



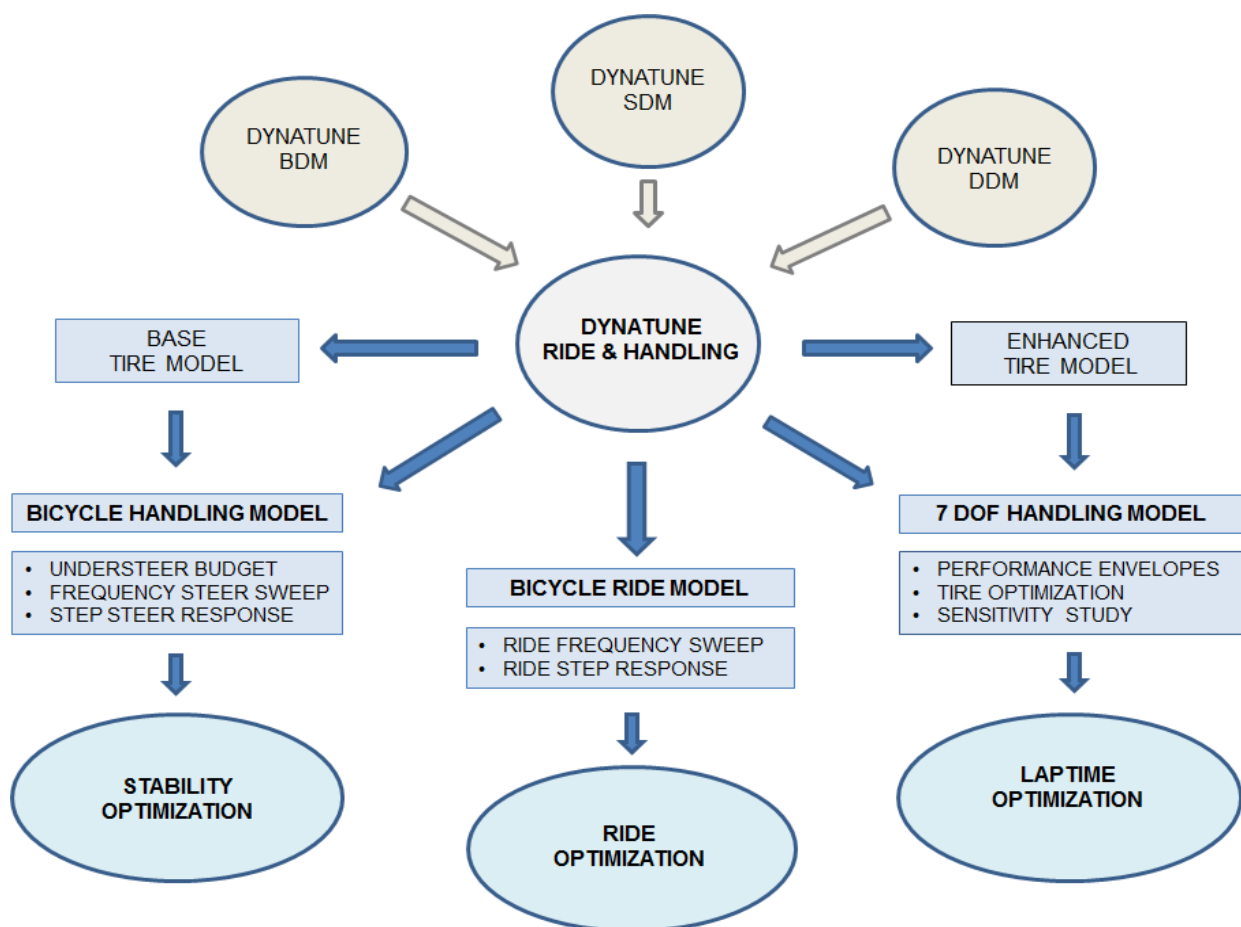
## DYNATUNE-XL SIMULATION TOOL SUITE

**SOFTWARE TOOLS FOR SUSPENSION DESIGN, RIDE & HANDLING,  
ACCELERATING & BRAKING USING MS EXCEL ® INTERFACE.**

**DYNATUNE-XL** is the registered name of a suite of core skill **MS EXCEL ®** based Engineering and Simulation Tools.

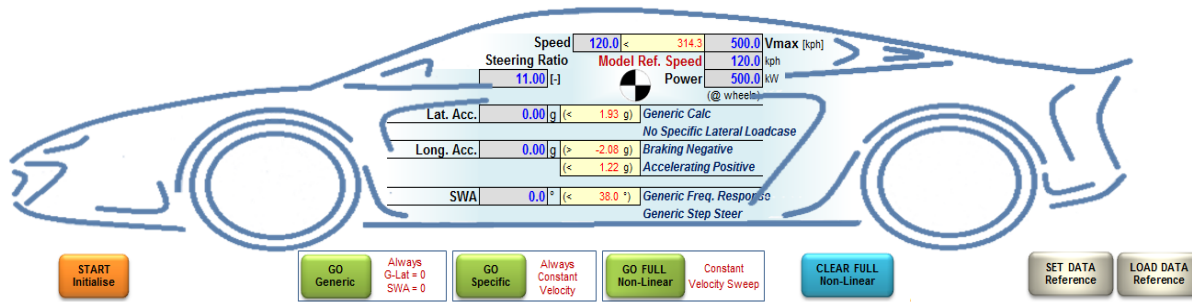
The **DYNATUNE-XL** Tool Suite does provide Professional Engineering Tools covering the most Important Aspects of Vehicle Dynamics. All Tools aim to achieve a Maximum of Results with a Minimum of Input Data allowing quick Setup Checks or - if wanted - more complex Generic Parameter Studies. Being a fully **MS EXCEL ®** based Tool does significantly reduce the application threshold for many engineers and technicians. MS Excel is available on most computers as part of **MS OFFICE ®** and widely supported in business applications.

Our Suite of Tools does exist out of the following (standalone) Modules:





## **DYNATUNE-XL – RIDE & HANDLING MODULE**



Click on picture to follow link to website

The **DYNATUNE-XL RIDE & HANDLING MODULE** has been specifically developed & validated over the last 30 years around the equations of a Bicycle Model & a 7-DOF Vehicle Model and is entirely focused on providing an efficient tool for optimizing the basic **RIDE & HANDLING** behaviour of a vehicle. Two levels of complexity (Expert & Race) do allow clients to select the best suited variant for their specific needs and/or knowledge status.

The Analytical Features have been developed to cover all disciplines of Vehicle Dynamics and are perfectly suited to cover all aspects from an upfront Concept Design Trade-Off Tool up to a typical Race/Development Engineers Setup at the (test-) track.

Various features can only be found in hugely complex expensive multi-body vehicle dynamics simulation tools. Finally, the included Performance Envelope Calculation and Laptime Simulation do underline the all-round-ness and inherent potential of this tool.

### Vehicle Input Characteristics:

- Vehicle Mass, Passenger & Load (incl. Inertia)
- Vehicle Aerodynamics (can be Ride Height Dependant)
- Brake Distribution & Axle Drive Concept (FWD, RWD & AWD)
- Spring, Rollbar & Damper Settings
- Suspension Kinematic Table
- Suspension Compliance Table
- Custom Linear or Non-Linear Tire Model
- Generic Tire Data Base and Kinematic & Compliance Data Base Available

### Simulation Features:

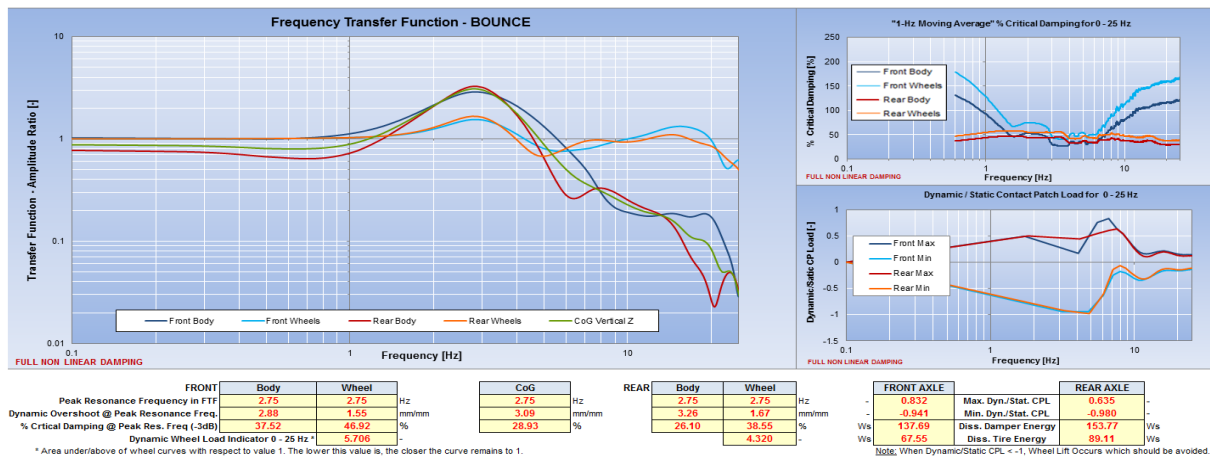
- Constant Velocity Lateral Sweep – Non-Linear
- Constant Radius Lateral Sweep – Non-Linear
- Frequency Steer Response Test – Linear & Partially Non-Linear w/ Load Transfer
- Step Steer Test – Linear & Partially Non-Linear w/ Load Transfer
- Body & Wheel Natural Frequencies & Damping Ratio Analysis
- Ride Bounce & Pitch Centre Analysis
- Ride Step & Frequency Response Test - Linear
- Limited Slip Differentials, Full Torque Vectoring Analysis & Yaw Moment Calculation
- Full Performance Envelope Calculation
- Regenerative Powertrain Braking
- Laptime Simulation with 20 Parameter Laptime Sensitivity Study Analysis (DOE)

The **DYNATUNE-XL R&H MODULE** has been used at the "cradle" of many important & iconic cars, is well established in the Automotive OEM World and is used by many Professionals & Vehicle Dynamics Enthusiasts all over the world.

## DYNATUNE-XL – SUSPENSION DESIGN MODULE



## DYNATUNE-XL – SUSPENSION TUNING MODULE



Click on picture to follow link to website

The **DYNATUNE-XL SUSPENSION TUNING MODULE** has been specially developed for those, who want to dive deep into the many complex vibrational aspects of suspension tuning. It is the perfect tool to analyse the often-complex interactions between springs and dampers.

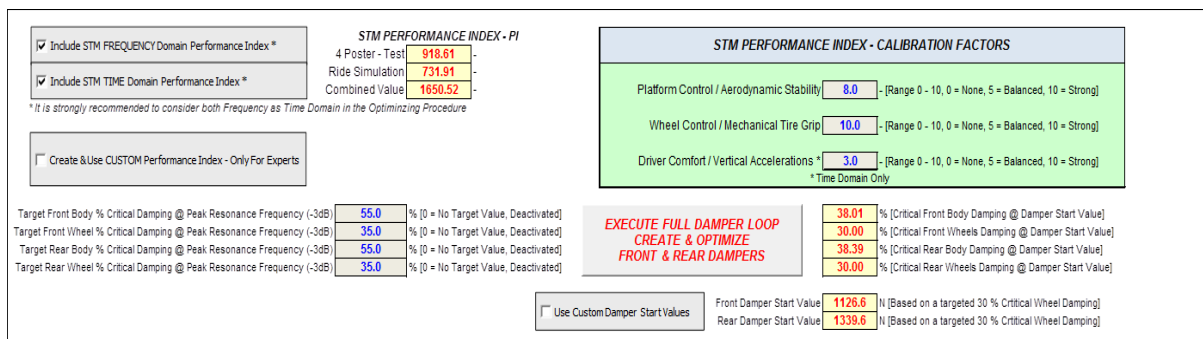
Next to the classical Damping Ratio and Bounce & Pitch Centre analysis the tool does offer to simulate dynamic events both in the Time Domain as in the Frequency Domain.

Typical Fully Dynamic Simulation Events are:

- Fully Dynamic Ride Step – Time Domain, Fully Non-Linear Damper
- Fully Dynamic Ride HavSin – Time Domain, Fully Non-Linear Damper
- Fully Dynamic Ride Frequency Response Test - Linear Decaying Amplitude
- Fully Dynamic Ride Frequency Response Test - Exponential Decaying Amplitude

All of the above events can be fully parametrized to specific test requirements. A full range of Key Performance Indicators will be calculated allowing objective comparisons of various setups.

On top of that **DYNATUNE STM** does also offer the truly Unique Feature to Optimize Damper Settings Automatically towards a range of customer defined Targets and/or Cost Functions.




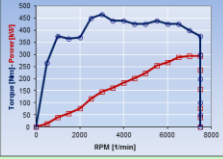
**DYNATUNE-XL STM** is a truly powerful standalone tool, which enables one to get the best out of one's ride setup by executing and analysing advanced 4-Poster Ride Setup Procedures combined with various Time Domain Ride Obstacles Event Simulations.





## DYNATUNE-XL – DRIVE-LINE DESIGN MODULE

**DYNATUNE DRIVE LINE DESIGN MODULE - RELEASE 8.0** Copyright DYNATUNE-XL

RPM (1/min)	TORQUE (Nm)	POWER (kW)	Power (PS)
0	0.0	0.0	0.0
500	265.0	13.9	18.9
1000	375.0	36.3	51.4
1500	365.0	57.3	78.0
2000	370.0	77.5	106.4
2500	450.0	117.8	160.2
3000	465.0	146.1	198.7
3500	440.0	161.3	219.3
4000	440.0	184.3	253.7
4500	425.0	206.3	279.4
5000	425.0	222.5	302.6
5500	440.0	253.4	344.7
6000	425.0	267.0	363.2
6500	425.0	289.3	393.4
7000	400.0	293.3	399.8
7500	375.0	294.5	400.8
7501	300.0	235.7	320.5
7502	200.0	157.1	213.7
7503	100.0	78.8	106.9
7504	50.0	39.3	53.4
7505	0.0	0.0	0.0

Engine / E-Motor (E-Clutch) Rotational Inertia  
Rotational Inertia at Gearbox Input Shaft (I = none) **0.150 kgm²**

Vehicle Data	
CAR 1 ICE PWT	
Wheelbase	2750 mm
Front Lift Coefficient (negative = Downforce)	-0.25
Rear Lift Coefficient (negative = Downforce)	-0.50
Drag Coefficient	0.30
Total Frontal Area	2.00 m²
Total Vehicle Mass	1000 kg
Vehicle Weight Distribution	50.0 % Fwd
Center of Gravity Height	400.0 mm
Road Gradient (‰ = Feet)	0.0 %
Front Axle Load (incl. Aero Loads @ Ref. Speed)	5136.5 N
Rear Axle Load (incl. Aero Loads @ Ref. Speed)	5368.0 N

**BLUE = ENTER DATA (CAR & CONTROL)**  
**GREEN = ENTER DATA (DRIVE LINE)**  
**RED = CALCULATED RESULTS - DO NOT TOUCH**

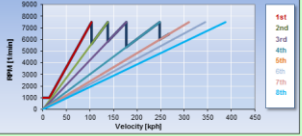
Drive Line Data	
Ratio 1st Gear & Rotational Inertia (I = none)	3.000 0.001 8.000 12.260 kgm²
Ratio 2nd Gear & Rotational Inertia (I = none)	2.250 0.001 6.150 8.911 kgm²
Ratio 3rd Gear & Rotational Inertia (I = none)	1.750 0.001 5.250 4.197 kgm²
Ratio 4th Gear & Rotational Inertia (I = none)	1.250 0.001 3.750 2.158 kgm²
Ratio 5th Gear & Rotational Inertia (I = none)	1.000 0.001 3.000 1.394 kgm²
Ratio 6th Gear & Rotational Inertia (I = none)	0.900 0.001 2.700 1.136 kgm²
Ratio 7th Gear & Rotational Inertia (I = none)	1.000 0.001 3.000 1.394 kgm²
Ratio 8th Gear & Rotational Inertia (I = none)	0.800 0.001 2.400 0.905 kgm²

Torque Split - % Torque to the Rear Axle **100.00 % RWD**  
If dyno data are available enter data in engine map and set efficiency to 1

Drive Line RPM Limits	
Engine / E-Motor Rev Limit	7500 1/min Shift Speed
1st/2nd Gear Shift RPM - Rev Drop to	1/min 7500 5625 165.4 mph
2nd/3rd Gear Shift RPM - Rev Drop to	1/min 7500 5831 172.81 mph
3rd/4th Gear Shift RPM - Rev Drop to	1/min 7500 5357 177.19 mph
4th/5th Gear Shift RPM - Rev Drop to	1/min 7500 6006 248.08 mph
5th/6th Gear Shift RPM - Rev Drop to	1/min 7500 6750 310.08 mph
6th/7th Gear Shift RPM - Rev Drop to	1/min 7500 6333 344.53 mph
7th/8th Gear Shift RPM - Rev Drop to	1/min 7500 6000 310.08 mph
RPM Limited Top Speed at Rev Limit in 8th Gear	1/min 7500 387.58 mph

TIRE DATA	
Tire Grip - Friction Coefficient	1.50
Tire Rolling Radius	329.0 mm
Wheel Rotational Inertia (I = none)	1.50 kgm²
Tire Rolling Resistance	0.013

Some Other Vehicle Calcs	
Reference Velocity for Calculating Vehicle Data	
Actual Max. Acc. @ Speed & Required Power	0 0.99 269.83 kW
Max. Acc. @ Speed 100 % FWD & Req. Power	0 0.61 165.15 kW
Max. Acc. @ Speed 100 % RWD & Req. Power	0 0.99 269.83 kW
Max. Acc. @ Speed w/ Perfect AWD & Req. Power	0 1.56 424.83 kW
Optimum AWD Torque Split FR for Max Acceleration	72.28 % RWD
RPM in 1st Gear	7756 1/min
RPM in 2nd Gear	5442 1/min
RPM in 3rd Gear	4133 1/min
RPM in 4th Gear	3023 1/min
RPM in 5th Gear	2419 1/min
RPM in 6th Gear	2177 1/min
RPM in 7th Gear	2419 1/min
RPM in 8th Gear	1935 1/min



Top Speed Results	
Theoretical Top Speed (based on Power only)	271.1 kph
Top Speed Achieved (max simulation time 60s)	269.4 kph
Top Speed achieved in Gear No. after	41.87 5

**Performance Results From Standstill**

Time from standstill to achieve	kph 100.0 3.62 s
Time from standstill to achieve	mph 50.0 3.40 s
Time to from standstill to do	nm 0.25 11.30 s
Velocity after	nm 0.25 127.7 kph
Time to from standstill to do	nm 0.00 28.54 s
Velocity after	nm 1000.0 245.1 kph

**Rolling Acceleration Results**

Start Velocity	60.0 kph
End Velocity	160.0 kph
Start/End in Gear No.	2 3
Time to End Velocity & RPM	4.740 6771 1/min
Time to achieve distance	nm 300.0 7.73 s
Distance achieved in Gear No. & RPM	4 5827 1/min

Total Rotational Inertia in 1st Gear (4 x Wheels & PWT) **18.27 kgm²**  
Equivalent 'added' vehicle Mass due to Rotational Inertia **168.75 kg**


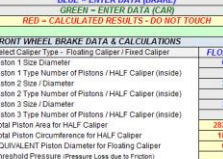
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The **DYNATUNE-XL DRIVE-LINE DESIGN MODULE** does permit to optimize gearbox (up to 8 gears) and differential ratios and match the Drive-Line perfectly to the Engine Torque & Power Characteristics. It is a must have tool for straight forward straight-line performance analysis and is essential for any custom build gearbox gear ratio specifications.

Next to ICE Power Trains also Electrical Propulsion can be simulated and optimized. Powertrain and Rotational Inertia's of the 4 Wheels are fully considered.

## DYNATUNE-XL – BRAKE- SYSTEM DESIGN MODULE

**DYNATUNE BRAKE SYSTEM DESIGN MODULE - RELEASE 8.0** Copyright DYNATUNE-XL

VELOCITY (km/h)	FRONT BRAKE FORCE (N)	REAR BRAKE FORCE (N)
0	0.0	0.0
50	1000.0	500.0
100	1500.0	750.0
150	2000.0	1000.0
200	2500.0	1250.0
250	3000.0	1500.0
300	3500.0	1750.0
350	4000.0	2000.0
400	4500.0	2250.0
450	5000.0	2500.0
500	5500.0	2750.0
550	6000.0	3000.0
600	6500.0	3250.0
650	7000.0	3500.0
700	7500.0	3750.0
750	8000.0	4000.0
800	8500.0	4250.0
850	9000.0	4500.0
900	9500.0	4750.0
950	10000.0	5000.0
1000	10500.0	5250.0

**BLUE = ENTER DATA (BRAKE)**  
**GREEN = ENTER DATA (CAR)**  
**RED = CALCULATED RESULTS - DO NOT TOUCH**

VEHICLE DATA & LOAD CONDITIONS	
Imposed Vehicle Speed	100.0 kph
Max Tire Grip - Friction Coefficient	1.25
Wheelbase	2000 mm
Front Lift Coefficient (negative = Downforce)	-0.25
Rear Lift Coefficient (negative = Downforce)	-0.50
Drag Coefficient (incl. aero drag deceleration)	0.30
Total Frontal Area	1.50 m²

**CAR 1 - BALANCE BAR 1 UP** **1 UP** **Chart View**

CAR 1 - BALANCE BAR 1 UP	
Total Vehicle Mass	825 780 kg
Vehicle Weight Distribution	50.0 45.0 % Fwd
Center of Gravity Height	350.0 mm
Front Axle Load (incl. Aerodynamic Loads)	3239.2 3484.5 N
Rear Axle Load (incl. Aerodynamic Loads)	3472.8 4363.3 N

**FRONT WHEEL BRAKE DATA & CALCULATIONS**

FRONT WHEEL BRAKE DATA & CALCULATIONS	
Select Caliper Type - Floating Caliper / Fixed Caliper	FL OUT
Piston 1 Size Diameter	40.00 mm
Piston 1 Type Number of Pistons / HALF Caliper (inside)	1
Piston 2 Size Diameter	35.00 mm
Piston 2 Type Number of Pistons / HALF Caliper (inside)	0
Piston 3 Size Diameter	25.00 mm
Piston 3 Type Number of Pistons / HALF Caliper (inside)	0
Total Piston Area for HALF Caliper	2627.43 mm²
Total Piston Circumference for HALF Caliper	188.50 mm
EQUIVALENT Piston Diameter for Floating Caliper	60.00 mm
Threshold Pressure (Pressure Loss due to Friction)	0.34 bar
Brake Disc Outer Diameter	243.0 mm
Effective Disc Diameter (calculated w/ Brake Pad Width)	193.0 mm
Brake Pad Width (in Disc Radius direction)	50.0 mm
Brake Pad Area (1 Pad)	4090.00 mm²
Friction Coefficient Brake Pad μ	0.35
Brake Factor C (x2 x μ)	1.90
Tire Rolling Radius	285.00 mm

**REAR WHEEL BRAKE DATA & CALCULATIONS**

REAR WHEEL BRAKE DATA & CALCULATIONS	
Select Caliper Type - Floating Caliper / Fixed Caliper	FL OUT
Piston 1 Size Diameter	43.00 mm
Piston 1 Type Number of Pistons / HALF Caliper (inside)	1
Piston 2 Size Diameter	20.00 mm
Piston 2 Type Number of Pistons / HALF Caliper (inside)	0
Piston 3 Size Diameter	15.00 mm
Piston 3 Type Number of Pistons / HALF Caliper (inside)	0
Total Piston Area for HALF Caliper	1482.20 mm²
Total Piston Circumference for HALF Caliper	135.09 mm
EQUIVALENT Piston Diameter for Floating Caliper	43.00 mm
Threshold Pressure (Pressure Loss due to Friction)	0.68 bar
Brake Disc Outer Diameter	223.0 mm
Effective Disc Diameter (calculated w/ Brake Pad Width)	163.0 mm
Brake Pad Width (in Disc Radius direction)	35.0 mm
Brake Pad Area (1 Pad)	3006.00 mm²
Friction Coefficient Brake Pad μ	0.35
Brake Factor C (x2 x μ)	1.00
Tire Rolling Radius	285.00 mm

**Car Results**

Car Results	
Calculated w/ Imposed Velocity due to Drag Force only	1.07 0.00 s
Stopping Distance From Imposed Velocity	36.58 33.20 m
Average Deceleration During Stop	5.31 1.21 g

**NOTE: THIS TOOL DOES NOT CONSIDER ANY BRAKE BOOSTERS !**

Set Threshold Pressure to 0 to "Reset" Sheet  
Threshold Pressure / mm of Piston Circumference **0.005 mm/mm**  
End Deformation / Surface Pressure (in 1st & 2nd) **0.025 mm/mm**  
1/2 Brake Pad Deformation = 0 then Piston Travel will be 0 in Calculation

**FRONT BRAKE SYSTEM DATA & CALCULATIONS**

Front Brake Master Cylinder Diameter	16.00 mm
Front Brake Pressure Control Valve Limit	500.00 bar
Front Master Cylinder Piston Area	254.47 mm²
HALF Caliper Pistons / Master Cylinder Surface Area Ratio	11.11
Oil Displacement for both Front Calipers / mm Piston Travel	1654.87 mm³/min
Front Master Cylinder Travel @ Max Braking	1 UP GVW
Front Master Cylinder Force @ Max Braking	2.25 2.42 mm
Front Master Cylinder Force @ Max Braking	1486.14 1581.90 N
Piston Force on 1 Brake Pad @ Max Braking (Clamp Load)	1 UP GVW
Surface Pressure on 1 Brake Pad @ Max Braking	2.60 2.10 mm²
Deformation of 1 Brake Pad @ Max Braking	0.051 0.052 mm
Burn of all 4 Pad Deformations on both Front Calipers	0.202 0.210 mm

**REAR BRAKE SYSTEM DATA & CALCULATIONS**

Rear Master Cylinder Diameter	16.00 mm
Rear Brake Pressure Control Valve Limit	500.00 bar
Rear Master Cylinder Piston Area	254.47 mm²
HALF Caliper Pistons / Master Cylinder Surface Area Ratio	5.74
Oil Displacement for both Rear Calipers / mm Piston Travel	2904.48 mm³/min
Rear Master Cylinder Travel @ Max Braking	1 UP GVW
Rear Master Cylinder Force @ Max Braking	0.79 0.80 mm
Rear Master Cylinder Force @ Max Braking	1486.14 1581.90 N
Piston Force on 1 Brake Pad @ Max Braking (Clamp Load)	1 UP GVW
Surface Pressure on 1 Brake Pad @ Max Braking	4174.38 4493.43 N
Deformation of 1 Brake Pad @ Max Braking	1.30 1.32 mm²
Burn of all 4 Pad Deformations on both Rear Calipers	0.035 0.037 mm

**PEDAL BOX DATA & CALCULATIONS**

Pedal Ratio	3.00
Balance Bar Bar Width	76.00 mm
Center Bias Bar / Caliper Piston Travel Ratio	6.41 mm/mm
Center Travel / Caliper Piston Travel Ratio	26.23 mm/mm
1 UP GVW	
Force @ Center Bias Bar @ Max Braking	2860.28 3183.92 N
Travel @ Center Bias Bar @ Max Braking	1.52 1.64 mm

Force @ Center Bias Bar @ Max Braking  
Travel @ Center Bias Bar @ Max Braking

Use Standard OBD Tandem Brake Master Cylinder instead of Race Balance Bar

**Result are OK, when:**

- 1) Front Axle Grip Saturation Line is above Diagonal Line & below Max Tire Grip.
- 2) Rear Axle Grip Saturation Line is below Diagonal Line (and below Front Braking Line).
- 3) Maximum Braking Performance is achieved when Front & Rear Brake Line are as close as possible (Max. Braking AID are respecting 1 and 2).

EU Road Legal Car: Front Braking Line must be in between Homologation Lines K

Click on picture to follow link to website



The **DYNATUNE-XL BRAKE DESIGN MODULE** is indispensable if you are a club racer or you build/modify your own car. Our **DYNATUNE BDM** does allow one to design (or mix & match) brake hydraulic systems considering all parameters which do affect braking performance. One can define Piston & Rotor Diameters and select the best matching Brake Master Cylinder for optimal Brake Distribution and Pedal Travel.

Classical (OEM) Tandem Master Brake Cylinders or Racing Brake-Bias-Balance-Bars are available as base configurations. Aerodynamic Downforce & Drag Influence are also taken into consideration.

## **SOFTWARE REQUIREMENTS & LICENSE MANAGEMENT**

Software requirements for **RELEASE 8.0** and onward are **Full** Versions (incl. latest updates) of **MS EXCEL ® 2010, 2013, 2016 or 2019** or **Office/365** with a **MS Windows ® XP, Windows Vista, Windows 7 Starter, Windows 7, Windows 8 or 10 Operating System**.

All Modules of **DYNATUNE-XL** come as a compiled executable (\*.exe) binary file which will call **MS EXCEL®** as a separate stand-alone instance. Source code is copyright protected and safe data handling is guaranteed through secure binary files.

Standard Customer Licenses are typically valid for the use of the workbooks (and ALL user-saved variants) on 1 computer and for 1 user only without a timing constraint.

The protection software does offer to the customer next to the security of encoded binary data handling also - by means of a unique License Key Verification Procedure - a state-of-the-art data protection.

License support is available for the latest releases only and as there is no annual maintenance fee existing clients with older product releases can acquire "upgrading" licenses to the latest version release at special client rates.

Recommended minimum hardware configuration for the **DYNATUNE-XL** Tools are Intel Core i5/i7 CPU (or similar) with 4GB Ram.

All Units in **DYNATUNE-XL** are SI.

## **DYNATUNE-XL DEMO VERSIONS**

DEMO Versions of the following DYNATUNE-XL Modules can be downloaded here:

- DYNATUNE Ride & Handling Module: <http://www.dynatune-xl.com/download-demo-rh.html>
- DYNATUNE Suspension Design Module: <http://www.dynatune-xl.com/download-demo-sdm.html>
- DYNATUNE Suspension Tuning Module: <http://www.dynatune-xl.com/download-demo-stm.html>

## **DYNATUNE-XL STORE**

B2C customers can acquire the various **DYNATUNE-XL** Modules online in our webstore:

[http://www.dynatune-xl.com/store/c1/Featured\\_Products.html](http://www.dynatune-xl.com/store/c1/Featured_Products.html)

B2B customers are kindly requested to contact us directly.

## **DYNATUNE-XL CONTACT**

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