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Enterprise No.:
NO 939 350 675 MVA

TEST REPORT

TITLE

Dielectric Testing of 2 MVA Transformer

TEST CONDUCTED BY (AUTHOR(S))

Horst Förster *H.F.*
Rolf Hegerberg

/ajf

CLIENT(S)

Møre Trafo

LR NO.

LR F2415

DATE

2006-03-10

CLIENT'S REF.

Kårstein Longva

ELECTRONIC FILE CODE

060301rh14392

RESPONSIBLE

Laboratory Manager Rolf Hegerberg *Rolf Hegerberg*

PROJECT NO.

14X30013

NUMBER OF PAGES

10

TEST LOCATION

High voltage laboratory, SINTEF Energy Research

TEST OBJECT

Three-phase, 2-winding transformer, 2000 kVA, 22000/417 V, 50 Hz
Type OTK9578 H; Ser.No 0600206

TEST OBJECT RECEIVED

2006-02-27

TEST PROGRAM

Lightning impulse voltage test at 125 kV 1,2/50 µsec according to IEC 60076-3
(2000-03), sub-cl. 13.

DATE OF TEST

2006-02-28

SUMMARY

The test object fulfilled the requirements according to the standard. No flashover or puncture occurred.

The test results relate only to the items tested

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KEYWORDSSELECTED BY
AUTHOR(S)

IEC 60076-3

Dielectric testing

Power transformer

Lightning impulse

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1 TEST OBJECT

The test object was a 2000 kVA 50 Hz, 22000V/417 V; D yn11; ONAN; two-winding, three-phase transformer.

Type: OTK9578 H, Ser.No: 0600206.

2 TEST PROGRAM

Standard lightning impulses was applied to each of the line terminals (A, B and C) while the other terminals were earthed through a low impedance of 40 Ω in order to be able to produce an acceptable waveshape of the lightning impulse. IEC publication 60722 (1982) recommends an impedance to keep the overshoot of the impulse of less than 10 %. With the chosen impedance, this overhoot was limited to 9 %, while the rise-time of the impulse was kept within the required range of $1,2 \pm 30 \% / 50 \pm 20 \%$. The low voltage terminals were solidly earthed during the tests. The tap changer was kept in the principal position, pos 1, during the tests.

An impulse of 50% of the rated LI withstand level were applied to establish a reference for the voltage and current recordings. Subsequently three impulses of rated LI level of 125 kV was applied to each of the terminals.

The impulse voltage and the tank current was recorded for each impulse.

The tests were witnessed by:

Kårstein Longva

Arnulf Karlsvik

Terje Værnes.

all representing Møre Trafo.

3 RESULTS

The results are shown in table 1.

Rec.No	Terminal	Peak voltage (kV)	Rise/fall time (μ sec)	Comment
25 *	A	62,5	1,4/54	50 % LI
26	A	125,5	1,4/54	
27 *	A	125,3	1,4/54	
28	A	125,3	1,4/54	
29 *	B	62,4	1,4/54	50 % LI
30 *	B	125,1	1,4/54	
31	B	125,2	1,4/54	
32	B	125,1	1,4/54	
33 *	C	62,2	1,37/54	50 % LI
34	C	124,6	1,37/54	
35	C	124,7	1,37/54	
36 *	C	124,7	1,37/54	

*) Oscillogram included in the report. All oscillograms are stored in the laboratory's archives and are available on request.

A comparison of records 30 and 31 are shown in figure 1. In these oscillograms, the curve marked Difference is computed as the difference between osc 30 and 31 after scaling such that the peak values overlap. Both voltage and current oscillograms are compared, and apart from some high frequency oscillations at the start of the current trace, caused by trigger jitter or sampling errors, the oscillograms do not show any significant differences between voltage and current transients recorded at reduced voltage and full voltage

No breakdown or flashover occurred during the tests.

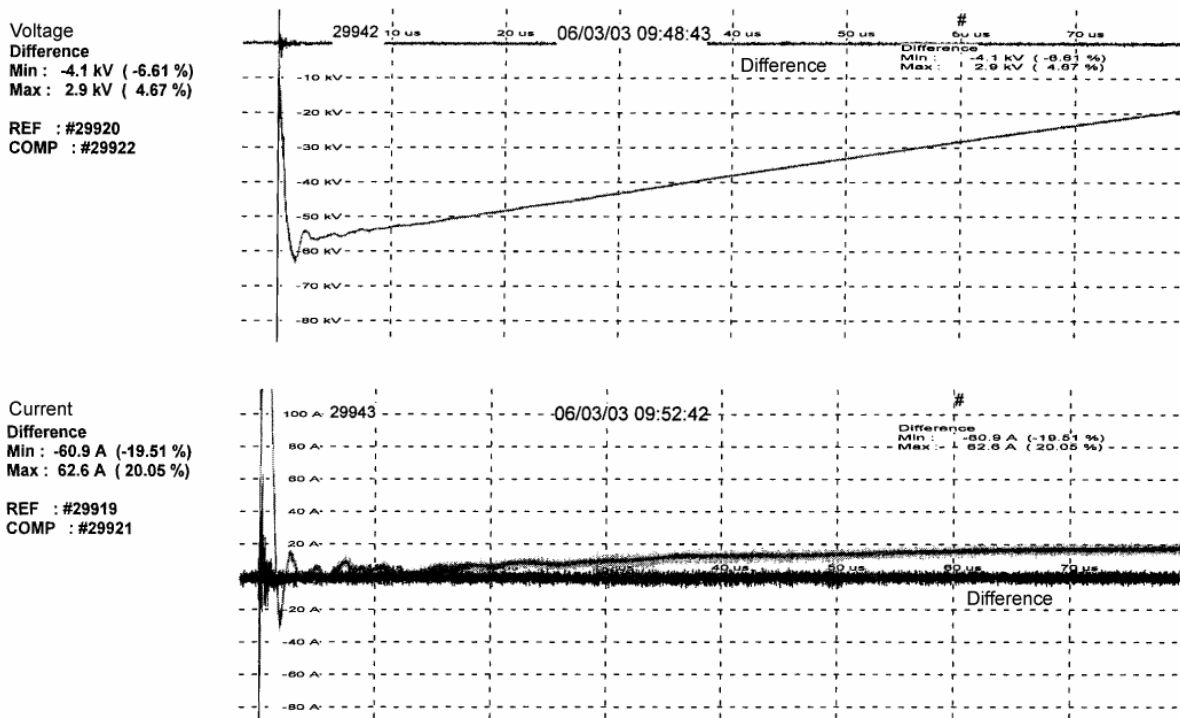
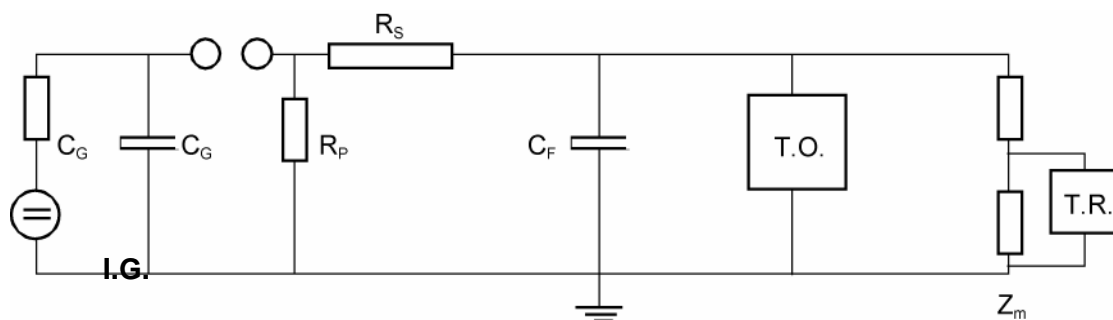


Figure 1: Comparison of voltage and current oscillograms for records 30 and 31.

4 TEST CIRCUIT



$$R_S = 28 \Omega$$

$$R_P = 760 \Omega$$

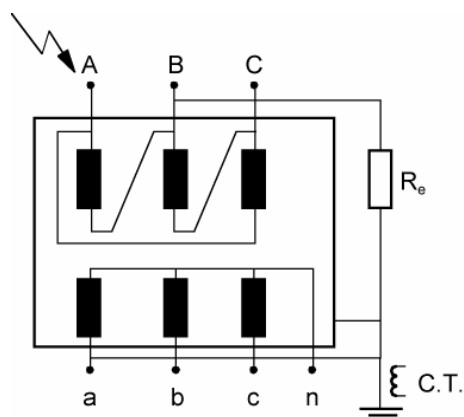
$$C_F = 0 \text{ (No front capacitor used)}$$

Z_M : Measuring impedance (Instr.No EFI 016-0321/0335)

T.R.: Transient recorder (Instr. No. SEfAS G05-0087)

I.G. : Impulse generator (Instr No EFI B03-0247)

T.O.: Test object (see below)



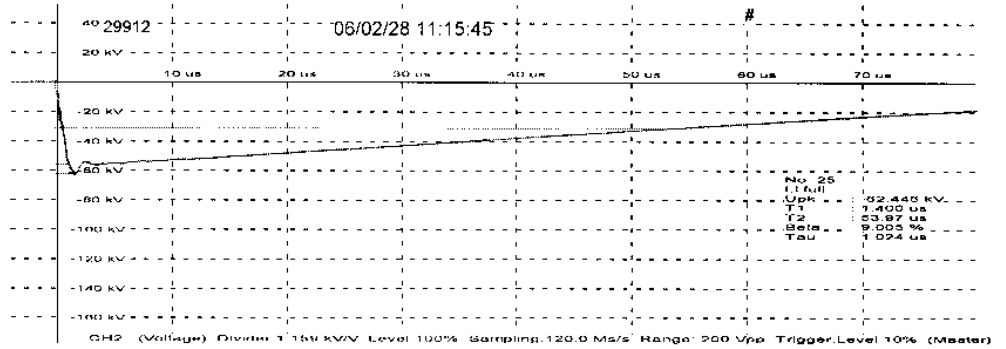
$$R_e = 40 \Omega$$

C.T.: Current transformer (Instr. No EFI I04-0284)

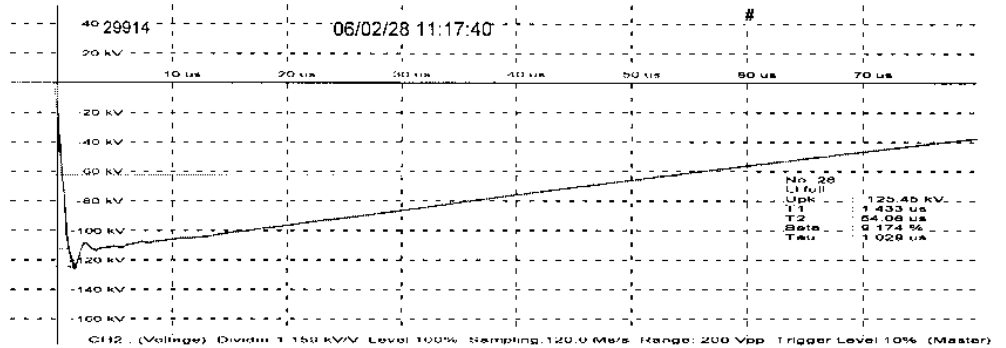
Figure 2: Test circuit and test object connections.

5 OSCILLOGRAMS

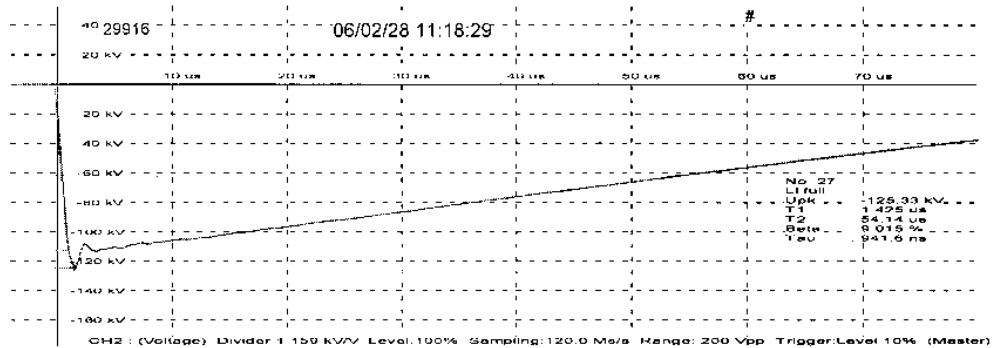
No. 25
 LI full
 Upk: -62.446 kV
 T1 : 1.400 us
 T2 : 53.97 us
 Beta : 9.005 %
 Tau: 1.024 us



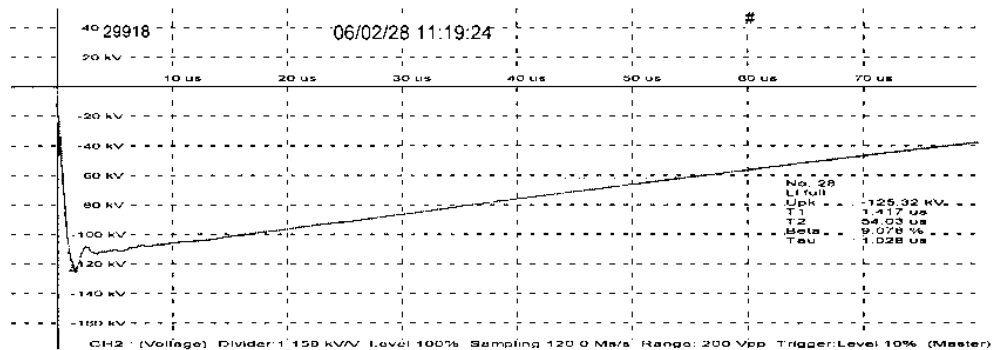
No. 26
 LI full
 Upk: -125.45 kV
 T1 : 1.433 us
 T2 : 54.06 us
 Beta : 9.174 %
 Tau: 1.029 us



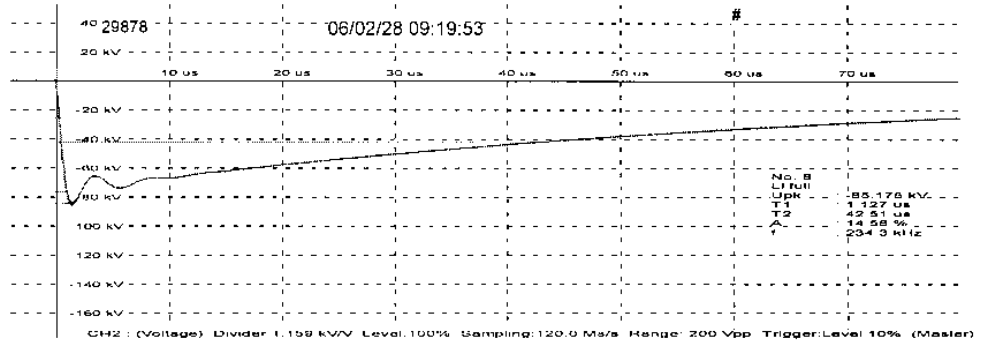
No. 27
 LI full
 Upk: -125.33 kV
 T1 : 1.425 us
 T2 : 54.14 us
 Beta : 9.015 %
 Tau: 941.6 ns



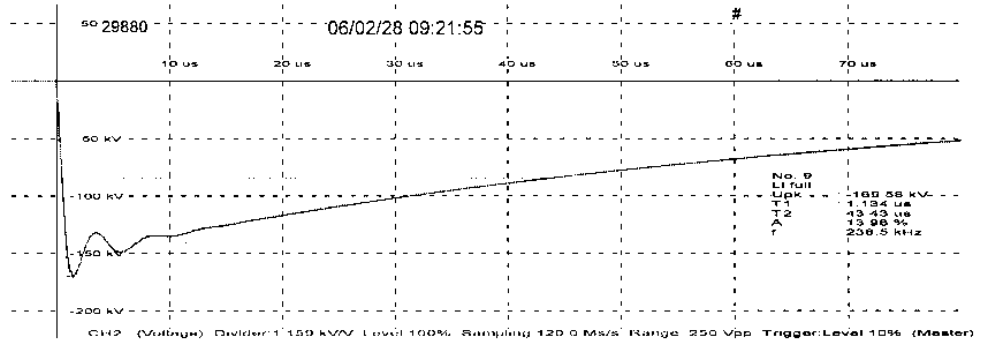
No. 28
 LI full
 Upk: -125.32 kV
 T1 : 1.417 us
 T2 : 54.03 us
 Beta : 9.078 %
 Tau: 1.028 us



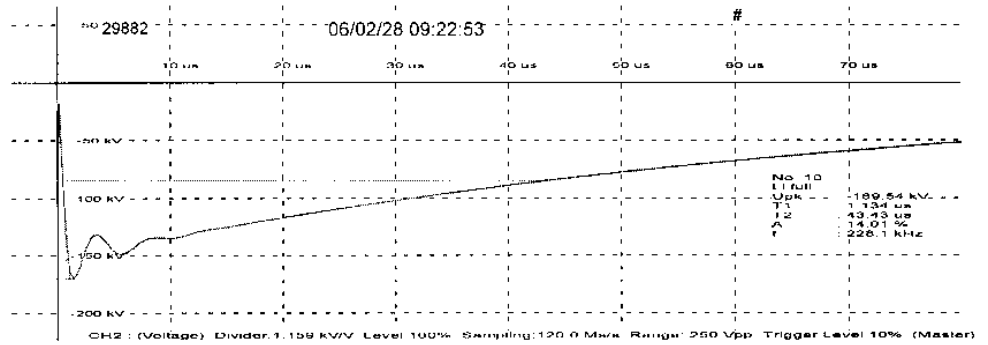
No. 8
LI full
Upk: -85.176 kV
T1 : 1.127 us
T2 : 42.51 us
A : 14.58 %
f : 234.3 kHz



No. 9
LI full
Upk: -169.58 kV
T1 : 1.134 us
T2 : 43.43 us
A : 13.96 %
f : 238.5 kHz



No. 10
LI full
Upk: -169.54 kV
T1 : 1.134 us
T2 : 43.43 us
A : 14.01 %
f : 228.1 kHz



No. 11
LI full
Upk: -169.57 kV
T1 : 1.132 us
T2 : 43.60 us
A : 14.01 %
f : 232.5 kHz

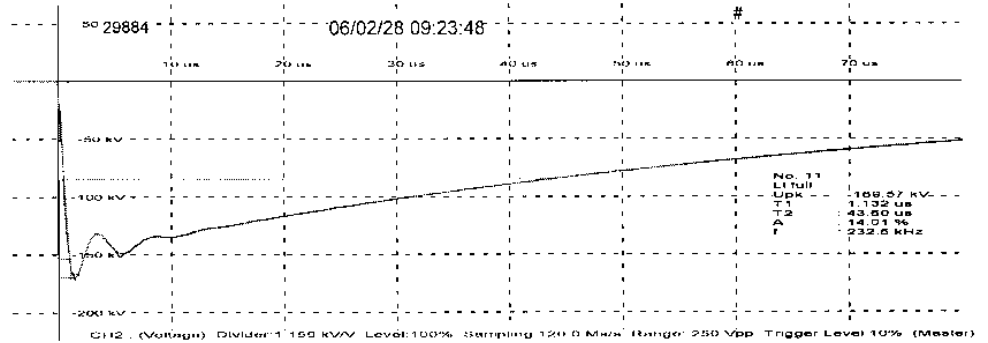


Figure 3: Example lightning impulse oscillograms.

6 RATINGS PLATE

02.03.2006

13:08:25

VD26227 LH2000A417.123

Engelsk Skilt Varenr. skilt :		SKILTDATA Merking X : <input type="checkbox"/>		02-mar-2006 Salgsordre: 0015703									
Hermetically sealed TRANSFORMER Do not open for service !				MØRE TRAFØ AS N-6230 SYKKYLVEN NORWAY									
				<table border="1"> <tr> <th>Environment</th> <th>Class</th> </tr> <tr> <td>Climatic-Temp.</td> <td></td> </tr> <tr> <td>Humidity/Pollu.</td> <td></td> </tr> <tr> <td>Fire behaviour</td> <td></td> </tr> </table>		Environment	Class	Climatic-Temp.		Humidity/Pollu.		Fire behaviour	
Environment	Class												
Climatic-Temp.													
Humidity/Pollu.													
Fire behaviour													
Prod.year: 2003		Norm. IEC60076 -1996		IEC CE									
Type : OTK 9578		Serial no. 0 2 - winding transformer		Approved oil : Type : NYTRO 10X Environm.appr. oil IEC296-IA,IIA									
3 -phase		50 Hz		Duty : Cont. Cooling ONAN									
Terminal	ABC		abc		Position 1 ABC								
Connections					Tappings Volt								
kVA	2000		2000		1 23100								
Volts	22000 + 2 x 2,5 %		417		2 22550								
	- 2 x 2,5 %				3 22000								
Amp.	52,49		2769		4 21450								
Vector group			D yn11		5 20900								
zt %					6								
Ro mOhm					7								
Xo mOhm					Total 4 268 kg								
Insul. class	A 105				Oil 818 kg								
Temp. class	A 105				Core total 2 699 kg								
Temp. rise wind.	65 Δ T				Coresheet 1 709 kg								
Insul. level	LI 125 AC 50				Enclosure 0 kg								
Wind. material	Al		Al		Encl.level IP 00								
Weight windings	400 kg		211		Soundpo.LwA 60 dB								
Temp. rise oil	60		Oilpressure dP 0,060 bar		Soundpr. LpA 48 dBA								
Total. surface m2	61		Design amb. 20 °C		Soundint.LIA dBA								
			Ms/Cu/Al -kg : 143										
			Connect.diagr. KS5581										

Figure 4: Ratings plate.

7 DIMENSION DRAWING

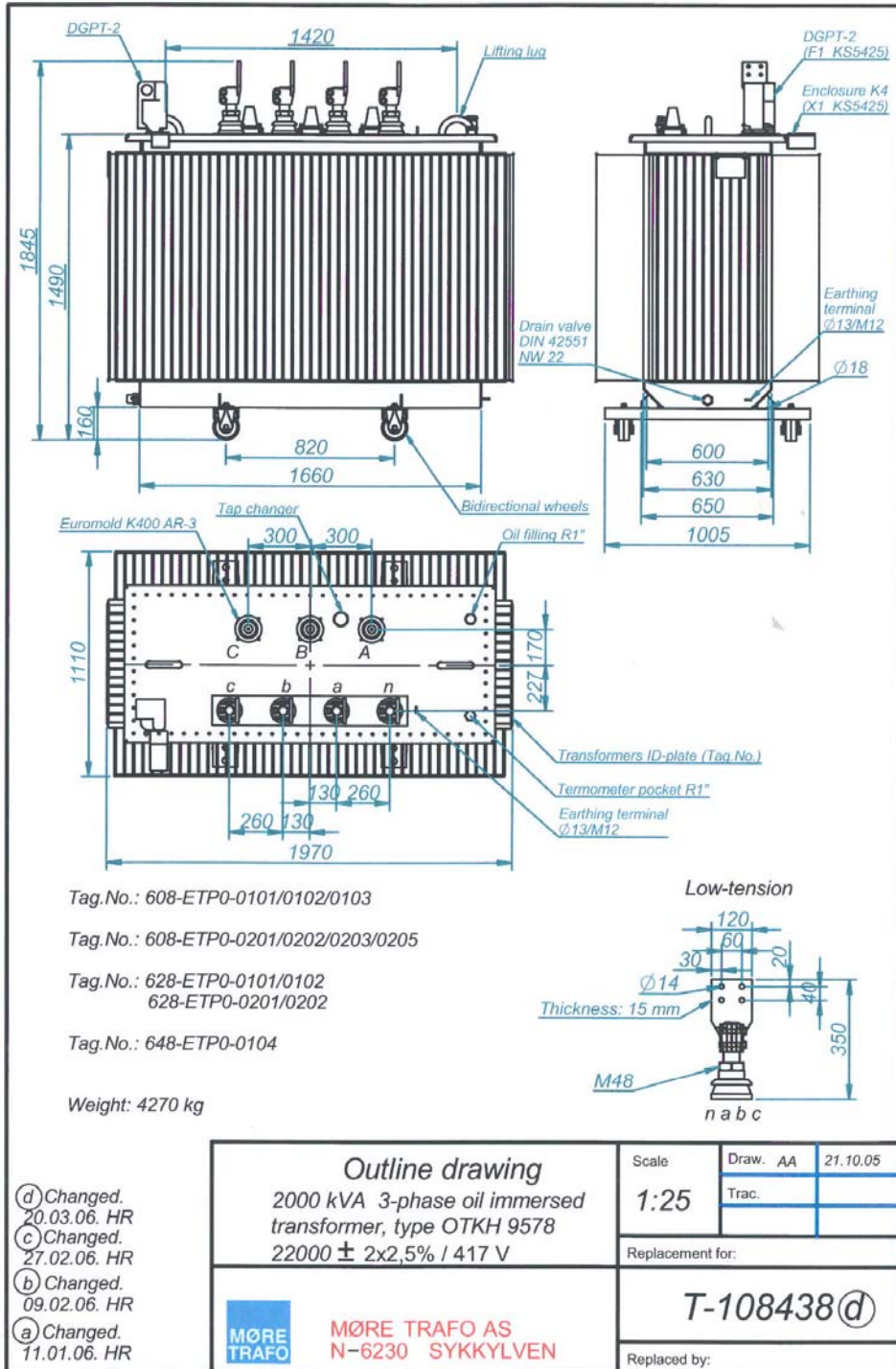


Figure 5: Dimension drawing.

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