

## Specifications for 70 liter Bioreactor with accessories

### General specifications –

*In-situ* steam sterilizable bioreactor vessel, 70 liter (10 liter minimum working volume) total capacity, jacketed vessel, having provision of heating and cooling during cultivation, The vessel should have provision for pH, Temperature, Dissolved oxygen, Sampling port and continuous culturing.

### Fermenter Vessel:-

- 70 Liter Total Volume bioreactor system primarily designed for microbial cultivations but should be adaptable to plant / animal cell cultivation systems.
- The vessel & the head plate should be made of SS316L material and provided with a SS316L jacket for Temperature control / Sterilization.
- Aspect ratio (H: D Ratio) – Total volume 3:0 and working volume 2:2
- The internal surface of the vessel to be electropolished to a Ra value of less than or equal to 0.4  $\mu$  and the outer surface should be Mirror finished after Electropolish. Certificate of proof of surface finish to be attached with the offer.
- The internal surface of all interconnecting pipe lines to the process should be of stainless steel SS316 L must have an internal finish of Ra  $\leq$  0.4  $\mu$
- *Vessel Pressure:* Vessel working pressure 2.0 Kg/cm<sup>2</sup> / full vacuum, vessel design pressure 3.0 Kg/cm<sup>2</sup>, jacket working pressure 2.8 Kg/cm<sup>2</sup> and jacket design pressure 4.0 Kg/cm<sup>2</sup>.
- Removable stainless steel Baffles (4 no's) to be provided
- Ports for Exhaust, Light glass, Pressure Gauge (-1 till 4 barg) , inlet / out steam, Safety Relief Valve, foam sensor, level sensor acid addition, alkali addition, antifoam addition, sparger air inlet, media addition and with drawl line, Jacket inlet and outlet, transfer line, temperature sensor, pH sensor, dissolved oxygen sensor, sampling, agitator, push valves etc.
- At least one addition line for inoculum / Nutrient transfer must be a FULLY CONTAINED ADDITION LINE (Fully re-sterilizable line) and the rest must be Push Valve type Lockable Ports.
- All wet parts in contact with fermentation broth/reagents/feed etc should confirm to USFDA guidelines. All elastomers used are to be of food grade materials, quality tested -as per USFDA 21 CFR.

- The equipment should comply with ASME Pressure Vessel Standards and must be ASME certified and stamped.
- Construction : The Fermentor must be floor standing vessel on skid made of SS304 tubes/square pipes.
- Rupture disc or suitable safety device to be provided for the vessel. The pressure rating of the rupture disc should be as per EU safety regulations.
- 5 No.'s of assignable peristaltic pumps (with easy tube loading head) connected to the Microprocessor based control system for acid, alkali, antifoam and nutrients (2). Also, provide suitable Liquid Addition Bottles for pH control, acid (1 Liter bottle) and alkali (1 Liter bottle), for foam control, antifoam (1 Liter bottle) and nutrients feedings (1 x 5 Liter and 1 x 10 Liter bottle). The bottles have to be complete with filters and on-line connectors for tubings for aseptic handling and transfer.
- All electrical and electronic parts should be liquid splash protected.
- Calibration certificates for all sensors should be provided.
- The vessel should be designed for *in-situ* sterilization:
  - Automated Empty Vessel Sterilization
  - Automated Full Vessel Sterilization.
- Fermenter system should be equipped with automated SIP (Steam in place) and cGMP validatable (IQ / OQ documents to be provided with the equipment )
- Requisite maintenance & user manual of the system should be supplied.

## **Agitation System**

- Drive: Top driven system with a magnetically coupled stirrer assembly driven by high Torque encoder feedback based Stirrer Motor. Magnetic coupling should be based on permanent magnets – engineering drawing should be provided with the offer.
- Type of impeller: (2 no's) adjustable six blade flat disc turbine (Rushton) impellers should be provided to facilitate good mixing and oxygen transfer for high cell density cultivation.
- Agitation rate: range 10 to 600 rpm controlled by an independent control loop having an accuracy of  $\pm 1\%$  of full scale. Feed back control for agitation control must be provided.
- Facility for easy removal of the agitator and its components from the vessel for maintenance and cleaning.

- Control: Adaptive PID, feed back control of agitation rpm.
- Sensor: Photo-optical Encoder
- Indication: Digital

### **Aeration System**

- Provision for mixing at least four gases (Air, Oxygen, Nitrogen and CO<sub>2</sub>), necessary rotameters, valves, gas mix station should be included.
- Air filtration with membrane filter  
Supply capacity for fermenter: Air: upto 2 VVM, Oxygen  $\geq$  0.5 VVM
- Sparger – One number ring type sparger with 24 holes on top ( $\varnothing$  1.5 mm)

### **Dissolved Oxygen (DO)**

Probe: *In-situ* sterilizable fast response and low drift Dissolved Oxygen sensor with titanium module, complete with cable.

Control: Self adaptive PID Cascade control, should function with any one and/or any combination up to four parameters (stirrer speed, aeration rate, gas mix and substrate feed) simultaneously. Capable of controlling DO in a range of 0 - 200% saturation (within  $\pm 2\%$  accuracy).

### **Air out let Exhaust condenser System**

- Sterilizable-in-place equipped with air filter made up of **SS 316 L having spiral exhaust condenser** (Mirrorpolished and electropolished finishing with Ra value  $\leq$  0.4  $\mu\text{m}$ )

### **Temperature Control System for sterilization and cultivation**

- The vessel should be designed for:
  - Automated Empty Vessel Sterilization
  - Automated Full Vessel Sterilization.
- Sensor: RTD/Pt 100
- Range: At least 10°C above cooling water temperature up to 130°C or, more with an accuracy of  $\pm 1.0$  °C.
- Temperature to be controlled by in-built hot water generator (Thermo circulator) and external cooling by chilled water circulation. The exact temperature control mechanism, through use of valves, centrifugal pumps, heat exchangers, if any, should be clearly explained by schematic diagram.

### **pH Control System**

- Controller should have the provision for user defined manipulation of critical control parameters.
- Adaptive PID Control : within  $\pm 0.1$  pH set points, with facility for dead band, control by addition of acid and base.
- Indication: Digital display
- Probe: Bioreactor *in-situ* sterilizable pH probe (gel filled) with plug and cable
- Equipped with the dose monitoring device for measurement of Acid / Alkali addition volumes during the cultivation

### **Foam Control System**

- Foam sensor with cable to be provided on the vessel to activate the peristaltic pump fitted in the antifoam inlet line for the addition of required quantity of antifoam agent.

### **Feeding Pumps**

- At least 3 No.'s of Fixed speed pumps (20 rpm, 24 V) inbuilt on console (with easy tube loading head) and Two additional standalone variable speed pumps of 0 – 100 rpm, having provision of computer interface input 0 – 10 volts or 4 – 20, mA & 230 Volts operation (with easy tube loading head) The pumps should have the provision of use in a standalone mode and also through remote controlled mode via computer coupled dedicated software. The software to drive the pumps at user defined feeding profiles and at different feed rates should be included.

The pumps must be configurable using the control system provided.

### **Sampling and Harvest System**

- Aseptic sampling system, steam supply valve and condensate trap for sterilization of sampling assembly before/ after every sampling. Equipped with Re-sterilizable sampling system.

### **Bottom Drain**

- *in-situ* sterilizable bottom drain assembly equipped with necessary vales for harvesting of the batch & to facilitate cleaning of the vessel

### **Control System**

- The system must be complete to measure and control stirrer speed, pH, temperature, Dissolved oxygen & foam.

- Latest Generation Microprocessor based Touch Screen Controller with self Tuning P.I.D. Controls i.e. the controller must have the capability to adapt to P.I.D. loops automatically without user intervention. Color touch screen interface to guide the user through operation of the controller. System must display ONLINE virtual overview of all process parameters on the controller screen itself.
- The real time process parameters should be displayed simultaneously on the monitor and on the computer (through Data Acquisition software). The system should also have the capability to have remote access of process parameters via. Internet
- Controller must be GAMP/cGMP /guidelines compliant. This fact must be explicitly stated in the printed catalogue of the manufacturer, a copy of which should be enclosed with the tender
- The advanced controller must have at least 15 or more in-built USERDEFINED control loops. All the 15 loops of the controller must be user assignable i.e. the function of these loops can be changed as and when desired by the user. The loops should be configurable for additional weight based feed addition control, on-line O<sub>2</sub> / CO<sub>2</sub> Analyzers, on-line viable cell biomass measurement or other similar functions by simple addition of components in future.
- The Controller must have Dose Monitoring facility for pH (Via amount of alkali / acid added to the fermenter) and DO (Via amount of Air / O<sub>2</sub> ) being fed to the culture for every batch cultivation.
- Fermentor system must be equipped with level control system. The fermenter should also have all the accessories for addition and withdrawal of medium / broth from the vessel. Two computer coupled variable speed peristaltic pump (0 – 100 rpm) for addition of nutrient during the cultivation should be provided. The system should also have the silicon tubing of different size - 100 meters for addition of acid medium etc in the vessel.
- The fermenter system should also have the spin filter for retention of cells in the bioreactor and perfusion pipe for removal of cell free fermentation broth during continuous cultivation at high dilution rates.

**Hardware and software for data acquisition (logging) and fermentation process control:**

Windows based Supervisory Control and Data Acquisition (SCADA) software for monitoring and control of various parameters with security features should be provided. The software must have capability for remote log in through LAN for real time data login and process control. Must have facilities for process validation, batch management features, multi-parameter display, time based programming of set points, regulation of process by both measured and calculated variable (by using equations), equation writing and its integration for control of fermenter parameters, ability to set both high and

low limits and alarms, graphic/plotting, off-line data integration (data sheet may be compatible with MS Excel etc.) and batch reports. It should have facilities for manual override of all values, set points and process parameters during the process.

The software should be able to do remote monitoring and control. The software should be adaptable with both analog and digital outputs using AD/DA cards. The software should be capable to program and execute the intermittent nutrient feeding during the fermentation

### **Spare parts for trouble free and maintenance free operation**

This includes one spare pH sensor, one DO Sensor, one DO Membrane kit, One Electrolyte, Cleaning solution for pH probes & ten Dornic hunter filters.

### **Desk top Computer:**

A suitable computer with i7 processor (Branded: DEL/HP) with 19" TFT monitor, Intel processor, 2 GB RAM, 500 GB Hard disk, 2 no's of USB ports along with printer (hp laser jet) must be provided.

### **Air compressor:**

Following air compressor should be included in the quotation to cater to the aeration requirement of the reactor

Type : Reciprocating Oil free, Cylinder : Three, Stage : Double, Motor : 5 hp Crompton  
Make, Phase : Three, Air receiver : 250 liter, Working Pressure : 10.5 bar,  
Piston displacement : 496 LPM or 17.5 CFM

### **Terms and Conditions –**

1. Please submit the TECHNICAL and FINANCIAL bids in separate sealed envelopes. Mark the two envelopes clearly as "Technical Bid" and "Financial Bid". Both the sealed envelopes should be sent in a single sealed envelope, clearly marked as "**Quotations for Purchase of 70 liter Bioreactor due on 19-10-12**". The quote should reach the following address on or before 19-10-12, up to 5 PM.

**Prof. A. K. Srivastava**  
**Department of Biochemical Engineering and Biotechnology**  
**Indian Institute of Technology Delhi**  
**Hauz Khas, New Delhi-110016**

2. Please quote F.O.B. & CIF New Delhi prices separately.
3. Technical bid should contain **compliance chart** based on specifications as per NIQ, but must not contain any commercial information
4. The quotations should be in the currency of the country of origin and should be valid for at least three months.
5. Please attach all the technical literature and a list of similar installations done in India.

6. The warranty on the equipment should be clearly specified.
7. Payment should be through irrevocable letter of credit.
8. If the quote is being submitted by the representative of the Principals/manufacturer themselves, a valid Agency ship/Dealership Certificate authorizing the agent to quote to IIT Delhi on behalf of the Principals should be enclosed.
9. Complete set of manuals for the operation of equipment should be given.
10. Clearly specify the installation requirements—such as space, power, frequency, environment (Temperature and humidity) etc.
11. The institute reserves the right to accept or reject any / all the quotations without assigning any reasons thereof.