

# **3<sup>rd</sup> International workshop on distribution transformer efficiency**

---

## **Distribution transformers – efficiency standards**

**by  
Prof Dennis J Allan**

**Treviso 2002**

**Distribution transformers  
– efficiency standards**

---

## **Design aims:**

**before 1970 – the aim was for**

**light weight, low cost transformers**

**after 1980 – the drive started for**

**low loss, high efficiency transformers**

**Treviso 2002**

**Distribution transformers  
– efficiency standards**

---

**Two ways to specify losses in transformers:**

- **standard losses related to rated power**
- **capitalised loss formulae**

# Treviso 2002

## Distribution transformers – efficiency standards

---

**Table of losses for dry-type transformers, 24kV**

| <b>Rated power, kVA</b> | <b>Load loss, W</b> | <b>No-load loss, W</b> |
|-------------------------|---------------------|------------------------|
| <b>250</b>              | <b>3800</b>         | <b>880</b>             |
| <b>400</b>              | <b>5500</b>         | <b>1200</b>            |
| <b>630</b>              | <b>7800</b>         | <b>1650</b>            |
| <b>1000</b>             | <b>11000</b>        | <b>2300</b>            |
| <b>1600</b>             | <b>16000</b>        | <b>3100</b>            |
| <b>2500</b>             | <b>23000</b>        | <b>5000</b>            |

**Treviso 2002**

**Distribution transformers  
– efficiency standards**

---

**Capitalisation of losses:**

**Capitalised loss = First cost + cost of losses**

## Capitalised cost of losses

$$\begin{aligned}\text{Cost of losses} &= \text{Cost of no-load loss} + \text{cost of load loss} \\ &= \text{No-load loss} \times \text{no-load capitalisation rate} \\ &\quad + \text{load loss} \times \text{load capitalisation rate} \\ &= \text{No-load loss (in kW)} \times \text{€5000/kW}^{**} \\ &\quad + \text{load loss (in kW)} \times \text{€1250/kW}^{**}\end{aligned}$$

**\*\* typical values indicated**

### Load loss of oil filled distribution transformers

Table II

| Rated power<br>kVA | List A<br>$P_k$ W | List B<br>$P_k$ W | List C<br>$P_k$ W |
|--------------------|-------------------|-------------------|-------------------|
| 630                | 6750              | 8700              | 5600              |
| 1600               | 17000             | 20000             | 14000             |
| 2500               | 28500             | 32000             | 22000             |

### No-load loss of oil filled distribution transformers

Table III

| Rated power<br>kVA | List A'<br>$P_0$ W | List B'<br>$P_0$ W | List C'<br>$P_0$ W |
|--------------------|--------------------|--------------------|--------------------|
| 630                | 1200               | 940                | 800                |
| 1600               | 2600               | 2200               | 1700               |
| 2500               | 3800               | 3200               | 2500               |

## Combinations of load and no-load loss options

Preferred couplings from Tables II and III of HD 428

- A – A'** mid-range load loss with high no-load loss
- B – B'** high load loss with mid range no-load loss
- C – B'** low load loss with mid-range no-load loss
- A – C'** mid-range load loss with low no-load loss
- C – C'** the low loss option

## What will be the future?

- **Revision of HD 428 is in hand by CLC TC 14**
- **National Regulation to improve efficiency?**
- **EU Directive to enforce efficiency in the Power Distribution Industry?**