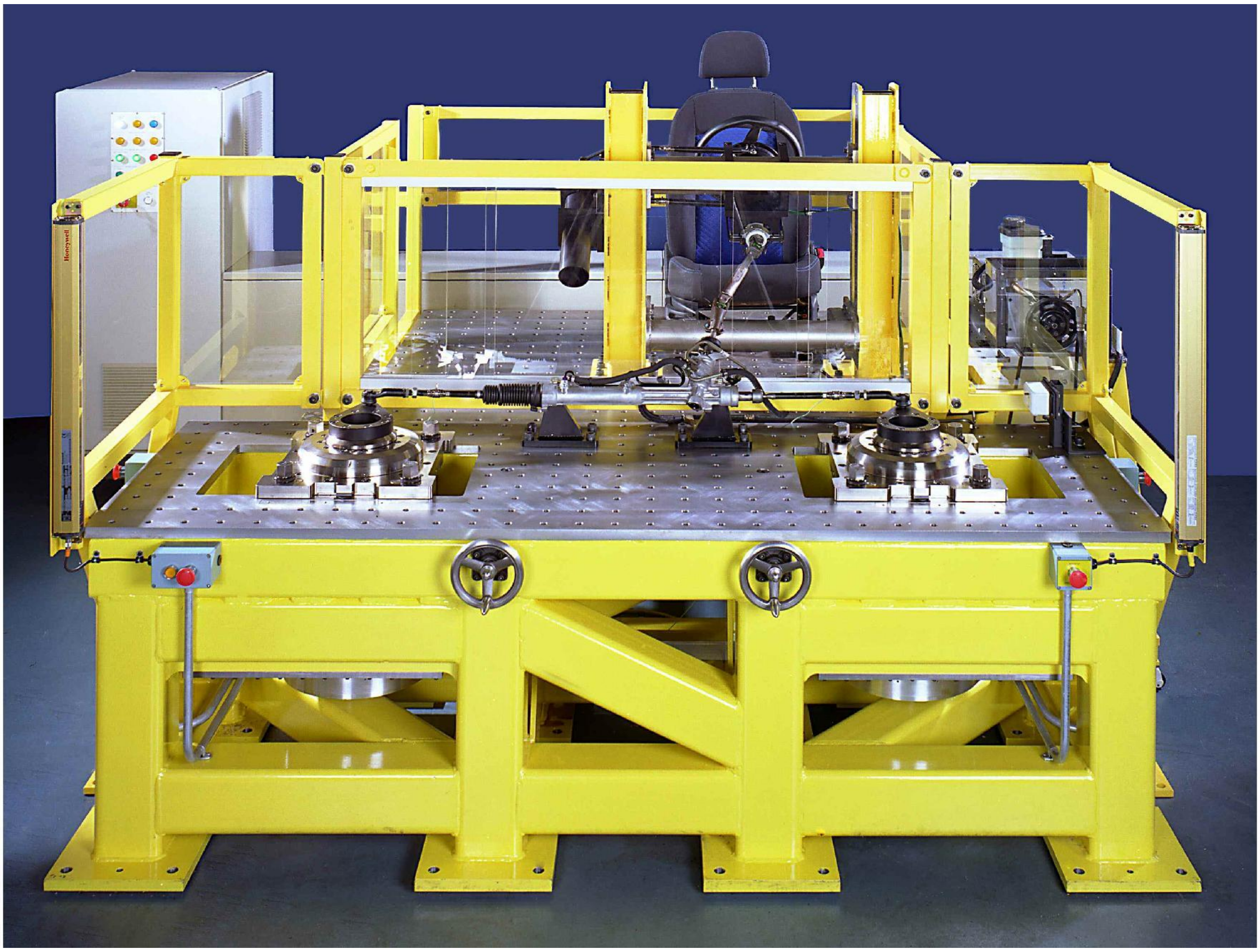
Steering System Test Machine (SSTM)

What is the SSTM?

The Steering System Test Machine (SSTM) is a computer-controlled machine for applying force and displacement inputs to a vehicle' s steering system in the laboratory. The SSTM is used to characterise steering system performance both objectively, using quasi-static and dynamic tests, and subjectively. Hardware in the Loop (HIL) testing can also be performed.



The frame of the machine allows the vehicle s steering column and steering wheel to be mounted so that manual inputs can be applied to the system (a seat is provided for the driver), and steering feedback to be measured. Optionally, the machine can be interfaced with ABD s SR30, SR60 or SR80 Steering Robots, to provide controlled position or torque inputs to the steering column.

The SSTM can also be supplied with an optional Hydraulic Power Pack to drive a proprietary vehicle power steering pump under speed control.

Testing capabilities

The rig can impart a wide variety of forces and displacements to a steering rack. Any of the 4 possible axes (2 x rack actuators, Steering Robot, power steering pump motor) can be controlled simultaneously in any combination of the available control modes; with the one obvious exception that only one axis at a time can be in position control. The rig can operate in standalone mode or in Hardware in the Loop (HiL) mode.

Command signals can be generated in a number of ways:

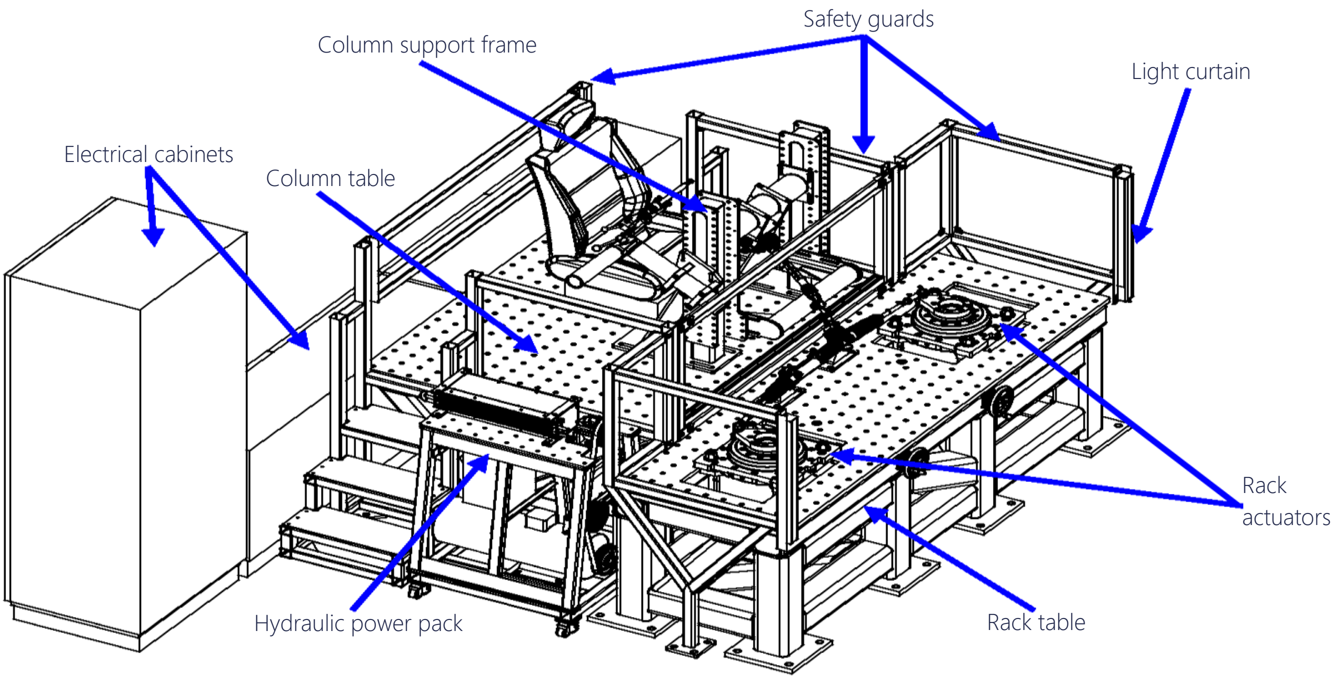
Command signal	Description
Standard template	User definable Fishhook, square wave, trapezoidal wave, pulse wave, continuous sine, linear sine sweep and constant velocity sine sweep profiles
ASCII file	Allows measured vehicle data to be used as command signals
User defined force / torque function of rack / steering wheel position	i.e. Steering feel test rack forces are generated as a function of rack position (linear, quadratic and cubic terms allowed)

Typical tests are:

Test description	Details
Open loop force control frequency sweep	Transfer function automatically displayed as Bode plot
Compliance tests	Used to determine compliance in steering system
Friction tests	Used to determine Rack, Column, and Ball-joint friction levels
Steering catch up	Used to evaluate power assistance characteristics
Steering feel	Rack forces generated as user defined function of rack displacement
Nibble	Tests that generally use recorded vehicle data as command signals
On centre	
Parking effort	

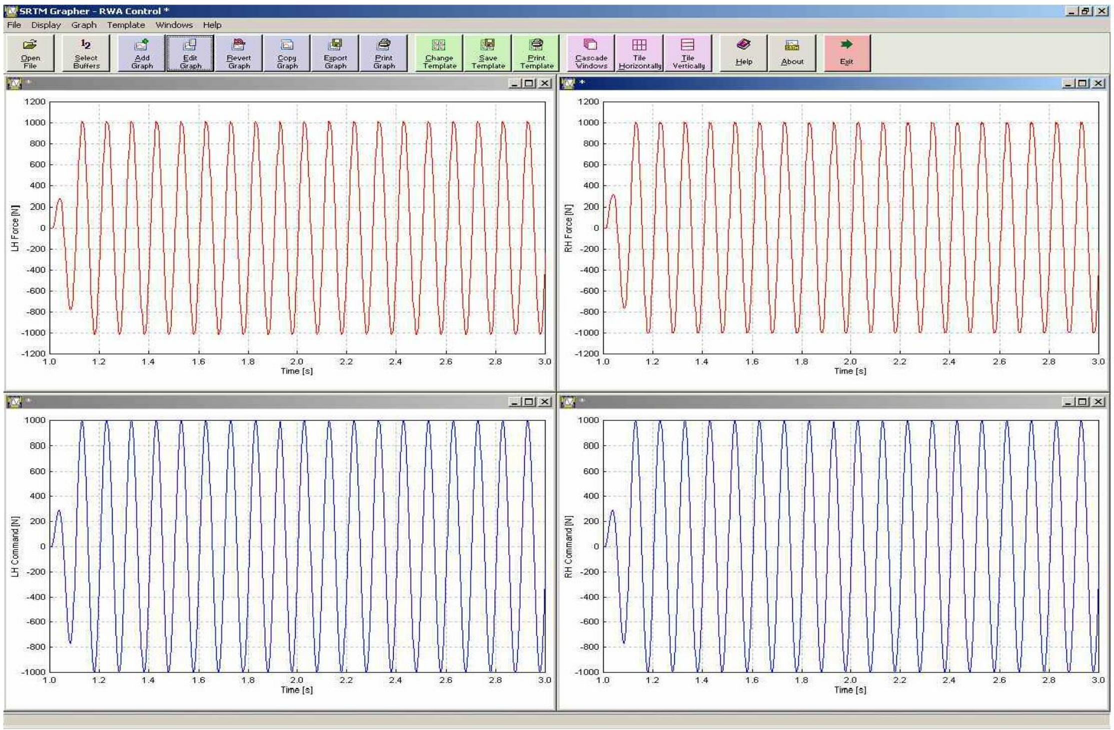
Middleton Drive
Bradford on Avon
Wiltshire
BA15 1GB England
Email: info@abdynamics.com
Tel: +44(0)1225 860 200
Release Date
5th May 2019
Document No.
SP6102
Issue No.
03

SSTM layout



Output

A flexible graph-plotting facility is provided to allow any parameter to be plotted against any other.



AB Dynamics
Middleton Drive
Bradford on Avon
Wiltshire
BA15 1GB England
Email: info@abdynamics.com
Tel: +44(0)1225 860 200

Release Date
5th May 2019
Document No.
SP6102
Issue No.
03

SSTM design concept

Rig overview

Each rack actuator consists of an assembly of two individual torque motors (Mounted to a common shaft) which are driven together to achieve maximum load output, and which can be driven one at a time for tests that require lower force output with a better force resolution. The lateral spacing of the rack actuators can be adjusted to suit different racks.

The control and integrated software suite

The machine is driven by direct-drive servo motors. These are controlled using a programmable multi-axis controller, which ensures smooth synchronised motion of the axes. The controller is interfaced to a computer, which controls the overall operation of the machine and provides the user interface. The system is designed to be highly flexible and user-friendly with help screens and pop-up selection tables to allow new test sequences to be specified quickly and easily.

The measurement system

Angular position of the rack actuators and Steering robot, if fitted, is provided by high-resolution optical encoders. Force and torque feedback is from high resolution piezoelectric load cells that are built into each of the track rods, and steering robot torque reaction mechanism, if fitted. The analogue signals from the load cell amplifiers are captured by 16-bit A/D converters (ADCs) that are integral to the servo-controller. The load channel charge amplifiers also have switchable gains to allow very high resolution for tests where small forces are applied.

Additional analogue input channels can be added to the rig s controller as an option, so that parameters external to the rig s control systems can also be recorded (up to 12 16-bit ADC channels and sixteen 12-bit ADC channels are possible); contact ABD for the viability of other ADC configurations.

Specification

Rig dimensions	Dimensions (mm)	2796* x 2213* x 1781
	Weight	3.5 tonnes
	Table surface height	800mm (excluding grout thickness)
	Maximum vertical ground loading	-0.03N/mm^2
Applied loads: rack actuator	Peak actuator torque (1 motor per actuator)	550Nm (4.4kN for 0.125m lever arm)
	Peak actuator torque (2 motors per actuator)	1100Nm (8.8N for 0.125m lever arm)
	Maximum duration for peak torque	30s (whether 1 or 2 motors per actuator)
	Maximum continuous torque (1 motor per actuator)	250Nm (2.0kN for a 0.125m lever arm)
	Maximum continuous torque (2 motors per actuator)	400Nm (3.2kN for a 0.125m lever arm)
Applied loads: force control	Force control bandwidth (-3dB)	-40Hz
	Actuator asymmetry: magnitude	±3%
	Actuator asymmetry: phase	<±2°
	Phase lag	<5ms
Displacement control	Bandwidth	-3Hz
Steering robot (SR30)	Maximum continuous steer torque	30Nm
Constant velocities	Peak rack actuator velocity (no load)	5rad/s
	Peak steer robot velocity (no load)	40rad/s

AB Dynamics
Middleton Drive
Bradford on Avon
Wiltshire
BA15 1GB England
Email: info@abdynamics.com
Tel: +44(0)1225 860 200

Release Date
5th May 2019
Document No.
SP6102
Issue No.
03