



Department of Applied Mechanics

Indian Institute of Technology Madras

Chennai – 600 036, India

Prof. Mahesh Panchagnula

PROJECT COORDINATOR

Ref: No. APM/MAHS/005

DATE

: 5th Sept. 2017

DUE DATE

: 26th Sept. 2017

Dear Sir,

1. Quotations are invited in duplicate for “Fabrication and assembly of spray nozzle test stands” as per the technical specification shown below/overleaf/**enclosed document**.
2. The quotations are to be in two parts as “**Technical Offer**” and “**Commercial offer**”.
The two parts of the offer are to be clearly marked on the envelopes. The two parts of the offer in separate envelopes must be enclosed in one bigger envelope duly sealed and super scribed with reference number and due date and must be addressed to the undersigned so as to reach him on or before the due date stipulated above.
3. Fax and Email quotations are not acceptable.
4. Quotations should be valid for 60 days from the due date and period of delivery required, warranty terms etc. should also be clearly indicated. A minimum of one-year warranty is required from the date of commissioning.
5. Imported supplies should be quoted **CIF Madras**.
6. Local firms to quote free delivery to this Institute. If quoted for Ex-Godown delivery charges be indicated separately.
7. Relevant literature pertaining to the items quoted with full specifications (and drawings, if any) should be sent along with the Quotations, wherever applicable. Samples / machine/ equipment if called for should be submitted / demonstrated free of charges, and collected back at the supplier’s expenses.
8. Compliancy certificate is to be provided indicating conformity to the technical specifications.
9. GST if applicable and such other taxes legally leviable and intended to be claimed should be distinctly shown along with the price quoted. If this is not indicated no such claim will be admitted at a later stage.
10. Goods should be supplied carriage paid and insured.
11. Goods shall not be supplied without an official Purchase order.

12. If the item is under DGS&D Rate Contract No. and the price must be mentioned. It may also please be indicated whether the supply can be made direct to us at the Rate contract price (Please note that we are not Direct Demanding Officers). If so, please send copy of the RC.
13. The Guarantee period of the item may be indicated clearly.
14. In case of LC. Payment, 90% of the payment will be made after completion of the supply. The balance 10% of the payment will be made after satisfactory installation of the equipment.
15. **Acceptance and Rejection:** - I.I.T. Madras has the sole right to accept the whole or any part of the tender or portion of the quantity offered or reject it in full without assigning any reason.
16. IITM has the right to make minor changes to the design & fabrication of the test stand to improve usability.
17. The detailed technical design shall be provided by IIT Madras. This detailed design documents shall be available for inspection by vendors in Fluid Mechanics Lab Room 202. For setting up appointment to see the designs, please contact Mr. P. Goheth (004579@iitmadras.ac.in, mobile: 8667683928).
18. Bids shall be opened on 27th Sept. 2017 at 1430hrs in Newton Hall, Department of Applied Mechanics, IIT Madras.
19. Technical Documentation to be submitted by vendor should contain
 - i. P&ID, MOC, BOM/BOQ & Vendor list for bought out items.
 - ii. Layout, Plan & Design drawings of the test stand to be fabricated.
 - iii. Evidence of supply of similar systems to an institute of national importance. Please attach a copy of the relevant purchase order with the bid.
20. For all other information or technical clarifications, please contact Mr. P. Goheth (004579@iitmadras.ac.in, mobile: 8667683928).

Yours faithfully



Project coordinator

TECHNICAL SPECIFICATION FOR FABRICATION OF SPRAY NOZZLE TEST STAND:

To fabricate, assemble and build TWO test stands as per design provided by IIT Madras. The proposed test stand should have a provision for mounting an air blast atomizer, generate a spray of mineral oil/kerosene/Jet-A fuel under controlled conditions and measure spray parameters.

- 1) The test stand should have a provision for
 - i. Accommodating all sprays of spray cone angle less than 100° .
 - a. The test rig should include provision for mechanical patternators and a measuring devices to measure the fluid.
 - b. The test rig should be capable of moving the nozzle mount transverse and longitudinal axis with automated controls
 - c. 12-15inch downstream distance to visualize spray characteristics to be accommodated
 - ii. Controlling fuel supply pressure in the range 0 – 10 bar (g) and measuring it using a pressure transducer with a minimum accuracy of $\pm 0.5\%$ of full scale.
 - iii. Fuel pressure measurement and control systems to be displayed digitally on the front of the test stand.
 - a. A remote display such as LCD or TFT Display with a minimum diagonal display size of 2 inch and touchpad for user input to control the pressure must be provided.
 - b. Separate display for pressure controller and pressure measurement near the nozzle input
 - c. Fabricator can also use the remote display provided by the supplier
 - d. Pressure controller id: FPC
 - e. Pressure to be displayed in Bar and Psig with minimum of two decimal number
 - iv. Three air supply ports each with its own independent flow rate measurement and control and supply pressure measurement and control systems to be displayed digitally on the front of the test stand.
 - a. Three air supply ports namely L1, L2 & L3 in which L1 has a flow range of 0-10kg/h, L2 & L3 have a flow rate of 0-100kg/h of compressed Air.

- b. Distance between each meter/controller/valves must be ten times the diameter of the piping
- v. Pressure measurement and pressure control system for compressed air (L1) to be displayed digitally on the front of the test stand in the range 0-10 bar (g) and measuring it using a pressure transducer to with a minimum accuracy of $\pm 0.5\%$ of full scale.
 - a. A remote display such as LCD or TFT Display with a minimum diagonal display size of 2 inch and touchpad for user input to control the pressure must be provided.
 - b. Fabricator can also use the remote display provided by the supplier
 - c. Separate display for pressure controller and pressure measurement near the nozzle input.
 - d. Pressure to be displayed in Bar and Psig with minimum of two decimal number
- vi. Pressure measurement and pressure control system for compressed air to be displayed digitally on the front of the test stand in the range 0-10 bar (g) on other two lines and measuring it using a pressure transducer to an accuracy of $\pm 0.5\%$ of full scale.
 - a. A remote display such as LCD or TFT Display with a minimum diagonal display size of 2 inch and touchpad for user input to control the pressure must be provided.
 - b. Fabricator can also use the remote display provided by the supplier
 - c. Pressure to be displayed in Bar and Psig with minimum of two decimal number
- vii. Controlling fuel temperature near a set point within a range of 20-40°C.
 - a. This will be through a plate heat exchanger with thermic fluid heater.
 - b. The flow rate of the working fluid is from 10- 90kg/h, the flow rate of the thermic fluid must be suitable to heat the working fluid up to the above specified temperature.
- viii. Monitor air temperature with an accuracy $\pm 0.1^\circ\text{C}$ using an RTD or a thermocouple and temperature to be displayed digitally using an LCD/TFT display with a minimum diagonal display size of 2 inch.

- ix. Spraying vertically, collecting the sprayed fuel and recirculating the same back to a supply tank after proper filtration.
 - a. A tank of capacity 150 liters for supplying working fluid to be provided and it should be made of SS 316 with explosion proof rating.
 - b. Connecting the spray chamber to an exhaust (blower).
 - c. A suitable oil mist separator should be provided before the exhaust to separate the vapour and collecting the liquid
 - d. The exhaust fan must be capable of providing a negative draft inside the spray chamber and should be able to control the flow rate up to 2500kg/h through a VFD.
 - e. The exhaust fan and its housing must be rated with explosion proofing.
 - f. The VFD control should be provided at the front of the test stand.
- x. Eliminating fine oil/fuel mist in the air leading to the exhaust fan.
- xi. Measuring fuel flow rate in the range 0-100 kg/h to an accuracy of $\pm \frac{1}{2}\%$ of rate using a Coriolis flow meter.
 - a. The Coriolis mass flow meter will be provided by IITM
 - b. Input power from +12 to +26VDC, 200mA maximum
 - c. The end connections will be of compression fitting type
 - d. The bend free lengths would be ten times the pipe diameter at upstream and down stream
 - e. Fabricator can also use the remote display provided by the supplier.
 - f. Mass Flow meter ID: FMFM
- xii. Measuring air flow rate on one of the three air streams in the range 0-10kg/h in the L1 compressed air stream, to an accuracy of $\pm \frac{1}{2}\%$ of full scale using Coriolis flow meters.
 - a. The Coriolis mass flow meter will be provided by IITM.
 - b. Input power from +12 to +26VDC, 200mA maximum.
 - c. The end connections will be of compression fitting type.
 - d. A remote display such as LCD or TFT Display with a minimum diagonal display size of 2 inch and touchpad for user input to control the pressure must be provided.

- e. Fabricator can also use the remote display provided by the supplier.
 - f. The bend free lengths would be ten times the pipe diameter at upstream and down stream
 - g. Mass Flow meter ID: L1MFM
- xiii. Measuring air flow rate on each of the two air streams (L2, L3) in the range 0-100kg/h to an accuracy of $\pm \frac{1}{2}\%$ of full scale using Coriolis flow meters.
- a. The Coriolis mass flow meters will be provided by IITM
 - b. Input power from +12 to +26VDC, 200mA maximum
 - c. The end connections will be of compression fitting type
 - d. A remote display such as LCD or TFT Display with a minimum diagonal display size of 2 inch and touchpad for user input to control the pressure must be provided.
 - e. Fabricator can also use the remote display provided by the supplier.
 - f. The bend free lengths would be ten times the pipe diameter at upstream and down stream
 - g. Mass Flow meter ID: L2MFM & L3MFM
- xiv. Mass flow controller on one of the three air streams in the range 0-10kg/h (in L1 compressed air stream) to an accuracy of $\pm 1\%$.
- a. A mass flow controller will be provided by IITM
 - b. Input power from +12 to +26VDC, 200mA maximum
 - c. The end connections will be of compression fitting type
 - d. A remote display such as LCD or TFT Display with a minimum diagonal display size of 2 inch and touchpad for user input to control the pressure must be provided.
 - e. Fabricator can also use the remote display provided by the supplier
 - f. The bend free lengths would be ten times the pipe diameter at upstream and down stream
 - g. Mass Flow controller ID: L1MFC
- xv. Mass flow controllers on two of the air streams (L2, L3) in the range 0-100kg/h to an accuracy of $\pm 1\%$.
- a. A mass flow controller will be provided by IITM

- b. Input power from +12 to +26VDC, 200mA maximum
 - c. The end connections will be of compression fitting type
 - d. A remote display such as LCD or TFT Display with a minimum diagonal display size of 2 inch and touchpad for user input to control the pressure must be provided.
 - e. Fabricator can also use the remote display provided by the supplier.
 - f. The bend free lengths would be ten times the pipe diameter at upstream and downstream
 - g. Mass Flow controller ID: L2MFC & L3MFC
- xvi. Acquiring flow rate, temperature and pressure data on all the air and fuel streams at the rate of at least 0.1 kHz.
- 2) An open volume of at least 30" × 30" × 35" aligning with the spray axis should be provided under the spray nozzle mount.
 - 3) Provision must be made to be able to rotate the spray nozzle manually through an angle of 180° while the nozzle is spraying. This will allow us to inspect the spray visually for non-uniformities.
 - 4) A backlight should be provided behind the spray nozzle for shadowgraph imaging.
 - 5) All piping and fittings shall be SS316 grade with compression/ferrule fittings
 - 6) All pressure measurements shall be made as close to the injector as possible with minimal pressure drop downstream.
 - 7) All frames and structures should be made using Structural Aluminum (Grade 8020) and covered with SS 304 panels.
 - 8) Eight calibrated measuring beakers which should measure up to 1000ml each and mounted in a straight line
 - 9) A fuel tank of capacity of 150 liters made of SS316 grade
 - 10) Mist elimination/Vapour separator tank should be made of SS316 material and be able to separate Kerosene or any other working fluid from the spray (Air + Kerosene)
 - 11) Filter or mesh should be provided to remove debris or any other materials while spraying after which the fuel has to be recirculated to the storage tank
 - 12) Wherever flexible hoses are used it should be of steel braided hose tube type

- 13) Every component like valves, meters, controllers, tanks, Heat exchanger and other devices must be certified with minimum of IP58.
- 14) All the enclosures should be ATEX certified / NEMA certified whichever is applicable.
- 15) On & off Switches, control switches for all pumps, blowers & compressor should be provided along with the other display parameters and one emergency stop should be provided to shut the whole system.
- 16) Proper mounting rails should be provided to mount the patternator inside the test stand.
- 17) Caster wheels should be provided for transporting the test stand.

Parameters to be displayed digitally with a touch pad (for controllers)at the front of Test stand for User Interface		
kerosene/Mineral Oil/Jet A		
Parameter	Range	
Pressure	0-10 Bar	
Temperature	0-40 Celsius	
Mass flow meter	0-100 kg/h	
Compressed Air		
Line-1 (L1)	Parameter	Range
	Pressure	0-10 Bar
	Pressure Controller	0-10 Bar
	Temperature	0-40 Celsius
	Mass flow meter	0-10 kg/h
	Mass Flow controller	10 kg/h
Line-2 (L2)		
	Parameter	Range
	Pressure	0-10 Bar
	Pressure Controller	0-10 Bar
	Temperature	0-40 Celsius
	Mass flow meter	0-100 kg/h
	Mass Flow controller	0-100 kg/h
Line-3 (L3)		
	Parameter	Range
	Pressure	0-10 Bar
	Pressure Controller	0-10 Bar
	Temperature	0-40 Celsius
	Mass flow meter	0-100 kg/h
	Mass Flow controller	0-100 kg/h

Materials provided by IITM:

Items	Quantity	End Connections
Mass Flow Meter (Kerosene 0-100 kg/h)	One	SS 316 ,Compression fittings
Mass Flow Meter (Air 0-10 kg/h)	One	SS 316 ,Compression fittings
Mass Flow Meter (Air 0-100 kg/h)	Two	SS 316 ,Compression fittings
Mass Flow Controller (Air)	Three	SS 316 ,Compression fittings

Materials to be procured by the fabricator:

Items	Quantity
Pressure controllers	3
Plate heat exchanger	1
Pressure Transmitters	5
Compressor	1
Pump	3
Blower	1
Air Dryers	3
Strainer	1
Needle Valve	1
Storage tank	2
Spray Collection Tank	1
Buffer tank	1
Mist Separator	1
Air filter	1
Air Dryer	3
NRV	6
Temperature Transmitters	2
Temperature Controller	1
Electric heater	1