



Collaborative Innovation Forum:
Functional Substitutes to 6PPD in
Tires

Wednesday, December 14, 2022

Laboratory Scale Performance Screening



Physical Testing

Does your product comply with regulations and match consumer expectations? ACE's physical testing capabilities will assure that your final product meets the demands of government regulations, industry standards, and customer-specific protocols.

PHYSICAL TESTING



Analytical Testing

ACE's many analytical test capabilities include specialized equipment and an array of wet chemistry solutions. Looking to outshine competitors but there is no established ASTM standard? ACE offers custom test solutions by creating methods that meet customer-defined applications.

ANALYTICAL TESTING

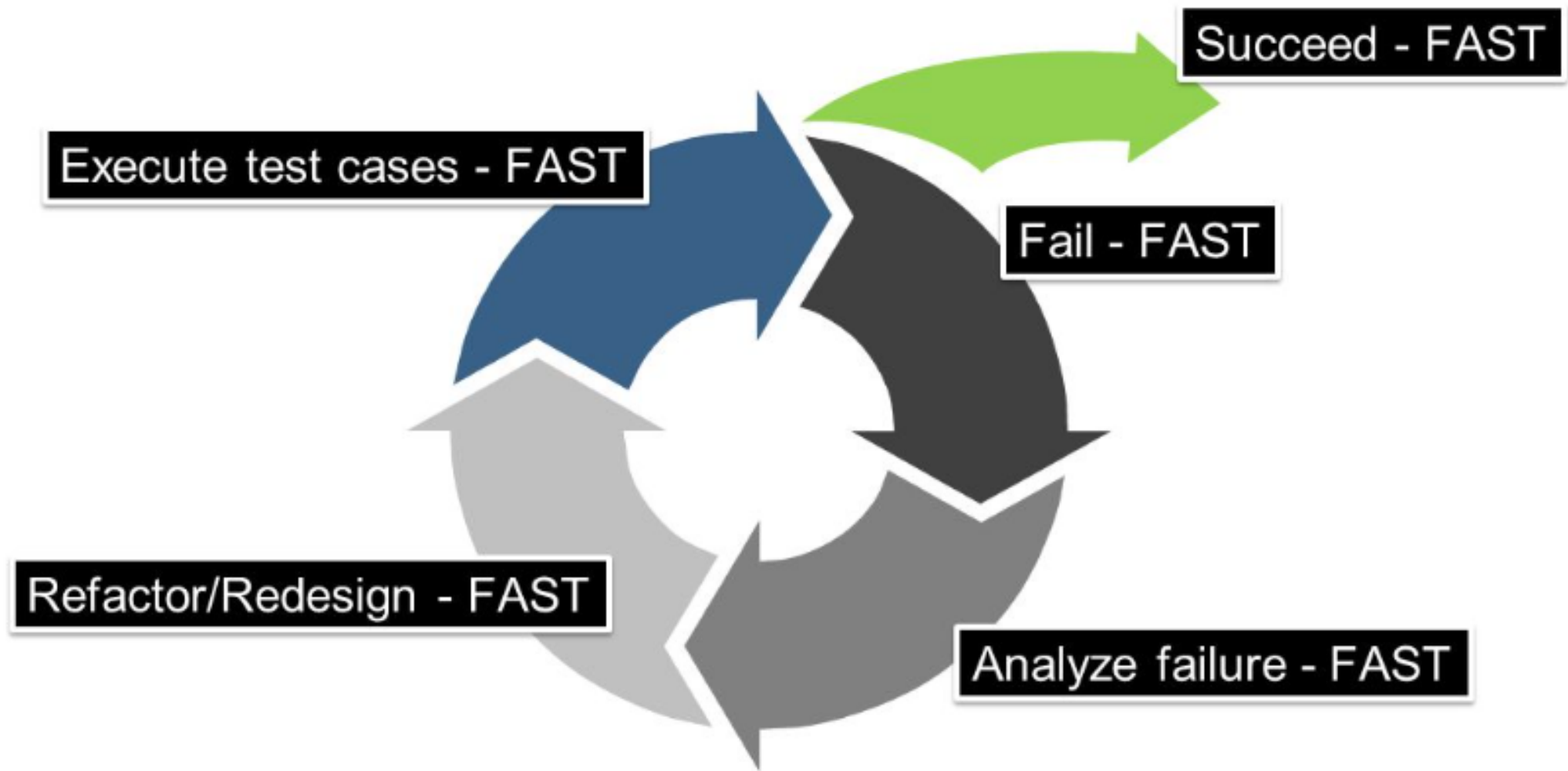


Expert Consulting

A team of agile, highly trained professionals puts ACE in the vanguard of today's most solutions-oriented independent testing laboratories. Our broad scope for research makes ACE a great partner for preserving product integrity in increasingly competitive industries and markets.

CONSULTING

Speed up development



Screening Process

Rheological and Processing

Physical / Mechanical Property

Weatherability / Ozone Resistance

Toxicity

Simulation



ALPHA TECHNOLOGIES

ENV-MULTI-RPA

ALPHA TECHNOLOGIES

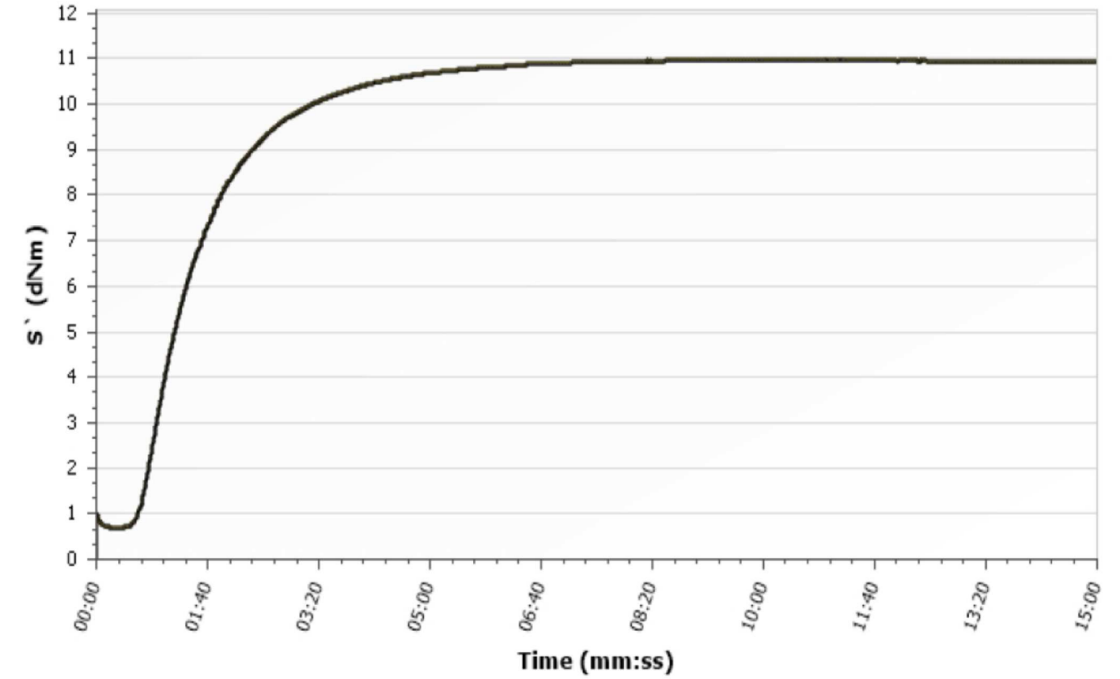
PREMIER-WY

Rheological and Processing



ASTM D5289 – Vulcanization Using Rotorless Cure Meters

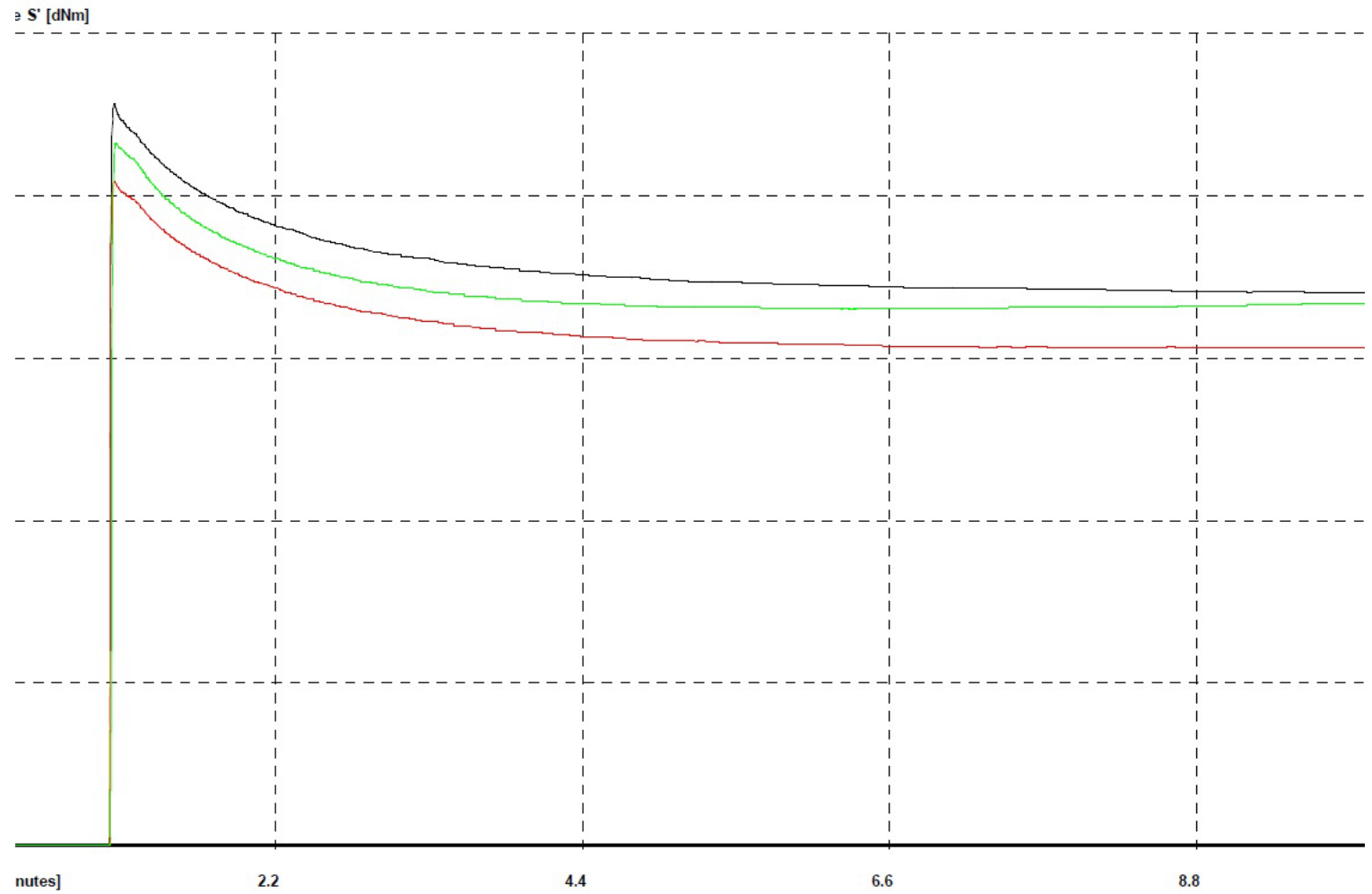
15 minutes @ 100°C



Sample ID	ML (dNm)	MH (dNm)	ts2 (min)	t50 (min)	t90 (min)
Internal	0.70	10.95	0.86	1.34	3.21

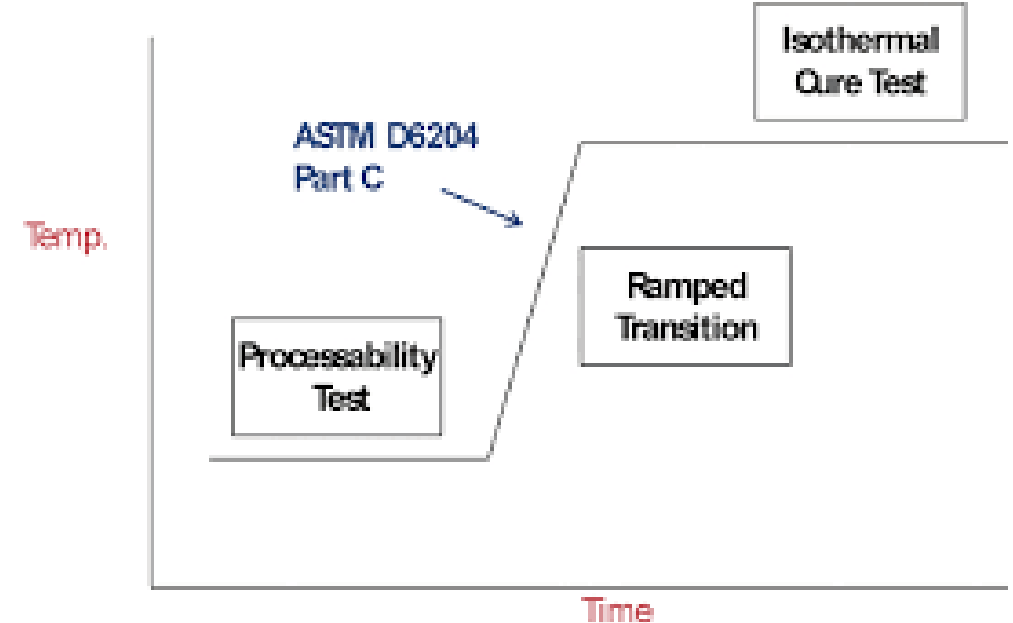
Rheology – MDR (Moving Die Rheometer)

Rheology – Mooney Viscometer



RPA – ASTM D6204

- Processability
 - Raw
 - Uncured
- Test Conditions
 - 4 minute preheat at 100°C
 - Low strain frequency sweep
 - 0.1, 2, and 20 Hz @ 7% strain
 - Correlates to MV
 - High strain frequency sweep
 - 0.1 and 1 Hz @ 100% strain
 - Low Tan Delta = Difficult to work with
 - Mixability for raw polymer
 - Processability for mixed compound





Physical / Mechanical

Physical Testing - Durometer

Durometers measure hardness by the penetration of an indenter into the rubber sample.

Type A (Shore A) the most used method in rubber. However, Types D, M, and OO are often used based on compound.

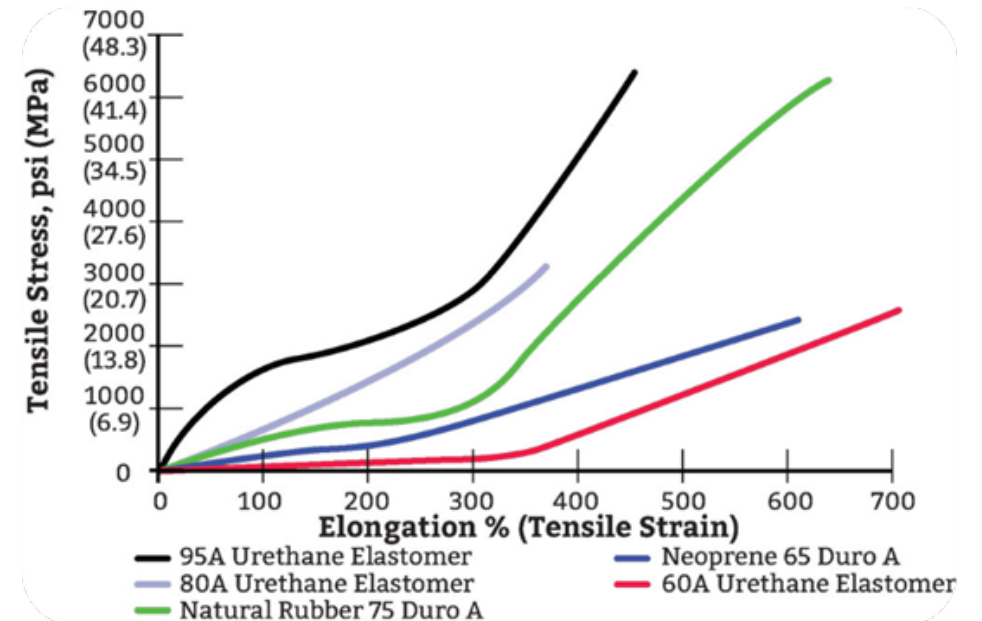
Type A durometers are typically used for softer vulcanized rubber with a durometer hardness of 20-90 A

Physical Testing – Tensile & Elongation

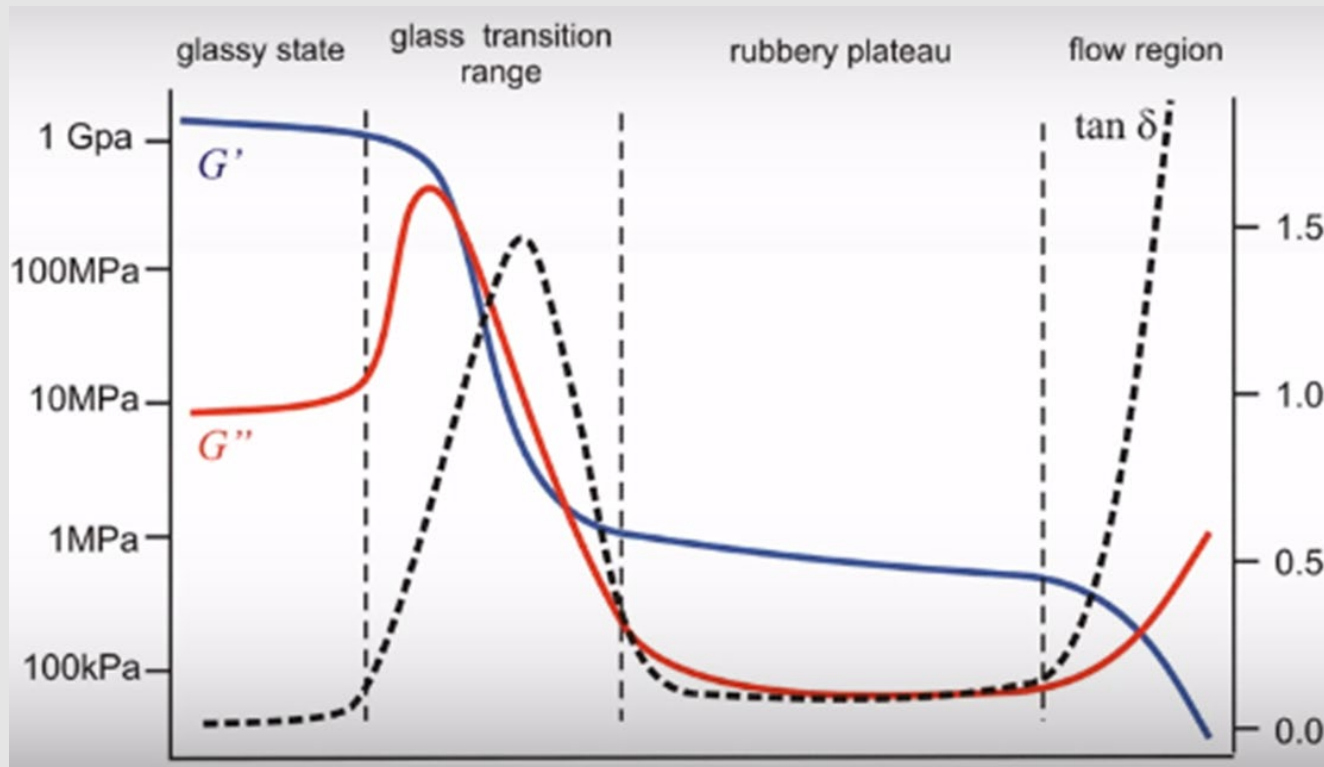
Standard measurement to determine the tensile strength and elongation (aka. Stress / Strain) of an elastomeric compound.

Typical properties observed:
Elongation @ Break (Eb) measured in percent change from original gage length, Tensile @ Break (Tb) strain/force required to break sample. Typically recorded as psi, Mpa, kg/sq cm.

Modulus at 100, 200, 300%, strain at predetermined points during the test, typically recorded in psi, Mpa, kg/sq cm.



DMA as a Predictor



- Common performance predictor in the tire industry.
- Standard test configuration is tension.
- Based on known correlations, rolling resistance, wet traction dry traction and snow traction can be pinpointed in laboratory compounds.
- Rolling resistance – Low Tan Delta at 60C
- Wet Traction – High Tan Delta at 0C
- Dry Traction – High Tan Delta at 10C
- Snow Traction – Low E' at -20C

Abrasion

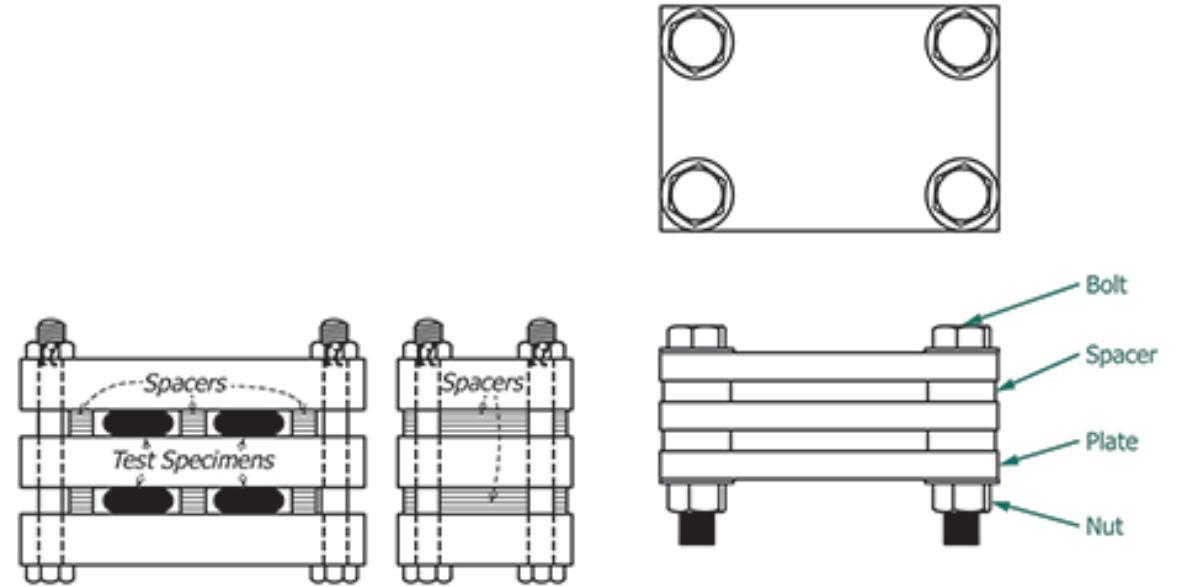
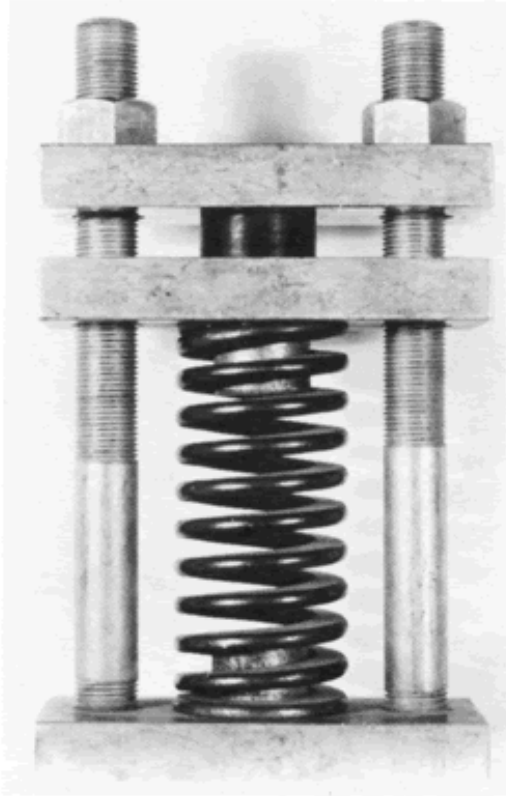
- DIN abrasion measures the volume loss due to the abrasive action of rubbing a test piece over a specified grade of abrasive sheet. The result can be reported as a relative volume loss or an abrasion resistance index





Flex Fatigue

- Fatigue life
 - Fatigue to failure
- Fatigue duration
 - Withstand set cycles
- Crack growth
 - Pierced sample



Compression Set

- ASTM D395 - Constant Force (Method A) or Constant Deflection (Method B)
- Measures the permanent deformation of the material to help understand the elastic recovery of materials

Conditioning – Temperature Aging

- Heat Aged or Accelerated aging is used to predict the relative deterioration or resistance to deterioration and subsequent loss of physical properties.
- Specimens are taken from the same material as used for the original material and aged in a predetermined environment including but not limited to time, temperature and other environmental conditions.
- After completing the physical properties testing of the original materials, specimens cut or sampled from the original material or prepared in the same manner. Initial measurements for thickness, hardness/durometer etc. are taken.
- Samples are aged according to customer request or manufacturer or other specifications. Upon completion of aging specimens are tested and results are compared to properties from original specimens and the changes are reported.

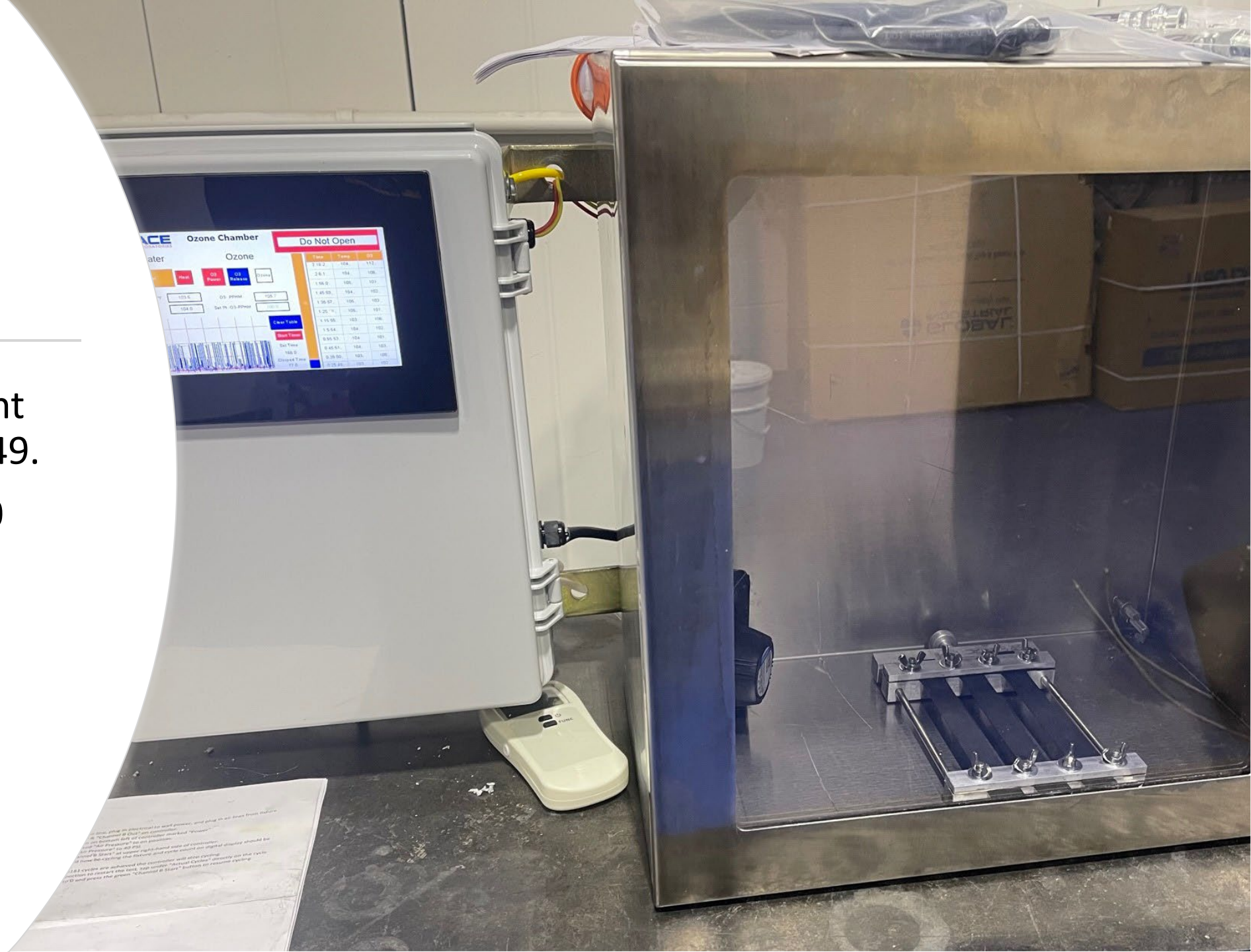


The background of the image is a dark, out-of-focus photograph of a car's wheel and tire. The tire's tread pattern is visible on the right side, while the left side shows the dark, curved shape of the wheel hub and spokes. The overall lighting is dim, creating a moody atmosphere.

Weathering - Ozone

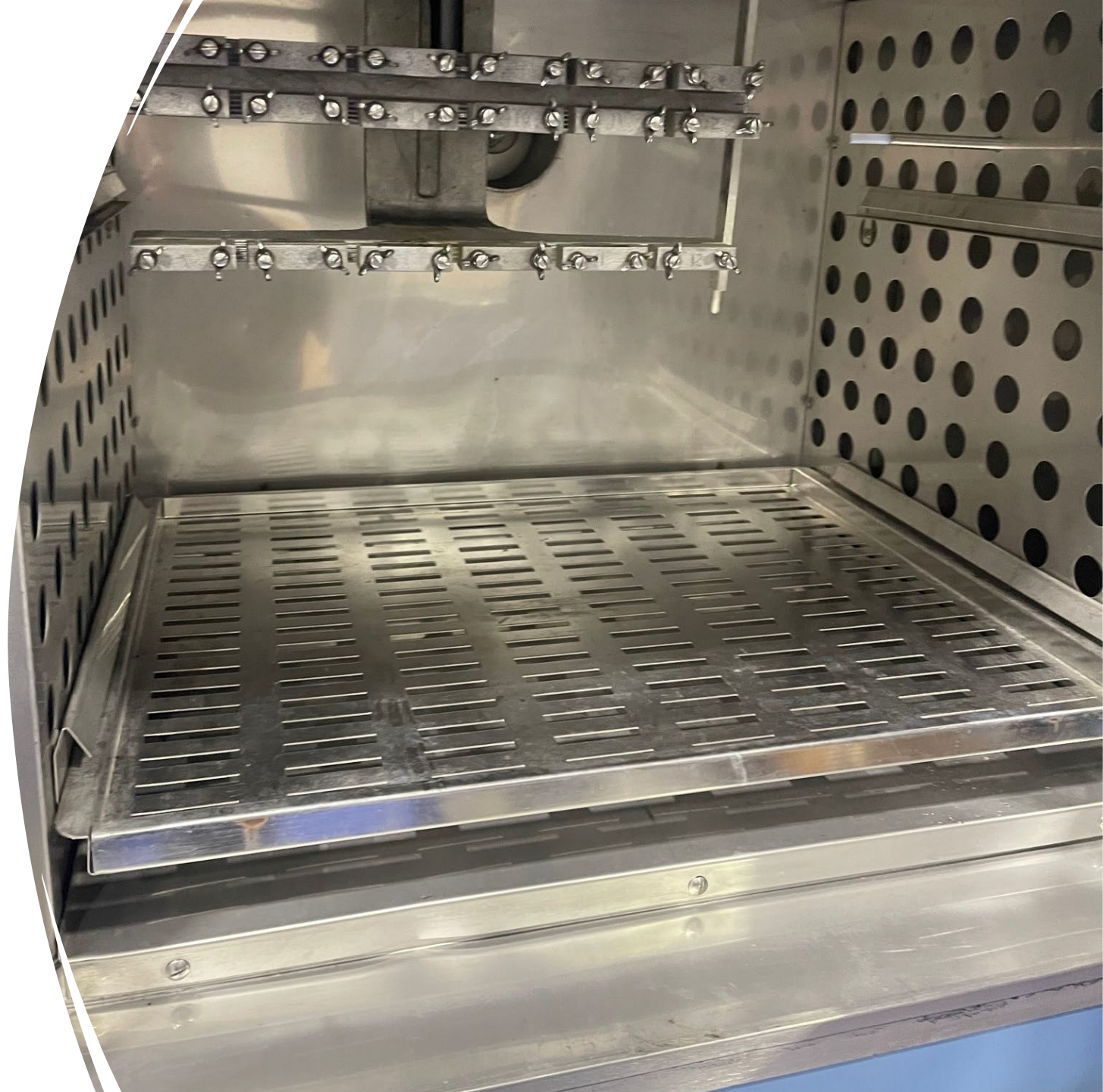
Static Ozone

- Strain (20%) and bent loop per ASTM D1149.
- Up to 70 hours at 50 PPHM and 40C



Dynamic Ozone

- Samples are subjected to a cyclic strain up to 25% at 30 RPM for up to 70 hrs.
- Ozone concentration at 50 PPHM at 40C

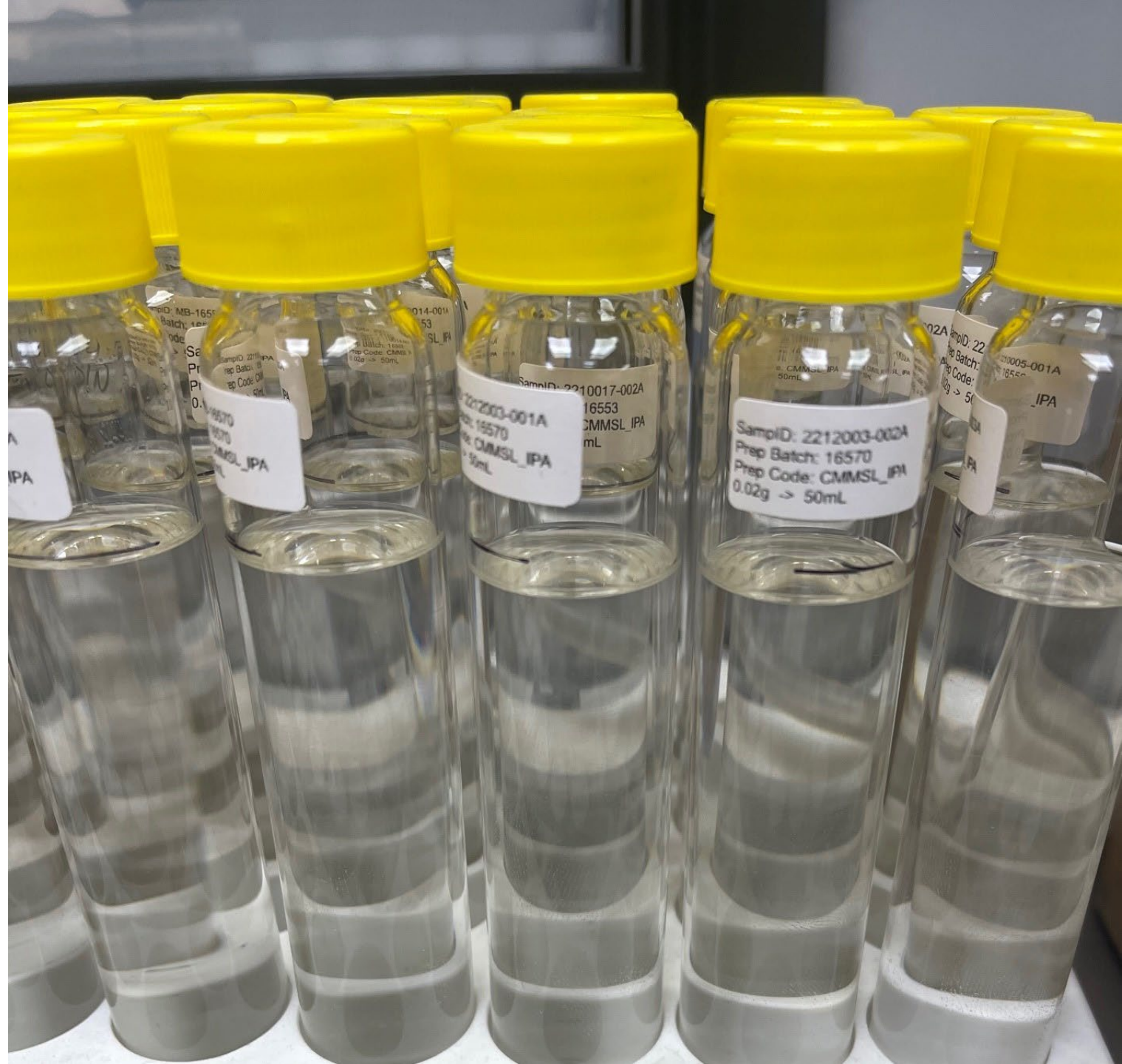




Toxicity

Crumb in Water

1. Crumb particles soaked in water at a 0.01% volume ratio for 3 days.
2. Crumb particles soaked in water at 0.01% volume ratio in open beaker located in ozone chamber
 1. 50 PPHM at 40C for 48 hours
3. Control water samples, standard soaked and ozone soak comparatively analyzed by chromatography for quinone and other leachables.



Water Spray

- Cure plaque conditioned in ozone chamber at 50 PPHM at 40C for 48 hours.
- Samples (3 plaques per variant) sprayed with DI water for 15 minutes.
- Collected water is analyzed via chromatography for quinone and other leachables.





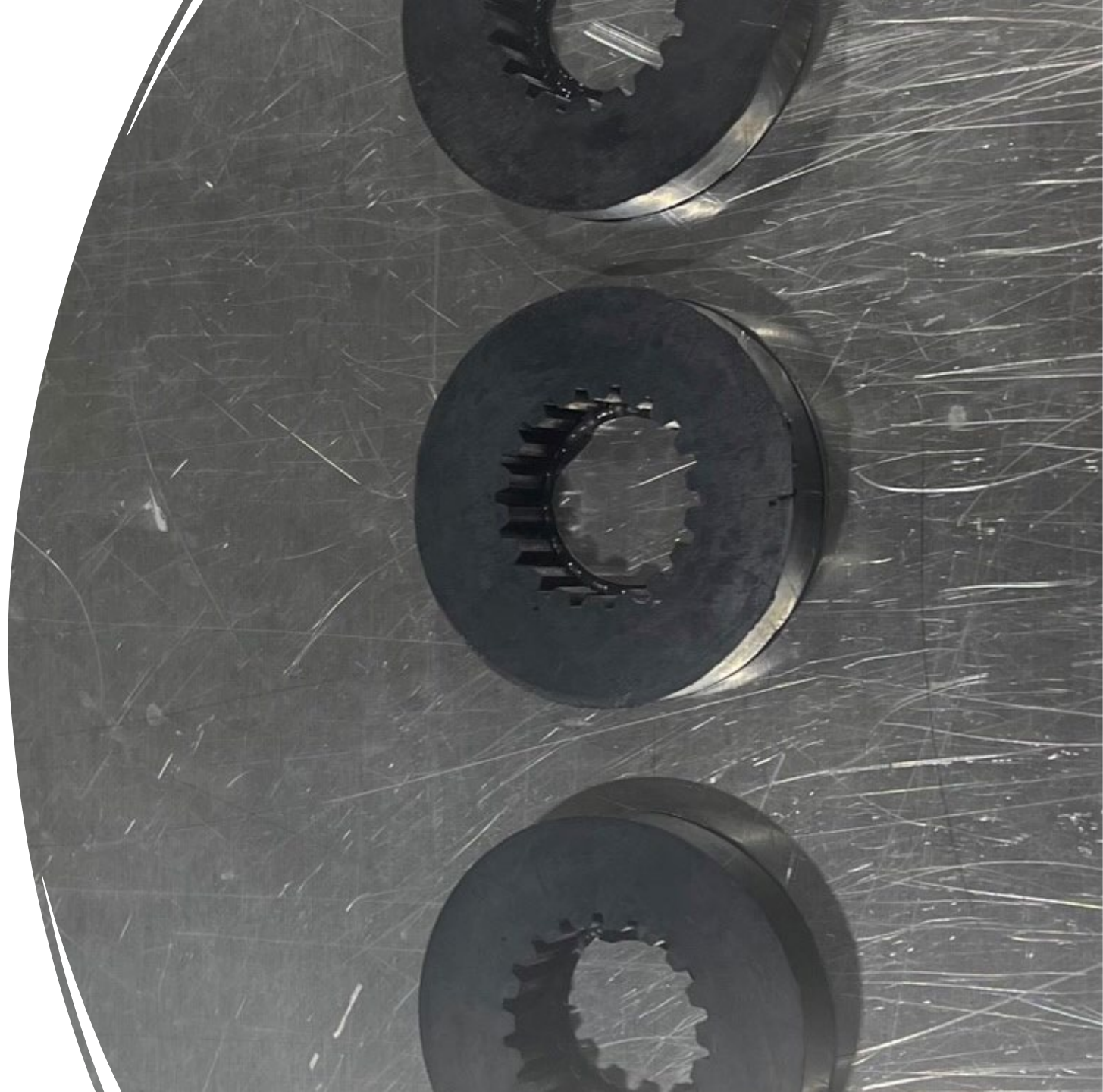
Surface Wipe

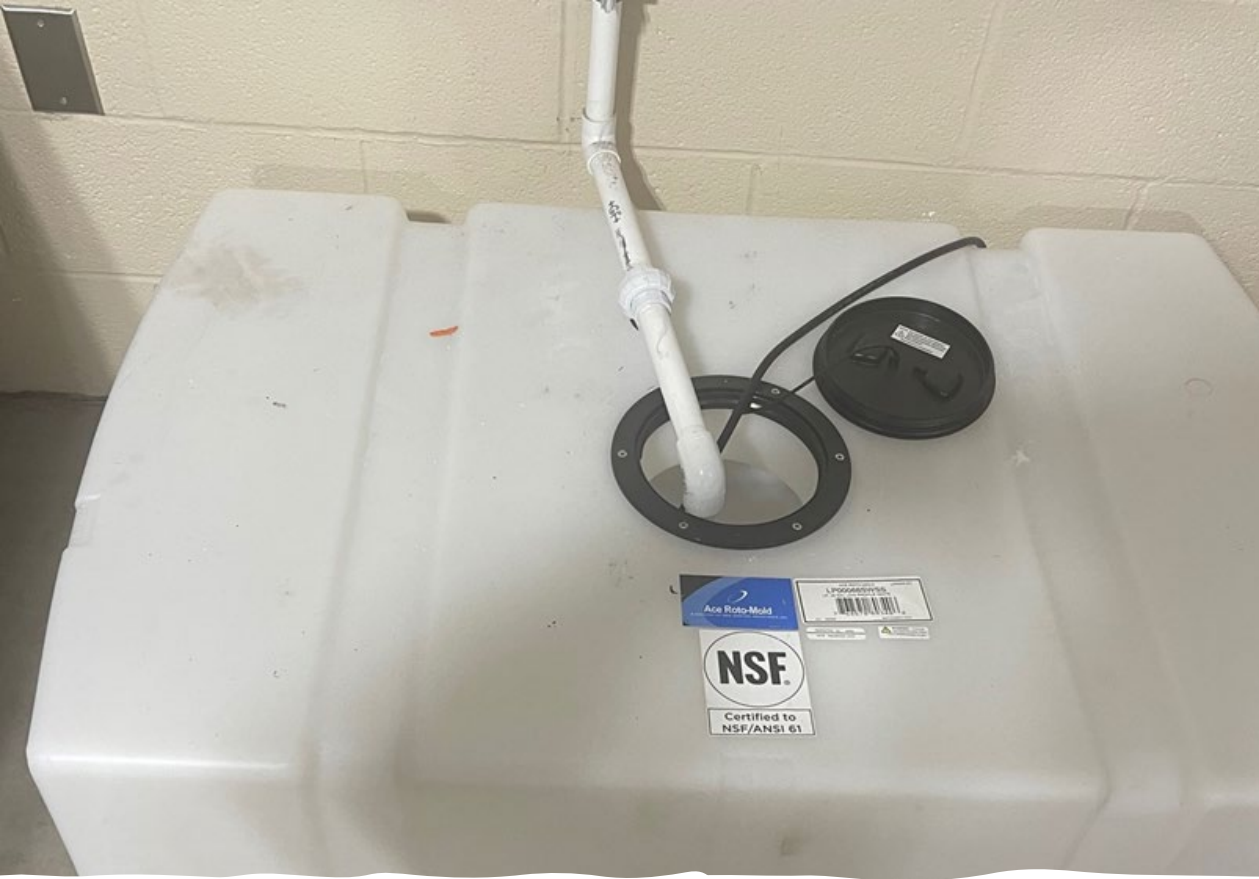
- Cure plaque conditioned in ozone chamber at 50 PPHM at 40C for 48 hours.
- Surface wiped after ozonation and analyzed for quinone and other leachables.



Simulation

- Test wheels molded from experimental tire compounds.
- One control samples is stabilized at lab conditions with the others placed in the ozone cabinet at 50 PPHM and 40C for up to 70 hrs.

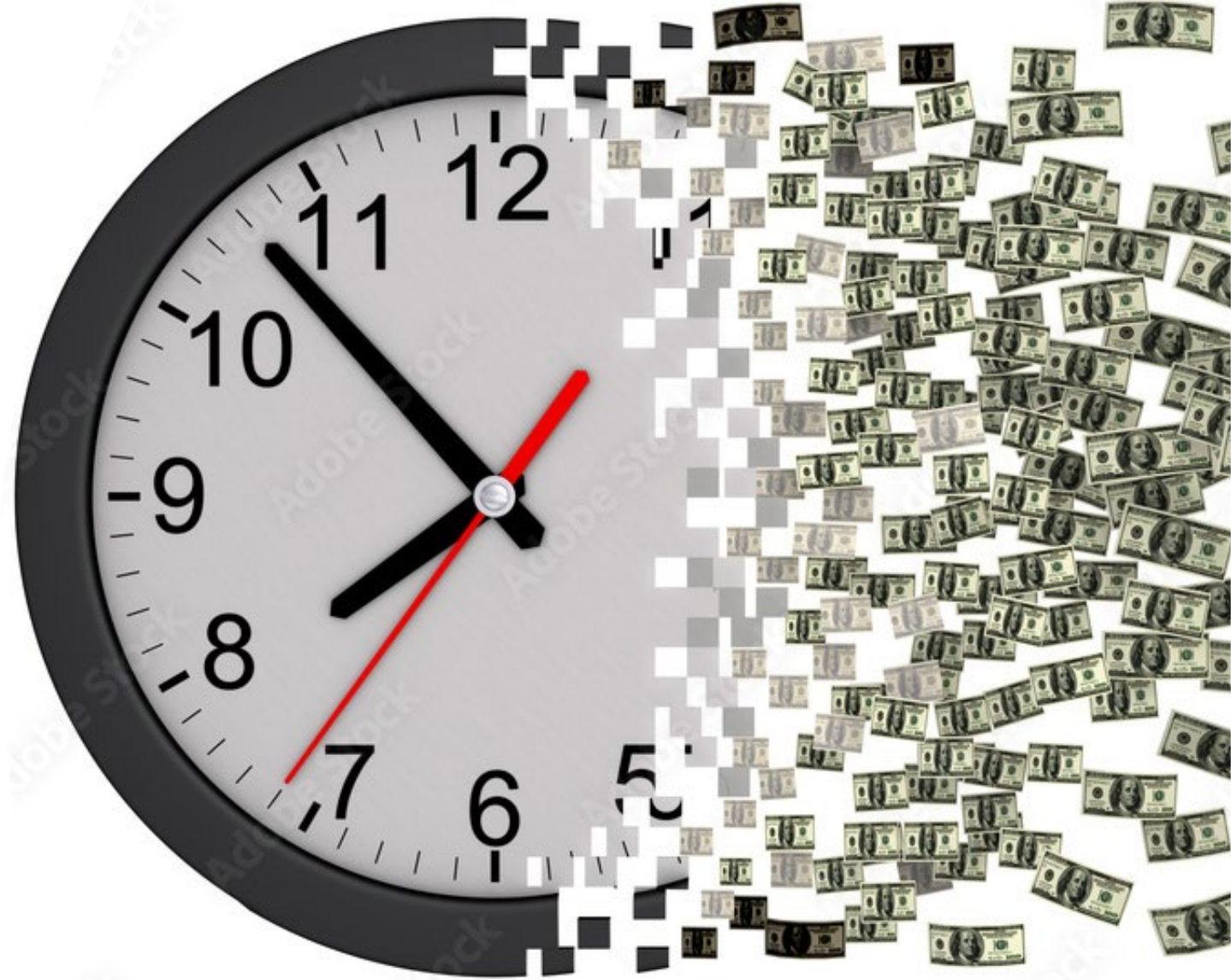




Simulative Test Method

Time is Money

- Lead time to complete a full analysis on a sample set is four weeks.
- Analysis can be done concurrently on multiple sample sets.



Scorecard

- Ranking Score
 - Rheological Changes
 - Processing Rank
 - Standard physical /mechanical testing rank
 - Weatherability rank
 - Toxicity rank

Send us your questions

- Erick Sharp
- ACE Laboratories
- erick@ace-laboratories.com
- Business: +1 330 577 4088
- Mobile: +1 740 630 7539



Rubber Nerds