

12 good reasons to buy an ABB TrafoStar™ transformer

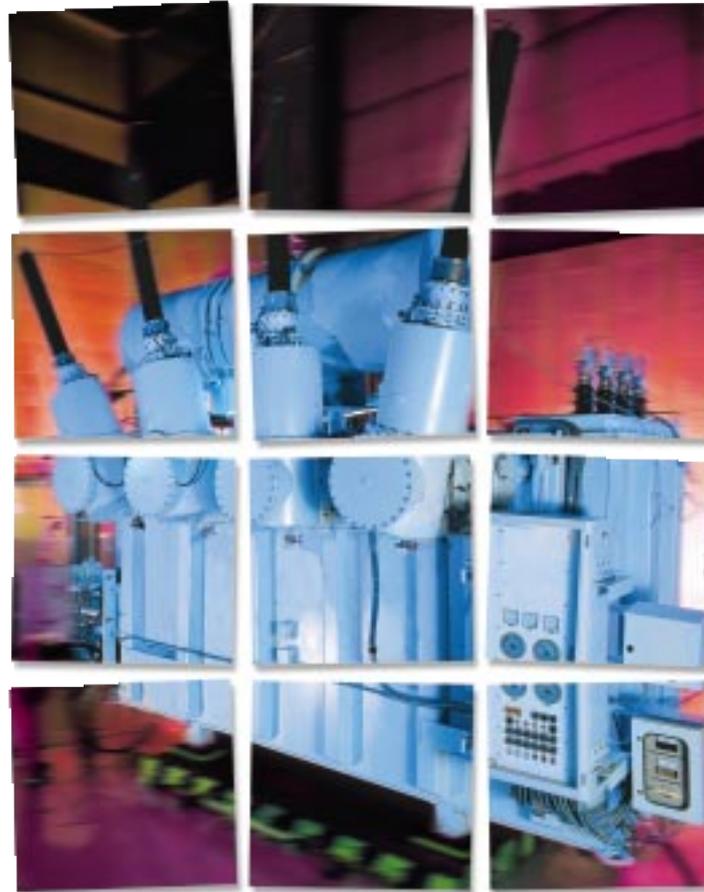


ABB Power Transmission





In densely populated areas, the ABB low-noise transformer can be located in sound-proof structures to limit noise.



Design and production quality is verified in world class testing facilities.



Power transformer designed for HVDC power transmission over long distances.



Substation with 450 MVA transformer.



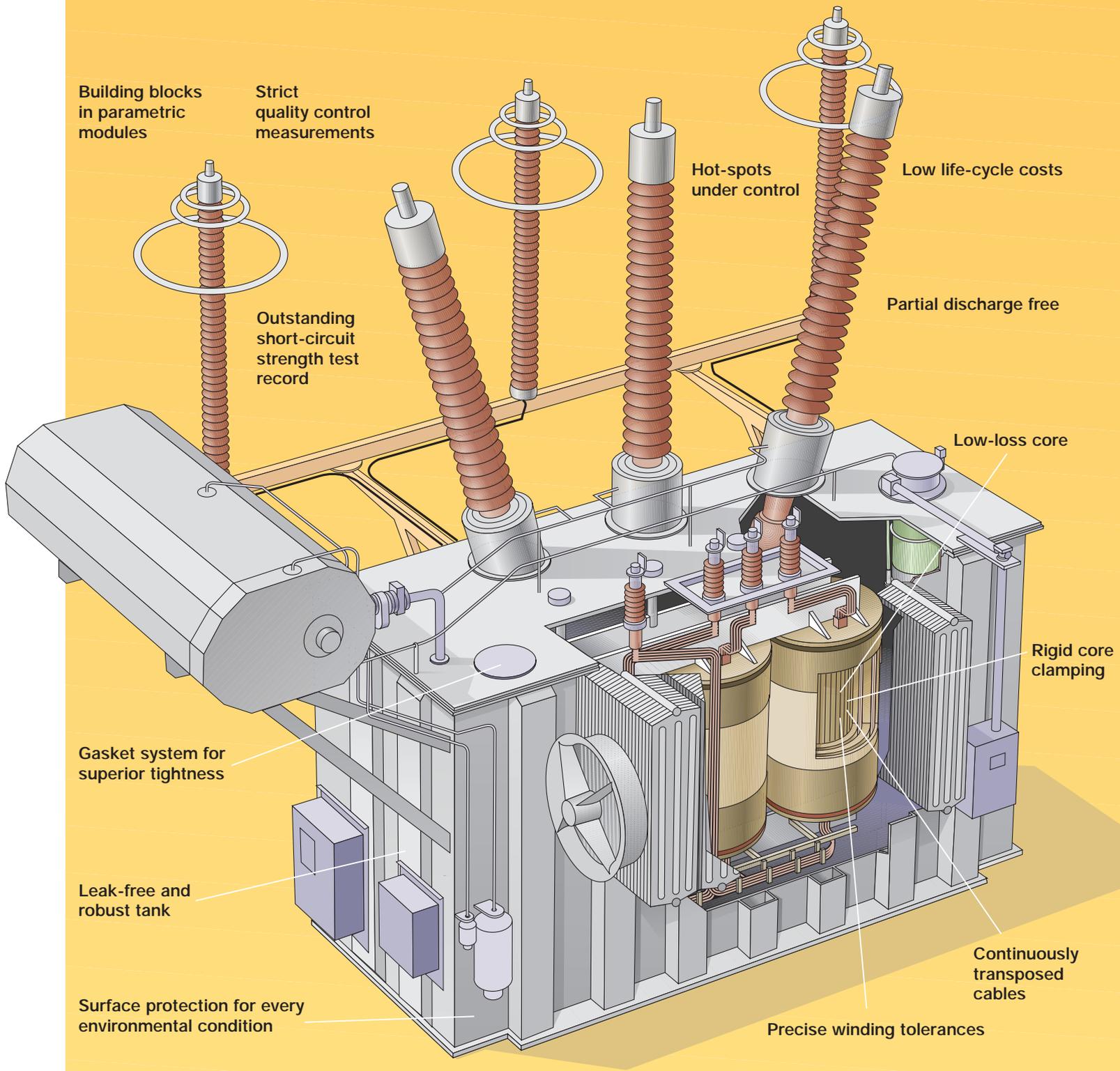
Static var compensation equipment in Kampur, India.



Tests with super conducting materials offer new insights into future power transformer technology.

Why choose a TrafoStar™ transformer?

1. Service-proven transformer design that meets your power needs
2. Robust design features make all the difference
3. Test records confirms ABB's continuously improved quality
4. First-class suppliers
5. Outstanding short-circuit strength test record
6. Short, on-time delivery – with ABB quality guaranteed
7. Low life-cycle costs
8. A lifetime of trouble-free operation
9. ABB resources to develop even more efficient solutions
10. Built on systems know-how
11. Creative financing solutions for cost-effective investments
12. Consistent transformer quality available from state-of-the-art factories world-wide



TrafoStar is built on the core type technology. It has a circular shaped core limb surrounded by concentricly arranged, cylinder-shaped windings. This transformer concept gives the most efficient use of the active material, while allowing short, competitive assembly times in the factory.

Our core type technology with cylindrical windings has an excellent capability to withstand short-circuits even under the most demanding fault conditions.

The high voltage windings are normally built as ordinary, interleaved or shielded disc windings, while the low voltage windings typically are of helical or layer design. The tapped portion of the winding is normally arranged as a separate physical winding shell. This design allows a balanced ampere turn distribution, avoiding excessive short-circuit forces and additional losses.

1. Service-proven transformer design that meets your power needs

- An advanced platform for the design and manufacture of power transformers
- Each transformer is designed and manufactured in component modules
- Each module uses the market's best practices
- Each module concept is verified by years of active use in ABB transformers
- Short factory throughput time

What it means for you:

- Customized transformers with proven design
- Short delivery time
- ABB quality guaranteed
- Full short-circuit strength
- Low life-cycle costs
- High reliability

TrafoStar™

Philosophy

TrafoStar is the common ABB concept for the design and manufacture of power transformers. A TrafoStar transformer is built of standardized, service-proven components and modules, ensuring flexible, dependable and tailor-made transformer designs.

History

Over the years, several major power transformer manufacturers have merged to form ABB, including Asea, BBC, GE USA, Westinghouse, Ansaldo, National Industri and Strömberg. TrafoStar utilizes the best practices this joint know-how and experience offers.

Design

Extensive R&D has generated common electrical and mechanical design rules that each TrafoStar transformer follows. A modularized design allows a repetitive approach that brings factory throughput time to a minimum with maximum quality.

Production

All production processes and work methods are carried out according to standardized procedures following the best practices developed by ABB transformer factories throughout the world. State-of-the-art tools and equipment, strict quality control and well-trained personnel ensures top quality manufacturing.

Testing

The design and manufacturing quality is verified in our world-class labs. All factories use the same, top-quality test equipment, test structure and protocols. The labs also include the latest in diagnostic equipment for accurate interpretation of test results.

Custom design

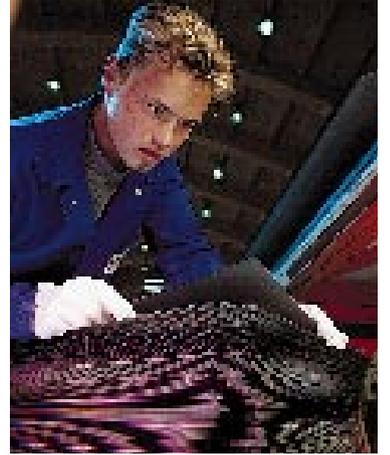
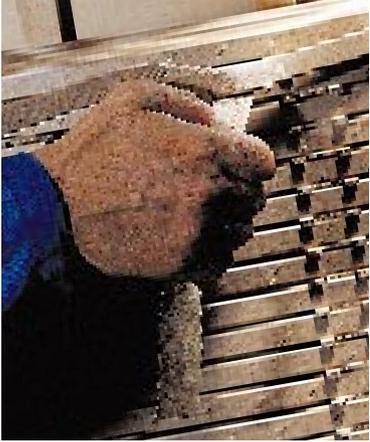
The TrafoStar concept permits infinite variability in transformer design to suit all customer needs.

Reliability

Modularization means that each process and piece of equipment that goes into making a TrafoStar transformer is tried, tested and verified. Therefore, we can ensure you absolutely reliable transformer performance.

Profitability

TrafoStar offers high reliability, high availability and low maintenance requirements. For you, our customer, that means low life-cycle costs.



The winding assembly follows rigorous quality standards. High cleanliness, high quality parts, precise manufacturing tolerances and constant 6-Sigma measurements ensure very low impedance variation.

Continuously transposed cables ensure lower losses. For more efficient cooling, net taping is sometimes used instead of traditional paper insulation.

The Ascecond core limb stocking creates an even and tight pressure on the limb lamination. This robust design gives short-circuit strength and high safety during transport.

The step-lap method is used to create good magnetic contact in the core joints. This ensures a low reluctance for the magnetic flux, which translates into low losses and low noise.

2. Robust design features make all the difference

- Global design rules ensure high quality
- Optimal material utilization
- Built in world-class production facilities
- Rigid clamping of core and windings
- Well established insulation system
- Optimal oil flow
- Leak-proof gasketing system
- Surface protection systems for all environmental conditions

What it means for you:

- Trouble-free operation
- Low life-cycle costs
- Short-circuit strength
- Ability to withstand the most severe dielectric stresses
- Low losses
- Low noise
- Controlled overloadability
- Strength to handle transport stresses

Strength for reliability

Electrical design rules

The design rules are based on the combined knowledge gained from the extensive R&D work performed by the ABB Group companies over many years. Continuous trials and experiments verify the transformers' short-circuit strength. They also result in extensive design rules and acceptance criteria to evaluate the stresses each winding design can sustain.

Mechanical design rules

ABB's mechanical design rules are built on well-developed calculation models that already at the design phase allow us to define factors such as noise level, losses and short-circuit strength.

Core design

The core design is a direct result of each customer's evaluation of factors such as losses, noise and weight. For demanding applications, only top quality steel is used. All designs utilize mitred 45-degree – conventional or step-lap – joints. Rigid clamping using Ascecond, a semi-conducting tape, keeps the core sheets of our large units together and gives the core a smoother, more efficient electrode shape.

Winding design

Sophisticated calculation models give proper winding dimensions for optimal electrical stress distribution and thermal performance. Together with precise manufacturing tolerances this ensures mechanical and dielectric stability and predictable temperature distribution.

Gasket system for superior performance

Coolers, bushings, pipes and covers – all need tight, leak-proof gaskets to protect the transformer and the environment. TrafoStar utilizes nitril rubber gaskets in grooves to ensure superior tightness over many years.

Corrosion protection

ABB has developed an environmentally friendly corrosion protection system to meet the demands of all climates.

Drying and filling

ABB pays particular attention to the drying and filling process. Absolute control of the insulation paper moisture level ensures efficient electric withstanding capability. During drying, the windings are subjected to cycles of pressure to make the insulation material settle and to establish the final winding height. Hot oil is vacuum filled from the bottom of the tank,

which makes sure that all voids are filled and that all solid insulation material is thoroughly impregnated with oil.

Skilled workforce

ABB's assembly personnel receive continuous training and education in areas such as joining and brazing. Key personnel undergo annual proficiency tests on various parts and components using X-ray and dissection techniques.

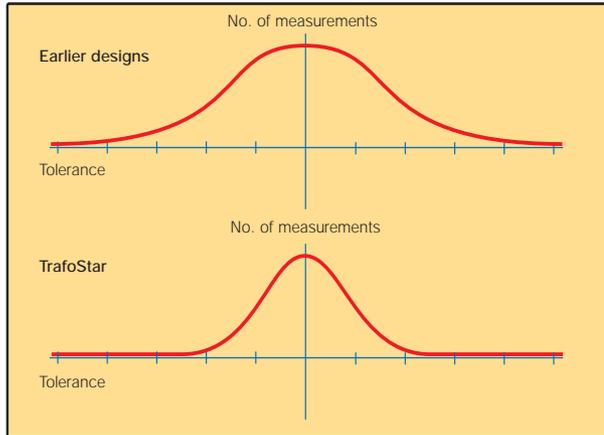
Cleanliness

No conductive particles are allowed to enter the active parts of the transformer. All our factories have dedicated clean areas where sensitive manufacturing processes are located.

Production quality

Each production step is operator controlled to ensure the highest quality. Elaborate control procedures and continuous measurements are used to verify the conformance to customer specifications.

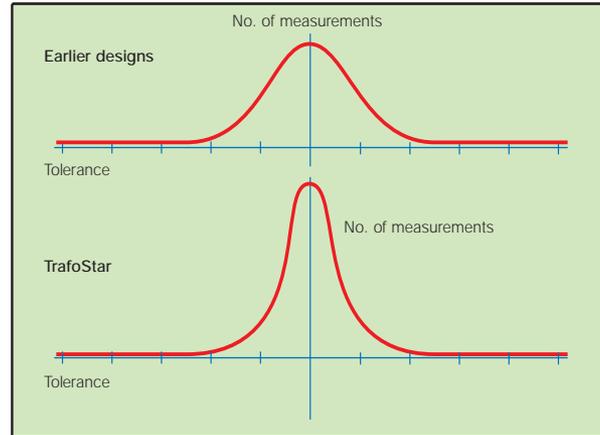
Losses



Losses

Advanced calculation tools, material expertise and precise manufacturing tolerances mean that tested losses are extremely close to calculated ones. ABB's TrafoStar concept has been able to reduce the test result scatter to a minimum.

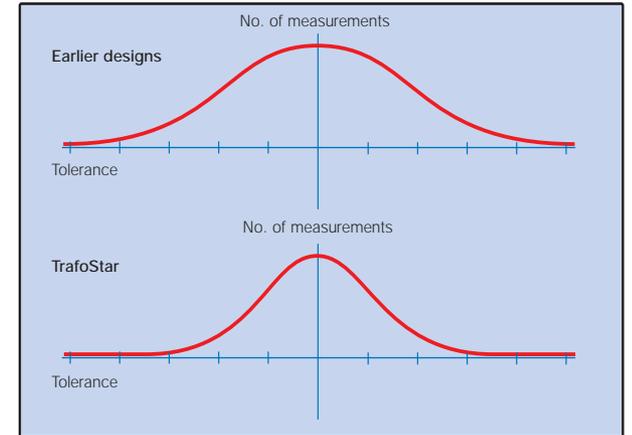
Impedance



Impedance

Having all construction processes under control ensures the right impedance. The mechanical tolerances must be exact. Modularized and standardized production methods and continuous 6-Sigma quality control measurements mean that our transformers have the impedance they are designed for.

Temperature rise



Temperature rise

The ability to calculate the oil flow at all sections of the winding is the key to designing transformers that do not overheat. TrafoStar's modularized design gives ABB control over this critical process and our temperature rise test results correspond very closely to the designed levels.

With a tight test result scatter, the risk for exceeding permissible values is greatly reduced.

3. Test records confirms ABB's continuously improved quality

- Modularized design using the best practices
- Best practices built on proven solutions
- All manufacturing stages quality checked by 6-Sigma
- World-class labs with calibrated equipment give trustworthy test results
- Measured and quantified variances provide valuable feed-back for continuous design and production improvement

What it means for you:

- Test records indicating high service reliability
- Confirmed high quality
- Transformers built to your specification and standards
- Proven solutions that give low scatter in tests
- Test results in line with calculated values
- Predictability in service
- Long service life

Strategy

TrafoStar includes a program for continuous improvement. On-going measurement and careful statistics about achieved tolerances give important input to new designs and product improvements.

Processes under control

Through elaborate 6-Sigma measurements of each production step, ABB validates that its designs are perfectly assembled on the factory floor.

Low scatter

The design and manufacturing quality is verified during testing. Test results close to predicted values during the design phase indicate that our processes are under control. ABB continuously monitors its test result scatter to reduce variation to an absolute minimum

Partial discharge free

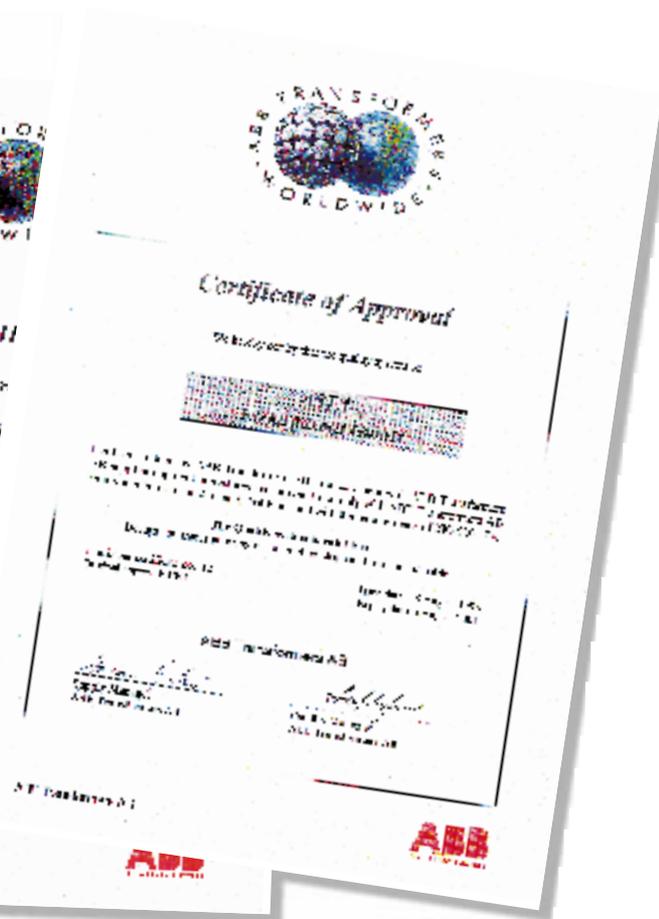
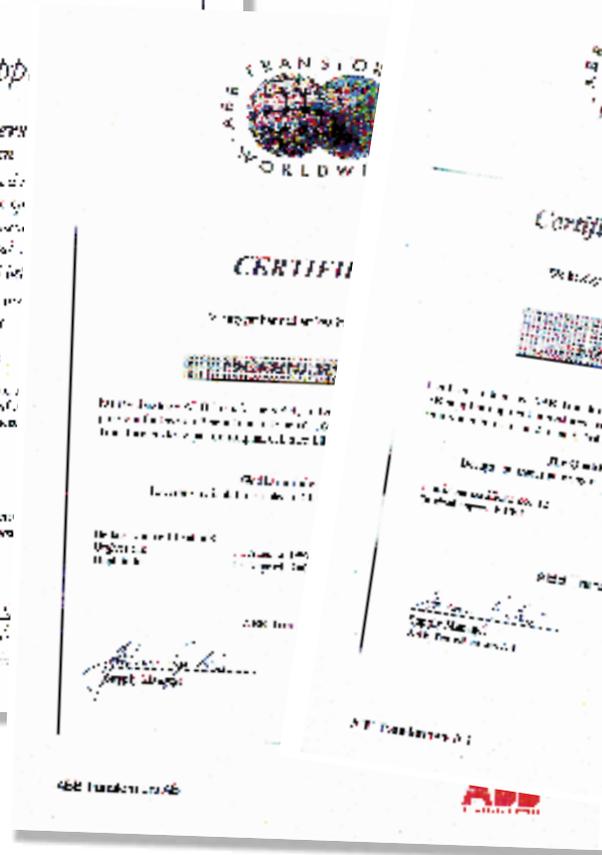
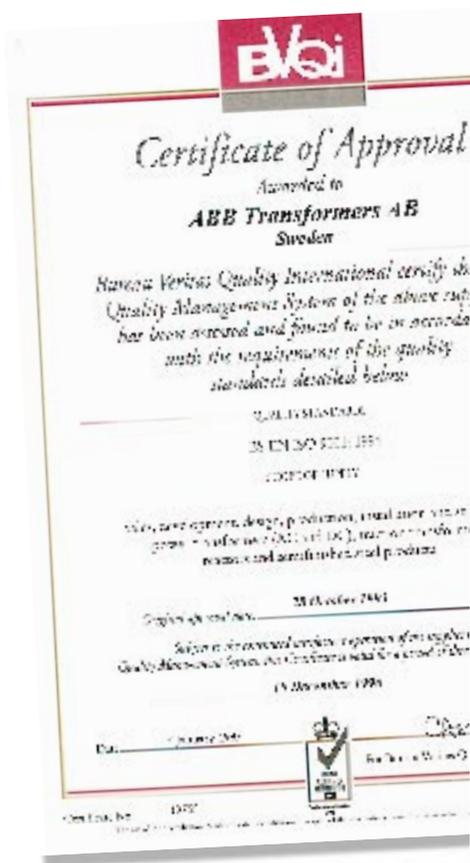
One effect of the TrafoStar modularized design is that we can manufacture our transformers vertically partial discharge free. ABB achieves this performance by ensuring that there are no sharp edges, that conductors are round and smooth, that insulating material is absolutely dry before filling and that all manufacturing is performed in clean, dust-free factories.

Hot spots under control

Advanced calculations, experiments, measurements and statistics help reduce hot spots to a minimum. We can determine potential areas with high leakage flux and take appropriate action through the selection of material and manufacturing tolerances at the design phase.

Contract review

All orders placed with ABB are validated with the customer before manufacturing begins. This process eliminates all surprises.



All ABB transformer factories have the ISO 9001 and ISO 14001 quality certification. Furthermore, we have a close co-operation with our first-class suppliers. They have all gone through the ABB quality control and audit program. On many accounts this means meeting even tougher standards.

4. First-class suppliers

- Quality agreements with audited suppliers
- Long-term supply agreements
- Common R&D means reliable solutions
- Key components built within ABB
 - Bushings
 - Tap changer
 - Insulation material

What it means for you:

- Overall ABB responsibility for the complete product
- High reliability
- Low life-cycle costs
- On-time deliveries

Efficient supply management

ABB strives to establish close, long-term partnerships with a limited number of first-class suppliers. In this way, we can guarantee cost-effective, high-quality components delivered on time.

Quality audits

The ABB Power Transformer Group has refined available quality systems based on continuous control and audits of all suppliers. ABB monitors faults, delays and technical performance in an effort to generate even better solutions for the future.

Common research and development

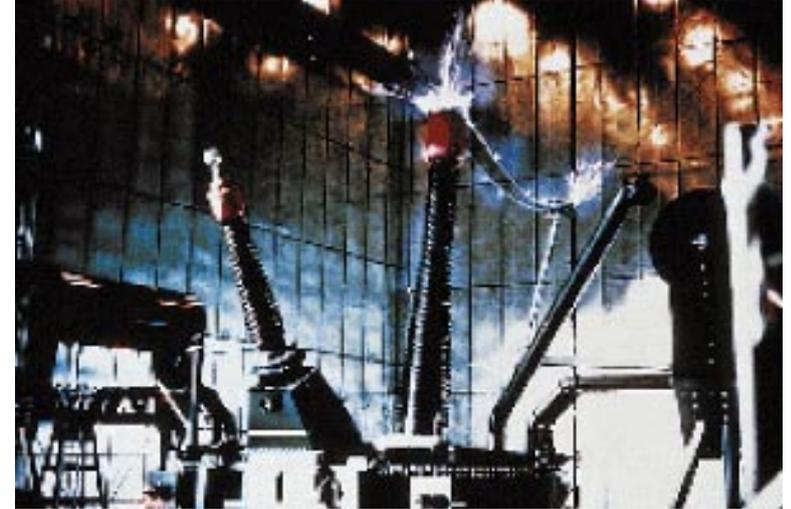
We constantly perform joint research and development projects with our partners. By utilizing a wide network of specialist's know-how, ABB in conjunction with its key suppliers, can develop new, effective and cost-efficient solutions. Superconducting materials and new cable technology are examples of ABB's commitment to develop new transformer technology.

Highly reliable

A transformer's reliability depends on the quality that is built into the equipment throughout the entire production chain. ABB and its suppliers are subjected to continuous 6-Sigma measurement. Just-in-time deliveries of components and subsystems and 6-Sigma protocols are used to verify quality control.

Smooth logistics

The entire production chain must run smoothly to ensure short delivery times. ABB communicates with its partners on both technical matters, such as drawings and research projects as well as confirming commercial documentation. ABB also encourages its supply partners to make innovative suggestions that help improve the logistics process and cut delivery times.



Our transformers are built to withstand tough service conditions. The short-circuit strength of our designs is renowned and ABB possesses the world's most comprehensive short-circuit test record to substantiate this claim.

5. Outstanding short-circuit strength test record

- More than 115 ABB power transformers of different designs have passed short-circuit tests
- The world's largest short-circuit tested transformer was manufactured by ABB
- No other manufacturer has such an extensive test record
- All tests performed by independent test labs
- World-class facilities for the highest manufacturing accuracy
- Each process is quality controlled through the application of 6-Sigma principles

What it means for you:

- Verified designs
- High reliability and availability

Short-circuit testing

Power transformers are vital components in power transmissions systems and electrically intensive industries. New patterns of interconnecting power networks and the trend to increase network capacity means that the short-circuit capability of power transformers is becoming more and more important.

Therefore, ABB applies its technological know-how into understanding short-circuit forces and effects. Unlike most other manufacturers, our approach is not based on a theoretical and statistical approach. Instead ABB challenges itself with the experience gained from more than 115 short-circuit tests and short-circuit events in the field.

Full scale short-circuit tests cover transformers rated from 10 MVA to 775 MVA, the largest short circuit tested power transformer in the world. The tests include practically all transformer designs and types, from single concentric to double concentric winding arrangements, and from generator step-units to interconnecting power transformers.

ABB's extensive test performance and deep know-how means that we can offer you transformers with the very best short-circuit performance available on the market today.



6. Short, on-time delivery – with ABB quality guaranteed

- Design, manufacturing and assembly processes are Modularized
- First-class suppliers
- First-class production
- Short factory throughput time
- Every step in the process chain is monitored according to the 6-Sigma quality system
- World-class test fields verify the design

What it means for you:

- Short, on-time deliveries
- ABB quality and reliability

6-sigma

ABB's vision is to be a world-class manufacturer, making world-class transformers. This vision is quantified according to the 6-Sigma methodology. Technically, the methodology means an acceptance level allowing less than 3 defects per one million opportunities. 6-Sigma makes good business sense. Our customers acknowledge high quality, and for ABB this results in lower costs.

Quality can be quantified

To assess quality, ABB has made a long-term commitment to maintaining production records and to use this information to constantly improve processes and solutions. We do not rely on beliefs – but on systematically analyzing and interpreting data. The ultimate goal is to reduce variances to a minimum.

Steady improvement

All ABB power transformer manufacturing plants world-wide are now involved in the 6-Sigma quality control program. All employees are trained, and every process is analysed and measured as part of a program of constant improvement. 6-Sigma also means that it is possible to track quality. Every step in the design, manufacturing and delivery process is checked and verified, which provides excellent feed-back if a fault occurs.

To date, ABB has documented many positive short-term results, both in its manufacturing and non-manufacturing processes. One example is the winding height of core transformers manufactured at our plant in Córdoba, Spain. In only two years the need for final adjustment was reduced to a minimum.

Other successful 6-Sigma projects are: Measurements on winding conductors for lower variances in loss measurements. Continuous measurements of dimensions and cooling channels in the windings for lower scatter in temperature measurements. Close measurements and analysis of drying processes for better drying and lower partial discharge in the transformers. With 27 plants around the world, ABB can share its findings and results permitting exponential increases in quality.

Short, on-time deliveries

High quality throughout the entire production process is a prerequisite for fast and smooth production. 6-Sigma helps us work in a structured and efficient manner. This means ABB can promise you short, on-time deliveries with ABB quality guaranteed.

- Purchase price
- + Cost of losses
- + Transport costs
- + Installation costs
- + Maintenance costs
- + Cost of down-time
- + Cost of scrapping

Life-Cycle Costs



There is a unique working condition for each transformer. We work closely with our customers to optimize the design so that the life-cycle costs of the equipment are as low as possible.

7. Low life-cycle costs

- Low losses
- High-quality insulation
- Hot-spots under control
- First-class components
- Durable corrosion protection systems for all climates
- Robust auxiliary wiring and control cabinets
- PCB-free oil
- The transformer can be recycled

What it means for you:

- The lowest cost per transmitted MWh
- High availability
- Low impact on the environment

Life-Cycle Costs, LCC

Optimized design

The customer's assessment of losses, noise, physical size and weight influence the design of the transformer. Our advanced design tools permit us to optimize performance according to these factors.

Purchase price

ABB's focus is total cost during the entire service life of the transformer. Since the purchase price is only one component in the life-cycle cost, we make sure that we build in life-long quality.

Losses

TrafoStar is flexible. The modularized concept allows us to adapt to a wide variety of customer needs. We design and build extremely efficient transformers for conditions where losses are considered to be very valuable. Equally, we can deliver cost-effective transformers for situations where higher losses are acceptable.

Transportation

ABB has extensive experience of transporting its transformers by truck, rail or boat. We make sure that our products can take the strain of transportation, and by having manufacturing plants world-wide we can both cut transportation distance and cost.

Installation

Experienced field technicians, modern tools and equipment and the modular approach of TrafoStar ensures high quality and fast installation times, regardless of site complexity.

High availability and low maintenance requirements

ABB's TrafoStar transformers are built to last. We trust our designs to give you high availability, low maintenance costs and good profitability.

Scrapping

The modular design helps reduce costs even at the decommissioning stage. TrafoStar is easy to dismantle and it is recyclable to a large extent, including our clean, PCB-free oil which eliminates the risk for environmental pollution and allows the oil to be recycled.



8. A lifetime of trouble-free operation

- Routine maintenance contracts
- Full-service contracts
- Monitoring and diagnostics contracts
- Operator training courses
- 24-hour-a-day service support

What it means for you:

- A lifetime of trouble-free operation
- Low life-cycle costs
- Power when you need it
- Lifetime guarantee

TrafoStar service contract

Customized full-service contracts

ABB offers to guarantee the performance of its transformer up to 25 years, under a TrafoStar service contract. We evaluate your network, its protection system and the loading conditions of the transformer to determine the need for monitoring, service, maintenance and spare parts. Then, ABB designs a customized service contract where we take full responsibility for the transformer, its maintenance and performance at fixed price per year. Power transformation cannot be any easier.

Routine service and maintenance

ABB has all the necessary knowledge, experience, personnel and equipment to efficiently service your transformers, regardless of original manufacturer.

Monitoring and diagnostics

Sophisticated sensors and remote control, make it possible for ABB to keep an eye on the performance of your transformers. Furthermore, we are able to test your population of transformers and diagnose their future. We give the green light to those you can trust, yellow for those that need further analysis, and red for those that are next in line to be refurbished or retired.

Each transformer leaves its fingerprints

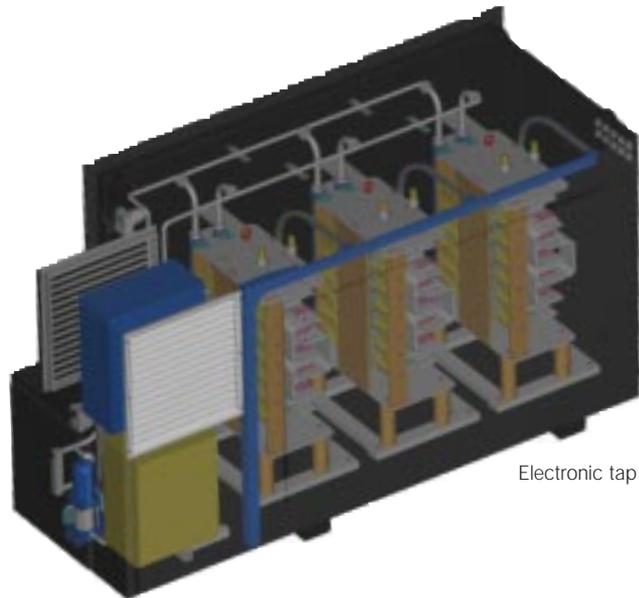
ABB retains the drawings and performance record for each transformer design. Thus we can accurately predict service requirements and service life of your ABB transformer in the field.

Trouble-free operation

Our full-range of after sales services are designed to give your ABB power transformer a lifetime of trouble-free and profitable operation.



Dryformer



Electronic tap changer

9. ABB resources to develop even more efficient solutions

- World leader in power transformers
- The combined strength of the ABB Group
- World-class R&D resulting in constantly improved power transformer technology
- Financial strength
- ABB's world-wide presence

What it means for you:

- Powerful, reliable supplier for the lifetime of your transformer
- New and improved products for optimal transmission performance
- Continuously improved quality
- Close to the customer
- The lowest cost per transmitted MWh

ABB - a world leader in electrical engineering

ABB is a world leading supplier within the field of electrical engineering to utilities and industry world-wide. With a turnover of some USD 35 billion per year and more than 210,000 employees, ABB has the resources, financial strength and know-how to be in the forefront of electrical engineering technology.

R&D investments

Within the ABB Power Transformer Group, we invest about 3% of our revenues each year in R&D. This means ABB is spending more than USD 30 million annually. We work closely together with customers, partners, universities and ABB's central R&D organization to cultivate the very latest developments and the most creative minds. It is this co-operative effort that leads to new insights and ever more efficient power transformer solutions for you.

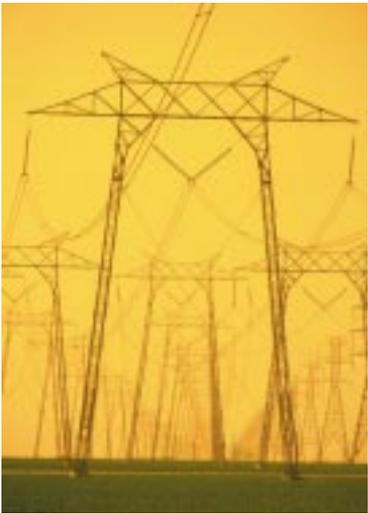
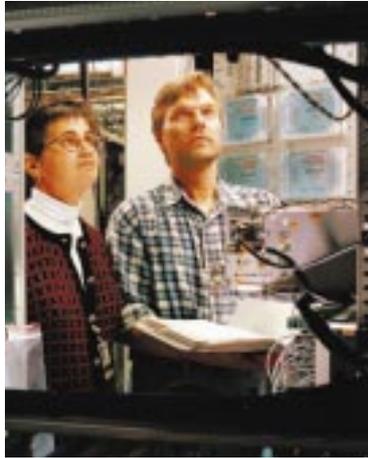
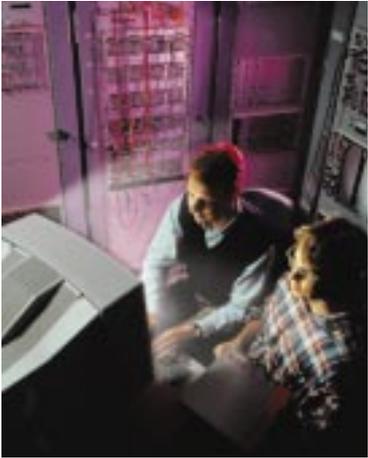
Some examples are:

Dry power transformers

ABB's new, dry power transformer technology replaces conventional conductors with cable materials, which completely eliminates the need for oil and cellulose insulation. This new transformer concept is particularly favorable in urban and environmentally sensitive areas, since oil is completely eliminated and a much higher safety level is achieved. Maintenance costs are also considerably lower than for conventional transformers.

Electronic tap changers

ABB Power Transformers has developed a unique electronic tap changer that regulates dips in system voltage within one cycle. There are no moving parts in the current path but the equipment is built up using well-known thyristor technology. This solution is service-proven in other ABB equipment.



10. Built on systems know-how

- More than 100 years of ABB experience in transmission and distribution technology
- Network analysis and optimization capability
- Specification consultancy knowledge
- Customized customer training
 - theoretical studies
 - practical, hands-on training
 - in-depth knowledge at ABB T&D University
- Active participation in international industry associations

What it means for you:

- Optimized transformers for your network
- Increased competence in your staff
- Access to the latest developments in power transformer technology

We set the transformer in its perspective

Systems knowledge

ABB is one of the world's leading suppliers of electrical engineering solutions to utilities and industry. Our experience dates back more than 100 years and covers all aspects of power generation, transmission, distribution and industrial applications where electricity is used. This experience and knowledge is built into each and every transformer we produce.

Optimized networks and industrial plants

ABB is committed to being a flexible and knowledgeable partner to utilities and industry world-wide. Together with our customers we can analyze individual needs and help make the specification process smooth and easy. And with our power network systems knowledge and industrial process experience, we can ensure that you will get an optimal transformer solution that perfectly fits into your existing power grid or industrial plant.

Tailor-made training

ABB offers tailor-made training for its customers so that the ABB transformers are ensured to perform as designed. The training includes theoretical studies of transformers in general with focus on your equipment. There is also extensive practical, hands-on training for service and maintenance personnel.

For even deeper knowledge ABB offers advanced courses in all aspects of transmission and distribution technology at our four T&D universities in Raleigh, North Carolina in the USA, Baden in Switzerland, Mannheim in Germany, and Ludvika in Sweden. For more information, please visit: www.abb.se/tduniversity

Harmonizing standards

ABB takes an active role in international industrial associations, such as Cigré, IEC and IEEE. Through continuous communication and open exchange of ideas and experiences with customers and suppliers there is a steady development of recommendations to improve standards leading to improved product quality and performance. Through this international participation ABB contributes with its global experience to standards development, and is kept up-to-date with customer needs and requirements.



USD 120,000,000
Brista Kraft AB
CHP power plant
Sweden



USD 15,000,000
Tuusulanjärven Energia Oy
Substations, transformers and distribution
grid
Finland



USD 17,000,000
Karlskoga
Power plant
Sweden



USD 25,000,000
Stockholms Energi
Substations
Sweden



USD 125,000,000
Tenaga Nasional Berhad
Generation, transmission and
distribution equipment
Malaysia

11. Creative financing solutions for cost-effective investments

- In-house financing with ABB Credit Group and/or ABB Structured Finance
- Advisor and arranger of financial transactions
- Cross-border leasing expertise
- Industrial viewpoint
- Local perspective
- International investor and underwriting capacity

What it means for you:

- Tailor-made financing
- Cost-efficient investments

ABB Credit Group

ABB Credit offers financial solutions created with one thing in mind – bringing your projects to reality. We offer financial strength, industrial as well as financial expertise, and a long successful history of complex international transactions. ABB Credit can provide you with the most advanced asset-based, structured financing available and we are recognized as one of the world's leaders in cross-border leasing. By combining short and long-term debt, fixed and floating interest rates, different currencies and sale-lease back schemes, we can create financing that is truly Optimized for your project.

Billions in references

ABB Credit's innovative financial solutions have proven to be so successful that since 1985, we've arranged more than USD 6.8 billion in cross-border and structured lease financing for power generation and transmission, transportation, and industrial projects all over the world. Every dollar is creatively designed to give you the advantages of competitive prices, long-term financing, off balance sheet financing and flexible rental profiles that track the expected cash flow of each project.

ABB Structured Finance

ABB Structured Finance provides financial advice and is active in structuring, arranging and closing transactions in the areas of export financing, limited resource financing and counter-trade.

In order to facilitate financial closing, ABB Structured Finance also provides debt financing and underwriting capacity to selected projects. The product range includes senior debt, subordinated debt, bridge financing and specially tailored structures.

Our Swiss banking affiliate, ABB Export Bank, has extensive experience of export and trade finance. Participation in, and syndication of, export and project finance transactions are greatly facilitated through its excellent ties with the international banking community.

ABB Energy Capital, a unit within ABB Structured Finance, is a leader in providing innovative financing for mid-sized projects such as improving environmental impact and energy efficiency. The company offers energy services providers, manufacturers, and other project developers creative financing solutions supporting their project initiatives in the industrial, commercial, institutional, residential, municipal, and federal markets.



12. Consistent transformer quality available from state-of-the-art factories world-wide

■ The largest power transformer manufacturer world-wide

- 1.2 billion USD revenues
- 7 000 employees
- 90 000 MVA per year
- More than 700 000 MVA in power transformers delivered the last 10 years

■ 27 power transformer factories world-wide

■ Close to the customer

■ Service support teams available 24 hours a day

■ The combined experience of 700 years of transformer manufacturing

- Asea
- Ansaldo
- BBC
- GE, USA
- National Industri
- Strömberg
- Westinghouse
- and more...

Finland, Vaasa

Max. size 1 200 MVA
Max voltage 420 kV

Sweden, Ludvika

Max. size 1 500 MVA
Max voltage 1 100 kV

Norway, Drammen

Max. size 500 MVA
Max voltage 420 kV

Scotland, Dundee

Max. size 250 MVA
Max voltage 420 kV

Germany, Bad Honnef

Max. size 1 100 MVA
Max voltage 525 kV

Germany, Halle

Max. size 100 MVA
Max voltage 220 kV

Italy, Legnano

Max. size 750 MVA
Max voltage 800 kV

Italy, Pomézia

Max. size 750 MVA
Max voltage 525 kV

Spain, Cordoba

Max. size 900 MVA
Max voltage 525 kV

Spain, Bilbao

Max. size 400 MVA
Max voltage 245 kV

Poland, Lodz

Max. size 500 MVA
Max voltage 420 kV

Switzerland, Geneva

Max. size 500 MVA
Max voltage 420 kV

Turkey, Istanbul

Max. size 300 MVA
Max voltage 380 kV

South Africa, Pretoria

Max. size 800 MVA
Max voltage 800 kV

Canada, Varennes

Max. size 1 200 MVA
Max voltage 800 kV

Canada, Guelph

Max. size 20 MVA
Max voltage 138 kV

USA, St Louis

Max. size 175 MVA
Max voltage 230 kV

Colombia, Bogota

Max. size 50 MVA
Max voltage 138 kV

Peru, Lima

Max. size 40 MVA
Max voltage 220 kV

Brazil, Guarulhos

Max. size 500 MVA
Max voltage 800 kV

India, Baroda

Max. size 250 MVA
Max voltage 220 kV

Vietnam, Hanoi

Max. size 100 MVA
Max voltage 110 kV

Thailand, Bangkok

Max. size 300 MVA
Max voltage 230 kV

China, Hefei

Max. size 360 MVA
Max voltage 220 kV

China, Chongqing

Max. size 1 000 MVA
Max voltage 550 kV

China, Zhongshan

Max. size 500 MVA
Max voltage 250 kV

Australia, Moorebank

Max. size 600 MVA
Max voltage 550 kV

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