water and wastewater control solutions

HEALY-RUFF

Engineering Guide Specification

HTC300 – Hydro pneumatic Tank Control

Revised: September 2013

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"HTC" Controller Engineer's Guide Specification

Control Type: Pump In Controller
File Name: SPC-HTC300-130627
Create Date: June 27, 2013
Last Revision: 1.0

Critical Notes – Read This First

1. The following specification allows you to tailor the specification to the Available Options of an "HTC" controller. ***Modification of this specification beyond the available options defined in this specification turn this into a much more expensive custom control panel.***

2. Horsepower Limitations
    a. Starters are not available in this configuration. Consult factory sales for a specification with power equipment. *Please provide horsepower and voltage data with your request.*

Standard Equipment Outline

1. UL Type 4 Painted Steel Enclosure (16"H x 14"W x 8"D)
2. UL 508 A Label
3. Control Circuit Breaker
4. Micro V-PAC II Controller
5. 0-200 PSI Transducer (Start pumps on pressure)
6. Integral float column (stops pumps on level)
7. 30 amp field terminals (#10 - # 26AWG)
8. Fused Analog Loops (2)
9. Low Suction Cutout Current Loop (requires optional transducer)

Optional Equipment Outline

1. Enclosure Heater (Required where ambient temperature reach 32° F or lower)
2. Float Column for Separate Mounting
3. Remote Web Hosting – monitor the process remotely via the internet with **icontrol**

Specification Modification Instructions

1. In general when you see a ___ line we are expecting you to insert a number or finish a word in the case of ___ plex the word should end up being simplex or duplex.

2. Instructions are shown in *italics.* Instructions are provided to help you select options. In general they should be deleted when you are finished with the specification.

3. You will also need to delete this line and all text above it.

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1. General
   01. Intent
      A. The Contractor shall furnish, install, and place into successful operation a system designed to automatically control the operation of ___ pumps as required to maintain the correct air to water ratio in the hydro-pneumatic tank.

   02. References
      A. The entire system shall be constructed in strict accordance with the latest published standards of NEMA, IEEE and ANSI. Wherever possible, control system components shall be Underwriters Laboratory listed. All control hardware and software shall be factory assembled, wired and thoroughly tested prior to shipment.

   03. 3rd Party Approval
      A. The control panel shall be built by a listed UL 508 Industrial Control Panel builder. Each control panel shall bear a serialized "Enclosed Industrial Control Panel Label." The control panel submittal shall contain a copy of the front page of the control panel builders UL508A standard that shows their UL file number. The name on the front page of the UL Standard shall match the name in the title block of the control panel submittal.

   04. Experience
      A. All of the equipment listed herein shall be furnished by a single supplier with at least ten (10) years experience in furnishing comparable systems and shall be of the latest and most modern design. The supplier shall be responsible for the correct operation of the equipment as specified.

   05. Submittal
      A. The Contractor shall submit six (6) complete sets of the following information for the Engineer's approval:
         1. Dimension drawings, wiring and/or hydraulic drawings for field and pipeline mounted equipment.
         2. Fabrication and nameplate legend drawings
         3. Internal wiring and piping schematic drawings
         4. System operational description

   06. Equipment Supplier
      A. The equipment described below is a standard product of the Healy-Ruff Company LLC. The purpose of specifying this equipment was to establish a minimum standard for the equipment to be provided.

   07. Construction Standards
      A. Wire Numbers – Each wire in the control panel shall be marked with a wire number that corresponds to the page and ladder rung of the schematic diagrams. A unique wire number shall be provided between component contacts and coils. Wire markers shall be Brady Thermatab or equal by Grafoplast or Thomas & Betts.

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B. Color Coding – Wires shall also be color coded as follows: 120 VAC Line = black; Neutral = white; Ground = green; Switched 120 VAC = red; + 24 VDC = blue, - 24 VDC = blue w/stripe, Foreign voltage = yellow, Intrinsically safe = light blue.

C. Component Identification – Each component in the system shall be identified by a unique number that corresponds to its coil's page and ladder rung location on the schematic drawings.

D. Wire – AC control conductors shall be 600 volt and a minimum of 18 gauge. DC control conductors shall be a 300 volt and a minimum of 18 gauge. Control conductors shall be UL Type MTW rated for 105^{o} C. Analog conductors shall be 22 gauge shielded twisted three conductor rated for 300 volts. Wire shall be Beldon 8771 or equal. Shields shall be grounded at the PLC or panel location. Power conductors shall be sized per UL and NEC standards and rated for 600 volts. Conductors shall be UL Type MTW, THHN or THWN rated for 90^{o} C.

E. Control Terminals – All field control conductors shall be connected to terminal blocks. Terminals shall have machine marked wire numbers. Connection of field control conductors directly to control panel components will not be allowed. Terminal blocks shall be rated for 30 amps at 600 volts. They shall be screw terminal type capable of terminating 10 to 26 gauge wire. Terminal bridge bars shall be provided when it is necessary to bridge multiple like terminals together. Terminals and accessories shall be Phoenix Contact "Clipline" or equal by Allen Bradley or Weidemueller.

08. Standard Product

A. The product defined in this specification shall be a standard cataloged product of the manufacturer. A custom "one of a kind design" shall not be considered equal.

B. A standard product shall be defined as a group of open-architecture components assembled and programmed to a predefined documented standard with standard schematics and O&M manual, and at least 20 previous installations.

C. The product shall be a "factory stock" item available for immediate shipment.

09. Description of Operation (*If you are specifying a simplex control system delete this text and paragraphs A.3, A.5.f, A.5.k, & A.5.m below.*

A. Automatic Level Control Sequence of Operation

1. A pressure transducer and level sensor shall continuously monitor the pressure and level in the hydro-pneumatic tank. The controller shall be capable of adding air or venting air as required maintaining the correct air to water ratio in the hydro-pneumatic tank.

2. When the tank pressure falls to the start lead pump setpoint, the lead pump shall be called to start. If the capacity of the lead pump is greater than the water demand of the system, the level in the tank will rise and the lead pump shall stop when the level reaches the pump stop elevation.

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3. If the capacity of one pump running is less than the system demand, the 1st lag pump will start when the system pressure drops to the 1st lag pump start setpoint. The lead and 1st lag pumps shall run in parallel until the level in the tank rises to the pump stop elevation.

4. If the capacity of two pumps running is less than the system demand, the 2nd lag pump will start when the level drops to the 2nd lag pump start setpoint. All three pumps will run in parallel until the level in the tank rises to the 2nd pump stop elevation.

5. When the pump stop float opens the system shall check the tank pressure and call for the air add or air vent circuit to add or subtract air from the system as required maintaining the optimum air to water ratio.

6. The following system setpoints shall be provided:
   a. High Pressure Alarm & Cutout
   b. High Pressure Restore
   c. Air Add
   d. Air Vent
   e. Start Lead
   f. Start 1st Lag
   g. Start 2nd Lag
   h. Low Pressure Alarm
   i. Low Suction Pressure Restore
   j. Low Suction Pressure Cutout/Alarm.
   k. Pump No.1 Failure Timer
   l. Pump No.2 Failure Timer
   m. Pump No.3 Failure Timer
   n. Pump No.1 Start Delay Timer
   o. Pump No.2 Start Delay Timer
   p. Pump No.3 Start Delay Timer
   q. High Pressure Alarm Delay Timer
   r. High Pressure Alarm Restore Delay Timer
   s. Low Pressure Alarm Delay Timer
   t. Low Suction Pressure Restore Delay Timer
   u. Low Suction Pressure Cutout Delay Timer

B. Interlock and Failure Circuits

1. If the respective pump running signal input is not received within 30 seconds (adjustable) of the pump being called to start, a pump failure alarm shall be displayed on the operator interface. The respective pump shall be removed from the alternation scheme and the next pump in sequence shall operate in its place. The pump shall remain cutout until the failure condition has cleared and the operator interface reset button is pressed.

2. *Delete this sentence and the next one if you want low suction cutout protection. If you <u>do not</u> want low suction protection delete this paragraph completely.* A pressure transducer shall continuously monitor system suction pressure. If the suction pressure falls below the low suction

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cutout setpoint, all pumps in the system shall be cutout and an alarm shall be displayed on the operator interface. The pumps shall remain cutout until the suction pressure rises to the low suction pressure restore setpoint.

3. If the hydro-pneumatic tank pressure rises above the high-pressure cutout setpoint, all pumps in the system shall be cutout and an alarm shall be displayed on the operator interface. All pumps shall remain cutout until the system pressure drops below the high-pressure cutout restore setpoint and the operator interface reset button is pressed.

10. Operator Interface Features
    A. Normal Operation
        1. The main screen shall indicate the system pressure and include screen navigation menu options.

        2. Secondary screens shall be included to indicate suction pressure and pump status for each pump.

        3. The controller shall be provided with Pump Status screens that provide the following information and control options:
            a. Pump Status (Off, Called, Running, & Failed)
            b. Failure Reset Button
            c. Today's Run Time 99.9 Hours
            d. Today's Starts 999
            e. Yesterday's Run Time 99.9 Hours
            f. Yesterday's Starts 999
            g. Total Run Time 99999.9 Hours
            h. Total Starts 999999

    B. User Interface Menu
        1. A "Menu" screen shall be provide access to an intuitive menu that allows the operator to:
            i Enter setpoints & change pump sequence
            ii Access active alarms and alarm history
            iii Access the password protected system setup
            iv Login to access system setup

        2. System Setup
            a. A separate password protected Setup button shall be provided to allow the operator to change the system setup parameters. The following parameters shall be provided:

                i Transducer Range (System and suction pressure)
                - The operator shall be prompted to enter the maximum pressure range of the transducer in PSI. Once entered the controller shall automatically scale all setpoints and displays in the controller without further operator intervention.

                ii Low Suction Cutout Protection
                - The operator shall be prompted to answer a yes or no question to enable low suction cutout protection. When enabled the low suction cutout setpoints shall be active.

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iii Alternation

- The operator shall be prompted to answer a yes or no question to enable alternation. If the operator selects Yes, the pumps will be automatically alternated after each complete operating cycle. Additionally the operator shall have a choice of selecting automatic or a fixed sequence from the normal operation setpoint menu. If No is selected the pumps will be called to start in their numeric sequence (1,2 or 1,2).

iv Pump Failure

- The operator shall be able to enable or disable pump failure control logic. If enabled the pump failure timers shall be adjustable from the setpoint menu. If disabled the pump failure timers and the reset buttons shall be inactive and the pump failure alarm messages shall be disabled.

v Air Add Air Vent Selection

- The operator shall be prompted to select Air Add or Air Vent from the menu. The system will operate a relay to add or vent air at the pump stop level based on this selection.

3. Alarms and Historical Events
   a. When an alarm is activated it shall be time stamped, date stamped and displayed on the screen until the operator acknowledges it. The main screen shall be displayed after the alarm is acknowledged. The alarm may be reset at any time once the alarm condition clears.

   b. A historical screen shall provide time and date stamped alarm activation, alarm acknowledgement, and alarm reset event historical data for the most recent 64 events. Arrows shall be provided as needed to page up or down to access these events.

2. Hardware and Software
   A. Operator Interface
      1. General – The operator interface shall be a 128 x 64 backlit LCD graphic display. A library of scalable graphics including pilot lights, push buttons, multi-position selector switches, numeric and ASCII data entry, 360° rotary gauges, bar graphs, analog gauges, animated Bitmaps, trending- capable of 10mS updates, alarm summary and alarm history, removable memory monitoring and management, scalable fonts and importing any True Type Fonts from development PC, and Language translation.

      2. It shall include ten programmable soft function keys, an Esc key, Enter key, and four soft menu keys.

      3. Environmental Ratings & Agency Approvals – The operator interface shall be suitable for Type 12, 4 & 4X environments. Additionally the front panel shall be manufacture from a UV resistant polyester substrate.

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4. Security – A four level, multi user security system shall be available for use by the owner. The control system supplier shall provide the owner with a suggested security program in the submittal stage of this project.

B. PLC

1. Processor and memory – The PLC Processor scan rate shall be 1.2 ms/K of memory or faster. Total available program memory shall be no less than 256K. Memory structure shall support monitoring of at least 5000 I/O points. A 256 MB removable mass storage device shall be provided to store the operating program and historical data.

2. I/O – In its base form the controller shall be provided with 8 standard digital inputs, 4 high-speed counter inputs, 6 relay outputs each with independently isolated contacts and 4 analog inputs. A CAN port shall be provided to interface with a wide variety of I/O expansion modules, and other V-PAC controllers. I/O expansion modules and V-PAC controller may be located locally or distributed up to 6,000' from the controller without the need for special line conditioning, amplifiers or other devices.

3. Communication I/O & Protocols – Each controller shall include two active RS-232/RS-485 serial ports in addition to the CAN network port. Supported protocols shall include: Modbus RTU Master/Slave, DF1, SNP and serial ASCII in and out. A control algorithm shall be supplied that supports store and forwarding of Modbus RTU addresses through multiple sites. When enabled, this communication feature shall allow the Modbus RTU Master to communicate with blocked or distant remote sites.

02. Relays & Timers

A. Control relays shall be rated for general purpose duty. They shall have four single pole double throw contacts. Contacts shall carry a UL inductive and resistive rating of 5 amps at 240 volts. They shall have a mechanical life expectance of 50,000,000 operations and an electrical life expectancy of 200,000 operations with a 3 amp120 VAC load. A LED shall be provided to indicate relay coil status.

B. Time delay relays shall be rated for general purpose duty. They shall have four single pole double throw contacts. Contacts shall carry a UL inductive rating .8 amps and a resistive rating of 3 amps at 240 volts. They shall have a mechanical life expectance of 50,000,000 operations and an electrical life expectancy of 200,000 operations with a 3 amp120 VAC load. LEDs shall be provided to indicate "power on" and timing "out." The timing range shall be adjustable from .1 second to 10 minutes.

C. All relays and timers shall be mounted on DIN rail with 14 blade sockets.

03. Level Sensor & System Pressure Transducer (*If the level control float will be mounted on the HTC controller delete this sentence and the last sentence of paragraph A below. If the level control float will be mounted on the HTC controller delete this sentence and the second sentence of paragraph A below.)*

A. The level control shall consist of 3" diameter float in cast iron housing with a magnetic linkage to control the stop switch. The float switch assembly shall be mounted on the bottom of the control

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enclosure. The float switch shall be provided with a separate NEMA 3R steel enclosure. Packing glands shall not be allowed. The float switch shall be mounted at the tank stop level elevation.

B. An integral pressure transducer rated for NEMA 4 and IP 65 appicaitons shall monitor system pressure. The transducer shall provide a 4- 20 mA dc output to the controller. Transducer shall, respond to pressure fluctuations in less than 500 microseconds, include EMI/RFI protection, survive reverse polarity connection and be accurate to +/- 1% FSO. Wetted material shall be 300 series stainless steel.

04. Enclosure
    A. All of the above equipment shall be mounted in or on a NEMA 4 painted steel enclosure. Enclosure color shall be ANSI 61 gray. The enclosure back plate shall be painted steel. A padlock hasp shall be provided on the enclosure door.

05. Suction Pressure Transducer (*Delete this paragraph if low suction cutout protection is not selected/required).*
    A. The pressure transducer shall be provided in a NEMA 4 non-metallic enclosure with bulkhead process connection. The transducer shall provide a 4- 20 mA dc output to the controller. Transducer shall, respond to pressure fluctuations in less than 500 microseconds, include EMI/RFI protection, survive reverse polarity connection and be accurate to +/- 1% FSO. Wetted material shall be 300 series stainless steel.

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