Amendments in Tender Enquiry No. A3 (51085)2019/PUR	
Existing	**Revised**
Annexure I Clause 7 Computer controlled Digital Controller The digital electronic controller should be able to conduct tests in stroke and load control modes. Controller shall support Proportional, Integral, Derivative, and Feed-forward (PIDF) control. Controller should have the capability to provide control for changes in stiffness of quasi brittle test specimens. Controller must allow for any and all inputs (minimum of four) to be assigned to any control channel by the user without requiring re-arranging controller hardware Control software shall have ability to automatically recognize added controller hardware (TEDS). Controller must have minimum 3 (+/-10 V) analog outputs in base configuration Controller must have option to control or acquire data up to 5 kHz for at least 8 external analog signals. Continuous synchronous data acquisition at user selectable sampling rate with maximum 5 kHz on all internal and external channels. Controller must support either 2 or 3 stage valve drivers Bumpless switch over from one mode to another mode with and without hydraulics. Controller should have adaptive Control System, allowing continuous update of PID terms for specimen stiffness and automatically compensating at minimum 1 kHz. Auto and manual tuning facility. The Controller should adapt for Peak/Valley control, Amplitude/Mean control, Amplitude and Phase control. Control loop update should be 5 kHz or faster. Loop closure rate should not be affected by number of control channels. Auto Loop Shaping: Position and Load, Multi term control, including PID, lag, feed forward and compensation, with serial, parallel and	**Annexure I Clause 7** Computer controlled Digital Controller The digital electronic controller should be able to conduct tests in stroke and load control modes. Controller shall support Proportional, Integral, Derivative, and Feed-forward (PIDF) control. Controller should have the capability to provide control for changes in stiffness of quasi brittle test specimens. Controller must allow for any and all inputs (minimum of four) to be assigned to any control channel by the user without requiring re-arranging controller hardware Control software shall have ability to automatically recognize added controller hardware (TEDS). Controller must have minimum 3 (+/-10 V) analog outputs in base configuration Controller must have option to control or acquire data up to 5 kHz for at least 8 external analog signals. Continuous synchronous data acquisition at user selectable sampling rate with maximum 5 kHz on all internal and external channels. Controller must support either 2 or 3 stage valve drivers Bumpless switch over from one mode to another mode with and without hydraulics. Controller should have adaptive Control System, allowing continuous update of PID terms for specimen stiffness and automatically compensating at minimum 1 kHz. Auto and manual tuning facility. The Controller should adapt for Peak/Valley control, Amplitude/Mean control, Amplitude and Phase control. Control loop update should be 5 kHz or faster. Loop closure rate should not be affected by number of control channels. Auto Loop Shaping: Position and Load, Multi term control, including PID, lag, feed forward and compensation, with serial, parallel and

cascade control. High speed computer interface, using the industry-standard Ethernet. Transducer signal conditioners for load, stroke and external strain sensors to provide high accuracy, low drift and low noise transducer signal with user selectable standard filters. Digital sensor conditioners providing minimum 16 bit data resolution across the complete span of the sensor. Interlocks and indicators are to be provided for transducer excitation failure and conditioner saturation. Automatic transducer recognition and calibration to be provided. The transducer should be provided with traceable calibration from the reputed accredited laboratory from the country of All adjustments on the signal conditioners are to be made by software. Programmable limit/event detection, providing rapid intelligent actions or test interruptions. User selectable limit/event detector actions such as hydraulic off, indicate, hold, change mode and hold, reset, unload, no action. Programmable error detection, providing rapid intelligent actions or test interruptions. User selectable error detector actions such as hydraulic off, indicate, hold, change mode and hold, reset, unload, no action. Programmable display meters, providing the user the flexibility of programming the parameters to be displayed on the meters. All test templates that support testing against standards can be modified by the user using the graphic interface (no requirement to change source code). All variable definitions and calculations as well as the test flow/sequence and logic are visible and can be changed by the user. The user should be able to select any of the following parameters for display cyclic/ramp signal track, mean, amplitude, min., max., peak, valley, current cycle count, total cycle count, segments etc. The user should be able to generate as many number of display meters as required to display the above parameters based on the requirement. Programmable display scopes, providing the user the flexibility of programming the parameter to be displayed on X and Y axis. User should be able to adjust the scaling and trace time based on the requirement.	cascade control. High speed computer interface, using the industry-standard Ethernet. Transducer signal conditioners for load, stroke and external strain sensors to provide high accuracy, low drift and low noise transducer signal with user selectable standard filters. Digital sensor conditioners providing minimum 16 bit data resolution across the complete span of the sensor. Interlocks and indicators are to be provided for transducer excitation failure and conditioner saturation. Automatic transducer recognition and calibration to be provided. The transducer should be provided with traceable calibration from the reputed accredited laboratory from the country of All adjustments on the signal conditioners are to be made by software. Programmable limit/event detection, providing rapid intelligent actions or test interruptions. User selectable limit/event detector actions such as hydraulic off, indicate, hold, change mode and hold, reset, unload, no action. Programmable error detection, providing rapid intelligent actions or test interruptions. User selectable error detector actions such as hydraulic off, indicate, hold, change mode and hold, reset, unload, no action. Programmable display meters, providing the user the flexibility of programming the parameters to be displayed on the meters. All test templates that support testing against standards can be modified by the user using the graphic interface (no requirement to change source code). All variable definitions and calculations as well as the test flow/sequence and logic are visible and can be changed by the user. The user should be able to select any of the following parameters for display cyclic/ramp signal track, mean, amplitude, min., max., peak, valley, current cycle count, total cycle count, segments etc. The user should be able to generate as many number of display meters as required to display the above parameters based on the requirement. Programmable display scopes, providing the user the flexibility of programming the parameter to be displayed on X and Y axis. User should be able to adjust the scaling and trace time based on the requirement.

The scope should have user selectable and auto scaling features. The scope should be able to plot one channel versus another channel. Programmable automatic mode changing to any transducer connected to the machine which has been selected for control including load limited displacement during specimen loading. Waveform command generation with 32-bit resolution up to 500 Hz for each sensor, with, sine, triangle, square, haversine, havertriangle, haversquare, ramp, dual ramp, trapezoid in relative and absolute modes and support for digital drive data or an analogue input of ±10 V. High precision digital signal conditioner and valve drivers should be provided for the control signals. The controller with necessary software should be able to run static tests and data acquisition should have the following features: Selection of wave form type, timed sample, peak / valley, max / min, level-crossing, cyclic / logarithmic and mean/amplitude with ability to tie data channels to a master signal. Starting quadrant, and number of cycles to stop, action to be taken at the end of the defined test. Run, hold, continue, and stop buttons for controlling the test. On line instantaneous adjustment of frequency, amplitude and mean of the cyclic waveform tests. Online visual indication of limit settings and status. Data acquisition and storage of external and internal signals with user adjustable sampling rate. The data acquisition mode in the form of maximum and minimum, level crossing, peak valley, continuous and high speed. Remote handset to be provided for the proposed test system to enable setting up of specimens in manual mode. The user should be able to switch on / off hydraulics from the controller. The user should start, pause and stop the test program. Emergency switch off button should be provided in the load frame, hydraulic power pack and near the controller The proposed controller should be able to connect two actuators independently in the same controller chassis. The proposed Controller	The scope should have user selectable and auto scaling features. The scope should be able to plot one channel versus another channel. Programmable automatic mode changing to any transducer connected to the machine which has been selected for control including load limited displacement during specimen loading. Waveform command generation with 32-bit resolution up to 500 Hz for each sensor, with, sine, triangle, square, haversine, havertriangle, haversquare, ramp, dual ramp, trapezoid in relative and absolute modes and support for digital drive data or an analogue input of ±10 V. High precision digital signal conditioner and valve drivers should be provided for the control signals. The controller with necessary software should be able to run static tests and data acquisition should have the following features: Selection of wave form type, timed sample, peak / valley, max / min, level-crossing, cyclic / logarithmic and mean/amplitude with ability to tie data channels to a master signal. Starting quadrant, and number of cycles to stop, action to be taken at the end of the defined test. Run, hold, continue, and stop buttons for controlling the test. On line instantaneous adjustment of frequency, amplitude and mean of the cyclic waveform tests. Online visual indication of limit settings and status. Data acquisition and storage of external and internal signals with user adjustable sampling rate. The data acquisition mode in the form of maximum and minimum, level crossing, peak valley, continuous and high speed. Remote handset to be provided for the proposed test system to enable setting up of specimens in manual mode. The user should be able to switch on / off hydraulics from the controller. The user should start, pause and stop the test program. Emergency switch off button should be provided in the load frame, hydraulic power pack and near the controller The proposed controller should be able to connect two actuators independently in the same controller chassis. The proposed Controller

must be expandable to at least four independent test stations (provision for future expansion) Controller should comply with UL / CSA / CE compliance. **The Manufacturer/ supplier should quote for the actuator, load cell, displacement transducer and digital controller all the four from the same manufacturer** **i.e., A manufacturer/ supplier attempting to quote for equipment for which they are not the OEM will be summarily rejected**	must be expandable to at least four independent test stations (provision for future expansion) Controller should comply with UL / CSA / CE compliance. **The Manufacturer/ supplier should quote for the actuator and digital controller from the same manufacturer/ supplier.** **i.e., A manufacturer/ supplier who does not comply with the above condition will be summarily rejected**
Annexure II Clause 14 Digital electronic controller Digital electronic controller should have following advanced control features. Adaptive Control System, allowing continuous update of PID terms for specimen stiffness and automatically compensating at minimum 1 kHz, Auto and manual tuning facility. The controller should adapt for peak/valley control, amplitude/mean control, amplitude and phase control. Control loop update should be minimum 5 kHz. Multi term control, including PID, lag, feed forward and compensation, with serial, parallel and cascade control. High speed computer interface, using the industry-standard IEEE-488.2 or USB. Transducer signal conditioner to provide high accuracy, low drift and low noise transducer signal with variable filters in the range 100 Hz to 1 kHz in increments of 1 Hz. Digital sensor conditioners providing minimum 19 bit data resolution across the complete span of the sensor. Interlocks and indicators are to be provided for transducer excitation failure and conditioner saturation. Automatic transducer recognition and calibration preventing a transducer overload. The transducer should be provided with traceable calibration. All adjustments on the signal conditioners are to be made by software. Programmable limit/event detection, providing rapid intelligent actions or test interruptions. User selectable limit/event detector actions such	**Annexure II Clause 14** Digital electronic controller Digital electronic controller should have following advanced control features. Adaptive Control System, allowing continuous update of PID terms for specimen stiffness and automatically compensating at minimum 1 kHz, Auto and manual tuning facility. The controller should adapt for peak/valley control, amplitude/mean control, amplitude and phase control. Control loop update should be minimum 5 kHz. Multi term control, including PID, lag, feed forward and compensation, with serial, parallel and cascade control. High speed computer interface, using the industry-standard IEEE-488.2 or USB. Transducer signal conditioner to provide high accuracy, low drift and low noise transducer signal with variable filters in the range 100 Hz to 1 kHz in increments of 1 Hz. Digital sensor conditioners providing minimum 19 bit data resolution across the complete span of the sensor. Interlocks and indicators are to be provided for transducer excitation failure and conditioner saturation. Automatic transducer recognition and calibration preventing a transducer overload. The transducer should be provided with traceable calibration. All adjustments on the signal conditioners are to be made by software. Programmable limit/event detection, providing rapid intelligent actions or test interruptions. User selectable limit/event detector actions such

as hydraulic off, indicate, hold, change mode and hold, reset, unload, no action etc. Programmable error detection, providing rapid intelligent actions or test interruptions. User selectable error detector actions such as hydraulic off, indicate, hold, change mode and hold, reset, unload, no action etc. Programmable display meters, providing the user the flexibility of programming the parameter to be displayed on the meters. The user should be able to select any of the following parameters for display: cyclic/ramp signal track, mean, amplitude, min, max, peak, valley, current cycle count, total cycle count, segments etc. The user should be able to generate as many no of display meters as required to display the above parameters based on the requirement. Programmable display scopes, providing the user the flexibility of programming the parameter to be displayed on X and Y axis. The user should be able to select any of the following parameters for the Y axis: load, stroke, command, servo drive, error etc. The user should be able to select any of the following parameters for the X axis: time, load, stroke. User should be able to adjust the scaling and trace time based on the requirement. The scope should have user selectable auto scaling feature. The scope should be able to plot one channel versus another channel. Pre-programmable automatic mode changing to any transducer connected to the machine which has been selected for control. Waveform command generation with 32 bit resolution at up to 1 kHz for each sensor, with, sine, triangle, square, haversine, havertriangle, haversquare, ramp, dual ramp, trapezoid in relative and absolute modes and support for digital drive data downloaded locally from a PC or via an analogue input of ±10 V. Service data playback of digital files via computer interface at up to 5,000 samples per second on all channels. Specimen protect facility to ensure load on specimen is kept within selectable limits during specimen loading. Minimum 4 digital I/O and 2 analogue outputs of ±10 V per channel of controller. The user should be able to configure any of the following parameters for analogue outputs: load, stroke, command, servo drive, ground. Minimum one analogue inputs of ±10 V	as hydraulic off, indicate, hold, change mode and hold, reset, unload, no action etc. Programmable error detection, providing rapid intelligent actions or test interruptions. User selectable error detector actions such as hydraulic off, indicate, hold, change mode and hold, reset, unload, no action etc. Programmable display meters, providing the user the flexibility of programming the parameter to be displayed on the meters. The user should be able to select any of the following parameters for display: cyclic/ramp signal track, mean, amplitude, min, max, peak, valley, current cycle count, total cycle count, segments etc. The user should be able to generate as many no of display meters as required to display the above parameters based on the requirement. Programmable display scopes, providing the user the flexibility of programming the parameter to be displayed on X and Y axis. The user should be able to select any of the following parameters for the Y axis: load, stroke, command, servo drive, error etc. The user should be able to select any of the following parameters for the X axis: time, load, stroke. User should be able to adjust the scaling and trace time based on the requirement. The scope should have user selectable auto scaling feature. The scope should be able to plot one channel versus another channel. Pre-programmable automatic mode changing to any transducer connected to the machine which has been selected for control. Waveform command generation with 32 bit resolution at up to 1 kHz for each sensor, with, sine, triangle, square, haversine, havertriangle, haversquare, ramp, dual ramp, trapezoid in relative and absolute modes and support for digital drive data downloaded locally from a PC or via an analogue input of ±10 V. Service data playback of digital files via computer interface at up to 5,000 samples per second on all channels. Specimen protect facility to ensure load on specimen is kept within selectable limits during specimen loading. Minimum 4 digital I/O and 2 analogue outputs of ±10 V per channel of controller. The user should be able to configure any of the following parameters for analogue outputs: load, stroke, command, servo drive, ground. Minimum one analogue inputs of ±10 V

per channel controller for data acquisition of external analog signals. Continuous synchronous data acquisition at user selectable sampling rate with maximum 5 kHz on all internal and external channels. The application software for running static, fatigue, dynamic tests and data acquisition should have the following features: selection of wave form type, frequency, mean/amplitude, peak/valley, starting quadrant, no of cycles to stop, action to be taken at the end of the defined test. Block loading capability: to drive actuator synchronously from single demand drive file or multiple demand drive files in sequence. It should be possible to define multiple number of segments in each demand drive file. It should be possible to define the number of cycles, set point, amplitude and wave shape in each segment. Run, hold, continue, and stop buttons for controlling the test. On line instantaneous adjustment of frequency, amplitude and mean of the cyclic waveform tests. Online visual indication of limit settings and status. Data acquisition and storage of external and internal signals with adjustable sampling rate. The digital controller and associated hardware should be compatible for installing demand drive file generation software which will be used to model the test rig and test structure to simulate product service conditions in a controlled laboratory environment using field measurements, including load, strain, displacement, velocity and acceleration. The software should be capable of running multi channel/multi axis testing up to four actuators by adding required additional controller boards. The controller should have provision for adding additional two controller boards (total of four channels) for multi axis testing requirements. Controller must be expandable to at least two independent test stations with common hydraulic power pack/ HSM **The Manufacturer/ supplier should quote for the actuator, load cell, displacement transducer and digital controller all the four from the same manufacturer** **i.e., A manufacturer/ supplier attempting to quote for equipment for which they are not**	per channel controller for data acquisition of external analog signals. Continuous synchronous data acquisition at user selectable sampling rate with maximum 5 kHz on all internal and external channels. The application software for running static, fatigue, dynamic tests and data acquisition should have the following features: selection of wave form type, frequency, mean/amplitude, peak/valley, starting quadrant, no of cycles to stop, action to be taken at the end of the defined test. Block loading capability: to drive actuator synchronously from single demand drive file or multiple demand drive files in sequence. It should be possible to define multiple number of segments in each demand drive file. It should be possible to define the number of cycles, set point, amplitude and wave shape in each segment. Run, hold, continue, and stop buttons for controlling the test. On line instantaneous adjustment of frequency, amplitude and mean of the cyclic waveform tests. Online visual indication of limit settings and status. Data acquisition and storage of external and internal signals with adjustable sampling rate. The digital controller and associated hardware should be compatible for installing demand drive file generation software which will be used to model the test rig and test structure to simulate product service conditions in a controlled laboratory environment using field measurements, including load, strain, displacement, velocity and acceleration. The software should be capable of running multi channel/multi axis testing up to four actuators by adding required additional controller boards. The controller should have provision for adding additional two controller boards (total of four channels) for multi axis testing requirements. Controller must be expandable to at least two independent test stations with common hydraulic power pack/ HSM **The Manufacturer/ supplier should quote for the actuator and digital controller from the same manufacturer/ supplier.** **i.e., A manufacturer/ supplier who does not comply with the above condition will be summarily rejected**

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