Capstick® Capacitor Test Data Packet

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Paktron System Summary

PAKTRON CAPACITORS

Company Overview

In existence since 1953, Paktron is one of the oldest capacitor manufacturers in the US. Paktron is the technological leader in the manufacture of multilayer polymer film capacitors and sells across diverse markets including automotive, commercial, Hi-Rel, military, space, and telecommunications. As a quality conscience company, Paktron follows the proven philosophy of building quality into its products. Inherent quality provides for both long-term reliability as well as outstanding product performance. Paktron's longevity is testament to its commitment to Quality.

Quality System Overview

Because of Paktron's multi-industry sales markets, rather than attempting to maintain registrations to each of the vast assortment of standardized qualty sytems specific to each of these markets, since 1953 Paktron has utilized an ever evolving, capacitor industry specific, documented quality system of its own which equals or exceeds the requirements of market oriented, standardized systems without the limitations imposed by market standardization. Paktron's Quality Assurance System is a full-featured system giving Paktron the ability to produce the finest products possible. The system includes, but is not limited to:

1. Operator Training
2. Receiving Inspection
3. Calibration
4. Out-going Inspection
5. Failure Analysis
6. Statistical Process Control
7. New Product/Process Authorization
8. Vender Qualification
9. Material Review
10. In-Process Inspections
11. Surveillance Testing
12. Qualification Testing
13. Reliability Testing

Documentation System

The Paktron documentation system strictly follows the guidelines as outlined in ISO-900x. The documentation system is separated into three different sections:

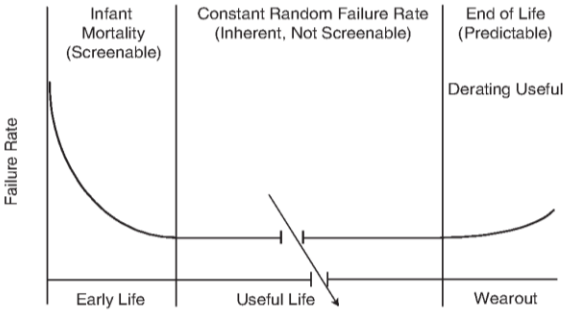
1) Procedure manuals:
   a) Quality Manual
   b) Document Control Procedures Manual
   c) Accounting Procedures Manual
   d) Engineering Procedures Manual
   Specifications
   e) Marketing and Sales Procedures Manual
   f) Purchasing Procedures Manual
   g) Production Control Procedures Manual
   h) Quality Control Procedures Manual
   i) Shipping and Receiving Procedures Manual
   j) Supplier Quality Assurance Procedures Manual
   k) Test and Reliability Procedures Manuals
2) General Procedures:
3) Specification systems:
   a) Assembly Specifications
   b) Design Specifications
   c) Equipment
   d) Material Specifications
   e) Process Specifications
   f) Quality Specifications

Statistical Process Control

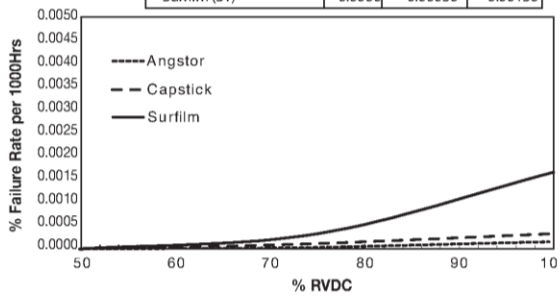
Like many other manufacturers, in order to meet the changing quality needs of its various customers, Paktron has long ago implemented a program of Statistical Process Control (SPC). This program placed the responsibility for quality directly on the production operators who must build quality into the product rather than trying to test defects out in the final test operations. This results in the production of more consistent quality and performance products. Day-to-day process control is being done with process control charts (X bar and R, percent defective, histograms and range charts) with the Paktron QA department moving into an overview function of doing trending analysis, process averaging, specification compliance control, etc. Using these systems of certification, quality levels in the low PPMs becomes not just a goal, but a reality.

Reliability

Paktron's Quality Assurance does not end once the product has been shipped to the customer. The long-term reliability of the product is as important as its initial implementation. Theoretically, a well-designed, well-engineered, thoroughly tested and properly applied component should "never" fail in operation (within the life of the equipment). However, practical experience shows that even the best design, manufacturing, and engineering efforts do not completely eliminate the occurrence of "field" failures. Usually, field failure categories encountered in components are the "infantile", "random", and in the case of mis-application, "wearout". Paktron eliminates the "infantile" category through extensive testing and strict controls (QA/SPC). The "wearout" category is eliminated by "guard-banding" the performance characteristics of the products and by maintaining close contacts between the Paktron and customer Engineering groups. "Random" failures occur after the infant mortality stage. They occur because of "undetectable" weaknesses in the products. Although the time of occurrence of random failures cannot be predicted, the probability of occurrence or non-occurrence of such failures can be calculated by means of the theory of probability. Paktron's reputation for "Quality" in the Industry is based not only on its ability to eliminate "infantile" failures through strict QA controls, but also on being able to minimize "random" failures through its SPC controls which detects/eliminates heretofore "undetectable" weaknesses and significantly increases the reliability of the product. Paktron's film capacitors are so inherently reliable that use life is measured in decades rather than hours of operation. While Paktron's own rigorous accelerated testing shows theoretical PPM failure levels in the single digits, customer feedback consistently reports zero PPM failure levels.



	@ %RVDC and 40°C		
	50%	75%	100%
Angstor (RA)	0.0000	0.00003	0.00014
Capstick (CS, CB)	0.0000	0.00010	0.00030
Surfilm (ST)	0.0000	0.00030	0.00150



Voltage Ratings

Like all polymer film capacitors, Paktron's product offerings have "true" voltage ratings and unlike other dielectric systems require no voltage de-ratings for maximizing reliability (MTBF) or use life. With FIT rates of well under 5 FIT when used at rated voltage, these capacitors provide a positive contribution to circuit MTBF calculations.

Circuit designers requiring 500 volt ratings in other dielectric systems for their 370 volt input applications are being penalized by that dielectric system's inherent deficiencies. In the polymer film capacitor industry, if a capacitor is rated at a certain voltage, then the capacitor is designed to be fully functional and reliable at that voltage for the life of the equipment. Many leading edge circuit designs take advantage of a polymer film capacitor's inherent reliability at rated voltage to both reduce board size and significantly improve performance.

Material Content

Paktron's product offerings neither contain nor are manufactured with any risk level hazardous material. The material content for polymer film capacitors is basically: polymer, aluminum, copper, tin, iron, microcrystalline polyolefin, trace amounts of other materials such as antimony and lead and various non-toxic, non-hazardous thermoplastics used for encasements. The polymers typically used are polyethylene terephthalate (PET), polyethylene napthalate (PEN) and/or polyphenylene sulfide (PPS). The products' terminations are coated (tinned) with either 60Sn-40Pb or 100% Sn to a thickness of 100-500 micro inches in order to facilitate soldering without the possibility of whisker growth with the 100% Sn meeting current industry guidelines for lead-free (Pb-free) with a lead (Pb) material content of under 0.1 wt% (1000ppm).

Capstick Capacitor Test Data

1. Life Testing
    a. Accelerated DC Dry Life Test (85°C / 125vdc / 2000 hrs): 106K100CS4
    b. Accelerated DC Dry Life Test (85°C / 500vdc / 2000 hrs): 474K400CS6
    c. Accelerated DC Dry Life Test (85°C / 625vdc / 2000 hrs): 105K500CS6
    d. Accelerated DC Dry Life Test (125°C / 62.5vdc / 2000 hrs): 106K100CB4
2. Moisture Resistance Testing
    a. Accelerated Moisture Test (85%RH/85°C / / 2000 hrs): 405K100CB4
    b. Accelerated Moisture Test (85%RH/85°C / 100vdc / 2000 hrs): 405K100CS4
3. Vibration Testing
    a. SMT Vibration Test (MIL-STD-202E, Method 204D): 106K100CB4G
    b. SMT Vibration Test (MIL-STD-202E, Method 204D): 405K100CS4G

PAKTRON CAPACITORS

Test File Comparison Report
106K100CS4

Test File Data

Tests	Code Names	Operators	Test Type
Initial	010909P011Ca	K.C.	Performance evaluation
Final	010909P011Ce	K.C.	Dry life

Test Criteria

Voltage	Temperature	%RH	Duration
125VDC	85°C ± 3°C	NA	2000 hrs ± 12 hrs

Special:	Standard Capstick units. Tested to IEC 384-1, paragraph 4.23

Test Data

	Initial				Final				
	Cap		DF	IR	Cap			DF	IR
Unit #	mfds	%Nom.	%	MegOhms	mfds	%Nom.	% Δ	%	MegOhms
1	9.928	-0.72	< 1.0%	> 100	9.794	-2.06	-1.35	< 1.0%	> 100
2	9.748	-2.52	< 1.0%	> 100	10.062	0.62	3.21	< 1.0%	> 100
3	9.552	-4.48	< 1.0%	> 100	10.004	0.04	4.73	< 1.0%	> 100
4	9.929	-0.71	< 1.0%	> 100	10.144	1.44	2.17	< 1.0%	> 100
5	9.574	-4.26	< 1.0%	> 100	9.863	-1.37	3.02	< 1.0%	> 100
6	10.069	0.69	< 1.0%	> 100	9.753	-2.47	-3.13	< 1.0%	> 100
7	10.020	0.20	< 1.0%	> 100	9.705	-2.95	-3.14	< 1.0%	> 100
8	9.941	-0.59	< 1.0%	> 100	10.054	0.54	1.14	< 1.0%	> 100
9	9.904	-0.96	< 1.0%	> 100	10.000	0.00	0.96	< 1.0%	> 100
10	10.146	1.46	< 1.0%	> 100	9.956	-0.44	-1.88	< 1.0%	> 100
11	9.926	-0.74	< 1.0%	> 100	9.716	-2.84	-2.12	< 1.0%	> 100
12	9.824	-1.76	< 1.0%	> 100	9.698	-3.02	-1.28	< 1.0%	> 100
13	9.821	-1.79	< 1.0%	> 100	9.676	-3.24	-1.48	< 1.0%	> 100
14	9.992	-0.08	< 1.0%	> 100	9.913	-0.87	-0.79	< 1.0%	> 100
15	9.567	-4.33	< 1.0%	> 100	9.825	-1.75	2.69	< 1.0%	> 100
16	10.158	1.58	< 1.0%	> 100	9.867	-1.33	-2.87	< 1.0%	> 100
17	10.010	0.10	< 1.0%	> 100	9.677	-3.23	-3.32	< 1.0%	> 100
18	9.943	-0.57	< 1.0%	> 100	9.740	-2.60	-2.05	< 1.0%	> 100
19	10.203	2.03	< 1.0%	> 100	9.767	-2.33	-4.27	< 1.0%	> 100
20	10.211	2.11	< 1.0%	> 100	9.827	-1.73	-3.76	< 1.0%	> 100
21	10.061	0.61	< 1.0%	> 100	10.036	0.36	-0.25	< 1.0%	> 100
22	9.927	-0.73	< 1.0%	> 100	10.136	1.36	2.11	< 1.0%	> 100
23	9.741	-2.59	< 1.0%	> 100	9.945	-0.55	2.10	< 1.0%	> 100
24	9.916	-0.84	< 1.0%	> 100	10.074	0.74	1.60	< 1.0%	> 100
25	9.586	-4.14	< 1.0%	> 100	9.749	-2.51	1.70	< 1.0%	> 100
Max	10.211	2.11	< 1.0%		10.144	1.44	4.73	< 1.0%	
Min	9.552	-4.48		> 100	9.676	-3.24	-4.27		> 100
Avg	9.908	-0.92			9.879	-1.21	-0.25		
Std	0.1904	1.90			0.1489	1.49	2.52		
Range	0.6585	6.59			0.4685	4.68	9.00		

Conclusion

Performance:

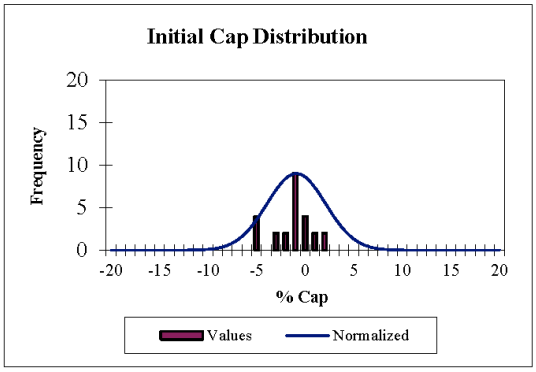
	Design Limits	Test Data	Pass
% Δ Cap (max)	5.00	4.73	✓
%DF (max)	1.00	< 1.0%	✓
IR (min)	100	> 100	✓

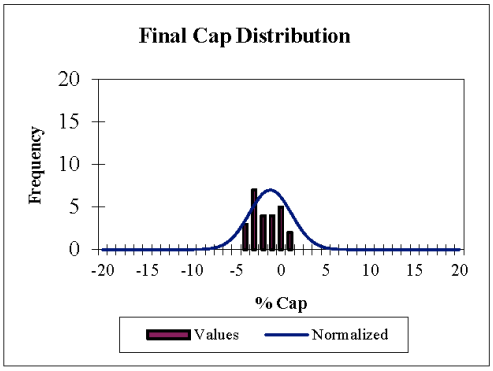
Notes:

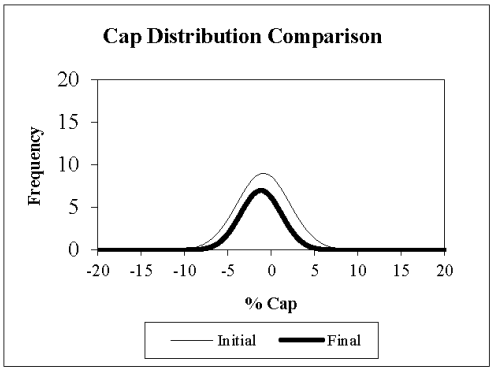
Test parts successfully meet performance criteria.

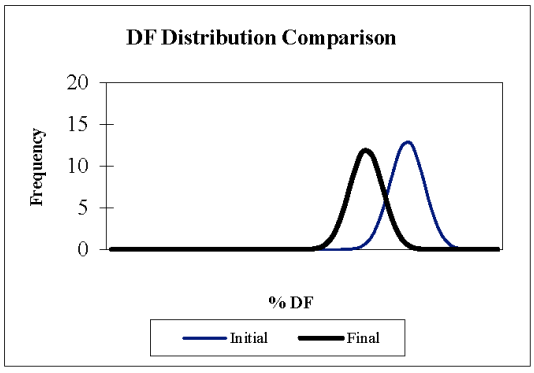
Paktron

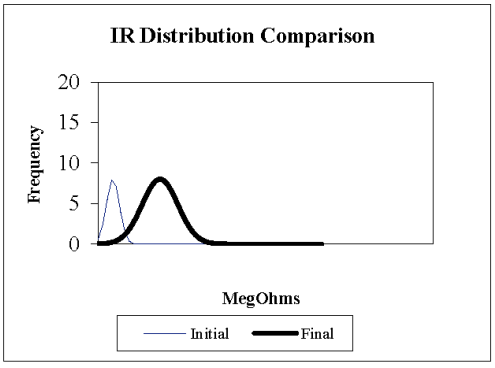
106K100CS4-Dry life











PAKTRON CAPACITORS

Test File Comparison Report
474K400CS6

Test File Data

Tests	Code Names	Operators	Test Type
Initial	001222R08Aa	B.A.	Performance evaluation
Final	001222R08Da	B.A.	Dry life

Test Criteria

Voltage	Temperature	%RH	Duration
500VDC	85°C ± 3°C	NA	2000 hrs ± 12 hrs

Special: Standard CS6 units.
Tested to IEC 384-1, paragraph 4.23

Test Data

	Initial				Final				
	Cap		DF	IR	Cap			DF	IR
Unit #	mfds	%Nom.	%	MegOhms	mfds	%Nom.	% Δ	%	MegOhms
1	0.471	0.21	< 1.0%	> 1,000	0.469	-0.21	-0.42	< 1.0%	> 1,000
2	0.453	-3.62	< 1.0%	> 1,000	0.442	-5.96	-2.43	< 1.0%	> 1,000
3	0.470	0.00	< 1.0%	> 1,000	0.469	-0.21	-0.21	< 1.0%	> 1,000
4	0.474	0.85	< 1.0%	> 1,000	0.473	0.64	-0.21	< 1.0%	> 1,000
5	0.469	-0.21	< 1.0%	> 1,000	0.467	-0.64	-0.43	< 1.0%	> 1,000
6	0.462	-1.70	< 1.0%	> 1,000	0.460	-2.13	-0.43	< 1.0%	> 1,000
7	0.467	-0.64	< 1.0%	> 1,000	0.465	-1.06	-0.43	< 1.0%	> 1,000
8	0.472	0.43	< 1.0%	> 1,000	0.471	0.21	-0.21	< 1.0%	> 1,000
9	0.469	-0.21	< 1.0%	> 1,000	0.468	-0.43	-0.21	< 1.0%	> 1,000
10	0.448	-4.68	< 1.0%	> 1,000	0.447	-4.89	-0.22	< 1.0%	> 1,000
11	0.465	-1.06	< 1.0%	> 1,000	0.463	-1.49	-0.43	< 1.0%	> 1,000
12	0.451	-4.04	< 1.0%	> 1,000	0.450	-4.26	-0.22	< 1.0%	> 1,000
13	0.464	-1.28	< 1.0%	> 1,000	0.461	-1.91	-0.65	< 1.0%	> 1,000
14	0.472	0.43	< 1.0%	> 1,000	0.471	0.21	-0.21	< 1.0%	> 1,000
15	0.467	-0.64	< 1.0%	> 1,000	0.466	-0.85	-0.21	< 1.0%	> 1,000
16	0.469	-0.21	< 1.0%	> 1,000	0.468	-0.43	-0.21	< 1.0%	> 1,000
17	0.454	-3.40	< 1.0%	> 1,000	0.453	-3.62	-0.22	< 1.0%	> 1,000
18	0.467	-0.64	< 1.0%	> 1,000	0.466	-0.85	-0.21	< 1.0%	> 1,000
19	0.477	1.49	< 1.0%	> 1,000	0.475	1.06	-0.42	< 1.0%	> 1,000
20	0.449	-4.47	< 1.0%	> 1,000	0.448	-4.68	-0.22	< 1.0%	> 1,000
21	0.473	0.64	< 1.0%	> 1,000	0.472	0.43	-0.21	< 1.0%	> 1,000
22	0.474	0.85	< 1.0%	> 1,000	0.473	0.64	-0.21	< 1.0%	> 1,000
23									
24									
25									
Max	0.477	1.49	< 1.0%		0.475	1.06	-0.21	< 1.0%	
Min	0.448	-4.68		> 1,000	0.442	-5.96	-2.43		> 1,000
Avg	0.465	-1.00			0.464	-1.38	-0.39		
Std	0.0085	1.82			0.0093	1.98	0.46		
Range	0.0290	6.17			0.0330	7.02	2.22		

Conclusion

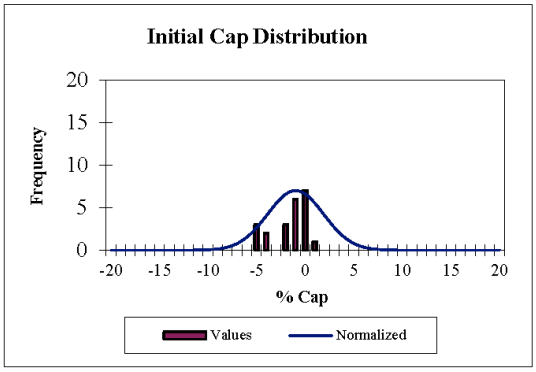
Performance:

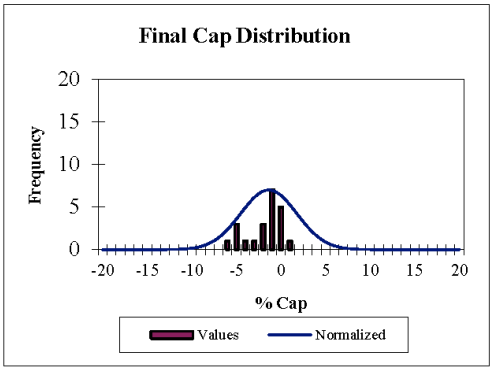
	Design Limits	Test Data	Pass
% Δ Cap (max)	5.00	2.43	✓
%DF (max)	1.00	< 1.0%	✓
IR (min)	1,000	> 1,000	✓

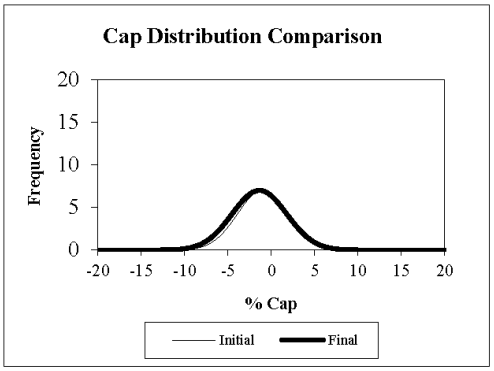
Notes:
Test parts successfully meet performance criteria.

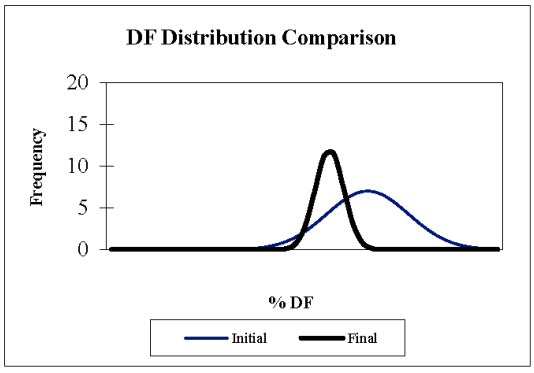
Paktron

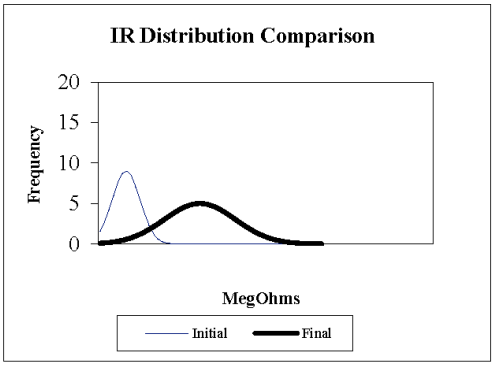
474K400CS6-Dry life











PAKTRON CAPACITORS

Test File Comparison Report
105K500CS6

Test File Data

Tests	Code Names	Operators	Test Type
Initial	009086R08Aa	R.P.	Performance evaluation
Final	009108R08Da	R.P.	Dry life

Test Criteria

Voltage	Temperature	%RH	Duration
625VDC	85°C ± 3°C	NA	2000 hrs ± 12 hrs

Special:	Standard CS6 units. Tested to IEC 384-1, paragraph 4.23

Test Data

	Initial				Final				
	Cap		DF	IR	Cap			DF	IR
Unit #	mfds	%Nom.	%	MegOhms	mfds	%Nom.	% Δ	%	MegOhms
1	1.015	1.50	< 1.0%	> 1000	0.978	-2.20	-3.65	< 1.0%	> 1000
2	0.997	-0.30	< 1.0%	> 1000	0.999	-0.10	0.20	< 1.0%	> 1000
3	1.019	1.90	< 1.0%	> 1000	0.990	-1.00	-2.85	< 1.0%	> 1000
4	1.015	1.50	< 1.0%	> 1000	0.993	-0.70	-2.17	< 1.0%	> 1000
5	1.005	0.50	< 1.0%	> 1000	0.972	-2.80	-3.28	< 1.0%	> 1000
6	1.001	0.10	< 1.0%	> 1000	0.969	-3.10	-3.20	< 1.0%	> 1000
7	1.016	1.60	< 1.0%	> 1000	0.985	-1.50	-3.05	< 1.0%	> 1000
8	0.995	-0.50	< 1.0%	> 1000	0.974	-2.60	-2.11	< 1.0%	> 1000
9	0.992	-0.80	< 1.0%	> 1000	0.972	-2.80	-2.02	< 1.0%	> 1000
10	1.006	0.60	< 1.0%	> 1000	0.971	-2.90	-3.48	< 1.0%	> 1000
11	1.014	1.40	< 1.0%	> 1000	0.990	-1.00	-2.37	< 1.0%	> 1000
12	1.015	1.50	< 1.0%	> 1000	1.001	0.10	-1.38	< 1.0%	> 1000
13	0.994	-0.60	< 1.0%	> 1000	0.984	-1.60	-1.01	< 1.0%	> 1000
14	0.997	-0.30	< 1.0%	> 1000	1.002	0.20	0.50	< 1.0%	> 1000
15	1.002	0.20	< 1.0%	> 1000	0.999	-0.10	-0.30	< 1.0%	> 1000
16	0.997	-0.30	< 1.0%	> 1000	0.979	-2.10	-1.81	< 1.0%	> 1000
17	1.011	1.10	< 1.0%	> 1000	0.989	-1.10	-2.18	< 1.0%	> 1000
18	1.007	0.70	< 1.0%	> 1000	0.979	-2.10	-2.78	< 1.0%	> 1000
19	0.991	-0.90	< 1.0%	> 1000	0.976	-2.40	-1.51	< 1.0%	> 1000
20	0.995	-0.50	< 1.0%	> 1000	0.999	-0.10	0.40	< 1.0%	> 1000
21	1.000	0.00	< 1.0%	> 1000	0.969	-3.10	-3.10	< 1.0%	> 1000
22	0.992	-0.80	< 1.0%	> 1000	0.978	-2.20	-1.41	< 1.0%	> 1000
23	0.997	-0.30	< 1.0%	> 1000	0.975	-2.50	-2.21	< 1.0%	> 1000
24	0.992	-0.80	< 1.0%	> 1000	0.984	-1.60	-0.81	< 1.0%	> 1000
24	1.020	2.00	< 1.0%	> 1000	0.974	-2.60	-4.51	< 1.0%	> 1000
Max	1.020	2.00	< 1.0%		1.002	0.20	0.50	< 1.0%	
Min	0.991	-0.90		> 1000	0.969	-3.10	-4.51		> 1000
Avg	1.003	0.34			0.983	-1.68	-2.00		
Std	0.0094	0.94			0.0106	1.06	1.29		
Range	0.0290	2.90			0.0330	3.30	5.01		

Conclusion

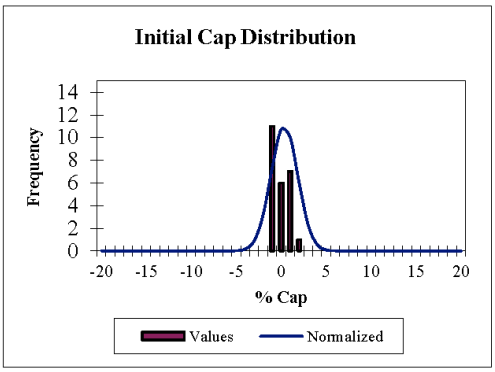
Performance:

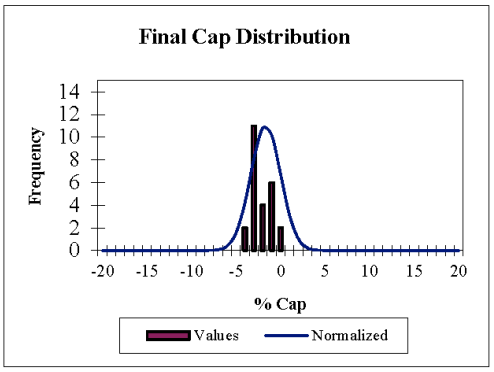
	Design Limits	Test Data	Pass
% Δ Cap (max)	5.00	4.51	✓
%DF (max)	1.00	< 1.0%	✓
IR (min)	1,000.0	> 1000	✓

Notes:

Test parts successfully meet performance criteria.

Paktron


Initial Cap Distribution
Frequency
14
12
10
8
6
4
2
0
-20 -15 -10 -5 0 5 10 15 20
% Cap
Values
Normalized


Final Cap Distribution
Frequency
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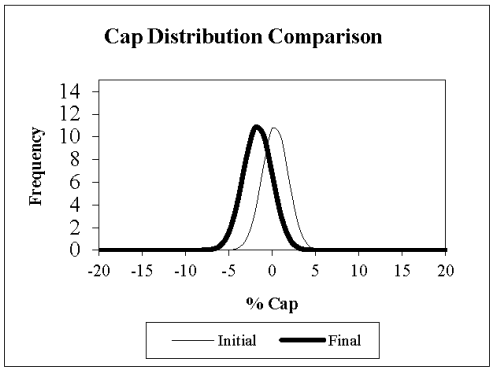
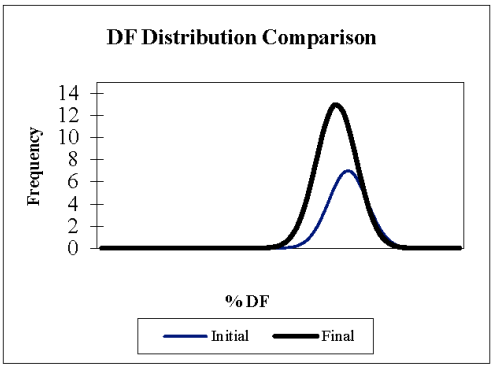
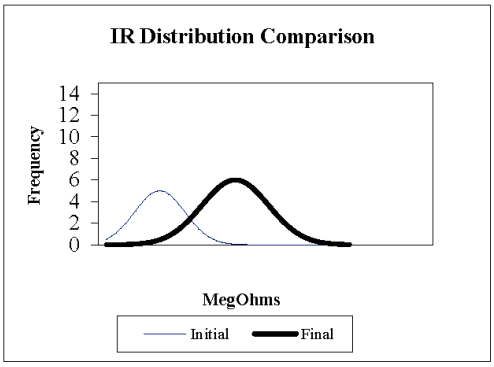
12
10
8
6
4
2
0
-20 -15 -10 -5 0 5 10 15 20
% Cap
Values
Normalized


Cap Distribution Comparison
Frequency
14
12
10
8
6
4
2
0
-20 -15 -10 -5 0 5 10 15 20
% Cap
Initial
Final


DF Distribution Comparison
Frequency
14
12
10
8
6
4
2
0
% DF
Initial
Final


IR Distribution Comparison
Frequency
14
12
10
8
6
4
2
0
MegOhms
Initial
Final

PAKTRON CAPACITORS

Test File Comparison Report
106K100CB4

Test File Data

Tests	Code Names	Operators	Test Type
Initial	008073R08Aa	K.C.	Performance evaluation
Final	008073R08Da	K.C.	Dry life

Test Criteria

Voltage	Temperature	%RH	Duration
62.5VDC	125°C ± 3°C	NA	2000 hrs ± 12 hrs

Special: Standard Capstick units.
Tested to IEC 384-1, paragraph 4.23

Test Data

	Initial				Final				
	Cap		DF	IR	Cap			DF	IR
Unit #	mfds	%Nom.	%	MegOhms	mfds	%Nom.	% Δ	%	MegOhms
1	9.205	-7.95	< 1.0%	> 100	8.905	-10.95	-3.26	< 1.0%	> 100
2	9.070	-9.30	< 1.0%	> 100	8.794	-12.06	-3.05	< 1.0%	> 100
3	9.530	-4.70	< 1.0%	> 100	9.499	-5.01	-0.33	< 1.0%	> 100
4	9.269	-7.31	< 1.0%	> 100	9.209	-7.91	-0.65	< 1.0%	> 100
5	9.312	-6.88	< 1.0%	> 100	9.025	-9.75	-3.08	< 1.0%	> 100
6	9.925	-0.75	< 1.0%	> 100	9.754	-2.46	-1.72	< 1.0%	> 100
7	9.264	-7.36	< 1.0%	> 100	9.052	-9.48	-2.29	< 1.0%	> 100
8	9.296	-7.04	< 1.0%	> 100	9.083	-9.17	-2.29	< 1.0%	> 100
9	9.108	-8.92	< 1.0%	> 100	8.929	-10.71	-1.96	< 1.0%	> 100
10	9.396	-6.04	< 1.0%	> 100	9.186	-8.15	-2.24	< 1.0%	> 100
11	9.017	-9.83	< 1.0%	> 100	8.836	-11.64	-2.01	< 1.0%	> 100
12	9.140	-8.60	< 1.0%	> 100	8.926	-10.74	-2.34	< 1.0%	> 100
13	9.207	-7.93	< 1.0%	> 100	8.972	-10.28	-2.55	< 1.0%	> 100
14	9.024	-9.76	< 1.0%	> 100	8.986	-10.14	-0.43	< 1.0%	> 100
15	9.928	-0.72	< 1.0%	> 100	9.920	-0.80	-0.08	< 1.0%	> 100
16	9.260	-7.40	< 1.0%	> 100	9.213	-7.88	-0.51	< 1.0%	> 100
17	9.313	-6.87	< 1.0%	> 100	9.318	-6.82	0.05	< 1.0%	> 100
18	9.914	-0.86	< 1.0%	> 100	9.648	-3.52	-2.68	< 1.0%	> 100
19	9.260	-7.40	< 1.0%	> 100	8.915	-10.85	-3.73	< 1.0%	> 100
20	9.287	-7.13	< 1.0%	> 100	9.206	-7.94	-0.88	< 1.0%	> 100
21	9.089	-9.11	< 1.0%	> 100	9.061	-9.39	-0.30	< 1.0%	> 100
22	9.376	-6.24	< 1.0%	> 100	9.037	-9.63	-3.62	< 1.0%	> 100
23	9.997	-0.03	< 1.0%	> 100	9.772	-2.28	-2.25	< 1.0%	> 100
24	9.132	-8.68	< 1.0%	> 100	8.916	-10.84	-2.37	< 1.0%	> 100
25	9.024	-9.76	< 1.0%	> 100	8.856	-11.44	-1.87	< 1.0%	> 100
Max	9.997	-0.03	< 1.0%		9.920	-0.80	0.05	< 1.0%	
Min	9.017	-9.83		> 100	8.794	-12.06	-3.73		> 100
Avg	9.334	-6.66			9.161	-8.39	-1.86		
Std	0.2920	2.92			0.3126	3.13	1.13		
Range	0.9800	9.80			1.1267	11.27	3.78		

Conclusion

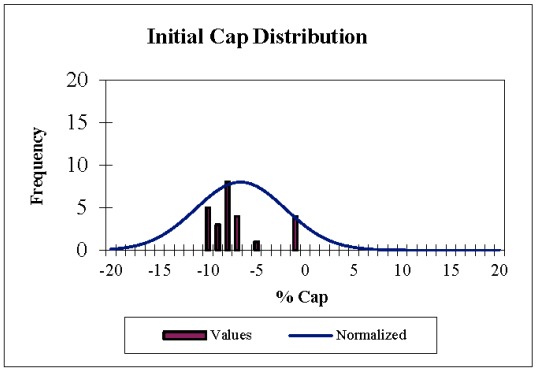
Performance:

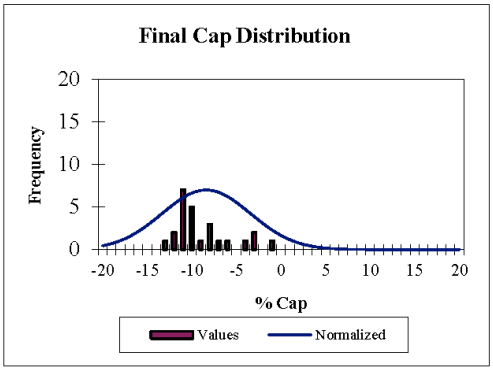
	Design Limits	Test Data	Pass
% Δ Cap (max)	5.00	3.73	✓
%DF (max)	1.00	< 1.0%	✓
IR (min)	100	> 100	✓

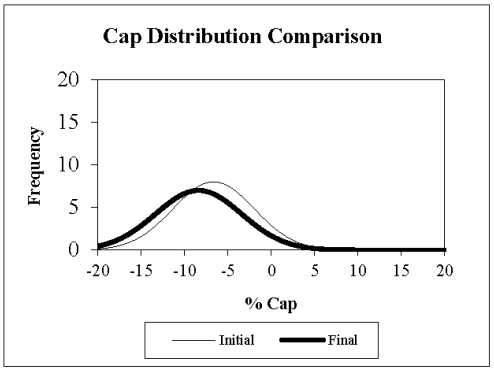
Notes:
Test parts successfully meet performance criteria.

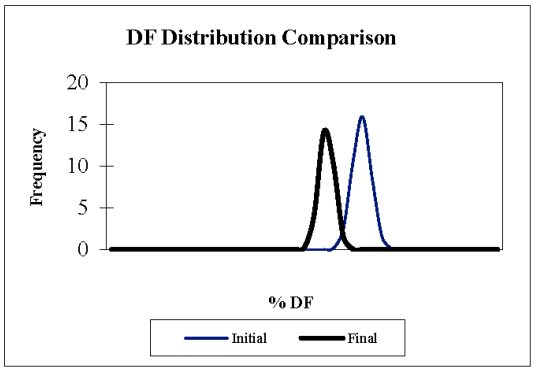
Paktron

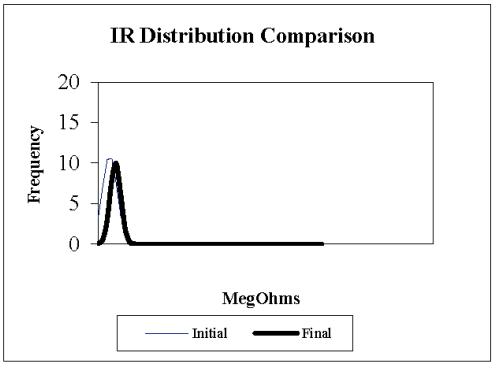
106K100CB4-Dry life











PAKTRON CAPACITORS

Test File Comparison Report
405K100CB4

Test File Data

Tests	Code Names	Operators	Test Type
Initial	010521P002Ca	K.C.	Performance evaluation
Final	010521P002Ce	K.C.	Moisture Resistance

Test Criteria

Voltage	Temperature	%RH	Duration
	85°C ± 3°C	85%	2000 hrs ± 12 hrs

Special: Standard Capstick units.
Tested to IEC 68-2-3 (steady state moisture resistance test, no applied voltage), except: 85°C instead of 40°C, 85%RH instead of 95% and 83.3days instead of 56.

Test Data

	Initial				Final				
	Cap		DF	IR	Cap			DF	IR
Unit #	mfds	%Nom.	%	MegOhms	mfds	%Nom.	% Δ	%	MegOhms
1	4.052	1.30	< 1.0%	> 75	4.190	4.75	3.41	< 1.0%	> 75
2	4.099	2.48	< 1.0%	> 75	4.229	5.73	3.17	< 1.0%	> 75
3	4.135	3.38	< 1.0%	> 75	4.282	7.05	3.56	< 1.0%	> 75
4	4.095	2.38	< 1.0%	> 75	4.236	5.90	3.44	< 1.0%	> 75
5	4.083	2.08	< 1.0%	> 75	4.220	5.50	3.36	< 1.0%	> 75
6	4.060	1.50	< 1.0%	> 75	4.187	4.68	3.13	< 1.0%	> 75
7	4.120	3.00	< 1.0%	> 75	4.274	6.85	3.74	< 1.0%	> 75
8	4.083	2.08	< 1.0%	> 75	4.230	5.75	3.60	< 1.0%	> 75
9	4.054	1.35	< 1.0%	> 75	4.186	4.65	3.26	< 1.0%	> 75
10	4.248	6.20	< 1.0%	> 75	4.386	9.65	3.25	< 1.0%	> 75
11	4.127	3.18	< 1.0%	> 75	4.259	6.48	3.20	< 1.0%	> 75
12	4.190	4.75	< 1.0%	> 75	4.339	8.48	3.56	< 1.0%	> 75
13	4.150	3.75	< 1.0%	> 75	4.284	7.10	3.23	< 1.0%	> 75
14	4.048	1.20	< 1.0%	> 75	4.182	4.55	3.31	< 1.0%	> 75
15	4.190	4.75	< 1.0%	> 75	4.314	7.85	2.96	< 1.0%	> 75
16	4.081	2.03	< 1.0%	> 75	4.210	5.25	3.16	< 1.0%	> 75
17	4.062	1.55	< 1.0%	> 75	4.197	4.93	3.32	< 1.0%	> 75
18	4.050	1.25	< 1.0%	> 75	4.174	4.35	3.06	< 1.0%	> 75
19	4.088	2.20	< 1.0%	> 75	4.224	5.60	3.33	< 1.0%	> 75
20	3.944	-1.40	< 1.0%	> 75	4.071	1.78	3.22	< 1.0%	> 75
21	4.063	1.58	< 1.0%	> 75	4.204	5.10	3.47	< 1.0%	> 75
22	3.938	-1.55	< 1.0%	> 75	4.061	1.53	3.12	< 1.0%	> 75
23									
24									
25									
Max	4.248	6.20	< 1.0%		4.386	9.65	3.74	< 1.0%	
Min	3.938	-1.55		> 75	4.061	1.53	2.96		> 75
Avg	4.089	2.23			4.225	5.61	3.31		
Std	0.0694	1.74			0.0732	1.83	0.19		
Range	0.3100	7.75			0.3250	8.13	0.78		

Conclusion

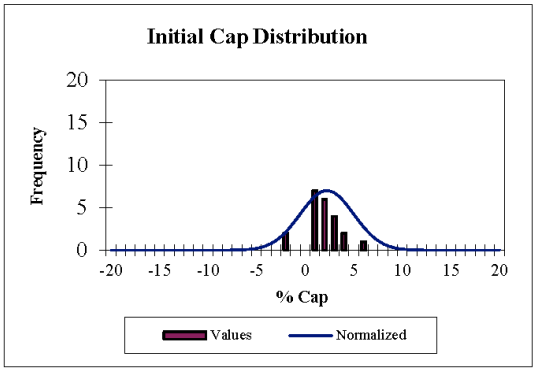
Performance:

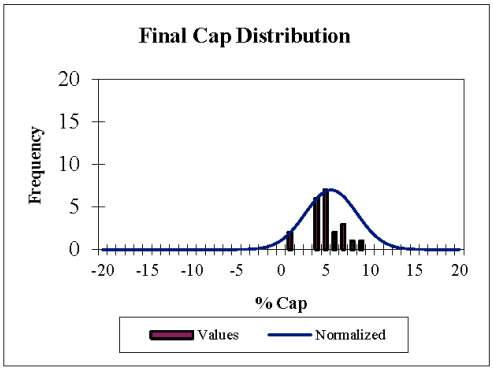
	Design Limits	Test Data	Pass
% Δ Cap (max)	7.00	3.74	✓
%DF (max)	1.00	< 1.0%	✓
IR (min)	75	> 75	✓

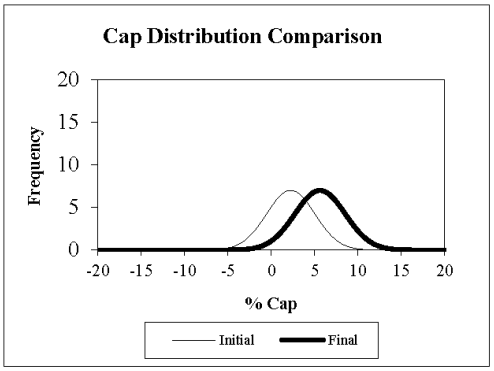
Notes:
Test parts successfully meet performance criteria.

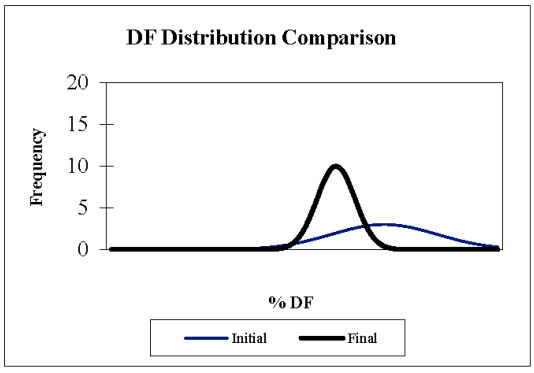
Paktron

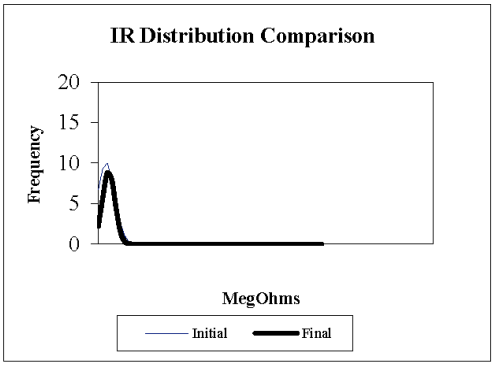
405K100CB4-Moisture Resistance











PAKTRON CAPACITORS

Test File Comparison Report
405K100CS4

Test File Data

Tests	Code Names	Operators	Test Type
Initial	010924P002Ca	K.C.	Performance evaluation
Final	010924P002Ce	K.C.	Moisture Resistance

Test Criteria

Voltage	Temperature	%RH	Duration
100VDC	85°C ± 3°C	0.85	2000 hrs ± 12 hrs

Special: Standard CS4 units.
Tested to IEC 68-2-3 (steady state moisture resistance test, applied voltage),
except: 85°C instead of 40°C, 85%RH instead of 95% and 83.3days instead of 56.

Test Data

	Initial				Final				
	Cap		DF	IR	Cap			DF	IR
Unit #	mfds	%Nom.	%	MegOhms	mfds	%Nom.	% Δ	%	MegOhms
1	4.172	4.31	< 1.0%	> 75	4.169	4.22	-0.09	< 1.0%	> 75
2	4.005	0.13	< 1.0%	> 75	4.032	0.80	0.66	< 1.0%	> 75
3	3.994	-0.16	< 1.0%	> 75	4.024	0.61	0.76	< 1.0%	> 75
4	4.005	0.13	< 1.0%	> 75	4.039	0.99	0.85	< 1.0%	> 75
5	4.074	1.84	< 1.0%	> 75	4.104	2.60	0.75	< 1.0%	> 75
6	4.081	2.03	< 1.0%	> 75	4.066	1.65	-0.37	< 1.0%	> 75
7	4.112	2.79	< 1.0%	> 75	4.142	3.55	0.74	< 1.0%	> 75
8	4.100	2.51	< 1.0%	> 75	4.123	3.07	0.56	< 1.0%	> 75
9	4.009	0.22	< 1.0%	> 75	4.036	0.89	0.66	< 1.0%	> 75
10	4.039	0.99	< 1.0%	> 75	4.066	1.65	0.66	< 1.0%	> 75
11	4.089	2.22	< 1.0%	> 75	4.119	2.98	0.74	< 1.0%	> 75
12	4.112	2.79	< 1.0%	> 75	4.142	3.55	0.74	< 1.0%	> 75
13	4.142	3.55	< 1.0%	> 75	4.172	4.31	0.73	< 1.0%	> 75
14	4.081	2.03	< 1.0%	> 75	4.115	2.88	0.84	< 1.0%	> 75
15	4.134	3.36	< 1.0%	> 75	4.165	4.12	0.74	< 1.0%	> 75
16	4.138	3.46	< 1.0%	> 75	4.169	4.22	0.73	< 1.0%	> 75
17	4.093	2.32	< 1.0%	> 75	4.123	3.07	0.74	< 1.0%	> 75
18	4.039	0.99	< 1.0%	> 75	4.058	1.46	0.47	< 1.0%	> 75
19	3.994	-0.14	< 1.0%	> 75	4.031	0.76	0.90	< 1.0%	> 75
20	3.971	-0.72	< 1.0%	> 75	4.001	0.03	0.77	< 1.0%	> 75
21	4.123	3.07	< 1.0%	> 75	3.963	-0.91	-3.87	< 1.0%	> 75
22	4.127	3.17	< 1.0%	> 75	4.169	4.22	1.01	< 1.0%	> 75
23									
24									
25									
Max	4.172	4.31	< 1.0%		4.172	4.31	1.01	< 1.0%	
Min	3.971	-0.72		> 75	3.963	-0.91	-3.87		> 75
Avg	4.074	1.86			4.092	2.30	0.44		
Std	0.0568	1.42			0.0614	1.53	0.99		
Range	0.2014	5.04			0.2090	5.23	4.88		

Conclusion

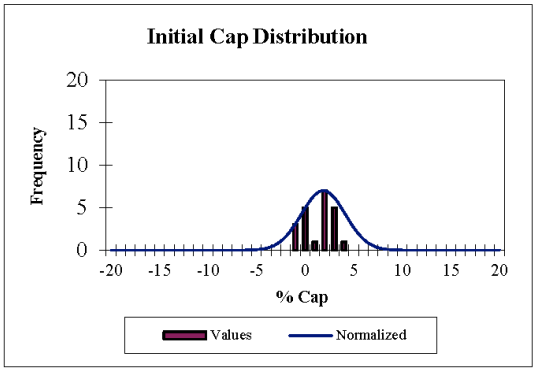
Performance:

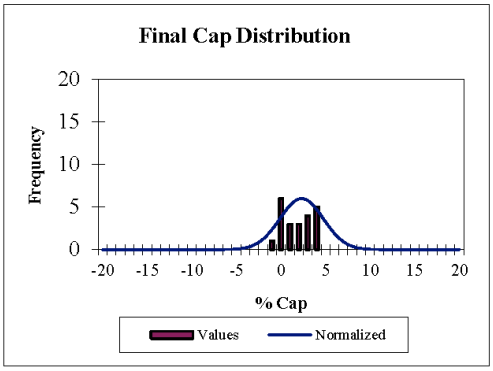
	Design Limits	Test Data	Pass
% Δ Cap (max)	5.00	3.87	✓
%DF (max)	1.00	< 1.0%	✓
IR (min)	75	> 75	✓

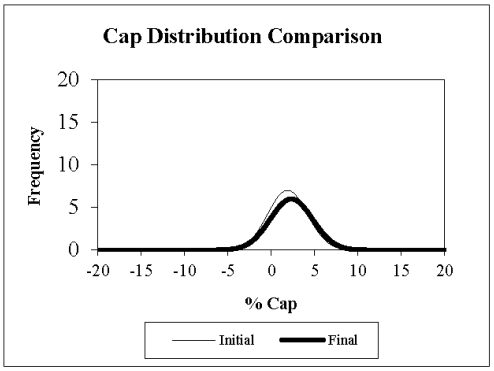
Notes:
Test parts successfully meet performance criteria.

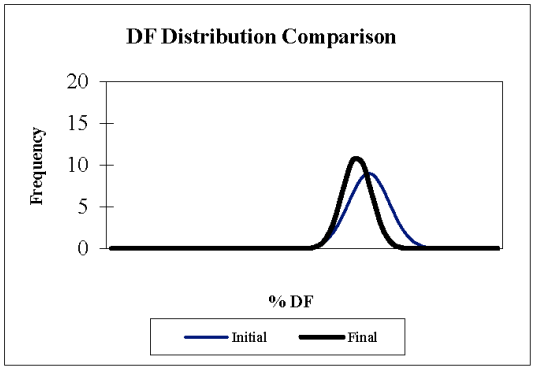
Paktron

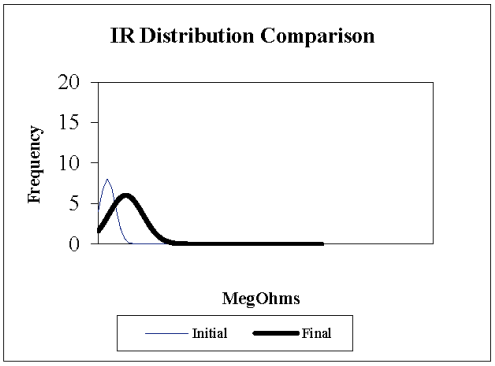
405K100CS4-Moisture Resistance











PAKTRON CAPACITORS

Test File Comparison Report
106K100CB4

Test File Data

Tests	Code Names	Operators	Test Type
Initial	010817P005Ca	K.C.	Performance evaluation
Final	010817P005Cb	K.C.	Vibration

Test Criteria

Voltage	Temperature	%RH	Duration
			3 hours

Special: Standard CB4 units.
Tested to MIL-STD-202E, Method 204D (50g vibration testing),
except: frequency is fixed.

Test Data

> 100

	Initial				Final				
	Cap		DF	IR	Cap			DF	IR
Unit #	mfds	%Nom.	%	MegOhms	mfds	%Nom.	% Δ	%	MegOhms
1	9.544	-4.56	< 1.0%	> 100	9.548	-4.52	0.04	< 1.0%	> 100
2	9.760	-2.40	< 1.0%	> 100	9.756	-2.44	-0.04	< 1.0%	> 100
3	9.629	-3.71	< 1.0%	> 100	9.631	-3.69	0.02	< 1.0%	> 100
4	9.657	-3.43	< 1.0%	> 100	9.661	-3.39	0.04	< 1.0%	> 100
5	9.957	-0.43	< 1.0%	> 100	9.963	-0.37	0.06	< 1.0%	> 100
6	9.689	-3.11	< 1.0%	> 100	9.694	-3.06	0.05	< 1.0%	> 100
7	9.780	-2.20	< 1.0%	> 100	9.784	-2.16	0.04	< 1.0%	> 100
8	9.733	-2.67	< 1.0%	> 100	9.736	-2.64	0.03	< 1.0%	> 100
9	10.212	2.12	< 1.0%	> 100	10.213	2.13	0.01	< 1.0%	> 100
10	9.712	-2.88	< 1.0%	> 100	9.713	-2.87	0.01	< 1.0%	> 100
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
Max	10.212	2.12	< 1.0%		10.213	2.13	0.06	< 1.0%	
Min	9.544	-4.56		> 100	9.548	-4.52	-0.04		> 100
Avg	9.767	-2.33			9.770	-2.30	0.03		
Std	0.1804	1.80			0.1802	1.80	0.03		
Range	0.6680	6.68			0.6650	6.65	0.10		

Conclusion

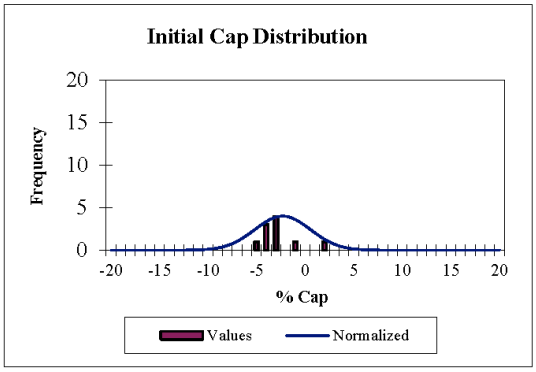
Performance:

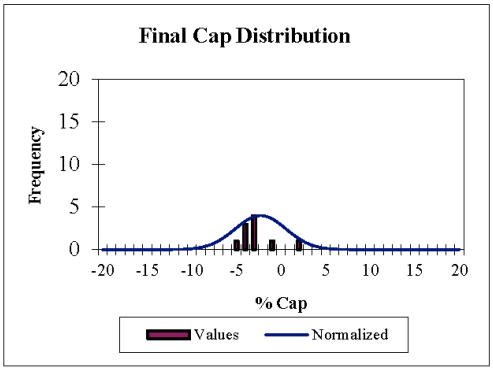
	Design Limits	Test Data	Pass
% Δ Cap (max)	5.00	0.06	✓
%DF (max)	1.00	< 1.0%	✓
IR (min)	100	> 100	✓

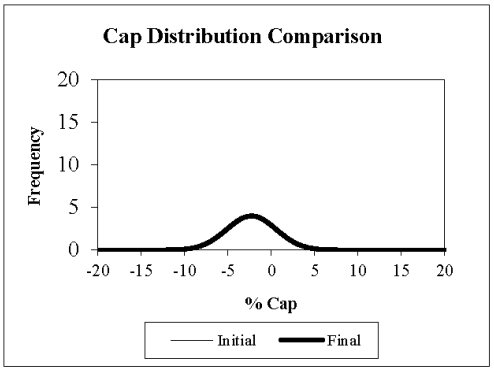
Notes:
Test parts successfully meet performance criteria.

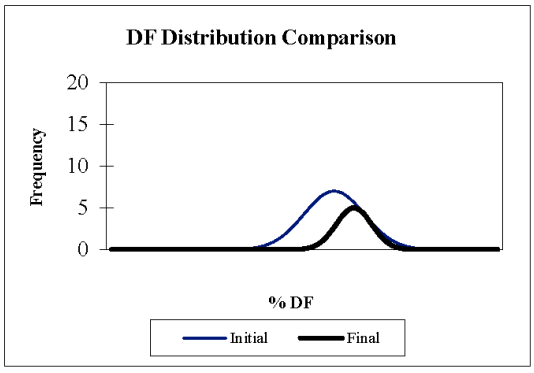
Paktron

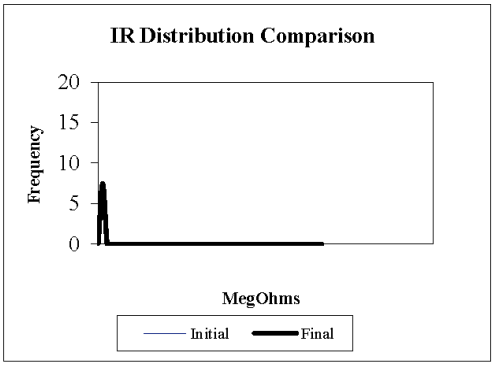
106K100CB4-Vibration











PAKTRON CAPACITORS

Test File Comparison Report
405K100CS4

Test File Data

Tests	Code Names	Operators	Test Type
Initial	010629P005Ca	K.C.	Performance evaluation
Final	010629P005Cb	K.C.	Vibration

Test Criteria

Voltage	Temperature	%RH	Duration
			3 hours

Special: Standard CS4 units.
Tested to MIL-STD-202E, Method 204D (50g vibration testing),
except: frequency is fixed.

Test Data

	Initial				Final				
	Cap		DF	IR	Cap			DF	IR
Unit #	mfds	%Nom.	%	MegOhms	mfds	%Nom.	% Δ	%	MegOhms
1	4.004	0.10	< 1.0%	> 250	4.005	0.13	0.02	< 1.0%	> 250
2	3.885	-2.87	< 1.0%	> 250	3.887	-2.82	0.05	< 1.0%	> 250
3	4.048	1.20	< 1.0%	> 250	4.049	1.23	0.02	< 1.0%	> 250
4	3.988	-0.30	< 1.0%	> 250	3.987	-0.32	-0.03	< 1.0%	> 250
5	3.801	-4.97	< 1.0%	> 250	3.803	-4.92	0.05	< 1.0%	> 250
6	3.985	-0.37	< 1.0%	> 250	3.989	-0.27	0.10	< 1.0%	> 250
7	4.070	1.75	< 1.0%	> 250	4.073	1.83	0.07	< 1.0%	> 250
8	3.759	-6.02	< 1.0%	> 250	3.761	-5.97	0.05	< 1.0%	> 250
9	3.798	-5.05	< 1.0%	> 250	3.799	-5.02	0.03	< 1.0%	> 250
10	3.932	-1.70	< 1.0%	> 250	3.935	-1.62	0.08	< 1.0%	> 250
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
Max	4.070	1.75	< 1.0%		4.073	1.83	0.10	< 1.0%	
Min	3.759	-6.02		> 250	3.761	-5.97	-0.03		> 250
Avg	3.927	-1.82			3.929	-1.78	0.05		
Std	0.1052	2.63			0.1052	2.63	0.03		
Range	0.3110	7.78			0.3120	7.80	0.13		

Conclusion

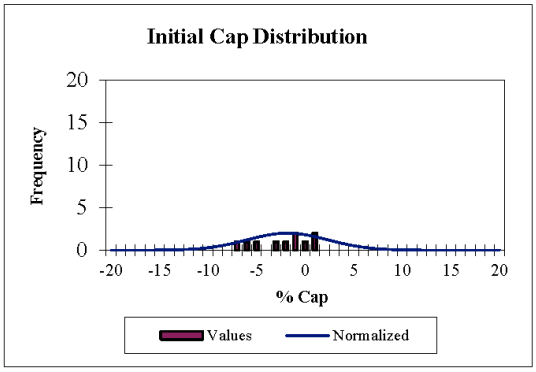
Performance:

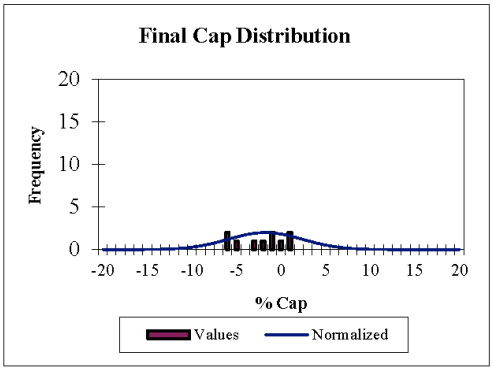
	Design Limits	Test Data	Pass
% Δ Cap (max)	5.00	0.10	✓
%DF (max)	1.00	< 1.0%	✓
IR (min)	250	> 250	✓

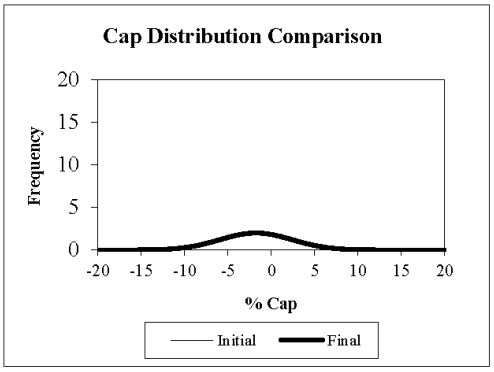
Notes:
Test parts successfully meet performance criteria.

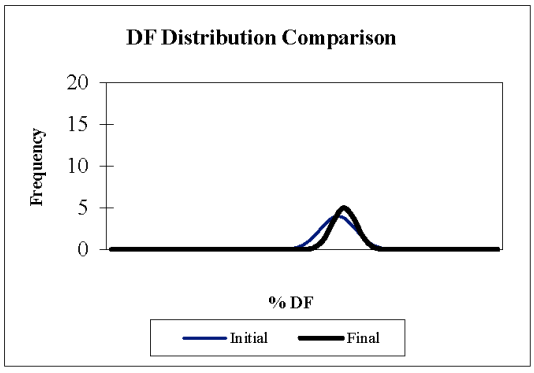
Paktron

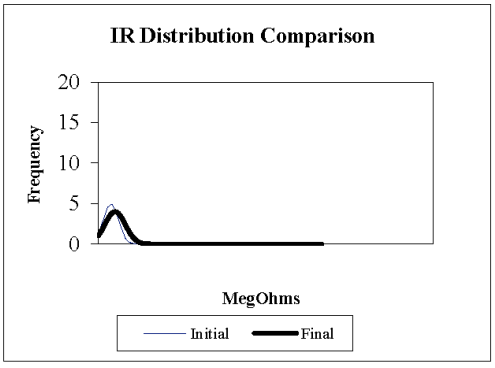
405K100CS4-Vibration











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