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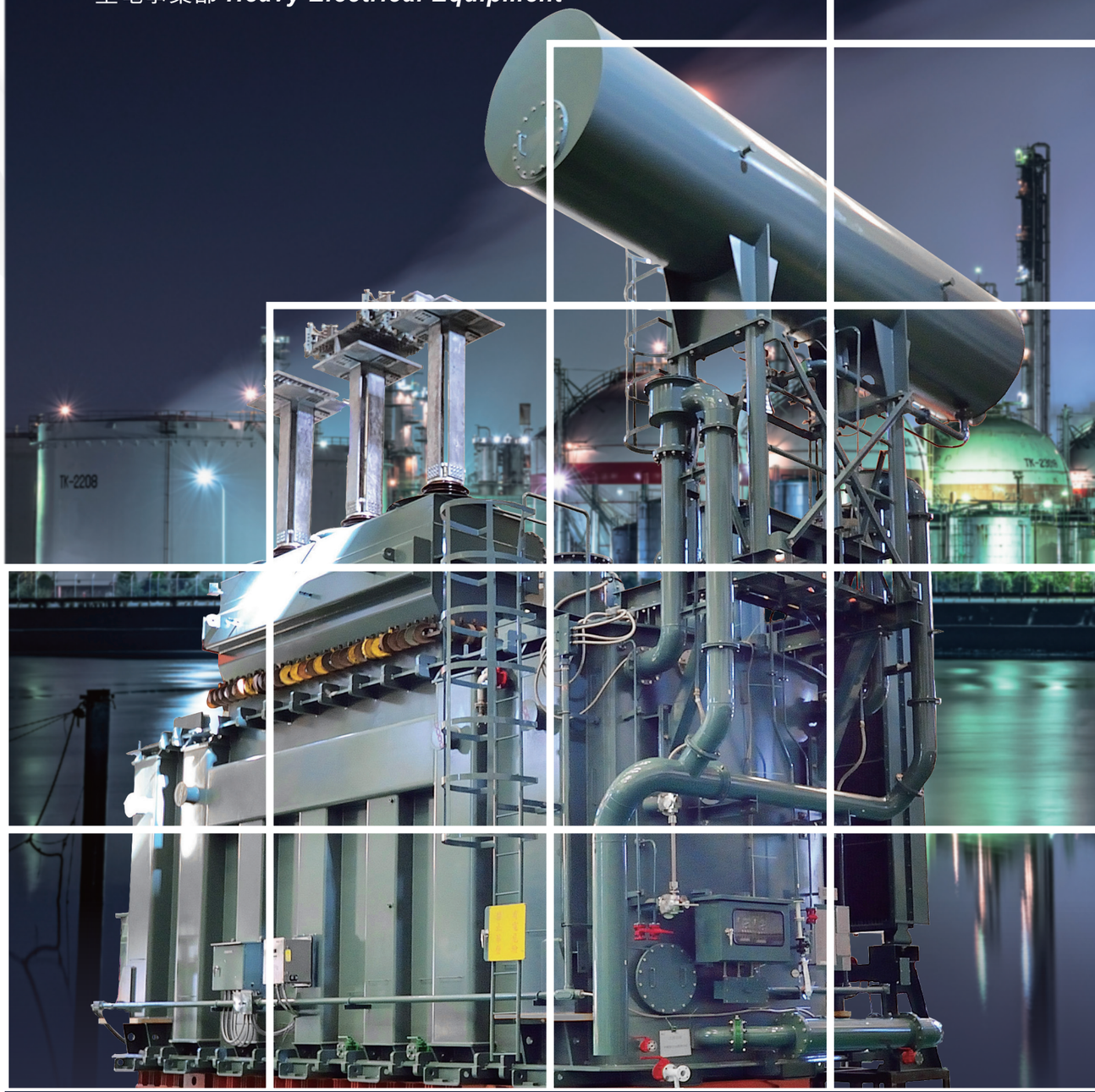
電子書

Web Code

2024-01

TATUNG

電力事業群 ***Power Business Group***
重電事業部 ***Heavy Electrical Equipment***



電力變壓器
Power Transformers



Professional Trustworthy Quality

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MIRDC ISO 9001 MIRDC ISO 14001 MIRDC ISO 14064-1 MIRDC ISO 45001

SGS ISO 50001 · TAF Testing Laboratory 2306 · KEMA Laboratories



發展沿革

Development and Innovation



1961
自日本東芝株式會社引進油浸電力變壓器技術
Introduced the technique of oil-immersed transformer from TOSHIBA in Japan.

1964
完成台電公司3 相69kV 級12.5MVA 電力變壓電器的開發
Succeeded in the development of the country first 3 § 69kV 12.5MVA power transformer for Taiwan Power Co..

1978
電力變壓器榮獲政府評定為甲級廠
Ident i f ied as plant of class A
by R.O.C. Government.

1981
完成台電公司3 相161kV 級200MVA
電力變壓器的開發
Succeeded in the development of 3 § 161kV 200MVA power transformer for Taiwan Power Co..

1984
完成台電公司345kV 級500MVA 單三型超高壓電力變壓器的開發
Succeeded in the development of the country first three single-phase with 6 tanks 345kV 500MVA ultra high voltage power transformer for Taiwan Power Co..

1961 | 1984

1989
完成台灣塑膠公司3 相161kV 級150MVA
三相一體型電力變壓器的開發
Succeeded in the development of 3 § 161kV 150MVA power transformer, three phases in one tank for Formosa Plastics Co..

1990
完成台電公司通霄電廠火力發電用3 相161kV 級170MVA 及新天輪電廠水力發電用3相161kV 級134MVA 電力變壓器的開發
Succeeded in the development of 3 § 161kV 170MVA power transformer for Taiwan Power TUNG-HSIAO thermal-power plant and 3 § 161kV 134MVA power transformer for Taiwan Power NEW TIEN-LUN hydropower plant.

1991
完成台電公司明潭電廠3 相345kV 級36.6MVA 起動用變壓器的開發
Succeeded in the development of 3 § 345kV 36.6MVA starting-transformer for Taiwan Power MING-TANG hydropower plant.

1992
完成台電公司明潭電廠水力發電用3 相345kV 級300MVA 電力變壓器的開發
Succeeded in the development of 3 § 345kV 300MVA power transformer for Taiwan Power MING-TANG hydropower plant.

1989 | 1992

1994
自日本北芝株式會社引進低噪音變壓器技術，自日本東芝株式會社引進SF_6 氣體絕緣變壓器技術
Introduced the technique of low noise level power transformer from KITASHIBA in Japan. Introduced the technique of SF_6 gas insulated power transformer from TOSHIBA in Japan.

1995
完成台電公司3 相69kV 級25MVA 50dB 低噪音電力變壓器的開發
Succeeded in the development of 3 § 69kV 25MVA 50dB low noise level power transformer for Taiwan Power Co..

1996
完成台電公司3 相69kV 級25MVA 氣體(SF_6) 絕緣電力變壓器的開發，完成台電公司興達電廠火力發電用3相 345kV級330MVA電力變壓器的開發，完成台灣塑膠公司3相345kV 級70MVA 電力變壓器的開發
Succeeded in the development of 3 § 69kV 25MVA SF_6 gas insulated power transformer for Taiwan Power Co.. Succeeded in the development of 3 § 345kV 330MVA power transformer for Taiwan Power HSIN-TA thermal-power plant. Succeeded in the development of 3 § 345kV 70MVA power transformer for Formosa Plastics Co..

1994 | 1996

1998
完成民營電廠長生電力發電用3 相166kV 級386MVA 及 242MVA 電力變壓器的開發
Succeeded in the development of 3 § 166kV 386MVA and 242MVA combined cycle generation transformer for EVER POWER IPP CO. LTD..

2000
完成台電公司3 相345kV 級500MVA 特三型超高壓電力變壓器的開發
Succeeded in the development of 3 § 345kV 500MVA ultra high voltage power transformer, three single-phase with three tanks , for Taiwan Power Co..

2003
完成台電公司3 相161kV 級60MVA 氣體(SF_6) 絕緣電力變壓器的開發
Succeeded in the development of 3 § 161kV 60MVA SF_6 gas insulated power transformer, for Taiwan Power Co..

2006
完成台電公司3 相345kV 級340MVA 三相一體型超高壓電力變壓器的開發
Succeeded in the development of 3 § 345kV 340MVA ultra high voltage power transformer, three phases in one tank, for Taiwan Power Co..

1998 | 2006

2010
完成三福氣體3 相161kV 級25MVA 植物油浸環保電力變壓器的開發
Succeeded in the development of 3 § 161kV 25MVA nature ester fluid-filled ECO transformer for Air Products San Fu Co..

2011
外銷3 相141kV 27/45MVA變壓器至澳洲
Exported 3 § 141kV 27/45MVA Transformers to CS-Energy in Australia

2013
完成台電公司3 相345kV級100MVAR 並聯電抗器的開發,完成3 相161kV 級60MVA(BIL 750kV)捷運松山線用SF_6氣體絕緣變壓器開發
Succeeded in the development of 3 § 345kV 100MVAR radial core shunt reactors for Taiwan Power Co.. Succeeded in the development of 3 § 161kV 60MVA SF_6 gas insulated power transformer for Songshan MRT Line..

2014
外銷3 相120kV 28/37/47MVA變壓器至加拿大(極地氣候-40℃)
Exported 3 § 120kV 28/37/47MVA Transformers to Canada(polar climate-40℃)

2010 | 2014

2017
完成台電公司3 相161kV級728MVA 三相一體特高壓電力變壓器的開發
Succeeded in the development of 3 § 161kV 728MVA extra high voltage power transformer, three phases in one tank, for Taiwan Power Co..

2018
外銷3 相132kV 125MVA變壓器至阿曼,完成KEMA短路試驗驗證
Exported 3 § 132kV 125MVA Transformers to Oman , Obtained KEMA short-circuit type test certificate.

2021
完成台電公司3 相345kV級505MVA 三相一體超高壓電力變壓器的開發
Succeeded in the development of 3 § 345kV 505MVA ultra high voltage power transformer,three phases in one tank, for Taiwan Power Co..

2023
完成台電公司3 相161kV級505MVA 三相一體特高壓電力變壓器的開發
Succeeded in the development of 3 § 161kV 505MVA extra high voltage power transformer,three phases in one tank, for Taiwan Power Co..

2017 | 2023

產品特色

Product Features



高度信賴性

大同電力變壓器的品質深受國、內外顧客的肯定，係根基於全方位的設計技術、純熟的製造技術及完整且嚴格的品質管制。

High reliability

The quality of TATUNG power transformers has won good reputation from domestic and abroad customers based on advanced design technique, skillful manufacturing technique, complete and strict quality control system.

特性優異的鐵心構造

採用V 型不切斷衝片(V-notch)、階疊型(step-lap) 的先進結構，確保大同電力變壓器具有低噪音、低鐵損、低激磁電流的優異特性。

Excellent core construction

Advanced V-notch and step-lap construction are adopted to obtain the best performances of the core, such as low sound level, low no-load loss and low exciting current.

具有耐突波能力的繞組

大同電力變壓器均經電位振動解析程式詳細計算，突波在繞組各部位的電位振動情形，再對繞組進行最適當的絕緣配置，以確保其耐突波能力。

Surge-proof winding

The windings of TATUNG power transformers are designed for surge proof. By utilizing the voltage oscillation analysis program, the voltage oscillation is calculated in the windings which a simulated surge is applied. An appropriate insulation arrangement is adopted for the windings according to the results of simulation to ensure its ability of surge-proof.

先進的乾燥設備

採用最佳的氣相乾燥設備，確保大同電力變壓器心體能快速、均勻地受熱，在不損傷絕緣物特性的情況下，達到充分的乾燥。

Advanced vapor-phase drying system

For heating the interior (core and winding assembly) rapidly and evenly, TATUNG utilizes the most advanced vapor-phase drying oven to make the insulation materials be dried thoroughly without sacrificing its performance.

高效率的冷卻方式

大同電力變壓器的繞組均採用導油構造，確保絕緣油能快速、均勻地流過繞組各部位，提高冷卻效果，降低最熱點溫度。

High-efficiency cooling method

The directed flow construction adopted in the windings ensures the insulating oil flowing through all parts of windings rapidly and evenly to improve cooling efficiency and reduce hottest-spot temperature.

多樣化的洩漏磁通對策

活用解析軟體計算變壓器各部分的洩漏磁通大小，再依情況需要採取適當的預防措施（外殼加裝遮磁矽鋼片等），避免造成局部過熱，以確保大同電力變壓器的壽命。

Variability of countermeasure for leakage flux

Avoiding the local overheating by leakage flux, some appropriate preventive means are adopted, for example, equipping a magnetic shield on the tank, according to the magnitude of leakage flux calculation by analysis software.



充分的耐短路機械強度

大同電力變壓器高、低壓繞組間的安匝分佈力求平衡，並使用解析軟體詳細計算短路時各部位的發生應力，對於使用材質的選定、繞組的前置處理及裝配特別加以注意，提供充分的耐短路機械強度。

Sufficient strength against short-circuit electromagnetic mechanical force

The ampere-turns distribution between primary and secondary windings is designed as balanced as possible according to the detailed short-circuit stress calculation by analysis software. Special attention is paid for the selection of materials and the pre-compressing process of the windings to provide sufficient strength of windings against the short-circuit electromagnetic mechanical force.



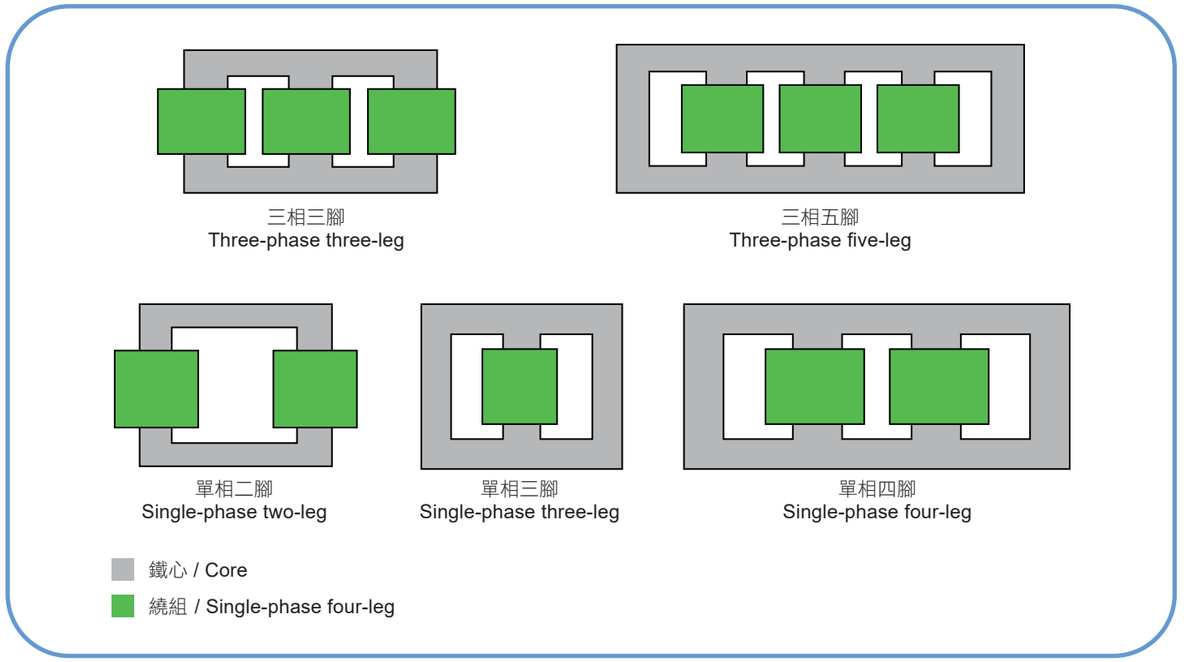
鐵心 Core

採用低噪音、低鐵損、低激磁電流的v型不切斷衝片、階疊型的先進結構

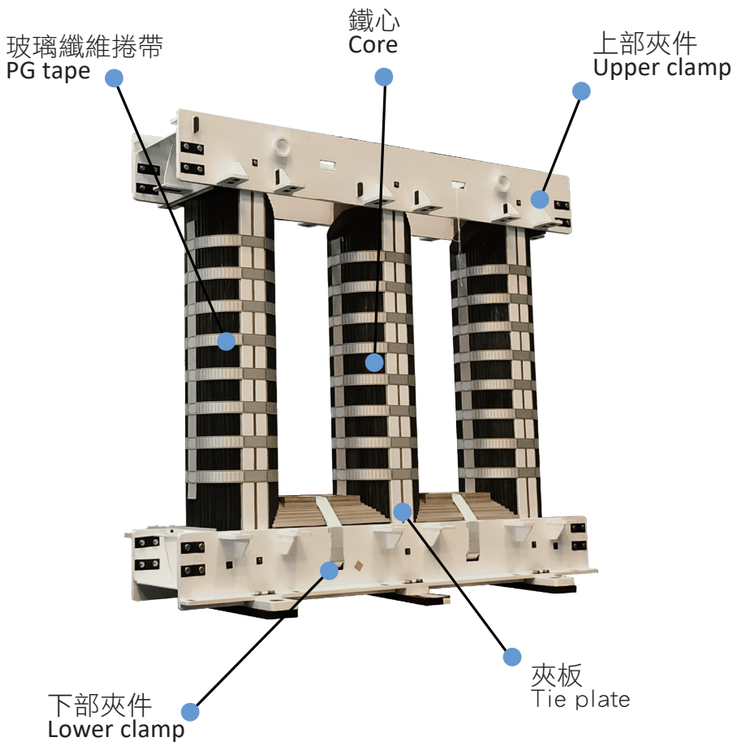
- 三相變壓器通常使用三腳鐵心，而大容量變壓器有時會因輸送高度的限制，必須採用五腳鐵心，另外，超大容量電力變壓器有時為了降低洩漏磁通帶來的不良影響及增加外殼的機械強度也會採用五腳鐵心的構造。
- 單相變壓器通常採用二腳鐵心，對於超高壓、超大容量電力變壓器因侷限於輸送方面的限制，有時會採用單相三腳或單相四腳鐵心，因該鐵心軛鐵斷面積約為主腳的50%，故鐵心的高度就可以大幅降低，比較容易符合輸送的高度限制。
- 鐵心材料是採品質優良、高導磁性的冷軋延方向性矽鋼片疊積而成，矽鋼片表面皆經過絕緣薄膜的處理，以增加層間電阻，減少層間渦流損，完成後之鐵心表面並塗以耐溫、耐候的環氧樹脂以防止生銹腐蝕。
- 變壓器鐵心的接合方式影響特性甚巨，不僅腳鐵與軛鐵的接合部以 45° 銜接來發揮方向性矽鋼片的特性，大同電力變壓器更採用低噪音、低鐵損、低激磁電流的V 型不切斷衝片(V–notch)、階疊型(step-lap) 的先進結構，並經謹慎裝配作業及牢固締緊，使鐵心具有足夠機械強度以支持繞組並防止輸送或運轉時鐵心發生鬆動。

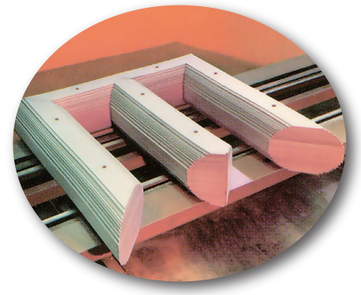
V-notch cut, step-lap laminated construction.

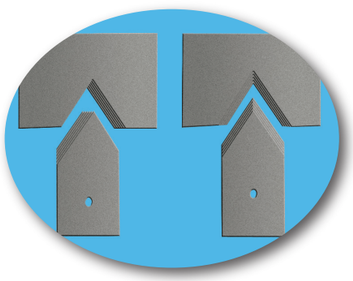
- Three-leg core construction is applied for most of the three-phase TATUNG transformers. However, on occasion three-phase five-leg construction is applied for large capacity rating of transformer to reduce the height for meeting the transportation height limit, and it is also applied for huge capacity ratings to reduce the negative influence of leakage flux and increase the mechanical strength of tank.
- Two-leg core construction is applied for most of the single-phase TATUNG transformers. For power transformers with extra-high voltage and gigantic capacity ratings, single-phase threeleg or four-leg core construction, in which the yoke cross-section is half of the limb, is applied to reduce the transformer height for meeting transportation height limit.
- TATUNG ut i l i zes the high-grade, high permeability, grain oriented, cold rolled silicon steel strips for core laminations. The insulation coat ing on the strips sur face increases resistances and reduces eddy losses between layers. The accomplished core is painted with a heatproof and weather-proof epoxy resin as a protection against rustiness
- The performances of the core depend extremely on its construction. In general, the mitre-joint construction is applied to take the best advantage of grain oriented silicon steel strips. More advanced construction called V-notch, step-lap is applied for TATUNG power transformers to obtain the best performances of the core, such as low noise level, low noload loss and low exciting current. The core is assembled and clamped properly to have sufficient mechanical strength to support the windings and prevent it from loose during transportation or operation.



鐵心示意圖 Figure of Core and clamping







V 型不切斷衝片、階疊型的先進結構
V-notch, step-lap construction

繞組 Windings

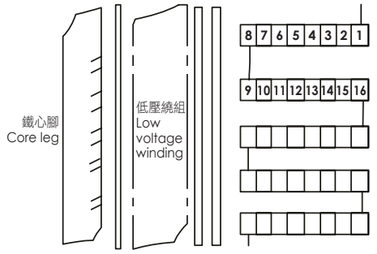
大同電力變壓器的繞組具有耐突波、冷卻效果佳、耐短路機械應力、低損失、壽命長的特點

- 繞組具有耐突波(surge-proof) 設計，大同電力變壓器繞組均經電位振動解析程式詳細計算，突波在繞組各部的電位振動情形，再對繞組進行最適當的絕緣配置，以確保其耐突波能力。
- 繞組內部採用導油構造，絕緣油均勻流經繞組各部位，可降低最熱點溫度，絕緣壽命長。
- 大容量變壓器的導線採用轉位電纜線，機械強度高、可大量降低渦流損失。
- 導線的絕緣被覆採用耐熱等級較高的絕緣紙，確保變壓器絕緣壽命。
- 為避免運轉中變壓器繞組的絕緣物因熱脹冷縮而引起鬆動，繞組在製造過程中，均經過充分的乾燥收縮處理，並加以締緊，再經過真空注油處理，以確保變壓器之品質。
- 連續圓板線圈
  在絕緣筒上放置軌條，軌條上放置溝形間隔片，然後，將導體連續地捲繞成多個圓板所組成的線圈，在捲繞的過程中，導體無須剪斷、焊接，是最常採用的線圈，高電壓的圓板線圈有時會在端部裝置匝間遮蔽導體，以增加線圈的串聯電容來改善繞組的電位分佈情形。
- 高串容線圈
  利用導體的交互捲繞方式，來提高相鄰導體間的電位差，增加線圈內的儲存電能 (相當於提高串聯電容)，可改善突波侵入線圈時的電位分佈情形，適用於69kV 級以上的高電壓繞組，以達到小型化設計的目的。
- 螺狀線圈
  將多條導線沿半徑方向同時重疊捲繞成螺旋狀的繞組，適用於大電流(數百安培以上)、低電壓的繞組。
- 圓筒線圈
  將導體直接捲繞在絕緣筒上，若有冷卻上的需要時，可在絕緣筒與繞組間裝置油道，增加冷卻效果，適用於安定繞組或分接頭繞組等較小容量的繞組。

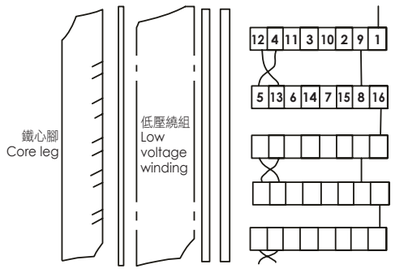
Windings with surge-proof, high cooling efficiency, sufficient short-circuit mechanical strength, low load-loss and long service life characteristics.

- The windings of TATUNG power transformers are designed for surge proof. Appropriate insulation arrangements are applied according to the detailed impulse voltage distribution simulations carried by voltage oscillation analysis program.
- The directed flow construction adopted in the windings provides the paths for insulating oil flowing through rapidly and evenly to increase cooling efficiency and reduce hottest-spot temperature.
- The continuously transposed cable (CTC) is applied for large capacity transformer windings to obtain high mechanical strength and reduce a large amount of eddy current losses.
- The conductors wrapped with thermal upgraded cellulose insulation paper is used to prolong the service life of the transformers.
- The windings are dried and compressed sufficiently in manufacturing process that can prevent it from the loose of insulation material caused by hot expansion and cold shrinkage during operation. Then, filling oil in vacuum condition is applied to ensure the quality of the transformers.
- Continuous disk winding
  Rails are put on an insulating cylinder and key spacers are put on the rails, and then conductors wound continuously in radial direction become a disk shape. The finished winding cons i s t s of a number of disks. Conductors in the process of winding need not cut off and weld. This type of winding is largely used for power transformers. When voltage is high, a turn shield strip sometimes is inserted into the several disks of the line end increasing the winding series capacitance to have better impulse voltage distribution.
- High series capacitance (HSC) disk winding
  In HSC disk winding, conductors are interleaved arrangement resulting in high potential difference between adjacent conductors. It increases the electrical potential storage energy in the winding, equivalent to increase voltage distribution. This type of winding is applied for the voltage level of 69kv and above for compact design.
- Helical winding
  Several flat conductors are wound to radial direction at the same time to form a helical winding. This type of the winding is suitable for heavier current(above hundreds of ampere) and lower voltage windings.
- Cylindrical winding
  The paralleled conductors are wound several turns on insulating tube directly to form a cylindrical winding layer. Oil duct strips, if necessary, are inserted between insulating tube and winding layer to improve the cooling efficiency. This type of winding is suitable for stabilization winding or tap winding.

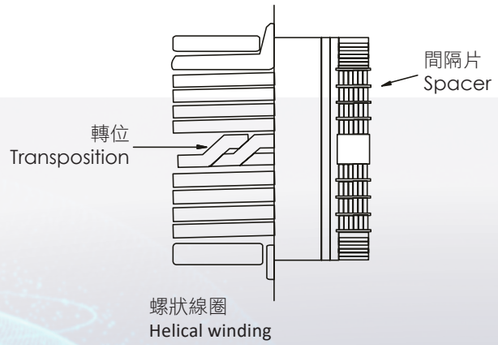
線圈種類示意圖 Figures of various windings

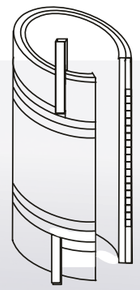


連續圓板線圈
Disk type continuous winding

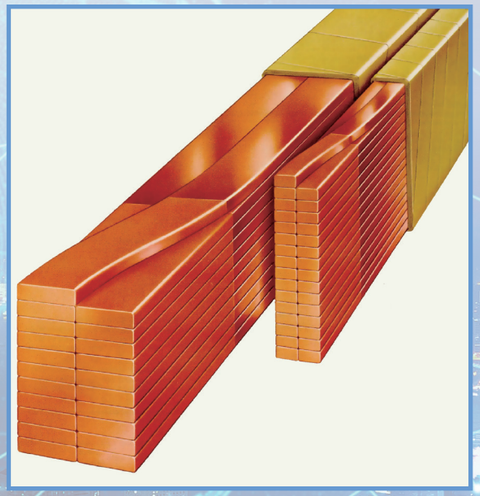


高串容線圈
High series capacitance winding

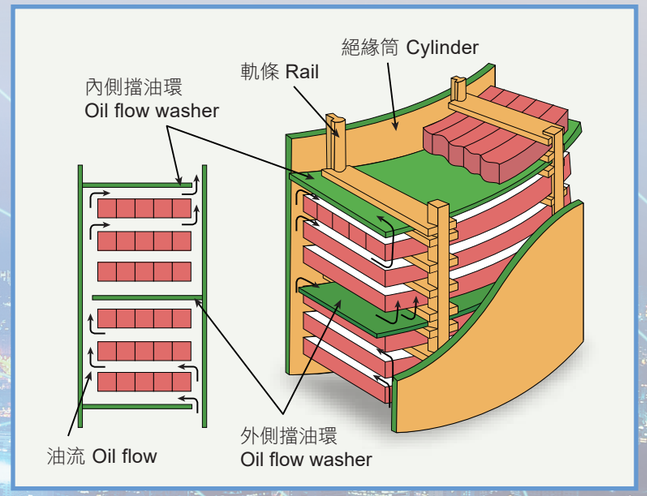




圓筒線圈
Cylindrical winding



低損失、高強度的轉位電纜線
Continuously transposed cable withlow eddy loss, high mechanic strength characteristics.



冷卻效果佳的導油構造
Directed flow construction with high cooling efficiency characteristic.

解析技術 Analysis Technologies

●電場解析

運轉中的變壓器需能承受正常運轉及異常時的各種電壓。一般的絕緣物在均等電場下，具有非常大的絕緣強度，但在不均等的電場下，因電場應力會局部集中，使絕緣物在很低的電壓下就會引起局部絕緣破壞。變壓器內的絕緣構造不可能配置成各部電場都完全均等，因此在絕緣設計上，最重要的是必須充分檢討電場分佈狀況，避免電場應力的局部集中。大同電力變壓器在設計時，利用有限元素分析軟體，對變壓器各處的電場強度進行解析，使該設計符合絕緣耐壓的要求

●繞組電位振動解析

當變壓器遭受急陡波頭的衝擊電壓(突波)侵入時，繞組內部受電容、電感的影響，對地、匝間、節間或繞組間等會受到局部性的極高電壓。在衝擊波入侵初期，由於電感的感抗甚大，電容的容抗很小，初期電流幾乎都以電容的充電電流入侵繞組。所以在衝擊波入侵初期，線路端部的電位梯度最大，必須加強繞組本身的絕緣，以承受局部集中的電位梯度；或增加串聯電容，降低分佈係數α，抑制內部電位震盪。大同電力變壓器在設計時均會以電位振動解析程式，模擬雷衝擊波在繞組內部造成的電位振動情形(如左下圖所示)，再依此計算結果(電壓大小、波形)，以決定繞組的捲繞方式及對繞組內部進行最適當的絕緣配置，以確保繞組絕緣。-

$$\alpha = \sqrt{\frac{C}{K}}$$

C：繞組對地總電容

K：繞組總串聯電容

●Electric field analysis

Transformers in service shall be capable of withstanding normal operating voltage and extraordinary over voltage. Generally, the insulation materials have very high insulating strength under an uniform electric field. On the contrary in non-uniform electric field, under relative low voltage a local insulation breakdown may be occurred at the point where the potential gradient is too high. Since it is difficult to achieve an uniform electric field for the design of transformer's internal insulation structure, therefore the most important thing is to check the distribution of electric field to avoid the stress concentration.
The finite element analysis software is applied to simulate the electric stress distribution in the transformer for meeting the dielectric requirement.

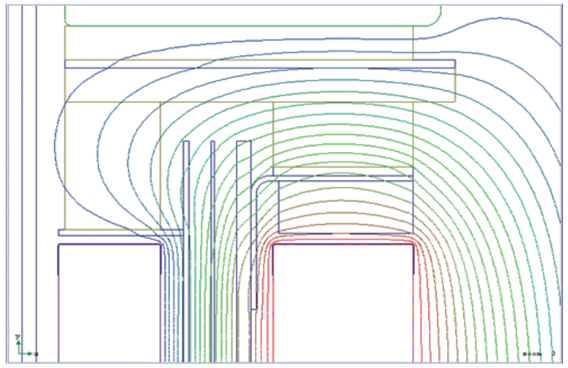
●Voltage oscillation analysis

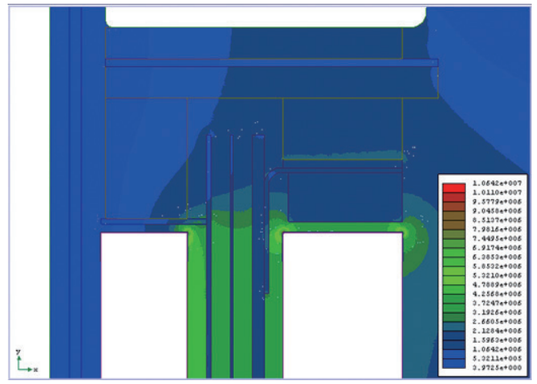
When the transformer is invaded by an impulse voltage, the insulation of winding to ground, turn to turn and section to section of winding, or winding to winding will be influenced by a fair high local voltage because of the existent inductance and capacitance. Since the inductive reactance is far greater than the capacitive reactance during the initial state of the impulse invasion, the initial current almost flows through the winding in the way of capacitive charge resulting in a high voltage gradient occurred at the end of the winding. Thereby, the insulation of winding shall be strengthened to sustain the local voltage gradient concentration or the series capacitance of winding shall be increased to minimize the distribution constant α and depress the internal voltage oscillation. The voltage oscillation analysis program is applied to calculate the voltage oscillation of winding with an impulse voltage simulated, then an appropriate type of winding and arrangement of insulation are adopted according to the results of calculation to ensure the insulation strength of winding.

$$\alpha = \sqrt{\frac{C}{K}}$$

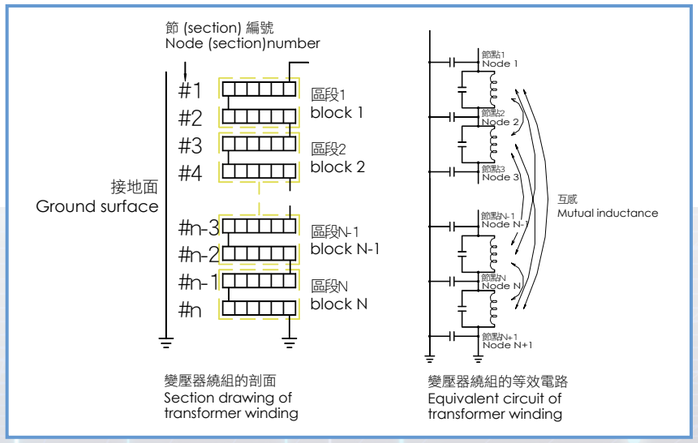
C： total capacitance between winding and ground
K： total series capacitance of winding
a：distribution constant

電場解析 Electric field analysis

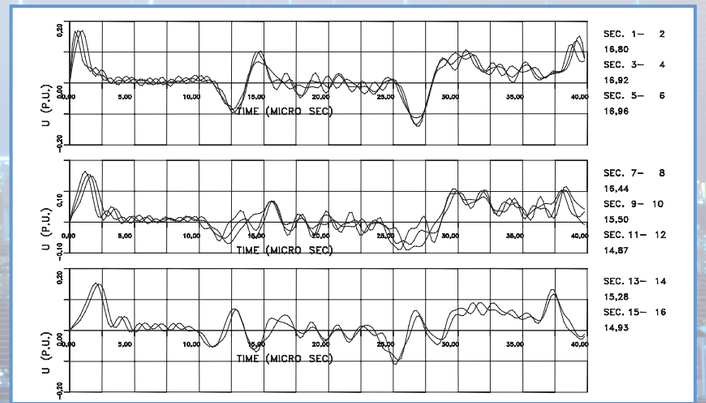




繞組電位振動解析 Voltage oscillation analysis



繞組電位振動波形 Voltage oscillation of the winding



解析技術 Analysis Technologies

●磁場解析

變壓器的漏磁自繞組趨向高導磁率的鐵心或外殼流通，然後再歸回繞組。漏磁通路中有磁性物質時，磁通會在該部分集中，如有金屬等高導磁物件，則該金屬物與漏磁交鏈的關係，金屬物內將產生渦流而發生渦流損，會造成局部過熱現象。大同電力變壓器利用有限元素分析軟 體，進行磁場解析，可以正確的計算出變壓器內的金屬物(鐵心夾板、夾件、上蓋、底板、外殼) 處的漏磁通密度，以判定是否會有局部過熱的現象發生，再採取必要的防範措施 (如：外殼加裝遮磁矽鋼片及鐵心夾板割槽等)，以避免因局部過熱加速周圍絕緣物的劣化，確保變壓器的壽命。

●耐短路機械力設計

變壓器外部發生短路故障時，由於電磁交互作用，高低壓繞組間產生不同方向的電磁機械力，此力常會導致變壓器繞組變形，甚至絕緣破壞，隨著變壓器的容量逐漸增大，所產生的電磁機械力更為嚴重，因此必須詳細分析電磁機械力的分佈狀況，以決定適當的材質及結構，確保變壓器具有充分的耐短路機械強度。大同電力變壓器的設計工程師依據電磁理論，開發出一套計算變壓器內部電磁機械力的計算程式，詳細、正確地解析各部位的機械力，避免因外部的短路故障造成變壓器的損壞。

●Magnetic field analysis

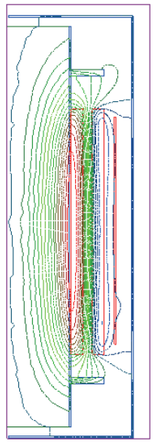
The leakage flux in transformer flows from the winding through the core or tank with high permeability, apt to invite leakage flux concentration, and traces back. The high permeability metal in the return path with linkage associated with leakage flux shall result in local overheating because of eddy loss occurred within the metal. Finite element analysis software is applied to simulate the leakage flux density of metal parts of the transformer such as, core clamp, tie plate, tank cover, base plate and tank. If there is a local overheating occurred, it needs to take a preventive means, for example providing shield made of silicon steel strips on the inner walls of tank and slitting in tie plate, to avoid shortening service life of transformer due to deterioration of adjacent insulation.

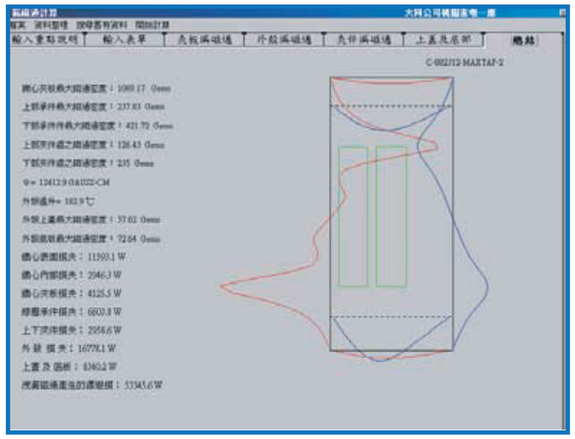
●Short-circuit electromagnetic force

analysis A huge opposite electromagnetic force caused by electromagnetic interaction between primary and secondary of windings will be ccurred during external short-circuit. The force will result in the distortion of the windings even breakdown of the insulation. Because of the increasing capacity of transformers, the short-circuit electromagnetic force becomes stronger.

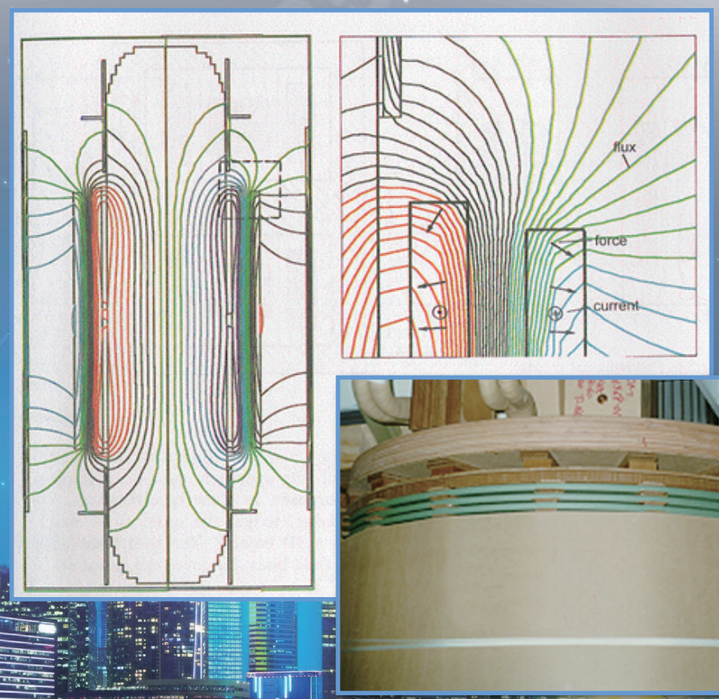
Therefore, appropriate materials and structure of windings shall be applied by analyzing the electromagnetic forces to have sufficient mechanical strength withstanding the forces. Utilizing electromagnetic force analysis software developed by TATUNG design engineers, the electromagnetic force distribution of windings can accurately and detailedly be calculated. Some proper countermeasures will be taken to prevent transformer from damage due to external short circuit failure.

磁場解析 Magnetic field analysis





耐短路機械力設計 Short-circuit electromagnetic force analysis



保護裝置 Protect Devices ▶ ▶ ▶ ▶

●油劣化防止裝置

大同電力變壓器採用無壓密封型(OH-D) 油劣化防止裝置，該裝置有一圓形儲油槽裝置在變壓器外殼上方，而槽內則有一尼龍補強之合成橡膠質空氣袋，可隔離變壓器絕緣油與外部大氣接觸，避免絕緣油因吸收空氣中的氧及水份而降低絕緣耐壓。變壓器內之絕緣油體積常隨溫度之變化而改變，促使空氣袋膨脹或收縮，空氣袋之進出口與吸濕呼吸器相互連接，防止水氣凝結袋內，空氣內壓力常保一大氣壓，可確保空氣袋長年運轉之品質，且保養簡單。

●撲氣電驛

撲氣電驛是一種保護油浸變壓器的電驛。當變壓器故障而有氣體聚集或油流(氣流) 急速通過本電驛時，動作接點即行接通反應，而達到保護變壓器之目的。

●放壓裝置

變壓器內部因故障或某種原因促使絕緣油或氣體產生高壓力時，可藉放壓裝置洩放減壓，減免意外危險。本自動復歸型放壓裝置構造堅固、動作確實並具有自動復歸之功效，其保養檢查簡單，為理想之變壓器保護設備。

● Oil preservation system

TATUNG employs an air sealed without pressure type in the oil preservation system (OH-D). The system has a circular conservator, mounted on the transformer's tank, with an air cell made of nylon-enhanced synthetic rubber inside isolating the insulation oil from atmosphere completely. The volume of insulation oil changes due to its temperature variation making the air cell expand or shrink. The air cell is connected to the dehydrating breather to avoid the insulating oil from absorbing oxygen and humidity that will reduce the oil dielectric strength. The air cell constantly retains an atmospheric pressure to ensure its quality for long term service and be maintained easily.

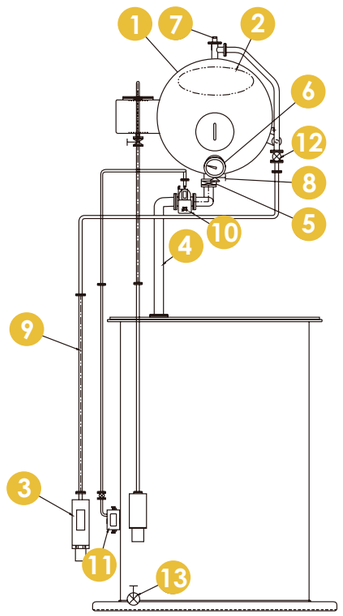
● Buchholz relay

Buchholz relay is used to protect oil immersed electric apparatuses, such as transformer, from being damaged. When fault occurred inside of the apparatus will generate and accumulate gases into the relay or make oil (or gases) rapidly flow through the relay to initiate an alarm or trip, so the apparatus is protected.

● Pressure relief device

The pressure relief device protects encased electrical apparatus, such as a transformer, from excessive insulating oil or gas pressure that may be developed due to an internal fault. The features of pressure relief device are self resealing, easy check and maintenance, faster response and narrower range in operating pressure.

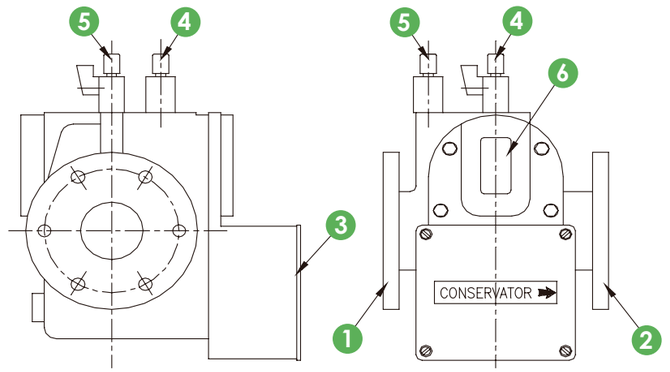
油劣化防止裝置 Oil preservation system



01.儲油槽
02.空氣袋
03.吸濕呼吸器
04.連接管
05.連接管用閥
06.油面計，附警報開關
07.儲油槽放氣栓
08.灌油放油閥
09.吸濕呼吸器連接管
10.撲氣電驛
11.氣體檢出裝置
12.閥
13.閥

01.Conservator tank
02.Air cell
03.Dehydrating breather
04.Connected tube
05.Valve of connected tube
06.Oil level gauge(with alarm switch)
07.Air relief plug
08.Oil drain valve
09.Connected tube of dehydrating breather
10.Buchholz relay
11.Gas sampling device
12.Valve
13.Valve

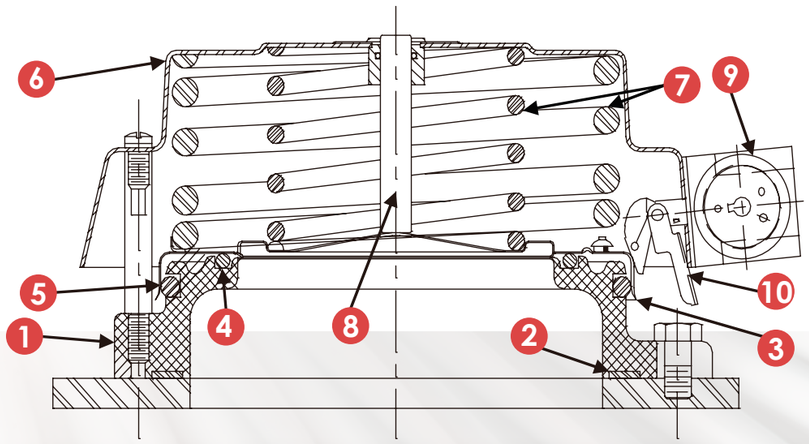
撲氣電驛 Buchholz relay



01.為油進去之凸緣
02.為油出去之凸緣
03.為配線用接線盒
04.為放出電驛內氣體之放氣栓
05.檢測栓
06.檢視窗

01.The flange for oil inlet
02.The flange for oil outlet
03.The box for wire connection
04.Air drain valve
05.Sampling cock
06.Visual check window

放壓裝置 Pressure relief device



01.主體
02.襯墊
03.閥體
04.襯墊環
05.襯墊環
06.上蓋
07.彈簧裝置
08.指示
09.警報開關
10.復原桿

01.Flange
02.Gasket
03.Valve disc
04.Gasket ring
05.Gasket ring
06.Cover
07.Spring
08.Indicator rod
09.Alarm switch
10.Reset lever

保護裝置 Protect Devices ▶ ▶ ▶ ▶

●針盤油溫度計

針盤油溫度計專供變壓器絕緣油之最高溫度測定用，溫度計附有最高溫度指示針，用以指示過去某一週期內之最高溫度，以及控制冷卻設備或促使發出警報用之可調整開關。定期的查閱紀錄，將有助於判斷不利於變壓器之異常情況，但切勿將其視為允許負載之指示。 (亦可依據客戶需要，提供繞組溫度計)

●針盤油面計

針盤油面計係裝於變壓器之儲油槽上，並將其內部油面之高低以百分率指示於刻度盤上。由於裝設位置之不同，可分為無壓密封(OH-D) 油劣化防止裝置型(第1 圖) 與標準型 (第2 圖)。其能將機器之內外側由隔離板完全隔絕，無漏油或因受日光照射而產生油劣化之虞。油面高低之指示，利用浮體隨油面之變化而升降之原理，將其動作由磁鐵隔著隔離板吸動指針而在刻度盤表示出來。

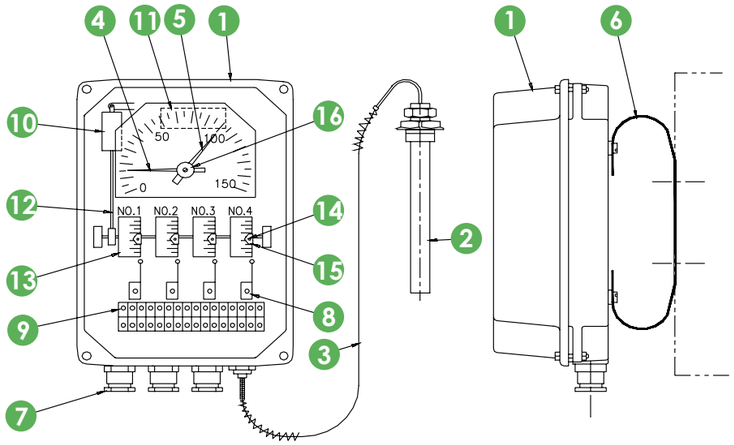
●Dial Type Thermometer (oil)

The dial thermometer measures the maximum temperature of the transformer oil. It is equipped with a maximum indicating pointer and adjustable switches to control the cooling equipment or to give a remote warning. Checking the records periodically will assist the user to estimate the condition of the transformer but not regard it as an index of transformer loading.(We also can offer a dial thermometer for winding temperature surveillance if customer requests.)

●Dial Type Oil Level Gauge

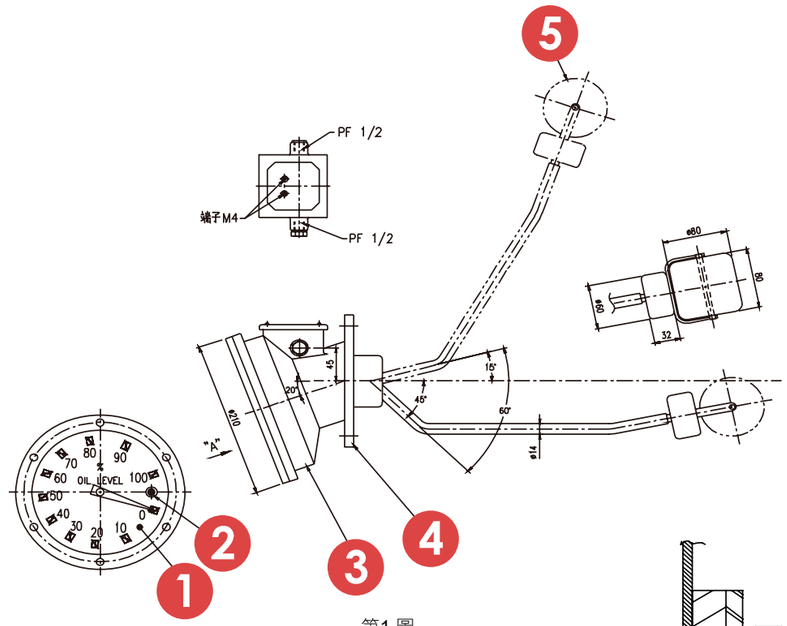
The dial oil level gauge is installed on the conservator. The height of oil level is indicated by the percentage scale. Because of the different install location, there are two types of dial oil level gauge used. One is air sealed without pressure type in the oil preservation system (figure 1) and another is the standard type (figure 2). The inside and outside of conservator can be completely isolated by a separate board of oil level gauge without being concerned of oil leakage or oil deterioration by sunshine. The principle of indicating the oil level is that the buoy floating up or down follows the oil change and drives the pointer by a isolated magnet.

針盤油溫度計 Dial Type Thermometer (oil)



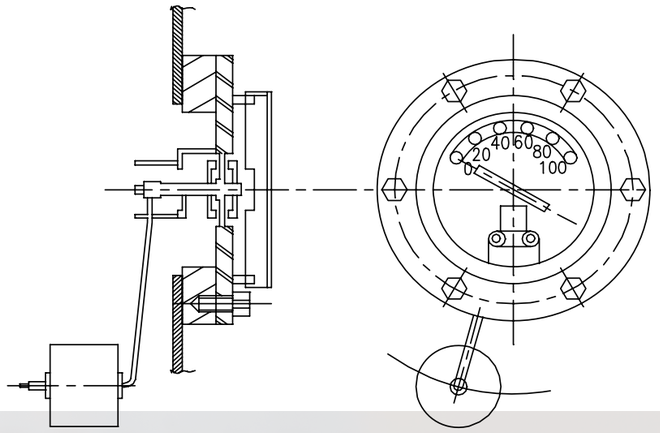
01.外殼	09.接線板	01.Casing	09.Terminal block
02.感溫部	10.測量伸縮囊	02.Sensing bulb	10.Measuring bellows
03.毛細管	11.補償伸縮囊	03.Capillary tubing	11.Compensating bellows
04.溫度指針	12.連桿	04.Indicating pointer	12.Linkage
05.最高溫度指針	13.刻度鼓輪	05.Maximum indicating pointer	13.Calibrated drum
06.防震件	14.鎖錠螺絲	06.Anti-vibration mountings	14.Locking screw
07.電纜封函蓋	15.紅色指針	07.Cable glands	15.Red pointer
08.微動開關	16齒輪軸	08.Micro switches	16.Gear wheel shaft

針盤油面計 Dial Type oil Level Gauge



01.刻度板
02.吸濕劑
03.主體
04.凸緣座
05.浮筒

第1 圖
figure 1



01.Calibrated dial
02.Silica gel
03.Flange
04.Base of Flange
05.Buoy

第 2 圖
figure 2



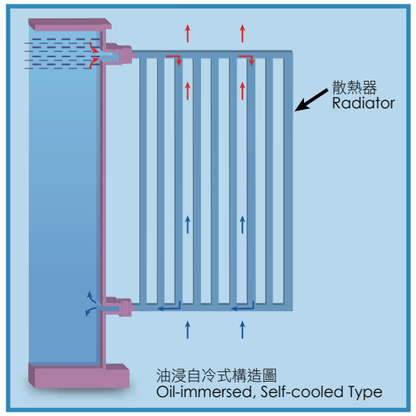
冷卻方式 Cooling System

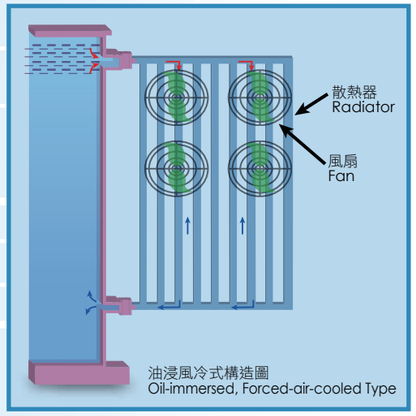
● 油浸自冷式構造圖

散熱器直接安裝在變壓器外殼的周圍，利用油自然對流、輻射和空氣對流的方式來散熱，採用自冷式的限制，其容量大約在數萬kVA 以內，且外形尺寸較大，但保養較簡單。

Oil-immersed, Self-cooled Type

Panel type radiators are mounted on the tank wall without cooling fan and oil pump. The heat is dissipated by oil and air convection and air radiation. The self-cooled type limits the transformer capacity about several MVA. It needs lager floor space but easy for maintenance.





● 油浸風冷式構造圖

在油浸自冷式散熱器的側面裝置風扇，利用風扇的運轉，將冷空氣帶入，熱空氣帶出，增加冷卻效果，風冷運轉時約可增加自冷時輸出容量的20%~40%。當輕載時採用自冷式運轉，重載時風扇才啟動，適合負載變動大的變壓器，或油浸自冷式變壓器考慮增加容量時使用。

● Oil immersed, Forced-air-cooled Type

Cooling fans are installed on panel radiators to increase cooling efficiency, When fans are working, the transformer will increase 20%~40% of capacity compared to the self-cooled type. It is designed for self-cooled in light loading and forced-air cooled in heavy loading. This type is suitable for large load fluctuation of transformer or for consideration of increasing the capacity of self-cooled type transformer.

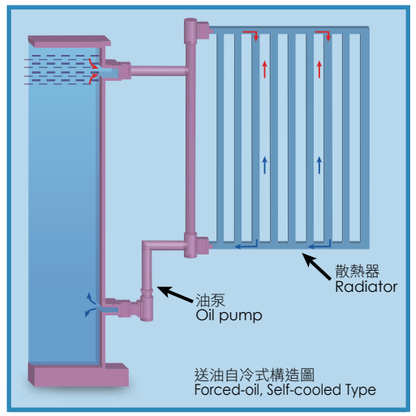
● 送油自冷式構造圖

特別是對大型變壓器的噪音有要求時，採用防音外殼的構造或是散熱器採用別置式的方式時，才採用送油自冷式。適合變壓器在屋內，散熱器在屋外的場合，無法採用油自然循環的方式，利用油泵來強制讓油循環，達到冷卻的效果。

● Forced-oil, Self-cooled Type

For larger capacity of transformer, a noise-proof enclosure or a group of separated radiators is adopted to comply with low sound level requirement. In this case,with the transformer located indoors and the radiators locatedoutdoors, the oil is difficult to circulate naturally by itself, therefore the forced-oil with self cooled type is applied.

Oil pumps are used to force the oil to circulate to obtain the cooling efficiency.

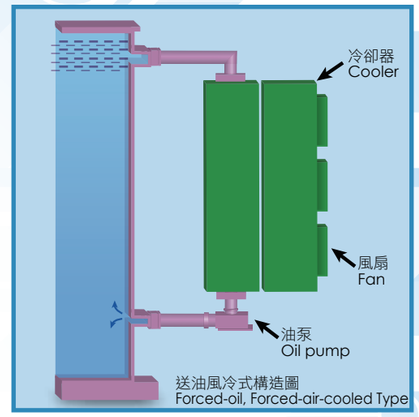


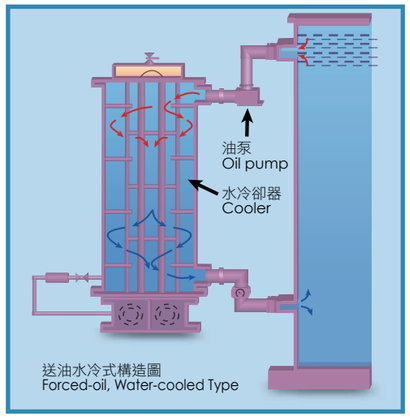
● 送油風冷式構造圖

送油風冷式最常使用在大型變壓器上，利用油泵強制讓油循環，其方式乃採用冷卻管、風扇、油泵、油流指示器一體的方式來散熱。佔地面積較同容量採用散熱器方式者小。

● Forced-oil, Forced-air-cooled Type

This type consisting of unit coolers arranged around the tank is mostly adopted for large transformer. The unit cooler is composed of a cooling tubes, fans, an oil-submerged pump and an oil flow indicator. The installation space of this type is much smaller than the panel type radiators for the same capacity.





● 送油水冷式構造圖

送油水冷式其特點為效率佳、小型輕量，適合設置在冷卻水取得容易、設置場所狹小的屋內。變壓器的內部冷卻構造和送油風冷式相同；地下變電所和水力發電廠等經常使用本方式。

● Forced-oil, Water-cooled Type

This type, with the characteristics of high efficiency and compact size, is suitable for installation of indoor site where a large amount of cooling air is unavailable and the cooling water is available. The internal construction of this type is the same with the forced-oil forced-air type. This type is usually installed in an underground substation or hydropower plant.



散熱器外觀圖
The Radiator



冷卻器外觀圖
The Cooler

外部接續方式 Bushing Connections

大同電力變壓器可提供油對空氣、油對油、油對SF_6、氣中導口等的各種接續方式，依照顧客的實際需要來設計，滿足顧客的需求。

●油－空氣

採用油對空氣的套管直接連接，經由套管接至架空線，是最經濟最簡單的接續方式，一般採用此型的變壓器是安裝在屋外。

●油－油

藉著電力電纜來連接的都市變電所與有鹽害問題的火力發電廠，電力變壓器的電力電纜是採用在油中直接連接的構造，採用油對油的形式時，變壓器外殼配置電纜接續箱，接續箱內再安裝油對油的套管，線圈接頭和電纜頭的接續是採用間接接續的方式。

●油－ SF_6

考慮用地取得的困難和環境調和等問題，變電所的小型化有逐漸增加的趨勢，可採用油對SF_6 的接續方式。變壓器的外殼配置連接SF_6 氣體導線的接續箱，接續箱中安裝油對SF_6 的套管，線圈接頭和導線的接續是採用間接接續的方式。

●氣中導口

變壓器安裝在屋內，可採用氣中導口直接接續的方式，電纜線經由上部或下部的線槽，再連接到屋外的架空線。導口引出的方式可依照顧客的需求來設計。

In order to meet customer's needs, TATUNG provides several methods of bushing connections, such as oil-to-air, oil-to-oil, oil-to-SF_6 and air duct, to satisfy customer's requirements.

● **Oil to Air**

The transmission line is connected to transformer terminal with direct-coupled oil-to-air bushing. This type is the most economical and simple one. The transformer with this type is usually installed outdoors.

● **Oil to Oil**

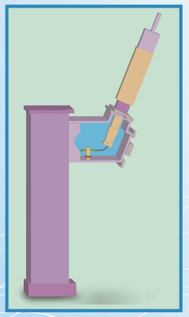
In urban substations , transformers are connected to salt-polluted thermal power plant with power cable and cable direct-coupled construction. TATUNG employs an oil indirect connection system with a cable connecting chamber mounted on the transformer tank. Transformer terminal is connected to the cable head through an oil-to-oil bushing in cable connection chamber.

● **Oil to SF_6**

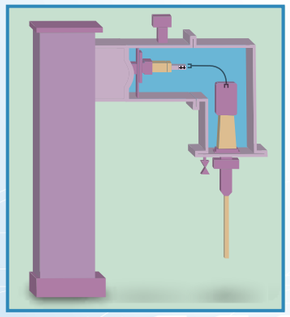
There is an increasing demand of gas insulated equipment in substations from the standpoint of site-acquisition difficulties and environmental harmony. In keeping with this tendency, gas insulated connection type of transformer is even increasing in the applications. The SF_6 gas insulated bus is connected with the transformer terminal through an oil-to-gas bushing in this case.

● **Air Duct**

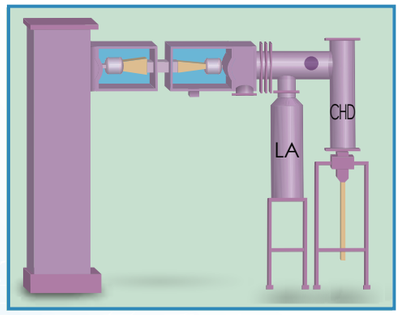
The air duct type can be used when the transformer is installed indoors. Cable is connected upward or downward to outdoor transmission line from the bus of transformer bushing. The outlet of air duct is designed according to customer's requirements.



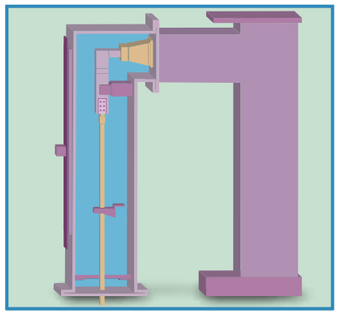
油－空氣 / Oil to Air



油－油 / Oil to Oil



油－ SF_6 Oil to SF_6



氣中導口 Air Duct

外部接續方式 Bushing Connections

套管的構造一般可分為單一型套管、油浸電容型套管與樹脂電容型套管三種。依照套管的種類又可分為油對空氣型、油對油型與油對SF_6 型套管。

● **單一型**

單一型套管其流通電流的中心導體裝設於中空的瓷質礙管內，其構造簡單、價格較便宜，通常使用於系統電壓30kV以下。

● **油浸電容型**

電容型套管係於中心導體周圍以絕緣紙與金屬鋁箔交互捲製後，再將礙管裝設於其外周，並填充絕緣油而成。

● **樹脂電容型**

樹脂電容型係將油浸電容型套管的油浸絕緣紙，以浸漬合成樹脂的絕緣紙取代，在捲製過程中加熱硬化而成。

The bushings by i t s cons t ruct ion are sorted into solid type bushing, oil impregnated bushing and resin impregnated paper bushing.
The bushings by application are sorted into oil-to-air, oil-to-oil and oil-to-SF_6.

● **Solid Type Bushing**

This type of bushing is used when the high current is applied. The current is carried by a solid rod pulled through the center of porcelain. It is cheaper with simple construction and used in system voltage under 30kV.

● **Oil Impregnated Bushing**

The main electrical insulation is given by a condenser body, which is wound with a continuous aluminum sheet and pure Kraft paper on the central conductor, filled with insulating oil.

● **Resin Impregnated Paper Bushing**

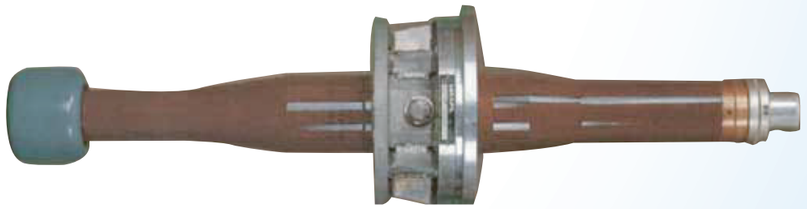
The insulation core is wound with high quality crepe paper and aluminum sheet, and then shall be dried and thoroughly resin impregnated under vacuum. A subsequent curing process is applied to obtain a compact, solid body.



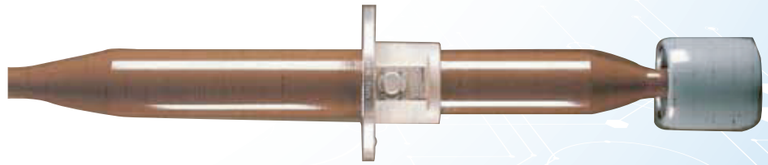
油- 空氣套管(低壓)
Oil-to-Air type(Low Voltage)



油- 空氣套管(高壓)
Oil-to-Air type(High Voltage)



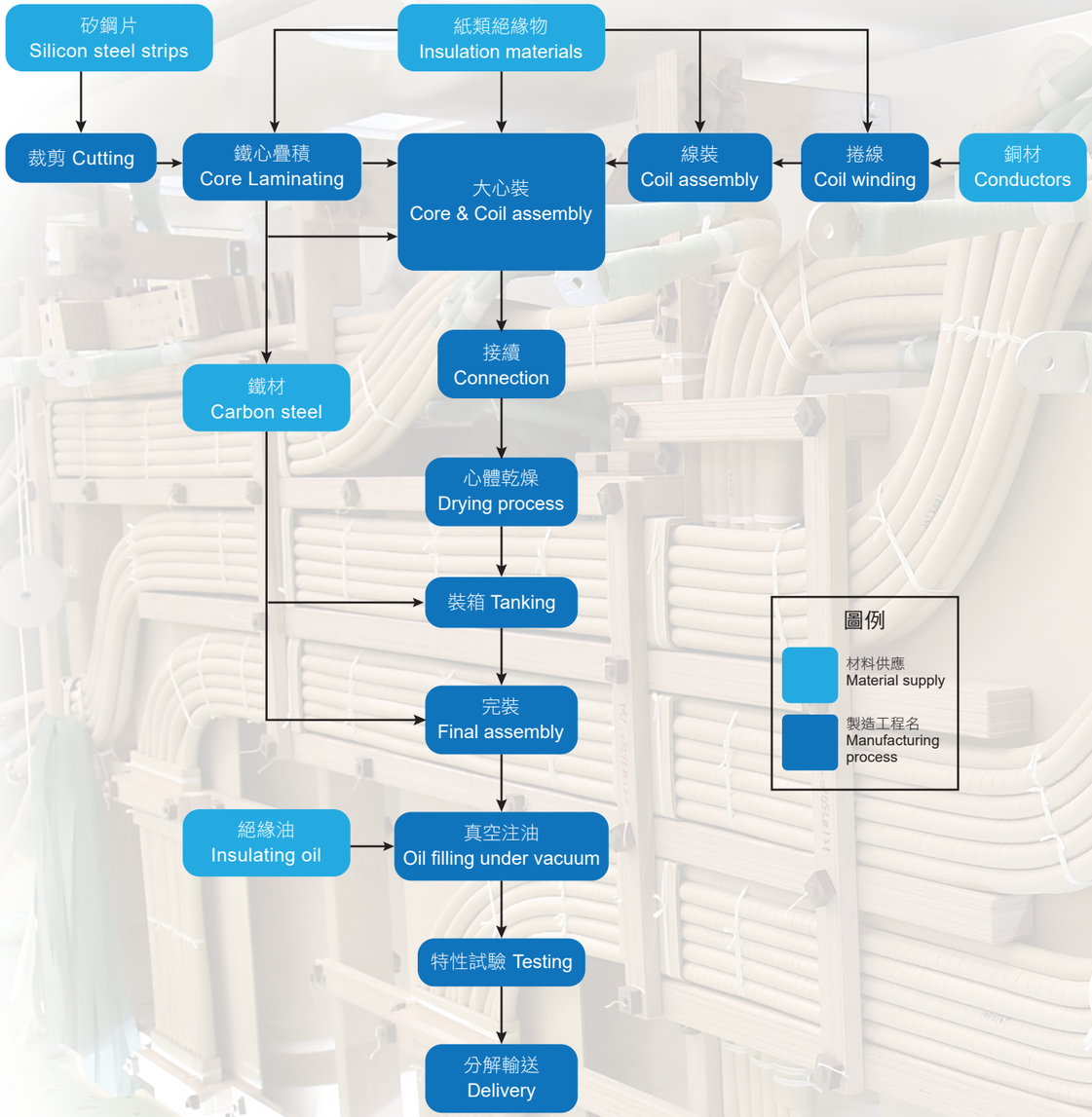
油-SF_6 套管
Oil-to-SF_6 type



油- 油套管
Oil-to-Oil type

製程管理 Manufacturing Process Control

- 大同電力變壓器從材料選用、鐵心疊積、線圈捲繞、心體裝配、接續、乾燥、裝箱、真空注油至完成試驗的每一個製程，均經嚴格的品質管制
- Strict quality control applies to all manufacturing processes of TATUNG power transformers from the selection of materials, core laminating, coil winding, core and coil assembly, connections, drying process, tanking, oil filling to final testing.





確實的防塵管理

大同電力變壓器的心體(繞組、鐵心) 裝配均在落塵量及溼度嚴格管制下的防塵室內進行，防止雜質侵入變壓器，產生局部放電，甚至造成絕緣破壞。

The interior (core & coil assembly) of TATUNG power transformers is performed in a dust proof clean room under strict humidity and dust control to avoid partial discharge or even damage to the insulation due to the foreign objects entering into the windings.



橫式繞線機 Horizontal Type Winding Machine

可承載5噸之繞線設備，最大承製外徑可達2M

The maximum load is 5 tons and the maximum external diameter can reach to 2M.

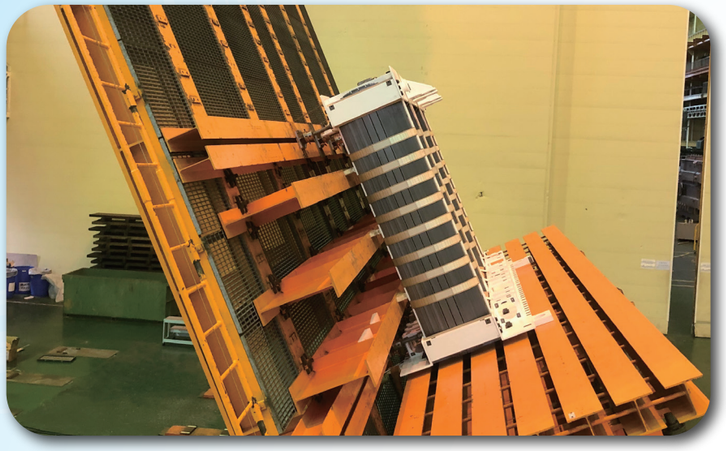


直立式繞線 Vertical Type Winding Machine

可承載10噸之繞線設備，最大承製外徑可達2M

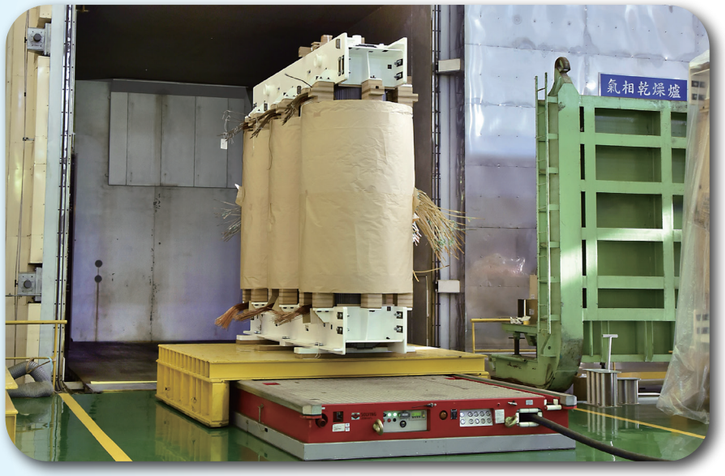
The maximum load is 10 tons and the maximum external diameter can reach to 2M.

製程管理 Manufacturing Process Control





鐵心起立架 Core Erection Facility
設備可承載260噸的鐵心翻轉起立 The maximum weight of the core up to 260 tons can be erected.



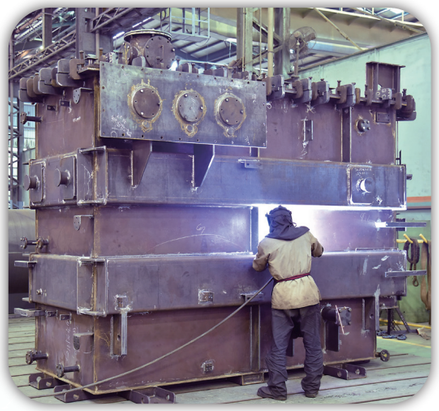


氣相乾燥爐&氣墊搬運車
The vapor-phase drying oven & Air Cushion Transporter
乾燥爐規格(長*寬*高): 11M*5M*5.3M & 搬運車使變壓器移動作業迅速及平穩可承重250噸
Dimensions(L*W*H): 11M*5M*5.3M & The air cushion transporter with maximum load at 250 tons can move the transformer rapidly and smoothly.

鐵心疊積 Core Lamination Facility



CNC電離子切割機 CNC Plasma Cutting Machine



擁有自行設計及外箱製造能力
Tatung can design and manufacture the transformer by ourselves.



具備分解運輸及現場組裝技術，提供高電壓大容量變壓器之運輸需求
The disassembly and site installation of transformers with high voltage and large capacity will be adopted according to transportation requirements.





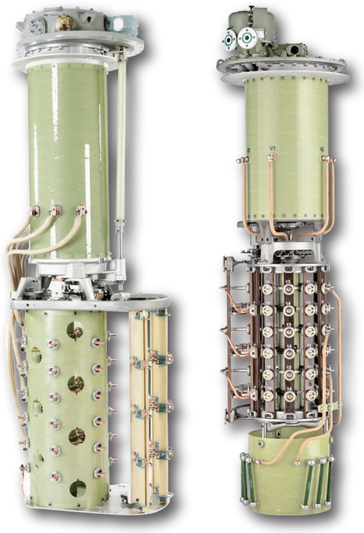
蓄熱式焚化爐空氣污染防制設備 Regenerative Thermal Oxidizer & 塗裝室 Painting Room
採用環保署認可之全密閉集氣方式回收氣體及新鮮空氣換氣率，符合固定汙染源空氣汙染物排放標準及勞工相關安全規範。
The gas recovery and fresh air exchange rate are adopted in a fully enclosed gas collection method approved by the Environmental Protection Agency, which complies with the emission standards of air pollutants from fixed pollution sources and relevant labor safety regulations.

電壓切換方式 Tap Changers

●有載分接頭切換器

在負載狀態下切換變壓器分接頭的切換器。本切換器使用電阻式切換方式，依變壓器規格、分接頭數目、切換電壓、電流的大小等來決定有載分接頭切換器規格。有載分接頭切換器特點如下：

1. 極短時間內可完成切換動作。
2. 可切換範圍廣、分接頭數目多。
3. 有獨立油室，以確保被污染的油不會流到變壓器內部。



●On Load Tap Changer

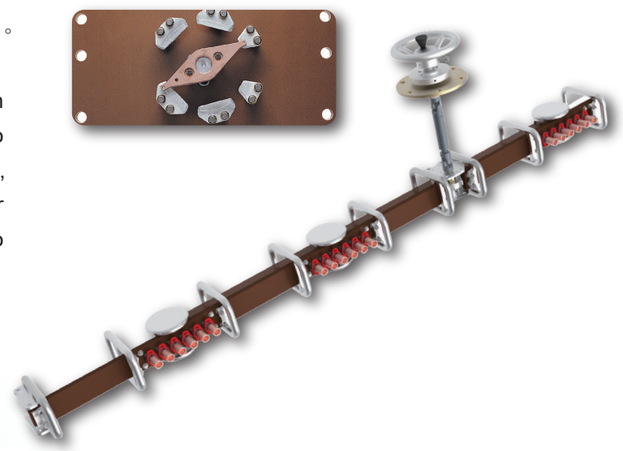
The on-load tap-changer is a resistance-type tap changer, and the connection of taps can be changed under loading condition. The selection of on-load tap-changer is determined by the rating of transformer, the number of the taps, the step voltage and loading current. The features of on-load tap-changer are as follows：

1. It is very short duration in changing taps.
2. Wide range of changing voltage and many terminals of tap selector.
3. The diverter switch chamber of the tap changer is sealed off the transformer main tank, the polluted oil does not flow into the transformer tank to influence transformer oil quality.

●無電壓分接頭切換器

在無電壓狀態下切換變壓器分接頭的切換器。本切換器由上下兩個支持件、鍍銀之銅質固定接觸棒、可動接觸子及偏心軸等構成，分接頭數目在五個以內，其特點如下：

1. 可於變壓器外殼上進行切換操作。
2. 採用環型接觸切換器，操作穩定確實。
3. 把手處裝有鎖錠裝置，可避免誤操作。
4. 把手處裝有指示窗，可藉由此窗確認分接頭指示位置。



●De-energized Tap Changer

The De-energized tap-changer is changed its connection of taps in no voltage condition. It is composed of two supporting plates (above and under the tap connectors), fixed copper robs and movable contactors with silver coating, and a eccentric shaft. The tap changer has no more than five taps. Its features are as fallows：

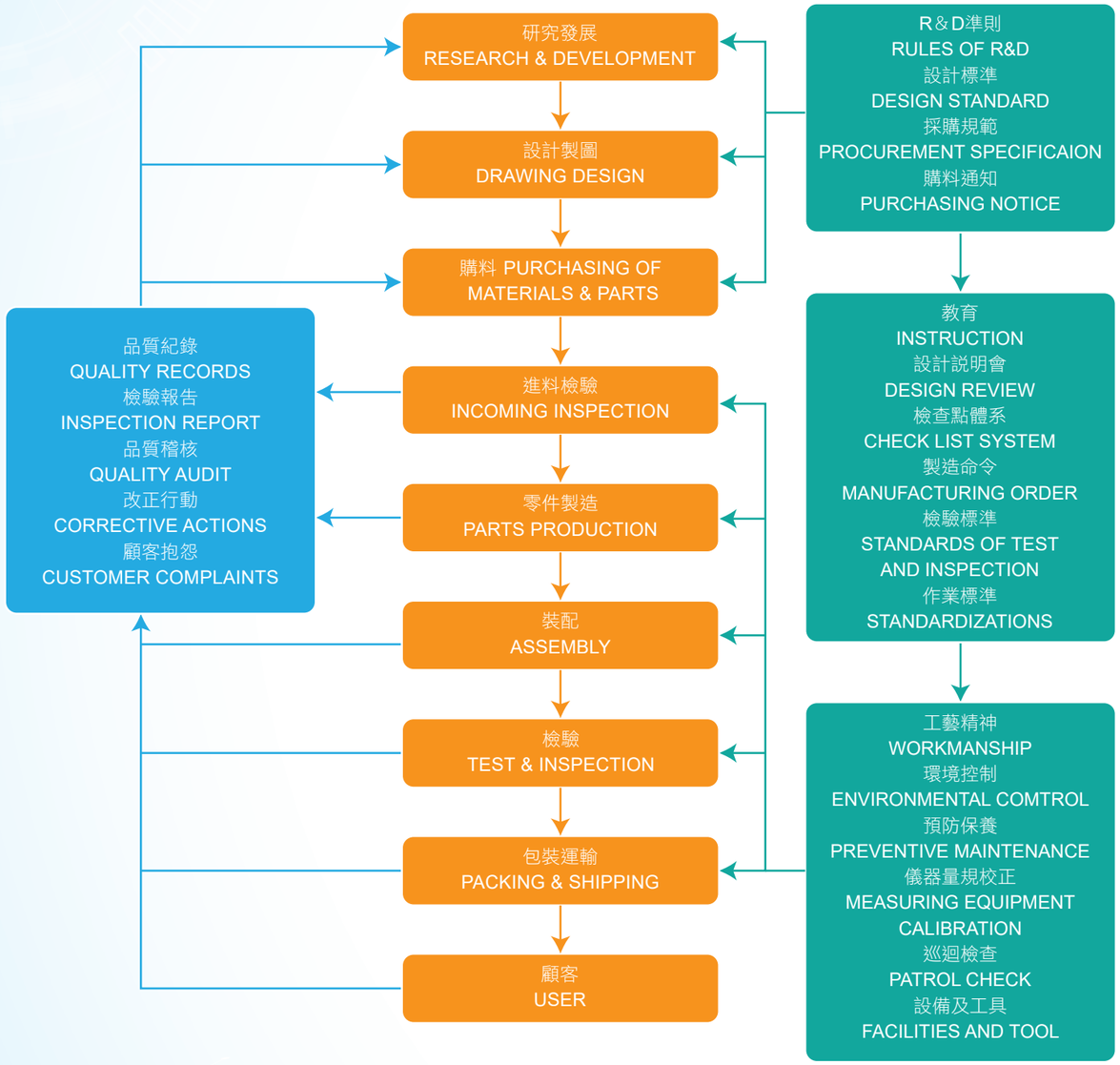
1. It can be operated outside the tank of transformer.
2. Because it is a wedge contact type tap changer, it can be operated accurately.
3. The tap changing handle can be locked to avoid incorrect operation.
4. The tap position can be confirmed by the number showing in the indicating window of the handle.

標準配件 Standard Accessories

配件名稱		Name of accessories	
標準配件	01.套管	Standard accessories	1. Bushing
	02.無電壓分接頭切換器(或有載分接頭切換器)		2. De-energized tap-changer(Or On-load tap-changer)
	03.控制箱		3. Control box
	04.儲油槽		4. Conservator tank
	05.上部濾油閥		5. Upper oil filter valve
	06.下部濾油兼檢油栓		6. Lower oil filter and sampling valve
	07.散熱器(或冷卻器)		7. Radiator (or Cooler)
	08.冷卻扇(風冷才提供)		8. Cooling fan (When the transformer is FA cooling type.)
	09.油泵(送油式才提供)		9. Oil pump (When the transformer is FOA cooling type.)
	10. 油流指示器(送油式才提供)		10. Oil flow indicator (When the transformer is FOA cooling type.)
	11.吸濕呼吸器		11. Dehydrating breather
	12.自動復歸型放壓裝置		12. Automatic reset pressure relief device
	13.撲氣電驛		13. Buchholz relay
	14.針盤油面計		14. Dial oil gauge
	15.針盤溫度計(油溫指示)		15. Dial thermometer(The oil temperature indication)
	16.公司商標		16. Trade mark of co.
	17.不銹鋼銘牌		17. Name plate
	18.吊鉤		18. Lifting lug
	19.人孔(或手孔)		19. Man hole or Hand hole
	20.梯子		20. Ladder
	21.千斤頂座		21. Jack boss
	22.底座		22. Base
	23.基礎螺栓		23. Foundation bolt
	24.接地接頭		24. Grounding terminal
選用配件(顧客指定時才提供)	01.避雷器	Optional accessories (Offered when customer requests.)	1. Lighting arrester
	02.中性點接地電阻器(NGR)		2. Neutral grounding Resister (NGR)
	03.活線濾油機(有油浸式OLTC 時)		3. Hot line oil purifier(When Oil-type OLTC is used.)
	04.並聯控制(有OLTC 時)		4. Parallel control(When OLTC is used.)
	05.遙控盤(有OLTC 時，同變壓器之完整盤)		5. Remote control panel
	06.導口(或電纜箱)		6. Duct (or Cable box)
	07.套管型比流器(BCT)		7. Bushing current transformer (BCT)
	08.繞組溫度計及測溫電阻		8. Winding temperature indicator with thermal image resistor.
	09.棒型溫度計(角度型溫度計)		9. L Type thermometer(Angle type thermometer)
	10.衝擊油壓電驛		10. Sudden oil pressure relay
	11.氣體檢出裝置		11. Gas detector device
	12.車輪		12. Wheel
	13.油取樣閥		13. Oil sampling valve

品質管理 Quality Control

- 大同電力變壓器從產品設計階段至完成出廠，材料、零件的進料驗收及製程中的品管和最後的成品測試，均有專人認真執行各項工作，使能做出無缺點的產品交送顧客。
- TATUNG power transformers from the stage of design, the inspection of raw material and parts, the quality control of manufacturing process and the final test to the products delivery are under specialists doing their best efforts to guarantee zero defect of all products.

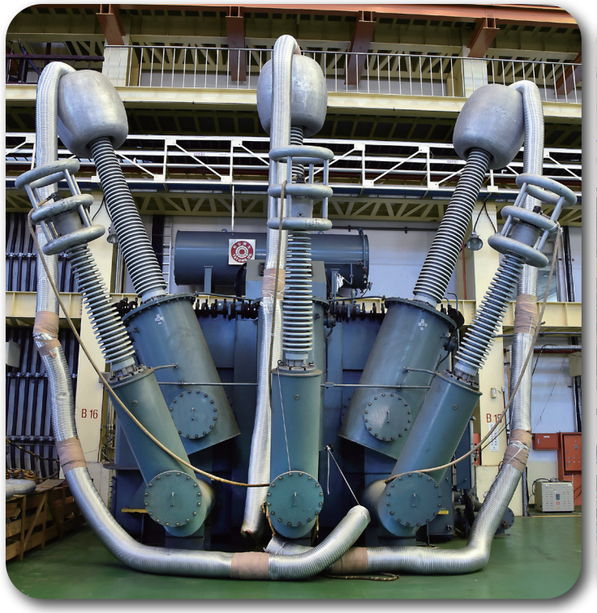


圖例
- 品管對策 QC Action
- 主流程 Main Process
- 回饋 Feed Back of Action





控制試驗室 Operation Room



120MVA 試驗變壓器 120MVA Testing Transformer



試驗用天車 Testing Crane



感應用串聯共振塔
Series Resonance Equipment



衝擊電壓試驗設備2400kV
2400kV Impulse generator



衝擊截斷裝置及電壓互感器
Chopped Wave Generator & PT

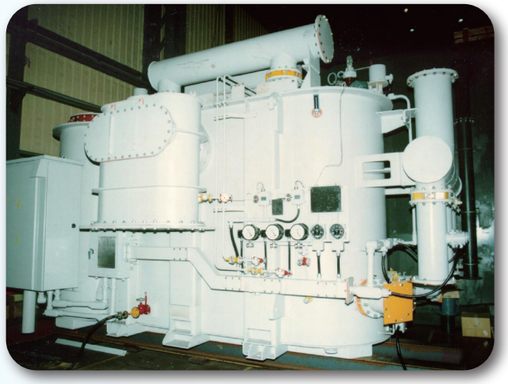
代表實績 Achievements



台電大林廠3 相161kV級728MVA 三相一體特高壓電力變壓器
3 § 161kV 728MVA extra high voltage power transformer, three phases in one tank.



台電大潭電廠3 相345kV級505MVA 三相一體超高壓電力變壓器
3 § 345kV 505MVA ultra high voltage power transformer, three phases in one tank.



台電公司SF6 氣體絕緣變壓器 69kV-25MVA
SF6 Gas-Insulated Transformer 69kV-25MVA



外銷美國電力變壓器 3相138-12.47kV 83MVA
3 § 138-12.47kV 83MVA Transformers to U.S.A



台電公司超高壓自耦變壓器 345kV-500MVA
Power Transformer 345kV-500MVA



台電興達電廠火力發電用變壓器 345kV-330MVA
Thermal Power Generation Transformer
345kV-330MVA



台灣塑膠公司汽電共生用變壓器 161kV-150MVA
Cogeneration Transformer 161kV-150MVA



民營電廠長生電力發電用變壓器 166kV-386MVA
Thermal Power (IPP) Generation Transformer
166kV-386MVA



台電公司SF6 氣體絕緣變壓器 161kV-60MVA
SF6 Gas-Insulated Transformer 161kV-
60MVA



台電大潭電廠火力發電用變壓器 345kV-340MVA
Thermal Power Generation Transformer
345kV-340MVA

代表實績 Achievements



台電明潭電廠水力發電用變壓器 345kV-300MVA /
Pumping and Generation Transformer 345kV-300MVA



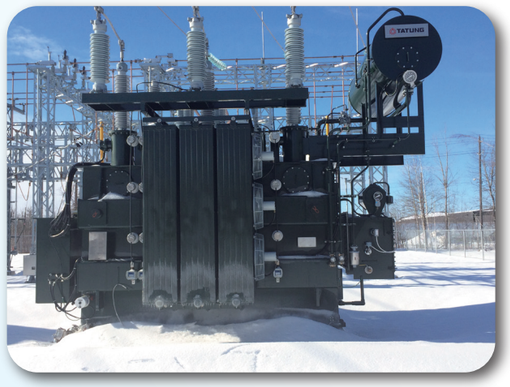
大陸台化寧波熱電公司變壓器 236kV-150MVA
Power Transformer 236kV-150MVA



外銷關島電力變壓器 115kV-112MVA
Power Transformer 115kV-112MVA



外銷3 相50Hz 154kV 39MVA變壓器至日本仙台
3§ 50Hz 154kV 39MVA Transformers to Sendai, Japan



外銷3 相120kV 28/37/47MVA變壓器至加拿大
(極地氣候-40℃)
3§ 120kV 28/37/47MVA Transformers exported to
Canada (polar climate -40℃)



大陸台化寧波熱電公司變壓器 110kV-100MVA
Power Transformer 110kV-100MVA