



ELECTRICAL RESEARCH AND DEVELOPMENT ASSOCIATION

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ERDA Road, Makarpura Industrial Estate, Vadodra-390 010, India.

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TEST REPORT

SHEET : 01 of 11

| | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| NAME & ADDRESS OF CUSTOMER Tibrewala Electronics Ltd. Bombay Highway, Balanagar, Hyderabad-500037 Andhra Pradesh, India. | REPORT NO. : RP-1516-051614 | |
| | DATE : 29.03.2016 | |
| | CUSTOMER REF.NO. | DATE |
| | TEL/ERDA/2015-2016 | 28.01.2016 |
| | DATE OF SAMPLE RECEIPT | DATE OF TESTING |
| | 28.01.2016 | 08.02.2016 to 18.03.2016 |
| SAMPLE DESCRIPTION AC MOTOR CAPACITORS Rated Capacitance : 35 MFD \pm 5% Rated voltage : 440V AC Rated frequency : 50/60 Hz Type of dielectric : MPP Ref. to self-healing: SH Climate category : -25°C to +85°C Reference to IS : IS 2993:1998 Class of Safety Protection: P2 10000 AFC PROTECTED | SAMPLE IDENTIFICATION ERDA Sample code Nos.: ERDA-00125355 to ERDA-00125385 (31 Nos.) Marking no. : 1 to 31 Manufactured by : Tibrewala Electronics Ltd. Brand name : TIBCON Capacitors ENCLOSURE : Photographs of test sample, ERDA sample code no. and name plate, as per sheet 11 of 11 | |
| TEST DETAILS As per sheet 2 of 11. | TEST SPECIFICATION As per sheet 2 of 11. | |
| TEST RESULTS : As per sheets 3 of 11 to 10 of 11. | | |
| REMARKS : 1) The capacitor conforms to the requirements of test specification for test no. 1 to 5 & 7 to 8 as per sheet no. 2 of 11. 2) Only observations were made in test no. 6 as per sheet no. 2 of 11 as per customer's request. | | |
| NOTE : All the mentioned test on sheet 2 of 11 were tested at a frequency of 50 Hz. | | |
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| Note : 1. This report relates only to the particular sample received for testing in good condition at E.R.D.A. 2. This report cannot be reproduced in part under any circumstances. 3. Publication of this report requires prior permission in writing from Director, E.R.D.A. 4. Only the tests asked for by the customer have been carried out. 5. In case of any dispute, Vadodra will be the exclusive jurisdiction & shall be construed as where the cause has arisen. | | |
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REPORT NO.: RP-1516-051614

SHEET : 02 of 11

DATE : 29.03.2016

TEST DETAILS :

| SR. NO. | TEST DETAILS | TEST SPECIFICATION |
|---------|-----------------------------------------|--------------------------------------|
| 1. | Sealing test | As per cl.no.2.4.1.a of IS 2993:1998 |
| 2. | Voltage test between terminals | As per cl.no.2.4.1.b of IS 2993:1998 |
| 3. | Voltage test between terminals and case | As per cl.no.2.4.1.c of IS 2993:1998 |
| 4. | Visual examination | As per cl.no.2.4.1.d of IS 2993:1998 |
| 5. | Capacitance measurement | As per cl.no.2.4.1.e of IS 2993:1998 |
| 6. | Tangent of loss angle | As per cl.no.2.4.1.f of IS 2993:1998 |
| 7. | Endurance Test | As per cl.no.2.13 of IS 2993:1998 |
| 8. | Self-Healing Test | As per cl.no.2.15 of IS 2993:1998 |


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REPORT NO.: RP-1516-051614

SHEET : 03 of 11

DATE : 29.03.2016

Test serial no. 1 to 6 conducted on all 31 nos. capacitor (Mark no. 1 to 31)

| Sr. No. | Particulars of Tests & Cl. No. | Requirement as per Specification | Obtained Value | Remarks |
|---------|---------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1. | Sealing test (Cl. No.: 2.4.1.a) | The capacitors shall be mounted in an oven at a temperature of $10^{\circ}\text{C} \pm 2^{\circ}\text{C}$ higher than the maximum permissible capacitor operating temperature, for sufficient time for all parts of the capacitor to reach this temperature. It shall be maintained at this temperature for one hour before cooling. No liquid leakage or distortion in case shall occur. Liquids are allowed to wet the surface but not to form droplets. | No liquid leakage or case distortion observed after all capacitors were heated in air circulating chamber at $95 \pm 2^{\circ}\text{C}$ temperature for one hour, where maximum permissible capacitor operating temperature was 85°C . | Conforms |
| 2. | Voltage test between terminals (Cl. No.: 2.4.1.b) | Capacitors shall withstand ac test voltage of $2U_N$ between terminals for 2 seconds, at rated frequency, as per table 2a of IS 2993:1998. During the test no flash over or permanent breakdown shall occur. | All capacitors withstood the 880 Volts ac for 2 seconds. During the test no flash over or permanent breakdown occurred. | Conforms |
| 3. | Voltage Test between Terminals and Case (Cl. No.: 2.4.1.c) | Capacitors shall withstand $2U_N + 1000$ V but not less than 2000 V ac for 02 seconds, between terminals joined together & capacitor case. No routine test is required if the case is made entirely of insulation material. | All capacitors withstood the 2000 Volts ac for 2 seconds, between terminals joined together & capacitor case. | Conforms |

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REPORT NO.: RP-1516-051614

SHEET : 04 of 11

DATE : 29.03.2016

| Sr. No. | Particulars of Tests & Cl. No. | Requirement as per Specification | Obtained Value | Remarks |
|---------|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 4. | Visual Examination (Cl. No.: 2.4.1.d) | The condition, workmanship, marking and finish shall be satisfactory. The marking shall be legible after rubbing the marking for 15s with a piece of cotton cloth soaked in water. The test shall be repeated with further piece of cloth, soaked in petroleum sprit. | The condition, workmanship, marking and finish are satisfactory for all capacitors. The marking is legible after rubbing the marking for 15s with a piece of cotton cloth soaked in water and petroleum sprit respectively. | Conforms |
| 5. | Capacitance Measurement (Cl. No.: 2.4.1.e) | Capacitance shall be measured at rated voltage and frequency. It shall not deviate from the specified value. Specified value: 35 MFD \pm 5% | Measured values for all capacitors are not deviated from 35.00 MFD \pm 5% for all capacitors. Measured values for all capacitors are as per Table-1 on sheet 07 of 11. | Conforms |
| 6. | Tangent of Loss Angle (Cl. No.: 2.4.1.f) | The tangent of loss angle shall be measured at rated voltage and frequency. | Measured values for all tangent of loss angles are as per Table-2 on sheet 08 of 11. Only observation were made as per customer's request. | --- |

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REPORT NO.: RP-1516-051614

SHEET : 05 of 11

DATE : 29.03.2016

Test serial no. 7 conducted on 21 nos. capacitor (Mark no. 1 to 21)

| Sr. No. | Particulars of Tests & Cl. No. | Requirement as per Specification | Obtained value | Remarks |
|---------|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 7. | Endurance Test (Cl. No.: 2.13) | <p>The batch of 21 nos. capacitors is kept in a hot air circulating chamber at $(t_c - 15)^\circ\text{C}$ and energized according to the appropriate voltage and test cycle. The thermocouple is placed on the capacitor having the lowest $\tan \delta$ value.</p> <p>During the first 24 h, the difference between t_c and the indication of the temperature recording instrument shall be noted and adjustments made to ensure the temperature of each capacitor case is at $t_c \pm 2^\circ\text{C}$. The test is then continued to the end of the appropriate test time.</p> <p>The capacitors are energized at $1.25U_n$ for 600h continuously.</p> <p>During the test, no permanent breakdown, interruption or flashover shall occur.</p> <p>No leak should be apparent which forms droplets within 10 min when kept at upper temperature limit in the most unfavorable position.</p> <p>At the end of the test, the capacitors shall cool down freely to the ambient temperature.</p> <p>The capacitance is then measured.</p> <p>Permitted change is 3%.</p> <p>No. of failures allowed : 2 nos.</p> | <p>All the capacitors were kept at 70°C in energized condition at 550V. After 24hour time measured case temperature was 76°C. Then test temperature of case for each capacitor was maintained at $85^\circ\text{C} \pm 2^\circ\text{C}$ throughout the test.</p> <p>The capacitors were energized at $1.25U_n$ (i.e 550V) for 600h continuously.</p> <p>During the test, no permanent breakdown, interruption or flashover occurred.</p> <p>Leakage was observed on one capacitor(Mark no. 1)</p> <p>The capacitance was then measured.</p> <p>Measured values of capacitance for all capacitors after and before this test are as per table-3 on Sheet 09 of 11.</p> <p>Change in capacitance was not more than 3 %.</p> | Conforms |

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REPORT NO.: RP-1516-051614

DATE : 29.03.2016

SHEET : 06 of 11

Test serial no. 8 conducted on 10 nos. capacitor (Mark no. 22 to 31)

| Sr. No. | Particulars of Tests & Cl. No. | Requirement as per Specification | Obtained value | Remarks |
|---------|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 8. | Self-healing Test (Cl. No.: 2.15) | <p>Capacitors are subjected to $2.0U_N$ ac (at 880 V) for 60 seconds, between its terminals. If fewer than five self-healing breakdowns (clearings) occur during this time, the voltage shall be increased at a rate of not more than 200 V per minute until five clearings have occurred since the beginning of the test or until the voltage has reached a maximum of $3.5 U_N$.</p> <p>The voltage shall then be decreased to 0.8 times the voltage at which the fifth clearing occurred or 0.8 times the maximum voltage and maintained for 10 s. One additional clearing in each capacitor shall be permitted during this period. The capacitors shall meet the following requirements:</p> <p>a) change of Capacitance is $< 0.5\%$ b) RC value is ≥ 100 s.</p> | <p>Obtained results are as per Table-5 on sheet 10 of 11.</p> <p>Measured values of capacitance for all capacitors after and before this test are as per table-4 on Sheet 10 of 11.</p> <p>Change in capacitance observed $< 0.5\%$.</p> <p>RC value > 100s observed.</p> | Conforms |

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Table -1
(for Routine test Sr. No. 5)

Measurement of capacitance:

| MARK NO. | MEASURED CAPACITANCE (μ F) | Δ C (%) | MARK NO. | MEASURED CAPACITANCE (μ F) | Δ C (%) |
|----------|---------------------------------|----------------|----------|---------------------------------|----------------|
| 1 | 35.138 | 0.39 | 17 | 35.224 | 0.64 |
| 2 | 35.282 | 0.81 | 18 | 35.225 | 0.64 |
| 3 | 35.171 | 0.49 | 19 | 35.216 | 0.62 |
| 4 | 35.099 | 0.28 | 20 | 35.093 | 0.27 |
| 5 | 35.320 | 0.91 | 21 | 35.258 | 0.74 |
| 6 | 35.120 | 0.34 | 22 | 35.218 | 0.62 |
| 7 | 35.202 | 0.58 | 23 | 35.195 | 0.56 |
| 8 | 35.236 | 0.67 | 24 | 35.228 | 0.65 |
| 9 | 35.151 | 0.43 | 25 | 35.292 | 0.83 |
| 10 | 35.175 | 0.50 | 26 | 35.231 | 0.66 |
| 11 | 35.216 | 0.62 | 27 | 35.175 | 0.50 |
| 12 | 35.186 | 0.53 | 28 | 35.270 | 0.77 |
| 13 | 35.409 | 1.17 | 29 | 35.169 | 0.48 |
| 14 | 35.178 | 0.51 | 30 | 35.099 | 0.28 |
| 15 | 35.284 | 0.81 | 31 | 35.140 | 0.40 |
| 16 | 35.210 | 0.60 | -- | | |

Remark: Measured values are not deviated from 35.00 MFD \pm 5% for all capacitors.


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Table - 2
(for Routine test Sr. No. 6)

Measured Tangent of loss angle:

| MARK NO. | Measured Tangent of loss angle | MARK NO. | Measured Tangent of loss angle |
|----------|--------------------------------|----------|--------------------------------|
| 1 | 0.000324 | 17 | 0.000377 |
| 2 | 0.000398 | 18 | 0.000415 |
| 3 | 0.000333 | 19 | 0.000324 |
| 4 | 0.000436 | 20 | 0.000342 |
| 5 | 0.000446 | 21 | 0.000394 |
| 6 | 0.000442 | 22 | 0.000365 |
| 7 | 0.000357 | 23 | 0.000337 |
| 8 | 0.000337 | 24 | 0.000364 |
| 9 | 0.000326 | 25 | 0.000377 |
| 10 | 0.000339 | 26 | 0.000378 |
| 11 | 0.000349 | 27 | 0.000366 |
| 12 | 0.000394 | 28 | 0.000378 |
| 13 | 0.000372 | 29 | 0.000376 |
| 14 | 0.000360 | 30 | 0.000409 |
| 15 | 0.000377 | 31 | 0.000338 |
| 16 | 0.000373 | -- | -- |

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Table -3
(for Type test Sr. No.7)

Measurement of capacitance before and after Endurance test was:

| MARK NO. | CAPACITANCE (μ F) BEFORE TEST | CAPACITANCE (μ F) AFTER TEST | Δ C (%) |
|----------|------------------------------------|-----------------------------------|----------------|
| 1 | 35.138 | 35.123 | -0.04 |
| 2 | 35.282 | 35.250 | -0.09 |
| 3 | 35.171 | 35.142 | -0.08 |
| 4 | 35.099 | 35.079 | -0.06 |
| 5 | 35.320 | 35.295 | -0.07 |
| 6 | 35.120 | 35.122 | 0.01 |
| 7 | 35.202 | 35.172 | -0.09 |
| 8 | 35.236 | 35.224 | -0.03 |
| 9 | 35.151 | 35.122 | -0.08 |
| 10 | 35.175 | 35.152 | -0.07 |
| 11 | 35.216 | 35.205 | -0.03 |
| 12 | 35.186 | 35.162 | -0.07 |
| 13 | 35.409 | 35.387 | -0.06 |
| 14 | 35.178 | 35.149 | -0.08 |
| 15 | 35.284 | 35.260 | -0.07 |
| 16 | 35.210 | 35.158 | -0.15 |
| 17 | 35.224 | 35.202 | -0.06 |
| 18 | 35.225 | 35.207 | -0.05 |
| 19 | 35.216 | 35.146 | -0.20 |
| 20 | 35.093 | 35.086 | -0.02 |
| 21 | 35.258 | 35.210 | -0.14 |

Remark : Change in capacitance observed is not more than 3 %.

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Table -4

(for Type test Sr. No.8)

Measurement of capacitance before and after Self-Healing test was:

| MARK NO. | CAPACITANCE (μ F) BEFORE TEST | CAPACITANCE (μ F) AFTER TEST | Δ C (%) |
|----------|------------------------------------|-----------------------------------|----------------|
| 22 | 35.218 | 35.226 | 0.02 |
| 23 | 35.195 | 35.206 | 0.03 |
| 24 | 35.228 | 35.236 | 0.02 |
| 25 | 35.292 | 35.299 | 0.02 |
| 26 | 35.231 | 35.240 | 0.03 |
| 27 | 35.175 | 35.182 | 0.02 |
| 28 | 35.270 | 35.277 | 0.02 |
| 29 | 35.169 | 35.178 | 0.03 |
| 30 | 35.099 | 35.101 | 0.01 |
| 31 | 35.140 | 35.147 | 0.02 |

Remark : Change in capacitance observed is not more than 0.5 %.

Table - 5 (for Type test sr. no. 8)

Measurement of self-healings :

| MARK NO. | VOLTAGE AT WHICH \geq 5 SELF-HEALINGS OBSERVED (U_t) | NO. OF SELF-HEALINGS OBSERVED AT $0.8 U_t$ | RC Value (s) |
|----------|------------------------------------------------------------|--------------------------------------------|--------------|
| 22 | 890 V | 0 | 195.5 |
| 23 | 885 V | 0 | 197.9 |
| 24 | 887 V | 0 | 195.9 |
| 25 | 881 V | 0 | 194.5 |
| 26 | 895 V | 0 | 197.3 |
| 27 | 897 V | 0 | 194.9 |
| 28 | 882 V | 0 | 197.5 |
| 29 | 889 V | 0 | 197.3 |
| 30 | 885 V | 0 | 199.0 |
| 31 | 887 V | 0 | 198.6 |

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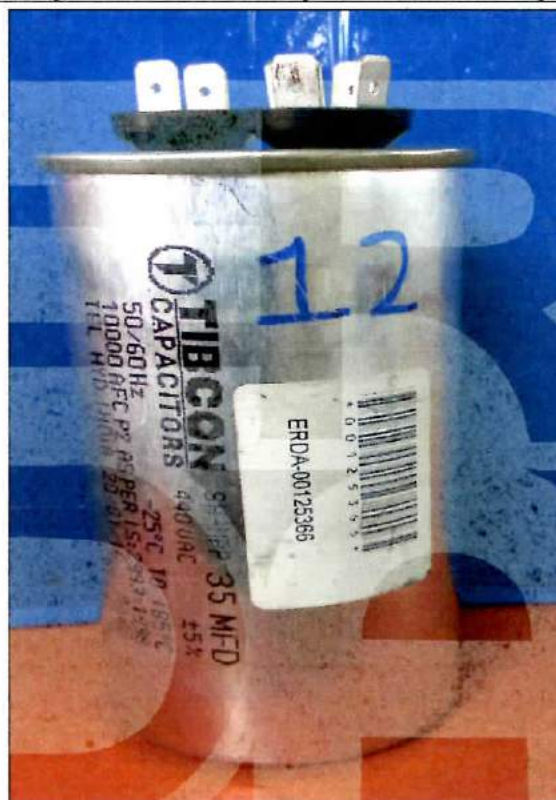
PHOTOGRAPH OF TEST SAMPLE

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SHEET : 11 of 11

DATE : 29.03.2016

Test Sample
(one of the sample from batch)



Rating plate



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