FAISALABAD ELECTRIC SUPPLY COMPANY LIMITED

FESCO SPECIFICATION 2025

OUTDOOR L.T. CURRENT TRANSFORMERS FOR METERING

TECHNICAL SERVICES DIRECTORATE

FESCO FAISALABAD

SPECIFICATION

OUTDOOR L.T. CURRENT TRANSFORMERS FOR METERING

0. FOREWORD

0.1 This Specification has been prepared by Technical Services directorate, FESCO.

0.2 This specification is intended for the purpose of procurement and specifying design of material and does not include the provision of contract.

0.3 The specification is subjected to revision as and when required.

0.4 Current transformers shall be listed in accordance with latest revision of the following standards:

IEC-61869-1	General requirements for instrument transformers
IEC 61869-2	Additional requirements for Current Transformers
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 60815-1	Selection and dimensioning of insulators for polluted conditions (Creepage)
IEC 60068	Environmental and Climatic testing (Dry Heat, Damp Heat, Cold, Solar Radiation)
IEC 60270	Partial Discharge measurements

1. SCOPE

1.1 This specification describes LT Current Transformers to be used in outdoor with LT of Transformers for metering purposes (loss monitoring) but not for billing.

1.2 Window Type, current transformer has been standardized in three different ratings of 200/5, 400/5, 600/5 each of which shall have 120% rated current.

2. DEFINITIONS

2.1 Current Transformers

An instrument transformer, in which the secondary current, in normal conditions of use, is substantially proportional to the primary current and differs in phase from it by and angle which is approximately zero for and appropriate direction of the connection.

2.2 Rated Primary Current

The value of the primary current on which the performance of the transformer is based.

2.3 Rated Secondary Current

The value of secondary current on which the performance of the transformer is based.

2.4 Current error (Ratio Error)

The error which is transformer introduces into the measurement of a current and which arises from the fact that the actual transformation ratio is not equal to the rated transformation ratio. The current error expressed in percent is given by formula

$$\text{Current error \%} = \frac{(Kn \times Is - Ip) \times 100}{Ip}$$

Where Kn is the rated transformation ratio, Ip is the actual primary current & Is is the actual secondary current where Ip is allowing under the conditions of measurement.

2.5 Phase displacement

The difference in phase between the primary & secondary current Vectors the direction of the vectors being so chosen that the angle is zero for a perfect transformer. The phase displacement is said to be positive when the secondary current vector leads the primary current vector. It is usually expressed in minutes or centiradians.

NOTE: This definition is strictly correct for sinusoidal current only.

2.6 Accuracy class

A designation assigned to the current transformer the errors of which remain within specified limits under prescribed conditions of use.

2.7 Burden

The burden is the total impedance of the secondary circuit, expressed in ohms (Ω) and the associated power factor. The burden is usually expressed as the apparent power in volt amperes (VA) absorbed at a specified power factor and the rated secondary current. The rated burden is the value of the burden for which the accuracy class and other performance parameters are specified.

2.8 Rated Burden

The value of the burden on which the accuracy requirements of the specifications are based.

2.9 Rated Output

The value of the apparent power (in volt amperes at a specified power factor) which the transformer is intended to supply to the secondary circuit at the rated secondary current and with rated burden connected to it.

2.10 Rated Short Time Thermal Current (I_{th})

The rms value of the primary current which a transformer will withstand for one second without suffering harmful effects. The secondary winding being short circuited.

2.11 Rated Dynamic Current (I_{dyn})

The peak value of the primary current which a transformer will withstand, withstand being damaged electricity or mechanically by the resulting electromagnetic forces, the secondary winding being short circuited.

2.12 Rated instrument security current

The value of the current assigned by the manufacture as the lowest primary current (Ips) at which the rms value of the secondary current (Iss) multiplied by the transformation ratio (Kn) does not exceed 0.9 times the value of the primary current, the secondary burden being equal to the primary burden. This may be expressed by the formula:

$$Kn \times Iss < 0.9\ Ips$$

2.13 Instrument security factor (F)

The ratio of the rated instrument security current (Ips) to the rated primary current (Ipn) as expressed by the formula:

$$F = \frac{Ips}{Ipn}$$

2.14 Outdoor CT

Current Transformer that can be used without additional protection in exposed environment.

2.15 Base

Back of Outdoor CT by which it is generally fixed on a cross arm and terminal block is connected to it.

2.16 Cover

Enclosure (fixed) on bottom of CT which protects secondary terminals.

2.17 Terminal Block

Support made of insulating material on which secondary terminals of CT are grouped with an external circuit.

2.18 Basic insulation

Insulation applied to live parts to provide basic protection against electric shock.

3. DIMENSIONS

3.1 The dimensions shall be as per fig. II (for reference)

3.2 The minimum inner diameter for the primary conductor opening shall be 50 mm for all specified ratings (200/5, 400/5, 600/5). The maximum overall outer dimension of CT shall not exceed 150mm to fit standard installation brackets.

3.3 The overall height, width and depth must be larger than the indoor version to accommodate thicker cast resin.

3.4 Thicker epoxy is needed to maintain the minimum creepage and resist outdoor environmental stress (UV, thermal cycling, pollution).

3.5 The external insulation surface shall provide the necessary creepage distance for a heavy pollution level (Pollution Class IV) as per IEC 60815, ensuring a minimum creepage distance of ≥ 25mm/kV based on the highest system voltage (440V)

4. GENERAL REQUIREMENTS

4.1 The current transforms shall be single pole, single ratio, and dry type.

4.2 General shape is shown in fig. II

4.3 The core shall be toroidal (ring) form and it shall be made of high Grade, low loss grain-oriented silicon steel or a material with superior magnetic properties and stability.

4.4 The insulation used for secondary winding shall be able to withstand the effects of heating and mechanical stresses to which it may be subjected in normal operation and under short circuit conditions and it shall be non-hygroscopic.

4.5 The housing material shall be a metallic material or equivalent weather-resistant and UV-resistant compound, offering superior durability and protection against mechanical stresses, UV degradation and outdoor environmental conditions. The terminal enclosure and its cover (metallic or otherwise) shall meet a minimum IP65 rating for outdoor use, to provide protection against dust ingress and water jets as per IEC 60529.

4.6 The current transformer ratio shall be clearly marked on the body.

4.7 The secondary winding shall terminate and fixed permanently to the suitable terminals as shown in Fig. I. The terminals shall he rigidly fixed to the body and shall be of chrome/nickel plated brass. The secondary terminals shall be sized to securely terminate a copper cable up to $6mm^2$ using a standard lug / ferrule.

NOTE: The terminal cover shall be metallic or equivalent weather resistant material to provide enhanced mechanical strength, UV resistance, and long-term protection in outdoor environments. A metallic cable gland suitable for standard metering cable diameters (e.g., 8 mm to 12 mm) shall be provided. The entire terminal enclosure, including the cover and cable gland, must meet a minimum IP65 rating, ensuring protection against dust ingress and water jets. This rating shall be verified by Test method 11.10.

5. CLIMATE CONDITIONS

5.1 Ambient Temperature

Maximum Temperature	55°C
Maximum Mean over any 24 hrs	50°C
Minimum Temperature	-10°C

5.2 Relative Humidity

The relative humidity may range from 0 to 100 percent.

5.3 Altitude

The Current Transformers shall be suitable for installation upto 1000 m above sea level.

6. RATINGS

6.1 STANDARD RATINGS

i.	Type	Metering
ii.	Nominal System Voltage	415V
iii.	Highest System Voltage	440V
iv.	Rated Primary Current	200, 400 and 600 A with extended range of 120%
v.	Rated Secondary Current	5 A with extended range of 120%
vi.	Accuracy Class	0.5
vii.	Rated Burden	5VA
viii.	Rated Frequency	50Hz
ix.	Instrument Security Factor	5FS
x.	Rated power frequency withstand voltage for 1 min	3kV
xi.	Inter turn over-voltage	100V
xii.	Temperature Rise of CT	not more than 50°C

Rated output at the basic secondary current i.e, 5 amps shall be 5VA.

6.2 Rated continuous thermal current

The current transformer shall be able to pass up to 120% of the primary current, with secondary connected to unity power factor burden corresponding to the rated output, continuously without any damage.

6.3 Thermal rating

The current transformer shall be able to withstand without any damage a current of up to 25 times the rated primary current for a period of one second.

6.4 Dynamic rating

The current transformer shall be able to withstand without any damage a short time dynamic current up to 2.5 times the rated thermal current for a period of one second.

6.5 Rated Insulation level

The Rated insulation level shall be 3 KV (rms) for one minute power frequency voltage.

6.6 Temperature rise

The maximum temperature rise of the winding or that of the core shall not exceed 50 deg. C when carrying a primary current equal to 120% rated current, with the secondary connected to a unity, Power factor burden corresponding to the rated output.

6.7 Instrument security factor

The value of the instrument security factor shall be less than 5 (see definitions 2.13)

7. ACCURACY

7.1 The standard accuracy class of all the current transformers shall be 0.5 at different percentages of current.

7.2 The limits of error shall be as under:

Percentage current (ratio) error at percentage of ratio current shown below				Phase displacement percentage of rated current shown below							
				Minutes				Centiradians			
5	20	100	120	5	20	100	120	5	20	100	120
1.5	0.75	0.5	0.5	90	45	30	30	2.7	1.35	0.9	0.9

8. TERMINAL MARKINGS

8.1 The marking of the terminal shall be as shown in Fig I. "S1" & "S2" shall be marked on the secondary terminals whereas P1 & P2 shall be marked on current transformer housing to indicate the primary winding polarities.

8.2 The terminals marked 'P1' and 'S1' shall have the same policy at the same instant

8.3 The marking shall be clear and indelible.

9. RATING PLATE

9.1 All the current transformers shall carry at least the following Information, which shall be marked, on the external rating plate attached to the current transformer housing. All the Markings must be indelible and distinct.

a) Manufacturers name or trade mark
b) FESCO P.O. No. and Date
c) Type designation
d) Serial No.
e) IP rating
f) The rated Primary and secondary currents, e.g. 200/5 A
g) Rated frequency
h) Rated output and accuracy class and the extended current Range(e.g. 5VA, class 0.5, ext. 120%) respectively
i) Meter security factor n<5.
j) Weight

10. TESTS

10.1 Type Tests

The following type tests shall be performed on one current transformer of each different type or rating offered in compliance with IEC 61869-1 and IEC 61869-2:

a) Type Accuracy test
b) Temperature rise test
c) Instrument security current test
d) Rated Insulation level test (Power Frequency withstand)
e) Short time current withstand test
f) Ingress Protection (IP) test
g) Climatic Test (Dry Heat, Damp Heat, Cold Test)
h) Solar Radiation Withstand Test
i) Mechanical Impact Test (Spring Hammer Test)

10.2 Routine tests

a) Visual examination
b) Verification of dimensions
c) Routine accuracy test.
d) Verification of terminal markings.
e) Power frequency test on secondary winding.
f) Over Voltage Inter-turn test.
g) Resistance of Secondary Winding Test
h) Partial Discharge (PD) test

11. TEST METHODS

11.1 Type Accuracy Test

The test shall be conducted to prove compliance with clause 7. Tests shall be made for each current value given in clause 7.2 and at 25% and 100% of rated burden.

11.2 Routine Accuracy Test

The routine accuracy test shall be conducted for only one value of current and burden. The current shall be the value of rated extended range of the current transformer and the burden shall be the rated burden.

11.3 Temperature Rise Test

A test shall be made to provide compliance will clause 6.6. The current transformer shall be deemed to have attained a steady temperature when the rate of temperature rise does not exceed one deg Centigrade per hour.

11.4 Instrument Security Current

The current Transformer shall comply with the specified Instrument Security Factor (FS) rating (e.g FS ≤ 5) as per IEC 61869-2. Compliance shall be verified via the indirect saturation method (Secondary Excitation Test) as per IEC.

11.5 Visual Examination

The current transformers shall be examined visually for the defects as under:-

Examination	Defects
Construction	Not of General shape shown in Fig 1, II. Any component part missing or damaged Rating label/sticker missing Terminal loose

Markings	The marking of the terminal or that on the rating label/sticker not conforming to clauses 8 & 9. Ratio not marked on the body.
Finish	General workmanship poor, presence of rust on any part.

11.6 Verifications of Dimensions

The dimensions shall be verified for conformance to those given in Fig II.

11.7 Polarity Test and Verification of Terminal Marking

Use of a conductor for the Primary winding and then with direct current passing through the secondary winding, connect a high voltage i.e, Voltmeter across the outlet terminals of the same winding so as to get a small positive deflection of the pointer. Then transfer the two voltmeter leads directly across the transformer to the adjacent primary respectively corresponding leads. The direct current excitation is then broken, thereby inducting a voltage in the primary winding (Inductive kick) which will cause a deflection in the voltmeter. If the pointer swing in the same direction as before (Positive), the polarity is correct. If the pointer swings in the negative direction, the polarity is incorrect.

11.8 Power Frequency Test On Secondary Winding

The secondary winding Insulation shall withstand for 1 minute a test voltage of 3 KV rms which shall be substantially sinusoidal waveform and of any convenient frequency between 25 & 100 Hz. The test voltage shall be applied between terminal of the secondary winding connected together and earth; the frame being connected to earth.

11.9 Over voltage inter turn test (Secondary Injection Method)

With the primary winding open circuited, a voltage at rated frequency shall be applied for 1 minute to the secondary winding. The value of the voltage shall be such as to produce a secondary current of rms value equal to the extended range secondary current or a value of 100V peak, which ever be the lower.

11.10 Ingress Protection (IP) Test

The terminal box assembly, including the metallic cover, gasketing and cable gland, shall meet a minimum Ingress Protection (IP) rating of IP65 or higher ensuring protection against dust ingress and water jets. The test shall be performed as per IEC 60529 to verify compliance with the IP65 rating.

(a) Dust Tight IP6X

The enclosure shall be subjected to fine talcum powder dust in a chamber under vacuum or pressure conditions. Upon internal inspection, there shall be no ingress of dust observed.

(b) Water Jet IPX5

The enclosure shall be subjected to low-pressure water jets (6.3 mm nozzle) from all practicable directions. The test duration and flow rate (12.5 L/min) shall conform to IEC 60529. Upon internal inspection, water must not enter in a quantity that interferes with the satisfactory operation of the CT.

11.11 Partial Discharge (PD) Test

The test shall be carried out as per IEC 60270. The test voltage shall be applied for 1 minute between the secondary winding and the earth/frame. The magnitude of the test voltage shall be 1.2 times the rated voltage of the secondary circuit (e.g., 1.2 x 100V = 120V rms). The partial Discharge level during the test shall not exceed 10 pico-coulombs (pC).

11.12 Short time Current withstand Test

The test shall be performed as a type test in accordance with IEC 61869-2, Clause 7.2.201 to verify compliance with Clauses 6.3 and 6.4. For window type CT, the manufacturer shall insert a temporary single-turn primary conductor (bar or rod) through the CT window, which shall be connected to the short-circuit test facility. The secondary winding must be short-circuited during the test. The current source shall be energized for the specified duration to achieve the following:

a) Thermal Withstand: The current shall equal the rated short-time thermal current (I th) for duration of 1 second.

b) Dynamic Withstand: The peak current shall equal the rated dynamic current (I dyn).

Upon test completion, the CT must show no external damage (cracking, deformation or displacement) and shall successfully pass the post-fault verification tests on Clause 11.8 and 11.2.

11.13 Resistance of Secondary Winding Test

The resistance of the secondary winding shall be measured at 75°C (or converted to 75°C if measured at ambient temperature i.e, 25°C) using a DC bridge or micro-ohmmeter. The measured value must not exceed the design value guaranteed by the manufacturer.

11.14 Climatic and Environmental Tests

The CT shall withstand the Dry Heat, Damp Heat, Cold, and Solar Radiation tests as specified in IEC 61869-1. No visible damage or degradation of the epoxy housing shall occur and the CT shall successfully pass the Routine Accuracy Test (11.2) afterward.

11.15 Mechanical Impact Test (Spring Hammer Test)

The enclosure shall be subjected to mechanical impacts using a spring hammer to verify an appropriate level of protection (e.g., IK08 or higher) against external mechanical stresses. The enclosure must remain intact, and the CT must pass the Routine Accuracy Test (11.2) afterward

12. PACKING

12.1 Current transformer shall be securely packed in an individual carton capable of withstanding the rigorous of transportation by Railway or truck.

12.2 Packing must specifically include adequate internal cushioning and moisture protection to safeguard the terminal box, cable gland and the transparent cover against impact and ingress during transit.

13. FIGURES

Fig 1 & II.

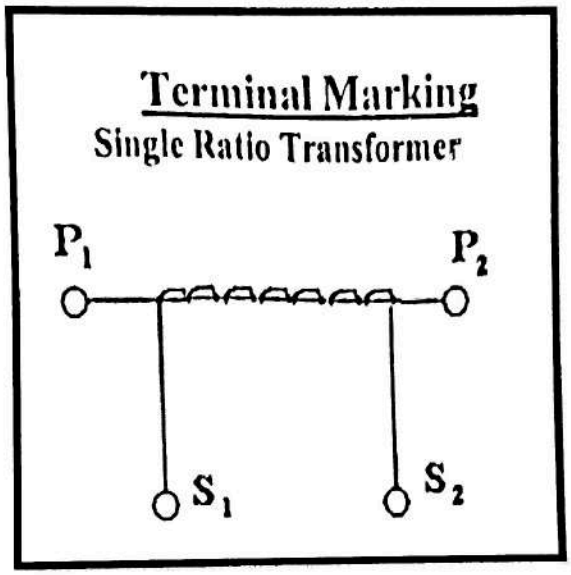

Figure I. Terminal Marking, Single Ratio Transformer

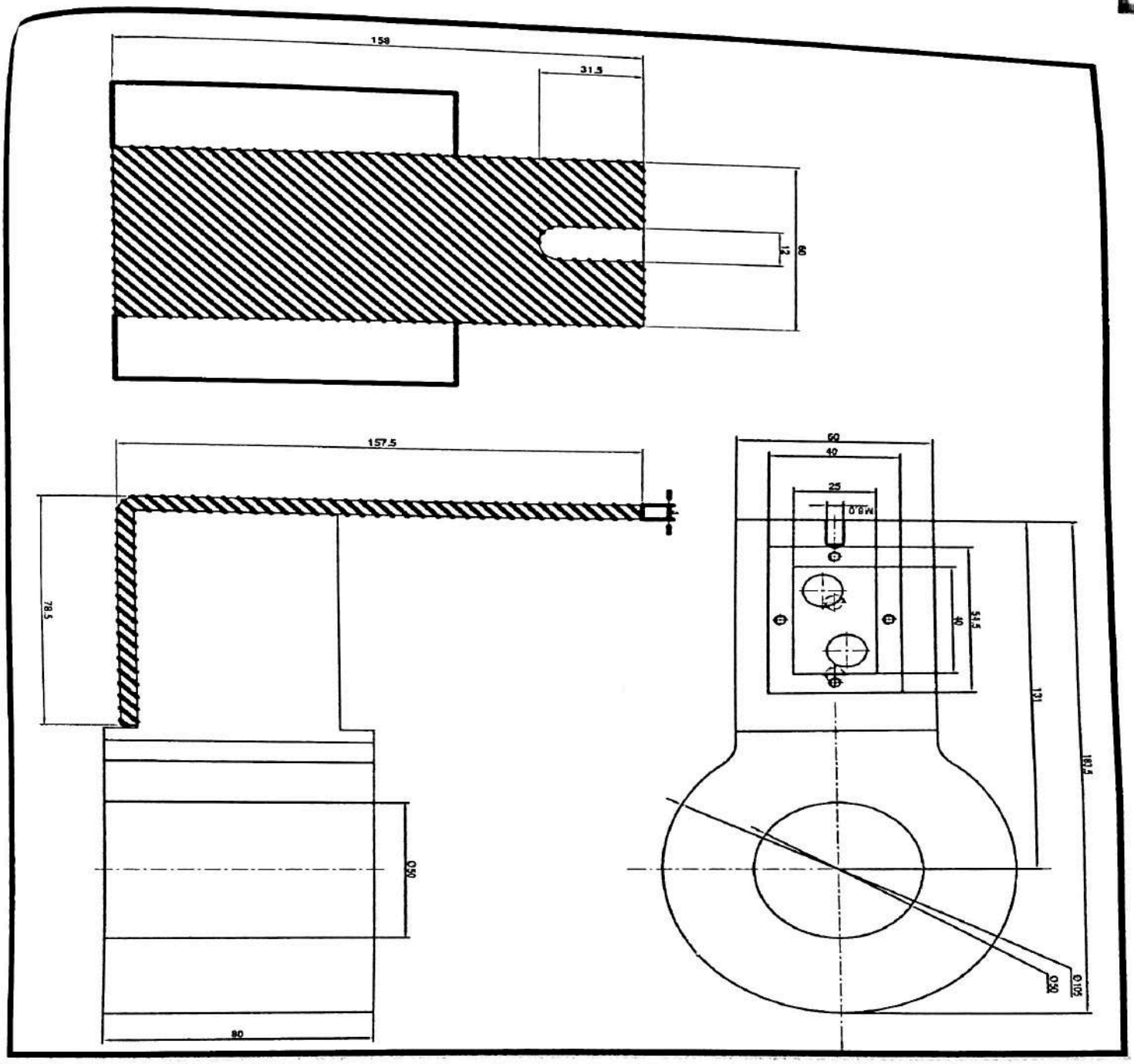

Figure II. CT Drawing and dimension details

NOTE: All Dimensions are in mm (Tol ±2%)

NOTE: The Dimensions provided are for guidance only. The bidder shall provide General Arrangement drawings confirming all dimensions (including window size and mounting pitch) meet the minimum requirement of this specification.

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