



**screening
systems,
inc.™**



Stress for Success™

*Environmental Stress Screening
Systems for Accelerated Product
Development and Production Testing*



Q
&
A



What common approach has allowed industry leading manufacturers to maximize their revenues, while meeting their customers' demands for increasingly higher levels of reliability?



Environmental Stress Screening (ESS)

ESS plays a vital role in helping prominent electronics manufacturers maximize their revenues through improved system reliability. ESS is a process in which products are subjected to rapid thermal cycling, coupled with vibration in order to precipitate latent flaws. When properly implemented, ESS does not cause flaws, but only accelerates the rate at which they surface.

ESS delivers several important cost benefits to manufacturers. Accelerated testing reduces the time required to identify inherent design flaws, and can thus dramatically shorten the product development cycle. When used as a production test, ESS will weed out marginal units, reducing warranty and service costs by minimizing the occurrence of field failure. ESS can also be used as a process control tool to spot marginal assembly procedures.

Screening Systems pioneered the field of ESS, and still leads the way in both product technology and service. Our founder, Richard Baker, led the team that developed the underlying concepts for quasi-random, tri-axial ESS in the mid-1970's while employed by Hughes Aircraft Company. He quickly realized that the technique had applications beyond the military and aerospace markets, licensed the technology and in 1979 co-founded Screening Systems. From that beginning, Screening Systems has developed a broad product line, designed to meet the varied needs of users for all types of ESS testing. Our continuing focus on delivering the ideal solution for each customer's specific need has enabled us to build the largest installed base of ESS systems worldwide; serving markets such as telecommunications, data storage, computers, biomedical instrumentation, transportation and military/aerospace.

Beyond systems, fixturing and accessories, we also offer modeling, technical consulting and testing; this range of services enables you to take full advantage of the benefits of ESS technology.



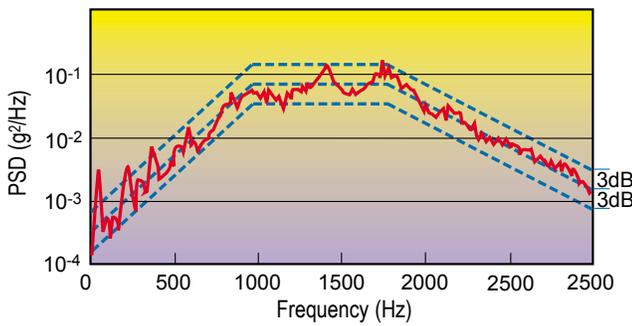
The two primary uses of ESS are design validation and production unit screening. With our unmatched combination of analytic modeling capabilities, superior product features, and broad industry experience, Screening Systems can deliver the most thorough and cost effective ESS program available today.

ESS SYSTEMS •••

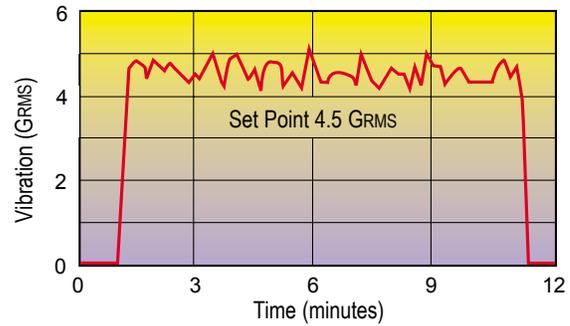
Screening Systems manufactures a wide range of ESS products for HALT (highly accelerated life test) and HASS (highly accelerated stress screening) applications. While our QRS™ systems offer a variety of options and custom capabilities, all are built around the same basic elements; these include a vibration table, precision pneumatic vibrators, digital control valves, and accelerometers and thermocouples for both closed loop control and product monitoring in a microprocessor based control system. Each of these system components has been carefully designed to deliver the utmost in performance, ease of use, economy, safety and reliability.

VIBRATION PERFORMANCE

In order to achieve meaningful ESS results, vibration in all six degrees of freedom (three translational and three rotational axes) is required. Furthermore, the power spectral density (PSD) of the applied vibration, that is, the amount of vibration power as a function of frequency, should approach true random vibration as closely as possible. Together, these factors ensure that all possible product resonances are equally excited. Screening Systems uses its tri-axial, six degrees of freedom, quasi-random vibration system to achieve a virtually ideal excitation PSD over the 5 Hz to 2 kHz range. Several key elements of this system are patented. Testing at frequencies greater than a few kilohertz is counterproductive, because it does not produce part displacements significant enough to activate failure mechanisms, even at high acceleration (G) levels. In fact, funneling actuator energy into these higher frequencies just consumes power, lowering overall system efficiency.



The PSD of a typical Screening Systems table demonstrates a very close match to ideal vibration performance.



Closed loop control delivers extremely stable vibration performance over time.

A key element in our system is our unique, modally rich, frequency damped, honeycomb table (A). This table forms an ideal platform through which a flat PSD can be faithfully transmitted from actuators to the product under test. A solid table cannot accomplish this, as it would vibrate at a few resonant frequencies, producing spikes in the PSD, as well as a pattern of vibration nodes and antinodes. These show up as either “hot spots” or “dead zones”, i.e. points on the table that experience either very large or very little vibration motion. In contrast, Screening Systems segmented tables effectively scramble lower frequencies into a flat PSD, with significant damping of high frequencies.

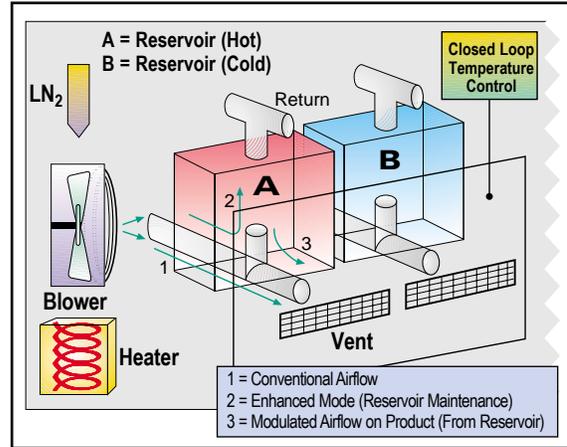
Excitation of this honeycomb platform is provided by an array of pneumatic vibrators, located under the table, which oscillate at varying rates. A fast acting digital valve system (B) independently modulates the air pressure of each vibrator (C), so that the fundamental frequency of each vibrator is continuously changing. This results in a PSD that closely approximates random vibration, and offers far superior results to electrodynamic shakers, which cannot produce a 6 DOF excitation spectrum. Closed loop control, using an array of accelerometers, enhances vibration stability and ensures repeatability.





TEMPERATURE CONTROL

Accelerated changes in chamber temperature also serve to precipitate latent flaws, while minimizing test cycle time. Screening Systems' products achieve maximum temperature ramps from 30°C/minute to >200°C/minute, and work over a range of -100°C to 200°C. This is accomplished by the use of liquid nitrogen cooling and nichrome resistive heating elements, combined with powerful blowers to achieve air velocities of 800 ft/minute to 6000 ft/min over the units under test. Fast air flow also minimizes the lag time between actual product temperature and the chamber air temperature, enhancing test accuracy and repeatability.



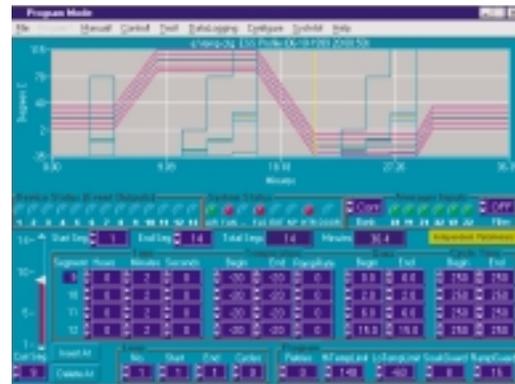
Screening System's patented reservoir system delivers high temperature ramp rates while minimizing consumables.

EASE OF USE



Despite their power and extensive functionality, Screening Systems products are simple to use, and can easily be configured for operation by production line personnel. Windows[®] 98 based control software presents users with a familiar menu structure, thus minimizing the required operator training. Furthermore, built in interfaces, including TCP/IP, facilitate easy integration with production control and statistical process control systems, and enables data sharing over an intranet. System software can perform data logging of control and unit accelerometer and thermocouple data, as well as full vibration spectral analysis, thus eliminating the need for separate test equipment with these capabilities. To maintain compatibility with products already in use, Screening Systems still supports its proprietary RVP-100 controller.

Ease of use is further enhanced by ergonomically designed entry ports, which ensure that parts can be loaded and unloaded quickly. Automated part loading is available with some models for high volume throughput applications.



ECONOMY

Screening Systems has introduced a number of innovations intended to maximize efficiency and reduce operating costs. Careful attention has been given to the design of the system airflow in order to optimize the delivery efficiency of the heating and cooling systems. In particular, our products make frugal use of the consumable liquid nitrogen, which constitutes a major system operating expense. Our QRS-600 includes an adjustable height

ceiling as a standard feature. This allows the testing volume to be matched to the size of the work pieces, thus ensuring that the smallest possible volume is heated and cooled. However, the ultimate economy stems from our extensive experience and flexible product line; our applications engineers work with you so that you purchase only the functionality and performance your application requires.

SAFETY

Operator safety is of paramount concern at Screening Systems; all of our products have numerous safeguards built into their mechanical, electrical and liquid nitrogen delivery systems. For example, interlocks automatically disable heating and liquid nitrogen delivery should the door be opened during a testing cycle. Temperature is continuously monitored using thermocouples, and the control software will initiate a shutdown if it exceeds either high or low preset limits. This is backed by a redundant system built directly into the control electronics that can open a mechanical relay in the heater circuit itself.

In terms of operator controls, Screening Systems products also have an emergency shutoff switch, require a key for operation and provide three levels of user access. This latter feature can be used to limit the ability of production personnel to change

operating parameters or run test profiles. The liquid nitrogen system contains an in-line contaminant filter to maintain proper valve operation. Furthermore, there is a redundant, liquid nitrogen safety valve that can shut off coolant delivery in case of system malfunction. This system can also be configured to shut down if the built-in gas monitor detects liquid nitrogen leakage.

Safeguards are also included to ensure that applied stresses are carefully controlled to remain within limits that don't reduce the field life or performance of the products under test. Vibration levels are continuously monitored during testing, and the system will automatically shutdown if it detects an excessive transient peak, or if the RMS signal of any given accelerometer or the composite signal from all accelerometers exceeds set limits.

RELIABILITY

Needless to say, we've applied our extensive understanding of reliability to the products that we build ourselves. This shows up in many individual design features, such as an actuator hammer constructed for smooth operation and long life, even at low vibration levels or cold start temperatures. The results are workhorse systems, which can withstand the rigors of operation in harsh industrial environments for extended periods. A testament to this durability is the fact that Screening Systems products have been in continuous use for 20 years.

ADDITIONAL SERVICES

MODELING & ANALYSIS

We believe that ESS should ideally begin early in the product design phase. Screening Systems, using proprietary analysis tools, can build a computer model of the system under development. Simulation then yields the maximum vibration (in the X, Y and Z axes), shock and temperature that the system can withstand. Developers can then use this information to identify inherent weaknesses and produce more robust designs. Modeling also provides a quantitative basis for determining the screening parameters of actual production units. Screening Systems' product and ESS modeling capabilities are unique in the industry. While others rely solely on rough rules of thumb, our proprietary analysis and modeling software, together with a huge database of past models, enables us to quickly identify lifetime limiting components and design flaws with uncanny accuracy. Modeling also allows customers to characterize high value or limited run products without subjecting them to the damage required from HALT testing.



TESTING

Screening Systems offers HALT or HASS testing services on prototypes and early production units to empirically determine the products' operational limits. These services are conducted at a number of locations distributed throughout the United States. The use of Screening Systems' testing services is particularly valuable when a developer desires rapid results on a prototype.





PRODUCTS

Screening Systems produces a broad range of HALT (highly accelerated life test) and HASS (highly accelerated stress screening) products to satisfy the needs of manufacturers of everything from a single PC board weighing a few ounces to full equipment racks weighing thousands of pounds. All Screening Systems products include the following features:

- *Our six degrees of freedom (Omni-axial), quasi-random vibration system*
- *An input excitation level of at least 30 GRMS on all axes (products actually experience acceleration levels that are typically 2-4 times this amount), over a continuous frequency spectrum from 5 Hz to 2kHz*
- *Six channel accelerometer feedback, with accelerometers (included) located on top of vibration table*
- *Product mounting via a diamond pattern of 3/8"-16 threaded, stainless steel inserts on 3 inch centers (metric M10x1.5 threaded inserts or other patterns available upon request)*

Following is a brief summary of each Screening Systems model; a selection chart comparing the major features of each model is also included to guide users in selecting the right system for a given application.



QRS-210 SYSTEM FOR VIBRATION SCREENING

The QRS-210 enables vibration HALT and HASS on printed circuit boards, as well as small subassemblies and complete systems. Its 26" x 30" tabletop surface can handle loads up to 250 pounds. The QRS-210 is provided with casters, and can easily be moved to a convenient location for testing within a lab or production area.



QRS-300 LARGE SYSTEM FOR VIBRATION SCREENING

The QRS-300 family consists of a remote control console that can be used to drive one or two 26" x 30" or 44" x 44" free standing vibration tables. These tables can be used by themselves, allowing easy access from all four sides, or placed inside an acoustic enclosure or existing AGREE chamber. With a maximum payload of 600 pounds, the larger tables enable vibration HALT and HASS on everything from small printed circuit boards to large assemblies.



QRS-410T SYSTEM FOR VIBRATION & THERMAL SCREENING

The QRS-410T provides both vibration and thermal HALT/HASS capabilities. The standard 26" x 30" tabletop supplied with the QRS-410T has a load capacity of 250 pounds (26" x 38" table also available), enabling testing of printed circuit boards, small subassemblies and complete systems. Casters allow the unit to be easily moved for convenient placement within a lab or production area. A high performance version of this machine is also available that offers faster thermal ramp rates over a wider overall range.



QRS-600 LARGE SYSTEM FOR VIBRATION & THERMAL PRODUCTION LINE SCREENING

The QRS-600 is intended for vibration and thermal HALT, as well as HASS in a production line environment, handling loads in excess of 600 lbs. Its 44" x 44" Slide Out retractable table and Slide Away rear door facilitates efficient work flow, and minimizes the use of valuable floor space. Our Fast Flow thermal delivery system, together with our Auto-Height adjustable ceiling, reduces testing time and maximizes economy.



QRS-700 COMPACT SYSTEM FOR VIBRATION & THERMAL SCREENING

The compact QRS-700T is the ideal choice for vibration and thermal HALT/HASS of small products when either space is limited or extremely high performance is required. The unit is based on a small, 15" x 18" table with a load capacity of 90 pounds. The QRS-700T features both fast temperature cycling and vibration excitation levels of up to 50 GRMS.



QRS-1200 LARGE SYSTEM FOR VIBRATION SCREENING OF EQUIPMENT RACKS

The QRS-1200 provides vibration HASS capabilities for large electronic consoles and single/multiple bay assemblies. Each QRS-1200 is supplied with a custom designed, product specific mechanical interface, with a load capacity of up to 4000 pounds, and also comes with an acoustic enclosure including lights and fans.



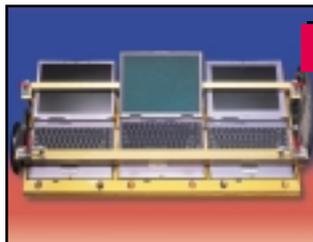
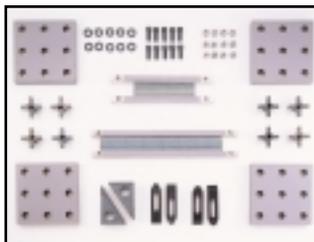
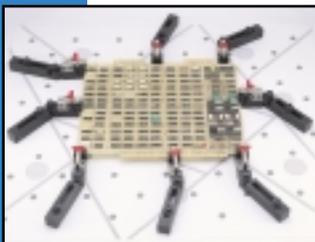
QRS-3000 SYSTEM FOR VIBRATION & THERMAL PRODUCTION LINE SCREENING

The QRS-3000 is custom designed for high volume, automated, assembly line HASS. Its modular design allows the product to be supplied in a wide range of configurations, enabling smooth integration into a production line; it is even available with temperature only or vibration only options. The use of standard sized vibration fixture pallets and automated product sequencing facilitates rapid testing.



SSC™-2000 SMART SCREEN CONTROLLER

The SSC™-2000 Smart Screen Controller is a PC based system that enables both manual and automated control of virtually all aspects of system operation. The Windows® 98 based software is easy to learn and use, and supports RS-232, GPIB, and TCP/IP interfaces. The SSC™-2000 also includes a built-in spectrum analyzer and provides extensive data logging and display capabilities for precise analysis and statistical process control purposes. Our proprietary RVP controller is still available for backward compatibility.



FIXTURES

In order to preserve the superior vibrational characteristics of Screening Systems' table and actuators, careful attention must be paid to the way subject parts are attached to the tabletop.

If a baseplate is used, it must be stiff enough to transmit the vibration energy of the table, while being small enough to allow the various table segments to vibrate freely in all directions. For smaller parts, such as PC boards, the ideal fixture is several separate clamps. Consideration must even be given to the material composition of the fixturing; for example, magnesium alloy is an excellent choice because it is lightweight, and also has inherent damping characteristics and so does not introduce frequency spikes in the PSD transmitted to the attached part. Screening Systems fully understands the tradeoffs between fixturing performance, convenience and cost, and offers both custom fixturing as well as the following standard products:

- SBF™-100 Eight clamps for HALT testing of PCBA's
- General Fixture Kit Mounting brackets for HALT testing of subassemblies



PRODUCT SELECTION MATRIX

	Testing Type		Functionality		Maximum Acceleration (5-2000Hz) GRMS	Interior Dimensions (D x W x H) in. (cm)	Payload lbs. (kg)	Tabletop Dimensions (D x W) in. (cm)	Temperature Range °C	Temperature Rate of Change °C/min.	Mobility	Controller Compatibility	
	HALT	HASS	Temp.	Vibration								SSC-2000	RVP-100
QRS-210	✓	✓		✓	35	28 x 32 x 21 (71 x 81 x 53)	250 (113)	26 x 30 (66 x 76)	—	—	Wheels	✓	✓
<i>Application: Development labs or production areas</i>													
QRS-300E	✓	✓		✓	30	—	600 (272)	44 x 44 (112 x 112)	—	—	Airglides	✓	✓
<i>Application: Screening inside acoustic chamber</i>													
QRS-300CE	✓	✓		✓	30	—	600 (272)	44 x 44 (112 x 112)	—	—	Airglides	✓	✓
<i>Application: With existing AGREE chambers</i>													
QRS-310	✓	✓		✓	35	—	250 (113)	26 x 30 (66 x 76)	—	—	Airglides	✓	✓
<i>Application: Screening inside acoustic chamber</i>													
QRS-310C	✓	✓		✓	35	—	250 (113)	26 x 30 (66 x 76)	—	—	Airglides	✓	✓
<i>Application: With existing AGREE chambers</i>													
QRS-310D	✓	✓		✓	35	—	500 (227)	2 - 26 x 30 (2 - 66 x 76)	—	—	Airglides	✓	✓
<i>Application: Screening extended shapes</i>													
QRS-410T	✓	✓	✓	✓	35	27.5 x 41.5 x 31.5 (70 x 105 x 80)	250/300 (113/136)	26 x 30 or 38 (66 x 76 or 97)	-60/150 or -100/200*	30 to 50/60*	Wheels	✓	
<i>Application: R&D labs or production areas</i>													
QRS-600	✓	✓	✓	✓	30	48 x 54 x 16-44 (122 x 137 x 41-112)	600 (272)	44 X 44 (112 x 112)	-100 to 180/200	60 to 100	Stationary	✓	
<i>Application: R&D labs or production areas</i>													
QRS-700	✓	✓	✓	✓	50	16 x 26 x 19 (41 x 66 x 48)	90 (41)	15 x 18 (38 x 46)	-100 to 200	>60	Wheels	✓	
<i>Application: R&D labs and Service Departments</i>													
QRS-1200		✓		✓	12	—	4000 (1815)	—	—	—	Stationary	✓	
<i>Application: Electronic consoles or racks</i>													
QRS-3000		✓	✓	✓	30	Custom	300 (136)	27 X 34 (69 x 86)	-60/150 or -100/200*	60	Stationary	✓	
<i>Application: Assembly line screening</i>													

* with High Performance Option

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