

TEST BENCHES

For Automobile Industry - Axles and Transmission Gearboxes

Dynaspede is at its best when it comes to Total Solutions right from conceptualizing through implementation of application Specific machines and control systems. What sets Dynaspede apart?... is that we enjoy working long hours..... on off-the-beat concepts..... that very often results in resolving problems than solving them. Our Special Projects Group (SPG) is a multi-disciplinary group of academicians and practicing engineers, working in an institutional atmosphere and well trained in the art of looking beyond the obvious.

Test rig manufactured by Dynaspede for full load / part load testing of transmissions are broadly classified in the following concepts:

Conventional approach ... consisting of driving arrangement and dynamometer as loading device.

Advantages:

1. Simple construction
2. Simple electronics

Disadvantages:

1. Not an energy efficient method. The power is dissipated as heat.
2. Connected load is high

AC regenerative type ... consisting of an AC motor to drive the input of test object at adjustable speeds and a loading device consisting of an AC induction generator in tandem with a digital AC drive to regenerate the testing power back into the system. Dynaspede has done considerable work on this form of test systems.

Advantages:

1. Energy Efficient System - Power only to the extent of overcoming frictional losses and conversion losses will be consumed. However, the extent of energy saving will be far less than the savings in Di_Vector technique.
2. Relatively Low Maintenance System – As both the driving and loading motors are AC motors, replacement of carbon brushes as in the case of DC motors is eliminated making the system more reliable for endurance tests as compared to DC regeneration form of loading. .

Disadvantages:

1. High Connected Load – Though the power consumed is only to the extent of overcoming frictional & conversion losses, connected load is high. Two numbers AC motors rated higher than the engine power & corresponding AC drives are required.
2. Complex Electronics – Two numbers digital AC drives rated higher than the engine rating will be required along with associated synchronizing circuitry.

Di-Vector technology based transmission test rigs

Presently under Patent formalities, **Di-Vector technology** provides an elegant and cost-effective means for load testing of gearboxes, cardan shafts and virtually any form of *power transmission components*. It is the result of Dynaspede's long search for a neat engineering solution to the taunting problem of inadequate *installed power* capacity, often imposing a limitation on conducting load trials, *performance verification* or *design validation* on mechanical transmission components.

Di-vector technology is a big leap forward from the well known 4-square method of load testing such components. A test set up implemented on Di-Vector technology does not require any more power for full-load (or overload) testing of a component, than what is needed for its no-load testing. In other words, the test component can now be artificially loaded up to its rated power by remote, independent and infinite control of speed and torque ...even under dynamic conditions with significant reduction in testing power and installed capacity.

This design is based on the novel and proprietary concept of deriving the speed and torque from two independent sources with no interaction between the two. In this concept the transmission elements are connected back to back are made to run at required speeds by a relatively low power motor, which has to overcome only the frictional losses in the mechanical system running at its maximum speed. The desired torque is applied from an independent source, which provides a relative twist between the two transmission elements. The torque and speed both are adjustable under dynamic and static condition.

Salient features of Di_Vector technology based transmission test rig:

Power consumed and connected load is only to the extent of frictional losses expected to be less than 30%

Proprietary loading technique is employed, which ensures Infinite control of loading under dynamic conditions from remote operator stations, which can be analogue or digital.

Bi-directional loading of transmission at full power levels.

The loading being electronic, is amenable for automatic closed loop feedback control.

Therefore, the torque developed can be continually monitored and automatically corrected against deviations due to changes in temperature and external disturbances.

The driving power is monitored by reaction torque sensor.

PC based system associated with the test rig facilitates testing of transmission for endurance in the desired loading pattern. The site conditions of the vehicle can also be simulated in the test rig under the transient load test conditions

Advantages:

1. Energy Efficient System - Power only to the extent of overcoming frictional losses will be consumed. Power conversion as in the case of regenerative systems is avoided.
2. Low Maintenance System – A single low power motor is used and the electronics is limited to a single low powered digital AC drive making the electronics involved simple.
3. Connected Load Is Low – In this system, a single low power motor will be used only to overcome frictional losses. Indirect costs of installed capacity and other incidental tariffs are considerably reduced compared to the regenerative system.
4. Two transmissions can be tested together.

Disadvantages

1. Marginally more complex mechanicals.
2. Two identical transmission elements are required.

TEST BENCHES For study of Transmission Gear Box

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Dynaspede offers a wide range of custom built test benches for endurance and production line testing.

TEST BENCHES designed and manufactured by Dynaspede include:

- Load testing of Engines.
- Engine friction monitoring
- Endurance testing or production line testing of Mechanical transmissions Viz., Gear boxes, Belt transmission, Chain transmission, Axles etc.
- Load testing of starter motors
- Load testing of wiper motors
- Testing of window regulators
- Performance evaluation of Alternators
- Test benches for defence and R & D institutions.
- Load testing of Pumps.
- Customised requirements.

SYSTEM COMPONENTS for Test Benches Offered by Dynaspede include:

- Variable speed drives.
- Dynamometers
- Force and speed sensors.
- Dynamic loading system for 4 square test benches

OBJECTIVE: Objective of this test bench is to perform production line load testing of transmission gear boxes at variable speeds and variable loads. The test bench is designed and manufactured with emphasis on conservation of power and low cycle time.

INTRODUCTION:

In the production line, routine testing of automobile gear boxes are carried out to check for abnormal noise in each gear position at adjustable speeds and loads. Flushing and running-in test is also carried out in production line for deburring of gears. Conventionally drive and brake combinations are used for testing of gear boxes, wherein the entire braking energy is dissipated as heat.

Dynaspede test rigs for production line are designed and manufactured to meet all the requirements of routine testing with emphasis on cycle time and conservation of power. Dynaspede employs AC regenerative system in such test rigs. In the AC regenerative form of test rigs, power only to the extent of overcoming frictional losses will be consumed. Moving contacts like slip rings and brushes as in the case of DC regenerative systems is eliminated in this concept, thereby, increasing the reliability of the system.

TEST SETUP:

Mounting Structure:

The mounting structure is a sturdy floor mounted mechanical structure designed for low vibrations to accommodate fixtures to mount test gear boxes and all the test rig elements.

Gear Box Mounting Arrangement:

The gearbox mounting fixture is provided with a machined base with mounting bracket for flange mounting of the gear box under test. To reduce the cycle time, quick clamping arrangement is provided.

Drive Arrangement:

The driving unit consists of a suitably rated AC induction motor speed controlled by an adjustable speed, microprocessor based digital AC drive.

Loading Arrangement:

Dynaspede's exclusive AC dynamometer, which is a combination of an AC motor with an integrally mounted magnetic particle torque valve forms the loading arrangement. Built-in speed sensors provided, track and control the slip speed between the input and output speeds of the torque valve for adjustable loads.

Torque Monitoring Arrangement:

Dynaspede's exclusive in-line torque transducer is used to continuously monitor the braking torque.

Speed Sensors: Dynaspede 3 phase AC tachogenerator, suitably positioned on the test bench, is used to monitor / measure the speed.

Oil circulation and filtration arrangement: Oil circulation and filtration arrangement with quick acting hydraulic connectors is used for circulation of oil to the test gear boxes.

Control System: The control system continually tracks the speed at the torque valve and controls the synchronous speed of the motor to maintain it marginally below the driven speed. The braking torque is precisely settable on the magnetic particle torque valve. The torque thus transmitted through the torque valve reflects on the AC motor, tending to drive it beyond the synchronous speed and thus acting as an induction generator, providing an easy means of regenerating the braking power back into the system.

Automation: PC / PLC based system are offered to automatically control the sequence of operation and monitor the test parameters.

Questionnaire For Transmission Gear Box Test Rig

1. Details of the gear box:

Input power..... Input speed..... Input torque to gear box..... Output torque from the gear box.....
For deciding on the fixture arrangement, we need: Gear box dimensions..... Gear box weight.....

2. The transmission ratios of the gear box:

No. of forward gears..... Ratio of each forward gear..... Ratio of reverse gear.....

3. Details of Intermediate / Auxiliary gear box, if any:

Input power..... Input speed..... Output speed..... Ratio.....

4. Tests desired to be conducted:

- * Load test (Specify the maximum percentage of gear box loading required during test.):.....
- * Noise level test: (Instrumentation required for conducting noise level test.).....
- * No load test:
- * Details of other tests to be conducted.....

5. Automation:

- * PLC based control system
- * PC based control system
- * Control system without PLC & PC
- * Any other automation required.....

6. Instrumentation required for the test rig:.....

7. Test parameters to be monitored:

- * Torque
- * Speed
- * Power (Can be monitored only with PLC or PC based system)
- * Any other parameter to be monitored.....

8. Accuracy of measurement:

9. Test set up required for: * Endurance test * Type test * Routine test

10. Test cycle time:

Total cycle time including loading / unloading the gear box from the test rig.....
Actual time of gear box testing.....

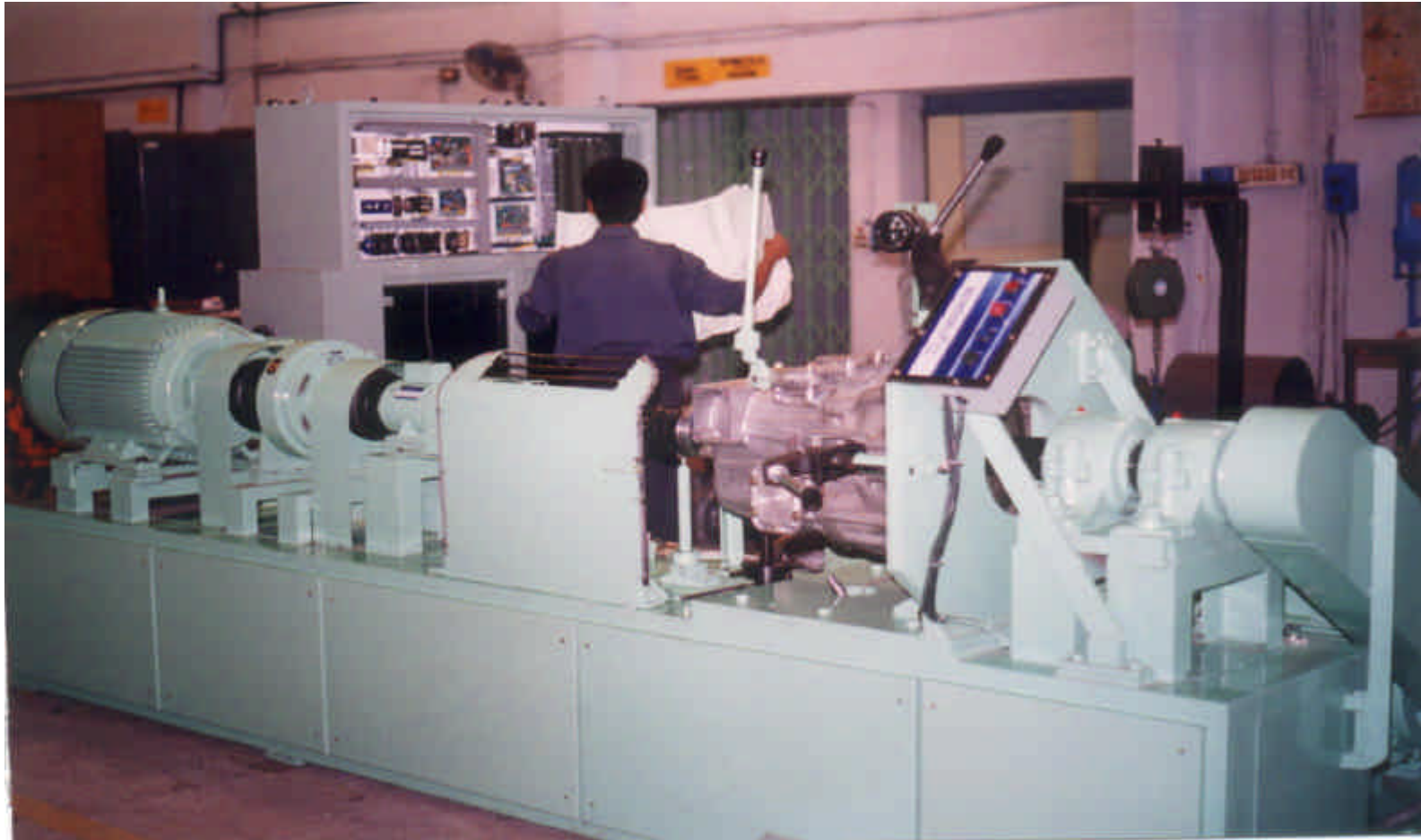
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**TEST BENCH FOR PRODUCTION LINE TESTING OF THE TRANSMISSION
GEAR BOXES BASED ON THE CONCEPT OF AC REGENERATION**

Production line transmission test rig

TEST BENCHES For Endurance Testing of Transaxles

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SYSTEM COMPONENTS for Test Benches Offered by Dynaspede include:

- Variable speed drives.
- Dynamometers
- Force and speed sensors.
- Dynamic loading system for 4 square test benches

OBJECTIVE :

The objective of this test bench is to perform endurance testing of transaxles at variable speeds and variable loads with emphasis on conservation of power and reduction in installed power.

INTRODUCTION:

In the conventional approach, the trans-axle is driven from an adjustable speed electric motor and the loading device for exerting braking torque on the test unit is used. The testing power drawn from the electric motor is almost wholly absorbed in the loading device which, in effect, is a braking unit that dissipates (wastes) this energy into heat.

In the regenerative system the braking energy is regenerated back into the mains, thus the power consumed is only to the extent of overcoming frictional and conversion losses. However, indirect costs of installed capacity and other incidental tariffs are applicable in all forms of regenerative system.

In the present case the same full-load test conditions of the transmission element can be achieved from a power source just adequate to keep the test bench running under no-load. This condition, which demands only a small power to overcome the frictional and mechanical imperfections in the machine, is just what Di-Vector technology promises to approach.

Dynaspede's proprietary Di-Vector technology is a step ahead of the popular 4 square method of testing for power transmission components. This technology, (presently under patent formalities) was developed and field tested by Dynaspede as an energy efficient alternative for full load testing of power transmitting components operating under varying load profiles and duty cycles. This concept provides the driving power, self generated within a synchronously driven mechanical loop, without the need for additional power except to overcome static losses in the system.

TEST SETUP:

Mounting Structure:

The mounting structure is a self-supporting, floor mounted bed designed for low vibrations to accommodate the test transmission units, driving system, torquing system and transducers.

The transmission assemblies are flange mounted on to the test bed by means of interchangeable adapter plates. The sprockets are fastened to the wheel shaft ends of transmission assembly and transmission chains are used to connect the sprockets, thus completing the mechanical loop.

Drive Arrangement:

The drive arrangement consists of a suitably rated AC induction motor, speed controlled by an adjustable speed, microprocessor based digital AC drive.

Loading Arrangement:

The torque is infinitely and electronically controlled by a torquing device. The torquing device capable of introducing the desired system torque, is essentially a combination of heli-planetary form of transmission and a motorized torque source. When such a torquer is introduced in the path of closed loop and synchronously driven mechanical loop, the system torque can be remote controlled both under static and dynamic conditions. Thus the system velocity and torque can be vectorially controlled by conventional automatic feed back control techniques.

Torque Monitoring:

A high accuracy In-line brushless rotating torque transducer monitors the load torque both under static and dynamic conditions and for feed back.

Speed Monitoring:

Dynaspede AC tachogenerator is used to monitor the speed and for feed back purpose.

Control System:

PC based control system serves all the control needs of the Test Bench. The PC console houses all digital controls and peripherals such as the PLC, PC, Colour Monitor, keyboard and track ball. The system automatically sequence the various tests according to a prescribed program and stores the results of tests in tabular and graphical display.

Questionnaire For Transaxle Test Rig

1. Details of the Transaxles:

Input power..... Input speed..... Input torque to Transaxle..... Output torque from Transaxle.....
For deciding on the fixture arrangement, we need: Transaxle dimensions..... Transaxle weight.....

2. The transmission ratios of the Transaxles:

No. of forward gears..... Ratio of each forward gear..... Ratio of reverse gear.....

3. Details of Intermediate / Auxiliary Transaxles, if any:

Input power..... Input speed..... Output speed..... Ratio.....

4. Tests desired to be conducted:

- * Load test (Specify the maximum percentage of Transaxles loading required during test.):.....
- * Noise level test: (Instrumentation required for conducting noise level test.).....
- * No load test:
- * Details of other tests to be conducted.....

5. Automation:

- * PLC based control system
- * PC based control system
- * Control system without PLC & PC
- * Any other automation required.

6. Test parameters to be monitored:

- * Torque
- * Speed
- * Power (Can be monitored only with PLC or PC based system)
- * Any other parameter to be monitored.....

7. Accuracy of measurement:

8. Test set up required for: * Endurance test * Type test * Routine test

9. Test cycle time:

Total cycle time including loading / unloading the gear box from the test rig.....
Actual time of Transaxles testing.....

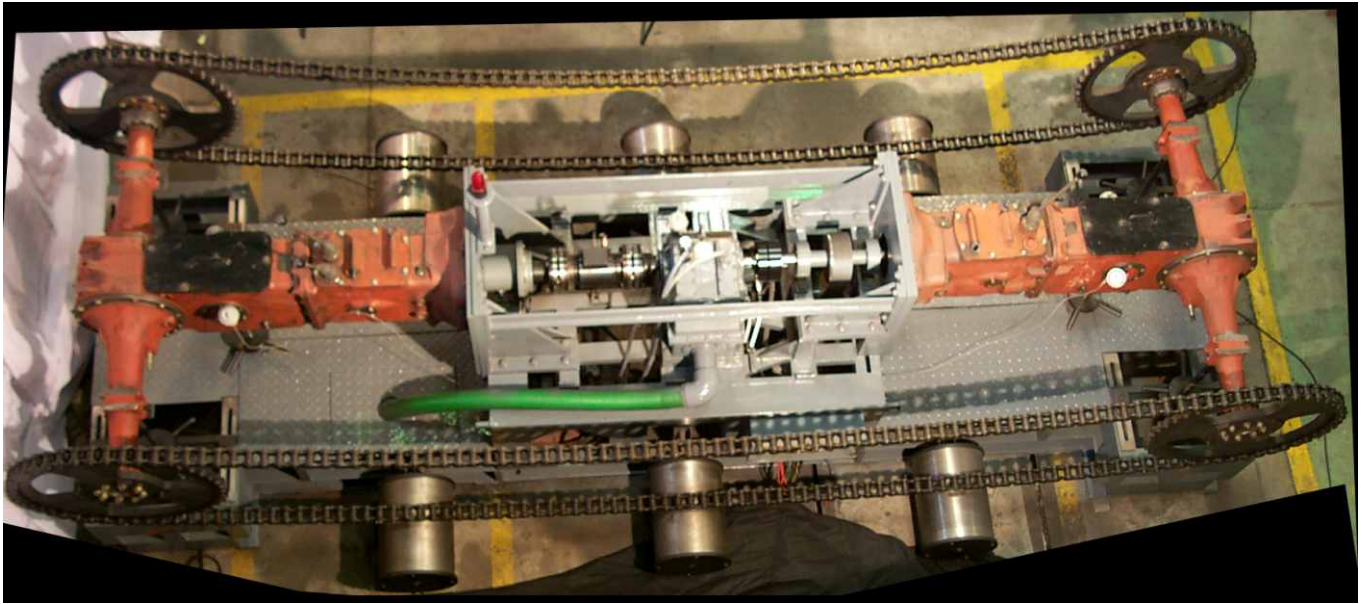
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BASED ON DI-VECTOR TECHNOLOGY**