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**Instrument transformers for metering
service — Part 1: General measuring
instrument**

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by The Japan Electrical Manufacturers' Association (JEMA)/Japanese Standards Association (JSA) with a draft being attached, based on the provision of Article 12, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act. This edition replaces the previous edition (**JIS C 1736-1** : 2009), which has been technically revised.

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JIS C 1736 series consists of the following 2 parts under the general title *Instrument transformers for metering service* :

JIS C 1736-1 *Part 1: General measuring instrument*

JIS C 1736-2 *Part 2: Measuring instruments used in transaction or certification*

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Instrument transformers for metering service — Part 1 : General measuring instrument

1 Scope

This Standard specifies requirements for the instrument transformers for metering service used in combination with a watt-hour meter, a var-hour meter or a maximum demand watt-hour meter at the commercial frequency.

2 Normative reference

There are no normative references in this Standard.

3 Terms and definitions

For the purpose of this Standard, the following terms and definitions apply.

3.1 Terms relating to general terms

3.1.1

instrument transformer

equipment for current and voltage transformation to be used together with a watt-hour meter, a var-hour meter or a maximum demand watt-hour meter

NOTE It is a general term of a current transformer, a voltage transformer and a combined instrument transformer.

3.1.2

dry type instrument transformer

instrument transformer of which the principal components such as an iron core and winding are used in the air

3.1.3

mould type instrument transformer

instrument transformer of which the entire surface of winding is covered with resin or insulating material containing resin among dry type instrument transformers

3.1.4

oil-immersed instrument transformer

instrument transformer of which the principal components such as an iron core and winding are immersed in insulating oil

3.1.5

gas insulated instrument transformer

instrument transformer of which the principal components such as an iron core and winding are stored in the container filled with inert gas

For the inert gas, sulfur hexafluoride gas (SF₆ gas) is generally used.

3.1.6

primary winding

winding to which current or voltage to be transformed is applied

3.1.7

secondary winding

winding which supplies current or voltage to a watt-hour meter, a var-hour meter or a maximum demand watt-hour meter

3.1.8

secondary circuit

external circuit which receives current or voltage supplied by the secondary winding of an instrument transformer

3.1.9

maximum voltage

maximum circuit voltage normally generated which can guarantee the performance specified in this Standard under the standard service conditions

3.1.10

true transformation ratio

ratio of the current or voltage actually supplied from a secondary winding to the current or voltage actually applied to a primary winding, which is a value obtained by measurement

3.1.11

nominal transformation ratio

ratio of the rated secondary current to the rated primary current, or ratio of the rated secondary voltage to the rated primary voltage

3.1.12

ratio error (current transformation ratio error or voltage transformation ratio error)

error caused by the fact that the true transformation ratio is not equal to the nominal transformation ratio

Two types of ratio error are current transformation ratio error and voltage transformation ratio error. The ratio error is expressed by the following formula.

$$\varepsilon = \frac{K_n - K}{K}$$

where, ε : ratio error (%)
 K_n : nominal transformation ratio
 K : true transformation ratio

3.1.13

phase angle

phase difference between a primary current vector and a secondary current vector, or phase difference between a primary voltage vector and a secondary voltage vector

The direction of a vector is selected in the direction where the phase angle of an ideal instrument transformer is taken as zero, and the phase angle when a secondary current vector or a secondary voltage vector progresses is taken as being positive, which is expressed in arc-minute.

3.1.14

resultant error

error in which the measurement of a watt-hour meter, a var-hour meter or a maximum demand watt-hour meter is affected by an instrument transformer, which is a value obtained by combining a ratio error and an error due to phase angle

3.1.15

burden

load connected between the secondary terminals of an instrument transformer, which is expressed by the apparent power (VA) consumed by the load at rated secondary current or rated secondary voltage at rated frequency and the power factor of the load

3.1.16

rated burden

secondary burden per winding which serves as the performance assurance acceptance criteria specified in this Standard

3.1.17

service burden

burden which is connected to instrument transformer in service

3.1.18

range of service burden

range of burden in which the change due to the burden of the resultant error of the instrument transformer used together with an electric meter is permitted according to the service division of the electric meter

3.1.19

rated frequency

frequency which serves as the performance assurance acceptance criteria specified in

this Standard

3.1.20

accuracy class

class which indicates the accuracy of an instrument transformer expressed by the limit value of a resultant error when the rated current or rated voltage at rated frequency is applied under the rated burden

3.1.21

partial discharge

discharge in which the insulation between conductors is only partially bridged

It does not include the discharge in which the the insulation between conductors is completely bridged.

3.1.22

rated gas pressure

gas pressure which serves as the performance criteria of a gas insulated instrument transformer expressed as gauge pressure at 20 °C

3.1.23

minimum guaranteed gas pressure

minimum gas pressure which can guarantee insulation performance and energization performance expressed as gauge pressure at 20 °C

3.1.24

accumulation method

leak test method in which the container junction of a gas insulated instrument transformer, the gas piping surrounding and the whole equipment under test are enclosed by a polyethylene sheet, etc., and the leaking gas accumulated in the space inside the sheet is detected by a gas detector after the elapse of an appropriate period of time

3.1.25

tracing method

leak test method for checking the existence of gas leakage along the part to be tested with a gas detector directly brought to near the container junction of a gas insulated instrument transformer or the gas piping surrounding

3.1.26

initial temperature

initial temperature of winding to be set in the calculation of thermal withstand current and secondary short-circuit

3.2 Terms relating to current transformer

3.2.1

current transformer

instrument transformer which proportionally transforms primary current into secondary current, including the current transformer portion of a combined instrument transformer

3.2.2

window type current transformer

current transformer used by inserting or winding the primary conductor such as a bus bar, single bushing and cable into or around the current transformer iron core window on which a secondary winding is wound

Some window type current transformers have the insulation in the main circuit side and some do not.

3.2.3

split type current transformer

current transformer in which a secondary winding is wound around each of the split iron cores, which is a kind of a window type current transformer

It has the structure such that it can be installed in an existing bus bar or cable. Generally, it does not have the insulation in the main circuit side.

3.2.4

tightening torque

torque which serves as the performance assurance acceptance criteria specified in this Standard

The torque which serves as the criteria is applied to the split type current transformer having the structure such that assembly is performed using bolts and screw threads among them.

3.2.5

rated current

primary current and secondary current which serve as the performance assurance acceptance criteria specified in this Standard

3.2.6

rated withstand current

limit of overcurrent which guarantees the performance specified in this Standard, expressed by the rated overcurrent strength (value of the guaranteed overcurrent divided by the rated primary current), or the rated overcurrent (value of the guaranteed overcurrent)

3.2.7

multiple ratio current transformer

current transformer with two or more rated primary currents

It is used when a wide range of primary currents are measured with one current transformer. Current values are switched by a series-parallel switching system or a multi-tap switching system.

3.3 Terms relating to voltage transformer and combined instrument transformer**3.3.1****voltage transformer**

instrument transformer which proportionally transforms primary voltage into secondary voltage, including the voltage transformer portion of a combined instrument transformer and the capacitor voltage transformer

3.3.2**combined instrument transformer**

instrument transformer in which a current transformer and a voltage transformer are integrated into one unit, put into an enclosure, etc. and connected

3.3.3**capacitor voltage transformer**

voltage transformer utilizing the divided voltage by capacitor

3.3.4**unearthed voltage transformer**

voltage transformer used in order to measure the voltage between electric lines by connecting two or more primary terminals to each different electric line

3.3.5**earthed voltage transformer**

voltage transformer used in order to measure the voltage between the electric line and ground by connecting one end of a primary terminal to the electric line and the other end to the ground

3.3.6**rated voltage**

primary voltage and secondary voltage which serve as the performance assurance acceptance criteria specified in this Standard

3.3.7**main capacitor of capacitor voltage transformer**

capacitor between the line-side primary terminal and the voltage dividing point of a capacitor voltage transformer

3.3.8

voltage dividing capacitor of capacitor voltage transformer

capacitor between the voltage dividing point and the earth side terminal of a capacitor voltage transformer

3.3.9

voltage converter of capacitor voltage transformer

voltage converter connected in parallel used by directly connecting to a voltage dividing capacitor or through a resonance reactor

3.3.10

divided voltage

terminal voltage of a voltage dividing capacitor when primary voltage is applied to a capacitor voltage transformer

3.3.11

limiting load

limit of the load in which a voltage transformer can be used without exceeding the predetermined temperature rise when a voltage transformer is continuously used at a rated primary voltage at rated frequency, which is expressed in the apparent power (VA) at rated secondary voltage

A capacitor voltage transformer is excluded.

4 Service condition

4.1 Standard service condition

The service condition which satisfies all the following conditions is called the standard service condition. Unless otherwise specified, a instrument transformer shall be used under this condition.

- a) When the ambient temperature is $-20\text{ }^{\circ}\text{C}$ to $40\text{ }^{\circ}\text{C}$ and the average ambient temperature for 24 h is $35\text{ }^{\circ}\text{C}$ or under
- b) When the installation location does not exceed an altitude of 1 000 m
- c) When the service condition does not correspond to any of **4.2**

4.2 Special service condition

The service condition corresponding to any of the following conditions is called the special service condition. When an instrument transformer is used under this service condition, it shall be especially specified.

- a) When used under the condition not in the range of the altitude and ambient temperature specified in **4.1 a)** and **b)**
- b) When used at the location exposed to extreme salt breeze

- c) When used in an always humid environment
- d) When used at the location where excessive water vapour or oil vapour exists
- e) When used at the location where explosive, inflammable or other harmful gases exist or these gases may reach
- f) When used at the excessively dusty location
- g) When used at the location subjected to abnormal vibration or impact
- h) When used at the specially snowy and icy location
- i) When used under the special conditions other than those above-mentioned

5 Structure

5.1 General

The instrument transformer shall be so structured that it has sufficient durability electrically and mechanically, clamping parts thereof are hard to be loosened and maintenance inspection can be performed safely and easily.

5.2 Mechanical strength

Each part of an instrument transformer shall have the strength which withstands the following pressure.

- a) Static constant horizontal acceleration of 5 m/s^2
- b) Wind pressure of wind speed of 40 m/s (limited to the outdoor type)
- c) Dynamic force at the time of resonance when vibrating the lower end of the stand to which an instrument transformer is attached taking the seismic wave as a sinusoidal wave. This load shall be applied only to the instrument transformer exceeding 100 kg in mass. The vibration condition at the time of resonance shall be as agreed between the interested parties.

5.3 Insulating tubes

For the insulating tubes, the required electric properties and mechanical properties shall be good and the prolonged use shall be enabled.

5.4 Internal structure

For internal structure, the material of an iron core, winding, etc., to be used shall be of good quality, the assembly shall be strong, and the looseness of clamping parts and the displacement of relative positions shall not occur in transportation and prolonged service.

5.5 Sealing structure

The sealing structure shall be as follows.

- a) The oil-immersed type shall have the sealing structure in which nitrogen gas is enclosed on the oil surface or oil is filled up.
- b) The gas insulation type shall be so structured that insulating gas such as sulfur

hexafluoride gas (SF₆ gas) is enclosed and the independent sealing is enabled.

5.6 Sealing

The instrument transformer shall be equipped with a sealing structure on a lid, a primary-terminal, a secondary-terminal box, etc. when required so that the structure and performance cannot be changed in order to maintain the service provisions.

5.7 Polarity

It shall be the subtractive polarity.

6 Ratings

6.1 Maximum voltage

The maximum voltage of an instrument transformer shall be as given in Table 1; however, the window type current transformer without the insulation in the main circuit side is excluded.

Table 1 Maximum voltage of instrument transformer

Unit: kV			
Nominal voltage	Maximum voltage	Nominal voltage	Maximum voltage
0.22	0.23	33	34.5
0.44	0.46	66	69
1.1	1.15	77	80.5
3.3	3.45	110	115
6.6	6.9	154	161
11	11.5	187	195.5 ^{b)}
13.2	13.8 ^{a)}	220	230 ^{b)}
16.5	17.25 ^{a)}	275	287.5 ^{b)}
22	23	500	550 ^{b)}
Notes ^{a)} The instrument transformers with a maximum voltage of 13.8 kV and 17.25 kV are limited to those used for a generator circuit. ^{b)} The instrument transformers with a maximum voltage of 195.5 kV or over are applicable to the line of an effectively earthed system.			

6.2 Rated current

The rated current of a current transformer shall be as given in Table 2.

The values other than those given in Table 2 shall be as agreed between the interested parties.

Table 2 Rated current of current transformer

Unit: A

Rated primary current				Rated secondary current
10	100	1 000	10 000	5
—	120	1 200	12 000	
15	150	1 500	15 000	
20	200	2 000	20 000	
25	250	2 500	—	
30	300	3 000	30 000	
40	400	4 000	—	
50	500	5 000	—	
60	600	6 000	—	
75	750	—	—	
80	800	8 000	—	
The rated primary current of a multiple ratio current transformer shall be selected from this table, and in the case of the dual ratio current transformer, the double ratio should be adopted.				

6.3 Rated voltage

The rated voltage of a voltage transformer shall be as given in Table 3 and Table 4.

The values other than those given in Table 3 and Table 4 shall be as agreed between the interested parties.

Table 3 Rated voltage of unearthed voltage transformer and three-phase earthed voltage transformer

Rated primary voltage				Rated secondary voltage V
kV				
—	1.1	11	110	110
—	—	13.2 ^{a)}	—	
—	—	16.5 ^{a)}	154	
0.22	—	22	—	
—	3.3	33	—	
0.44	6.6	66	—	
—	—	77	—	
Note ^{a)} The voltage transformers with a rated primary voltage of 13.2 kV and 16.5 kV are limited to those used for a generator circuit.				

**Table 4 Rated voltage of single-phase earthed voltage transformer
(including capacitor voltage transformer)**

Rated primary voltage kV		Rated secondary voltage V
11/√3	110/√3	110/√3
13.2/√3 a)	—	
16.5/√3 a)	154/√3	
—	187/√3	
22/√3	220/√3	
—	275/√3	
33/√3	500/√3	
66/√3	550/√3	
77/√3	—	
Note a) The voltage transformers with a rated primary voltage of 13.2/√3 kV and 16.5/√3 kV are limited to those used for a generator circuit.		

6.4 Rated withstand current

The withstand current of a current transformer shall be the value in Table 5 when expressed by the rated overcurrent strength, and the value in Table 6 when expressed by the rated overcurrent. The values other than those given in Table 5 and Table 6 shall be as agreed between the interested parties.

The current application time shall be 1 s.

Table 5 Rated overcurrent strength of current transformer

Rated overcurrent strength ^{a)}	Overcurrent to be guaranteed
40	40 times the rated primary current
75	75 times the rated primary current
150	150 times the rated primary current
300	300 times the rated primary current
Note ^{a)} When the rated overcurrent strength exceeds 300, it shall be treated as a special product.	

Table 6 Rated overcurrent of current transformer

Nominal voltage kV	Maximum voltage kV	Rated overcurrent ^{a)}						
		kA						
0.22	0.23	— ^{b)}	—	—	—	—	—	—
0.44	0.46	— ^{b)}	—	—	—	—	—	—
1.1	1.15	— ^{b)}	—	—	—	—	—	—
3.3	3.45	1.6	4	8	16	25	40	—
6.6	6.9	2	4	8	12.5	20	31.5	40
11	11.5	25	40	50	80	—	—	—
22	23	12.5	20	25	40	50	63	—
33	34.5	12.5	16	25	31.5	40	—	—
66	69	12.5	20	25	31.5	40	—	—
77	80.5	12.5	20	25	31.5	—	—	—
110	115	12.5	20	25	31.5	40	—	—
154	161	12.5	20	25	31.5	40	—	—
187	195.5	12.5	16	25	31.5	40	50	—
220	230	20	25	31.5	40	50	63	—
275	287.5	16	20	31.5	40	50	63	—
500	550	40	50	63	—	—	—	—
Notes ^{a)} When the value obtained by converting the rated overcurrent into the rated overcurrent strength exceeds 300, it shall be treated as a special product. ^{b)} When the maximum voltage is 1.15 kV or under, it is generally expressed by the overcurrent strength.								

6.5 Accuracy class

The accuracy class of an instrument transformer shall be four classes as given in Table 7.

Table 7 Accuracy class of instrument transformer

Accuracy class	Main usage
Class 0.2 W	For extra special precision watt-hour meters, for var-hour meters and for maximum demand watt-hour meters
Class 0.3 W	For special precision watt-hour meters, for var-hour meters and for maximum demand watt-hour meters
Class 0.5 W	For precision watt-hour meters, for var-hour meters and for maximum demand watt-hour meters
Class 1.0 W	For ordinary watt-hour meters, for var-hour meters and for maximum demand watt-hour meters

6.6 Rated burden

6.6.1 Current transformer

The rated burden of a current transformer shall be as given in Table 8.

The values other than those given in Table 8 shall be as agreed between the inter-

ested parties.

The rated burden should be selected as close to the service burden as possible.

Table 8 Rated burden of current transformer

Unit: VA

Accuracy class	Rated burden					
Class 0.2 W	2	3	5	10	15	
Class 0.3 W	2	3	5	10	15	25
Class 0.5 W						
Class 1.0 W						

6.6.2 Voltage transformer

The rated burden of a voltage transformer shall be as given in Table 9.

The values other than those given in Table 9 shall be as agreed between the interested parties.

The rated burden should be selected as close to the service burden as possible.

Table 9 Rated burden of voltage transformer

Unit: VA

Accuracy class	Rated burden					
Class 0.2 W	5	10				
Class 0.3 W	5	10	15	25	50	
Class 0.5 W						
Class 1.0 W						

6.7 Rated frequency

The rated frequency of an instrument transformer shall be 50 Hz, 60 Hz, or 50 Hz·60 Hz in common.

7 Performance

7.1 Withstand current

The withstand current of a current transformer shall be as follows.

- a) **Thermal withstand current** The thermal withstand current of a current transformer, when tested in accordance with **8.3.1 a) 1)**, shall satisfy the requirements in **c)**.

When verification is performed by calculation according to the calculation formula in **8.3.1 a) 2)**, the final temperature shall not exceed 250 °C for the heat resistance Class A and the heat resistance Class E, and 350 °C for the heat re-

sistance Class B.

- b) **Mechanical withstand current** The mechanical withstand current of a current transformer, when tested in accordance with **8.3.1 b)**, shall satisfy the requirements in c).
- c) **Acceptance criteria of withstand current** The acceptance criteria of withstand current shall be as follows.
 - 1) There shall be no damage on appearance.
 - 2) There shall be no significant change of a resultant error (for each phase) between before and after the withstand current test.

The test point of resultant error shall be taken as two points of the rated primary current at rated frequency and the current 0.2 times the rated primary current under the rated burden (a power factor of 0.8 lagging current).

- 3) There shall be no abnormality in the partial discharge test specified in **8.3.4 d)**.

7.2 Secondary short-circuit

For the secondary short-circuit of a voltage transformer, when tested in accordance with **8.3.2**, the voltage transformer shall not be damaged thermally and mechanically.

When the thermal short-circuit strength is verified by calculation according to the calculation formula in **8.3.1 a) 2)**, the final temperature shall not exceed 250 °C for the heat resistance Class A and the heat resistance Class E, and 350 °C for the heat resistance Class B.

The acceptance criteria of a secondary short-circuit shall be as follows.

- a) There shall be no damage on appearance.
- b) There shall be no significant change of a resultant error (for each phase) between before and after the short-circuit test.

The test point of resultant error shall be taken as one point of rated primary voltage at rated frequency under the rated burden (a power factor of 0.2 lagging current).

- c) There shall be no abnormality in the partial discharge test specified in **8.3.4 d)**.

7.3 Temperature rise

The temperature rise of an instrument transformer, when tested in accordance with **8.3.3**, shall be not more than the values specified in Table 10. If it is difficult to measure the temperature rise of the oil, it may be omitted by agreement between the interested parties.

Table 10 Limits of temperature rise of instrument transformer

Unit: K

Target		Limit of temperature rise		
		Heat re- sistance Class A	Heat re- sistance Class E	Heat re- sistance Class B
Winding	Dry self-cooled type	55	70	75
	Oil-immersed self-cooled type		—	—
	Gas insulation type ^{a)}	—	70	—
Oil	When oil in body tank contacts open air directly	50	—	—
	When oil in body tank does not contact open air directly	55	—	—
Surface of metal parts such as terminal, iron core in contact with insulating material ^{b)}		Temperature which does not damage adjacent insulating material		
Notes ^{a)} In the case of gas insulation type, the temperature rise of gas is not specified.				
^{b)} Limited to the case where the temperature can be measured.				

7.4 Withstand voltage

The withstand voltage of an instrument transformer shall be as follows.

The withstand voltage performance of a window type current transformer without the insulation in the main circuit side shall be applied only to the low voltage side.

- a) **Lightning-impulse withstand voltage** For the lightning-impulse withstand voltage of an instrument transformer, when tested in accordance with **8.3.4 a)**, the voltage specified in Table 11 shall be applied and the instrument transformer shall withstand it.

Table 11 Test voltage of instrument transformer (lightning-impulse withstand voltage)

Unit: kV

Nominal voltage	Maximum voltage	Test voltage				
		Full wave			Chopped wave	Full wave
		Primary side of current transformer, unearthed and earthed voltage transformers	Between secondary winding terminals ^{c)}	Between the secondary winding and the enclosure	Primary side of unearthed and earthed voltage transformers (excluding capacitor voltage transformer)	Primary side of instrument transformer used out of protection range of lightning arrester (for non-protected area)
0.22	0.23	—	—	—	—	—
0.44	0.46	—	—	—	—	—
1.1	1.15	—	—	—	—	—
3.3	3.45	30 45	4.5	7	— 50	—
6.6	6.9	45 60			— 65	—
11	11.5	75 90			— 100	—
13.2	13.8 ^{a)}	100 115			— 125	—
16.5	17.25 ^{a)}	100 115			— 125	—
22	23	100 ^{b)} 125 150			— — 165	180
33	34.5	150 ^{b)} 170 200			— — 220	240
66	69	350			385	420
77	80.5	400			440	480
110	115	550			605	660
154	161	750			825	900
187	195.5	650 ^{b)} 750			715 825	900
220	230	750 ^{b)} 900			825 990	1080
275	287.5	950 ^{b)} 1050			1045 1155	1260
500	550	1300 ^{b)} 1425 1550 1800			1430 1568 1705 1980	1800
Notes ^{a)} The instrument transformers with a maximum voltage of 13.8 kV and 17.25 kV are limited to those used for a generator circuit. ^{b)} Reduced test voltage value. ^{c)} For multiple ratio current transformers, between terminals having the maximum number of turns.						

- b) **Short-time commercial frequency withstand voltage** For the short-time commercial frequency withstand voltage of an instrument transformer, when tested in accordance with 8.3.4 b), the voltage specified in Table 12 shall be applied and the instrument transformer shall withstand it.

Table 12 Test voltage of instrument transformer (short-time commercial frequency withstand voltage and prolonged commercial frequency withstand voltage)

Unit: kV

Nominal voltage	Maximum voltage	Test voltage			
		Short-time commercial frequency withstand voltage			Prolonged commercial frequency withstand voltage ^{a)}
		Between the primary windings (primary conductors) connected together and the secondary windings and enclosure connected together of current transformer and unearthed voltage transformer	Between the earth-side primary terminal and the enclosure of earthed voltage transformer	Between terminals of voltage dividing capacitor of capacitor voltage transformer	Between the primary windings (primary conductors) connected together and the secondary windings and enclosure connected together of current transformer
		Between the line-side primary terminal and the earth-side primary terminal of capacitor voltage transformer	Between the secondary winding and the enclosure		Between the line-side primary terminal and the earth-side primary terminal of earthed voltage transformer and capacitor voltage transformer
			Between windings in which primary winding ^{b)} or secondary winding is comprised of two or more mutually insulated windings		
0.22	0.23	2	2 ^{d)}	—	—
0.44	0.46	3			
1.1	1.15	4			
3.3	3.45	10 16			
6.6	6.9	16 22			

Table 12 (concluded)

11	11.5	28		Divided voltage of short-time commercial frequency withstand voltage value between the line-side primary terminal and the earth-side primary terminal	
13.2	13.8 ^{c)}	39			
16.5	17.25 ^{c)}	39			
22	23	50			
33	34.5	70			
66	69	140			
77	80.5	160			
110	115	230			
154	161	325			
187	195.5	—		Divided voltage of prolonged commercial frequency withstand voltage value between line-side primary terminal and earth-side primary terminal	170-225-170
220	230				200-265-200
275	287.5				250-330-250
500	550				475-635-475
Notes ^{a)} Three figures of test voltage of prolonged commercial frequency withstand voltage refer to the test voltages V_1 , V_2 and V_3 corresponding to the application time T_1 , T_2 and T_3 in order. T_1 , T_2 and T_3 indicate the application time in prolonged commercial frequency withstand voltage test as shown in Figure 1.					
^{b)} The primary winding is limited to the current transformer.					
^{c)} The instrument transformers with a maximum voltage of 13.8 kV and 17.25 kV are limited to those used for a generator circuit.					
^{d)} When there is the designation for improving the insulation performance of the earth-side primary terminal, it shall be taken as a special product, and for the instrument transformer with a maximum voltage of 11.5 kV, 13.8 kV and 17.25 kV, the test voltage shall be 4 kV, and for the instrument transformer with a maximum voltage of 23 kV or over, the test voltage shall be 10 kV.					

- c) **Induced withstand voltage** For the induced withstand voltage of an instrument transformer, when tested in accordance with 8.3.4 c), the voltage specified in Table 13 shall be applied according to the type and the instrument transformer shall withstand it.

Table 13 Test voltage of voltage transformer (induced withstand voltage)

Type	Test voltage
Unearthed voltage transformer	2 times the rated primary voltage
Single-phase earthed voltage transformer	3.46 times the rated primary voltage
Three-phase earthed voltage transformer ^{a)}	2 times the rated primary voltage
Voltage converter of capacitor voltage transformer	Divided voltage of test voltage between line-side primary terminal and earth-side primary terminal in Table 12
Note ^{a)} The test voltage of three-phase earthed voltage transformer is induced between the line-side primary terminal and the earth-side primary terminal.	

- d) **Partial discharge** For the partial discharge of an instrument transformer, when tested in accordance with **8.3.4 d)**, the discharged electric charge shall not exceed 50 pC including the effect of external noise, etc. for mould type instrument transformers and oil-immersed instrument transformers. The partial discharge shall not be detected for gas insulated instrument transformer.
- e) **Prolonged commercial frequency withstand voltage** For the prolonged commercial frequency withstand voltage of an instrument transformer, when tested in accordance with **8.3.4 e)**, internal partial discharge shall not be detected continuously until the test is ended after the test voltage specified in Table 12 is applied.
- f) **Withstand voltage between winding terminals** For the withstand voltage between winding terminals of secondary winding of a current transformer, when tested in accordance with **8.3.4 f)**, either the voltage induced when the rated primary current is applied or the voltage with a peak value of 3 kV between the terminals of the winding with the maximum number of winding among the windings which share an iron core, whichever is lower, shall be applied and the instrument transformer shall withstand this.

The winding having a centre tap, when 3 kV is applied between the terminals of winding with the maximum number of winding, shall withstand this. For the withstand voltage between the terminals of winding without the maximum number of winding when there are two or more windings which share an iron core, the voltage induced between the open terminals of the winding concerned (a peak value of 3 kV or under) shall be applied under the condition that the voltage between the terminals of winding with the maximum number of winding becomes 3 kV, and the instrument transformer shall withstand this. The withstand voltage value between the terminals of the winding other than the secondary winding shall be treated as the winding without the maximum number of winding.

7.5 Abnormal phenomenon

For the abnormal phenomenon of a capacitor voltage transformer, when tested in accordance with **8.3.5**, the abnormal voltage shall not be generated between secondary terminals.

7.6 Resultant error

7.6.1 Current transformer

The resultant error of the current transformer in electric power measurement (the resultant error of respective phase for three-phase current transformer), when tested in accordance with 8.3.6, shall conform to the values specified in Table 14.

The value of the limit of resultant error of middle primary current shall be determined by an interpolation method.

Table 14 Limit of resultant error of current transformer

Accuracy class	Primary side load power factor of 1		Primary side load power factor of 0.5 lagging current	
	Primary current A	Limit %	Primary current A	Limit %
Class 0.2 W	0.05 I_n to 1.2 I_n	± 0.2	0.1 I_n to 1.2 I_n	± 0.4
	0.025 I_n	$\pm 0.3^a$	0.05 I_n	$\pm 0.6^a$
Class 0.3 W	0.05 I_n to 1.2 I_n	± 0.3	0.1 I_n to 1.2 I_n	± 0.6
	0.025 I_n	$\pm 0.45^a$	0.05 I_n	$\pm 0.9^a$
Class 0.5 W	0.05 I_n to 1.2 I_n	± 0.5	0.1 I_n to 1.2 I_n	± 1.0
	0.025 I_n	$\pm 0.75^a$	0.05 I_n	$\pm 1.5^a$
Class 1.0 W	0.1 I_n to 1.2 I_n	± 1.0	0.2 I_n to 1.2 I_n	± 2.0
	0.05 I_n	± 1.3	0.1 I_n	± 2.5
NOTE I_n indicates the rated primary current at rated frequency. Note ^{a)} The values are for reference.				

7.6.2 Voltage transformer

The resultant error of the voltage transformer in electric power measurement (the resultant error of respective phase or between respective wires for three-phase voltage transformer), when tested in accordance with 8.3.6, shall conform to the values specified in Table 15.

Table 15 Limit of resultant error of voltage transformer

Accuracy class	Primary voltage V	Limit %	
		Primary side load power factor of 1	Primary side load power factor of 0.5 lagging current
Class 0.2 W	0.9 V_n to 1.1 V_n	±0.2	±0.4
Class 0.3 W		±0.3	±0.6
Class 0.5 W		±0.5	±1.0
Class 1.0 W		±1.0	±2.0
NOTE V_n indicates the rated primary voltage at rated frequency.			

7.6.3 Combined instrument transformer

The resultant error of the combined instrument transformer in electric power meas-

urement (total resultant error for three-phase combined instrument transformer), when tested in accordance with 8.3.6, shall conform to the values specified in Table 16.

The value of the limit of resultant error of middle primary current shall be determined by an interpolation method. However, the resultant error of the current transformer and voltage transformer which constitute a combined instrument transformer (total resultant error for three-phase) shall not exceed 2 times the limit values specified in Table 14 and Table 15.

Table 16 Limit of resultant error of combined instrument transformer

Accuracy class	Primary side load power factor of 1			Primary side load power factor of 0.5 lagging current ^{a)}				
	Primary current	Primary voltage	Limit %	Primary current	Primary voltage	Limit %		
Class 0.2 W	0.05 I_n to 1.2 I_n	0.9 V_n to 1.1 V_n	±0.2	0.1 I_n to 1.2 I_n	0.9 V_n to 1.1 V_n	±0.3		
	0.025 I_n		±0.3 ^{b)}	0.05 I_n		±0.45 ^{b)}		
Class 0.3 W	0.05 I_n to 1.2 I_n		±0.3	0.1 I_n to 1.2 I_n		±0.45		
	0.025 I_n		±0.45 ^{b)}	0.05 I_n		±0.7 ^{b)}		
Class 0.5 W	0.05 I_n to 1.2 I_n		±0.5	0.1 I_n to 1.2 I_n		±0.75		
	0.025 I_n		±0.75 ^{b)}	0.05 I_n		±1.15 ^{b)}		
Class 1.0 W	0.05 I_n to 1.2 I_n		±1.0	0.1 I_n to 1.2 I_n		±1.5		
NOTE I_n and V_n indicate the rated primary current and the rated primary voltage at rated frequency.								
Notes ^{a)} For the three-phase combined instrument transformer, the primary side load power factor of 0.5 lagging current is applied in positive phase sequence and negative phase sequence.								
^{b)} The values are for reference.								

7.7 Current characteristics

For the current characteristics of a current transformer, when tested in accordance with 8.3.7, the change of the resultant error based on a current change (the resultant error of respective phase for three-phase current transformer and total resultant error for three-phase combined instrument transformer) shall conform to the values specified in Table 17.

Table 17 Current characteristics of current transformer

Accuracy class	Primary side load power factor of 1		Primary side load power factor of 0.5 lagging current ^{a)}	
	Primary current	Limit of change %	Current range	Limit of change %
Class 0.2 W	0.05 I_n to 1.2 I_n	0.2	0.1 I_n to 1.2 I_n	0.3
Class 0.3 W	0.05 I_n to 1.2 I_n	0.3	0.1 I_n to 1.2 I_n	0.45
Class 0.5 W	0.05 I_n to 1.2 I_n	0.5	0.1 I_n to 1.2 I_n	0.75
Class 1.0 W	0.05 I_n to 1.2 I_n	1.3	0.1 I_n to 1.2 I_n	2.0
NOTE I_n indicates the rated primary current at rated frequency.				
Note ^{a)} For the three-phase combined instrument transformer, the primary side load power factor of 0.5 lagging current is applied in positive phase sequence and negative phase sequence.				