



## **R2 65 04 01    Technical Directive**

Cast resin power transformers

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Issue: March 2006

Version: 2.0

For: Location IJmuiden

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### Information and changes:


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# 1. INTRODUCTION

This technical directive defines the requirements to manufacture, test and delivery of cast resin power transformer site in for the Corus in IJmuiden

The transformer shall be of a standard, well-proven and reliable design. Compliance with the requirements in this technical directive does not exempt manufacturer from his obligation to apply the most recent developments as to components, manufacturing and testing.

The data sheets in chapter 8 contain technical directives for this particular equipment which may overrule the requirements elsewhere in this documents.


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## 2. STANDARDS AND REGULATIONS

Transformer and accessories shall be in accordance with the most recent edition of standards and regulations as listed below:

|                    |  |
|--------------------|--|
| NEN EN IEC 60076   | : Power transformers All Parts   |
| NEN 10616          | : Power transformers-Terminal and tapping markings.                              |
| NEN EN IEC 61378-1 | : Converter transformers - Part 1: Transformers for industrial applications      |
| NEN EN IEC 60529   | : Degrees of protection provided by enclosures (IP Code)                         |
| NEN 1010           | : Safety requirements for low-voltage installations                              |
| NEN EN 50160       | : Voltage characteristics of electricity supplied by public distribution systems |

Furthermore transformer shall comply with European low voltage- and EMC rules where applicable.

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### 3. GENERAL REQUIREMENTS

#### 3.1. Environmentals conditions

Ambient (indoor) temperatures : Minimum -5 °C and Maximum +35 °C  
 Relative humidity : 80%  
 Altitude : 0 m. (sea level)  
 Location : Indoors  
 International Protection code : IP21 according to NEN-EN-IEC 60529  
 Climatic class : Class C1 according to NEN-EN-IEC 60076-11  
 Environment class : Class E2 according to NEN-EN-IEC 60076-11  
 Fire behaviour class : Class F1 according to NEN-EN-IEC 60076-11

#### 3.2. General electrical requirements


System : Isolated neutral  
 System frequency : 50 Hz (+4, -6 %)  
 Withstand voltage of material : (Ref. NEN-EN-IEC 60076-11 table 3)

| Highest voltage for equipment<br>Um | Rated short duration separate<br>source AC withstand voltage<br>(r.m.s.) kV | Rated lightning impulse<br>withstand voltage (peak value)<br>kV |
|-------------------------------------|---|---|
| ≤ 1,1 kV                            | <b>10 kV (special)</b>  | <b>20 kV (special)</b>  |
| 3,6 kV                              | 10 kV   | 40 kV (liste 2)   |
| 7,2 kV                              | 20 kV   | 60 kV “   |
| 12 kV                               | 28 kV   | 75 kV “   |

Partial discharges : less than 10 pC  
 Vectorgroup two winding transformers : Dyn5  
 Vectorgroup three winding transformers : Dyn5 d0  
 Class of Insulation : F  
 Temperature rise : 100 °C (At the calculated load losses including the losses caused by harmonics according the calculation NEN-EN-IEC 61378-1)  
 Cooling : AN

For distribution transformers : Harmonic voltage at full load. According NEN EN 50160 for distribution (THD = 8 %)  
 For convertor transformers : Harmonic current at full load see table:

|      |     |       |      |      |      |      |      |     |      |      |      |      |      |      |      |      |
|------|-----|-------|------|------|------|------|------|-----|------|------|------|------|------|------|------|------|
| I1   | I5  | I7    | I11  | I13  | I17  | I19  | I23  | I25 | I29  | I31  | I35  | I37  | I41  | I43  | I47  | I49  |
| 100% | 20% | 14,1% | 9,1% | 7,7% | 5,9% | 5,3% | 4,3% | 4%  | 3,4% | 3,2% | 2,9% | 2,7% | 2,4% | 2,3% | 2,1% | 2,0% |

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### 3.3. Winding and terminals

High voltage windings must be fibre glass reinforced void free full vacuum cast resin insulated. The low voltage winding may be:

- A. void free full vacuum cast resin insulated; or
- B. cast resin insulated or pre-impregnated, with the edges (top and bottom) enclosed with resin and bound by a heating process to a strong cylinder.

Winding material is preferable made from electrolytic copper.

The winding end terminals (including neutral) must be made of copper.

### 3.4. Appraisal of Load and No-Load losses

If not specified, losses are calculated into prices and added to the total price during quote evaluation: Calculated load losses including the losses caused by harmonics according to the calculation NEN-EN-IEC 61378-1

No-load losses : 2,5 euro per watt

Load losses : 1,5 euro per watt

Guaranteed losses are measured at the rated tapping; this value is applicable without any + tolerance. The Test certification must state the magnetising losses for each transformer tap. The reference temperature for the copper losses is per IEC standard (75 °C).

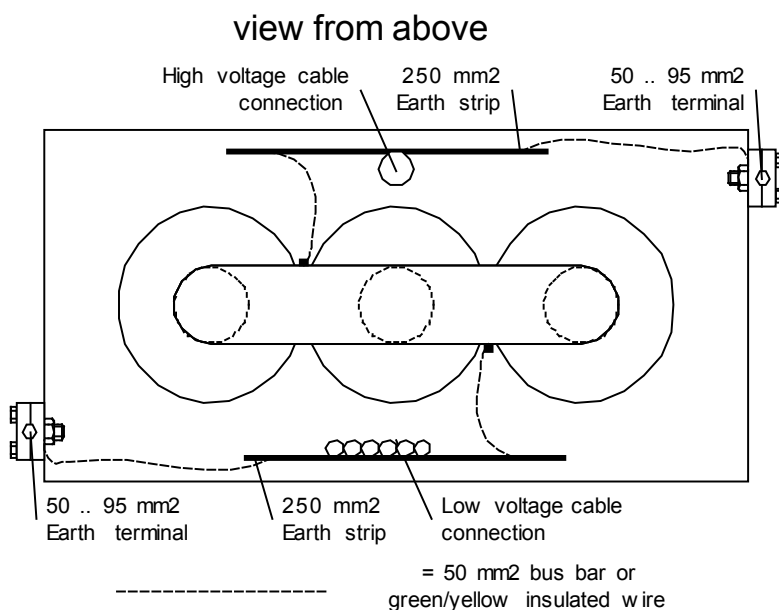
### 3.5. Enclosure

The enclosure must allow infrared photography to the high and low voltage terminals without removing the enclosure.

### 3.6. Mounting


Transformer to be provided with lifting lugs and 90° turn able guide rollers.

### 3.7. Earthing



250 mm<sup>2</sup> copper earthing strip, at the bottom, or top in case low voltage cables are connected at the top. Additional holes Ø12 mm shall be supplied on the earthing strip.

At the high voltage side, each phase must be provided with earthing knob with a diameter of 25 mm.

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### **3.8. Cable installation**

Cable supports shall be installed inside the transformer enclosure to support high and low voltage cables up to the terminals on the transformer.

The transformer enclosure shall contain the cable entry holes from below or above so that no on-site drilling in the enclosure is required.

### **3.9. Temperature monitoring**

Transformer must include a temperature monitoring device (power supply 24-240 Vac-dc) to which six PTC-elements, i.e. two per LV-coil, 1 x PTC 145 °C and 1 x PTC 155 °C, can be connected.

The output of the device must feature potential free contacts wired to terminals for ALARM 145 °C NC/NO and TRIP 155 °C NC/NO. Trip contact is time delayed for approx. 2 sec. Output contacts capability 5A and 250 Vac-dc.

PTC-elements shall be completely wired to a separate terminal box located on the outside of the transformer, see data sheet. The terminal box shall include terminals for the connection of customer's cable.

Furthermore, each transformer is to be furnished with a dial-type temperature indicator with capillary tube, located in the coil of the centre core; indicator is furnished with two adjustable contacts.

Said tube must be easily transferable to another core.

### **3.10. Surface treatment**


Primers and top layer: manufacture's standard

### **3.11. Tap changer**

The tap changer shall be off-load with steps at the HV side. The higher tap shall correspond to the higher voltage in the HV side

### **3.12. Rating plate**

The rating plate should include as a minimum the NEN-EN-IEC 60076 required plus the schematic drawing of the windings.

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## 4. INSPECTION AND ACCEPTANCE TESTS

In order to secure fulfilment on the part of the supplier the quality requirements, this one should have a quality certificate according to the corresponding ISO standard serial 9000, issued for a reputable agency

### 4.1. Inspection

Buyer or his authorised representative may carry out intermediate visual inspection during manufacturing of transformer and accessories in order to verify conformity with the specification

### 4.2. Acceptance tests

The manufacturer must provide all necessary equipment required for testing and have personnel available to carry out the required inspection and testing.

The transformer must be tested in accordance with the most recent standards and regulations

Buyer or his authorized agent may witness routine tests on one or a small number of transformer or witness routine tests on all transformers.

In any case, manufacturer shall document all tests on the data sheets and related documents.


Manufacturer shall notify the buyer or his authorized agent well in advance (minimum 4 weeks notice) at which point in time the routine tests will be performed (during normal working hours).

Routine tests according NEN-EN-IEC 60076. including

- Additional partial discharge test according to section 22.4.1.2 (NEN-EN-IEC 60076-11)
- Load losses including the losses caused by harmonics according the NEN-EN-IEC 61378-1
- No-load test, also at 110% of the rated voltage

Optional tests according NEN-EN-IEC 60076


- The transformer may be submitted to a shortcircuit test,
- Lightning impulse test according to section 21, optional price
- Temperature-rise test according to section 23 (including the losses caused by harmonics according the NEN-EN-IEC 61378-1), optional price
- Measurement of sound level according to section 24, optional price

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## 5. PACKAGING AND TRANSPORTATION

The following requirement shall be fulfilled by supplier

- Weather protected (closed truck, foil wrapping or other)
- Transportation from manufacturer's to end-user, not off-loaded.

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## 6. DOCUMENTATION AND TECHNICAL DATA

### 6.1. With quotation

- Electrical data
- Dimensional data and weights
- Conservation method
- List of specific civil-and/or mechanical requirements.
- Guaranteed losses (No-load, Load and load losses including losses due to harmonics)
- Guaranteed temperature rise
- Guaranteed sound power (Lw) and pressure (Lp) level
- Price and delivery time
- Optional price for Lightning impulse test
- Optional price for temperature rise test.
- Optional price for Measurement of sound level

### 6.2. After award of order


- Priced list of recommended spare parts 1 month.
- Final dimensional-/arrangement drawings and weights: 1 month
- Parts lists incl. origin of materials 1 month
- Manufacturing- inspection- and test plan 1 month
- Operation- and maintenance manual 1 month
- Schematic- and connection diagrams 1 month
- Commissioning procedures 1 month

### 6.3. Before testing

The supplier shall issue the procedures not later than four weeks before the beginning of the factory acceptance tests.

### 6.4. After inspection

Signed routine test certificates and measurement of transformer as mentioned in chapter 4

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## 7. GUARANTEE CONDITIONS

The supplier shall guarantee the transformer and all the accessories included in the scope of supply. All the expenses related to the equipment, caused by any fault in the transformers or their accessories, must be afforded by the supplier during the guarantee period.

This guarantee should remain valid until 18 months after the transformers have been put on service or 24 months after ex-works delivery, what happens first.

Following specifications are subject to the guarantee conditions as specified in the commercial part of this order:

| Item                                 | Acceptable margin | Action when margin is exceeded |
|--------------------------------------|-------------------|--------------------------------|
| No load losses                       | 0%                | Reimbursement                  |
| Short circuit losses                 | 0%                | Reimbursement                  |
| Short circuit losses incl. Harmonics | 0%                | Reimbursement                  |
| Temperature rise                     | 0%                | Reimbursement / rejection      |
| Noise level                          | 0%                | Rejection                      |

### No-load and load losses

When measured losses at the acceptance test exceed the ordered values, the capitalized costs will be calculated, based on the appraisal of load and no-load losses, and deducted from the ordered transformer price.

Calculation of the penalty


$$B = A_0 \cdot (P_{om} - P_{og}) + A_k \cdot (P_{km} - P_{kg})$$

|                 |   |                           |
|-----------------|---|---------------------------|
| B               | = | Penalty                   |
| A <sub>0</sub>  | = | Appraisal no-load losses  |
| P <sub>om</sub> | = | Measured no-load losses   |
| P <sub>og</sub> | = | Guaranteed no-load losses |
| A <sub>k</sub>  | = | Appraisal load losses     |
| P <sub>km</sub> | = | Measured load losses      |
| P <sub>kg</sub> | = | Guaranteed load losses    |

When temperature rise at the acceptance test exceeds the ordered values, its costs will be calculated as follows:

- the power of the transformer at the ordered temperature rise is calculated
- the transformer price will be multiplied by the relative power decrease to obtain the price to be deducted from the ordered transformer price.
- When the transformer power decrease is more than 5 %, the transformer will be rejected.

When the noise level exceeds the guaranteed noise level, the transformer will be rejected.

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## 8. Data sheet for standard distribution transformer

End user: Corus Packaging Plus, location IJmuiden, Netherlands.  
 Project: .....  
 Engineer: ..... Tel. ....

Number of transformers: .....  
 Transformer identification: .....

The selected value is checked

### 8.1. Primary voltage


|  | <input type="checkbox"/> 3 kV | <input type="checkbox"/> 6 kV | <input type="checkbox"/> 10 kV | Notes            |
|--|-------------------------------|-------------------------------|--------------------------------|------------------|
| Phases   | 3                             | 3                             | 3                              |                  |
| Vectorgroup  | Dyn5                          | Dyn5                          | Dyn5                           |                  |
| Rated primary voltage (principal tapping)                          | 3,15 kV                       | 6,3 kV                        | 10,5 kV                        | ~ + 5 %          |
| Primary system earthing  | Insulated (not earthed)       |                               |                                |                  |
| Primary voltage operating range (Min. - Max.) at principal tapping | 2,7 .. 3,3 kV                 | 5,4 - 6,6 kV                  | 8,0 .. 11,0 kV                 | - 20 % .. + 10 % |
| Tappings (no-load switching)                                       | 3000                          | 6000                          | 10000                          | Ca. -5 %         |
|  | 3075                          | 6150                          | 10250                          | Ca. -2,5 %       |
|  | 3150                          | 6300                          | 10500                          | Principal        |
|  | 3225                          | 6450                          | 10750                          | Ca. +2,5 %       |
|  | 3300                          | 6600                          | 11000                          | Ca. +5 %         |

### 8.2. Secondary voltage

|                         |                                |                                |                                |                                |
|-------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| Rated secondary voltage | <input type="checkbox"/> 240 V | <input type="checkbox"/> 420 V | <input type="checkbox"/> 525 V | <input type="checkbox"/> 725 V |
| Secondary neutral       | Solid earthed                  |                                |                                |                                |

### 8.3. Rated power

| kVA   | <input type="checkbox"/> 1000  | <input type="checkbox"/> 1250 | <input type="checkbox"/> 1600 | <input type="checkbox"/> 2500 |
|---|--|-------------------------------|-------------------------------|-------------------------------|
| Short circuit impedance   | 6 %  | 7,5 %                         | 7,5%                          | 7,5 %                         |
| Guaranteed weighed sound pressure level Lp at 1 meter                         | 57 dB(A)   | 58 dB(A)                      | 59 dB(A)                      | 61 dB(A)                      |
| Power rating  | At full load secondary voltage   |                               |                               |                               |
| Type of load:<br>Load with a THD of less than 8%<br>Load with a THD of ca 30% | <input type="checkbox"/> (Normal distribution according IEC 50160)<br><input type="checkbox"/> see 3.2 (Converter transformers according NEN-EN-IEC 61378) |                               |                               |                               |

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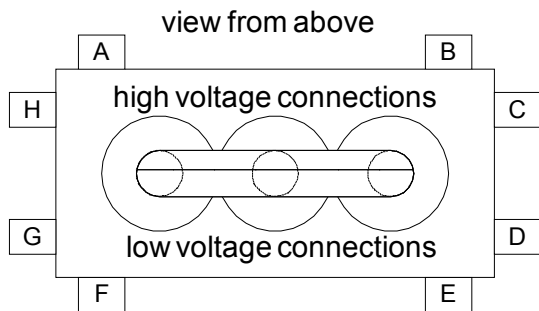
**8.4. Maximum dimensions**

Length x Width x Height = .....x .....x .....x mm

**8.5. Cable connection**

|                               |                                     |                                     |
|-------------------------------|-------------------------------------|-------------------------------------|
| High voltage cable connection | <input type="checkbox"/> From above | <input type="checkbox"/> From below |
| Low voltage cable connection  | <input type="checkbox"/> From above | <input type="checkbox"/> From below |

**8.6. Location of temperature protection / indicator**



Location of temperature protection and indicator: .....

**8.7. Special applications**

- Crane application  (special requirements added)
- Heavy polluted environment  (special requirements added)

**8.8. Special requirements**

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## 9. Explanation.

**Version 1.0:** (only in Dutch)


This Technical Directive replaces HO-standards  
65.00.04.001 and 65.00.40.001

**Version 1.1:** (only in Dutch)

Logo changed

**Version 2.0:**

Document completely changed.

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