

**HITACHI**  
Inspire the Next



# HITACHI AMORPHOUS TRANSFORMERS



## Hitachi amorphous transformers reduce electric cost and environmental burdens.

**Hitachi Amorphous Transformers are super energy saving transformers that represent the advanced technological strength of the world leading high-tech company, Hitachi Industrial Equipment Systems Co., Ltd. (Hitachi – IES)**

**Hitachi Transformer's superior performance makes significant contribution to energy and CO<sub>2</sub> reduction by saving “No load losses (standby energy)”.**

Nakajo division, the production site of Hitachi Transformers has its roots in Kameido works, Tokyo. Kameido works made great contribution to Hitachi Group's development since its start and relocated to Nakajo, Niigata prefecture in 1974. Nakajo division is one of Hitachi's state-of-art factories surrounded by green forest and overlooking Japan Sea. Nakajo works makes every effort to provide an environmentally friendly operation using for example the most advanced effluent treatment facilities and other energy saving facilities such as Hitachi Amorphous Transformers.



Nakajo division

Hitachi Transformers have been well-received for their energy saving effects and commended numerous times. In 1979 and 2005, Nakajo won the Japanese Economy Minister's Prize for its excellence in energy management of production facilities.

Nakajo works also maintains ISO14001(JQA-EM5428) certification.

As a market leader, Hitachi IES delivers many high efficiency transformers to various institutes, hospitals, universities, factories and large size commercial facilities.

To achieve Hitachi Group's "Environmental Vision 2025" to reduce 100 million tons of annual CO<sub>2</sub> emission, Hitachi IES continues to introduce products which contribute to the global environment and energy conservation.



Registration number: JQA-EM5428  
Registration date: July 29, 1997

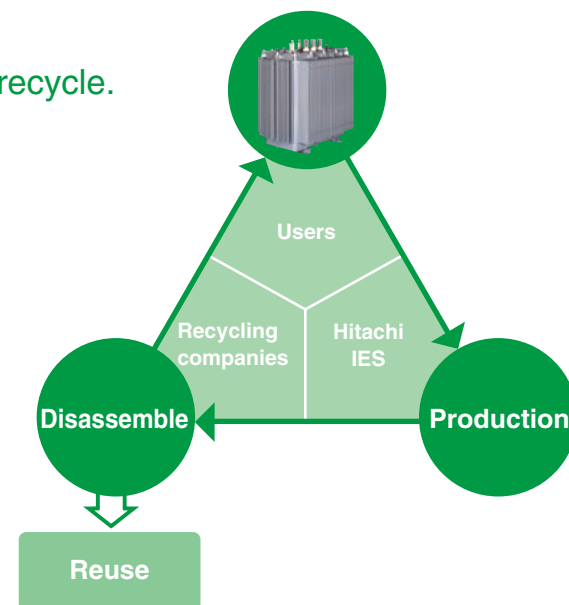
The Energy Saving Systems Division (Nakajo Division) of Hitachi Industrial Equipment Systems Co., Ltd. obtained ISO 14001 certification, an international standard for environmental management systems.

## Hitachi amorphous transformers are produced by state-of-art technology.

Many years of R&D effort realized the lowest loss transformers.  
 The combination of high technology and long years experience lead our transformers to the first level quality and performance in the world.  
 Hitachi IES produces the wide range of transformers for various applications.  
 Great benefits and high quality is always guaranteed.

### Hitachi amorphous transformer is suitable for recycle.

There is increasing demand of amorphous transformer to prevent global warming.  
 Amorphous core is made of recyclable material. Hitachi IES offers the transformer which is suitable for the recycle system.



## Product Lineup



Oil-Immersed Type Transformer

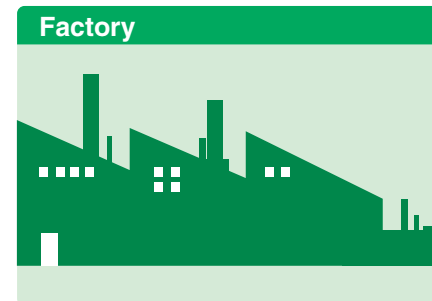


Molded Type Transformer

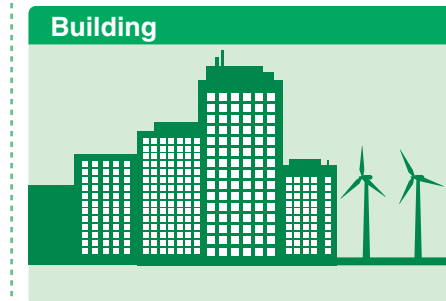


Overhead Type Transformer

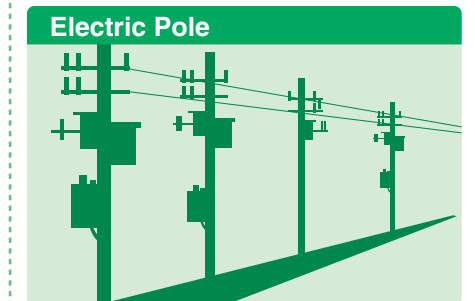
## Application



**For Outside Installation**  
 (Factory, outside facilities)



**For Inside Installation**  
 (Office building, hotel, hospital, inside facilities)



**For Utility Companies**

## Product Range

Products	Phase	Voltage (kV)	Capacity (kVA)
Oil-Immersed Type	Single or Three	0.2-22	10-3,000
Molded Type		0.2-11	10-1,500
Overhead type	Single	0.2-6.6	10-100

## Key Points to Save Energy with Transformers

### Hitachi Amorphous Transformer is the solution for saving energy.

There are two type of losses which are generated during operation : No load loss and Load loss.

Amorphous material has great advantage in reducing No load loss. By applying this material to the transformer core with Hitach IES's advanced technologies, it is possible to achive high efficiency and save huge amount of energy in many years.

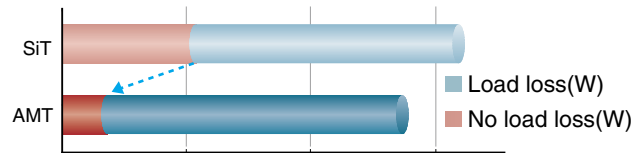
#### No Load Loss (Iron loss)

The constant loss that always occurs regardless of whether loaded or not.

#### Load Loss (Copper loss)

The loss occurs because of the flow of load current when loaded.

- Reductin of No Load Loss
  - Reductin of Load Loss
- } **Energy Saving  
CO2 Reduction**



### Amorphous Transformer is the Solutions

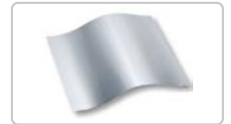
#### What is Amorphous Transformer?

The amorphous is a non-crystal substance created by rapidly freezing liquids of high temperature. Because there is no rule of atomic arrangement, the energy loss (hysteresis loss) is small when the flux of magnetic induction passes the iron core. In addition, eddy current loss is decreased because the thickness is approximately 0.03 mm, which is about 1/10 comparing with silicon steel. Therefore, the no load loss (eddy current loss and hysteresis loss) can be decreased to about 1/5 of silicon steel's.

#### Atomic Arrangement



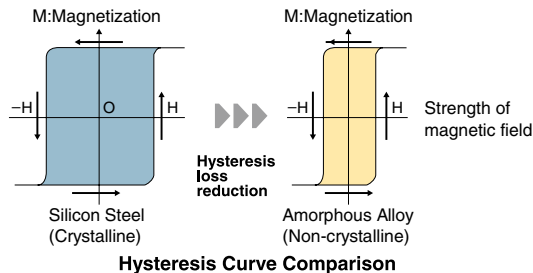
↓ Thickness 25μm  
↑ (1/10 of conventional materials)



Ribbon thickness is 1/10 of Silicon Steel's  
[Silicon Steel:0.23mm, Amorphous Alloy:0.025mm]

#### About the loss of transformers

The load loss and no load loss occur at the same time when the transformer is operated, the loss is a useless output chiefly converted into heat.



#### Hysteresis loss

By magnetic induction, magnetic domain rotates to have unified direction. The loss caused by this movement is hysteresis loss.

#### Eddy current loss

When magnetic flux flows, eddy current flows to negate the flux. This eddy current cause loss proportional to the resistance.

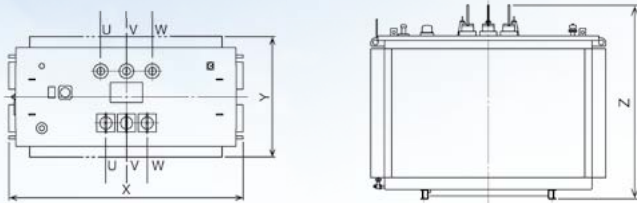
#### Material Characteristics Comparison

Higher electrical resistance, almost triple of Silicon steel's  
[Silicon Steel:50 μΩ-cm,  
Amorphous Alloy:130 μΩ-cm ]

Material	Saturation flux density (T)	Electrical resistance (μΩ-cm)	Iron loss (W/kg) <sup>(※1)</sup>	Thickness (mm)
Silicon steel(Crystalline)	2.03	50	0.440	0.23
Amorphous Alloy (Non-crystal line)	1.56	130	0.070	0.025

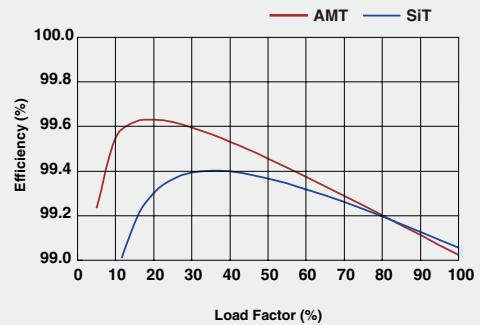
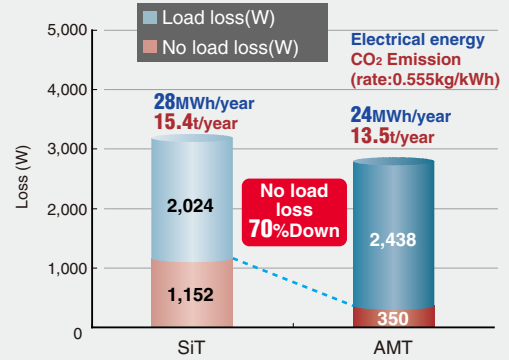
(※1) Estimated; 50Hz, flux density 1.3T

Oil-Immersed Type



Item		SiT	AMT
Dimension (mm)	X	1,420(100)	1,620(114)
	Y	1,075(100)	1,125(105)
	Z	1,510(100)	1,510(100)
Mass (kg)		2,445(100)	3,120(128)

3P 1000kVA 6kV/210V 60Hz



Item		SiT	AMT
100 % Loaded Loss (W)	No-Load Loss	1,152(100)	350(30)
	Load Loss	8,095(100)	9,750(120)
	Total Loss	9,247(100)	10,100(109)
50% Loaded Total Loss (W)		3,176(100)	2,788(88)

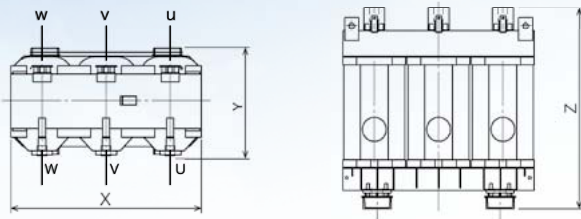
Characteristic Table

Oil Immersed Type

Phase	Core Type	Voltage (V)	Frequency (Hz)	Capacity (kVA)	No Load Loss (W)	Load Loss (W)	Efficiency (%)	50% Loaded Total Loss (W)
3P	Amorphous Steel	6.6kV/210	50Hz	100	85	1,640	98.30	495
				500	200	6,300	98.71	1,775
				1,000	315	10,600	98.92	2,965
			60Hz	100	85	1,640	98.30	495
				500	190	6,150	98.74	1,727
				1,000	350	9,750	99.00	2,787
3P	Silicon Steel	6.6kV/210	50Hz	100	248	1,392	98.38	596
				500	602	4,337	99.02	1,686
				1,000	1,212	8,326	99.05	3,294
			60Hz	100	237	1,302	98.48	562
				500	580	4,400	99.01	1,680
				1,000	1,152	8,095	99.08	3,175

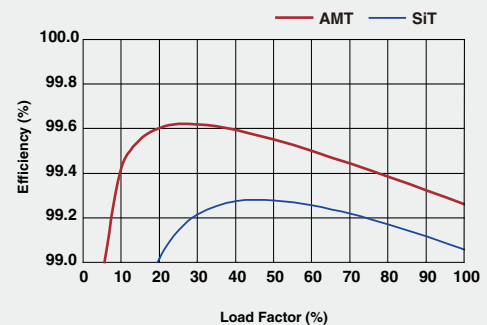
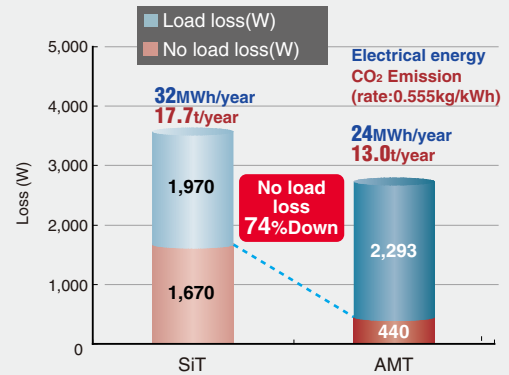
SiT=Silicon Steel Core Transformer  
AMT=Amorphous Steel Core Transformer

## Molded Type



Item		SiT	AMT
Dimension (mm)	X	1,395(100)	1,430(96)
	Y	700(100)	800(114)
	Z	1,490(100)	1,605(108)
Mass (kg)		2,400(100)	3,050(120)

## 3P 1000kVA 6kV/210V 60Hz



Item		SiT	AMT
100 % Loaded Loss (W)	No-Load Loss	1,670(100)	440(26)
	Load Loss	7,880(100)	9,170(116)
	Total Loss	9,550(100)	9,610(101)
50% Loaded Total Loss (W)		3,640(100)	2,733(75)

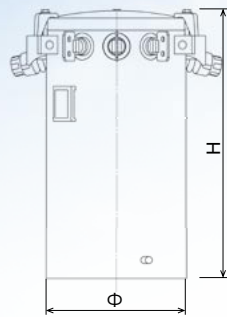
## Characteristic Table

### Molded Type

Phase	Core Type	Voltage (V)	Frequency (Hz)	Capacity (kVA)	No Load Loss (W)	Load Loss (W)	Efficiency (%)	50% Loaded Total Loss (W)
3P	Amorphous Steel	6.6kV/210	50Hz	100	100	1,750	98.40	537
				500	270	5,360	98.88	1,610
				1,000	460	8,970	99.06	2,702
			60Hz	100	95	1,800	98.14	545
				500	240	5,450	98.87	1,602
				1,000	440	9,170	99.04	2,732
3P	Silicon Steel	6.6kV/210	50Hz	100	288	1,875	97.88	756
				500	888	4,521	98.92	2,018
				1,000	1,640	7,880	99.05	3,610
			60Hz	100	300	1,875	97.87	768
				500	939	4,522	98.91	2,069
				1,000	1,670	7,880	99.05	3,640

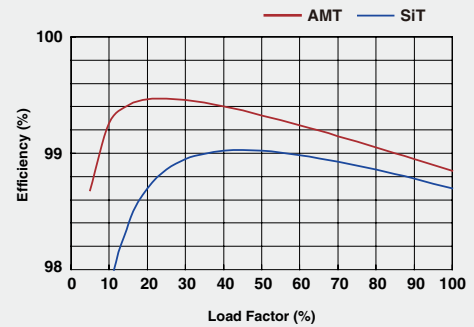
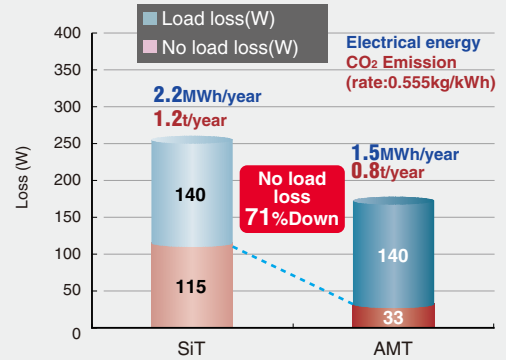
SiT=Silicon Steel Core Transformer  
AMT=Amorphous Steel Core Transformer

Overhead Type



Item		SiT	AMT
Dimension (mm)	Φ	435(100)	435(100)
	H	830(100)	890(107)
Mass (kg)		258(100)	310(120)

1P 50kVA 6kV/210V 60Hz



Item		SiT	AMT
100 % Loaded Loss (W)	No-Load Loss	115(100)	33(29)
	Load Loss	558(100)	558(100)
	Total Loss	673(100)	591(88)
50% Loaded Total Loss (W)		255(100)	173(68)
Total Owning Cost (*1)		100	89

Notes \*1 A factor =10(US\$/W)  
 B factor =3(US\$/W)  
 On the premise that "T.O.C. of SiT is 100"

Characteristic Table

Overhead Type

Phase	Core Type	Voltage (V)	Frequency (Hz)	Capacity (kVA)	No Load Loss (W)	Load Loss (W)	50% Loaded Total Loss (W)
1P	Amorphous Steel	6.6kV/210	50Hz	50	32	470	149
	Silicocon Steel				85	470	202
1P	Amorphous Steel		60Hz		33	558	172
	Silicocon Steel				115	558	254

SiT=Silicon Steel Core Transformer  
 AMT=Amorphous Steel Core Transformer

## Calculation Examples

### Annual Loss of Electricity Cost (money amount/year)

$$= \langle \text{No Load Loss (W)} + \text{Load Loss (W)} \times (\text{Load Factor})^2 \rangle / 1,000 \times 365 \text{ (days)} \times 24 \text{h} \times \text{Electric Charge ( /kWh)} / 1,000$$

#### Test calculation column

$$= \langle \text{ (W)} + \text{ (W)} \times (\text{ )}^2 \rangle / 1,000 \times 365 \text{ (days)} \times 24 \text{h} \times \text{Electric Charge ( /kWh)} / 1,000$$

### Reduction of Carbon-dioxide emissions

$$= \text{Electric power suppliers' emission coefficient } 0.444[\text{kg-CO}_2/\text{kWh}] \times \text{ [kg-CO}_2/\text{kWh}]$$

### Case Study (Nakajo Works)

#### Transformer Characteristics

	No Load Loss (W)	Load Loss (W)
25 years Old SiT	1,800	11,300
AMT	350	9,750

- 50% Load Factor - JPY11/kWh - CO<sub>2</sub> emission coefficient 0.444 (kg-CO<sub>2</sub>/kWh)

### Annual Loss of Electricity Cost (money amount/year)

$$\text{SiT: } \langle 1,800 \text{ (W)} + 11,300 \text{ (W)} \times 0.5^2 \rangle / 1,000 \times 365 \text{ (days)} \times 24 \text{h} \times 11 \text{ (JPY/kWh)} / 1,000 = 446 \text{ (k JPY/year)}$$

$$\text{AMT: } \langle 350 \text{ (W)} + 9,750 \text{ (W)} \times 0.5^2 \rangle / 1,000 \times 365 \text{ (days)} \times 24 \text{h} \times 11 \text{ (JPY/kWh)} / 1,000 = 269 \text{ (k JPY/year)}$$

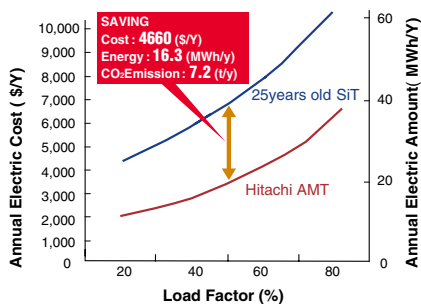
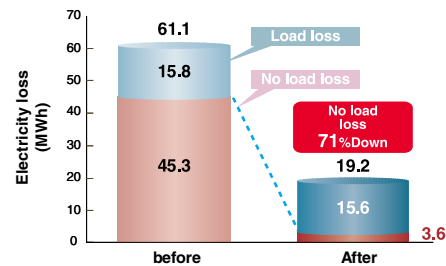
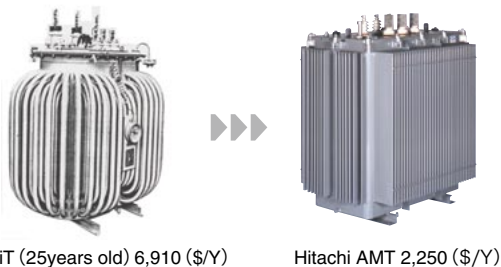
$$\Rightarrow \text{Great Cost Saving Effect: } 446 \text{ (k JPY/year)} - 269 \text{ (k JPY/year)} = 177 \text{ (k JPY/year)}$$

### Reduction of CO<sub>2</sub> emissions

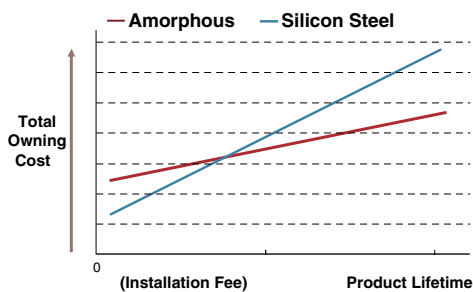
$$\text{SiT: } \langle 1,800 \text{ (W)} + 11,300 \text{ (W)} \times 0.5^2 \rangle / 1,000 \times 365 \text{ (days)} \times 24 \text{h} \times 0.444[\text{kg-CO}_2/\text{kWh}] / 1,000 = 18.0 \text{ (t/year)}$$

$$\text{AMT: } \langle 350 \text{ (W)} + 9,750 \text{ (W)} \times 0.5^2 \rangle / 1,000 \times 365 \text{ (days)} \times 24 \text{h} \times 0.444[\text{kg-CO}_2/\text{kWh}] / 1,000 = 10.8 \text{ (t/year)}$$

$$\Rightarrow \text{Great CO}_2 \text{ Reduction Effect: } 18.0 \text{ (t/year)} - 10.8 \text{ (t/year)} = 7.2 \text{ (t/year)}$$



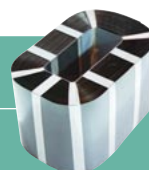
Electric cost : \$/Y 10 cent/kWh CO<sub>2</sub>Emission Rate:0.444kg -CO<sub>2</sub>/kWh



Transformer has long life cycle. Amorphous transformer shows advantages in total owning cost.

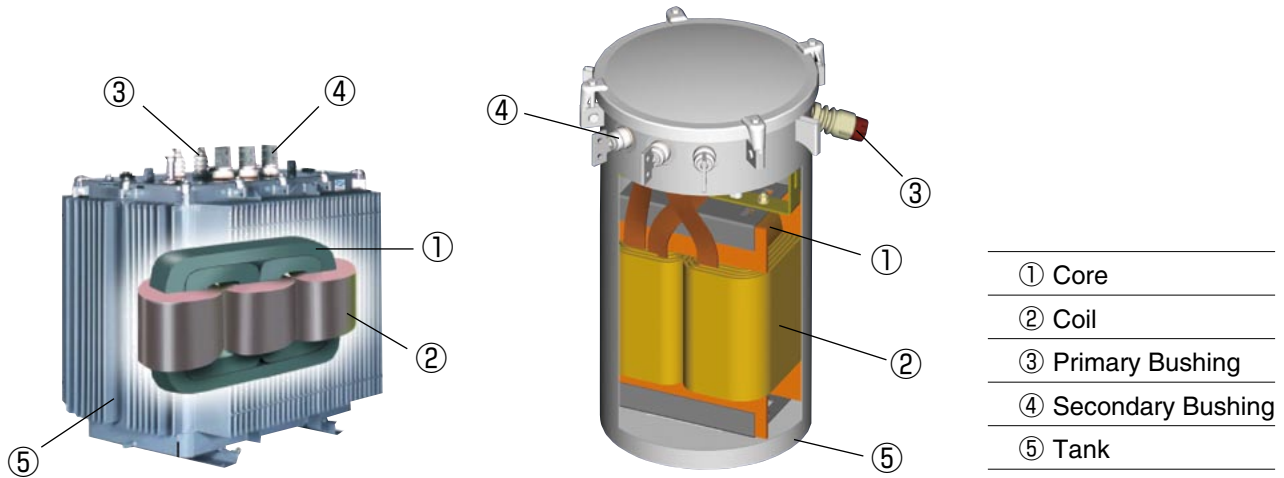
## Hitachi IES also offers

Amorphous Transformer Cores and Production Technologies.





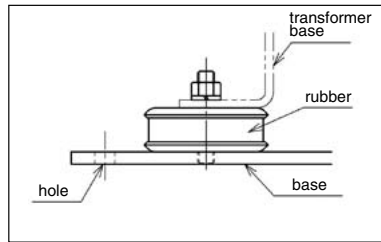
## Amorphous Transformer Structure



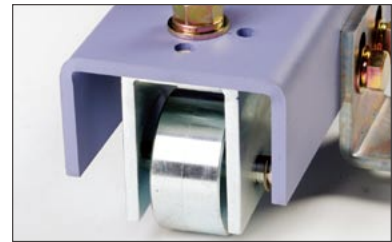
## Accessories



Dial Temperature Gauge



Rubber vibration insulator



Wheel

### Oil Immersed Transformer Standard / Option Accessories

● Standard ○ Option

Accessories	Capacity(kVA)	10-50	75-100	150-200	300-500	750-1,500	1,500-2,000
Primary Bushing		●	●	●	●	●	●
Secondary Bushing		●	●	●	●	●	●
Internal Control Tap Changer		●	●	●	●	※	※
External Control Tap Changer		※	※	※	○	●	●
Name Plate, Connection Diagram		●	●	●	●	●	●
Hand Hole		※	●	●	●	●	●
Lifting lugs for total body		●	●	●	●	●	●
Lifting lugs for internal body		※	●	●	●	●	●
Base		●	●	●	●	●	●
Earthing Terminal		●	●	●	●	●	●
Monitor (with pressure release valve)		※	○	●	●	●	※
Monitor (without pressure release valve)		※	※	※	※	※	●
High Voltage Terminal Cover		※	●	●	●	●	●
Oil Drain Tap		○	○	●	●	※	※
Oil Drain Valve		○	○	○	○	●	●
Pressure Release Valve		※	※	※	※	●	●
Dial Temperature Gauge		○	○	○	○	○	●
Contact Preventing Plate		○	○	○	○	○	○
Foundation bolt		○	○	○	○	○	○
Activated Alumina		○	○	○	○	○	○
Rubber vibration insulator (with Stopper)		○	○	○	○	○	○
Solt Tolerant Bushing (primary)		○	○	○	○	○	○
Flat Wheel		○	○	○	○	○	※
Upper Terminal Block		※	○	○	○	○	○
Bus Flange		※	○	○	○	○	○
Direction Change of Secondary Terminal		※	○	○	○	※	※
Colour Change		○	○	○	○	○	○
Solt Tolerant Coating		○	○	○	○	○	○
Special Coating		○	○	○	○	○	○
Low Temperature Resistance( Pt100Ω )		○	○	○	○	○	○
Primary, Secondary terminal Connection bolt		●	●	●	●	●	●

※Please contact us for the details.

## **Hitachi Industrial Equipment Systems Co., Ltd.**

### **Principal Office(International Sales Dept.)**

AKS Building, 3, Kanda Neribeicho, Chiyoda-ku, Tokyo, 101-0022, Japan

TEL: +81-(0)3-4345-6063

FAX: +81-(0)3-4345-6914

<http://www.hitachi-ies.co.jp/english/>

### **USA**

#### **Hitachi America, Ltd.**

(Industrial Components & Equipment Division)

50 Prospect Avenue, Tarrytown,

New York, 10591-4698

TEL: +1(914)332-5800

FAX: +1(914)332-5555

<http://www.hitachi-america.us/products/business/isd/index.html>

### **Europe**

#### **Hitachi Europe GmbH**

(Industrial Components & Equipment Group)

Am Seestern 18 (Euro Center)

D-40547 Düsseldorf

P.O.BOX 11053, 40545 Düsseldorf

TEL: +49 (211) 5283 0

FAX: +49 (211) 5283 649

<http://www.hitachi-ds.com/en/>

### **China**

#### **Hitachi (China) Ltd.**

(Shanghai Office)

(Hitachi (Shanghai) Trading Co., Ltd.)

(Industrial Equipment Systems Division)

18th Floor, Rui Jin Building No.205

Maoming Road (S) Shanghai, 200020

TEL: +86 (21) 6472-1002

FAX: +86 (21) 6472-4990

<http://www.hitachi.com.cn/micro/IEG/index.html>

### **Asia & Middle East**

#### **Hitachi Asia Ltd.**

Industrial Components & Equipment Division

24 Jurong Port Road, #03-05 Office Block, CWT Distripark

Singapore, 619097

TEL: +65 (6271) 6086

FAX: +65 (6278) 4521

<http://www.hitachi.com.sg/>

Information in this brochure is subject to change without notice.

For further information, please contact your nearest sales representative.