

# VPI and Air-Barrier Transformers: Technical Comparison

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## Introduction

In addition to cast resin transformers (TSL), the market offers two other types of dry-type transformers: **VPI (Vacuum Pressure Impregnation)** and **air-barrier**. These insulation technologies offer a balance between cost and performance, making them popular for various applications.

[Engineering audit for transformer selection](#)

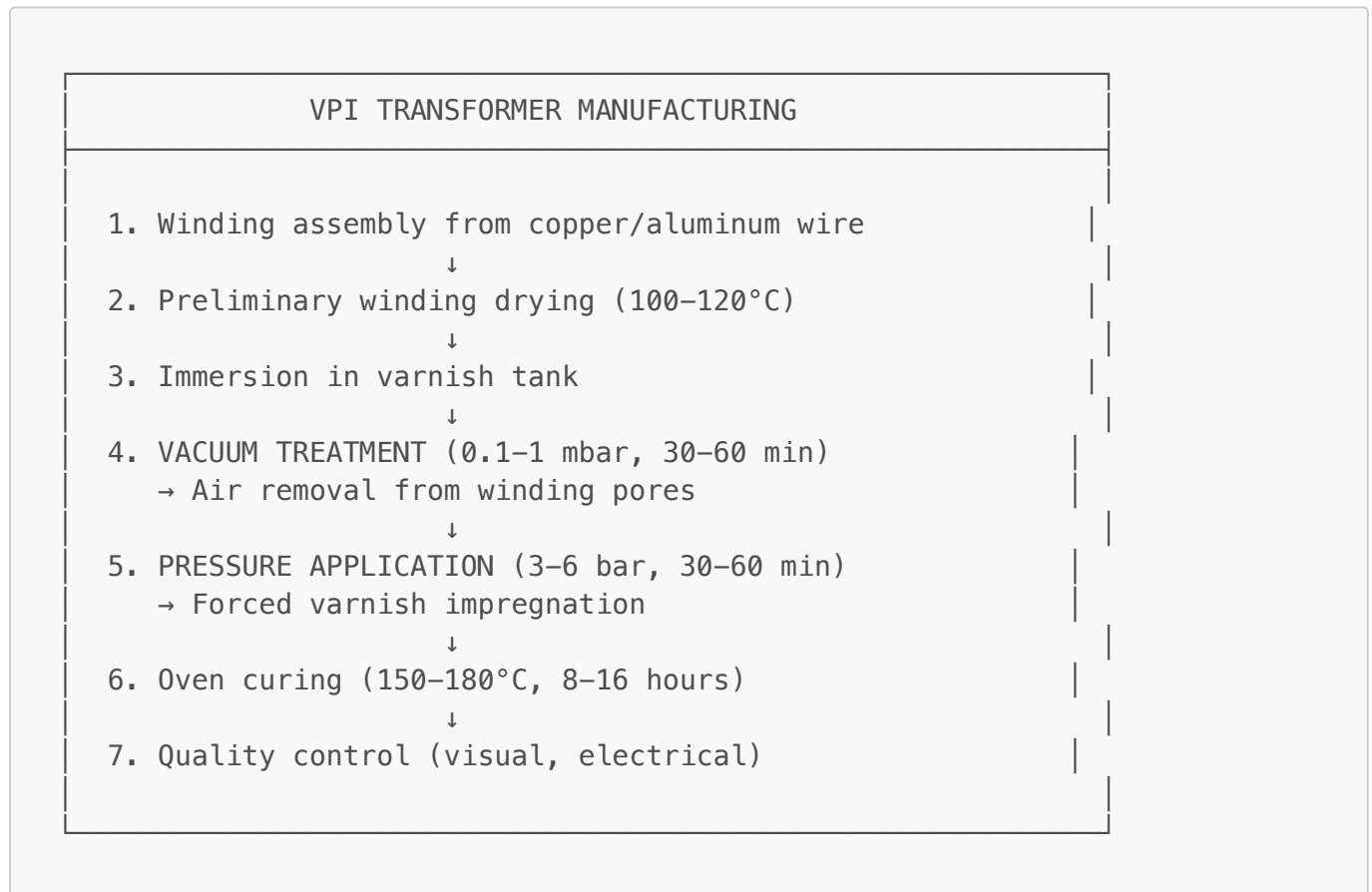
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## VPI Transformers (Vacuum Pressure Impregnation)

What is VPI Technology?

**VPI (Vacuum Pressure Impregnation)** is an insulation technology in which transformer windings are immersed in insulating varnish under vacuum and then cured under pressure. This ensures deep varnish penetration into the windings and elimination of air voids.

VPI Manufacturing Process



VPI Insulation Materials

**Insulating Varnishes:**

- Polyester varnishes (resistance up to 155°C)

- Epoxy varnishes (resistance up to 180°C)
- Polyurethane varnishes (flexibility, moisture resistance)

**Purpose:**

- Filling pores and voids in windings
- Increasing mechanical strength
- Protection from moisture and dust
- Improving thermal conductivity

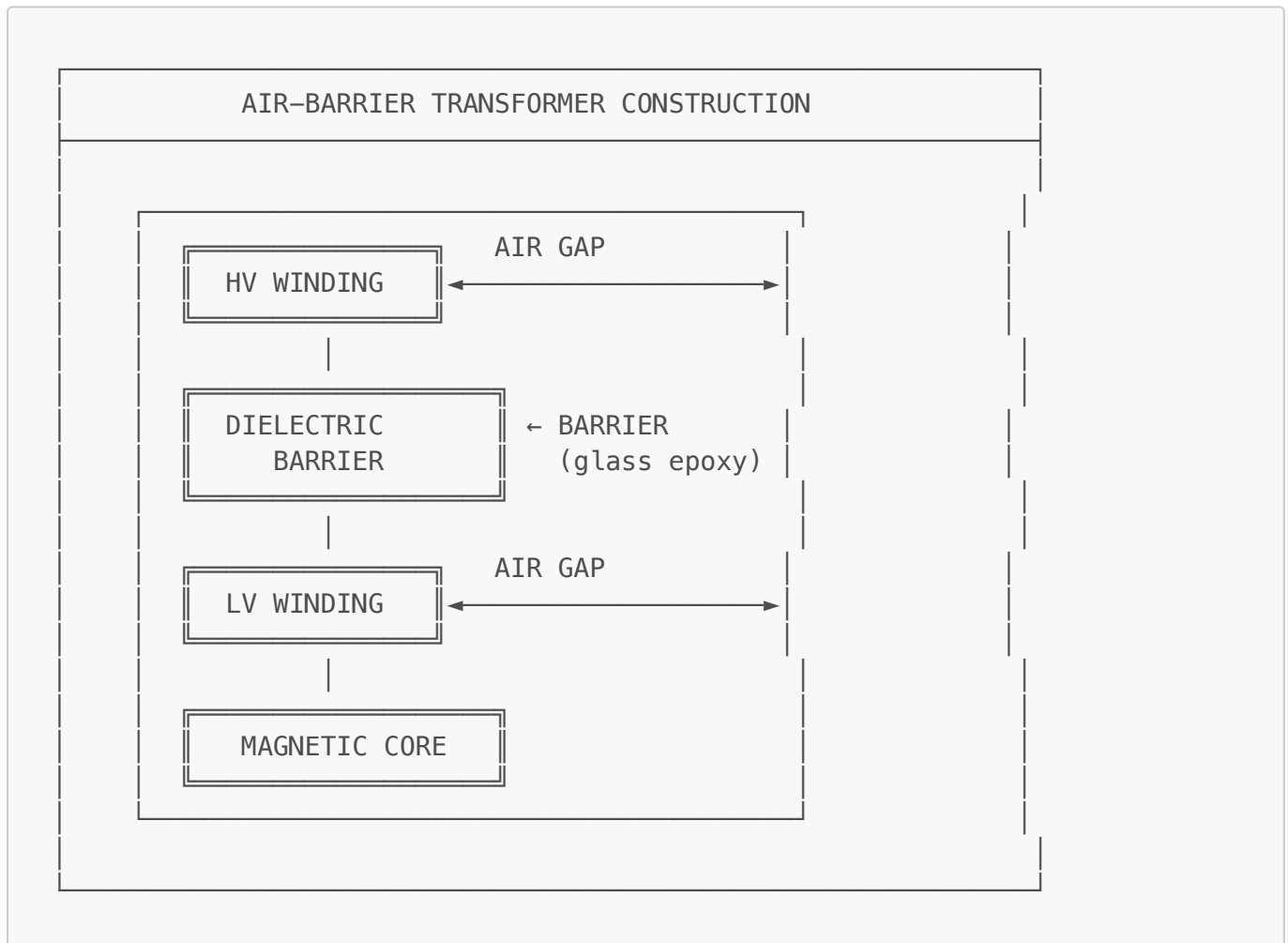
## Air-Barrier Transformers

### Operating Principle

**Air-barrier insulation** uses a combination of:

- Dielectric barriers (insulating plates, sheets)
- Air gaps between windings
- Surface varnish impregnation of windings

### Construction



### Barrier Materials

- **Glass epoxy laminate** (glass epoxy composite)
- **Electrical cardboard**
- **Polymer films** (polyester, polyimide)
- **Insulating tapes**

## VPI vs Air-Barrier Transformers Comparison

Parameter	VPI	Air-Barrier
<b>Hermeticity</b>	Partial	None
<b>Moisture Resistance</b>	Good	Low
<b>Mechanical Strength</b>	Medium	Low
<b>Service Life</b>	25-30 years	15-25 years
<b>Cost</b>	Medium	Low
<b>Repairability</b>	Simple	Simple
<b>Overload Capability</b>	Good	Good
<b>Heat Dissipation</b>	Good	Excellent
<b>Room Requirements</b>	Dry rooms	Clean dry rooms
<b>Voltage</b>	up to 35 kV	up to 10 kV

## VPI Transformer Technical Specifications

### VPI 10/0.4 kV Specifications Table

Power (kVA)	No-Load Losses (W)	SC Losses (W)	Uk (%)	Efficiency (%)	Weight (kg)
100	320	1850	4	97.8	580
160	450	2500	4	98.1	750
250	620	3400	4	98.3	980
400	880	4900	4	98.5	1380
630	1200	6800	4	98.6	1850
1000	1700	10000	5	98.7	2500
1600	2400	14800	6	98.8	3600

### VPI Advantages

#### ✓ Cost-Effectiveness

- 20-30% cheaper than cast resin
- Optimal price/quality ratio

**✓ Flexible Design**

- Suitable for wide range of applications
- Customization possible

**✓ Moderate Moisture Resistance**

- Moisture protection in controlled conditions
- Impregnated insulation

**✓ Simple Repair**

- Windings accessible for repair
- Re-impregnation possible

**✓ Good Overload Capability**

- Withstand short-term overloads
- Thermal resistance

**VPI Disadvantages****✗ Not Fully Hermetic**

- Inferior to cast resin
- Requires controlled conditions

**✗ Less Effective at High Thermal Loads**

- Compared to cast resin
- May require forced cooling

**✗ Sensitivity to Aggressive Environment**

- Not suitable for chemically active environments
- Requires protective enclosure

[B2B supply of VPI transformers](#)

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## Air-Barrier Transformer Technical Specifications

### Air-Barrier 10/0.4 kV Specifications Table

Power (kVA)	No-Load Losses (W)	SC Losses (W)	Uk (%)	Efficiency (%)	Weight (kg)
100	350	1950	4	97.7	520
160	500	2650	4	97.9	680
250	680	3600	4	98.1	890
400	950	5200	4	98.3	1250

<b>Power (kVA)</b>	<b>No-Load Losses (W)</b>	<b>SC Losses (W)</b>	<b>Uk (%)</b>	<b>Efficiency (%)</b>	<b>Weight (kg)</b>
630	1350	7200	4	98.4	1680

## Air-Barrier Advantages

### ✓ **Low Cost**

- Most affordable dry transformer type
- Up to 40% savings compared to TSL

### ✓ **Excellent Ventilation**

- Air gaps provide natural cooling
- Good heat dissipation

### ✓ **Simple Repair**

- Full access to windings
- Individual element replacement possible

### ✓ **Lightweight**

- Lower weight compared to cast types
- Simplifies installation

## Air-Barrier Disadvantages

### ✗ **Moisture Sensitivity**

- Require dry rooms
- Not suitable for outdoor installation

### ✗ **Dust Sensitivity**

- Dust reduces insulation properties
- Require regular cleaning

### ✗ **Low Mechanical Strength**

- Inferior to VPI and cast resin
- Sensitive to vibrations

### ✗ **Limited Service Life**

- 15-25 years (vs 30-40 for TSL)
- Rapid insulation aging

### ✗ **Voltage Limitation**

- Maximum 10 kV
- Not suitable for high-voltage networks

[Equipment selection by specifications](#)

# Application Areas

## VPI Transformers

### Ideal for:

- 🏢 Office buildings and business centers
- 🏭 Industrial enterprises (dry workshops)
- 🛒 Shopping malls
- 🎓 Educational institutions
- 🏥 Healthcare facilities (non-critical zones)
- ⚡ Distribution substations

### Not Recommended for:

- Outdoor installation without enclosure
- Chemically active environments
- High-humidity rooms

## Air-Barrier Transformers

### Ideal for:

- 🏭 Dry production facilities
- 🛠️ Workshops
- 📦 Warehouses with dry mode
- 💡 Lighting systems
- ⚡ Temporary installations

### Not Recommended for:

- Outdoor installation
- Humid rooms
- Dusty production
- Mission-critical facilities

# Three-Way Insulation Type Comparison

DRY TRANSFORMER INSULATION TYPE COMPARISON			
CRITERION	CAST (TSL)	VPI	AIR-BARRIER
Cost	\$\$\$\$	\$\$\$	\$\$
Service Life	30-40 yrs	25-30	15-25 years
Moisture Resist.	Excellent	Good	Low
Mech. Strength	High	Medium	Low
Repairability	Complex	Simple	Simple

Overload	Limited	Good	Good
Installation	Indoor/Out	Indoor	Indoor only
Voltage	up to 35kV	up to 35kV	up to 10kV
Fire Safety	K0	K0	K0

## Selection Recommendations

Choose TSL (Cast Resin) if:

- Maximum reliability is required
- Installation in mission-critical facilities
- Possible temperature and humidity fluctuations
- Minimal maintenance is needed
- Budget allows

Choose VPI if:

- Balance of price and quality is needed
- Operating conditions are controlled
- Regular inspection is possible
- Good overload capability is required

Choose Air-Barrier if:

- Limited budget
- Dry clean room available
- Temporary or backup installation
- Repair simplicity is priority

[Customs and logistics services](#)

## Why Buy from Metal-Asia.pw

 **Full Range** — TSL, VPI, Air-Barrier
  **Technical Consultation** — optimal type selection
  **Direct Supplies** — no intermediary markups
  **Quality Control** — at manufacturer
  **Manufacturer Warranty**

[Engineering selection and procurement](#)

## Useful Links

- [Power transformers](#)
- [Electrical equipment](#)
- [Quality control NDT](#)
- [Audit China B2B](#)
- [Contacts](#)

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*Document prepared based on manufacturer technical documentation and IEC 60076-11 standards.*