Commission Regulation (EU) No 548/2014 of 21 May 2014 on implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to small, medium and large power transformers

COMMISSION REGULATION (EU) No 548/2014

of 21 May 2014

on implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to small, medium and large power transformers

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products[(1)], and in particular Article 15(1) thereof,

After consulting the Ecodesign Consultation Forum,

Whereas:

(1) The Commission has carried out a preparatory study that analysed the environmental and economic aspects of transformers. The study was developed together with stakeholders and interested parties from the Union and the results have been have made publicly available. Transformers are considered as energy related products within the meaning of Article 2(1) of Directive 2009/125/EC.

(2) The study showed that energy in the use phase is the most significant environmental aspect that can be addressed through product design. Significant amounts of raw materials (copper, iron, resin, aluminium) are used in the manufacturing of transformers, but market mechanisms seem to be ensuring an adequate end-of-life treatment, and therefore it is not necessary to establish related ecodesign requirements.

(3) Ecodesign requirements set out in Annex I apply to products placed on the market or put into service wherever they are installed. Therefore such requirements cannot be made dependant on the application in which the product is used.

(4) Transformers are usually purchased under framework agreements. In this context, purchase refers to the act of contracting with the manufacturer for the delivery of a given volume of transformers. The contract is deemed to have come into force on the date of signature by the parties.

(5) Certain categories of transformers should not be covered by this Regulation, due to their specific function,. The energy consumption and saving potential of such transformers is negligible compared to other transformers.

(6) Regulatory concessions are granted because of the weight limitations for mounting transformers on utility poles. In order to avoid misuse of transformers specifically manufactured for pole-mounted operation, they should include a visible display

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'For pole-mounted operation only', so as to facilitate the work of national market surveillance authorities.

(7) Regulatory concessions are granted to transformers equipped with equipment capable of performing voltage regulation functions to integrate distributed generation from renewable sources into the distribution grid. Such concessions should gradually be phased out as this emerging technology matures and measurement standards become available to separate the losses associated to the core transformer from those associated to the equipment performing additional functions.

(8) Ecodesign requirements for the energy performance/efficiency of medium power transformers and for the energy efficiency of large power transformers should be set with a view to harmonising ecodesign requirements for these devices throughout the Union. Such requirements would also contribute to the efficient functioning of the internal market and to improving Member States' environmental performance.

(9) Establishment of ecodesign requirements for medium and large power transformers is also necessary to increase the market penetration of technologies and design options improving their energy performance or efficiency. Total losses of the transformers fleet in the EU27 in 2008 amounted to 93,4 TWh per year. The cost-effective improvement potential through more efficient design has been estimated in about 16,2 TWh per year in 2025, which corresponds to 3,7 Mt of CO_2 emissions.

(10) It is necessary to provide for a staged entry into force of the ecodesign requirements in order to provide an appropriate timeframe for manufacturers to redesign their products. Time limits for the implementation of those requirements should be set taking into account impacts on the costs for manufacturers, in particular small and medium size enterprises, while ensuring timely achievement of the policy objectives.

(11) To allow an effective implementation of the regulation, National Regulating Authorities are strongly advised to take account of the effect of minimum efficiency requirements on the initial cost of the transformer and to allow for the installation of more efficient transformers than the regulation requires, whenever these are economically justified on a whole life cycle basis, including an adequate evaluation of losses reduction.

(12) To facilitate compliance checks, manufacturers should be asked to provide information in the technical documentation referred to in Annexes IV and V to Directive 2009/125/EC.

(13) The measures provided for in this Regulation are in accordance with the opinion of the Committee established by Article 19(1) of Directive 2009/125/EC,

HAS ADOPTED THIS REGULATION:

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[F1 Article 1

Subject matter and scope

1 This Regulation sets out ecodesign requirements for placing on the market or putting into service power transformers with a minimum power rating of 1 kVA used in 50 Hz electricity transmission and distribution networks or for industrial applications.

This Regulation shall apply to transformers purchased after 11 June 2014.

2 This Regulation shall not apply to transformers specifically designed 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-energised 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[(2)] 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 programme 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;

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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[3];

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

except as regards the requirements set out in point 4(a), (b) and (d).of Annex I to this Regulation.

3 Medium and large power transformers, regardless of when they were first placed on the market or put into service, shall be reassessed for conformity and comply with this Regulation, if they are subject to all of the following operations:

a replacement of the core or part thereof;

b replacement of one or more of the complete windings.

This is without prejudice to the legal obligations under other Union's harmonisation legislation that these products could be subject to.**]**

Textual Amendments

F1 Substituted by 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 (Text with EEA relevance).

Article 2

Definitions

For the purpose of this Regulation and its annexes the following definitions shall apply.

(1) 'Power transformer' means a static piece of apparatus with two or more windings which, by electromagnetic induction, transforms a system of alternating voltage and current into another system of alternating voltage and current usually of different values and at the same frequency for the purpose of transmitting electrical power.

(2) 'Small power transformer' means a power transformer with a highest voltage for equipment not exceeding 1,1 kV.

(3) **[**F1'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.

(4) '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.**]**

(5) 'Liquid-immersed transformer' means a power transformer in which the magnetic circuit and windings are immersed in liquid.

(6) 'Dry-type transformer' means a power transformer in which the magnetic circuit and windings are not immersed in an insulating liquid.

(7) **[**F1'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.**]**

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(8) 'Voltage Regulation Distribution Transformer' means a medium power transformer equipped with additional components, inside or outside of the transformer tank, to automatically control the input or output voltage of the transformer for on-load voltage regulation purposes.

(9) 'Winding' refers to the assembly of turns forming an electrical circuit associated with one of the voltages assigned to the transformer.

(10) 'Rated voltage of a winding' (U_r) is the voltage assigned to be applied, or developed at no-load, between the terminals of an untapped winding, or of a tapped winding connected on the principal tapping.

(11) 'High-voltage winding' refers to the winding having the highest rated voltage.

(12) 'Highest voltage for equipment' (U_m) applicable to a transformer winding is the highest r.m.s phase-to-phase voltage in a three-phase system for which a transformer winding is designed in respect of its insulation.

(13) 'Rated power' (S_r) is a conventional value of apparent power assigned to a winding which, together with the rated voltage of the winding, determines its rated current.

(14) 'Load loss' (P_k) means the absorbed active power at rated frequency and reference temperature associated with a pair of windings when the rated current (tapping current) is flowing through the line terminal(s) of one of the windings and the terminals of the other windings are in short-circuit with any winding fitted with tappings connected to its principal tapping, while further windings, if existing, are open-circuited.

(15) 'No load loss' (P_o) means the active power absorbed at rated frequency when the transformer is energised and the secondary circuit is open. The applied voltage is the rated voltage, and if the energized winding is fitted with a tapping, it is connected to its principal tapping.

(16) 'Peak Efficiency Index' (PEI) means the maximum value of the ratio of the transmitted apparent power of a transformer minus the electrical losses to the transmitted apparent power of the transformer.

(17) **[**[F2]'Declared value(s)' mean the values given in the technical documentation pursuant to point 2 of Annex IV to Directive 2009/125/EC, and where applicable, the values used to calculate these values.

(18) 'Dual voltage transformer' means a transformer with one or more windings with two voltages available in order to be able to operate and supply rated power at either of two different voltage values.

(19) 'Witnessed testing' means actively observing the physical testing of the product under investigation by another party, to draw conclusions on the validity of the test and the test results. This may include conclusions on the compliance of testing and calculations methods used with applicable standards and legislation.

(20) 'Factory acceptance test' means a test on an ordered product where the customer uses witnessed testing to verify the product's full accordance with contractual requirements, before they are accepted or put into service.

(21) 'Equivalent model' means a model which has the same technical characteristics relevant for the technical information to be provided, but which is placed on the market or put into service by the same manufacturer or importer as another model with a different model identifier.

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(22) 'Model identifier' means the code, usually alphanumeric, which distinguishes a specific product model from other models with the same trade mark or the same manufacturer's or importer's name.**]**

Textual Amendments

F1 Substituted by 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 (Text with EEA relevance).

F2 Inserted by 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 (Text with EEA relevance).

Article 3

Eco-design requirements

[[F1]The ecodesign requirements set out in Annex I shall apply from the dates indicated therein.

If threshold voltages in electricity distribution networks deviate from the standard ones across the Union[4], Member States shall notify the Commission accordingly, so that a public notification can be made for the correct interpretation of Tables I.1, I.2, I.3a, I.3b, I.4, I.5, I.6, I.7, I.8 and I.9 in Annex I.**]**

Textual Amendments

F1 Substituted by 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 (Text with EEA relevance).

[**[F1]Article 4

Conformity assessment

1 The conformity assessment procedure referred to in Article 8 of Directive 2009/125/EC shall be the internal design control system set out in Annex IV to that Directive or the management system set out in Annex V to that Directive.

2 For the purposes of the conformity assessment pursuant to Article 8 of Directive 2009/125/EC, the technical documentation shall contain a copy of the product information provided in accordance with point 4 of Annex I, and the details and the results of the calculations set out in Annex II to this Regulation.

3 Where the information included in the technical documentation for a particular model has been obtained:

a from a model that has the same technical characteristics relevant for the technical information to be provided but is produced by a different manufacturer; or

b by calculation on the basis of design or extrapolation from another model of the same or a different manufacturer, or both;

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the technical documentation shall include the details of such calculation, the assessment undertaken by the manufacturer to verify the accuracy of the calculation and, where appropriate, the declaration of identity between the models of different manufacturers.

4 The technical documentation shall include a list of all equivalent models, including model identifiers.**]**

Textual Amendments

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Article 5

Verification procedure for market surveillance purposes

When performing the market surveillance checks referred to in Directive 2009/125/EC, Article 3(2), Member State authorities shall apply the verification procedure set out in Annex III to this Regulation.

Article 6

Indicative Benchmarks

The indicative benchmarks for the best-performing transformers technologically possible at the time of adoption of this Regulation are identified in Annex IV.

[F1 Article 7

Review

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 1 July 2023. The review shall in particular address the following issues:

— the extent to which requirements set out for Tier 2 have been cost-effective and the appropriateness to introduce stricter Tier 3 requirements,

— the appropriateness of the concessions introduced for medium and large power transformers in cases where installation costs would have been disproportionate,

— the possibility of utilising the PEI calculation for losses alongside the losses in absolute values for medium power transformers,

— the possibility to adopt a technology-neutral approach to the minimum requirements set out for liquid-immersed, dry-type and, possibly, electronic transformers,

— the appropriateness of setting minimum performance requirements for small power transformers,

— the appropriateness of the exemptions for transformers in offshore applications,

— the appropriateness of the concessions for pole-mounted transformers and for special combinations of winding voltages for medium power transformers,

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— the possibility and appropriateness of covering environmental impacts other than energy in the use phase, such as noise and material efficiency.**]**

Textual Amendments

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[F2 Article 8

Circumvention

The manufacturer, importer or authorised representative shall not place on the market products designed to be able to detect they are being tested (e.g. by recognising the test conditions or test cycle), and to react specifically by automatically altering their performance during the test with the aim of reaching a more favourable level for any of the parameters declared by the manufacturer, importer or authorised representative in the technical documentation or included in any documentation provided.**]**

Textual Amendments

F2 Inserted by 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 (Text with EEA relevance).

[F1 Article 9]

Entry into force

The Regulation shall enter into force on the 20th day following its publication in the *Official Journal of the European Union*.

Textual Amendments

F1 Substituted by 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 (Text with EEA relevance).

This Regulation shall be binding in its entirety and directly applicable in all Member States.

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ANNEX I

Ecodesign requirements

1. Minimum energy performance or efficiency requirements for medium power transformers

Medium power transformers shall comply with the maximum allowed load and no-load losses or the Peak Efficiency Index (PEI) values set out in Tables I.1 to I.5, excluding medium power pole-mounted transformers, which shall comply with the maximum allowed load and no load losses values set out in Table I.6.

[[F2]As of the date of application of Tier 2 requirements (1 July 2021), when the one-to-one replacement of an existing medium power transformer entails disproportionate costs associated with their installation, the replacement transformer is, exceptionally, only required to meet Tier 1 requirements for the given rated power.

In this respect, installation costs are disproportionate if the costs of the replacement of the complete substation housing the transformer and/or the acquisition or rental of additional floor space are higher than the net present value of the additional avoided electricity losses (tariffs, taxes and levies excluded) of a Tier 2 compliant replacement transformer over its normally expected service life. The net present value shall be calculated based on capitalised loss values using widely accepted social discount rates[(5)].

In this case, the manufacturer, importer, or authorised representative shall include in the technical documentation of the replacement transformer the following information:

— Address and contact details of the commissioner of the replacement transformer

— The station where the replacement transformer is to be installed. This shall be unequivocally identified by either a specific location or a specific installation type (e.g., station or cabin model)

— The technical and/or economic justification of the disproportionate cost to install a transformer that is only Tier 1 compliant instead of a Tier 2 compliant one. If the transformers(s) were commissioned by a tendering process, all the necessary information regarding the analysis of bids and the award decision shall be provided.

In the above cases, the manufacturer, importer or authorised representative shall notify the competent national market surveillance authorities.**]**

1.1. Requirements for three-phase medium power transformers with rated power ≤ 3 150 kVA

TABLE I.1: **[**[F1]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 WITH $U_M \leq 3{,}6$ KV**]**

	Tier 1 (from 1 July 2015)		**Tier 2 (from 1 July 2021)**	
Rated Power (kVA)	**Maximum load losses P_k (W)[a]**	**Maximum no-load losses P_o (W)[a]**	**Maximum load losses P_k (W)[a]**	**Maximum no-load losses P_o (W)[a]**
≤ 25	C_k (900)	A_o (70)	A_k (600)	A_o – 10 % (63)

a Maximum losses for kVA ratings that fall in between the ratings given in Table I.1 shall be obtained by linear interpolation.

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50	C_k (1 100)	A_o (90)	A_k (750)	A_o – 10 % (81)
100	C_k (1 750)	A_o (145)	A_k (1 250)	A_o – 10 % (130)
160	C_k (2 350)	A_o (210)	A_k (1 750)	A_o – 10 % (189)
250	C_k (3 250)	A_o (300)	A_k (2 350)	A_o – 10 % (270)
315	C_k (3 900)	A_o (360)	A_k (2 800)	A_o – 10 % (324)
400	C_k (4 600)	A_o (430)	A_k (3 250)	A_o – 10 % (387)
500	C_k (5 500)	A_o (510)	A_k (3 900)	A_o – 10 % (459)
630	C_k (6 500)	A_o (600)	A_k (4 600)	A_o – 10 % (540)
800	C_k (8 400)	A_o (650)	A_k (6 000)	A_o – 10 % (585)
1 000	C_k (10 500)	A_o (770)	A_k (7 600)	A_o – 10 % (693)
1 250	B_k (11 000)	A_o (950)	A_k (9 500)	A_o – 10 % (855)
1 600	B_k (14 000)	A_o (1 200)	A_k (12 000)	A_o – 10 % (1 080)
2 000	B_k (18 000)	A_o (1 450)	A_k (15 000)	A_o – 10 % (1 305)
2 500	B_k (22 000)	A_o (1 750)	A_k (18 500)	A_o – 10 % (1 575)
3 150	B_k (27 500)	A_o (2 200)	A_k (23 000)	A_o – 10 % (1 980)

a Maximum losses for kVA ratings that fall in between the ratings given in Table I.1 shall be obtained by linear interpolation.

TABLE I.2: **[**[F1]MAXIMUM LOAD AND NO-LOAD LOSSES (IN W) FOR THREE-PHASE DRY-TYPE MEDIUM POWER TRANSFORMERS WITH ONE WINDING WITH UM ≤ 24KV AND THE OTHER WITH UM ≤ 3,6 KV**]**

	Tier 1 (1 July 2015)		**Tier 2 (1 July 2021)**	
Rated Power (kVA)	**Maximum load losses P_k (W)[a]**	**Maximum no-load losses P_o (W)[a]**	**Maximum load losses P_k (W)[a]**	**Maximum no-load losses P_o (W)[a]**
≤ 50	B_k (1 700)	A_o (200)	A_k (1 500)	A_o – 10 % (180)
100	B_k (2 050)	A_o (280)	A_k (1 800)	A_o – 10 % (252)
160	B_k (2 900)	A_o (400)	A_k (2 600)	A_o – 10 % (360)
250	B_k (3 800)	A_o (520)	A_k (3 400)	A_o – 10 % (468)
400	B_k (5 500)	A_o (750)	A_k (4 500)	A_o – 10 % (675)
630	B_k (7 600)	A_o (1 100)	A_k (7 100)	A_o – 10 % (990)

a Maximum losses for kVA ratings that fall in between the ratings given in Table I.2 shall be obtained by linear interpolation.

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800	A_k (8 000)	A_o (1 300)	A_k (8 000)	A_o – 10 % (1 170)
1 000	A_k (9 000)	A_o (1 550)	A_k (9 000)	A_o – 10 % (1 395)
1 250	A_k (11 000)	A_o (1 800)	A_k (11 000)	A_o – 10 % (1 620)
1 600	A_k (13 000)	A_o (2 200)	A_k (13 000)	A_o – 10 % (1 980)
2 000	A_k (16 000)	A_o (2 600)	A_k (16 000)	A_o – 10 % (2 340)
2 500	A_k (19 000)	A_o (3 100)	A_k (19 000)	A_o – 10 % (2 790)
3 150	A_k (22 000)	A_o (3 800)	A_k (22 000)	A_o – 10 % (3 420)

a Maximum losses for kVA ratings that fall in between the ratings given in Table I.2 shall be obtained by linear interpolation.

[F1TABLE 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)**	**No load losses (P_o)**
For both liquid immersed (Table I.1) and dry type (Table I.2)		No correction	No correction
Primary highest voltage for equipment $U_m \leq 24$kV	Secondary highest voltage for equipment $U_m > 3{,}6$ kV		
For liquid immersed (Table I.1)		10 %	15 %
Primary highest voltage for equipment Um = 36kV	Secondary highest voltage for equipment Um ≤ 3,6 kV		
Primary highest voltage for equipment Um = 36kV	Secondary highest voltage for equipment Um > 3,6 kV	10 %	15 %
For dry type (Table I.2)		10 %	15 %
Primary highest voltage for equipment Um = 36kV	Secondary highest voltage for equipment Um ≤ 3,6 kV		
Primary highest voltage for equipment Um = 36kV	Secondary highest voltage for equipment Um > 3,6 kV	15 %	20 %

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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 (Pk)[a]**	**No load losses (Po)[a]**
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	The losses shall be calculated based on the higher voltage of the dual voltage winding	10 %	15 %

a The losses shall be calculated on the base 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.]

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of the combination of voltages.			
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 %

a The losses shall be calculated on the base 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.**]**

1.2. Requirements for medium power transformers with rated power > 3 150 kVA

TABLE I.4: MINIMUM PEAK EFFICIENCY INDEX (PEI) VALUES FOR LIQUID IMMERSED MEDIUM POWER TRANSFORMERS

Rated Power (kVA)	**Tier 1 (1 July 2015)**	**Tier 2 (1 July 2021)**
	Minimum Peak Efficiency Index (%)	
3 150 < $S_r \leq$ 4 000	99,465	99,532
5 000	99,483	99,548
6 300	99,510	99,571
8 000	99,535	99,593
10 000	99,560	99,615
12 500	99,588	99,640
16 000	99,615	99,663
20 000	99,639	99,684
25 000	99,657	99,700
31 500	99,671	99,712
40 000	99,684	99,724

Minimum PEI values for kVA ratings that fall in between the ratings given in Table I.4 shall be calculated by linear interpolation.

TABLE I.5: MINIMUM PEAK EFFICIENCY INDEX (PEI) VALUES FOR DRY TYPE MEDIUM POWER TRANSFORMERS

Rated Power (kVA)	**Tier 1 (1 July 2015)**	**Tier 2 (1 July 2021)**
	Minimum Peak Efficiency Index (%)	

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3 150 < S_r ≤ 4 000	99,348	99,382
5 000	99,354	99,387
6 300	99,356	99,389
8 000	99,357	99,390
≥ 10 000	99,357	99,390

Minimum PEI values for kVA ratings that fall in between the ratings given in Table I.5 shall be calculated by linear interpolation.

1.3. **Requirements for medium power transformers with rated power ≤ 3 150 kVA equipped with tapping connections suitable for operation while being energised or on-load for voltage adaptation purposes. Voltage Regulation Distribution Transformers are included in this category.**

The maximum allowable levels of losses set out in Tables I.1 and I.2 shall be increased by 20 % for no load losses and 5 % for load losses in Tier 1 and by 10 % for no load losses in Tier 2.

[[F1]1.4. **For the one-to-one replacement of existing medium power pole-mounted transformers with power ratings between 25 kVA and 400 kVA, the applicable maximum levels of load and no-load losses are not the ones in Tables I.1 and I.2, but those in Table I.6 below. Maximum allowable losses for kVA ratings other than those explicitly mentioned in Table I.6 shall be obtained by linear interpolation or extrapolation. The correction factors for special combinations of winding voltages indicated in Tables I.3a and I.3b are also applicable.**

For the one-to-one replacement of existing medium power pole-mounted transformers, the manufacturer, importer or authorised representative shall include in the technical documentation of the transformer the following information:

— the address and contact details of the commissioner of the replacement transformer;

— the station where the replacement transformer is to be installed. This shall be unequivocally identified either by a specific location or an specific installation type (e.g. technical description of the pole).

In the above cases, the manufacturer, importer or authorised representative shall notify the competent national market surveillance authorities.

With regard to the installation of new pole-mounted transformers, it is the requirements in Tables I.1 and I.2, in conjunction with Tables I.3a and I.3b where justified, which are applicable.**]**

TABLE I.6: MAXIMUM LOAD AND NO-LOAD LOSSES (IN W) FOR MEDIUM POWER LIQUID IMMERSED POLE-MOUNTED TRANSFORMERS

	Tier 1 (1 July 2015)		**Tier 2 (1 July 2021)**	
Rated Power (kVA)	**Maximum load losses (in W)[a]**	**Maximum no-load losses (in W)[a]**	**Maximum load losses (in W)[a]**	**Maximum no-load losses (in W)[a]**
25	C_k (900)	A_o (70)	B_k (725)	A_o (70)
50	C_k (1 100)	A_o (90)	B_k (875)	A_o (90)

a Maximum allowable losses for kVA ratings that fall in between the ratings given in Table I.6 shall be obtained by linear interpolation.

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100	C_k (1 750)	A_o (145)	B_k (1 475)	A_o (145)
160	C_k + 32 % (3 102)	C_o (300)	C_k + 32 % (3 102)	C_o – 10 % (270)
200	C_k (2 750)	C_o (356)	B_k (2 333)	B_o (310)
250	C_k (3 250)	C_o (425)	B_k (2 750)	B_o (360)
315	C_k (3 900)	C_o (520)	B_k (3 250)	B_o (440)

a Maximum allowable losses for kVA ratings that fall in between the ratings given in Table I.6 shall be obtained by linear interpolation.

[F1 2. Minimum energy efficiency requirements for large power transformers

Minimum efficiency requirements for large power transformers are set out in Tables I.7, I.8 and I.9.

There may be specific instances where the replacement of an existing transformer, or the installation of a new one, meeting the applicable minimum requirements set out in Tables I.7, I.8 and I.9 would result in disproportionate costs. As general rule, costs can be considered to be disproportionate when the extra transportation and/or installation costs of a Tier 2 or Tier 1, as applicable, compliant transformer would be higher than the net present value of the additional avoided electricity losses (tariffs, taxes and levies excluded) over its normally expected service life. This net present value shall be calculated based on capitalised loss values using widely accepted social discount rates(6).

In those cases, the following fall-back provisions apply:

As of the date of application of Tier 2 requirements (1 July 2021), when the one-to-one replacement of a large power transformers in an existing site entails disproportionate costs associated to its transportation and/or installation, or is technically infeasible, the replacement transformer is, exceptionally, only required to comply with Tier 1 requirements for the given rated power.

Furthermore, if the cost of installing a replacement transformer complying with Tier 1 requirements are also disproportionate, or where no technically feasible solutions exist, no minimum requirements shall apply to the replacement transformer.

As of the date of application of Tier 2 requirements (1 July 2021), when the installation of a new large power transformer in a new site entails disproportionate costs associated to their transportation and/or installation, or is technically infeasible, the new transformer is, exceptionally, only required to meet Tier 1 requirements for the given rated power.

In these cases, the manufacturer, importer or authorised representative responsible for placing on the market or putting into service the transformer shall:

include in the technical documentation of the new or replacement transformer the following information:

— address and contact details of the commissioner of the transformer,

— the specific location where the transformer is to be installed,

— the technical and/or economic justification to install a new or replacement transformer that does not comply with Tier 2 or Tier 1 requirements. If the transformer(s) were commissioned by a tendering process, all the necessary information regarding the analysis of bids and the award decision, shall also be provided,

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— notify the competent national market surveillance authorities.

TABLE I.7

Minimum Peak Efficiency Index requirements for liquid immersed large power transformers

Rated Power (MVA)	**Tier 1 (1.7.2015)**	**Tier 2 (1.7.2021)**
	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

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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

Minimum PEI values for MVA ratings that fall in between the ratings given in Table I.7 shall be calculated by linear interpolation

TABLE I.8

Minimum Peak Efficiency Index requirements for dry-type large power transformers with Um ≤ 36kV

Rated Power (MVA)	**Tier 1 (1.7.2015)**	**Tier 2 (1.7.2021)**
	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

Minimum PEI values for MVA ratings that fall in between the ratings given in Table I.8 shall be calculated by linear interpolation

TABLE I.9

Minimum Peak Efficiency Index requirements for dry-type large power transformers with Um > 36kV

Rated Power (MVA)	**Tier 1 (1.7.2015)**	**Tier 2 (1.7.2021)**
	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

Status: Point in time view as at 31/12/2020.
Changes to legislation: There are outstanding changes not yet made to Commission Regulation (EU) No 548/2014. Any changes that have already been made to the legislation appear in the content and are referenced with annotations. (See end of Document for details)

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 Table I.9 shall be calculated by linear interpolation.**]**

3. **Product information requirements**

From 1 July 2015, the following product information requirements for transformers included in the scope of this Regulation (Article 1) shall be included in any related product documentation, including free access websites of manufacturers:

(a) information on rated power, load loss and no-load loss and the electrical power of any cooling system required at no load;

(b) for medium power (where applicable) and large power transformers, the value of the Peak Efficiency Index and the power at which it occurs;

(c) for dual voltage transformers, the maximum rated power at the lower voltage, according to Table I.3;

(d) information on the weight of all the main components of a power transformer (including at least the conductor, the nature of the conductor and the core material);

(e) For medium power pole mounted transformers, a visible display ‘For pole-mounted operation only’.

[[F1]For medium and large power transformers only, the information under (a); (c) and (d) shall also be included on the rating plate of the transformer.**]**

4. **Technical documentation**

The following information shall be included in the technical documentation of power transformers:

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(a) manufacturer's name and address;

(b) model identifier, the alphanumeric code to distinguish one model from other models of the same manufacturer;

(c) the information required under point 3[F1;]

(d) [F2the specific reason(s) why transformers are considered to be exempted from the Regulation in accordance with Article 1.2.]

[F3. . . . . .]

Textual Amendments

F3 Deleted by 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 (Text with EEA relevance).

[F1ANNEX II

Measurement methods

For the purpose of compliance with the requirements of this Regulation, measurements shall be made using a reliable, accurate and reproducible measurement procedure, which takes into account the generally recognised state of the art measurement methods, including methods set out in documents the reference numbers of which have been published for that purpose in the *Official Journal of the European Union*.

Calculation methods

The methodology for calculating the Peak Efficiency Index (PEI) for medium and large power transformers referred to in Tables I.4, I.5, I.7, I.8 and I.9 of Annex I is based on the ratio of the transmitted apparent power of a transformer minus the electrical losses to the transmitted apparent power of the transformer. The calculation of PEI shall use state-of-the-art methodology available in the latest version of the relevant harmonised standards for medium and large power transformers.

The formula to be used for the Peak Efficiency Index calculation is:

$$PEI = 1 - \frac{2\left(P_0 + P_{c0} + P_{ck}(k_{PEI})\right)}{S_r\sqrt{\frac{P_0 + P_{c0} + P_{ck}(k_{PEI})}{P_k}}} = 1 - \frac{2}{S_r}\sqrt{\left(P_0 + P_{c0} + P_{ck}(k_{PEI})\right)P_k}\ (\%)$$

Where:

P_0 is the no load losses measured at rated voltage and rated frequency on the rated tap

P_{c0} is the electrical power required by the cooling system for no load operation, derived from the type test measurements of the power taken by the fan and liquid pump motors (for ONAN and ONAN/ONAF cooling systems P_{c0} is always zero)

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P_{ck} (k_{PEI})	is the electrical power required by the cooling system in addition to P_{c0} to operate at k_{PEI} times the rated load. P_{ck} is a function of the load. P_{ck} (k_{PEI}) is derived from the type test measurements of the power taken by the fan and liquid pump motors (for ONAN cooling systems P_{ck} is always zero).
P_k	is the measured load loss at rated current and rated frequency on the rated tap corrected to the reference temperature
S_r	is the rated power of the transformer or autotransformer on which P_k is based
k_{PEI}	is the load factor at which Peak Efficiency Index occurs.**]**

[[F4]ANNEX III

Product compliance verification by market surveillance authorities

Textual Amendments

F4 Substituted by Commission Regulation (EU) 2016/2282 of 30 November 2016 amending Regulations (EC) No 1275/2008, (EC) No 107/2009, (EC) No 278/2009, (EC) No 640/2009, (EC) No 641/2009, (EC) No 642/2009, (EC) No 643/2009, (EU) No 1015/2010, (EU) No 1016/2010, (EU) No 327/2011, (EU) No 206/2012, (EU) No 547/2012, (EU) No 932/2012, (EU) No 617/2013, (EU) No 666/2013, (EU) No 813/2013, (EU) No 814/2013, (EU) No 66/2014, (EU) No 548/2014, (EU) No 1253/2014, (EU) 2015/1095, (EU) 2015/1185, (EU) 2015/1188, (EU) 2015/1189 and (EU) 2016/2281 with regard to the use of tolerances in verification procedures (Text with EEA relevance).

The verification tolerances defined in this Annex relate only to the verification of the measured parameters by Member State authorities and shall not be used by the manufacturer or importer as an allowed tolerance to establish the values in the technical documentation or in interpreting these values with a view to achieving compliance or to communicate better performance by any means.

[[F2]Where a model has been designed to be able to detect it being tested (e.g. by recognizing the test conditions or test cycle), and to react specifically by automatically altering its performance during the test with the objective of reaching a more favourable level for any of the parameters specified in this Regulation or included in the technical documentation, or included in any of the documentation provided, the model and all equivalent models shall be considered not compliant.**]**

When verifying the compliance of a product model with the requirements laid down in this Regulation and its Annexes pursuant to Article 3(2) of Directive 2009/125/EC, for the requirements referred to in this Annex, the authorities of the Member States shall apply the following procedure:

(1) The Member State authorities shall verify one single unit of the model. Given the weight and size limitations in the transportation of medium and large power transformers, Member States authorities may decide to undertake the verification procedure at the premises of manufacturers, before they are put into service in their final destination.

[[F2]The Member State authority can do this verification using its own testing equipment.

Status: *Point in time view as at 31/12/2020.*
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If Factory Acceptance Tests (FATs) are planned for such transformers, which will test parameters laid down in Annex I of this Regulation, the Member State authorities may decide to use witnessed testing during these FATs to gather test results which can be used to verify compliance of the transformer under investigation. The authorities may request a manufacturer to disclose information on any planned FATs relevant for witnessed testing.

If the result referred to in point 2(c) is not achieved, the model and all equivalent models shall be considered not to comply with this Regulation. The Member State authorities shall provide all relevant information to the authorities of the other Member States and to the Commission without delay after a decision is taken on the non-compliance of the model.**]**

(2) The model shall be considered to comply with the applicable requirements if:

(a) the values given in the technical documentation pursuant to point 2 of Annex IV to Directive 2009/125/EC (declared values), and, where applicable, the values used to calculate these values, are not more favourable for the manufacturer or importer than the results of the corresponding measurements carried out pursuant to paragraph (g) thereof; and

(b) the declared values meet any requirements laid down in this Regulation, and any required product information published by the manufacturer or importer does not contain values that are more favourable for the manufacturer or importer than the declared values; and

(c) when the Member State authorities test the unit of the model, the determined values (the values of the relevant parameters as measured in testing and the values calculated from these measurements) comply with the respective verification tolerances as given in Table 1.

(3) **[**[F1]If the results referred to in point 2(a), (b) or (c) are not achieved, the model and all equivalent models shall be considered not to comply with this Regulation.**]**

(4) The Member State authorities shall provide all relevant information to the authorities of the other Member States and to the Commission without delay after a decision being taken on the non-compliance of the model according to point 3.

The Member State authorities shall use the measurement and calculation methods set out in Annex II.

The Member State authorities shall only apply the verification tolerances that are set out in Table 1 and shall only use the procedure described in points 1 to 4 for the requirements referred to in this Annex. No other tolerances, such as those set out in harmonised standards or in any other measurement method, shall be applied.

TABLE 1

Verification tolerances

Parameters	**Verification tolerances**
Load losses	The determined value shall not exceed the declared value by more than 5 %.
No-load losses	The determined value shall not exceed the declared value by more than 5 %.

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The electrical power required by the cooling system for no-load operation	The determined value shall not exceed the declared value by more than 5 %.**]**

ANNEX IV

Indicative Benchmarks

At the time of adoption of this Regulation, the best available technology on the market for medium power transformers was identified as follows:

(a) Liquid-immersed medium power transformers: A_o – 20 %, A_k – 20 %

(b) Dry-type medium power transformers: A_o – 20 %, A_k – 20 %

(c) **[**[F1]Medium power transformers with amorphous steel core: Ao-50 %, Ak.**]**

The availability of material to manufacture transformers with amorphous steel core needs further development, before such values of losses can be considered to become minimum requirements in the future.

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(1) OJ L 285, 31.10.2009, p. 10.

(2) **[**[F1]Directive 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres (OJ L 100, 19.4.1994, p. 1).**]**

(3) **[**[F1]Council Directive 2009/71/Euratom of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations. (OJ L 172, 2.7.2009, p. 18).**]**

(4) **[**[F1]Cenelec EN 60038 includes in Annex 2B a national deviation in the Czech Republic according to which the standard voltage for the highest voltage for equipment in AC three-phase systems are 38,5 kV instead of 36 kV and 25 kV instead of 24 kV.**]**

(5) **[**[F2]The European Commission Better Regulation Toolbox suggest using a value of 4 % for the social discount rate
https://ec.europa.eu/info/sites/info/files/file_import/better-regulation-toolbox-61_en_0.pdf**]**

(6) **[**[F1]The European Commission Better Regulation Toolbox suggest using a value of 4 % for the social discount rate
https://ec.europa.eu/info/sites/info/files/file_import/better-regulation-toolbox-61_en_0.pdf**]**

Textual Amendments

F1 Substituted by 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 (Text with EEA relevance).

F2 Inserted by 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 (Text with EEA relevance).

Status:
Point in time view as at 31/12/2020.

Changes to legislation:
There are outstanding changes not yet made to Commission Regulation (EU) No 548/2014. Any changes that have already been made to the legislation appear in the content and are referenced with annotations.