

To all economic operators who requested the Tender Dossier or were provided the Tender Dossier

Re:

Additional Information no. 1 to tender conditions in response to a request by the economic operator pursuant to s. 49 (1) of the Act No. 137/2006 Sb. on public contracts, as amended on the day of commencement of the contract award procedure (hereinafter referred to as "the PCA") and the contract notice in accordance with s. 147 (8) of the PCA

Name of the public contract: **Multi-Purpose Multi-Channel Electrohydraulic Loading System**

Contract registration number: **483599**

Contracting Authority: **University of West Bohemia in Pilsen**
Registered office: Univerzitní 8, Plzeň, 30614, Czech Republic
Registration number: 497 77 513

Representative of the Contracting Authority: **Advokátní kancelář Volopich, Tomšíček & spol., s.r.o.**
registered office at Vlastina 23, 323 00, Plzeň, Czech Republic
Registration number: 02476649

Based on a request for additional information and pursuant to s. 49 (2) of the PCA, the representative of the Contracting Authority hereby provides to all economic operators, who had requested the Tender Dossier or had been provided the Tender Dossier, the following response to the request for additional information which the Contracting Authority received:

Economic Operator's Enquiry No. 1:

Page 38/49 of the Tender Dossier states that:

"For each loading cylinder, the scope of delivery also includes the following:

-...

- at least two (2) two-stage Moog servo valves"

By means of our calculations, we have found that in order to meet the requirements/parameters specified in tables on page 38/49, it is possible to install only one MOOG servo valve on the hydraulic motors with the lower force.

Question: Is it therefore possible to offer only a single servo valve for the hydraulic motor, provided that the requirements/parameters in tables on page 39/49 are met?

Answer to the economic operator's enquiry no. 1:

Originally, the Contracting Authority requested at least two (2) two-stage MOOG servo valves. On the basis of the enquiry by the economic operator, the Contracting Authority permits the supply of the following:

- one (1) or two (2) two-stage MOOG servo valves, depending on the rated loading force of the hydraulic motor in question, provided that the offered deliverable meets all minimum technical requirements for the deliverable under the public contract, as stipulated in the Tender Dossier by the Contracting Authority.

Economic Operator's Enquiry No. 2:

Page 44/49 of the Tender Dossier states that:

“The scope of delivery includes three (3) remote control units for controlling the position of loading cylinder piston rod at reduced pressure and flow rate of oil.”

We assume that the three remote control units are of four-channel type, in order to cover the setting requirements of 10 hydraulic motors.

Answer to the economic operator's enquiry no. 2:

To cover the range of parameters of hydraulic motors, three four-channel remote control units can be supplied.

The Contracting Authority hereby provides, as Annex No. 1 to this Additional Information No. 1, the updated Annex No. 1 to the binding draft of purchase contract, the latter comprising Annex No. 5 to the Tender Dossier. When preparing their tenders, the Tenderers are required to use Annex No. 1 to the Additional Information No. 1 as the annex to the binding draft of purchase contract and have it dated and signed by the Tenderer or by a person authorized to represent the Tenderer.

Notification by the Contracting Authority Pursuant to s. 147 (8) of the PCA

Pursuant to s. 147 (8) of the PCA, the representative of the Contracting Authority hereby notifies all economic operators who requested or were provided the Tender Dossier of the following:

As the Contracting Authority updated the tender conditions of the Tender Dossier (as above), it extends the time limit for receipt of tenders pursuant to s. 40 (3) of the PCA by seven (7) calendar days.

On 2nd September 2014 the representative of the Contracting Authority sent the amended contract notice for publication, wherein the new time limit for receipt of tenders and the new date of opening the envelopes are stated.

With respect to the above procedure, the Contracting Authority extends the time limit of the contract award procedure pursuant to s. 40 (3) of the PCA as follows:

The time limit for receipt of tenders shall elapse on 26th September 2014 at 14:00 hours.

At the same time, the date of opening the envelopes with tenders shall be as follows:

The envelopes with tenders shall be opened on 26th September 2014 at 14:05 hours.

The envelopes with tenders shall be opened in the registered office of the Contracting Authority at Univerzitní 8, Plzeň, Czech Republic, in the meeting room no. R007.

Annex No. 1: Annex No. 1 to Purchase Contract: Parameters of Goods

Plzeň, date 2nd September 2014



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Mgr. Helena Draslarová

i.s. JUDr. Daniel Volopich, attorney-at-law
Advokátní kancelář Volopich, Tomšíček & spol., s. r. o.
acting on behalf of the representative of the Contracting
Authority on the basis of power of attorney

Annex 1 to Purchase Contract: Parameters of Goods

○ General Specifications

The Goods allow the following tests at ordinary temperatures to be conducted:

- High-cycle and low-cycle fatigue testing
- Simulations of service loading and mapping the response to such loading
- Research of static properties of structures (stiffness, compliance)
- Research of dynamic properties of structures across time and frequency intervals.

SFLTS enables demanding tests of structures fabricated of various kinds of materials (e.g. metals, non-metals, composites) and their combinations (non-permanent and permanent joints).

The electrohydraulic loading system shall also be used to support the work undertaken in the Transport Vehicle Components Testing Shop (referred to as “TVCTS”) located in the vicinity. Consequently, the latter facility is provided with pressurized oil supply via flexible pressure hoses and with installations of other movable elements of the loading system (loading cylinders, scavenge pumps for oil and others).

TVCTS is provided with a testing machine for combined loading of specimens of materials by axial force and torque. TVCTS is equipped with a two-part kit for attaching items to a T-slotted bed plate in a variable manner to allow the tested parts to be loaded by axial force and torque.

The delivery includes T-slotted bed plates for both testing shops, a loading vertical portal frame and brackets adjustable in vertical and horizontal directions for mounting the loading cylinders (hydraulic motors) or parts to be tested.

Where the need for minor building work (drilling holes, digging cavities for anchor elements and others) in the premises arises during delivery, installation and commissioning of the Equipment, such building shall be acceptable and the Seller shall perform this work as part of the installation.

The Equipment is new, fully functional and complete and its operation is facilitated by electronic control circuits and fully-fledged software with a licence, ready for full use.

The electrohydraulic loading system and its various parts will be placed in spaces which are depicted in the attached drawings and shown in the photographs of the current state of the RTI building in Annex 2 to this Contract.

○ Hydraulic Units

The source of pressurized oil is able to produce sufficient pressure and deliver adequate flow of high-pressure oil to the pressurized oil distribution system in order to drive the loading cylinders (hydraulic motors). It permits economic operation of SFLTS and TVCTS laboratories with fewer loading cylinders. It can support energy-intensive tests as well. Hence, the source of pressurized oil consists of two identical and interconnected hydraulic units capable of operating independently and in conjunction to enable the user to choose an efficient mode of operation of the source of pressurized oil.

The parameters of hydraulic units are as follows:

Flow rate	165-170 l/min.
Pressure	28 MPa

The scope of delivery of the hydraulic units includes their cooling system. The scope of delivery of the cooling system for hydraulic units includes the connections to the building's metering and regulating system. The cooling of the medium can be provided by the existing cooling system installed close to the room intended for the units.

The Buyer operates a source of cooling water of the following parameters:

Temperature drop	15/25°C
Pressure	3 bar
Maximum flow	13 m ³ /hour

The scope of delivery includes hydraulic oil in an amount required for the full operation, sources of pressurized oil and filtering devices for the pressurized oil distribution system.

To ensure environmentally sound operation, the hydraulic units are equipped with drip pans provided with level sensors and accumulators for damping pulsations and noise in the hydraulic distribution system.

Every hydraulic unit is provided with a remote control device. One remote control device shall be kept in the SFLTS control room and the other in the TVCTS control room.

○ Hydraulic distribution system

The pressurized oil distribution system consist of fixed and movable parts.

1. **The fixed part of high-pressure oil distribution system** (pipe distribution system) is routed through pre-installed channels to both facilities (SFLTS and TVCTS) and connects the hydraulic units to the stands for hydraulic motor manifolds. Wherever permitted by the operating conditions, fixed pipe distribution systems is used. The pipe distribution system is mainly used for connecting the hydraulic units with the four (4) stands for hydraulic motor manifolds.

The pipe distribution system is rated to the flow of 500 l/min up to the first branching point. Downstream of this branching point, the pipe distribution system is rated for the flow of 250 l/min. The configuration is documented in the schematic in Fig. 1.

The minimum required parameters are as follows:

- Two (2) stands for hydraulic motor manifolds are allocated to SFLTS:
 - each of the stands allocated to SFLTS carries five (5) hydraulic motor manifolds, so that a dedicated hydraulic motor manifold is available for each loading cylinder (hydraulic motor) of the SFLTS facility.
- Two (2) stands for hydraulic motor manifolds are allocated to SFLTS:
 - One stand is provided with one (1) hydraulic motor manifold for the machine for combined loading of specimens of materials by axial force and torque,
 - One stand is provided with two (2) hydraulic motor manifolds for the hydraulic motors of the two-part loading set for loading components by axial force and torque.

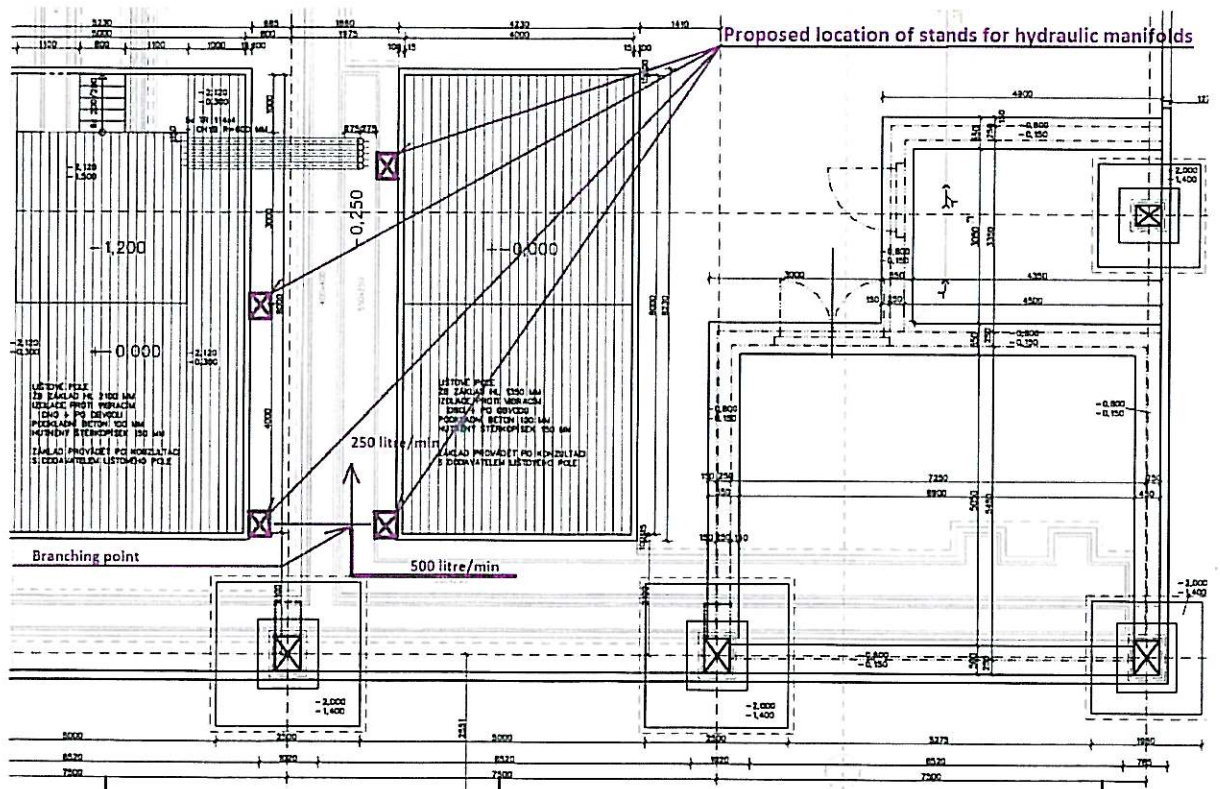
All hydraulic motor manifolds are capable of operating in on/off/low pressure and flow modes.

Two (2) hydraulic oil accumulators are attached to every hydraulic motor manifold stand:

- no less than 20 litres for the pressure branch of the hydraulic distribution system with an anti-rotation lock (safety lock against release),
- no less than 10 litres for the return branch of the hydraulic distribution system with an anti-rotation lock (safety lock against release),

The scope of installation of pipe distribution systems includes coating the inside of the pre-installed channels with protective paint against oil-based substances.

Fig. 1



2. **The movable part of the high-pressure oil distribution system** comprises high-pressure line and return hoses and threaded connectors for the start/stop valves of the manifold and the electrohydraulic cylinders. The scope of delivery also includes protective flexible sleeves for high-pressure as well return lines and a set of connectors and fittings for connecting and routing these hoses to the electrohydraulic cylinders.

The movable part of the high-pressure oil distribution system consists of two types of connecting hoses (with protective sleeves) rated for the flow rates of 65 l/min and 130 l/min.

The required range of hoses is defined in the following table:

Hose type	Flow rate	Length	Quantity
High-pressure hose, including protective sleeves	65 l/min	2 m	3 pcs
Return line hose, including protective sleeves			3 pcs
High-pressure hose, including protective sleeves		4 m	3 pcs
Return line hose, including protective sleeves			3 pcs
High-pressure hose, including protective sleeves	130 l/min	2 m	4 pcs
Return line hose, including protective sleeves			4 pcs
High-pressure hose, including protective sleeves		4 m	4 pcs
Return line hose, including protective sleeves			4 pcs

A set of connectors and fittings will be supplied with the hoses for connecting and routing these hoses to the electrohydraulic cylinders.

The required range of connectors is defined in the following table:

Type of hose to be used with the connector	Flow rate	Type	Quantity
high-pressure	65 l/min	straight	2 pcs
return			2 pcs
high-pressure		right-angle	2 pcs
return			2 pcs
high-pressure	130 l/min	straight	2 pcs
return			2 pcs
high-pressure		right-angle	2 pcs
return			2 pcs

The fixed, movable and connecting parts of the hydraulic distribution system withstand the effects of oil under operating conditions (flow rate, pressure, and temperature). The pressurized oil distribution system includes a system for removing excess oil from cylinders.

○ **Independent loading cylinders**

The scope of delivery includes ten (10) independent loading cylinders (linear hydraulic motors with hydrostatic bearings) for SFLTS. The loading cylinders are configurable to obtain various test arrangements. Configurations with various numbers of cylinders and directions of action with regard to the tested item and to one another must be available.

The main parameters of the loading cylinder are as follows:

- Rated load (corresponds to the minimum required force which the loading cylinder exerts while applying static load in tension and compression),
- Rated stroke (corresponds to the minimum required stroke, which is the distance between end positions of the loading cylinder piston rod),

- Rated stroke amplitude (corresponds to the minimum required amplitude of the harmonic motion of the piston rod of a non-loaded loading cylinder from its zero position at the frequency of 10 Hz).

The rated parameters of loading cylinders and their quantity are given in the following table.

Rated force	Rated stroke	Rated stroke amplitude	Quantity
10 kN	50 mm	24 mm	2 pcs
25 kN	100 mm	25 mm	2 pcs
40 kN	250 mm	30 mm	2 pcs
100 kN	250 mm	12 mm	2 pcs
160 kN	250 mm	8 mm	2 pcs

The cylinders are designed and sized for achieving 80 % of the rated static force during cyclic loading. The working pressure of the hydraulic motors is equal to the pressure of the oil supplied by the hydraulic units, i.e. 28 MPa.

Supplied with each loading cylinder is an integrated position sensor and a force transducer, the measurement ranges of which shall include the rated parameters of the loading cylinders.

The accuracy of the sensors, i.e. maximum permissible deviations relative to the nominal values for individual categories of loading cylinders, is explained in the following table:

Loading cylinder		Sensor accuracy	
Rated force	Rated stroke	Stroke sensor linearity	Load measurement
10 kN	50 mm	0.4%	0.25%
25 kN	100 mm	0.4%	0.25%
40 kN	250 mm	0.4%	0.25%
100 kN	250 mm	0.4%	0.25%
160 kN	250 mm	0.4%	0.25%

For each loading cylinder, the scope of delivery also includes the following:

- Connecting plate (servo block) with min. two (2) pcs of oil accumulators corresponding to delivered cylinders with a flushing unit,
- one (1) or two (2) two-stage MOOG servovalves, in accordance with the rated loading force of the relevant hydraulic motor, to meet all required parameters,
- scavenge pump with hydraulic connections,
- blank plate.

Technical and structural parameters of the servo blocks, servo valves, oil accumulators, flushing units, scavenge pumps and, where relevant, blank plates shall be designed and supplied by the Seller to provide reliable and safe operation of the required loading cylinders at the required rated parameters (rated load, rated stroke and rated stroke amplitude).

In order to eliminate parasitic transverse forces from the 3D loading state, every loading cylinder is provided with removable ball joints:

- one ball joint to be affixed to the toe of the loading cylinder,
- one ball joint to be affixed near the force transducer.

The ball joints are adjustable and with no play. They permit turning by 0° through $\pm 20^\circ$ in all directions. Their load capacity is no less than the rated load of the loading cylinder.

○ **Testing machine for biaxial-load testing of specimens of materials**

The Seller shall equip the TVCTS facility with a loading machine offering combined loading of specimens of materials by axial force and torque. The scope of delivery includes all interconnecting components and accessories for full-fledged operation of the testing equipment. The assembly operations lead to full connection between the parts supplied in order to support the required functions of the entire system

This hydraulic testing machine includes hydraulic grips for the rated axial and torsional loads with the following parameters:

- distance between the hydraulic grip faces: at least 600 mm while the hydraulic motor is in its midway position,
- sets of jaws for gripping flat testing specimens of 0.1 mm – 32 mm thickness and up to 100 mm width and for cylindrical testing specimens with diameters of 10 – 34 mm; they permit the specimens to be gripped sideways,
- control block of hydraulic wedge grips which are sized for simultaneous maximum load of the combined loading unit and adjustable down pressure of 10 to 100 %,
- the system must prevent the grips from being opened while the test is running; it shall not be possible to start the device in load control with open grips.

The biaxial testing machine shall have a combined drive consisting of one (1) linear hydraulic motor with hydrostatic bearings and one (1) rotary hydraulic motor with hydrostatic bearings.

The main parameters of the hydraulic motor are as follows:

- Rated load (corresponds to the minimum required force which the linear hydraulic motor exerts while applying static load in tension or compression),
- Rated stroke (corresponds to the minimum required stroke, which is the distance between end positions of the piston rod of the linear hydraulic motor),
- Rated stroke amplitude (corresponds to the minimum required amplitude of the harmonic motion of the piston rod of a non-loaded linear hydraulic motor from its zero position at the frequency of 10 Hz)
- Rated torque (corresponds to the minimum torque delivered by the rotary hydraulic motor while applying torsional static load).
- Rated angular displacement (corresponds to the minimum angle, by which the piston rod of the rotary hydraulic motor rotates from the initial to the limit position),
- Rated angular displacement amplitude (corresponds to the minimum required amplitude of the harmonic motion of the piston rod of a non-loaded rotary hydraulic from its zero position at the frequency of 10 Hz).

The required rated parameters of hydraulic motors of the biaxial testing machine are listed in the following table:

Linear hydraulic motor		
Rated force	Rated stroke	Rated stroke amplitude
250 kN	100 mm	2.00 mm
Rotary hydraulic motor		
Rated torque	Rated angular displacement	Rated angular displacement amplitude
2 kNm	100°	10°

The hydraulic motors supplied are designed and sized to deliver 80 % of the rated static load (force, torque) in cyclic loading. The working pressure of the hydraulic motors is equal to the pressure of the oil supplied by the hydraulic units, i.e. 28 MPa.

The scope of delivery of the hydraulic motors includes the necessary sensors. The linear hydraulic motor must be provided with an integrated position sensor and a force transducer (load cell) inertia-compensated by means of a built-in accelerometer. The hydraulic motor must be provided with a force transducer, an angular position sensor and a torque transducer. The measurement ranges of the sensor include and cover the rated parameters of the loading hydraulic motors. The accuracy of the sensors, i.e. their maximum permissible deviations for individual categories of loading cylinders, is explained in the following table:

Sensor accuracy			
Linear hydraulic motor		Rotary hydraulic motor	
Position measurement	Load measurement	Angular measurement	Torque measurement
0.2%	0.5%	0.2°	0.2%

The rotary and axial actuators must be designed in such way that the weight of the rotary actuator does not have any effect on the performance of the axial – linear actuator (hydraulic motor).

The scope of delivery of the combined drive shall include additional electrohydraulic elements for its smooth functioning:

- For the linear drive:
 - At least one (1) connecting plate (servo block) with at least one (1) oil accumulator and a flushing unit,
 - At least one (1) two-stage servo valve; in configurations with more than one servo valve, at least one of them shall be capable of being isolated hydraulically, without dismantling.
- for the rotary drive:
 - At least one (1) connecting plate (servo block) with at least one (1) oil accumulator and a flushing unit,
 - At least one (1) two-stage servo valve.

The Seller supplies a total of two (3) scavenge pumps with hydraulic connections.

Technical and structural parameters of the servo blocks, servo valves, oil accumulators, flushing units, scavenge pumps and, where relevant, blank plates shall be designed by the Seller to provide reliable and safe operation of the required loading cylinders at the required rated parameters (rated load, rated stroke and rated stroke amplitude). The device shall be controllable from a single point: by either the handset or the control system (PC). No parallel control is allowed. It shall only be possible to move the crosshead up/down in the setup mode (low pressure mode). In the high pressure mode (test run mode), it shall not be possible to move the crosshead up/down.

The biaxial testing machine is connected to the source of pressurized oil via a hydraulic motor manifold with the on/off/low feature. The hydraulic motor manifold is installed on a stand which provides the connections for the testing machine via supply hoses without any contact with the floor. Scavenge pumps are supplied for all hydrostatic bearings.

The combined drive is located on the top crosshead of the loading frame. The top crosshead features mechanical locking and hydraulic release functions and its vertical position is hydraulically adjustable.

The loading frame is mounted on an elastic base and meets the following parameters and contains all the elements listed below:

- axial stiffness of frame at 1000 mm (max. vertical size of the test space): 1000 kN/mm or better,
- torsional stiffness of frame: 14000 kNm/rad or better,
- table with a T-slotted plate and connection points for the set of linear and torsional loads and an adapter for connecting combined external sensors with connecting bolts.

The scope of delivery includes the following essential measuring instruments:

- Biaxial extensometer for measuring the shear deformation angle on the surface of circular specimens with the following parameters:
 - axial: ± 2.5 mm or better,
 - torsional: ± 2 mm or better,
- uniaxial extensometer for dynamic measurement with the following parameters:
 - gauge length: 20 – 25 mm,
 - travel expressed as percentage of the gauge length: ± 20 %,
 - non-linearity: 0.15 %,
 - control system of the machine must be able to work with additional at least 2 external analogue channels (± 10 V DC).

The scope of delivery includes a control personal computer (PC) (the hardware configuration of the PC must be adequate for operating the machine and for running tests with all required parameters and specifications) with an LCD monitor and the necessary equipment for operating the machine. The PC shall include pre-installed software to enable full control of the machine and the tests, including the setting up of tests, running the tests and evaluation of test results. The software shall offer at least the following functions: full control of the device (machine), including loop tuning, limit and event setup, ramp and waveform generation, data acquisition and saving on PC disk, setting up additional channels (inputs) and preparing software blocks of tests. The control modes must include load-control, position-control and amplitude-control. The software shall continuously display the status of the device (machine) and shall offer several levels of access to the software configuration (an administrator level different from the operator level) for safety purposes. The setup of critical parameters shall only be available at the administrator level. The minimal requirements for tests supported by the software solution shall include quasi static testing and high cycle fatigue testing. At least one (1) commercial licence of the software shall be provided.

○ **Two-part set for variable biaxial testing of components**

The TVCTS facility is also equipped with a two-part set of hydraulic motors and support elements for variable-configuration mounting on the T-slotted plate for loading components by axial force and torque. The scope of delivery includes all interconnecting components and accessories for full-fledged operation of the testing equipment. The assembly operations provide full connection between the parts supplied in order to support the required functions of the entire system.

The core parts of the set for variable biaxial testing of components are one (1) linear loading cylinder (linear hydraulic motor with hydrostatic bearings) and one (1) rotary loading cylinder (rotary hydraulic motor with hydrostatic bearings). The main parameters of the loading cylinders (hydraulic motors) are as follows:

- Rated load (corresponds to the minimum required force which the linear hydraulic motor exerts while applying static load in tension or compression),
- Rated stroke (corresponds to the minimum required stroke, which is the distance between end positions of the piston rod of the linear hydraulic motor),
- Rated stroke amplitude (corresponds to the minimum required amplitude of the harmonic motion of the piston rod of a non-loaded linear hydraulic motor from its zero position at the frequency of 10 Hz)
- Rated torque (corresponds to the minimum torque delivered by the rotary hydraulic motor while applying torsional static load).
- Rated angular displacement (corresponds to the minimum angle, by which the piston rod of the rotary hydraulic motor rotates from the initial to the limit position),
- Rated angular displacement amplitude (corresponds to the minimum required amplitude of the harmonic motion of the piston rod of a non-loaded rotary hydraulic from its zero position at the frequency of 10 Hz).

The required rated parameters of hydraulic motors of the biaxial testing machine are listed in the following table:

Linear hydraulic motor		
Rated force	Rated stroke	Rated stroke amplitude
40 kN	100 mm	16.00 mm
Rotary hydraulic motor		
Rated torque	Rated angular displacement	Rated angular displacement amplitude
8 kNm	100°	9°

The hydraulic motors supplied are designed and sized to deliver 80 % of the rated static load (force, torque) in cyclic loading. The working pressure of the hydraulic motors is equal to the pressure of the oil supplied by the hydraulic units, i.e. 28 MPa.

The rotary hydraulic motor is sized to transmit an axial force of no less than 55 kN.

The scope of delivery of the hydraulic motors includes the necessary sensors: the integrated position sensor and the force transducer for the linear hydraulic motor, or an angular position sensor and torque transducer for the rotary hydraulic motor including an accelerometer to enable compensation of the mass of inertia on the torque transducer. The measurement ranges of the sensor include and cover the rated parameters of the loading hydraulic motors.

Sensor accuracy			
Linear hydraulic motor		Rotary hydraulic motor	
Stroke sensor: linearity	Force transducer	Angular displacement sensor: linearity	Torque transducer
0.25%	0.10%	0.25%	0.10%

The scope of delivery of the above-specified set includes additional electrohydraulic elements:

- for the linear drive:
 - One (1) connecting plate (servo block) with two (2) accumulators and a flushing unit,
 - One (1) two-stage servo valve,
- for the rotary drive:
 - One (1) connecting plate (servo block) with two (2) accumulators and a flushing unit,
 - Two (2) two-stage servo valves.

Technical and structural parameters of the servo blocks, servo valves, oil accumulators, flushing units, scavenge pumps and, where relevant, blank plates shall be designed and supplied by the Seller to provide reliable and safe operation of the required loading cylinders at the required rated parameters (rated load, rated stroke and rated stroke amplitude).

Both hydraulic motors are connected to the source of pressurized oil via hydraulic motor manifolds with the on/off/low feature.

A total of two (2) scavenge pumps with hydraulic connections will be supplied.

The scope of delivery includes mechanical components allowing variable testing configurations. These include the following:

- One (1) rotary cylinder bracket,
- One (1) linear cylinder bracket mounted on the linear drive plate,
- One (1) linear drive plate to connect the linear hydraulic motor to the pair of hydrostatic bearings carrying the torsional load up to the rated value of 8 kNm,

- Two (2) play-free universal joints for dynamic loading by the rated axial force of 40 kN and a torsional load of 8 kNm,
- The universal joints shall be provided on their ends with adapter plates with threaded holes for direct mounting of test specimens or adaptors for clamping test specimens.

The materials and dimensions of the mechanical elements are selected so that the elements withstand the static and cyclic loads acting on the test rig in applications with the loading hydraulic motors supplied as part of the two-part set of hydraulic motors.

○ **Control and measuring electronics, software, computers, clamping bed, accessories**

▪ **Digital control and measuring electronics**

The supplied control and measuring electronics support independent, as well as parallel operation of all separate loading cylinders in the SFLTS facility, as well as the operation of the loading machine for combined loading of specimens and the two-part set for loading of components by axial force and torque in TVCTS. The term “operation” shall be interpreted as the control, measurement, recording and evaluation of all quantities relevant to particular tests.

The control electronics permit the loading parameters for each electrohydraulic loading cylinder to be controlled in accordance with requirements of particular tests.

- In the linear hydraulic motors, these parameters include the following: force, stroke, acceleration, engineering strain, loading frequency and pre-stress,
- In the rotary hydraulic motors, these parameters include the following: torque, angular displacement, angular acceleration, engineering strain, loading frequency and pre-stress.

The control electronics support simultaneous measurement and recording of all quantities required for documenting and evaluating the particular test.

The digital control and measuring electronics is delivered in a modular cabinet with a back-up power source which permits safe shutdown and save a current data of all running tests in the event of power outage.

The scope of delivery includes three (3) remote control units for controlling the position of loading cylinder piston rod at reduced pressure and flow rate of oil.

The scope of delivery also includes software for control of tests. This software allows schedules for loading parameters to be entered and controlled:

- static loading,
- loading with a harmonic pattern,
- loading with a harmonic pattern in programmable loading blocks,
- random loading with required spectral power density,

Reproduction of the measured data is possible as well.

▪ **Control computers**

The scope of delivery includes four (4) operator's computers with the required accessories. Two (2) operator's computers shall be located in the SFLTS control room and the other two (2) in the TVCTS control room. Every operator workplace allows one or more independent tests to be controlled.

The computers supplied are configured to support reliable communication with the control and measuring electronics supplied and to achieve the required parameters of process control, measurement and data storage.

- digital control frequency: 10 kHz,
- all measuring channels can be monitored simultaneously and in synchronism,
- A/D conversion frequency: 100 kHz,
- 24-bit data

▪ **Software**

The software is compatible with the control electronics in terms of test control and supports test data recording, measuring during testing, graphical plotting of measured data and analysis of the recorded data during and after testing.

Frequency spectra calculation and process analysis by means of the rain flow method is available for processing the measured data.

The scope of delivery includes a system for reproduction of measured data offering iteration algorithms to achieve optimum correlation between the pre-defined loading pattern and the actual schedule.

The licence allows all software modules to be used with all channels of the control electronics. At least one (1) commercial licence of the software shall be provided..

▪ **Clamping bed and support structures**

The scope of delivery includes a T-slotted clamping bed and support structures for building variable test and loading rigs. The following clamping system elements shall be included:

- T-slotted plates for foundation blocks of SFLTS and TVCTS facilities,
- One (1) vertical two-column frame with an adjustable-height crosshead,
- Four (4) hydraulic motor brackets with adjustable vertical and horizontal positions and a horizontal loading axis.

The SFLTS is provided with T-slotted plates for the existing foundation block with the footprint of 8 × 4 m.

The TVCTS is provided with T-slotted plates for a part of the existing foundation block with the footprint of 5 × 4 m.

The height of the T-slotted plates is 300 mm.

The T-slots are oriented in the longitudinal direction and spaced at 250 mm.

The T-slotted plates rest on a polymer concrete layer of 50 mm thickness and are held by anchors for dynamic loading in the existing foundation blocks.

The vertical two-column frame with an adjustable-height crosshead comprises the following:

- Two (2) columns of 3.5 m height,
- One (1) crosshead with the length of 3 m (adjustable by means of a crane, all fastening work shall be manual); the vertical position of the crosshead can be changed in steps of no more than 100 mm
- At least one (1) hydraulic motor bracket travelling on the crosshead and designed to allow mounting the maximum of two (2) independent loading cylinders with rated forces of 10 to 160 kN.

The design of the bracket should allow its position on the crosshead to be changed, either manually or by other means. The attachment of the hydraulic motor to the bracket shall provide maximum stiffness of the hydraulic motor-bracket joint. For this reason, the hydraulic motor must not be suspended by the ends of its body.

The parameters of the required four vertically and horizontally adjustable hydraulic motor brackets with a horizontal loading axis are as follows:

- The horizontal loading axis position shall be 300 to 1200 mm above the bracket toe,
- The horizontal loading axis shall be adjustable in transverse direction by ± 100 mm,
- The bracket shall be designed for attaching a hydraulic motor rated for 160 kN in a horizontal direction to the flange.

Together with these four (4) brackets, the Seller will supply additional two (2) adapters for mounting smaller loading cylinders or tested parts.

The material of the clamping bed and the support structures, their sections and T-slots is designed and rated for static and cyclic loads imposed by the test rigs with the loading cylinders supplied.

Signature of the Tenderer / the person representing the Tenderer:

In [TO BE COMPLETED BY TENDERER] on [TO BE COMPLETED BY TENDERER]

.....
[TO BE COMPLETED BY TENDERER –
company name + name and signature of the
Tenderer / person representing the Tenderer]