ANNEXURE-VIII

SCOPE OF WORK AND JOB SPECIFICATION
FOR
WORKSHOP EQUIPMENT FOR INSTRUMENTATION

CLIENT: **RFCL**

PROJECT: **REVIVAL OF RAMAGUNDAM FERTILIZER PROJECT**

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ABBREVIATIONS & TERMS

(b)	:	Blank space
°C	:	Degree Centigrade
CD	:	Compact Disc
CDROM	:	Compact Disc Read Only Memory
COTS	:	Commercially Off The Shelf
Dwg	:	Drawing
dB/db	:	Decibel
EIA	:	European Industries Association
EMC	:	Electro Magnetic Compatibility
EMI	:	Electromagnetic Interference
FAT	:	Factory Acceptance Testing
FCAPS	:	Fault, Configuration, Accounting, Performance & Security
FM	:	Frequency Modulation
GB	:	Giga Byte
GUI	:	Graphical User Interface
HDD	:	Hard Disc Drive
ISO	:	International Standardization Organization
IP	:	Internet Protocol
Kbps	:	Kilo Bits per Second
LAN	:	Local Area Network
LCD	:	Liquid Crystal Display
LED	:	Light Emitting Diode
NA	:	Not Applicable
nm	:	nanometer
OEM	:	Original Equipment Manufacture
PC	:	Personal Computer
PCB	:	Printed Circuit Board
PCM	:	Pulse Code Modulation

PMR form	:	Project Management and Responsibility form
PTR form	:	Proven Track Record form
RAM	:	Random Access Memory
Rev	:	Revision
RFI	:	Radio Frequency Interference
RH	:	Relative Humidity
SAT	:	Site Acceptance Testing
SOS form	:	Source of Supply form
VAC	:	Volts AC
VDC	:	Volts DC
VF	:	Voice Frequency

1. INTRODUCTION

This Document provides the technical requirements for workshop equipments for instrumentation.

1.1 TERMS AND DEFINITIONS

BIDDER	Agency (Vendor/Package Vendor) that makes the bid in its name and takes the total responsibility for the job irrespective of support from any other sub-agency.
SUB-VENDOR	Sub-agency identified by the Bidder at the bid stage for execution of a pre-defined part of the work.
BID	Bidder's offer
BID DOCUMENT	This tender document
Client	M/s RFCL
PMC	Engineers India Limited (EIL)

2. SCOPE OF WORK & SUPPLY

2.1 Bidder's scope of work and supply for the workshop equipments along with all Standard Accessories as per Detailed Technical Specification and impart training at RFCL Site to the Operating Staff (wherever specified). The complete instrumentation workshop is to be established for RFCL Complex.

Bidder to note that workshop equipment shall be of the makes indicated in the list or its equivalent make (if applicable).

Sr. No.	Item Description	Qty.	UOM	Makes Or Equivalent Make of
1	Hydraulic Test Jig for Control Valves	1	No.	CALDER HYDRAULIC CO, ENGLAND, K MASS CONTROL
2	Safety Valve (Angle Valve) Test Jig Pneumatic	1	No.	MOTOYAMA ENGG WORKS, JAPAN, K MASS CONTROL
3	Temperature Bath (Fluidized Mass)	2	No.	FLUKE, YOKOGAWA OR EQUIVALENT
4	Portable Electro pneumatic Calibrator	4	No.	FLUKE, YOKOGAWA OR EQUIVALENT
5	Instrument Calibration Test Bench	1	No.	FLUKE, YOKOGAWA OR EQUIVALENT
6	Digital Temp Indicator for Thermocouples	2	No.	FLUKE, YOKOGAWA OR EQUIVALENT
7	Digital Temp Indicator for RTDs	2	No.	FLUKE, YOKOGAWA OR EQUIVALENT
8	DC Voltage/Current Standard	2	No.	FLUKE, YOKOGAWA OR EQUIVALENT
9	Portable DC Potentiometer	8	No.	FLUKE, YOKOGAWA OR EQUIVALENT
10	Dead WT Tester 1-600KG/Cm^2	2	No.	BUDENBURG
11	Dead WT Tester 2-300KG/Cm^2	2	No.	BUDENBURG
12	Dead WT Tester 0-7KG/Cm^2	2	No.	BUDENBURG

13	Function Generator	2	No.	NETWORK, FLUKE, YOKOGAWA OR EQUIVALENT
14	Portable Calibrator	2	No.	FLUKE, YOKOGAWA OR EQUIVALENT
15	Test Lab (CRO)	2	No.	APLAB
16	Portable Calibrator/ Hand Held Communicator (HART Protocol)	2	No.	FLUKE, YOKOGAWA OR EQUIVALENT
17	Temperature Bath (Ambient to 600 Deg C)	1	No.	FLUKE, YOKOGAWA OR EQUIVALENT
18	Digital Pressurizer	2	No.	YOKOGAWA
19	Power Supply Unit	2	No.	HIL
20	Calibration INST TK3	2	No.	BENTLY NAVADA
21	Decade Capacitance Box	2	No.	FLUKE, YOKOGAWA
22	Temp Indicator	2	No.	FLUKE, YOKOGAWA
23	W&T Gauges Series 1500	2	No.	FLUKE, YOKOGAWA
24	Hydraulic Pipe Bending M/C	1	No.	
25	Decade Inductance Box	2	No.	AEC
26	Digital Manometer	2	No.	FUJI
27	Desoldering Station	2	No.	PACE
28	Ordinary Digital Multimeter	10	No.	FLUKE, YOKOGAWA OR EQUIVALENT
29	Digital Clamp-On meter	2	No.	FLUKE, HITACHI, METRAVI, MOTWANE, RISHAB OR EQUIVALENT
30	100 V Megger	1	No.	SHANTI, WACO, HITACHI, MEGGER OR EQUIVALENT
31	500 V Megger	1	No.	SHANTI, WACO, HITACHI, MEGGER FLUKE, YOKOGAWA OR EQUIVALENT
32	Non-Contact Temperature Gun	1	No.	FLUKE OR EQUIVALENT
33	SHAKER TABLE	1	No.	BENTLY NAVEDA
34	Intrinsically Safe True RMS Digital Multimeter	2	No.	FLUKE, YOKOGAWA OR EQUIVALENT

A) Bidder to quote separately items recommended for Two years operational spares cost, with price validity up to warranty period.

B) For all the supplied equipment initial power up, commissioning / acceptance testing will be in the supplier's scope

C) Special tools & tackles and accessories for full functioning of the supplied items are part of supply scope

D) Training to RFCL engineers at site for 4 mandays (Two persons for two days) shall be provided for Control valve & safety valve test jigs each

E) Bidder's shall also quote for PWAMC for Control valve & safety valve test jigs for 2 years as detailed in this specification

2.2 Bidder's scope includes procurement, supply and installation of all workshop equipments covered under clause no. 2.1 and all other associated items not indicated here but required for completion of the system.

2.3 Supply of the technical literature, drawings and documentation for all the workshop equipment's for all the Testing equipment along with offer is mandatory failing which offer will not be evaluated.

2.4 SPARES

Bidder shall to quote separately items recommended for Two years operational spares cost, with price validity up to warranty period.

2.5 Bidder shall visit the site for any clarification required.

2.6 Bidder shall be completely responsible for the successful completion of the job.

2.7 Bidder shall provide special tools and tackles for maintenance, calibration etc. if any. The list of special tools and tackles considered shall be submitted along with the offer. The price of the same shall be included in the base price.

2.8 All electrical receptacles shall confirm to IS/BS standards.

2.9 Bidder shall also quote for Post Warranty Maintenance Contract (PWMC) for two (2) years against Control valve & safety valve test jig. The Price for PWMC shall be separately provided with the quotation. (Bidder may note that PWMC price will be considered for evaluation).

2.10 Provenness Requirements

The workshop equipments covered under clause no. 2.1, other bought out items and services as offered should have been supplied and working satisfactorily for a period of minimum 8000 hours on the date of issue of enquiry.

2.11 Certificate for Logistic Supports

a. In case, of not being the manufacturer, bidder shall submit authorization letter from the manufacturer to quote its (manufacturer's) product for this project.
b. Bidder shall also furnish Performance Guarantee certificate as per the format attached with the bid document from the manufacturer.
c. The offered workshop equipment's manufacturer shall have their own service centers / authorized service centers in India. Bidder shall provide the details and addresses of manufacturer's service centre in India.

3. DESIGN OBJECTIVES AND GUIDELINES

3.1 ENVIRONMENTAL SPECIFICATIONS

All the items covered in this MR shall be dispatched RFCL, Telangana.

All equipment, test instruments, special tools and tackles shall be capable of maintaining the guaranteed performance with operational lifetime of 20 years minimum when operating continuously under the following environmental conditions:

a) Operating Temperature: For workshop equipments STORAGE:	 -10° C to +50° C
b) Ambient Temperature (Max./Min.)	47.5 Deg C/ 8.4 Deg C
c) Electromagnetic Compatibility	Shall meet the requirements as per IEC 801 and other International standards. workshop equipment shall not have any EMI with the electronics equipment installed at site, control room, SS, etc.
d) Relative humidity	97.4% (max) to 11%(min)
e) Rainfall	138.2mm in 24 Hr

3.2 Design Guidelines

a) All equipment shall be immune to EMI, RFI interference generated by any nearby source & shall meet the latest international standards in this regard.

b) All test instruments, special tools and tackles, shall be procured and supplied as a package with its carrying cases, accessories (interconnecting cables, connectors, lamps, batteries, fuses) from their respective manufacturer.

c) Software, if any, to be used shall be provided with latest anti-virus protection software. All software should be license software and certificates for the same shall be provided. Certificate of calibration of all instruments shall be provided. Warranty cards for all instruments shall be provided and same shall be in the name of the RFCL.

d) Electrical power supply requirement of the instruments offered under this sub-section shall be 240 V AC, 50 Hertz nominal, single phase, unless specified otherwise.

e) All instruments offered, shall conform to the relevant Indian /International Standards. All instrument shall be traceable to national / international testing laboratory.

f) All instruments shall be supplied with carry case – portable units. Portable instrument shall have rugged carry case and rechargeable battery unit.

g) All necessary power supplies required by bidder for workshop equipments being supplied by bidder shall be generated from single point power supply (240 V AC, 50HZ) provided by purchaser. Supply & installation of power cables, power distribution Junction boxes and all necessary hardware consumables required for power distribution from single point supply *for the* equipments shall be done by bidder. Bidder shall terminate the cable in the Power distribution box (to be provided by the bidder).

h) All equipment shall have their own regulated power supplies with fuses, isolators, etc.

i) All equipment shall be provided with short circuit and over voltage protection.

4. WORKSHOP EQUIPMENT SPECIFICATIONS

Detailed specifications for the workshop equipments (as per list in clause 2.1) shall be as follows. These specifications are basic and minimum requirements to be followed by the bidder for selection of equipments. Any specifications other than this shall be brought to purchaser notice for approval before procurement by the bidder:

Item 1 : Hydraulic Test Jig for Control Valves

The test jig shall be suitable for valve sizes upto 24", 2500# rating.

1) Requirement: Valve Test Bench for testing Ball Valve, control valve and On-off valve
2) Installation: Fixed type
3) Power Requirement: Bidder to specify
4)Test pressure required is 10 kg to 450 kg;
5) Air Hydro Panel Pressure Gauges: 6"dial
6)Pressure Gauges Accuracy: +/- 1% of full scale
7) Test Bench Complete with a) Test Port and b) control panel

a) Test Ports:
1) Bench Mounted test suitable for RF Flanges having following features.
i)Type of Fixing: Adjustable 3 jaw hydraulic proportional seat clamping.
ii)Flange Sizes: 1 to 24" Size and up to rating 600#
iii)Medium of testing: Air and Water

2. Floor test with extra port with suitable flexible connection having following features.
i)Type of Fixing : With ½" Port connection through removal flange.
ii) Flange Types: RF, RTJ and Lens face;
iii) Flange Sizes: Up to 24" Size and up to rating 2500#
iv)Medium of testing: Air and Water

b) Control panel:
Should be suitable for both type of test media, i.e. gas and water (air-hydro panel)
Control Panel shall be fabricated from stainless steel with a satin finish;
Tubings: SS316 Swagelok make preferably;
Medium of test: Control panel shall be suitable for Dual provision of testing with gas (air/nitrogen)and water with the following features.
1.Air Pressure inlet: Air at 7 Kg/cm2 max. Corresponding Test Pressure: 420 Kg/sq.cm With air booster of ratio 1:60
2.Water Pressure Test Pressure: Max upto 650 Kg/sq.cm from water Tank through booster.
3.Test pressure in case of direct nitrogen: 140 Kg/cm2

Note:
a) Gas/water booster along with respective accumulators will be a part of offer;
b) Relief valve on accumulators to control over-pressure;
c) Arrangement should consist following options for valve to put under test: 1) a pressure tube for external testing having options for connecting to different blind flanges; 2) a face sealing plate for all compatible sizes fixed on permanent support on which test valve is placed and tightened with help of clamps;
d) Arrangement for connecting external N2 cylinder for testing with nitrogen is required;
e) The vendor shall offer rate list for spares and consumables as for maintenance of test bench. The rates will be valid for one year from commissioning of test bench at site;
f) Certification from vendor for pressure holding at 650 Kg with booster isolated is required;
g) MOC certification is required;
h) Warranty will be applicable for any manufacturing defect up-to 12months from installation /18months from supply whichever is earlier. Warranty date will commence from receiving date;
i) Vendor shall arrange free of cost arrangement for installation and commissioning of test bench at RFCL, Ramagundam site and demonstrate the performance of machine. Vendor shall also provide one day training to our personnel free of cost.
j) An undertaking from vendor for availability of spares of offered item for at least 10 years after supply.
k) Calibration certificate for all the instruments of the offered package is required.
l) Installation and operation manual (1 no. hard copy + one no. electronic copy) at the time of supply is required
m) Parts list of test bench, pump and booster and clamping unit and other specific items to be submitted with supply.
N) All Other Accessories of the test bench Including the test flanges (size and rating Given below) shall be quoted separately and shall be valid for one year.

RTJ flanges are required for 1500# 1", 1.5", 2", 3", 4", 6", 8", 12", 14", 18", 24" and 2500# 6", 10", 12", 18", 24";
LF Flanges are required for 1500# 4",8",10" and 12" and 2500# 6" and 8";
24" to 36 " ANSI 150# 300# and 600# Test flange one each

Item 2: Safety valves (Angle valves) Test Jig Pneumatic

The test jig shall be suitable for valve sizes up to 8 to10", 2500#.
1) Requirement: Valve Test Bench for testing Pressure Relief valves and pressure reducing angle valves.
2) Installation: Fixed type
3) Power Requirement: Bidder to specify
4) Test pressure required is 10 kg to 600 kg;

5) Air Hydro Panel Pressure Gauges: 6”dial
6) Pressure Gauges Accuracy: +/- 1% of full scale
7) Test Bench Complete with a) Test Port and b) control panel

a) Test Ports:
1) Bench Mounted test suitable for RF Flanges having following features.
i) Type of Fixing: Adjustable 3 jaw hydraulic proportional seat clamping.
ii) Flange Sizes: 1 to 12” Size and up to 2500#
iii) Flanges types: Suitable for RF, RTJ and Lens face
iv)Medium of testing: Air

b) Control panel:
Should be suitable for Air/ gas
Control Panel shall be fabricated from stainless steel with a satin finish;
Tubings: SS316 Swagelok make preferably;
All accessories for Control panel shall be part of supply.
Medium of test: Control panel shall be suitable for testing with gas (air/nitrogen) with the following features.
1. Air Pressure inlet: Air at 7 Kg/cm2 max. Corresponding Test Pressure: 650 Kg/sq.cm
2. Test pressure in case of direct nitrogen: 140 Kg/cm2

Note:
a) Gas booster along with respective accumulators will be a part of offer;
b) Relief valve on accumulators to control over-pressure;
c) Arrangement should consist following options for valve to put under test: 1) a pressure tube for external testing having options for connecting to different blind flanges; 2) a face sealing plate for all compatible sizes fixed on permanent support on which test valve is placed and tightened with help of clamps;
d) Arrangement for connecting external N2 cylinder for testing with nitrogen is required;
e)The vendor shall offer rate list for spares and consumables as for maintenance of test bench. The rates will be valid for one year from commissioning of test bench at site;
f) Certification from vendor for pressure holding at 650 Kg with booster isolated is required;
g) MOC certification is required;
h) Warranty will be applicable for any manufacturing defect up-to 12months from installation /18months from supply whichever is earlier. Warranty date will commence from receiving date;
i) Vendor shall arrange free of cost arrangement for installation and commissioning of test bench at RFCL, Ramagundam site and demonstrate the performance of machine. Vendor shall also provide one day training to our personnel free of cost.
j) An undertaking from vendor for availability of spares of offered item for at least 10 years after supply.
k) Calibration certificate for all the instruments of the offered package is required.
l) Installation and operation manual (1 no. hard copy + one no. electronic copy) at the time of supply is required
m) Parts list of test bench, pump and booster and clamping unit and other specific items to be submitted with supply.
N) All Other Accessories of the test bench shall be quoted separately.

Item 3: Temperature Bath (Fluidized Bath)

The temperature bath shall be microprocessor based and shall have fully controlled temperature range of 50 to 700 deg. C. This should meet below specifications: - Fluidized Calibration Bath should be suitable for comparison calibration of RTDs, T/Cs, Liquid in Glass Thermometers (Total immersion types) etc. The design of fluidized bath should be perfect enough to eliminate the possibility of any powder loss. Bath should be sealed design and should not discharge alumina powder which could cause health problems to the operator. There should be no requirement of maintaining any additional inventory for alumina powder thereby making the system more cost-effective for longer runs / years of use. Sensors should not be in direct contact with alumina powder.

Temperature Range - 50°C to 700°C, without change in thermal media Accuracy - ± 0.020 °C to ±0.035°C at 660°C - comparison calibration.
Working Volume - 67mm dia. 475mm deep
Heaters - 3 x 1kW
Power - 3kW, 208-240VAC, 50 Hz, single phase
Warm up time - 240 minutes from 50°C to 700°C
Supply Air Pressure - Less than 1 Bar, 30 litres/minute max. Low pressure should be there so that no stress is developed in SPRT's / PRT's and they do not break
PC Interface - Serial Interface with Windows Driven Software having capability to control, automatically log & display the temperature of bath with graphical presentation
Safety - Safety melting fuse, blocked filter cutout, low flow indication, elapsed time indication, over pressure diaphragm
Fluidizing Medium - appr. 22kg alumina powder
To be supplied with equalizing block, PC communication interface, software and evaluation report.

Reference sensor SPRT should be also supplied with below specifications:
The resistance element should be of pure platinum, coiled and mounted in a strain free construction. All support members should be of quartz construction for most stable performance and minimal drift. A platinum radiation shield shall be there to prevent heat radiating up the inside of the sheath. A 2.5-meter length cable shall be attached with the sensor with low thermal emf with gold plated terminals.

Sheath Material:

The SPRT shall have Quartz as the internal components are visible and can be inspected.

Technical Specifications:

Sr. No.	Parameter	Value
1	R TPW	25.5 Ohm
2	Measuring range	-200 to 670 deg C
3	Recommended current	1mA max
4	Nominal Sensitivity	0.1ohm/degC
5	Resistance Ratio	Wga > 1.11807 as required by ITS 90
6	Long term drift	0.001 deg C /Year
7	Internal Leads	4 wire Platinum
8	Nominal Diameter	7.5mm
9	Stem length	480mm
10	Sensor length	35mm

Accuracy Details: -

The SPRT shall be calibrated at Fixed Point and the below uncertainties shall be achieved.

Fixed Point	°C	Typical Uncertainties
BP Nitrogen	-195.798	10mK
TP Mercury	-38.8344	2mK
TP Water	0.01	1mK
FP Indium	156.598	3 mk

Accredited Fixed point Calibration certificate shall be provided. Hard Carry case shall also be included.

Item 4 : Portable Electro-pneumatic Calibrator

Range 1

Pressure Range : Vac to 2bar
Best Accuracy : 0.04%
Best Resolution : 0.0001 bar
Temperature Stability: Less than 0.005% per °C
Sensor : Piezoresistive
Pressure connection : 1/8" BSP female in a stainless steel manifold
Units : Bar, PSI, KPa, in, inHg, mmHg, Kg/cm2, Atm
LOOP CURRENT CALIBRATION
Ranges : +/- 200mA, and '% of 4-20mA'
Accuracy : 0.05% of reading +/- 2 digit, (0.1% for '% of 4-20mA' range)
Resolution : 10µA (200mA range), 0.1% (% of 4-20mA range)
Loop resistance : Less than 2Ω
Power : PP3 battery, life 50 hours continuous use

Range 2

Pressure Range : 0 to 10bar
Accuracy : 0.04% of full scale
Best Resolution : 0.001 bar
Sensor : Piezo-resistive - stainless steel diaphragm
LOOP CURRENT CALIBRATION
Ranges : +/- 200mA, and '% of 4-20mA'
Accuracy : 0.05% of reading +/- 2 digit, (0.1% for '% of 4-20mA' range)
Resolution : 10µA (200mA range), 0.1% (% of 4-20mA range)
Loop resistance : Less than 2Ω
Power : PP3 battery, life 50 hours continuous use

Range 3

Pressure range : 0 to 70 bar
Accuracy : 0.04%
Best Resolution : 0.01 bar
Sensor : Piezo-resistive - stainless steel diaphragm
Electrical
Range : Loop current measurement 0 to 200mA
Resolution : 10µA
Resistance : Loop load 5Ω
Accuracy : 0.05% of reading ±1 digit
Power Source : Internal rechargeable NiMH batteries, or mains supply
Display : 7 segment LCD with 'Low Battery' warning indicator

Range 4

Pressure range : 0 to 100 bar
Accuracy : 0.04%
Best Resolution : 0.01 bar
Sensor : Piezo-resistive - stainless steel diaphragm
Electrical
Range : Loop current measurement 0 to 200mA
Resolution : 10µA
Resistance : Loop load 5Ω
Accuracy : 0.05% of reading ±1 digit
Power Source : Internal rechargeable NiMH batteries, or mains supply
Display : 7 segment LCD with 'Low Battery' warning indicator

Item 5 : Instrument Calibration Test Bench

UNIVERSAL ELECTRONIC CUM PNUEMATIC TEST BENCH
SUITABLE FOR UNIVERSAL CALIBRATION PURPOSE – ALL MODULES SHOULD BE MOUNTED ON THE CONSOLE AND IT SHOULD BE A PROPER CONSOLE MOUNTED TEST BENCH
Calibration Bench should be capable to calibrate the following equipments:

a) Digital Multimeter (0.1m volt to 1000 Volt AC, 0.1 m volt to 1000 Volt DC, 10 Amp, 0 to 200 Mega Ohm)
b) AC/DC Signal sources
c) Analog DC Voltmeter
    - 0-60 Volt
    - 0-75 Volt
    - 0-100 Volt
    - 0-150 Volt
    - 0-200 Volt
d) Analog AC Voltmeter
    - 0-100 Volt
    - 0-500 Volt
e) Analog DC Ammeter
    - 0-200 Amp
    - 0-300 Amp
    - 0-400 Amp
    - 0-500 Amp
    - 0-600 Amp
f) Analog AC Ammeter
    - 0-30 Amp
    - 0-400 Amp
g) AC/ DC mili-voltmeter
h) Digital AC/DC Clamp on meters (0-1100 Amp)
i) Ohm meters, Resistance boxes
j) Temperature indicators
    - 0 -200° C
    - 0-600° C
    - 0-1200° C
k) RTD transmitters
l) Power Supplies :
m) Thermocouple transmitters (0 - 1200°C)
n) Signal generators, frequency meters, timer counters
o) Digital RPM meter
    - 0-1500 RPM
    - 0-3000 RPM

Insulation Tester:
Test Voltages upto 2.5KV
Resistance Value upto 10Gohm

DIMENSIONS AND MATERIAL FOR CALIBRATION BENCH

Overall (including Console): Width 200 x Height 156 x Depth 85cm
Primary console: Width 200 x Height 29 x Depth 47 cm
The bench assembly should be constructed from mild steel throughout and whole assembly should have good paint finished. 2 drawer unit – mounted under work table to be provided.

ACCESSORIES

Calibration Bench should be equipped with ON/OFF Power switch to provide isolation for the entire bench power supply, residual current breaker with over current protection.
Calibration Bench should have the feature to calibrate the instruments measuring capacitance / inductance in the range of 1nF to 100uF and 1mH to 10 H respectively.
Calibration Bench should have the following sockets and monitoring systems

- Mains Voltage Digital Display meters (0– 300 Volt)
- Mains power sockets isolated or non-isolated
- Static Earth Socket
- Under Console Lighting Switch
- Main Power ON Indicator

Calibration bench should be supplied with a set of testing leads.

SUPPLIES REQUIRED FOR CALIBRATION BENCH

Calibration Bench should have following supplies:

Dual 24 Volt DC/ 2 Amp output supply floating with respect to each other and ground, A power ON/OFF switch, fuses and LED indicators should also be provided. Which should be suitable for powering loop signal instrumentation.

Variable 0-270 Volt /50Hz, 10 Amp Power unit. The voltage and current should be monitored and displayed on two digital display meters. Output voltage should be adjusted through control knob on front panel.

Variable 0-60 Volt DC power supply. The output voltage and current should be monitored and displayed on digital display meters. Output voltage and current should be adjusted through control knobs on front panel.

Quad DC power supplies. The voltage and current ratings are 5V (8 Amp), 12V (8Amp), 24V (4Amp), 48V (3Amp). Each Supply should be switched ON and OFF individually and has its own fuse and power LED. These Power supplies should be free from Ripples and Noise and equipped with over Volt protection.

STANDARD FEATURE

Calibration Bench should be equipped with Multifunction Calibrator with Built in Industrial PC along-with preloaded control programs and calibration software. Multifunction Calibrator and control centre should have the complete capabilities to perform listed calibrations.

Calibration bench should have one good 6.5 digit DMM mounted in the console to be used for reference measuring device

SOFTWARE FOR CALIBRATION

The calibration software and database system should be window based capable to meet international calibration. It should be user friendly and secure. It should be able to perform automatic calibration of the specimen as per standard or predefined procedures. Create, edit, test and documents calibration procedure with predefined template for calibration of multimeters, RTD, Thermocouple, Power meters, Frequency counter etc. There should be provision to create customized template for calibration procedures. Calculate and report measurement uncertainty as per ISO 17025 standard in customized calibration report. Transfer of calibration report to standard windows files. Track asset information including calibration and maintenance history and status, traceability, users, customers and locators. Analyse and report asset information, produce certificates and reports to meet ISO standards.

Technical Specification for Multifunction Calibrator and Control Centre with built in PC

The multifunction Calibrator should be mounted centrally in the primary console it would act as a control centre for the whole bench. It shall incorporate an industrial PC that is preloaded with the control programs and calibration software.

The control software should allow a wide range of functions to be selected using mouse, keyboard. Precise calibration should be possible using the deviation function - this provides a direct error readout for the instrument being calibrated.

Parameter	**Range / accuracy**
DC Voltage - Std Output - Resolution -1 yr Uncertainty	Range : 0 to ± 1045V Resolution : 100nV to 1000uV Best 1 year : ± 16ppm of setting
AC Voltage - Std Output -Resolution - 1 yr Uncertainty	Range : 1mV to 1045V (10Hz to 20kHz, Sine-wave) Resolution : 1uV to 10mV Best 1 Year Specification : ± 315ppm of setting
DC Current - Std Output -Resolution - 1 yr Uncertainty	Range : 0 to ± 21A Resolution : 1nA to 10uA Best 1 Year Specification: ± 85ppm of setting
AC Current - Std Output -Resolution - 1 yr Uncertainty	Range : 10uA to 21A (20Hz to 1kHz, Sine- wave) Resolution : 10nA to 100uA Best 1 Year Specification: ± 0.05% of setting

Resistance - Std Output - 1 yr Uncertainty	1 ohm to 1G ohms (Fixed Values, decade steps) Best 1 Year Specification: ± 20ppm of setting
Capacitance - Std Output - 1 yr Uncertainty	Values : 1nF,10nF,100nF,1uF,10uF & 100uF (100V Max) Best 1 Year Specification: ± 0.25%
Frequency - Std Output - 1 yr Uncertainty	Range : 0.1Hz to 10MHz / 100nS to 10S Best 1 Year Specification: ± 20ppm of setting
RTD - Temp Source Accuracy	Pt100 (-200° to 850° C) Best 1 Year Specification: ± 0.2 °C
Temp – Standard Output (By simulation Technique) -Range -1 Yr Uncertainty	Thermocouple Source 8 types – B, E, J, K,N, R, S, T (-) 270 to 1800° C Best 1 year Accuracy ± 0.15 °C

It should allow the user to perform in-house calibration for the instruments.
It should have universal calibration software easy cal, which assist in calibration, Print certificates, calculate uncertainties as per ISO17025 for many items (More than 800 built-in procedures). Further more can be built for specific requirement.
All the modules included in the test bench shall be supplied with calibration certificate traceable to National / International standards.

Technical Specifications for Insulation Tester Calibrator:
The Insulation Tester Calibrator should have the following specs:
The precision instrument should be suitable for calibrating and testing general purpose insulation testers with test voltages up to 2.5kV.
It should be constructed in a high strength co-polymer plastic case and powered by a rechargeable battery. The insulation tester being calibrated should be tested for open circuit voltage and short circuit current. These are displayed on the digital meter mounted on the front panel. Seven selectable precision resistors provide the insulation resistance test. A separate continuity Test to be provided. Also fitted should be 4 fixed low resistance values for verification of the low ohm ranges.

Resistance (Insulation) **:** 10G Ω, 1G Ω, 100M Ω, 10M Ω, 1M Ω, 500K Ω, or 100K Ω
Resistance (Low ohm) **:** 1 Ω, 10 Ω, 100Ω, or 1K Ω
Resistance accuracy **:** Low Ohm 1%, Insulation resistance: 100K - 1G, 1%. 10G, 5%
Resistance temp coeff. **:** < than 250ppm per °C insulation resistance, < 50ppm low resistance
Continuity **:** Selectable 5Ω
Open circuit voltage measure **:** 0 to 2kV range, 0 to 2.5kV range, both ranges 1% of f/s accuracy
Voltage display **:** 1.999kV full scale, and 2.50kV full scale
Short circuit current measure **:** 0 to 2mA range, 0 to 20mA range, both ranges 1% of f/s accuracy
Current display **:** 1.999mA full scale, and 19.99mA full scale
Power **:** Internal battery, 6V re-chargeable NiCad, >500hrs between charges

Details of other modules mounted in the console of the test bench:

Item	Console mounted mV calibrator
Type	nd ramp, fine adjustment (inching) eter for quick positioning and fine adjustment through up/down buttons
Input range	0-220mV 0-2.2V 0-22V

Output range	0-220mV 0-2.2V 0-22V
Accuracy	**±0.02% of span**
Qty.	**1 No.**

Item	Console mounted mA calibrator
Input range	0 to 60mA
Output range	0 to 20mA
Protection	100% range
Accuracy	0.02%
Qty.	1 No.

Item	Console mounted RTD calibrator
Type	Suitable for 2, 3, 4 wire industrial / plant RTD's Sources and measures
Display	Digital
Accuracy	±0.05 deg C
Power	Powered from Test Bench's internal power supply
Qty.	1 No.

Item	Console mounted pressure calibrators
Type	*Precision Electronic Pressure calibrator with digital display*
Range	Four modules should be there for below ranges 0-2kg/cm2 0-10kg/cm2, differential 0-200kg/cm2 0-600kg/cm2
Best Accuracy	+/- 0.04 %
Over Range protection	20% of span
Display- Type	LCD
Power Supply	Through Test Bench power supply
Qty.	Total four modules

Item	Console mounted vacuum calibrator
Range	(-)12 to 0 psi
Accuracy	± 0.04% FS
Display	LCD
Power supply	Through Test Bench power supply
Qty.	1 No.

Air Compressor

Max. Working Pressure: 25 bar

Qty : 1 no.

Bench Line Pressure Control

This should be there for managing the internal line pressures. The external line pressure should be connected to the console rear panel (35 bar to suit above air compressor).

The regulator (venting max i/p pressure rated to 35 bar) used should be non-relieving type and should set the internal line pressures to the calibration modules. There should be a gauge (atleast 60mm) to display the internal regulated line pressure. The external line pressure should be isolated using a needle block valve on the front panel. Direct output of the internal line pressure should be also available on the front panel via Minimess or Quick Release connectors. Qty. 1 no.

Electric Operated Vacuum Pump

An electrically operated vacuum pump complete with vacuum gauges (0-750 mm Hg), lube oil level switches, moisture trap, inlet dust filter, exhaust mist filter etc. as necessary for the pump shall be provided. The vacuum pump shall be single stage, oil sealed, rotary vane type offering high degree of efficiency combined with minimum maintenance. Vacuum pump shall be capable of providing very high degree of vacuum typically 3 X 10^{-2} mbar or better. The pump shall have high water vapor tolerance typically greater than 15 mbar. The pump shall have its own arrangement for air cooling if required lube oil level switches, moisture trap, inlet dust filter, exhaust mist filter, etc. as necessary for the pump shall be included.

Qty : 1 no.

All above units should be supplied with hoses, leads, extension cables, accessories for operation etc. and should be fully wired in the back of the console. Console should have fan arrangement and ventilation.

Item 6 : Digital Temp Indicator for Thermocouples

Measurement Parameters and Ranges

DC Voltage	Range : 100 mV Resolution : 1 µV Accuracy : 0.020% RDG + 3µV
Thermocouple type	K, T, J, E, R, S, B, U, L, C, N, Platine, Mo, NiMo/NiCo
Input Range	-250 to 2310°C
Display	160 x 160 pixel liquid crystal graphical display with back display of result as table of values or trend curve
Power supply	4 AA alkaline batteries 1.5 V

Item 7 : Digital Temp Indicator for RTD's

Measurement Parameters and Ranges

Resistance	400 Ω, 3600 Ω Resolution: 1m Ω, 10m Ω Accuracy : 0.012% RDG + 10mΩ, 0.012% RDG + 100mΩ
Resistive probes Measurement	Pt50, Pt100, Pt200, Pt500, Pt1000, Ni100, Ni 120, Ni 1000, Cu10, Cu 50
Display	160 x 160-pixel liquid crystal graphical display with backlit display of result as table of values or trend curve
Power Supply	4 AA alkaline batteries 1.5 V

Item 8 : DC Voltage/ Current Standard

DC Voltage Source	0 to 21V
DC Voltage Measure	Two Ranges Selectable 0 to 5V, 5 to 25V
DC Current Source	0 to 50mA
DC Current Measure	Two Ranges – Selectable 0 to 25mA, 25 to 125mA
Accuracy	±0.01%

Item 9 : Portable DC Potentiometer

Temperature Range : -200°C to +800°C
Accuracy : ± 0.3°C accuracy
Set Points °C : -200, -100, -50, -20, -10, 0, 10, 20, 30, 40, 50, 60, 80, 100, 150, 200, 250, 300, 400, 500, 600, 700, 800.
Maximum Current : 50mA

Type: Portable

Environment: AC lab Environment
DC variable resistor with 6 dials;
Resistance Range: 0.100 Ohm to 1111.210 Ohm
Resolution: 0.001 Ohm
Accuracy: +/- (0.01% + 2 mOhm)
Max allowable input power: 1 W
Connection: Through Banana sockets

Note:
1 Operational Manual and Test certificates traceable to NABL shall be part of supply.
2 Standard Warranty One year / 18 Months shall be applicable.

Item 10 : Dead Weight Tester 1-600 KG/CM^2

Dead weight pressure gauge tester with all required accessories shall be provided for testing of pressure gauges. The measuring range shall be 10 - 600 kg/cm^2 with an accuracy not less than 0.02%. Instrument shall be fitted with priming lever pump, hand wheel pressure adjustment, leveling screw and built-in spirit indicator.

Item 11 : Dead Weight Tester 2-300 KG/CM^2

Dead weight pressure gauge tester with all required accessories shall be provided for testing of pressure gauges. The measuring range shall be 2 - 300 kg/cm^2 with an accuracy not less than 0.02%. Instrument shall be fitted with priming lever pump, hand wheel pressure adjustment, leveling screw and built-in spirit indicator

Item 12 : Dead Weight Tester 0-7 KG/CM^2

Dead weight pressure gauge tester with all required accessories shall be provided for testing of pressure gauges. The measuring range shall be 0 – 7 kg/cm^2 with an accuracy not less than 0.02%. Instrument shall be fitted with priming lever pump, hand wheel pressure adjustment, leveling screw and built-in spirit indicator

Item 13 : Function Generator

1	Frequency Range	0.002 Hz to 20 MHz
2	Accuracy	±3% of full range from 0.01Hz to 1MHz ranges ±5% of full range on 10MHz range
3	Time Symmetry	Square wave variation less than±1% from 0.001Hz to 200KHz, ±0.5% from 20Hz to 20KHz
4	Waveforms	Sine, square, triangle, pulse, positive square, negative square, DC
5	Operation Mode	Continuous, Triggered orGated
6	Amplitude Range	upto 20V p-p upto 10V p-p into 50 ohms load
7	Display	Digital display
8	Input supply	230 V ±10% AC, 50 Hz
9	Accessories	Mains Cord BNC Cable Manual and test certificate

Item 14 : Portable Calibrator

Portable multifunction type Current, Thermocouple / RTD calibrator / Simulator
It should be a high accuracy instrument for onsite application as well, easy to use, all necessary process functions embedded, and suitable for maintenance, quality control, and calibration. This should make the job of several units in one instrument. Simulation, emission

Portable calibrator able to measure and to generate simultaneously.

It should be able to measure and generate voltage, current, frequency, resistance signals, resistive probes and thermocouples.

It should be supplied with manual, certificate, with a strap and a stand for desktop use, a quick battery charger, and a set of 6 measuring cables with crocodile clips and should have USB port. It should use unique connections: by pushing on the terminal's top and inserting:
Wires with a diameter up to 3 mm Compensated thermocouple connectors and by releasing.
Wires are tighten between 2 brass plates which provide an great thermal gradient, so that allows a very good cold junction compensation for thermocouples Should also allow 4mm banana plugs and also security connectors to be connected on the front panel

Functions: following physical values to be measured and simulated:
• Voltage
• Current
• Resistance
• Temperature by thermocouples, RTD and thermistors Résistance
• Frequency/counting from signal and dry contacts
It should allow scaling of process signals and corrections to temperature probes.
resistance which digital data transfer uninterrupted.

Display

During measuring average, maximum, minimum and the number of measurements are displayed on the left. during emission this part of screen displays all details of ramps, steps and constant value emission functions.
Drop-down menus are used with the navigator, and an on-line help is available graphically display probe connections an wires
Accuracies – simulation / measure

Display	Dual Digital LCD with backlight
Volts	Simulation : upto 20V Measurement : upto 50V
Millivolt	Simulation : 0-100mV Measurement : 0-100mV
mA (Current)	Simulation : 0-24mA Measurement : 0-50mA
Typical Accuracies	Better than 0.02%
Thermocouple Types (Measurement & Simulation)	K, T, J, E, R, S, B, N , U ,L ,C
RTD(Measurement & Simulation)	PT100, Pt1000, and various other types
Operating temperature range	0°C to 50°C
Power Supply	Rechargeable battery with 230V, 50Hz Single Phase Charging
Dimensions and Weight	210mm x 110mmx 50mm & 900gm
Accessories	Test Leads with clips Rechargeable battery with Charger Manual Calibration certificate

Item 15 : Test Lab (CRO)

Sr. No.	Parameter	Description
1	Bandwidth	100 MHz
2	Analog Channels	2 Numbers
3	Real-time Sample Rate	1 GSa/s (each channel), 500MSa/s (dual channels)
4	Vertical Sensitivity	2 mV/div to 10V/div
5	Trigger Mode	Edge, pulse width, slope, video, pattern, continuous time and alternate

6	Math	+, - , x, FFT
7	PC Interface	USB, RS232
8	Display	5.7" TFT QVGA (320X240) with 64K color LCD backlit display
9	Accessories	Mains cable Test probes USB cable Packing kit Manual and calibration certificate

Item 16 : Portable Calibrator/ Hand Held Communicator (HART protocol)

It should be a high accuracy instrument for onsite application as well, easy to use, all necessary process functions embedded, and suitable for maintenance, quality control, and calibration.

This should make the job of several units in one instrument.

- Simulation, emission
- Pressure, temperature, process signal measurements.
- A Bluetooth interface, quick access to functions, on line help for connection, should high performances for onsite use

Portable calibrator able to measure and to generate simultaneously on 2 isolated channels or to measure on two channels with a wide backlit display for use in all lightning conditions.
It should be able to measure and generate voltage, current, frequency, resistance signals, resistive probes and thermocouples. Unit should also perform calibration automatically on HART protocol transmitters.
It should be supplied with manual, certificate, with a strap and a stand for desktop use, a quick battery charger, and a set of 6 measuring cables with crocodile clips and should have USB port.
It should use unique connections: by pushing on the terminal's top and inserting:
Wires with a diameter up to 3 mm or 10AWG Compensated thermocouple connectors and by releasing. should also allow 4mm banana plugs and also security connectors to be connected on the front panel
Functions: following physical values to be measured and simulated:
• Voltage
• Current
• Resistance
• Temperature by thermocouples, RTD and thermistors Résistance
• Frequency/counting from signal and dry contacts
It should allow scaling of process signals and corrections to temperature probes.
It should be compatible with HART transmitters by inserting a 250ohms resistance which digital data transfer uninterrupted.
It should store data and can send them to PC for analysis.

HART Protocol: should work with HART Protocol instruments:
• Connection of 1 to 15 analogue sensors with 24V volts power supply
• Compatibility with Protocols « HART 5 » and « HART 6 ». Setting and configuration of these sensor through the Calibrator
• Loop supply with insertion of 250Ω internal resistance.
• "Verify " hart menu option: Verification of the current loops and the detectors (manually or automatically). All the information are stored into the Verification report.
• Loop current and detectors can be adjusted from the units
• HART Instrument status: Some informations about the behaviour of the instrument under test can be displayed: overload loop, out of limit variable…
Calibration : Sensor calibration :
Calibration coefficient can be implemented in order to correct sensors.
Should be able to issue calibration reports.

Electronic devices calibration:
Calibration can be performed by comparison (2 probes and temperature generator driven) or using signal generation. Two methods are available: manual or automatic, with uncertainty taken into account. Calibration setpoints are to be entered by user.

Transmitter mode : The measured value is emitted as 4-20mA or voltage.
Display
Dual display continuously displays the measurement value, the emitted value, the gauge and the used functions.
On the toplines date, time and external temperature are indicated.
During measuring average, maximum, minimum and the number of measurements are displayed on the left. during emission this part of screen displays all details of ramps, steps and constant value emission functions.
Drop-down menus are used with the navigator, and an on-line help is available graphically display probe connections an wires
Accuracies – simulation / measure
DC Current : upto 0.009%±2microA
DC Voltage : Upto 0.007%±0.5mV
Resistance : Upto 0.008% ±1ohm
Frequency 0.01%rdg

The calibrator shall be supplied with Test Leads, Manual, HART Modem, carry case

Item 17 : Temp. Bath (Amb – 600 Deg c)

Sr. No.	Item	Specifications
1	Functional Requirement	1. The offered temperature calibrator should have inbuilt three channel temperature indicator. One channel shall be used for readout of standard PRT and the remaining two channels shall be used for readout of two numbers of test probes under calibration. Thermostat testing should also be possible on these two channels. 2. The calibrator should have inbuilt temperature indicator for reference probe and two universal inputs for PRT / Thermocouple / Process Inputs. 3. The temperature of the calibrator should be easily settable through front panel keys and the digital display of the set and achieved block temperature should be available on front panel.
2	Temperature Range	35°C to 660°C
3	Stability over 30 minutes	±0.02ºC at 50ºC ±0.02ºC at 250ºC ±0.03ºC at 650ºC
4	Display resolution	0.01ºC in full range
5	Heating time	30ºC to 650ºC in 20 minutes (approx.)
6	Cooling time	650ºC to 150ºC in 60 minutes (approx.)
7	Calibration volume	The offered calibrator should have calibration volume of minimum 35mm dia and 148 mm depth.
8	Calibration Block	The offered calibrator shall be provided with calibration block with pockets of diameter 4.5mm (2 nos.), 6.4mm (2 nos.), 8.0mm and 9.5mm.
9	Display Unit	The display unit shall be programmable to ºC, ºF or K.
10	PC Interface	The Ethernet port and communication cable should be provided with calibrator for PC connectivity.
11	Software	The calibrator should be provided with software for performing automatic temperature cycling. Additionally, this temperature cycling should also be possible from front panel keypad.
12	Data logging	The calibrator should have data logging facility with logged data export to USB.
13	Power supply	The temperature calibrator should be operational on single phase 230V AC 50 Hz supply.
14	Reference Probe	The calibrator should be provided with reference probe of suitable range.

15	Additional Features	1. The offered temperature calibrator should have possibility for expansion to perform calibration of following equipments by using the appropriate accessory kit that should be suitable for use with the bath itself. a. Surface sensors (through surface sensor calibration kit) b. Infrared thermometers/thermal imagers (through black body kit). 2. There should be provision of Offset elimination for reference probe so that block can follow the reference input. 3. There should be In Built Web Server in the offered temperature calibrator. 4. The data should be Tamper Proof and in accordance with 21CFR, Part 11.

Item 18: Digital Pressurizer

Type : Benchtop
Pressure Range : 0 to 600 Bar
Output connector : M 20 x 1.5
No. of Ports : 2nos.
Working medium : Distilled water, Drier Oil

Item **19 : Power Supply Unit**

Parameter	Description
Voltage Range	0-64V, 5A (Continuously Adjustable)
Voltage / Current Range Meters	0-64V / 0-5A
Display	3 Digit DPM LCD
Power Supply Connection	230V AC ±10% 50Hz, single phase
Protection	Short Circuit and Overload Protection.
Accessories	Supplied with mains power cable, test leads with clips, manual & test certificate.

Item 20 : Calibration INST TK3

Item 21 : Decade Capacitance Box

Parameter	Description
Features	Compact and robust, housed in a metal case that provides complete screening, with a protective rubber cover to guard against wear and tear. 5-digit thumbwheel switch enables simple and precise setting of the capacitance value.
Measuring Range	100pF to 10µF
Residual Capacitance	Approximately 40pF
Accuracy	1% (Best Basic accuracy)
Accessories	Supplied with manual and certificate.

Item 22 : Temp. Indicator

The Indicator should be of high accuracy for measurement of Platinum Resistance Thermometers, Thermistors, Thermocouple and Process Instrumentation (4-20mA) over the range -270°C to 1820°C.

The unit shall display in °C, °F, K, Ohms, mV and mA with numeric and graphical display modes. The large back lit display makes configuring the instrument and setting the scrolling strip charts intuitive. The USB port allows for the use of a mouse, keyboard or USB Drive.

1	Input Channel:	3 Universal input channel for SPRTs, PRTs, Thermistors and thermocouples
2	Ranges:	SPRTs: 0-115Ω PRTs: 0-460Ω Thermistors: 0-32kΩ, 0-130kΩ, 0-490kΩ Thermocouples : ±115mV 4-20mA: 0-30mA
3	Units	°C, °F, K, Ω, mV, mA
4	Accuracy (Over I year)	SPRTs/PRTs: 5ppm Thermistors: 50ppm Thermocouples: 2µV 4-20mA: 0.002mA
5	Temperature Accuracy (Initial)	SPRTs/PRTs (at 0°C): 3mK (over full range): 5mK Thermistors: 50ppm Thermocouples: Type B: ±0.23°C Type E: ±0.03°C Type J: ±0.04°C Type K: ±0.05°C Type L: ±0.04°C Type N: ±0.06°C Type R ±0.17°C Type S: ±0.19°C Type T: ±0.05°C Au-Pt: ±0.12°C
6	Resolution:	Resistance (PRTs): 0.00001Ω (Thermistors): 0.001Ω Voltage: 0.00001mV Current: 0.001mA Temperature: 0.0001°
7	Temperature conversions:	PRTs: IEC60751(2008), Callendar-van Dusen, ITS90 Thermocouples: IEC584-1 1995 (B,E,J,K,N,R,S,T), L, Au-Pt Thermistors: Steinhart-Hart, Polynomial
8	Sensors Currents :	SPRTs/PRTs: 1mA and 1.428mA ±0.4% (reversing) Thermistors: 5µA (reversing)
9	Keep Warm Currents:	1mA and 1.428mA
10	Input Connectors:	SPRTs/PRTs: LemoEPG.1B.306. HLN 6-pin gold plated contacts Thermocouple: Miniature Thermocouple socket (ASTM E 1684-05) 4-20mA: 4mm sockets
11	Interfaces:	Ethernet, USB and RS 232

12	Display:	Color TFT LCD with LED backlight
13	Operating Conditions:	0-45 degree Celsius temp, 0-99% humidity
14	Display Units:	°C, °F, K, Ohms, mV and mA
15	Measurements Time:	950 ms
16	Logging facility:	>180 days of time stamped measurements to internal memory
17	Terminal Adaptor:	Adaptor for connecting bare wire, spades or banana plugs shall be provided
18	Carrying case:	Carrying case for portability shall be supplied
19	Certificate	Traceable calibration certificate should be provided

Item 23 : Digital Pressure Gauges (W&T gauges series 1500)

Dial Size	150 mm
Accuracy	± 0.25% FSD
Connection	1/2" BSP bottom connection
Pointer	Knife edge micro meter adjustable pointer
Range	0 - 1 kg/cm.Sq - 1no. 0 – 2 kg/cm.Sq - 1no. 0 - 10 kg/cm.Sq – 1no. 0 - 25 kg/cm.Sq – 1no. 0 – 160 kg/cm.Sq – 1no. 0 – 250 kg/cm.Sq – 1no. 0 – 600 kg/cm.Sq – 1no. 1 set = 7 gauges
Features	Bourdon SS316 Movement SS304 Shank SS316
Accessories	Operation Manual Carry case

Item 24 : Hydraulic Pipe Bending M/C

Bench Top Tube Benders features:
- Rugged, lightweight aluminum construction
- 1 to 180° bending range
- Suitable for ½ to 1” OD SS/CS Pipes.
- Self Standing type
- Bending of Alloy 2507 tubing
- Bending of heavy-wall annealed stainless steel piping
- Compression media: Hydraulic oil.

Item 25 : Decade Inductance Box

Parameter	Description
Features	Compact, robust and accurate decade inductance box. Housed in a fully screened metal case, finished in two tone blue and black. Connection is by industry standard 4mm terminals and includes a case connection.
Measuring Range	1mH to 10H
Accuracy	3% of setting
Residual Inductance	less than <1µH
Operating Voltage	30V
Accessories	Supplied with manual and certificate.

Item 26 : Digital Manometer

MEASUREMENT RANGE : DIFF, PR.: 0 to 500mbar
ACCURACY : ±0.2% OF RDG±1DGT
BATTERY OPERATED
OPERATING TEMPERATURE : 50 DEG C
CALIBRATION CERTIFICATE
CARRYING CASE

Item 27 : De-soldering station

Parameter	Description
Type	Multi-function SMD Rework Station with Digital Display
Features	Heater/Sensor Failed Detection, Energy Saver Mode, Temperature "Lock-Out" feature, ESD Safe and Spike Free Circuitry, Delayed Suction, Light Weight Soldering Iron, Hot Air Function, Built-in vacuum pump.
Temperature Range	Two adjustable temp controller with maximum setting of 150 °C to 480 °C (for soldering purpose) and maximum setting 300°C to 450°C (for de-soldering cum sucking purpose)
Display	Digital Display
Air Flow	1.5 L / Min -40L / Min
Accessories	Supplied with Magnifying glass & TWZ 100 (tweezer), Soldering Iron with pre-loaded standard tip, De-soldering Iron with pre-loaded standard tip, Hot air wand with 4 nozzles, 2 Iron holder, Hot air gun holders, Maintenance kit, AC power cord with plug, Operation manual

Item 28 : Ordinary Digital Multimeter

1. Display LCD
2. Impact resistant casing
3. Single rotary switch operation
4. Auto polarity
5. Low battery and over range indication
6. Auto power off
7. Power: Battery operated
8. Audio continuity
9. AC current measurement range 0-40 Amp
10. AC voltage measurement range 0-500-1000 V
11. DC Voltage measurement range 0-500-1000 V
12. Accuracy of measurement of above parameters +- 2%
13. Capacitance, frequency, diode test measurement
14. Transistor testing facility.
15. Resistance measurement facility.
16. Data hold Facility
17. Temperature measurement probe
18. Backlit illumination
19. Accessories: Test leads, operating manual, battery, leather carrying case.

Item 29 : Clamp-on meter

1. Display LCD
2. Impact resistant casing
3. Single rotary switch operation
4. Auto polarity
5. Low battery and over range indication
6. Auto power off
7. Power: Battery operated
8. Audio continuity
9. AC current measurement range 0-400-1000 Amp

10. DC current measurement range 0-1000
11. AC voltage measurement range 0-500-1000 V
12. Accuracy of measurement of above parameters +- 2%
13. Capacitance, frequency, diode test measurement
14. Transistor testing facility.
15. Resistance measurement facility.
16. Data hold facility.
17. Jaw dia size minimum 40 mm
18. Accessories: Test leads, operating manual, battery, leather carrying case.

Item 30 : 100 V Megger

1. 100 V Insulation Tester Analog Type.
2. Hand driven clutch generator housed in an aluminium body with metallic carrying handle along with its accessories like leads of 5 mtr length, leather carrying case, user manual and etc.
3. Instrument must be as per IS 2992:1980 with latest amendments.
4. Measurement range: 0-5
5. 00 Mega Ohm with infinity and resolution is 0.1 Mega Ohm.

Item 31 : 500 V Megger

1. 500 V Insulation Tester Analog Type.
2. Hand driven clutch generator housed in an aluminium body with metallic carrying handle along with its accessories like leads of 5 mtr length, leather carrying case, user manual and etc.
3. Instrument must be as per IS 2992:1980 with latest amendments.
4. Measurement range: 0-1000 Mega Ohm with infinity and resolution is 0.1 Mega Ohm.

Item 32 : Non-Contact Temperature Gun

The item shall be a noncontact temperature infrared thermometer that measures from 0 deg C to 200 Deg C. It shall have a high distance to spot ratio. It shall have user-selectable interfaces with a bright backlit display unit indicating Max, Min, Differential & Average temperatures. It shall have audible & visible alarms for rapid detection of high and low temperatures outside the ranges.

S No	Parameter	Specifications
1	Temperature range	0 deg C to 200 Deg C
2	IR accuracy	Temp ranges >= 0 Deg C, having accuracy of +/-1 Deg C or 1% of the reading, whichever is greater < 0 Deg C, having accuracy of +/-2 Deg C or 2% of the reading, whichever is greater
3	IR repeatability	+/- 0.5% of reading or +/-0.5 Deg C
4	Display resolution	0.1 Deg C
5	Distance: Spot ratio	60:1 (approximately)
6	Minimum Spot size	Around 19 mm
7	Laser sighting	Offset dual laser
8	Spectral response	8 µm – 14 µm
9	Response time (95%)	< 500 ms
10	Emissivity	Digitally adjustable
11	Contact Measurements	With K-type thermocouples a) Input Temp range: -270 Deg C to 1372 Deg C b) Input accuracy: +/- 1 % or +/- 1 Deg C c) Repeatability: +/- 0.5% of reading or +/- 0.5%, whichever is greater

12	Measurement Options	a) Hi/Low alarms: Audible & two-color visual b) Min/Max/Avg/Dif: Yes c) Switchable Celsius & Fahrenheit: Yes d) Backlight: Normal & Extra bright for darker environments e) Probe Input: K-Type Thermocouples & IR temperature f) Trigger lock: Yes g) Data storage: 99 points h) Display: Dot matrix with function menus
13	General Specifications	
	Safety and compliance	IEC 60825-1 FDA Laser Class II IEC 61326-1 CE Compliant
	Ingress protection	IP54
	Operating temperature	0 Deg C to 50 Deg C
	Storage temperature	-20 Deg C to 60 Deg C
	Relative humidity	10% to 90% RH non condensing upto 30 Deg C
	Power	Batteries- Rechargeable/ Non-Rechargeable
	Battery life	More than 8 hours with laser and backlight on, approximately more than 10 times of above for laser and backlight off, with 100% duty cycle

Item 33: Calibration INST Shaker Table

Shaker Table shall be suitable for field check of accelerometers, velocity transducers and proximity probes over a wide operating frequency and amplitude range. With a simple, easy to use interface, the unit shall be completely self-contained vibration reference source that conveniently validates the entire channel of transducers through measurement

Frequency Range (operating)- 7Hz- 10kHz (420-600Kcpm)
Maximum Amplitude (100 Hz, no payload)- 20gpk

Frequency	Acceleration (Peak or RMS)	Velocity (Peak)	Displacement (Peak to Peak)
CPM Hz	g pk g rms m/s^2 pk m/s^2 rms	in/s pk mm/s pk	mils pk - pk mm pk - pk

Item 34: Intrinsically Safe True RMS Digital Multimeter

1. Display LCD
2. Impact resistant casing
3. Single rotary switch operation
4. Auto polarity
5. Low battery and over range indication
6. Auto power off
7. Power: Battery operated
8. Audio continuity

9. Capacitance, frequency, diode test measurement
10. Transistor testing facility.
11. Resistance measurement facility.
12. Data hold Facility
13. Temperature measurement probe
14. Backlit illumination
15. Accessories: Test leads, operating manual, battery, leather carrying case.
16. warranty : minimum 2 years

DC voltage	Range	0.1 mV to 1000 V
	Accuracy	±0.05% + 1
AC voltage	Range	0.1 mV to 1000 V
	Accuracy	±0.7% +4
DC current	Range	0.1 µA to 10 A
	Accuracy	±0.2% + 4
AC current	Range	0.1 µA to 10 A
	Accuracy	±1.0% + 2
Resistance	Range	0.1 Ω to 50 MΩ
	Accuracy	±(0.2% + 1)
Conductance	Range	60.00 nS
	Accuracy	±(1.0% + 10)
Diode test	Range	2.0 V
	Accuracy	±(2.0% + 1)
Duty cycle	Range	0.0% to 99.9%
	Accuracy	Within ±(0.2% per kHz + 0.1%) for rise times <1 µs
Capacitance	Range	10 nF to 9999 µF
	Accuracy	±(1.0% + 2)
Frequency	Range	0.5 Hz to 199.99 kHz
	Accuracy	±(0.005% + 1)
Temperature	Range	-200°C to +1090°C (-328°F to +1994°F)
	Accuracy	±(1.0% + 10)°C [±(1.0% + 10)°F]
Display counts	6000 counts/19,999 counts in high-resolution mode	
Peak capture	Record transients up to 250 us	
Min/Max/Avg recording	Display signals up to approximately 100 ms	

Safety criteria

ATEX	II 2 G Ex ia IIC T4 Gb
	II 2 D Ex ia IIIC T130°C Db
	I M1 Ex ia I Ma
NEC-500	Class I, Div 1, Groups A-D, 130°C
IEXEx	Ex ia IIC T4 Gb
	Ex ia IIIC T130°C Db
	Ex ia I Ma
GOST R Ex	Overvoltage protection: Measurement Category III, 1000 V, Pollution Degree 2
	Measurement Category IV, 600 V, Pollution Degree 2
	IP rating IP67

5. GENERAL

5.1 i) TRAINING

The bidder's quote shall include 04 Mandays (Two persons for two days) site training to RFCL personnel for control valve & safety valve test jig each

The course shall be conducted at site at a time to be mutually agreed with the successful Bidder at a later date.

It shall be explicitly understood, however, that Purchaser's personnel shall be fully associated during Engineering, Testing and commissioning activities and this opportunity shall be taken by bidder to impart on-the-job training in addition to the course mentioned above.

This course shall be conducted after the equipment shipment to site, at a mutually agreed time.

The training course to be conducted at site, shall be mainly devoted to the operation of equipment, testing of equipment/sub-assembly, preventive breakdown, Trouble shooting and normal maintenance activities. The training imparted shall cover all aspects of each equipment used in the system.

Bidder shall provide comprehensive documentation, course material, manuals, literature etc. as required for proper training of personnel at his own cost. Consolidated and comprehensive documentation shall be available to each participant. After the completion of course, all such materials shall become the property of the RFCL. Bidder shall update the course material of manuals in case there are any changes owing to revisions/modifications in equipment/system specifications.

The training as detailed above shall be considered in the evaluation of the offer.

ii) **PACKING**

All equipment shall be individually packed in suitable containers/crates designed to avoid damage to the equipment during transit and storage in accordance with best commercial practice and with the requirements of applicable specifications. The materials used for packaging, wrapping, sealing, moisture resistant barriers, corrosion preventers, etc. shall be of recognized brands and shall conform to best standards in the areas in which the articles are packaged. The packing shall protect the equipment from impact, vibration, rough handling, rain, dust, damp, insects, rodents, etc. Each container/crate shall be subjected to impact, vibration and other mechanical tests. Each container shall be clearly marked with the following information at prominent places (provided as sample):

RFCL	: M/s RFCL
PROJECT	: Revival of Ramagundam Fertilizer Project (WORKSHOP EQUIPMENT)
DESCRIPTION	:
SERIAL NO. OF EQUIPMENT	:
ADDRESS	:

All equipment shall be tested for damage after their receipt at site by bidder as per RFQ. If any equipment, part, subsystem, component, accessory is found to be damaged during the transit, the same shall be replaced by the Bidder, free of all costs to the RFCL. The bidder shall replace such item as shall be found damaged by bidder or as indicated to bidder, within 30 days of receipt of intimation.

5.2 QUALITY ASSURANCE, TESTING AND COMMISSIONING

A) QUALITY ASSURANCE PROGRAM

Bidder shall submit the details of Quality Assurance Program followed by him beginning with raw materials, active, passive and fabricated components, units, sub-assemblies, assemblies, wiring, interconnections, structures etc. to finished product. Bidder shall obtain and forward the Quality Assurance Program for equipment supplied by Sub-vendor, if any.

The RFCL/EIL reserves the right to inspect and test equipment at all stages of production and commissioning of the system. The inspection and testing shall include but not be limited to raw materials, components, sub-assemblies, prototypes, produced units, guaranteed performance specifications, etc.

For Factory inspection and testing, Bidder shall arrange all that is required e.g., quality assurance personnel, space, test gear etc. for successful carrying out of the job by the RFCL/EIL, at Bidder's cost, at the Manufacturer's works.

RFCL/EIL shall have free entry and access to any and all parts of the Manufacturer's facilities associated with manufacturing and testing of the system at any given time.

It shall be explicitly understood that under no circumstances shall any approval of the RFCL/EIL relieve the Bidder of his responsibility for material, design, quality assurance and the guaranteed performance of the system and its constituents.

B) TEST CATEGORIES, TESTING & COMMISSIONING

i) **Test categories**

The following tests (in the same sequence) shall be conducted for acceptance of the equipment and the system before final acceptance of the system:

- Site Acceptance testing (SAT)
- Trial Run

ii) These tests shall be carried out on all equipment supplied by Bidder.

iii) Bidder shall arrange all necessary test instruments, manpower, test-gear, accessories, etc.

iv) All technical personnel assigned by Bidder shall be fully conversant with the system specifications and requirements. They shall have the specific capability to make the system operative quickly and efficiently and shall not interfere or be interfered by other concurrent testing, construction and commissioning activities in progress. They shall also have the capability to incorporate any minor modifications/suggestions put forward by RFCL/EIL.

v) Power supply and any temporary commissioning facility including communication system required for installation/testing/commissioning of the workshop equipment, shall be arranged by the Bidder.

vi) **Test Plan**

Bidder shall submit to RFCL and PMC `Test Plans' well in advance of commencement of actual testing in each of the above mentioned test categories (refer clause a)).

<u>The plans shall include:</u>

- System, Equipment functional and performance description (in short) and Tests to be conducted and purpose of test.
- Test procedures (including time schedule for the tests) and identification of test inputs details and desired test results.

vii) **Test Report**

The observations and test results obtained during various tests conducted shall be compiled and documented to produce Test Reports by Bidder. The Test Reports shall be given for each equipment/item and system as a whole. The report shall contain the following information to a minimum:

- Test results
- Comparison of test results with anticipated (as per specifications) test result as given in test plans and reasons for deviations if any.
- The data furnished shall prove convincingly that: The

system meets the guaranteed performance objectives.

Mechanical and Electrical limits were not exceeded.

Failure profile of the equipment during the tests is well within the specified limits.

viii) **Failure of Components**

Till the system is accepted by the RFCL, a log of each and every failure of components shall be maintained. It shall give the date and time of failure, description of failed component, circuit, module, component designation, effect of failure of component on the system/equipment, cause of failure, date and time of repair, mean time to repair etc. Repair/modification done at any point of time at one site shall be carried out by bidder at all the sites. Detailed documentation for the same shall be submitted to RFCL for future reference.

If the malfunctions and/or failures of a unit/module/sub-system/ equipment repeat during a test, the test shall be terminated and Bidder shall replace the necessary component or module to correct the deficiency. Thereafter, the tests shall commence all over again from the start.

If after the replacement the equipment still fails to meet the specifications, Bidder shall replace the equipment with a new one and tests shall begin all over again. If a unit/subsystem/module has failed during the test, the test shall be suspended and restarted all over again only after the Bidder has placed the Equipment back into acceptable operation. RFCL's approval shall be obtained for any allowable logistics time required to replace the failed component/unit/module/sub-system.

C) INSTALLATION

Bidder shall include all installation accessories / materials required for proper installation of the equipment.

Bidder’s scope shall include Installation for all equipment which require permanent installation/ fixing. Necessary civil jobs for mounting will be carried out by RFCL for fixing. Required utilities like power, water and instrument air will also be provided by RFCL.

D) PRE-COMMISSIONING & COMMISSIONING

Bidder’s scope shall include pre-Commissioning and functional demonstration for all equipment.

E) TRIAL RUN

Bidder’s scope shall include Trial Run for Control valve & safety valve test jigs. Bidder shall keep the facilities up for 15 days for `TRIAL RUN'.

F) TRIAL RUN

Upon successful completion of the `TRIAL RUN', any shortfalls when compared to the contract shall be made good by the Bidder. For all other equipment full functional tests will be carried out by RFCL for final acceptance

5.3 WARRANTY

The warranty and guarantee must be 18 months from the date of receipt of material or 12 months from the date of satisfactory operation checking/ commissioning whichever is earlier.

5.4 DELETED

5.5 POST WARRANTY ANNUAL MAINTENANCE CONTRACT (PWAMC)

The Bidders shall provide **two years** Post Warranty Annual Maintenance Contract (Comprehensive) as part of their supply, installation and commissioning for the complete equipment system (Control valve & safety valve test jig**.)**

The offer for PWAMC shall be valid for two years from date of expiry of the defect liability period (Warranty period) and the offer for PWAMC for 2 (Two) years **shall be considered in the evaluation of the offer.**

Bidder shall provide total maintenance of the system including all hardware / software, of all the offered items/system of all the workshop equipment.
System bidder shall also obtain PWAMC from OEM for all bought out items. The bid shall be made year wise up to 2 years and the quoted price shall be valid for two years from date of expiry of the defect liability period (Warranty period) .

The PWAMC order shall be placed separately by RFCL, after expiry of warranty period. During warranty period, bidder shall carryout the regular, emergency and software maintenance services as per PWAMC [clause ii below]. Services provided during the warranty period shall be without any additional cost.

Warranty shall cover replacement of any failure components / rectification of any defect at no extra cost and arranging requisite spare parts shall be entirely bidder's responsibility. Any failure to carry out the necessary replacement and rectify the defect during warranty period shall be at the risk and cost of the bidder.

The following are the minimum terms and conditions for the PWAMC:

i) The PWAMC includes complete servicing, regular & preventive maintenance and breakdown maintenance whenever required for the complete system. This also includes all the maintenance spares, test equipments, tools and tackle as required, labors, spares parts which require routing replacement and all consumables (excluding paper, printer cartridge) required for repair or replacement of the all items supplied including bought out item.

ii) Visits

(a) Regular Visits:

The bidder's **certified Field Service** engineer shall visit the site once in three months for routine maintenance, providing guidance to operators as and when required, hardware/software checks/inspections, full system checkouts, preventive maintenance adjustments and carry out corrective actions for the complete system.

It shall include study and advice on daily maintenance, cleaning of hardware, modification/addition related to system/hardware configuration/data base, if any problem is reported, running of equipment, on-line servicing and solving reported problems. Checks shall be conducted on running system.

The hardware/software check shall include minor modifications to improve existing application performance, backup operations and application software updates (latest releases). The duration of stay of engineer shall be limited to 3 days (8 hours per day) per visit. However, if any problem reported is not solved during the visit, engineer shall visit again and the visit shall not be counted as a regular visit.

Identification of any hardware / software modification carried out in the system from the date of last modification and updating of as-built documents, records etc., as and when any modification is carried out or identified shall be bidder's responsibility.

(b) Preventive Maintenance Visits:

The engineers of the suppliers shall visit once in a year for Preventive Maintenance of the complete system subject to availability of shutdown. Client will inform the bidder one month in advance for shutdown dates.

The engineer shall carryout as a minimum complete overhaul of the system, inspection of hardware and software, fault prediction, inspection of power supply quality, environmental and operating condition checks, major repairs /replacement and detailed reporting. This visit is in addition to visit required for periodic maintenance.

(c) Emergency Visits:

The Engineers of the suppliers shall report to site with necessary spares within 48 hours after receipt of a written intimation / telephone call from RFCL for restoring the system. The engineers deputed shall be well qualified and experienced. The system must be brought back within 24 hours after reporting at site.

iii. The bidder shall explicitly define in PWAMC offer, the various checks to be carried out by the engineer for the above listed items during various visit listed herein. Also a standard document consisting of standard procedures and formats for carrying out various activities of Annual Maintenance Contract shall be furnished. These lists of checks are subject to RFCL approval.

iv. Owner personnel will work on system day-to-day basis and wherever possible, owner shall inform the type of failure of hardware /software to bidder based on diagnostic available with the system. However bidder shall be fully responsible to attend and rectify the root cause and the failure at the shortest possible time.

v. Bidder to note that M/s RFCL engineers shall associate with the bidder while carrying out the Post Warranty Maintenance Contract activities. On-job training of these associated engineers shall be covered under this scope.

vi. The service engineer shall maintain a Service Logbook at the site indicating the activities carried out during preventive & breakdown maintenance and also submit service/calibration reports based on the maintenance/repairs carried out, parts/modules repaired/replaced along with fault analysis.

vii. The contract shall include detailed proposal related to Maintenance Services with necessary tools and tackles. Travel, boarding and lodging for service engineer shall be included in this package itself.

Bidder shall furnish a list of spares in the PWAMC offer which shall be maintained by them for owner's review. In event of breakdowns, repairing or replacement should be possible within 48 hours maximum without any lead-time for procurement of spares

5.6 VENDOR DATA REQUIREMENTS

Vendor shall submit various drawings and documents like operation and instruction manuals, catalogues, MTC, performance test certificates, pertaining to various items as per functional requirement. Please refer attached Vendor Data Requirements document also.

All test instruments or part of the equipment used for testing shall have test certificates traceable to NABL.