Dry-type transformers
HiDry$^{72}$
Dry-type transformers
Class 72.5 kV

- A technical breakthrough
- Safe and ecological
- Reliable transformer technology
- Limited contribution with calorific energy to the source of fire
- Self-extinguishing
Dry-type transformers
The widest technology available

- Unique manufacturer with three coil technologies:
  - Vacuum cast coil
  - RESIBLOC®
  - Open wound
- Complementing technologies dedicated to specific market demands.
- Nearly 40 years of experience
- Proprietary technology and R&D departments
Dry-type transformers
Difference between RESIBLOC®, vacuum cast coil and open wound

Open wound

RESIBLOC®
HV insulation application

Vacuum cast coil
Casting under vacuum

Vacuum cast coil
HV disk winding
Dry-type transformers
Global producer with focus factories

Focus factories dedicated to produce dry-type transformers

USA
Germany
Russia
Korea
Spain
India
Egypt
Saudi Arabia
China
### Dry-type transformers

Global producer with focus factories II

<table>
<thead>
<tr>
<th></th>
<th>Vacuum cast coil</th>
<th>RESIBLOC®</th>
<th>Open Wound</th>
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<tbody>
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<td>RU*</td>
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</table>

* Assembly units
Dry-type transformers
Main advantages of dry transformers

- Safety for people and property
- Environmentally friendly
- Maintenance and pollution-free solution
- No fire hazard
- Easy installation
- Excellent resistance to short circuit currents
- Excellent capacity to support overloads
- Excellent performance in case of seismic events
- Suited for damp and contaminated areas
- Reduced cost on civil installation works and fire protection systems
Dry-type transformers
Applications

- Public works
- Hospitals
- Airports
- Shopping centers
- Public buildings
- Office buildings
- Stadiums
- Variable speed drives

- Special industries
- Utilities
- Ships
- Oil and gas
- Metal and mining industry
- Metro systems/ trains
- Wind and solar power
- Application with rectifiers
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HiDry™
The range I

- Ratings up to 63 MVA
- Primary voltage up to 72,5 kV:
  - with 325 kV BIL / AC 140 kV according to IEC
  - 350 kV BIL / AC 140 kV according to IEEE
  - 180 kV BIL / AC 90 kV, according to GOST
- Secondary voltage up to 36 kV:
  - with 170 kV BIL / AC70 kV according to IEC
- With or without on-load tap changer (OLTC)
HiDry\textsuperscript{72}  
The range II

- Classes: E2, C2, F1
- Partial discharges: <10 pC
- Insulation: 155 °C (F), 180 °C (H)
- AN, ANAF (up to +30%), AFWF
- Design temperature: 40 °C
- Star or delta connection
- Up to 17 taps with ± 10% regulation range
- Options, enclosure IP21 up to IP54
HiDry
The boarder lines

High power

High voltage

Small dry type

Power

Voltage

60 MVA

40 MVA

3.15 MVA

40.5 kV

72.5 kV

Evolution

Evolution
HiDry™
Technical advantages

For retrofit or new installations
- Similar footprint as existing transformers
- For indoor or outdoor installation
- Paralleling with existing oil-transformers possible

Safe and environment friendly
- No flammable liquids
- Self-extinguishing solid insulation
- 10-20 times smaller combustible mass, minimum smoke
- No risk of explosion
- Lower insurance liabilities
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Customer benefits

- Environmentally-friendly and cost-efficient
  - Optimized load loss
  - Lower infrastructural cost
  - Simple installation, no special civil works
  - Minimal requirements for safety and protection installations
  - Bushings available upon customer request
  - Virtually maintenance free
  - Easier unload and more efficient logistic costs
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Applications areas

- Inner-city substations
- Indoor and underground substations
- Chemical, oil and gas industry
- Environmentally sensitive areas (e.g. water protection areas)
- Renewable generation (e.g. off-shore wind turbines)
- Fire-risk areas (e.g. forests)
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Example on utilization

- The compact internal substations can be built in urban areas with limited space.
- Lower cost, lower environment impact.
- Less losses and higher people’s security.
Erection and commissioning
Easy and fast installation and commissioning
HiDry\textsuperscript{72}

Energy efficiency

- Saving in losses:
  - Dry transformers allow installation close to/inside buildings.
  - Quantified over a 30-years period, the total saving is 8.5 GWh or 280 MWh per year.
  - Resulting in reduced emissions (EU power mix):
    - CO\textsubscript{2}: 140 tons/yr
    - SO\textsubscript{2}: 375 kg/yr
    - NO\textsubscript{x}: 175 kg/yr
- Additional savings:
  - Civil works.
  - Fire protection system.
  - Commissioning.
  - Yearly maintenance.
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Technical achievements
72.5 kV dry-type transformer
A technically demanding design

- Development strongly supported by ABB Corporate Research and University collaborations.
- Extensive use of computer simulations allowed fast development and product optimization.
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Voltage distribution during impulse test

Voltage distribution along windings for 325 kV lightning impulse test

Temporal behavior of voltage distribution during application of lightning impulse

Max. values

<table>
<thead>
<tr>
<th>Max. values</th>
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<tbody>
<tr>
<td>30</td>
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<tr>
<td>25</td>
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<td>15</td>
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<td>10</td>
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<td>5</td>
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<td>0</td>
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</table>

Time (usec)

Actual Voltage (kV)

2 - 3: 24.1 @ 1.3 usec
Development strongly supported by simulations
Dielectric field stress

Simulation of electrical field stress during BIL and AC testing
Development strongly supported by simulations
Magnetic fields and eddy currents

Eddy current losses in structural components

Magnetic stray field
…and confirmed by extensive experimental testing
Exceeding the limits of standards

…and being tested beyond the limits in order to proof the expected safety margin
72.5 kV dry-type transformer
Overall sizes

<table>
<thead>
<tr>
<th></th>
<th>25 MVA, 66 / 10 kV</th>
<th>40 MVA, 66 / 10 kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (mm)</td>
<td>4370</td>
<td>4970</td>
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<tr>
<td>Width (mm)</td>
<td>2000</td>
<td>2000</td>
</tr>
<tr>
<td>Height (mm)</td>
<td>4120</td>
<td>4120</td>
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Dry-type w/o OLTC

Oil-filled

Dry transformer

Oil transformer
72.5 kV dry-type transformer
On-load tap changer

Characteristics of OLTC:
- Dry, oil-free technology
- Linear type
- For up to 23 taps and ± 18% regulation range (*)
- > 100’000 operations
- Low maintenance

(*) presently limited availability, please contact us for clarification
Conclusion and summary: ABB transformers
Safety – reliability – low losses

- Based upon a wide experience, ABB manufactures dry type transformers with the most technologically advanced design.

- Ratings of up to 60 MVA and voltages of up to 72.5 kV.

- Your advantages:
  - Protection of the environment
  - All materials practically halogens free
  - Limited contribution with calorific energy to the source of fire
  - Self-extinguishing
  - Enhanced safety
  - Reliable technology
  - Nearly maintenance free
  - Cost-efficient solutions
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