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สัญญาจ้างเลขที่ รฟ.ยธ. 1021/5/...../..... 33, 2567  
- 2 ก.ค. 2567  
ลงวันที่.....

**STATE RAILWAY OF THAILAND  
SPECIFICATION  
FOR  
BOGIE TESTING EQUIPMENT  
AT  
KAENG KHOI NEW DEPOT**

.....

**1. Introduction**

State Railway of Thailand (hereinafter referred to as SRT) needs to purchase a bogie testing equipment which is able to test a variety of bogies for all SRT's rolling stocks including 2-axle and 3-axle bogies in order to complete overhaul of bogies.

**2. Scope**

SRT requests bidder for offer a bogie testing equipment and hand it over complete installaion and ready to use for all SRT's rolling stocks which includes;

- a) Facility layout and design
- b) Design of operation management for different bogie types from different workshops where are far away from each other.
- c) Supply of the bogie testing equipment, calibration devices, software, and neccessary equipment in order to complete all functions of the bogie testing equipment
- d) Supply of the spring testing machine, calibration devices, software, neccessary equipment in order to complete all functions of the spring testing machine, and hardwares and softwares in order to connect, communicate, and transfer all data to the bogie testing equipment
- e) Supply of the oil damper testing machine, calibration devices, software, neccessary equipment in order to complete all functions of the oil damper testing machine, and hardwares and softwares in order to connect, communicate, and transfer all data to the bogie testing equipment
- f) Workmen for bogie testing equipment installation
- g) Supervision of bogie testing equipment and related devices including the technical assistance in the installation and training of operation, programming, testing, recording, report printing, calibration, and maintenance
- h) Supply of adaptors and special tools for testing, calibration, repairing, and maintenance of the bogie testing equipment

The installation of bogie testing equipment as well as the minor work, for example wiring and connecting the power supply and internet shall also be performed by bidder under the supervision of bidder and SRT. All costs of design, installation, training including SRT supervision shall be borne by the contractor.

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### 3. General Requirement

- a) Bogie testing equipment shall be used to test and record each wheel load of a bogie for locomotives, DMUs, and coaches in order to control the wheel load and other important functions on a bogie after assembling or before disassembling in the workshop. The digital measuring values shall be recorded by the PLC.
- b) The bogie testing equipment shall be able to perform the test functions at least as follows;
  - Vertical load application
  - Wheel load distribution on each wheel
  - Analysis and calculation of shimplates for primary and secondary suspensions
  - Leakage test and adjustment of secondary air suspension under load
  - Diameter measuring of the wheel
  - Distance measuring between wheel rims
  - Measuring of heights on top of the bogie frame
  - Adjustment of heights under the bogie under loaded situation
- c) The bogie testing equipment shall be highly productivity, accurate, and economical.
- d) The bogie testing equipment shall be programmed for the test and record all data automatically. After finishing the test, a test report shall be created automatically. User can print the report directly by the bogie testing equipment. Be noted that the menu functions and report forms shall be of custom-made in Thai language.
- e) The bogie testing equipment shall be installed in the suitable inspection pit in order to allow inspectors checking the bogie. Bidder is requested to built and construct the inspection pit including proper drainage system by bidder responsibility without any charges to SRT.
- f) The bogie testing equipment shall be:
  - Developed for the testing of bogie load for use in SRT
  - Easy to operate and provide simplified and easily accessible controls for optimum operator efficiency and output
  - Exceptionally robust method construction
  - Computer controlled which means that the test results and test parameters can be called up at any time, and the load application and load measuring is directly controlled by computer control PLC.

### 4. SRT Conditions

- a) General
 

|                             |                               |
|-----------------------------|-------------------------------|
| - Track gauge               | 1,000 mm                      |
| - Maximum axle load         | 20 ton/axle                   |
| - Maximum relative humidity | 100%                          |
| - Maximum temperature       | 45°C                          |
| - Electric supply           | 380 Volt, 3 phase, 50 Hz      |
|                             | 220 Volt, Single phase, 50 Hz |

### 5. Unit of Measurement

The use of the International System of Units (SI) is required for the designs and calculations throughout bidder proposal and contractor documents.

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All equipment shall be designed in the metric system, except the case where other measuring unit is commonly used.

## 6. Bogie Testing Equipment

The bogie testing equipment shall be consisted of high class components that meet railway standard requirement and integrated with;

### a) Main Body

The main body shall be of rigid steel frame construction designed to be equipped with a test stand, a hydraulic power unit, an oil cylinder device and load cell. The frame shall be a closed frame in order to remind the load forces which are applied to the workshop floor. The bogie testing equipment shall be positioned in an inspection pit but in a way that possibly floods in the workshop can not damage the electric parts or sensors on the machine. The inspection pit shall be made by the bidder according to manufacturer's foundation plan. Safety fences shall be made by the bidder.

### b) Hydraulic Unit

The hydraulic unit and collecting oil tank shall be supplied and installed by bidder in order to supply the oil pressure to the oil cylinder device. This unit consists of oil pump, an electric motor, tank, and control valve(s). The programmed values, such as loads or travel distances shall be determined by the function of the hydraulics via the electronic control circuits. Both cylinders shall be of very finely controlled through proportional valves. Each one can be individually controlled or both synchronously. The hydraulic unit shall be integrated with a pump and 250-L oil tank which is driven from a central motor. It shall also be integrated with overload protection with cooler, electronic heat control and oil level control. The oil pressure shall be constantly and electronically monitored. A collecting tank shall also be provided in order to prevent hydraulic oil from escaping on to the floor during maintenance work or in the event of leakage. Hydraulic shall be according to international EN ISO 4413 standard. Cylinders shall be of two-speed adjustable (fast, slow) for load application.

### c) Industrial Grade Computer

All functions of the bogie testing equipment shall be controlled by mean of PC controller and equipped with UPS to prevent loss data when the power failure occurred. It shall be designed for use in a workshop where rough conditions are generally encountered. For that reason, the using of home use PC or business PC is not acceptable. There are minimum requirements for PC specification is shown as follows;

- |                      |  |
|----------------------|--|
| - Processor          | Intel® Processor Core™ i5-series CPU                                       |
| - Memory             | 4 GB DDR3 1,600 MHz ECC memory   |
| - Internal storage   | 2 units of 1 TB 7,200 rpm 3.5-inch SATA-3                                  |
| - Optical drive      | External DVD/CD drive  |
| - RAID               | RAID 1   |
| - Communications     | 2 units of 10/100/1000 Ethernet LAN RJ-45                                  |
| - Ports              | 3 units of USB 2.0 port<br>1 unit of USB 3.0 port<br>1 unit of RS-232 port |
| - Monitor            | LED 19-inch touch screen monitor   |
| - Operating system   | Microsoft Windows 7 Professional 64-bit                                    |
| - Antivirus software | Internet Security for 3 years  |

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- Warranty ProSupport 7×24 Technical Support & Assistance for 2 years
- Miscellaneous Mouse (same brand name of PC)
- Keyboard (same brand name of PC)
- UPS 750 W
- A4-Color Laser Printer

## d) Software

Software shall be able to state and reject the value that is not fulfilled the requirement (the standard can only be set by supervisor). The software shall be of Microsoft Windows based and very user friendly with user interface in Thai language. Software module shall support the calibration procedure, with 10 load points calibration. Software or Code shall allow programmer and user to be interface from/to other systems in order to share recorded data.

Users shall be able to prepare new test programs for other type of bogies. It shall be possible to display, print, save and recall test programs and bogie specific parameters. Most data shall be tested or measured and recorded automatically whereas some data may needs to measure and record manually. Therefore, the software shall allow users to enter the data which have been manually tested or measured. Data test results shall be visualized online in different folders/windows. All data recorded and bogie specific test parameter shall be also recorded in the database. The data shall be saved into SQL database. Different user levels as for operator, programming, and maintenance shall be allowed to open, edit, or delete any data with username and password protected.

Report form shall be able to design, create, and edit by users. The report shall be printed with all measured values and their specific test parameters. If any test value is out of tolerance then it shall be marked on the monitor and printed report.

## e) Miscellaneous

- Digital levelling instrument for measuring of height
- Digital wheel diameter measuring
- Digital distance measuring between wheel rims
- PC Cabinet
- Electric cabinet
- Calibration tools
- Adaptors

7. Spring Testing Machine

Three spring types shall be tested by the spring testing machine. Definitions of each spring type and minimum testing requirements are described below;

## 7.1 Helical springs

- Maximum free height of helical springs to be tested is 500 mm.
- Minimum free height of helical springs to be tested is 80 mm.
- Maximum outer diameter of helical springs to be tested is 300 mm.
- Minimum outer diameter of helical springs to be tested is 50 mm.
- It shall be able to perform all test functions i.e. axial stiffness, height under different loads, lateral bowing direction under load, optional transversal stiffness, etc.
- It shall be also able to perform spring stiffness for individual spring and combined spring.

## 7.2 Rubber conical springs

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- Maximum free height of rubber conical springs to be tested is 500 mm.
- Maximum outer diameter of rubber conical springs to be tested is 300 mm.
- It shall be able to perform all test functions i.e. axial stiffness, height under different loads, lateral bowing direction under load, etc.

### 7.3 Metal rubber springs (Chevron)

- The Chevron spring installed in SPRINTER (BREL LIMITED) shall be able to test by the Spring Testing Machine.
- It shall be able to perform all test functions i.e. axial stiffness, height under different loads.

The spring testing machine shall be made in a robust welded construction with 2 strong guiding columns for the cross beam. The machine shall be able to apply force  $\geq 180$  kN. The machine shall be furnished with door and security lock. The spring testing machine shall be consisted of high class components that meet railway standard requirement and integrated with;

#### a) Adapter for difference springs

Adapters for fixing/holding of each helical spring shall be also provided together with the spring testing machine. Contractor shall be responsibility to survey numbers of different springs using in SRT and to supply adapters for them. It shall be supplied with the necessary parts/equipment for testing conical springs and metal/rubber springs.

#### b) Load measurement, stroke measuring axial

At least three load cells shall be installed in triangular arrangement. Precision of load application shall be in steps of  $\pm 100$  N or better. Load cells shall have at least 100% safety against overload. Load application and stroke shall be controlled with PLC. Resolution of stroke measuring system shall be of  $\pm 0.1$  m or better. It shall be able to test helical spring packages.

#### c) Measuring of lateral

The spring testing shall be able to determine the bowing direction and bowing angle. The bowing criteria shall be measured automatically and controlled by PLC. It shall be able to test transversal stiffness for helical springs. It shall be also able to apply lateral forces to spring by pulling or pushing which allows testing the lateral stiffness.

#### d) Industrial Grade Computer

All functions of the spring testing machine shall be controlled by mean of PC controller integrated with PLC and equipped with UPS to prevent loss data when the power failure occurred. It shall be designed for use in a workshop where rough conditions are generally encountered. For that reason, the using of home use PC or business PC is not acceptable. There are minimum requirements for PC specification is shown as follows;

- |                    |   |
|--------------------|---|
| - Processor        | Intel® Processor Core™ i5-series CPU      |
| - Memory           | 4 GB DDR3 1,600 MHz ECC memory            |
| - Internal storage | 2 units of 1 TB 7,200 rpm 3.5-inch SATA-3 |
| - Optical drive    | External DVD/CD drive                     |
| - RAID             | RAID 1                                    |
| - Communications   | 2 units of 10/100/1000 Ethernet LAN RJ-45 |
| - Ports            | 3 units of USB 2.0 port                   |
|                    | 1 unit of USB 3.0 port                    |
|                    | 1 unit of RS-232 port                     |

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- Monitor LED 19-inch touch screen monitor
- Operating system Microsoft Windows 7 Professional 64-bit
- Antivirus software Internet Security for 3 years
- Warranty ProSupport 7×24 Technical Support & Assistance for 2 years
- Miscellaneous Mouse (same brand name of PC)
- Keyboard (same brand name of PC)
- UPS 750 W
- A4-Color Laser Printer

## e) Software

Software shall be able to state and reject the value that is not fulfilled the requirement (the standard can only be set by supervisor). The software shall be of Microsoft Windows based and very user friendly with user interface in Thai language. Software module shall support the calibration procedure. Software or Code shall allow programmer and user to be interface from/to other systems in order to share recorded data.

Users shall be able to prepare new test programs for springs. It shall be possible to display, print, save and recall test programs and specific parameters. Most data shall be tested or measured and recorded automatically whereas some data may needs to measure and record manually. Therefore, the software shall allow users to enter the data which have been manually tested or measured. Data test results shall be visualized online in different folders/windows. All data recorded, force/stroke diagrams and spring specific test parameters shall be also recorded in the database. The data shall be saved into SQL database. Different user levels as for operator, programming, and maintenance shall be allowed to open, edit, or delete any data with username and password protected. Test programs shall be displayed as flow chart on the screen.

Report form shall be able to design, create, and edit by users. The report shall be printed with all measured values, force/stroke, and their specific test parameters. If any test value is out of tolerance then it shall be marked on the monitor and printed report.

## f) Hydraulic

Hydraulic using for the spring testing machine shall be in accordance with international EN 693. Two speeds (fast and slow) shall be able to control load application cylinders. Overload protection shall be also provided. It shall be integrated with cooler, electronic heat control, and oil level control.

## g) Miscellaneous

- Calibrations for axial load and axial height

8. Oil Damper Testing Machine

## Oil Damper data

|                        |         |
|------------------------|---------|
| Max. absorber length   | 1200 mm |
| Min. absorber length   | 200 mm  |
| Max. absorber diameter | 200 mm  |
| Max. absorber weight   | 50 kg   |

## Dimensions

|                                      |                       |
|--------------------------------------|-----------------------|
| Required space L x B x H             | 2900 x 1600 x 2350 mm |
| Total weight, incl. electric control | 1800 kg               |

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|                                  |                     |
|----------------------------------|---------------------|
| Floor load                       | 1250 kg/m2          |
| Absorber slide                   |                     |
| Max. stroke                      | 600mm               |
| Max. speed                       | 0.5m/s              |
| Max. acceleration                | 20 m/s <sup>2</sup> |
| Max. advancing force             | 25 kN               |
| Swivel axle                      |                     |
| Max. torsional angle             | 110°                |
| End position horizontal          | -15°                |
| End position vertical            | 95°                 |
| Electrics                        |                     |
| Operating voltage                | 3 x 400 Volt +N+PE  |
| Frequency                        | 50/60 Hz            |
| Fuse                             | 63 A                |
| Connection power                 | 15 kVA              |
| Industrial PC                    |                     |
| Operating system                 | Windows 7           |
| screen                           | 17" Multitouch      |
| Measuring systems                |                     |
| Accuracy of the load application | +/- 50 N            |

#### Testing standards including related standards

- DIN EN 13802:2012 (stan-dard-concept)  
Railway applications, spring elements, hydraulic absorb-ers
- EN 13913 Railway applications, Elastomere spring elements, Me-chanical components, components based on elastomere materials
- EN 14363 Railway applications, driving technical test for the driving technical permission of railway vehicles, test of the drive condition and stationary experiments

## 9. Operation and Measurement

### a) Application of the Bogie Testing Equipment

The bogie testing equipment shall apply the load with two hydraulic cylinders which each one can apply independent or both synchronous the load. The use of spindle technology is not accepted. The pistons shall be of 100 mm diameter (minimum) and 125 mm inner diameter of cylinder which are controlled by computer. Each cylinder shall be able to create a load of 250 kN in each step of  $\pm 100$  N which is measured by a load cell. The cylinders shall be of vertical position (stoke) which are controlled by electronic scales in each step of 0.1 mm. Each load cylinder shall be of with four precision linear ball bearings on precision linear guides from first quality supplier. The load cylinder shall be laterally adjustable, each one is independent of the other. The position shall be showed in digits, in steps of 0.1 mm.

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## Lateral adjustment of load cylinders

- Cylinder 1 0 – 1,575 mm
- Cylinder 2 600 – 1,575 mm

It shall be possible to adjust the position of the load cylinders without the help of tools. It shall be easy and quick adjustment. The adjustment time shall be less than 2 minutes. Horizontal beam which is carrying the load cylinders in the height shall be adjusted fully automatically within a range of 1,200 mm.

## b) Measuring of the wheel load.

The load shall be fully automatic measured on each wheel within tolerance of  $\pm 200$  N. The system to determine the wheel load shall be with digital oscillating wire load cells, which are free of influence from lateral loads causes by the wheels. It shall be possible to test for all SRT rolling stocks which are 2-axle bogie and 3-axle bogie. All bogies with mentioned above, wheel loads shall be tested and measured without any adjustment on the wheel load measuring devices. The measured values shall be displayed on the screen. If some load wheel is more than the appropriate value, the wheel shall be highlighted or showed as faulty on the screen/report. Bogie weight shall also be measured, recorded, and reported.

The bogie testing equipment shall be designed to deal with overload at least 100% of the nominal load without causing any measuring defaults.

## c) Wheel Diameter Measuring

Wheel diameter measuring may be used an additional manual wheel diameter measuring instruments. However, the diameter on each wheel can be easily measured by the operator which is displayed in digital value. The measure result may be entered the system manually. Precision of wheel diameter measuring shall be in the limit of  $\pm 0,2$  mm.

## d) Measuring of Heights on the Bogies

Heights on the bogies shall be measured by additional instruments which are leveling instrument installed on the column with magnetic stand and digital measurement. Resolution of the measurement shall be not more than 0.15 mm. It shall measure and record the heights directly to the computer with automatic calculation and comparison the defined tolerance value.

## e) Automatic calculation of thickness of each shim plate

The bogie testing equipment shall fully automatic measure strokes of the primary suspension during load application. Resolution of the measurement shall be not more than  $\pm 0.1$  mm. Based on the wheel load distribution and strokes of the primary suspension, the thickness of each shim plate shall be fully automatic calculated and displayed on the screen. Force-stroke diagram of primary suspension under different loads shall be displayed.

## f) Measuring of Distance between Wheel Rims

6 (six) laser measuring sensors shall be provided for fully automatic determination of distance between wheel rims. Resolution of the measurement shall be not more than  $\pm 0.1$  mm. The distance measured shall be visually displayed on the screen. The sensors shall be easily adjustable for 2-axle and 3-axle bogies with different axle distances.

## g) Air Suspension Testing

The bogie testing equipment shall be integrated with a facility to test fully automatic air leakage of the secondary air suspension. During the load test programming,

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the load will be applied onto the bogie with filled air suspension, and the pressure of the air suspension shall be recorded. As the result, a possible leakage shall be calculated and displayed on screen. Maximum pressure of air suspension testing shall be of not less than 10 Bar. Resolution of the measurement shall be not more than  $\pm 0.05$  Bar. Each side shall be tested individually and independent of the other one. The test result shall be also displayed on the screen in form of pressure/time diagram.

#### h) Calibration

Any equipment shall be able to calibrate. For the bogie testing equipment, load calibration tools shall be supplied with internationally recognized test certificate. Bidder is requested to deliver all the necessary tools together with the related equipment, and training shall include the calibration procedure as well.

Tools for calibration of additional equipment as mentioned above, for example, wheel rim distance sensors, air suspension testing unit, etc. shall also be provided by bidder responsibility.

#### i) Mechanical Interface between Bogie and Load Cylinder

Mechanical Interface between bogie and load cylinder/adaptor shall be designed, manufactured, and supplied covering all SRT rolling stocks by contractor responsibility.

### 10. Technical Standards and Safety Standards

The equipment should be met the standards as followed below :

- |  |                |
|--|----------------|
| - CE-conformity regulations                          | 2006/42/EC     |
| - Electrical material                                | 2006/95/EC     |
| - Electro magnetic resistance                        | 2004/108/EC    |
| - Basics, general design principles                  | EN ISO 12100   |
| - Electrical equipment for machines                  | EN 60204-1     |
| - Emergency Stop system                              | EN 13850       |
| - Avoiding of unexpected start                       | EN 1037        |
| - Safety module for safeguard                        | EN 1088        |
| - Fluid technical machines and components-hydraulics | SN EN ISO 4413 |
| - Pumps and pump units for fluids                    | EN 809         |
| - Risk classification                                | EN 14121-1     |
| - CE certificate                                     |                |

  
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