



SUPPLEMENTAL/BID BULLETIN NO. 04

**SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF VARIOUS
MECHANICAL ENGINEERING LABORATORY EQUIPMENT
ABC: P 29,971,856.00**

This bid bulletin dated March 8, 2019 is issued to clarify, modify or amend items in the Bidding Documents. This shall form an integral part of the Bid Documents.
(Please take note of the items with technical specifications in red font.)

**PUMP (CENTRIFUGAL, PISTON & SELF-PRIMING SIDE CHANNEL PUMP) TEST
RIG – 1 SET**

Technical Description:

The trainer must include two centrifugal pumps, one piston pump as a positive-displacement pump and a self-priming side-channel pump. The side-channel pump must work primarily as a centrifugal pump and, depending on liquid level, can also act as a positive-displacement pump that permits gases to be pumped.

The pump being investigated must pump water in a closed circuit. In the process, the performance data of the pump and pressure losses in the pipeline are recorded.

The centrifugal pumps can also be operated in parallel or in series configuration. Each pump is driven by a separate three-phase AC motor. The speed of the motors for the centrifugal pumps is variably adjustable by a frequency converter. All motors are mounted on swivel bearings, so the torque can be measured by way of a force sensor, enabling the mechanical drive power output to be determined.

The measured values must be transmitted directly to a PC via USB connection thru its data acquisition software. The performance data of the pump and losses in the pipeline must be calculated by the software and represented by characteristic curves.

The trainer set must be equipped with a reversible three-phase AC motor with variable speed.

Learning Objectives:

- Investigation and comparison of the operating behavior of various pump types:
 - centrifugal pumps
 - piston pump (positive-displacement pump)
 - side-channel pump
- Recording a pump characteristic curve
- Recording a system characteristic curve
- Determining efficiency
- Investigation and comparison of parallel and series configuration of centrifugal pumps
- Comparison of pump types

Technical Data:

Centrifugal pumps:

- max. flow rate (Q): 300L/min (or equivalent/better)
- max. head (H): 16.9m (or equivalent/better)
- nominal speed: 2900 per minute

Three-phase AC motor 2x, for centrifugal pump power output: 1.1 kW (or equivalent/better)

Side-channel pump, self-priming, one-stage:

- Q: 83.3L/min, H: 50m (or equivalent/better)
- nominal speed: 1450 per minute
- Three-phase AC motor for side-channel pump power output: 1.1 kW (or equivalent/better)
- Piston pump: 17L/min, H: 60m, Nominal speed: 405 rev per minute (or equivalent/better)
- Three-phase AC motor for piston pump power output: 0.55 kW (or equivalent/better)
- Three-phase AC motor, additional motor, reversible
- Power output: 0.75 kW (or equivalent/better)
- Speed range: 750 to 3000 rev per minute

Measuring ranges:

- flow rate: 0 to 500L/min
- pressure (inlet): -1 to 1.5 bars
- Pressure (outlet): 0 to 10 bars
- Torque: 0 to 15 Nm
- Speed: 0 to 3000 per minute
- Pump electrical power consumption: 0 to 2 kW

Overall dimensions: 2860 L x 1200 W x 1960 H mm

Weight: 430kg

Power supply

Supply 230 or 400V/ 60Hz/ 3-phase
Nominal consumption (output) 5.5 kW

Noise emissions: < 70 dB(A) (or equivalent/better)

Centrifugal pumps: (or equivalent/better)

Type 32-125/116
Rated speed: 2900 rpm
Max. head: 20 m
Max. capacity: 380 l/min

Side channel pump (self priming): (or equivalent/better)

Rated speed: 1450 rpm
Max. head: 25 m
Max. capacity: 80 l/min

Drive motors: (or equivalent/better)

2 x three-phase AC motors, adjustable (for centrifugal pump)
Rated power: 1.1 kW
Rated speed: 1500 rpm
Speed regulated by 100 Hz frequency converter (=> 3000 rpm)

Speed range: 750 to 3000 rpm
1 x three-phase AC motor (for side channel pump)
Rated power: 1.1 kW
Rated speed: 1500 rpm
1 x three-phase AC motor (for reciprocating pump)
Rated power: 0.55 kW
Rated speed: 1500 rpm
1 x three-phase AC motor, adjustable (additional motor)
Rated power: 0.75 kW
Rated speed: 1500 rpm
Speed regulated by 100 Hz frequency converter (=> 3000 rpm)
Speed range: 750 to 3000 rpm
Clockwise / anticlockwise rotation

Reciprocating pump: (or equivalent/better)

Rated speed at 50 Hz: 1400 l/min
Strokes: 369 liters/min
Speed: (For pulleys with effective diameter)
dw = 63 mm and dw = 236 mm results in a translation
belt drive ratio (i): 3.75
Max. head: 60 m (or equivalent/better)
Max. capacity: 17 liters/min

Volumetric flow measurement:

Cross-section: DN32

Max. flow: 500 liters/min

Supply: 230 V

Output: 0 to 20 mA

Speed measurement:

Sensor: Photoelectric proximity switch (or equivalent/better)

Torque measurement:

Measuring range: 0 to 500 N

Supply: 24 V

Output: 0 to 10 V

Lever arm: 0.05 m -> Display: 0-10 N

Intake pressure measurement:

Measuring range: (relative) -1 to 1.5 bars

Supply: 24 V

Output: 0 to 10 V

Delivery pressure measurement: (5x)

Measuring range: 0 to 10 bars

Supply: 24 V

Output: 0 to 10 V

Supply tank:

Content: 320 dm³ (or equivalent/better)

Height difference (z) between pressure sensors:

z Pump 1 0.21 m

z Pump 1 0.21 m

z Pump 3 0.12 m

z Pump 4 0 m

z Pump 5 0.72 m

Pipes:

Pump 1,2 intake side: DN50

Delivery side: DN32

Pump 3 Intake side: DN32

Delivery side: DN32

Pump 4 Intake side: DN26

Delivery side: DN26

Pump 5 Suction side DN32

Pressure side DN32

2.STEAM GENERATOR and AXIAL STEAM TURBINE TRAINER – 1 SET

Technical Description:

The trainer must contain all the components of a real large-scale plant: A once-through water-tube boiler with super-heater, a condenser with water jet pump for vacuum operation, a feed water tank, pumps for condensate and feed water, a steam turbine with dynamometer, shaft sealing with labyrinth and sealing steam.

Features:

- Trainer with electric-powered heater for steam generation
- Condenser as a thick-walled glass cylinder with Water-cooled tube coil and water jet pump for air extraction
- Closed-circuit feed water supply
- Must have the following Faults:
 - Condenser pressure too high
 - Steam pressure too high
 - Gas pressure too low
 - Steam temperature too high
 - Feedwater level too low

- Feedwater flow rate too low

2.1 STEAM GENERATOR MODULE

Dimensions: 1.83 x 0.79 x 1.77 meters

Nominal Consumption Output: 0.9 kW (or equivalent/better)

Water Supply

Cooling water: 300 Liters per hour

Vacuum pump: 240 to 720 Liters per hour

Electrically powered (or equivalent/better)

Boiler / Steam Generator

Heating Capacity: 6kW (or equivalent/better)

Heat-up Time: approximately 20mins (or equivalent/better)

Steam Output: 8 kg/h (or equivalent/better)

Feedwater Tank: 16 liters

Operation Pressure : 7 bar

Electrical Connection: 7kW

Power Consumption: 18A (or equivalent/better)

Voltage: 3 x 230V

Superheater

Electrical power: 750 W

Max. steam temperature: 250 °C

Steam temperature controller: 0 to 240 °C

Condenser

Material: Copper

Tube: 8 mm dia. (or equivalent/better)

Exchange area: 0.0852 m²

Condensate pump

Design: Two diaphragm pump connected in series

Max. flow rate: 18 L/h (or equivalent/better)

Max. under pressure: 200 mbar abs.

Air pump

Design: Water jet pump with non-return valve

Minimum final pressure: 16 mbar

Water consumption: (3.5bar) 330 L/h (or equivalent/better)

Feed water tank Content: 3.9 L (or equivalent/better)

Boiler Pressure relief valve: > 10 bars

Condenser Pressure relief valve: > 1.2 bar

Steam temperature controller

Primary proportional band: 5 to 10

Integral time constant: 5 min

Derivative time constant: 1.25 min

Set point limit: 250 °C

Excess alarm value: 240 °C

Instrumentation (or equivalent/better)

All measured variables must be digitally displayed in the control console and provided with PC data acquisition using the data acquisition software.

- Flow, Pressure and Temperature measurement
- Condenser temperature and pressure
- Cooling water inlet temperature and pressure
- Cooling water outlet temperature and pressure
- Condensate return temperature and pressure

2.2 AXIAL STEAM TURBINE

Dimensions: 1.53 x 0.79 x 1.77 meters

Max. speed: 40,000 per minute

Pressure steam inlet: 0 to 16 bars

Condenser: 0 to 1.6bars

Differential pressure: 0 to 50 mbar

Consumption Output: 0.5 kW (or equivalent/better)

Turbine

Design: Single-stage axial impulse turbine

Vertical shaft and floating bearing of the rotor disc.

Speed: 33,000 per minute

Overspeed: max. 40,000 per minute

Critical bending speed: 48.000 per minute (or equivalent/better)

Steam state at turbine inlet

Pressure: up to 10 bar

Temperature: up to 240 °C

Guide vane system

One Laval nozzle, replaceable

Smallest cross section: 1.3 mm dia., 1.33 mm²

Largest cross section: 2.5 mm dia., 5.72 mm²

Nozzle angle: $\alpha=15^\circ$

Bearing

Stainless ball bearings covered design with lubrication

Shaft seal

Labyrinth seal with sealing steam (or equivalent/better)

Condenser

Material: Copper tube 8 mm dia.

Heat exchanger area: 0.0852 m²

Rotor disc

Stainless steel, milled blades with shrunk on cover ring

Average diameter: 52 mm

Number of blades: 28 (or equivalent/better)

Blade height: 4 mm

Blade pitch: 5,6 mm

Entry angle: $\beta=20^\circ$

Exit angle: $\beta=20^\circ$

Circumferential velocity at nominal speed: 40,000 per minute

Eddy-current brake with strain gauge force sensor

Measuring range: 0 to 50 Newton meter

Speed measurement via photoelectric reflex switch

Measuring range: 0 to 50,000 per minute

Quick action valve / solenoid valve

Design: override piston valve, normally closed

Nominal diameter: DN13

Connection: G1/4 "
Pressure range: 0 to 25 bar
Kv value: 3.9 m²/h
Temperature: -10 to 250 °C

Monitoring equipment

The emergency trip is triggered when the over speed is exceeded.
Trigger speed: less than 40,000 per minute (or equivalent/better)

Instrumentation (or equivalent/better)

All measured variables must be digitally displayed in the control console and provided with PC data acquisition using the data acquisition software.

- Pressure and Temperature measurement
- Turbine inlet temperature and pressure
- Condenser temperature and pressure
- Cooling water inlet temperature and pressure
- Cooling water outlet temperature and pressure
- Condensate return temperature and pressure

3. ICE PLANT TRAINER WITH INDUSTRIAL REFRIGERATION – 1 SET

Technical Description:

Complete Industrial refrigeration Ice Plant Trainer set with ice storage, dry and wet cooling tower, and a circuit with glycol-water mixture.

Must include data acquisition software that will measure and record all required variables which will enable energy balance.

Minimum required experiments:

- Design and operation of an energy-efficient refrigeration system
- Function and operation of an Ice storage plant both for charge and discharge
- Energy flow balance
- Energy transport via different media
- Compression refrigeration cycle in the log p-h diagram
- Function and operation of a wet cooling tower
- Function and operation of a dry cooling tower

Specifications:

- Investigation of the charging and discharging of an ice storage plant trainer
- System must include ice storage, compression refrigeration system, dry and wet cooling tower
- Glycol-water circuits with pumps: cooling of the refrigerant condenser, heating of the refrigerant evaporator, charging/discharging of the ice storage, operation of dry cooling tower
- With water circuit pump to operate the wet cooling tower
- Complete with state-of-the-art instrumentation panel with digital display to measure temperature, pressure, flow rates and power consumption

Technical Data:

Compressor, refrigeration capacity: 1.7kW @ -15/32°C (or equivalent/better)

Pumps (glycol-water mixture)

- max. flow rate: 4.5 cubic meter per hour
- max. head: 5.6 meters (or equivalent/better)

Pump wet cooling tower (water)

- max. flow rate: 4.5 cubic meter per hour
- max. head: 18 meters (or equivalent/better)

Ice store: 150 Liters (or equivalent/better)

Compensation tank: 20L (or equivalent/better)

Wet cooling tower, rated cooling capacity: 12 kW (or equivalent/better)

Dry cooling tower, rated cooling capacity: 13.8 kW (or equivalent/better)

Measuring ranges

- temperature: 12x -20... 100°C, 4x -50... 150°C, 4 x 0-60°C
- pressure: 1x -1... 9bar, 1x -1... 24bar
- flow rate: 3x 100... 1200L/h, 2x 60... 1500L/h, 1x150... 1600L/h, 1x 10... 100L/h (R134a)
- Power: 2250 W

DELIVERY: 180 CALENDAR DAYS

WARRANTY:

FIVE (5) YEARS ON WORKSMANSHIP AND AFTER-SALES SERVICE,

TWO (2) YEARS AGAINST FACTORY DEFECTS

MUST INCLUDE:

ON-SITE INSTALLATION and TESTING


FIVE (5) DAYS RIGID TRAINING FOR FACULTY AND LABORATORY TECHNICIANS


WITH CORRESPONDING LABORATORY EXPERIMENT MANUALS ATTACHED

Important Reminders:

Submission, Receipt and Opening of Bids will be on March 18, 2019 at 10:00 AM.

For guidance an information of all concerned.


ANTONIO B. MERCADO
Head, BAC Secretariat


RANIE B. CANLAS, MSCpE
Chairman, Bids and Awards Committee