Date: November 17, 2013
To: Mrs. Cindy Mittanck, Technical Writing Instructor
    Washington University in St. Louis
From: Will Gooding, Mechanical Engineering Student
Subject: Report on Materials Science Laboratory Condition and Possible Improvements

Attached is my report, “Materials Science Laboratory at Washington University: Current Condition and Possible Improvements.” I have completed the majority of the tasks described in my initial proposal of October 21, 2013 and my progress memo of November 17, 2013. Some of these tasks continued to evolve as my research continued even after the most recent progress report. The tasks completed include a thorough investigation into the current condition of the undergraduate materials science laboratory at Washington University, proposed upgrades to the Lab, a cost analysis of those upgrades, and a discussion of how these upgrades must be absorbed into the course structure in order to maximize their benefit.

My findings suggest an overhaul of the Laboratory would be in the best interest of the Mechanical Engineering (MEMS) Department. Many of the current machines are unreliable, out-of-date, and interfere with the overall learning process. Of the eight primary pieces of equipment in the lab, seven do not align with the high standard of education, technology, and innovation of Washington University. This is due to a variety of reasons including the use of floppy discs, a lack of safety measures, inaccurate data results, and a high rate of mechanical failure.

On the basis of these findings, I recommend that the MEMS department follow my renovation plan to repair two of the current machines, and purchase three new machines (to replace four existing machines) for a total projected cost of $57,000. I believe these upgrades are necessary in order to continue to build the reputation of the Washington University School of Engineering within the academic community.

I appreciate your inviting me to conduct this research and submit this proposal. I plan to also submit a copy of this to the MEMS department. If you have any questions or comments as you read, please don’t hesitate to contact me at the phone or email listed above.

Sincerely,

Will Gooding
Materials Science Laboratory at Washington University

Current Condition and Possible Improvements

Prepared for:  Mrs. Cindy Mittanck
Technical Writing Instructor
Washington University in St. Louis

Prepared by:  Will Gooding
Mechanical Engineering Student
Class of 2015
Washington University in St. Louis

December 9, 2013
Executive Summary

“Materials Science Laboratory at Washington University: Current Conditions and Possible Improvements”

Prepared by: Will Gooding
Mechanical Engineering Student
Class of 2015
Washington University in St. Louis

On October 21, 2013, Mrs. Cindy Mittanck, Technical Writing Instructor at Washington University in St. Louis, formally approved my proposal to investigate the current state of the undergraduate materials science laboratory and develop a plan of improvement.

My findings on the current state of the lab show several concerning factors regarding the physical machinery in the lab. Several machines are technologically out-of-date, several break frequently, and many provide inaccurate experimental results. Additionally, several aspects of the Lab do not line up with the high standard of education, technology, and innovation at Washington University, including:

- The use of floppy discs
- A lack of automated data collection software
- A lack of internet connectivity
- Wasted instructional time due to equipment malfunction
- Highly inaccurate experimental results

Altogether, these factors impede the overall learning experience of the Materials Science course (MEMS 361). Through my research of modern materials testing machines from a variety of sources, I recommend the following actions be taken to update the Lab, with a total cost of $57,000.

- Repairs and updates to two machines totaling $12,250
- Purchases of three new machines totaling $44,750

In order to maximize the benefits of these upgrades I also recommend that the MEMS 361 course structure be altered slightly to adjust to the modern technology used by modern professional engineers.

These upgrades are necessary in order to maintain and improve the reputation of the MEMS Department and, more generally, the Washington University School of Engineering within the international academic community.
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Introduction

Currently, the Undergraduate Materials Science Laboratory, as a part of the Mechanical Engineering and Materials Science (MEMS) department, is a resource that does not fulfill its full potential as an educational tool and resource at Washington University. The Lab is used primarily by students in the laboratory portion of the undergraduate class MEMS 361: Materials Science and is in need of an update. This report will discuss possible upgrades to the lab, their feasibility and necessity, and other essential changes to the course structure.

Materials Science is the study of the interaction and interconnection between properties, processing, performance, and structure in materials. For example, if a car piston needs to have a minimum strength and heat resistance (two material properties), a materials scientist would consider what atomic structure would be needed, and what corresponding processing could be utilized to obtain that structure, in order to yield the best performance (maybe the cheapest or lightest option that still meets the minimum requirements). The MEMS 361 class uses experiment and theory to investigate this interconnection in real and ideal materials. These empirical formulas, concepts, and theories are taught in the classroom portion of the course and the lab portion demonstrates the application of these concepts in real-world engineering scenarios. Essentially, the classroom portion teaches the facts and the lab applies them by using techniques that are common in real-world industrial settings. The laboratory portion is significant for two primary reasons: it deepens the students' knowledge and grasp of the material by showing the real-world applications of abstract concepts and it gives the students valuable experience in conducting tests and experiments that are utilized in professional settings.

In its current state, the Lab facility does not allow the lab portion of the course to fulfill this twofold role. As a Mechanical Engineering undergraduate student in the course I have first-hand experience with the current Lab. This semester, three of the eight major pieces of equipment used in the Lab were broken for significant portions of the semester. Of the remaining five machines, one provided very inaccurate results (error of more than 25%), two date from before 1980, and only two machines were fully functional and yielded accurate results. One of the most common phrases uttered by the Teaching Assistants (TAs) when showing students how to use a machine is, “I'll tell you what it should be doing right now…” or “well, we'll have it working by the time you use it.” A detailed evaluation of these
machines follows, along with the steps that should be taken in order to keep the Materials Science course in line with the high standard of academic excellence held at Washington University.

II. Current State of the Lab
The current Lab is composed of several common pieces of materials testing equipment and other sample preparation devices. The main issue with the Lab lies in the fact that the technology and machinery it houses have not been updated in a long time; some machines date back to the pre-digital age as far back as the sixties. Here is a brief run through of the current machinery in the lab, the average accuracy (as compared to standard values of material properties) of the machine obtained from several lab groups, and a description of the issues that arose during use, ordered from best to worst condition. This information on theses eight pieces is summarized at the end of this section in Table 2.1.

The Rockwell Tester is a nondestructive machine used to measure the approximate strength of high strength materials. To do this, the machine presses a small indenting head, usually a ball or pyramid shape, into the sample with a known force and measures the depth of the indentation made. The machine requires the user to simply insert the sample, select the specific test (different tests are used for different types of materials), and press start. The machine did not malfunction and the results obtained had an average error of only 10%.

The X-Ray Diffractometer is a complex apparatus that is used to examine the atomic-level structure of a sample. It irradiates a sample with a beam of x-rays at a specific wavelength and, by rotating a detector around the sample, plots the intensity of x-rays detected over a range of angles. These data can then be used to determine the crystal structure of the sample, calculate the interatomic spacing, and identify unknown samples through comparison with tabulated empirical data. The technology of this machine is highly out-of-date. It runs on MSDOS (the precursor to Windows), requires a floppy disc to transfer data, and takes a long time (at least 30 minutes) to run a test. Despite these limitations, it provided extremely accurate results (2% error) and functioned properly when used.

The Flexural Tester measures the strength and relative hardness of brittle materials. It works by pressing down in the middle of a sample, supported at both ends, until it fractures (imagine
laying uncooked spaghetti across a pot and breaking the noodles in half by pushing down in the middle). The machine in the Lab is up-to-date technologically; however, some pieces are cracked or dented, and several wires are held in place by duct tape. It functioned properly and provided accurate results with only 10% error.

**The Tensile Tester** tests the stress-strain properties of a material by gripping a sample and slowly pulling it apart until it breaks. The tensile testing machine in the lab is slightly older than the flexural tester, likely from the early nineties. It is connected to a computer without an Internet connection or CD-ROM drive. In fact, the only way to transfer data from the computer is with a floppy disc. The data collection itself is run through an Excel Macro, which does not allow much flexibility in the experiment being run and limits the scope of further analysis. One of the two gripping arms of the machine is broken while the rest of the machine is intact. This semester, it provided fairly accurate results with approximately 20% error.

**The Vicker’s Microhardness Tester**, like the Rockwell tester, tests the surface hardness of a material by forcing an indenting head into a sample; however, it can be used on much harder materials because it can make and measure much smaller indentations. To conduct a Vicker’s test, the user must first mount the sample in a clay mold, to ensure a flat mount, and then place it on the stage beneath the microscope lenses. The surface of the sample is brought into focus and the indenting process is started. Next, the user manually measures the surface indentation by aligning two sets of parallel lines with the image seen in the microscope lens. The Vicker’s tester in the lab is quite old, is technologically dissimilar to modern machines, and is highly susceptible to human error. It provided inaccurate results with error values in excess of 50%.

**The IZOD Tester** is used to measure the *impact energy*, the energy absorbed by the material when a large and focused load fractures it, of low strength materials. It functions by simply raising a wedge shaped pendulum to a certain height and dropping it, allowing it to swing down and break the sample in half. The IZOD tester is from the late eighties. It provided
fairly accurate data (around 20% error) and functioned properly, but does show signs of heavy wear such as scratches, dents, and faded energy scale labels.

*The Charpy Tester* is another impact energy tester, like the IZOD, that is used for high strength materials. The main difference is in the weight of the pendulum and the length of the pendulum arm, giving the Charpy tester a much more energetic collision. The machine is from the late sixties and does not function well. In my class, it broke midway through the experiment and the partial data that was collected was too inaccurate to analyze, forcing the TA to provide data from a previous year in order for students to complete the write-up.

*The Sample Mounter* is a device used to mount metallic samples into a resin mold for analysis under a microscope or similar device. The user places the sample in the bottom of a chamber and fills the rest with Bakelite pellets. The device then applies heat and pressure to the pellets for several minutes until the sample is firmly mounted in the resin. This device is old, unreliable, and difficult to use.

<table>
<thead>
<tr>
<th>Equipment of Interest</th>
<th>Is it broken?</th>
<th>Error of Results</th>
<th>Other Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rockwell Tester</td>
<td>No</td>
<td>10%</td>
<td>Simple, automated testing machine</td>
</tr>
<tr>
<td>X-Ray Diffractometer</td>
<td>No</td>
<td>3%</td>
<td>Runs on MSDOS Old but works well</td>
</tr>
<tr>
<td>Flexural Tester</td>
<td>No</td>
<td>10%</td>
<td>Minor cosmetic issues, duct tape in places</td>
</tr>
<tr>
<td>Tensile Tester</td>
<td>Yes</td>
<td>20%</td>
<td>Data saved to floppy discs One grip is broken</td>
</tr>
<tr>
<td>Vicker’s Tester</td>
<td>No</td>
<td>50%</td>
<td>Tedious to use, very prone to human error</td>
</tr>
<tr>
<td>IZOD</td>
<td>No</td>
<td>15%</td>
<td>Very out-of-date</td>
</tr>
<tr>
<td>Charpy</td>
<td>Yes</td>
<td>25%</td>
<td>From the 1960s</td>
</tr>
<tr>
<td>Sample Mounter</td>
<td>Yes</td>
<td>n/a</td>
<td>Old and unreliable</td>
</tr>
</tbody>
</table>

III. Proposed Upgrades

It is quite clear that the current Lab is in a less than ideal condition. In order to bring the Lab into the twenty-first century and up to the high standard of Washington University, I propose the following
actions to address the current issues. Based on the current state of the machines, I have determined this to be the most cost-effective, economically feasible plan for keeping, fixing, and purchasing equipment in order to update the Lab. The plan is summarized in Table 2.2. [1]

**Machines that do not need to be replaced**

The machines that my investigation has found to not need replacement are the **Rockwell Tester** and the **X-Ray Diffractometer**. A new Rockwell Tester would cost the department $12,000. However, the test has been automated since it was first developed and modern machines are largely identical to the older model in the Lab in all aspects except aesthetics. Since the current machine functions properly, the purchase of a new machine is not pertinent.

The X-Ray Diffractometer is not nearly as up-to-date. Modern machines have many more features, work faster, and are much easier to use, however they cost between $500,000 and $1,600,000. Since the current machine does function properly and this price is far outside the feasible range for this proposal I do not believe the replacement of this machine is either pertinent or economically responsible for the MEMS department.

**Machines needing repair**

The machines that need repair and maintenance, rather than replacement, are the **Flexural** and **Tensile Testing** machines. Purchasing a new machine that could conduct both Flexural and Tensile tests would cost $75,000. However, since these machines are relatively up-to-date, it would be much more cost-effective to repair the current machines rather than purchase a new one. The Flexural Tester only needs minor maintenance to bring it back into full working condition. “Minor” maintenance on these complex machines is still quite expensive, and these repairs would cost around $3,250.

The tensile tester needs a little bit more work, namely, a new upper griping arm and a complete technical overhaul. The arm was damaged several years ago and still can function in gripping a sample although it cannot grip as well as it is intended to and introduces added error to the experiment. It needs to be fixed. The technology of the device is out-of-date as well. Luckily, new technology can be integrated into this type of machine without having to purchase a completely new machine. Necessary

[1] All price figures and estimates were obtained from the manufacturers; see the references section for more information.
Improvements would include purchasing a new computer, a new computer-tester interface, and new data-collection software on the computer. These improvements would cost a total of around $9,000, bringing the total cost for repairs of current machinery to $12,250.\(^2\)

**Machines needing replacement**

The machines for which replacement seems the best option are the Vicker’s Tester, the IZOD and Charpy impact testers, and the Sample Mounter. These four machines can be replaced by purchasing only three new machines, as newer impact testing devices can conduct both IZOD and Charpy tests. These three purchases are detailed below and full specifications for each machine can be found in the Appendix.

*Tucon 1202 Microhardness Tester: Figure 3.1*

This Microhardness tester is a state-of-the-ark automated machine that can conduct both Vicker’s and Knoop Microhardness tests (essentially, it has twice the capability as the current machine). It conducts the tests automatically and can yield much more precise results than the current device. Additional features include automated testing, on-board statistics, USB output, and automatic unit conversions. Purchasing this machine would cost $12,000.

*Figure 3.1: Tucon 1202 Microhardness Tester*\(^5\)

\(^2\) The two estimates for the repairs to the Tensile and Flexural machines may not be completely accurate. They are educated approximations as a real cost could only be determined by having a technician physically inspect the machines and determine what needs to be done.

\(^5\) [http://www.buehler.com/sites/default/files/product-images/IMG_9878_0.jpg](http://www.buehler.com/sites/default/files/product-images/IMG_9878_0.jpg)
**Instron CEAST 9050 Motorized Pendulum Impact System: Figure 3.2**

This impact tester uses a pneumatic hammer to cover the impact energy ranges of both the IZOD and Charpy without the additional mass used in the current Charpy machine. Some key features include a simple computer interface, automated testing, and time-continuous data acquisition (allowing more in depth analysis of impact behavior of materials). Additionally, it is a completely enclosed tester, which prevents the dangerous metal fragments that are launched from the current machines with each test. Purchasing this machine would cost $20,000.

![Figure 3.2: Instron CEAST 9050 Impact System](http://www.azom.com/images/equipments/EquipmentImage_1126.jpg)

**Extec Labpress 40 Pneumatic Mounting Device: Figure 3.3**

This device is similar to the current sample mounter, but it is much more intuitive and technologically advanced. While the old device needed a complex set of directions with 15 steps, this machine is essentially “put in the sample and press go.” It is faster, automated, and it allows for a much cleaner packing and mounting than the current device. Purchasing this, along with a few necessary accessories, would cost $12,750.

![Figure 3.3: Extec Labpress 40](http://www.extec.com/mounting/equipment/labpress-40-fully-automatic-mounting-press/)
This leads to a total cost of purchasing new machines of $44,750 and a total cost of the upgrades, repairs, and purchases, of $57,000 (see Table 2.2).

<table>
<thead>
<tr>
<th>Equipment of Interest</th>
<th>Conclusion</th>
<th>Proposed Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rockwell Tester</td>
<td>Does not need replacement</td>
<td>$0</td>
</tr>
<tr>
<td>X-Ray Diffractometer</td>
<td>Replacement not feasible nor pertinent</td>
<td>$0</td>
</tr>
<tr>
<td>Flexural Tester</td>
<td>Maintenance required</td>
<td>$3,250</td>
</tr>
<tr>
<td>Tensile Tester</td>
<td>Repairs and Technological Overhaul</td>
<td>$9,000</td>
</tr>
<tr>
<td>Vicker’s Tester</td>
<td>Needs replacement</td>
<td>$12,000</td>
</tr>
<tr>
<td>IZOD</td>
<td>Needs replacement</td>
<td>$20,000</td>
</tr>
<tr>
<td>Charpy</td>
<td>Needs replacement</td>
<td>(for both)</td>
</tr>
<tr>
<td>Sample Mounter</td>
<td>Needs replacement</td>
<td>$12,750</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td></td>
<td><strong>$57,000</strong></td>
</tr>
</tbody>
</table>

**IV. Other Benefits of the Upgrades**

There are several benefits of these proposed upgrades outside of the benefits with respect to education, accuracy of data, and the reliability of machines. First of all, newer machines are safer. This was mentioned briefly with the enclosed modern Impact tester, preventing dangerous metal shards from flying through the air, however it is also true of the other machines. Modern machines that can be trusted to work properly have a much lower risk of dangerous malfunctions and also include many more safety features to protect the students in the lab. Second, they will also make the Lab time more efficient as less time is wasted waiting for the TA to figure out how to use and/or fix a certain machine. Third, and perhaps most important, students will take the entire course more seriously if it runs smoothly. When machines don’t work, students begin to regard the class much more casually, interfering with their true understanding and appreciation for materials science. Improving the quality and reliability of the lab equipment would add additional seriousness to the course and further improve the quality of education.
V. Cost Analysis

This rejuvenation of the undergraduate Materials Science Lab would represent a significant investment for the MEMS department. This section will address two primary questions: “Is the investment worth it?” and “what are possible sources of funding in order to offset some of the cost?”

*Is the investment worth it?*

Referring back to the introduction, the role of the lab section of the course is to deepen the understanding of the material and to provide experience and knowledge applicable to a real-world engineering career. The fact is that subpar lab equipment detracts from the learning process by obscuring the connections between theory and practice. Modern and reliable lab equipment enhances the learning process by facilitating a hands-on application of theories and concepts learned in the classroom portion of the course. Additionally, modern engineers use modern techniques, on modern equipment, with modern technology in their day-to-day tasks. Professional engineers do not use the antiquated techniques and equipment that currently is used in the Lab because they are less time efficient and not as versatile. Updating the machines will allow graduating students a significant edge over competing students from other schools when applying for jobs because they would already have experience using these modern techniques. Furthermore, judging from the age of the current machinery, this investment would be long-lasting, and represents an extremely important investment into the educational merit of the MEMS Department that is well worth the cost.

*What are possible sources of funding?*

I propose the main potential source of funding for these updates would be corporate or individual donors. Washington University has raised a significant amount of money through naming opportunities on the South 40 residential, the Danforth University Center, and various benches, windows, and entrances around campus. For example, the cost to have the entrance to Eliot B House named after you is $25,000. Other opportunities cost as much as $2,500,000 with many even bigger locations left “TBD.” While the MEMS Department does not have any opportunities that would likely be able to raise the entire cost at once, three opportunities have potential to raise large portions.

[http://south40initiative.wustl.edu/giving/](http://south40initiative.wustl.edu/giving/)
The first, and most obvious, is the Materials Science Laboratory itself. A corporate or individual donor could likely be found that would be willing to donate a significant amount of money to found the “[Insert Name Here] Undergraduate Materials Science Laboratory.” Also, the Computer-Aided Design lab and the departmental office space are unnamed, other potential sources for sponsors. These opportunities, combined with simple generosity on the part of Alumni, friends, and interested corporations could cover a significant portion of the cost of the upgrade.

VI. Integration of Upgrades Into the Course Structure

In order to maximize the impact of these upgrades, the course itself must be altered to best utilize the benefits of the new machines. One common argument against modernization and implementing automated devices into educational laboratories is that older machinery forces the student to do more of the hard work and yields a deeper grasp of the underlying concepts. Conrad Wolfram, the cofounder of the Wolfram family of computational software, addressed this argument in a TED talk on Mathematics Education in 2010:

What we’ve crucially got to do is to separate what we’re trying to get done from how it gets done. Now early on for cars, a hundred years ago, it was true that the mechanics of a car were pretty closely associated with driving it. There was no automation between, so you kind of had to be a mechanic to drive a car. But that’s long since changed and now the subject of driving is totally different than the subject of car mechanics. They got completely separated.

What we need to do is get people experience in what they’re actually trying to do.

If you want to go drive a car, it’s good to get experience in driving a car. That’s different from experience in maintaining the car…

When the automation gets good, you can go much further by doing it on the machine with a computer than you can by hand, and the subject of the mechanics of calculating becomes a distinct subject from using, applying or doing math. 

In a similar way, modern automation in materials testing and laboratory methods can help give a student greater experience in what actually matters rather than getting bogged down with mechanical difficulties and the antiquated “car mechanics” of materials science. This would allow students to go further into the material with the updated machines and separate the mechanics of the machine operation from the actually subject of using, applying, and understanding materials science.

As such, the structure of the course must be altered to accommodate this additional automation. Because the tests themselves will take less time to run, additional and/or more complicated procedures could be implemented without extending the lab time. The Materials Science faculty members could also spend some time with the current curriculum, the new machines, and the TAs in order to develop new strategies and techniques to fully utilize the new capabilities.

VII. Conclusion and Recommendations for Action

The current state of the Materials Science Laboratory at Washington University is not where it needs to be. Something should be done in order to maintain the high standard of the MEMS Department, the Engineering School, and Washington University as a whole within the international engineering community. I recommend the upgrades listed above in order to update the Lab, namely, the repair of two machines and the purchase of three new machines with a total estimated cost of $57,000. A good first step for this process would be bringing in a technician to evaluate and provide accurate cost estimates for the necessary repairs to the Tensile and Flexural testing machines. In order to integrate the upgrades into the coursework, a reexamination of the Materials Science (MEMS 361) course structure and curriculum should accompany these improvements. Although this would represent a significant financial investment in a time where financial responsibility is pertinent, it is necessary to ensure a complete grasp of the underlying principles and practice of Materials Science for undergraduate students and provide them every opportunity to use real-world machinery while in school, before entering the work force. There are also many possible sources of funding for the project, the most promising of which would be naming opportunities for specific MEMS Departmental spaces, including the Lab itself. These sources of funding make this upgrade a feasible project for the near future of the MEMS department at Washington University.
VIII. References and Acknowledgements

[1] The following individuals were extremely helpful in providing advice and pricing information for the products and services listed above

<table>
<thead>
<tr>
<th>Shaun Potts</th>
<th>Bill Heideman</th>
<th>Andrea S. Rinaldi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instron Engineering</td>
<td>Berg Engineering &amp; Sales</td>
<td>Extec Inc.</td>
</tr>
<tr>
<td>(781)-254-4972</td>
<td>(847)-577-3980</td>
<td>1-860-741-3435</td>
</tr>
<tr>
<td><a href="mailto:shaun_potts@instron.com">shaun_potts@instron.com</a></td>
<td><a href="mailto:BHeideman@BergEng.com">BHeideman@BergEng.com</a></td>
<td><a href="mailto:arinaldi@extec.com">arinaldi@extec.com</a></td>
</tr>
</tbody>
</table>

[2] In order to determine the true cost of the proposed repairs on the Flexural and Tensile testing machines, a technician would need to be called to inspect the current machines.

[3] The information about naming on the South 40 was obtained through the South 40 Initiative website: http://south40initiative.wustl.edu/giving/


Full Video: http://www.youtube.com/watch?v=60OVlfAUPJg

General background information on Materials Science as well as the function of the machines used in the lab was obtained through the Course, taught by Dr. Shankar Sastry, as well as the following textbook.


Image Sources


IX. Appendix

Attached are the full specs for each of the three new machines mentioned in this report.

The Tukon 1102 & 1202 Knoop/Vickers Series Hardness Testers offer a versatile and user friendly solution for a wide range of micro-hardness scale testing. For single scale micro-hardness testing, the Tukon 1102 Tester is equipped with a three position turret which includes one indenter position as well as a 10x and 50x objective. For more demanding applications, the Tukon 1202 Tester is equipped with a six position turret, including two indenter positions as well as 5x, 10x and 50x long working distance objectives. Both units include USB output, eight dial selectable test forces and an innovative touch panel user interface for rapid test method handling and data collection.

Optional Hi Res CCD camera system can be integrated inside the frame - no visible wires

8 dial selectable test forces ranging from 1.0 grams - 1 kg (2 kg optional)

Motorized 3 position or 6 position turret with “Shortest Path” program logic control.

High quality long working distance objectives providing maximum specimen clearance

LED specimen Illumination

Smart UI: Intuitive touch screen interface with hard key buttons for system control

USB output for easy data-export

Applications

- Effect of heat treatment
- Hardness depths of carburized layer
- Steels, non-ferrous metals, IC wafer
- Metallic foils, platings, coatings, surface layers, laminated metals
- Ceramics, steels, non-ferrous metals
- Thin plates, metallic foils, plating, miniature objects
- Hardness resulting from welding or deposition

www.wilson-hardness.com
CEAST 9000 Series Specifications

<table>
<thead>
<tr>
<th></th>
<th>CEAST 9050 Manual</th>
<th>CEAST 9050 Motorized</th>
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</thead>
<tbody>
<tr>
<td><strong>Hammer Energy Range</strong></td>
<td>J ft-lb</td>
<td>J ft-lb</td>
</tr>
<tr>
<td></td>
<td>0.5 - 30, 0.37 - 35.9</td>
<td>0.5 - 30, 0.37 - 35.9</td>
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<tr>
<td><strong>Hammer Release</strong></td>
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<td>Manual (Pneumatic Optional)</td>
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<td><strong>Hammer Braking</strong></td>
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<td>Manual</td>
</tr>
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<td><strong>Hammer Recovery</strong></td>
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<td><strong>Hammer Identification</strong></td>
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<td>Automatic</td>
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<td><strong>Electrical Supply</strong></td>
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<td>100 - 240 V 50 - 60 Hz, 100 - 240 V 50 - 60 Hz</td>
</tr>
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<td><strong>Compressed Air Supply</strong></td>
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<tr>
<td><strong>Machine Dimensions</strong></td>
<td>(w x d x h)</td>
<td>mm in</td>
</tr>
<tr>
<td></td>
<td>1005 x 480 x 1100</td>
<td>1025 x 520 x 1100</td>
</tr>
<tr>
<td><strong>Machine Weight</strong></td>
<td>kg lbs</td>
<td>220 (130 with 50 J Plate), 480 (175 with 50 J Plate)</td>
</tr>
<tr>
<td></td>
<td>270 (180 with 50 J Plate), 656 (320 with 50 J Plate)</td>
<td></td>
</tr>
<tr>
<td><strong>Safety Guards</strong></td>
<td>-</td>
<td>Standard (Full Enclosure Optional)</td>
</tr>
<tr>
<td></td>
<td>Full Enclosure</td>
<td></td>
</tr>
</tbody>
</table>

CEAST 9050

The CEAST 9050 is an advanced pendulum tester that performs uninstrumented to semi-automatic instrumented tests. Hammer energies range from 0.5 - 30 J (0.37 - 35.9 ft-lb) and are available for Charpy, Izod, Tensile Impact, Syritat, and Pipe testing standards.

Standard features include:
- Monolithic cast iron frame
- Intuitive touch panel operation
- Automatic hammer identification and verification
- Angular encoder measuring ±0.05° resolution
- Quick-change hammers and specimen supports
- Hammer disc brake system

Optional features include:
- Increased height safety enclosure for Manual Model
- Slip ring and Trigger for instrumented hammer data acquisition
- Accessories to facilitate operations

Tests to the following standards:
- ISO 179
- ASTM D6110
- DIN 51453
- EN 286
- ASTM D256
- ISO 2247
- ASTM E22

Manual Model

The CEAST 9050 manual model has manual hammer repositioning and disc braking. The hammer release has a two-handed operation that is standard but can be specified as pneumatic.

Features

Standard Safety Guards
A fully protective safety guard on both sides of any pendulum version allows safe operation according to the compulsory CE directive.

Hammer Brake System
The hammer disc brake is characterized by a double braking surface that assures high-braking torque with low effort and smooth operation, even for the heaviest hammers. The brake is manually operated on the Manual Model or pneumatically operated in the Motorized Model.

Hammer Angle Measurement
Using a non-contacting magnetic encoder allows for virtually zero friction and a resolution of 0.05°.

Hammer Identification System
This system automatically recognizes the mounted hammer and retrieves all the relevant data (code, test standard, nominal energy, and impact speed) from the internal database. Repetitive data input and the risk of error is completely eliminated.
Motorized Model
The CEAST 9050 motorized model is equipped with a pneumatically-operated hammer release and disc braking system that is standard. The hammer repositioning eases use and increase the output in tests. A data acquisition trigger is included.

Touch Panel
A high resolution 6.5-inch color display with touch-screen technology allows the most flexible and intuitive use of the instrument.

Embedded-PC Technology
Allows an Ethernet connection to PC Networks (LAN), data exchange through a removable USB stick, and direct printing on standard USB printers.

Quick Change Hammers
Equipped with an ergonomic quick-change mechanism, the hammers can be easily changed without the use of tools or screws and the innovative wedge system assures a firm fitting.

Quick Change Supports and Fixtures
Through an ergonomic fixing system, vices for all test types, can be easily and quickly changed and positioned.

The Results Are In...
Do you need to know more than the absorbed energy for your pendulum test? Would seeing the load-time curve help understand your results?

Uninstrumented
Uninstrumented pendulum tests provide the energy taken to break the specimen and allow the impact resistance to be calculated. Different materials may have the same absorbed energy while failing in different ways. This information can only be collected by instrumenting your test.

VS

Instrumented
The addition of an instrumented hammer and Data Acquisition System (DAS) allow the engineer to “see” types of information that were previously unknown, including failure type and ductile-brittle behavior. With instrumentation, the load on the specimen is continuously recorded as a function of time and gives a more complete representation of the test than a single energy value collected during uninstrumented tests.
**Extex's Labpress 40** is a new advanced Automatic Mounting Press for compression mounting of material samples in thermosetting resin mounts. The unit has an integral hydraulic pumping system to apply the correct pressure to a range of interchangeable molds.

The Labpress 40 is a compact unit with digital instrumentation for clear display of time and temperature. Both of these parameters can be set to give the required automatic molding cycle. The unit requires only single phase electrical power and a water supply. A water inlet and outlet are located on the rear panel.

The Labpress 40 features a compact lightweight design, integral hydraulic pressurizing system, interchangeable mold sizes in inch and metric diameters, quick and easy mold change.

The hydraulic pressurizing system is contained in the metal cabinet. It comprises a compact hydraulic pump and controller which applies pressure to a mold through an intermediate cylinder. The cylinder acts as an amplification stage so that pressure applied to the mold is adequate to mold all currently used compression mounting materials. A control valve is fitted below the front control panel and can be adjusted for molding a particular resin.

The Labpress 40 can be configured with 1"; 1 ¼"; 1 ½"; 25mm; 30mm; and 40mm mold assemblies.