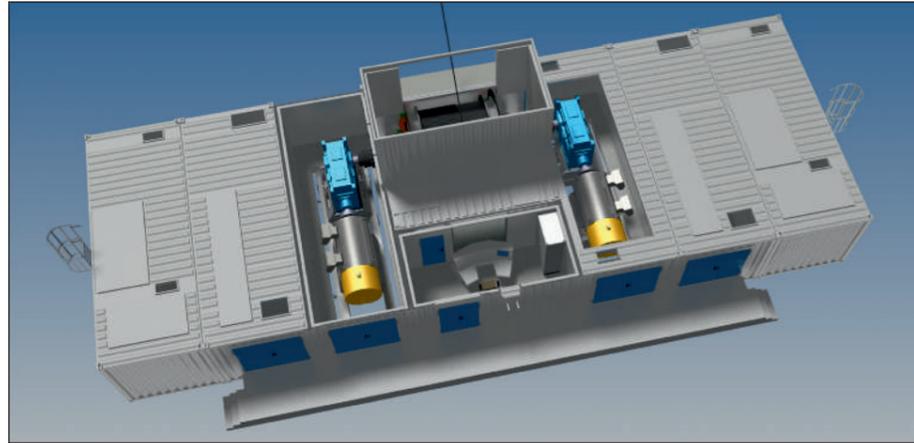
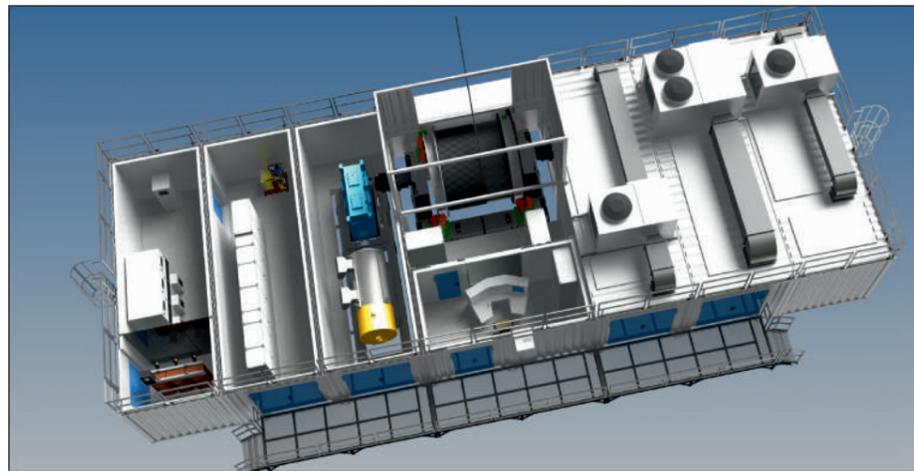


of voltage 3 x 690 V, 50 Hz. Both AFE converters are produced by Rockwell and are of the same type, and provide a full four-quadrant control of motor no.1 or motor no. 2 respectively. Each of the AFE inverter consists of two parallel-connected converters, DC link (voltage 970 V) and the inverter of output voltage of 0 to 690 V, 0 to 50 Hz. In a situation where both the motors are in operation, the AFE converter, supplying the motor no.1, operates as the master and controls the speed of the entire system (i.e. both motors), while the AFE converter of motor no.2 acts as a torque servo synchronized with the converter of motor no.1 using a synchronization line (synchrolink).



If the winder is operated at reduced power mode, the corresponding driving motor is powered by the corresponding AFE converter and the other half of the drive is idle (driving motor is geared to rotate freely). In addition, in these containers there are cooling units of oil filling of the gearboxes.



The third container from the left, and the third container from the right, is the location of the drives. Each of the drives is formed by a common anchoring frame, on which the gearbox and the electric motor are mounted. Three-stage bevel gear type B3SH21 (size A12, 5) are used with external cooling system of the oil filling. Asynchronous motors are used for the drive, each rated at 1,250 kW (741 min⁻¹, 1350 A, 690 V, 50 Hz). Connection of the gearbox and engine is ensured by torsion suspension clutches, and the connection of output shafts of the gearbox with the main shaft of the winding system is ensured by jaw clutches. Three central containers contain the winding system (winding drum, main shaft, bearing pedestals, pedestals with brake units) on a common anchoring frame, and also + RB switchboard of the electrohydraulic brake system Reprimatic HR15K and, in a separate container, the control panel +RT of the machinist, together with the +RA control switchboard.

Individual design option

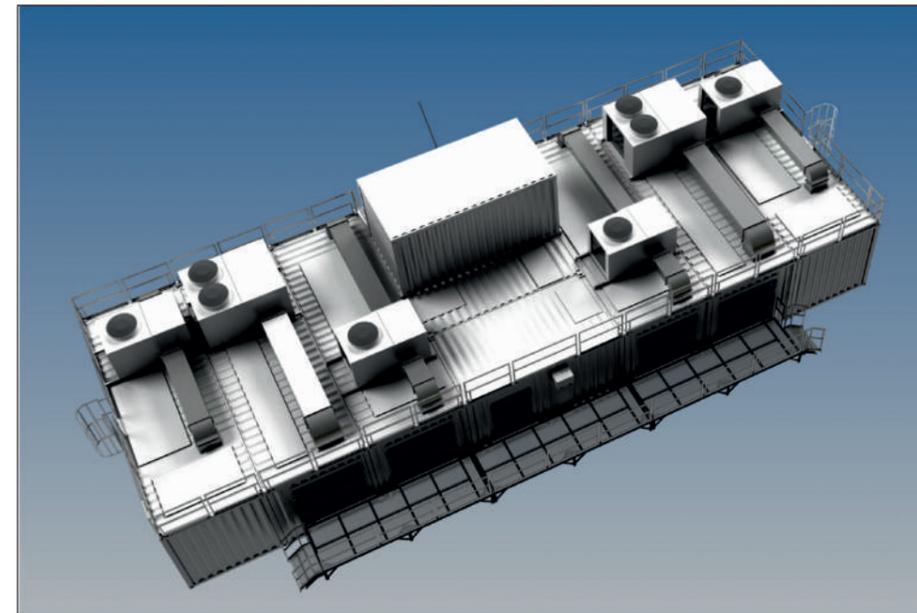
As mentioned above, winders in container design may be supplied in a different configuration and with different technical parameters compared to the type 1B2622/CS – upon request of the customer and their needs.

① **Terminological note:** Only for the purpose of this document, the term *transport container* (skips, cages, etc.) has been replaced by the term *transport receptacle* to avoid confusion with the container in which the winder is transported.

Winders in container design

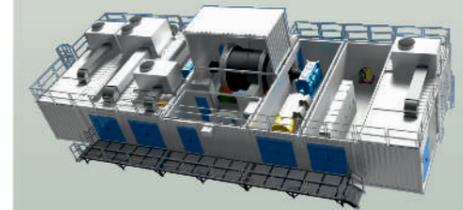
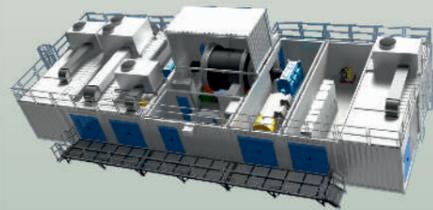
Range of application

Winders in container design are primarily intended for shaft sinking, i.e. for the transport of extracted material and transport of people in a *transport receptacle* (see *explanatory note*). In conjunction with an equipment cage it is also used for mounting of shaft equipment. In the case of replacement of a transport receptacle or equipment cage a transport receptacle of suitable type (cage or skip), these winders may also be used for regular transportation of people, materials, or auxiliary extraction. Winders in bin design may be delivered to the customer in single or double drum design. The drive is asynchronous – single or double motor - via one or two gearboxes. **The type of a winding system, the number of motors and their power, as well as other essential parameters (speed, depth, maximum static force in the rope, power-supply system, etc.) are selected based on customer's requirements.** As regards the supply system it is possible to supply winders for **different supply voltage** (10.5 kV, 6 kV and others) **with different frequency values** (50 Hz and 60 Hz).



Advantages of the solution

The biggest **advantage of winders in container design is their easy mobility.** Mechanical and electrical part of the winder, including HV switchgear, is built in 6 containers for a single-motor design, and in 9 containers for a double-engine design; the containers may be individually transported by truck or rail. For their **establishment and anchoring a simple reinforced concrete slab is sufficient** – only one winding system requires deeper anchoring. The concrete foundation must contain grounding electrodes. Containers on the slab are set up, levelled, and bolted to each other at sealed contact points. Each container has a raised floor and within the space between the bottom of the container and its raised floor there is a cable duct. The floor of the containers is formed by removable tiles, which allows unrestricted access to cable bundles, if necessary. These are fitted with connectors with a corresponding protection at contact points; therefore the **assembly of the container set is easy, even in terms of the electrical equipment.** For convenient and safe access - due to the increased container floors - the longer side of the container set is fitted with a screwed-on service platform (forms part of the supply) with two access staircases which lead into the access door into the containers. Individual containers are fitted with sealed roof girders in places above the switchboards and drives, which enable easy removal of individual components, if necessary. Roof of the container sets of the extraction winder is equipped with guard rails and to enable access to it there are ladders with safety cage on two sides. The containers are **well insulated** and equipped with heating panels for heating, as well as with industrial air conditioning units, which provide ventilation and cooling. **This allows the winder in container design to work in a wide range of ambient temperatures from -40 to +40°C (-40 až +104°F).** After completion of sinking and shaft equipment works **the set may easily be disassembled and individual containers including accessories transported to another place of use.** Installation and preparation for operation of the winder in container design **consumes minimum time, same as its disassembly and preparation for transportation.** In addition, this version of the winder is **able to work autonomously without the need for extensive technical background.**



Other advantages include the **installation of an automatic fire protection system**, which is fitted as standard. Using fire detectors, this system monitors the whole container set and ensures not only the actuation of a fire alarm, but also self-activated fire extinguishers (they are installed in two containers, in which the oil cooling units for gearboxes are located). The other containers are equipped with manual fire extinguishers.

Scope of mechanical and electrical part

The mechanical part of the winder in container design consists of:

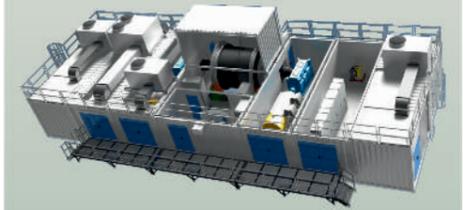
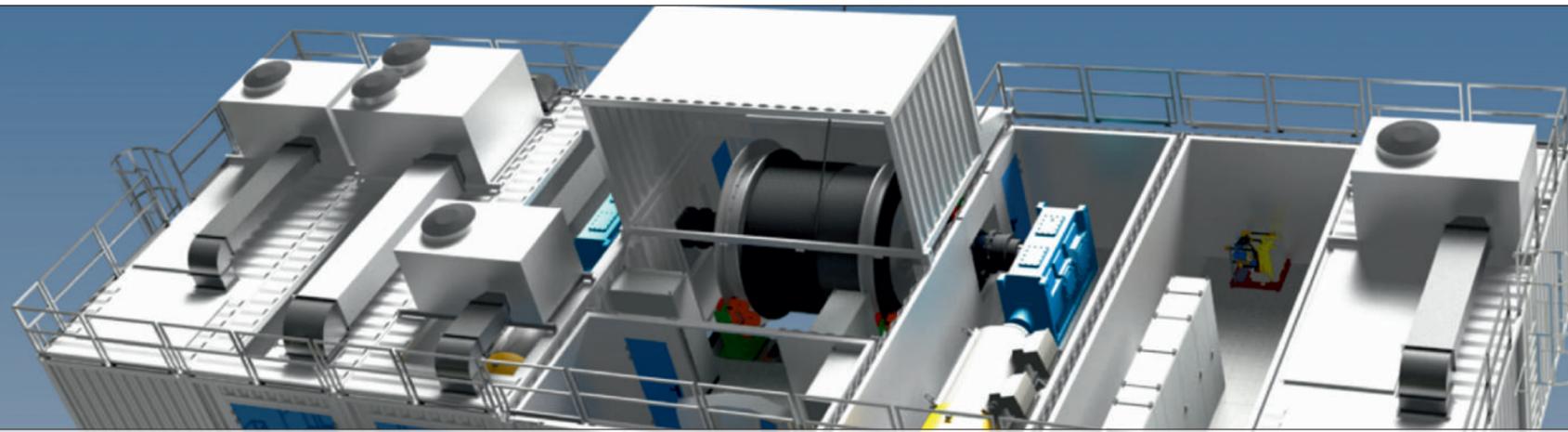
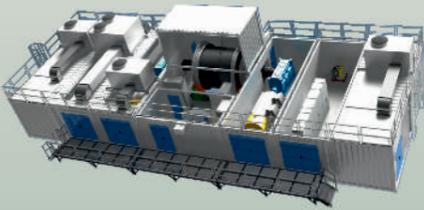
- 1 anchoring frame of the winding system,
- 1 winding drum with two brake discs,
- 1 main shaft with bearings,
- 2 frames for the motor drive and gearbox,
- 2 gearboxes,
- 2 torsionally-sprung clutches (motor-gearbox),
- 2 jaw clutches (automatic - hose reel),
- 4 brake pedestals fitted with disc brake units,
- 1 switchboard +RB cabinet with electrohydraulic brake system HR15K for power-supply and control of the brake units
- 2 cooling units for the oil filling of the gearbox

In the case of implementation of single-motor option, the number of gear boxes, elastic couplings, gear couplings, cooling units and frames for the drive and gearbox is reduced from two pieces to one.

Technical description

So far there have been produced and delivered two identical winders in container design type 1B2622/CS for the needs of the Russian mining company OOO Eurochem Volgkallij, and the delivery of two other sets to the Russian market is currently under negotiation. The following technical description and specifications are referring to the winder of this type.

Winder type 1B2622/CS is a single-drum double-motor winder, which is installed in the set of 9 containers. The winding drum is fitted with a metallic lining type Lebus for multilayer winding. It is equipped with two brake discs and through the main shaft it is supported on two bearing pedestals. Double row self-aligning spherical roller bearings are used which are greased using a microprocessor-controlled automatic lubrication system. Operating on each of the brake discs there four brake units type Svendborg (eight units in total), which are hydraulically powered and controlled by electro-hydraulic braking system Reprimatic HR15K. Winder is powered through two gearboxes by two asynchronous drives with a total output of 2 x 1250 kW. Each of the asynchronous motors is powered and controlled by the AFE converter manufactured by Rockwell. Superior control of the winder and brake system, as well as implementation of all necessary safeguard, is ensured by a set of three programmable controllers from Rockwell type CompactLogix that operate in a redundant communication network. The control panel of the machinist is digitized with joystick control of the drive and brakes. It is equipped with two touch screens, which visualize all operating and fault conditions. An advanced system of central visualization of operating and fault conditions ensures diagnostics of the entire winder and its accessories. In addition, the Transdatik system is implemented on the winder that allows remote monitoring, management, and adjustment of parameter settings from a central service of INCO engineering, which considerably speeds up the implementation



Technical parameters (valid for winder type 1B2622/CS)

Maximum static force in the rope	250 kN	Brake units	8 x BSFH 515
Maximum depth	1200 m	Working pressure of the braking apparatus	145 bar
Transport speed – extraction / people / inspection	8 / 6 / 1 m/s	Gearbox	2 x B3SH21
Nominal winding drum diameter	2600 mm	Total power	2 x 1250 kW
Nominal width of the winding drum	2200 mm	Supply network	10,5 kV, 50Hz
Winding rope diameter	40 mm	Total weight (approximately)	187 tun
Number of winding layers	3	Highest point of the assembled container set	6000 mm
Ground plan dimensions of the assembled container set	23900 + 1695 (ladders) x 8600 + 1650 (platform) mm		

The electrical part of the winder in container design consists of:

- 2 asynchronous motors,
- 2 HV switchboards,
- 2 converter transformers,
- 2 frequency converters AFE +UA,
- 1 switchboard +RM1 of auxiliary drives
- 1 switchboard +RA for control and safeguard,
- 1 control panel of the machinist +RT,
- 1 set of cables,
- 1 set of sensors.

In the case of implementation of single-motor option, the number of motors, +HV switchboards, transformers and frequency converters is reduced from two pieces to one.

of service.

Deployment in containers

In the extreme left and the extreme right container of winder type 1B2622/CS there is a HV switchgear and converter transformers. As HV switchgear, two three-pole switchgears of the same type are used, produced by Schneider. One field of each of HV switchgears is always for the supply (SEPAM type of protection), one field contains a connector (for switching between two independent 10.5 kV, 50 Hz inputs) and one outlet field (SEPAM type of protection). Each field of the HV switchgear is equipped with a high-voltage switch, circuit breaker, and earthing. As converter transformers, two identical double-winding three-phase transformers are used of 10.5 / 0.69 kV.

In the second container from the right and in the second container from left there are switchgears of AFE converters that are powered by the converter transformers

