COMPACT KIOSK-TYPE TRANSFORMER STATION GRÄPER
PKP 630

Basic technical specifications:

- HV nominal voltage: 3 AC 22 kV 50 Hz
- LV nominal voltage: 3/PEN AC 420/242 V 50 Hz / TN-C,
- Frequency: 50 Hz
- Transformer nominal power: to 630 kVA
- HV bus-bars nominal current: regarding to HV switchgear type to 630 A
- LV bus-bars nominal current: to 1000 A
- HV/LV distributor nominal insulation voltage: 24 kV / 1000 V
- HV distributor short-time / dynamic current: 16 kA / 40 kA
- LV distributor short-time / dynamic current: to 25 kA / to 60 kA
- LV distributor cover: IP 20
- Whole station cover: IP 23D
- Temperature coefficient (cover class): K 20
- External dimensions (LxWxH): 3000x2100x2560 mm
- Empty skeleton weight with the door: cca 8300 kg
- Environment: 3.1.1. basic (inside the kiosk-type TS room),
  4.1.1. external, ordinary (outside the TS room)
- Exposure. class: for internal components: XC1; for external components: XC4, XF1, XA1.
- Operating conditions: ambient temperature $-40°C \leq t \leq +40°C$
  altitude up to 1 000 m asl.

Note: If the transformer substation is used in different climate and operating conditions, the TS supplier has to be consulted.

Electrical current injury prevention: (STN EN 33 3201, STN EN 33 2000-4-41)

- in normal operation mode (of the live parts): in HV system by: 4.1.1 – out of reach placement
  4.1.1 – live parts insulation
  4.1.1 – barriers cover
  in LV system by: 3.7.1. live parts insulation
  3.7.2. barriers or covers
  3.8.5. out of reach placement (position)

– in case of failure (of dead parts): in HV system by: 4.2.5. automatic feed disconnection with quick IT networks disconnections to be off (with low imped. neutral TR grounding)
4.2.9. bonding – uniform potential installation
in LV system by: 3.2. automatic feed disconnection
3.6.1. additional protection by residual current device (TS install.)
3.6.2. additional protection – additional protecting bonding

Station construction:

Externally controlled compact kiosk-type transformer substation is partially flush-mounted, suitable also for placing in sloped terrain, with external dimensions of 3000x2100 mm, total height of 2560 mm, clear height of 2310 mm, ground sinking depth of 700 mm, over ground height of 1 860 mm (with flat roof). Self-supporting construction of the TS is by default made of reinforced concrete Gräper LC 30/37, with 8/12 granularity. Steel reinforcement frame is composed of steel bars and mats, it is bilaterally welded and conductively connected together and takes part in bonding, grounding, or even lightning protection system. The installation of the station skeleton does not require any foundations, but only a well flushed and rammed out cut. The transformer substation is type-approved, conforming to the STN EN 62271-202 norm and meets the resistance tests against internal arcing fault of the German PEHLA directive.

Station construction a compact unit comprised of two monolithic parts: basement tank with sidewalls and a flat roof.

Basement tank with sidewalls: made of waterproof and oil proof concrete (crack width up to 0,2 mm guaranteed) as an oil catch tank. The construction resistance against strong chemical action of liquids, cnforms to the DIN directive. The tank serves as the foundation for the non-freezing part of the TS and for lifting the whole station by means of 4 anchor points (sealed chasing nuts) RD 30, placed in the longer sides of the TS (as viewed on „A", "C"). In order to join the external grounding two M12 points of HV/LV switchgear are led from the sidewalls of the station.The bell casting method was used to construct the tank and door frames, thus creating a monolithic unit which meets requirements for the impermeability of water and oil substances. All surfaces of the transformer substation touching the ground and cable feeder entry and exit seals are painted by two layers of black penetrating insulation paint, and the basement tank can be treated with waterproof and impermeable coating from inside upon customer request.

HV and LV cable entry holes are made on production in the lower part of the body (HV or LV distributor´s side). After cable installation, the entry holes are sealed by Hauff press fittings (e.g. HSI 150 D3/60 or HSI90 D1/82) with corresponding number and diameter of the entry neck (according to cable type), which is fitted by bayonet lock and covered with thermal shrinking plastic sleeve. Upon demand a system lid with a neck with a sleeve for sealing the cable protector (FXKV...) or thermal shrinking sleeve may be delivered or substituted by cold shrinking sleeves. Unoccupied inlets are sealed with system lid with bolt sealing and bayonet lock. Opening for the side entry of a temporary LV outlet (eg. Gräper system BD Ø 12 or Hauff-BD) is made in the LV distributor chamber.
The entry space for HV and LV cables (cable chamber) is separated from the HV and LV distributor space by a metal or plywood board with pre-drilled holes and the distributors are placed on a stell construction.

Internal walls are treated with white washable paint by default. The surface finish of the external walls is to be selected by the customer from the following selection:

- concrete with bare filler (exposed aggregate concrete) with 8/12 granularity,

- raw concrete in final finish colour according to the RAL colour palette,

- plastered concrete with material (scraped finish), or material Rollputz (rolled-on plaster), in final finish colour according to the RAL palette of colours,
- stone facing (for example Dupa-Stone), facade bricks, wood of other material as required by customer

Roof: connected to the walls from inside at 4 points by screws and overlapping the wall contour by 9 cm. The roof can be lifted by 4 anchor points (sealed chasing nuts) RD 18. In order to increase the

protection of the concrete surface against humidity, the upper roof is covered with additional hydrophobic coating, which fills capillary pores and acts against the hygroscopic properties of the concrete.
Surface treatment of the roof can be made of exposed aggregate concrete or fair-face concrete with rough surface and paint according to the RAL palette of colours, the shape of the roof (flat, saddle) is optional as well.

Door: All metal parts including doors, frames, and ventilating parts are made by default of hot-dip galvanized 1,5 mm thick sheet steel, basic paint and two layers of the finish paint in RAL 7032 colour palette. The door is equipped with armour including external knob and internal handle with plastic lock cover and a pawl for fixing the door in open position at a 95° angle. For arrestment – the locking, bob weights and point-to-point bars are used within each door wing frame (four- point locking system Gräper). The lock is adapted for standard lock inserts. The outer side of the door is covered by warning plates in terms of the valid EN.
Optionally, the door and ventilating parts can be made of anodized aluminium and 2 lock inserts can be used for double lockout.

The access to the HV and LV switchgear of the substation is provided by a single wing doors with full air exchange (slit shades Gräper with approved DIN 40 050 V2A safety level) with internal dimensions WxH of 855x 1 440 mm, on the HV/LV transformer´s side there is a double wing steel door with partial air exchange system and internal dimensions WxH of 2840x1440mm. The door is equipped with an arresting pawl for fixing in an open position and door wings are connected with the frame by a green-yellow copper conductor with 16 mm^2 cross-section area.

Air exchange: The air vents for TR air exchange are placed in the single-wing door to the TR and in the double wing door to the distributor space on the LV distributor side. Air vent size is designed to provide sufficient air exchange and transformer cooling. Air vents are equipped with grid (lamellas - blinds Gräper) and net against foreign bodies.

Grounding:

Internal grounding of the TS is composed of:
- **bonding bar** (BB) Cu 30x4 mm with clips M12, located on the spreader insulator 1 kV, which is directly connected with all the technological components of the TS (vessel of the TR distributors tanks of the HV, LV, metal shield of the HV cables, branch bar PEN) and with individual mounting components (construction components – tank and roof reinforcement, frames, door, grate, conducting „U"- beam of the transformer, bearing structures of the distributors...) by Cu conductor with S_{min} 30 mm^2. Each conductor of the grounding connected to BB is labelled.
- **earth artery** implemented by strip conductor Fe with S_{min} 125 mm^2, being part of the TS reinforcement and it is cast directly in the external walls and kiosk´s beam, connecting the common points of the grounding. Flexible parts are connected by appropriate Cu frame copper line or grounding Cu cable with min. section of 16 mm^2.
- **2 nodes of the grounding feeder** by Hauff HDE-M12/X to connect the external grounding (in general line FeZn 30x4 mm) to the bonding bar (form internal part of the node through connecting screw M12-St 37 Zn, form external part of the node through **test clips** of the **SZ1, SZ2** grounding with screw M12). Grounding feeder nodes are generally lead out on the front wall of the distributor chamber.

Transformer substation in the standard finish is not equipped with an external lightning rod, as it is a ground object mostly located close to other higher objects. All the metal reinforcements built into the corresponding parts of the TS (roof, walls, false ceiling, basement tank) are welded into a single unit, using conductive attachments (e.g. Cu lines 35 mm^2). Reinforcements are welded together, thus creating a Faraday´s cage and after the installation of the roof can be immediately connected to the grounding. On customer demand, the transformer station can be equipped with with external lightning rod with one collector in the middle of the roof and two leads connected to the common TS grounding via test clips in terms of the valid STN, EN.

For each transformer station a common grounding system for HV and LV facilities must be constructed, its design needs to take into account the operating conditions – fault current value of the distribution network in the given region, power transformer node operation mode and local soil conditions (STN EN 33 3201, STN EN 33 2000-5-54, PNE 33 2000-1)

Installation:

The internal installation of the station includes interior lighting of the TS, consisting of 2 oval incandescent 60 W lamps fitted with gate switch in the distributor´s space of high and low voltage and 2 one-phase sockets of 230 V. Circuits feeding the lighting and socket installation are led out of the main LV distributor through installation breakers or are coupled with residual current device.
Further equipment – as specified by customer.

Internal TS space is divided into 2 compartments on the level of the basement tank: the transformer chamber and HV/LV switchgear space . The TS over ground part comprises a single common space, divided by supporting constructions parts into 2 separate compartments .

Transformer:

Oil, hermetic or dry-type transformers up to the power of 630 kVA may be used in the substation. In case of oil leakage the seat of the transformer is designed as an impermeable oil catch tank. If the transformer is equipped with bolster, it is fixed against side movement.Transformer insertion and removal can be performed through an entrance door or by crane if roof is removed. ax. dimensions TR (LxWxH) are: 2600x880x1800 mm.
Transformer cooling is atmospheric. Air exchange is provided by air vents at the bottom of the door of the transformer substation (on the transformer´s side) and in transformer chamber´s walls. Transformer´s protection against over current, or sthortcut is ensured:
a) on HV side – by plugs or by switch with safety relay
b) on LV side – by air breaker with the electric trigger

High voltage distributor:

In transformer substation it is possible to use all the types of the commonly produced covered HV gas insulated distributors SF6 (for example GA, GA-C by Moeller, 8DJ10, 8DJ20 by Siemens, RM6 by Merlin Gerin,...), or type-approved vacuum distributors up to the width of 1600 mm (depending on the required width of the LV distributor). Nominal current rating of the distributors is st to 630A depending on type, shortcut resistance (nominal short-time current 1s) up to 20kA, optionally up to 25kA. The HV distributor may be supplied by the customer or by the Gräper company including zinc-coated supporting construction and a construction for decreasing pressure in the arcing fault in the HV distributor conforming to PEHLA standards. Max. dimensions of the HV distributor (WxHxL) are: cca 1600x1400x800 mm.

Low voltage distributor:

Panel version of LV distributor is covered with IP 20. The feeder is equipped with air breaker depending on the transformer´s power, there are sank breakage bar switches (8-10 outlets with switches to 400 A and construction width of 100 mm for one TR, or adequate number of outlets with switches to 160 A and construction width of 50 mm), or circuit breakers. Outlet field is fitted with bar switches or breakers with max. attached cable section of 300 mm^2. Nominal current of the distributor is by default up to 1000 A, shorting resistance (short-time nominal withstand current 1 s) to 25 kA. Besides this, the distributor can include electric energy consumption monitor, circuits for station lightning and service socket. The clips can be grounded on the main breaker´s feeder („ball pivots“) Ø 25 mm, which allow to protect the working place during the maintenance on LV distributor via grounding tool (shorting set). Max. dimensions of one LV distributor (WxLxH) are ca: 1200x1650x400 mm.
Note: The number of LV outlets is limited by customer´s demands for LV distributor to be equipped with further devices such as monitors, etc.

The distributors meet STN EN 60439-1 norm and also DIN VDE 0660, part 500, VDE 0100, VDE 0414, UVV standard requirements.

Cable connections:

HV distributor is connected with the transformer through 24 kV single-core cables 24-N2XSY 3x1x35 mm^2 and LV distributor is connected with the transformer through 1 kV cables 1-NYY-O 1x150 mm^2, resp. 1x240 mm^2, or NSGAFÖU (identical with CHBU cable).

Within the production process the cable connections for high voltage are checked in each phase, it is also possible to make file TE tests of the fractional discharges in Gräper company´s own test-room, following VDE 0434, VDE 0472 technical norms. According to the regulations the prescribed value is TE ≤ 20pC. The real achieved value is ≤ 5 pC.

Transformer station construction specifications:

The station is constructed according to the norms and rules of STN EN, DIN, UVV etc., directly following the bellow given normative standards:

Cellular concrete	- DIN 4219
Reinforced concrete	- DIN 1045
VDE Directives	- DIN 0141, 0101, 0100
Directive on the protection of ground waters	- GwSchV

Federal directive on waste disposal - BimSchV
Electromagnetic radiation compliance - BimSchV č.26

Individual structural components of the transformer substation are made of uninflammable materials, fire resistance of the station construction meets STN 73 0821 (fire resistance class required is F90, class documented is F120).

Delivery, assembly, ground cut for station placement:

The kiosk-type transformer station is delivered assembled and prepared for HV, LV cable connection and grounding. It is installed by crane into a prepared pit with compressed and flat surface according to the design project of the transformer substation´s producer – Gräper company (ground cut dimensions: 360x210 cm, cutting depth: 90 cm, compressed layer thickness: min. 20 cm).