

# IEEE Guide for Loss Evaluation of Distribution and Power Transformers and Reactors

IEEE Power and Energy Society

Sponsored by the  
Transformers Committee

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USA

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# **IEEE Guide for Loss Evaluation of Distribution and Power Transformers and Reactors**

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**Transformers Committee**  
of the  
**IEEE Power and Energy Society**

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**Abstract:** The economic loss evaluation of liquid-filled distribution and power transformers, dry-type distribution and power transformers, and reactors is covered in this guide.

**Keywords:** economic evaluation, IEEE C57.120™, losses, reactor, transformer

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## Introduction

This introduction is not part of IEEE Std C57.120-2017, IEEE Guide for Loss Evaluation of Distribution and Power Transformers and Reactors.

This guide provides details and explanations for determining the constituent components and the methodology for determining the economic value of losses of distribution and power transformers and reactors for both utility and non-utility segments. This guide focuses on the cost of losses from the energy consumption of equipment perspective and does not provide methods to quantify other social or environmental benefits that could be related to equipment efficiencies.

Losses are quantified typically for the purposes of purchasing evaluation or replacement cost analysis. It is important to quantify losses because manufacturers of equipment have a large number of design options available to them and, by providing loss values from the user, it will help the manufacturer to propose the most economic design to fit the user's circumstances.

Loss evaluation is a means to quantify operating cost and is an economic decision. Quantifying losses for comparison is a straightforward process, however, the information required for such evaluation involves forecasting and prediction of costs over a future timeframe. There are many sources of this information available and it is up to the evaluator to identify and select the most appropriate source of data applicable to their circumstances. Economic circumstances are constantly changing and specific to each user's situation, making it impossible for any single number to be used everywhere for loss evaluation.

Prediction of future costs and forecasting requires frequent updating and it is up to the evaluator to use the best information available to determine their own values of losses.

In addition to the identification of value, the evaluator is identified as a reasonable evaluation timeframe. For example, the time period of evaluation may be the useful life of the equipment or be limited to the useful life of the facility or limited by internal corporate investment criteria. The determination of an evaluation time period is entirely dependent on the user and their circumstances.

This guide identifies parameters to consider when performing a loss evaluation, but it is up to the user to identify the parameters most applicable to their circumstances. To provide an example, a primary service transformer in an industrial plant may only have losses evaluated on the basis of energy cost charged to the facility, but an industrial user may include a loss-on-loss factor for secondary step-down transformers in the same facility and include some of the evaluation parameters for distribution transformers.

Merchant generating plants may not need to calculate the parameters associated with transmission assets or the loss-on-loss multipliers for the generator's transformer because their plant is metered at the transmission connection point and the losses in the generation plant transformers only take away from the plant's revenue capability.

This guide will assist the user to decide how to value the efficiency of equipment. Ultimately, the efficiency depends heavily on how the equipment is used, where on the power system it is used, and what decisions are made regarding operating conditions such as loading beyond nameplate and timing of asset additions/replacement. One shall make the selection of parameters for the evaluation based on the best available knowledge.

This guide uses publicly available information on wholesale electricity prices, transformer costs, and other dollar values. These numbers are provided for illustrative purposes only. Actual price (or cost) will vary by time and location. Each user of this guide should determine the price or cost values that he or she believes appropriate for making loss evaluations.

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# IEEE Guide for Loss Evaluation of Distribution and Power Transformers and Reactors

## 1. Overview

### 1.1 Scope

This guide covers the economic loss evaluation of liquid-filled distribution and power transformers, dry-type distribution and power transformers, and reactors.

### 1.2 Purpose

The purpose of this guide is to provide a method of establishing the dollar value of the electric power needed to supply the losses of a transformer (includes distribution and power transformers as well as reactors in this guide). Users can use this loss evaluation to determine the relative economic benefit of a high-first-cost, low-loss unit versus one with a lower first cost and higher losses. Manufacturers can use the evaluation to optimize the design and provide the most economical unit to bid and manufacture. The evaluated cost of losses also enables a user to compare the offerings of two or more manufacturers to aid in making the best purchase choice among competing transformers. Loss evaluation also provides information to a user for establishing the optimum time to retire or replace existing units with modern low-loss transformers. The user should determine, on a dollars-per-kilowatt basis, the sum of the present worth of each kilowatt of losses of a transformer throughout its life, or some other selected period of time. A portion of this evaluated cost can be paid to the manufacturer to reduce losses. However, this evaluated cost includes other costs associated with owning a more expensive piece of equipment, such as financing costs, taxes, etc. This guide provides formulas by which the costs of energy, power, money, and the loading pattern of a transformer can be converted to dollars-per-kilowatt values of the transformer losses.

These dollars-per-kilowatt figures should be furnished to the manufacturer when bids are requested. If the final tested values of losses vary from the manufacturer's guaranteed values, economic adjustments may be made. Nothing in this guide is mandatory. It should not be inferred that the methodology described in this guide is the only valid methodology for computing the cost of transformer losses. Many users have developed their own transformer loss evaluation techniques that are suitable for the intended purpose.

This guide uses publicly available information on wholesale electricity prices, transformer costs, and other dollar values. These numbers are provided for illustrative purposes only. Actual price (or cost) will vary by time and location. Each user of this guide should determine the price or cost values that it believes appropriate for making loss evaluations.

This guide offers a methodology to determine, and thereby specify, the economic value of no-load, load, and auxiliary losses. The use of this guide allows manufacturers to tailor the design to the unique economic situation of each user, and allows the user to evaluate multiple designs.