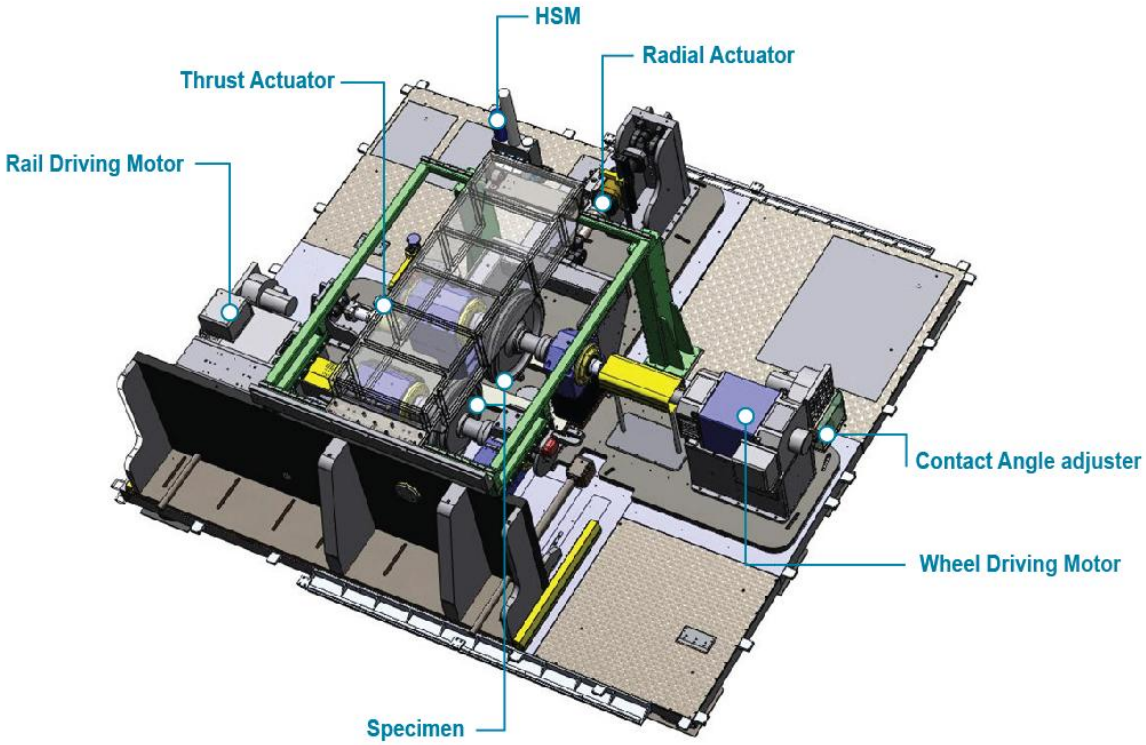
High Speed Wheel / Rail Contact Simulation System

The high speed wheel & rail contact simulation system is to analyze and measure all the matters between wheel and rail contact surface during the high speed rotation.

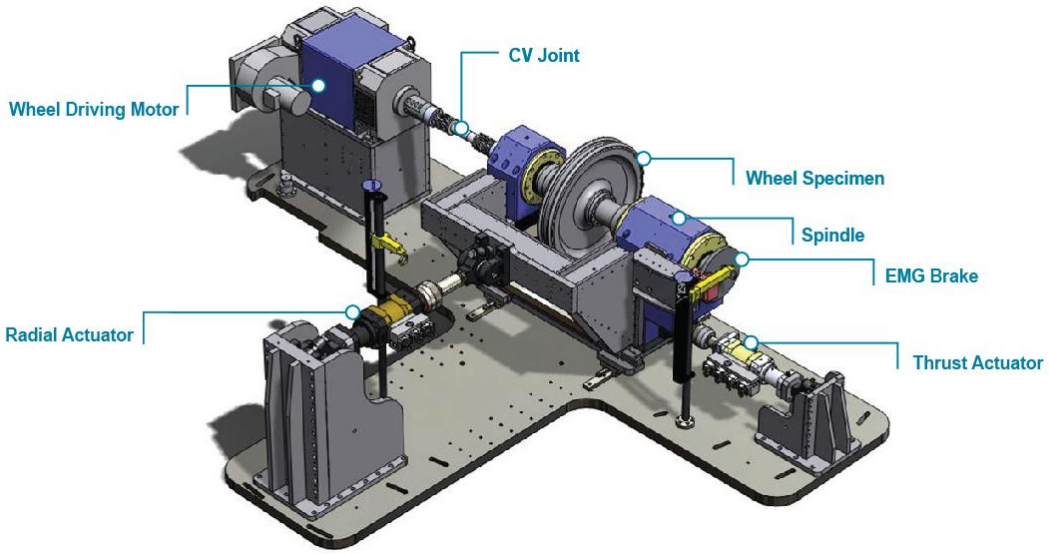
The system is organized by the main frame, wheel & rail disk specimen, wheel & rail driving motor, radial & thrust load actuator, contact angle & attack angle adjuster, EMG brake, environmental chamber, main control system, sensors, and etc.

There are various test can be done by this system such as rolling contact test (RCF test), adhesive strength test, wear test, etc. from subway to high speed train. In addition, the system has environmental simulation equipment of water, oil, air, sand injection with temperature control (-30℃~80℃).



Performance Specification

Specimen	Wheel & Rail : up to 1000mm(diameter)	
Test Speed	0~2470 rpm @1000mm(diameter)	
Radial Force	Max. 180kN, ±2.5mm@20Hz	
Thrust Force	Max. 100kN, ±7.5mm@20Hz	
Slip rate	-10~+100%	
Torque Control	1% of full scale	
Contact Angle	0~3º (1% of full scale)	
Attack Angle	-3º~+3º (1% of full scale)	
Environment	Dry, Wet, Oil, Sand, Temperature, Humidity	
Control System	Controller	rpm, Radial & thrust force, Slip rate, HSM, Environment, Laser scan
	Manual	Contact & Attack angle, Test space adjustment
Safety Device	Safety shield, EMG(motor current, acceleration, BRG temp.) CCD camera	



	Specifications
Wheel Driving Module	Motor type : AC servo motor
	Power : 355kw
	Drive shaft : Continuous Velocity (CV) joint
	High rigidity spindle
	Spindle oil lubrication system
	Speed range : 0~2470rpm at 1000mm dia.
	Radial force capacity of spindle : 180kN
	Thrust force capacity of spindle : 100kN
	Static tolerance of spindle : 150%
	EMG brake system should is included

	Specifications
Radial Actuator	Force rate : 180kN
	Hydro-static bearing type
	Stroke : ±75mm
	Dynamic performance : ±2.5mm @ 20Hz
Thrust Actuator	Force rate : 100kN
	Hydro-static bearing type
	Stroke : ±75mm
	Dynamic performance : ±7.5mm @ 20Hz

Wheel Driving Module

The wheel driving module is comprised of the 355kW AC servo motor for rotating the wheel specimen and the high performance hydraulic servo actuators (100kN and 180kN) for the radial & thrust load at the contact point between the wheel and rail. Those are around the wheel specimen in the form of T.

The motor's dynamic force is transferred to the spindle through the CV-joint for protecting the radial & thrust actuator's movement.

The spindle which is holding the specimen is designed to have high rigidity for the radial & thrust load and high speed rotation.

Every component of the rig is designed for easy setting and detaching with enough rigidity. In addition, there is a brake system to stop the wheel specimen in the emergency situation.

KNR is using the high reliability and performance hydrostatic actuator for the radial & thrust load.

The actuators are equipped with differential pressure stabilization capabilities to minimize oil column resonance effects and designed to provide minimum friction and to allow for high overturning moments. The Intima actuators utilize polymer hydrostatic rod bearings with close tolerance machining and elimination of high pressure seals. Engineering hydraulic cushions are included in the cylinder end-caps to protect the actuators from an unplanned open loop condition. A fatigue rated one-piece piston rod is used to ensure long service life.

The actuators are designed to keep the resonance frequency high and any resulting amplifications low.

The zero-backlash swivel joint with preload adjustable bearing is placed at the front & rear end of the actuator.

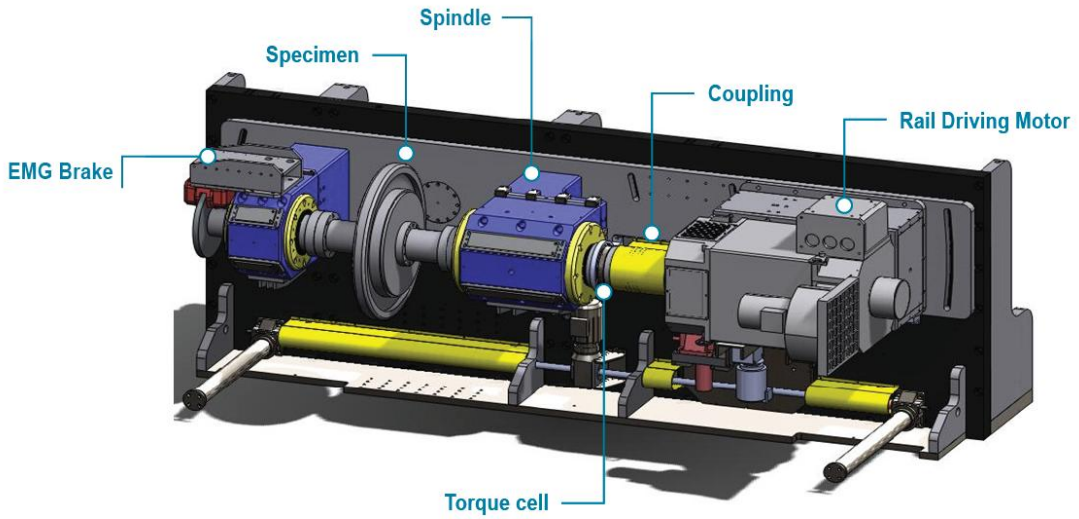
The swivel joints have the proper angular displacements to allow the table to exercise through all extreme displacement conditions. The swivel joints are rated to allow full dynamic loading and worst case loading conditions.

Local close coupled accumulation and flow averaging line accumulation are considered to allow smooth performance of the system if needed.

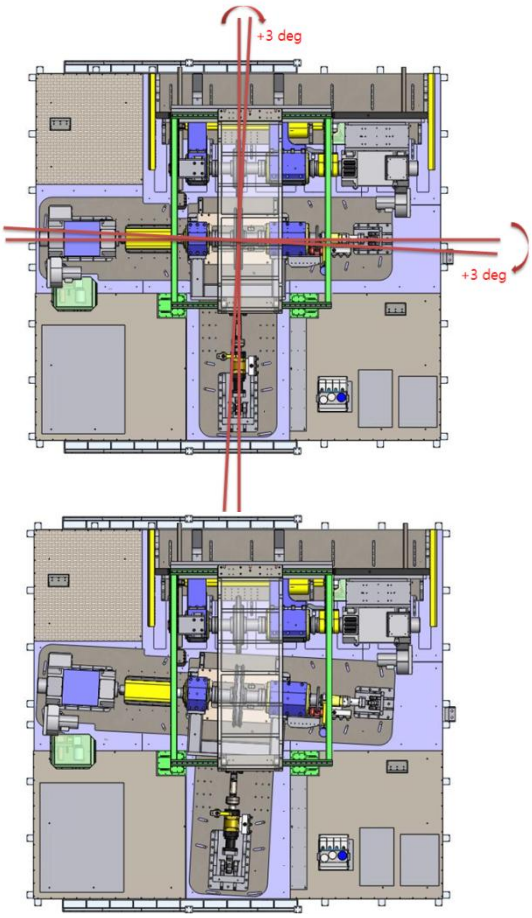
	Specifications
Rail Driving Module	Motor type : AC servo motor
	Power : 355kw
	Drive shaft : continuous velocity (CV) joint
	High rigidity spindle
	Spindle oil lubrication system
	Speed range : 0~2470rpm at 1000mm dia.
	Radial force capacity of spindle : 180kN
	Thrust force capacity of spindle : 100kN
	Static tolerance of spindle : 150%
	Torque transducer
	• Fatigue rating : 5kNm • Load capacity : ≧ 150% of full range • Non-linearity : ≦±0.1% of full scale • Hysteresis : ≦±0.1% of full scale • Repeatability : ≦±0.5%
	EMG brake system should is included

Rail Driving Module

The rail driving module is composed of 355kW AC servo motor and spindle Emergency brake, and there is a sensor for measuring the friction torque between the motor and spindle.

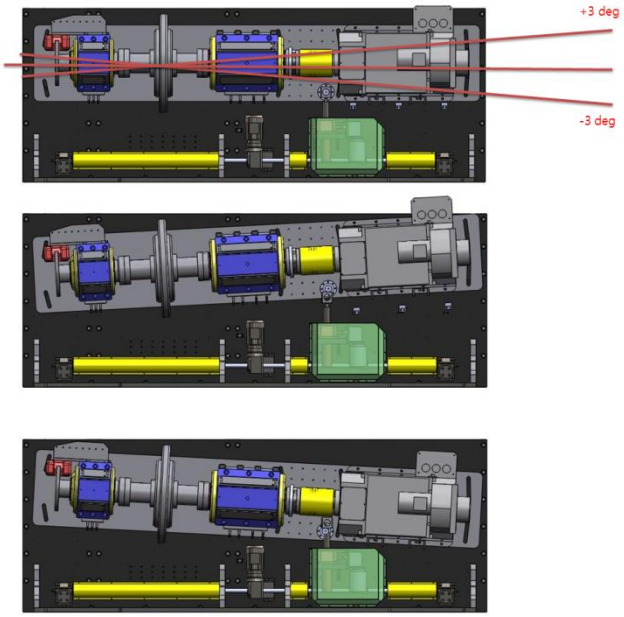


The torque sensor is including the telemetry which is the non-contact type. Therefore, it is easy to maintenance. The rail driving module is set at the high rigidity fixture (horizontal direction) for the attack angle adjustment.



Contact Angle Adjuster

The contact & attack angle of the specimen can be adjusted by the mechanical structure. The contact angle adjuster is to simulate the real contacting condition between the wheel and rail. Form the above picture, this equipment can rotate the wheel driving module (clock wise 0°~+3°) around the wheel specimen. The user can control the angle by the electric motor through the sensor.

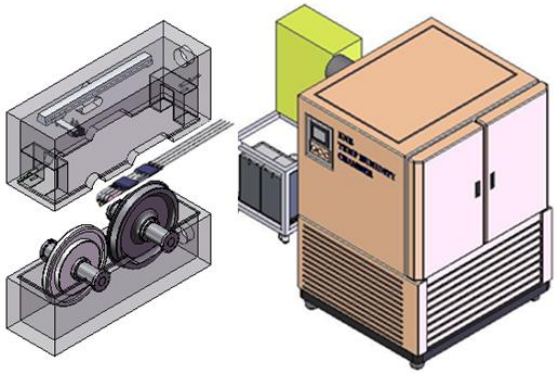


Attack angle adjuster

The attack angle adjuster can rotate the rail driving module (-3°~+3° of the rail specimen) to simulate train's curving movement.
The user can control the rotation angle through the sensor by the electric motor.

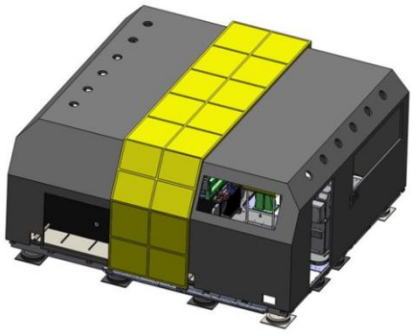
Environmental Chamber

There are three modules of the environmental chamber such as the main chamber for the temperature control, sub chamber for the temperature control around the specimen by using the air after the main chamber,



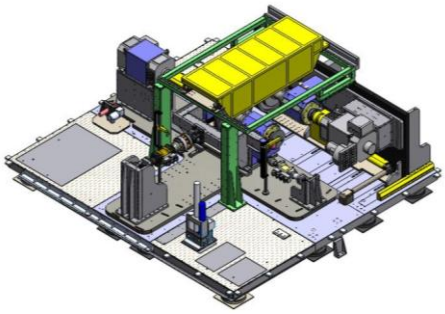
	Specifications
Environmental chamber	- Temperature range : -30℃ ~ +80℃
	- Humidity range : 30% - 98% (Absolute humidity)
	- Temperature profile control by controller
	- Oil injection system (max. 5lpm)
	- Water injection system (max. 5lpm)
	- Sand injection system (max. 5kg/min)
	- Container for oil, water, sand
	min. volume : 5 liter

and the equipment with nozzle system for simulating second environment such as water, oil, air and sand.
The environment chamber is designed to set at the main frame easily and controlled by the main control system for the temperature and injection (water, oil, and sand).



Safety Cover

The high speed wheel & rail contact simulation system creates the particle from the specimen and the particle will be scattered with high speed during the test because this test is a high speed rotation test of the real size specimen. Therefore, the test will be really dangerous. From that reason, the system has multiple safety covers.
The sub camber is the first safety cover. For the second safety cover (yellow part), there is a composite material cover with the beam structure and multi laver.



The third cover is the main cover for the system and the same as the second cover structure.

Deneb- DE & Sabio-D

The high performance multi axes digital control system (Deneb-DE) and dynamic control software (Sabio-D) can provide reliable test results of RCF, wear, and adhesion test.