DYNADRIVE

The Asynchronous Approach to Testing
ROTRONICS TEST BENCHES

For almost 15 years, Rotronics has been designing and manufacturing engine and chassis test benches for industry, motorsport and technical training use. The company’s experience in the fields of electronics, mechanical and software engineering enable it to offer a complete service: from design and fabrication to installation and commissioning.

Since its creation, the company has always drawn upon technical innovation to respond to the client’s needs and today offers a wide range of unique solutions. Over the years Rotronics has gained much experience in the development of asynchronous engine and chassis testing, resulting in the development of the Dynadrive test bench.

Today Rotronics offers clients its specialist expertise in order to supply high performance test equipment adapted both to their specific needs and to their budget.

The Asynchronous Approach

A Dynadrive test bench incorporates an asynchronous load/absorption unit that enables a wide range of engine and vehicle test regimes. The integration of an asynchronous unit allows a range of testing that is not possible with conventional absorption only devices, such as an electromagnetic brake. The principal benefit is the ability to apply a variable load to the engine (or chassis) test bed. This allows the simulation, with the engine at operating temperature, of the following load conditions:

- reduced load - vehicle descending a hill
- engine deceleration
- high speed low load running.

The asynchronous Dynadrive approach also offers new possibilities for the evaluation of engines and their components:

- driving an incomplete engine in order to test longevity or to measure the power absorbed by a sub assembly, the engine distributor system for example,
- driving a complete engine without combustion to measure and optimize friction losses.

A Dynadrive vehicle test bench can have an asynchronous load/absorption unit for each wheel allowing independent or linked control of load and rotational velocity. This allows evaluation of a complete range of vehicle to road interactions, for example skidding.

A further advantage of an asynchronous load/absorption unit is its performance and rapid response time when changing operating characteristics. For example its low inertia allows accelerations of the order of 10,000 revs/min/sec.

The asynchronous Dynadrive test bench allows a full range of engine / vehicle operating conditions to be simulated. Any sequence of operating conditions can be programmed; such as those required for pollution testing, or the reproduction of operating conditions as measured by vehicle on-board data-acquisition systems.
The components of a complete Dynadrive solution

**The asynchronous load / absorption unit:**
This unit, derived from an asynchronous AC induction motor, is adapted for integration to the test bench. Models of different power ratings are available; from a few KW up to several hundred KW, with rotational velocities reaching 10,000 revs/min.

For absorbing very high power outputs a supplementary electromagnetic brake can be added; a configuration referred to as a “Tandem machine”. This allows the use of a lower specification asynchronous unit and hence provides an economic solution.

There are three general load/absorption solutions:
- low inertia, for application requiring high rotational velocity and acceleration,
- high torque, for testing diesel engines or for vehicle test benches,
- high power for large capacity engines, diesel or motorsport applications.

**System control electronics:**
A central electronic system controls the test bench components, the asynchronous load /absorption unit(s) and, in the case of a Tandem machine, manages the synchronization of the electromagnetic brake. The system, constructed by a renown specialist in the control of asynchronous motors, has been developed by Rotronics for test bench use. This electronic unit manages the flow of electric power in both load and absorption modes of operation.

**Power measurement:**
Power is generally measured by an in-line torque meter in order to obtain rapid and precise values. However, if the machine allows it, a torque arm can be installed to measure power by the classical method using a load sensor.
Energy dissipation:
Whereas a test bench equipped with a conventional electromagnetic brake uses water cooling, an asynchronous load/absorption unit generates electricity in absorption mode. Rotronics offers several solutions for managing this by product:
- The first involves selling the power back to the national supplier. This allows the energy to be recovered however the initial capital investment may be difficult to recoup in the case of low intensity test bench operation.
- An alternative solution is to dissipate the recovered electricity through discharge resistor arrays according to the Joule effect. While less environmentally sound this solution is usually more economical and avoids the necessary administration required for selling power to the national supplier.

Test Control and management:
Control and management of testing is ensured by the Kronos software package, communicating with the asynchronous load / absorption unit via a high speed Profibus interface. The Kronos Sequencer module allows either standard or preprogrammed test cycles to be run or the simulation of specific operating conditions.

Schematics of different Dynadrive engine test bench solutions:

*Engine test bench with energy dissipation through discharge resistances.*
Engine test bench with an electromagnetic absorption unit (brake) in tandem with the asynchronous unit, with energy dissipation through discharge resistances.

Engine test bench with energy regeneration to the national grid.

Engine test bench with an electromagnetic absorption unit (brake) in tandem with the asynchronous unit, with energy regeneration to the national grid.
Applications:

**Industrial projects: For a cleaner world…**

The majority of industrial projects involve pollution reduction; an asynchronous testing approach with variable loading cycles is essential for this application, for both engine and vehicle test benches. Component and gear box test benches also benefit from this technology.

For certain applications the asynchronous test bed is a prerequisite; the development of hybrid engines being one as only an asynchronous load/absorption unit is able to drive the hybrid allowing optimization of the energy recovery phase.

**Motorsport: where simulation of extreme conditions is essential**

In the world of motorsport, the asynchronous approach to testing allows simulation of the toughest operating conditions. It enables the refinement of engine management strategies, particularly under low load. An engine management strategy for the acceleration phase can now be entirely and precisely defined on an asynchronous test bench whereas previously it was only possible during circuit testing.

Finally, asynchronous test benches allow an engine to be driven without combustion in order to measure and reduce friction losses due to its components, an essential activity when preparing a race engine. The proliferation of diesel engines in several motorsport categories also justifies the use of the asynchronous test bench.