TECNICAS REUNIDAS TSK UTE TSK TÉCNICAS REUNIDAS ASHUGANJ NORTH	**Ashuganj Power Station Company Ltd. (APSCL)**	Ashuganj Power Station Company Ltd. APSCL

ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)

UTS PROJECT NO. 7485	**UNIT:**
PURCHASE ORDER NUMBER (P.O.R) : 0748512010	**EQUIPMENT : 400/230KV INTERBUS TRANSFORMERS**

REVIEW RESPONSE BY PURCHASER:

Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions:

☐ REJECTED	☐ Reviewed With Comments	☒ Review. Without Comments
☐ COMMENTS AS NOTED	☐ REVIEWED AS BUILT	☐ FOR INFORMATION

DATE: 28/10/2015

DOCUMENT VENDOR IDENTIFICATION:HYOSUNG

DOCUMENT TITLE: OPERATION & MAINTENANCE MANUAL

VENDOR DOCUMENT No: NT14-BA1-022	REV: 3	CODE: MAN-0001
UTS DOCUMENT No: V-0748512010-0026	REV: 4	
KKS DOCUMENT No.: 07485-20-ADT-CMO-HYO-001	REV: 4	

EX-factory Operation & Maintenance Documents

10034377

WARNING

The instructions and procedures included in this manual are intended to provide general guidance to trained personnel, with experience and expertise in the safe and careful performance of their job. These instructions and procedures cannot and does not cover all details of every task nor can it cover all possible situations that may be encountered during the performance of the tasks.

The User is solely responsible for ensuring that all work is performed safely and without damage to the transformer and accessories.

If any additional guidance is required, contact NANTONG HYOSUNG 86-513-88905580

It must be noted that the instructions and procedures in this manual cannot consider all possible site conditions and circumstances. As experts in the design and construction of the equipment, NANTONG HYOSUNG reserves the right for NANTONG HYOSUNG's Field Service Supervisors or Engineers and Managers in Pittsburgh or Changwon to modify the instructions and procedures herein to meet the intent of the requirements under the specific conditions or circumstances that may arise.

All work performed on the transformer covered under this manual must be performed in compliance with all site, local, state and national regulations. If any such regulations conflict with any instructions or procedures in this manual, contact NANTONG HYOSUNG for clarification.

Safety Notations

The following notations are used in this manual to alert the user to potential safety hazards

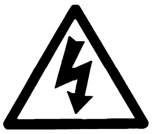
Kinds of Mark	Meaning of Mark
	Danger indicates an immanently dangerous situation which, if not avoided, results in death or serious injury to personnel. This signal word is limited to the most extreme situation
	Warning indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury
	Caution indicates a potentially hazardous situation which, if not to avoided, may result in equipment or installation damage. It may also be used to alert against unsafe practices.
	Electrical Hazard warning

Table of Contents

Section 4. Installation and Assembly

Section 5. Vacuum Oil Processing Procedures

Section 6. Commissioning Tests

Section 7. Power Transformer Maintenance and Repair

Section 8. Component Instruction Leaflets and Manuals

Section 9. Transformer Drawings

Introduction

Hyosung Group, founded in 1957, has grown into a leading South Korean enterprise in the fields of heavy industry, fiber, chemicals, information communication, industrial materials, construction, trade and so on. The products such as transformer, circuit breaker and industrial motor produced by the Group rank the top in the markets in South Korea. Nantong Hyosung Transformer Co., Ltd., a sole proprietorship of Hyosung Group in Hai'an, is engaged in the manufacturing of electric transformer, dry transformer and special transformer.

Currently there are almost 200 technicians in the Company, among whom one is an expert on rectifier transformer enjoying the subsidy of the State Council and two are experts on electric transformers. The Company now has 55 series and 1565 types of transformers of 750kV, 500kV, 220kV and below. Hyosung and Samni transformers with complete specification and advanced technology are widely used in the industries such as power, metallurgy, chemistry and construction. The Company is the first to pass the system certificates of ISO9001, ISO14001 and ISO10012 in the industry. In 2005, the products under the level of 110kV were listed in China Top Brand.

The Company introduces world-class production lines and NC processing equipment from Germany, Japan and Ukraine and builds a new test hall for transformers of 1000kV, thus increasing the productivity, product quality and technical level to a higher level. In 1998, the Company produced two SZ9-20000/220 products for Sichuan Xinguangxing Aluminum Co., Ltd.; in May, 2004, SFFZ-63000/220 was running in Nantong Baori Steel; and in December, 2004, the SFPSZ9-150000/220 was successfully put into operation in Bayan Nur Power Bureau in Inner Mongolia. In January, 2005, the electric transformer and rectifier transformers of 220kV passed the national approval, enabling the Company to be the fourth, with the fifth electric transformer of 220kV, to pass the short-circuit withstanding test by the national testing center. Currently, the ultra high voltage transformers of 750kV and 500kV have officially put into operation.

Hyosung Group is the first famous enterprise to develop the ultra high voltage transformer of 765kV, leading the development of the electric equipment of 765kV in South Korea. The products have been sold in markets in the US, Japan, Southeast Asia and Middle East. In March, 2006, Nantong Youbang Transformer Co., Ltd. joined the Hyosung Group and set up the Nantong Hyosung Transformer Co., Ltd. Currently, the Company has invested USD 60 million to build a new factory in the Development Zone in Hai'an. The factory covers an area of 187,000m2 (about 280 mu) and was put into operation after completion in October, 2007 as scheduled. The productivity of the Company reaches 21,500MVA (35,000MVA in the future). With advanced management, and world-class high-voltage technology, the Company will embrace a sharp growth and provide better products and service in the markets both at home and abroad.

NANTONG HYOSUNG

No. 88, Xiaoxing Road, Hai'an Development Zone, Jiangsu Province

Postal code: 226611
Tel: 86-513-88905824 (switchboard)

Technical data

CHARACTERISTICS	REQUIRED	HYOSUNG
1. INTERBUS TRANSFORMERS DATA		
• Manufacturer		Hyosung，China
• Place of manufacture		China
• Identification	20ADT10 20ADT20	20ADT10 20ADT20
• No. of units	2	2
• Design standard	IEC 60076	IEC 60076
• Type	Three phase	Three phase
• Type of core	Core type	Core type
• Thickness of lamination		0.3 Rev3
• Installation	Outdoor	Outdoor
• Type of cooling	ONAN/ONAF	ONAN/ONAF
• Frequency, Hz	50±3% continuous. Up to ±5% during 10 minutes	50±3% continuous. Up to ±5% during 10 minutes
• HV grid rated voltage, kV	400±10%	400±10%
• LV grid rated voltage, kV	230±10%	230±10%
• Number of phases	3	3
• Number of windings	3	3
• Type of wingding: – Primary winding – Secondary winding – Tertiary winding	Stabilizing winding	Continuous Rev3 Continuous Rev3 Helical Rev3
• Rated voltages: – Primary voltage winding, kV – Secondary voltage winding, kV – Tertiary winding, kV	400 kV +8x1,25-12x1,25% 230 kV 13,8 kV	400 kV +8x1,25-12x1,25% 230 kV 13,8 kV
• Rated power at 8ºC: – ONAN/ONAF operation, MVA	268/358	268/358

CHARACTERISTICS	REQUIRED	HYOSUNG
• Rated power at 20ºC: – ONAN/ONAF operation, MVA	244/325	244/325
• Rated power at 35ºC: – ONAN/ONAF operation, MVA	212/282	212/282
• Rated power at 40ºC: – ONAN/ONAF operation, MVA	200/267	200/267
• Rated power in ONAF operation with a fan or radiator out of service, MVA	325	325
• Overload capacity	Acc to IEC 60076-7	Acc to IEC 60076-7
• Copper temperature rise limit under continuous rated power, measured by resistance variation, ºK	59	59
• Top oil temperature rise limit under continuous rated power, measured by thermometer, ºK	54	54
• Hot spot temperature rise of windings under continuous rated power, ºK	84	84
• Maximum temperature rise in the following margins: – 0.95 Un < U < 1.05 Un – 0.90 Un < U < 0.95 Un – 1.05 Un < U < 1.10 Un	Top oil / Primary winding / Secondary winding / Tertiary winding 54/59/59/NA 54/59/59/NA 54/59/59/NA	54/59/59/NA 54/59/59/NA 54/59/59/NA
• Vector group	YNyn0d11	YNyn0+d11
• Neutral of the primary voltage winding	Directly earthed	Directly earthed
• Neutral of the secondary voltage winding	Directly earthed	Directly earthed
• Three-phase short circuit current in 400 kV system: – Symmetrical, kA rms – Peak current, kA peak	28,5 81	28,5 81
• Three-phase short circuit current in 230 kV system: – Symmetrical, kA rms – Peak current, kA peak	45 125	45 125
• RMS symmetrical short circuit current that the Transformer can withstand for 2 seconds, In times	6,6	6,6
Peak current withstood by the transformer, – Primary winding, kA peak – Secondary winding, kA peak – Tertiary winding, kA peak	8,74 15,22-	8,74 15,22

CHARACTERISTICS	REQUIRED	HYOSUNG
• Maximum flux density al rated volts, frequency and ratio, Tesla	1,65	1,65
• Admissible core overexcitation:	108,2% continuous 110,5% for 10 min	108,2% continuous 110,5% for 10 min
• Maximum current density in winding at Full Load on normal tap: - Primary winding A/mm2 - Secondary winding A/mm2 - Tertiary winding A/mm2		About 3.27 [Rev3] About 3.55 [Rev3] About 4.45 [Rev3]
• Impedance voltage at 75ºC at rated power (base 325 MVA): - Lower tap (minimum voltage), % - Main tap, % - Higher tap (maximum voltage), %	17	About 17.23 [Rev3] About 17.02 [Rev3] About 17.78 [Rev3]
• Inductive component - Lower tap, % - Main tap, % - Higher tap, %	17	About 17.23 [Rev3] About 17.02 [Rev3] About 17.78 [Rev3]
• Resistive component - Lower tap, % - Main tap, % - Higher tap, %		About 0.35 [Rev3] About 0.27 [Rev3] About 0.27 [Rev3]
• Zero-sequence impedance in the main tap, %	17	17
• X/R Ratio	Less than 70	69（RAT TAP） [Rev3]
• Tolerances	Acc. to IEC60076-1	Acc. to IEC60076-1
• RMS fundamental exciting current, A.		About3.27 [Rev3]
• RMS 3 harmonic current, A.		About 0.3 [Rev3]
• RMS 5 harmonic current, A.		About 0.21 [Rev3]

CHARACTERISTICS	REQUIRED	HYOSUNG
• RMS 7 harmonic current, A.		About 0.02 [Rev3]
• Highest voltage for the equipment (Um) – Phases of the primary winding, kV rms. – Neutral of the primary winding, kV rms. – Phases of the secondary winding, kV rms. – Neutral of the secondary winding, kV rms. – Phases of the tertiary winding, kV rms.	420 17,5 245 17,5 -	420 17,5 245 17,5 17,5** [Rev4]
• Switching impulse withstand voltage: – Phases of the primary winding, kV peak – Phases of the secondary winding, kV peak	1050 850	1050 850
• Lightning impulse withstand voltage: – Phases of the primary winding, kV rms. – Neutral of the primary winding, kV rms. – Phases of the secondary winding, kV rms. – Neutral of the secondary winding, kV rms. – Phases of the tertiary winding, kV rms.	1425 95 1050 95 -	1425 95 1050 95 95** [Rev4]
• Short duration induced or separate source AC withstand voltage: – Phases of the primary winding, kV rms. – Neutral of the primary winding, kV rms. – Phases of the secondary winding, kV rms. – Neutral of the secondary winding, kV rms. – Phases of the tertiary winding, kV rms.	630 38 460 38 -	630 38 460 38 38** [Rev4]
• Insulation: – Primary winding – Secondary winding – Tertiary winding	Graded Graded Uniform	Graded Graded Uniform
• Type of insulation paper – Insulation of tapping – Insulation of tapping connections – Insulation of core bolts – Insulation of laminations	Thermally upgraded	Thermally upgraded Thermally upgraded N/A N/A
• Type of coil supports: – Axial – Radial		Strip [Rev3] Spacer [Rev3]
• Type of material used for gaskets and joints.		ACM [Rev3]
• Capacitance: – Primary voltage winding to earth, nF – Secondary voltage winding to earth, nF – Between primary and secondary windings, nF		About 1.15 [Rev3] About 2.07 [Rev3] About 1.45 [Rev3]

CHARACTERISTICS	REQUIRED	HYOSUNG
• Excitation current: – At 90% of the rated voltage – At 100% of the rated voltage – At 110% of the rated voltage		0.20 Rev3 0.22 Rev3 1.34 Rev3
• Maximum in rush current and decay constant, A-s		3553A-0.9S（HV） Rev3
• Noise level at rated power (325 MVA): – Maximum sound pressure level at 1 m, dB – Maximum sound power level, dB	85 105	85 105
·• Level of radio interferences (RIV), measured at 1 MHz, µV		Less than 2500
• Minimum useful life, years	25	25
• Supply voltage for control circuits: – Cooling – Control	400 VAC ±10% 3Ph+N+PE 110 VDC +10%-15%	400 VAC ±10% 3Ph+N+PE 110 VDC +10%-15%
2. BUSHING DATA		
• Place of manufacture		China
• Applicable standard (unless otherwise specified in this document)	IEC 60137	IEC 60137
• Bushing type	Condenser	Condenser
• Insulation type	RIP or OIP	RIP（HV&LV） OIP(HVN&LVN)
• Filling material	Oil (HVN, LVN) Epoxy resin (HV, LV)	Oil (HVN, LVN) Epoxy resin (HV, LV)
·• Voltage for internal ionisation (partial discharges) in the HV bushings, kV		550 Rev4
·• Manufacturer – Primary voltage bushings – Primary voltage neutral bushing – Secondary voltage bushings – Secondary voltage neutral bushing		Shenyang Trench Shenyang Trench Shenyang Trench Shenyang Trench
·• Model – Primary voltage bushings – Primary voltage neutral bushing – Secondary voltage bushings – Secondary voltage neutral bushing		ETG Rev3 BRDLW Rev3 ETO Rev3 BRDLW Rev3

CHARACTERISTICS	REQUIRED	HYOSUNG
• Clearance, (mm) – phase-to-earth – phase-to-phase – phase-to-neutral and to lower voltage from bushing live parts	- 170 - 170	- 170mm （for primary neutral and secondary neutral bushings）
• Length of creepage distance – Primary voltage neutral bushing – Secondary voltage neutral bushing	> 31mm/kV > 31mm/kV	> 31mm/kV > 31mm/kV
• Highest voltage for the equipment (Um) – Primary voltage bushings, kV – Primary voltage neutral bushing, kV – Secondary voltage bushings, kV – Secondary voltage neutral bushing, kV	420 17,5 230 17,5	550 Rev3 52*** Rev3 245 Rev4 123*** Rev4
• Switching impulse withstand voltage: – Phases of the primary winding, kV peak	Dry/Wet 1050/1050	Dry/Wet 1175/1175 Rev3
• Lightning impulse test voltage: – Primary voltage bushings, kV – Primary voltage neutral bushing, kV – Secondary voltage bushings, kV – Secondary voltage neutral bushing, kV	1425 95 1050 95	1550 Rev3 250 Rev3 1050 Rev3 550 Rev3
• Power frequency test voltage: – Primary voltage bushings, kV – Primary voltage neutral bushing, kV – Secondary voltage bushings, kV – Secondary voltage neutral bushing, kV (1) Whenever applicable in accordance with that established in section 8.1.1 of standard IEC60137 (2) The voltage values indicated are in accordance with the requirements set out in section 9.3.2 of the IEC 60137.	Wet(1)/dry(2) 630/630 38/38 460/460 38/38	Wet(1)/dry(2) 680/680 Rev4 95/95 Rev3 460/460 Rev3 230/230 Rev3
• Rated current: – Primary voltage bushings, A – Primary voltage neutral bushing, A – Secondary voltage bushings, A – Secondary voltage neutral bushing, A	630 1250 1250 630	1250 Rev3 1250 1250 1250 Rev3
• Magnetization current, A		N/A* Rev3
• Colour of the isolator		Brown （HVN,LVN）
3. ON LOAD TAP CHANGER DATA		
• Place of manufacture		Germany Rev3

CHARACTERISTICS	REQUIRED	HYOSUNG
• Applicable standard (unless otherwise specified in this document)	IEC 60214	IEC 60214
• Manufacturer	MR	MR
• Model		VRFIII Rev3
• Tag Charger Type	On load	On load
• Number of taps, including the main tap	21	21
• Tapped wingding	Primary winding	Primary winding
• Location on winding	HV neutral	HV neutral
• Tap range variation	+8x1,25-12x1,25%	+8x1,25-12x1,25%
• Tag Change Step Size %	1,25%	1,25%
• Tap capacity in accordance with IEC 60076	Full power	Full power
• Tapping voltage variation category		CFVV Rev3
• Insulation requirements – Highest voltage for the equipment (Um), kV – Lightning impulse test voltage, kV peak – Power frequency test voltage, kV	 123 550 230	 123 550 230
• Maximum current in continuous operation, A	1000	1000
• Tap changer tank – Independent tank to that of the transformer – Supported vacuum (including oil conservator)	 YES ABSOLUTE VACUUM	 YES ABSOLUTE VACUUM

CHARACTERISTICS	REQUIRED	HYOSUNG
– Thermometer to measure oil temperature – Pt 100 to measure oil temperature – Top oil high oil temperature thermostat with changeover contacts for alarm and tripping – Alarm for changer malfunction – Alarm for loss of power supply of the tap-changer – Local driving cabinet – Mechanical tap position indicator. The indicator shall be visible by a man operating the tap changer manually with the handle. – Buchholz relay with redundant changeover contacts for tripping between OLTC and conservator tank compartment. – Mechanical operations counter. – "Raise-lower" pushbuttons or selector switch, for manual electric control. – "Manual-Automatic" selector switch. – Local/Remote selector switch. – Time delay relay adjustable from 0 to 120 seconds. – Maximum limit switch. – Minimum limit switch. – Tap changer motor on. – Tap changer motor Stop order. – Signal converter at 4-20 mA for tap changer position. – Facilities to block operation if the voltage is above or below preset values. – Tap changer motor protection and control circuit protection devices. – Terminal blocks and test switches. – Door actuated internal light. – Anti-condensation heater with circuit breaker. – Convenience outlet of approved type. – Oil sampling and drain valves for the tap changer tank – Fill and drain valves for the tap changer oil conservator	REQUIRED	YES
4. COOLING EQUIPMENT DATA		
• Motor-operated fans : – Number of fans – Rated voltage – Rated frequency, Hz – Protection class – Fan rated unit power, kW	 N+1 400 V, 3 PH + N + PE 50 IP55	 24+1 Rev4 400 V, 3 PH + N + PE 50 IP55 0.55
• Cabinet of the cooling system: – Protection class in accordance with IEC 60529 – Dual supply at 400 V, three-phase + N+PE, 50 Hz – Preferential power supply selector – Automatic power supply changeover – Local control means – Contacts for remote signalling – Dual supply at 110 VDC with positive pole decoupling diodes – Designed against moisture condensation	 IP65 REQUIRED REQUIRED REQUIRED REQUIRED REQUIRED REQUIRED REQUIRED	 IP65 YES YES YES YES YES YES YES
• Number of radiators	N+1	27+1 ****
• Cooling surface of each radiator/cooler		About 130m2 Rev3

CHARACTERISTICS	REQUIRED	HYOSUNG
<u>5. TRANSFORMER CONNECTIONS (TERMINAL ARRANGEMENTS)</u>		
• Primary voltage side – Phases: Terminals and flange for connection of SF6 bus duct – Neutral: Strip/cable terminal for connection to the earthing cable	 REQUIRED REQUIRED	 YES YES
• Low voltage side: – Phases: Compartment for 230 XLPE cable bottom entry (oil to oil type). Compartment galvanized steel supports also valid for cable support. – Neutral: Strip/cable terminal for connection to the earthing cable	 REQUIRED REQUIRED	 YES YES
<u>6. CURRENT TRANSFORMERS</u>		
• Place of manufacture		China
<u>6.1 High voltage side:</u>		
• For the thermal image device – Manufacturer – Type – Applicable standard – Quantity – Transformation ratio – Rated output, VA – Accuracy class – Terminals type	 Bushing IEC 61869 1 Short-circuiting	 Nanjing Zhida [Rev5] Bushing IEC 61869 1 700/5 [Rev3] 15 [Rev3] 0.5S [Rev3] Short-circuiting
<u>6.2 High voltage neutral side:</u>		
• For protection: – Manufacturer – Type – Applicable standard – Quantity, per phase – Transformation ratio – Rated output, VA – Accuracy class and accuracy limit factor – Terminals type	 Bushing IEC 61869 1 500/1 30 5P20 Short-circuiting Sealable covers	 Nanjing Zhida [Rev5] Bushing IEC 61869 1 500/1 30 5P20 Short-circuiting Sealable covers
<u>6.3 Low voltage neutral side:</u>		
• For protection: – Manufacturer – Type – Applicable standard – Quantity, per phase – Transformation ratio – Rated output, VA – Accuracy class and accuracy limit factor – Terminals type	 Bushing IEC 61869 1 500/1 30 5P20 Short-circuiting Sealable covers	 Nanjing Zhida [Rev5] Bushing IEC 61869 1 500/1 30 5P20 Short-circuiting Sealable covers

CHARACTERISTICS	REQUIRED	HYOSUNG
7. OIL		
• Place of manufacture		China
• Applicable standard	IEC 60296	IEC 60296-2012 Rev6
• Type		Petro 45X Rev6
• Manufacturer		CNPC Rev3
• Total transformer capacity, L		About 86000 Rev3
• Total volume of conservator tank, L		About 8100 Rev3
• Quantity of oil in coolers, L		About76000 Rev3
• Maximum pressure of oil at the inlet to cooler under service conditions.		About 41 kPa Rev3
• Volume of oil in conservator between high and low level marks at Auxiliary Equipment , L		About 7900 Rev3
• Maximum oil pressure in system and position , kPa g		About 48 Rev3
• Temperature gradient transformer oil at Full Load (between cooler inlet and cooler outlet), K		About 23.1 Rev3
• Reserve over total capacity, %	REQUIRED	5%
• Free of PCBs	REQUIRED	YES
8. TRANSFORMER TANK		
• Vacuum supported (including oil conservators and radiators)	Full vacuum	Full vacuum
• Drain valves and oil sampling valves	REQUIRED	YES
• Valves for tank oil sampling	REQUIRED	YES
• Valves for oil filtering	REQUIRED	YES
• Radiator isolation valves	REQUIRED	YES
• Pressure relief valves with change-over contacts for tripping	REQUIRED	YES
• Suspension eyebolts and pulling rings for complete transformer,	REQUIRED	YES

CHARACTERISTICS	REQUIRED	HYOSUNG
• Eyebolts for cover, tank, conservator and radiators removal	REQUIRED	YES
• Four (4) jack pads near the corners of the tank and Support for hydraulic jacks	REQUIRED	YES
• Nitrogen or inert gas for transport	REQUIRED	YES
• Transformer rating plate	REQUIRED	YES
• Earth terminals	2	2
• Flexible connections between the tank and the cover	REQUIRED	YES
• Manhole and hand-hole including blind covers	REQUIRED	YES
• Ladder	REQUIRED	YES
9. TRANSFORMER ACCESSORIES		
• List type, model and manufacturer of each device fitted to the transformer	REQUIRED	YES
• Oil conservator, with rubber bag and filling, blowdown and draining valves	REQUIRED	YES
• Dehydrating (Drycol) breather for the main tank and dehydrating (dessicant) breather for OLTC tank at human height	REQUIRED	YES
• Oil level gauge of magnetic type, with changeover contacts for high and low level alarms and trip (redundant trip contacts shall be supplied), with 4-20 mA analogue output and at human height, for transformer tank and for OLTC	REQUIRED	YES
• Oil preservation system	REQUIRED	YES
• Winding temperature indicator (thermal image), with contacts for alarm and trip (redundant trip contacts shall be supplied), and 4-20 mA analogue output for communication with the DCS.	REQUIRED	YES
• Thermometer for the top oil of the transformer tank, connected to a Pt100 probe, with change-over contacts for alarm and tripping (redundant trip contacts shall be supplied) and 4-20 mA analogue output.	REQUIRED	YES

CHARACTERISTICS	REQUIRED	HYOSUNG
• Top oil high temperature thermostat with change-over contacts for alarm and tripping (redundant trip contacts shall be supplied)	REQUIRED	YES
• Pt100 RTDs to measure the tank top oil (double), One for thermometer and the other one for cooling control	REQUIRED	YES
• Buchholz relay with two floats and with changeover contacts for alarm and tripping (redundant trip contacts shall be supplied)	REQUIRED	YES
• Buchholz relay gas sampling	REQUIRED	YES
• Connection from the core and another connection from the frame via cables to two 2 kV bushing terminals, complete with shorting links, mounted in an external IP65 box located next to a hand hole cover in the tank top. To allow for testing of the insulation of the core and frame,	REQUIRED	YES
• Cabling to the terminals of all the circuits between components and transformer cabinets (protected by reinforced tube).	REQUIRED	YES
• Earthing terminals for grounding bushings	REQUIRED	YES
• Thermometer pocket on each heat exchanger oil inlet and outlet pipe	REQUIRED	YES
• Transformer core and winding lifting eyebolts	REQUIRED	YES
• Leak tight boxes with an IP65 degree of protection for the outlet of the cabling of secondary circuits of the current transformers	REQUIRED	YES
10. GUARANTEED LOSSES		
• No-load loss (in the iron): – At 90% of the rated voltage, kW – At 100% of the rated voltage, kW – At 110% of the rated voltage, kW	178	About 160 Rev3 178 Rev3 About 220 Rev3
• Load loss (in the copper) referred to 75º C for ONAF mode in: – Maximum voltage tap, kW – Central tap, kW – Minimum voltage tap, Kw	900	About 929 Rev3 900 About 1205 Rev3
• Total cooling consumption, kW		13.75 Rev4

CHARACTERISTICS	REQUIRED	HYOSUNG
• Total losses (including cooling) in ONAN/ONAF operation, kW: – At 8ºC, kW – At 20ºC, kW – At 35ºC, kW – At 40ºC, kW		About 735/1319[Rev3] 695/1087 [Rev3] About 456/817[Rev3] About 409/736[Rev3]
• Total losses at Full Load 75º C, when operating on tap position giving maximum losses, kW		About 1390 [Rev3]
• Load Losses at Full Load on tap position with maximum losses, kW		About 1087 [Rev3]
• Efficiency at: - Full load Unity pf. % - Full load 0,85 pf. % - ¾ Full load Unity pf. % - ¾ Full load 0,85 pf. % - ½ Full load Unity pf. % - ½ Full load 0,85 pf. % - 1/4 Full load Unity pf. % - 1/4 Full load 0,85 pf. %		99.96% [Rev3] About 99.61% [Rev3] About 99.72% [Rev3] About 99.67% [Rev3] About 99.75% [Rev3] About 99.70% [Rev3] About 99.71% [Rev3] About 99.66% [Rev3]
• Regulation at 75º C and Full Load (of normal operating voltage). - At Unity pf. - At 0,85 pf lagging. - At 0,95 pf leading.		About 1.947 [Rev3] About 11.047 [Rev3] About 3.920 [Rev3]
11. DIMENSIONS AND WEIGHTS		
• Approximate dimensions: – Maximum length, mm – Maximum width, mm – Height to top of tank, mm – Height top part of oil conservator, mm – Length x width x height for transport, mm		About 14000 [Rev3] About 7200 [Rev6] About 4450 [Rev3] About 9500 [Rev3] 1100X4850X4500 [Rev6]
• Minimum distances to walls for cooling and maintenance reasons		About 1500mm [Rev3]
• Approximate weight: – Core, t – Windings, t – For core and winding removal, t – Total without oil, t – Oil, t – Total with oil, t – For transport, t		About 129 [Rev3] About 34 [Rev3] About 188 [Rev3] About 76 [Rev3] About 290 [Rev3] About 214 [Rev3]
12. TESTS		
12.1 Routine tests		
• General inspection. Verification of dimensions, location of the bushings, layout of the valves and rest of accessories in accordance with the approved drawings.	REQUIRED	YES

CHARACTERISTICS	REQUIRED	HYOSUNG
• Verification of the correct wiring of the power, control, protection and signalling devices in accordance with the electrical diagrams approved.	REQUIRED	YES
• Verification of the correct operation of the protection and monitoring devices.	REQUIRED	YES
• Measurement of the winding resistance in each tap of the changer.	REQUIRED	YES
• Verification of the polarity and of the connection group and measurement of the transformation ratio in each tap of the changer.	REQUIRED	YES
• Measurement of the short-circuit impedance and of the load loss in the central and end taps of the changer. The resistive and inductive component for said taps shall be determined.	REQUIRED	YES
• Measurement of no-load current and loss. This test shall be performed at rated frequency and at 90%, 100% and 110% of the rated voltage. The no-load losses and the current shall be calculated, as well as the degree of saturation of the core.	REQUIRED	YES
• Verification of the phase and sequence	REQUIRED	YES
12.2 Type tests		
• Temperature rise type test. Redundancy N+1 shall be checked. The total and individual losses of the cooling devices shall be measure	REQUIRED	YES
• Measurement of noise level, with all motor-operated fans in operation	REQUIRED	YES
12.3 Special tests		
• Measurement of zero-sequence impedance.	REQUIRED	YES
• Measurement of the insulation resistance to earth of the windings.	REQUIRED	YES
• Measurement of the harmonics at no-load current.	REQUIRED	YES
• Measurement of the capacitances and the corresponding dissipation factor (tg δ) between windings and between the windings and the ground. Voltages between 2 and 10 kV shall be applied, verifying potential variations with voltage.	REQUIRED	YES

CHARACTERISTICS	REQUIRED	HYOSUNG
• Frequency response analysis (FRA).	REQUIRED	YES
• Gas in oil analysis.	REQUIRED	YES
• Characteristic test of bushing type current transformers.	REQUIRED	YES
12.4 Additional tests		
• Vacuum test of the tank and accessories	CERTIFICATION	YES
• Transformer tanks, conservators, oil pipework and cooling plant shall withstand, without leak or permanent distortion, the application for 24 hours of a pressure which is such that the test pressure at any point in the equipment is twice the working pressure at that point, or 0.7 kg/cm2 plus the working pressure at that point, or 0.3 kg/cm2 plus the pressure exerted at that point when the pressure relief valve is opened slowly by oil pressure, whichever is the greater.	REQUIRED	YES
• Measurement of the dielectric strength of the oil.	REQUIRED	YES
• Verification of the core earthing.	REQUIRED	YES
• Radio discharge measurement in accordance with IEC or partial discharge test in accordance with IEC.	REQUIRED	YES
12.5 Dielectric tests		
• Separate Source AC	REQUIRED	YES
• Short-duration induced AC voltage test (shall be performed with partial discharge measurements)	REQUIRED	YES
• Lightning impulse test (HV & LV winding phases)	REQUIRED	YES
12.6 Bushings, current transformers and tap changers tests		
• Routine test in accordance with IEC 60137, IEC 61869 and IEC 60214, respectively.	REQUIRED	YES
• Protocols for type tests	REQUIRED	YES
12.7 Cooling equipment		
• Wiring checks	REQUIRED	YES

CHARACTERISTICS	REQUIRED	HYOSUNG
• Verification of operation of control, protections, alarms, forced cooling, etc..	REQUIRED	YES
• Measurement of insulation resistance.	REQUIRED	YES
• Dielectric strength test.	REQUIRED	YES
• Measurement of the power consumed by the cooling equipment.	REQUIRED	YES

Note：*The bushing will not be magnetized , so there is no magnetizing current

**The tertiary winding is buried stablizing winding

***During AC test on HV line, the voltage of VLN go up to about 153kV,

So, LVN Bushing voltage level should be more than HVN Bushing Voltage level.

****The number of radiators is 27+1, not 24+1, detailed infromation please refer to the outline drawing.

Section 1

Safe Working Practices

Section 1
Safe Working Practices

These warnings apply to every part of this section and should be considered as applicable to each line in this section.

1.1 Introduction:

Workers who use this manual should be trained by their company's Safety organization in the company's Safe Working Practices. Workers who have not been trained in Safe Working Practices or their company's Safety Program, or companies without a Safety Program should delegate or contract all work on this equipment to individuals or companies who have been properly trained. This NANTONG HYOSUNG manual is not intended to replace the user's Safety Program or any policies of the user's Safety Program.

This section is provided to help remind trained, qualified workers of the risks that may be present when working on power transformers, and to provide suggestions in some cases to mitigate those risks. This manual cannot anticipate all conditions that might occur at every jobsite and must be used as a general reference and not as a procedure for working safely. The contents of this section are presented as "Thought Joggers" intended to help the user recognize the various risks associated with this type of work.

Workers must follow all local, state and federal safety requirements and the user's site-specific Safety Program requirements. It is the User's sole responsibility to be aware of all applicable requirements.

Failure to properly mitigate the risks associated with this type of work could result in serious injury or death.

If your company does not have an OSHA-compliant Safety Program, contact NANTONG HYOSUNG for no-cost guidance on sources of Safety training and sources who can help your organization develop a Safety Program.

1.2 Communication:
Communication is critically important when working with others. Every job should be thoroughly discussed with the full crew before starting work to ensure that everyone understands the work that will be performed by each worker and the risks associated with that work. When multiple crews are working at a site, each crew leader should understand the scope of the other crews' work as well. When circumstances change, everyone who might be affected should be informed.

1.3 Personal Protective Equipment (PPE):
Every worker should have the proper PPE to protect them from all expected risks. The site or worker's Safety Co-ordinator should determine the risks that exist at the site and during the tasks performed by the worker.

In addition to any special equipment that may be required, the following types of common PPE should be available to the worker at all times, and used when needed.

PPE	Protects Against
Hard hat	Head bumps and small falling objects
Safety Glasses	Eye damage from grinding, drilling, filing, chipping, broken tools or airborne dusts and debris
Goggles	Same as above but provides better coverage
Face Shields	Eye or facial damage from grinding, drilling, painting, chemical handling or similar activities
Rubber Gloves	Chemical handling
High voltage gloves	Low voltages – used under leather gloves
Leather gloves	Scrapes and cuts
Cut-resistant gloves	Cuts
Ear Plugs	Moderate noise levels
Ear muffs	Higher noise levels (when used with ear plugs)
Respirators	Airborne dusts, or chemicals
Safety boots	Toe damage from dropped objects
Safety Harness	Falls
Flame Resistant (FR) Clothing	Arc-flash exposure

1.4 Thought-Joggers for Mitigating Risks

The following sections are presented as “Thought-Joggers” to help the user determine the possible risks in the tasks associated with receiving, installing, testing and maintaining the transformer. These Thought-Joggers are questions and comments that will cover many of the common situations with this type of work, and should be considered when the job is planned and discussed with the work crew before the work begins. Thought-Joggers should help the user and the work crew to think through their approach to performing their tasks safely and to recognize and mitigate any other potential risks that may exist in performing their tasks.

Working in Energized Substations and Power Plants

There are several hazards and risks associated with working in energized stations. Workers should consider the following:

- All substations and power plants should have an Evacuation Plan or Emergency Response Plan
    - *Are the workers prepared to respond to a site emergency*? All workers should know the alarm signal for site evacuation and the evacuation route and muster location.
- All workers on site should know how to contact emergency services in the event of a fire or other emergency.
- All workers should be aware of the site conditions
    - *Is the plant a chemical plant with hazardous materials*? Workers should have the right types of PPE on hand
    - *Are high-pressure steam pipes or flammable gas or fluid pipes on-site*? Workers should be aware of the locations and risks of all hazardous or underground pipe systems.
    - *Are overhead or underground power lines or circuits energized*? Safe working clearances must be maintained at all times. Only circuits that can be verified as properly grounded should be considered de-energized.
    - *Are control or protective relay circuits completely isolated*? Workers should review the site electrical drawings to determine whether any circuits in the scope of their work are interconnected with other circuits at the site. Some items to consider when working on interconnected circuits:
        - Control circuits could be energized intermittently. Some examples are fans or other equipment on thermostats or timers, load tap changers or similar equipment operating on remotely controlled operation, circuits through auxiliary contacts on circuit breakers or switches or instrument transformers on circuits that may be switched on or off. Do not assume that a circuit is de-energized just because you measure no voltage or current. Review the entire circuit and ensure that all sources of energization are controlled.
    - *Are all mechanical systems completely isolated*? Workers should also review the site mechanical drawings to determine if any systems in the scope of their work are interconnected with other systems at the site. Some items to consider:

  - Mechanical, hydraulic, pneumatic, thermal and other types of systems can operate intermittently. Some examples are pressure relief devices, pumps, hoppers or conveyors on timers or other control systems, devices on remotely controlled operation, elevators and cranes. Do not assume that any mechanical system is not capable of operating just because it is not operating when it is checked. Review the system drawings and ensure that all sources of operation are removed or de-coupled.

- Other work may be performed on the site at the same time which could impact your job
  - *Will your work be performed under a Clearance*? If so:
    - *Who issues and controls the Clearance*? The site's Clearance Co-ordinator or Operator should issue the clearance and keep track of all Clearances that are issued.
    - *Are all workers trained and knowledgeable in the site's Lockout/Tagout and Clearance procedures*? All workers must be trained and understand these requirements.
    - *Does everyone working under the Clearance understand the Clearance Boundaries*? Every worker must know the boundaries of the Clearance they are working under.
    - *Has the Clearance holder reviewed the site drawings and "walked down" the Clearance to verify that all possible sources of energization are isolated and locked out*? Failure to do either creates a risk that a possible source of energization may be overlooked.
    - *Are all circuits grounded and all systems locked-out or decoupled after the Clearance is issued, before any work is performed*? Workers must understand that a Clearance only means that the circuits and systems have been "cleared" of energization sources. They are not safe to work on until they have been properly grounded and configured so they cannot be operated.
      - *Have all connections to the transformer been isolated*?
        - The people that establish the clearance need to be aware of all backfeed possibilities. Transformers with auxiliary transformers connected to the same bus or directly to the transformer can energize (backfeed) the transformer at full voltage if the aux transformer's secondary voltage is connected to another energized source.
        - If the transformer is equipped with three or more sets of windings (YV or ZV windings) all windings must be isolated and grounded.
      - *Will testing or other work be performed that will require test terminals to be disconnected or ungrounded*? This may affect the location of the ground cables when they are attached.

- *Are the Grounding Cables safe to use*?
  - *Is the available fault current known at the site, and are the ground cables adequately sized for the available fault current*? Available fault current can vary widely from site to site. The system operator should provide the maximum available fault current values. The correct size of ground cable must be selected to meet the maximum available fault current. The user's Safety Program may permit installing multiple ground cables if individual cables are not sufficient for the fault current levels. De-rating factors may be required when multiple ground cables are used.
  - *Have the ground cables been tested and OK for service*? Cables should be tested periodically, according to the user's Safety Program policies.
  - *Have the ground cables been visually inspected before use*? Cables and clamps should be inspected before every use. Frayed or damaged ground cables should not be used.
  - *Is the correct type of clamp being used for the item being grounded and the ground connection point*? See Figure 1.1 for examples of various types of ground clamps.
- *Will the cables or bus that will be grounded be tested for voltage before the grounds are connected*? Personal protective grounds must not be installed before the bus or cable to be grounded is first tested with a hot-stick mounted proximity meter and proven to be de-energized.
  - *Will the ground cables be connected in the proper sequence*? When installing ground cables, the grounded end should be connected first, then the cable or bus should be connected. When removing ground cables, the cable or bus should be disconnected first, then the grounded end.

- o *Can other crews lift loads over your work area or haul loads through your work area*? Workers should be aware of other work that can impact their work area. Marking work areas with Caution tape or warning signs can help make other crews aware of your presence. Communication and co-ordination with other crews is important.
- o *Could circuits that must be energized or de-energized for your job to be performed be switched by other workers on site*? All workers must be understand and strictly observe the site's Lockout/Tagout program.
- o *Could site conditions be affected by other crew's jobs (smoke, noise, piping systems, deluge systems, etc.)*? Workers should have the right types of PPE on hand for any expected conditions. Communication and co-ordination with other crews is important.

- Adverse environmental conditions may exist
  - o *Are extreme temperatures expected*? Extreme temperatures can cause a variety of problems from heat stroke to chills. Workers should be properly dressed and drink a sufficient amount of liquids

- *Is extreme weather expected*? Work should not be performed during high winds, sleet and hail, lightning, tornados, hurricanes and other extreme weather conditions
- *Are ice or snow expected*? Ice or snow can create slick roads and walking surfaces. Workers need to adjust their work to such conditions.

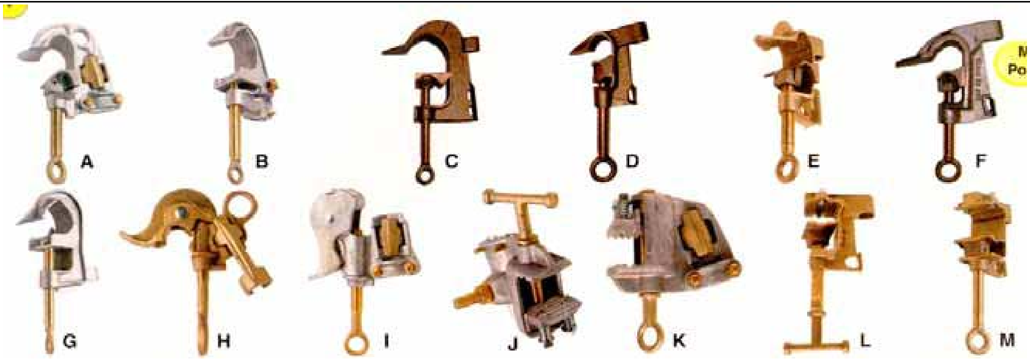


Figure 1.1
(From USBR FIST 5-1)

Clamps A-I have jaws designed to attach to round surfaces like a substation bus or conductor. Clamps J-M are designed for attaching to flat surfaces.

Delivery and Assembly of the Transformer

Transformer deliveries are heavy loads requiring special lifting and moving techniques and equipment. Transformers should only be moved by people trained and qualified in heavy lifting and rigging.

All heavy lifts or moves should have a Lifting Plan or a Moving Plan that considers the following potential risks.

- Underground pipes or other unseen hazards should be addressed.
    - *Are site drawings available to determine the locations of any underground hazards*?
    - *Do steel plates or other devices need to be placed on the ground to better distribute the weight of the crane, trailer or any loads*?
    - *Are the ground, roadway and any bridges that may be travelled over all rated for the expected loads*?
- Safe working clearances from energized lines and equipment must be maintained at all times.
    - *Has the crane been properly grounded*?
    - *Will the crane be operated near any energized busses or power lines*? Workers should maintain safe distances from the crane at all times if there is any risk of contact.
- Using cranes, jacks, cribbing, slings or hardware that are not rated for the load can cause lifting accidents.
    - *Is the correct weight of the transformer and the crates known*?
    - *Are the equipment, slings and hardware capable of safely lifting the transformer*?
    - If jacking and sliding will be performed:
        - *Have the hydraulic jacks and hoses been inspected and verified to be in safe operating condition*?
        - *Are the hydraulic jacks gang-operated*?
            - *Are gang-operated jacks equally rated with equal performance*?
            - *Has the controller been inspected and in safe operating condition*?
        - *Are the jacks located squarely below the transformer's jacking pads*?
        - *Are the timbers or rollers in safe condition*?
        - *Is the connection point for pulling and sliding the transformer secure and adequate for the load to be applied*?

For the transformer or parts that will be lifted by crane:

- *Has the crane been inspected and verified that it is in good condition*?
- *Has the angle of the boom been considered in the crane lifting capability*?
- *Will the crane's outriggers be fully extended and utilized during lifting*?
- *Are the slings and rigging hardware adequately rated for the loads*?
  - *Have the angles of the attached slings been considered when determining the sling and rigging ratings*? Sling capabilities must be de-rated when they are not used to lift loads in a strictly vertical direction or when they are wrapped around loads rather than attached to shackles. See Figure 1.2 for some examples. Consult your Safety Program guidelines or contact NANTONG HYOSUNG for more information.
- *Will the loads be properly lifted*?
  - *Are tag lines available for controlling the loads when lifted*? All loads should have a tag line attached to help control the location and movement of the load during the lift.
  - *Have the tops of the crates been set in-place and nailed down before any crates are lifted*? Crates can collapse if lifted without the cover in-place.

- The transformer tank must be connected to the site's ground grid immediately after it is placed onto the foundation.
  - *Is the station ground grid in place*?
  - *Are the ground cables on-hand*? If not, use personal protective grounds as a temporary connection until the permanent cables can be installed.
- All work requiring people to perform tasks inside the transformers should be done under the user's Confined Space procedures under their Safety Program. The workers should consider the following possible risks:
  - *Have the Entrant and Attendant(s) been trained in their Confined Space procedures*?
  - *Does the Attendant know how to contact emergency services, if required*? *Is a phone available on-site*?
  - *Is the air monitoring equipment OK to use*? *Has it been tested and calibrated? Does it provide audible alarms or other signals if the safe gas levels for working inside the transformer are not met*?
  - *Was the transformer filled with Nitrogen before this starting this internal work*? If the transformer was filled with Nitrogen, the Nitrogen must be completely removed by applying vacuum (we recommend down to 1 Torr for at least 30 minutes), then dry-air can be added before starting ventilation with dry air. Simply ventilating with dry air may not remove all of the nitrogen inside the transformer and unsafe areas could exist inside the transformer that may not be detected with the gas monitor.

- *Is the air safe to breathe*? The transformer should be ventilated by adding dry air at a sufficient flow rate to purge gasses from the transformer and maintain a sufficient oxygen level while workers are inside. This can only be verified if a gas monitor is used. Oxygen needs to be within the required maximum and minimum levels and CO and CO2 must be below the maximum levels.
- *Is the air at risk of fire or explosion*? The gas monitor should also monitor explosive gas levels (Lower Explosive Limit or LEL)
- *Are dry-air cylinders being used to ventilate the transformer tank while the worker will be inside the transformer*? If so, it may be necessary to replace the cylinder when the worker is inside the transformer and a third worker may be necessary for this task. The Attendant cannot leave their post to replace the dry air cylinder while the worker is inside the tank. A dry air generator can eliminate this problem.

- *Do the workers have appropriate clothing for the tasks*? Loose clothing and jewelry around moving parts like fans and motors can cause serious accidents. Fire Retardant (FR) clothing may be required for some areas or tasks.
- *Are workers prepared to work in manlifts, on ladders or on top of the transformer*?
  - *Have the workers been trained in manlift operation*? Training should be performed in accordance with the user's Safety Program.
  - *Is the manlift properly grounded*? Grounding should be performed in accordance with the user's Safety Program.
  - *Is the manlift the right size and rating for the job*? The loads and equipment ratings need to be known.
  - *Have the ladders been inspected*? Ladder inspections should be performed in accordance with the user's Safety Program.
  - *Are the ladders the right type, size and rating for the job*?
  - *Are all ladders properly tied off and secure*?
  - *Is a rope or other system available near the ladder to allow workers to bring tools and equipment to or from the transformer cover without carrying it as they climb the ladder*? Workers should avoid carrying equipment while climbing ladders.
  - *Is the transformer equipped with a fall restraint system or other connection points approved by the user's Safety Program*?
  - *If a worker falls, will their PPE or other systems limit their fall to a safe distance*?
- *Have workers been trained in the safe operation of all power tools and equipment to be used on the job*?
  - Workers should be aware of pinch points and line of fire risks.
  - Workers should wear the proper clothing and PPE for the tools and the task

- *Will any welding be performed on the job*?
    - *Does a person need to be assigned to work as a "Fire Watch"*? *If so, does the "Fire Watch" know what to do in case of a fire*?
    - *Are the right types of Fire Extinguishers available and on-hand*?
    - *Have all combustible materials in the area been cleaned up before welding*?

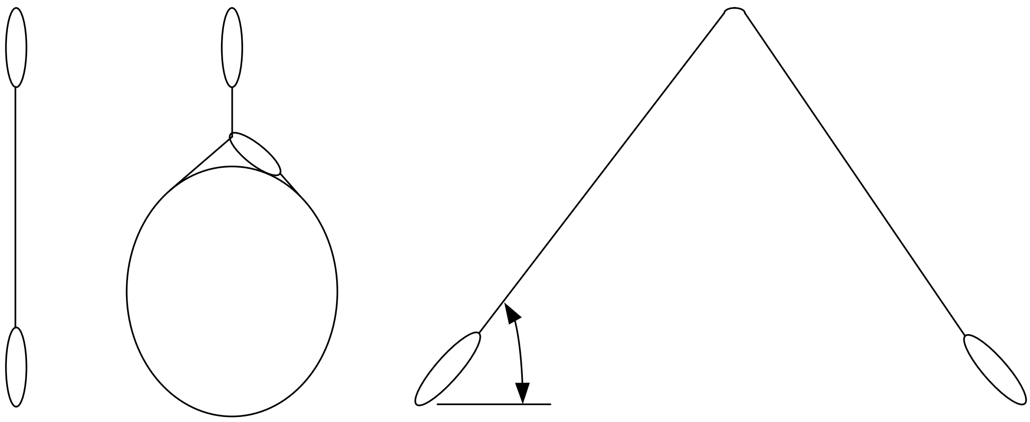


Figure A Figure B Figure C

Configuration	Figure A	Figure B	Figure C	
			Angle=60°	Angle = 45°
Allowable Loading as a Percentage of Sling Rating	100%	80%	86%	70%

Figure 1.2

Vacuum Oil Processing and Filling

Transformers are filled with hot oil under vacuum. This presents several potential environmental and safety risks that the workers should consider.

- The site should be adequately protected from oil spills during oil storage and handling.
  - *Are the workers aware of the site's Spill Prevention Plan and the requirements under the plan*?
  - *Are berms or other protective devices required under the oil tanks or tankers*?
  - *Are emergency spill kits, absorbents and pads available, if needed*?
  - *Is the area around the tanks, tankers and transformer adequately secured and protected from vehicles or equipment that could collide with the tanks, tankers or transformer and cause an oil spill*?
  - *Are all oil and vacuum hoses adequately protected from damage during the vacuum and oil pumping processes*?
- Pumped oil can build up a considerable static charge. All equipment used in oil handling must be properly grounded to bleed off the static charge and protect the site from fires and explosions.
  - *Is the transformer tank properly grounded*?
  - *Are all tanks, tankers, and oil processing trailers properly grounded before starting any oil handling*?
  - *Have all oil hoses been tested to ensure that the internal static wire is intact*?
  - *Are the right types of fire extinguishers available and on-hand*?
  - *Are all transformer bushings adequately grounded during oil filling*? The tops of all bushings should be connected to ground during oil filling. Standard copper mausing wire is normally sufficient for this purpose.
- All major parts of NANTONG HYOSUNG transformer tanks are designed to withstand full vacuum. Workers should understand that loads on any part of the transformer can increase the mechanical stress beyond the designed limits and cause tank damage.
  - *Are all workers aware that they should stay off of the transformer, and any parts of the transformer, when vacuum is applied*?
  - *Are all toolboxes, test equipment and other heavy items, or any items that might need to be retrieved removed from the transformer cover or other parts of the transformer*?

Testing

Transformers require both high-voltage and low-voltage testing. Both types of testing can present safety risks.

Workers should consider the following:

- The equipment users must understand how to safely operate all electrical test equipment before use.
  - *Is the test equipment properly grounded according to the manufacturers' instructions*?
  - *Has the test equipment, including cables and test probes, been inspected before each use*?
  - *Will all meters and probes be used within their rated voltage or current limits*? Meters must not be used at voltage or current levels beyond their ratings. The voltage and current rating should be listed on all electrical test equipment, or in the manufacturers' instructions. This applies to meters, leads and test probes. Voltages greater than 480V should never be measured directly with a handheld meter, but should be measured with a proximity meter mounted on a hot stick.
- Users must understand the hazards associated with testing power transformers
  - *Have the test equipment operators and assistants been trained in the safe operation of their equipment*?
  - *Will test voltages be transformed to unsafe levels by the transformer*? AC test voltages applied to low voltage transformer windings are transformed to higher voltages by the transformer turns ratio. For example, applying a 10kV Doble test voltage to the XV terminal of a 230/18kV GSU transformer can produce 128kV on the HV bushing terminals. Safe working clearances must be maintained.
  - *Will DC test voltages be applied to the transformer*? Transformers can hold a large capacitive charge when DC test voltages are applied. DC test equipment must always be discharged according to the manufacturers' instructions before disconnecting the test leads.
  - *Are all workers in the work area where test voltages are being applied aware of the risks before starting the tests*? Does the area around the testing need to be roped off?
  - *Is the transformer tank under vacuum*? Testing should never be performed while the transformer is under vacuum. A partial vacuum will flash over at a far lower voltage than a transformer under atmospheric air pressure.

- All tested components must be left in safe conditions after testing.
    - *Are all CT's shorted and grounded after testing*?
    - *Are all fans free from obstructions*?
    - *Are all terminals and components in the control cabinets free from obstructions or debris*?

Operation and Maintenance

- The transformer tank and all cabinets must be grounded at all times.
    - *Are the ground connections all visible and intact*?
- While NANTONG HYOSUNG transformers have not experienced problems with static electrification, conditions that could cause static electrification conditions should be avoided.
    - *Do the user's operational procedures or the transformer's cooling controls allow pumps to run for long periods with the transformer de-energized*?
        - To avoid the possibility of causing this problem, the controls for forced-oil cooling should be designed to only switch pumps on after the transformer is energized.
        - The cooling control system on transformers with only forced oil cooling should be designed to automatically switch on the first cooling stage when the transformer is energized.
        - Running time should be limited to just a few minutes when testing oil pumps on de-energized transformers.
- Safe working clearances should be maintained at all times when the transformer is energized.
    - *Is any work required on or near the top of the transformer*?
        - Never work on the transformer cover, or store tools or equipment on the transformer cover when the transformer is energized at system voltages.
    - *Have any protective relays caused an alarm or a trip or are any unusual conditions observed*?
        - *Are the responders aware of the various possible causes of alarms or trips*? See the Troubleshooting section 7.8 in this manual for guidance.
        - Do not approach the transformer until it is de-energized if the Buchholz relay, Gas Accumulation Relay or Pressure Relief Device are in the alarm state.
        - Never Overload the transformer and exceed the highest Temperature given specification.

    - Immediately de-energize the transformer if unusual sounds are observed inside the transformer such as knocking or crackling. This could be signs of internal electrical problems and could lead to catastrophic failure if ignored.
    - Immediately de-energize the transformer and clean the bushing surfaces under a Clearance if excessive corona is observed across the bushing surfaces. This is possible in high contamination, salt-spray or dusty environments.
    - Never operate the transformer without lightning arresters.

- *Will the Tap Changers be operated safely*?
  - De-energized tap changers should never be operated when the transformer is energized.
  - Load Tap Changers should never be hand cranked when the transformer is energized. Local operation of the LTC should only be done with the electrical controls.
  - LTC troubleshooting should be performed with the transformer de-energized.
- *Are the transformer and bushing oil levels maintained at the proper levels*?
  - Never operate the transformer with transformer oil or bushing oil below the minimum safe levels.
  - Overfilling the transformer with oil could cause oil to be released from the pressure relief device or to damage the conservator bladder when the transformer is heavily loaded.
- *Are the control cabinets properly maintained and in good condition*?
  - *Are any drawings or manuals near the cabinet heaters where they could start a fire*?
  - *Are the cabinet door stops functional*?
  - *Are all energized terminals safe from accidental contact*?
  - *Are the cabinet lights functional*?
  - *Has the cabinet been scanned with thermovision to detect any hot-spots on circuit breaker, contactor or relay terminals*?

Section 2
General Construction

Section 2
General Construction

NANTONG HYOSUNG manufactures transformers in both core form and shell form construction.

2.1 Core Form Design and Construction

The core is designed and constructed with high permeability, low loss cold-rolled non-aging silicon steel. Each lamination is coated to insulate the sheets and reduce eddy current losses. The core is designed with 3 or 5 legs, depending on the transformer design, operational requirements and shipping dimension limits.

Core legs are held in place with fiberglass bands beneath the windings to withstand shipping impacts. Upper and lower core yokes are held with stainless steel bands over fiberglass bands and connected with an insulating buckle to provide maximum mechanical strength and eliminate circulating currents. The complete core is supported by a structural steel core frame to provide structural rigidity for withstand of short-circuit and transportation mechanical forces.

Each core steel sheet is precisely cut to size and shape using automated core cutting machines, then hand stacked into an E-core as shown above, consisting of the legs and bottom yoke in a step-lap configuration using overlapped mitered joints. The lower core frame and flitch plates are mounted to the

E-core before up-righting. The windings are then added to the E-core and the top yoke and frame are installed.

The core is divided into sections with insulated ducts between sections for cooling. Sections are connected in one place with sheet copper jumpers. The core is insulated from the core frame and grounded through an external connection to provide a convenient test point.

All windings are designed and manufactured to withstand the electrical, mechanical and thermal stresses of all types of faults and overvoltage conditions like lightning impulses and switching surges as specified by IEEE Standards and customer specifications.

NANTONG HYOSUNG's winding rooms are controlled-access positive-pressure clean rooms designed to minimize dust and other contaminants during the winding process. The winding rooms are equipped with both horizontal and vertical winding machines to provide greater manufacturing flexibility.

Windings are designed and constructed with insulated copper conductors in rectangular or continuously transposed cables. Winding conductors are crimped or welded to leads connecting the windings to other windings, tap changers or bushings.

After the windings have been constructed, they are clamped and dried under iso-static pressure to remove moisture from the insulation and shrink the windings to their clamped, in-service height. The individual windings are nested into a phase assembly as they are placed onto each core leg then the le ads and support structure are added.

The windings are then clamped under pressure to the core frame and the complete active part is dried using a vapor-phase process. After the final vapor-phase process, all windings are re-compressed to their designed values and all bolted connections are re-tightened. Transformers rated 80 MVA and greater are typically equipped with dash-pots to provide constant clamping pressure to the windings under all conditions.

2.2 Tank Design and Construction

All NANTONG HYOSUNG transformer tanks and conservator tanks are designed to withstand full vacuum. This allows the transformer to be oil-filled completely under vacuum, eliminating oxygen and moisture from the oil and extending the service-life of the transformer.

All gasket joints on the tank utilize rectangular or round o-ring gaskets with grooved flange faces to provide an oil-tight and gas-tight seal. Gaskets in most areas are nitrile, Buna-n type rubber and gaskets in higher temperature locations are Viton rubber. NANTONG HYOSUNG's gaskets should provide many years of service before replacement is required.

The tank is generally provided with manholes to permit access into the transformer, if needed. The tank is also equipped with jacking, lifting and pulling facilities for moving the transformer and is designed to be lifted or moved without oil.

The tank may be provided with electro-static or flux shields on the tank walls to reduce stray losses. These shields are grounded to the tank in one location.

2.3 Radiators or Heat Exchangers

NANTONG HYOSUNG radiators are efficient cooling units designed for use on large transformers requiring a self-cooling rating. The radiators are detachable and removed for shipment. Radiators are constructed on stamped steel sheets, welded together to provide a large surface area and internal vertical paths for oil circulation. Each radiator is equipped with lifting eyes for lifting the radiators during transformer assembly as well as upper and lower threaded plugs for oil draining or venting. Larger transformers are equipped with a radiator support structure to reduce mechanical stresses on the radiator piping joints.

Radiators can be equipped with fans to provide forced air cooling.

Heat Exchangers from various suppliers are used on NANTONG HYOSUNG transformers when forced oil cooling ratings are required. Heat exchangers require oil pumps to circulate the oil through the cooling tubes. Fans are also required to force air across the cooling tubes for effective heat removal. Heat exchangers can be supplied with aluminum, steel or copper tubes and fins depending on customer requirements.

Heat Exchangers are also equipped with a support structure to reduce mechanical stresses on the pump and oil piping joints.

2.4 Conservator Design and Construction

Unless the transformer is specified to use a nitrogen blanket or sealed tank oil preservation system, NANTONG HYOSUNG will provide a conservator with diaphragm type oil preservation system.

NANTONG HYOSUNG's conservator with diaphragm oil preservation system serves as an oil expansion tank and utilizes a Buna-n or similar rubber bladder to completely isolate the oil from the atmosphere while holding the oil at a constant pressure as the oil to increases or decreases in volume with increases or decreases in oil temperature due to load and ambient temperature variations. The outside of the bladder is in contact with the oil and the inside is in contact with the air. The bladder contracts and expands with increases or decreases in the oil volume and as it changes, the air moving into or out from the bladder passes through a dessicant breather to maintain a low moisture level in the air and bladder.

By preventing exposure of the oil to air, the oxygen and moisture content of the oil can be maintained at low levels, greatly reducing sludging and acidification of the oil and resulting accelerated aging of the transformer insulation.

The round conservator tank is equipped with valves that permit the vacuum pressure inside and outside the bladder to be equalized during vacuum processing, eliminating damage to the bladder. The tank is also equipped with an oil level gauge that is oriented for easy viewing from ground level.

The conservator tank is also equipped with a drain valve and a vent cock. The vent cock is used to vent the small amount of nitrogen gas introduced during the last stage of oil filling. The inside of the conservator tank is equipped with a guard structure that holds the bladder away from the vent cock or vacuum valve during oil processing and filling.

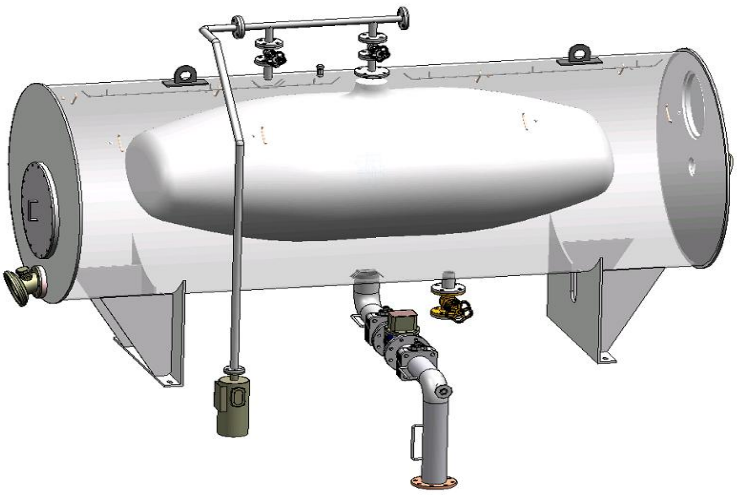


Figure 2.1 Typical Structural of Rubber Cell Conservator

2.5 Factory Oil Processing

All NANTONG HYOSUNG transformers are thoroughly dried out, flushed and impregnated at the factory. NANTONG HYOSUNG's field oil processing and filling procedures do not require costly oil circulations under most conditions, saving several days of processing time and thousands of dollars in installation costs.

Section 3
Shipment, Receipt and Storage

Section 3
Shipment, Receipt and Storage

3.1 Packing and Shipment

The transformers are normally shipped without oil. During shipping, the tank is filled with dry air. A pressure gauge and stop valve are provided to enable the pressure of the inert gas within the tank to be read upon receipt.

The transformer should arrive with positive pressure, indicating that moisture did not enter the transformer during shipping. The transformer must be filled with nitrogen during shipping. See the next section, *Receiving Transformer and Accessories*, for specific details.

All opening for transformer components, e.g. bushings which have been removed from the transformer during transport, are covered by means of blanking off plates. All parts are carefully packed for transport in such a manner that they are protected against mechanical injury and injurious effect of climatic conditions encountered during transit to their destination, as well as during long storage before erection.

NANTONG HYOSUNG designs transformers to withstand a 3G impact in all three directions and mounts an impact recorder on each transformer during delivery, but any impact of 3G or greater must be reported immediately to NANTONG HYOSUNG. Impact recorders are calibrated to ensure accurate data. The direction of each axis is a function of the mounting of the impact recorder and should be visually verified one each impact recorder before it is removed from the transformer. The time recorded on the impact recorder will be Chinese time, not local time. Any efforts to match recorded impacts with the location of the transformer will need to make this time adjustment.

All impact recorders must be shipped back to NANTONG HYOSUNG. The shipping address is:

NANTONG HYOSUNG TRANSFORMER CO., LTD.

No. 88, Xiaoxing Road, Hai'an Development Zone, Jiangsu Province

Postal code: 226611
Tel: 86-513-88905824 (switchboard)

3.2 Receiving Transformer and Accessories

Parts can be damaged or lost during shipping. Following the steps in this section will help to identify any such parts so they can be repaired or replaced as soon as possible.

Equipment Required:

- Packing List
- Crowbar, hammer, nails, wrenches and screwdrivers
- Digital camera
- 2500V megger
- Software and connecting cable for impact recorder (if an electronic recorder is used)

Inspection of Main Tank Before Off-Loading:

1. Visually inspect the tank and any attached fittings for signs of damage such as dents, stolen or misaligned parts, paint damage or areas where the tank was welded down and cut free from transport vehicles. Photograph any suspected damage before off-loading and check off the appropriate boxes on the Shipment Inspection Report.
2. Check the pressure gauge to verify positive pressure. Photograph the gauge. Record the results on the Shipment Inspection Report.

Inspection of Main Tank After Off-Loading:

1. Review the impact recorder data. Verify that the impact recorder's battery is still charged and the unit is functional. Impacts of 3G or less are OK. If an electronic recorder is used, download the record file. If a chart-type recorder is used deliver the chart paper to the NANTONG HYOSUNG field engineer as soon as he arrives. Record the recorder serial number and results on the Shipment Inspection report.
2. Megger test the core and core frame at 1000Vdc. Record the core test results on the Shipment Inspection report and record the core frame results separately.
3. Review the results with the customer. E-mail the photos, Shipment Inspection Report and test results to NANTONG HYOSUNG at the address listed below.
   ylchang@hyosung.com.cn; byang@hyosung.com.cn

Recommended Tests if Shipping Damage is Suspected

CAUTION

ELECTRICAL TESTS CAN NEVER BE MADE WHILE THE TRANSFORMER IS UNDER VACUUM, DUE TO INCREASED RISK OF FLASHOVER.

1. Check pressure on unit with pressure-vacuum gauge. If zero reading, purge with dry air and check for leaks. Note that pressure varies with temperature, and this factor should be considered.

2. Check percent moisture content in transformer. It should never exceed dew point in Figure 3.1.

3. Perform internal inspection. See section 4.4 for detailed requirements.

WARNING

WORK INSIDE THE TRANSFORMER REQUIRES A CONFINED SPACE PERMIT AND MUST BE PERFORMED IN ACCORDANCE WITH OSHA REQUIREMENTS.

SEE THE SAFE WORK PRACTICES SECTION FOR MORE DETAILS

WARNING

OBSERVE ALL SAFETY LABELS ON THE TRANSFORMER

4. Measure the exciting current on each HV winding.
5. Make ratio test on all windings and taps. All windings and taps should check within 0.5%.
6. Check winding continuity and resistance if unit is off ratio.
7. After filling with oil make Megger test on insulation resistance. HV to XV and Ground, XV to HV and Ground, and HV and XV to Ground. Coils should be under oil for comparison with factory test measurements.
8. If core yoke shows signs of shifting, disconnect core ground bushing and end frame ground bushing from tank cover and test end frames to core with 2500 volt Megger. This might happen when unit has been subjected to severe shocks in transit by carrier.(Minimum acceptable values are 50 mega-ohms.)

Shipment Inspection Report:

A NANTONG HYOSUNG Shipment Inspection report form must be filled in and e-mailed to NANTONG HYOSUNG. All sections, lines and boxes on the form must be filled in completely. Enter N/A if any areas do not apply. Contact NANTONG HYOSUNG if you do not have a copy of the form.

DEWPOINT TEST

1. Measure internal tank temperature and measure the Dew Point temperature of the air inside the tank.
2. Use Figure 3.1 for pressure between 0 and 0.35bar
3. Use upper and left axes for temperatures recorded in Celsius, use the lower and right axes for temperatures recorded in Fahrenheit.

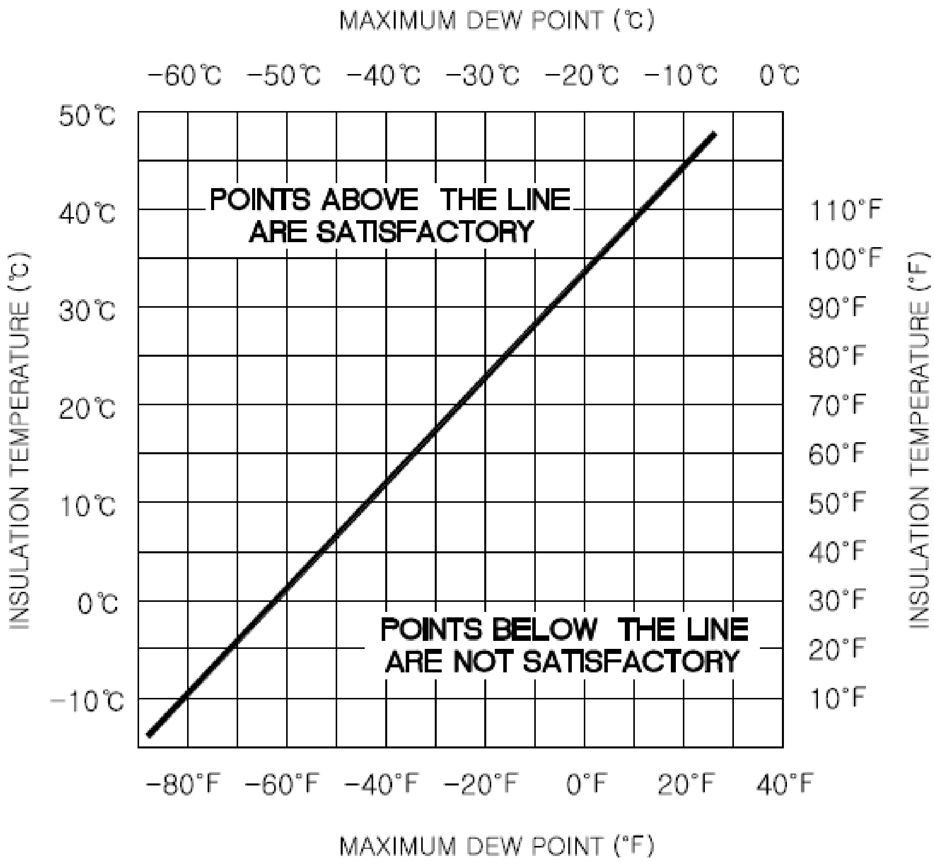


Figure 3.1 Dew Point Limit

Inventory and Inspection of the Accessories:

1. Verify that all crates, pallets and components listed on the packing list have been received and check off the appropriate box on the Shipment Inspection Report. Check all crates and pallets for external damage. Photograph any suspected areas and report on the Shipment Inspection Report.
2. Open each crate and verify contents against the packing list. Look for water intrusion or damaged components. Photograph any damaged parts and record missing parts and damaged parts on the Shipment Inspection Report.
3. Locate the Instruction Manual. It should be in the main control cabinet or in one of the crates. If not found, call NANTONG HYOSUNG.
4. Check bushing crates to verify that all internal supports are in place and undamaged. Verify that crates are roughly level and that all oil filled bushings inside each crate are inclined with the top oil reservoir elevated. Verify that all bushing stud connectors have been delivered. Record missing parts and record and photograph any damaged parts.
5. Check lightning arresters to verify that porcelain is not damaged and that all arrester sections and grading rings have been delivered. Record missing parts and record and photograph any damaged parts.
6. Check radiators for any signs of damage including dents on plates or edges, paint damage or missing blanking plates. Record missing parts and record and photograph any damaged parts.
7. Check all piping sections. Record missing parts and record and photograph any damaged parts.
8. Check the main control cabinet and any other cabinets provided on the order. Check to verify that the cabinet is not damaged and all internal components are in-place and undamaged. Record missing parts and record and photograph any damaged parts.
9. A claim should be filed immediately with the carrier if any missing parts suspected damage are found.
10. Review the results with the customer. E-mail the Shipment Inspection report, photos, and other information on any missing or damaged parts to NANTONG HYOSUNG.

Impact Recorder

Note that impacts recorded by the impact recorder are only an indication of possible damage and not conclusive evidence that shipping damage or even impacts have occurred. Impact recorders may record impacts if the impact recorder is accidently kicked by a rigger, if rigging comes in contact with the recorder, or under similar circumstances. The transformer may also withstand impacts well beyond 3G's without any damage. The determination of damage can only be made following testing and/or an internal inspection.

Examination

After the transformer is moved on the pad in the site, its arriving time should be recorded and the impact recorder data should be examined.

Notification

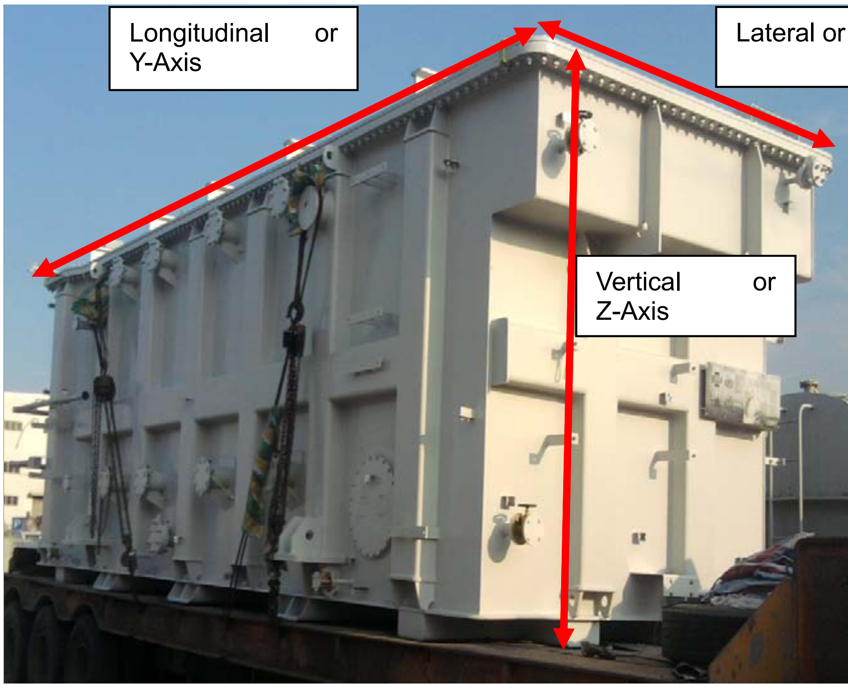
The recorder is part of the shipment. If it is missing or damaged, the seal broken, or has been disturbed in any way, a specific carrier's inspection report must be issued by the carrier, to relieve the customer of responsibility for the recorder.

Examine the recorder in the presence of the carrier's agent. Both the carrier and customer personnel must check when impacts are recorded in3G or above.

If impacts are recorded in 3G or above, the customer should notify a representative of NANTONG HYOSUNG (if one is not present at that time) for advice.

Orientation of Impact Recorder on the Transformer

Most types of impact recorders have axis or direction marks on them that correspond to the axis or direction as recorded on the strip chart or electronic file. The impact recorder should normally be mounted on the transformer with the orientation of the impact recorder axes as shown below to match the axes on the transformer.



It must be noted, that in some cases the impact recorder may not be oriented as shown in the photo above. In these cases, the axes indicated on the strip chart or electronic report will not correspond to the same axes on the transformer and all impact directions must be adjusted accordingly.

Electronic-Type Impact Recorders

The MLOG IM100 model impact recorder is battery powered and records impacts in all three directions. The detailed data must be connected with a special data cable and shown on the monitor interface. Also the date can be downloaded onto a PC with MLOG software loaded. NANTONG HYOSUNG's field service engineers are equipped with the necessary cable and monitor.

Maker	MESSKO
Model No.	MLOG IM100
Battery Life	1~2 years
Figure	

3.3 Receiving Oil

See the Oil Processing and Filling Section of this manual.

CAUTION

NEVER ATTEMPT TO MOVE A FULLY ASSEMBLED TRANSFORMER. MOVING A FULLY ASSEMBLED TRANSFORMER MAY CAUSE DAMAGE TO THE EXTERNAL OR INTERNAL STRUCTURES.
CONTACT OUR LOCAL REPRESENTATIVE FOR SPECIAL INSTRUCTIONS PRIOR TO MOVING ANY TRANSFORMER.

TRANSFORMERS MUST BE MOVED IN THE UPRIGHT POSITION UNLESS THE UNIT WAS DESIGNED FOR HORIZONTAL SHIPMENT. THE OUTLINE DRAWING AND THE EXTERNAL ASSEMBLY DRAWINGS SHOW THE POINTS FOR LIFTING, JACKING OR PULLING THE TRANSFORMER. NEVER ATTEMPT TO LIFT OR MOVE A TRANSFORMER FROM ANY PART OTHER THAN THE FACILITIES PROVIDED FOR THAT PURPOSE.

3.4 Moving and Handling

Setting the transformer on the foundation

Note the transformer base diagram on the outline drawing and be certain the foundation pad and piers support the transformer in the designated areas. In some instances a separate base diagram is supplied and it will be included in the instruction book.

Cooling air requirements

The transformer must be positioned so that adequate air circulation is provided to cool the transformer.

Relocating the transformer

NANTONG HYOSUNG's standard design provides for lifting and pulling the transformer in the shipping configuration, without oil. If the transformer must be relocated after assembly and oil filling, the oil must be drained before the transformer is moved. Failure to drain the oil before moving may result in structural damage.

NANTONG HYOSUNG does not recommend moving a transformer with any accessories mounted with or without oil. Such a move is made at the owner's risk and any damage as a result is not covered under the warranty.

3.5 Temporary Storage

If the transformer will not be assembled immediately, the following steps should be taken:

- Locate the accessories in a secure area where theft is not a concern
- Reclose all crates. Replace any plastic covers, place all hardware back into original containers, nail the crate covers back on. Photograph the reclosed crates.
- Ensure that all parts susceptible to rain, ice or wind damage are properly stowed. Electronic components such as monitoring devices should be stored indoors. Record the storage location of any parts stored in other areas.
- Add dry air to the main tank to 2-3 psi, if pressure is less than 2psi. Photograph the pressure gauge.
- E-mail the information and photos to NANTONG HYOSUNG. Call the phone number listed in the Introduction Section for the correct e-mail address for your transformer.

If the transformer will not be oil-filled within 90 days after leaving the factory, the appropriate NANTONG HYOSUNG procedure, as listed below, must be followed.

Days After Shipping from the Factory Until Start of Assembly	Procedure
90-150*	*Short Term Storage of Oil-Filled Transformers*
151-365	*Medium Term Storage of Oil-Filled Transformers*
>365	*Long Term Storage of Oil-Filled Transformers*

* Dependent on transformer kV class

<u>Special Oil Processing Requirements for Stored Transformers</u>

CAUTION

NOTE THAT ALL TRANSFORMERS THAT HAVE BEEN STORED BEYOND 90 DAYS AFTER THE EX-FACTORY DATE REQUIRE ADDITIONAL OIL PROCESSING. THE OIL PROCESSING REQUIREMENTS FOR STORED TRANSFORMERS ARE LISTED IN THE OIL PROCESSING AND FILLING SECTION OF THIS MANUAL.

Short Term Storage of Oil-Filled Transformers

If the transformer cannot be installed immediately upon arrival and oil filling is impractical, it is possible to store some transformers under a positive dry air pressure. The maximum length of time under this storage method is dependent on the transformer kV class as follows.

Transformer HV kV Class	Maximum Short Term Storage
Up to 230kV	150 days from ex-factory date
345kV and greater	90 days from ex-factory date

The following steps must be taken for Short Term Storage:

- Inventory and check of all crates and contents
- Reclose and secure all crates
- Store any electronic components indoors
- Connect the transformer tank to a secure ground
- Perform the following steps within one month if the transformer can't be installed within 3 months after reaching the site:
    - Install the conservator and breather and fill the conservator with qualified oil to the required level.
    - Or fill nitrogen (dew point below -40℃) to the tank. Pressure should be kept at the level of 0.01~0.03MPa. Check and record the pressure everyday.
- Regular inspection on the oil leakage, oil level and appearance should be carried during storage. Check the oil insulation every six months.
- Ship impact recorders to NANTONG HYOSUNG

The transformer pressure and cylinder pressure should be recorded every day for the first two weeks. These reading should preferably be taken at approximately the same time every day and the time and temperature also noted on the log.

After two weeks of daily logging, the pressure readings may be reduced to once every seven days.

An accurate log is important as it may be the determining factor in any decisions that may have to be made on further drying of the windings.

CAUTION

IT IS IMPORTANT TO MAINTAIN POSITIVE DRY-AIR PRESSURE DURING ANY STORAGE WHEN THE TRANSFORMER IS NOT FULLY FILLED WITH OIL. ZERO OR NEGATIVE PRESSURE INDICATES THE PRESENCE OF A FAULTY SEAL WHICH COULD ALLOW MOISTURE TO ENTER THE TRANSFORMER.

Medium Term Storage of Oil-Filled Transformers

If the transformer must be stored longer than the limit for Short Term Storage, a Medium Term Storage can be performed with partial oil filling.

The following steps must be taken for Medium Term Storage:

- Inventory and check of all crates and contents
- Reclose and secure all crates
- Store any electronic components indoors
- Install valve and pressure gauge on each radiator and fill to 2 psi with dry air
- Check and ensure that all pipes and the conservator tank are gasketed and sealed
- Cover all bushing and lightning arrester crates with tarps and secure the tarps
- Connect the transformer tank to a secure ground
- Schedule and co-ordinate oil delivery
- Provide any required environmental safeguards
- Test and accept or reject the oil
- Inspect any oil storage tanks or tankers
- Vacuum process and oil fill transformer tank
    - 4 hour vacuum after reaching 1 Torr
    - Fill oil to 12” below the cover
    - Install pressure gauge on valve above oil level
    - Add dry air above the oil and pressurize to 3 psi
    - Seal the tank
- Perform core and frame megger tests
- Ship impact recorders to NANTONG HYOSUNG
- Prepare and send Assembly Report to NANTONG HYOSUNG
    - Include the gallons of oil pumped into the transformer, as measured
    - Include photographs of radiator pressure gauges, tank pressure gauge, tank grounding and crates as stored.
    - Note location of any stored electronic components
- Weekly inspections to check for positive pressure and no oil leaks.

The pressure relief devices should be mounted before oil filling.
An accurate log of inspection and maintenance data is required. This must be reviewed by the user prior to energizing the transformer. If the data is questionable, contact NANTONG HYOSUNG.

At the end of the storage period, samples of oil must be drawn from the bottom of the transformer and from the tap changer compartments and tested for electrical strength, power factor and water content.

If the transformer is equipped with pumps, operate one half of the pumps for 30 minutes and then operate the other half for 30 minutes. Repeat this operation every three months during the storage period.

Long Term Storage of Oil Filled Transformers

If the transformer must be stored for longer than one year after the ex-factory shipping date, all oil filled components must be mounted and the transformer must be fully oil filled.

The following steps must be taken for Long Term Storage:

- Inventory and check of all crates and contents
- Store any electronic components indoors
- Verify that transformer is on permanent foundation
- Connect the transformer tank to a secure ground
- Assemble the transformer
    - Install turrets
    - Bushings and arresters do not need to be installed, if they can be stored indoors in their crates or other suitable storage racks
    - Bushings and arresters need to be installed if they cannot be stored indoors in their crates or other suitable storage racks
    - Install radiators or heat exchangers
    - Install conservator
    - Install all oil piping and valves
        - Reliable power must be supplied for the Heater in local control cabinet and occasional exercising of pumps, if equipped.
- Reclose and secure all crates with uninstalled components, store indoors
- Schedule and co-ordinate oil delivery
- Provide any required environmental safeguards
- Test and accept or reject the oil
- Inspect any oil storage tanks or tankers
- Vacuum process and oil fill the transformer, including the radiators, piping and conservator per NANTONG HYOSUNG's standard oil filling procedures.
- Perform core and frame megger tests, winding megger tests (only if bushings have been installed) and functional checks of the heater/thermostat circuit (and pump circuit, if equipped)
- Ship impact recorders to NANTONG HYOSUNG
- Prepare and send Assembly Report to NANTONG HYOSUNG
    - Include gallons of oil pumped into the transformer, as measured
    - Include all test results
    - Include photographs of assembled transformer and stored crates
    - Note location of stored crates

Section 4
Installation and Assembly

Section 4
Installation and Assembly

CAUTION

FAILURE TO SUPPORT THE TRANSFORMER BASE PROPERLY MAY RESULT IN DAMAGE TO THE TRANSFORMER TANK AND ADJACENT APPARATUS IN THE SUBSTATION

WARNING

WORK INSIDE THE TRANSFORMER REQUIRES A CONFINED SPACE PERMIT AND MUST BE PERFORMED IN ACCORDANCE WITH OSHA REQUIREMENTS.

SEE THE SAFE WORK PRACTICES SECTION FOR MORE DETAILS

WARNING

IF THE TRANSFORMER WAS FILLED WITH NITROGEN GAS, THE NITROGEN MUST BE REMOVED BY APPLYING VACUUM AT 1 TORR FOR 2 HOUR OR LONGER, BEFORE BREAKING VACUUM AND REFILLING WITH DRY-AIR AND VENTILLATING THE TANK

4.1 Required Tools and Equipment (See the Safe Working Practices Section for PPE requirements)

The tools and equipment listed below are not supplied by NANTONG HYOSUNG with the transformer, and must be supplied by the installation and testing crews.
REQUIRED TOOLS AND EQUIPMENT FOR ASSEMBLY

Equipment	Specs.	Task
Crane with slings and rigging hardware	See Drawings for weights	Transformer assembly
Manlift		General
Ladders		General
Hydraulic jacks		Installation and general
Rope		Lifting and rigging, tag line
Oil processing trailer	See Section 5	Vacuum oil processing and filling
Vacuum and oil hoses and fittings		
Dry Nitrogen Gas Cylinder or Air Cylinder w/regulators and hoses		
Vacuum gauge	to 0.01 torr	
Tygon tubing		
Assorted flanges and pipe fittings to make up the oil and vacuum connections	2" – 4"	
Oxygen meter (O_2, CO, CO_2, LEL's)	Calibrated and tested	Internal inspection or internal work
Dry air (cylinders or generator)	-42℃	
Clean plastic sheets and tarps		
Anti-seize compound	See Section 4.10	Connecting stainless steel hardware
Oxide removing grease	See Section 4.10	Cleaning copper and aluminum current-carrying surfaces
Torque wrenches	Small, medium and large size	Transformer and component assembly
Crow's foot wrenches		Torquing bushing top terminals
Ratchets	10-30mm	General assembly
Open and box-end wrenches	10-46mm	
Adjustable wrenches	6,8,10,12 and 15"	
Sockets	10-46mm and ¼"-3"	
Misc. hand tools, hammers, chisels, blunt chisels, wedges, screwdrivers, socket drivers, allen wrenches, torx wrenches, pliers, tape measures, levels, pliers, etc.		
Hydraulic crimping tool with dies	4.7/0 248kCmil) and 6.2/0 (350kCmil)	Connecting ground cables and terminals
Silicon grease and rubber cement (adhesive)		Installing gaskets

REQUIRED TOOLS AND EQUIPMENT FOR TESTING

Equipment	Specs.	Task
Dew Point Tester		Dew point test
Variac or variable AC voltage supply	to 140VAC	Breaker and relay tests
DC power supply	125V	Alarm and trip tests
Oil hi-pot tester	ASTM D877 or D1816	Oil acceptance tests
Oil moisture tester	Doble Domino or Karl Fischer	
Megger	500V to 5000VDC	Megger tests
Hand operated air pump		Gas accumulation relay test
Multi-meter		General
Fused jumpers		General
Temperature probe calibration tester		Oil and winding gauge calibration and functional tests
Qualitrol (or equivalent) Rapid Pressure Rise Relay test kit		Rapid Pressure Rise Relay test
Power factor test set	Doble M4000 series	Power factor, TTR and excitation tests
Ground cables		
Mausing wire		
Hygrometer		
Winding resistance test set		Winding resistance tests
DC continuity tester (buzzer)		Wiring checks
Manlift	Check outline drawing for height requirements	All tests above ground level
Ladders		

OPTIONAL TOOLS AND EQUIPMENT

Equipment	Specs.	Task	Required if:
Welding machine	200 ~250A AC/DC	Repairs or modifications	Damage occurs or modifications are required
SFRA test set	Doble M5000 series	SFRA tests	SFRA test is required
Leakage reactance test set	Doble M4110		
Phase rotation meter		3-phase pump or fan rotation checks	AC supply voltage is 3-phase
Diesel or gas-powered generator	230/460VAC	Fan, pump, components and functional tests	Sufficient AC supply voltage source is not available on-site
Laptop computer with an assortment of interconnection cables (serial, null-modem, USB, etc.)		Programming or program editing	Transformer is equipped with electronic devices or monitoring equipment requiring programming

4.2 Setting the Transformer on the Foundation

Carefully move the transformer into the correct position on the substation pad and make certain that the base is flat and level. Install shims under the base for leveling if necessary.

4.3 Grounding the Transformer Tank

The transformer tank must be connected to a secure ground before any work is done in or on the transformer.

4.4 Inspecting the Active Part

An internal inspection should be performed by the NANTONG HYOSUNG Field Service Engineer or NANTONG HYOSUNG's contractor. If the customer performs the inspection, the inspection should be performed by an engineer who has been trained in performing transformer inspections. The Engineer will check for any signs of movement or damage during shipping.

The internal inspection is a Confined Space entry and must be performed in accordance with OSHA and all other applicable regulations and requirements. See the Safe Working Practices section.

When you open a transformer, take precautions to prevent moisture or dirt entering the transformer or moisture condensing in the transformer. Always observe these precautions:

4.4.1 Breaking vacuum

Never break vacuum with atmospheric air, always use dry air or dry nitrogen.

4.4.2 Weather

Do not open the transformer or leave it open during rapidly changing weather conditions unless the opening is completely protected from weather.

Do not open the transformer if the relative humidity is greater than 75%.

Do not work inside the transformer if moisture is condensing on the inside of the tank.

4.4.3 Clothing

Never enter a transformer with dirty or wet clothing. Clean cloth shoe covers or nitrile rubber overshoes must be worn.

4.4.4 Ventilation of Tank

Dry air must be used to ventilate the inside of the tank when it is opened for internal fitting or for inspection. These restrictions must also be followed:

a. The dry air must have a dew point not higher than -42℃
b. Purge all air hoses with dry air to remove all moisture and dirt prior to use.
c. Use a pressure regulator to control the pressure of the incoming air.
d. Dry air should be blown into the transformer below the working level to maintain flow of air out through the cover opening. Air hoses may be taken into the transformer if they are clean, dry and made from an oil-proof material.
d. The dry air flow rate should be adjusted to maintain continuous airflow outward through the tank openings. To conserve dry air and prevent the entrance of dirt and moisture, place a light cover of plywood, hardboard, or plastic over the manhole opening. The work should be performed in a sequence such that when accessories such as bushings are being installed, only one opening other than the manhole will be open at any time.

4.5 Temporary Sealing of the Transformer Between Work Days

a. Remove all the tools and working material from the transformer.
b. Continue to purge the transformer tank with dry air for 30 minutes after all the material has been removed.
c. Seal the tank and pressurize it with dry air to 0.01~0.03MPa.
d. If the next work period and re-opening of the transformer will not occur within three days, we recommend after sealing the tank, that you pull vacuum on the transformer to an absolute pressure of 1 torr or less and hold this level for 4 hours. Break the vacuum with dry air and pressurize the tank to 0.01~0.03MPa .

4.6 Bolt & Nut Assembly

Equipment Required**:**

- Calibrated torque wrench
- Assorted sockets and crows foot wrenches
- Nickel or nickel/graphite anti-seize compound for stainless steel nuts and bolts such as Chesterton 725 or Loctite Nickel Anti-Seize with application brush
- Electrical contact oxide removing grease such as Sanchem NO-OX-ID and clean rags

Procedure**:**

<u>Nuts and Bolts That Require Torquing with a Calibrated Torque Wrench</u>:
All current carrying connections must be torqued to their required torque values, as listed in the Tables in Section 4.7, using a calibrated torque wrench. This includes all bottom bushing connection nuts and bolts, all bushing stud connector hardware, all bushing terminal connector to cable connections, and all ground cable connection nuts and bolts. This also includes the top terminal of TRENCH draw lead bushings and the draw lead jam nut of and top terminal of XIAN XD draw lead bushings (or similar bushing components if required by other bushing manufacturer).

Conservator support structure bolts must also be torqued to their required torque values using a calibrated torque wrench.

Special Case – Qualitrol Pressure Relief Device: Qualitrol Series XPRD Pressure Relief Devices are supplied with ½” mounting bolts to attach the cast iron base of the device to the transformer. This may be changed to M16 bolts by NANTONG HYOSUNG. These mounting bolts, whether steel or stainless steel, should be torqued to 210N • m, and a flat washer must be used between the flange and the bolt head or nut. Applying torque greater than 210N • m, or failure to use a flat washer could cause the cast iron flange to crack and require the device to be replaced at the installer’s expense.

Special Cases – Bushing and LTC manufacturers specify the torque values for the mounting bolts and for some current-carrying connections. The manufacturers’ torque values supersede any NANTONG HYOSUNG values listed in the Tables in this section.

CAUTION

Note: Any torque values listed in component manufacturers' bulletins included with this manual supersede the NANTONG HYOSUNG standard torque values in this Section for those components.

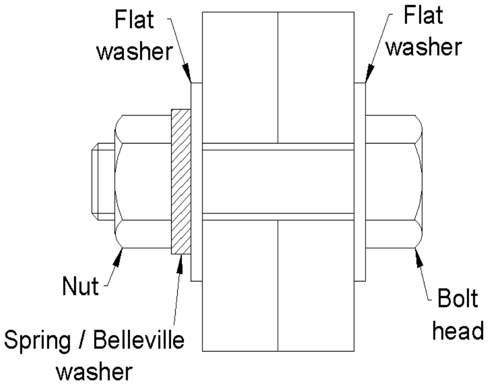
Nuts and Bolts That Do Not Require a Torque Wrench:
Bolts connecting steel, stainless steel or aluminum flanges that are not listed above must be tightened to the torque values listed in the Tables below, but this can be done without using a torque wrench.

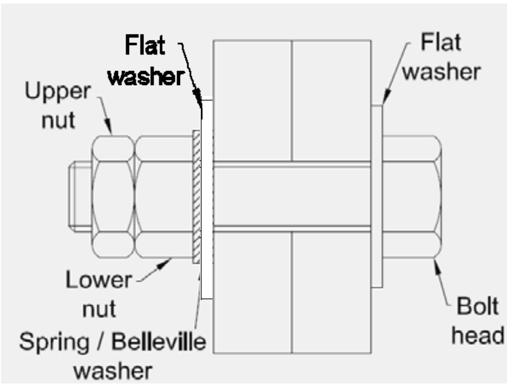
Thread Lubricants:
All galvanized steel, bronze or brass threaded connections must be made without any thread lubrication.

All external stainless steel threaded connections must be made using a nickel/graphite anti-seize compound on the threads to prevent galling. All stainless steel threaded connections inside the transformer and under oil must be made without any anti-seize compound.

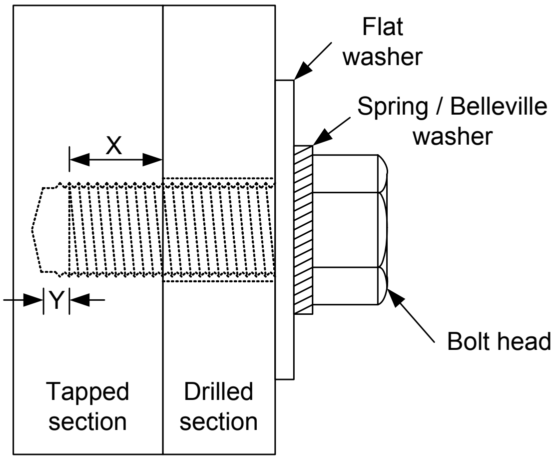
Nut, Bolt and Washer Configurations:

Standard Connections:
Spring/Belleville Washer Connections: When connecting flanges or other joints with Spring/Belleville washers, the connection should be made as shown below. A flat washer must be provided under the bolt head. The Spring/Belleville washer must have a flat washer between the Spring/Belleville washer and the flange or other surface to protect the surface from damage. In case of using the Double nuts, the connection should be made shown below. Lower nut must have a Spring/Belleville washer between the Lower nut and the flat washer or other surface. The bolt length must be long enough to provide at least one full thread beyond the outer end of the nut.





<u>Tapped Bolt Hole Connections</u>:
When connecting flanges or other joints where the bottom surface is equipped with a drilled and tapped threaded hole (like a pump, for example) the connection should be made as shown below. A Spring/Belleville washer must be provided between the bolt head and the flat washer. The length of the bolt is critical. The bolt must be long enough to meet the minimum engagement length (X in the drawing) and must not be too long to meet the minimum blind hole depth (Y in the drawing).



The minimum length of engagement, X, of the bolt into the threaded hole should be at least 1 times the diameter of the bolt. The blind hole, Y, should be at least 0.3 times the diameter of the bolt. Additional flat washers and Spring/Belleville may be used, if needed, to meet these requirements.

The bolt material must be the same general material as the part with the tapped hole. All such connections with stainless steel threaded holes and bolts must have the bolt coated with a nickel-graphite anti-seize compound before torquing.

4.7 Required Torque Values

Table 4.1 applies to galvanized steel, SAE Grade 5 nuts and bolts through an un-threaded hole in Steel, Stainless Steel, Copper or Aluminum base material

TABLE 4.1
Galvanized SAE Grade 5 and Hardware
Unthreaded Steel. Stainless Steel, Copper or Aluminum Base Material
Torque in N • m

Bolt Material	**Galvanized Steel SAE Grade 5 Non-Lubricated**
Bolt Size	**Torque in N • m**
M6	10
M8	25
M10	50
M12	86
M14	135
M16	210
M18	300
M20	425
M22	580
M24	730
M27	1100
M30	1450

4.8 Standard Bolt Dimensions

Table 4.7

Standard Bolt & Nut	Dimension(mm)				
	Hex-Bolt			Hex-Nut	
	A	B	C	A	B
M6	11.5	10	6	11.5	10
M8	15	13	8	15	13
M10	19.6	17	10	19.6	17
M12	21.9	19	12	21.9	19
M14	25.4	22	14	25.4	22
M16	27.7	24	16	27.7	24
M18	31.2	27	18	31.2	27
M20	34.6	30	20	34.6	30
M22	37	32	22	37	32
M24	41.6	36	24	41.6	36
M27	47.3	41	27	47.3	41
M30	53.1	46	30	53.1	46
M33	57.7	50	33	57.7	50
M36	63.5	55	36	63.5	55
M39	69.3	60	39	69.3	60
M42	75	65	42	75	65
M45	80.8	70	45	80.8	70
M48	86.5	75	48	86.5	75
M52	92.4	80	52	92.4	80
M56	98.1	85	56	98.1	85
M60	104	90	60	104	90
M64	110	95	64	110	95
M68	115	100	68	115	100

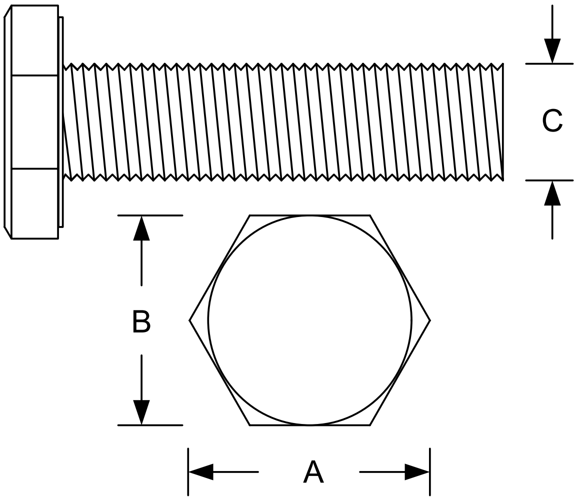


Figure 4.1 Hex-bolt

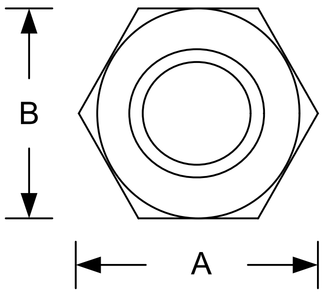
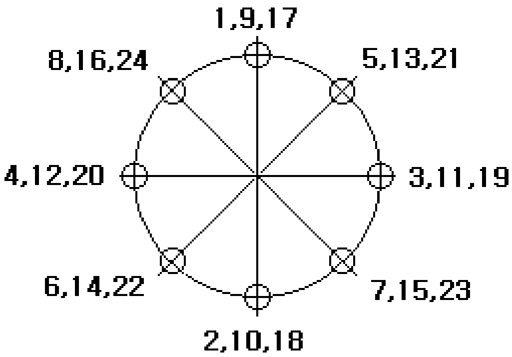
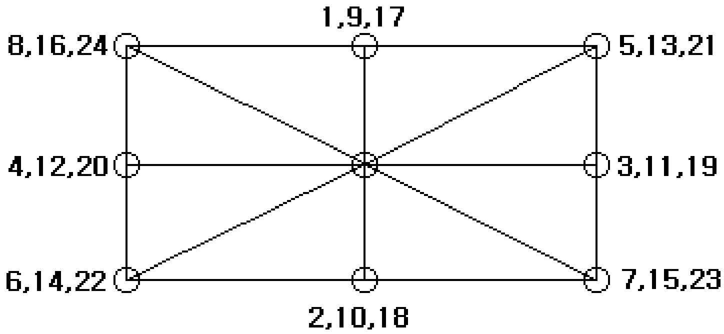


Figure 4.2 Hex-nut

4.9 Tightening Sequence for Nuts and Bolts

The general tightening sequence of nuts and bolts is as follows





4.10 Assembly Safeguards

CAUTION DO NOT ATTEMPT TO OPERATE THE PUMP VALVES WHEN THE PUMPS ARE IN OPERATION. ALWAYS SHUT OFF THE PUMP MOTOR BEFORE OPENING OR CLOSING ANY VALVES. FAILURE TO FOLLOW THESE PRECAUTIONS MAY CAUSE EQUIPMENT DAMAGE AND PERSONAL INJURY.
DANGER BE CERTAIN THE INTERNAL PRESSURE IN THE TRANSFORMER IS AT ZERO(0) GAUGE BEFORE OPENING THE MANHOLE COVER.
WARNING WORK INSIDE THE TRANSFORMER REQUIRES A CONFINED SPACE PERMIT AND MUST BE PERFORMED IN ACCORDANCE WITH OSHA REQUIREMENTS. SEE THE SAFE WORK PRACTICES SECTION FOR MORE DETAILS

WARNING IF THE TRANSFORMER WAS FILLED WITH NITROGEN GAS, THE NITROGEN MUST BE REMOVED BY APPLYING VACUUM AT 1 TORR FOR 2 HOUR OR LONGER, BEFORE BREAKING VACUUM AND REFILLING WITH DRY-AIR AND VENTILLATING THE TANK
CAUTION TO PREVENT DAMAGE TO THE TRANSFORMER INTERNAL STRUCTURES IT MAY BE NECESSARY TO INSTALL CLEAN TEMPORARY STRUCTURES ABOVE THE CORE AND COILS TO SUPPORT WORKERS INSIDE THE TRANSFORMER
WARNING ENERGIZED CURRENT TRANSFORMERS CAN PRODUCE VERY HIGH VOLTAGES IF THE SECONDARY CIRCUIT IS OPEN-CIRCUITED. THIS CAN CAUSE SEVERE INJURIES TO WORKERS AND EQUIPMENT. ALL CT CIRCUITS SHOULD BE CLOSED AND GROUNDED EXCEPT WHEN BEING CONNECTED TO RELAY AND METERING EQUIPMENT BY QUALIFIED PROTECTION AND CONTROLS TECHNICIANS.

4.11 Recommended Assembly Order and Quality Checks

This procedure applies to the on-site assembly of all new oil-filled transformers. Many of the tasks listed below are covered in detail in various NANTONG HYOSUNG procedures and all work must be done in conformance with those procedures. This procedure only covers the recommended order for performing the tasks.

After the transformer tank has been placed on the foundation in the final location, and all parts have been inventoried, inspected and verified as clean and dry, the transformer assembly should be performed in the following general order. The exact order of assembly should always be determined by the installation crew leader, and can be modified as long as safety is not compromised, equipment is not at risk and test results will not be adversely affected.

Grounding:

The tank ground should be connected to the site's ground grid, or other secure ground point as soon as possible after the transformer is placed on the foundation. This is a safety issue and must be done before any other work is done on the transformer.

Preliminary Tests:

It is recommended that the CT's be pre-tested before the transformer is assembled and filled with oil. A full series of ratio, polarity, insulation and excitation tests on each CT will ensure that the correct CT is installed in the turret properly and that no shipping damage has occurred.

It is also recommended that any bushings showing any signs of shipping damage such as crate damage or shifted porcelain be tested before the transformer is filled with oil.

Performing these tests before the transformer is filled with oil will minimize the cost and impact of any problem.

Assembly:

The optimal order of assembly for the major components varies by transformer design and should be evaluated by the NANTONG HYOSUNG field service engineer or supervisor on the assembly crew, considering all of the following issues:

If the transformer was shipped by barge or exposed to salt spray or other corrosive contaminants during shipping, the transformer tank and all conduits and parts that were exposed must be washed with a pressure washer before assembly can start. If the site is an energized substation, it may be necessary to perform this pressure washing before bringing the transformer into the station if the work cannot be performed safely. Any crates with components found to have moisture intrusion during shipping must also be pressure washed to remove any corrosive contaminants.

The conservator support structure must be installed and all bolts torqued before the conservator or conservator piping can be attached. The conservator should be loosely bolted to the conservator support structure before the conservator piping (including the Buchholz relay, if equipped) is installed and the conservator position must be adjusted using the slotted holes to align the piping, if the mis-alignment is greater than 1/8” in any direction, before bolting the piping together and torquing the bolts that hold the conservator in place.

The turrets must be installed before the bushings or gas collection piping are installed.

If any gas collection piping or conduits, or any LTC operating shafts are designed to be routed over any manhole or handhole covers, all internal work through these manholes or handholes should be performed before the piping, conduits or operating shafts are installed, to avoid later partial disassembly.

All cabinets or conduits that were removed for shipping, and are located behind radiators must be installed before the radiators.

All bushings that are bottom-connected through handholes on the tank wall behind radiators must be installed and connected internally before the radiators are installed.

Any bushings that require lower corona shields should be measured and evaluated before assembly to verify whether the bushing can be installed from the top of the turret with the shield attached or whether the shield must be connected internally after the bushing is mounted in the turret. Bushing shields must be placed around the conductor or mounted to the bushing bottom before connecting the bushing.

All bushings that require the draw-lead nut or top terminal to be torque to manufacturers’ specified values must be torque before installing any bushing stud connectors or neutral ground bus connections, or before testing.

The installation of all radiator or heat exchanger support structures and cooling piping and pumps (if equipped) must be co-ordinated with the installation of the radiators or heat exchangers to prevent radiator piping and components from being exposed to excessive mechanical stresses during or after assembly. If a complicated support system is provided, consult with NANTONG HYOSUNG before starting the assembly if a NANTONG HYOSUNG field service engineer is not on-site.

All arrester support structures must be installed after the radiators or heat exchangers if they are mounted directly above the radiators or heat exchangers.

Bus or cable connections to neutral bushings should be measured and placed in the proper position, but final connection to the bushing can be delayed until after commissioning tests are completed.

All accessories such are relays, pressure relief devices, gauges and temperature controllers should be installed after the risk of damage from installing other components has passed. All wiring to these components should be tested for insulation strength at 500Vdc before the wiring is terminated at the devices.

All internal and external cabinet grounds and lightning arrester grounds must be connected before testing the accessories or wiring.

If the transformer is equipped with pumps, the pumps must not be energized before the transformer and oil piping is filled with oil.

If the transformer is equipped with a LTC, the LTC must be manually operated over the full range of taps to verify correct position indication and correct operation of limit switches before operating power can be connected to the LTC. The LTC cannot be operated electrically before all manual tests are completed and correct operation is verified, and the LTC cannot be operated electrically or tested before the transformer and LTC are filled with oil.
If the transformer is equipped with an LTC with an oil filtration system, the filtration system operation must be thoroughly tested and the filter tank and piping must be filled with oil before any electrical testing is performed on the filter system or LTC.

The transformer must be filled with oil only after all major components and accessories that cannot be installed or replaced without removing the oil have been installed.

All bolted connections requiring torques with a calibrated torque wrench, must be torque to the required value when the connection is first made, and again as a final torque before releasing the transformer for service.

Testing, Supplied Power and Final Connections and Checks:

Perform final commissioning tests must only be performed after the transformer has been filled with oil and the oil temperature has cooled to less than 40°C

- Power factor and capacitance on the transformer and bushings
- Power factor on the oil
- Ratio and single phase excitation. Excitation tests must be performed before any DC tests.
- SFRA (if required)
- Winding resistance (after the excitation tests)
- Insulation resistance - core, core frame and windings (after the excitation tests)
- Test current transformers from the control cabinet terminals for ratio, polarity, megger and plot the excitation curve.
- Functionally test the AC power circuit and components: automatic transfer switch (if equipped), cooling controls, pumps (if equipped), fans, cabinet heaters and lights. Verify correct 3-phase power rotation, if designed for 3-phase supply power, and mark the rotation direction at the main terminal connections if the power supply is not permanent.
- LTC electrical functional tests
- Calibrate or check temperature gauges
- Functional test on all protective relays and alarms

- Program and functionally test all electronic components or monitoring devices

Bushing stud connectors must be installed after all tests are completed. All connections must be torque after installation

The transformer must be thoroughly checked for oil leaks after testing is complete.

The transformer and work area must be cleaned and all debris disposed of properly.

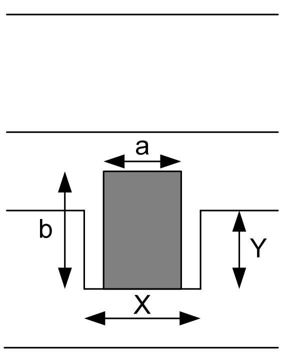
Clean-UP and Release for Service:

All nicks, scuffs and scratches must be repaired with abrasive tools and the touch-up paint that is provided. This must be the last step in the assembly process before any safety grounds are removed and the transformer is released for service.

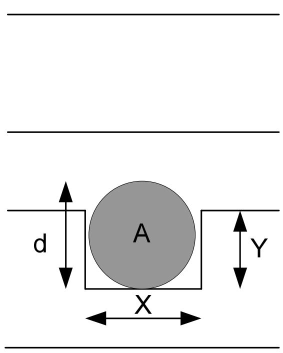
If any issues are encountered during assembly, or if the drawings, procedures or equipment can be improved to facilitate the assembly and ensure high quality, please notify NANTONG HYOSUNG. We place a high value on your constructive feedback.

4.12 Gasketing

NANTONG HYOSUNG's standard gasketing system uses flat or round o-ring type gaskets and flanges equipped with machined gasket grooves. The proper size gaskets must be installed for each joint to ensure leak-free service. Gaskets should be sized as follows:



X = Gasket groove width
Y = Gasket groove depth
Gasket groove area = (X x Y)



a = Gasket width
b = Gasket height
Gasket area = (a x b)

(X x Y) must equal (a x b) and b should be approximately 1.5 x Y

d = Gasket thickness (Diameter)
A = Gasket area
Gasket area A = $\pi(d/2)^2$

Gasket area should be approximately 0.75 x (X x Y) and d should be at least 1.2 x Y

Note that the center of the gasket should be approximately in the center of the of the gasket groove. There must be some practical tolerance for these dimensions, but for flat o-ring gaskets the cross-sectional area of the gasket (a x b) must be at least as large as the cross-sectional area of the gasket groove and should be no more than 15% larger. The gasket height should be between 1.3 and 1.5 times the gasket groove depth. Round o-rings should fit in the groove with minimal stretching and the gasket cross sectional diameter should be between 1.2 and 1.4 times the gasket groove depth.

Gaskets are normally buna-n material, or nitrile with a 70 Durometer value. Viton gaskets may also be used in higher temperature areas. Gaskets should be coated lightly with Vaseline or a similar product before installing

Gaskets on vertical flange faces may require a small amount of glue to secure them during assembly.

4.13 Installing Bushings

Bushings may be draw-lead or bottom-connected types. Review the bushing supplier's documentation and instructions for lifting and rigging instructions and installation procedures. Note that bushing manufacturers have critical torque requirements for draw-lead nut and top terminals.

All current carrying connections must be torqued using a calibrated torque wrench to the torque values listed in the manufacturer's instructions. Bottom terminals must be torqued to the values listed in the appropriate Table for hardware and base material in Section 4.7.

The top terminal on TRENCH draw lead type bushings can be supplied in one of three different standard design styles, as shown in Figure 4.3. The hex-head and slotted round head types shown in the left and center sketches must be torqued using standard 1.75", 2", 2.5" or 3" crow's foot wrenches with a standard torque wrench. The bushing head with raised, rounded ridges shown in the right sketch requires a 2" special tool, as shown in Figure 4.4. Torque values are listed in the TRENCH bushing instruction leaflet.

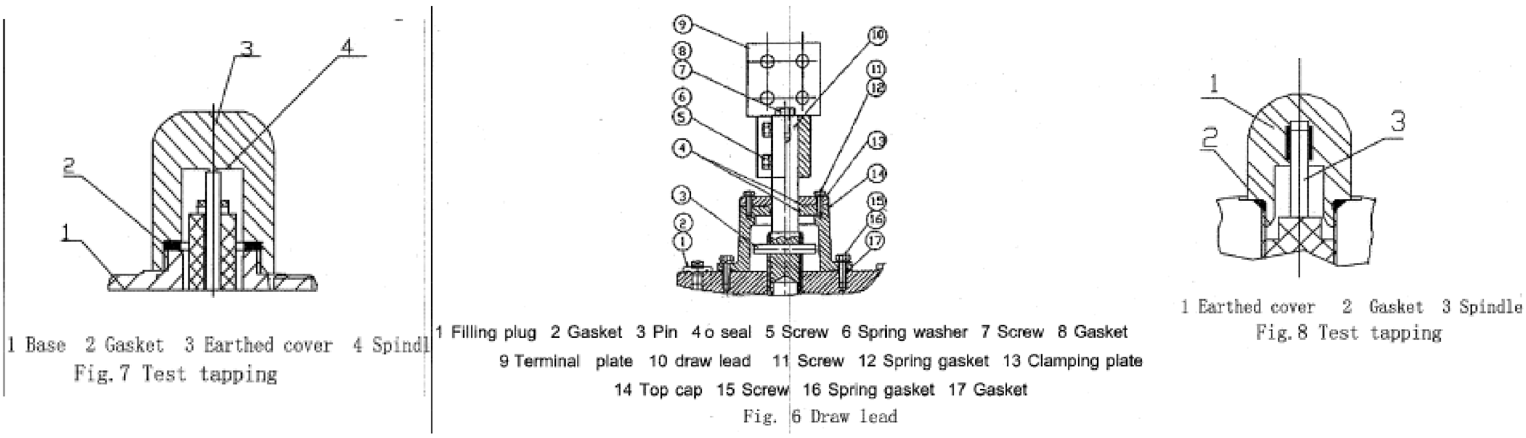


Figure 4.3 –TRENCH Bushing Top Terminal Styles

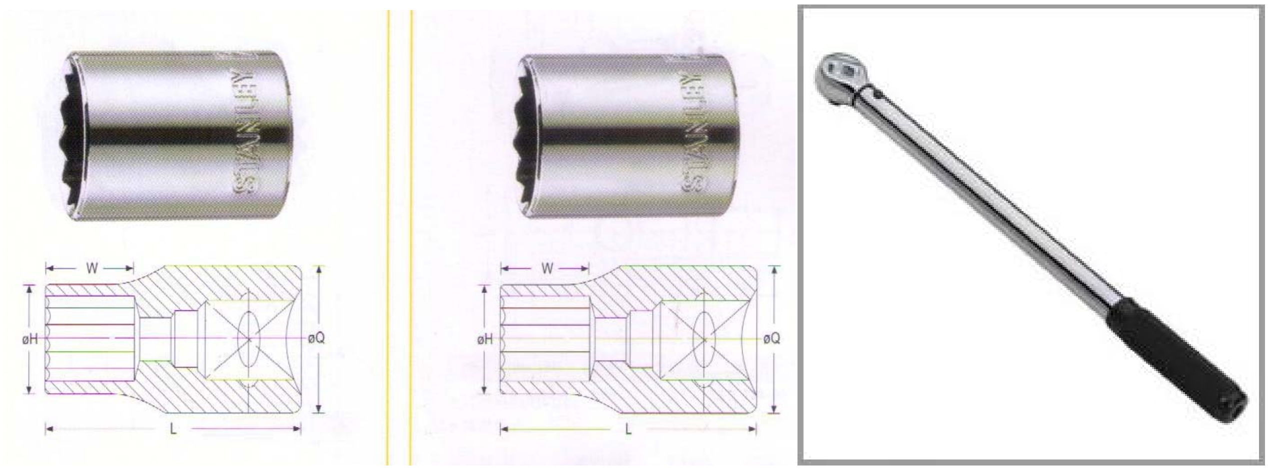


Figure 4.4 – Special Tool

XIAN XD draw lead type bushings also have torque requirements for the draw lead nut and the top terminal. The required torque values are listed in the XIAN XD Instruction Manual. No special tools should be required other than crow's foot wrenches in the required sizes.

Other bushing manufactures can have similar torque requirements for current-carrying connections. If the torque values are not included in the manufacturer's instruction leaflet or manual, contact NANTONG HYOSUNG for guidance.
Failure to properly torque current-carrying parts on bushings can lead to equipment damage, outages and can void the warranty.

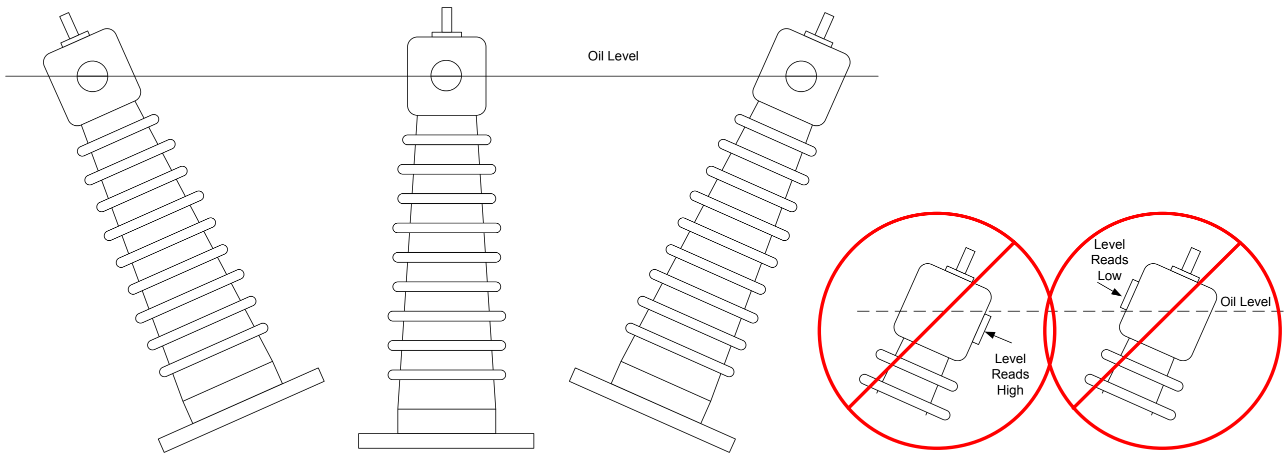
Orientation of the Bushing Oil Level Gauge

Bushings with glass bowl oil level gauges do not require any special mounting orientation.

Bushings that are mounted horizontally and equipped with an oil level gauge should have the bushing oriented to facilitate viewing of the gauge from ground level.

Bushings that are mounted on an angle and equipped with a sight glass in the head of the bushing must have the bushing oriented as shown below so the oil level gauge will provide the correct reading. Bushings with oil level gauges should be mounted similarly, but the oil level may read slightly high or low when mounted on an angle.

Bushings mounted on compound angles will require slightly different orientation to properly locate the oil level gauge. A level placed on the face of the gauge should read level when the bushing is rotated to the correct mounting position.



Correct Sight Glass Orientations Incorrect Sight Glass Orientations

4.14 Installing Radiators and Cooling Equipment

> **WARNING**
>
> Radiators are easily damaged if they are not lifted properly. Never lift a NANTONG HYOSUNG radiator from any part except the factory installed lifting eyes on the upper and lower headers.

NANTONG HYOSUNG radiators are equipped with lifting eyes on the upper and lower header pipes. These lifting eyes are the only points where rigging can be attached for lifting the radiators.

To remove the radiators from their crates, there are two possible methods:

1. If two cranes are available, connect slings for one crane to the lower header lifting eyes and the other crane's slings to the upper header lifting eyes. Slowly lift both sides simultaneously, keeping the radiators approximately horizontal.

2. If only one crane is available, connect slings to the upper header lifting eyes and slowly lift the radiator, uprighting it before lifting it from the crate. The bottom of radiator should be supported by a board to protect the drain plug from damage during lifting.

Radiators should be set on boards on the ground if they will not be installed immediately after lifting from the crates.

Radiators are gasketed and sealed at the factory. Open the flange cover plates and inspect the internal part of the radiators to ensure that they are clean and dry before mounting them.

When installing radiators, great care must be taken to ensure that none of the gaskets fall from the gasket groove and become pinched when the flanges are bolted together.

Do not run pumps without oil or with the valves closed to avoid damage to the pumps.

Fan motors must be checked to ensure that drain plugs are properly installed. Fans may be equipped with directional plugs that must all be oriented to prevent moisture intrusion in the mounted position. Contact NANTONG HYOSUNG if you have any questions.

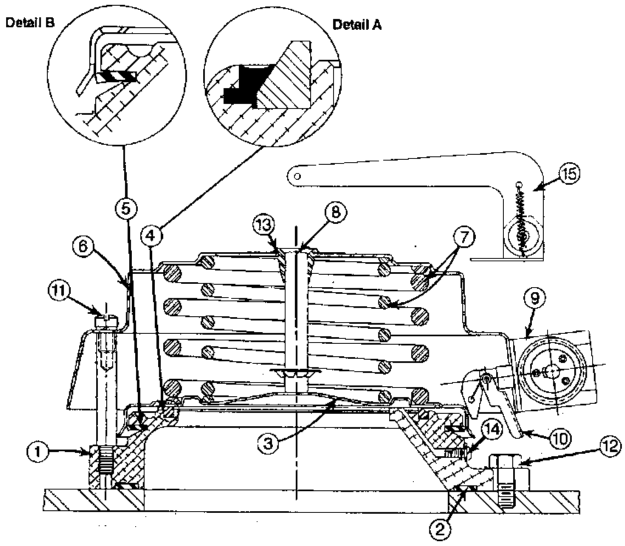
Conservators, pipes, radiators and heat exchangers should all be checked before installation to ensure that any bags of silica gel or other items that may have been placed inside for shipping are removed before installation.

4.15 Installing Pressure Relief Devices

The transformer may be furnished with more than one pressure relief device. In general, one device should be provided for every 10,000 gallons of total oil volume. If removed for shipping, the pressure relief devices need to be re-installed using new gaskets. The pressure relief devices are rated for vacuum and do not need to be removed during vacuum processing.

Note that the cast base of the Qualitrol Pressure Relief Device can be easily broken if the mounting bolts are over torqued. The ½” or M12 mounting bolts must be torqued to 86N • m and no higher.

Refer to the following drawing and steps listed below for installation of the semaphore.



Pressure Relief Device

The following steps shall be completed in order.

1. Remove one cover mounting screw (Item 11 in the drawing)

WARNING

NOTE: Do not remove more than one cover mounting screw. The cover is under spring Pressure and could be released.

2. Locate the mounting hole of the semaphore assembly (Item 15 in the drawing) over the location of the removed screw and reconnect the mounting screw – do not fully tighten the screw yet.
3. Align the tip of the semaphore directly above the indicating pin (Item 8 in the drawing) in the center of the pressure relief device cover.
4. Tighten the mounting screw
5. Check the semaphore for free movement from horizontal to vertical position.
6. Set the semaphore in a horizontal position (as shown in the drawing) with the top of the semaphore directly the indicating pin.

4.16 Installing the Gas Accumulation Relay

The transformer may be equipped with a Buchholz relay that performs this function. If so, follow the procedures in Installing the Buchholz Relay below. .

Mount the relay in the designated location.

If the transformer is equipped with a Buchholz Relay instead of a Gas Accumulation Relay, skip this paragraph. For Gas Accumulation Relays, the tubing connecting the relay to the valve on the transformer gas collection piping must be properly configured or the relay will not work properly. The tubing must have a continuous upward slope from the main valve toward the relay and should be as short as possible. Any sharp bends or downward sloping areas will trap any gas bubbles and block the tube, preventing correct operation of the relay.

Connect the tubing and sample valve and close the sample valve.

The relay can withstand vacuum, but the valve to the relay should be closed during oil filling. After filling is complete, install a drain bucket under the sample valve then open the main valve and sample valve and observe the gauge drop to 0cc. Let enough oil drain from the sample valve to ensure that no air remains in the relay or tubing. If the gauge does not start to drop after a 10-15 seconds, check the tubing between the main valve and the relay.

4.17 Installing the Buchholz Relay

Install the Buchholz relay in the designated location in the conservator oil piping. The relay must be installed in the upwardly sloping horizontal section of the oil piping.

Connect the gas collection tubing and sample valve and close the sample valve.

After oil filling, open the sample valve and bleed off any air in the sample tubing.

4.18 Installing Oil and Winding Temperature Gauges

Mount the gauges on the locations shown on the detailed outline drawing. Check or set the temperature settings for each contact. Check and program electronic temperature controllers, as required. Install the temperature probes after testing is complete.

Section 5
Vacuum Oil Processing Procedures

Section 5
Vacuum Oil Processing Procedures

Quality Issues:

- Processing, dry-out and oil impregnation are all affected by temperature. Follow the appropriate procedures for the specific ambient temperature conditions during installation.
- The transformer cover and walls will flex inward when the transformer is under full vacuum. All cable and bus connections to the top of bushings must be disconnected to ensure that they are not damaged from the movement they will experience.
- No workers may stand on the transformer cover when the transformer is under vacuum.
- No electrical tests may be performed while the transformer is under vacuum.
- Failure to observe the stand time requirement may cause incomplete insulation impregnation, leading to transformer failure upon energization.

Equipment Required:

- Processing trailer with hoses, fittings, filters, vacuum chamber and sufficiently rated heaters.
  - Vacuum pumps should have a minimum 4300 liter/minute and must be capable of attaining a 0.1 Torr blank-off vacuum pressure.
  - Connections from the pump to the transformer tank must be as short as possible and a diameter of three inches. There should be no low spots in the vacuum line in which oil or water can collect. The vacuum system (pumps and hoses) must be capable of attaining a blank off pressure of 0.1 Torr or less.
- Vacuum/pressure gauge
  - The pressure in the tank during vacuum operations must be measured through a connection to the top section to the section of the tank above the oil level. Do not take pressure measurements at locations other than the tank itself. We recommend measuring the pressure in the tank with a properly calibrated aneroid gauge or manometer.
- Hi-Pot Oil Test Set (ASTM 877 or ASTM 1816)

Process Flowchart:
The Process Flowchart shows all of the standard and optional steps included in this procedure. The process steps are color coded as follows and the Procedure section or subsection is listed in each process step on the flowchart.

These steps are required for vacuum processing all oil-filled transformers.

These steps are only required when specified by NANTONG HYOSUNG or the customer, or if field tests on the oil after filling do not meet all requirements.

These steps are only required if the transformer fails the dew point test and requires dry out before the start of vacuum processing.

These steps are only required if the vacuum processing is performed in cold weather and the temperature of the transformer's active part is less than 10°C (50°F).

These steps are only required if the transformer processing is started more than 90 days and less than 181 days after the transformer is shipped from the factory.

Figure 5.1

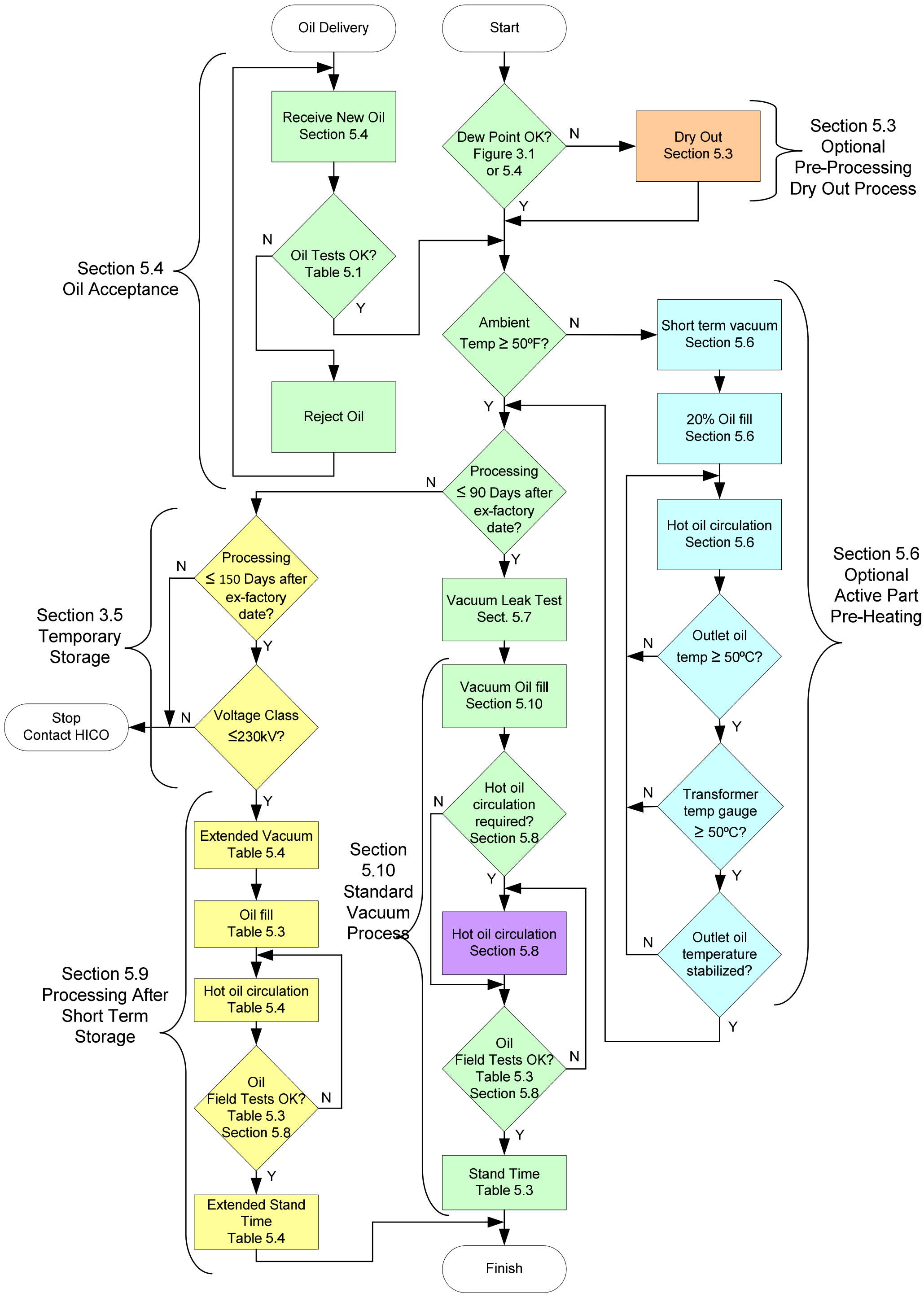


Figure 5.2 Flow Chart

Ambient Temperature Conditions:
In extreme cold weather, a tent or panel enclosure may be constructed around the transformer and equipped with internal heaters to facilitate processing. When this is done, the ambient temperature shall be defined as the temperature inside the tent or enclosure.

When the 24-hour average ambient temperature at the site over the two days prior to the start of vacuum processing is not less than 10°C (50°F), NANTONG HYOSUNG's standard processing requirements shall be observed.

When the 24-hour average ambient temperature at the site over the two days prior to the start of vacuum processing is less than 10°C (50°F), NANTONG HYOSUNG's cold weather processing requirements in Section 5.6, Active Part Pre-Heat, shall be observed.

Ambient Humidity Conditions:
When the relative humidity at the site is not greater than 75% at any time while the transformer is open, NANTONG HYOSUNG's standard processing requirements shall be observed.

When the relative humidity at the site is not greater than 75%, the transformer must not be open for mor e than 8 hours. When the relative humidity at the site is not greater than 65%, the transformer must not be open for more than 12 hours. This is in addition to any vacuum requirements under NANTONG HYO SUNG's standard processing requirements.

If transformer need to be opened under high relative humidity (higher than 75%),the transformer should filled dry air to limit the entrance of moisture.And after all operation finished, a vacuum should be taken to remove trapper air and moisture. During the vacuum hold period, hot oil may be pumped into the tank to expedite the moisture removal and should be drained as long as the desired temperature is obtained to allow the moisture to be removed by the vacuum pump. This heating process may be repeated as required.

Determining Required Heater Capacity:
The oil processing trailer must have sufficiently rated heaters to raise and maintain the required oil temperature under the expected ambient conditions. Required heater capacity can be estimated with the following formula:

$$H = FR \times \Delta T \times C$$

where…

H = the required total heater capacity in kW
FR = the flow rate in gallons per minute
ΔT = the difference in the required oil temperature and the ambient oil temperature (°C or °F)
C = a constant, 0.06 if ΔT is in °F or 0.108 if ΔT is in °C

Example: Calculate the amount of heating required to raise the oil temperature to 60°C (140°F) when the ambient temperature is 20°C (68°F) and the flow rate is 40GPM.
$H = 40 \times (60-20) \times 0.108 = 172.8$ kW or $H = 40 \times (140-68) \times 0.06 = 172.8$ kW

Pre-Processing Quality Check:

- Verify that all valves for any oil monitoring equipment, rapid pressure relief device relays, Hydra Gas Monitoring system or other devices that cannot withstand vacuum are closed before starting the vacuum process.
- If the transformer is equipped with a LTC, and the LTC barrier is not rated to withstand full vacuum, verify that the pipe between the LTC and the tank is in place and all valves between the LTC and main tank are open at all times when vacuum is applied.
- Verify that the bushings are all disconnected from the HV, XV and YV buses or cables to avoid damage when vacuum is applied.

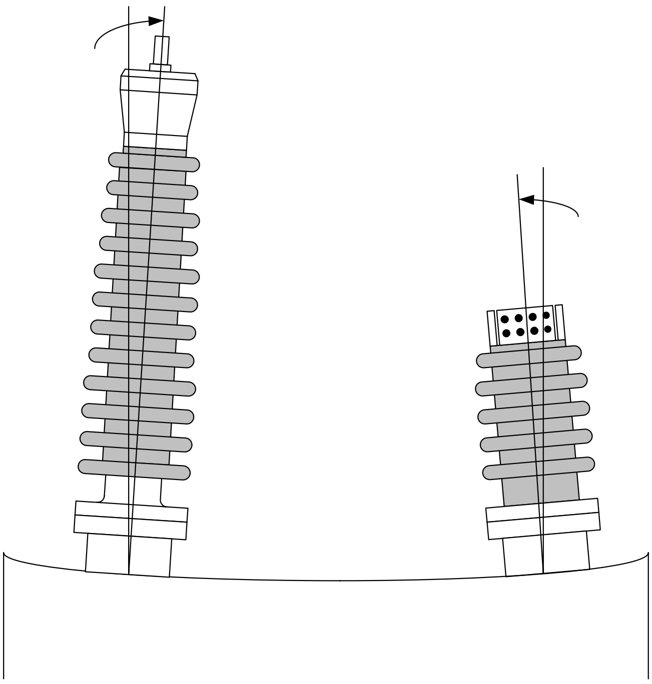


Figure 5.3 Tank Cover Flex Example During Vacuum

5.1 Grounding

- Verify that tank ground is connected to the site ground grid. If not, make the connection to the site ground grid or another reliable ground source.
- Ground the oil processing trailer to the transformer tank, or site ground grid.
- Ground any generator that may be used.
- Install static ground wires to the top of each bushing and connect these to the tank.
- All oil hoses must contain internal static wires. The hoses must be tested to verify electrical continuity between the fittings on both ends before each use.
- All temporary grounds must be removed after the work is completed.

WARNING

Transformer oil can generate a large static charge when pumped through hoses or pipes, Also, electrical fields in energized substations and power plants can induce high voltages on ungrounded transformer windings. All oil hoses must be equipped with internal static discharge wires and all tanks, tankers, transformers and processing trailers must be securely grounded.

5.2 Dew Point Test

Perform a dew-point test on the dry air inside the transformer and analyze the results using the chart below. Record the ambient temperature and measured dew point on the Shipment Inspection report.

1. ENTER CURVE AT INSULATION TEMPERATURE LEFT (°C) OR RIGHT (°F).
2. MOVE TO DEW POINT LINE.
3. READ THE MAXIMUM ACCEPTABLE DEW POINT, ON BOTTOM (°F) OR ON TOP (°C)
4. USE THIS CURVE FOR PRESSURE BETWEEN 0 AND 0.35bar.

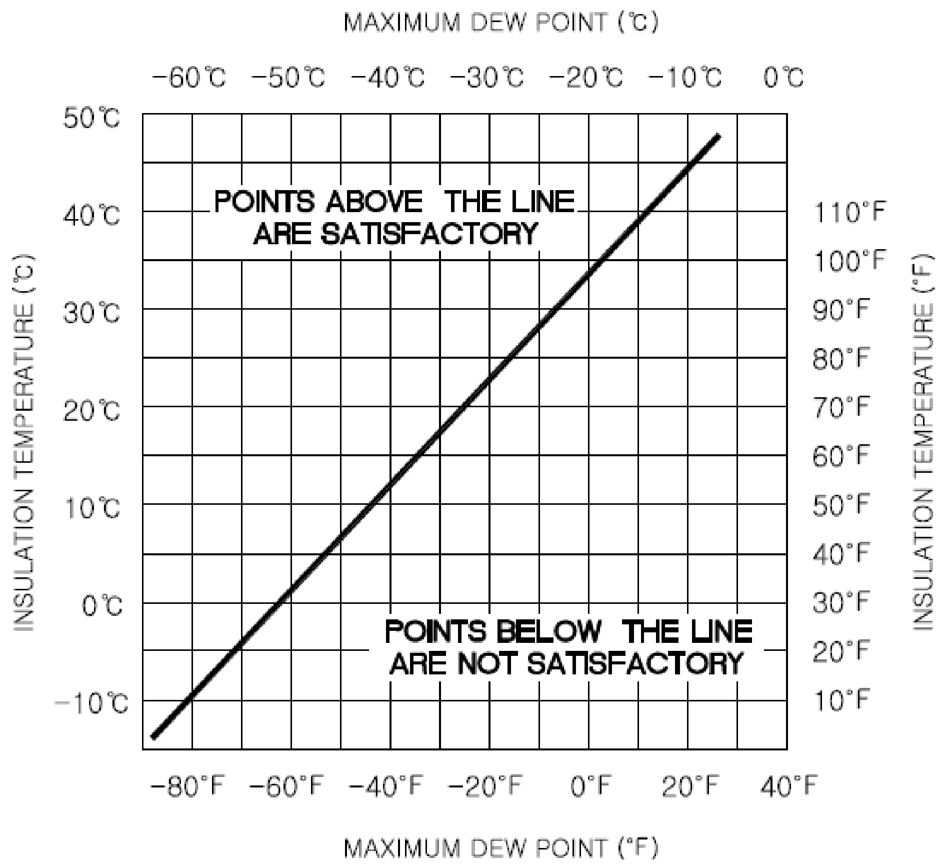


Figure 5.4 Dew Point Limit

5.3 Pre-Processing Dry Out Process

If the Dew Point test is satisfactory, skip this section and go to Section 5 – Ambient Temperature Conditions.

If the Dew Point test is not satisfactory, apply vacuum to 1 Torr for 12 hours or longer. Refill the transformer with dry air (minimum -42°C dew point) and wait for 12 hours or longer then repeat the Dew Point test on the transformer. If the test is satisfactory, go to Section 5. If the test is not satisfactory, apply vacuum again for 12 hours or longer, refill with dry air again and wait for 12 hours again before retesting. If the retest is not satisfactory, the active part pre-heating process described in Section 5.6 must be performed.

5.4 Oil Acceptance

Oil Testing

The oil supplier must provide a certified test report on the bulk oil from which the delivered oil was obtai ned and the oil must meet the following requirements for acceptance. The dielectric strength of the deliv ered oil must also be tested on-site using ASTM D1816-97 or D877-00 before acceptance and before being placed into any other tank or tanker.

Table 5.1

Acceptance Criteria for Oil Delivered in Tankers or Drums – Per IEEE C57-12-106-2002	
Test and Method	Acceptance Criteria
Min. Dielectric Strength (ASTM D1816-97)	
1 mm Gap	20 kV
2 mm Gap	35 kV
or alternate test method (ASTM D877-00)	
2.5 mm Gap	30 kV
Max. Dissipation Factor (ASTM D924-99c1)	
25°C	0.05 %
100°C	0.30 %
Min. Interfacial Tension (ASTM D971-99a)	40 mN/m
Max. Color (ASTM D1500-98)	0.5 ASTM Units
Max. Neutralization Number (ASTM D974-02)	0.015 mg KOH/g
Max. Water Content (ASTM D1533-00)	15 mg/kg (ppm)
Oxidation Inhibitor Content (ASTM D2668-96)	
Type I Oil – Max.	0.08 %
Type I Oil – Min.	0.00 %
Type II Oil – Max	0.3 %
Type II Oil – Min.	> 0.08 %
Corrosive Sulfur (ASTM D1275-96a)	Not corrosive
Max. Relative Density (ASTM 1298-99)	
15°C / 15°C	0.91

Rejecting Oil that Fails to Meet Test Criteria

Oil that fails to meet the acceptable criteria listed in Table 5.1 above, must be rejected or processed on-site and retested before being placed into the transformer. Oil with corrosive sulfur must be rejected.

5.5 Ambient Temperature Check

Monitor the daily temperature at the site for 2 days prior to the start of processing. If the average daily temperature during each day is 10°C (50°F) or greater, standard processing may be performed. If the average daily temperature is less than 10°C (50°F), an active part pre-heat shall be performed.

5.6 Active Part Pre-Heat

If the ambient temperature is 10°C (50°F) or greater, active part pre-heat is not required, skip this section and go to Section 5.10 - Vacuum Oil Filling Process.

Short Term Vacuum

- Refer to the valve positions as shown in Section 5.10 – Vacuum Oil Filling Process
- Configure the processing trailer vacuum and oil hoses, and transformer valves, including any equalizing valves, for initial vacuum
- Pull vacuum on the transformer (and LTC, if equipped) to 1 Torr or below. Hold vacuum at this level for 30 minutes.

50% Oil Fill

- Close the lower radiator or heat exchanger shut-off valves, but leave the upper valves open. Configure the remaining valves for Initial Oil Filling, as shown in Section 5.10 – Vacuum Oil Filling Process. If the transformer is equipped with a LTC, keep LTC equalization valves open.
- If the average daily ambient temperature is below 0°C (32°F), the transformer should be covered with insulating blankets to facilitate the heating of the active part.
- Maintain vacuum at 10 Torr or less during oil filling and fill the main tank with about 50% of the total oil volume using the oil processing trailer's pumps, filters, heaters and vacuum chamber. The temperature of the oil leaving the oil processing trailer should be maintained as close to the maximum 75°C (167°F) as possible, and not less than 50°C (122°F)（The speed of the oil flow shall not exceed 5T/h during oil filling）.

Hot Oil Circulation for Heating the Core and Coil

- When the tank is about 100% filled, stop the pumps and configure the processing trailer vacuum and oil hoses, and transformer valves for Oil Filtering as shown in Section 5.10 – Vacuum Oil Filling Process. If the transformer is equipped with a LTC, keep LTC equalization valves open.
- Maintain the temperature of the oil leaving the oil processing trailer as close to the maximum 75°C (167°F) as possible, and not less than 50°C (122°F) and maintain the vacuum level at 10 Torr or below.
- Continue vacuum/hot oil circulation until the transformer outlet oil temperature has reached 50°C or greater.

  NOTE: If the oil processing trailer is equipped with sufficient heaters, the transformer is properly blanketed and after 3 times cycling or more of hot oil circulation it is still not possible to reach and maintain the 50°C transformer outlet oil temperature, contact NANTONG HYOSUNG. An alternate 30°C outlet oil /10°C tank/ 3 times cycling process may be authorized.

  A spray inlet nozzle attached to a temporary manhole cover may also be used, if available. The spray must be directed away from any bushings inside the tank to eliminate the risk of thermal shock damage to the bushings.

- Drain all the oil from the tank with vacuum and back-fill with dry air.
- Immediately start the Vacuum Oil Filling Process as listed in Section 5.10 below.

5.7 Vacuum Leak Test

- After the required Vacuum Level Prior to Oil Filling as listed in Table 5.3 is reached, close the vacuum valve at the oil processing trailer and wait for 10 minutes then monitor the vacuum level. If the pressure rises more than 2000Pa • L/s, it should be checked for leaks and any leaks repaired before starting again.

If there are no leaks and the pressure still rises more than the maximum allowable level, the transformer insulation may be wet. Fill the transformer with dry air, wait 6 hours then retest the Dew Point.

5.8 Processing Parameters

Table 5.3

Vacuum Treatment and Oil Filling		≤69kV Class	≥69kV to <230kV Class	≥230kV to <345kV Class	≥345kV Class
Vacuum	Vacuum Level Prior to and Following Oil Filling	2 mm Hg	1 mm Hg	1 mm Hg	0.5 mm Hg
	Vacuum Level During Oil Filling	2 mm Hg	1 mm Hg	1 mm Hg	1 mm Hg
	Min. Vacuum Hold Time After Reaching Specified Vacuum Level, Before Oil Filling	8 Hours	18 Hours	24 Hours	30 Hours
During Oil Filling	Oil Temperature Min	10°C	10°C	10°C	10°C
	Max	75°C	75°C	75°C	75°C
	Max. Oil Fill Rate	5t/h	5t/h	5t/h	5t/h
After Oil Filling	Min Dielectric Strength Per ASTM D-1816 1mm Gap	25 kV	30 kV	32 kV	35 kV
	2mm Gap	45 kV	52 kV	55 kV	60 kV
	Max. Water Content of Oil	20 ppm	10 ppm	10 ppm	10 ppm

	Max. Oil Power Factor at 25°C	0.05 %	0.05 %	0.05 %	0.05 %
	at 100°C	0.40%	0.40%	0.30%	0.30%
	Min. Stand Time After Oil Filling Before Energization	12 Hours	24 Hours	48 Hours	72 Hours

* For more information, please consult IEEE Std C57.106-2002

Stand Time

After oil filling, the transformer must not be energized before the time listed under "Stand Time After Oil Filling Before Energization" in Table 5.3. When the transformer must be energized as quickly as possible, the stand time can start as soon as the core and coils have been covered with oil. If hot oil circulation is performed, the circulations can be made during the stand time.

After stand time is complete and the transformer is energized, there is no additional hold time required before the transformer can carry load up to the full nameplate rating.

Hot Oil Circulation After Oil Filling

Hot oil circulation is not required for NANTONG HYOSUNG's standard oil processing process. Hot oil circulation is only required when:

- The transformer has not been assembled within 150 days after leaving the factory and the HV voltage class is ≤230kV (See Short Term Storage in Section 3)
- After the transformer is filled with oil, the tested oil fails to meet any of the following Processing Parameters listed in Table 5.3 for After Oil Filling (Min. Dielectric Strength per ASTM D-1816 test at 1mm or 2mm gaps, Max. Water Content of Oil, or Max Oil Power Factor)
- Required or specified by the customer
- When specified by NANTONG HYOSUNG (when special requirements such as extra low moisture or dissolved gas requirements exist)

If hot oil circulation is required, the following steps must be performed.

- After the transformer has been fully filled with oil, configure the oil hoses and valves as shown in the Oil Filtering in Figure 5.10. If the transformer is equipped with a LTC, keep LTC equalization valves closed.
- Circulate oil through the transformer and the oil processing trailer's heaters, vacuum chamber and filters maintaining a 1 Torr or stronger vacuum in the vacuum chamber.
- Control the flow rate to provide an oil temperature into the transformer of 75°C (167°F) and an oil temperature out of the transformer of 50°C (122°F) or greater. The temperatures shall be measured in the oil processing trailer so oil temperature into the transformer will be the temperature of the oil leaving the trailer.
- If the minimum oil temperature out of the transformer cannot be maintained, verify that the heaters are sufficiently rated (See Determining Required Heater Capacity). It may be necessary to add insulating blankets to the transformer or construct a heated enclosure around the transformer.

- After the oil temperature out of the transformer reaches and is stabilized at 50°C (122°F) or greater, the count of circulated gallons can start. For one required pass, circulate the total quantity of oil as listed on the nameplate. For two required passes, circulate 3 times the total quantity of oil as listed on the nameplate, etc.
- If an oil sample is required for moisture, the sample must be drawn within 10 minutes after the end of the circulation, while the oil is still hot. Record the oil temperature and include this information with the paperwork for the sample that is sent to the test lab.
- After the hot oil circulation is complete, remove the oil hoses and configure all valves to their normal (in-service) positions as shown in the Valve Nameplate drawing in Section 10.

5.9 Processing After Short Term Storage (Refer to Section 3.5. Not approved for transformers greater than 230kV or for storage beyond 150 days after leaving the factory)

Follow the requirements herein and the parameters listed in Table 5.3, except for the requirements listed below in Table 5.4.

Table 5.4
Processing After Short Term Storage

Vacuum Treatment and Oil Filling		≤ 230kV Class
Vacuum	Min. Vacuum Hold Time After Reaching Specified Vacuum Level, Before Oil Filling	24 Hours
After Oil Filling	Hot Oil Circulation Passes Required	3
	Stand Time After Oil Filling Before Energization	48 Hours

Section 5.10 – Vacuum Oil Filling Process
For transformers with a conservator and with an in-tank LTC with a LTC conservator
Please refer to the valve location drawing in Section 9.
Initial Vacuum

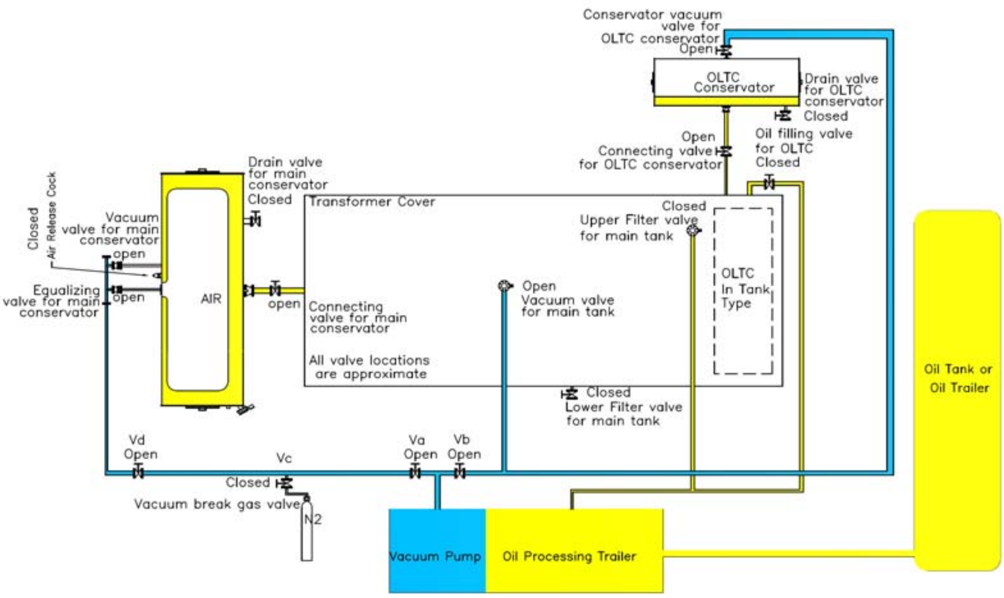


Figure 5.5
Initial Vacuum

Notes: Valves Va, Vb, Vc ,Vd and connecting hoses or pipes are not supplied with the transformer. All valve locations are approximate and shown for function only.

1. Review the LTC (OLTC) instruction manual for oil processing requirements.
2. Inspect all vacuum and oil hoses for cleanliness before using.
3. Check electrical continuity with an Ohm-meter on all oil hoses before using. Do not use any hoses that do not pass this test since the static discharge wire is not functional.
4. Remove the main tank and LTC conservators' desiccant breathers from their mounting flanges and store them in a safe place. Also close the valves for RPRR, B-H relay, etc.
5. Connect all vacuum hoses and valves as shown in Figure 5.5. Note that the transformer main tank and LTC tank must both have vacuum applied simultaneously.
6. Connect oil hoses as shown in Figure 5.5. (Note on MR Jansen-type LTC's the Oil Filling Valve is normally the "S" flanged pipe connection on the LTC cover plate – Check the LTC instruction manual – Figure 5.5 is drawn for one LTC. If three LTC's are used, connect hoses to all three)
7. Configure all valve positions as shown in Figure 5.5. Open all cooling system valves.
8. Be sure the removal the equalizing pipe between main tank and LTC for transportation purpose.
9. Pull vacuum on the main tank and LTC at the level specified in Table 5.3.
10. Check the leakage rate per Section 5.7 and Table 5.2.
11. After leakage rate has been determined to be within limits, hold the vacuum at the level and time specified in Table 5.3.
12. After the specified vacuum has been applied for the specified length of time, proceed to the next step – Initial Oil Filling.

Initial Oil Filling

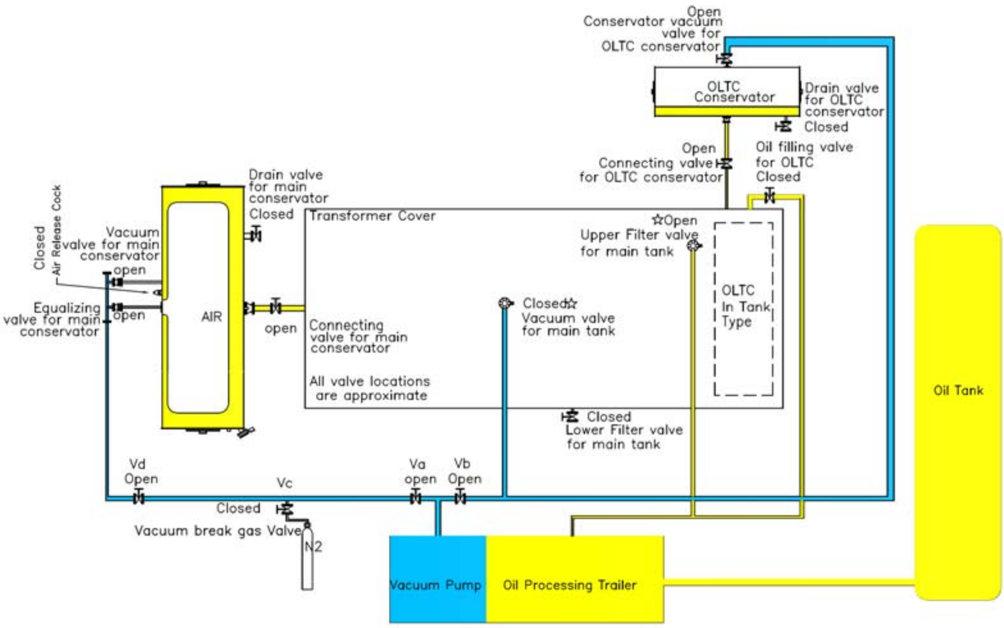


Figure 5.6
Initial Oil Filling

1. With the valves still in the same configurations as shown in Figure 5.5, open the Upper Filter Valve and start oil filling through the heaters, vacuum chamber and filters of the oil processing trailer within the flow rate limits listed in Table 5.3 while maintaining the vacuum level specified in Table 5.3.
2. When the oil has been filled to a level approximately 4”-6” below the tank cover, configure all valve positions as shown in Figure 5.6 (close vacuum valve so vacuum will be pulled through the main tank conservator and the LTC conservator) (Note that the LTC conservator is not equipped with a diaphragm)
3. Continue oil filling the main tank until the conservator Oil Level gauge indicates 25°C or indicates 4. Stop oil filling.
4. Maintain vacuum on the main tank and LTC.
5. Proceed to the next step – LTC Oil Filling

LTC Oil Filling

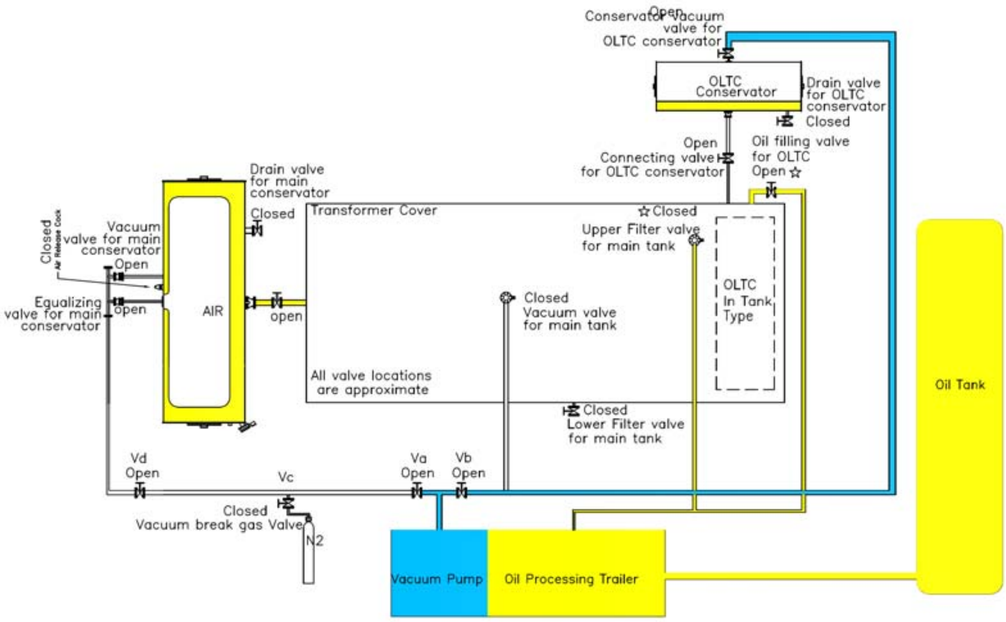


Figure 5.7
LTC Oil Filling

Notes: Refer to the OLTC Manual.

1. Configure the valves as shown in Figure 5.7.
2. Maintain vacuum on the main tank and LTC.
3. Fill oil into the LTC to the appropriate level for the oil temperature, as indicated on the LTC conservator oil level gauge. Close the Oil Filling Valve for OLTC when the correct oil level is reached.
4. Proceed to the next step – <u>Break Vacuum and Final Oil Filling</u>

Break Vacuum and Final Oil Filling

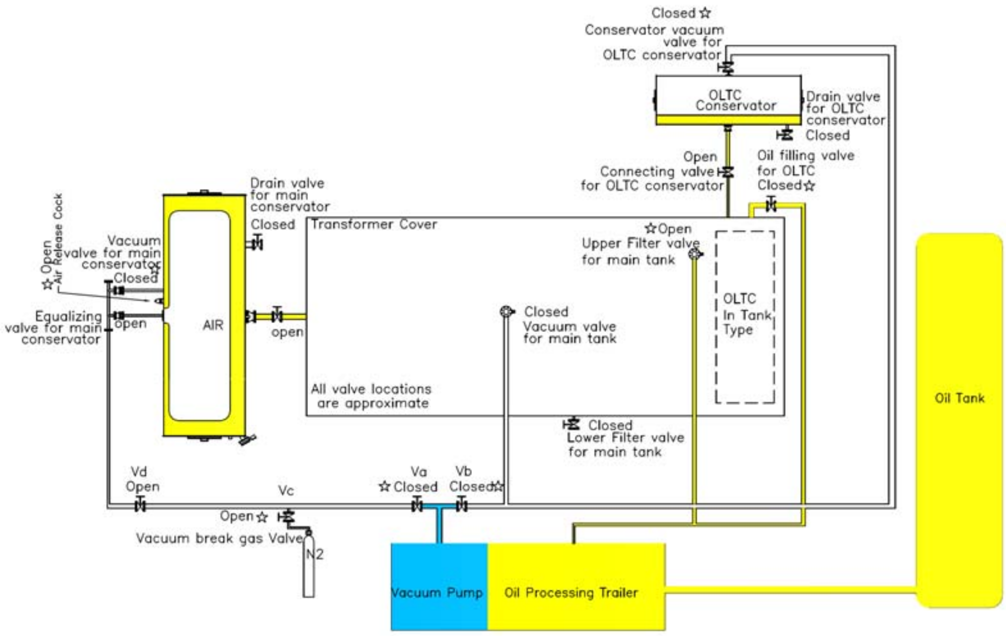


Figure 5.8
Break Vacuum and Final Oil Filling

1. Starting with the valves still configured as shown in Figure 5.7, open the Vacuum Break Gas Valve then slowly pressurize with dry air or nitrogen gas and add dry air or nitrogen until the pressure in the pipe, conservator and conservator diaphragm, as well as the LTC conservator, are at 0 psig relative pressure (atmospheric pressure)
2. Configure the valves as shown in Figure 5.8
3. Open the air release cock on the top of the conservator.
4. Increase the dry air or nitrogen pressure into the conservator diaphragm to 0.15-0.3psi (approximately 0.01-0.02kg/cm^2) pressure. This slight pressure applied through the conservator equalizing valve will expand the conservator diaphragm to its normal operating condition.
5. Continue filling oil slowly until all of the air is vented through air release cock and a small amount of oil escapes. Stop pumping and close the air release cock.
6. Close the gas cylinder valve, bleed off any residual pressure and remove the vacuum hose connections, then re-install the main tank and LTC conservators' desiccant breathers.
7. Check the oil level gauge indication and the oil temperature and compare to the oil level nameplate. Add more oil, if the level is below the correct range.
8. If additional oil filtering or hot oil circulations are required proceed to the last step – Oil Filtering.
9. If additional oil filtering or hot oil circulations are not required proceed to the next step – Final Valve Positions

Final Valve Positions

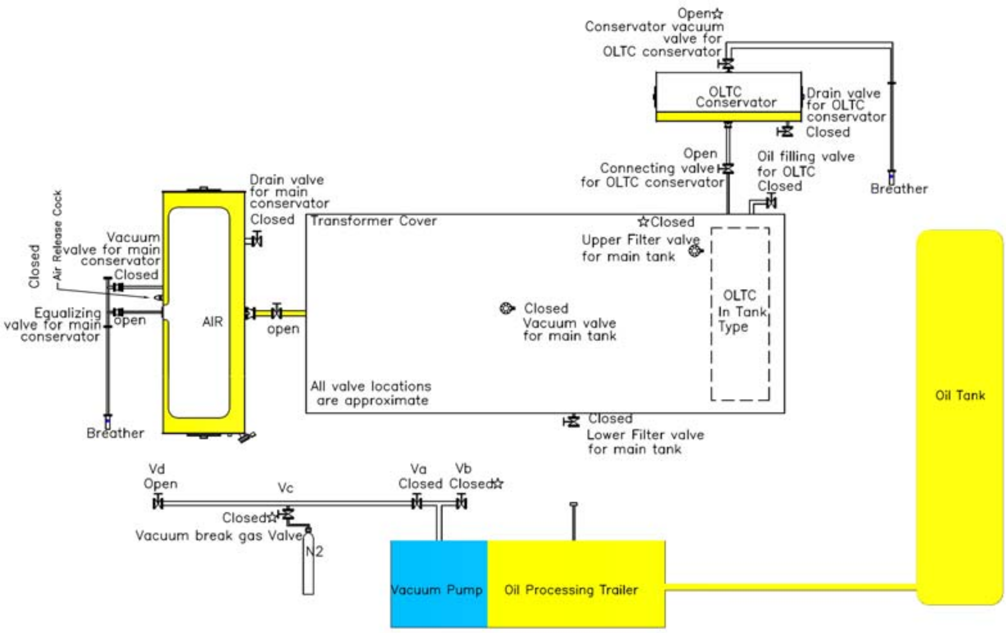


Figure 5.9
Final Valve Positions

1. Configure all valves as shown in Figure 5.9. Keep all cooling system valves open.
2. Verify that the supply valves for the gas accumulation relay & Online-Gas monitor (if equipped) is open and vent any trapped air in the gas accumulation relay or Buchholz relay through the sample valve.
3. Draw an oil sample and have the sample analyzed for dissolved gasses and physical properties by a qualified laboratory. The oil sample should be taken while the oil is 30°C or greater to provide meaningful percent moisture saturation values, and the oil sample temperature must accurately be measured and provided to the lab with the sample.
4. Do not energize the transformer until the required stand time has been met, as specified in Table 5.3 and the oil sample results have been received and approved by HICO.
5. If oil test results are not acceptable, additional oil processing is required depended on our manual.

Oil Filtering

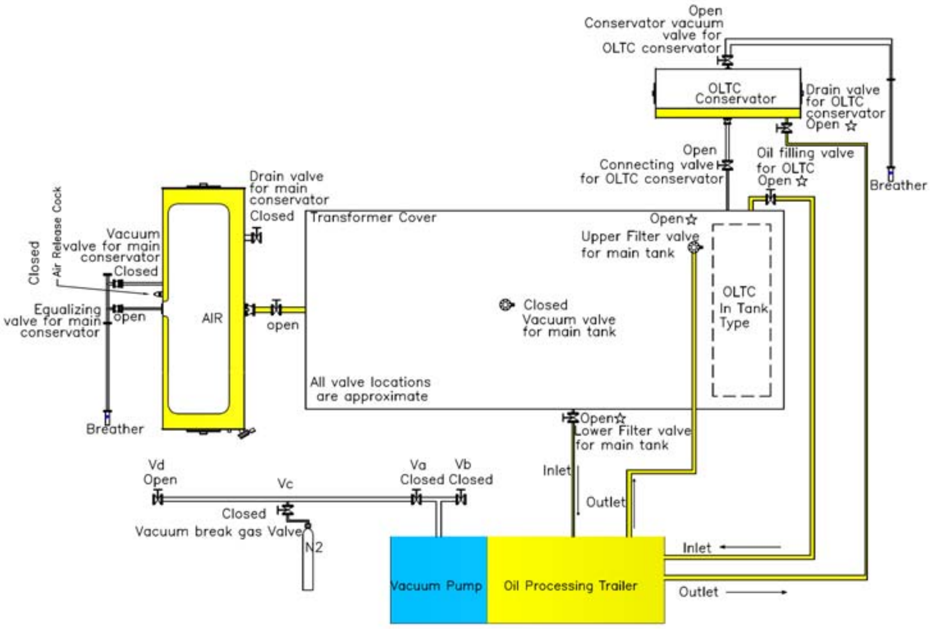


Figure 5.10
Oil Filtering

1. If additional oil filtering or hot oil circulations are required for the main tank and/or the LTC, configure all valves as shown in Figure 5.10.
2. For filtering, use new ½ micron filters and circulate the oil through the oil processing trailer
3. The main tank and LTC compartments should be circulated separately, and not at the same time.
4. For hot oil circulations, follow the steps in Section 5.8

Section 6
Commissioning Tests

The following tests are covered in this section. The Table below lists each test as either required or optional for commissioning and recommended or optional for maintenance testing.

Table 6.1

Tests	Procedures	Commissioning Tests		Recommended (√) and Optional (O) Maintenance Tests
		Required	Optional	
Power Factor and Capacitance	Doble Test Procedures Section 6.1 Section 6.2	√		√
Sweep Frequency Response Analysis (SFRA)			√	**O**
Transformer Turns Ratio	Doble Test Procedures and Section 6.3	√		√
Insulation Resistance of Core, Core Frame Megger	Section 6.4	√		√
Winding Megger	Section 6.5	√		√
Single-Phase Excitation	Doble Test Procedures and Section 6.6	√		√
Winding Resistance	Section 6.7	√		√
Rapid Pressure Rise Relay	Section 6.8	**X**		**X**
Pressure Relief Device	Section 6.9	**X**		**X**
Gas Accumulation Relay or Buchholz Relay	Section 6.10	**X**		**X**
Current Transformers	Section 6.11	**X**		**X**
Oil and Winding Temperature Gauges	Section 6.12	**X**		**X**
Oil Level Gauges	Section 6.13	**X**		**X**
Circuit Breakers	Section 6.14	**X**		**X**
Fans and Pumps	Section 6.15	**X**		**O**
Cooling Controls, Control Relays and Contactors	Section 6.16	**X**		**X**
De-energized Tap Changer	Section 6.17	**X**		**X**
Load Tap Changer	LTC manufacturer's procedures and Section 6.18	**If equipped**		**If equipped**
Annunciator and/or Alarms	Section 6.19	**X**		**X**
Cabinet Heaters	Section 6.20	**X**		**X**
Thermovision	Thermovision camera supplier's procedures and Section 6.21		**X**	**X**
Dissolved Gas-in-oil Analysis	Section 6.22	**X**		**X**

General Test Procedures:

WARNING

Lethal voltages can be generated during transformer testing. Test equipment should only be used by, and tests should only be performed by, trained and qualified technicians.

If additional details or documentation are required for any components, contact NANTONG HYOSUNG at (412) 787-1170.

6.1 Power Factor and Capacitance Testing

Use Doble test equipment and procedures for power factor and capacitance tests on the transformer, bushings. Contact Doble or NANTONG HYOSUNG, if these procedures are not on-hand.

Note that power factor and capacitance tests during commissioning should be performed with the transformer in the same configuration as when the transformer was tested at the factory. Normally, this should be the in-service configuration, but this may not always be the case. If there are differences between field commissioning tests and factory tests, the factory test configuration should be checked. Contact NANTONG HYOSUNG is this information is not listed on the factory test report. Some configuration differences that can affect these tests are:

- Core grounding
  - Test results can vary if the core ground connections are not in-place for both tests.
  - If the core ground is connected through resistors, tests results can vary if the resistors are not connected during for both tests.
- Tertiary bushing grounding
  - If the tertiary winding is connected in a delta with an external ground connection, test results can vary if the ground connection is not attached for both tests.
  - If the tertiary winding is connected in a broken delta (open delta) with external connections to complete and ground the delta, test results can vary if the delta is not connected and grounded for both tests.
- Tank grounding
  - If the ground at the site is temporary, and not a full ground grid, test results can vary.

6.2 Sweep Frequency Response Analysis (SFRA) Testing Use Doble test equipment and procedures for SFRA tests. Contact Doble or NANTONG HYOSUNG, if these procedures are not on-hand.

Note that the comments under Power Factor and Capacitance Testing above also apply to SFRA testing. The field commissioning tests must be made in the same configuration as the factory tests. SFRA tests are even more sensitive to differences in test configurations.

Note: SFRA commissioning test results often do not exactly match the factory test results due to specific differences in test equipment, grounding conditions, test methods, electrical fields and normal physical differences in lead positions. The SFRA test should only be considered as a diagnostic tool, and not a pass/fail acceptance test. If significant variations are found between field and factory waveforms, a Doble leakage reactance test should be performed per Doble procedures. Contact NANTONG HYOSUNG for leakage reactance test interpretation.

6.3 Turns Ratio Test

Use a calibrated 3-phase or single-phase tester designed for this purpose. If the transformer is not equipped with a load tap changer (LTC) test the ratio on each de-energized tap changer (DETC) position. If the transformer has both DETC and a LTC, test each DETC tap ratio and each LTC tap ratio to the winding without tap changer respectively.
Compare results to the factory test report.

6.4 Core, Core Frame Insulation Resistance Tests

Locate the test terminals and disconnect the terminal ground connections. Apply 2500Vdc for one minute and record the final value. Discharge the test specimen after each test before touching the test terminals.

Insulation resistance test values are temperature dependent. If test values are to be recorded for future reference, or compared to factory test values, they should be converted to 20ºC equivalent values using the temperature correction factors in Table 6.2 or the curve in Figure 6.1. Interpolate the values for data points between those points by using Figure 6.1.

ºC	ºF	Correction Factor
0ºC	32ºF	0.25
5ºC	41ºF	0.36
10ºC	50ºF	0.5
15ºC	59ºF	0.72
20ºC	68ºF	1
25ºC	77ºF	1.3
30ºC	86ºF	1.98
35ºC	95ºF	2.7
40ºC	104ºF	3.95
45ºC	113ºF	5.6
50ºC	122ºF	7.85

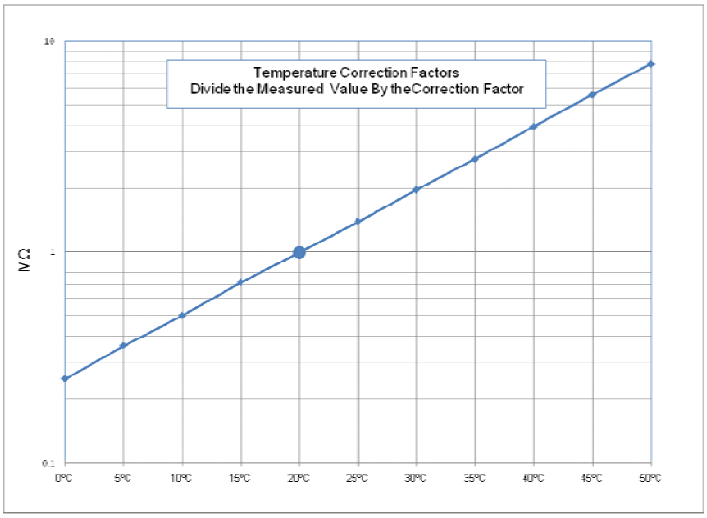


Table 6.2 Figure 6.1

Example, a core megger tests at 150MΩ when the transformer oil is at 10ºC.

$$R=150M\Omega \times t_{10C} = 150M\Omega \times 0.5 = 75M\Omega$$

If the transformer is a core-form design and has both core and core frame test terminals test each of the following values:

- Core to ground
- Core frame to ground
- Core to Core frame

If the transformer has multiple core section ground test terminals, perform the above tests on each core section.

All Core, Core Frame sections should test at 50MΩ or greater at 20ºC oil or internal temperature. Use Figure 6.2 to determine acceptable test values. All points on and above the curve are acceptable.

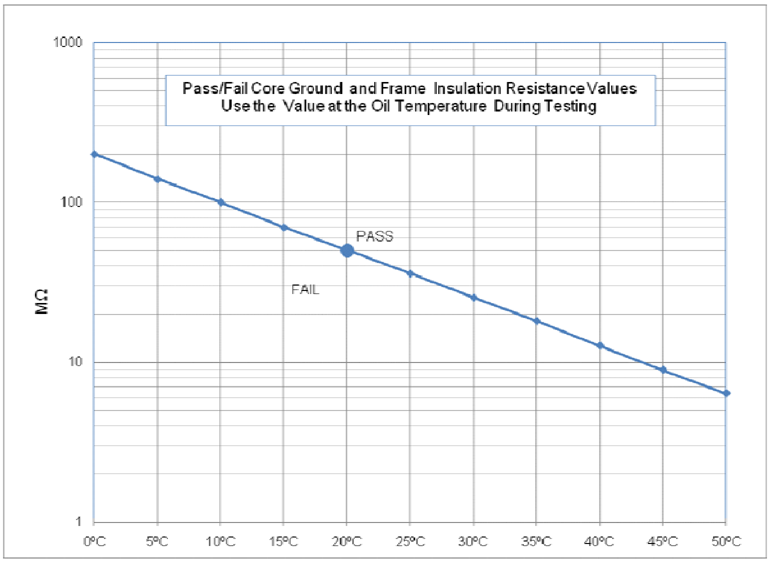


Figure 6.2

6.5 Winding Insulation Resistance Tests

Disconnect all temporary ground wires connected to any of the bushings. Verify that any neutral bushings are not connected to ground. For three-phase transformers, connect all 3 HV bushings together electrically by attaching test leads or other cables to the top terminals and repeat for is the XV, YV bushings (if equipped). Apply 5000Vdc for one minute and record the final value.

WARNING

Discharge the test specimen after each test before touching the test terminals.

For two-winding transformers perform the following tests:

- HV to XV & ground
- XV to HV & ground
- HV & XV to ground

For three winding transformers perform the following tests:

- HV to XV YV & ground
- XV to HV YV & ground
- YV to HV XV & ground
- HV & XV to YV & ground
- HV, XV & YV to ground

All windings should test at 1000MΩ or greater at 20ºC oil or internal temperature. Use Figure 6.3 to determine acceptable test values. All points on and above the curve are acceptable.

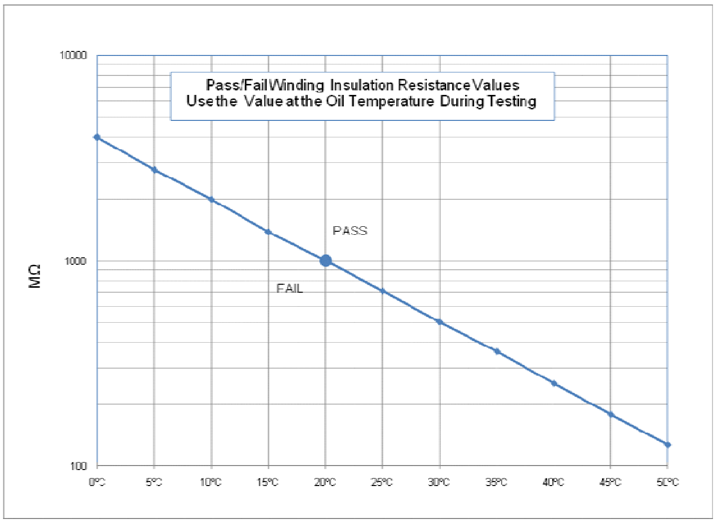


Figure 6.3

6.6 Single-Phase Excitation

The test voltage should normally be applied from the HV side for comparison to factory test values. This test can be performed with the Doble test set or another tester designed for this purpose. Review the factory test report to determine the tap position and test voltage. For transformers with wye-connected HV windings measure the following:

- H1-H0
- H2-H0
- H3-H0

For transformers with delta-connected HV windings measure the following:

- H1-H3 (H1-H2 short circuit)
- H2-H1 (H2-H3 short circuit)
- H3-H2 (H3-H1 short circuit)

6.7 Winding Resistance

This test can be performed on all windings, but must be performed on any winding equipped with a DETC or LTC. Use test equipment designed for this purpose and follow the test equipment instructions for safe operation.

If the transformer is not equipped with a load tap changer (LTC) test the ratio on each de-energized tap changer (DETC) position. If the transformer has both DETC and a LTC, test each DETC tap ratio with the LTC in the neutral position, then test each LTC tap ratio with the DETC in the rated tap position.
Note: Transformer windings can accumulate a large charge during this test and these charges must always be discharged after each test.

Test results for 55°C rise and 65°C rise transformers with copper windings should be converted from the tested temperature values to 75°C or 85°C reference values, respectively, using the following formula:

$$R = Rm\left(\frac{Tr + 234.5}{Tm + 234.5}\right)$$ （IEEE 为 234.5； IEC 为 235）

Where: *R*= the resistance at the reference values (75°C or 85°C) in Ohms
Rm= the resistance of the winding at the tested temperature in Ohms
Tr= the desired reference temperature in Celsius (75°C or 85°C)
Tm= the temperature of the windings when tested in Celsius

6.8 Rapid Pressure Rise Relay

The rapid pressure rise relay needs to be tested with the Qualitrol Field Test Kit, or a similar test set-up as follows:

1. De-energize the Rapid Pressure Rise Relay control circuit and remove the cable plug.
2. Connect the test light to pins “A” and “C” in the electrical connector.
3. Remove the 1/16” pipe plug from the cover of the Relay and install a cross connector in the tapped hole.
4. Connect a 0-5 psi pressure gage to the top of the cross and squeeze blub to the other side, using rubber tubing if necessary.
5. If there is a 1/8” NPT breather plug in the Relay housing, remove it and replace it with a solid pipe plug of the same size.

6. If there is a drain hole situated near the base of the housing, plug this hole with a small tapered rubber plug.
7. The objective of this set up is to prevent any air from escaping the housing while the test is being conducted. To ensure this, be positive that the system is airtight when the set up is complete.

Test Procedure

1. Place finger over the open port of the cross connector and operate the squeeze bulb to attain test pressure on the gauge:

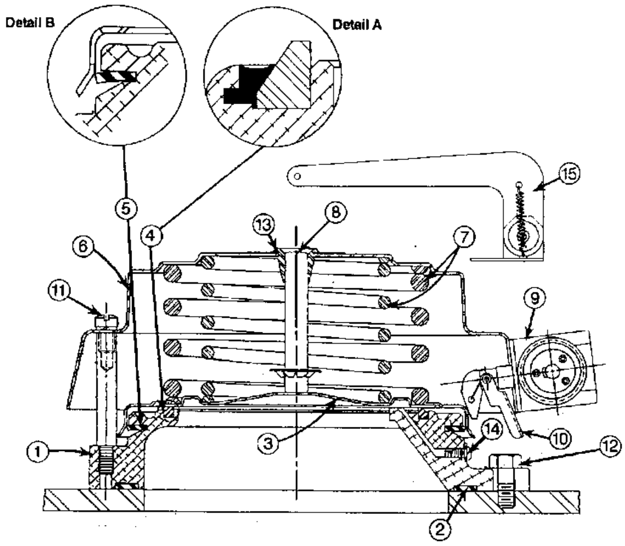
    3.25-3.50 psi for 900 Series

    2.50-2.75 psi for 910 Series

   Hold this pressure for 45 seconds minimum by squeezing the bulb as necessary.
2. After 45 seconds, remove finger quickly from the open port, allowing the air to escape rapidly from the Relay housing. If the test light glows, the Rapid Pressure Rise Relay is within specification for this portion of the test. If the test light does not glow, several more attempts should be made to verify operating procedure. If the light bulb still fails to light, the Relay is not within specification.
3. Wait one minute for Relay mechanism to stabilize.
4. Next, place finger over open port again and operate the squeeze bulb to attain test pressure (1.25-1.50 psi for 900 Series) (.75-1.00 psi for 910 Series) on the gage and hold for 45 seconds minimum by squeezing the bulb as necessary.
5. After 45 seconds, remove finger quickly, allowing air to escape rapidly from the Relay housing. If the test light does not glow, the Rapid Pressure Rise Relay is within specification for this portion of the test. If the test light does not glow, several more attempts should be made to verify operating procedure. If the light bulb continues to light, the Relay is not within specification.

6.9 Pressure Relief Device

The pressure relief device can only be functionally tested by removing the device and installing it on a pressure test stand. This test is done by the manufacturer and does not need to be repeated in the field. Field testing should be limited to electrical testing of the contacts as described below.



Testing Procedure

1. Activate the contacts by manipulating the reset arm, Item 10 in the drawing above.
2. Check the terminals in the control cabinet with an Ohmmeter, continuity tester or similar device to verify correct contact configuration and action.

6.10 Gas Accumulation Relay or Buchholz Relay

The transformer may be equipped with a Buchholz relay that performs this function. If so, follow the instructions under the Buchholz Relay Testing section below.

The Gas Accumulation Relay can withstand vacuum, but the valve to the relay should be closed during oil filling. After filling is complete, install a drain bucket under the sample valve then open the main valve and sample valve and observe the gauge drop to 0cc. Let enough oil drain from the sample valve to ensure that no air remains in the relay or tubing. If the gauge does not start to drop after a 10-15 seconds, check the tubing between the main valve and the relay.

Gas Accumulation Relay Testing Procedure

1. Inject air into the sample valve with a hand pump.
2. Observe the gauge rise to 150cc or higher.
3. Measure the contacts in the control cabinet with an Ohmmeter, continuity tester or similar device to verify that they are closed and the alarm is present.
4. Remove the pump, drain the sample tubing until the gauge falls back to 0cc and oil comes out of the sample valve.
5. Verify that the contacts in the control cabinet have opened and the alarm has cleared.

Buchholz Relay Testing Procedure

Some Buchholz relays are equipped with a test button on the relay, if this is the case, simply press the button and measure the contacts in the control cabinet with an Ohmmeter, continuity tester or similar device to verify that they are closed and the alarm is present. Release the button and verify that the contacts have opened and the alarm has cleared.

If the Buchholz is not equipped with a test button, perform the following steps:

1. Inject air into the sample valve with a hand pump.
2. Measure the contacts in the control cabinet with an Ohmmeter, continuity tester or similar device to verify that they are closed and the alarm is present.
3. Remove the air pump and drain the sample tubing until oil comes out of the sample valve.
4. Verify that the contacts in the control cabinet have opened and the alarm has cleared.

6.11 Current Transformers

Locate the BCT Wiring Diagram and the Current Transformer (CT) terminals in the control cabinet and on the cover or turrets. Remove all shorting pins or temporary jumpers during testing.

Current transformers should be tested for ratio and polarity before oil filling to avoid costly and time consuming reprocessing if any problems are found. Do not test CT's, or perform any electrical tests, when the transformer is under vacuum.

Each CT must first be tested for ratio and polarity at the first CT terminal block (cover or turret) to verify the correct connections at each CT terminal block and CT orientation inside the transformer or turret.

After oil filling and completion of wiring, each CT must be tested again at the control cabinet customer connection points to verify the wiring between the CT terminal Blocks on the cover or turret and the customer connection points in the main control cabinet. Each of the following tests must be performed for the final tests:

- Universal meter
- Ratior
- Polarity
- Excitation

Note: Place grounding pins back in the terminal strips or reattach temporary jumpers to ensure that all CT's are shorted and grounded before the transformer is turned over to the customer's relay crew.

6.12 Oil and Winding Temperature Gauges

Mount the gauges on the locations shown on the detailed outline drawing. Install the temperature probes after testing is complete.

The oil and winding gauges should read the same approximate temperatures when the transformer is not in service.

Testing Procedure

1. Use a test set designed for testing capillary tube type temperature gauges. Use the correct size bushing to ensure a minimal gap between the probe and the heated well. Bring the temperature up through the range, stopping at the alarm set points. Wait long enough for the gauge to reach the final temperature and stabilize. Measure at least three points on the temperature scale before deciding to make any calibration adjustments. If adjustments are required, use the calibration screw on the front face of the gauge to adjust the calibration.
2. Measure the contacts in the control cabinet with an Ohmmeter, continuity tester or similar device to verify that the contacts open and close at the right temperatures..

6.13 Oil Level Gauges

The transformer will normally be furnished with one oil level gauge, mounted on the conservator and shipped in place. A second gauge on the main tank may be assembled for some transformers.

The internal part of the gauge contains the float and a magnetic coupler. The outer part contains the gauge faceplate, contacts and magnetic coupler.

Testing Procedure

1. Remove the mounting connection for the outer part of the gauge and hold it in place while rotating the gauge to move the indicator to the set-point alarm positions.
2. Measure the contacts in the control cabinet with an Ohmmeter, continuity tester or similar device to verify that they are open and closed in the appropriate positions.
3. Reinstall the outer part of the gauge after testing.

6.14 Fans and Pumps

Verify correct operation and rotation for fans and pumps. This will require auxiliary power. Fans should blow onto radiators and normally pull air across heat exchanger coils. Pumps should circulate oil from the upper part of the tank into the lower part. If a three-phase generator is used for these tests, check the rotation of the supply voltage at the terminal strip where the generator voltage is connected and mark clockwise or counterclockwise rotation next to the terminal strip with a Sharpie or other permanent marker.

1. Megger the cooling circuit at 380V before energizing
2. If single-phase fans are used and rotation is not correct, the fan blades will need to be reversed.
3. If single-phase pumps are used and do not start, check the wiring diagram and verify correct connections including any starting capacitors. If rotation is not correct, contact NANTONG HYOSUNG.
4. If three-phase pumps or fans are used and rotation is not correct, disconnect and swap any two phases. If the phases are swapped at the terminals where the external circuit connects to the transformer, effectively changing the entire circuit, verify correct operation on every other 3-phase device.
5. Measure phase currents for each fan and pump and measure total cooling group circuit currents through the circuit breakers

6.15 Cooling Controls, Control Relays and Contactors

Auxiliary power for cooling and DC power for relay operation will be required for these tests. If the permanent circuits are not connected to the transformer, use a generator and DC power supply.

Review the control diagram to understand the function of each component. In general, functionally test as follows:

1. Check Auto/Manual switch operation and verify the ability to switch each cooling group on and off in Manual
2. Place Auto/Manual switch in Auto
    a. If the transformer has OFAF cooling and requires cooling whenever the transformer is energized, verify that the conditions that will activate initial cooling upon energization (circuit breaker aux contact, bushing potential device, etc.) are correct by applying the signal from the remote location. Short or open the contacts for each oil flow gauge at the control cabinet terminals to simulate loss of flow for each cooling group and verify the alarm and cooling circuit breaker trip.
    b. If the transformer has two stage cooling activated by temperature and equipped with analog temperature gauges, short the winding and/or oil temperature gauge contact terminals in the control cabinet with a fused jumper (correct gauge operation should already have been tested and verified to these terminals)
    c. If the transformer has an electronic temperature gauge/controller, verify correct programming and settings and simulate cooling control output contact operation using the OEM's procedures
3. If the cooling control circuit has a fail-safe design, disconnect voltage or simulate loss of power to the control circuit while the cooling is on and verify correct fail-safe operation
4. If a customer-supplied cooling lockout contact is provided to disable cooling in the event of a transformer trip, simulate the contact operation with a fused jumper to verify that the cooling circuit is switched off.

6.16 De-energized Tap Changer (DETC)

The TTR and winding resistance tests provide electrical tests for the DETC. Change taps through the full range and observe the resistance in the movement. If any abnormalities are suspected, contact NANTONG HYOSUNG. When TTR tests are performed, always make the last test on the in-service tap position and do not operate the DETC after testing. If the DETC tap setting is changed, always perform a TTR test before re-energizing the transformer.

6.17 Load Tap Changer

Follow the LTC manufacturer's testing procedures. In general:

1. Check Local operation with the hand crank before applying operating voltage. Verify correct operation and the raise and lower limits.
2. Connect supply voltage to the LTC and verify correct Local, Manual electrical operation through the full range of taps. Verify correct limit switch contact operation at the raise and lower limits.
3. Verify local and remote tap position indications
4. Review the wiring diagrams and LTC documentation to understand and verify the correct automatic controls operation. Use a Variac and apply a simulated PT voltage to the control circuit to initiate raise and lower operations in Local/Auto through the full range of taps.
5. With a simulated PT voltage applied to the control circuit and with the LTC in Local/Auto, switch to Local/Manual and change the tap position by two or three taps in either direction. Switch back to Local/Auto and the LTC should change taps and return to the original tap position.
6. Check remote operation with the LTC in Remote. If the control circuits are connected to the transformer, verify operation from the relay or control room. If not, short the appropriate raise and lower contacts at the control cabinet terminals with a fused jumper. Verify that a remote raise operation results in the same tap change direction as a local raise operation and repeat for a lower operation.

6.18 Annunciator and/or Alarms

Simulate each device or component's operation by applying a fused jumper at the appropriate terminals in the control cabinet if all devices have been tested to these terminals by this time. If the devices have not been tested to the control cabinet terminals by this time, or if wiring changes have occurred since testing, apply the fused jumper at the terminals on each device or component. Verify that each alarm is picked up when the device sends an alarm, that additional alarms do not incorrectly pick up and that the alarm seals-in or does not seal-in as required. Verify that each alarm clears correctly.

6.19 Cabinet Heaters

Check the wiring diagram to verify if heaters should be always on or switched on with a thermostat /humidistat. If always on, energize and measure voltage across the heater, verify that the heater is getting warm. If switched on, energize the circuit and set the temperature on the thermostat /humidistat below ambient temperature to active the heaters. Measure voltage across the heater and verify that the heater is getting warm. Keep the area around the heater elements clear. NANTONG HYOSUNG recommends a 10ºC temperature setting and an 80% humidity setting.

6.20 Dissolved Gas-in-oil Analysis (DGA)

A baseline oil sample must be taken and tested for dissolved gasses and physical properties after the transformer has been filled with oil and before energization as listed in Section 5.10.

Draw an oil sample and test for dissolved gasses after the transformer has been energized for 24 h ours. Draw a second oil sample and test for dissolved gasses after the transformer has been carryin g at least 50% rated load for 3-7 days.

If the average daily ambient temperature is less than 20°C (68°F), the oil sample should be drawn immediately after the oil filling process is complete and the oil is still warm. Oil samples in cold weather when the oil is cold can produce erroneous moisture saturation test results.

<u>SAMPLING PROCEDURE</u>

> **CAUTION**
>
> If the transformer has a nitrogen blanket oil preservation system, check the pressure gauge on the tank to verify that the nitrogen is at a positive pressure before opening the sample valve and attempting to dr aw an oil sample. If the nitrogen is under vacuum, air could be drawn into the tank which could possibly cause the transformer to fail.

Materials Required

- Clean 50cc syringe with 3-way valve and Tygon tubing
- Digital thermometer
- Clean ½ liter dark glass or dark plastic bottle
- 5 gallon and 1 gallon buckets
- Oil absorbent pads and rags

The oil sample may be taken from the sample port on the lower filter valve (main drain valve), the sample port from the Gas Accumulation or Buchholz Relay or any other available valve on the transformer. The recommended sampling point is the lower filter (or main drain) valve.

Inspect the syringe, tubing and sample bottle before use. Do not use supplies with any dirt, contamination of residual oil.

The sample should drawn in the following general order:

1. Remove the cover from the sample valve and clean the sampling port with a clean rag
2. Place the 1 gallon or 5 gallon bucket under the sample port to catch any oil that may fall
3. Connect the tygon tubing to the syringe’s 3-way valve intake port and the transformer valve’s sample port
4. Connect the tygon tubing to the syringe’s 3-way valve drain output port and place the other end of the tubing securely in the 5 gallon bucket

5. Check the positions of the syringe's 3-way valve and set the 3-way valve in the position that will pass the oil from the transformer into the 3-way valve's intake port and out of the 3-way valve's drain output port. Note that the handle of the 3-way valve always points toward the closed port.

6. Verify that the sample valve is closed, then open the main valve

7. Slowly open the sample valve. Oil should start to flow through the tubing and into the 5 gallon bucket. Drain 1 or 1.5 gallons of oil into the 5 gallon bucket to thoroughly flush the transformer valve, Tygon tubing and 3-way valve on the syringe.

8. Configure the 3-way valve to direct oil from the transformer into the syringe. The oil pressure should push the plunger of the syringe. Do not pull back on the plunger.

WARNING

Be prepared to change the valve position well before the plunger is fully extended. If the 3-way valve is not switched in time, the plunger could be pushed out of the syringe and you will spill oil.

9. When the syringe has 50cc of oil in it, re-configure the 3-way valve so the oil passes from the syringe and out through the 3-way valve drain port and into the 5 gallon bucket.

10. Repeat steps 8 and 9 to flush the syringe 3 or 4 times. Hold the syringe with the 3-way valve at the top so any air bubbles will be forced out through the drain port.

11. Fill the syringe one final time and close the 3-way valve then the transformer sample valve. Hold the syringe up and check for any air bubbles. If any bubbles are present, gently tap the syringe to get the bubbles to the top of the syringe, then open the 3-way valve and push all air bubbles out through the drain port. If any bubbles appear after this, leave them in the syringe.

12. Avoid having the syringe filled with oil in direct sunlight for more than a short time. Also take care in packaging the syringe for shipping to the lab to prevent breakage or leaks.

13. Rinse the bottle with oil from the same sample port two or three times before filling the bottle to within ½" of the top. Measure the temperature of the oil in the bottle with the digital thermometer.

14. Record the site name, transformer serial number and oil sample temperature on the paperwork that is submitted to the Lab for testing.

15. Instruct the Lab to test for the following:

    Dissolved Gasses

    - Hydrogen
    - Oxygen
    - Carbon Monoxide

- Carbon Dioxide
- Methane
- Ethane
- Ethylene
- Acetylene

Physical Properties

- Moisture (ppm) (also report % saturation)
- Interfacial Tension
- Acid Number
- Color
- Dielectric Breakdown (ASTM D877 and D1816)
- Power Factor (90°C)
- Oxidation Inhibitor

6.21 Test Approval Before Energization

All commissioning test results must be reviewed and approved by the Electricity Sector of local Stat before the transformer is energized for the first time. Failure to meet this requirement may void the warranty.

Section 7
Power Transformer Maintenance and Repair

Section 7
Power Transformer Maintenance and Repair

7.1 General Requirements for Inspection and Maintenance

The inspection items are classified into three categories in this manual.

Routine Inspections (Table 7.1)

> The routine inspection should be made preferably daily on every transformer in service. Oil temperature and/or winding temperature, load current, ambient temperature and oil level in transformer should be daily checked and recorded.

Periodical Inspections (Table 7.2)

> The periodical inspection should be made occasionally, minor repair should be done once every one year, overhaul should be done five years after commissioning and then once every ten years in order to ascertain the good performance of a transformer and its parts. Most of the periodical inspections should be made in detail when the transformer is de-energized.

Periodic Testing (Table 7.3)

> Some additional inspections or measurements of electrical characteristics of at transformer are recommended as preventive maintenance actions and when any transformer trouble should be investigated.

Repainting of radiators and transformer tanks, and exchange of parts, gaskets and bearings of motors should be planned and executed regularly as a part of an effective preventive maintenance program to ensure reliable performance.

If any protective relays alarms occur, investigate the trouble in accordance with the Troubleshooting section below.

It is essential to determine all relay actions and their sequence when investigating any power system alarm or trip.

Any abnormal symptoms such as unusual noises, high or low oil levels, high temperatures, oil escaping from the pressure relief device, etc., should be investigated and corrected as quickly as possible.

7.2 Spare and Replacement Parts

NANTONG HYOSUNG recommends that owners keep critical spare parts on-hand for each transformer. Lead-times on some parts like high voltage bushings can be as long as one year. A proactive approach of stocking spare parts can ensure that a failed component can be quickly replaced, avoiding lengthy outages.

Transformers cannot or should not be operated without the following components in good functional co ndition:

- Bushings
- Lightning arresters
- Protective relays (Buchholz, rapid pressure rise, gas accumulation, pressure relief, etc.)
- Cooling components and controls (fans, pumps, circuit breakers, contactors, relays, etc.)

Many transformers share common components. A well-planned universal spare parts plan can cover several transformers with a relatively small number of spare parts. NANTONG HYOSUNG can assist in developing a spare parts plan if support is needed.

All replacement parts are available from Nantong Hyosung. Contact us at:

Nantong Hyosung
Jiangsu Province,P.R.China
Haian Economic Development Zone
No.88 Xiaoxing Road
Phone: 86 -513-88905556
Fax: 86 -513-88905580

7.3 Inspection Records

The establishment of the report and recording of the condition and repair of the transformers is required for a good maintenance program.

A preventive maintenance system will operate satisfactorily with the following records.

An equipment record

> This may range from a simple index card and card file to an equipment database which contains the basic information of a transformer itself such as the serial number, the location, size, etc.

A repair record

> This should keep a running record of all maintenance and repairs performed on a transformer. It is the essential diagnostic record for avoiding future difficulties.

An inspection checklist or inspector's record.

> This should include a list of the points to be checked or measured on a transformer and the establishment of the time that these checks should be made. The results of all regular inspections should be retained in a file or database.

7.4 Routine Inspections (Daily Inspection)

Table 7.1

No.	Items	Method	Action
1.	Oil Temperature And Winding Temperature Indicator	Visual check of temperatures at the time of inspection and recent maximum temperatures. Winding temperature should show higher temperatures when the transformer is under moderate to heavy load. Temperatures should be below alarm points.	If temperatures appear to be wrong, check tank temperature with Thermovision, and compare to top oil temperature. Recalibrate gauges, if needed. If temps are high, check cooling operation. If cooling is OK, check radiators or heat exchangers for debris.
	Load current, Ambient Temperature	Load current and ambient temperature should be recorded at the same time.	
2	Oil level in transformer	Visual check of the dial type oil level gauge.	Oil level should vary with top oil temperature, if not, check the dial gauge and check the actual oil level.
3	Oil leaks	Check oil leaks visually from radiators, flanges, pipes and transformer tank.	Review this manual. Contact NANTONG HYOSUNG if additional instructions are required.
4	Abnormal noise and vibration	Abnormal or unusual noise, especially from fan motors, should be carefully checked.	Check connections. Rebalancing may be required.
5.	Appearance	Bolt connections	Tighten any loose connections
		Dirt and Dust: Visually inspect heat exchanger coils or radiators	Keep clean to maintain cooling capacity.
		Corona: Visually inspect bushings and arresters	Keep clean to maintain dielectric withstand capabilities.
		Paint: Inspect for signs of rust or corrosion, especially on radiators or heat exchangers.	Clean and touch-up or repaint, as required
		Moisture: Visually inspect for moisture in the terminal box, control panel and protective relays.	If any moisture is found, dry it out, and ensure that space heaters are functioning correctly.

7.5 Periodic Inspections (Cycles as indicated)

Table 7.2

No.	Items	Method	Action
1.	Breather (6 months)	Check the discoloration of silicagel in breather due to absorbed moisture.	If the color of silicagel has turned pink by more than two thirds, dry out or exchange it.
2.	Fan motors (3 years)	Measure insulation resistance of fan motors with a 500V megger.	If insulation resistance is less than 2MΩ, replace motor.
3.	Control panel and terminal box (3 years)	Check the water-tightness of control panel and a terminal box.	Replace the rubber gasket if it is worn or damaged.
4.	Switches, circuit breakers, contactors and control relays (3 years)	Check the tightness of all control wiring connections.	Tighten any loose connections.
		Test all switches, relays and alarms. Megger test wiring.	Repair or replace, as needed
		Thermovision checks on Circuit Breaker and Contactor terminals	Tighten, repair or replace, as needed
5.	Oil Leaks (Annual)	Check all gasketed connections and complete tank for signs of leakage.	Regasket, or repair if needed

7.6 Periodic Testing (Cycles as indicated or if troubleshooting is required)

Table 7.3

No.	Items	Method	Action
1.	Oil DGA and physical properties (Annual)	Draw sample and test at qualified oil lab. Refer to IEEE C57.104.	If any measured values are not satisfactory, additional testing or filtering and/or reprocessing may be required.
2.	Power factor, capacitance and insulation of windings and bushings (3 years)	Doble power factor and capacitance tests	Contact NANTONG HYOSUNG if any significant changes are found from factory or previous field tests
3.	Ratio test (3 years)	Transformer turns ratio test on all taps	Compare with the factory test report and previous tests. Test values should not vary more than 0.5%
4.	Winding Resistance (3 years)	By bridge method. If oil pumps are provided, they should be operated during tests and the oil temperature should be measured. Test data must be corrected for temperature.	Contact NANTONG HYOSUNG if any significant changes are found from factory or previous field tests
5.	Exciting current at low voltage (3 years)	Doble or similar individual phase test method.	Contact NANTONG HYOSUNG if any significant changes are found from factory or previous field tests
6.	Bushing current transformers (3 years)	Ratio, and excitation and megger tests	Contact NANTONG HYOSUNG if any significant changes are found from factory or
7.	Protective relays and controls (3 years)	Functional test of all controls and relays	Replace any faulty components

7.7 Regular Maintenance

Table 7.4

No.	Material and Parts	Maintenance frequency	Remarks
1.	Bushings and insulators	Clean as required for local conditions.	Coastal environments and locations near industrial sites will require more frequent cleaning. Visible corona is a sign that cleaning is needed.
2.	Radiators and heat exchangers	Clean as required for local conditions.	Use care when cleaning. Use compressed air or low pressure water. Do not use pressure washers.
3.	Paint	As required	Touch-up painting should be performed after commissioning and whenever maintenance is performed. Complete repainting should be required less often if touch-up painting is done regularly.
4.	Fans and pumps	Expected life is ten years.	Replace when needed
5.	LTC	Per the manufacturer's manual.	

7.8 Troubleshooting

When the transformer does not perform as expected, it is important that the cause of the action be determined and corrected. Troubleshooting is an art that requires logic, experience and knowledge of how the system and equipment are designed to operate and how they are constructed.

7.9 Diagnosis of protective relays in operation

If any protective relay or gauge gives an alarm, investigate the causes as listed below.

<u>Temperature Indicator</u>

- Types

Analog or electronic type may be provided. Analog Qualitrol type and AKM style are shown below for reference.

- Function

The temperature indicator Indicates maximum oil & winding temperature of a transformer. It also has protective functions to give an alarm or tripping signal, and automatic function to control cooling system.

- Possible causes of elevated temperatures
    - o Overloading
    - o Insufficient cooling due to dust or other foreign materials
    - o Mis-operation of thermal relay

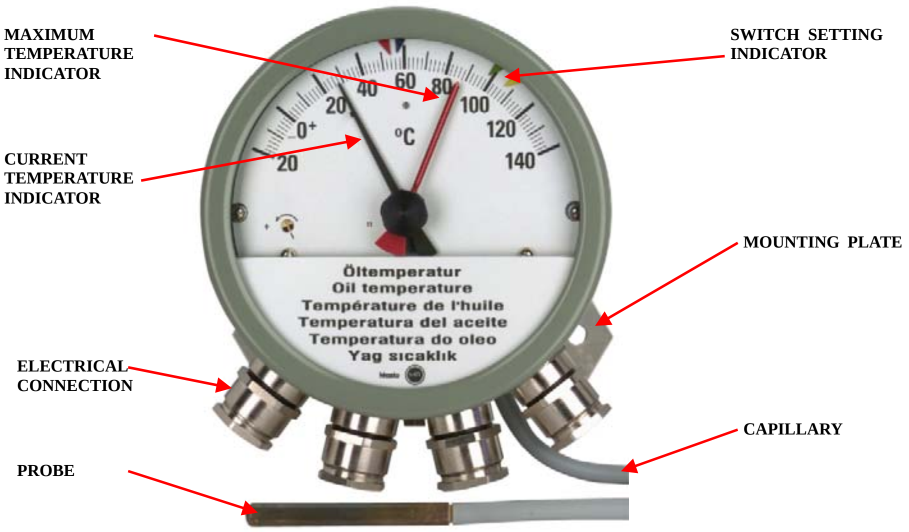


Figure 7.1 Messko style oil winding temperature indicator

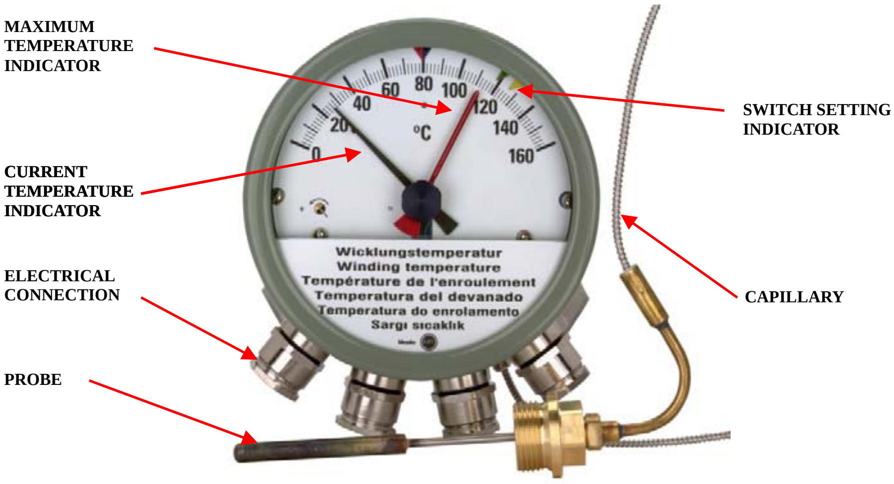


Figure 7.2. Messko style winding temperature indicator

<u>Oil Level Gauge</u>

- Function

The dial type oil level gauge indicates the oil level in the conservator of an oil-immersed transformer.

When the oil level comes down to the bottom of a conservator, its pointer indicates low and gives an alarm.

- Possible causes of abnormal oil level indication
  - o Shortage of oil and/or oil leakage
  - o Abnormally low ambient temperature in winter season with low oil level
  - o Conservator bladder failure

Figure 7.3. Messko style Oil Level Gauges

Rapid Pressure Rise Relay

- Function

The rapid pressure rise relay detects pressure waves in the transformer.

- Possible causes of relay action
  - o Internal faults
  - o Oil surges from abnormal operation
  - o Circuit problems (corrosion, water intrusion, etc.)

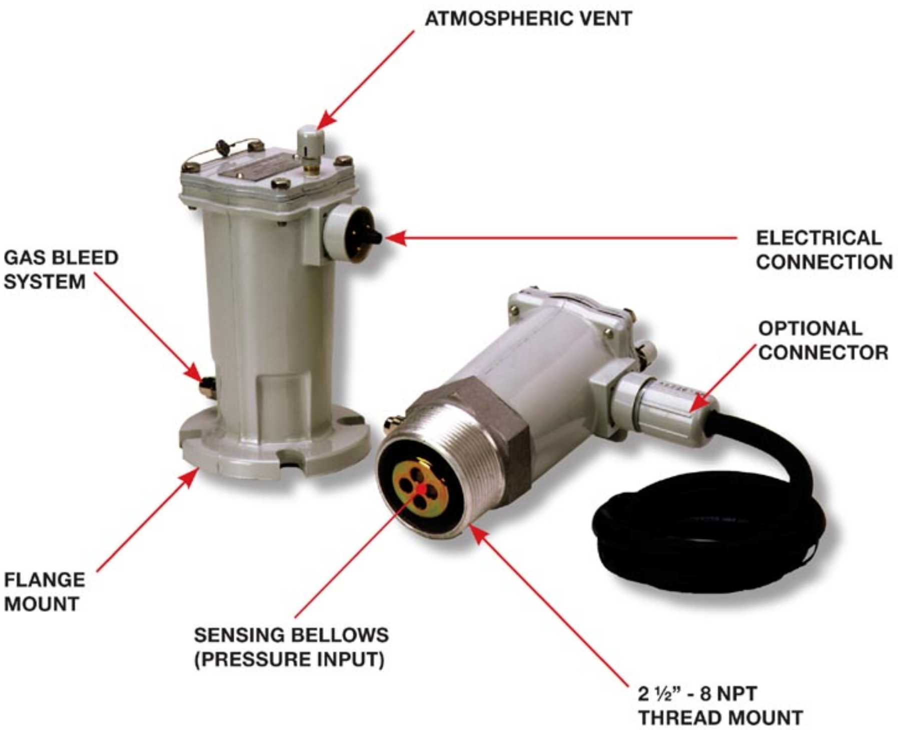


Figure 7.4 Rapid Pressure Rise Relay

Pressure Relief Device

- Function

The pressure relief device protects the transformer tank when the tank pressure rises above the rated pressure withstand of the device.

- Possible causes of relay action
    - Internal faults
    - Closed conservator piping valve when transformer is energized
    - Clogged conservator breather or closed breather valves
    - Circuit problems (corrosion, water intrusion, etc.)

Figure 7.5 Outline of pressure relief device

7.10 Recommended Instructions for Repairing Weld Leaks

This instruction leaflet is intended to give general instructions concerning recommended practices for repairing weld leaks in power transformers or their auxiliaries. Variations of these instructions may be desirable for special repair tasks, but normally weld leaks can be successfully sealed if these instructions are followed.

CAUTION

WELDING REPAIRS SHOULD NEVER BE MADE ON AN ENERGIZED TRANSFORMER. ALSO, THE WELDING MACHINE GROUND MUST BE LOCATED TO ENSURE THAT WELDING CURRENT DOES NOT PASS THROUGH ANY COMPONENTS OR CIRCUITS.

CAUTION

THE TANK MATERIAL TO BE WELDED MUST BE CHECKED WITH A MAGNET TO DETERMINE IF IT IS REGULAR STEEL OR STAINLESS (OR ANOTHER NON-MAGNETIC STEEL) BEFORE SELECTING THE PROPER WELDING ROD AND TECHNIQUE.

Repair Steps

- De-energize the transformer.
- If the liquid has not been removed, pull a vacuum of several pounds per square inch above the liquid to stop the liquid leak. This may be done with a vacuum pump or by sealing all fittings on the tank and draining sufficient oil to obtain the necessary vacuum to obtain a neutral or negative head pressure at the weld area. Be careful not to apply negative pressures to any sensitive components like Hydran or similar monitoring devices or to RPRR relays. Oil head pressure is approximately 1/2psi per foot.
- Peen the weld leak area, if possible, with the ball end of a ball-peen hammer or with a blunt or round-nosed chisel.
- Grind or brush the paint from the area to be welded and the ground lead for the arc welding machine.
- DC current, straight polarity is preferred with the transformer connected to positive, grounded polarity and the electrode connected to negative polarity. The welding machine must adjusted to supply the desired welding current to ensure that the weld will have adequate fusion and is not at risk of burning through the base material.
- Clean and remove any residual oil with denatured alcohol or another petroleum distillate.
- Apply a string bead sealing weld over the weld defect in a single, quick pass. This weld should be deposited horizontal or vertically depending upon circumstances. If the weld is deposited vertically, it is recommended that it be made downward to drive any liquid seepage ahead of the weld.

- Successive beads should be deposited adjacent to and over the first sealing bead or a single pass may be weave across it to complete the weld.
- Remove all slag between each successive weld bead or pass.
- Clean the repaired area and check with a dye penetrant or other suitable test to be sure the defect has been repaired.
- After testing for leaks, re-clean the area and apply touch-up paint.

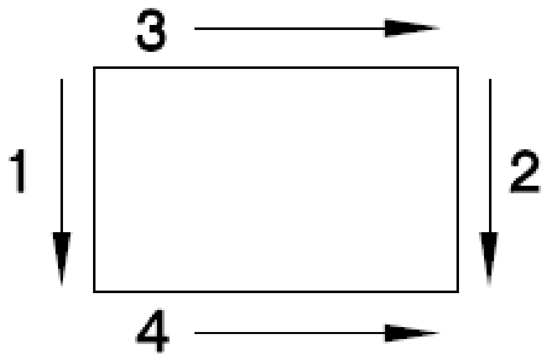


Figure 7.6 Welding sequence for patch

<u>Alternate Method using a Patch</u>

A patch may be welded to the transformer case to repair a leak as an alternate to the method above. The recommended method is as follows.

- De-energize the transformer, pull the required vacuum, peen the weld. clean the weld area, check the liquid level.
- Fit a patch of 4.5mm or 6mm (approximately ¼") thick steel over the area to be sealed. If the oil head pressure cannot be eliminated or if the leak is substantial, it may be necessary to construct the patch with a ½" hole in the center, tapped for a ½" threaded pipe plug. Tack weld this patch in place, then weld it to the transformer case by welding the sides first, vertically downward, then horizontally across the top of the patch and finally horizontally across the bottom. If a patch with a tapped hole was used, install and tighten the pipe plug after welding.
  Clean the repaired area and check to be sure the leak has been stopped.
- After testing for leaks, re-clean the area and apply touch-up paint.

<u>Radiator Repairs</u>

The NANTONG HYOSUNG radiators consist of different numbers of fin elements welded to each other and to a formed header. The elements are made from two sheets of 1.0mm thick mild steel continuously welded along their outer edges and with intermediate seams between the individual lobes.

Field repair of a seam between lobes or replacement of an element is not recommended. The radiator should be returned to the factory for repair.

To repair weld leaks around the header flange, along the outer edge of the elements or in the weld where the elements join the header or each other, the following procedure is recommended.

- Close the radiator valves between the radiator and the transformer case. Drain the liquid from the radiator and remove the radiator from transformer case.
- Grind or brush the paint from the area to be repaired. Also remove any liquid, dirt or foreign matter.
- If the weld to be repaired is around the header flange use 3mm diameter electrodes with current settings between 115 to 125 amperes. Weld horizontally around the flange.
- An oxygen-acetylene welding technique is recommended for repairing a weld along the edge of an element, a weld joining the elements to each other, or a weld joining the elements to the header. The recommended procedure for repairing a leak along the edge of an element is outlined below:

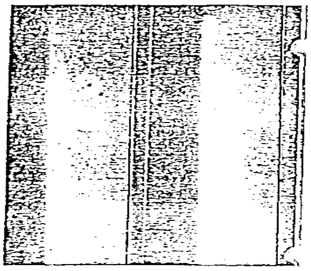


Figure 7.7 Radiator Section prepared for welding

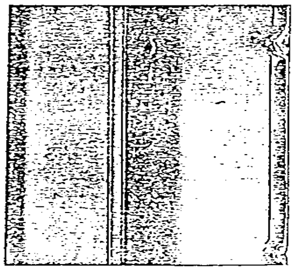


Figure 7.8 Radiator Section after welding

- o Heat the full length of the seam with the oxy-acetylene torch to drive out all trapped oil.
- o Find the exact location of the leak by means of a suitable leak detector.
- o When the exact location of the leak has been determined, notch the edge of the element as shown in Figure 7.7 at points 50 to 75mm on either side of the leak. These notches may be cut with a hack saw, a file, or a small grinder.
- o Start by filling one of the notches. Next, fill in the second notch. Finally fuse the edges of the element between the notches moving forward with a slightly weaving motion. Be sure to tie this weld into both filled notches.
  Figure 7.8 shows the repaired element before touching up the repaired area.

- Clean the repaired area and check with a suitable leak detector to be sure the leak has been stopped.
- After testing for leak is, re-clean the area and apply touch-up paint.
- Reinstall the radiator.

Section 8
Component Instruction Leaflets and Manuals

Section 8
Component Instruction Leaflets and Manuals

Section 8
Component Instruction Leaflets and Manuals

8.1 Tap-changer

On-Load Tap-Changer
VACUTAP VR® I II III

Operating Instructions

288/03 EN

Table of contents

1 Introduction

This technical file contains detailed descriptions on the safe and proper installation, connection, commissioning and monitoring of the product.

It also includes safety instructions and general information about the product.

This technical file is intended solely for specially trained and authorized personnel.

1.1 Validity

This technical file applies to the following types of on-load tap changer VACUTAP® VR:

- VACUTAP® VRC
- VACUTAP® VRE
- VACUTAP® VRD
- VACUTAP® VRF
- VACUTAP® VRG

1.2 Manufacturer

The product is manufactured by:

Maschinenfabrik Reinhausen GmbH

Falkensteinstraße 8
93059 Regensburg, Germany
Tel.: (+49) 9 41/40 90-0
Fax: (+49) 9 41/40 90-7001
E-mail: sales@reinhausen.com

Further information on the product and copies of this technical file are available from this address if required.

1.3 Subject to change without notice

The information contained in this technical file comprises the technical specifications approved at the time of printing. Significant modifications will be included in a new edition of the technical file.

The document number and version number of this technical file are shown in the footer.

1.4 Completeness

This technical file is incomplete without the supporting documentation.

1.5 Supporting documents

The following documents also apply in addition to this technical file:

- Unpacking instructions
- Supplement
- Routine test report

Also observe generally valid legislation, standards, guidelines and specifications on accident prevention and environmental protection in the respective country of use.

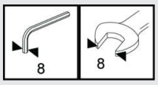
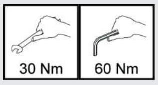
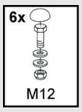
1.6 Safekeeping

This technical file and all supporting documents must be kept ready at hand and accessible for future use at all times.

1.7 Notation conventions

This section contains an overview of the symbols and textual emphasis used.

1.7.1 Symbols

Symbol	Definition
	Wrench size
	Tightening torque
	Number and type of fastening materials used
	Fill with oil
	Cut open, cut through
	Clean
	Visual inspection
	Use your hand

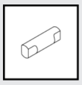
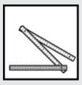
Symbol	Definition
	Adapter ring
	Apply a coat of paint
	Use a file
	Grease
	Coupling bolt
	Use a ruler
	Use a saw
	Hose clip
	Wire eye, locking wire
	Use a screwdriver

Table 1: Symbols

1.7.2 Hazard communication system

Warnings in this technical file use the following format:

⚠ WARNING

Type and source of danger

Consequences

- ▶ Action
- ▶ Action

The following signal words are used:

Signal word	Definition
DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

Signal word	Definition
WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates measures to be taken to prevent damage to property.

Table 2: Signal words in warning notices

Pictograms warn of dangers:

Pictogram	Definition
	Warning of a danger point
	Warning of dangerous electrical voltage
	Warning of combustible substances
	Warning of danger of tipping

Table 3: Pictograms used in warning notices

1.7.3 Information system

Information is designed to simplify and improve understanding of particular procedures. In this technical file it is laid out as follows:

Important information.

2 Safety

2.1 General safety information

The technical file contains detailed descriptions on the safe and proper installation, connection, commissioning and monitoring of the product.

- Read this technical file through carefully to familiarize yourself with the product.
- Particular attention should be paid to the information given in this chapter.

2.2 Appropriate use

The product and associated equipment and special tools supplied with it comply with the relevant legislation, regulations and standards, particularly health and safety requirements, applicable at the time of delivery.

If used as intended and in compliance with the specified requirements and conditions in this technical file as well as the warning notices in this technical file and attached to the product, then the product does not present any hazards to people, property or the environment. This applies throughout the product's entire life, from delivery through installation and operation to disassembly and disposal.

The operational quality assurance system ensures a consistently high quality standard, particularly in regard to the observance of health and safety requirements.

The following is considered appropriate use

- The product must be operated in accordance with this technical file and the agreed delivery conditions and technical data
- The equipment and special tools supplied must be used solely for the intended purpose and in accordance with the specifications of this technical file
- The product must be used only with the transformer specified in the order
- The serial numbers of the drive, on-load tap-changer and protective relay must match

The on-load tap-changer is not intended to be used with an oil filter unit.

⚠ DANGER

Danger of death or severe injury and damage to property and the environment!

Danger of death or severe injury and damage to property and the environment due to electrical voltage, falling and/or tipping parts as well as dangerous cramped conditions resulting from moving parts!

- ► Adherence to the following prerequisites and conditions is mandatory.
- ► Adhere to warning notices.

Since the on-load tap-changer was dimensioned as per IEC 60214-1, it can switch currents of up to twice the value of the rated through current.

On-load tap-change operations are not to be performed during operating conditions with higher currents.

Examples of such operating conditions are:

- Inrush current impulses when transformers are switched on
- Short circuit

The rated step voltage may be briefly exceeded by up to 10 % as long as the rated through current is not exceeded. Such an operating condition can occur due to overexcitation of the transformer after load shedding, for example.

The on-load tap-changer can be operated in the temperature range of the surrounding transformer oil of between -25 ° and +105 °C and with overload up to +115 °C in accordance with IEC 60214-1.

2.2.1 Required minimum installation height of the oil conservator

The installation height (H) of the oil conservator for the on-load tap-changer is the distance between the upper edge of the on-load tap-changer head cover and the oil level in the oil conservator.

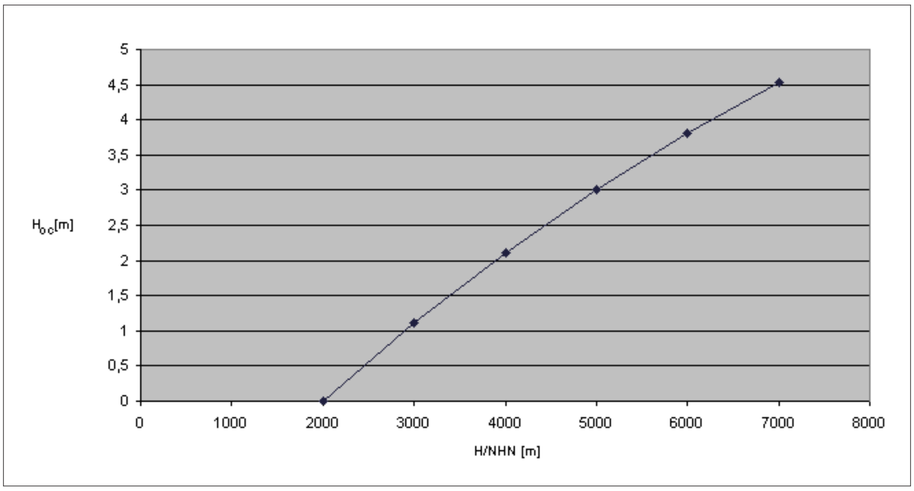


Figure 1: Required minimum height of the oil conservator

H_{oc}[m]	Installation height H of the oil conservator [m]
H/NHN [m]	Installation height [m] above sea level

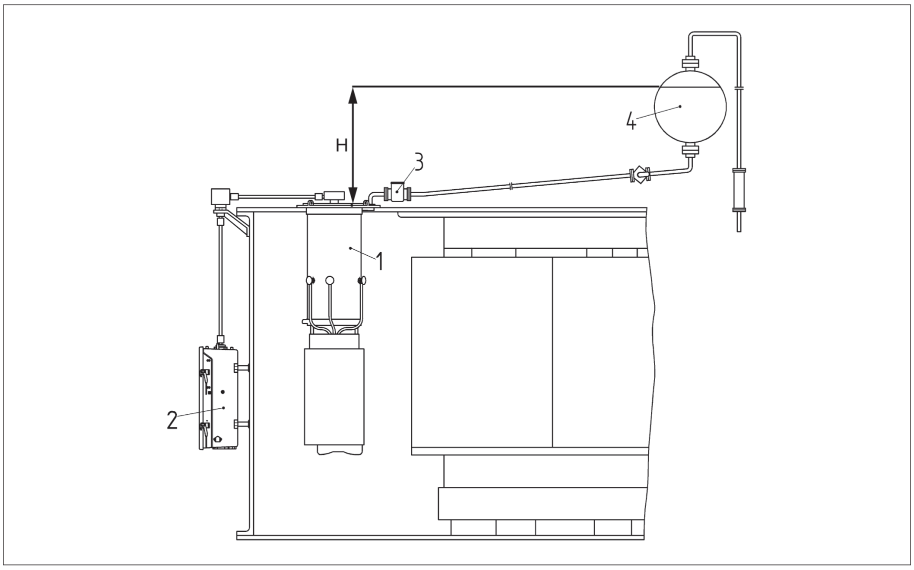


Figure 2: Transformer with on-load tap-changer, schematic presentation

1	On-load tap-changer	3	Protective relay
2	Motor-drive unit	4	Oil conservator
H	Installation height of the oil conservator [m] = distance between the upper edge of the on-load tap-changer head cover and the oil level in the oil conservator		

2.2.2 Maximum installation height of the oil conservator

In addition to the minimum installation height specified in the previous section, the maximum installation height of the oil conservator must also be observed.

The maximum installation height of the oil conservator for the on-load tap-changer is "**minimum height + 10 m**".

The installation height of the oil conservator must be taken into account when designing pressure relief devices.

If the oil conservators for the on-load tap-changer and transformer are at different heights, the difference in height between them must be no more than 3 m.

Other applications must be reviewed on a case-by-case basis.

2.3 Inappropriate use

Use is considered to be inappropriate if the product is used other than as described in the Appropriate use [▶ 12] section.

Maschinenfabrik Reinhausen GmbH does not accept liability for damage resulting from unauthorized or inappropriate changes to the product. Inappropriate changes to the product without consultation with Maschinenfabrik Reinhausen can lead to personal injury, damage to property and operational disruption.

2.4 Personnel qualification

The product is designed solely for use in electrical energy systems and facilities operated by appropriately trained staff. This staff comprises people who are familiar with the installation, assembly, commissioning and operation of such products.

2.5 Operator's duty of care

To prevent accidents, disruptions and damage as well as unacceptable adverse effects on the environment, those responsible for transport, installation, operation, maintenance and disposal of the product or parts of the product must ensure the following:

- All warning and hazard notices are complied with.
- Personnel are instructed regularly in all relevant aspects of operational safety, the operating instructions and particularly the safety instructions contained therein.
- Regulations and operating instructions for safe working as well as the relevant instructions for staff procedures in the case of accidents and fires are kept on hand at all times and are displayed in the workplace where applicable.
- The product is only used when in a sound operational condition and safety equipment in particular is checked regularly for operational reliability.
- Only replacement parts, lubricants and auxiliary materials which are authorized by the manufacturer are used.

- The specified operating conditions and requirements of the installation location are complied with.
- All necessary devices and personal protective equipment for the specific activity are made available.
- The prescribed maintenance intervals and the relevant regulations are complied with.
- Installation, electrical connection and commissioning of the product may only be carried out by qualified and trained personnel in accordance with this technical file.
- The operator must ensure appropriate use of the product.

2.6 Personal protective equipment

Personal protective equipment must be worn during work to minimize risks to health.

- Always wear the personal protective equipment required for the job at hand.
- Follow information about personal protective equipment provided in the work area.

Always wear	
	**Protective clothing** Close-fitting work clothing with a low breaking strength, with tight sleeves and with no protruding parts. It mainly serves to protect the wearer against being caught by moving machine parts. Do not wear any rings, necklaces or other jewelry.
	**Safety shoes** To protect against falling heavy objects and slipping on slippery surfaces.

Table 4: Personal protective equipment to be worn at all times

Wear the following in special environments	Special personal protective equipment is needed in special environments. The choice of equipment depends on the circumstances.
	**Safety glasses** To protect the eyes from flying parts and splashing liquids.

Wear the following in special environments	Special personal protective equipment is needed in special environments. The choice of equipment depends on the circumstances.
	**Hard hat** To protect from falling and flying parts and materials.
	**Hearing protection** To protect from hearing damage.

Table 5: Personal protective equipment to be worn in special environments

2.7 Protective devices

The following protective devices for the product are included as standard in the scope of delivery or are available as options.

2.7.1 Protective relay RS

The protective relay RS is an oil flow-controlled relay in accordance with IEC 60214-1. It is installed between the on-load tap-changer head and the oil conservator of the on-load tap-changer.

It triggers when the specified oil flow between oil compartment of the on-load tap-changer and oil conservator is exceeded.

2.7.2 Rupture disk

The rupture disk is a pressure relief device without signaling contact in accordance with IEC 60214-1 and is located in the on-load tap-changer head cover.

The rupture disk responds to a defined overpressure in the oil compartment of the on-load tap-changer.

2.7.3 Pressure relief device MPreC®

If required by the customer, instead of the rupture disk MR can provide a pre-installed pressure relief device type MPReC®, which meets all requirements in accordance with IEC 60214-1.

The pressure relief device responds to a defined overpressure in the oil compartment of the on-load tap-changer.

2.7.4 Tap-change supervisory control

The tap-change supervisory control monitors both the drive shaft between on-load tap-changer(s) and motor-drive unit and the correct switching of the diverter switch.

2.7.5 Temperature monitoring

The temperature monitoring device monitors the oil temperature in the oil compartment of the on-load tap-changer.

3 Product description

This chapter contains an overview of the design and function of the product.

3.1 Function description

On-load tap-changers are used to adjust the desired tap of a tap winding under load.

During the tap change operation the fine tap selector first selects the desired tap of the tap winding. The diverter switch then switches from the current-carrying tap to the preselected tap. During this tap change operation one tapping step of the tap winding is briefly bridged with an ohmic resistor so that the diverter switch operation can be carried out without any interruption in current.

3.2 Performance features

The on-load tap-changer is particularly characterized by the following properties:

- Less maintenance
- Significantly reduced operating costs
- No arcing in the insulating oil
- Extended lifespan of the insulating oil

3.3 Scope of delivery

The product is packaged with protection against moisture and is delivered as follows:

- Oil compartment with on-load tap-changer head and built-in diverter switch insert
- Tap selector
- Motor-drive unit
- Drive shaft with coupling parts and bevel gear
- Protective relay
- Technical files

Single-phase on-load tap-changers are also available as an on-load tap-changer set with a common motor-drive unit.

Please note the following:

- Check the shipment for completeness on the basis of the shipping documents.
- Store the parts in a dry place until installation.

- The product must remain in its airtight, protective wrapping and may only be removed immediately before installation.

3.4 Setup/models

The on-load tap-changer consists of the on-load tap-changer head, oil compartment with built-in diverter switch insert and the tap selector mounted below (also available with change-over selector on request).

The design and designation of the physical arrangement of the on-load tap-changer is shown in the installation drawings in the appendix.

For the number of maximum operating positions of the on-load tap-changer, refer to the Technical data.

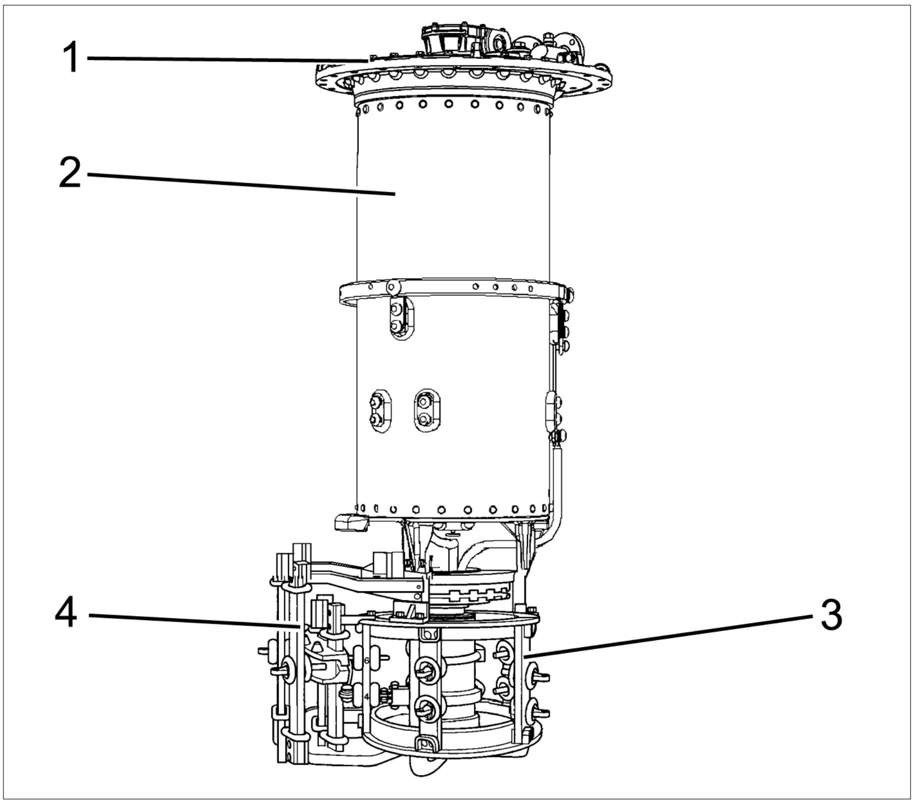


Figure 3: VACUTAP® VRC/VRE

1	On-load tap-changer head	3	Tap selector
2	On-load tap-changer oil compartment	4	Change-over selector

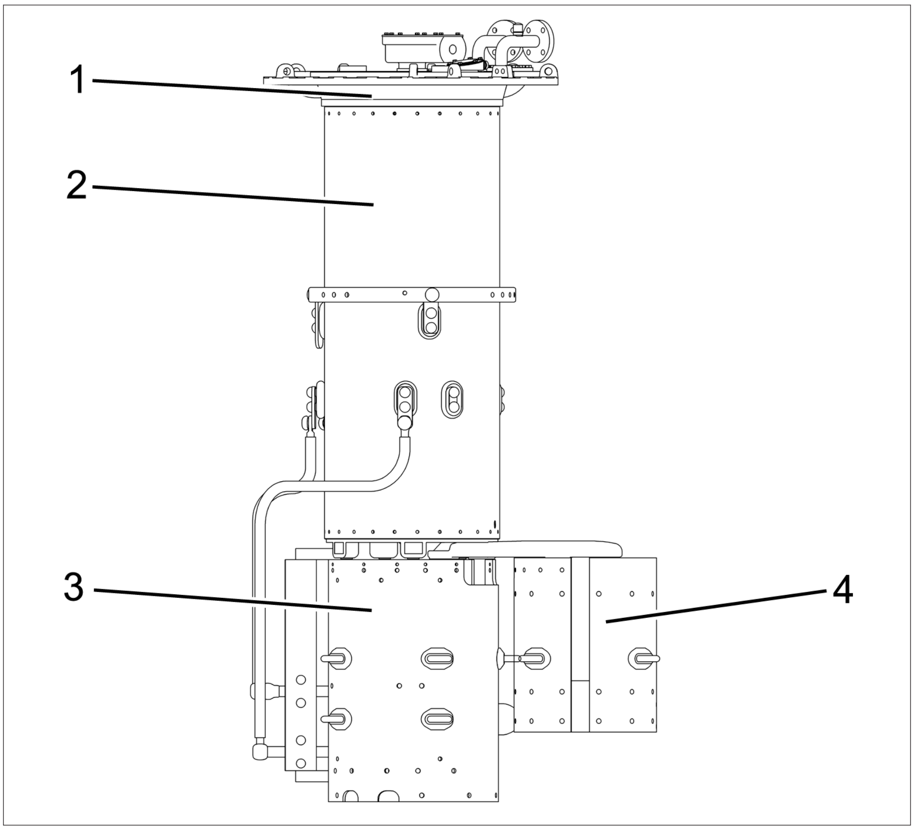


Figure 4: VACUTAP® VRD/VRF

1	On-load tap-changer head	3	Tap selector
2	On-load tap-changer oil compartment	4	Change-over selector

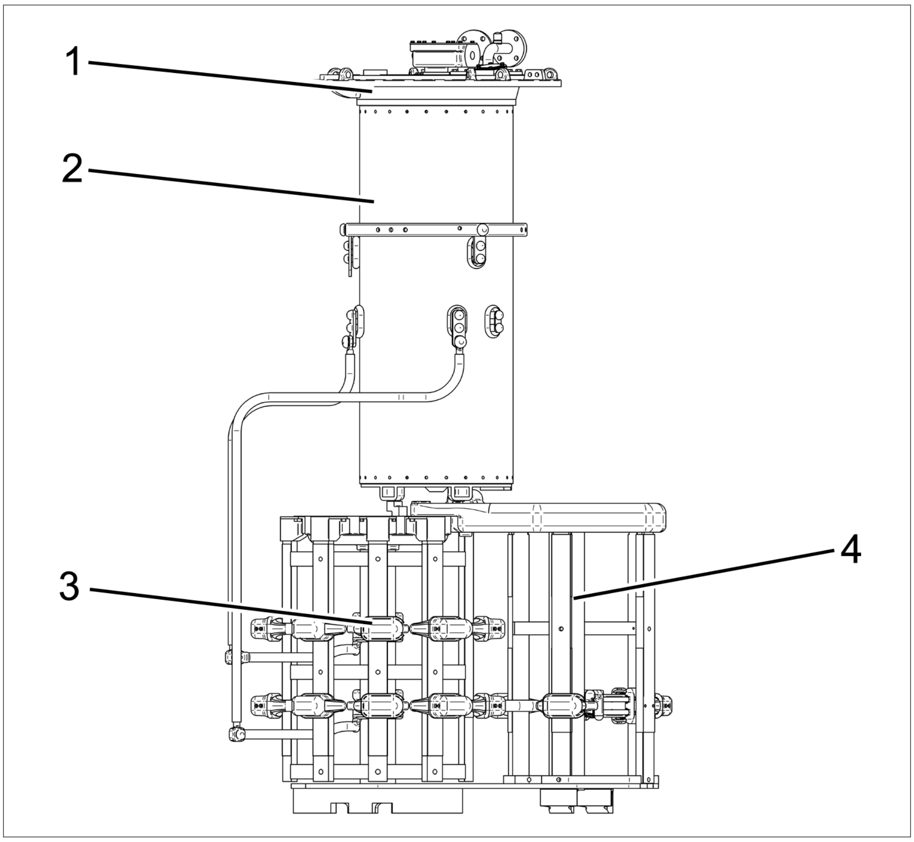


Figure 5: VACUTAP® VRG

1	On-load tap-changer head	3	Tap selector
2	On-load tap-changer oil compartment	4	Change-over selector

3.5 Pipe connections

The on-load tap-changer head features 4 pipe connections for different purposes.

After loosening the pressure ring (4 M10 screws/size 17 wrench), 2 pipe connections (R and S) can be freely swiveled.

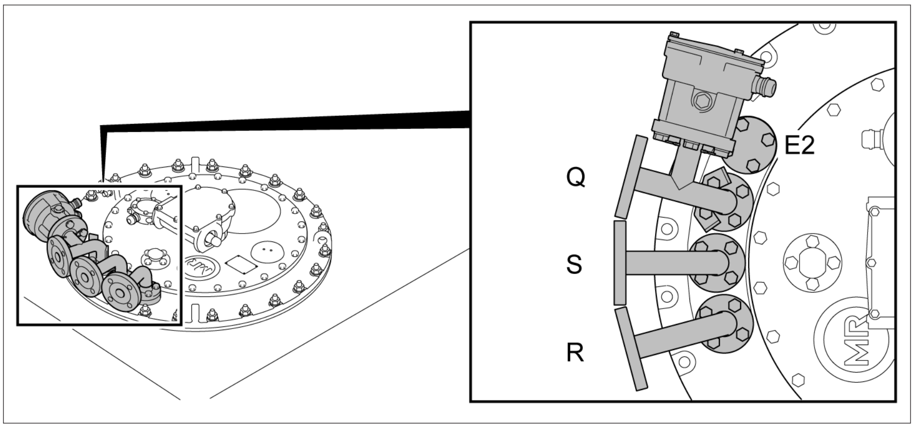


Figure 6: Pipe connections

3.5.1 Pipe connection R for the RS protective relay

Pipe connection R is provided for the attachment of the RS protective relay and the connection of the on-load tap-changer oil conservator.

The protective relay is attached as described in the respective MR operating instructions for the protective relay.

The functions of the R and Q pipe connections can be interchanged. Therefore the RS protective relay can also be connected to pipe connection Q and the motor-drive unit can be connected to the tap-change supervisory control via pipe connection R.

3.5.2 Pipe connection S

Pipe connection S features a vent screw and should be connected to a pipe that ends with a drain valve on the side of the transformer tank at operating height.

3.5.3 Pipe connection Q (special design, required only with tap-change supervisory control)

Pipe connection Q is closed with a blank cover and is intended for connecting the motor-drive unit to the optional tap-change supervisory control.

The functions of the R and Q pipe connections can be interchanged. Therefore the RS protective relay can also be connected to pipe connection Q and the motor-drive unit can be connected to the tap-change supervisory control via pipe connection R.

3.5.4 Pipe connection E2

The pipe connection E2 is closed with a blank cover. It leads into the oil tank of the transformer, directly under the on-load tap-changer head and can be connected to a collective pipe for the Buchholz relay, if necessary.

4 Packaging, transport and storage

4.1 Packaging

4.1.1 Purpose

The packaging is designed to protect the packaged goods during transport, loading and unloading as well as periods of storage in such a way that no (detrimental) changes occur. The packaging must protect the goods against permitted transport stresses such as vibration, knocks and moisture (rain, snow, condensation).

The packaging also prevents the packaged goods from moving impermissibly within the packaging. The packaged goods must be prepared for shipment before actually being packed so that the goods can be transported safely, economically and in accordance with regulations.

4.1.2 Suitability

The packaging is suitable for

- all common types of transportation
- stackability - 1000 kg/m^2 top surface

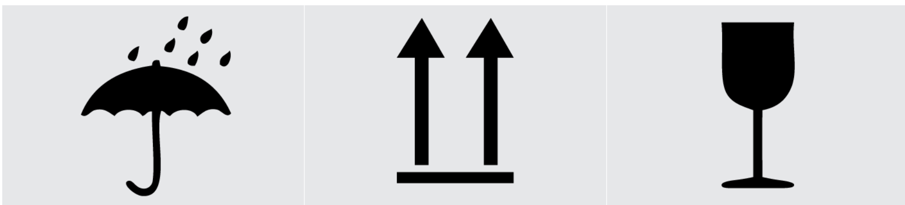
The packaged goods are packed in a stable wooden crate. This crate ensures that the shipment is secure when in the intended transportation position and that none of its parts touch the loading surface of the means of transport or touch the ground after unloading.

The packaged goods are stabilized inside the crate to prevent impermissible changes in position.

The sealed packaging surrounds the packaged goods on all sides with a PE foil. The product is protected using desiccant. The PE foil is bonded after the drying agent is added and any remaining air is extracted. This can be seen on the form-fit of the PE foil.

4.1.3 Markings

The packaging bears a signature with instructions for safe transport and correct storage. The following symbols apply to the shipment (of non-hazardous goods). Adherence to these symbols is mandatory.



Protect against moisture	Top	Fragile

Table 6: Shipping pictograms

4.2 Transportation, receipt and handling of shipments

⚠ WARNING

Danger of death and damage to property!

Danger of death and damage to property due to tipping or falling load!

- ▶ Only trained and appointed persons may select the sling gear and secure the load.
- ▶ Do not walk under the hanging load.
- ▶ Use means of transport and lifting gear with a carrying capacity of > 500 kg.

In addition to oscillation stress and shock stress, jolts must also be expected during transportation. In order to prevent possible damage, avoid dropping, tipping, knocking over and colliding with the product.

If a box falls from a certain height (e.g. when slings tear) or experiences an unbroken fall, damage must be expected regardless of the weight.

Every delivered shipment must be checked for the following by the recipient before acceptance (acknowledgment of receipt):

- Completeness based on the delivery slip
- External damage of any type.

The checks must take place after unloading when the crate or transport container can be accessed from all sides.

Visible damage

If external transport damage is detected on receipt of the shipment, proceed as follows:

- Immediately record the transport damage found in the shipping documents and have this countersigned by the carrier.
- In the event of severe damage, total loss or high damage costs, immediately notify the sales department at Maschinenfabrik Reinhausen and the relevant insurance company.
- After identifying damage, do not modify the condition of the shipment further and retain the packaging material until an inspection decision has been made by the transport company or the insurance company.
- Record the details of the damage immediately onsite together with the carrier involved. This is essential for any claim for damages!
- If possible, photograph damage to packaging and packaged goods. This also applies to signs of corrosion on the packaged goods due to moisture inside the packaging (rain, snow, condensation).
- ***NOTICE!*** Be absolutely sure to also check the sealed packaging. If the sealed packaging is damaged, do not under any circumstances commission the packaged goods. If this is not done, the packaged goods may be damaged.

- Name the damaged parts.

Hidden damage When damages are not determined until unpacking after receipt of the shipment (hidden damage), proceed as follows:

- Make the party responsible for the damage liable as soon as possible by telephone and in writing, and prepare a damage report.
- Observe the time periods applicable to such actions in the respective country. Inquire about these in good time.

With hidden damage, it is very hard to make the transportation company (or other responsible party) liable. Any insurance claims for such damages can only be successful if relevant provisions are expressly included in the insurance terms and conditions.

4.3 Storage of shipments

Packaged goods with a functional sealed packaging can be stored outdoors when the following conditions are complied with.

Selection and arrangement of the storage location should meet the following requirements:

- Stored goods are protected against moisture (flooding, water from melting snow and ice), dirt, pests such as rats, mice, termites and so on, and against unauthorized access.
- Store the crates on timber beams and planks as a protection against rising damp and for better ventilation.
- Carrying capacity of the substrate under the goods is sufficient.
- Entrance and exit paths are kept free.

Check stored goods at regular intervals. Also take appropriate action after storms, heavy rain or snow and so on.

Protect the packaging foil from direct sunlight so that it does not disintegrate under the influence of UV rays, which would cause the packaging to lose its sealing function.

If installation of the product is delayed beyond the normal time frame, suitable measures must be taken without delay. The following measures can be used:

- Correctly regenerate the drying agent and restore the sealed packaging.
- Unpack the packed goods and store in suitable storage space (well ventilated, as dust-free as possible, humidity < 50 % where possible).

4.4 Unpacking shipments and checking for transportation damages

- **NOTICE!** Wherever possible keep the crate packaged for transport to the place where installation will take place. Do not open the sealed packaging until just before installation. If this is not done, damage to property may occur due to ineffectively sealed packaging in locations with an unsuitable climate!
- When unpacking, check the condition of the packaged goods.
- Check completeness based on the delivery slip.

5 Installing the on-load tap-changer in the transformer

When installing the on-load tap-changer in the transformer a distinction is made between installations in transformers in standard design and bell-type tank design.

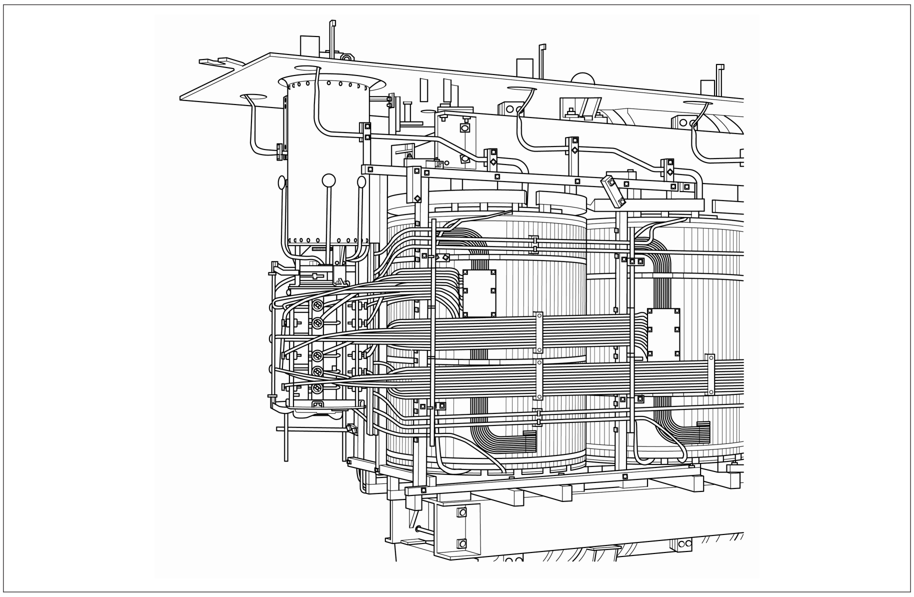


Figure 7: On-load tap-changer in a transformer with standard design

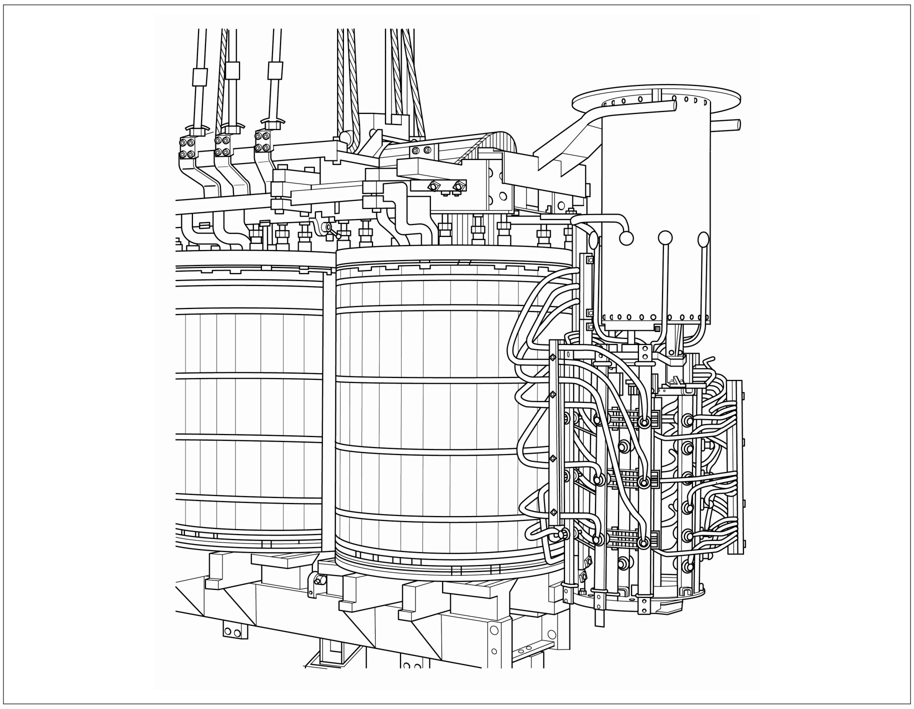


Figure 8: On-load tap-changer in a transformer with bell-type tank design

5.1 Preparatory work

Perform the work stated below before installing the on-load tap-changer in the transformer.

5.1.1 Fitting mounting flange on transformer cover

A mounting flange is required for fitting the on-load tap-changer head on the transformer cover. This can be supplied as an option or can be produced by the customer. Mounting flanges made by the customer must comply with the installation drawings in the appendix.

► Fit mounting flange on transformer cover.

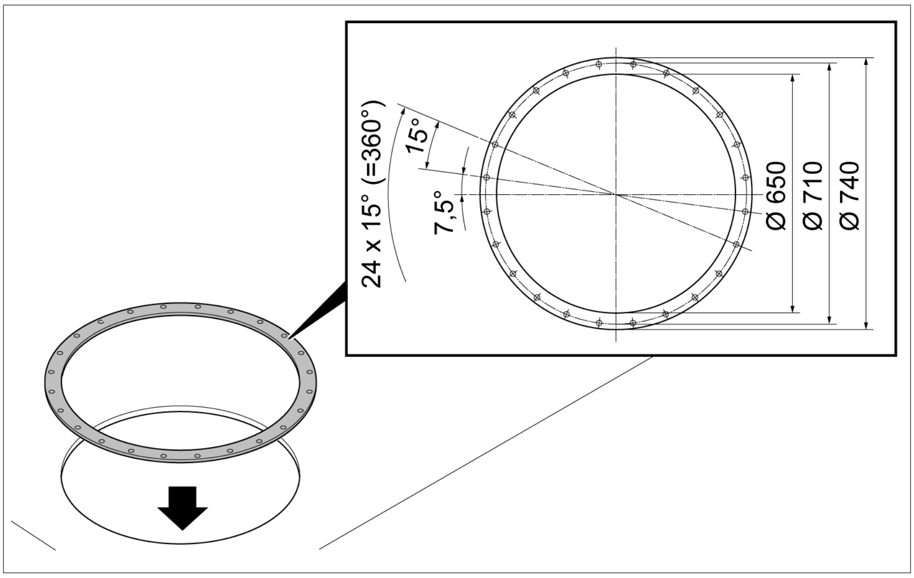


Figure 9: Mounting flange

5.1.2 Fitting stud bolts on mounting flange

To attach the stud bolts to the mounting flange, use a tracing template. This can be provided upon request free of charge for the initial installation of the on-load tap-changer.

1. Place tracing template on mounting flange and use the four markings to align.

2. Fit stud bolts on mounting flange.

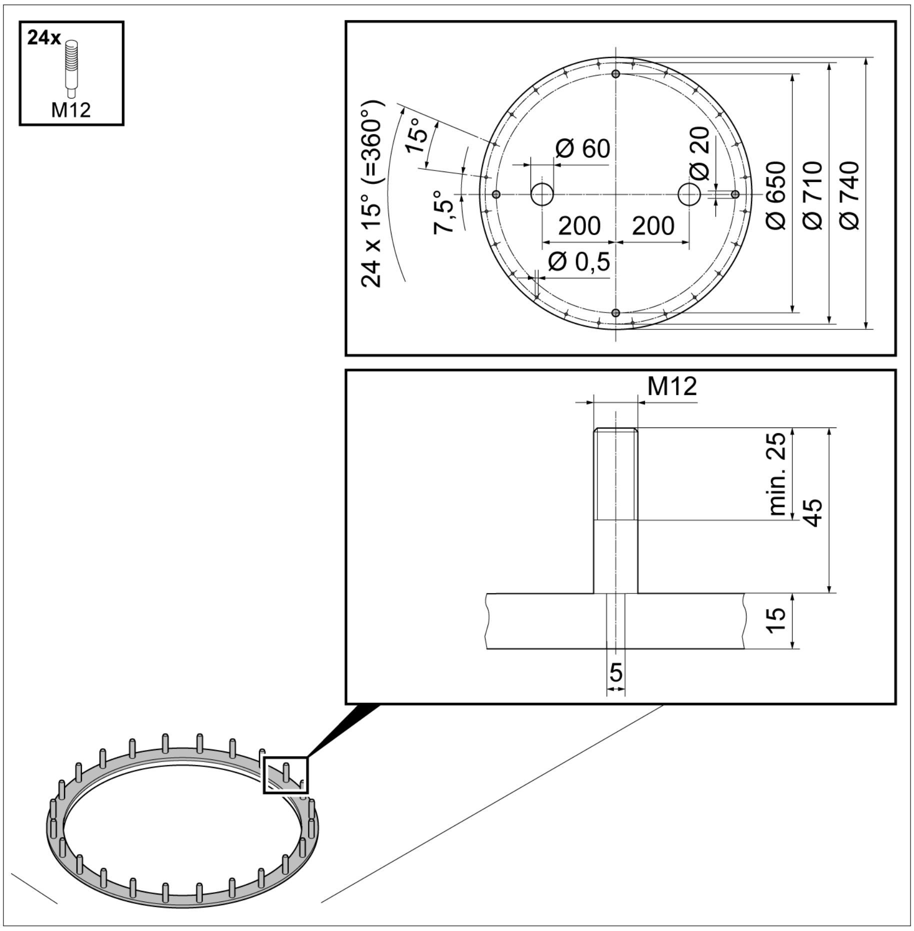


Figure 10: Tracing template, stud bolts

5.2 Installing the standard design on-load tap-changer in the transformer

Prior to installing the on-load tap-changer, remove the red-colored packaging and transport material from the on-load tap-changer.

5.2.1 Fastening oil compartment of the on-load tap-changer on transformer cover

1. **⚠ CAUTION!** Place the oil compartment on a level surface and secure it against tipping. An unstably positioned oil compartment may tip over, resulting in serious injuries and damage.

2. Clean sealing surfaces on mounting flange and on-load tap-changer head, place oil-resistant gasket on mounting flange.

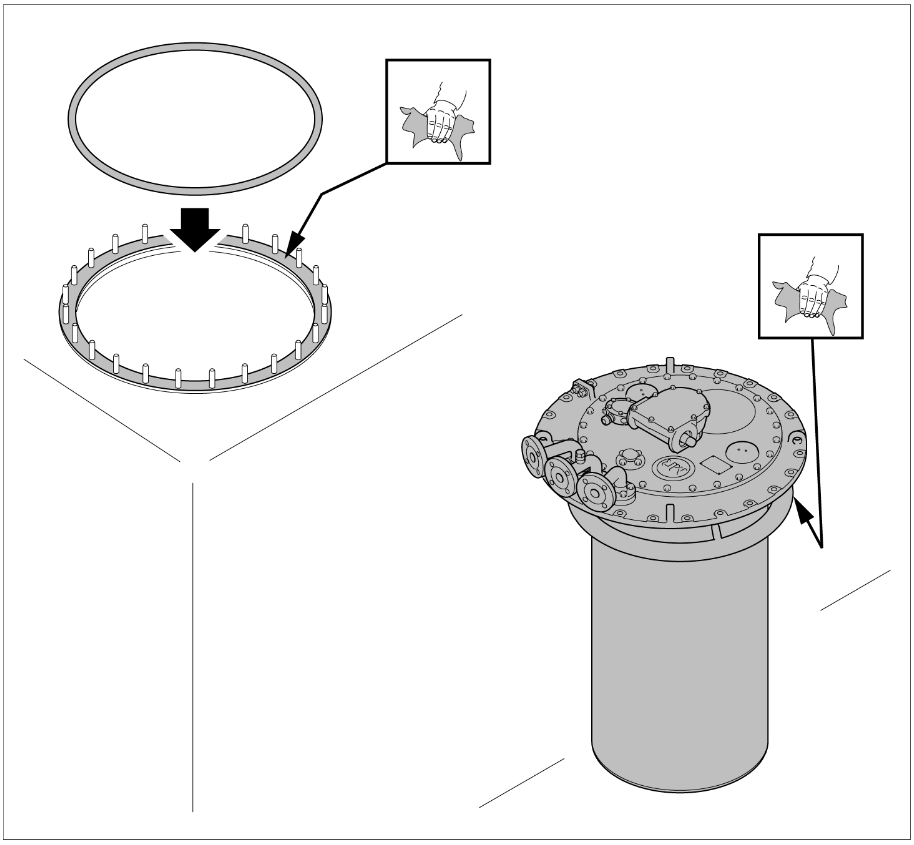


Figure 11: Sealing surfaces, seal

3. Lift the oil compartment by hooking up the on-load tap-changer head and carefully lower the oil compartment into the cover opening of the transformer.

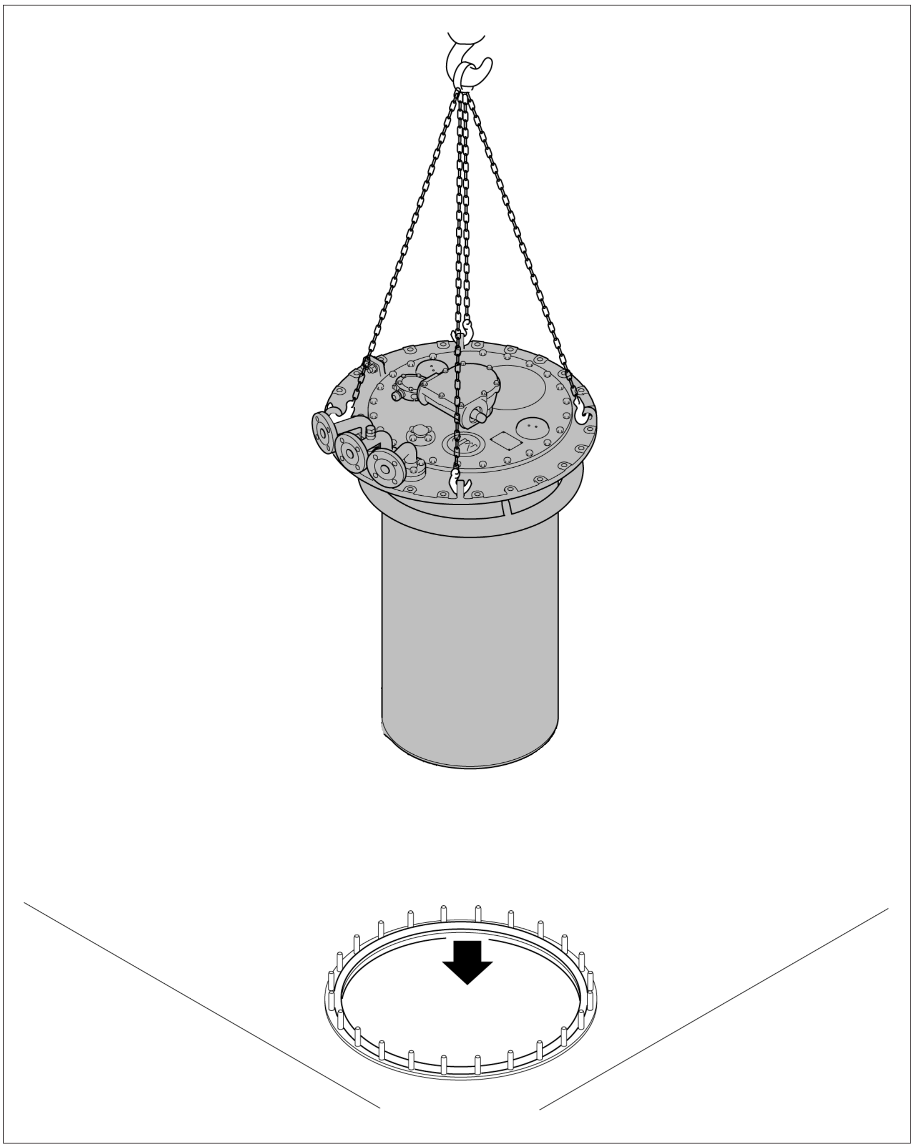


Figure 12: Oil compartment

4. Check that the on-load tap-changer head is mounted in the position specified by the design.

5. Screw on-load tap-changer head to the mounting flange.

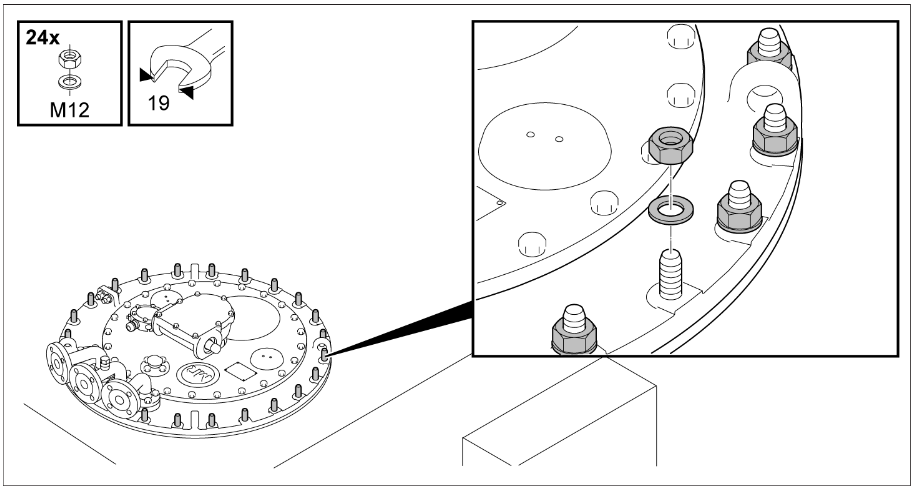


Figure 13: On-load tap-changer head with mounting flange

6. Remove the blocking device from the coupling of the oil compartment base.

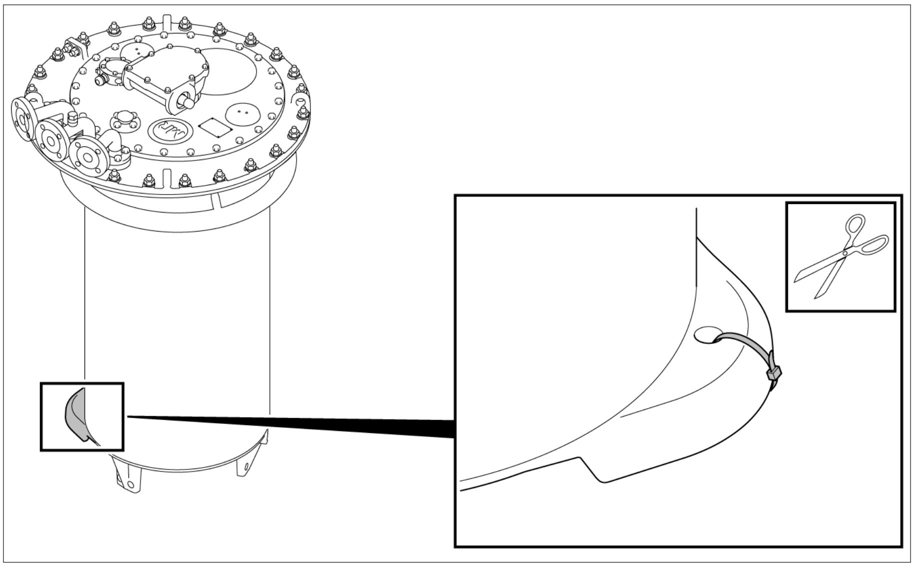


Figure 14: VACUTAP® VRC/VRE, blocking strip

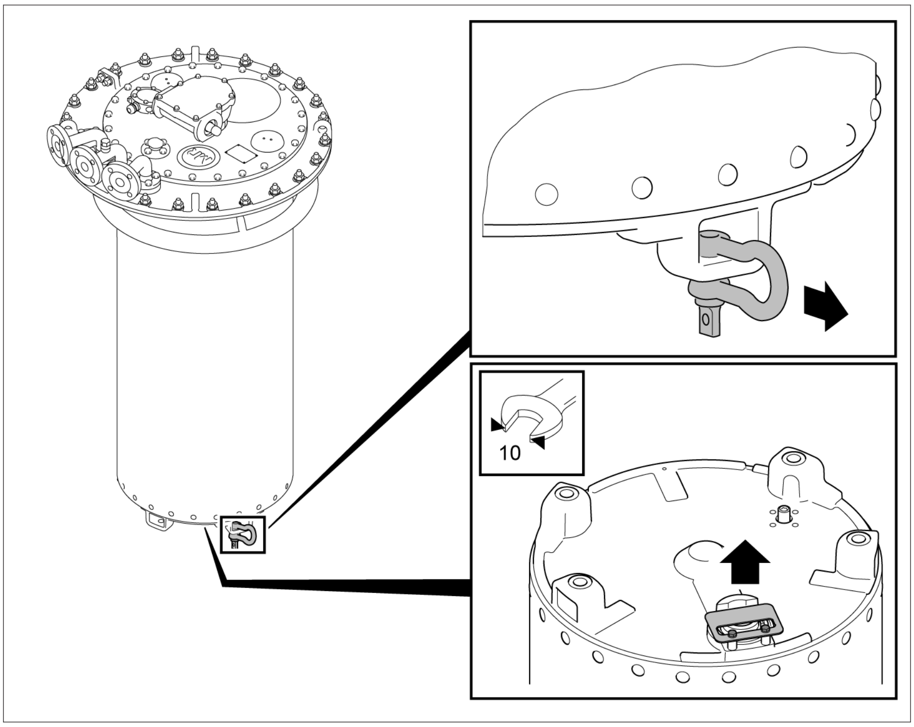


Figure 15: VACUTAP® VRD/VRF, blocking plate and shackle

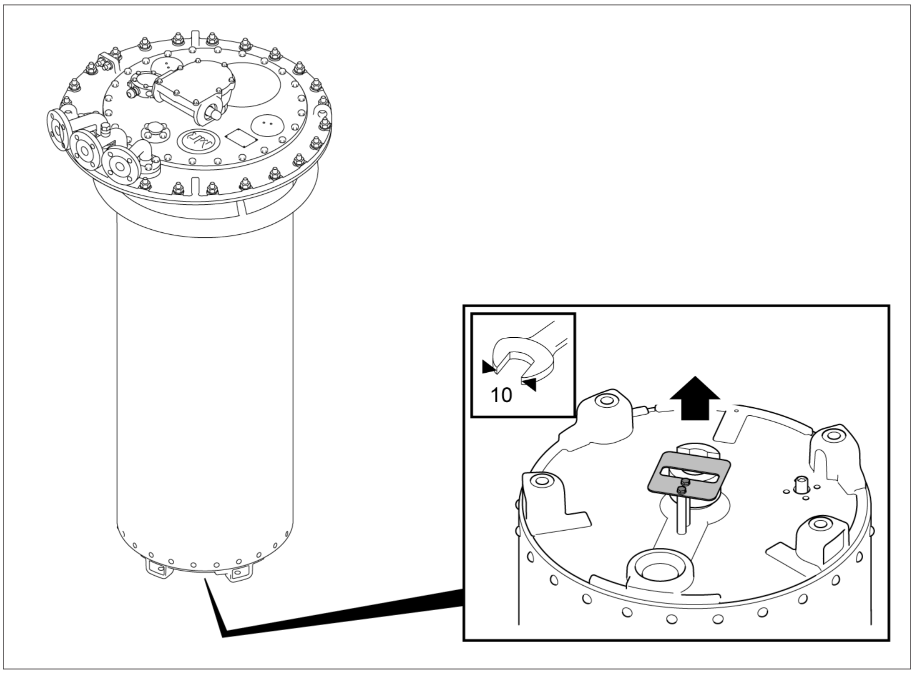


Figure 16: VACUTAP® VRG, blocking plate and shackle

5.2.2 Securing tap selector on oil compartment of the on-load tap-changer VRC/VRE

1. **⚠ CAUTION!** Place the tap selector on a level surface and secure it against tipping. An unstably positioned tap selector may tip, resulting in serious injuries and damage.
2. Remove plastic bag with fastening materials from the tap selector and lay out.

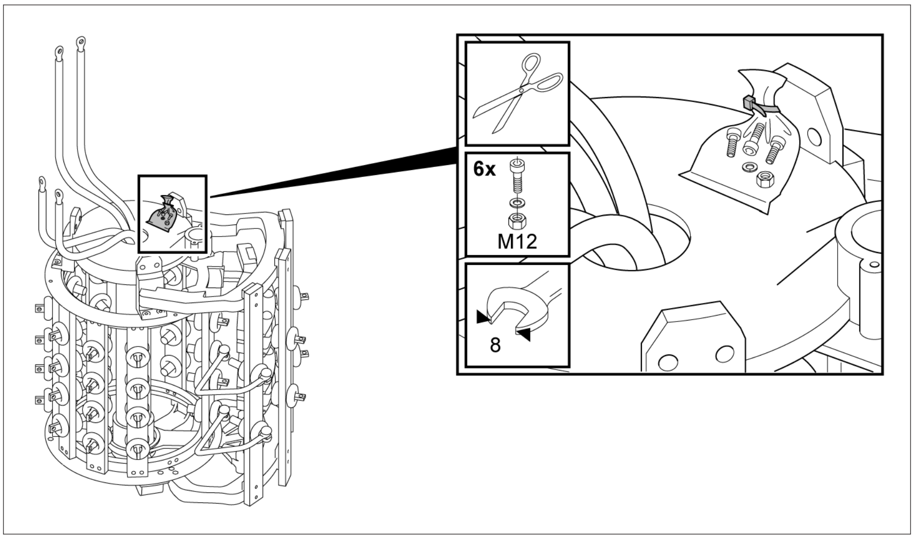


Figure 17: Plastic bag with fastening materials

3. Remove the blocking strip from the tap selector coupling. Once the blocking strip is removed, the tap selector coupling must no longer be turned.

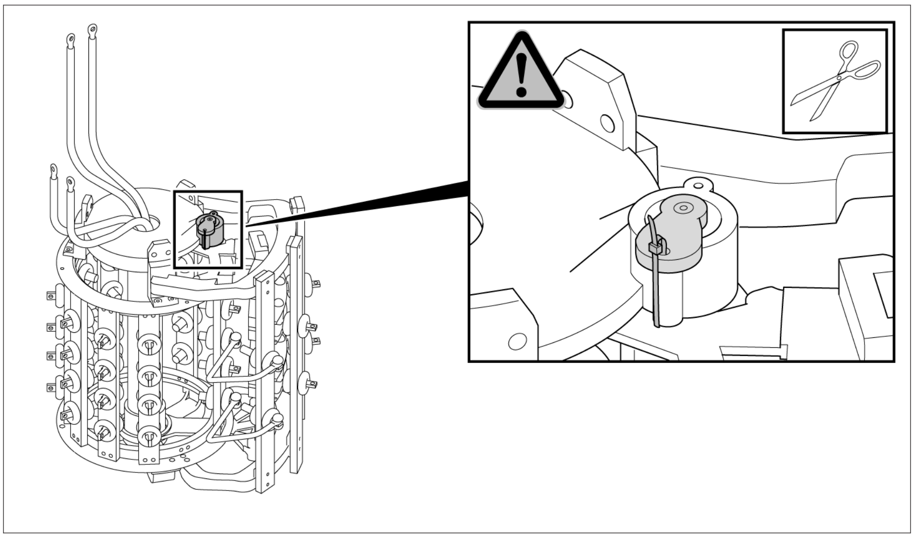


Figure 18: Blocking strip

4. Place the tap selector on the lifting device. The weight of the tap selector is a maximum of 165 kg.

5. **NOTICE!** Carefully lift tap selector below the oil compartment ensuring that the tap selector take-off leads are free and do not touch the oil compartment. If this is not done, the tap selector take-off leads may be damaged.
6. Align the position of both coupling parts and attachment points on the oil compartment and the tap selector with one another. The correct position of the two coupling parts is shown in the adjustment plans in the appendix.
7. Screw tap selector onto oil compartment.

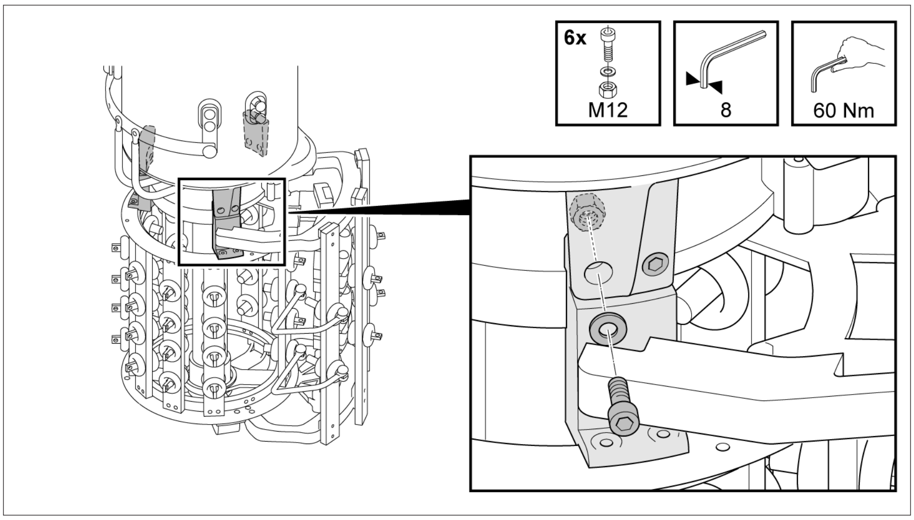


Figure 19: Tap selector with oil compartment

5.2.3 Securing tap selector on oil compartment of the on-load tap-changer VRC/VRE

1. **⚠ CAUTION!** Place the tap selector on a level surface and secure it against tipping. An unstably positioned tap selector may tip, resulting in serious injuries and damage.

2. Remove plastic bag with fastening materials from the tap selector and lay out.

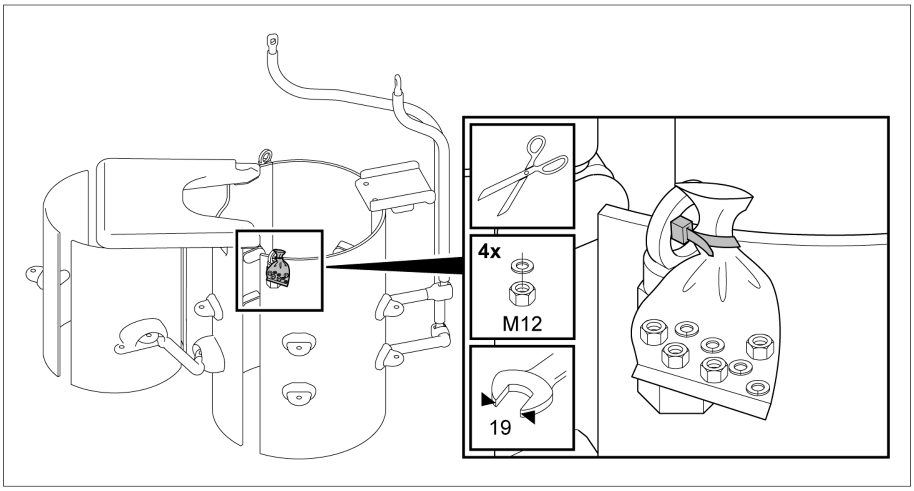


Figure 20: Plastic bag with fastening materials

3. Remove the blocking strip from the tap selector coupling. Once the blocking strip is removed, the tap selector coupling must no longer be turned.

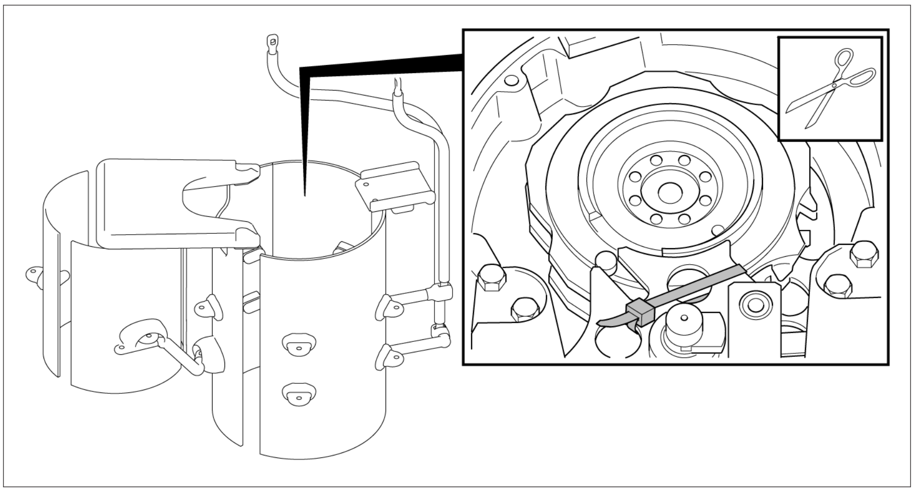


Figure 21: Blocking strip

4. Place the tap selector on the lifting device. The weight of the tap selector is a maximum of 270 kg.

5. Remove the ring nuts from the tap selector.

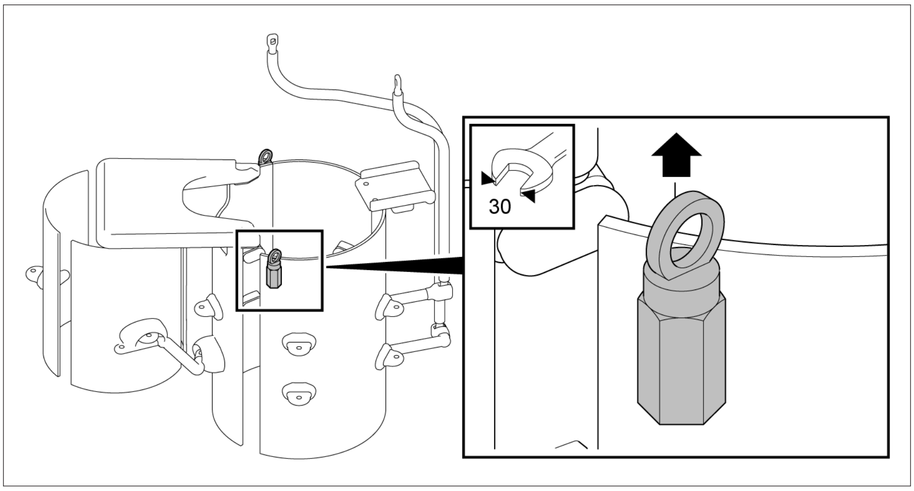


Figure 22: Ring nut

6. **NOTICE!** Carefully lift tap selector below the oil compartment ensuring that the tap selector take-off leads are free and do not touch the oil compartment. If this is not done, the tap selector take-off leads may be damaged.
7. Align the position of both coupling parts and attachment points on the oil compartment and the tap selector with one another. The correct position of the two coupling parts is shown in the adjustment plans in the appendix.
8. Screw tap selector onto oil compartment.

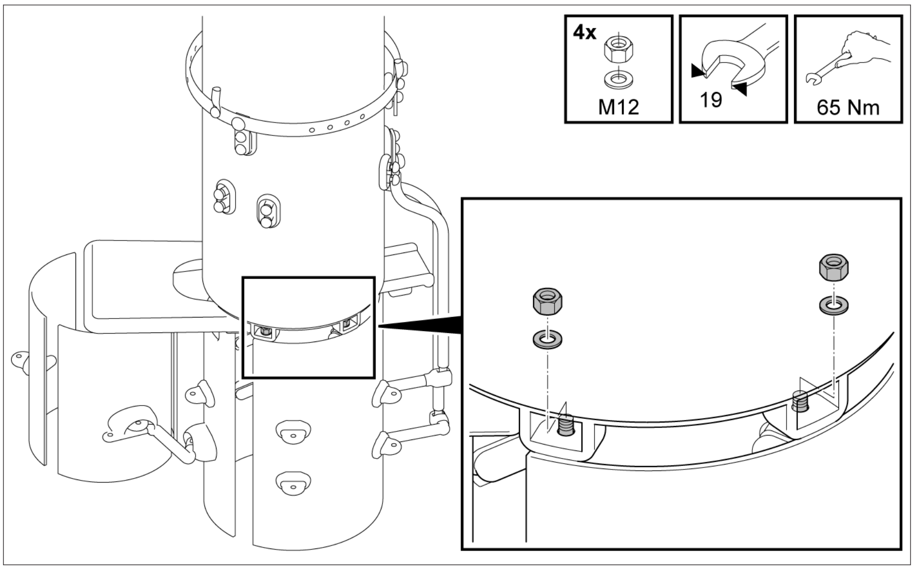


Figure 23: Tap selector with oil compartment

9. Remove the wooden support on the underside of the change-over selector.

5.2.4 Securing tap selector on oil compartment of the on-load tap-changer VRG

1. **⚠ CAUTION!** Place the tap selector on a level surface and secure it against tipping. An unstably positioned tap selector may tip, resulting in serious injuries and damage.
2. Remove plastic bag with fastening materials from the tap selector and lay out.

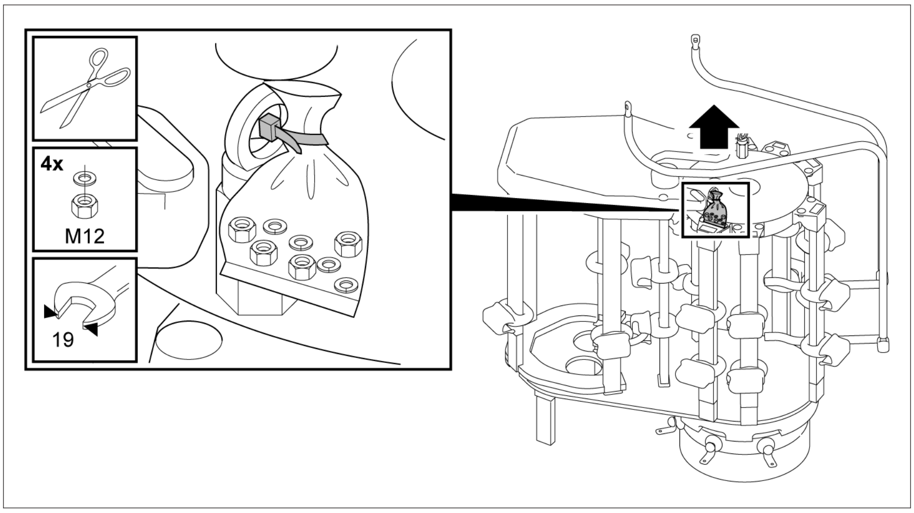


Figure 24: Plastic bag with fastening materials

3. Remove the blocking strip from the tap selector coupling. Once the blocking strip is removed, the tap selector coupling must no longer be turned.

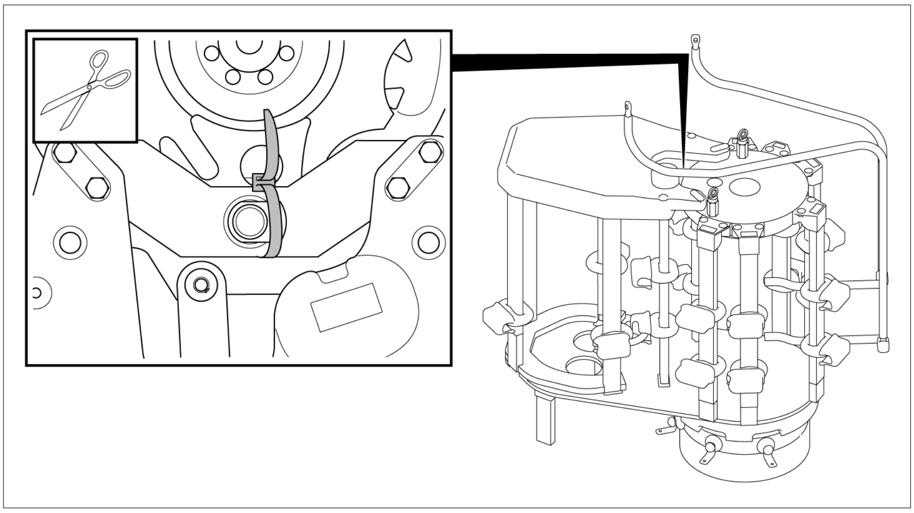


Figure 25: Blocking strip

4. Place the tap selector on the lifting device. The weight of the tap selector is a maximum of 465 kg.

5. Remove the ring nuts from the tap selector.

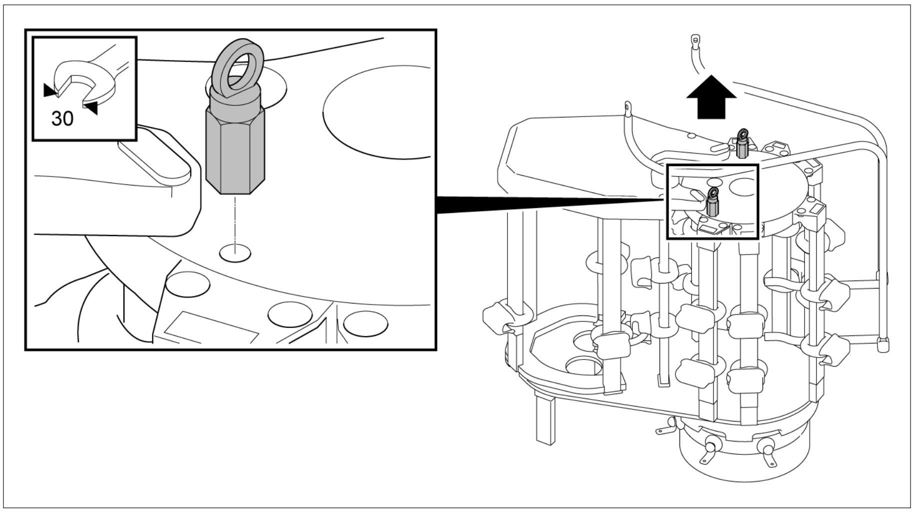


Figure 26: Ring nut

6. **NOTICE!** Carefully lift tap selector below the oil compartment ensuring that the tap selector take-off leads are free and do not touch the oil compartment. If this is not done, the tap selector take-off leads may be damaged.
7. Align the position of both coupling parts and attachment points on the oil compartment and the tap selector with one another. The correct position of the two coupling parts is shown in the adjustment plans in the appendix.
8. Screw tap selector onto oil compartment.

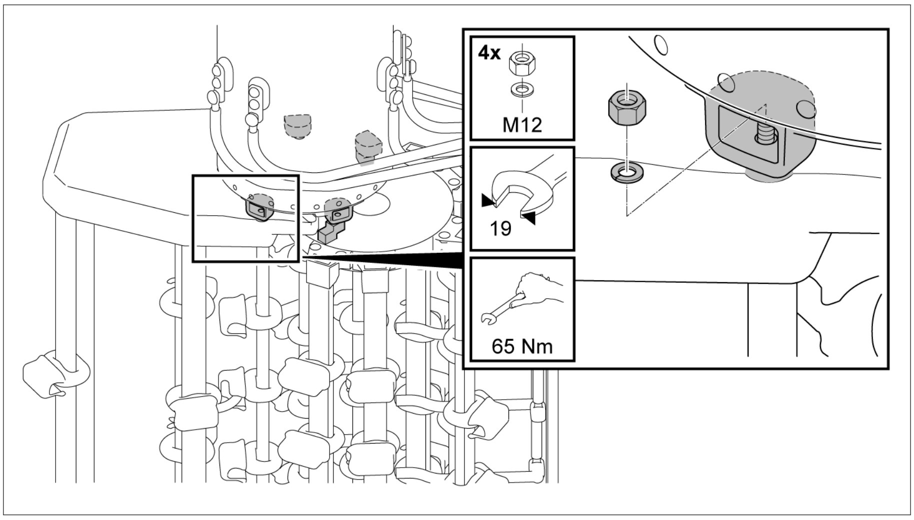


Figure 27: Tap selector with oil compartment

5.2.5 Connecting tap selector take-off leads

Proceed as follows to connect the tap selector take-off leads:

1. **NOTICE!** Screw tap selector take-off lead to connecting piece with care. Comply with specified tightening torque and secure screw connection. Failure to do so may result in damage to the on-load tap-changer and transformer.
2. Attach screening caps to screw connection.

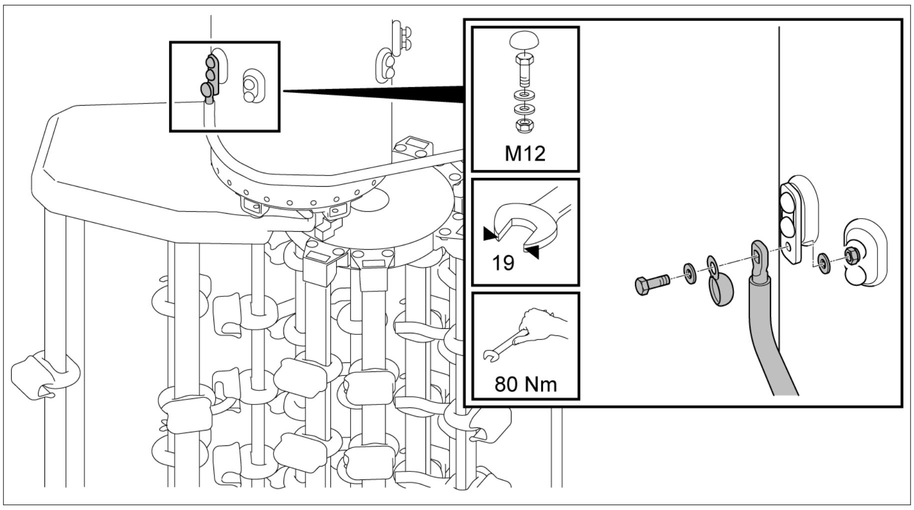


Figure 28: Tap selector take-off lead

5.3 Installing the on-load tap-changer in the transformer in the bell-type tank version

Prior to installing the on-load tap-changer, remove the red-colored packaging and transport material from the on-load tap-changer.

Proceed as follows to install the on-load tap-changer into a transformer with bell-type tank design:

5.3.1 Securing tap selector on oil compartment of the on-load tap-changer VRC/VRE

1. **⚠ CAUTION!** Place the tap selector on a level surface and secure it against tipping. An unstably positioned tap selector may tip, resulting in serious injuries and damage.

2. Remove plastic bag with fastening materials from the tap selector and lay out.

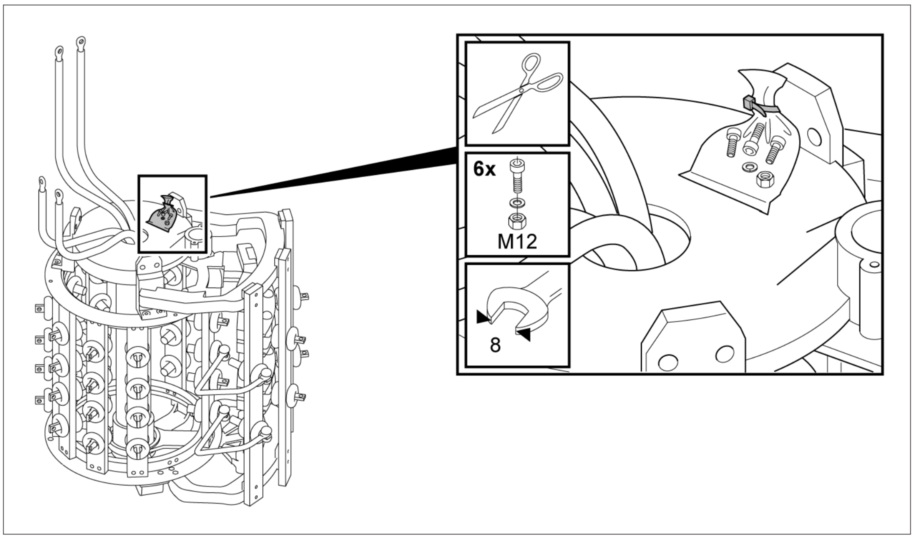


Figure 29: Plastic bag with fastening materials

3. Remove the blocking strip from the tap selector coupling. Once the blocking strip is removed, the tap selector coupling must no longer be turned.

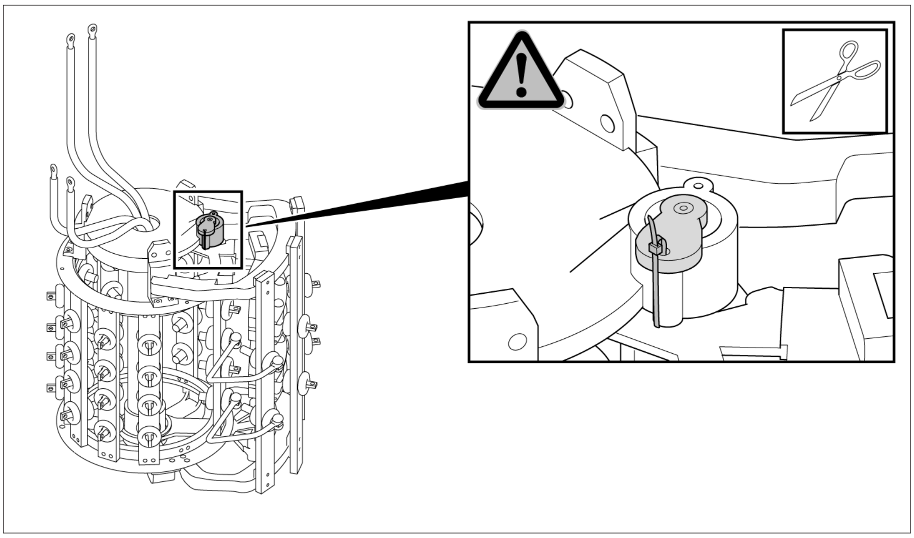


Figure 30: Blocking strip

4. **⚠ CAUTION!** Place the oil compartment on a level surface and secure it against tipping. An unstably positioned oil compartment may tip over, resulting in serious injuries and damage.

5. Remove the blocking device from the coupling of the oil compartment base.

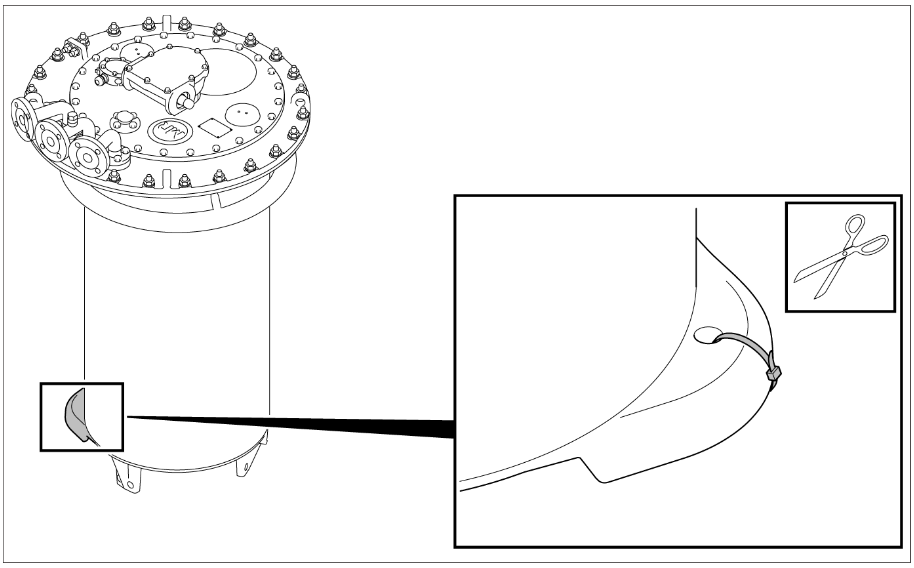


Figure 31: Blocking strip

6. Lift the oil compartment by hooking up the on-load tap-changer head and carefully raise above tap selector.
7. Align the position of both coupling parts and attachment points on the oil compartment and the tap selector with one another. The correct position of the two coupling parts is shown in the adjustment plans in the appendix.
8. Screw tap selector onto oil compartment.

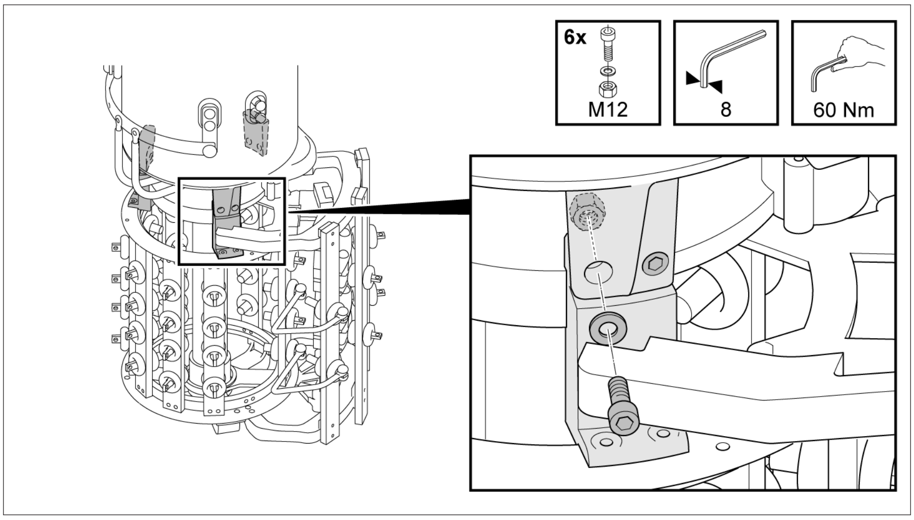


Figure 32: Tap selector with oil compartment

5.3.2 Securing tap selector on oil compartment of the on-load tap-changer VRC/VRE

1. **⚠ CAUTION!** Place the tap selector on a level surface and secure it against tipping. An unstably positioned tap selector may tip, resulting in serious injuries and damage.
2. Remove plastic bag with fastening materials from the tap selector and lay out.

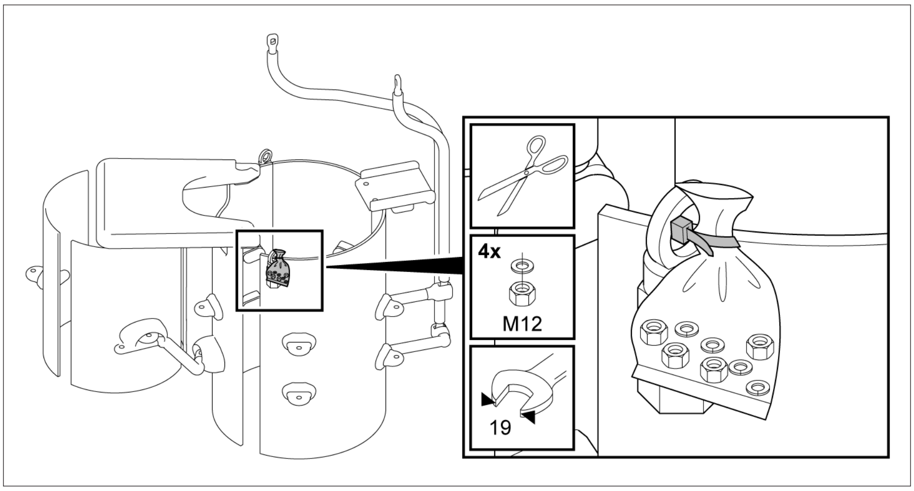


Figure 33: Plastic bag with fastening materials

3. Remove the ring nuts from the tap selector.

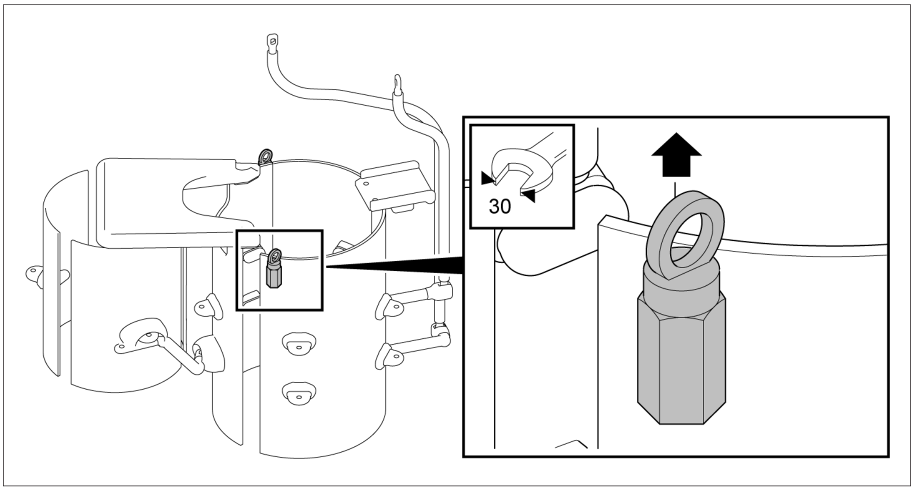


Figure 34: Ring nut

4. Remove the blocking strip from the tap selector coupling. Once the blocking strip is removed, the tap selector coupling must no longer be turned.

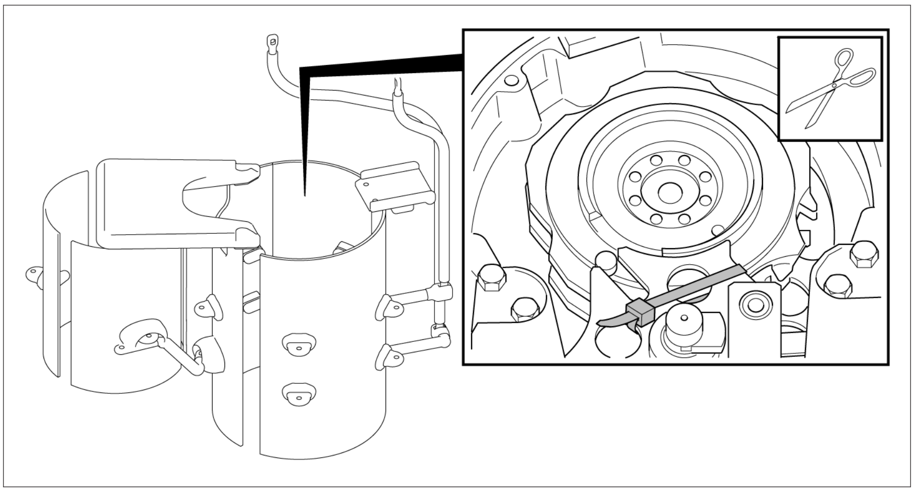


Figure 35: Blocking strip

5. **⚠ CAUTION!** Place the oil compartment on a level surface and secure it against tipping. An unstably positioned oil compartment may tip over, resulting in serious injuries and damage.
6. Lift the oil compartment by hooking up the on-load tap-changer head and remove the blocking device on the coupling of the oil compartment base.

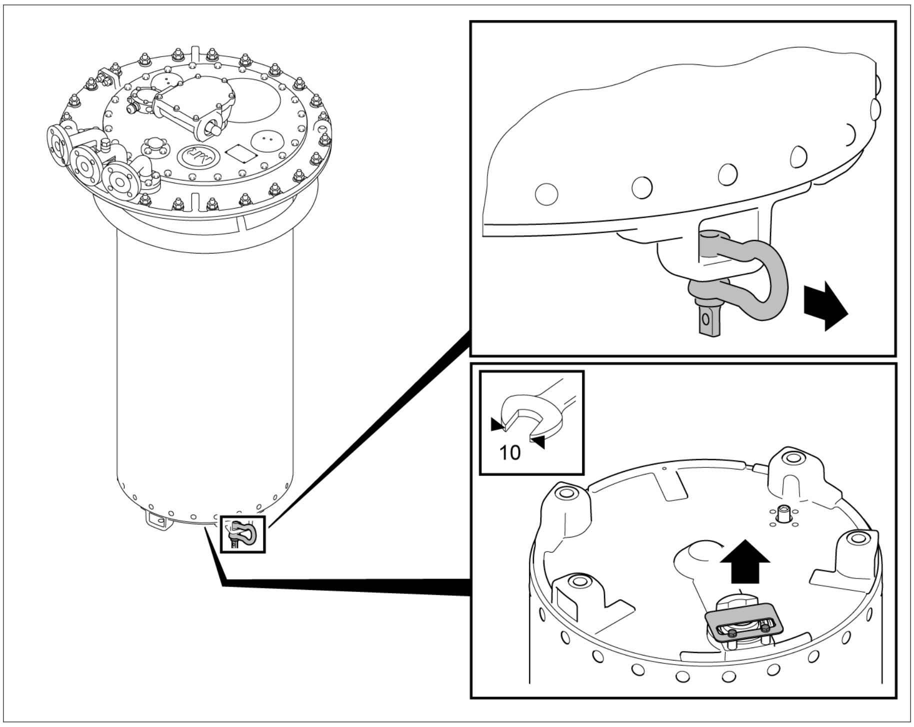


Figure 36: Blocking plate and shackle

7. Carefully raise oil compartment above tap selector.
8. Align the position of both coupling parts and attachment points on the oil compartment and the tap selector with one another. The correct position of the two coupling parts is shown in the adjustment plans in the appendix.
9. Screw tap selector onto oil compartment.

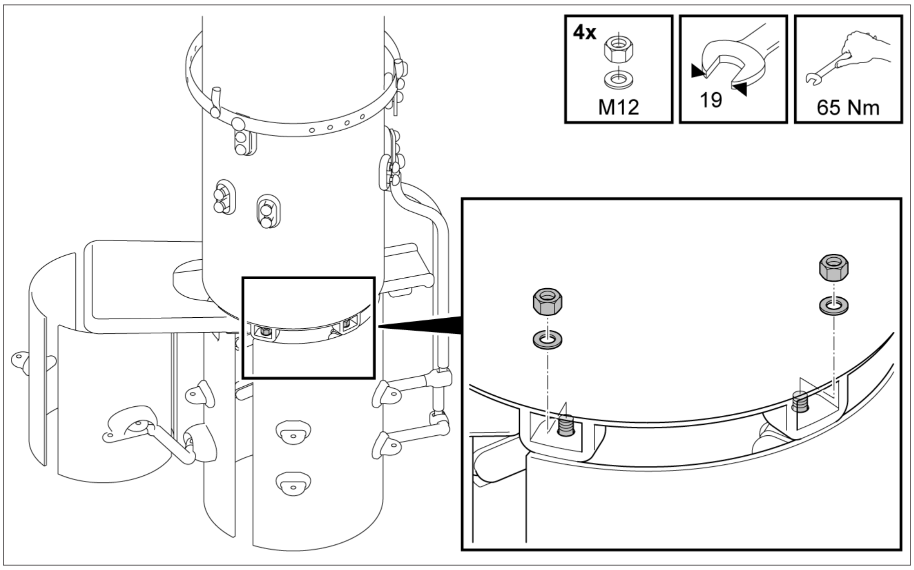


Figure 37: Tap selector with oil compartment

5.3.3 Securing tap selector on oil compartment of the on-load tap-changer VRG

1. **⚠ CAUTION!** Place the tap selector on a level surface and secure it against tipping. An unstably positioned tap selector may tip, resulting in serious injuries and damage.

2. Remove plastic bag with fastening materials from the tap selector and lay out.

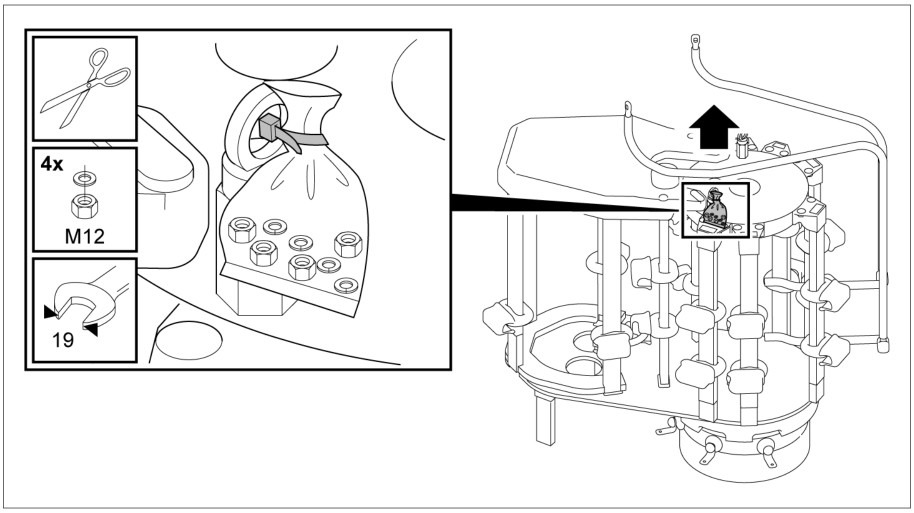


Figure 38: Plastic bag with fastening materials

3. Remove the ring nuts from the tap selector.

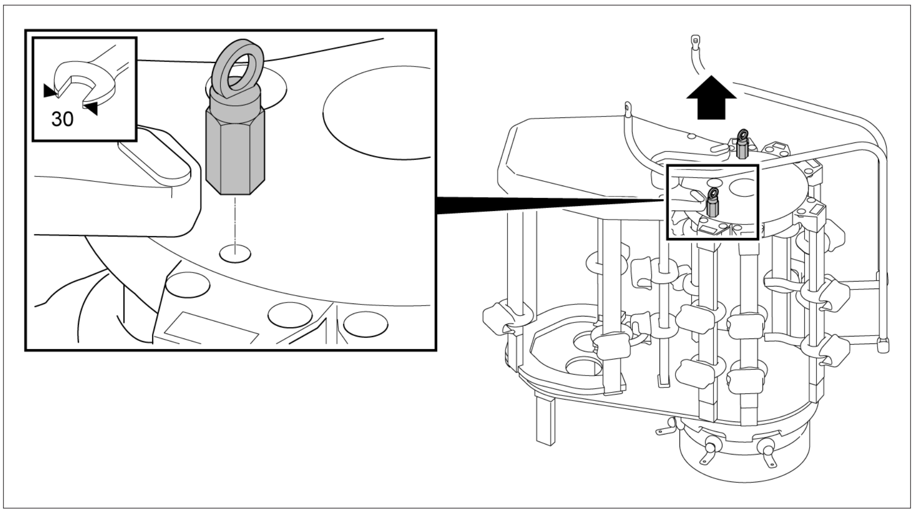


Figure 39: Ring nut

4. Remove the blocking strip from the tap selector coupling. Once the blocking strip is removed, the tap selector coupling must no longer be turned.

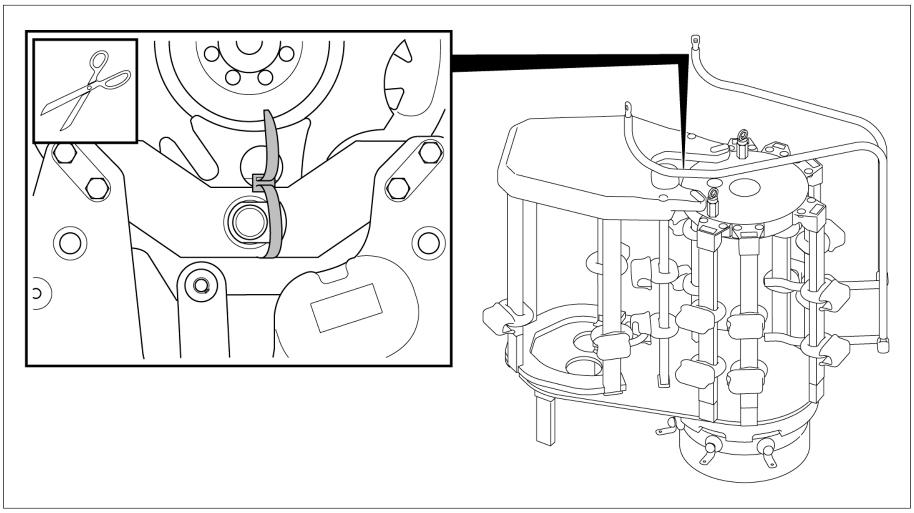


Figure 40: Blocking strip

5. **⚠ CAUTION!** Place the oil compartment on a level surface and secure it against tipping. An unstably positioned oil compartment may tip over, resulting in serious injuries and damage.
6. Lift the oil compartment by hooking up the on-load tap-changer head and remove the blocking device on the coupling of the oil compartment base.

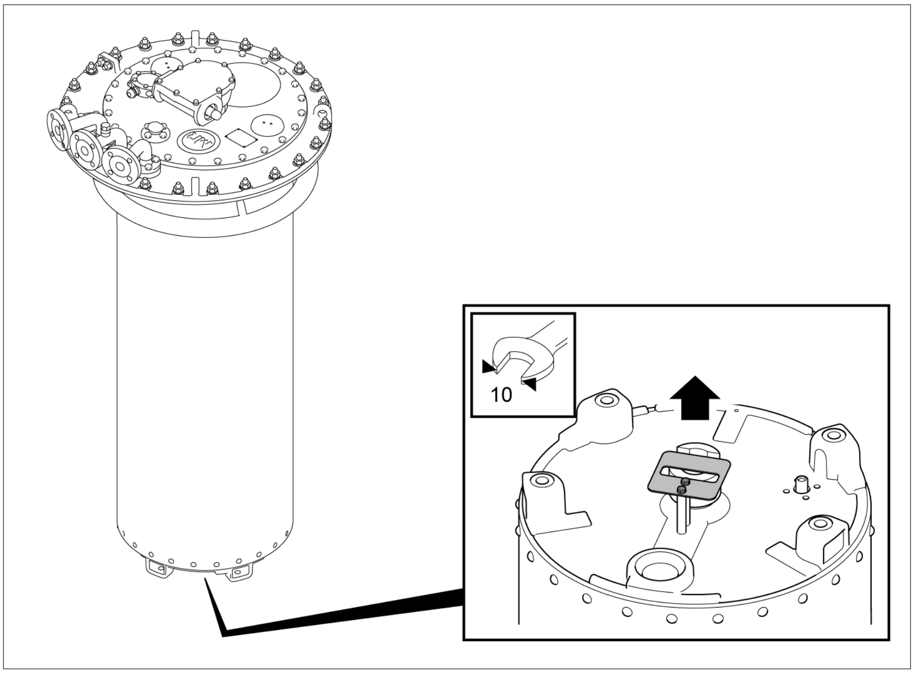


Figure 41: Blocking plate and shackle

7. Carefully raise oil compartment above tap selector.
8. Align the position of both coupling parts and attachment points on the oil compartment and the tap selector with one another. The correct position of the two coupling parts is shown in the adjustment plans in the appendix.
9. Screw tap selector onto oil compartment.

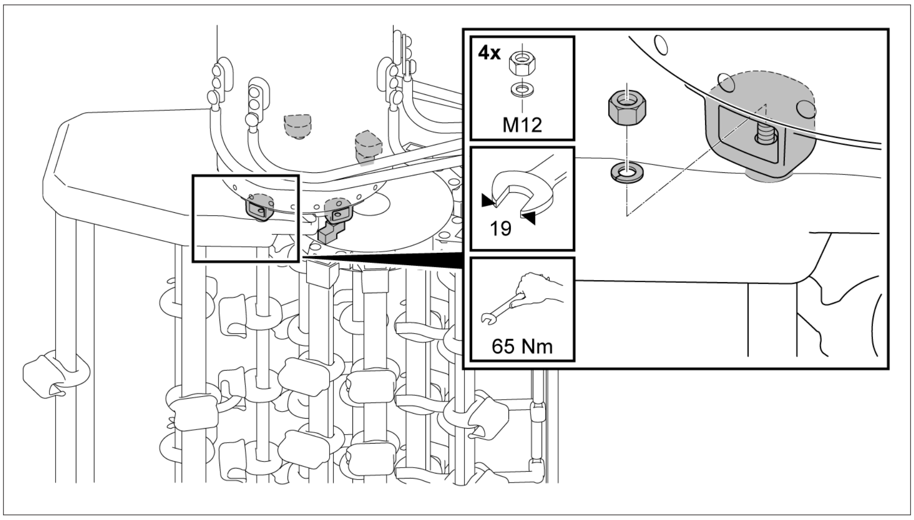


Figure 42: Tap selector with oil compartment

5.3.4 Connecting tap selector take-off leads

Proceed as follows to connect the tap selector take-off leads:

1. **NOTICE!** Screw tap selector take-off lead to connecting piece with care. Comply with specified tightening torque and secure screw connection. Failure to do so may result in damage to the on-load tap-changer and transformer.
2. Attach screening caps to screw connection.

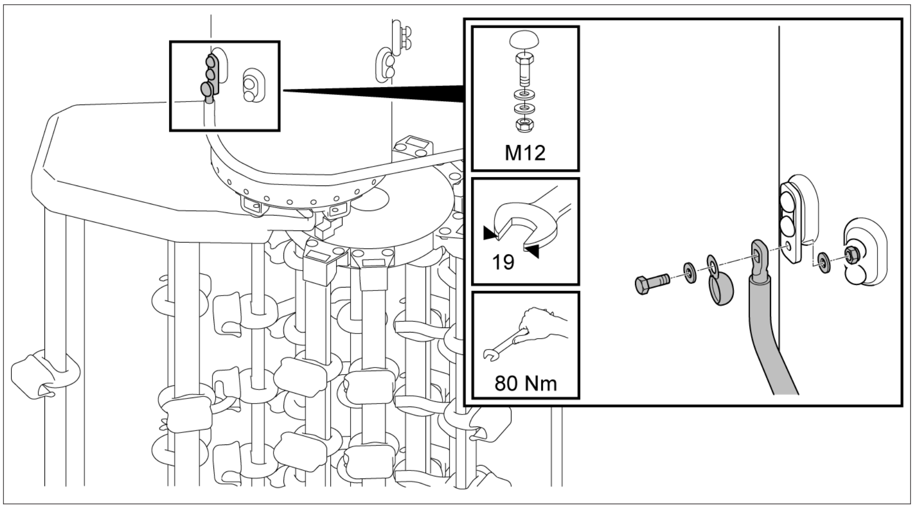


Figure 43: Tap selector take-off lead

5.3.5 Inserting on-load tap-changer into supporting structure

1. **NOTICE!** Use spacers to insert on-load tap-changer vertically into supporting structure (maximum 1° deviation from the vertical) so that the on-load tap-changer reaches its final installation height and only has to be raised a maximum of 5 to 20 mm after fitting the bell-type tank. If this is not done, once the tap winding and on-load tap-changer take-off lead are connected tension may occur which will damage the on-load tap-changer and transformer. There is also a risk of malfunctions from tap selector contacts closing incorrectly.

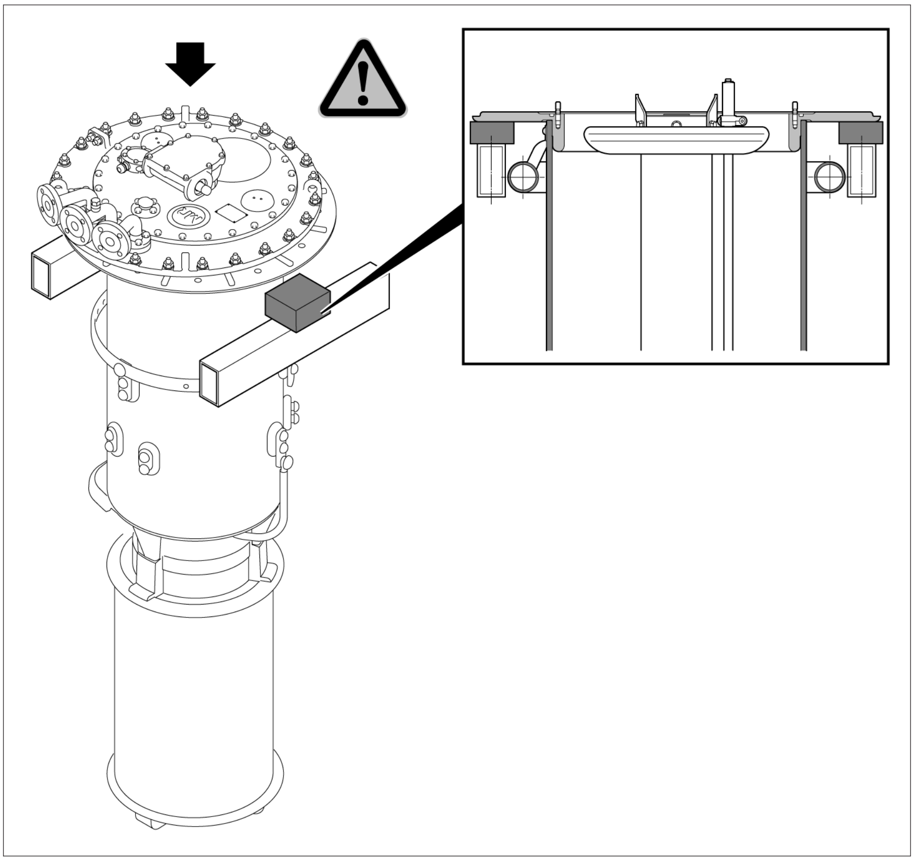


Figure 44: On-load tap-changer with spacers on supporting structure

2. Remove the wooden support on the bottom of the change-over selector (if present).

3. Temporarily fasten on-load tap-changer to supporting structure. The supporting flange has through holes for this purpose.

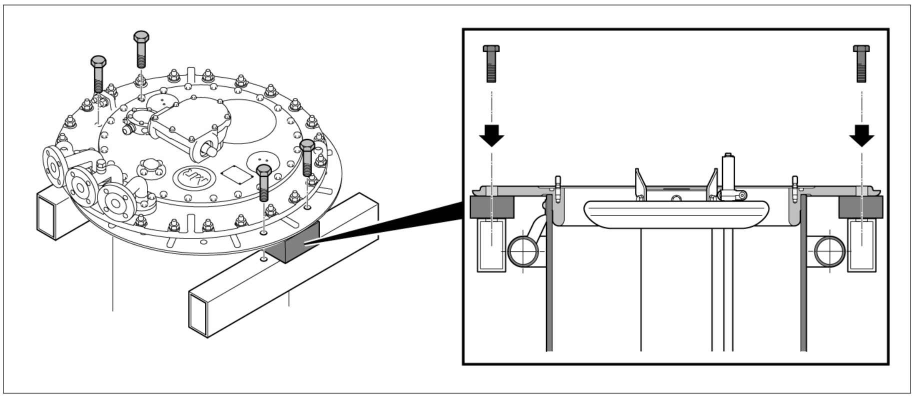


Figure 45: Fastening the on-load tap-changer

4. Connect tap winding and on-load tap-changer take-off lead.
5. Remove temporary fastening and spacers.

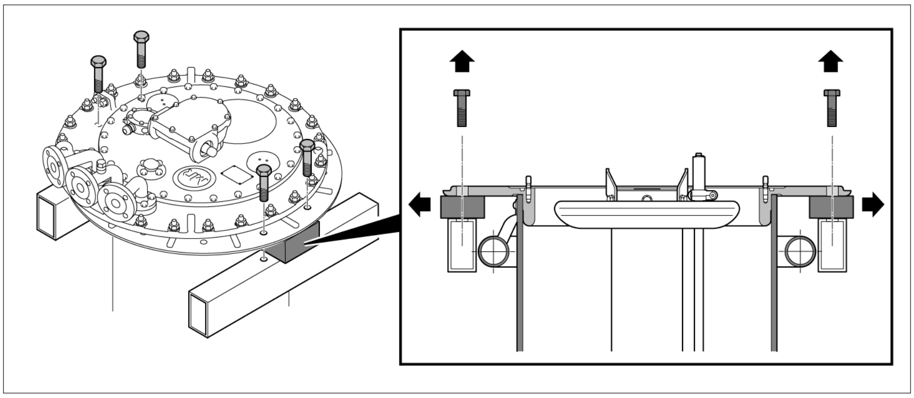


Figure 46: Temporary fastening

5.3.6 Removing on-load tap-changer head cover

⚠ WARNING

Danger of death or severe injury!

Danger of death or severe injury from explosive gases under the on-load tap-changer head cover!

- ▶ Ensure that there are no naked flames, hot surfaces or sparks (for example caused by static charging) in the immediate surroundings and that none occur.
- ▶ De-energize all auxiliary circuits (for example tap-change supervisory control, pressure relief device, pressure-operated relays) before removing the on-load tap-changer head cover.
- ▶ Do not operate any electric devices during the work (for example risk of sparks caused by impact wrench).
- ▶ Only use conductive and grounded hoses, pipes and pump equipment that are approved for flammable liquids.

NOTICE

Damage to the on-load tap-changer and transformer!

Small parts in the oil compartment may block the diverter switch insert, thereby damaging the on-load tap-changer and transformer!

- ▶ Take care to avoid parts falling into the oil compartment.
- ▶ Check that you have the same number of small parts when disassembling and reassembling.

1. Loosen screws with locking washers on the on-load tap-changer head cover.

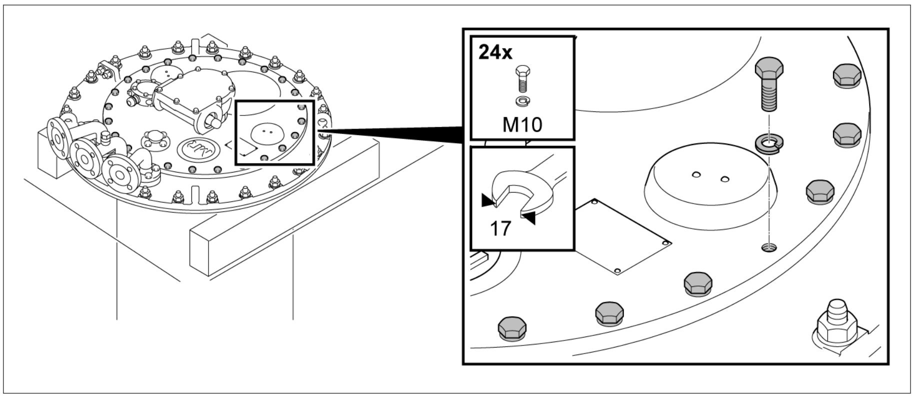


Figure 47: On-load tap-changer head cover

2. **NOTICE!** Remove the on-load tap-changer head cover. Check that the sealing surfaces on the on-load tap-changer head cover and on-load tap-changer head are in sound condition when removing and during all other work. Ensure that o-ring is in sound condition also. Damaged sealing surfaces result in oil escaping and therefore on-load tap-changer and transformer damage.

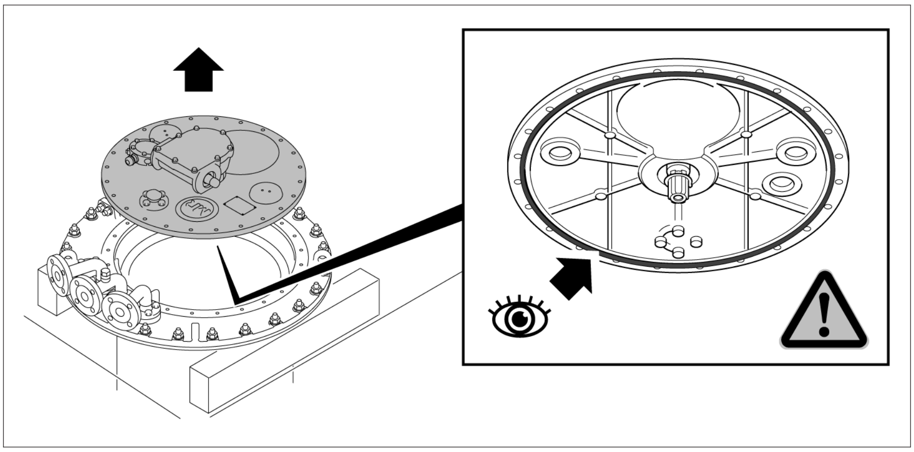


Figure 48: On-load tap-changer head cover

3. **NOTICE!** Do not expose the open oil compartment to ambient humidity for more than 10 hours. If you do, this may result in damage to the on-load tap-changer and transformer due to insufficient dielectric strength of the diverter switch oil!

5.3.7 Removing tap position indicator (version without multiple coarse change-over selector)

► Pull the spring clip off the shaft end and remove the tap position indicator disc.

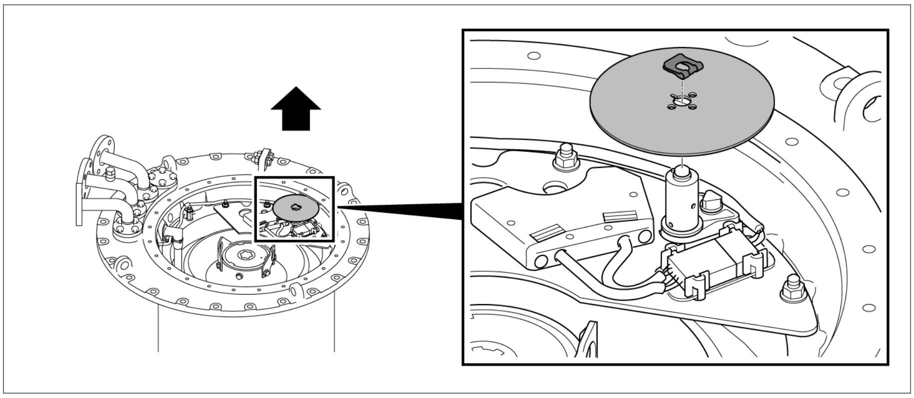


Figure 49: Tap position indicator disk

5.3.8 Removing tap position indicator from multiple coarse change-over selector with more than 35 operating positions

1. Ensure that the red marks on the panel, tap position indicator disk and cover disk produce a continuous red line.
2. Remove countersunk head screw.

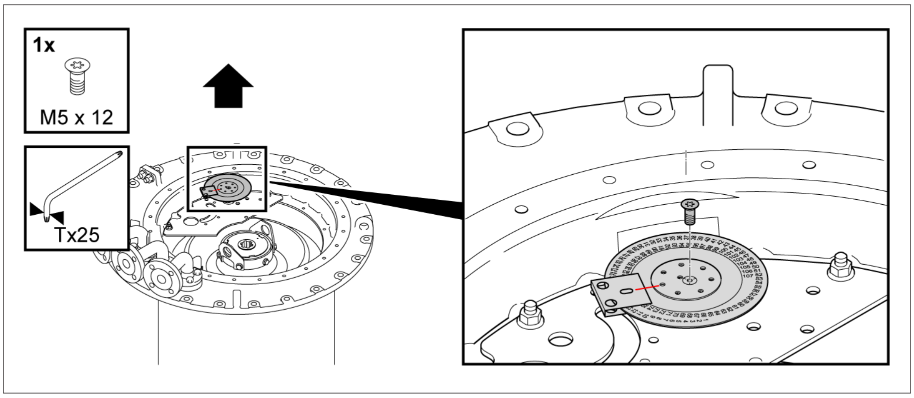


Figure 50: Countersunk head screw

3. Lever cover disk off underlying disk with flat screwdriver and pull out position-indication disk from between panel and bracket.

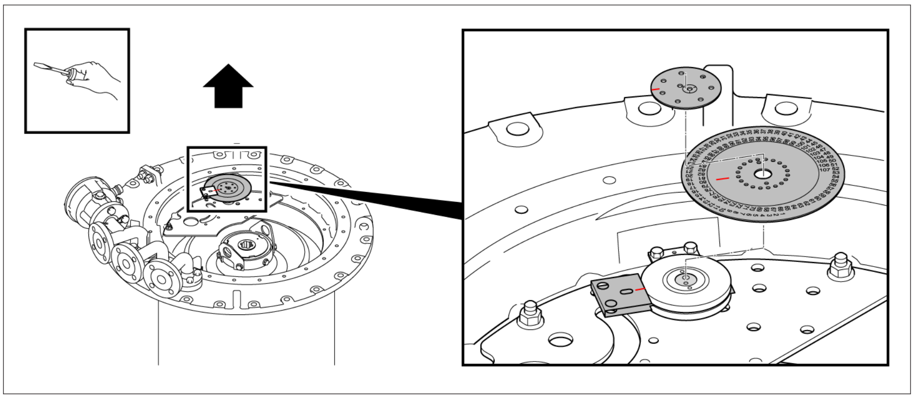


Figure 51: Cover disk and position-indication disk

4. Remove hexagon screws and associated lock tab.

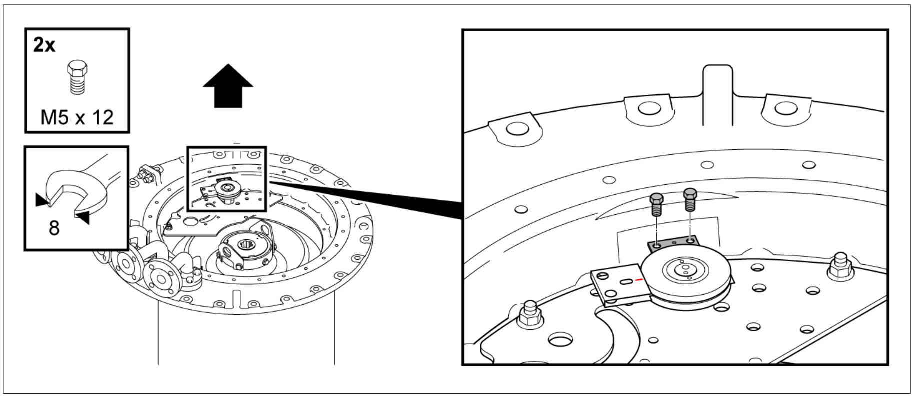


Figure 52: Lock tab

5. Pull panel and bracket up and off indicator drive shaft.

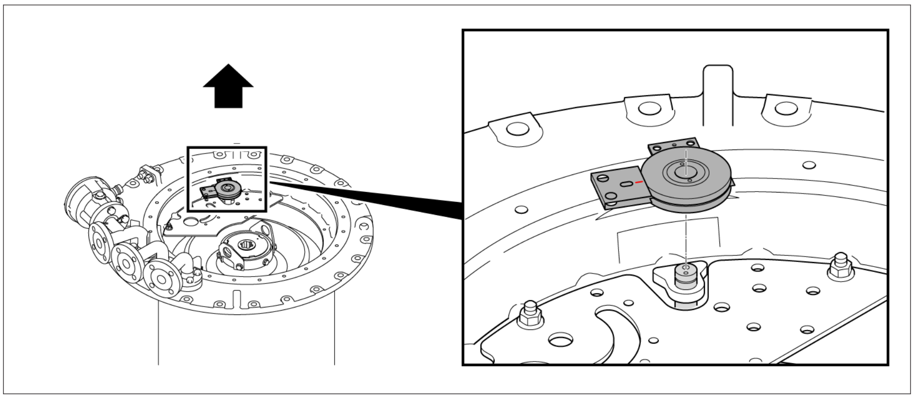


Figure 53: Panel

5.3.9 Removing tap-change supervisory control (if present)

NOTICE

Damage to the on-load tap-changer and transformer!

Removing the tap-change supervisory control without due care may damage it, thereby resulting in damage to the on-load tap-changer and transformer!

► Remove tap-change supervisory control with care in order not to damage or rip out the connecting leads.

1. Take tap-change supervisory control plug connector out of bracket and disconnect.

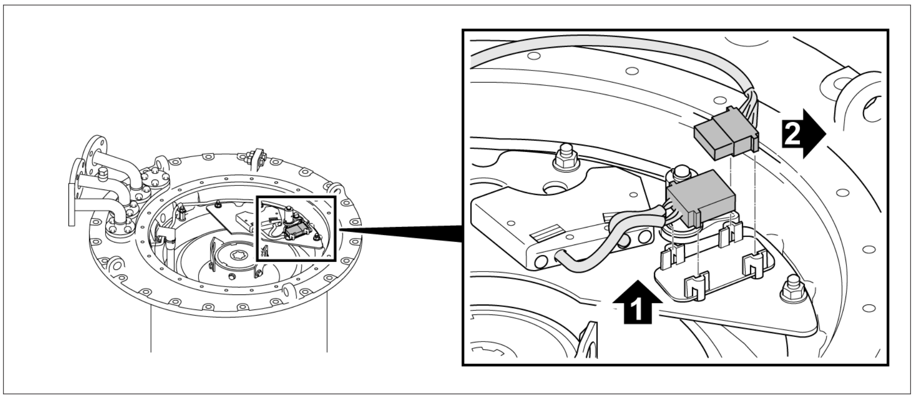


Figure 54: Plug connector

2. Remove nuts and locking elements (3 or 4 depending on model) on the mounting plate.

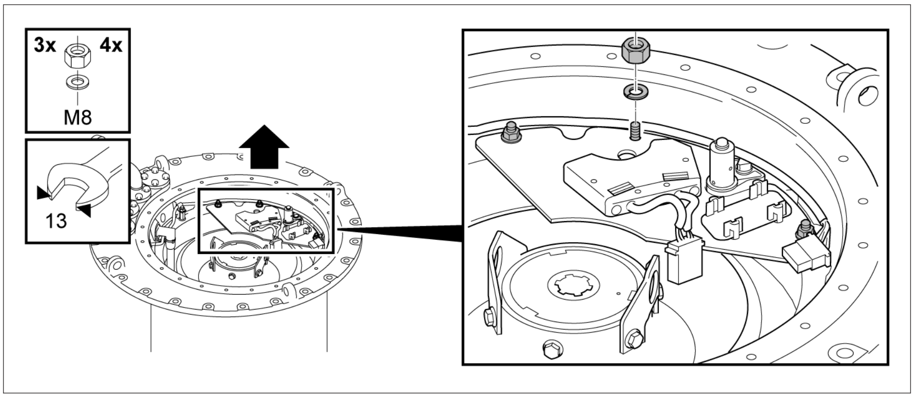


Figure 55: Mounting plate with nuts and locking washers

3. Remove the tap-change supervisory control together with the mounting plate and drive shaft.

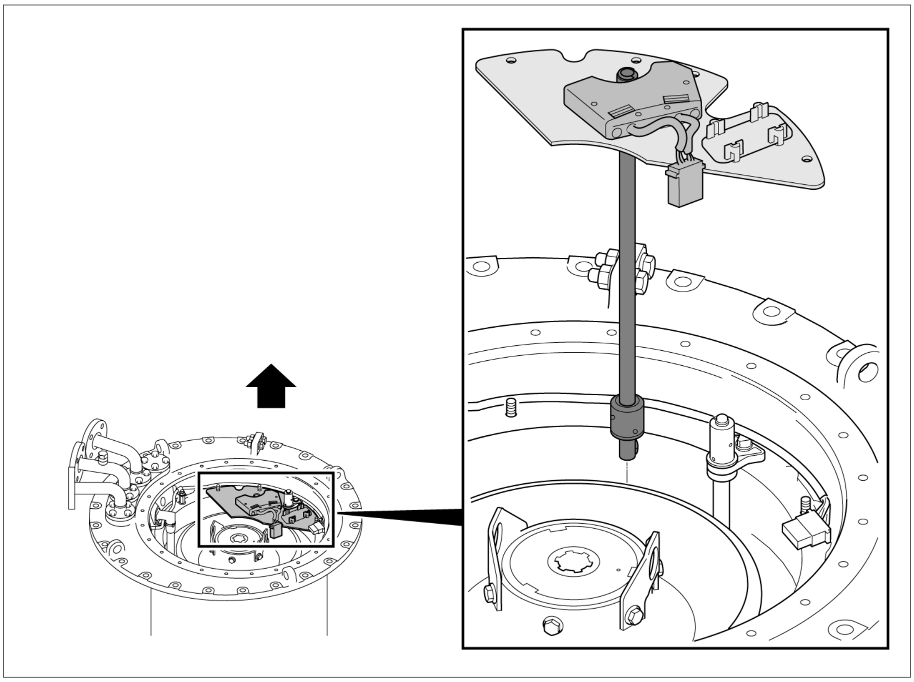


Figure 56: Tap-change supervisory control with mounting plate and drive shaft

4. Remove nut and Teflon strip from stud bolt.

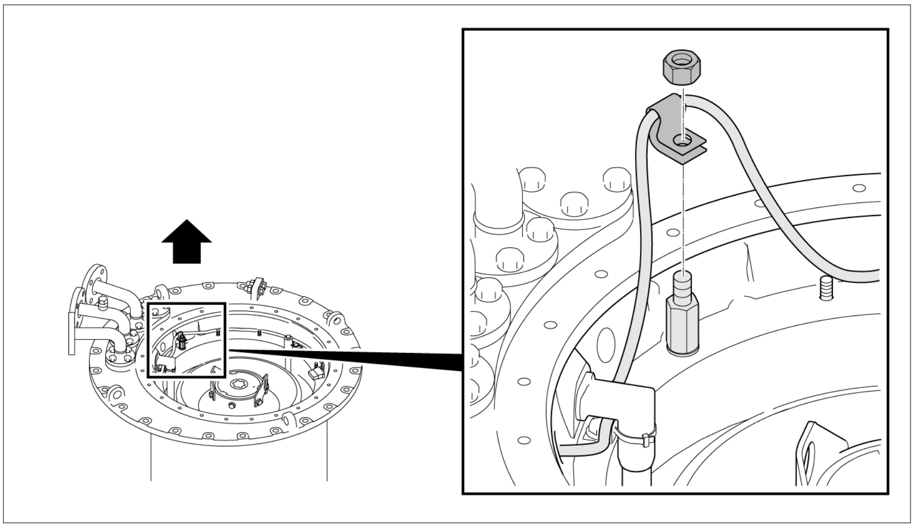


Figure 57: Stud bolt with Teflon strip and nut

5.3.10 Removing the oil suction pipe

1. Remove cable ties from the oil suction pipe.

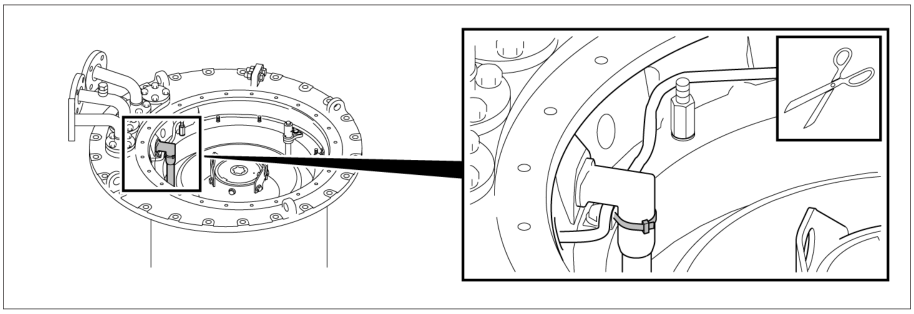


Figure 58: Cable tie

2. Pull oil suction pipe out of on-load tap-changer head.

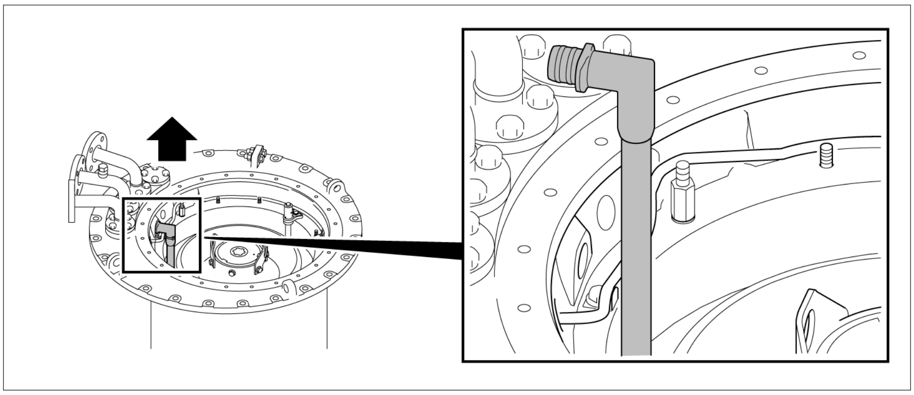


Figure 59: Oil suction pipe

3. Swivel lead of tap-change supervisory control out of on-load tap-changer head in direction indicated by arrow until the cable will not be damaged when the diverter switch insert is pulled out.

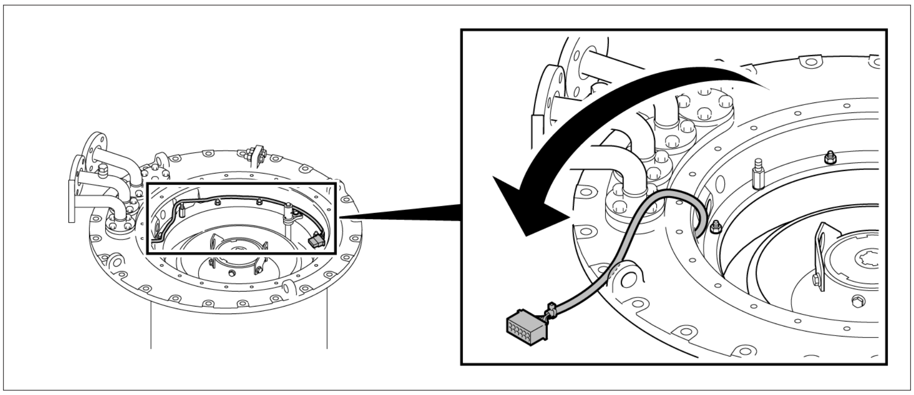


Figure 60: Swiveling out tap-change supervisory control lead

5.3.11 Lifting on-load tap-changer head off supporting flange

1. Remove nuts and safety elements between on-load tap-changer head and supporting flange.

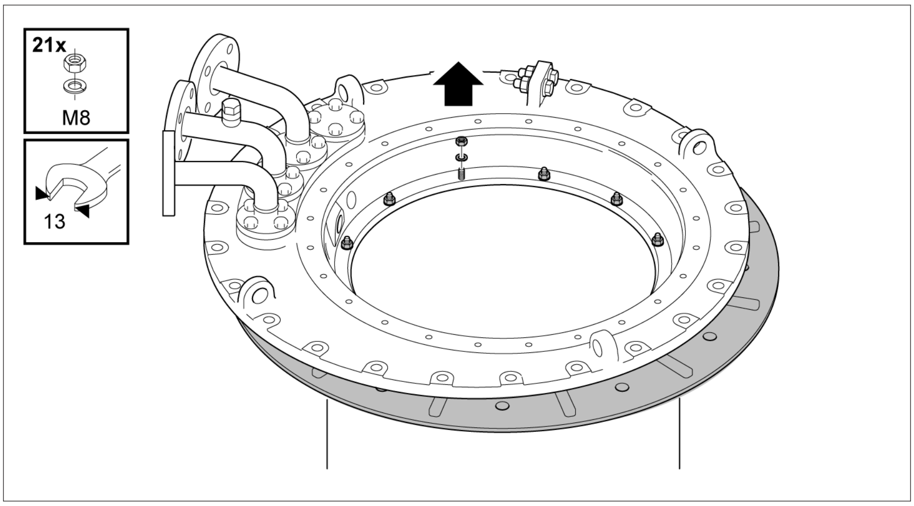


Figure 61: On-load tap-changer head with nuts

2. Lift off the on-load tap-changer head from the supporting flange.

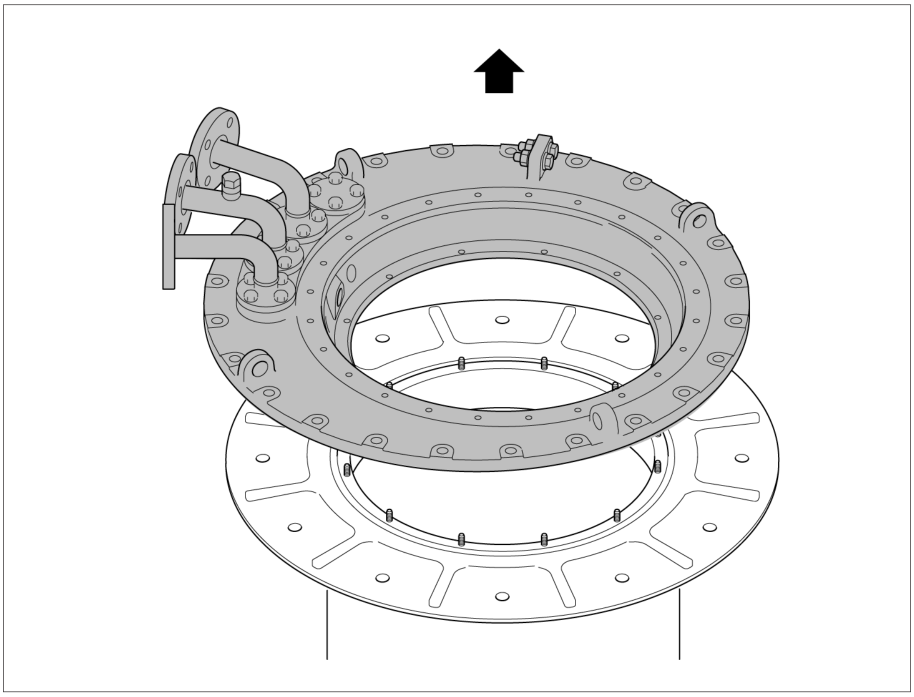


Figure 62: On-load tap-changer head

5.3.12 Mounting the bell-type tank

1. Clean sealing surface of supporting flange, place o-ring on supporting flange.

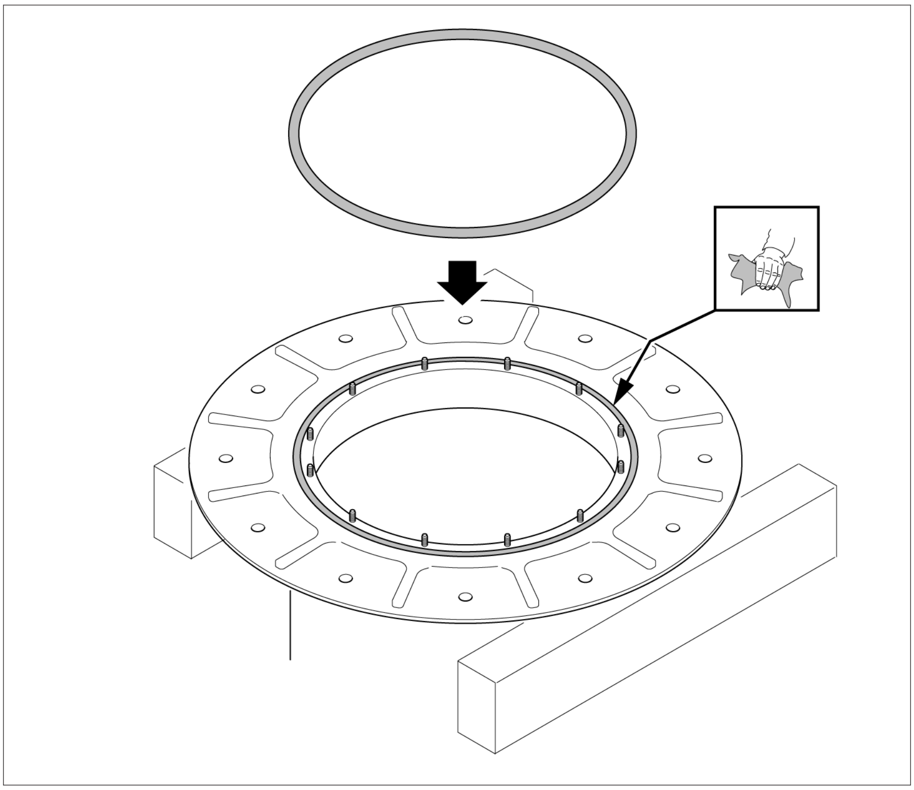


Figure 63: Supporting flange with o-ring

2. Lift the bell-type tank over the active part of the transformer.

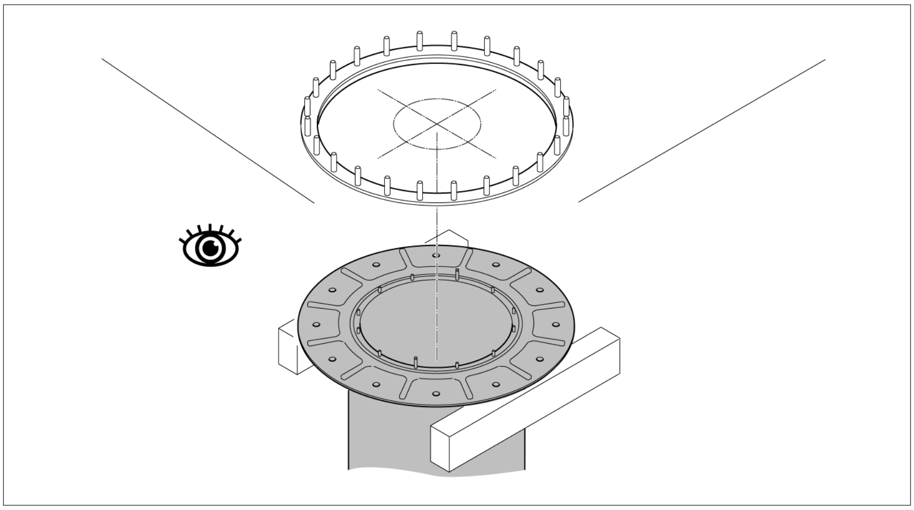


Figure 64: Bell-type tank

5.3.13 Mounting on-load tap-changer head on bell-type tank

1. Clean sealing surfaces on mounting flange and on-load tap-changer head, place oil-resistant gasket on mounting flange.

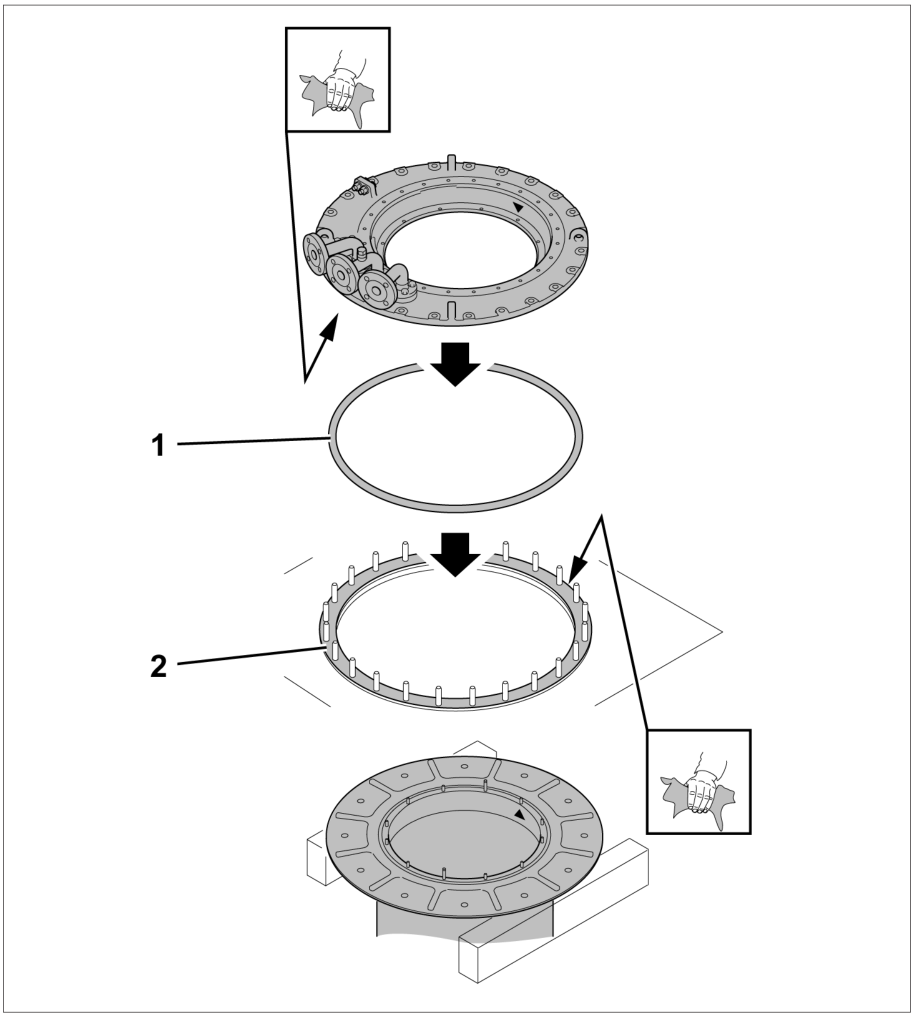


Figure 65: Mounting flange with gasket

1	Gasket	2	Mounting flange

2. Position on-load tap-changer head on mounting flange such that the markings on the supporting flange and on-load tap-changer head match up. Note fitted bolt on supporting flange.

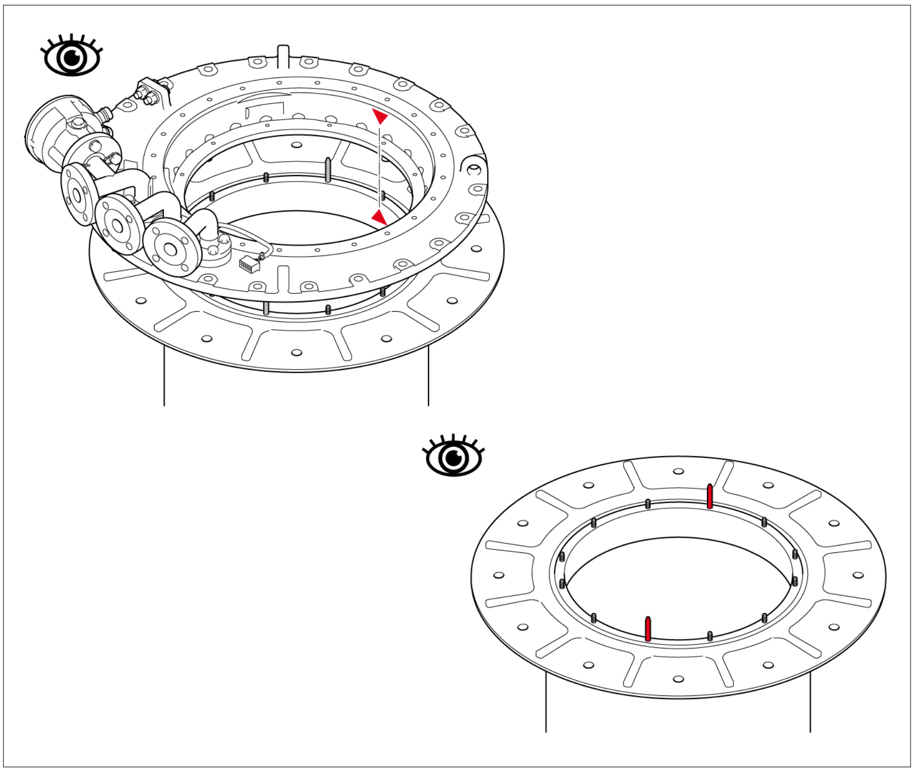


Figure 66: Markings and fitted bolt

5.3.14 Connecting on-load tap-changer head and on-load tap-changer

1. **NOTICE!** Carefully insert lifting device into the on-load tap-changer head with claws turned in. Always lift the on-load tap-changer using the specified lifting device. If the connection screws from the supporting

flange are used to lift the on-load tap-changer, the screws may be damaged, which makes it impossible to properly screw the on-load tap-changer and the on-load tap-changer head together!

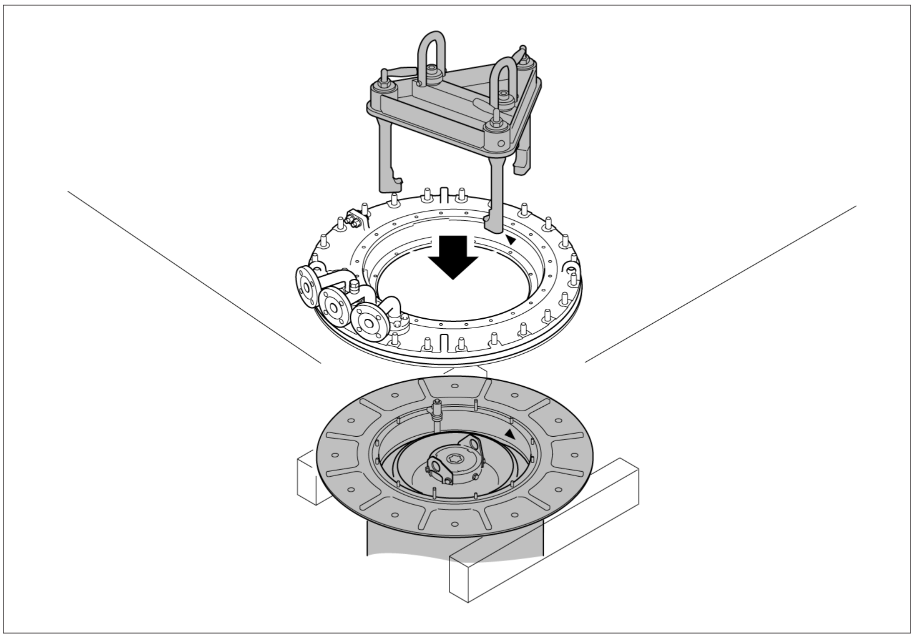


Figure 67: Lifting device

2. **NOTICE!** Swing claws of lifting device outwards, use lifting device to lift on-load tap-changer. Make sure that the triangle markings on the supporting flange and on-load tap-changer head match up so that all supporting flange stud bolts go easily through the mounting holes of the on-load tap-changer head. Inaccurate alignment of on-load tap-changer head to supporting flange will damage the on-load tap-changer.

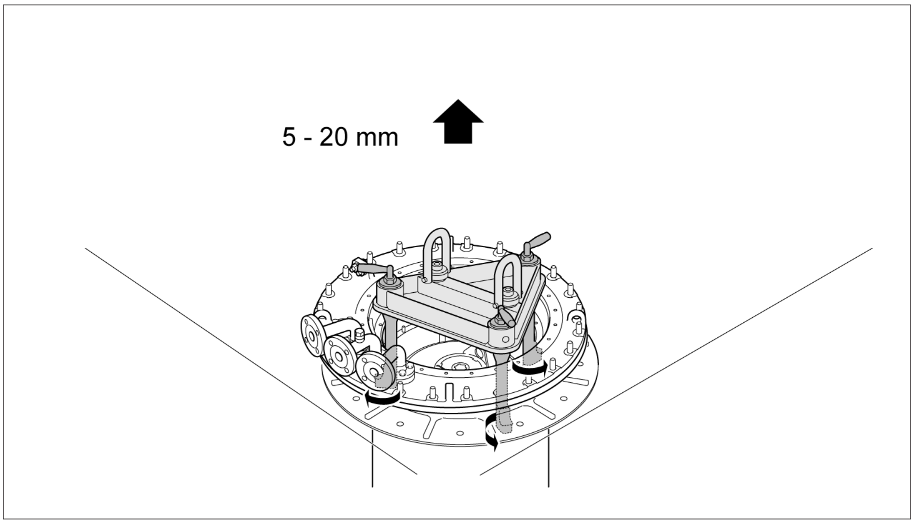


Figure 68: Lifting on-load tap-changer

When screwing the on-load tap-changer head onto the supporting flange, leave the bolts for the mounting plate of the tap-change supervisory control as well as the bolts for the mounting bracket of the oil suction pipe (if present) free.

3. Screw on-load tap-changer head down to underlying supporting flange with nuts and safety elements.

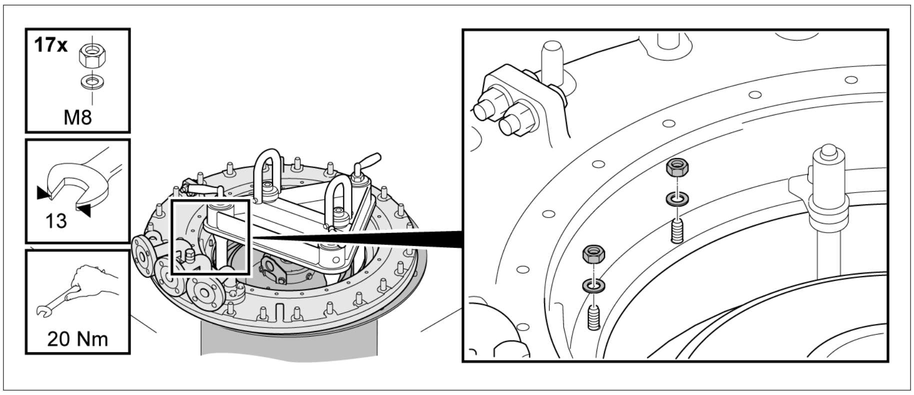


Figure 69: Screwing the on-load tap-changer head onto the supporting flange

4. Now remove the lifting device with the claws turned in.

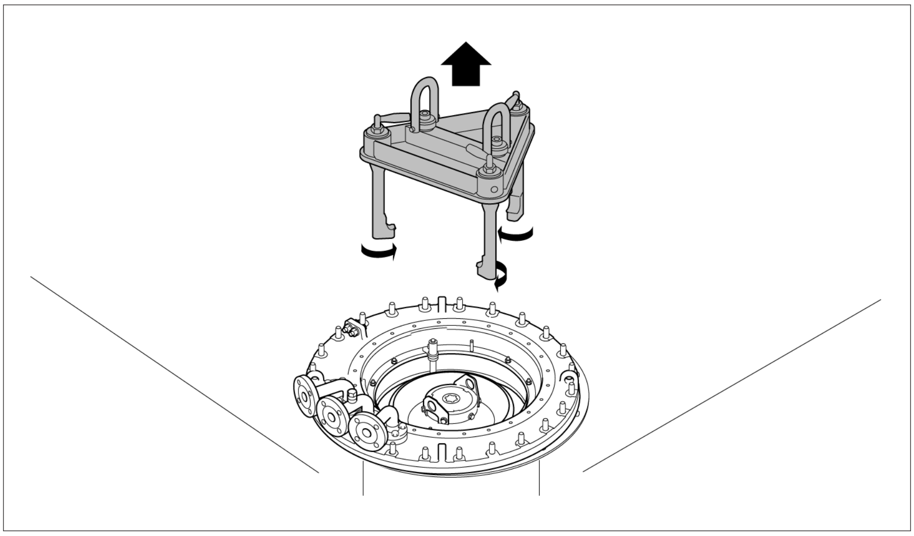


Figure 70: Removing lifting device

5. Screw on-load tap-changer head to the mounting flange.

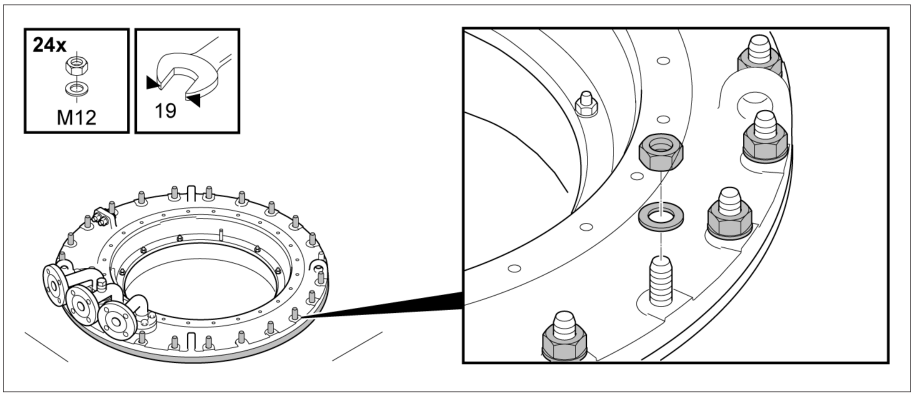


Figure 71: Screwing on-load tap-changer head to the mounting flange

5.3.15 Inserting oil suction pipe

NOTICE

Damage to the on-load tap-changer!

Damage to the on-load tap-changer and oil suction pipe due to incorrect order of installation.

► Strictly adhere to the order of installation. Make sure to always install the diverter switch insert before inserting the oil suction pipe into the oil compartment.

1. Insert the oil suction pipe into the on-load tap-changer head.

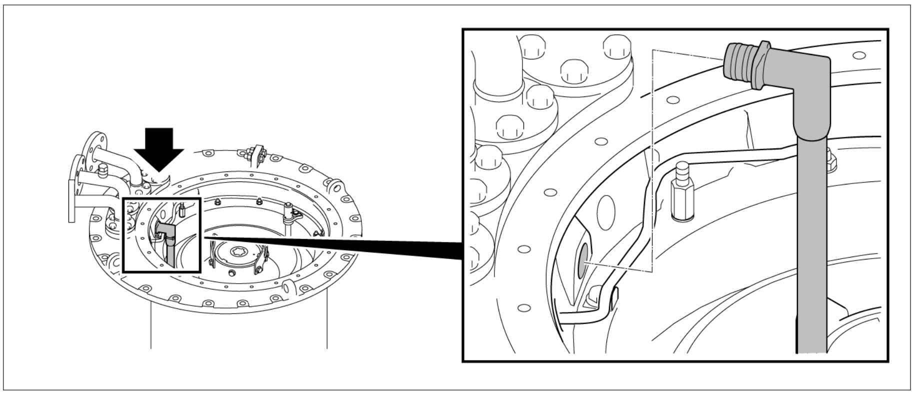


Figure 72: Inserting oil suction pipe

2. Fasten oil suction pipe on retaining bracket with cable tie.

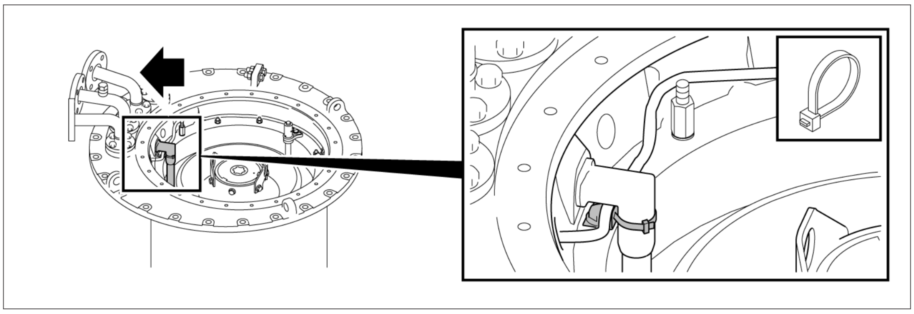


Figure 73: Fastening the oil suction pipe

5.3.16 Inserting tap-change supervisory control (if present)

1. Insert tap-change supervisory control with mounting plate and drive shaft.

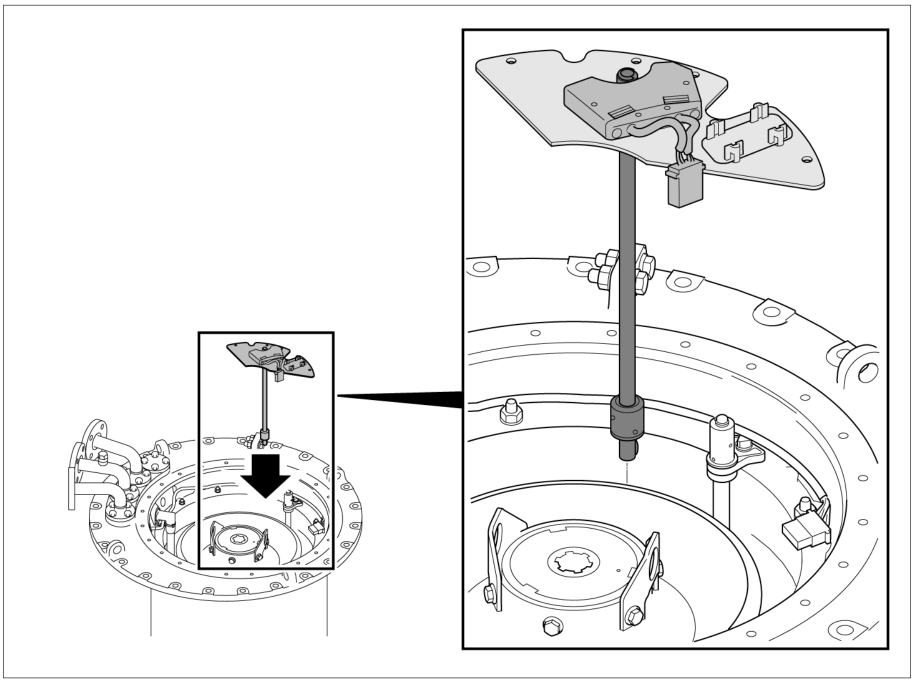


Figure 74: Mounting plate with drive shaft

2. Check that drive shaft feather key is seated correctly in groove.

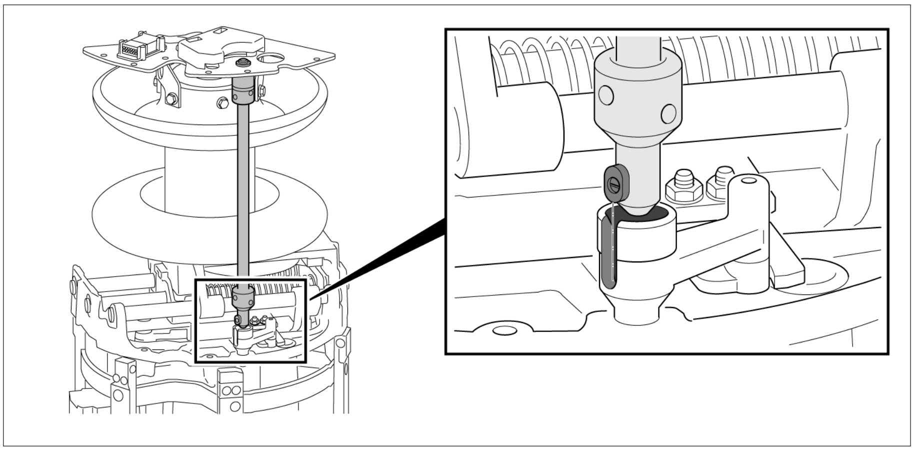


Figure 75: Feather key and groove

3. Secure mounting plate (3 or 4 nuts and locking washers depending on model).

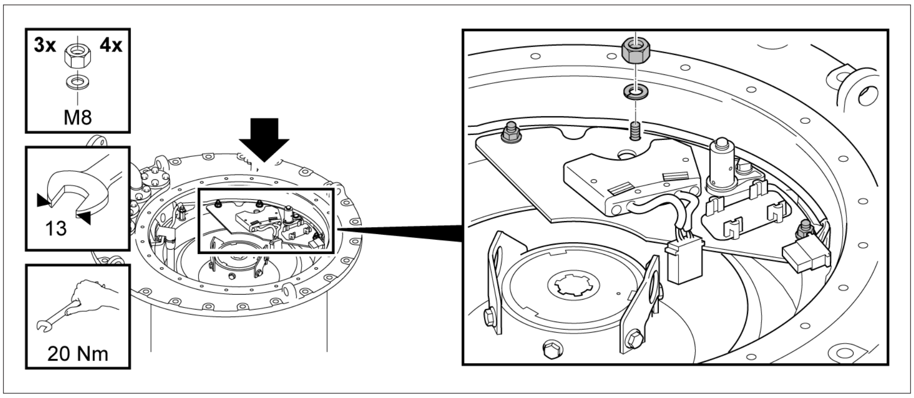


Figure 76: Mounting plate

4. Connect plug connector outside its bracket.

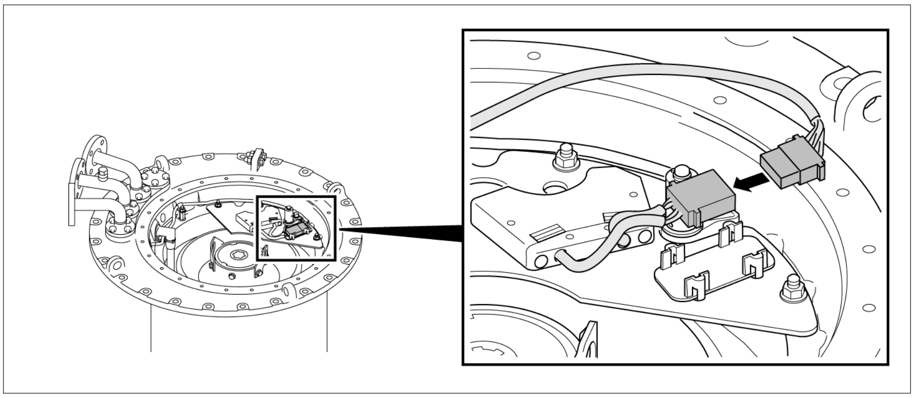


Figure 77: Plug connector

5. Insert plug connector into the bracket.

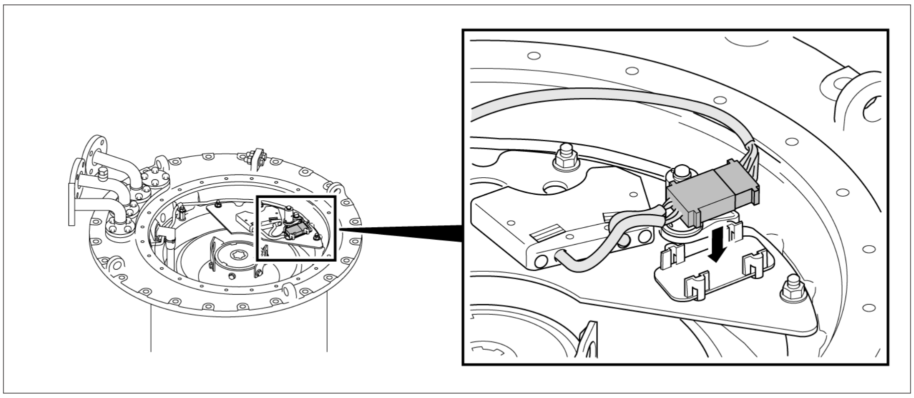


Figure 78: Plug connector in bracket

6. Attach Teflon strip with nut onto stud bolts.

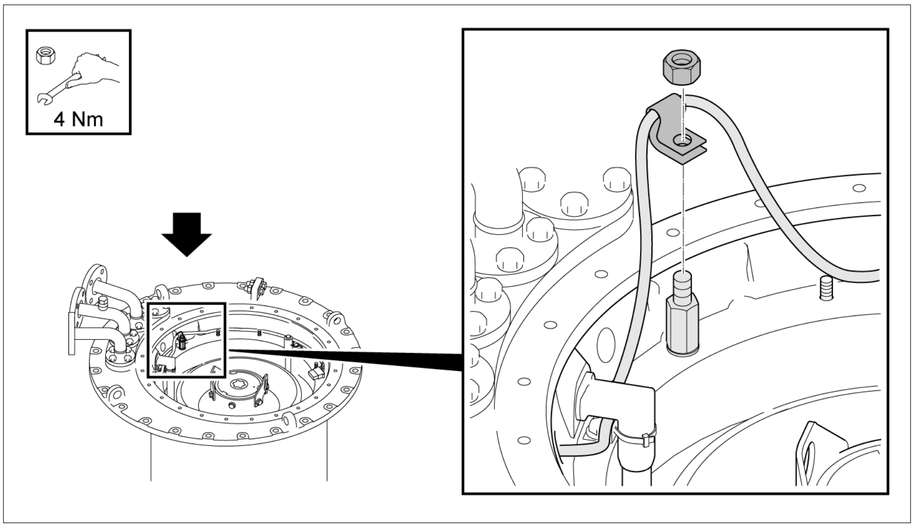


Figure 79: Stud bolt with Teflon strip and nut

5.3.17 Inserting the tap position indicator without multiple coarse change-over selector

Due to the coupling pin, the tap position indicator disc can only be installed when in the correct position.

► Place tap position indicator disk on indicator drive shaft, slide spring clip on to shaft end.

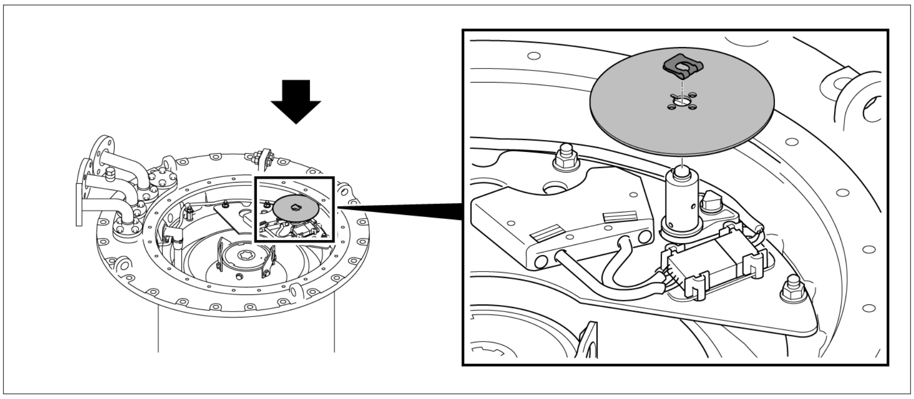


Figure 80: Tap position indicator disk

5.3.18 Inserting tap position indicator of multiple coarse change-over selector with more than 35 operating positions

1. Place panel with bracket on indicator drive shaft and secure with hexagon screws and associated lock tab.

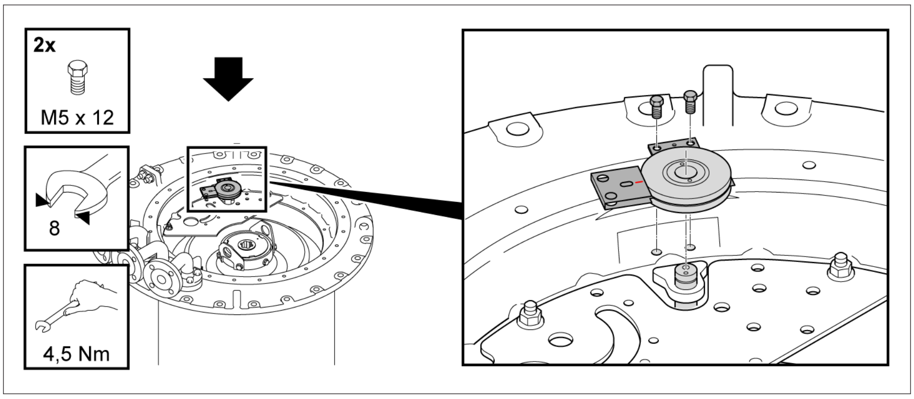


Figure 81: Panel

2. Insert position-indication disk horizontally between panel and bracket and fit cover disk. Align tap position indicator disc and cover disk to produce a continuous red line.

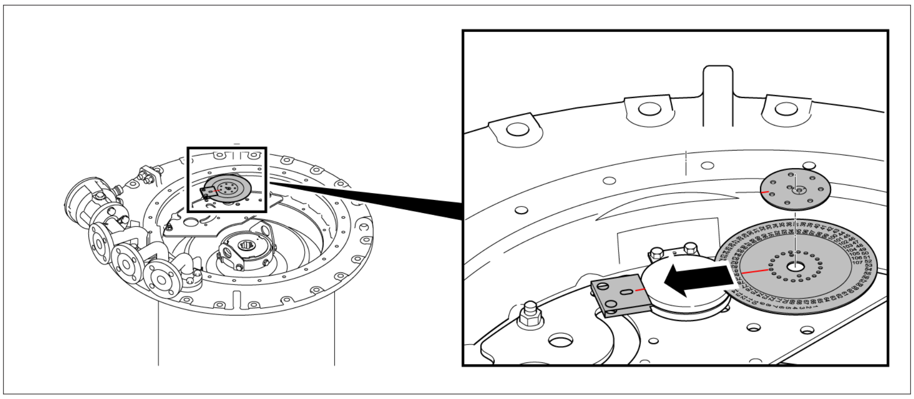


Figure 82: Position-indication disk

3. Secure cover disk with countersunk head screw. The countersunk head screw must be suitable for center-punching.

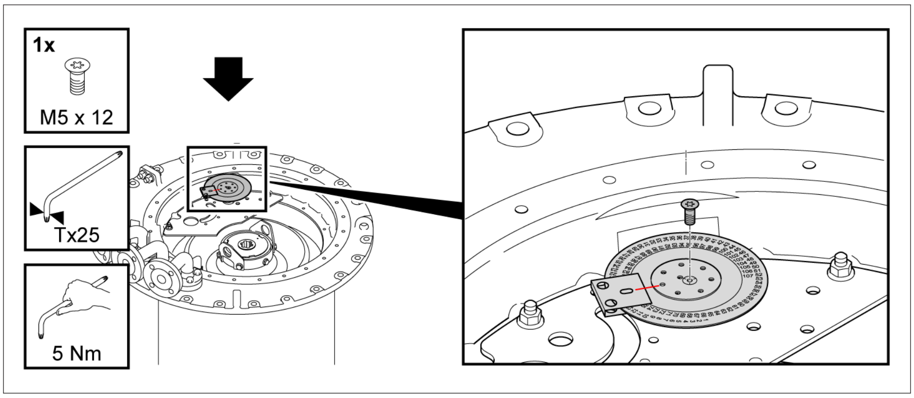


Figure 83: Cover disk

4. Secure countersunk head screw by center-punching.

5.3.19 Securing on-load tap-changer head cover

1. **NOTICE!** Place the on-load tap-changer head cover on the on-load tap-changer head and take care not to damage the o-ring inserted in the on-load tap-changer head cover. A damaged o-ring will cause oil to escape

from the diverter switch oil compartment, resulting in on-load tap-changer damage. Also ensure that the red triangular marks on the on-load tap-changer head and the on-load tap-changer head cover match up.

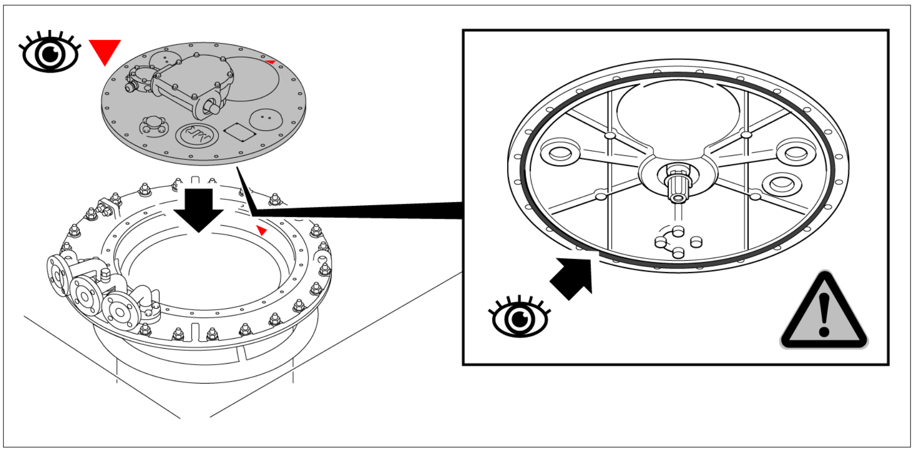


Figure 84: On-load tap-changer head cover with o-ring

2. Screw on-load tap-changer head cover using screws and locking washers.

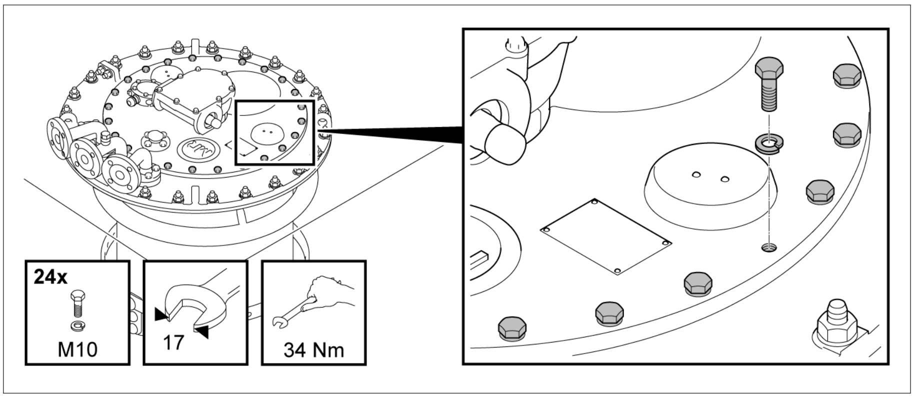


Figure 85: On-load tap-changer head cover

6 Connecting tap winding and on-load tap-changer take-off lead

NOTICE

Damage to the on-load tap-changer!

Connecting leads which place mechanical strain on the on-load tap-changer will damage the on-load tap-changer!

- ▶ Establish and secure connections with care.
- ▶ Connect connecting leads to tap selector without warping or deforming.
- ▶ If necessary use an expansion loop for connecting leads.

The tap winding and on-load tap-changer take-off lead must be connected in accordance with the connection diagram included with the delivery.

6.1 Tap selector connection contacts VRC/VRE

The tap selector connection contacts are indicated on the tap selector bars, have crimped ends and a through-hole for M10 screws to allow the tap selector take-off leads to be connected by means of cable shoes.

Screening caps are available on request.

In this case a locking washer must be placed below each screening cap. The M10 connection screws, the nuts and locking washers are not included in the scope of delivery.

The through-holes of the connection contacts are either horizontal or vertical, depending on the on-load tap-changer version.

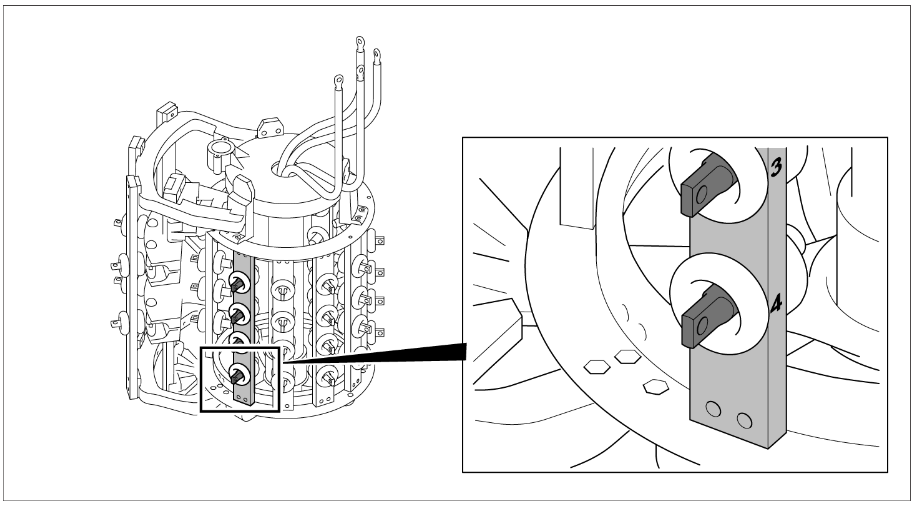


Figure 86: Tap selector connection contacts

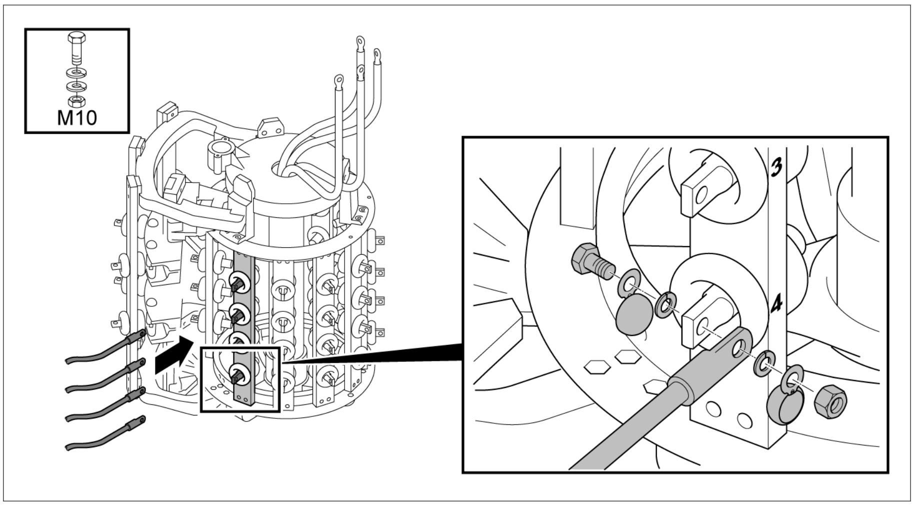


Figure 87: Screening caps

6.2 Tap selector connection contacts for multiple coarse change-over selector VRC

In the case of multiple coarse change-over selectors, special attention must be paid when routing the cables for connecting the tap selector connection contacts and the multiple coarse change-over selector connection contacts. These cables should be as far away as possible from neighboring connection contacts.

► Tap selector connection contacts that face both multiple course tap selector columns must have at least 3 mm of paper insulation to ensure dielectric strength.

In this regard, please also pay attention to the dimensional drawing on which the order is based.

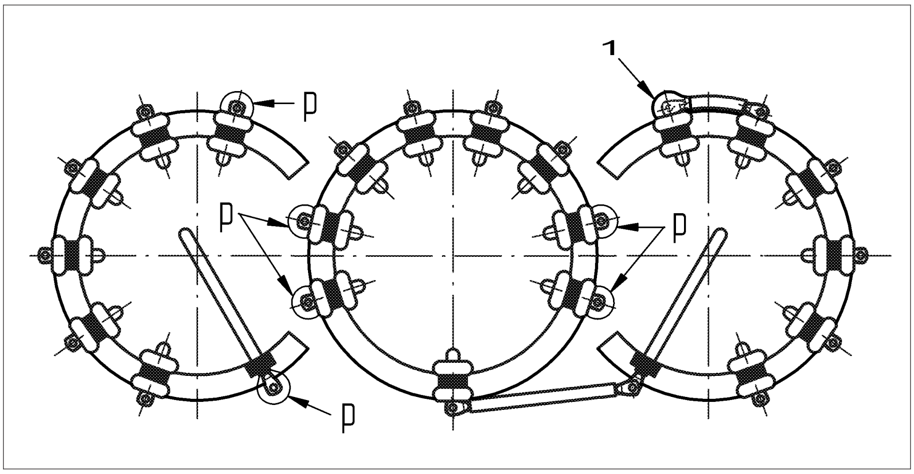


Figure 88: Paper insulation

1	Connection from MR already has 3 mm of paper insulation	p	Connections to be insulated

6.3 Change-over selector connection contacts for reversing change-over selector connection VRC/VRE

The (+) and (-) change-over selector connection contacts are designed as connecting lugs with through-holes for M10 screws for reversing change-over selector connection.

Connection contact K is designed as an extended fine tap selector connection contact (also with through-hole for M10 screws).

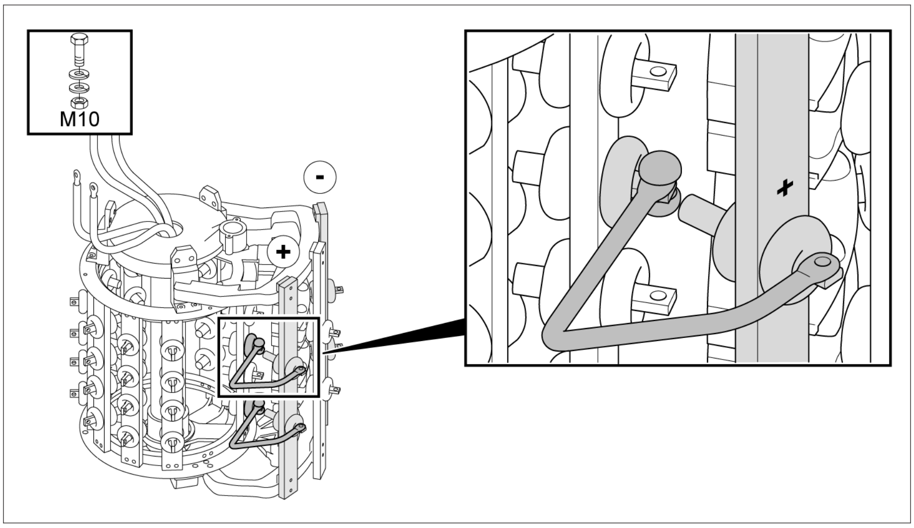


Figure 89: Change-over selector connection contacts for reversing change-over selector connection

NOTICE

Damage to the on-load tap-changer!

Connection leads situated too close to the change-over selector's moving parts block the change-over selector and therefore result in on-load tap-changer damage!

► Connection leads in the area of the change-over selector have to be routed such that they are at a sufficient distance from the change-over selector's moving parts.

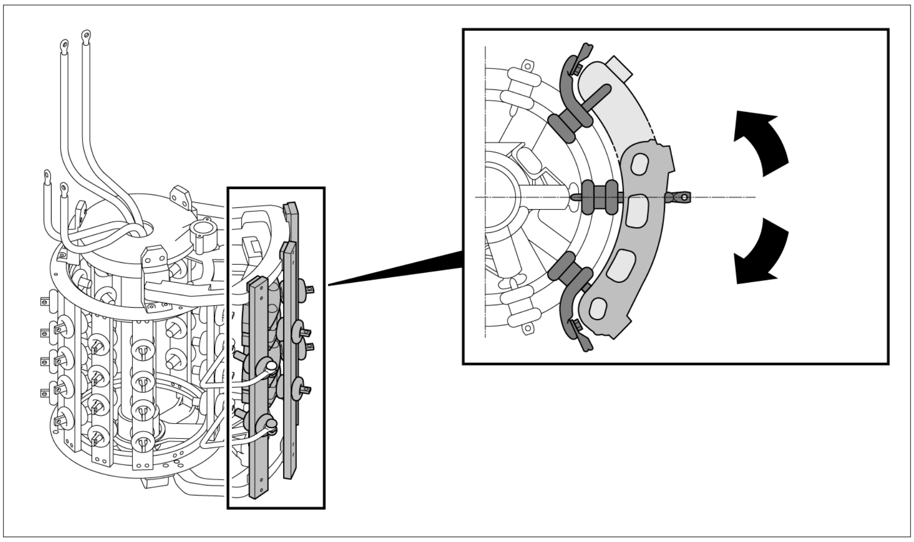


Figure 90: Change-over selector connection contacts for reversing change-over selector connection (top view)

6.4 Change-over selector connection contacts for coarse tap selector connection VRC/VRE

With coarse tap selector connection, the (+) and (-) change-over selector connection contacts are secured to the respective laminated paper bars of the coarse change-over selector. Their external appearance is identical to the fine tap selector contacts (through-hole for M10 screws, always in vertical position).

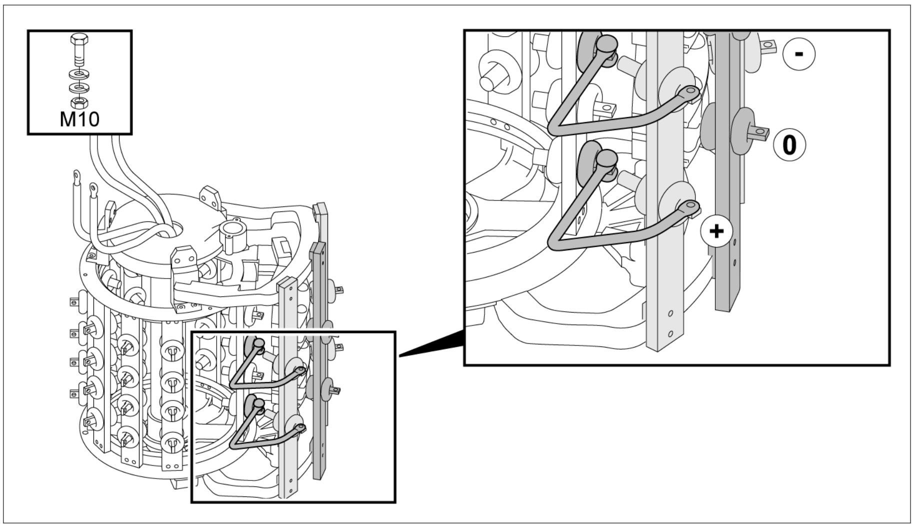


Figure 91: Change-over selector connection contacts for coarse tap selector connection

NOTICE

Damage to the on-load tap-changer!

Connection leads situated too close to the change-over selector's moving parts block the change-over selector and therefore result in on-load tap-changer damage!

► Connection leads in the area of the change-over selector have to be routed such that they are at a sufficient distance from the change-over selector's moving parts.

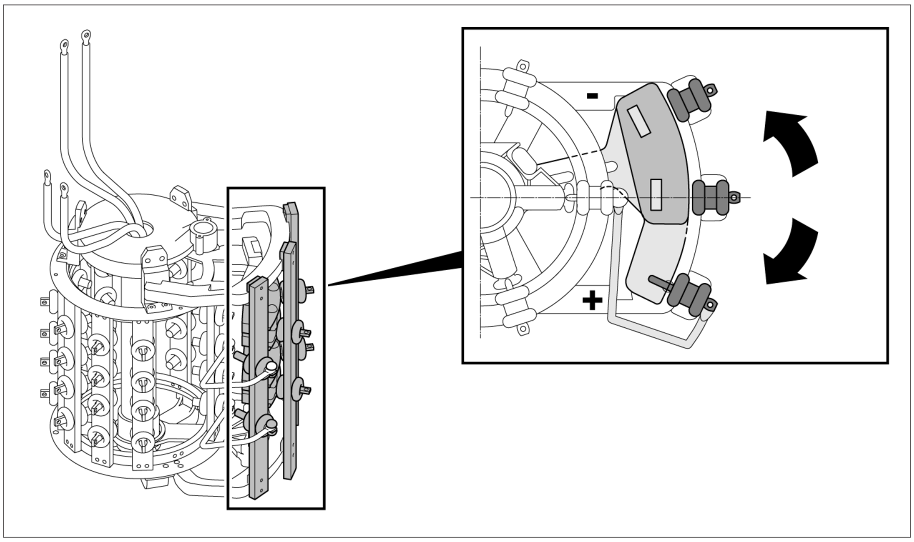


Figure 92: Change-over selector connection contacts for coarse tap selector connection (top view)

6.5 Tap selector connection contacts VRD/VRF

The tap selector connection contacts have a through-hole for M12 screws. The screening caps are supplied separately.

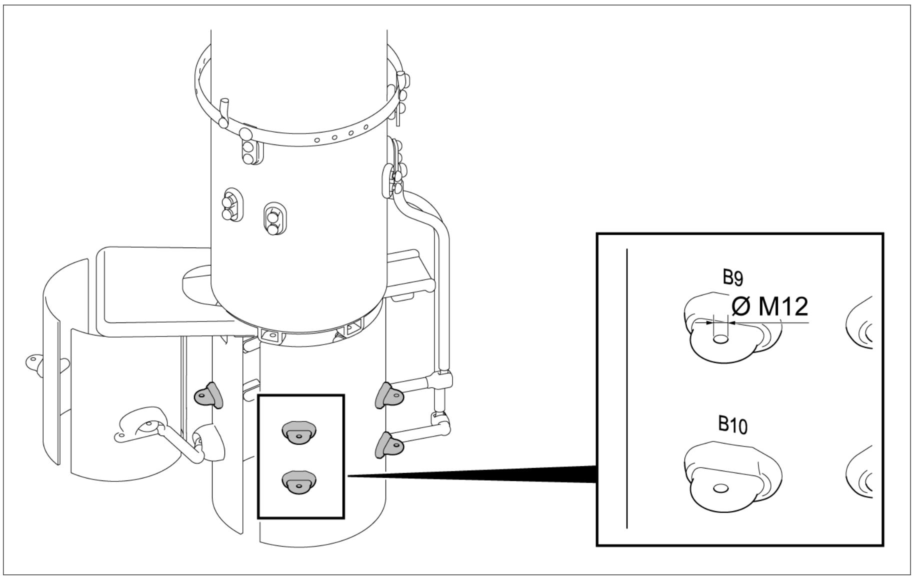


Figure 93: Tap selector connection contacts

6.6 Change-over selector connection contacts for reversing change-over selector connection VRD/VRF

The (+) and (-) change-over selector connection contacts are designed like fine tap selector connection contacts for reversing change-over selector connections. The change-over selector connection contacts (0) are produced as terminal lugs of the crimped connecting lead (=0/K) with a through-hole for M12 screws.

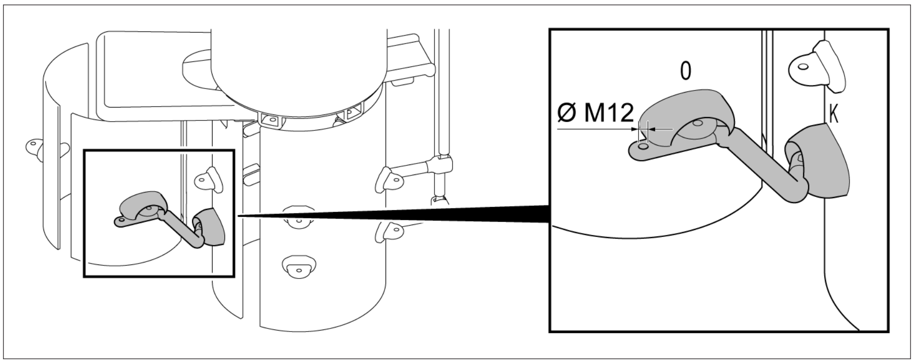


Figure 94: Change-over selector connection contacts for reversing change-over selector connection

6.7 Change-over selector connection contacts for coarse tap selector connection VRD/VRF

For coarse tap selector connection, the (0) and (–) change-over selector connection contacts are designed like the fine tap selector connection contacts. The change-over selector connection contacts (+) are produced as terminal lugs of the crimped connecting lead (+/K) with a through-hole for M12 screws.

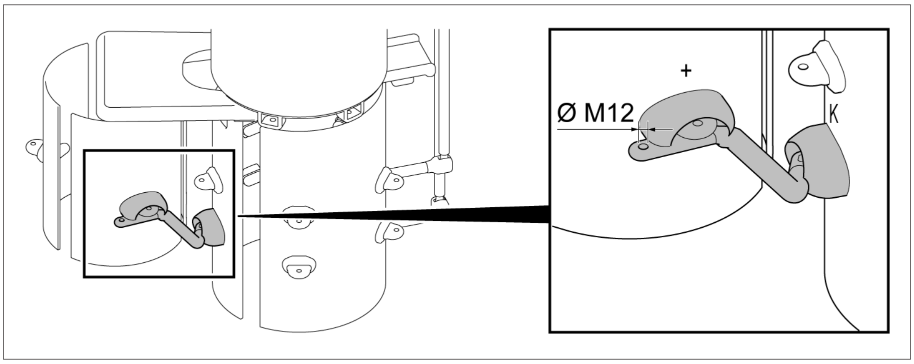


Figure 95: Change-over selector connection contacts for coarse tap selector connection

6.8 Parallel bridges for VRF I 1601

Bridges for connecting the connection contacts of the fine tap selector and change-over selector in parallel in accordance with drawing 786919 [▶ 140] will be supplied.

6.9 Fine-tap-selector and change-over-selector connection contacts VRG

The tap selector connection contacts are indicated on the tap selector bars. The connection is made at the thread stud of the tap selector connection contact via cable shoes and locknuts.

Every connection point must be covered by a screening cap. The screening caps are designed for lateral connection with a straight cable shoe or for front connection with an angled cable shoe.

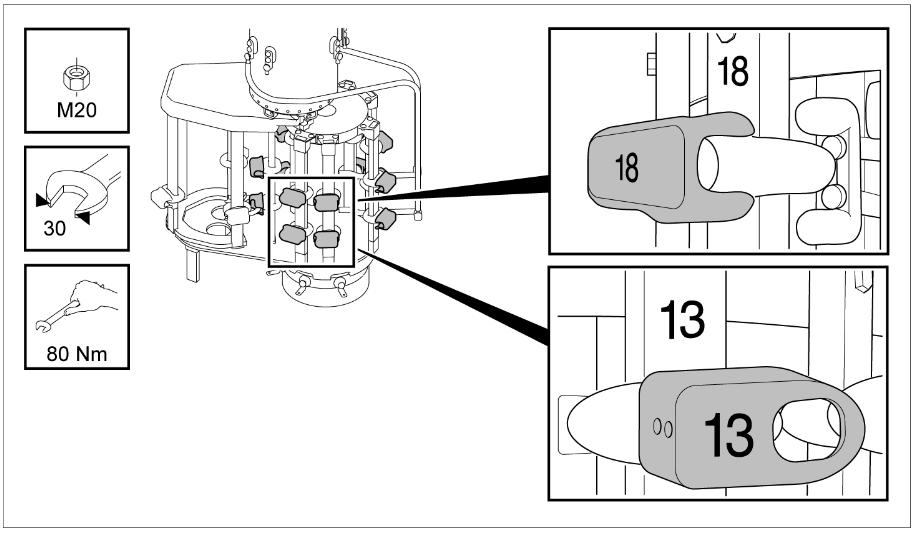


Figure 96: Fine tap selector connection contacts and change-over selector connection contacts

Each screening cap is attached with a steel angle piece and 2 screws. The connection is secured by centre-punching at the perimeter of the screw head. The distance between the screening caps and adjacent tap selector take-off leads must be at least 25 mm!

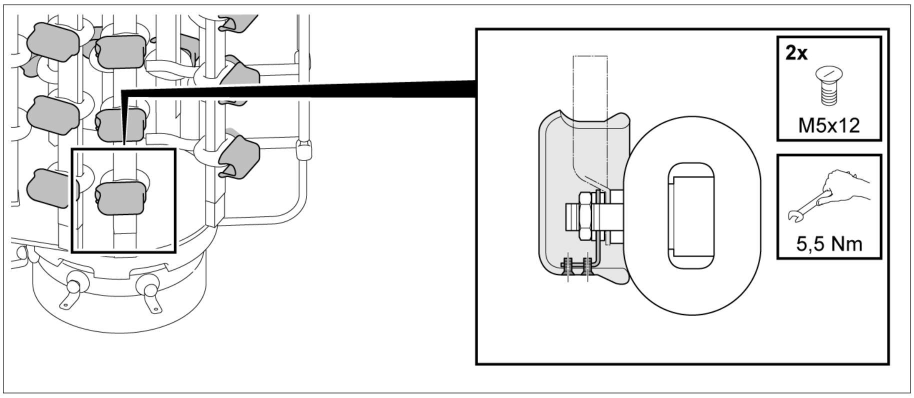


Figure 97: Screening caps

6.10 Parallel bridges for VRG I 1601

Bridges for connecting the connection contacts of the fine tap selector and change-over selector in parallel in accordance with drawing 786920 [▶ 141] will be supplied.

6.11 Connecting on-load tap-changer take-off lead

There are through-holes 13 mm in diameter at three points on the oil compartment's connecting ring.

1. Connect the on-load tap-changer take-off lead to the connecting ring of the oil compartment.

2. Secure screw connection.

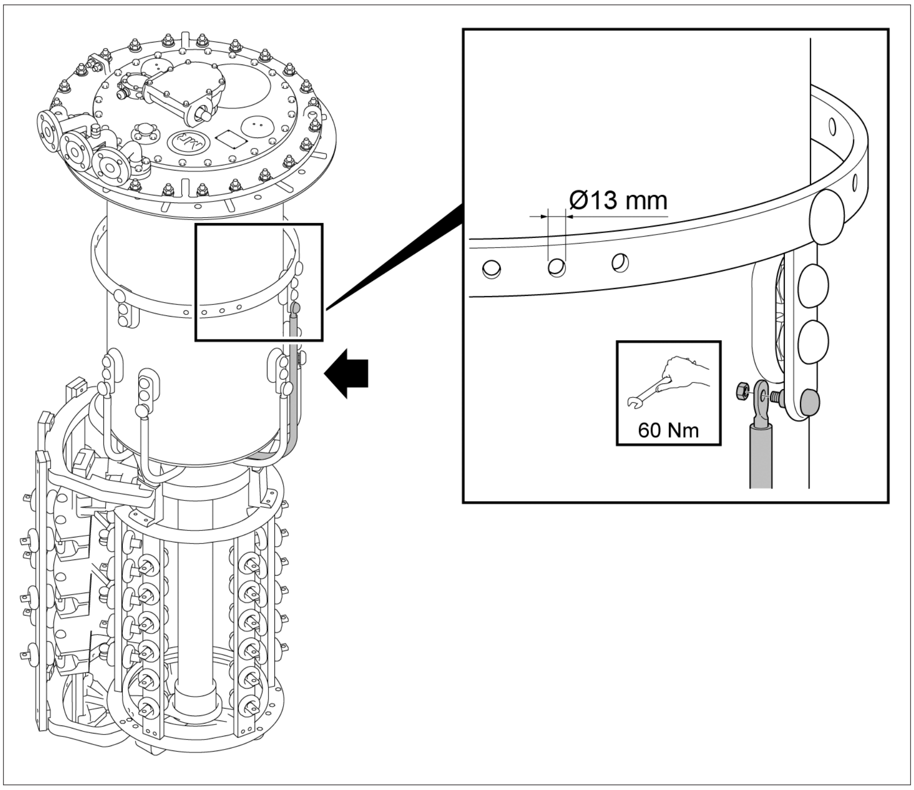


Figure 98: On-load tap-changer take-off lead

7 Carrying out the transformer ratio test

We recommend carrying out a transformer ratio test before the transformer is dried.

7.1 Carrying out transformer ratio test with TAPMOTION® TD test drive

NOTICE

Damage to the on-load tap-changer!

Performing too many operations without complete oil filling will damage the on-load tap-changer!

- ► Do not perform more than 250 tap-change operations on the on-load tap-changer without oil before drying.
- ► Before first actuating the on-load tap-changer after drying the transformer, the tap selector must be completely immersed in transformer oil and the oil compartment must be completely filled with oil.

After the transformer ratio test, open the kerosene drain plug in the oil compartment if the on-load tap-changer is to be dried with kerosene in the transformer tank. After drying, the diverter switch insert must be removed, the kerosene drain plug in the oil compartment closed and the diverter switch insert refitted.

In order to run the transformer ratio test, we recommend using the TAPMOTION® TD test drive. The precise process is described in the test drive operating instructions.

7.2 Carrying out the transformer ratio test manually

NOTICE

Damage to the on-load tap-changer!

Actuating the on-load tap-changer via the coupling tube will cause damage to the on-load tap-changer!

- ► Only actuate the on-load tap-changer via the drive shaft of the upper gear unit.
- ► When using a drill, do not exceed a maximum speed of 250 rpm.

NOTICE

Damage to the on-load tap-changer!

Performing too many operations without complete oil filling will damage the on-load tap-changer!

- ► Do not perform more than 250 tap-change operations on the on-load tap-changer without oil before drying.
- ► Before first actuating the on-load tap-changer after drying the transformer, the tap selector must be completely immersed in transformer oil and the oil compartment must be completely filled with oil.

To operate the drive shaft of the upper gear unit of the on-load tap-changer head, a short tube (diameter 25 mm) with screwed-in coupling bolt (diameter 12 mm) may be used together with a hand wheel or crank.

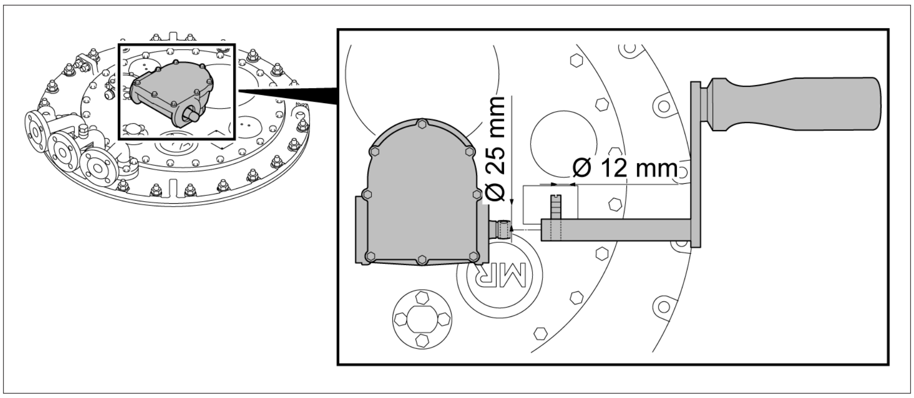


Figure 99: Upper gear unit with hand crank

If using more than one on-load tap-changer column, all on-load tap-changer heads have to be linked to one another by the horizontal drive shaft part.

1. Move on-load tap-changer into the desired operating position (8.25 revolutions on drive shaft of the upper gear unit). The diverter switch operation can be heard distinctly.
2. ***NOTICE!*** After operating the diverter switch, continue to crank 2.5 revolutions in the same direction on the drive shaft of the upper gear unit in order to correctly end the tap change operation. An incomplete tap-change operation may damage the on-load tap-changer!

When actuating the change-over selector a higher torque is required.

3. Carry out the transformer ratio test in all operating positions.

Always check the operating position reached through the inspection window in the on-load tap-changer head cover. The end positions, which are indicated in the connection diagram supplied with the delivery, must never be overshot.

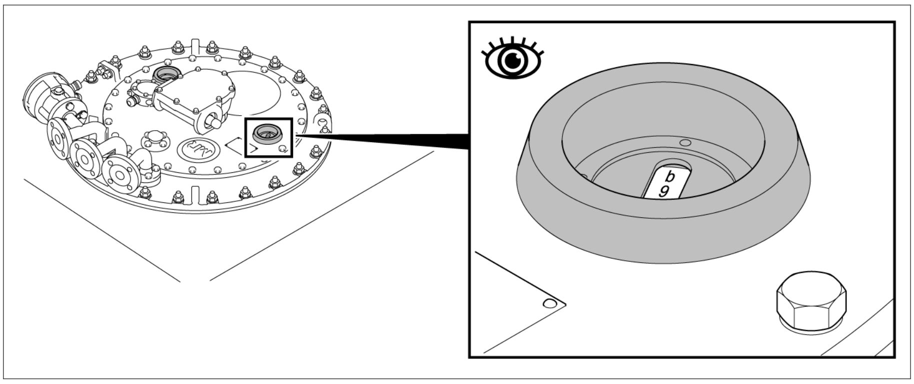


Figure 100: Inspection window

4. Once the transformer ratio test is complete, return on-load tap-changer to its adjustment position (see supplied connection diagram of the on-load tap-changer).

After the transformer ratio test, open the kerosene drain plug in the oil compartment if the on-load tap-changer is to be dried with kerosene in the transformer tank. After drying, the diverter switch insert must be removed, the kerosene drain plug in the oil compartment closed and the diverter switch insert refitted.

8 Measuring DC resistance on transformer

Note the measurement scenarios listed below and the associated maximum measured currents when measuring DC resistance on the transformer.

The measured DC current is normally restricted to 10 % of the rated current of the measured transformer winding in order to prevent the winding from overheating.

	DC resistance measurement in various on-load tap-changer operating positions without interruption of measured current during the change of operating position	DC resistance measurement in various on-load tap-changer operating positions with interruption of measured current during the change of operating position (the measured current must be 0 A when changing operating position)
Oil compartment empty	Maximum 10 A DC	Maximum 50 A DC
Oil compartment filled with insulating oil	Maximum 50 A DC	Maximum 50 A DC

Table 7: Maximum permitted measured currents when measuring DC resistance on transformer

9 Drying the on-load tap-changer

A prerequisite for the dielectric values assured by MR for the on-load tap-changer is a minimum drying procedure (vacuum drying or vapor-phase drying) performed following the instructions below.

9.1 Vacuum-drying in the autoclave

1. ***NOTICE!*** Remove the on-load tap-changer head cover (24 screws M10/ wrench size 17 with locking washers) and store it outside the autoclave.If this is not done, the on-load tap-changer head cover may be damaged.
2. ***NOTICE!*** Remove on-load tap-changer accessories (motor-drive unit, protective relay, pressure-operated relay, pressure relief device, bevel gear, temperature sensor, oil filter unit) and store outside autoclave.If this is not done, the on-load tap-changer accessories may be damaged.
3. Seal off unused pipe connections with a suitable blank cover.
4. Heat up the on-load tap-changer in air at atmospheric pressure with a temperature increase of about 10 °C/h to a final temperature of maximum 110 °C.
5. Pre-dry the on-load tap-changer in circulating air at a max. temperature of 110 °C for a period of 20 hours.
6. Vacuum dry on-load tap-changer at between 105 °C and maximum 125 °C. Residual pressure of no more than 10^{-3} bar. The drying period depends on the drying period of the transformer but should be at least 50 hours.

9.2 Vacuum-drying in the transformer tank

The on-load tap-changer head cover remains closed during the entire drying process.

1. Establish a connecting lead either between the connections E2 and Q or connections E2 and R on the on-load tap-changer head.

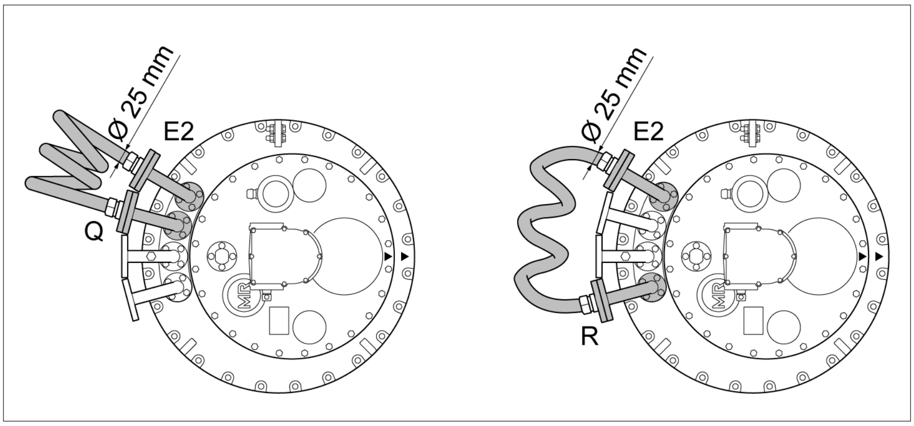


Figure 101: Connecting lead

2. Seal off unused pipe connections with a suitable blank cover.
3. Heat up the on-load tap-changer in air at atmospheric pressure with a temperature increase of about 10 °C/h to a final temperature of maximum 110 °C.
4. Pre-dry the on-load tap-changer in circulating air at a max. temperature of 110 °C for a period of 20 hours.
5. Vacuum dry on-load tap-changer at between 105 °C and maximum 125 °C. Residual pressure of no more than 10^{-3} bar. The drying period depends on the drying period of the transformer but should be at least 50 hours.

9.3 Vapor-phase drying in the autoclave

For vapor-phase drying in the autoclave, you must open the kerosene drain plug in the oil compartment base before drying so that the kerosene condensate can drain from the oil compartment.

1. **NOTICE!** Unscrew kerosene drain plug between oil compartment base and tap selector gear clockwise until it starts to get hard to turn.Never unscrew the kerosene drain plug all the way.

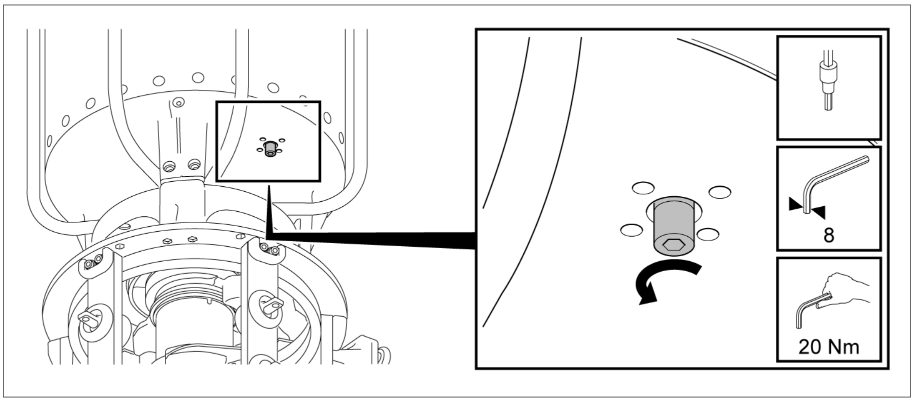


Figure 102: Kerosene drain plug

2. **NOTICE!** Remove the on-load tap-changer head cover (24 screws M10/ wrench size 17 with locking washers) and store it outside the auto-clave.If this is not done, the on-load tap-changer head cover may be damaged.
3. **NOTICE!** Remove on-load tap-changer accessories (motor-drive unit, protective relay, pressure-operated relay, pressure relief device, bevel gear, temperature sensor, oil filter unit) and store outside autoclave.If this is not done, the on-load tap-changer accessories may be damaged.
4. Seal off unused pipe connections with a suitable blank cover.
5. Supply kerosene vapor at a temperature of around 90 °C. Keep this temperature constant for about 3 to 4 hours.
6. Increase the kerosene vapor temperature by approx. 10 °C/hour to the desired final temperature (125 °C maximum on the on-load tap-changer).
7. Vacuum dry on-load tap-changer at between 105 °C and maximum 125 °C. Residual pressure of no more than 10^{-3} bar. The drying period depends on the drying period of the transformer but should be at least 50 hours.
8. **NOTICE!** Close kerosene drain plug (tightening torque 20 Nm). An open kerosene drain plug means that oil will escape from the oil compartment and therefore results in damage to the on-load tap-changer and transformer.

9.4 Vapor-phase drying in the transformer tank

For vapor-phase drying in the transformer tank, you have to open the kerosene drain plug before drying so that the kerosene condensate can drain from the oil compartment.

The kerosene drain plug is located in the oil compartment base and is not generally accessible from the outside. For this reason, you first have to remove the diverter switch insert, open the kerosene drain plug, and then install the diverter switch insert again. After the drying process, you have to remove the diverter switch insert again to close the kerosene drain plug.

NOTICE

Damage to the on-load tap-changer!

Damage to the on-load tap-changer and oil suction pipe due to incorrect order of installation.

► Strictly adhere to the order of installation. Make sure to always install the diverter switch insert before inserting the oil suction pipe into the oil compartment.

9.4.1 Removing diverter switch insert

Before you can remove the diverter switch insert, you have to drive the on-load tap-changer to the adjustment position and remove the on-load tap-changer head cover, tap position indicator, tap-change supervisory control and oil suction pipe.

9.4.1.1 Moving on-load tap-changer to adjustment position

► Move on-load tap-changer to adjustment position.

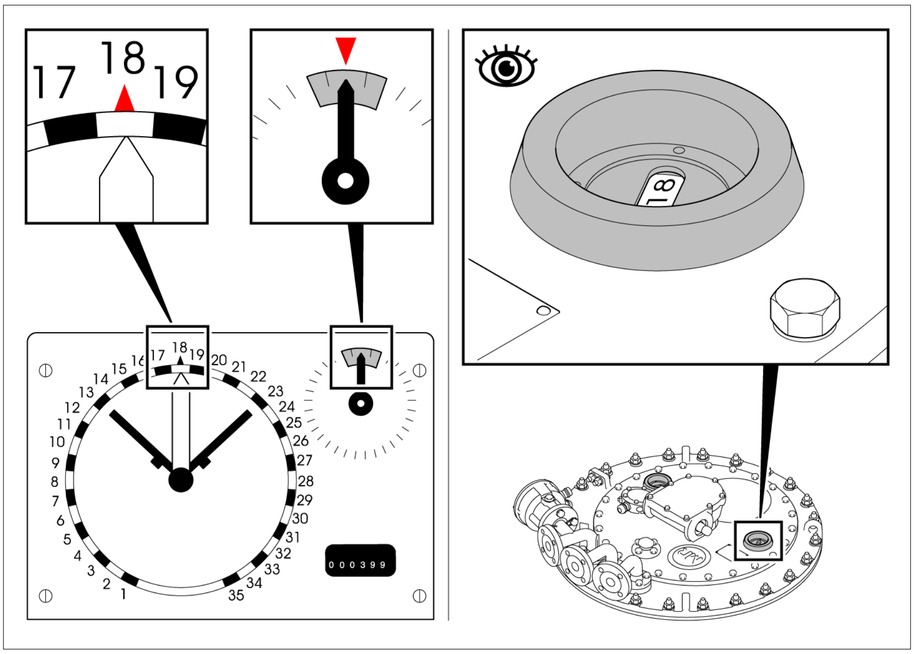


Figure 103: Adjustment position

9.4.1.2 Removing on-load tap-changer head cover

⚠ WARNING

Danger of death or severe injury!

Danger of death or severe injury from explosive gases under the on-load tap-changer head cover!

- ▶ Ensure that there are no naked flames, hot surfaces or sparks (for example caused by static charging) in the immediate surroundings and that none occur.
- ▶ De-energize all auxiliary circuits (for example tap-change supervisory control, pressure relief device, pressure-operated relays) before removing the on-load tap-changer head cover.
- ▶ Do not operate any electric devices during the work (for example risk of sparks caused by impact wrench).
- ▶ Only use conductive and grounded hoses, pipes and pump equipment that are approved for flammable liquids.

NOTICE

Damage to the on-load tap-changer and transformer!

Small parts in the oil compartment may block the diverter switch insert, thereby damaging the on-load tap-changer and transformer!

- ▶ Take care to avoid parts falling into the oil compartment.
- ▶ Check that you have the same number of small parts when disassembling and reassembling.

1. Loosen screws with locking washers on the on-load tap-changer head cover.

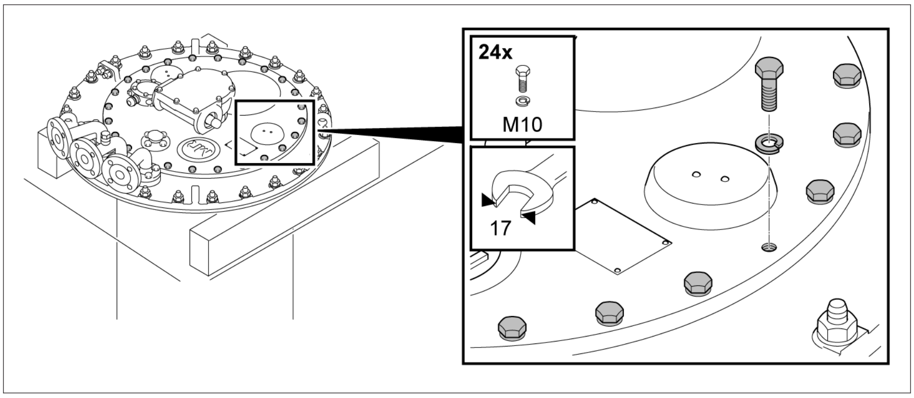


Figure 104: On-load tap-changer head cover

2. ***NOTICE!*** Remove the on-load tap-changer head cover. Check that the sealing surfaces on the on-load tap-changer head cover and on-load tap-changer head are in sound condition when removing and during all

other work. Ensure that o-ring is in sound condition also. Damaged sealing surfaces result in oil escaping and therefore on-load tap-changer and transformer damage.

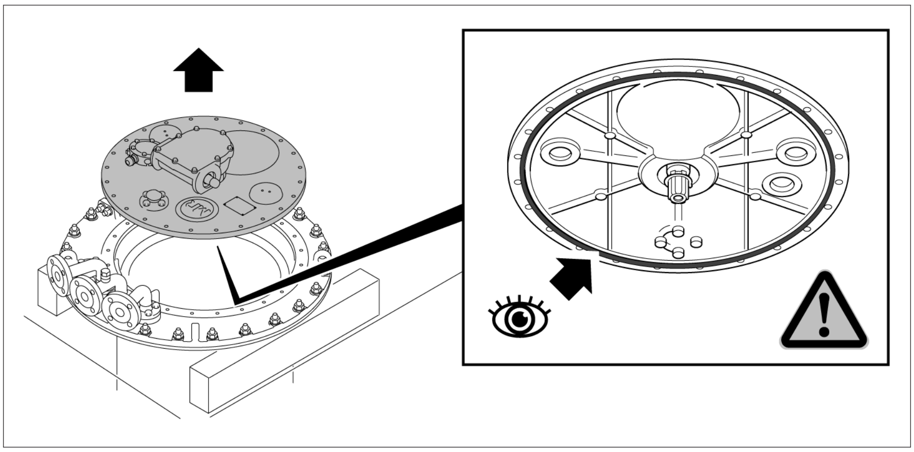


Figure 105: On-load tap-changer head cover

3. **NOTICE!** Do not expose the open oil compartment to ambient humidity for more than 10 hours. If you do, this may result in damage to the on-load tap-changer and transformer due to insufficient dielectric strength of the diverter switch oil!

9.4.1.3 Removing tap position indicator (version without multiple coarse change-over selector)

► Pull the spring clip off the shaft end and remove the tap position indicator disc.

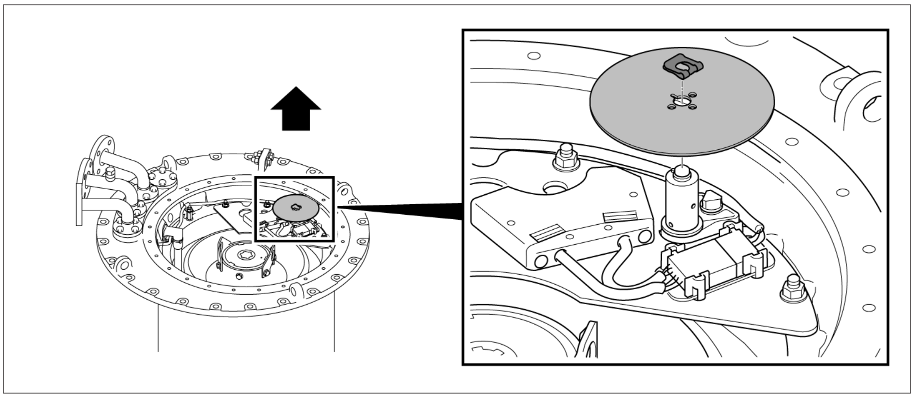


Figure 106: Tap position indicator disk

9.4.1.4 Removing tap position indicator from multiple coarse change-over selector with more than 35 operating positions

1. Ensure that the red marks on the panel, tap position indicator disk and cover disk produce a continuous red line.

2. Remove countersunk head screw.

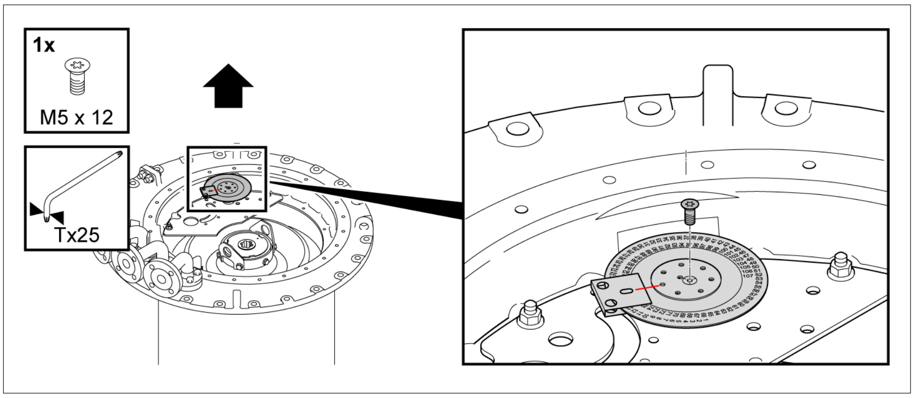


Figure 107: Countersunk head screw

3. Lever cover disk off underlying disk with flat screwdriver and pull out position-indication disk from between panel and bracket.

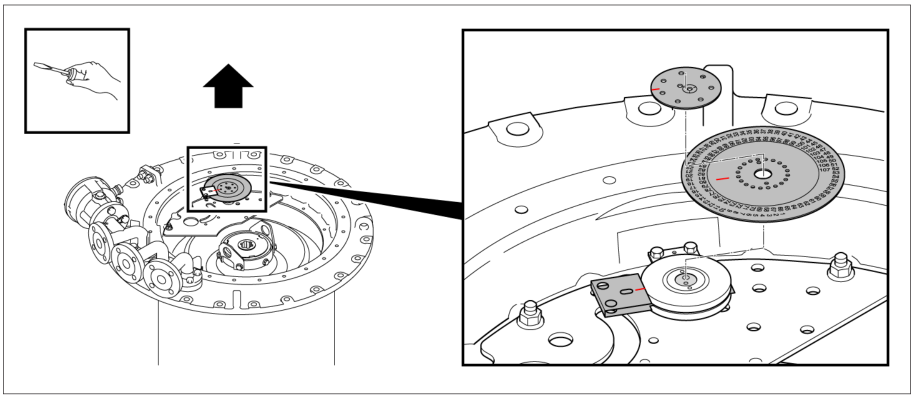


Figure 108: Cover disk and position-indication disk

4. Remove hexagon screws and associated lock tab.

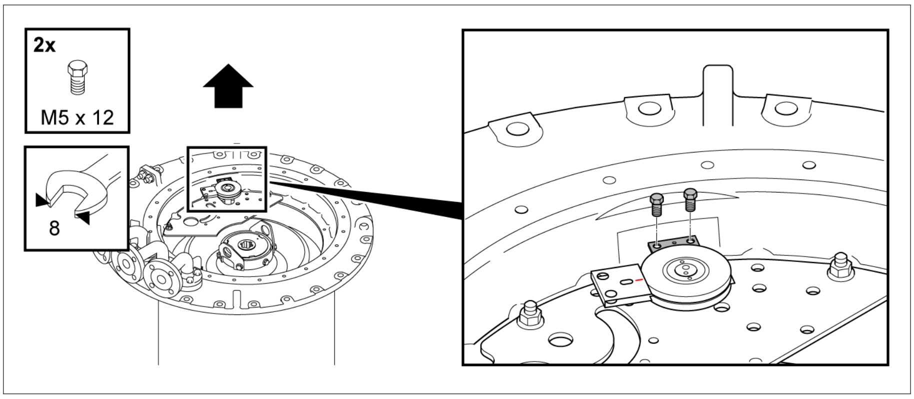


Figure 109: Lock tab

5. Pull panel and bracket up and off indicator drive shaft.

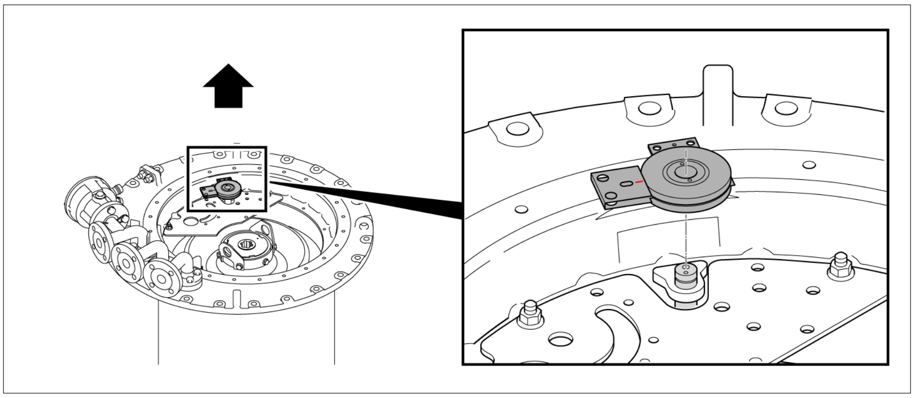


Figure 110: Panel

9.4.1.5 Removing tap-change supervisory control (if present)

NOTICE

Damage to the on-load tap-changer and transformer!

Removing the tap-change supervisory control without due care may damage it, thereby resulting in damage to the on-load tap-changer and transformer!

► Remove tap-change supervisory control with care in order not to damage or rip out the connecting leads.

1. Take tap-change supervisory control plug connector out of bracket and disconnect.

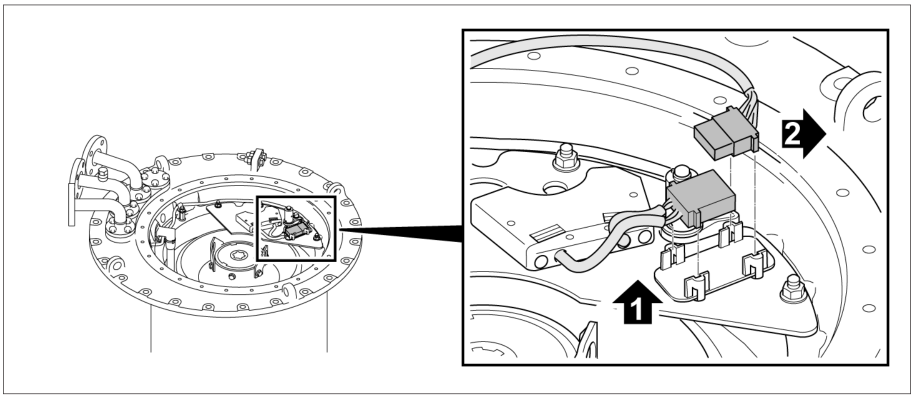


Figure 111: Plug connector

2. Remove nuts and locking elements (3 or 4 depending on model) on the mounting plate.

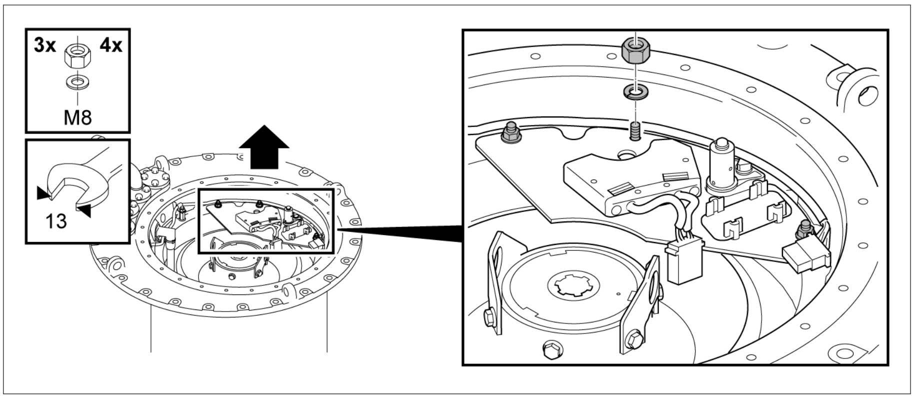


Figure 112: Mounting plate with nuts and locking washers

3. Remove the tap-change supervisory control together with the mounting plate and drive shaft.

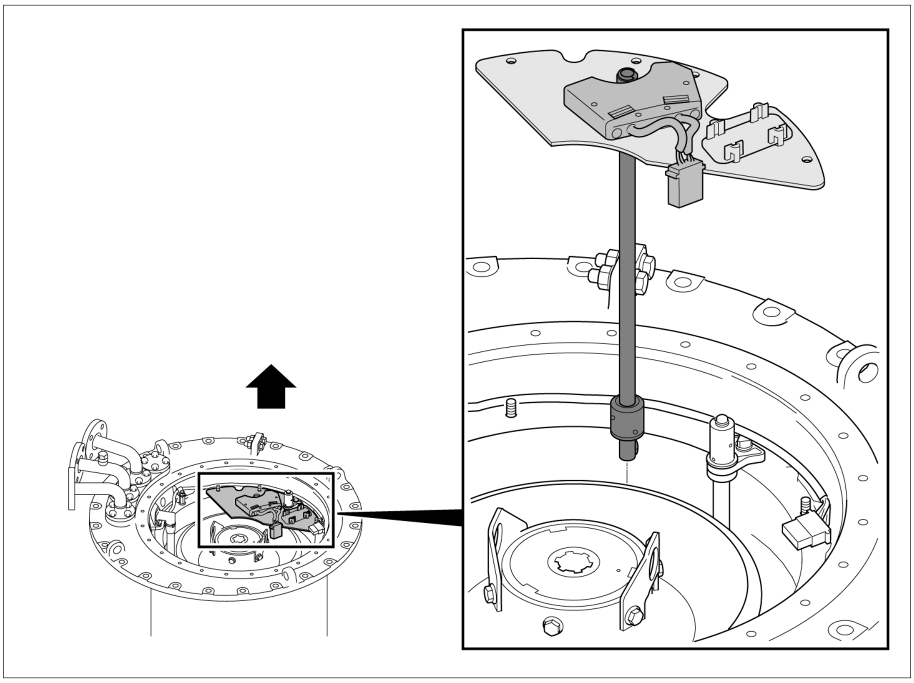


Figure 113: Tap-change supervisory control with mounting plate and drive shaft

4. Remove nut and Teflon strip from stud bolt.

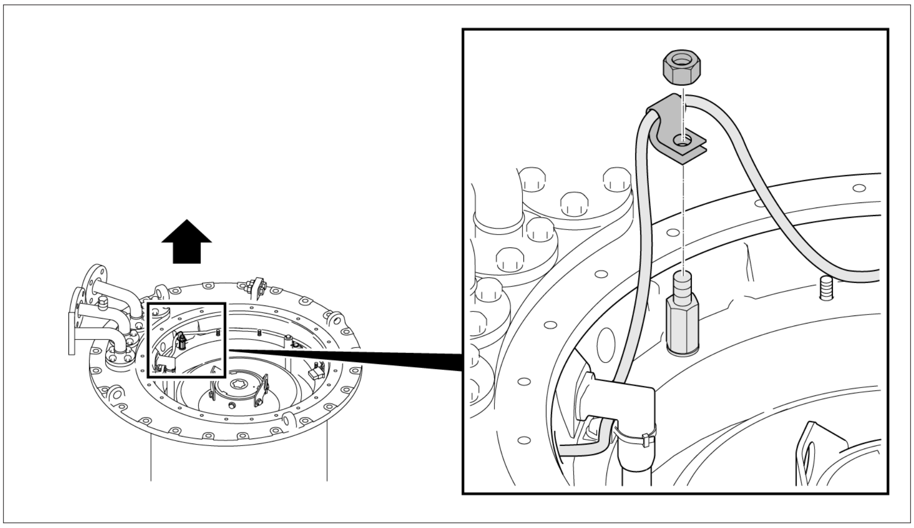


Figure 114: Stud bolt with Teflon strip and nut

9.4.1.6 Removing the oil suction pipe

1. Remove cable ties from the oil suction pipe.

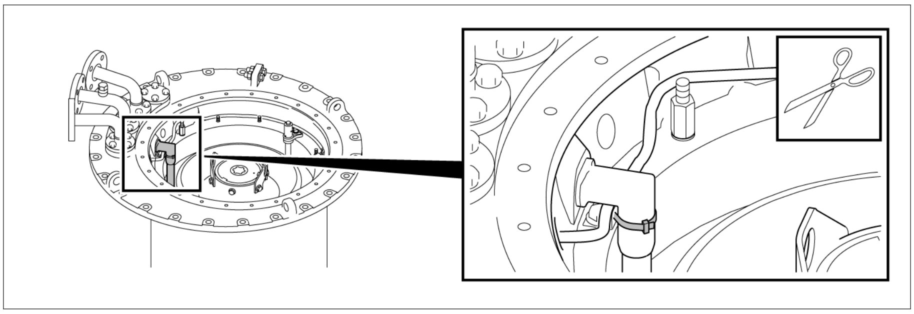


Figure 115: Cable tie

2. Pull oil suction pipe out of on-load tap-changer head.

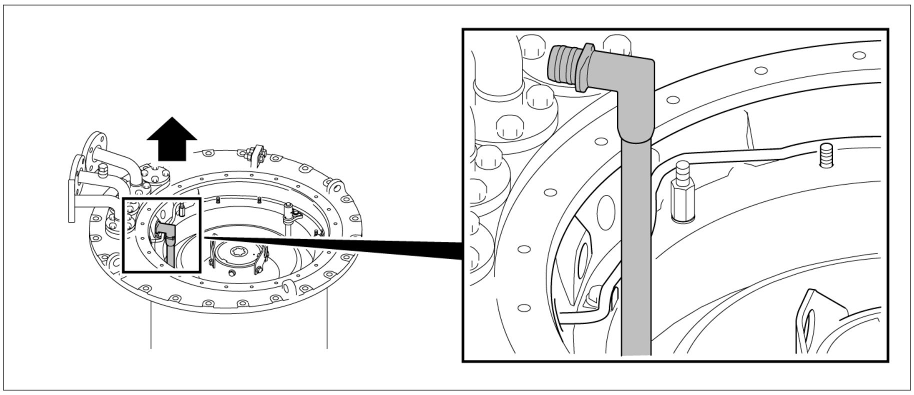


Figure 116: Oil suction pipe

3. Swivel lead of tap-change supervisory control out of on-load tap-changer head in direction indicated by arrow until the cable will not be damaged when the diverter switch insert is pulled out.

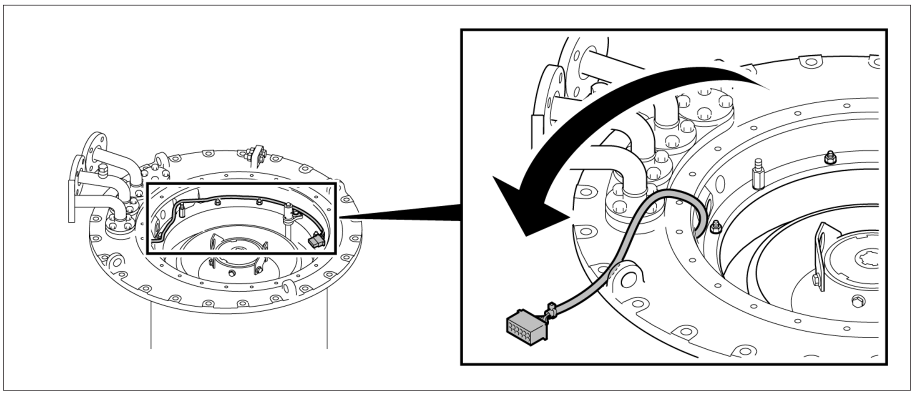


Figure 117: Swiveling out tap-change supervisory control lead

9.4.1.7 Lifting out diverter switch insert

1. By turning the coupling tube on the upper screening ring, align it in such a manner that the triangular marks on the on-load tap-changer head and those on the coupling tube match up.

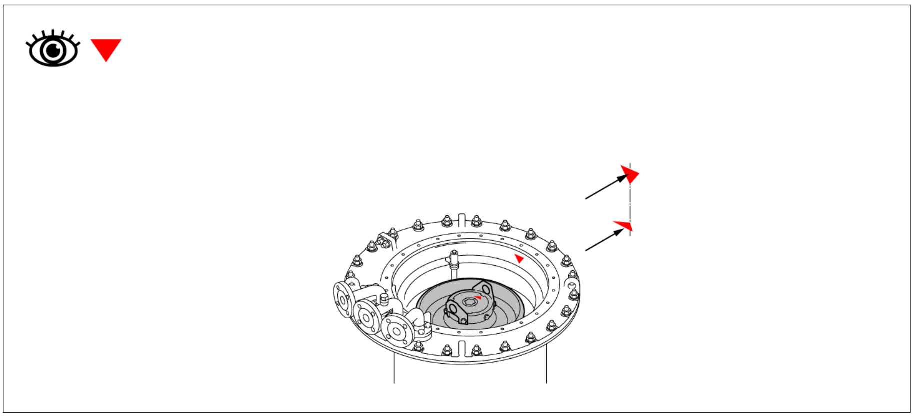


Figure 118: Aligning the coupling tube

2. Insert the lifting gear in the eyebolts of the coupling tube and position vertically above the diverter switch insert.

3. Lift the diverter switch insert slowly and vertically out of oil compartment.

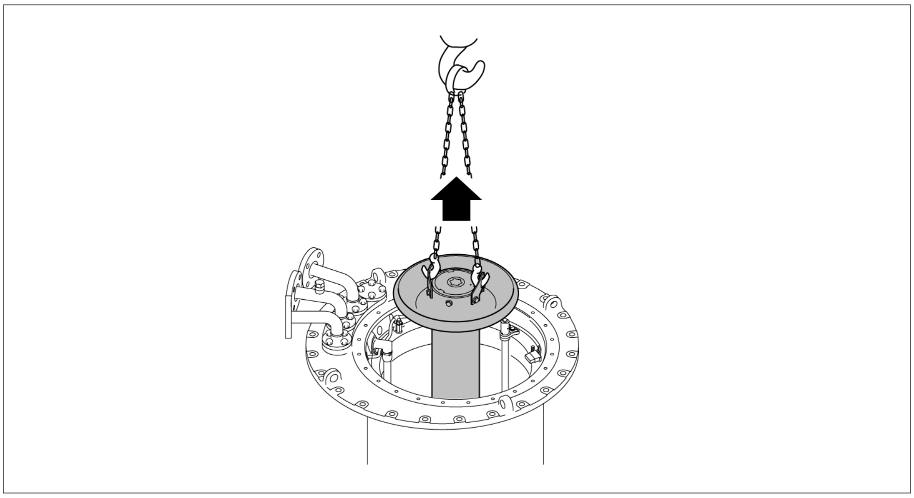


Figure 119: Diverter switch insert

4. **⚠ CAUTION!** Place the diverter switch insert on a level surface and secure it against tipping. An unstably positioned diverter switch insert may tip, resulting in injuries and damage.
5. ***NOTICE!*** Neither operate the diverter switch insert while removed nor change the position of the tap selector coupling.Otherwise, the diverter switch insert may be damaged when being reinstalled.

9.4.2 Opening kerosene drain plug

► ***NOTICE!*** Unscrew kerosene drain plug with extended socket wrench counter-clockwise until it starts to get hard to turn.Never unscrew the kerosene drain plug all the way.

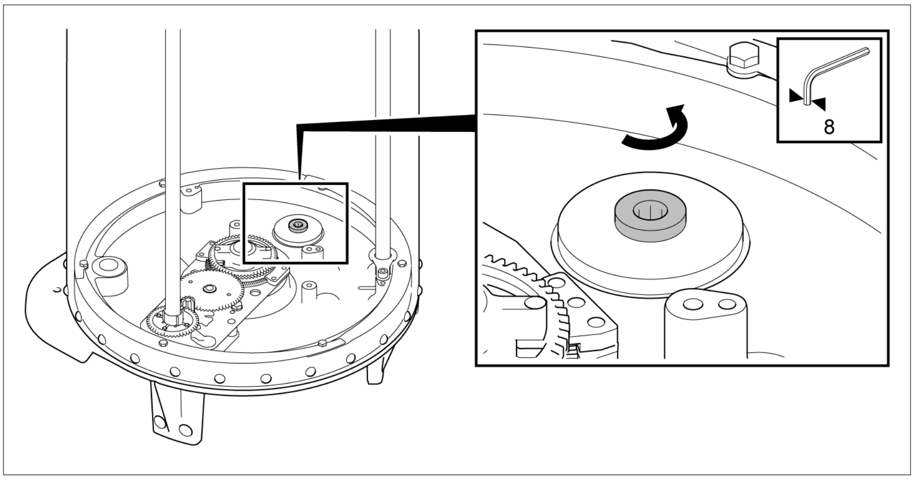


Figure 120: Kerosene drain plug

9.4.3 Inserting diverter switch insert

After you have inserted the diverter switch insert, you have to insert the oil suction pipe, tap-change supervisory control and the tap position indicator and attach the on-load tap-changer head cover.

9.4.3.1 Inserting diverter switch insert

1. Check that all six insulating shims are present in the energy accumulator carrier.

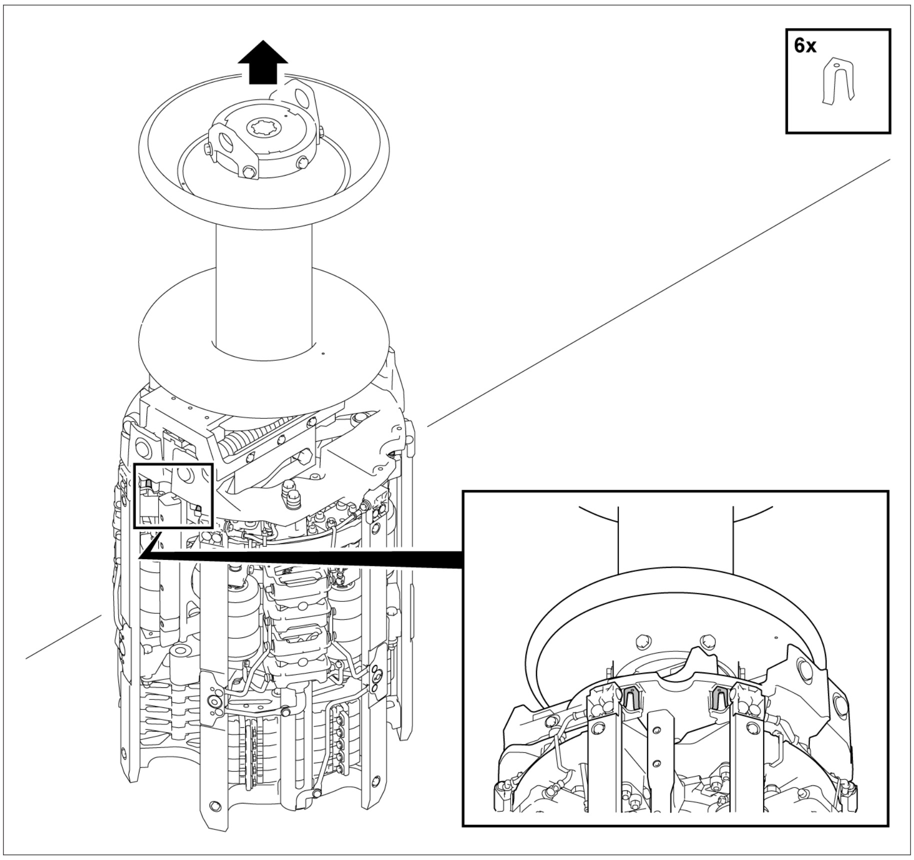


Figure 121: Insulating shim

2. To fit the diverter switch insert, ensure that the tap selector coupling is in the adjustment position.

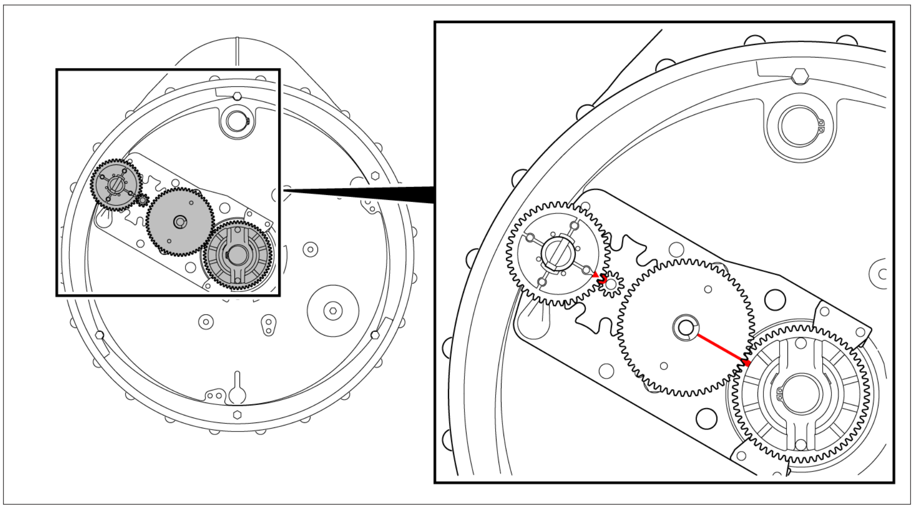


Figure 122: Adjustment markings in oil compartment base VACUTAP® VRC/VRE

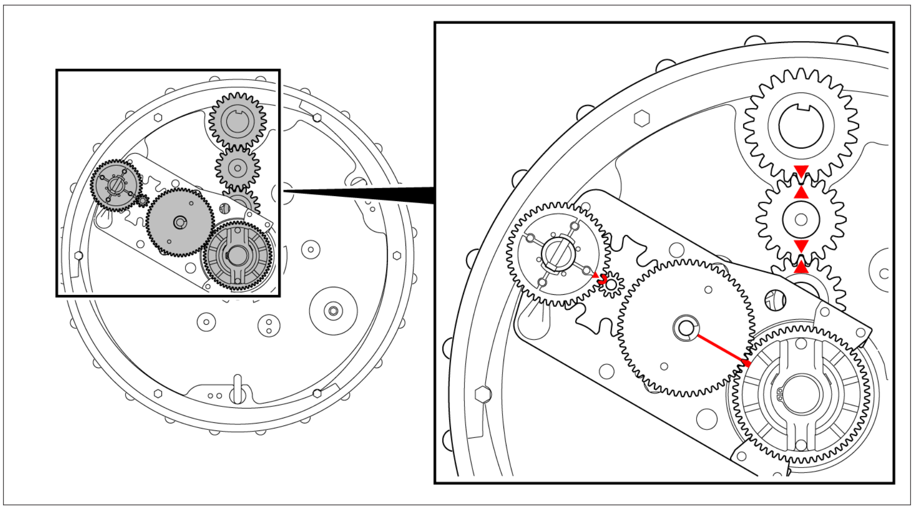


Figure 123: Adjustment markings in oil compartment base VACUTAP® VRD/VRF

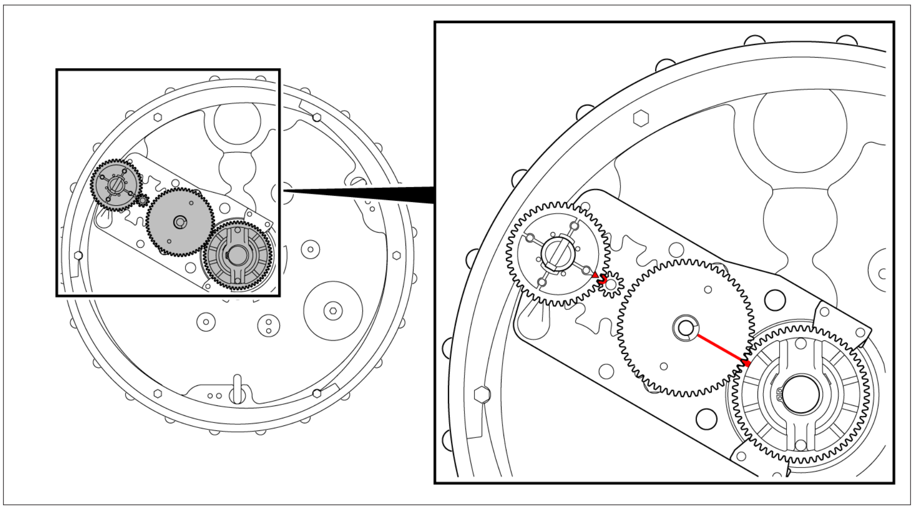


Figure 124: Adjustment markings in oil compartment base VACUTAP® VRG

3. Ensure that the diverter switch insert's energy accumulator is interlocked (the energy accumulator's eccentric disk is at its highest point).
4. Attach lifting gear to diverter switch insert and position diverter switch insert over oil compartment.
5. Align diverter switch insert such that the red markings at the top of the energy accumulator and on the on-load tap-changer head are opposite one another.

6. Slowly lower diverter switch insert until it meets the oil compartment base.

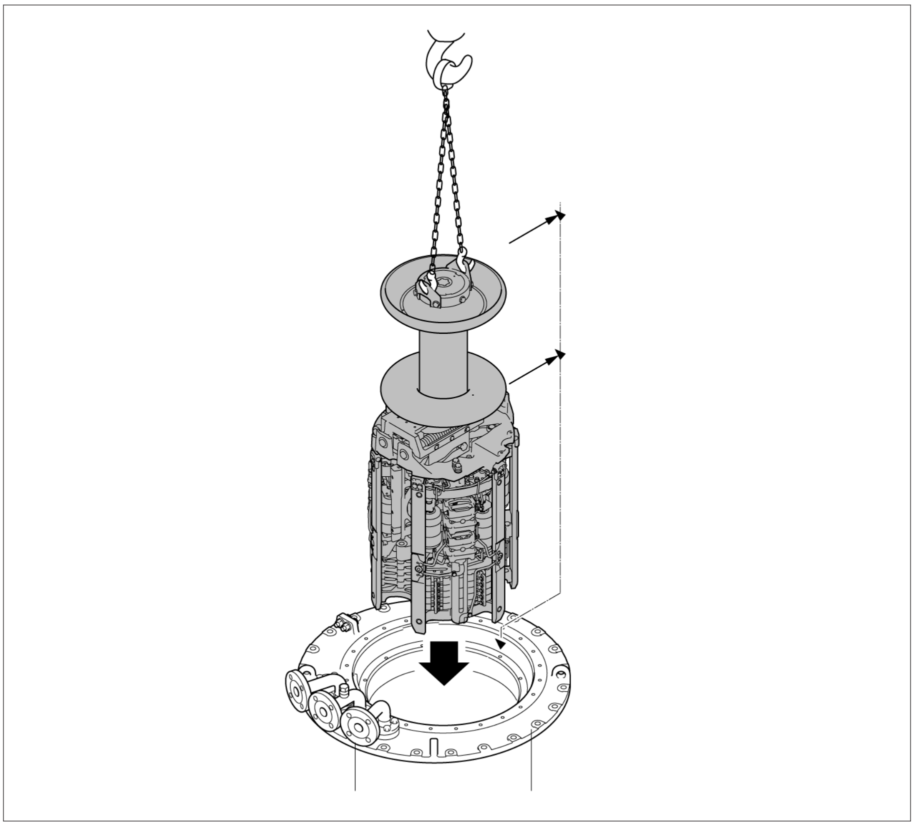


Figure 125: Markings

7. Carefully press until energy accumulator carrier is in position. The shape of the tap selector coupling ensures that coupling is only possible in the correct position.

8. Check the distance between the upper edge of the diverter switch insert coupling tube and the on-load tap-changer head flange. The distance is 10 ± 2 mm (cover mounting and bell-type tank mounting).

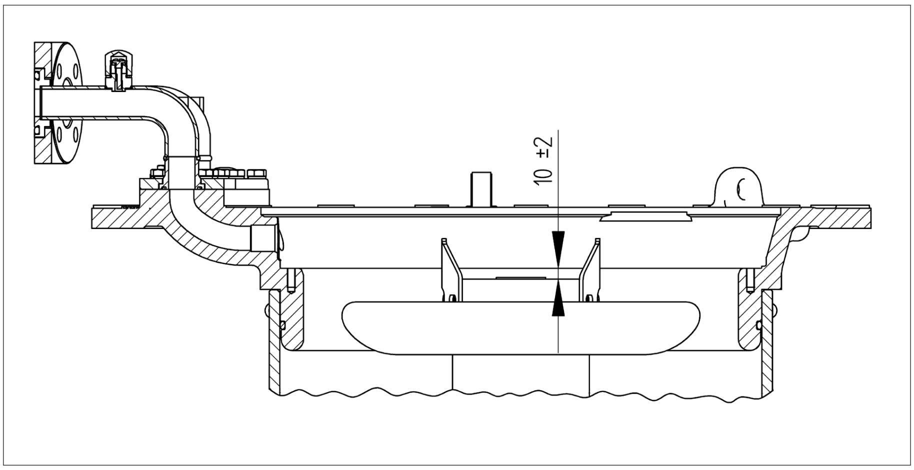


Figure 126: Distance between the upper edge of the coupling tube and the on-load tap-changer head flange

9.4.3.2 Inserting oil suction pipe

NOTICE

Damage to the on-load tap-changer!

Damage to the on-load tap-changer and oil suction pipe due to incorrect order of installation.

► Strictly adhere to the order of installation. Make sure to always install the diverter switch insert before inserting the oil suction pipe into the oil compartment.

1. Insert the oil suction pipe into the on-load tap-changer head.

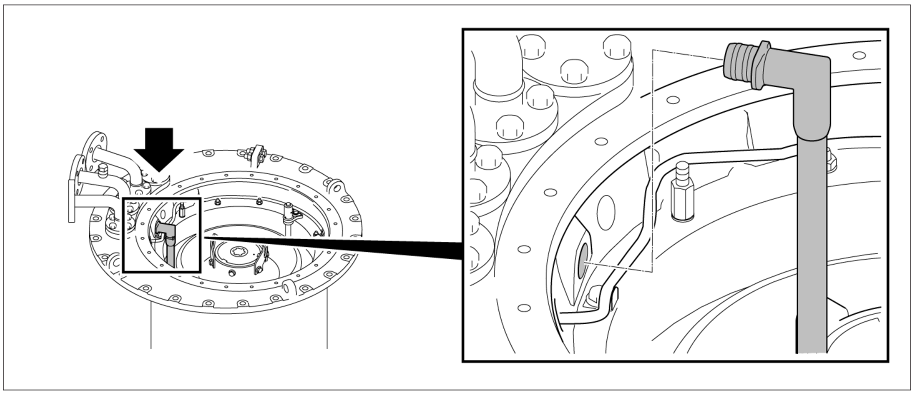


Figure 127: Inserting oil suction pipe

2. Fasten oil suction pipe on retaining bracket with cable tie.

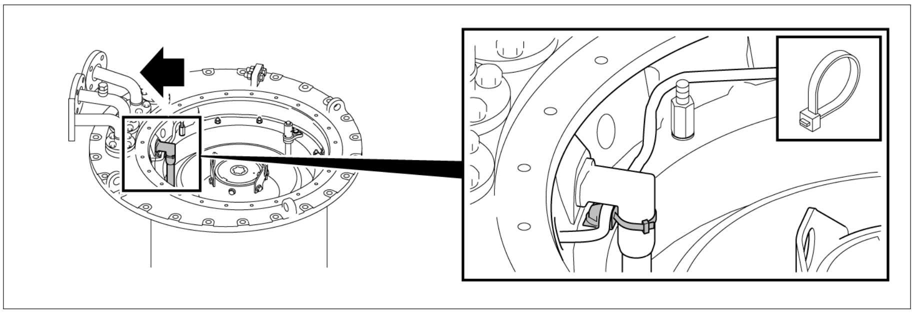


Figure 128: Fastening the oil suction pipe

9.4.3.3 Inserting tap-change supervisory control (if present)

1. Insert tap-change supervisory control with mounting plate and drive shaft.

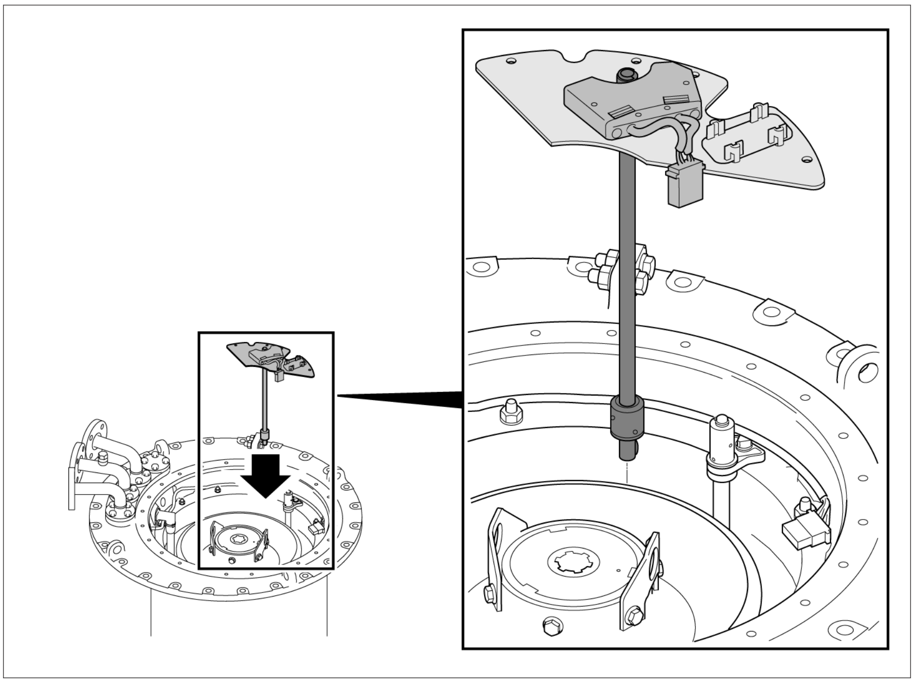


Figure 129: Mounting plate with drive shaft

2. Check that drive shaft feather key is seated correctly in groove.

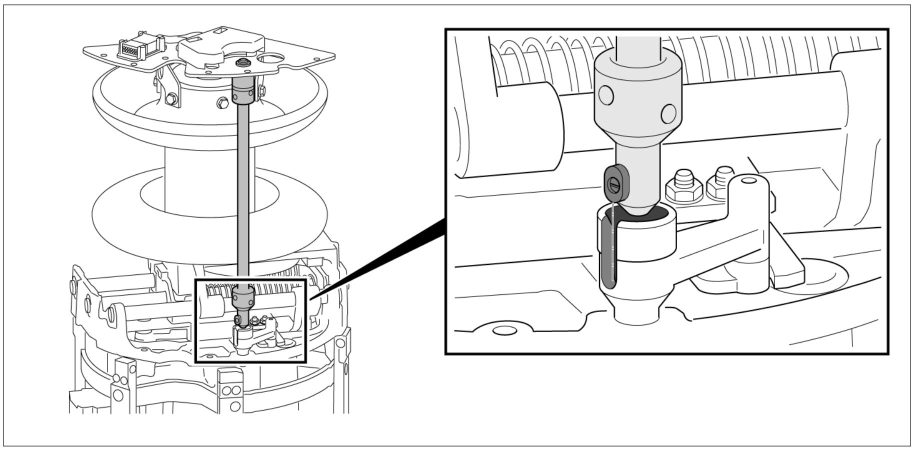


Figure 130: Feather key and groove

3. Secure mounting plate (3 or 4 nuts and locking washers depending on model).

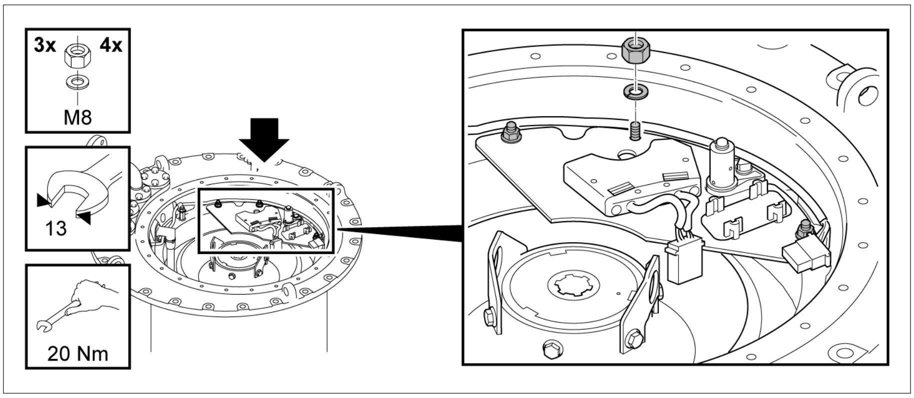


Figure 131: Mounting plate

4. Connect plug connector outside its bracket.

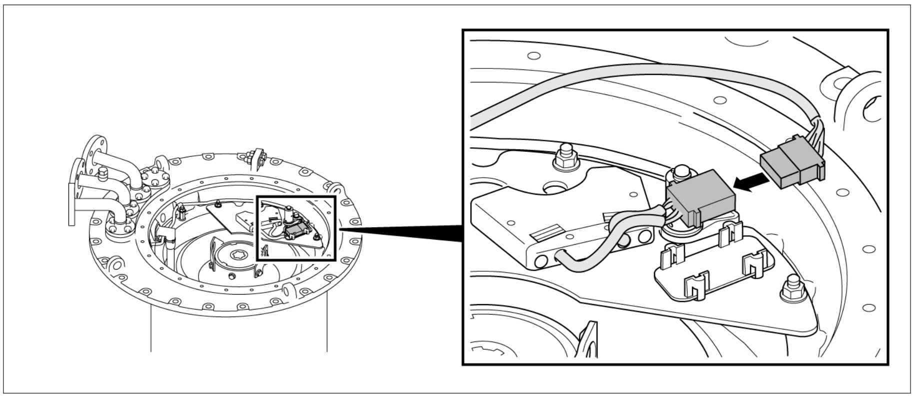


Figure 132: Plug connector

5. Insert plug connector into the bracket.

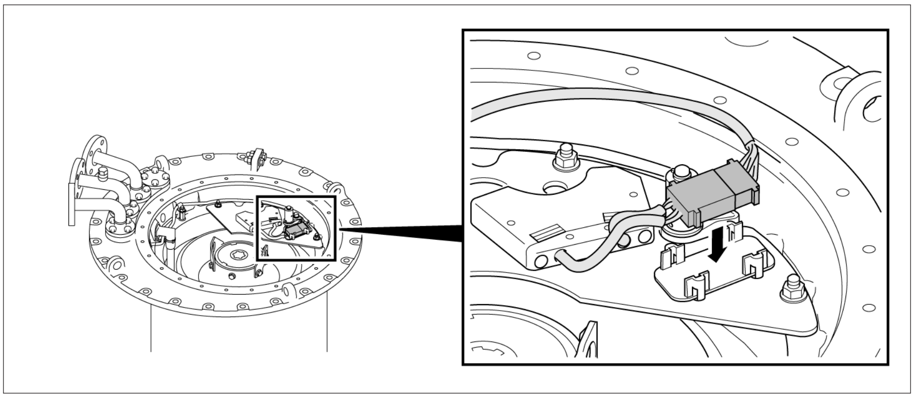


Figure 133: Plug connector in bracket

6. Attach Teflon strip with nut onto stud bolts.

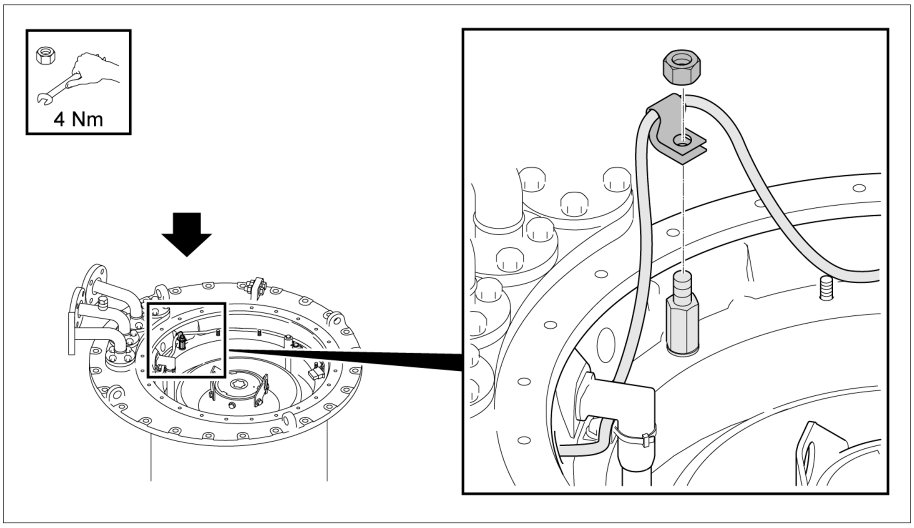


Figure 134: Stud bolt with Teflon strip and nut

9.4.3.4 Inserting the tap position indicator without multiple coarse change-over selector

Due to the coupling pin, the tap position indicator disc can only be installed when in the correct position.

► Place tap position indicator disk on indicator drive shaft, slide spring clip on to shaft end.

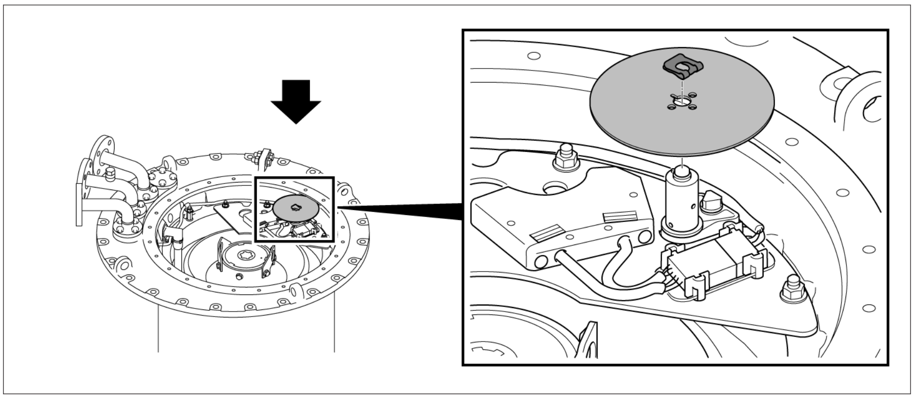


Figure 135: Tap position indicator disk

9.4.3.5 Inserting tap position indicator of multiple coarse change-over selector with more than 35 operating positions

1. Place panel with bracket on indicator drive shaft and secure with hexagon screws and associated lock tab.

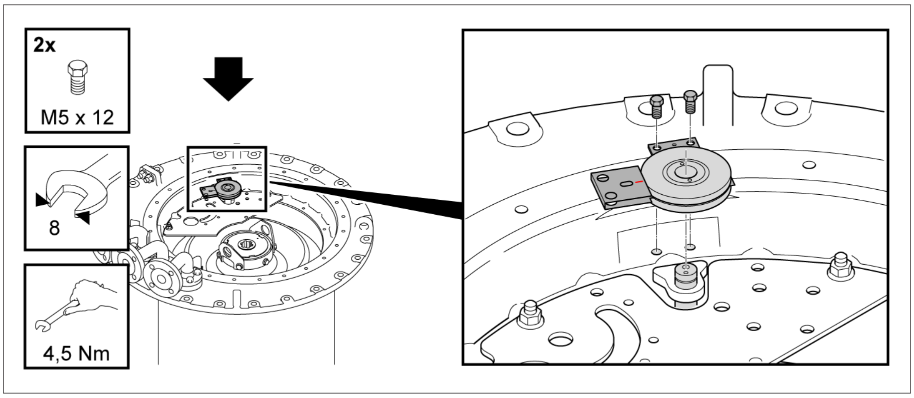


Figure 136: Panel

2. Insert position-indication disk horizontally between panel and bracket and fit cover disk. Align tap position indicator disc and cover disk to produce a continuous red line.

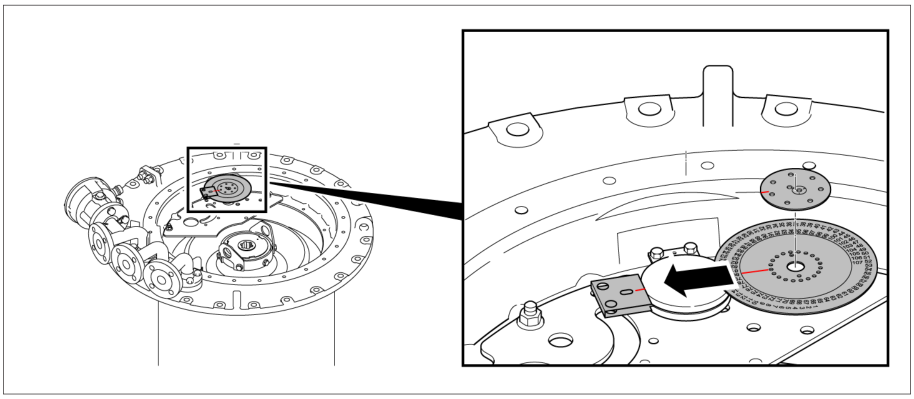


Figure 137: Position-indication disk

3. Secure cover disk with countersunk head screw. The countersunk head screw must be suitable for center-punching.

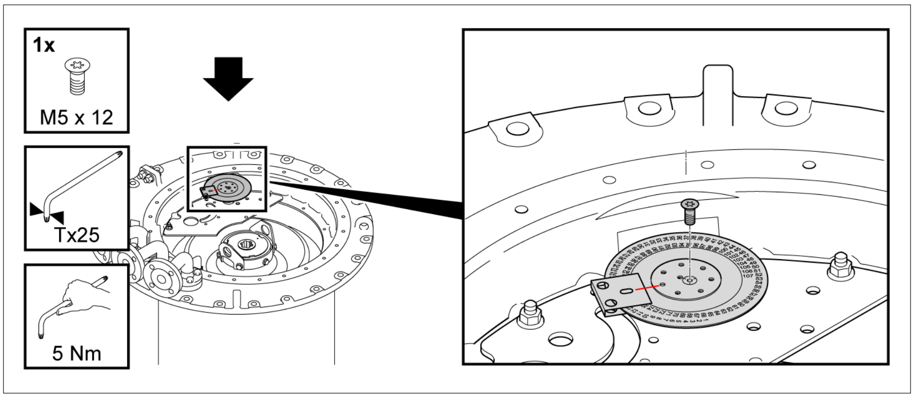


Figure 138: Cover disk

4. Secure countersunk head screw by center-punching.

9.4.3.6 Securing on-load tap-changer head cover

1. **NOTICE!** Place the on-load tap-changer head cover on the on-load tap-changer head and take care not to damage the o-ring inserted in the on-load tap-changer head cover. A damaged o-ring will cause oil to escape

from the diverter switch oil compartment, resulting in on-load tap-changer damage. Also ensure that the red triangular marks on the on-load tap-changer head and the on-load tap-changer head cover match up.

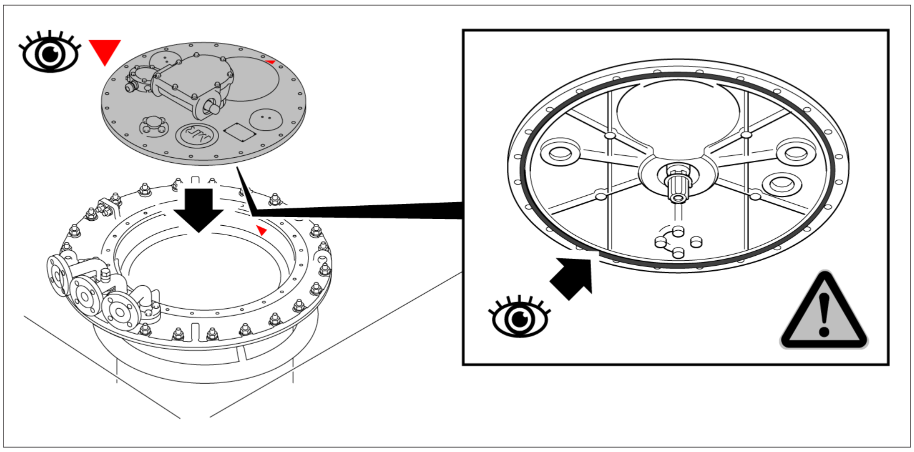


Figure 139: On-load tap-changer head cover with o-ring

2. Screw on-load tap-changer head cover using screws and locking washers.

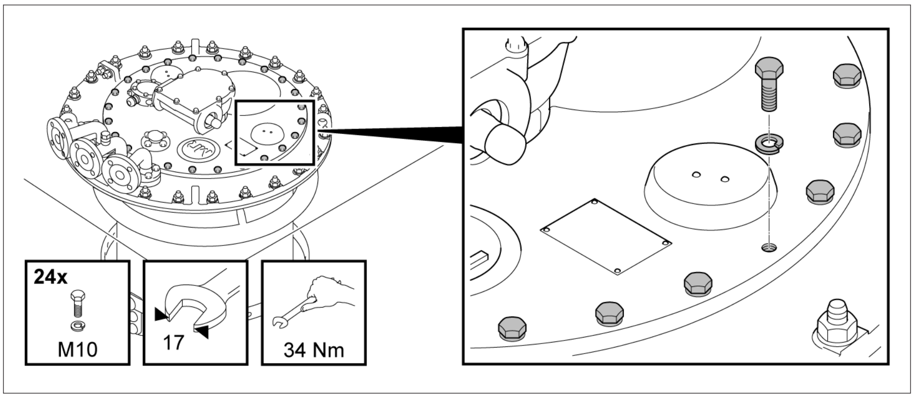


Figure 140: On-load tap-changer head cover

9.4.4 Drying the on-load tap-changer

1. Connect pipe connections R and Q of on-load tap-changer head to the kerosene vapor lead using one shared lead.

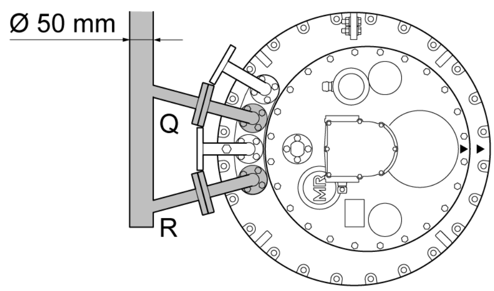


Figure 141: Shared lead

2. Seal off unused pipe connections with a suitable blank cover.
3. Supply kerosene vapor at a temperature of around 90 °C. Keep this temperature constant for about 3 to 4 hours.
4. Increase the kerosene vapor temperature by approx. 10 °C/hour to the desired final temperature (125 °C maximum on the on-load tap-changer).
5. Vacuum dry on-load tap-changer at between 105 °C and maximum 125 °C. Residual pressure of no more than 10^{-3} bar. The drying period depends on the drying period of the transformer but should be at least 50 hours.

9.4.5 Closing kerosene drain plug

1. Remove diverter switch insert [▶ 88].
2. Close kerosene drain plug with extended socket wrench by turning clockwise (tightening torque 20 Nm).
3. Insert diverter switch insert [▶ 97].

10 Filling the oil compartment of the on-load tap-changer with oil

After drying, completely fill the oil compartment (diverter switch insert fitted) with oil again as soon as possible so that an impermissible amount of humidity is not absorbed from the surroundings.

When filling the oil compartment and its oil conservator, use only new mineral insulating oil for transformers in accordance with IEC 60296 (Specification for unused mineral insulating oils for transformers and switchgear).

1. Establish a connecting lead between the pipe connection E2 and one of the pipe connections R, S or Q to ensure equal pressure during evacuation in the oil compartment and transformer.

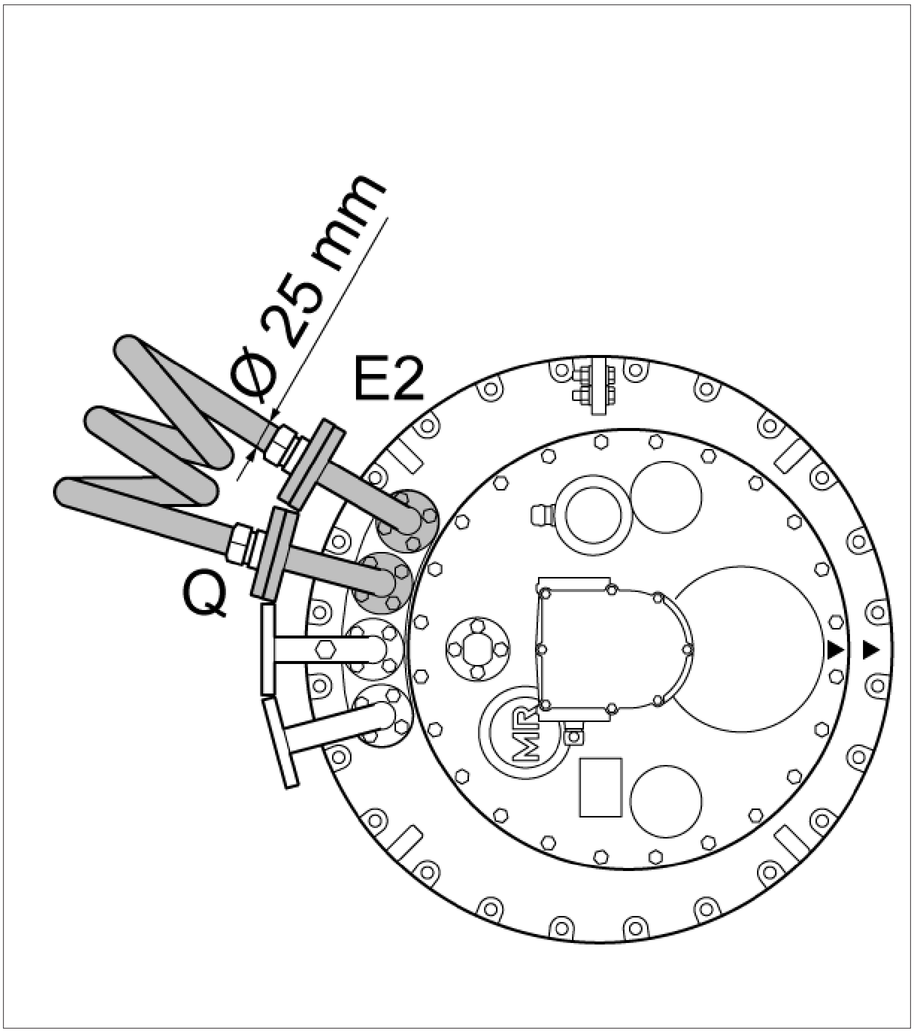


Figure 142: Connecting lead between E2 and Q.

2. Fill on-load tap-changer with oil using one of the remaining pipe connections of the on-load tap-changer head.

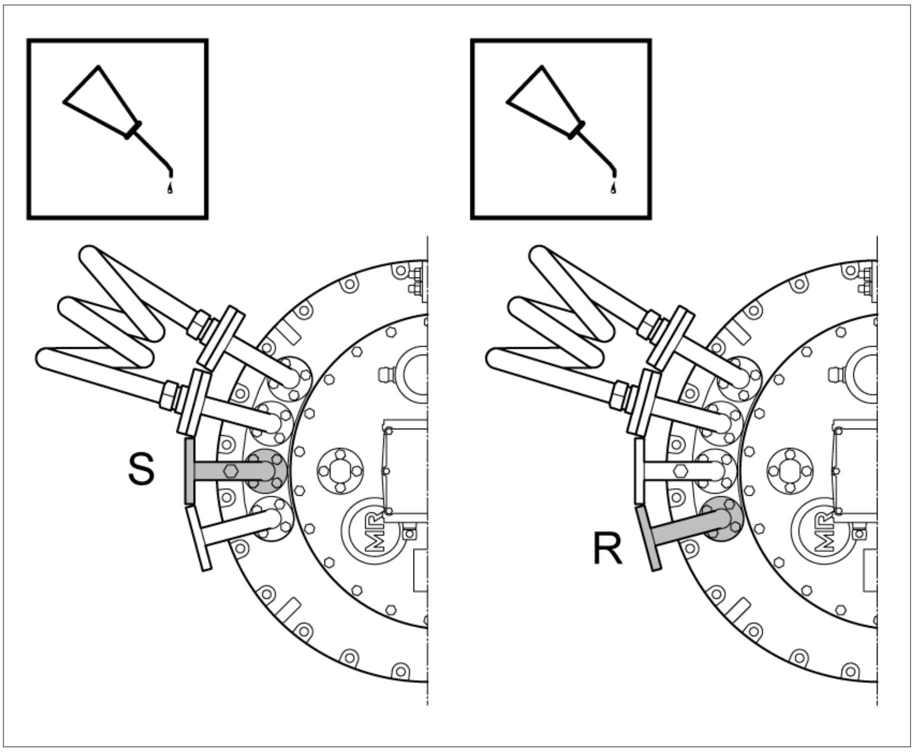


Figure 143: Pipe connection S and R

NOTICE

Damage to the on-load tap-changer!

Damage to the on-load tap-changer by actuating the on-load tap-changer without oil!

► Before actuating the on-load tap-changer for the first time, the tap selector must be completely immersed in transformer oil and the oil compartment completely filled with oil.

► The on-load tap-changer can be operated in the temperature range of the surrounding transformer oil of between -25 ° and +105 °C and with overload up to +115 °C in accordance with IEC 60214-1.

11 Fitting tap-change supervisory control, protective relay and drive components

11.1 Connecting tap-change supervisory control (if present)

► Connect monitoring contacts integrated in on-load tap-changer head (terminal box on pipe connection Q,) to corresponding motor-drive unit terminals using connecting lead (see connection diagram of relevant motor-drive unit).

11.2 Fitting RS protective relay

► Fit protective relay as described in relevant MR operating instructions "RS protective relay".

11.3 Fitting motor-drive unit

► Fit motor-drive unit as described in relevant MR operating instructions "TAPMOTION® ED".

11.4 Fitting bevel gear

The stamped serial number of the bevel gear must match the serial number of the on-load tap-changer.

The horizontal drive shaft must align with the shaft end of the upper gear unit on the on-load tap-changer head.

► Attach bevel gear to support on the transformer cover with 2 bolts (through-holes 18 mm in diameter).

The information provided above applies analogously to special design bevel gears and angle gears, as well as to intermediate bearings of the vertical or horizontal drive shaft.

11.5 Fitting horizontal and vertical drive shaft

NOTICE

Damage to the on-load tap-changer!

Damage to the on-load tap-changer due to incorrect alignment of the upper gear unit!

► Only align upper gear unit if pressure segments are loosened.

► Only align upper gear unit by turning drive shaft of upper gear unit.

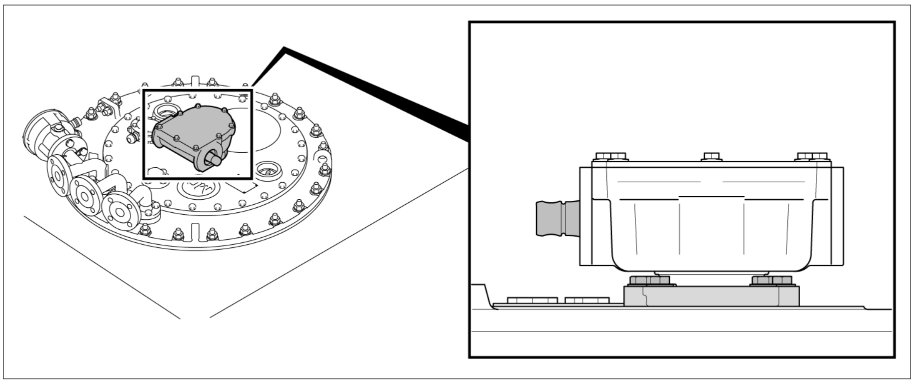


Figure 144: Upper gear unit

1. Install horizontal and vertical drive shaft as described in MR operating instructions "Drive shaft".
2. Couple drive shafts with motor-drive unit and on-load tap-changer as described in MR operating instructions "TAPMOTION® ED".

11.5.1 On-load tap-changer sets and combinations

Due to the special arrangement of three and two-column designs, the on-load tap-changer heads must be coupled together above the transformer cover.

Proceed as follows:

1. Check that the operating positions of all on-load tap-changers are identical (inspection window in the on-load tap-changer head). Each on-load tap-changer must be in the adjustment position.
2. Loosen pressure segments of upper gear units by loosening the 6 bolts M8/wrench 13.
3. ***NOTICE!*** Only move upper gear units into the installation position desired by turning drive shafts of upper gear units with loosened pressure segments.Otherwise, the on-load tap-changer may be damaged when aligning the upper gear unit.
4. Lock and secure pressure segments (tightening torque 15 Nm).
5. Note arrow on drive shaft flange under the stamped serial number. The direction of the arrow indicates the direction of rotation when turning the hand crank of the motor-drive unit clockwise and must be identical for all gear units.
6. Move each on-load tap-changer separately one step by rotating the shaft ends counter-clockwise until the diverter switch operates once.
7. Check that the operating positions of all on-load tap-changer heads are the same.
8. Fit horizontal drive shaft between the on-load tap-changer heads. Individually couple each on-load tap-changer. Start with the on-load tap-changer located closest to the motor-drive unit.

9. After installing all drive shafts, continue cranking another 2.5 revolutions counter-clockwise on the drive shaft of the upper gear unit to correctly complete the tap-change operation.
10. Move on-load tap-changer back into adjustment position by turning drive shaft clockwise. Once the adjustment position has been reached and the diverter switch has undergone the tap-change operation, continue cranking another 2.5 revolutions clockwise on the drive shaft of the upper gear unit to correctly complete the tap-change operation.
11. Check simultaneous operation of all on-load tap-changers.
12. Check that the operating positions of all on-load tap-changer heads are the same.
13. Fit vertical drive shaft.

12 Commissioning of on-load tap-changer by transformer manufacturer

12.1 Bleeding on-load tap-changer head and suction pipe

Before first commissioning, the on-load tap-changer head and the suction pipe on pipe connection S must be bled.

12.1.1 Bleeding on-load tap-changer head

1. Open all forward and return valves in the pipe system.
2. Remove screw cap on air-vent valve E1 on the on-load tap-changer head cover.

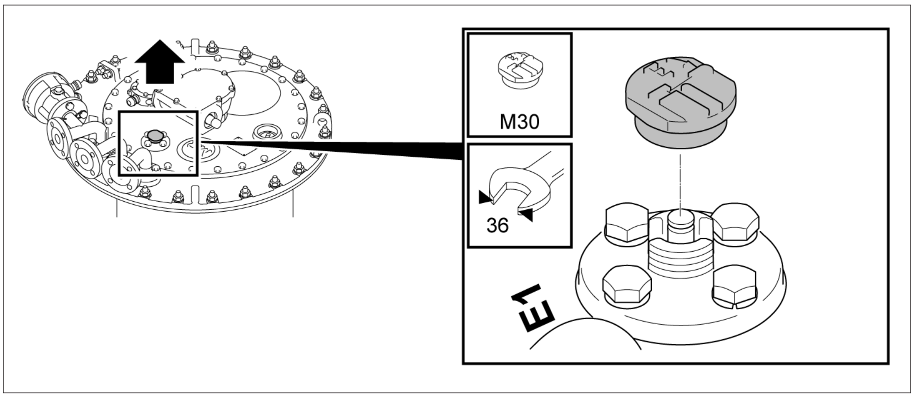


Figure 145: Screw cap

3. Use screwdriver to lift valve tappet on air-vent valve E1 and bleed on-load tap-changer head.

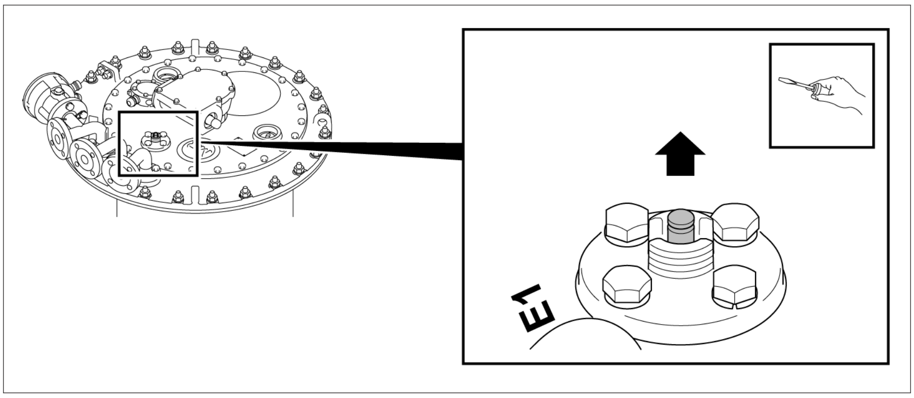


Figure 146: Valve tappet

4. Seal air-vent valve E1 with screw cap (tightening torque 10 Nm).

12.1.2 Bleeding suction pipe on pipe connection S

1. Remove screw cap from pipe connection S.

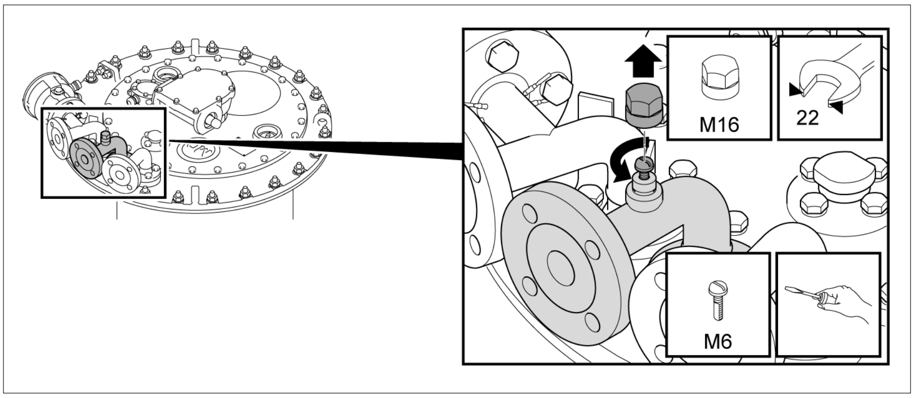


Figure 147: Screw cap

2. Open vent screw and bleed piping.
3. Close vent screw (tightening torque 2 Nm).
4. Seal vent screw with screw cap (tightening torque 9 Nm).

12.2 Performing trial tap-change operations

Before energizing the transformer, test tap change operations must be carried out to check the mechanical functions of on-load tap-changer and motor-drive unit.

NOTICE

Damage to the on-load tap-changer!

Damage to the on-load tap-changer by actuating the on-load tap-changer without oil!

- ► Before actuating the on-load tap-changer for the first time, the tap selector must be completely immersed in transformer oil and the oil compartment completely filled with oil.
- ► The on-load tap-changer can be operated in the temperature range of the surrounding transformer oil of between -25 ° and +105 °C and with overload up to +115 °C in accordance with IEC 60214-1.

1. Undertake tap change operation tests across entire range of settings.
2. *NOTICE!* Make sure that in each operating position the tap position indicators of motor-drive unit and on-load tap-changer (inspection window in the on-load tap-changer head) read the same position. An incorrectly coupled motor-drive unit will damage the on-load tap-changer.
3. Check, in both end positions, the function of the electrical and mechanical end stop (see operating instructions for the "TAPMOTION® ED").

12.3 Grounding the on-load tap-changer

1. Connect the grounding screw on the on-load tap-changer head to the transformer cover.

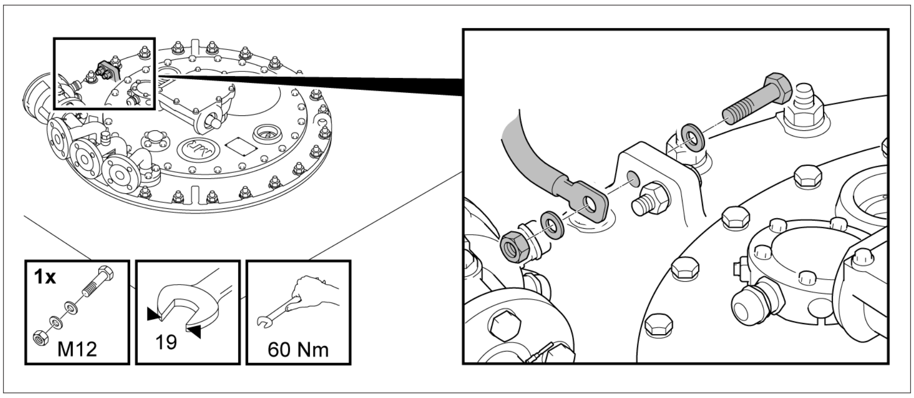


Figure 148: Head grounding screw

2. Connect the grounding screw (M12, wrench size 19, tightening torque 60 Nm) of the motor-drive protective housing to the transformer tank.
3. When using a temperature sensor, ground the temperature sensor housing on the on-load tap-changer using the grounding cable on the transformer.

12.4 Electrical high-voltage tests on the transformer

⚠ WARNING

Danger of death or severe injury!

Danger of death or severe injury from explosive gases under the on-load tap-changer head cover, in the pipework system, in the oil conservator, at the dehydrating breather opening and from flying parts and hot oil splashing!

- ▶ Ensure that there are no naked flames, hot surfaces or sparks (for example caused by static charging) in the immediate surroundings and that none occur.
- ▶ Only use conductive and grounded hoses, pipes and pump equipment that are approved for flammable liquids.
- ▶ Use suitable personal protective equipment/clothing.
- ▶ Keep away from the danger area during the transformer test.
- ▶ Observe applicable fire protection regulations.
- ▶ Make sure that only trained technicians perform work on the transformer.

Every on-load tap-changer has been specially designed by the manufacturer for the transformer in the respective purchase order and is subjected to strict tests and quality controls at the manufacturer's factory.

However, joint operation of transformer and on-load tap-changer cannot be simulated by the manufacturer and cannot be tested on the on-load tap-changer alone.

For this reason, irregularities or malfunctions cannot be ruled out completely during verification of the initial simultaneous operation of the transformer and the on-load tap-changer.

It is absolutely mandatory that all the on-load tap-changer protective devices provided are ready for operation.

In extreme cases, the on-load tap-changer cover may burst with the accompanying danger of flying parts or hot oil being sprayed out.

For this reason, it is essential that you ensure only trained, instructed expert personnel who are familiar with and comply with the pertinent safety and technical regulations, who are aware of the potential risks, and who consistently use the occupational safety equipment provided to prevent injury and property damage are assigned to perform such a transformer test.

Note the following points for the electrical high-voltage tests on the transformer:

- Ensure that the ground connections on the motor-drive protective housing and motor-drive protective housing fastening are free of paint.
- Only perform high voltage test if motor-drive unit door is closed.
- Disconnect external connections to electronic components in the motor-drive unit to prevent damage from overvoltage.
- When connecting the motor-drive unit's supply voltage, only use the holes in the protective housing base intended for lead insertion.
- Guide all ground connecting leads to one central connection point (establishment of suitable reference ground).
- Disconnect all electronic components before the high voltage test. Before a wiring dielectric test, remove all devices with a withstand voltage of < 1000 V.
- Leads used for testing must be removed before the high voltage test, as these function as antennas.
- Wherever possible, route the measurement and data leads separately from the energy cables.

If you have any questions about possible sources of danger, consult the manufacturer before starting to test the transformer.

The electrical tests required for transformer acceptance may only be undertaken once the aforementioned work is complete.

13 Transporting the transformer to the installation site

⚠ WARNING

Danger of death or severe injury!

Danger of death or severe injury from explosive gases under the on-load tap-changer head cover, in the pipework system, in the oil conservator or at the dehydrating breather opening!

► Ensure that there are no naked flames, hot surfaces or sparks (for example caused by static charging) in the immediate surroundings and that none occur.

13.1 Transport with removed motor-drive unit

If you have to remove the drive to transport the transformer, proceed as follows:

1. Ensure that the drive and the on-load tap-changer/off-circuit tap-changer are in the adjustment position.
2. Remove the drive.
3. Do not actuate the drive while the on-load tap-changer/off-circuit tap-changer is not coupled.
4. Do not actuate an on-load tap-changer/off-circuit tap-changer which is not coupled.
5. Transport the drive to the installation site in the MR delivery packaging.

► Fit the motor-drive unit to the transformer at the installation site in accordance with the MR operating instructions "TAPMOTION® ED" and "Drive shaft".

13.2 Transport with oil fill and without oil conservator

If the transformer is filled with oil but stored or transported without an oil conservator, a connecting lead for pressure compensation must be installed between the interior of the compartment and the transformer tank's oil chamber.

To do so, proceed as follows:

► Establish the connecting lead on the on-load tap-changer head between connections E2 and Q or E2 and R.

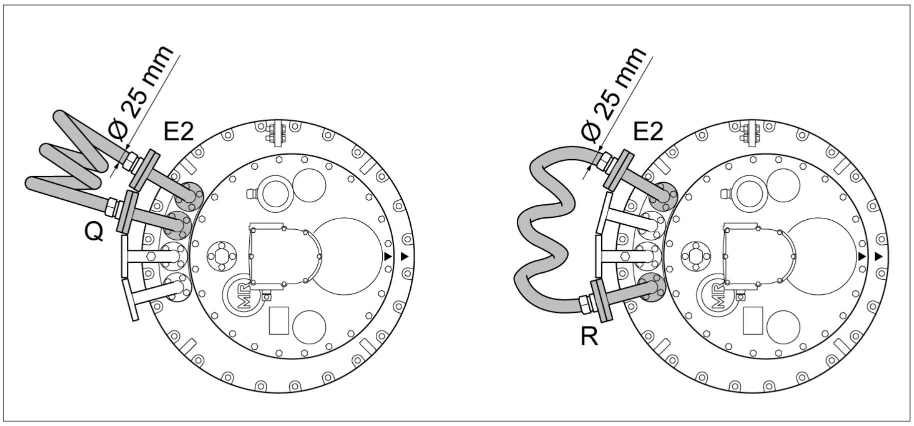


Figure 149: Connecting lead

In case of a short-term immobilization time of maximum 4 weeks without an oil conservator, dropping the oil level in the on-load tap-changer head by about 5 liters is also sufficient.

13.3 Transport without oil fill

1. **NOTICE!** Completely empty the oil compartment of the on-load tap-changer if the transformer is completely emptied of oil.If this is not done, the oil compartment may be damaged.
2. Preserve the interior of the oil compartment in the same way as the transformer (for example by filling with N2).

For longer immobilization periods, the motor-drive unit heating must be connected and operated.

For downtimes prior to commissioning of more than 8 weeks and operation interruptions more than 2 weeks, the heating must be connected and switched on to avoid condensation water in the interior of the protective housing.

13.3.1 Emptying the oil compartment by using the oil suction pipe

⚠ WARNING

Danger of death or severe injury!

Danger of death or severe injury from explosive gases under the on-load tap-changer head cover!

- ▶ Ensure that there are no naked flames, hot surfaces or sparks (for example caused by static charging) in the immediate surroundings and that none occur.
- ▶ De-energize all auxiliary circuits (for example tap-change supervisory control, pressure relief device, pressure-operated relays) before removing the on-load tap-changer head cover.
- ▶ Do not operate any electric devices during the work (for example risk of sparks caused by impact wrench).
- ▶ Only use conductive and grounded hoses, pipes and pump equipment that are approved for flammable liquids.

1. De-energize all auxiliary circuits (for example the tap-change supervisory control, pressure relief device, pressure-operated relays).
2. If the stop-cock (slide valve) between the oil conservator and oil compartment is open, open the air-vent valve E1 on the on-load tap-changer head.
3. Drain off the gas from under the on-load tap-changer cover. Ensure sufficient fresh air (for example in transformer cells and work tents).
4. Once the gas has been drained off and the oil is flowing out of the air-vent valve, close this valve and close the stop-cock between the oil conservator and oil compartment.
5. Open air-vent valve again and drain off around 5–10 liters of oil via the drain pipe until the area under the on-load tap-changer head cover is free of oil.
6. Loosen 24 screws M10/wrench size 17 with locking washers on on-load tap-changer head cover.
7. Remove the on-load tap-changer head cover.
8. Extract oil via pipe connection S.
9. Open stop-cock between oil conservator and oil compartment.
   ⇨ The oil from the oil conservator flows into the oil compartment.
10. Extract oil via pipe connection S.
11. Place the on-load tap-changer head cover on the on-load tap-changer head.
12. Use 24 screws M10/wrench 17 to screw down on-load tap-changer head cover (tightening torque 34 Nm).

14 Commissioning the transformer at the operating site

⚠ WARNING

Danger of death or severe injury!

Danger of death or severe injury from explosive gases under the on-load tap-changer head cover, in the pipework system, in the oil conservator or at the dehydrating breather opening!

► Ensure that there are no naked flames, hot surfaces or sparks (for example caused by static charging) in the immediate surroundings and that none occur.

NOTICE

Damage to the on-load tap-changer!

Damage to the on-load tap-changer by actuating the on-load tap-changer without oil!

► Before actuating the on-load tap-changer for the first time, the tap selector must be completely immersed in transformer oil and the oil compartment completely filled with oil.

► The on-load tap-changer can be operated in the temperature range of the surrounding transformer oil of between -25 ° and +105 °C and with overload up to +115 °C in accordance with IEC 60214-1.

When filling the oil compartment and its oil conservator, use only new mineral insulating oil for transformers in accordance with IEC 60296 (Specification for unused mineral insulating oils for transformers and switchgear).

1. Establish a connecting lead between the pipe connection E2 and one of the pipe connections R, S or Q to ensure equal pressure during evacuation in the oil compartment and transformer.

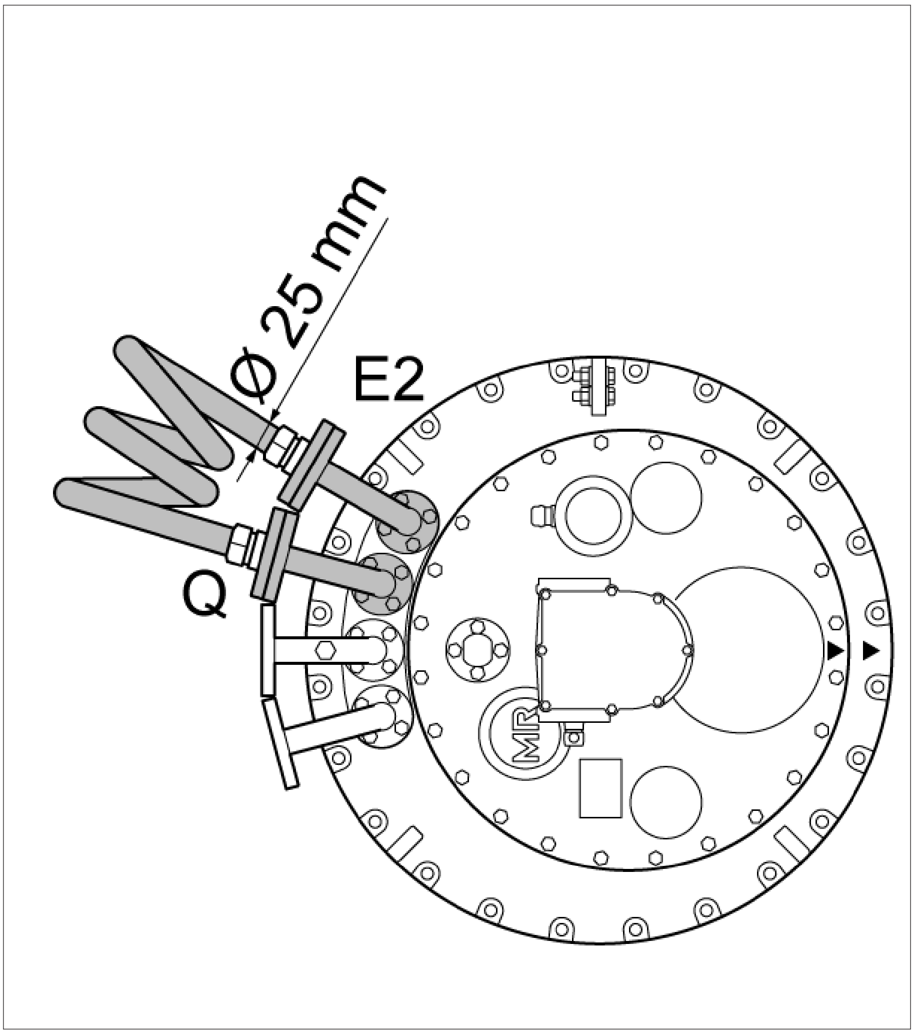


Figure 150: Connecting lead between E2 and Q.

2. Fill on-load tap-changer with oil using one of the remaining pipe connections of the on-load tap-changer head.

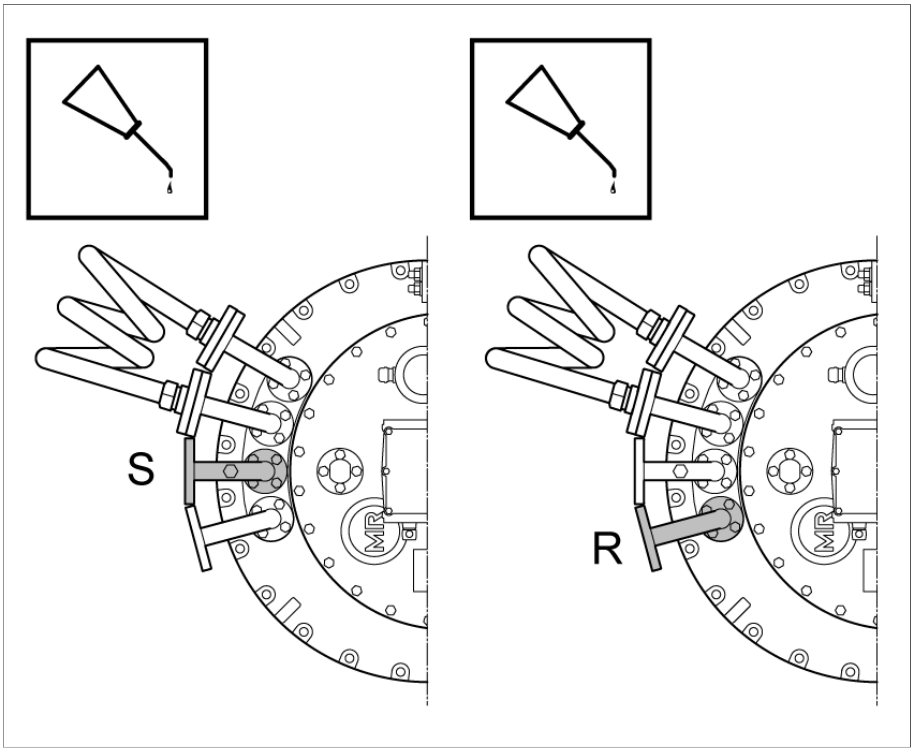


Figure 151: Pipe connection S and R

3. Take oil sample from oil compartment.
4. Record temperature of oil sample just after sample is taken.
5. Determine dielectric strength and water content at a diverter switch oil temperature of 20 °C ± 5 °C. The dielectric strength and water content must comply with the limit values provided in the appendix [▶ 134].
6. Bleed the on-load tap-changer.
7. Carry out [▶ 115] tap change operation tests.
8. Loop in signaling contact for falling below the minimum oil level in the on-load tap-changer's oil conservator in the tripping circuit of the circuit breaker.
9. Check function of protective relay as described in operating instructions "RS Protective relay".

NOTICE

Damage to the on-load tap-changer and transformer!

An inrush current impulse which has not fully subsided can damage the on-load tap-changer and transformer in the event of an on-load tap changing operation!

► Once the transformer has been switched on, ensure that the inrush current impulse has fully subsided before undertaking an on-load tap changing operation. The inrush current impulses are usually a multiple of the transformer rated current and can overload the on-load tap-changer during the diverter switch operation.

During all function checks and tests when commissioning, in addition to the safety instructions in Chapter 2, also note the safety notice provided in the chapter Electrical high voltage testing on the transformer [▶ 116].

10. After the transformer has been switched on and the inrush current impulse has subsided, on-load tap-changer tap-change operations can be performed both under no load and load conditions.

15 Monitoring during operation

⚠ WARNING

Danger of death or severe injury!

Danger of death or severe injury from explosive gases under the on-load tap-changer head cover, in the pipework system, in the oil conservator or at the dehydrating breather opening!

- ▶ Ensure that there are no naked flames, hot surfaces or sparks (for example caused by static charging) in the immediate surroundings and that none occur.

NOTICE

Damage to the on-load tap-changer!

Damage to the on-load tap-changer!

- ▶ Make sure that the contact that indicates that the oil has fallen below the minimum oil level in the on-load tap-changer's oil conservator was looped through to the tripping circuit of the circuit breaker and that the circuit breaker will immediately de-energize the transformer when the oil falls below this minimum oil level in the oil conservator.
- ▶ Make sure that the protective relay RS and additional protective devices (e.g. pressure relief device MPreC®) were looped through to the tripping circuit of the circuit breaker and that the circuit breaker will immediately de-energize the transformer when the protective relay or additional protective devices have been tripped.

Monitoring the on-load tap-changer and motor-drive unit is limited to occasional visual checks of on-load tap-changer head, protective relay and motor-drive unit. For efficiency reasons these visual checks can be combined with the usual checks on the transformer.

Pay particular attention to the following:

- Oil impermeability at the sealing points of the on-load tap-changer head, protective relay and connected pipes
- Gaskets of the protective housing of the motor-drive unit
- Correct functioning of the installed electrical heater in the protective housing of the motor-drive unit
- Protective relay function test in accordance with respective operating instructions
- Perfect condition of the silica gel breather for the on-load tap-changer oil conservator

The insulating oils in the transformer, including the on-load tap-changer, are to be monitored by the operator following the appropriate rules and regulations.

The oil quality of the on-load tap-changer oil should be checked at regular intervals:

- For on-load tap-changers used on the neutral point of windings (class 1 in accordance with IEC 60214-1): **every 7 years**

- For on-load tap-changers used at points other than the neutral point of windings (class 2 in accordance with IEC 60214-1): **every 2 years**

To do so, proceed as follows:

1. Take oil sample from oil compartment.
2. Record temperature of oil sample just after sample is taken.
3. Determine dielectric strength and water content at a diverter switch oil temperature of 20 °C ± 5 °C. The dielectric strength and water content must comply with the limit values provided in the appendix [▶ 134].

16 Fault elimination

⚠ WARNING

Danger of death or severe injury!

Danger of death or severe injury from explosive gases under the on-load tap-changer head cover!

- ▶ Ensure that there are no naked flames, hot surfaces or sparks (for example caused by static charging) in the immediate surroundings and that none occur.
- ▶ De-energize all auxiliary circuits (for example tap-change supervisory control, pressure relief device, pressure-operated relays) before removing the on-load tap-changer head cover.
- ▶ Do not operate any electric devices during the work (for example risk of sparks caused by impact wrench).
- ▶ Only use conductive and grounded hoses, pipes and pump equipment that are approved for flammable liquids.

NOTICE

Damage to the on-load tap-changer and transformer!

Tripping of the protective relay or other protective devices can indicate damage on the on-load tap-changer and transformer! The transformer must not be energized without first undertaking checks!

- ▶ Check on-load tap-changer and transformer when protective relay or other protective devices have been tripped.
- ▶ Do not use the equipment again until you are sure there is no damage to the on-load tap-changer or transformer.

The table below should offer you help in detecting and if necessary remedying faults.

Do not use the equipment again until you are sure there is no damage to the on-load tap-changer or transformer.

For more information, please consult the operating instructions for the RS protective relay or the relevant protective device.

In the event of faults on the on-load tap-changer and motor-drive unit, which cannot be easily corrected on site, or if the RS protective relay or additional protective devices have been tripped, please inform your authorized MR representative, the transformer manufacturer or contact us directly at:

Maschinenfabrik Reinhausen GmbH
Technischer Service
Postfach 12 03 60
93025 Regensburg
Germany
Phone: +49 94140 90-0

Fax: +49 9 41 40 90-7001
E-mail: service@reinhausen.com
Internet: www.reinhausen.com

Error pattern	Action
Tripping of protective relay (for example RS)	Remove diverter switch insert following maintenance instructions for the on-load tap-changer present. Depending on the reason for the tripping, take measurements/carry out checks on the transformer.
Tripping of pressure relief device (for example MPreC®)	Remove diverter switch insert following maintenance instructions for the on-load tap-changer present. Depending on the reason for the tripping, take measurements/carry out checks on the transformer.
Tripping of pressure-operated relay (for example DW 2000)	Remove diverter switch insert following maintenance instructions for the on-load tap-changer present. Depending on the reason for the tripping, take measurements/carry out checks on the transformer.
Activation of tap-change supervisory control	Remove diverter switch insert following maintenance instructions for the on-load tap-changer present. Depending on the reason for the tripping, take measurements/carry out checks on the transformer.
Activation of rupture disk in on-load tap-changer head cover	Remove diverter switch insert following maintenance instructions for the on-load tap-changer present. Depending on the reason for the tripping, take measurements/carry out checks on the transformer.
Tripping of motor protective switch in motor-drive unit	Request "Information sheet on motor protective switch tripping" from MR, complete and return to MR.
Tripping of signaling contact that indicates that the oil has fallen below the minimum oil level in the on-load tap-changer oil conservator	Check pipework system (pipes etc.) and on-load tap-changer head for leaks. Check oil level and oil quality of diverter switch oil in accordance with operating instructions for on-load tap-changer. If the oil falls below the limit values, also contact MR.
On-load tap-changer not changing tap position (sluggishness, Raise keys/Lower keys not working, diverter switch action not audible)	Contact MR.
No change in voltage on transformer despite change in position on motor-drive unit	Contact MR.
Tap position indicator on motor-drive unit and on-load tap-changer different	Contact MR.
Noises on drive shaft or motor-drive unit when changing tap position	Ensure proper mounting of the drive shaft in accordance with its operating instructions. Check that hose clips and guard plates are seated correctly. Contact MR in the event of noise from the motor-drive unit.

Error pattern	Action
Red message on monitoring unit	If possible read out database and send to MR along with error code.
Warning or tripping of Buchholz relay on transformer	Notify manufacturer of transformer.
Deviation from desired value when measuring winding resistance of transformer	Contact manufacturer of transformer and if necessary MR and provide measured values.
Deviation from desired value during dissolved gas analysis (transformer oil)	Contact manufacturer of transformer and if necessary MR and provide measured values.
Deviation from desired value during transformer ratio test	Contact manufacturer of transformer and if necessary MR and provide measured values.
Deviation from limit value for diverter switch oil values	Carry out oil change, check oil conservator breather of on-load tap-changer.

Table 8: Fault elimination

17 Maintenance

17.1 Scope and execution

The scope and execution of maintenance are determined by the maintenance instructions for the corresponding on-load tap-changer. If the appropriate preparations are made, proper maintenance can be carried out within one day per on-load tap-changer pole.

We strongly recommend having maintenance carried out by our Technical Service department. If this route is taken, in addition to the correct performance of all work, certain components will be upgraded to the latest state of technology and manufacturing status.

If maintenance is not carried out by our Technical Service department, please ensure that the personnel who carry out the maintenance are trained by MR or are otherwise suitably qualified to carry out the work.

In such cases, we would ask you to forward to us a report on the maintenance performed so we can update our maintenance files. For inquiries about spare parts, please provide the serial number (see name plate on on-load tap-changer head and motor-drive unit) and the number of tap-change operations.

17.2 Maintenance intervals

NOTICE

Damage to on-load tap-changer and transformer!

Damage to on-load tap-changer and transformer from non-observance of maintenance intervals and improper maintenance!

- ► Observe maintenance intervals.
- ► Ensure complete and proper maintenance.

Maintenance should be performed on the on-load tap-changer after 300,000 switching operations. A label on the inside of the door of the ED motor-drive unit clearly specifies the relevant maintenance interval. These intervals do not apply when operated together with TAPGUARD.

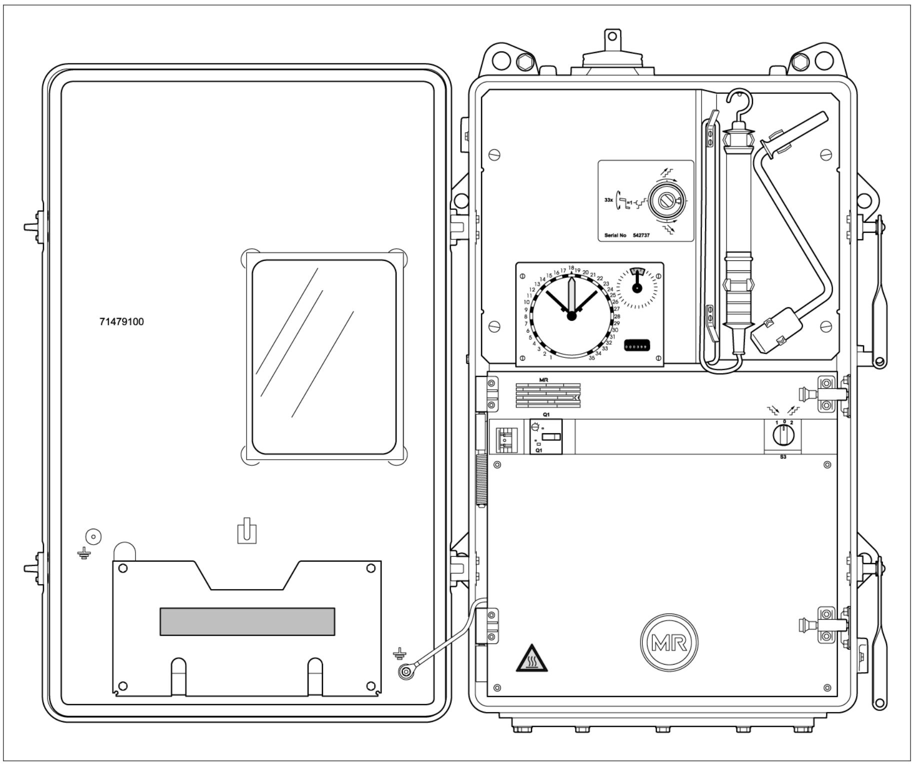


Figure 152: Label showing maintenance intervals

The diverter switch insert must be replaced after 1.2 million switching operations.

After 1.2 million switching operations (motor-drive unit counter reading), the tap selector requires maintenance work.

17.3 Oil change

17.3.1 Oil to use

NOTICE

Damage to the on-load tap-changer!

Damage to the on-load tap-changer resulting from switching the on-load tap-changer at impermissible oil temperatures!

► The on-load tap-changer can be operated in the temperature range of the surrounding transformer oil of between -25 ° and +105 °C and with overload up to +115 °C in accordance with IEC 60214-1.

When filling the oil compartment and its oil conservator, use only new mineral insulating oil for transformers in accordance with IEC 60296 (Specification for unused mineral insulating oils for transformers and switchgear).

The dielectric strength and water content of the diverter switch oil must be determined after filling with oil:

1. Take oil sample from oil compartment.

2. Record temperature of oil sample just after sample is taken.
3. Determine dielectric strength and water content at a diverter switch oil temperature of 20 °C ± 5 °C. The dielectric strength and water content must comply with the limit values provided in the appendix [▶ 134].

17.3.2 Performing oil change

Carry out the oil change in accordance with the maintenance instructions for the corresponding on-load tap-changer (available on request).

Glossary

DC

Abbreviation for "Direct Current"

Dielectric strength

Material-specific property of isolators [kV/2.5 mm]; maximum electrical field strength without a breakdown (arc)

IEC

Abbreviation for "International Electrotechnical Commission"

MR

Abbreviation for "Maschinenfabrik Reinhausen GmbH"

18 Appendix

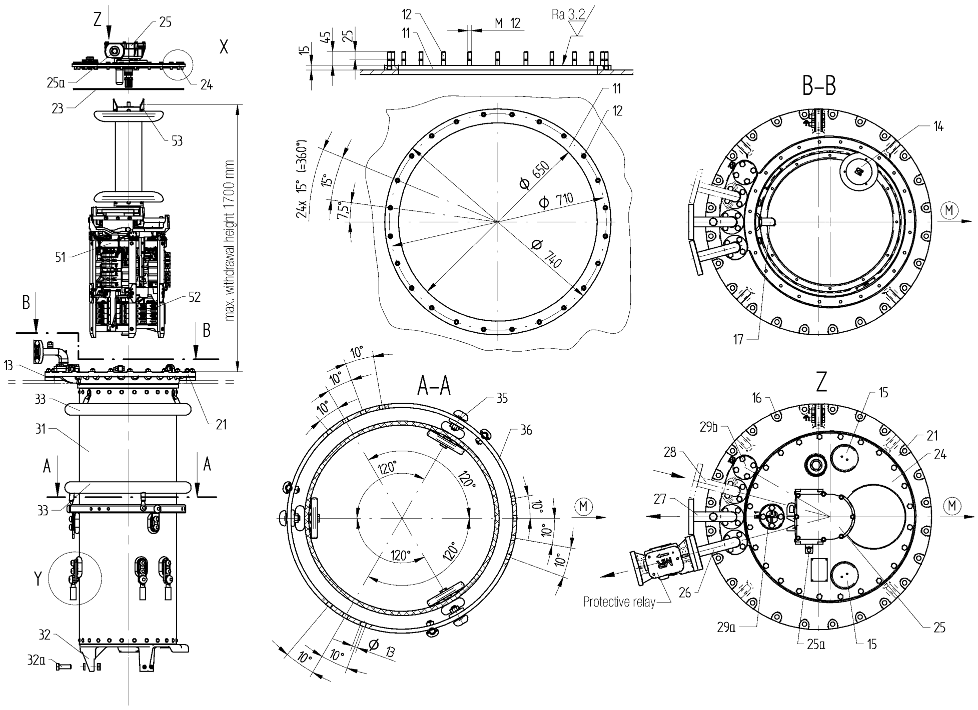
18.1 Limit values for dielectric strength and water content of on-load tap-changer oil

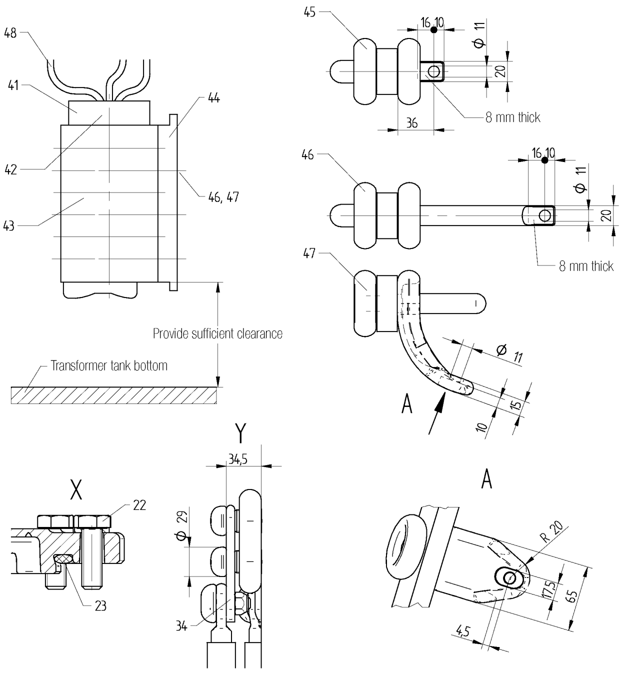
The following table provides the limit values for dielectric strength (measured in accordance with IEC 60156) and water content of the on-load tap-changer oil.

	U_d (kV/2.5 mm)	H_2O (ppm)
When commissioning the transformer for the first time	60 minimum	12 maximum
During operation	30 (minimum)	30 (maximum)
After maintenance	50 (minimum)	15 (maximum)

Table 9: Limit values for on-load tap-changer oil

18.2 VACUTAP® VRC/VRE, installation drawing (899992)





11 Mounting flange on transformer cover
12 Fixing bolt M12
13 Gasket for on-load tap-changer head
14 Remove position indicator disc before withdrawal of diverter switch unit
15 Inspection window
16 Through hole 15 mm DIA
17 Suction pipe

21 On-load tap-changer head
22 Bolt for on-load tap-changer head cover
23 Gasket for on-load tap-changer head cover
24 On-load tap-changer head cover
25 Centric gear unit with drive shaft 25a
26 Pipe connection R for protective relay
27 Pipe connection S with bleeder screw (optional)
28 Pipe connection Q (optional)
29a Bleeder valve of on-load tap-changer head cover
29b Bleeding facility for transformer oil

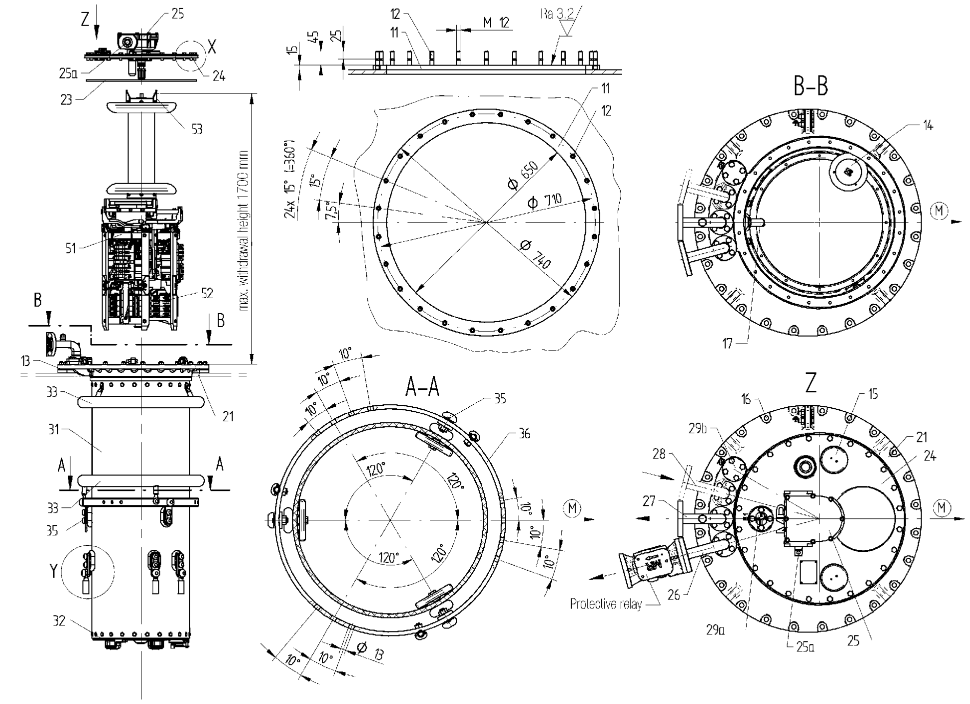
31 Diverter switch oil compartment
32 Oil compartment bottom with tap selector supporting screw 32a
33 Grading rings (with 170 kV, 245 kV, 300 kV only)
34 Terminal of diverter switch oil compartment
35 Connection terminal for on-load tap-changer take-off lead
36 Connection ring for on-load tap-changer take-off lead

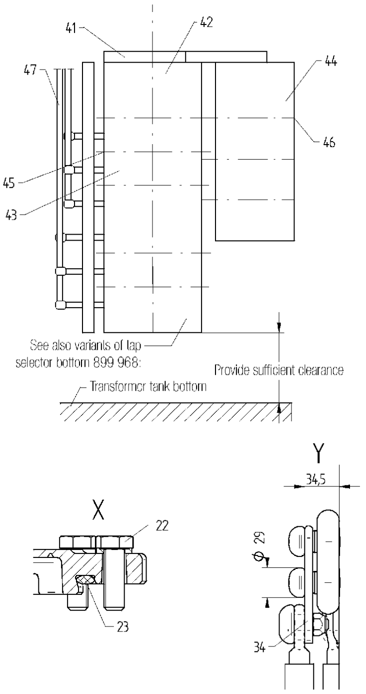
41 Tap selector suspension
42 Tap selector gear
43 Tap selector
44 Change-over selector
45 Tap selector terminals (see corresponding dimension drawing)
46 Change-over selector terminal "K" and/or "0"
47 Change-over selector terminal "+" and/or "–"
48 Connection lead for tap selector

51 Diverter switch unit
52 Transition resistors
53 Carrying ring

M Change-over selector side

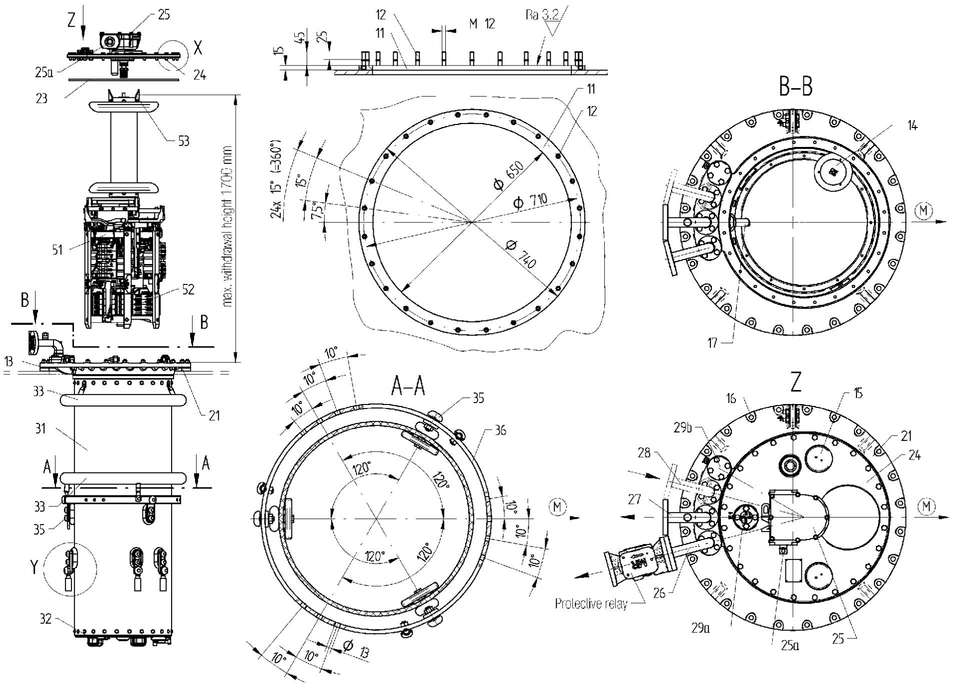
18.3 VACUTAP® VRD/VRF, installation drawing (899898)

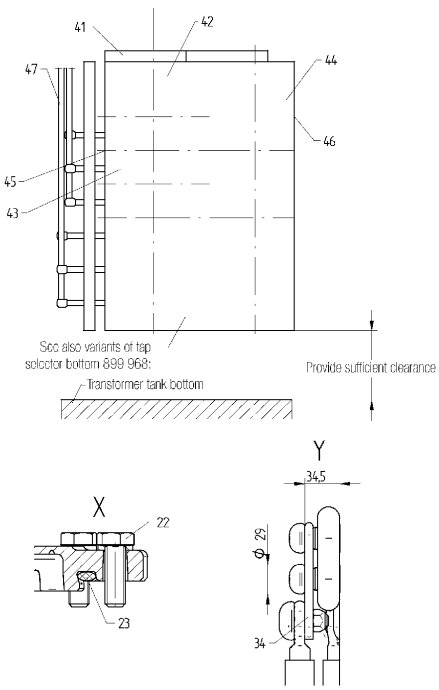




11	Mounting flange on transformer cover
12	Fixing bolt M12
13	Gasket for on-load tap-changer head
14	Remove position indicator disc before withdrawal of diverter switch unit
15	Inspection window
16	Through hole 15 mm DIA
17	Suction pipe
21	On-load tap-changer head
22	Bolt for on-load tap-changer head cover
23	Gasket for on-load tap-changer head cover
24	On-load tap-changer head cover
25	Centric gear unit with drive shaft 25a
26	Pipe connection R for protective relay
27	Pipe connection S with bleeder screw (optional)
28	Pipe connection Q (optional)
29a	Bleeder valve of on load tap changer head cover
29b	Bleeding facility for transformer oil
31	Diverter switch oil compartment
32	Oil compartment bottom
33	Grading rings (with 170 kV, 245 kV, 300 kV, 362 kV only)
34	Terminal of diverter switch oil compartment
35	Connection terminal for on load tap changer take off lead
36	Connection ring for on-load tap-changer take-off lead
41	Tap selector suspension
42	Tap selector gear
43	Tap selector
44	Change-over selector
45	Tap selector terminals (see corresponding dimension drawing)
46	Change-over selector terminal (see corresponding dimension drawing)
47	Connection lead for tap selector
51	Diverter switch unit
52	Transition resistors
53	Carrying ring
(M)	Drive side of the tap selector

18.4 VACUTAP® VRG, installation drawing (899945)





11 Mounting flange on transformer cover
12 Fixing bolt M12
13 Gasket for on-load tap-changer head
14 Remove position indicator disc before withdrawal of diverter switch unit
15 Inspection window
16 Through hole 15 mm DIA
17 Suction pipe

21 On-load tap-changer head
22 Bolt for on-load tap-changer head cover
23 Gasket for on-load tap-changer head cover
24 On-load tap-changer head cover
25 Centric gear unit with drive shaft 25a
26 Pipe connection R for protective relay
27 Pipe connection S with bleeder screw (optional)
28 Pipe connection Q (optional)
29a Bleeder valve of on-load tap-changer head cover
29b Bleeding facility for transformer oil

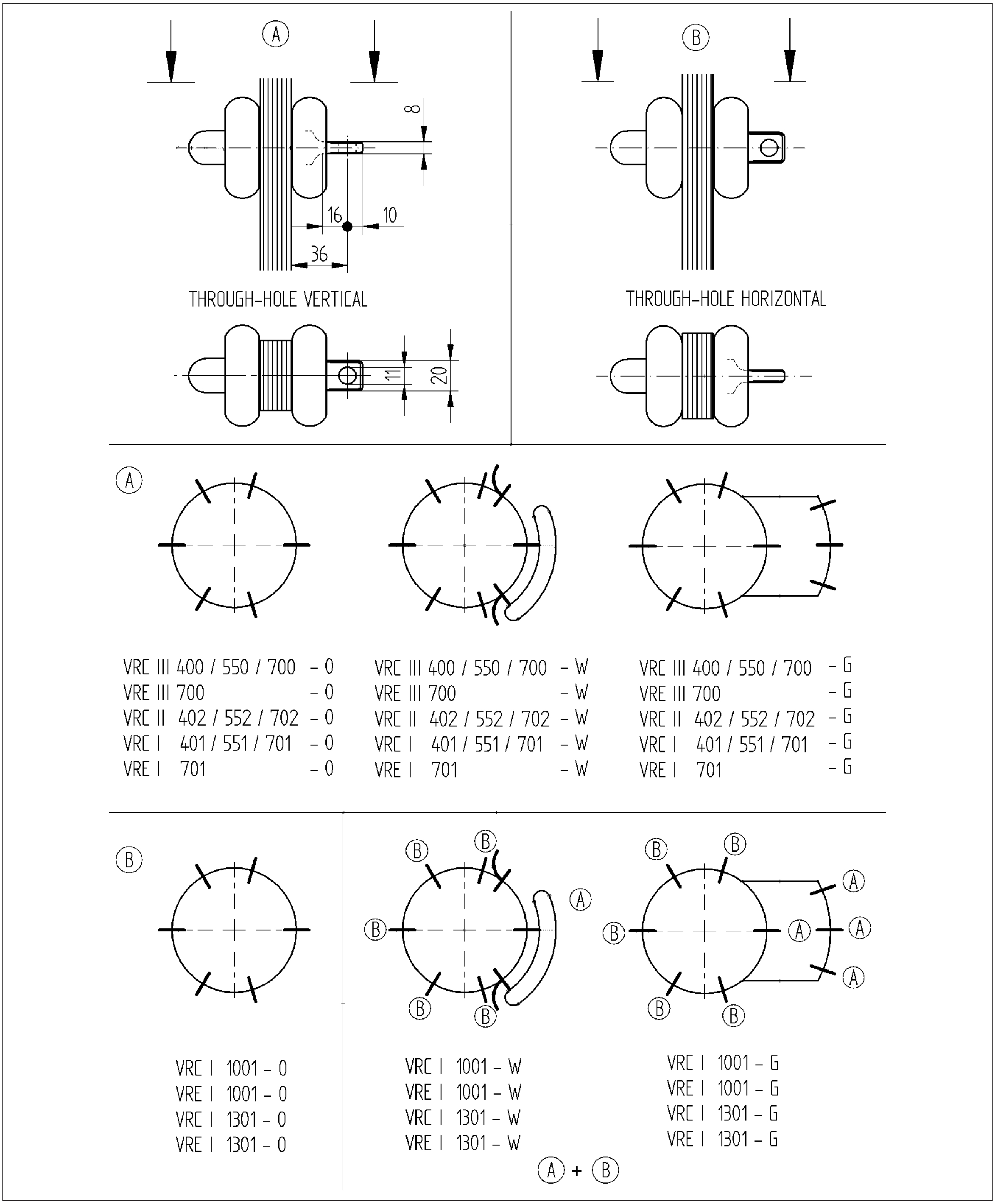
31 Diverter switch oil compartment
32 Oil compartment bottom
33 Grading rings (with 170 kV, 245 kV, 300 kV, 362 kV only)
34 Terminal of diverter switch oil compartment
35 Connection terminal for on-load tap-changer take-off lead
36 Connection ring for on-load tap-changer take-off lead

41 Tap selector suspension
42 Tap selector gear
43 Tap selector
44 Change-over selector
45 Tap selector terminals (see corresponding dimension drawing)
46 Change-over selector terminal (see corresponding dimension drawing)
47 Connection lead for tap selector

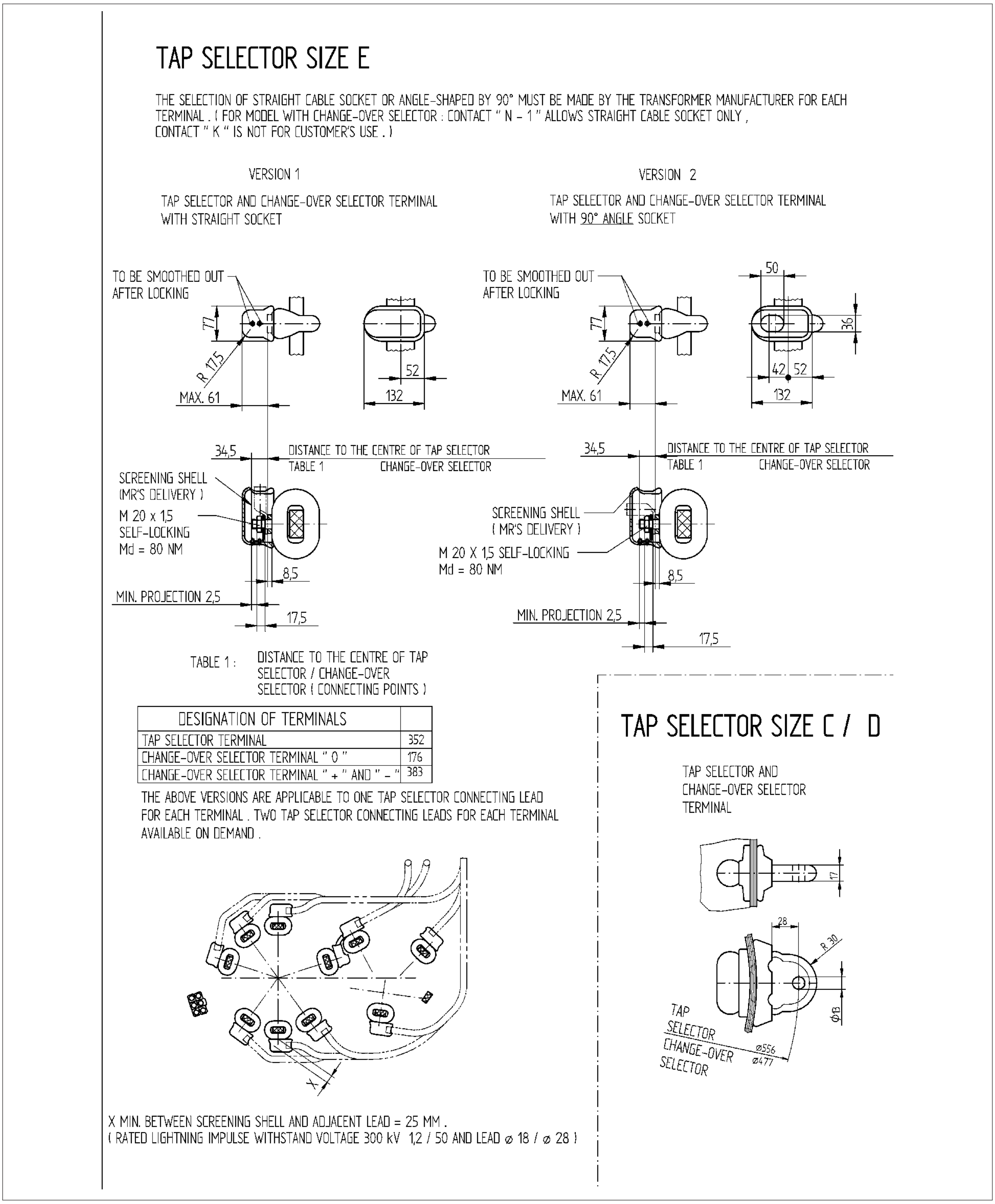
51 Diverter switch unit
52 Transition resistors
53 Carrying ring

(M) Drive side of the tap selector

18.5 VACUTAP® VR, installation position of tap selector connection contacts (727042)



18.6 VACUTAP® VRD/VRF/VRG, fine tap selector connection contact and change-over selector connection contact (899941)

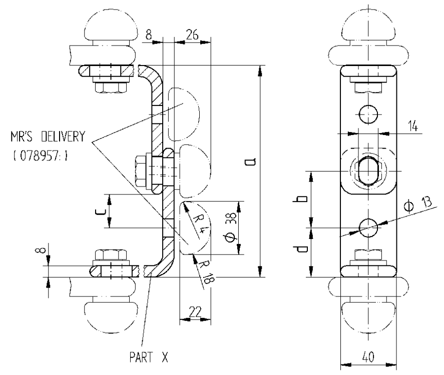


DESIGNATION OF TERMINALS	
TAP SELECTOR TERMINAL	352
CHANGE-OVER SELECTOR TERMINAL " 0 "	176
CHANGE-OVER SELECTOR TERMINAL " + " AND " – "	383

18.7 VACUTAP® VRF, bridges to parallel connection of tap selector connection contacts (786919)

VRF I 1601 TAP SELECTOR SIZE C / D
1 : 1,5

2 TAP SELECTOR CONTACT PLANES IN PARALLEL



REQUIRED PARALLEL BRIDGES ON ON-LOAD TAP-CHANGERS WITHOUT CHANGE-OVER SELECTOR

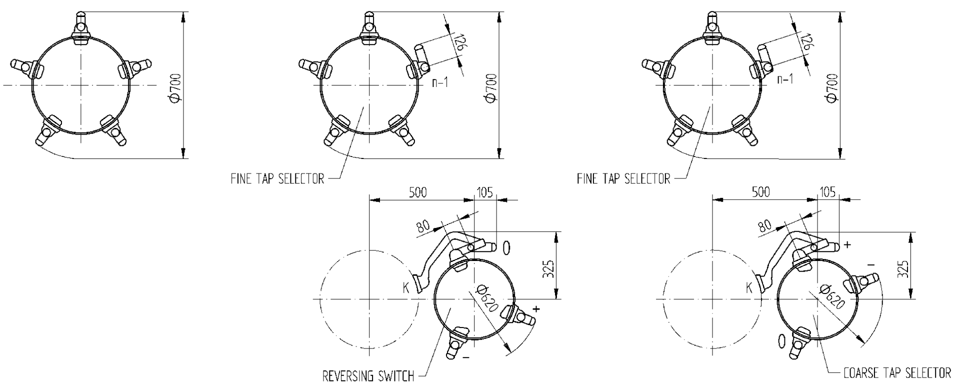
USE	PART X	a	b	c	d
IN ALL CONTACT POSITIONS	077141	148	39	22	35

REQUIRED PARALLEL BRIDGES ON ON-LOAD TAP-CHANGERS WITH CHANGE-OVER SELECTOR

USE	PART X	a	b	c	d
FINE TAP SELECTOR / TAP SELEC. SIZE C AND D / CONTACTS 1 TO N-2	077141	148	39	22	35
FINE TAP SELECTOR / TAP SELEC. SIZE C AND D / CONTACT N-1	097668	148	39	22	35
COARSE TAP SELECTOR / TAP SELECTOR SIZE C / CONTACT 0 AND –	077196	183	46.5	29.5	45
COARSE TAP SELECTOR / TAP SELECTOR SIZE C / CONTACT +	097669	187	48.5	31.5	45
COARSE TAP SELECTOR / TAP SELECTOR SIZE D / CONTACT 0 AND –	077197	298	74	57	75
COARSE TAP SELECTOR / TAP SELECTOR SIZE D / CONTACT +	097670	302	76	59	75
REVERSING SWITCH / TAP SELECTOR SIZE C / CONTACT + AND –	077196	183	46.5	29.5	45
REVERSING SWITCH / TAP SELECTOR SIZE C / CONTACT 0	097669	187	48.5	31.5	45
REVERSING SWITCH / TAP SELECTOR SIZE D / CONTACT + AND –	077197	298	74	57	75
REVERSING SWITCH / TAP SELECTOR SIZE D / CONTACT 0	097670	302	76	59	75

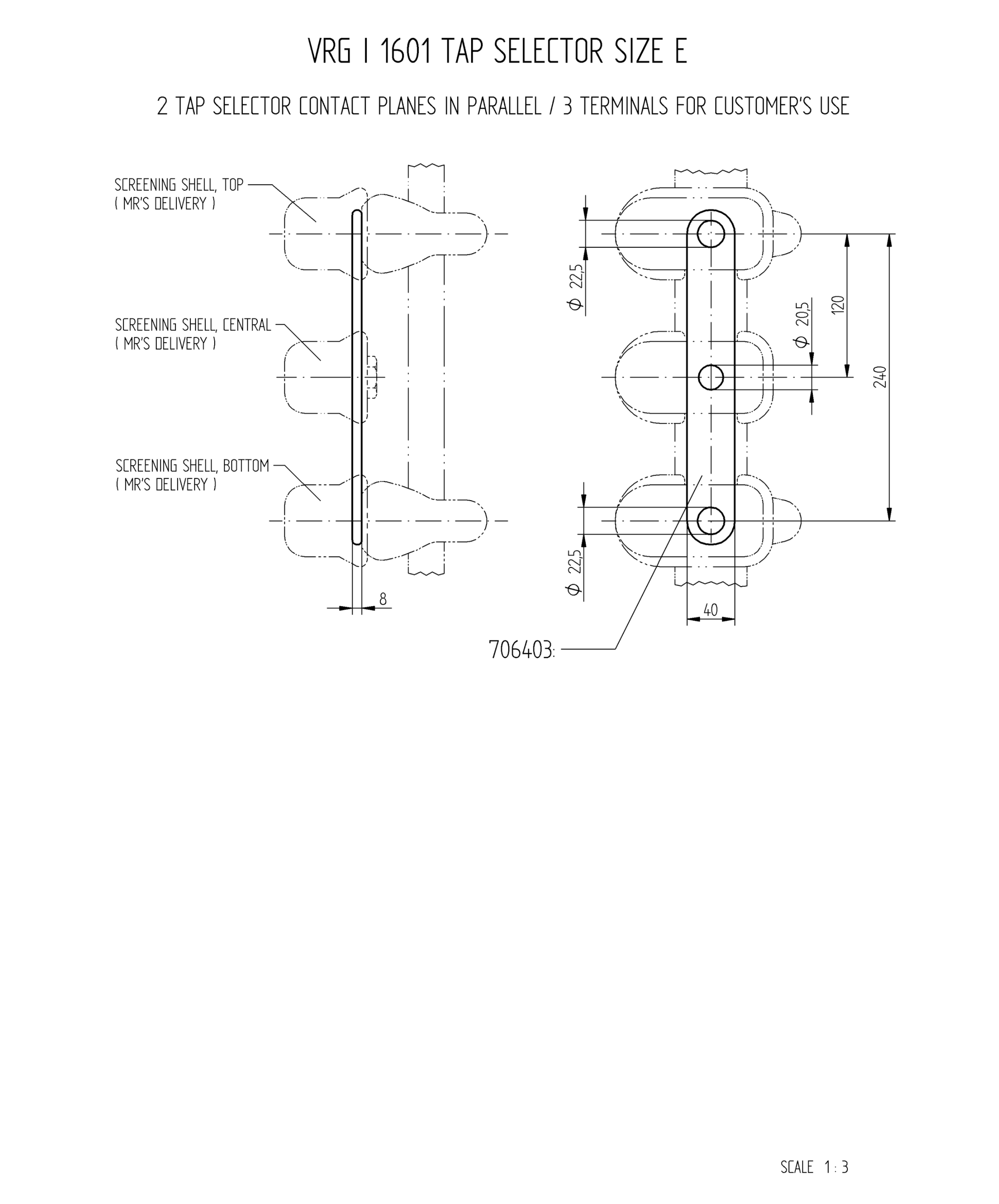
ARRANGEMENT OF THE PARALLEL BRIDGES ON THE ON-LOAD TAP-CHANGER (TAP SELECTOR PITCH 10 REPRESENTATION)

WITHOUT CHANGE-OVER SELECTOR — WITH REVERSING SWITCH — WITH COARSE TAP SELECTOR

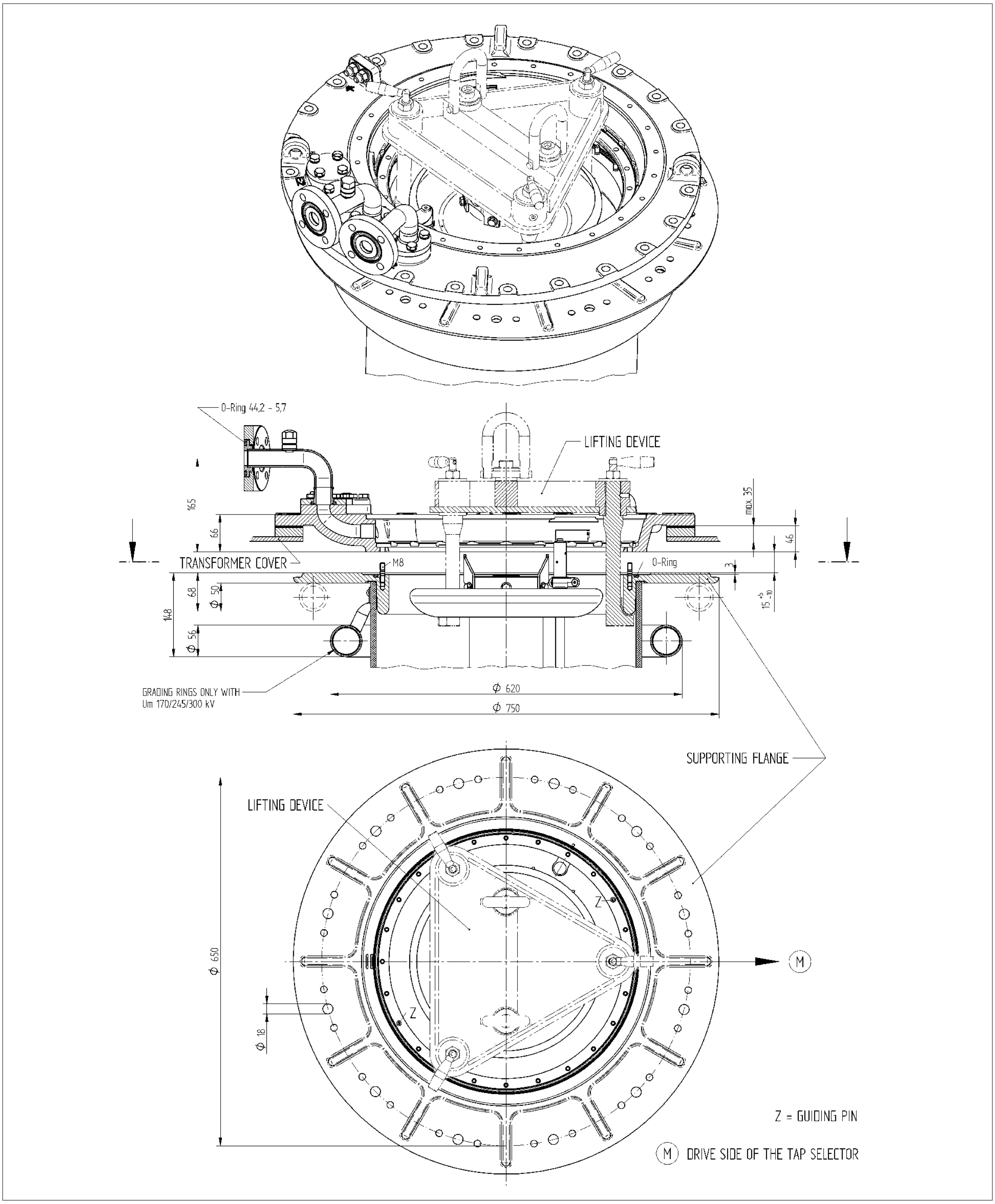


SCALE 1 : 10 (1 : 1,5)

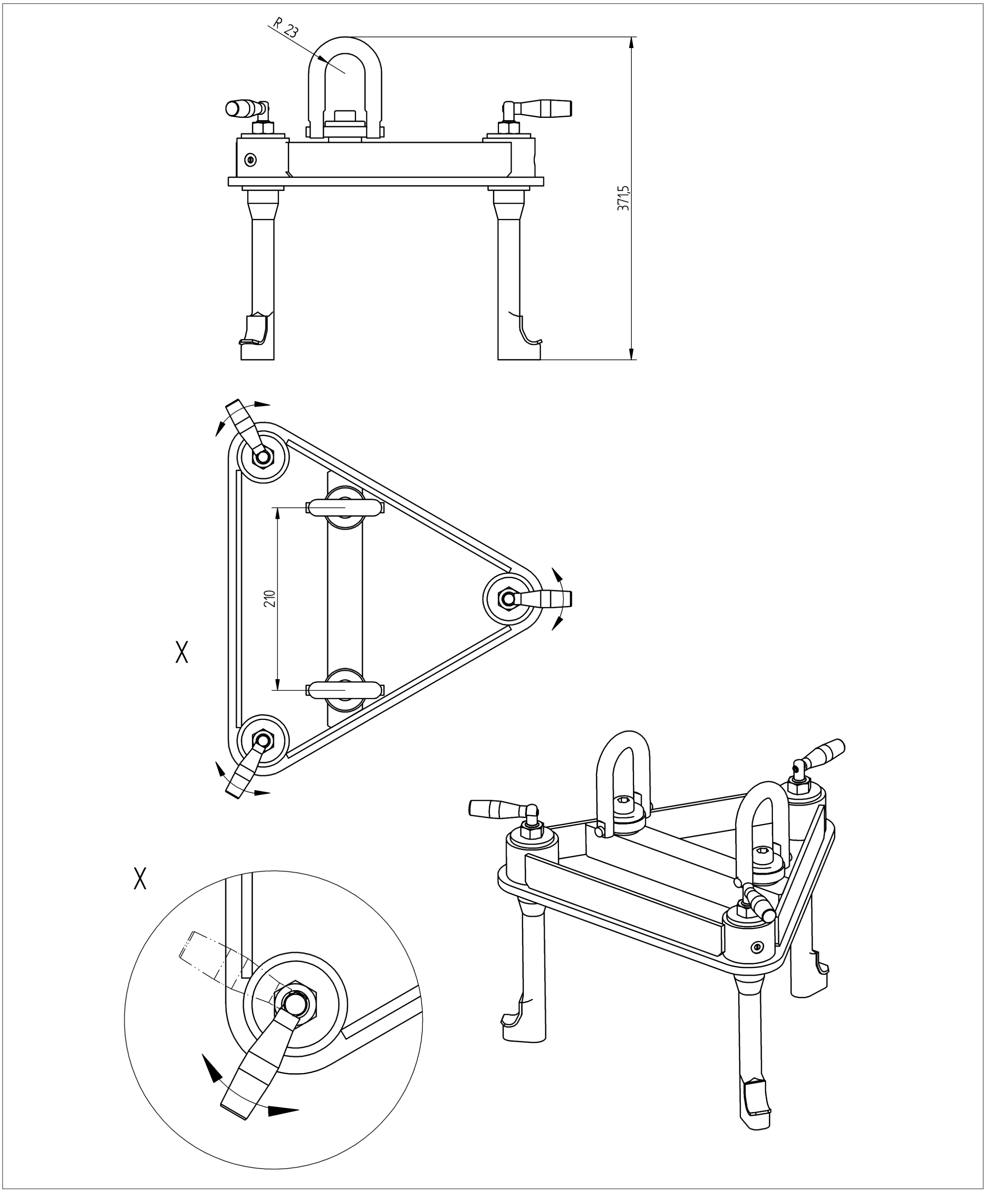
18.8 VACUTAP® VRG, bridges to parallel connection of tap selector connection contacts (786920)



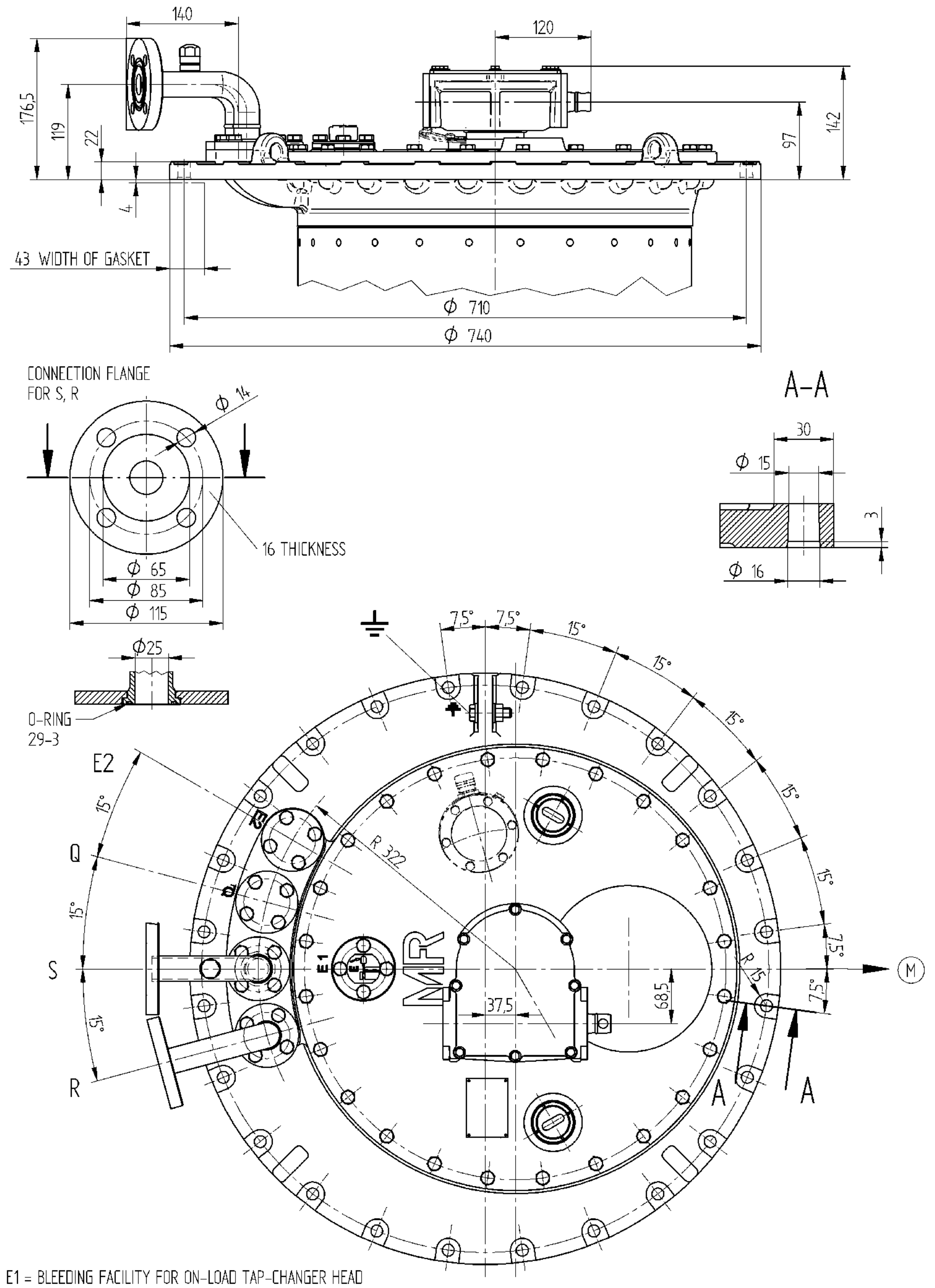
18.9 VACUTAP® VR, special design for bell-type tank installation (720781)



18.10 VACUTAP® VR, lifting device for bell-type tank installation (720845)



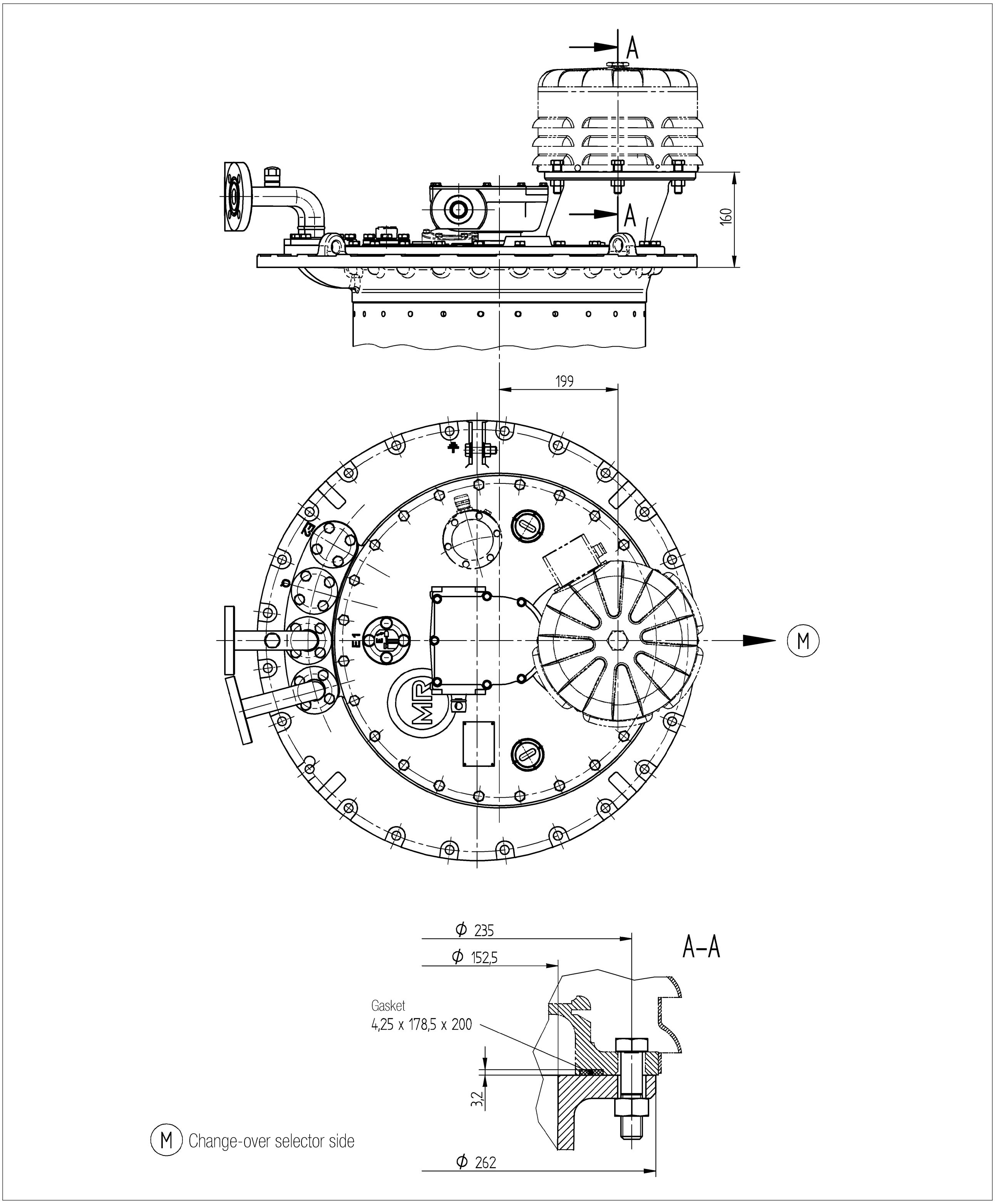
18.11 VACUTAP® VR, on-load tap-changer head (720847)



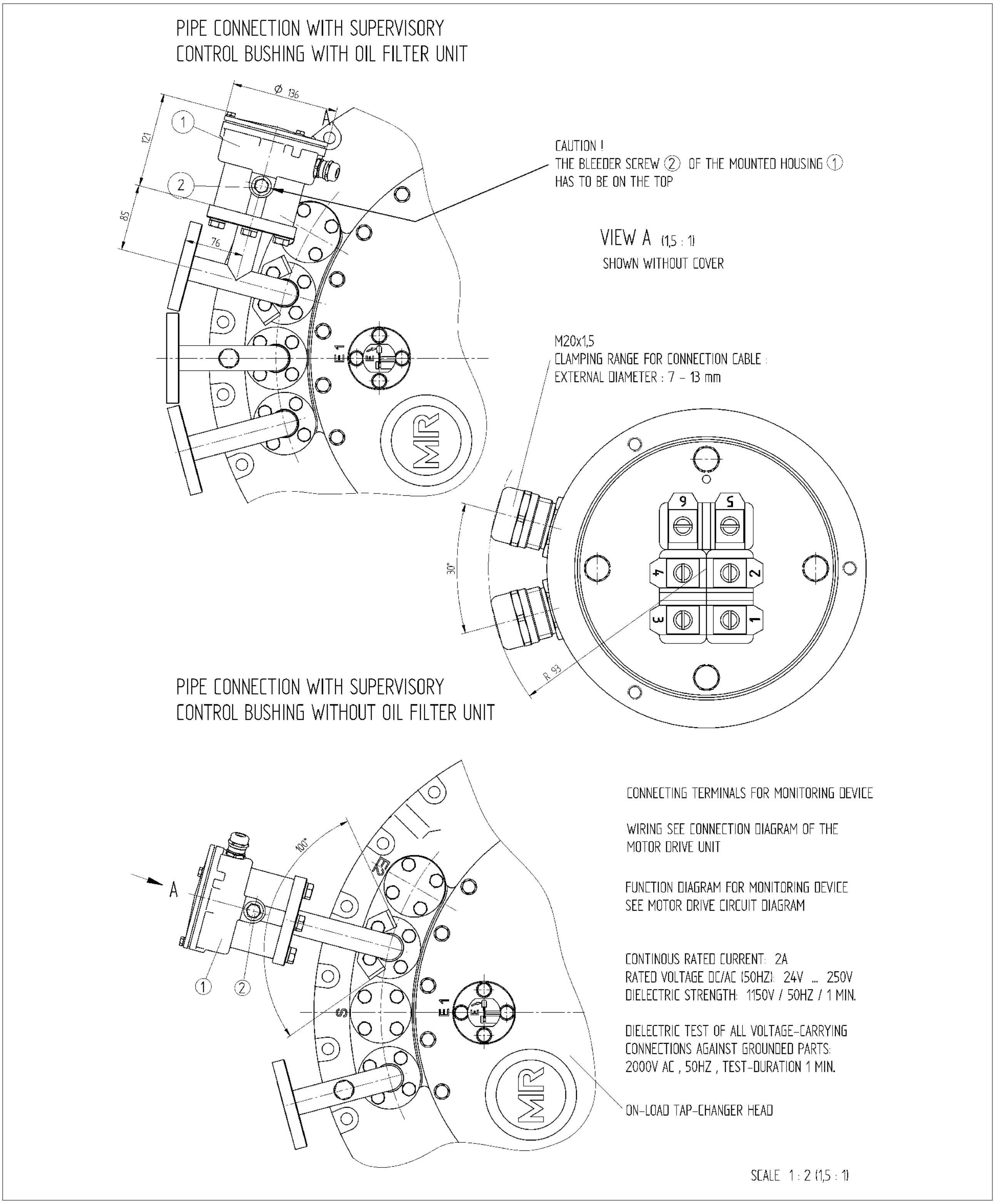
E1 = BLEEDING FACILITY FOR ON-LOAD TAP-CHANGER HEAD
E2 = BLEEDING FACILITY FOR SPACE UNDER THE HEAD OUTSIDE THE TAP-CHANGER OIL COMPARTMENT (SAME PIPE CONNECTION AS R, S OR BLEEDER SCREW CAN BE USED)
Q = CONNECTION FOR OIL RETURN OR TAP CHANGE SUPERVISORY CONTROL
S = CONNECTION WITH BLEEDER SCREW (OPTIONAL)
R = CONNECTION FOR PROTECTIVE RELAY
⏚ = EARTH CONNECTION M12

(M) DRIVE SIDE OF THE TAP SELECTOR

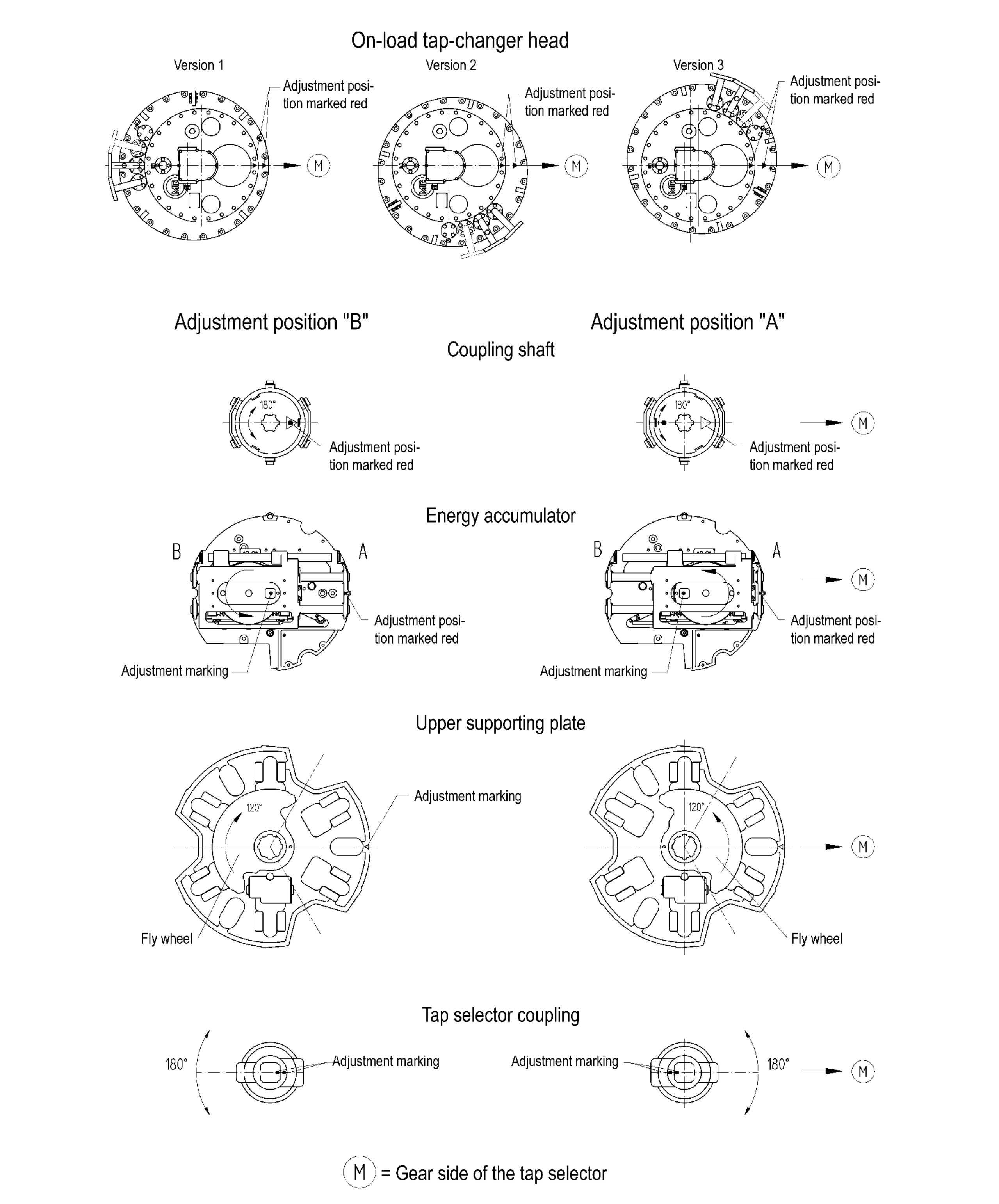
18.12 VACUTAP® VR, on-load tap-changer head with flange for pressure relief device (899946)



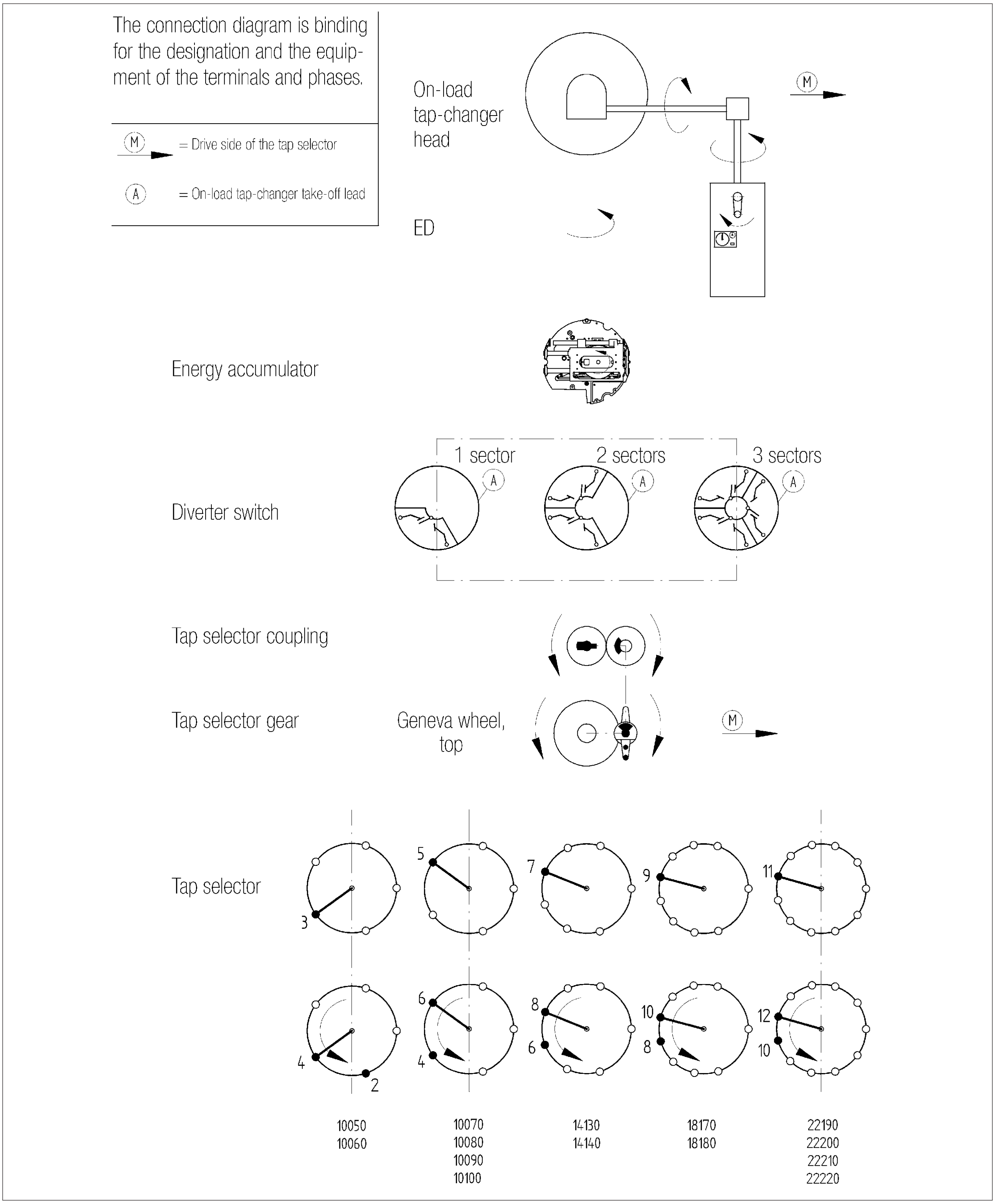
18.13 VACUTAP® VR, pipe connection Q with connecting terminals of tap-change supervisory control (899648)

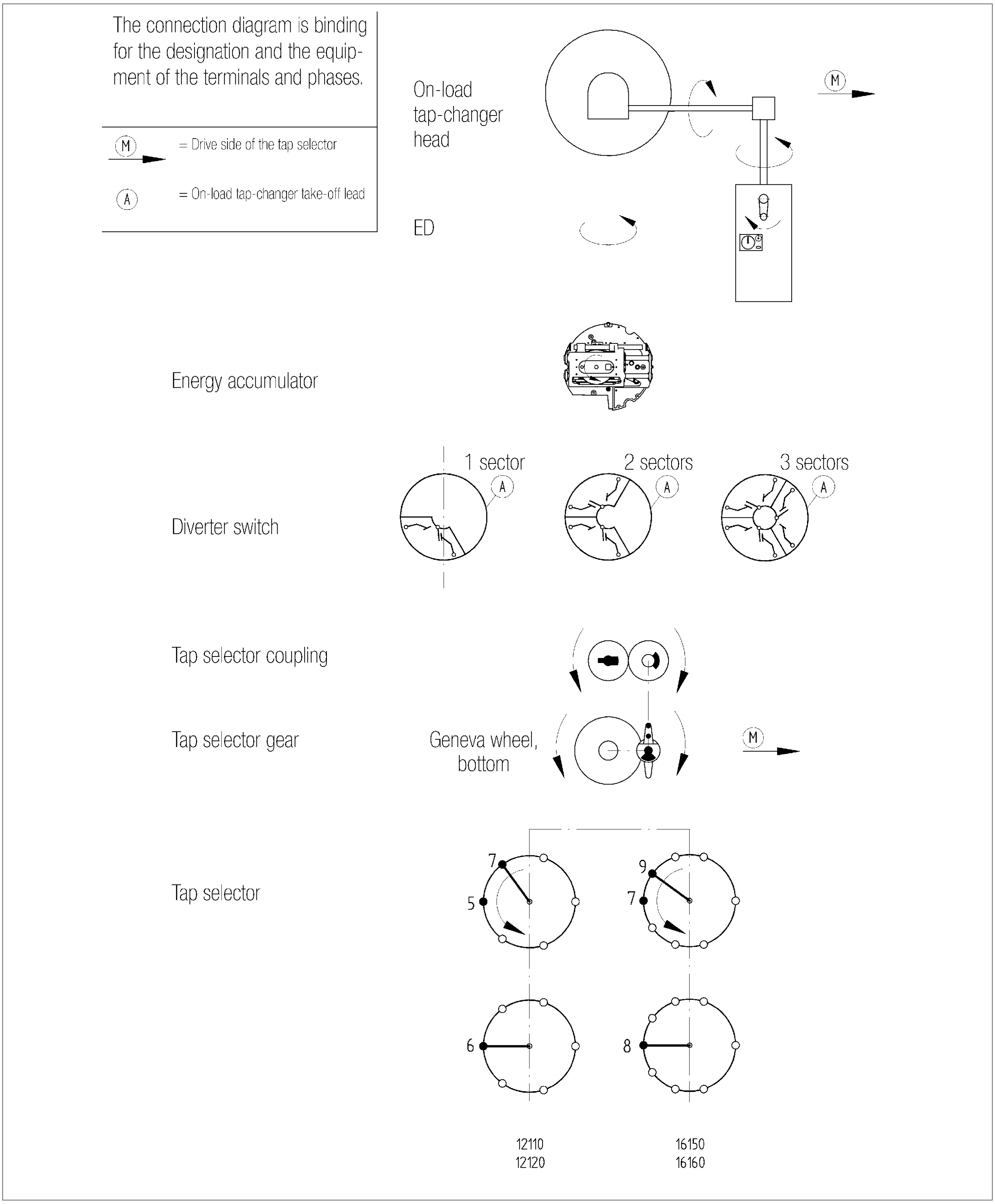


18.14 VACUTAP® VR, adjustment positions (728557)

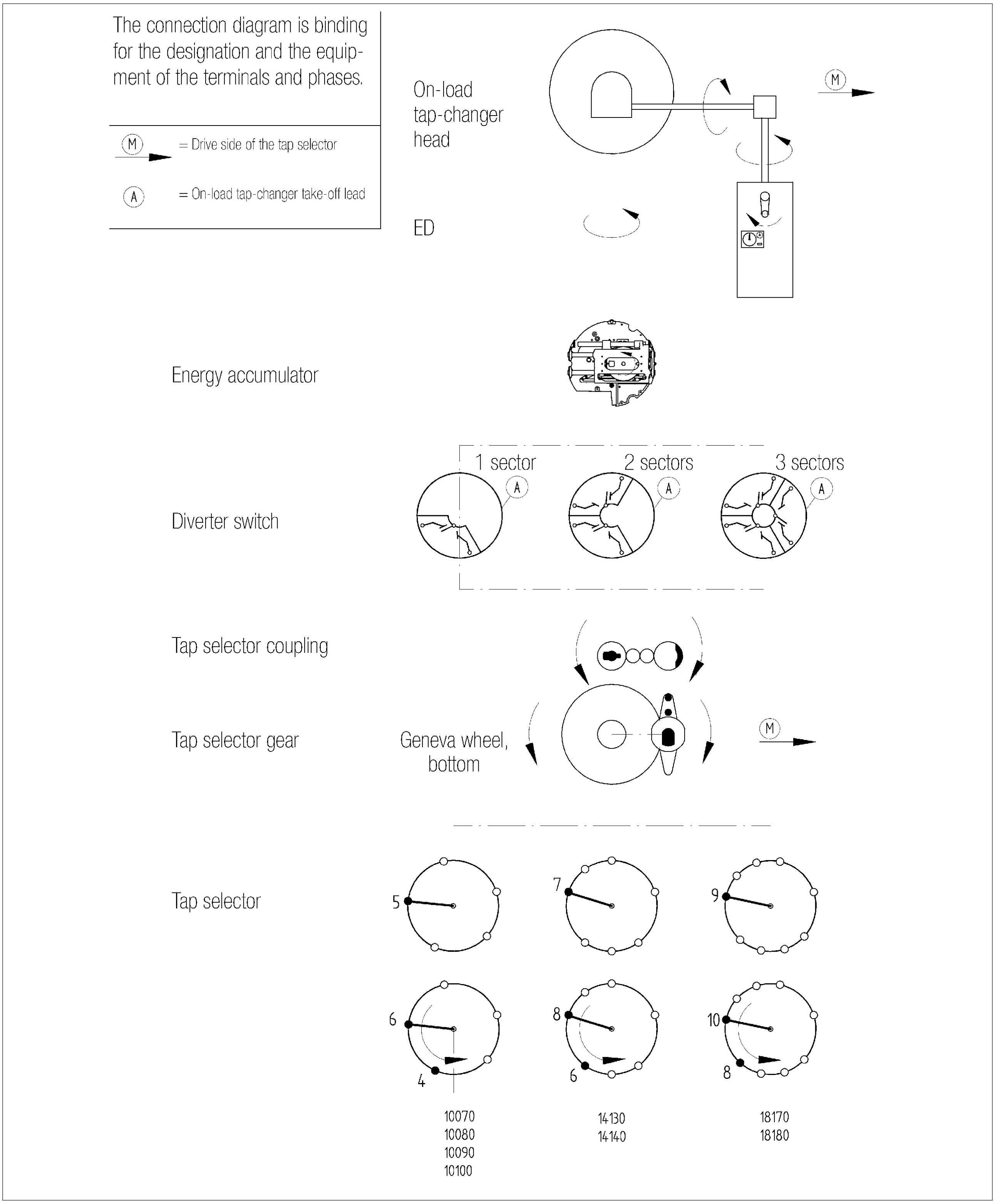


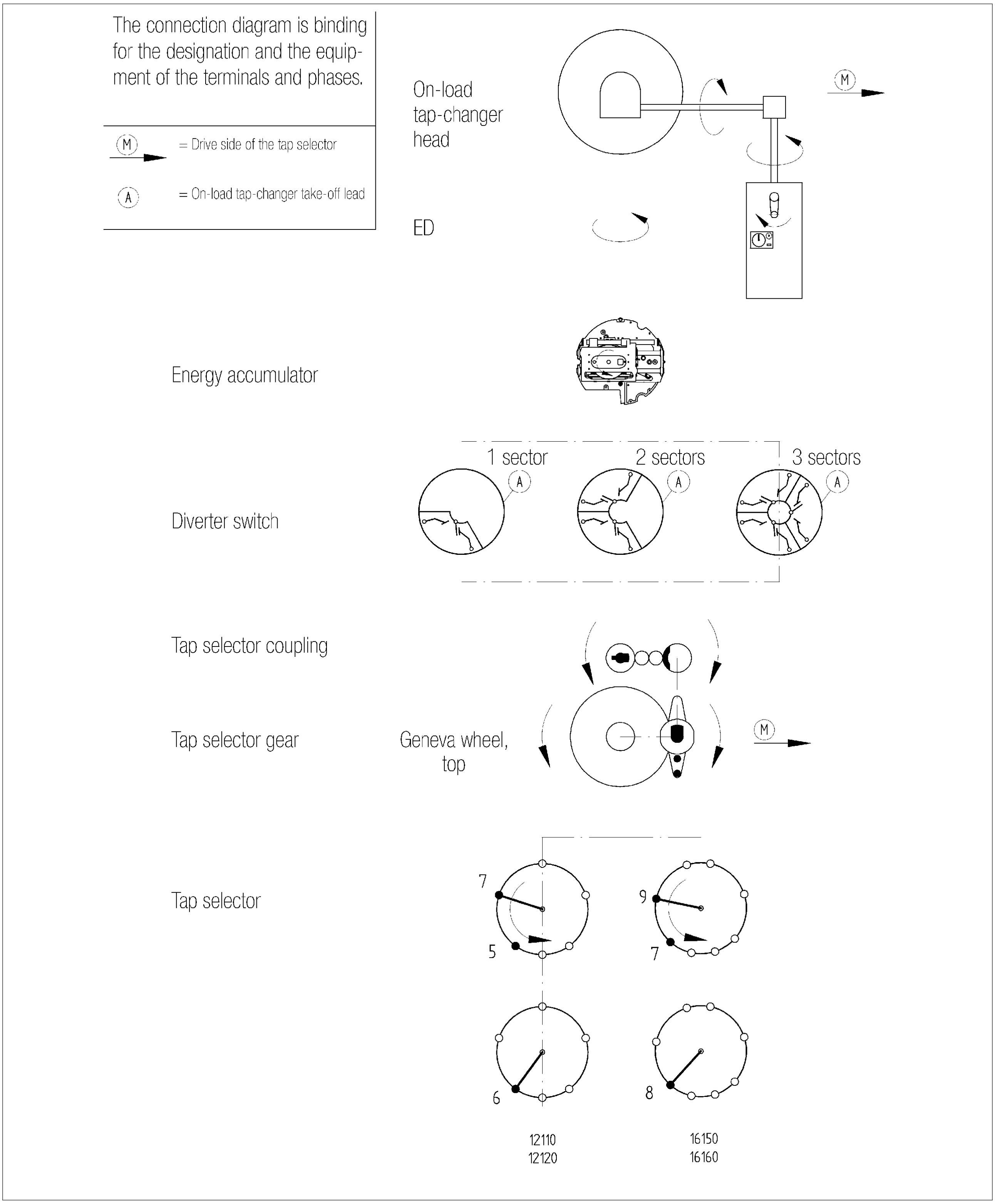
18.15 VACUTAP® VRC/VRE, adjustment plan without change-over selector (719853)



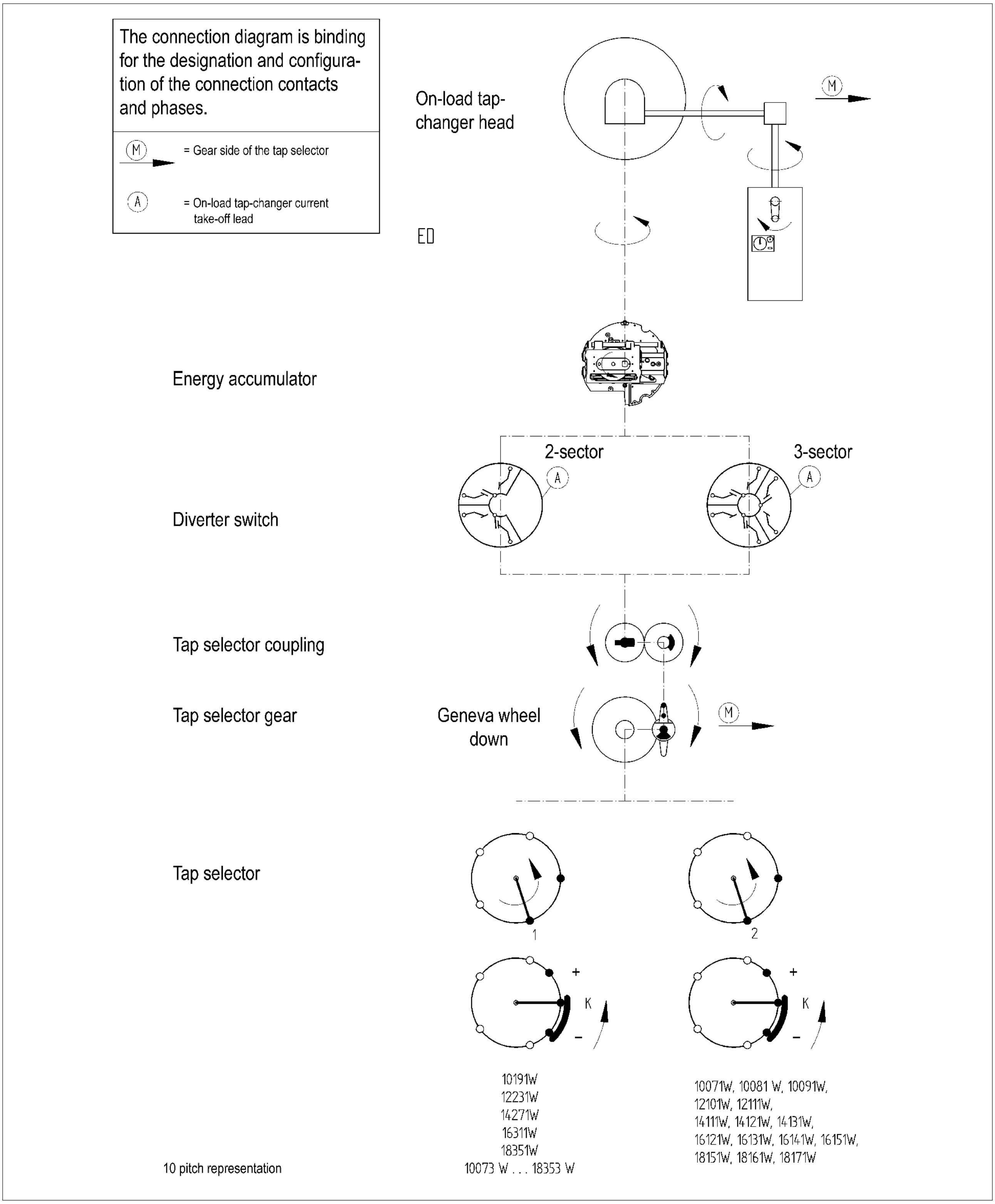

The connection diagram is binding for the designation and the equipment of the terminals and phases.
M = Drive side of the tap selector
A = On-load tap-changer take-off lead
On-load tap-changer head
M
ED
Energy accumulator
1 sector
2 sectors
3 sectors
A
Diverter switch
Tap selector coupling
Tap selector gear
Geneva wheel, bottom
M
Tap selector
7
5
9
7
6
8
12110
12120
16150
16160

18.16 VACUTAP® VRD/VRF, adjustment plan without change-over selector (721089)

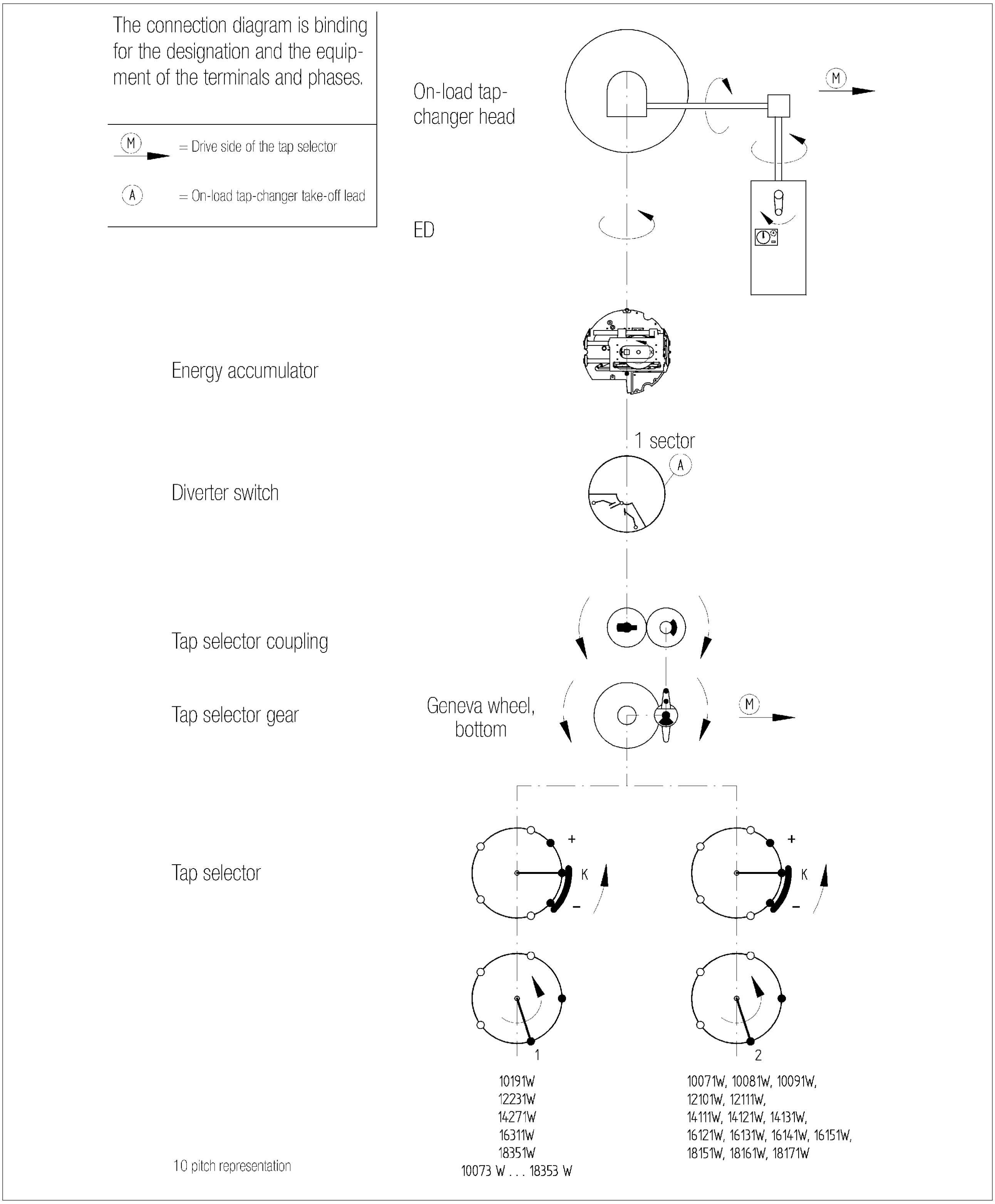



The connection diagram is binding for the designation and the equipment of the terminals and phases.
M = Drive side of the tap selector
A = On-load tap-changer take-off lead
On-load tap-changer head
M
ED
Energy accumulator
1 sector
2 sectors
3 sectors
A
Diverter switch
Tap selector coupling
Tap selector gear
Geneva wheel, top
M
Tap selector
7
5
9
7
6
8
12110
12120
16150
16160

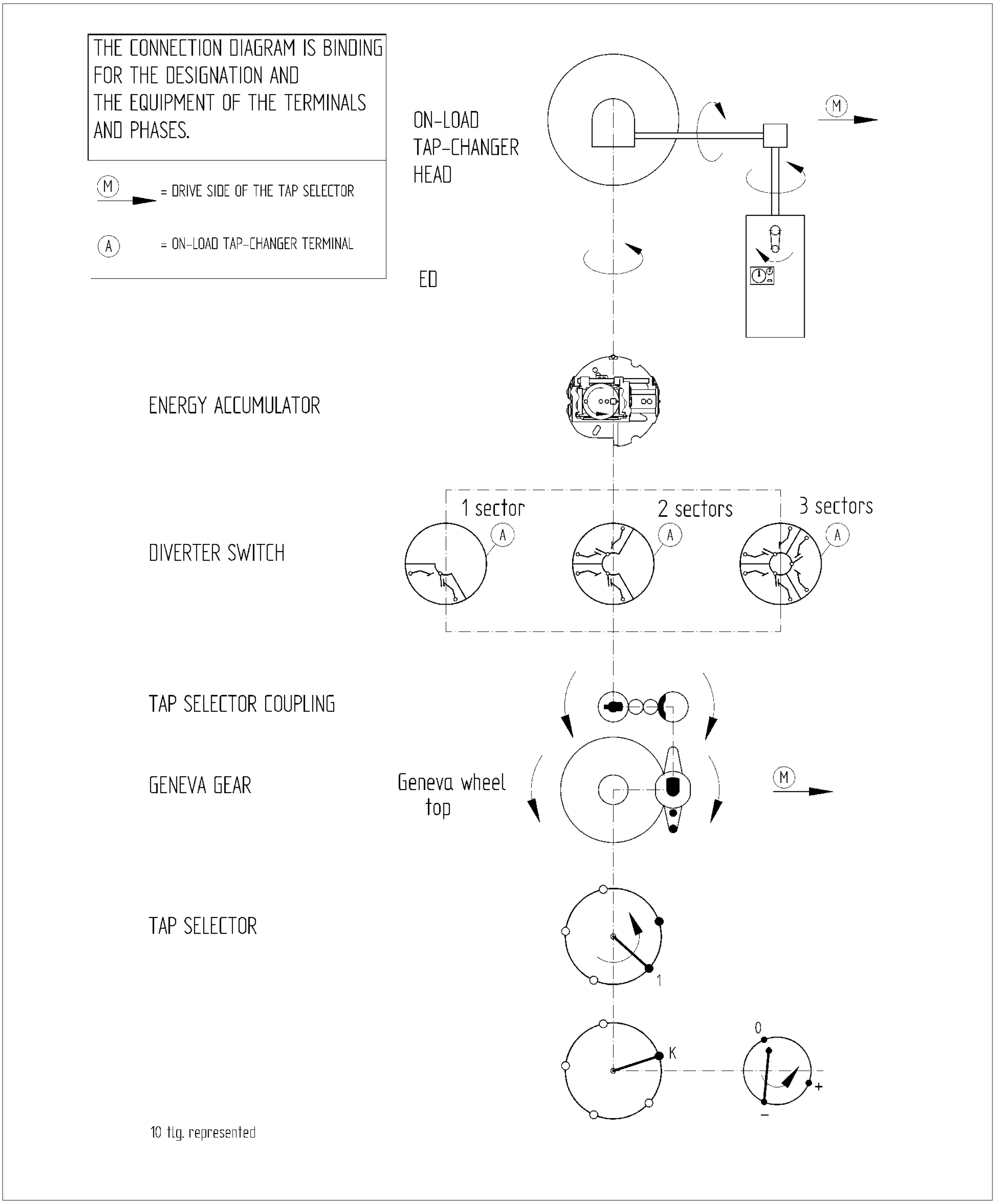
18.17 VACUTAP® VRC III/VRC II/VRE III, adjustment plan with reversing change-over selector connection (719850)



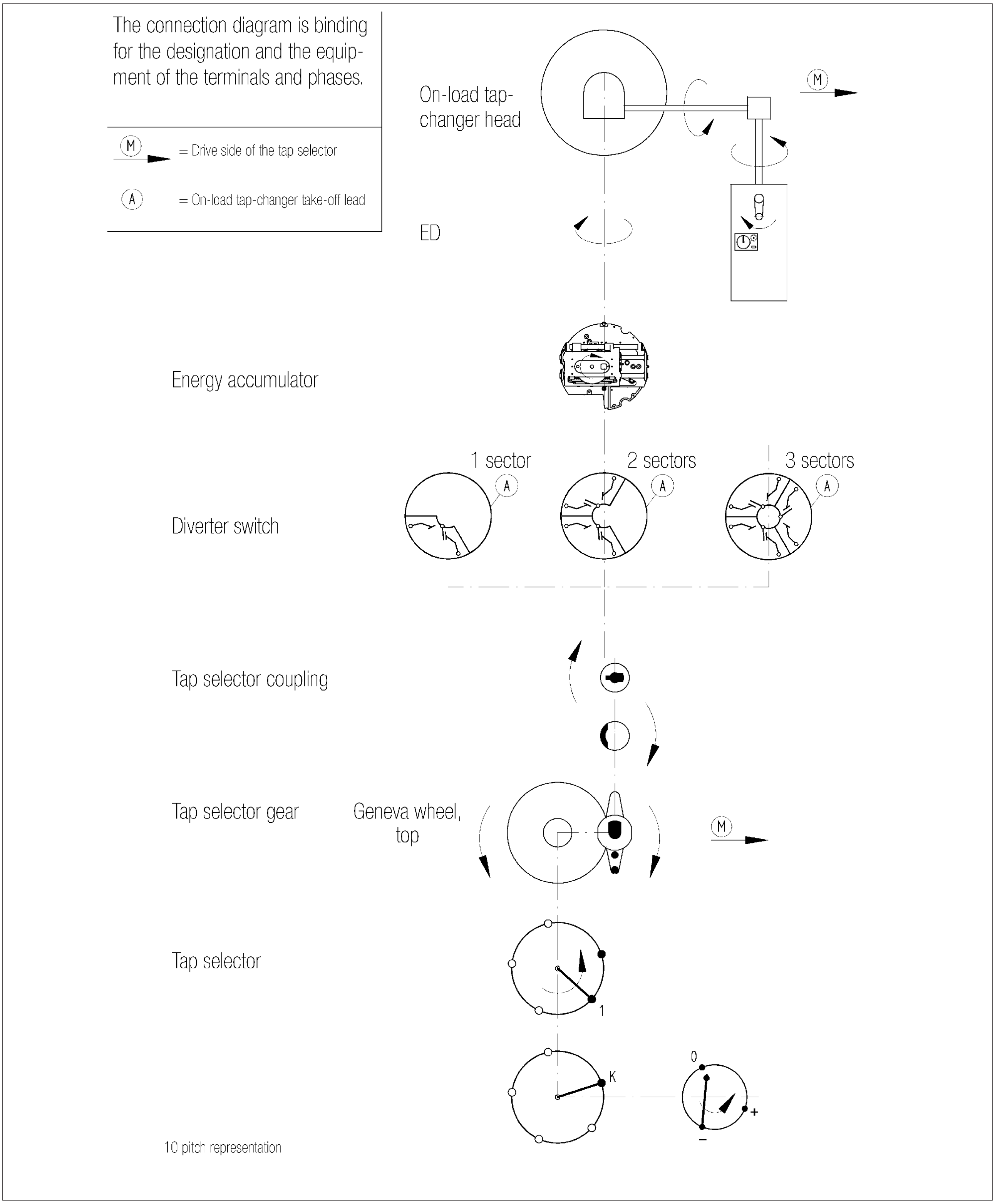
18.18 VACUTAP® VRC I/VRE I, adjustment plan with reversing change-over selector connection (719851)



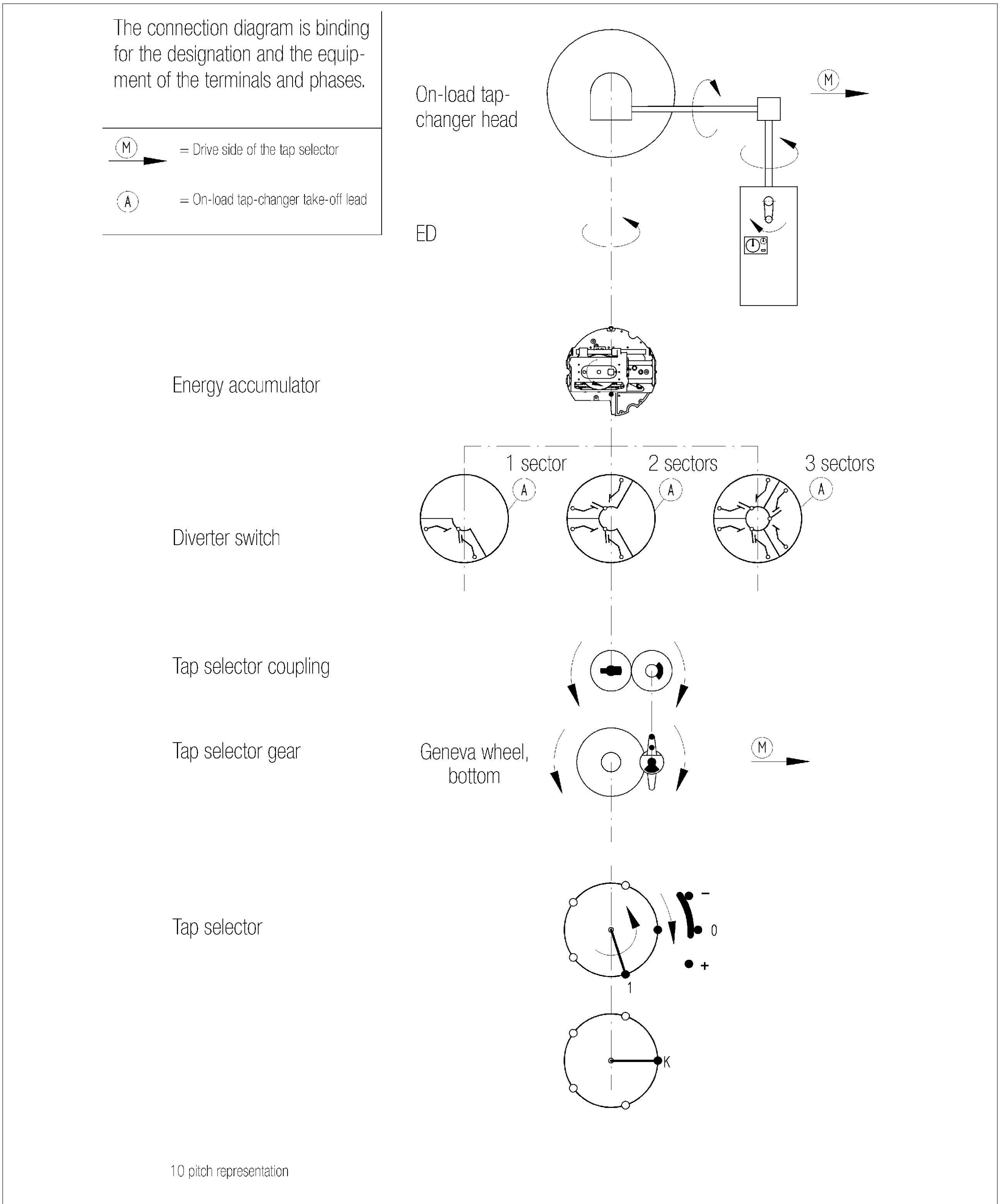
18.19 VACUTAP® VRD/VRF, adjustment plan with reversing change-over selector connection (721092)



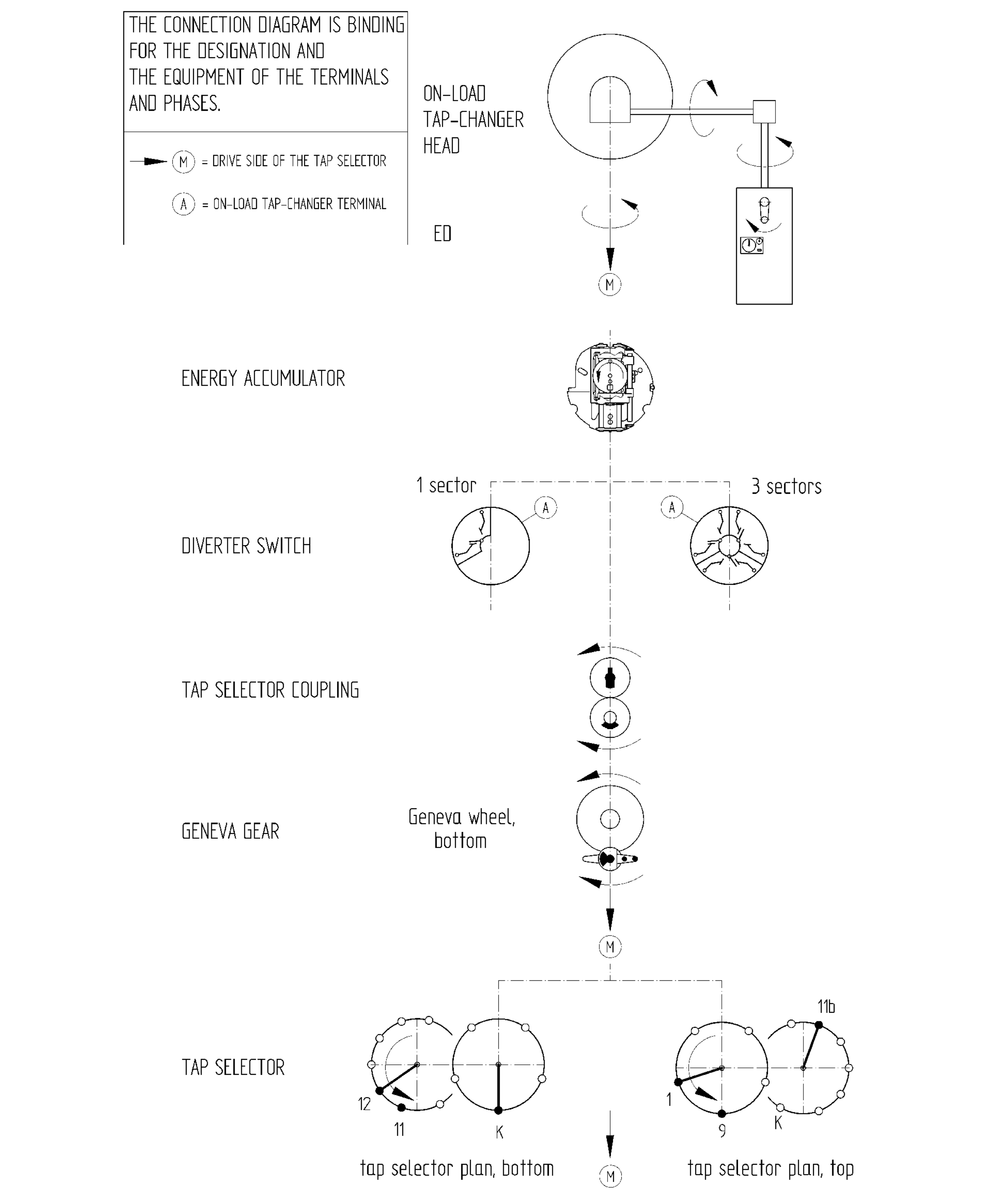
18.20 VACUTAP® VRG, adjustment plan with reversing change-over selector connection (727074)



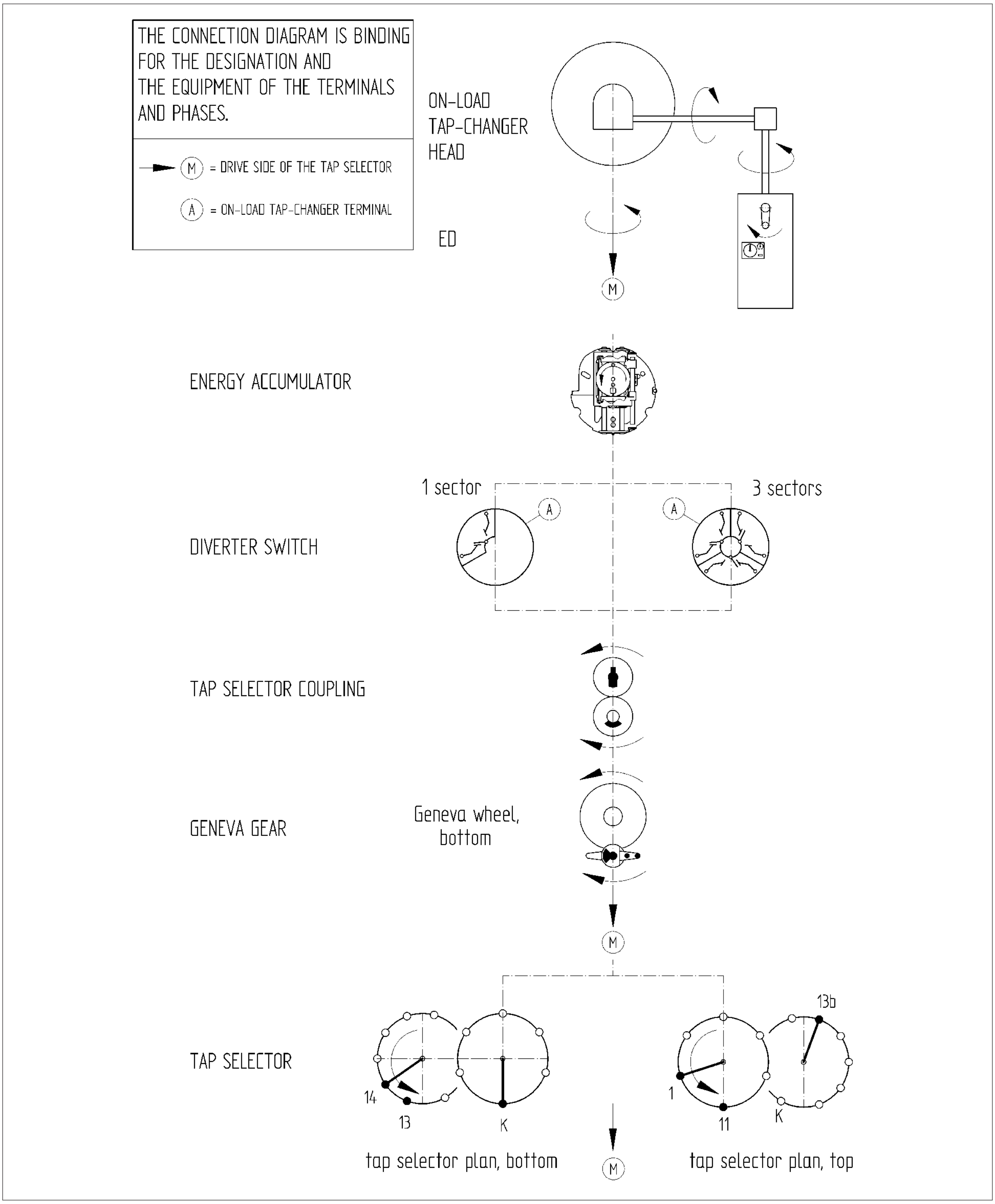
18.21 VACUTAP® VRC/VRE, adjustment plan with coarse tap selector connection (719852)



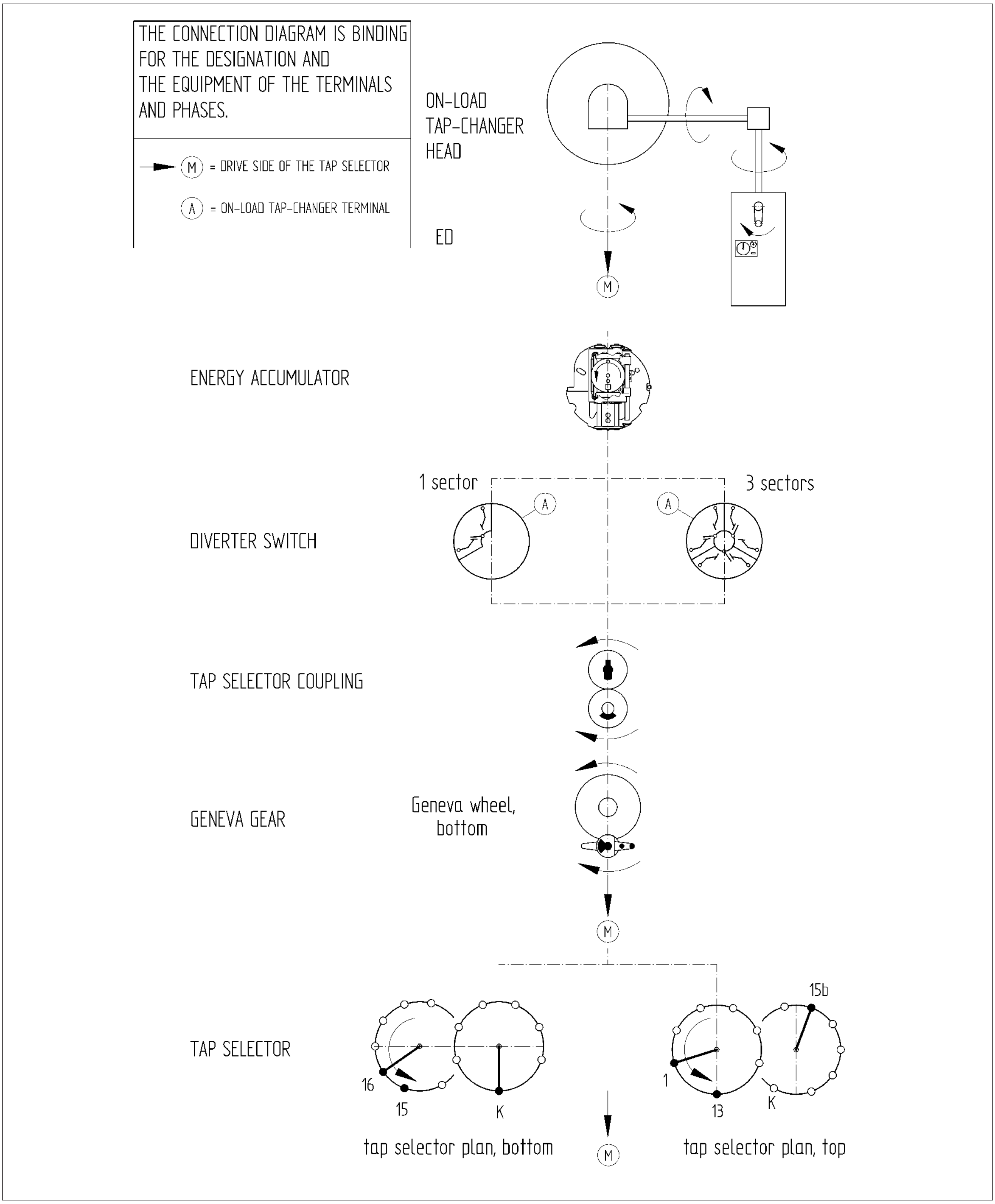
18.22 VACUTAP® VRC, adjustment plan with multiple coarse change-over selector for change-over selector division 10, 2-5 coarse tap connections (731412)



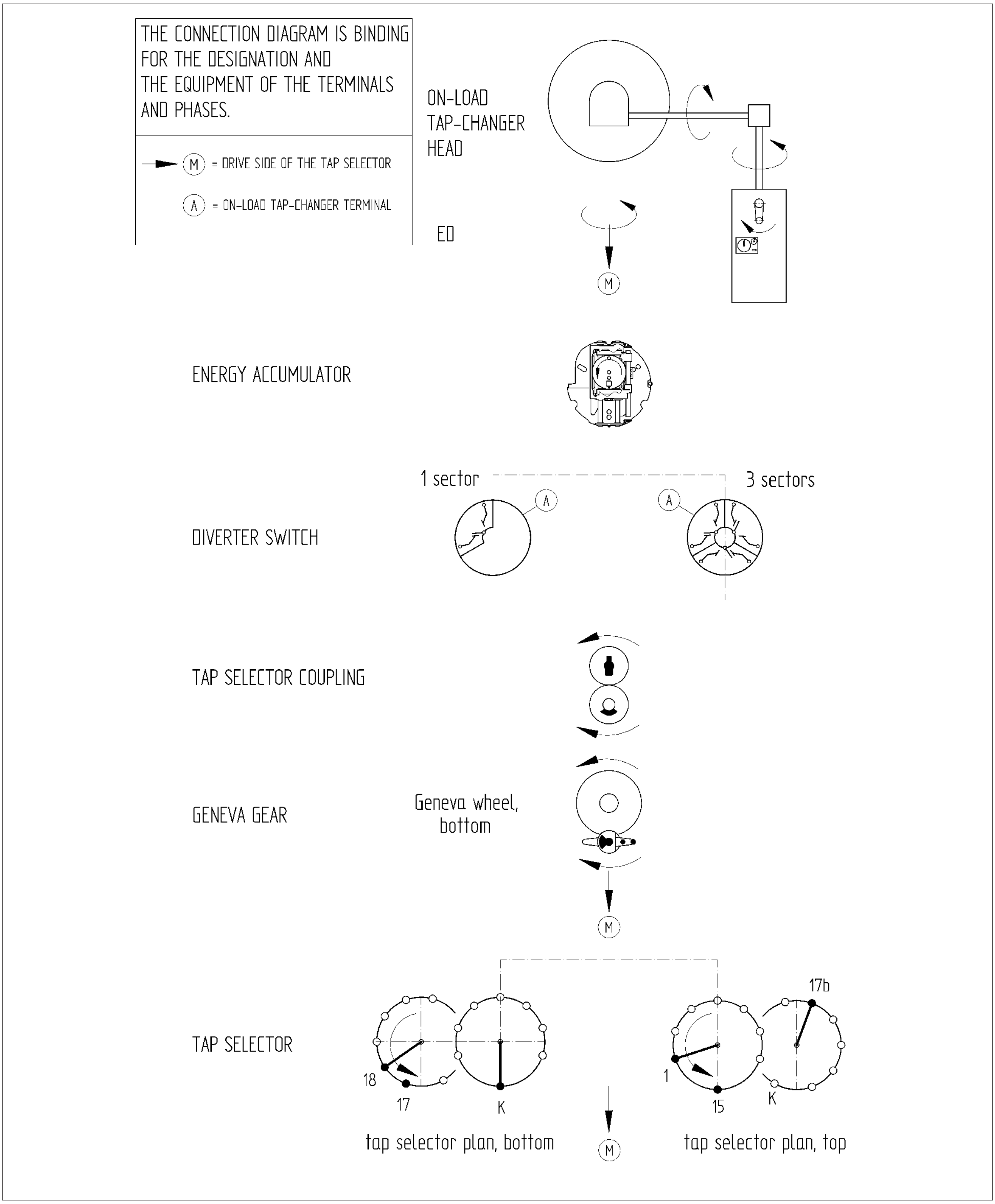
18.23 VACUTAP® VRC, adjustment plan with multiple coarse change-over selector for change-over selector division 12, 2-5 coarse tap connections (731411)



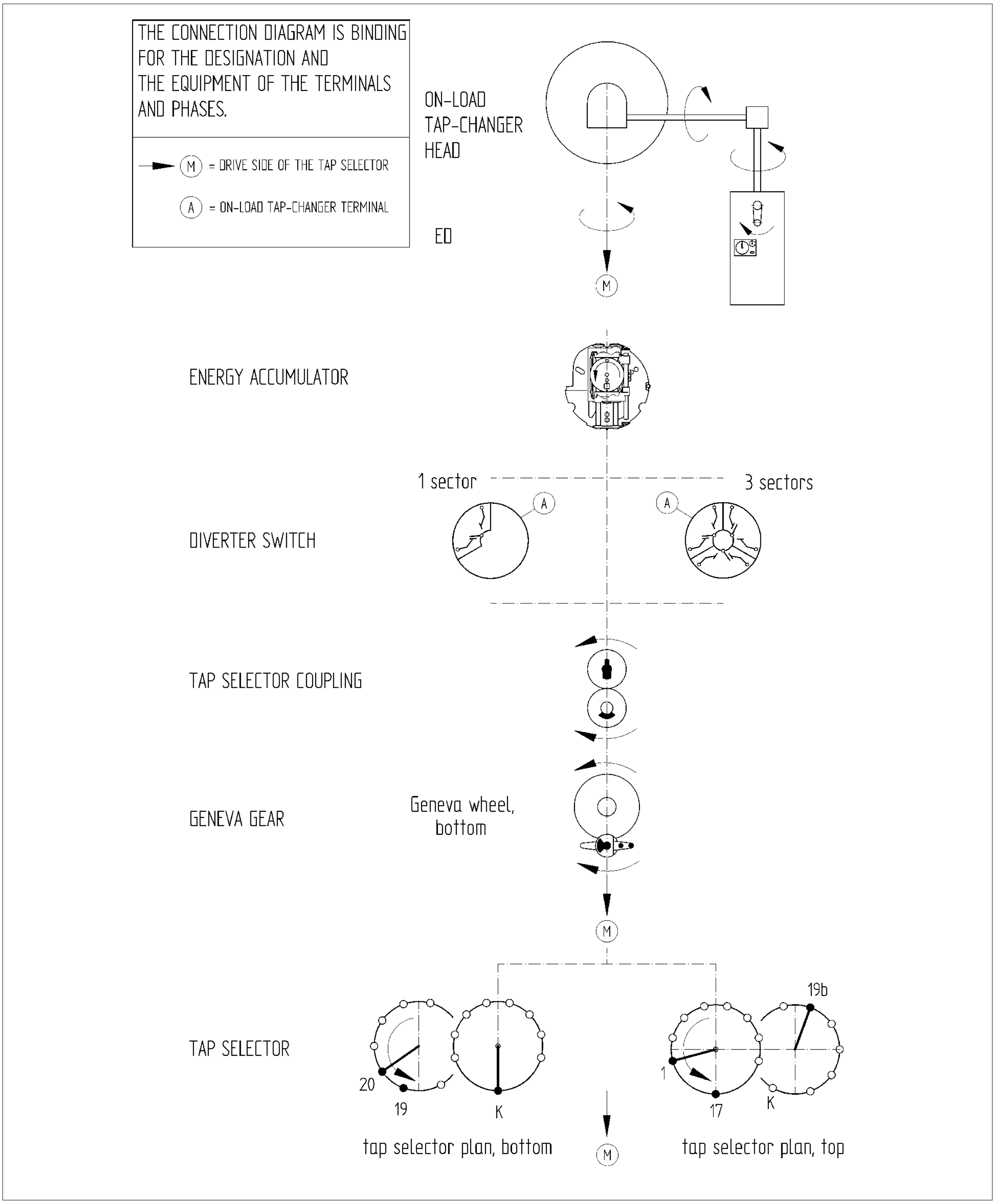
18.24 VACUTAP® VRC, adjustment plan with multiple coarse change-over selector for change-over selector division 14, 2-5 coarse tap connections (731410)



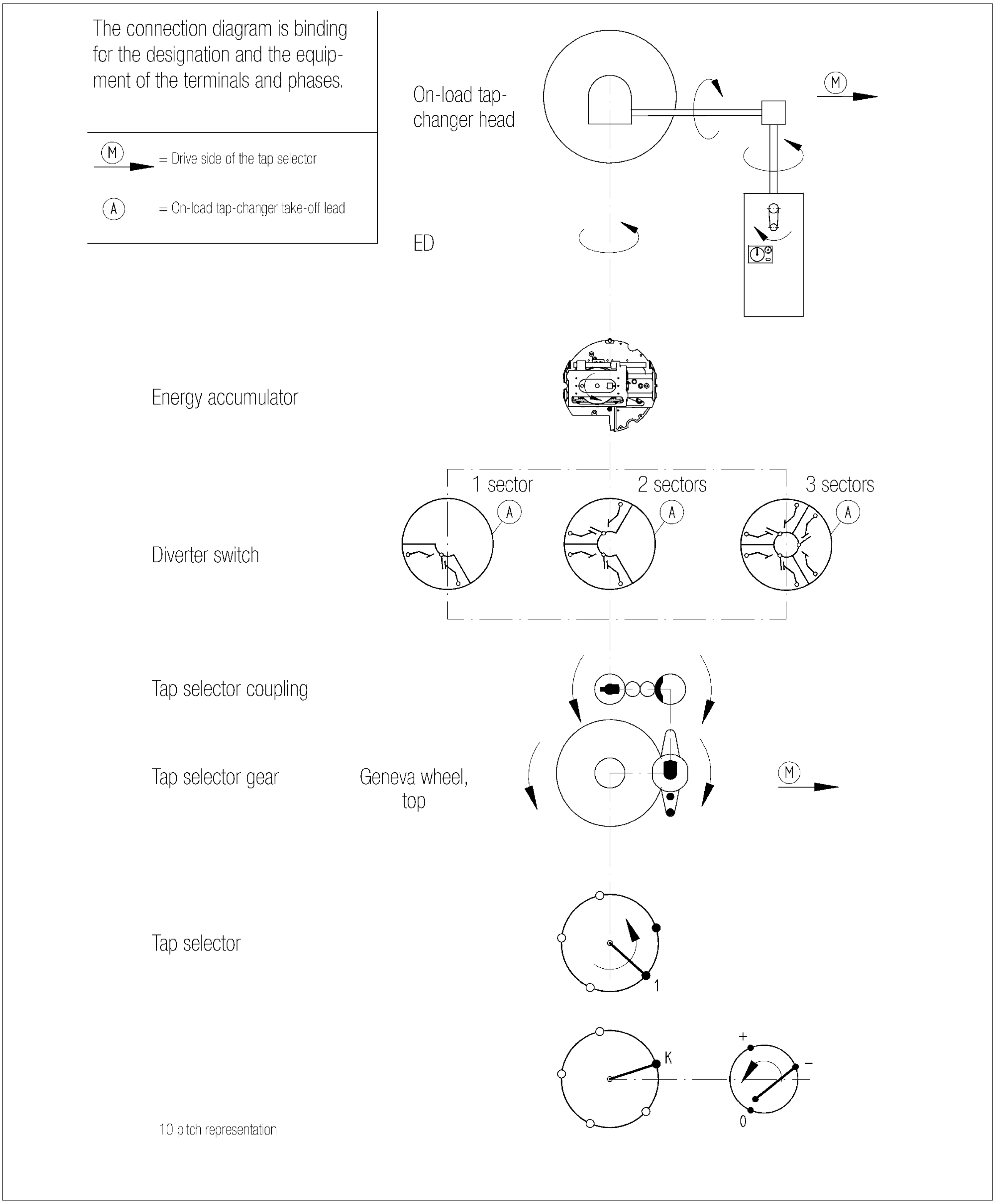
18.25 VACUTAP® VRC, adjustment plan with multiple coarse change-over selector for change-over selector division 16, 2-5 coarse tap connections (731000)



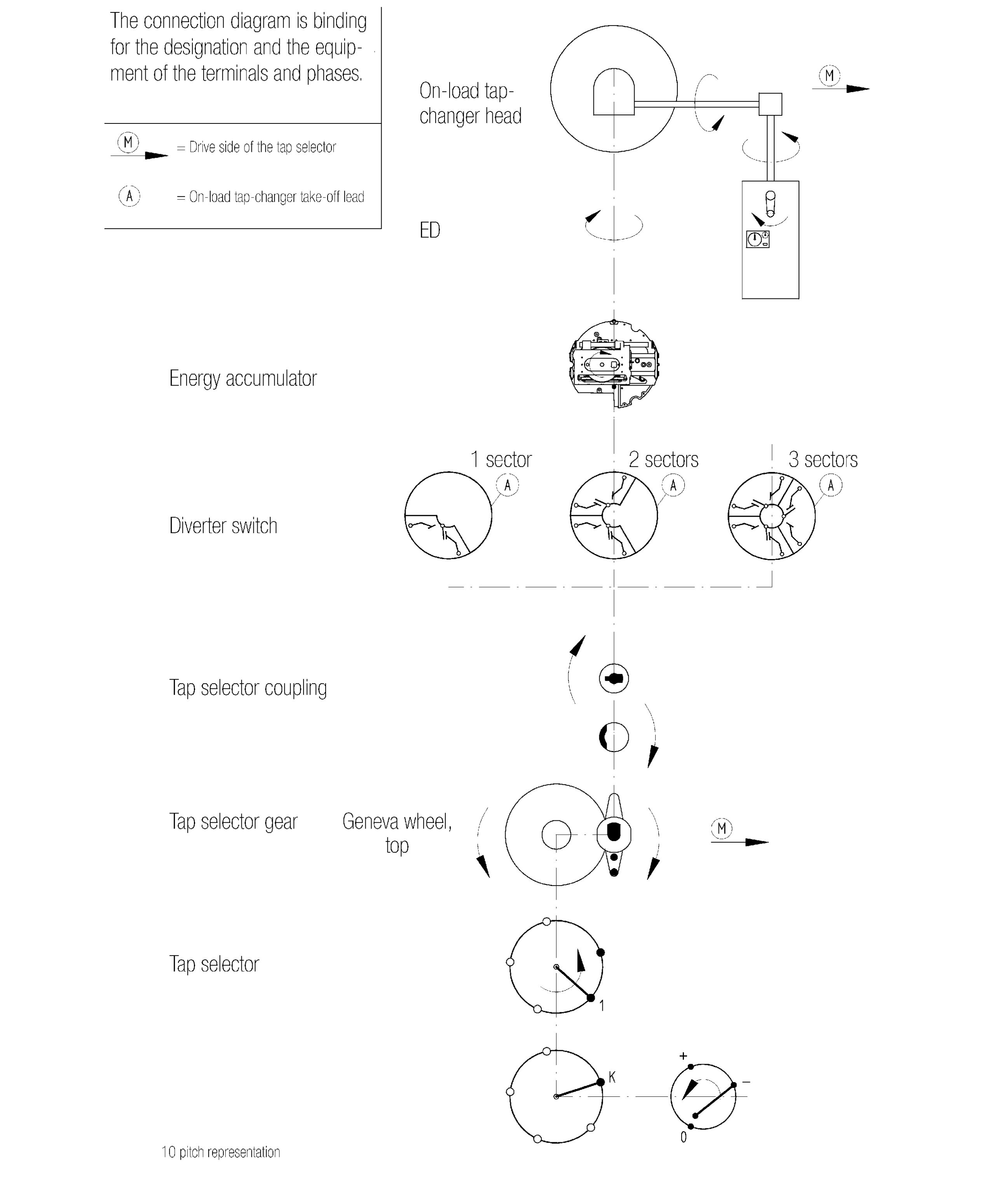
18.26 VACUTAP® VRC, adjustment plan with multiple coarse change-over selector for change-over selector division 18, 2-5 coarse tap connections (730977)



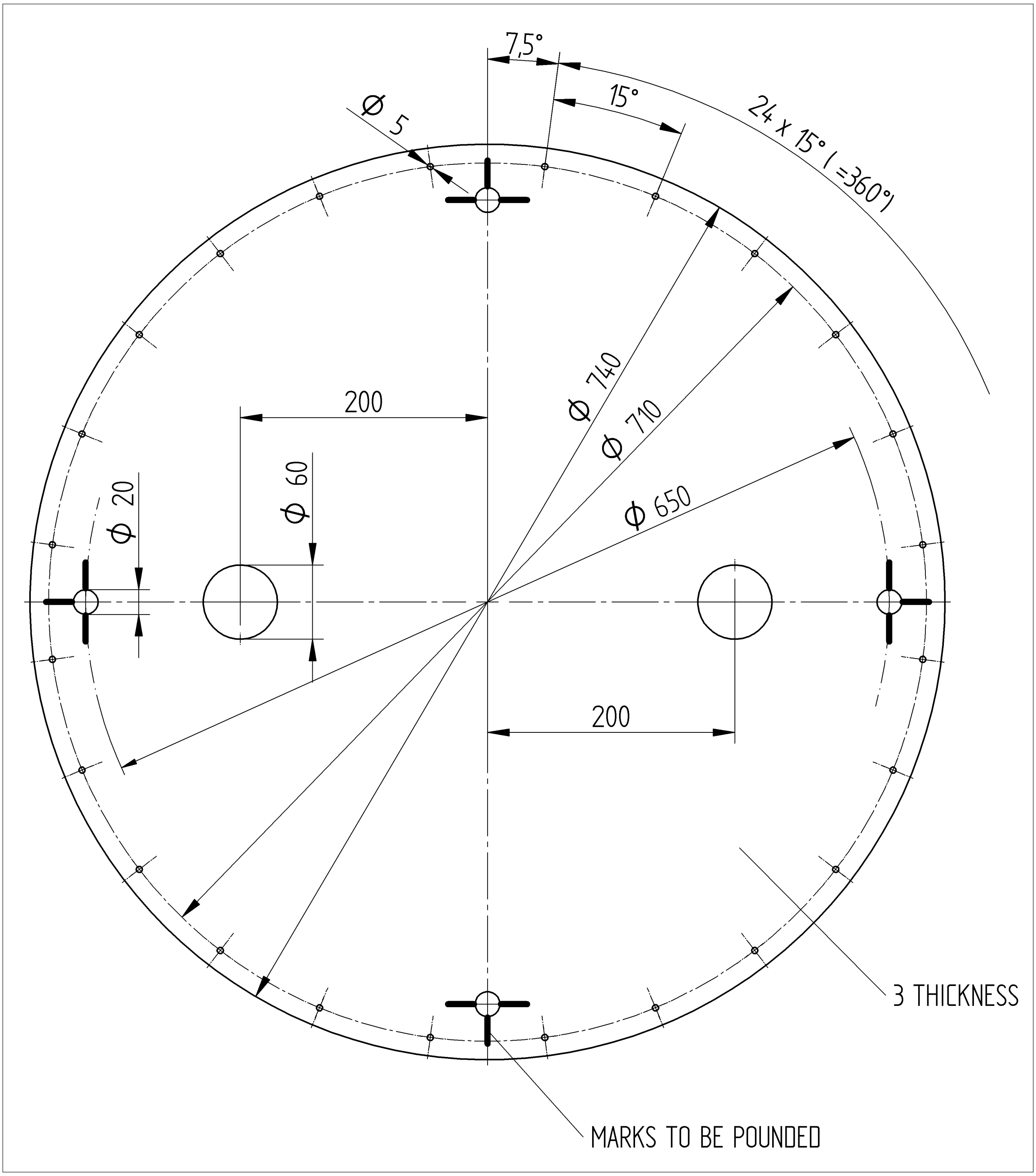
18.27 VACUTAP® VRD/VRF, adjustment plan with coarse tap selector connection (721091)



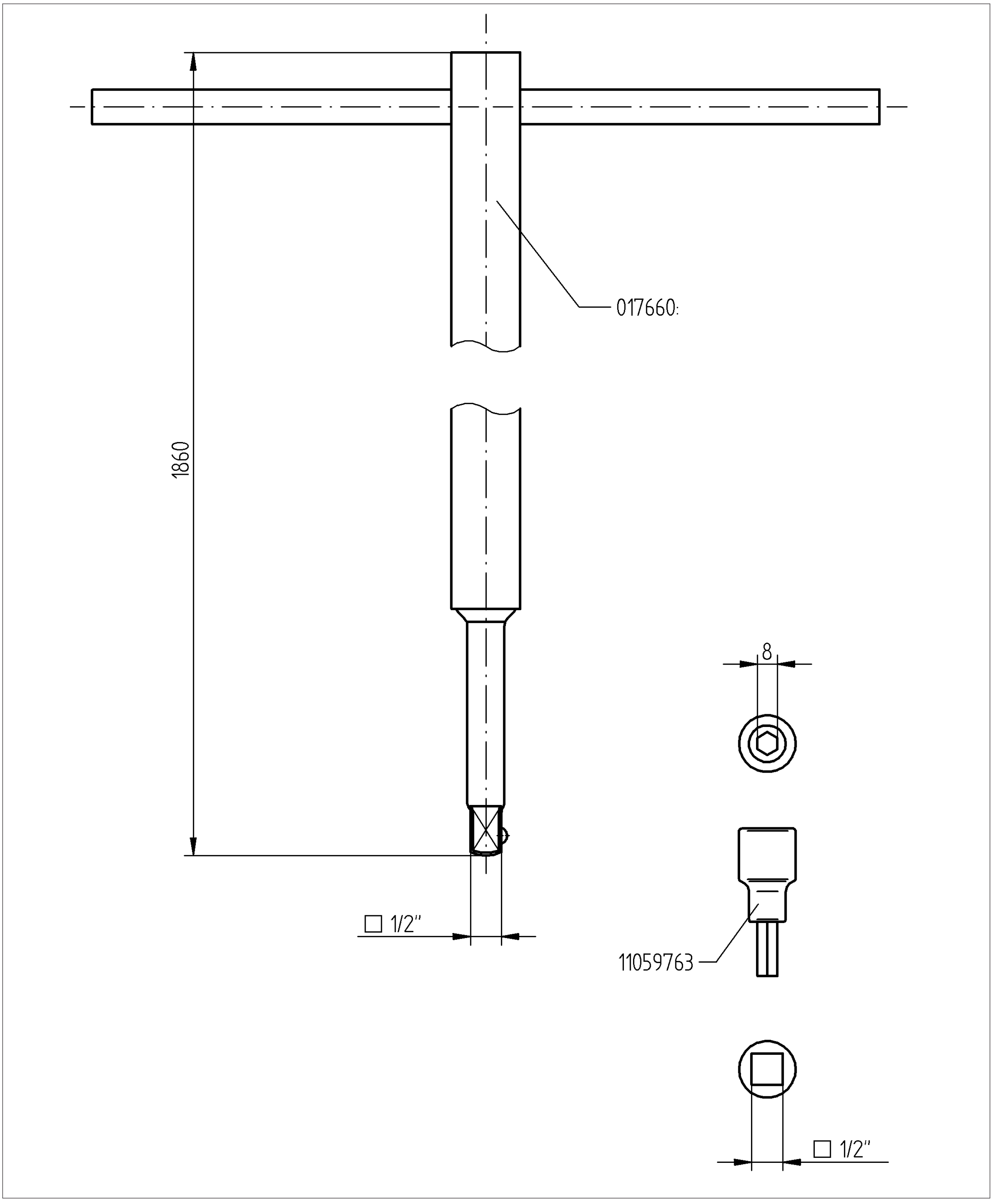
18.28 VACUTAP® VRG, adjustment plan with coarse tap selector connection (727075)



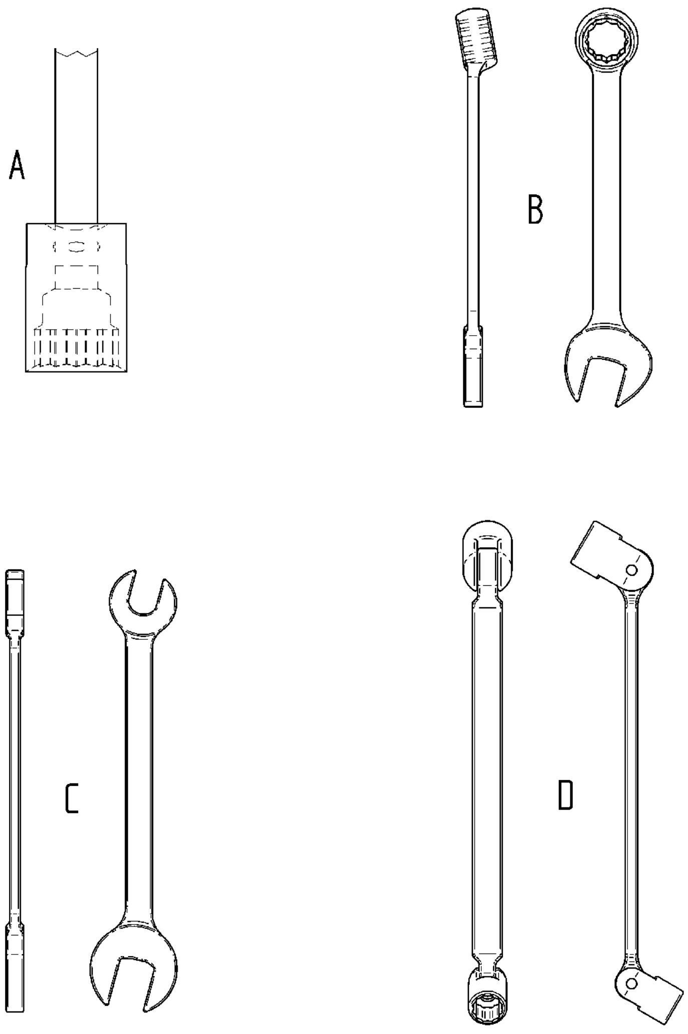
18.29 Tracing template for on-load tap-changer head (890183)



18.30 Socket wrench for kerosene drain plug (723015)

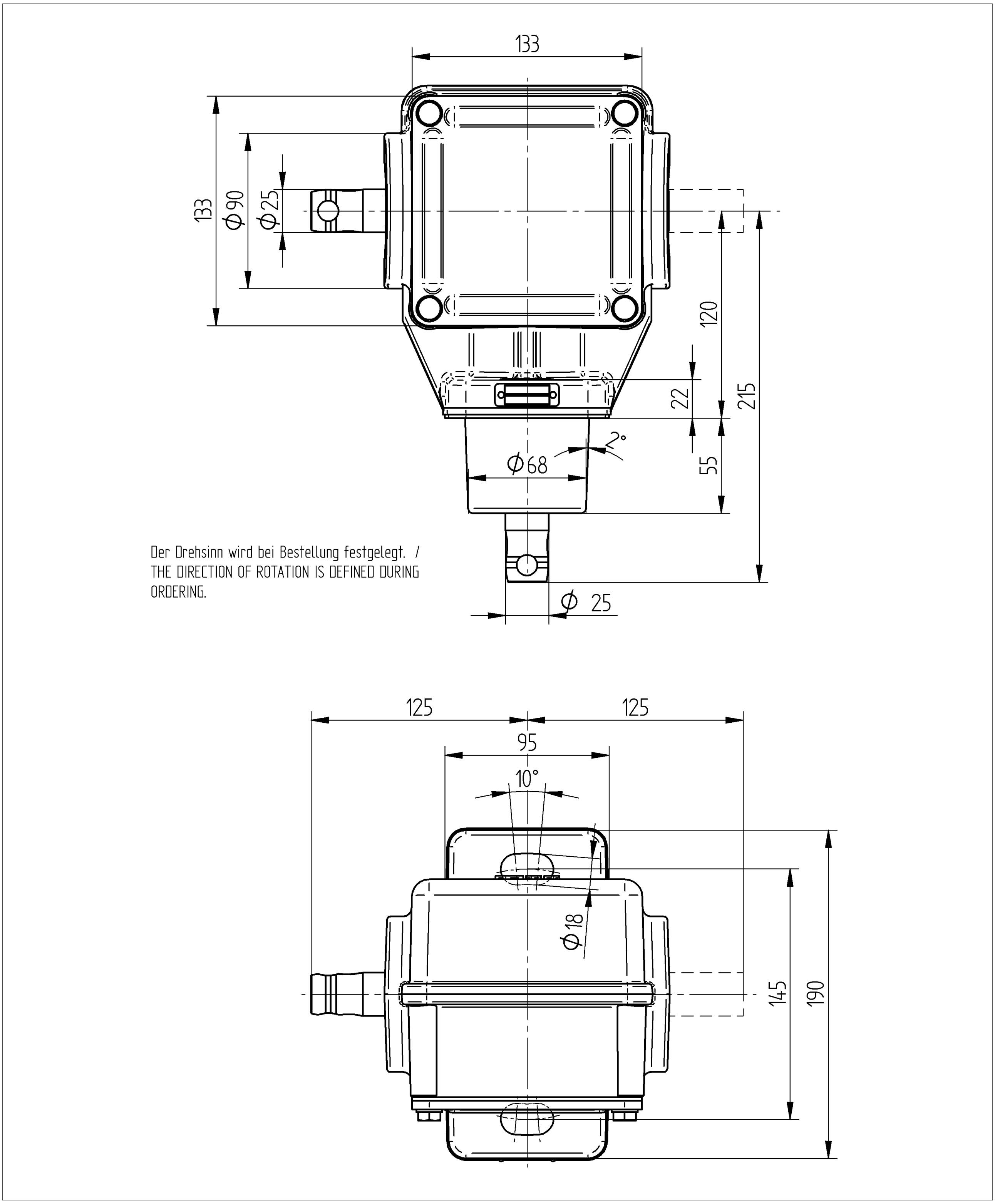


18.31 Screw tools for installation and maintenance (723016)



SER. NO.	QUANTITY	DESIGNATION	FIGURE	DIN	WRENCH SIZE IN MM
1	1	SOCKET WRENCH INSERT	A	3124	17
2	1	RING AND OPEN-JAW WRENCH	B	3113	8
3	1	RING AND OPEN-JAW WRENCH	B	3113	10
4	1	RING AND OPEN-JAW WRENCH	B	3113	13
5	1	DOUBLE-ENDED OPEN-JAW WRENCH	C	3110	17 / 19
6	1	DOUBLE-ENDED OPEN-JAW WRENCH	C	3110	19 / 22
7	1	DOUBLE-ENDED FLEXIBLE HEAD SPANNER	D	-	13 / 17

18.32 Bevel gear CD 6400, dimensional drawing (892916)



MR worldwide

Australia
Reinhausen Australia Pty. Ltd.
17/20-22 St Albans Road
Kingsgrove NSW 2208
Phone: +61 2 9502 2202
Fax: +61 2 9502 2224
E-Mail: sales@au.reinhausen.com

Brazil
MR do Brasil Indústria Mecánica Ltda.
Av. Elias Yazbek, 465
CEP: 06803-000
Embu - São Paulo
Phone: +55 11 4785 2150
Fax: +55 11 4785 2185
E-Mail: vendas@reinhausen.com.br

Canada
Reinhausen Canada Inc.
3755, rue Java, Suite 180
Brossard, Québec J4Y 0E4
Phone: +1 514 370 5377
Fax: +1 450 659 3092
E-Mail: m.foata@ca.reinhausen.com

India
Easun-MR Tap Changers Ltd.
612, CTH Road
Tiruninravur, Chennai 602 024
Phone: +91 44 26300883
Fax: +91 44 26390881
E-Mail: easunmr@vsnl.com

Indonesia
Pt. Reinhausen Indonesia
German Center, Suite 6310,
Jl. Kapt. Subijanto Dj.
BSD City, Tangerang
Phone: +62 21 5315-3183
Fax: +62 21 5315-3184
E-Mail: c.haering@id.reinhausen.com

Iran
Iran Transfo After Sales Services Co.
Zanjan, Industrial Township No. 1 (Aliabad)
Corner of Morad Str.
Postal Code 4533144551
E-Mail: itass@iran-transfo.com

Italy
Reinhausen Italia S.r.l.
Via Alserio, 16
20159 Milano
Phone: +39 02 6943471
Fax: +39 02 69434766
E-Mail: sales@it.reinhausen.com

Japan
MR Japan Corporation
German Industry Park
1-18-2 Hakusan, Midori-ku
Yokohama 226-0006
Phone: +81 45 929 5728
Fax: +81 45 929 5741

Luxembourg
Reinhausen Luxembourg S.A.
72, Rue de Prés
L-7333 Steinsel
Phone: +352 27 3347 1
Fax: +352 27 3347 99
E-Mail: sales@lu.reinhausen.com

Malaysia
Reinhausen Asia-Pacific Sdn. Bhd
Level 11 Chulan Tower
No. 3 Jalan Conlay
50450 Kuala Lumpur
Phone: +60 3 2142 6481
Fax: +60 3 2142 6422
E-Mail: mr_rap@my.reinhausen.com

P.R.C. (China)
MR China Ltd. (MRT)
开德贸易（上海）有限公司
中国上海浦东新区浦东南路 360 号
新上海国际大厦 4 楼 E 座
邮编： 200120
电话：＋86 21 61634588
传真：＋86 21 61634582
邮箱：mr-sales@cn.reinhausen.com
mr-service@cn.reinhausen.com

Russian Federation
OOO MR
Naberezhnaya Akademika Tupoleva
15, Bld. 2 ("Tupolev Plaza")
105005 Moscow
Phone: +7 495 980 89 67
Fax: +7 495 980 89 67
E-Mail: mrr@reinhausen.ru

South Africa
Reinhausen South Africa (Pty) Ltd.
No. 15, Third Street, Booysens Reserve
Johannesburg
Phone: +27 11 8352077
Fax: +27 11 8353806
E-Mail: support@za.reinhausen.com

South Korea
Reinhausen Korea Ltd.
21st floor, Standard Chartered Bank Bldg.,
47, Chongro, Chongro-gu,
Seoul 110-702
Phone: +82 2 767 4909
Fax: +82 2 736 0049
E-Mail: you-mi.jang@kr.reinhausen.com

U.S.A.
Reinhausen Manufacturing Inc.
2549 North 9th Avenue
Humboldt, TN 38343
Phone: +1 731 784 7681
Fax: +1 731 784 7682
E-Mail: sales@reinhausen.com

United Arab Emirates
Reinhausen Middle East FZE
Dubai Airport Freezone, Building Phase 6
3rd floor, Office No. 6EB, 341 Dubai
Phone: +971 4 2368 451
Fax: +971 4 2368 225
Email: service@ae.reinhausen.com

Maschinenfabrik Reinhausen GmbH
Falkensteinstrasse 8
93059 Regensburg

+49 (0)941 4090-0
+49(0)941 4090-7001
sales@reinhausen.com

www.reinhausen.com

288/03 EN ▪ 06/13 ▪ F0154202

Motor-Drive Unit TAPMOTION® ED

Operating Instructions

138/06

Table of contents

1 Introduction

This technical file contains detailed descriptions on the safe and proper installation, connection, commissioning and monitoring of the product.

It also includes safety instructions and general information about the product.

This technical file is intended solely for specially trained and authorized personnel.

1.1 Validity

This technical file is valid for the TAPMOTION® ED product.

1.2 Manufacturer

The product is manufactured by:

Maschinenfabrik Reinhausen GmbH

Falkensteinstraße 8
93059 Regensburg, Germany
Tel.: (+49) 9 41/40 90-0
Fax: (+49) 9 41/40 90-7001
E-mail: sales@reinhausen.com

Further information on the product and copies of this technical file are available from this address if required.

1.3 Subject to change without notice

The information contained in this technical file comprises the technical specifications approved at the time of printing. Significant modifications will be included in a new edition of the technical file.

The document number and version number of this technical file are shown in the footer.

1.4 Completeness

This technical file is incomplete without the supporting documentation.

1.5 Supporting documents

The following documents also apply in addition to this technical file:

- Connection diagrams
- Routine test report
- Supplement

Also observe generally valid legislation, standards, guidelines and specifications on accident prevention and environmental protection in the respective country of use.

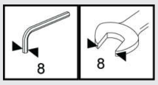
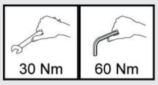
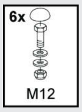
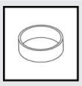
1.6 Safekeeping

This technical file and all supporting documents must be kept ready at hand and accessible for future use at all times.

1.7 Notation conventions

This section contains an overview of the symbols and textual emphasis used.

1.7.1 Symbols

Symbol	Definition
	Wrench size
	Tightening torque
	Number and type of fastening materials used
	Fill with oil
	Cut open, cut through
	Clean
	Visual inspection
	Use your hand
	Adapter ring
	Apply a coat of paint
	Use a file

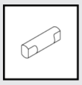
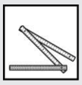
Symbol	Definition
	Grease
	Coupling bolt
	Use a ruler
	Use a saw
	Hose clip

Table 1: Symbols

1.7.2 Hazard communication system

Warnings in this technical file use the following format:

⚠ WARNING

Type and source of danger

Consequences

- ▶ Action
- ▶ Action

The following signal words are used:

Signal word	Definition
DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates measures to be taken to prevent damage to property.

Table 2: Signal words in warning notices

Pictograms warn of dangers:

Pictogram	Definition
	Warning of a danger point

Pictogram	Definition
	Warning of dangerous electrical voltage
	Warning of combustible substances
	Warning of danger of tipping

Table 3: Pictograms used in warning notices

1.7.3 Information system

Information is designed to simplify and improve understanding of particular procedures. In this technical file it is laid out as follows:

Important information.

2 Safety

2.1 General safety information

The technical file contains detailed descriptions on the safe and proper installation, connection, commissioning and monitoring of the product.

- Read this technical file through carefully to familiarize yourself with the product.
- Particular attention should be paid to the information given in this chapter.

2.2 Appropriate use

The product and associated equipment and special tools supplied with it comply with the relevant legislation, regulations and standards, particularly health and safety requirements, applicable at the time of delivery.

If used as intended and in compliance with the specified requirements and conditions in this technical file as well as the warning notices in this technical file and attached to the product, then the product does not present any hazards to people, property or the environment. This applies throughout the product's entire life, from delivery through installation and operation to disassembly and disposal.

The operational quality assurance system ensures a consistently high quality standard, particularly in regard to the observance of health and safety requirements.

The following is considered appropriate use

- the product must be operated in accordance with this technical file and the agreed delivery conditions and technical data
- the associated equipment and special tools supplied with it are used solely for the intended purpose and in accordance with the specifications of this technical file
- the product must only be used with the on-load tap-changer/off-circuit tap-changer specified in the order
- the serial number of the drive must match that of the on-load tap-changer/off-circuit tap-changer.

2.3 Inappropriate use

Use is considered to be inappropriate if the product is used other than as described in the Appropriate use section.

Maschinenfabrik Reinhausen does not accept liability for damage resulting from unauthorized or inappropriate changes to the product. Inappropriate changes to the product without consultation with Maschinenfabrik Reinhausen can lead to personal injury, damage to property and operational disruption.

2.4 Personnel qualification

The product is designed solely for use in electrical energy systems and facilities operated by appropriately trained staff. This staff comprises people who are familiar with the installation, assembly, commissioning and operation of such products.

2.5 Operator's duty of care

To prevent accidents, disruptions and damage as well as unacceptable adverse effects on the environment, those responsible for transport, installation, operation, maintenance and disposal of the product or parts of the product must ensure the following:

- All warning and hazard notices are complied with.
- Personnel are instructed regularly in all relevant aspects of operational safety, the operating instructions and particularly the safety instructions contained therein.
- Regulations and operating instructions for safe working as well as the relevant instructions for staff procedures in the case of accidents and fires are kept on hand at all times and are displayed in the workplace where applicable.
- The product is only used when in a sound operational condition and safety equipment in particular is checked regularly for operational reliability.
- Only replacement parts, lubricants and auxiliary materials which are authorized by the manufacturer are used.
- The specified operating conditions and requirements of the installation location are complied with.
- All necessary devices and personal protective equipment for the specific activity are made available.
- The prescribed maintenance intervals and the relevant regulations are complied with.
- Installation, electrical connection and commissioning of the product may only be carried out by qualified and trained personnel in accordance with this technical file.
- The operator must ensure appropriate use of the product.

2.6 Personal protective equipment

Personal protective equipment must be worn during work to minimize risks to health.

- Always wear the personal protective equipment required for the job at hand.
- Follow information about personal protective equipment provided in the work area.

Always wear	
	**Protective clothing** Close-fitting work clothing with a low breaking strength, with tight sleeves and with no protruding parts. It mainly serves to protect the wearer against being caught by moving machine parts. Do not wear any rings, necklaces or other jewelry.
	**Safety shoes** To protect against falling heavy objects and slipping on slippery surfaces.

Table 4: Personal protective equipment to be worn at all times

Wear the following in special environments	Special personal protective equipment is needed in special environments. The choice of equipment depends on the circumstances.
	**Safety glasses** To protect the eyes from flying parts and splashing liquids.
	**Hard hat** To protect from falling and flying parts and materials.
	**Hearing protection** To protect from hearing damage.

Table 5: Personal protective equipment to be worn in special environments

2.7 Protective devices

The following protective devices are fitted in the drive:

- End stop device (mechanical and electric)
- Device protecting against unintentional passage
- Motor protection device
- Protection against accidental contact

3 Product description

This chapter contains an overview of the design and function of the product.

3.1 Function description

The motor-drive unit works by adjusting the operating position of on-load tap-changers and off-circuit tap-changers in regulating transformers to the individual operating requirements.

The tap-change operation is activated by starting the motor-drive unit (a single control impulse triggered, for example, by a regulator of the TAPCON®-series). This operation is always completed regardless of any other control pulses emitted during the tap-change operation. In the standard design, the next tap-change operation can only proceed once all control devices have reached their rest positions.

3.2 Type designation

The various basic designs of the TAPMOTION® ED are clearly identified by explicit product definitions.

Type designation	Description	Variants
ED 100-ST	Product designation	Electric Drive
ED **100**-ST	Transmission gear design	100 or 200 (depending on the torque required)
ED 100-**S**T	Protective housing design	S = small protective housing L = large protective housing
ED 100-S**T**	Special applications	… = none C = Plunger coil design T = TAPCON® or TAPGUARD®

Table 6: Type designation

3.3 Performance features

The motor-drive unit is particularly characterized by the following properties:

- common swing frame concept for all on-load tap-changers
- reduced design work thanks to common fastening and output geometry for all TAPMOTION® ED designs
- clear indication field which is easy to read
- modern terminal technology
- rapid replacement of the position transmitter modules since the functions of the position transmitter board and position transmitter module are separate

- quiet transmission gear with zero-maintenance belt-type transmission gear
- panel heater as anti-condensation heater

3.4 Scope of delivery

The motor-drive unit is packaged with protection against moisture and is delivered as follows:

- Motor-drive unit
- Product documentation

Please note the following:

1. Check the shipment for completeness on the basis of the shipping documents.
2. Store the parts in a dry place until installation.
3. The product must remain in its airtight, protective wrapping and may only be removed immediately before installation.

3.5 Attachment

This chapter contains an overview of how to attach the motor-drive unit.

Components not described here in detail are described in the motor-drive unit's technical data.

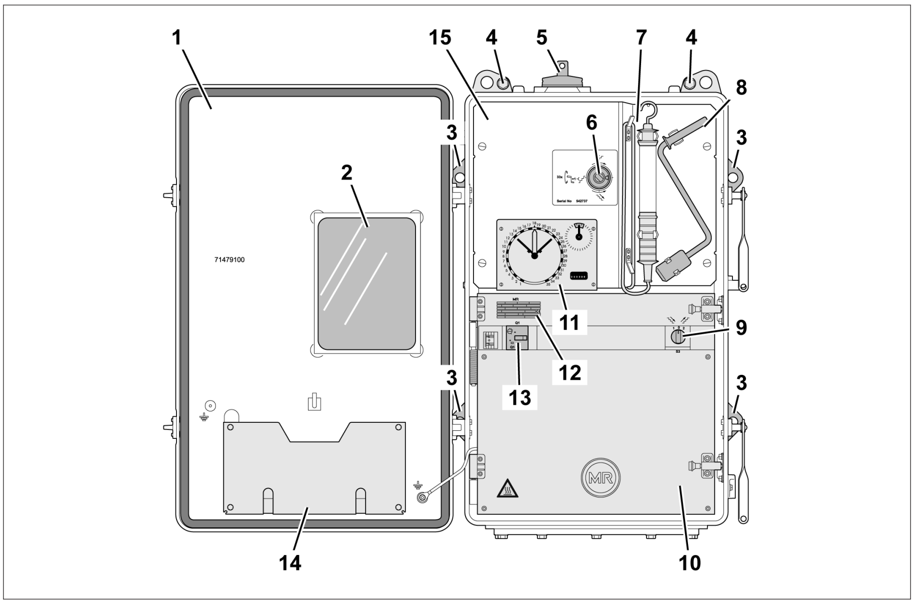


Figure 1: Motor-drive unit, open

1	Protective housing cover	9	S3 control switch
2	Viewing window for indication field	10	Swing frame/anti-condensa-tion heater
3	Fixing lug	11	Indication field
4	Ground connection	12	Name plate
5	Output shaft	13	Motor protective switch Q1
6	Hand crank aperture with hand crank safety switch	14	Document pocket
7	Hand lamp	15	Transmission gear cover plate
8	Hand crank		

3.5.1 Name plate

The name plate can be found on the swing frame and contains the following information:

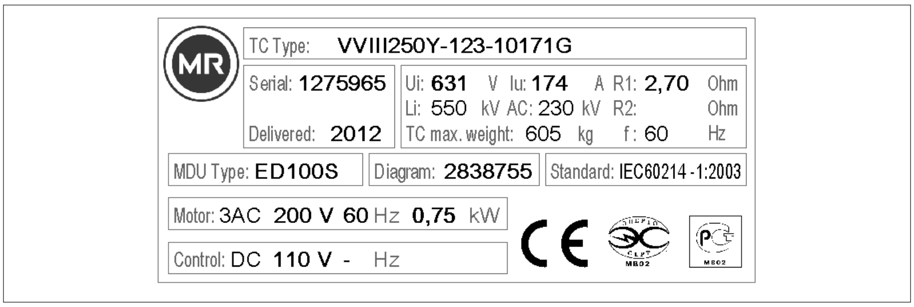


Figure 2: Name plate

3.5.2 Indication field

A clear indication field is fitted in the motor-drive unit. Pointer and operations counter are mechanically driven and indicate the tap-change operation sequence of the motor-drive unit. The reset-wheel on the operations counter is lead-sealed at the factory.

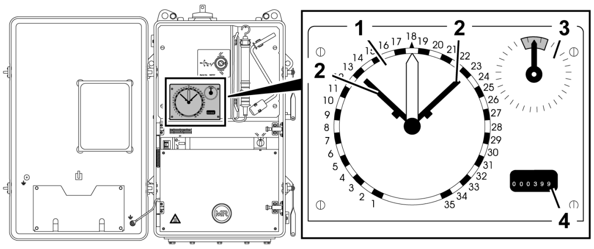


Figure 3: Indication field

1	Tap position indicator	3	The tap-change indicator: Shows the current position of the control cam (33 tap-change indicator sections per operating position)
2	The two drag hands indicate the regulating range currently used	4	The mechanical operations counter shows the overall number of tap-change operations

3.5.3 Anti-condensation heater

The anti-condensation heater is designed as a panel heater which also acts as the front cover of the swing frame.

The design of the motor-drive unit and panel heater ensures that air circulates inside the motor-drive unit and therefore that there is a constant interior temperature which is always higher than the outside temperature.

3.5.4 Swing frame/terminal rail

The swing frame protects all electrical and mechanical parts of the motor-drive unit behind the frame against accidental contact.

The terminal rail behind the swing frame facilitates an easy electrical connection of the motor-drive unit. The wiring is easily connected using vertically arranged cap rails with the corresponding installed terminal bars.

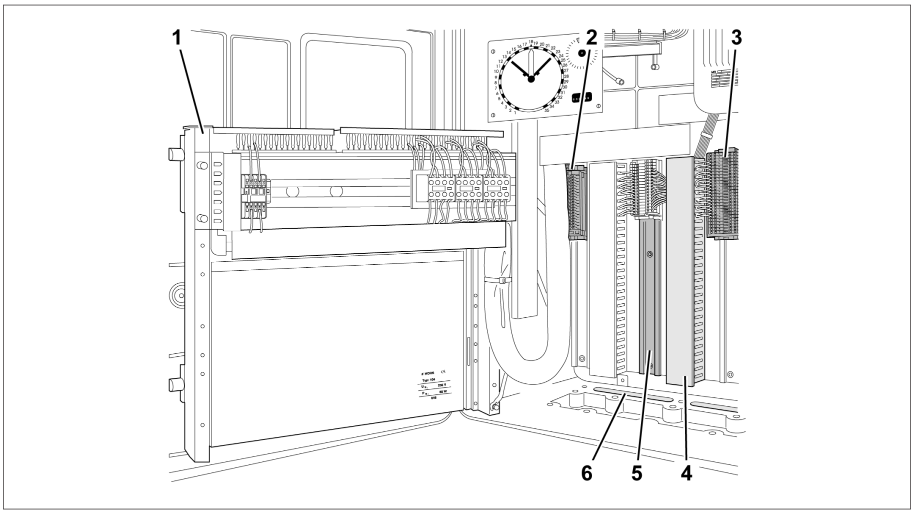


Figure 4: Terminal rail

1	Swing frame	4	Cable duct
2	Position transmitter module	5	Terminal rail
3	Terminal bar X1	6	Opening for cable entry (sealed by 3 base plates)

3.5.5 Position transmitter equipment

NOTICE

Damage to the on-load tap-changer and motor-drive unit!

Damage to on-load tap-changer and motor-drive unit due to incorrect use of position transmitter equipment!

- ▶ Only circuits stated in the chapter Technical data for position transmitter equipment [▶ 42] may be connected to the position transmitter module connections.
- ▶ The switchover point of the position transmitter equipment in the motor-drive unit is not the same as the switchover point of the diverter switch. This depends on the type of diverter switch. This fact should be noted when project planning the locking circuits between the motor-drive unit and external equipment (e.g. transformer circuit breaker).
- ▶ For external monitoring, locking and control purposes, it is not therefore the position transmitter equipment but the "Tap changer in operation" position transit contact shown in the connection diagram that should be used.

The position transmitter equipment is used to indicate the operating position of the on-load tap-changer/off-circuit tap-changer when idle.

The remote display is available in various versions.

The position transmitter module for connection by the customer is located on the terminal rail [▶ 15].

For more information about the position transmitter equipment, see Technical data for position transmitter equipment [▶ 42].

3.5.6 Transmission gear cover plate

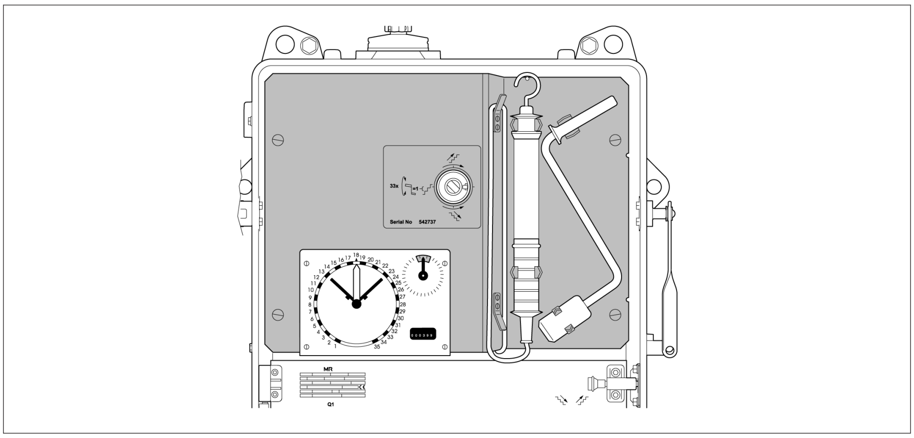
⚠ WARNING

Danger of death and severe injury from electrical voltage!

Danger of death and severe injury from electrical voltage if the transmission gear cover plate is not fitted.

▶ Never start up motor-drive unit without transmission gear cover plate.

The touch-protected transmission gear cover plate features an opening for the hand crank used in manual mode.



Transmission gear cover plate

4 Packaging, transport and storage

4.1 Packaging

4.1.1 Purpose

The packaging is designed to protect the packaged goods during transport, loading and unloading as well as periods of storage in such a way that no (detrimental) changes occur. The packaging must protect the goods against permitted transport stresses such as vibration, knocks and moisture (rain, snow, condensation).

The packaging also prevents the packaged goods from moving impermissibly within the packaging. The packaged goods must be prepared for shipment before actually being packed so that the goods can be transported safely, economically and in accordance with regulations.

4.1.2 Suitability

The packaging is suitable for

- all common types of transportation
- stackability - 1000 kg/m^2 top surface

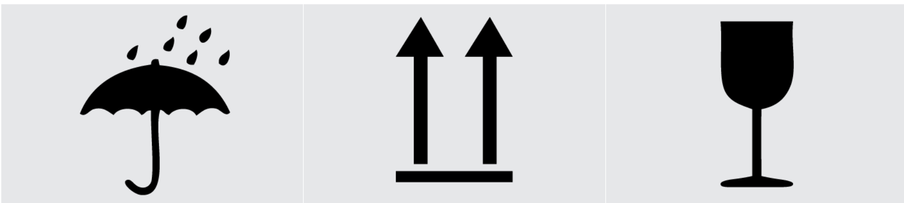
The packaged goods are packed in a stable wooden crate. This crate ensures that the shipment is secure when in the intended transportation position and that none of its parts touch the loading surface of the means of transport or touch the ground after unloading.

The packaged goods are stabilized inside the crate to prevent impermissible changes in position.

The sealed packaging surrounds the packaged goods on all sides with a PE foil. The product is protected using desiccant. The PE foil is bonded after the drying agent is added and any remaining air is extracted. This can be seen on the form-fit of the PE foil.

4.1.3 Markings

The packaging bears a signature with instructions for safe transport and correct storage. The following symbols apply to the shipment (of non-hazardous goods). Adherence to these symbols is mandatory.



Protect against moisture	Top	Fragile

Table 7: Shipping pictograms

4.2 Transportation, receipt and handling of shipments

⚠ WARNING

Danger of death and damage to property!

Danger of death and damage to property due to tipping or falling load!

- ▶ Only trained and appointed persons may select the sling gear and secure the load.
- ▶ Do not walk under the hanging load.
- ▶ Use means of transport and lifting gear with a carrying capacity of > 500 kg.

In addition to oscillation stress and shock stress, jolts must also be expected during transportation. In order to prevent possible damage, avoid dropping, tipping, knocking over and colliding with the product.

If a box falls from a certain height (e.g. when slings tear) or experiences an unbroken fall, damage must be expected regardless of the weight.

Every delivered shipment must be checked for the following by the recipient before acceptance (acknowledgment of receipt):

- Completeness based on the delivery slip
- External damage of any type.

The checks must take place after unloading when the crate or transport container can be accessed from all sides.

Visible damage

If external transport damage is detected on receipt of the shipment, proceed as follows:

- Immediately record the transport damage found in the shipping documents and have this countersigned by the carrier.
- In the event of severe damage, total loss or high damage costs, immediately notify the sales department at Maschinenfabrik Reinhausen and the relevant insurance company.
- After identifying damage, do not modify the condition of the shipment further and retain the packaging material until an inspection decision has been made by the transport company or the insurance company.
- Record the details of the damage immediately onsite together with the carrier involved. This is essential for any claim for damages!
- If possible, photograph damage to packaging and packaged goods. This also applies to signs of corrosion on the packaged goods due to moisture inside the packaging (rain, snow, condensation).
- Be absolutely sure to also check the sealed packaging.

NOTICE

Damage to packaged goods!

Damage to packaged goods due to damaged sealed packaging!

► If the sealed packaging is damaged, do not under any circumstances install or commission the packaged goods.

- Name the damaged parts.

Hidden damage

When damages are not determined until unpacking after receipt of the shipment (hidden damage), proceed as follows:

- Make the party responsible for the damage liable as soon as possible by telephone and in writing, and prepare a damage report.
- Observe the time periods applicable to such actions in the respective country. Inquire about these in good time.

With hidden damage, it is very hard to make the transportation company (or other responsible party) liable. Any insurance claims for such damages can only be successful if relevant provisions are expressly included in the insurance terms and conditions.

4.3 Storage of shipments

Packaged goods with a functional sealed packaging can be stored outdoors when the following conditions are complied with.

Selection and arrangement of the storage location should meet the following requirements:

- Stored goods are protected against moisture (flooding, water from melting snow and ice), dirt, pests such as rats, mice, termites and so on, and against unauthorized access.
- Store the crates on timber beams and planks as a protection against rising damp and for better ventilation.
- Carrying capacity of the substrate under the goods is sufficient.
- Entrance and exit paths are kept free.

Check stored goods at regular intervals. Also take appropriate action after storms, heavy rain or snow and so on.

Protect the packaging foil from direct sunlight so that it does not disintegrate under the influence of UV rays, which would cause the packaging to lose its sealing function.

If installation of the product is delayed beyond the normal time frame, suitable measures must be taken without delay. The following measures can be used:

- Correctly regenerate the drying agent and restore the sealed packaging.
- Unpack the packed goods and store in suitable storage space (well ventilated, as dust-free as possible, humidity < 50 % where possible).

4.4 Unpacking shipments and checking for transportation damages

NOTICE

Damage to property!

Damage to property due to ineffectively sealed packaging in locations with an unsuitable climate!

- ► Leave the product in its sealed packaging until installation.
- ► Do not open the sealed packaging until just before installation.

- Wherever possible keep the crate packaged for transport to the place where installation will take place.
- When unpacking, check the condition of the packaged goods.
- Check completeness based on the delivery slip.

5 Drying transformer

5.1 Drying transformer in autoclave

Observe the following information when drying the transformer in a autoclave.

NOTICE

Damage to drive and on-load tap-changer/off-circuit tap-changer!

If the drive is dried in an autoclave, the drive and on-load tap-changer/off-circuit tap-changer may be damaged.

► Do not dry drive in an autoclave.

5.2 Drying transformer in its own tank

If you dry the transformer in its own tank, the drive can remain attached to the transformer during drying.

6 Fitting motor-drive unit on transformer

6.1 Fitting motor-drive unit on transformer

1. Fit 4 stud bolts (not supplied by MR) to transformer tank.

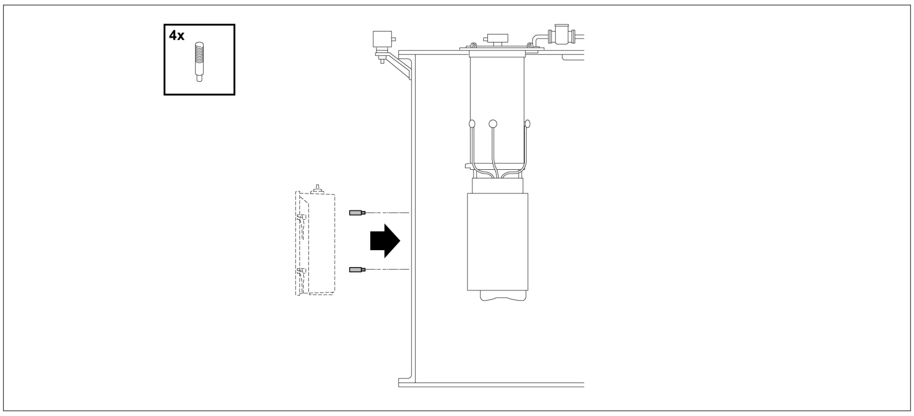


Figure 5: Stud bolt

2. **NOTICE!** Fit the drive vertically to the transformer tank so that its output shaft is correctly aligned with the vertical shaft of the bevel gear. If this is not done, the drive may be damaged.

The assembly holes for this purpose are on the outside of the protective housing's mounting straps.

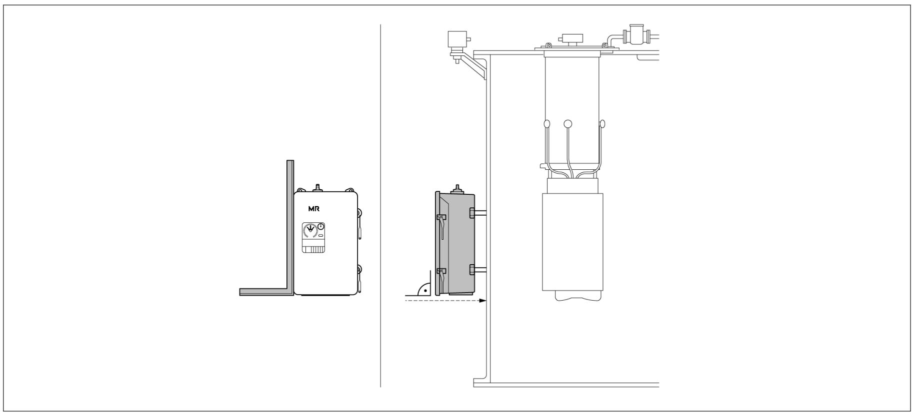


Figure 6: Fitting drive

3. **NOTICE!** Secure drive without warping or deforming. If this is not done, the drive may be damaged.

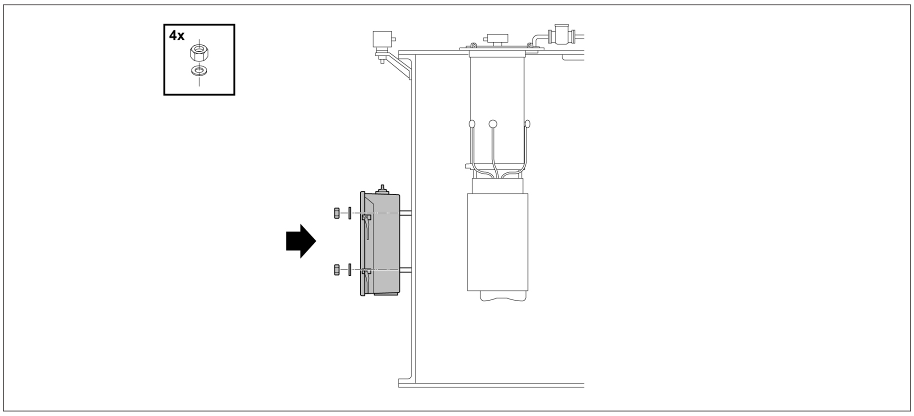


Figure 7: Securing drive

4. Vibration dampers must be used on transformers where the motor-drive unit is subject to vibration (MR special design).
5. Connect the grounding screw of the motor-drive unit to the transformer tank.

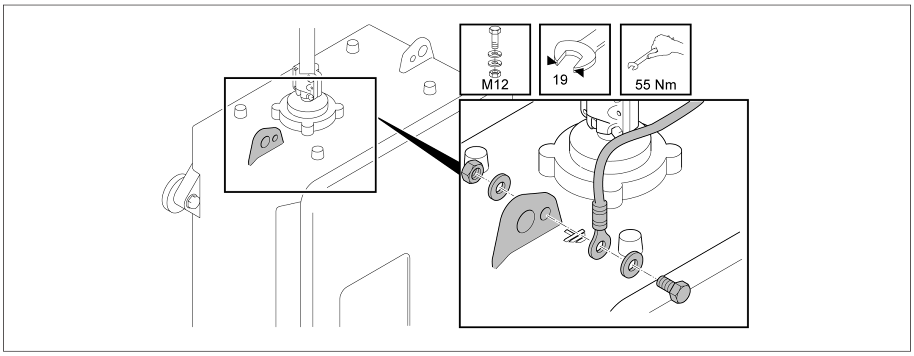


Figure 8: Grounding screw

6. Connect main grounding conductor to grounding conductor terminal on terminal bar X1 (minimum connection cross-section 2.5 mm^2).

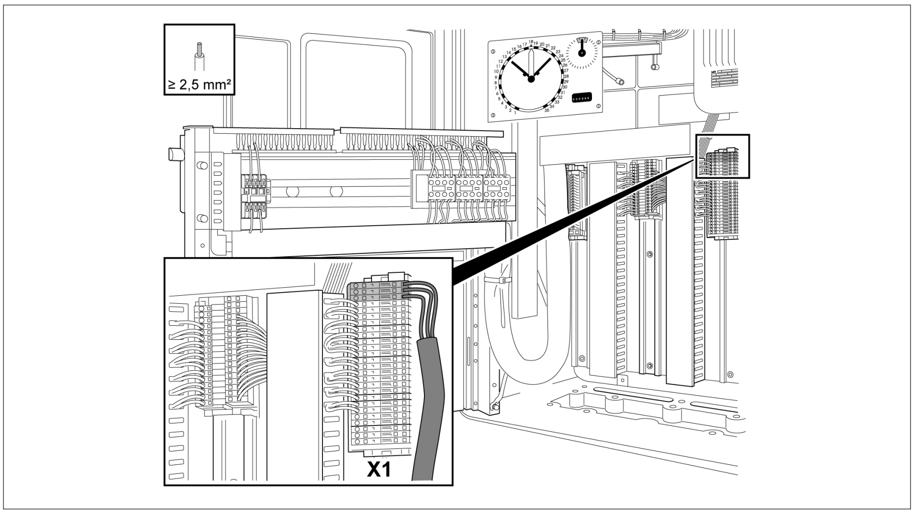


Figure 9: Main grounding conductor

6.2 Mounting drive shafts and bevel gear

The process of mounting the drive shafts and bevel gear is described in the operating instructions for the drive shafts.

6.3 Coupling on-load tap-changer and motor-drive unit

⚠ WARNING

Danger of death or severe injury!

Danger of death or severe injury due to motor-drive unit starting up by accident and due to electric voltage!

- ▶ Before starting any coupling work make sure that the motor protective switch is tripped.
- ▶ Carry out any adjustment work in manual mode only.
- ▶ When manually operating the motor-drive unit only use the hand crank provided for this purpose.
- ▶ Note that the hand crank safety switch causes a 2-pole disconnection of the motor circuit but that the control circuit is not interrupted.

NOTICE

Damage to the on-load tap-changer!

Performing too many operations without oil will damage the on-load tap-changer!

- ▶ Do not perform more than 250 tap-change operations on the on-load tap-changer without oil before drying.
- ▶ Before first actuating the on-load tap-changer after drying the transformer, the tap selector must be completely immersed in transformer oil and the oil compartment must be completely filled with oil.

1. **NOTICE!** Move on-load tap-changer/off-circuit tap-changer and the motor-drive unit into adjustment position before commencing any adjustment work. Ensure that tap position indicators for the motor-drive unit and on-load tap-changer/off-circuit tap-changer match. Otherwise damage to the on-load tap-changer and transformer may result.

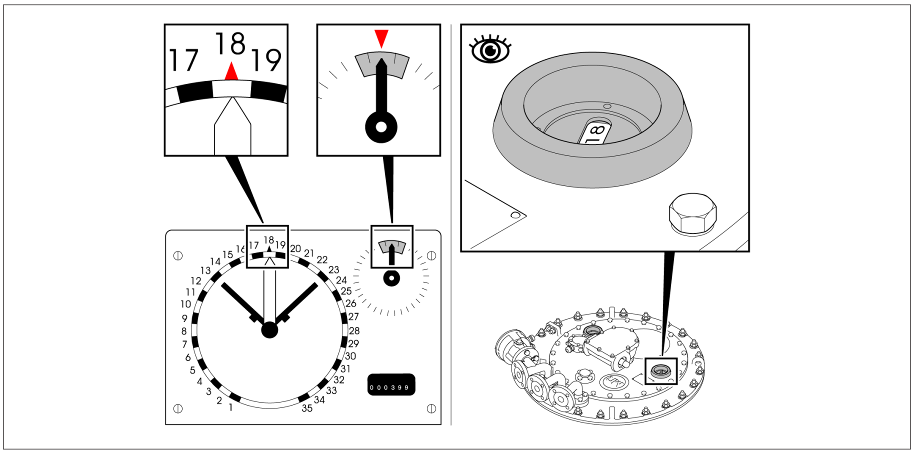


Figure 10: Adjustment position

2. Attach the hand crank in the motor-drive unit to the shaft end located in the upper cover plate. This activates a hand crank safety switch which disconnects the motor circuit at 2 poles.

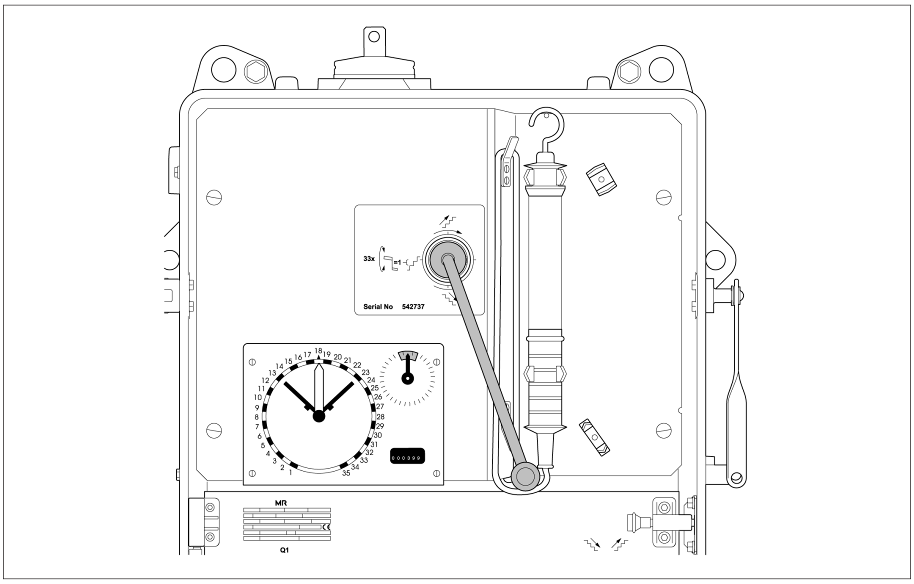


Figure 11: Hand crank

3. Turn the hand crank clockwise until the diverter switch operation begins. When turning the hand crank, observe the tap-change indicator which mechanically reflects the progress of the tap-change operation.

One on-load tap-change operation is represented by one rotation of the tap-change indicator. This indicator is divided into 33 tap-change indicator sections each of which corresponds to one hand crank revolution in the standard motor-drive unit design. The time of the switchover depends on the on-load tap-changer/off-circuit tap-changer type, but is always 2 tap-change indicator sections before the tap-change indicator gray field at the latest.

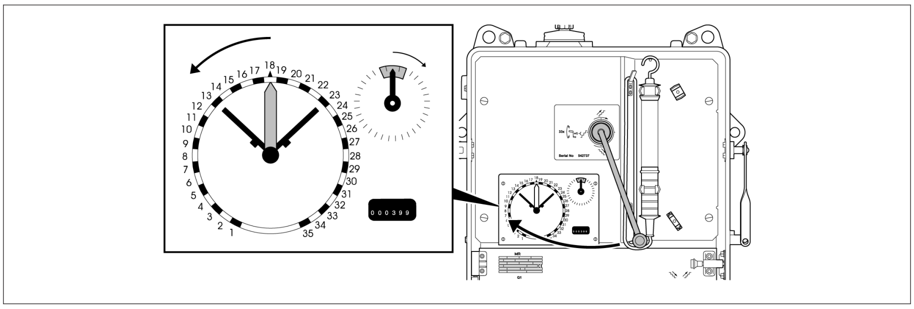


Figure 12: Turning the hand crank until the diverter switch operation begins

4. Once the diverter switch operation begins, turn the hand crank in the same direction while counting the sections required for the pointer to reach the mid-position of the area marked in gray on the tap-change indicator. Note the determined value A and the direction of rotation (example: A=2).

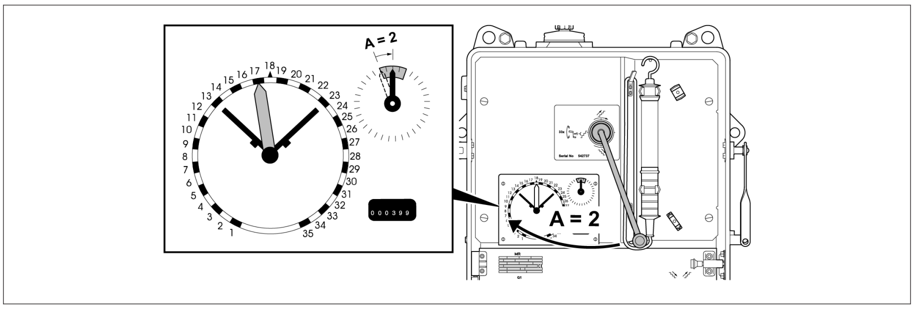


Figure 13: Counting the tap changes needed to reach the mid-position

5. If the determined value A is less than 8 tap-change indicator sections, turn another 8-A tap-change indicator sections in the same direction (example: 8-2=6) to complete the tap-change operation. Then turn in the opposite direction until the pointer is in the mid-position of the area marked in gray on the tap-change indicator.

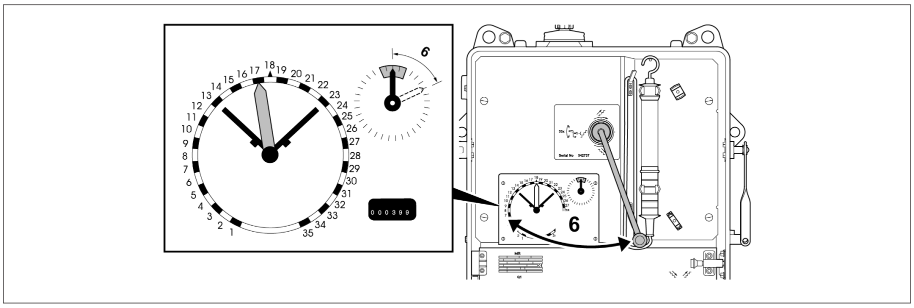


Figure 14: Completing diverter switch operation

6. Turn the hand crank counter-clockwise until the diverter switch operation begins

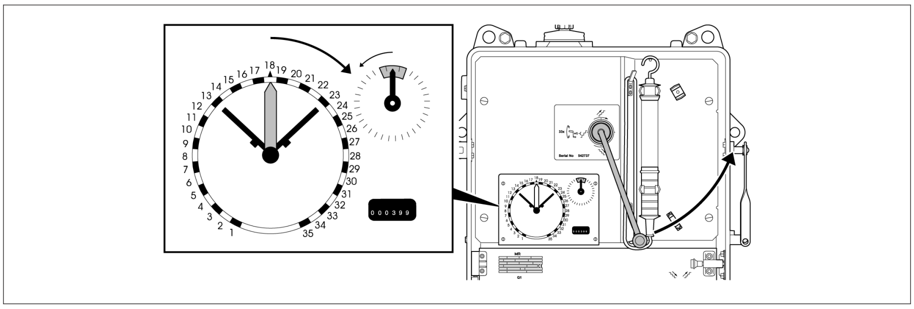


Figure 15: Turning hand crank in the opposite direction

7. Once the diverter switch operation begins, turn the hand crank in the same direction while counting the sections required for the pointer to reach the mid-position of the area marked in gray on the tap-change indicator. Note the determined value B and the direction of rotation (example: B=5). If the values obtained for A and B are identical, the on-load tap-changer and the motor-drive unit are correctly coupled.

The number of tap-change indicator sections from the beginning of the diverter switch operation until the pointer reaches the mid-position of the area marked in gray on the tap-change indicator should be the same in both directions. A slight asymmetry of a maximum of 1 tap-change indicator section is permissible.

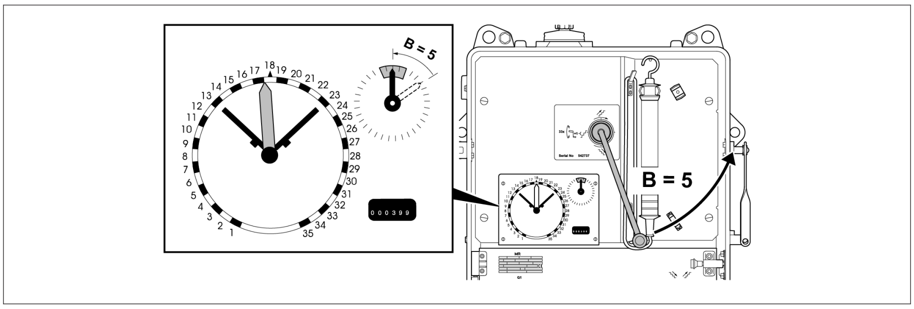


Figure 16: Counting tap-change indicator sections needed to reach the mid-position

8. If the determined value B is less than 8 tap-change indicator sections, turn another 8-B tap-change indicator sections in the same direction (example: 8-5=3) to complete the tap-change operation. Then turn in the opposite direction until the pointer is in the mid-position of the area marked in gray on the tap-change indicator.

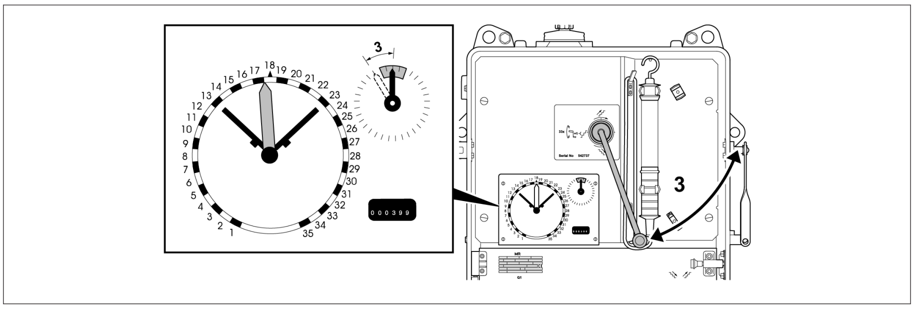


Figure 17: Completing diverter switch operation

9. If the values determined for A and B are different, establish correction value C by halving the difference between A and B: **C=|(A-B) x 0.5|**
Example: C=|(2-5) x 0.5|=|-1.5|=1.5

Also take numbers after the decimal point into account.

10. If the correction value **|C|** is less than 0.5 tap-change indicator section, no further actions are required. Refer to point 17 for how to proceed next.
11. Use hand crank to perform one on-load tap-changing operation up to the diverter switch action in the direction with the higher determined value A or B (example: counter-clockwise because B > A).

12. Uncouple the motor-drive unit and the vertical drive shaft by removing the coupling brackets. After uncoupling, don't turn drive shaft any further.

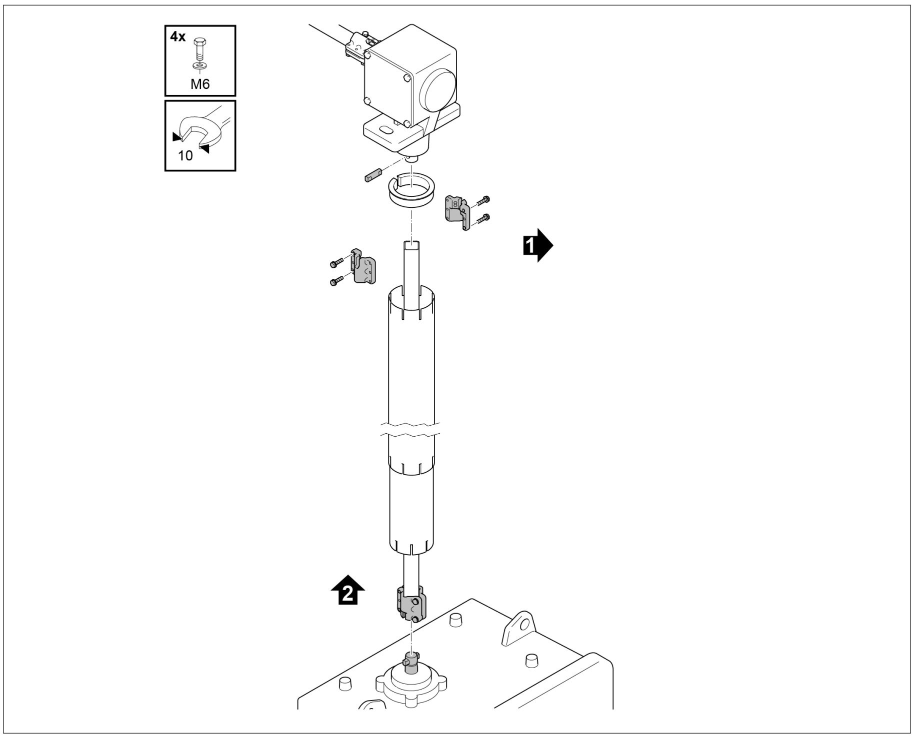


Figure 18: Uncoupling motor-drive unit and drive shaft

13. Operate the motor-drive unit using the hand crank in same direction, continuing by C tap-change indicator sections on the tap-change indicator (example: 1.5 tap-change indicator sections).
14. Couple motor-drive unit and on-load tap-changer by refitting the vertical drive shaft (reverse order to that described under point 12, tightening torque 9 Nm). Do not turn drive shaft and motor-drive unit any further.

⚠ DANGER

Danger of death or severe injury and damage to property!

Danger of death and damage to property due to incomplete on-load tap-changing operation!

► Always complete on-load tap-changing operation by continuing to turn hand crank in the same direction until mid-position of area marked in gray on the tap-change indicator is reached.

► If the on-load tap-changer is coupled correctly, the on-load tap-changing operation is always completed by continuing to turn hand crank in the same direction until the mid-position is reached. There is no need to calculate a correction value as in points 5 and 8.

15. Continue to turn in the same direction while counting the sections required for the pointer to reach the mid-position of the area marked in gray on the tap-change indicator. Note the determined value A and the direction of rotation. If the determined value A is less than 8 tap-change

indicator sections, turn another 8-A tap-change indicator sections in the same direction to complete the tap-change operation. Then turn in the opposite direction until the indicator is in mid-position of the area marked in gray on the tap-change indicator. Check coupling again as described.

16. The pointer of the tap-change indicator must be in mid-position of the area marked in gray once the on-load tap-changing operation with the hand crank is complete.

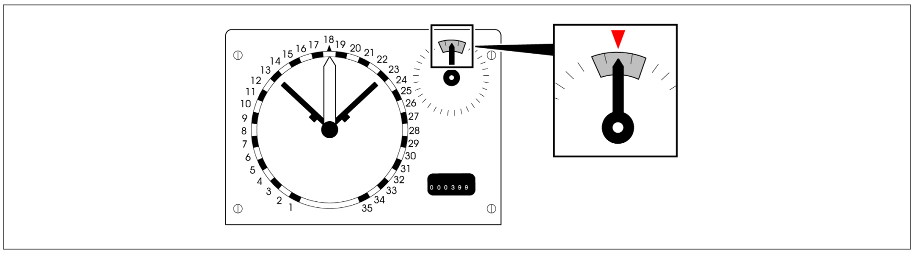


Figure 19: Indicator in mid-position

17. Once coupling is complete in both directions, check by undertaking several on-load tap-changing operations and check that the on-load tap-changer and motor-drive unit are in the same tap position.

6.4 Installing electrics for motor-drive unit

⚠ WARNING

Danger of death or severe injury!

An energized transformer and energized on-load tap-changer components could cause death or serious injuries when installing the electrics!

► Adherence to the following safety precautions is mandatory.

The drive may only be connected to circuits with an external isolating device with all poles disconnected so the equipment can be fully de-energized if required (service, maintenance etc.).

Suitable equipment includes isolating devices in accordance with IEC 60947-1 and IEC60947-3 (e.g. non-automatic circuit-breaker). When stating the circuit breaker type, note the properties of the relevant circuits (voltage, maximum currents). The following should also be noted during installation:

- It must be easy for the operator to access the isolating device
- The isolating device must be labeled for the motor-drive unit and circuits to be isolated
- The isolating device must not be part of the power line
- The isolating device must not interrupt the main grounding conductor

Unless otherwise specified, the connections for the supply current circuits must have a conductor cross-section of at least 1.5 mm^2.

Proceed as follows to electrically connect the motor-drive unit:

1. Switch off voltage supply.

2. Lock voltage supply to prevent unintentional restart.
3. Make sure everything is de-energized.
4. Visibly ground and short circuit motor-drive unit.
5. Cover or cordon off adjacent energized parts.
6. Connect motor-drive unit following connection diagrams provided in the document pocket. Note the supply voltage stated in the connection diagram.

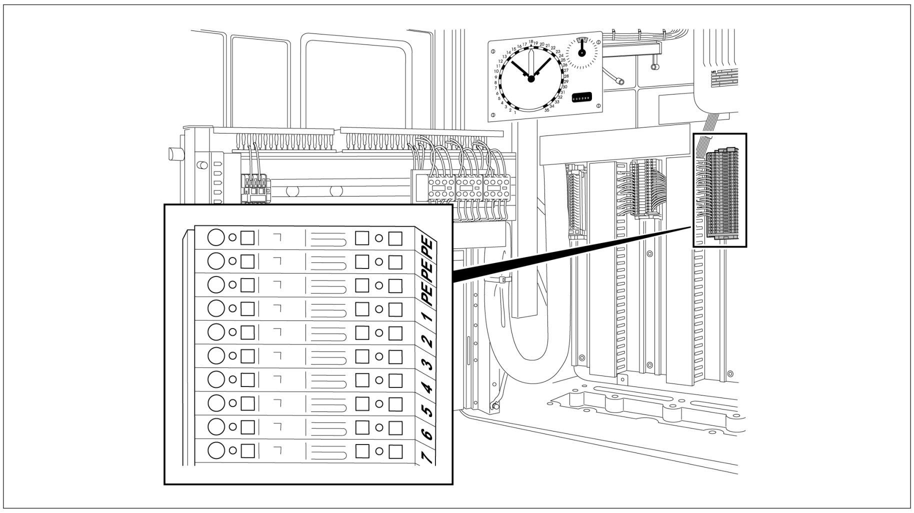


Figure 20: Example: Standard terminal block X1

7 Performing tests

Please contact Maschinenfabrik Reinhausen if any aspect of the tests is not clear.

7.1 Performing function tests

7.1.1 Preparations

⚠ WARNING

Danger of death or severe injury!

Danger of death or severe injury due to electrical voltage!

► The relevant safety instructions must be observed.

► Ensure that the motor-drive unit is connected in accordance with the connection diagrams provided.

► Provide protection against accidental contact before energizing the drive. The transmission gear cover plate must be fitted and the motor and swing frame closed.

► Ensure that the motor-drive unit and on-load tap-changer/off-circuit tap-changer are correctly coupled and that they are in the same tap position for each operating position.

NOTICE

Damage to on-load tap-changer and motor-drive unit!

Damage to on-load tap-changer and motor-drive unit due to electrical voltage!

► The relevant safety instructions must be observed.

► Ensure that the motor-drive unit is connected in accordance with the connection diagrams provided.

► Ensure that the motor-drive unit and on-load tap-changer/off-circuit tap-changer are correctly coupled and that they are in the same tap position for each operating position.

Only perform tap changes on the motor-drive unit with the hand crank if the motor protective switch Q1 is tripped!

7.1.2 Checking field of rotation

Check the field of rotation when using a 3-phase motor.

► When checking the motor circuit voltage, make sure that voltage applied to the connecting terminals has a clockwise phase sequence.

7.1.3 Checking correct electric switch-off

1. Check that the motor-drive unit switches off automatically after performing one operation of the on-load tap-changer/off-circuit tap-changer and that the pointer of the tap-change indicator stops within the gray field.
2. Carry out this test in both directions.

7.1.4 Checking mechanical and electric end stop of on-load tap-changer/off-circuit tap-changer and motor-drive unit

1. Press control switch S3 to switch motor-drive unit to last but one operating position.

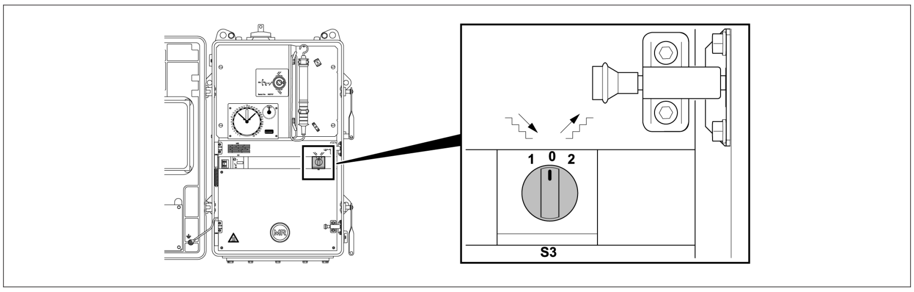


Figure 21: S3 control switch

2. Trip motor protective switch Q1.
3. Using the hand crank, manually operate the motor-drive unit to its last operating position. If the last operating position isn't reached, check coupling between on-load tap-changer/off-circuit tap-changer and motor-drive unit.
4. Continue turning motor-drive unit in the same direction with the hand crank until the motor-drive unit is mechanically blocked.
5. Turn back motor-drive unit with hand crank to mid-position of tap-change indicator.
6. Take off hand crank.
7. Engage motor protective switch Q1.
8. Check that the motor-drive unit does not continue to operate when the S3 switch is turned further in the same direction as under point 1.
9. Perform check for both end positions.

7.2 Electrical high-voltage tests on the transformer

⚠ WARNING

Danger of death or severe injury!

Danger of death or severe injury from explosive gases under the on-load tap-changer head cover, in the pipework system, in the oil conservator, at the dehydrating breather opening and from flying parts and hot oil splashing!

- ▶ Ensure that there are no naked flames, hot surfaces or sparks (for example caused by static charging) in the immediate surroundings and that none occur.
- ▶ Only use conductive and grounded hoses, pipes and pump equipment that are approved for flammable liquids.
- ▶ Use suitable personal protective equipment/clothing.
- ▶ Keep away from the danger area during the transformer test.
- ▶ Observe applicable fire protection regulations.
- ▶ Make sure that only trained technicians perform work on the transformer.

For this reason, it is essential that you ensure only trained, instructed expert personnel who are familiar with and comply with the pertinent safety and technical regulations, who are aware of the potential risks, and who consistently use the occupational safety equipment provided to prevent injury and property damage are assigned to perform such a transformer test.

Note the following points for the electrical high-voltage tests on the transformer:

- Ensure that the ground connections on the motor-drive protective housing and motor-drive protective housing fastening are free of paint.
- Only perform high voltage test if motor-drive unit door is closed.
- Disconnect external connections to electronic components in the motor-drive unit to prevent damage from overvoltage.
- When connecting the motor-drive unit's supply voltage, only use the holes in the protective housing base intended for lead insertion.
- Guide all ground connecting leads to one central connection point (establishment of suitable reference ground).
- Disconnect all electronic components before the high voltage test. Before a wiring dielectric test, remove all devices with a withstand voltage of < 1000 V.
- Leads used for testing must be removed before the high voltage test, as these function as antennas.
- Wherever possible, route the measurement and data leads separately from the energy cables.

If you have any questions about possible sources of danger, consult the manufacturer before starting to test the transformer.

The electrical tests required for transformer acceptance may only be undertaken once the aforementioned work is complete.

7.3 Dielectric tests on transformer wiring

Note the following points for dielectric tests on the transformer wiring:

The motor-drive unit is put through dielectric tests before delivery.

► Before the dielectric test for the transformer wiring, disconnect drive from the section to be tested to rule out increased component loading for those components fitted in the motor-drive unit.

8 Transporting the transformer to the installation site

If you have to remove the motor-drive unit to transport the transformer, proceed as follows:

1. Ensure that the drive and the on-load tap-changer/off-circuit tap-changer are in the adjustment position.
2. Remove the drive.
3. Do not actuate the drive while the on-load tap-changer/off-circuit tap-changer is not coupled.
4. Do not actuate an on-load tap-changer/off-circuit tap-changer which is not coupled.
5. Transport the drive to the installation site in the MR delivery packaging.
6. Fit drive to transformer at the operating site.

9 Commissioning the transformer at the operating site

Before commissioning the transformer, repeat the function tests.

⚠ WARNING

Danger of death or severe injury!

Danger of death or severe injury due to incorrect operation!

- ► Under no circumstances is the transformer to be commissioned if the functions are not satisfied in accordance with the Function tests section.

NOTICE

Damage to the on-load tap-changer and motor-drive unit!

Damage to on-load tap-changer and motor-drive unit due to condensate in the motor-drive unit!

- ► Always keep protective housing of the motor-drive unit tightly closed.
- ► If the standstill time before commissioning exceeds 8 weeks or operation is interrupted for longer than 2 weeks, the heater must be connected and turned on to prevent the condensation of moisture inside the protective housing. If this is not possible (e.g. during transportation), place a sufficient amount of dehydrating agent in the protective housing.

NOTICE

Damage to the on-load tap-changer and motor-drive unit!

Damage to on-load tap-changer and motor-drive unit due to incorrect use of position transmitter equipment!

- ► Only circuits stated in the chapter Technical data for position transmitter equipment [► 42] may be connected to the position transmitter module connections.
- ► The switchover point of the position transmitter equipment in the motor-drive unit is not the same as the switchover point of the diverter switch. This depends on the type of diverter switch. This fact should be noted when project planning the locking circuits between the motor-drive unit and external equipment (e.g. transformer circuit breaker).
- ► For external monitoring, locking and control purposes, it is not therefore the position transmitter equipment but the "Tap changer in operation" position transit contact shown in the connection diagram that should be used.

10 Actuating motor-drive unit with hand crank

It is imperative that you observe the following information about actuating the motor-drive unit with the hand crank.

- ⚠ **WARNING!** Only actuate the motor-drive unit with the hand crank fitted in the motor-drive unit. Otherwise, there is a risk of serious injury. The safety switch in the hand crank disconnects the motor circuit at two poles however, it does not disconnect the control circuit.
- Only actuate motor-drive unit with hand crank to center [▶ 25].
- ***NOTICE!*** Only actuate the motor-drive unit with the hand crank in an emergency provided that the motor-drive unit has been correctly centered. Failure to do so may result in damage to the on-load tap-changer and transformer. An emergency should be understood to be failure of the motor-drive unit's voltage supply when there is an urgent need to perform a tap change.
- ***NOTICE!*** It is essential to complete all started tap changes without changing direction of rotation. The tap change is complete when the indicator is in the mid-position of the area marked in gray on the tap-change indicator. Failure to do so may result in damage to the on-load tap-changer and transformer.

11 Maintenance

⚠ WARNING

Danger of death or severe injury!

Danger of death or severe injury due to failure to observe the safety instructions!

▶ Perform control checks with the supply voltage connected.

▶ Note relevant safety instructions.

Regular maintenance is not required. We do however recommend that you contact MR's Technical Service team after 600,000 tap-change operations.

Monitoring of the motor-drive unit is limited to occasional visual inspections. For efficiency reasons these visual checks can be combined with the usual checks on the transformer.

Pay particular attention to the following:

- Gaskets of the protective housing of the motor-drive unit
- Correct functioning of the installed electrical heater in the protective housing of the motor-drive unit

When maintaining the on-load tap-changer, a function test should also be carried out on the motor-drive unit.

12 Special designs

The standard design of the motor-drive unit can be modified to accommodate specific operating requirements.

Feature	Special equipment in motor-drive unit
VACUTAP® VT	Recovery time delay (60 s)
On-load tap-changer with change-over selector for star-delta change-over operation	Star-delta monitoring
Furnace and electrolysis operation	Additional input terminals for "operation without step-by step switch"
Thermostat for on-load tap-changers	Temperature monitoring with break contact for the control circuit
Higher maximum number of operating positions	Control gear + on-load tap-change position indicator for 70 operating positions Control gear + on-load tap-change position indicator for 105 operating positions
Special on-load tap-changer arrangement: ABC arrangement	Control gear for ABC arrangement
Temperature range < -30 °C	Externally-located control elements Main switch for disconnecting all circuits except the heating circuit Thermostatically-controlled additional heater Temperature monitoring depending on oil used

Table 8: Special designs

13 Technical data

13.1 Technical data for TAPMOTION® ED

The technical data is relevant to the standard design and may vary depending on the design delivered. Subject to change without prior notice.

Motor-drive unit	ED 100-S/L	ED 200-S/L	
Motor power	0.75 kW	2.0 kW	2.2 kW
Voltage	3 AC/N 230/400 V		
Current	approx. 1.9 A	approx. 5.2 A	approx. 6.2 A
Frequency	50 Hz		
Synchronous speed	1500 rpm		
Rotations of the drive shaft per tap-change operation	16.5		
Duration of the tap-change operation	approx. 5.4 s		
Rated torque on the drive shaft	45 Nm	90 Nm	125 Nm
Rotations of the hand crank per tap-change operation	33		54
Maximum number of operating positions	35		
Heater voltage and control	AC 230 V		
Power input of the control circuit (control / operation)	100 VA/25 VA		
Heating power	50 W for ED 100/200 S 60 W for ED 100/200 L		
Temperature range (ambient temperature)	-25 °C to +50 °C		
Protection from foreign objects and water	IP 66 in accordance with DIN EN 60529		
Test voltage to ground	2 kV/60 s		
Weight	maximum 130 kg		

Table 9: Technical data for TAPMOTION® ED

13.2 Technical data for position transmitter equipment

Resistance-type position transmitter module

Standard resistance: 10.0 Ω (0.6 W, +/-1 %) per tap position

The number of desired operating positions determines the number of loaded resistors.

The decisive power loss of the position transmitter module is 0.6 W because in the worst-case scenario only one resistor is energized. The supply voltage should not exceed DC 220 V. If your setup is more demanding, please contact Maschinenfabrik Reinhausen.

Position transmitter module with N/O contact range (break-before-make contact)

AC: 250 V, 0.5 A (resistive loading)

DC: 220 V, 0.2 A (resistive loading)

Minimum voltage level for signal and data processing: 24 V

Position transmitter module with N/O contact range, (make-before-break-type)

AC, DC: 250 V, 0.02 A (resistive loading)

AC, DC: 24 V, 0.20 A (resistive loading)

Minimum voltage level for signal and data processing: 24 V

Position transmitter module with N/O contact range, 10 A (make-before-break-type) for controlling current matching transformer in industrial applications.

AC, DC: 250 V, 10 A (resistive loading)

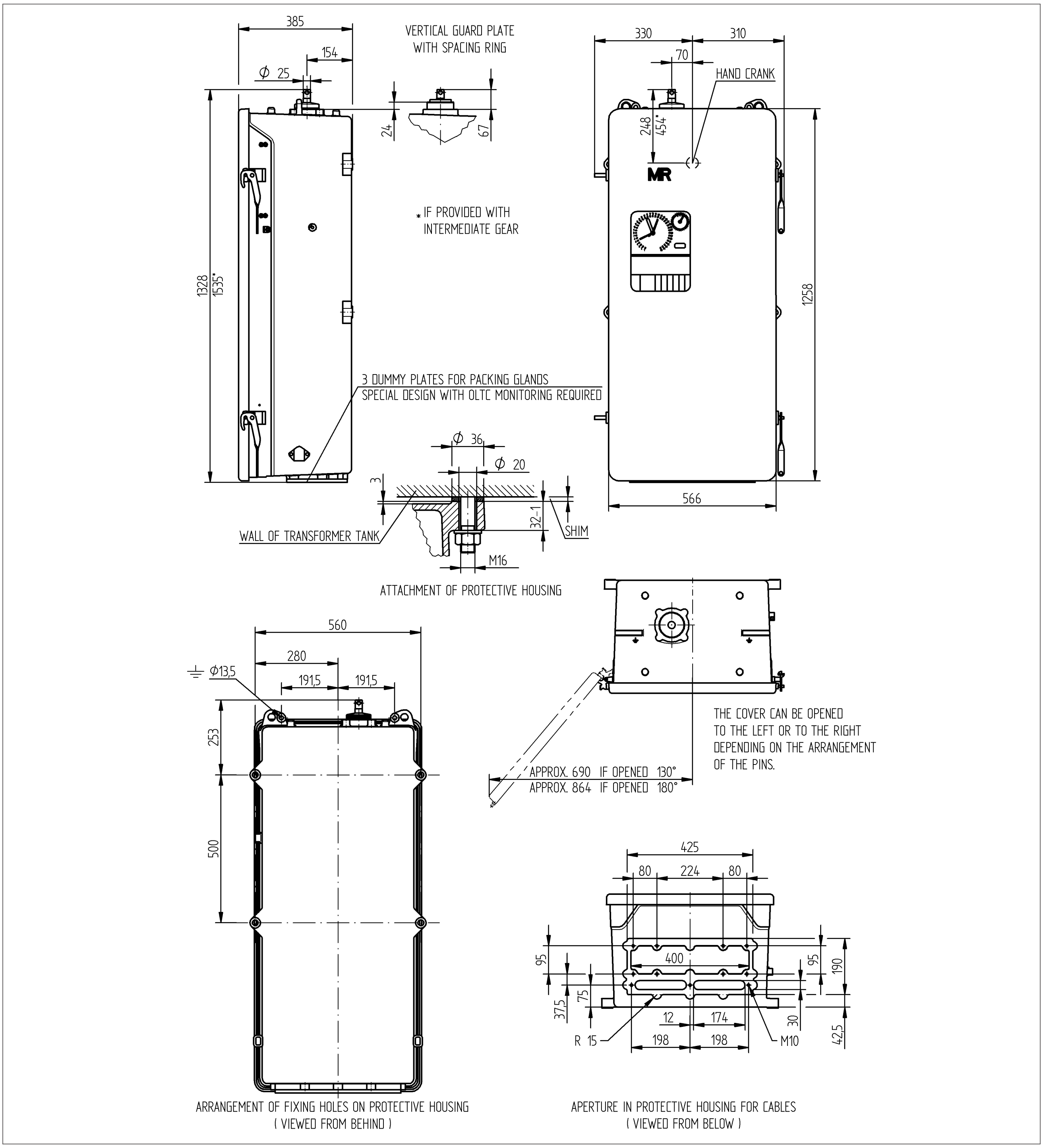
Position transmitter module, diode matrix

DC: 220 V, 0.2 A (resistive loading)

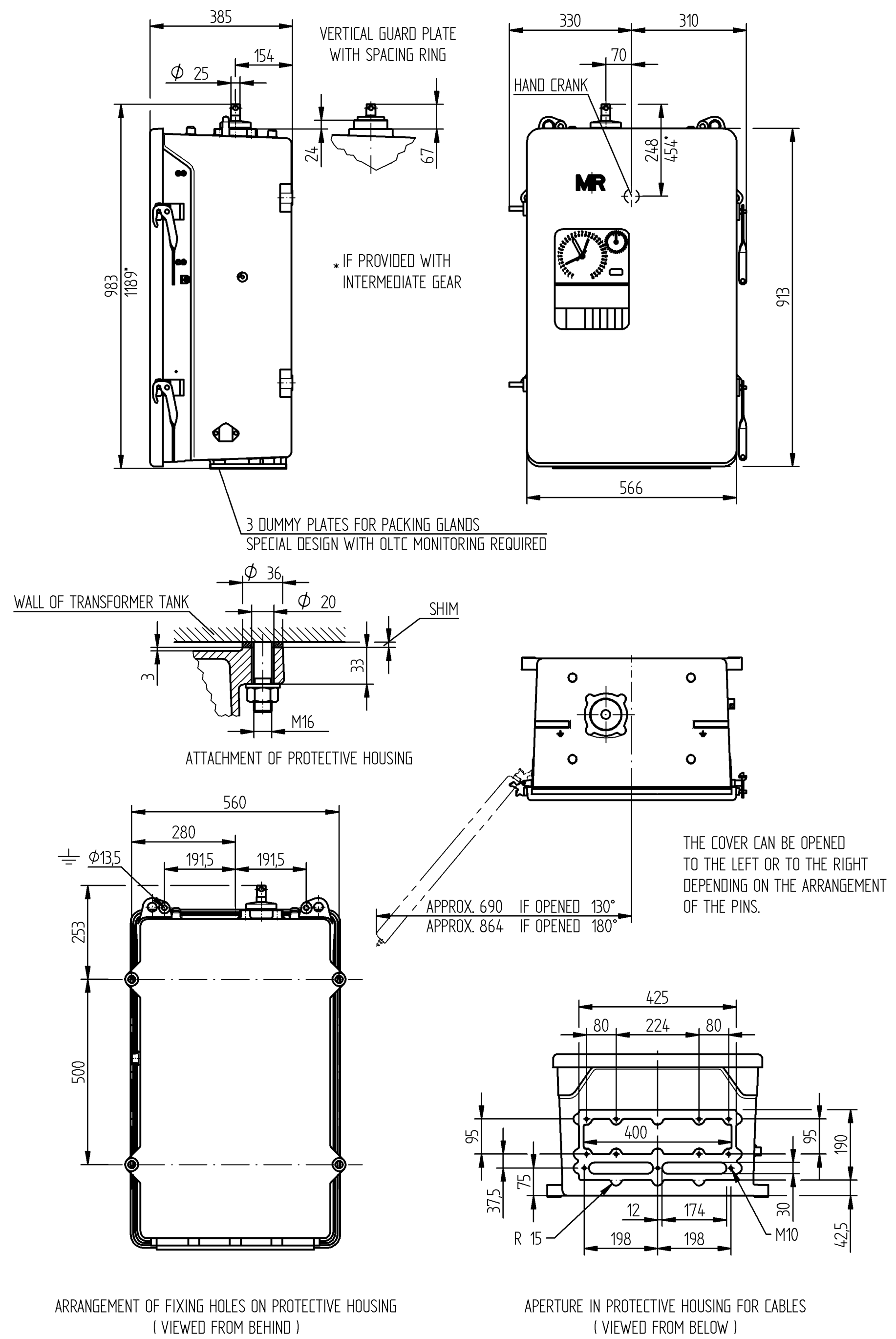
Minimum voltage level for signal and data processing: 24 V

14 Appendix

14.1 TAPMOTION® ED-L, protective housing (898802)



14.2 TAPMOTION® ED-S, protective housing (898801)



MR worldwide

Australia
Reinhausen Australia Pty. Ltd.
17/20-22 St Albans Road
Kingsgrove NSW 2208
Phone: +61 2 9502 2202
Fax: +61 2 9502 2224
E-Mail: sales@au.reinhausen.com

Brazil
MR do Brasil Indústria Mecánica Ltda.
Av. Elias Yazbek, 465
CEP: 06803-000
Embu - São Paulo
Phone: +55 11 4785 2150
Fax: +55 11 4785 2185
E-Mail: vendas@reinhausen.com.br

Canada
Reinhausen Canada Inc.
3755, rue Java, Suite 180
Brossard, Québec J4Y 0E4
Phone: +1 514 370 5377
Fax: +1 450 659 3092
E-Mail: m.foata@ca.reinhausen.com

India
Easun-MR Tap Changers Ltd.
612, CTH Road
Tiruninravur, Chennai 602 024
Phone: +91 44 26300883
Fax: +91 44 26390881
E-Mail: easunmr@vsnl.com

Indonesia
Pt. Reinhausen Indonesia
German Center, Suite 6310,
Jl. Kapt. Subijanto Dj.
BSD City, Tangerang
Phone: +62 21 5315-3183
Fax: +62 21 5315-3184
E-Mail: c.haering@id.reinhausen.com

Iran
Iran Transfo After Sales Services Co.
Zanjan, Industrial Township No. 1 (Aliabad)
Corner of Morad Str.
Postal Code 4533144551
E-Mail: itass@iran-transfo.com

Italy
Reinhausen Italia S.r.l.
Via Alserio, 16
20159 Milano
Phone: +39 02 6943471
Fax: +39 02 69434766
E-Mail: sales@it.reinhausen.com

Japan
MR Japan Corporation
German Industry Park
1-18-2 Hakusan, Midori-ku
Yokohama 226-0006
Phone: +81 45 929 5728
Fax: +81 45 929 5741

Luxembourg
Reinhausen Luxembourg S.A.
72, Rue de Prés
L-7333 Steinsel
Phone: +352 27 3347 1
Fax: +352 27 3347 99
E-Mail: sales@lu.reinhausen.com

Malaysia
Reinhausen Asia-Pacific Sdn. Bhd
Level 11 Chulan Tower
No. 3 Jalan Conlay
50450 Kuala Lumpur
Phone: +60 3 2142 6481
Fax: +60 3 2142 6422
E-Mail: mr_rap@my.reinhausen.com

P.R.C. (China)
MR China Ltd. (MRT)
开德贸易（上海）有限公司
中国上海浦东新区浦东南路 360 号
新上海国际大厦 4 楼 E 座
邮编： 200120
电话：＋86 21 61634588
传真：＋86 21 61634582
邮箱：mr-sales@cn.reinhausen.com
mr-service@cn.reinhausen.com

Russian Federation
OOO MR
Naberezhnaya Akademika Tupoleva
15, Bld. 2 ("Tupolev Plaza")
105005 Moscow
Phone: +7 495 980 89 67
Fax: +7 495 980 89 67
E-Mail: mrr@reinhausen.ru

South Africa
Reinhausen South Africa (Pty) Ltd.
No. 15, Third Street, Booysens Reserve
Johannesburg
Phone: +27 11 8352077
Fax: +27 11 8353806
E-Mail: support@za.reinhausen.com

South Korea
Reinhausen Korea Ltd.
21st floor, Standard Chartered Bank Bldg.,
47, Chongro, Chongro-gu,
Seoul 110-702
Phone: +82 2 767 4909
Fax: +82 2 736 0049
E-Mail: you-mi.jang@kr.reinhausen.com

U.S.A.
Reinhausen Manufacturing Inc.
2549 North 9th Avenue
Humboldt, TN 38343
Phone: +1 731 784 7681
Fax: +1 731 784 7682
E-Mail: sales@reinhausen.com

United Arab Emirates
Reinhausen Middle East FZE
Dubai Airport Freezone, Building Phase 6
3rd floor, Office No. 6EB, 341 Dubai
Phone: +971 4 2368 451
Fax: +971 4 2368 225
Email: service@ae.reinhausen.com

Maschinenfabrik Reinhausen GmbH
Falkensteinstrasse 8
93059 Regensburg

+49 (0)941 4090-0
+49(0)941 4090-7001
sales@reinhausen.com

www.reinhausen.com

138/06 ▪ 05/13 ▪ F0047005

Drive Shaft

Operating Instructions

042/08 EN

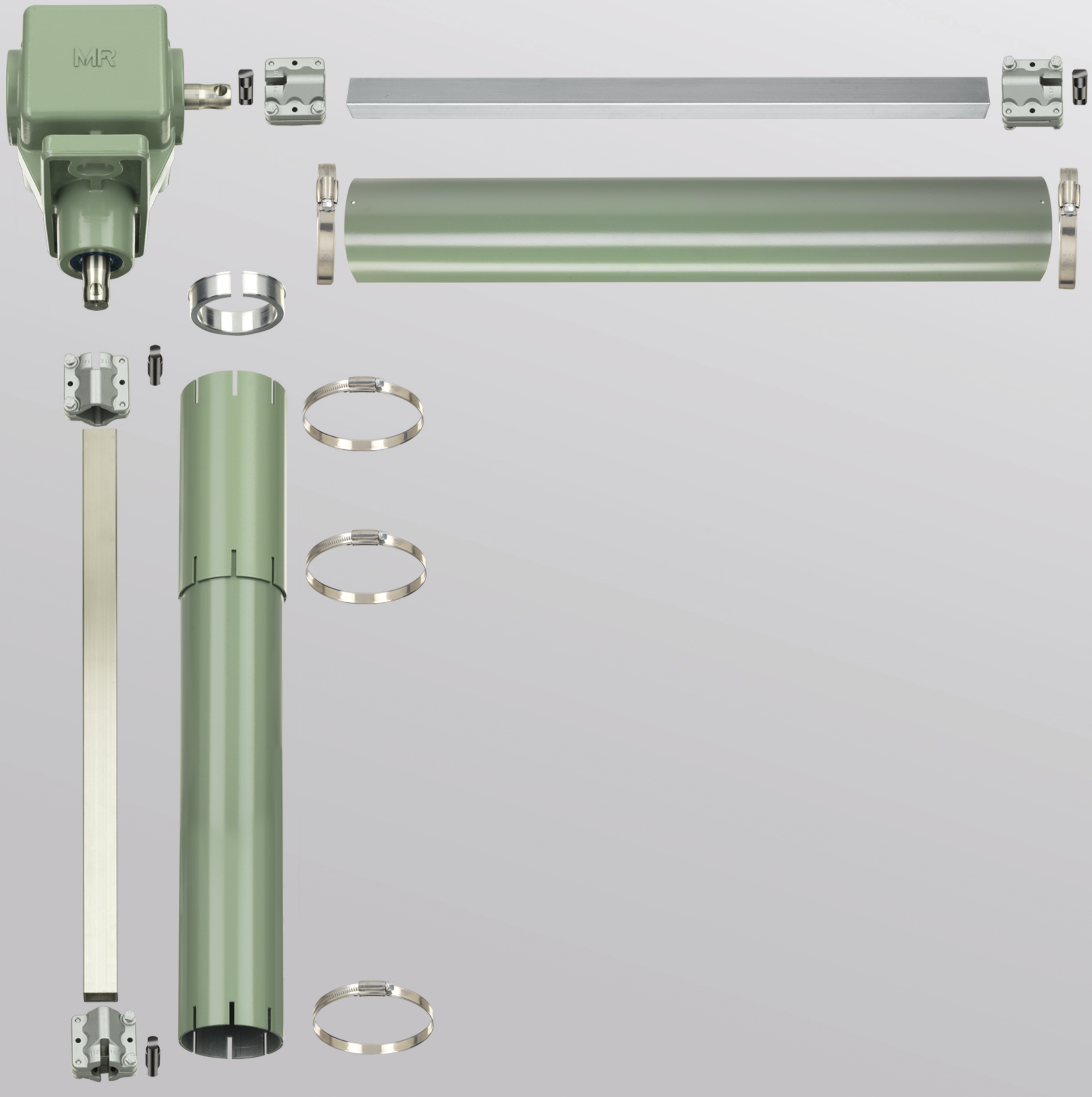


Table of contents

1 Introduction

This technical file contains detailed descriptions on the safe and proper installation, connection, commissioning and monitoring of the product.

It also includes safety instructions and general information about the product.

This technical file is intended solely for specially trained and authorized personnel.

1.1 Validity

This technical file applies to the following types of drive shaft:

- Drive shaft
- Drive shaft with insulator
- Drive shaft with cardan joints

1.2 Manufacturer

The product is manufactured by:

Maschinenfabrik Reinhausen GmbH

Falkensteinstraße 8
93059 Regensburg, Germany
Tel.: (+49) 9 41/40 90-0
Fax: (+49) 9 41/40 90-7001
E-mail: sales@reinhausen.com

Further information on the product and copies of this technical file are available from this address if required.

1.3 Subject to change without notice

The information contained in this technical file comprises the technical specifications approved at the time of printing. Significant modifications will be included in a new edition of the technical file.

The document number and version number of this technical file are shown in the footer.

1.4 Completeness

This technical file is incomplete without the supporting documentation.

1.5 Supporting documents

The following documents also apply in addition to this technical file:

- Supplements

- Dimensional drawing

Also observe generally valid legislation, standards, guidelines and specifications on accident prevention and environmental protection in the respective country of use.

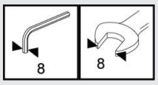
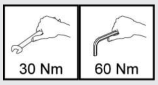
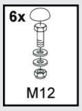
1.6 Safekeeping

This technical file and all supporting documents must be kept ready at hand and accessible for future use at all times.

1.7 Notation conventions

This section contains an overview of the abbreviations, symbols and textual emphasis used.

1.7.1 Symbols used

Symbol	Definition
	Wrench size
	Tightening torque
	Number and type of fastening materials used
	Fill with oil
	Cut open, cut through
	Clean
	Visual inspection
	Use your hand
	Adapter ring
	Apply a coat of paint

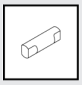
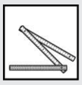
Symbol	Definition
	Use a file
	Grease
	Coupling bolt
	Use a ruler
	Use a saw
	Hose clip

Table 1: Symbols used

1.7.2 Hazard communication system

Warnings in this technical file use the following format:

⚠ WARNING

Type and source of danger

Consequences

- ▶ Action
- ▶ Action

The following signal words are used:

Signal word	Definition
DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates measures to be taken to prevent damage to property.

Table 2: Signal words in warning notices

Pictograms warn of dangers:

Pictogram	Definition
	Warning of a danger point
	Warning of dangerous electrical voltage
	Warning of combustible substances
	Warning of danger of tipping

Table 3: Pictograms used in warning notices

1.7.3 Information system

Information is designed to simplify and improve understanding of particular procedures. In this technical file it is laid out as follows:

Important information.

2 Safety

2.1 General safety information

The technical file contains detailed descriptions on the safe and proper installation, connection, commissioning and monitoring of the product.

- Read this technical file through carefully to familiarize yourself with the product.
- Particular attention should be paid to the information given in this chapter.

2.2 Appropriate use

The product and associated equipment and special tools supplied with it comply with the relevant legislation, regulations and standards, particularly health and safety requirements, applicable at the time of delivery.

If used as intended and in compliance with the specified requirements and conditions in this technical file as well as the warning notices in this technical file and attached to the product, then the product does not present any hazards to people, property or the environment. This applies throughout the product's entire life, from delivery through installation and operation to disassembly and disposal.

The operational quality assurance system ensures a consistently high quality standard, particularly in regard to the observance of health and safety requirements.

The following is considered appropriate use

- The product must be operated in accordance with this technical file and the agreed delivery conditions and technical data
- The equipment and special tools supplied must be used solely for the intended purpose and in accordance with the specifications of this technical file
- The product must be used only with the transformer specified in the order

2.3 Inappropriate use

Use is considered to be inappropriate if the product is used other than as described in the Appropriate use section.

Maschinenfabrik Reinhausen does not accept liability for damage resulting from unauthorized or inappropriate changes to the product. Inappropriate changes to the product without consultation with Maschinenfabrik Reinhausen can lead to personal injury, damage to property and operational disruption.

2.4 Personnel qualification

The product is designed solely for use in electrical energy systems and facilities operated by appropriately trained staff. This staff comprises people who are familiar with the installation, assembly, commissioning and operation of such products.

2.5 Operator's duty of care

To prevent accidents, disruptions and damage as well as unacceptable adverse effects on the environment, those responsible for transport, installation, operation, maintenance and disposal of the product or parts of the product must ensure the following:

- All warning and hazard notices are complied with.
- Personnel are instructed regularly in all relevant aspects of operational safety, the operating instructions and particularly the safety instructions contained therein.
- Regulations and operating instructions for safe working as well as the relevant instructions for staff procedures in the case of accidents and fires are kept on hand at all times and are displayed in the workplace where applicable.
- The product is only used when in a sound operational condition and safety equipment in particular is checked regularly for operational reliability.
- Only replacement parts, lubricants and auxiliary materials which are authorized by the manufacturer are used.
- The specified operating conditions and requirements of the installation location are complied with.
- All necessary devices and personal protective equipment for the specific activity are made available.
- The prescribed maintenance intervals and the relevant regulations are complied with.
- Installation, electrical connection and commissioning of the product may only be carried out by qualified and trained personnel in accordance with this technical file.
- The operator must ensure appropriate use of the product.

2.6 Personal protective equipment

Personal protective equipment must be worn during work to minimize risks to health.

- Always wear the personal protective equipment required for the job at hand.
- Follow information about personal protective equipment provided in the work area.

Always wear	
	**Protective clothing** Close-fitting work clothing with a low breaking strength, with tight sleeves and with no protruding parts. It mainly serves to protect the wearer against being caught by moving machine parts. Do not wear any rings, necklaces or other jewelry.
	**Safety shoes** To protect against falling heavy objects and slipping on slippery surfaces.

Table 4: Personal protective equipment to be worn at all times

Wear the following in special environments	Special personal protective equipment is needed in special environments. The choice of equipment depends on the circumstances.
	**Safety glasses** To protect the eyes from flying parts and splashing liquids.
	**Hard hat** To protect from falling and flying parts and materials.
	**Hearing protection** To protect from hearing damage.

Table 5: Personal protective equipment to be worn in special environments

3 Product description

This chapter contains an overview of the design and function of the product.

3.1 Function description of drive shaft

The drive shaft is the mechanical connection between motor-drive and on-load tap-changer head / off-circuit tap-changer head.

The bevel gear changes the direction from vertical to horizontal (see drawing 892916 [▶ 47]).

Accordingly, the vertical drive shaft has to be mounted between drive and bevel gear and the horizontal drive shaft between bevel gear and on-load tap-changer or off-circuit tap-changer.

3.2 Performance features of drive shaft

The product is particularly characterized by the following properties:

- Resistance to corrosion

3.3 Scope of delivery

The product is packaged with protection against moisture and is delivered as follows:

- Drive shaft
- Bevel gear
- Operating instructions
- Supplements
- Dimensional drawing

Please note the following:

- Check the shipment for completeness on the basis of the shipping documents.
- Store the parts in a dry place until installation.
- The product must remain in its airtight, protective wrapping and may only be removed immediately before installation.

3.4 Setup/models of drive shaft

The drive shaft consists of a square tube and is coupled by two coupling brackets and one coupling bolt at both ends to the drive / driven shaft end of the device to be connected.

3.4.1 Model without cardan shaft, without insulator (= normal model)

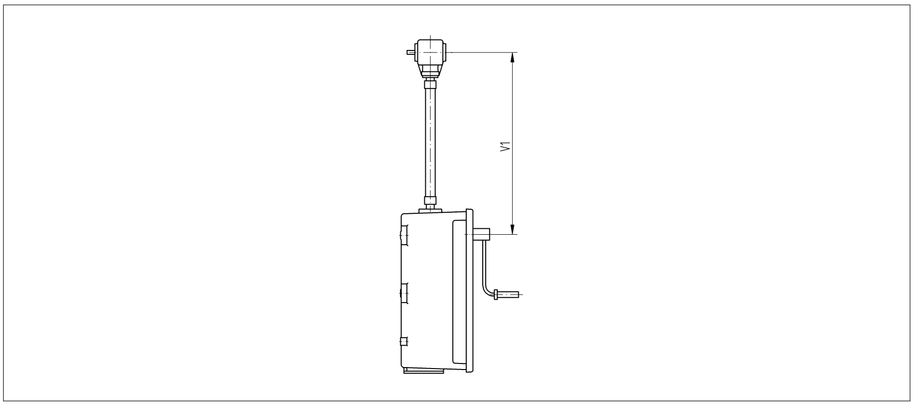


Figure 1: Model without cardan shaft, without insulator (= normal model)

Configuration	V 1 min [mm]	Intermediate bearing for [mm]
Middle of hand crank – middle of bevel gear (maximum permissible axial offset 2°)	526	V 1 > 2462

3.4.2 Model without cardan shaft, with insulator (= special model)

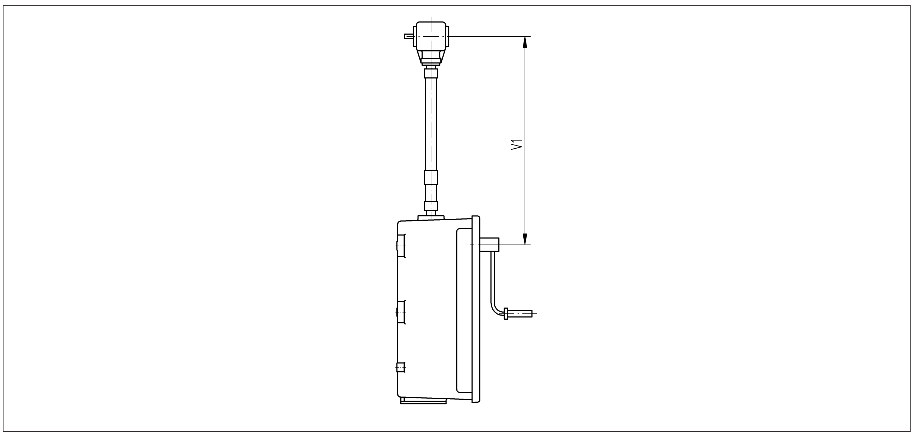


Figure 2: Model without cardan shaft, with insulator (= special model)

Configuration	V 1 min [mm]	Intermediate bearing for [mm]
Middle of hand crank – middle of bevel gear (maximum permissible axial offset 2°)	697	V 1 > 2462

3.4.3 Model with cardan shaft, without insulator (= special model)

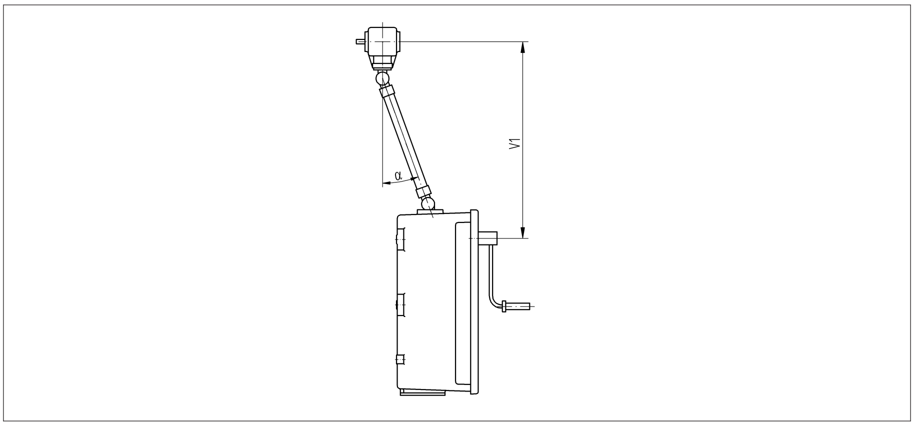


Figure 3: Model with cardan shaft, without insulator (= special model)

Configuration	V 1 min [mm]	Intermediate bearing for [mm]
Middle of hand crank – middle of bevel gear (maximum permissible axial offset alpha = 20°)	790	V 1 > 2556

3.4.4 Model with cardan shaft, with insulator (= special model)

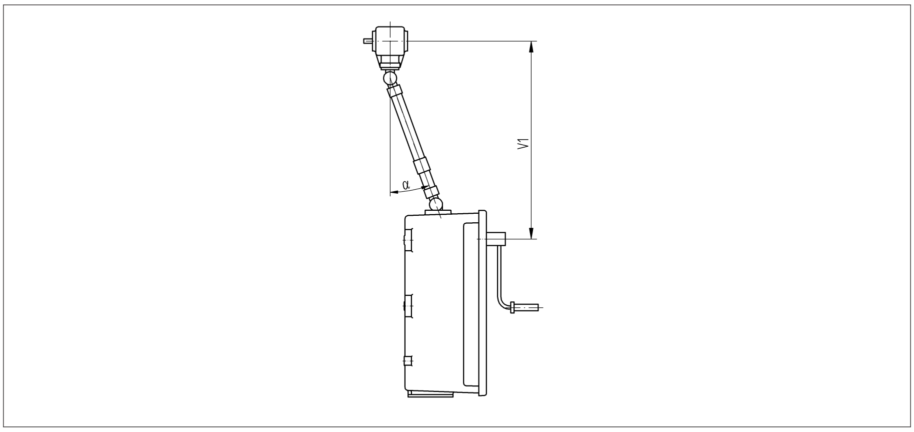


Figure 4: Model with cardan shaft, with insulator (= special model)

Configuration	V 1 min [mm]	Intermediate bearing for [mm]
Middle of hand crank – middle of bevel gear (maximum permissible axial offset alpha = 20°)	975	V 1 > 2556

4 Packaging, transport and storage

4.1 Packaging

4.1.1 Purpose

The packaging is designed to protect the packaged goods during transport, loading and unloading as well as periods of storage in such a way that no (detrimental) changes occur. The packaging must protect the goods against permitted transport stresses such as vibration, knocks and moisture (rain, snow, condensation).

The packaging also prevents the packaged goods from moving impermissibly within the packaging. The packaged goods must be prepared for shipment before actually being packed so that the goods can be transported safely, economically and in accordance with regulations.

4.1.2 Suitability

The packaging is suitable for

- all common types of transportation
- stackability - 1000 kg/m^2 top surface

The packaged goods are packed in a stable wooden crate. This crate ensures that the shipment is secure when in the intended transportation position and that none of its parts touch the loading surface of the means of transport or touch the ground after unloading.

The packaged goods are stabilized inside the crate to prevent impermissible changes in position.

4.1.3 Markings

The packaging bears a signature with instructions for safe transport and correct storage. The following symbols apply to the shipment (of non-hazardous goods). Adherence to these symbols is mandatory.

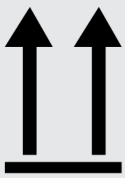
		
Protect against moisture	Top	Fragile

Table 6: Shipping pictograms

4.2 Transportation, receipt and handling of shipments

⚠ WARNING

Danger of death or severe injury!

Danger due to tipping or falling load!

- ▶ Only trained and appointed persons may select the sling gear and secure the load.
- ▶ Do not walk under the hanging load.
- ▶ Use means of transport and lifting gear with a carrying capacity of > 500 kg.

NOTICE

Damage to packaged goods!

Damage due to tipping or falling load!

- ▶ Only trained and appointed persons may select the sling gear and secure the load.
- ▶ Use means of transport and lifting gear with a carrying capacity of > 500 kg.

In addition to oscillation stress and shock stress, jolts must also be expected during transportation. In order to prevent possible damage, avoid dropping, tipping, knocking over and colliding with the product.

If a box falls from a certain height (e.g. when slings tear) or experiences an unbroken fall, damage must be expected regardless of the weight.

Every delivered shipment must be checked for the following by the recipient before acceptance (acknowledgment of receipt):

- Completeness based on the delivery slip
- External damage of any type.

The checks must take place after unloading when the crate or transport container can be accessed from all sides.

Visible damage

If external transport damage is detected on receipt of the shipment, proceed as follows:

- Immediately record the transport damage found in the shipping documents and have this countersigned by the carrier.
- In the event of severe damage, total loss or high damage costs, immediately notify the sales department at Maschinenfabrik Reinhausen and the relevant insurance company.
- After identifying damage, do not modify the condition of the shipment further and retain the packaging material until an inspection decision has been made by the transport company or the insurance company.
- Record the details of the damage immediately together with the carrier involved. This is essential for any claim for damages!
- If possible, photograph damage to packaging and packaged goods. This also applies to signs of corrosion on the packaged goods due to moisture inside the packaging (rain, snow, condensation).

- Name the damaged parts.

Hidden damage When damages are not determined until unpacking after receipt of the shipment (hidden damage), proceed as follows:

- Make the party responsible for the damage liable as soon as possible by telephone and in writing, and prepare a damage report.
- Observe the time periods applicable to such actions in the respective country. Inquire about these in good time.

With hidden damage, it is very hard to make the transportation company (or other responsible party) liable. Any insurance claims for such damages can only be successful if relevant provisions are expressly included in the insurance terms and conditions.

4.3 Storage of shipments

Packaged goods can be stored outdoors when the following conditions are complied with.

Selection and arrangement of the storage location should meet the following requirements:

- Stored goods are protected against moisture (flooding, water from melting snow and ice), dirt, pests such as rats, mice, termites and so on, and against unauthorized access.
- Store the crates on timber beams and planks as a protection against rising damp and for better ventilation.
- Carrying capacity of the substrate under the goods is sufficient.
- Entrance and exit paths are kept free.

Check stored goods at regular intervals. Also take appropriate action after storms, heavy rain or snow and so on.

4.4 Unpacking shipments and checking for transportation damages

- Wherever possible keep the crate packaged for transport to the place where installation will take place.
- When unpacking, check the condition of the packaged goods.
- Check completeness based on the delivery slip.

5 Drying transformer

5.1 Drying transformer in autoclave

Observe the following information when drying the transformer in an autoclave.

NOTICE

Damage to drive shaft, on-load tap-changer and transformer!

If the drive shaft is dried in a furnace, this may cause damage to the drive shaft and restrict its correct function.

► Do not dry drive shaft in an autoclave.

5.2 Drying transformer in the transformer tank

If you dry the active part in the transformer tank, the drive shaft may remain fitted to the transformer.

6 Fitting drive shaft

In accordance with IEC standard 60214, all drive shafts located on the outside of the transformer need to be protected with safety coverings.

NOTICE

Damage to the on-load tap-changer!

Damage to the on-load tap-changer by actuating the on-load tap-changer without oil!

- ► Before actuating the on-load tap-changer for the first time, the tap selector must be completely immersed in transformer oil and the diverter switch oil compartment completely filled with oil.
- ► The on-load tap-changer can be operated in the temperature range of the surrounding transformer oil of between -25 ° and +105 °C and with overload up to +115 °C in accordance with IEC 60214-1.

Observe the following during mounting:

NOTICE

Damage to drive and on-load tap-changer or off-circuit tap-changer!

Trouble-free operation of the motor-drive and the on-load tap-changer or off-circuit tap-changer cannot be guaranteed.

- ► The shaft ends to be connected must be exactly aligned.

Minor axial displacement can be tolerated as long as it does not exceed 35 mm per 1000 mm square tube length (that corresponds to 2°).

Square tubes, coupling brackets, coupling bolts, screws, and locking washers are corrosion-resistant. We therefore recommend not applying the same external coating to these parts as to the transformer tank.

The square tubes and the vertical protective cover are supplied in overlengths (graded standard lengths). These parts must be cut to the required size before mounting on the transformer. In rare cases the inner tube of the telescopic protective tube has to be cut.

Standard lengths	Motor-drive unit	Manual drive
400	•	•
600	•	•
900	•	•
1300	•	•
1700	•	•
2000	•	•
2500	Not permitted	•[1)]

Table 7: Graded standard lengths of square tubes

The maximum total drive shaft length of the drive - last pole = 15 m.

[1] l>2000 only possible for vertical installation without shaft protection! Telescopic protective tubes for manual drives with vertical dimensions V1> 2462 should be delivered vertically, similar to the motor-drive unit with intermediate bearing.

6.1 Fitting vertical drive shaft

Couple drive shaft with motor-drive unit and on-load tap-changer as described in MR operating instructions for TAPMOTION® ED.

⚠ WARNING

The motor-drive unit may be started by accident if the motor protective switch is not tripped!

Risk of injury from starting the motor-drive unit by accident!

► Trip motor protective switch before starting to fit the drive shafts!

To fit the vertical drive shaft to the drive, proceed as follows:

1. Grease the coupling bolts, coupling brackets and ball heads, e.g. ISOFLEX TOPAS L 32.

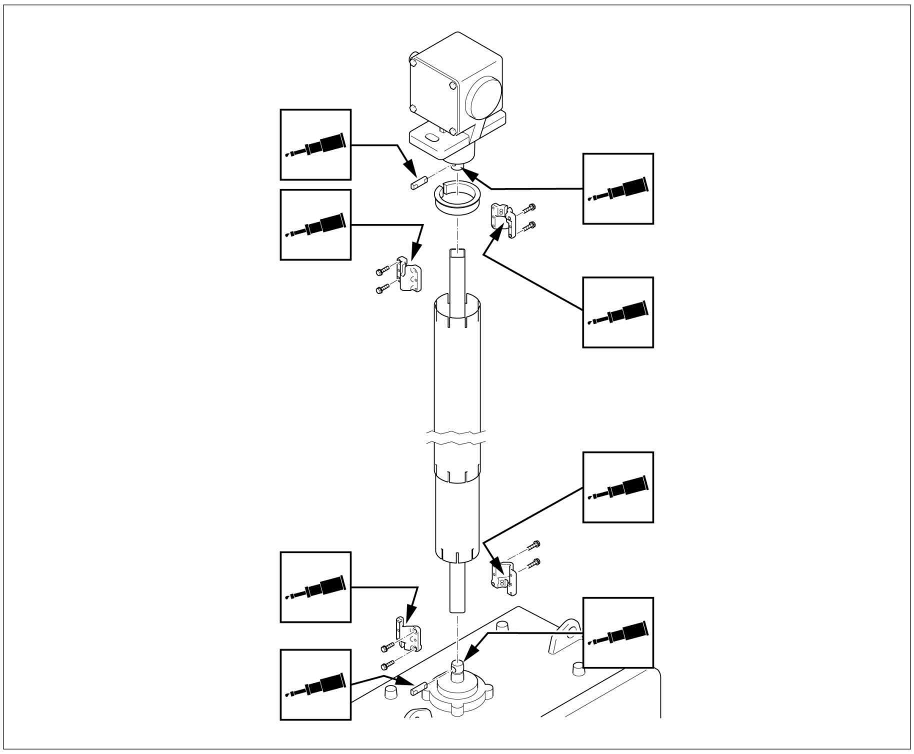


Figure 5: Grease the coupling bolts, coupling brackets and ball heads.

2. Determine dimension A between the shaft end of the drive and the shaft end of the bevel gear. Shorten square tube to length of A–9 mm.

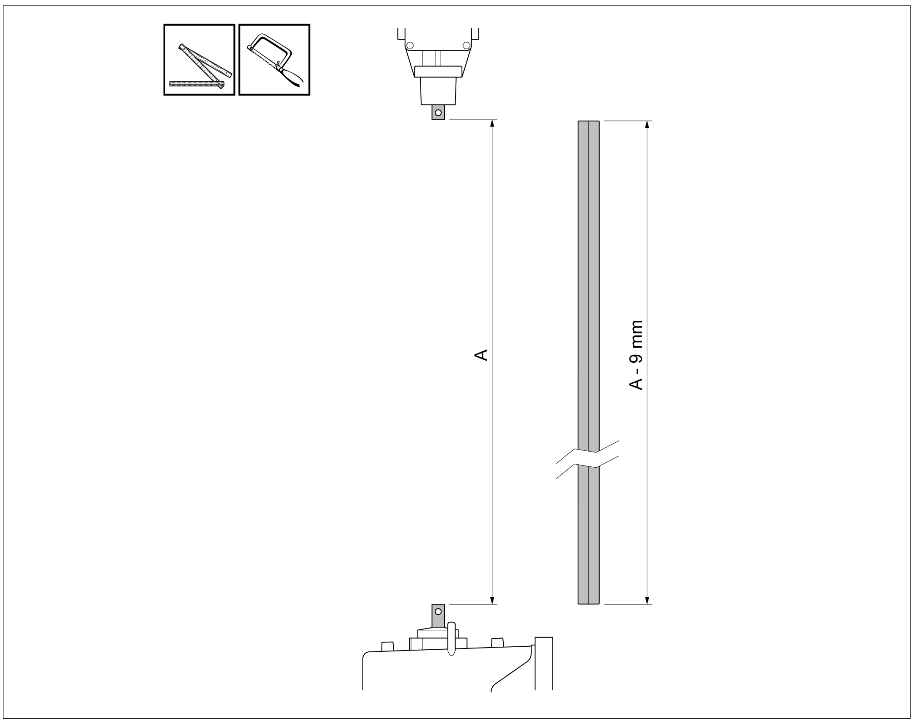


Figure 6: Shortening square tube

3. Deburr cut surface of square tube.

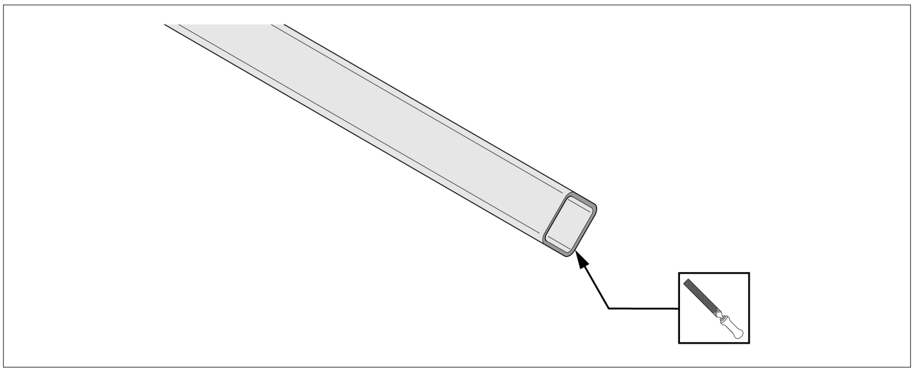


Figure 7: Deburring cut surfaces

4. Slide loosely screwed together coupling part onto square tube until stop is reached.

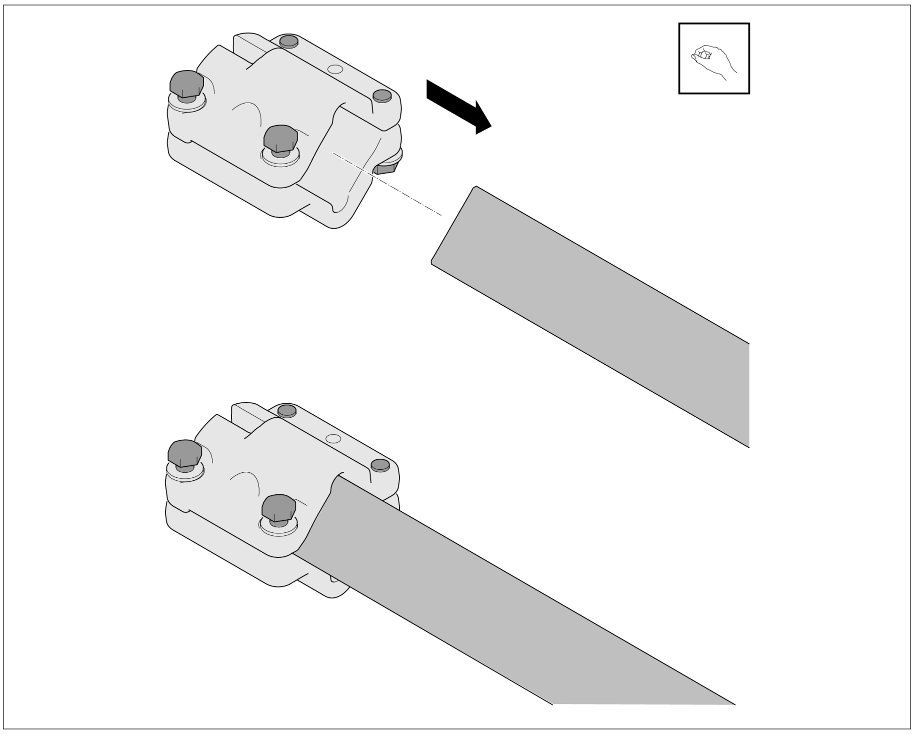


Figure 8: Sliding coupling part onto square tube

5. Insert coupling bolt into lower shaft end. Grease coupling parts and coupling bolts. Slide square tube with coupling part on to coupling bolt.

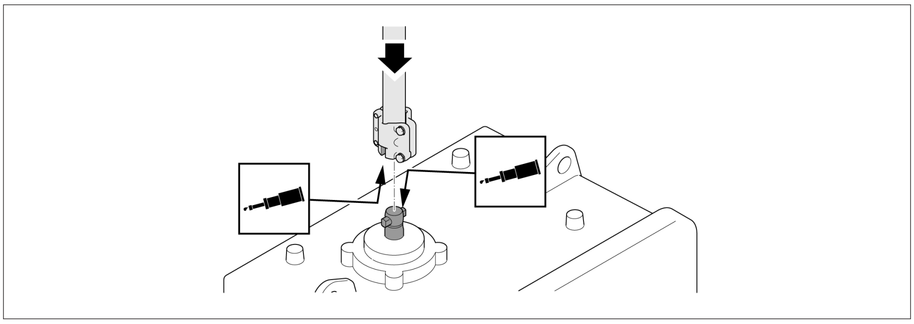


Figure 9: Sliding square tube with coupling part on to coupling bolt

6. Secure vertical drive shaft to drive.

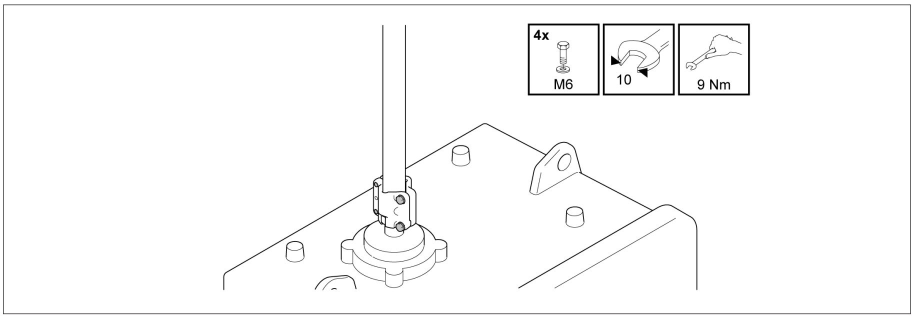


Figure 10: Mounting vertical drive shaft on drive

7. Pivot square tube with coupling part.

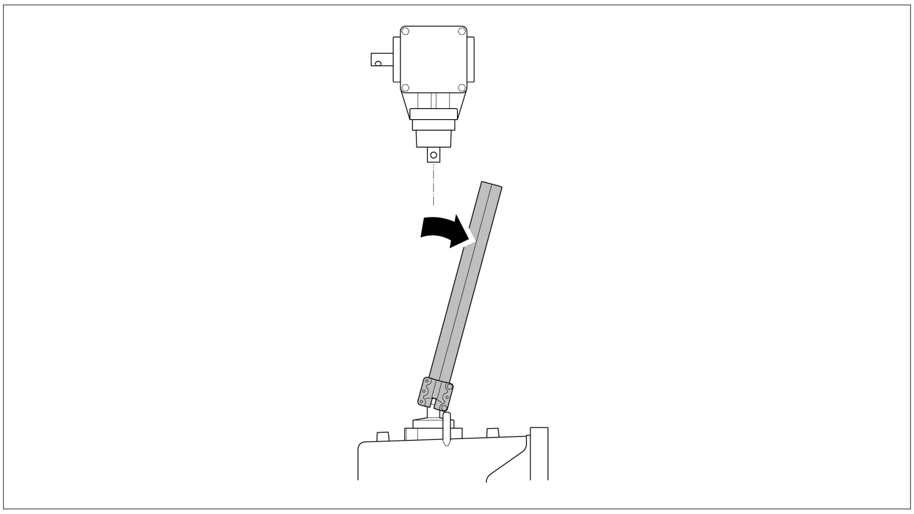


Figure 11: Pivoting square tube

8. When installing inner tube of telescopic protective tube, if necessary shorten on side without slits. The minimum dimension for overlapping the two protective tubes is 100 mm.

Inner tube must not be deformed and must be deburred in order to slide easily in the outer tube.

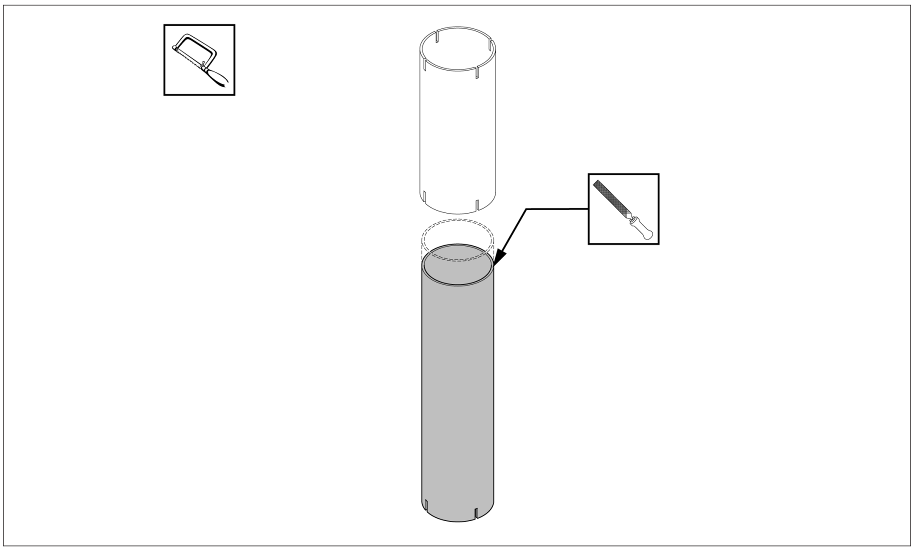


Figure 12: Deburring inner tube

Dimension A (= distance between the shaft end of the drive and the shaft end of the bevel gear)	Inner tube	Outer tube
170 mm...190 mm	Shorten to 200 mm	= 200 mm
191 mm...1130 mm	Dimension A + 20 mm	= 200 mm
1131 mm...1598 mm	= 700 mm	= 1150 mm
1599 mm...2009 mm	= 1150 mm	= 1150 mm

9. Slide outer tube over inner tube (with slot at bottom). Slide telescopic protective tubes onto square tube. Then slide hose clips over telescopic protective tubes.

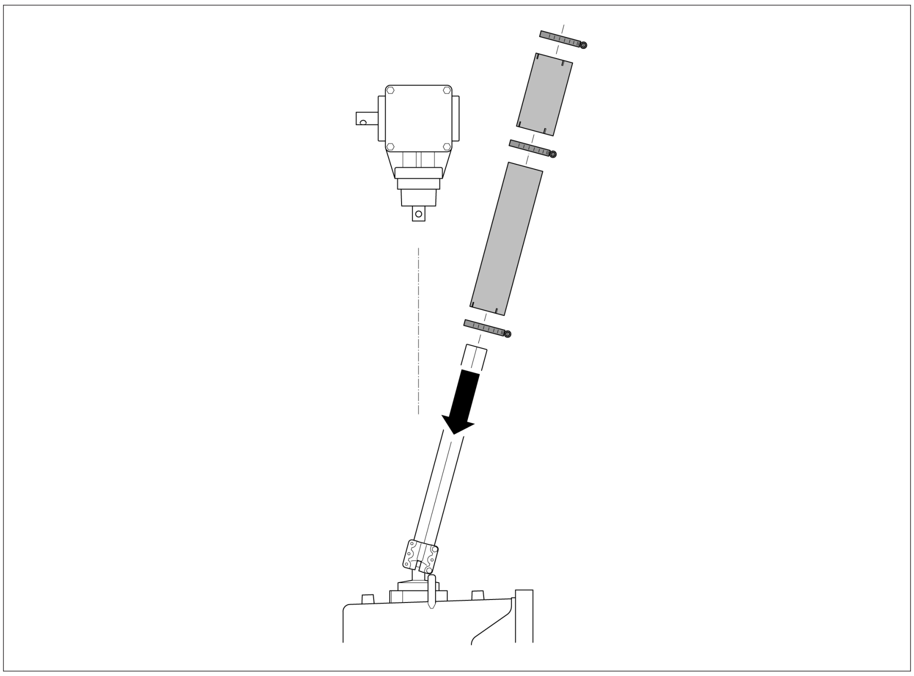


Figure 13: Sliding on telescopic protective tube

10. Place adapter ring over bearing collar of bevel gear and slide upwards. Push in coupling bolt. Swing square tube in.

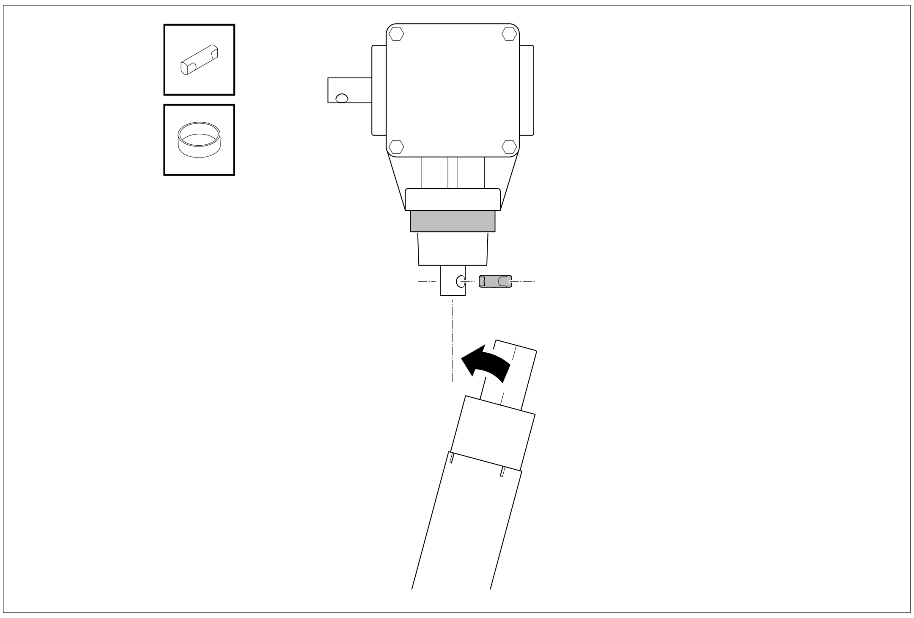


Figure 14: Fitting adapter ring and coupling bolt

11. Grease coupling brackets and mount on bevel gear. Set a unilateral axial clearance of 3 mm between the coupling bolt and upper coupling piece.

To prepare for alignment, tighten screws to approx. 6 Nm. After aligning on-load tap-changer to drive (see MR operating instructions for TAPMOTION® ED), tighten screws to 9 Nm.

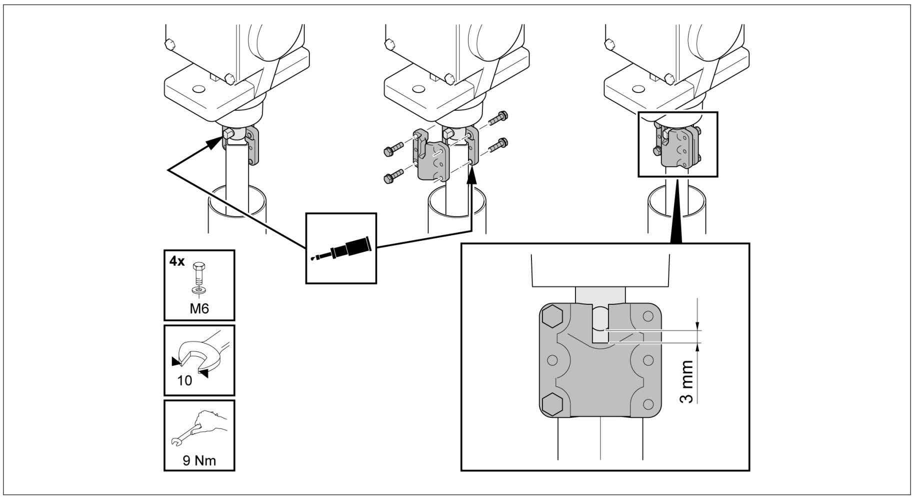


Figure 15: Mounting coupling brackets

12. Attach protective tube (inner tube) with a hose clip to the bearing collar of the drive **1**. Then slider upper protective tube (outer tube) over adapter on bevel gear **2**. Secure upper protective tube with hose clip both at top end and at transition to bottom protective tube **3**.

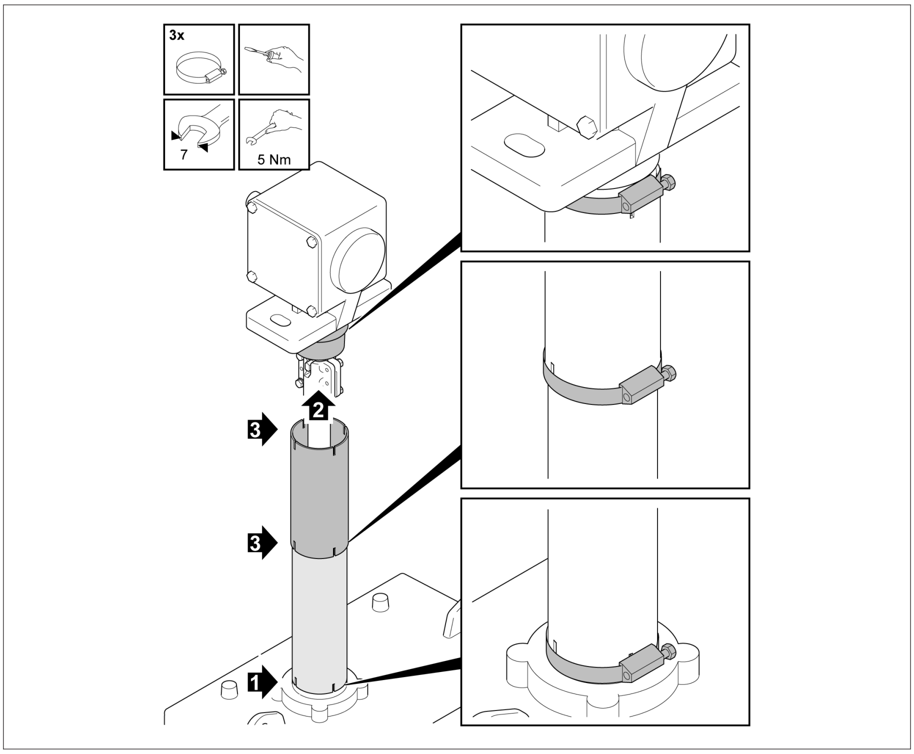


Figure 16: Mounting protective tube

6.2 Fitting horizontal drive shaft

NOTICE

Damage to the on-load tap-changer!

Damage to the on-load tap-changer due to incorrect alignment of the upper gear unit!

- ► Only align upper gear unit if pressure segments are loosened.
- ► Never turn upper gear unit around its own axis to align it.
- ► Only align upper gear unit by turning drive shaft of upper gear unit.

To fit the horizontal drive shaft, proceed as follows.

1. Calculate dimension A between shaft end of upper gear unit and shaft end of bevel gear and shorten square tube to length A – 9 mm.

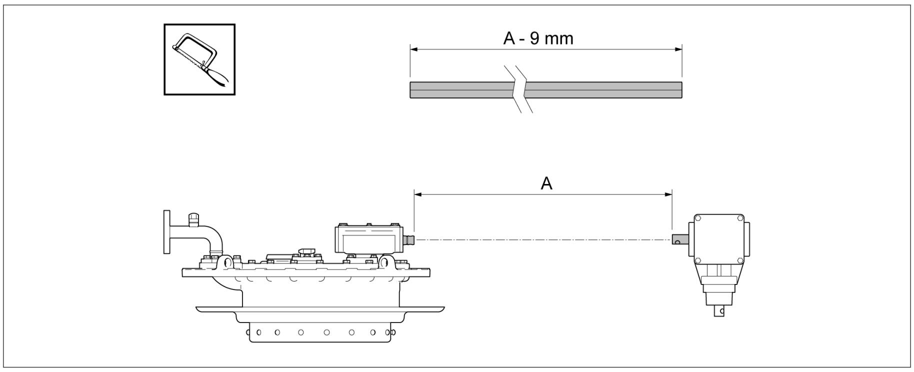


Figure 17: Shortening square tube

2. Calculate inside width B between housings of upper gear unit and bevel gear. Cut guard plate (LSB = length of guard plate) accordingly and deburr the cutting surface. Protect guard plate against corrosion with a coat of paint.

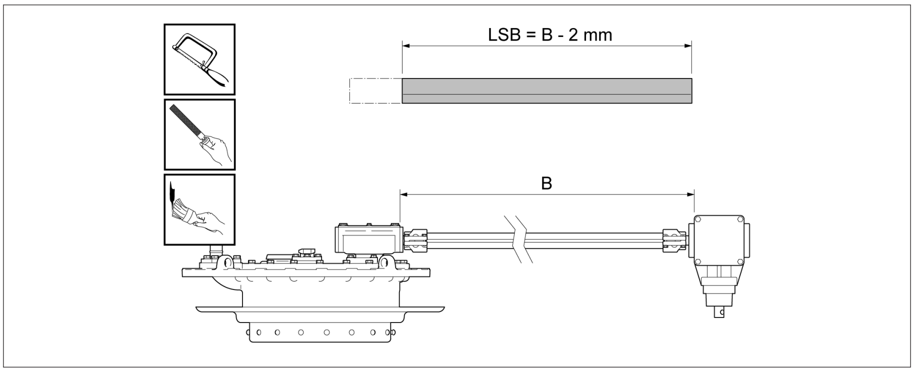


Figure 18: Shortening, deburring and coating guard plate

3. Slide loosely screwed together coupling part onto square tube until stop is reached.

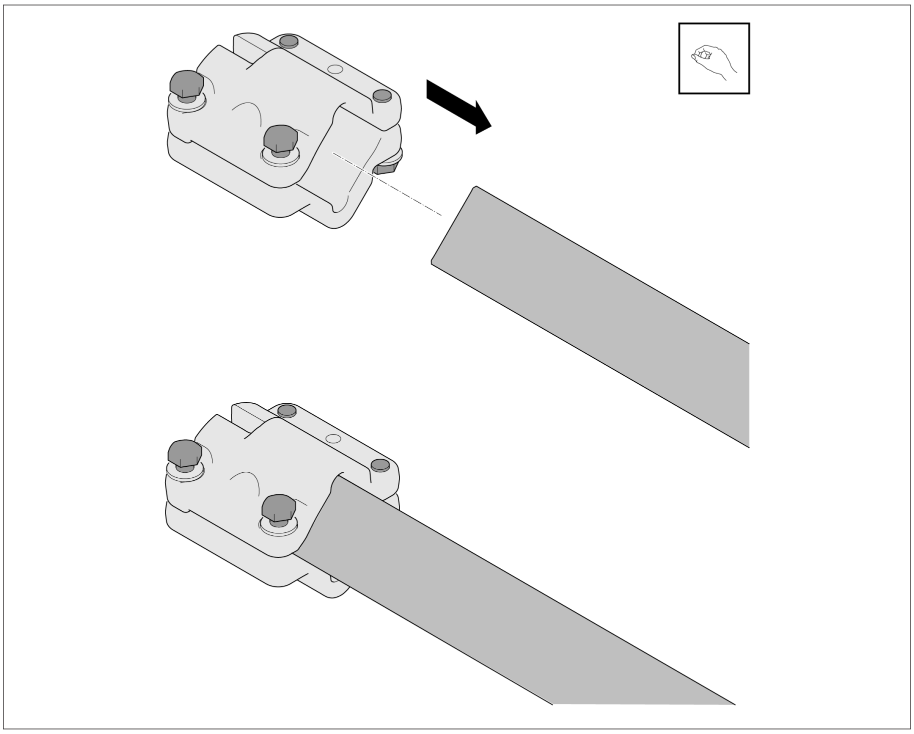


Figure 19: Sliding coupling part onto square tube

4. Grease coupling bolt. Fit coupling bolt onto bevel gear and slide square tube with coupling part over it.

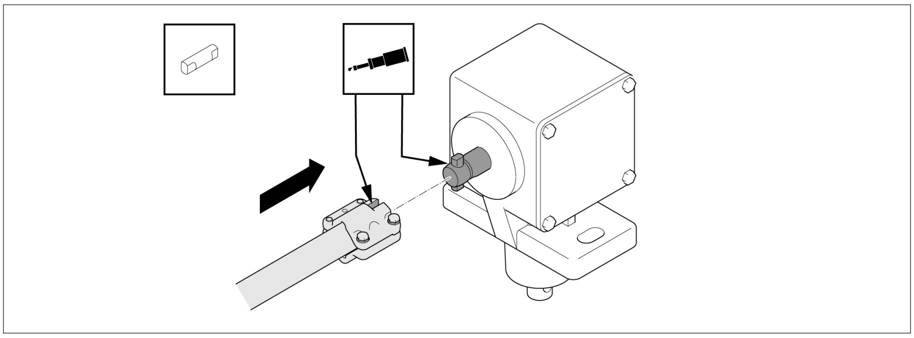


Figure 20: Attaching coupling part to bevel gear

5. Mount horizontal drive shaft on bevel gear.

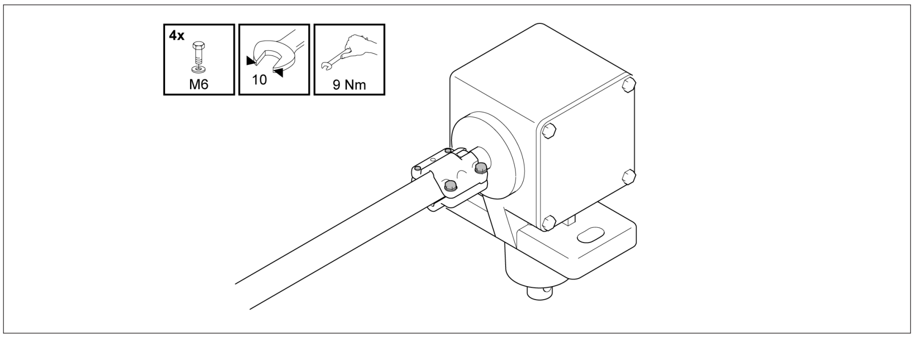


Figure 21: Mounting horizontal drive shaft on bevel gear

6. Grease coupling bolts and coupling brackets for upper gear unit. Mount coupling brackets on upper gear unit.

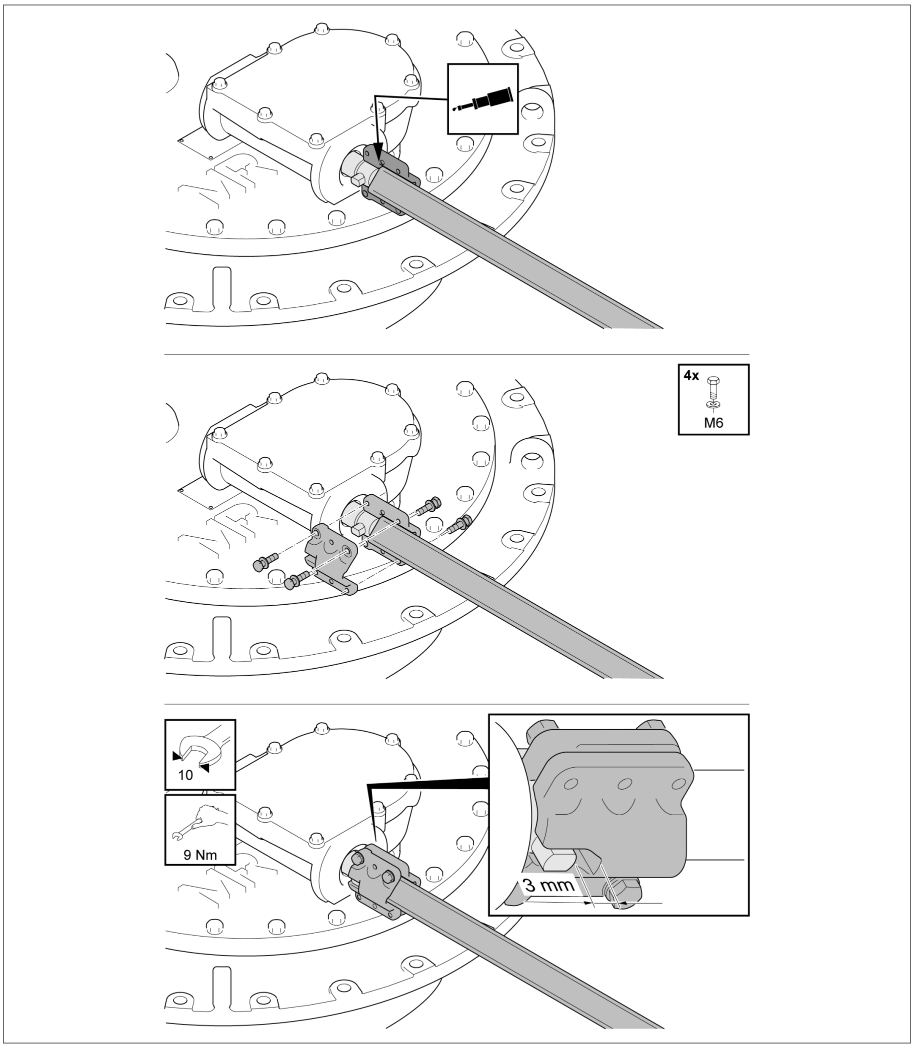


Figure 22: Mounting horizontal drive shaft on upper gear unit

7. Now attach shortened guard plate to housing lugs on the on-load tap-changer head and bevel gear. Secure each end of guard plate with a hose clip.

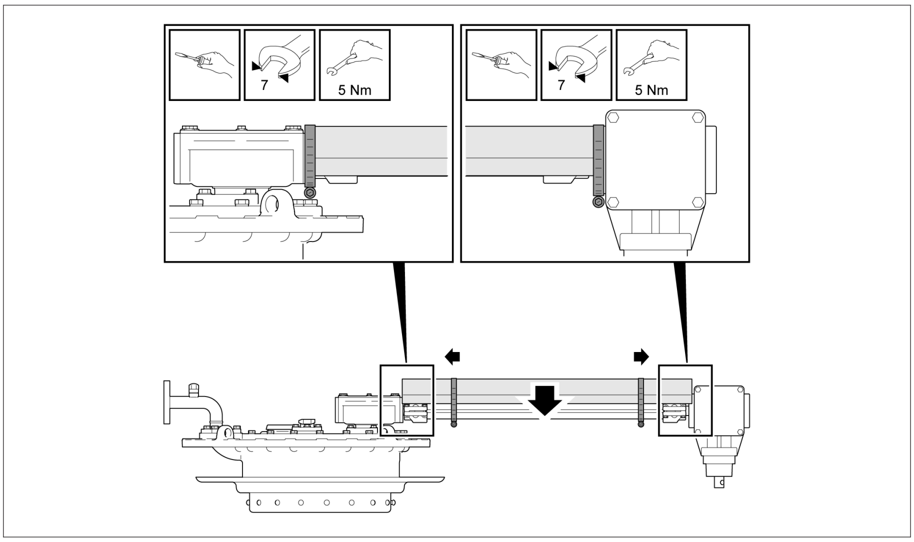


Figure 23: Fitting guard plate

8. If using a bearing bracket or angle gear, attach caps to the guard plate.

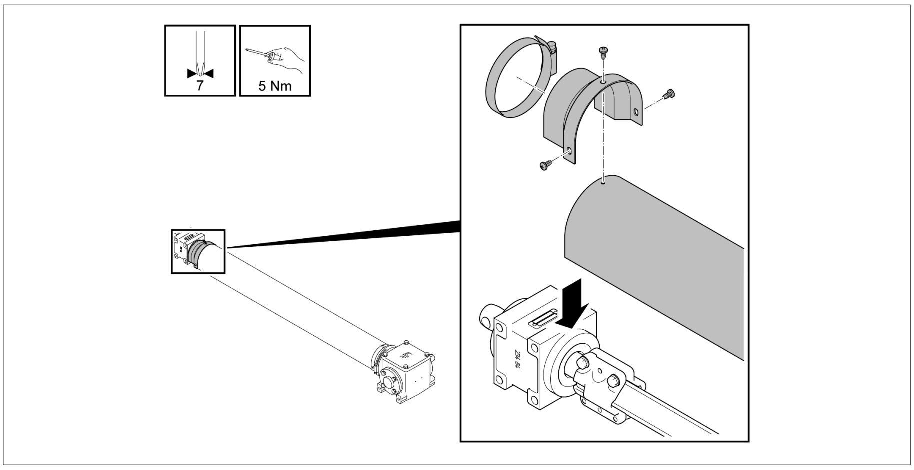


Figure 24: Bearing bracket caps

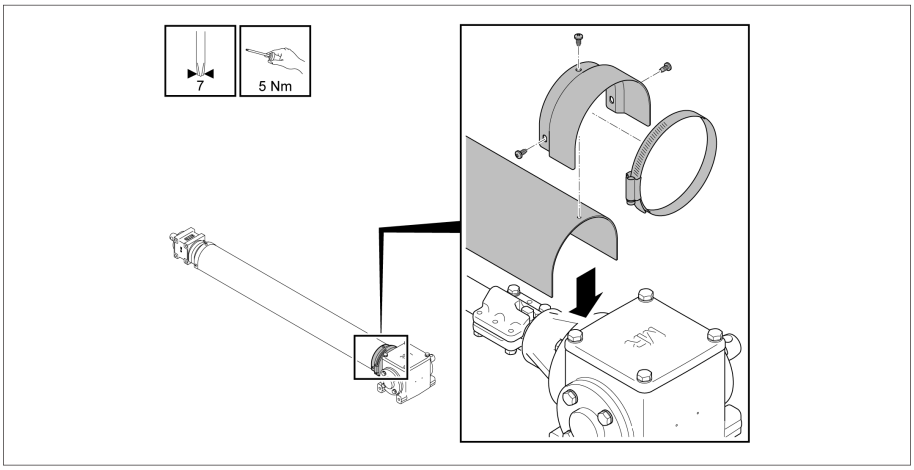


Figure 25: Angle gear caps

7 Fitting drive shaft with cardan joints

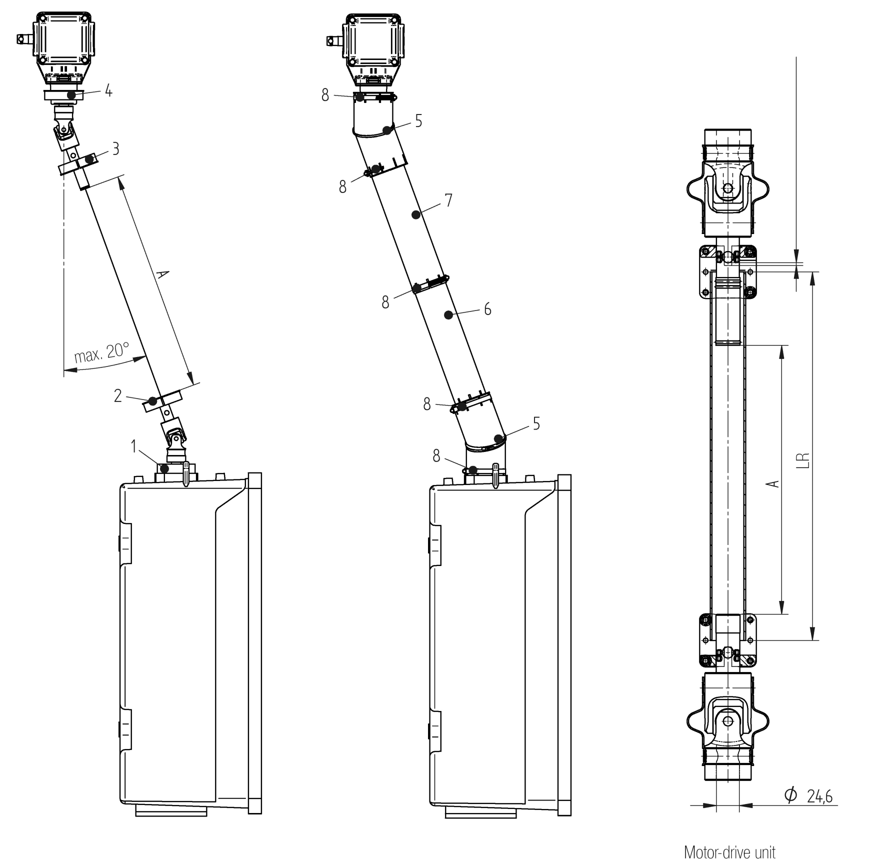
NOTICE

Damage to drive shaft!

Damage to expansion bellows from bending cardan joint!

► Ensure a matching position of the opposing cardan joint straps!

Installation of the drive shaft with cardan joints is mainly designed as a vertical drive shaft between motor-drive unit and bevel gear. Technically, a horizontal design is also possible. Note, however, that when using the horizontal design the guard plate supplied has to be adapted accordingly.



LR = A + 106

LR – Length of square tube

A – Distance between shaft ends

Item	Name	Quantity
1	Adapter ring d82 x 102	1
2	Adapter ring d87 x 102.5	1
3	Adapter ring d92 x 102.5	1
4	Adapter ring d71 x 102.5	1
5	Pivotable protective tube	2
6	Inner telescopic tube	1
7	Outer telescopic tube	1
8	Hose clip 87-112	5

Figure 26: Drive shaft with cardan joint

To fit the drive shaft with cardan joints, proceed as follows:

1. Grease the coupling bolts, coupling brackets and ball heads, e.g. ISOFLEX TOPAS L 32.

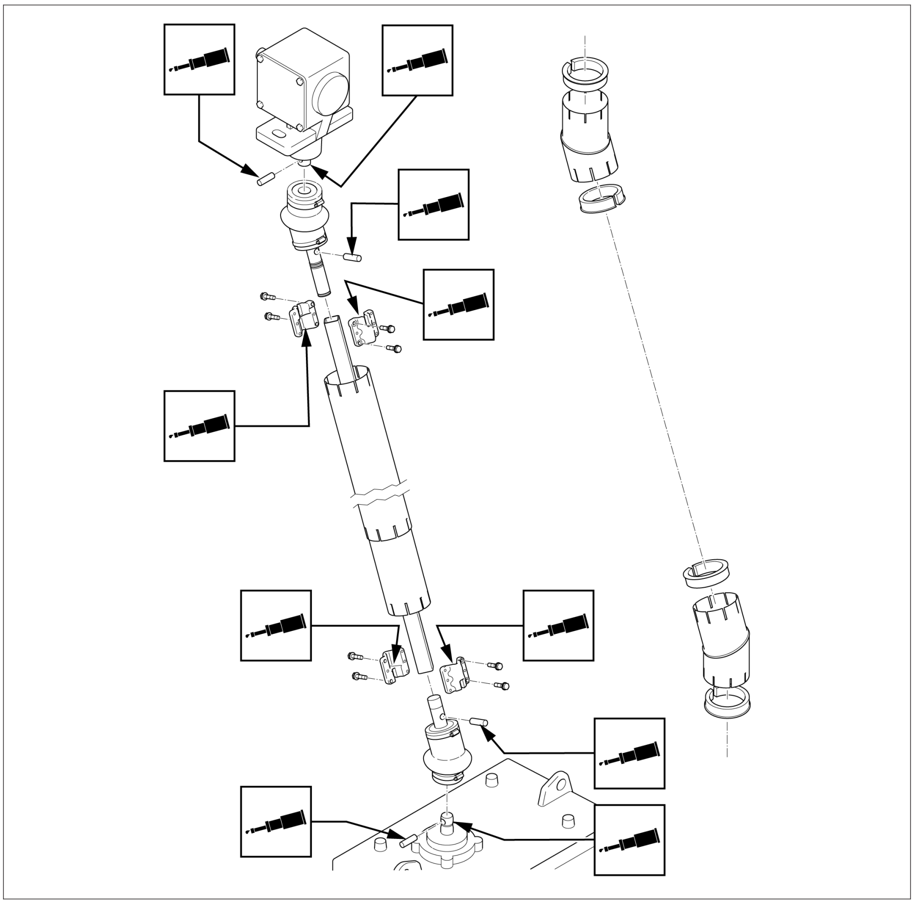


Figure 27: Grease the coupling bolts, coupling brackets and ball heads.

2. Insert adapter in neck of pivotable protective tubes **1**. Place both parts of pivotable protective tube inside one another **2** and turn towards one another **3** to set the corresponding angle.

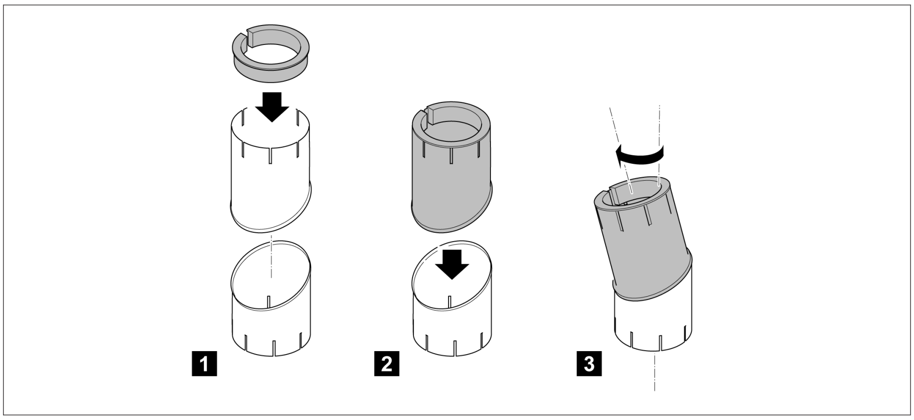


Figure 28: Inserting adapter in pivotable protective tubes

3. When supplied, the cardan joints are fitted with coupling bolts **1**. To mount on the shaft end, the following steps must be taken: Remove hose clip **2**. Slide up expansion bellows **3**. Remove coupling bolt **4**. Slide cardan joint over device's output shaft **5**. Push in coupling bolt **6**. Slide expansion bellows over this **7**. Secure expansion bellows with hose clip **8**.

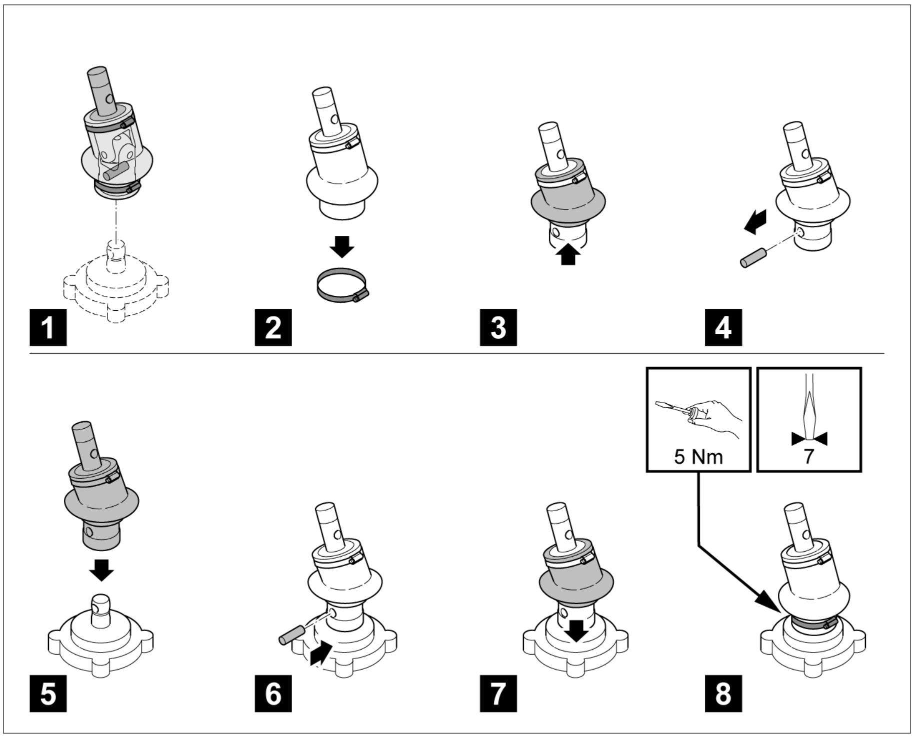


Figure 29: Mounting cardan joints

4. Connect shorter cardan joint supplied to ball-shaped head of motor-drive unit with cardan joint bolt.

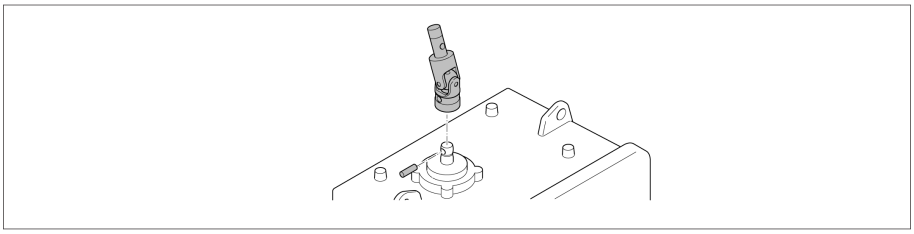


Figure 30: Fitting cardan joint to ball-shaped head of motor-drive unit

5. Fit second, longer cardan joint to bevel gear.

If a cardan joint is attached to the upper gear unit, then use a cardan joint with an inner hub diameter of 25 mm.

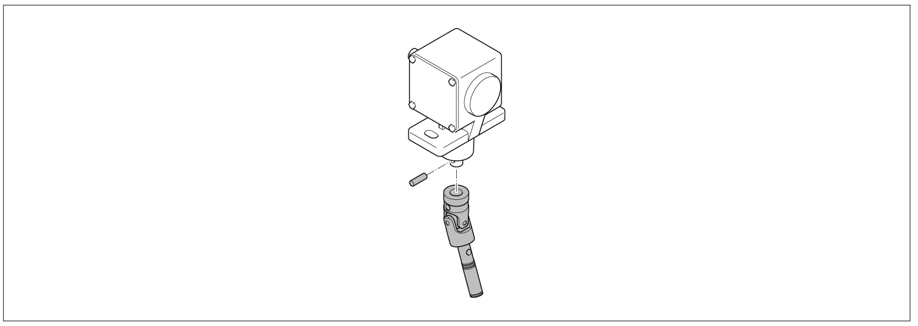


Figure 31: Fitting second cardan joint on bevel gear

6. Secure cardan shaft bolt to expansion bellows with hose clip.

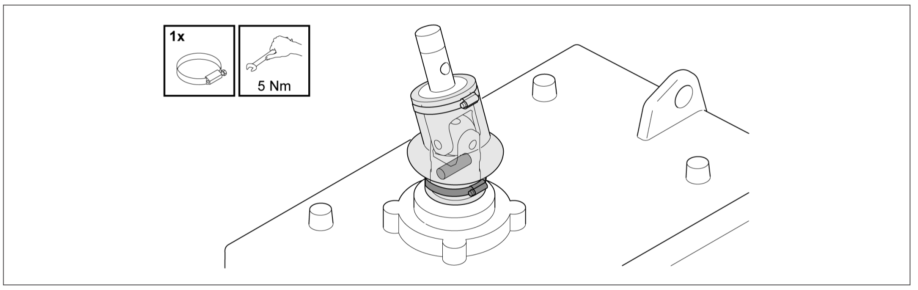


Figure 32: Securing cardan shaft bolt with hose clip

7. Provisionally connect loose shaft ends of the joints to an angle bar and align.

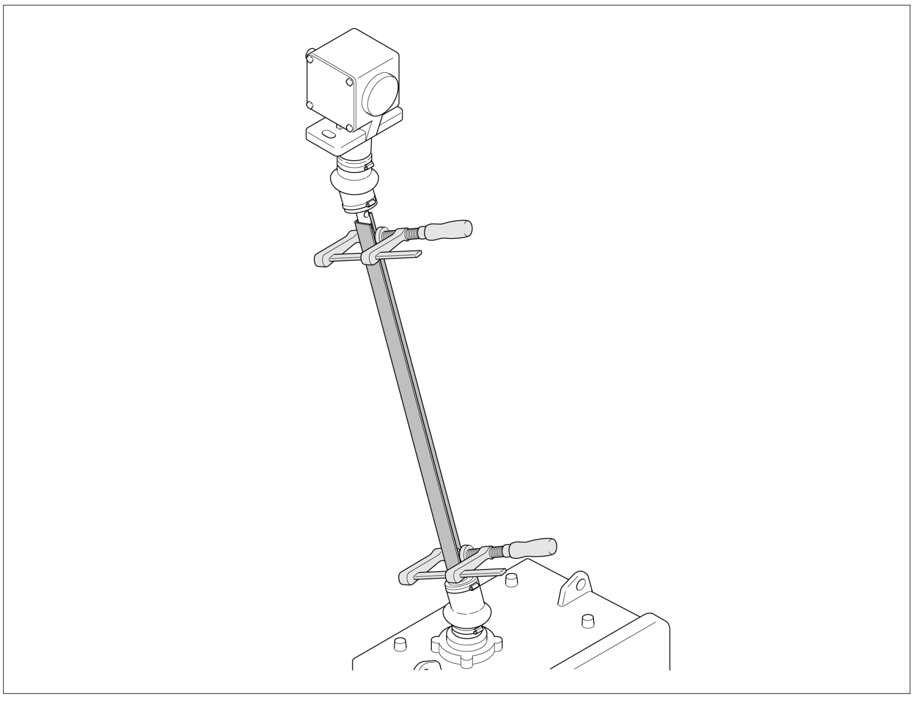


Figure 33: Connecting shaft ends with angle bar

8. Determine dimension A between the shaft ends. Cut square tube to LR = A + 106 mm (LR = length of square tube). Deburr cut surface of square tube.

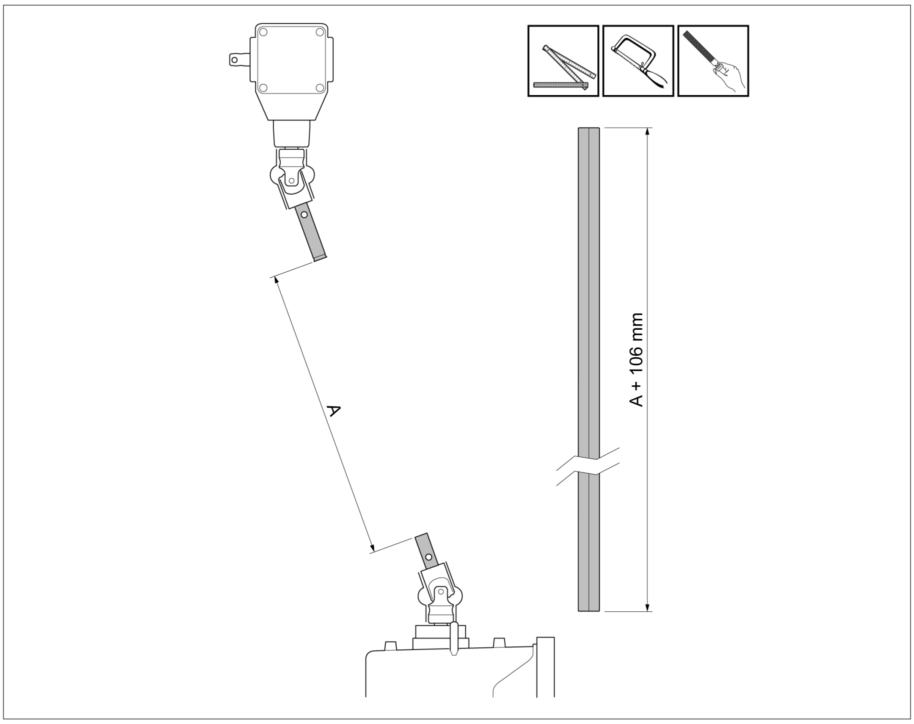


Figure 34: Shortening square tube

9. Before mounting, shorten both telescopic tubes to dimension A/2 + 120 mm (A = dimension between both cardan joint ends) and deburr.

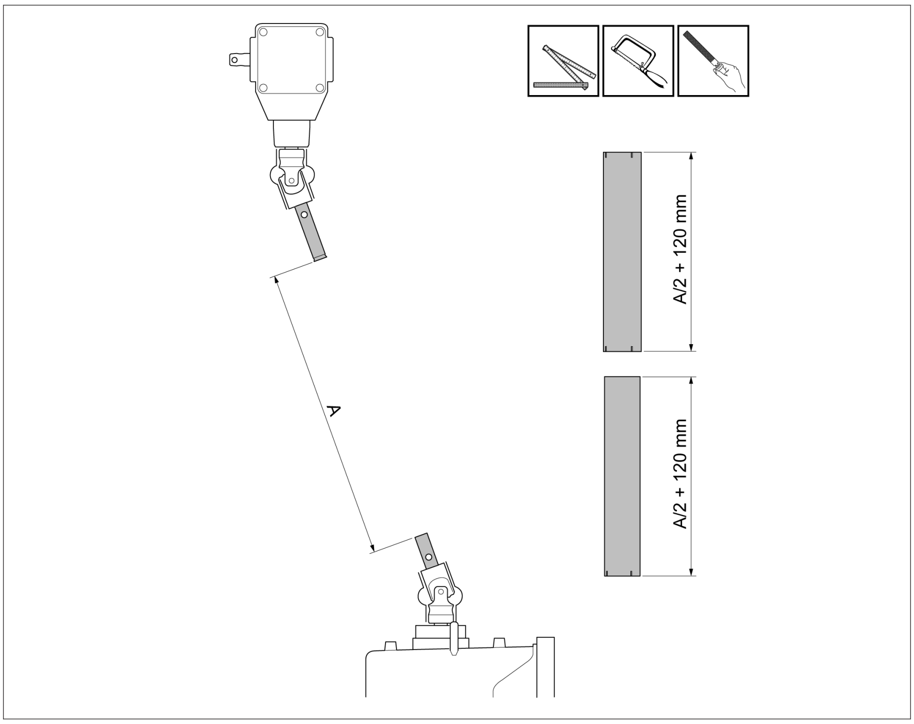


Figure 35: Shortening telescopic tubes

10. Fit one adapter to bearing collar of motor-drive unit and fit other adapter to bearing collar of bevel gear.

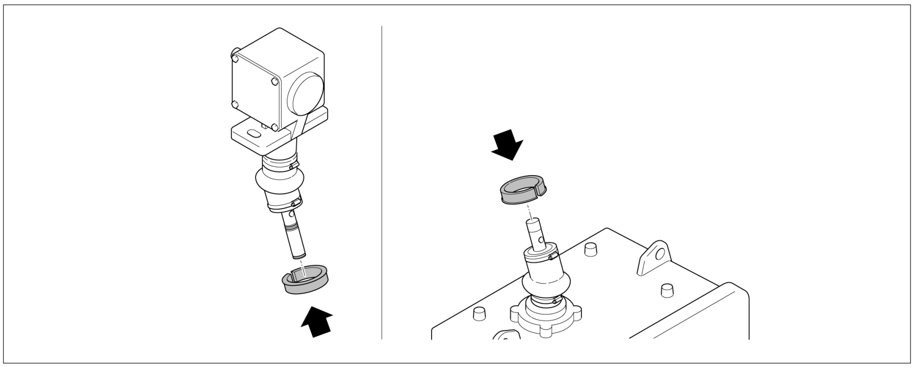


Figure 36: Fitting adapters

11. Slide previously shortened and deburred square tube over upper cardan joint end until stop is reached.

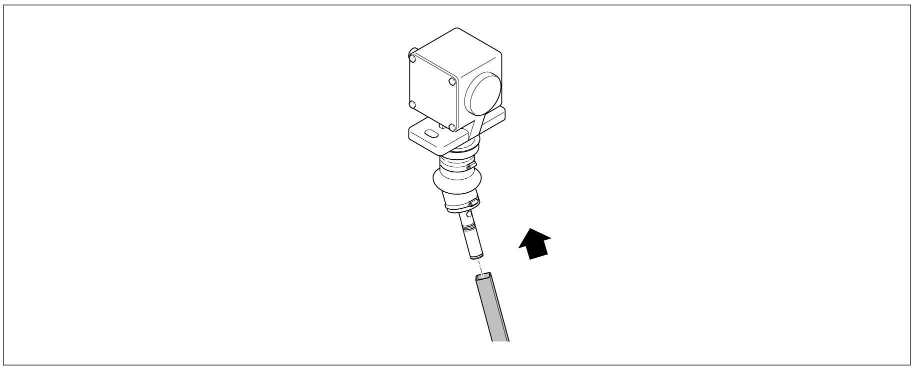


Figure 37: Sliding square tube over upper cardan joint end

12. Thread upper flexible protective tube with long outlet up onto square tube from below.

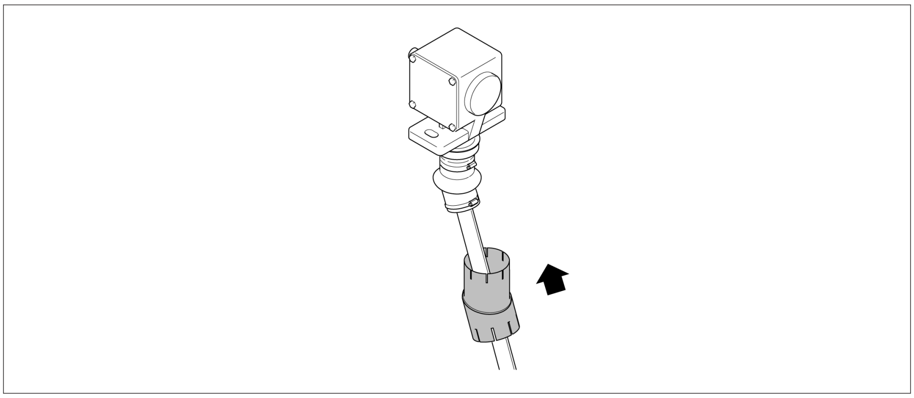


Figure 38: Sliding flexible protective tube over square tube

13. Thread on outer and inner tubes such that the slotted sides of the outer and inner tube are both facing down.

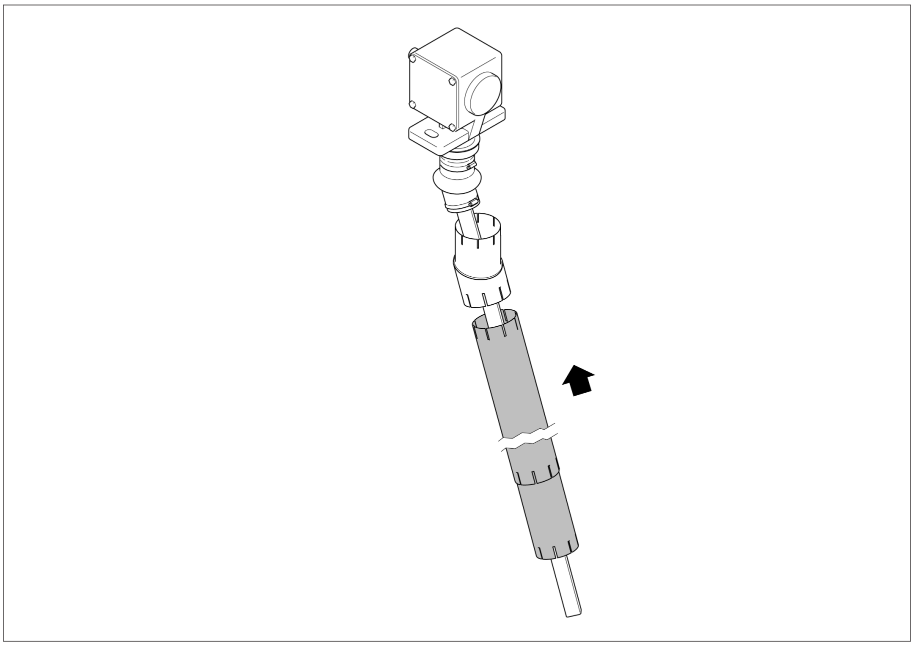


Figure 39: Sliding on telescopic tubes

14. Slide everything up and secure with a screw clamp.

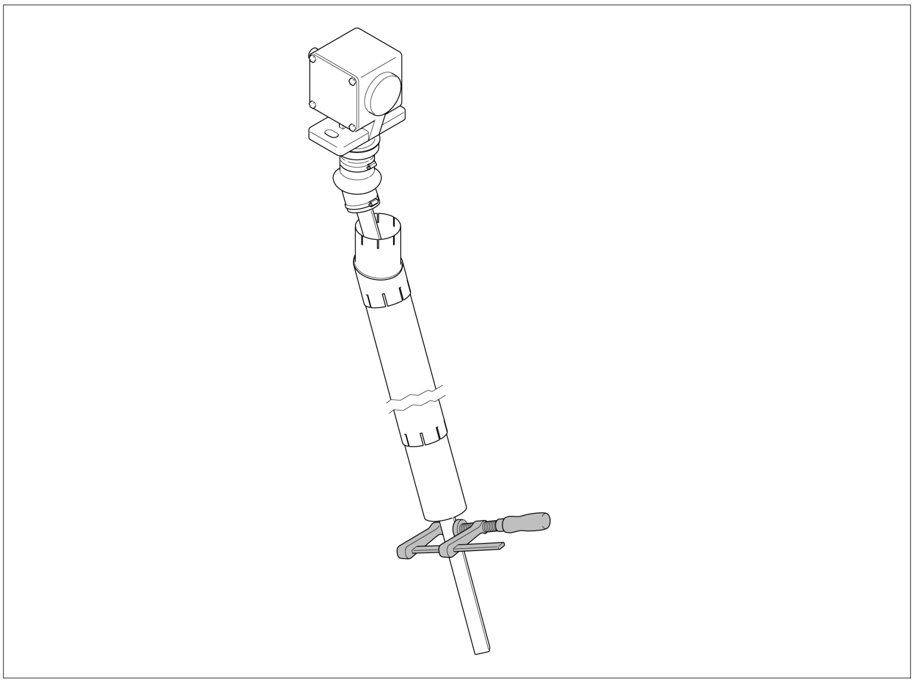


Figure 40: Securing everything with a screw clamp

15. Slide bottom flexible protective tube (also with long outlet up) on to the square tube and secure with screw clamp.

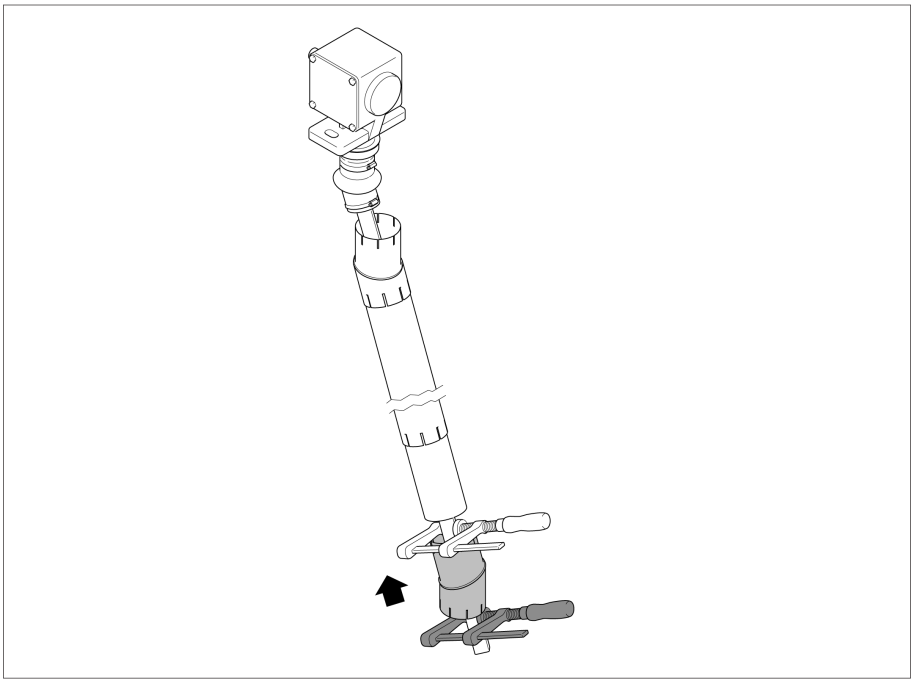


Figure 41: Sliding bottom flexible protective tube onto square tube

16. Swing in square tube and slide all the way down.

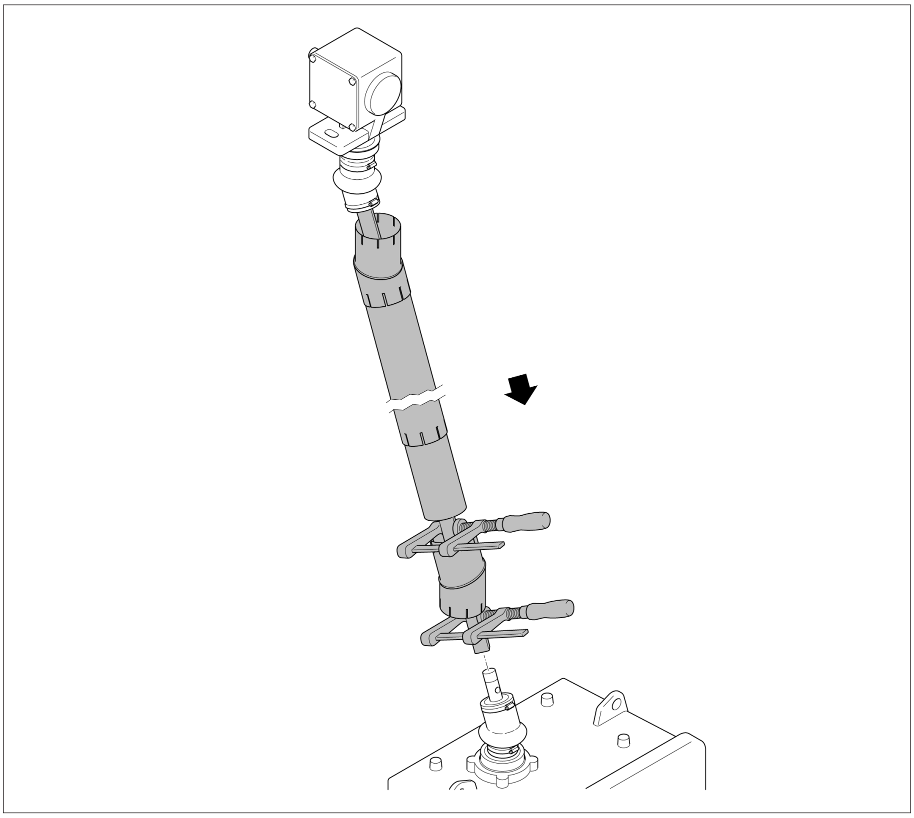


Figure 42: Swinging square tube in

17. Tighten bottom coupling brackets. Shaft end and coupling part must be securely connected such that no axial clearance remains between the coupling bolt and coupling bracket.

To prepare for alignment, tighten screws to approx. 6 Nm. After aligning on-load tap-changer to drive (see MR operating instructions for TAPMOTION® ED), tighten screws to 9 Nm.

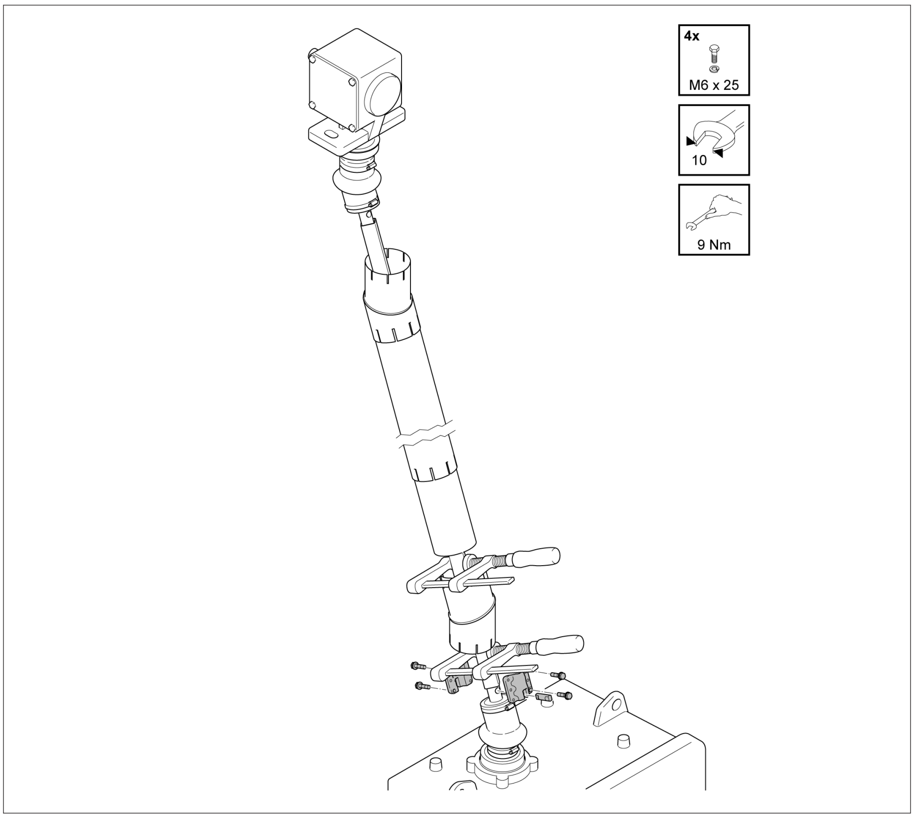


Figure 43: Tightening lower coupling brackets

18. Fit upper coupling brackets with 3 mm axial clearance.

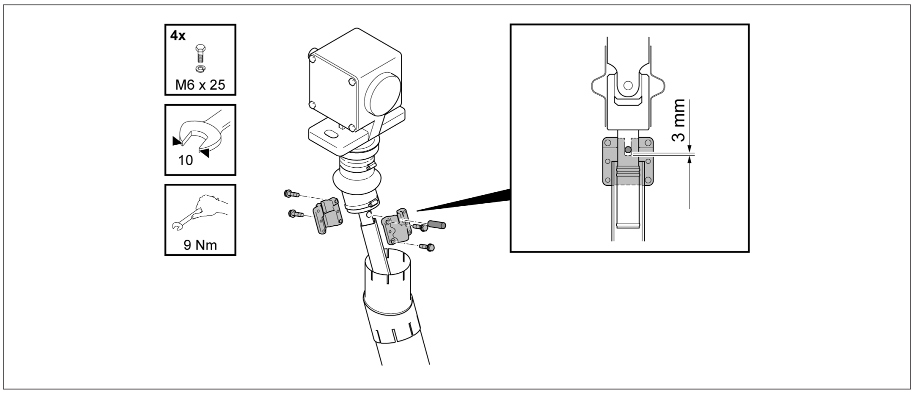


Figure 44: Fitting upper coupling brackets

19. Working from top to bottom, mount the individual parts of the shaft protection. Set angle position between both parts of pivotable protective tube and fix with available hose clip. Secure both upper and lower protective tubes with a hose clip at both ends. Secure the two telescopic protective tubes to one another using a hose clip.

The plastic adapters must be at the respective end of the pivotable protective tube. Only slide telescopic pipe into upper and lower pivotable protective tubes by the width of the adapter before tightening the hose clips.

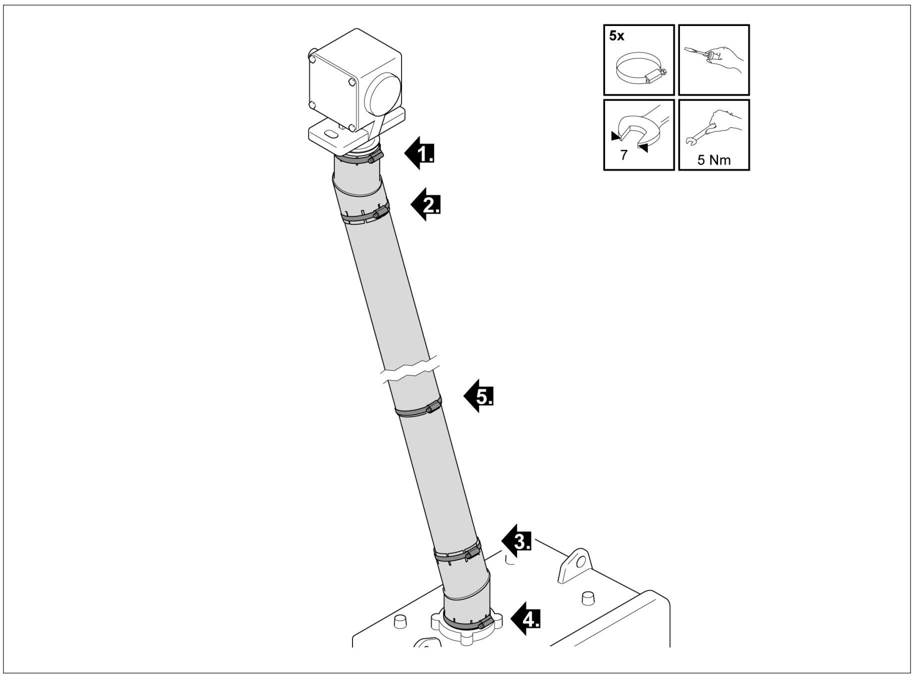


Figure 45: Securing telescopic pipes and flexible protective tubes with hose clips

8 Fitting drive shaft with insulator

A model with insulator in the vertical drive shaft is available for insulating installation of the drive shaft.

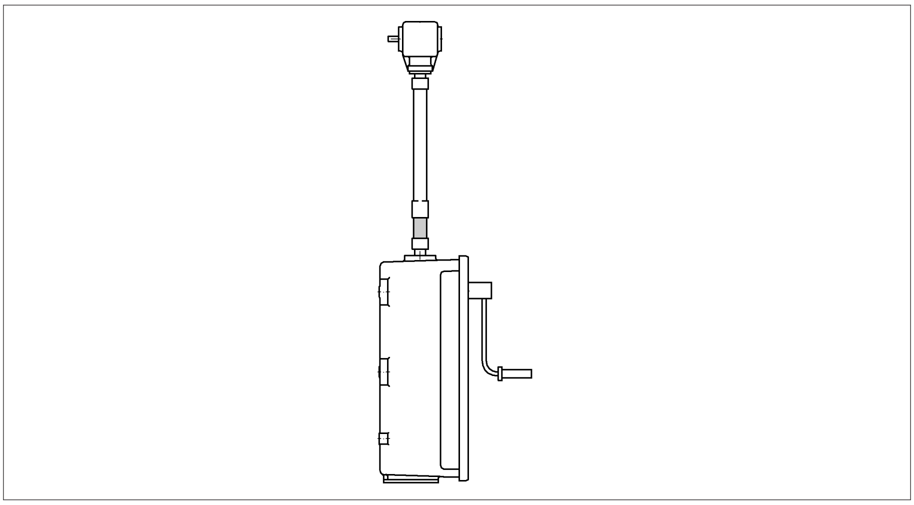


Figure 46: Model with insulator (~ maximum permissible offset = 2°)

The insulator can also be used in connection with the universal cardan shaft.

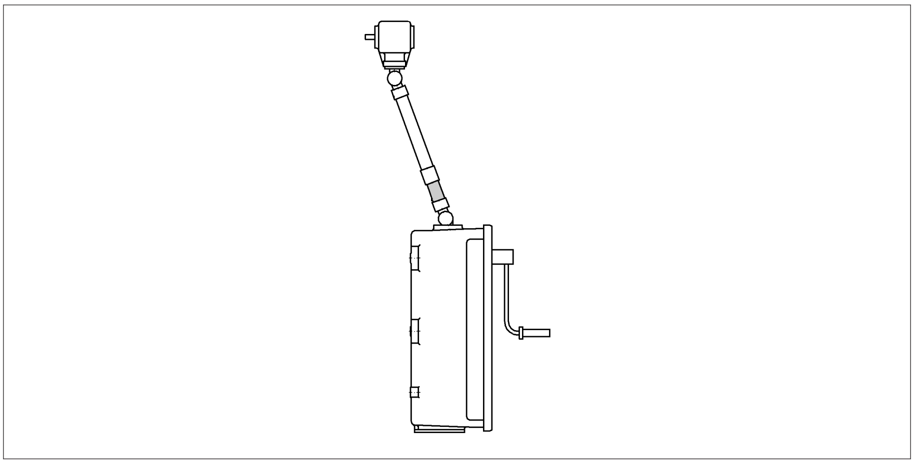
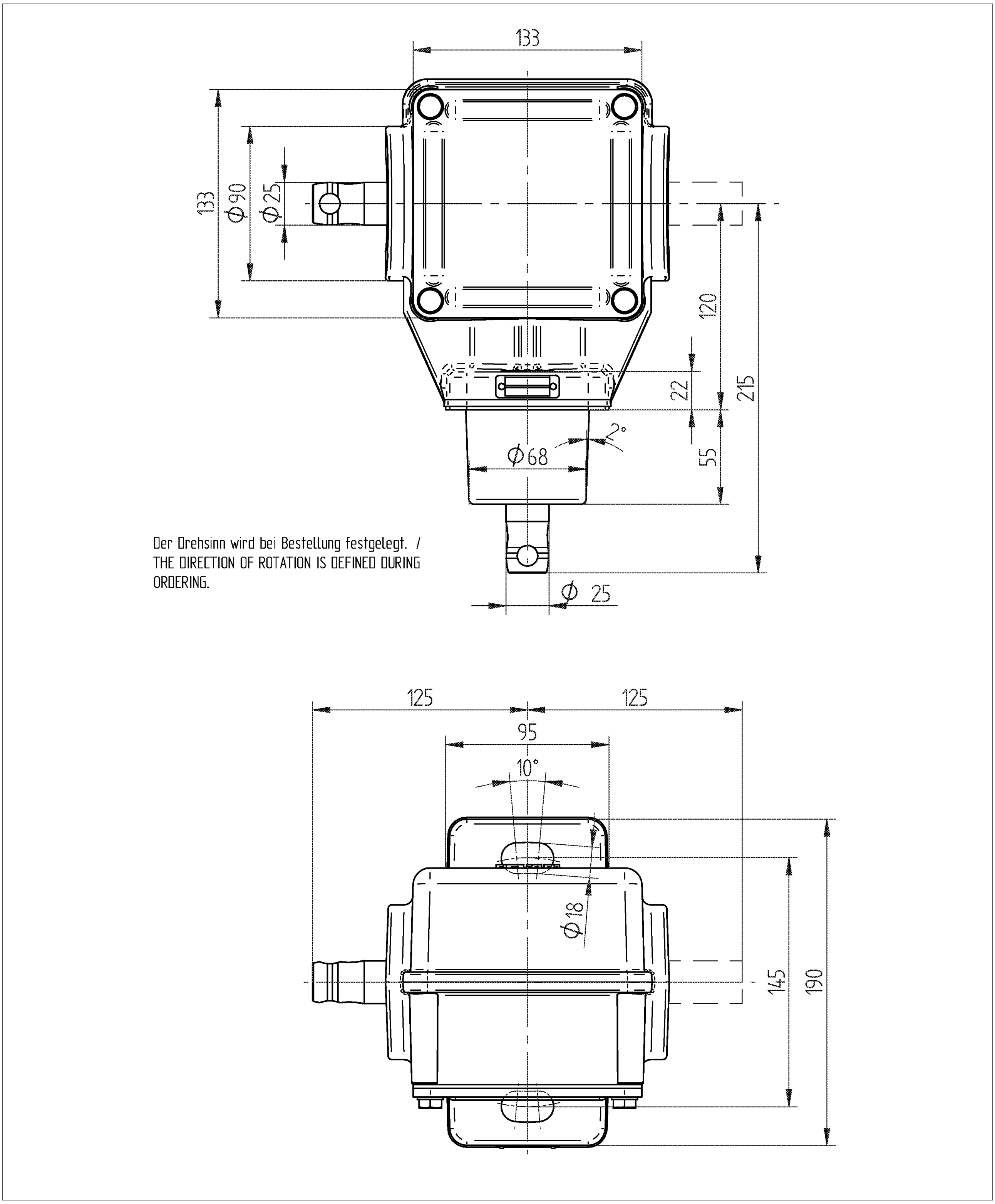


Figure 47: Model with insulator (~ maximum permissible offset = 20°)

9 Appendix

9.1 Bevel gear - dimensional drawing (892916)



MR worldwide

Australia
Reinhausen Australia Pty. Ltd.
Ground Floor
6-10 Geeves Avenue
Rockdale N. S. W. 2216
Phone: +61 2 9556 2133
Fax: +61 2 9597 1339
E-Mail: sales@au.reinhausen.com

Brazil
MR do Brasil Indústria Mecánica Ltda.
Av. Elias Yazbek, 465
CEP: 06803-000
Embu - São Paulo
Phone: +55 11 4785 2150
Fax: +55 11 4785 2185
E-Mail: vendas@reinhausen.com.br

Canada
Reinhausen Canada Inc.
3755, rue Java, Suite 180
Brossard, Québec J4Y 0E4
Phone: +1 514 370 5377
Fax: +1 450 659 3092
E-Mail: m.foata@ca.reinhausen.com

India
Easun-MR Tap Changers Ltd.
612, CTH Road
Tiruninravur, Chennai 602 024
Phone: +91 44 26300883
Fax: +91 44 26390881
E-Mail: easunmr@vsnl.com

Indonesia
Pt. Reinhausen Indonesia
German Center, Suite 6310,
Jl. Kapt. Subijanto Dj.
BSD City, Tangerang
Phone: +62 21 5315-3183
Fax: +62 21 5315-3184
E-Mail: c.haering@id.reinhausen.com

Iran
Iran Transfo After Sales Services Co.
Zanjan, Industrial Township No. 1 (Aliabad)
Corner of Morad Str.
Postal Code 4533144551
E-Mail: itass@iran-transfo.com

Italy
Reinhausen Italia S.r.l.
Via Alserio, 16
20159 Milano
Phone: +39 02 6943471
Fax: +39 02 69434766
E-Mail: sales@it.reinhausen.com

Japan
MR Japan Corporation
German Industry Park
1-18-2 Hakusan, Midori-ku
Yokohama 226-0006
Phone: +81 45 929 5728
Fax: +81 45 929 5741

Luxembourg
Reinhausen Luxembourg S.A.
72, Rue de Prés
L-7333 Steinsel
Phone: +352 27 3347 1
Fax: +352 27 3347 99
E-Mail: sales@lu.reinhausen.com

Malaysia
Reinhausen Asia-Pacific Sdn. Bhd
Level 11 Chulan Tower
No. 3 Jalan Conlay
50450 Kuala Lumpur
Phone: +60 3 2142 6481
Fax: +60 3 2142 6422
E-Mail: mr_rap@my.reinhausen.com

P.R.C. (China)
MR China Ltd. (MRT)
开德贸易（上海）有限公司
中国上海浦东新区浦东南路 360 号
新上海国际大厦 4 楼 E 座
邮编： 200120
电话：＋86 21 61634588
传真：＋86 21 61634582
邮箱：mr-sales@cn.reinhausen.com
mr-service@cn.reinhausen.com

Russian Federation
OOO MR
Naberezhnaya Akademika Tupoleva
15, Bld. 2 ("Tupolev Plaza")
105005 Moscow
Phone: +7 495 980 89 67
Fax: +7 495 980 89 67
E-Mail: mrr@reinhausen.ru

South Africa
Reinhausen South Africa (Pty) Ltd.
No. 15, Third Street, Booysens Reserve
Johannesburg
Phone: +27 11 8352077
Fax: +27 11 8353806
E-Mail: support@za.reinhausen.com

South Korea
Reinhausen Korea Ltd.
21st floor, Standard Chartered Bank Bldg.,
47, Chongro, Chongro-gu,
Seoul 110-702
Phone: +82 2 767 4909
Fax: +82 2 736 0049
E-Mail: you-mi.jang@kr.reinhausen.com

U.S.A.
Reinhausen Manufacturing Inc.
2549 North 9th Avenue
Humboldt, TN 38343
Phone: +1 731 784 7681
Fax: +1 731 784 7682
E-Mail: sales@reinhausen.com

United Arab Emirates
Reinhausen Middle East FZE
Dubai Airport Freezone, Building Phase 6
3rd floor, Office No. 6EB, 341 Dubai
Phone: +971 4 2368 451
Fax: +971 4 2368 225
Email: service@ae.reinhausen.com

Digital signal transfer device SC001

Operating Instructions 153/03

Table of Contents

1 Introduction

This technical file contains detailed descriptions on the safe and proper mounting, connection, commissioning and monitoring of the product.

It also includes safety instructions and general information about the product.

This technical file is intended solely for specially trained and authorized personnel.

1.1 Manufacturer

The product is manufactured by:

Maschinenfabrik Reinhausen GmbH
Falkensteinstraße 8
93059 Regensburg
Tel.: (+49) 9 41/40 90-0
Fax: (+49) 9 41/40 90-7001
E-Mail: sales@reinhausen.com

Further information on the product and copies of this technical file are available from this address if required.

1.2 Subject to change without notice

The information contained in this technical file comprise the technical specifications approved at the time of printing. Significant modifications will be included in a new edition of the technical file.

The document and version numbers of this technical file are shown in the footer.

1.3 Completeness

This technical file is incomplete without the supporting documentation.

1.4 Supporting documents

Also observe generally valid legislation, standards, guidelines and specifications on accident prevention and environmental protection in the respective country of use.

1.5 Safekeeping

This technical file and all supporting documents must be kept ready to hand and accessible for future use at all times.

1.6 Notation conventions

This section contains an overview of the abbreviations, symbols and textual emphasis used.

1.6.1 Abbreviations used

Abbreviation	Definition
°C	Degrees Celsius
A	Ampere
AC	Alternating Current
AgSnO2	Silver tin oxide
BCD	Binary Coded Decimal
DC	Direct Current
DIN	Deutsches Institut für Normung (German Institute for Standardization)
EMC	Electromagnetic compatibility
Hz	Hertz
I	Current
IEC	International Electrotechnical Commission
IP	Internet Protocol
kg	Kilogram
km	Kilometer
kV	Kilovolt
LDC	Line Drop Compensation
m	Meter
max.	Maximum
MR	Maschinenfabrik Reinhausen
MHz	Megahertz
min.	Minimum
mm	Millimeter
ms	Millisecond
mW	Milliwatt
RS-232	Serial interface (recommended standard)
s	Second
SC	Signal converter (signal transmitter)
T	Time
TTL	Transistor-Transistor-Logic
V	Voltage
V_{actual}	Actual voltage

Abbreviation	Definition
$V_{desired}$	Desired voltage
V	Volt
VA	Volt-ampere
VDE	German Association for Electrical, Electronic & Information Technologies

Table 1 Abbreviations used

1.6.2 Hazard communication system

Warnings in this technical file use the following format:

DANGER!

Danger

Consequences

- ► Action
- ► Action

The following signal words are used:

Signal word	Hazard level	Consequence of failure to comply
Danger	Immediate threat of danger	Death or serious injury could occur
Warning	Possible threat of danger	Death or serious injury could occur
Attention	Possible dangerous situation	Minor or moderate injury could occur
Note	Possible dangerous situation	Damage to property could occur

Table 2 Signal words in warning notices

Pictograms warn of dangers:

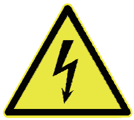
Pictogram	Meaning
	Danger
	Dangerous electrical voltage
	Fire hazard
	Danger of tipping

Table 3 Symbols used in warning notices

1.6.3 Information system

Information is designed to simplify and improve understanding of particular procedures. In this technical file they are laid out as follows:

	Important information

2 Safety

2.1 General safety information

This technical file contains detailed descriptions on the safe and proper mounting, connection, commissioning and monitoring of the product.

Read this technical file through carefully to familiarize yourself with the product.

Particular attention should be paid to the information given in this chapter.

2.2 Appropriate use

The product and associated equipment and special tools supplied with it comply with the relevant legislation, regulations and standards, particularly health and safety requirements, applicable at the time of delivery.

If used as intended and in compliance with the specified requirements and conditions in this technical file as well as the warning notices in this technical file and attached to the product, then the product does not present any hazards to people, property or the environment. This applies throughout the product's full life, from delivery through installation and operation to disassembly and disposal.

The operational quality assurance system ensures a consistently high quality standard, particularly in regard to the observance of health and safety requirements.

Use is considered to be appropriate if

- the product is operated in accordance with this technical file and the agreed delivery conditions and technical data, and
- the associated equipment and special tools supplied with it are used solely for the intended purpose and in accordance with the specifications of this technical file.
- the product is used only with the transformer specified in the order.

2.3 Inappropriate use

Use is considered to be inappropriate if the product is used other than as described in Appropriate use.

Maschinenfabrik Reinhausen does not accept liability for damage resulting from unauthorized or inappropriate changes to the product. Inappropriate changes to the product without consultation with Maschinenfabrik Reinhausen can lead to personal injury, damage to property and operational disruption.

2.4 Personnel qualification

The product is designed solely for use in electrical energy systems and facilities operated by appropriately trained staff. This staff comprises people who are familiar with the installation, assembly, commissioning and operation of such products.

2.5 Operator duty of care

To prevent accidents, disruptions and damages as well as unacceptable adverse effects on the environment, those responsible for transport, installation, operation, maintenance and disposal of the product or parts of the product must ensure the following:

- All warning and hazard notices are complied with.
- Personnel are instructed regularly in all relevant aspects of operational safety, the operating instructions and particularly the safety instructions contained therein.
- Regulations and operating instructions for safe working as well as the relevant instructions for staff procedures in the case of accidents and fires are kept on hand at all times and are displayed in the workplace where applicable.
- The product is only used when in a sound operational condition and safety equipment in particular is checked regularly for operational reliability.
- Only replacement parts, lubricants and auxiliary materials which are authorized by the manufacturer are used.
- The specified operating conditions and requirements of the installation location are complied with.
- All necessary devices and personal protective equipment for each activity are made available.
- The prescribed maintenance intervals and the relevant regulations are complied with.

- Fitting, electrical connection and commissioning of the product may only be carried out by qualified and trained personnel in accordance with this technical file.
- The operator must ensure appropriate use of the product.

3 Product description

The signal transfer device for remotely displaying positions transfers digital signals generated in the motor-drive unit over large distances (up to max. 50 km). The digital signals can be prepared and displayed anywhere, usually in the control room.

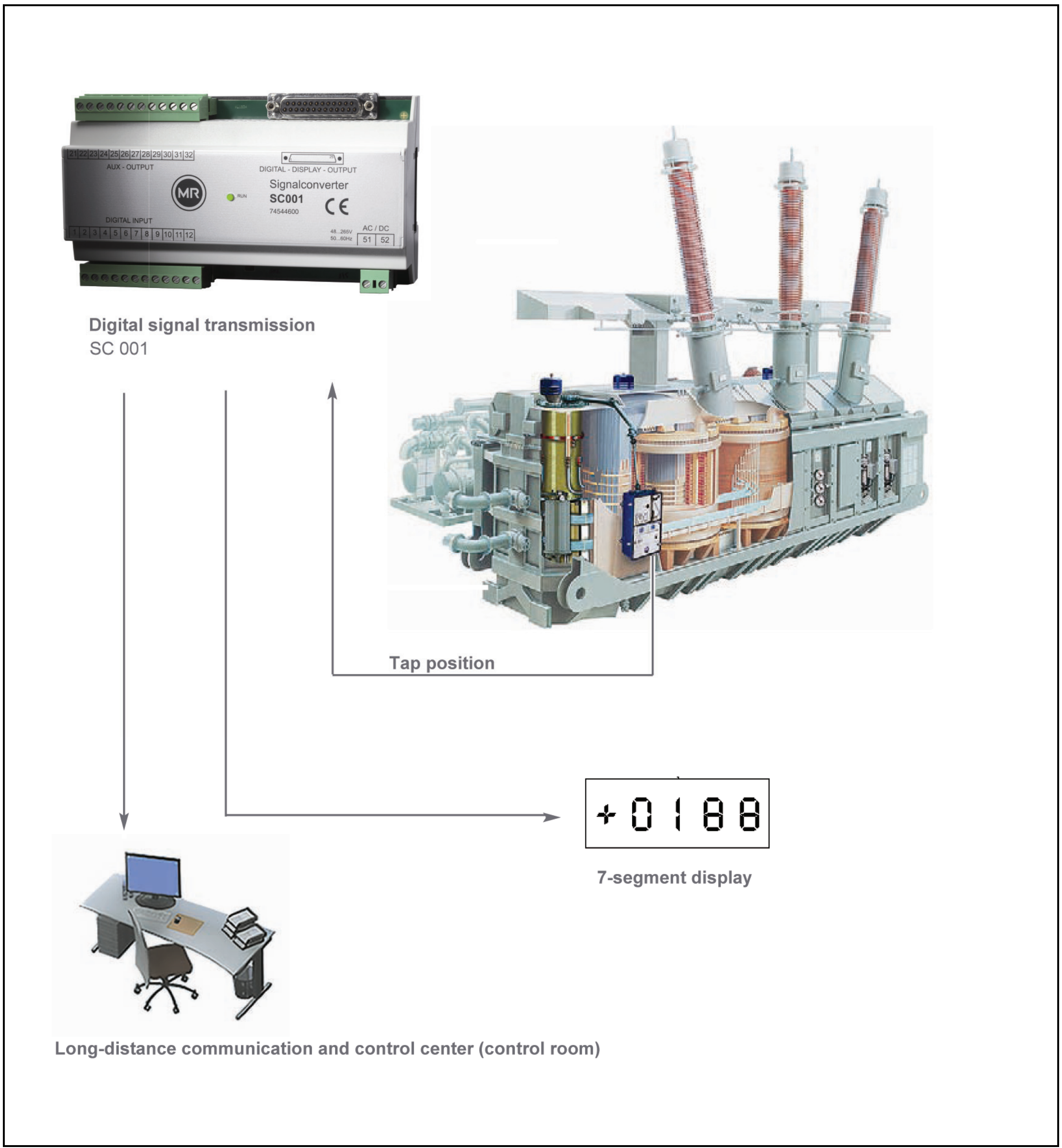


Figure 1 Overview of digital signal transmission

3.1 Function description

The signal transmitter in the control room produces a stabilized voltage (terminal 1) on the position transmitter equipment fitted in the motor-drive unit.

Motor-drive unit:

The stabilized voltage (24 V DC) created on the position transmitter module (diode matrix) is transferred to the position transmitter board's slider via the position transmitter cable. For every motor-drive unit position, there is a button on the position transmitter board, which is approached by the slider. The buttons are connected with the position transmitter module via the position transmitter cable. In the position transmitter module, the buttons' signals are digitally coded using diode gates, to suit the tap changer's position designation and the desired code (BCD, dual, gray), and transferred to the outputs.

Control room:

The output signals of the position transmitter module are connected to the signal transmitter installed in the control room (terminals 2...12). These signals activate relays. There are 2 relays for each bit: one to activate the display (5 V DC, TTL level) and one for potential-free signal provision. The signals with their various codes are connected to the display using a serial cable (max. 20 m). In the display, the signal is converted into 7-segment code and displayed digitally. The original signal is also available, potential-free, on the signal transmitter. If further contacts are required, they can be provided using additional interposing relays.

3.2 Performance features

The product is particularly characterized by the following properties:

- High quality material
- Digital tap position capture via BCD code, gray code and dual code
- Global use possible thanks to wide-range power supply unit

3.3 Scope of delivery

The product is packaged with protection against moisture and is delivered as follows:

- Digital signal transfer device SC001

Please note the following:

1. Use dispatch documents to check that the delivery is complete.
2. Store the parts in a dry place until installation.
3. The product must remain in its airtight, protective wrapping and may only be removed immediately before installation.

The functional range of the product is dependent on the equipment ordered or the product version and not the content of this technical file.

3.4 Setup/models

Position transmitter equipment with a diode matrix is needed in the motor-drive unit. The diode matrix must be designed for the desired code and position designation of the motor-drive unit. The diode matrix in the motor-drive unit is connected to the signal transmitter in the control room via one line for the slider signal and one line for each bit of the digital signal.

A signal transmitter is needed in the control room. Due to its large voltage range, this is independent of voltage and given its modular structure, it is independent of code too. The signal transmitter generally features potential-free contacts at which the signal is also available decoupled. A display unit is also needed to display the operating position. The display contains 2.5 digits plus the sign (+/-) and is not dependent on the position number, just the code required.

3.5 AUX DIGITAL OUTPUT connection assignment

	BCD	GRAY	DUAL
32 <-	-	-	-
31 <-	+	+	+
30 <-	100	G100	
29 <-	80	Y10	
28 <-	40	A10	64
27 <-	20	R10	32
26 <-	10	G10	16
25 <-	8	Y1	8
24 <-	4	A1	4
23 <-	2	R1	2
22 <-	1	G1	1
21 ->	V		

Table 4 AUX DIGITAL OUTPUT connection assignment

4 Packaging, Transport and Storage

4.1 Packaging

4.1.1 Purpose

The packaging is designed to protect the packaged goods both during transport and for loading and unloading as well as during periods of storage in such a way that no (detrimental) changes occur. The packaging must protect the goods against permitted transport stresses such as vibration, knocks and moisture (rain, snow, condensation).

The packaging also prevents undesired position changes of the packaged goods within the packaging during storage. The packaged goods must be prepared for shipment before actually being packed so that the goods can be transported safely, economically and in accordance with regulations.

4.1.2 Suitability, structure and production

The goods are packaged in a sturdy cardboard box. This ensures that the shipment remains in the intended transport position and that none of its components touches the load surface during transport or the floor after it is unloaded.

The box is designed for a maximum load of 10 kg.

Inlays inside the box stabilize the goods, preventing impermissible changes of position, and protect them from vibration.

4.1.3 Markings

The packaging bears a signature with symbols with instructions for safe transport and correct storage. The following symbols apply to the dispatch (of non-hazardous goods). Adherence to these symbols is mandatory.

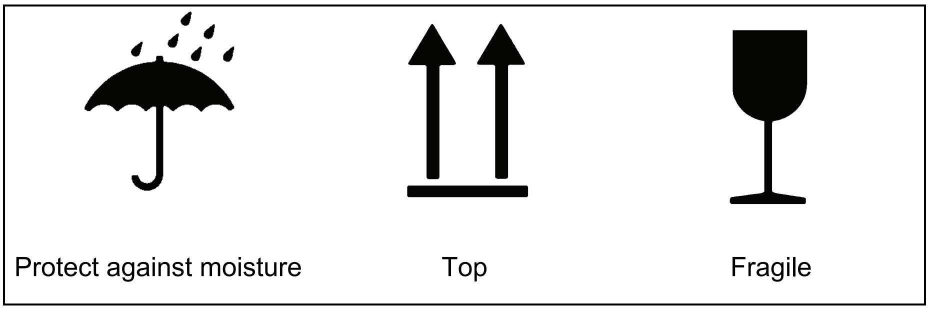


Figure 2 Shipping pictograms

4.2 Transportation, receipt and handling of shipments

In addition to oscillation and shock stress, jolts must also be expected during transportation. In order to prevent possible damage, avoid dropping, tipping, knocking over and colliding with the product.

If a crate falls from a particular height (e.g. when slings tear) or experiences an unbroken fall, damage must be expected regardless of the weight.

Before acceptance, all deliveries must be checked by the recipient (acknowledgement of receipt) for the following:

- Completeness based on the delivery slip
- External damage of any type.

The checks must take place after unloading when the crate can be accessed from all sides.

If external transport damage is detected on receipt of the shipment, proceed as follows:

- Immediately record the transport damage found in the shipping documents and have this countersigned by the carrier.
- In the event of severe damage, total loss or high damage costs, immediately notify the sales department at Maschinenfabrik Reinhausen and the relevant insurance company.
- After identifying the damage do not modify the condition of the shipment further and also retain the packaging material, until an inspection decision has been made by the transport company or the insurance company.
- Record the details of the damage immediately together with the carrier involved. This is essential for any claim for damages!
- If possible, photograph damage to packaging and packaged goods. This also applies to signs of corrosion on the packaged goods due to moisture inside the packaging (rain, snow, condensation).
- Name the damaged parts.

When damages are hidden, i.e. damages which are not determined until unpacking after the receipt of the shipment, proceed as follows:

- Make the party responsible for the damage liable as soon as possible by telephone and in writing, and prepare a damage report.
- Observe, in this regard, the time periods applicable to such actions in the respective country. Inquire about these in good time.

With hidden damage, it is very hard to make the transportation company (or other responsible party) liable. Any insurance claims for such damages can only be successful if relevant provisions are expressly included in the insurance terms and conditions.

4.3 Storage of shipments

Selection and arrangement of the storage location should meet the following requirements:

- Stored goods are protected against moisture (flooding, water from melting snow and ice), dirt, pests such as rats, mice, termites and so on, and against unauthorized access.
- Store the box on timber beams and planks as a protection against rising damp and for better ventilation.
- Carrying capacity of the ground under the goods is sufficient.
- Entrance and exit paths are kept free.

Check stored goods at regular intervals. Also take appropriate action after storms, heavy rain or snow and so on.

5 Commissioning

5.1 Electromagnetic compatibility

The product was developed in compliance with the relevant EMC standards. To ensure compliance with the EMC standards, please note the following points.

5.1.1 Wiring requirement of installation site

Note the following when selecting the installation site:

- The system's overvoltage protection must be effective.
- The system's ground connection must comply with all technical regulations.
- Separate system parts must be joined by a potential equalization.
- The device and its wiring must be at least 10 m away from circuit-breakers, load disconnectors and busbars.

5.1.2 Wiring requirement of operating site

Note the following when wiring the operating site:

- The connection cables must be laid in metallic cable ducts with a ground connection.
- Do not route lines which cause interference (e.g. power lines) and lines susceptible to interference (e.g. signal lines) in the same cable duct.
- Maintain a gap of at least 10 cm between lines causing interference and those susceptible to interference.
- Reserve lines must be grounded at both ends.
- The device must never be connected using multi-pin collective cables.

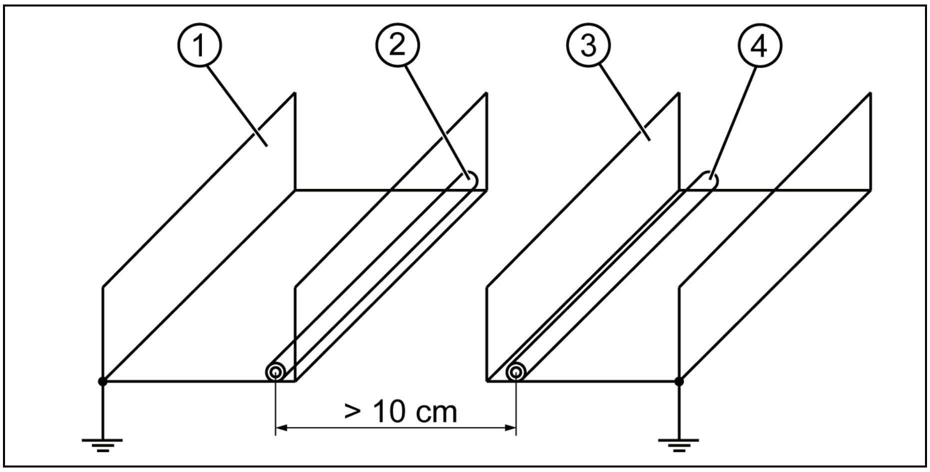


Figure 3 Recommended wiring

1	Cable duct for lines causing interference
2	Interference-causing line (e.g. power line)
3	Cable duct for lines susceptible to interference
4	Line susceptible to interference (e.g. signal line)

- Signal lines must be routed in shielded cables.
- The individual conductors (outgoing/return conductors) in the cable core must be twisted in pairs.
- The shield must be fully (360º) connected to the device or a nearby ground rail.

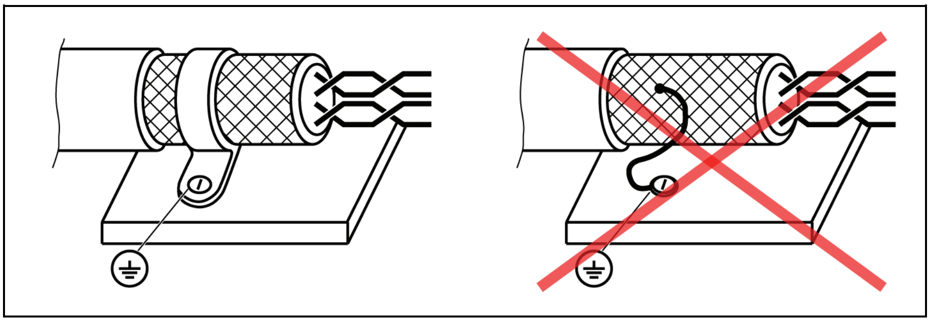


Figure 4 Recommended shielding connection, do not extend the shield to the grounding point with a wire (pigtail).

NOTE
Reduced effectiveness of the shielding. **Using "pigtails" may considerably reduce the effectiveness of the shielding.** ► Connect shield to cover all areas.

5.1.3 Wiring requirement in control cabinet

Note the following when wiring the control cabinet:

- The control cabinet for fitting the device must be prepared in accordance with EMC requirements:
  - functional division of control cabinet (physical separation)
  - constant potential equalization (all metal parts are joined)
  - line routing in accordance with EMC requirements (separation of lines which cause interference and those susceptible to interference)
  - optimum shielding (metal housing)
  - overvoltage protection (lightning protection)
  - collective grounding (main grounding rail)
  - cable bushings in accordance with EMC requirements
  - any contactor coils present must be interconnected
- The device's connection cables must be laid in contact with the grounded metal housing or in metallic cable ducts with a ground connection.
- Signal and power/switching lines should be laid in separate cable ducts.

5.2 Connecting digital signal transfer device

Connect the lines to be wired to the device to the system periphery as shown in the connection diagrams supplied.

NOTICE

Damage to digital signal transfer device and system periphery

An incorrectly connected digital signal transfer device may result in damage to the device itself and the system periphery.

► Prior to commissioning, be sure to check the entire configuration and the measuring and operating voltage.

To obtain a better overview when connecting cables, only use as many leads as necessary.

Use only the specified cables for wiring. You can connect all standard cables with a cross-section of up to 2.5 mm².

5.3 Removing digital signal transfer device

Two recesses in the PCB, accessible externally, are used to unlock the device from the cap rail.

► To remove, insert a screwdriver 2 into recess 1 and move it towards the housing.

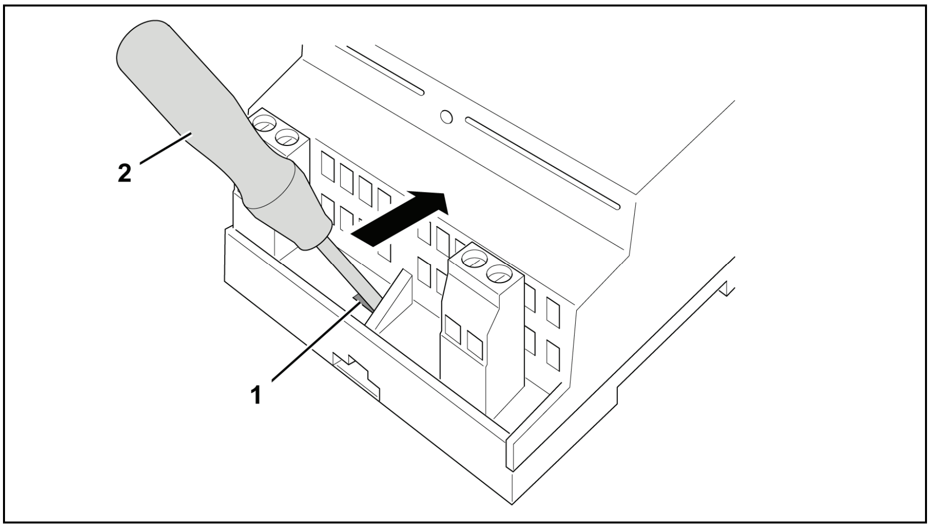


Figure 5 Disassembly

1	Recess
2	Screwdriver

6 Technical Data

6.1 Modular signal transfer unit

6.1.1 Connection

see connection diagram **Digital remote display of positions** on page 29

Power supply	
2 connection terminals 51, 52	in a pluggable design
Input voltage	48...300 V AC, 48...425 V DC (50, 60 Hz)
Actuation: 12 connection terminals, in a pluggable design	
Terminal 1	24 V DC stabilized
Terminals 2...10	Relay actuation (1...199 independent of code)
Terminal 11, 12	Relay actuation (+/- sign)
Potential-free contacts: 12 connection terminals, in a pluggable design	
Terminal 21	Input voltage
Terminals 22...30	Output (1...199 independent of code)
Terminal 31, 32	Output (+/- sign)
Display unit	
25-pole socket terminal strip (in accordance with RS-232)	5 V DC stabilized (TTL level)

Table 5 Actuation

6.1.2 Relay equipment

24 network relays, 1 per changeover contact	
Operating voltage	24 V DC
Contact material	AgSnO2
Nominal rating	170 mW
Response value	75 mW
Operating range/response class	DIN/IEC/VDE-2b
Response time/release time	5 ms/6 ms
AC/DC switching capacity	1500 VA/load limit curve

Table 6 Relay equipment

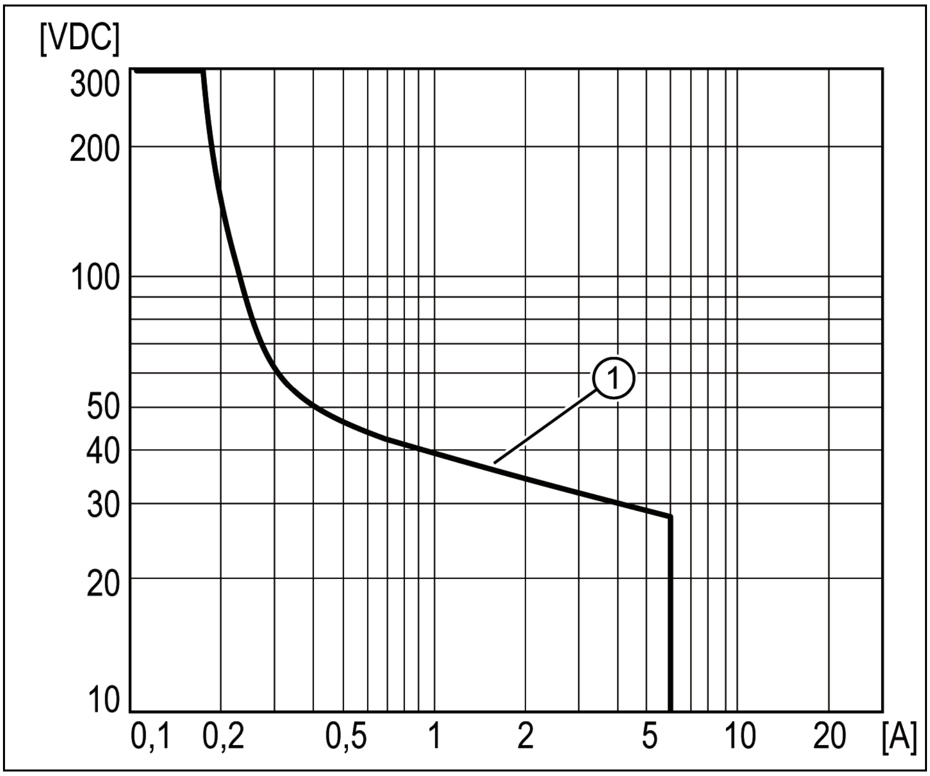


Figure 6 Maximum contact loadability of outputs with direct current

1	Ohmic load

Definition of load limit curve:	
During 1000 cycles, there must not be any arcs lasting > 10 ms.	
Operating temperature:	-25 °C to +80 °C
Transmission distance:	max. 50 km (motor-drive unit to signal transmitter)

Table 7 Load limit curve, operating temperature, transmission distance

6.2 Modular display unit

see also **7-segment display for remote display of positions - dimensional drawing (898700)** on page 32

Modular display unit	
Control panel section:	22.5 mm x 67.5 mm
Design:	2.5 digits with sign (+/- 199) Height of digits 14 mm
Supply voltage:	DC 5V
Connection:	25-pole connector strip (in accordance with RS-232)
Actuation:	BCD code, dual code, gray code (TTL level DC 5V) Other codes on request.
Operating temperature:	-25°C to +80°C
Transmission distance:	max. 20 m (from signal transmitter to display)

Table 8 Modular display unit

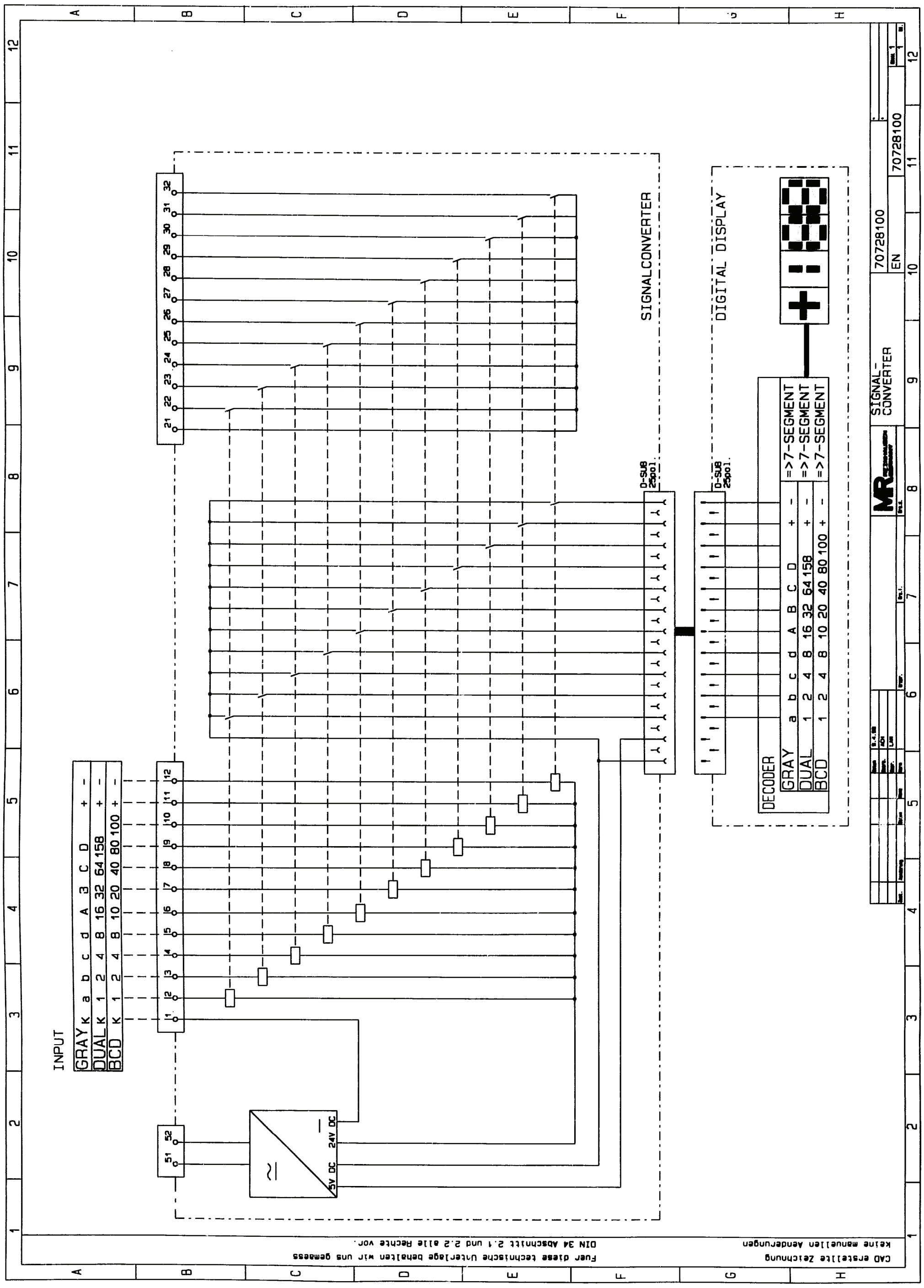
6.3 Connection cable to display

Connection cable to display	
Model:	25-pole, male/female
Standard length:	1.8 m (3 m, 10 m can be supplied as options)
Operating temperature:	-25°C to +80°C

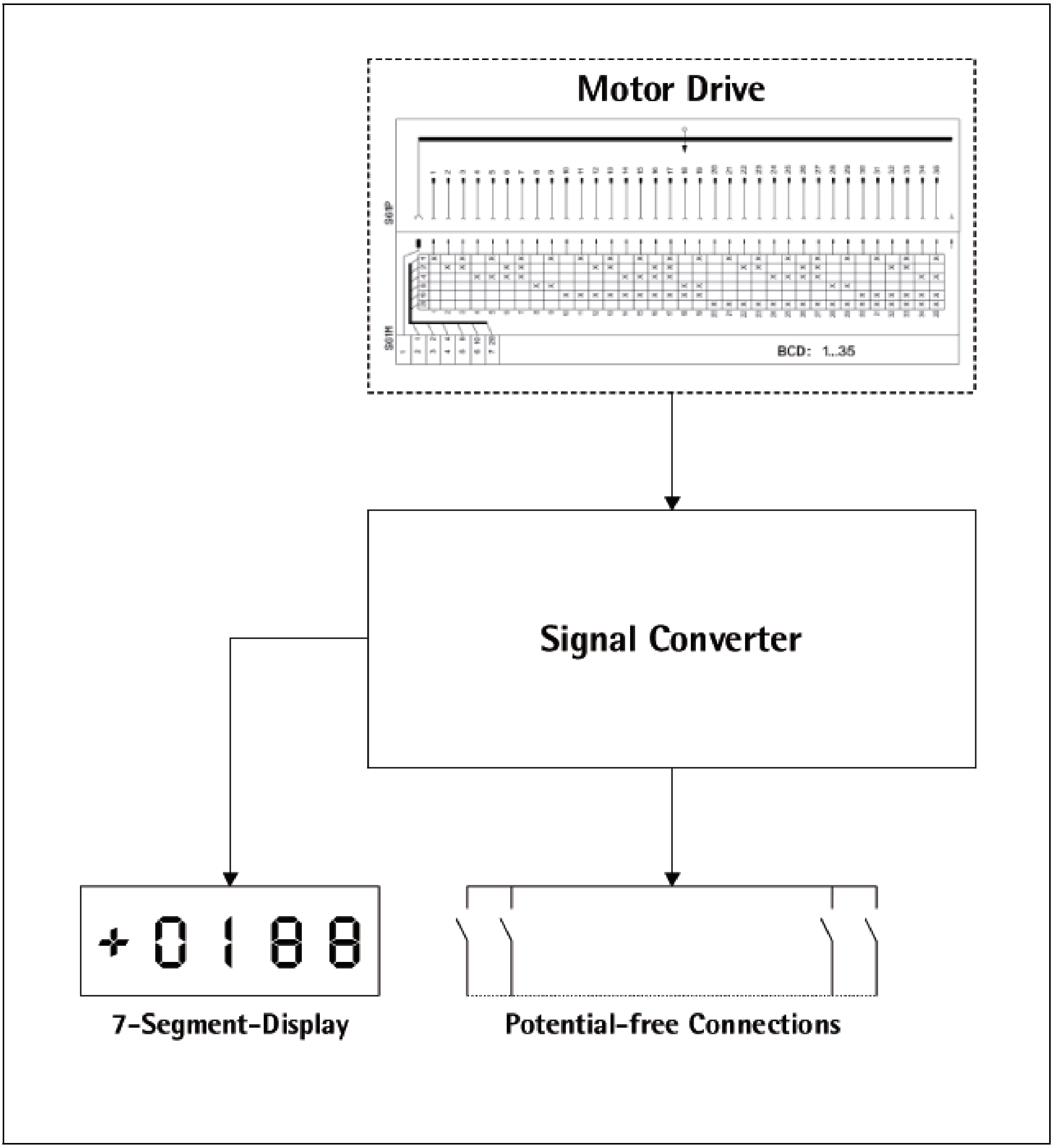
Table 9 Connection cable to display

7 Appendix

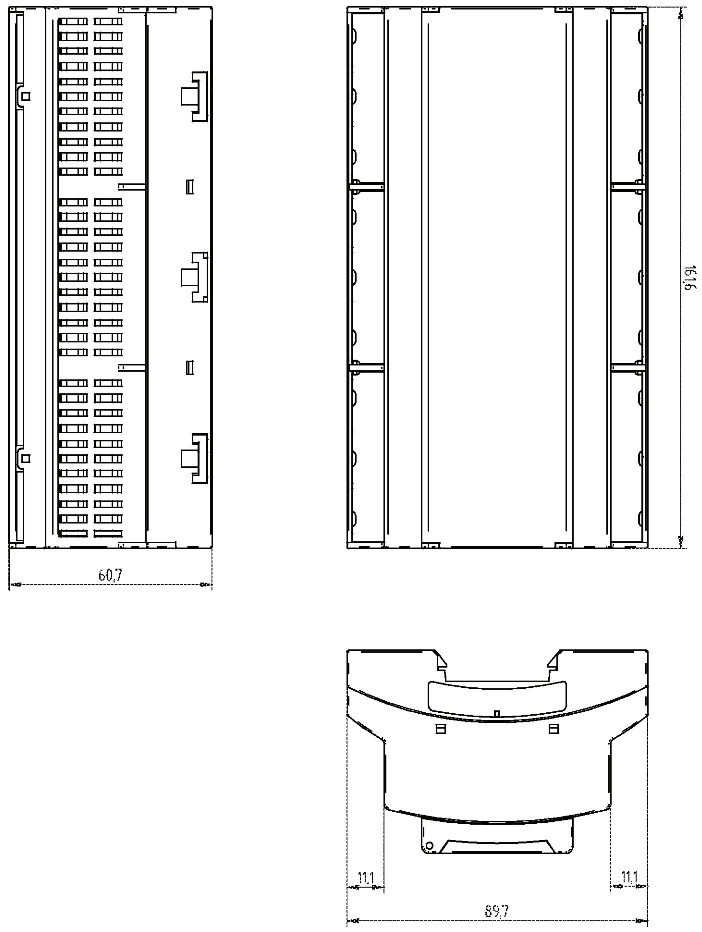
7.1 Digital remote display of positions (707281)



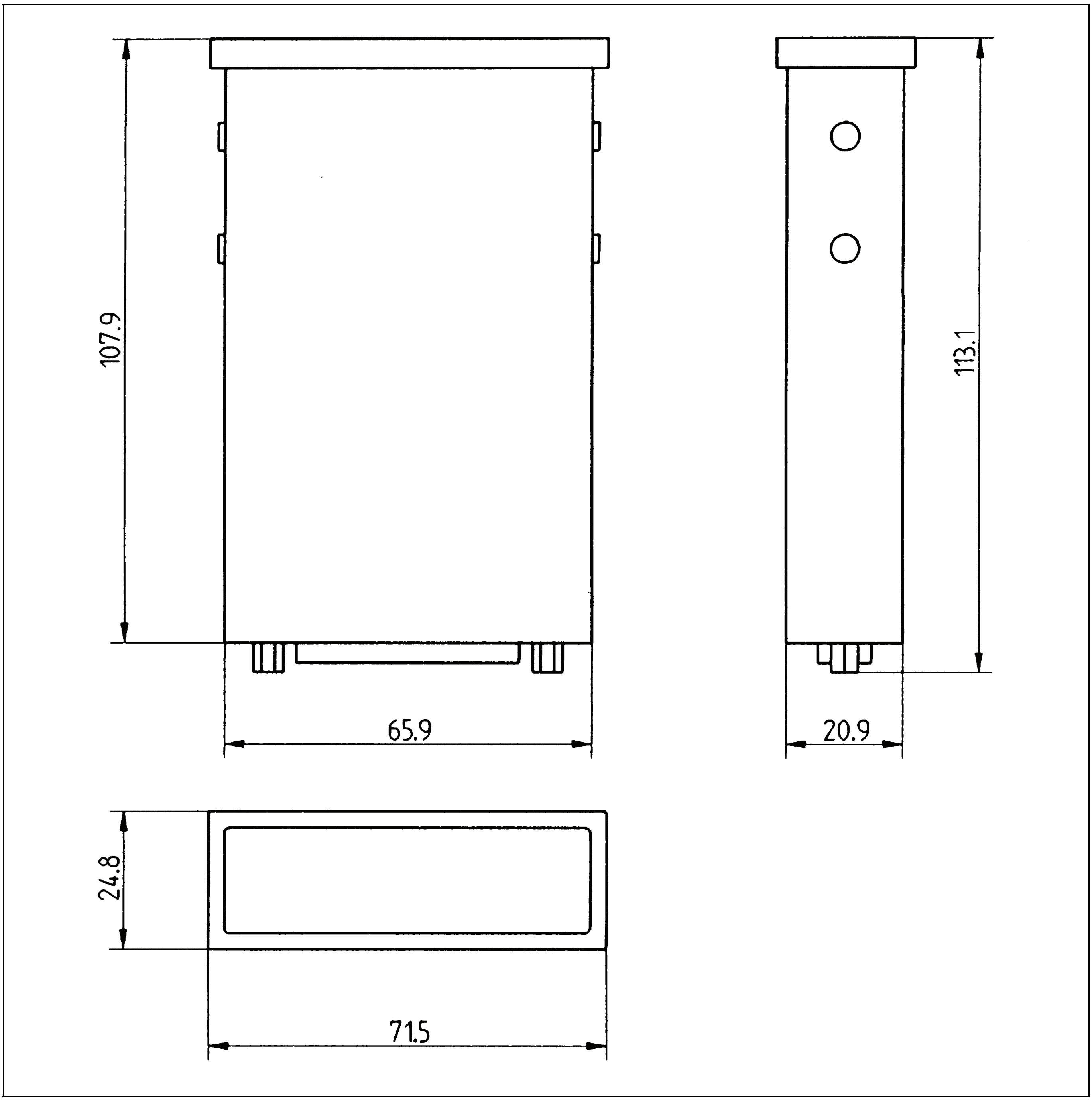
7.2 Block diagram for tap position indicator



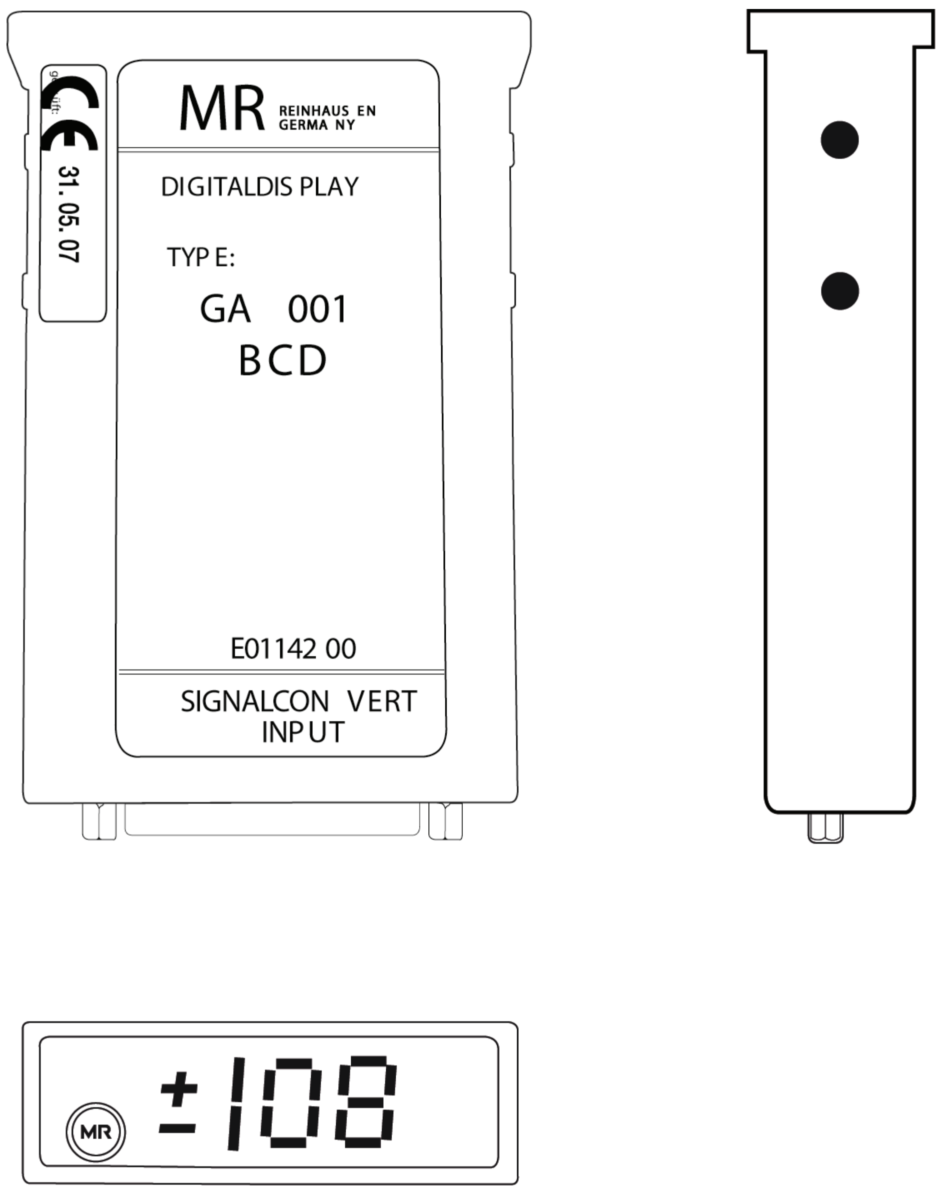
7.3 Dimensional drawing for housing



7.4 7-segment display for remote display of positions - dimensional drawing (898700)



7.5 7-segment display for remote display of positions - detailed drawings



8 MR worldwide

Australia
Reinhausen Australia Pty. Ltd.
Ground Floor
6-10 Geeves Avenue
Rockdale N. S. W. 2216
Phone: +61 2 9556 2133
Fax: +61 2 9597 1339
E-Mail: sales@au.reinhausen.com

Brazil
MR do Brasil Indústria Mecánica Ltda.
Av. Elias Yazbek, 465
CEP: 06803-000
Embu - São Paulo
Phone: +55 11 4785 2150
Fax: +55 11 4785 2185
E-Mail: vendas@reinhausen.com.br

Canada
Reinhausen Canada Inc.
3755, rue Java, Suite 180
Brossard, Québec J4Y 0E4, Canada
Phone: +1 514 370 5377
Fax: +1 450 659 3092
E-Mail: m.foata@ca.reinhausen.com

Germany
Maschinenfabrik Reinhausen GmbH
Falkensteinstrasse 8
93059 Regensburg
Phone: +49 941 4090 0
Fax: +49 4090 7001
E-Mail: sales@reinhausen.com

India
Easun-MR Tap Changers Ltd.
612, CTH Road
Tiruninravur, Chennai 602 024
Phone: +91 44 26300883
Fax: +91 44 26390881
E-Mail: easunmr@vsnl.com

Indonesia
Pt. Reinhausen Indonesia
German Center, Suite 6310,
Jl. Kapt. Subijanto Dj.
BSD City, Tangerang
Phone: +62 21 5315-3183
Fax: +62 21 5315-3184
E-Mail: c.haering@id.reinhausen.com

Iran
Iran Transfo After Sales Services Co.
Zanjan, Industrial Township No. 1 (Aliabad)
Corner of Morad Str.
Postal Code 4533144551
E-Mail: itass@iran-transfo.com

Italy
Reinhausen Italia S.r.l.
Via Alserio, 16
20159 Milano
Phone: +39 02 6943471
Fax: +39 02 69434766
E-Mail: sales@it.reinhausen.com

Japan
MR Japan Corporation
German Industry Park
1-18-2 Hakusan, Midori-ku
Yokohama 226-0006
Phone: +81 45 929 5728
Fax: +81 45 929 5741

Luxembourg
Reinhausen Luxembourg S.A.
72, Rue de Prés
L-7333 Steinsel
Phone: +352 27 3347 1
Fax: +352 27 3347 99
E-Mail: sales@lu.reinhausen.com

Malaysia
Reinhausen Asia-Pacific Sdn. Bhd
Level 11 Chulan Tower
No. 3 Jalan Conlay
50450 Kuala Lumpur
Phone: +60 3 2142 6481
Fax: +60 3 2142 6422
E-Mail: mr_rap@my.reinhausen.com

P.R.C. (China)
MR China Ltd. (MRT)
开德贸易（上海）有限公司
中国上海浦东新区浦东南路360号
新上海国际大厦4楼E座
邮编： 200120
电话：＋86 21 61634588
传真：＋86 21 61634582
邮箱：mr-sales@cn.reinhausen.com
mr-service@cn.reinhausen.com

Russian Federation
OOO MR
Naberezhnaya Akademika Tupoleva
15, Bld. 2 ("Tupolev Plaza")
105005 Moscow
Phone: +7 495 980 89 67
Fax: +7 495 980 89 67
E-Mail: mrr@reinhausen.ru

South Africa
Reinhausen South Africa (Pty) Ltd.
No. 15, Third Street, Booysens Reserve
Johannesburg
Phone: +27 11 8352077
Fax: +27 11 8353806
E-Mail: support@za.reinhausen.com

South Korea
Reinhausen Korea Ltd.
Baek Sang Bldg. Room No. 1500
197-28, Kwanhun-Dong, Chongro-Ku
Seoul 110-718, Korea
Phone: +82 2 767 4909
Fax: +82 2 736 0049
E-Mail: you-mi.jang@kr.reinhausen.com

U.S.A.
Reinhausen Manufacturing Inc.
2549 North 9th Avenue
Humboldt, TN 38343
Phone: +1 731 784 7681
Fax: +1 731 784 7682
E-Mail: sales@reinhausen.com

153/03 EN ▪ 02/12 ▪ F0049302

Maschinenfabrik Reinhausen GmbH
Falkensteinstrasse 8
93059 Regensburg, Germany

+49 941 4090 0
+49 941 4090 7001
sales@reinhausen.com

www.reinhausen.com

MESSKO® MPreC®

DRUCKENTLASTUNGSVENTIL
PRESSURE RELIEF DEVICE
DISPOSITIF DE SURPRESSION
VÁLVULA DE SOBREPRESIÓN MECÁNICA

Betriebsanleitung/Operating Instructions/Instructions d’opération/Instrucciones de Operación

BA2066/05/07 DE-EN-FR-ES . MESSKO INSTRUMENTS

Inhaltsverzeichnis/Table of contents/Table des matières/Tabla de Contenido

HINWEIS

Die in dieser Betriebsanleitung enthaltenen Angaben können von dem gelieferten Gerät abweichen.

Änderungen bleiben vorbehalten.

CE

Für zukünftige Verwendung aufbewahren!

1 Sicherheit

1.1 Sicherheitshinweise

Alle Personen, die mit der Montage und Inbetriebnahme des Geräts zu tun haben, müssen
- fachlich ausreichend qualifiziert sein und
- diese Betriebsanleitung genau beachten.

Bei Fehlbedienung oder Missbrauch drohen Gefahren für
- Leib und Leben,
- das Gerät und andere Sachwerte des Betreibers und
- die effiziente Funktionsweise des Gerätes

In dieser Betriebsanleitung werden drei Arten von Sicherheitshinweisen verwendet, um wichtige Informationen hervorzuheben.

WARNUNG

weist auf besondere Gefahren für Leib und Leben hin. Ein Nichtbeachten dieser Hinweise kann zu schwersten Verletzungen oder Tod führen.

ACHTUNG

weist auf Gefahren für das Gerät oder andere Sachwerte des Betreibers hin. Ferner können Gefahren für Leib und Leben nicht ausgeschlossen werden.

HINWEIS

weist auf wichtige Informationen zu einer konkreten Thematik hin.

1.2 Bestimmungsgemäße Verwendung

Das Druckentlastungsventil schützt Transformatoren vor unzulässigen Druckerhöhungen. Bei einem vorbestimmten Druck öffnet das Druckentlastungsventil, baut den Druck ab und schließt nach dem Druckabbau wieder dicht ab.

Vor Inbetriebnahme des Geräts sind die auf dem Typenschild und in der Betriebsanleitung angegebenen Grenzwerte in der Anwendung zu beachten und unbedingt einzuhalten.

1.3 Hinweise für den Betrieb des Geräts

Die nationalen Unfallverhütungsvorschriften hat der Anwender unbedingt einzuhalten.

Es wird besonders darauf hingewiesen, dass das Arbeiten an aktiven, d.h. berührungsgefährlichen Teilen nur zulässig ist, wenn diese Teile spannungsfrei sind oder gegen direktes Berühren geschützt sind.

Bei der elektrischen Installation sind die nationalen Vorschriften zu beachten. Um einen störungsfreien Betrieb zu gewährleisten, ist der Schutzleiter unbedingt anzuschließen.

ACHTUNG

Einbau, elektrischer Anschluss, Inbetriebnahme und Wartung des Geräts dürfen ausschließlich von qualifiziertem, ausgebildetem Personal gemäß dieser Betriebsanleitung durchgeführt werden.

Der Betreiber hat für die bestimmungsgemäße Verwendung des Geräts Sorge zu tragen.

Eigenmächtig und unsachgemäß durchgeführte Arbeiten bei Ein- und Umbau, elektrischem Anschluss, Inbetriebnahme und Wartung - ohne Rücksprache mit Messko - sind aus Sicherheitsgründen verboten!

WARNUNG

Beachten sie unbedingt die nationalen Brandschutzvorschriften.

ACHTUNG

Trocknen sie das Druckentlastungsventil nicht mit dem Aktivteil des Transformators.

2 Produktbeschreibung

2.1 Ausführung mit Standardhaube

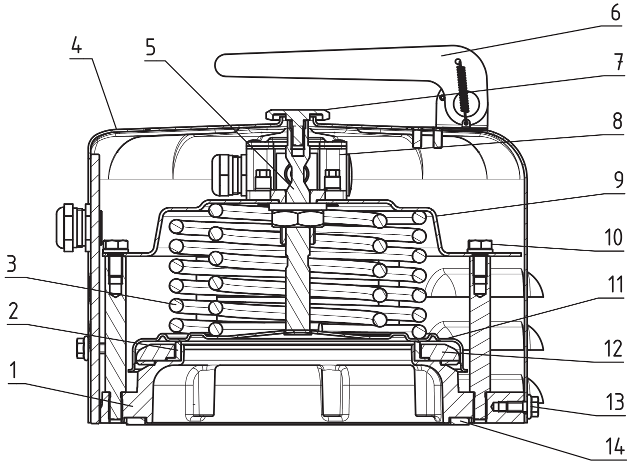


Bild 1

Das Druckentlastungsventil ist in verschiedenen Ausführungen erhältlich. Der Aufbau und die Funktionsweise sind jedoch immer gleich.
Der Gehäuseflansch (Bild 1/1) des Druckentlastungsventils wird auf dem Transformatorkessel bzw. auf dem Stufenschalter montiert. An dem Gehäuseflansch sind eine Dichtung (Bild 1/2) und eine Dichtlippe (Bild 1/12) angebracht. Der Ventilteller (Bild 1/11) wird durch ein Federpaket (Bild 1/3) auf die Dichtung gedrückt. Das Federpaket wird durch ein Widerlager (Bild 1/9), das mit 6 Schrauben (Bild 1/10) an dem Flansch angeschraubt ist, niedergehalten.

WARNUNG

Das Widerlager spannt das Federpaket vor und ist mit 6 Schrauben (Bild 1/10) gesichert. Diese Schrauben dürfen unter keinen Umständen gelöst werden!!!

Ansonsten besteht Verletzungsgefahr!!!

Das Gerät ist mit verschiedenen Ansprechdrücken erhältlich. Überschreitet der Druck unter dem Ventilteller den Ansprechdruck des Federpakets, so springt der Ventilteller auf, wodurch sich der Druck abrupt normalisiert. Danach verschließt das Federpaket den Ventilteller wieder dicht.
Beim Auslösen des Ventils wird ein farbiger Signalstift (Bild 1/5) (rot bei Mineralöl, blau bei Silikonöl) aus dem Gehäuse gedrückt. Dieser rastet beim Herausspringen ein und signalisiert, dass das Ventil ausgelöst hat (Bild 3). Zusätzlich kann eine Semaphore (Bild 1/6) angebracht sein, die beim Auslösen hochklappt und das Signal verdeutlicht.
Desweiteren können die Geräte optional mit 1 oder 2 Mikroschaltern (Bild 1/8) ausgestattet sein, die beim Auslösen des Ventils zwangsweise durch den Signalstift geschaltet werden. Die verschiedenen Anschlussarten der Mikroschalter sind in Kapitel 4 beschrieben.

Typ	Ansprechdruck		
	[psi]	[bar]	[kPa]
LMPRD 4 psi	4 ± 1	0,28	28
LMPRD 6 psi	6 ± 1	0,41	41
LMPRD 8 psi	8 ± 1	0,55	55
LMPRD 10 psi	10 ± 1	0,69	69
LMPRD 12 psi	12 ± 1	0,83	83
LMPRD 15 psi	15 ± 2	1,03	103
LMPRD 20 psi	20 ± 2	1,38	138
LMPRD 25 psi	25 ± 2	1,72	172
LMPRD 30 psi	30 ± 2	2,07	207

Tabelle 1

2.2 Ausführung mit Vollgusshaube (OD)

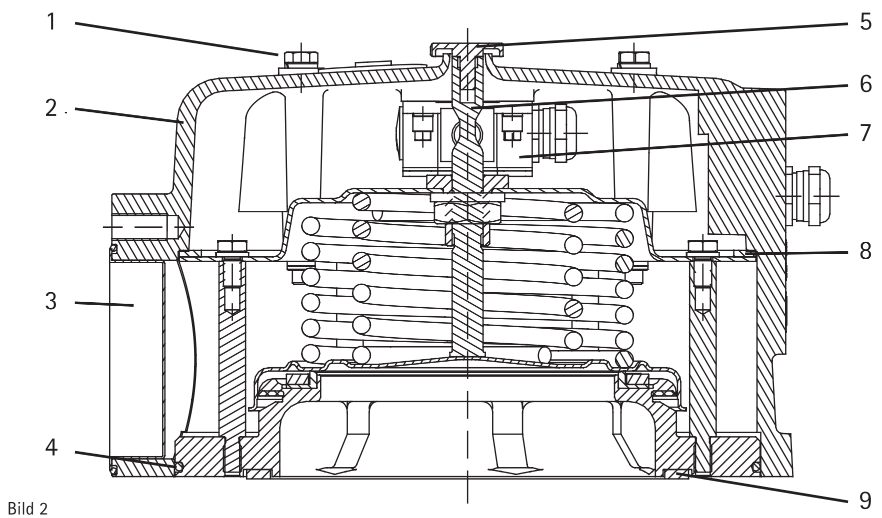


Bild 2

Die Ausführung des MPreC®-Druckentlastungsventils mit der Vollgusshaube für gerichteten Ölfluss ist ähnlich dem Aufbau eines MPreC®-Druckentlastungsventils mit Standardhaube.

Das Druckentlastungsventil wird ohne Haube (Bild 2/2) am Gegenflansch des Transformators angeschraubt, dann die Haube aufgesetzt und am Ventil fixiert. Die Haube hat eine Austrittsöffnung (Bild 2/3) zur Ableitung des Öls im Auslösefall und ist ansonsten zum Ventil hin mit einer Dichtung (Bild 2/4) abgedichtet. An die Austrittsöffnung kann ein Rohr angeflanscht werden, um das austretende Öl gezielt ableiten zu können. Die Mikroschalter (Bild 2/7) sind vom Funktionsteil des Ventils mit einer Dichtung (Bild 2/8) gekapselt und somit vor Umwelteinflüssen und austretendem Öl geschützt.

3 Montage

3.1 Montage für Ausführung mit Standardhaube

> ⚠ **ACHTUNG**
>
> Die in dieser Montage- und Betriebsanleitung vorgeschriebenen Betriebs- und Montagebedingungen müssen strikt eingehalten werden.

Das Druckentlastungsventil kann horizontal und vertikal montiert werden. Beim vertikalen Einbau ist darauf zu achten, dass das Stehblech (Bild 3/2) keinesfalls nach oben oder unten

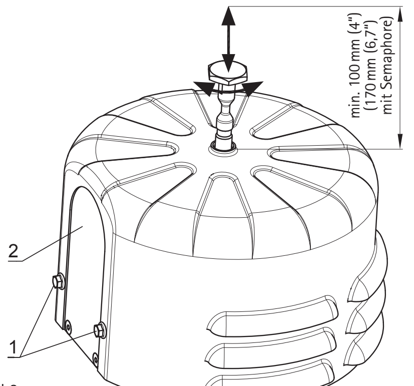


Bild 3

zeigen darf. Dieses muss beim Einbau nach rechts oder links zeigen. Über dem Ventil muss ausreichend Platz (min. 100 mm, mit Semaphore min. 170 mm, Bild 3) vorhanden sein, so dass der Signalstift voll aus dem Gehäuse gedrückt und die Semaphore (falls vorhanden) vollständig umklappen kann (Stellung „Alarm“).

3.1.1 Öffnen des Geräts

Zur Montage des Druckentlastungsventils muss zunächst die Abdeckhaube (Bild 1/4) abgenommen werden. Hierzu den Signalstift (Bild 1/5) herausziehen und die Kappe (Bild 1/7) des Signalstiftes mit 2 Gabelschlüsseln SW12 und SW32 (alternativ Zangen) abschrauben. Danach die 2 Schrauben SW10 (Bild 3/1) am Stehblech und die Schraube SW10 auf der gegenüberliegenden Seite (Bild 1/13) abschrauben. Abschließend die Haube abziehen.

3.1.2 Montage des Geräts

Die Montage erfolgt über die Bohrungen am Gehäuseflansch mittels M12- bzw. 1/2"-Schrauben. Die Abmessungen sind im Anhang angegeben. Bei der Montage muss eine Montagedichtung (Bild 1/14)/(Bild 9) (wird optional mitgeliefert) unter dem Gerät eingebaut werden.

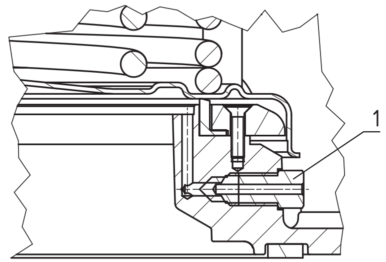


Bild 4

3.1.3 Entlüftungsschraube

Bei vertikalem Einbau sammelt sich unter dem Ventilteller kein Gas! Eine Entlüftung ist daher nicht notwendig.

Bei horizontalem Einbau kann das Druckentlastungsventil nach dem Einfüllen des Transformatorenöles entlüftet werden. Hierzu die Entlüftungsschraube (Bild 4/1) mit einem Schraubenschlüssel SW10 oder einem Schraubendreher öffnen. Sobald Öl austritt die Schraube fest verschließen.

ACHTUNG

Die Entlüftung eines Druckentlastungsventils an einem Stufenschalter ist nur zulässig, wenn der Hersteller des Stufenschalters zustimmt.

3.1.4 Schließen des Geräts

Nach der Montage muss das Gerät wieder verschlossen werden. Hierzu die Abdeckhaube so auf das Druckentlastungsventil aufsetzen, dass die Bohrungen für die Befestigungsschrauben in der Abdeckhaube auf die zugehörigen Gewindelöcher im MESSKO® MPreC® ausgerichtet sind.

Zum Fixieren der Abdeckhaube die 2 Schrauben (Bild 3/1) SW10 am Stehblech und die Schraube (Bild 1/13) SW10 auf der gegenüberliegenden Seite wieder anschrauben (M_A=5 Nm).

Abschließend die Kappe SW32 wieder auf den Signalstift SW12 aufschrauben (M_A=8 Nm) und diesen bis zum Anschlag in das Gerät drücken.

ACHTUNG

Der Signalstift muss abschließend wieder in das Gerät gedrückt werden. Falls eine Semaphore vorhanden ist, muss diese umgeklappt werden, so dass die Spitze auf dem Signalstift steht. Ansonsten ist eine Auslösung des Druckentlastungsventils (visuell und elektrisch) gekennzeichnet.

3.2 Montage der Ausführung mit Vollgusshaube (OD)

Das Druckentlastungsventil wird auf einen Gegenflansch am Transformator o. ä. montiert.

Zur Montage muss zunächst die Vollgusshaube (Bild 2/2) abgenommen werden. Hierzu den Signalstift (Bild 2/6) herausziehen und die Kappe (Bild 2/5) des Signalstiftes mit 2 Gabelschlüsseln SW12 und SW32 (alternativ Zangen) abschrauben. Danach die 4 Schrauben SW13 (Bild 2/1) auf der Haube abschrauben und die Haube abheben.

Bei der Montage zuerst den Gehäuseflansch mit dem Federpaket über die 6 Bohrungen festschrauben. Unter dem Gerät muss eine Montagedichtung (wird optional mitgeliefert) eingebaut werden (Bild 2/9).

ACHTUNG

Das Ventil kann nur bei demontierter Haube entlüftet werden. Hierzu entsprechend Kap 3.1.3 vorgehen.

Danach die Haube auf das Federpaket aufsetzen. Die Haube in die richtige Position drehen und die 4 Schrauben (Bild 2/1) mehrfach über Kreuz leicht anziehen, um ein Verkanten der Haube beim Absenken zu vermeiden. Nach dem Absenken die 4 Schrauben in gleicher Weise bis auf ein Drehmoment von 23 Nm anziehen, um einen gleichmäßigen Druck auf die innen liegende Flachdichtung (Bild 2/9) sicherzustellen. Abschließend die Signalkappe wieder auf den Signalstift aufschrauben.

ACHTUNG

Der Signalstift muss abschließend wieder in das Gerät gedrückt werden. Falls eine Semaphore vorhanden ist, muss diese umgeklappt werden, so dass die Spitze auf dem Signalstift steht. Ansonsten ist eine Auslösung des Druckentlastungsventils (visuell und elektrisch) gekennzeichnet.

An der Vorderseite des Geräts kann ein Abflussrohr o. ä. angeflanscht werden. Dichtung und Schrauben mit Federscheiben liegen dem Gerät bei. Ein Schweiß- oder Schraubflansch kann optional mitbestellt werden.

ACHTUNG

Als Transportschutz ist die Austrittsöffnung mit einer Kunststoffkappe (Bild 2/3) verschlossen. Diese muss vor der Montage des Ventils abgenommen werden und darf keinesfalls im Betrieb als Verschlusskappe verwendet werden.

4 Elektrischer Anschluss (optional)

Die optional eingebauten Mikroschalter können wie folgt angeschlossen werden:
- Anschluss über Kabelverschraubungen im Gerät
- Anschluss über ANSI- oder Westinghouse-Stecker
- Anschluss über eine Anschluss-Box

Beachten Sie dazu auch die Bilder 6 bis 11.

Jeder Mikroschalter ist als galvanisch getrennter Öffner und Schließer ausgeführt.

> ⚠ **ACHTUNG**
>
> Der elektrische Anschluss darf ausschließlich von qualifiziertem, ausgebildetem Personal, welches in die entsprechenden Sicherheitsvorschriften des jeweiligen Landes unterwiesen wurde, durchgeführt werden.

> ⚠ **WARNUNG**
>
> Elektrische, lebensgefährliche Spannung!
>
> Vor dem Öffnen des Schaltergehäuses bzw. der Anschluss-Box muss die Spannungsversorgung abgeschaltet werden.

4.1 Anschluss über Kabelverschraubungen

Zum Anschließen von Mikroschaltern muss das Gerät geöffnet sein (Kap 3.1.1). Danach die 4 Deckelschrauben des Mikroschaltergehäuses lösen und den Deckel abnehmen. Das Kabel für die Verdrahtung muss entsprechend entmantelt und abisoliert werden. Die Kabelverschraubungen M20x1,5 (für Leitungen Ø 8...15 mm) am Stehblech (Bild 3/2) und am Mikroschaltergehäuse (Bild 6, S. 28) öffnen (SW24) und anschließend das Kabel durch die beiden Kabelverschraubungen stecken.

Die Verdrahtung erfolgt entsprechend dem Anschlussplan an den 4 Klemmschrauben bzw. an einer der beiden Erdungsklemmen (ME) (Bild 6, S. 28). Abschließend die Kabelverschraubungen (M_A=5,0 Nm) verschließen, das Mikroschaltergehäuse verschließen und die Abdeckhaube wieder aufsetzen.

4.2 Anschluss über die Anschluss-Box

Öffnen der Anschluss-Box über die 4 Schrauben. Das Kabel für die Verdrahtung entmanteln und die Litzen ca. 7 mm abisolieren. Die Kabelverschraubung M25x1,5 (für Leitungen Ø 13...20 mm) öffnen (SW32) und das Kabel durchstecken. Die Verdrahtung erfolgt entsprechend dem Anschlussplan (Bild 8, S. 29) an der beschrifteten Klemmleiste. Abschließend die Kabelverschraubung (M_A=6,7 Nm) und die Anschluss-Box wieder verschließen.

4.3 Anschluss mit ANSI-Stecker

Prüfen Sie vor dem Anschluss des Druckentlastungsventils, ob der Stecker (Pinbelegung) auf die Buchse am Stehblech passt. Das Kabel des ANSI-Steckers ist entsprechend der jeweiligen Anwendung zu verlegen. Das Kabel ist zu entmanteln und die einzelnen Litzen abzuisolieren. Die Litzen sind entsprechend Bild 10, S. 30 für 1 oder 2 Mikroschalter anzuschliessen.

Den Stecker auf die Buchse des Druckentlastungsventils aufstecken und im Uhrzeigersinn bis zum Anschlag festdrehen. Es wird empfohlen das Kabel während der Montage festzuhalten.
Es ist unbedingt darauf zu achten, dass das Anschlusskabel nicht verdreht wird.

5 Betrieb und Wartung

5.1 Inbetriebnahme

Das Druckentlastungsventil ist nach der Montage und dem elektrischen Anschluss betriebsbereit.

Zur Überprüfung der Mikroschalter gehen Sie wie folgt vor: Ziehen Sie den Signalstift aus dem Gehäuse in die Stellung „ALARM" (Bild 5), um die Mikroschalter zu betätigen. Anschließend den Signalstift wieder in das Gehäuse, Stellung „BETRIEB", drücken, um die Mikroschalter zurückzuschalten.

Soll eine Leistungsfreischaltung durch das Druckentlastungsventil erfolgen, so muss überprüft werden, ob die Leistungsschalter des zu schützenden Transformators allseitig spannungsfrei schalten, wenn der Signalstift sich in der Stellung „ALARM" befindet.

Während der Prüfung ist zu beachten, dass
- der Transformator spannungslos bleibt,
- die Arbeitserde am Transformator nicht aufgehoben wird und
- die automatische Feuerlöscheinrichtung gesichert ist.

Die Einschaltung darf erst wieder möglich sein, wenn das Druckentlastungsventil durch die Rückstellung des Signalstiftes in Stellung „BETRIEB" gebracht wurde.

5.2 Signalstift in Stellung „BETRIEB"

Steht der Signalstift in Stellung „BETRIEB", so hat keine Auslösung des Druckentlastungsventils stattgefunden. Sollte ein Mikroschalter trotzdem ein Signal melden, so kann der Fehler im Auslösestromkreis liegen. Überprüfen Sie in diesem Fall den Auslösestromkreis.

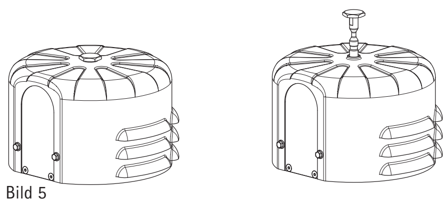


Bild 5

5.3 Signalstift in Stellung „ALARM"

Steht der Signalstift in Stellung „ALARM", so hat das Druckentlastungsventil ausgelöst. Klären Sie hierzu folgende Fragen und setzen Sie sich ggf. mit dem Hersteller des Transformators bzw. des Stufenschalters in Verbindung, um weitere Maßnahmen einleiten zu können:

- Ist am Druckentlastungsventil Öl ausgetreten?
- War der Transformator einer mechanischen Belastung ausgesetzt?
- Wie groß war die Belastung des Transformators zum Zeitpunkt der Auslösung?
- Ist eine Verstellung des Laststufenschalters unmittelbar vor oder bei der Auslösung durchgeführt worden?
- Haben zum Zeitpunkt der Auslösung weitere Schutzeinrichtungen angesprochen?
- Sind zum Zeitpunkt der Auslösung Schalthandlungen im Netz durchgeführt worden?
- Sind zum Zeitpunkt der Auslösung Überspannungen registriert worden?
- Wie hoch ist der statische Druck auf das Druckentlastungsventil (Höhendifferenz zwischen Ölspiegel im Ausdehner und Druckentlastungsventil)?

⚠ ACHTUNG

Der Signalstift muss abschließend wieder in das Gerät gedrückt werden. Ein erneutes Auslösen des Ventils kann sonst nicht angezeigt werden.

5.4 Wartung

Eine regelmäßige Wartung ist nicht erforderlich.

Bei den turnusmäßigen Überprüfungen des Transformators empfehlen wir folgende Kontrolle durchzuführen:

- Überprüfen sie den äußeren Zustand des eingebauten Geräts auf Beschädigungen und Verschmutzungen. Entfernen sie ggf. die Verschmutzungen.

⚠ WARNUNG

Beachten sie hierbei unbedingt die einschlägigen Sicherheitsvorschriften; andernfalls besteht Lebensgefahr.

6 Technische Daten

Abmessungen:	siehe Anhang
Auslassöffnung (Version mit Vollgusshaube (OD)):	90 mm (3,54")
Gewicht:	ca. 6 kg mit Standardhaube ca. 11 kg mit Vollgusshaube (OD)
Werkstoffe:	Alle Teile witterungs- und trafoölbeständig; alle außenliegenden Teile seewasser- und UV-beständig.

Kenndaten:

Aufstellung:	Innenraum und Freiluft, tropenfest
Umgebungstemp.:	-50...+80 °C (mechanisch) -40...+80 °C (Mikroschalter)
Öltemperatur:	-30...+120 °C
Ansprechdruck:	siehe Tabelle 1
Ventildichtheit:	Leckagetest mit Heliumüberdruck

Mikroschalter:

Kontakte:	Pro Mikroschalter 1x Öffner, 1x Schließer, galvanisch getrennt
Gebrauchskategorie:	IEC 60947-5-1 AC-15/DC-13
Schaltleistung:	AC: 3 A/240 V; 6 A/120 V DC: 1,1 A/250 V; 2,2 A/125 V
max. Dauerstrom:	10 A
Nennisolationsspannung:	AC: 2.500 V/1 min.

Anschluss über Kabelverschraubungen:

Anschlussklemmen:	Eindrähtig: 0,5-2,5 mm², AWG 20-10; Litze mit Aderendhülse: 0,5-1,5 mm², AWG 20-15
Kabelverschraubung:	Alle M20x1,5 für Kabel Ø 8...15 mm
Schutzart:	IP 65 nach IEC 60 529 (geschlossenes Gerät)

ANSI-Stecker:

Kabel:	AWG 16, SOOW, 600 V
Kabellänge:	Verschiedene Längen auf Anfrage (24"...240" Standard)
Schutzart:	IP 65 nach IEC 60529 (geschlossenes Gerät)

Anschluss-Box:

Anschlussklemmen:	Eindrähtig: 1-4 mm², AWG 18-8; Litze mit Aderendhülse: 0,5-2,5 mm², AWG 20-10
Kabelverschraubung:	M25x1,5 für Kabel Ø 13...20 mm
Schutzart:	IP 65 nach IEC 60529

Montagedichtung (optional):

Material:	NBR oder Viton
Abmessungen:	Ø 200 x Ø 178,5 x 4,25

> **NOTE**
> Information contained in these operating instructions may differ from the actual equipment delivered.
>
> Subject to change without prior notice.

CE

Please keep this manual for future reference!

1 Safety

1.1 Safety instructions

All personnel involved in installation, commissioning, operation or maintenance of this equipment must:
- be sufficiently qualified
- strictly observe these operating instructions.

Incorrect operator control or misuse can cause:
- serious or fatal injury
- damage to the equipment and other property of the user
- a reduction in the efficiency of the equipment.

The safety instructions in this manual are presented in three different ways to highlight their importance.

> **WARNING**
> This information indicates particular danger to life and limb. Disregarding this warning may lead to severe or fatal injury.

> **CAUTION**
> This information indicates particular danger to the equipment or other property of the user. Severe or fatal injury cannot be excluded.

> **NOTE**
> These notes give important information on a certain topic.

1.2 Operation in accordance with intended use

The pressure relief device protects transformers against non-permissible increases in pressure. Once a specific predetermined degree of pressure has been reached, the pressure relief device will open, reduce the pressure, and reseal itself tightly after achieving the required reduction in pressure.

It is essential to read and observe the limit values for operation indicated on the nameplate and in the operating instructions prior to commissioning the device.

1.3 Notes on equipment operation

The user must comply with the national accident prevention regulations.

It is particularly pointed out that work to be performed on live (i.e., touch-endangered) parts is only permitted when these parts are either de-energized or protected against direct contact.

Electrical installation is subject to the relevant national safety regulations. It is imperative to connect the protective conductor in order to ensure trouble-free operation.

> **CAUTION**
> Installation, electrical connection, commissioning, and maintenance of the device may only be performed by qualified, trained personnel and only in accordance with these operating instructions.
>
> It is the responsibility of the user to make sure that the device is only used for the specified application.
>
> For safety reasons, all unauthorized and incorrectly executed jobs (i.e., installation, modification, electrical connection, commissioning and maintenace of the equipment) are prohibited without the prior permission of Messko!

> **WARNING**
> All national fire prevention regulations must be strictly observed.

> **CAUTION**
> Never dry the pressure relief device together with the transformer's active part.

2 Product specification

2.1 Model with standard cover

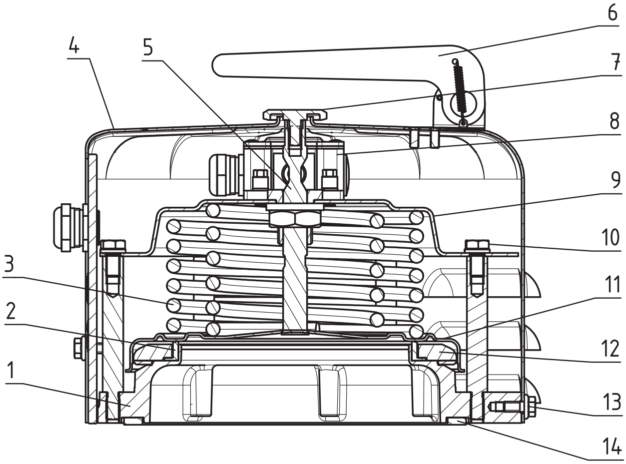


Fig. 1

Although the pressure relief device is available in different models, its design and mode of operation are always identical.

The housing flange (Fig. 1/1) of the pressure relief device is mounted on the transformer tank or on the on-load tap-changer. A gasket (Fig. 1/2) and a sealing lip (Fig. 1/12) are attached to the housing flange. The valve plate (Fig. 1/11) is pressed against the gasket by a spring assembly (Fig. 1/3). The spring assembly is held down by a counter-bearing (Fig. 1/9)fastened to the flange with six screws (Fig. 1/10).

WARNING

The counter-bearing preloads the spring assembly and is secured with 6 screws. Never under any circumstances unscrew these screws!!!

Danger of injury!!!

The device is available with different tripping pressures. If the pressure under the valve plate exceeds the tripping pressure of the spring assembly, the valve plate will open, causing an abrupt normalization of the pressure. Afterwards the spring assembly closes the valve plate tight again.

Every time the valve is tripped, a colored signal pin (Fig. 1/5) is pressed out of the housing (red for mineral oil, blue for silicone oil). This pin snaps into place while being pressed out. It signals the user that the valve has been tripped (Fig. 3). In addition, a semaphore (Fig. 1/6) can be attached which flips up when tripping occurs to call attention to the signal.

Furthermore, the pressure relief devices are available with either one or two optional micro-switches (Fig. 1/8) which are force-switched by the signal pin when the valve trips. The different types of connections of the micro-switches are described in chapter 4.

Type	Tripping pressure		
	[psi]	[bar]	[kPa]
LMPRD 4 psi	4 ± 1	0.28	28
LMPRD 6 psi	6 ± 1	0.41	41
LMPRD 8 psi	8 ± 1	0.55	55
LMPRD 10 psi	10 ± 1	0.69	69
LMPRD 12 psi	12 ± 1	0.83	83
LMPRD 15 psi	15 ± 2	1.03	103
LMPRD 20 psi	20 ± 2	1.38	138
LMPRD 25 psi	25 ± 2	1.72	172
LMPRD 30 psi	30 ± 2	2.07	207

Table 1

2.2 Model with oil-directed cover (OD)

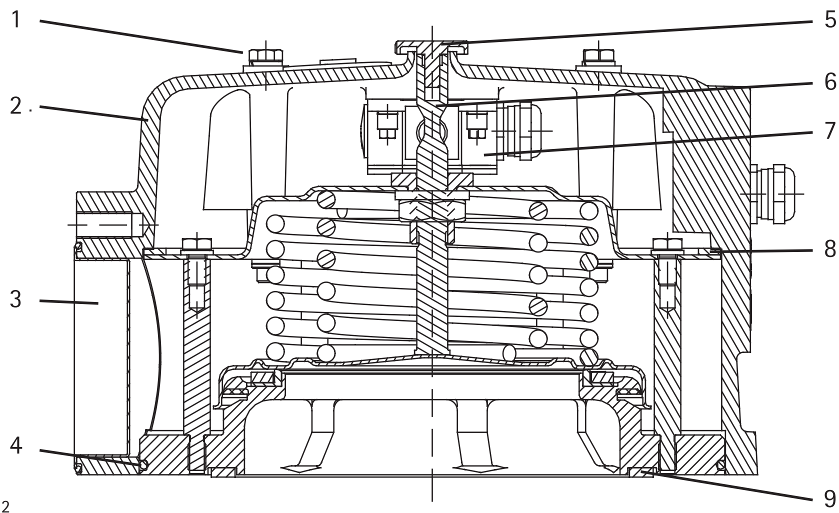


Fig. 2

The design of the MPreC® pressure relief device with a solid cast metal cover for directed oil flow is similar to the design of an MPreC® pressure relief device with a standard cover.

The pressure relief device is bolted to a transformer counter flange with the cover removed (Fig. 2/2). Afterwards, the cover is attached and secured to the device. The cover has an outlet (Fig. 2/3) to let the oil escape in case the pressure relief device is tripped but is otherwise sealed off with a gasket (Fig. 2/4) in the direction of the device. A pipe can be flanged to the outlet to drain off the escaping oil in a controlled manner. The micro-switches (Fig. 2/7) are encapsulated from the functional part of the valve with a gasket (Fig. 2/8) and are thus protected from escaping oil as well as environmental influences.

3 Installation

3.1 Installation of model with standard cover

> ⚠ **CAUTION**
>
> The operating and installation instructions specified for this installation and operating manual must be strictly complied with.

The pressure relief device can be installed horizontally or vertically. For vertical installation, please make sure that the base plate (Fig. 3/2) never points up or down. It must always point to the right or to the left during installation. Also please be sure

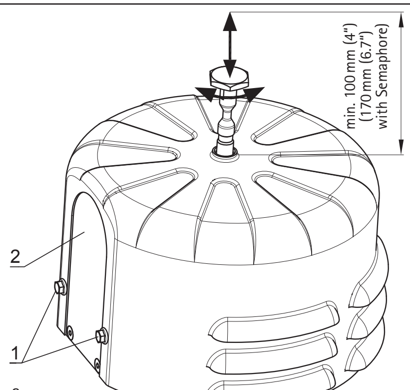


Fig. 3

to leave sufficient space above the valve (min. 100 mm, with a semaphore: min. 170 mm, Fig. 3) so that the signal pin can be completely pressed out of the housing and the semaphore (if present) is able to fold over completely ("Alarm" position).

3.1.1 Opening the pressure relief device

To install the pressure relief device, remove the cover (Fig. 1/4) first. Pull out the signal pin (Fig. 1/5) and unscrew the signal pin's cap (Fig. 1/7) with two SW12 and SW32 fork wrenches (or pliers). Then remove the two SW10 screws (Fig. 3/1) from the base plate (vertical plate) and the SW10 screw (Fig. 1/13) on the opposite side. Then remove the cover.

3.1.2 Mounting the pressure relief device

The pressure relief device is installed via the drilled holes on the housing flange by means of M12 respectively 1/2" screws. The dimensions are given in the Appendix. When mounting the device, be sure to install a mounting gasket (Fig. 1/14)/(Fig. 9) (optionally included in the delivery) under the device.

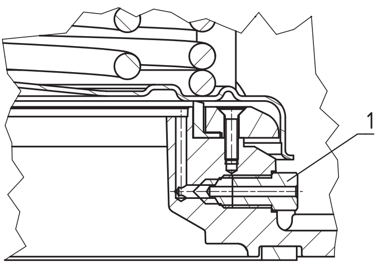


Fig. 4

3.1.3 Bleed screw

If installed vertically, no gas will collect under the valve plate of the pressure relief device and there is no need to bleed the valve.

If installed horizontally, the pressure relief valve can be bled after the transformer oil is filled. To do this, open the bleed screw (Fig. 4/1) with a SW10 wrench or a screwdriver and tightly lock the screw as soon as oil starts to escape.

> ⚠ **CAUTION**
> Bleeding a pressure relief valve on an on-load tap-changer is not permitted without the prior consent of the on-load tap-changer manufacturer.

3.1.4 Closing the pressure relief device

The pressure relief device must be closed after installation. To do this place the cover on the pressure relief valve in such a way that the holes for the mounting screws in the cover are aligned with the associated threaded holes of the MESSKO® MPreC® pressure relief device.

To attach the cover, screw the two SW10 screws (Fig. 3/1) to the base plate (vertical plate) and the SW10 screw (Fig. 1/13) on the opposite side (M_A = 5 Nm).

Then screw the SW32 cap back onto the SW12 signal pin (MA = 8 Nm) and press the signal pin back into the device as far as it will go.

> ⚠ **CAUTION**
> The signal pin must be pressed back into the device afterwards. If there is a semaphore, it must be folded over so that the tip is on the signal pin. Otherwise it will indicate a tripping of the pressure relief valve (visually and electrically).

3.2 Installation of model with oil-directed cover (OD)

The pressure relief device is mounted on a counter-flange of the transformer or similar.

First, remove the solid cast metal cover (Fig. 2/2) of the pressure relief device. This is done by pulling out the signal pin (Fig. 2/6) and unscrewing its cap (Fig. 2/5) with two SW12 and SW32 fork wrenches (or pliers). Then unscrew the 4 screws SW13 (Fig. 2/1) on the cover and lift off the cover.

During assembly, first screw the housing flange to the spring assembly using the 6 bored holes. A mounting gasket (Fig. 2/9, is provided optionally) must be installed under the device. This gasket can be provided optionally.

> ⚠ **CAUTION**
> The valve can only be bled when the cover is removed. Proceed as described in chapter 3.1.3.

The cast metal cover can now be placed on the pressure relief device. Turn the cover to the correct position and gently tighten the 4 screws (figure 2/1) several times crosswise to prevent the cover from tilting when being lowered. After the cover has been lowered, tighten the 4 screws in the same way up to a torque of 23 Nm to ensure a uniform pressure on the flat gasket located inside (figure 2/9). Then screw the signal cap back onto the signal pin.

> ⚠ **CAUTION**
> The signal pin must then be pressed back into the device. If a semaphore exists, it must be positioned to rest with its tip on the signal pin. Otherwise, a triggering of the pressure relief device is indicated both visually and electrically.

A drainage pipe or similar can be flanged to the front of the pressure relief device. Gasket and screws with spring washers are included with the device. A welded or screw flange can be ordered as an option.

> ⚠ **CAUTION**
> The outlet opening of the pressure relief device is closed with a plastic cap (Fig. 2/3) during transportation. This cap must be removed before the valve is assembled. Never under any conditions use it as a closing cap during operation.

4 Electrical connection (optional)

The optionally installed micro-switches can be connected as follows:

- Cable gland connection inside the device
- Connection with ANSI or Westinghouse connectors
- Connection with a terminal box

See also figures 6 to 11.

Each micro-switch is designed as a galvanically isolated NC and NO contact.

CAUTION

Electrical connection of the pressure relief device may only be performed by qualified, skilled personnel trained in the applicable safety regulations of the particular country.

WARNING

Life threatening electrical voltage!
It is imperative to turn off the power supply before opening the switch housing or the terminal box.

4.1 Connection with cable gland

To connect micro-switches, the device must be open (chapter 3.1.1). Then unscrew the four screws of the micro-switch housing and remove the cover. The cable for the wiring connection must be stripped and bared. Open the M20x1.5 cable glands (for Ø 8...15 mm leads) on the base plate (Fig. 3/2) and on the micro-switch housing (Fig. 6, page 28) (SW24) and then thread the cable through the two cable glands.

Wiring is done as shown by the connection diagram on the four clamping screws and on one of the two grounding terminals (M_E) (Fig. 6, page 28). Then close the cable glands (M_A=5.0 Nm), the micro-switch housing, and replace the cover.

4.2 Connection via terminal box

Open the terminal box with the 4 screws. Strip the cable for the wiring and bare the wires approx. 7 mm. Open the M25x1.5 cable glands (for lines Ø 13 to 20 mm) and thread the cable through. The wiring is based on the connection diagram (Fig. 8, page 29) on the labeled terminal strip. Then close the cable glands (M_A = 6.7 Nm) and the terminal box again.

4.3 Connection with ANSI connector

Before connecting the pressure relief device, check to determine whether the plug connector (pin allocation) fits on the socket on the floor plate. The cable of the ANSI plug connector must be installed based on the particular application. The cable jacket must be stripped and the individual wires must be bared. The wires must be connected as shown in Fig. 10, page 30 for 1 or 2 micro-switches.

Connect the plug connector to the socket of the pressure relief valve and tighten clockwise as far as it will go. We recommend holding the cable during mounting. Make absolutely sure not to twist the connection cable.

5 Operation and maintenance

5.1 Commissioning

The pressure relief device is ready for operation after installation and electrical connection.

To check the micro-switches, proceed as shown below. Pull the signal pin out of the housing to the position "ALARM" (Fig. 5) to activate the micro-switches. Then press the signal pin back into the housing to the position "OPERATION" to switch back the micro-switches.

If a temporary power disconnection by the pressure relief device is desired, check to determine whether the circuit breakers of the transformer to be protected disconnect it from all power supply sources while the signal pin is in the "ALARM" position.

While performing this test, please make sure that

- the transformer remains de-energized
- the working ground on the transformer is not neutralized
- the automatic fire extinguishing equipment is provided.

Switch-on must be made impossible until after the pressure relief valve is back in the "OPERATION" position by resetting the signal pin.

5.2 Signal pin in "OPERATION" position

If the signal pin is in the "OPERATION" position, this means that the pressure relief device has not been tripped. If the micro-switch reports a signal anyway, the cause may be in the tripping circuit. In this case, check the tripping current circuit.

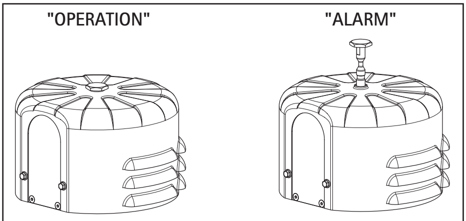


Fig. 5

5.3 Signal pin in "ALARM" position

If the signal pin is in the "ALARM" position, this means that the pressure relief device has been tripped. In this case, clarify the following questions and contact the transformer manufacturer or the on-load tap-changer manufacturer so that any neces-sary further measures can be initiated.

- Has oil escaped from the pressure relief device?
- Was the transformer subjected to mechanical stress?
- How great was the stress exerted on the transformer at the time the valve was tripped?
- Was an adjustment of the on-load tap-changer performed directly before or during the tripping?
- Did additional safety devices respond at the same time that the valve was tripped?
- Were switching operations being performed on the network at the time the valve was tripped?
- Were overvoltages registered at the time the valve was tripped?
- How high is the static pressure acting on the pressure relief device (height difference between the oil level in the oil conservator and the pressure relief device)?

CAUTION

The signal pin must be pressed back into the device or a new tripping of the valve cannot be indicated.

5.4 Maintenance

Regular maintenance is not required.

We recommend performing the following checks during periodic transformer inspections:

- Inspection of the external condition of the built-in device for damage and dirt. Remove dirt as necessary.

WARNING

It is imperative to observe the relevant safety regulations to prevent life-threatening danger.

6 Technical data

Dimensions:	See Appendix
Outlet opening (model with oil-directed cover(OD)):	90 mm (3.54")
Weight:	Approx. 6 kg with standard cover Approx. 11 kg with oil-directed cover
Materials:	All components are weather-proof and transformer-oil resistant. All exterior components are seawater and UV-resistant

Characteristic data:

Place of installation:	Indoors and outdoors, suitable for the tropics
Ambient temperature:	-50...+80 °C (mechanical) -40...+80 °C (micro-switch)
Oil temperature:	-30...+120 °C
Tripping pressure:	See table 1
Valve tightness:	Leakage test with helium overpressure

Micro-switch:

Contacts:	Per micro-switch: 1x NC contact, 1x NO contact, galvanically isolated
Category of use:	IEC 60947-5-1 AC-15/DC-13
Switching capacity:	AC: 3 A/240 V; 6 A/120 V DC: 1.1 A/250 V; 2.2 A/125 V
Max. continuous current:	10 A
Rated isolation voltage:	AC: 2,500 V/1 min.

Cable gland connection:

Connection terminals:	Single wire: 0.5 - 2.5 mm², AWG 20-10; Lead with core sleeve: 0.5 - 1.5 mm², AWG 20-15
Cable gland:	All M25x1.5 for cables Ø 8...15 mm
Protecting rating:	IP 65 as per IEC 60 529 (device closed)

ANSI-connector:

Cable:	AWG 16, SOOW, 600 V
Cable length:	Different lengths on request (24"...240" standard)
Protecting rating:	IP 65 as per to IEC 60 529 (device closed)

Terminal box:

Connection terminals:	Single wire: 1 - 4 mm², AWG 18-8; Lead with core sleeve: 0.5 - 2.5 mm², AWG 20-10
Cable gland:	All M25x1.5 for cables Ø 13...20 mm
Protecting rating:	IP 65 as per IEC 60 529 (device closed)

Mounting gasket (optional):

Material:	NBR or Viton
Dimensions:	Ø 200 x Ø 178.5 x 4.25

> **NOTE**
>
> Les données incluses pourraient différer dans les détails de l'équipement livré.
>
> Nous nous réservons le droit de faire des modifications sans avis préalable.

CE

Prière de garder ce manuel disponible pour référence future!

1 Sécurité

1.1 Instructions de sécurité

Tout le personnel impliqué dans les travaux d'installation, mise en service, opération ou entretien de l'équipement doit:
- être adéquatement qualifié, et
- observer strictement ces instructions d'opération.

Toute opération inadéquate ou emploi abusif peut mener à
- des blessures sérieuses ou fatales,
- des dommages à l'équipement ou à la propriété de l'utilisateur
- une réduction de l'efficacité de l'équipement.

Les instructions de sécurité dans ce manuel sont présentées en trois formats différents afin de mettre l'emphase sur l'information importante.

> **Avertissement**
>
> Cette information indique un danger particulier à la vie et à la santé. Toute négligence de cet avertissement peut mener à des blessures sérieuses ou fatales.

> **MISE EN GARDE**
>
> Cette information indique un danger particulier à l'équipement ou à tout autre propriété de l'utilisateur. Des blessures sérieuses ou fatales ne peuvent être exclues.

> **NOTE**
>
> Ces notes donnent une importante information sur certains sujets.

1.2 Domaine d'application

Le dispositif de surpression protège les transformateurs contre les surpressions inadmissibles et non sécuritaires. Une fois qu'un certain degré prédéterminé de pression est atteint, le dispositif de surpression ouvrira, réduisant la pression, et se refermera hermétiquement une fois la réduction de pression requise atteinte.

Il est important de lire et d'observer les valeurs limites d'opération indiquées sur la plaque signalétique et dans les instructions d'opération avant la mise en service du dispositif.

1.3 Notes importantes sur l'opération de l'équipement

L'utilisateur est obligé de se conformer aux règlements nationaux de santé & sécurité.

Il est important d'accentuer que les travaux effectués sur les composants sous tension, représentant un danger au contact, sont permis seulement lorsque ces composants sont hors tension ou protégés contre un contact direct.

L'installation électrique est sujette aux règlements de sécurité nationaux applicables. Il est impératif de raccorder le conducteur de malt afin d'assurer une opération sécuritaire.

> **MISE EN GARDE**
>
> L'installation, le raccordement électrique, la mise en service et l'entretien du dispositif ne peut être effectué que par un personnel qualifié et expérimenté, et seulement selon les présentes instructions d'opération.
>
> L'utilisateur détient la responsabilité de s'assurer que le dispositif est utilisé seulement pour l'application spécifiée.
>
> Pour raisons de sécurité, tout travail non autorisé ou inadéquatement exécuté, tel que l'installation, la modification, l'altération de l'équipement, le raccordement électrique ou la mise en service de l'équipement, sont prohibés sans consulter préalablement Messko!

> **Avertissement**
>
> Tous les règlements applicables de protection d'incendie doivent être strictement observés.

> **MISE EN GARDE**
>
> S'assurer de ne jamais «sécher» la soupape de surpression en même temps que la partie active du transformateur.

2 Spécification du produit

2.1 Version avec capot standard

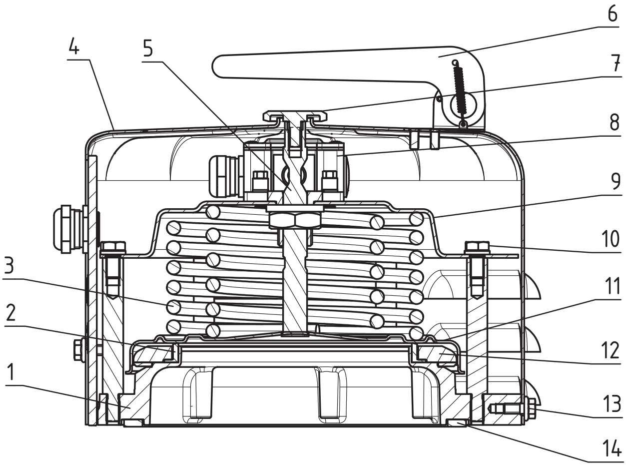


Fig. 1

Malgré que le dispositif de surpression puisse être disponible en divers types, sa conception et mode d'opération demeurent identiques.

La bride du carter (Fig. 1/1) du dispositif de surpression est montée respectivement sur le réservoir du transformateur et sur le changeur de prises. La bride du carter contient, de plus, un joint (Fig. 1/2) et une lèvre de scellement (Fig. 1/12). Le disque de soupape (Fig. 1/11) est compressé contre le joint à l'aide d'un ensemble à ressort (Fig. 1/3). L'ensemble à ressort est maintenu à l'aide d'un palier de renvoi (Fig. 1/9) serré à la bride à l'aide de six vis (Fig. 1/10).

Avertissement

Le palier de renvoi qui précharge l'ensemble à ressort est maintenu par six vis (Fig. 1/10). Ces vis ne doivent pas être retirées sous aucun prétexte et en aucune circonstance!!!

Danger de blessures!!!

Le dispositif est disponible en une variété de niveaux de pression d'opération. Si la pression en-dessous du disque de soupape dépasse la pression d'opération de l'ensemble à ressort, le disque de soupape s'ouvrira causant une diminution abrupte de la pression. Subséquemment, le disque de soupape sera refermé hermétiquement par l'ensemble à ressort.
À chaque déclenchement de la soupape, une fiche de signal colorée (Fig. 1/5) émerge du carter (rouge pour huile minérale, bleu pour huile de silicone). Cette fiche est maintenue vers l'extérieur pour aviser l'utilisateur que la soupape a déclenchée (Fig. 3). De plus, un sémaphore (Fig. 1/6) peut être monté et se relève lors du déclenchement afin d'attirer l'attention.

De plus, le dispositif de surpression est disponible en version ayant un micro rupteur ou deux micro rupteurs optionnels (Fig. 1/8) actionné (s) par la fiche de signal durant le déclenchement de la soupape. Les divers types de raccordement des micro rupteurs sont décrits au chapitre 4.

Type	Pression d'opération		
	[psi]	[bar]	[kPa]
LMPRD 4 psi	4 ± 1	0,28	28
LMPRD 6 psi	6 ± 1	0,41	41
LMPRD 8 psi	8 ± 1	0,55	55
LMPRD 10 psi	10 ± 1	0,69	69
LMPRD 12 psi	12 ± 1	0,83	83
LMPRD 15 psi	15 ± 2	1,03	103
LMPRD 20 psi	20 ± 2	1,38	138
LMPRD 25 psi	25 ± 2	1,72	172
LMPRD 30 psi	30 ± 2	2,07	207

Tableau 1

2.2 Version avec capot en alliage (OD)

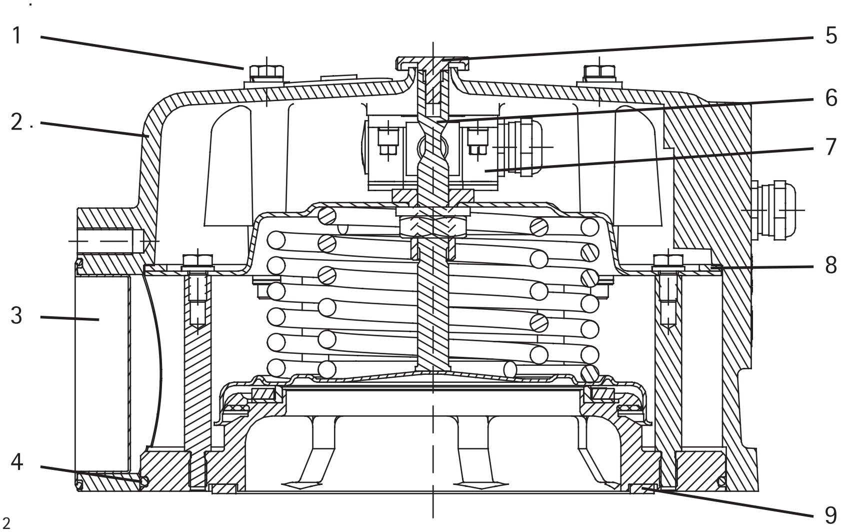


Fig. 2

La version du dispositif de surpression MPreC® avec capot en alliage pour flux d'huile dirigé est identique dans sa conception à un dispositif de surpression MPreC® avec capot standard. Le dispositif de surpression est vissé sans capot (fig. 2/2) sur la contre-bride du transformateur, puis le capot est posé et fixé sur la soupape. Le capot est muni d'une ouverture de sortie (fig. 2/3) pour évacuer l'huile en cas de déclenchement du système. Par ailleurs, il est étanchéifié avec la soupape à l'aide d'un joint (fig. 2/4). Un tuyau peut être fixé par bride sur l'ouverture de sortie afin de pouvoir diriger l'huile qui s'évacue. Les micro rupteurs (fig. 2/7) sont séparés de la partie fonctionnelle de la soupape par un joint (fig. 2/8). Ils sont ainsi protégés de l'influence des conditions ambiantes et de l'huile qui s'évacue.

3 Installation

3.1 Montage de la version avec capot standard

> ⚠ **MISE EN GARDE**
>
> Les instructions d'opération et de montage exigées par ce manuel d'installation et d'opération doivent être strictement suivies.

L'installation du dispositif de surpression peut être horizontale ou verticale. Pour une installation verticale, s'assurer que la plaque de montage (Fig. 3/2) ne pointe jamais à l'horizontale vers le haut ou le bas. Durant l'installation, elle doit toujours pointer vers la gauche ou la droite. Aussi, s'assurer de garder un espace suffisant au-dessus de la soupape (min. 100 mm, avec un sémaphore de 170 mm minimum, Fig. 3) afin de maintenir un espace suffisant pour pouvoir assurer la sortie complète de la fiche de signal hors du carter et que le sémaphore (si présent) soit capable de se relever complètement (position «Alarme»).

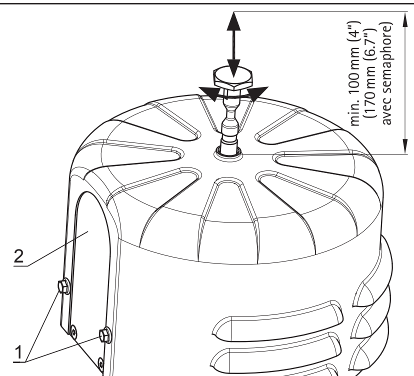


Fig. 3

3.1.1 Ouverture du dispositif de surpression

Pour installer le dispositif de surpression, le couvercle (Fig. 1/ 4) doit être retiré en premier. Pour ce faire, retirer la fiche de signal (Fig. 1/5) et desserrer le capot de la fiche de signal (Fig. 1/7) à l'aide de deux (2) clés à fourche SW12 et SW32 (utiliser des pinces en alternative). Retirer alors les deux vis SW10 (Fig. 3/1) et la vis SW10 au côté opposé (Fig. 1/13) de la plaque de montage. Terminer en retirant le couvercle.

3.1.2 Montage du dispositif de surpression

Le dispositif de surpression est installé par l'intermédiaire des perçages sur la bride du carter à l'aide de vis M12 respectivement 1/2". Les dimensions concernées sont indiquées dans l'Annexe. Lors du montage du dispositif, s'assurer d'installer un joint de montage (Fig. 1/14)/(Fig. 9) (inclus en option à la livraison) sous le dispositif.

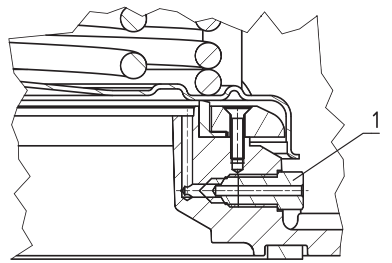


Fig. 4

3.1.3 Vis de purge

Si installé à la verticale, aucun gaz ne s'accumulera sous le disque de soupape du dispositif de surpression, évitant ainsi la nécessité de purger la soupape!

Si installé à l'horizontale, la soupape du dispositif de surpression peut être purgée après le remplissage d'huile du transformateur. À cette fin, ouvrir la vis de purge (Fig. 4/1) à l'aide d'une clé de serrage SW10 ou d'un tournevis et serrer fermement la vis une fois que l'huile commence à émerger.

> ⚠ **MISE EN GARDE**
>
> La purge d'une soupape de surpression sur un changeur de prise en charge n'est pas permise sans le consentement préalable du fabricant du changeur de prise en charge.

3.1.4 Fermeture du dispositif de surpression

Le dispositif de surpression doit être refermé après installation. À cette fin, placer le couvercle sur la soupape du dispositif de surpression en sorte que les alésages pour les vis de fixation dans le couvercle soient alignés avec les trous taraudés du MESSKO® MPreC®.
Pour attacher le couvercle, serrer les deux vis (Fig. 3/1) SW10 à la plaque support et la vis (Fig. 1/13) SW10 au côté opposé (M_A=5 Nm).
Terminer en vissant le capot SW32 dans la fiche de signal SW12 (M_A=8 Nm) et en pressant la fiche de signal vers le bas dans le dispositif jusqu'à arrêt.

> ⚠ **MISE EN GARDE**
>
> La fiche de signal doit être poussée dans le dispositif. En présence d'un sémaphore, ce dernier doit être plié de façon que la pointe soit sur la fiche de signal. Sinon, il indiquera un déclenchement de la soupape de surpression (visuellement et électriquement).

3.2 Montage de la version avec capot en alliage (OD)

Le dispositif de surpression est monté sur une contre-bride du transformateur ou un élément similaire.

Pour le montage, le capot en alliage (fig. 2/2) doit d'abord être retiré. Pour cela, retirer la goupille de signalisation (fig.2/6) et en dévisser le capuchon (fig. 2/5) avec 2 clés à fourche SW12 et SW32 (ou avec des pinces). Ensuite, dévisser les 4 vis SW13 (fig. 2/1) du capot et retirer ce dernier.

Lors du montage, d'abord visser la bride du carter au niveau des 6 perçages avec l'ensemble à ressorts. Un joint de montage doit être placé sous le dispositif (fourni en option) (fig. 2/9).

> ⚠ **MISE EN GARDE**
>
> La soupape ne peut être purgée de son air que lorsque le capot est démonté. Se reporter pour cela au chap 3.1.3.

Poser ensuite le capot sur l'ensemble à ressorts. Pivoter le capot dans la position correcte et serrer légèrement et progressivement les 4 vis (fig. 2/1) en séquence diagonale, afin d'éviter le blocage du capot lors de la descente. Après la descente, serrer les 4 vis de la même manière jusqu'à ce que le couple de 23 Nm soit atteint, afin de garantir une pression uniforme sur le joint plat situé à l'intérieur (fig. 2/9). Pour finir, revisser le capuchon de signalisation sur la tige de signalisation.

> ⚠ **MISE EN GARDE**
>
> La douille de signalisation doit enfin être réinsérée dans le dispositif. En cas de présence d'un sémaphore, celui-ci doit être rabattu, de sorte que la pointe se trouve sur la goupille de signalisation. Par ailleurs, un déclenchement du dispositif de surpression est indiqué (visuellement et électriquement).

Un tuyau d'évacuation ou un système similaire peut être fixé par bride sur la face avant du dispositif. Un joint et des vis avec des rondelles élastiques sont fournis avec le dispositif. Une bride à souder ou une bride à visser peut être commandée en option.

> ⚠ **MISE EN GARDE**
>
> Pour la protéger pendant le transport, l'ouverture de sortie est fermée par un capuchon en plastique (fig.2/3). Celui-ci doit être retiré avant le montage de la soupape et ne doit en aucun cas être utilisé en service comme capuchon de fermeture.

4 Raccordement électrique (optionnel)

Les micro rupteurs bâtis en option dans le dispositif peuvent être raccordés comme suit:

- Raccordement du presse-étoupe de câble à l'intérieur du dispositif
- Raccordement à l'aide de raccords ANSI ou Westinghouse
- Raccordement avec boîte à bornes

Veuillez à ce sujet aussi tenir compte des figures 6 à 11.

Chaque micro rupteur comprend un contact NF et un NO galvaniquement isolés.

⚠ **MISE EN GARDE**

Le raccordement électrique du dispositif de surpression ne peut être effectué que par un personnel qualifié et formé dans les règlements de santé & sécurité du pays concerné.

⚡ **Avertissement**

Tensions électriques dangereuses!

Il est impératif de désactiver l'alimentation avant d'ouvrir le boîtier de l'interrupteur ou la boîte à bornes.

4.1 Raccordement du presse-étoupe de câble

Pour raccorder un micro rupteur, commencer par ouvrir le dispositif (chapitre 3.1.1). Desserrer ensuite les quatre vis du carter du micro rupteur et retirer le couvercle. Le câble pour le raccordement du filage doit être adéquatement dénudé et isolé. Ouvrir le presse-étoupe de câble M20x1.5 (pour conducteurs Ø 8...15 mm) à la plaque de montage (Fig. 3/2) et à l'enclos du micro rupteur (Fig. 6, page 28) SW24 et pousser le câble à travers les deux presse-étoupes de câble.

Le filage du micro rupteur est selon le diagramme de filage aux quatre pinces de bornes et à une des bornes de MALT (ME) (Fig. 6, page 28). Terminer en fermant les presse-étoupes de câble (M_A=5.0 Nm), l'enclos du micro rupteur, et la remise du couvercle.

4.2 Raccordement par boîte à bornes

Ouvrir la boîte à bornes à l'aide des 4 vis. Retirer la gaine du câble pour le filage et dénuder les fils d'environ 7 mm. Ouvrir les presse-étoupes de câble vissées M25x1.5, clé 32 mm (pour les lignes de Ø 13 à 20 mm) et engager le câble Le filage est effectué basé sur le diagramme de raccordement (Fig. 8, page 29) sur la bande de bornes étiquetée. Fermer ensuite les presse-étoupes de câble vissées (M_A=6.7 Nm) ainsi que la boîte à bornes.

4.3 Raccordement à l'aide d'un raccord ANSI

Avant le raccordement du dispositif de surpression, vérifier pour déterminer que le raccord de prise (allocation de fiche) s'adapte à la douille sur la plaque. Le câble du raccord de prise ANSI doit être installé selon l'application particulière. La gaine du câble doit être retirée et les fils individuels dénudés. Les fils devront être raccordés tel que montré à la Fig. 10, page 30 pour 1 ou 2 micro rupteurs. Raccorder le raccord de prise à la douille de la soupape de surpression et serrer dans le sens horaire jusqu'à blocage. Il est recommandé de retenir le câble durant le montage.

S'assurer de ne pas déformer/tourner le câble de raccordement.

5 Opération et entretien

5.1 Mise en service

Le dispositif de surpression sera prêt pour opération suite à l'installation et au raccordement électrique.

Pour vérifier les micro rupteurs, suivre les procédures cidessous. Tirer la fiche de signal hors du carter en position «ALARME» (Fig. 5) de façon de pouvoir activer les micro rupteurs. Pousser ensuite la fiche de signal dans le carter et de nouveau en position «OPÉRATION» de façon que les micro rupteurs puissent être rebranchés.

Si un débranchement de puissance est requis par le dispositif de surpression, il est alors important d'essayer si les interrupteurs de puissance du transformateur qui devront être protégés pourront débrancher le transformateur de toutes les sources d'alimentation pendant que la fiche de signal est en position «ALARME».

Lors de l'exécution de l'essai, s'assurer que:

- le transformateur demeure hors tension,
- que la mise à la terre pour les travaux sur le transformateur n'est pas annulée, et
- que l'équipement d'extinction automatique est opérationnel de façon fiable.

L'opération de fermeture devra être prohibée jusqu'au retour du dispositif de surpression à sa position «OPÉRATION» par le réarmement de la fiche de signal.

5.2 Fiche de signal en position «OPÉRATION»

Si la fiche de signal est en position «OPÉRATION» ceci veut dire que le dispositif de surpression n'a pas été déclenché. Si le micro rupteur émet un signal quand même, ce défaut peut être attribuable au circuit de déclenchement. Dans un tel cas, il est recommandé de vérifier le circuit de déclenchement.

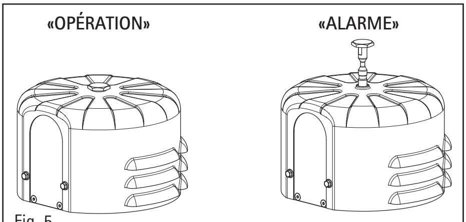


Fig. 5

5.3 Fiche de signal en position «ALARME»

Si la fiche de signal est en position «ALARME», ceci veut dire que le dispositif de surpression a été déclenché. Dans ce cas, il est recommandé de clarifier les points suivants et de contacter le fabricant du transformateur ou du changeur de prises hors charge, afin de définir la nécessité d'initier les mesures suivantes:

- L'huile a-t-elle coulée du dispositif de surpression?
- Le transformateur a été sujet à des contraintes mécaniques?
- Quelle était l'intensité des contraintes appliquées sur le transformateur au moment du déclenchement de la soupape?
- Des réajustements ont-ils été effectués sur le changeur de prises en charge juste avant le déclenchement de la soupape?
- Les dispositifs d'alarme additionnels ont-ils répondu de la même façon lors du déclenchement de la soupape?
- Des opérations de manœuvre ont-elles été effectuées sur le réseau au moment du déclenchement de la soupape?
- Des surtensions ont été enregistrées au moment du déclenchement de la soupape?
- Quelle était la valeur de la pression statique opérant sur le dispositif de surpression (différence d'élévation entre le niveau d'huile dans le conservateur d'huile et le dispositif de surpression)?

MISE EN GARDE

La fiche de signal doit être subséquemment retournée par pression dans le dispositif de surpression sinon un nouveau déclenchement de la soupape ne peut être autrement indiqué.

5.4 Entretien

Un entretien régulier n'est pas requis.

Il est recommandé d'effectuer les vérifications suivantes durant les inspections périodiques sur le transformateur:

- Inspection de la condition externe du dispositif intégré pour des dommages ou impuretés. Enlever les impuretés, si requis.

Avertissement

Il est impératif d'observer les règlements de sécurité applicables afin d'éviter tout danger à la vie et à la santé.

6 Données techniques

Dimensions:	Voir annexe
Ouverture de sortie (version avec capot en alliage (OD)):	90 mm (3.54")
Poids:	Environ 8 kg avec capot standard Environ 11 kg avec capot en alliage (OD)
Matériaux:	Tous les composants sont à l'épreuve des intempéries et résistent à l'huile de transformateur. Tous les composants externes sont à l'épreuve de l'eau saline et aux rayons UV.

Données Caractéristiques:

Lieu d'installation:	Intérieur et extérieur, à l'épreuve des tropiques
Température ambiante:	-50...+80 °C (mécanique) -40...+80 °C (micro rupteur)
Température de l'huile:	-30...+120 °C
Pression d'opération:	Voir tableau 1
Étanchéité de la soupape:	Essai de fuite avec surpression d'hélium

Micro rupteur:

Contacts:	Par micro rupteur 1x contact NF , 1x contact NO, métalliquement isolés
Catégorie d'utilisation:	CEI 60947-5-1 CA-15/CC-13
Charge de contact:	CA: 3 A/240 V; 6 A/120 V CC: 1.1 A/250 V; 2.2 A/125 V
Courant maximal permanent:	10 A
Tension d'isolation nominale:	CA: 2,500 V/1 min.

Raccord de presse-étoupe de câble:

Pinces de bornes:	Simple noyau: 0.5-2.5 mm², AWG 20-10; Conducteur à bague: 0.5-1.5 mm², AWG 20-15
Presse-étoupe de câble:	M25x1.5 pour câbles Ø 8...15 mm
Degré de protection:	IP 65 selon CEI 60 529 (couvercle monté)

Raccord ANSI:

Câble:	AWG 16, SOOW, 600 V
Longueur:	Longueur sur mesure et sur demande (24"...240" normalisé)
Degré de protection:	IP 65 selon CEI 60 529 (couvercle monté)

Boîte à bornes:

Pinces de bornes:	Simple noyau: 1 - 4 mm², AWG 18-8; Conducteur à bague: 0.5-2.5 mm², AWG 20-10
Presse-étoupe de câble:	M25x1.5 pour câbles Ø 13...20 mm
Degré de protection:	IP 65 selon CEI 60 529 (couvercle monté)

Joint de montage (optionnel):

Matériel:	NBR ou Viton
Dimensions:	Ø 200 x Ø 178.5 x 4.25

> **ADVERTENCIA**
>
> Información contenida en este manual puede diferir del equipo provisto.
>
> Messko se reserva el derecho de alterar esta información sin previo aviso.

CE

Favor mantener esta información en sus archivos para futura referencia.

1 Seguridad

1.1 Instrucciones de Seguridad

Todo el personal involucrado en la instalación, puesta en servicio, operación y mantenimiento de este equipo debe:
- estar adecuadamente calificado, y
- observar estríctamente las instrucciones de operación.

Operación inadecuada o abuso puede conducir a:
- Heridas serias o fatales.
- Daños al equipo y otra propiedad del usuario.
- Una reducción en la eficiencia del equipo.

Las instrucciones de seguridad de este manual están representadas de tres maneras distintas para enfatizar información importante.

> **¡PELIGRO!**
>
> Esta información indica un riesgo considerable para su vida o salud. No tomar en cuenta este aviso puede conllevar a heridas de carácter serio o fatal.

> **ATENCIÓN**
>
> Esta información indica riesgo particular para el equipo u otra propiedad del usuario. Heridas serias o fatales no deben ser excluidas.

> **ADVERTENCIA**
>
> Estas notas proveen información importante acerca de una determinada materia.

1.2 Aplicación Específica

La válvula de sobrepresión mecánica proteje al transformador contra aumentos de presión excesivos. Una vez que una presión predeterminada específica es alcanzada, la válvula de sobrepresión se abre, reduce la presión dentro del tanque y se sella herméticamente por si misma una vez que se alcanza una adecuada reducción de la presión.

Es importante observar los valores límites indicados en la placa de identificación del equipo y en las instrucciones de operación, previo a la puesta en servicio.

1.3 Notes importantes acerca de la operacion del equipo

El usuario tiene la obligación de observar las regulaciones de salud y seguridad locales.

Se hace énfasis en trabajos realizados con partes activas, es decir, partes cuyo contacto implique peligro, estas deben ser permitidas solamente cuando estas estén desenergizados o debidamente aisladas.

La instalación eléctrica está sujeta a las normas nacionales de seguridad. Es imperativo conectar el equipo a tierra para asegurar una operación óptima.

> **ATENCIÓN**
>
> Instalación, conección eléctrica, puesta en servicio y mantenimiento del equipo pueden ser realizadas solamente por personal calificado y de acuerdo a las instrucciones en este manual de operación.
>
> Es responsabilidad del usuario asegurarse que el aparato se use para los fines respectivos.
>
> Por razones de seguridad todo trabajo ejecutado impropiamemte, por ejemplo, instalación, modificación, alteración del equipo, conecciones eléctricas o puesta en servicio estan prohibidos sin previamente consultar a Messko!

> **¡PELIGRO!**
>
> Todas la regulaciones contra incendio aplicables deben ser estrictamente observadas.

> **ATENCIÓN**
>
> Asegúrese de remover el aparato durante el secado de la parte activa del transformador.

2 Descripción del Producto

2.1 Modelo con cubierta estándar

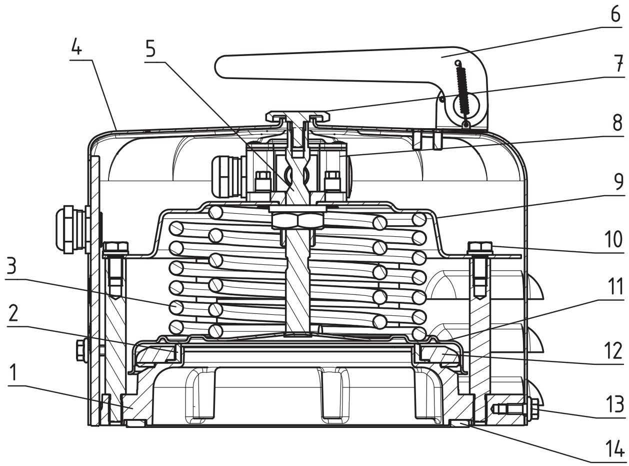


Fig. 2

Aun cuando la válvula de sobrepresión mecánica está disponible en una variedad de tipos, su diseño y modo de operación es siempre el mismo.

La brida de la cubierta (Fig. 1/1) del aparato es montada sobre el tanque del transfomador o el cambiador de tomas. Además la brida contiene un sello superior (Fig. 1/2) y un sello adicional lateral (Fig. 1/12). El disco de sellado (Fig. 1/ 11) se sella contra el empaque accionado por un paquete de resortes (Fig. 1/3). El paquete de resortes es sostenido por una placa soporte la cual esta fijada a la brida por medio de seis tornillos (Fig. 1/10). El aparato esá disponible en una variedad de presiones de

> **¡PELIGRO!**
>
> La placa soporte que tensa los resortes está sostenida por seis tornillos (Fig. 1/10). Estos tornillos no debe ser removidos bajo ninguna circunstancia!!!
>
> Caso contrario existe peligro de lesiones!!

operación. Si la presión bajo el disco de sellado excede la presión de operación del paquete de resortes, el disco de sellado se abre instantáneamente provocando una disminución de la presión interna. Subsequentemente, el paquete de resortes vuelve a cerrar el disco de sellado.

Al activarse la válvula un pin indicador de operación sobresale de la cubierta (Fig. 1/5) (rojo en caso de aceite mineral, azul en caso de aceite de silicona). Una vez que la válvula opera, este indicador queda trabado, indicando que la válvula se ha activado (Fig. 2). Además, la válvula puede ser equipada con un semáforo (Fig. 1/6) el cual se extiende en caso de accionamiemto de la válvula para llamar la atención del operador.

Opcionalmente, la válvula esta disponible con uno o dos microinterruptores (Fig. 1/8) que son operados mecánicamente por el vástago del pin indicador al momento de activarse.

Los diferentes tipo de conectores disponible son descritos en el capítulo 4.

Tipo	Presión de operación		
	[psi]	[bar]	[kPa]
LMPRD 4 psi	4 ± 1	0,28	28
LMPRD 6 psi	6 ± 1	0,41	41
LMPRD 8 psi	8 ± 1	0,55	55
LMPRD 10 psi	10 ± 1	0,69	69
LMPRD 12 psi	12 ± 1	0,83	83
LMPRD 15 psi	15 ± 2	1,03	103
LMPRD 20 psi	20 ± 2	1,38	138
LMPRD 25 psi	25 ± 2	1,72	172
LMPRD 30 psi	30 ± 2	2,07	207

Tabla 1

El modelo de válvula de alivio de presión MPreC® provisto de cubierta de control de llenado para la salida de aceite controlada

2.2 Modelo con cubierta de control de llenado (OD)

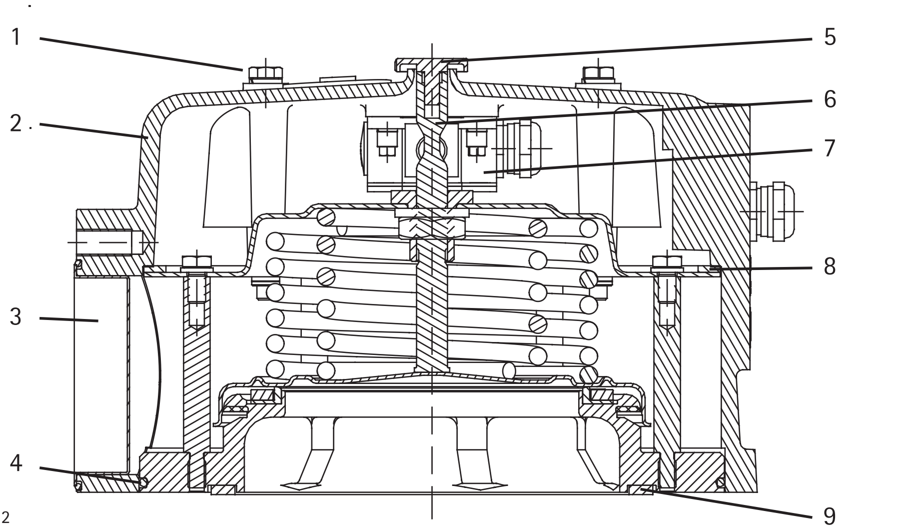


Fig. 2

es similar al diseño de una válvula de alivio de presión MPreC® con cubierta estándar.
La válvula de alivio de presión se atornilla (figura 2/2) sin cubierta a la contrabrida del transformador, procediéndose a continuación a su colocación y fijación en la válvula. La cubierta posee un orificio de salida (figura 2/3) para purgar el aceite en caso de activación. Por lo demás presenta un cerramiento hermético, mediante junta, quedando así aislada de la válvula (figura 2/4). Se puede fijar un tubo mediante bridas al orificio de salida para encauzar el aceite que vaya saliendo. Los microinterruptores (figura 2/7) se hallan capsulados mediante una junta (figura 2/8) quedando así segregados de la parte funcional de la válvula y protegidos tanto de los factores medioambientales como del aceite que vaya saliendo.

3 Instalación

3.1 Montaje para el modelo con cubierta estándar

> ⚠ **ATENCIÓN**
>
> Las instrucciones de instalación y operación dadas en este manual deben ser estríctamente cumplidas.

La válvula de sobrepresión puede ser montada de manera horizontal o vertical. Para instalación horizontal favor asegurarse de que la placa lateral (fig. 3/2) no esté nunca orientada hacia arriba o hacia abajo. Esta deberá siempre estar orientada a la derecha o a la izquierda. De la misma manera, favor asegurar-

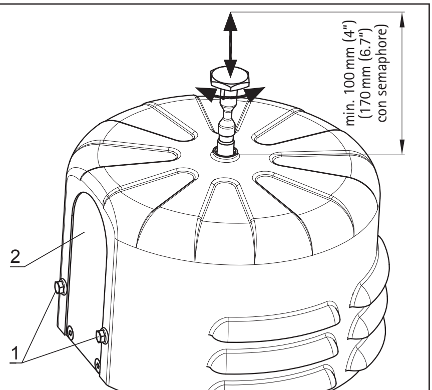


Fig. 3

se de dejar suficiente espacio sobre la válvula (min. 100 mm, 170 mm. en caso de tener semáforo, Fig. 3) de manera de dejar suficiente espacio para que el pin indicador de operación pueda sobresalir completamente de la cubierta y el semáforo (si esta incluido) pueda extenderse completamente (posición de «ALARM»).

3.1.1 Abriendo la válvula

Para instalar la válvula de sobrepresión, la cubierta (Fig. 1/4) debe ser removida. Para esto, tire del pin indicador (Fig. 1/5) y remueva la parte hexagonal con dos llaves (2) SW12 y SW32 (utilizar pinzas alternativamente). A continuación quite los dos tornillos SW10 (Fig. 3/1) de la placa base (placa vertical) y el tornillo SW10 (Fig. 1/13) en el lado opuesto. Luego quitar la cubierta.

3.1.2 Montaje de la válvula de sobrepresión

La válvula es fijada a través de los agujeros en la brida mediante tornillos M12 o tornillos de 1/2". Las dimensiones de esta son mostradas en el apéndice. Al montar el dispositivo, asegúrese de instalar el empaque (Fig. 1/14)/(Fig. 9) (incluido opcionalmente) entre el aparato y el flange del transformador.

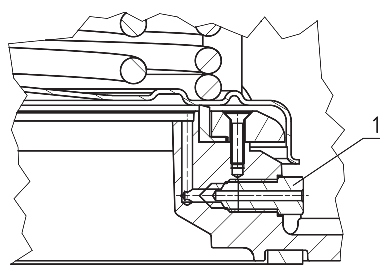


Fig. 4

3.1.3 Tornillo de Purga

Si la válvula es instalada verticalmente no existirá acumulación de gas debajo del disco de sellado de la válvula, obviando la necesidad de purgar la misma!
Si la válvula está instalada horizontalmente, esta puede ser purgada una vez que el transformador ha sido llenado con aceite. Para hacer esto, abra el tornillo de purga (Fig. 4/1) con una llave SW10 o un destornillador y ciérrelo firmemente una vez que comience a salir aceite.

> **ATENCIÓN**
> Purgar la válvula se sobrepresión en un cambiador de tomas no es permitido sin el consentimiento del fabricante del cambiador.

3.1.4 Cerrando la válvula de sobrepresión

La válvula debe ser cerrada despues de la instalación. Para este fin, coloque la cubierta de la válvula de alivio de presión de forma que los agujeros para los tornillos de montaje en la cubierta estén alineados con los correspondientes agujeros con rosca de la válvula de alivio de presión MESSKO® MPreC®.
Para asegurar la cubierta reinstale los dos tornillos (Fig. 3/1) SW10 en la placa base (placa vertical) y el tornillo SW10 (Fig. 1/13) en el lado opuesto (MA = 5 Nm).
Para terminar, vuelva a colocar la tuerca hexagonal SW32 en el pin indicador (M_A=8 Nm) y empuje este hacia abajo hasta que se detenga por completo.

> **ATENCIÓN**
> El pin indicador debe ser empujado completamente hacia adentro al finalizar el emsamble. En caso de que la válvula este equipada con un semáforo, este debe ser devuelto a su posición original de manera que el extremo quede sobre el pin indicador. Caso contrario, este indicará una condición de «ALARMA» (visual y eléctricamente).

3.2 Montaje del modelo con cubierta de control de llenado

La válvula de descarga de presión se instala sobre una contrabrida en el transformador o similar.
Para proceder al montaje, en primer lugar se ha de retirar la cubierta de control de llenado (figura 2/2). A tal efecto, extraer el pin indicador (figura 2/6) y desenroscar la caperuza (figura 2/5) del mismo sirviéndose de 2 llaves fijas de ancho 12 y ancho 32 (alicates como alternativa). A continuación, desenroscar los 4 tornillos de ancho 13 (figura 2/1) situados sobre la cubierta y levantar la cubierta.
Para el montaje, atornillar en primer lugar la brida de la carcasa con el conjunto de resortes sirviéndose de los 6 orificios. Bajo el aparato se habrá de incorporar una junta de montaje (se suministra de manera opcional) (figura 2/9).

> **ATENCIÓN**
> Sólo se puede purgar de aire la válvula con la cubierta desmontada. Proceder a tal efecto según el cap. 3.1.3.

A continuación, colocar la cubierta sobre el conjunto de resortes. Girar la cubierta a la posición apropiada y apretar ligeramente los 4 tornillos varias veces en cruz (figura 2/1) para evitar que la cubierta se ladee al bajar. Una vez haya descendido, apretar los 4 tornillos de igual manera a un par de apriete de hasta 23 Nm, con el fin de garantizar una presión uniforme sobre la junta plana interior (figura 2/9). Para concluir, volver a enroscar la caperuza sobre el pin indicador.

> **ATENCIÓN**
> Presionar a continuación el pin indicador para volver a introducirlo en el aparato. En caso de haber semáforo, plegarlo de forma que la punta recaiga sobre el pin indicador. Por lo demás, aparece una indicación en caso de activación de la válvula de alivio de presión (de forma visual y eléctrica).

Se puede fijar mediante bridas un tubo de descarga o similar a la parte delantera del aparato. La junta y los tornillos provistos de arandelas de resorte se suministran con el aparato. Se puede solicitar de forma opcional en el pedido una brida empernada o de solddura.

> **ATENCIÓN**
> Para protegerlo durante el transporte, el orificio de salida se bloquea con una inserto de plástico (figura 2/3). Este debe ser retirado antes de instalar la válvula y bajo ningún concepto se utilizará como tapón de cierre durante el servicio.

4 Conección eléctrica (opcional)

Los microinterruptores, suministrados opcionalmente con el aparato, pueden ser conectados de la siguiente manera:

- Conección interna con prensacables
- Conección con conector tipo ANSI o Westinghouse
- Conección por medio de caja de terminales

Obsérvense además las figuras 6 a 11.

Cada microinterruptor incluye un contacto NA y NC aislados eléctricamente.

> **ATENCIÓN**
>
> La conección eléctrica del aparato sólo puede ser ejecutada por personal capacitado entrenado en la regulaciones de salud y seguridad aplicables de país en cuestión.

> **¡PELIGRO!**
>
> Peligro de alto voltage!
>
> Es imperativo desenergizar el aparato antes de abrir el compartimiento de los microinterruptores o la caja terminal.

4.1 Conección con prensacable

Para conectar un microinterruptor, comience por abrir la válvula (capítulo 3.1.1). A continuación remueva los cuatro tornillos del compartimiento de los microinterruptores y retire la tapa. El cable a conectar debe estar adecuadamente preparado y aislado. Abra el prensacable M20x1.5 (para conductores Ø 8...15 mm) en la placa lateral (Fig. 3/2) y en el compartimiento de los microinterruptores (Fig. 6, página 28) SW24 para después pasar el cable a través de los dos prensacables.

El microinterruptor se conecta de acuerdo al esquema de conección; conecte los cables a las las cuatro terminales más un cable a tierra (ME) (Fig. 6, página 28). Para terminar ajuste los prensacables (M_A=5.0 Nm), y cierre el compartimiento del microinterruptor.

4.2 Conección por caja de terminales

Para abrir la caja retire los cuatro tornillos. Remueva la cubierta del cable, la aislación de los conductores debe ser removida aproximadamente unos 7 mm. Abra los prensacables M25x1.5, con una llave de 32 mm (para líneas de Ø 13 a 20 mm) e introduzca el cable a través. El cableado se debe hacer de acuerdo al esquema de conección (Fig. 8, página 29) en las terminales numeradas. Para finalizar cierre los prensacables (M_A=6.7 Nm) y la caja de terminales.

4.3 Conección por medio de conector tipo ANSI

Antes de conectar la válvula de sobrepresión asegúrese de que el conector es compatible con el receptáculo localizado en la placa lateral. La aislación del cable debe ser removida y los conductores preparados debidamente. Los conductores deben ser conectados de acuerdo al esquema Fig. 10, página 30 para uno o dos microinterruptores. Inserte el conector en el receptáculo y enrósquelo en sentido horario hasta que este llegue tan adentro como sea posible. Es recomendable sostener el cable durante esta operación para asegurarse de que este no gire.

5 Operación y mantenimiento

5.1 Puesta en servicio

La válvulade sobrepresión estará lista para operar después de realizadas la instalación y conecciones correspondientes.

Para probar los microinterruptores proceda como se indica a continuación. Tire el pin indicador de la cubierta a la posición «ALARMA» (Fig. 5) de manera que este sea activado. A continuación empuje el pin indicador hacia abajo a la posición de «OPERACIÓN» de manera que los microinterruptores vuelvan la posición de operación.

En caso de que una desconección temporal de la válvula sea necesaria, es importante segurarse que las protecciones del tranformador desenergizarán completamente la unidad en caso de que el pin indicador esté en la posición de «ALARMA».

Al realizar esta prueba favor asegurarse de que:

- El transformador esté desenergizado,
- Que la conección a tierra del transformador esté conectada,y
- Que el equipo automático extintor de incendio es confiable y funcional.

La energización de la unidad sólo es permitida una vez que la válvula de sobrepresión se encuentre en posición «OPERACIÓN», y el pin indicador esté en su posición espectiva.

5.2 Pin indicador en posición de «OPERACIÓN»

Si el pin indicador se encuentra en posición «OPERACIÓN» significa que no se ha producido la activación de la válvula de sobrepresión. No obstante, en caso de que un interruptor emita una señal esta podría atribuirse a un error en el circuito correspondiente. En tal caso, compruebe el circuito en cuestión.

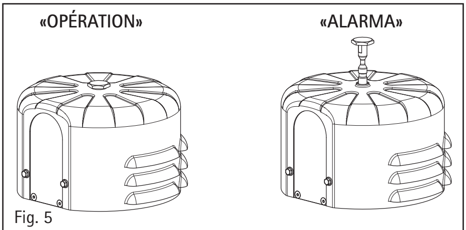


Fig. 5

5.3 Pin indicador en posición de «ALARMA»

Si el pin indicador se encuentra en la posiciónde «ALARMA», signifca que la válvula de sobrepresión se ha activado.

En este caso se deben aclarar las siguientes preguntas y onerse en contacto con el fabricante del transformador y del cambiador de tomas bajo carga a fin de adoptar las medidas necesarias:

- Ha salido aceite de la vávula de sobrepresión?
- Ha sido el transformador sometidos a esfuerzos mecánicos?
- Cuan intenso fué el esfuerzo antes del la activación del aparato?
- Se realizaron ajustes o trabajos en el cambiador de tomas bajo carga justo antes de la activación del aparato?
- Elementos de protección adicionales respondieron al mismo tiempo que la válvula de sobrepresión se activó?
- Se produjo la activación de la válvula durante el proceso de cambio de tomas?
- Se registraron sobrevoltajes en el sistema al momento que la válvula se activó?
- Cuan alta es la presión de la columna de aceite a la que está sometida la válvula (diferencia de altura entre el tanque conservador y la válvula de sobrepresión)?

ATENCIÓN

Presionar a continuación el pin indicador para volver a introducirlo en el aparato. De lo contrario no se podrá indicar una nueva activación de la válvula.

5.4 Mantenimiento

Mantenimiento regular del aparato no es requerido. Se recomienda observar lo siguiente durante cada inspección de rutina del transformador:

- Verifique el estado general de la unidad en cuanto a posibles daños externos y suciedad. Si es necesario remueva la suciedad.

¡PELIGRO!

Respete indefectiblemente las prescripciones de seguridad correspondientes; en caso contrario existe peligro de muerte.

6 Datos técnicos

Dimensiones:	Vea el anexo
Abertura de descarga (versión con cubierta de control de llenado (OD)):	90 mm (3,54“)
Peso:	Aprox. 8 kg con cubierta estándar Aprox. 11 kg con cubierta de control de llenado (OD)
Materiales:	Todos los componentes son resistentes a la intemperie y al aceite de transformador. Los componentes externos son resistentes al ambiente salino y rayos UV.

Características técnicas

Lugar de instalación:	Exterior o interior, resistente a ambiente tropical
Temperatura ambiente:	-50...+80 °C (mecánica) -40...+80 °C (microinterruptor)
Temperatura de aceite:	-30...+120 °C
Presión de operación:	Vea tabla 1
Hermeticidad de la válvula:	Prueba de hermeticidad con helio a alta presión

Microinterruptor

Contacts:	Uno NA y un NC por cada microinterruptor, eléctricamente aislados.
Clasificación:	IEC 60947-5-1 AC-15/DC-13
Capacidad de los contactos:	AC 3 A/240 V; 6 A/120 V DC 1.1 A/250 V; 2.2 A/125 V
Corriente continua máxima:	10A
Tensin de aislación nominal:	AC: 2,500 V/1 min.

Conección por prensa cables:

Terminales:	monofilamento: 0.5-2.5 mm², AWG 20-10 Conductor con ferrul: 0.5-1.5 mm², AWG 20-15
Prensa cables:	M25x1.5 para cables Ø 8...15 mm
Grado de protección:	IP 65 según IEC60 529 (para instalación sobre una cubierta)

Conector ANSI:

cables:	AWG 16, S00W, 600 V
Largo del cable:	según requerimiento (24“...240“estandar)
Grado de protección:	IP 65 según IEC 60 529 (para instalación sobre una cubierta)

Caja de terminales:

Terminales:	monofilamento: 1-4 mm², AWG 18-8; Conductor con ferrul: 0.5-1.5 mm², AWG 20-10
Prensa cable:	M25x1.5 para cables Ø 13...20 mm
Grado de protección:	IP 65 según IEC 60 529 (para instalación sobre una cubierta)

Empaque de instalación (opcional):

Material:	NBR o Viton
Dimensiones:	Ø 200 x Ø 178.5 x 4.25

7 Anhang/Appendix/Annexe/Annexe

7.1 Anschluss über Kabelverschraubungen Version Standardhaube/Cable gland connection model with standard cover/ Raccordement du presse-étoupe de câble version capot standard/Conexión mediante racores para cables versión cubierta estándar

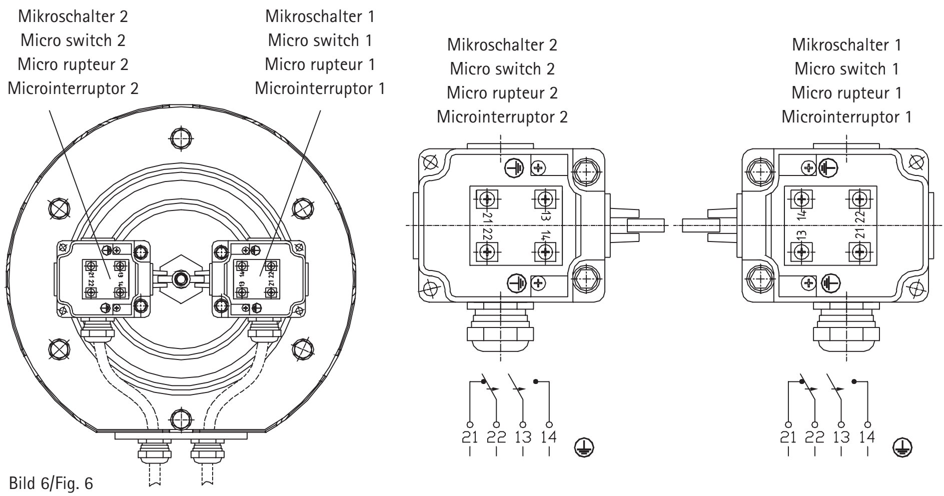
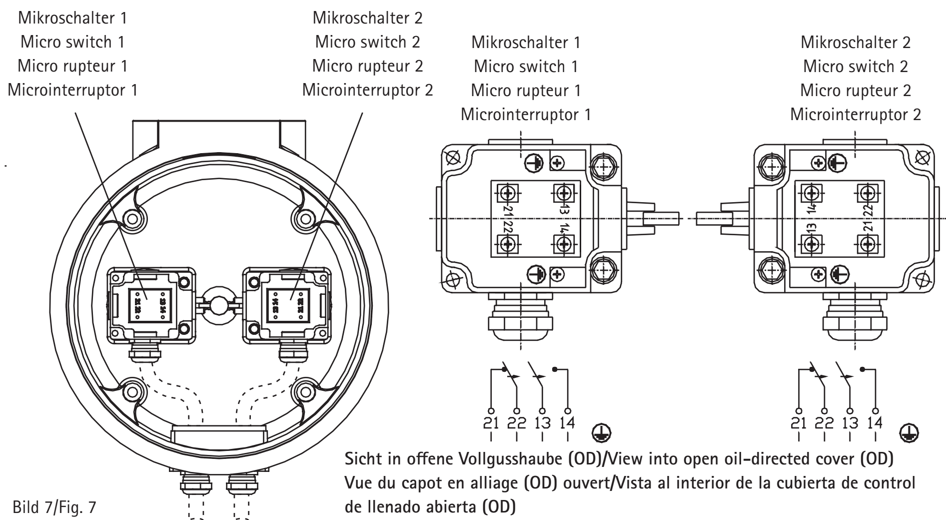


Bild 6/Fig. 6

7.2 Anschluss über Kabelverschraubungen an Vollgusshaube (OD)/Cable gland connection model with oil-directed cover (OD) Raccordement du presse-étoupe de câble version capot en alliage (OD)/Conexión mediante racores para cables a la cubierta de control de llenado (OD)

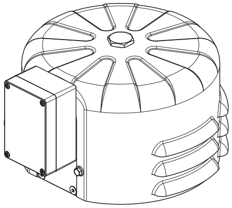


Sicht in offene Vollgusshaube (OD)/View into open oil-directed cover (OD) Vue du capot en alliage (OD) ouvert/Vista al interior de la cubierta de control de llenado abierta (OD)

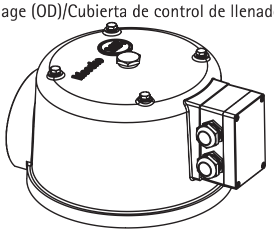
Bild 7/Fig. 7

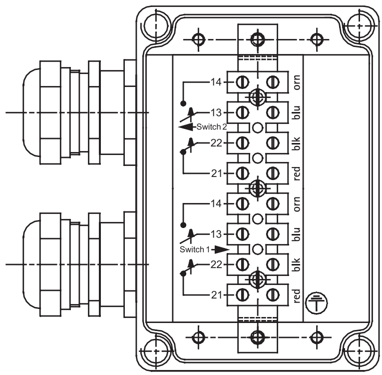
7.3 Anschluss über die Anschluss-Box/Connection via terminal box/ Raccordement par boîte à bornes/Conección por caja de terminales

Standardhaube/Standard Cover
Capot standard/Cubierta estándar



Vollgusshaube (OD)/Oil-directed Cover (OD)
Capot en alliage (OD)/Cubierta de control de llenado (OD)



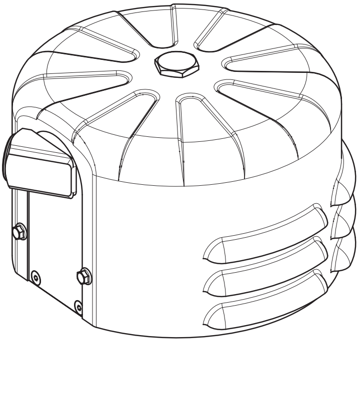


siehe auch Kap 7.1 und 7.2/see also chapter 7.1 and 7.2
voir aussi chap 7.1 et 7.2/véase además cap 7.1 y 7.2

Bild 8/Fig. 8

7.4 Anschluss mit ANSI-Stecker/Connection with ANSI connector/ Raccordement à l'aide d'un raccord ANSI/Conección por medio de conector tipo ANSI

Standardhaube/Standard Cover
Capot standard/Cubierta estándar



Vollgusshaube (OD)/Oil-directed Cover (OD)
Capot en alliage (OD)/Cubierta de control de llenado (OD)

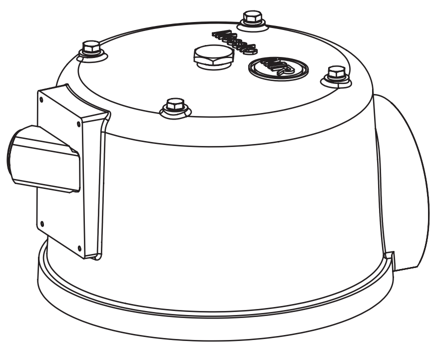
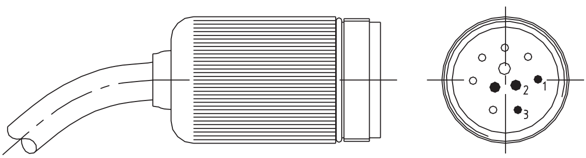
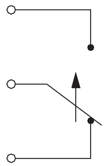


Bild 9/Fig. 9

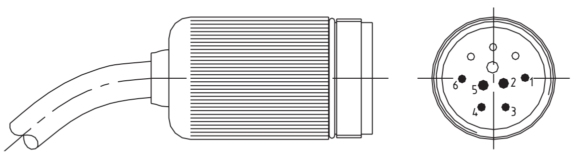
ANSI-Stecker 1 Mikroschalter/ANSI-connector 1 micro-switch
Raccord ANSI 1 micro rupteur/Conector ANSI 1 microinterruptor



- Pin 1 (schwarz, black, noir, negro)
- Pin 2 (rot, red, rouge, rojo)
- Pin 3 (blau, blue, bleu, brun)



ANSI-Stecker 2 Mikroschalter/ANSI-connector 2 micro-switch
Raccord ANSI 2 micro rupteur/Conector ANSI 2 microinterruptor



- Pin 1 (schwarz, black, noir, negro)
- Pin 2 (rot, red, rouge, rojo)
- Pin 3 (blau, blue, bleu, brun)
- Pin 4 (orange, orange, orange, naranjo)
- Pin 5 (gelb, yellow, jaune, amarillo)
- Pin 6 (braun, brown, azúl, café)

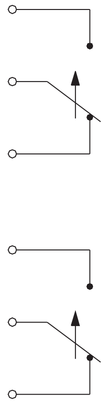
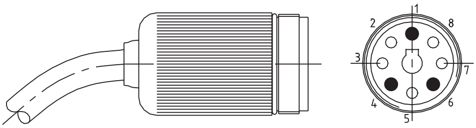


Bild 10/Fig. 10

7.5 Anschluss mit Westinghouse-Stecker/Westinghouse connector connection/ Raccordement à l'aide d'un raccord Westinghouse/Conexión por medio de conector tipo Westinghouse

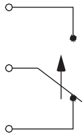
Westinghouse-Stecker für 1 Mikroschalter ohne Erdung
Westinghouse-connector for 1 micro-switch without grounding
Raccord Westinghouse 1 micro rupteur
Conector Westinghouse 1 microinterruptor



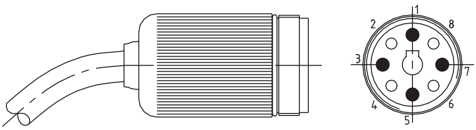
– Pin 4 (grün, green, vert, verde

– Pin 6 (weiß, white, blanc, blanco)

– Pin 1 (schwarz, black, noir, negro)



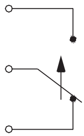
Westinghouse-Stecker für 1 Mikroschalter mit Erdung
Westinghouse-connector for 1 micro-switch with grounding
Raccord Westinghouse 1 micro rupteur
Conector Westinghouse 1 microinterruptor



– Pin 3 (grün, green, vert, verde

– Pin 7 (weiß, white, blanc, blanco)

– Pin 1 (schwarz, black, noir, negro)



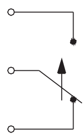
– Pin 5 (rot, red, rouge, rojo

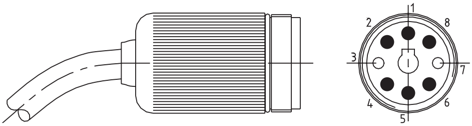
Westinghouse-Stecker für 2 Mikroschalter ohne Erdung
Westinghouse-connector for 2 micro-switch without grounding
Raccord Westinghouse 2 micro rupteur
Conector Westinghouse 2 microinterruptor

– Pin 5 (blau, blue, bleu, brun)

– Pin 6 (orange, orange, orange, naranjo)

– Pin 1 (rot, red, rouge, rojo





– Pin 8 (grün, green, vert, verde

– Pin 2 (weiß, white, blanc, blanco)

– Pin 4 (schwarz, black, noir, negro)

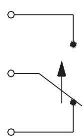


Bild 11/Fig. 11

siehe auch Bild 9/see also Fig. 9
voir aussi fig. 9/ver también figura 9

7.6 Abmessungen mit Standardhaube/Dimensions with standard cover Dimensions avec capot standard/Dimensiones con cubierta estándar

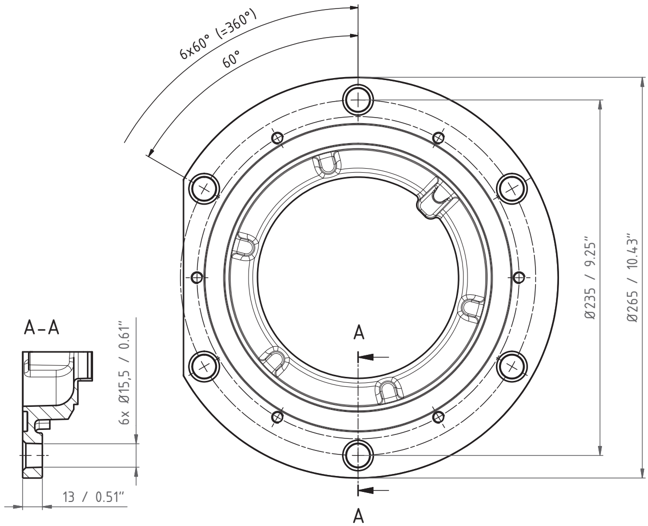


Bild 12/Fig. 12

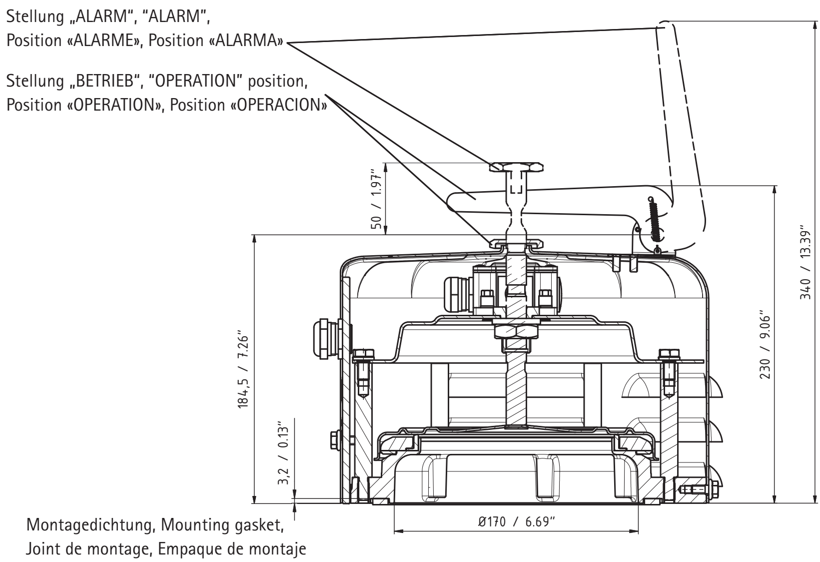


Bild 13/Fig. 13

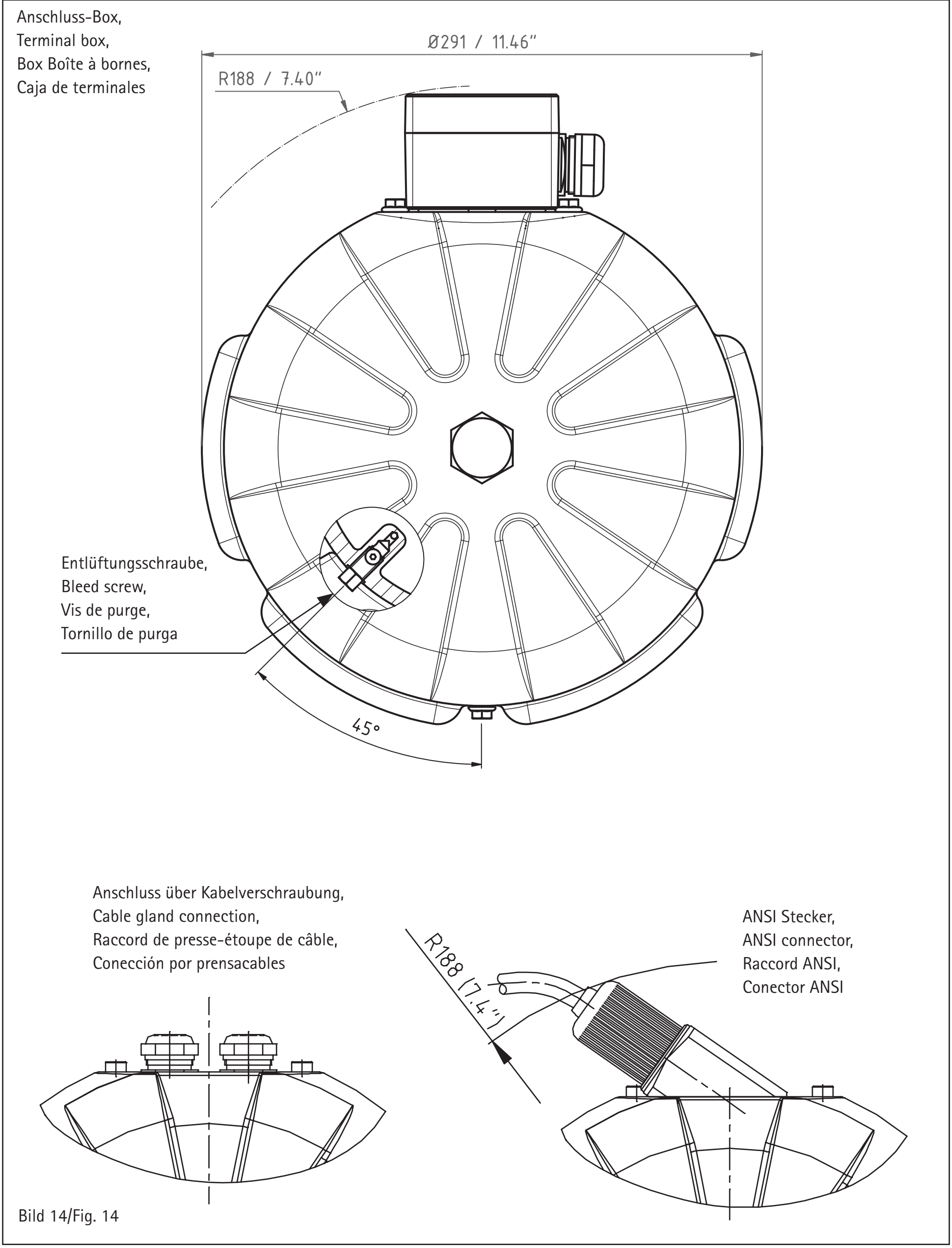


Bild 14/Fig. 14

7.7 Abmessungen mit Vollgusshaube (OD)/Dimensions with oil-directed cover (OD)
Dimensions avec capot en alliage (OD)/Dimensiones con cubierta de control de llenado (OD)

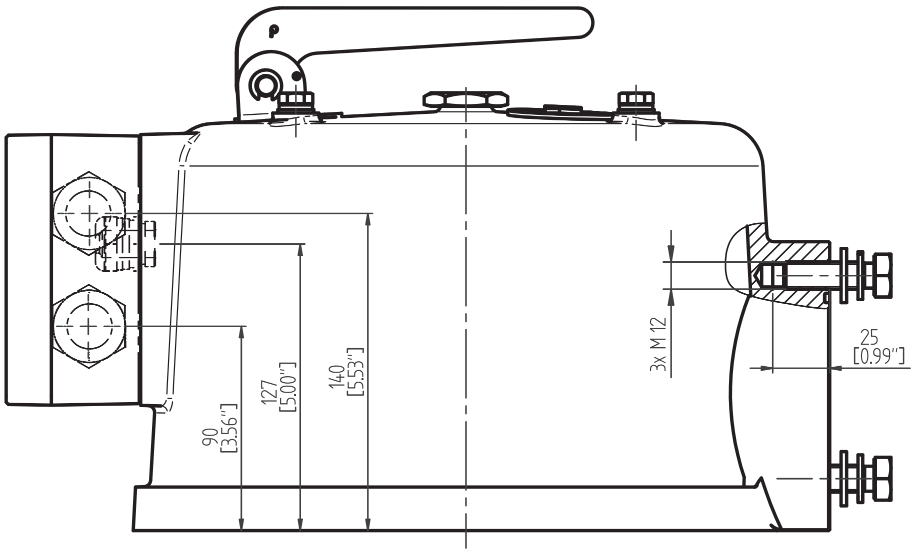


Bild 15/Fig. 15

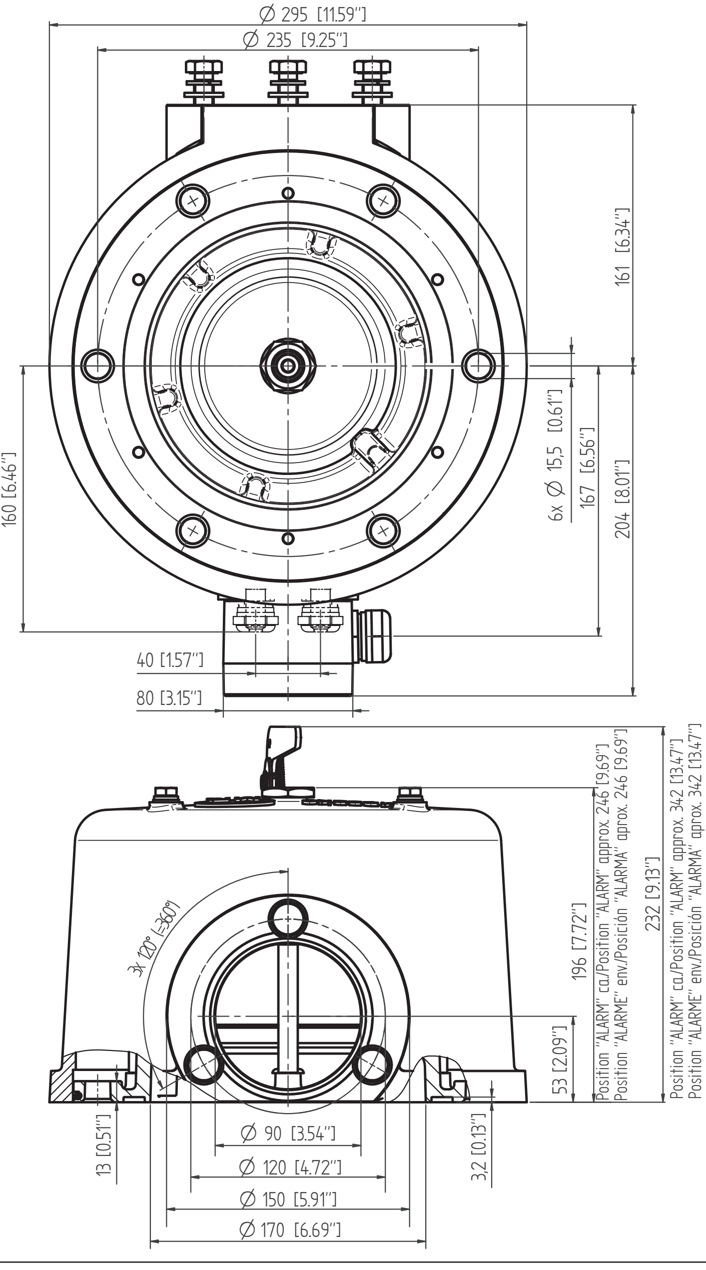


Bild 16/Fig. 16

Messko GmbH
Gewerbegebiet An den Drei Hasen
Messko-Platz 1, 61440 Oberursel, Germany

Phone: +49 6171 6398-0
Fax: +49 6171 6398-98
Email: info@messko.com

www.messko.com

Please note:
The data in our publications may differ from the data of the devices delivered. We reserve the right to make changes without notice.

BA2066/05/07 DE-EN-FR-ES – MESSKO® MPreC® –
MS99084003 – 05/14 –

THE POWER BEHIND POWER.

www.messko.com

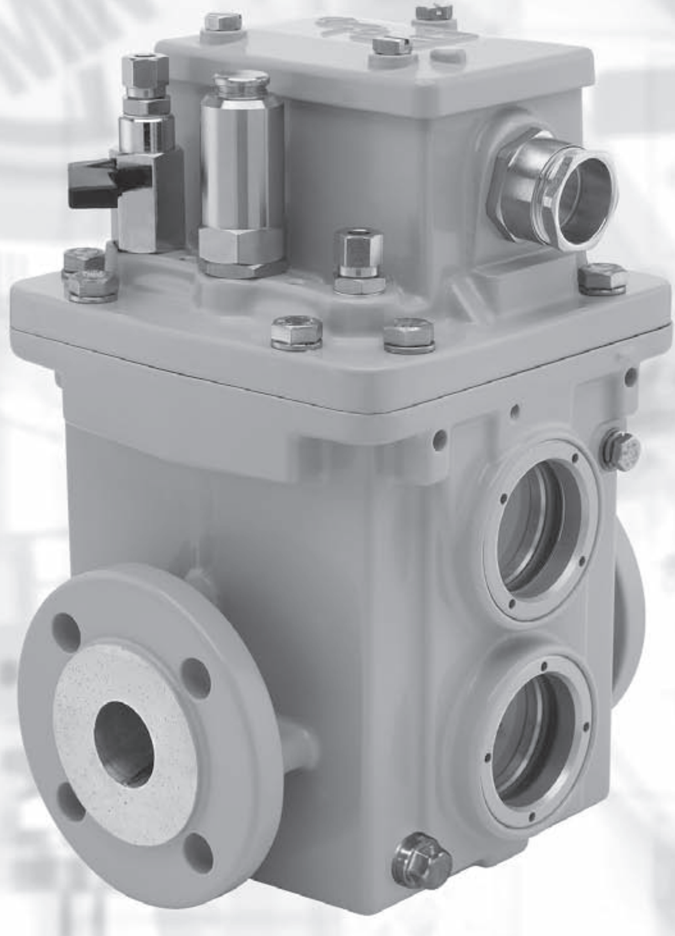
MESSKO® MSafe® Buchholzrelais / Buchholz relay

Betriebsanleitung / Operating Instructions

BA2722549/01: deutsch
english

MESSKO® MSafe®-Serie:
MESSKO® MSafe®-Series:

MBR25-6
MBR25-16
MBR25-G
MBR50-6
MBR50-16
MBR80-6/4
MBR80-16/8
MBR80-16/4
MBR80-CH
MBR80-QU



Vor der Montage und Inbetriebnahme folgende Hinweise beachten!
Before installing and commissioning observe the following notes.

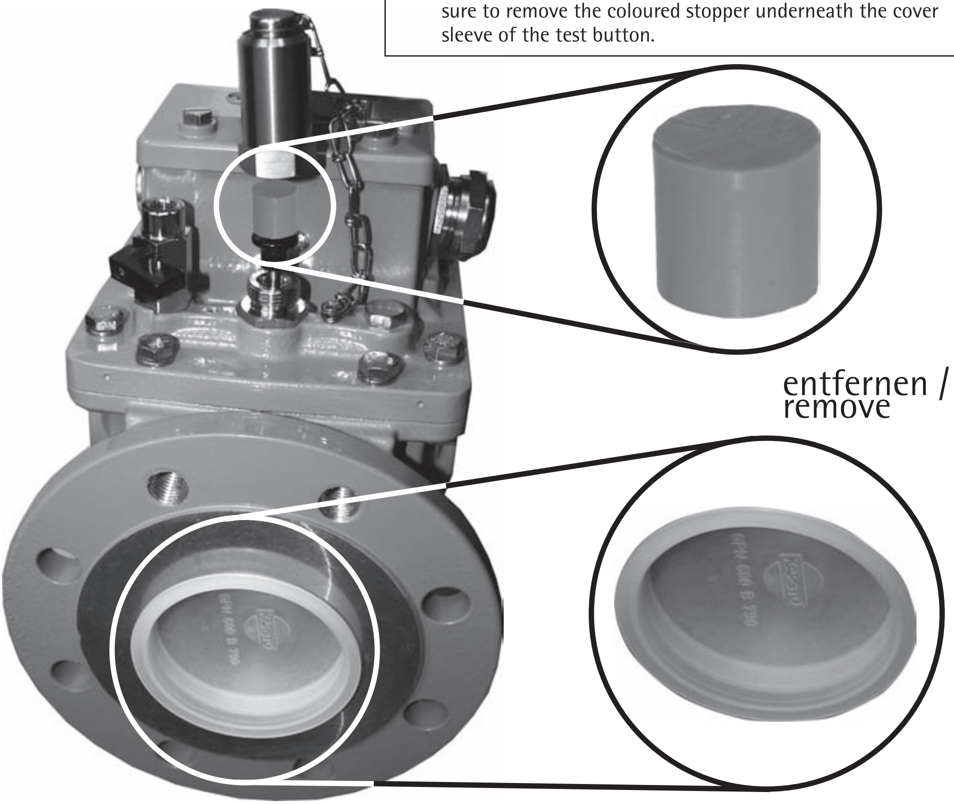
HINWEIS / NOTE

- Vor der Montage des Buchholzrelais die Plastikabdeckung auf beiden Flanschöffnungen entfernen!

  Vor Inbetriebnahme des Geräts unbedingt den farbigen Stopfen unterhalb der Abdeckhülse des Prüftasters entfernen!

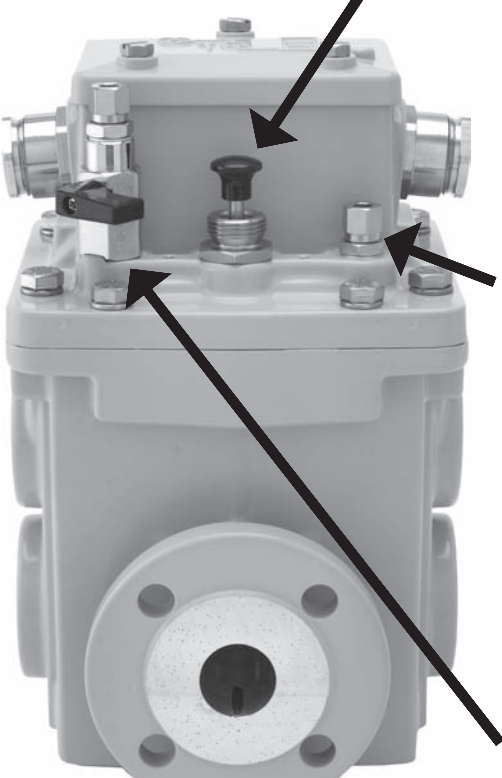
- Make sure to remove the plastic cover on both flange openings before mounting the buchholz relay!

  Before you commission the device, you must be absolutely sure to remove the coloured stopper underneath the cover sleeve of the test button.



HINWEIS / NOTE

- Bei Nichtverwendung des Prüftasters diesen mit der mitgelieferten Abdeckhülse sichern!
- Secure with the cover sleeve when not using the test button!



HINWEIS / NOTE

- Ist das Gerät mit dem optionalen Anschluss für pneumatische Prüfung bestückt, dann diesen bei Nichtgebrauch mit der mitgelieferten Verschlusskappe sichern!
- If the device is equipped with the optional connection for pneumatical test, secure when not in use with the supplied closing cap!

HINWEIS / NOTE

- Bei Nichtverwendung des Gasentnahmeventils dieses mit der mitgelieferten Verschlusskappe sichern!
- Secure with supplied closing cap when not using the gas withdrawl valve!

Inhaltsverzeichnis

Contents

! HINWEIS

Die in dieser Betriebsanleitung enthaltenen Angaben können von dem gelieferten Gerät abweichen.

Änderungen bleiben vorbehalten.

CE

! Note

Data contained herein may differ in details from the equipment delivered.

We reserve the right to make alterations without notice.

Für zukünftige Verwendung aufbewahren!

Please keep this manual for future reference!

1 Sicherheit

1.1 Sicherheitshinweise

Alle Personen, die mit der Montage, Inbetriebnahme, Bedienung und Instandhaltung des Geräts zu tun haben, müssen

- fachlich ausreichend qualifiziert sein und
- diese Betriebsanleitung genau beachten.

Bei Fehlbedienung oder Missbrauch drohen Gefahren für

- Leib und Leben,
- das Gerät und andere Sachwerte des Betreibers und
- die effiziente Funktionsweise des Gerätes.

In dieser Betriebsanleitung werden drei Arten von Sicherheitshinweisen verwendet, um wichtige Informationen hervorzuheben.

WARNUNG

weist auf besondere Gefahren für Leib und Leben hin. Ein Nichtbeachten dieser Hinweise kann zu schwersten Verletzungen oder Tod führen.

ACHTUNG

weist auf Gefahren für das Gerät oder andere Sachwerte des Betreibers hin. Ferner können Gefahren für Leib und Leben nicht ausgeschlossen werden.

HINWEIS

weist auf wichtige Informationen zu einer konkreten Thematik hin.

1.2 Bestimmungsgemäße Verwendung

Das MSafe® übernimmt die Funktion einer zentralen Schutzeinrichtung für flüssigkeitsgefüllte Transformatoren und Drosselspulen mit Ausdehnungsgefäß. Es überwacht den Isolierflüssigkeitskreislauf auf das Vorhandensein von freien Gasen, auf Isolierflüssigkeitsverlust infolge von Undichtigkeiten und auf eine Druckwelle infolge eines spontanen Ereignisses, die sich in Richtung Ausdehnungsgefäß bewegt.

Beachten Sie die angegebenen Grenzwerte auf dem Typenschild und in der Betriebsanleitung vor der Inbetriebnahme des Geräts und halten Sie diese unbedingt ein.

1.3 Hinweise für den Betrieb des Geräts

Die nationalen Unfallverhütungsvorschriften hat der Anwender unbedingt einzuhalten.

Es wird besonders darauf hingewiesen, dass das Arbeiten an aktiven, d.h. berührungsgefährlichen Teilen nur zulässig ist,

ACHTUNG

Einbau, elektrischer Anschluss und Inbetriebnahme des Geräts dürfen ausschließlich von qualifiziertem, ausgebildetem Personal gemäß dieser Betriebsanleitung durchgeführt werden.

Der Betreiber hat für die bestimmungsgemäße Verwendung des Geräts Sorge zu tragen.

Eigenmächtig und unsachgemäß durchgeführte Arbeiten bei Ein- und Umbau, elektrischem Anschluss, Inbetriebnahme und Wartung – ohne Rücksprache mit Messko – sind aus Sicherheitsgründen verboten!

WARNUNG

Beachten Sie unbedingt die nationalen Brandschutzvorschriften und die Vorschriften für den Umgang mit toxischen und brennbaren Gasen.

wenn diese Teile spannungsfrei und gegen Wiedereinschalten gesichert oder gegen direktes Berühren geschützt sind.

Bei der elektrischen Installation sind die nationalen Vorschriften zu beachten. Schließen Sie unbedingt den Schutzleiter an, um einen störungsfreien Betrieb zu gewährleisten.

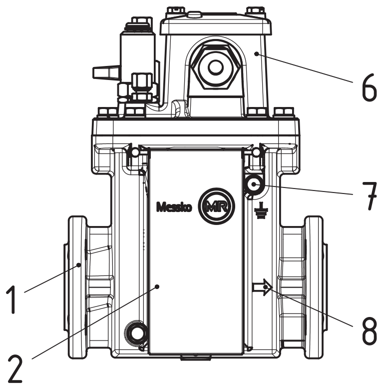
2 Produktbeschreibung

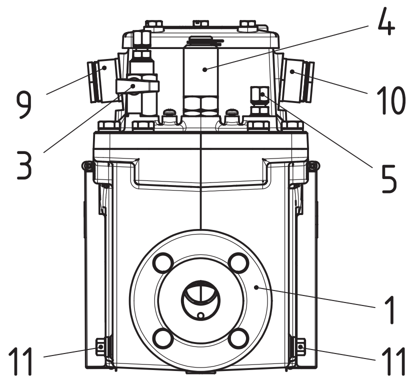
In die Rohrleitung zwischen Kessel und Ausdehnungsgefäß eingebaut, spricht das MSafe® auf Fehler an, die im Inneren des zu schützenden Transformators auftreten. Nicht sichtbare Schäden können durch das Buchholzrelais frühzeitig erkannt und dazu verwendet werden, die zu schützende Einrichtung direkt abzuschalten:

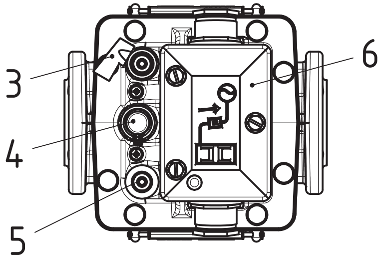
- In Richtung Ausdehnungsgefäß wandernde Gase lösen das Meldesystem des Bucholzrelais aus.
- Eine bei rascher Gasentwicklung entstehende Druckwelle löst das Meldesystem des Bucholzrelais aus.
- Bei zu niedrigem Ölstand im Ausdehnungsgefäß und bei Ölverlust übernimmt das Buchholzrelais die Funktion eines Ölstandmelders.

Es ist als Zweischwimmer-Buchholzrelais in unterschiedlichen Ausführungen für die Nennrohrdurchmesser DN25, DN50 und DN80 erhältlich.

- MBR25-6, MBR25-16 und MBR25-G (Gewinde 1 1/2")
- MBR50-6 und MBR50-16
- MBR80-6/4, MBR80-16/8 und MBR80-16/4
- MBR80-CH und MBR80-QU (quadratischer Flansch)
- Es ist auf Kundenwunsch mit bis zu 4 Schliessern, Öffnern und/oder Wechslern bestückbar.







1 Rohranschlussflansch
2 Schauglasabdeckung (optional)
3 Gasentnahmeventil
4 Prüftaster mit Abdeckhülse
5 Anschluss pneumatische Prüfung (optional)
6 Anschluss-Box
7 Erdungsschraube
8 Fließrichtung (roter Pfeil)
9 Kabelverschraubung links
10 Kabelverschraubung rechts
11 Ölablassschraube

Bild 1

Folgende Ausführungen werden optional angeboten:

- Schauglasabdeckung
- Reset für Funktionstest (Prüftaster)
- Anschluss für pneumatische Prüfung
- Offshore-Ausführung

2.1 Wirkungsweise

Das Buchholzrelais ist im Verbindungsrohr zwischen Transformatorkessel und Ausdehnungsgefäß eingebaut und reagiert auf Störungen wie folgt:

a) In der Isolierflüssigkeit ist freies Gas vorhanden

Das Gas wandert in der Flüssigkeit nach oben, sammelt sich im Gasraum des Buchholzrelais und verdrängt die Isolierflüssigkeit. Mit fallendem Flüssigkeitsspiegel sinkt der obere Schwimmer. Durch die Bewegung des Schwimmers wird ein Schaltkontakt betätigt (Magnetschaltröhre), der ein Signal (Warnung) auslöst. Der untere Schwimmer bleibt unbeeinflusst, da ab einer bestimmten Gasmenge diese über die Rohrleitung zum Ausdehnungsgefäß abströmt.

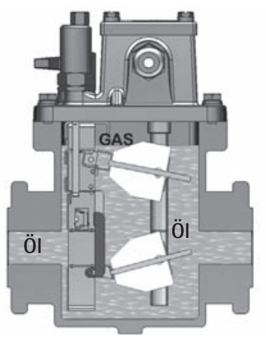


Bild 2

b) Isolierflüssigkeitsverlust infolge von Undichtigkeiten

Mit dem Flüssigkeitsniveau sinkt zunächst der obere Schwimmer nach unten. Es wird ein Signal (Warnung) ausgelöst. Bei weiterem Flüssigkeitsverlust entleeren sich Ausdehnungsgefäß und Rohrleitung sowie das Buchholzrelais. Mit fallendem Flüssigkeitsspiegel sinkt der untere Schwimmer. Durch die Bewegung des Schwimmers wird ein Schaltkontakt betätigt, wodurch die Abschaltung des Trafos erfolgen kann (Alarm).

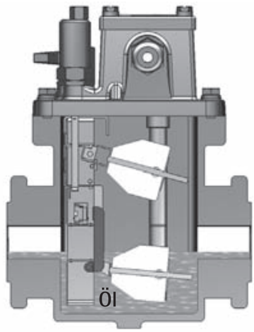


Bild 3

c) Infolge eines spontanen Ereignisses entsteht eine Druckwelle, die sich in Richtung Ausdehnungsgefäß bewegt

Die Strömung trifft auf die im Flüssigkeitsstrom angeordnete Stauklappe. Übersteigt die Strömungsgeschwindigkeit die Ansprechempfindlichkeit der Stauklappe, bewegt sich diese in Strömungsrichtung. Durch diese Bewegung wird ein Schaltkontakt betätigt, wodurch die Abschaltung des Trafos erfolgen kann (Alarm).

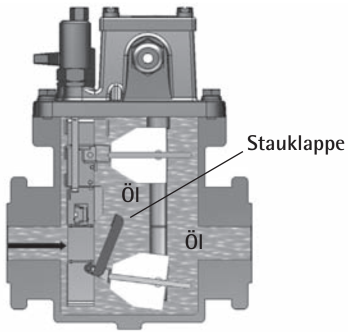


Bild 4

3 Montage

Achten Sie auf die unterschiedlichen Abmessungen und Bauformen des MSafe® (siehe Anhang Kap. 9.2/9.3 Abmessungen).

Bereiten Sie das Anschlussrohr entsprechend des verwendeten Rohmaßes DN25, DN50 oder DN80 mit einem passenden Anschlussflansch vor.

3.1 Einbau in Rohrleitung

Montieren Sie den MSafe®-Anschlussflansch zusammen mit einer passenden Flanschdichtung so am Rohrflansch, dass der aufgedruckte Pfeil (Bild 1/8) in Fließrichtung (in Richtung Ausdehnungsgefäß) zeigt.

> ⚠ **ACHTUNG**
>
> Die in dieser Montage- und Betriebsanleitung vorgeschriebenen Betriebs- und Montagebedingungen müssen strikt eingehalten werden; andernfalls kann es zu Beschädigungen und Fehlfunktionen des Gerätes kommen.

- Die Neigung des Geräts darf in Rohrrichtung 0 Grad nicht unter- und 5 Grad nicht überschreiten (Bild 5).
- Die Neigung des Geräts quer zur Rohrrichtung darf gegenüber der Senkrechten 5 Grad nicht überschreiten (Bild 6).

3.2 Entlüften des MSafe® Buchholzrelais

> ⚠ **WARNUNG**
>
> Explosionsgefahr und Gefahr vor brennbaren und toxischen Gasen!
>
> Im Fehlerfall können im Buchholzrelais befindliche Gase in Verbindung mit Luft ein explosives Gasgemisch bilden. Rauchen oder funkenschlagende Arbeiten sind im Gefahrenbereich verboten!
>
> Das Einatmen von austretenden Gasen ist zu vermeiden, da diese toxisch sein können.

- Absperrventil zum Ausdehnungsgefäß (Bild 5/2) öffnen.
- Gasentnahmeventil des MSafe-Buchholzrelais (Bild 1/3) öffnen und Luft oder Gas entweichen lassen. Bei Austritt von Isolierflüssigkeit das Gasentnahmeventil wieder schliessen.

3.3 Isolierflüssigkeit über Ölablassschraube ablassen

Um bei Ausbau des Buchholzrelais oder Wartungsarbeiten die Isolierflüssigkeit aus dem Gerät restlos zu entfernen sind zwei Ölablassschrauben vorhanden (Bild 1/11). Dazu eine der beiden Schrauben (G 1/8") mit einem Gabelschlüssel (SW 10) abdrehen und die abfließende Isolierflüssigkeit in einem geeigneten Behälter auffangen.

Anschließend die Ölablassschraube wieder anschrauben und mit einem Drehmoment von max. 5 Nm festziehen. Dichtigkeit kontrollieren.

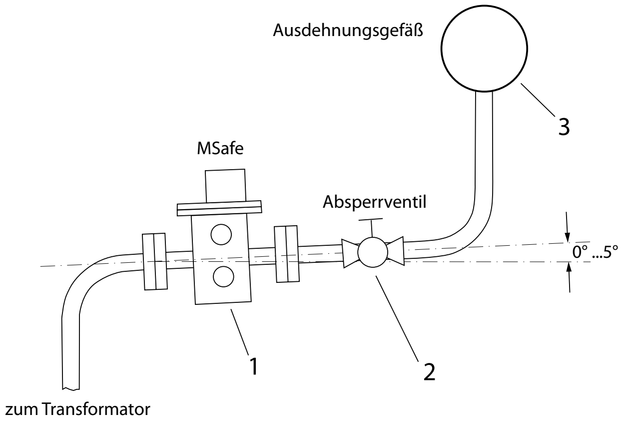


Bild 5

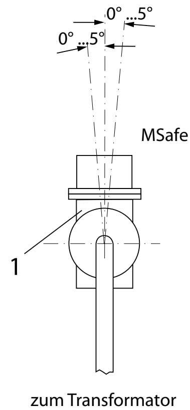


Bild 6

4 Elektrischer Anschluss

Die eingebauten Schalter können über eine Klemmleiste in der Anschluss-Box mit einer Signalisierungseinrichtung oder Fernwarte verbunden werden.

ACHTUNG

Der elektrische Anschluss darf ausschließlich von qualifiziertem, ausgebildetem Personal, welches in die entsprechenden Sicherheitsvorschriften des jeweiligen Landes unterwiesen wurde, durchgeführt werden.

WARNUNG

Elektrische, lebensgefährliche Spannung!

Vor dem Öffnen des Gerätes müssen alle Anschlussleitungen stromlos sein.

4.1 Anschluss über Anschluss-Box

Öffnen Sie die Anschluss-Box (Bild 1/6) über die 3 Befestigungsschrauben. Das Kabel für die Verdrahtung entmanteln und die Litzen ca. 7 mm abisolieren. Die gewünschte Kabelverschraubung (Bild 1/9 oder 1/10) M25x1,5 (für Leitungen Ø 13...20 mm) öffnen (SW30) und Kabel durchstecken. Die Verdrahtung erfolgt entsprechend dem Anschlussplan, der auf der Deckelinnenseite der Anschluss-Box aufgedruckt ist (siehe Anhang, Kap. 9.1, Bild 8). Der Anschlussplan entspricht dem fehlerfreien Betriebszustand. Abschließend ist die Kabelverschraubung und die Anschluss-Box wieder flüssigkeitsdicht zu verschließen.

4.2 Geräteerdung

Das Gerät kann über die Erdungsschraube (Bild 1/7) außen und/oder die Erdungsschraube in der Anschluss-Box (siehe Kap. 9 Anhang, Bild 8) geerdet werden.

5 Betrieb

5.1 Alarmtabelle

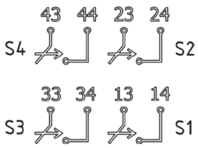
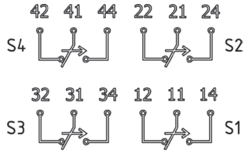
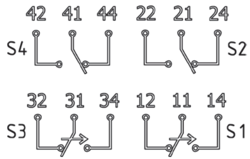
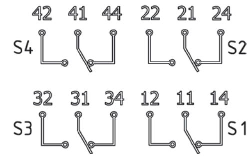
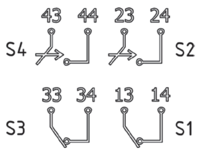
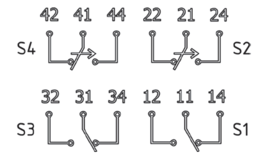
Das Messko MSafe® ist gemäß des Aufdrucks auf der Innenseite der Anschluss-Box mit bis zu 4 Schliesser-, Öffner- und/oder Wechslerkontakten bestückt. In der nachfolgenden Tabelle sind die Schalterstellungen der Schaltkontakte für den normalen Betriebszustand und für den Fehlerfall aufgeführt.

5.2 Freigabe einer blockierten Stauklappe (nur MSafe® mit Resetfunktion (optional))

Die Stauklappe kann wie folgt wieder freigegeben werden:

Die Abdeckhülse (Bild 7/2) mit einem Gabelschlüssel (SW24) lösen und abschrauben. Den darunter befindlichen Prüftaster (Bild 7/3) bis zum Anschlag nach links drehen, sodass die Stauklappe wieder freigegeben wird. Überprüfen Sie dies über das Schauglas des Schutzrelais.

Alarmtabelle

	Schliesser (NO)	Öffner (NC)	Wechsler (CO)	Bemerkung
Normaler Betriebs-zustand				Es liegt kein Fehler vor. Alle Kontakte in Ausgangsposition.
Ansammlung von Gasen				Es hat sich Gas im oberen Teil des Buchholzrelais angesammelt (Bild 2). Die Kontakte S2 und S4 (optional) haben geschaltet. Überprüfen Sie über die Schaugläser des MSafe Buchholzrelais den Pegelstand der Isolierflüssigkeit. Überprüfen Sie den Zustand des Transformators!
Isolierflüssigkeits-verlust				Es ist zu einem Verlust von Isolierflüssigkeit gekommen (Bild 3). Es wurden die Kontakte S2 und S4 (optional) sowie S1 und S3 (optional) geschaltet. Überprüfen Sie über die Schaugläser des MSafe Buchholzrelais den Pegelstand der Isolierflüssigkeit. Der Transformator wurde möglicherweise zur Sicherheit über die Kontakte S1 und S3 (optional) abgeschaltet!
Plötzlicher Isolierflüssigkeits-schwall				Es ist ein Isolierflüssigkeitsschwall aufgetreten, sodass die Stauklappe (Bild 4) aktiviert wurde. Der Transformator wurde möglicherweise zur Sicherheit über die Kontakte S1 und S3 (optional) abgeschaltet! Überprüfen Sie über die Schaugläser des MSafe Buchholzrelais die Position der Stauklappe. Überprüfen Sie den Zustand des Transformators. Zur Freigabe der Stauklappe siehe Kapitel 5.2.

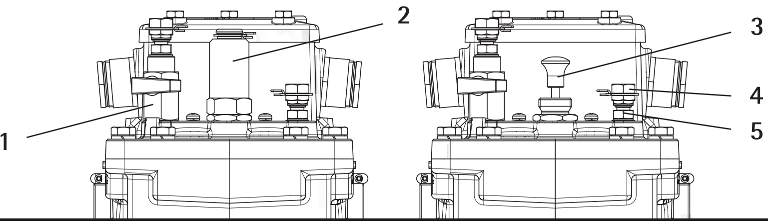


Bild 7

6 Prüfungen

6.1 Dichtigkeit

Zum Schutze der Umwelt und zur Betriebssicherheit ist es äußerst wichtig, dass keine Flüssigkeit austritt. Prüfen Sie deshalb nach der Montage den Flanschanschluss auf Leckage.

6.2 Funktionsprüfung des MSafe® über Prüftatster

Diese Prüfung ist nur bei befülltem MSafe® möglich.

• Die Abdeckhülse (Bild 7/2) mit einem Gabelschlüssel (SW24) lösen und abschrauben.

• Den darunter befindlichen Prüftaster (Bild 7/3) vollständig nach unten drücken und halten. Beide Schwimmer sollten sich gesenkt haben und über die Schutzgasmagnetschalter Signale an die Warte abgegeben haben. Funktionsbestätigung einholen!

• Prüftaster wieder in Ausgangsposition zurückführen, Abdeckhülse aufsetzen und mit Gabelschlüssel festziehen.

6.3 Funktionsprüfung des MSafe® mit Resetfunktion (optional)

Diese Prüfung ist nur bei befülltem MSafe® möglich.

Die Vorgehensweise ist wie unter Kap. 6.2 beschrieben. Darüber hinaus ist zur Freigabe der Stauklappe der Prüftaster (Bild 7/3) bis zum Anschlag nach links drehen. Überprüfen Sie dies über das Schauglas des Schutzrelais.

6.4 Pneumatische Prüfung (optional)

WARNUNG

Explosionsgefahr und Gefahr vor brennbaren und toxischen Gasen!

Im Fehlerfall können im Buchholzrelais befindliche Gase in Verbindung mit Luft ein explosives Gasgemisch bilden. Rauchen oder funkenschlagende Arbeiten sind im Gefahrenbereich verboten!

Das Einatmen von austretenden Gasen ist zu vermeiden, da diese toxisch sein können.

6.4.1 Prüfung „Ansammlung von Gasen“

Dieser Test dient der Simulation einer Gasansammlung im oberen Teil des Buchholzrelais, sodass die Kontakte S2 und S4 (optional) schalten. Benötigt wird dazu eine Pumpe, um eine Luftmenge von ca. 300 ml über den Anschluss für die pneumatische Prüfung (Bild 1/5) in das Buchholzrelais einzubringen.

Vorgehensweise:

1. Evtl. im Buchholzrelais befindliche Gase über das Gasentnahmeventil (Bild 7/1) ablassen.

2. Verschlusskappe vom Anschluss für pneumatische Prüfung (Bild 7/4) abschrauben.

3. Gelieferte Pumpe über M10x1-Adapter mit Anschluss für pneumatische Prüfung (Bild 7/4) verschrauben.

4. Über mehrere Pumpenstöße Luft in das Buchholz Relais einbringen, bis dass sich der obere Schwimmer soweit gesenkt hat, dass die Kontakte S2 und S4 (optional) schalten. Dies über ein Messgerät (elektrischer Durchgangsprüfer) prüfen bzw. über die Schaltwarte abfragen.

5. Nach Überprüfung der Funktionalität den oberen Schwimmer wieder in Ausgangsposition bringen, indem die eingebrachte Luft über das Gasentnahmeventil (Bild 7/1) abgelassen wird. Dies über die Schaugläser überprüfen.

6.4.2 Prüfung „Plötzlicher Isolierflüssigkeitsschwall“

Dieser Test dient dazu, die Stauklappe des Buchholzrelais (Bild 4) zu aktivieren und den unteren Schwimmer umzulegen, um damit die Kontakte S1 und S3 (optional) zu schalten, die ggfs. den Transformator über die Warte abschalten.

Benötigt wird dazu eine Gasflasche mit Stickstoff (N2) oder

WARNUNG

Für diese Prüfung keine brennbaren Gase, sondern Stickstoff oder Pressluft verwenden.
Stellen Sie sicher, dass die verwendete Gasflasche gegen Sturz gesichert ist.
Überprüfen Sie, dass die mit der Gasflasche verbundenen Geräte ordnungsgemäß angeschlossen und dicht sind. Achten Sie auf ordnungsgemäßes Öffnen und Schließen des Ventils.
Das Einatmen von austretendem Stickstoff ist zu vermeiden, da dies zur Erstickung führen kann.

Pressluft, um Stickstoff bzw. Pressluft bei Minimum 6,5 bar über den Anschluss für pneumatische Prüfung (Bild 7/4) „stoßartig“ in das Buchholzrelais einzubringen (kurzzeitiges Öffnen und Schließen der Gasflasche).

Vorgehensweise:

1. Evtl. im Buchholzrelais befindliche Gase über das Gasentnahmeventil (Bild 7/1) ablassen.

2. Verschlusskappe vom Anschluss für pneumatische Prüfung (Bild 7/4) abschrauben.

3. Stickstoff- oder Pressluft-Gasflasche mit geeigneten Armaturen über M10x1-Adapter mit Anschluss für pneumatische Prüfung (Bild 7/4) verschrauben.

4. Durch kurzzeitiges Öffnen und Schließen des Ventils Stickstoff oder Pressluft stoßartig in das Buchholzrelais einbringen, sodass die untere Stauklappe ausgelöst wird und der damit gekoppelte untere Schwimmer sich soweit gesenkt hat, um die Kontakte S1 und S3 (optional) zu schalten. Dies über ein Messgerät (elektrische Durchgangsprüfung) prüfen bzw. über die Schaltwarte abfragen.

5. Nach Überprüfung der Funktionalität die Schwimmer wieder in Ausgangsposition bringen, indem die eingebrachte Luft über das Gasentnahmeventil (Bild 7/1) abgelassen wird. Dies über die Schaugläser überprüfen.

Verfügt das Buchholzrelais über die optionale Resetfunktion, so ist zur Freigabe der Stauklappe der Prüftaster (Bild 7/3) bis zum Anschlag nach links zu drehen.

Überprüfen Sie dies über das Schauglas des Buchholzrelais.

⚠ **ACHTUNG**

Die eingebrachte Gasmenge kontrollieren.

Es besteht die Gefahr, dass sehr viel Gas in den Ausdehner des Transformators gelangt.

Diese Prüfung nur durch Fachkundige durchführen.

7 Wartung

Das MSafe® Buchholzrelais ist wartungsfrei.

8 Technische Daten

Abmessungen: siehe Anhang, Kap. 9.2 und 9.3 Abmessungen

Werkstoffe:

Gehäuse und Oberteil inklusive Anschluss-Box:	Al-Guss, lackiert RAL 7033 oder 7038 (ähnlich ANSI 70 lichtgrau), pulverbeschichtet; seewasserbeständige Ausführung (Offshore) (optional)
Sichtscheibe:	Sicherheitsglas mit UV-Filter

Kenndaten:

Aufstellung:	Innenraum und Freiluft, tropenfest
Umgebungstemperatur:	-50... +80° C
Temperatur Isolierflüssigkeit:	-30... +120° C (Mineralöl)
Schutzart:	IP 55 nach DIN EN 60 529
Nennrohrdurchmesser:	DN25, DN50, DN80 oder DN25 mit G 1 1/2“-Gewindeanschluss
Einbaumaße Anschlussrohr:	siehe Anhang, Kap. 9.2 Abmess.
Ansprechdruck Stauklappe:	für DN25, DN50 und DN80 auf Kundenwunsch 1 m/s, 1,5 m/s, 2 m/s oder 2,5 m/s (jeweils ±15%); 0,65 m/s oder 3 m/s auf Anfrage

Schutzgasmagnetschalter:

Anzahl und Art:	auf Kundenwunsch Schließer, Öffner und/oder Wechsler; potentialfrei; 2 Stück pro Funktion
Nennspannung:	24-250 V AC/DC
Max. Nennstrom:	2 A AC/DC
Min. Schaltstrom:	5 mA/24 V DC
Max. Durchgangsstrom:	3 A AC/DC
Max. Schaltleistung AC:	1,2 VA-400 VA
Max. Schaltleistung DC:	1,2 W-250 W
Nennisolationsspannung:	2,7 kV AC/2 Sek. Kontakte gegen Gehäuse; 1 kV AC/2 Sek. geöffnete Kontakte
Isolationswiderstand:	1000 MΩ/500 V DC

Anschluss über Anschluss-Box:

Klemmleistenbelegung:	siehe Anhang, Kap. 9.1
Anschlussklemmen:	min. 0,25 mm² / max. 4 mm²
Kabelverschraubung:	M25x1,5 für Kabel Ø 13...20mm oder 1/2“ NPT

Mechanische Prüfungen:

Prüfung:	Norm:
Vibration 5-35 Hz und 10-150 Hz bei 2 g, 2h	IEC 60068-2-6
Erdbeben 2-10 Hz, 22,5 mm, 1 h	IEC 60068-2-57
Schock 10 g, 10 ms	IEC 60068-2-27
Dauerschwingtest 100, 200, 300, 400 Hz, 1 g, 2h	

1 Safety

1.1 Safety instructions

All personnel involved in installation, commissioning, operation or maintenance of this equipment must:

- be suitably qualified and
- strictly observe these operating instructions.

Improper operation or misuse can lead to

- serious or fatal injury,
- damage to the equipment and other property of the user
- a reduction in the efficiency of the equipment.

Safety instructions in this manual are presented in three different forms to emphasize important information.

WARNING

This information indicates particular danger to life and health. Disregarding such a warning can lead to serious or fatal injury.

CAUTION

This information indicates particular danger to the equipment or other property of the user. Serious or fatal injury cannot be excluded.

NOTE

These notes give important information on a certain issue.

1.2 Specified application

The MSafe® acts as a central protection system for liquid-filled transformers and reactors with oil conservator. It monitors the insulating fluid circuit for the presence of free gases, for loss of insulating fluid due to leaks and for a shock wave, due to a spontaneous event, which moves towards the oil conservator.

Pay attention to the limit values specified on the nameplate and in the operating instructions prior to initial start-up of the device and ensure that they are strictly observed.

1.3 Important notes on equipment operation

The user is advised to strictly comply with the national accident prevention regulations.

It is especially emphasized that work on active or live components is only permissible while these components are either de-energized and secured against reconnection or protected against direct contact.

Electrical installation is subject to the relevant national safety regulations. It is imperative to connect the protective earth conductor (PE) to ensure trouble-free operation.

CAUTION

Installation, electrical connection, commissioning, and maintenance of the device may only be carried out by qualified, skilled personnel and only in accordance with these operating instructions.

It is the responsibility of the user to make sure that the device is used for the specified application only.

For safety reasons, any unauthorized and improperly executed work, i.e. installation, modification, alteration of the equipment, electrical connection, or commissioning of the equipment, are forbidden without first consulting Messko!

WARNING

All relevant fire protection regulations and specifications for handling toxic and flammable gases must be strictly observed.

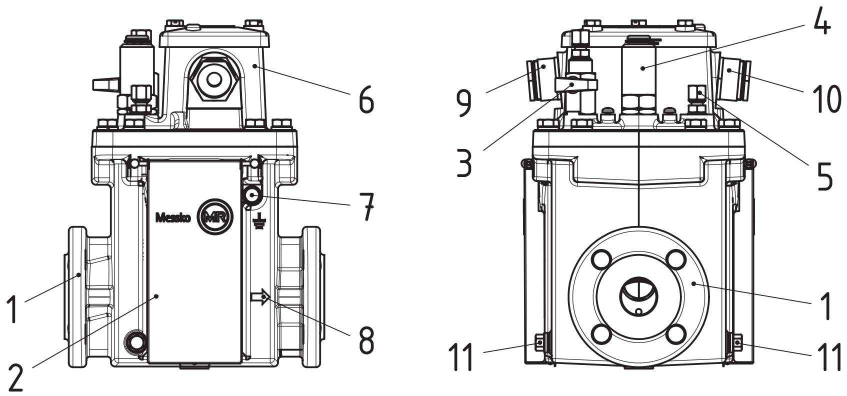
2 Product specification

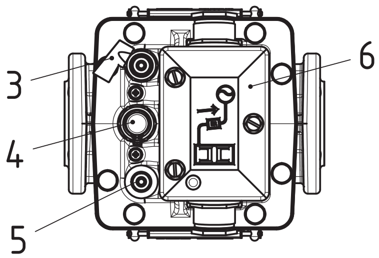
Installed in the pipeline between tank and oil conservator, the MSafe® reacts to faults which occur inside the transformer. Damages which are not visible can be detected early by the Buchholz relay and can be used to shut down the equipment beeing protected:

- Gases moving in the direction of the oil conservator trigger the signaling system of the Buchholz relay.
- Shock waves created by the rapid gas development trigger the signaling system of the Buchholz relay.
- The Buchholz relay also takes over the function of an oil level indicator when there is not enough oil in the conservator or when there is an oil leak.

It is available as two-float Buchholz relay in different versions for the nominal tube diameters DN25, DN50 and DN80.

- MBR25-6, MBR25-16 and MBR25-G (1 1/2" threaded connection)
- MBR50-6 and MBR50-16
- MBR80-6/4, MBR80-16/8 and MBR80-16/4
- MBR80-CH and MBR80-QU (square flange)
- Equipped with up to 4 normally open, normally closed and/or changover contacts on customer request.





1 Connecting flange
2 Inspection glass cover (optional)
3 Gas withdrawal
4 Test button with cover sleeve
5 Pneumatic test connector (optional)
6 Terminal box
7 Grounding screw
8 Flow direction (red arrow)
9 Cable gland left
10 Cable gland right
11 Oil drain screw

Fig. 1

The following versions are offered optional:

- Inspection glass cover
- Reset for function test (test button)
- Connection for pneumatical test
- Offshore version

2.1 Mode of operation

The Buchholz relay is installed in the pipeline between tank and oil conservator and reacts to occuring faults as follows:

a) The insulating fluid contains free gas

The gas in the fluid moves upwards, accumulates within the Buchholz relay and displaces the insulating fluid. When the level of liquid falls, the upper float sinks accordingly. The movement of the float activates a switching contact (Reed switch) which triggers a signal (warning). This does not affect the lower float since after a certain amount of gas is reached, the gas flows off through the pipe to the oil conservator.

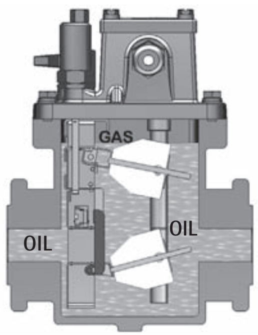


Fig. 2

b) Loss of insulating fluid due to leaks

First, the upper float sinks when the level of the fluid drops. A signal (warning) is triggered. If more fluid is lost, the oil conservator, pipe and the Buchholz relay become empty. The lower float sinks when the level of fluid falls. The movement of the float activates a switching contact which can be used to trip the transformer.

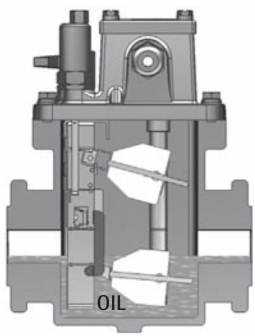


Fig. 3

c) A spontaneous event creates a shock wave which moves in the direction of the oil conservator

The current caused by the shock wave strikes a flap valve positioned within its path. If the speed of the current exceeds the triggering sensitivity of the flap valve, the flap valve moves in the direction of the current. This motion activates a switching contact which can be used to trip the transformer.

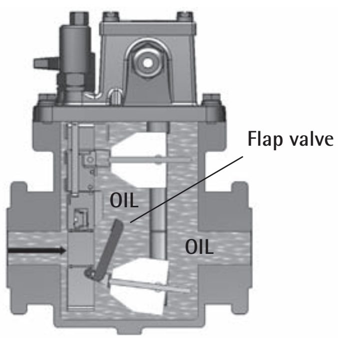


Fig. 4

3 Installation

Pay attention to the various dimensions and designs of the MSafe® (refer to Appendix, Section 9.2/9.3 Dimensions).

Prepare the connection pipe with a suitable connecting flange according to the size used DN25, DN50 or DN80.

3.1 Installation in pipe

CAUTION

The operating and installation requirements described in this manual must be strictly complied with. If not, the device may be damaged or may malfunction.

Assemble the MSafe® connecting flange with an appropriate flange gasket on the pipe flange in such a way that the imprinted arrow (Fig. 1/8) is pointing in the flow direction (towards the oil conservator).

- The inclination of the device in the direction of the pipe may not be less than 0 degrees and not more than 5 degrees (Fig. 5).
- The inclination of the device transverse to the direction of the pipe may not exceed 5 degrees compared to the vertical (Fig. 6).

3.2 Bleeding of the MSafe® Buchholz relay

WARNING

Risk of explosion and risk of flammable and toxic gases!

In the event of an error, gases in the Buchholz relay may form an explosive gas mixture in connection with air. Smoking or work involving sparks is prohibited in the hazard area!

Avoid breathing in any gases escaping as they may be toxic.

- Open shut-off valve to oil conservator (Fig. 5/2).
- Open gas withdrawl valve of MSafe Buchholz relay (Fig. 1/3) and allow air or gas to escape. Close gas withdrawl valve again if insulating fluid escapes.

3.3 Drain off insulating fluid via oil drain screw

Two oil drain screws are provided for removing all traces of the insulating fluid from the device when removing the Buchholz relay or carrying out maintenance work (Fig. 1/11). To drain off the fluid, unscrew one of the two screws using an open-end wrench (A/F 10) and collect the insulating fluid in a suitable container as it runs out.

Then screw the oil drain screw back in and tighten with max. 5 Nm torque. Check for leak-tightness.

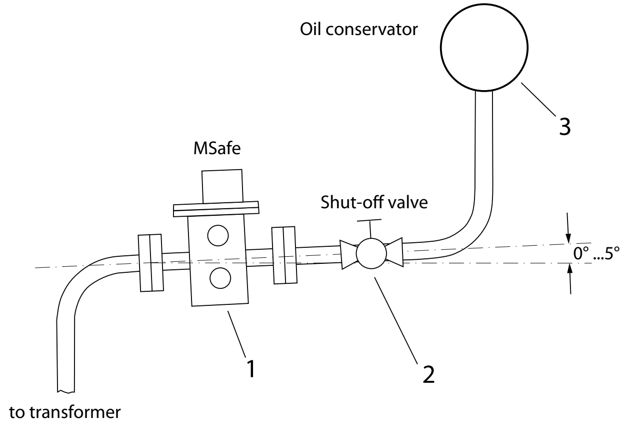


Fig. 5

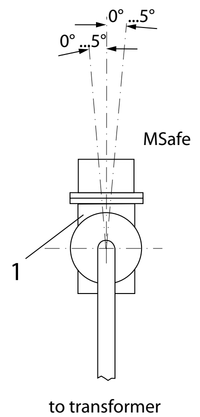


Fig. 6

4 Electrical connection

The installed switches can be connected to a signaling device or remote control room via a terminal strip in the terminal box.

4.1 Connection via terminal box

CAUTION

Electrical connections may only be carried out by qualified, skilled personnel trained in the applicable safety regulations of the relevant country.

WARNING

Hazardous electrical voltages!

All connecting wiring must be free of voltage before opening the device.

Open the terminal box (Fig. 1/6) using the 3 fixing screws. Strip the insulation from the cable for wiring and remove approx. 7 mm of insulation from the strands. Open the desired cable gland (Fig. 1/9 or 1/10) M25x1.5 (for cables Ø 13...20 mm) (A/F30) and push the cable through. Wire up the cable according to the connection diagram printed on the inside of the cover of the terminal box (refer to Appendix, Section 9.1, Fig. 8). The connection diagram is equivalent to the error-free operating condition. The cable gland and the terminal box must then be resealed liquid-tight.

4.2 Device grounding

The device can be grounded with the grounding screw (Fig. 1/7) outside the MSafe® and/or with the grounding screw inside the terminal box (refer to Appendix, Fig. 8).

5 Operation

5.1 Alarm table

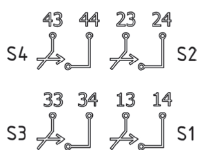
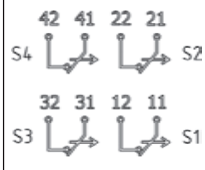
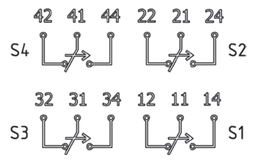
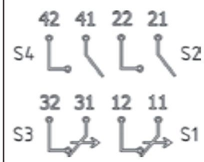
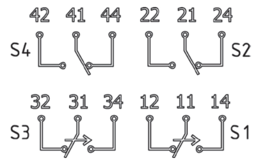
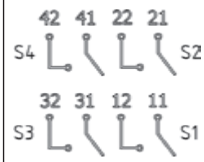
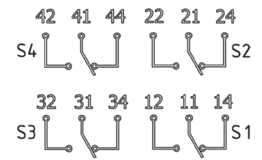
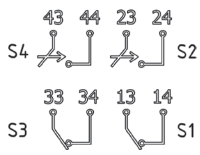
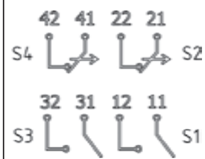
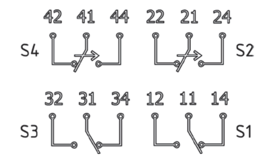
The Messko MSafe® is fitted with up to 4 normally open, normally closed and/or change-over contacts according to the imprint on the inside of the terminal box. The following table shows the switch positions for the normal operating conditions and the error case.

5.2 Releasing of blocked flap valve (only MSafe with reset function (optional))

The flap valve can be enabled again as follows:

Unscrew the cover sleeve (Fig. 7/2) using an open-ended wrench (A/F24) and detach. Turn the test button located below (Fig. 7/3) to the left up to the limit stop so that flap valve is released again. Check this through the inspection glass of the protective relay.

Alarm table

	Normally open (NO)	Normally closed (NC)	Changeover (CO)	Remarks
Normal operating-state				No failures. All contacts in initial position.
Accumulation of gas				Gas has collected in the upper part of the Buchholz relay (Fig. 2). Contacts S2 and S4 (optional) have switched. Check the level of the insulating fluid via the inspection glasses of the MSafe Buchholz relay. Check the condition of the transformer!
Loss of insulating fluid				A loss of insulating fluid has occurred (Fig. 3). Contacts S2 and S4 (optional) as well as S1 and S3 (optional) were switched. Check the level of the insulating fluid via the inspection glasses of the MSafe Buchholz relay. The transformer has possibly been switched off for safety's sake via contacts S1 and S3 (optional)!
Fast-moving insulating fluid current				A rush of insulating fluid has occurred which has activated the triggering flap (Fig. 4). The transformer has possibly been switched off for safety's sake via contacts S1 and S3 (optional)! Check the position of the flap valve via the inspection glasses of the MSafe Buchholz relay. Check the condition of the transformer. Refer to Section 5.2 to release the flap valve.

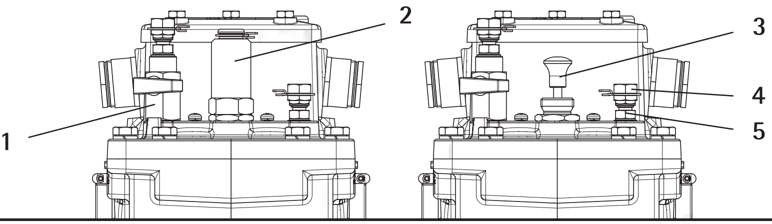


Fig. 7

6 Tests

6.1 Leak-tightness

It is extremely important that no liquid escapes for protection of the environment and operating safety. Therefore check the flange connection for leaks after assembly.

6.2 Function test of the MSafe® via test button

This test is only possible with filled MSafe®.

• Unscrew the cover sleeve (Fig. 7/2) using an open-jaw wrench (A/F24)

• Press the test button located below (Fig. 7/3) down completely and hold. Both floats should have sunk and transmitted signals to the control room via the reed switches. Obtain confirmation of function!

• Return test button back to starting position, replace cover sleeve and tighten with open-jaw wrench.

6.3 Function test of MSafe® with reset function (optional)

This test is only possible with filled MSafe®.

The procedure is as described in Section 6.2. In addition, turn the test button (Fig. 7/3) to the left up to the limit stop to release the flap valve. Check this through the inspection glass of the protective relay.

6.4 Pneumatic test (optional)

WARNING

Risk of explosion and risk of flammable and toxic gases!

In the event of an error, gases in the Buchholz relay may form an explosive gas mixture in connection with air. Smoking or work involving sparks is prohibited in the hazard area!

Avoid breathing in any gases escaping as they may be toxic.

6.4.1 Test for “Accumulation of gases”

This test is used to simulate an accumulation of gases in the upper part of the Buchholz relay so that contacts S2 and S4 (optional) are activated. A pump is required to introduce approx. 300 ml of air into the Buchholz relay via the pneumatic test connector (Fig. 1/5).

Procedure:

1. Bleed off any gases in the Buchholz relay via the gas withdrawl (Fig. 7/1).

2. Unscrew the end cap and remove from the pneumatic test connector (Fig. 7/4).

3. Screw the pump supplied to the pneumatic test connector using M10x1 adapter (Fig. 7/4).

4. Use the pump to introduce air into the Buchholz relay in short bursts until the upper float has dropped so far that contacts S2 and S4 (optional) are activated. Test this using a measuring instrument (electrical continuity tester) or read out via the control room.

5. After checking the functionality, return the upper float to its starting position by bleeding off the introduced air via the gas withdrawl (Fig. 7/1). Check this through the inspection windows.

6.4.2 Test for “Sudden rush of insulating fluid”

This test is used to activate the flap valve of the Buchholz relay (Fig. 4) and move the lower float thus activating contacts S1 and S3 (optional) which normally shut down the transformer via the control room.

This requires a gas cylinder of nitrogen (N2) or compressed air to introduce nitrogen into the Buchholz relay “in bursts” at minimum 6.5 bar (briefly opening and closing the gas cylinder) via the pneumatic test connector (Fig. 7/4).

WARNING

Do not use flammable gases for this test; use nitrogen or compressed air.
Ensure that the gas cylinder used is secured against falling over.
Check that the equipment attached to the gas cylinder is properly connected and there are no leaks. Take care to ensure that the valve is opened and closed properly.
Avoid breathing in any nitrogen escaping as this can lead to asphyxiation.

Procedure:

1. Bleed off any gases in the Buchholz relay via the gas withdrawl (Fig. 7/1).

2. Unscrew the end cap and remove from the pneumatic test connector (Fig. 7/4).

3. Screw the nitrogen or compressed air cylinder with suitable armature to the pneumatic test connector using M10x1 adapter (Fig. 7/4).

4. Introduce nitrogen or compressed air into the Buchholz relay in bursts by briefly opening and closing the gas cylinder so that the lower flap valve is activated and the lower float connected to it has sunk so far that contacts S1 and S3 (optional) are activated. Test this using a measuring instrument (electrical continuity tester) or read out via the control room.

5. After checking the functionality, return the float to its starting position by bleeding off the introduced air via the gas withdrawl (Fig. 7/1). Check this through the inspection windows.

If the Buchholz relay has the optional reset function, the test button (7/3) must be turned anti-clockwise until the limit stop is reached to release the flap valve.

Check this through the inspection window of the Buchholz relay.

> ⚠ **CAUTION**
>
> Check the amount of gas introduced.
> There is a risk that a very large quantity of gas will get into the transformer's oil conservator.
> This test must only be performed by experts.

7 Maintenance

The MSafe® buchholz relay is maintenance-free.

8 Technical Data

Dimensions:	Refer to Appendix, Sect. 9.2 and 9.3
Materials:	
Housing and upper part including terminal box:	Aluminium casting, RAL 7033 or 7038 (similar to ANSI 70 light grey), powder coated; Offshore model optional
Inspection glass:	Safety glass with UV filter
Installation:	Indoors and outdoors, tropical proof
Ambient temperature:	-50... +80° C
Isolation liquid temperature:	-30... +120° C (mineral oil)
Protection mode:	IP 55 as per DIN EN 60 529
Nominal tube diameter:	DN25, DN50, DN80 or DN25 with G 1 1/2" threaded connection
Installation dimensions of connection pipe:	Refer to Appendix, Sect. 9.2
Flap triggering pressure:	For DN25, DN50 and DN80 on customer request 1 m/s, 1.5 m/s, 2 m/s or 2.5 m/s (each ±15%); 0.65 m/s or 3 m/s on request

Protected Reed switch:

Number and type:	Normally open, normally closed and/or changeover contacts on customer request; potential free; 2 pieces per function
Nominal voltage:	24-250 V AC/DC
Max. nominal current:	2 A AC/DC
Min. switching current:	5 mA/24 V DC
Max. through current:	3 A AC/DC
Max. switching capacity AC:	1.2 VA-400 VA
Max. switching capacity DC:	1.2 W-250 W
Rated insulation voltage:	2.7 kV AC/2 sec. contacts against housing; 1 kV AC/2 sec. open contacts
Insulation resistance:	1000 MΩ/500 V DC

Connection via terminal-box:

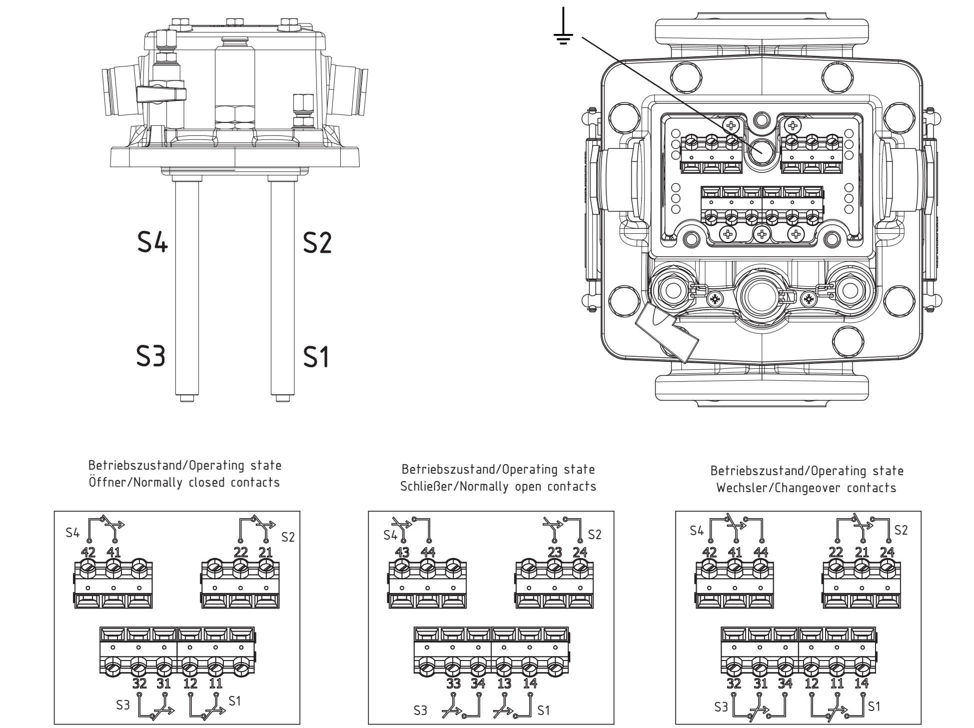
Terminal strip assignment:	Refer to Appendix, Sect. 9.1
Connection terminals:	Min. 0.25 mm² / max. 4 mm²
Cable gland:	M25x1.5 for cable Ø 13...20 mm or 1/2" NPT

Mechanical tests:

Tests:	Standard:
Vibration 5-35 Hz and 10-150 Hz at 2 g, 2 h	IEC 60068-2-6
Earthquake 2-10 Hz, 22.5 mm, 1 h	IEC 60068-2-57
Shock 10 g, 10 ms	IEC 60068-2-27
Continuous oscillation test 100, 200, 300, 400 Hz, 1 g, 2 h	

9 Anhang/Appendix

9.1 Elektrischer Anschluss über Anschluss-Box / Electrical connection via terminal box

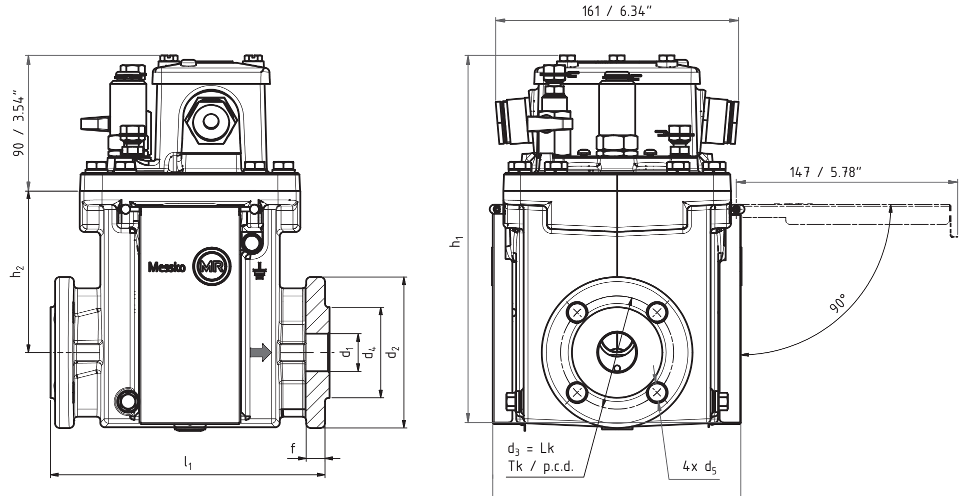


Bild/Fig. 8

9.2 Abmessungen der Geräte mit Rundflansch / Dimensions of devices with circular flange

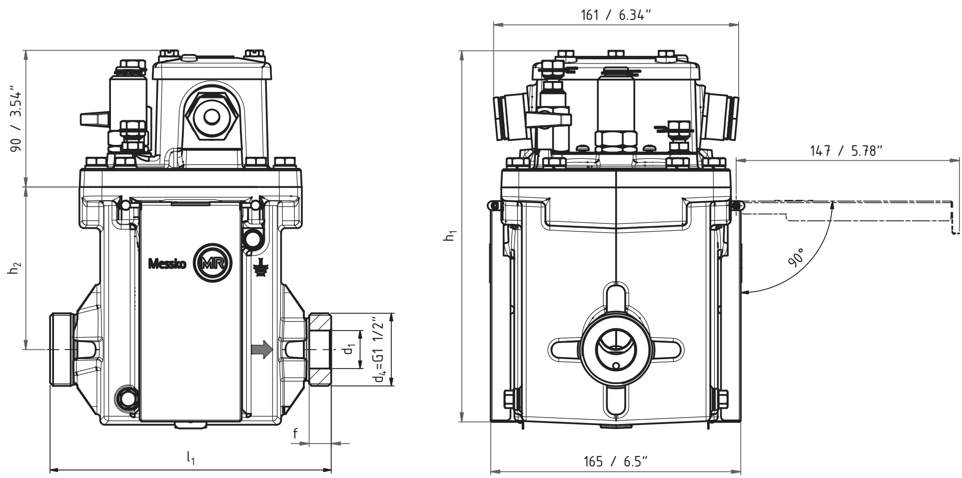
Maßtabelle/dimension table									
Typ/Type	**d1**	**d2**	**d3 = p.c.d.**	**d4**	**Ø d5**	**f**	**l1**	**h1**	**h2**
MBR25-6	25/0.98"	100/3.94"	75/2.95"	60/2.36"	4 x 12/0.47"	12,5/0.49"	185/7.28"	244/9.61"	107/4.21"
MBR25-16	25/0.98"	115/4.53"	85/3.35"	68/2.68"	4 x 14/0.55"	20/0.78"	200/7.87"	244/9.61"	107/4.21"
MBR25-G	25/0.98"	-	-	G1 1/2"	-	14,5/0.57"	185/7.28"	244/9.61"	107/4.21"
MBR50-6	50/1.97"	140/5.51"	110/4.33"	90/3.54"	4 x 14/0.55"	19/0.75"	185/7.28"	244/9.61"	95/3.74"
MBR50-16	50/1.97"	165/6.50"	125/4.92"	102/4.02"	4 x 18/0.71"	23/0.91"	195/7.68"	244/9.61"	95/3.74"
MBR80-6/4	80/3.15"	190/7.48"	150/5.91"	130/5.12"	4 x 18/0.71"	15/0.59"	195/7.68"	244/9.61"	95/3.74"
MBR80-16/8	80/3.15"	200/7.87"	160/6.29"	138/5.45"	6 x 18/0.71" 2 x M16	17,5/0.69"	195/7.68"	244/9.61"	95/3.74"
MBR80-16/4	80/ 3.15"	200/7.87"	160/6.29"	138/5.45"	4 x 18/0.71"	17,5/0.69"	195/7.68"	244/9.61"	95/3.74"

MSafe® - Buchholzrelais MBR25-6 und MBR25/16
MSafe® - Buchholz relay MBR25-6 and MBR25/16



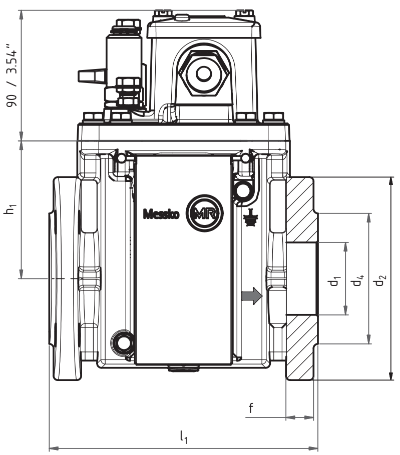
Bild/Fig. 9 Für Abmessungen siehe Maßtabelle Kap. 9.2
For dimensions refer to dimension table chap. 9.2

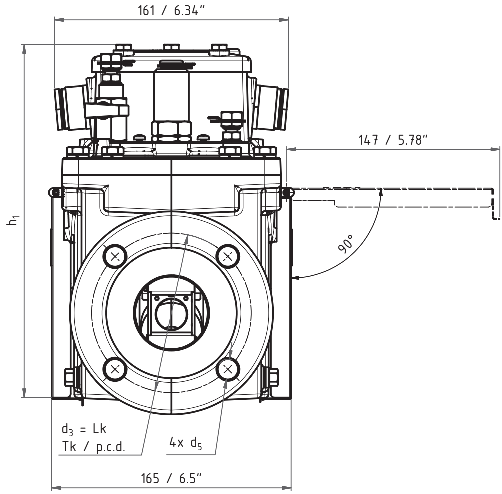
MSafe® - Buchholzrelais MBR25-G
MSafe® - Buchholz relay MBR25-G



Bild/Fig. 10 Für Abmessungen siehe Maßtabelle Kap. 9.2
For dimensions refer to dimension table chap. 9.2

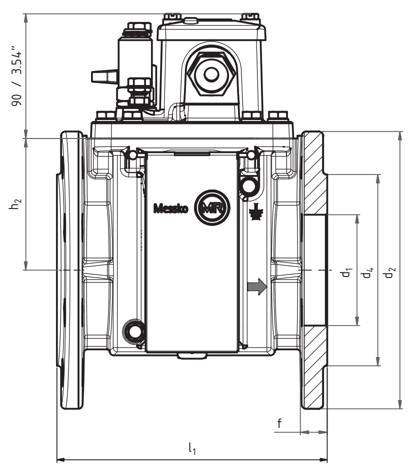
MSafe® - Buchholzrelais MBR50-6 und MBR50-16
MSafe® - Buchholz relay MBR50-6 and MBR50-16

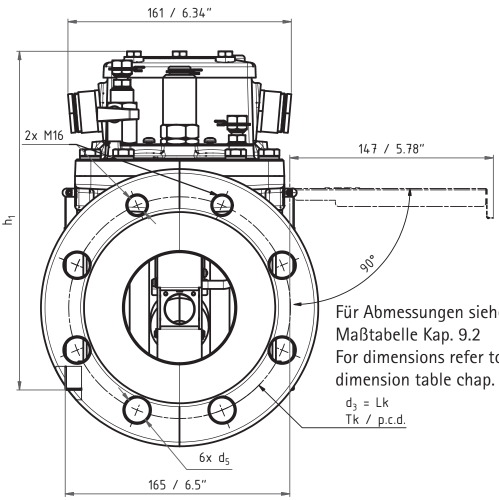




Bild/Fig. 11 Für Abmessungen siehe Maßtabelle Kap. 9.2
For dimensions refer to dimension table chap. 9.2

MSafe® - Buchholzrelais MBR80-6/4, MBR80-16/8 und MBR80-16/4
MSafe® - Buchholz relay MBR80-6/4, MBR80-16/8 and MBR80-16/4





Für Abmessungen siehe Maßtabelle Kap. 9.2
For dimensions refer to dimension table chap. 9.2

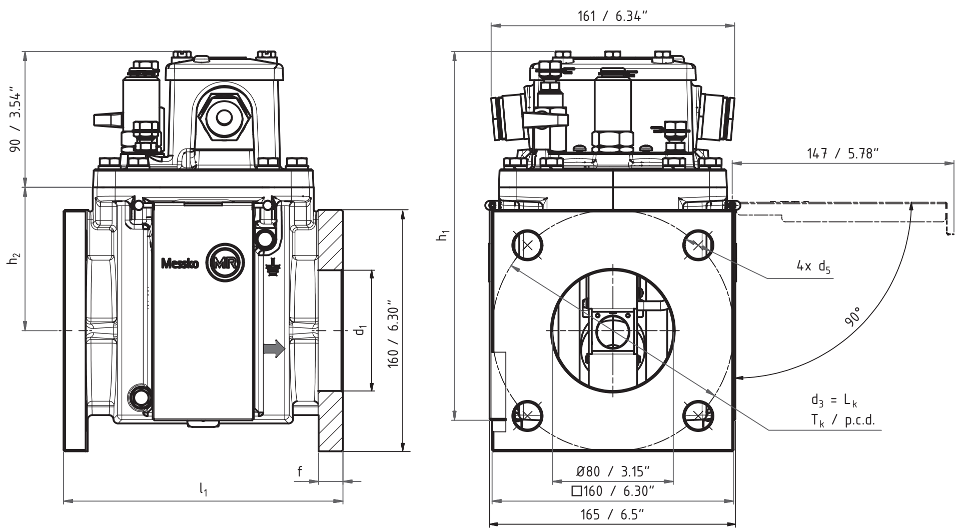
In den 4-Loch-Versionen des MBR80 sind die 4 Flanschbohrungen wie bei dem MBR50 (siehe weiter oben) angeordnet!
In the 4 hole versions of the MBR80 the 4 flange hole drills are arranged as in the MBR50 (see above)!

Bild/Fig. 12

9.3 Abmessungen der Geräte mit quadratischem Flansch / Dimensions of devices with square flange

Maßtabelle/dimension table							
Typ/Type	d1	d3 = p.c.d.	Ø d5	f	l1	h1	h2
MBR80-CH	80/3.15"	160/6.30"	4 x 18/0.71"	16/0.63"	185/7.28"	244/9.61"	95/3.74"
MBR80-QU	80/3.15"	132/5.20"	4 x 18/0.71"	21/0.83"	200/7.87"	244/9.61"	95/3.74"

MSafe® - Buchholzrelais MBR80-CH
MSafe® - Buchholz relay MBR80-CH



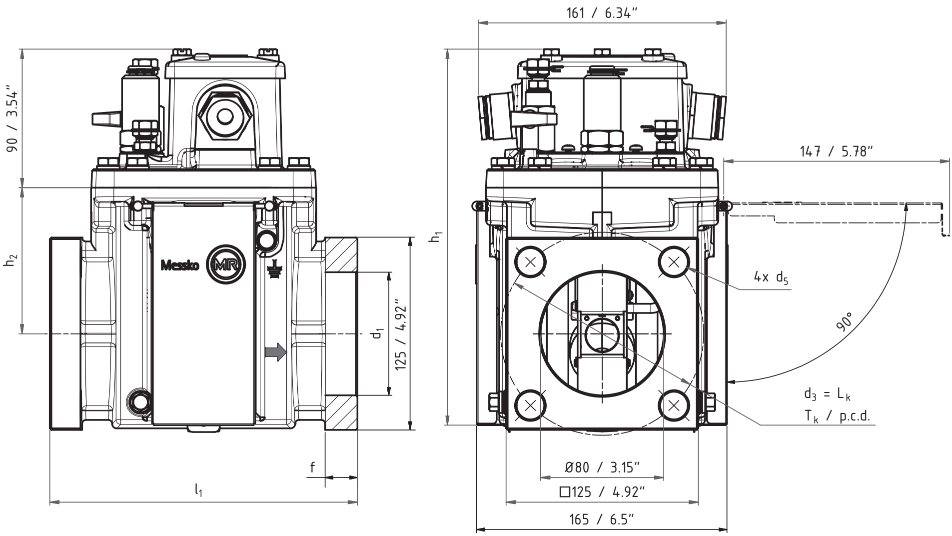
Für Abmessungen siehe Maßtabelle Kap. 9.3
Bild/Fig. 13 For dimensions refer to dimension table chap. 9.3

www.messko.com

Messko GmbH
Gewerbegebiet An den Drei Hasen
Messko-Platz 1
D-61440 Oberursel/Taunus

Phone: +49 (0)6171 / 6398 - 0
Fax: +49 (0)6171 / 6398 - 98
E-Mail: info@messko.com
www.messko.com

MSafe® - Buchholzrelais MBR80-QU
MSafe® - Buchholz relay MBR80-QU



Bild/Fig. 14 Für Abmessungen siehe Maßtabelle Kap. 9.3
For dimensions refer to dimension table chap. 9.3

Bitte beachten: Die in allen unseren Publikationen enthaltenen Angaben können in Details von dem gelieferten Gerät abweichen. Änderungen bleiben vorbehalten.

Important note: The information contained in all of our publications may differ in detail from the actual equipment delivered. We reserve the right to make alterations without notice.

BA2722549/01 DE/EN • 08/12 • Art.Nr./Art. no. 77394901 • Printed in Germany •

Section 8
Component Instruction Leaflets and Manuals

8.2 Fan

Science,technology and
Creating are unlimited

ZHEJIANG ERG TECHNOLOGY CO.,LTD.
Add: Shaliu Exploitative District Sanmen,Zhejiang.China
Tel：0086-576-83200088 83200178 83200032
Fax：0086-576-83200188 83201988
http://www.erg.com.cn   E-mail：user@erg.cn
P.C.：317113

USAGE MANUAL

SPECIFICATION OF THE SERIES LOW-NOISE FANS FOR TRANSFORMER

ZHEJIANG ERG TECHNOLOGY CO.,LTD.

SPECIFICATION OF THE SERIES LOW-NOISE FANS FOR TRANSFORMER

INTRODUCTION

Zhejiang ERG Technology Co. , Ltd (the predecessor is Sanmen ERG Technology Co., Ltd), initiated in 1994, which is the national high technology enterprise the provincial development centre&technology centre. Our company set up academician experts workstation , three product testing centers, two labs, which is refrigeration teaching experiment of Zhejiang University and one of the top 100 of the most development potential minor enterprise. However, our company directly participate in draft the national standards six items, revise three items, self-developed intellectual property fifty items.

Our company mainly manufacture: CRH electric locomotive pump, diesel locomotive pump,transformer oil pump,oil flow relay, fan, valves, motor and transformer cooling systems, insulation terminals CT,control box,terminal box,which is one of the most comprehensive manufacturers prouce, motor, transformer cooling system components at home market, and aslo one of the largest enterprises replace imported products.Our products used in CRH (Wuhan-Guangzhou section) high-speed rail and other railway board of the trains, with stable performance and run well. Moreover, other products are selected by some important domestic projects such as Qinshan nuclear power station Dayawan nuclear power station Three Gorges Gezhou Dam Yangtze Power.

Our company has built a strict quality control system and a modern enterprise management system, passed the certification of international quality system ISO 9001-2000, the environment system ISO 14000-2000 ,3C,UL and other certifications in Europe and America.Creats enterprise culture which conformed to the company, possess learning organization and innovation platform such as quality school,training centre,technical exchange centre youth activities centre library and so on. Always produces opportunities for the staffs and makecontributions for social development.

◎ Product summary

The low noise fan used by transformer is developed. Designed and manufactured together with Zhejiang University Hvdrokinetics Graduate School according to the mechanical sector standard JB/T964 22010《Transformer Fan》. The low noise fan used by transformer is specially used on the big and middle-sized transformer cooler and radiator. The vane of this low noise fan adopts the aerofoil type and its material adopts the die-casting aluminum. Compared with the same type steeliness products. The low noise fan used by transform has several characteristics such as the light weight, stable performance and low noise etc. The protecting grade of this low noise fan is IP55 and its fan structure is: straight axis link by the axis flowing type impeller with the outdoor three different phase electromotor.

◎ SPECIFICATION OF THE SERIES LOW-NOISE FANS FOR TRANSFORMER

DBF □—□ □ □ □

- Symbol for Special Environment
- Pole of motor
- Direction of wind
- Diameter of impeller 1/100,mm
- Design NO.(The first design abridges)
- Low-noise Fans for Transformer

CFZ □—□ □ □ □

- Symbol for Special Environment
- Pole of motor
- Direction of wind
- Diameter of impeller 1/100,mm
- Design NO.(The first design abridges)
- Air scavenging gear

◎ Special Environment Code

W—denoted general outside condition and can be ignored.

TH—TH denoted humid tropic.

TA—TA denoted dry tropic.

SPECIFICATION OF THE SERIES LOW-NOISE FANS FOR TRANSFORMER

◎ Direction of wind

Q—front (air from motor to impeller)

H—back(air from the impeller to motor)

Note: Give indication of the product specification and type while you order it.

◎ Performance parameter (See as following tables)

Model	impeller diameter (mm)	input air (M^3/h)	total pressure (Pa)	rotate speed (r.p.m)	Power (kw)	Voltage (V)	Frequency (Hz)	electric current (A)	Nosie (A)
4Q-4	Φ400	4200	103	1440	0.25	380	50	0.8	68
5Q-4	Φ500	5600	144	1440	0.55	380	50	1.6	70
5Q-6	Φ500	7200	120	960	0.37	380	50	1.2	62
5Q-8	Φ500	5800	70	720	0.25	380	50	1.1	58
5Q-10	Φ500	4700	50	580	0.18	380	50	1.1	57
6Q-8	Φ600	8590	100	720	0.37	380	50	1.5	64
6.3Q-6	Φ630	10600	130	960	0.55	380	50	1.9	66
6.3Q-8	Φ630	9000	100	720	0.37	380	50	1.4	62
7Q-6	Φ700	14600	150	960	0.75	380	50	2.2	73
7Q-8	Φ700	13500	130	720	0.55	380	50	2.2	64
7Q-10	Φ700	11100	65	580	0.25	380	50	1.2	58
7Q-12	Φ700	9500	50	480	0.18	380	50	1.1	55
7.3Q-8	Φ730	14500	130	720	0.55	380	50	1.9	66
7.3Q-10	Φ730	11800	75	580	0.37	380	50	1.5	58
7.3Q-12	Φ730	10000	60	480	0.25	380	50	1.3	54
8Q-6	Φ800	16000	216	960	1.50	380	50	4.0	75
8Q-8a	Φ800	19200	90	720	0.55	380	50	2.2	65
8Q-8b	Φ800	16000	135	720	0.75	380	50	2.4	68
8Q-10	Φ800	14500	70	580	0.37	380	50	1.5	61
8Q-12	Φ800	13500	55	480	0.25	380	50	1.3	57
9Q-6	Φ900	18000	165	960	1.50	380	50	4.0	73
9Q-8	Φ900	16000	150	720	1.10	380	50	3.0	68
9Q-10	Φ900	18000	90	580	0.75	380	50	3.2	64
9Q-12	Φ900	16000	70	480	0.55	380	50	2.3	60
9Q-14	Φ900	13500	65	400	0.37	380	50	1.9	57
10Q-8	Φ1000	25000	185	720	2.20	380	50	5.8	71
10Q-10	Φ1000	22000	135	580	1.10	380	50	3.2	67
10Q-12	Φ1000	19000	100	480	0.75	380	50	3.0	65
10Q-14	Φ1000	17000	80	400	0.37	380	50	1.9	60
10Q-16	Φ1000	15000	70	360	0.37	380	50	1.9	55
11Q-12	Φ1100	21000	80	480	0.75	380	50	3.0	64
11Q-16	Φ1100	19000	68	360	0.55	380	50	3.0	60
12.5Q-16	Φ1250	25000	60	360	0.75	380	50	3.5	65

1. When put BF、DBF、CFZ before the model respectively,it stand for ordinary type, low-noise type,being equipped with air pipe，you should note it when ordering
2. Air quantity, total pressure are tested under Standard air intake condition according to GB1236-85《the fan aerodynamic performance test method》.3. Noise value is measured according to GB/T2888-91 《Fan and blower noise measurement method》。On the standard test devices, the distance from measuring centre to the center of outlet flat is 1M , measuring point and air flow direction are at a 45 □ angle; the allowable error is +3db（A）, measured values are parameters under rated aerodynamic condition, noise evaluation can refer to related standard.
4. Do not install the overly dense mesh protection cover on the inlet and outlet air of fan, the distance from inlet air to resistance wind ≥1.5D. Otherwise it will reduce aerodynamic parameters, while noise increase. If the Parameters in the above table are changed, we will take mutual agreement as the standard when ordering
5. Special specifications7.1Q, 7.56Q are not included in the table.

◎ Design Characteristics

● The design of this series of low noise transformer fan adopts the section-change aerofoil vane and optimizes the vane parameters .And this low noise transformer fan has several characteristics such an the big wind amount ,high wind pressure ,low noise ,high efficiency and long natural life etc.

● This low noise transformer fan adopts the high strength aluminum alloy to found by rule and line and this low noise transformer fan has several characteristics such as the light weight and up standing corrosion-resistant performance.

● The impeller adopts the straight axis linking with the electromotor and it can blow in the level way or in the straight way according to the different installation way of the cooler and the radiator.

● All the fans are installed with the protection network.

● The electromotor is the totally closed outdoor three-phase electromotor. Internal have thermistors overload protection, temperature value for 110 ,Its protecting grade is IP55and the fan can operate continually.

◎ Operation Conditions

● The ambient air temperature: between -40℃ and 75℃;

● Height above sea level: less than 1000m;

● The relative humidity: the highest average relative humidity in the most moist month is 95%,wi-th the lowest average temperature (in the same time)of 25℃;

● The maximum sun radiation intensity: 0.98kw/m²;

● The maximum rainfall intensity: 50mm/10min;

● Allow the sand and dust existing, ice, snow, frost and dew existing;

Motor use IP55 protection class and F class insulation, when altitude is less than 1000m and Round air temperature (measure with resistance) less than 75℃, the temperature of resistor winding isn't excess 45K and the allowable temperature(measure with thermometer) of the bearing not excess95℃.

The motor use low-noise bearing, It can continuous run in the rated load under the normal using conditions.

◎ Installation and Maintenance of the Fan

- The relevant staff members should check the fans to find whether the fans haying been damaged and distorted or not before this device to be installed, and if the relevant staff members find that the fans have been repaired.
- The insulation resistance of the stator winding to the hot state machine shell can be measured by using the 500Vmega-ohm ohmmeter and its resistance value should not be less than 1M,and it should be processed with the dry management if the drop of its resistance value having been caused by the insulation suffering from the damp.
- During the installation process, all the parts should be checked to see whether the link is firm or not and the attrition phenomenon should not appear between the vanes and the wind canisters and the clearance should also be uniform.
- The fan should be checked by carrying through the test operation after the installation of the fan having been finished, and the fan should not be used until its test operation has been in the normal way.
- The fan should not begin to be reused until it has been checked according to the above mentioned check-up steps after it has been left away for a long time.
- The fan terminal box must be airproofed after it has been in connection and it also should have the reliable grounding.
- This product is fit for the three-phase alternating electrical source and the fan can operate normally under the rating voltage and frequency(referring to the condition when the electrical source is in accordance with the provision of the GB755-87 standard) stated by the nameplate.
- The patrol check of the transformer fan which has been put into operation for the first time should be strengthened in a week, and if the relevant staff members have found that there are something abnormal with the fan, such as the acute vibration, abnormal sound, too big current and the bearing is being overheated, the fan should be stopped in time and examined immediately and the fan should not be put into operation until all the malfunction has been removed.
- When the fan begins to be put into operation again after it has been stopped for a longer time, the clearance between the air flow channel and the wind canister should be guaranteed to be no foreign matters, then the relevant staff members should begin to check with stirring the impeller and the fan can be put into operation again when all the things including the power supply line have been normal.
- Whenthe electromotor has been left for a longer time or the electromotor has been affected with damp badly and the insulation resistance is too small, the electromotor should not be put into operation again until it has been processed with the dry disposal.

- During the process If dismantling-machine inspection, all kinds of left over including the lubricating grease should be put in order firstly with the tearing being cleaned completely. All the parts should be examined carefully and the relevant staff members should take the correct measures to deal with the discoverable malfunctions (see the list of the normal trouble and the disposal ways and means). For the products which have been out of the factory, when the users ask to repeat the test of checking the product's performance of being able to bear the voltage, the test voltage is 1600V and the sustaining time is 1 min. If the relevant staff members find there is nothing wrong with this product the reassembly would begin and the lubricating grease will be added into this product.

◎ Transportation and Preservation

- During the transportation process of this product, much attention must be paid to the action of taking up or letting down this product carefully, and the product should be placed according to the sign of the packing box and kept upright.
- The preservation place should be ventilated, dry, and clean and there is no Corrosive gas, and there should be rainproof measures in the course of storing.
- It is unsuitable to open the packing box if this product won't be used temporarily, and the packing box should be kept properly.

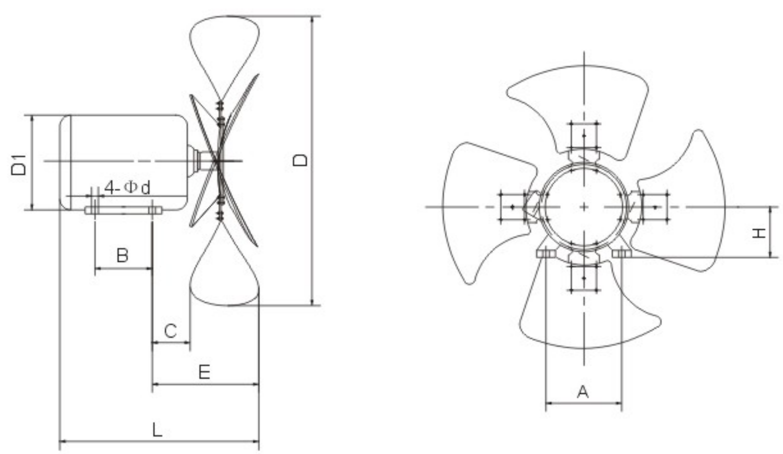
◎ Regular faults, reasons and solutions

No	Problem	Possible causes	Methods of resolving
1	The motor will not run-ning after switch on po-wer	1.The connecting of motor is loose-jointed 2.Have problems in the control system 3.Motor burn	1.Connect the power again 2.Check and repair the control system 3.Change the motor
2	There have noise when motor running	1.Local distortion of the rubber band 2.Collision between impeller and casing 3.Bad bearing	1.It'll disappear as the fan running some minutes 2.Adjust the distance of motor and casings 3.Change the bearing
3	Water entered the connection box	1.Loose bolts 2.Water entered the connection box when clean the transformer with high pressure water.	1.Tighten the bolts 2.Forbid cleaning the transformer with high pressure water
4	Motor burn	1.Motor running short of one phase 2.Water entered the connection box	1.Ensure the safeguard of phase available 2.Tighten the bolts

5	Much vibration occur w -hen fan runnin	1.Setting of the fan is loose 2.Strength of fan bracket is not enough 3.Fan vibrates	1.Tighten the bolts 2.Increase the strength of the bracket 3.Change the fan
6	Setting distance of fan and radiator is unequal	1.Deviation of fan flange aperture 2.Deviation of radiator setting aperture	1.Repair the flange aperture 2.Repair the radiator setting aperture
7	Electric current or tem-perature of motor is too high	1.Bad bearing 2.Motor running short of one phase 3.Impeller and casings attrition 4.Voltage and frequency of the power is disqualification 5.Wind tunnel jam	1.Change the bearing 2.Ensure the safeguard of phase avail-able and Connect the power again 3.Adjust the distance of motor and casin -gs 4.Adjust the voltage and frequency of the po -wer 5.Remove the jam

◎ Order notice

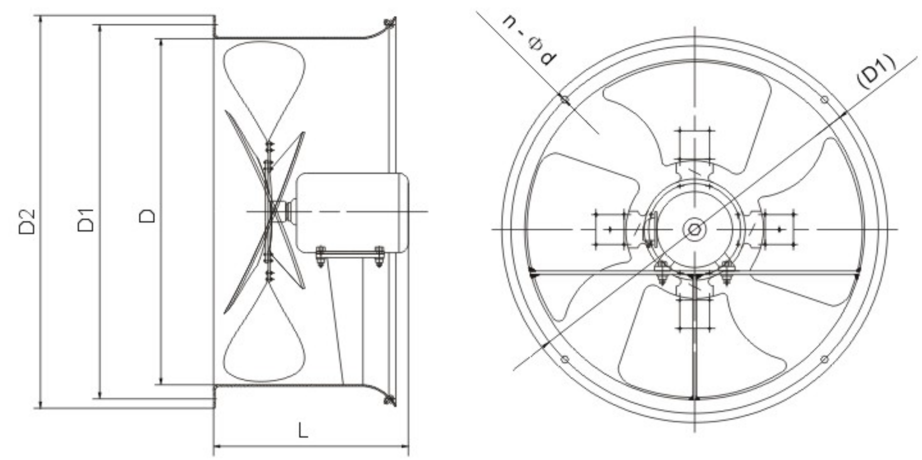
- To order the product, indicate the specification and type and requirements in detail.
- If there are some special demands, please explain in detail while ordering;
- If this product specification can not meet the users demand our company can design according to the user's performance parameters to meet the user's demand.



DBF outline structur drawing

◎ The dimension table

Model Type	D	D1	C	L	B	4-Φd	A	H	E
DBF-5Q	Φ500	Φ155	70	300	100	4-Φ10	125	80	155
DBF-6.3Q	Φ630	Φ155	60	370	140	4-Φ10	125	90	195
DBF-7Q	Φ700	Φ165	60~80	370	125	4-Φ10	140	90	190~200
DBF-8Q	Φ800	Φ190	60~85	440	140	4-Φ12	160	100	220~245
DBF-9Q	Φ900	Φ190	60~85	465	140	4-Φ12	160	100	245~275
DBF-10Q	Φ1000	Φ210	90~120	500	140	4-Φ12	190	112	275~290
DBF-12.5Q	Φ1250	Φ230	80~100	525	178	4-Φ12	216	132	275~295



CFZ outline structur drawing

◎ The dimension table

Type	D	D1	D2	n-Φd	L	D
CFZ-5Q	Φ500	Φ565	Φ594	4-Φ15	330	Φ15
CFZ-6.3Q	Φ630	Φ710	Φ735	4-Φ15	360	Φ15
CFZ-7Q	Φ700	Φ770	Φ810	4-Φ15	360	Φ15
CFZ-8Q	Φ800	Φ880	Φ905	6-Φ19	400	Φ19
CFZ-9Q	Φ900	Φ962	Φ1000	6-Φ19	455	Φ19
CFZ-10Q	Φ1000	Φ1066	Φ1106	6-Φ19	490	Φ19
CFZ-12.5Q	Φ1250	Φ1310	Φ1360	8-Φ19	515	Φ19

Note:All of dimensions in the table above are subject to change.
The standard drawing can be supplied on request.

SPECIFICATION OF THE SERIES LOW-NOISE FANS FOR TRANSFORMER


Oil pump for transformer


Axial flow transformer oil pump


Electric locomotive transformer oil pump


Cooling fan for transformer


Oil flowing relay

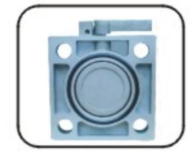

Oil flow indicator


TCT terminal box

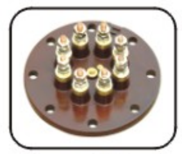

BCT terminal box


BD series butterfly valves for transformer


Australia insulated terminal


BD series butterfly valves for transformer


BCT terminal box


Siemens CT board

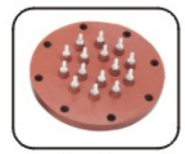
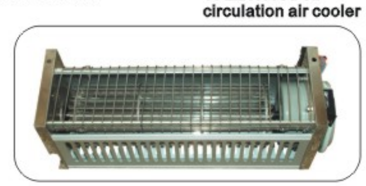

Toshiba CT board


ABB CT board


YFZL forced oil circulation air cooler


Control box


Insulated terminal


Cross flow cooling fan for dry-type transformer


Oil cooler


YS forced oil circulation water cooler

Section 8
Component Instruction Leaflets and Manuals

8.3 Bushing

HVN & LVN Bushing

TRENCH		Supercodes	IH 01
	Oil Impregnated Paper Transformer/Air Bushing	Issue No.	3
	Installation and Maintenance Recommendations	Page 1 of	8

1. **Range**

1.1 Oil imprgnated paper transformer bushing (hereinafter referred to as a bushing) is used for insulation and support on transformers.

1.2 The maximum angle between the axial of the bushing and the vertical is 30 ° when mounted in transformers.

2 **Technical data**

2.1 Power factor (tan δ) measured at $\geq$10℃ ambient temperature, 1.05 Ur/$\sqrt{3}$ should be less than 0.007.

2.2 Partial discharge under max. working voltage should be less than 10pC.

3. **Bushing structure**

The bushing consists of container, porcelain, flange and core.

The core is manufactured from superior grade Kraft paper and foil wound onto an aluminum tube, which forms partial condensers layers to control electrical stress. After evacuation and impregnation, the core becomes a high electric property insulator.

Porcelain is used for the external insulation as well as container of the insulation..

The oil level inside the bushing can be observed through oil gauge at the top of container.

Mounting flange for installing connection is in the middle of bushing and air release plug and test tapping on the flange.

The bushing is a completely sealed unit filled with transformer oil which is processed strictly. Thus the bushing can be prevented from sunlight and poisonous in air. The bushing is weatherproof.

					Original	Approved by	SYL	2007/6/30
					BUSHING	Audited by	SYL	2007/6/30
						Standardized	XG	2007/6/30
						Checked by	XZL	2007/6/30
Mark	Dep.	File No.	Signature	Date		Made by	LYM	2007/6/30

4. Removal from the packing case

4.1 The type, code and description should be checked according to contract before installation. And make sure the parts are in accordance with packing list, the bushing is not damaged and no oil leakage during the transportation.

4.2 If the porcelain is damaged, please contact the supplier immediately. It is not permitted to disassemble the bushing without approval of the supplier.

5. Installation

5.1 With the packing case resting the correct way up on a flat horizontal surface open the lid of the case.

Fit rope slings by means of shackles into the holes provided in the lifting lugs on the flange. The slings should be of such a length so that when attached to a spreader, the spreader is at least 600mm above the top of the bushing when the bushing is in a vertical position. See Fig.3.

Fit rope pulley blocks to either the center of the spreader or the crane hood and attach a rope necklace between the bushing container and the first porcelain shed. Lift the bushing from the case.

5.2 Clean the under side of the mounting flange, earth band and bottom porcelain.

5.3 Fit the corona shield to Fig. 5

5.4 Top terminal of bushing

5.4.1 See fig.6. The terminal plate pt.9, bolts pt. 5 and pt.6, spring gasket, Draw lead pt.10, o ring pt. 4, bolts are supplied separately with the bushing. The Draw lead pt. 10 is secured to the transformer pigtail. The top arrangement of the bushing during transportation and storage is shown in Fig.4.

5.4.2 Remove pt. 1 and pt. 2 which are used for transportation only. See Fig. 4.

5.4.3 Remove the top cap pt. 14, gasket pt. 17 by unscrewing pt. 15 and pt. 16. See Fig.6.

5.4.4 Remove the brass screw pt.7 and gasket pt.8 from pt.10. Thread a wire of sufficient strength to comply with any safety standard down the central tube of the bushing and attach the wire to a suitable M12 bolt fitted to the end of the draw lead pt.10.

5.4.5 Fit pt.10 to the end of the transformer pigtail and thoroughly clean the draw lead surface and the transformer lead. Clean the gasket sealing on the top face of the transformer turret and position the gasket in. Having checked that the earthband and lower porcelain are thoroughly clean and dry, lower the bushing into the transformer at the same time pull the transformer lead into the bushing.

5.4.6 Bolt the bushing into position taking care to check that the gasket between the transformer turret flange and the bushing mounting flange is correctly positioned.

5.4.7 Position the draw lead pt.10 within the central tube by means of the pin pt.3 and remove the wire from the connector. Replace pt.7 and pt.8.

5.4.8 Replace pt.17 and pt.14 ensuring that the o seal pt.4 is inserted into the neck of the top cap, secure in position with screws and lockwashers, screwing hard down to a torque of 7.7 Nm.

There are two kinds of different material washer for pt. 17, the Nebar washer(yellow)is used for in service, the black one is for storage and transportation.

5.4.9 Fit gasket pt.4 and pt. 13 on the draw lead, secure in position with the M6 screws and lockwashers pt.11 and pt.12 to a torque of 2.3Nm.

5.4.10 Insert the terminal plate pt.9 into draw lead, secure with bolt pt.5 and spring gasket pt.6.

Must be careful not to damage O seal when fitting clamping plate pt.13 and top cap pt.14.

Should it be necessary to remove the bushing from the transformer, the above procedure should be reversed.

5.5 Check the oil level, adjust if necessary as described in section 6.5.

5.6 When the transformer is completed and has been filled with oil, the bushing central tube can be air released. Unscrew pt.11, pt.13 and pt.16 enough to lift top cap pt.14 a few millimeters enabling air to be released, after air releasing is complete the top cap and terminal plate should be secured to the torque as stated above.

5.7 The transformer turret can be air released by unscrewing the square headed screw situated on the mounting flange, after air releasing is complete the screw should be tightened. Fig.2.

5.8 Test tapping terminal Fig.7 & 8

5.8.1 In case test tapping to Fig. 7

Remove the cover pt. 3, now the spindle is electrically disconnected from the flange. Connect a wire to the spindle and testing may proceed after the test apparatus has been connected to the wire.

Remove the wire and replace the cover after tests. The spindle is now earthed through the flange.

In case the test tapping is used in an open circuit, the tap must be earthed remotely through the wire connected to the spindle when the bushing is in service. It is recommended that the test tapping be used only in conjunction with low voltage impedance instruments with overvoltage protection.

5.8.2 In case test tapping to Fig. 8 Remove the cover pt.1,then connect the spindle to the test instrument

Replace the cover(a torque of 20Nm) after test, ensure the earthing and seal properties of the bushing.

Note: 1. The test bridge must be connected to the bushing before the application of test voltage, because voltage at the test tapping is up to several kilovolts when it is open circuit.

2 Removing and replacing the cover is strictly prohibited when the test voltage is applied. Dangerous:high voltage.

3 The test arrangement should be according to GB775”

6. <u>Maintenance</u>

6.1 The acceptance tests should be carried out to GB4109 “ high voltage bushing specification ” and GB775,the oil in the tank should meet the requirement of the related national standard.

Break down voltage≥45kV／2.5mm.

tg δ (90℃) ≤0.0035.

Moisture≤30ppm

6.2 The acceptance tests should also be carried out to item "16 bushing" of GB50150-2006.

note: 1 when the bushing is tested at low voltage in air ,there shoud not be any evidence of dew on the surface.

2 The test arrangement should be according to GB775.

6.3 The oil level in the bushing should be at the mark line on the oil gauge glass or the hand should point to 20℃ and should be observed regularly. If the oil level is not correct , it should be adjusted to section 6.5.

6.4 The power factor and capacitance should be checked periodically and the record should be kept for checking. The tests can be done through test tapping in the flange of the bushing. The routine tests were done by the bushing supplier in accordance with IEC137-95" Up to and Including 1000V Bushing For Alternative System" and GB4109" High Voltage Bushing Specification".

6.5 Oil level adjustment Fig.6

Remove the filling plug pt.1. remove the gasket and sample the oil.

If the oil level in the bushing is lower, the bushing should be topped up with oil which comply with section 6.6.

If the oil level is higher, insert a plastic pipe into the filling plug, drain the extra oil. After this, fit the filling plug to proper position.

6.6 The oil filled in the bushing is NYNAS transformer oil. After process, the oil should meet the following requirements:

Break down voltage	≥60kV/2.5mm (sphere electrode)
Moisture	≤10ppm
tg δ (90℃)	≤0.0035

Others should be in accordance with IEC296.

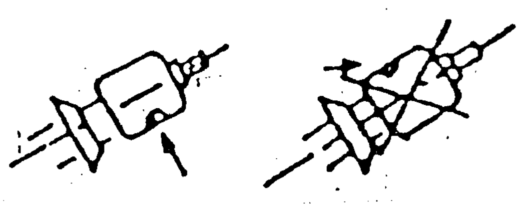
7. <u>Packing</u>

The bushing is horizontally packed in wooden case. The wooden case should be strong enough to protect the bushing from damage during transportation. There are supporting timber inside the case.

8. Handling and storage

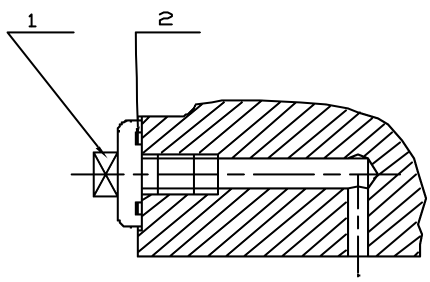
The bushing should be kept in case or rack as shown in Fig.1 if it is not used for long time. If the bushing is left outdoor, the case should be covered with weatherproof oilcloth or similar material.

Send the service record and protective tests record and the comments on the quality at any time to the manufacturer so that the quality can be improved immediately.



The oil gauge should be underside of the bushing during storage and handling

Fig.1



1Air release plug 2 Gasket
Fig.2

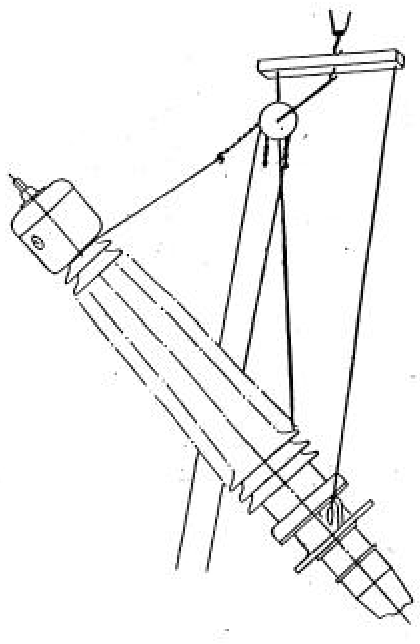
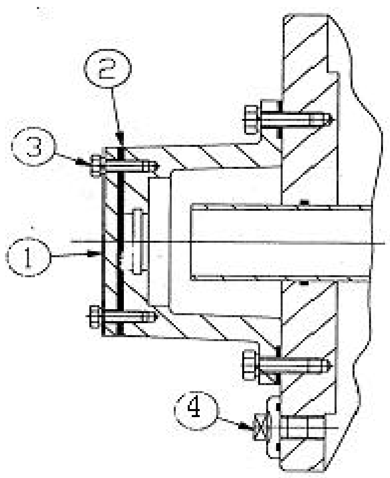
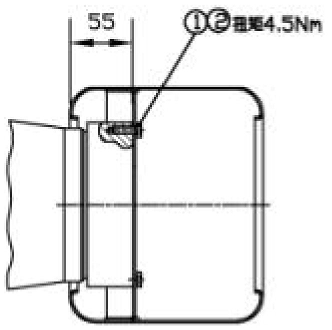


Fig. 3 Lifting

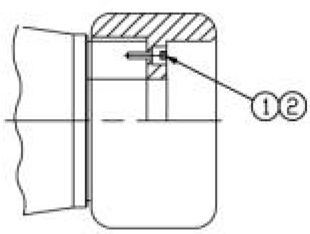


1 Transport plate 2 Gasket 3 Screw 4 Oil filling plug

Fig.4 Transportation assembly

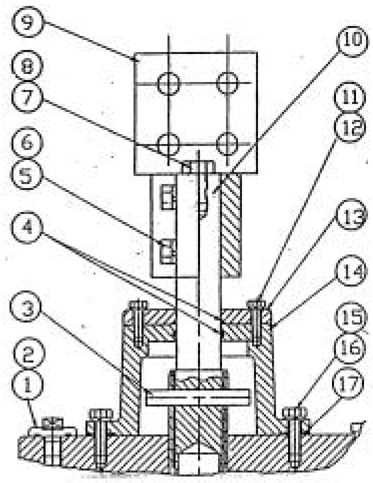


1 Screw 2 Gasket



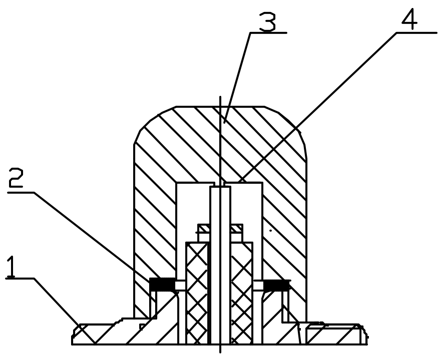
1 Screw 2 Gasket

Fig. 5 Corona shield



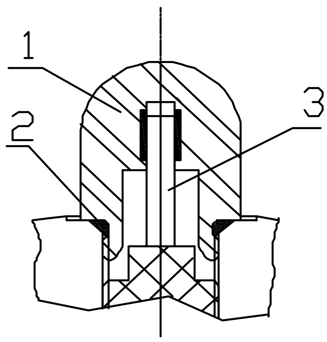
1 Filling plug 2 Gasket 3 Pin 4 o seal 5 Screw 6 Spring washer 7 Screw 8 Gasket 9 Terminal plate 10 draw lead 11 Screw 12 Spring gasket 13 Clamping plate 14 Top cap 15 Screw 16 Spring gasket 17 Gasket

Fig. 6 Draw lead



1 Base 2 Gasket 3 Earthed cover 4 Spindle

Fig.7 Test tapping



1 Earthed cover 2 Gasket 3 Spindle

Fig.8 Test tapping

Trench High Voltage Products Ltd., Shenyang China

Dao Yi Economic Development Zone shenya ng, China 110136

Tel：(+)86-24-88923999 Fax ：(+)86-24-89737200

LV Bushing

TRENCH	Epoxy Resin Impregnated Paper Condenser oil /oil Bushing **Installation and Maintenance Recommendations**	Supercodes	IH 21
		Issue No.	8
		Page 1of	8

1. **Range**

Epoxy resin impregnated paper condenser oil/ oil bushing (hereinafter referred to as a bushing) is used for connection between transformers and cable boxes.

.

2. **Specification**

2.1 Power factor (tan δ) measured at ≥10℃ambient temperature, 1.05 Ur/3 should be smaller than 0.006.

2.2 Partial discharge at max. operating voltage should be smaller than 10pC.

3. **Bushing structure**

The bushing consists of porcelain, flange and core, and epoxy resin impregnate paper(ERIP).

The bushing is voltage graded by aluminium foils forming partial condensers, which control the electrical stress throughout the thickness and along the surface to produce an efficient compact design. The bushings are supplied horizontally with the insulator protected by polythene sleeves and metal canisters containing a corrosion inhibitor.

					Original	Approved by	SYL	2007/11/28
					BUSHING	Audited by	SYL	2007/11/28
						Standardized	XG	2007/11/28
						Checked by	XZL	2007/11/28
Mark	Dep.	File No.	Signature	Date		Made by	XG	2007/11/28

4. Installation

4.1 The protection (the cases, metal canisters, gaskets and screws) should be retained for repacking of the bushing after testing when the bushing is removed from packing case.

4.1.1 With the packing case resting the correct way up on a flat horizontal surface open the lid of the case remove any supports or protective sections from the top of the bushing. Attach suitably sized shackles and lifting slings to the mounting flange and lift the bushing clear of the packing and remove the protective packing and detach the corona shield. Keep the packing for repackaging after the tests. Thoroughly clean the insulation, flange, and the corona shield.

Note: Clean cotton cloth should be used to clean the surface of the insulator, any organic agent such as industrial spirit and acetone is prohibited.

4.1.2 Check the type and code of the bushing according to the contract. Check the components and documentation to the packing list and any damage to the bushing during the transportation.

4.1.3 Some special screws in the bushing can't be removed otherwise the gas tight property will be deteriorated. Fig 1-1, Fig1-2

4.2 Mounting the bushing in the transformer If lifting lugs are not provided fit suitable eyebolts to the tapped holes in the mounting flange. Fit a rope sling to either the lifting lugs or the eyebolts fitted to the mounting flange and lift the bushing above the hole in the transformer turret.

4.3 Transformer's pigtail

4.3.1 In case Fig1, Fig2, and Fig3, pt. 3 draw lead should be fixed to the transformer pigtail. Thread a wire of sufficient strength to comply with any safety standard down the central tube of the bushing and attach the wire to a suitable M10 bolt fitted to the end of pt.3 draw lead. thoroughly clean the draw lead surface and the transformer lead. Clean the gasket sealing on the top face of the transformer turret and position the gasket in. Having checked that the flange and insulation are thoroughly clean and dry, lower the bushing into the transformer at the same time pull the transformer lead into the bushing. Take care not to damage the insulation. Bolt the bushing into position taking care to check that the gasket between the transformer turret flange and the bushing mounting flange is correctly positioned. In case of Fig. 1, position the draw lead within the central tube by means of the pin pt.4 and remove the wire. Replace pt.5 and pt.2, screwing hard down to a torque of 30 Nm. In case of Fig. 2, position the draw lead within the central tube by means of the pin pt.5 and remove the wire. Replace pt.2, screwing hard down to a torque of 18 Nm. In case of Fig. 3, position the draw lead within the central tube by means of the pin pt.5 and remove the wire. Replace pt.7 and pt.4, screwing hard down to a torque of 30 Nm. The cleanness of the parts must be checked during fitting.

4.3.2 Connect the transformer’s pigtail to the terminal plate of the bushing directly if draw rod type is adopted.

4.4 Corona shield In case of Fig. 2-1, screw the corona shield to the bushing and position the corona shield by means of pt. 1 screw and pt. 2 stopping block. Make sure the corona shield is positioned rigidly by unscrewing it until it can’t be unscrewed. In case of Fig. 2-2, fix the corona shield to the end of the bushing using 4 screws directly. In case of Fig. 2-3, fix the corona shield to the end of the bushing using 4 screws directly. After the bushing has been fitted to the transformer the exposed end of the bushing must be protected by a suitable canister which must not be removed until the cable box duct is ready to be assembled.

4.5 Assembly of cable box duct

When the transformer is completed and has been filled with oil, the bushing central tube can be air released by unscrew pt. 2 clamping nut in Fig. 1-1 pt. 3 and 4 in Fig. 1-1 half turn. After air releasing is complete the part should be retightened to a torque of 30Nm. In case of Fig. 1-2, fix pt. 6 corona shield using pt. 1 and 2 to a toque of 4.5Nm. Thoroughly clean the insulation at the cable box end of the bushing including the connecting surface. Connect busbar or cable to the terminal of the bushing.

Note: The above procedure depends on the design of the cable box duct.

4.6 Test tapping terminal Fig.3& 4

4.6.1 See Fig.3 .Remove the cover pt. 3, now the spindle pt.4 is electrically disconnected from the flange. Connect a wire to the spindle and testing may proceed after the test apparatus has been connected to the wire.

Remove the wire and replace the cover after tests. The spindle pt.4 .is now earthed through the flange.

In case the test tapping is used in an open circuit, the tap must be earthed remotely through the wire connected to the spindle when the bushing is in service. It is recommended that the test tapping be used only in conjunction with low voltage impedance instruments with overvoltage protection.

4.6.2 See Fig. 4 Remove the cover pt.1,then connect the spindle pt.3 to the test instrument

Replace the cover(a torque of 20Nm) after test, ensure the earthing and seal properties of the bushing.

Note: 1. The test bridge must be connected to the bushing before the application of test voltage, because voltage at the test tapping is up to several kilovolts when it is open circuit.

2. Removing and replacing the cover is strictly prohibited when the test voltage is applied. Dangerous: high voltage.

3. The test arrangement should be according to GB775”

5.**<u>Maintenance</u>**

5.1 The ex-work tests have been done on the bushing in accordance with IEC137-2003 1000V and above Bushings For Alternative System and GB4109 High Voltage Bushing Specification.

5.2 The acceptance tests should be done in such conditions that simulate the operating environment of the bushing. It is not allowed to test the bushing in air because the moisture and dirt in air will affect the test results.

5.3 The bushing is a self sealed unit. Other than periodically checking the power factor, no other action is considered necessary.

5.4 The both ends of the bushing should be protected by canisters during the storage and transportation.

Note: Send the operation record, protective tests record and the comments on the quality at any time to the manufacturer to enable the continuous improvement.

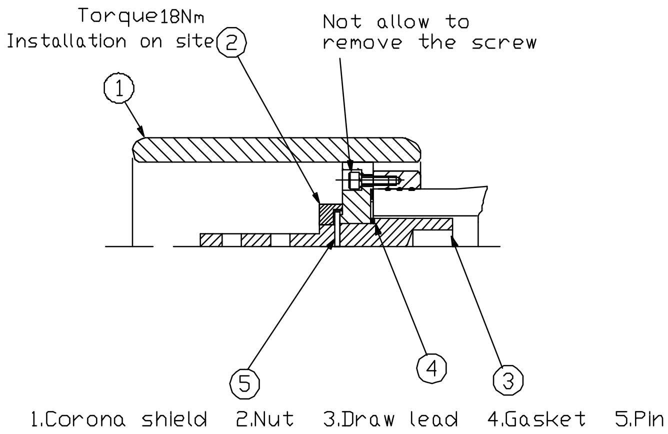


Fig. 1-1

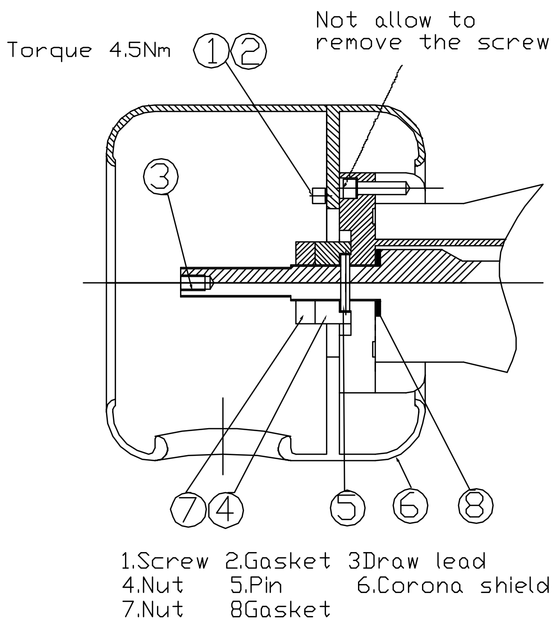

Torque 4.5Nm
Not allow to
remove the screw
1 2
3
7 4
5 6 8
1.Screw 2.Gasket 3Draw lead
4.Nut 5.Pin 6.Corona shield
7.Nut 8Gasket

Fig. 1-2

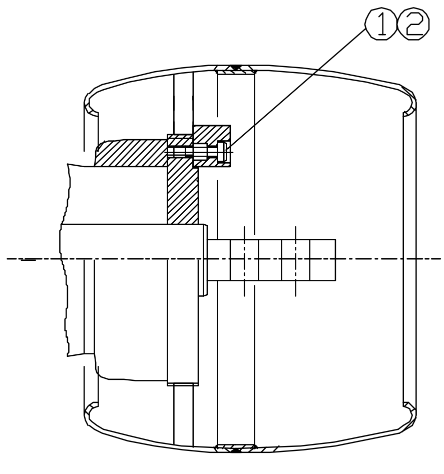

1 2

Fig. 2-1

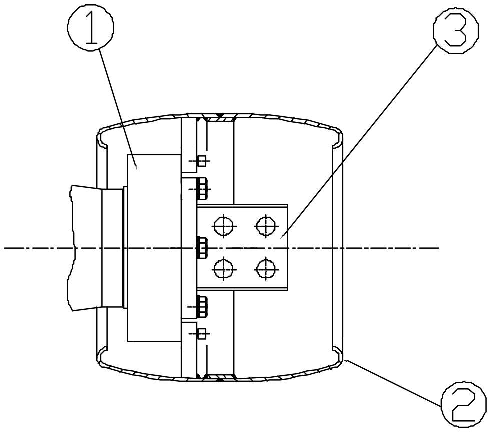


Fig. 2-2

1 Bottom plate 2 Corona shield 3 Terminal plate(oil end)

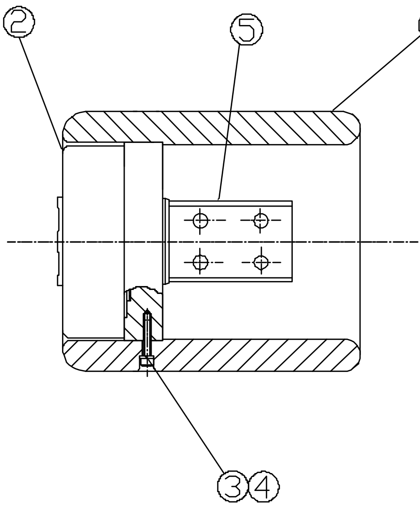
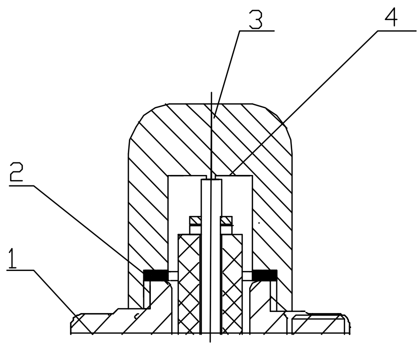
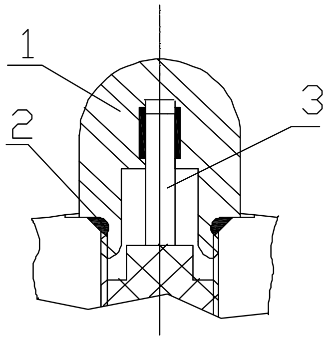


Fig.2-3

1 Corona shield 2 Bottom plate 3 Screw

4 Spring gasket 5 Terminal plate(oil end)





1 Base 2 Gasket 3 Earthed cover 1 Earthed cover 2 Gasket 3 Spindle
4 Spindle

Fig.3 Test tap Fig. 4 Test tap

Trench High Voltage Products Ltd., Shenyang China
Dao Yi Economic Development Zone Shenyang, China 110136
Tel：(+)86-24-88923999 Fax：(+)86-24-89737200

1. **Range**

Epoxy resin impregnated paper condenser oil/SF6 bushing (hereinafter referred to as a bushing) is used for direct connection between transformer and SF6 switchgears.

It is important to ensure that the design of the SF6 duct clearances are adequate and that the SF6 operating pressure is in excess of 3.5 bar gauge . The pressure will depend on the design of the gas insulated switchgear.

2 **Technical data**

2.1 Power factor (tan δ) measured at ≥10℃ambient temperature, 1.05 Ur/$\sqrt{3}$ should be less than 0.007.

2.2 Partial discharge under max. working voltage should be less than 10pC.

3. **Bushing structure**

The bushing consists of porcelain, flange and core, and epoxy resin impregnate paper(ERIP).

The bushing is voltage graded by aluminium foils forming partial condensers which control the electrical stress throughout the thickness and along the surface to produce an efficient compact design .The condenser is assembled within a central aluminium flange which provides a surface the SF6 duct and the transformer turret.

4. **Removal from the packing case**

4.1 The type, code and description should be checked according to contract before installation. And make sure the parts are in accordance with packing list, the bushing is not damaged during the transportation.

4.2 Some special screws in the bushing can't removed otherwise the gas tight property will be deteriorated. see Fig.1

5. **Installation**

5.1 With the packing case resting the correct way up on a flat horizontal surface open the lid of the case remove any supports or protective sections from the of the bushing. Attach suitably sized shackles and lifting slings to the mounting flange and lift the bushing velar of the packing from the oil end of the bushing and detach the corona shield.

5.2 Carefully lift the bushing clear of the canister and thoroughly degrease the underside of the mounting flange, insulation, contact surfaces on the connector and inside the bore of the casting and lift the bushing above the hole in the transformer turret.

5.3 With the bushing at the correct angle and placed above the hole in the transformer turret, having ensured that the earthband and the transformer end of the bushing are thoroughly clean and dry, lower the bushing into the transformer.

5.5 Bolt the transformer lead to the terminal at the end of the bushing.

5.6 Oil end corona shield assembly

5.6.1 1 See Fig. 2-1 screws down corona shield to bushing with pt.1and turn localizer pt.2 .

Reverse corona shield judgment if is locked-in.

5.4.2 See Fig. 2-2 fix the corona shield Pt.2 onto the end nut Pt. 1 using screw s.

5.4.3 See Fig. 2-3 screw the corona shield Pt. 1 onto the end nut Pt 2. Secure spring gasket Pt. 4 and screws Pt. 3, unscrew the corona shield Pt. 1 until the corona shield is secured against the end nut Pt 2.

5.6 The transformer turret can be air released by unscrewing the square headed screw situated on the mounting flange, after air releasing is complete the screw should be tightened. Fig.3.

5.7.assembling the SF6 duct

5.7.1 The SF6 end protective canister must not be removed until the switchgear erectors are ready to assemble the SF6 duct and the work must be carried out with the minimum of delay.

5.7.2 Remove the protective canister.

5.7.3 Thoroughly clean the insulation surface and the SF6 flange.

5.7.4 Secure the bus-bar to the SF6 end terminal.

5.7.5 Fit the SF6 duct ensuring that the duct is thoroughly clean and dry and that any gaskets are correctly positioned.

Note: above installation based on switchgear.

5.8. Test tapping terminal Fig.4& 5

5.8.1 See Fig.4 .Remove the cover pt. 3, now the spindle pt.4 is electrically disconnected from the flange. Connect a wire to the spindle and testing may proceed after the test apparatus has been connected to the wire.

Remove the wire and replace the cover after tests. The spindle pt.4 .is now earthed through the flange.

In case the test tapping is used in an open circuit, the tap must be earthed remotely through the wire connected to the spindle when the bushing is in service. It is recommended that the test tapping be used only in conjunction with low voltage impedance instruments with overvoltage protection.

5.8.2 See Fig. 5 Remove the cover pt.1,then connect the spindle pt.3 to the test instrument

Replace the cover(a torque of 20Nm) after test, ensure the earthing and seal properties of the bushing.

Note: 1. The test bridge must be connected to the bushing before the application of test voltage, because voltage at the test tapping is up to several kilovolts when it is open circuit.

2.Removing and replacing the cover is strictly prohibited when the test voltage is applied. Dangerous: high voltage.

3. The test arrangement should be according to GB775"

6. **Maintenance**

6.1 The acceptance tests must be done to IEC60137 and GB772 bushing must be put into a individual test tank filled with transformer oil during the tests .

6.2 It is not allowed to test the bushing in air.

6.3The power factor and capacitance should be checked periodically and the record should be kept for checking.

7. **Packing**

The bushing is horizontally packed in wooden case with plastic bag and drier . The wooden case should be strong enough to protect the bushing from damage during transportation. There are supporting timber inside the case.

8.**Handling and storage**

The bushing should be kept in case or rack with the oil end and SF6 end wrapped by plastic bag filled with some drier if it is not used for long time.

Note: Send the service record and protective tests record and the comments on the quality at any time to the manufacturer so that the quality can be improved immediately.

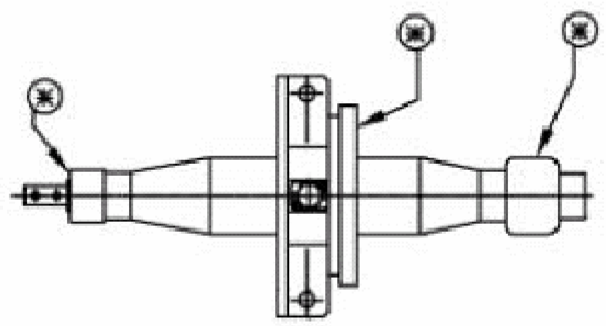
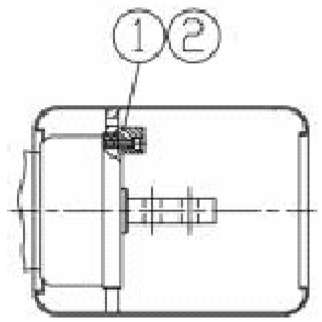
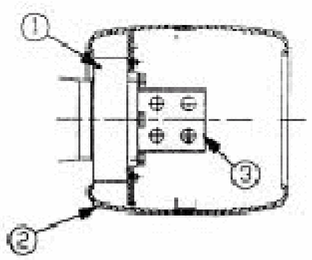


Fig.1 * not allow to remove these screws



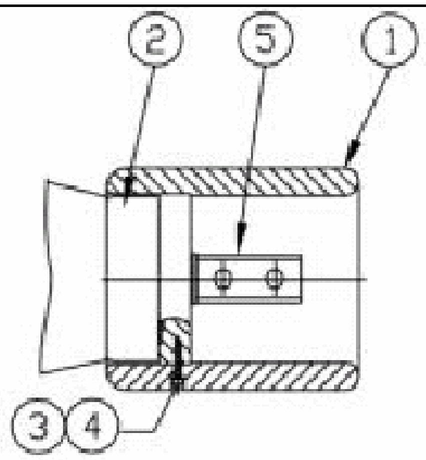
1.screw 2. localizer

Fig.2-1



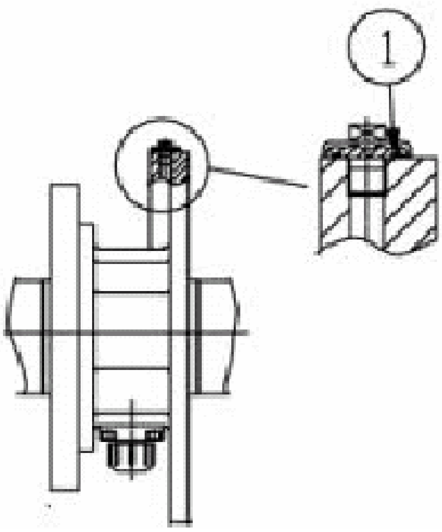
1.end nut 2. corona shield 3. terminal

Fig.2-2



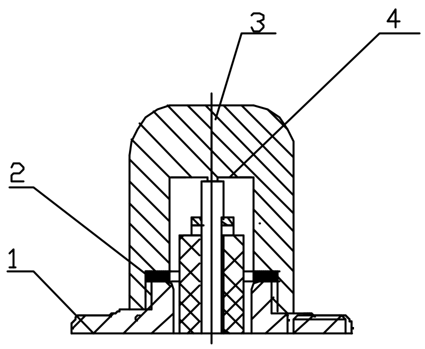
1.conona shield 2.end nut 3.screw 4. spring gasket 5. terminal

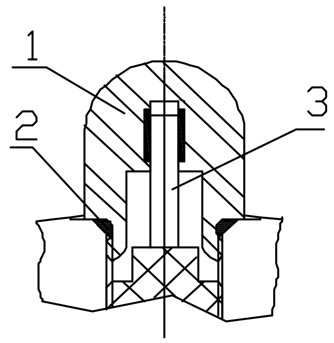
Fig 2-2



1. square headed screw

Fig 3





1 Base 2 Gasket 3 Earthed cover 4 Spindle

Fig.4 Test tapping

1 Earthed cover 2 Gasket 3 Spindle

Fig.5 Test tapping

Trench High Voltage Products Ltd., Shenyang China
Dao Yi Economic Development Zone S henyang, China 110136
Tel: (+)86-24-88923999 Fax: (+)86-24-89737200

Section 8
Component Instruction Leaflets and Manuals

8.4 Current transformer

Bushing Current Transformer

Operation Instruction

Nanjing Zhida Electric Co.,Ltd
Tel: 025-85565389 Fax: 85575112

1. General Information

1.1 Our product is bushing type current transformer.Current transformers are used extensively for measuring current and monitoring the operation of the power grid.

1.2 Explanation of type

L R (B) -( )

Voltage rating(Kv)

B:protective use;without:measuring use

Bushing type

Current transformer

2. **Technical data and specifications**

2.1 Rated primary current scope

50，75，100，125，150，200，250，300，400，500，600，750，800，1000，1200，1250，1500，1600，2000，2400，2500，3000，3500，4000，5000，6000，7000，8000，9000，10000，12000，15000，20000A etc.

2.2 Rated secondary current: 1A, 5A etc

2.3 Error limit of measuring current transformer

2.3.1 For current transformer of Class 0.2~Class1.0, when the rated secondary burden is of any value among 25%~100% burden rating, the current error and phase error at rated frequency 50Hz can't exceed the referred values in Table 1.

Table 1

Accuracy	Current error ±%				Phase error ±%			
	（at following rated current percent values）				（at following rated current percent values）			
	5	20	100	120	5	20	100	120
0.2	0.75	0.35	0.2	0.2	30	15	10	10
0.5	1.5	0.75	0.5	0.5	90	45	30	30
1	3.0	1.5	1.0	1.0	180	90	60	60

2.3.2 For current transformer of Class 0.2S~Class0.5S, when the rated secondary burden is of any value among 25%~100% burden rating, the current error and phase error at rated frequency 50Hz can't exceed the referred values in Table 2.

Table 2

Accuracy	Current error ±% (at following rated current percent values)					Phase error ±% (at following rated current percent values)				
	1	5	20	100	120	1	5	20	100	120
0.2S	0.75	0.35	0.2	0.2	0.2	30	15	10	10	10
0.5S	1.5	0.75	0.5	0.5	0.5	90	45	30	30	30

2.3.3 For current transformer of Class 3.0~Class 5.0, when the rated secondary burden is of any value among 50%~100% burden rating, the current error at rated frequency 50Hz can’t exceed the referred values in Table 3.

Table 3

Accuracy	Current error ±% (at following rated current percent values)	
	50	120
3	3	3
5	5	5
Note: No requirement is specified on the phase error at Class 3 and Class 5.		

2.4 Error limit of protective current transformer

Current error, phase error and composite error at rated frequency 50Hz and rated burden can’t exceed the referred values in Table 4.

Table 4

Accuracy	Current error ±% （at rated primary current）	Phase error （at rated primary current）		composite error % （at rated primary current）
		±（’）	±（crad）	
5P	1	60	1.8	5
10P	3	—	—	10

2.5 Rated frequency withstand voltage: 3kV, 1 min.

3. Operation Instruction

3.1 Bushing type current transformer is consisted of ring core, magnet wire and other insulation materials. The secondary windings can be single ratio or multi ratios.

3.2 Bushing type current transformer is used to assemble in transformer turrets.

3.3 When the nameplate is upward, the tope part is P1.Polarity: Subtractive.

3.4.The bushing type current transformer should not open circuit when operating and you shuold put the terminal to short circuit or else it will cause high voltage.

4. Cautions

4.1 Handle with care to avoid striking in transportation and assembly process.Protect against rain and moisture.

4.2 Storage at dry house to avoid moisture and corrosion.

Section 8
Component Instruction Leaflets and Manuals

8.5 Pressure relief valve

YSF_8-□/□Series of pressure relief device for transformers User's Manual

Application

●The products comprise of directional oil-gushing to prevents contaminated from the transformer oil, and protect environment.
●The products that coupled with electrical alarm signal realize remote control.
●The products are apt for electrical equipments such as gas or liquid insulate transformer, instrument transformers, on-load tap-changer, high voltage switch etc.
●Once there's something wrong in such electrical equipments, valve open and relieve the pressure to avoid oil basin.
●With the pressure reduced the valve automatically closed to prevent water and impurity got in from outside.

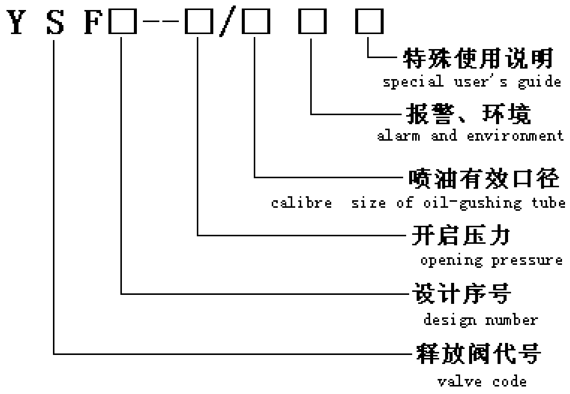
Working conditions and install mode

- Environment temperature
 - 30℃～40℃.

a）Install in the oil basin to cover
b）Install in the oil basin to sidepiece upside
c）Install in lift pedestal

What the letter mean:
K:electrical alarm signal
J:machinery alarm signal
B: with locking devices
TH： Humid Tropics ；
TA：Dry Tropics ；
T:Humid and Dry Tropics

Model Specification



For example 1: YSF_8-55/130KJBTH
Namely, fuel injection caliber Φ130 mm, opening pressure of 55 kPa, with machinery,electrical alarm signal, humid tropics applicable, with locking devices, 8th design , model II registered mark of the pressure release valve.
For example 2: YSF_8-55/80KJBTH
Namely, fuel injection caliber Φ80 mm, opening pressure of 55 kPa, with machinery, electrical alarm signal, with locking devices, humid tropics applicable, the 8th design directional injection pressure release valve.

The product specification and basic parameter

Effective caliber of oil-gushing （mm）	Opening pressure （k Pa）	Tolerance of Opening pressure （k Pa）	Closing Pressure （k Pa）	Sealed Pressure （k Pa）
Φ50 Φ80 Φ130	35	±5	19	21
	55		29.5	33
	70		37.5	42
	85		45.5	51
	135		72	80

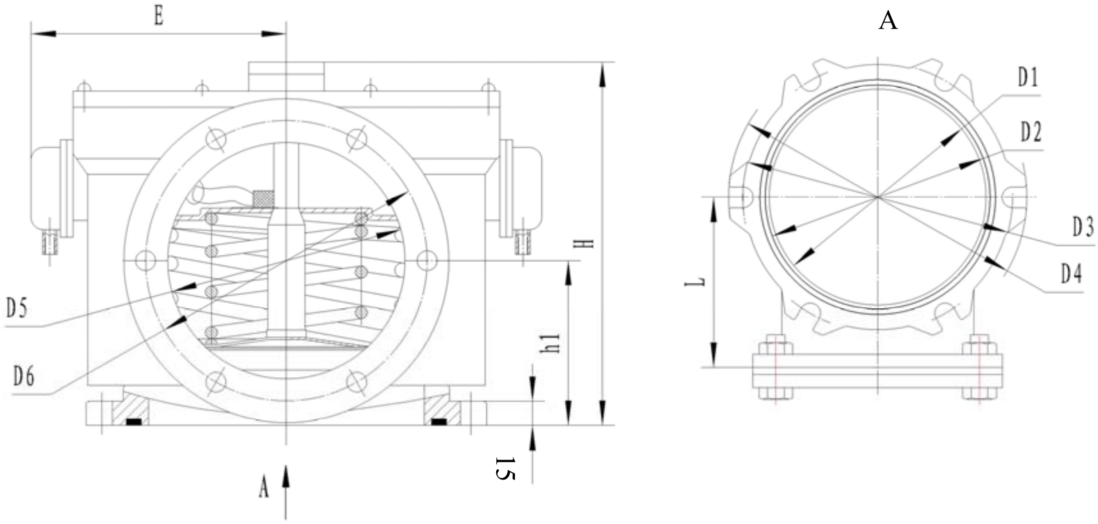
Selection of pressure relief device

- selection of effective caliber

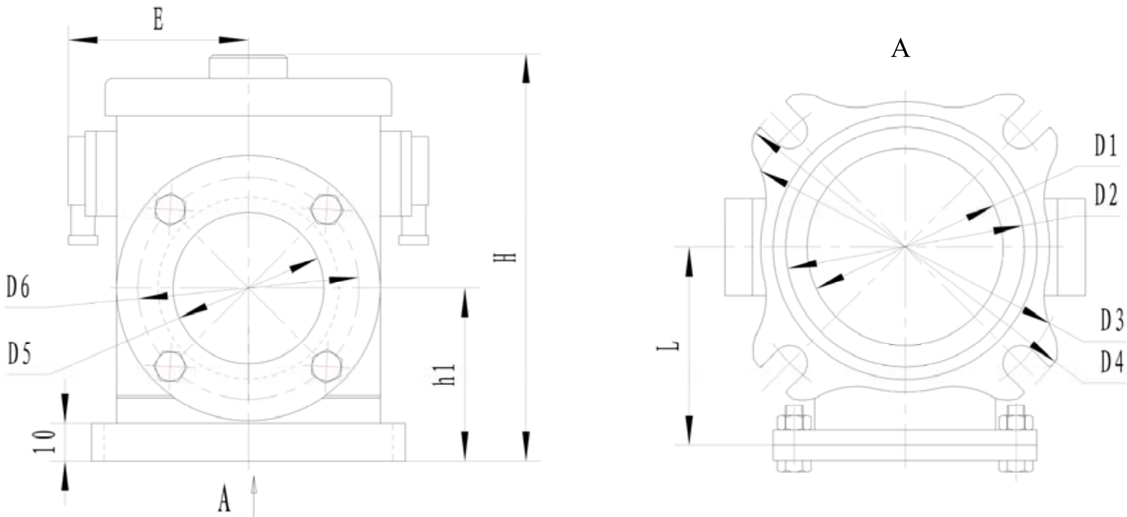
Total weight of oil（t）	∠1.5～4.5	4.5～11.5	11.5～23
Effective caliber of oil-gushing valve （mm）	Φ50	Φ80	Φ130

Attention: When total oil weight more than 23 tons,
The quantity of release valve that chooses should be:
Total oil weight(tons) /23=Φ130 calibers of pressure release valve quantity(decimal fraction up to integer)
●selection of opening pressure
a）The opening pressure of pressure release valve should be equal to or slightly less than 0.6～0.7 safe pressure in oil tank;
b） Use product specification and basic parameter to assure the opening pressure.

Configuration and installation dimensions



● YSF8-/80 and 130 series pressures release valve figure and configuration chart.



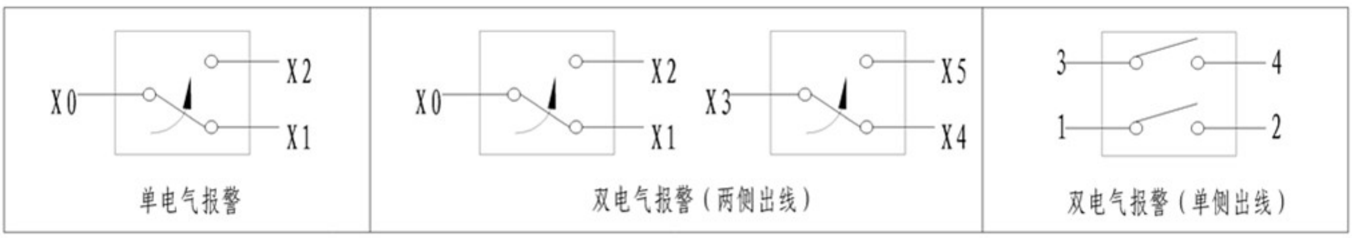
●YSF$_8$-/50 series pressures release valve figure and configuration chart.

Shape and installation dimensions

Units: mm

caliber of oil-gushing（mm）	D1	D2	D3	D4	D5	D6	H	h1	L	E	Valve pedestal install bolt Diameter × quantity	Definite direction bolt Diameter × quantity
φ50	Φ84	Φ90	φ130	φ150	φ56	φ88	178	65	79. 5	90	M12×4	M6×4
φ80	φ127	φ133	φ170	φ200	φ100	φ144	210	104	140	130	M12×6	M10×6
φ130	φ180	φ189	φ235	φ260	φ148	φ200	250	131	179. 5	183	M16×6	M10×6

The conjunction and basic parameter of the electric switch



Basic parameter of electric switch

electrical Source sort	Working voltage	Working current	
		Resistance	Reactance（A）
Alternating current（AC）	220（V）	5（A）	3（cosΦ=0.4）
Direct current（DC）		0.3（A）	0.05（T=7ms）

Install 、Using、Debugging

● Install: Pressure releasing valve and tank connect with the stud bolt

Attention:

1）The bottom of pressure releasing valve assemble to seal well;

2）When connect the pressure releasing valve and tank, tighten the bolts equality, avoid that valve pedestal rupture.

●Using: With latching that must be removed before equipment circulate, insure the normal work of the pressure releases valve.

●Debugging: Electric alarm switch,should manual debug deferent signal of switch whether exactitude、sensitive，before the equipments circulate .

Method ：1）Measure export signal of switch when pressure releasing valve actionless by multimeter to see whether in accordance with the signal mark of the switch.

Viz.: (a) "Common" towards "Normal open" normal open.

(b) "Common" towards "Normal closed" normal closed.

Experiment of simulate releasing valve's action,checkout whether inching switch accurate export behavioural signal.

Method: Raise the small red hat of the pressure releasing valve,then releasing valve turn on, check whether the switch measure of the electric signal change.

Viz.: (a) "Common" of switch towards "Normal open": "Normal open" should turn to "Normal closed";

(b) "Common" of switch towards "Normal closed": "Normal closed" should turn to "Normal open";

(c) Examine the signal switch and control circuit connect whether right and good.

Attention: The small red hat must be replacement after test over, insure that the pressure releasing valve normal working and warning.

Product malfunction analysis

malfunction phenomena	Reason	Solution method
（1） Valve oil leak	a）The pressure of oil basin between the pressurize -pressure and open-pressure of valve a long time, then leaking ，but this instance is very rarely.	Check badness phenomena of transformers, eliminate hidden trouble.
	b）Valve working time long，sealing member aging and invalidation.	Make use of the power-off time maintain、change sealing member.
	c） Eyewinker stay at the sealing plane of the sealing member.	Make use of the power-off time eliminate eyewinker.
	d）Accessory、parts metamorphose or wear off.	Make use of the power-off time maintain、change.
（2）The signal switch export behavioural signal naught	a）Control circuitry connect abnormity or contact badness and circuit interruption.	1、According to the hookup of signal switch accurately connect; 2、Use multimeter measure circuitry joints contact good or not.
	b） The signal switch be block 、stop up.	Pull the small red hat of valve，checking switch whether operate sensitive，at the same time measure switch whether out-put signal.
（3）Valve no working	a）Latching of vavle dose not be backout.	Backout latching.
	b）The pressure in oil basin is smaller than the open-pressure.	Use manometer check that whether the pressure in oil basin reaches the open-pressure of the valve.
	c） Oil basin and valve have leaky place.	Check oil basin and valve whether pressurize good.

Crucial hint

●Latching should operate strictly according to caution requirement, insure that the pressure releasing valve normal working.

●When install, accessory、 parts of the pressure releasing valve shouldn't be arbitrium teardown.

●When equipment run, as if releasing valve turn on result in the instruction pole up, replace the instruction pole by hand before find out reason, unchain warning alarm.

Maintenance and Inspection

Make use of the power-off time during maintenance of the pressure releasing valve:

●If turn on action sensitive? If there is block or stop up should eliminate.

●If the sealing gaskets are aged or deformed or damaged?

●If accessory、 parts whether metamorphose or wear off?

●If the signal switch whether operate sensitive?

How to Make Order

●The customer should be appropriate prepare several pressure releasing valve to switchover during maintenance.

●Product every examine and repair, after teardown should change new sealing element,the sealing after teardown do not suitable continue to use.

●Please specify the model, opening pressure, caliber of oil-gushing, mode of signal, using environment, quantity and switch down-lead length(If no indication, then no down-lead.)

Spare parts and maintenance are available, also special designs asked and manufactures.

Shenyang STI Electric Technology Co.,Ltd.
Company Address**:** No.39 Shiji Road Hunnan New Urban District Shenyang China
Postcode：110179
Sales phone：024-89368025 Tele fax：024-89368108
Telephone：024-89378958
http://www.stielec.com E-mail ：sales@stielec.com
service@stielec.com

Section 8
Component Instruction Leaflets and Manuals

8.6 Thermometer

Patent No. ZL 01 2 41472.7

BWY-804J（TH）Temperature Oil Surface Thermometer

Installation and Operation Manual

DALIAN SHIYOU ELECTRIC POWER TECHNOLOGY Co., Ltd.

Table of Contents

List of Figures

1 Type description:

B W Y－80 4 J （TH）

- **（TH）** humid tropics protection
- **J** mechanical-electrical integration, output(4-20) mA
- **4** number of switches
- **80** linear scale
- **Y** oil surface
- **W** thermometer
- **B** transformer

2 General Introduction

BWY-804J (TH) transformers oil surface thermometer is designed by advanced technology on the basis of BWY-804B temperature indicating controller. The designer combined BWY-804B temperature indicating controller with DFY-24 stabilized voltage supply. It features small size, full functions, being easy to install and use. It has an extensive range of application. It has good protection performance and works properly in outdoor conditions. The controller is equipped with four sets of adjustable control switches, separately used for starting transformer cooling system and signal alarming. BWY-804J (TH) transformers oil surface thermometer outputs a DC(4-20) mA standard current signal to computer system.

3 Working Principle

BWY-804J (TH) transformers oil surface thermometer mainly consists of elastic element (corrugated tube), capillary and temperature sensitive bulb. The sealed system formed by the three components is filled with temperature sensing medium. When the measuring temperature changes, volume of the medium inside the temperature sensing bulb will change accordingly, the increment in volume is sent through capillary to the meter's elastic element, which in turn produces a displacement. After amplification, the displacement indicates the measured temperature and drives micro-adjust switch to output control signal to drive cooling system. Thus, the purpose of controlling temperature rise of the transformer is achieved.

4 Major performance and technical parameters

4.1 Technical parameter of BWY-804J (TH) transformers oil surface thermometer

4.1.1 Output signal: current value : (4-20)mA

4.1.2 Service conditions: environmental temperature (-40~+55)℃, relative humidity: ≤95%

4.1.3 Measuing range : (0-150)℃

4.1.4 Degree of accuracy: class 1.5(the maximum error detection points allowing is ±2.25℃).

4.1.5 Switch performance: four sets of adjustable switches, each set of switches can be set freely within the whole range.

4.1.6 Switch error: ±2℃

4.1.7 Switch changeover error:（6±2）℃。

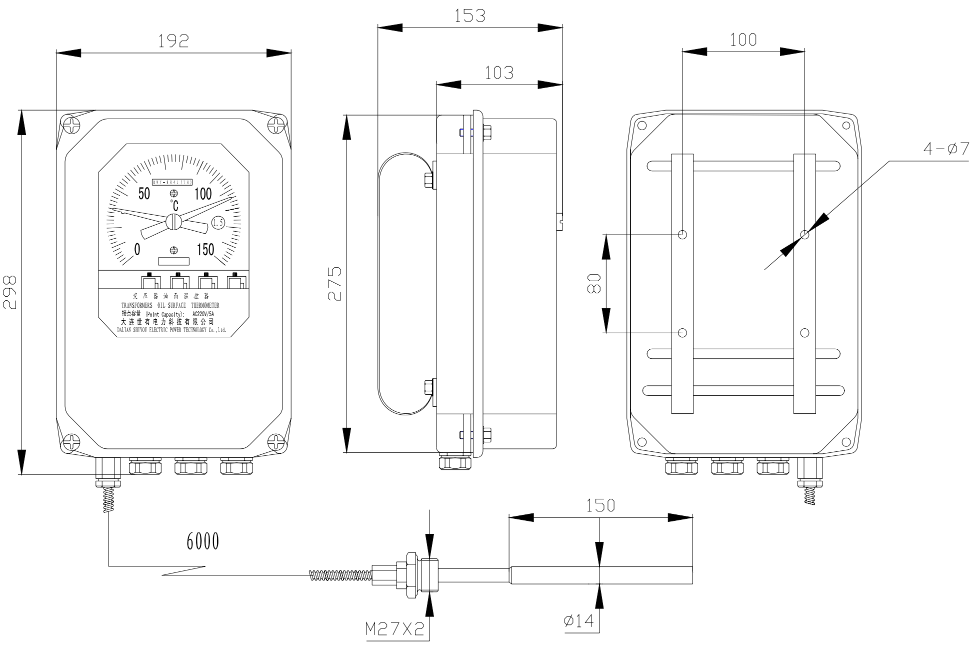
4.1.8 Rated power of switch: AC220V / 5 A，DC220V / 3 A

4.1.9 Dimension of temperature sensitive bulb: (Φ14×150)mm, installation screw thread: (M27×2)mm or (M33×2)mm.

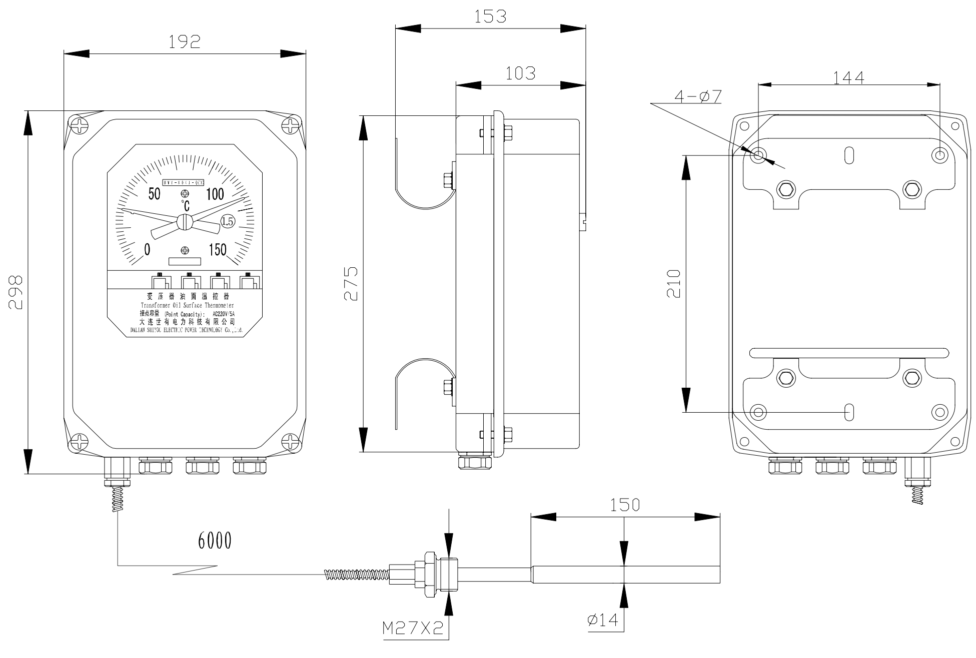
4.1.10 Length of capillary: 6m

4.1.11 Protection Grade: IP55.

4.1.12 Outline and installation dimensions of instrument (see Figure 1)



(1)



(2)

Figure 1

4.2 Technical parameters of XMZ-155 digital temperature indicator

4.2.1 Input signal: DC (4-20)mA

4.2.2 Output signal: DC (4-20)mA

4.2.3 Service conditions: environmental temperature (0~50)℃, relative humidity: ≤85%

4.2.4 Operational power supply: AC / DC（100-260）V, frequency: (50~60) Hz

4.2.5 Degree of accuracy：Class 1.0

4.2.6 Indicating mode: indicated by digital tube

4.2.7 Mounted form: flush mounted

4.2.8 Outline dimension: 160mm × 80mm× 80mm

4.2.9 Dimension of hole: 152^{+1}mm ×76^{+1}mm (see Figure 2)

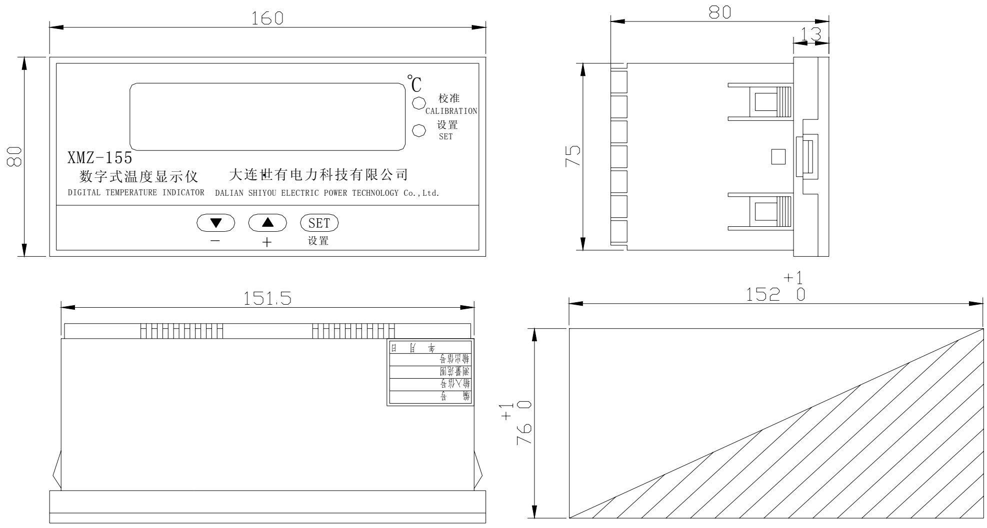


Figure 2 : Dimension of outline and hole of XMZ-155

5 Installation and Operation

5.1 The Instrument should be placed vertically during working

5.2 Insert digital indicator into the hole in control desk, and then push it lightly

5.3 Installation of temperature sensitive bulb

Prior to the installation of temperature sensitive bulb, fill the installation hole with transformer oil, then slowly insert temperature sensitive bulb. Tighten the M27× 2 installation joint, loosen the M18× 1.5 hollow screw on the installation joint and wind stuffing around the Φ11 lengthened conduit. Before thoroughly tightening the hollow screw, users should adjust insertion depth of the temperature sensitive bulb (choose possibly maximum insertion depth) to ensure the temperature sensitive bulb fully emerged in the oil.

5.4 The tube between temperature sensitive bulb and gauge outfit should be 300mm long. Bend radius shouldn't be shorter than 100mm. Extra tubes should be bent into a round (Φ200mm min.), and then fixed on the transformer.

5.5 Open the cover of instrument by taking out 4 M6 crews on it, and then connect wires according to Figure 3.

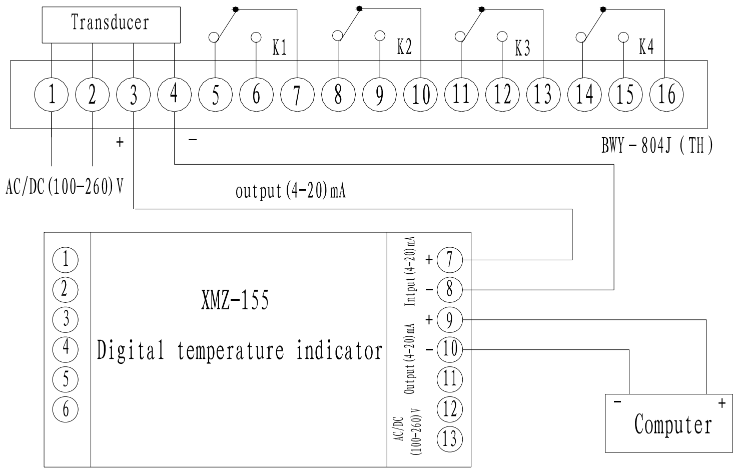


Figure 3: Connection Diagram

Note: don't touch components of instrument during connecting wires

5.6 Switch setting: before leaving the factory, the switch has been set as follows:

K1＝55℃　K2＝65℃　K3＝80℃　K4＝100℃

Switch setting: before leaving the factory, the switch has been set as follows:

5.6.1 Take out the screw in recording axis (see Figure 4-3) on red contact indicating finger (see Figure 4-4)

5.6.2 Rotate dial (see Figure 4-2) to make the end of red contact indicating finger to the setting point, and then screw down the screw in recording axis.

5.6.3 Move downward the position limit block (Figure 4-5) to turn the dial. Once the meter pointer turns to the setting point, the micro-adjust switch will switchover; thus, whether the temperature value is correctly set can be tested. If the value is not correctly set, please repeat the above step until correctly calibrated.

1、Indicating finger
2、Dial
3、Contact indicating finger
4、Screw in recording axis
5、Position limit board
6、BWY-804J transducer

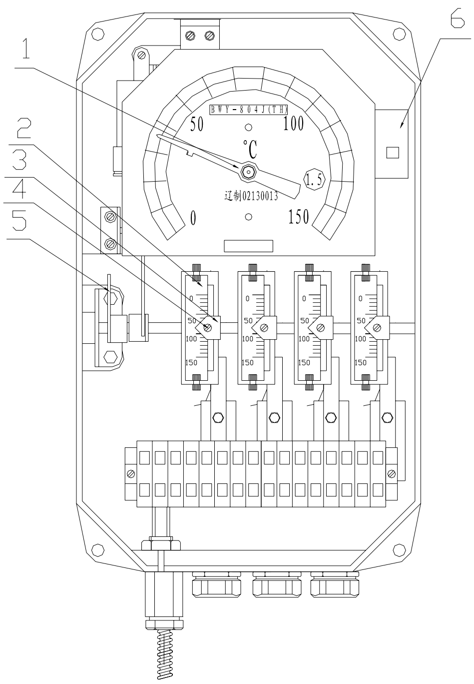


Figure 4: Structure Drawing

6 Attentions

6.1 In the process of use, Is prohibited prod Instrument pointer with hands.

6.2 Please read this Manual before using, and keep well.

6.3The temperature controller should be stored in an aired and dry room. During transportation, intense impact should be avoided. After a storage period of 12 months, an inspection on temperature indication should be conducted to ensure normal service.

6.4 Subject to the operations specified in this manual, within 18 months from the date of delivery of the product, the factory will repair or replace the product with problem.

Notice: Please carefully read the following introduction before utilization and pay attention to the following items. Contact us if there is any problem. Tel: 0411-87869878.

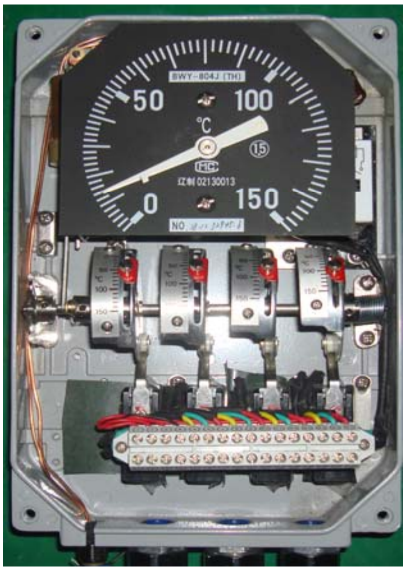


Figure I

1. Technical parameter of the transformer oil surface thermometer BWY-804J (TH)

1.1. Output signal: DC (4 - 20) mA current.

1.2. Working condition: ambient temperature (-40~+55) ℃, relative humidity ≤95%.

1.3. Measuring range: (0~150) ℃.

1.4. Accuracy: Grade 1.5 (permitted maximum tolerance at the testing point is ±2.25℃).

1.5. Performance of the switch: Four full-range adjustable switches.

1.6. Switch action tolerance: ±2℃.

1.7. Switching tolerance of the switch: (6±2)℃.

1.8. Rating power of the switch: AC220V / 5A, DC 220V / 3A.

1.9. Length of the capillary: 6m (it can be manufactured to 18m according to the requirements of the client).

1.10. Protection grade: IP55.

2. Setting values should be changed in accordance with the following procedures if needed.

2.1. Refer to Figure II: Unscrew the screws on the red connecting point indicated needle with slotted screwdriver, rotate the dial to make the red connecting point indicated needle tip point to the required setting point, then screw on the screws.

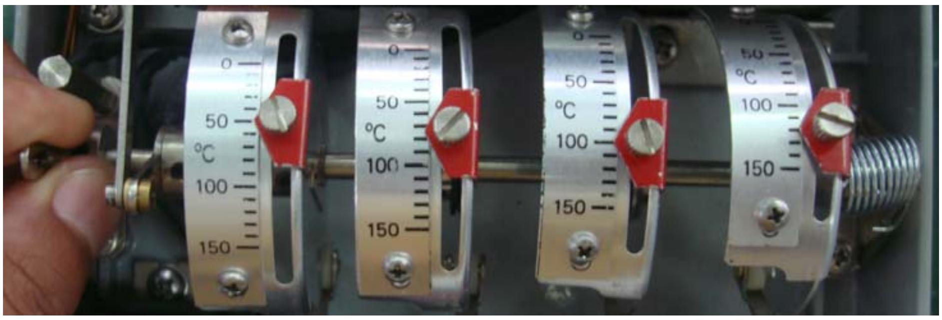


Figure II

2.2. Refer to the Figure II: Manually move the limitation plate downward slightly to make the dial rotate, the indicated needle gradually moves to the upper limit of temperature, the switch connecting point will close at each setting point, so as to verify whether the temperature setting value is correct, repeat the above procedures if not, till it is calibrated.

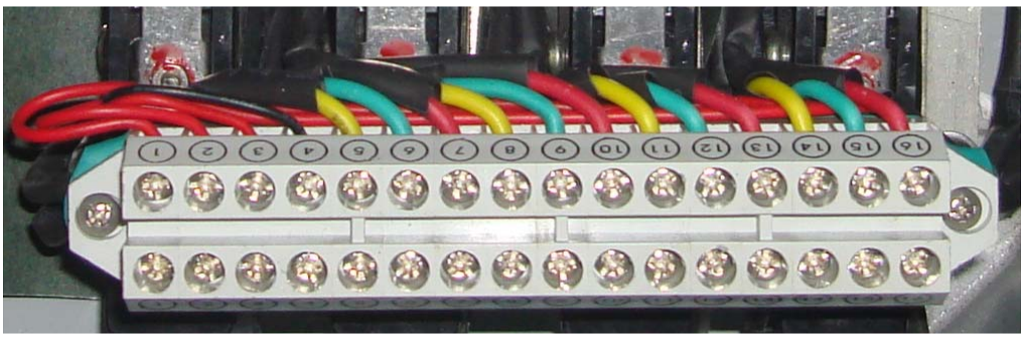


Figure III

3. Introduction to the connection

3.1. Terminals (Figure III) 1 and 2 are the working power of the temperature transmitter, i.e. AC220V±10%. Terminals 3 and 4 are output (4-20) mA current signal terminals of the temperature transmitter, that is, 3 is the positive pole, and 4 is the negative pole, terminals 5, 6 and 7; 8, 9 and 10; 11, 12 and 13; 14, 15 and 16 are respectively NO, NC circuit of K1, K2, K3 and K4, among which terminals 5, 8, 11 and 14 are the NC connection of the switch and terminals 6, 9, 12 and 15 are the NO connection of the switch, terminals 7, 10, 13 and 16 are the public terminals of the switch.

3.2 If the transmitted signal is abnormal, move the shift of multimeter to AC voltage 750V to see whether there is voltage on the terminals 1 and 2: it should be AC220V±10%, if it is normal, move the shift of the multimeter to DC current 200mA, disconnect the external connection of the meter to measure the output current on terminals 3 and 4, to see if it is normal. Calculated formula of current output is shown as follows: (20mA-4mA)/150℃=0.1066mA/℃，that is, 1℃ corresponds to 0.1066mA, current value corresponding to the present temperature of the meter = present temperature of the meter×0.1066mA /℃+radix 4mA.

3.3. Do remember to tighten the meter cap screws after integration so as to prevent the rainwater from entering under which condition short circuit will happen and the circuit may be burnt out.

Attachment: A comparison table of temperature value and current value

mA ℃ / ℃	0	1	2	3	4	5	6	7	8	9
0	4.000	4.107	4.213	4.320	4.427	4.533	4.640	4.747	4.853	4.960
10	5.067	5.173	5.280	5.387	5.493	5.600	5.707	5.813	5.920	6.027
20	6.133	6.240	6.347	6.453	6.560	6.667	6.773	6.880	6.987	7.093
30	7.200	7.307	7.413	7.520	7.627	7.733	7.840	7.947	8.053	8.160
40	8.267	8.373	8.480	8.587	8.693	8.800	8.907	9.013	9.120	9.227
50	9.333	9.440	9.547	9.653	9.760	9.867	9.973	10.080	10.187	10.293
60	10.400	10.507	10.613	10.720	10.827	10.933	11.040	11.147	11.253	11.360
70	11.467	11.573	11.680	11.787	11.893	12.000	12.107	12.213	12.320	12.427
80	12.533	12.640	12.747	12.853	12.960	13.067	13.173	13.280	13.387	13.493
90	13.600	13.707	13.813	13.920	14.027	14.133	14.240	14.347	14.453	14.560
100	14.667	14.773	14.880	14.987	15.093	15.200	15.307	15.413	15.520	15.627
110	15.733	15.840	15.947	16.053	16.160	16.267	16.373	16.480	16.587	16.693
120	16.800	16.907	17.013	17.120	17.227	17.333	17.440	17.547	17.653	17.760
130	17.867	17.973	18.080	18.187	18.293	18.400	18.507	18.613	18.720	18.827
140	18.933	19.040	19.147	19.253	19.360	19.467	19.573	19.680	19.787	19.893
150	20.000									

Address: 642, Sanli, Yongzheng Street, Jinzhou New District, Dalian
Tel: 0411－87804698
Tel: 0411－87804658 ext. 8899
Fax. 0411－87805542
P.C: 116100
No.: SM－006－03－09－E

Patent No.ZL 01 2 41312.7

BWR-04J（TH）Transformer Windings Thermometer

Installation and Operation Manual

DALIAN SHIYOU ELECTRIC POWER TECHNOLOGY Co.,Ltd.

Table of Contents

List of Figures

1 Type description

B W R— 04 J （TH）

- **Humid Tropics Protection**
- **Mechanical-electrical integration, output (4-20) mA current**
- **Number of switches**
- **Windings**
- **Thermometer**
- **Transformer**

2 General Introduction

BWR--04J（TH）transformer windings thermometer is designed for measuring and controlling temperature of the transformer's top oil and windings,Based on BWR-04B type and by adopting international advanced technology, BWR-04B(TH) type is the integration of BL type converter and DFY-24V stabilized power supply, etc. This kind of product features compactness, complete functions, convenience of installation and easiness of operation,output DC (4-20) mA standard current signal to computer system.

3 Working Principle

BWR-04J (TH) transformer windings thermometer mainly consists of elastic element, temperature sensitive bulb, sensor conduit, heating element, temperature transmitter, integrated converter, and digital indicator.

Temperature sensitive bulb of transformer windings thermometer is inserted in the oil hole on the top of oil tank (see Figure 1). When the load of transformer is zero, the count on transformer windings thermometer shows the temperature of oil. When load on transformer changes, the current (proportional to load) from current transformer collected in electrical heating element through converter. The heat produced by electrical heating element increases the displacement of elastic element. That's to say, the temperature indicated by the thermometer is a summation of the temperature of the transformer's top oil and the windings' temperature rise over that of the oil's.

1.Current Transformer
2. Temperature sensitive bulb
3. Capillary
4. Electrothermal element
5. BL-E type converter
6. Computer

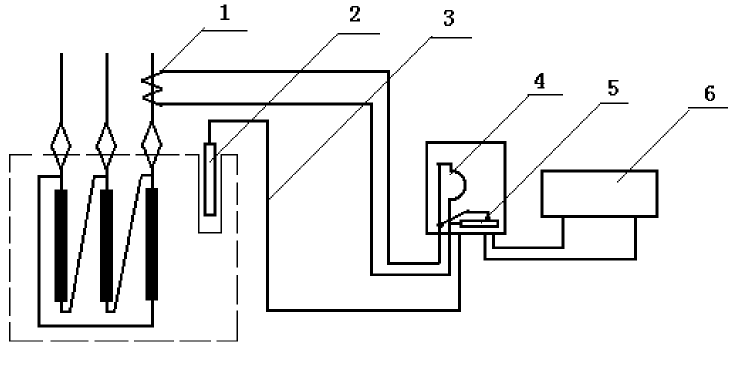


Figure 1

4 Major performance and technical parameters

4.1 Technical parameter of BWR-04J (TH) transformer windings thermometer.

4.1.1 Output signal :DC (4-20) mA current signal .

4.1.2 Service conditions: environmental temperature (-40~+55)℃, relative humidity: ≤95%.

4.1.3 Measuring range : (0-150)℃.

4.1.4 Degree of accuracy: class 2.0(the maximum error detection points allowing is ±3℃).

4.1.5 Switch performance: four sets of adjustable switches, each set of switches can be set freely within the whole range.

4.1.6 Switch error: ±2℃.

4.1.7 Switch changeover error: (6±2)℃.

4.1.8 Rated power of switch: AC220V / 5 A，DC220V/3A.

4.1.9 Dimension of temperature sensitive bulb: (Φ14×150)mm, installation screw thread: (M27×2)mm.

4.1.10 Length of capillary: 6m.

4.1.11 Outline and installation dimensions of instrument (see Figure 2).

4.1.12 Protection Grade:IP55 .

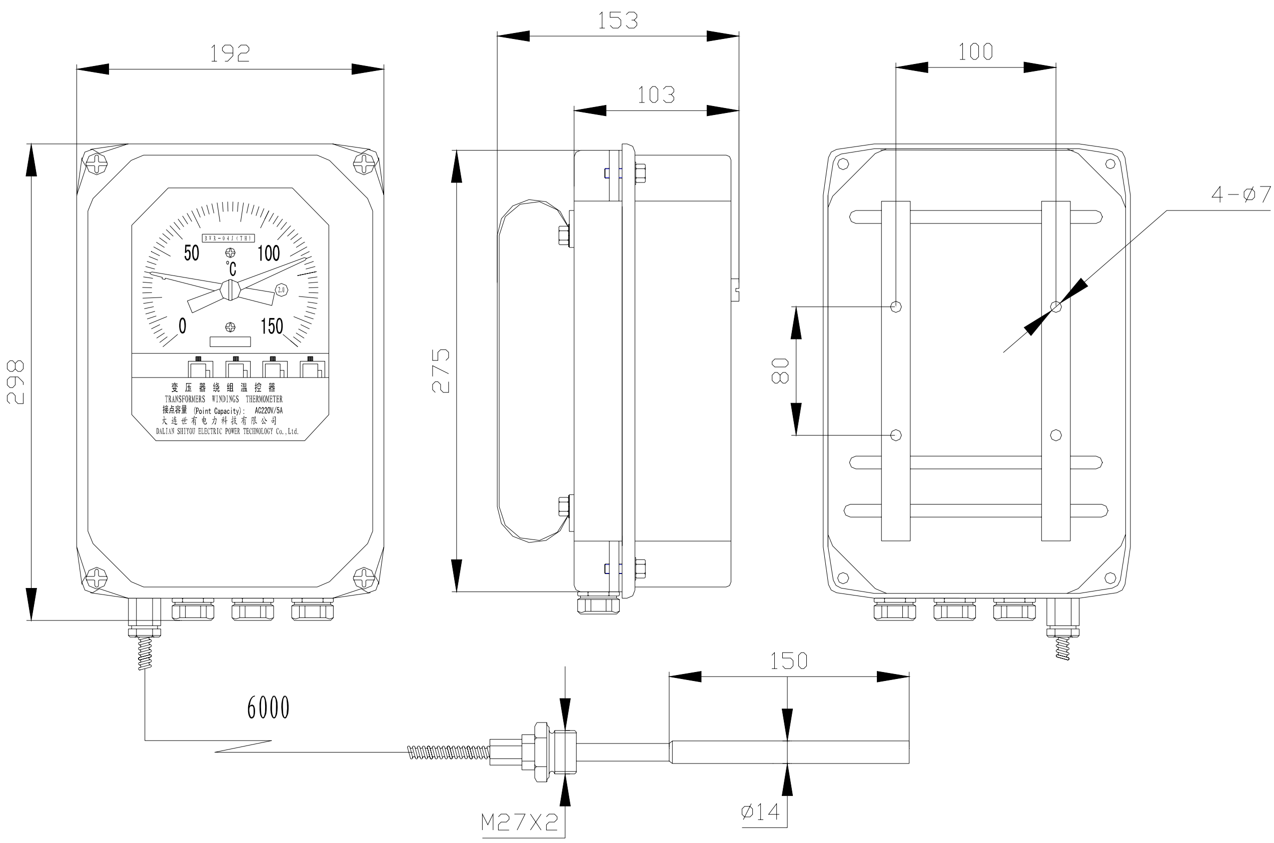
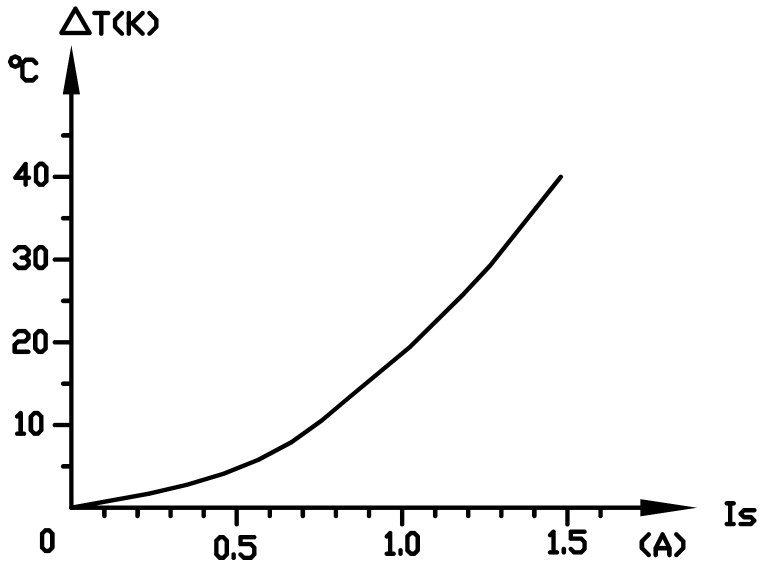


Figure 2: Outline and installation dimensions

4.1.13 Temperature characteristic of electrical heating element is shown in Figure 3.



△T（℃）	Is（A）
10	0.74
12	0.80
14	0.86
16	0.92
18	0.98
20	1.04
22	1.09
24	1.14
26	1.19
28	1.24
30	1.28
32	1.32
34	1.36
36	1.40
38	1.44

Figure 3

4.2 XMZ-155 technical parameters

4.2.1 Input signal: DC (4-20)mA

4.2.2 Output signal: DC (4-20)mA

4.2.3 Service conditions: environmental temperature (0~50)℃, relative humidity: ≤85%

4.2.4 Operational power supply: AC/DC(100-260)V, frequency: (50~60) Hz

4.2.5 Indicating mode: indicated by digital tube

4.2.6 Degree of accuracy：Class 1.0

4.2.7 Mounted form: flush mounted

4.2.8 Dimension of hole: 152^{+1}mm ×76^{+1}mm

4.2.9 Outline dimension: 160mm × 80mm× 80mm (see Figure 4)

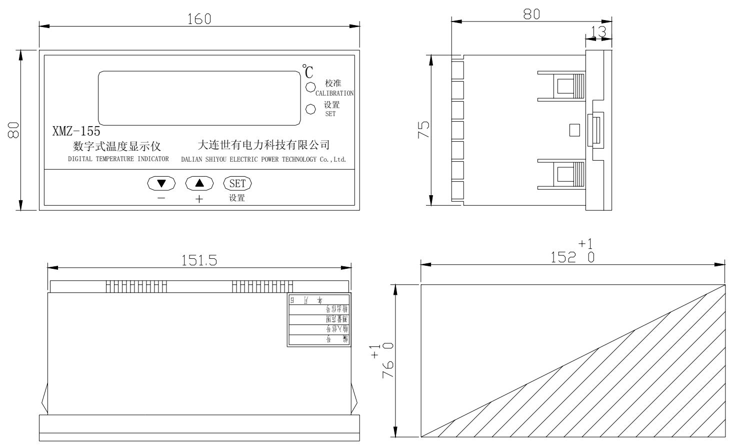


Figure 4

5 Selection of converter

Selection of transformer windings thermometer mainly refers to selection of converter. Users have to only know the secondary current rating of current transformer, and then can know find specifications of converter from Form 1. For example, if Ip=3.5A, Form 1 shows 5A≥(Ip=3.5A)>3A, therefore BL-E converter in Catalog A should be selected.

Form 1

Catalog	Secondary current rating of current transformer Ip(A)	Output current Is (A)	K	Equivalent impedance(Ω)
A	**5≥Ip>3**	**（32~38）%×Ip**	**3**	**R≤0.56**
		（24~32）%×Ip	**4**	
		（15~24）%×Ip	**5**	
		（10~15）%×Ip	**6**	
B	**3≥Ip>2**	**（50~60）%×Ip**	**3**	**R≤1.35**
		（40~50）%×Ip	**4**	
		（28~40）%×Ip	**5**	
		（17~28）%×Ip	**6**	
C	**2≥Ip>1**	**（75~90）%×Ip**	**3**	**R≤2.5**
		（60~75）%×Ip	**4**	
		（40~60）%×Ip	**5**	
		（25~40）%×Ip	**6**	
D	**1≥Ip>0.61**	**（150~180）%×Ip**	**3**	**R≤12.0**
		（120~150）%×Ip	**4**	
		（100~120）%×Ip	**5**	
		（50~100）%×Ip	**6**	

6 Installation and Operation

6.1 The Instrument should be placed vertically during running .

6.2 Fix thermometer on transformer, and insert digital indicator into the hole in control desk, then push it lightly.

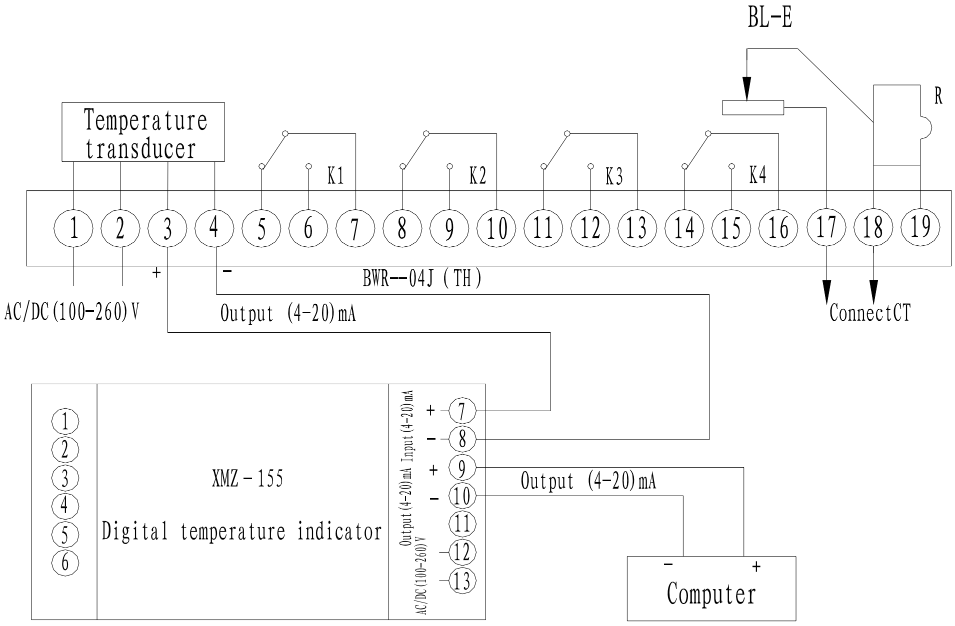
6.3 Installation of temperature sensitive bulb

Prior to the installation of temperature sensitive bulb, fill the installation hole with transformer oil, then slowly insert temperature sensitive bulb. Tighten the M27 × 2 installation joint, loosen the M18 × 1.5 hollow screw on the installation joint and wind stuffing around theΦ11 lengthened conduit. Before thoroughly tightening the hollow screw, users should adjust insertion depth of the temperature sensitive bulb (choose possibly maximum insertion depth) to ensure the temperature sensitive bulb fully emerged in the oil.

6.4 The tube between temperature sensitive bulb and gauge outfit should be 300mm long. Bend radius shouldn't be shorter than 100mm. Extra tubes should be bent into a round (Φ200mm min.), and then fixed on the transformer.

6.5 Connect wires

6.5.1 For wiring connecting wires, please see Figure 5:



Note: don't touch components of instrument during connecting wires

Figure 5: Wire connecting diagram

6.5.2 Firstly connect BWR-04J, XMZ-155 digital indicator and computer with wires (KVV-4×1.5 wires are recommended) (see Figure 5).

6.5.3 Switch K1, K2, K3 and K4 in control circuit with user wires (KVV-8×4 wires are recommended) (see Figure 5).

6.6 Switch setting: before leaving the factory, the switch has been set as follows:

K1=50℃, K2=75℃, K3=100℃, K4=120℃,For changing set value, please comply with the following steps:

6.6.1 Take out the screw in recording axis (see Figure 6-4) on red contact indicating finger (see Figure 6-3)

6.6.2 Rotate dial (see Figure 6-2) to make the end of red contact indicating finger to the setting point, and then screw down the screw in recording axis.

6.6.3 Move downward the position limit board (see Figure 6-5) to turn the dial. Once the meter pointer turns to the setting point, the micro-adjust switch will switchover; thus, whether the temperature value is correctly set can be tested. If the value is not correctly set, please repeat the above step until correctly calibrated.

1 **Indicating finger**
2 **Dial**
3 **Red contact indicating finger**
4 **Screw in recording axis**
5 **position limit board**
6 **BWR-04J transducer**
7 **BL-E integrated converter**

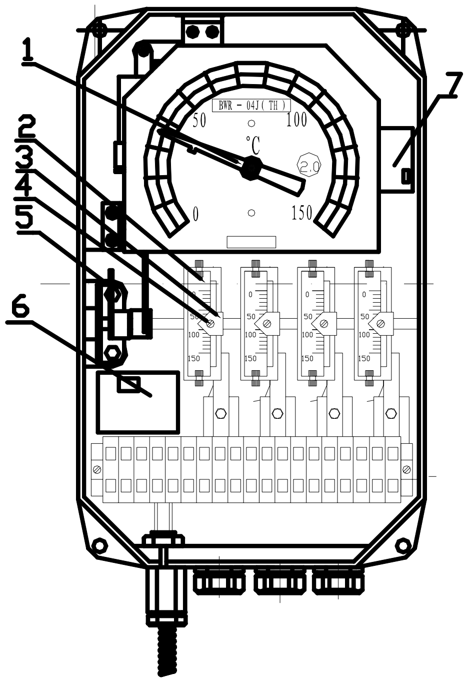


Figure 6: Structure Drawing

6.7 Adjustment and Determination of Is

The adjustment and determination of Is is conducted in the laboratory. After connecting wire according to the diagram, carry on the following steps

6.7.1 Remove short-circuit wire between terminals 18 and 19 (19 are specially designed for verifying current-Is).

6.7.2 Connect wire according to Figure 7

Notes:

B: 2kVA 250V voltage regulator
R': 1kW load (bulb, heater etc.)
A1: 0.5 class (0-10)A AC current meter
A2: 0.5 class (0-5)A AC current meter

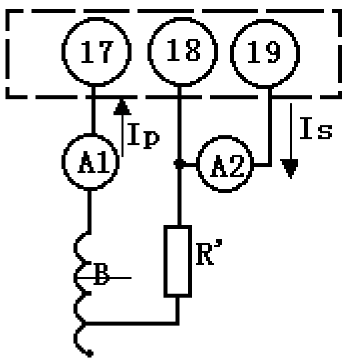


Figure 7: Adjustment and Determination of Is

6.7.3 Refer to transformer specification book for Ip value of secondary rated current of current transformer. For example, check Ip=3.5A, BL-E type converter "A" catalogue should be selected by referring to table 1, press the related key.

6.7.4 Refer to transformer specification book for the transformer windings' average temperature riseΔT. Users also can ask the transformer manufacturer for this value. For example, checkΔT=20℃.

6.7.5 When Ip=3.5A, ΔT=20℃, the Temperature Characteristic Drawing shows Is=1.04A.

6.7.6 When Ip=3.5A, Is=1.04A: the corresponding Is/Ip=1.04/3.5≈30%, i.e. Is=30% Ip.

6.7.7 It can be seen from table 1, when K=4, the Is=(24%~32%)Ip, the BL-E type converter "4" position can be selected. Connect the switch "K" to terminal 4, adjust potentiometer W to ensure Is=1.04A.

6.7.8 Connect terminals 18 and 19 as its original state

6.7.9 Replace the meter cover and fasten the nut

7 Attentions

7.1 Please read this Manual before using, and keep well.

7.2The temperature controller should be stored in an aired and dry room. During transportation, intense impact should be avoided. After a storage period of 12 months, an inspection on temperature indication should be conducted to ensure normal service.

7.3 Subject to the operations specified in this manual, within 18 months from the date of delivery of the product, the company will repair or replace the product with problem.

Notice: Please carefully read the following introduction before utilization and pay attention to the following items. Contact us if there is any problem. Tel: 0411-87869878.

1. Selection of converter

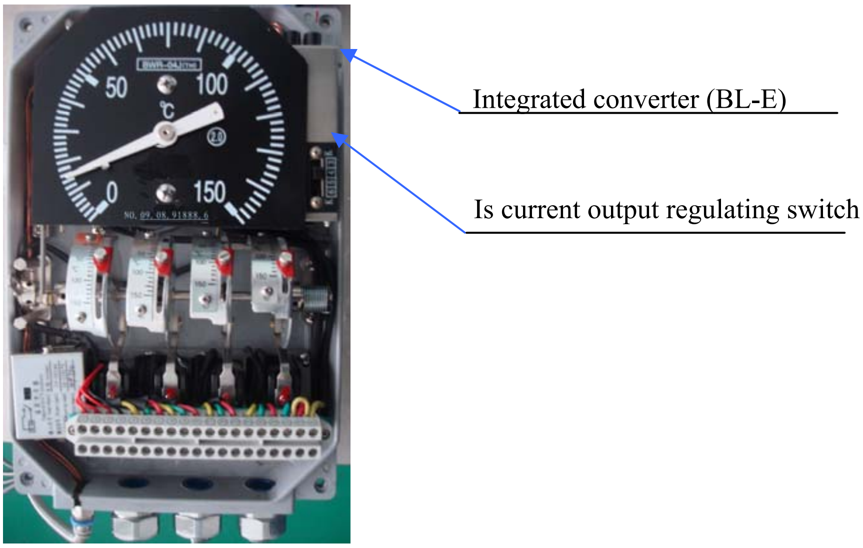


Figure I

△T (℃)	Is (A)
10	0.74
12	0.80
14	0.86
16	0.92
18	0.98
20	1.04
22	1.09
24	1.14
26	1.19
28	1.24
30	1.28
32	1.32
34	1.36
36	1.40
38	1.44

Table I

1.1. Calculate: value of IP

Determine the current ratio of the transformer

Rating current of the transformer

e.g.: current ratio of the transformer: 1500A: 5A; rating current of the transformer: 600A, calculate: 600A×5A/1500A=2A

i.e.: Ip=2A, obtain the value from Table II: refer to Figure III to press the corresponding key of C.

1.2. Calculate: value of Is

Copper oil temperature difference provided by the transformer factory: ΔT

e.g.: ΔT=20ºC, obtain the value from Table I: Is=1.04A

1.3. Calculate the value of K, shift key selection of regulating switch

Given value: Is=1.04A Ip=2A

i.e.: Is / Ip=1.04A /2A=52%, obtain the value from Table II, K=5, select shift V, refer to Figure I to move the regulating switch to the 5th position.

1.4. Experiment: whether the Is output is 1.04A after applying current of 2A, regulations could be implemented through the potential meter shown in Figure II if required.

Shift	Transformer current transformer secondary rating current Ip (A)	Output current Is (A)	Regulating wire terminal K
A	5≥ Ip>3	(32~38)%×Ip	3
		(24~32)%×Ip	4
		(15~24)%×Ip	5
		(10~15)%×Ip	6
B	3≥ Ip>2	(50~60)%×Ip	3
		(40~50)%×Ip	4
		(28~40)%×Ip	5
		(17~28)%×Ip	6
C	2≥ Ip>1	(75~90)%×Ip	3
		(60~75)%×Ip	4
		(40~60)%×Ip	5
		(25~40)%×Ip	6
D	1≥ Ip>0.61	(150~180)%×Ip	3
		(120~150)%×Ip	4
		(100~120)%×Ip	5
		(50~100)%×Ip	6

Table II

Figure II

Figure III

2. Setting values should be changed in accordance with the following procedures if needed.

2.1 Refer to Figure IV: Unscrew the screws on the red connecting point indicated needle with slotted screwdriver, rotate the dial to make the red connecting point indicated needle tip point to the required setting point, then screw on the screws.

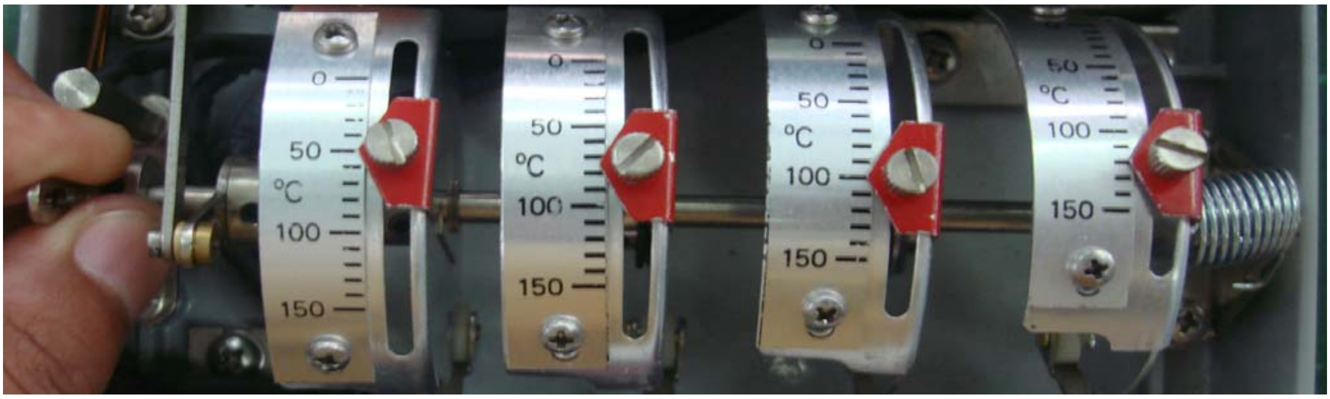


Figure IV

2.2 Refer to the Figure IV: Manually move the limitation plate downward slightly to make the dial rotate, the indicated needle gradually moves to the upper limit of temperature, the switch connecting point will close at each setting point, so as to verify whether the temperature setting value is correct, repeat the above procedures if not, till it is calibrated.

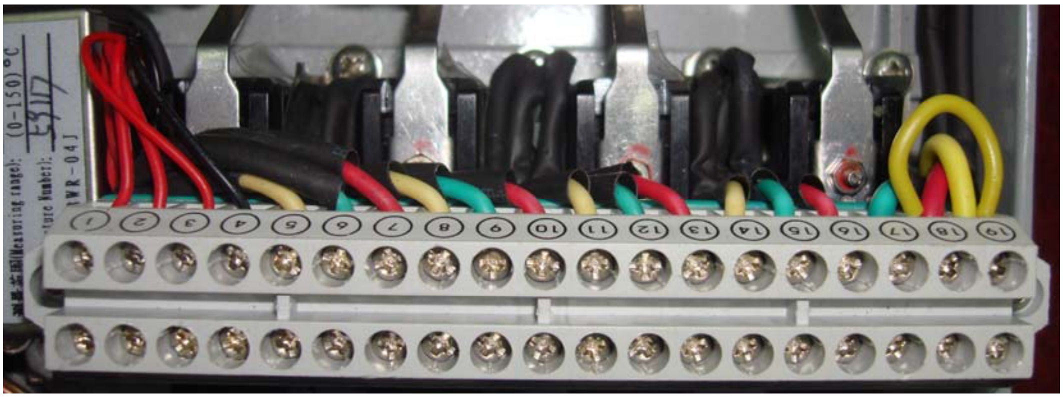


Figure V

3. Introduction to the connection (refer to Figure V)

3.1. 1 and 2 are the working power of the temperature transmitter【5i.e. AC/DC(100-260)V±10%】, 3 and 4 are output (4-20) mA current signal terminals of the temperature transmitter, that is, 3 is the positive pole, and 4 is the negative pole, if the transmitted signal is abnormal, move the shift of the multimeter to AC/DC voltage 750V to see whether there is voltage on the terminals 1 and 2: it should be 【5i.e. AC/DC(100-260)V±10%】, if it is normal, move the shift of the multimeter to DC current 200mA, disconnect the external connection of the meter to measure the output current on terminals 3 and 4, to see if it is normal. Calculated formula of current output is shown as follows: (20mA-4mA)/150℃=0.1066mA/℃, that is, 1℃ corresponds to 0.1066mA, current value corresponding to the present temperature of the meter = present temperature of the meter×0.1066mA /℃+radix 4mA.

3.2. Terminals 5, 6, 7; terminals 8, 9, 10; terminals 11, 12, 13 and terminals 14, 15, 16 are respectively NO, NC circuit of K1, K2, K3 and K4. Terminals 5, 8, 11 and 14 are NC; terminals 6, 9, 12 and 15 are NO, terminals 7, 10, 13, and 16 are public terminals.

3.3. Winding Is integration: CT current is input through terminals 17 and 18, remove the short circuit wire between terminals 18 and 19, connect an AC ampere meter with proper range to monitor the Is current, regulations could be done in accordance with Figure II if it is not precise. Disconnect the power after regulation, and connect the short circuit wire between terminals 18 and 19 as the original status.

3.4. Do remember to tighten the meter cap screws after integration so as to prevent the rainwater from entering under which condition short circuit will happen and the circuit may be burnt out.

3.5. If there is wrong input IP value selection when the transformer is running, in order to avoid wrong action of the transformer, please remove the rear protection, CT circuit is short connected, then change the shift keys.

Attachment: A comparison table of temperature vs. current.

mA℃ / ℃	0	1	2	3	4	5	6	7	8	9
0	4.000	4.107	4.213	4.320	4.427	4.533	4.640	4.747	4.853	4.960
10	5.067	5.173	5.280	5.387	5.493	5.600	5.707	5.813	5.920	6.027
20	6.133	6.240	6.347	6.453	6.560	6.667	6.773	6.880	6.987	7.093
30	7.200	7.307	7.413	7.520	7.627	7.733	7.840	7.947	8.053	8.160
40	8.267	8.373	8.480	8.587	8.693	8.800	8.907	9.013	9.120	9.227
50	9.333	9.440	9.547	9.653	9.760	9.867	9.973	10.080	10.187	10.293
60	10.400	10.507	10.613	10.720	10.827	10.933	11.040	11.147	11.253	11.360
70	11.467	11.573	11.680	11.787	11.893	12.000	12.107	12.213	12.320	12.427
80	12.533	12.640	12.747	12.853	12.960	13.067	13.173	13.280	13.387	13.493
90	13.600	13.707	13.813	13.920	14.027	14.133	14.240	14.347	14.453	14.560
100	14.667	14.773	14.880	14.987	15.093	15.200	15.307	15.413	15.520	15.627
110	15.733	15.840	15.947	16.053	16.160	16.267	16.373	16.480	16.587	16.693
120	16.800	16.907	17.013	17.120	17.227	17.333	17.440	17.547	17.653	17.760
130	17.867	17.973	18.080	18.187	18.293	18.400	18.507	18.613	18.720	18.827
140	18.933	19.040	19.147	19.253	19.360	19.467	19.573	19.680	19.787	19.893
150	20.000									

Address: 642, Sanli, Yongzheng Street, Jinzhou New District, Dalian
Tel: 0411－87804698
Tel: 0411－87804658 ext. 8899
Fax. 0411－87805542
P.C: 116100
No.: SM－001－03－05－E

XMT—22B Digital Temperature Display Regulator

Mounting Operating Instruction Manual

Dalian Shiyou Electric Power Technology Co., Ltd.

Table of Contents

List of Figures

1 Type description：

XMT —22 B

- **B**: Output standard DC (4-20)mA current signal
- **22**: Connect with thermal resistance
- **XMT**: Digital temperature display regulator

2 General introduction：

Model XMT-22B digital temperature display regulator should be used in conjunction with thermal resistor, it may measure the temperature of various gases, liquids and steams in industrial production within the scope of (0～150)℃. Meanwhile, it may output standard DC (4～20)mA current signal that has linear relationship with range as required, so that the computer system may use it.

The indicator has the advantages of convenient observation, direct and accurate reading, no parallax, good shock-proof performance, etc. It is widely used for temperature measurement in industrial production process, laboratory, and scientific research unit, medical and sanitary industry and so on.

3 Major technical parameters

3.1 Input signal: platinum resistance: Pt100.

3.2 Output signal: DC current value (4-20) mA.

3.3 Service conditions: environmental temperature (0~50)℃, relative humidity: ≤85%.

3.4 Operational power supply: AC / DC (100-260) V, frequency: (50~60) Hz.

3.5 Power at connection point: AC220V/ 5A.

3.6 Degree of accuracy：Class 1.0.

3.7 Indicating mode: indicated by digital tube.

3.8 Mounted form: flush mounted.

3.9 Outline dimension: 160mm ×80mm× 80mm.

3.10 Dimension of hole: 152+1mm×76+1mm, (see Figure 1):

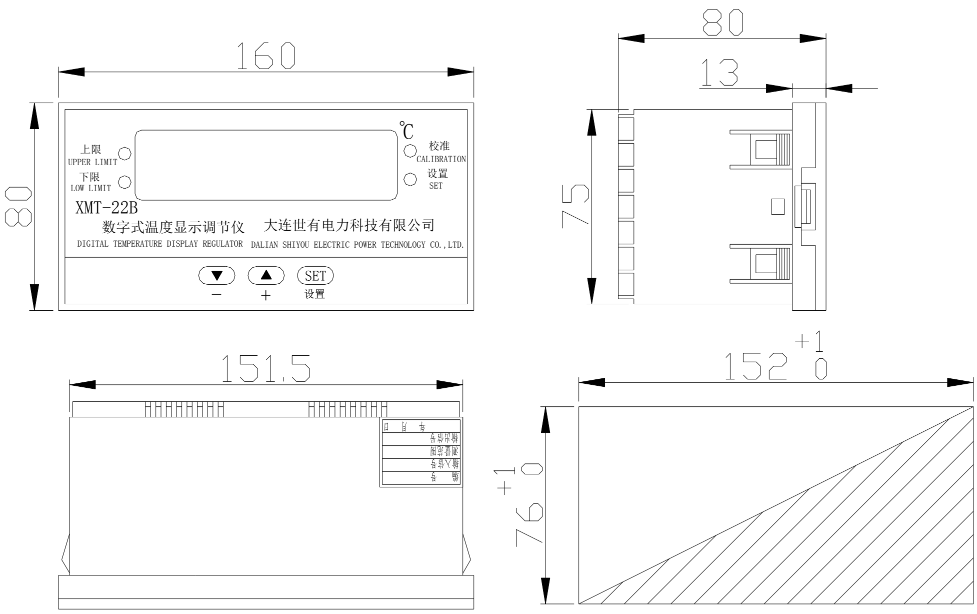


Figure 1　Dimension of outline and hole of XMT-22B

3.11 About connection point of relay (see Form 1):

Form1

Indicated temperature and setting temperature status	**Status of connection point**	**Status of indicator light**
T 〈T1 〈T2	**upper limit 1, 2 switched on; lower limit 4, 5 switched on**	**The red is off, the green off**
T1 〈T 〈T2	**upper limit 1, 2 switched on; lower limit 5, 6 switched on**	**The red is off, the green on**
T1 〈T2 〈T	**upper limit 2, 3 switched on; lower limit 5, 6 switched on**	**The red is on, the green on**
Note: T = temperature determined ;T1 = setting value of upper limit; T2 = setting value of lower limit		

4　Instructions

4.1　Refer to Figure 2 for panel arrangement

Figure 2

4.2 Definition of keys

4.2.1 ▼/ -: Parameter -1

4.2.2 ▲/+: Parameter+1

4.2.3 SET/setting: Function setting key, confirmation key

4.3 Refer to Figure 3 for terminal wiring:

Figure 3

4.4 Parameter setting:

XMT-22B Digital temperature display regulator could work after power on. User can correct upper limit, low limit and switching error according to needs. Operation steps are as follows:

4.4.1 Push **SET** key for 2 seconds, and enter parameter setting. Now the setting indicator light is on, and display as 0P.

4.4.2 Push **▲,▼** key, input parameter change password “58”, and push **SET** key for confirmation.

4.4.3 When “upper limit” indicator light flash, push **▲,▼** key, input corrected value and push **SET** key for confirmation. Input low limit value (“low limit” indicator light flash) and difference value (“℃”flash) in turn, then push **SET** key for confirmation.

4.4.4 Push **SET** key for 1 seconds can quit parameter setting.

Note: User must push **SET** key after inputting correction value each time, otherwise the value is invalid.

5 Attentions

5.1 Users should carefully read this operating instruction manual before using, and please properly keep the operating instruction manual.

5.2 The indicator should be stored indoors in ventilated and dry place, and fierce collision should be avoided in transport, when the storage period exceeds 12 months, verification of temperature readout should be made once, so as to ensure normal usage.

5.3 On the prerequisite of observing use of this operating instruction manual, within 18 months since the ex-factory date, the factory will be responsible for repairing and changing in case of any problem.

Attachment: Appended table for contrast between temperature value, platinum resistance value and current value: (executing JJG229-1998 standard)

Ω	mA ℃ / ℃	0	1	2	3	4	5	6	7	8	9
100	0	4.000	4.107	4.213	4.320	4.427	4.533	4.640	4.747	4.853	4.960
103.90	10	5.067	5.173	5.280	5.387	5.493	5.600	5.707	5.813	5.920	6.027
107.79	20	6.133	6.240	6.347	6.453	6.560	6.667	6.773	6.880	6.987	7.093
111.67	30	7.200	7.307	7.413	7.520	7.627	7.733	7.840	7.947	8.053	8.160
115.54	40	8.267	8.373	8.480	8.587	8.693	8.800	8.907	9.013	9.120	9.227
119.40	50	9.333	9.440	9.547	9.653	9.760	9.867	9.973	10.080	10.187	10.293
123.24	60	10.400	10.507	10.613	10.720	10.827	10.933	11.040	11.147	11.253	11.360
127.08	70	11.467	11.573	11.680	11.787	11.893	12.000	12.107	12.213	12.320	12.427
130.90	80	12.533	12.640	12.747	12.853	12.960	13.067	13.173	13.280	13.387	13.493
134.71	90	13.600	13.707	13.813	13.920	14.027	14.133	14.240	14.347	14.453	14.560
138.51	100	14.667	14.773	14.880	14.987	15.093	15.200	15.307	15.413	15.520	15.627
142.29	110	15.733	15.840	15.947	16.053	16.160	16.267	16.373	16.480	16.587	16.693
146.07	120	16.800	16.907	17.013	17.120	17.227	17.333	17.440	17.547	17.653	17.760
149.83	130	17.867	17.973	18.080	18.187	18.293	18.400	18.507	18.613	18.720	18.827
153.96	140	18.933	19.040	19.147	19.253	19.360	19.467	19.573	19.680	19.787	19.893
157.33	150	20.000									

Address: No. 642, Yongzheng Street Sanli, Jinzhou new District, Dalian
Tel of Operation Department: 0411-87804698
Fax of Operation Department: 0411-87805542
Switchboard: 0411-87804658 Ext.8899
Postal Code: 116100
Number: SM－042－01－E

Section 8
Component Instruction Leaflets and Manuals

8.7 Oil-level indicator

Series YZF

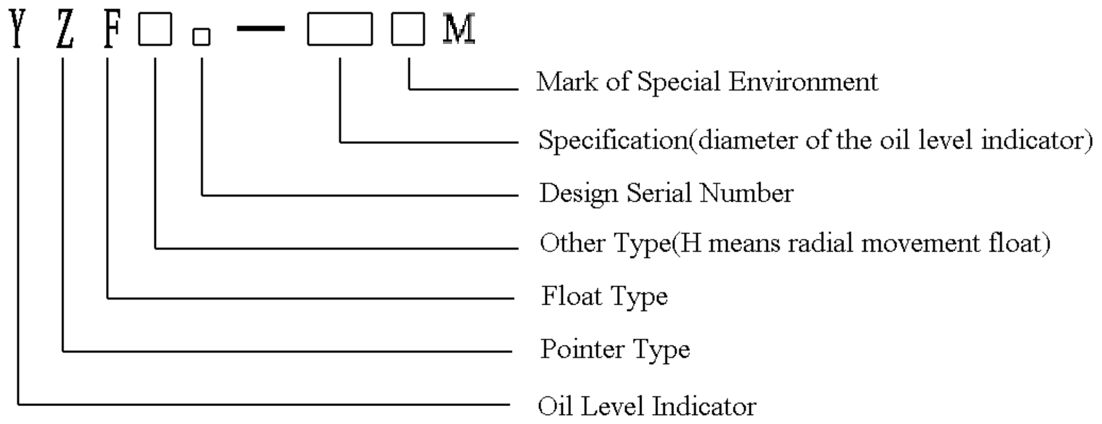
Dial Type Oil Level Indicator
User’s Manual

Shenyang STI Electric Technology Co.,Ltd.

一. Summary

•The oil level indicator Series YZF is a device designed for measuring oil level.
•It applies to conservator vessel of hermetically sealed large and medium-sized transformer.
•The variation of oil level in conservator vessel can be displayed directly and accurately.
•It can realize remote monitoring via the electric alarm inside the product.

Model Explanation



Meaning of letters: Y means oil level indicator, Z means pointer type, F means float, H means radial swing, M means analog signals output ,TH means used in humid tropics.
e.g:1.YZF_2-200M means the oil level indicator is pointer type, float type, design serial number is 2 (axial swing) ,the indicator diameter is 200 mm with analog signals output.
2.YZFH-200TH means the oil level indicator is pointer type, float type, radial swing, the indicator diameter is 200 mm and used in humid tropics.

●Specifications and Basic Parameters

specification	pivot angle of float (α)	float rod L (mm)	float equipped with (mm)	screw thread for outlet
YZFH-140M	120°	L<300	Φ80	M18x1.5
YZFH-200M		300<L<500	Φ94	
YZFH-250M		L>500	Φ102	
YZF_2-200M	45°	L<800	Φ80	
YZF_2-250M		800<L<1600 L>1600	Φ94 Φ102	

●ounting Consistency

The mounting consistency of the oil level indicator YZF Series mainly depend on the material that the flange sealing gasket used.

Norminal Manufacture(nitrile ring gasket)

perating condition :

Ambient Temperature: -30℃～+50℃

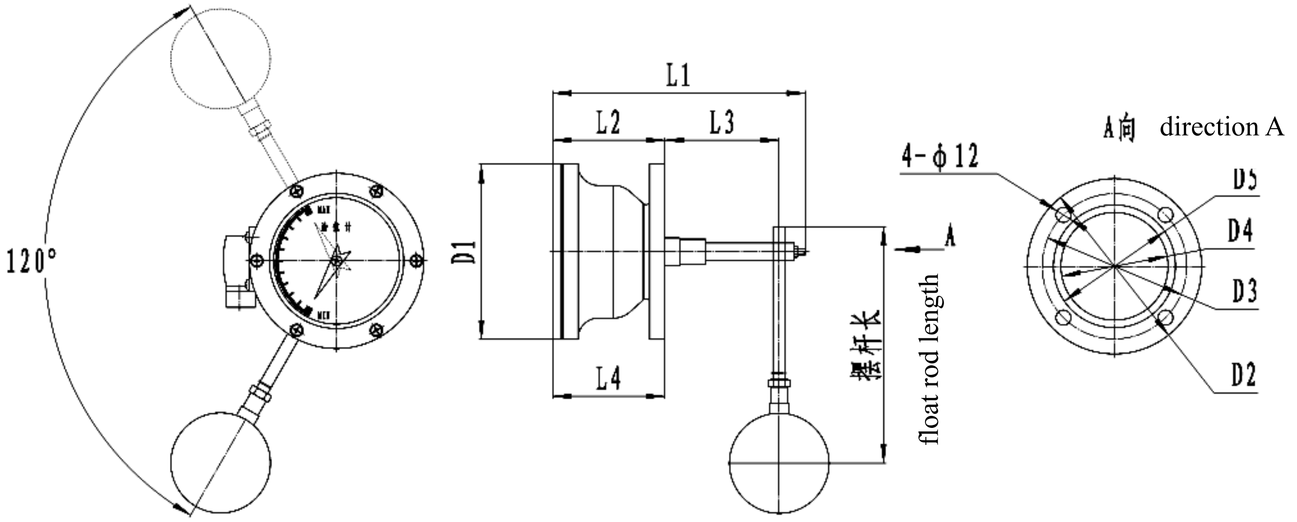
Relative Humidity: less than 90%(20℃)，less than 72%(40℃)

Insulation Liquid: transformer oil or silicone oil

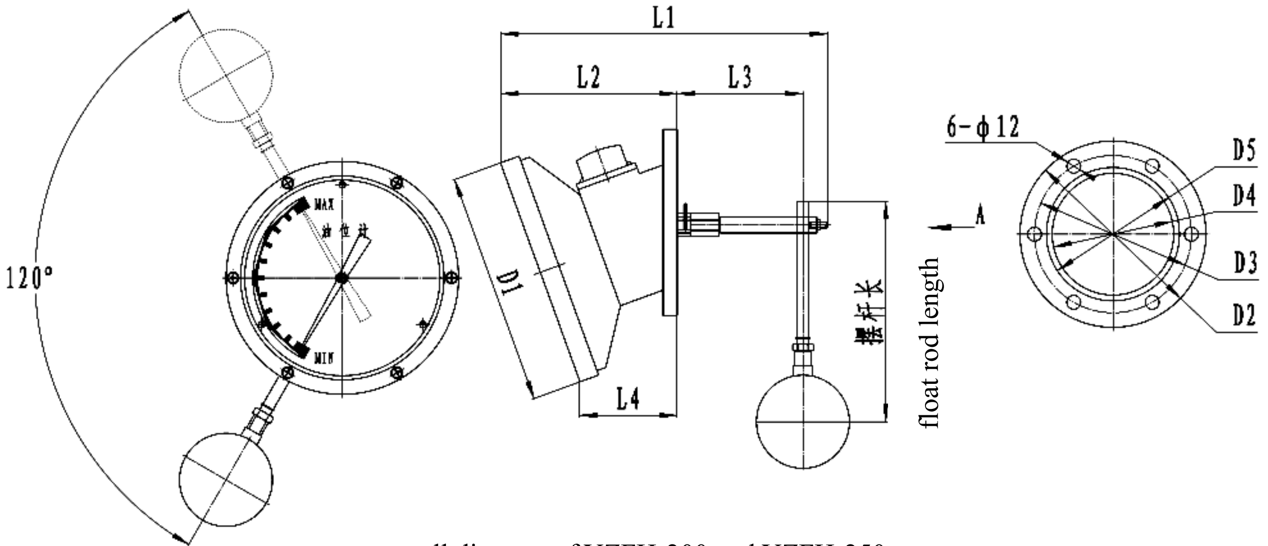
Contact Capacity: AC 220V/10A; DC 220V/1A

If this product uses in severe environment (e.g. the lowest temperature can reach below minus 30 degrees centigrade or coastal district), we will adjust the product consistency according to regional situation.

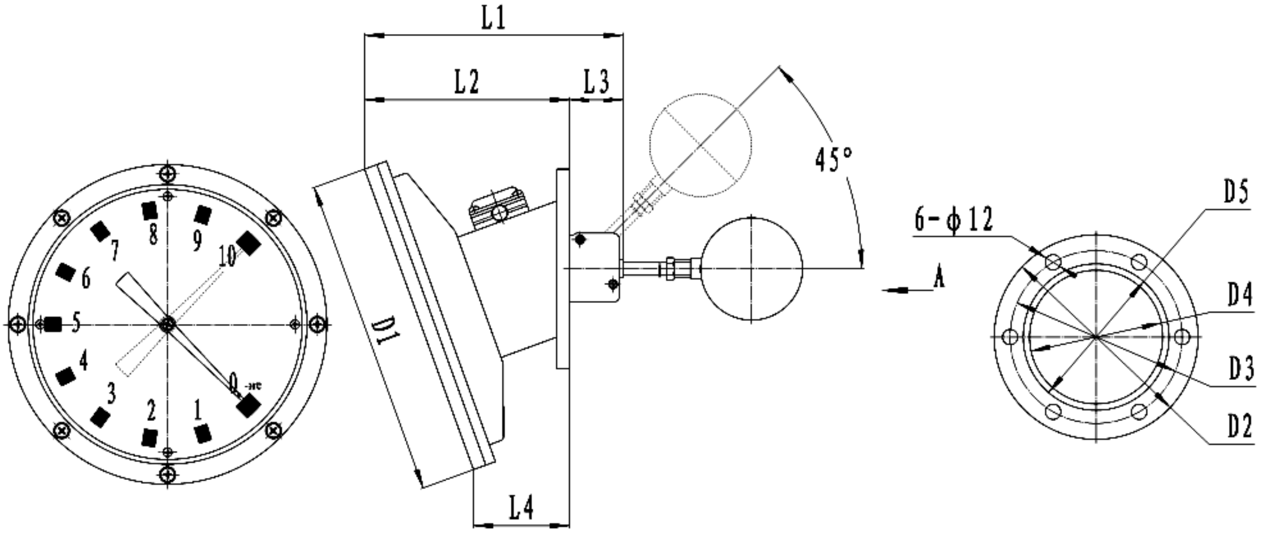
二. verall Dimension Diagram



overall diagram of YZFH-140



overall diagram of YZFH-200 and YZFH-250



overall diagram of YZF_2-200 and YZF_2-250

Unit:mm

Model	D1	D2	D3	D4	D5	L1	L2	L3	L4
YZFH-140M	140	140	116	86	98	205	90	92	90
YZFH-200M	200	160	135	105	115	285	165	108	84
	200	160	138	105	115	285	165	108	84
	200	190	170	137	151	285	165	108	84
YZFH-250M	250	160	130	105	115	285	165	108	75
	250	190	170	137	151	285	165	108	75
YZF_2-200M	200	160	135	105	115	210	165	45	84
	200	160	138	105	115	210	165	45	84
	200	190	170	137	151	210	165	45	84
YZF_2-250M	250	160	130	105	115	210	165	45	75
	250	190	170	137	151	210	165	45	75

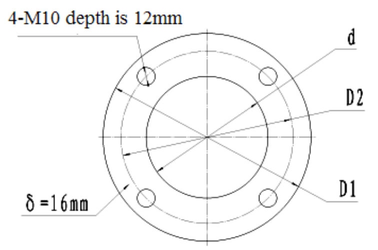
三. Mounting and Maintenance

●Operating Principle

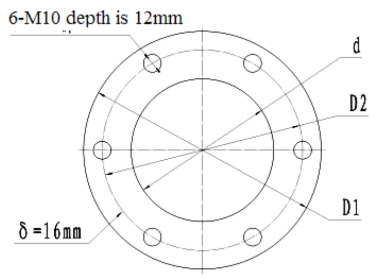
The liquid level inside the conservator fluctuates due to expansion and contraction or leakage,the float senses this variation and reacts this variation on the pointer via the drive mechanism,oil level variation can be displayed on the dial.The microswitch inside the oil level indicator activates and sends out electric signal when the oil level reaches the preset value of alarm or trip.

●Mounting

Fasten the float rod and the float together and fix it on the drive mechanism of the oil level indicator first.Confirm all the connection mechanism and the sealing gaskets fastened tightly,then put the float rod into the conservator vessel,fasten the oil level indicator on the mounting flange with bolts.User provides for flange.The mounting flange dimension is as follows(see dimension chart).



Mounting Flange for YZF-140

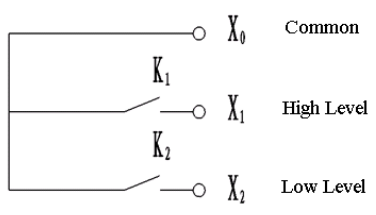


Mounting Flange for YZF-200 and YZF-250

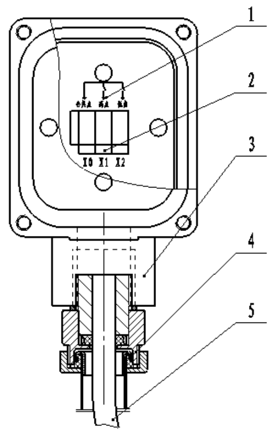
Model	D_1(mm)	D_2(mm)	D_3(mm)
YZFH-140	140	116	82
YZFH-200	160	135	96
	160	138	96
	195	170	130
YZFH-250	160	130	96
	195	170	130
YZF_2-200	160	135	96
	160	138	96
	195	170	130
YZF_2-250	160	130	96
	195	170	130

●Wiring

The wiring of signal switch is as follows.X1 is high level normal open contact,X2 is low level normal open contact. K2 switches on and sends out signal when the oil level falls down to the low level.K1 switches on and sends out signal when the oil level rises to the high level.



Wiring Diagram(enlarge drawing)



1.wiring diagram　2.wiring post

3.terminal box　4.metal hose connector

5.wire(user provides)

●**Maintenance and Matters Needing Attention**

The oil level indicator is a precision meter,do not disassemble arbitrarily without special reasons.In case of breakdown, please contact us in time.

a.Do not hit the drive part fiercely when checking the oil level indicator.

b.The oil level indicator doesn't apply to the locale with vibration and bumps.It should not be affected by collision.

c.The liquid level the oil level indicator measured shouldn't fluctuate fiercely .

d.Fix the float when transporting the oil level indicator assembled to the conservator vessel(install on-site best).

e.We provide with two kinds of connectors:

1.Metal cable gland:Equipped with the cable that the diameter is φ10 without special requirements with the dimension.

2.Metal hose connector:Equipped with the hose that the diameter is φ15 without special requirements with the dimension.

f.Files equipped with:1. Product Certificate　2.User's manual

Shenyang STI Electric Technology Co.,Ltd.
Address:No.39 Shiji Road Hunnan New Urban District Shenyang China
Postcode:110179
Sales Phone: 0086-24-89368025
Fax: 0086-24-89368108
Technical Support: 0086-24-89378958
E-mail　: sales@stielec.com

Section 8
Component Instruction Leaflets and Manuals

8.8 Buchholz relay

CEDASPE S.p.a.

I - 20098 S. GIULIANO MIL. (ITALY) - VIA COLOMBARA, 1 - FRAZ. PEDRIANO
TELEFONO +39 0298.20.44.11 - TELEFAX +39 02 98.20.44.22
E-Mail: cedaspe@cedaspe.com - InterNet Site: http://www.cedaspe.com
CAP. SOC. € 500.000 I.V. - TVA-P.I. IT 01065780155 - C.F. 01065780155
R.E.A. MI 729991 - IMPORT - EXPORT MI 142410 - REG. IMPR. 132146/3344/46 TRIB. MI

INSTALLATION, OPERATION AND MAINTENANCE GUIDE

BUCCHOLZ RELAY WITH FLANGE PN6 or P10

TYPE EB25; EB50; EB80

MOUNTING POSITION

The gas actuated relay is mounted on the connecting pipe between the transformer and the conservator.
The pipe should be arranged in such a position to allow the easy flow to the relay of gas arising from faults in the transformer.
It should be connected at the highest point on the transformer cover and should not extend into the transformer.
The pipe should not contain any right-angle elbows. Its diameter should correspond to the diameter of the hole for the passage of oil of the relay.
The pipe must be arranged to slope upwards towards the conservator at an angle of about 2 to 4 degrees to the horizontal (max 5 degrees).
The part of the pipe preceding the relay should be straight for a length equal to at least five pipe diameters; the part of the pipe leading to the conservator immediately adjacent to the relay should be straight for a length equal to at least three pipe diameters.
A flat surface on the cover of the relay makes it possible, by means of a spirit level, to obtain the correct mounting position.
The petcock at the top of the relay should be below the bottom of the conservator.
When mounting, the arrow on the relay should point in the same direction as the oil flow to the conservator.
If the transformer is provided with an explosion vent or similar attachment, this must be sealed in such a way that any gas liberated by the transformer does not accumulate in the vent, otherwise the operation of the alarm float will be delayed.

SETTING TO WORK

Once the relay has been mounted, unscrew the knurled cap which covers the push-button for checking the circuits and remove from inside it the small spacer which immobilises the alarm and tripping floats in their lower position, thereby preventing their movement during despatch.
Open up the gas release cock, located on the relay cover, to allow the relay to fill up with oil.
The filling up and the position of the floats are seen through the inspection windows.
When the relay is filled with oil, close the gas release cock.
The electrical circuits is connected as shown in the diagram accompanying the relay.

TESTING ON SITE

The relay is provided with a push-button, self restoring, for checking the continuity of the electrical circuits.
The procedure for testing is very simple: unscrew the knurled cap Pos.3 (see drawing) which protect the push-button and press it slowly in order to activate first the alarm contact and after the trip contact.
When the push-button end his stroke release it slowly in order to turn off the trip contact and after the alarm contact.
It is possible to see the movement of the float through the inspection windows.

CHECKING AFTER ACTUATION OF THE RELAY

Alarm

When the alarm signal is given, the colour of the gas should be observed through the inspection-windows.
The gas may be released or samples of it taken for analysis. (If the relay is supplied with our "Buchholz gas sampling apparatus RG3.2", this operation can be carried out at eye-level).
It should be noted that:

- whitish gas : it is caused by electric arcing in contact with paper, cotton and silk
- yellowish gas : it is caused by wood and cardboard
- greyish gas : it is caused by from a breakdown of the magnetic circuit
- black gas : it is caused by from free arcing in the oil

Note that there may be air in the transformer during putting in operation or after an operation of refilling oil.
In similar cases the alarm is only temporary and should end in a short period.

Trip

If the relay disconnects the transformer, similar checks on the gas should be made to determine the colour and the quantity of gas collected and the relay resetted.
It is always good practice to have this gas analysed.
In any case, the transformer should not be put back immediately into service, as this would increase the seriousness of the fault.
Note that tripping contact can be actuated also by oil leak; in that case refill oil into conservator after discovered the fall of oil and before reconnecting the transformer.

TESTING GAS ON SITE

If a gas analyser kit is available it is possible to have an idea of the cause that generated the gas by checking the precipitate inside the test tube of the gas analyser.
If gas is due only to oil decomposition, in the test tube 1 a white precipitate is formed which, exposed to the light, slowly turns brown.
Should, however, in the test tube "2" a black precipitate be formed, this means that the gases contain decomposition products of solid insulation, such as cotton, paper, wood and the like.
In such a case, a coil deficiency has taken place.
In the case the Buchholz relay operation is caused by air (first installation into work, total oil refilling, defect in the cooling system) there isn't any formation of precipitate inside the tubes.
After the sample of the gases has been drawn, the cock should be closed again, and the analyser housed in its container.

I - 20098 S. GIULIANO MIL. (ITALY) - VIA COLOMBARA, 1 - FRAZ. PEDRIANO
TELEFONO +39 0298.20.44.11 - TELEFAX +39 02 98.20.44.22
E-Mail: cedaspe@cedaspe.com - InterNet Site: http://www.cedaspe.com
CAP. SOC. € 500.000 I.V. - TVA-P.I. IT 01065780155 - C.F. 01065780155
R.E.A. MI 729991 - IMPORT - EXPORT MI 142410 - REG. IMPR. 132146/3344/46 TRIB. MI

BUCHHOLZ GAS SAMPLING DEVICE RG3.2

1.0 Instructions for installation

The Buchholz gas sampling device "RG3.2" must be fitted on the transformer tank, from the ground level, within handy height.
A copper tube (size 8 mm OD/ 6 mm ID) must be used to connect the "RG3.2" device, from the cock "12", to the top of the Buchholz relay, cock "R"; for connecting the tube to the cocks, special unions "14" shall be used.
For filling the «RG3.2» device with oil, open the cocks "R" and "12", open the cock "2" and wait until oil has entirely filled the «RG3.2» device, then close the cock "2"; oil level inside «RG3.2» may be controlled through the inspection windows located on the two sides.
After the gas sampling device «RG3.2» has been oil filled, the cock "R" of the relay must stay in open position (unless it has been previously removed).
In the normal operating conditions, the gas sampling device, the Buchholz relay and the connecting tube between them should be oil filled.

2.0 Operating Instructions

2.1 Gas sampling from the Buchholz relay

Cock "R" should be in open position.
Open oil drain cock "11" and watch through the «RG3.2» windows until gas is seen to have flown into the «RG3.2» device; then close "11".
Now, the gas, formerly accumulated inside the Buchholz relay due to some electrical failure inside the transformer, may be sampled for examination or released, by opening the cock "2".
The gas should be totally released (i.e. until the «RG3.2» is completely filled again with oil) to reset the Buchholz relay in normal operating conditions; in the case it is necessary to maintain the gas inside the «RG3.2», the shut-off cock "12" and "2" must be closed; cock "2" may be reopened for sampling the gas for examination, or for gas release.

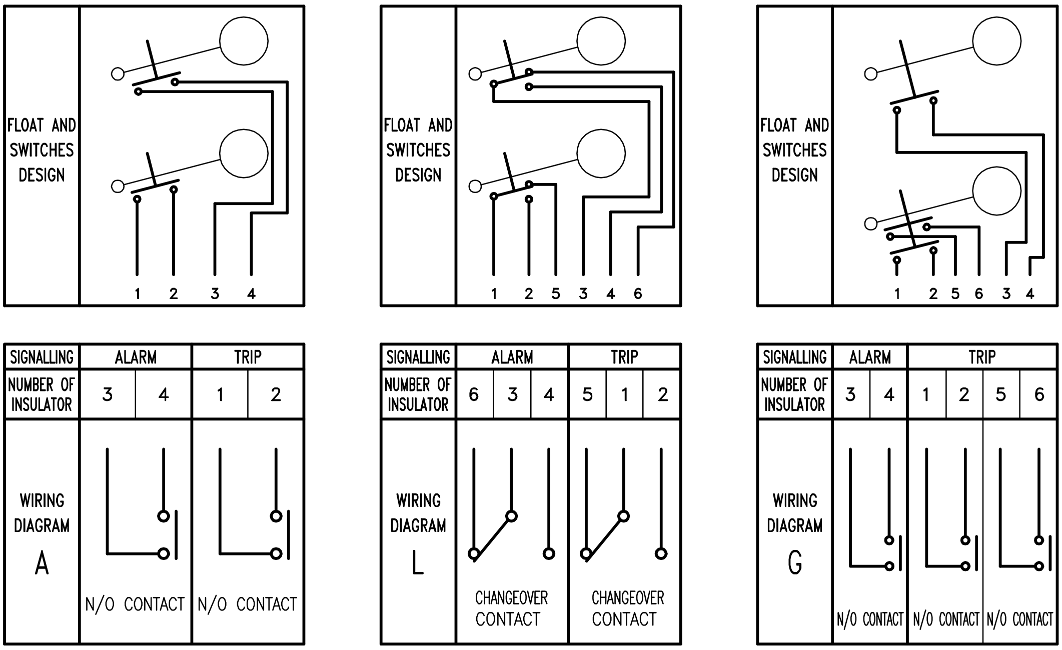
2.2 Checking alarm circuits

Cock "12" in open position.
Inject air inside «RG3.2» through the bottom valve "8" (after removing the knurled protecting cap), using a bottle of compressed air or a normal bicycle tyre pump, until the alarm signal (or signals) have been set in operation.
To reset the Buchholz relay in normal operating conditions, follow above instructions for gas sampling and release.

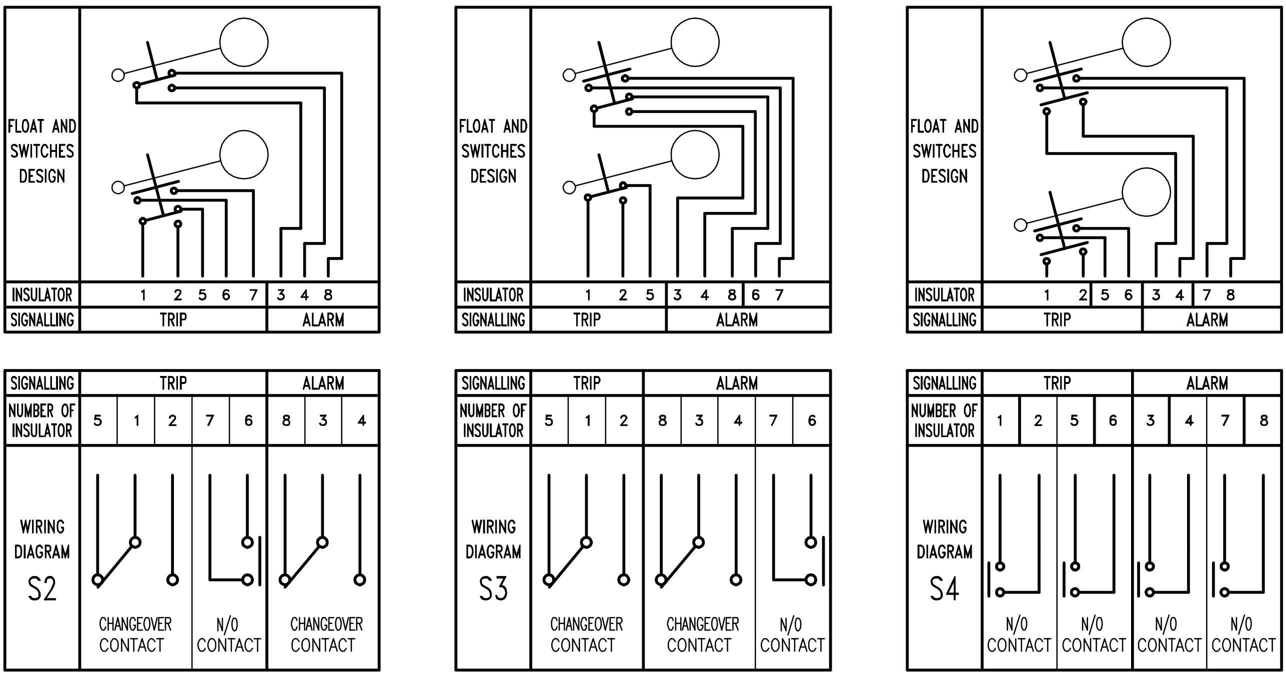
2.3 Checking trip circuits

Cock "12" in open position.
Inject air inside «RG3.2» through the bottom valve "8" (after removing the knurled protecting cap), using a bottle of compressed air or a normal bicycle tyre pump, until the trip signal (or signals) have been set in operation.
To reset the Buchholz relay in normal operating conditions, follow above instructions for gas sampling and release.

STANDARD WIRING DIAGRAM



SPECIAL WIRING DIAGRAM



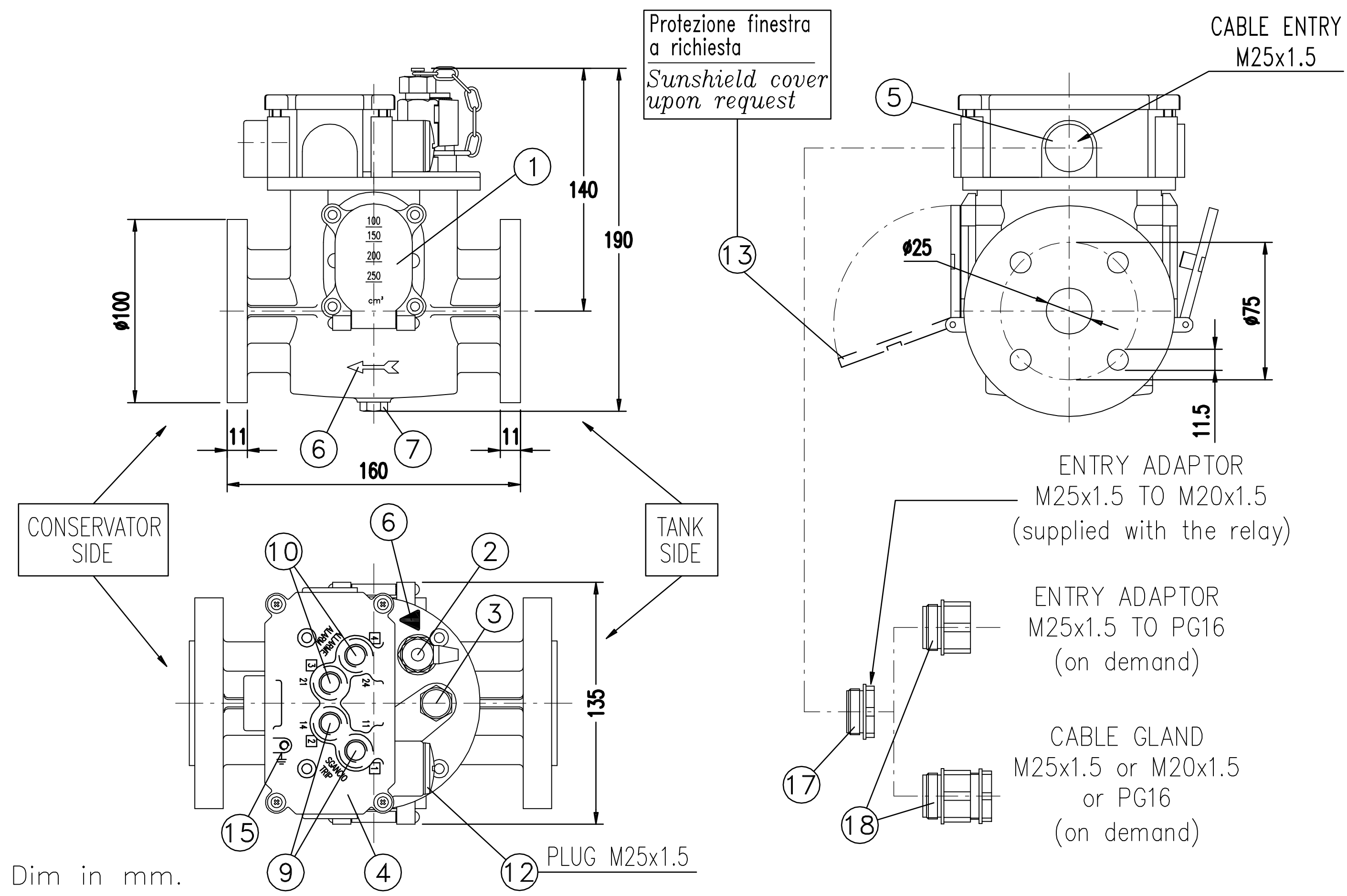
CEDASPE

Wiring diagram

Float and switch design

A4 (210x297)   LMT [(0,0) (196,286)]   FILE =PAGE 11.DWG   REV. 02 DTD 03/03/10

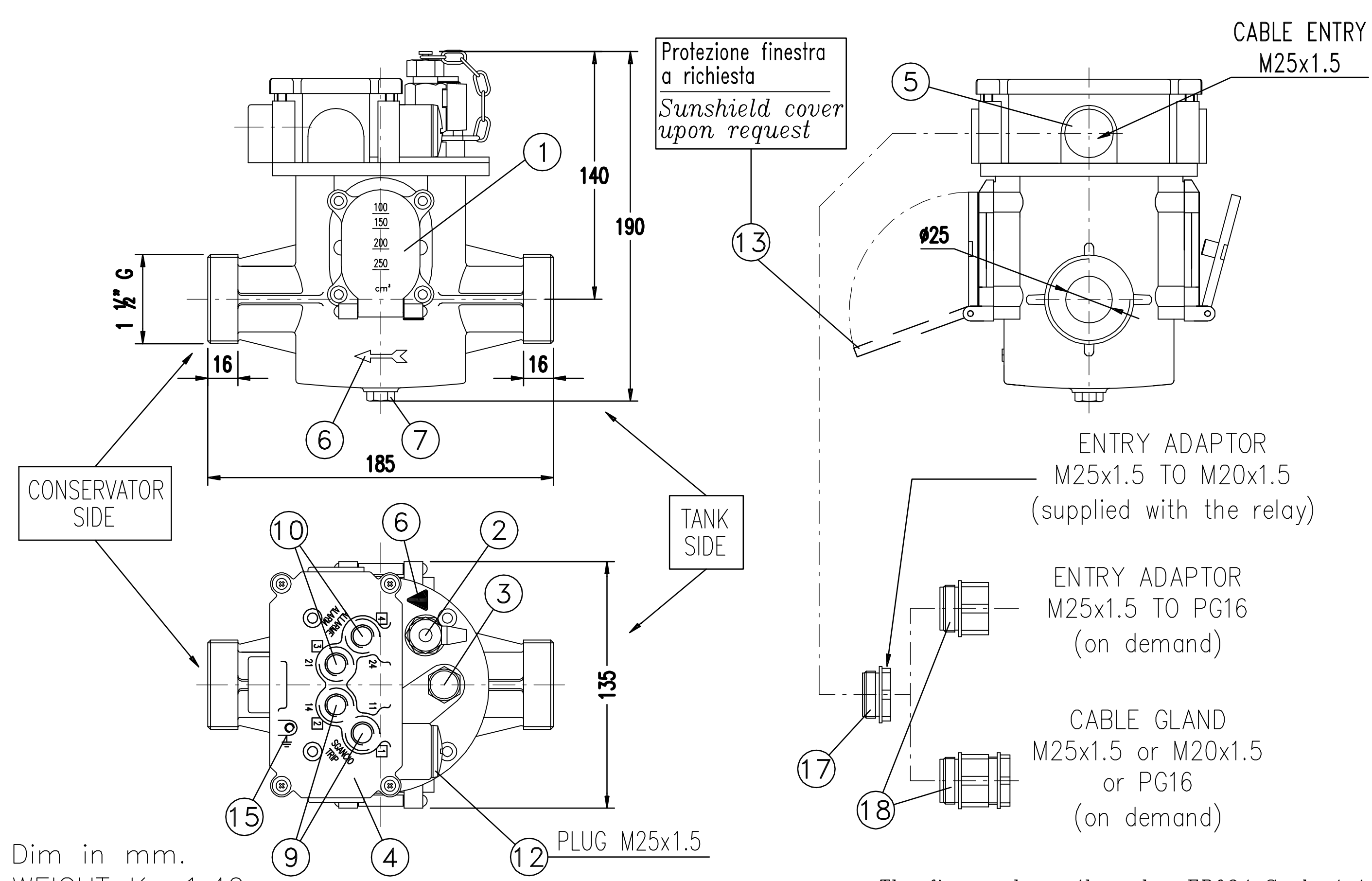
TYPE ET025



Dim in mm.
WEIGHT Kg 1.50

The figure shows the relay ET025 Scale 1:4

TYPE EB024



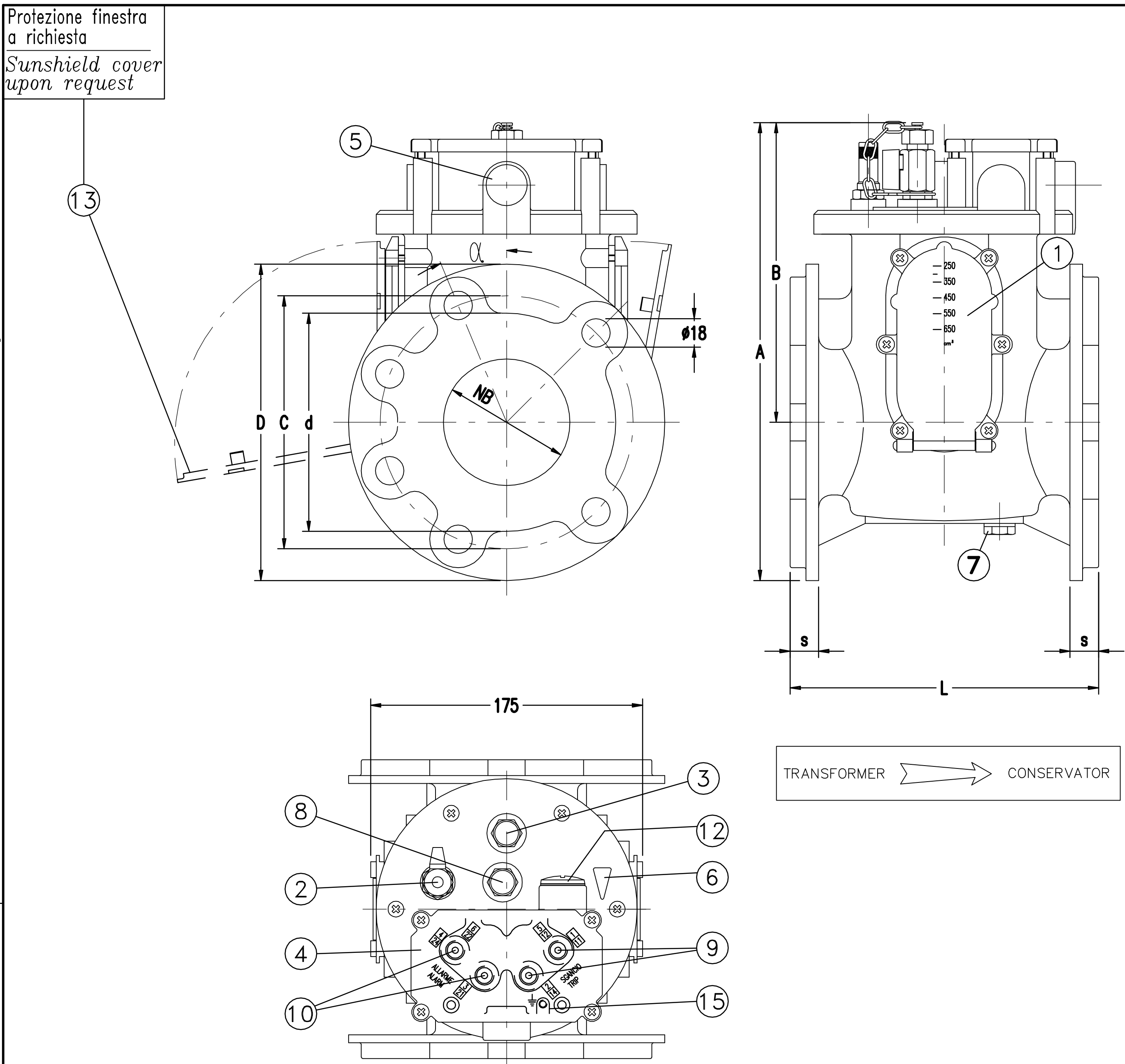
Dim in mm.
WEIGHT Kg 1.40

The figure shows the relay EB024 Scale 1:4

CEDASPE

Gas actuated relay ET 25 / EB 24 EN50216-2

A4 (210x297)
LMT [(0,0) (196,286)]
FILE = PAGE 12.dwg
REV. 05 DTD 02/05/12



Z = Nr of holes

Tipo *Type*	NB	A	D	C	B	s	L	α	d	Z	Peso (kg) *Weight (kg)*
EB050	50	267	165	125	185	18	195	45°	102	4	≃ 4.60
EB079	80	303	200	160	203	18	195	45°	138	4	≃ 5.50
EB080	80	303	200	160	203	18	195	22.5°	138	8	≃ 5.50
ET050	50	254	140	110	200	14	185	45°	/	4	≃ 4.50

dim in mm.

The figure shows the relay EB080/EB079 Scale 1:4

CEDASPE

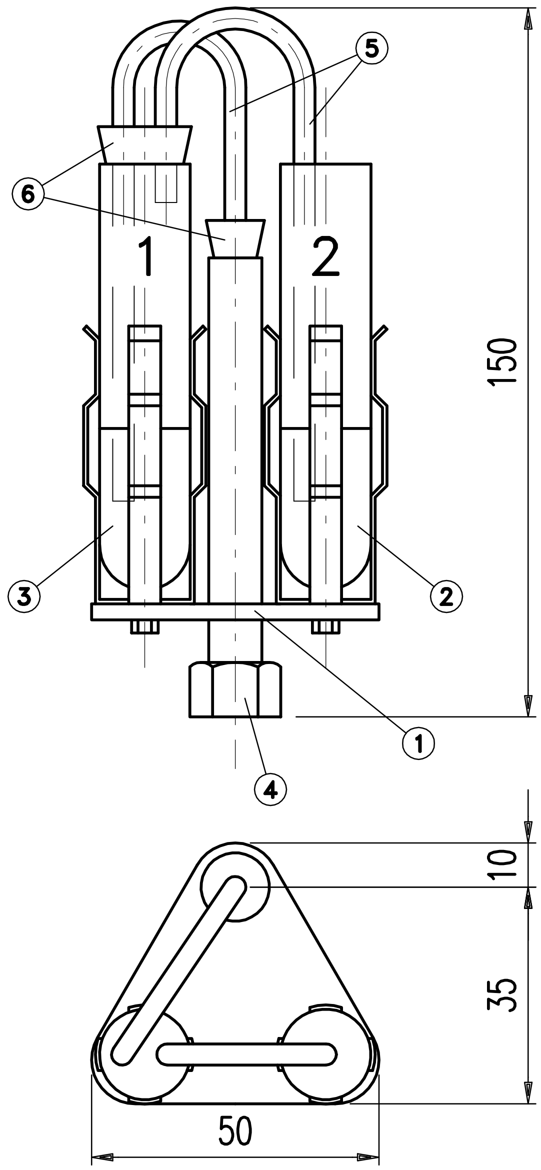
Gas actuated relay type EB EN50216-2

A4 (210x297) LMT [(0,0) (196,286)]

FILE = PAGE 13.dwg

REV. 04 DTD 13/05/11

Schema di montaggio
Mounting sketch



Pos.	Description
6	Rubber plugs
5	Glass tubes
4	Revolving nut 1/4" BSP
3	Test probe 1
2	Test probe 2
1	Support

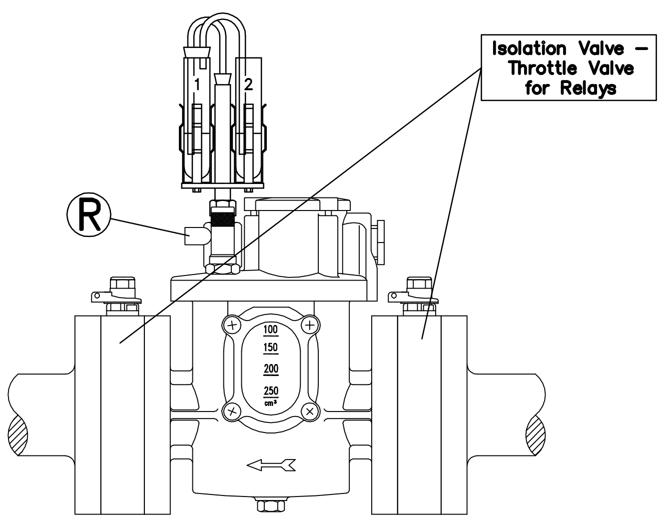


Fig. A: directly on relay

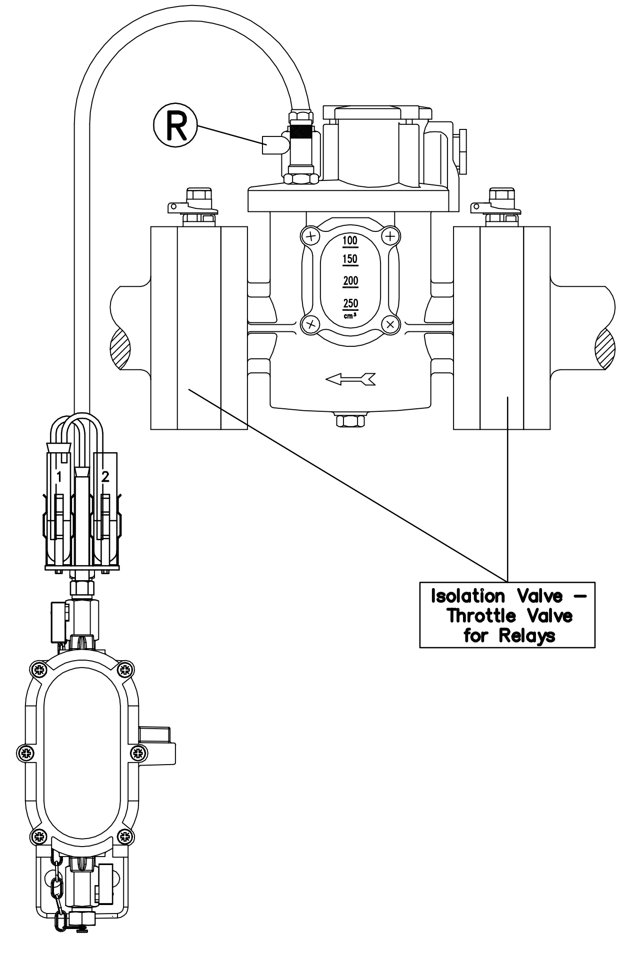


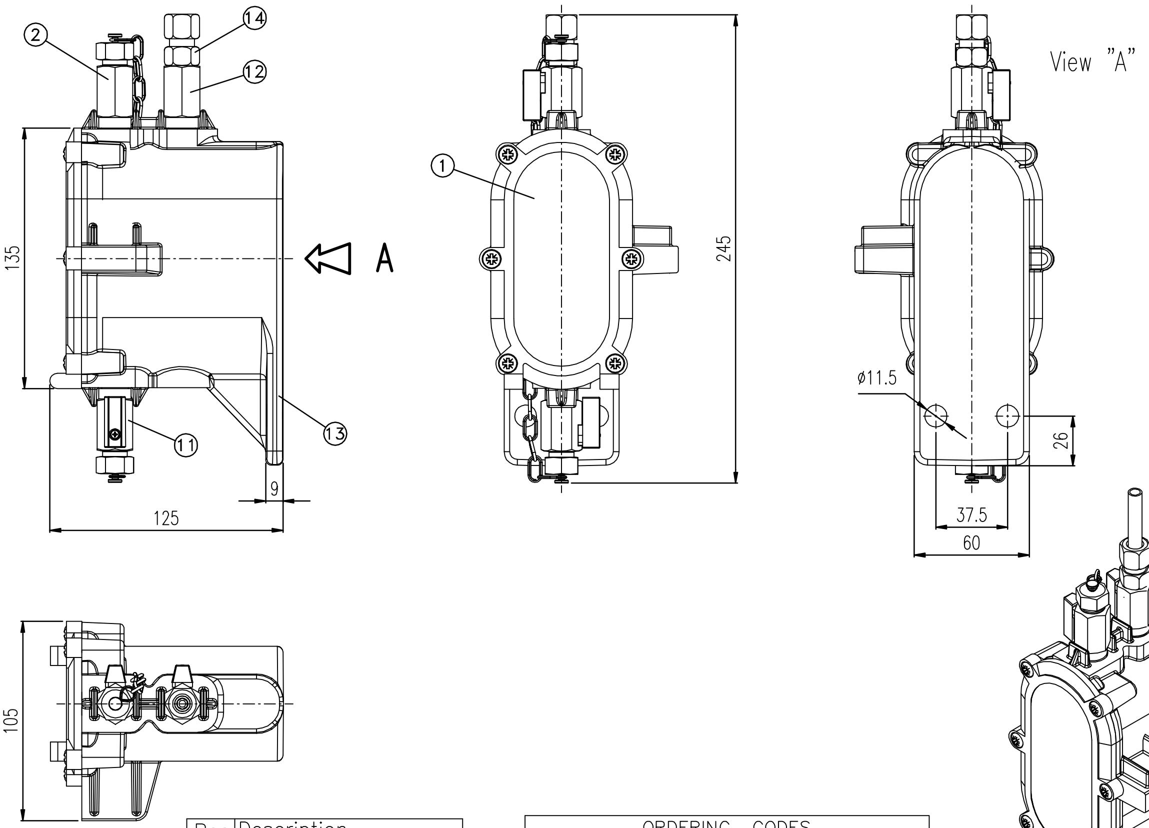
Fig. B: With RG3 apparatus

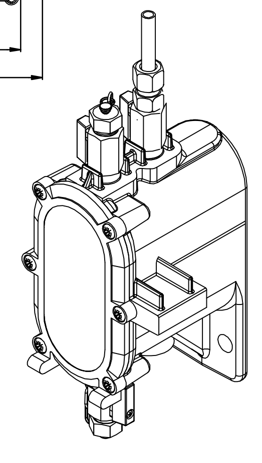
CEDASPE

Gas analyser for Buchholz relays

FILE = PAGE 26.DWG
LMT [(0,0) (196,286)] A4 (210x297)
REV 02 DTD 18/09/12

FILE = 3680 .DWG
REV 02 DTD 18/09/12

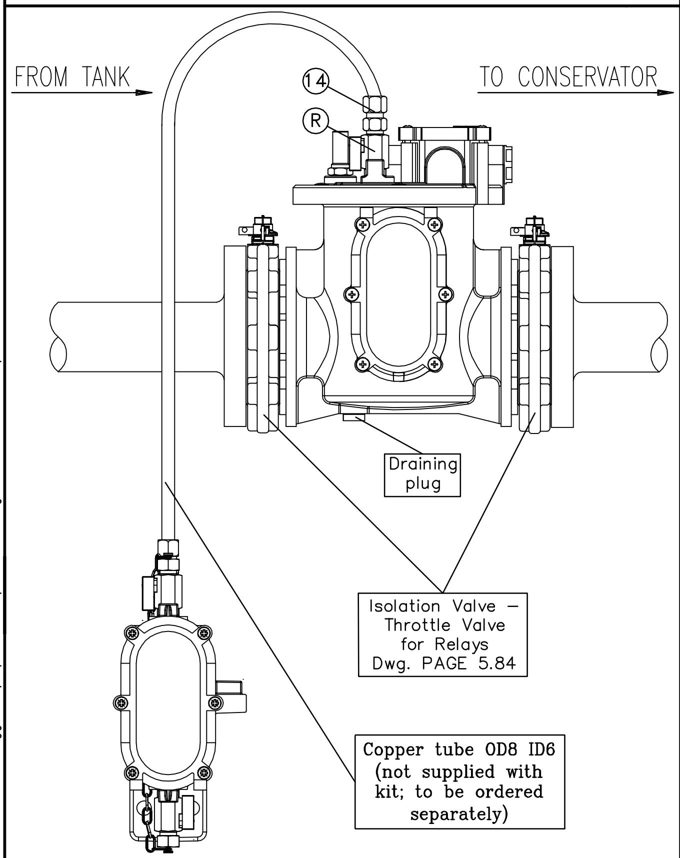




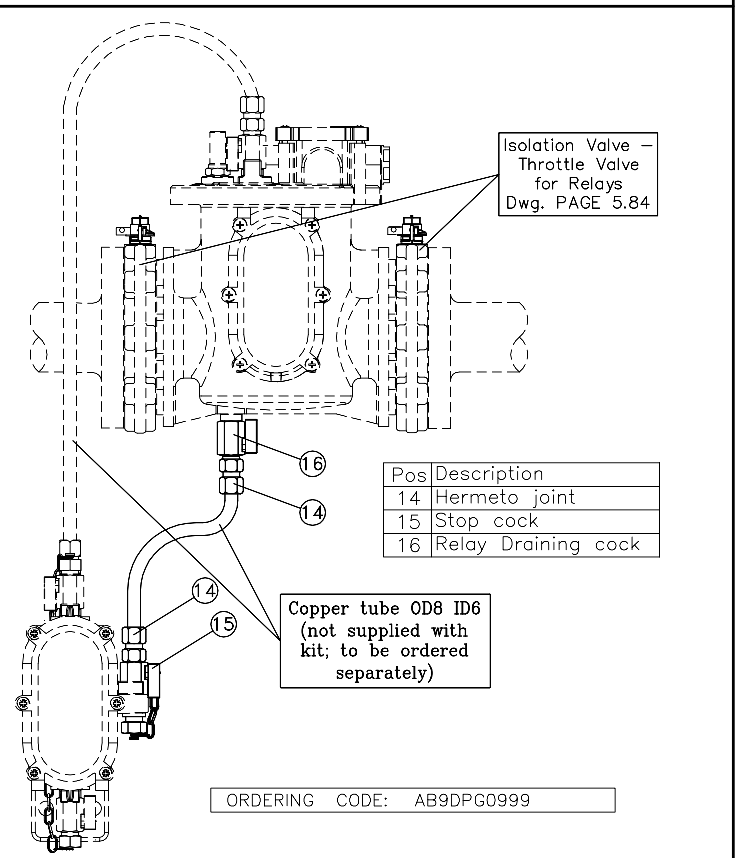
Pos	Description
1	Inspection window
2	Gas release cock
11	Oil drain cock
12	Stop cock
13	Fixing plate
14	Hermeto joint

ORDERING CODES		
MODEL	WINDOW MATERIAL	CODE
RG3.2PF-FVT	TEMPERED GLASS	AB9DPG0172
RG3.2PF	MACROLON	AB9DPG0102

RG3 Mounting sketch



OPTIONAL: Relay oil draining Kit



Pos	Description
14	Hermeto joint
15	Stop cock
16	Relay Draining cock

ORDERING CODE: AB9DPG0999

CEDASPE

Titolo

New Gas collecting device RG3.2-PF

Suitable for relays series EB & ET

Data	31/08/12
Scala	1:4
Dis.	
Visto	

Dis. Nr 3680

1 2

Section 8
Component Instruction Leaflets and Manuals

8.9 Radiador

华丰片散

安装使用说明书

INSTALLATION& OPERATION INSTRUCTION

HUA FENG FIN RADIATOR
MAKE YOU MORE SATISFIED
华丰散热器让您更满意!

涿州华丰工业制品有限公司 散热器公司
Zhuo Zhou Hua Feng Industrial Products Co.,Ltd Radiator Branch

地址：河北省涿州市 邮编：072750 传真：(0312)3962146
电话：(0312)3962141 、3962140、 3962148
Add：Zhuo zhou,Hebei Post code：072750 Fax：(0312)3962146
Tel：(0312)3962141、3962140、3962148

Http:www.huafengjixie.com E-mail:huafeng-sanreqi@163.com

涿州华丰工业制品有限公司 散热器公司
Zhuo Zhou Hua Feng Industrial Products Co.,Ltd Radiator Branch

安装使用说明

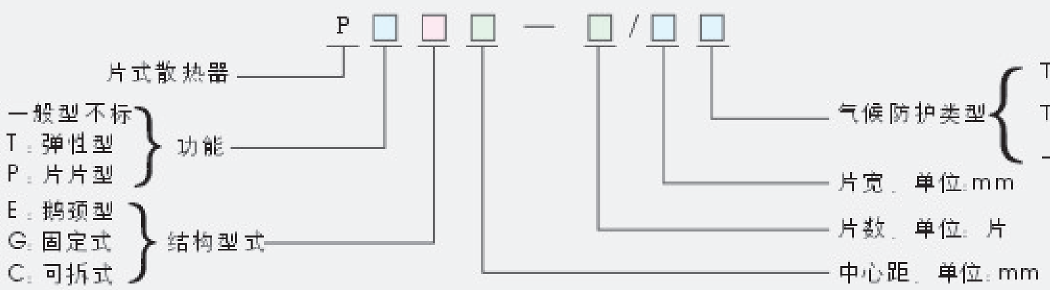
片式散热器是油浸式电力变压器理想的散热组件，具有散热性能好，便于安装、维修，外形美观等优点。

1、结构型式
- 固 定 式：直接焊接在变压器油箱上
- 可 拆 式：用法兰与变压器连接

2、冷却方式
- 自 冷 式：散热器通过空气自然对流散发热量
- 风 冷 式：散热器通过风机吹风(底吹或侧吹)散发热量
- 强油风冷：散热器通过泵强迫油循环并利用风机吹风散发热量

产品结构尺寸如图一、图二、图三所示，其中A为中心距、N为片数、B为片宽。

3、型号(规格)标识



4、产品安装
- 散热器安装前请去掉集流管口端盖，拧紧放油放气阀盖。
- 散热器组间距请不要小于50mm。
- 下集流管中心离地面应保持适当高度，以利于空气对流。
- 固定式散热器安装，根据集流管外径尺寸及中心距尺寸，在变压器油箱侧壁上开孔，将散热器直接焊接在油箱上。
- 可拆式散热器安装：

(1).请按所选散热器中心距尺寸，散热器组间距尺寸及散热器法兰尺寸在变压器油箱上配接法兰接口。
(2).请按法兰中心孔尺寸和螺钉孔尺寸配制橡胶密封垫，选用紧固螺栓、螺母、垫圈。
(3).请按散热器组间距尺寸和图五中给出的尺寸配制连接板，选用螺栓、螺母、垫圈。
(4).请按图五的所示方法将散热器与油箱法兰(或阀门)对接紧固密封，并将相邻两组散热器用拉板连接牢固。
(5).当采用底吹风冷时，下部集流管上为您提供了悬挂风机用的弯板(自冷式散热器不带弯板)，每两组散热器悬挂一台风机，当同侧散热器组数为奇数时，请按图五方式布置。
(6).当采用侧吹风冷时，请将风机安装固定在散热器的适当位置上，风机位置见图四。

5、注意事项
- 安装前如需进行密封性检验，其试验压力(内压)不许超过0.12MPa(即1.2个标准大气压)。
- 弹性散热器如需检漏，必须对散热片进行限位，加注变压器油时，请采用半真空或真空注油方式。
- 安装过程中请谨慎操作，防止磕碰、挤压、摔伤产品。
- 安装时先将散热器与变压器主体联接，螺栓不拧紧，然后将散热器的间距调整均匀，把连接板拧紧固定，再将散热器法兰中的螺栓紧固。

INTRODUCION

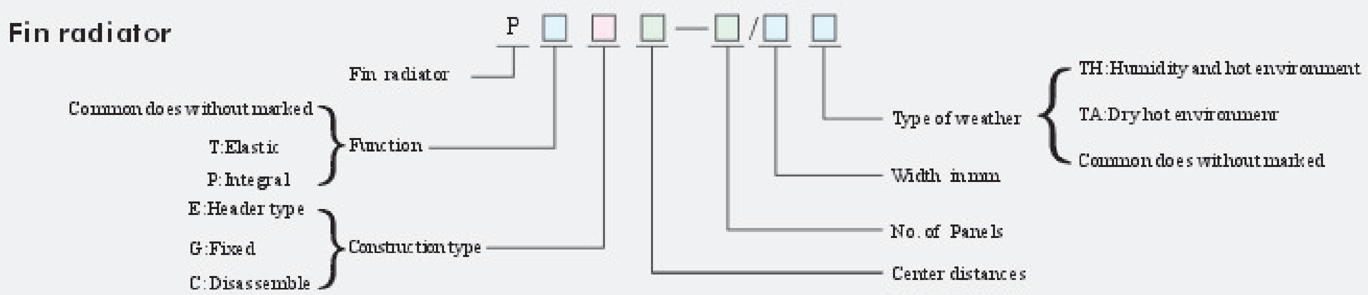
The fin radiator is an ideal heat-emission element for oil—dip type transformer with its characteristics of excellent emission performance, easy install and maintenance as well as good appearance.

1. Construction type:
- Fixed type: The radiator is welded directly to the oil tank of transformer.
- Disassemble type: connected to transformer by flange.

2. Cooling methods:
- Self-Cooling: emit the heat by nature air—flow
- Forced-air cooling emit the heat by air blower from end or side.
- Forced-oil and forced-air cooling: emit heat by enforced oil circulation togecher with air blower.

The stucture and dimensions see Fig. 1. Fig. 2 and Fig. 3. A is center distance, N is the number of elements, B is width.

3. Specification and marks:

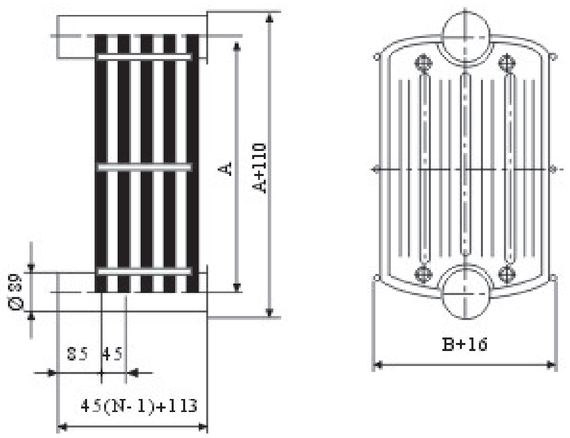


4. Mounting:
- Before mounting, remove the caps and tight the oil discharging valve.
- The distance between radiator groups should keep more than 50 mm.
- To keep a suitable distance from lower tube to the earth for smoothing air flow.
- For the mounting of Type PG, drill holes on the oil tank according to the diameter and the centre of the tubes and weld them together.
- To mounting of Type PC,

(1) • Select the suitable flange on oil tank with reference of selected center distance, group distance and the size of flange on radiators.
(2) • Select the suitable rubber seals, bolts, nuts and washers with reference of the center hole of flange and the size of bolts.
(3) • Choose connection punits,nuts,bolts and washer according to the distance of groups and dimensions provided in fig.5.
(4) • Connect and fasten the radiators to tank's flanges (or valves), and connect the neighbouring groups with connective punits(fig.5).
(5) • When blowing from end, a winding plate provided under the lower tube for set blower(model of forced—air cooling and forced—oil and forced—air cooling), each blower for two groups. When the number of groups is odd, set them as shown in fig.5.
(6) • When blowing from side, set blower at suitable position as shown in fig.4.

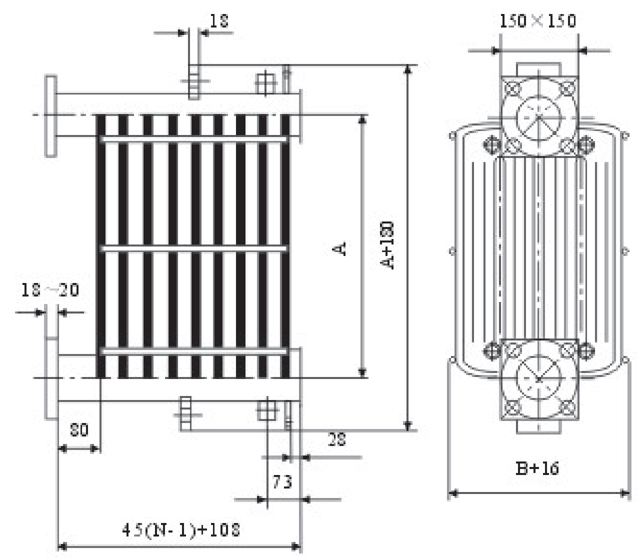
5. Important notes:
- If air tightness testing needed before installation. the testing pressure(inside)should not exceed 0.12Mpa
- If tightness testing need for elastic type of radiator. then the position limiting need to be made. When charging the transformer oil, semivacuum or full vacuum needed.
- Always be careful during installation to prevent from knocking, squeezing, pushing and falling down.
- When mounting, connect the radiator to transformer first and leave the bolts loosing. Adjust the distance radiators then fasten the connection bolts and fasten the bolts of radiator flange at last.

华丰片式散热器
Hua Feng Fin Radiator Branch



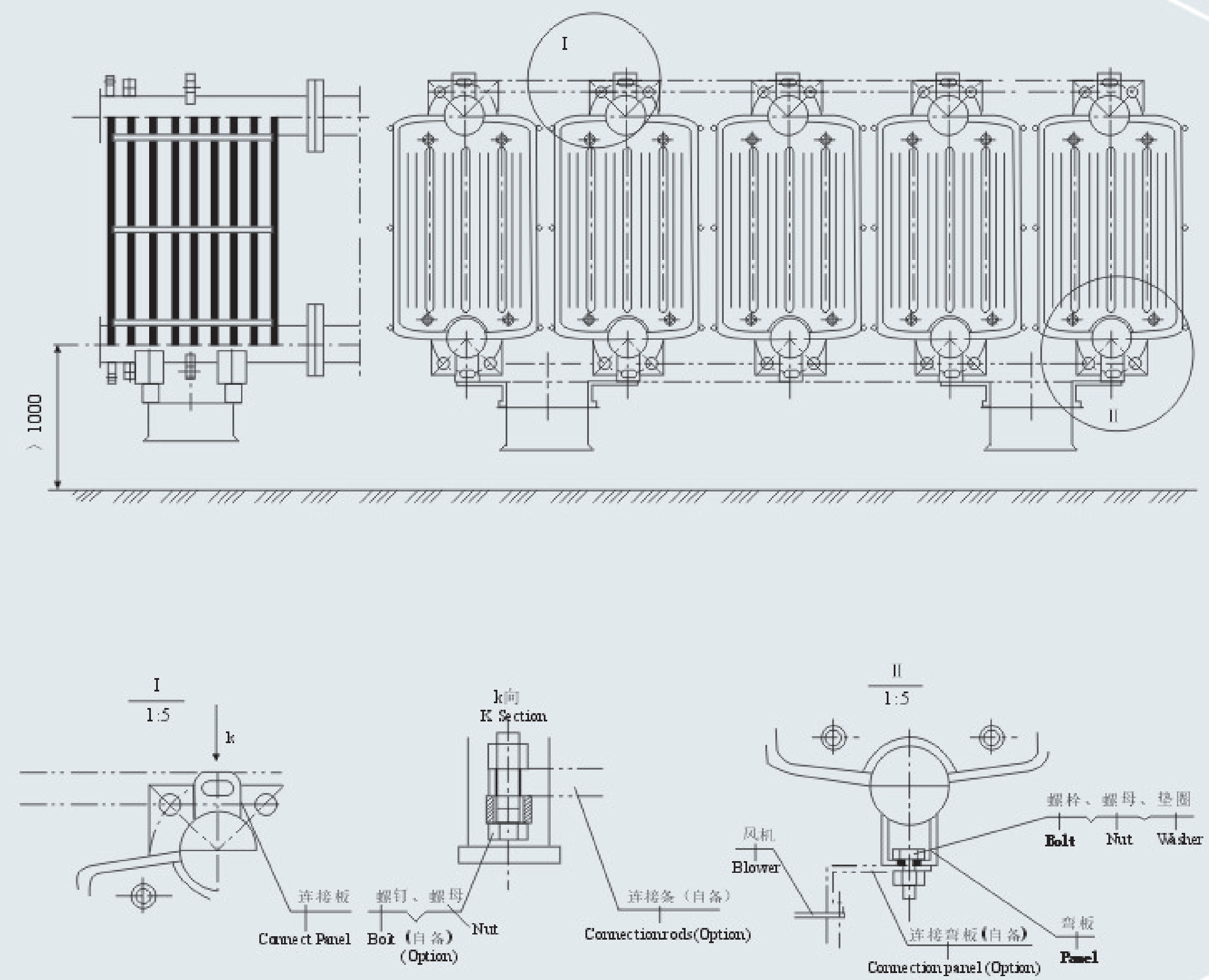
图一 固定式片式散热器（PG 型）

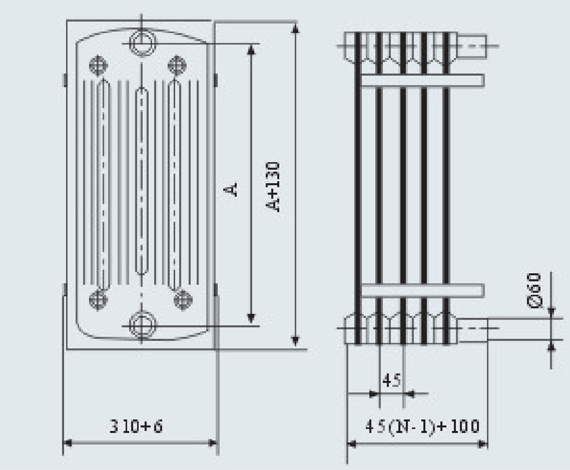
Fig.1 Radiator without flanges



图二 可拆式片式散热器（PC 型）

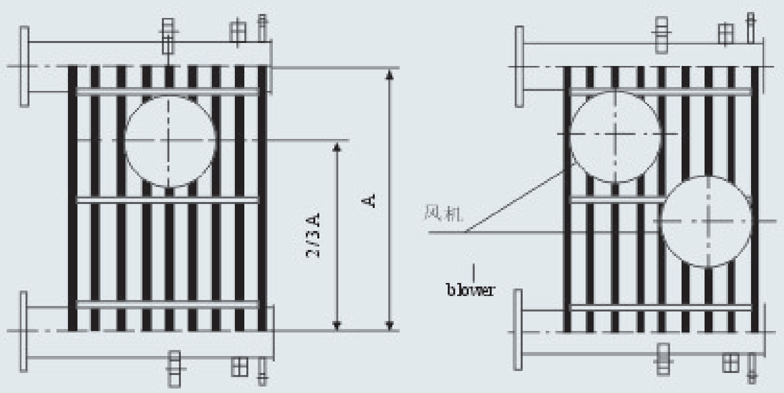
Fig.2 Radiator with flanges





图三 片片式散热器（PPG 型）

Fig.3 Integral radiator



图四 风冷侧吹风机的安装位置示意图

Fig.4 Installation of instruction of a side air blower

图五 可拆散热器安装方法及风冷底吹风机的安装方法

Fig.5 Installation method of radiator with flanges and end blow blower

Section 8
Component Instruction Leaflets and Manuals

8.10 Oil

[Typical Properties]

Typical Properties of Petro45X Transformer Oil

PROPERTY	UNIT	TEST METHOD	SPECIFICATION LIMITS (IEC60296-2012)		TYPICAL DATA
			MIN	MAX	
1 –Function					
Viscosity at 40°C	mm^2/s	ISO 3104		12	9.3
Viscosity at -30℃	mm^2/s	ISO 3104		1800	1000
Pour point	°C	ISO 3016		-40	-45
Water content	mg/kg	IEC60814		30	25
Breakdown voltage					
-- Before treatment	kV	IEC60156	30		40-60
-- After treatment	kV	IEC60156	70		>70
Density at 20℃	kg/m^3	ISO 12185		895	873
DDF at 90°C		IEC60247		0.005	<0.001
2 –Refining/stability					
Appearance		IEC60296	Clear & transparent, no sediment and no suspended matter		Visual inspection
Acidity	mgKOH/g	IEC 62021-1		0.01	<0.01
Interfacial tension	mN/m	ASTMD971	40		45
Total sulfur content	%	ASTMD5453		0.15	0.01
Corrosive sulfur		DIN 51353	Non-corrosive		Non-corrosive
Potential corrosive sulfur		IEC62535	Non-corrosive		Non-corrosive
Corrosive sulfur		ASTMD1275B	-		Non-corrosive
DBDS content	mg/kg	IEC 62697-1	Not detectable		Not detectable
Inhibitors	%	IEC60666	0.08	0.40	0.38
Metal passivator additives	mg/kg	IEC60666	Not detectable		Not detectable
2-furfural content and its related compound	mg/kg	IEC61198		0.05	<0.05
3 –Performance					
Oxidation stability at 120°C,500 h					
- Total acidity	mgKOH/g	IEC61125C		0.3	0.08
- sludge	%			0.05	<0.01
- DDF at 90°C		IEC60247		0.050	0.034
4 –Health, safety and environment (HSE)					
Flash point (PM)	°C	ISO 2719	135		145
PCA content	%	IP346		3	<3
PCB content	mg/kg	IEC 61619	Not detectable		Not detectable

Material Safety Data Sheet

KunLun Petro 45X Transformer Oil

Version: A1 **Release Date: December 19th, 2012**

Section 1 Product and Company Identification

Product Name: Petro 45X Transformer Oil

Product Type: Electrical Insulating Oil

Trade Name: Petro 45X Transformer Oil

Recommended Use: Transformers, switchgear and similar electrical equipment in which oil is required as an insulating and for heat transfer.

Service Call: 400-810-3000 800-810-3001

Website: http://www.kunlunlube.com.cn

Manufacturer: PetroChina Lubricant Company

Address: 17/F Building A, PetroChina KunLun Plaza, No.8 Taiyanggong Jinxingyuan, Chaoyang District Beijing, China

Fax: 0086-10-63592290

Emergency Call: 0086-10-62095168

Section 2 Composition/Information of Ingredient

This product is mixture of hydrotreating light naphthenic-base fraction and the additive, the composition content is listed by weight

Generic Composition: Severe treat min. oils & additives

Ingredient	Value(s)	CAS No.
Hydrotreating Light Naphthenic-Base Distillates	＞99.6	64742-53-6
2,6-BHT	＜0.4	128-37-0

Section 3 Hazards Identification

This Product is Class B Combustible Liquid according to National Standard “Fire Prevention Code of Petro-Chemical Enterprise Design”.

This product is not classified as dangerous goods according to “List of Dangerous Goods” (GB12268), The product does not exist the unpredictable risk under normal condition of use.

Physical / chemical hazard class: Not classified as hazardous waste.

Health risk categories: no significant hazards.

Health hazards: This product may generate oil mist to cause skin and eye irritation, excessive exposure to liquid and oil mist may cause respiratory irritation and damage, and aggravate existing asthma and other respiratory diseases. The inadvertent large amounts are ingested severe damage to the digestive system; it is timely to take rescue measures.

Environmental Hazards: Be harmful to the environment, should prevent the pollution of soil, water.

Section 4 First Aid measures

Inhalation: Rapidly take away to fresh air, keep ventilation. Seeking immediate medical assistance if dizziness, nausea or unconsciousness.

Ingestion: Induce vomiting by drinking enough water, a large number of swallow should be immediately sent to hospital for treatment to induce vomiting or other rescue measures under the guidance of a physician.

Eye Contact: Immediately open the upper and lower eyelids, Flush thoroughly with water and physiological saline. If irritation occurs, get medical assistance.

Skin Contact: Remove contaminated clothing and shoes. Wash with soap and water. Handle with care and dispose of in a safe manner. Seek medical attention if skin irritation, swelling or redness develops and persists.

Section 5 Fire Fight Measures

Risk Characteristics: Flash Point ＞135℃, can cause combustion by fire, high temperature or oxidant.

Hazardous Combustion Products: CO/CO_2/Sulfide/ Suspended Solid Particles and Complex Combustion Mixture

Fire Fighting Instructions: Firefighters are required to wear gas masks and firefighting suits, Put out fire downwind. Take containers away from the scene to empty Department. Evacuate immediately when color change of containers or sound from the pressure relief safety devices.

Extinguishing Media: Dry chemical, carbon dioxide (CO_2), foam or sand. Do not use a direct stream of water.

Section 6 Accidental Release Measures

Emergency Treatment: When a leak is discovered, immediately cut off the source of fire, isolate combustible. After risk assessment, organize contaminated areas personnel to a safe area if necessary. Must wear personal safety protection equipment when cleaning leakage and should pay attention to prevent secondary disasters such as personal injury and environmental pollution during emergency rescue.

A small leak: collecting leaking liquid in a sealed containers much as possible, use sand, activated carbon or other inert materials to absorb the residue. Can also use non-flammable dispersant is made of latex to wash, lotion needs harmless disposal.

Large Leak: briefing to the relevant departments according to the degree of risk. Build a causeway or trenching asylum. Transferred to a sealed container with a pump and recycling or shipped to waste disposal sites.

Section 7 Handling and Storage

Handling Precautions: comply with the fire safety design specification requirements when using this product and avoid excessive oil mist generated during the operation. The operator should be subject to fire safety training, equipped with the necessary labor protective equipment to avoid inhalation of oil mist, eliminate leakage of production and operating equipment and avoid slipping.

Storage Note: This product should be sealed storage, stored in a cool, dry, ventilated place, away from open flames and high temperature heat, strong oxidants and flammable materials, to avoid mixing with water and impurities and other foreign matter. The storage area should be equipped with the necessary fire equipment, leakage processing equipment. Empty containers may still remain product, avoid heating, cutting, welding.

Section 8 Exposure Control/Personal Protection

Exposure limits: When oil mists and smoke can occur, the following standards are recommended: 3 mg/m ^{3}15min - AFS （Sweden, 6/2005） STEL, 1 mg/m ^{3}8h - TWA.
Recommended Monitoring Procedures: If the components of the product have exposure limits, it needs to have air or biological monitoring for personal and workplace to determine the effectiveness of ventilation facilities, or take other control measures, or to use necessary respiratory protective devices. It should refer to EU EN689 assessment method standard about inhalation of chemical reagents and national guidance documents on the detection of harmful substances.
Profession Exposure Control: Forced ventilation and local exhaust can reduce the exposure concentration in the air. The operating device uses oil-resistant material. Store under the recommended conditions. If heating, temperature control device should be used to avoid overheating.
Health Measures: Operating in accordance with the industrial hygiene and safety measures.
Respiratory Protection: If the product needs manually heating, it should choose to wear A1P2 or A2P2 filter respirator. Automatic production line with good ventilation does not need to wear a respirator.
Hand Protection: Wear suitable oil-resistant protective gloves made by Nitrile rubber or high quality PVC.
Eye Protection: If contact is likely, safety glasses should be worn.
Skin and Body Protection: Wear protective clothing if there is a risk of skin contact and change them frequently, or when contaminated.

Section 9 Physical and Chemical Properties

Items	Typical Data
Form	Viscous Liquid
Color	<0.5
Odor	Odorless
Pour Point	-42℃
Density, 20℃	873kg/m ^{3}
Flash Point, Close	142℃
Solubility in Water	Non soluble
Solubility in Organic Solutions	Soluble
Viscosity, 40℃	9.3mm^2/s
DMSO Extraction (IP346)	<3%

Section 10 Stability and Reactivity

Stability: Stable at normal conditions
Avoid: Excessive highly oxidizing agents.
Avoid condition: Open flame, high heat resource

Hazardous Decomposition Products: Material does not decompose at ambient temperatures.
Hazardous Reaction Potential: Polymerization will not occur

Section 11 Toxicological Information

Potential Acute Health Hazards

Acute toxicity: Lower

Ingestion: May induce nausea and even vomiting and diarrhea.

Inhalation: Inhalation of oil mist or vapor produced under high temperature may cause irritation to the respiratory tract.

Skin contact: Prolonged or repeated exposure may lead to skin dryness or cracking.

Eye contact: May cause redness and transient pain.

Potential Chronic Health Hazards

Chronic Effects: Inhalation of oil mist or vapor produced under high temperature may cause irritation to the respiratory tract.

Section 12 Ecological Information

Ecotoxicity: Not expected to be harmful to aquatic organisms, but potential bioaccumulate may cause ecotoxicity.

Mobility: Non-volatilized liquid, no oil mist pollution to air; Low solubility and floats and is expected to migrate from water to the land. It will be absorbed by the soil particles and can not flow when entering into the soil.

Persistence/degradability: The base oil is expected to be inherently biodegradable with potential bioaccumulation.

Section 13 Disposal Consideration

Disposal Recommendations: Waste Mineral Oils listed in HW08 of “National Catalogue of Hazardous Wastes”

Regulatory Disposal Information: Comply with local laws and regulations. If possible, should be entrusted with the appropriate qualified hazardous waste disposal agency for product recycling. Recommended as a boiler fuel under controlled conditions and monitor the emission gases harmful substances of high-temperature combustion. Airtight container stored and the necessary identification when temporary saves.

Section 14 Transportation Information

“List of Dangerous Goods” (GB12268): The product is not classified as 9 categories of hazardous goods

China / international transport regulations: Not Regulated for Land Transport

SEA (IMDG): Not Regulated for Sea Transport

AIR (IATA): Not Regulated for Air Transport

Section 15 Regulatory Information

According to principles of hazardous substances and preparations classification in China and Europe, it is not regarded as hazardous goods. No legal identification is required.

Comply with the chemicals directory requirements of the following countries and regions: IECSC (China), DSL (Canada), EINECS (EU), on ENCS (Japan), KECI (Korea), PICCS (Philippines), TSCA (United States) and AICS (Australia).

Section 16 Other Information

This material safety data sheet is based on current knowledge and applicable laws and regulations, the description of the product from the health, safety and environmental requirements, having possibility of amendments to update existing reference standards and testing data.

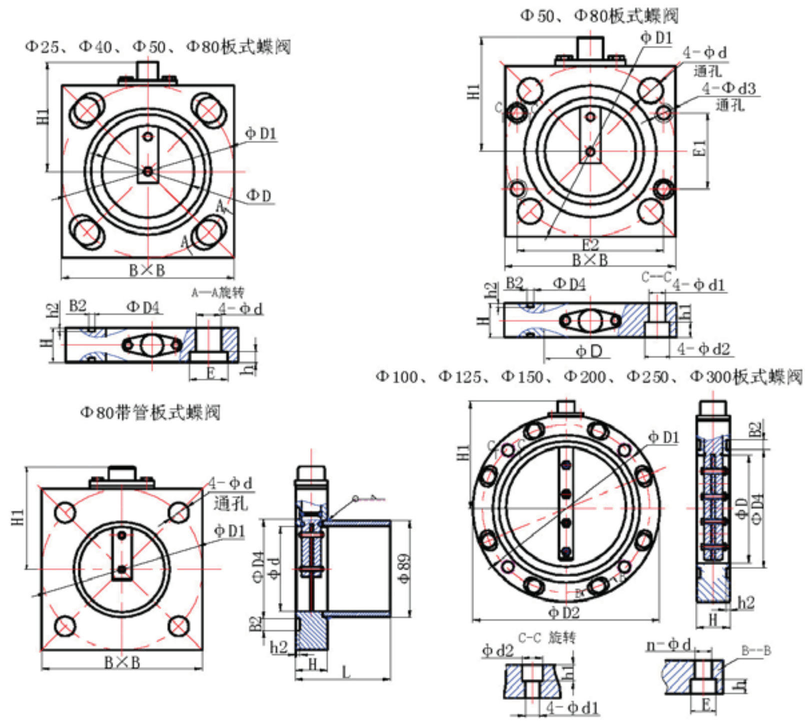
The data and recommendations provided by the material Safety Data Sheet are only apply to this product. In addition to the prescribed use, China Petroleum oil company will not be held responsible due to failure to follow recommended any damage or injury caused by the views. Users can get additional information by the sales department and technical service department.

Section 8
Component Instruction Leaflets and Manuals

8.11 Valve

主要产品

Main Products



BDB系列板式蝶阀

BDB Series of Plate Type Butterfly Valves

BDB系列板式蝶阀是根据国内外产品的特点开发的新一代板式蝶阀，是我国铸铁板式蝶阀的换代产品，阀体材料有Q235钢板和不锈钢，杜绝了过去用铸铁制造所造成的渗漏现象。阀体和阀片配合面经高级数控车床精密加工，渗漏量极小，性能优于同行业产品。蝶阀两端面配有断面为“工”字型密封圈，安全可靠，并配有专用异形螺栓。其中带管的板式蝶阀带一段您所需要的连管，它比传统的蝶阀减少一个泄露面，并节约一个法兰，经济实惠。蝶阀表面可根据用户要求采用喷漆、喷塑、热浸锌或电镀锌几种处理方式。

BDB series of plate type butterfly valves is a new generation of products developed to suits for demands of both abroad and home, is the replacement of casting iron valves. The valve body made of Q235 steel or stainless steel, so the penetration leakage caused by casting iron can be completely avoided. Valve body and valve disk matching through fine matching process provide very tiny penetration leakage by advanced numerical control lathe. The capability is in leading position. Both ends of valve equipped with "*" type of sealing ring provide safety and reliable, fitted by shaped bolts. The pipe is available for valves need piping connected and it's a economic product by saving a flange. The surface can be treated by painting, painting with plastic, hot-dipped galvanization and galvanized.

BDB系列板式蝶阀尺寸表 Specification of BDB series of plate type butterfly valve

通径 D Nominate Dia	图号 Drawing No.	型号 Type	D1	D2	B	H	d	E	h	E1	E2	d1	d2	h1	d3	H1	D4	B2	h2	n	备注
25	HFDFB25-001	BDB-150/25	85		90											80	45	11	4		
40	HFDFB40-001	BDB-150/40	85		90											80	48	9	4		
50	HFDFB50-001	BDB-150/50- Ⅰ	125		125	30	14	23	10												
	HFDFB50-002	BDB-150/50- Ⅱ	110		120											98	60	11	4		
	HFDFB50-003	BDB-150/50-b1-125	125		125	30	14			36	93				M12						
	HFDFB50-004	BDB-150/50-b2-125	125	200	125	30	14			50	95	13	20	15							
80	HFDFB80-001	BDB-150/80	150		150	30	22	36	10							110					
	HFDFB80-002	BDB-150/80-y160	160			30	22	36	10							128					圆阀
	HFDFB80-003	BDB-150/80-G	150		150	30	22									110	94	11	4		带管阀
	HFDFB80-004	BDB-150/50-b1-160	160		160	30	19			55	135				M12	115					
	HFDFB80-005	BDB-150/50-b2-160	160		160	30	19			70	130	13	20	15		115					
	HFDFB80-006	BDB-150/80	150		150	35	22	36	10							110					
100	HFDFB100-001	BDB-250/100	180	220		35	18	30	10							140	120	13.5	5		
	HFDFB100-002	BDB-250/100- Ⅰ	180	215												138					
125	HFDFB125-001	BDB-250/125	200	235		40	18	30	10							149	140	13.5	5		
	HFDFB125-002	BDB-250/125- Ⅰ	210	245												154					
	HFDFB125-003	BDB-250/125- Ⅱ	210	245								18	26	20						8	
150	HFDFB150-001	BDB-250/150	240	280												171	165	13.5	5		
	HFDFB150-002	BDB-250/150- Ⅰ	240	280								18	26	20							
200	HFDFB200-001	BDB-250/200	295	340												201	220	13.5	5		
	HFDFB200-002	BDB-250/200- Ⅰ	295	340		46	22	36	10			18	26	20							
250	HFDFB250-001	BDB-250/250	350	390												226	285	13.5	5		
	HFDFB250-002	BDB-250/250- Ⅰ	350	390								18	26	20						12	
300	HFDFB300-001	BDB-250/300	400	440												252	318	8.5	5.6		
	HFDFB300-002	BDB-250/300- Ⅰ	400	440								18	26	20							

注：可根据客户要求特殊定货

Z45W-16T BRASS FLANGED GATE VALVE

OPERATING INSTRUCTIONS

1.Summarize:

Z45W-16T brass flanged gate vavle, connected with pipes, is used to stop or put the medium through, which is direct current configuration. The teakage test should comply with GB/T13927 D, the size ot flange end should comply with GB9113.

2.Model No.

Z 4 5 W -16 T

- T — Body material Brass
- 16 — Nominal pressure 1.6MPa
- W — Flashboard material Brass
- 5 — Structure direct current
- 4 — Connect type flange
- Z — Model Name gate valve

3.Technology parameter

1).Nominal pressure: 1.6Mpa;

2).Working pressure: 1.6Mpa max under nominal temperature;

3).Medium: oil;

4).Temperature: ≤150℃.

4.Configuration:

4.1 This valve consists of brass body, valve pole, cover, flashboard, valve seat, suffing, press circle, press nut, handwheel, scutcheon or nut etc.

4.2 Direct current gate valve, the medium pressure and screw tight when assembling can assure the no leadage on outlet.

4.3Figure dimension shown as drawing 1, assemble dimension is as table 1.

5. Installation and use.

5.1 Please clean side face first before installation.

1.2 The flange flat must be even.

5.3 When connecting body flange with pipe flange, the bolts around the flange should be screwed evenly until the face of stop valve touch the pipe flange well, then tightened. Not tighten down in separately.

5.4 The handlwheel is anticlockwise turned to open the valve, while clockwise turn to close.

5.5 Don't use some handle with added arm of force to replace the original one, in case of damaging valves by the over fore.

5.6 The pipe for installation valves must be clean, no sand admitted.

6. Storage, package and transportation:

Storage, package and transportation should comply with Q/AM1905.

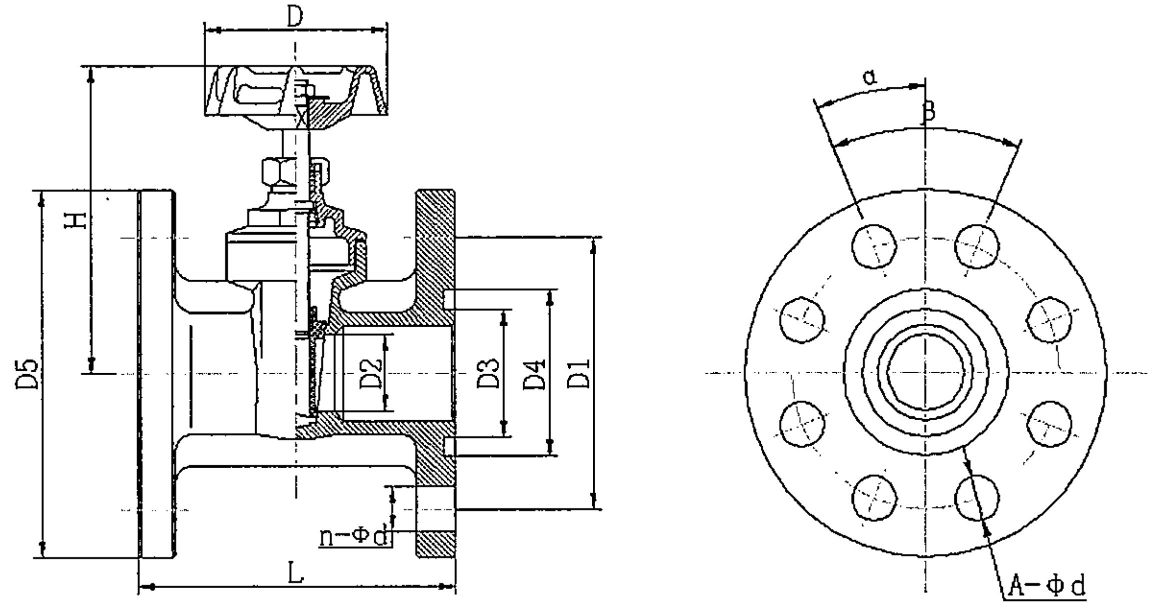


图 1

Z45W-16T 变压器专用法兰铜闸阀外形尺寸图

DN	D1	D2	D3	D4	D5	A-Φd	α	β	D	L	H
25	85	25	40	52	115	4-Φ14	45°	90°	120	95	98.5
50	125	45	74	90	160	4-Φ18	45°	90°	140	115	137
80	160	68	110	130	195	8-Φ18	22.5°	45°	180	155	198
100	180	90	122	146	215	8-Φ18	22.5°	45°	200	175	241
125	210	125			250	8-Φ18	22.5°	45°	220	180	380
150	240	150			285	8-Φ22	22.5°	45°	250	200	420
200	295	200			340	12-Φ22	15°	30°	300	250	530
250	350	250			395	12-Φ22	15°	30°	450	325	709
300	400	300			445	16-Φ22	15°	30°	500	346	812

Section 8
Component Instruction Leaflets and Manuals

8.12 Transport monitoring

MESSKO® MLog® IM50 / IM100
TRANSPORT MONITOR

Betriebsanleitung/Operating Instructions

BA 3431002/00 DE-EN . MESSKO INSTRUMENTS

Inhaltsverzeichnis

Contents

! HINWEIS

Die in dieser Betriebsanleitung enthaltenen Angaben können von dem gelieferten Gerät abweichen.

Änderungen bleiben vorbehalten.

! NOTE

Data contained herein may differ in details from the equipment delivered.

We reserve the right to make alterations without notice.

CE

Für zukünftige Verwendung aufbewahren!

Please keep this manual for future reference!

1 Allgemeines

1.1 Sicherheitshinweise

Alle Personen, die mit der Montage und dem Betrieb des Geräts zu tun haben, müssen

- fachlich ausreichend qualifiziert sein und
- diese Betriebsanleitung genau beachten.

Bei fehlerhafter Konfiguration oder Mantage ist die einwandfreie Funktion nicht gewährleistet.

In dieser Betriebsanleitung werden Hinweise verwendet, um wichtige Informationen hervorzuheben.

> **HINWEIS**
>
> weist auf wichtige Informationen zu einer konkreten Thematik hin.

1.2 Bestimmungsgemäße Verwendung

Die MESSKO® MLog® Transportüberwachung IM50/IM100 dient zur Transport- und Zustandsüberwachung von Gütern jeglicher Art.

Die Transportüberwachung wird fest an einem Transportgut montiert, um während des Transports über Sensoren z.B. die Beschleunigungswerte aufzunehmen. Sofern eingestellte Grenzwerte überschritten werden werden die Daten dauerhaft gespeichert und die Überschreitung ggfs. am Gerät angezeigt. Auf diese Weise können schädliche Belastungen für das Transportgut während eines Transportes rechtzeitig erkannt werden. Der Transportverlauf kann visualisiert werden. Überwachte Güter können sein: Schwerlasten wie z.B. Leistungstransformatoren, Generatoren, Satelliten, Papierrollen usw..

Vor Inbetriebnahme des Geräts sind die auf dem Typenschild und in der Betriebsanleitung angegebenen Grenzwerte in der Anwendung zu beachten und unbedingt einzuhalten.

1.3 Hinweise für den Betrieb des Geräts

Die nationalen Unfallverhütungsvorschriften sind vom Anwender unbedingt einzuhalten.

Es wird besonders darauf hingewiesen, dass das Arbeiten an aktiven, d.h. berührungsgefährlichen Teilen, nur zulässig ist, wenn diese Teile spannungsfrei oder gegen direktes Berühren geschützt sind.

Bei der Installation sind die nationalen Vorschriften zu beachten.

> **HINWEIS**
>
> Der Einbau und die Inbetriebnahme sollten nur gemäß dieser Betriebsanleitung durchgeführt werden.
>
> Der Betreiber hat für die bestimmungsgemäße Verwendung des Geräts Sorge zu tragen.

1.4 Varianten des MESSKO® MLog®

Das Gerät ist den zwei Varianten IM50 und IM100 mit folgenden Ausbaustufen erhältlich:

- MLog IM50
  - Messung der Beschleunigung in X-, Y- und Z-Richtung
  - Messung der Umgebungstemperatur
  - Messung der Umgebungsfeuchte
  - Registrierung der GPS-Position (optional)
- MLog IM100
  - Messung der Beschleunigung in X-, Y- und Z-Richtung
  - Messung der Umgebungstemperatur
  - Messung der Umgebungsfeuchte
  - Registrierung der GPS-Position (optional)
  - Display
  - 6 Universaleingänge (optional)
  - 2 Digitaleingange (optional)
  - Bluetooth-Modul (optional)
  - GSM-Modul (optional)

2 Inbetriebnahme

2.1 Lieferumfang

Öffnen Sie die Verpackung und überprüfen Sie den Lieferumfang.

Anzahl	Beschreibung	Abbildung
1 x	Messko MLog-Transportüberwachungsgerät IM100 oder IM50	 
1 x	USB-Stick mit Software MLog Analyser (der Lizenzschlüssel wurde mit der Auftragsbestätigung übermittelt)	
6 x	Batterien 1,5 V LR14 Varta 4014	
1 x	Mini-USB-Kabel (B-Typ)	

Anzahl	Beschreibung	Abbildung
1 x	Montage-Kit 4x Sechskantmutter 4x U-Scheibe 4x Federscheibe	

2.2 Batterien und SIM-Karte (nur optional bei IM100)

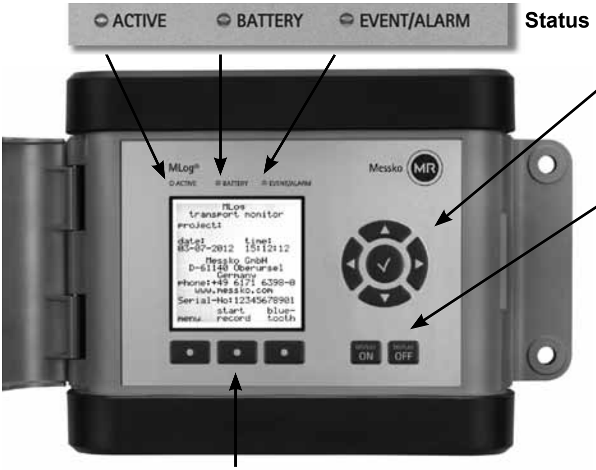
Zum Austausch der MLog-Batterien die 10 Kreuzschlitzschrauben auf der Rückseite des MLog lösen und die Rückwand abnehmen. Es sind 6x LR14 Alkaline-Batterien erforderlich.

Haben Sie ein MLog IM100 mit optionalem GSM Modul, so können Sie den SIM-Kartenhalter jetzt mit einer SIM-Karte bestücken.

> **HINWEIS**
>
> Verwenden Sie nur handelsübliche Alkaline-Batterien vom Typ LR14.
>
> Alkaline-Batterien nicht aufladen!

> **HINWEIS**
>
> Entsorgen Sie verbrauchte Batterien bitte fachgerecht!

2.3 MLog IM100 Bedienelemente und Status LED‘s



Status LED‘s

Steuerkreuz

Navigation innerhalb einer Bildschirmseite (z.B. Werte verändern, zwischen Werten springen, Einträge bestätigen

Display On / Off

Display ein-/ausschalten

(detaillierte Funktionen siehe Tabelle)
(Display schaltet sich bei Nichtbenutzung der MLog-Tasten automatisch nach 3 Minuten ab)

3 Softkeys

Seitenweise blättern, übergeordnete Operationen (z.B. Abbruch, zurück, speichern, ...)

> **HINWEIS**
>
> Der Start einer neuen Aufzeichnung wird unterbunden, wenn der Batteriestand niedrig ist.
> Die Timer-Aufzeichnung wird aber gestartet (ohne GSM/GPS/Bluetooth).

<table>
<tr><th rowspan="2">Bedienung</th><th rowspan="2">Betriebs-modus</th><th rowspan="2">Speicher-status</th><th rowspan="2">Funktion bei Druck auf „ON“-Taste</th><th colspan="3">LED</th></tr>
<tr><th>ACTIVE (grün)</th><th>BATTERY (gelb) Batterie-warnung</th><th>EVENT/ ALARM (rot)</th></tr>
<tr><td rowspan="3">ON-Taste länger als 4 Sekunden drücken</td><td rowspan="2">Keine Auf-zeichnung</td><td>Speicher leer</td><td rowspan="3">Display einschalten</td><td rowspan="3">aus</td><td rowspan="3">5 Sekunden blinken</td><td rowspan="3">aus</td></tr>
<tr><td>Logbuch im Speicher</td></tr>
<tr><td>Aufzeich-nung läuft</td><td>Logbuch im Speicher</td></tr>
<tr><td rowspan="3">ON-Taste 1-2 Sekunden drücken</td><td rowspan="2">Keine Auf-zeichnung</td><td>Speicher leer</td><td rowspan="3">LED An-zeige siehe rechts</td><td rowspan="2">3 Sekunden leuchten</td><td rowspan="3">5 Sek. blinken</td><td>aus</td></tr>
<tr><td rowspan="2">Logbuch im Speicher</td><td>3 Sek. leuch-ten</td></tr>
<tr><td>Aufzeich-nung läuft</td><td>3 Sekunden blinken</td><td>5 Sek. blinken, wenn Alarm(e) im Speicher</td></tr>
<tr><td>Automatische Funktion</td><td>Gerät zeichnet ein Event oder Alarm auf</td><td>Logbuch im Speicher</td><td>-</td><td>aus</td><td>aus</td><td>1x blinken</td></tr>
</table>

2.4 MLog IM50 Bedienelemente und Status LED‘s

Status LED‘s

> **HINWEIS**
> Der Start einer neuen Aufzeichnung wird unterbunden, wenn der Batteriestand niedrig ist.
> Die Timer-Aufzeichnung wird aber gestartet (ohne GPS).

<table>
<tr><th rowspan="2">Bedienung</th><th rowspan="2">Betriebs-modus</th><th rowspan="2">Speicher-status</th><th rowspan="2">Funktion bei Druck auf „ON“-Taste</th><th colspan="3">LED</th></tr>
<tr><th>ACTIVE (grün)</th><th>BATTERY (gelb) Batterie-warnung</th><th>EVENT/ ALARM (rot)</th></tr>
<tr><td rowspan="3">ON-Taste länger als 4 Sekunden drücken</td><td rowspan="2">Keine Auf-zeichnung</td><td>Speicher leer</td><td>Aufzeich-nungsstart</td><td rowspan="3">aus</td><td rowspan="3">5 Sek. blinken</td><td>aus</td></tr>
<tr><td>Logbuch im Speicher</td><td rowspan="2">Keine Funk-tion</td><td>5 Sekunden blinken</td></tr>
<tr><td>Aufzeich-nung läuft</td><td>Logbuch im Speicher</td><td>aus</td></tr>
<tr><td rowspan="3">ON-Taste 1-2 Sekunden drücken</td><td rowspan="2">Keine Auf-zeichnung</td><td>Speicher leer</td><td rowspan="3">LED An-zeige siehe rechts</td><td rowspan="2">3 Sekunden leuchten</td><td rowspan="3">5 Sekunden blinken</td><td>aus</td></tr>
<tr><td rowspan="2">Logbuch im Speicher</td><td>3 Sek. leuch-ten</td></tr>
<tr><td>Aufzeich-nung läuft</td><td>3 Sekunden blinken</td><td>5 Sek. blinken, wenn Alarm(e) im Speicher</td></tr>
<tr><td>Automatische Funktion</td><td>Gerät zeichnet ein Event oder Alarm auf</td><td>Logbuch im Speicher</td><td>-</td><td>aus</td><td>aus</td><td>1x blinken</td></tr>
</table>

Die OFF-Taste ist für zukünftige Funktionen reserviert.

2.5 Installation MLog Analyser-Software

HINWEIS

Vorraussetzung zur Installation der MLog Analyser-Software ist das Betriebssystem Microsoft Windows XP (Service Pack 3) oder eine neuere Version von Microsoft Windows.

Bei der Installation der Analyser-Software gehen Sie wie folgt vor:

(1) Starten Sie die Setup-Datei aus dem Unterverzeichnis \setup von dem mitgelieferten USB-Stick.

(2) Wählen Sie die Sprache aus, die Sie durch den Installationsprozess führen soll.

(3) Folgen Sie den Anweisungen des Setup-Wizards.

(4) War die Installation erfolgreich, so kann nun die Verbindung zwischen MLog und Analyser-Software hergestellt werden.

(5) Starten Sie dazu die Analyser-Software über das erzeugte MLog-Programmsymbol.

VIDEO

Siehe auch Videoanleitung

„**01_MLog-Analyser-Installation**“

in der MLog Analyser-Software unter

Hilfe-Menü > Willkommen > Einführungsvideos.

3 MLog für einen Transport vorbereiten

Vor jedem zu überwachenden Transport sollte das MLog unbedingt konfiguriert werden. Die notwendigen Schritte sind in der folgenden Auflistung beschrieben.

(1) Überprüfen Sie den Zustand der Batterien und wechseln Sie diese gegebenenfalls aus (siehe Kapitel 2.2).

> **HINWEIS**
>
> Messko empfiehlt, für jeden Transport neue Batterien zu verwenden.

> **VIDEO**
>
> Siehe auch Videoanleitung
>
> „**02_Batterien-und-SIM-Karte-einlegen**“ und
>
> „**03_SIM-Karte-Aktivierung**“
>
> in der MLog Analyser-Software unter
>
> Hilfe-Menü > Willkommen > Einführungsvideos.

(2) Optional:
Verfügt Ihr MLog IM100 über ein optionales GSM-Modul, setzen Sie eine SIM-Karte ein, um Benachrichtigungen des MLog per SMS-Kurznachricht versenden zu können (siehe Kapitel 2.2).

Geben Sie die SIM-Karten PIN am MLog ein, um die SIM-Karte und damit die SMS Benachrichtigungsfunktion zu aktivieren. Die PIN muss eine Länge von 4 Zeichen haben.

(3) Verbinden Sie nun das MLog mit dem PC über das USB-Kabel und starten Sie die MLog-Analyser Software auf dem PC.

Alternativ dazu können Sie die Verbindung mit einem MLog IM100 auch über das optionale Bluetooth-Modul herstellen. Dazu müssen Sie vorher den PC mit dem MLog über die Bluetooth-Funktion des PC-Betriebssystems herstellen (Code „1234“). Danach erfolgt der Verbindungsaufbau wie im Folgenden beschrieben.

(4) Stellen Sie eine Verbindung zum MLog über die Programmfunktion „Verbindung zu MLog herstellen“ her. Die Seriennummer des Gerätes, mit dem Sie verbinden können, wird angezeigt. Wählen Sie den COM-Port mit dem angeschlossenen MLog aus.
Der Verbindungsaufbau wird nun in einem Fenster angezeigt.

> **VIDEO**
>
> Siehe auch Videoanleitung
>
> „**04_MLog-für-Transport-vorbereiten**“
>
> in der MLog Analyser-Software unter
>
> Hilfe-Menü > Willkommen > Einführungsvideos.

(5) Kontrollieren Sie den Verbindungsstatus über die Analyser-Software. Diesen finden Sie im Programmfenster unten links.

(6) Wählen Sie im linken Menübaum „Verbundenes MLog“ den Punkt „Geräteinformationen“ aus und überprüfen sie die auf der rechten Seite des Programmfensters angezeigten Gerätedaten. Sie zeigen die Komponenten des MLog entsprechend ihrer bestellten Hardwarekonfiguration sowie die Seriennummer zur eindeutigen Identifizierung Ihres Gerätes an.

(7) Beginnen Sie nun mit der Konfiguration des MLog für einen Transport. Wählen Sie dazu im Menübaum den Punkt „Konfiguration - Grundeinstellungen“. Geben Sie unter Grundeinstellungen einen Namen für das Transportprojekt ein und wählen Sie die MLog-Sprache aus.

(8) Selektieren Sie im Menübaum den Eintrag „Aufzeichnungseinstellungen“. Im rechten Fenster können Sie jetzt einstellen, ob das MLog in einem bestimmten Zeitintervall und / oder bei Überschreitung von Grenzwerten Daten aufzeichnen soll.

(9) Optional:
Konfigurieren Sie die Aufzeichnung von GPS-Daten (nur wenn Ihr MLog mit einem optionalen GPS-Modul ausgestattet ist).

> **HINWEIS**
>
> Beachten Sie, dass häufige GPS-Positionsabfragen die Batterielaufzeit verkürzen.

(10) Stellen Sie die Start- und Endzeit für die Aufzeichnung von Mess- und optional von GPS-Daten ein.

(11) Selektieren Sie nun den Punkt „Interne Sensoren – Beschleunigung“ und konfigurieren Sie die Einstellungen für Beschleunigung. Welche Grenzwerte für die Beschleunigung (Erkennung von Stößen) Sie einstellen sollten, richtet sich nach dem zu überwachenden Transportgut und dessen Belastungsgrenzen.

(12) Konfigurieren Sie die Einstellungen für Luftfeuchtigkeit, falls die Überwachung der Feuchtigkeit für Ihr Transportgut relevant ist.

(13) Konfigurieren Sie die Einstellungen für die Umgebungstemperatur, falls die Überwachung der Temperatur für Ihr Transportgut relevant ist.

(14) Optional:
Wenn Ihr MLog IM100 mit einem optionalen GSM-Modul ausgestattet ist, geben Sie die Empfänger-Telefonnummern für den SMS-Versand ein, falls Sie bei bestimmten Ereignissen sofort per SMS Informiert werden möchten.

> **HINWEIS**
> Beachten Sie, dass ein SMS Versand nur mit einer freigeschalteten SIM-Karte und nur aus mit GSM versorgten Gebieten möglich ist. Berücksichtigen Sie auch die Fähigkeit Ihrer SIM-Karte, international SMS Nachrichten versenden zu können.

(15) Optional:
Sie können jetzt bestimmen, wie oft und/oder bei welchen Ereignissen das MLog SMS-Nachrichten an die jeweiligen Empfänger versenden soll.

Aktivieren sie den SMS-Versand nach Zeitintervall und konfigurieren Sie das Zeitintervall, sowie die dazugehörigen Empfänger-Nummern. Das MLog wird in diesem Zeitintervall eine SMS versenden und damit eine Nachverfolgbarkeit des Transportes aus der Ferne ermöglichen.

> **HINWEIS**
> Häufiger SMS-Versand verkürzt die Batterielaufzeit!

Auch im Fall von Grenzwertüberschreitungen kann das MLog an bestimmte Empfänger eine SMS versenden. Markieren Sie dazu die entsprechenden Felder in der Software.

(16) Sie können nach Abschluss aller Einstellungen eine Konfigurationsvorlage aus diesen Daten erstellen, um diese später auf ein angeschlossenes und kompatibles MLog zu übertragen. Damit können Sie ihre persönlichen Standardeinstellungen für mehrere Geräte schnell vornehmen.

(17) Unterbrechen Sie nun die Verbindung zwischen MLog und Analyser-Software durch die Programmfunktion „Verbindung zu MLog trennen“. Entfernen Sie das USB-Kabel. Drücken Sie kurz die „ON“ Taste am MLog und achten Sie auf die „Active“ LED. Sie muss nun für 3 Sekunden aufleuchten und damit anzeigen, dass das MLog bereit zur Aufzeichnung ist. Die LED Anzeigen sind in den Kapiteln 2.3/2.4 beschrieben.

> **HINWEIS**
> Der Start der Aufzeichnung darf erst nach durchgeführter Montage erfolgen, da das MLog die Montagelage als Normallage beim Start ermittelt. Diese Lage wird benötigt, um Beschleunigungswerte korrekt ermitteln zu können.

(18) Montieren Sie das MLog am zu überwachenden Transportgut.

> **VIDEO**
> Siehe auch Videoanleitung
> „**05_MLog-Montage-Demontage**“
> in der MLog Analyser-Software unter
> Hilfe-Menü > Willkommen > Einführungsvideos.

4 Kontrolle des MLog im laufenden Betrieb

(1) Klappen Sie den MLog Schutzdeckel auf und drücken Sie kurz die „ON“ Taste am Gerät.

(2) Nun zeigen Ihnen die LEDs den aktuellen Status des Gerätes gemäß der Kapitel 2.3/2.4 an.

(3) Falls die Batterie-LED blinkt, sollten Sie die Batterien wechseln (siehe Kapitel 2.2).

(4) Blinkt die „Event/Alarm“ LED, überprüfen Sie das Logbuch des Gerätes am Display (nur IM100) oder mit Hilfe der MLog Analyser Software.

> **HINWEIS**
> Ein Blinken dieser LED zeigt an, dass mindestens eine Grenzwertüberschreitung vom Gerät ermittelt wurde.

(5) Die LEDs gehen selbstständig wieder aus, um Strom zu sparen.

> **HINWEIS**
> Sollte die Batteriespannung unter ein bestimmtes Niveau absinken, werden optional vorhandene GSM-, GPS- und Bluetooth-Module deaktiviert, um die Grundfunktionen des MLog weiterhin sicherzustellen.
>
> Damit werden Grenzwertüberschreitungen für Beschleunigung, Temperatur und Feuchte weiterhin erkannt und gespeichert, sowie zeitgesteuerte Aufzeichnungen vorgenommen.

5 Transportauswertung

Wenn ein Transport abgeschlossen wurde, können die vom MLog während des Transports ermittelten Daten ausgelesen und ausgewertet werden.

VIDEO

Siehe auch Videoanleitung

„**06_MLog-Transportauswertung**“

in der MLog Analyser-Software unter

Hilfe-Menü > Willkommen > Einführungsvideos.

(1) Prüfen Sie über die „ON“ Taste am MLog, ob die Aufzeichnung bereits durch den Timer beendet wurde. Sollte die Aufzeichnung noch aktiv sein, sollte Sie vor der Demontage über den MLog Analyser beendet werden, um Stossaufzeichnungen durch die Demontage zu vermeiden.

(2) Demontieren Sie das Gerät vom Transportgut.

VIDEO

Siehe auch Videoanleitung

„**05_MLog-Montage-Demontage**“

in der MLog Analyser-Software unter

Hilfe-Menü > Willkommen > Einführungsvideos.

(3) Verbinden Sie das MLog über das USB-Kabel mit dem PC.

(4) Starten Sie die Analyser-Software und stellen Sie die Verbindung zum MLog her.

(5) Lesen Sie das Logbuch über die Programmfunktion „Logbuch von MLog auslesen“ aus.

HINWEIS

Sie sollten das Logbuch nun über die Programmfunktion „Speichern“ auf der Festplatte Ihres PC sichern.

(6) Klappen Sie im mittleren Programmfenster im Logbuch den Eintrag „Logbucheinträge – Aufzeichnungen“ auf. Selektieren Sie diesen Eintrag mit einem Mausklick.

(7) Wählen Sie nun die Programmfunktion „Messdaten als Diagramm anzeigen“. Es öffnet sich ein Programmfenster mit einem Diagramm, in dem für jeden Sensor eine Kurve mit den Messwerten über die gesamte Dauer der Aufzeichnung dargestellt wird.

HINWEIS

Sie können das Diagrammfenster für eine bessere Ansicht vergrößern.

(8) Sie können zwischen den Daten für jeden Sensor über die Liste „Messdaten“ oberhalb des Diagramms umschalten. Diese Kurven dienen einem schnellen Überblick über den Transportverlauf. Sie können daraus entnehmen, ob während der Reise Grenzwerte überschritten wurden.

(9) Sie können bei Bedarf nun weitere Daten einsehen, indem Sie die jeweiligen Einträge im Logbuch-Baum selektieren und sich die Daten entweder als Diagramm anzeigen lassen, oder aber bei einzelnen Einträgen die Messwerte direkt unterhalb des Logbuch-Fensters im Bereich „Details zum ausgewählten Logbucheintrag“ ablesen.

(10) Selektieren sie nun den obersten Eintrag im Logbuch-Baum und klicken Sie mit der Maus oberhalb des Logbuch-Fensters auf das Symbol „Report erzeugen“. Der MLog Analyser erstellt nun eine Zusammenfassung der gesamten Aufzeichnungsdauer (den Report) im PDF-Format.

HINWEIS

Dieses PDF-Dokument sollten Sie zur Archivierung abspeichern.

(11) Abschließend können Sie das Dokument ausdrucken und als Nachweis des durchgeführten Transports zum Beispiel Ihrem Kunden oder Auftraggeber zur Verfügung stellen.

(12) Um das MLog nun noch für die nächste Aufzeichnung vorzubereiten, sollten Sie das im Speicher des MLog befindliche Logbuch über die Programmfunktion „Logbuch von MLog löschen“ löschen.

HINWEIS

Stellen Sie sicher, dass Sie das Logbuch zuvor auf der Festplatte Ihres PC gesichert haben.

(13) Wenn das Gerät für einen längeren Zeitraum nicht genutzt wird, sollten Sie die Batterien entfernen.

6 Technische Daten

Gehäuse:

Werkstoffe:	Grundgehäuse: Luran S, Protektoren: Softell TKS, beständig gegen Witterung und Alterung, gute Chemikalienresistenz
Abmessungen:	297 mm x 196 mm x 59 mm
Montage:	4x Durchgangsbohrung M8

Anzeige- und Bedienelemente:

Display (IM100):	LCD-Display, schwarz/weiß, 128 x 128 Pixel, transreflektiv
Status LED‘s:	1x grün „ACTIVE“, 1x gelb „BATTERY“, 1x rot „EVENT/ ALARM“
Taster:	IM100: 10 Taster, Kontakte Edelstahl, vergoldet IM50: 2 Taster, Kontakte Edelstahl, vergoldet
Software:	MLog® Analyser

Spannungsversorgung:

Batterietyp:	6x LR14, C-Zelle, Alkaline (Zn-MnO2)
Nennspannung:	1,5 V
Kapazität:	Min. 7800 mAh

Messwert Beschleunigung:

Sensortyp:	3-Achsen-Beschleunigungssensor
Messbereich:	± 16 g in X-, Y- und Z-Richtung
Genauigkeit:	± 0,16 g
Auflösung:	0,1 g
Min. Schockdauer:	einstellbar von 0 bis 1000 ms

Messwert Temperatur:

Messbereich:	-40° C ... +125° C
Genauigkeit:	± 1° C (Messbreich -20° C ... +80° C)
Auflösung:	± 0,1° C

Messwert Feuchte:

Messbereich:	0 ... 100%rF
Genauigkeit:	± 3%rF (Messbreich 20%rF ... 80%rF)
Auflösung:	± 1%rF

Digitaleingänge (optional) (nur IM100):

Anzahl:	Max. 2 Eingänge
Signalspannung „0“:	< 0,8 V
Signalspannung „1“:	> 2,4 V
Abtastrate:	Einstellbar ab 10 ms

Universaleingänge (optional) (nur IM100):

Anzahl:	Max. 6 Eingänge
Nennspannung:	0-5 VDC
Auflösung:	12bit A/D-Wandler
Messfehler:	0,2% vom Messbereichsendwert
Innenwiderstand:	> 10 kΩ
Abtastrate:	Einstellbar ab 10 ms

Datenspeicher:

Aktivierungszeit:	< 1 ms
Uhrzeit:	Koordinierte Weltzeit UTC (Datum/Zeit)
Speichermedium:	nichtflüchtiger EEPROM
Ereignisspeicher:	125.000 Ereignisse (64 Byte/ Ereignis
Schockspeicher:	400 Schockereignisse (1,9 s / Schock), 1,6 kHz Abtastrate

Schnittstellen:

USB:	Mini-USB, B-Typ
Bluetooth:	Version 2.1 + EDR, Reichweite Klasse 1 (100 m), optional, nur IM 100

GSM-Modul (optional) (nur IM100):

Protokolle:	GSM/GPRS/EDGE
Frequenzen:	Quad-Band, 850/900/1800/ 1900 MHz
Sendeleistung:	Class 4 (2W@850/900 MHz), Class 1 (1W@1800/1900 MHz)

GPS-Modul (optional):

Übertragungswerte:	Längen- und Breitengrad, weltweit

Betriebsbedingungen:

Schutzklasse:	IP 65
Umgebungstemperatur:	-40° C ... +80° C
Gewicht:	1,8 kg

1 General

1.1 Safety notes

All persons involved with the fitting and operation of the device must be

- adequately professionally qualified and
- strictly observe these operating instructions.

Perfect function is not guaranteed in the event of incorrect configuration or fitting.

Notes are used in these operating instructions to emphasize important information.

> **NOTE**
>
> refers to important information on a specific topic.

1.2 Intended use

The MESSKO® MLog® transport monitor IM50/IM100 is used for monitoring the transport and status of all types of goods.

The transport monitor is firmly attached to a cargo item so that during the transport it can record the acceleration values, for example, via sensors. If set limit values are exceeded, the data are permanently stored and the violation of limit may be displayed on the device. In this way, loads that are detrimental to the cargo item can be identified in good time during a transport. The course of the transport can be visualized. Monitored goods may be: Heavy loads, e.g. power transformers, generators, satellites, paper rolls, etc..

It is imperative in use to observe and comply with the limit values shown on the rating plate and specified in the operating instructions prior to commissioning the device.

1.3 Notes for operation of the device

It is imperative that the user complies with the national accident prevention regulations.

Special reference is made to the fact that working on live parts, i.e. parts that are dangerous if touched, is only permitted if these parts have been de-energized or protected against direct contact.

The national regulations must be observed during installation.

> **NOTE**
>
> Installation and commissioning should only be carried out in accordance with these operating instructions.
>
> The operator shall ensure that the device is used for its intended purpose.

1.4 Variants of the MESSKO® MLog®

The device is available in two versions IM50 and IM100 with the following extension stages:

- MLog IM50
  - Measurement of the acceleration in X, Y and Z direction
  - Measurement of the ambient air temperature
  - Measurement of the ambient humidity
  - Recording of the GPS position (optional)
- MLog IM100
  - Measurement of the acceleration in X, Y and Z direction
  - Measurement of the ambient air temperature
  - Measurement of the ambient humidity
  - Recording of the GPS position (optional)
  - Display
  - 6 universal inputs (optional)
  - 2 digital inputs (optional)
  - Bluetooth module (optional)
  - GSM module (optional)

2 Commissioning

2.1 Scope of supply

Open the packaging and check the package contents.

Number	Description	Figure
1 x	Messko MLog Transport Monitor IM100 or IM50	
		
1 x	USB stick with MLog Analyser software (the license key was sent with the order confirmation)	
6 x	batteries 1.5 V LR14 Varta 4014	
1 x	mini USB cable (B type)	

Number	Description	Figure
1 x	Assembly kit 4x hex. nut 4x washer 4x spring washer	

2.2 Batteries and SIM card (only optional for IM100)

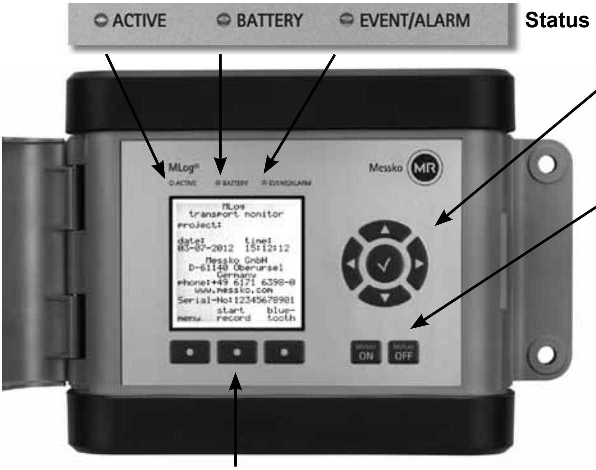
To replace the MLog batteries, unscrew the 10 Phillips-head screws on the rear of the MLog and remove the back. The unit requires 6x LR14 alkaline batteries.

If you have an MLog IM100 with optional GSM module, you can now insert a SIM card into the SIM card holder.

> **NOTE**
>
> Use only standard alkaline batteries of the LR14 type.
>
> Do not recharge alkaline batteries!

> **NOTE**
>
> Please dispose of used batteries in a proper manner!

2.3 MLog IM100 Operating elements and status LEDs



Status LEDs

D-pad

Navigation within a screen page (e.g. modify values, switch between values, confirm entries)

Display On / Off

Switch display on/off

(see table for detailed functions)
(Display will automatically turn off after 3 minutes if the MLog buttons are not used)

3 softkeys

Scroll page by page, higher level operations (e.g. cancel, back, save, ...)

> **NOTE**
>
> The start of a recording is prevented when the battery status is weak, but the timer recording is started (without GPS/GSM/Bluetooth).

<table>
<tr><th rowspan="2">Operation</th><th rowspan="2">Device status</th><th rowspan="2">Memory state</th><th rowspan="2">Function when pres-sing „ON“ button</th><th colspan="3">LED</th></tr>
<tr><th>ACTIVE (green)</th><th>BATTERY (yellow) when battery state is weak</th><th>EVENT/ ALARM (red)</th></tr>
<tr><td rowspan="3">Press ON button longer than 4 sec</td><td rowspan="2">No recording</td><td>Memory empty</td><td rowspan="3">Display switched on</td><td rowspan="3">off</td><td rowspan="3">flashes 5 sec</td><td rowspan="3">off</td></tr>
<tr><td>Log book in memory</td></tr>
<tr><td>Recording in progress</td><td>Log book in memory</td></tr>
<tr><td rowspan="3">Press ON button 1-2 sec</td><td rowspan="2">No recording</td><td>Memory empty</td><td rowspan="3">LED see right</td><td rowspan="2">3 sec flashing</td><td rowspan="3">flashes 5 sec</td><td>off</td></tr>
<tr><td rowspan="2">Log book in memory</td><td>3 sec lit</td></tr>
<tr><td>Recording in progress</td><td>3 sec flashing</td><td>5 sec flashing if alarm(s) recorded</td></tr>
<tr><td>Automatic function</td><td>Device is recording an event or an alarm</td><td>Logbuch im Speicher</td><td>-</td><td>off</td><td>off</td><td>1x flashing</td></tr>
</table>

2.4 MLog IM50 Operating elements and status LEDs

Status LEDs

> **NOTE**
> The start of a recording is prevented when the battery status is weak, but the timer recording is started (without GPS).

<table>
<tr><th rowspan="2">Operation</th><th rowspan="2">Device status</th><th rowspan="2">Memory status</th><th rowspan="2">Function when pres-sing „ON“ button</th><th colspan="3">LED</th></tr>
<tr><th>ACTIVE (green)</th><th>BATTERY (yellow) when battery is weak</th><th>EVENT/ ALARM (red)</th></tr>
<tr><td rowspan="3">Press ON button longer than 4 sec</td><td rowspan="2">No recording</td><td>Memory empty</td><td>Recording start</td><td rowspan="3">off</td><td rowspan="3">flashes 5 sec</td><td>off</td></tr>
<tr><td>Log book in memory</td><td rowspan="2">No function</td><td>5 sec flashing</td></tr>
<tr><td>Recording in progress</td><td>Log book in memory</td><td>off</td></tr>
<tr><td rowspan="3">Press ON button 1-2 sec</td><td rowspan="2">No recording</td><td>Memory empty</td><td rowspan="3">LED see right</td><td rowspan="2">3 sec lit</td><td rowspan="3">flashes 5 sec</td><td>off</td></tr>
<tr><td rowspan="2">Log book in memory</td><td>3 sec lit</td></tr>
<tr><td>Recording in progress</td><td>3 sec flashing</td><td>5 sec flashing if alarm(s) recorded</td></tr>
<tr><td>Automatic function</td><td>Device is recording an event or an alarm</td><td>Log book in memory</td><td>-</td><td>off</td><td>off</td><td>1x flashing</td></tr>
</table>

The „OFF“ button is reserved for future functions.

2.5 Installation of MLog Analyser software

NOTE

The requirement for installing the MLog Analyser software is the Microsoft Windows XP operating system (Service Pack 3) or a higher version of Microsoft Windows.

Proceed as follows when installing the Analyser software:

(1) Launch the setup file from the \setup subdirectory of the USB stick supplied.

(2) Select the language to be used to guide you through the installation process.

(3) Follow the instructions of the setup wizard.

(4) If the installation has been successful, it is then possible to establish the connection between the MLog and the Analyser software.

(5) To do this, launch the Analyser software via the MLog program icon created.

VIDEO

See also video instruction

„**01_MLog-Analyser-installation**“

in the MLog Analyser software under

Help menu > Welcome > Introduction Videos.

3 Prepare MLog for a transport

It is imperative to configure the MLog before every transport that is to be monitored. The following list describes the steps necessary.

(1) Check the condition of the batteries and replace them if necessary (see Section 2.2).

> **NOTE**
> Messko recommends using new batteries for each transport.

> **VIDEO**
> See also video instruction
> „**02_Batteries-and-SIM-card-insert**“ and
> „**03_SIM-card-activation**“
> in the MLog Analyser software under
> Help menu > Welcome > Introduction Videos.

(2) Optional:
If your MLog IM100 has an optional GSM module, insert a SIM card so that you can send MLog messages by SMS text message (see Section 2.2).

Enter the SIM card PIN in the MLog to activate the SIM card and consequently the SMS messaging function. The PIN must have a length of 4 characters

(3) Then connect the MLog to the PC via the USB cable and launch the MLog Analyser software on the PC.

Alternatively, you can also establish the connection to an MLog IM100 via the optional Bluetooth module. To do this, first establish a connection between the PC and the MLog via the Bluetooth function of the PC's operating system (code “1234”). The connection is then established as described below.

(4) Establish a connection to the MLog via the program function “Establish Connection to MLog”. The serial number of the device to which you can connect will be displayed. Select the COM port with the connected MLog.
Establishment of the connection is now displayed in a window.

> **VIDEO**
> See also video instruction
> „**04_Prepare-MLog-for-transport**“
> in the MLog Analyser software under
> Help menu > Welcome > Introduction Videos.

(5) Check the connection state via the Analyser software. You will find this on the bottom left in the program window.

(6) In the left-hand menu tree “Connected MLog”, select the item “Device Information” and check the device data displayed on the right-hand side of the program window. They show the components of the MLog corresponding to its ordered hardware configuration and the serial number for unambiguous identification of your device.

(7) Now start configuring the MLog for a transport. First select the item “Configuration - Base settings” in the menu tree. In Base settings, enter a name for the transport project and select the MLog language.

(8) Select the entry “Recording Settings” in the menu tree. In the right-hand window you can now set whether the MLog should record data in a specified time interval and/or when limit values are exceeded.

(9) Optional:
Configure the recording of GPS data (only if your MLog is equipped with an optional GPS module).

> **NOTE**
> Please note that frequent GPS location queries shorten the battery life!

(10) Set the start and end time for the recording of measured data and optionally of GPS data.

(11) Now select the item “Internal Sensors - Acceleration” and configure the settings for acceleration. The limit values you should set for the acceleration (identification of impacts) will depend on the transport goods to be monitored and its load limits.

(12) Configure the settings for air humidity if it is important to monitor the humidity for your transport goods.

(13) Configure the settings for the ambient temperature if it is important to monitor the temperature for

your transport goods.

(14) Optional:
If your MLog IM100 is equipped with an optional GSM module, enter the recipient telephone numbers for sending SMS messages if you would like to be notified immediately by text about specific events.

> **NOTE**
>
> Please note that SMS messages can only be sent with an activated SIM card and this is only possible from areas with GSM provision. Also take into account your SIM card's ability to send international SMS messages.

(15) Optional:
You can now determine how frequently and/or for what events the MLog should send SMS messages to the relevant recipient.

Activate SMS messaging per time interval and configure the time interval and the associated recipient numbers. The MLog will send an SMS message during this time period and therefore enable remote traceability of the transport.

> **NOTE**
>
> Frequent SMS shortens the battery life!

The MLog can also send an SMS message to specific recipients in the event that limit values are exceeded. Highlight the appropriate fields in the software to do this.

(16) After completing all the settings, create a configuration template from these data in order to transfer it later to a connected and compatible MLog.
This will enable you to use your personal default settings quickly for several devices.

(17) Now disconnect the link between MLog and Analyser software using the program function "Cut Connection to MLog". Remove the USB cable. Briefly press the "ON" button on the MLog and pay attention to the "ACTIVE" LED. It must now light up for 3 seconds thus showing that the MLog is

> **NOTE**
>
> The recording must not start until after the device has been fitted because the MLog determines the fitting position as the normal position on starting. This position is required so that acceleration values can be determined correctly.

ready to record. The LED displays are described in Sections 2.3/2.4.

(18) Mounting the MLog on the transport good to be monitored.

> **VIDEO**
>
> See also video instruction
>
> „**05_MLog-Assembly-Disassembly**"
>
> in the MLog Analyser software under
>
> Help menu > Welcome > Introduction Videos.

4 Checking of MLog during ongoing operation

(1) Open the MLog's protective cover and briefly press the "ON" key on the device.

(2) The LEDs will now indicate the current status of the device in in accordance with Sections 2.3/2.4.

(3) Replace the batteries if the battery LED flashes (see Section 2.2.).

(4) Check the device's logbook on the display (only IM100) or by using the MLog Analyser software if the "Event/Alarm" LED flashes.

> **NOTE**
>
> Flashing of this LED indicates that the device has determined at least one instance where the limit value has been exceeded.

(5) The LEDs go off again automatically to save power.

> **NOTE**
>
> If the battery voltage drops below a certain level, any GSM, GPS and Bluetooth modules optionally available are deactivated to ensure the MLog's basic functions continue to work.
>
> This means that any limit values for acceleration, temperature and relative humidity which are exceeded continue to be identified and saved, and any time-controlled recordings are made.

5 Transport evaluation

When a transport has been completed, the data determined by the MLog during the transport can be read and evaluated.

> **VIDEO**
>
> See also video instruction
>
> „**06_MLog-transport-evaluation**“
>
> in the MLog Analyser software under
>
> Help menu > Welcome > Introduction Videos.

(1) Use the “ON” key on the MLog to check whether the timer has already ended the recording. If the recording is still active, it should be ended via the MLog Analyser before removal to prevent any shocks due to the removal process from being recorded.

(2) Remove the device from the transport good.

> **VIDEO**
>
> See also video instruction
>
> „**05_MLog-Assembly-Disassembly**“
>
> in the MLog Analyser software under
>
> Help menu > Welcome > Introduction Videos.

(3) Then connect the MLog to the PC via the USB cable.

(4) Launch the Analyser software and establish the connection to the MLog.

(5) Read the logbook using the program function “Read out Log Book from MLog”.

> **NOTE**
>
> You should now backup the logbook to the hard drive of your PC using the program’s “Save” function.

(6) In the middle program window in the logbook, expand the entry “Log Book Entries – Records”. Click on this entry to select it.

(7) Then select the program function “Show Measuring Data as Diagram.” A program window opens with a diagram showing a curve for each sensor with the measured values as a function of the recording’s entire duration.

> **NOTE**
>
> You can enlarge the diagram window for a better view.

(8) Toggle between the data for each sensor via the list “Measuring Data” above the diagram. These curves provide a quick overview of the transport’s progress. You can see from them whether limit values were exceeded during the journey.

(9) Inspect other data as required by selecting the relevant entries in the logbook tree and either displaying the data as a diagram or, in the case of individual entries, by reading the measured values directly below the logbook window in the area marked “Details of selected Log Book Entry”.

(10) Then select the topmost entry in the logbook tree and click above the logbook window on the “Generate Report” icon. The MLog Analyser will then create a summary of the entire recording period (the report) in PDF format.

> **NOTE**
>
> You should save this PDF document for archiving.

(11) Finally, print out the document and make it available to your customer or ordering party, for example, as proof of the transport carried out.

(12) To prepare the MLog for the next recording, delete the logbook located in the MLog’s memory via the program function “Delete Log Book on MLog”.

> **NOTE**
>
> Make shure that the log book is stored on the harddrive beforehand.

(13) Remove the batteries if the device will not be used for a longish period.

6 Technical data

Housing:

Materials:	Basic housing: Luran S, Protectors: Softell TKS, resistant to weathering and aging, good resistance to chemicals
Dimensions:	297 mm x 196 mm x 59 mm
Mounting:	4x through-hole M8

Display and operating elements:

Display (IM100):	LCD display, black/white, 128 x 128 pixel, transreflective
Status LEDs:	1x green “ACTIVE”, 1x yellow “BATTERY”, 1x red “EVENT/ ALARM”
Push-button:	IM100: 10 push-buttons, contacts stainless steel, gold-plated IM50: 2 push-buttons, contacts stainless steel, gold-plated
Software:	MLog® Analyser

Power supply:

Battery type:	6x LR14, C cell, alkaline (Zn-MnO2)
Nominal voltage:	1.5 V
Capacity:	Min. 7800 mAh

Measured value for acceleration:

Sensor type:	3-axis acceleration sensor
Measuring range:	± 16 g in X, Y and Z direction
Accuracy:	± 0.16 g
Resolution:	0.1 g
Min. shock duration:	adjustable from 0 to 1000 ms

Measured value for temperature:

Measuring range:	-40° C ... +125° C
Accuracy:	± 1° C (measuring range -20° C ... +80° C)
Resolution:	± 0.1° C

Measured value for relative humidity:

Measuring range:	0 ... 100%rH
Accuracy:	± 3%rH (measuring range 20%rH ... 80%rH)
Resolution:	± 1%rH

Digital inputs (optional) (only IM100):

Number:	max. 2 inputs
Signal voltage “0”:	< 0.8 V
Signal voltage “1”:	> 2.4 V
Scanning frequency:	adjustable from 10 ms

Universal inputs (optional) (only IM100):

Number:	max. 6 inputs
Nominal voltage:	0-5 VDC
Resolution:	12bit A/D converter
Measuring error:	0.2% of the measuring range end value
Internal resistance:	> 10 kΩ
Scanning frequency:	Adjustable from 10 ms

Data memory:

Activation time:	< 1 ms
Time:	Coordinated Universal Time (UTC), date/time
Storage medium:	non-volatile EEPROM
Event memory:	125,000 events (64 byte/ event)
Shock memory:	400 shock events (1.9 s/ shock), 1.6 kHz scanning frequency

Ports:

USB:	mini USB, B type
Bluetooth:	version 2.1 + EDR, range class 1 (100 m), optional, only IM100

GSM module (optional) (only IM100):

Protocols:	GSM/GPRS/EDGE
Frequencies:	quad-band, 850/900/1800/ 1900 MHz
Transmitting power:	class 4 (2W@850/900 MHz), class 1 (1W@1800/1900 MHz)

GPS module (optional):

Transmission values:	Longitude & Latitude, globally

Operating conditions:

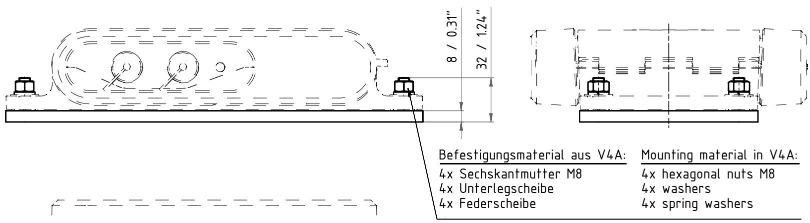
Class of protection:	IP 65
Ambient temperature:	-40° C ... +80° C
Weight:	1.8 kg

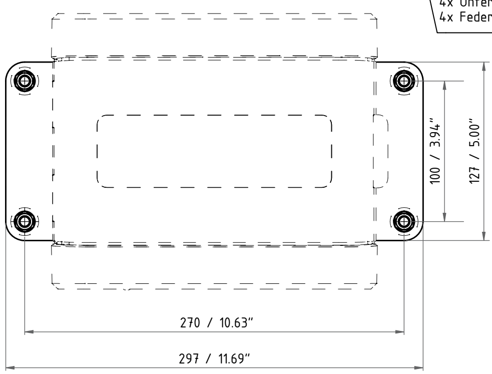
7 Anhang / Appendix

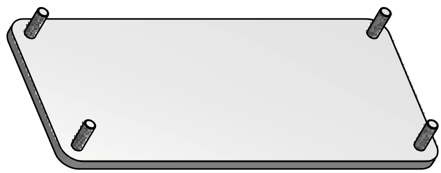
7.1 Zubehör / Accessories

Optional bestellbares Zubehör / Optional Accessories	
Bezeichnung / Description	**Art.-Nr. / Art. no.**
Befestigungsplatte zum Anschweißen / Fixation plate for welding	78076700
Montage-Kit (4x Mutter, 4x Unterlegscheibe, 4x Federscheibe) / Assembly kit (4x nut, 4x washer, 4x spring washer)	78609400
Batterie LR14 Varta 4014 (20 Stück) / Battery LR14 Varta 4014 (20 pieces)	78000200
Mini USB-Kabel (1 Stück) / Mini USB cable (1 piece)	78161200
MLog Sensorkabel (ca. 3 Meter) / MLog sensor cable (approx. 3 meter)	78909300

Befestigungsplatte/Fixation plate



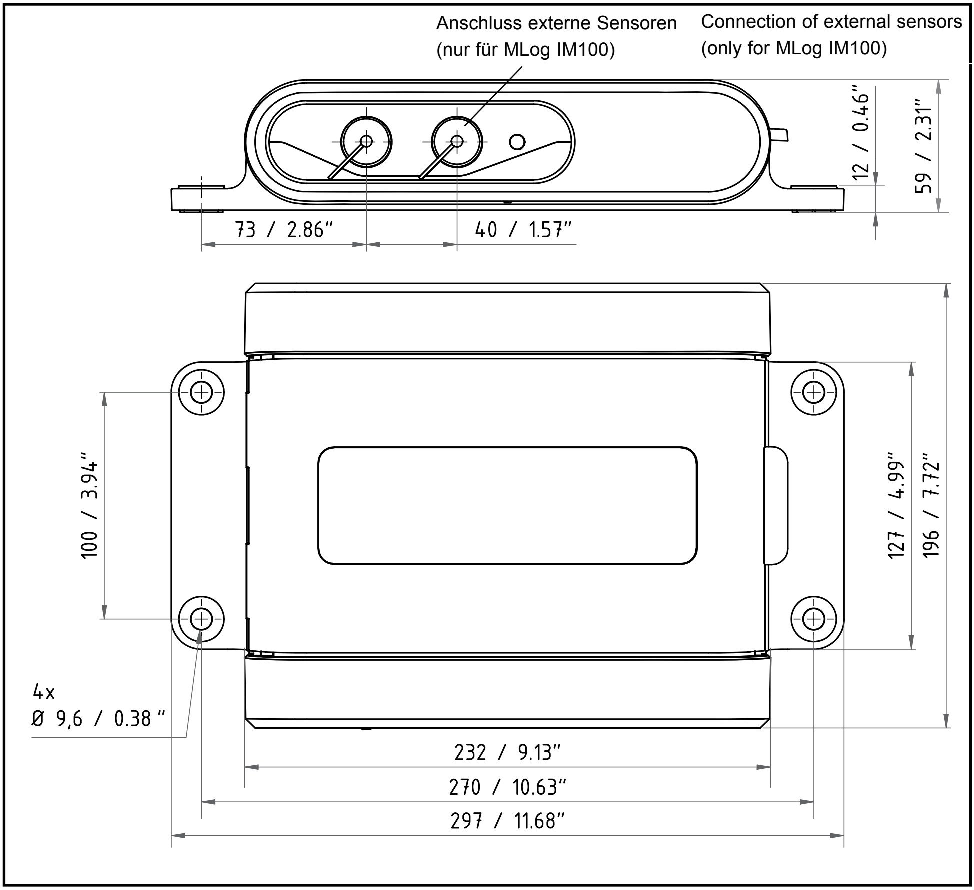




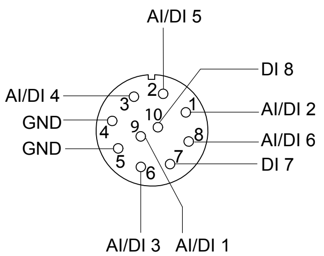
Das MLog kann über die optionale Befestigungsplatte problemlos an dem Transportgut befestigt werden.
Die Befestigungsplatte ist dazu auf ebener Fläche mit dem Transportgut zu verschweißen.

The MLog can easily be attached to the transport goods via the optional fixation plate.
The fixation plate must be welded to the transport goods on a flat surface.

7.2 Abmessungen / Dimensions



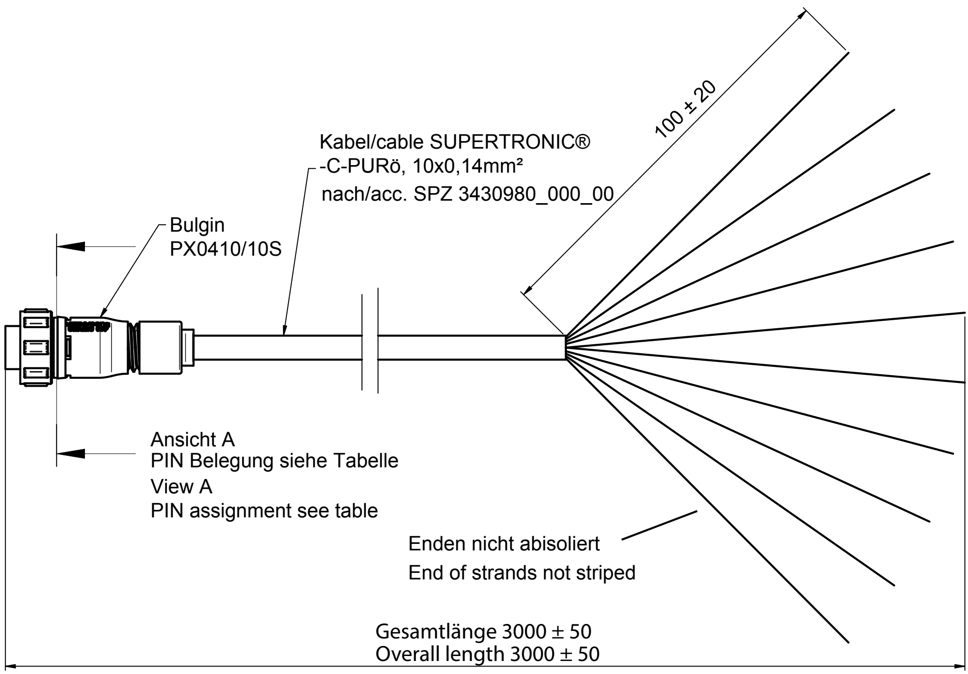
7.3 Anschlusssteckerbelegung Sensoren (optional nur IM 100) / Sensor connector assignment (optional IM100 only)



Ansicht A (kabelseitig)

View A (cable side)

Bezeichnung / Description	Erläuterung / Explanation	PIN	Farbe / Colour
AI/DI 1	Universal Input 1	9	schwarz / black
AI/DI 2	Universal Input 2	1	weiß / white
AI/DI 3	Universal Input 3	6	rosa / pink
AI/DI 4	Universal Input 4	3	grün / green
AI/DI 5	Universal Input 5	2	braun / brown
AI/DI 6	Universal Input 6	8	rot / red
DI 7	Digital Input 7	7	blau / blue
DI 8	Digital Input 8	10	violett / violet
GND	Masse / Ground	4	gelb / yellow
GND	Masse / Ground	5	grau / grey



Messko GmbH
Gewerbegebiet An den Drei Hasen
Messko-Platz 1, 61440 Oberursel, Germany

Phone: +49 6171 6398-0
Fax: +49 6171 6398-98
E-Mail: info@messko.com

www.messko.com

Please note:
The data in our publications may differ from the data of the devices delivered. We reserve the right to make changes without notice.

BA 3431002/00 DE-EN – MLog® Transport Monitor –
78925000 – 05/13

THE POWER BEHIND POWER.

Section 8
Component Instruction Leaflets and Manuals

8.13 Drycol Breather

Installation and Operating Manual For Drycol Breather – Insulation Drier And Mark 8.1 Control Cubicle.

Revision D 06/04/2011

GRID

Contents

SAFETY FIRST!

Do not operate this equipment without an earth connected to the earthing point on the control cabinet.

The equipment contains no user serviceable components. Therefore, no attempt should be made to dismantle.

Isolate all incoming supplies before removing the terminal cover.

GRID | ALSTOM

DECLARATION OF CONFORMITY

Manufacturers Name: ALSTOM Grid UK Ltd – Services

Manufacturer's Address: ALSTOM Grid UK Ltd – Services
Lichfield Road
Stafford
ST17 4UQ
England

Declares that product: Drycol Mk8.1

Conforms to the following specifications:

BS EN61000-4-2:	1995	8kV Air & Contact Discharge
BS EN61000-4-3:	1997	10V/m
BS EN61000-4-4:	1995	AC Supply & Alarm: ±4kV; Breather: ±2kV
BS EN61000-4-5:	1995	AC Supply: ±6kV comm. ±4kV diff. Alarm: ±6kV comm. ±2kV diff. Breather: ±1kV comm.
BS EN61000-4-6:	1996	AC Supply & Breather: 150kHz - 80MHz, 10v rms Alarm: 50kHz – 100MHz, 10V rms
BS EN61000-4-10:	1993	100A/m @ 100kHz & 1MHz
BS EN61000-4-11:	1994	100% for 50ms – 5000ms (with finer steps)
BS EN61000-4-12:	1995	Damped Oscillatory Wave - Alarm: 1MHz & 100kHz, 1kV comm. 0.5kV diff. AC Supply 1MHz & 100kHz, 2.5kV comm. 1kV diff. Ring Wave – 6kV comm. 3kV diff.
BS EN55022:	1998	Class A

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carries the CE mark accordingly.

Additional Specifications

This equipment has been designed for use within National Grid Transco owned electricity substations and therefore complies with their specifications:

NGTS 1, NGTS 2.3, NGTS 2.19, NGTS 3.12.3, NGTS 3.24.4 & NGTS 3.24.15

1 Summary of Drycol Breather Functions

Air in the Drycol Breather is refrigerated by use of thermoelectric modules which create a thermosyphon action, enabling the air above the oil in the conservator to continuously circulate through the Drycol breather.

The Drycol control cabinet places the breather into a freeze mode for 5¾ hours, during which time condensed moisture is retained in the breather, generally in a frozen state and dry air is returned to the conservator.

Following the freeze mode, the control cabinet places the breather into a defrost mode. The defrost period is set to 15 minutes. During this time the breather is supplied with a defrost current for a maximum of 15 minutes or, if fitted with a thermal switch, until the temperature of the breather is sufficient to have melted the frozen condensate. If this temperature is reached before the end of the 15-minute defrost cycle, the control cabinet will supply zero current for the remainder of the cycle.

The cycle is then automatically and continuously repeated.

External air drawn in when the oil level in the conservator falls, passes through the Drycol breather and is dried before entering the conservator. When the conservator oil level rises, air is expelled through the breather air vent. The general arrangement of both the A and B Type breathers are shown in Fig 1 and 2.

2 Modification of the Conservator

The Type A Drycol breather as assembled to a conservator as shown in Fig 3. An alternative arrangement for smaller conservators is shown in Fig 4. These figures are typical only.

The Type B Drycol breather as assembled to a conservator as shown in Fig 5. An alternative arrangement for smaller conservators is shown in Fig 6. These figures are typical only.

The position of the breather relative to the centre line of the conservator end plate is dictated by the fittings on the end plate.

3 Pipes for Drycol Breather (Fig 3, 4, 5 and 6)

Two pipes are fixed to and taken through the conservator in the manner shown in these figures. The breather inlet and outlet are fitted to outer flanges on these pipes that connect to the airspace above the oil in the conservator. The minimum horizontal run of the lower (outlet) pipe is 500mm, a length of 1500mm is preferred. The pipes within the conservator must be clear of obstructions.

4 Temperature Range

The Drycol system will operate satisfactorily in ambient temperatures of -50°C to +50°C. To minimise the effect of solar radiation the Drycol breather is painted white. Painting the conservator white will assist in locations with strong sunlight. It is imperative that the Drycol breather remains white and is not painted any other colour. In regions with a high solar gain it may be advisable to fit a solar radiation shield to further minimise the effects of solar radiation.

The Mark 8 Control Cabinet can operate satisfactorily at a minimum ambient temperature of -40°C. For ambient temperatures below -40°C the cabinet must be fitted with the optional integral heater. With the heater energised the cabinet will operate satisfactorily at a temperature of -50°C. It is important to note that the system must not be energised from cold at temperatures below -40°C, or with the cabinet door opened at very low temperatures, otherwise spurious operation may result.

5 Interconnecting Cable

The interconnecting cable supplied with the Drycol connects the breather to the control cabinet. The cable is fitted with male and female sockets, which connect directly to both the control cabinet and breather.

Caution: The Drycol must only be used with the cable supplied.

The standard length of cable is 9m, however any permutation of length is available up to a maximum of 18m. Cable lengths other than these must not be used. Surplus cable should be coiled and secured.

6 Compatibility

When fitting a Mk8 control cabinet to an existing Drycol breather an insulation resistance test should be performed across the interconnecting cable pins A, B, C and D to earth. If any of the pins indicate a low reading or are down to earth the breather module and cable should be replaced.

7 Supply Voltage

Supply to the control cabinet should preferably be independent of the transformer supply to maintain Drycol function during a transformer shutdown.

The control cabinet can accept 110/120 volts AC or 220/240 volts AC at either 50 or 60Hz. The unit draws approximately 2A. The label on the front fascia of the control cabinet indicates which setting has been made at the factory.

Warning: Protection components are fitted between the mains supply Input and earth. Do not operate this equipment without an earth connected.

8 Alarm Contacts

The control cabinet is fitted with an alarm circuit, which utilises a volt free single pole changeover contact that gives either normally closed or normally open contact positions. The technical specification for this contact is as follows:

- Isolation from earth and all other ports: 2kV rms
- Maximum contact load: 8A at 250V rms
- Minimum contact load: 1mA at 5V rms
- Maximum contact load: 5A at 30V DC

The alarms will operate for the following reasons

- Loss of Incoming Supply
- Mal-function of Control Cabinet
- Mal-function of Drycol Breather Module

9 Cable Glanding

The mains supply and alarm output should be cabled using armoured cable to BS 5467 or equivalent. The cables should be made off to the supplied IP 66 glands, with the armour securely bonded to the equipment enclosure through the gland, and the supplied boot fitted in place to shroud the assembly. The two supplied ferrite sheaths must be fitted over the incoming mains and alarm cables and tie-wrapped in position inside the enclosure as shown in Fig 7.

A dedicated earth strap should be taken from the cabinet earth stud to the substation earth mat.

An earthing strap of at least 75mm^2 and 3mm thick is recommended.

10 Time Cycle

The control cabinet uses quartz crystal timing. This gives a total cycle time of 6 hours, inclusive of a 15-minute defrost/dwell period.

11 Cabinet Mounting

The control cabinet may be mounted on the transformer cooler frame or other non-vibratory location, 1 to 1.5m above ground level, within the interconnecting cable range of the Drycol breather.

If the cabinet is to be mounted on a transformer tank or a vibrating surface, it should be isolated from the tank with bobbin type anti-vibration mountings fitted in a shear/compression disposition. The rubber portion of the mounting must be protected from sunlight using the recommended cover.

The heat sink at the rear of the control cabinet should have free ventilation above and below for thermal convection currents to flow.

The heat sink has a high emissivity and should be shaded from direct sunlight.

The enclosure and mounting brackets are 316-grade stainless steel so mounting hardware should also be stainless steel in order to avoid dissimilar metal corrosion.

A general arrangement of the control cabinet is given in Fig 14.

12 Air Vent and Water Outlet Hoses

The external air vents supplied with the breather must be fitted to a ¼ inch BSP tapped hole in the underside of the top (inlet) pipe as shown in Fig 8 of this manual.

Where blockage by insects is liable to occur, air vent and water outlet hoses terminating in gauze canisters are supplied with the Drycol. These fittings are not required in temperate climates, as detailed in Fig 9, 10 and 11.

13 Vibration - Tank Mounted Conservators

The bottom (outlet) pipe inside the conservator should be supported to prevent whip. Severe vibration merits special consideration.

14 Commissioning Tests

- Before switching on the incoming supply, connect the control cabinet to the breather, using the supplied interconnecting cable.

- The selector switch in the control cabinet should be in the 'B' type breather setting for both types of Drycol Breather. This setting should be maintained for the operation of the breather.

- Set the incoming voltage selector switch in the control cabinet to the correct operating voltage 110/120 volts AC or 220/240 volts AC.

- Switch on the incoming supply. Check that the incoming supply LED is illuminated and that a freeze current of 6A ±0.5A when supplying both 'A' and 'B' Type breathers. Typically, 1A = 1 LED. As Fig 12.

- Press and hold the cycle advance button. The cycle position LED's will start to increment clockwise.

- Release the cycle advance button once the control cabinet switches from a freeze to a defrost current, as Fig 13.

- Check that a defrost current in the region of 4A ±0.5A when supplying both 'A' and 'B' Type breathers.

- Press and hold the cycle advance button until a freeze current is indicated.

- The D4, D5 or D6 light may illuminate upon cycling, this is not an alarm. These LED's simply show the status of the thermal switch located in the breather unit.

- In order to verify the operation of the alarm contacts, note the contact position of the unit whilst energised and supplying a freeze current.

- Remove Interconnecting cable from control cabinet. The alarm contacts will change state after one minute. Alternatively remove the incoming supply to the control cabinet and the alarm contacts will change state immediately.

15 Storage

The control cabinet contains wet aluminium electrolytic capacitors that require special precautions during prolonged periods of storage. Do not store the unit at temperatures above 40°C. The control cabinet must be energised at least once every 4 years, as described below.

- Set the voltage selector for the appropriate supply and connect the mains input terminals to a suitable mains supply.

- Using a suitable cable, connect a breather to the cabinet and set the breather type switch to the B position.

- Energise the unit for a minimum of 1 hour and check that normal operation is established.

- Switch off and remove all connections.

16 Services

The breather is filled with a closed cell rigid polyurethane foam. Due to the nature of its thermal insulation, it is not economically repairable and in the rare event of a failure, a replacement unit should be installed.

NO ATTEMPT MUST BE MADE TO DISMANTLE THE BREATHER

For safe disposal, please return faulty equipment to the address given below.

A comprehensive range of spares are readily available, and technical assistance can be sought by contacting the Drycol Department quoting the serial number of the equipment and a description of the fault symptoms:

Drycol Department
ALSTOM Grid UK Ltd - Services
Lichfield Road
Stafford
ST17 4UQ
England

Telephone: National 01785 718444
International +44 1785 718444

Facsimile: National 01785 718456
International +44 1785 718456

Email: martin.alcock@alstom.com

17 Company Policy

The Company's policy is one of continuous development and improvement. The right is therefore reserved to supply products that may differ slightly from those illustrated and or described in this publication.

18 Cautionary Notice

This equipment is supplied at mains voltage and before any internal work is undertaken the incoming supply should be disconnected.

The product complies with the radio emission disturbance characteristics of BS EN55022: 1998 Class A. In a domestic environment this product may cause radio interference, in which case the user may be required to make adequate measures.

This product complies with the relevant clauses of National Grid Company (NGC) technical specification NGTS 2.13 Issue 3: April 1998, with agreed amendments.

19 Description of MK8 Control Cabinet LED's

D1 - D8 LED's represent -

D1. (5V Supply On)	This LED shows the internal power supply to the control chip.
D2. (+12V Supply On)	The internal power supply to the freeze cycle of the power circuit.
D3. (-12V Supply On)	The internal power supply to the defrost cycle of the power circuit.
D4. (Ignore Thermal Switch)	These LED's confirm the operation of the internal breather thermostat.
D5. (Switch Never Hot)	These LED's are for <u>information only</u> and serve no purpose to the user.
D6. (Switch Absent Cold)	These LED's <u>do not</u> represent a fault.
D7. (Under Voltage Fault)	This LED confirms a low resistance fault on the breather.
D8. (Over Voltage Fault)	This LED confirms a high resistance fault on the breather.

NOTE:

If D7 and D8 are illuminated at the same time, this indicates that there has been a fault present for over 6 hours.

The other LED's represent -

Alarm Tripped	This illuminates when there is a fault on the Drycol System. If the alarm tripped LED is illuminated please contact the Drycol Department using the contact details below
Incoming Supply On	This LED indicates a healthy incoming supply voltage. If this LED is not illuminated, there is a problem with the control cabinet.
Freeze current LED	Each LED represents 1 Amp. For both A and B Type Drycol Breathers you should have 6A ± 1A in Freeze.
Defrost current LED	Each LED represents 1 Amp. For both A and B Type Drycol Breathers you should have 4A ± 1A in Defrost.
Cycle position LED's	(24 LED's in a Circle), each LED represents 15 minutes. The Drycol works on a 6 Hour cycle, These LED's let you know how advanced the cycle is.

If the alarm tripped LED is illuminated please contact the Drycol Department using the contact details below –

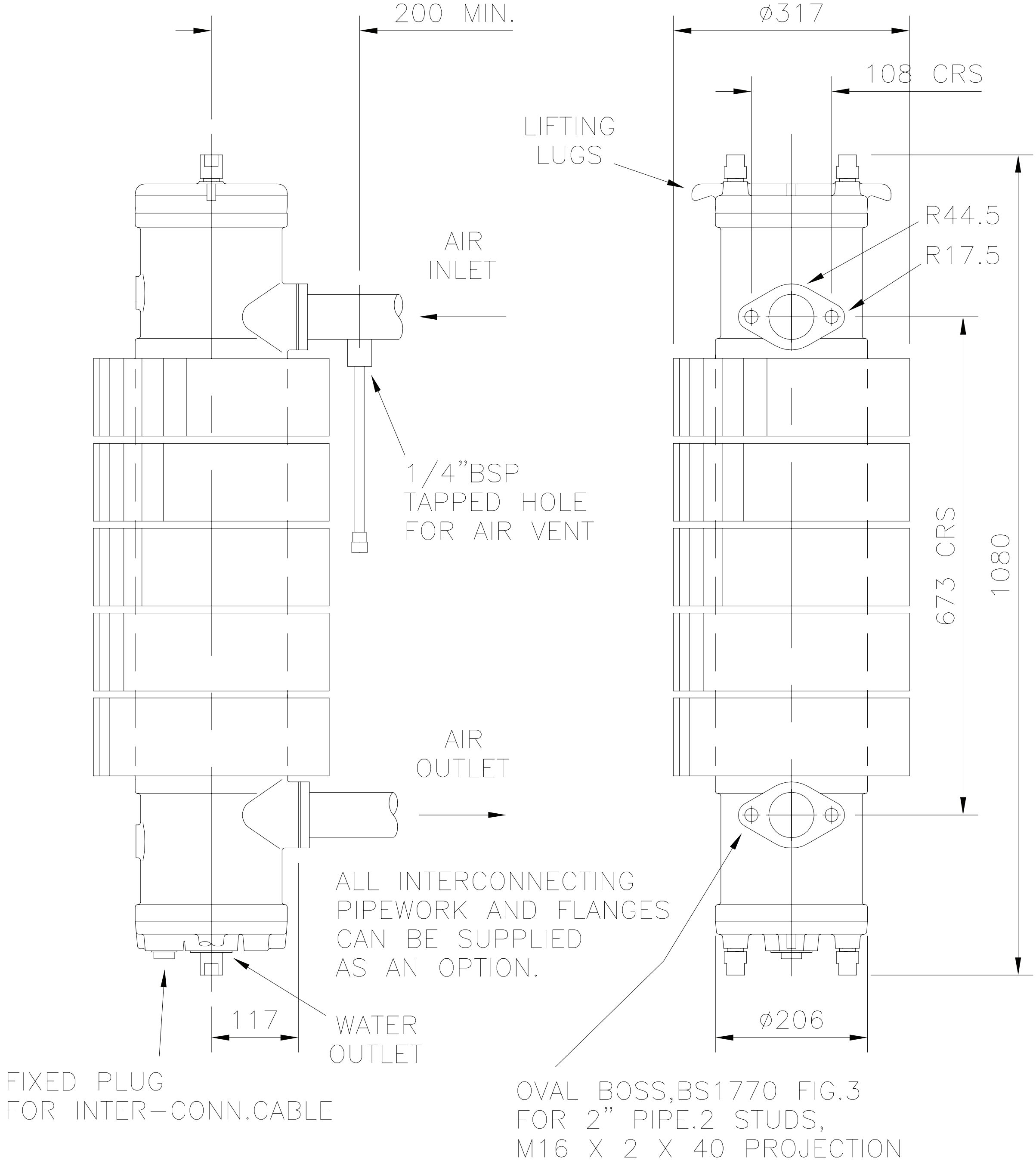
20 Contact Details

Drycol Department
ALSTOM Grid UK Ltd - Services
Lichfield Road
Stafford
ST17 4UQ
England

Telephone:	National	01785 718444
	International	+44 1785 718444
Facsimile:	National	01785 718456
	International	+44 1785 718456
Email:	martin.alcock@alstom.com	

FIG.1

GENERAL ARRANGEMENT OF DRYCOL 'A' BREATHER



WHERE BLOCKAGE BY INSECTS MAY OCCUR, AIR VENT AND WATER OUTLET HOSES TERMINATING IN GAUZE CANISTERS CAN BE SUPPLIED. WHERE AMBIENT TEMPERATURES BELOW 0°C ARE EXPERIENCED, THESE MUST NOT BE USED.

STANDARD LENGTH OF INTER-CONNECTING CABLE IS 9 METRES. NON STANDARD LENGTHS, INCREASING IN INCREMENTS OF 1M, BETWEEN 9M AND 18M, ARE AVAILABLE.

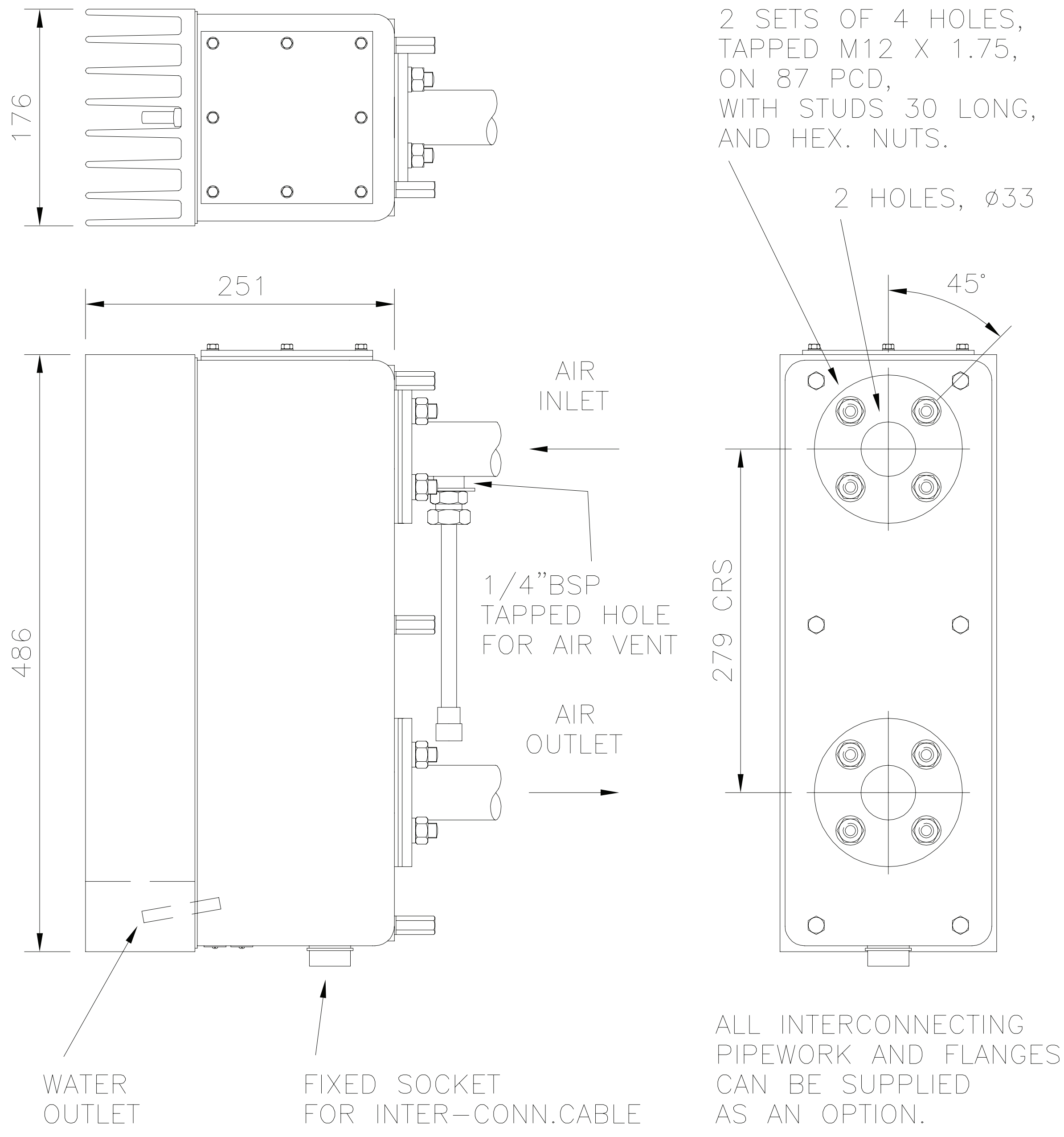
BREATHER WEIGHT:52Kg

INFORMATION FROM DRAWING NUMBER 42SM01508 REV. C.

ALSTOM | GRID

FIG.2

GENERAL ARRANGEMENT OF DRYCOL 'B' BREATHER



WHERE BLOCKAGE BY INSECTS MAY OCCUR, AIR VENT AND WATER OUTLET HOSES TERMINATING IN GAUZE CANISTERS CAN BE SUPPLIED. WHERE AMBIENT TEMPERATURES BELOW 0°C ARE EXPERIENCED, THESE MUST NOT BE USED.

STANDARD LENGTH OF INTER-CONNECTING CABLE IS 9 METRES. NON STANDARD LENGTHS, INCREASING IN INCREMENTS OF 1M, BETWEEN 9M AND 18M, ARE AVAILABLE.

BREATHER WEIGHT:16Kg

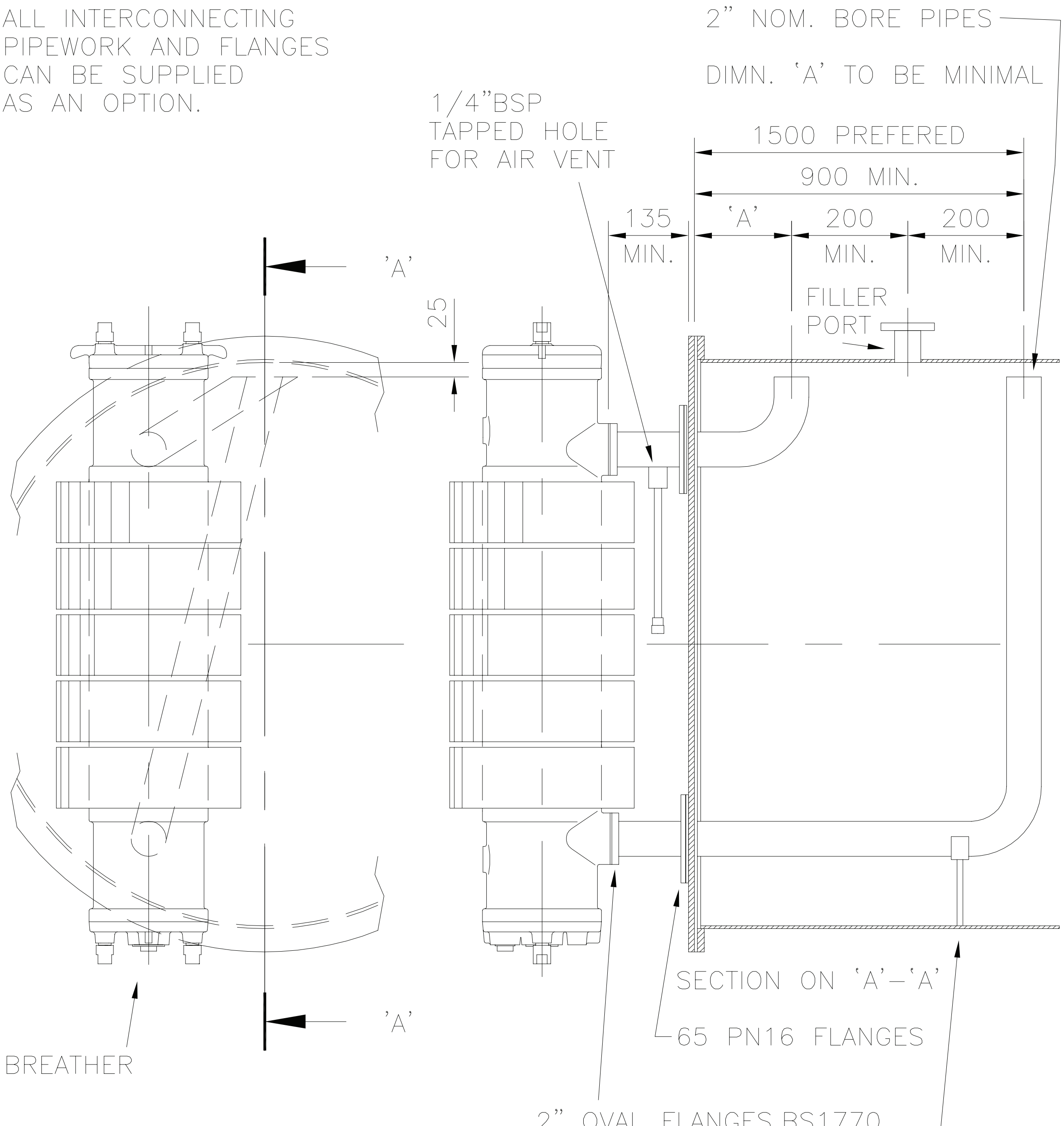
INFORMATION FROM DRAWING NUMBER 42SM01509 REV. C.

GRID

FIG.3

TYPE 'A' BREATHER FITTED TO CONSERVATOR ø925 & OVER

ALL INTERCONNECTING PIPEWORK AND FLANGES CAN BE SUPPLIED AS AN OPTION.



THE POSITION OF THE BREATHER WILL BE DICTATED BY FITTINGS ATTACHED TO THE CONSERVATOR END PLATE.

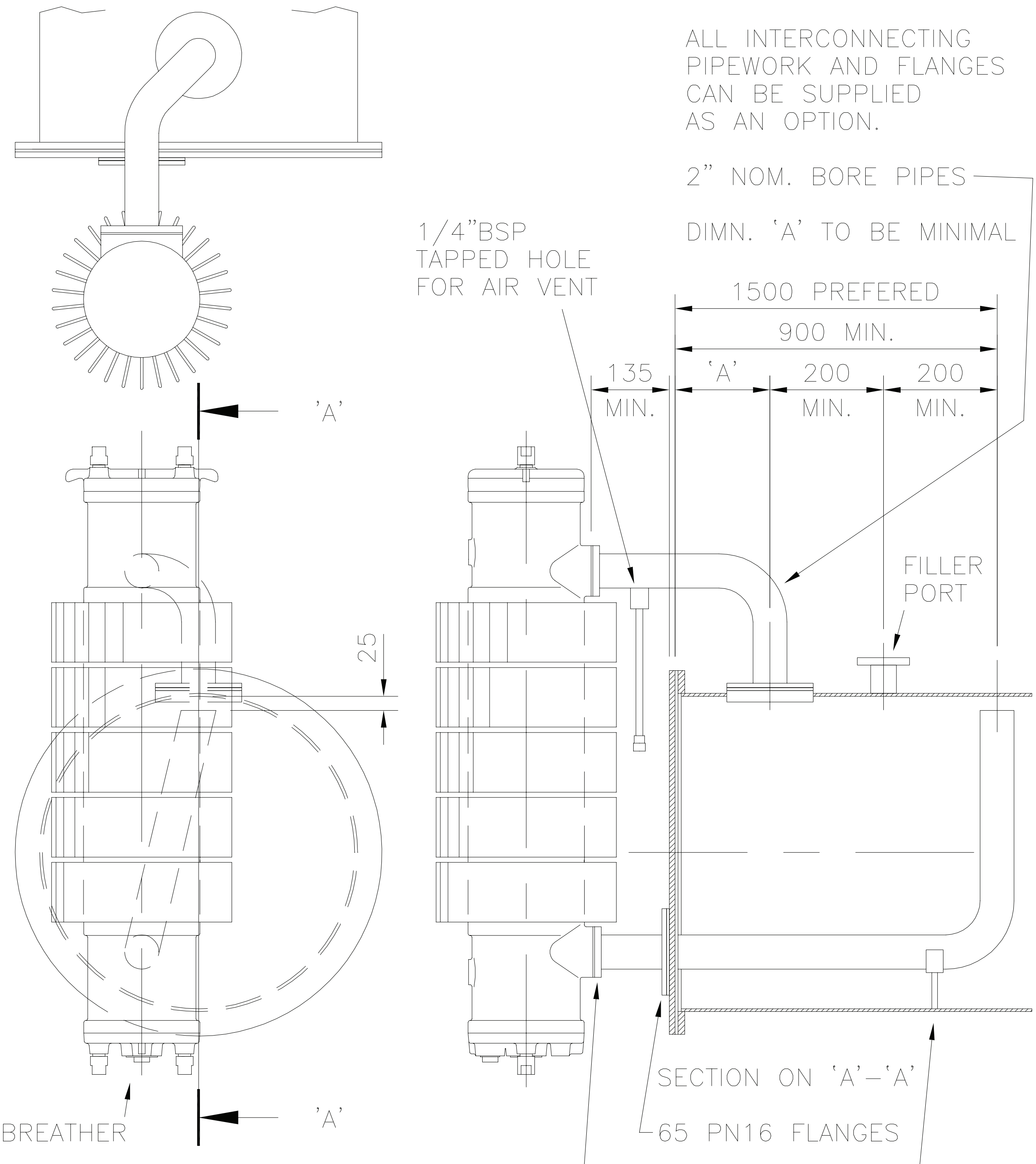
SUPPORT FOR BOTTOM PIPE REQUIRED WHERE A SIGNIFICANT DEGREE OF VIBRATION IS PRESENT.

INFORMATION FROM DRAWING NUMBER 42SM01512 REV. C.

GRID

FIG.4

TYPE 'A' BREATHER FITTED TO CONSERVATOR BELOW Ø925



THE POSITION OF THE BREATHER WILL BE DICTATED BY FITTINGS ATTACHED TO THE CONSERVATOR END PLATE.

SUPPORT FOR BOTTOM PIPE REQUIRED WHERE A SIGNIFICANT DEGREE OF VIBRATION IS PRESENT.

INFORMATION FROM DRAWING NUMBER 42SM01511 REV. C.

ALSTOM | GRID

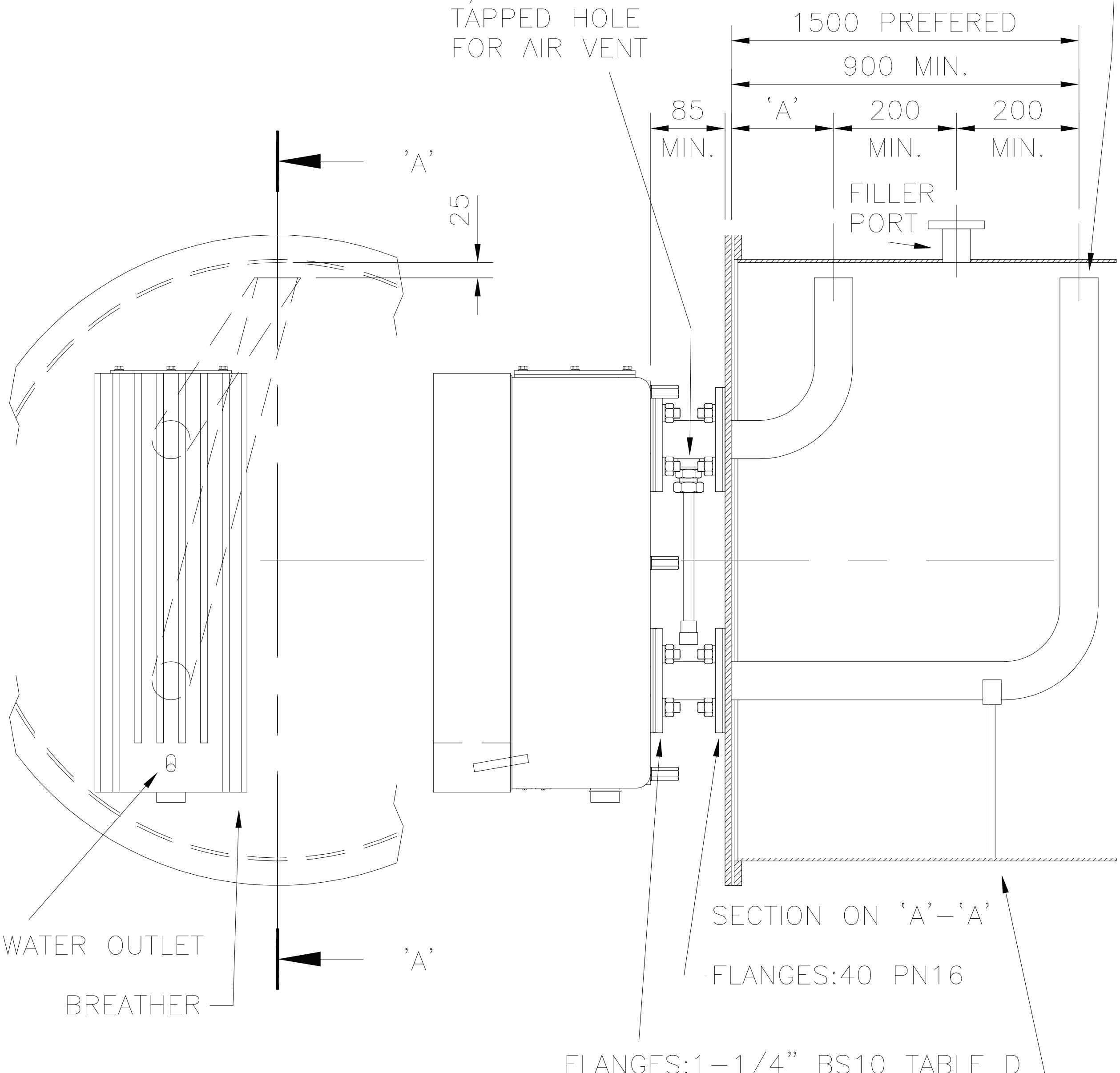
FIG.5

TYPE 'B' BREATHER FITTED TO CONSERVATOR Ø460 & OVER

ALL INTERCONNECTING PIPEWORK AND FLANGES CAN BE SUPPLIED AS AN OPTION.

1-1/4" NOM. BORE PIPES

DIMN. 'A' TO BE MINIMAL



THE POSITION OF THE BREATHER WILL BE DICTATED BY FITTINGS ATTACHED TO THE CONSERVATOR END PLATE.

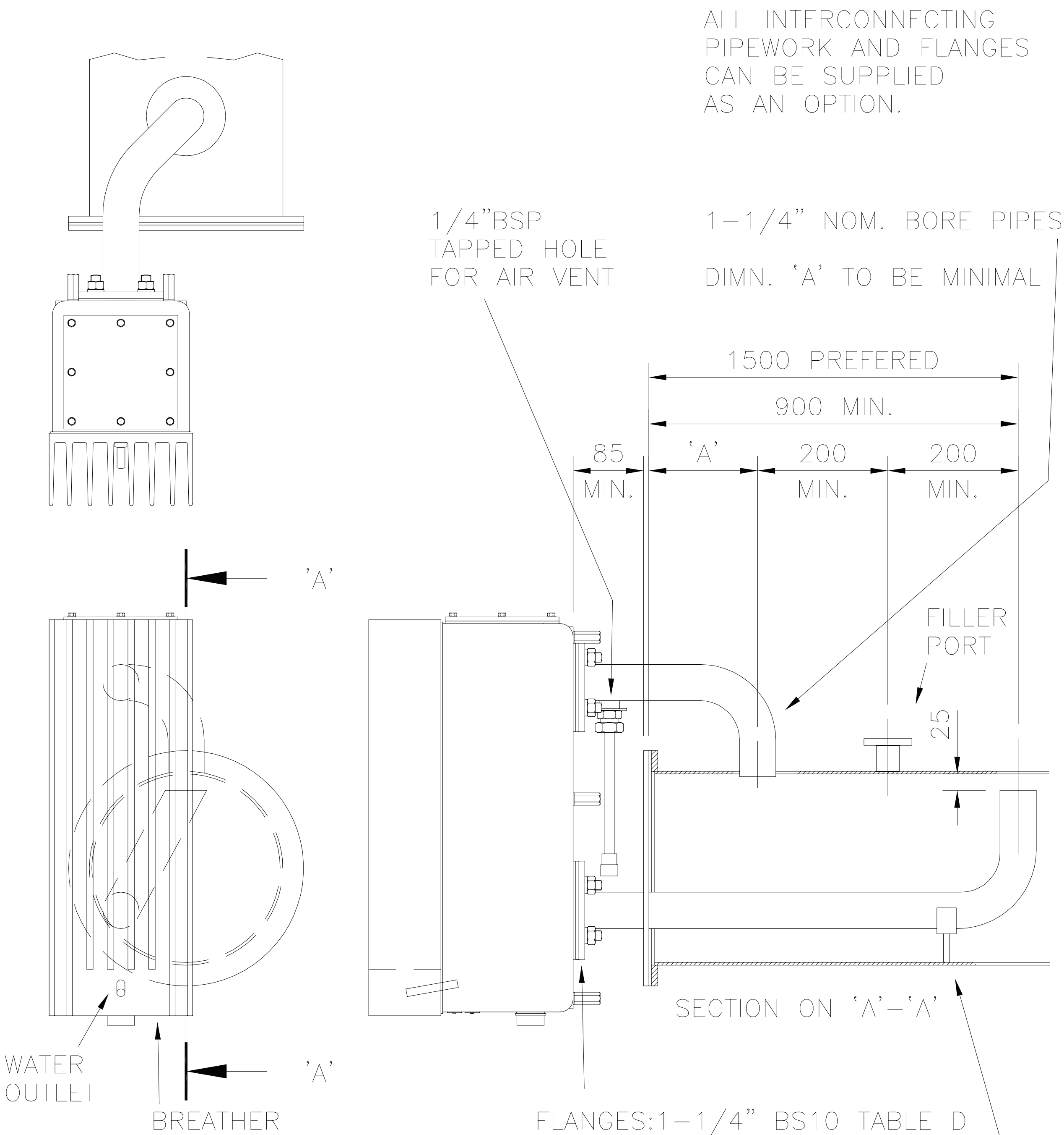
SUPPORT FOR BOTTOM PIPE REQUIRED WHERE A SIGNIFICANT DEGREE OF VIBRATION IS PRESENT.

INFORMATION FROM DRAWING NUMBER 42SM01514 REV. C.

ALSTOM GRID

FIG.6

TYPE 'B' BREATHER FITTED TO CONSERVATOR BELOW ø460



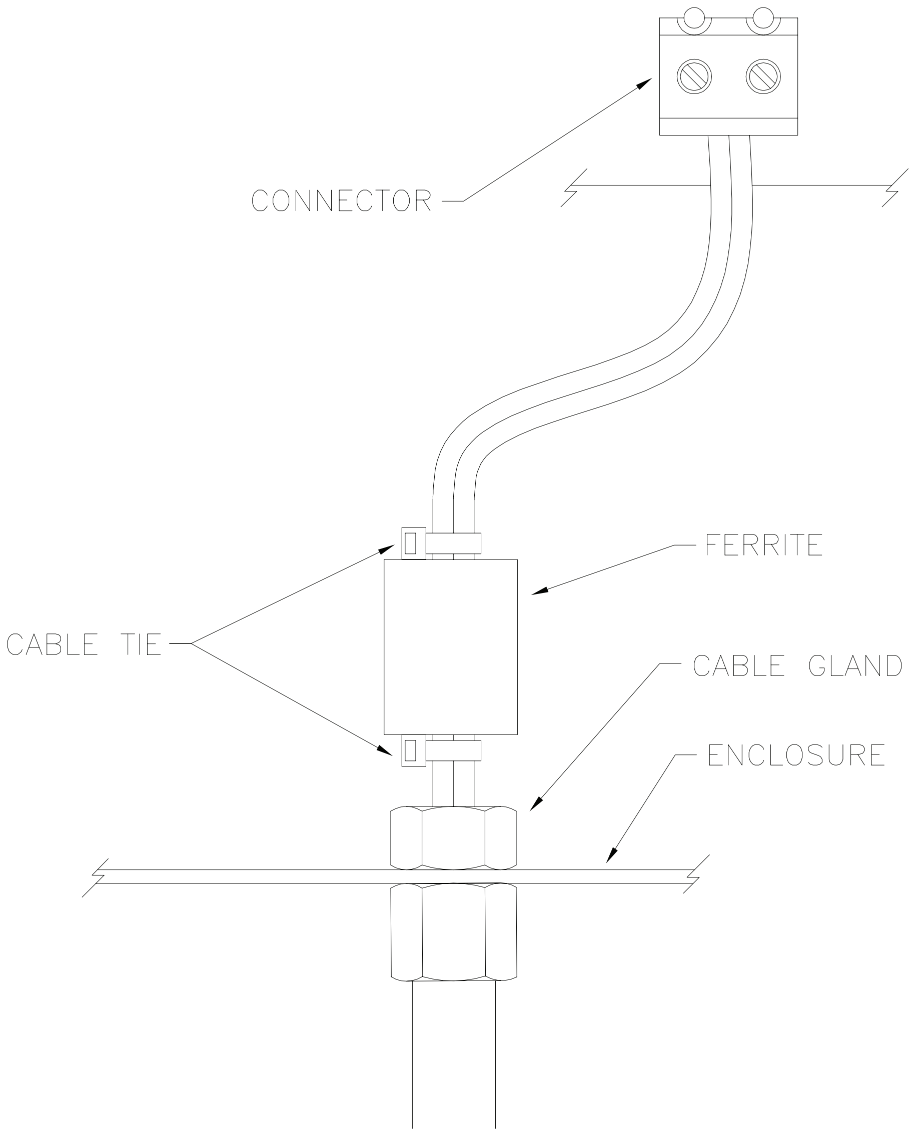
THE POSITION OF THE BREATHER WILL BE DICTATED BY FITTINGS ATTACHED TO THE CONSERVATOR END PLATE.

SUPPORT FOR BOTTOM PIPE REQUIRED WHERE A SIGNIFICANT DEGREE OF VIBRATION IS PRESENT.

ALSTOM GRID

FIG.7

FERRITE SHIELD INSTALLATION FOR DRYCOL BREATHER CONTROL CABINET

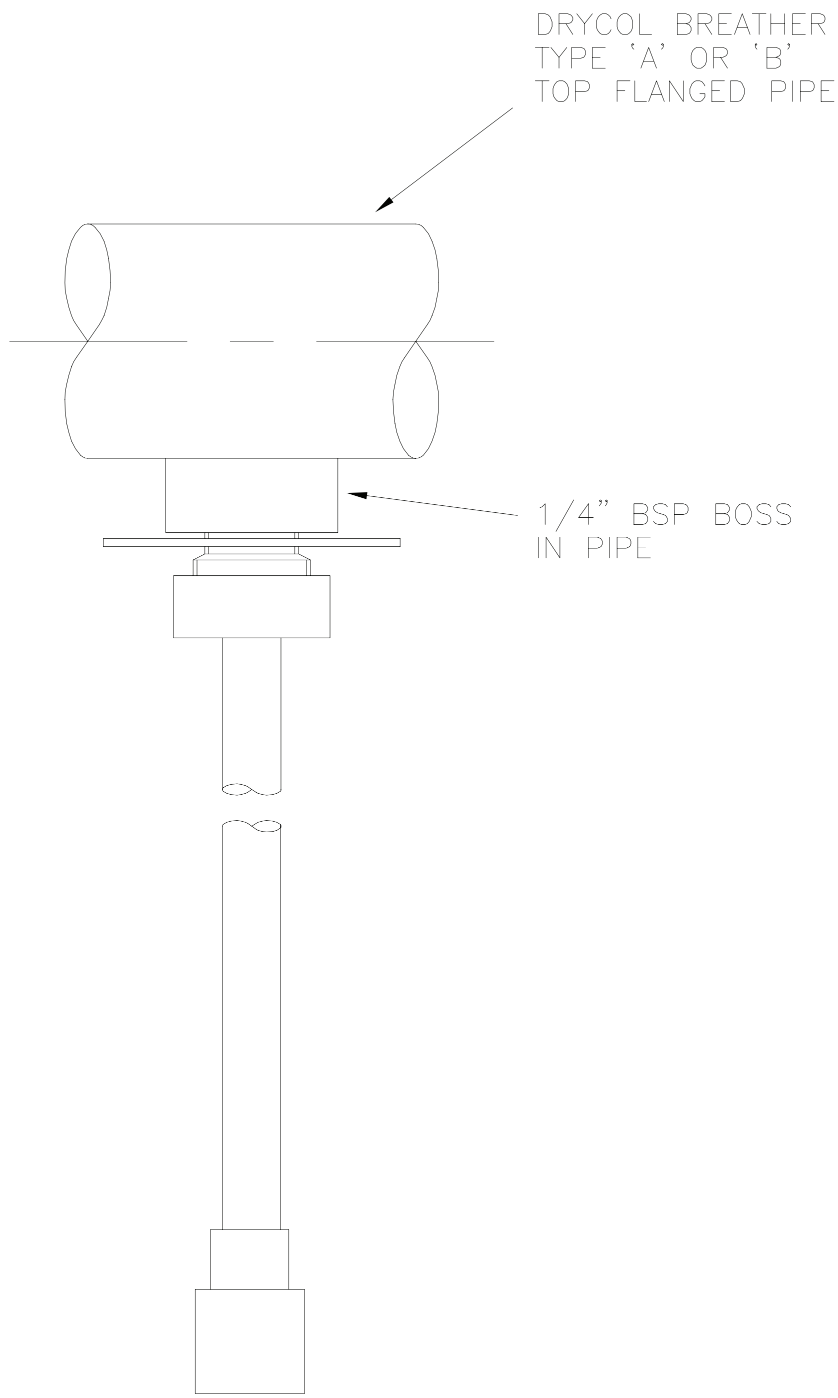


INFORMATION FROM DRAWING NUMBER 42SM01564 REV. A.

ALSTOM GRID

FIG.8

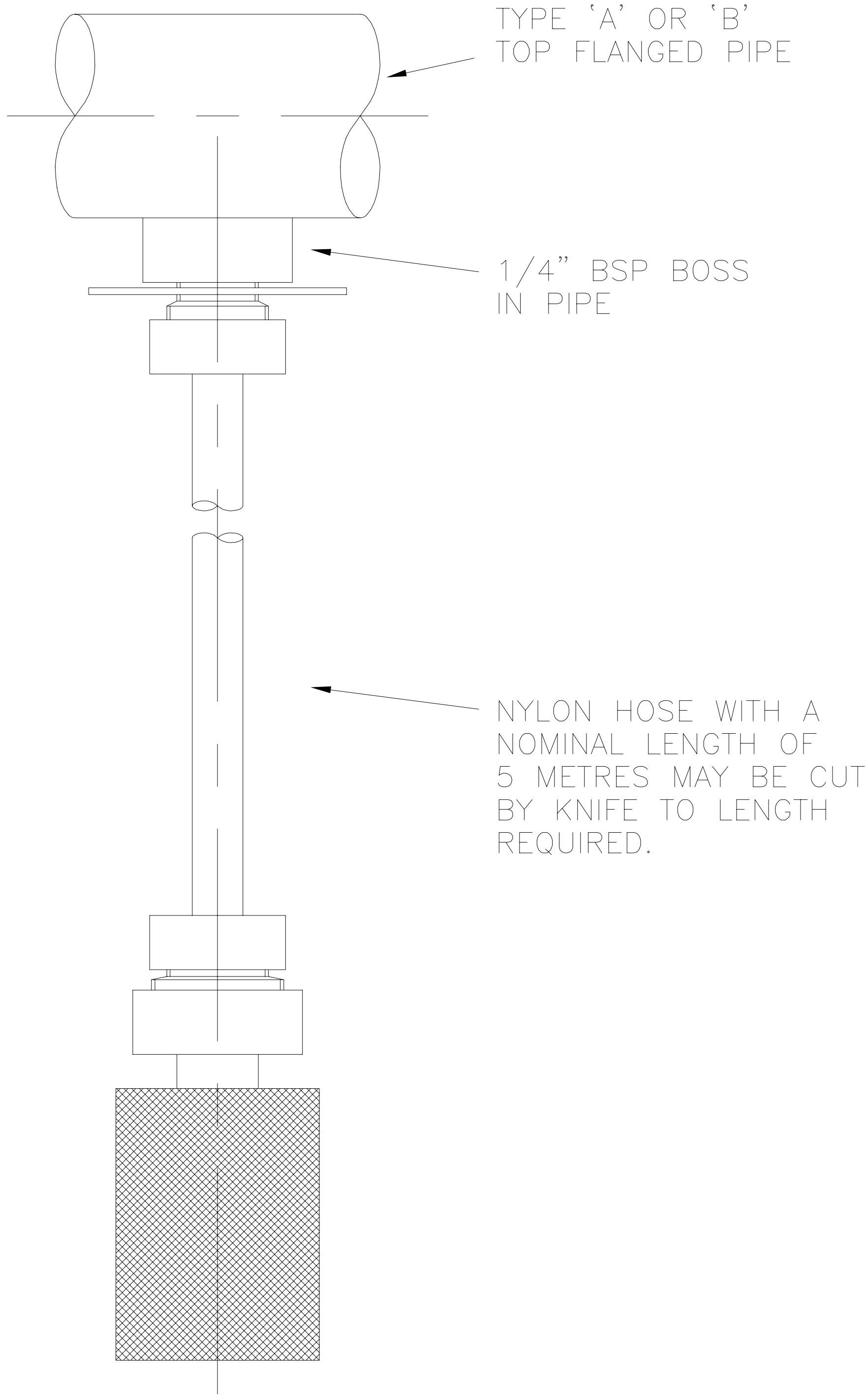
STANDARD AIR VENT FILTER FOR DRYCOL BREATHER TYPE 'A' AND 'B'



INFORMATION FROM DRAWING NUMBER 42SM01516 REV. C.

FIG.9

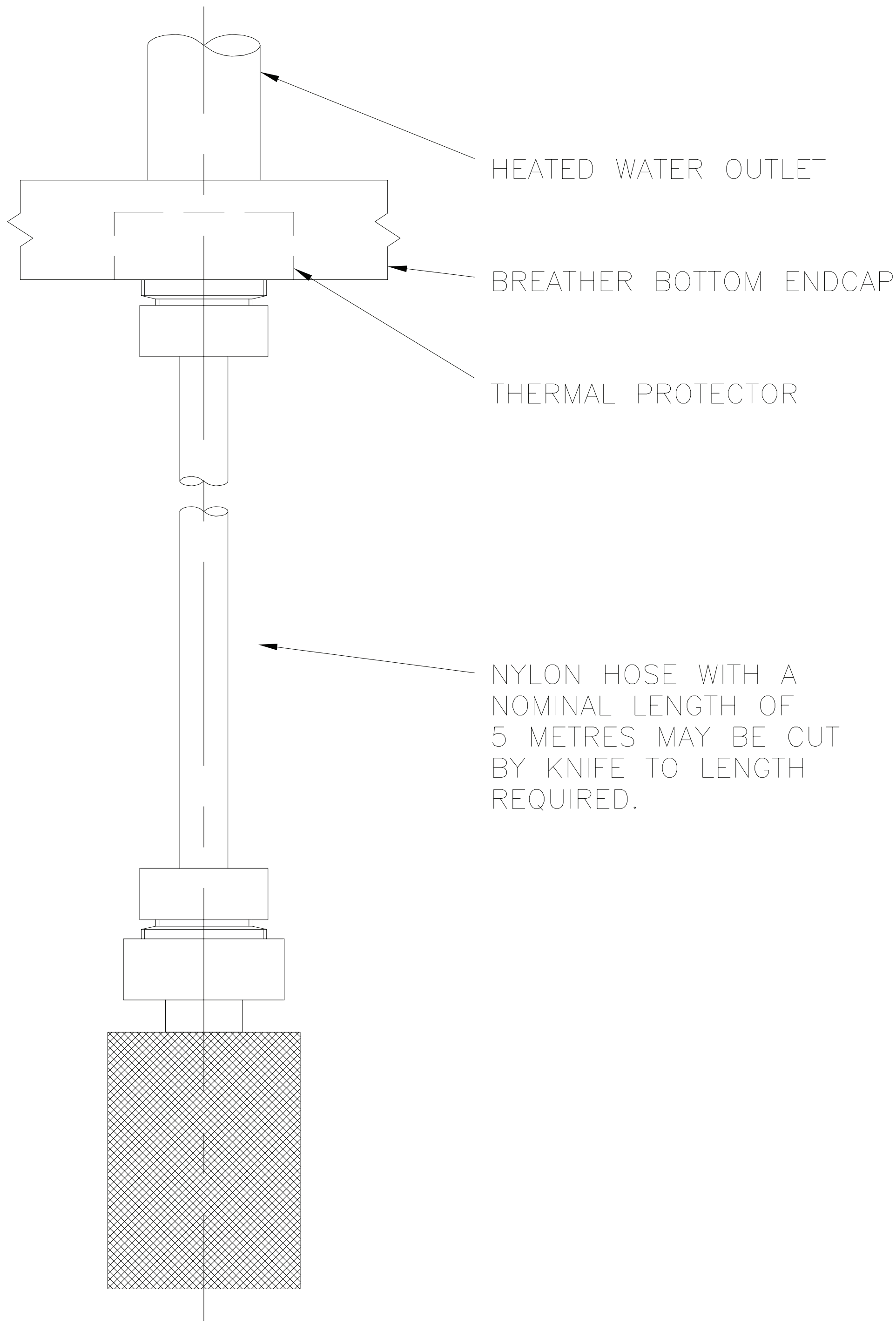
TROPICAL AIR VENT FILTER FOR DRYCOL BREATHER TYPE 'A' AND 'B'



INFORMATION FROM DRAWING NUMBER 42SM01517 REV. C.

FIG.10

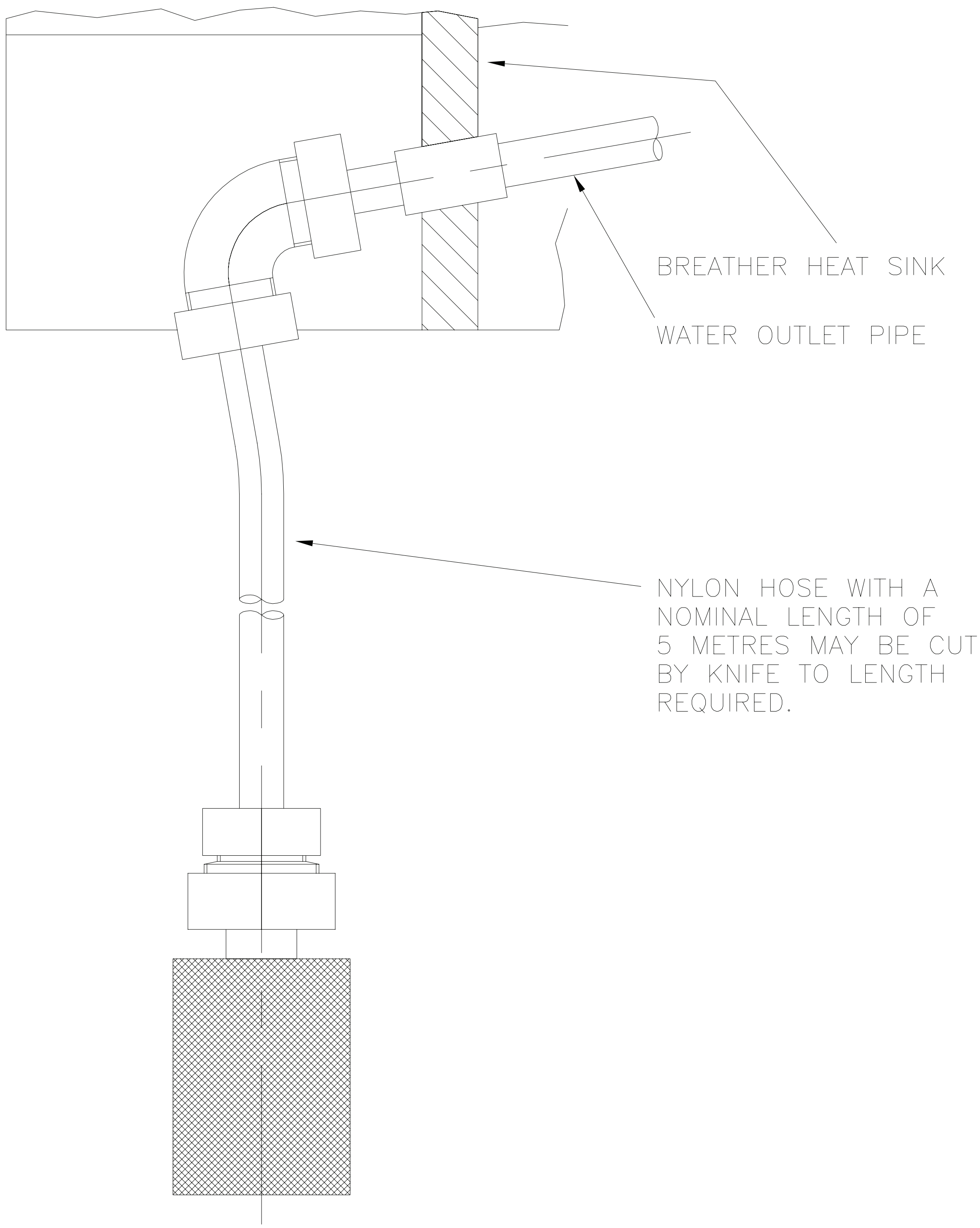
TROPICAL WATER VENT FILTER FOR DRYCOL BREATHER TYPE 'A'



INFORMATION FROM DRAWING NUMBER 42SM01518 REV. C.

FIG.11

TROPICAL WATER VENT FILTER FOR DRYCOL BREATHER TYPE 'B'



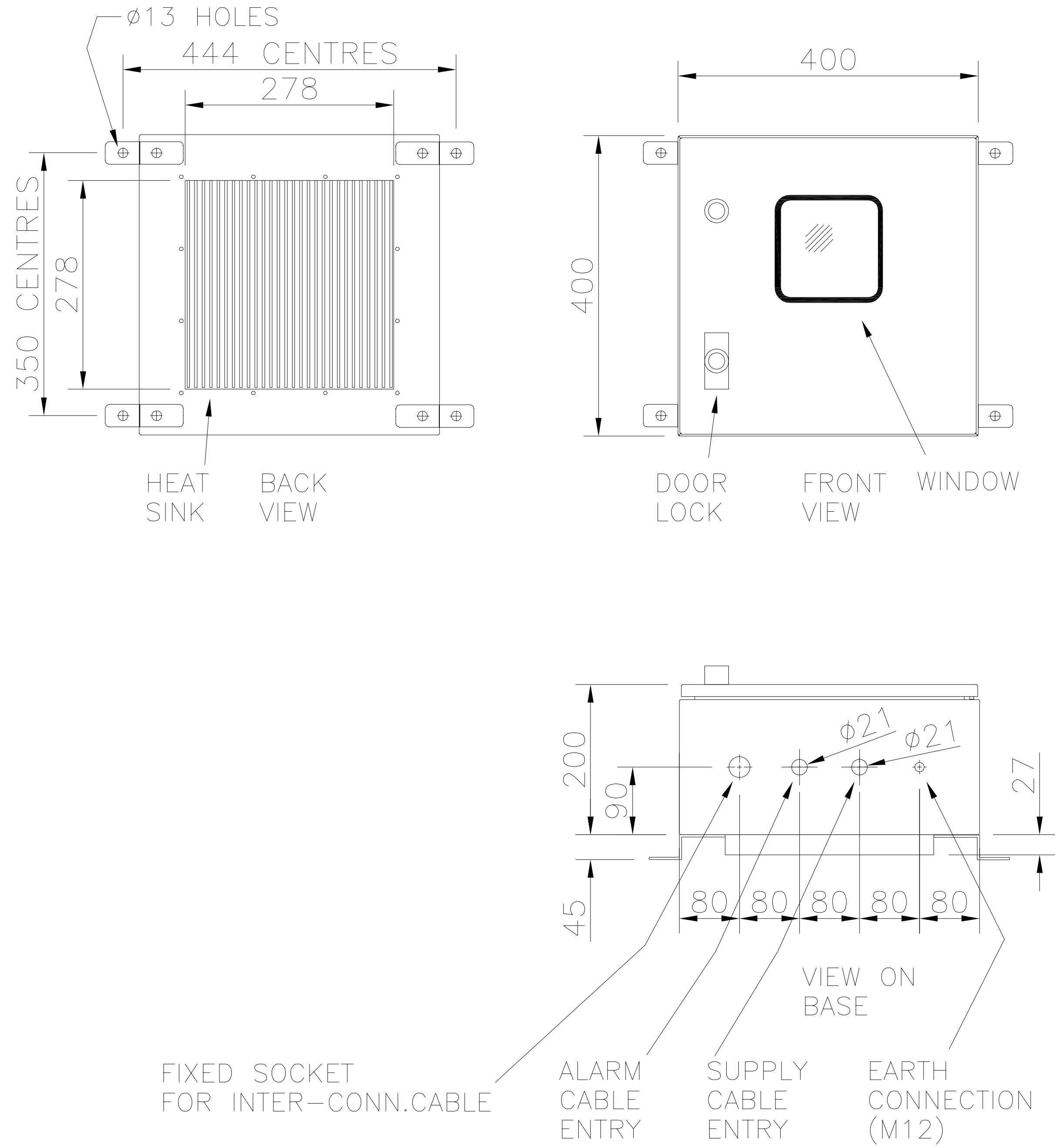
INFORMATION FROM DRAWING NUMBER 42SM01519 REV. C.

FIG. 12 – FREEZE MODE

FIG. 13 – DEFROST MODE

FIG.14

GENERAL ARRANGEMENT OF MK. 8 CONTROL CABINET



CABINET WEIGHT: 20Kg

INFORMATION FROM DRAWING NUMBER 42SM01565 REV. A.

Section 8
Component Instruction Leaflets and Manuals

8.14 Insulation paper

WEIDMANN

DATA SHEET

22HCC INSULDUR® CREPE PAPER

Thermal Class E (120°C) rated insulation

Property	Unit	Typical Value	Value Range
Caliper (Thickness)	inch	0.0032	0.0029 - 0.0034
	mm	0.081	0.074 – 0.086
Tensile, MD	lbs/inch	56	30 minimum
	kN/m	9.80	5.25 minimum
Elongation, MD (Stretch)	%	20	15 - 30
Crepe Weight	lbs/1000 ft^2	17.0	15.3 - 19.3
	g/m^2	83	75 - 94
Apparent Density	g/cc	1.05	0.95 - 1.15
Finch Edge Tear (5/8 inch wide)	lbs	30	15 minimum
Finch Edge Tear (15.9 mm wide)	kg	13.3	6.8 minimum
Tensile Energy Absorption (T.E.A.)	lbs-ft/ft^2	68	-
Ash Content	%	<1	-
Moisture Content	%	6	4.0 – 7.0
Insuldur™ Content	%	3.0	2.0 – 4.0
Nitrogen Content	%	1.9	1.3 – 2.5
Dielectric Strength - Air	V/mil	250	-
	kV/mm	9.8	-
Dielectric Strength - Oil	kV/mil	1.88	-
	kV/mm	74.0	-
Impulse – Oil	kV/mil	4.4	-
	kV/mm	173.2	-

- Meets requirements of thermally upgraded paper according to definitions developed by IEEE and IEC.
- All breakdown testing done in accordance with ASTM method D149. Air tests done at ambient temperature and humidity. Oil impregnation done under ASTM D2413 method A.
- Rate of rise for A.C. (60Hz) dielectric test - 125 volts per second for air and 500 volts per second for oil impregnated samples using 2" (50.8 mm) diameter brass electrode with 1/4" (6.4 mm) radius edges.
- Typical Values represent nominal property data only and should not be interpreted as specification.

V5 02/28/13 MSS

WEIDMANN ELECTRICAL TECHNOLOGY INC.
700 West Court Street, P. O. Box 716, Urbana, OH 43078, USA
T +1 937 652 1220, www.weidmann-electrical.com

A Member of the **WICOR** Group

Section 09
Transformer Drawings

Section 09
Transformer Drawings

ASHUGANJ 450 MW CCPP (NORTH) PROJECT

INTERBUS TRANSFORMER

LOCAL CONTROL PANEL

3ph 50Hz 400/230kV ONAN/ONAF 244/325MVA OLTC

20ADT10GH001/20ADT20GH001

TECNICAS REUNIDAS TSK

UTE TSK TÉCNICAS REUNIDAS
ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)

REVIEW RESPONSE BY PURCHASER

Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

- [-] REJECTED
- [-] Reviewed With Comments
- [-] Review. Without Comments
- [-] COMMENTS AS NOTED
- [-] REVIEWED AS BUILT
- [-] FOR INFORMATION

DATE: -

DOCUMENT VENDOR IDENTIFICATION:	HYOSUNG	SH. NO.:	1
DOCUMENT TITLE:	WIRING DIAGRAM COVER	SHEET:	23
VENDOR DOCUMENT No:	NT14-BA1-008 / CODE: DIA-0015	REV:	5
UTS DOCUMENT No:	-	REV:	-
KKS DOCUMENT No:	07485-20-ADT-JDW-HYO-001		

UTS PROJECT NO. 7485	-	UNIT:	-
PURCHASE ORDER NUMBER (P.O.R.)	074851201	EQUIPMENT:	400/230KV(INTERBUS) TR.

CONTENTS	SHEET NO.	NOTE
COVER	1	
DRAWING CONTENTS	2	
OUTLINE DRAWING	3	
INTERIOR DRAWING	4	
DEVICE LIST(1)	5	
DEVICE LIST(2)	6	
LOCATION DIAGRAM	7	
MAIN CIRCUIT(1)	8	
MAIN CIRCUIT(2)	9	
MAIN CIRCUIT(3)	10	
HEATER AND LIGHTING	11	
APPENDIX POWER CIRCUIT	12	
CONTROL CIRCUIT(1)	13	
CONTROL CIRCUIT(2)	14	
CONTROL CIRCUIT(3)	15	
CONTROL CIRCUIT(4)	16	
SIGNAL CIRCUIT	17	
CT CIRCUIT	18	
PROTECTION RELAY	19	
INTELLIGENT TEMPERATURE MONITOR	20	
OLTC MOTOR DRIVE UNIT	21	
TERMINAL BLOCK(1)	22	
TERMINAL BLOCK(2)	23	

TECNICAS REUNIDAS TSK
UTE TSK TÉCNICAS REUNIDAS ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)

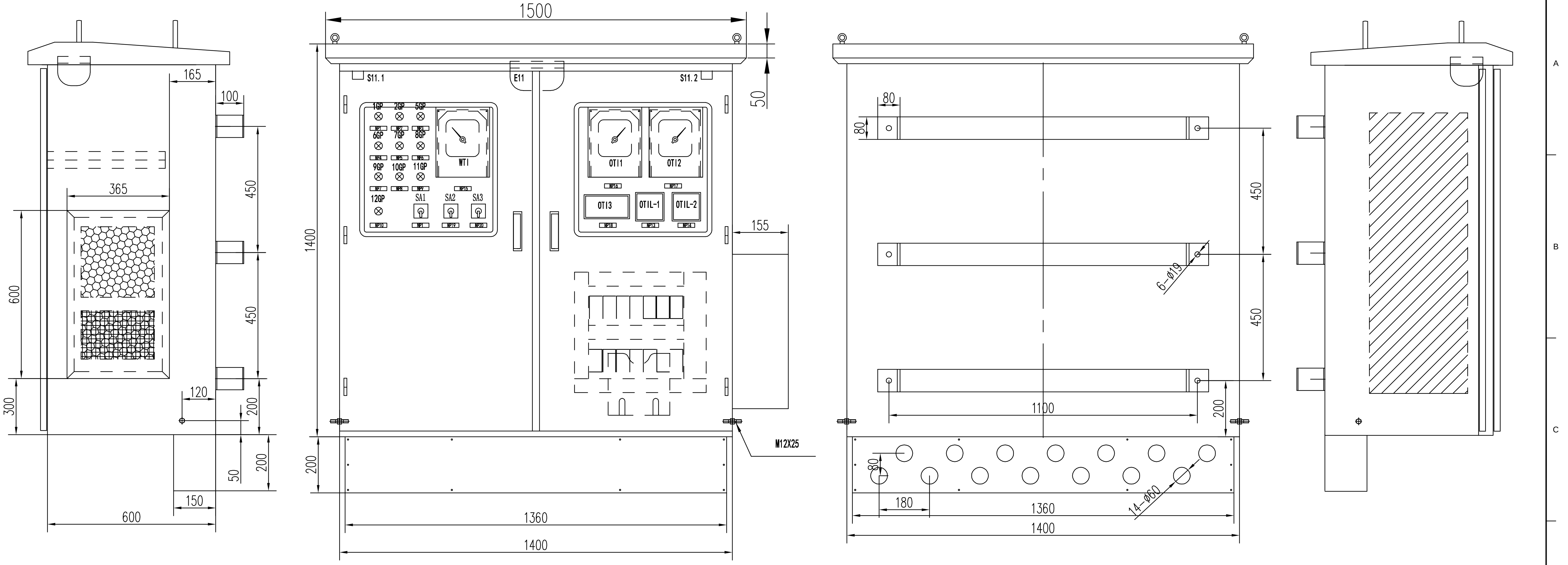
REVIEW RESPONSE BY PURCHASER

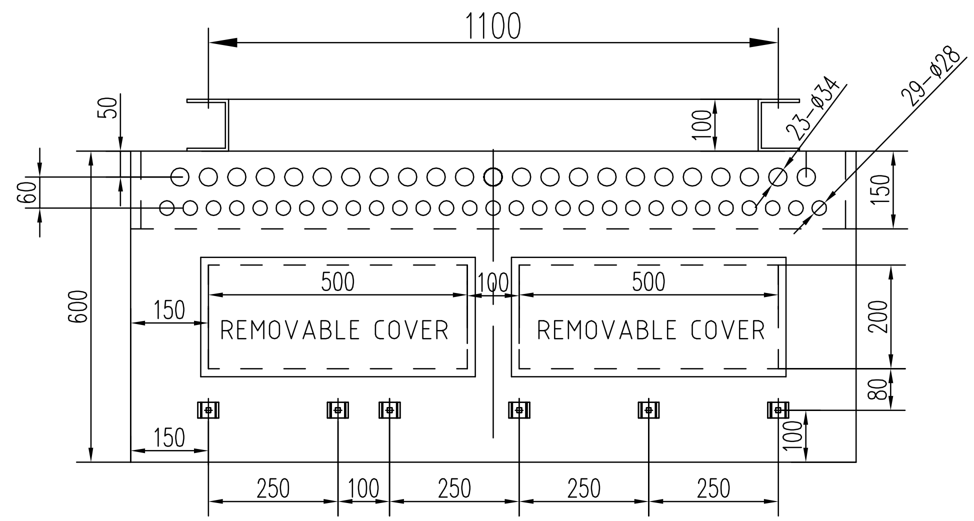
Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

- [-] REJECTED
- [-] Reviewed With Comments
- [-] Review. Without Comments
- [-] COMMENTS AS NOTED
- [-] REVIEWED AS BUILT
- [-] FOR INFORMATION

DATE: -

DOCUMENT VENDOR IDENTIFICATION: HYOSUNG		SH. NO.: 2	
DOCUMENT TITLE: WIRING DIAGRAM DRAWING CONTENTS		SHEET: 23	
VENDOR DOCUMENT No: NT14-BA1-008	CODE: DIA-0015	REV: 5	
UTS DOCUMENT No: -		REV: -	UTS PROJECT NO. 7485 -	UNIT: -
KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001			PURCHASE ORDER NUMBER (P.O.R.) 074851201	EQUIPMENT: 400/230KV(INTERBUS) TR.





TECHNICAL REQUIREMENTS:
PROTECTION CLASS: IP65
MATERIALS: 2.5MM THICKNESS
COLD ROLLED STEEL
PAINTING COLOR: RAL 7030

LABLE INSTRUCTIONS

NP1	POWER SUPPLY 1 ON	NP11	POWER 1/OFF/POWER 2
NP2	POWER SUPPLY 2 ON	NP13	OIL LEVEL DIGITAL INDICATOR FOR MAIN CONVERSATION
NP3	FANS COOLING GROUP I RUNNING	NP14	OIL LEVEL DIGITAL INDICATOR FOR OLTC CONVERSATION
NP4	FANS COOLING GROUP II RUNNING	NP15	WINDING TEMPERATURE INDICATOR
NP5	FANS COOLING GROUP I FAILURE	NP16	OIL TEMPERATURE INDICATOR 1
NP6	FANS COOLING GROUP II FAILURE	NP17	OIL TEMPERATURE INDICATOR 2
NP7	SPARE FAN RUNNING	NP18	OIL TEMPERATURE DIGITAL INDICATOR
NP8	SPARE FAN FAILURE	NP19	FANS COOLING CONTROL
NP9	ALL FANS FAILURE	NP20	SPARE
NP10	DC POWER ON		

TECNICAS REUNIDAS TSK
UTE TSK TÉCNICAS REUNIDAS ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

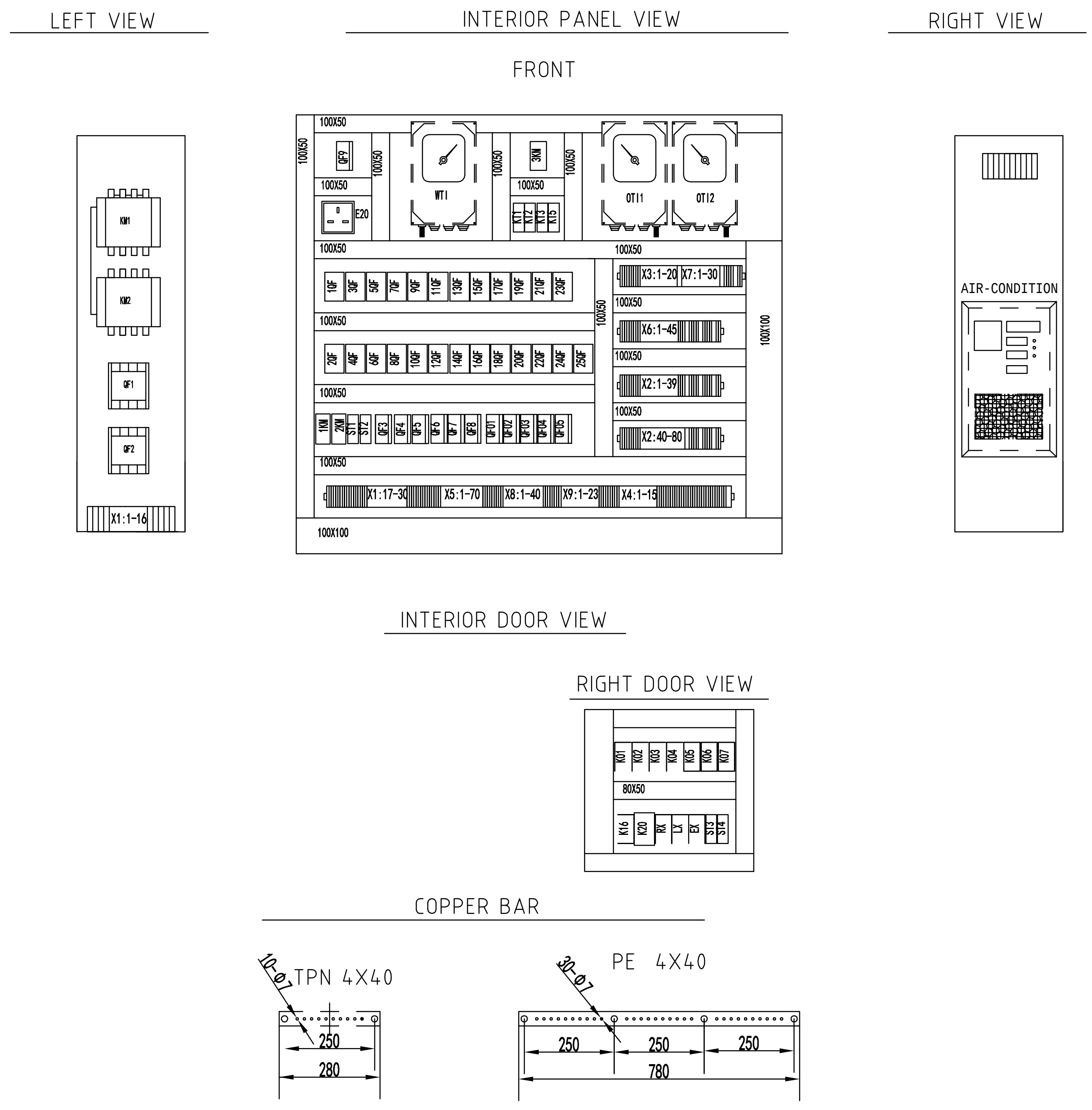
REVIEW RESPONSE BY PURCHASER

Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

- REJECTED
- Reviewed With Comments
- Review. Without Comments
- COMMENTS AS NOTED
- REVIEWED AS BUILT
- FOR INFORMATION

DATE: -

DOCUMENT VENDOR IDENTIFICATION: HYOSUNG		SH. NO.: 3	ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)
DOCUMENT TITLE: WIRING DIAGRAM OUTLINE DRAWING		SHEET: 23	
VENDOR DOCUMENT No: NT14-BA1-008	CODE: DIA-0015	REV: 5	
UTS DOCUMENT No: -		REV: -	UTS PROJECT NO. 7485 - / UNIT: -
KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001			PURCHASE ORDER NUMBER (P.O.R.) 074851201 / EQUIPMENT: 400/230KV(INTERBUS) TR.



Ashuganj Power Station Company Ltd. (APSCL)

TECNICAS REUNIDAS TSK

UTE TSK TÉCNICAS REUNIDAS ASHUGANJ NORTH

REVIEW RESPONSE BY PURCHASER

Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

- REJECTED
- Reviewed With Comments
- Review. Without Comments
- COMMENTS AS NOTED
- REVIEWED AS BUILT
- FOR INFORMATION

DATE: -

DOCUMENT VENDOR IDENTIFICATION:	HYOSUNG	SH. NO.:	4
DOCUMENT TITLE:	WIRING DIAGRAM INTERIOR DRAWING	SHEET:	23
VENDOR DOCUMENT No:	NT14-BA1-008 / CODE: DIA-0015	REV:	5
UTS DOCUMENT No:	-	REV:	-
KKS DOCUMENT No:	07485-20-ADT-JDW-HYO-001		

ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)

UTS PROJECT NO. 7485 -	UNIT: -
PURCHASE ORDER NUMBER (P.O.R.) 074851201	EQUIPMENT: 400/230KV(INTERBUS) TR.

NO.	DEVICE	DESCRIPTION	TYPE	QUANTITY	RATING	MANUFACTURER
35	RX, LX, EX	RELAY	CAD32FDC	3	DC 110V	SCHNEIDER
34	7GP,8GP,10GP,11GP	SIGNAL LIGHT	AD16-22B/Y26	4	DC 110V YELLOW	SIEMENS(SUZHOU)
33	1GP,2GP,5GP,6GP,9GP	SIGNAL LIGHT	AD16-22B/R26	5	DC 110V RED	SIEMENS(SUZHOU)
32	SA3	CHANGE-OVER SWITCH	LWZ2-25/2D004	1	SPARE	CHINA
31	SA2	CHANGE-OVER SWITCH	LWZ2-16/1D	1	OFF/AUTO/ON	CHINA
30	SA1	CHANGE-OVER SWITCH	LWZ2-25/2D004	1	POWER 1/OFF/POWER 2	CHINA
29	KT5	TIME RELAY	ETR4-11A	1	DC 110V	SCHNEIDER
28	KT3	TIME RELAY	ETR4-11A	1	DC 110V	SCHNEIDER
27	KT2	TIME RELAY	ETR4-70A	1	DC 110V	SCHNEIDER
26	KT1	TIME RELAY	ETR4-70A	1	DC 110V	SCHNEIDER
25	K20	RELAY	CAD50FDC	1	DC 110V	SCHNEIDER
24	I1,I2	DIODE		2		CHINA
23	K01-K07,K16	RELAY	CAD32FDC	8	DC 110V	SCHNEIDER
22	QF05	CIRCUIT BREAKER	A9N22074+A9N26924	1	2P 6A	SCHNEIDER
21	QF04	CIRCUIT BREAKER	A9N22074+A9N26924	1	2P 6A	SCHNEIDER
20	QF03	CIRCUIT BREAKER	A9N22073+A9N26924	1	2P 4A	SCHNEIDER
19	QF02	CIRCUIT BREAKER	A9F18220+A9A26924	1	2P 20A	SCHNEIDER
18	QF01	CIRCUIT BREAKER	A9F18202+A9A26924	1	2P 2A	SCHNEIDER
17	1QF-25QF	CIRCUIT BREAKER	GV2ME07C+GVAE11+GVAD1001	25	SETING 1.8A	SCHNEIDER
16	QF9	CIRCUIT BREAKER	A9N22071+A9N26924	1	2P 2A	SCHNEIDER
15	QF8	CIRCUIT BREAKER	A9F19402+A9A26924	1	4P 2A	SCHNEIDER
14	QF7	CIRCUIT BREAKER	A9F18204+A9A26924	1	2P 4A	SCHNEIDER
13	QF5,QF6	CIRCUIT BREAKER	A9F19325+A9A26924	2	3P 25A	SCHNEIDER
12	QF3,QF4	CIRCUIT BREAKER	A9N22076+A9N26924	2	2P 16A	SCHNEIDER
11	QF1 ,QF2	CIRCUIT BREAKER	NSX100 4P+OF	2	4P 100A 5	SCHNEIDER
10	ST4	MONITORING RELAY	EMR5-W500-1-D	1		MOELLER
9	ST3	MONITORING RELAY	CM-ESS.2	1	DC 110V	ABB
8	ST1,ST2	MONITORING RELAY	EMR5-W500-1-D	2		MOELLER
7	KM1,KM2	DC.CONTACTOR	LC1-F115FDC+LA9D4002+LAD-N04C	2	DC 110V	SCHNEIDER
6	3KM	DC.CONTACTOR	LC1-D09FDC	1	DC 110V	SCHNEIDER
5	1KM,2KM	DC.CONTACTOR	LC1-D25FDC+LADN22C	2	DC 110V	SCHNEIDER
4	AIR	AIR CONTIONING	AC0300X	1	AC230V 300W	CHINA
3	E11	LIGHT INSIDE CABINET (WITH COVER)		1	25W AC230V	CHINA
2	S11.1,S11.2	POSITION LIMITED SWITCH	LX19K	2		CHINA
1	E20	SOCKET	B426	1	AC230V 20A	CHINA

TECNICAS REUNIDAS TSK
UTE TSK TÉCNICAS REUNIDAS
ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

APSCL

REVIEW RESPONSE BY PURCHASER

Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

- REJECTED - Reviewed With Comments - Review. Without Comments
- COMMENTS AS NOTED - REVIEWED AS BUILT - FOR INFORMATION

DATE: -

DOCUMENT VENDOR IDENTIFICATION: HYOSUNG		SH. NO.: 5	ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)
DOCUMENT TITLE: WIRING DIAGRAM DEVICE LIST		SHEET: 23	
VENDOR DOCUMENT No: NT14-BA1-008	CODE: DIA-0015	REV: 5	
UTS DOCUMENT No: -		REV: -	UTS PROJECT NO. 7485 - / UNIT: -
KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001			PURCHASE ORDER NUMBER (P.O.R.) 074851201 / EQUIPMENT: 400/230KV(INTERBUS) TR.

NO.	DEVICE	DESCRIPTION	TYPE	QUANTITY	RATING	MANUFACTURER
55						
55		CABLE	2.5mm^2 black 600V/1000V BVR	-	PVC INSULATION, FLAME RETARDANT	CHINA
54		CABLE	4mm^2 black 600V/1000V BVR	-	PVC INSULATION, FLAME RETARDANT	CHINA
53		CABLE	6mm^2 black 600V/1000V BVR	-	PVC INSULATION, FLAME RETARDANT	CHINA
52		CABLE	10mm^2 black 600V/1000V BVR	-	PVC INSULATION, FLAME RETARDANT	CHINA
51		CABLE	16mm^2 black 600V/1000V BVR	-	PVC INSULATION, FLAME RETARDANT	CHINA
50	OLI1-1	OIL LEVEL DIGITAL INDICATOR	YZF3	1		CHINA
49	OLI2-1	OIL LEVEL DIGITAL INDICATOR	YZF3	1		CHINA
48	OTI1	OIL TEMPERATURE INDICATOR	BWY-804J	1		CHINA
47	OTI2	OIL TEMPERATURE INDICATOR	BWY-804J	1		CHINA
46	OTI3	OIL TEMPERATURE DIGITAL INDICATOR	XMT-22B	1		CHINA
45	WTI	WINDING TEMPERATURE INDICATOR	BWR-04J	1		CHINA
44	TPN	PLATE		1		CHINA
43	PE	EARTH PLATE		1		CHINA
42	X6(5,8,13,16,21,26,31,41,45)	TERMINAL BLOCK	USKLG 5	9		PHOENIX
41	X4	TERMINAL BLOCK	OTTA 6-T	15		CHINA
40	X3,X5,X6,X7,X8,X9	TERMINAL BLOCK	UK5N	199		PHOENIX
39	X2	TERMINAL BLOCK	UK6N	80		PHOENIX
38	X1(17-30)	TERMINAL BLOCK	UK6N	13		PHOENIX
37	X1(1-16)	TERMINAL BLOCK	UK35N	16		PHOENIX
36	12GP	SIGNAL LIGHT	AD16-22B/R28	1	DC 110V, RED	SIEMENS(SUZHOU)

TECNICAS REUNIDAS
UTE TSK TÉCNICAS REUNIDAS
ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

REVIEW RESPONSE BY PURCHASER

Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

- REJECTED
- Reviewed With Comments
- Review. Without Comments
- COMMENTS AS NOTED
- REVIEWED AS BUILT
- FOR INFORMATION

DATE: -

DOCUMENT VENDOR IDENTIFICATION: HYOSUNG

DOCUMENT TITLE: WIRING DIAGRAM DEVICE LIST

VENDOR DOCUMENT No: NT14-BA1-008

CODE: DIA-0015

UTS DOCUMENT No: -

KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001

SH. NO.: 6

SHEET: 23

REV: 5

REV: -

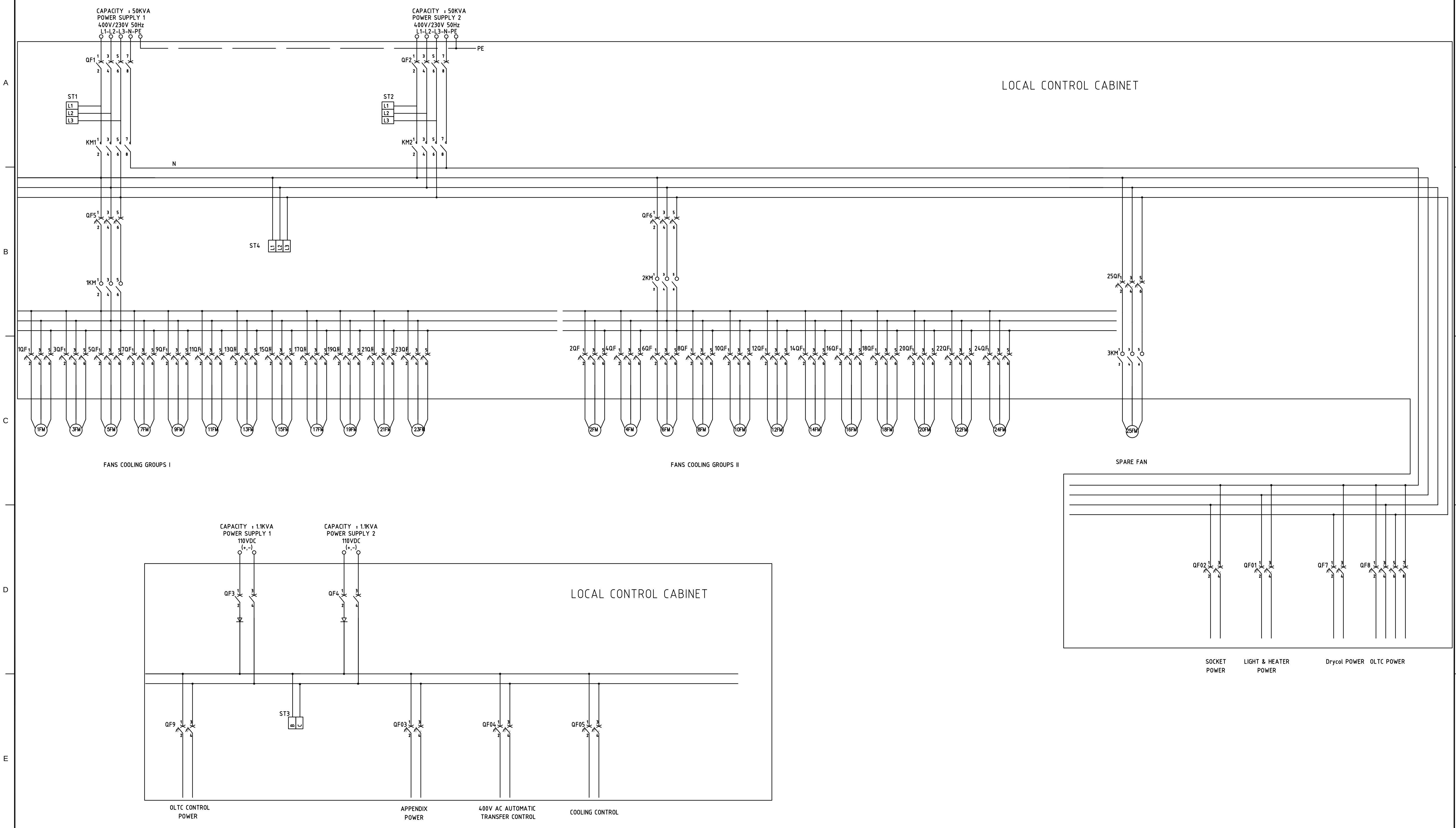
ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)

UTS PROJECT NO. 7485 -

UNIT: -

PURCHASE ORDER NUMBER (P.O.R.) 074851201

EQUIPMENT: 400/230KV(INTERBUS) TR.

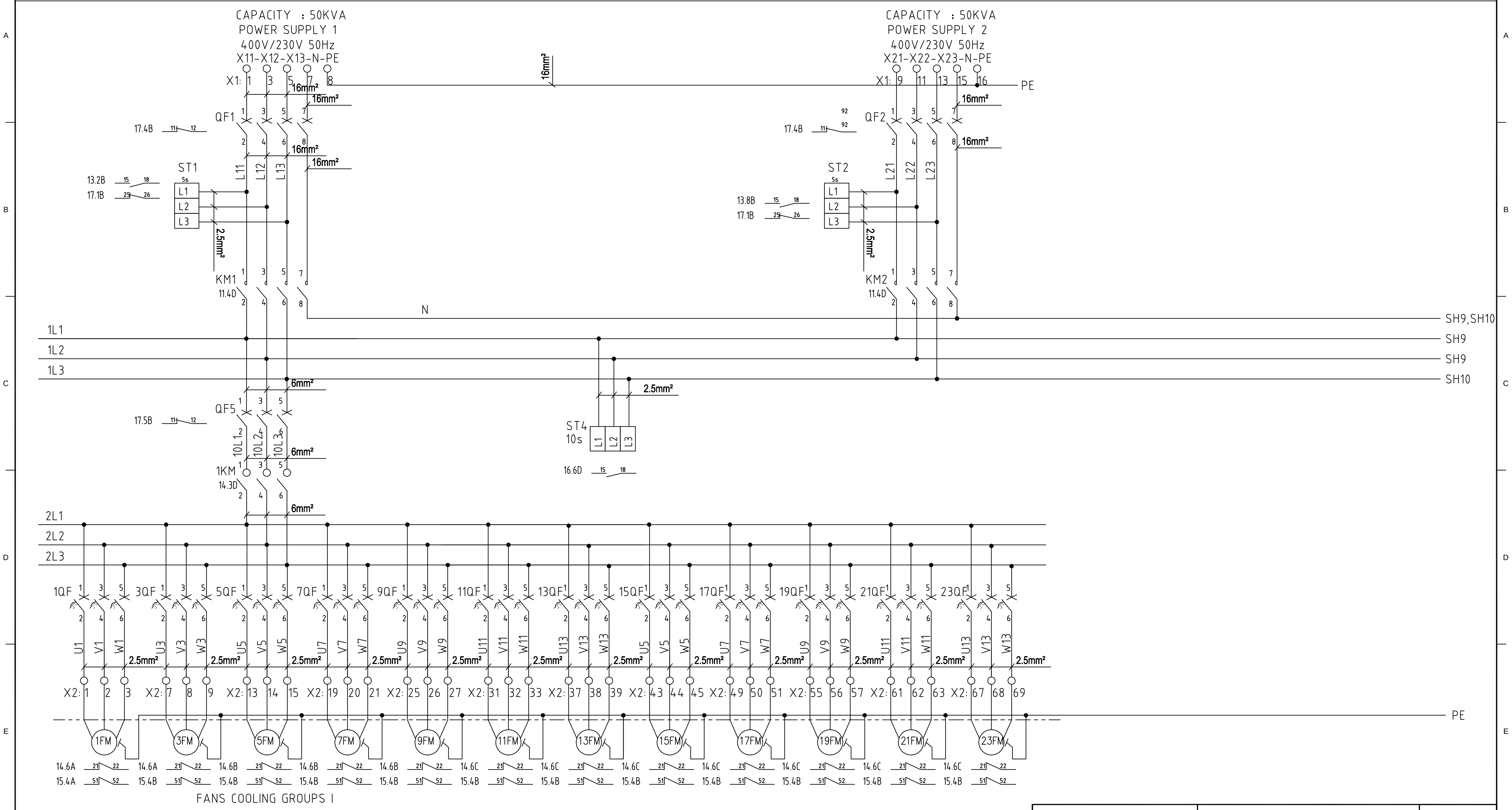


TECNICAS REUNIDAS
TSK
UTE TSK TÉCNICAS REUNIDAS
ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

REVIEW RESPONSE BY PURCHASER	DOCUMENT VENDOR IDENTIFICATION: HYOSUNG	SH. NO.: 7	ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)
Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.	DOCUMENT TITLE: WIRING DIAGRAM LOCATION DIAGRAM	SHEET: 23	
- REJECTED / - Reviewed With Comments / - Review. Without Comments	VENDOR DOCUMENT No: NT14-BA1-008 / CODE: DIA-0015	REV: 5	
- COMMENTS AS NOTED / - REVIEWED AS BUILT / - FOR INFORMATION	UTS DOCUMENT No: -	REV: -	UTS PROJECT NO. 7485 - / UNIT: -
DATE: -	KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001		PURCHASE ORDER NUMBER (P.O.R.) 074851201 / EQUIPMENT: 400/230KV(INTERBUS) TR.

AC POWER



TECNICAS REUNIDAS / TSK — UTE TSK TÉCNICAS REUNIDAS ASHUGANJ NORTH	Ashuganj Power Station Company Ltd. (APSCL)

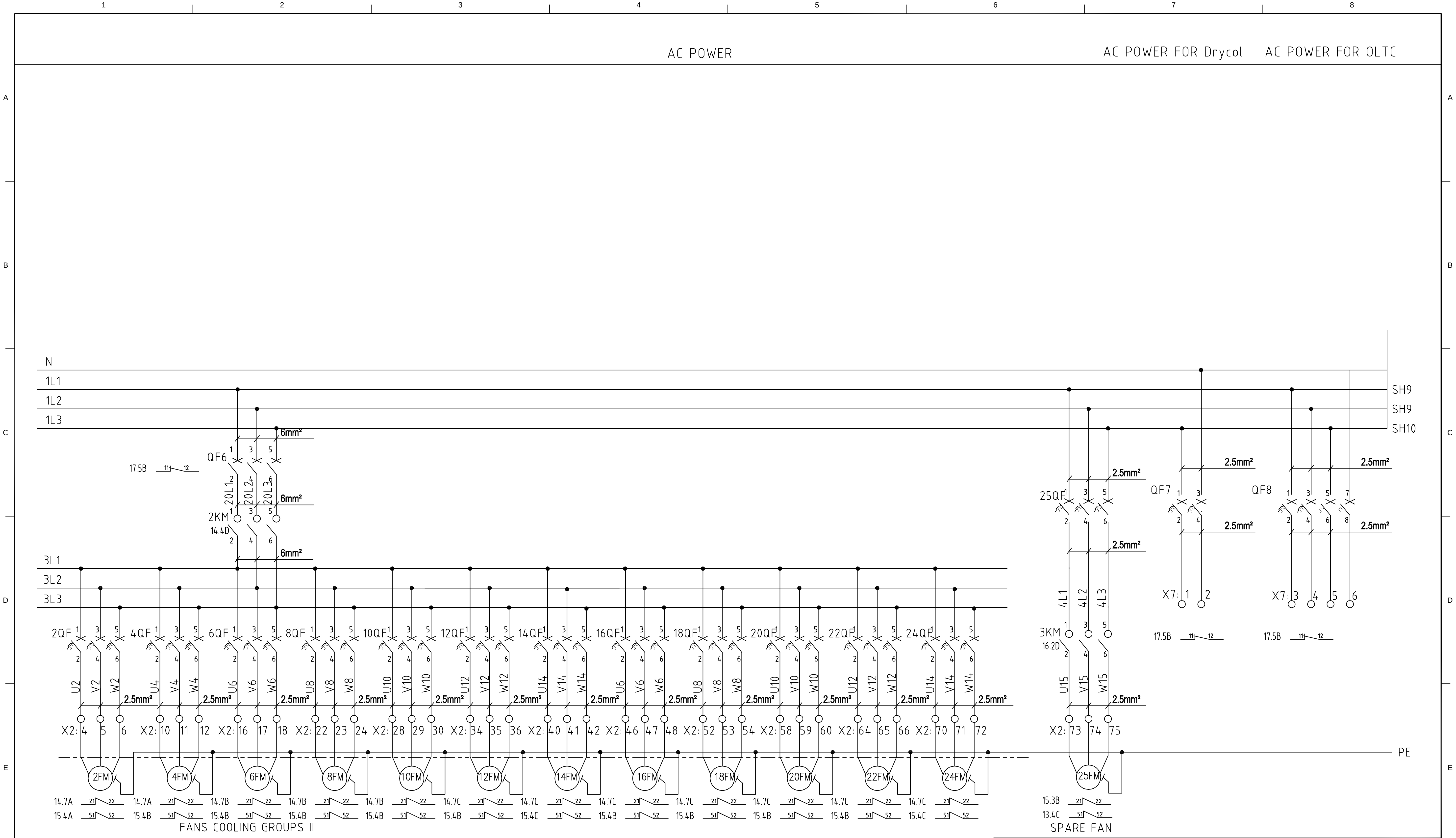
REVIEW RESPONSE BY PURCHASER

Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

- REJECTED
- Reviewed With Comments
- Review. Without Comments
- COMMENTS AS NOTED
- REVIEWED AS BUILT
- FOR INFORMATION

DATE: -

DOCUMENT VENDOR IDENTIFICATION: HYOSUNG		SH. NO.: 8	ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)
DOCUMENT TITLE: WIRING DIAGRAM MAIN CIRCUIT(1)		SHEET: 23	
VENDOR DOCUMENT No: NT14-BA1-008	CODE: DIA-0015	REV: 5	
UTS DOCUMENT No: -		REV: -	UTS PROJECT NO. 7485 - / UNIT: -
KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001			PURCHASE ORDER NUMBER (P.O.R.) 074851201 / EQUIPMENT: 400/230KV(INTERBUS) TR.



TECNICAS REUNIDAS

TSK

UTE TSK TÉCNICAS REUNIDAS
ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

REVIEW RESPONSE BY PURCHASER

Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

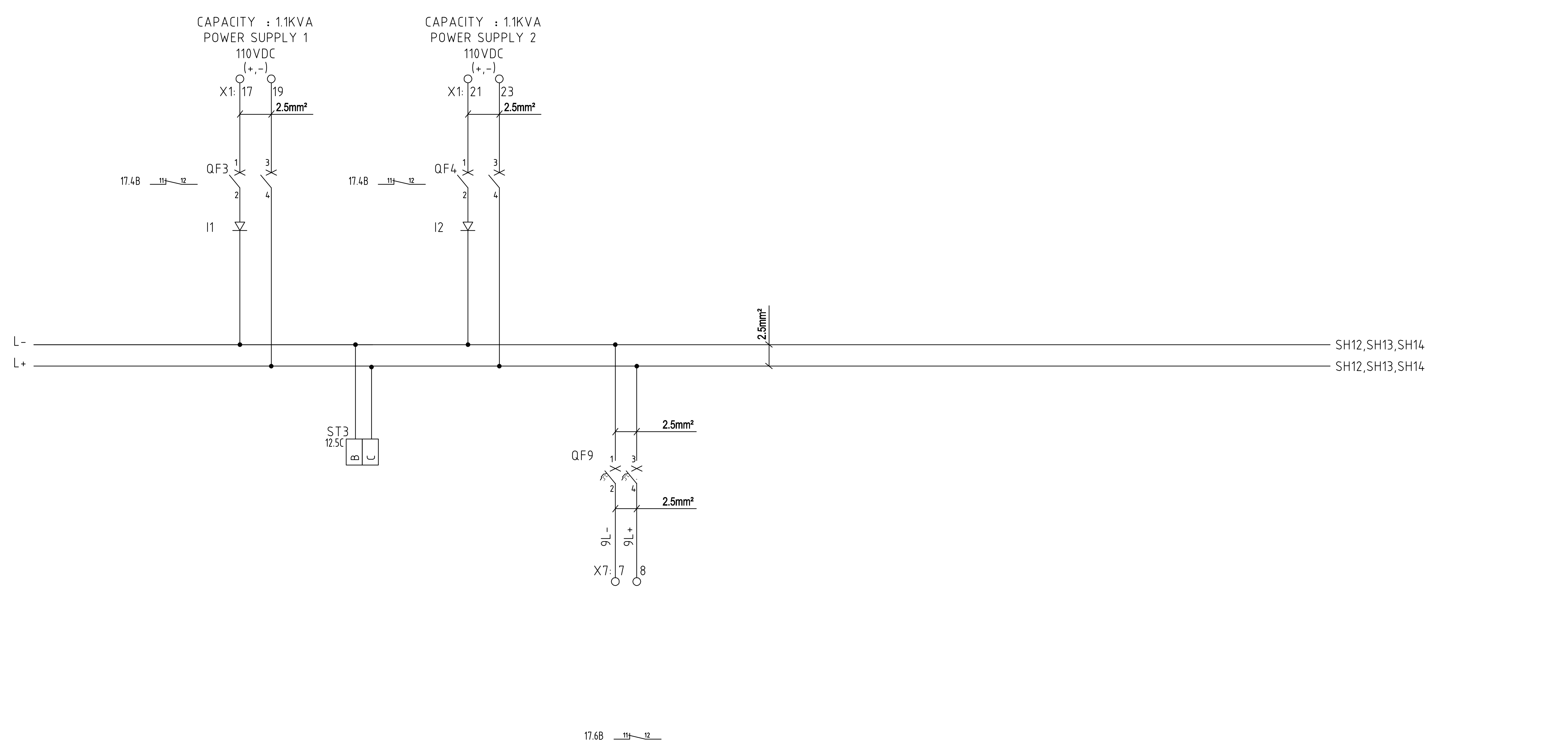
- REJECTED
- Reviewed With Comments
- Review. Without Comments
- COMMENTS AS NOTED
- REVIEWED AS BUILT
- FOR INFORMATION

DATE: -

DOCUMENT VENDOR IDENTIFICATION: HYOSUNG		SH. NO.: 9	ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)
DOCUMENT TITLE: WIRING DIAGRAM MAIN CIRCUIT(1)		SHEET: 23	
VENDOR DOCUMENT No: NT14-BA1-008	CODE: DIA-0015	REV: 5	
UTS DOCUMENT No: -		REV: -	UTS PROJECT NO. 7485 - / UNIT: -
KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001			PURCHASE ORDER NUMBER (P.O.R.) 074851201 / EQUIPMENT: 400/230KV(INTERBUS) TR.

DC POWER

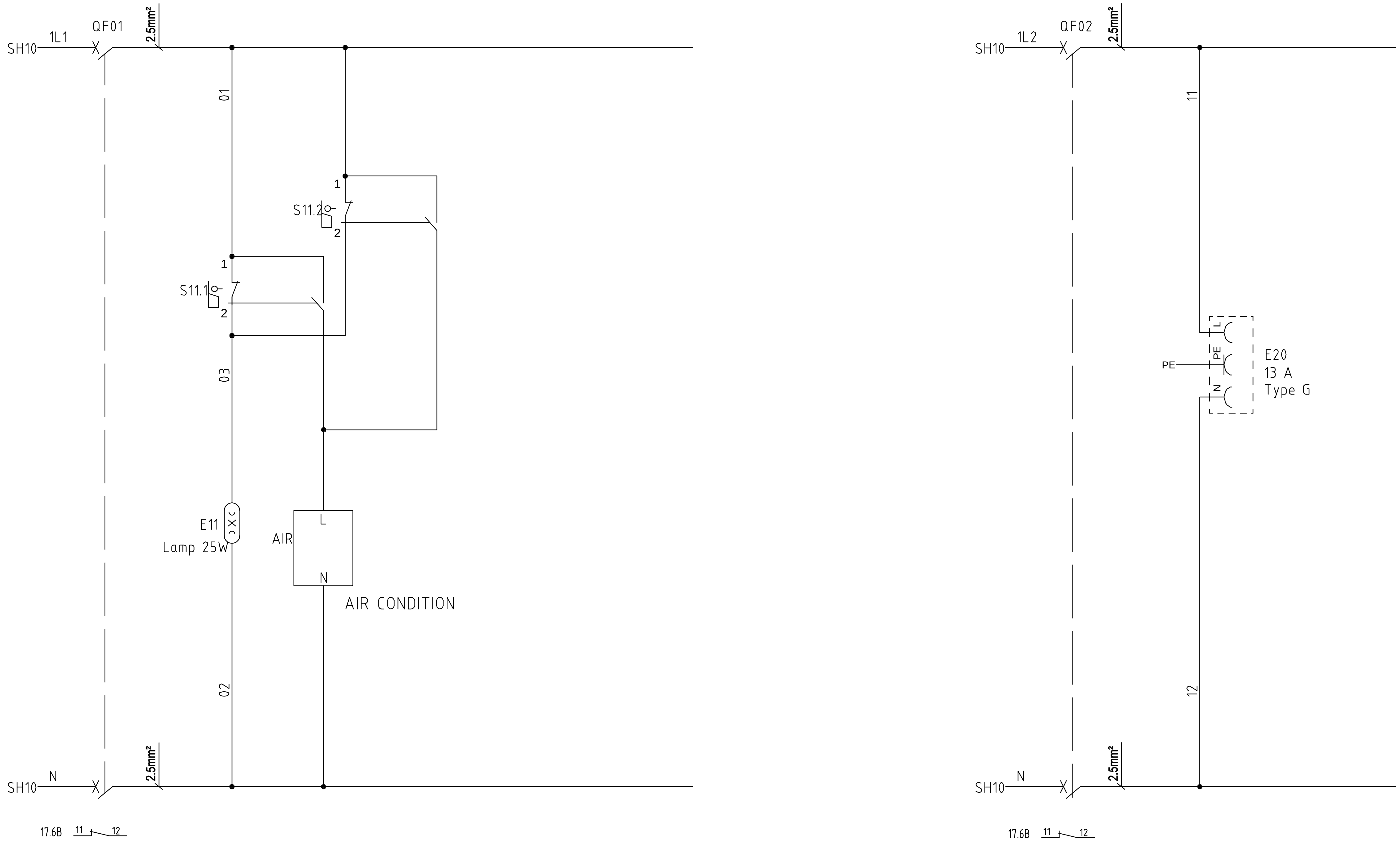
DC POWER FOR OLTC



TECNICAS REUNIDAS TSK UTE TSK TÉCNICAS REUNIDAS ASHUGANJ NORTH	Ashuganj Power Station Company Ltd. (APSCL)		
REVIEW RESPONSE BY PURCHASER	DOCUMENT VENDOR IDENTIFICATION: HYOSUNG	SH. NO.: 10	ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)
Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.	DOCUMENT TITLE: WIRING DIAGRAM MAIN CIRCUIT(1)	SHEET: 23	
- REJECTED - Reviewed With Comments - Review. Without Comments	VENDOR DOCUMENT No: NT14-BA1-008 CODE: DIA-0015	REV: 5	
- COMMENTS AS NOTED - REVIEWED AS BUILT - FOR INFORMATION	UTS DOCUMENT No: -	REV: -	UTS PROJECT NO. 7485 - UNIT: -
DATE: -	KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001		PURCHASE ORDER NUMBER (P.O.R.) 074851201 EQUIPMENT: 400/230KV(INTERBUS) TR.

LIGHT & HEATER&AIR CONDITION

SOCKET



TECNICAS REUNIDAS

TSK

UTE TSK TÉCNICAS REUNIDAS
ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

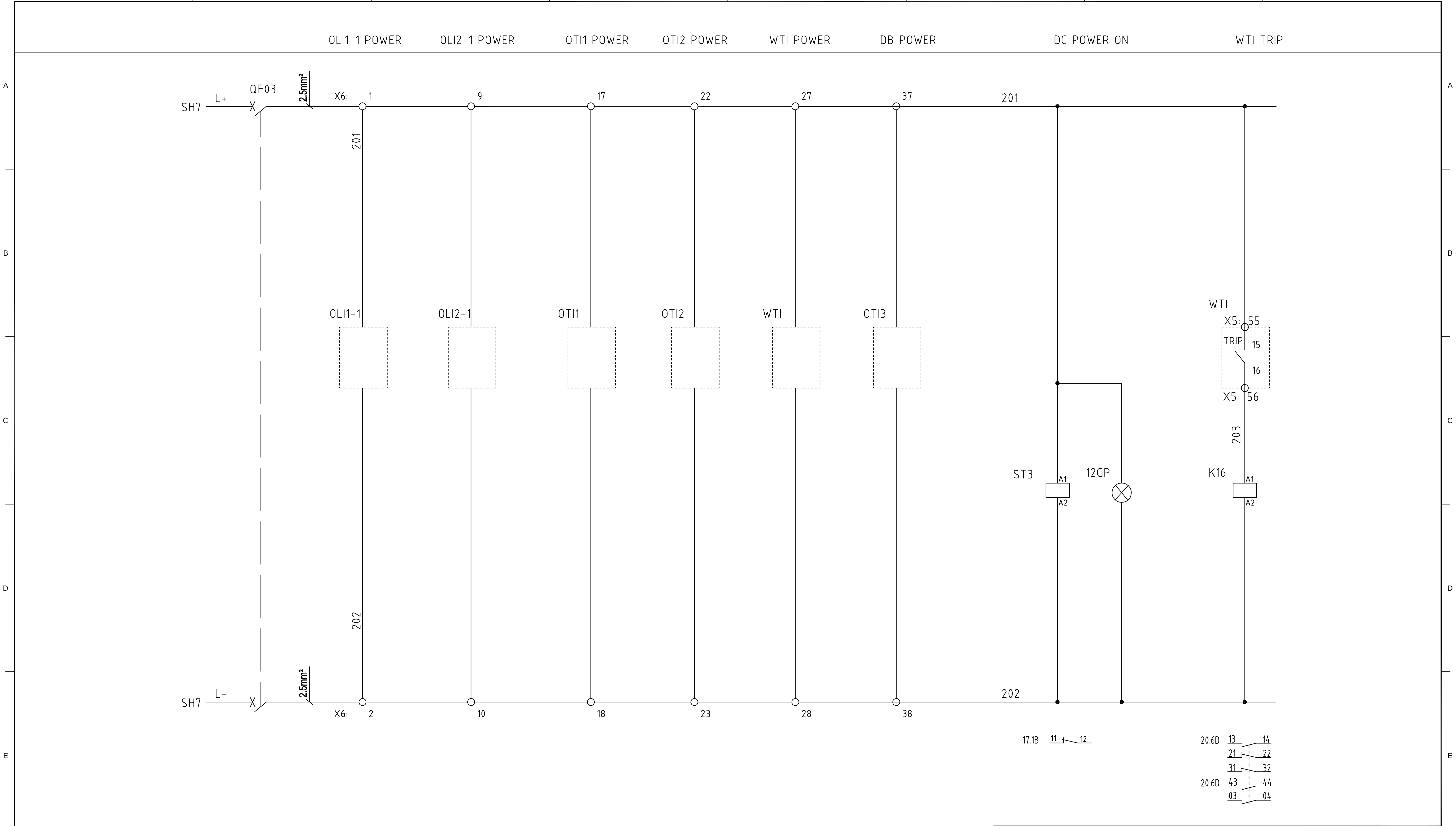
REVIEW RESPONSE BY PURCHASER

Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

- [-] REJECTED
- [-] Reviewed With Comments
- [-] Review. Without Comments
- [-] COMMENTS AS NOTED
- [-] REVIEWED AS BUILT
- [-] FOR INFORMATION

DATE: -

DOCUMENT VENDOR IDENTIFICATION: HYOSUNG		SH. NO.: 11	ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)
DOCUMENT TITLE: WIRING DIAGRAM HEATER AND LIGHTING		SHEET: 23	
VENDOR DOCUMENT No: NT14-BA1-008	CODE: DIA-0015	REV: 5	
UTS DOCUMENT No: -		REV: -	UTS PROJECT NO. 7485 - / UNIT: -
KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001			PURCHASE ORDER NUMBER (P.O.R.) 074851201 / EQUIPMENT: 400/230KV(INTERBUS) TR.



TECNICAS REUNIDAS

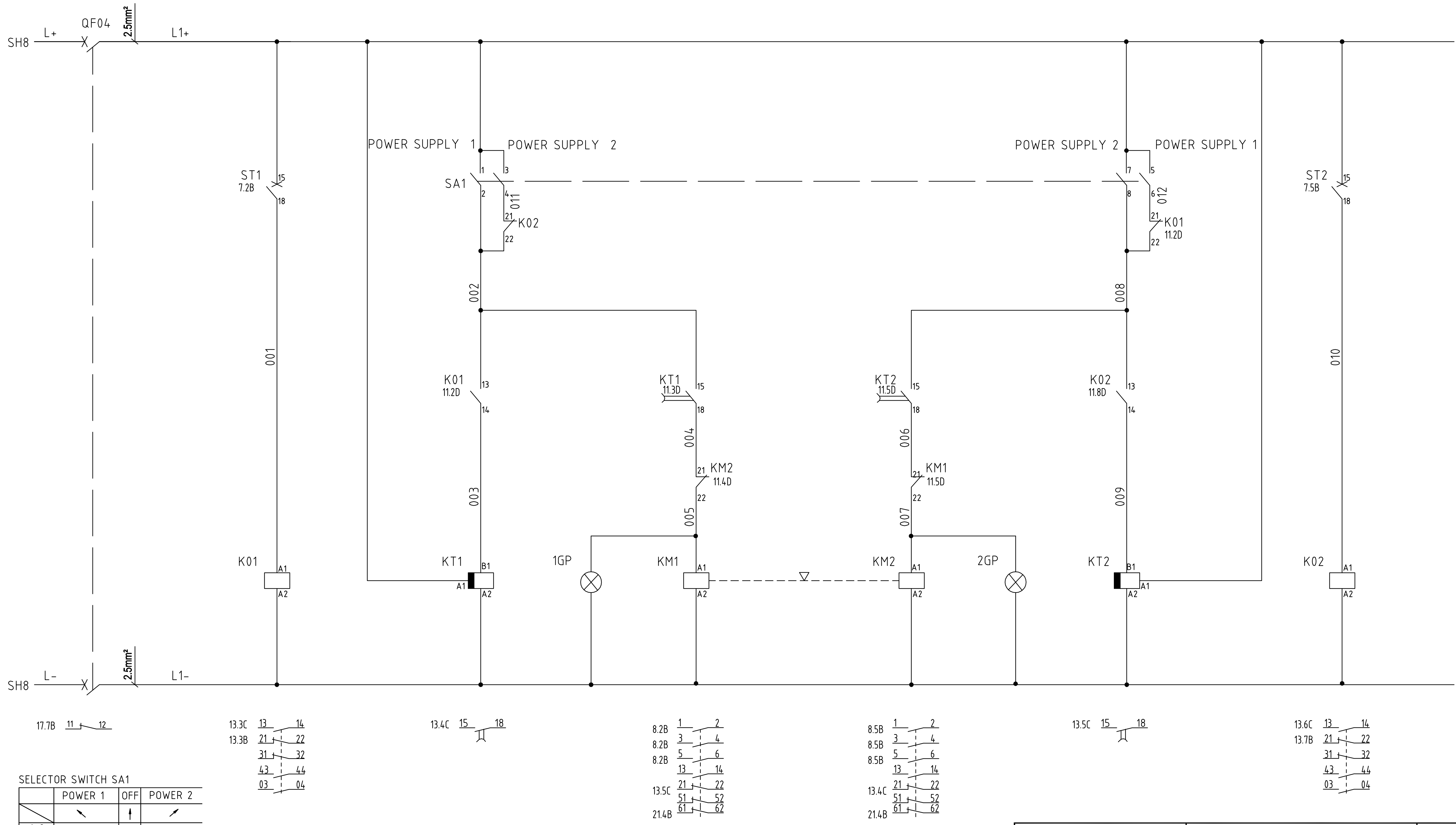
TSK

UTE TSK TÉCNICAS REUNIDAS
ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

REVIEW RESPONSE BY PURCHASER	DOCUMENT VENDOR IDENTIFICATION: HYOSUNG	SH. NO.: 12	ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)
Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.	DOCUMENT TITLE: WIRING DIAGRAM APPENDIX POWER CIRCUIT	SHEET: 23	
- REJECTED / - Reviewed With Comments / - Review. Without Comments	VENDOR DOCUMENT No: NT14-BA1-008 / CODE: DIA-0015	REV: 5	
- COMMENTS AS NOTED / - REVIEWED AS BUILT / - FOR INFORMATION	UTS DOCUMENT No: -	REV: -	UTS PROJECT NO. 7485 - / UNIT: -
DATE: -	KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001		PURCHASE ORDER NUMBER (P.O.R.) 074851201 / EQUIPMENT: 400/230KV(INTERBUS) TR.

POWER SUPPLY 1 ON | 400V AC AUTOMATIC TRANSFER CONTROL | POWER SUPPLY 2 ON



SELECTOR SWITCH SA1

	POWER 1	OFF	POWER 2
	↖	↑	↗
1-2	×		
3-4			×
5-6	×		
7-8			×

TECNICAS REUNIDAS | TSK
UTE TSK TÉCNICAS REUNIDAS
ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

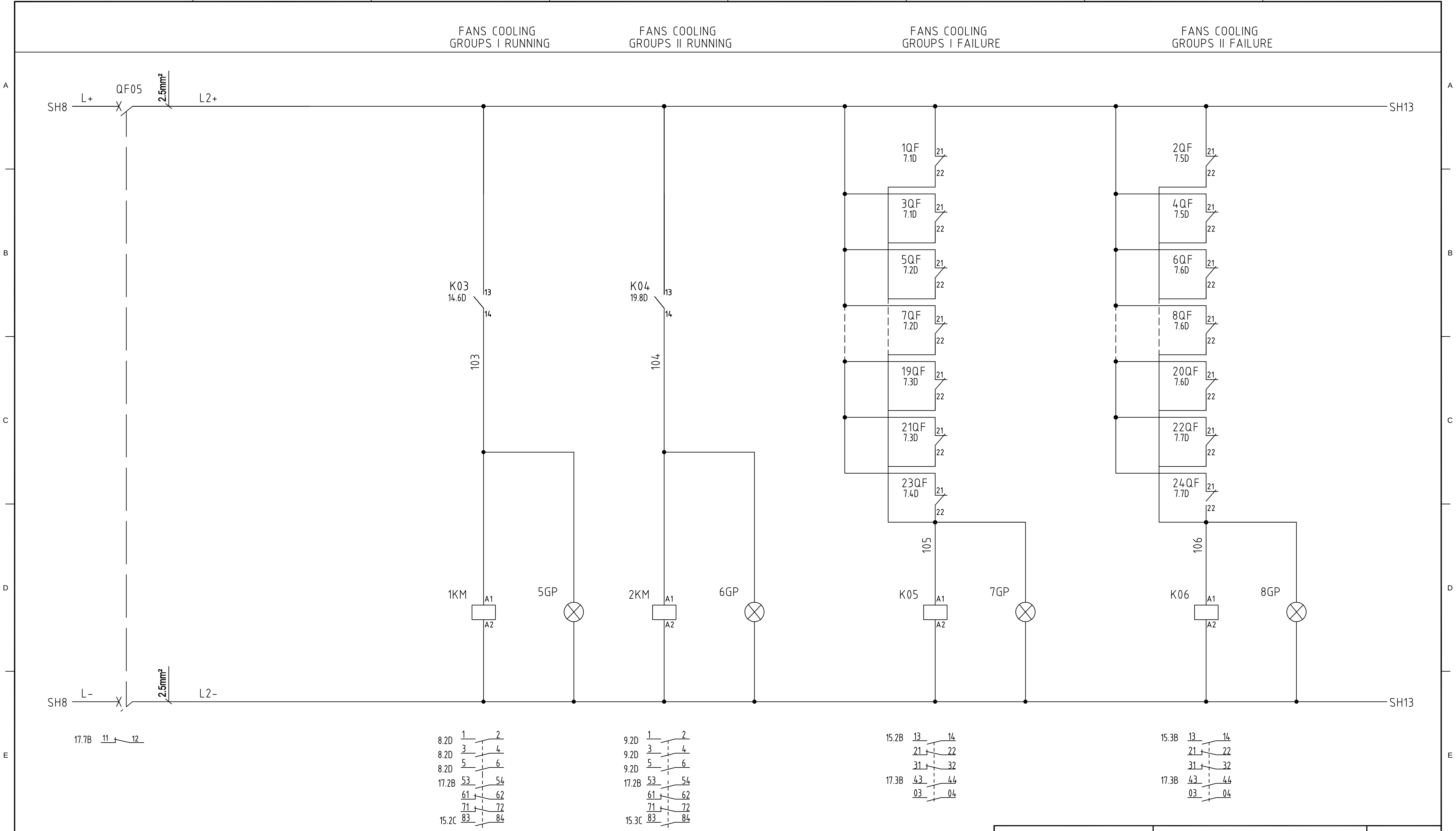
REVIEW RESPONSE BY PURCHASER

Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

- REJECTED | - Reviewed With Comments | - Review. Without Comments
- COMMENTS AS NOTED | - REVIEWED AS BUILT | - FOR INFORMATION

DATE: -

DOCUMENT VENDOR IDENTIFICATION: HYOSUNG		SH. NO.: 13	ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)
DOCUMENT TITLE: WIRING DIAGRAM CONTROL CIRCUIT(1)		SHEET: 23	
VENDOR DOCUMENT No: NT14-BA1-008	CODE: DIA-0015	REV: 5	
UTS DOCUMENT No: -		REV: -	UTS PROJECT NO. 7485 - / UNIT: -
KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001			PURCHASE ORDER NUMBER (P.O.R.) 074851201 / EQUIPMENT: 400/230KV(INTERBUS) TR.



TECNICAS REUNIDAS
TSK
UTE TSK TÉCNICAS REUNIDAS
ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)

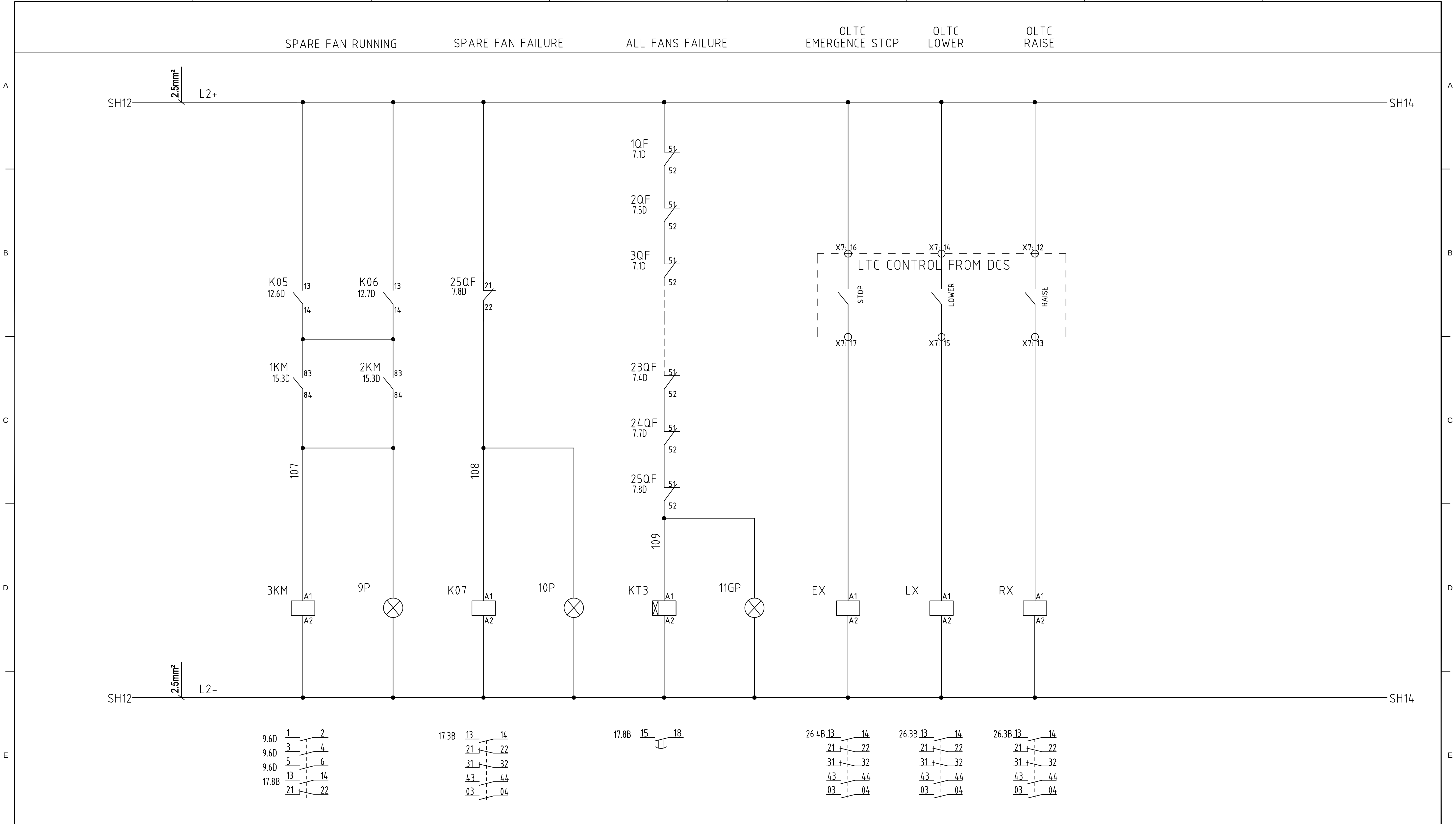
REVIEW RESPONSE BY PURCHASER

Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

- REJECTED
- Reviewed With Comments
- Review. Without Comments
- COMMENTS AS NOTED
- REVIEWED AS BUILT
- FOR INFORMATION

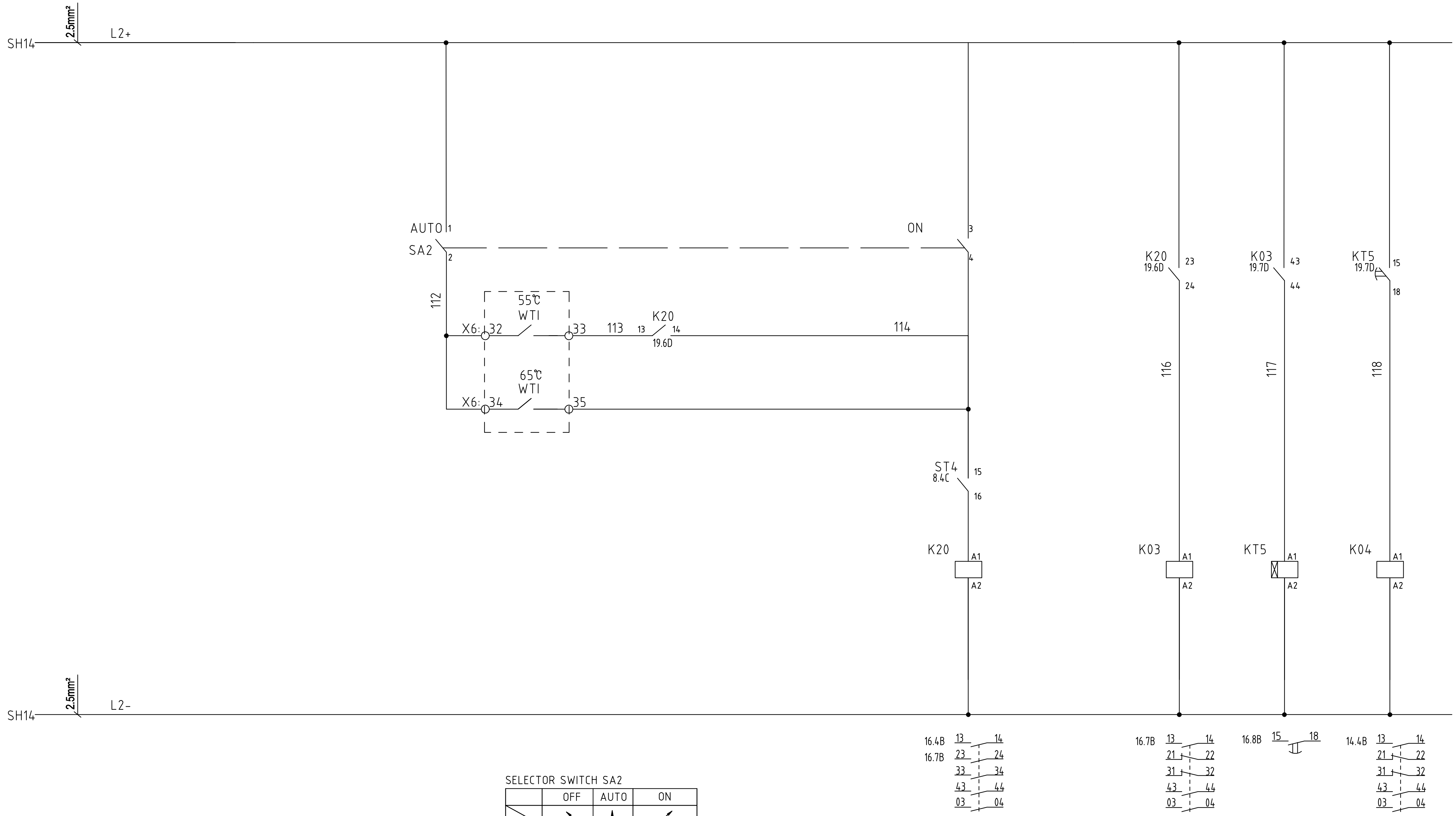
DATE: -

DOCUMENT VENDOR IDENTIFICATION: HYOSUNG		SH. NO.: 14	
DOCUMENT TITLE: WIRING DIAGRAM CONTROL CIRCUIT(2)		SHEET: 23	
VENDOR DOCUMENT No: NT14-BA1-008	CODE: DIA-0015	REV: 5	
UTS DOCUMENT No: -		REV: -	UTS PROJECT NO. 7485 - / UNIT: -
KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001			PURCHASE ORDER NUMBER (P.O.R.) 074851201 / EQUIPMENT: 400/230KV(INTERBUS) TR.



REVIEW RESPONSE BY PURCHASER Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions. - REJECTED - Reviewed With Comments - Review. Without Comments - COMMENTS AS NOTED - REVIEWED AS BUILT - FOR INFORMATION DATE: -	DOCUMENT VENDOR IDENTIFICATION: HYOSUNG	SH. NO.: 15	UTE TSK TÉCNICAS REUNIDAS ASHUGANJ NORTH — Ashuganj Power Station Company Ltd. (APSCL)
	DOCUMENT TITLE: WIRING DIAGRAM CONTROL CIRCUIT(3)	SHEET: 23	ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)
	VENDOR DOCUMENT No: NT14-BA1-008 — CODE: DIA-0015	REV: 5	
	UTS DOCUMENT No: -	REV: -	UTS PROJECT NO. 7485 - — UNIT: -
	KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001		PURCHASE ORDER NUMBER (P.O.R.) 074851201 — EQUIPMENT: 400/230KV(INTERBUS) TR.

COOLING CONTROL



SELECTOR SWITCH SA2

	OFF	AUTO	ON
1-2		×	
3-4			×
5-6		×	
7-8			×

TECNICAS REUNIDAS

TSK

UTE TSK TÉCNICAS REUNIDAS
ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

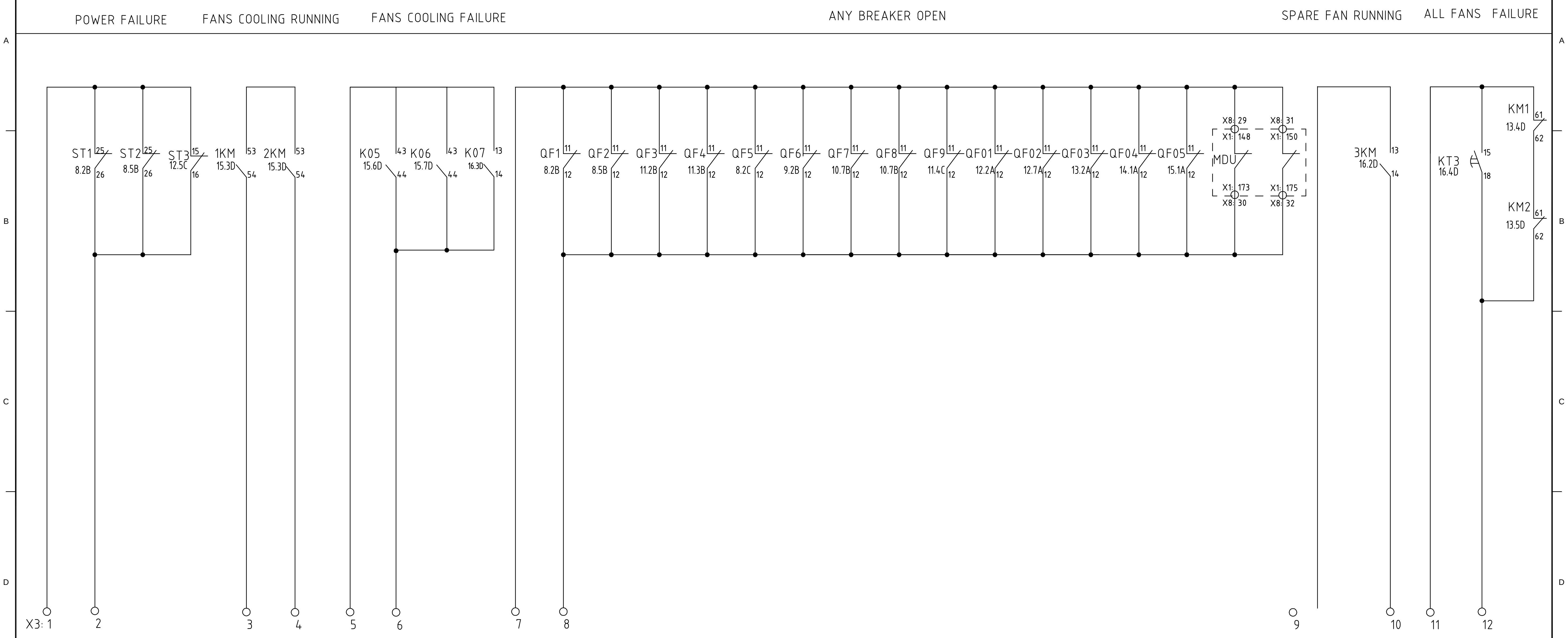
REVIEW RESPONSE BY PURCHASER

Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

- REJECTED
- Reviewed With Comments
- Review. Without Comments
- COMMENTS AS NOTED
- REVIEWED AS BUILT
- FOR INFORMATION

DATE: -

DOCUMENT VENDOR IDENTIFICATION: HYOSUNG		SH. NO.: 16	ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)
DOCUMENT TITLE: WIRING DIAGRAM CONTROL CIRCUIT(4)		SHEET: 23	
VENDOR DOCUMENT No: NT14-BA1-008	CODE: DIA-0015	REV: 5	
UTS DOCUMENT No: -		REV: -	UTS PROJECT NO. 7485 - / UNIT: -
KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001			PURCHASE ORDER NUMBER (P.O.R.) 074851201 / EQUIPMENT: 400/230KV(INTERBUS) TR.



Tecnicas Reunidas | TSK

UTE TSK TÉCNICAS REUNIDAS
ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

REVIEW RESPONSE BY PURCHASER

Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

- [-] REJECTED
- [-] Reviewed With Comments
- [-] Review. Without Comments
- [-] COMMENTS AS NOTED
- [-] REVIEWED AS BUILT
- [-] FOR INFORMATION

DATE: -

DOCUMENT VENDOR IDENTIFICATION: HYOSUNG		SH. NO.:	17
DOCUMENT TITLE: WIRING DIAGRAM SIGNAL CIRCUIT		SHEET:	23
VENDOR DOCUMENT No: NT14-BA1-008	CODE: DIA-0015	REV:	5
UTS DOCUMENT No: -		REV:	-
KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001			

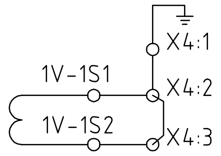
ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)

UTS PROJECT NO. 7485 -	UNIT: -
PURCHASE ORDER NUMBER (P.O.R.) 074851201	EQUIPMENT: 400/230KV(INTERBUS) TR.

PHASE 1U
CURRENT TRANSFORMER

700/5
0.5s,15VA
FOR WTI

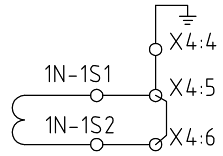
PHASE 1V
CURRENT TRANSFORMER



PHASE 1W
CURRENT TRANSFORMER

PHASE 1N
CURRENT TRANSFORMER

500/1
5P20,30VA



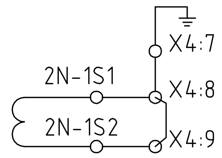
PHASE 2U
CURRENT TRANSFORMER

PHASE 2V
CURRENT TRANSFORMER

PHASE 2W
CURRENT TRANSFORMER

PHASE 2N
CURRENT TRANSFORMER

500/1
5P20,30VA



TECNICAS REUNIDAS
UTE TSK TÉCNICAS REUNIDAS
ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

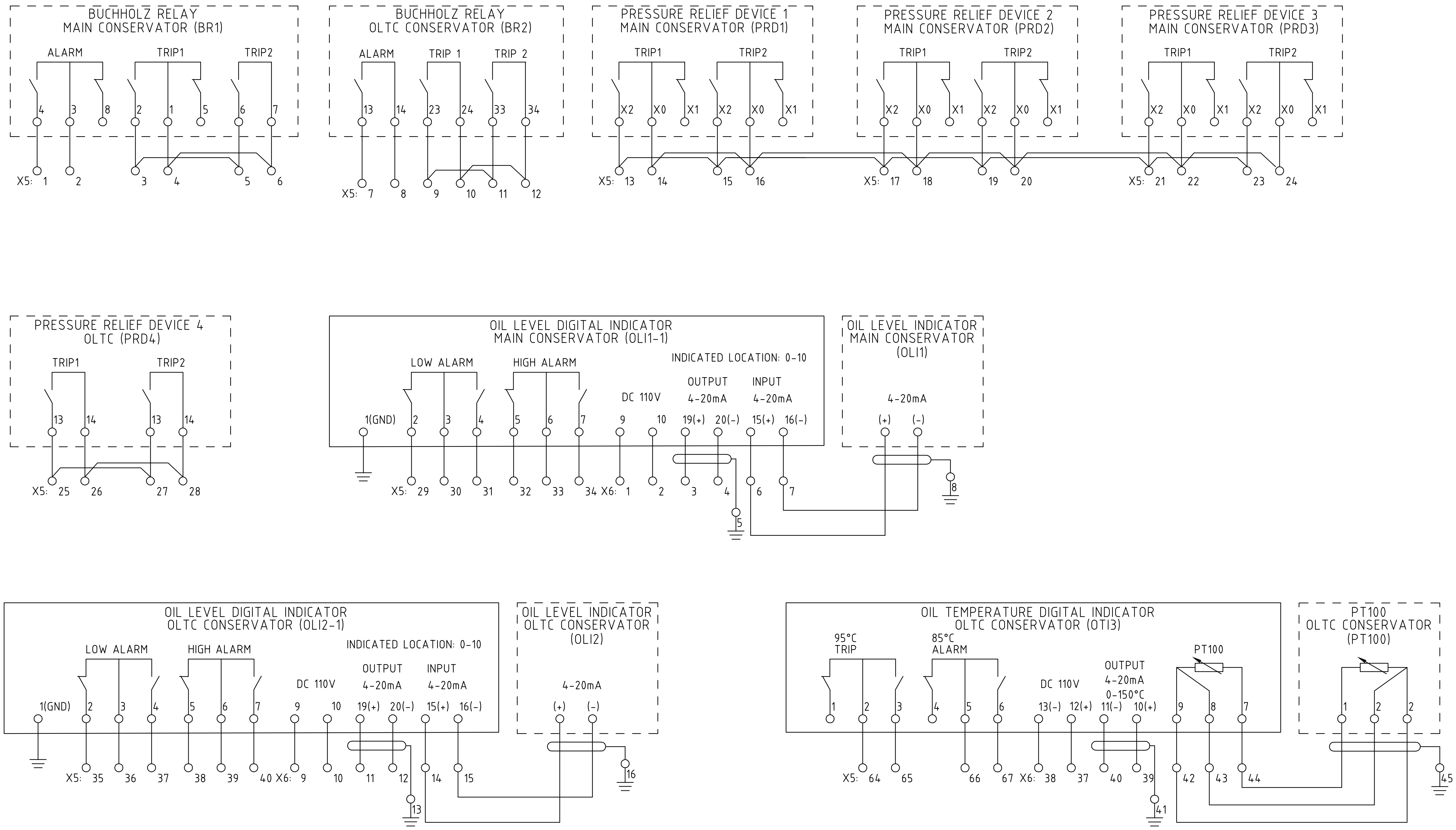
REVIEW RESPONSE BY PURCHASER

Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

- [-] REJECTED
- [-] Reviewed With Comments
- [-] Review. Without Comments
- [-] COMMENTS AS NOTED
- [-] REVIEWED AS BUILT
- [-] FOR INFORMATION

DATE: -

DOCUMENT VENDOR IDENTIFICATION: HYOSUNG		SH. NO.: 18	ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)
DOCUMENT TITLE: WIRING DIAGRAM CT CIRCUIT		SHEET: 23	
VENDOR DOCUMENT No: NT14-BA1-008	CODE: DIA-0015	REV: 5	
UTS DOCUMENT No: -		REV: -	UTS PROJECT NO. 7485 - / UNIT: -
KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001			PURCHASE ORDER NUMBER (P.O.R.) 074851201 / EQUIPMENT: 400/230KV(INTERBUS) TR.



TECNICAS REUNIDAS

TSK

UTE TSK TÉCNICAS REUNIDAS
ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

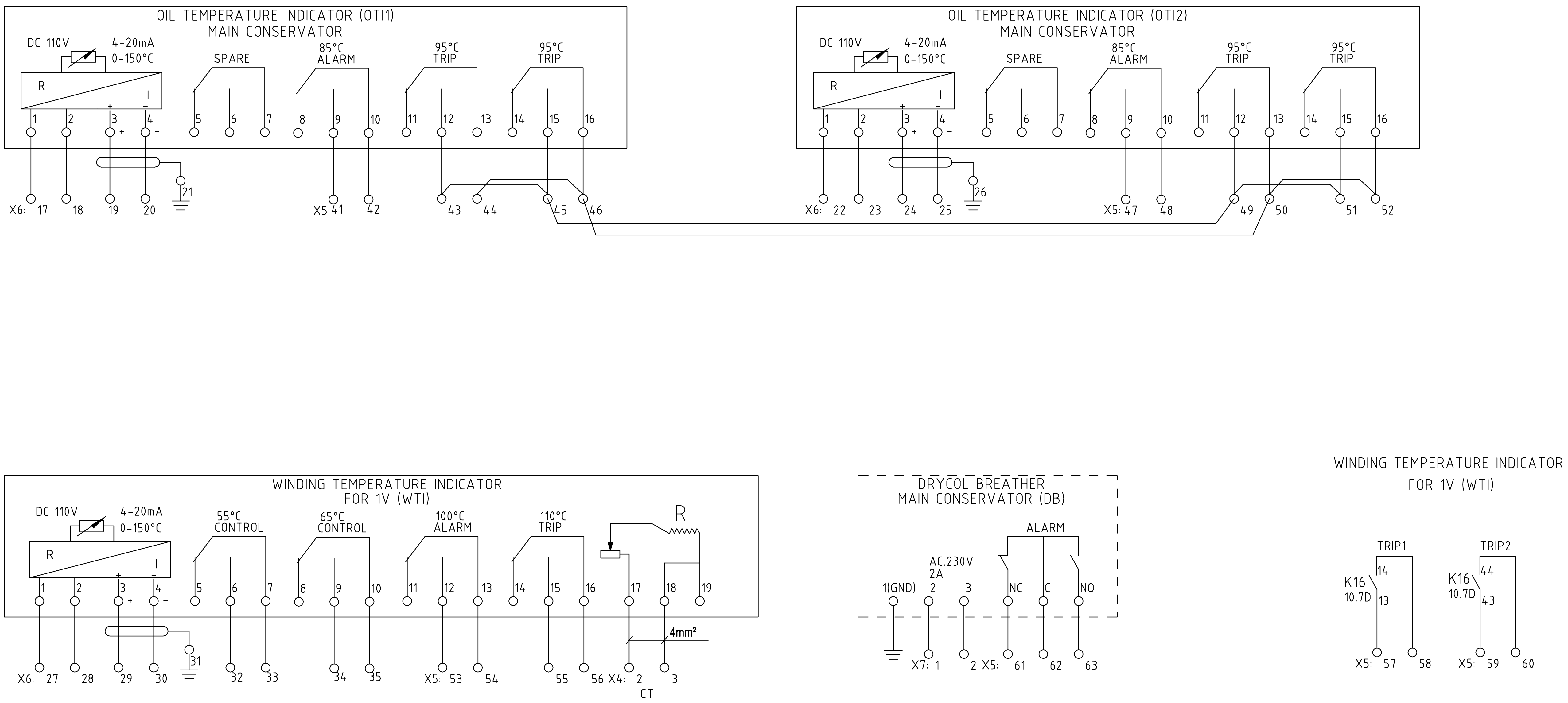
REVIEW RESPONSE BY PURCHASER

Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

- REJECTED - Reviewed With Comments - Review. Without Comments
- COMMENTS AS NOTED - REVIEWED AS BUILT - FOR INFORMATION

DATE: -

DOCUMENT VENDOR IDENTIFICATION: HYOSUNG		SH. NO.: 19	ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)
DOCUMENT TITLE: WIRING DIAGRAM PROTECTION RELAY		SHEET: 23	
VENDOR DOCUMENT No: NT14-BA1-008	CODE: DIA-0015	REV: 5	
UTS DOCUMENT No: -		REV: -	UTS PROJECT NO. 7485 - / UNIT: -
KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001			PURCHASE ORDER NUMBER (P.O.R.) 074851201 / EQUIPMENT: 400/230KV(INTERBUS) TR.



TECNICAS REUNIDAS

TSK

UTE TSK TÉCNICAS REUNIDAS
ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)

REVIEW RESPONSE BY PURCHASER

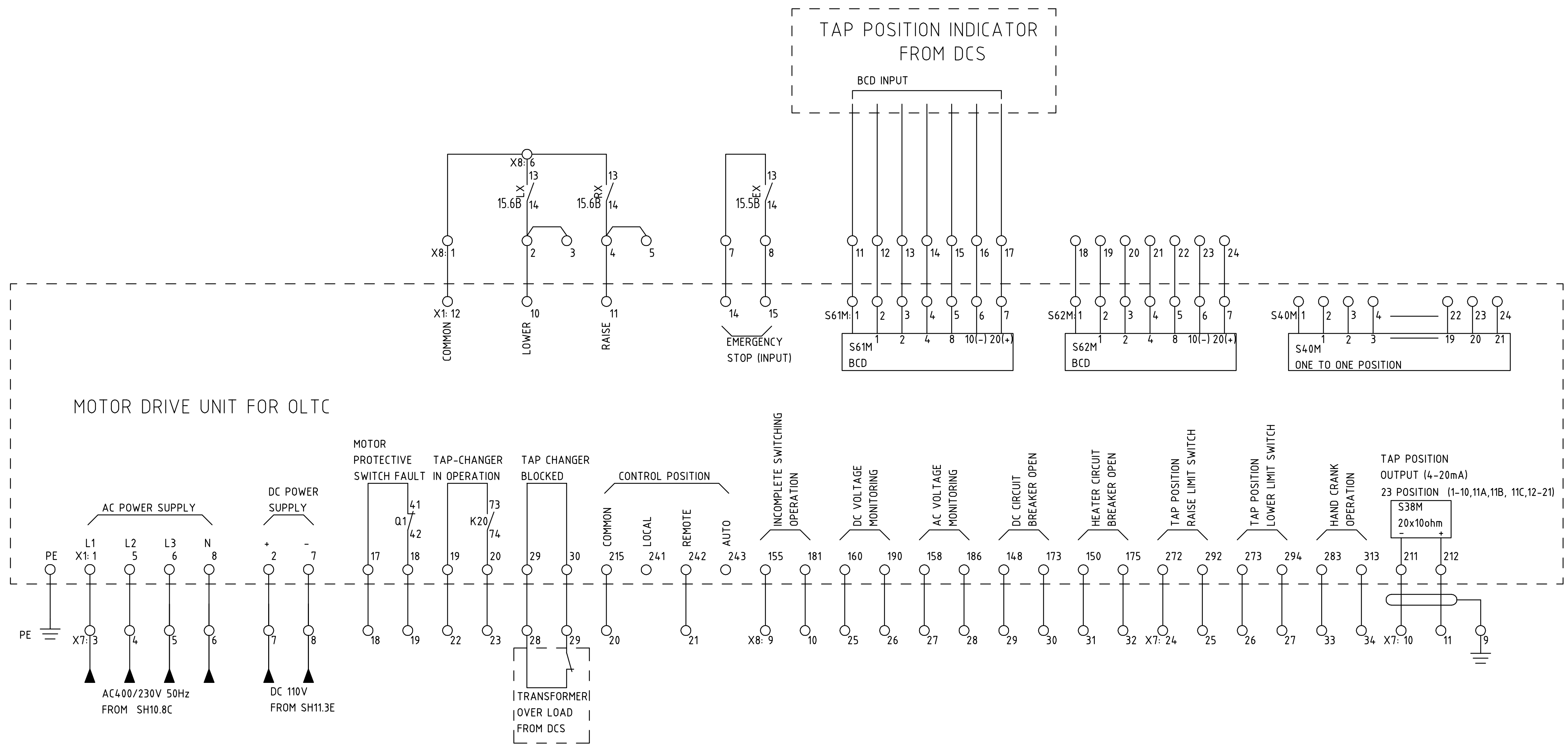
Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

- REJECTED | - Reviewed With Comments | - Review. Without Comments

- COMMENTS AS NOTED | - REVIEWED AS BUILT | - FOR INFORMATION

DATE: -

DOCUMENT VENDOR IDENTIFICATION: HYOSUNG		SH. NO.: 20	
DOCUMENT TITLE: WIRING DIAGRAM INTELLIGENT TEMPERATURE MONITOR		SHEET: 23	
VENDOR DOCUMENT No: NT14-BA1-008	CODE: DIA-0015	REV: 5	
UTS DOCUMENT No: -		REV: -	UTS PROJECT NO. 7485 -	UNIT: -
KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001			PURCHASE ORDER NUMBER (P.O.R.) 074851201	EQUIPMENT: 400/230KV(INTERBUS) TR.



TECNICAS REUNIDAS
TSK
UTE TSK TÉCNICAS REUNIDAS ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

REVIEW RESPONSE BY PURCHASER

Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

- REJECTED
- Reviewed With Comments
- Review. Without Comments
- COMMENTS AS NOTED
- REVIEWED AS BUILT
- FOR INFORMATION

DATE: -

DOCUMENT VENDOR IDENTIFICATION: HYOSUNG		SH. NO.: 21	ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)
DOCUMENT TITLE: WIRING DIAGRAM OLTC MOTOR DRIVE UNIT		SHEET: 23	
VENDOR DOCUMENT No: NT14-BA1-008	CODE: DIA-0015	REV: 5	
UTS DOCUMENT No: -		REV: -	UTS PROJECT NO. 7485 - / UNIT: -
KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001			PURCHASE ORDER NUMBER (P.O.R.) 074851201 / EQUIPMENT: 400/230KV(INTERBUS) TR.

X1:POWER TERMINAL

FROM	NO.	GO
QF1	1	POWER SUPPLY 1 400V/230V 50Hz
	2	
QF1	3	
	4	
QF1	5	
	6	
QF1	7	
PE	8	
QF2	9	POWER SUPPLY 2 400V/230V 50Hz
	10	
QF2	11	
	12	
QF2	13	
	14	
QF2	15	
	16	
- QF3	17	POWER SUPPLY 1 110VDC
	18	
+ QF3	19	
	20	
- QF4	21	POWER SUPPLY 2 110VDC
	22	
+ QF4	23	
	24	
25-30		SPARE

X2:Fans Cooling TERMINAL

FROM	NO.	GO	
1QF	1	1FM	FANS COOLING
1QF	2		
1QF	3		
2QF	4	2FM	
2QF	5		
2QF	6		
3QF	7	3FM	
3QF	8		
3QF	9		
4QF	10	4FM	
4QF	11		
4QF	12		
5QF	13	5FM	
5QF	14		
5QF	15		
6QF	16	6FM	
6QF	17		
6QF	18		
7QF	19	7FM	
7QF	20		
7QF	21		
8QF	22	8FM	
8QF	23		
8QF	24		
9QF	25	9FM	
9QF	26		
9QF	27		
10QF	28	10FM	
10QF	29		
10QF	30		
11QF	31	11FM	
11QF	32		
11QF	33		
12QF	34	12FM	
12QF	35		
12QF	36		
13QF	37	13FM	
13QF	38		
13QF	39		
14QF	40	14FM	
14QF	41		
14QF	42		
15QF	43	15FM	
15QF	44		
15QF	45		

X2:Fans Cooling TERMINAL

FROM	NO.	GO	
16QF	46	16FM	FANS COOLING
16QF	47		
16QF	48		
17QF	49	17FM	
17QF	50		
17QF	51		
18QF	52	18FM	
18QF	53		
18QF	54		
19QF	55	19FM	
19QF	56		
19QF	57		
20QF	58	20FM	
20QF	59		
20QF	60		
21QF	61	21FM	
21QF	62		
21QF	63		
22QF	64	22FM	
22QF	65		
22QF	66		
23QF	67	23FM	
23QF	68		
23QF	69		
24QF	70	24FM	
24QF	71		
24QF	72		
3KM	73	25FM	
3KM	74		
3KM	75		
76-80		SPARE	

X3:SINGAL TERMINAL

FROM	NO.	GO	
ST1.25	1	POWER FAILURE	CONTROL ROOM
ST1.26	2		
1KM.54	3	FANS COOLING RUNNING	
2KM.54	4		
K05.43	5	FANS COOLING FAILURE	
K07.14	6		
QF1.11	7	ANY BREAKER OPEN	
QF1.12	8		
3KM.13	9	SPARE FAN RUNNING	
3KM.14	10		
KT3.15	11	ALL FANS FAILURE	
KT3.18	12		
X8.29	13		
X8.30	14		
	15		
	16		
	17		
	18		
	19		
	20		

X4:CT TERMINAL

FROM	NO.	FUNCTION	GO
PE	1		FOR WTI
1V-1S1	2	700/5 0.5s,15VA	WTI.17
1V-1S2	3		WTI.18
PE	4	500/1 5P20,30VA	CONTROL ROOM
1N-1S1	5		
1N-1S2	6		
PE	7	500/1 5P20,30VA	CONTROL ROOM
2N-1S1	8		
2N-1S2	9		
	10		
	11		
	12		
	13		
	14		
	15		

X5:APPENDIX TERMINAL

FROM	NO.	FUNCTION	GO		
	1	ALARM	NO	4	BUCHHOLZ RELAY MAIN CONSERVATOR (BR1)
	2		CO	3	
	3	TRIP1	NO	2	
	4		CO	1	
	5	TRIP2	NO	6	
	6		CO	7	
	7	ALARM	NO	13	PROTECTIVE RELAY OLTC CONSERVATOR (BR2)
	8		CO	14	
	9	TRIP1	NO	23	
	10		CO	24	
	11	TRIP2	NO	33	
	12		CO	34	
	13	TRIP1	NO	X2	PRESSURE RELIEF DEVICE 1 MAIN CONSERVATOR (PRD1)
	14		CO	X0	
	15	TRIP2	NO	X2	
	16		CO	X0	
	17	TRIP1	NO	X2	PRESSURE RELIEF DEVICE 2 MAIN CONSERVATOR (PRD2)
	18		CO	X0	
	19	TRIP2	NO	X2	
	20		CO	X0	
	21	TRIP1	NO	X2	PRESSURE RELIEF DEVICE 3 MAIN CONSERVATOR (PRD3)
	22		CO	X0	
	23	TRIP2	NO	X2	
	24		CO	X0	
	25	TRIP1	CO	13	PRESSURE RELIEF DEVICE 4 OLTC (PRD4)
	26		NC	14	
	27	TRIP2	NO	13	
	28		CO	14	
	29	LOW	NC	2	OIL LEVEL DIGITAL INDICATOR MAIN CONSERVATOR (OLI1-1)
	30		CO	3	
	31		NO	4	
	32	HIGH	NC	5	
	33		CO	6	
	34		NO	7	

TECNICAS REUNIDAS TSK
UTE TSK TÉCNICAS REUNIDAS ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

REVIEW RESPONSE BY PURCHASER

Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

- [-] REJECTED
- [-] Reviewed With Comments
- [-] Review. Without Comments
- [-] COMMENTS AS NOTED
- [-] REVIEWED AS BUILT
- [-] FOR INFORMATION

DATE: -

DOCUMENT VENDOR IDENTIFICATION: HYOSUNG		SH. NO.: 22	ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)
DOCUMENT TITLE: WIRING DIAGRAM TERMINAL BLOCK(1)		SHEET: 23	
VENDOR DOCUMENT No: NT14-BA1-008	CODE: DIA-0015	REV: 5	
UTS DOCUMENT No: -		REV: -	UTS PROJECT NO. 7485 - / UNIT: -
KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001			PURCHASE ORDER NUMBER (P.O.R.) 074851201 / EQUIPMENT: 400/230KV(INTERBUS) TR.

X5:APPENDIX TERMINAL

FROM	NO.	FUNCTION		GO	
	35	LOW	NC	2	OIL LEVEL DIGITAL INDICATOR OLTC CONSERVATOR (OLI2-1)
	36		CO	3	
	37		NO	4	
	38	HIGH	NC	5	
	39		CO	6	
	40		NO	7	
	41	85°C ALARM	NO	9	OIL TEMPERATURE INDICATOR (OTI1) MAIN CONSERVATOR
	42		CO	10	
	43	95°C TRIP	NO	12	
	44		CO	13	
	45	95°C TRIP	NO	15	
	46		CO	16	
	47	85°C ALARM	NO	9	OIL TEMPERATURE INDICATOR (OTI2) OLTC CONSERVATOR
	48		CO	10	
	49	95°C TRIP	NO	12	
	50		CO	13	
	51	95°C TRIP	NO	15	
	52		CO	16	
	53	100°C ALARM	NO	12	WINDING TEMPERATURE INDICATOR FOR 1U (WTI)
	54		CO	13	
X6.1	55	110°C TRIP	NO	15	
K16.A1	56		CO	16	
K16.13	57	TRIP1	NO	K16.13	WINDING TEMPERATURE INDICATOR FOR 1U (WTI)
K16.14	58		CO	K16.14	
K16.43	59	TRIP2	NO	K16.43	
K16.44	60		CO	K16.44	
	61	ALARM	NC	NC	DRYCOL BREATHER MAIN CONSERVATOR (DB)
	62		CO	CO	
	63		NO	NO	
	64	95°C TRIP	CO	2	OIL TEMPERATURE DIGITAL INDICATOR (OTI3) OLTC CONSERVATOR
	65		NO	3	
	66	85°C ALARM	CO	5	
	67		NO	6	
	68				
	69				
	70				

X6:APPENDIX TERMINAL

FROM	NO.	FUNCTION		GO	
X5.55	1	DC110V	+	9	OIL LEVEL DIGITAL INDICATOR MAIN CONSERVATOR (OLI1-1)
K16.A2	2		–	10	
	3	OUTPUT 4-20mA	+	19	
	4		–	20	
PE	5				
OLI1-1.15	6	4-20mA	+	15(+)	OIL LEVEL INDICATOR (OLI1) MAIN CONSERVATOR
OLI1-1.16	7		–	16(-)	
PE	8				
QF03.4	9	DC110V	+	9	OIL LEVEL DIGITAL INDICATOR OLTC CONSERVATOR (OLI2-1)
	10		–	10	
	11	OUTPUT 4-20mA	+	19	
	12		–	20	
PE	13				
OLI2-1.15	14	4-20mA	+	15(+)	OIL LEVEL INDICATOR (OLI2) OLTC CONSERVATOR
OLI2-1.16	15		–	16(-)	
PE	16				
	17	DC110V	+	1	OIL TEMPERATURE INDICATOR (OTI1)
	18		–	2	
	19	4-20mA	+	3	
	20		–	4	
PE	21				
	22	DC110V	+	1	OIL TEMPERATURE INDICATOR (OTI2)
	23		–	2	
	24	4-20mA	+	3	
	25		–	4	
PE	26				
X6.37	27	DC110V	+	1	WINDING TEMPERATURE INDICATOR FOR 1U (WTI)
X6.38	28		–	2	
	29	4-20mA	+	3	
	30		–	4	
PE	31				
SA2.2	32	75°C CONTROL	NO	6	
K20.13	33		CO	7	
	34	85°C CONTROL	NO	9	
ST4.15	35		CO	10	
	36				
X6.27	37	DC110V	+	12	OIL TEMPERATURE DIGITAL INDICATOR (OTI3) OLTC CONSERVATOR
X6.28	38		–	13	
	39	4-20mA	+	10	
	40		–	11	
PE	41				
1	42	PT100		9	
2	43			8	
2	44			7	
PE	45				

X7:OLTC AND DRYCOL TERMINAL

FROM	NO.	GO	
QF7	1	7L	AC POWER FOR DRYCOL AC 230V
QF7	2	7N	
QF8	3	8L1	AC POWER FOR OLTC AC 400/230V 50Hz 3P+N
QF8	4	8L2	
QF8	5	8L3	
QF8	6	8LN	
QF9	7	9L-	DC POWER FOR OLTC DC 110V
QF9	8	9L+	
	9	PE	
	10	X1.211	TAP POSITION 4-20MA
	11	X1.212	
K20.23	12		TAP RAISE SIGNAL
RX.A1	13		
	14		TAP LOWER SIGNAL
LX.A1	15		
SA2.1	16		TAP STOP SIGNAL
EX.A1	17		
	18	X1.17	OLTC CIRCUIT BREAKER OPEN
	19	X1.18	
	20	X1.215	OLTC REMOTE POSITION
	21	X1.242	
	22	X1.19	OLTC MOTOR RUNNING
	23	X1.20	
	24	X1.272	TAP AT MAXIMUM
	25	X1.292	
	26	X1.273	TAP AT MINIMUM
	27	X1.294	
	28	X1.29	TAP CHANGER BLOCKED
	29	X1.30	
	30		

X9:SPARE TERMINALS

1-20

X8:OLTC TERMINALS

FROM	NO.	GO	
X8:6	1	X1.12	COMMON
LX.14	2	X1.10	OLTC LOWER
RX.14	3		
RX.14	4	X1.11	OLTC RAISE
	5		
LX.13,X8:1	6		
EX.13	7	X1.14	EMERGENCY STOP (INPUT)
EX.14	8	X1.15	
	9	X1.155	INCOMPLETE SWITCHING OPERATION
	10	X1.181	
	11	S61M.1	BCD TAP POSITION FOR INDICATOR
	12	S61M.2	
	13	S61M.3	
	14	S61M.4	
	15	S61M.5	
	16	S61M.6	
	17	S61M.7	
	18	S62M.1	BCD TAP POSITION
	19	S62M.2	
	20	S62M.3	
	21	S62M.4	
	22	S62M.5	
	23	S62M.6	
	24	S62M.7	
	25	X1.160	DC VOLTAGE MONITORING
	26	X1.190	
	27	X1.158	AC VOLTAGE MONITORING
	28	X1.186	
X3.13	29	X1.148	DC CIRCUIT BREAKER OPEN
X3.14	30	X1.173	
	31	X1.150	HEATER CIRCUIT BREAKER OPEN
	32	X1.175	
	33	X1.283	HAND CRANK OPERATION
	34	X1.313	
	35		
	36		
	37		
	38		
	39		
	40		

TECNICAS REUNIDAS TSK

UTE TSK TÉCNICAS REUNIDAS
ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

REVIEW RESPONSE BY PURCHASER

Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

- [-] REJECTED
- [-] Reviewed With Comments
- [-] Review. Without Comments
- [-] COMMENTS AS NOTED
- [-] REVIEWED AS BUILT
- [-] FOR INFORMATION

DATE: -

DOCUMENT VENDOR IDENTIFICATION: HYOSUNG		SH. NO.: 23	ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)
DOCUMENT TITLE: WIRING DIAGRAM TERMINAL BLOCK(2)		SHEET: 23	
VENDOR DOCUMENT No: NT14-BA1-008	CODE: DIA-0015	REV: 5	
UTS DOCUMENT No: -		REV: -	UTS PROJECT NO. 7485 - / UNIT: -
KKS DOCUMENT No: 07485-20-ADT-JDW-HYO-001			PURCHASE ORDER NUMBER (P.O.R.) 074851201 / EQUIPMENT: 400/230KV(INTERBUS) TR.

WEIGHT

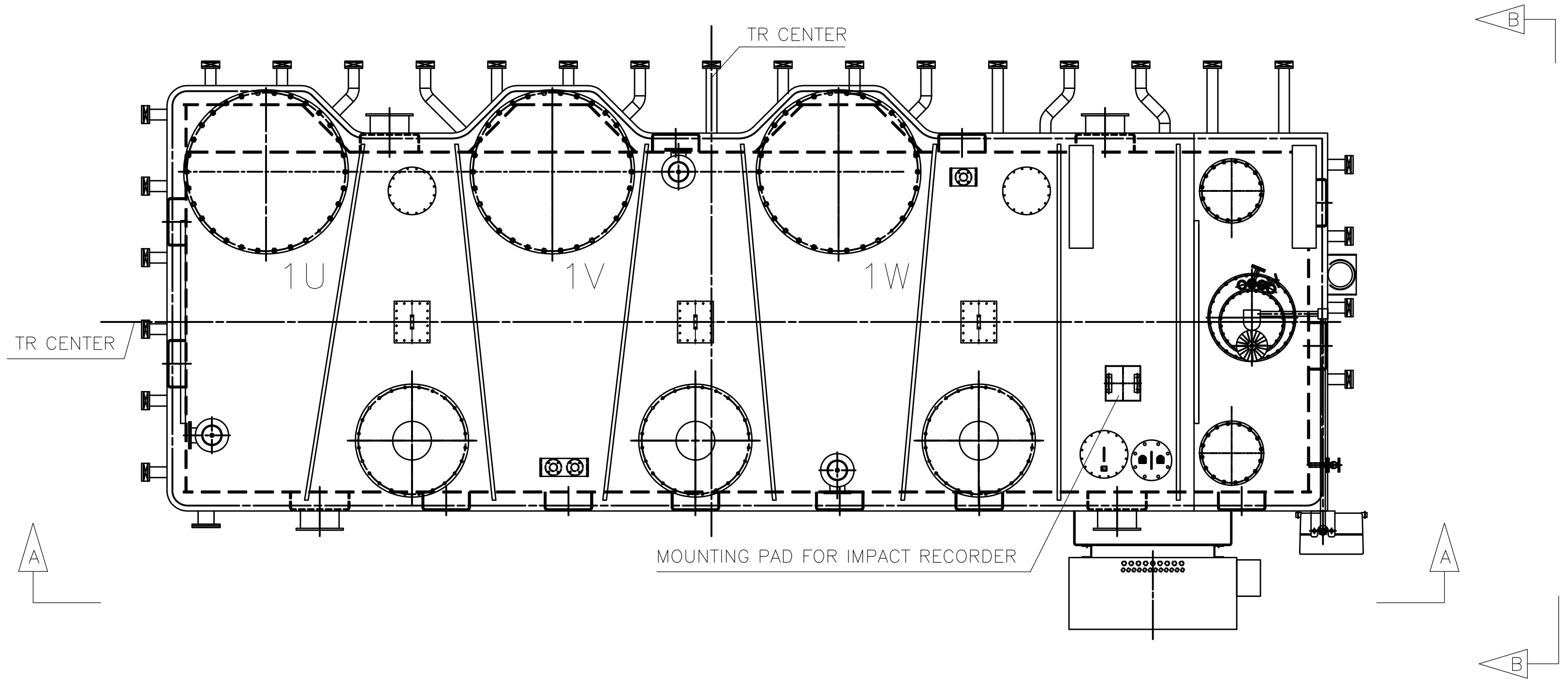
CORE AND COIL	:	188,070	KG
TANK AND FITTING	:	72,130	KG
INSULATING OIL	:	76,000	KG
		(86,364	L)
SHIPPING(WITHOUT OIL)	:	214,100	KG
TOTAL	:	336,200	KG

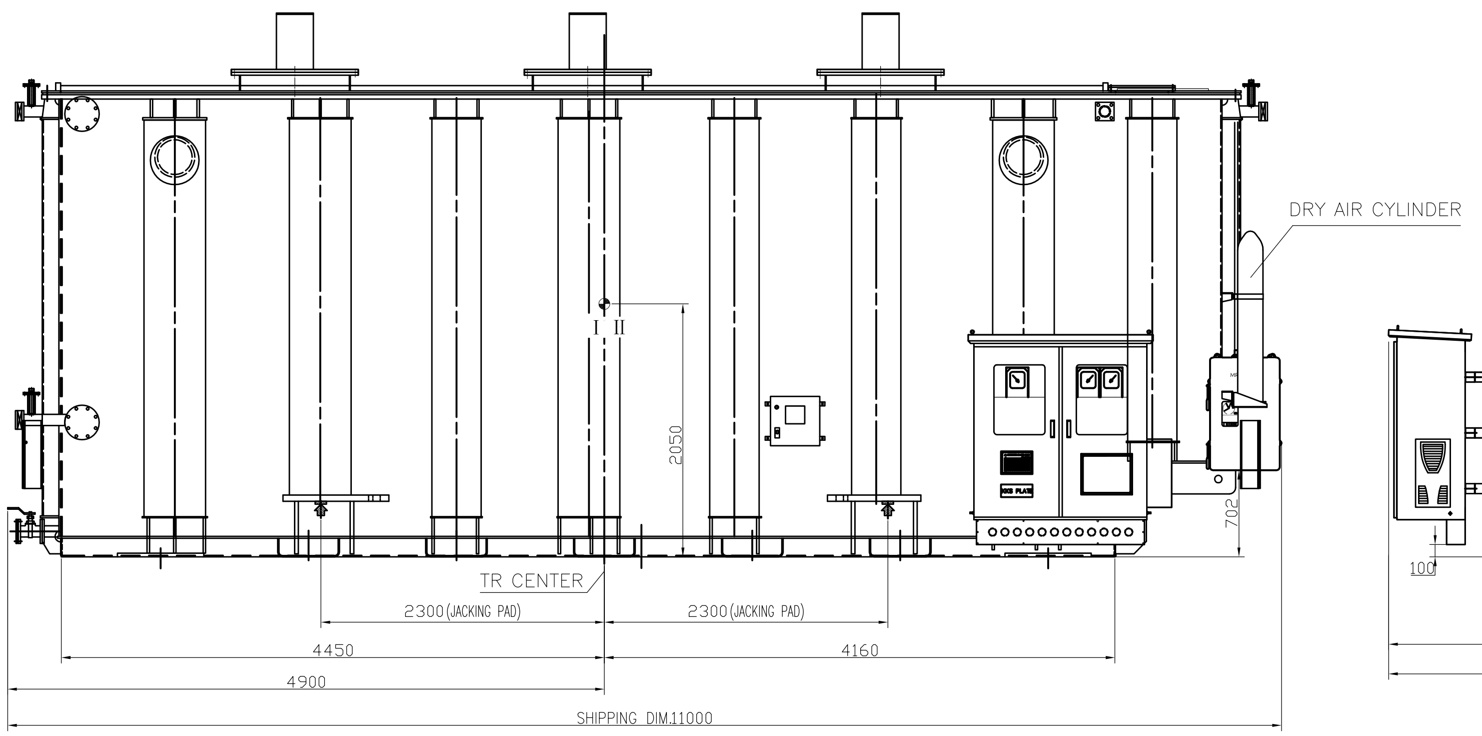
SHIPPING DIMENSION

11000(L) x 4850(W) x 4500(H)

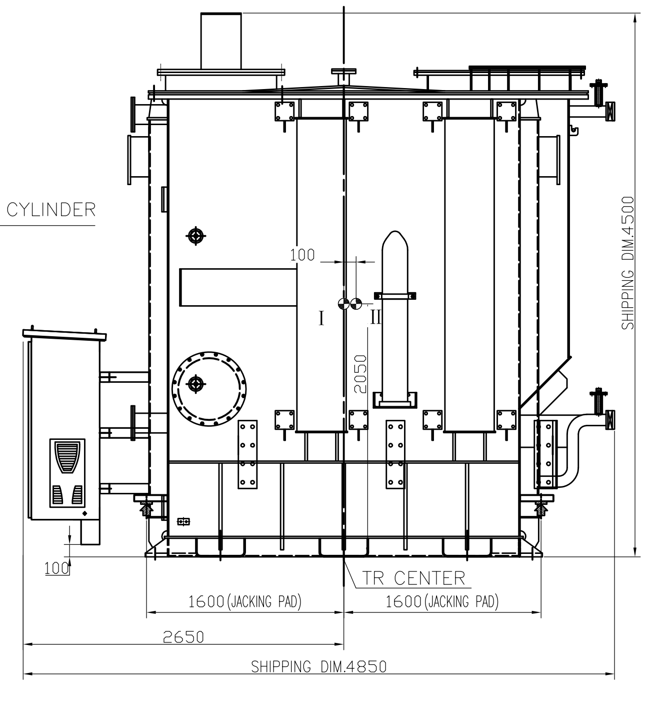
NOTE

1. DIMENSION TOLERANCE : ± 5%
2. ALL DIMENSIONS ARE IN MILLIMETERS.
3. MARK I : CENTER OF GRAVITY FOR TOTAL UNIT.
   MARK II : CENTER OF GRAVITY FOR SHIPPING.





View "A–A"



View "B–B"

3 PHASES 50Hz 244/325MVA ONAN/ONAF 400/230/13.8kV YNyn0+d11 WITH OLTC ON HV

UTE TSK TÉCNICAS REUNIDAS ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)

UTS PROJECT NO. 7485 -	UNIT: -
PURCHASE ORDER NUMBER (P.O.R.) 074851201	EQUIPMENT: 400/230KV(INTERBUS)TRANSFORMERS

REVIEW RESPONSE BY PURCHASER

Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

- REJECTED
- Reviewed With Comments
- Review. Without Comments
- COMMENTS AS NOTED
- REVIEWED AS BUILT
- FOR INFORMATION

DATE: -

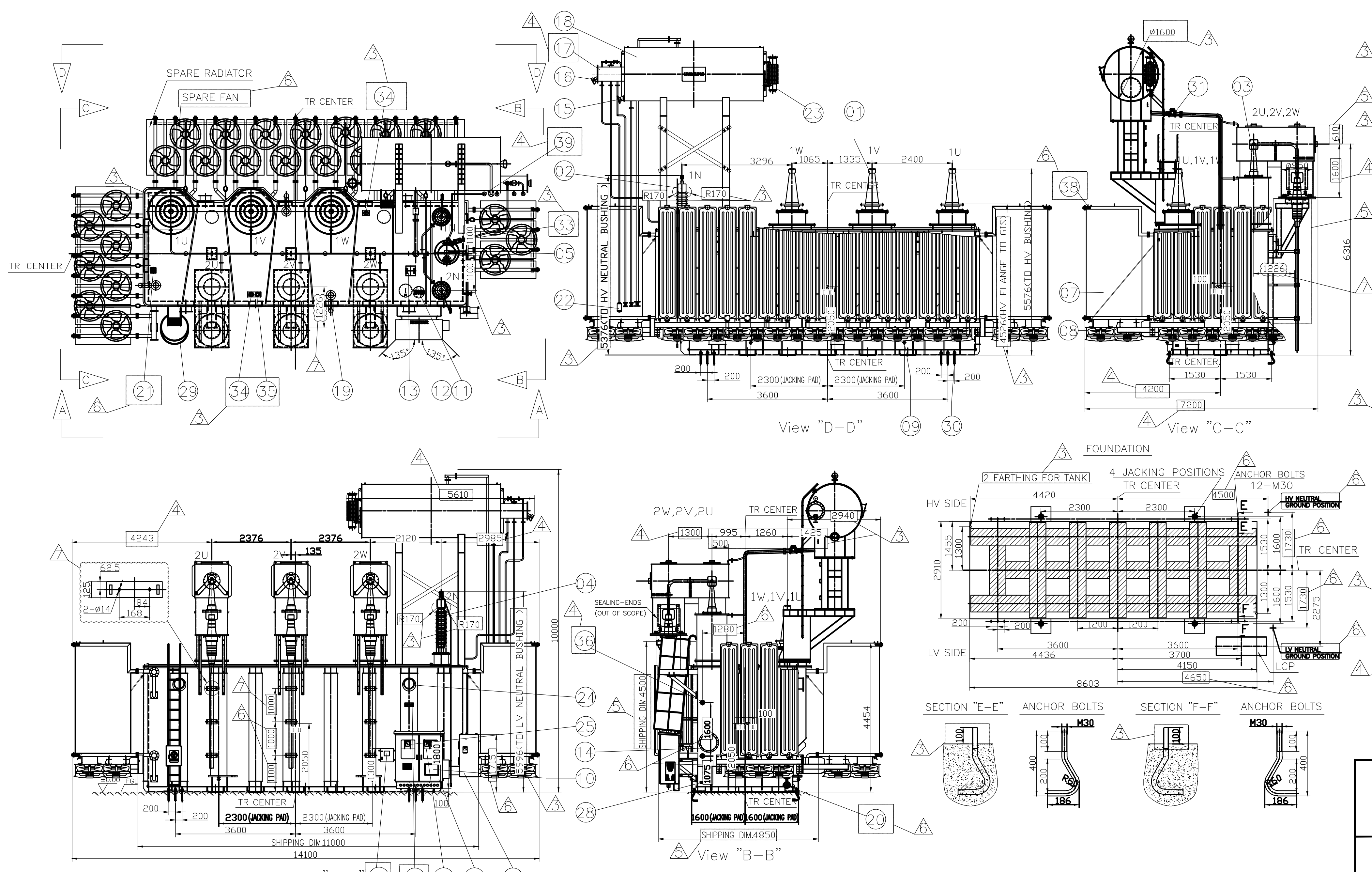
DOCUMENT VENDOR IDENTIFICATION: -

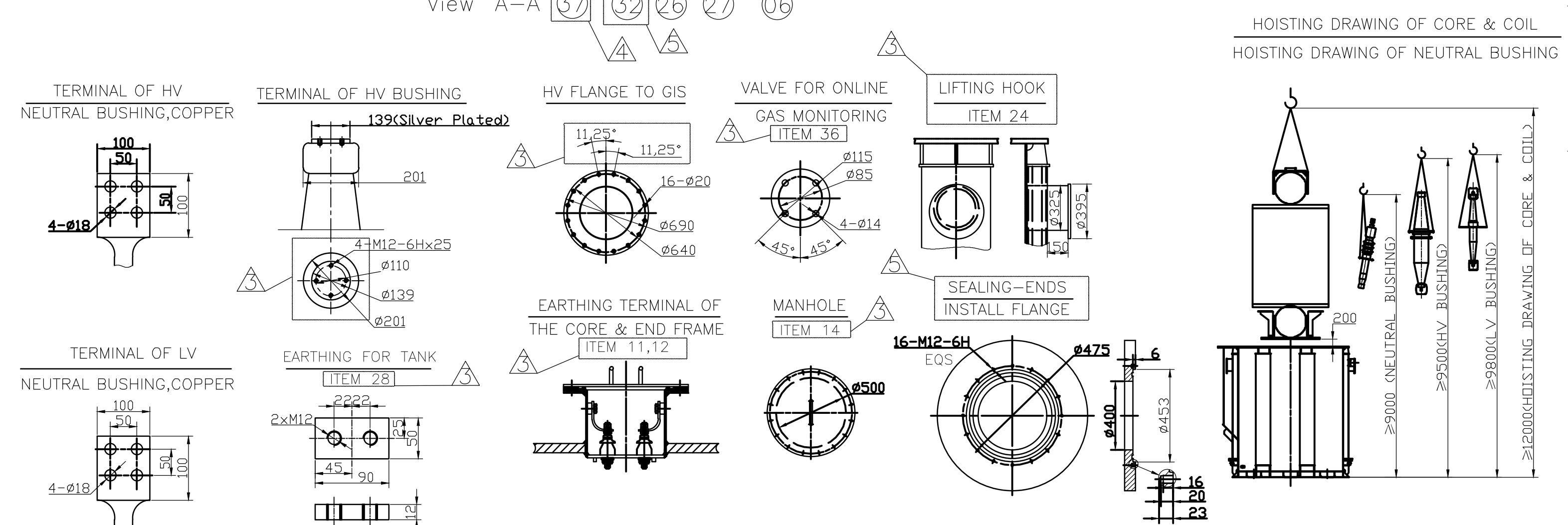
DOCUMENT TITLE: DRAWINGS OF THE PARTS FOR TRANSPORTATION AND FIELD ERECTION

VENDOR DOCUMENT No:	CODE:	REV:
NT14-BA1-023	PLD-0011	1

UTS DOCUMENT No:	REV:
-	-

KKS DOCUMENT No: 07485-20-ADT-JDM-HYO-001





NOTE

1. DIMENSION TOLERANCE : ± 5%.
2. ALL DIMENSIONS ARE IN MILLIMETERS.
3. MARK I : CENTER OF GRAVITY FOR TOTAL UNIT.
4. MARK II : CENTER OF GRAVITY FOR SHIPPING.
5. ANGLE OF PROJECTION: 3RD

WEIGHT

CORE AND COIL	: 188,070	KG
TANK AND FITTING	: 72,130	KG
INSULATING OIL	: 76,000	KG
	(86,364	L)
SHIPPING(WITHOUT OIL)	: 214,100	KG
TOTAL	: 336,200	KG

SHIPPING DIMENSION

11000mm(L)*4850mm(W)*4500mm(H)

TOTAL DIMENSION

14100mm(L)*7200mm(W)*10000mm(H)

- FOR WIND
TENSILE FORCE: NO REACTION FORCE
SHEAR FORCE: MAX. 15.95kN/BOLT
- FOR SEISMIC
TENSILE FORCE: NO REACTION FORCE
SHEAR FORCE: MAX. 64.50kN/BOLT

3 PHASES 50Hz 244/325MVA ONAN/ONAF 400/230/13.8kV YNyn0+d11 WITH OLTC ON HV

PART LIST

ITEM	DESCRIPTION	Q'TY
01	HV BUSHING	3 SETS
02	HV NEUTRAL BUSHING	1 SET
03	LV BUSHING	3 SETS
04	LV NEUTRAL BUSHING	1 SET
05	OLTC	1 SET
06	LOCAL CONTROL PANEL FOR OLTC	1 SET
07	RADIATOR	27+1 SETS
08	COOLING FAN	24+1 SETS
09	JACKING PAD	4 SETS
10	NAME PLATE	1 SET
11	GROUNDING BUSHING FOR END FRAME ASSEMBLY	1 SET
12	GROUNDING BUSHING FOR CORE	1 SET
13	MOUNTING PAD FOR IMPACT RECORDER	1 SET
14	MAN HOLE	1 SET
15	OIL LEVEL INDICATOR FOR MAIN CONSERVATOR	1 SET
16	OIL LEVEL INDICATOR FOR OLTC CONSERVATOR	1 SET
17	OLTC CONSERVATOR (RUBBER BAG)	1 SET
18	CONSERVATOR FOR MAIN TANK	1 SET
19	PRESSURE RELIEF DEVICE	3 SETS
20	DRAIN VALVE	1 SET
21	FILTERING VALVE FOR MAIN TANK	1 SET
22	BREATHER FOR OLTC CONSERVATOR	1 SET
23	DRYCOL FOR MIAN TANK BREATHER	1 SET
24	LIFTING HOOK	4 SETS
25	WINDING TEMPERATURE INDICATOR	1 SET
26	OIL TEMPERATURE INDICATOR	2 SETS
27	LOCAL CONTROL PANEL	1 SET
28	EARTHING PAD FOR TANK	2 SETS
29	LADDER FOR MAIN TANK	1 SET
30	ANCHOR BOLTS (ASTM F1554 Gr.105)	12 SETS
31	BUCHHOLZ RELAY FOR MAIN CONSERVATOR	1 SET
32	KKS PLATE	1 SET
33	BUCHHOLZ RELAY FOR OLTC CONSERVATOR	1 SET
34	PROBE FOR OIL TEMPERATURE INDICATOR	2 SETS
35	PROBR FOR WINDING TEMPERATURE INDICATOR	1 SET
36	VALVE FOR ONLINE GAS MONITORING	2 SETS
37	DRYCOL MK.8 CONTROL CABINET	1 SET
38	THERMOMETER POCKET FOR RADIATOR INLET/OUTLET PIPE	60 SETS
39	DRAIN/FILTERING VALVE FOR OLTC	1 SET

UTE TSK TÉCNICAS REUNIDAS ASHUGANJ NORTH

Ashuganj Power Station Company Ltd. (APSCL)

ASHUGANJ COMBINED CYCLE POWER PLANT PROJECT (NORTH)

UTS PROJECT NO. 7485 -	UNIT: -
PURCHASE ORDER NUMBER (P.O.R.) 074851201	EQUIPMENT: 400/230KV(INTERBUS)TRANSFORMERS

REVIEW RESPONSE BY PURCHASER

Purchaser review and comments do not indicate either responsibility or liability for accuracy and completeness of this document or alter any contractual terms and conditions.

- [ ] REJECTED
- [ ] Reviewed With Comments
- [ ] Review. Without Comments
- [ ] COMMENTS AS NOTED
- [ ] REVIEWED AS BUILT
- [ ] FOR INFORMATION

DATE: -

DOCUMENT VENDOR IDENTIFICATION: -

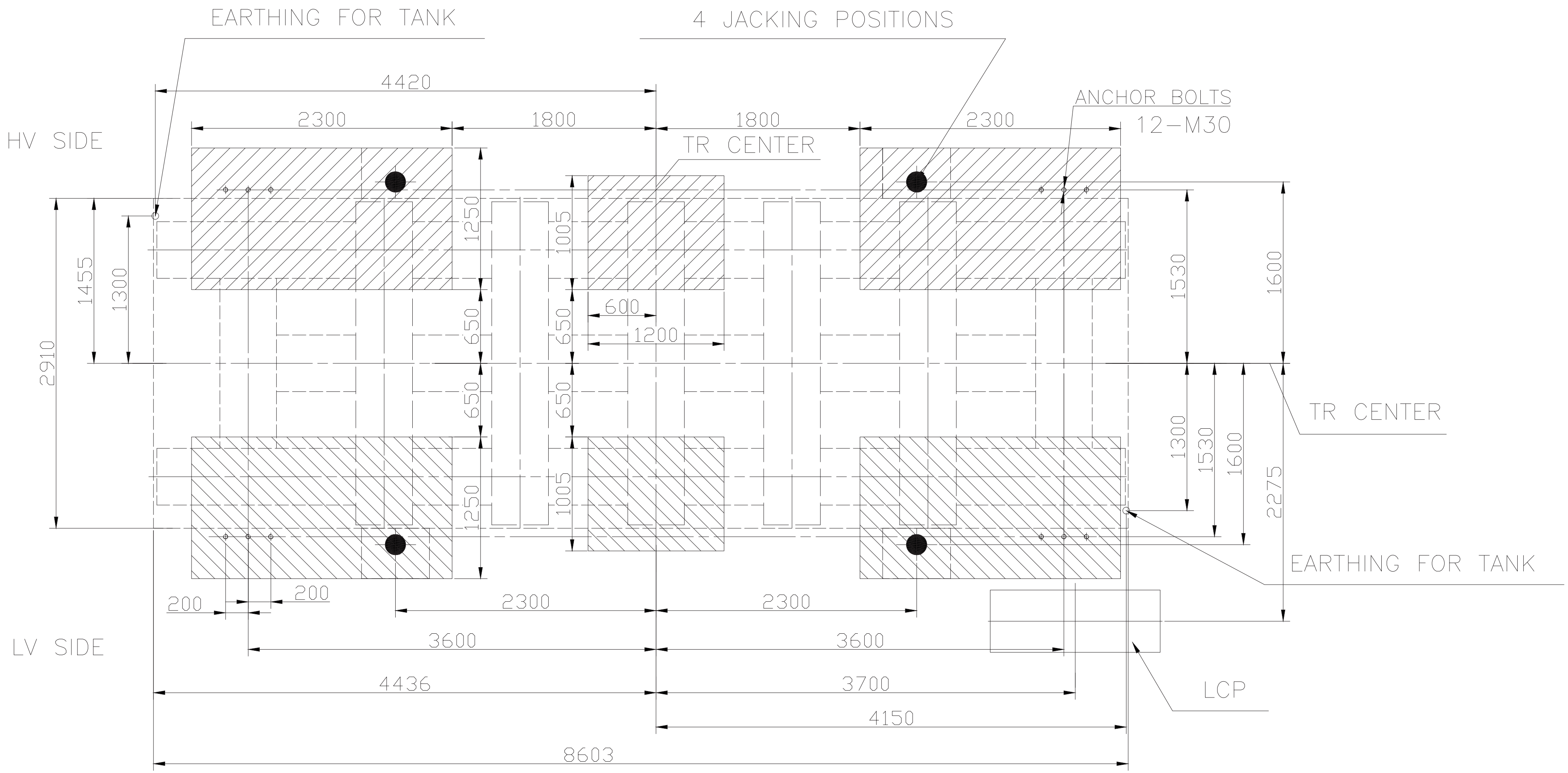
DOCUMENT TITLE: TRANSFORMER OUTLINE

VENDOR DOCUMENT No:	CODE:	REV:
NT14-BA1-006	PLG-0003	7

UTS DOCUMENT No:	REV:
-	-

KKS DOCUMENT No: 07485-20-ADT-JDA-HYO-001

FOUNDATION PLAN



3 PHASES 50Hz 244/325MVA ONAN/ONAF 400/230/13.8kV YNyn0+d11 WITH OLTC ON HV