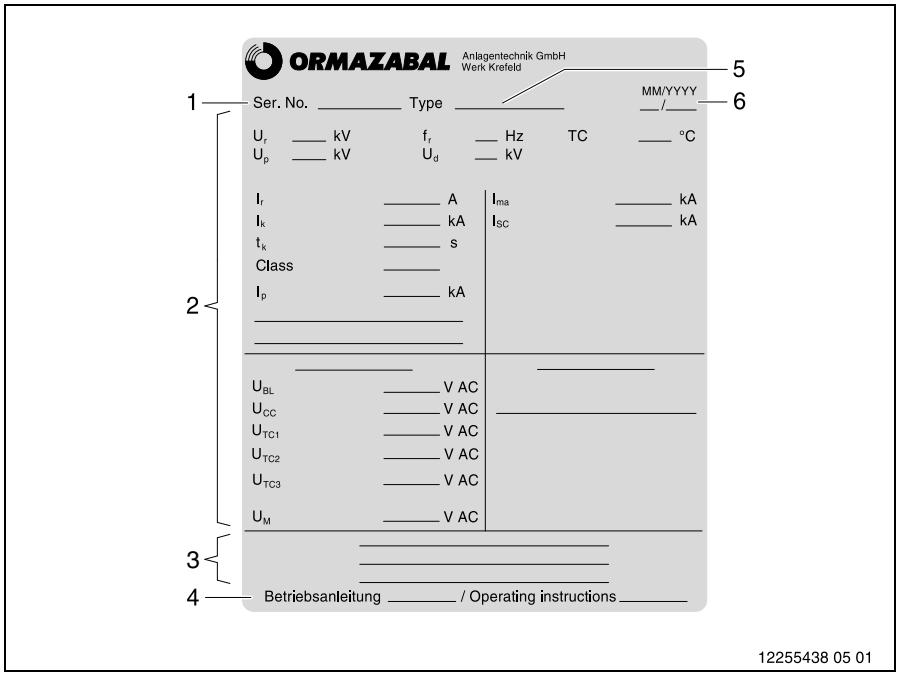

Fig. 5 Rating plate (sample)

1 Serial number
2 Technical data
3 Applied standards
4 Document numbers of the corresponding operating instructions (German/English)
5 Type of equipment
6 Manufacturing date: month/year

Type code for vacuum circuit-breaker NVL:

The overview Fig. 6 explains the principle of the type designation using the vacuum circuit-breaker NVL2A-12/ 20/630-150A as an example:

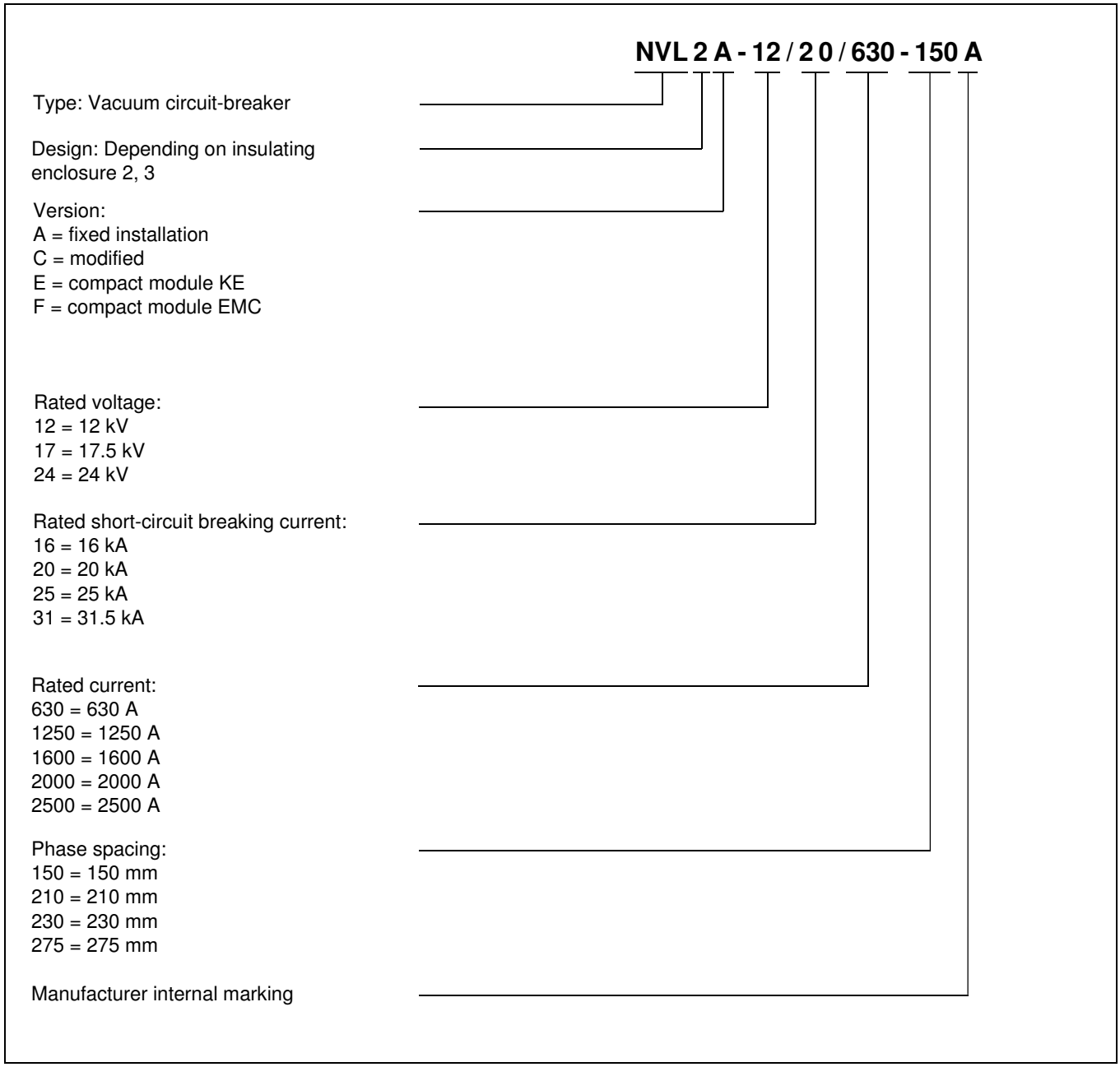

Fig. 6

3.4 Storage

⚠ **Intermediate storage of the circuit-breaker is only permitted with the circuit-breaker switched off and the spring accumulator drive mechanism relieved (position indicator on "O", spring accumulator indicator on "Relieved").**

Unit with single packaging:

- Dry and well ventilated storage room, climate acc. to DIN VDE 0670 part 1000 / IEC 60694
- Do not remove or damage the packaging

Unpacked units:

- cover loosely with protective foil
- sufficient air circulation must be maintained
- formation of condensation water must be avoided.

Storage must be so that damage and soiling is avoided.

With respect to humidity and air contamination strict compliance with the conditions for indoor switchgear acc. to IEC 60694 or VDE 0670 part 1000 is mandatory, condensation and thawing must be avoided.
Transport and storage is permitted own to -25°C.

Units with packaging for sea transport or similar, with internal protective foil:

- store dry and protected against weather
- protect against damage.

⚠ Check packaging for damage before storing.

Check desiccant (see Chap. 3.2)

– upon delivery
– later a appropriate intervals.

If the stability period of the desiccant has been exceeded:

– The protective effect of the packaging is no longer assured
– Apply measures for another intermediate storage.
– if necessary replace the desiccant

3.5 Installation of the NVL into the switchgear panel

3.5.1 Preparations

If the circuit-breaker is soiled all external parts must be cleaned. The insulating parts must be cleaned with a dry, lint-free cloth.

Attention!

Check the switch connections for damage.
If the circuit-breaker had been stored before commissioning, the breaker mechanism must be checked as specified in Chap. 6 (related to the year of manufacture)!

Grease the contacts of the circuit-breaker as specified in chapter 6.4.

3.5.2 Installation of the NVL in the switchgear panel

The circuit-breaker has mounting points (female threads M8) on the bottom side for fixed installation in open or encapsulated switchgear.
The circuit-breaker must be tightly bolted to a horizontal (max. inclination 5°), level surface (rails, carrier, console or similar) and should not be fastened under tension. If necessary use shims at the fastening points to compensate.
Any other mounting positions require the approval of the manufacturer.

Circuit-breakers on switchgear truck or chassis or in form of withdrawable circuit-breakers are equipped with special fastening facilities.

3.5.3 Primary connection of busbars

High voltage power lines and earth leads must be ín compliance with the applicable regulations of plant engineering.

For extension of the busbars the limit values specified in the regulations IEC 60694 or VDE 0670 Teil 1000 do apply.

The connection bars must be in accordance with DIN 46433 (with rounded edges).
Busbar connections shall not apply and forces to the breaker poles.

The clearance between live parts among each other and ground potential must be in compliance with applicable regulations or the tested terminal zones (Fig. 7 and Fig. 8). The terminal zones were tested according to VDE 0670 nominal circuit insulation level list 2.

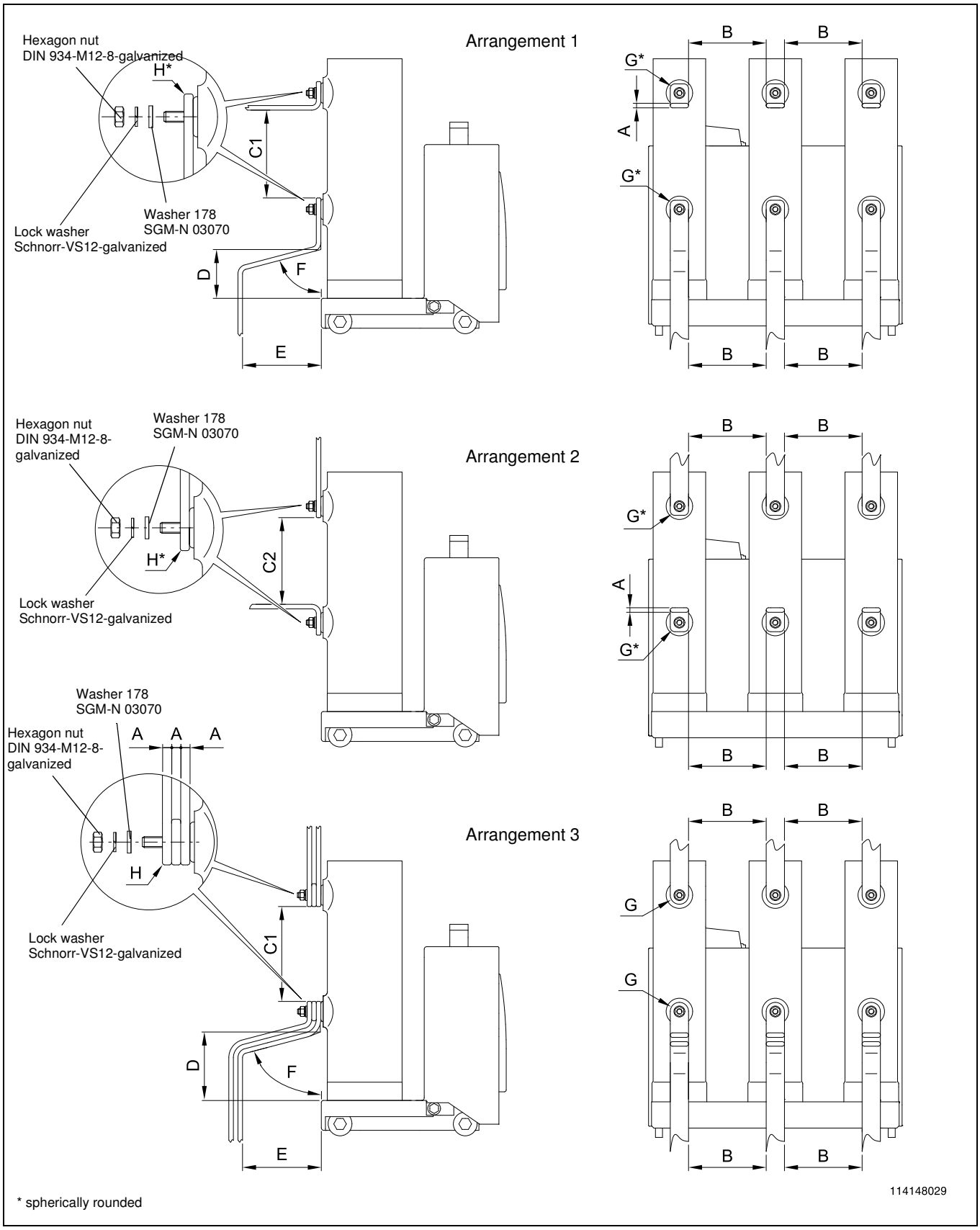

Fig. 7 Tested terminal zones NVL2

Rated voltage / Distance between pole centres	**12 kV / 150 mm**		**12 kV / 210 mm**	**17.5 kV / 150 mm** [1]	**17.5 kV / 210 mm** [1]	**24 kV / 210 mm** [1]		**24 kV / 275 mm**
A [mm]	10	5	5	10	5	5 [2]	10	5
B [mm]	100	105	135	105	150	170		190
C1 [mm]	110		110	140	140	190		190
C2 [mm]	110		110	145	145	190		190
D [mm]	90		90	90	90	150		140
E [mm]	110		110	135	135	170		170
F [°]	60		60	60	60	75		75
G [mm]	without radius		without radius	R 10	without radius	R 20		without radius
H [mm]	without radius		without radius	R 3	without radius	R 2,5 [2]	R 5	without radius

1) possible additional insulation plates (phase insulation) required in the panel; not included in the scope of delivery
2) for arrangement 1 and 2: Single busbar with shrink hose pulled over the bending edge up to hexagon nut M12

Table 1 Minimum spacings for tested terminal zones NVL2

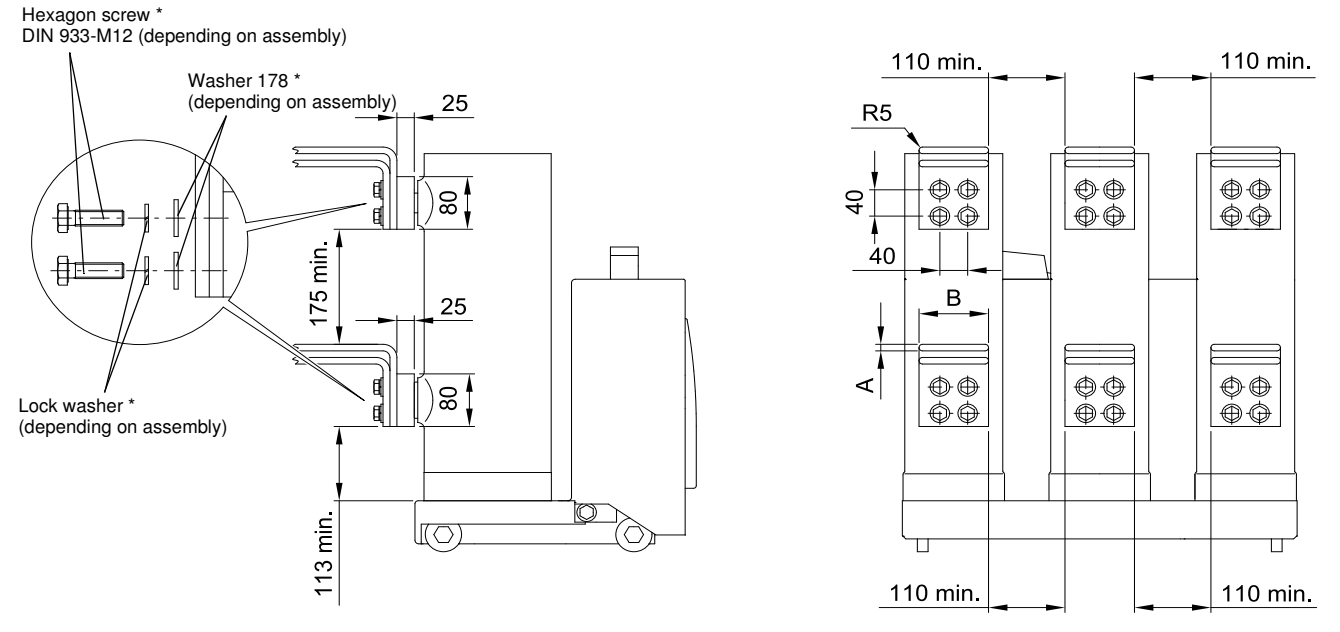

Fig. 8 Tested terminal zones NVL3

Rated voltage / Rated current / Distance between pole centres	**12 kV and 17.5 kV / 2000 A / 210 mm**		**12 kV and 17.5 kV / 2500 A / 210 mm**	
Busbars	double	single	double	double
Material* / surface*	Aluminium / painted	Copper / painted	Aluminium / painted	Copper / painted
A [mm]	10	10	10	10
B [mm]	80	100	100	80

* Examples for possible materials / surfaces

Table 2 Minimum spacings for tested terminal zones NVL3

The circuit-breaker is provided with a threaded connection M12, which can be used to connect the earth lead. Before connecting the earth lead this earthing point must be cleaned (metallic blank) and greased with a resin and acid free grease (see chapter 6.4).

When making electric screw or terminal connections the following must be observed:

1. Clean contact surfaces:

a) Connection copper - copper and its alloys

- Contact faces without metallic coating must be cleaned with appropriate tools or emery cloth (metallic blank) and subsequently slightly greased.
- Contact faces with metallic coating (e.g. tin, silver) must only be cleaned from dirt and slightly greased.

b) Connection aluminium - copper

- Under the influence of oxygen aluminium has tendency to form a thin, electrically insulating oxide layer, immediately after mechanical processing, which has the effect of a high contact resistance. Before assembly this oxide layer must be removed from the contact surfaces by means of a steel brush or coarse emery cloth. In order to avoid the formation of a new oxide layer each contact surface must be wiped clean with a clean, dry cloth and slightly greased.
- Copper contact faces must be treated as described under a).

Attention!

Tools or emery cloth used for the mechanical processing of the contact surfaces must not have been previously used for other metals. Metal chips must be removed before applying grease. The contact faces should be greased with resin and acid free grease (Chap. 6.4).

2. Screw connection:

For compliance with the required contact force the supplied connecting elements must be assembled as shown in Fig. 7 and Fig. 8 (tightening torque: 65 Nm ±5 Nm).

3.5.4 Connection of control and record leads

Control and record leads must be connected as specified in the corresponding diagram.

Fig. 9 to Fig. 11 show the internal assignment of the control plug in switch position "OFF". The specific version for the respective order can be found in the attached circuit documentation.

Since the coils for the shunt releases are only designed for short-term operation, their control leads are routed via the auxiliary switch.
This switches the coils off during the switching process, irrespective of the duration of the switching command.
The control leads of the trip element ON are additionally routed via the control switch for the drive mechanism, so that the trip element ON does not receive any voltage when the closing spring is not completely tensioned.

Attention!

- For a correct function the shunt releases require a minimum signal duration of 50 ms at nominal voltage (see Chap. 7).
- The trip elements are provided with a protective circuit for induced voltage limitation.
- In case of circuit-breakers on compact drawer units observe the possibly existing plug coding.
- The plug-in connector is provided with 64-pole connection (Crimp connection) as standard. The connection must be made in compliance with the circuit diagram.

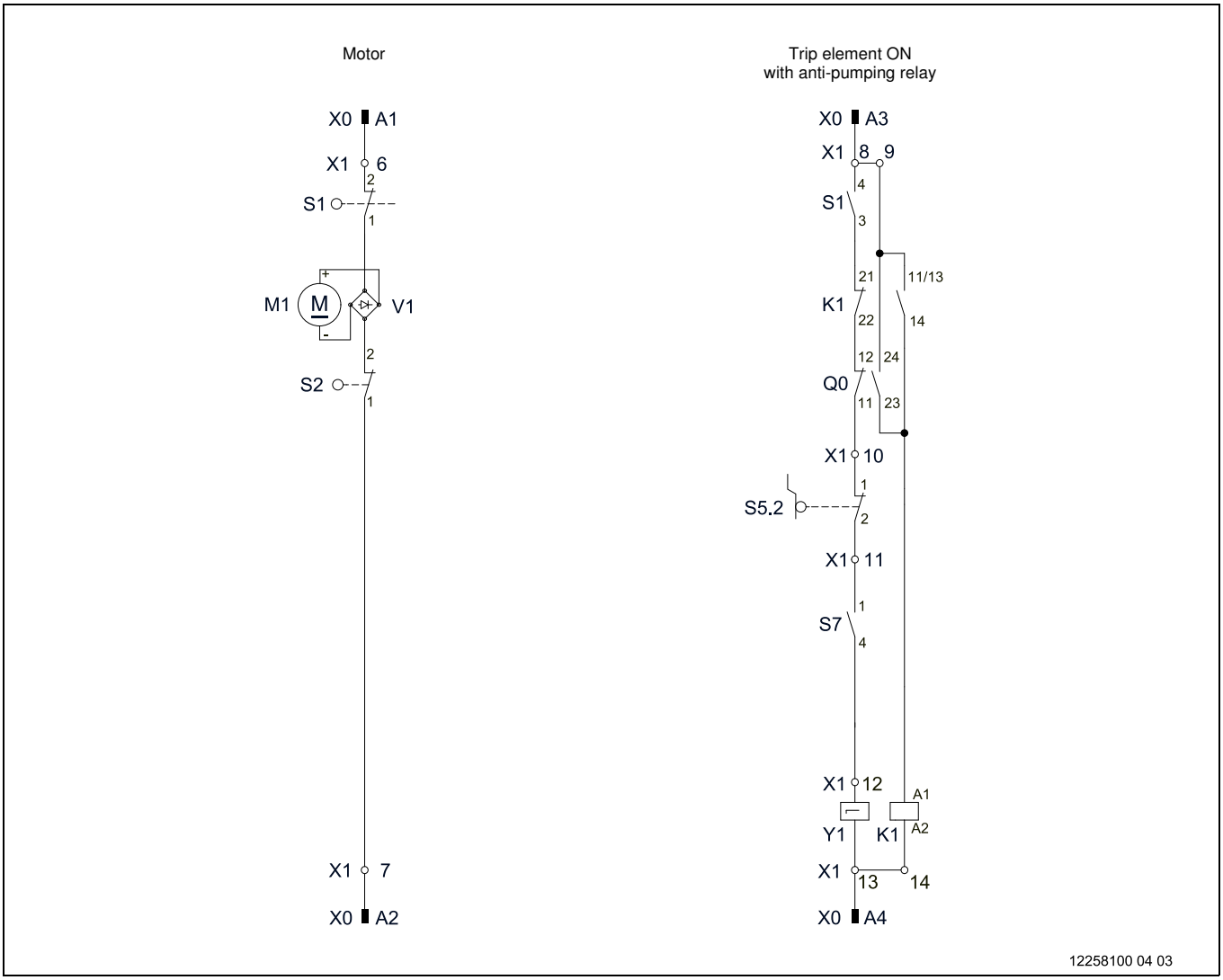

Fig. 9

K1 Anti-pumping relay
M1 Stored energy spring mechanism motor
Q0 Auxiliary switch 10-pole (alternative: 20/-pole)
S1 Control switch (ON release and motor)
S2 Signalling/control switch (spring accumulator)
S5.2 Control switch (interlocking of electric switching on (with drawer unit only))
S7 Control switch (release interlocking of electric switching on (in conjunction with Y7 only))
X0 Plug-in connector 64-pole
X1 Terminal strip
Y1 Trip element ON
V1 Rectifier for M1

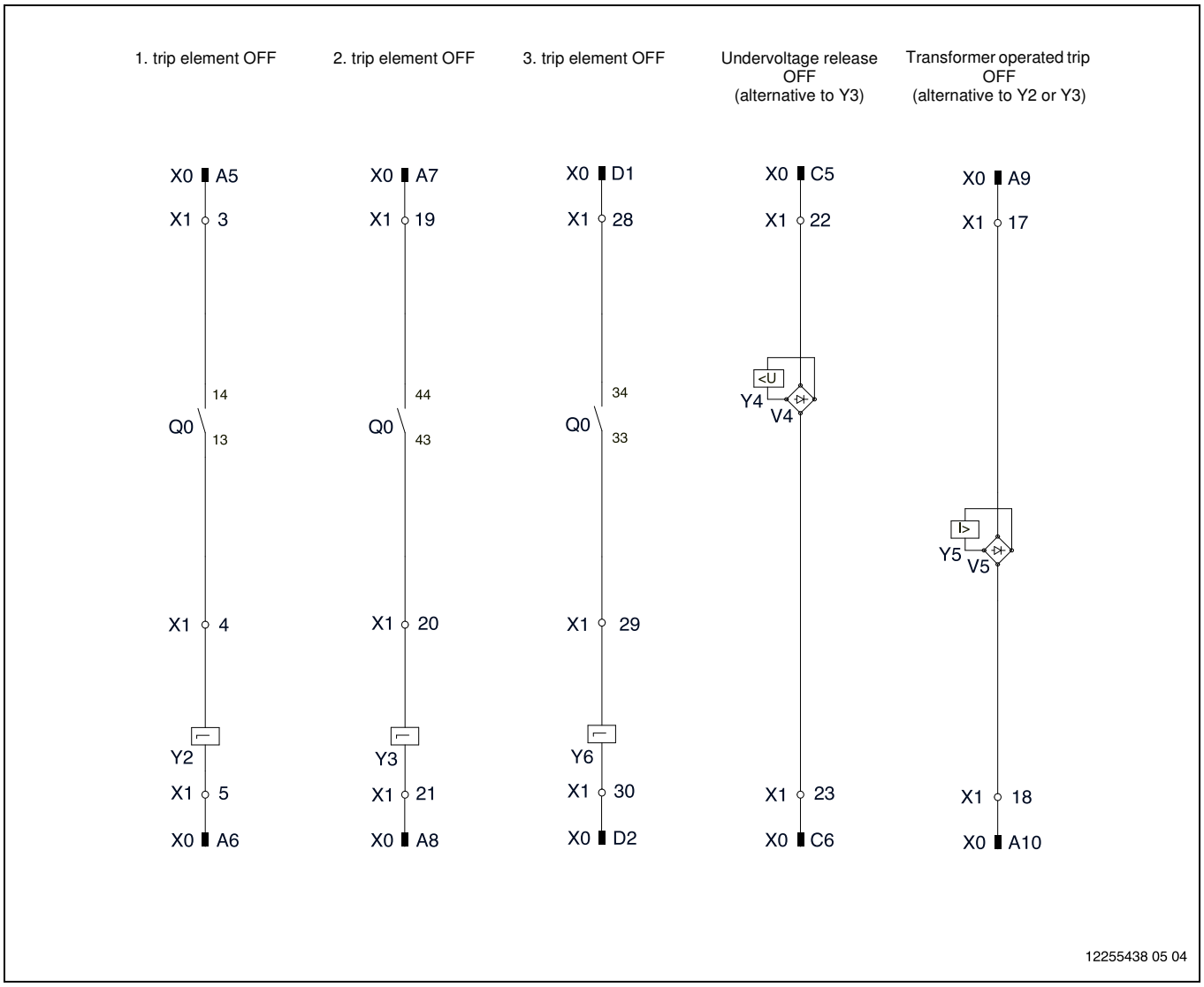

Fig. 10

Q0	Auxiliary switch 10-pole (alternative: 20/-pole)
V4	Rectifier for Y4
V5	Rectifier for Y5
X0	Plug-in connector 64-pole
X1	Terminal strip
Y2	1. trip element OFF
Y3	2. trip element OFF
Y4	Undervoltage release OFF (alternative to Y3)
Y5	Transformer operated trip OFF (alternative to Y2 or Y3)
Y6	3. trip element OFF

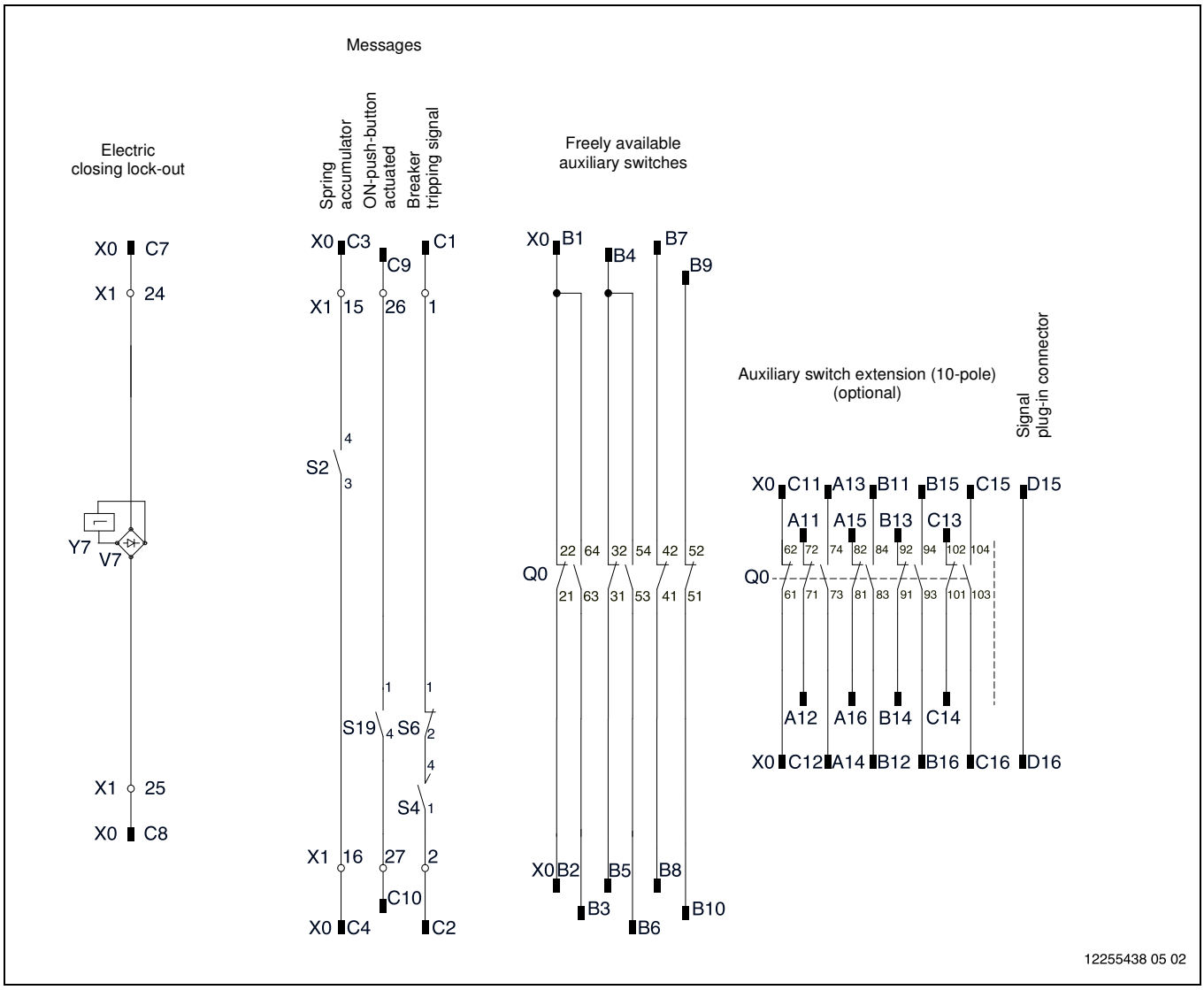

Fig. 11

Q0	Auxiliary switch 10-pole (alternative: 20/-pole)
S2	Signalling/control switch (spring accumulator)
S4	Fleeting contact switch (message OFF)
S6	Fleeting contact break (in case of local actuation)
S19	Signalling switch (mechanical ON push-button actuated)
V7	Rectifier for Y7
X0	Plug-in connector 64-pole
X1	Terminal strip
Y7	Electric closing lock-out (in conjunction with S7 only)

4 Technical description

4.1 General

Vacuum circuit-breakers are characterized by a high number of permissible switching cycles in combination with lowest maintenance efforts.

It is available either for fixed installation, mounted on a switching truck or as a withdrawable circuit-breaker.
For extremely small installation spaces circuit-breakers are available with additional insulation between live parts and against ground.
Here the connection is made by means of isolating contacts.

The vacuum circuit-breaker is suitable for automatic rapid reclosing (identical with the term automatic reclosing).
The operating sequences are listed in the technical data (chapter 7).

The vacuum circuit-breaker consists of the main assemblies switch mechanism and breaker pole. The switch mechanism is a spring accumulator actuator, which can be tensioned by means of wind-up motor or manually by means of a crank.

4.2 Breaker pole

4.2.1 Design and function

The movable switching contact in the vacuum interrupter chamber of the breaker pole is connected to the operating rocker via the internal contact pressure spring with impact sleeve and the insulating switchstick.
Both contact pressure spring and pole insulation spring are preloaded.
The movable switching contact as well as the fixed bottom connection are linked by flexible connectors.

In making operation insulating switchstick, impact sleeve, contact pressure spring as well as movable switching contact are moved up, until contact is established.
During this process the pole insulation spring is tensioned.
After the contact has closed the impact sleeve is moved up by the amount of the pre-stroke, whereby the contact spring is further tensioned and the contact force is generated.

When switching off both the contact pressure spring and the pole insulation spring are relieved. The contact pressure spring with its high accumulated energy presses against the movable switching contact and causes the impact sleeve with the insulating switchstick and the operating rocker to move.
Once the impact sleeve has moved down by the amount of the pre-stroke, it will reach the movable switching contact and drag it along.
The pole insulation spring supports this movement and returns the movable switching contact to its defined OFF-position.
A rubber buffer ensures damping of the breaking movement.

4.2.2 Arc extinction process

During the breaking process an arc in form of a metal vapour arc is generated in the vacuum interrupter chamber at the time of contact separation. Once the extinction distance is reached, it will extinct on the zero crossing of the current wave and will not be ignited again.

The arc causes a local fusing of the contact surfaces. The evaporating metal thereby mainly deposits on the contact, and for a lesser part on the screens surrounding the contacts.

The chopping current (normal chopping) at the vacuum interrupter chambers is less than 5 A and implies only minor overvoltages.
With an axial magnetic field in the vacuum interrupter chamber between the contacts it is achieved that the metal vapour arc also remains diffuse in the range of short-circuit currents, which results in a lower thermal strain on the contacts.

4.3 Switch mechanism

4.3.1 Design and function

The switch mechanism is designed as a spring accumulator actuator, which delivers the energy for the switching operations.

The circuit-breaker is switched on by the closing spring and switched off by the contact pressure springs and the pole insulation springs, which have been tensioned during the making operation. After switching on the closing switch is immediately tensioned again, if the wind-up motor is available and correctly connected. Once the tensioning process is completed, the drive energy for the switching sequence for rapid reclosing OFF-ON-OFF is available. Switch positions OFF "O" or ON "I" and the status of the closing spring "Relieved" or "Tensioned" are visible through inspection openings in the cover.

4.3.2 Tensioning of closing spring and making operation

The closing spring can be tensioned by means of a wind-up motor or a pluggable crankhandle via a gear drive (observe section 5.5!).
A closing mechanics retains the closing spring in tensioned condition.
The spring is released by the trip element ON or the push-button ON.
This rotates the ON-tripping shaft, the closing mechanics is unlatched.
The closing spring releases its tension and rotates the tripping shaft.
The cam disc on the tripping shaft moves the closing lever, which then presses the toggle system into stretched position.
The operating rockers transfer the movement of the toggle systems to the breaker poles; the breaker poles close.
At the end of the making operation the closing lever latches into the OFF tripping shaft.

4.3.3 Breaking operation

The breaking operation takes place by unlatching closing lever and toggle system. For this purpose the OFF tripping shaft is rotated by the trip mechanism OFF or the push-button OFF.
Pole insulation springs and contact pressure springs of the breaker poles press the toggle system and the breaker contacts to switch position OFF.

5 Operation / commissioning

5.1 Switching accessories

For mechanical operation of the NVL circuit-breaker the following accessories are needed (Fig. 13):

1. Crankhandle for the spring accumulator of the circuit-breaker drive
2. not shown: Key for push-button lock (optional)

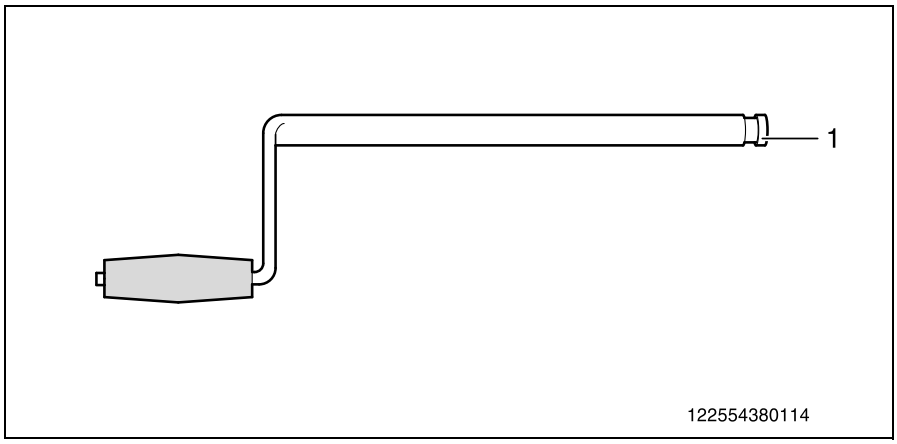

Fig. 13

5.2 Delivery condition of circuit-breaker

Upon delivery the vacuum circuit-breaker is in the following condition:

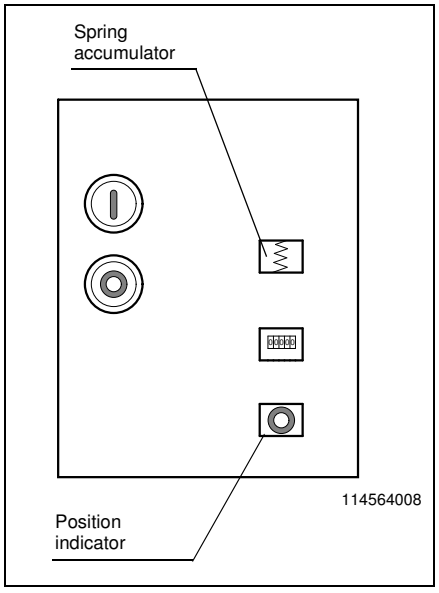

Fig. 12

Circuit-breaker switched off, spring accumulator relieved.

5.3 Preparations

Perform the following operations before applying primary voltage:

- Remove the transport protection cover from the breaker poles, the covers are marked accordingly.
- Check the breaker for damage.
- Remove any dirt resulting from transport, storage or installation with a lint-free cloth (especially from insulating materials).
- Check primary and secondary terminals, as well as protective conductor terminals.
- Tension the closing spring manually with the crankhandle (see Chap. 5.5.1).
- Switch the breaker on and off by pressing the push-buttons ON and OFF for testing (observe possible required auxiliary supply and possibly existing interlocks).
- With wind-up motor available: Tension the spring accumulator of the circuit-breaker by applying the auxiliary supply.
- Switch the circuit-breaker electrically on and off with the available trip elements.
- Keep these operating instructions in a place where they are at any time accessible for the operating personnel.

5.4 Switch operation

The following control elements and displays are arranged on the front face of the circuit-breaker (Fig. 14):

1 Push-button ON (I = green)
2 Push-button OFF (0 = red)
3 Spring accumulator display
4 Manual wind-up
5 Operations counter
6 Position indicator

Attention!

Before switching on by push-button you must strictly observe the switching position of the circuit-breaker, because a making operation of an already closed circuit-breaker can cause damage to the switch mechanism!

On an already closed circuit-breaker the making operation by means of an ON trip element is electrically locked.

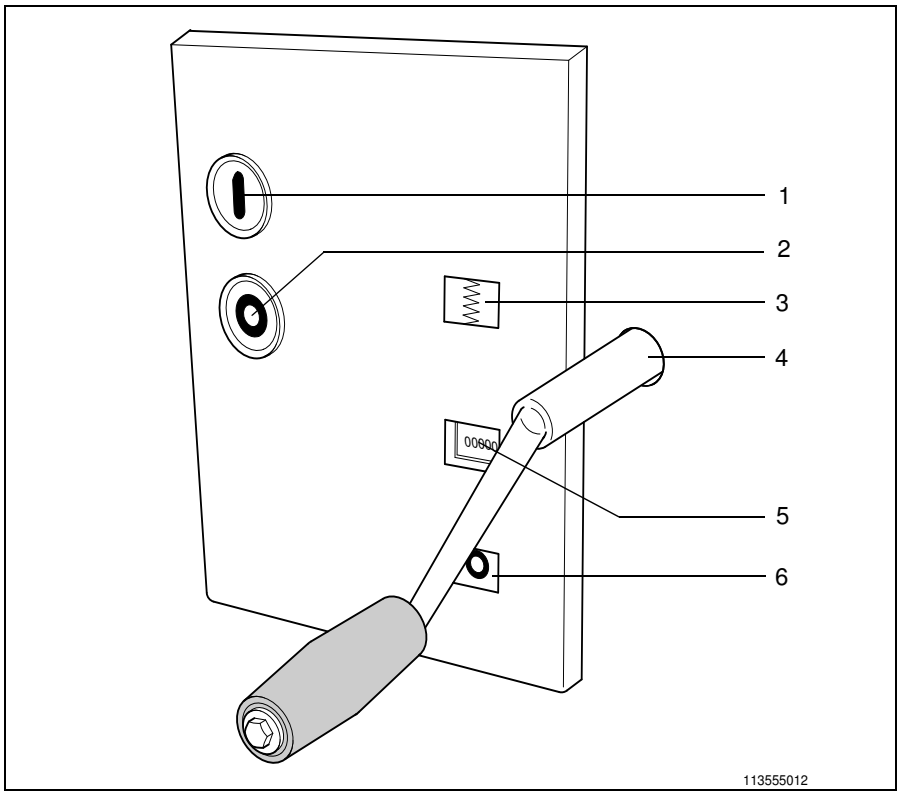

Fig. 14

5.5 Manual making and breaking

5.5.1 Tensioning the closing spring

Plug on the crankhandle for manual wind-up and turn it slowly clockwise, until the retaining segment of the tripping shaft audibly clicks into place.
The closing spring is now tensioned and the spring accumulator display shows the tensioned spring (Fig. 15)

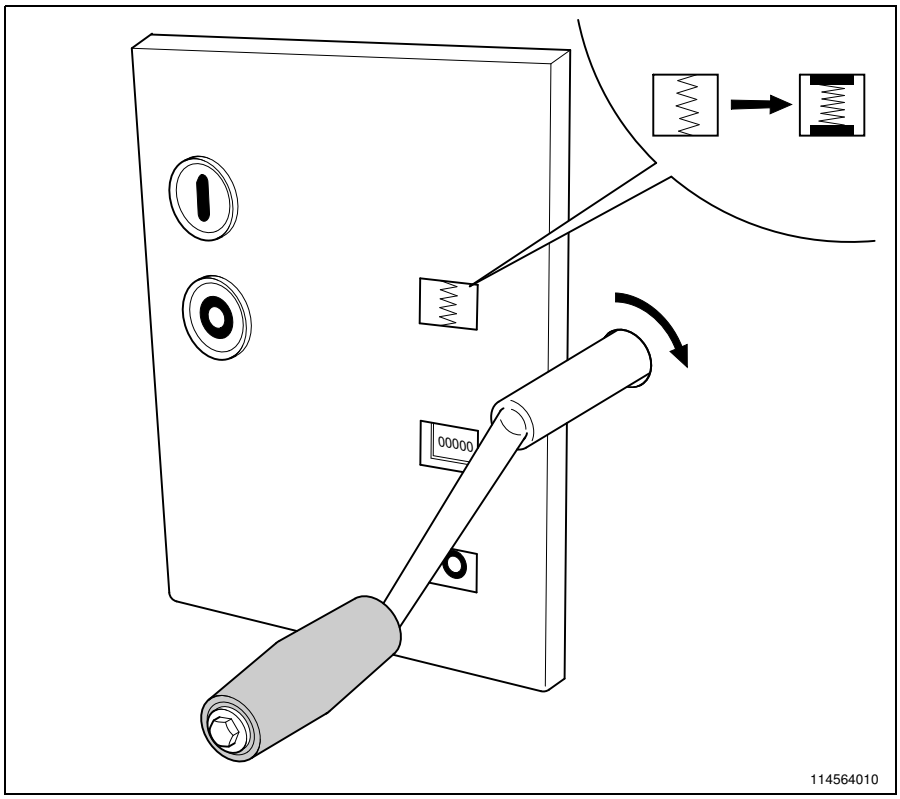

Fig. 15

5.5.2 Making

- If the push-button ON is provided with a key lock, turn the key to horizontal position ("push-button ON unlocked").
- Press push-button ON (Fig. 16).
- The circuit-breaker switches ON. The position indicator shows "I". The closing spring is now relieved and the closing spring accumulator indicator shows the relieved spring (Fig. 18).
- Tension the closing spring according to paragraph 5.5.1.

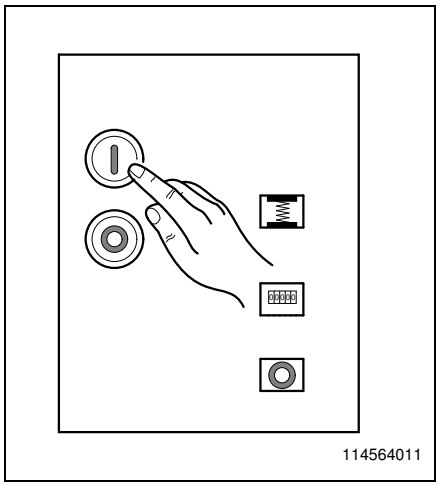

Fig. 16

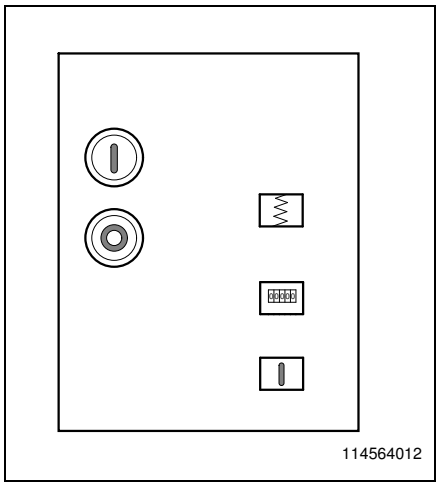

Fig. 18

5.5.3 Breaking

- If the push-button OFF is provided with a key lock, turn the key to horizontal position ("push-button OFF unlocked").
- Press push-button OFF (Fig. 17).
- The circuit-breaker switches OFF. The position indicator shows "0" (Fig. 19).

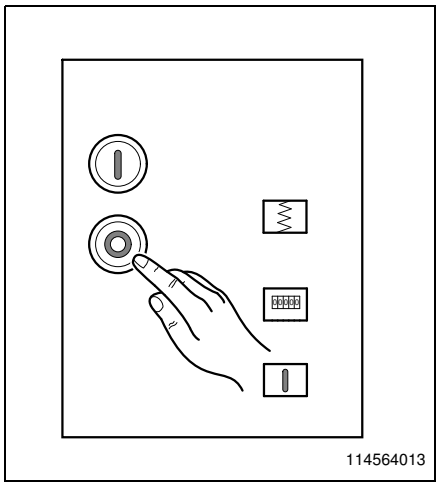

Fig. 17

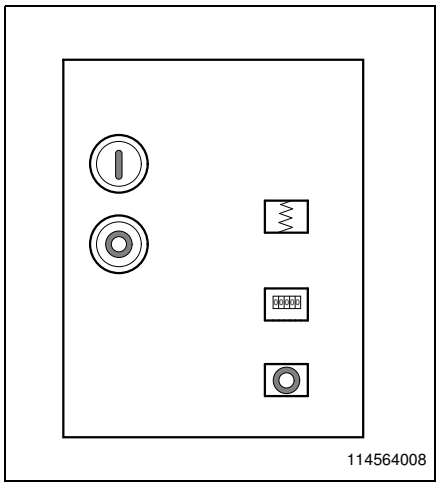

Fig. 19

5.6 Electrical making and breaking

5.6.1 Tensioning the closing spring

– The auxiliary supply for the wind-up motor must be applied according to the circuit diagram, whereafter the tensioning process of the closing spring will start.
– Once the tensioning process is finished the switch-on accumulator display will show the tensioned spring (Fig. 20).

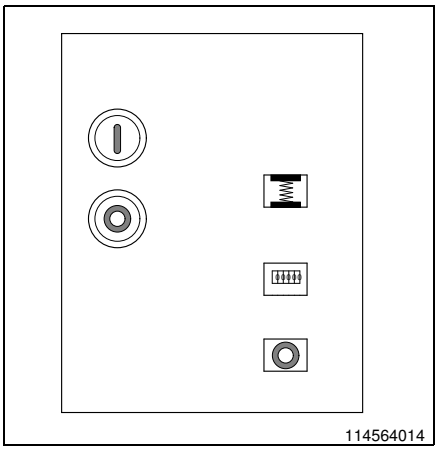

Fig. 20

5.6.2 Making

– Operate the trip element ON according to the circuit diagram using the auxiliary supply (observe possibly existing interlocks).
– The circuit-breaker switches ON.
– The position indicator shows "I" (Fig. 21).
– The closing spring is no longer tensioned.
– The switch-on accumulator display shows the relieved spring (Fig. 21).
– On circuit-breakers suitable for rapid reclosing the closing spring will be immediately retensioned after the making operation, if motor voltage is applied.
– After the tensioning process the circuit-breaker has stored the actuating energy for the switching sequence OFF-ON-OFF.

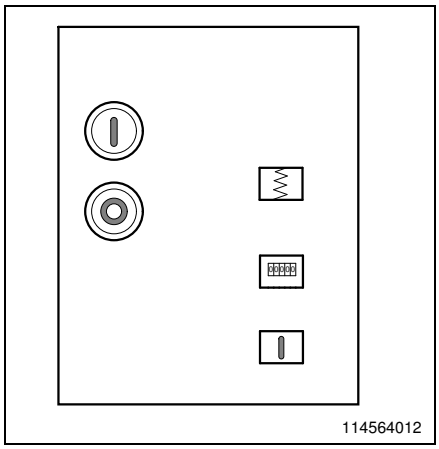

Fig. 21

5.6.3 Breaking

– Actuate the trip element OFF with the auxiliary supply by following the circuit diagram.
– The circuit-breaker switches OFF.
– The indicator window shows "0" (Fig. 22).

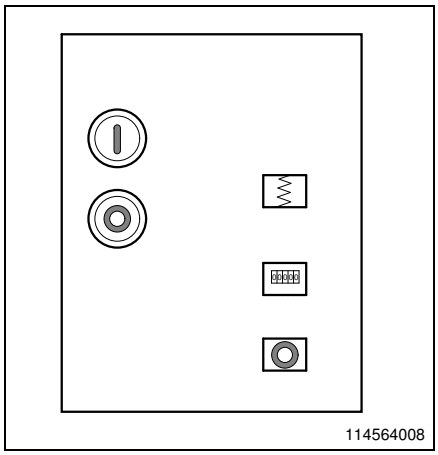

Fig. 22

6 Repair

6.1 General

Maintenance and repair are activities to maintain trouble-free operation and longest possible lifetime of the unit. It covers the following partial sections, which are closely related according to DIN 31 051 or IEC 1208:

- **Inspection:**
  Determination of the actual status
- **Maintenance:**
  Measures to maintain the nominal status (assurance of trouble-free function)
- **Repair**:
  Measure to re-establish the nominal status.

Vacuum circuit-breakers of type NVL are characterized by their simple and robust design.
They have a high expected service life. Their actuators require only minor maintenance and the vacuum interrupter chambers are maintenance free over their entire lifetime.
Even the frequent switching of load and short-circuit currents has no negative effect on the vacuum.

The maintenance intervals are determined by environmental conditions, switching frequency and the number of short-circuit breaking operations.

6.2 Inspection and maintenance

6.2.1 Inspection

Before starting inspection work the working area must be isolated and secured in compliance with the "Safety Rules" specified in DIN VDE/IEC.

Depending on operation and local conditions the switchgear should be inspected acc. to BGV A3 every four years, but at the latest after 10.000 switching cycles.

In case of highly unusual operating conditions (this also includes severe climatic conditions) and/or particular environmental loads (among other excessive dirt and aggressive air) inspections may required to be carried out a considerably shorter intervals.

The scope of inspection work includes, among others:

- Checking of switchgear for peculiarities, dirt and the effect of environmental influences.
- Performance of several no-load switching operations, this applies in particular for circuit-breakers which have only be rarely switched during operation.
- Checking of switchgear functions, such as its elements for actuation, locking, tripping, recording and other operations.
- Switching off of wind-up motor (if present). On the circuit-breaker press push-buttons ON and OFF as follows: OFF-ON-OFF.
- Visual examination of the lubrication on bearing, sliding faces etc.
- Determination of subsequent action (maintenance, repair) under due consideration of the maximum permissible number of switching cycles.

6.2.2 Maintenance

Before starting maintenance work the working area must be isolated and secured in compliance with the "Safety Rules" specified in DIN VDE/IEC.

Maintenance is required:
- 10 years after commissioning
- 20 years after commissioning
- if the inspection reveals that maintenance is required.

The vacuum interrupter chambers are maintenance free and have a minimum lifetime of 25 years.
If the limits of the the electrical lifetime or the permissible number of mechanical switching cycles of the vacuum interrupter chamber have been reached, the complete breaker poles must be examined by the manufacturer.

Attention!

Maintenance work must only be carried out by the manufacturer or specialist personnel trained by the manufacturer.

Scope of maintenance:

- Switch off wind-up motor (if present).
- On the circuit-breaker press push-buttons ON and OFF as follows: OFF - ON - OFF.
- Assess the general condition of the switch mechanism.
- Clean surfaces with a soft, dry and lint-free cloth.
- Grease or oil sliding faces and bearings with a resin and acid free lubricant (see Chap. 6.4).
  Reoiling has the purpose of refreshing the grease.

Note!

In case of problems during maintenance work and malfunctions you should contact the manufacturing plant.

When contacting the manufacturer the following information is strictly required:

- Type designation
- Serial number
- Year of manufacture

6.3 Malfunction

Fault	Possible cause	Fault remedy
1. Shunt release does not trip	– no voltage – voltage too low – Polarity on DC - trip elements mixed up – Trip element defective – Pulse duration too short	– Check supply leads and plug-in connectors (observe block diagram) – Check power source – Consult the manufacturer – Observe the pulse duration
2. Undervoltage release does not trip	– Blockage still plugged – continue with pnt. 1	– Remove blockage – see pnt. 1
3. Wind-up motor does not tension	– no voltage – voltage too low – Motor defect	– see pnt. 1
4. Position indicator ON/OFF in interim position	– Outer casing not properly assembled	– Release closing spring with switching sequence OFF-ON-OFF, remove outer casing and observe exact insertion of dogs for indicators when reassembling.
5. The breaker switches off immediately after switching on	– permanent "OFF"-signal applied – Undervoltage release has not picked up, if present	– see pnt. 1
6. Switch cannot be switched on mechanically	– if key lock is available	– unlock
7. Switch cannot be switched on mechanically and electrically	– electrical closing lock-out has not picked up	– Apply supply voltage – see pnt. 1
8. Switch cannot be switched on electrically	– see pnt. 1	– see pnt. 1

Table 3

6.4 Consumables

Application	Consumables	Manufacturer
Lubricant for contact faces and bearings	Rivolta SKD 4002	Bremer & Leguil GmbH Am Burgacker 30-42 47051 Duisburg
For refreshing	Basic oil for Rivolta	

Table 4

6.5 Return of switching devices

For Ormazabal switchgear a 30 year operating time is assumed. Due to the high dependability of the switchgear arc-faults are almost completely ruled out.
Our management system is certified acc. to ISO 9000 and ISO 14001 for years. An occupational health and safety management system acc. to OSHAS 18001 is integrated.
As a competent partner Ormazabal offers you the return of your switchgear after the expiration of the mentioned operating time. The related expenses depend on the legal requirements applicable at the time of return.

7 Technical data

7.1 Dimensions

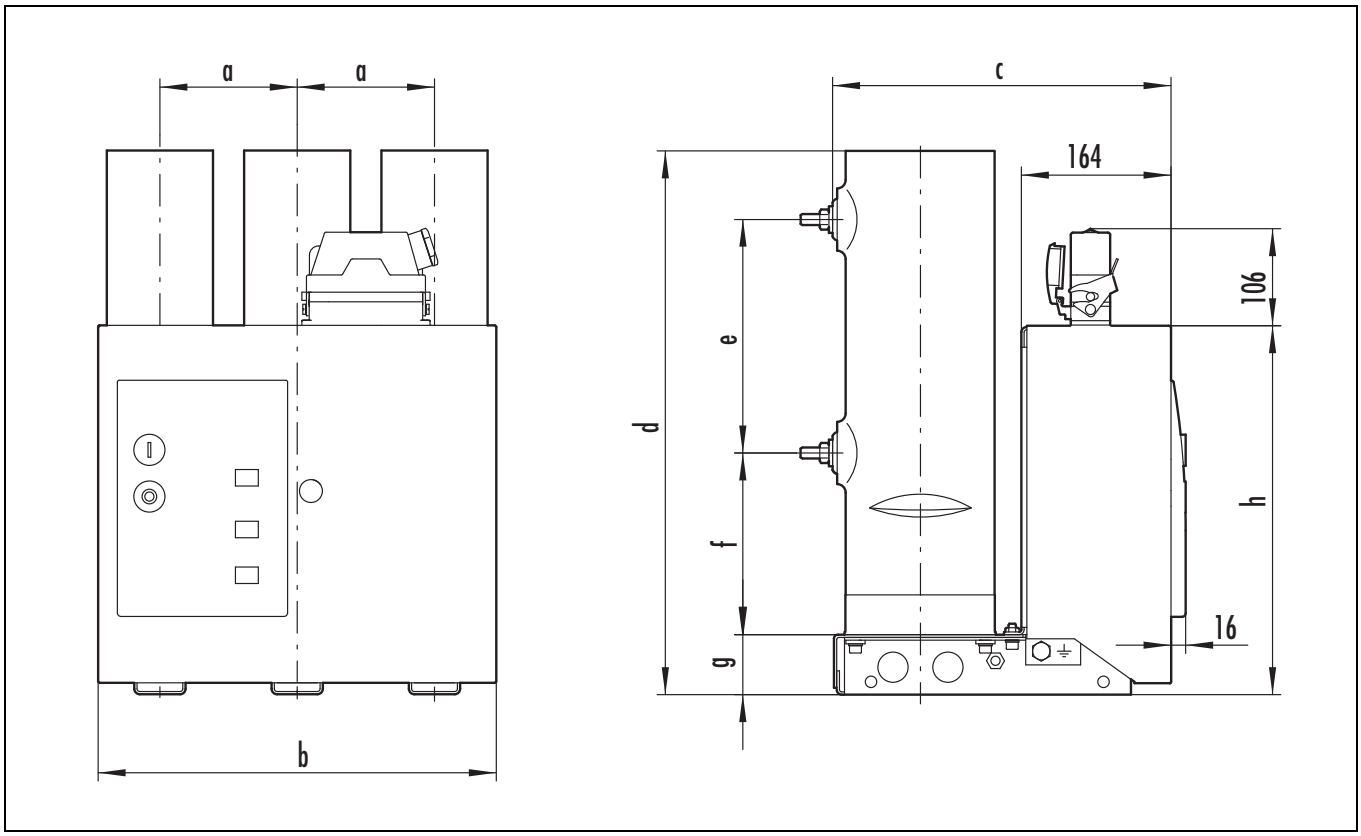

Fig. 23 (Measurements in mm)

Rated voltage U_r	kV	12			17.5			24		
Distance between pole centres **a**	mm	150	210	210	150*	210	210*	210*	230*	275
Rated normal current I_r	A	630	630	1600	630	630	1600	630	630	630
		1250	1250	2000	1250	1250	2000	–	1250	1250
		–	–	2500	–	–	2500	–	–	–
Type of insulating enclosure	–	2	2	3	2	2	3	2	2	2
Dimensions										
b	mm	435	555	555	435	555	555	555	595	685
c	mm	370	370	390	370	370	390	431	431	431
d	mm	594	594	594	594	594	594	594	594	594
e	mm	255	255	300	255	255	300	255	255	255
f	mm	198	198	153	198	198	153	198	198	198
g	mm	66	66	66	66	66	66	66	66	66
h	mm	402	402	402	402	402	402	402	402	402
* possible additional insulation plates (phase insulation) required in the panel; not included in the scope of delivery										

Table 5 (Measurements in mm)

7.2 Circuit-breaker NVL

The selection and representation of technical data is in accordance with the guidelines for the selection of circuit-breakers IEC 62271-100 item 8.

Permissible rated operating sequence		O-180 s-CO-180 s-CO O-0.3 s-CO-180 s-CO O-0.3 s CO-15 s-CO
Rated frequency	Hz	50
Mechanical switching delay	ms	< 45
Opening time	ms	< 55
Arcing time	ms	< 15
D.C.-component	%	33
Switching oeprations, max. permissible / hour		40
Mechanically admissible switching cycles		10 000
Ambient temperature	℃	-5 to +40
Ambient temperature, mean peak value of the 24-h-average	℃	+35
Relative humidity, measured over 24 h	%	maximum 95
Relative humidity, measured over 1 month	%	maximum 90
Weight	kg	55-150 (depending on version)
Altitude, maximum	m	1000[1)]
Minimum command time	ms	50

Table 6

1) For installation at higher altitudes a correction factor must be considered for the voltage values.

Unit	**kV**			**kA**				**A**				
Rated values	**Rated voltage**			**Rated short-circuit breaking current**				**Rated current**				
	12	17.5	24	16	20	25	31.5	630	1250	1600	2000	2500
	Rated power frequency withstand voltage			**Rated short-circuit making current**								
	28	38	50	40	50	63	80					
	Rated lightning impulse withstand voltage			**Rated short-time withstand current 3s**								
	75	95	125	16	20	25	31.5					
	Transient recovery voltage			**Rated peak withstand current**								
	20.6/ 61 µs	30/71 µs	41/87 µs	40	50	63	80					
Switch type												
NVL2	●	●	●	●	●	●	○	●	●			
NVL3	●	●					●		●	●	●	●

○ only up to 17.5kV

Table 7

7.3 Trip element and blocking magnet

	Trip element ON (Y1)	Trip element OFF Shunt release (Y2, Y3, Y6)	Trip element OFF Undervoltage release (Y4)	Electric closing lock-out (Y7)
Rated voltage U_r	Power consumption [A]	Power consumption [A]	Power consumption [A]	max. power consumption [A]
24 V DC	2.20	1.30	0.60	0.58
48 V DC	1.20	0.64	–	0.31
60 V DC	0.95	0.51	0.25	0.26
110 V DC	0.5	0.29	0.13	0.16
220 V DC	0.25	0.14	0.07	0.08
100 V AC	–	–	0.16	–
110 V AC	0.56	0.26	0.15	0.17
230 V AC	0.26	0.13	0.07	0.10

Table 8

"Transformer operated trip 0.5 A", "1A" (Y5)
Nominal trip element data:

Rated voltage	24 V DC
Winding resistance	40 Ω

Technical data for application as transformer operated trip:

Rated power	≈ 13 VA
min. required power for tripping	≈ 3 VA

Trip mechanism for protection systems with power pulse output (Y5)
Nominal trip element data:

Rated voltage	24 V DC
Winding resistance	40 Ω

Technical data for application as low-energy trip:

Power input during tripping	6 ... 10 W
Minimum duration of rectangular pulse	50 ms
Tripping energy	0.3 ... 0.5 Ws

7.4 Auxiliary switch (Q0)

The auxiliary switch is available in two different versions. The standard design has 5 make contacts and 5 break contacts; the extended version has 10 make contacts and 10 break contacts.

Rated insulation voltage: 250 V AC/DC
Degree of protection: 3 acc. to IEC 60947-1
Uninterrupted current: 8 A

Breaking capacity			
Rated voltage U_r AC/DC [V]	Rated current I_r AC [A]	Rated current I_r DC [A]	
		resistive load	inductive load (T=20 ms)
up to 220	8	8	8

Table 9

7.5 Wind-up motors (M1)

Rated voltage Ur	Power consumption [A]	Starting peak current [A]	Max. tensioning time with rated voltage [s]
24 V DC	2,40	7	7
48-60 V DC	1,20	4	7
110-125 V DC	0,65	3	7
220 V DC	0,25	1	7
100-110 V AC	0,65	3	7
220-240 V AC	0,35	1	7

Table 10

7.6 Tightening torques

Thread Nominal diameter	Screw joints Strength class 8.8	Welded Stud bolts
M5	6 Nm	-
M6	10 Nm	5.9 Nm
M8	25 Nm	14.7 / -0.2 Nm
M10	49 Nm	-
M12	86 Nm	-

Table 11

Note!

The values in this table do not apply for tightening torques specially mentioned in the documents.

7.7 Materials

Metals	Steel, copper, aluminium, zinc, silver
Plastic materials	PA, PE, fabric-based laminate, cast resin
Miscellaneous	Aluminium oxide, lubricants, oils, greases, ceramics

Table 12

7.8 Regulations and standards

Circuit-breakers of series NVL2, NVL3 have been type approved acc. to IEC 62271-100.

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