VARIABLE SPEED BOOSTER SPECIFICATION

SECTION 22 11 23.13 - DOMESTIC WATER PRESSURE BOOSTING SYSTEMS

# General

## SUMMARY

### This section includes variable speed, packaged pump station for domestic water applications.

### Sequence of operation

## REFERENCES

### UL Underwriters Laboratory

### ASTM American Standards for Testing Materials

### ASME American Society of Mechanical Engineers

### NSF National Sanitary Foundation

### NEC National Electrical Code aka NFPA 70

### NFPA National Fire Protection Association

### HI Hydraulic Institute

### NEMA National Electrical Manufacturers Association

### ANSI American National Standards Institute

## SUBMITTALS

### Pumps curves with condition point and pump operating capacities shall be supplied.

### Drawings

#### System outline drawing(s) including elevation, plan and detail views shall be provided.

#### Drawings shall include system connection and bolt-down sizes and locations as well as recommended NEC clearances.

#### System drawings/models CAD files in AutoCAD (.dwg), ACIS (.sat) or Revit compatible (.adsk) formats shall be supplied upon request.

#### Wiring diagrams in .pdf format shall be provided.

#### Installation, Operation and Maintenance manuals (IO&M’s) shall be provided for the pump station.

#### A copy of the manufacturer’s certificate of insurance showing as a minimum, general liability coverage of $1,000,000 and an excess liability coverage of $5,000,000.

## QUALITY ASSURANCE

### Manufacturers seeking authorization to furnish their product shall be a registered ISO9001:2008 manufacturer and shall hold a current Quality Management Certificate for the assembly of custom packaged pumping systems and controls for use in commercial, irrigation, municipal, industrial, and fire applications.

### The manufacturer shall have a minimum of 30 years’ experience in the fabrication of packaged pump stations.

### The pump station shall be hydrostatically tested to maximum working pressure (MWP) the station is rated at for a minimum of 1 hour. Maximum working pressure is rated 125psig, 175psig, 230psig or 300psig based on the pump selected.

### The pump station shall be factory run tested to ensure operating performance is maintained at the expected power draw.

### The pump station test facility instrumentation shall be NIST traceable and have current calibration certificates.

### Piping shall be built in compliance with ASME B31.1. Piping shall be fabricated by ASME Section IX certified welders.

### Structural steel weldments shall we fabricated by AWS D1.1 certified welders.

### Welder’s certifications shall be available upon request.

## THIRD Party testing and certifications

### The pump station shall be listed UL/cUL under category QCZJ for Packaged Pump Stations.

### The manufacturer shall be listed under UL508 for the manufacturer of control panels.

### The station shall be certified under NSF/ANSI Standard 61, Drinking Water System Components and NSF/ANSI 372 Lead Content Compliance.

# Product

## Acceptable Manufacturers

### **TIGERFLOW** Systems, LLC (“TIGERFLOW”)

### Preapproved equal

## Station

### The station shall be able to maintain a constant pressure through varying water flow rate, compliant with ASHRAE 90.1 pressure profile using variable speed drives and a pump specific PID control loop.

### The packaged pump station shall consist of:

#### One to eight pumps

#### Check valves located on the discharge branch of each pump

#### Ball isolation valves (up to 2”) for each set of pumps and check valves

#### Lug or grooved butterfly isolation valves (2.5” and above) for each set of pumps and check valves

#### 316 Stainless steel suction and discharge manifolds

#### One pressure transducer per pump located on the station discharge manifold

#### One pressure transducer per pump shall be provided on the suction manifold for applications where the water source is pressured city water. Water probes shall be provided for applications where the water source is an adjacent tank.

#### TEXAN DCP Control Platform

#### ABB ACH-580 Variable Frequency Drives with circuit breaker disconnects on each pump

#### A common base or frame for components listed above

## Components

### Pumps shall be ANSI / NSF Standard 61 and ANSI / NSF 372 approved. Pumps shall be an TIGERFLOW CD Series Model **CDXX-X** with a **X** HP, **TEFC** motor.

### Valve, check, wafer type, 1-1/2”

#### Body, spring retainer, spring, and disc shall be constructed of 316 stainless steel. The valve shall have a maximum working pressure of 600 psig.

#### The check valve shall be non-slam type that begins to close as the forward flow diminishes and fully closes at zero velocity preventing flow reversal and resultant water hammer.

#### The valve shall be ANSI/NSF Standard 61 listed and have a weighted average lead content of <=0.25%.

### Valve, check, wafer type, 2” and larger

#### Body, spring retainer, spring, and disc shall be constructed of 316 stainless steel. The valve shall have a maximum working pressure of 275 psig.

#### The Check Valve shall be of the silent operating type that begins to close as the forward flow diminishes and fully closes at zero velocity preventing flow reversal and resultant water hammer.

#### The valves used in potable water service shall be certified to NSF/ANSI 61, Drinking Water System Components – Health Effects, and certified to be Lead-Free in accordance with NSF/ANSI 372.

#### The valve design shall incorporate a center guided, spring loaded disc and having a short linear stroke that generates a flow area equal to the nominal valve size.

#### The operation of the valve shall not be affected by the position of installation. The valve shall be capable of operating in the horizontal or vertical positions with the flow up or down. Heavy duty springs for vertical flow down installations shall be provided when specified on 14 in. and larger valves.

#### All component parts shall be field replaceable without the need of special tools. Wafer and Globe styles shall be provided with a replaceable guide bushing held in position by the spring. The spring shall be designed to withstand 100,000 cycles without failure and provide a cracking pressure of 0.5 psi.

#### The valve disc and seat shall have a seating surface finish of 16 micro-inch or better to ensure positive seating at all pressures. The leakage rate shall not exceed the allowable rate for metal seated valves allowed by AWWA Standard C508 or 1 oz (30 ml) per hour per inch (mm) of valve diameter.

#### Wafer-style valve seats shall be fully retained with full size threads, and sealed with an o-ring.

### Valve, butterfly, lug-type

#### Body shall be one-piece lug design with extended neck to allow for 2" of piping insulation. A non-corrosive bushing and a self-adjusting stem seal shall be provided. No field adjustment shall be necessary to maintain optimum field performance.

#### Disc edge and hub on metal discs shall be spherically machined and hand polished for minimum torque and maximum sealing capability.

#### Stem shall be one-piece design. Disc to stem connection shall be and internal double "D" design with no possible leak paths in the disc-to-stem connection. External disc-to- stem connections such as disc screws or pins are not allowed. Stem shall be mechanically retained in the body neck and no part of the stem shall be exposed to the line media.

#### Seat shall be tongue-and-groove bonded seat with a primary hub seal and a molded flange O-ring suitable for weld-neck and slip-on flanges. The seat shall totally encapsulate the body isolating it from the line media and no flange gaskets shall be required.

#### Valve shall have a maximum working pressure of 250 psig. Valve shall be tested to 110% of the rated pressure.

### Valve, ball, 1-1/4” and smaller

#### Ball valves shall be 2-piece full port design constructed of forged copper silicon alloy brass body and end adapter.

#### Seats and stem packing shall be virgin PTFE. Stem shall be bottom loaded, blowout proof design with fluorocarbon elastomer O-ring to prevent stem leaks.

#### Ball valve shall have chrome plated brass ball and adjustable packing gland.

#### Valve sizes 1⁄4" – 2" shall be rated to 600psig (41 bar) WOG non-shock. Valves shall be certified to NSF/ ANSI standard 61/8.

#### Valve shall have a weighted average lead content of <=0.25% with respect to wetted area.

### Piping

#### Manifolds shall be constructed of either 316 stainless steel. Manifolds shall have a maximum working pressure of 300 psig.

#### Manifolds shall be grooved at both ends to allow change of suction and discharge connection geometry in the field.

#### Main and branch piping shall be sized for a maximum velocity of 10 ft/s.

### HYDRO-PNEUMATIC TANK (OPTIONAL)

#### Provide a Section VIII, ASME Code, National Board stamped, hydro-pneumatic tank. Tank shall be provided complete with a NSF approved replaceable bladder, bottom connection, air fill valve, tank drain valve and gauge. Tank shall be: (Model TF-132E, 132 gallon, 150 PSI) (Model TF-185E, 185 gallon, 200 PSI).

#### The hydro-pneumatic tank shall be mounted adjacent to system with a minimum 1” feed line and full port ball valve on the pump station discharge header or shall be remote mounted as shown per drawings. \* If the tank is adjacent mounted, it shall be the responsibility of the installing contractor to provide the feed line between the system tank feed valve and tank connection. If the tank is remote mounted, it shall be the responsibility of the installing contractor to provide the feed line, isolation valves, and any other necessary appurtenances between the tank and building piping.

### VARIABLE FREQUENCY DRIVES (VFD)

#### The VFDs shall be ABB ACH-580 variable frequency drives

#### Each drive shall have integrated circuit breaker disconnects

#### The VFDs shall have Bluetooth connectivity for remote monitoring and full diagnostics and troubleshooting

#### The display keypads shall have customizable displays including no less than the suction pressure (when a suction transducer is used), discharge pressure, pump frequency, pump power, and pump status.

#### The drives shall have variable speed cooling fans for improved noise control and energy utilization.

#### The drives shall be 100 kAic rated for short-circuit current rating (SCCR)

#### Drives will be configured to provide the following operating features:

#### Drive keypad will have manual, off and automatic mode selection and will accessible to operators without opening an enclosure.

#### When in automatic, drive will run upon closure of the respective run permissive contact

#### When in automatic and with a run permissive signal, drive speed will responded to a 0-10 V DC speed reference signal from pump controller.

#### Drive will provide a limited number of automatic resets for fault conditions and will maintain a history of faults.

### Controls

#### The controller shall be the **TIGERFLOW Texan DCP** platform consisting of the following:

#### Single point power connection

##### NEMA 4 lockable enclosure

##### Common alarm relay with dry contacts for customer monitoring.

##### An alarm horn with indicating light, a minimum sound level of 85 db, annunciating all alarm conditions

##### The panel shall be listed under UL/C-UL 508 and meet NEC (NFPA 70) requirements.

#### Redundant master control

##### The drives shall be able to rotate the master role due to drive failure or loss of power for complete redundant control. As long as 1 drive remains operational, the booster system shall run in automatic mode without the intervention of the operator.

#### Automatic fine-tuning for site conditions

##### The control platform shall be able to automatically calculate the minimum frequency at which the pump produces flow based on the site pressure setpoint and the available suction pressure at the station.

##### If the pressure setpoint or the suction pressure available changes, the system will automatically recalculate the minimum frequency without the need of a user-input adjustment.

#### Fault protection

##### The controller shall be able to provide as a minimum alarms and fault protection for the following conditions:

##### low flow or no flow

##### Low suction pressure

##### Low system or discharge pressure

##### Pump failure

##### VFD failure

##### Overload alarm

##### Undervoltage

#### System monitoring

##### The control panel shall display the following items on a single screen; output frequency, output current, reference signal, drive name, time, and operating mode (Hand vs Auto, Run vs Stop). Bi-color (red/green) status LED shall be included. Drive (equipment) name shall be customizable.

### BAS/BMS Communications

#### The booster shall be capable of BAS/BMS communication through Modbus TCP, Modbus RTU, BACnet MST, or BACnet/IP communication protocols.

#### The following event reporting shall be provided via BAS communication:

##### Individual VFD run and alarm status

##### Phase Loss Alarm

##### Individual Pump Run

##### Individual Pump Fault

##### Individual Pump Hand/Auto status

##### Low System Alarm

##### Low Suction alarm

##### High System Alarm

##### Individual Discharge Pressure Sensor Failure

##### Individual Suction Pressure Sensor Failure

### PUMP SEQUENCING

#### Lead and lag pumps are staged On and Off based on pressure, maintain a consistent pressure through variable flow demand. The system must have field adjustable settings and have programming to prevent short-cycling and premature pump failure.

#### TIGERFLOW “TEXAN DCP” Technology: The booster system controller shall monitor the pump frequency and compensate for varying friction losses in the system as described in ASHRAE 90.1.

#### The system must be able to alternate pumps based on true run time.

#### The system control algorithm shall use a speed adjust curve calculation proportional response. Step response algorithms shall not be considered equal.

### INSTRUMENTATION

#### Transducer wetted parts shall be a 300 series stainless steel.

#### Transducer shall output a 4-20 mA signal with a minimum accuracy of +1%.

#### Transducers shall be provided for each pump to provide full redundancy.

### VARIABLE SPEED DRIVES

#### The drives shall be ABB ACH-580, no substitutions.

#### The drive package as specified herein and defined on the drive schedule shall be enclosed in a UL Type enclosure (enclosures with only NEMA ratings are not acceptable), completely assembled and tested by the manufacturer to ISO9001 standards.

#### All drives shall utilize the same Advanced Control Panel (keypad) user interface.

##### Plain English text

##### The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable).

##### Safety interlock and run permissive status shall be displayed using predetermined application specific nomenclature, such as: Damper end switch, smoke alarm, vibration trip, and overpressure.

##### Safety interlock, run permissive, Supervisory, external fault status, drive name, drive fault contact info and override shall have the option of additional customized project specific terms, such as: AHU-1 End Switch, Office Smoke Alarm, CT-2 Vibration.

##### The control panel shall include at minimum the followings controls:

##### Four navigation keys (Up, Down, Left, Right) and two soft keys to simplify operation and programming.

##### Hand-Off-Auto selections and manual speed control without having to navigate to a parameter.

##### Fault Reset and Help keys. The Help key shall include assistance for programming and troubleshooting.

##### Multiple Home View screens shall be capable of displaying up to 21 points of information. Customizable modules shall include bar charts, graphs, meters, and data lists. Displays shall provide real time graphical trending of output power, frequency, and current within selectable intervals of 15/30/60 minutes and 24 hours.

##### There shall be a built-in time clock in the control panel. The clock shall have a battery backup with 10 years minimum life span. Daylight savings time shall be selectable.

##### I/O Summary display with a single screen shall indicate and provide:

##### The status/values of all analog inputs, analog outputs, digital inputs, and relay outputs. Drives that require access to internal or live components to measure these values, are not acceptable.

##### The programmed function of all analog inputs, analog outputs, digital inputs, and relay outputs.

##### The ability to force individual digital I/O high or low and individual analog I/O to desired value, for increased personal protection during drive commissioning and troubleshooting. Drives that require access to internal or live components to perform these functions, are not acceptable.

##### The drive shall automatically backup parameters to the control panel. In addition to the automatic backup, the drive shall allow two additional unique backup parameter sets to be stored. Backup files shall include a time and date stamp. In the event of a drive failure, the control panel of the original drive can be installed on the replacement drive, and parameters from that control panel can be downloaded into the replacement drive.

##### The control panel shall display local technical support contact information as part of drive fault status.

##### The control panel shall be removable, capable of remote mounting.

##### The control panel shall have the ability to store screen shots, which are downloadable via USB.

##### The drive shall generate a QR code, which contains drive identification data, information on the latest events, and values of status and counter parameters.

##### The LCD screen shall be backlit with the ability to adjust the screen brightness and contrast, with inverted contrast mode. A user-selectable timer shall dim the display and save power when not in use.

##### The control panel shall include assistants specifically designed to facilitate start-up. Assistants shall include: First Start Assistant, Basic Operation, Basic Control, and PID Assistant.

##### Primary settings for HVAC shall provide quick set-up without the use of alpha-numerical parameters, for commissioning the drive and customer interfaces to reduce programming time.

##### The drive shall be able to operate with the control panel removed.

##### **The drive shall be able to support a Bluetooth Advanced Control Panel. The Bluetooth control panel shall be FCC and QDL (Qualified Design Listing) certified.**

##### **A free app (iOS and Android) shall replicate the control panel on a mobile device or tablet. The control panel’s programming and control functionality shall function on the device. Customizing text, such as AHU-1 End Switch, shall be supported by the device’s keyboard.**

##### Bluetooth connectivity shall allow uploading, downloading, and emailing of parameter sets.

##### Bluetooth connectivity shall include two pairing modes: Always discoverable with a fixed passcode, and manual discovery with a unique generated passcode every pairing.

##### Bluetooth connectivity shall be capable of being switched

##### At a minimum, the drives shall have internal impedance equivalent to 5% to reduce the harmonics to the power line. 5% impedance may be from dual (positive and negative DC link) chokes, or AC line reactor. Drives with only one DC link choke shall add an AC line choke integral to the drive enclosure. Reference the drive schedule to determine if additional harmonic mitigation is required for the system to comply with IEEE 519-2014. The drive shall have cooling fans that are designed for field replacement. The primary cooling fan shall operate only when required and be variable speed for increased longevity and lower noise levels. Drives whose primary cooling fans are not variable speed, shall include a spare cooling fan.

##### The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 135% overload for 2 seconds every minute. The minimum current rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors.

##### The input current rating of the drive shall not be greater than the output current rating. Per NFPA 70 430.122, drives with higher input current ratings may require the upstream wiring, protection devices, and source transformers to be upsized.

##### Circuit boards shall be coated per IEC 60721-3-3; Chemical gasses Class 3C2 and Solid particles Class 3S2.

##### Earth (ground) fault detection shall function in both modulating (running) and non-modulating modes.

##### Coordinated AC transient surge protection system consisting of 4 MOVs (phase-to-phase and phase-to-ground), a capacitor clamp, and internal chokes. The MOVs shall comply with UL 1449 4th Edition. Drives that do not include coordinated AC transient surge protection shall include an external TVSS/SPD (Transient Voltage Surge Suppressor/Surge Protection Device).

##### Disconnect – A circuit breaker or disconnect switch shall be provided when indicated on the drive schedule. The disconnect shall be door interlocked and padlockable. Drive input fusing shall be included on all packaged units that include a disconnecting means. All disconnect configurations shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508A label. Disconnect packages manufactured by anyone other than the drive manufacturer, are not acceptable.

# execution

## Installation

### Installation of the system shall be performed by the contractor/subcontractor following the manufacturer’s recommendations and shall meet applicable federal, state and local codes.

### Coordination of building trades and subcontractors and compliance with federal, state, and local codes shall be performed by the contractor with unit responsibility.

## Start-Up

### A factory authorized representative shall perform the booster system start-up, including the verification of proper installation, and fine-tuning of operating parameters if needed.

### During start-up, the station shall be tested for start and stop conditions, pump condition point and full station flow.

## WARRANTY

### The packaged booster system shall have a manufacturer’s 24-month warranty.