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Information Brief

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## Reliability from day one:

*How IBM delivers retail-hardened systems designed to help withstand the real retail world*

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### Overview

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- *Retail hardening helps ensure POS systems deliver high uptime and long-term reliability, both of which are critical in maintaining business profitability and customer loyalty*
- *IBM builds retail hardening into each stage of product development – design, manufacturing and performance testing*
- *During each stage, IBM POS systems and peripherals meet extremely high standards – often exceeding accepted PC industry requirements*

“Retail hardened” is the term IBM Retail Store Solutions uses to describe point-of-sale (POS) systems that are designed to deliver high uptime and long-term reliability in a wide range of retail store environments.

IBM incorporates retail hardening in all three phases of production: design, manufacturing and testing. In each case, POS system units and peripherals from IBM meet extremely high standards – and as detailed in this paper, those standards often exceed accepted PC industry requirements.

IBM is not the only company, however, that claims to offer “retail hardened” solutions. This information brief is designed to give retailers a more detailed explanation of the design principles, manufacturing practices and testing methodologies that support the IBM concept of retail hardening. Essentially, this concept represents more than 30 years of knowledge and experience IBM has accumulated working with retailers all over the world, in every size store and every segment of this vast, diverse industry.

### **Setting a high standard**

Reliability – which includes day-to-day uptime as well as long-term durability – is the most important performance factor for any POS system, for one very simple reason. If the system goes down, even for a few minutes, the store can't complete transactions. Revenue goes down, followed shortly by declines in customer satisfaction, loyalty and profitability.

As retail businesses grow and expand, reliability at the POS becomes even more important. The reason is scalability. In retail, even the most minor problems – so-called “quick fix” failures that only take a few moments to resolve – can scale rapidly in frequency and severity as individual stores add lanes and retail businesses acquire more stores. In other words, what is a headache for a retailer supporting 10 POS terminals becomes a more serious disruption for a retailer supporting 50 systems and an even larger setback for a retailer supporting 10,000 systems or more.

In the PC industry, accepted reliability requirements are based on office usage. This is a problem, because as any retailer knows, the typical store poses far more hazards than the typical office, including dirt, dust, grease, grime, shock, vibration, spills, magnetic fields and RF interference. POS systems often work longer hours than office PCs. Which means a POS system that only meets office-based reliability requirements may be more susceptible to common retail hazards. Consequently, it may be more prone to fail in a retail setting.

For all these reasons, IBM is committed to ensuring the POS systems and peripherals in the IBM Retail Store Solutions portfolio meet a higher standard – one we call “IBM retail hardening”. IBM believes the benefits of genuinely retail-hardened POS systems are significant. They can help retailers maintain high uptime in harsh environments, so transactions can be completed and technical support costs can be minimized. Plus, these systems are designed to provide a stable POS platform for many years, as well as parts and service for up to seven years. Retail hardening is also one of the reasons why a recent Gartner report found that IBM POS systems generally command a higher end-of-life residual value than generic PC-based POS systems, also known as PC cash drawer systems.†

### **Phase one: Designing systems exclusively for retail**

IBM Retail Store Solutions develops products exclusively for retail. These are not office PCs repackaged or customized for retail applications; they are POS systems specifically designed to meet the unique demands of the real retail world. During industrial design, IBM ensures retail hardening through:

- *Material selection*

IBM insists on high-quality materials. We select thick grades of sheet metal and plastic. The plastic we select is UV-resistant to prevent yellowing, which can occur with POS systems that are exposed to direct sunlight. It is pliant, so it helps resist cracking. Plus, the plastic we use to construct the exterior components of the POS system (including the monitor and peripherals) meets the highest ratings for flammability. This plastic helps minimize risk, because it is designed to help control the spread of fire in a store, should one occur.

† From “Total Cost of Ownership for POS and PC Cash Drawer Solutions: A Comparative Analysis of Retail Check-out Environments,” an IDC white paper sponsored by IBM, December 2002.

- *Component selection*

IBM uses considerable collective purchasing power to acquire high-quality components. During the past few years, we have created an “A-list” of key suppliers. We invest heavily in quality assurance programs for these select few suppliers. This allows IBM to select components that are designed to deliver longer life spans under retail conditions. A good example is our connectors, the majority of which are gold-plated to reduce corrosion. Other commercial PC manufacturers use tin-plated connectors that are not as robust for retail environments.

In some situations where IBM was unable to find the proper retail-ready components, we designed them. For example, we have created a motherboard with a planned production life of 18 to 24 months – considerably longer than the life of a typical PC. We do this because most rollouts in retail can take 18 to 24 months. With our motherboard, retailers can maintain a single platform throughout an enterprise rollout without having to purchase all the hardware in advance of the installation. If a standard PC motherboard were used, retailers would probably have to buy all the systems in advance or support up to four discrete hardware platforms.

- *Holistic design*

IBM Retail Store Solutions designs the logic unit, the display, the keyboard, the printer, and other peripherals. The result is a stylish, cohesive package that is designed to work together. This is in stark contrast to some other providers that design the logic unit and assemble the rest of the POS system from other suppliers. With our approach, we can design the logic unit to conceal peripherals and cables.

We also help reduce the time to service a problem. For example, what if there is an application problem when the cash drawer is opened? Is it a cash drawer problem? Is it the motherboard? Is it the operating system? Is it a driver? In any situation where there are multiple parties responsible for POS components, retailers may have to place several calls to figure out what is wrong, and even more to determine which party is responsible for fixing the problem. IBM provides a single resource for identifying and resolving any concern.

- *Retail-oriented design*

IBM designs POS systems for long-term reliability in retail. Our design benchmark for which we strive is seven years of high-volume operation. For example, we recently switched from double-shot keyboard molding to laser etching to reduce the impact of constant wear on the keys. We also design our power supplies to withstand up to a 20% dip in power without the need for secondary UPS equipment, or a complete loss of power in the millisecond range. (Power line disturbances occur in supermarkets when freezers and compressors kick on, or in large cities when power companies switch transformers. In retail, they can cause systems to hang, requiring a reboot.) We take these extra steps during product design not only because retailers expect their POS systems to last much longer than an office PC, but also because more retailers are moving toward 24x7 operation, or at least an environment where the POS is powered up 24x7.

Designing for retail also means our designs include processor sockets, feature card slots and other factors that allow for easy upgrades, which improves investment protection. We use strong, robust power supplies that reduce the need for separate peripheral power bricks and promote energy-efficient operation. We create systems that are easy to integrate in the store without special tools or expertise, with numbered ports and latching connectors. Latching connectors also help ensure cables are not accidentally unplugged, which can cause the system to hang. And we provide these features in formats that meet unique retail needs, such as 12"-wide systems for space-constrained areas, integrated units for clean and simple presentation, or distributed units that can be hidden under a check stand.

### **Phase two: Manufacturing innovations**

To produce retail-hardened POS systems and peripherals, IBM Retail Store Solutions employs a number of special practices. These include:

- *Board flex testing*  
We use a proprietary pneumatic fixture that flexes the motherboard to stress solder joints. This is done while the system is executing software instructions, and helps eliminate cards with cold solder joints that increase the risk of intermittent board failure, also known as the system “hanging”.
- *Power cycling*  
Systems are power cycled (turned on and off) numerous times during the manufacturing process to help eliminate the risk of early life failures.
- *Round robin testing*  
In every batch of systems, a few units are sample tested at random for compatibility. We load them up with an operating system, POS software and drivers, then put each interface through its paces. This helps identify issues that result from nearly imperceptible variability in component quality.
- *Extended burn-in*  
Every POS system we produce is subjected to an extended burn-in, during which we power it up and run it for 12 hours at an elevated temperature. In conventional PC manufacturing, burn-in typically lasts for 30 minutes, and is usually performed at room temperature. Extended burn-in helps reduce out-of-box failures.
- *Preshipment integration*  
We have a separate facility that takes all the elements of the solution – including peripherals, hard file, memory, adapter card and software – and assembles them as a service offering for our customers. This service also affords us a final quality check. The fully integrated solution is shipped to the customer intact, in a special box, so they can plug it in and go once it arrives. This not only helps reduce out-of-box failures, it speeds up the installation process.

**Phase three: Testing to higher standards**

POS systems and peripherals from IBM are tested thoroughly and rigorously to meet a wide range of international and internal IBM standards for quality. IBM performance testing simulates worst-case scenarios to make sure our products will provide reliable operation. We believe that any system unit that does not pass this battery of tests should not be referred to as “retail-hardened”. Most important, we test the whole POS system, not just an isolated system unit. At IBM, product testing covers:

- *Electrostatic discharge*

Electrostatic discharge (ESD) is the transfer of static electricity from one person or object to another, and is common in stores with carpeted floors. When a person touches metal and there is a visible arc and audible snap, the discharge is approximately 7,000 volts. The PC industry standard for ESD testing is 8,000 volts. By contrast, all IBM POS systems are tested up to 15,000 volts to help ensure proper operation in the most stressful situations, such as in arid regions where customers may have significant problems related to elevated ESD voltage.

During ESD tests at IBM, the entire system – including peripherals – is placed on a grounded metal table and repeatedly exposed to high levels of ESD. Testers simulate air contact, direct contact from a shopping cart, and indirect contact through the metal frame. As a result, IBM systems have a very low risk of hanging, even when exposed to elevated ESD voltages.

- *Dust and dirt*

In the 1980s, IBM found systems that were in the field for five to 10 years, opened them up and examined what was inside. The ingredients included dirt, grease, skin particles, hair, lint, insects and rodent droppings. Based on the chemical makeup of these substances, IBM created a formula called "IBM Retail Dirt", which we used at that time to design POS systems that could withstand real-world retail store conditions. We have continued to improve on these designs over several generations of POS systems. In fact, we refined these POS designs to the point where "Retail Dirt" is rarely a factor in reported field failures.

- *Thermal dynamics*

IBM POS systems are located on cruise ships, beaches, mountaintop resorts and in jungles. They sit in drive-through windows, and are rolled out into parking lots for sidewalk sales. They are also shipped in a variety of conditions, from the desert in summer to the sub-zero tundra winter. To help make sure IBM POS systems can withstand prolonged exposure to a wide range of temperature and humidity, we use environmental chambers in our test labs. First, test system units are exposed to air temperatures from -40°C (-40°F) to 60°C (140°F) to help ensure components do not become loose or disconnected during the most extreme shipping conditions. Next the systems are brought from -40°C back to 0°C (32°F) or down from 60°C to 45°C (113°F) and started up. We also perform an exposure test on these systems that occurs gradually over five days. The system units are run continuously for eight to 10 hours at 0°C and low humidity, then another eight to 10 hours at 45°C and low humidity, then another cycle at 45°C and medium humidity, then 30°C and high humidity, and finally at 7.2°C and high humidity. These tests allow IBM to create POS systems that can operate comfortably in temperatures from 10°C to 40°C at a range of humidity.



- *Spills and drips*

Spilled beverages and other liquid hazards can wreak havoc with a POS system that is not properly designed to defend against them. This is especially critical in food service environments, where POS systems are regularly exposed to water as well as carbonated beverages. IBM performs two liquid tests, both of which exceed prevailing requirements in the PC industry. One involves slowly dripping a variety of liquids on the system over a period of time. The other involves dumping an extra large cup of liquid (a frequent occurrence at the POS in sports arenas, pubs and bars). The system must continue to operate after exposure to the liquid. To ensure this, system units feature containment areas that direct the liquid away from sensitive electronics and toward drains so it can exit the unit. Displays, printers and keyboards also have design features – such as seals and gutters – that divert liquid away.

- *Magnetic susceptibility*

During these tests, IBM POS system performance is measured in relationship to the devices that demagnetize anti-theft tags. These devices emit strong magnetic fields that can disable the system unit's magnetic stripe reader, distort the display image or corrupt the hard file. These tests allow IBM to specify exactly how close the system unit can be placed to the anti-theft devices without experiencing interference.

- *Operational vibration*

IBM conducts a variety of operational vibration tests to simulate the abuse system units receive in a normal retail store. One test simulates the constant opening and closing of a cash drawer and the shock of breaking coin rolls against the edge of an open cash drawer. The test involves weighing down the cash drawer with coins and repeatedly opening and shutting the drawer with a pneumatic arm. Other tests simulate the kind of vibrations experienced on an airplane flying through turbulence or a semi-tractor trailer driving on a bumpy road – both common occurrences during shipping. IBM uses spring-loaded tables to shake the product violently along all three axes to identify any potential weaknesses in the design or in the packaging materials. Other shaker tables simulate a less violent vibration, but for a longer period. Test systems are powered up and run during both of these tests, and must continue to operate flawlessly for the duration of the vibration.

- *Drop fragility*

To make sure IBM POS systems are designed to be robust enough to withstand rough handling during shipping and delivery, IBM performs several drop tests. Test systems are dropped eight times, from heights of 30 to 36 inches, while in their shipping packages. Each device is dropped on all three sides to make sure it will not crack or shatter and will still power up and operate without incident after each drop. Depending on the product, some out-of-packaging drops are also done.

- *Chemical resistance*

Retailers use a wide range of industrial-strength cleaners in their stores, most of which are used at the POS. To account for this, IBM performs chemical testing on the exterior packaging and display unit. Cleaners are applied directly and wiped off several times daily for two to three weeks, then examined for effects. This allows IBM to select the most resilient plastic, as well as tell retailers which cleaners may cause cracking. This test is also ideal for making sure display seals are tight, because many cleaners will destroy touchscreen sensors if they penetrate the unit.

- *Lightning strike*

POS systems can't be unplugged every time a thunderstorm rolls in. IBM tests all POS systems to ensure they can withstand a power surge at amplitudes of 2,000 volts, which is equivalent to a lightning strike to the ground outside the store. No system can survive a direct strike to the store. But IBM POS systems are designed so a direct strike will shut down the power supply first, which helps prevent further damage to the rest of the system, including connected peripherals.

- *Radio frequency interference*

Sources of radio frequency (RF) interference include inventory scanners, security devices, electronic shelf labels, and customers with cell phones and pagers. Even if a store does not have any of these sources, RF interference from neighboring stores – especially in a mall – can still pose problems. During RF testing, each system unit is powered up and then bombarded with a wide range of RF signals to make sure it is shielded from interference and transactions will not be affected. Because RF interference can cause systems to hang or information to be corrupted or lost, IBM tests POS systems beyond accepted PC industry requirements for the amount of RF interference the system unit can withstand.

**Why IBM?**

- *Experience*

Few competitors can match IBM in terms of retail experience on staff. Nearly 25% of the IBM Retail Store Solutions development team has more than 20 years of experience in retail, and approximately 40% average 10 years of retail experience or more. Our designers and engineers understand the retail environment and the requirements it places on technology. Since 1980, the RSS team has patented key retail technologies and contributed directly to establishing IBM as the leader in issuance of United States patents.

- *Resources*

The commitment IBM makes to designing, manufacturing and testing POS products requires a great deal of time and a significant investment in equipment and research. We make this investment because it results in a higher-quality product that helps our customers improve reliability and save money. Plus, we are not limited to the resources within our division. We also tap into the entire IBM corps of scientists for their expertise in materials, metallurgy, other engineering disciplines and award-winning research.

- *Focus*

IBM Retail Store Solutions has been dedicated to POS equipment since 1972, and retail is the second largest industry group at IBM. This focus allows us to make design decisions based on retailers' unique needs, whether the customer needs 200 POS systems or 5,000 units worldwide. It also enables us to handle special requests for customization quickly and easily.

- *Presence*

With close to two million POS systems shipped and installed, IBM can be found in virtually every segment of the retail industry. We're in a wide range of department stores, specialty shops, supermarkets and many other stores all around the world. These placements effectively act as the world's largest retail test laboratory, and we pride ourselves in taking what we learn in each segment and applying it to all of the segments we serve.

**About the authors**

*Randy Adair*

Randy Adair is a certified Project Manager, currently managing the Hardware Test and Development Support department within IBM Retail Store Solutions. His team is responsible for planning and executing the hardware testing for all IBM POS systems. Randy's background in software and hardware testing, product assurance, usability and product development makes him uniquely qualified to focus on ensuring superior quality and retail hardening in IBM products. Randy joined the IBM retail group in 1981.

*Breck Barker*

Breck Barker joined IBM Retail Store Solutions in 1982 as a member of the 4680 POS development team. During his 26 years with IBM, he has participated in or led the development teams for several retail hardware products. He has also managed the POS hardware and software development organization and provided technical support as the retail hardware product manager for Europe. Today, Breck serves IBM as a professional engineer and a project manager professional.

*Doug Behning*

Doug Behning oversees field quality and manufacturing related processes for IBM Retail Store Solutions, and has special expertise in manufacturing processes designed to help increase yields and overall reliability. Doug also maintains regular contact with field service and sales engineers as well as customers to follow up on quality control and reliability issues with POS products. He has been with IBM since 1975.

*Donna Hagemann*

Donna Hagemann joined IBM Retail Store Solutions in 1982 as a product engineer, where she helped modify IBM POS designs for specific customer requirements. In the following 20 years, she has participated in every aspect of IBM POS hardware, including development engineering, manufacturing management, production control (inventory management), product planning, product marketing, sales, technical support and product brand management. This unique history, which combines technical, business and customer-oriented responsibilities, gives her first-hand knowledge of the issues that retail hardening addresses.

*Dave Landers*

Dave Landers is an IBM senior technical staff member and the system unit development manager for IBM Retail Store Solutions. He has been responsible for designing and continuously improving many of the POS systems in the current Retail Store Solutions portfolio. Dave has a deep understanding of how specific design choices affect performance in the short and long-term. He has been with IBM Retail Store Solutions since 1979.



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