

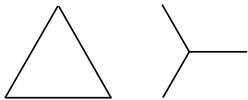


Some of the frequently asked questions by engineers and electricians over the years have been: **When should I use a Scott T transformer? Why not replace all of the transformers with this design? Why are they less expensive?**

In order to assess when a Scott T design should be used and the reasons to use a Scott T we have tried to summarize the information from a number of resources and published articles.

There are certain advantages for almost every transformer connection, which is why they were initially developed and produced. At one time, when deliveries were long and locations were remote, it was possible to install three single phase transformers connected as a Delta-Delta or Delta-Wye. If one winding failed the remaining two units could be reconnected in Vee-Vee to replace the Delta-Delta or in a Scott T configuration to replace a Delta-Wye as a de-rated unit. This would get the system back up and running even if it was in a limited capacity. This was a very practical solution for remote locations such as marine applications where replacement units are not readily available for the Scott T design.

Delta-Wye



This is the traditional and most popular winding configuration for transformers. It's principally used to:

- (1) Step down voltage in three phase systems
- (2) Provide electrical isolation in three phase systems

The advantages of this configuration are well documented.

- (1) Third harmonic voltages are eliminated by the circulation of the harmonic current trapped in the primary Delta winding.
- (2) The secondary neutral can be grounded and it can be utilized for giving four-wire supply which can accommodate both single and three phase loads.
- (3) An unbalanced four wire supply may be given and the resulting unbalanced voltages are relatively small, being proportional only to the internal impedances of the windings. Balanced and unbalanced loads may therefore be supplied simultaneously.
- (4) Phase angles between the phases are symmetrical allowing 3 phase balanced loads (motor, drives) to be supplied with no regard to imbalance occurring.

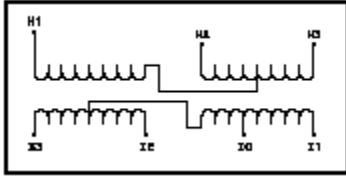
The Disadvantages of Delta-Wye

1. No primary neutral point is available for grounding. This is not necessarily a disadvantage, as the system on the primary side of a transformer is generally grounded at the generator or at the step-up transformer secondary
2. A fault of one phase renders a three-phase unit inoperative until that phase is repaired. This also can be an advantage for safety reasons.

Application

The primary application for the Delta Wye connection is used for stepping down to supply a four wire load which may be balanced or unbalanced. This connection allows for a combination of loads such as motors and lighting to be combined and supplied by one circuit. This connection is equally suited for stepping-up to supply high voltage distribution or transmission lines. As the third harmonic voltages are eliminated in the high voltage, the neutral is available for grounding.

Scott T Connections



This connection was initially developed and is a practical solution for the conversion of three phase primary to a two phase secondary. On the three phase side a neutral point is available for grounding or for loading. On the two phase side the windings may be connected to give three or four wire supply.

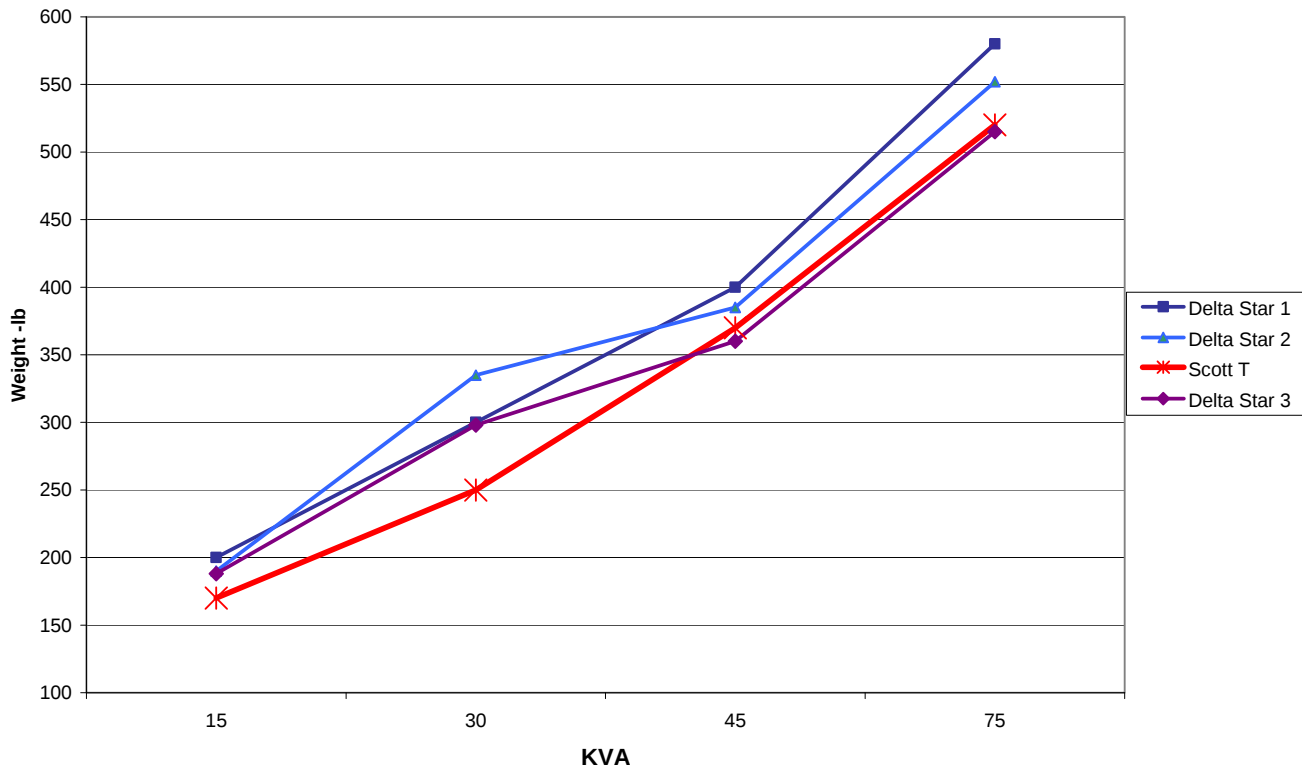
The Advantages of the Scott T configuration

1. *If desired, a three phase, two phase, or single phase load may be supplied simultaneously*
2. *The neutral points can be available for grounding or loading purposes*

The Disadvantages when used for 3 Phase Loading

1. *This type of asymmetrical connection (3 phases, 2 coils), reconstructs three phases from 2 windings. This can cause unequal voltage drops in the windings, resulting in potentially unbalanced voltages to be applied to the load.*
2. *The transformation ratio of the coils and the voltage obtained may be slightly unbalanced due to manufacturing variances of the interconnected coils.*
3. *This design's neutral has to be solidly grounded. If it is not grounded solidly, the secondary voltages could become unstable.*
4. *Since this design will have a low impedance, special care will have to be taken on the primary protection fault current capacity. This could be an issue if the system was designed for a Delta-Wye connection.*
5. *The inherent single phase construction and characteristics of this connection produces a comparatively bulky and heavier transformer when compared with a normal three phase transformer of the same rating.*
6. *In the "Auten Stigant & Franklin" JOP Transformer Book 10th edition, they refer to the Scott T connection for a practical way of connecting a three phase primary to a two phase secondary. However when connecting a three phase primary to a three phase secondary in a Scott T configuration they state that **"two single phase transformers can be installed. Their total rated kVA must be 15.5% greater if the transformers are interchangeable or 7.75% greater if non-interchangeable."** Interchangeable refers to separate single phase units that can be replaced independently.*
7. *In a comparative analysis of the published weights of the one commercially available Scott T transformer (only one manufacturer still constructs a dry-type Scott T) and a number of Delta-Wye transformer manufacturers you will find that Scott T's are, in most instances, lighter than the similar kVA copper Delta-Wye units. This goes against the mathematical principals and the sizing requirements stated by "Auten Stigant & Franklin". It suggests that the Scott T transformers do not meet and are not equivalent to their Delta-Wye equivalent kVAs.*

Weight Compariosn between Delta Star and Scott T



8. A fault in one phase will render all of the commercially available Scott T transformers inoperative until that phase is repaired as the individual phases are not interchangeable.

Conclusion:

The Scott T connection in theory would be suitable for supplying a three, two and single phase load simultaneously, but such loads are not found together in modern practice. The Scott T would not be recommended as a connection for 3 phase to 3 phase applications for the following reasons:

- The loads of modern buildings and office buildings are inherently unbalanced and contain equipment that can be sensitive to potential voltage fluctuations that may be caused by the Scott T design.*
- A properly sized Scott T transformer will have to be a minimum of 7.75% larger than the equivalent Delta-Wye transformer. Properly sized, it would be a bulkier and heavier option and should not be considered a less expensive solution.*

Applications requiring 3 phase to 3 phase configuration are best served by a Delta-Wye configuration. This configuration is the smallest and best suited for the unbalanced loads and sensitive equipment of today's applications that could be affected by voltage fluctuations.

References:

Stigant & Franklin" JOP Transformer Book 10th edition

IEEE 1100-1999

Electrical Construction & Maintenance, October 1989 issue, Using the T Connected transformer