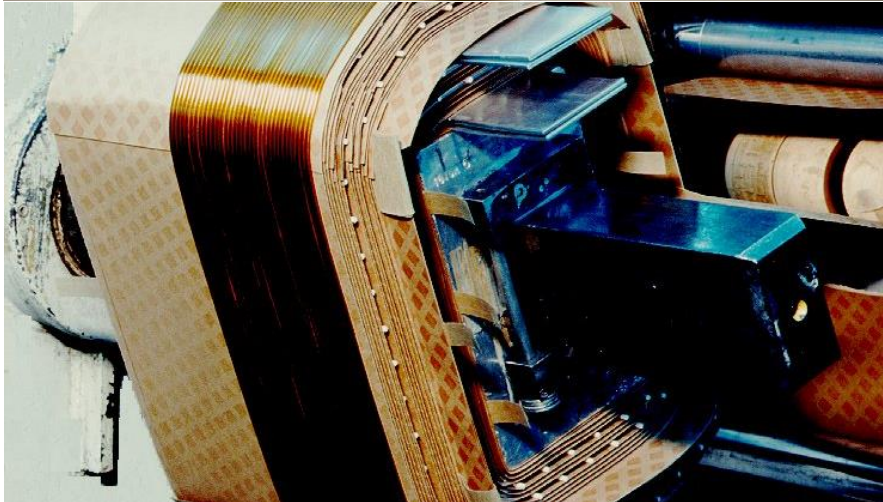


WEIDMANN

**INTRODUCING WEIDMANN INSULATIONS® DPE PAPER –
ADVANCED, COST EFFECTIVE INSULATION FOR DISTRIBUTION
TRANSFORMERS: VALUE & BENEFITS FOR UTILITIES**

INSULATION PAPER

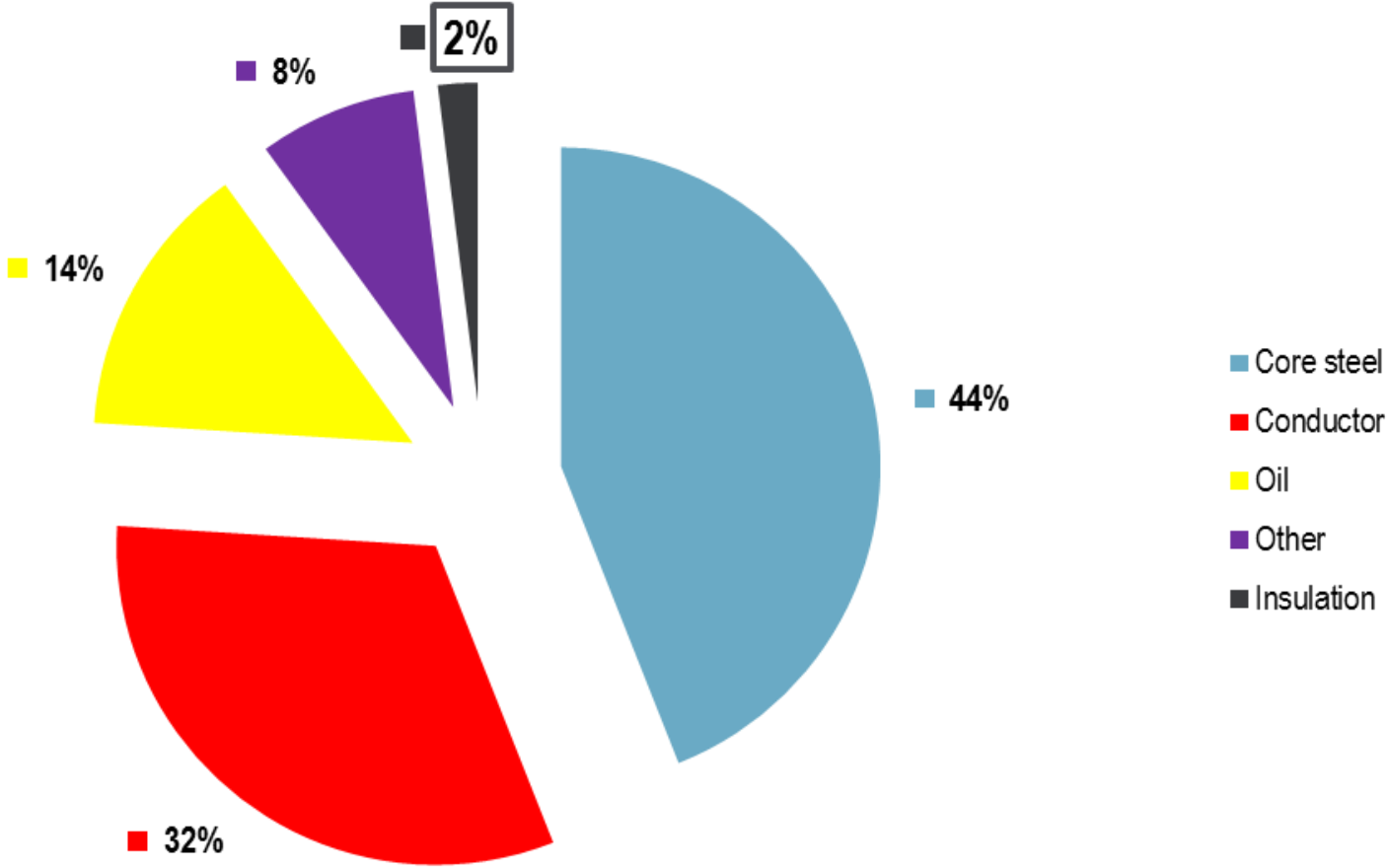
FOUNDATION FOR QUALITY, PERFORMANCE, AND LONGEVITY OF DISTRIBUTION TRANSFORMERS



- Kraft cellulose paper and mineral oil together are a reliable and cost effective insulation system
- In use for over 100 years
- The size, weight, health and life of transformers are, to a great extent, defined by the solid insulation paper used in the design
- Yet, as important as the solid insulation paper is to the life of a distribution transformer...

INSULATION PAPER IN DISTRIBUTION TRANSFORMERS

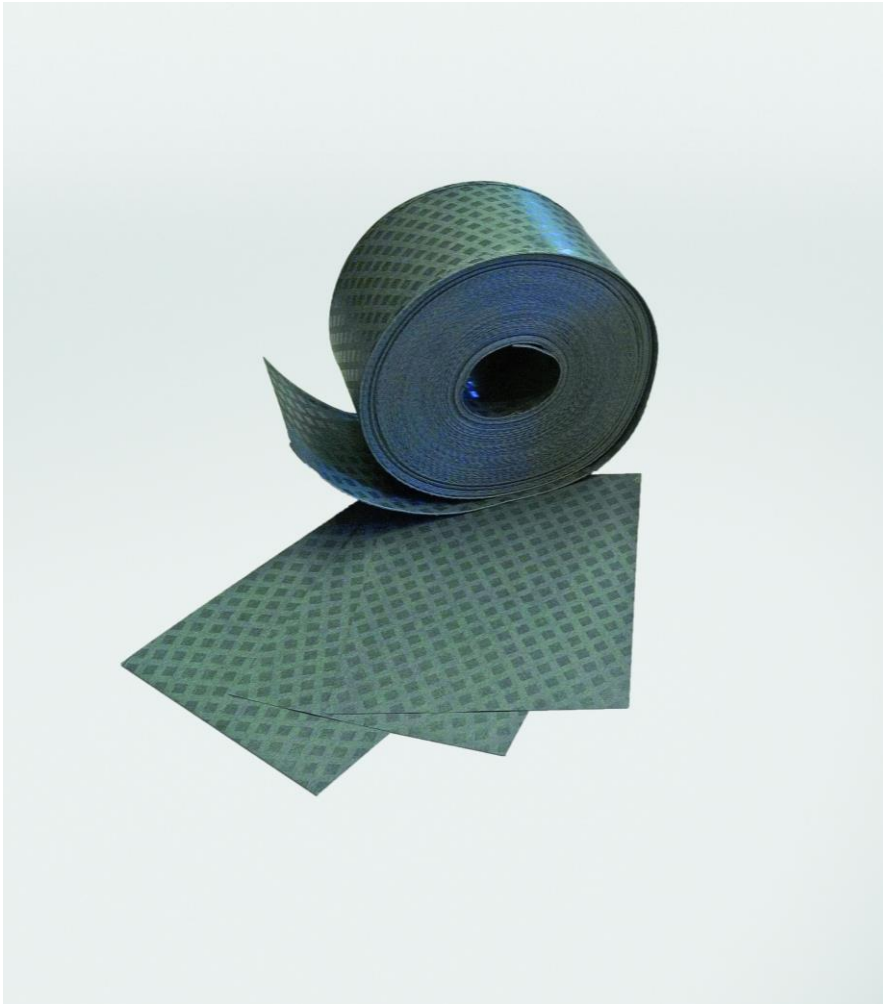
SMALL PORTION OF TOTAL TRANSFORMER COST



WHY THE NEED FOR BETTER INSULATION PAPER IN DISTRIBUTION TRANSFORMERS?

- New and ongoing pressures have prompted development and evaluation of new insulation materials in order to:
 - Offset size / weight increases from efficiency regulations
 - Handle increasing loads, without increased size
 - Provide increased overload capability
 - Increase reliability and longevity
- Thus, a cost effective new insulation paper that achieves these benefits, when insulation paper is only a small portion of total transformer cost anyway, would significantly upgrade transformer performance at practically no additional cost

INTRODUCING – WEIDMANN INSULUTIONS® DPE PAPER DIAMOND PATTERN ENHANCED (DPE)



- New special grade of layer insulation paper for liquid-immersed distribution transformers
- INSULutions® DPE is engineered using 100% cellulose to minimize cost, yet it overcomes the limits of traditional Kraft cellulose papers, providing:
 - Higher thermal endurance (in both mineral oil & ester liquid) – slower aging
 - Better dielectric performance – improved insulation design
 - Better drying & impregnation with dielectric liquids – improved quality and less moisture in the transformer

INSULUTIONS® DPE - PROVEN TECHNOLOGY OVER A HUNDRED THOUSAND IN SERVICE



- INSULutions® DPE is used daily in regular commercial production, in a wide variety of designs, including:
 - Different voltage classes
 - Wide range of capacities (kVA)
 - Countless different constructions (single phase / three phase, wound core / stacked core, poles, pads, submersibles, etc.)
- Both in mineral oil & ester liquids
- Application in various regions around the world

DPE HIGHER THERMAL CLASS – TEMPERATURE LIMITS

INSULATION SYSTEM THERMAL CLASS AND RESPECTIVE TRANSFORMER DESIGN TEMPERATURE LIMITS BASED ON IEEE STANDARD TERMINOLOGY

INSULATION SYSTEM	INSULATING MATERIAL AND LIQUID	TRANSFORMER AVERAGE WINDING TEMPERATURE RISE (AWR), °C	TRANSFORMER HOTTEST SPOT TEMPERATURE (TEMPERATURE INDEX), °C	SYSTEM THERMAL CLASS, °C
INDUSTRY PROVEN SYSTEM	Kraft in mineral oil	55	95	105
	TU Kraft in mineral oil	65	110	120
DPE SYSTEM	DPE in mineral oil	75	120	130
	DPE in ester liquid	85	130	140

SIGNIFICANCE OF 130°C THERMAL CLASS IN MINERAL OIL CAN BE ANOTHER INDUSTRY “STEP CHANGE”

- In the late 1950's, transformer manufacturers developed Thermally Upgraded Kraft (TUK) papers, as a cost effective way to extend transformer life (vs. non-TU Kraft papers)
- In 1962, NEMA officially recognized TUK in standard TR-1-1962 by establishing the higher temperature rise limit of 65 °C for oil-immersed transformers using TUK (vs. 55 °C for transformers using non-TU Kraft)
- The option to use a dual temperature rating of 55 °C / 65 °C was also standardized at that time
- Today, 65 °C rise transformers are the norm in North America for both distribution and power transformers
- Now, by using DPE paper in mineral oil, distribution transformers can:
 - Have even further extended life at 65 °C rise (practically double thermal life of TUK)
 - or be advanced to 75 °C AWR, or to a dual temperature rating of 65 °C / 75 °C and run hotter without failures (physically smaller or more kVA capacity in same size)
- By staying 100 % cellulose-based, this increased performance comes at practically no additional cost
- IEEE C57.154 “Std. for Distribution, Power, & Regulating Transformers Using Higher Temperature Insulation Systems” supports application of such systems

INSULATIONS® DPE - VALUE & BENEFITS FOR UTILITIES

MAINTAINING 65 °C TEMPERATURE RATING

- Longer life
 - At 65 °C, the life of DPE is more than twice as long as standard TUK paper
- Less vulnerable to emergency events
 - Overheating on hot days
 - Over-voltages due to lightning, etc.
- Overall operational reliability increase
 - Reduction in capital investment costs
 - Better asset amortization
- Increased overload capacity
 - 10 °C increase in insulation thermal class provides about 12% additional overload capacity

INSULATIONS® DPE - VALUE & BENEFITS FOR UTILITIES USING A HIGHER TEMPERATURE RATING

- 65 °C / 75 °C Dual-Temperature Rating
 - Smaller base kVA rating transformers that can carry a higher load
 - Example: 90 kVA transformer can cover the same load as 100 kVA transformer
 - Potential transformer size and weight reduction
 - Potential offset of DOE efficiency regulation impact on weight and size
 - Smaller multiple transformer substations
 - One transformer can carry increased emergency load for a long time
- 75 °C Temperature Rating
 - Increased kVA output in the same footprint (size & weight)
 - Option to address an increase in current and/or future energy demand (e.g. for electric vehicle charging, urban growth, etc.)
 - Can potentially offset impact of increased transformer size and weight due to DOE efficiency requirements



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THANK YOU