Expression of Interest for development, realisation and qualification of Oxygen Storage Bottle

1. INTRODUCTION

Liquid Propulsion Systems Centre, Valiamala, Thiruvananthapuram, India is established under the Indian Space Research Organization for the design and development of liquid rocket engines and stages for its Launch Vehicles and Spacecrafts.

As part of its development program the center intends to develop an Oxygen Storage Bottle from Monel K500 material.

Attention of reputed manufactures is drawn for the development, realisation and qualification of seamless Oxygen Storage Bottle made of Monel K500 material preferably through flow forming technique.

2. TECHNICAL REQUIREMENTS

2.1. Stated requirements of oxygen storage bottle

2.1.1. Storage media: Gaseous Oxygen

2.1.2. Operating pressure (MEOP): 150 bar

2.1.3. Volume: 12 liter (approx.)

2.1.4. Size: as per drawing no FCPS-01-00-00-01-00-001

2.2. Prerequisites

2.3. Option 1

The primary option is to have oxygen storage bottles of seamless construction without welding.

2.4. Option 2

As a secondary option the Oxygen Storage Bottle can be developed with one weld.

2.5. Scope of Development

The scope of development covers:

2.5.1. Procurement of raw materials

2.5.2. Process finalization for realization of Oxygen Storage Bottle as per option 1 or option 2

2.5.3. Realisation of tooling

2.5.4. Development and qualification of 2 Nos Oxygen Storage Bottles

2.5.5. Supply of 3 Nos. Oxygen Storage Bottles.

3. RAW MATERIAL

3.1. General requirement

3.1.1. Input raw material of Monel K500 (UNS N05500) shall be sourced from reputed OEM as per applicable AMS 4676 standard. Party shall mention the proposed OEM details while submitting offer.

3.1.2. The Primary melting method shall be EAF/AIM/VIM. The secondary melting shall be by VAR/ESR

3.1.3. The preform shall be procured in solution annealed condition.

3.2. Chemical composition

The chemical composition of the alloy shall be as specified in the below Table 1. It shall conform to AMS4676, determined by wet chemical methods in accordance with ASTM E1473 methods, or by other standard analytical methods. Composition variations shall meet the applicable requirements of AMS2269.

Table 1: Chemical composition

Element	C	Mn	Fe	S	Si	Cu	Al	Ti	Fe	Ni
Wt (%)	0.2 max	1.5 max	2.0 max	0.01 max	1.0 max	27.0-33.0	2.0-4.0	0.25-1.0	2.0 max	Bal.

3.3. Mechanical properties

The mechanical properties shall conform to the specifications in the Table 2

Table 2: Mechanical properties

Material condition	Tensile Strength, MPa	Yield Strength at 0.2% Offset, MPa	Elongation in 4D, %	Hardness
Annealed	620-760	275-415	45-25	140-185 HB
After aged	965 min.	689 min.	20 min.	≥ 262 HB

3.4. Physical properties

The physical properties of Monel K500 shall be

Density: 8.44 gm/cc

Melting point: 1315-1350^{o}C

3.5. Microstructure:

The microstructure shall meet the size of ASTM 5 or finer requirement.

3.6. Inclusion Rating:

3.6.1. Inclusion rating shall be determined in accordance with ASTM E 45 method A and shall not exceed the limits given in Table 3.

Table 3 Inclusion rating limits

Type of Inclusion	Thin	Heavy
A	1.0	1.0
B	1.0	1.0
C	1.5	1.0
D	1.5	1.0

3.7. Defects

The raw material shall meet the requirements of Class A for ultrasonic testing.

3.7.1. Raw material testing and certification

The following certificates from the OEM shall have to be submitted along with the supply.

3.7.2. Chemical Composition: Minimum one no of sample per heat batch at preform stage.

3.7.3. Microstructure: At least two samples from each heat shall be analyzed for microstructure and grain size at preform stage.

3.7.4. Inclusion Rating: Determined in accordance with ASTM E 45 method A

3.7.5. Ultrasonic Testing: Product shall be 100% ultrasonically tested as per AMS 2630 (latest).

3.7.6. Mechanical Test: Specimen shall be drawn from preform in longitudinal and transverse direction and precipitation treated (aged) as per AMS4676 or approved QAP and shall be tensile tested and shall meet the minimum tensile properties requirement.

4. WELDING

4.1.1. In case of option 2, welded construction, the vendor shall specify the welding process

4.1.2. During the processs of realization, the vendor shall generate WPS and PQR documents as per ASME Section IX standard

5. HEAT TREATMENT

5.1.1. Oxygen storage bottle shall be aged as per AMS 4676 standard in Vacuum.

5.1.2. Details of any intermediate heat treatment shall be indicated.

6. SURFACE TREATMENT

6.1.1. The Oxygen Storage Bottle shall be descaled and protected against corrosion by suitable surface treatment.

6.1.2. The surface treatment proposed shall be indicated.

7. PREQUALIFICATION AND ACCEPTANCE TESTS

7.1.1. All Oxygen Storage Bottle shall be 100% ultrasonically tested as per AMS 2632 (contact technique) or AMS 2634 (immersion technique) to the requirement of Class A1.

7.1.2. All Oxygen Storage Bottle shall be Dye penetrant tested 100 % on outer surface area as per ASTM E 145.

7.1.3. Dimensional Inspection (including thickness measurement) for all bottles shall be done as per drawing.

7.1.4. Volume measurement shall be done for at least one bottle in supplied batch.

7.1.5. All oxygen storage bottles shall be subjected to Hydraulic pressure test at 300 bar for 30 sec. Expansion shall be less than 5%.

7.1.6. One Oxygen Storage Bottle from development batch, after hydraulic pressure test at 300 bar, shall be sectioned and subjected to mechanical properties evaluation, microstructure evaluations as per approved QAP.

7.1.7. One Oxygen Storage Bottle from development batch shall be subjected to Hydraulic burst test. The minimum burst pressure shall be 600 bar.

7.1.8. Strain gauge mounting for both tests shall be as per sketch 2

8. DELIVERY PERIOD

8.1.1. The development and qualification shall be completed in 6 months

8.1.2. The final delivery shall be made within 4 months of clearance of the qualification hardware.

9. SUBMISSION OF PROPOSAL

The vendors shall submit the following technical details along with the Expression of Interest

9.1. For Option 1

9.1.1. A Process plan for realization of Oxygen Storage Bottle of seamless construction without welding

9.1.2. Specification of equipment available at the vendors facility and which the vendor intends to use for the realization

9.1.3. List of tooling required to be developed

9.1.4. Test facilities for burst test and proof pressure test

9.1.5. In-process & post-process heat treatment

9.1.6. Surface treatments

9.1.7. Guaranteed accuracy

9.1.8. Guaranteed surface finish

9.2. For Option 2

9.2.1. A Process plan for realization of Oxygen Storage Bottle with one weld

9.2.2. Specification of equipment available at the vendors facility and which the vendor intends to use for the realization

9.2.3. Specification of welding process and equipment the vendor intends to use for the realisation

9.2.4. List of tooling required to be developed

9.2.5. Test facilities for burst test and proof pressure test

9.2.6. In-process & post-process heat treatment

9.2.7. Surface treatments

9.2.8. Guaranteed accuracy

9.2.9. Guaranteed surface finish

9.3. Conformation statement to clause 3

9.3.1. The vendor shall submit a confirmation that the raw materials shall conform to clauses 3.1to 3.7

9.3.2. The vendor can also submit his alternate proposal on raw material properties given at clauses 3.1to 3.7 for our consideration

9.4. Sub-contracting

9.4.1. Subcontracting of major operations is not permitted. The bidders shall state their sub-contracting proposals in the bid.

9.5. Modifications/Alternate proposals

9.5.1. The bidders can suggest modifications to the oxygen storage bottles without affecting their stated requirements.

9.5.2. The bidders can also submit alternate proposals for realization, subject to meeting the stated requirements of the oxygen storage bottles.

9.5.3. The modifications/alternate proposals will be discussed during evaluation of the bids and accepted modifications/proposals will be communicated to all bidders before finalizing the process.

9.6. Submission of bids

9.6.1. The bids shall individually address all the points mentioned above.

9.6.2. The bidders are requested to submit their compliance to or their proposals against each of the clauses.

9.7. Commercial details of the proposal

The company shall be financially strong to execute the work under this Expression of Interest.

To qualify for participation in the tender the company (OEM) shall have an experience in this field for 3 years immediately preceeding Dec 2020. Also their annual turnover should not be less than Rs 2000 lakhs for the last three years. Further they should have a good customer base in aerospace or aviation.

The following commercial details of the company and proposal shall be submitted along with the Expression of Interest

9.7.1. Annual turnover for the last three years

9.7.2. Proof of experience in the field for 3 years immediately preceding Dec 2020

9.7.3. List of customers in aerospace or aviation

9.7.4. Details of similar parts realised

9.7.5. Company website

9.8. Mode of operation of tender

9.8.1. In the first stage the companies have to respond to this Expression of Interest giving all details sought for above. ***No price is to be quoted now***.

9.8.2. Companies who fulfill the financial and technical criterion may be called for a technical presentation within 3 weeks of submission of the Expression of Interest.

9.8.3. Based on the discussions so held, one or more acceptable solutions shall be decided upon.

9.8.4. Detailed technical specification and evaluation criterion will be generated for each solution.

9.8.5. In the second stage, techno-commercial and price bids will be invited from the shortlisted vendors on two part bid basis.

9.8.6. The final selection will be based upon the techno- commercial evaluation matrix, and the price bid.

9.9. Date of submission of EOI

The final date of submission of the EOI is given in the call letter for EOI.

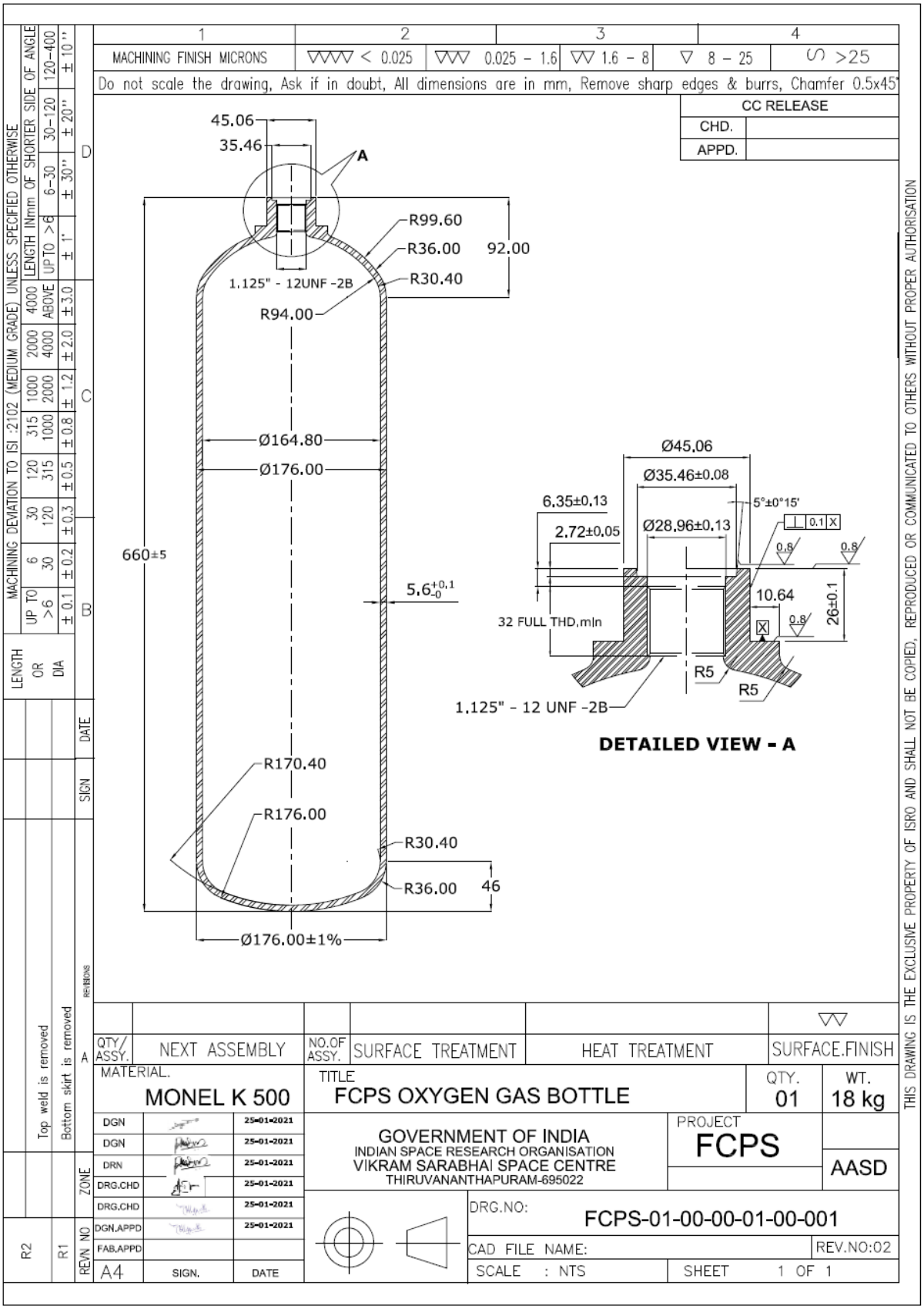
9.10. Annexure

The following sketches form part of this Expression of Interest

9.10.1. FCPS Oxygen Gas Bottle, drg no FCPS-01-00-00-01-00-001

9.10.2. Sketch 2, Strain Gauge Mounting Location For Monel K 500 Bottle

Annexure 9.10.1



Annexure 9.10.2

LOCATION NO.	LOCATION	DIRECTION
1	26 mm from the bottom of gas bottle (P+)	M
		H
2	154 mm from the bottom of gas bottle (P+)	M
		H
3	256 mm from the bottom of gas bottle (P+)	M
		H
4	357 mm from the bottom of gas bottle (P+)	M
		H
5	458 mm from the bottom of gas bottle (P+)	M
		H
6	559 mm from the bottom of gas bottle (P+)	M
		H
7	612 mm from the bottom of gas bottle (P+)	M
		H
8	458 mm from the bottom of gas bottle (P-)	M
		H
9	256 mm from the bottom of gas bottle (P-)	M
		H
10	26 mm from the bottom of gas bottle (P-)	M
		H

STRAIN GAUGE MOUNTING LOCATION FOR MONEL K 500 BOTTLE