**جدول الكميات لمشروع تأهيل بئر عزون الجنوبي**

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**MSc. Hydrological Engineering**

**Electro mechanical works for groundwater well no. 15-17/007 in Azzoun**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Item** | **Description** | | **Unit** | **Unit Price /$US** | **Qty.** | **Total**  **/$US** |
| **Electrical and Mechanical Works:**  The contractor shall submit in his offer and supply maintenance manuals, catalogs, characteristic curves, testing certificates, shipping, lading documents and specifications of pumps, motor, fittings, mechanical and electrical control devices, cables, wiring and all accessories and ancillaries to complete the work. All to be new and not renewed in accordance with the specified specifications. The contractor should verify the design sizes of equipments by conducting field visits to the well and must be before ordering any equipment or materials as follows: the contactor must check and verify and match between the reality and the design quantities (well dimensions, pumping electric data) ,as mentioned in this tender. If he notices any difference or no matching, then he must inform the supervisor engineer and find together a suitable solution to such conditions. This include checking and fitting all dimensions mentioned in the tender as the well's hole diameter, well crookedness, pump diameter, electric connections, cables, pipes diameter, discharge head inlet and outlet. The contractor must check in particular that the size of the hole of the well is enough to install the 5” pumping pipes, and the pump cables together. The data and figures and sizes mentioned in this tender are the best estimate of information we got for this well from **Azzoun Municipality, the well operator technical report submitted by Shreem Company**. The contractor should be responsible technically and financially to verify all the information listed below and supply and install the suitable materials that fit with the reality. All connections including the electrical and mechanical fittings should be according to the instructions of the supervisor engineer. The price of items in this tender include all works (labor and machine) that are required to disjoin the existing mechanical and electrical installations and to supply and install new items as shown below; it includes all types of mechanical and electrical connections and all types of civil works that are necessary to safely test and operate the pumping equipments. | | | | | | |
| 1 | | **Supply and install a** multi stage submersible pumping Turbine complete (pump, screen, shaft bowels, stages, connection head to the 6”/5”,4” pips and, all related accessories all as specified in the technical specifications attached with the tender. The price includes any other works to achieve the required head and quantity and efficiency all according to the Annex.  Current well hole diameter is **10**” and total well depth is **340** meters; and the existing pump diameter is **8"**. The existing pumping pipes diameter is **5"** /**112 m**, and **4”/200 m**; and the existing total length inside the well is approx. **312** meters, it is also intended to increase the pumping pipes to 330 meters. The dynamic drawdown is not known exactly (noticed air pockets in water above 60 m3/hr). Static water level is around **210** meters below surface. The contractor offer for the submersible turbine properties has to fit as follows:   * Liquid water is suitable for domestic and agriculture uses; which is **potable water**. * Design capacity (m3/h): **70** * Design anticipated total head (TDH) (m): Anticipated turbine discharge at TDH at **360 m** * Maximum pump column and discharge head assembly head losses (m): 3 * Shut-off head limits (m):minimum **450m** * Turbine overall efficiency at the intended point is not less than **75%** * **The** motor is permanent magnet type and must withstand static and dynamic inlet pressure minimum **10 bars**. * Minimum bowl efficiency at run out capacity (80 %) * NPSHA at maximum run out capacity (m): 8 * NPSHA at maximum anticipated TDH (m): 5 * Motor and pump operating speed (rpm): 2,900 * Non-overloaded motor. * Max. Pump and motor diameter (in): **8”** * Stainless steel column, stainless steel screen filter * Column pipe and discharge head diameter (in): **5”, 4”** * Cooling using stainless steel shroud **Original** (not local) encases the motor and to direct the water inlet to the pump as to pass from underneath and cool down the motor temperature according to the manufacturer recommendations and up-to pump inlet. * Closed impellers manufactured from bronze and cast iron bowels. * The well pump shall be capable to run on/ off every few minutes with technical warnings and without mechanical faults. * The electrical motor must be supplied with RTD (**PT 100)** temperature protection sensor. The type of motor connection must be suitable to present the motor temperature digitally on control panel. The price include all wiring, PT cables and connections and works required to connect the motor inside the well and the main control panel with the thermistor relay and off-alarm * The price include double thrust bearing to carry axial and lateral loads * Supply and install inductive absorbers (voltage spike and circulating currents) as **CoolBlue -NaLA** noise line absorbers installed directly on the lead wires only between VFD and the system’s electric motor inside the drive cabinet. The number of cores and sizes should be according to the manufactures recommendations. * Contractor has to connect the motor cable and control panel upon his responsibility. Using the flat cables **shielded with galvanized sheets** overall the well depth to prevent cable scratches with well walls and to protect the cable. It includes to carry the insulation resistance with megger. * The motor shall be designed and built for 24-hours **continuous service** at any and all points within the required range of operation without overheating, or cavitations or excessive vibration and strain. * Motor has to be new and furnished with a stainless **steel name plate** with data of the serial no., speed, Kw, input voltage, full load, Hz, power etc.) and motor must be at least 1.25 larger than Pump brake horse power or 1.15 larger than the total Input Horsepower to the Electrical Motor. * The motor shall be permanent magnet and furnished with a removable water block lead assembly to prevent ingress of water and a sand slinger shall be installed where the shaft inters the stator. * The motor shall be filled at the factory with a treated glycol water internal lubricating solution for a maximum reliability and long life. * All works from supplying, installing connecting running and testing are under the contractor's expenses. * All works must be according to the Palestinian standards and engineer’s and manufacturer instructions and the specification and drawings. * The price also includes **any missing works not mentioned to execute this work.** * The contractor must submit the motor specifications, certificate of origin, catalogues and on site testing report which shows that the motor is matching with the manufacturer specifications. * The well pump shall be capable to run at shutoff head for a few minutes without mechanical problems as cavitations and overheating. * The **motor and turbine must fit** with each other according to manufacturers’ instructions. * The turbine torque design and motor design should be **duty inverter** at speed range the design torque values between 1:10 * The price includes supplying and installing all required in **non return valve** (built in) flanges, coupling, reducers, bolts, spacers, sleeves, nuts, etc. to connect between the turbine outlet, turbine column and the rising pipes and discharge head accordingly. The price also includes casting concrete foundation and I steel sections to hold the turbine where necessary. The price includes all repair works as a result of old turbine disjoin or new turbine installation.   The contractor shall do in site testing the turbine in accordance with the performance curve and submitting the test report. Before installing any new materials, the contractor must get the initial records for existing conditions of the well including: the well pumping capacity in m3/hr, water level inside the (dynamic and static). Therefore, the contractor must prepare suitable water meter and water level meter to carry on these measures. Therefore, the price of the turbine includes the costs of all these tests. In case the contractor failed to get these measurements, the turbine price will be less by 30% than the price proposed in his tender. | Lump Sum | 27000 | 1 | 27000 |
| 2 | | **Supply and install submersible electric** cable with the following specifications:  The cable is **flat with a light blue outer sheath**, drinkable conductors for permanent submersion in potable water, to respective depths and up –to 600 meters. It is water resistance tested to the European standard EN 505825-2-21 (AD8 condition complete submersion in water) and meets the requirements of BS 6920, and IEC 60228 covering the suitability of non-metallic materials and products for use in contact with water. The **EPR (Ethylene Propylene Rubber)** insulation and Elastomeric Cross-linked outer sheath should provide a robust and **water-tight** barrier.  The voltage rating is **0.6/1kV** and a temperature rating of -25oC to +90oC. It is suitable for use in water of a maximum temperature of 80oC  the conductor main construction properties are as follows:   * **Class 5** (Flexible Conductor) fine stranded tinned pure Copper * Voltage rating: (0.6/1kv) 600 V between the conductor and earth, and 1000 V rms between adjacent conductors. * Inner Insulation: **EPR** (Ethylene Propylene Rubber) * **Outer sheath/ Jacket**: Elastomeric Cross-linked compound including filler materials   The conductors sizes minimum **3x150**+**1x70 mm2** (or supply and install two cables (two run) with same EPR specifications each one **3\*95 +1\*50** to minimize voltage drop and to fit inside well hole)- (1FL, 3GI3 quality insulation). The contractor must submit his offer based on field visit to the site and decide which option to go. The price of both options is fixed for 350 meters only. The price for this item includes the supply and install of electric conductor (PT cables and connections) between the submersible motor and control panel on the surface to read the motor temperature. The junction box (**Water Proof**) and main connection as shown in the Annex. The cable is fixed to the pipes by stainless **steel clamps each 2 m** with soft rubber underneath **and pvc ties each meter**. The price includes the costs to install cable protection using **galvanized sheets** and encase the cable overall the well depth to prevent cable scratches with well walls and carry the protect the cable to carry the cable insulation resistance with megger and connect to control panel. | M.L | 120 | 350 | 42000 |
| 3 | | **Main Electrical Control Panel Unit (optional)**: Price includes disjoin all the existing electrical connections and cables and panels and supply and install suitable new control panel for pumping **70 m3 @ 36.0 bars**, and installing in the site for the mode of operation, a control board according to the following specifications and supervisor instructions: control panel box shall be made of **three major compartments** and the price for this item include all equipments and works mentioned below: **The first** compartment is for main hour meter and fusses- Main Company Breaker. **The second** compartment is for the **200 hp inverter** as ABB, or equivalent as shown specifications, main breaker as Siemens, contactors, capacitor(s) bank, main cables inlet/outlet.), It shall be **IP66** protected, thermally painted paint as (RAL 7302). All main cables and wiring are inside ducts and must be closed with special plastic cover and protected against human electric shock. **The third** compartment includes all control circuits, and secondary contactor, breakers for the high voltage cabinet or the low voltage. The control panel must be fixed to the wall by six Jumbo screws and laid on a reinforced concrete foundation 40-50 cm above the ground. The contractor should submit **as built drawing** including soft and hard copy drawings. In case the contractor will use any digital control equipment including PLC he must submit the cable, the software, and new version of computer laptop and any other accessories that are necessary to operate and maintain these digital equipment; meanwhile the price for this item includes to train the well’s operator and committee on how to use and program the PLC and control panel and all installed equipment in this tender. The training period should not be less than **9-hours training hours** over three separate days.  The **labeled nameplates** should be mounted at the front of the main board behind the doors and above every switch and group of lamps. Control electric **lamps 24v** must be fixed to control all operation system, the starter shall be used to start, run, stop , protect and control manually and automatically by using the general required installation of the following equipments completely. The price for this item includes:   * The power circuit must consist of the following: **main circuit breakers** MCCB 3**\*300A**, 25KA adjustable one for the **company** and one for **generator** (as MOLLER) **two pieces**. The price includes supplying and installing **manual change over with mechanical interlock** switch 4\***300A**, SOCOMEC type for manual operation. * Bus bar **400A/0.6KV** (3 phases and neutral and earth) * Complete unit 4p \* 20KA **surge arrestors** of replaceable type. With box fuse **3\*110**. * Digital screen inverter **200 hp** see the annex. Solid state frequency converter as ABB type (with **bypass contactor 200 hp** as MOELLER type equipped with over /under load, over temperature and all control system needed with all protections rated at suitable power that matches the pump motor with (0.8-1.2) over load range). The inverter must be programmed to meet with manufacturers obligations for start-up and shut down of the submersible turbine   **Capacitor Banks**: Standby capacitor banks with discharge resistors compensating reactor dry type 400v 50 Hz to reach power factor 0.97 Ducati. Three phase capacitor with resistors **40 KVAR** Ducati type.   * **Digital multi meter** which is able to read directly from a screen (V, Hz, KW, A, PF). * **Low and high voltage, phase sequence and phase failure relay(s)** of best quality as MOELLER. * **On-off push** button set and emergency off button. * **Reset** push buttons red color 22 mm. * **Overload** relay unit rated at 1-1.5 of motor full load including digital motor screen protection control board. * **Temperature relay** unit and rated for the submersible motor. It includes thermal protection relay and thermistor sensor, including cable screened twisted pair (screen earthed at one end only) digital motor screen protection control board with all cables and connections. * HRC fuses **3\*110A** complete Fernaz type. * WHM 50\*50mm. * **24 h clock** with 150 hr mechanical reserve. * Suitable **automatic breaker** **300A** with adjustable thermal and magnetic protection (ISC>=25KA) NZM. * (0-500V) 96\*96mm **Voltmeter** with selector switch between phases and neutral. * (0-300A) 96\*96mm ammeter for the three phases. * 3 phase fuse holders set , 10\*38mm , with suitable fuses , * **Suitable earth leakage relay** class **A (AC and Dc trip).** * Contactor with discharge 40 KVAR Moeller type. * **Running hour** timer * **Manual motor speed** controller and mouthed on outside board (range 0.8-1.2 normal speed) * **On-off** lamps for inside doors cabinets * **Breakers** for service as Siemens type. * **Relays** and timers 24 V for no flow switch and high-pressure, low-pressure sensors, temperature. * Three phase 50 Hz 390V (**KWh-meter**), /5A-200/5 CT’s. The KW-h meter as electromechanical meter or solid state and pre-paid card electric type. * 24V/ 50Hz **indication lam**ps installed in front of the control cabinet.. * 3 position selector switch **A-O-M**. * 220-2\* 12V (AC) **transformer 100VA.** * The price includes **all cables** to be used for control purposes shall have the following cross section: * **(3\*150 mm2 +70 mm2**) for the internal connections inside main board and the contractor has to check and order the exact required length (as item 2 properties). * 1.5 mm2 for the coil driving wheel circuits. * 2.5 mm2 for the circuits of tension measurements. * 1.5 mm2 for the sensors. * 4.0 mm2 for the circuits of intensity measurements. * All terminals shall be carefully protected to assure electrical insulation and protection against human shock. * Switches, measuring instruments, and warning lights shall be installed in the front side of the panel. * The control panel shall be manufactured with enough space **(minimum 40% free space of the total size)** to insure easy maintenance and no interface between the wiring for all circuits. * **All wires must be coded clearly** and fixed with special wire heads to avoid loose connection. * All timers (PSK), relays and contactors shall be of best quality as Siemens * The contractor shall supply any other materials and devices that might be missed here and considered to be essential to complete the work without claiming any changes in unit prices. * The control panel must be equipped with an alarming bell (100 dB at 8 meters distance) and flashing red alarm (should be visible from 300 meter during day). **Alarms for all cases of failure as: voltage drop, low or high voltage or phase failure, phase sequence, high or low pressure and no flow, high temperature etc.** * The control panel **must be equipped with** control circuit for either the probe water sensor or to build digital screen for hydrostatic water level sensor. * **Temperature control** as digital screen * The alarm must be muted with/without general reset and there should a special button in the front door to stop/reset it alone. * Circuits must consist of the all necessary materials to operate and protect the system automatically and manually, the wiring color system, numbering all the components. The price includes the design of the whole system of control the contractor is intending to carry. The contractor should also submit at the end of work a s built drawing.   The control panel deign should include:   * Transformer 230/24V 150VA * Water level relay HK type. * 220V AC /120 Watt and **two fans** with filter in each compartment, one for taking in air and the other for taking out the air with grid ( for the panel) complete with thermostat protection. * SIREN (alarm system)   Alarm system 24V are equipped **ON-delay timers** for :   1. High pressure outlet 2. Low pressure outlet 3. No flow 4. Soft start faults 5. High temperature 6. Low, and high voltage, phase sequence , phase failure  * The price includes **all works, as excavation** works for installing pressure switches, flow switch and level sensor and all the electrical parts with suitable conduits and metal ducts to complete the works. * The price includes installing and testing for the mode of operation all mentioned devices and sensors. The control panel must be equipped with earthling unit so the price includes. * **Earthling**: The price of the control panel includes supplying and installing complete earth unit with earth equalizer compressing C40 box copper B.B. 25 mm2, with minimum two concrete manholes as foundation lines , two earth electrodes, D>19m, L=1.5m and any other missing materials to earth the pumping station . The price includes testing earth unit so as to fulfill the standard requirements (resistance less than 1.5-2 ohm). The across different fittings in the piping system. * The price also include supply all materials (as cables, in-out sockets and install, two outlets as 3-phase complete service unit for the pumping room including Main MCB 5\*20A -10 KA MOLLER type. MCB 2 \*10A – 10KA Moeller type the control * The price include all cable materials and works to conduct the electrical connections of the thermistor sensor inside the motor -(the cable 3x1.5 mm2 , the cable should be of suitable length. Use flexible thermal conduits, cable glands, wire terminals& labeling at both ends and all the accessories needed to complete the work as excavation & backfilling, the cable from the control panel to the head of pump motor. | L.S | 16000 | 1 | 16000 |
| 4 | | **Flow Control switch**: Supplying and installing an electrical flow switch suitable for 6" pipes, powered by a 24v-dc power source. Price includes all cables and protection conduits required to connect it with the control panel, according to the instructions of the supervisor engineer. | Num. | 150 | 1 | 150 |
| 5 | | **Pressure Control switch** Supply and install two pressure switches 1-12 bar powered by a 24v-dc. Price includes all cables and protection conduits required to connect it with the control panel, according to the instructions of the supervisor engineer | Num. | 100 | 2 | 200 |
| 6 | | Supply and install pressure 2" **Relief Valve**, 16 atm, complete, The price includes all 2” piping excavation, cutting, welding, adding screws, bolts and accessories that are needed to assemble the valve and according to specifications in the Annex. The Price also includes supplying and installing 2" coupling, 2”conical record, 2”nipple and 2" gate valve, according to the instructions of the supervisor engineer. | piece | 800 | 1 | 800 |
| 7 | | **Pump lifting and reinstallation**: All works related to disjoin all the existing pumping installations: discharge head, pumping pipes turbine, cables, connections, etc and reinstall the pumping pipes and extension pipes, turbine, cables and all related accessories. The price involves checking and operating the pump after finishing all project works to insure no vibration or unusual sound, according to the instructions of the supervisor engineer. The price includes all machines and labor works related to well's dismantling and installation. | Lump sum | 5000 | 1 | 5000 |
| 8 | | **Pressure gauge**: Supply and assemble pressure gauge, 25 bar with oil liquid Rotal ASME, B40. Price includes excavation, cutting, welding, adding coupling, and accessories that are needed to assemble the gauge, according to the instructions of the supervisor engineer. | Num. | 50 | 1 | 50 |
| 9 | | **Compound air valve**: Supply and assemble 2" compound air valve complete, 16 bar. The price includes excavation, cutting, welding, adding screws, bolts and accessories that are needed to assemble the valve. The valves should be according to specifications mentioned in Annex. The Price also include supplying and installing 2" coupling, nipple and 2" gate valve. | Num. | 400 | 1 | 400 |
| 10 | | **Dresser:** Supply and assemble 6" dresser complete. Price includes ears 60 cm rods and screws, bolts, excavation, cutting, welding, and adding accessories that are needed to assemble the dresser with NP 16 bar. | Num. | 200 | 1 | 200 |
| 11 | | Supply and install a complete 6" cast iron water meter according to ISO 4064 (class B) or equivalent. Capacity 150 m³/hr, 16 bar painted with epoxy coated from both inside and outside, the measuring unit should be removable type without removing the body Price includes excavation, cutting, welding, adding dresser, flanges, screws, bolts, gaskets and adding accessories that are needed to assemble the valve with the dresser. | Num. | 800 | 1 | 800 |
| **Total costs of all materials and works** | | | **Without the optional item** | | | **76600** |
| **Total costs of all materials and works** | | | **With the optional item** | | | **92600** |

**Note: According to the request of Well’s Committee the items of rising pipes is excluded of the tender. Moreover, if the optional item number 3 (control panel) is optional and may excluded and replaced by upgrading the existing control panel. In this case it must match with the new pump and control requirements. Therefore, upgrading the existing control panel has to be done by specialist electro- mechanical engineer; he has to make sure that all protections and devices’ capacitates or sizes (inverter, contactors, breakers, earthing, display screens and wiring.. etc.) are suitable with the new pumping installation.**

**Costs Summary**

|  |  |
| --- | --- |
| **Description** | **Total amount /$US** |
| **All Mechanical and Electrical works for the groundwater well. 15-17/007** |  |
| **Total in words (includes) –$US** | |

**Company / Contractor Name: --------------------------------------------**

**Address: -----------------------------------------------------------------**

**Telephone: -------------------------------------- Fax: ---------------------**

**Signature and Stamp: --------------------------------**

**Date: -----------------------------**

**Annex:**

**General Information well 15-17/007**

Location: Azzoun-Qalqilya District

Coordinates: E= 155413 N= 175003, Z= 229 a.m.s.l

ID Number: **15-17/007**

Total Depth: 340 meters

Static Water Level: 210 meters below surface

Pump Existing Setting: 312 below surface

Diameter of Drilling: 10"

Existing Pumping pipes diameter: (5” /112 m), (4”/200)

Existing Pumping Capacity: 60 m3/hr

**Annex –General Technical Specifications**

**Quality Assurance**

The contractor shall offer new pumps and electric motors suitable for running the pumps from manufacturers specializing in the design and manufacturing of water pumps and electric motors in accordance with international standards for more than 20 years experience. These pumps and electric motors should have been successfully used in the West Bank.

1. All materials and components supplied to this project including pumps, motors, controls, sensors, switches, valves, meters, strainers, fittings, shafts and pipes should pass the quality assurance tests at the factories producing these materials and components in accordance with accepted international standards. The contractor shall supply certificates indicating that the materials supplied have passed such tests.
2. The Contractor shall prove that he has successfully implemented similar works specified in this section in at least 3 other projects.

**Submittals**

* Pump Submittals: Provide shop drawings, pump test results, performance curves, warranty and certificate approving installation for the pump.
* Pump motor submittal: Provide shop drawing, performance characteristics, warranty and certificate approving the installation and suitability of the electric motor for the continuous successful operation of the system.
* Operation and Maintenance Manuals: Provide 4 copies of the Operation and Maintenance manual; containing complete parts list, recommended maintenance schedules and procedures, and guide for operation.
* Contractors shall provide complete submittals for the pumping station and all installations that will be implemented at the well site, including the pipes, valves, fittings and electric control unit, for approval.

**Reference Standards**

In these reference standards, the Palestinian Standards when appropriate to the use shall prevail. However, when the Palestinian Standards do not cover a certain part or activity, the appropriate international standard will be used. Preference will be given to ISO otherwise the US (AWWA, ANSI, ASTM, API, ACI, IEC) or English BS standards will be used. The following is a list of standards related to the work proposed in this project:

* American Water Works Association AWWA C200: Steel water pipe\_6 IN. (150 mm) and larger
* American Water Works Association AWWA C207: Steel pipe flanges for waterworks services – sizes 4 in. through 144 in. (100 mm through 3600 mm)
* American Water Works Association AWWA C508: Swing-check valves for water works service, 2-in through 24 in. (50-mm through 600-mm)
* American Water Works Association AWWA C509: Resilient-Seated Gate valves for water supply services
* American Water Works Association AWWA C512: Air release, air/ vaccum, and combination air valves for waterworks service
* American Water Works Association AWWA C701: Cold-water meters-turbine type, for customer service
* ACIS 301-Standard Specification for Structural Concrete
* AC1 318-Building Code Requirements for Structural Concrete. ANSI/ASTM A36-Standard Specification for Carbon Structural Steel
* ANSI/ASTM A53-Standard Specification for Pipe, Steel, Black and Hot -Dipped, Zinc- Coated, Welded and Seamless
* ASTM D 751 Hydrostatic Burst Test, Section 33, Procedure A ISO 6002-1992: Bolted bonnet steel gate valves
* ISO 5781 Hydraulic fluid power - Pressure-reducing valves, sequence valves, unloading valves, throttle valves and check valves -- Mounting surfaces
* ISO 5752 Metal valves for use in flanged pipe systems -- Face-to-face and centre-to-face dimensions
* ISO 5171 Gas welding equipment. Pressure gauges used in welding, cutting and allied processes
* ISO 4126 Safety devices for protection against excessive pressure
* EN 1074-4 Valves for water supply - Fitness for purpose requirements and appropriate verification tests - Part 4: Air valves
* PSI 186-97: Steel pipes for general use.
* PWA, 2000: Planning and design guidelines “ pumping stations for water”
* PWA, 2003. Construction and installation of pipes in water supply and sewerage trenches.

**Vertical Pump:** Vertical Multi Stage Centrifugal Pump and all the accessories it needs to get a working system with design discharge (Q) at a total pumping (dynamic) head (HT ) as specified in the BoQ for each well . Efficiency of this pump should not be less than 73% at the design point.

**Pump Assembly:** Bowls-Cast Iron A48 Class 30/ DIN GG20, BS 1452 Grade 220, free from blowholes, sand holes and other faults, internally epoxy or porcelain coated, externally coated with backed epoxy. Impellers are of enclosed type and of Zinc Free Bronze unless specified otherwise in the Bill of Quantities. Bowl Bearings- High-lead Tin bronze B584 C937. Turbine Shaft Stainless steel- A582 type 416, with diameter as given in BoQ, Bowl Bolts-SS A276 Type316. Suction Strainer-SS A276 type 316. The recommended maximum outside diameters are defined in the BoQ, the Outside and internal pump diameters and all materials of pump elements and the diameter of the SS- shaft should be clearly identified in the catalogues presented and also in the offer. Out Diameter of pump should be appropriate to the diameter of the well casing, shut off head should be also clearly identified through the H-Q performance curves that should be submitted with the (Efficiency- Q) curves of all pumps.

The pump should be supplied with a pump nameplate easy to read and corrosion resistance containing complete pump information including: pump manufacturer's name, serial number, pump model number, number of stages, speed, total dynamic head and discharge in m3/hr or liters per second the middle design point, year manufactured, etc.

**Electric Motor:** Shall be a vertical hollow shaft 3 phase induction motor with enclosed fan cooling (squirrel cage) with maximum speed n= 1500 r.p.m. rated at an output power according to the BoQ, Supply voltage =380-440 Vrms, inverter duty 50/60Hz, turn down 10:1 Efficiency premium >94%, P.F>0.87. Thrust Load minimum=1.5xRated Load, water proof with high protection degree IP55 and insulation class F, including none –reverse ratchet with all protections needed, suitable to drive the above mentioned pump without over loading, with multiple thermal protection thermestors, space heater (max temp. at well site 46°C), drive shaft, couplings, flanges, nuts, bolts,...etc, and all necessary fittings and cables for installation of the pumping unit. Complete thermal protection unit, complete current overload unit service factor 1.15, double thrust bearing design, spike resistant wiring, and full load efficiency not less than 94%. Steady bushing if needed. It is designed as continuous duty cycle and direct on line start if needed. The maximum number of starts is as NEMA. Maximum altitude is 1000 m above sea level. The column shaft (connecting the pump) shall be directly connected to driver motor by means of an adjustable flanged spacer coupling, suitably sized to transmit the required driving torque and be easily accessible for adjustment, packing or mechanical seal replacement.

**Electric Power Control, Switch and Distribution Board**

The main power control switch and distribution board should be built in a dust tight, water proof IP65 steel sheet cabinet (2mm thick) rust free, factory made with front door and lock (gray thermally painted). The top of the three cabinets should be 180-220cm from finished floor and its base is protected by min 20cm cement block. All wiring, bus bars and marking terminal unit and electric company kWh meter are to be in this power cabinet. On/Off push button, emergency button, warning lamps, alarm, digital multi-meter for measuring Current, Voltages and Power. Cabinet dimensions have to be not less than 30% free space as specified in the BoQ (200 X 180 X 40 cm). The cabinet should include inverter starter (appropriate for the rated motor power and torque) with all protection relays timers, fuses, circuit breakers, bypass contactors and any other components necessary for protection of the 3 phase motor and the pump according to the attached technical drawings and the engineer’s instructions. All circuit breakers must be secured through thermal and magnetic combination action while over load release should be of thermal type with calibration adjustable between 0.8 and 1.5 of the motor full current. Relays, circuit breakers, contactors, timers and any other protection components should be of best quality as Merlin Gerlin, Moeller, ABB , Schneider or other approved equivalent type. Transformer 220/ 2x12Vrms should be included in the control cabinet.

The Cabinet shall be manufactured in approved Factory with at least five similar jobs of the same level

**In addition to the above, the cabinet should include at least the followings:**

**a) Over load protection spikes and loose connections** adjustable 0.8 – 1.5 Nominal motor current, short circuit capacity 4PX20 kA surge arrestors of replicable type.

**b) Protection relays** for: phase failure, phase sequence, short circuit and earth leakage.

**c) Digital multimeter:** Digital screens to be installed on the front door of the cabinet for presentation of the measuring variables : V, A, kW, Hz, PF , Water level above the pump in (m) and pressure in bar at the well ground surface level .

d) **Analogue Multimeters:** Analogue multimeters for measuring the three phase supply voltages and three phase supply currents of the induction motors are to be installed on the front panel of the control cabinet as specified in the BoQ.

**e) Warning lamps** for soft start fault, over load, No flow, High pressure, Low pressure and Low water level in the well and high temperature .

**f) Capacitor bank** with discharge resistors, reactors and contactor operating at 3phase 400V, 50 Hz to improve the power factor of the motor to achieve 0.95 lagging as specified in the. The capacitors have to be connected in DELTA-connection, the capacity of each capacitor have to be based on the supply voltage of 400V(rms-Value).

**g- Earthing unit**: Earth equalizer, Comprising C14 box, Copper B.B. 70 mm2 foundation line 3 earth electrodes (D> 19 mm, L = 1.5m) and any other necessary material or components to achieve an earthing resistance of REarth <1.5 Ohm for the whole pumping station. Earthing unit should be properly connected to the power/control cabinet of the booster pump and to other components according to the technical drawings.

**Accessories:**

**Water Level Sensor if any:** ( Out Diam.<19mm to fit in the 25 /or 32mm PVC sleeve pipe), 4-20 mA with all necessary components for proper operation and the cable (with enough length>180m or as specified ) which includes the wires and thin pipe. The sensor will be connected via its cable with the electric board to measure continuously the water level above the pump. The measured value in m should be shown digitally on the front panel of the control cabinet in accordance with technical specifications and/or engineer's directions. This water level sensor have to be used also for protection of the motor against dry running by switching the motor OFF if the water level above the pump sinks to a definite adjustable limit.

**Pressure Switches:** A set of low and high pressure switches 0-30 bar to be connected with the control panel unit including all required cables and accessories in accordance with drawings and/or engineer’s directions.

**Flow Switch:** Electric flow switch (at least 16bar) suitable for the pipe to be installed in (6” or 4” steel pipes) powered by a 24 V source. Flow switches shall have no moving parts, include 316 Stainless Steel Sensor, suitable for water temperatures up to 40oC, and Pressures of 40 bars or more, Exotic Alloys for Corrosion Resistance including all cables and accessories to connect it to the control unit in accordance drawings and/or engineer’s directions.

**Water Flow Meter:** Turbine water flow meter (6” or 4” as specified in BoQ, cast iron body, at least 16 or 25 bars as BoQ) complete with flanges, gaskets, bolts and nuts all according to AWWA C207, AWWA C701, or appropriate ISO standards. The meter shall have an accuracy of ±1.5% or better, maximum pressure drop at maximum discharge 0.3 bar. Materials: meter housing (cast iron epoxy coated or cast bronze), rotor (thermoplastic or stainless steel), rotor bearing pivots (stainless steel type 316). The standard register is a straight-reading, permanently sealed magnetic drive register. The meter to include an automatic reading through 100 mA @ 24 V ac/dc reed switch, cable length 5 meters and an LCD to display meters reading in SI units.

**Strainers** (cast iron, at least 16/25 bars as BoQ). Strainers body will be made of cast iron. Strainer body will be coated with an epoxy powder minimum thickness 120 microns. Screen shall be made of stainless steel. For maintenance purposes, covers shall be provided to allow ample access to inspection, cleaning and servicing. A drain bend at the bottom of the body, fitted with a stopcock shall be incorporated. Head loss shall not be more than 0.1 bars, when clean, at the nominal flow rate of the control valve or water meter protected by the strainer box.

**One Way (check) Valves**, cast iron, swing type: Check valves shall be swing type and shall meet the material requirements of ISO 5781 or EN 1074-3. The valves shall be iron body, bronze mounted, single disc, 16/25 bars as BoQ working water pressure, nonshock, and hydrostatically tested at a minimum of 36 bars (525 psi). The check valve shall BE:

1. When there is no flow through the line the disc shall hang lightly against its seat in practically a vertical position. When open, the disc shall swing clear of the waterway.
2. Check valves shall have bronze seat and body rings, extended bronze hinge pins and bronze nuts on the bolts of bolted covers.
3. Valves shall be so constructed that disc and body seat may easily be removed and replaced without removing the valve from the line. Valves shall be fitted with an extended hinge arm with outside lever and spring. Springs with various tensions shall be provided and springs approved by the Engineer shall be installed.

**Gate Valves:** (Resilient seated Rising Stem Gate Valves, metal seal, at least 16 bars) complete with flanges, gaskets, bolts and nuts according to AWWA C509, AWWA C207 standards and drawings. The Gate valve shall be of iron body, have flanged ends, and shall be bronze, solid wedge, non rising-stem-type gate valve. The valve shall be rated for 16/25 as BoQ-bar pressure and a minimum of 36 bars test pressure. The valve should have the following characteristics:

1. Valves shall be outside screw and yoke type with rising stem.
2. Face to face metal valves dimension shall conform to ISO 5752 or EN 558-1,2.
3. Bronze gate rings shall be fitted into grooves of dovetail or similar shape in the gates. For grooves or other shapes, the rings shall be firmly attached to the gates with bronze rivets.
4. Hand wheels shall turn counterclockwise to open the valves. Hand wheels shall be of ample size and shall have an arrow and the word OPEN cast thereon to indicate the direction of opening.
5. Stuffing box follower bolts shall be of steel and the nuts shall be of bronze.
6. The design of the valves shall permit packing the valves without undue leakage while they are wide open and in service.
7. O-ring stuffing boxes may be used.

**Analog Pressure Gages (range: 0- 20 bar):** Pressure gauges ( with Analog Scale) shall be manufactured in accordance with ISO 5171 or EN 837-1,2,3 and shall be furnished and installed in each pump suction and discharge nozzle and in accordance with the bill of quantities. Where gauge taps are not available in the pump’s suction or discharge nozzle, the necessary taps in the adjacent piping shall be made for installation of gauge connections. Each pressure gauge should be equipped with a stop valve of the same pressure rating.

**Digital Pressure Measuring Sensor (range 0-20bar).** The designto measure digitally the pressure in the discharge pipe near the well opening. The digital measurement in bar should be indicated at the front panel of the control cabinet. All work should in accordance with these technical specifications, drawings and engineers directions.

**Air Release/ Air Relief Valves:** Air relief valves shall be of the double orifice pattern with cast iron bodies, the inlet flange shall be fitted and drilled in accordance with EN 1074-4. The valves shall be adequately sized for the release of air from the pipeline without restriction of rate of filling or flow due to backpressure. Air shall be allowed to enter at a rate sufficient to prevent excessive reduction of pressure in the pipe during pipeline emptying. The “aerokenetic” type shall be provided, air valves with internal operating linkages shall be avoided. Valves shall be designed to prevent the operating elements being in contact with the pipeline liquid by approved means such as the provision of an auxiliary float and chamber sufficiently large to isolate the orifice valves and seats throughout the rated operational range. Air valves shall be fitted with a separate isolating sluice or gate valve and gearing shall be provided, where necessary, to facilitate operation. EN 1074-4. All air relief valves and associated isolating valves shall be works tested and capable of withstanding the same test pressure as the pipeline or vessel on which they operate. All materials used in the manufacture of the valve shall conform to EN 1074-4.

**Pressure Relief Valves:** It is designedwith adjustable setting to allow pressure relief when pressure exceeds an adjustable setting in accordance with ISO 4126. The pressure/surge relief valve shall be heavily constructed cast iron valve body, with integral end flanges and full unobstructed flow through area. The disc shall be cast iron having a replaceable resilient seat for tight shut-off. The Pivot shaft shall be stainless steel and be a single unit (not stubs), extending through the valve body with a weight and lever mounted on one or both ends. The pressure/surge relief valve shall be adjusted at the factory to hold closed against the normal operating system pressure. When the system pressure exceeds this setting, the surge relief Valve shall open immediately to relieve the pressure rise, but closes slowly at an adjustable rate as the system pressure returns to normal. A heavy-duty oil dashpot system and stainless steel oil reservoir shall be externally mounted on the valve to control the rate of closure, in such a manner, to positively prevent any slam. The closing rate shall be externally and infinitely adjustable thru a

color-coded flow control valve having a locking device to prevent tampering, once the close rate is set. Prior to shipment of the valves the manufacturer shall factory test the valves under the pressure and flow conditions specified above. The manufacturer shall submit to the Engineer with certified copies of the factory test results. Surge relief valves shall be in accordance with ISO 4126 and shall be installed on the plant water lines as BoQ.

The surge relief valve shall be heavily constructed cast iron valve body, with integral end flanges and full unobstructed flow through area. The disc shall be cast iron having a replaceable resilient seat for tight shut-off. The Pivot shaft shall be stainless steel and be a single unit (not stubs), extending through the valve body with a weight and lever mounted on one or both ends.

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**Black Steel Pipes at least 3.96mm Thick** externally painted two faces or coated as BoQ with backed epoxy manufactured in accordance with PSI 186-97 and AWWA C-200 for connecting the riser column pipe through the well discharge head with the valves, switches, meters, strainer , gages and dressers in accordance with BoQ and drawings and engineer's directions. Price includes all jacks, accessories, material, welding, cutting and supports needed to connect and support the pipe in place and its connections. Black steel pipe should have been tested at a pressure of 55 bars or above.

**Seamless Steel Pipes**: ASTM A53 Gr. B Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Seamless cold drawn. Corrosion resistant Nickel–copper alloys length 3 meters per pipes threaded end coupling not less than 15 cm or as Specified in the BoQ. The pipes are Sch40 not less than 7.1 mm thickness. Tensile strength > 415 MPa

**Pumping Shafts if any:** the carbon steel (1040/1045) or stainless steel 304/316 rods are used to transmit rotational torque from the motor and down to the pump bowels. It’s manufactured according ASTM A29, A510 1040. It is composed of minimum corrosion resistant and alloys as iron medium carbon manganese-sulfur-phosphorus. Its tensile strength >620 MPa. Tested for toughness high strength and signs of misalignment.

**Flanged Dresser: 6” and 4”** complete for (16/25 bars) with two tie rods 60 cm long diameter of 5”/8 and 4 ears for each dresser in accordance with drawings and engineers. Material of dresser shall be high strength steel

**Wash Out**: the main wash out end is shown in drawings. The work shall be completed according to the contract condition and the engineer approval. The material needed including a heavy duty 3" flanged cast iron gate valve (16/25 bars, all piping and all accessories, fittings, piping and joints needed as shown in the drawings.

**Mechanical and Electrical Works:**

**General Specifications**: The contractor should attach in his offer type of turbine and details information on it if either imported as foreign turbine. He should include the manufacturer brand name, performance and testing curves (and due point), full specifications of manufacturing materials and dimensions of the stages, bowels, main shaft, retainers, stabilizers, lockers, etc. . The contractor must submit the turbine original performance/testing curve from the company or from an approved turbines test lab. Before installing any new materials, the contractor must get the initial records for existing conditions of the well including: the well pumping capacity in m3/hr, water level inside the (dynamic and static). These tests must be reported before start any import and supply orders. Therefore, the contractor must prepare suitable water meter and water level meter to carry on these measures. The contractor will not be paid any money for taking these records and their cost will be considered as undeclared/indirect costs that are already included in the turbine price.

All fittings in this project must meet the standard specification mentioned in the Annex. The contractor should install them wherever the supervisor engineer decides within each project area and not to claim any variation for that. The installation process includes all works such as excavation in all kinds of rocks and soils, welding, shaping, cleaning the site of work and painting.

The contractor shall submit in his offer and supply maintenance manuals, catalogs, characteristic curves, testing certificates, shipping, lading documents and specifications of pumps, motor, fittings, shafts, , retainers, mechanical and electrical control devices, cables, wiring and all accessories and ancillaries to complete the work. All materials have to be new and not renewed in accordance with the specified specifications. The contractor should verify before ordering any equipment or materials, all dimensions mentioned in the following specifications including the well's hole diameter, pump diameter, columns diameter, discharge head inlet and outlet. The sizes mentioned in this contract are the best estimate of information we got for this well. The contractor should be responsible technically and financially to supply the suitable materials.

**Electric Cable Connection**

**Splicing of electric cable should be done by a qualified person.**

* Use correct electric cable designed for submersible well pumps.
* Peel the coating at the end of the cable and lead line of the motor about 40 mm to expose the copper wire.
* Connect the bare wire about 20 mm long using a crimp link of the appropriate size. Each individual wire should be crimped and insulated individually. Use the waterproof adhesive tape for 3 to 5 layers to wrap the individual connections. The wires should then be bundled together and insulated again using adhesive tape again for 3 to 5 layers ensuring that it is totally waterproof.
* The waterproof adhesive tape should be elongated by pulling in 200% before wrapping it round the wire in spiral advantage method with half of the tape in each round being over-lapped. The shrinkage of the tape will fasten and waterproof the connected cable end better.
* The bare copper wire and adhesive tape should be kept clean.

**Submersible Turbine Pump and Settings**

* Furnish all labor, materials, equipment and incidentals required, install, complete and ready for operation and field test, submersible turbine pump and motor including all details in respect to the setting in the well.
* All necessary and desirable accessory equipment and auxiliaries whether specifically mentioned in this specification or not shall be furnished and installed as required for an installation incorporating the highest standards for this type of service. Also included shall be supervisory services during installation and field testing of each unit and instructing the regular operating personnel in the proper care, operation and maintenance of the equipment.

**Related Work**

* Instrumentation and control work, except as specified herein are included Instrumentation and controls provided in this section shall adhere to Instrumentation and control specifications
* Mechanical work and appurtenances are included
* Electrical work, except as specified herein, is included

**Submittals**

* Submit shop drawings and product data. Submittals shall include the following:
* Certified dimensional drawings of each item of equipment and auxiliary apparatus to be furnished including: pump supports and anchor bolt plans and details.
* Schematic electrical wiring diagram and other data as required for complete pump installation.
* Literature and drawings describing the equipment in sufficient detail. including materials of construction, to indicate full conformance with the detail specifications.
* Total weight of pumping unit as well as weights of individual components
  + **Design Data**

1. Manufacturer's certified rating curves, to satisfy the specified design conditions including operating speed , showing pump characteristics of discharge, anticipated field head, brake horsepower, bowl efficiency and guaranteed net positive suction head required (NPSHR). Curves shall show the full recommended range of performance and include shut-off head. This information shall be prepared specifically for the pump proposed. Catalog sheets showing a family of curves will not be acceptable.
2. Calculations for velocity of flow past the motor based on motor proposed and designated well casing shall be submitted. Should such calculations show a velocity below that required by the motor manufacturer for adequate motor cooling a design of an enclosing flow inducer (suction sleeve/shroud) shall be submitted for approval. In any case of the results of calculations the contractor should install a shroud around the motor according to the standards of shrouds installation. Therefore, the contractor should make this step before he submits his offer to import the suitable submersible pump. These decisions will be considered according to the results of the step draw down test.
   * **Test Reports**

1. Copies of all test data as described above

2. Tabulated data for the drive motors including rated horsepower, full load rpm, power factor and efficiency curves at ½ , 3/4 and full load, service factor and (Kw) input. including when the pump is at its design point. Submit a certified statement from the motor manufacturer that the motors are capable of continuous operation on the power supply without affecting their design life for bearings or windings

3. A schedule of the date of shop testing and delivery of the equipment to the job site

4. Description of pump factory test procedures and equipment

* **Operation and Maintenance Data**

The maintenance instructions shall include troubleshooting data and full preventative maintenance schedules and complete spare parts lists with ordering information

Complete operating and maintenance instructions shall be furnished for all equipment included under this section.

**Reference Standards**

**A**. Design, manufacturing and assembly of elements of the equipment specified herein shall be in accordance with PWA and EU standards.

**Quality Assurance**

* To assure unity of responsibility, the motors shall be furnished and coordinated by the pump manufacturer. The Contractor and manufacturer shall assume responsibility for the satisfactory installation and operation of the entire pumping system including pump, motor, surface discharge head and controls, as specified herein.
* The equipment specified herein is intended to be standard pumping equipment of proven ability as manufactured by concerns having extensive experience in the production of such equipment. Units specified herein shall be furnished by a single manufacturer. The equipment furnished shall be designed, constructed and installed to operate satisfactorily when installed as shown on the contractor submittals.
* Pumps shall be manufactured in accordance with the standards specified herein.
* The Contractor shall be fully responsible for the design, arrangement and operation of all connected rotating components, to ensure operation meets all specified conditions.
* The Contractor shall be fully responsible for all elements of the pump installation and pump setting so that the installation meets the requirements as shown on the contractor submittals and as specified herein including depth of setting, discharge column pipe, column check valve, installation of water level instrumentation and surface discharge head assembly.

**System Description**

The submersible pump, to be installed under this section, is a new pump to be set in a newly extended drilling water supply well.

**Delivery, Storage and Handling**

* All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the unit and equipment are ready for operation.
* All equipment and parts must be properly protected against any damage during shipment. Store the equipment in accordance with manufacturer's recommendations
* Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
* The finished surfaces of all exposed flanges shall be protected by wooden or equivalent blank thongs, strongly built and securely bolted thereto.
* Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
* No shipment shall be made until all required submittals have been approved by the Engineer and shipment approved by the Engineer in writing.

**Maintenance**

Provide a list of recommended spare parts for 1 year operation of the pump, together with the current price of each item.

**Warranty**

* The equipment shall be warranted for a period of one year from date of substantial completion as defined under the General Conditions, to be free from defects in workmanship, design or material. If the equipment should fail during the warranty period due to a defective part(s), it shall be replaced and the unit(s) restored to service at no additional cost to the Owner.

**Pumping Unit Accessories**

1. Low Level No flow Shut-Off

Wire a with a suspended sensor and solid-state relay for low level shut-off and alarm to be installed under this section, shall be as furnished and as specified in the control panel specifications.

**B-** High temperature Shut –off

Wire PT100 cable between, motor and control panel.

**Products**

**General**

* The pumping units shall all be supplied by one manufacturer and shall be complete including pumps, motors, submersible power cable and motor RTDs.
* The pumps, motors, and devices shall be designed and built for 24-hour continuous service at any and all points within the required range of operation, without overheating, without cavitations, and without excessive vibration or strain. All parts shall be so designed and proportioned as to have liberal strength, stability and stiffness and to be especially constructed to meet the Specifications.
* Pump support and surface discharge is to be as shown in the BOQ. Each major piece of equipment shall be furnished with a stainless steel nameplate (with embossed data) securely mounted to the body of the equipment. As a minimum, the nameplate for the pumps shall include the manufacturer's name and model number, serial number, rated flow capacity, head, speed and all other pertinent data. As a minimum, nameplates for motors shall include the manufacturer's name and model number, serial number, KW/horsepower, speed, input voltage, full load amperes, Hz and power and service factors and insulation code.

**Conditions of Operation**.

* The pump shall be designed for the conditions of service tabulated as follows and shall operate within the system head curves as appended. The pump shall have a rising head capacity curve for stable pump operation from the minimum head operating point to the shut-off head.
* Depth of turbine 330 m below surface
* Pumping pipes existing: 5", 4”
* Static water level 210 m below surface
* Dynamic water level during pumping (to be determined during the pumping testy/Step Draw Down Test SDDT)

1. Existing pumping capacity 60 m³/h (according to the results of the SDDT)
2. Hole diameter 10"

**Column Check Valve**

* The pump column shall be equipped with a stainless steel poppet check valve non-spring return located one column pipe joint above pump discharge.
* The check valve diameter shall be x-in and constructed of Type 316 stainless steel with disc and bushings of the same material. Fasteners shall be Type 316 stainless steel. The pressure rating of the valve shall be 1.5 times shutoff head (such as to accommodate the maximum pressure of the pump's total dynamic head through its entire performance curve from shut off run out).

**Design Data**

* Manufacturer's certified rating curves, to satisfy the specified design conditions including operating speed , showing pump characteristics of discharge, anticipated field head, brake horsepower, bowl efficiency and guaranteed net positive suction head required (NPSHR). Curves shall show the full recommended range of performance and include shut-off head. This information shall be prepared specifically for the pump proposed. Catalog sheets showing a family of curves will not be acceptable.
* Calculations for velocity of flow past the motor based on motor proposed and designated well casing shall be submitted. Should such calculations show a velocity below that required by the motor manufacturer for adequate motor cooling a design of an enclosing flow inducer (suction sleeve/shroud) shall be submitted for approval

**Pump Support and Surface Discharge**

* Discharge pipe system shall comply with the requirements specified herein
* Disk dimensions 0.8\*0.8 m thickness 5 cm cover over discharge pipe
* Provide manufacturer's written documentation that all components in contact with water are non toxic and are suitable for use with potable water and meet NSF 61 Certification
* The t pump shall be installed in the well utilizing the existing supporting means including column pipe, surface discharge assembly and all other accessory equipment.
* The plate shall be adapted (cut or drilled) to accommodate the power cable and access tubes.

**Field Testing**

1. After the pump has been completely installed, a test of the equipment shall be conducted by the Contractor under the direction of the Engineer to prove compliance with the requirements set forth for the pump design. An efficiency test of the pump shall also be conducted and the Contractor shall furnish all instruments, meters, gauges and incidentals which may be required for the test.
2. Pump capacity and pump discharge head shall be recorded at a minimum of 5 capacity points along the curve. One of the capacity points shall be within plus or minus 2 percent of the design capacity as shown on the approved shop drawing submittal of a pump curve. The pump at all times shall be operated at plus or minus 5 percent of the design speed
3. Upon recording pump discharge and pressure at 5 capacity points, the pump shall be shut down and the water level recovered within I-in of static levels. At this time, the pump shall be operated within plus or minus 2 percent of the design capacity for a period of I hour. Measurements of pump capacity, discharge head, horsepower input and motor speed shall be made.
4. Pump performance shall be computed from field pump test data. After accounting for field test accuracy, the well pump shall be expected to operate within 5 percent of the approved head capacity curve and not more than 2 percent from the approved efficiency) curve. Correct an) condition to obtain performance equal to these field operating conditions

**Fittings Materials Specifications**

**Check valves**

1. Body: Cast Iron
2. Disc: Cast Iron
3. Cover: Cast Iron
4. Seat Holder Cast: Iron
5. Body Seat Ring: Bronze ASTM B62
6. Disc Seat Ring: Rubber (BUNA-N) ASTM D 2000 AA 7008
7. Hinge Pin: Stainless Steel
8. Plug: Malleable Iron
9. Cover: Bolt & Nut: Steel
10. Seat Holder Bolt: Stainless Steel
11. Cover Gasket: Rubber (BUNA-N)
12. Coating: fusion bonded epoxy inside and outside

**Gate valves none rising stem:**

1. Body: Cast Iron
2. Bonnet: Cast Iron
3. Packing Box: Cast Iron
4. Disc Cast: Iron
5. Hand Wheel: Cast Iron
6. Body Seat Ring: Bronze
7. Disc Seat Ring: Bronze
8. Gland Cast: Iron
9. Stem Nut: Bronze
10. Stem Bronze
11. Bonnet Gasket: steel
12. Packing Box Gasket: steel
13. Bonnet Bolt & Nut: Steel
14. Gland Stud & Nut: Steel
15. Packing Box Stud & Nut: Steel
16. Top Nut: Steel
17. Washer: Steel
18. Packing: Graphite Fiber Commercial
19. Operating Nut: Cast Iron A 126 Class B
20. Coating: Electro statically applied epoxy inside and outside,

**Combination Air Valve**

1. Body: PN21 Sphere Nodular ASTM-536 60-40-18
2. Rolling Seal: Rubber E.P.D.M
3. Clamping Stem: Reinforced Nylon
4. Float: Foamed Polypropylene
5. Base: Brass ASTM B-124
6. O-Ring: Buna-N
7. Cover : PN21 Cast iron ASTM A-48 CL-35B
8. Nozzle Seat: Bronze ASTM B-62 B-271 C83600
9. Nozzle Seal: Rubber E.P.D.M
10. O-Ring: Buna-N
11. Bolt and Nut: Galvanized Steel, Chromate Plated
12. Float: Stainless Steel 304L
13. Body: PN21 Cast iron ASTM A-48 CL-35B
14. Sleeve: Reinforced Nylon
15. Threaded Outlet: Brass
16. 16: Coating: fusion bonded epoxy inside and outside

**Butterfly Valves: (GEAR)**

1. Stem: Stainless steel
2. Body: Cast iron
3. Bushing: Brass
4. O ring: EPDM
5. Bushing (spacer): Polymeric
6. Disc: Stainless steel
7. Liner: EPDM
8. Washer: Bronze
9. Retaining ring: Spring steel
10. Plug: Plastic
11. Coating: Fusion bonded epoxy inside and outside

**Water meter specifications and materials.**

1. Working pressure 16 or 25 bars as required.
2. Max. temperature 60 C
3. Body: cast iron
4. Coating: epoxy
5. Connection: Flanged ends

**Strainers Specifications:**

1. Body: cast iron ASTM 126 class B
2. Cover: cast iron ASTM 126 class B
3. Screen: stainless steel
4. Gasket: Buna -N
5. Plug: steel
6. Bolts: steel
7. Coating: fusion bonded epoxy inside and outside

**Control Valves specifications (float valves and pressure reducing valves)**

1. Connection: flanged
2. Water temperature up to 60 C
3. Working pressure 25 bars
4. Valve body and cover ductile iron (ASTM A-536)
5. Valve internals: stainless steel and bronze
6. Control trim: brass
7. Elastomers: Buna-N
8. Coating: fusion bonded epoxy

**Painting works include** adding two faces (red oxide as priming paint and zinc oxide base oil paint for finish). The pipe surface must be painted with two coats from all sides, particularly lower part to the ground. Therefore, the pipe must hold on supports above the ground minimum 30 cms, and then released to ground down after the paint was dry. Prepare the surface and stir the paint before use or mix using a power agitator. Before applying paint, a thinner liquid has to be added to the pipes surface to clean away oil and grease, use a detergent to remove excess dirt and contaminants. Remove the metallic debris such as mill scale and rust using disc sanders, sandpaper or wire brushes which ensures an adhesive surface.

**Carbon steel line shafts: According to ASTM A576**

**Irrigation Steel Pipes Welded Black Steel Pipes, ASTM A53 or as API5L:**

**A53 Type F**, which is longitudinally furnace butt welded or continuous welded (Grade A only),

**A53 Type E**, which is longitudinally [electric resistance welded](http://en.wikipedia.org/wiki/Seam_welding) (Grades A)

**Solid state frequency inverter**

* Wide Voltage Range: 320 ~ 480V
* Input Frequency Range: 40 ~ 65Hz
* Output Voltage Range: 0 ~ rated input voltage
* Output Frequency Range: 0 ~ 500Hz
* Overload Capacity: 60s with 150% of rated current, 2s with 180% of rated current
* From 0.75 ~ 7.5KW Plastic house; 11 ~ 630KW is metal house
* Control Mode: High Quality V/F Control
* Speed Accuracy: V/F + 0.5% of maximum speed
* 20 channels for frequency setting
* Analog signal: 0 ~ 10V,-10V ~ 10V,0 ~ 20mA.
* Pulse setting input: 0~50 KHz.
* Built-in RS485 communication port
* Solid state programmable screen and PLC configurations
* All model are integrated IGBT
* The malfunction ratio is 0.8% within 24 months warranty