Calspan Tire Performance Research and Testing

Calspan Corporation, Buffalo, NY, USA

CALSPAN TIRE TESTING | 40+ YEARS

MORE THAN **100,000** TIRES TESTED

COVERING A DISTANCE GREATER THAN
10 TRIPS TO THE MOON

CITED IN MORE THAN **1,200**
SCIENTIFIC PAPERS

SUPPORTED TIRE AND VEHICLE
DEVELOPMENT FOR **40+ YEARS**

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CALSPAN TIRE TESTING

- MOST POWERFUL TIRE TESTING MACHINE IN THE WORLD
- MOST EXPERIENCED TECHNICAL STAFF IN THE WORLD
- EXCEPTIONAL TESTING CAPABILITIES
- PROVEN MEASUREMENT REPEATABILITY AND ACCURACY
- INDEPENDENT ORGANIZATION
- CUSTOMER CONFIDENTIALITY

→ATTRACTS TOP-TIER AUTOMOTIVE COMPANIES

→MEASURE AND UNDERSTAND

MEASURE AND UNDERSTAND

SIMULATION	PERFORMANCE	DURABILITY
BENCHMARKING	CALSPAN TIRE TESTING	QUALITY
THERMAL	CONSTRUCTION	MATERIALS

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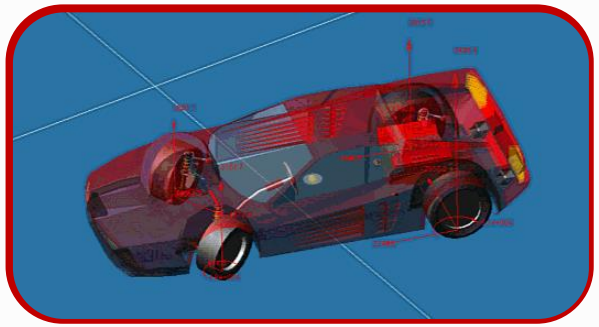
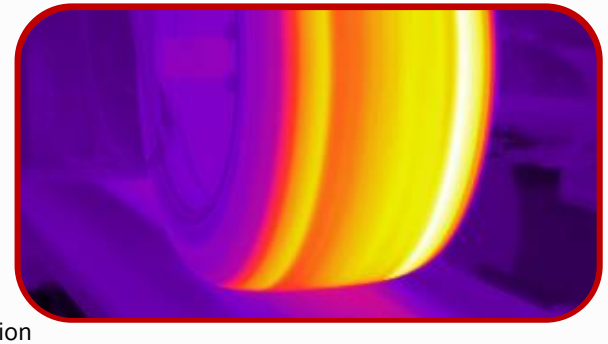
MEASURE AND UNDERSTAND



CALSPAN
TIRE TESTING



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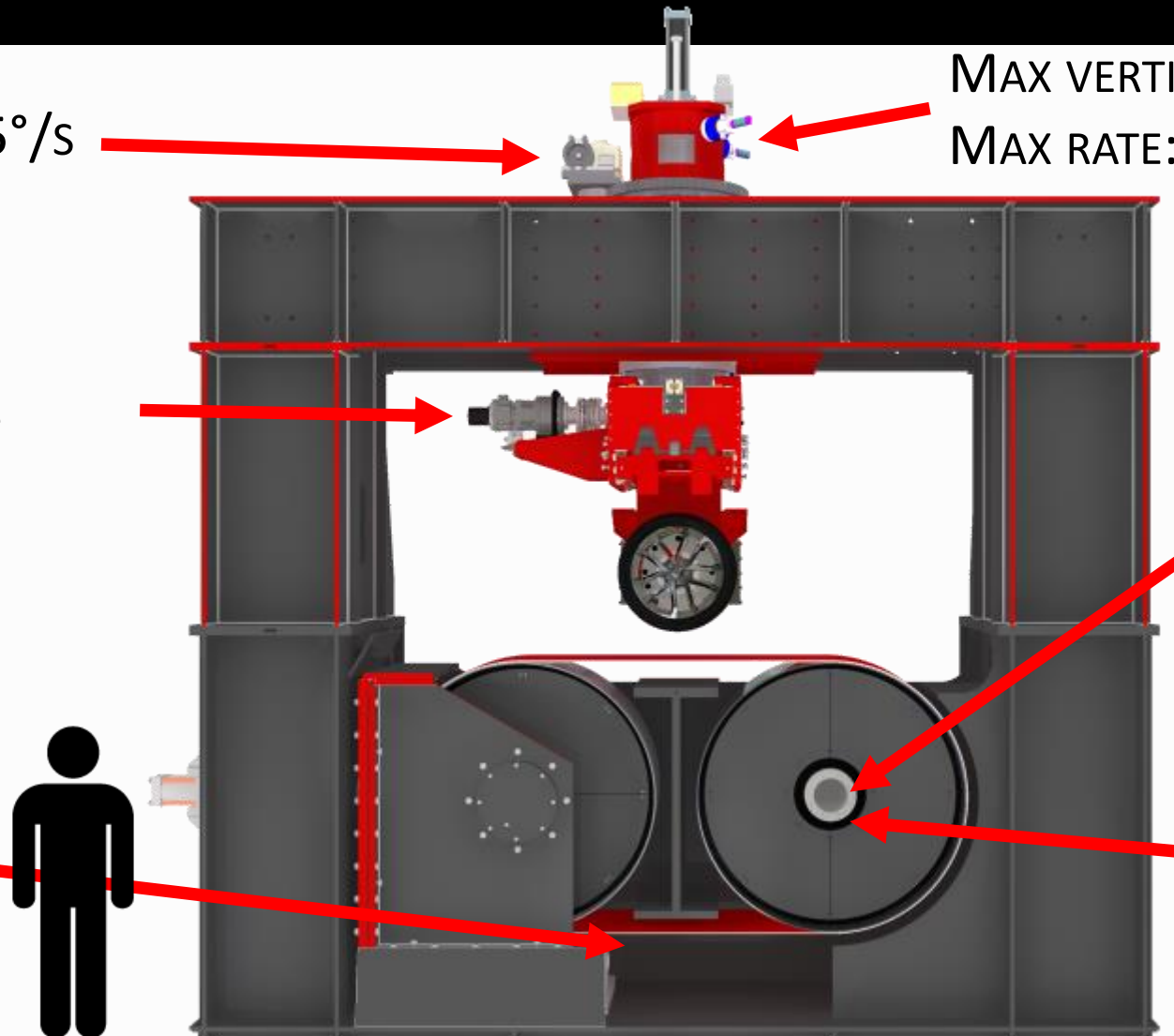
CALSPAN TIRE TESTING – MECHANICAL

±28° SLIP ANGLE AT 15°/S

±25° CAMBER AT 7 °/S

BELT LENGTH: 9.5 M



MAX VERTICAL LOAD: 53 KN

MAX RATE: 178 MM/S

TOP SPEED: 360 KM/H

SPEED CHANGE: 7.7 M/S^2

ELECTRIC DRIVE:

MAX POWER: 1000 KW

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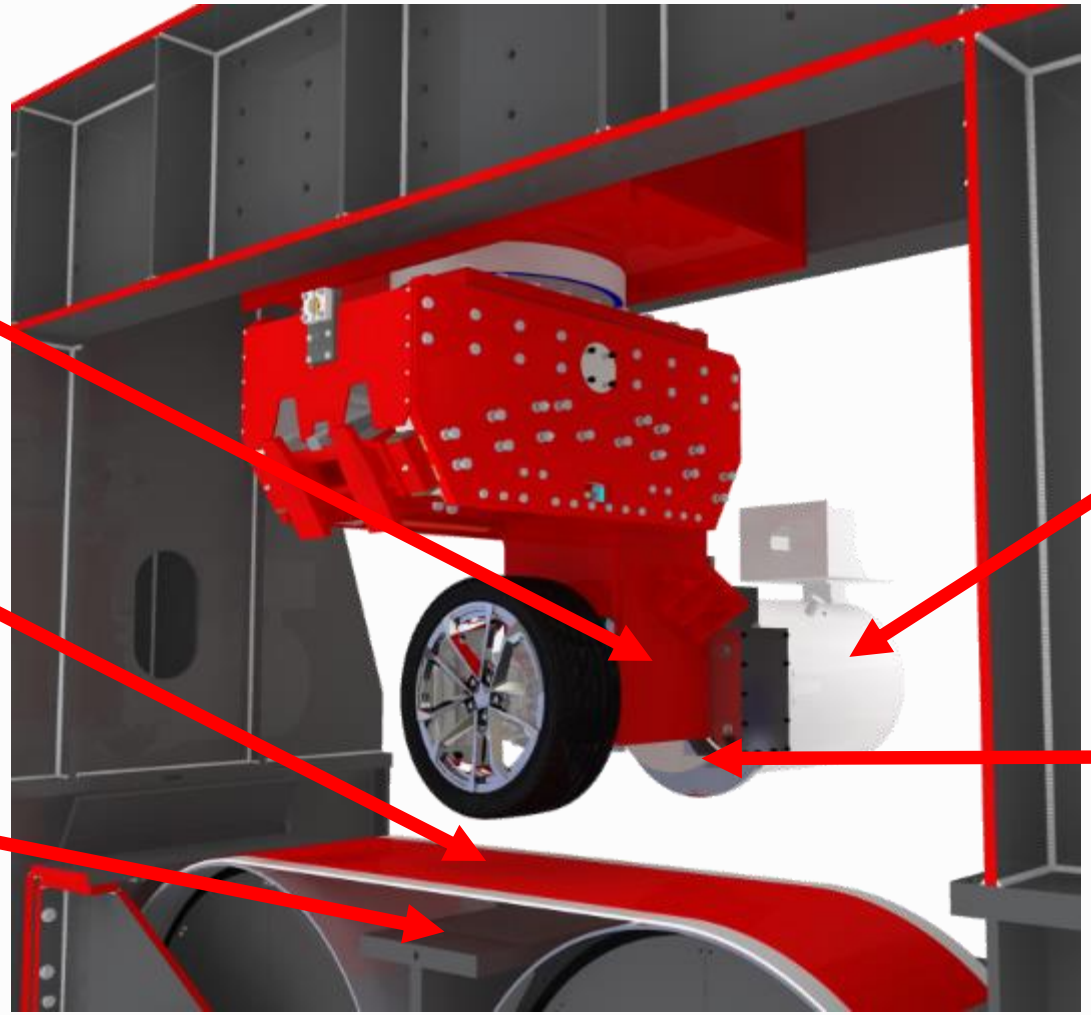
CALSPAN TIRE TESTING – MECHANICAL

Bespoke balances for F&M measurements.

Max Fx: 40 kN
Max Fy: 40 kN

Bespoke air bearing design



Electric drive:
Max power: 750 kW
Max torque: 10.8 kNm

Disc brake:
Max torque: 20 kNm
Torque rate: 19 kNm/s

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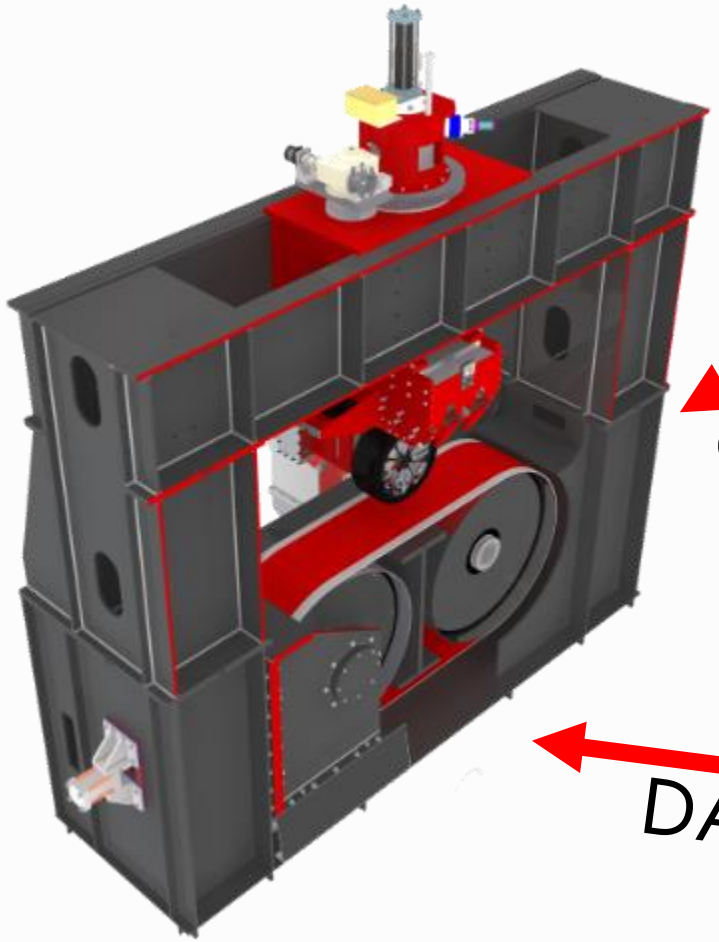
CALSPAN TIRE TESTING – ELECTRICAL



CONTROL

DAQ

- COMPLETE SOURCE CODE
- COMPLETE CONTROL
- SAMPLING UP TO 2 KHZ
- EXTENDABLE
  - ADDITIONAL SENSORS
  - ADDITIONAL DAQS

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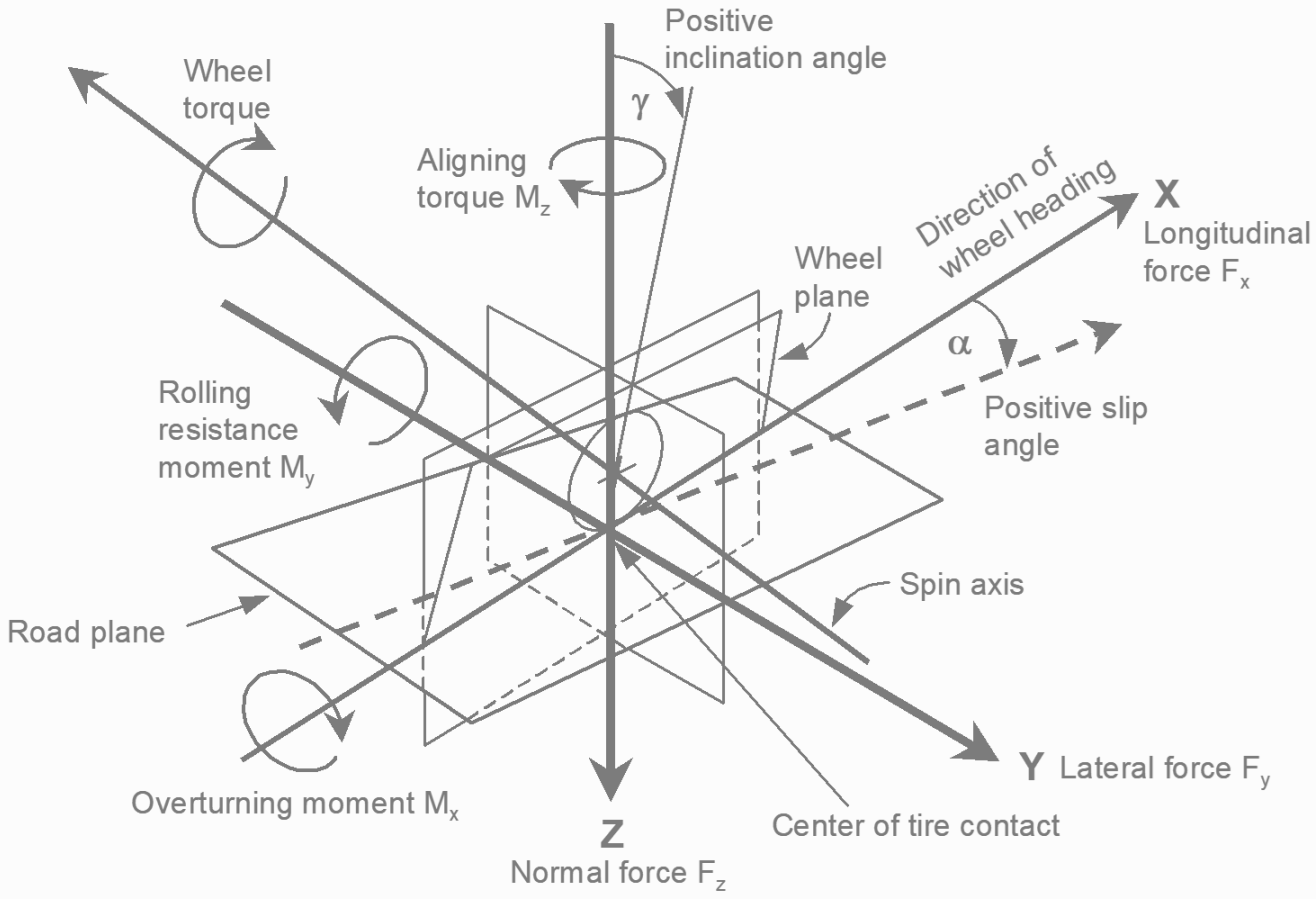
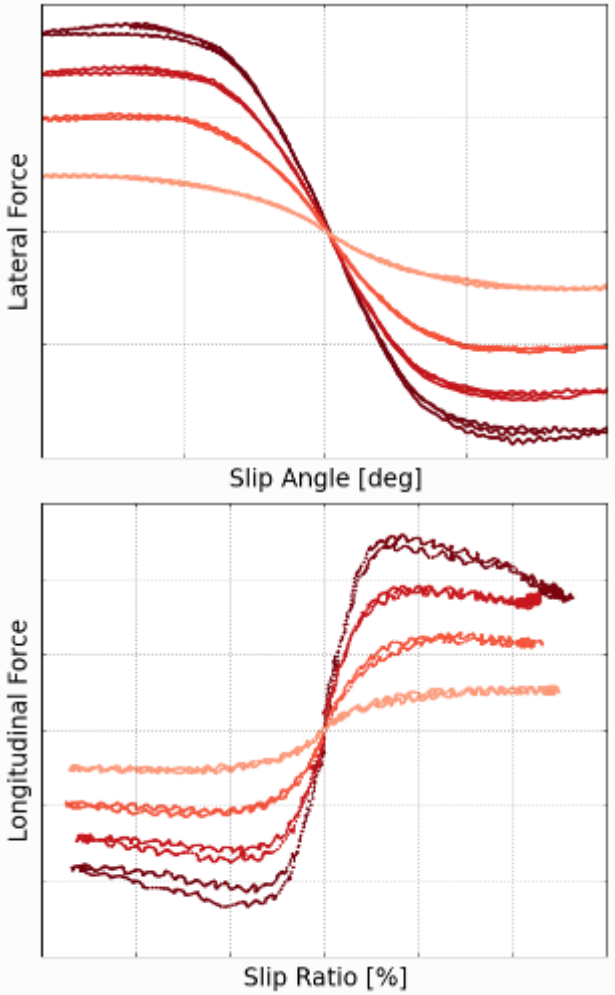
MEASUREMENTS

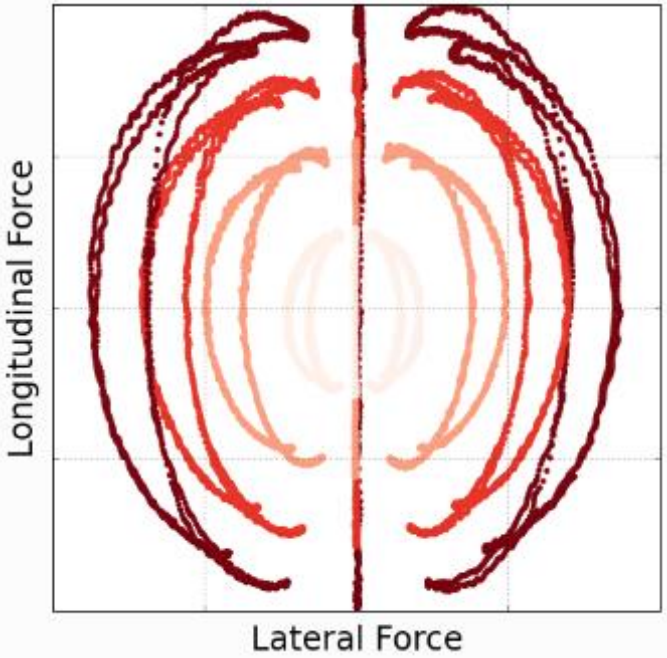
- FORCES AND MOMENTS
  - FX, FY, FZ, MX, MY, MZ
- POSITIONS/VELOCITIES
  - SA, IA, RL, RE, N, SR, V
- TEMPERATURES
  - SURFACE, LINER, SIDEWALL, ROAD, AMBIENT
- WEAR



COMMON TEST TYPES

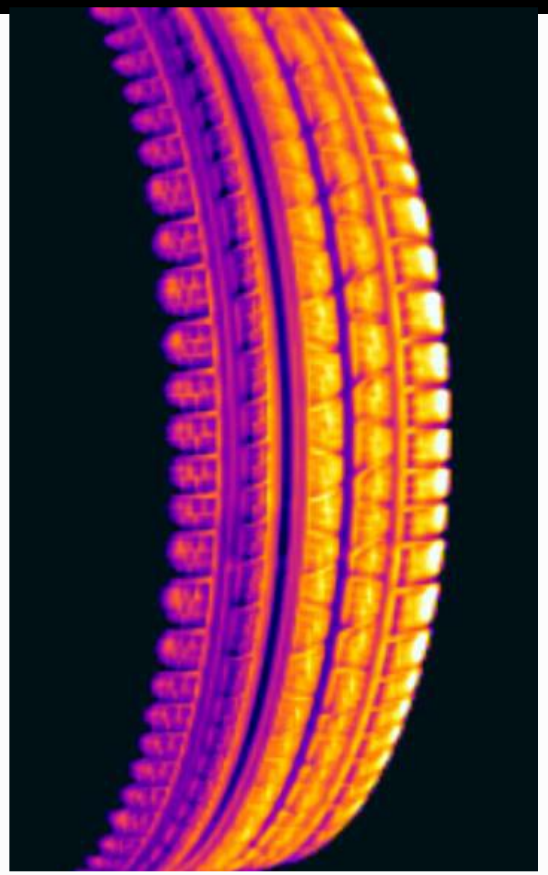
- THE PURPOSE OF THE TESTING DETERMINES TEST PROCEDURES
- THE TEST PROCEDURE AFFECTS THE DATA
- COMMON TESTS
  - FREE-ROLLING CORNERING
  - SPEED CHARACTERIZATION
  - BRAKE-DRIVING
  - BRAKE-DRIVING WHILE CORNERING
  - STATIC TESTS
  - RELAXATION LENGTH
- MANY OTHER TEST TYPES



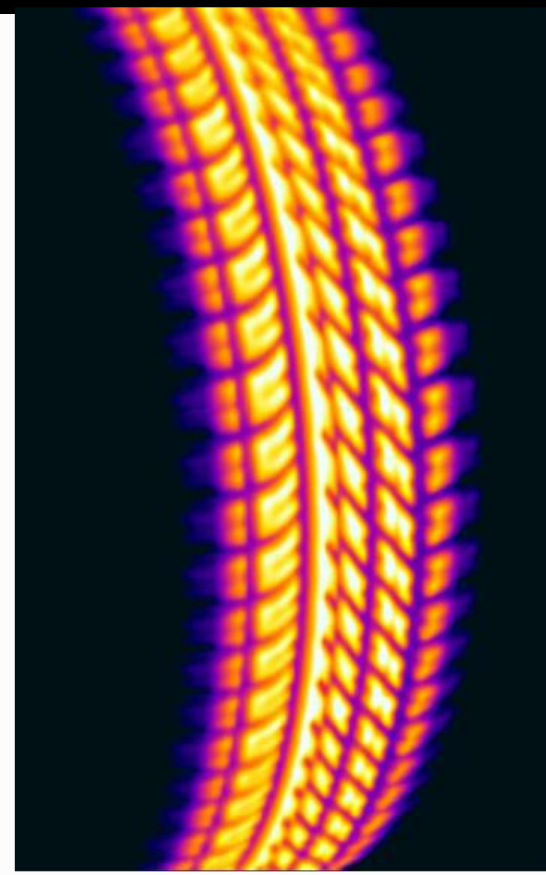


THERMAL TESTING

- CALSPAN'S THERMAL IMAGING IS INTEGRATED TO THE TEST SYSTEM.
- PROVIDES DETAILED INSIGHT INTO CONTACT PATCH BEHAVIOR
- VERY POWERFUL WHEN EVALUATING TIRE CONSTRUCTION DESIGNS.

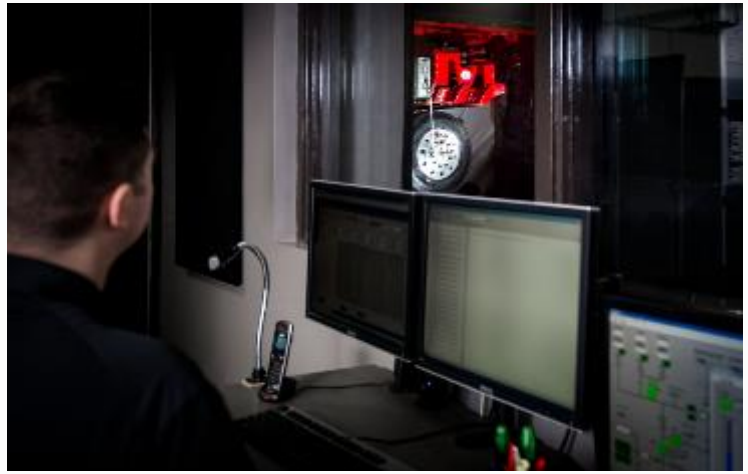


TIRE A



TIRE B

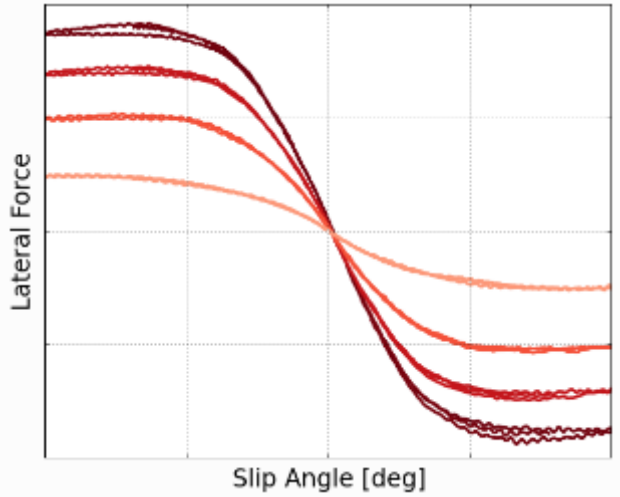
WHY CALSPAN TIRE TESTING?



- MORE QUALITY DATA PER UNIT TIME
- TIRE DATA REDUCES DESIGN/SETUP ITERATIONS NEEDED
- TESTING PROCEDURES CAN BE DESIGNED TO MIMIC REALITY
- SEVERE TEST CASES CAN SAFELY BE EVALUATED

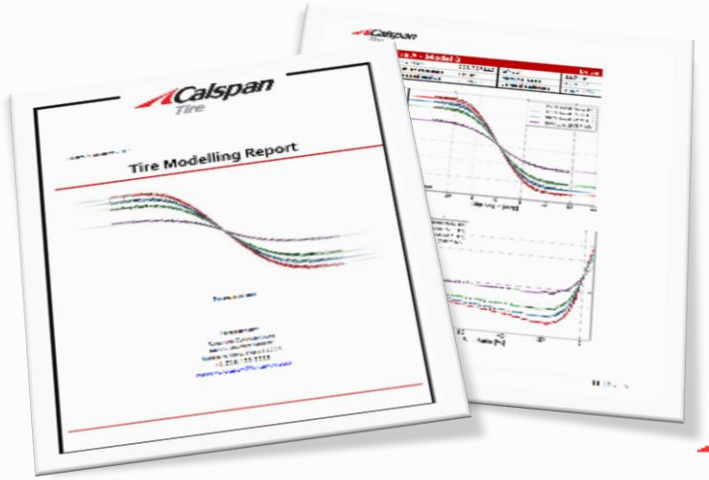
ANALYZING RESULTS AND CONCLUSIONS

- DATA PROCESSING:
  - METRICS
  - VISUALIZATIONS
  - MODELS
    - → UNDERSTAND AND MAKE DECISIONS



- TESTING OFTEN LEADS TO :
  - NEW QUESTIONS
  - NEW PATHS IN THE TEST AND ANALYSIS PROCESS
  - NEW/FUTURE WORK

- TESTING OFTEN REVEALS UNKNOWNS
  - → NEW UNDERSTANDING AND IMPROVEMENTS



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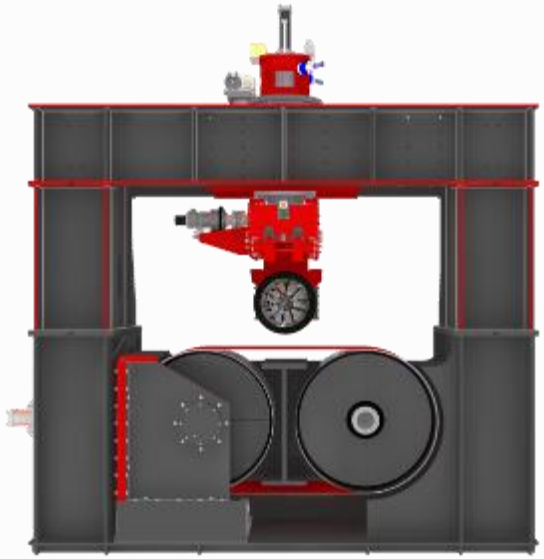
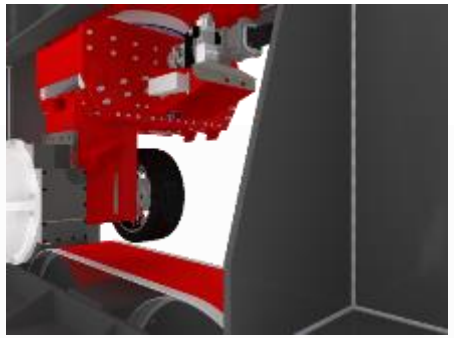
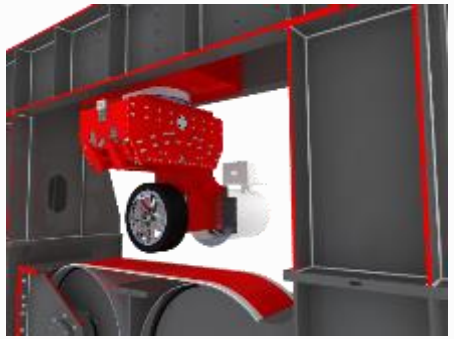
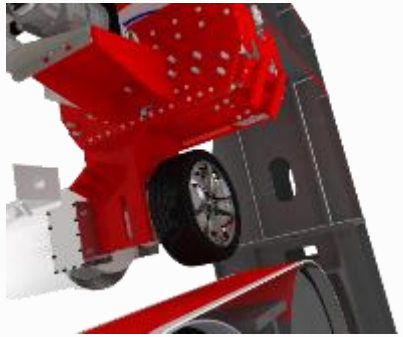
CALSPAN TIRE TESTING SPECIFICATIONS



Description	Units		Units	
Minimum Loaded Radius	mm	196	in	7.8
Maximum Loaded Radius	mm	610	in	24
Maximum Loaded Displacement Rate	mm/s	178	in/s	7
Smallest Rim Diameter	mm	254	in	10
Maximum Tire Width	mm	605	in	23.8
Maximum Vertical Load	kN	53	lb	12,000
Lateral Force Capability	kN	±40	lb	8992
Longitudinal Force Capability	kN	±40	lb	8992
Slip Angle Range	deg	±30	deg	±30
Maximum Slip Angle Rate	deg/s	15	deg/s	15
Inclination Angle Range	deg	±25	deg	±25
Inclination Angle Range (Motorcycle)	deg	50 / -10	deg	50 / -10
Inclination Angle Rate	deg/s	7	deg/s	7
Spindle Speed	rpm	±3,600	rpm	±3,600
Spindle Torque at 850 rpm	kNm	10.8	lb-ft	8000
Spindle Torque at 1400 rpm	kNm	10.8	lb-ft	8000
Spindle Torque at 2200 rpm	kNm	6.9	lb-ft	5110
Spindle Torque at 3000rpm	kNm	4.0	lb-ft	2900
Spindle Torque at 3600rpm	kNm	2	lb-ft	1440
Spindle Torque Rate	kNm/s	19	lb-ft/s	14,000
Disk Brake Torque	kNm	20	lb-ft	14,000
Roadway Speed (2nd gear / 1st gear)	kph	±360/160	mph	224 / 100
Roadway Maximum Drag Force (2nd gear / 1st gear)	kN	±28/64	lb	6295 / 14,500
Maximum Lateral Belt Travel	mm	±5	in	0.2
Bearing Temperature Control [Surface]	deg C	10 -38	deg F	50 - 100
Tire Inflation Max	kPa	2,400	psi	350







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