

# ITW Paktron System Summary

## Company Overview

In existence since 1953 and an integral part of its parent company, ITW (Illinois Tool Works Inc.), since 1960, Paktron is one of the oldest capacitor manufacturers in the US. ITW is a \$16.0+ billion diversified manufacturer of highly engineered components and industrial systems and consumables. ITW consists of approximately 825 decentralized operations in 52 countries and employs some 60,000 people. 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 quality systems 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                 | 8. Vender Qualification    |
| 2. Receiving Inspection              | 9. Material Review         |
| 3. Calibration                       | 10. In-Process Inspections |
| 4. Out-going Inspection              | 11. Surveillance Testing   |
| 5. Failure Analysis                  | 12. Qualification Testing  |
| 6. Statistical Process Control       | 13. Reliability Testing    |
| 7. New Product/Process Authorization |                            |

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

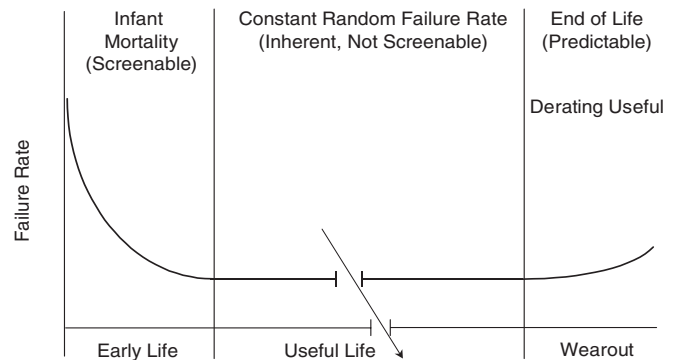
## Statistical Process Control

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

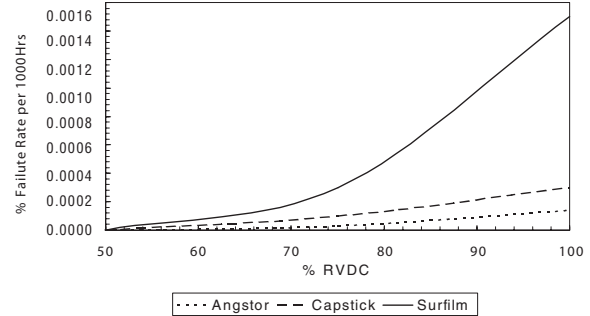
Paktron's Quality Assurance does not end once the product has been shipped to the customer. The long-term reliability of the product is as important as its initial implementation. Theoretically, a well-designed, well-engineered, thoroughly tested and properly applied component should "never" fail in 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.

## Reliability



## % Failure Rate per 1000 Hours @90% Confidence Level

	@ %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 naphthalate (PEN) and/or polyphenylene sulfide (PPS). The products' terminations are coated (tinned) with 60Sn-40Pb to a thickness of 100-500 micro inches in order to facilitate soldering without the possibility of whisker growth while still meeting current industry guidelines for lead-free (Pb-free) with a lead (Pb) material content of under 0.1w percent (1000ppm).