

Materials Characterization and Testing Capabilities at MRIGlobal

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Background

MRIGlobal is expanding its offerings in the material science testing realm and the purpose of this poster is to bring a broader awareness of our capabilities. Materials science focuses how materials perform and determining the cause of failures when they occur. Modern material manufacturing requires a fundamental understanding of how materials are structured at the atomic and macro scales and its study provides insight on how materials can be improved. From the protective case on your smartphone to the large steel beams comprising bridges, engineered materials pervade our everyday lives and understanding how to test them is paramount to future successes.

Materials Testing at MRIGlobal

While this doesn't encompass all the testing that occurs at MRIGlobal, these items are highlighted to increase awareness of the different types of testing available.

Environmental chambers are used to simulate environmental conditions to determine ruggedness of materials by how they are affected by external forces over short and long periods of time. Historically, we have subjected materials to temperature and humidity extremes, but we recently acquired an accelerated weathering tester to simulate the effects of sunlight, rain, and condensation on the longevity of materials.

The UTM is used for tensile/flexural strength testing of plastics, threads, and elastomers.

Environmental Chamber

The Thermotron environmental chamber is capable of conducting accelerated aging of materials using accurate and precise control of both temperature and humidity. This chamber is 2'x2'x2' and is capable of holding temperature and humidity set points for extended periods of time. The software allows for complex temperature and humidity cycling to better mimic real world conditions and keeps an exportable data log of the exact conditions within the chamber for the duration of the test. Currently calibrated to ISO 9001 standard and is recalibrated yearly.

Table 1. Thermotron Environmental Chamber Performance Specifications

Thermotron Performance Specifications	
Temperature Range	-68°C to 180°C
Humidity Range	10 to 98% RH
Cooling Rate	
180°C to -65°C	72 minutes
71°C to -65°C	54 minutes
85°C to -40°C	32 minutes
Heating Rate	
-65°C to 180°C	43 minutes
-65°C to 71°C	17 minutes
-40°C to 85°C	16 minutes



Figure 1. Thermotron S-Series Environmental Chamber

Q-Lab Accelerated Weathering Tester

The QUV Accelerated Weathering tester is capable of simulating long-term aging of materials caused by sunlight, elevated temperatures, humidity, and rainfall. This chamber is typically used to test the ruggedness of paints, protective coatings on common materials, plastics, fabrics, and anything that would be subjected to consistent environmental effects.

This type of testing does come with potential drawbacks, it is nearly impossible to perfectly replicate the complexity of conditions that a material would be subjected to when left to deal with natural environmental forces. Additionally, in order to accelerate aging, the material is subjected to conditions that it would not necessarily encounter normally (increased irradiance, higher temperatures, etc.). Care must be taken when making a determination of whether the result is indicative of how a material would perform, or if the testing parameters went above and beyond causing reactions that would never occur otherwise. The rule of thumb is that the faster you try to age a material, the lower the likelihood that the data are relevant to real world aging mechanisms. This testing, when done alongside an unaccelerated aging test, can be used to mimic the effects of years worth of environmental effects in a fraction of the time.

Table 2. QUV Spray Specifications

QUV Spray Performance Specifications	
Condensation Temperature Range	40°C - 80°C
Irradiance (W/mm ²)	
Minimum	0.20
Maximum	1.55
Rain Simulation Water Consumption	
Minimum	Variable
Maximum	4L/min

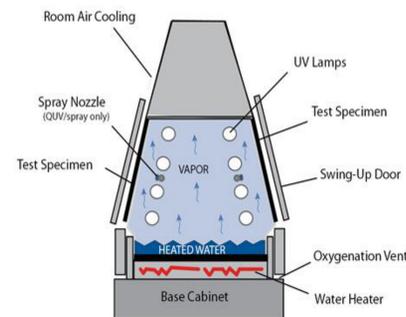


Figure 3. QUV Spray Diagram¹



Figure 2. Q-Lab QUV Spray Accelerated Weathering Tester

References

¹QUV Accelerated Weathering Tester. (n.d.). Q-Lab. Retrieved April 25, 2022, from <https://www.q-lab.com/products/quv-weathering-tester/quv>

Universal Testing Machine (UTM)

The Universal Testing Machine is aptly named due to its wide range of testing capabilities including:

- Tension
- Compression
- Adhesion
- Pull-Out
- Bending
- Hysteresis

UTM is used to test a wide variety of materials like concrete, steel, springs, rope, chains, plastics, etc. and our model can handle materials requiring 100kN of force. Results obtained using ASTM parameters can be compared to published values. Many industries use UTM to determine the quality of their materials and ensure that they meet safety regulations.

Figure 4. Tensile Stress/Strain Curves for Various Aged Materials

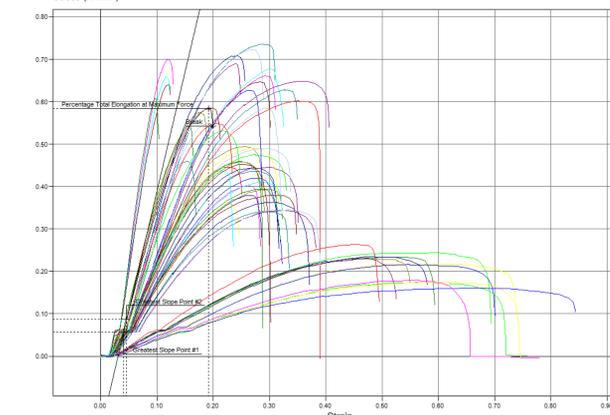


Figure 5. Ametek Lloyd LD100 UTM

Future Prospects

The chambers and UTM expands our opportunities in the defense and commercial spheres. We currently conduct tests for clients that are interested in knowing how their materials will stand up to the elements and this expansion in capabilities allows us to better serve those operational needs.

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