

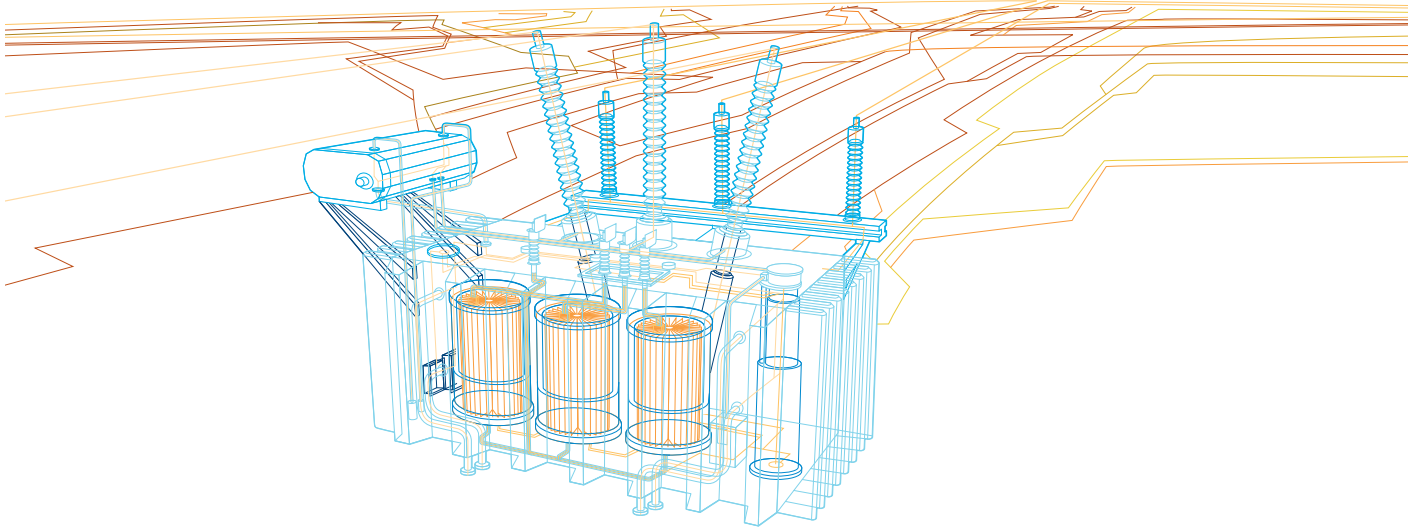
Transformers

# Energy efficient transformer solutions European Minimum Energy Performance Standard (MEPS)

Power and productivity  
for a better world™



# The EU MEPS (European Minimum Energy Performance Standard)



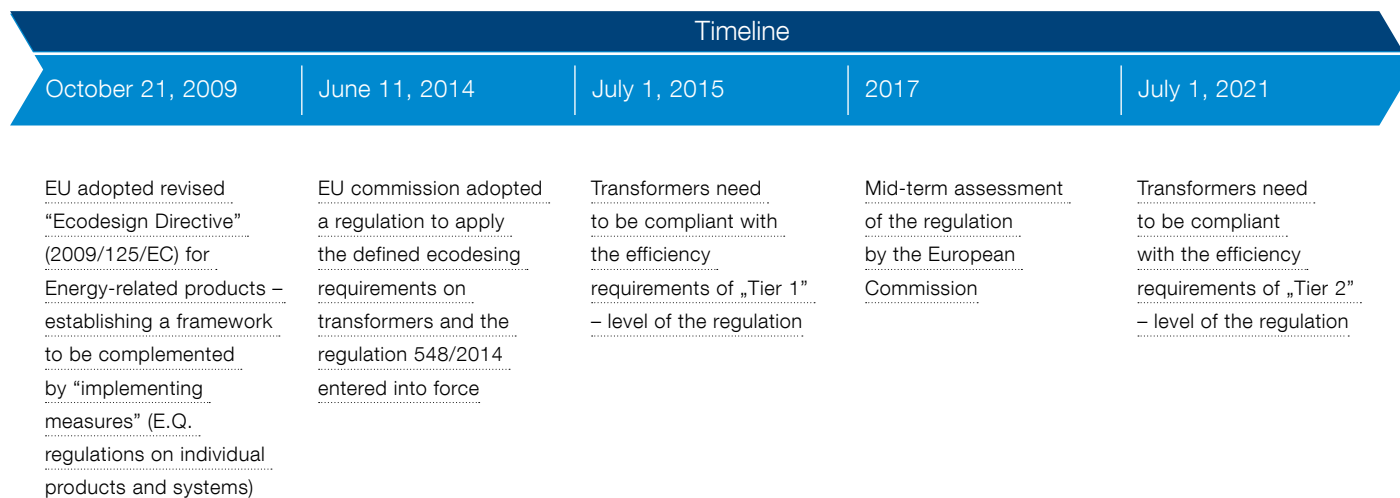
Transformers have been identified as one of the ERP priority groups with considerable energy saving potential. Within 28 member states of the European Union the total losses originating from an existing fleet of transformers amounts to approximately 100 TWh annually. This corresponds 40 Mt of CO<sub>2</sub> emissions.

## Introduction

The EU MEPS (European Minimum Energy Performance Standard) sets a mandatory minimum efficiency level for transformers introduced into European market. The EcoDesign Directive 2009/125/EC of the European Parliament establishes a framework to set Ecodesign requirements for energy-related products (ERPs). Transformers have been identified as one of the ERP priority groups with considerable energy saving potential. Within EU28 the total losses originating from an existing fleet of transformers amounts to approximately 100 TWh annually. This corresponds 40 Mt of CO<sub>2</sub> emissions.

For implementing the directive with regard to transformers, the European Commission has set as a legal framework the regulation No 548/2014 which states the minimum efficiency levels of transformers. The aim of the regulation is to prevent non-efficient products from being placed into the European market. The regulation is binding in it's entirety and directly applicable in all EU28<sup>1</sup>.

<sup>1</sup> Countries of the European Economic Area (Norway, Iceland, Liechtenstein) have committed to implement the same or very similar minimum efficiency standards set by EU Ecodesign regulations through national legislation. Other closely associated countries like Switzerland have in the past also transposed EU Ecodesign requirements.



## Scope

EU MEPS covers both, dry-type and liquid-filled distribution transformers as well as power transformers with a minimum power rating of 1kVA used in electricity transmission and distribution networks or in industrial applications.

There are some special installations and applications of transformers that are exempted from the regulation. Transformers specifically designed and used in applications such as the following are excluded:

- **instrument transformers**, specifically designed to supply measuring instruments, meters, relays and other similar apparatus,
- **transformers** with low-voltage windings specifically designed **for use with rectifiers** to provide a DC supply,
- **transformers specifically** designed to be directly connected to a furnace,
- **transformers specifically** designed for offshore applications and floating offshore applications,
- **transformers specially** designed for emergency installations,
- **transformers and auto-transformers specifically** designed for railway feeding systems,
- **earthing or grounding transformers**, this is, three-phase transformers intended to provide a neutral point for system grounding purposes,
- **traction transformers** mounted on rolling stock, this is, transformers connected to an AC or DC contact line, directly or through a converter, used in fixed installations of railway applications,
- **starting transformers**, specifically designed for starting three-phase induction motors so as to eliminate supply voltage dips,
- **testing transformers**, specifically designed to be used in a circuit to produce a specific voltage or current for the purpose of testing electrical equipment,
- **welding transformers**, specifically designed for use in arc welding equipment or resistance welding equipment,
- **transformers specifically** designed for explosion-proof and underground mining applications,
- **transformers specifically** designed for deep water (submerged) applications,
- **medium voltage (MV) to medium voltage (MV) interface transformers** up to 5MVA,
- **large power transformers** where it is demonstrated that for a particular application, technically feasible alternatives are not available to meet the minimum efficiency requirements set out by this Regulation,
- **large power transformers** which are like for like replacements in the same physical location/installation for existing large power transformers, where this replacement cannot be achieved without entailing disproportionate costs associated to their transportation and/or installation.



# Frequently asked questions



## **Are manufacturers allowed to produce transformers with lower efficiency than required in the regulation?**

Transformers not compliant with the regulation may no longer be placed in the European market (EU28-countries and Iceland, Liechtenstein, Norway) as of July 1, 2015. Switzerland is expected to adopt the same requirements. By then all new transformers need to meet the “Tier 1” minimum efficiency requirements of the regulation (except the specific special transformers / installations which are exempted from the regulation).

However, the regulations do not apply outside Europe. Therefore, it will be possible for manufacturers in Europe to produce low efficiency transformers with high energy losses for markets that do not have minimum efficiency requirements.

## **Do I, as a customer, have to specify in my inquiry documents that the transformer needs to meet the minimum efficiency requirements?**

No, this is not necessary. It is primarily the manufacturer's responsibility to ensure that the transformers are compliant with the regulation. Producing or importing a non-compliant transformer into European market is illegal beginning July 1, 2015.

## **Is there a tolerance for exceeding the MEPS values?**

No, there is no tolerance. If the loss values exceed the requirements of the regulation, the transformer is considered to be non-compliant and thus cannot be delivered to the European market.

For the verification measurements conducted by the surveillance authorities, there is a 5 percent tolerance. However, this tolerance shall not be used by the manufacturer of importer as an allowed tolerance.

## **How can I be sure that a transformer is compliant?**

All the transformers will have to bear a CE-marking as a sign of compliancy with the prevailing directives. An easy way to verify the compliancy is by checking whether the transformer has the appropriate marking on the main rating plate. The manufacturers will also have a responsibility of making a duly signed EC Declaration of Conformity document available.

## **Do these changes mean that transformer prices will increase?**

Increasing transformer efficiency and the reducing the environmental footprint usually includes the use of either higher grade materials or more materials or both. Usually this leads to a cost increase which results an initial price increase. However, it should be noted that the increased energy efficiency brings savings during the lifetime of the transformer.

As of July 1, transformers not compliant with the EcoDesign Directive 2009/125/EC, Regulation Nr. 548/2014 may no longer be placed in the European market (EU28 countries and Iceland, Liechtenstein, Norway).

**As a customer, I have been utilizing capitalization values for the transformer losses in my inquiry and tender evaluations. Should I continue to do so despite the regulation?**

Yes, you should continue to do so. The regulation is only for setting a minimum floor level for the transformer efficiency. Total Cost of Ownership method (TCO) is used to minimize the investment required to obtain the greatest energy savings for the least cost. This results in the selection of transformers whose losses are economically optimal for the given need / case.

The regulation defines a constraint for the losses.

The manufacturer should provide an offer with optimized loss values that may be lower than the maximum value defined by the regulation.

**Is it possible to procure transformers now that meet the “Tier 2” requirements scheduled to become mandatory July 1, 2021?**

Yes it is. A customer may make reference to the “Tier 2”-level of the regulation in his inquiry. ABB can produce products today that meet “Tier 2” requirements as well as products with efficiencies beyond future minimum levels.

However, when talking about the “Tier-2”-levels, it should be noted that the European Commission will conduct a “mid-term” assessment for the regulation latest during the year 2017 where “Tier-2” requirement levels will be reviewed and may be amended.

**Are the European EcoDesign transformers the best what the technology can offer?**

The regulations are a considerable step forward in ensuring the reduction of transformer losses. From a pure technical point of view lower losses can be achieved. The values are a compromise between reducing transformer losses and what can in short-term be realized with reasonable and moderate efforts. Too ambitious target setting might result in a short term shortage of some materials, eg, high grade core steel. The losses can be reduced further.

As an example, the new EN 50588 standard for distribution transformers contains a very low AAAo class for no-load loss. Its values are only about half of the European eco design 2015 required Ao loss values.

**What needs to be considered in order to minimize transformer energy losses in a specific application?**

The typical load profile of the transformer should be known. If the average load is rather low, it makes most sense to minimize no-load loss, whereas for a transformer operated at high average load, the main focus should be on minimizing the load loss.

**Is there a grace period after July 1, 2015?**

No. In fact the transition period passed already. The industry and the market was given a grace period from the regulation coming into force (June 2014) until July 1, 2015.

# ABB transformer solutions – available today

## Efficiency requirements and classes

### Main structure

- Oil distribution transformers (up to 3.15MVA,  $HV \leq 24kV$ ,  $LV \leq 1.1kV$ ) – maximum losses level defined
- Pole-mounted oil distribution transformers (160-315kVA)
  - maximum losses level defined
- Oil distribution transformers (3.15 – 40MVA up to 36kV)
  - minimum PEI value defined
- Dry transformers (up to 3.15MVA,  $HV \leq 24kV$ ,  $LV \leq 1.1kV$ )
  - maximum losses level defined
- Dry transformers (3.15 – 40MVA up to 36kV) – minimum PEI value defined
- Power transformers – minimum PEI value defined

### Transformers with rating up to 3,150kVA and nominal voltage up to and including 36kV

The maximum allowed loss levels for transformers with ratings up to and including 3,150kVA are based on the classification of the EN standards 50464-1:2007 and 50541-1:2011.

Note: These EN standards are currently being united and revised to support the regulation more directly. Lower efficiency classes than in the EU MEPS will disappear completely.

### Liquid-filled distribution transformers with one winding with $U_m \leq 24 kV$ and other one with $U \leq 1,1 kV$ ,

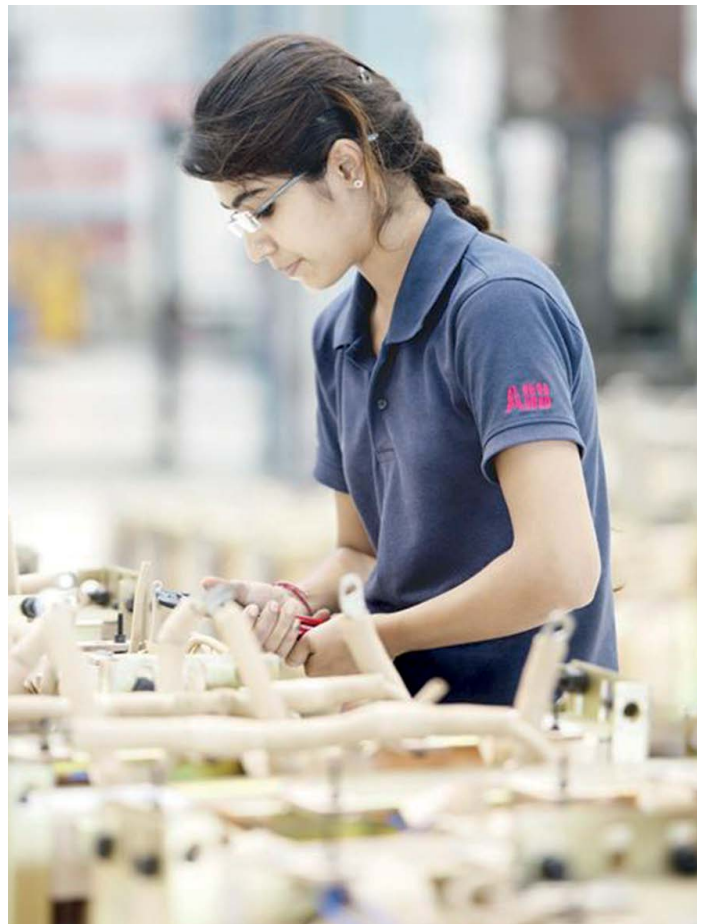
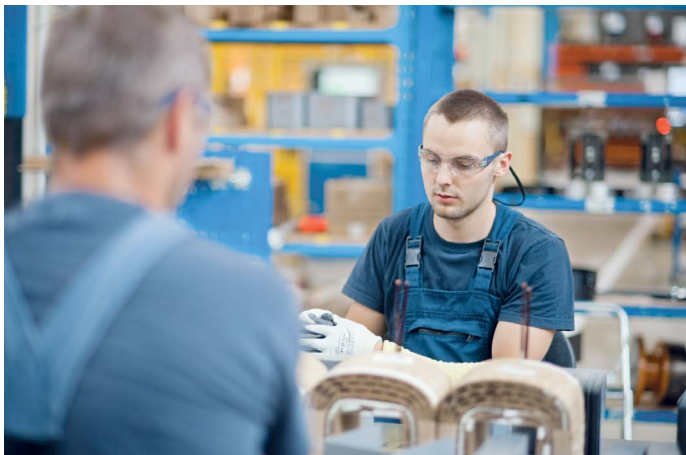
	Tier 1	Tier 2
25 – 1,000kVA	Ck, A0	Ak, A0-10%
1001 – 3,150kVA	Bk, A0	Ak, A0-10%

### Pole-mounted transformers (note: must bear a sign “For pole-mounted operations only”)

	Tier 1	Tier 2
25 – 159kVA	Ck, A0	Bk, A0
160kVA	Ck+32%,C0	Ck+32%,C0-10%
161 – 315kVA	Ck, C0	Bk, B0

### Dry-type transformers with one winding with $U_m \leq 24kV$ and other one with $U \leq 1,1 kV$ ,

	Tier 1	Tier 2
25 – 630kVA	Bk, A0	Ak, A0-10%
631 – 3,150kVA	Ak, A0	Ak, A0-10%





Concessions for transformers with voltages differing from the above defined (rated power ≤ 3,150kVA)

Ref	Insulation level	Correction of load losses and no load losses
1	One winding with $U_m \leq 24\text{kV}$ and the other with $U_m > 1,1\text{ kV}$	Maximum levels of losses indicated in tables can be increased by 10% for no-load losses and by 10% for load losses
2	One winding with $U_m = 36\text{kV}$ and the other with $U_m \leq 1,1\text{kV}$	Maximum levels of losses indicated in tables can be increased by 15% for no-load losses and by 10% for load losses
3	One winding with $U_m = 36\text{kV}$ and the other with $U_m > 1,1\text{kV}$	Maximum levels of losses indicated in tables can be increased by 20% for no-load losses and by 15% for load losses

The regulation defines also concession for transformers with dual voltage windings.

Transformers with rating >3,150kVA and/or nominal voltage >36kV

For the transformers with higher rating than 3,150kVA, an index called Peak Efficiency Index (PEI) is introduced. The methodology for calculating the PEI is based on the ratio of the transmitted apparent power of a transformer minus the electrical losses to the transmitted apparent power of the transformers:

$$PEI = 1 - \frac{2(P_0 + P_{c0})}{S_r \sqrt{\frac{P_0 + P_{c0}}{P_k}}}$$

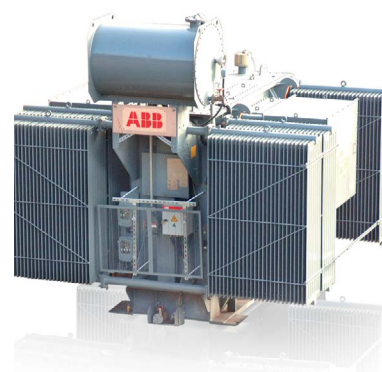
$P_0$  is the no-load losses measure at rated voltage and rated frequency, on the rated tap

$P_{c0}$  is the electrical power required by the cooling system for no-load operation

$P_k$  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

PEI represents a highest value of efficiency index that can be achieved at the optimum value of loading factor.



The regulation lists minimum allowed values of peak efficiency index for dry-type transformers up to 63,000kVA and for liquid-filled transformers up to indefinite rating.

#### Example (Liquid-filled transformer):

	Tier 1	Tier 2
25 MVA	99,657	99,700

#### Markings and documentation

Beginning July 1, 2015, the following product information requirements for transformers not exempted from the scope of the regulation must be shown on the rating plate in addition to the EN 60076-1 requirements:

- The values and the name of the classes of no-load loss and load loss for transformers  $\leq 3,150\text{kVA}$
- For transformers  $> 3,150\text{kVA}$  the PEI
- Information on the weight of all the main components of a transformer (including at least the conductor, the nature of the conductor and the core material)
- For pole-mounted transformers, a visible display plate “For pole-mounted operation only”

A sample rating plate compliant with the new requirements

<b>CE</b>		<b>ABB</b>	
<b>Type</b> TNOSCT-100/11PNS UNI			
<b>No.</b> 1LPL525913		<b>Year of manufacture</b> 2014	
<b>Rated power</b> 100 kV-A		<b>No. of phases</b> 3	
<b>TRANSFORMER to specification</b> EN (IEC) 60076-1			
<b>Rated voltage [V]</b>	<b>Current [A]</b>	<b>Insulation level</b>	
HV 11000 $\pm 2 \times 2.5\%$	5.25	LI75 AC28	
LV 415	139.10	AC3	
<b>Tap no.</b>	<b>HV voltage [V]</b>	<b>Connection symbol</b>	Dyn11
1	11550	<b>Cooling</b>	ONAN
2	11275	<b>Rated frequency</b>	50 Hz
3	11000	<b>Short-circuit imp.</b>	3.88 %
4	10725	<b>Load losses</b>	1750 W
5	10450	<b>No-load losses</b>	145 W
<b>Ambient temp.</b> 40°C		<b>Total mass</b>	463 kg
<b>Temperature rise of:</b>		<b>Mass of active part</b>	279 kg
<b>Windings</b> 60K	<b>Oil</b> 55K	<b>Mass of oil</b>	100 kg
<b>Type of oil</b> Mineral Nyltro Taurus		<b>Oil to</b>	IEC 60296
<b>Windings material HV/LV:</b> Al/Al		<b>Core material:</b> grain-oriented electrical steel	
<b>Mass of windings:</b> 53kg		<b>Mass of core:</b> 169kg	

In addition EU MEPS lists information that has to be shown in transformers documentation.

#### ABB and EU MEPS

ABB has been in the energy business for 130 years and offers a full range of transformer products compliant with the requirements available.

Our technologies are used along the entire energy value chain in both the utility and the industrial sectors. ABB enables customers to maximize the value of energy used to improve their competitiveness while reducing environmental impact and enhancing sustainability. Solutions from ABB can help customers achieve:

- Reduced energy costs
- Reduced greenhouse gas emissions
- Reduced need for additional generating capacity

Energy efficiency improvements can also provide additional operational benefits, such as improved productivity, improved quality, and reduced maintenance burdens.

As the world market and technology leader in the transformer industry, ABB is committed to support customers with transformer solutions that enhance sustainability. Energy efficiency is one of the major drivers of our research and development activity. Today ABB is able to offer transformers with efficiency levels beyond the second level (“Tier 2”) of the European regulation scheduled for the year 2021.

The regulation list maximum allowed losses or minimum allowed values of peak efficiency index for dry-type transformers up to 63,000kVA and for liquid-filled transformers up to indefinite rating.



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