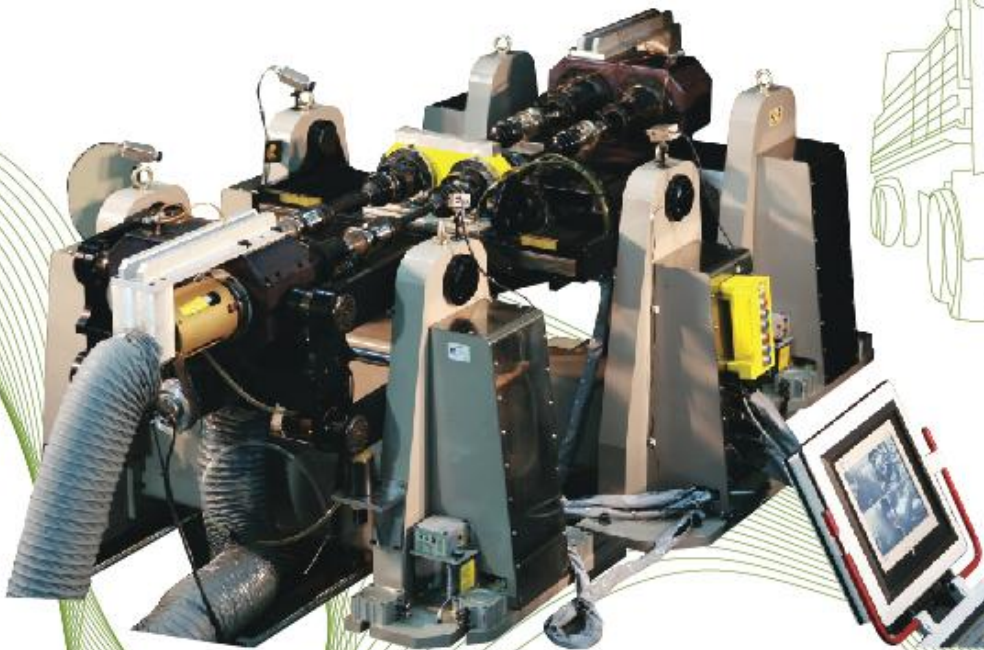


Drive Shaft Simulation System

Drive Shaft Simulation System is designed for automotive CV joint and drive shaft testing. All components are designed to handle up to 300 hp continuously or torque up to 3000 Nm or speed up to equivalent rotation speed to vehicle velocity 300 km/h. This system will faithfully reproduce speed, torque, jounce and steer motion simultaneously on four specimens. The complete assembly is dynamically balanced to operate smoothly over a whole operating speed range. This system is capable of superior simulation and block cycle testing. This system provides a high performance solution to your dynamic experiment requirements.



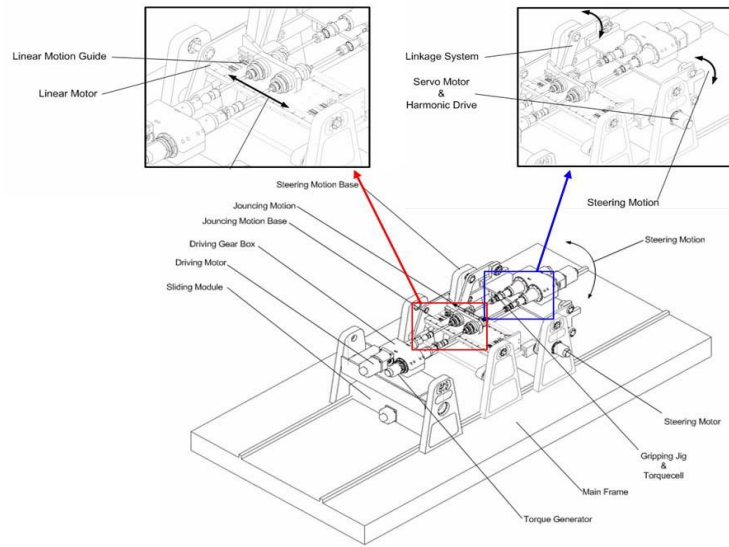


Fig. 1 Over view of Drive Shaft Simulation System

Figure 1 shows the overview of the Drive Shaft Simulation System (without the safety cover). This system is designed to use four drive shaft specimens which are for the torque loop and a road load data from the real car. The simulation works from driving motion, jounce motion, and steering motion to the specimen. The main hardware components for this system are driving section for the driving motion, jounce section for the jounce motion, steering section for the steering motion, and a torque generation section for the torque.

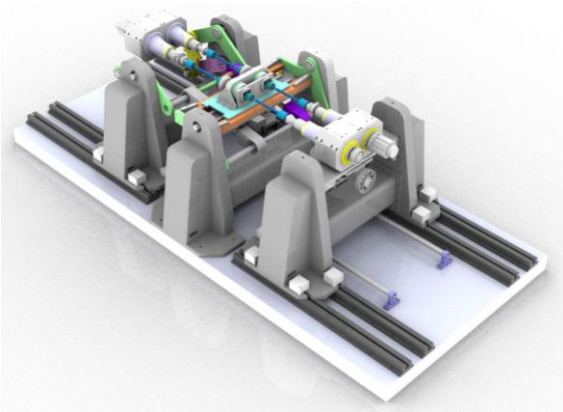


Table 1 shows the specifications for each section. In this system, the drive shaft specimen performs 300km/h equivalent vehicle speed and move up to 400mm(+/-200mm) for the jounce motion. Also, the steering motion simulates 55° (+/- 27.5 °) and the torque is +/- 3000 Nm.

Table. 1 Drive Shaft Simulation System Specifications

Driving Section	
Equivalent vehicle velocity	300 km/h
Angular Acceleration	150 rpm/s
Measuring Accuracy	±0.1% of FS
Jounce Section	
Jounce Traveling	Max. 400 mm
Jounce Velocity	2 m/s
Jounce Acceleration	15 g
Measuring Accuracy	±0.1% of FS
Steer Section	
Steering Angle	0° ~ 55°
Max. Steering Velocity	0° ~ 55° / 1Hz
Measuring Accuracy	±0.1% of FS
Torque Generator Section	
Max. Torque	±3000Nm
Torque Change Rate	50% of FS/s
Measuring Accuracy	0.1% of FS

For the option, a sensor for the rotational axial force is possible and the measurement range is 200N.

Axial Force Measurement (option)	
Load Capacity	max. 200N
Measuring Accuracy	±0.1% of FS

The following shows the detail specifications of the main modules.

Equipment Specification

Gear boxes

- High Grade Double Helical Gear
- max. Speed Capacity : Equivalent Angular Velocity to 300km/h
- max. Torque Capacity : 3000Nm
- max. Power Capacity : 300HP

Rotary Actuators for Torque cell

- Dual Torque cell for Minimize of Power Loss
- High Performance Servo Motor for Torque Generating
- max. Angle : Free
- Dynamic Balancing

Rotational Power & Signal Transmit Slip Ring

- max. Angular Velocity : more than 3,000rpm
- Electric Power Passing Through
- Dynamic Balancing

Gearbox & Bearing Lubrication

- Enforced Oil Circulation Type
- Enforced Air Blow Type Oil Cooling System

Safety Enclosure Guard

- Tunnel Type Steel Plate Enclosure Guard
- Poly-Carbonate Inspection Window

Safety Device

- Electric Power Source Leakage Breaker
- Control System Over-Load Breaker
- Motor Over-Current Breaker
- Actuator Over Stroke
- Load Cell Over Capacity
- Test Termination
- Emergency Stop

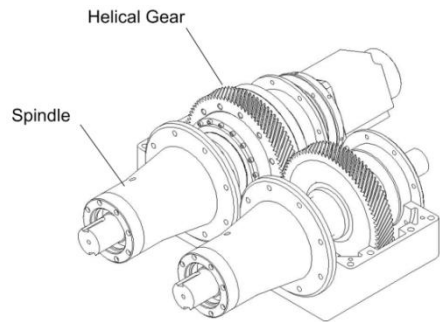


Fig. 2 Gear box section view

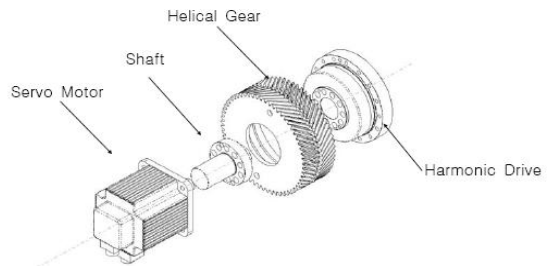


Fig. 3 Torque Generator section view

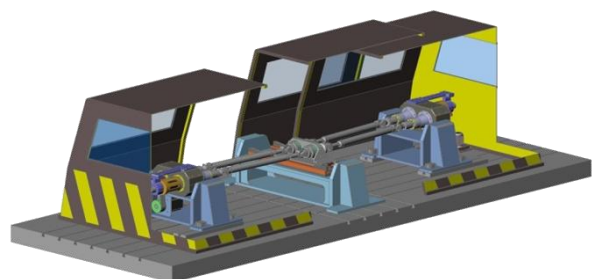


Fig. 4 Safety guard section view

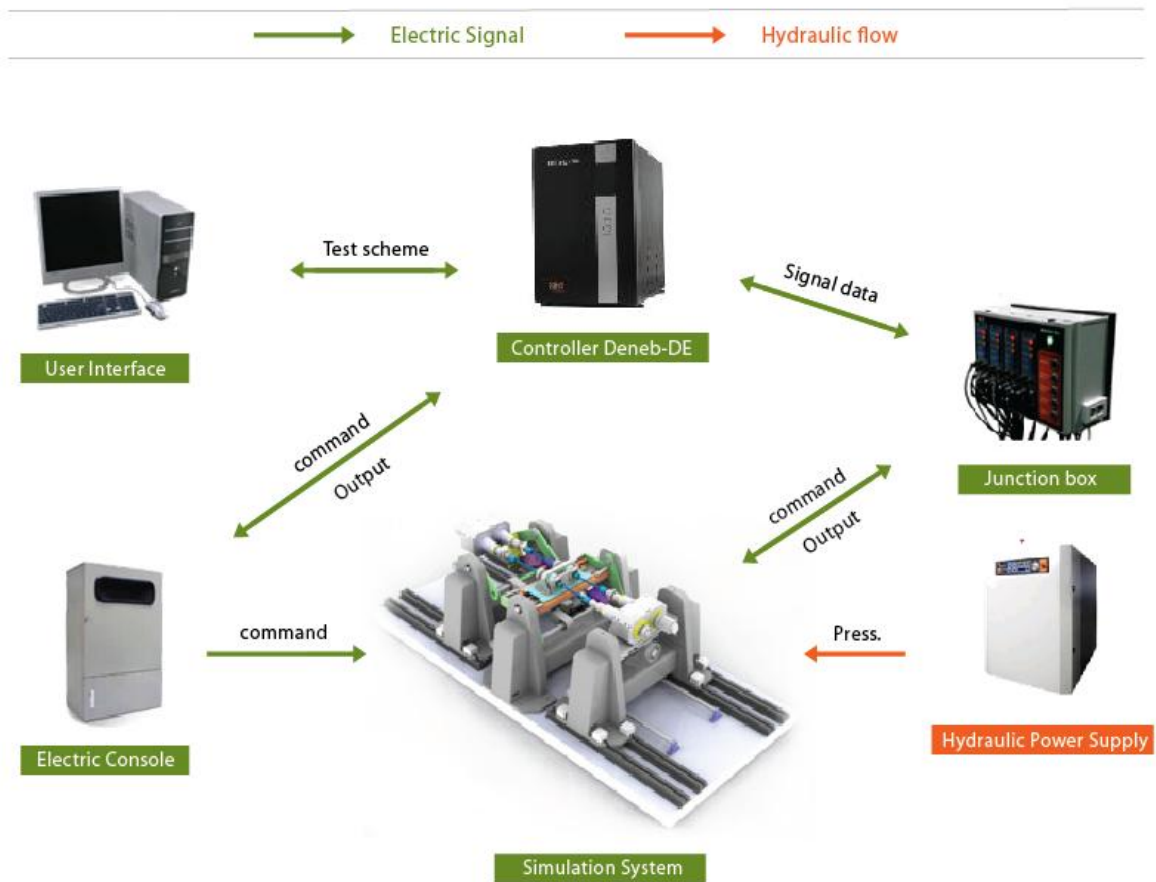


Fig. 5 Drive Shaft Simulation System Schematic Diagram

Figure 5 shows a schematic diagram of the Drive Shaft Simulation System.

The control system has two main parts which are user interface and a controller. This system has a four axes motion system including torque motor system, driving motor system, jounce motor system, and steering motor system. This simulation system is working with the above four motor systems and getting a real time feedback in a close-loop.

In order for the maximum performance, the hardware has to be composed of a user interface module(PC) and a controller for the motion control. The command from the user interface goes through

GB LAN to the controller and the data from the test is used as a real time feedback in the controller and transferred to a user interface module and showed up in the screen.

The torque from the torque generator has a torque loop that is engaged to four specimens and gets the value from a torque sensor in a driving unit.

The rpm of the driving motor is measured by an encoder signal in the motor and this is the same for the steering and jounce motion. The error of the sensor is less than 0.1% of F.S. For supplementary, a lubrication unit is used for the gear box.

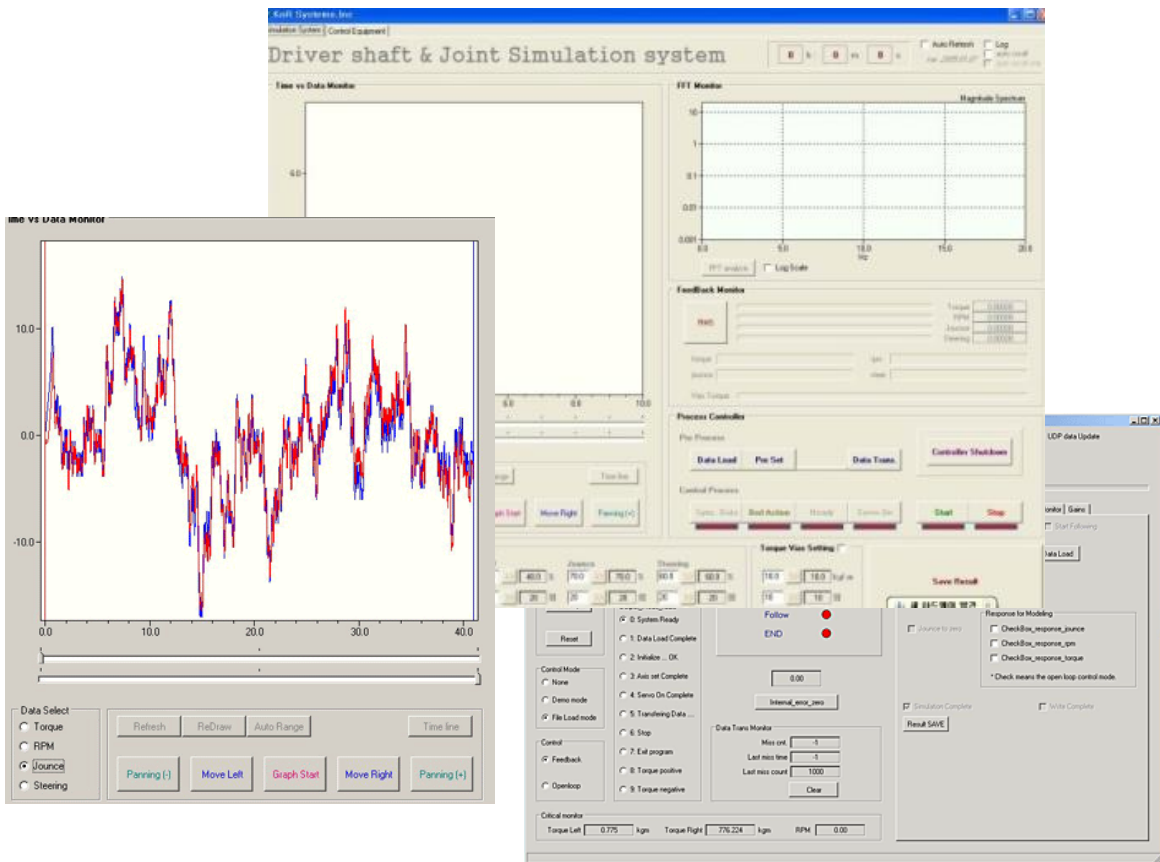


Fig. 6 Drive shaft Simulation System Software

The lubrication line is installed in serial to eliminate unlubricated area because of the pressure difference between each line. The heated lubricant can reuse after the cooling at the chiller.

There is a cooling fan to prevent increasing the room temperature and heating up the motor system from the safety guard. In addition, the circulation fan is installed at the top of the safety guard to circulate inside and outside air.

Fig. 6 is to show the Drive Shaft Simulation System's software captured screen. Our system is

organized by the user interface module and controller to control every test steps.

To simulate the road load data, the basic format is the RPC-3 with 4 channel data file.

In the main graph window, the user can select the object to show the graph which the user wants. When the test is started, the user can monitor the real time graph with the desired value (Blue line) and measured value (Red line). The area of the graph can be changed and set the limit by the user.