# E3 premium efficiency—CSL-3 2007 final rule efficiency transformers

Eaton Corporation's E3 transformers represent the next level premium efficiency jump in the dry-type, three-phase ventilated transformer market, having a marked increase in energy savings over the standard NEMA® TP-1 transformers being specified today. The E3 transformer represents the right choice for those looking for lowest energy/heat losses, green/LEED® design and 24-hours-a-day, 7-days-a-week energy savings with no additional maintenance to maintain efficiency.

## History

In an effort to increase energy efficiency within the U.S. electrical system, effective January 1, 2007, the federal government implemented legislation found within EPACT 2005 standards to change manufacturing of dry-type transformers such that they had to meet the NEMA TP-1 energy efficiency levels. The foundation and reasoning for this change was started in a 2004 government study called, "10 CFR Part 430—Energy Conservation Program for Commercial and Industrial Equipment: Energy Conservation Standards for Distribution Transformers; Proposed Rule." This study laid the foundations of five different efficiency levels (Candidate Standard Levels—CSL) for a multitude of transformer technologies. Whereas many transformer technologies (both dry and oil-filled, low and medium voltage) were discussed, the CSL-1 transformer represents the least efficiency level of low voltage, dry-type transformers listed. This energy efficiency level is at the same performance as NEMA TP-1 transformers (the current required efficiency performance). The CSL-2 through CSL-5 classifications represent increasingly higher performance energy efficiency levels (with CSL-5 being the highest efficiencies/lowest losses). While CSL-5 is the most efficient transformer in this classification shown, currently the material costs necessary to meet those efficiencies are prohibitive in the commercial market. The CSL-3 level has a significant increase in performance when compared with NEMA TP-1 efficiency levels, but can be reasonably priced with today's materials.

The 10 CFR Part 430 standard was an evolving standard. As more was learned about possible transformer efficiencies, materials and performance, the standard continued to evolve until the "10 CFR Part 431—Energy Conservation Program for Commercial Equipment: Distribution Transformers Energy Conservation Standards; Final Rule" was published in October 2007. This final rule shows improvements and refinements made as the standard matured, changing CSL-3 minimum efficiency levels from an average of 28 percent lower losses than NEMA TP-1 to an average of 32 percent (see table on page 2).

While many competitors have stayed stagnant at the 2004 levels, Eaton Corporation is continuing to provide cutting-edge efficiencies and performance to our customers looking for that extra squeeze when designing a LEED or green building.

Because there is no ongoing maintenance to maintain the designed efficiency over time, the opportunity for savings comes without headaches (such as light bulb/ballast changes, additional control wiring to gain energy savings, and changes in user environment or habits). Eaton's E3 transformers are a "no additional work" issue for the design engineer who wants to gain energy savings and a great way to save energy within today's modern buildings.

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## Transformer Efficiency (%) and Decreased Losses vs. TP-1

| TP-1 | | CSL-3 Draft 2004 | | CSL-3 Final 2007 | | Eaton's E3 | |
|---|---|---|---|---|---|---|---|
| Min. Effi-ciency | kVA | Min. Effi-ciency | Reduced Losses vs. TP-1 | Min. Effi-ciency | Reduced Losses vs. TP-1 | Measured Effi-ciency | Reduced Losses vs. TP-1 |
| 97 | 15 | 97.6 | 20% | 97.97 | 32% | 98.02 | 34% |
| 97.5 | 30 | 98.1 | 24% | 98.29 | 32% | 98.36 | 34% |
| 97.7 | 45 | 98.3 | 26% | 98.45 | 33% | 98.63 | 40% |
| 98.0 | 75 | 98.6 | 30% | 98.64 | 32% | 98.71 | 35% |
| 98.2 | 112.5 | 98.8 | 33% | 98.77 | 32% | 98.86 | 37% |
| 98.3 | 150 | 98.9 | 35% | 98.86 | 33% | 99.00 | 41% |
| 98.5 | 225 | 98.9 | 27% | 98.97 | 31% | 99.07 | 38% |
| 98.6 | 300 | 99.0 | 29% | 99.04 | 31% | N/A | N/A |
| | Average | | 28% | | 32% | | 37% |

## Environmental Impact of E3 Transformers vs. Standard NEMA TP-1

| kVA | Lbs of $CO_2$ Saved | Number of Men (Average Weight 200 lbs) $CO_2$ Savings Equivalence | Pollution Cleaning |
|---|---|---|---|
| 15 | 608 | 3.0 | 61 |
| 30 | 991 | 5.0 | 99 |
| 45 | 1411 | 7.0 | 141 |
| 75 | 2007 | 10.0 | 201 |
| 112.5 | 2682 | 13.4 | 269 |
| 150 | 3513 | 17.6 | 352 |
| 225 | 4422 | 22.1 | 443 |
| 300 | 5520 | 27.6 | 553 |

❶ Environmental impact data per nationalized averages of utility pollution production in 2004 published by the U.S. EPA eGrid report in 2007. Transformer losses based on 35 percent loading of nameplate with linear load.

## Features and benefits

- 480 volt to 208/120 volt standard
- 150°C or 115°C temperature rise available
- Copper windings and terminals standard; aluminum not available
- CSL-3 2007 Final Rule efficiencies levels
- Increased efficiencies help to gain LEED points (because LEED only incorporates regulated losses, the comparison of "No Load Losses" against standard NEMA TP-1 transformers can be used to document energy savings)
- 30–40 percent less losses than NEMA TP-1 transformers
- No additional maintenance to maintain energy efficiency and savings
- K-13 (K-9 available)—can be used in areas of high concentration of non-linear loads
- 25-year, pro-rated, warranty
- Ultra-low excitation (no-load) losses
- Available in three-phase ratings from 15 to 300 kVA
- Reduced heat output helps to reduce cooling costs
- Energy savings provides a return on investment (ROI) energy savings analysis
- Environmentally friendly through reduced pollution due to low energy losses
- 200 percent rated neutral
- Single electrostatic shield for attenuation of common-mode and transverse-mode noise
- 220°C insulation system
- Operating costs kept to a minimum
- May be installed as a stand-alone transformer, or included with an Integrated Facility System™ (IFS)
- Meet NEMA ST-20 audible sound level standards
- Enclosures are NEMA 2 drip-proof. The addition of optional weathershields makes the enclosure NEMA 3R rainproof

## Premium Efficiency Transformer Selection Information

| | Full Cap Tap | | | °C | Dimensions (in) | | | | Dimensions (mm) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| kVA | FCAN | FCBN | Type | Temp. Rise | H | W | D | Weight (lbs) | H | W | D | Weight (kg) | Frame | Wiring Diagram Number | Weathershield Catalog Number | Style Number |
| 15 | 2 at +2.5% | 4 at –2.5% | DT-3 | 115 | 30 | 23 | 16.5 | 325 | 762 | 584 | 419 | 147 | 912B | 283C | WS38 | N48M28F15CUE3 |
| 30 | 2 at +2.5% | 4 at –2.5% | DT-3 | 115 | 30 | 23 | 16.5 | 370 | 762 | 584 | 419 | 168 | 912B | 283B | WS38 | N48M28F30CUE3 |
| 45 | 2 at +2.5% | 4 at –2.5% | DT-3 | 115 | 39.18 | 29 | 22 | 635 | 995 | 737 | 559 | 288 | 915D | 283B | WS39 | N48M28F45CUE3 |
| 75 | 2 at +2.5% | 4 at –2.5% | DT-3 | 115 | 39.18 | 29 | 22 | 870 | 995 | 737 | 559 | 395 | 915D | 283B | WS39 | N48M28F75CUE3 |
| 112.5 | 2 at +2.5% | 4 at –2.5% | DT-3 | 115 | 56.18 | 31.25 | 24.24 | 1526 | 1427 | 794 | 616 | 692 | 917 | 283B | WS34 | N48M28F12CUE3 |
| 150 | 2 at +2.5% | 4 at –2.5% | DT-3 | 115 | 56.18 | 31.25 | 24.24 | 1665 | 1427 | 794 | 616 | 755 | 917 | 283B | WS34 | N48M28F49CUE3 |
| 225 | 2 at +2.5% | 4 at –2.5% | DT-3 | 115 | 62.18 | 31.25 | 30.25 | 2120 | 1579 | 794 | 768 | 962 | 918A | 283B | WS34 | N48M28F22CUE3 |
| 300 | 2 at +2.5% | 4 at –2.5% | DT-3 | 115 | 75 | 44.46 | 35.75 | 3900 | 1905 | 1129 | 908 | 1769 | 919 | 292A | WS35 | N48M28F33CUE3 |

**Eaton Corporation**
Electrical Sector
1111 Superior Ave.
Cleveland, OH 44114
United States
877-ETN-CARE (877-386-2273)
Eaton.com

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