PACIFIC CREST
TRANSFORMERS

May 2012

"The Right Stuff" (or be sure to secure the ***BEST*** transformer for your need)

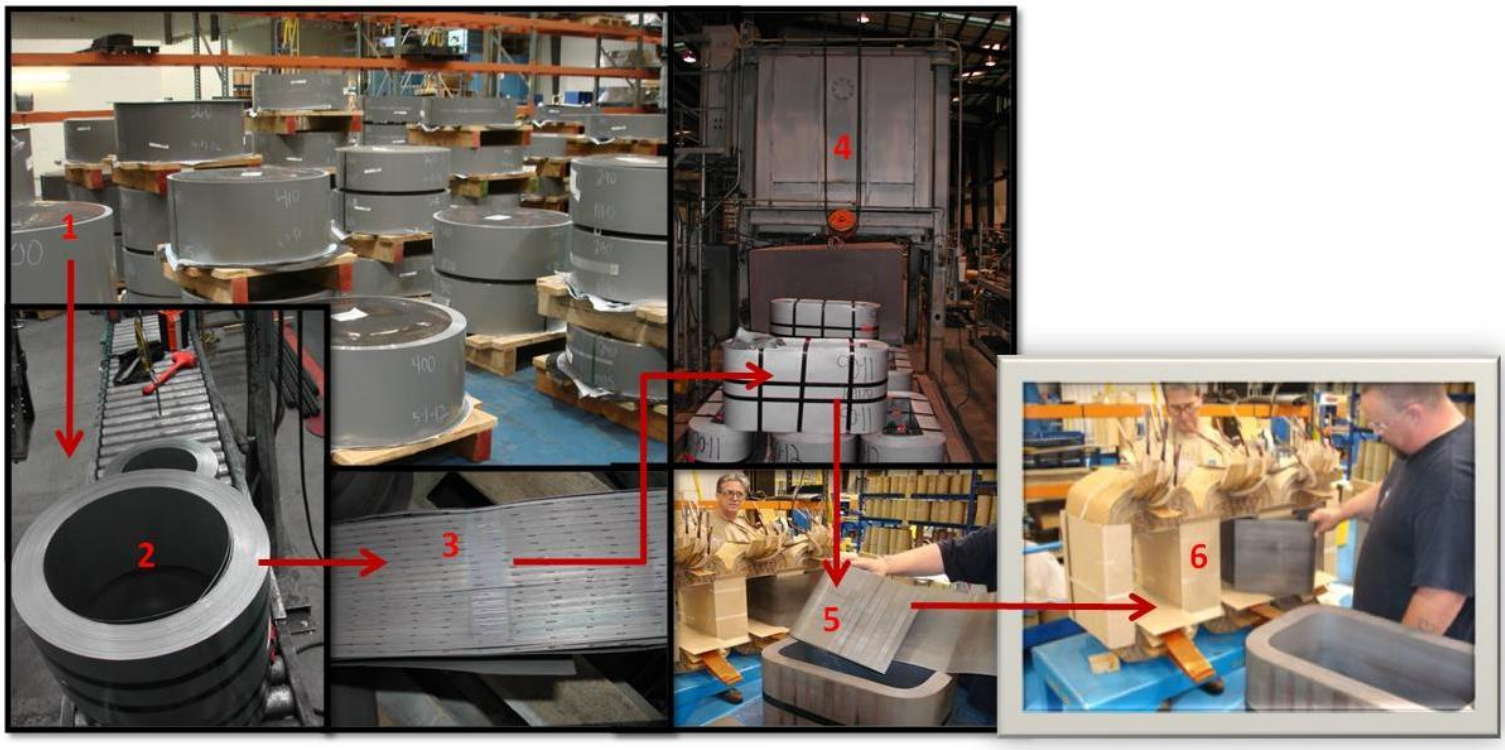
There is far more to specifying a liquid filled transformer than mere kVA and voltages. Although all transformers must meet ANSI construction and test standards, the optimum design needs to take into consideration the application and operating environment of the installed transformer to insure optimum performance and long term operation.

There are several types of core and coil construction available. Most however are dependent on that which is routinely available from the various manufacturers. Each has their advantage and a basic understanding of same provides the customer with a valuable tool in evaluating offers. This paper's goal is to provide this tool to enable you to order "the right stuff".

Core construction

There are 2 basic types of transformer cores i.e. shell form and core form. In shell form construction the iron surrounds the windings. In core shell construction the windings surrounds the core.

The following depicts the production of wound cores commonly used in shell form construction.



1. Silicon core steel stock coils
2. Core after shearing operation
3. Close-up of gaps in core steel laminations

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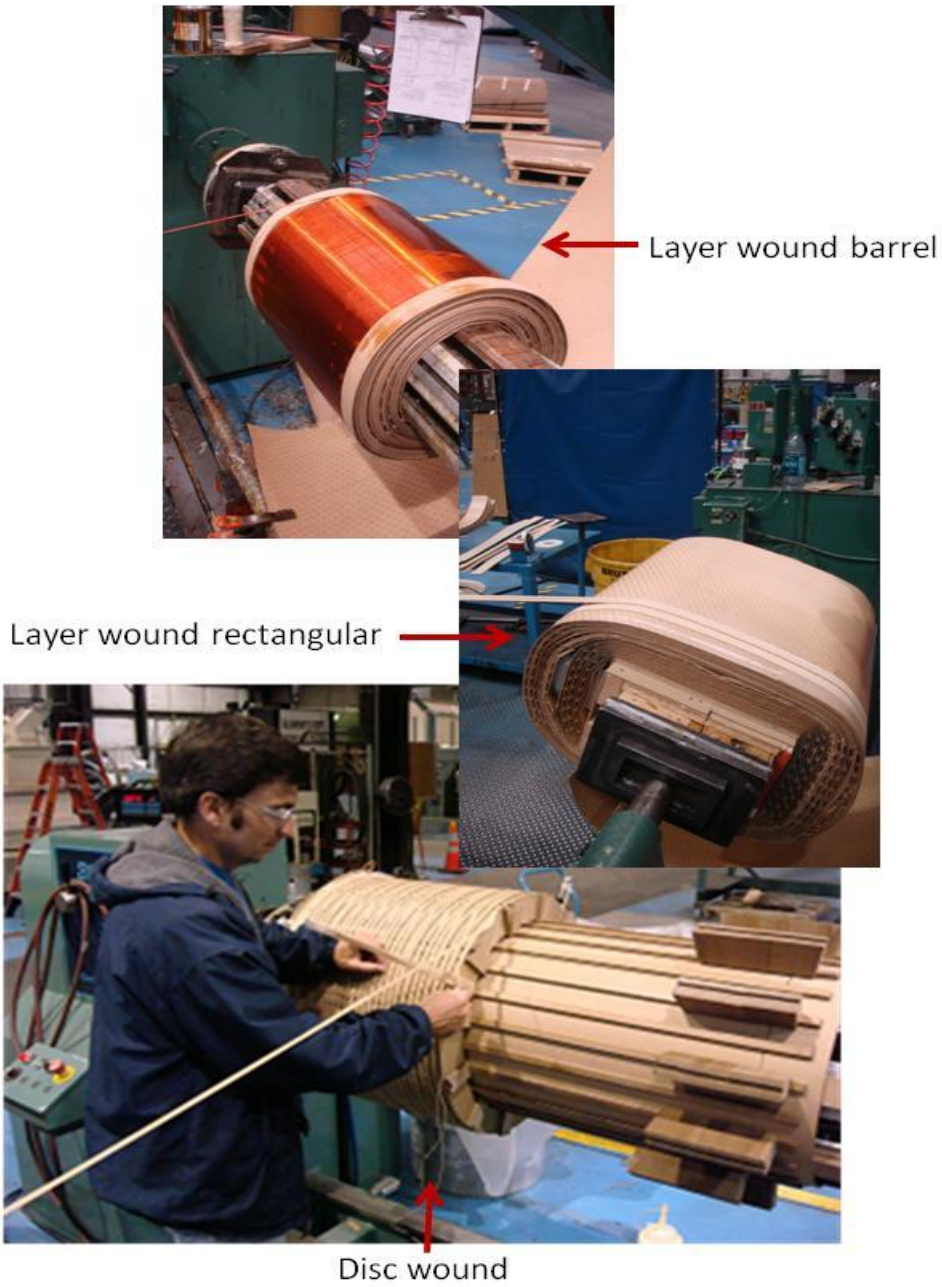
4. Pressed cores ready for stress annealing in core oven
5. Close-up of core “book” after annealing
6. Installing core laminations on coils

The following composite hi-lights the production of stacked cores used in core form construction.

1. Varied widths of silicon steel in queue for shearing
2. Core shear
3. Precision miter cut laminations
4. a – assembled “E” stacked core
   b- assembled “E” cruciform stacked core
5. Installed coil on core leg

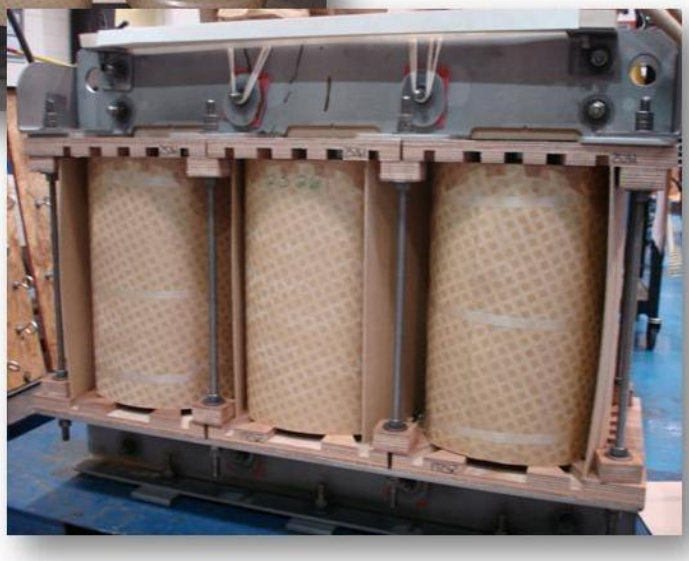
Winding types:



Core/Coil assemblies:

5 legged distributed gap core/coil

3 legged stacked core/coil



3 legged cruciform core/coil

Five legged distributed gap formed cores require rectangular coil construction. This type of core and coil construction is widely used for general distribution and smaller kVA applications. The outside core legs provide a return path for magnetic flux in wye-wye connected transformers.

Three legged stacked core construction also incorporates the use of rectangular wound coils. The return path for magnetic flux is not a problem provided that either the primary or secondary windings are delta connected. For wye-wye applications a delta connected tertiary winding can be provided to provide the return path.

Cruciform cores which are paired with either layer or disc wound coils, are constructed using a number of lamination widths that when assembled form core legs that are largely round.

Layer wound coils may be either barrel (round) or rectangular wound. The secondary windings are most often wound utilizing full coil width conductor. The layer dielectric insulation must be sufficient to manage the volts per turn as well as the mechanical stress of the relatively large conductor.

Layer wound primary windings are normally constructed with either round or rectangular conductor insulated with varnish or thermally upgraded kraft paper. The turns are wound with each turn, tight against the preceding, across the width of the coil. Upon reaching the end of the winding space, layer insulation is inserted after which the subsequent turns are added in the opposite direction. This process is continued until the total required turns are reached.

A critical requirement in the design of layer wound coils is to provide the proper primary dielectric layer insulation. It must be able to withstand two times the number of layer turns times the volts per turn. Cooling ducts are also wound between layers to allow for the flow of insulating fluid to dissipate resulting heat.

Disc wound coils are round and incorporate cruciform cores. They are primarily utilized with low voltages greater that 600 volt class. The primary difference between disc and layer wound barrel coils is that the high voltage winding is wound with rectangular conductor with each turn being wound directly over the preceding turn (radially) until the number of design turns per disc is reached. The process is continued adding additional series connected discs within the winding space until the total required turns are obtained.

The advantage of disc wound over layer wound is that each turn can be braced to prevent movement. Additionally, each turn is in direct contact with the insulating fluid which provides improved cooling characteristics. Efficient cooling of the winding conductors is crucial in ensuring against thermal aging of the insulation system. Excess heating leads to gassing in the insulating fluid. Dissolved gas accumulation leads to a breakdown in the dielectric properties of the fluid which in turn can result in premature transformer failure.

No matter which core and coil construction technique is employed, appropriate core/coil bracing must be included to provide adequate protection from electromechanical forces on windings due to inrush current and short- circuit occurrences.

Although all transformer designs must be designed to accommodate normal handling and installation stresses, several applications, such as mobile mining and petrochemical, require that the core/coil assembly as well as the tank itself be constructed with sufficient bracing to manage the day to day rigors of such harsh operation environments.

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Application Specific Design Capability

The ever evolving industrial marketplace has created an ever growing need for transformers that are designed to meet exacting load profiles. ANSI and NEMA standards provide a foundation for minimum design and testing requirements. These standards are not however all encompassing. In order to supply the BEST solution, today's transformer manufacturer must be able to employ a complete array of technologies. Construction of transformers on high volume production lines cannot meet this requirement.

Pacific Crest Transformer has been serving the industrial marketplace since 1919. All transformers are *custom* designed and built to meet exacting load requirements. Customer supplied specifications are used in conjunction with industry standards to select the BEST design solution per requirement. As stated in the beginning of this paper, there are several types of core and coil construction available within the transformer manufacturing community. ALL are available to PCT. The difference lies in the fact that PCT selects the RIGHT solution for each opportunity.

The manufacturing process is closely monitored by Quality Control from start to finish. Documented check points insure that the specific design parameters for each order are met. Permanent QC files are maintained for each order. The manufacturing process is certified by ISO 9001, ISO 14001, and OHSA 18001.