EPIL/HV TEST REPORT

Project No.: *H13-70002*
Equipment under Test: *MV Capacitor*

Type	*: PK 400/11.56 EDRI*
Serial Number	*: PK-T-t-11.56-1*
Rated Voltage	*: 11.56 kV*
Rated Power	*: 400 kVAr*
Rated Capacitance	*: 9.53 μF*
Rated Frequency	*: 50 Hz*
Rated Current	*: 34.61 A*
Insulation Level	*: 28/95 kV*
Temperature Category	*: -40/55°C*
Internal Fuse	*: NO*

Manufactured by: *PARTO KHAZEN Co.*
Applicant: *PARTO KHAZEN Co.*
Applicant Contact Information: *+98-21-88882956*

Trade Mark: PKC

Tested According to: *IEC 60871-1:2014*
Reception Date of Sample: *29-May-2021*
Testing Date: *22 to 24-July-2021* **Issue Date:** *28-July-2021*
Test Result: *See pages 4 to 9*
No. of Pages: *12*

Prepared and Tested by: Test Engineer
A. Takzare
Chief Executive Officer
S. M. Mirsadri

Approved:

Verified by: Technical Manager
H. Jahangir on behalf of
Engineering Deputy of
Test and Inspection
Prof. B. Vahidi / Prof. S. H. Fathi

The statement of conformity decision is made based on EPIL Procedure No., CBP-708-01 and ISO/IEC Guide 98-4.

Technical Department
ISO IEC 17025
Accredited Lab

CONTENTS

		Page
1	**GENERAL INFORMATION**	3
1.1	Product Information	3
1.2	Client Information	3
1.3	Performed Tests	3
1.4	Test Results and Descriptions	3
2	**PERFORMANCE and RESULTS of TESTS**	4
2.1	Capacitance Measurement (Routine Test)	4
2.2	Measurement of the Tangent of the Loss Angle of the Capacitor (Routine Test)	5
2.3	Thermal Stability Test (Type Test)	6
2.4	Measurement of the Tangent of the Loss Angle of the Capacitor at Elevated Temperature (Type Test)	9
3	**FIGURES**	10
	ANNEX A: EUT ELEMENT CONFIGURATION	12

E.P.I.L.
Technical Department
ISO IEC 17025
Accredited Lab

1. GENERAL INFORMATION

1.1. Product Information

Equipment under Test	: MV Capacitor
Manufacturer	: PARTO KHAZEN Co.
Type	: PK 400/11.56 EDRI
Serial Number	: PK-T-t-11.56-1
Rated Voltage	: 11.56 kV
Rated Power	: 400 kVAr
Rated Capacitance	: 9.53 µF
Rated Frequency	: 50 Hz
Insulation Level	: 28/95 kV
Temperature Category	: -40/55°C
Internal Fuse	: NO
Normative Document	: IEC 60871-1:2014

1.2. Client Information

Applicant	: PARTO KHAZEN Co.
Telephone	: +98-21-88882956
Fax	: +98-21-88882959

1.3. Performed Tests

Test	Test According to	Result
Capacitance Measurement (Routine Test)	IEC 60871-1:2014	Passed
Measurement of the Tangent of the Loss Angle of the Capacitor (Routine Test)	IEC 60871-1:2014	Performed*
Thermal Stability Test (Type Test)	IEC 60871-1:2014	Passed
Measurement of the Tangent of the Loss Angle of the Capacitor at Elevated Temperature (Type Test)	IEC 60871-1:2014	Performed*

* The requirements regarding capacitor losses shall be agreed upon between manufacturer and purchaser. Since no value is notified to the laboratory, the result of the test is given as "Performed".

1.4. Test Results and Descriptions:

See pages 4 to 9.

E.P.I.L.
Technical Department
ISO IEC 17025
Accredited Lab

2. PERFORMANCE and RESULTS of TESTS

2.1 Capacitance Measurement (Routine Test)

2.1.1 Test data

Equipment Under Test (EUT)	: MV Capacitor
Manufacturer	: PARTO KHAZEN Co.
Location	: E.P.I.L
Date	: 22-July-2021
Test Expert	: Ms. Takzare
Normative Document	: IEC 60871-1:2014

2.1.2 Ambient conditions

Ambient Temperature	: 25 °C
Relative Humidity	: 35 %

2.1.3 Performance of test

The capacitance is measured at rated voltage according to clause 7.1 of IEC 60871-1: 2014. In order to reveal any change in capacitance, a preliminary measurement is performed with a reduced voltage not higher than 0.15 U_N.

2.1.4 Acceptance conditions of test

The capacitance shall not differ from the rated capacitance by more than -5% to +10%.

2.1.5 Result of test

Table 1. Result of capacitance measurement

Applied Voltage (kV)	Measured Capacitance (μF)	Result
11.56	9.5057	Passed
1.5	9.4971	

E.P.I.L. Technical Department ISO IEC 17025 Accredited Lab

2.2 Measurement of the Tangent of the Loss Angle of the Capacitor (Routine Test)

2.2.1 Test data

Equipment Under Test (EUT)	: MV Capacitor
Manufacturer	: PARTO KHAZEN Co.
Location	: E.P.I.L
Date	: 22-July-2021
Test Expert	: Ms. Takzare
Normative Document	: IEC 60871-1:2014

2.2.2 Ambient conditions

Ambient Temperature	: 25 °C
Relative Humidity	: 35 %

2.2.3 Performance of test

The capacitor losses (tanδ) is measured at rated voltage according to clause 8.1 of IEC 60871-1:2014.

2.2.4 Acceptance condition of test

The requirements regarding capacitor losses shall be agreed upon between manufacturer and purchaser.

2.2.5 Result of Test

Table 2: Result of measurement of the tangent of the loss angle

Applied Voltage (kV)	Measured tanδ	Result
11.56	1.32×10^{-4}	Performed*

* The requirements regarding capacitor losses shall be agreed upon between manufacturer and purchaser. Since no value is notified to the laboratory, the result of the test is given as "Performed".

E.P.I.L Co.
Technical Department
ISO IEC 17025
Accredited Lab

2.3 Thermal Stability Test (Type Test)

2.3.1 Test data

Equipment under Test (EUT)	: MV Capacitor
Manufacturer	: PARTO KHAZEN Co.
Location	: E.P.I.L
Date	: 22-July-2021 to 24-July-2021
Test Expert	: Ms. Takzare
Normative Document	: IEC 60871-1:2014

2.3.2 Ambient conditions

Ambient Temperature	: 25 °C
Relative Humidity	: 35 %

2.3.3 Performance of test

The capacitor unit subjected to the test is placed between two dummy capacitors each containing resistors. The dissipation in the resistors is adjusted to a value such that the case temperature of the dummy capacitors near the top opposing faces are equal to or greater than those of the test capacitor. The separation between the units is 10 cm, which according to manufacturer claim, is equal to or less than the normal spacing. The assembly is placed in a heated enclosure with no forced ventilation with ambient air temperature at or above the appropriate temperature shown in Table 2 of IEC 60871-1 (55 °C for symbol D capacitor). The test capacitor is subjected for a period of at least 48 h, to an a.c. voltage of substantially sinusoidal form. The magnitude of the voltage throughout the test is adjusted to 13.90 kV to give an output of 1.44 times the capacitor rated power.

E.P.I.L.
Technical Department
ISO IEC 17025
Accredited Lab

Figure 2 (refer to section 3: FIGURES of the test report) shows the sensors arrangement during the thermal stability test. The sensors are applied as follows:

T1: Test room temperature
T2: Main capacitor near top temperature # 1
T3: Main capacitor top temperature
T4: Main capacitor near top temperature # 2
T5: Dummy capacitor 1 near top temperature
T6: Dummy capacitor 2 near top temperature

2.3.4 Acceptance conditions of test

During the last 6 h the temperature of the container near the top shall be measured at least four times. Throughout this period of 6 h, the temperature rise shall not increase by more than 1 K. Should a greater change be observed, the test shall be continued until the above requirement is satisfied for four consecutive measurements during a subsequent 6 h period. In case the thermal stability condition is not reached in 72 h, the test shall be stopped and the capacitor shall be declared to have failed in this test.

Before and after the test the capacitance shall be measured within the temperature range according to 5.2 of IEC 60871 and the two measurements shall be corrected to the same dielectric temperature. The difference between the two measurements shall be less than an amount corresponding to either breakdown of an element or operation of an internal fuse.

2.3.5 Result of Test

Table 3 shows the temperatures measured for the last 6 hours of the test with 1 hour interval. Table 4 shows the result of measurement of capacitance at 11.56 kV before and after the thermal stability test.

E.P.I.L.
Technical Department
ISO IEC 17025
Accredited Lab

Table 3. Temperatures measured for the last 6 hours of the test

Sensor / Time	T1 (°C)	T2(°C)	T3 (°C)	T4 (°C)	T5 (°C)	T6 (°C)
04:00	55.0	69.2	74.1	61.2	70.2	69.4
05:00	55.0	69.3	74.0	61.2	70.5	69.3
06:00	55.5	69.5	74.0	61.8	70.6	69.5
07:00	55.6	69.6	74.2	61.9	70.3	69.9
08:00	55.4	69.2	74.0	61.4	70.1	69.5
09:00	55.7	68.8	73.9	61.5	70.1	69.5
10:00	55.9	68.9	73.9	61.5	70.1	69.7

Table 4. Capacitance measured before and after the test

	Before	After
Capacitance (μF)	9.5057	9.4528

Throughout the last 6 h of the test, temperature rise above 1 °C is not observed and thermal stability is reached within 48 h. The difference between two capacitance measurements before and after the test is less than an amount corresponding to breakdown of an element (With reference to ANNEX A).

✓ **PASSED**

E.P.I.L.
Technical Department
ISO IEC 17025
Accredited Lab

2.4 Measurement of the Tangent of The Loss Angle of the Capacitor at Elevated Temperature (Type Test)

2.4.1 Test data

Equipment Under Test (EUT)	: MV Capacitor
Manufacturer	: PARTO KHAZEN Co.
Location	: E.P.I.L
Date	: 24-July-2021
Test Expert	: Ms. Takzare
Normative Document	: IEC 60871-1:2014

2.4.2 Ambient conditions

Ambient Temperature	: 25 °C
Relative Humidity	: 35 %

2.4.3 Performance of test

Capacitor loss tangent (tanδ) is measured at the end of the thermal stability test in accordance with clause 14 of IEC 60871-1:2014.

2.4.4 Acceptance condition of test

The value of tanδ measured in accordance with clause 14.1 shall not exceed the value declared by the manufacturer, or the value agreed upon between manufacturer and purchaser.

2.4.5 Result of Test

Table 5: Tangent of the loss angle measured at elevated temperature

Applied Voltage (kV)	Measured tanδ	Result
13.90	1.31×10^{-4}	Performed*

* The requirements regarding capacitor losses shall be agreed upon between manufacturer and purchaser. Since no value is notified to the laboratory, the result of the test is given as "Performsed".

E.P.I.L
Technical Department
ISO IEC 17025
Accredited Lab

3. FIGURES

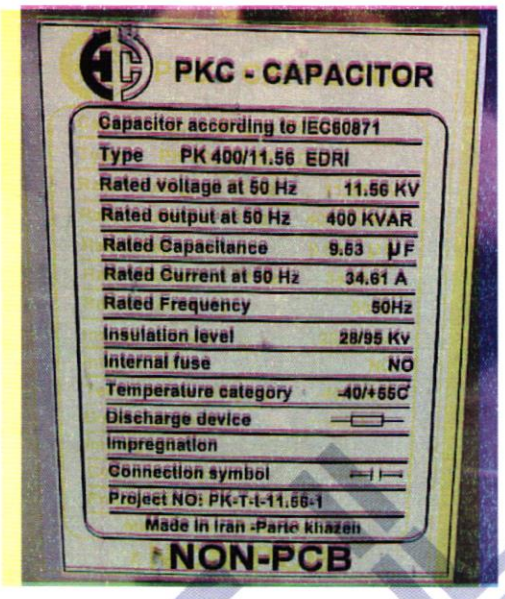

Figure 1: Nameplate of equipment under test

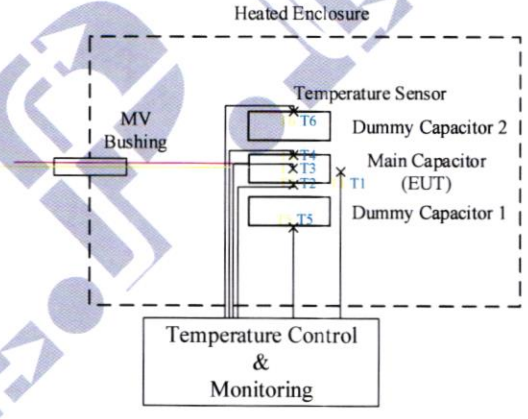

Figure 2: Sensors arrangement during the thermal stability test

E.P.I.L.
Technical Department
ISO IEC 17025
Accredited Lab

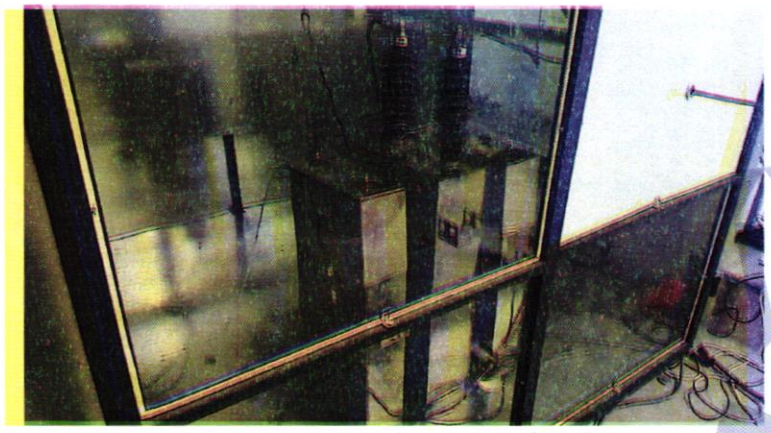

Figure 3: Equipment under thermal stability test

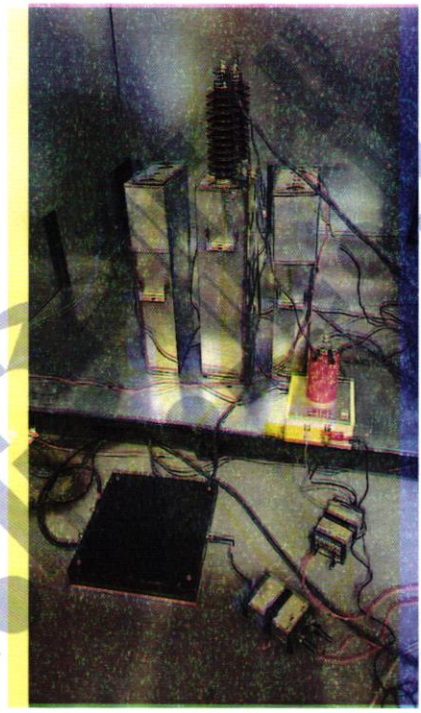

Figure 4: Equipment under tangent of the loss angle test at ambient temperature

E.P.I.L.
Technical Department
ISO IEC 17025
Accredited Lab

ANNEX A: EUT ELEMENT CONFIGURATION