



A Quality Test Demands A Quality Fixture

A Check List for getting a quality board test fixture first time, every time.

Every in-circuit and functional board test system requires a test fixture--a physical interface--to enable the system to test the specific board-under-test. Fixturing is often viewed as one of the most significant test investments made over the life of a test system. Therefore, obtaining quality fixtures in the most efficient way is a critical factor in maximizing return on test system investment.

When an imperfect fixture is built, valuable time and resources are lost to rework; performance is reduced; time-to-market is increased hence, manufacturing costs rise. The criteria below can help you evaluate a fixturing vendor to ensure you are working with one that will consistently deliver fixtures that meet your test needs.

To evaluate a fixturing vendor, you will need to evaluate both its business and manufacturing capabilities. For ease of use, the criteria for evaluating a vendor has been put into checklist form. The first part of the checklist contains questions relating to the business of the vendor. The second part includes questions regarding the manufacturing capabilities of the vendor.

Vendor Business Qualifications

Select a vendor with a proven history of delivering quality fixtures. Research these key elements:

- **References::** Ask the vendor for references, and follow up with them to ensure your vendor has provided quality fixturing to its customers. References will frequently be the best objective sources for information about the vendor's stability, customer service and responsiveness, and staff expertise. Take advantage of other customers' prior experience with the vendor. Does the vendor encourage a site visit? Do they return phone calls?
- **Staff:** Talk to the vendor about the abilities of staff. Ask how staff is trained and kept abreast of new techniques. You want to be sure the vendor has a trained staff that is able to understand your fixturing requirements and will be able to implement your fixture design, manufacture your fixture, and can support your fixturing needs. Ask the vendor's references about their experiences with staff.
- **Financial Stability:** Ask the vendor for financial audit information so you can evaluate their business stability. Look for a vendor with sufficient resources to stay in business, with the ability to support and warrant its products.
- **Equipment:** Having the right equipment is essential. A quality fixturing vendor will have the necessary equipment, including:
 - Drill machine with the capability of drilling accurate, straight, perpendicular holes into thick (up to 9/16") fixturing plates;
 - Semi-automatic wire wrap machine, if your fixture accommodates this application;
 - Verifier machine capable of verifying all of the wiring connections; and

- X Ycoordinate machine capable of digitizing parts.
 - Processes: Because fixture building is a precise process with little room for error, it is important to find a fixturing vendor who is either ISO 9000 certified, or who can prove that its processes are standardized and documented. Also, because processes should be updated as customer feedback is received, ask the vendor how customer comments are incorporated.
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Vendor Manufacturing Capabilities

Again, because fixture building is a precise process, it is important for your fixturing vendor to be knowledgeable about fixture building and to have strict manufacturing processes in place. When selecting a vendor to build your fixture, make sure you and your vendor discuss project definition, customer materials (which you provide), fixture materials (which your vendor will obtain), and specific fixture processes. All of these details impact the quality and accuracy of your fixture.

Project Definition

Prior to starting a fixture build, it is important for you and your vendor to agree on the project definition. The project should not be started until all project specifications and expectations have been documented and agreed upon. Spending the time at the beginning of the project to determine its scope will help to ensure that your fixture will be built according to your needs. Some of the items to be discussed and documented include:

- Project Management: The vendor should have project management processes in place that outline the frequency of project updates and how they will be delivered (i.e., phone calls, update letters, fax, e-mail, etc.) Look for vendors who are pro-active in project management and who take client relationships seriously.
- Cost of Project: Project cost should be outlined and agreed upon, prior to project start. You may want to ask how incremental changes to the fixture are handled and how additional costs might be incurred.
- Delivery Schedules: Schedules should be documented and agreed upon. Ensure that your vendor can meet your delivery needs without compromising your fixture requirements.
- Support: The vendor should be specific about how they will support your fixture once it has been delivered. Ask about the cost of the support and what can be expected when engineering changes are required.
- Fixture Maintenance: Eventually, most fixtures will need some degree of inspection and maintenance to ensure proper performance. Because fixturing vendors have the tools and resources to accommodate this, many offer fixture maintenance as a service. The type of maintenance usually required is inspecting and replacing damaged or worn parts, replacing vacuum sealing materials such as gasketing, and cleaning or replacing probes.

Customer Materials

Getting a fixture that will meet your test needs will depend on the information and materials that you provide to the vendor. The fixturing vendor will develop a fixture based on the information you provide. Most vendors will require the following materials. (Note: make sure all the materials are of the same revision!)

- A loaded known good board;
- A blank board, to ensure accurate probe registration;
- Fixturing files (if available) that include drilling and wiring information;
- Fixture electronics information, either schematics and parts necessary to build the electronics, or "fixture-ready" electronics for the vendor to install; and
- Mechanical information, including mechanical gate requirements, any special mechanical devices, and milling requirements.

Fixture Materials

The materials used to build your fixture will impact your tests and the life of your fixture. Because the material is such a critical factor, insist that your vendor consider the following guidelines when building your fixture.

- **Fixture Kit:** The fixture kit material--the base of your fixture -- should be constructed of durable material that will be able to withstand your manufacturing environment. It should also provide a strong base for all of the fixture accessories, such as wires, probes and mechanical devices.
- **Probe Plate:** The probe plate used should be made from material that allows clean, straight drilled holes. It should also be made to withstand the density of the board so that the flatness will not change more than .050" during fixture pull down or testing.
- **Probe Selection:** Select a vendor who is knowledgeable in contact issues. Fixture design is the time to select probe styles. Probe density and circuit board contaminants set the criteria for the probe type and spring force. Eight-ounce probes are the standard force, and for a no-clean board manufacturing process, 10-ounce probes are the default. Table 1 can be used as a guideline for selecting probe types based on the target that is to be tested. Table 1.
Probe types by target.

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Probe types by target.

When testing these targets...	Use these probe styles:
Testpads, vias	Chisels
Unsoldered vias	Chisels
Through-hole leads	Crowns/waffle
Edge fingers	Spherical

Table 2.
Probe receptacle insertion height

- **Probe Receptacles:** Use Table 2 as a guideline for setting receptacle insertion height.

Target type	Receptacle Insertion Height
Through-hole	0.175"
Via	0.190"

Long stroke	0.190"
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- **Mechanical Gates:** Gates are used when top access to the board-under-test is required or when you have an application that is high-throughput, low-maintenance. Whether purchased by you or supplied by the fixturing vendor, look for gates constructed to withstand your manufacturing environment. Gates should be built for operator ease and safety, and be able to accommodate any devices that may need to be added to the gate, such as pushrods and top-side probing devices.

Fixture Processes:

Fixture probe plate drilling is the most critical element of building a fixture. Pay special attention to your vendor's drilling processes. The drill process has a direct impact on the accuracy of your fixture's performance and will be impossible to modify after the fixture has been built.

- **Fixture Drilling:** Ensure that your vendor has a drill machine that can adequately drill thick plates (up to 9/16"), and has processes that ensure the finished holes are drilled straight. If the drilling process is not accurate and the finished hole is not straight, probe contact could be intermittent and unreliable. Ask your vendor what their drill process is, and look for vendors who use a process of drilling two passes to get a straight finished hole. The two-pass drill process consists of first, drilling the hole using a special cutting tool called a "center drill" with drilling depth set so only a shallow, chamfered pilot hole is drilled in the plate material. The second drilling pass, which completes the process, uses a long-flute carbide bit to drill the holes to final diameter and depth. A long-flute bit is recommended because it continually removes the probe plate material from the hole as it drills. Using drill bits with insufficient flute length can destroy the bit, the fixture plate, or both.
- **Changing Drill Bits:** Check with your vendor on the frequency for changing drill bits. If drill bits are not changed properly, and worn bits are used, the bit may leave a tapered hole. As a guideline, look for vendors with processes in place to ensure that drill bits are changed at the following frequencies: for 50 mil bits, change after 150 holes have been drilled; for 75 mil bits, change after 1000 holes have been drilled; and for 100 mil bits, change after 2000 holes have been drilled.
- **Fixture Wiring: Wire Wrap Process.** When asking your vendor about their fixture wiring process, you may find that there are several techniques. Some vendors will use semi-automatic wire wrap machines and others will use manual, hand-held wire-wrap guns. Regardless of the technique, the outcome should be the same. The wrap should consist of multiple wraps that are close together and firmly attached.
- **Fixture Wiring Verification:** Another key element to the wiring process is the verification of the wiring. Ask your vendor about their method for ensuring that the finished fixture will contain no wiring errors. Again, the techniques will vary from vendor to vendor, but the outcome should be the same. You should expect to receive a fixture that has no wiring errors. Some vendors will use automatic verifiers, others may verify the wiring manually, while still others may have a board test system available for wire verification. Make sure you understand the consequences of receiving a fixture that has not been verified, as wiring problems will cause extra time in debug.
- **Vacuum Seal:** If your fixture requires vacuum, look for vendors who have vacuum resources available to check the fixture seal prior to shipping. Your fixture should be constructed so that when vacuum is applied, the board can be pulled down evenly onto the testhead without any air leaks, whistling noises, or operator assistance. When vacuum is removed, the fixture should allow the board to be released gently and not "pop off" the fixture.
- **Fixture Shipment:** The process for shipping the fixture is as critical as any other fixture building process.

Unfortunately, many vendors overlook this, potentially leading to delivery of a damaged fixture. Considering the significant cost of a fixture, you want to find a vendor with processes in place to ship the fixture so it does not get damaged. Look for vendors who ship their fixtures in shock-protective cases, and who wrap their fixtures in anti-static bags to protect fixture electronics.

Conclusion

Thorough, systematic communication with your potential fixturing vendor can greatly reduce costly time delays and frustration caused by poorly managed projects or poorly constructed fixtures. The above criteria for selecting a fixturing vendor is intended to help you protect your test system investment by helping you get the quality of fixture you need, every time. Don't be shy about asking these questions --you deserve to be confident in the fixture that your fixturing vendor will supply.