Outdoor circuit breakers
OSM
Tavrida Electric

three-pole design
rated voltage 15.5 and 27 kV
rated current 630 A

DRIBO, spol. s r.o.

Pražákova 36
619 00 Brno
Czech Republic

Tel.: +420 533 101 111, **Fax:** +420 543 216 619, **E-mail:** dribo@dribo.cz, **Internet:** http://www.dribo.eu

OSM type vacuum circuit breakers

The OSM outdoor circuit breaker (recloser) from Tavrida Electric is intended for automatic switching in power networks, and to serve as outdoor circuit breaker in power distribution stations for voltages up to 27 kV.

The OSM circuit breakers are distinctive by their highly reliable switching mechanism. Conventional circuit breakers use a rather complex operating mechanism for the transfer of forces from the actuator to the main contacts, and moving contacts are kept in ON and OFF positions by mechanical latches exposed to critical stresses which are the main reasons for defects.

The Tavrida Electric vacuum circuit breakers feature an extremely simplified switching mechanism, with particular focus on the minimization of the number of mechanical components.

Contact erosion is kept at a minimum owing to the switching process taking place in axial magnetic field. All switching elements are aligned in one straight axis symmetrical line, which means that all mechanical movements are direct and linear.

The OSM uses a well-sealed and insulated vacuum switching module, encapsulated in an aluminium tank and being the result of the “combined insulation” concept. The concept is based on the capability of the insulation barrier to slow down the spreading of the main discharge. Each live part is all the time surrounded by this insulation barrier.

The OSM reclosers are using up-to-date materials, such as silicone rubber for connections and flexible parts, polymers for solid structures (which provide the product with mechanical resistance). The processing of the materials takes place in specially developed high-pressure casting molds to eliminate the emergence of cavities which might give rise to difficulties related to partial discharges.

The weight of the vacuum circuit breaker module from Tavrida, along with the robust aluminium tank is approx. 70 kg.

The result is a recloser with by far the most compact size and lightest weight. In addition, there is no oil or SF6 gas used in the switching device thanks to which the environmental risks can be eliminated. Patented combined insulation delivers an environmentally friendly product.

Key benefits of the circuit breakers

The Tavrida Electric vacuum interrupters combine a simple structure with extremely long mechanical and electrical lifespan.

The use of a specially designed axial magnetic field distribution provides for even current density between the contacts and, consequently, substantial improvement of the interrupting performance in vacuum.

Carefully selected contact material, expert contact design and optimized switching are the result of bounce-free contact closing.

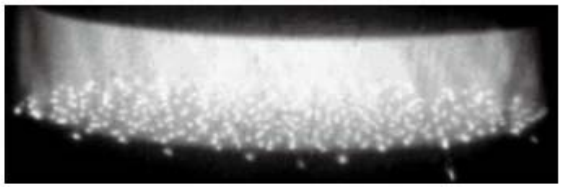
The substantially increased mechanical service life and reduction of the size of vacuum interrupters has been achieved by using steel sleeves composed from the individual discs welded together, in comparison with the traditionally used bent steel sleeve.

The result is 30 000 to 150 000 (applies for special design) C-O operating cycles at rated current, or 200 C-O cycles at maximum short-circuit breaking current without replacing or adjusting any part of the OSM circuit breaker.

The vacuum circuit breakers are entirely maintenance free over a total life expectancy of at least 25 years.

The OSM circuit breakers are designed with regard to a maximum compactness and minimum weight.

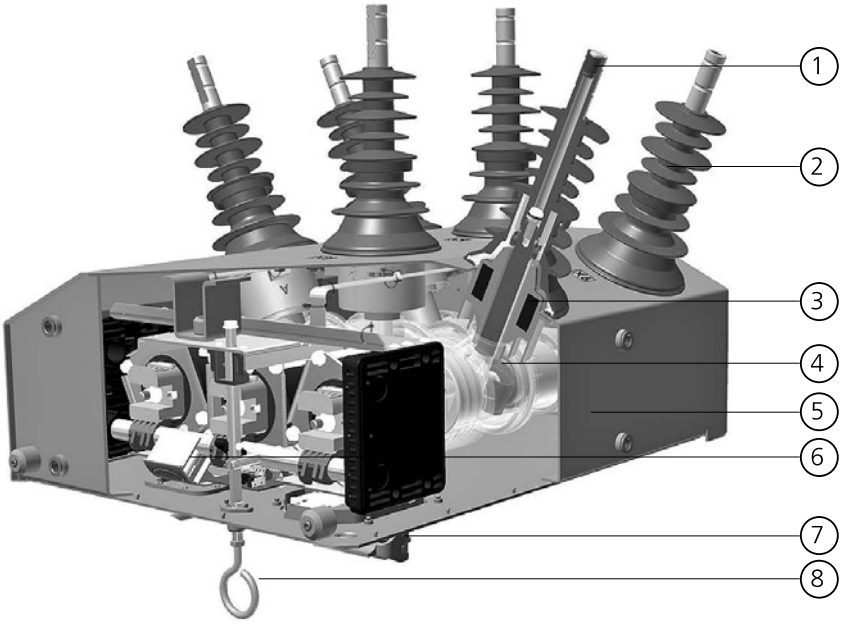
The vacuum interrupters are made from environmentally friendly materials, the disposal of which does not require any special procedures to be utilized..



Softly dispersed electric arc in vacuum owing to the effects of axial magnetic field.

Comparison of steel sleeves: composed steel sleeve of TEL type, welded together from individual discs.

Structural elements



1 - MV power terminals – the OSM can be equipped with various types of inlet terminals, such as the NEMA terminal blocks with two or four openings, or cable terminals.

2 – MV main circuit bushings – the OSM contains six main bushings made from a polymer resistant to UV radiation. The bushings are covered with light grey silicone rubber that ensures creepage distance of 500 mm for 15.5 kV bushings, and 860 mm for 27 kV bushing version. The bushings are clearly marked with labels carrying the terminal marking X1, X2, X3 at the input side, and X4, X5 A X6 at the output side.

3 – Current transformers in sleeves – in one set of sleeves in the box there are three built in current transformers. The CT in the middle is connected with the control cabinet.

4 – ISM vacuum circuit breaker module – the vacuum interrupter is situated below a cover made from polycarbonate.

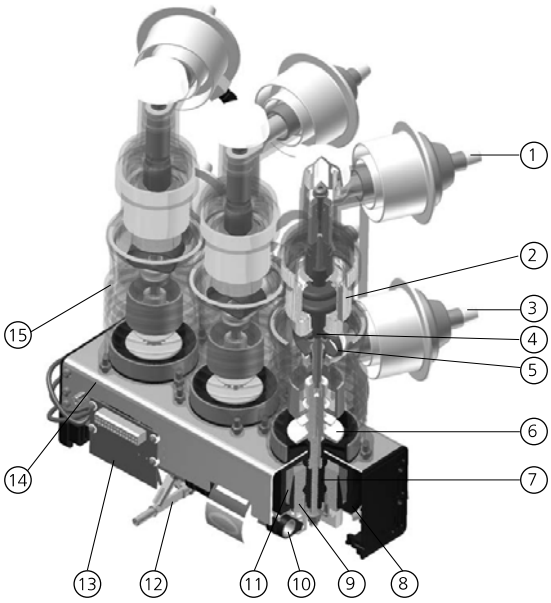
5 – Protective tank – the tank with protective function is made from aluminium alloy and coated with light grey (RAL 7038) powder coating. The tank features the protection degree of IP65.

6 – Mechanical indicator of the position of main contacts – The position indicator is located on the base of the tank, under protective cover, and is clearly visible from the ground. In case the circuit breaker is ON, the indicator is red (I). The OFF (0) position is indicated in green.

7 – Connector – the cover of control cable serves as a protection element for the terminal board.

8 – Manual (emergency) trip operation mechanism – the lever for manual switching OFF is situated in the base of the tank. When the lever is pulled down, the OSM mechanically trips, i.e. switches into OFF position, and becomes electrically locked against switching ON. The OSM remains locked and cannot be operated until the lever with hook is pushed back into the ON position.

Vacuum switching module



1. Upper power terminal
2. Vacuum interrupter
3. Lower power terminal
4. Movable contact with sealing bellows
5. Flexible conductive junction piece
6. Insulated pull rod
7. Opening and contact pressure spring
8. Magnetic actuator (drive)
9. Armature
10. Synchronizing shaft
11. Magnetic actuator coil
12. Interlocking pins
13. Auxiliary contacts
14. Supporting structure
15. Insulators

Switching principle

In the OFF state the contacts of the vacuum circuit breaker are maintained by the force of the opening spring. The opening spring is situated in the inside of magnetic actuator. The contacts of the vacuum circuit breaker are actuated by current pulses supplied from capacitors in the control module and fed directly into the coil of the actuator.

Current flowing through the coil generates magnetic flux in the gap between the magnetic circuit core and the anchor of the actuator. Increasing current flow increases the magnetic flux and thence the attractive forces between the core and the anchor. The anchor, the insulated pull rod and the movable contacts are on the move.

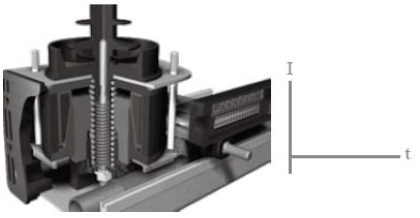
As soon as the anchor comes close to the upper side of magnetic core, the air gap decreases and the magnetic forces further increase. The anchor speed, along with the movable contacts increases to 1 m/s. At this speed the contacts respond optimally, without bouncing, and the possibility of electric arc generation in the vacuum still before contact closure is reduced.

If the power contacts are closed, the movable contacts are in idle state, but the anchor is all the time pushed back by the force of the compressed spring. In the end position the anchor is kept by forces generated by saturated permeable material of the core. The saturation of the ferromagnetic material is strong enough to generate a magnetic flux which is capable of keeping the anchor in ON state, despite the fact that there is no more electric current flowing through the coil.

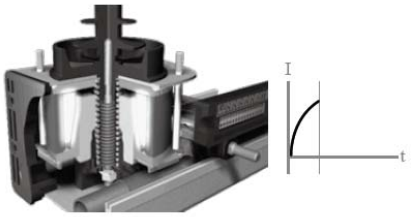
In ON state the contacts of the vacuum circuit breaker are held by the force of the magnetic drive. It could be shown by intensive testing that the residual flux of the ring-shaped magnet is strong enough to keep the actuator in ON state even in environments affected by vibrations.

Tripping of the vacuum circuit breaker requires a small current of reversed polarity supplied by the control module, which then flows during 15 to 20 ms through the coil. This current partially demagnetizes the ring-shaped magnet and reduces the magnetic holding force of the anchor. Reversing forces of the compressed tripping spring and forces of the pressure spring are acting on the anchor, release the moving contact, and significantly accelerate the tripping of the circuit breaker.

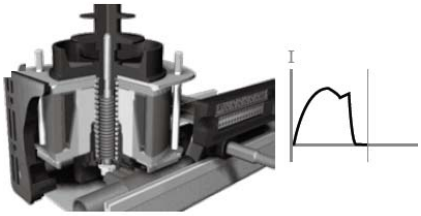
The OSM can also be tripped by manually turning round the synchronization bar. The attractive magnetic forces of the ring-shaped magnet are now acting on the anchor which starts to move. With the increasing air gap the tripping and contact holding springs overcome the magnetic attractive force and the vacuum circuit breaker switches OFF.



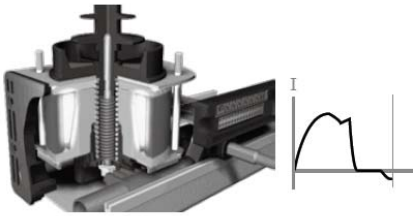
ISM in OFF state



ISM in OFF state- the excitation of the magnetic drive coil is about to start.



ISM in ON state



ISM in ON state – magnetic actuator is excited and ready for tripping.

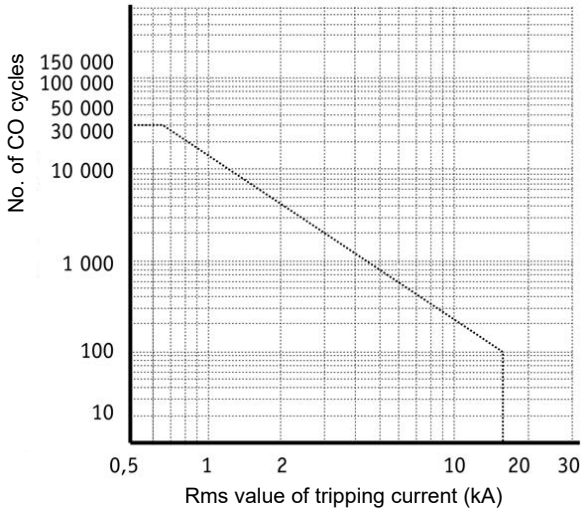
Technical data

Basic operating parameters		OSM15_AI	OSM25_AI
Rated voltage	kV	15,5	27
Rated current	A	630	630
Rated frequency	Hz	50 / 60	50 / 60
Rated power frequency withstand voltage, 1 min dry	kV	50	60
Rated power frequency withstand voltage, 10 s wet	kV	45	50
Rated lightning impulse withstand voltage (peak)	kV	110	125
Partial discharge level (at 10 pC)	kV	13,2	16,4
Rated short-circuit breaking cu	kA	16	12,5
Rated peak withstand current	kA	41,6	32,5
Rated short-time withstand current	kA	16	12,5
Rated duration of short ciruit	s	4	4
Cable line breaking current	A	25	31,5
Overhead line breaking current	A	10	10

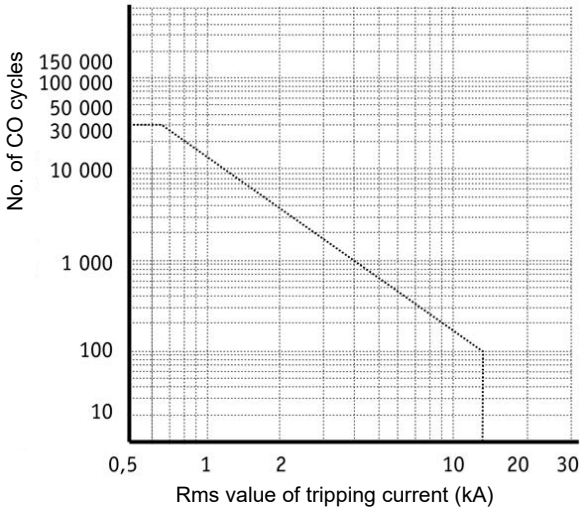
Switching performance	OSM15_AI	OSM25_AI
Mechanical life (CO-cycles)	30 000	
Operating cycles, rated current (CO-cyles)	30 000	
Operating cycles, rated-short circuit breaking current (O-oper.)	100	100
Closing time, not more than	77 ms	
Breaking time, not more than	43 ms	
Interruption period	23 ms	
Rated switching sequence	O-0.3s-CO-10s-CO-10s-CO	

Other data	OSM15_AI	OSM25_AI
Number of auxiliary contacts	3NC + 1NO	
Resistance of the main circuit (no more than)	85 μΩ	85 μΩ
Highest operation temperature	+55 ºC	
Lowest operation temperature	-40 ºC	
Sun radiation intensity	≤ 1,1 kW/m^2	
Protection degree	IP65	
Operating altitude, max	3000 m (at altitudes above 1000 m the insulation level needs to be re-calculated using a formula in the standard)	
Weight	68 kg	72 kg
Creepage distance	500 mm	860 mm

Service life curve of the OSM circuit breaker

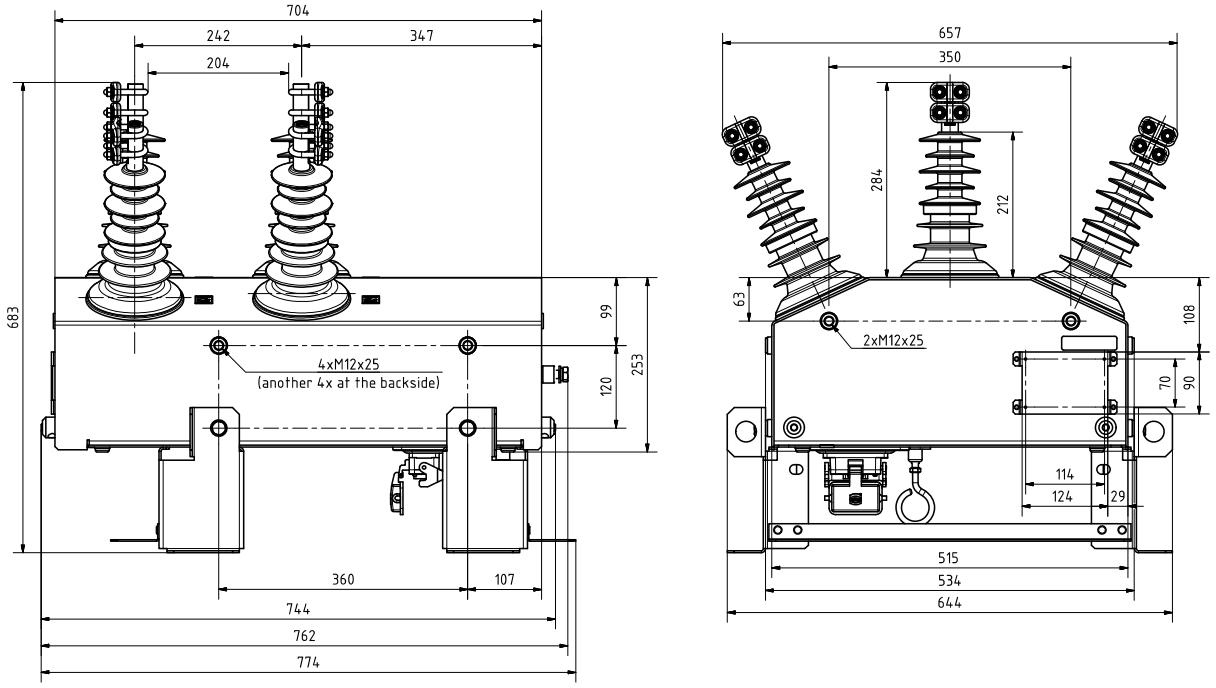


OSM15_AI

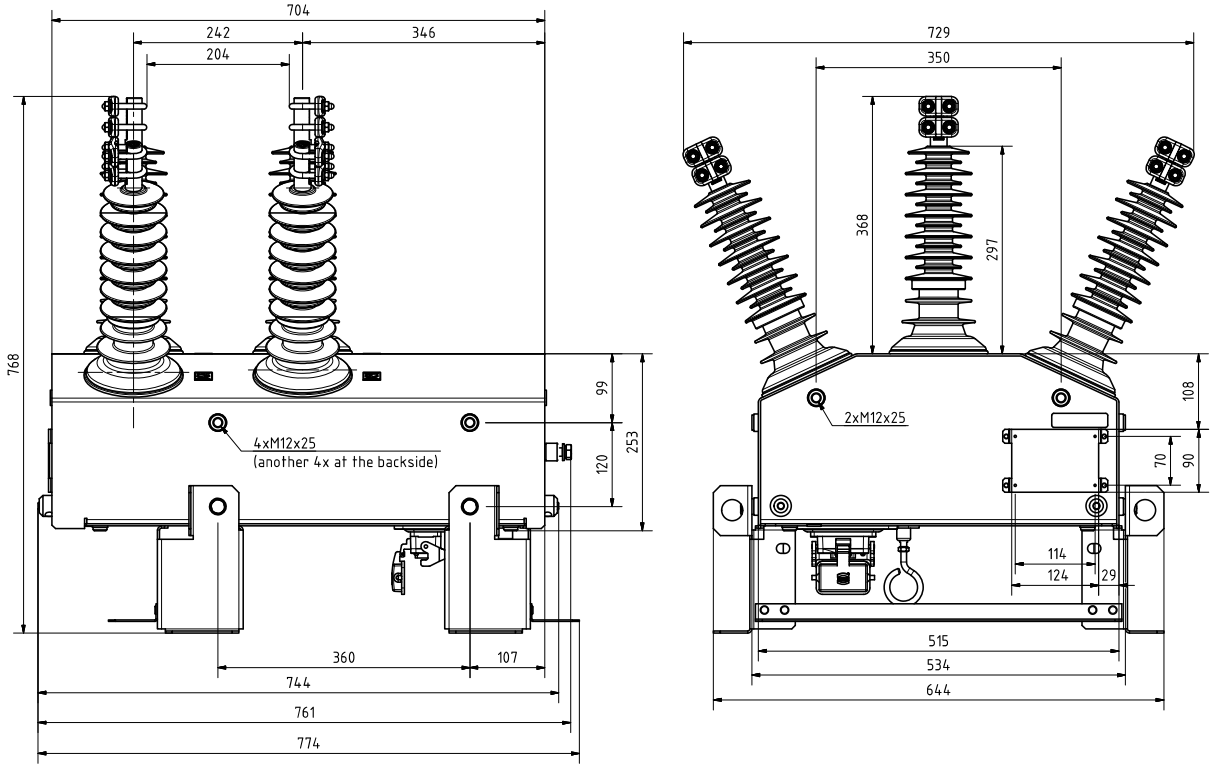


OSM25_AI

Dimensional drawings



OSM15_AI circuit breaker



OSM25_AI circuit breaker