RaceDataPower

Master Directory of Engineering Workbooks

Each workbook may contain several additional worksheets and graphs.
Click on link to go directly to program

Units Conversion
Conversion Tool
Conversion matrices for hundreds of common and not so common units.

Bearings
Clearances
Bearing Clearance
Determines hot running clearances.

Loading
Plane Bearings
PV calculations for thrust and journal bearings.
Roller Bearings
Expected life of ball and roller bearings.

Brakes
Disc Disc Systems
Determine mechanical and hydraulic brake balance prior to fabrication.
Disc Drum Systems
Mechanical and hydraulic brake calculations for various combinations.

Friction material data
Ferodo DS 11
Friction and wear characteristics of brake friction materials.

Brake force regulation
Brake Target Values
Determine braking force limits for vehicle prior to component specification.

Theory of Operation- Brake Tutorial
Brakes 101
Brake system theory tutorial.
Braking Calculations
Brake energy and vented air speed calculations.

Electrics
Lambda Sensors
Descriptive white paper on design, function, and use of oxygen sensors in racing engines.
Resistors
Determines resistance of series and parallel circuits with resistor color code.
Spark Plug
White paper on Bosch spark plugs detailing identification, heat range and installation.
Thermocouples
Comprehensive lookup table covering most popular T/C (type J, K, T, etc).
Wire Capacity
Determines appropriate current capacity given wire size, length and material.
Galvanic Couples
Calculates galvanic couple (voltage) between dissimilar metals.

Engine Design
Combustion
Basic Combustion
Very comprehensive program covers properties of air, short course on fuel chemistry and ignition principles. Calculates required firing voltage based on cylinder conditions and spark plug gap.
Emissions Model
UNOCAL predictive emissions model.
Emission Tuning
Tuning for reduced emissions.
Exhaust Species
Typical gasoline exhaust emission compositions.
Knock Frequency
Calculates the fundamental knock frequencies of any gasoline engine.
Operating Temps
Calculate EGT from air/fuel ratios. Graphs EGT vs crank angle.

Tuning EGT & PST
White paper on the capabilities and limitations of using exhaust gas termperatures and spark plug seat temperatures for engine tuning.

Wiebe Functions
Visualize your mass fraction burned curve vs crank angle considering ignition timing and ignition delay.

Modeling Parameters
Computer Analysis2s
Detailed two stroke engine blueprinting reference worksheet, designed for computer modeling purposes.

Computer Analysis4s
Detailed four stroke engine blueprinting reference worksheet, designed for computer modeling purposes.

Pistons
Piston Damage
Piston failure mode analysis guidelines.

Pistons
Comprehensive piston tutorial including calculation of hot running clearances and piston design limits.

Valve Train
Baseline Cam Analysis
Comprehensive camshaft analysis from user imported CamDr data.

Valve Float Exhaust
Used to select valve spring rate and preload for a given camshaft, component mass and engine speed.

Valve Float Intake
Used to select intake valve spring rate (inner and outer springs) and preload for a given camshaft, component mass and engine speed.

Valve Hit
Valve to piston interference analysis for any crank and valve angle.

Valve Size
Calculate optimum inlet valve sizes for any size engine and operating speed.

Valve Springs
Determines and inventories valve spring rates from entered measured dimensions, includes seat and nose pressure, coil bind, spring frequency and stress.

Engine calculations
BMEP comparison
Interesting comparison of engine state of tune using BMEP values to normalize for engine size.

Bore Stroke Displacement
Quick calculator to determine bore, stroke and displacement given any two values.

Compression pressure
Calculates nominal compression ratio, and effective compression ratio, given inlet valve timing. Displays in-cylinder temperature and pressure at any crank angle for any inlet pressure and temperature.

Crankshaft
Calculate instant piston velocity and acceleration for any crank angle and engine speed. Used with piston mass, program calculates inertial loading of connecting rod, wrist pin and big end bearing.

Engine Truth Table
Matrix of 230 combinations of tuning variables and race conditions.

Power Estimate
Calculates maximum BMEP and engine power from a few engine dimensions. Very useful as a predictive starting point.

Pseudo Flow
Calculates instantaneous inlet valve air velocity (and reversion) at all crank angles and engine speeds using actual camshaft lift data. Useful for camshaft design selection, cam indexing and speed prediction.

Time Event Calcs
Program compares engine events based on crank degrees to actual time units at any rpm.

Fuel and Air Supply
Carb Theory
Carburetor Air Flow
Calculates carburetor size for a given engine and operating condition.

Throttle Area
Calculates throttle area for every throttle plate angle, diameter and shaft diameter.

Fuel systems
Air & Fuel Delivery Targets
Determine air and fuel mass requirement for any size engine, operating conditions and fuel. Very helpful for selecting fuel pumps, injector flow rates and injector mapping.

Fuel Transport
Calculates the effect of fuel evaporation on inlet charge cooling using any fuel and fuel ratio.

Fuel Consumption
The Ultimate Pit Stop strategy workbook. Determine range and pit intervals for up to three cars. Pit stop strategies win races.

Injection
Fuel injector data base
A comprehensive data base of Bosch fuel injectors containing flow rate test data.

Fuel injector testing
SAE injector test procedures including determination of fuel flows at different pressures and densities.

Injection Timing
Displays injection spray window relative to camshaft events based on rpm, injector duty cycle and cam.

Mikuni
Fuel Control Systems
Qualitative description of Mikuni fuel circuits.
Transitional jet orifice
Calculates orifice flow areas at all needle heights for various needles and nozzles.

Walbro

Walbro Carbs
Tuning the Walbro carburetor.

Induction & Exhaust

Resonant Tune
Describes the concepts of induction resonant tuning for improved performance.
Hemholz
Calculates dimensions for Hemholz tuning.
Pipe Organ
Calculates inlet runner length for inlet tuning.
Pipe design
Program calculates optimum two stroke tuned pipe design based on port areas, temperatures, and rpms.
Port Areas
Calculates port areas for two stroke engines.
Time Areas
Calculates effective time areas for two stroke ports.

Testing / Tuning
Correction Factors
Race Tune
Descriptive white paper on tuning a racing engine using several fuel properties to improve engine performance.
Corrections
Discussion of engine correction factors.

Fuel Enrichment Index
Calculation of fuel enrichment index using fuel specific gravity and stoic value.
Humidity
Displays absolute water vapor content of air at any relative humidity and temperature.
Mixture Correction
Displays air/fuel mixture correction for any barometric pressure and temperature.
Power Correction
Calculates engine power correction which is quite different than air density correction.

Weather Trac
Program calculates air density, viscosity and water content due to changes in weather conditions and predicts required fuel adjustment with actual engine power.

Dyno Testing
Dyno Correction Factors
Calculates engine correction factors at any temperature and pressure using SAE, DIN and STP correction formulas.
Dyno Mapping Matrix
Helpful series of matrices to pinpoint ideal mixture and ignition timing values across the entire operating range, not just peak HP.

Flow Testing
Air Bench
Master flow worksheet for use with a flow bench.
Air Factors
Air density and viscosity calculations under various operating conditions.

Fuels & Lubes
Fuels
Autoignition
Vivid demonstration of how temperature and pressure affect Autoignition for isooctane.
Bond Energies
For budding fuel chemists. Table of bond energies for various hydrocarbons.
Dielectrics
Dielectric values of various fuels. Used by fuel tech inspectors and race team fuel chemists.
Flame Temps
Combustion temperatures for basic classes of fuel components.
Fuel Facts
Fuel distillation curves for racing fuels and pump gasolines.
Fuel Transport
Calculates the effect of fuel evaporation on inlet charge cooling.
Fuel Components
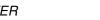Descriptions and characteristics of most common fuel components sorted by carbon number.
Fuel Energy
Heats of combustion for various fuel components.
Fuel Temps
Calculates changes in fuel distillation curves when race fuels are mixed.
Fuel Tune
Fuel blending workbook to predict performance and dielectric characteristics of various blends of fuels.

IR spectrums
Infra red absorption frequencies for classes of hydrocarbons.
Octane Values
Quantitative effects of lead addition to various fuel components.
Sensitivity
Octane sensitivity (MON, RON), street octane, race octane ratings.
Stoichiometry
Component stoichiometric analysis for FirePower brand racing fuels.
Racing Fuels
Comparison of racing fuel blend properties.
Waukesha Octane Engine
Testing protocols and measurement for octane certification.

Lubrication
Accusump
Calculates Accusump capacity required and delivered oil volume with pressure drops.

Lubricants
Gear Lube Viscosity
Viscosity vs temperature for various gear lubes.
Motor Oil Viscosity
Viscosity vs temperature for various motor oils.
Oil Analysis
Detailed descriptions of oil analysis readings and their significance.
Oil Report
User definable oil report tracking workbooks.
Special Oils
Actual viscosity vs temperature for special oil formulations.
Trans Oil Viscosity
Viscosity vs temperature for various trans oils.

Physics & Chemistry
HyperPhysics
An interactive physics tutorial encompassing a wide range of technical topics with interactive calculation of equations.
HyperChem
An interactive chemistry tutorial encompassing a broad range of chemistry concepts.

Soil Analysis

Soil Composition
Determination of soil composition for off road racing.

Structural
Abrasives
Technical information for honing, lapping and micro finishing using various types of abrasives (Sunnen, BRM, etc.).
Surface Finish
Conversion table and definitions for measurement of surface roughness.

Cylinder preparation
Cylinder Honing
A tutorial on the proper cylinder honing techniques to obtain optimum ring sealing with minimum cylinder and ring wear.
Cylinder Geometry
Procedures for cylinder measurement and evaluation.
Cylinder Rating
Program used for rating and evaluation of cylinder preparation.

Fasteners
Fastener Corrosion
Description of types of fastener corrosion.
Galvanic Couples
Corrosion due to dissimilar metals.
Bolt Clamp Analysis
Calculates proper torque values and clamping forces for various grade bolts, washers and clamped material.

Machining
Tap Drill Sizes
SAE/metric conversion chart for tap drill sizes. Print it out and place in your machining center.
Tube Spinning
Calculations to determine final size of spun tube.

Materials
Properties
E-modulus, G-modulus, shear, elasticity, density, coefficient of expansion for a variety of structural materials.
Brinell Hardness
Hardness conversion tables and charts for Brinell to Rockwell A-F scales. Includes instructions for homemade hardness tester.
Tubing
Tubing wall thickness chart.
Wire & Steel Gauge
All you need to know about Wire and sheet gauge standards.

Metals

Aluminum
Physical properties of wrought, cast, heat treated, and various aluminum alloys, including mill specs.

Hot Strength
Temperature to tensile strength sensitivity for alloys of aluminum at various temperatures.

Alloy Steels
Physical properties of cast alloy, low alloy, wrought, and nitrated wrought steels.

Carbon Steels
Properties of carbon steels including cast, carburized, hardened and free-cutting/wrought steels.

Tempering Temps
Tempering temperatures, heat color and spark tests of steels.

Cast Irons
Properties of cast irons; gray, malleable, nodular/ductile, white/alloy, iron based super alloys and wrought steels.

Specialty
Properties of specialty steels; high and low temp, heat resistant and ultra-strength wrought steels.

Stainless
Properties of a wide range of stainless steels.

Nonferrous Metals
Properties of many metals and their special alloys including; aluminum, cobalt, copper, lead, nickel, magnesium, precious metals, tin, zinc and more.

Structural Mechanics

Beams Bending
Point load and center load of round beams.

Torsional Tubes
Torsional deflection of solid and hollow round beams.

Suspension

Dynamic Suspension Analysis

Shock Analysis
Calculates shock motion, velocity, frequency, critical damping, viscous and coulomb damping values for any spring / shock combination.

Suspension Dynamics
Calculation of basic motion resistance and vehicle mass distribution.

Kart Chassis Design
Discussion of torsional tubular plane of kart chassis including camber flex, torsional deflection and sprung mass.

Ride Rate
Calculates effective ride rate from spring and tire spring rates.

Springs

Anti Roll Bars
Design your own anti-roll bars and evaluate their rate, weight, natural frequency, and torsional stiffness.

Coil Springs
Suspension coil spring design program determines spring rate, displacement under load, coil bind, natural frequency and more.

Leaf Springs
Calculates rate and frequency of single or stacked leaf springs.

Torsional Coils
Calculates spring rate of torsional clock springs.

Torsion Bars
Calculates rate and frequency of torsion bar springs for solid or hollow, round or square bars.

Steering

Steering
Descriptive analysis of steering geometry.

Acker Rack
Calculates Ackerman steering effects for rack and pinion steering for any steered angle.

Acker Bell
Calculates Ackerman steering effects for bell crank steering for any steered angle.

Geometry
Fundamental dynamic steering geometry relationships (caster, camber, SAI, slip angle, scrub radius, tire trail, contact footprint, etc.).

Suspension Total Rate
Calculates suspension total spring rates including springs, bars, tires, roll couple and all frequencies.

Thermodynamics

Thermal Properties
Thermodynamic properties of various materials including liquids, gasses and solids.

Thermodynamics
Calculates radiant and conductive heat transfer.

Tires

Tire loading forces
White paper discussion of tire friction coefficients, slip angles, corner stiffness, tire spring rates, vertical loading and grip.

Off Road tires

Roll resistance
Calculates tire rolling resistance on soft ground such as dirt or snow.

Road tires
Avon Tire Spring Rates
Spring rates for selected Avon tires at various tire pressures.

Track and corner analysis
Cornering Truths
Stringline and raceline analysis and absolute truths regarding maximum cornering performance.
G Forces
Analysis of lateral, longitudinal and combined G forces that make up operational limits of any vehicle.
Equations
Basic equations of linear and circular motion.

Speed vs Radius vs G
Graphical relationship between corner radius, vehicle speed and lateral G force.
Car test
A track simulation program that permits entry of vehicle specifications and will calculate lap times for a large number of race tracks. Useful to estimate the value of performance modifications.

Track maps
Track Analysis
Using properly drawn scaled track maps, maximum and minimum corner speeds and gear ratio can be determined very accurately. Current tracks include:

AutoBahn
Blackhawk Farms
Barber Motorsports Park
Brainerd
Fontana
GingerMan
Heartland Park
Long Beach
Mid Ohio
Miller Park
Moroso
Portland
Putnam Park
Road America
Road Atlanta
Sebring
Watkins Glen

Vehicle Dynamics
Vehicle dynamics
Analysis of vehicle cornering forces, balance, grip and SAE vehicle co-ordinate system.

Weight Transfer
Calculates dynamic weight transfer based on loading, gravity centers, aero forces and roll couples.

Acceleration
Acceleration
Determines aero, rolling parasitic losses and predicts terminal velocity for any torque curve, gear ratio, tire size and aero shape.
Gear
Calculates and inventories gear ratios for reference.
Multigear Auto
Modern gearing analysis using torque curve, vehicle weight and aero, rolling and driveline losses, and tires to determine acceleration and speed in each gear.
Multigear Moto
Multigear Auto concept expanded to include reduction gearbox found on some motorcycles.
Multigear Snow
Applies Multigear Moto concept to CVT clutches.

Snow Pro Clutch Slip
A discussion and analysis of CVT clutch ratios, actual and apparent as influenced by clutch belt slippage.

Aerodynamics
Air Density Calculator
Calculates air density for any altitude, barometric pressure, temperature and humidity.
Coast Down
Estimates aerodynamic drag coefficient and tire rolling resistance from vehicle coastdown speed data.
Drag Force
Determines the aero drag forces at any vehicle speed.

Vibration & Balance
Balance Holes
Predicts effect on balance of holes drilled into a disc.
Polar Moments
Calculates rotational inertia from disc size and speed.
Rotational
Calculates moment of inertia from rotary pendulum.

Vibration
Sine Wave
Programmable sine wave generator. Multiple waves demonstrate superposition principle.
Tire Vibration
Natural frequencies of suspension, tires and wheels.
Vibration Analysis
Basics of vibration theory and analysis.