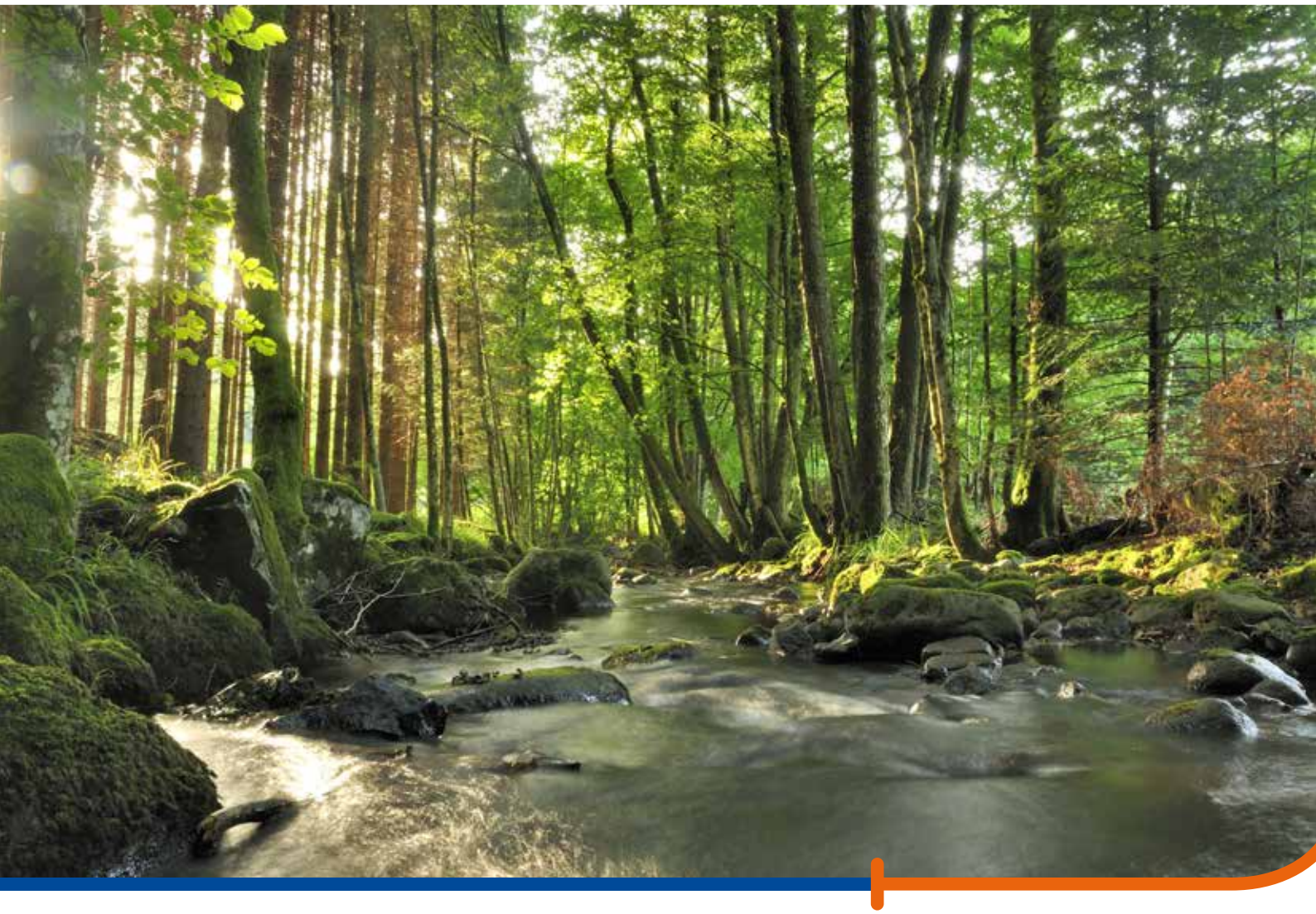
NEWS REGARDING TRANSFORMERS

Revision of the European Commission's Ecodesign Regulation and entry into force of Tier 2 loss requirements on July 1, 2021



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General Information

Title of the Regulation:
Commission Regulation (EU) 2019/1783 of 1 October 2019 amending Regulation (EU) No 548/2014 on implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to small, medium and large power transformers.

Contents:
The Ecodesign Directive defines the requirements for the environmentally sound design of energy-related products. Higher energy efficiency values and the increased environmental compatibility of electrical appliances contribute to the reduction of CO2 emissions in this context.

As a basis for the revision of the regulation implementing the European Directive, a study was conducted to analyze the appropriateness of the decisions already taken and those envisaged.

To summarize, increasing EU targets is intended to increase efficiency by 20%. In the next step, the Tier 2 loss requirements set out in Regulation 548/2014 will enter into force on July 1, 2021.

Exceptions:
This Regulation shall not apply to transformers specifically designed and used for the following applications:

a) instrument transformers, specifically designed to transmit an information signal to measuring instruments, meters and protective or control devices or similar apparatus;

b) transformers specifically designed and intended to provide a DC power supply to electronic or rectifier loads. This exemption does not include transformers that are intended to provide an AC supply from DC sources such as transformers for wind turbine and photovoltaic applications or transformers designed for DC transmission and distribution applications;

c) transformers specifically designed to be directly connected to a furnace;

d) transformers specifically designed to be installed on fixed or floating offshore platforms, offshore wind turbines or on board ships and all kinds of vessels;

e) transformers specifically designed to provide for a situation limited in time when the normal power supply is interrupted due to either an unplanned occurrence (such as a power failure) or a station refurbishment, but not to permanently upgrade an existing substation;

f) transformers (with separate or auto-connected windings) connected to an AC or DC contact line, directly or through a converter, used in fixed installations for railway applications;

g) earthing or grounding transformers specifically designed to be connected in a power system to provide a neutral connection for earthing either directly or via an impedance;

h) traction transformers specifically designed to be mounted on rolling stock, connected to an AC or DC contact line, directly or through a converter, for specific use in fixed installations for railway applications;

i) starting transformers, specifically designed for starting three-phase induction motors so as to eliminate supply voltage dips and that remain de-energized during normal operation;

j) testing transformers, specifically designed to be used in a circuit to produce a specific voltage or current for the purpose of testing electrical equipment;

k) welding transformers, specifically designed for use in arc-welding equipment or resistance-welding equipment;

l) transformers specifically designed for explosion-proof applications in accordance with Directive 94/9/EC of the European Parliament and of the Council and underground mining applications;

m) transformers specifically designed for deep water (submerged) applications;

n) medium voltage (MV) to medium voltage (MV) interface transformers up to 5 MVA used as interface transformers used in a network voltage conversion program and placed at the junction between two voltage levels of two medium voltage networks and that need to be able to cope with emergency overloads;

o) medium and large power transformers specifically designed to contribute to the safety of nuclear installations, as defined in Article 3 of Council Directive 2009/71/Euratom;

p) three-phase medium power transformers with a power rating below 5 kVA;

Source:
Commission Regulation (EU) 2019/1783 of October 1, 2019, Article 1, Section 2

Important Changes Brought About by Regulation 019/1783

This document attempts to summarize the most important changes to the EU Regulation. For a comprehensive overview, reference must be made at this point to the regulation itself.

Product definition:

- "medium power transformer" means a power transformer with all windings having rated power lower than or equal to 3,150 kVA, and highest voltage for equipment greater than 1.1 kV and lower than or equal to 36 kV;
- "large power transformer" means a power transformer with at least one winding having either rated power greater than 3,150 kVA or highest voltage for equipment greater than 36 kV;
- "medium power pole-mounted transformer" means a power transformer with a rated power of up to 400 kVA suitable for outdoor service and specifically designed to be mounted on the support structures of overhead power lines;

Repair:

Within the meaning of the Regulation "repair" means replacing the core (partly or completely) or of one or several complete coils, i.e. windings may be processed without replacing them without restriction.

Since laws cannot be enacted retroactively, equipment placed on the market before June 11, 2014, may be repaired without restrictions.

Equipment placed on the market after June 11, 2014, must, after repair, meet the loss requirements in effect at the time they were placed back on the market (see Regulation 2019/1783 Article 1, paragraph 3).

The Commission shall review this Regulation in the light of technological progress and shall present the results of the assessment, including, if appropriate, a draft revision proposal, to the Consultation Forum no later than July 1, 2023.

(Quote from Commission Regulation (EU) 2019/1783 of October 1, 2019, Article 1, Section 2)

New Harmonized Standards Implementing the Amendments Introduced By Regulation 2019/1783

The previously valid harmonized standards for medium power transformers (EN 50588) and large power transformers (EN 50629) will be replaced by the EN 50708 series of standards, which implements the amendments associated with Regulation 2019/1783.

The new EN 50708 series of standards is divided into the general section, medium power transformers and large power transformers.

	1	Common part	2	Medium power transformers	3	Large power transformers
General requirements	1–1	**EN50708-1-1** Power transformers – Additional European requirements: Part 1-1 Common part – General requirements	2–1	**EN50708-2-1** Power transformers – Additional European requirements: Part 2-1 Medium power transformers – General requirements	3–1	**EN50708-3-1** Power transformers – Additional European requirements: Part 3-1 Large power transformers – General requirements
Assessment of energy efficiency	1–2	**EN50708-1-2** Power transformers – Additional European requirements: Part 1-2 Common part – Assessment of energy performance	2–2		3–2	
Accessories	1–3		2–3	**EN50708-2-3** Power transformers – Additional European requirements: Part 2-3 Medium power transformers – Accessories	3–3	
Special tests	1–4		2–4	**EN50708-2-4** Power transformers – Additional European requirements: Part 2-4 Medium power transformers – Special tests	3–4	**EN50708-3-4** Power transformers – Additional European requirements: Part 3-4 Large power transformers – Special tests
Single-phase power transformers	1–5		2–5	**EN50708-2-5** Power transformers – Additional European requirements: Part 2-5 Medium power transformers – Single phase	3–5	
Non-conventional technologies	1–6		2–6	**EN50708-2-6** Power transformers – Additional European requirements: Part 2-6 Medium power transformers – Non conventional technologies	3–6	

Quelle: CENELEC TC14

Transition from Tier 1 to Tier 2

From July 1, 2021, legal requirements stipulate that only transformers with loss specifications according to Tier 2 may be placed on the market. The date the risk is transferred to the purchaser shall be decisive in this respect. The date of entry into force shall be considered as a fixed date without a transition phase, which means that transformers may still exhibit Tier 1 losses until June 30, 2021 and must comply with Tier 2 losses from July 1, 2021.

The emergence of Tier 3 loss requirements has already been decided, but the amount and date of entry into force of the new loss requirements is currently unknown.

Requirements for Three-Phase Medium Power Transformers

The following tables and table designations are taken from Regulation 548/2014 and Regulation 2019/1783.

a) Liquid-immersed medium power transformers

Table I.1: Maximum load and no-load losses (in W) for three-phase liquid-immersed medium power transformers with one winding with $U_m \leq 24$ kV and the other one with $U_m \leq 3.6$ kV.

	Tier 1 (July 1, 2015)		Tier 2 (July 1, 2021)	
Rated power (kVA)	Maximum load losses P_k (W)*	Maximum no-load losses P_0 (W)*	Maximum load losses P_k (W)*	Maximum no-load losses P_0 (W)*
≤ 25	C_k (900)	A_0 (70)	A_k (600)	A_0 -10% (63)
50	C_k (1,100)	A_0 (90)	A_k (750)	A_0 -10% (81)
100	C_k (1,750)	A_0 (145)	A_k (1,250)	A_0 -10% (130)
160	C_k (2,350)	A_0 (210)	A_k (1,750)	A_0 -10% (189)
250	C_k (3,250)	A_0 (300)	A_k (2,350)	A_0 -10% (270)
315	C_k (3,900)	A_0 (360)	A_k (2,800)	A_0 -10% (324)
400	C_k (4,600)	A_0 (430)	A_k (3,250)	A_0 -10% (387)
500	C_k (5,500)	A_0 (510)	A_k (3,900)	A_0 -10% (459)
630	C_k (6,500)	A_0 (600)	A_k (4,600)	A_0 -10% (540)
800	C_k (8,400)	A_0 (650)	A_k (6,000)	A_0 -10% (585)
1,000	C_k (10,500)	A_0 (770)	A_k (7,600)	A_0 -10% (693)
1,250	B_k (11,000)	A_0 (950)	A_k (9,500)	A_0 -10% (855)
1,600	B_k (14,000)	A_0 (1,200)	A_k (12,000)	A_0 -10% (1,080)
2,000	B_k (18,000)	A_0 (1,450)	A_k (15,000)	A_0 -10% (1,305)
2,500	B_k (22,000)	A_0 (1,750)	A_k (18,500)	A_0 -10% (1,575)
3,150	B_k (27,500)	A_0 (2,200)	A_k (23,000)	A_0 -10% (1,980)

b) Dry-type medium power transformers

Table I.2: Maximum load and no-load losses (in W) for three-phase medium power transformers with one winding with $U_m \leq 24$ kV and the other one with $U_m \leq 3.6$ kV.

	Tier 1 (July 1, 2015)		Tier 2 (July 1, 2021)	
Rated power (kVA)	Maximum load losses P_k (W)*	Maximum no-load losses P_0 (W)*	Maximum load losses P_k (W)*	Maximum no-load losses P_0 (W)*
≤ 50	B_k (1,700)	A_0 (200)	A_k (1,500)	A_0 -10% (180)
100	B_k (2,050)	A_0 (280)	A_k (1,800)	A_0 -10% (252)
160	B_k (2,900)	A_0 (400)	A_k (2,600)	A_0 -10% (360)
250	B_k (3,800)	A_0 (520)	A_k (3,400)	A_0 -10% (468)
400	B_k (5,500)	A_0 (750)	A_k (4,500)	A_0 -10% (675)
630	B_k (7,600)	A_0 (1,100)	A_k (7,100)	A_0 -10% (990)
800	A_k (8,000)	A_0 (1,300)	A_k (8,000)	A_0 -10% (1,170)
1,000	A_k (9,000)	A_0 (1,550)	A_k (9,000)	A_0 -10% (1,395)
1,250	A_k (11,000)	A_0 (1,800)	A_k (11,000)	A_0 -10% (1,620)
1,600	A_k (13,000)	A_0 (2,200)	A_k (13,000)	A_0 -10% (1,980)
2,000	A_k (16,000)	A_0 (2,600)	A_k (16,000)	A_0 -10% (2,340)
2,500	A_k (19,000)	A_0 (3,100)	A_k (19,000)	A_0 -10% (2,790)
3,150	A_k (22,000)	A_0 (3,800)	A_k (22,000)	A_0 -10% (3,420)

c) Pole-mounted medium power transformers with power ratings between 25 kV and 400 kVA

Table I.6: Maximum load and no-load losses (in W) for medium power liquid immersed pole-mounted transformers

	Tier 1 (July 1, 2015)		Tier 2 (July 1, 2021)	
Rated power (kVA)	Maximum load losses P_k (W)*	Maximum no-load losses P_0 (W)*	Maximum load losses P_k (W)*	Maximum no-load losses P_0 (W)*
25	C_k (900)	A_0 (70)	B_k (725)	A_0 (70)
50	C_k (1,100)	A_0 (90)	B_k (875)	A_0 (90)
100	C_k (1,750)	A_0 (145)	B_k (1,475)	A_0 (145)
160	C_k +32% (3,102)	A_0 (300)	C_k +32% (3,102)	C_0 -10% (270)
200	C_k (2,750)	C_0 (356)	B_k (2,333)	B_0 (310)
250	C_k (3,250)	C_0 (425)	B_k (2,750)	B_0 (360)
315	C_k (3,900)	C_0 (520)	B_k (3,250)	B_0 (440)

* Maximum allowable losses for kVA ratings that fall in between the ratings given in Tables I.1, I.2 and I.6 are obtained by linear interpolation.

d) Correction factors depend on the highest equipment voltage

Table I.3a: Correction factors to be applied to the load and no load losses indicated in Tables I.1, I.2 and I.6 for medium power transformers with special combinations of winding voltages (for rated power ≤ 3,150 kVA)

Special combination of voltages in one winding		Load losses P_k (W)	No-load losses P_0 (W)
For liquid-immersed transformers (table I.1) and dry-type transformers (table I.2)			
Primary highest voltage for equipment $U_m \leq 24$ kV	Secondary highest voltage for equipment $U_m > 3{,}6$ kV	No correction	No correction
For liquid-immersed transformers (table I.1)			
Primary highest voltage for equipment $U_m = 36$ kV	Secondary highest voltage for equipment $U_m \leq 3{,}6$ kV	10 %	15 %
Primary highest voltage for equipment $U_m = 36$ kV	Secondary highest voltage for equipment $U_m > 3{,}6$ kV	10 %	15 %
For dry-type transformers (table I.2)			
Primary highest voltage for equipment $U_m = 36$ kV	HSecondary highest voltage for equipment $U_m \leq 3{,}6$ kV	10 %	15 %
Primary highest voltage for equipment $U_m = 36$ kV	Secondary highest voltage for equipment $U_m > 3{,}6$ kV	15 %	20 %

e) Correction factors for dual voltage transformers

Table I.3b: Correction factors to be applied to the load and no load losses indicated in Tables I.1, I.2 and I.6 for medium power transformers with dual voltage in one or both windings differing more than 10% and rated power ≤ 3,150 kVA.

Type of dual voltage	Reference voltage for the application of correction factors	Load losses P_k (W)*	No-load losses P_0 (W)*
Dual voltage on one winding with reduced power output on the lower low-voltage winding **AND** maximum available power on the lower voltage of the low-voltage winding limited to 0.85 of the rated power assigned to the low-voltage winding at its higher voltage	Losses shall be calculated based on the higher voltage of the low-voltage winding	No correction	No correction
Dual voltage on one winding with reduced power output on the lower high-voltage winding **AND** maximum available power on the lower voltage of the high-voltage winding limited to 0.85 of the rated power assigned to the high-voltage winding at its higher voltage	Losses shall be calculated based on the higher voltage of the high-voltage winding	No correction	No correction
Dual voltage on one winding **AND** full rated power available on both windings, i.e., the full nominal power is available regardless of the combination of voltages	The losses shall be calculated based on the higher voltage of the dual voltage winding	10 %	15 %
Dual voltage on both windings **AND** rated power available on all combinations of windings, i. e., both voltages on one winding are fully rated in combination with one of the voltages on the other winding	The losses shall be calculated based on the higher voltages of both dual voltage windings	20 %	20 %

* The losses shall be calculated on the basis of the voltage of the winding specified in the second column and can be increased with the correction factors given in the last 2 columns. In any case, whatever the combinations of winding voltages, the losses cannot exceed the values given in Tables I.1, I.2 and I.6 corrected by the factors in this table.

Minimum energy efficiency requirements for large power transformers

The following tables and table designations are taken from Regulation 548/2014 and Regulation 2019/1783.

a) Liquid-immersed large power transformers

Table I.7: Minimum Peak Efficiency Index requirements for liquid-immersed large power transformers

Rated Power (MVA)	Tier 1 (July 1, 2015)	Tier 2 (July 1, 2021)
	Minimum Peak Efficiency Index (%)*	
≤ 0.025	97.742	98.251
0.05	98.584	98.891
0.1	98.867	99.093
0.16	99.012	99.191
0.25	99.112	99.283
0.315	99.154	99.320
0.4	99.209	99.369
0.5	99.247	99.398
0.63	99.295	99.437
0.8	99.343	99.473
1	99.360	99.484
1.25	99.418	99.487
1.6	99.424	99.494
2	99.426	99.502
2.5	99.441	99.514
3.15	99.444	99.518
4	99.465	99.532
5	99.483	99.548
6.3	99.510	99.571
8	99.535	99.593
10	99.560	99.615
12.5	99.588	99.640
16	99.615	99.663
20	99.639	99.684
25	99.657	99.700
31.5	99.671	99.712
40	99.684	99.724
50	99.696	99.734
63	99.709	99.745
80	99.723	99.758
100	99.737	99.770
125	99.737	99.780
160	99.737	99.790
≥ 200	99.737	99.797

b) Dry-type large power transformers with $U_m \leq 36$ kV

Table I.8: Minimum Peak Efficiency Index requirements for dry-type large power transformers with $U_m \leq 36$ kV

Rated Power (MVA)	Tier 1 (July 1, 2015)	Tier 2 (July 1, 2021)
	Minimum Peak Efficiency Index (%)*	
3.15 < Sr ≤ 4	99.348	99.382
5	99.354	99.387
6.3	99.356	99.389
8	99.357	99.390
≥ 10	99.357	99.390

c) Dry-type large power transformers with $U_m > 36$ kV

Table I.9: Minimum Peak Efficiency Index requirements for dry-type large power transformers with $U_m > 36$ kV

Rated Power (MVA)	Tier 1 (July 1, 2015)	Tier 2 (July 1, 2021)
	Minimum Peak Efficiency Index (%)*	
≤ 0.05	96.174	96.590
0.1	97.514	97.790
0.16	97.792	98.016
0.25	98.155	98.345
0.4	98.334	98.570
0.63	98.494	98.619
0.8	98.677	98.745
1	98.775	98.837
1.25	98.832	98.892
1.6	98.903	98.960
2	98.942	98.996
2.5	98.933	99.045
3.15	99.048	99.097
4	99.158	99.225
5	99.200	99.265
6.3	99.242	99.303
8	99.298	99.356
10	99.330	99.385
12.5	99.370	99.422
16	99.416	99.464
20	99.468	99.513
25	99.521	99.564
31.5	99.551	99.592
40	99.567	99.607
50	99.585	99.623
≥63	99.590	99.626

* Minimum PEI values for MVA ratings that fall in between the ratings given in Tables I.7, I.8 and I.9 shall be calculated by linear interpolation.

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