How to Select the Proper Engine Dynamometer

Water Brake, Eddy Current and AC Engine Dynamometers

Selecting any SuperFlow Engine Dynamometer, whether it be water brake, eddy current or alternating current (AC) motor load has the same general guidelines and typically comes down to four main factors: the RPM requirements, the torque requirements, the control tolerances and the test requirements.

Water Brake Absorbers

Water brake dynamometers use a hydraulic brake that converts the energy produced by the engine into heat transferred to the water flowing through the dynamometer. There is a stationary side (stator) and a spinning side (rotor) each with cup shaped pockets that transfer water from one side to the other. An automatic control valve bolted to the dynamometer controls the amount of water in the dynamometer based on the test requirements to produce the required load against the engine.

The major advantage of water brake absorbers is that they offer a wide dynamic range meaning one dynamometer can test a wide range of engine speeds and engine torques – the SF-902S dynamometer for example is rated for 15,000 rpm and up to 1,250 lb.ft of torque, however it can also easily test small single cylinder engines that make less than 40 lb.ft. of torque. Water brake dynamometers are also the most economical type of absorber for dynamic testing making them great for a wide range of applications from testing internal combustion engines to electric motors.

Eddy Current (EC) Absorbers

Eddy current dynamometers use an electromagnetic brake to load an engine. A rotor spins inside a magnetic field created by energizing a stationary coil. The spinning section creates resistance to the magnetic field thus applying load to the engine. This process turns energy from the engine into heat in the rotor which is dissipated by cooling water flowing through the absorber.

The major advantage of water cooled eddy current engine dynos is their precise and rapid load control. Varying the energy supplied to the coil can adjust the load from zero to 100% in a few milliseconds and the adjustment can also be very precise. The drawback to eddy current dynamometers is they are typically 40-60% more expensive than a water brake dynamometer and their dynamic range is narrower as well. This means eddy current dynamometers are typically selected for more specialized testing.

Alternating Current (AC) Absorbers

Alternating current (AC) dynamometers use an electric motor to load an engine. When configured with a regenerative drive the energy the motor absorbs can be converted into electrical energy and returned to
the power grid, reducing the cost of testing over time. AC dynamometers offer both excellent steady state and transient control. An additional benefit of AC dynamometers is, in addition to loading an engine, they can also motor an engine to simulate the inertia of a vehicle motoring the engine down a hill or performing tightly controlled transient simulations like those required in a government mandated emissions drive cycles.

Selecting the Type of Absorber
With an understanding of how each type of dynamometer creates load and some of their advantages for different types of testing we can discuss the remaining factors we need to understand to select the proper absorber.

1. **RPM and Torque** – it is always helpful to have a torque curve of the engines you want to test – comparing engine torque to dynamometer torque across the speed range allows us to quickly determine the available absorbers for a project. Sometimes the complete torque curve isn’t available - at a minimum we need to know peak torque and the RPM it occurs at as well as the speed range the absorber will need to accommodate. We recommend a 15 to 20% safety margin (depending on the type of absorber) between the dynamometers torque curve and the engines torque curve to allow the dynamometers control system room to maintain control of the engine and for instances where some engines inevitably make more power than expected.

2. **Control Tolerances** – modern electronics have advanced the control tolerances available to water brake dynamometers a long way in recent years. SuperFlow’s dual valve control system found on both the SF-Powermark dyno and SF-Blackwidow dyno can produce steady state control of +/- 10-20 RPM and it also allows us flexibility to use different control strategies to choose the best one for a given application. Both eddy current and AC dynamometers will have much tighter control in both steady state and transient testing than a water brake dynamometer – here we could expect +/- 2 RPM or better depending on the prime mover.

3. **Test Requirements** – all three types of absorbers can perform steady state, step, sweep and transient test profiles. SuperFlow’s WinDyn Data Acquisition and Control System allows users to select the desired profile, input parameters for starting and ending points and ramp or step times and then execute the test. Additionally, track lap data, emissions drive cycles and other transient profiles can be input into the software and run on the dynamometer. Again, only the AC dynamometers are capable of motoring an engine for inertia simulation so any requirement for a drive cycle of other emissions test profile would require an AC system.

Contact SuperFlow for System Prices
Combining the overall application requirements for speed, torque, control, and test requirements leads us to the correct power absorber and dynamometer system. Our sales engineers are trained to listen to the application, ask questions when needed and help you select the proper equipment for an economical solution for your project. If you have an engine testing need you’d like to inquire about call us at 800.471.7701 or contact us online at SuperFlow.com.