Motive Lab

All Weather Climatic Chamber and Chassis Dynamometer Test Facility

Vehicle Technology International Conference

Winnipeg, Manitoba

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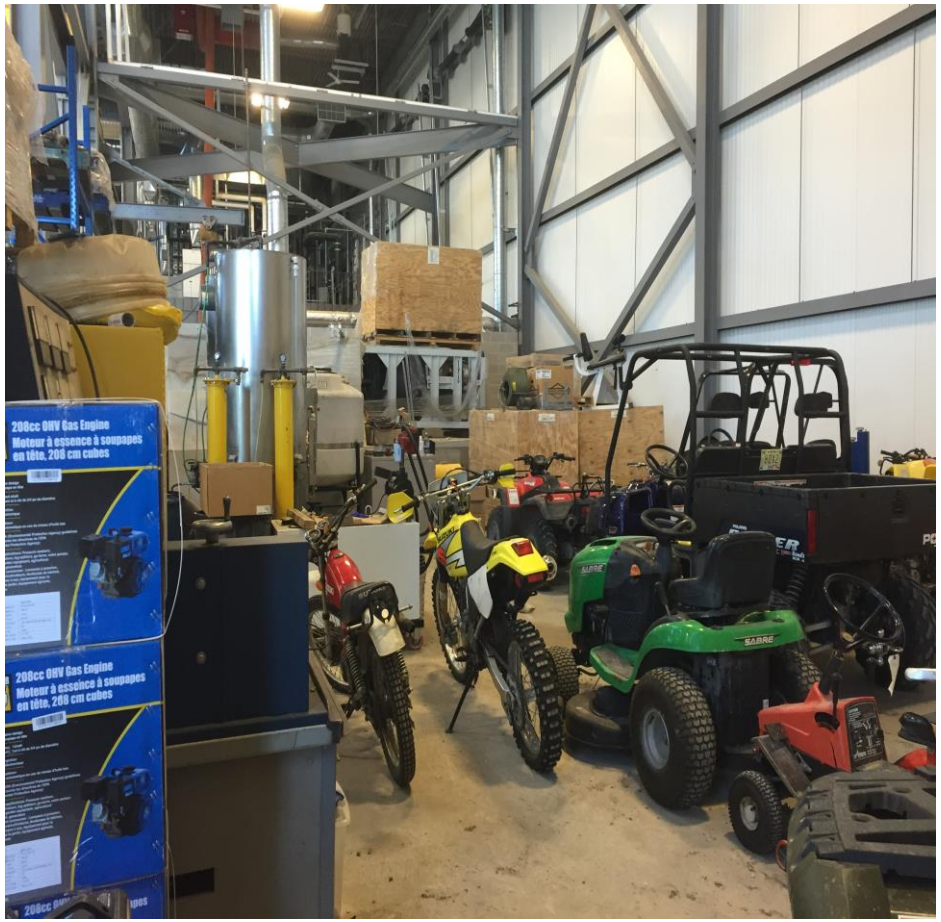
Red River College | Research Partnerships & Innovation

Project Charter



MotiveLab™

- MotiveLab is a 7000 sq. ft. Climatic and Integrated Dynamometer testing facility located at Red River College's Notre Dame Campus, co-located in the Vehicle Technology Research Centre.

- Capable of accommodating large vehicles , E.g. on-highway coach. Overall Chamber room size: 61' Deep, 21' Wide , 17' high. Main Door Size: 13' Wide 14' 7" high

- Two main modes of operation – Closed loop and Open loop

MotiveLab™ - Thermal

- MotiveLab has thermal capability of producing a chamber temperature range of -40^{o}C to 50^{o}C (+/- 1^{o}C) year round.

- In a Static operation (i.e. no additional heat being generated) the temperature can be maintained indefinitely.

- In a Dynamic operation the Chamber can maintain -40^{o}C for up to 15 minutes under a 650 hp load (1.63 M BTU’s).

Main Sceen

Pages | Tools | Alarm

Admin

Start up | Main Screen | Cooling System | MAU | Control Page

WT Mode
OFF | Air Exchange | Closed Circuit | Maintenance

AirTemp Control
OFF | Tank Charging | Auto | No Tank | Use Tank | Charge Tank | Temp Achieved

Make Up Air Mode
OFF | Ambient | Partial Dry | Full Dry

Vehicle Exhaust Control
OFF | Manual

Main Fan Mode
OFF | Slow | Fast
Fan Param

HeatTracing

Purge Outlet Dmp 3
Purge Outlet Dmp 4

Ex Fan Speed
0.0 rpm

Exhaust Gas Temp
27.2 °C

Inlet Dmp 1
Inlet Dmp 2

Air Temp
22.8 °C

Air Temp
23.3 °C

Fan Speed
0.0 rpm

Temperature
22.8 °C

Dew Point
18.1 °C

Dyno Speed
0.5 kph

Air Temp (C)
22.80
45.0 Target
60.00 50.00 40.00 30.00 20.00 10.00 0.00 -10.00 -20.00 -30.00 -40.00

RH (%)
74.61
100.00 90.00 80.00 70.00 60.00 50.00 40.00 30.00 20.00 10.00 0.00

03:10:35 PM 2019-09-16 Test Section North Side Door Open ON
10:53:52 AM 2019-09-12 Test Section Control Room Door Open OFF

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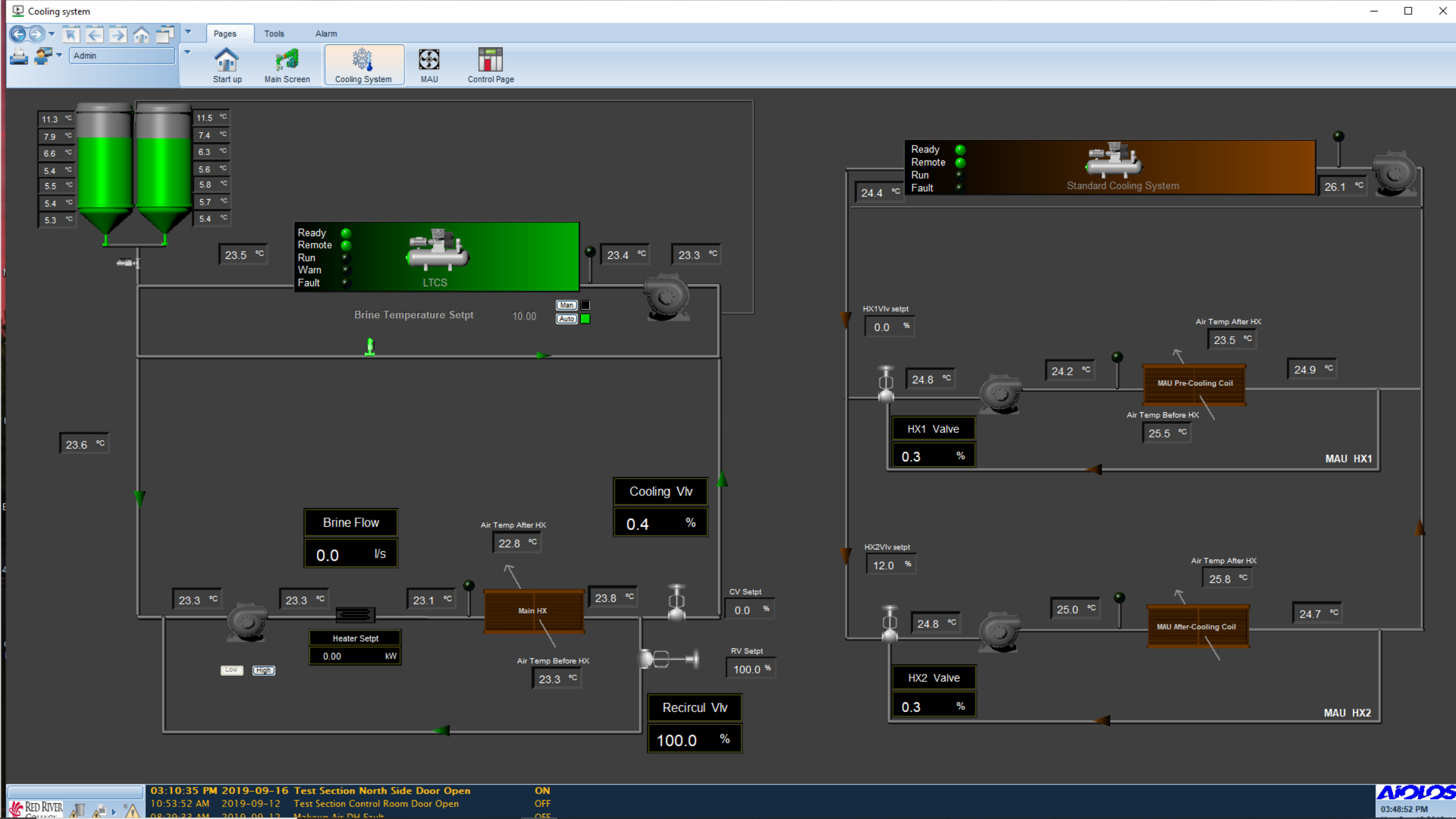
03:47:47 PM

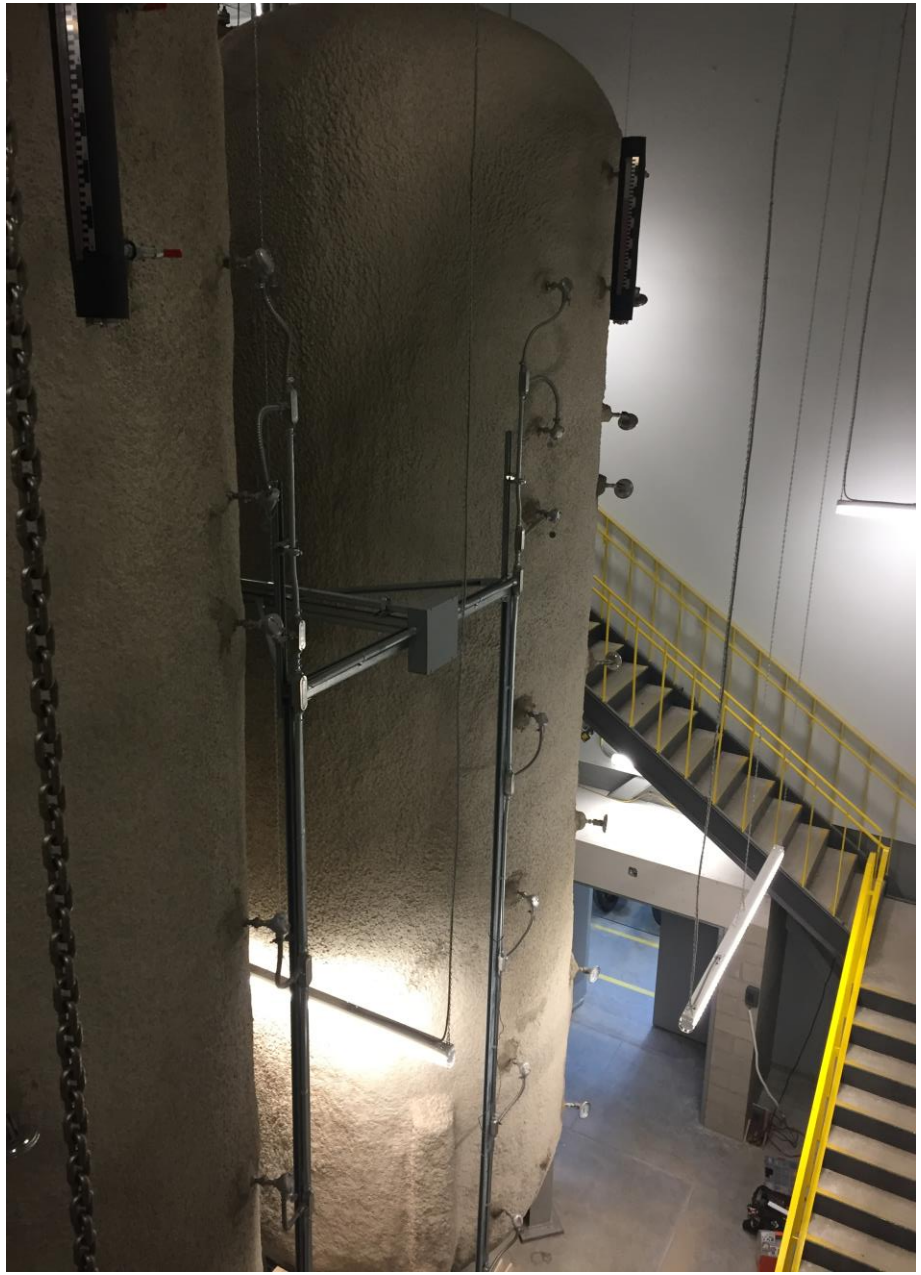

Cooling system
Pages
Tools
Alarm
Admin
Start up
Main Screen
Cooling System
MAU
Control Page
11.3 °C
7.9 °C
6.6 °C
5.4 °C
5.5 °C
5.4 °C
5.3 °C
11.5 °C
7.4 °C
6.3 °C
5.6 °C
5.8 °C
5.7 °C
5.4 °C
23.5 °C
Ready
Remote
Run
Warn
Fault
LTCS
23.4 °C
23.3 °C
Brine Temperature Setpt
10.00
Man
Auto
23.6 °C
Brine Flow
0.0 l/s
Cooling Vlv
0.4 %
Air Temp After HX
22.8 °C
23.3 °C
23.3 °C
23.1 °C
Main HX
23.8 °C
CV Setpt
0.0 %
Heater Setpt
0.00 kW
Low
High
Air Temp Before HX
23.3 °C
RV Setpt
100.0 %
Recircul Vlv
100.0 %
Ready
Remote
Run
Fault
Standard Cooling System
24.4 °C
26.1 °C
HX1Vlv setpt
0.0 %
Air Temp After HX
23.5 °C
24.8 °C
24.2 °C
MAU Pre-Cooling Coil
24.9 °C
Air Temp Before HX
25.5 °C
HX1 Valve
0.3 %
MAU HX1
HX2Vlv setpt
12.0 %
Air Temp After HX
25.8 °C
24.8 °C
25.0 °C
MAU After-Cooling Coil
24.7 °C
HX2 Valve
0.3 %
MAU HX2
03:10:35 PM 2019-09-16 Test Section North Side Door Open ON
10:53:52 AM 2019-09-12 Test Section Control Room Door Open OFF
03:48:52 PM

Outside Winnipeg Temperature June 20th - 28°C

Thermal Equipment Facts

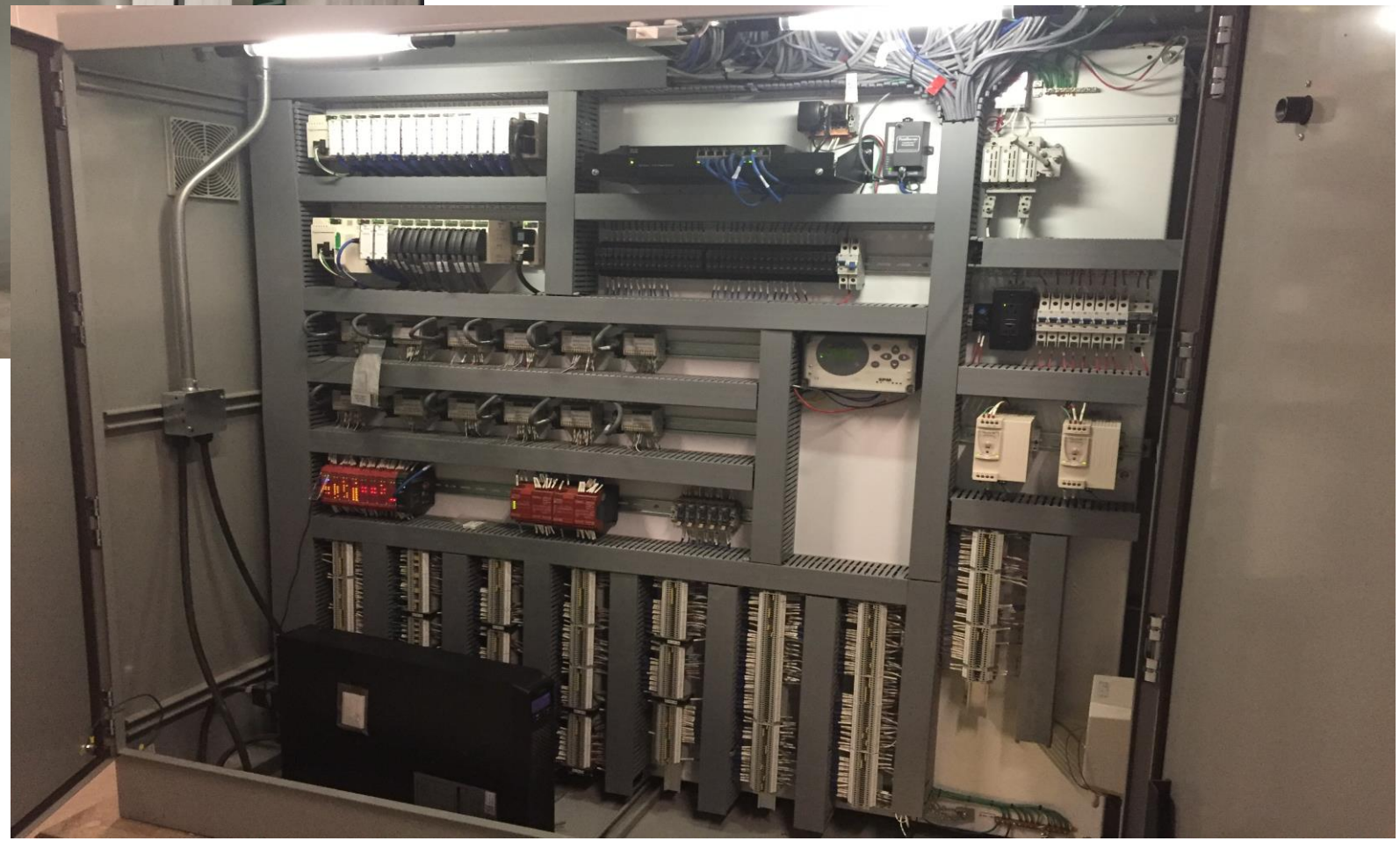
- Low Temperature Chiller:
  - Operating Weight – 34,000 lbs.
  - Size – 247 Tons (Average Home A/C – 2.0 Tons)
  - Refrigerant – RG - 507 (4800 lbs.)
- Brine Tanks:
  - Full Weight – 135,000 lbs. (each)
  - Capacity – 33,000 Liters (each) - Dynalene HC-50
  - Height – 30’
- Main Chamber Fan:
  - Rating - 125 HP
  - Weight – 10,300 lbs.
  - “Wind Effect” – creates 50km/h at full speed within the Chamber
- Main Brine Pumps:
  - Flow Rate – Max 95l/s
  - 100 HP
- Vehicle Exhaust Fan
  - 100 HP
  - Flow Rate – 23731 CFM

Main Chamber Fan



One of 2 Brine Storage Tanks

Make-Up Air Unit



Chamber PLC Control Rack

Main Low Temperature Chiller

MotiveLab™ - Chassis Dynamometer

- Integral 3 Axle Chassis Dynamometer, 2 Stationary Axles (Tandem Axle Configuration), one adjustable.

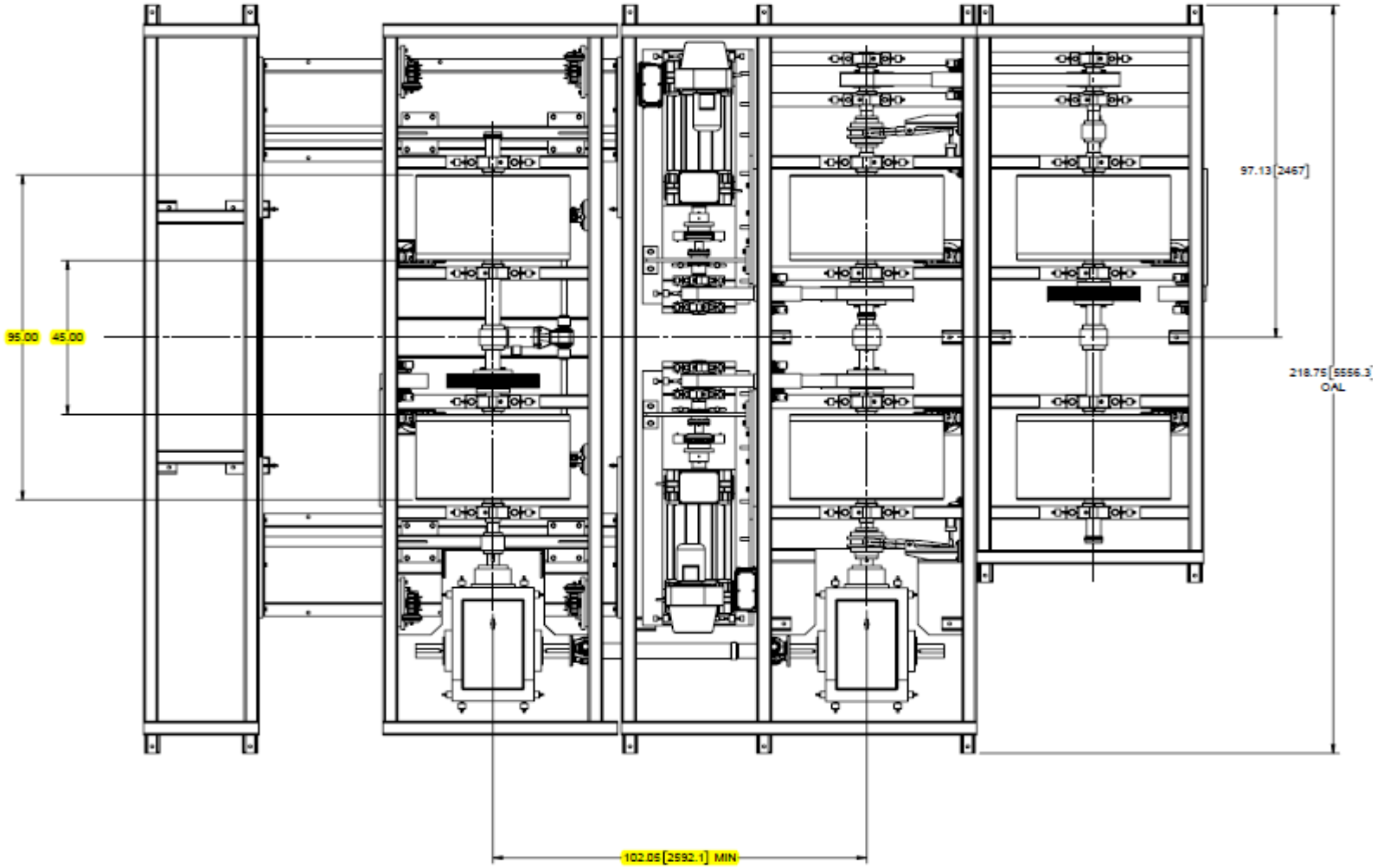
- Capable of 650 HP continuous (to the Rollers) with up to 1800 HP for short durations (E.g. To produce a Torque Curve) .

- Regenerative AC motors, resulting in fast response times and ground topology simulation.

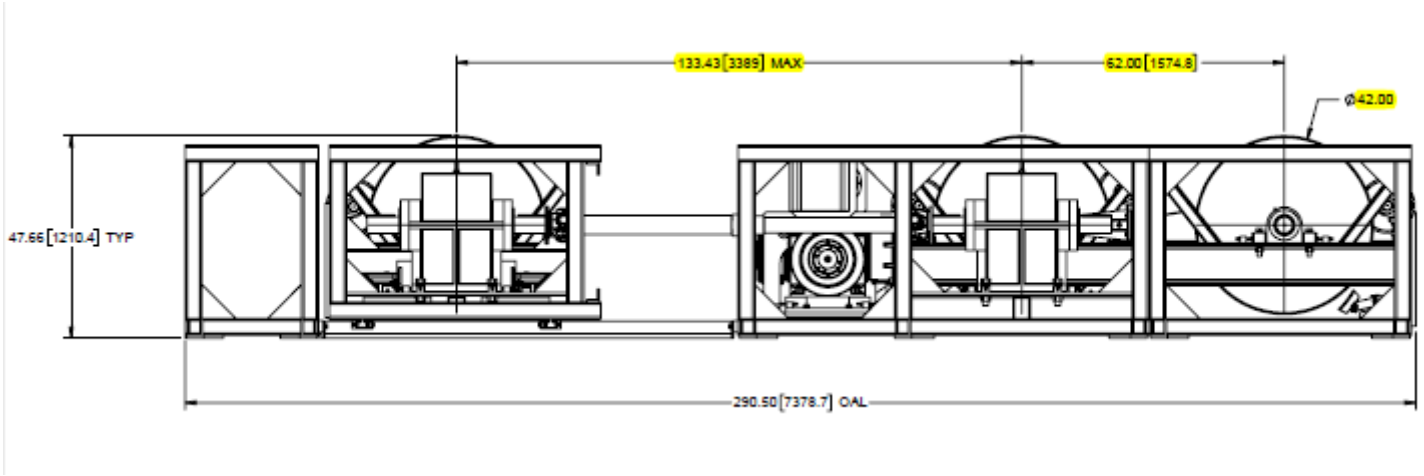
Dynamometer Equipment Facts

- Dynamometer Weight Capacity:
  - Maximum Axle Weight: 30, 000 lbs./Axle
- Axle Spacing:
  - Width: 95” Outside dimension – all three Roller sets
  - Tandem Axles (Center to Center Roller Spacing): 62”
  - Adjustable Axle (Center to Inner Tandem Rollers): 102” to 133”
- AC Regeneration:
  - Dynamometer has the capacity to Regenerate enough Power to run the Dynamometer and Cooling system with minimum Utility Power Draw.
- Resistor Load Bank:
  - Continuous 1.25M BTU’s load dissipation capacity

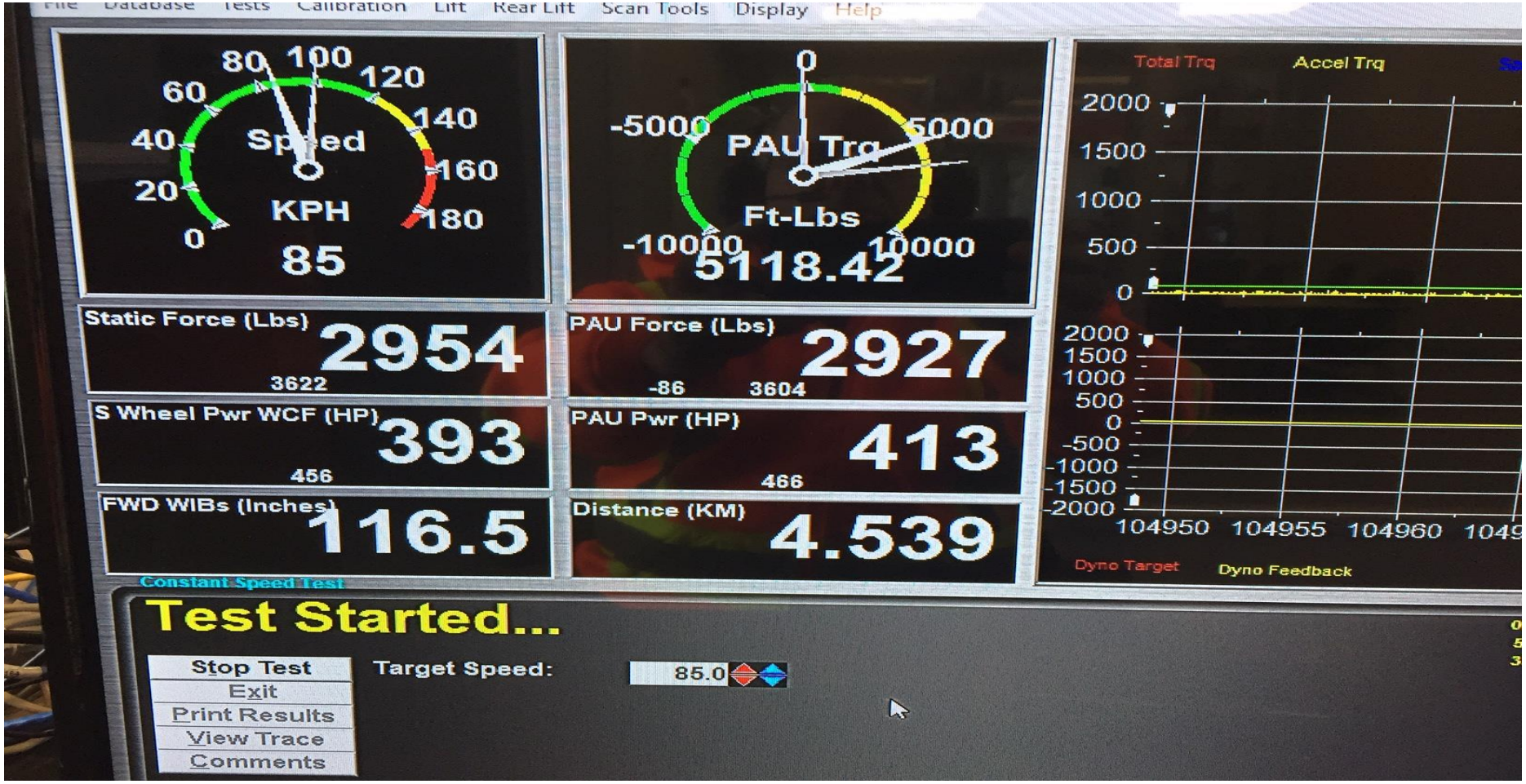
Dynamometer Roller Configuration (Fully Retracted)



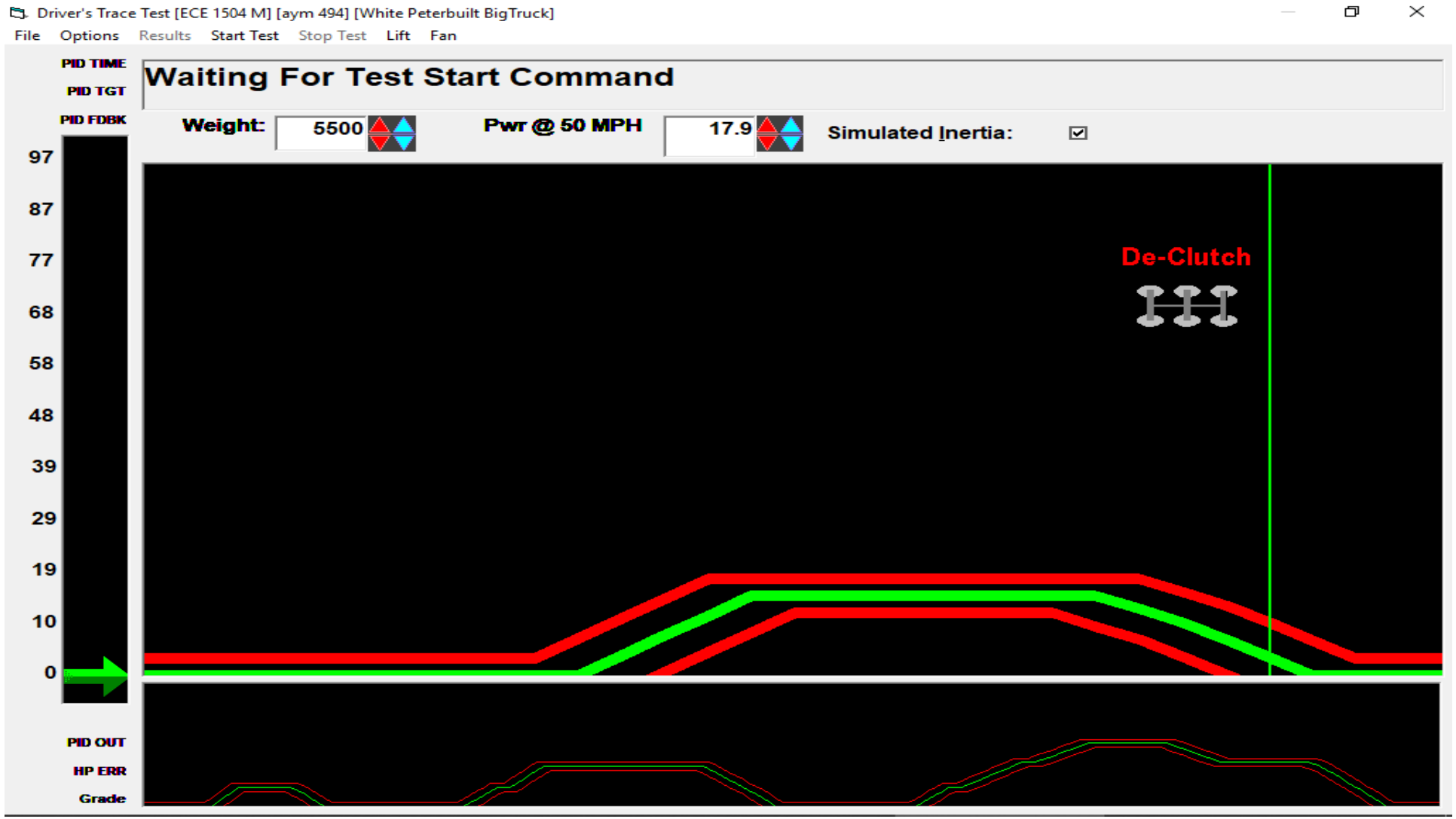
Dynamometer Roller Configuration – Extended



Sample Screenshot for Dynamometer Control



Terrain Profile Example

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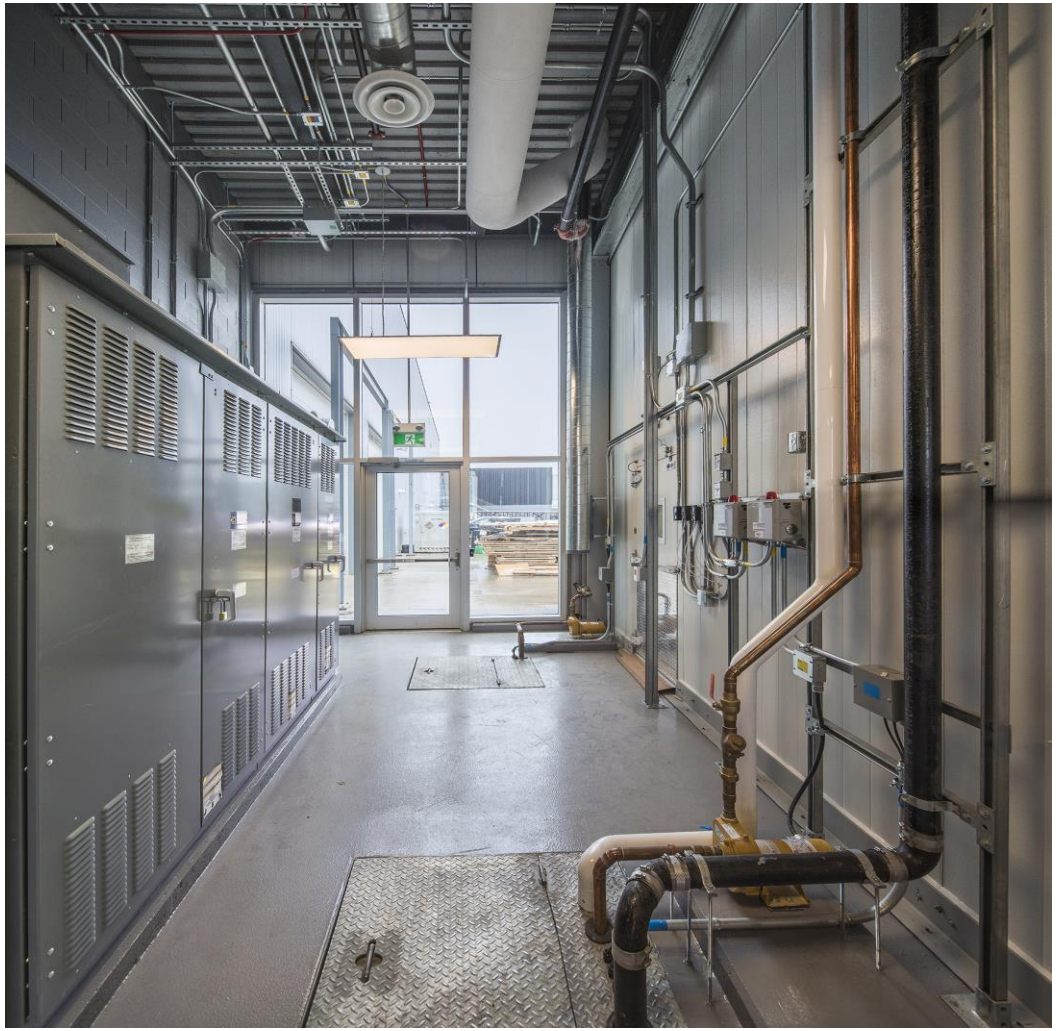
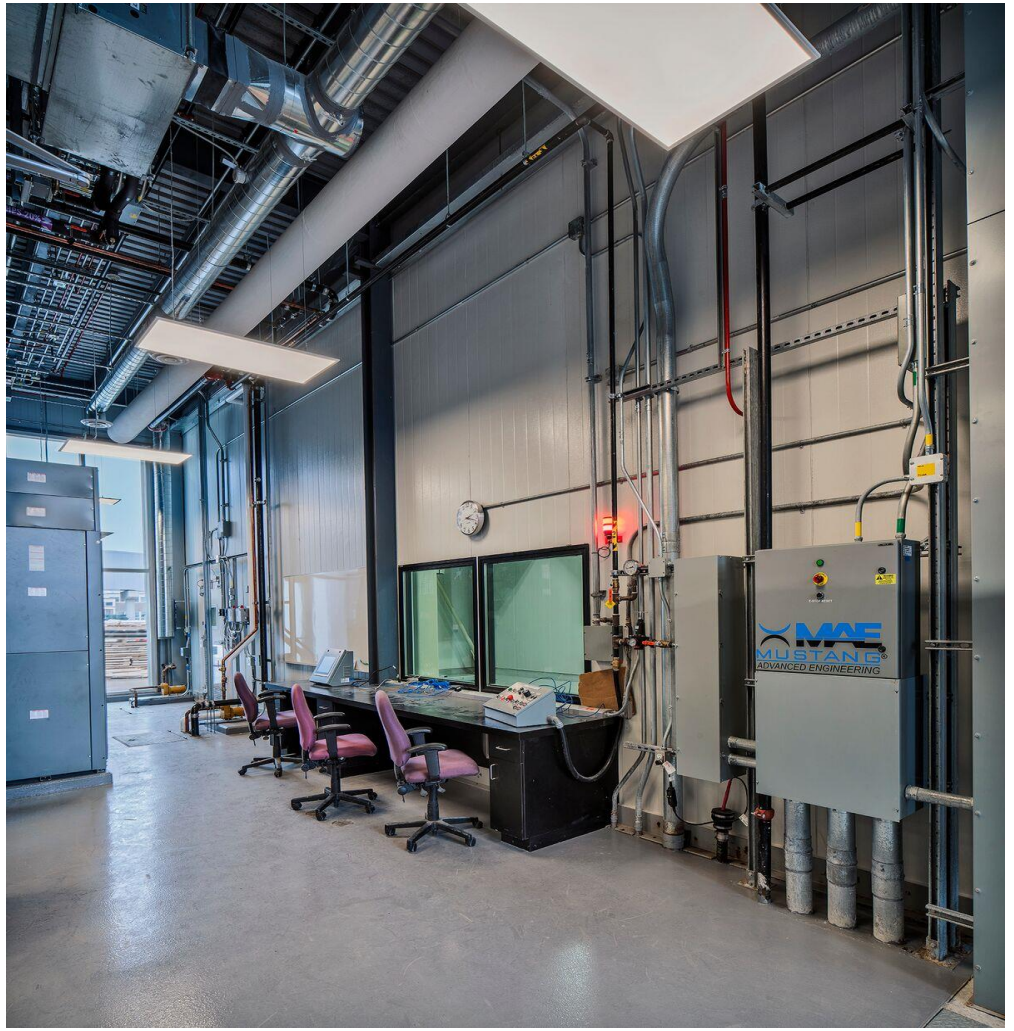
Resistive Load Bank

Dynamometer and Chamber
Power Control Racks

MotiveLab Control Room





Additional Opportunities

- Given the large capacity of the Chamber there have been several other opportunities outside of Heavy Vehicle testing. Some examples include:
  - Validation of Large Stationary Equipment that is required to operate over a wide temperature range.
  - Personal Mobility testing and Equipment functionality – E.g. First responders with all the gear they need to carry in all temperatures.
  - Film Industry – when requiring consistent and secure sets.

Typical Tests

With the ability to reproduce temperature and terrain profiles, iterative design changes can be validated.

Some Typical testing scenarios could include:

- HVAC Verification on Transit and On-Highway Coaches (Drawn Down/Up Testing)
- Emissions Testing.
- Range Tests (Diesel and Electric)

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