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TENSION COMPRESSION FLEXURE

SYSTEM INTEGRATION AND AUTOMATION



Tinius  Olsen

THE FIRST NAME
IN MATERIALS TESTING

AUTOMATED MATERIALS TESTING

Tinius Olsen is excited to introduce you to the next evolution of mechanical testing with automated testing options. As part of a testing solution, a number of options exist in terms of what kinds of tests are performed, and at what capacity, when we talk about automated testing. The different testing options that could be considered as part of an automated testing solution most

often include not just a horizontal, or vertical, tensile test, but also a flexural test, and/or a hardness test (select one or multiple scales), and/or any other type of physical testing equipment that can report importable test data to our Horizon software.

The key advantage with all our automated materials testing solutions is the flexibility and control of the

different testing and test machines that can be performed. Typically centered around a Tinius Olsen tensile tester, the loading capacity, desired specimen volume throughput and range of tests performed can be scaled according to your needs.

Robot. In this example the robot picks the next specimen from the same location and puts it through the different test stations.

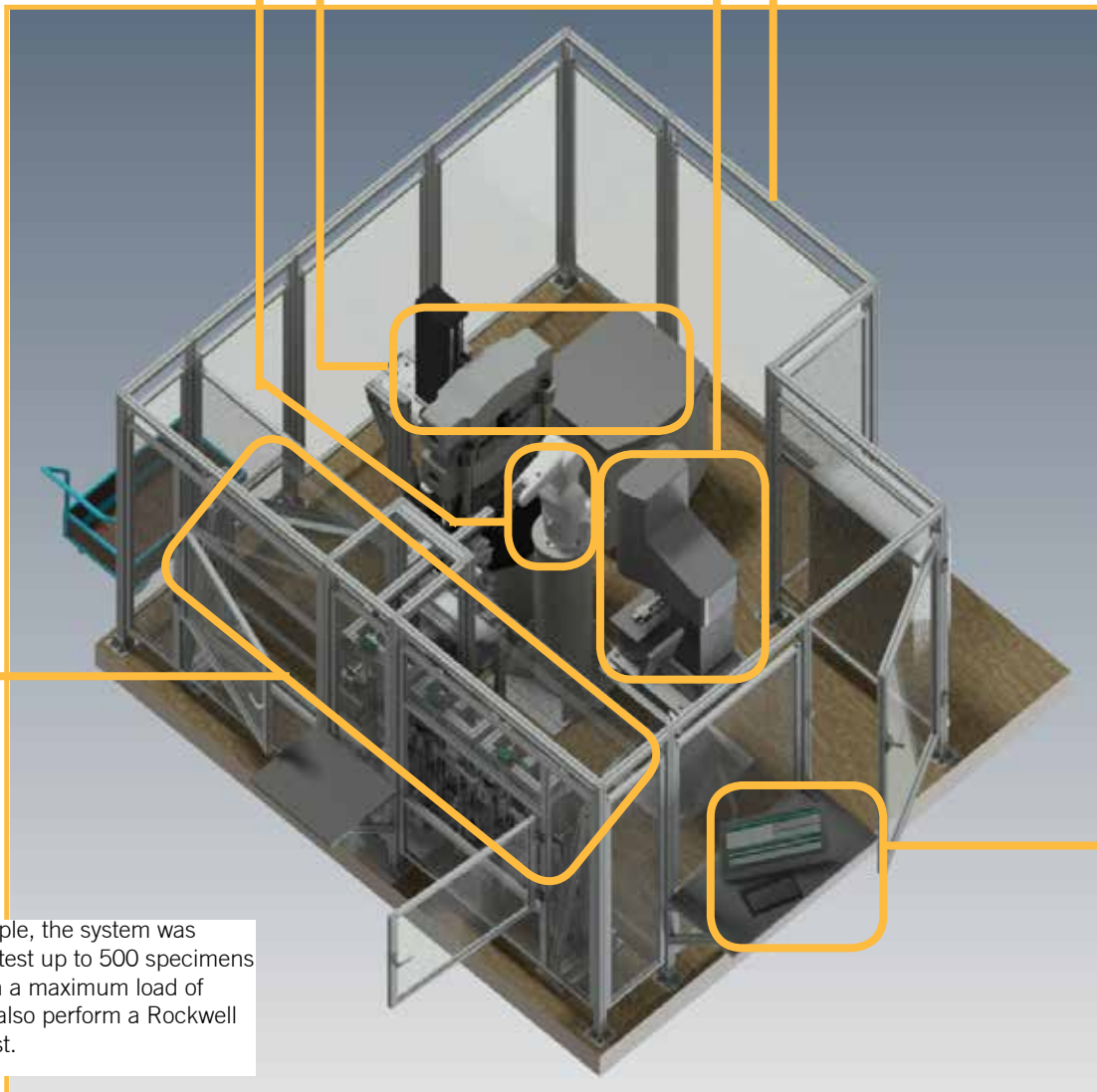
Specimen Racks. In this example, 3 large racks hold up to 50kg (100lb) each of specimens which are driven to a pick-and-place arm.

Core Tester. In this example, the core, or primary, tester is a hydraulic tensile testing machine, which uses a precision automatic, variable gauge length extensometer.

Secondary Tester. In this example the secondary tester is an automatic Rockwell hardness tester.

Safety Screen. Designed to protect operators from the movement of the robot, the safety screen features interlocked doors to prevent any unauthorised access.

System Controller running Horizon software - the "brains" of the testing solution.



In this example, the system was designed to test up to 500 specimens per day, with a maximum load of 750kN and also perform a Rockwell hardness test.

PRIMARY TEST STATION



Tinius Olsen's core technology is tensile testing machinery; we have been making testing machines, testing for tensile strength, compressive strength, flexural strength, shear strength, peel strength....and many other physical parameters since our founding in 1880. We have witnessed many different technological advances over the years that we have been able to integrate into our testing machines, but none have been as exciting as the incorporation of a robot with computer control and data analysis software.

At the heart of all automated systems from Tinius Olsen is a tensile tester. These testers can have either a vertical orientation, or, more commonly for our automated systems, a horizontal orientation and consist of an electromechanical tensile tester, which is available in a selection of maximum test capacities. Testing in the horizontal plane allows us to use a precision extensometer that takes advantage of gravity to rest on, and follow, the specimen as it is pulled to break; using air bearings and a non-slip finish on the knife edges of the extensometer, we can readily achieve Class A accuracy on the extensometer.

Alternatively, the primary test station could comprise a vertically oriented hydraulic testing machine. Using open front crossheads on the tester allows the robot to place the sample into the tester and the hydraulic grips can be easily closed. Extensometry is achieved using either our standard non-contacting extensometers or our automatic clip on extensometer.

For lower force testing, this machine could be a standard electromechanical testing machine, using, for example, pneumatic grips, whose operation can be controlled remotely.

150kN capacity horizontal tensile tester with parallel hydraulic grips and a precision horizontal extensometer make this tester ideal for automation.



10kN capacity tensile tester with pneumatic grips that can be controlled by Horizon software make this tester ideal for automation.



1000kN hydraulic testing machine with open parallel hydraulic grips with an automatic variable gauge length extensometer (not shown) make this system ideal for automation.



Summary of Notable Features of Primary Test Station

- Testing machines can be used in either stand-alone or integrated into a robotic automated test cell.
- Machine loading capacity is not restricted and can be either vertical or horizontal in operation, keeping footprint at optimal values.
- Specimen throughput can be optimized to the capabilities of the testing machines.

SPECIMEN STORAGE STATION



The fundamental advantage of an integrated and robotic test system is the ability to test a large number of specimens leaving operators available to perform other types of quality tests. These large numbers of specimens have to be stored in such a way that allows easy access for the robotic arm to grab the 'next' specimen. These storage systems can be simple specimen racks that are arranged in an arc around the robot arm so the robot moves around to pick the next specimen, or multiple large storage racks that are pneumatically moved into position so that the robot returns to the same place to collect the next specimen.

Specimen racks arranged in an arc around the robot. The robot is programmed with all the specimen locations so it knows where to pick the next sample.



In this example the specimen racks are arranged on a pneumatically driven frame. The specimens are loaded into the racks and the racks moved into position. The specimens are driven to the same reference point so that robot selects the next specimen from the same location.

SAMPLE IDENTIFICATION STATION

Once a specimen has been selected, it is important to know as much as possible about the specimen. Each specimen should be identified, most commonly, with a barcode. The barcode can hold unique information about the specimen and can be read into the Horizon software. Alternatively, the barcode can trigger an import of data into the Horizon software. Unique information for each specimen may include identifiers, test parameters, result limits or any other relevant data.



Results from a six station Deflection Temperature Under Load test run on an HDTM603.

DIMENSIONAL MEASUREMENTS



While the barcode information is being read and stored, the specimen width and thickness is measured in the reduced section of the specimen. The pneumatic arms on the width and thickness gauges are activated and the measurements recorded. Once recorded, the robot lifts and moves the specimen and the width and thickness measured for a second time. This is repeated a third time and the minimum values are logged into the computer.

Dimensional measurement station where the width and thickness of each specimen is measured.



SAFETY AND SECURITY



The key to the entire automated robotic testing system is that it can run without operator involvement. While this by itself has numerous advantages, it presents a possibility of a hazard to unfamiliar bystanders if the robot moves. To prevent any damage to operators and onlookers the entire testing system can be surrounded by polycarbonate safety shielding, with interlocked access doors and specimen loading doors to prevent any unauthorised access.

In this particular example, the entire testing system was enclosed with polycarbonate safety screens.. Access to the specimen loading racks is achieved by a simple door/window, and the whole has one main door to allow access.

SECONDARY TEST STATION



In this particular example the primary test station is the horizontal tensile tester on the left. The secondary test station here is the flexural test being performed on a standard electromechanical tensile tester (see inset for detail). This particular configuration was used to test ASTM D638 specimens of polypropylene.

The secondary test station could really be any type of physical test equipment, such as another tensile test frame running a flexural test on the specimen, or a Rockell hardness test, or Vicker. Knoop/Brinell or a combination of these, or an impact test, etc.

If space permits, there is no reason why a third or fourth test station couldn't be included in the system. These additional stations could be a repeat of the primary and/or secondary station, so as to increase specimen throughput.

In the example below the primary test station is the hydraulic tensile tester on the right. The secondary test station here is the automatic hardness tester on the left which is ready to perform a Rockwell hardness test.



ROBOTIC HANDLING



To make the entire system truly automated, the engine that is at the heart of the system, quite literally, is a robot. We use a robot that has six axes of rotation and have developed a custom pneumatic hand that can pick up different specimen types. This hand can accommodate a variety of different specimen shapes, sizes and weight and the gripping force can be modified to ensure secure specimen holding without risking the possible introduction of a stress point or weakening of the more fragile specimens.

The robot can be programmed so that it can move the specimen from station to station, rotating the specimen so it can be loaded either horizontally, vertically, or any angle in between, depending on the requirements of each piece of testing equipment within the system.

SYSTEM CONTROL



While the robot is the “mechanical engine” of the automated system, it is our Horizon software that is the “brains” of any automation system. Each piece of equipment can work independently and Horizon is listening and ordering each piece to complete the test.

Not only does it control the movement of the specimen through the different testing routines, but it also listens to input from other external testers and will place these results into a complete summary report.

Summary of Notable Features of Horizon Software

- Full PC networking integration and backup across a PC network using industry standard SQL database structure.
- Multiple licensing of Horizon for multiple installation to review methods, results and reports away from the testing machine, lab or plant.
- Multi level user password capability.
- Recall function enables users to add key data perhaps not available, or missed, prior to the test.
- Built in Team Viewer licenses enabling TO engineers to log in directly, upon request, and provide on-machine technical support.
- Live results during test; there is no limit to the number of results displayed and these need not be used in the test report.
- With sufficient PC power and bandwidth, multiple testing machines can be run from one PC.
- Users can use pre written international standards methods as templates to modify and build their own test methods.

SYSTEM INTEGRATION AND OPERATION



Hardware Requirements for Horizon

- 2 GHz Pentium Dual Core or better
- 8 GB RAM
 - Using multiple testing machines may require additional memory and/or a faster processor
 - 32-bit systems are limited to a maximum of 4GB of which only 3.25GB is available due to system overheads
- 512 MB DirectX 10.0 capable video card or better
 - A non-integrated Video Card is recommended for best performance
- 40 GB of available hard disk space (minimum)
 - NOTE: SQL Server 2012 Express (installs with Horizon) requires a minimum of 6 GB
- Machine Communication
 - RS232 Machines (i.e. 398, SR2, S-Series, T-Series, 602, MP993, MP600, Impact, & HDV):
 - 1 port per testing machine is required. The port may be either an integrated RS232 port OR USB port using an RS232/USB adapter.
 - USB Machines (i.e. MP1200 & VMC controlled):
 - 1 USB port required per testing machine
- Additional Ports
 - 1 USB Port for use with the software key (required)
 - Ports required for each measuring devices, barcode scanners, etc.
 - 1 USB Port & 1 DisplayPort if using Touch Screen purchased from Tinius Olsen
- DVD-ROM Drive (to run installation DVD)
- Mouse or pointing device and keyboard supported by Windows
- Monitor
 - 32-bit color
 - 1600 x 900 (Widescreen) or higher
 - If a Touch Screen is used, Windows 8 (or above) is best
- Windows compatible printer (for reporting capabilities)
- Windows compatible sound card and speakers (for audio playback)
- An active Internet connection (for TeamViewer use and Help Desk support) recommended

Hardware Requirements for Robot

- Windows 10 Pro 64-bit operating system
- Intel i7 quad-core processor
- 32GB RAM
- 4GB video card

Software Requirements for Horizon

- The Horizon Software is designed for 32-bit and 64-bit operating systems running Windows Vista SP2, Windows 7 SP1 or Windows 8. It will NOT install on anything below these Operating Systems (i.e. Windows XP, Windows Vista SP1, Windows 7, etc.).
 - NOTE: A 64-bit Operating System is preferred for best performance.
 - NOTE: If using Windows 8 (or higher) the “.NET Framework 3.5” Windows Feature MUST be enabled before attempting installation.
- Internet Explorer 8 or higher
- Once installed, users MUST be granted full read/write access to the installed software folders (i.e. the “Horizon” and “Microsoft SQL Server” folders).



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