11 Ways to Decrease Downtime and Increase Productivity of Your Automated Test Equipment

Increasing productivity and decreasing downtime of your facility's automated test equipment is every manufacturer's dream. But, for new automated test equipment, planning to decrease downtime should start long before your automated test equipment is on the factory floor. In fact, it should start well before the first component is ever assembled. A highly productive machine starts with a good design that uses the proper materials, takes advantage of the latest technologies as appropriate, and can be easily maintained and serviced throughout its lifecycle. As experts in developing automated solutions, our engineer's at PrimeTest Automation have put together the 11 methods highlighted in this whitepaper to help you design, develop, and maintain automated test equipment with less downtime and increased productivity.

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Perform an Extensive Design Analysis

Building automated test equipment is complex and costly. Thus, when designing your automated test equipment, rather than looking at two-dimensional static designs on paper, it's best to envision how components will work together using a three-dimensional software-based approach. By investing in software and robotic simulation or mechanical finite element analysis (FEA) tools, you can increase the quality and reliability of your automated test equipment by subjecting your initial designs and machine upgrades to real-world conditions in a simulation environment. For example, you can use simulation software to program and test a robot off-line to avoid creating downtime for an assembly line that may greatly depend on the robot. Additionally, FEA tools can help you calculate component displacements, strains, and stresses, which can help you more effectively select the proper components for your automated test equipment.

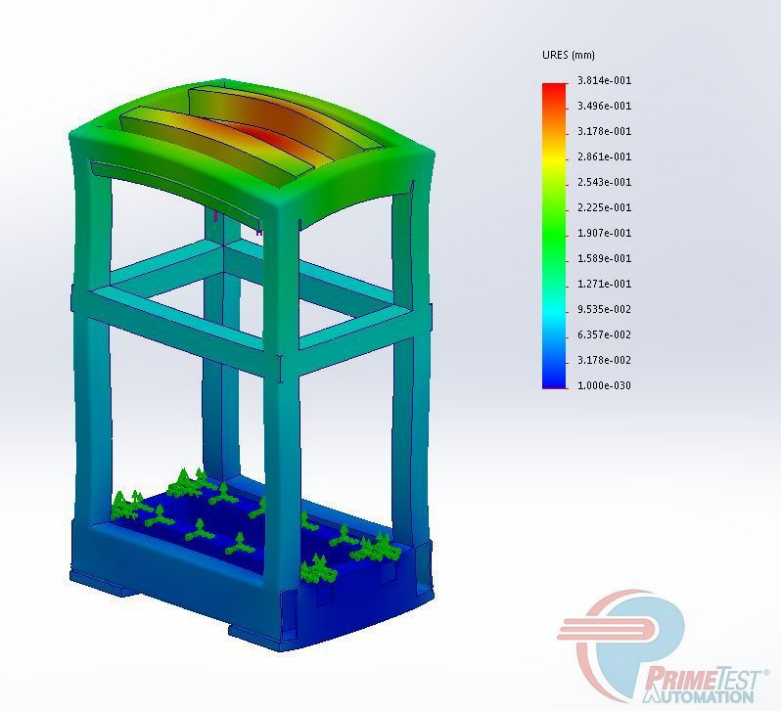

Figure 1. An example of a four-post displacement calculated using FEA software.

Select the Proper Components for the Job

Investing the time during the design phase to evaluate key characteristics for each component and using this information to select the components best suited for your machine will help you develop a more reliable and efficient machine.

When designing automated test equipment, it is important to understand the desired machine rate to know how to select, not just the components that will work for the lowest price, but the components that will allow for maximum performance. Machine designers need to consider a variety of physical properties for each component going into the system including the following:

- Strength and wear resistance
- Weight
- Price and source
- Corrosion resistance, conductivity, and magnetism

Investing the time during the design phase to evaluate these characteristics for each component and using this information to select the components best suited for your machine will help you develop a more reliable and efficient machine.

Avoid Custom Components and Work with Reputable Suppliers

When developing automated test equipment, machine designers often face the question of using custom or commercial off-the-shelf (COTS) parts. While there may be specific situations where a custom component is truly the best or only answer, if you are using numerous custom components in your automated test equipment, especially when equivalent COTS components are available, you run the risk of facing challenges regarding the time it takes to get the parts and necessary expertise to make system repairs and upgrades. Additionally, since it's not always possible to have every spare part available in your facility at all times, it is important to choose components from reputable manufacturers with fast ship programs. In the end, from your initial investment to performing repairs and upgrades, it's typically more cost effective to use a COTS solution versus a custom component when possible.

A stable foundation allows for a stable machine, which increases accuracy and repeatability.

Start With a Solid Foundation: Welded Steel Over Aluminum Extrusion

Often, large machines are placed on bases manufactured from aluminum extrusion that is bolted together with fasteners or T-slot connectors. Because these materials are fairly light and not permanently secured, aluminum extrusion bases are prone to shifting under high inertia loads, such as those generated by a rapidly moving robot, or by the bumps endured during the transportation of the equipment from the machine builder to the end user. This can be a big problem because when the base shifts, the entire system can become misaligned. To avoid these issues, build your automated test equipment using a steel base that is welded together. At PrimeTest Automation, one of our 10 Commandments of Automation Machine Engineering is that a stable foundation allows for a stable machine, which increases accuracy and repeatability.

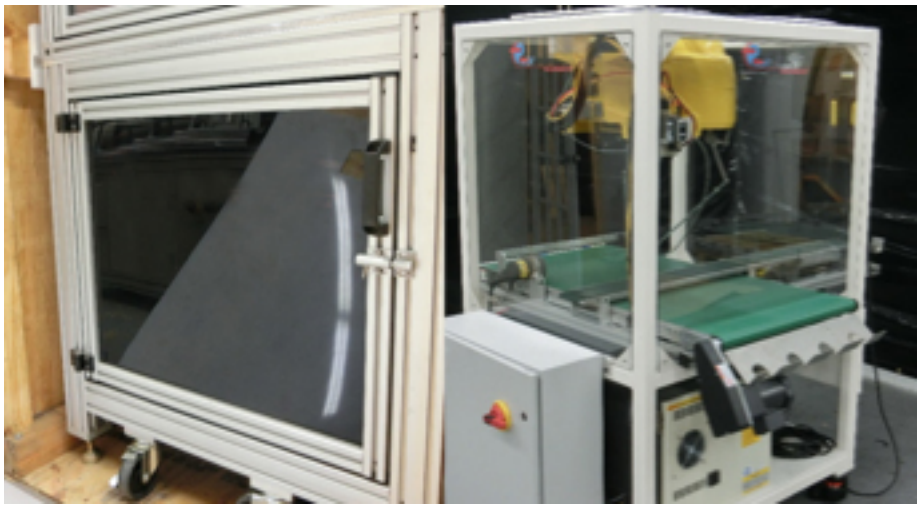

Figure 2. A comparison of a machine built using an aluminum frame (right) versus a machine using a steel base (left).

Assemble Your Automated Test Equipment Using Dowel Pins

When building mechanical assemblies for automated test equipment, many parts need to be joined together. While welding is the best way to permanently secure a joint, there are instances where the two pieces should not be permanently fixed together. In these cases, the best option to ensure machine stability is to use dowel pins. Steel dowel pins and their corresponding holes are designed to fit tightly together, unlike bolts or screws that may allow significant variations that can lead to misalignment. Additionally, components using dowel pins can be disassembled and reassembled if necessary while maintaining precise alignment.

Cable Management Should Not Be an Afterthought

Automated test equipment on the manufacturing floor is complex and relies on a variety of cables and hoses to conduct data transfer and communications, provide power, and perform functions such as delivering compressed air. Cable and hose management is critical to the performance of the automated test equipment. However, the inclusion of cables in a system is often overlooked during the design phase and tends to be treated as an afterthought during assembly automation. Instead, to avoid downtime, repetitive repairs, and increased operational costs, machine designers need to think about how the cables will run through the machine and be protected from chaffing, pinching, and stress. Methods for accomplishing this protection include determining anchor points and incorporating cable carriers into your design right from the beginning. In short, for better efficiency, design cables into the automated test equipment and don’t make them an afterthought. This is yet another one of our 10 Commandments of Automation Machine Engineering at PrimeTest Automation.

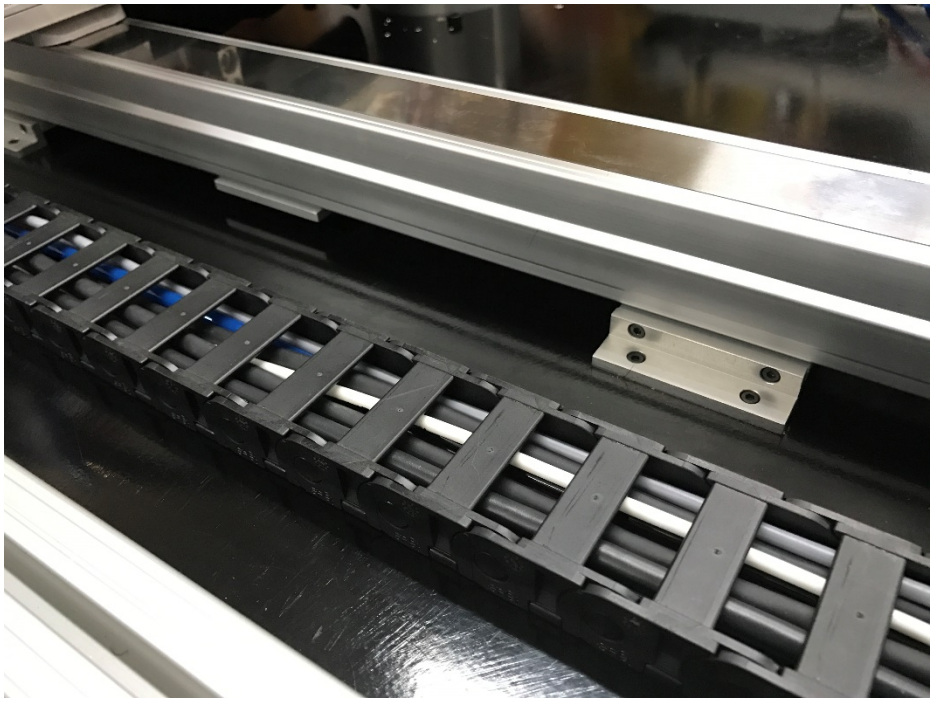

Figure 3. An example of automated test equipment that has properly planned cable management.

Develop Control Safeguards

When developing your automated test equipment control software, it is important to include preventative controls that make the software intelligent enough to thwart misuse that could potentially damage the machine. For example, the software should limit high-risk tasks to users with specific training and permissions, and limits such as maximum rates, levels, or throughputs should be set where appropriate. One common area for unintended machine damage occurs when maintenance staff are working on equipment in manual mode. During this time, they often cycle individual axis of motion that can cause collisions between different axis by moving the machine in sequences that do not normally occur during the machine process. Spending the extra time to create software protections against these unintended collisions upfront can save you significant time and money for repairs in the future.

Planned downtime for change over can be accelerated by using intelligent machine features such as quick-change tooling and servo motor driven actuators.

Design for Serviceability and Flexible Changeover
It's no secret that most parts used in automated test equipment will wear over time and need to be repaired or replaced, so it's best to plan for this from the beginning by building a machine that is easy to service and offers flexible changeover. First, you should design your mechanical assemblies to allow for tool access for parts management and quick repair. For example, you should mount external components that have a shorter life span, such as proximity sensors, in easily accessible areas. Second, as we mentioned in the "avoid custom components" section, using COTS or standardized hardware, even for parts as small as the fasteners will help make service much more efficient and cost effective. Third, when thinking about planned downtime for change over, this process can be accelerated by using intelligent machine features such as quick change tooling and servo motor driven actuators. These servo actuators can quickly adjust conveyor guide rails or fixture sidewalls to rapidly reconfigure a system to run multiple product sizes. This flexibility not only helps reduce downtime during changeover, but it also has an added benefit of allowing a single piece of equipment to have a better ROI because it can be used across multiple different product sizes.

Utilize Intelligent Fault Handling and Messaging

Investing the time upfront to incorporate diagnostic features that allow the system to easily give a clear indication of problem areas as they arise will help decrease diagnostic time and ultimately decrease downtime. For example, if an issue arises and the fault handling software has the ability to display the problematic sensor's description and label number on the operator's screen, the operator can identify the location of the fault quicker, accelerating the repair. Additionally, process monitoring in the form of graphing key process characteristics (KPC's) with upper and lower process limits on the machine interface is a good method for alerting machine operators of process drift.

This method can allow for scheduled machine maintenance to be planned for instead of unscheduled maintenance and machine downtime.

Incorporate Remote Support

When software issues arise or upgrades are necessary, troubleshooting and upgrading can often be performed remotely by a third party such as the machine builder. Thus, it is best to initially incorporate remote access by installing a remote access device that allows the third party to quickly connect to the equipment and provide assistance. This saves you time and money because instead of bringing a third party onsite to perform what may be a simple repair or upgrade, many issues can be solved remotely.

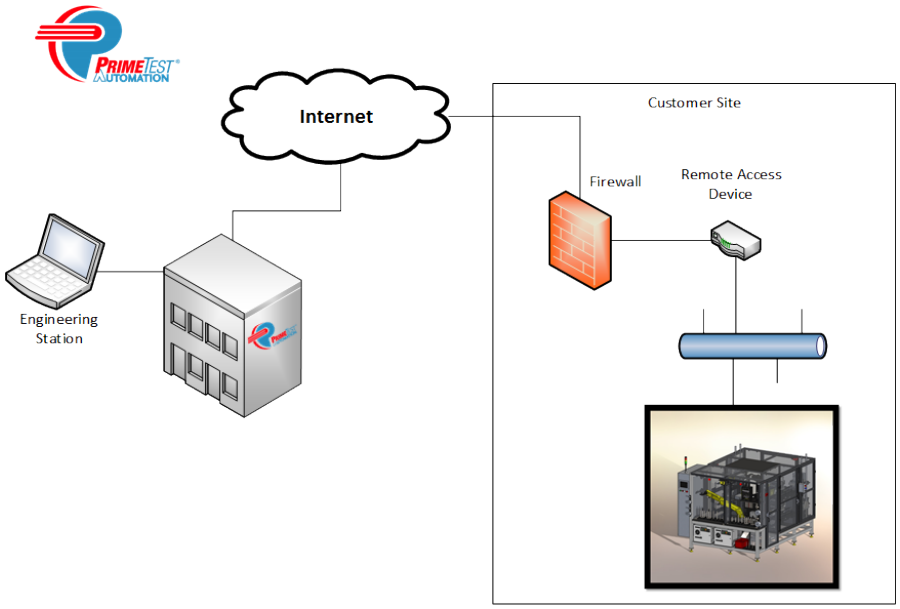

Figure 4. A diagram of how PrimeTest Automation structures remote access for clients.

Don't Just Train Operators to Operate the Automated Test Equipment

Beyond training operators to perform the tasks required to operate the automated test equipment, it's best to

While downtime costs vary widely across industries, they can be significant. Thus, your initial investment to plan for methods to minimize downtime can payoff extremely quick.

train operators to maintain machines as well. Instead of just performing scheduled maintenance and keeping a spare parts list, you should train operators to perform routine maintenance and update the spare parts list as needed. While you are making an initial investment in this additional training upfront, it can save you a lot of time and money in the long run when it comes to performing routine maintenance on your machines. Additionally, if you are working with a third-party integrator to develop your system, ensure that their experts who design and develop your machine can offer your operators the proper training to ensure system longevity.

Achieving the Holy Grail of Manufacturing: Less Downtime and More Productivity for Your Automated Test Equipment

When downtime occurs for your automated test equipment, especially if it is unplanned, employees and machines are sitting idle and products are not being made. While downtime costs vary widely across industries, they can be significant. Thus, your initial investment to plan for methods to minimize downtime can payoff extremely quick. In the end, to save time and money throughout the lifespan of your automated test equipment, choose to work with an integrator, such as PrimeTest automation, that will incorporate technology into your machine that will minimize the effects of downtime and increase productivity.

To learn more about PrimeTest Automation's automation experience and how we can help you decrease downtime and increase productivity, visit our core competencies page. http://primetest.com/core-competencies/