

Addendum 02

The Pre – Bid Meeting was held on **11/10/2019** at **3.00 p.m.** in the **Board Room**, NITK Surathkal for the purchase of “**Tribotester**” (**Tender Notification No: NITK/CRF/Tribo/04 Dated: 13/09/2019**). The following queries were discussed & the Reply/Clarification given to the prospective bidders

Queries & Reply/Clarification

Serial No	Specification reference No	NITK Tender specification	Queries by Vendors	Committee's decision	Change to the tender document
1	1	<p>Tribometer: Which is essentially the main unit consisting of mechanical, electrical components, furnace, cooling system as per ASTM G99 or similar international standard meant for wear and friction testing of solid materials in lubricated or dry conditions for up to 1000 °C. The software which is a part of the tribometer is built to operate, make measurements, display real time data, store the data and aid in analysis of the results. The main requirements of the tribometer is highlighted in the section Tribometer 2. The tribometer should be designed to use water as coolant to protect the</p>	<p>Other heat management systems both active (using other coolants) or passive (effective insulation combined with good design of the mechanical parts w.r.t the furnace chamber) offer protection to mechanical parts during high temperatures. In such a scenario, neither water nor a chiller might be required. Ducom asks the committee to have flexibility in accommodating other designs which protect the mechanical parts during high temperature operation.</p>	<p>Other designs will be allowed. For designs with passive protections for spindle, bearings other components, the warranty period will be increased to 5 years.</p>	<p>Designs with passive cooling can be allowed.</p>

		mechanical parts during high temperatures. Water needs to be supplied by a chiller and should be integrated well with the tribometer. It includes, samples holders, safety features, interlocks, accessories, fixtures, calibrations aids, tools to operate the tribometer, add-ons, consumables.			
2	1.1.1.5.	The layout should be such that the electronics are well separated from water lines and heat produced from the furnace.	See remarks on point #1. (specification reference)	Other designs will be allowed. For designs with passive protections for spindle, bearings other components, the warranty period will be increased to 5 years.	Designs with passive cooling can be allowed.
3	1.1.1.7.	The environment in the test chamber must not be contaminated by the air and water circulation	See remarks on point #1.	Other designs will be allowed. For designs with passive protections for spindle, bearings other components, the warranty period will be increased to 5 years.	Designs with passive cooling can be allowed.
4	1.1.3.5.	Withstand high temperatures without oxidation and wear.	At high temperatures of 1000 deg C, oxidation and wear of mechanical assemblies would be unavoidable. Materials are selected to minimize oxidation and wear in order to ensure long service life of the instrument. Please clarify and suggest material systems which do not oxidise and wear at 1000 deg C.	The level of oxidation should not hamper working for atleast 10 years. If oxidation and wear tear of components are going to be high then they have to include such spares in the bid. Design should allow easy removal of such parts.	The level of oxidation should not hamper working for atleast 10 years. If oxidation and wear tear of components are going to be high then they have to include such spares in the bid. Design should allow easy removal of such parts.
5	1.2.3.	Loading Type: By Dead Weight	Advanced automated loading systems offering accurate load control can be provided as against standard dead weight systems. This	Can be allowed. This is advantageous for testing. However, Load and friction force	Can be allowed. This is advantageous for testing.

			<p>also adds the ability to conduct advanced tests where a loading cycle can be programmed and executed without user intervention. Ducom asks the committee to keep the method of loading (either dead weight or automated) open and flexible which meet the minimum technical requirement of 0.2 to 50 N load range.</p>	<p>calibration of automated loading should be possible by a dead weight loading or equivalent methods. We need not have to approach or rely on the OEM or other calibration institutes to get calibrations performed. It should be simple. All accessories and standards for calibration should be provided.</p>	<p>However, Load and friction force calibration of automated loading should be possible by a dead weight loading or equivalent methods. We need not have to approach or rely on the OEM or other calibration institutes to get calibrations performed. It should be simple. All accessories and standards for calibration should be provided.</p>
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6	1.3.1.	Top and side heating elements combined with water cooling system to allow for precise and homogeneously sample temperature control up to 1000 °C	Ducom asks the committee to keep the heating chamber design and configuration flexible and open so as to meet the technical requirement of a homogeneous sample temperature of 1,000 deg C.	Other designs will be allowed. For designs with passive protections for spindle, bearings other components, the warranty period will be increased to 5 years	Designs with passive cooling can be allowed. Also, refer to serial number 8.
7	1.3.2.	Oven Temperature 1000 °C	For the sample to be at 1000 deg C, the oven should be at higher temperatures > 1000 deg C. Please clarify.	Yes. Has to be more than the sample temperature	Has to be more than the sample temperature.
8	1.5.1.	Chiller should be provided with water cooling to the furnace walls and the mechanical system wherever necessary.	Please see point #1	Designs without chiller can be allowed. However, the outer surface of the furnace may not reach more than 400C in case of stainless steel or Inconel based casing. Organic painted mild steel casings may not have temperatures more than 200 C on the surface. A safety light must indicate that the surface is hot.	Designs without chiller can be allowed. However, the outer surface of the furnace may not reach more than 400C in case of stainless steel or Inconel based casing. Organic painted mild steel casings may not have temperatures more than 200 C on the surface. A safety light must indicate that the surface is hot. Appropriate gloves and tongs must be included.
9	1.5.2.	The water lines must be sealed and far away from the electronics	Please see point #1	Designs without chiller can be allowed	Designs without chiller can be allowed. Refer to serial number 8
10	1.5.3.	There must be an in-built safety system to protect the furnace wall and linings during heating if the water flow rates are low.	Please see point #1	Designs without chiller can be allowed	Designs without chiller can be allowed. Refer to serial number 8

11	1.5.4.	The water conduits should be capable of easy cleaning and maintenance	Please see point #1	Designs without chiller and active cooling can be allowed	Designs without chiller can be allowed. Refer to serial number 8.
12	1.10.6.	Fully conform to ASTM G99, ASTM G133 and DIN 50324 standards	ASTM G133 relates to a linear reciprocating system. The overall specifications of load, rpm and motion do not comply with ASTM G133. Please clarify.	Committee agrees with the vendor. ASTM G133 is not present in scope for rotary tribometer	Modified to: Fully conform to ASTM G99, and DIN 50324 standards
13	1.10.7.	Differential arm with two LVDT sensors for precise temperature drift compensation	Other designs and sensors (non-LVDT based) also provide accurate temperature drift compensation. Ducom asks the technical committee to keep the design and type of sensors open which meet the requirements of temperature drift compensation.	Other designs can be allowed; however, the equivalence has to be demonstrated during installation.	Other designs can be allowed;
14	1.10.8.	Radius sensor allows an automatic display of the arm on the sample	It is not clear what is the arm on the sample. Please clarify.	This is a feature of dead loading system which helps to automate the start and stop conditions.	Not applicable to automated loading designs
15	1.10.9.	Purging of Nitrogen, Argon etc; Relative Humidity & Primary Vacuum option available with THT	Please clarify what is THT.	HTT short form for High Temperature Tribometer (it was a typographic error)	Modified to: Purging of Nitrogen, Argon etc; Relative Humidity & Primary Vacuum option available with HTT.
16	1.10.10.	Motorized and software controlled tribometer arm used for normal loading	Please clarify if this refers to motorized and software controlled normal loading in addition to the dead weight loading mentioned in point 1.2.3	This is a feature of dead weight loading system which helps to automate the start and stop conditions. Other design can be allowed. During environment-controlled tests, once the desired conditions are reached	Modified to: In dead weight loading designs, Motorized and software-controlled loading should be possible.

				we should be able start the test from the software.	
17	1.10.11.	Carriage with graduated guide and adjustment knob	Please clarify.	We should be able to able to perform tests at different radii and the radii can be selected to a precision of 0.02mm	No change
18	1.10.13.	2 Independent thermal couples for sample and oven; 1 additional thermocouple for TOP Heating Cover in case of temperature up to 1000 °C	addressed in point #1.3.5	Yes	No change
19	1.10.16.	Plastic Cover: For low temperature measurement tests with environment control	Please clarify	It is for protection and gives provision for environmental control.	No change

Following points to be included in the Addendum 02:

20	1.9.1 to 1.9.14	<p>Consumables</p> <p>1.9.1. 6 mm diameter 100Cr6 balls, 100 pieces</p> <p>1.9.2. 3 mm diameter 100Cr6 balls, 100 pieces</p> <p>1.9.3. 1.5 mm diameter 100Cr6 balls, 500 pieces</p> <p>1.9.4. 10 mm diameter 100Cr6 balls, 10 pieces</p>		Refer Annexure H-A: Common additional items	Removed from tender document. Refer Annexure H-A: Common additional items
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		<p>1.9.5. 6 mm diameter Al₂O₃ (alumina) balls, 50 pieces</p> <p>1.9.6. 3 mm diameter Al₂O₃ (alumina) balls, 10 pieces</p> <p>1.9.7. 1.5 mm diameter Al₂O₃ (alumina) balls, 50 pieces</p> <p>1.9.8. 10 mm diameter Al₂O₃ (alumina) balls, 5 pieces</p> <p>1.9.9. 6 mm diameter WC (hard metal) balls, 10 pieces</p> <p>1.9.10. 3 mm diameter WC (hard metal) balls, 10 pieces</p> <p>1.9.11. 1.5 mm diameter WC (hard metal) balls, 20 pieces</p> <p>1.9.12. 10 mm diameter WC (hard metal) balls, 5 pieces</p> <p>1.9.13. 54 mm diameter – Inconel 5 pieces (suitable for wear test above 850-degree C)</p> <p>1.9.14. 54 mm diameter – Stainless steel (304 L or 316 L)- 10 pieces</p>			
21	5	Rigid Teak Wood table with granite mount		If the tribometer has an integrated table, this supply can be ignored.	If the tribometer has an integrated table, this supply can be ignored.

		5.1.1.1. 6 x 4x 3 ft (wooden table)			
		5.1.1.2. 6 ft x 4 ft x 3 in. or larger thick granite slab top			
22	1.10.17.1-1.10.17.15	<p>1.10.17. Profilometer for wear track measurements</p> <p>1.10.17.1. Compact Profilometer the profilometer wear measurement option allows for sample wear rate and roughness evaluation without the need to remove the sample out of tribometer. Tribometer software should have integrated functions for easy wear rate calculation. This option includes:</p> <p>1.10.17.2. Stylus profilometer with touch screen</p> <p>1.10.17.3. Holder for profilometer</p> <p>1.10.17.4. Software for wear and roughness analysis</p> <p>1.10.17.5. User benefits: Study of sample wear after the measurement or during measurement pauses, without the removal of sample</p>		Equivalent Non- contact profilometers will be acceptable	Equivalent Non- contact profilometers will be acceptable

		<p>1.10.17.6. Compatible with rotating and linear movement modes</p> <p>1.10.17.7. Sample roughness evaluation</p> <p>1.10.17.8. Integrated software function for easy sample wear rate evaluation</p> <p>1.10.17.9. Technical specifications:</p> <p>1.10.17.10. Stylus tip radius 2 um</p> <p>1.10.17.11. Gauge force 1.5 – 3.0 mN</p> <p>1.10.17.12. Depth gauge range (switchable by software) 400 um / 100 um / 10 um</p> <p>1.10.17.13. Depth gauge resolution (switchable by software) 50 nm / 10 nm / 5 nm</p> <p>1.10.17.14. Profile evaluation length 0.25 – 25.0 mm</p> <p>1.10.17.15. Measuring speed 1 mm/s</p>			
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23	1.2.1-1.2.2	Load Cell 1.2.1. Max. Load (N) : 50 or Higher 1.2.2. Min. Load (mN) : 200 or Lower		Load accuracy must be greater than 1% of the applied load	Load accuracy must be greater than 1% of the applied load
24	1.2.5	1.2.5. Friction Force Resolution (mN) : 0.03 or better		Friction force should be accurate to better than 1%	Friction force should be accurate to better than 1%
25	Addendum	Heating algorithm		Heating times should be approximately one hour and not more than 2 hours. Suggestion: PID based/equivalent heating controller and good heating algorithm should be used to reach the temperature of interest as quickly as possible for a given material. Different furnace options can be provided for different temperature ranges. Achieving any temperature for a given material should take approximately the same time.	Heating times should be approximately one hour and not more than 2 hours. Suggestion: PID based/equivalent heating controller and good heating algorithm should be used to reach the temperature of interest as quickly as possible for a given material. Different furnace options can be provided for different temperature ranges. Achieving any temperature for a given material should take approximately the same time.
26	Addendum	Warranty		As per the committee decision, Warranty period is extended to 5 years and AMC for two years after warranty period needs to be quoted. L1 will be calculated considering AMC period. Payment for	As per the committee decision, Warranty period is extended to 5 years and AMC for two years after warranty period needs to be quoted. L1 will be calculated considering AMC

				AMC will be done at the respective time	period. Payment for AMC will be done at the respective time
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Along with the items mentioned in Annexure H of the original tender document and the above addendum, Items in Annexure H-A as per the specifications has to be provided. Find the Annexure H-A attached.

Annexure H-A

A. Linear reciprocatory tribometer/module

This can either be a standalone equipment or an additional module along with rotary or fretting tribometers. Should be as per ASTM G133 or equivalent standard.

1	Adjustable Stroke: range 1-25 mm or more with accuracy 1%	Velocity variation being sinusoidal.
2	Adjustable Frequency: 1-10 Hz or more	
3	Load: 0.5 to 60N or better with 1% accuracy	Dead weight or automatic. Load calibration should be simple, should be do-able in weekly regularity. Calibration kits should be included
4	Friction force:0-20N or better. Accuracy better than 1%	Friction calibration should simple, should be do-able in weekly regularity. Calibration kits should be included. This accuracy will have to be demonstrated
5	Universal (Square or circular) sample holder max 32mm	

6	Pin holders and ball holders of different sizes 3,6 and 10 mm to be provided.	For standalone equipments, additional set of pin and ball holders should be provided even if they are common to other equipments in scope.
7	Oil cup for lubricated tests should be provided. Should be heatable to atleast 100 C	Stroke length when used with oil cup must be atleast 20mm.
8	Compatible profilometer should be provided	Contact or non-contact type
9	Room temperature to 400C	High temperature pin and ball holders of size 3,6 and 10mm must be included. Stroke length when using high temperatures must be 10mm or more. It should not take more than 1 hour to achieve the set temperature
10	Built in humidity and temperature sensor which is in the proximity of the sample	Detachable when performing very high temperature test. Should be optionally logged in the software
11	Environmental chamber for ambient temperature experiments should be provided with a transparent shatter proof plastic.	It must have holes for gas purging, sensor wires etc. At least it must have a peep hole if it is completely metallic casing
12	Table, UPS, and other necessities have to be supplied if the equipment is going to be a standalone equipment.	
13	Software and PC could be same for rotary and linear reciprocatory or a separate PC with software will have to be installed. Easy to visualize and handle software for operating and logging of data to be provided.	For standalone equipment, separate PC with software is preferred. The software should have features of controlling the tribometer. It should be possible to pause a test and restart a test at any point, stop a test at any point. Should intimate errors, faults like over temperatures, under heating, malfunctioning of fans for cooling of electronics is provided.
14	Should be compatible with the profilometer provided for rotary tribometer	Contact or non-contact is allowed.

15	If standalone equipment is provided, robust table with granite top should be provided such that after placing the equipment 2x2 sq. ft area should be free for working	
16	If standalone equipment is provided, separate UPS and battery back-up should be provided as appropriate to the equipment power ratings so that we have 30 minutes back up.	

B. Fretting tribometer-Standalone or additional module to the rotary tribometer or linear reciprocatory tribometer platform

1	Maximum Load range: 0.5 to 60 N down force or more with 1% accuracy	Dead weight or automatic. Load calibration should simple, should be do-able in weekly regularity. Calibration kits should be included
2	Friction force 0.05N-20 N with 1% accuracy	
3	Stroke length range 0.05mm-1mm with 1% accuracy	
4	Frequency 7 Hz or more	
5	Universal (Square or circular or triangular) sample holder – maximum size 32mm	
6	Data acquisition rates should be alterable. Maximum acquisition rate must be atleast 100 times the max frequency offered.	

7	Temperatures from RT to 450 C	It should not take more than 1 Hr to achieve the set temperature
8	Pin and ball holder of sizes 3, 6 and 10 mm should be included	For standalone equipments, additional set of pin and ball holders should be provided even if they are common to other equipments in scope.
9	Easy to visualize and handle software for operating and logging of data	The software should have features of controlling the tribometer. It should be possible to pause a test and restart a test at any point, stop a test at any point. Should intimate errors, faults like over temperatures, under heating, malfunctioning of fans for cooling of electronics is provided. Should help in saving data, raw files, making a report on testing. Compare and analyze results.
10	Should be compatible with the profilometer provided for rotary tribometer	Contact or non-contact is allowed
11	Environmental chamber for ambient temperature experiments should be provided with a transparent shatter proof plastic.	It must have holes for gas purging, sensor wires etc. At least it must have a peep hole if it is completely metallic casing
12	If standalone equipment is provided, robust table with granite top should be provided such that after placing the equipment 2x2 sq. ft area should be free for working	
13	If standalone equipment is provided, separate UPS and battery back-up should be provided as appropriate to the equipment power ratings so that we have 30 minutes back up.	The data should be retrievable even if the tribometer stops. Also, the tribometer should be able to cool down to safe temperatures with in 30 minutes. That is the furnace should be detachable if the regular power supply is hampered.

Common additional items for rotary, linear reciprocatory and fretting equipments:

1.	Humidity controller 5 to 95% RH over 20-40C	Should be compatible with all the three equipments or modules
2.	20 Nos of 3,6, and 10 mm balls of 100Cr6 steel, > 99.0% pure Alumina, WC-Co	Radius variations less than 5% and surface roughness less Ra =0.5 micrometer.
3.	Flat samples, 5 Nos, of 2-inch diameter and 8mm thick, of 100Cr 6 steel, >99.0% pure Alumina, WC-Co	Flat surfaces ground parallel to each other with surface roughness less than 2 micrometer.
4.	Warranty period for all equipments and modules will be 5 years and 2 years AMC shall be included in the bid.	
5.	Any other materials consumables, measures, and set ups meant of day to day running of the equipments have to be provided. Example, h-BN for easy removal of threaded components subjected to high temperatures.	

Please note the additional mandatory requirements:

Rotary 1000 C tribometer, 400 C linear reciprocatory tribometer and 400 C fretting tribometers should be supplied to at least 5 reputed Government institutions and their complete contact details has to be provided.

We request you to quote for the following optional items for future upgradations:

Optional items:

1	Acoustic emission sensor with good sensitivity, range and acquisition times, integratable with the software for logging should be provided.	Should be compatible with all the three equipments or modules
2	800 C stage for fretting and Linear reciprocatory	

Following points to be included in the Addendum 02:

- Under tender document, Section 2: Condition of Contract, Pg. No. 13 of 32, clause No. 2 may be read as
“Incase of Import, CIP rate should be quoted. All components of expenditure to arrive by Air at Bangalore need to be explicitly specified. If ship by sea, the nearest seaport Mangaluru/Chennai. However, during financial comparison 6% additional charges will be levied to cover custom clearance and local transport”

It is decided to extend the Bid submission date by following dates

Last date for request tender document : 03/01/2020, before 3.00 p. m.
Last date for Bid submission : 03/01/2020, before 4.00 p. m.
Bid opening date(tentative) : 06/01/2020 @ 3.00 p.m.

Sd/-
Buyer
Dr. Sumanth Govindarajan

Sd/-
Chairman
Central Research Facility
NITK, Surathkal