Test rigs in industry

AD7 UK REVA 2003

Application Notes

The car industry is a major user of test rigs, such as this one at Jaguar, manufactured by Froude Consine

Application principle

Variable speed drives and motors in test rigs are used to simulate real life conditions as closely as possible for testing a variety of components and assembles during all stages of product development and manufacture.

The majority of test rigs are used in the automotive and aerospace industries, testing cars, motorcycles, trucks, tractors, racing cars, tanks, helicopters and jet engines.

AC variable speed drives are very well suited to test rig applications, as they can be used to simulate real conditions in a highly dynamic, accurate, linear and repeatable way.

They are very responsive and can stop and start quickly to replicate high speed events. For example, in an engine or transmission when the clutch is depressed, torque is instantly reduced to zero. When the clutch is released, torque is fully applied again very quickly.

Detailed description

The most common types of automotive test rig are chassis dynamometers, engine dynamometers and transmission rigs.

Chassis dynamometer testing usually employs one drive and motor per test unit axle or wheel, depending on the type of testing being performed. Typical power ranges are in the order of 7.3 to 7300 kW. Regeneration is often a key requirement. This means that the drive is able to regenerate electric power when the motor is absorbing energy or providing a load, returning this energy to the supply and reducing operational costs. The energy can also be recycled between drives, again reducing energy requirements.

Regenerative AC drives also bring a number of additional benefits: multi-pulse drive arrangements requiring bulky and expensive transformers are no longer required, additional flexibility is built into the drives and the drive provides very low harmonic distortion and unity power factor.

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Multidrive solutions are used where there is more than one motor, with the motors back-to-back for example, one motoring and the other generating. The item under test will be between the two motor shafts, with energy being re-circulated on the common DC bus from which the drives are supplied.

The multidrive supply section is dimensioned to give the required overload and acceleration as well as take account of system losses. If regeneration is not necessary, this solution can also be non-regenerative.

Required drive performance

Drives for test rigs need to fulfil a number of key requirements, of which excellent torque response is the main one. Drives are often used as torque amplifiers, so the time from the torque reference to the torque on the motor shaft needs to be minimised - the more closely the actual torque follows the torque reference, the easier it is for the control system to control and therefore the better the overall test rig performance.

Torque linearity and resolution must also be controllable over a wide speed range, as low speeds and high torques are an essential requirement when testing gearboxes and transmissions, for example.

This can be achieved using Direct Torque Control, a radically different control philosophy used by ABB, which gives the fast torque rise times and response rates required for such high performance applications and which is superior to traditional Pulse Width Modulated drive control philosophies.

Multidrives involve two motors and drives, with one set motoring and the other generating; this unit is designed for the testing of cambelts

The chosen drive also needs to exhibit low noise levels and built-in safety routines, as well as features such as over-speed and direction protection.

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