

CIRCUIT CELLAR **ONLINE**

THE MAGAZINE FOR COMPUTER APPLICATIONS

Circuit Cellar Online offers articles illustrating creative solutions and unique applications through complete projects, practical tutorials, and useful design techniques.

[This Month](#)[Archive](#)[About Us](#)[Contact](#)[Looking for More?](#)

RESOURCE PAGES

RESOURCE LINKS

A Guide to online information about:

Spring Probes and Test Fixtures

by [Bob Paddock](#)

When I'm not working on these [Resource Pages](#) I spend my time working for a [Contract Manufacture/Design Firm](#). As I'm sure you will agree, there are days that seem like they were ripped from a [Dilbert® cartoon](#). Upper management had just finished extolling the virtues of the Teradyne [Flying Prober Manufacturing Defects Analyzer \(MDA\)](#) test systems that we recently acquired. They had just explained why they chose it over a bed-of-nails test system for our production line, when the department manager assigned me to design a bed-of-nails test system for one of our products.

One obvious thing you need for a bed-of-nails test is the nail. These test probes act as an electrical interface between the test equipment and the circuit board under test. This Resource Page covers some of what I've learned about "nails" Test Fixtures.



One of the first things I learned was that the proper term for a "nail" in this context is a Spring Probe. I naively thought a Spring Probe was simply a spring with a sharp point I could place my board on. It seems there is much more to this simple device that you have to take into

account. Things like: Will it mar the board? Will it make it through any contamination if working on a board coming into our Repair Department? How much travel can you have? How much load is enough and how much is too much so you don't break the probe while maintaining reliable electrical contact?



[CheckSum, Inc.](#)

CheckSum, Inc. offers [FIXTURE SYSTEMS - Frequently Asked Questions \(FAQs about Fixtures\)](#). There are some common questions about bed-of-nails fixturing. Here are some responses and general guidelines you may want to consider when planning for your test fixture. It starts off with *Bed-of-Nails Basics*.

[CheckSum](#) provides high-performance, easy-to-use, PC-based systems manufacturing defects analyzer (MDA) test systems.



[Accuprobe Inc.](#), manufactures and markets high-performance probing and interface products for use in the testing of integrated and hybrid circuits. Manufacturers of semiconductors use this company's proprietary products and hybrid circuits to electronically screen their products for defects before the products are incorporated into electronics systems. Such screening is accomplished in conjunction with automated test equipment (ATE), which transmits electrical signals through interface circuitry to probe cards, which make the electrical/mechanical contact with each circuit under test. The company's products are designed to provide efficient screening of the circuits thereby increasing yields to manufacturers.

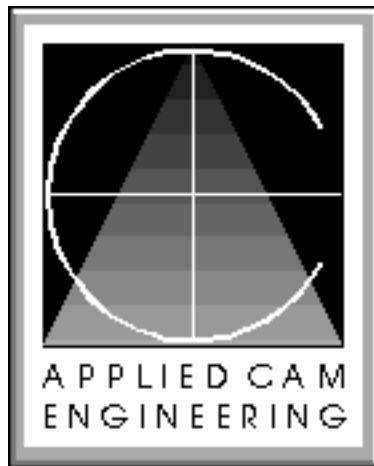
The company's products address both the semiconductor wafer sort or IC test segment as well as the Thick and Thin Film Hybrid Circuit and Laser Trim segment of the semiconductor device market. The company offers a wide selection of probe technologies including Probe Ring (Epoxy Ring), Metal and Ceramic Blades, Z adjustable, and Blade Spring probes.

Of most interest to us are:

- [Glossary of Terms.](#)
 - [Twelve different probe head styles are available.](#)
 - [Technical Bulletins - "Probe Tips".](#)
-

[Adam Microwave Consulting, Inc.](#) is a consulting firm that solves problems arising from measurements of microwave and radio frequency parameters. They offer a course in [RF & Microwave Test Fixture Design, Selection, and Measurement Techniques](#).

[Advanced Test Engineering Solutions, Inc.](#) is an independent test engineering consulting and educational firm that covers the ATE industry. Check out their links and course schedules if you need to learn more about ATE. Their [Test Fixtures and Probes](#) information can be found [here](#).



[Applied Cam Engineering](#) has two features that I did not see anyone else offering. Over-the-web-design via your web browser and a [FREE Fixture Design Offer](#).

[BlueSky](#) is a "Test Fixture Design Engine" delivered to you through your web browser.

Experts in the field of Test Fixture design have recorded the process of designing an optimal fixture. Employing Blue Granite Software's revolutionary technology, a fully automated fixture design is now available. BlueSky's SetUp Expert analyzes the data for board attributes affecting fixture design. The "[BEST METHOD](#)" for test will be selected given the customer's local resources.

BlueSky has been programmed to reduce maximum deflection of pins, reducing false opens at test. The outcomes, when compared to connect-the-dot methods, have shown substantial improvement in deflection extents.

The [IPC-D-356 format](#) has been chosen as the primary source file for BlueSky Fixture Design.

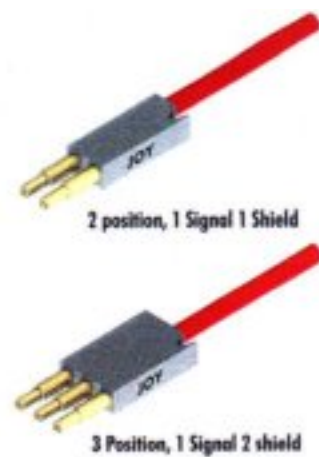
[Applied Relay Testing Ltd, England](#), specialist manufacturers of advanced test equipment for the production and laboratory test of electromechanical and Photo-MOS relay devices.

In situations such as laboratory testing where flexible manual relay test fixturing is required, Applied Relay Testing has developed a [general-purpose test fixture](#) that achieves a high level of performance at high voltages and low leakage currents. The test fixture is based on a fully guarded, interlocked concept that uses individual PTFE device connection pillars each loaded with two spring probes and is useful up to around 10 kV. A high level of safety is provided by an integral HV

interlock switch and full device pin shorting when access is enabled.

[Aspen Test Engineering, Inc.](#) has complete ATE fixture finishing services with custom fixture electronics for increased test coverage.

[ATE FIXTUREFAB/PROGRAMMING](#) is a full-service test company providing a broad range of test solutions to the electronics industry. ATE offers a complete line of translation hardware and software to assist with test equipment migrations. A fully equipped machine shop allows ATE to support all types of custom requirements including automated board-handling equipment. They offer PC board testing services, training, on-site installations, custom designs as required for pneumatic, vacuum, mechanical, bi-level, top-side probing, performance port, board handler, cassette options, testjet, opens express, polarity check, and junctions express.



[Bridge Technology](#) is a manufacturers representative supplying equipment for test and measurement applications (failure analysis, product engineering, etc.) and manufacturing applications in the semiconductor industry and other high-technology industries.

[BRIDGE Technology](#) is an authorized representative of [Joy Signal Technology](#).

The PoLo Spring Probe Connector System is a spring-loaded probe termination system that allows flexible configuration of high-speed signal and power lines. Many contact matrices are possible utilizing a base locator plate and keeper system.

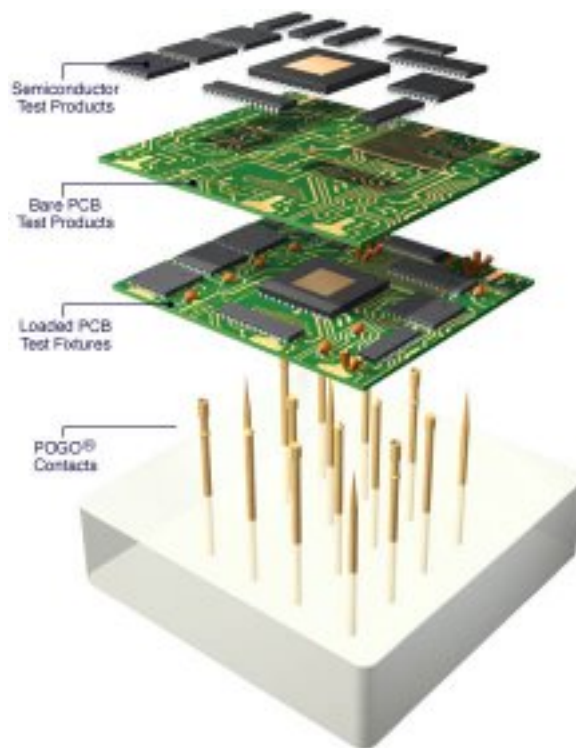
- Spring probes on 0.1" centers
- Many PoLo Spring Probe tip styles are available
- Cable is welded to contact
- Axial or 45° cable exit from thermoplastic strain relief
- Receptacle barrels are gold-plated nickel silver
- Service temperature range is -40°C to +105°C
- 3 pin: <2dB attenuation to 3 GHz, <15dB return loss to 1.4 GHz, Suitable for rise times to 150 pS

- 2 pin: <3dB attenuation to 1.4 GHz, <-15dB return loss to 400 MHz, Suitable for rise times to 350 pS



[The Equipment Reliability Institute](#) offers a course called [Vibration and Shock Test Fixture Design](#).

[ERI](#) is an affiliation of engineers dedicated to increasing the reliability and durability of automobiles, aircraft, and other vehicles, as well as electronic and other equipment. How? ERI develops and presents technical education to help you lessen or avoid future reliability and durability problems. ERI also offers consulting services for any specific and immediate reliability and/or durability problems. More can be found in their [FAQ](#).



[Everett Charles Technologies](#) has been a leader in the development of advanced technology board test products since 1965. Their line of products includes signature [POGO® Contacts](#), test fixtures, bare-board test systems, and semiconductor test products, many of which have become industry standards.

Check out [Design for Testability Guidelines](#) and [Strategies for Improving Accuracy for Fine Target Probing](#).

[The Everett Charles Test Fixture Division](#) is the world's leading

manufacturer and customizer of fixtures for testing loaded PCB.

[FEINMETALL GmbH](#) diversified product line includes.

- Standard Spring Contact Probes for loaded and bare-board PCB test down to 1.27 mm (50 mil) centers
 - Fine Pitch Spring Probes for testing fine structures including hybrid substrates down to 0.5 mm (20 mil)
 - Bare-board Spring and Rigid Probes made for ATG, Luther & Maelzer, Viking and Circuit Line test systems
 - Wire Harness Probes for continuity testing and push testing. Antiwalkout Probes for push-back testing and Switch Probes for presence testing.
 - Probes for special applications including high frequency, high current, and Kelvin 4-wire measurements, pneumatic probes, short travel, and special interface probes.
 - Customer-specific probes.
-

H+W TEST PRODUCTS

[H+W Test Products, Inc.](#), is the largest independently owned test-fixture kit manufacturer in the world. Test-fixture kits for most major automated test equipment (ATE) testers are available and ready for same-day shipments worldwide. H+W Test Products' world headquarters is located in Seekonk, MA. They are ready to answer any questions you may have on H+W fixture products, send you product literature, and tell you what's new.

HARWIN



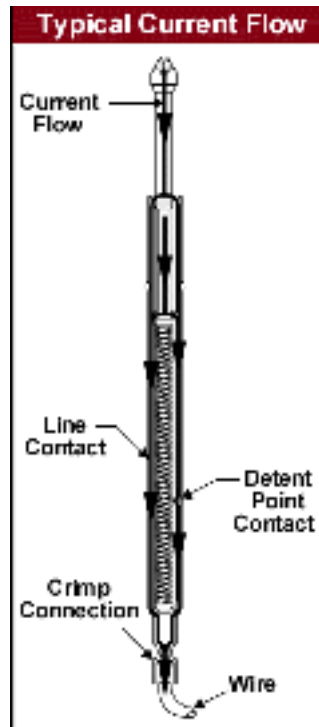
[HARWIN](#) has provided high-interconnection devices and hardware to OEM customers in the military, computer, aerospace, and telecommunication industries. For our interest in Spring Probes, the only information available on the web site was "Coming soon to the CD Catalog. Order Catalog by clicking here."

Interconnect Devices, Inc.

[Interconnect Devices Inc.](#) produces and supplies Spring Probes, Solid Pins, Battery Contacts, Double-Ended Spring Probes, High-Current Probes, Thermocouple Probes, Kelvin Probes, Coaxial Probes, and custom products.

Of specific interest to us in this [Resource Page](#) is the [Slide Show](#) of IDI's [ICT® Series Probes](#).

[ICT® Series Probes](#) are specifically designed to meet the needs of today's in-circuit test demands. The ICT Probes feature a DuraGold barrel. DuraGold is an IDI exclusive. Using an advanced alloying technique, precious metal is alloyed to the base metal prior to the forming. This results in a smooth, extremely uniform surface area on the inside of the barrel.



Every Spring Contact Probe in the IDI Catalogue has a [Technical Summary](#) that lists the operating parameters of the probe. In this section, these parameters will be discussed in detail.



[Lone Star Industrial](#) presents a [table](#) with a simple one-line summary of which type of Spring Probe you should use for certain applications (something I wish everyone else did).

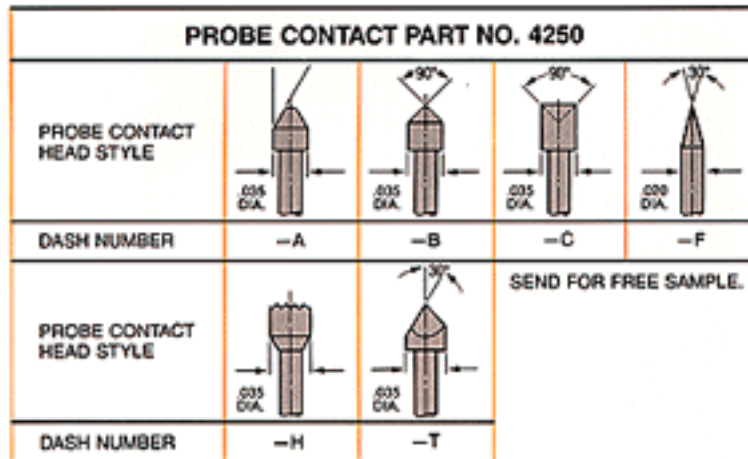
If you use a Java-compatible web browser they offer an animation to view.

[Program Data Incorporated](#) products are:

- Bare-board testers
- Pin loaders
- Test fixtures

- Fixture-generation software
- Board-repair software

[Test Probes and Test Pins](#)



[QA Technology Company Inc.](#) is one of the leaders in high reliability, long-life test probes and sockets. Their products are used in the testing of bare and loaded printed circuit boards, and in interfacing test fixtures to automatic test equipment. [QA's Patented Probes](#) feature a patented biasing system for the tail end of the plunger. Biasing is the name given to the intentional loading of the plunger against the inside surface of the probe tube. An angled surface machined on the tail mates with the spring and allows it to exert a small radial force on the plunger. This biasing force causes a well-defined wiping action between the plunger and the inner surface of the probe tube to provide improved electrical contact.

[QA offers a Competitor Products cross reference](#) that is divided into sections, which makes it easy to quickly find the best match for a given probe.

- General cross reference: Each QA series has three tables that list all available point styles, spring forces, and tube materials. Alongside each is the equivalent item from each manufacturer.
- Detailed cross reference: For each manufacturer, enter their part number and click the respective Submit button for the QA part number.



[Test Connections, Inc.](#) is a leading manufacturer of Spring Contact Probe Assemblies and Solid Translator Test Pins, which are used for electrical testing of printed etched circuit boards, with and without components. TCI products cover a wide variety of applications including: printed etched circuit board manufacturers, original equipment manufacturers (OEM) with ATE equipment in-house, manufacturers of related test fixtures, companies providing software programming with test fixture finishing, companies providing a service

to finish or fabricate test fixturing, bare-board testing services, as well as other applications.

Test Fixture Supplies

[Test Fixture Supplies](#)' core business is manufacturing in-circuit and functional test equipment. Complete in-house manufacture and finishing of: Tescon, Okano, Hioki, GenRad, Hewlett Packard, Marconi, Wayne Kerr. Most major systems catered for bare-board testing.



[Test-X](#) covers all aspects of Test Fixtures.

[Ultra High Spring Force Probes For Dirty Boards](#) -- [Quality One Test Fixturing Inc.](#) has released the latest revision to its family of pneumatic gates to accommodate usage of the new 17.1-oz spring probes. The Airgate family can compress up to 10,000 pounds, thus allowing the test engineer to use the ultra high-force spring probes to penetrate solder, process residue, oxidation, and contamination.

They have several educational papers in their Technical Reference Manual section. Their site is laid out so the links are browser-type dependent, so you have to go there from their home page.

The top three board test suppliers are [GenRad](#), [Hewlett Packard/Agilent](#), and [Teradyne](#).



The [General Radio Company](#) has three business units: (1) Advanced Diagnostic Solutions, (2) Electronic Manufacturing Solutions and (3) GR Software. In the 1970s [GenRad](#) practically created the automated test equipment (ATE) industry with the invention of its computer-controlled logic circuit analyzer.

PCB Assembly Solutions

[GenRad](#) provides electronics manufacturers with hardware, software, and services designed to accelerate product introductions, optimize

throughput, and improve process management from design through to manufacturing.

Their family of in-circuit, electrical, and functional in-line test and inspection solutions work in concert with the ProceSmart Solutions suite of process management software, delivering end-to-end ProceSmart solutions.

[GenRad](#) covers in-circuit test solutions, functional test solutions, test programming and fixturing.

Check out their [Technical Articles](#).

[GenRad](#) has sold their former instrument division to [QuadTech Inc.](#)



With such products as electrical safety testers, LCR meters and digibridges, megohmmeters and milliohmmeter, standards and decades, transformer test systems, and strobotac [strobe lights].



Once up on a time, when you said "HP" to a group of Engineers they immediately thought "test equipment." Now saying "HP" might just as well invoke the images of computers from [Wal-Mart](#). [Hewlett Packard](#) has renamed their [Test & Measurement division Agilent Technologies](#).



HP E3963A 100-pack replacement Spring Probes for servicing HP TestJet Probes in HP TestJet fixtures.

[HP TestJet technology](#)

In the early 1990s, testing digital parts became problematic. Previous in-circuit test techniques sought to ensure a correct, functioning part by applying digital patterns, called vectors, to the inputs of the device and monitoring the outputs of the device. If the outputs matched the expected patterns, the digital part was deemed to be the correct part, oriented properly, and soldered properly. This technique had two requirements that became difficult to supply by the mid-1990s:

- knowledge of the functioning of the digital part so that an appropriate set of patterns could be generated

- test probe access to every input and output of the device

The HP TestJet technique was patented and introduced by HP in 1994, after several years of research and refinement. It uses a property of most digital ICs in use during the mid-1990s: the lead frame (a metal framework that includes the devices input, output, and power pins, and their extensions up to the point where the silicon die is attached).



[Teradyne](#) is the world's largest supplier of automatic test equipment and software for the electronics and telecommunications industries, and a leading supplier of high-performance backplane assemblies and connectors.

[Teradyne](#) is the only broad-line supplier of test equipment for analog, mixed-signal, memory, and VLSI devices.

Obviously there are players other than the top three in the board test field. One such company is [W. M. Hague Company](#).

I found the following paper at their site interesting: [The Future of Semiconductor Substrate Testing: non-contact Technology non-contact Capacitive Sensor approach replaces moving probe, mechanical probe, and shorting rubber technologies in order to meet high throughput, high accuracy demands](#). by: Don Hague and Michio Kaida.



The US Army covers automated tests systems from a unique perspective. In their business, the first failure may very well be the last one that they will ever have in their life.

[The TACOM Automated Testing Systems \(ATS\) / Test Program Set \(TPS\) Engineering Activity](#) is one of the few government organizations

that has an in-house staff of experienced engineers developing and maintaining test program sets (TPS) that run on various automated test systems (ATS). Although the primary focus is on ATS/TPS work, other related technological areas have spun off various other projects.

One thing is for sure, the people at this site love acronyms.

Think test fixtures are always small units? Then check out this one measured in yards. This [Environmentally Controlled Test Fixture](#) (the largest in the world) was manufactured and delivered by Clegg Industry for the US Army. The "portable" radio frequency interference/electro-magnetic interference shielded laboratory consists of ten sections with over-all dimensions of 21' x 61' x 21'. Environmentally controlled by ten tons of cooling capacity heat pumps, the unit is sealed with special shielded materials to prevent entry or exit of radio frequency transmissions and electromagnetic interference. The unit was installed at an Army depot in Sacramento, California in March 1989 by Clegg Industries engineering personnel.

The fact that an item is listed here does not mean we promote its use for your application. No endorsement of the vendor or product is made or implied.

All product names and logos contained herein are the trademarks of their respective holders.

If you would like to add any information on this topic or request a specific topic to be covered, contact [Bob Paddock](#).

Circuit Cellar provides up-to-date information for engineers. Visit www.circuitcellar.com for more information and additional articles. ©Circuit Cellar, The Magazine for Computer Applications. Posted with permission. For subscription information, call (860) 875-2199 or e-mail subscribe@circuitcellar.com