

# High Angle Torque Testing System

The half shaft's high angle torque test, ultimate torsion test (Static Fracture Test), and fatigue test is performed by the High Angle Torque Testing System. The system can control the steering angle, high torque, and rotation. The system uses the servo motor for the rotational drive and steering motion and uses the hydraulic rotary actuator for the high torque generation. The Deneb-DE control system is for controlling three axes feedback control. The system is designed to decrease the vibration and noise because of the high torque rotation. The computer system has automatic and manual functions for the controlling and measuring.



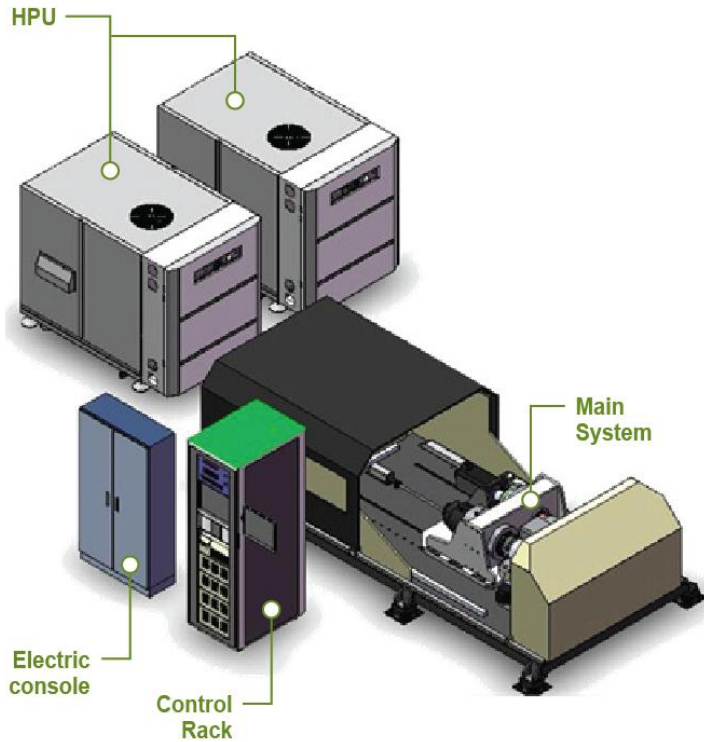


Fig. 1 Overview of Testing System

Fig 1 is shows the system's overview. There are two hydraulic power units, Electric console, Control rack, and Main system.

The two hydraulic Power Units (HPU) supply hydraulic pressure to the hydraulic rotary actuator through the service manifold and the hydraulic pressure is controlled by the servo valve. The electric console contains the drive unit of the electrical servo motor and other electrical components. The signal for the motor drive unit is controlled through the motion generation interface card. The control rack contains the controller and user interface module. The waveform and test schedule that are produced by the user interface software is transformed into signal for each module by the controller.

The sensor can measure the torque, velocity, and angle signals from the each operation module, then the signals is collected by the controller and used as feedback signals.

Fig 2 shows the overview of the main system. The main system contains the torque & driving section and steering section. The torque & driving section is placed on the position control jig for controlling position by the specimen's length (400~1200mm).

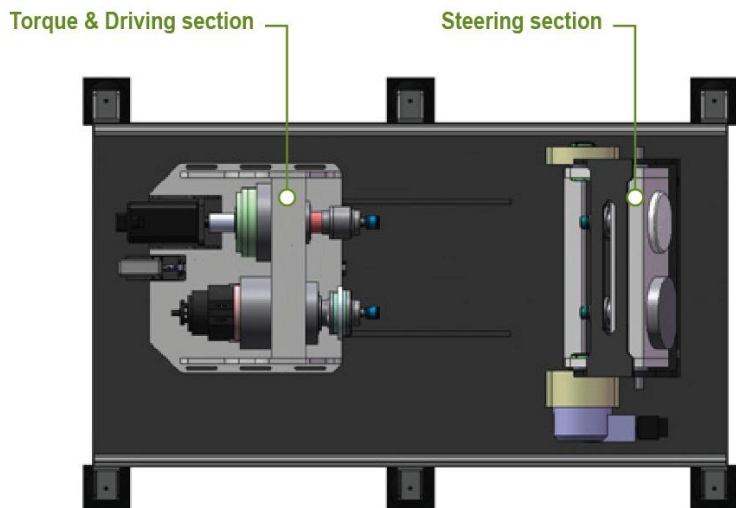


Fig. 2 Overview of Main System

### System Specification

- Torque loop system for Haft-shaft specimen testing
- Hybrid system with Hydraulic servo system and Electrical Servo System.
- Torque Generation with Hydraulic Servo rotary system
- Specimen Rotation and Swiveling motion by Electric Servo Motor
- Main Base Frame with high stiffness for heavy torque
- Driving section adjustment function with electric motor
- High Precision and wireless Torque measuring sensor included.

**Table. 1 Specification of High Angle Torque Testing System**

ITEM	Specifications	
<b>Frame</b>	Base Plate ( W X D X H )	3000 X 1200 X 1000 mm
<b>Specimen size</b>	Length	400 ~ 1200 mm
<b>Driving Adjustment</b>	Range	900 mm
<b>Torque</b>	Hydraulic rotary type	±10,000 Nm
<b>Driving speed</b>	Electric servo type	upto 50 rpm
<b>Swiveling</b>	Electric Servo type / range	0 ~ 50 deg.
	swiveling speed	10 deg/sec
<b>Hydraulic Power Supply</b>	Capacity	116lpm X 2 set

The high angle torque testing system can test the high angle torque test, ultimate torsion test (static fracture test), and fatigue test by applying the specimen rotation and torque under the specific angle which is from swiveling angle control of the haft-shaft specimen. The main system is a hybrid system which is composed by the hydraulic system and electrical system for the optimized test.

The driving adjustment function is for various specimen lengths that can change the length around the swiveling joint point. An electric motor is used for the driving adjustment and easy to move for setting the specimen.

The system has hydraulic rotary actuator (10kNm capacity) for the high capacity torque generation. The torque from the hydraulic rotary actuator transmits to the specimen by the torque loop.

The rotating section and swiveling section is using the electrical servo motor and has an appropriate reducer for each specimen. It can be operated by controller automatically and manually. The rotational speed is designed to operate up to 50 RPM for the test specification and is independent with torque. Therefore, the system is possible to supply the maximum torque at the maximum speed. The swiveling angle range is from 0 to 50 degree and the moving speed is 10 degree/sec. The rotation speed and swivel angle signals are collected through the encoder. Fig 3 is the simulation of the main frame stiffness with consideration of a variation on the maximum load.

The torque is measured by the torque cell which is in the torque loop. We install the wireless type torque cell because the system transmits the torque during the rotation. The signal from the cell is translated to measurable signals after through the signal amplifier and collected to the DAQ device at the controller.

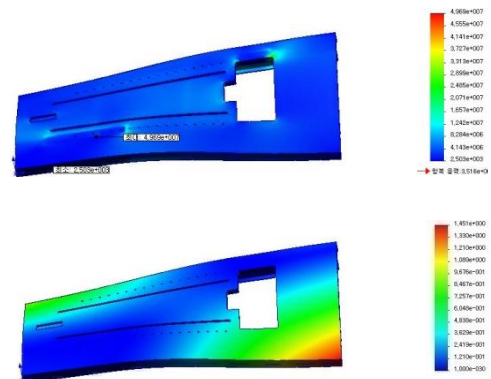


Fig. 3 Simulation Results of main frame

The system's control and user interface is organized by each independent computer system and the software is optimized for each system. Fig 4 is a schematic diagram of the torque generator which shows how to control between Server PC and Sensors through the Deneb-DE controller.

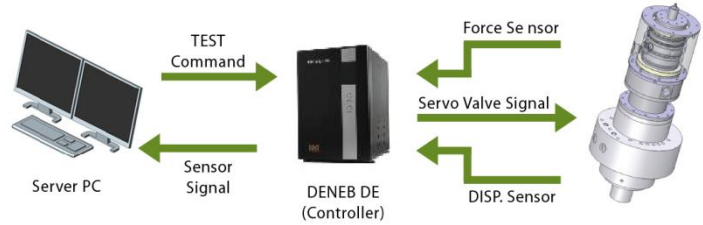


Fig. 4 Schematic Diagram of Torque control unit

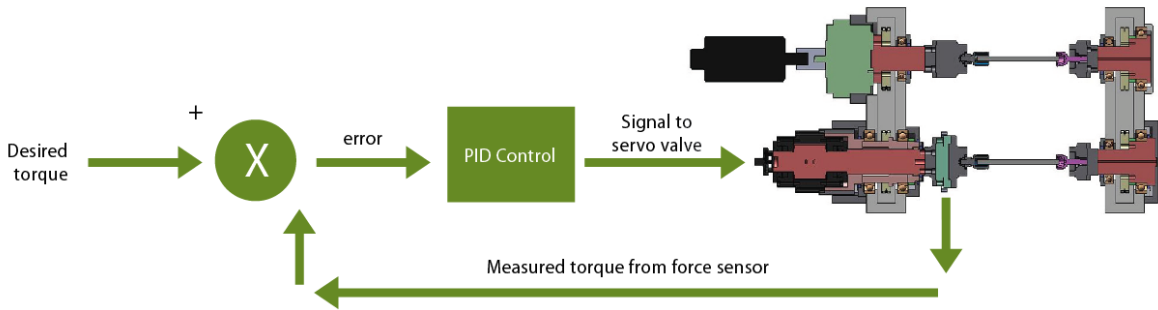


Fig. 5 FPID control loop diagram

Fig 5 is the control loop diagram. It is designed to control the same routine for the torque control, specimen rotation RPM control, and steering angle control.

The hydraulic power is used for the torque control with torque measuring sensor of the non-contact type. The electric servo motor is used for the

rotation RPM control and steering control with encoder.

Fig 6 is the operation software screen. It is based on Sabio-D for the Deneb DE controller. Sabio-D has to take pride in correct control performance and convenient GUI.

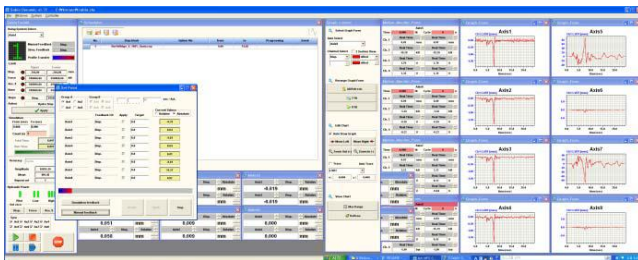


Fig. 6 High angle Torque test system Software

In addition, Sabio-D offers continuous upgrade service through the feedback from consumers. The newest technique introduces to meet condition of linear and nonlinear PID control. Also, Sabio-D has various application software.