TMC USA
world of transformers

TRAINING
on dry-type transformers

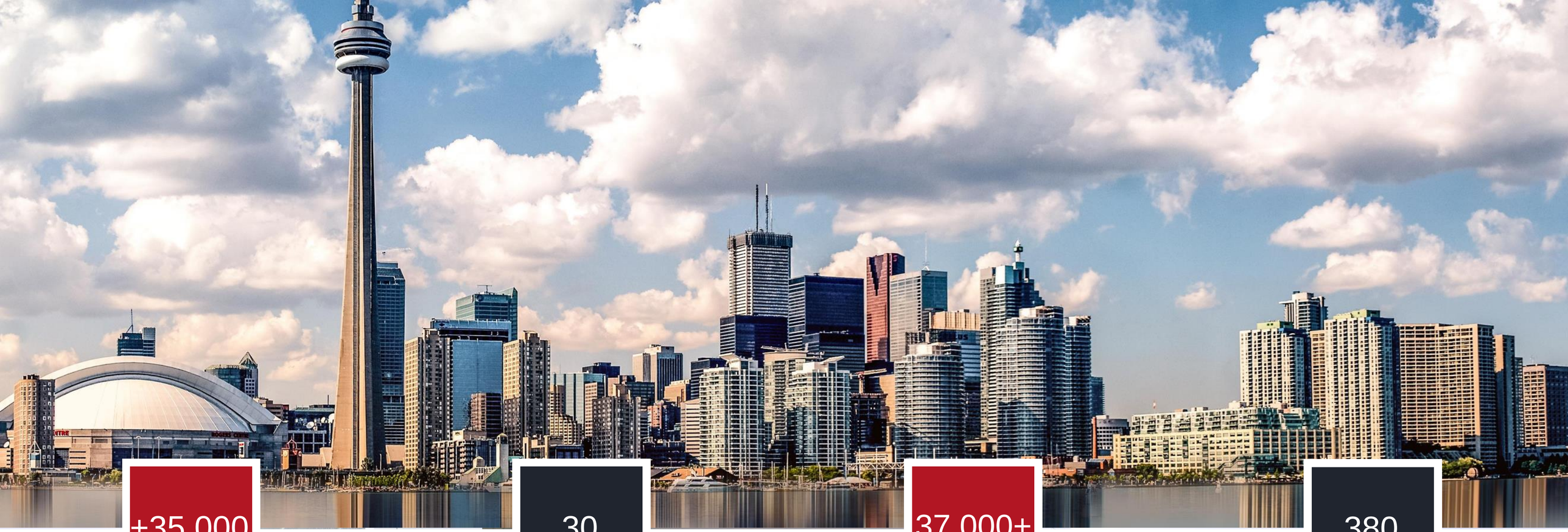
Presenters

Carlos García.

Industrial Engineer – Master in Business Administration.
25 years in the market of electrical equipment, including transformers, switchgears, substations. Worked in sales positions and management positions in ABB and other companies. In TMC since Apr-2018, currently as Sales Manager for North America.

Jhonatan Hernández.

Electrical Engineer – Master in Business Administration.
9 years of specific experience in technical and sales positions in Oil and Dry Transformers sector for multinational companies. Currently as Bid Manager for North America in TMC.



+35.000

TRANSFORMERS
MANUFACTURED AND SOLD

30

YEARS OF EXPERIENCE

37.000+

SQ.M PRODUCTION FACILITY
AROUND THE WORLD

380

EMPLOYEES

TMC USA
world of transformers

stv IEEE

Training Agenda

- The general concepts
- Product Portfolio
- Production Process
- Technical Concepts
- Accesories
- Applications
- Basic Maintenance

Dry-type transformers

The general concepts

What is a transformer

In almost every place where a human being is, there is a need for a transformer to change the energy from one voltage level to another.

- Shopping malls
- Hospitals
- Buildings
- Railway stations
- Airports
- Industries
- Ships
- Power plants

Type of transformers
Oil type and dry-type

- Mainly for outdoors installation
- Maintenance needed

- Mainly for indoors installation; outdoors installation is also possible
- No maintenance needed

CHARACTERISTICS	OIL TRAFOS	DRY TYPE	CAST RESIN
Flammability	YES	NO	NO
Self-extinguishing in case of electric damage	NO	YES	YES
Necessity of fire fighting measures such as oil bunds and fireproof structures	YES	NO	NO
Hygroscopicity of insulating materials	NO	YES	NO
Contribution to environmental pollution	YES	NO	NO
Strip windings and optimal resistance to short circuit phenomena	NO	NO	YES
Resistance stability to short circuit phenomena	NO	NO	YES
Energizing special procedures	NO	YES	NO
Maintenance	YES	YES	NO
Environmental pollution risk due to liquid losses	YES	NO	NO
insensitivity towards humid, saline and tropical environments	YES	NO	YES
Location close to load with savings on transmission losses, cabling, civil works and management costs	NO	NO	YES
Reliability without maintenance and installation without specifically specialized labour	NO	NO	YES
Capability to stand high, immediate and short overloads thanks to reduced current density and high thermal factor	NO	NO	YES

Dry-type transformers
Advantages

Safety for people and property

- No fire hazard
- Nonflammable and self extinguishing
- No special safety features required

Ecological and environmentally safe

- Environmentally conscience manufacturing (process and materials)
- Able to be installed closer to the point of consumption, reducing load cable losses
- No risk for leakage of insulation fluids, no ground or water contamination

Maintenance free

- Virtually maintenance free

Dry-type transformers
How it looks like

Dry type transformers, components:

- Steel magnetic core

- Copper/Aluminum windings and insulation resin material to build the coils

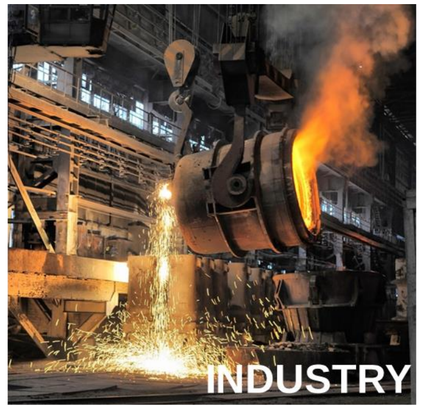
- 2 coils per phase for primary and secondary winding

Standard and special solutions

Different applications for dry type transformers

TMC Transformers

Experts on any kind of dry type transformers



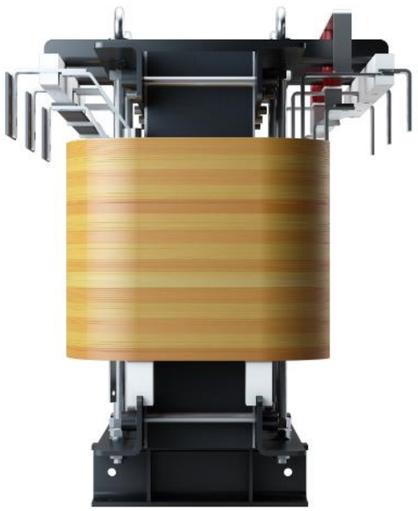
Product portfolio
Technologies

Experts on any kind of dry type transformers

Technologies

Cast-resin transformers

Vacuum cast technology
Available both for primary and secondary
Availability for cooling channels in both windings
All coils manufactured in home



VPI - VI

Vacuum pressure impregnated
Vacuum impregnated
Sealed borders available
All coils manufactured in home

Experts on any kind of dry type transformers

Product portfolio

Medium voltage cast-resin transformers

150 kVA to 25000 kVA
Class F or H
AN, AF, AFWF, AFAF

Up to 52 kV
Distribution transformers
And specials up to 48 pulses

Low voltage transformers and reactors

150 kVA to 5000 kVA
Air natural, air forced
or water forced

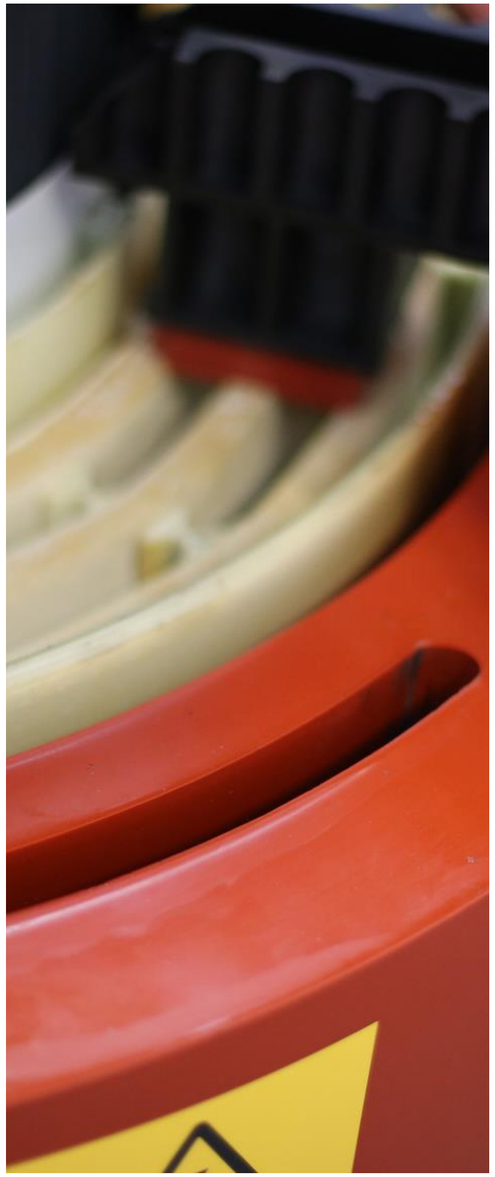
Up to 1.1 kV
All types of enclosures

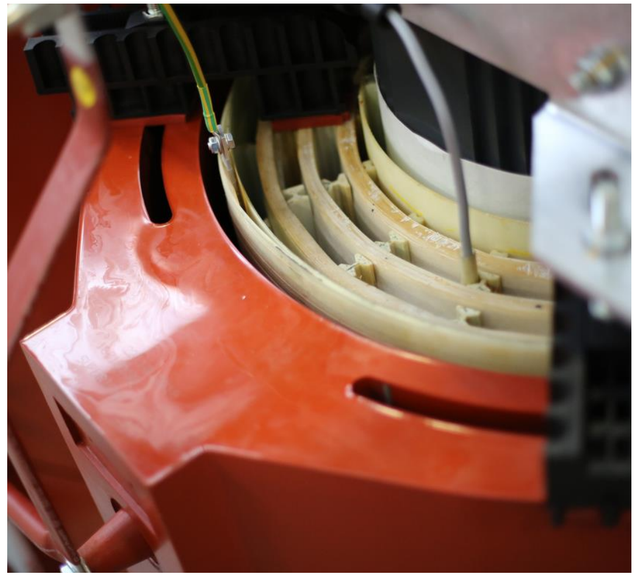
CAST RESIN

Key Points & Advantages

Distribution and special transformers

- Cast insulation system up to 25MVA and 52kV
- Winding material in aluminum or copper
- Combination of cast resin and foil winding offers the ultimate in terms of dielectric performance and short circuit withstand
- Axial air-cooling channels cast into coil for improved cooling for ratings >5MVA
- 155° or 180° thermal class



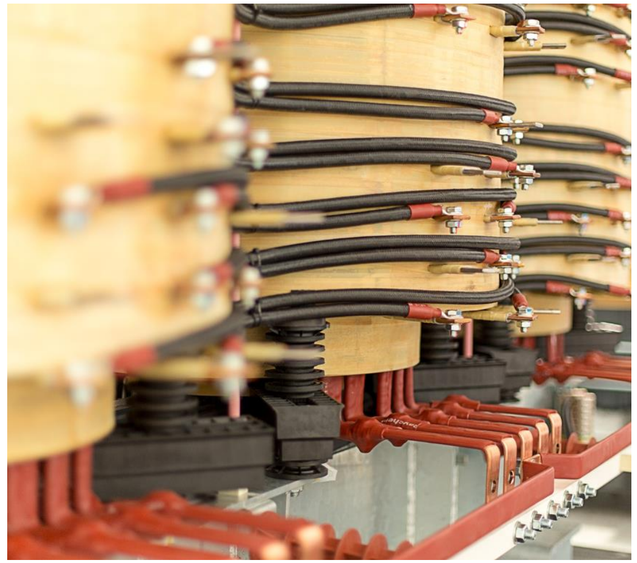


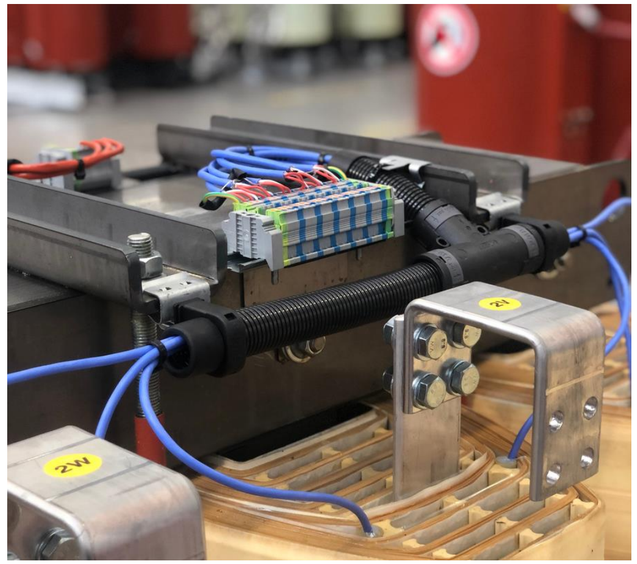
VPI

Key Points & Advantages

Medium voltage transformers

- Medium-voltage VPI distribution and special transformers with power up to 25MVA and voltages up to 34.5kV
- Winding material in aluminum or copper
- Processed in vacuum chamber: resin initially introduced under vacuum and then placed under positive pressure to improve impregnation
- 155°, 180° or 220° thermal class
- Flame retardant materials



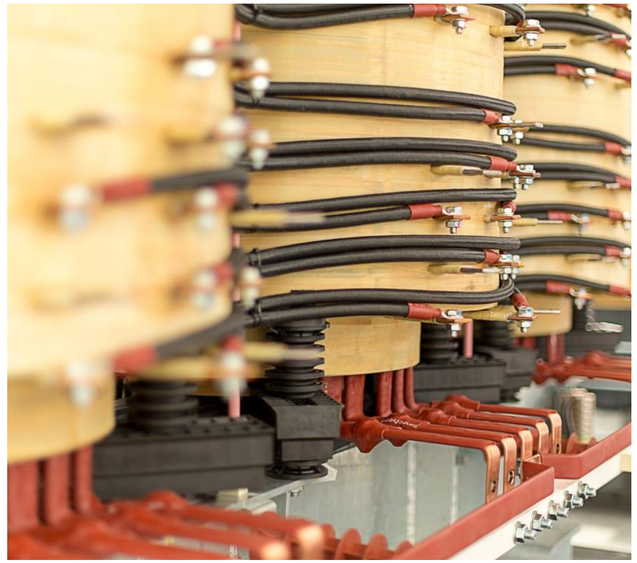


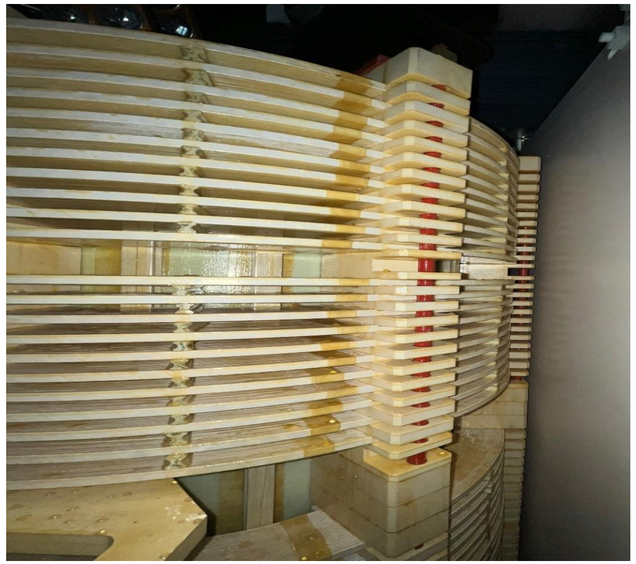
VPI

Key Points & Advantages

Low voltage transformers

- Low-voltage special and distribution VPI transformers with normal or reduced losses and according to customer specifications, up to 10MVA and with insulation class up to 1.1kV
- Winding material in aluminum or copper
- Processed in vacuum chamber: resin initially introduced under vacuum and then placed under positive pressure to improve impregnation
- 155°, 180° or 220° thermal class
- Flame retardant materials





TMC Transformers

VPI-VPE-VCC description

VPI: The windings are vacuum-pressure impregnated VPI, they are vacuum dipped into polyester resin (no filler, no moulds) and cured inside the oven.

VPE: The windings are vacuum-pressure encapsulated VPE, they are vacuum dipped with epoxy resin (no filler, no moulds) and cured inside the oven.

VCC: Vacuum cast coil means windings filled with epoxy resin under vacuum and the thermal class is 180 °C. The VCC windings are casted in moulds with epoxy resin (quartz +resin).

Pros & cons VPI-VPE vs VCC:

	Dimensions	Weight	Thermal class	Pollution resistance
VCC	✓✓✓	✓✓	✓✓	✓✓✓
VPI/VPE	✓	✓✓✓	✓✓✓	✓

Technical concepts

Standard Distribution Transformers

Dry type transformers

Main applicable standard for dry type transformers

IEEE Std C57.12.01™-2020
(Revision of IEEE Std C57.12.01-2015)

IEEE Standard for General Requirements for Dry-Type Distribution and Power Transformers

Scope

1.1 Scope

This standard describes electrical and mechanical requirements of single and polyphase ventilated, non-ventilated, and sealed dry-type distribution and power transformers or autotransformers, with a voltage of 601 V or higher in the highest voltage winding. This standard applies to all dry-type transformers, including those with solid-cast and/or resin encapsulated windings except as follows:

a) Instrument transformers
b) Step and induction-voltage regulators
c) Arc-furnace transformers
d) Rectifier transformers
e) Specialty and general-purpose transformers
f) Mine transformers
g) Testing transformers
h) Welding transformers

Dry type transformers
Insulation levels

Table 3—Dielectric insulation levels for dry-type transformers used on systems with BIL ratings 350 kV BIL and below

	Nominal L-L system voltages[d,e]	Low-frequency voltage insulation level	Basic lightning impulse insulation levels (BIL ratings) in common use kV crest[a,b] (1.2 × 50 µs)												
(kV rms)	(kV rms)	(kV rms)	10	20	30	45	60	95	110	125	150	200	250	300	350
1.5	1.2	4	S	1	1										
3.5	2.5	10		S	1	1									
6.9	5.0	12			S	1	1								
11	8.7	20				S	1	1							
17	15.0	34					S	1	1						
20	18.0	40						S	1	1					
27	25.0	50						2	S	1	1				
37	34.5	70								2	S	1			
49	46.0	95										S	1	1	
73	69.0	140											S	1	1
	Chopped wave[c] minimum time to flashover µs		1.0	1.0	1.0	1.25	1.5	1.6	1.8	2.0	2.25	2.7	3.0	3.0	3.0

NOTE—The latest edition of IEEE Std C62.22 [B9] should be consulted for information coordination with available surge arrester protection levels.

S = Standard values

1 = Optional higher level where exposure to overvoltages occurs and improved protective margins are required

2 = Optional lower levels where protective characteristics of applied surge arresters have been evaluated and found to provide appropriate surge protection.

According to IEEE C57.12.01, as a minimum th standard «S» value of insulation level must be used.

- Example: Primary voltage 13,8 kV
- Insulation level: 15 kV
- Low Frequency Voltage Insulation level: 34kV
- Minimum Basic Lighting Impulse Insulation Level: 60kV

Dry type transformers
DOE Efficiency

KVA	20-45 BIL			45-95 BIL			>= 96 BIL		
kVA Three Phase	2010	2016	%DIF	2010	2016	%DIF	2010	2016	%DIF
15	97.5	97.5	0	97.18	97.18	0	NA	NA	NA
30	97.9	97.9	0	97.63	97.63	0	NA	NA	NA
45	98.1	98.1	0	97.86	97.86	0	NA	NA	NA
75	98.33	98.33	0	98.12	98.13	0.01	NA	NA	NA
112.5	98.49	98.52	0.03	98.3	98.36	0.06	NA	NA	NA
150	98.6	98.65	0.05	98.42	98.51	0.09	NA	NA	NA
225	98.73	98.82	0.09	98.57	98.69	0.12	98.53	98.57	0.04
300	98.82	98.93	0.11	98.67	98.81	0.14	98.63	98.69	0.06
500	98.96	99.09	0.13	98.83	98.99	0.16	98.8	98.89	0.09
750	99.07	99.21	0.14	98.95	99.12	0.17	98.91	99.02	0.11
1000	99.14	99.28	0.14	99.03	99.2	0.17	98.99	99.11	0.12
1500	99.22	99.37	0.15	99.12	99.3	0.18	99.09	99.21	0.12
2000	99.27	99.43	0.16	99.18	99.36	0.18	99.15	99.28	0.13
2500	99.31	99.47	0.16	99.23	99.41	0.18	99.2	99.33	0.13

Efficiency values are at 50% of nameplate rated load and at a reference temperature of 75° C

One of the exceptions for Distribution Transformers per DOE 2016 are those with special impedance. Normal Impedance percentages for Dry Type Distribution Transformers as defined in 10 CFR 431 are as listed in the following Table.

Normal Impedance Range for Dry Type Transformers
Per Federal Regulations 10 CFR Part 431 Subpart K Table 2

Single Phase		Three Phase	
kVA	Impedance (%)	kVA	Impedance (%)
15	1.5-6.0	15	1.5-6.0
25	1.5-6.0	30	1.5-6.0
34.5	1.5-6.0	45	1.5-6.0
50	1.5-6.0	75	1.5-6.0
75	2.0-7.0	112.5	1.5-6.0
100	2.0-7.0	150	1.5-6.0
167	2.5-8.0	225	3.0-7.0
250	3.5-8.0	300	3.0-7.0
333	3.5-8.0	500	4.5-8.0
500	3.5-8.0	750	5.0-8.0
667	5.0-8.0	1000	5.0-8.0
833	5.0-8.0	1500	5.0-8.0
		2000	5.0-8.0
		2500	5.0-8.0

Dry type transformers

Thermal class and temperature rise in windings

IEEE Std C57.12.01-2015
IEEE Standard for General Requirements for Dry-Type Distribution and Power Transformers

Table 9—Limits of temperature rise for continuously rated dry-type transformer windings[9]

Insulation system temperature class (°C)	Winding hottest-spot temperature rise (°C)	Average winding temperature rise by resistance (°C)[a]
130	90	75
155	115	95
180	140	115
200	160	135
220	180	150

[a] Higher average winding temperature rises by resistance may apply if the manufacturer provides thermal-design test data substantiating that temperature limits of the insulation are not exceeded.

Considering class 180°C:

- If max. ambient temperature is 40ºC, it is considered a temperature rise in windings of 115°C.
- If max. ambient temperature is 50ºC, it is considered a temperature rise in windings of 105°C.

- **A 80K temperature rise is highly requested in Distribution Trasformers Market in USA.**

TMC temperature limit for VCC transformers : 180 °C
TMC temperature limit for VPI transformers : 220 °C

Experts on any kind of dry type transformers

Distribution transformers

Eco or Standard distribution transformers
Short or long series
Any kind of accessories or technical solutions

Experts on any kind of dry type transformers
Distribution transformers

Distribution dry type transformers

Standard IEEE / DOE Efficiency

Transformers are usually IP00 (Core and Coil)

Optional, typical enclosures Nema1, Nema 2 (INDOOR) or NEMA 3R (OUTDOOR)

Air natural (AA) or standard air forced cooling (FA)

Accesories: Temperature sensors, temperature monitoring device, lifting lugs, wheels

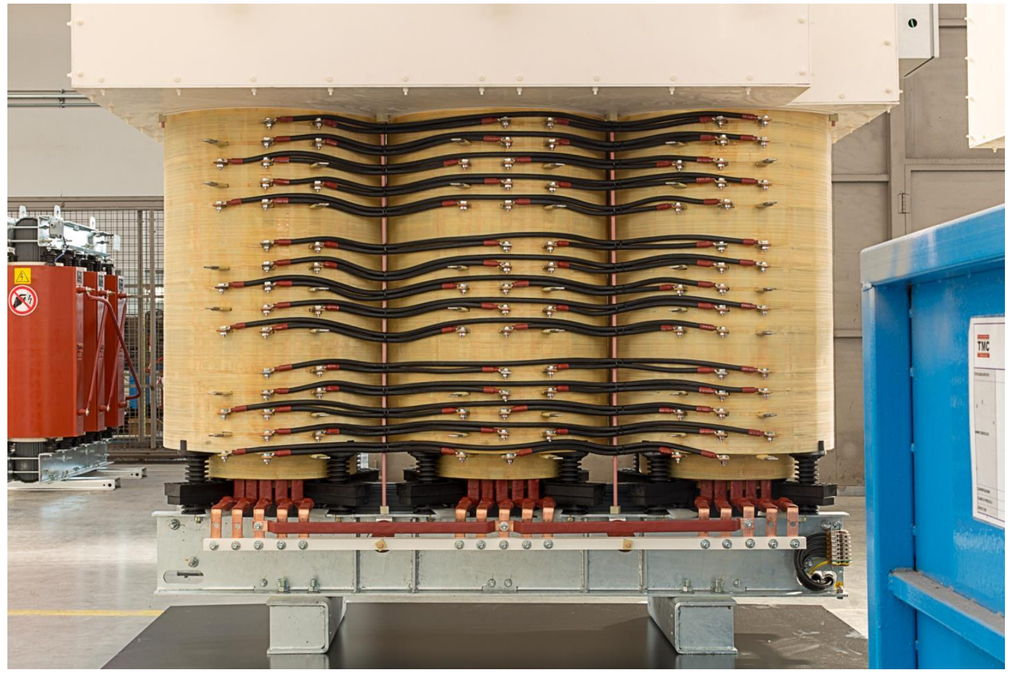
Custom design for special applications

Experts on any kind of dry type transformers

Special dry type transformers are needed
Special applications
Customized designs
Strong team of expert designers behind

Experts on any kind of dry type transformers

Tailor made for the most demanding applications



3750 kVA, primary voltage 11 kV, secondary windings 15 x 1250 V
Special top box for guiding air forced cooling
Transformer recently delivered

Multi-pulses dry type transformers

Up to 36 kV insulation level

Up to 20 MVA

Up to 48 pulses

VPI or vacuum cast technology.

Aluminum or copper Conductors

Special cooling systems when required.

Customer tailor-made solutions.

Custom design for special applications

Certifications

IEEE

UL

CSA

ABS

UNI

RENEWABLES CERTIFICATION
DNV·GL
Certificate no.
CC-GL-IV-1-00526-0

ISO

BUREAU VERITAS 1828
BUREAU VERITAS

CCS
CHINA CLASSIFICATION SOCIETY
中国船级社

Lloyd's Register

ClassNK
NIPPON KAIJI KYOKAI (UK) LTD

RINA 1861
RINA
UNI CEI 11352:2010
Società che forniscono servizi energetici (ESCO)

IEC
International Electrotechnical Commission

KR
KOREAN REGISTER

RUSSIAN MARITIME REGISTER OF SHIPPING
1913

Technical concepts

Railway Substation Transformers

Railway Substation Transformers

Applicable Standards - Cycle loads

IEEE 1653.1, 1653.2

Source:

IEEE 1653.1-2016: IEEE Standard for Traction Power Rectifier Transformers for Substation Applications up to 1500 V DC Nominal Output.

IEEE 1653.2-2020: IEEE Standard for Uncontrolled Traction Power Rectifiers for Substation Applications up to 1500 V DC Nominal Output

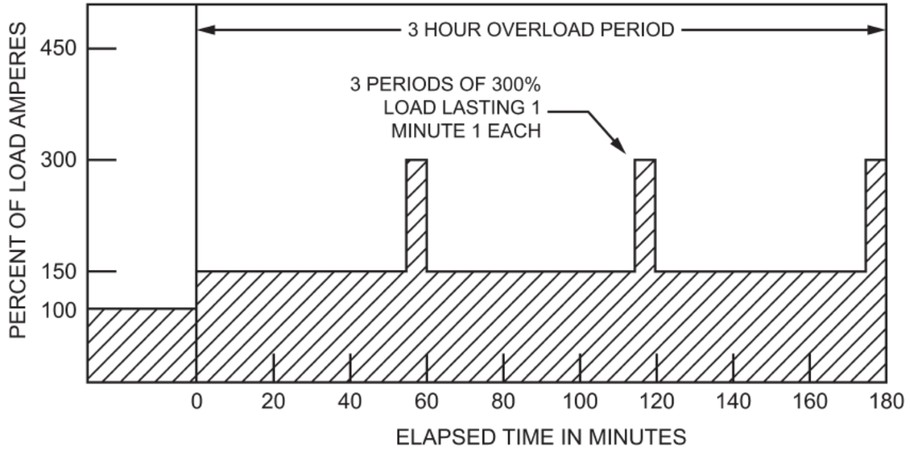


Figure 4—Extended heavy traction service

7.3.4 Extra heavy traction service

The standard rating of a rectifier unit for extra heavy traction service is as follows (refer to Figure 5, which can also be found in the former NEMA Pub. No. RI 9):

a) 100% rated load amperes continuously until constant temperatures have been reached by all parts of the rectifier unit, followed by 150% of rated load amperes for two hours and a superimposed cycle of overloads consisting of five periods of one min each at 300% of rated load amperes, followed by one period of 450% of rated load amperes for 15 s at the end of the two-hour period. These periods shall be evenly spaced throughout the two-hour period as indicated in Figure 5.

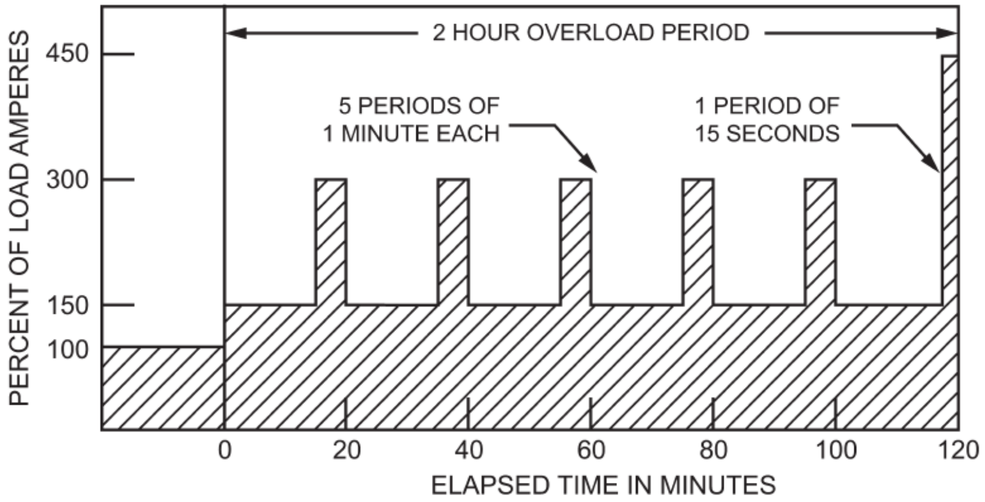


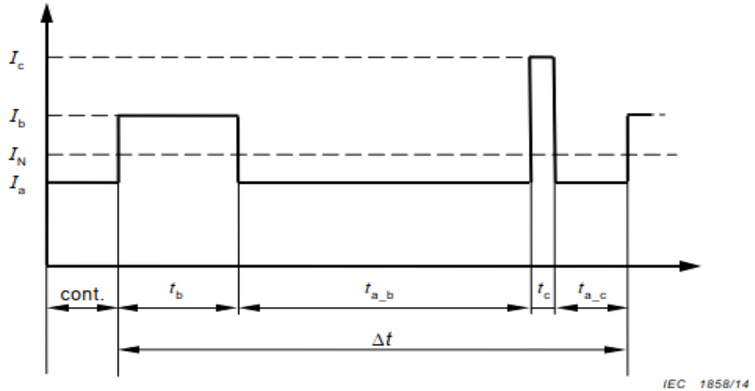
Figure 5—Extra heavy traction service

Railway Substation Transformers

Applicable Standards - Cycle loads

EN 50329, IEC 62695: Railway applications - Fixed installations - Traction transformers

(Europe – Canada)



Key

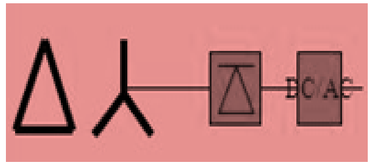
cont.	pre-heating period, injection of current until steady-state temperatures of windings at I_a are reached
I_a	service current in basic load condition
I_b	overload current b
I_c	overload current c
I_N	rated current
t_{a_b}	cool down period at current I_a after overload at current I_b
t_{a_c}	cool down period at current I_a after overload at current I_c
t_b	duration of overload current I_b
t_c	duration of overload current I_c
Δt	duration of the test cycle consisting of overloads and cool down periods

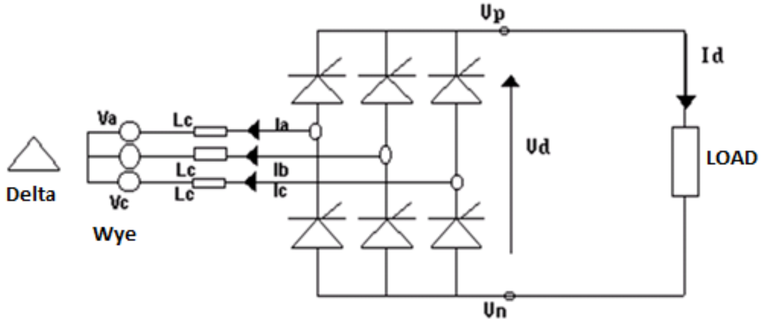
Duty class	Id.	p.u. of I_B	p.u. of I_N	Initial condition	Duration	Cool down period	Typical application	Note
I	-	1	1	-	Cont.	-	a.c. systems	
IA	a	1	0,9	-	Cont.	-	a.c. systems	
	b	1,7	1,494	a	480 s	3 120 s		
IB	a	1	0,873	-	Cont.	-	a.c. systems	
	b	2,2	1,903	a	300 s	3 300 s		
IC	a	1	0,691	-	Cont	-	a.c. systems	
	b	2,7	1,901	a	300 s	1 500 s		
ID	a	1	0,668	-	Cont.	-	a.c. systems	
	b	3,7	2,446	a	180 s	1 620 s		
IE	a	1	0,652	-	Cont.	-	a.c. systems	
	b	4,6	3,007	a	120 s	1 680 s		
IF	A	1	0,959	-	Cont.	-	a.c. systems	
	b	3	2,876	a	120 s	3 h		
V	a	1	0,827	-	Cont.	-	mass rapid transit trolley buses	
	b	1,5	1,240	a	2 h	3 h		
	c	2	1,654	a	60 s	1 800 s		
VI	a	1	0,823	-	Cont.	-	mainline railways mass rapid transit trolley buses	
	b	1,5	1,234	a	2 h	3 h		
	c	3	2,468	a	60 s	1 800 s		
VII	a	1	0,825	-	Cont.	-	light railways tramways	
	b	1,5	1,238	a	2 h	3 h		
	c	4,5	3,716	a	15 s	1 800 s		
VIII	a	1	0,814	-	Cont.	-	mass rapid transit trolley buses	cumulative
	b	1,5	1,221	a	2 h	-		
	c	2	1,628	b	60 s	3 h		
IXA	a	1	0,785	-	Cont.	-	mainline railways	cumulative
	b	1,5	1,177	a	2 h	-		
	c	3	2,355	b	300 s	3 h		
IXB	a	1	0,658	-	Cont.	-	mainline railways	cumulative
	b	2	1,315	a	2 h			
	c	3	1,973	b	300 s	3 h		
JP	a	1	0,912	-	Cont.		mainline railways	cumulative
	b	1,2	1,095	a	2 h			
	c	3	2,736	b	60 s	3 h		
CN	a	1	0,8	-	354 min		mainline railways	cumulative 24 h – cycle
	b	2	2	a	60 min			
	c	3	3	b	2 min	300 min		

Railway Substation Transformers

6 - 12 Pulse Rectifiers

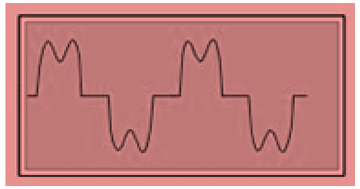
6 pulse rectifier





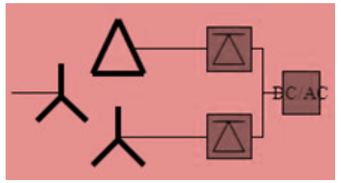
6 Pulse Rectifier

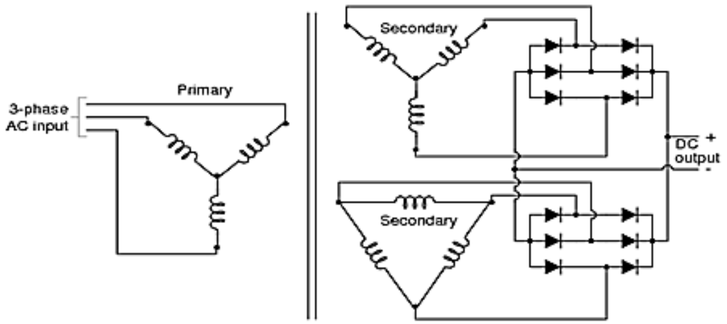
Transformer (if included) and cabling simple



Current quite distorted I_{thd}
32% to 48% (depending on network impedance)

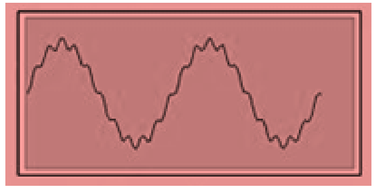
12 pulse rectifier





12 Pulse Rectifier

Transformer and cabling more complicated

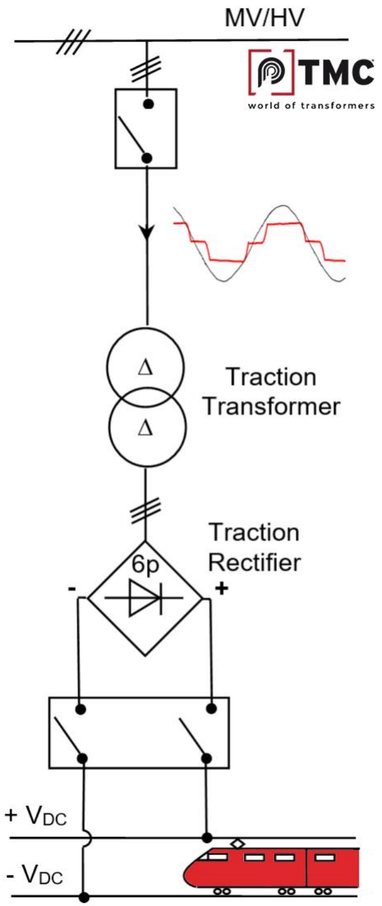


Current slightly distorted I_{thd}
8% to 12% (depending on network impedance)

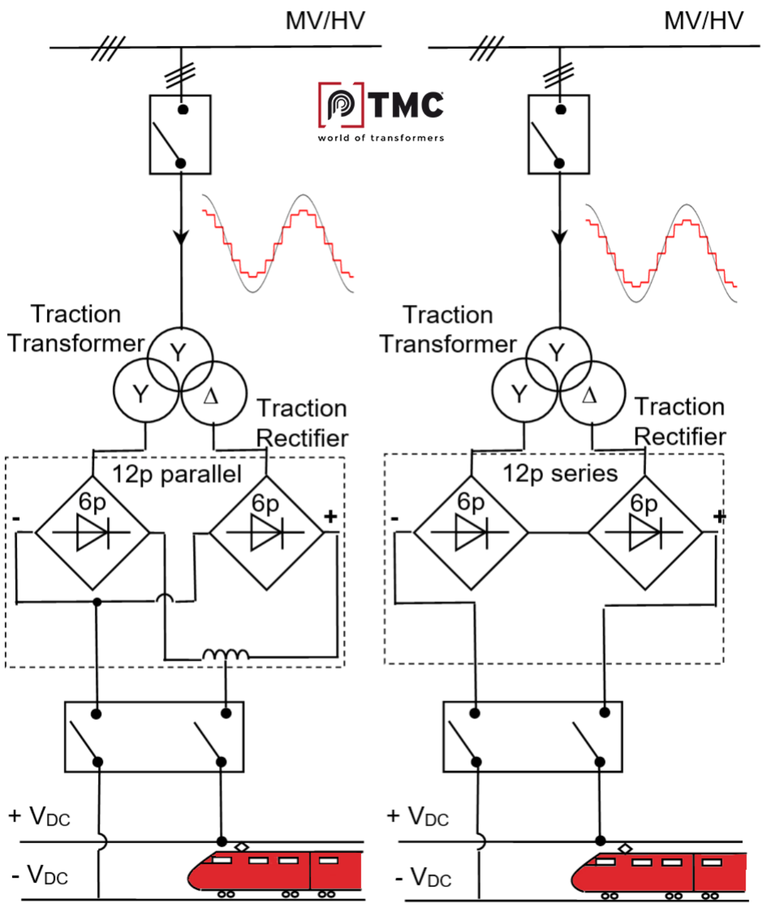
Railway Substation Transformers

6 - 12 Pulse Rectifiers

6 pulse rectifier

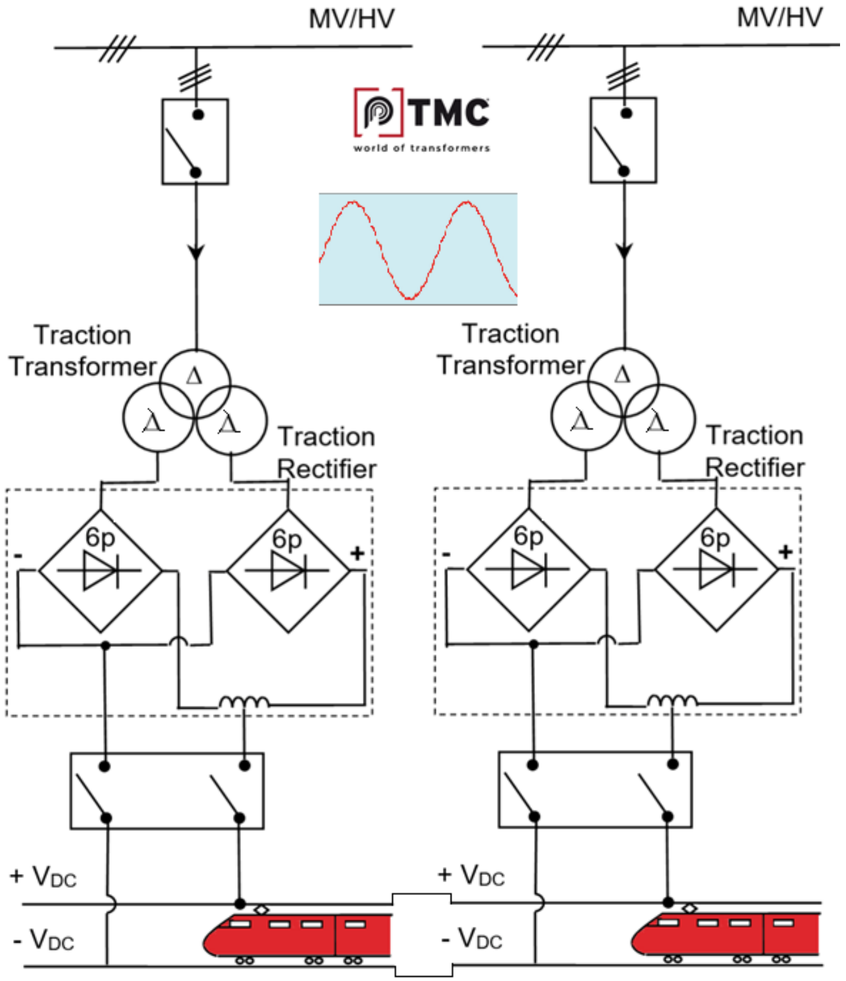


12 pulse rectifier



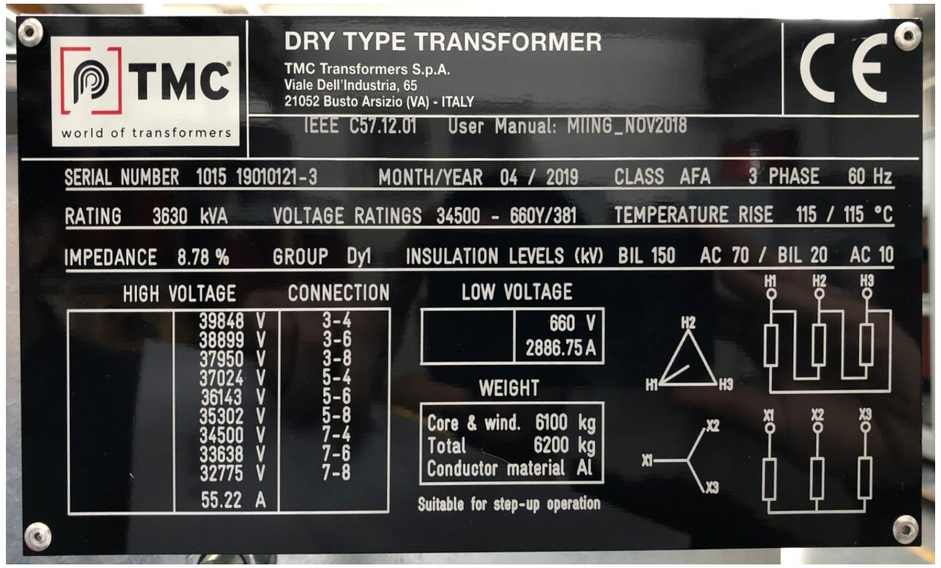
Railway Substation Transformers

Special 12P configuration: 24 Pulse effect in MV.



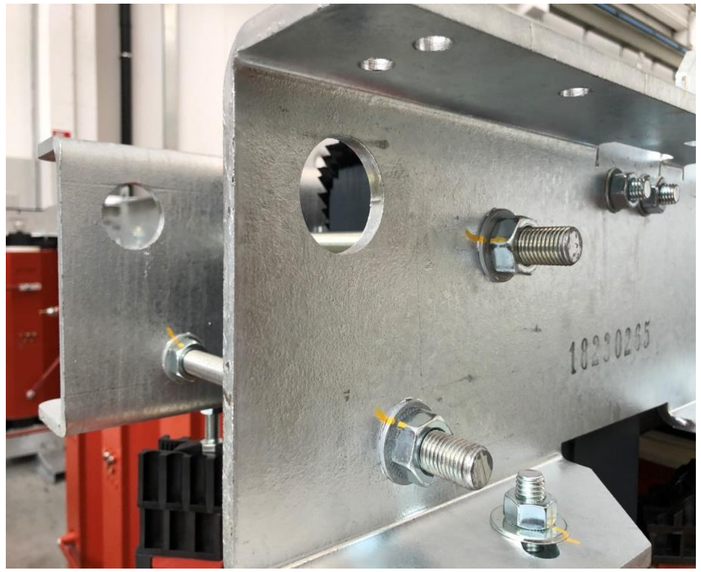
Dry-type transformers
Accessories

Dry type transformers
Standard accessories



Rating plate

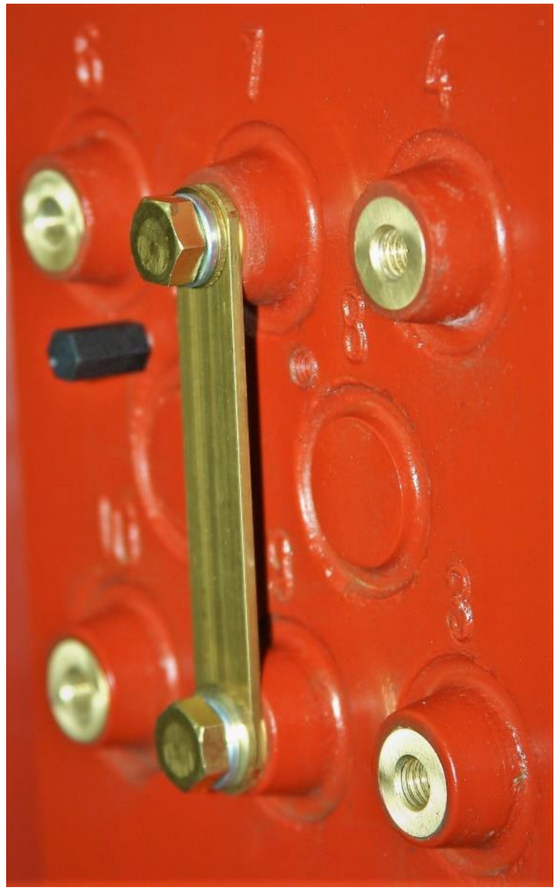
Lifting Lugs



Pulling Eyes

Dry type transformers
Off load Tap Changer

- The industry standard is having and off load regulation
- Commom tapping ratio is ±2 x 2.5%. (5 taps)
- Up to 7 taps is possible but have a price impact
- Tap changer are marked on the HV face in the coils



Dry type transformers

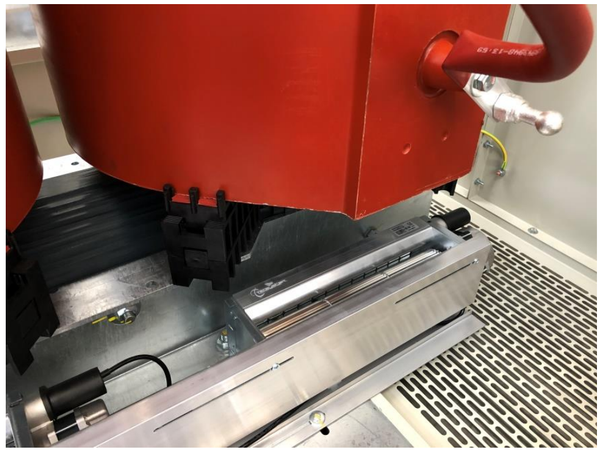
Standard accessories

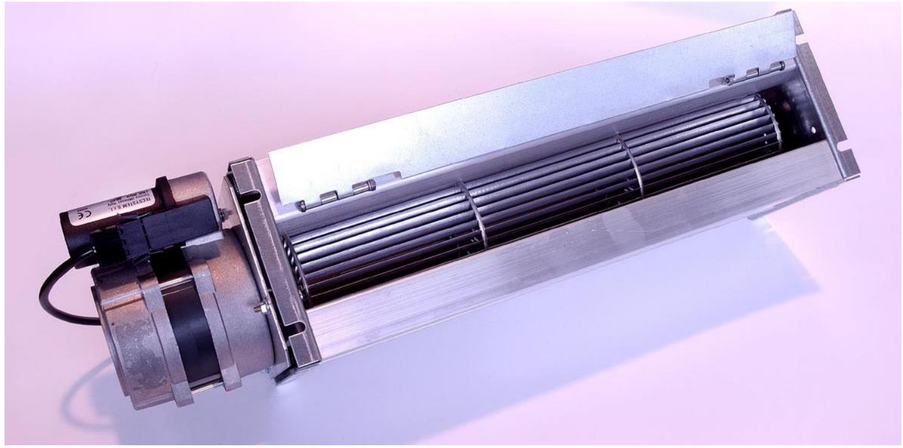
Bi-directional
wheels

Earthing
Terminals

Dry type transformers

Power and cooling – Air natural / air forced



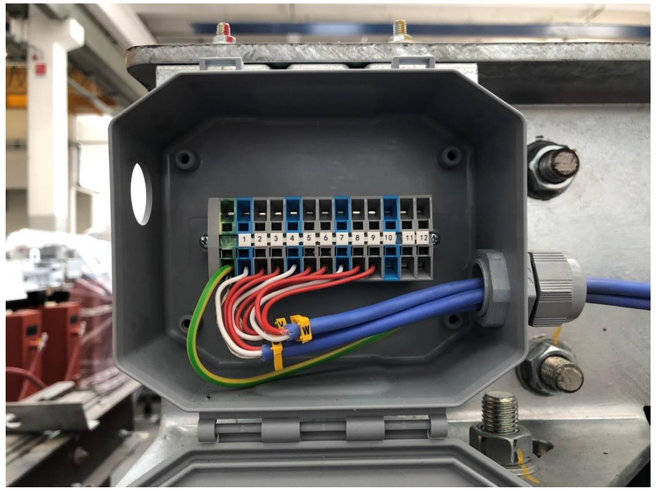


- Normally the rating is AA (air natural), and given in kVA
- In some cases, FA (air forced cooling) is required
  - Extra power can be from +20% up to +40%. Tipically +30%
  - Example 2500/3250kVA AA/FA
- The following accesories will be included:
  - Fans
  - Control Fan Box

Dry type transformers

Standard accessories

PT100 sensor



PT100 sensor box

Dry type transformers

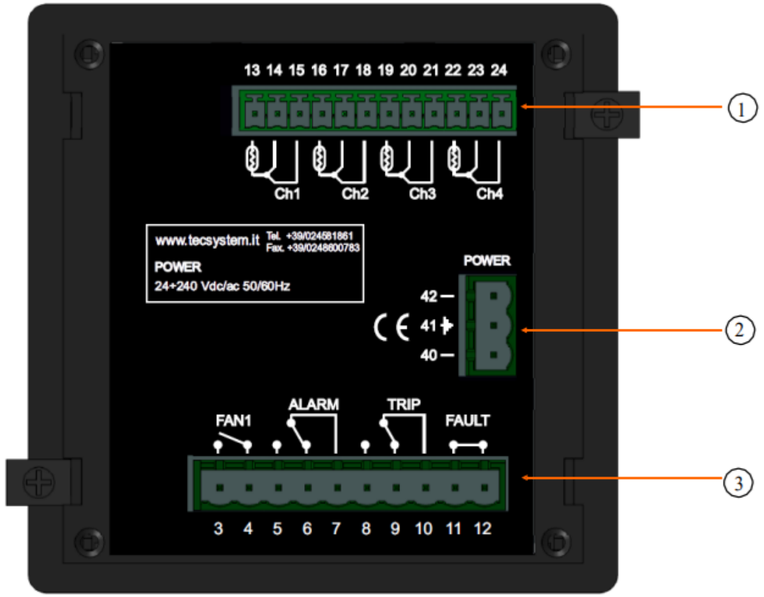
Temperature Monitoring Units

INTELLIGENT TRANSFORMER MONITOR

Operators can easily compare the winding with the highest temperature to pre-selected relay temperatures.

Dry type transformers

Temperature Monitoring Units

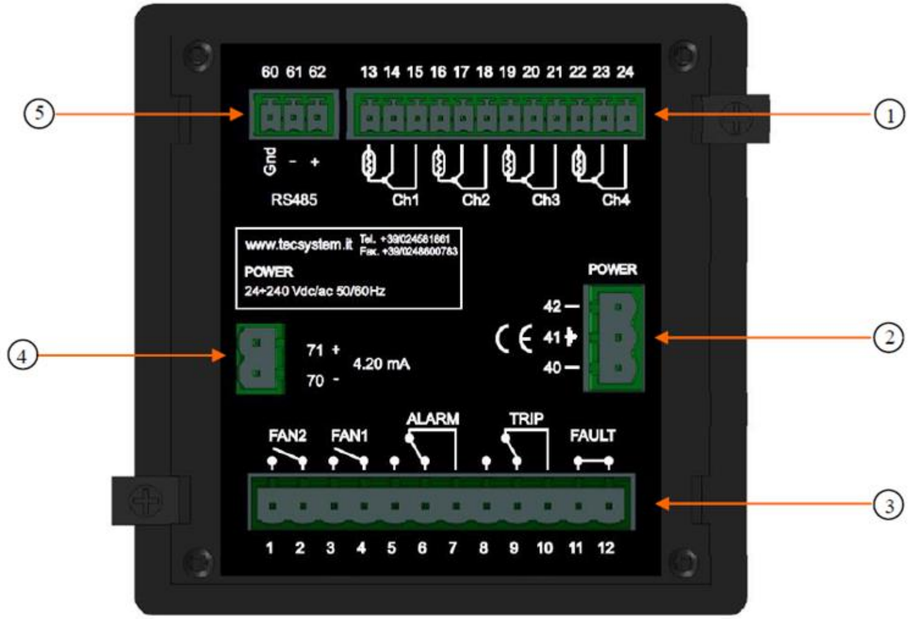


1)	Pt100 sensors (white-red-red)	3)	Relays (FAN1-ALARM-TRIP-FAULT)
2)	Supply 24-240Vac-dc 50/60Hz.		

Digital Thermomether connected up to 4 separated PT100 Sensors to measure the temperature in windings

Dry type transformers

Temperature Monitoring Units

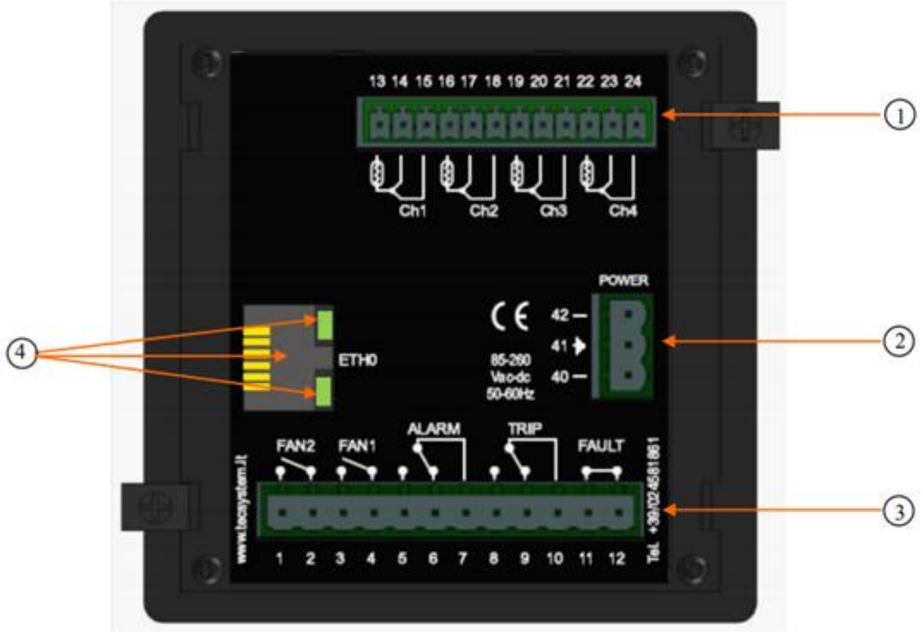


1)	Pt100 sensors (white-red-red)	3)	Relays (FAN2-FAN1-ALARM-TRIP-FAULT)
2)	Supply 24-240Vac-dc 50/60Hz.	4)	Output 4.20 mA
5)	Modbus RTU RS485 output		

Monitoring Unit with Modbus RTU - RS485 Comm

Dry type transformers

Temperature Monitoring Units



1)	Sensores Pt100 (blanco-rojo-rojo)	3)	Relés (FAN2-FAN1-ALARM-TRIP-FAULT)
2)	Alimentación 85-260Vca-cc 50/60Hz.	4)	Salida Ethernet RJ45, led Link-Activity, véase indicación en la Pág. 30.

Monitoring Unit with Ethernet Comm

Dry type transformers

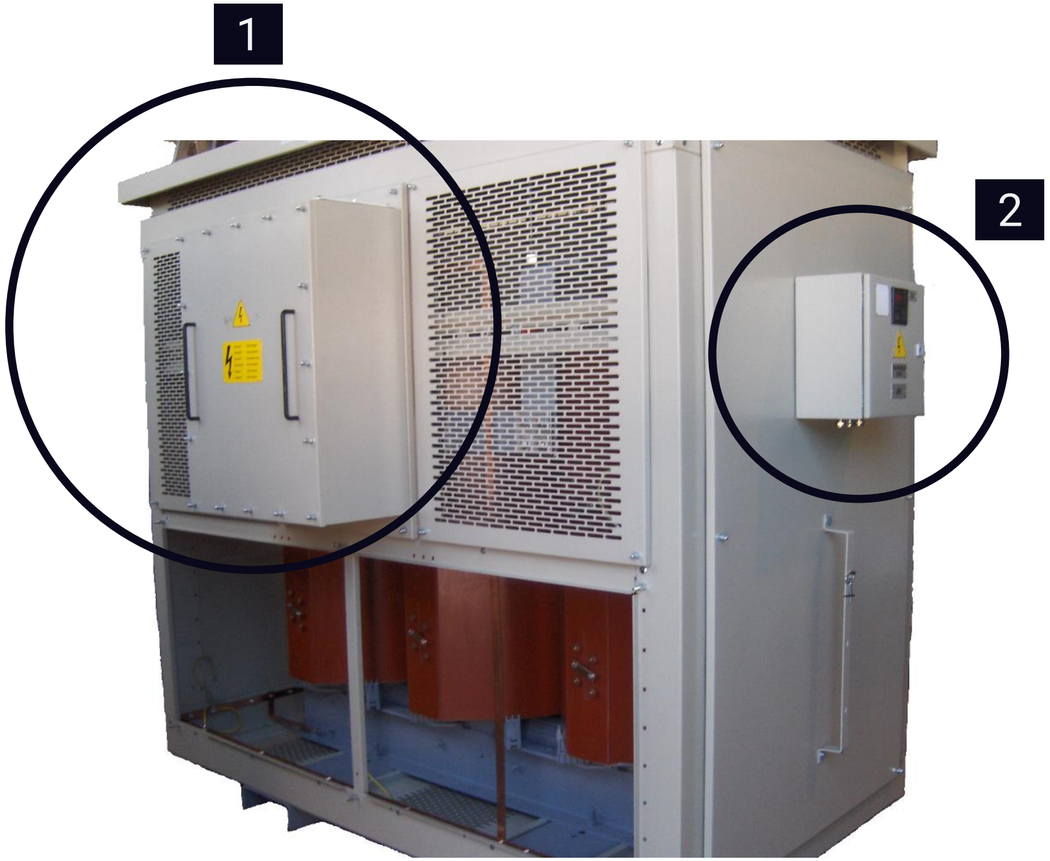
Protection devices in MV side

1

NEMA 3 box with protection devices (fuses, disconnector switch or disconnector switch with fuses) attached to the enclosure.

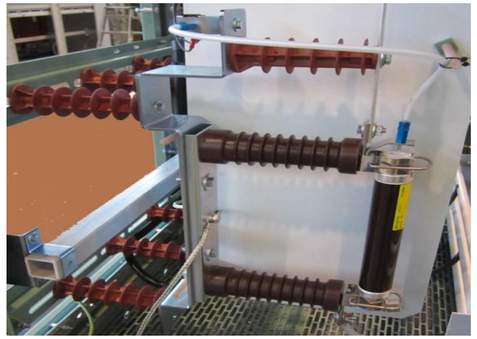
2

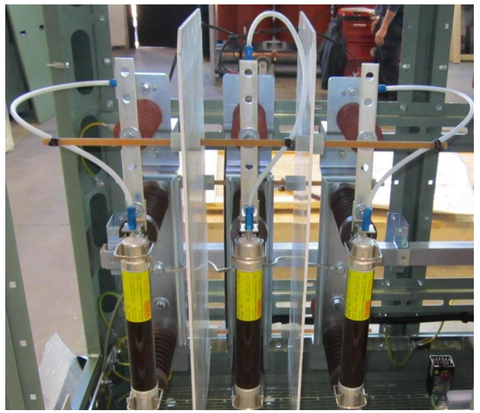
NEMA 3 marshalling box attached to the enclosure to locate terminal strips; with option to locate also the temperature monitoring unit.



Dry type transformers

Protection devices in MV side





Fuses
(only)
inside box

Disconnect Switch for
Primary Side

Fused Disconnect
Switch for Primary Side

Dry type transformers

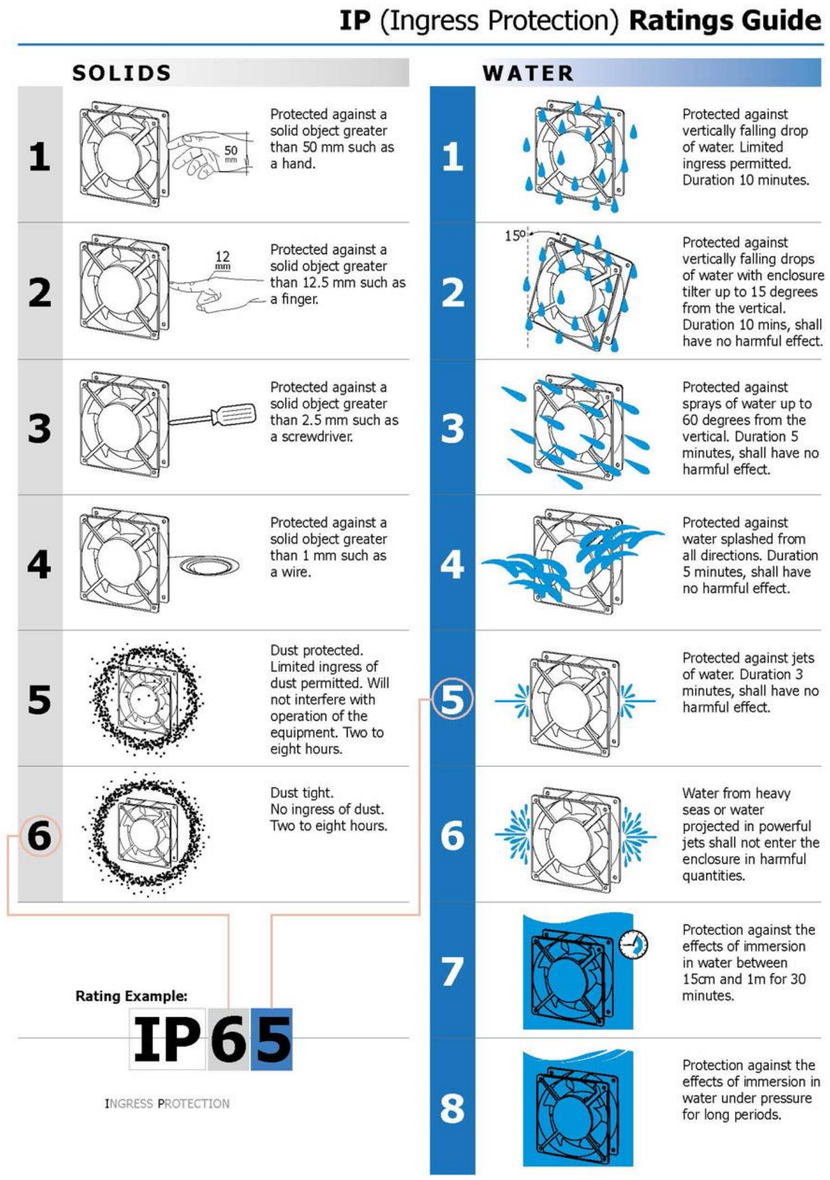
Enclosures – NEMA Ratings

NEMA 1 enclosures are typically used for protecting controls and terminations from objects and personnel. This style of enclosure, while offering a latching door, does not have a gasketed sealing surface**. NEMA 1 enclosures are used in applications where sealing out dust, oil, and water is not required**. **(INDOOR)**
NEMA 2 enclosures are intended for **indoor** use primarily to provide a **degree of protection against limited amounts of falling water and dirt**.
NEMA 3 enclosures are intended for outdoor use primarily to provide a degree of protection against windblown dust, rain, sleet, and external ice formation.
NEMA 3R enclosures are typically used in **outdoor** applications for wiring and junction boxes. This style of enclosure provides protection against falling rain, sleet, snow, and external ice formation. Indoors they protect against dripping water. This style of enclosure does not have a gasketed sealing surface. Some models have hasps for padlocking.
NEMA 3S enclosures are intended for outdoor use primarily to provide a degree of protection against windblown dust, rain, sleet, and to provide for operation of external mechanisms when ice laden.
NEMA 4 enclosures are used in many applications where an occasional washdown occurs or where machine tool cutter coolant is used. They also serve in applications where a pressurized stream of water will be used. NEMA 4 enclosures are gasketed and the door is clamped for maximum sealing.
NEMA 4X enclosures are made of stainless steel, aluminum, fiberglass, or polycarbonate. NEMA 4X enclosures are used in harsh environments where corrosive materials and caustic cleaners are used. Applications include food, such as meat/poultry processing facilities, where total washdown with disinfectants occur repeatedly, and petro-chemical facilities, including offshore petroleum sites.
NEMA 5 enclosures are intended for indoor use primarily to provide a degree of protection against settling airborne dust, falling dirt, and dripping non-corrosive liquids.
NEMA 6 enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against the entry of water during occasional, temporary submersion at a limited depth.
NEMA 6P enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against the entry of water during prolonged submersion at a limited depth.
NEMA 11 enclosures are intended for indoor use primarily to provide, by oil submersion, a degree of protection to enclosed equipment against the corrosive effects of liquids and gases.
NEMA 12 enclosures are intended for indoor use to provide a degree of protection against drips, falling dirt, and dripping non-corrosive liquids. NEMA 12 enclosures are most commonly used for indoor applications of automation control and electronic drives systems, including packaging, material handling, non-corrosive process control, and manufacturing applications. Gasketed doors seal the enclosure’s contents from airborne contaminants and non-pressurized water and oil.
NEMA 12K enclosures with knock-outs are intended for indoor use primarily to provide a degree of protection against dust, falling dirt, and dripping non-corrosive liquids other than at knock-outs.
NEMA 13 enclosures are intended for indoor use primarily to provide a degree of protection against dust, spraying of water, oil, and non-corrosive coolant.

Dry type transformers

Enclosures – IP Ratings

NEMA Type	IP23	IP30	IP32	IP55	IP64	IP65	IP66	IP67
1	X							
2		X						
3					X			
3R			X					
4							X	
4X							X	
6								X
12				X				
13						X		



Dry type transformers
Enclosures

Indoor (Nema 1, Nema 2)

Dry type transformers
Enclosures

Outdoor (Nema 3R)

Dry type transformers

Enclosures details

Cable access pannel at the bottom

Anticondensation heater inside the enclosure

Dry-type transformers
Basic Maintenance

Basic Maintenance

Site Environment Evaluation

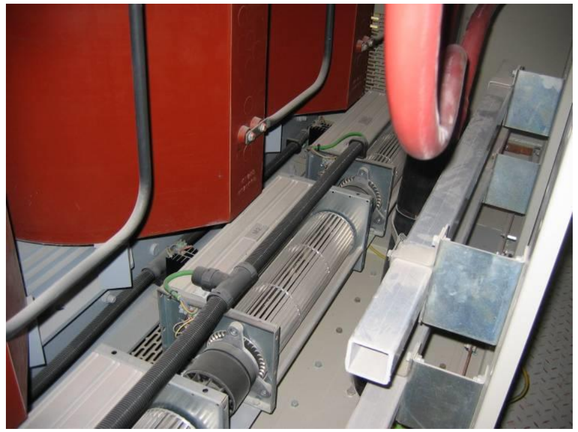
Based upon this qualitative assessment a regular maintenance program can be established. A general visual inspection must be done in order to establish the effective status of the environment ; the criteria for this assessment should be based upon:

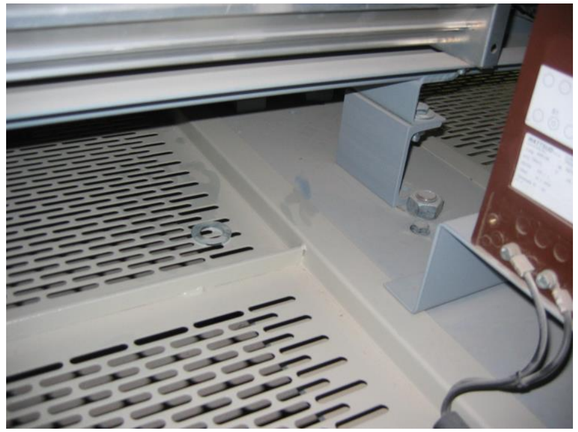
- **Excessive dust**
- **Presence of traces of electrical discharges (visual marks)**
- **Presence of abnormal color of the coils**
- **Traces of rust**
- **Sample check of the tightening torque on to the HV – LV bar connections**

From the data collected during the inspection the following diagram could be applicable in order to define a minimum Maintenance scheduling applicable to the transformer/s.

Basic Maintenance

Excessive dust





Basic Maintenance

Presence of Traces of Electrical Discharges (Visual Marks)

Basic Maintenance

Presence of Abnormal Colour of the Parts

Basic Maintenance

Traces of rust

Basic Maintenance

Maintenance Scheduling Matrix

	DUST				DISCHARGE TRACE				ABNORMAL COIL COLOR				TRACES OF RUST				RESULT
	None	Minor	Medium	Major	None	Minor	Medium	Major	None	Minor	Medium	Major	None	Minor	Medium	Major	
CASE 1		✓			X				X					✓			Schedule maintenance every 1 Year.
CASE 2				✓	X				X						✓		Schedule maintenance every 6 Months.
CASE 3						✓											Contact TMC Service for Evaluation
CASE 4										✓							Contact TMC Service for Evaluation

Other Cases :

In case of a particular environment other scheduling could be applicable, in example in presence of : Water spray – Sea water spray, Aggressive-Chemical environment, Heavy dust, Sand.

The Scheduling showed is only an example of maintenance matrix, a different matrix can be applied depending on the specific conditions of each particular project.

Basic Maintenance

Basic annual maintenance plan

- General Visual inspection
- Clean all surfaces, especially the conducting parts, by means of dry cloth and an industrial vacuum cleaner. It is not recommended to use a high-pressure air line to blow the dust away. Do not use solvents or any kind of liquid (especially on the coils)
- Clean all ventilation grills / openings
- Check and if necessary, re-tighten all bolts on the magnetic core clamping assembly, on the HV and LV connections, on the HV tapping or series / parallel links, and on all earth connections. The appropriate tightening torque must be applied
- Check the condition of all painted surfaces. This applies to the core, the enclosure and other structural metallic parts. Remove traces of rust, if any, by means of wire brush. When necessary, apply locally two coats of new paint. Only a temperature resistant (155 °C - 180°C - 220°C) and insulating paint should be used
- Check the operating settings and correct function of the thermal protection device (Temperature Monitoring Unit)
- Perform a Winding Insulation resistance test

Questions

¿?

Carlos Garcia – Sales Manager North America – c.garcia@tmctransformers.com
Jhonatan Hernández – Bid Manager North America – j.hernandez@tmctransformers.com
Bryan Herity – Area Sales Manager Northeast – b.herity@tmctransformers.com

TMC USA
world of transformers

THANK YOU!

Contacts

TMC Transformers USA Inc.

874 Walker Road, Dover
Kent 19904
Production plant:
1 Evercare Way, Waynesboro
GA 30830

marketing@tmctransformers.com
www.tmctransformers.us

NEXT TECHNOLOGY GROUP