

भारत सरकार/Government of India अंतरिक्ष विभाग/Department of Space द्रव नोदन प्रणाली केंद्र LIQUID PROPULSION SYSTEMS CENTRE एच ए एल 11 स्टेज, 80 फीट रोड HAL II STAGE, 80 FEET ROAD, बेंगलूरु/BANGALORE-560 008. फोन सं./Phone No.080 25037171/140 ई-मेल/Email: purchase@lpscb.gov.in



दिनांक/Date: 16.01.2025

लोक निविदा सूचना सं. एल बी2025000001-01 दिनांक 16.01.2025 PUBLIC TENDER NOTICE NO. LB2025000001-01 DATED 16.01.2025

स्वचालित वैद्युत परीक्षण यूनिट की अभिकल्पना, प्राप्ति, आपूर्ति, संस्थापन, परीक्षण, प्रवर्तन एवं प्रदर्शन के लिए निविदा। Tender for Design, Realization, Supply, Installation, Testing, Commissioning and Demonstration

of Automated Electrical Test Unit

निविदा वर्गीकरण: लोक निविदा Tender Classification: PUBLIC TENDER

निविदा की निर्धारित तिथियाँ/TENDER SCHEDULE

बोली-पूर्व बैठक की तिथि/Pre-bid Meeting Date	:	31.01.2025 10:00
बोली प्रस्तुति की आरंभिक तिथि/Bid Submission Start Date	:	31.01.2025 14:00
बोली स्पष्टीकरण की नियत तिथि/Bid Clarification Due Date	:	13.02.2025 14:00
बोली प्रस्तुतीकरण की नियत तिथि/Bid Submission Due Date	:	27.02.2025 14:00
बोली खुलने की तिथि/Bid Opening Date	:	27.02.2025 14:30
मूल्य बोली खुलने की तिथि / Price Bid Opening Date	:	13.03.2025 14:00

निविदा दस्तावेज़ <u>https://www.isro.gov.in/ OR https://eproc.vssc.gov.in</u> या इसरो ई-<u>प्रापण पोर्टल से डाउनलोड किए जा सकते हैं।/</u>Tender documents can be downloaded from <u>https://www.isro.gov.in/ OR https://eproc.vssc.gov.in_or ISRO E-Procurement Portal.</u>

> हस्ताक्षरित/Signed क्रय व भंडार अधिकारी/Purchase & Stores Officer

GOVERNMENT OF INDIA DEPARTMENT OF SPACE LIQUID PROPULSION SYSTEMS CENTRE (LPSC-B) BANGALORE

Tender for Automated Electrical Test Unit

Bids to be submitted online

Tender No.: LPSC-B/Liquid Propulsion Systems Centre,Bengaluru/LB202500000101 dated 16-01-2025

A. Tender Details

Tender No :	LPSC-B/Liquid Propulsion Systems Centre,Bengaluru/LB202500000101
Tender Date :	16-01-2025
Tender Classification:	GOODS
Purchase Entity :	Liquid Propulsion Systems Centre, Bengaluru
Centre :	LIQUID PROPULSION SYSTEMS CENTRE (LPSC-B)

Tender for Design, Realization, Supply, Installation, Testing, Commissioning and Demonstration of Automated Electrical Test Unit

Tender for Design, Realization, Supply, Installation, Testing, Commissioning and Demonstration of Automated Electrical Test Unit

A.1 Tender Schedule

Tender Publish Date :	16-01-2025 16:00
Bid Clarification Due Date :	13-02-2025 14:00
Bid Submission Start Date :	31-01-2025 14:00
Bid Submission Due Date :	27-02-2025 14:00
Bid Opening Date :	27-02-2025 14:30
Price Bid Opening Date :	13-03-2025 14:00
A.2 Pre-bid Meeting Details	
Date :	31-01-2025 10:00
Place :	LPSC, Bengaluru
Location :	80 Feet Road, Indiranagar, HAL 2nd Stage HPO

Centre :

Details :

LIQUID PROPULSION SYSTEMS CENTRE (LPSC-B), BANGALORE, KARNATAKA

All the vendors should visit LPSC(B) before bidding on the notified date to understand the requirement by visualizing the manual mode of testing at LPSC(B). The offers submitted by parties participating in site visit only will be considered for evaluation.

Vendors interested in site visit may intimate their willingness and furnish details of personnel visiting by sending mail to "purchase@lpscb.gov.in" at least 48 hours prior to site visit scheduled on 31st Jan, 2025 at 10:00 hours.

B. Tender Attachments

Technical Write-up/Drawings

Document : Specification

Instructions To Vendors

2. Instructions to Vendors

1. LPSC(B) invites offers through eprocurement portal (https://eproc.isro.gov.in) for the supply / service of items as listed in the Tender document.

2. Prospective vendors interested in participating in the tendering process need to get registered in the e-procurement portal by using Digital Signature Certificate. Offers submitted through our online portal only shall be considered and offers received through fax or email or in person shall not be considered.

3. The Tenderers are requested to update their address and contact details, if necessary and submit the Bids online at least two days prior to closing date to avoid last minute system / network related problems. In case of any technical issues, tenderers may write to helpdesk team (eprocure@vssc.gov.in, egps@lpscb.gov.in) for resolution. Request for the extension of the due date for such instances shall not be considered.

4. GST @ 5% is applicable for following goods mentioned under SI. No. 243B as per Department of Revenue Notification No. 25/2018 - Integrated Tax (Rate) dated 31/12/2018 (Amendment to Notification Nos. 07/2018 dated 25/01/2018 and 01/2017 dated 28/06/2017) and Department of Revenue Notification No. 24/2018 - Central Tax (Rate) dated 31/12/2018 (Amendment to Notification Nos. 06/2018 dated 25/01/2018 and 01/2017 dated 28/06/2017) and Government of Karnataka Notification No. 24/2018 dated 31/12/2018 (Amendment to Notification Nos. 06/2018 dated 25/01/2018 and 01/2017 dated 28/06/2017) and Government of Karnataka Notification No. 24/2018 dated 31/12/2018 (Amendment to Notification Nos. 06/2018 dated 25/01/2018 and 01/2017 dated 28/06/2017).

"Scientific and technical instruments, apparatus, equipment, accessories, parts, components, spares, tools, mock ups and modules, raw material and consumables required for Launch Vehicles and Satellites and Payloads"

5. LPSC(B), ISRO is eligible for Customs Duty Concession vide Notification No.12/2012-Customs dated 17/03/2012 and Notification No. 50/2017-Customs dated 30/06/2017. Necessary Customs Duty Concession Certificate shall be provided if applicable.

6. Offer Validity: The offer shall be valid for a period of 90 days (for Single Part Tender) and 120 days (for Two Part Tender) from the date of opening of the tender or any other period as specified in the

Tender document. Offers with lesser validity period than that specified are liable for exclusion from the procurement process.

7. In case of Two Part Tender, Tenderers shall not mention any kind of price element in Techno-Commercial Bid. If any Price element is mentioned in the Techno-Commercial bid, their offer shall be liable for rejection.

8. LPSC(B) reserves the right to accept or reject any quotation in part or in full or part without assigning any reason thereof. LPSC(B) shall be under no obligation to accept the lowest tender and reserves the right to accept whole or any part of the tender or part of the quantity offered and the Tenderers shall supply the same at the rates quoted.

9. Bank Details: Tenderer shall provide their bank details such as IFSC code, IBAN No., SWIFT etc. along with their offer which shall be not be changed till completion of supply/service.

10. Applicable Law: The Contract shall be governed by Indian Law for the time being in force and jurisdiction shall lie in the Courts of India.

11. Only Class-I and Class-II Local suppliers as per Public Procurement Policy (Preference to Make in India) Order, 2017 are eligible to participate in the bid unless otherwise specified in the Tender document.

12. As far as implementation of Public Procurement Policy (Preference to Make in India) Order, 2017 is concerned, the Office Orders vide No. P-45021/2/2017-B.E-II dated 15/06/2017, which is partially modified by Order No. P-45021/2/2017-PP(BE-II) dated 28/05/2018, Order No. P-45021/2/2017-PP(BE-II) dated 29/05/2019, Order No. P-45021/2/2017-PP (BE-II) dated 04/06/2020 and Order No. P-45021/2/2017-PP (BE-II) dated 16/09/2020 and subsequent Amendments issued by the Department for Promotion of Industries and Internal Trade (DPIIT), Ministry of Commerce and Industry regarding Class-I / Class-II local suppliers, Purchase preference, verification of local contents etc. shall be applicable to this tender unless otherwise specified in the Tender document. Therefore, bidders may ensure compliance of the same while submitting tenders.

13. Price Preference shall be extended to the MSEs under the Public Procurement Policy for MSEs formulated under the Micro, Small and Medium Enterprises Development Act, 2006 unless otherwise specified in the Tender document. Such MSEs shall produce documentary proof of registration as per provisions of the Policy i.e. registration with District Industries Centre (DIC) or Khadi and Village Industries Commission (KVIC) or Khadi and Industries Board (KVIB) or Coir Board or National Small Industries Commission (NSIC) or Directorate of Handicrafts and Handlooms or Udyog Aadhar Memorandum or any other body specified by Ministry of MSME.

14. Any bidder from a country which shares a land border with India will be eligible to bid in this tender,

only if the bidder is registered with the Competent Authority. Competent Authority for the purpose of registration shall be the Registration Committee constituted by the Department for Promotion of Industry and Internal Trade (DPIIT).

15. Resolution of Disputes: Any dispute, disagreement or question arising out of or relating to or in consequence of the contract or to its fulfillment, or the validity of enforcement thereof which cannot be settled mutually, or the settlement of which is not herein specifically provided for, shall within 30 (thirty) days from the date either party informs the other in writing that such dispute or disagreement exists be referred to arbitration by the sole arbitrator. The Arbitrator shall be appointed as per the Indian Arbitration and Conciliation Act 1996 and proceedings will be conducted in Bangalore. The Arbitration proceedings shall be conducted in accordance with and subject to the Arbitration and Conciliation Act 1996 (Act 26 of 1996) as amended from time to time and the decision of the Arbitrator shall be final and binding on the parties thereto. Each party shall bear its own cost of preparing and presenting its case. The cost of Arbitration including the fees and expenses of the Arbitrator shall be shared equally by the parties unless the award provides otherwise. Subject to provisions of this clause, the courts at Bangalore shall have exclusive jurisdiction. Performance under this Contract shall, however continue during Arbitration proceeding and no payment due or payable by the parties hereto shall be withheld unless any such payment is/or forms a part of the subject matter of the Arbitration proceedings.

16. Force Majeure: Neither party shall bear responsibility for the complete or partial non-performance of any of his obligations if the non-performance results from such force majeure circumstances such as, but not restricted to, flood, fire, earthquake, civil commotion, sabotage, explosion, epidemic, quarantine restriction, strike, lock-out, freight embargo, acts of the Government, acts of public enemy and other acts of God as well as war or revolution, military operation, blockade, acts or actions of State authorities or any other circumstance beyond the control of the parties provided the other party is notified in writing within 21 days from the date of commencement of the unforeseeable event.

C. Bid Templates

C.1 Technical Bid - Automated Electrical Test Unit

1. Data Acquisition System: Automated Electrical Test Unit. Refer Annexure for detailed specification

Item specifications for Data Acquisition System

SI No	Specification	Value	Compliance	Offered Specification	Remark
1	Automated Electrical Test Unit	Refer Annexure for detailed specification	Yes / No / Explain		

Supporting Documents required from Vendor

1. Operation manual, service manual, detailed engineering document, factory acceptance test doc

5 additional documents can be uploaded by the vendor

C.2 Commercial Terms / Bid

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SI. No.	Description	Compliance	Vendor Terms
1	delivery period shall be considered as 6 months from date of PO placement	Yes / No / Explain	
2	This is a Two Part Tender. Do not mention price element in Techno Commercial Bid. If any Price element mentioned in technical bid, your offer will not be considered.	Yes / No / Explain	
3	Goods and Services Tax (GST): Kindly mention percentage of GST considered in your offer along with HSN Code.	Yes / No / Explain	
4	Delivery Terms: FOR LPSC, Bangalore	Yes / No / Explain	
5	Delivery Period: The supply shall be completed within 06 months from the date of receipt of PO or date of issue of FIM (if applicable), whichever is later.	Yes / No / Explain	
6	Payment Terms: 100% payment shall be made within 30 days of receipt and acceptance of the items at our site.	Yes / No / Explain	
7	Liquidated Damages (LD): If the ordered items are not supplied within the delivery schedule, LD shall be levied from your bill @ 0.5% of the order value per week or 0.5% of the value of the stores for which the delivery is delayed for each week of delay subject to a maximum of 5% of the order value. However, in case of inordinate delay in completion period, LD@10% shall be recovered.	Yes / No / Explain	
8	Warranty: The items shall be warranted for a minimum period of 12 months from the date of supply or acceptance of items at our site which ever is later. Necessary warranty certificate shall be furnished along with the supply.	Yes / No / Explain	
9	Performance Bank Guarantee (PBG): You have to submit PBG towards fulfilment of warranty obligations and performance of the system for 3% of the Order Value from a Nationalized / Scheduled Bank on non-judicial stamp paper of appropriate value valid till the completion of warranty period plus 60 days as per the format provided by Department.	Yes / No / Explain	

10	Security Deposit (SD): You have to furnish a Bank Guarantee from a Nationalized / Scheduled Bank on non-judicial stamp paper of appropriate value for 3% of the order value within 10 days of receipt of order towards the faithful execution of the order valid till the completion of the scope of work as per order plus sixty days (as claim period). SD shall only be applicable for order value above INR 50.00 Lakhs. SD shall be returned to you immediately on execution of the order satisfactorily as per order terms. In case of non-performance / poor performance, the amount shall be withheld.	Yes / No / Explain	
11	Insurance: Being a Government of India Department, Insurance is not required at our cost. Please ensure the safe delivery of the ordered item with proper AIR / SEA / ROAD worthy packing.	Yes / No / Explain	
12	Free Issue Material (FIM), if applicable: You have to submit Bank Guarantee for a value equivalent to FIM (if applicable) from a Nationalized / Scheduled Bank on non-judicial stamp paper of appropriate value towards issue of FIM. The BG shall be valid till receipt and acceptance of supply and satisfactory accounting of FIM.	Yes / No / Explain	
13	Address, contact details like Telephone Number, e-mail, etc. on which order to be placed.	Yes / No / Explain	
14	Details of Principal: Address, contact details like Telephone Number, e-mail, etc. (if applicable)	Yes / No / Explain	
15	Bank Details: Bank name, Branch address, Account No., IFSC Code, IBAN Number, SWIFT, etc.	Yes / No / Explain	
16	Local Content (%): Please mention the percentage of Local Content and the location where local value addition takes place (Kindly enclose self-certification document)	Yes / No / Explain	
17	MSE Status: Kindly mention the classification under MSE and submit supporting documentation (if applicable)	Yes / No / Explain	
18	Validity of offer: 90 days (for Single Part Tender) / 120 days (for Two Part Tender) from the date of opening of tender or as specified in the Tender Document.	Yes / No / Explain	

19	Vendor shall offer Non Comprehensive AMC after expiry of the warranty period for a period of Three years. The scope of the non comprehensive AMC as per Annexure.	Yes / No / Explain	
20	Preventive Maintenance: Half Yearly	Yes / No / Explain	
21	Break down maintenance: Any number of breakdown calls during the contract period without any additional charges. The breakdown visit should cover the following: (a) The party should respond and attend to the problem within 24 hours from the time of intimation by LPSC(B). (b) Checking the system against breakdown. (c) Identify the nature of problem/s. (d) Rectify the identified problem/s and set right the system. (e) Demonstration of satisfactory performance of the system.	Yes / No / Explain	
22	PAYMENT TERMS: Maintenance charges shall be paid half yearly proportionately on completion of each satisfactory service. However, at the end of each service, a Service Report duly signed by contractor, Indentor and duly approved by Indentor Divisional Head shall be obtained from the user division to the effect that the system have been serviced and is working satisfactorily and the certified service report shall be submitted to the Sr. Accounts Officer, LPSC, along with your bill/invoice in duplicate with a copy to Purchase Officer.	Yes / No / Explain	
23	SECURITY DEPOSIT : The party shall submit the security deposit equivalent to 3% of the AMC value till the completion of contract in the form of bank guarantee or either form of negotiable instrument valid for the total AMC period, issued by a nationalized or scheduled bank in the form of Rs. 200 non-judicial stamp paper before commencement of the work in favour of Senior Accounts Officer, LPSC, Bangalore. This security deposit will be returned (interest free) after the successful completion of Annual Maintenance Contract. The security deposit shall have a further claim period of 6 months.	Yes / No / Explain	

24	Maintenance shall be carried out at our premises only. In case any item has to be taken to your premises for repairs, necessary Bank Guarantee for the value of the item shall be furnished, and valid till returning of the item.	Yes / No / Explain	
25	During AMC, in the event of damages to our property or injury to our personnel due to the negligence of your employees, the responsibility shall solely rests with you.	Yes / No / Explain	
26	Arbitration: In the event of dispute or difference arising out of or in connection with this purchase order/contract, which cannot be resolved through amicable settlement by mutual consultation, the same shall be settled under the Rules of Arbitration & Conciliation act 1996 under the Indian statue only, whose decision shall be final and binding on both the parties.	Yes / No / Explain	
27	Jurisdiction: The Courts in and around the City of Bangalore alone shall have jurisdiction to deal with and decide any matter or dispute whatsoever arising out of this agreement including those arising under the Arbitration Act.	Yes / No / Explain	
28	Force Majeure: Neither LPSC, Bangalore nor Supplier shall be consider in default of the performance of their obligations under this PO if such performance is prevented or delayed for any cause beyond reasonable control of the parties to the order getting affected such as Acts of God, War, Riots, Civil Commotion, Illegal Strikes, Legal Lock-outs, Epidemics, Fire Accidents, Floods, Earthquakes, Proclamation or Regulation or Ordinance of any Government Thereof provide notice in writing of any such cause with necessary proof that the obligation under the PO is hereby affected or prevented or delayed is given within 14 days from happening of the event.	Yes / No / Explain	

29	Fall Clause:The rate changed for the work/ supply shall in no event exceed the lowest rates for the similar work/ supply to any other party during the period of the contract. If at any time during stipulated time period, reduction on the charges for similar work/supply to other customer extended by you, shall forthwith notify to the Purchase and Store Division, rate payable under the contract after the rate , coming into force of such reduction shall stand correspondingly reduced & refunded to us	Yes / No / Explain	
30	Down-Time Compensation: In case the break-down are not attended to in time, i.e., within 24 hrs. of our intimation, down-time compensation at the rate of 0.5% of the Annual Maintenance charges per day shall be recovered from you subject to a maximum of 5% of the Contract value.	Yes / No / Explain	
31	Penalty Clause: In case service provider fails to complete the required work hours specified/month by the focal point, down time compensation @ 0.5% of cost of the non-completed work hours will be recovered per week. The quantum of down time compensation to be recovered will be decided by the service receiver after assessing the quantum of work hours not completed and the decision will be final and binding on the service provider.	Yes / No / Explain	
32	Name and Address of vendor/firm/company/establishment on which PO shall be placed in case of Order.	Yes / No / Explain	
33	Income tax at applicable rates shall be deducted at source.	Yes / No / Explain	
34	Any other terms & conditions.	Yes / No / Explain	

C.3 Price Bid

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Data Acquisition System: Automated Electrical Test Unit. Refer Annexure for detailed specificationData Acquisition 1.00 Nos.1
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Common charges (Applicable for all items)

Installation & Configuration	
Other Costs, if any (Value)	
Taxes, if any (Percentage)	

ANNEXURE 1 - TECHNICAL SPECIFICATION OF

AUTOMATED ELECTRICAL TEST UNIT

1. INTRODUCTION

This proposal is for an Automated Electrical Test Unit (ATU) to carry out electrical tests of Flow Control Valves, Latch valves and Thrust chamber assemblies and pulsing/cycling operations on these valves.

The testing of Flow Control Valves and Latch valves calls for verification of various parameters which needs to be stored and analyzed at various sub-assembly stages and final assembly before clearing for inducting into various projects. The proposal is for Design, Realization, Supply, Installation, Testing, Commissioning & Demonstration of satisfactory performance of Automated Electrical Test Unit at LPSC(B) as per the specification mentioned in this document.

2. COMPONENTS OF THE UNIT

The unit shall be an integrated system comprising of the following:

- Hardware This shall include Chassis, Controller, Digital Multimeter, Oscilloscope, Switch Module, digital I/O Module, Power supply and necessary cards to acquire voltage, current and resistance.
- ii. Application software The software shall cover all the required functional requirement specified and shall be built using LabVIEW or equivalent software with user friendly interface.
- iii. PC with preloaded latest operating system and office tools.
- iv. Colour Printer with scanner
- v. All required driver software

3. SOFTWARE REQUIREMENT

- The proposed Automated Electrical Test Unit will be used to carry out electrical tests on the following propulsion components:
 - a) Flow Control Valve
 - b) Latch Valve
 - c) Thrust Chamber Assemblies

- The unit shall command and acquire electrical test data of these components. Minimum required sampling rate is 10,000 samples/sec. Sampling rate should be programmable from 1 sample/s to 10K samples/s.
- The response of the valves shall be captured in Graphical format also. The status of the valves shall be clearly displayed on GUI as well as on Electrical Test Unit.
- The unit shall provide real-time display of the test results and have provision to generate Test Report that can be saved and retrieved for future analysis. Before start of the test, inputs shall be obtained from the user that are required to test the respective component and generate the appropriate test report.
- Provision shall be available to update or create new component specification in the test report.

The details of test conducted for each component and the procedures are described below. These are done manually as of now. The software proposed should automate the tests conducted on different components and produce the test reports and graphs as detailed below.

3.1. Flow Control Valve (FCV)

a) Description of Flow Control Valve

A Flow Control Valve (FCV) has two coils: Upstream (US) and Downstream (DS). FCV is normally in closed condition. Whenever voltage is applied to both the coils only, FCV can be opened.

b) Electrical tests of Flow Control Valve

- i. Coil Resistance
- ii. Insulation Resistance
- iii. Pull in & Drop out voltage
- iv. ON & OFF Response
- v. Pulsing Operation

3.1.1. Coil resistance

Coil resistance of US, DS shall be measured using 6 $\frac{1}{2}$ digit multimeter card. Resistance measurement shall have repeatability of ±0.25 Ω .

3.1.2. Insulation Resistance

Insulation resistance of US, DS shall be measured using High resistance meter. Insulation resistance is measured between leads and body of the valve. These values shall communicate to the ATU through IEEE – 488 bus (GPIB).

(High Resistance meter procurement is not in supplier scope, Available meters at LPSC(B): Agilent Technologies – 4339B, Keithley – 6517B).

3.1.3. Pull in & Drop out voltage

a. Configurable Parameters:

Configurable voltage US Configurable voltage DS Voltage Step for US Voltage Step for DS Configurable maximum safe voltage of US Configurable maximum safe voltage of DS

b. Measurement Procedure:

To measure US coil pull in voltage:

The unit shall gradually increase DS coil voltage in steps as configured till the coil is open fully and then reduce the voltage to configured value to avoid overheating. Then, the US coil supply voltage shall be gradually increased in steps as configured and the current of the coil shall be captured and saved. The voltage corresponding to the current at which the coil opens shall be measured and recorded as pull in voltage of US.

• To measure US coil drop out voltage:

The unit shall gradually reduce the voltage of US coil and the current shall be captured and saved. Measure & record the voltage corresponding to current of the coil where the coil closed as the drop out voltage of US. Now, the unit shall reduce the US & DS coil voltages to 0V.

To measure DS coil pull in voltage:

The unit shall gradually increase US coil voltage in steps as configured till the coil is open fully and then reduce the voltage to configured value to avoid overheating. Then, the DS coil supply voltage shall be gradually increased in steps as configured and the current of the coil shall be captured and saved. The voltage corresponding to the current at which the coil opens shall be measured and recorded as pull in voltage of DS.

To measure DS coil drop out voltage:

The unit shall gradually reduce the voltage of DS coil and the current shall be captured and saved. Measure and record the voltage corresponding to current of the coil where the coil closed as the drop out voltage of DS. Now, the unit shall reduce the US & DS coil voltages to 0V.

• To measure pull in voltage when US & DS are in parallel:

The unit shall gradually increase both the coil supply voltage in steps as configured, capture and save the current of the coils. The voltage corresponding to coil current (either US or DS) whichever open later shall be considered, measured and recorded as pull in voltage in parallel mode. For instance as unit increasing the voltage, first DS coil is opened then US coil is opened. So, for the measurement of pull in voltage, US coil current shall be considered.

To measure drop out voltage when US & DS are in parallel:

The unit shall gradually reduce the voltage of the coils. The voltage corresponding to the coil current (either US or DS) whichever closes first shall be considered, measured and recorded as the drop out voltage in parallel mode. For instance as unit decreasing the voltage, first DS coil is closed then US coil is closed. So, for the measurement of drop out voltage, DS coil current shall be considered.

Note: The unit can only increase the voltage up to configurable maximum safe voltage of respective US and DS during the test. If the valve doesn't open within the configurable maximum safe voltage, test needs to be aborted.

c. Test Results:

Pull in Voltage of US Drop out Voltage of US Pull in Voltage of DS Drop out Voltage of DS Pull in Voltage in Parallel mode Drop out Voltage in Parallel mode

3.1.4. ON & OFF Response

a. Configurable Parameters:

US:	Configurable voltage of the pulse	
	Configurable duration of the pulse	
DS:	Configurable voltage of the pulse	
	Configurable duration of the pulse	
Parallel mode:	Configurable voltage of the pulse	
	Configurable duration of the pulse	

b. Measurement Procedure:

The TTL pulse is applied to the input of the driver circuit. Output of the driver circuit shall be applied to the component. The current of the FCV shall be captured and saved. Note: Driver Circuit shall be provided by LPSC(B).

To measure US coil ON & OFF response:

The unit shall increase the voltage DS coil in steps as configured till coil opens fully and reduce to configured value to avoid overheating. The unit shall apply configured voltage pulse of configured duration to the US coil, capture and save the coil current graph, measure and record the ON & OFF responses.

To measure DS coil ON & OFF response:

The unit shall increase the voltage US coil in steps as configured till coil opens fully and reduce to configured value to avoid overheating. The unit shall apply configured voltage pulse of configured duration to the DS coil, capture and save the coil current graph, measure and record the ON & OFF responses.

To measure ON & OFF response when US & DS are in parallel:

The unit shall apply configured voltage of pulse of configured duration to the coils, capture and save the coil current graph and record the ON & OFF responses.

c. Test results

US ON response US OFF response DS ON response DS OFF response Parallel mode ON response Parallel mode OFF response

Note: Current waveform should be saved for Pull in, drop out, ON & OFF response testing.

A typical coil current (both ON & Off) graph captured in CRO is as shown in the following Figure (for reference).





3.1.5. Pulsing OF FCV

- Pulse ON time settable from 1 to 9999 msec
- Pulse OFF time settable from 1 to 9999 msec
- Pulse ON and OFF times will be independently settable
- Number of pulses settable from 1 to 999999
- Number of pulses applied should be indicated
- TTL type pulse output signal
- Pulse fall/raise times less than 10nsec
- Accuracy of pulse ON/OFF times less than 0.1% of set time
- Accuracy of pulse frequency: 1x10⁻⁴ PPM
- Driver circuit to drive solenoid valve rated for 70V DC, 9A. Driver circuit should be protected from back EMF. [The design of driver circuit for the pulsing is supplier's scope]
- Continuous Solenoid ON option for a maximum period of 10 min
- Provision for real time monitoring, capturing and recording of solenoid valve current.
- Provision for continuous ON for maximum 10 minutes. The duration for continuous operation shall be programmable.
- > Provision shall be given such that minimum 3 No of valves can be done simultaneously.

3.2. Latch Valve (LV)

a) Description of LV

A Latch Valve (LV) has two coils: open coil (OC) and close coil (CC). It has an inbuilt micro-switch with Pole, NC & NO. When voltage is applied to open coil, the LV is opened and continuity appears between pole and NO. When voltage is applied to close coil, the LV is closed and continuity appears between pole and NC.

b) Electrical Tests of LV

- i. Coil Resistance
- ii. Insulation Resistance
- iii. Minimum actuation voltage
- iv. Open & close Response
- v. Cycling operation

3.2.1. Coil resistance

Coil resistance of OC, CC is measured using measured using 6 $\frac{1}{2}$ digit multimeter card. Resistance measurement shall have repeatability of ±0.25 Ω .

3.2.2. Insulation Resistance

Insulation resistance of OC, CC and micro switch is measured using High resistance meter. Insulation resistance is measured between leads and body of the valve. These values should communicate to the ATU through IEEE – 488 bus (GPIB).

(High Resistance meter procurement is not in supplier scope, Available meters at LPSC(B): Agilent Technologies – 4339B, Keithley – 6517B).

3.2.3. Minimum Actuation voltage:

a. Configurable Parameters:

Voltage Step for OC

Voltage Step for CC

Configurable safe voltage of OC

Configurable safe voltage of CC

b. Measurement Procedure:

To measure OC minimum actuation voltage:

The unit shall gradually increase the OC supply voltage in steps as configured, capture and save the current of the coil. The voltage corresponding to current at which the coil opens shall be measured and recorded as minimum actuation voltage of OC and status of the valve to be monitored.

To measure CC minimum actuation voltage:

The unit shall gradually increase the CC supply voltage in steps as configured till the LV closed, capture and save the current of the coil. The voltage corresponding to current at which the coil opens shall be measured and recorded as minimum actuation voltage of CC and status of the valve to be monitored.

Note: If the valve not at all opening/ closing for the increased respective OC/CC coil voltage, then unit shall increase the voltage up to configurable maximum safe voltage of respective OC and CC.

c. Test results:

Minimum actuation voltage OC Minimum actuation voltage CC

3.2.4. Response measurement Procedure of LV:

a. Configurable Parameters:

OC: Configurable voltage of the pulse

Configurable duration of the pulse

CC: Configurable voltage of the pulse

Configurable duration of the pulse

b. Measurement Procedure:

• To measure OC response:

The unit shall apply configured voltage of pulse for configured duration to the OC and capture the coil current graph. Measure and record open coil response.

• To measure CC response:

Apply configured voltage of pulse for configured duration to the CC and capture the coil current graph. Measure and record close coil response.

c. Test results

- OC response
- CC response

Note: Current waveform should be saved for Minimum actuation, ON & OFF response testing. A typical coil current graph captured in CRO is as shown in the following Figure (for reference). The micro switch indication shall be provided throughout the Latch Valve Testing.



3.2.5. CYCLING OF LV

- Pulse ON time settable from 1 to 9999 msec
- Pulse OFF time settable from 1 to 9999 msec
- Pulse ON and OFF times will be independently settable
- Number of pulses settable from 1 to 999999
- Number of pulses applied should be indicated.
- > TTL type pulse output signal
- > Pulse fall/raise times less than 10nsec
- Accuracy of pulse ON/OFF times less than 0.1% of set time
- Accuracy of pulse frequency: 1x10⁻⁴ PPM

- Driver circuit to drive LV coil rated for 70V DC, 9A. Driver circuit should be protected from back EMF. [The design of driver circuit for the pulsing is supplier's scope]
- Provision for monitoring the valve coil current
- Provision shall be given such that minimum 3 No of valves can be done simultaneously

NOTE: The microswitch indication shall be provided throughout the Latch Valve Testing.

3.3. Thruster Chamber Assembly (TCA)

a) Description of Thruster Chamber Assembly

TCA is the assembled combination of FCV, Catalyst Bed Heater (CBH) and Thermocouple. FCV is normally in closed condition.

TCA electrical tests are done at 42V and 70V. 42V test procedure is same as FCV electrical test. (section No: 3.1). In 70V test, both US and DS coils of FCV are connected in series and it will be a single coil.

b) Electrical tests of Thruster Chamber Assembly @ 70V

- i. Coil Resistance
- ii. Insulation Resistance
- iii. Pull in & Drop out voltage
- iv. ON & OFF Response

3.3.1. Coil resistance

Coil resistance of FCV, CBH (main & redundant), thermocouple, FCV heater and thermistor shall be measured and stored using 6 $\frac{1}{2}$ digit multimeter card. Resistance measurement shall have repeatability of ±0.25 Ω .

3.3.2. Insulation Resistance

Insulation resistance of FCV, CBH (main & redundant), thermocouple shall be measured using High resistance meter. These values should communicate to the ATU through IEEE – 488 bus (GPIB).

(High Resistance meter procurement is not in supplier scope, Available meters at LPSC(B): Agilent Technologies – 4339B, Keithley – 6517B).

3.3.3. Pull in & Drop out voltage

a. Configurable Parameters:

Configurable voltage Step of coil

Configurable maximum safe voltage of coil

b. Measurement Procedure:

• To measure pull in voltage:

The unit shall gradually increase the coil supply voltage in steps as configured, capture and save the current of the coil. The voltage corresponding to current at which the coil is open shall be measured and recorded as pull in voltage. If the valve not at all opening for the increased coil voltage, then unit shall increase the voltage up to configurable maximum safe voltage of the coil.

To measure drop out voltage:

The unit shall gradually reduce the voltage of the coil, capture and save the current of the coil. Measure and record the voltage at which the coil is closed as the drop out voltage.

c. Test Results:

Pull in Voltage of FCV Drop out Voltage of FCV

3.3.4. ON & OFF Response

a. Configurable Parameters:

Configurable voltage of the pulse Configurable duration of the pulse

b. Measurement Procedure:

To measure ON & OFF response:

The unit shall apply configured voltage of pulse of configured duration to the coil, capture and save the coil current graph. Measure and record the ON & OFF responses.

c. Test results

ON response

OFF response

3.4. 100N FCV (Flow Control Valve)

100N FCV has single coil. FCV is normally in closed condition. Whenever voltage is applied to the coil, then FCV is in open condition.

a) Electrical tests of Flow Control Valve

- i. Coil Resistance
- ii. Insulation Resistance
- iii. Pull in & Drop out voltage
- iv. ON & OFF Response

3.4.1. Coil resistance

Coil resistance of FCV is measured using 6 $\frac{1}{2}$ digit multimeter. Resistance measurement shall have repeatability of ±0.25 Ω .

3.4.2. Insulation Resistance

Insulation resistance of FCV is measured using High resistance meter. Insulation resistance is measured between leads and body of the valve. These values should communicate to the ATU through IEEE – 488 bus (GPIB).

(High Resistance meter procurement is not in supplier scope, Available meters at LPSCB: Agilent Technologies – 4339B, Keithley – 6517B).

3.4.3. Pull in & Drop out voltage

a. Configurable Parameters:

Configured voltage Step of FCV Configurable maximum safe voltage of FCV

b. Measurement Procedure:

• Actuate the coil for 10 times at 28V DC.

To measure coil pull in voltage at no load:

The FCV coil supply voltage shall be gradually increased in steps as configured and the current of the coil shall be captured and saved. The voltage corresponding to the current at which the coil opens shall be measured and recorded as pull in voltage at no load. If the valve not at all opening for the increased coil voltage, then unit shall increase the voltage up to configurable maximum safe voltage of the FCV.

- To measure coil drop out voltage: The unit shall gradually reduce the voltage of FCV coil, capture and save the current. Measure and record the voltage of the coil where the coil closed as the drop out voltage at no load.
- Now unit should ask to apply the inlet pressure and acknowledge the inlet pressure value.
- Again, actuate the coil for 10 times at 28V DC with the applied inlet pressure.
- To measure coil pull in voltage at 25 bar (g):

The FCV coil supply voltage shall be gradually increased in steps as configured and the current of the coil shall be captured and saved. The voltage corresponding to the current at which the coil opens shall be measured and recorded as pull in voltage at no load. If the valve not at all opening for the increased coil voltage, then unit shall increase the voltage up to configurable maximum safe voltage of the FCV.

c. Test Results:

Pull in Voltage of FCV at no load Drop out Voltage of FCV at no load Pull in Voltage of FCV at 25 bar

3.4.4. ON & OFF Response

a. Configurable Parameters:

Configurable voltage of the pulse

Configurable duration of the pulse

b. Measurement Procedure of FCV

The pulse is applied to the input of the driver circuit. Output of the driver circuit shall be applied to the component. The current of the FCV should be captured.

To measure FCV coil ON & OFF response:

The unit shall apply configured voltage pulse of configured duration to the FCV coil and capture the coil current graph. Measure and record the ON & OFF responses.

c. Test results

ON response at 42V DC

OFF response at 42V DC

ON response at 28V DC

OFF response at 28V DC

Note: Current waveform should be saved for pull in, drop out, ON & OFF response testing.

4. HARDWARE SPECIFICATION

4.1. Chassis

SI No.	Description	Specification	
1	Power supply	230V AC, 50Hz	
2	System bandwidth	8GB/s or higher	
3	Cooling	Suitable cooling to be provided	
4	EMI/EMC EN61000-3-2, EN61000-3-3 or equivaler		
Note: Chassis shall have 2 Nos. of dummy slots for future expansion			

4.2. Controller

SI No.	Description	Specification		
1	Controller	Embedded controller/ PXI/ PXIe /Proprietary controller with real time storage and analysis		
2	Processor	Core i7 or better		
3	Processor speed	2.6 GHz or higher		
4	Operating system	Latest Windows / Linux / RTOS / proprietary		
5	RAM	16 GB and expandable up to 64 GB		
6	Hard disk size	512 GB or higher		
7	Communication	Shall support GPIB, RJ-45 port		
8	Data Interface	Ethernet 10 GB, LAN, USB (4 Nos.)		
9	LED indication	System failure, Power on Alarm, Network Connectivity Indication etc		

4.3. Digital Multimeter card

SI No.	Description	Specification		
1	Digits of resolution	6.5 or better		
2	Minimum DC voltage range	± 300V (minimum)		
3	Maximum Sampling rate	1.8MS/s or higher		
4	Basic DC voltage accuracy	25 ppm or higher		
5	DC current range	-3 A to 3 A		
6	Shall be capable of AC/DC voltage, AC/DC current and 2- or 4-wire resistance measurements, as well as diode tests.			

4.4. Oscilloscope card

SI No.	Description	Specification
1	Minimum No. of channels	2
2	Resolution	8 bits or higher
3	Sampling rate	1G S/s or higher
4	Bandwidth	100MHz or higher

4.5. Switch module

SI No.	Description	Specification	
1	Maximum DC voltage	150V (DC & AC) or higher	
2	Maximum current (carry)	1A or higher	
3	Relay type	Electro Magnetic Relay (EMR)	
4	Bandwidth	10MHz or higher	
5	Minimum No. of cross points	128	

4.6. Digital I/O module

SI No.	Description	Specification
1	No. of digital Inputs	24 or above
2	No. of digital Outputs	24 or above
3	Digital input voltage range	-60 to 60 V
4	Output voltage range	-60 to 60 V

5	Signaling type	Single ended	
Note: Channel to channel isolation is required			

4.7. Power supply

SI No.	Description	Specification	
1	Input voltage	230VAC, 50Hz, single phase	
2	Rated output voltage	0 - 100V or higher	
3	Rated output current	0 - 8A or higher	
4	Minimum rated output power	800W or higher	
5	Maximum line regulation	0.01% of rated output +2mV	
6	Maximum load regulation	0.01% of rated output +2mV	
7	Ripple and noise	< 10mV _{rms}	
8	Protection	Over voltage, over current and over temperature	
9	Indications	Voltage & Current :4 digit Accuracy: 0.5%	
10	Operating temperature	10-50°C	
11	Humidity	10 to 95%	
12	Power factor	0.99	
13	Cooling	Suitable cooling to be provided	
Note: P through	Note: Power supply shall be interfaced to PC/controller, shall be programmable through software and obey maximum safe voltage condition.		

4.8. PC

SI No.	Description	Specification	
1	Processor	Core i5	
2	Monitor	21" or above	
3	RAM	8GB or above	
4	Hard disk drive size	1TB or above	
5	Operating system	Latest Windows / Linux / RTOS / proprietary	
6	USB ports	4 or above	
7	Input power supply	230VAC, 50Hz, Single phase	
8	Office tools	Latest office tools with perpetual license	

Note: Sufficient PCI slots, HDMI & RJ 45 ports shall be provided. Keyboard and mouse shall be provided.

4.9. Colour printer with scanner

SI No.	Description	Specification
1	Printable Area	Shall support A4 size print & scan
2	Resolution	600 x 600 True DPI
3	Print direction	Duplex
4	Input power supply	230VAC, 50Hz, single phase
5	Print support	Both black, white and color

5. SCOPE OF WORK

5.1. SUPPLIER'S SCOPE OF WORK

- Design of Automated electrical test unit.
- Obtaining LPSC approval for the design.
- For technical evaluation, party shall provide design of hardware and software that includes algorithms used in the design flow.
- Party shall specify the make of all the bought-out items, mention the bill of materials and list of essential spares in the tender. Party should enclose the detailed specification catalogue and specification compliance matrix.
- The party shall provide factory acceptance test document. Validation is to be carried out at party's site before dispatch and after installation at LPSC(B).
- The product shall have protection for Electrostatic discharge, electromagnetic interference, over voltage/over current and output driver failure.
- Input power will be 220-240V AC, 50 Hz, single phase.
- Power requirement for timer, driver circuit, LEDs, push button, switches must be incorporated internally in the interface unit.
- All components of the unit shall be of industrial standard.
- The party shall provide interface box to connect various valves (Series/ parallel) to the test unit.

- The ATU should be supplied with latest supported Operating system and in case the OS of the ATU goes out of support, vendor should support in upgrading the software to a supported version of OS during warranty and AMC period.
- All Software shall be supplied with perpetual license.
- The party shall ensure driver circuit back EMF protection.
- All the parties should visit LPSC(B) before bidding on the notified date to understand the requirement by visualizing the manual mode of testing at LPSC(B). The offers submitted by parties participating in site visit only will be considered for evaluation.
- If the party is not an OEM, the party must provide an authorization certificate from OEM.
- The party shall provide earlier PO copies of similar Data Acquisition System delivered to other Aerospace / Government Institutions.
- Warranty: 12 months from the date of commissioning and acceptance of the system at LPSC.
- Party shall quote for non-comprehensive AMC for a period of three years after expiry of warranty period.
- Bid should contain split up cost of unit cost and AMC cost. Evaluation shall be based on both unit cost and AMC cost.
- The release of AMC order after completion of 1-year warranty is at the discretion of LPSC(B).
 In case AMC order is not released, service should be provided on chargeable basis.
- Party shall quote for minimum spares for trouble free operation of unit for 2 years.
- Party shall assure availability of all components of ATU for at least 6 years from date of supply.
- Installation and commissioning: The supplier shall take full responsibility of installation & commissioning of the systems at LPSC(B) including onsite acceptance tests and demonstration of performance of the system before handing over the system to LPSC(B). The party shall provide training to LPSC personnel after commissioning.
- Documentation: Operation manual, service manual, detailed engineering document with all necessary drawings of ATU shall be provided. After installation and validation of the system, application software code has to be given to LPSC(B).
- Pre Dispatch Inspection (PDI): PDI shall be carried out before the dispatch of item in presence of LPSC-B team.

5.2. LPSC SCOPE OF WORK

- a. To review and approve the design of the system.
- b. To make ready the installation site.
- c. Insulation Resistance meter will be provided at the time of Installation and validation of the system.
- d. The test components FCV, LV & TCA and the driver circuit required for the response test for these components will be provided by LPSC(B) at the time of testing the unit at LPSC (B).

5.3. QUALITY CLAUSE

- a. Certificate of Conformance or Test Report for the ATU with all relevant data shall be provided by vendor.
- b. Upon commissioning, validation shall be carried out as per the approved validation document at LPSC, Bengaluru.
- c. All implemented protection methods shall meet the relevant safety standards.
- d. Ensure proper grounding and shielding of the equipment.
- e. The item shall be suitably packed as per standard procedure to avoid damage or deterioration during transportation, handling and storage.
- f. The following standards shall be complied & OEM Certification shall be provided.
 - i. Electromagnetic compatibility-2004/108/EC or equivalent.
 - ii. Electrical equipment for measurement, control and laboratory use, Part 1(EN 61326-1:2006 or equivalent).
 - iii. Safety requirements for electrical equipment for measurement, control and laboratory use, Part 1- EN 61010-1 or equivalent.

5.4. SCOPE OF WORK FOR AMC

Scope of the work includes that the party shall be held responsible to check the system thoroughly and identify the problems if any, rectify the same and demonstrate the system performance to a satisfactory level during preventive as well as breakdown maintenance.

Type: Non-Comprehensive

Duration of AMC: 3 years

Quantity: 01 No.

Preventive maintenance:

Preventive maintenance frequency:Half yearlyPreventive maintenance:Total 2 visits per year shall be made (6 visits in 3 years)

Breakdown maintenance:

Any number of breakdown calls during the contract period without any additional charges. The breakdown visit should cover the following:

- The party should respond and attend to the problem within 24 hours from the time of intimation by LPSC(B).
- Checking the system against breakdown.
- Identify the nature of problem/s.
- Rectify the identified problem/s and set right the system.
- Demonstration of satisfactory performance of the system.

6. VALVE SPECIFICATION (This is for reference to vendors)

6.1. Flow Control Valve

SI No	Parameters	1N Valve	11N Valve	100N Valve
1	Coil Resistance	85 \pm 5Ω (US & DS each)	65 <u>+</u> 5Ω (US & DS each)	35 ± 2Ω
2	Insulation Resistance	>50MΩ at predefined DC voltage		
3	Pull in voltage	25V DC (max)		21V DC (Max)
4	Drop out voltage	1.5 V DC (min)		2V DC (min)
5	ON & OFF response	10ms (max) at 37V DC		25ms (max) at 28V DC 15ms (max) at 42V DC

6.2. Latch Valve

SI No	Parameters	Value
1	Coil Resistance	90 \pm 5Ω (OC & CC each)

2	Insulation Resistance	$>$ 50M Ω at predefined DC voltage
3	Minimum actuation voltage (V_{MA})	$3V DC \le V_{MA} \le 18 V DC$
4	Response (in ms)	20ms (max) at 28V DC & 42V DC

6.3. Thruster Chamber Assembly @ 70V application

SI No	Parameters	Value
1	Coil Resistance	130 ± 10 Ω
2	Insulation Resistance	$>$ 50M Ω at predefined DC voltage
3	Pull in voltage	50V DC (max)
4	Drop out voltage	3 V DC (min)
5	ON & OFF response	10ms (max) at 37V DC

6.4. Driver Circuit Pin details (25 pin connector)

SI No	Description	Pin No.
1	Supply Voltage	9
2	Input -1, 0 to 5V	3
3	Output - 1	11
4	Input – 2, 0 to 5V	5
5	Output -2	13
6	D. Gnd, Ret	2, 23, 24

7. TEST RESULT FORMATS

LPSC Logo

LIQUID PROPULSION SYSTEMS CENTRE, BENGALURU ISRO logo Test result format of 1N/11N FCV

Project: (type/editable)

Post assembly test: (type/editable)

Date, Temp (°C), RH (%)

Inlet pressure (absolute bar):

FCV ID	Spec	Valve ID 1	Valve ID 2	Valve ID 3	Valve ID 4			
CR: (Ω)								
US	85 ± 5 Ω (1N)							
DS	65 ± 5 Ω (11N)							
IR: (MΩ)	IR: (MΩ)							
US	>50MΩ @							
DS	100VDC							
Pull in Voltage (V)			·	·				
US								
DS	25VDC(Max)							
parallel								
Drop out Voltage (V)								
US								
DS	1.5VDC(Min)							
parallel								
On response (ms)			·	·				
US								
DS	10ms (Max)							
parallel								
Off response (ms)								
US								
DS	10ms (Max)							
parallel								

Test done:

Engr-in-charge:

QA, Engr:

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Test result format of SFLV/BPLV

Project: (type/editable)

Date, Temp (°C), RH (%)

Post assembly test: (type/editable)

Inlet pressure (absolute bar):

Flow media: GN₂/DM water

SFLV/BPLV ID	Spec	Valve ID 1	Valve ID 2	Valve ID 3	Valve ID 4		
CR: (Ω)							
OC	90 + 5 O						
СС	50 <u>-</u> 5 M						
ΙR: (ΜΩ)							
OC	> 50MO @						
СС							
Micro switch	100700						
Minimum actuation Vol	tage (V)		1	1			
OC	3V < V _{MAV} <						
СС	18V						
On response (ms) @ 28\	/ (Configurable)		1	1			
OC	20ms (Max)						
СС	ZUMS (IMAX)						
Off response (ms) @ 28	/ (Configurable)		1	1			
OC	20ms (Max)						
СС							
On response (ms) @42V	(Configurable)						
US	20ms (Max)						
DS							
Off response (ms) @42V	(Configurable)	1	1	1	1		
US	20ms (Max)						
DS							

Test done:

Engr-in-charge:

QA, Engr:

LPSC Logo

LIQUID PROPULSION SYSTEMS CENTRE, BENGALURU ISRO logo

Test result format of TCA @ 42V

Project: (type/editable)

Date, Temp (°C), RH (%)

Post assembly test: (type/editable)

Inlet pressure (absolute bar):

TCA ID		TCA ID 1	TCA ID 2	TCA ID 3	TCA ID 4
FCV ID		Valve ID 1	Valve ID 2	Valve ID 3	Valve ID 4
CBH (M) ID	Spec	CBH ID 1	CBH ID 2	CBH ID 3	CBH ID 4
CBH (R) ID		CBH ID 1	CBH ID 2	CBH ID 3	CBH ID 4
Thermocouple ID		TC ID 1	TC ID 2	TC ID 3	TC ID 4
CR: (Ω)				·	
US	85 ± 5 Ω (1N)				
DS	65 ± 5 Ω (11N)				
FCV heater H1					
FCV heater H2	3.2kΩ				
FCV heater H3	(Nominal)				
FCV heater H4					
Thermistor T1					
Thermistor T2	$10k\Omega$ (Nominal)				
CBH (main)	178 ± 10 Ω (1W)				
CBH (redn)	415 ± 10 Ω (3W)				
ТС	16 ± 2 Ω				
IR: (MΩ)					
US					
DS	> 50MΩ @				
CBH (main)	100VDC				
CBH (redn)					
ТС	> 50MΩ @				
Pull in Voltage (V)	50VDC				
US					
DS	25VDC(Max)				

parallel								
Drop out Voltage (V)	Drop out Voltage (V)							
US	1.5VDC(Min)							
DS								
parallel								
On response (ms)	I	I		I				
US								
DS	10ms (Max)							
parallel								
Off response (ms)								
US								
DS	10ms (Max)							
parallel								

Note: FCV heaters exist after module assembly and can be 2 or more Nos depending on project requirement.

Test done:

Engr-in-charge:

QA, Engr:

LPSC Logo

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ISRO logo

Test result format of TCA @ 70V

Project: (type/editable)

Date, Temp (°C), RH (%)

Post assembly test: (type/editable)

Inlet pressure (absolute bar):

TCA ID		TCA ID 1	TCA ID 2	TCA ID 3	TCA ID 4
FCV ID		Valve ID 1	Valve ID 2	Valve ID 3	Valve ID 4
CBH (M) ID	Spec	CBH ID 1	CBH ID 2	CBH ID 3	CBH ID 4
CBH (R) ID		CBH ID 1	CBH ID 2	CBH ID 3	CBH ID 4
Thermocouple ID		TC ID 1	TC ID 2	TC ID 3	TC ID 4
CR: (Ω)					
FCV	130 ± 10 Ω (1N)				
FCV heater H1	3.2kΩ				
FCV heater H2	(Nominal)				
Thermistor T1	10kΩ (Nominal)				
CBH (main)					
CBH (redn)	- 1/8 ± 10 ½ (100)				
ТС	16 ± 2 Ω				
IR: (MΩ)					
FCV	> 50MO @				
CBH (main)	100VDC				
CBH (redn)					
ТС	> 50ΜΩ @				
Pull in Voltage (V)	50VDC (Max)				
Drop out Voltage (V)	3V (Min)				
On response (ms)					
Off response (ms)	10ms (Max)				

Note: FCV heaters, thermisors exist after module assembly and can be 2 or more Nos depending on project requirement.

Test done:

Engr-in-charge:

QA, Engr:

LPSC Logo

LIQUID PROPULSION SYSTEMS CENTRE, BENGALURU ISRO logo

Test result format of 100N FCV

Project: (type/editable)

Date, Temp (°C), RH (%)

Post assembly test: (type/editable)

Inlet pressure (absolute bar):

100N FCV ID	Spec	Valve ID 1	Valve ID 2	Valve ID 3	Valve ID 4
CR: (Ω)	35 ± 2 Ω				
IR: (MΩ)	> 50MΩ @ 250VDC				
Pull in Voltage (V) @ no load	21VDC (Max)				
Drop out Voltage (V) @ no load	2VDC (Min)				
Pull in Voltage (V) @ 25bar (g)	21VDC (Max)				
On response (ms) @ 28V	25ms (Max)				
Off response (ms) @ 28V	25ms (Max)				
On response (ms) @ 42V	15ms (Max)				
Off response (ms) @ 42V	15ms (Max)				

Note: As 100N FCV test involves with and without load, unit should be aware or ask the user whether load is given or not given.

Test done:

Engr-in-charge:

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