

# Pacific Shellfish – South Bend, LLC – Operation and Maintenance Manual

## Wastewater System

### **WAC 173-240-150(2)(a) - The names and phone numbers of the responsible individuals.**

Chris Jones, Divisional Operations Manager – (360) 765-2245

Jenn Allison, Assistant General Manager – (360) 942-7825

Amy Wentworth, Director of EHS – (503) 905-4276

### **WAC 173-240-150(2)(b) - A description of plant type, flow pattern, operation, and efficiency expected.**

Pacific Shellfish – South Bend, LLC (Facility) is a processor of prepared fresh and live oysters. The Standard Industrial Classification (SIC) code is 2092. Raw product delivery is taken from commercial fishing vessels and trucked in shells from other locations, cleaned, and sorted. Cleaned oysters are either packed on ice live in the shell or shucked onsite before being packaged in containers. Finished product is shipped by truck for distribution.

Process wastewater from the Facility is generated by equipment cleaning, shell washing operations, and precipitation contact with uncovered, contained outdoor areas. The collection system consists of a primary collection sump that collects wastewater from the process areas of the main building, the shell conveyor, and the shell washing operation area to settle solids from the wastewater. Wastewater is pumped from the collection sump over a hydrosieve to remove solids. The screened water flows into the recycle/treatment tank where chemical treatment is injected to reduce fecal coliform. The treated water is pumped and recycled as shell wash water that then feeds over the hydrosieve. As the volume of water in the recycle/treatment tank increases, water will feed over a weir to the discharge pipe. The discharge pipe contains a port for sample collection and a totalizing effluent flow meter with data logger prior to the outfall. After the flow meter the wastewater discharges to the Willapa River.

As part of the upgrades, process wastewater generated at the Facility is now recycled to the shell washing operation. Wastewater generated from the shell washing operation represents the most significant portion of wastewater previously discharged from the Facility. It was pumped from the river and is a suspected source of fecal coliform. Recycling the wastewater will allow continuous disinfection for fecal coliform removal and a significant reduction of the volume of wastewater discharging from the Facility through the outfall.

### **WAC 173-240-150(2)(c) - The principal design criteria.**

The following are the criteria developed for the design of the wastewater treatment system at the Facility:

- Prevent unnecessary introduction of bird droppings into wastewater collection streams to reduce fecal coliform concentrations
- Limit long term ponding and/or contact of wastewater with solids on unpaved surfaces
- Capture precipitation falling on the shell conveyor
- Treat wastewater to meet the Permit Limits for fecal coliform
- Provide a means of recording volumes discharged to reliably report maximum daily flow

**WAC 173-240-150(2)(d) - A process description of each plant unit, that includes function, relationship to other plant units, and schematic diagrams.**

*Refer to Appendix A: Plans and Specifications Submittal for Wastewater Modifications Coast Seafoods Company, South Bend, Washington*

**WAC 173-240-150(2)(e) - An explanation of the operational objectives for the various wastewater parameters, such as sludge age, settleability, etc.**

It is the Facility's responsibility to maintain compliance with the permit limits set by the Washington Department of Ecology. The limits we must strive to achieve are:

Effluent Limitations: Outfall #001		
Parameter	Average Monthly	Maximum Daily
Flow, GPD	175,000	175,000
Temperature, °C	18	18
Total Suspended Solids, lbs/ 1,000 lbs product after shucking	36	45
Oil and Grease, lbs/ 1,000 lbs product after shucking	1.7	2.2
Fecal Coliform, # of colonies/100 mL	200	400
Effluent Limitations: Outfall #001		
Parameter	Average Weekly	Total Average Weekly
Equivalent Oxygen Demand (EOD)	15 µg/L	199 µg/L
Effluent Limitations: Outfall #001		
Parameter	Minimum Daily	Maximum Daily
pH	6.0	9.0

**WAC 173-240-150(2)(f) - A discussion of the detailed operation of each unit and a description of various controls, recommended settings, fail-safe features, etc.**

*Refer to Appendix A: Plans and Specifications Submittal for Wastewater Modifications Coast Seafoods Company, South Bend, Washington*

**WAC 173-240-150(2)(g) - A discussion of how the facilities are to be operated during anticipated startups and shutdowns, maintenance procedures, and less than design loading conditions, so as to maintain efficient treatment.**

*Refer to Appendix A: Plans and Specifications Submittal for Wastewater Modifications Coast Seafoods Company, South Bend, Washington*

**WAC 173-240-150(2)(h) - A section on laboratory procedures that includes sampling techniques, monitoring requirements, and sample analysis.**

Note: Permit requirements have been summarized below. Personnel should refer to the official permit for a comprehensive overview of all permit requirements.

Monitoring Requirements:

Category	Parameter	Units	Sample Point	Minimum Sampling Frequency	Sample Type
Wastewater Effluent	Flow	GPD	Outfall	Daily	Metered
Wastewater Effluent	CBOD5	mg/L	Outfall	Weekly <sup>1</sup>	Grab
Wastewater Effluent	Ammonia (NH <sub>3</sub> -N)	mg/L	Outfall	Weekly <sup>1</sup>	Grab
Wastewater Effluent	pH	Standard Units	Outfall	Monthly	Grab
Wastewater Effluent	Temperature	°C	Outfall	Monthly	Grab
Wastewater Effluent	Oil & Grease	mg/L	Outfall	Monthly	Grab
Wastewater Effluent	Fecal Coliform	Colonies/100mL	Outfall	Monthly	Grab
Wastewater Effluent	Total Suspended Solids	mg/L	Outfall	Monthly	Grab
Production	Product after Shucking	lbs/day	N/A	Daily	N/A
<sup>1</sup> These parameters must be analyzed weekly and reporting during the months of July, August, and September.					

1. Wastewater sampling is performed monthly during production by QA personnel or another trained individual. Grab sampling is conducted for samples.
2. Weekly, during July to September, grab samples are collected for Carbonaceous Biochemical Oxygen Demand and ammonia.
3. Sample analysis for Total Suspended Solids, Oil & Grease, Fecal Coliform, Biochemical Oxygen Demand, and are conducted at the below certified lab:

Dragon Analytical Laboratory  
627 Durell Rd SE, Suite B105  
Tumwater, WA 98501

4. Grab sampling is conducted on-site for pH and temperature using a handheld meter by the QA Manager or other trained individual. Results are maintained on the Sump Water Report.
5. Documentation for sampling is maintained by the QA Manager. A Chain of Custody is filled out with each sample submitted to the lab.

**WAC 173-240-150(2)(i) - Recordkeeping procedures and sample forms to be used.**

A maintenance log specific to aspects of the wastewater system will be maintained on-site for five (5) years in the QA office. Template forms can be found in *Appendix B*.

**WAC 173-240-150(2)(j) - A maintenance schedule that incorporates manufacturer's recommendations, preventative maintenance and housekeeping schedules, and special tools and equipment usage.**

Task	Frequency	Special tools	Equipment Usage
Visually inspect, and if needed, clean the Andritz hydrosieve	1/day	N/a	Screen solids from wastewater
Drain AMT 394A-95 pump when subject to freezing temps. Plug.	As needed, when subject to freezing	N/a	Pump from primary sump to screen
Clean suction line strainer for AMT 394A-95 pump	1/month	N/a	
Vacuum dirt accumulations around vent openings of AMT 394A-95 pump	1/month	N/a	
Check electrical connections of AMT 394A-95 pump	1/month	N/a	
Check AMP 394A-95 pump for proper operation	1/day	N/a	
Drain MP Pumps Chemflo 5 pump when subject to freezing temps; or introduce sufficient antifreeze	As needed, when subject to freezing	N/a	Pump from recycle tank to shell wash
Clean Teledyne Isco Sampler	1/month	N/a	Sample wastewater
Replace pump tube on Teledyne Isco Sampler	As needed, after 500,000 pumps	N/a	
Replace discharge tube on Teledyne Isco Sampler	As needed	N/a	
Replace or renew internal desiccant of Teledyne Isco Sampler	As needed	N/a	

Documents discussing manufacturer's recommendation for maintenance are included in *Appendix C* for applicable equipment.

**WAC 173-240-150(2)(k) - A section on safety.**

Safety of our employees is a top priority. No employee shall be required to perform an activity that they feel is unsafe or outside their comfort range.



Each employee is trained on the Emergency Action Plan and Safety programs. These programs are managed by the QA Manager.

The sump and recycle tank are confined spaces. The sump is to remain covered at all times unless cleaning or maintenance work is being conducted on it. The recycle tank lid is to remain closed at all times unless cleaning or maintenance work is being conducted on it. If work needs to be conducted inside either the sump or tank, all OSHA requirements will be followed.

The treatment chemical for the wastewater will be handled following all safety precautions outlined in the safety data sheet for the chemical in use.

**WAC 173-240-150(2)(I) - A section that contains the spare parts inventory, address of local suppliers, equipment warranties, and appropriate equipment catalogues.**

Spare Parts Inventory:

None

Address of Local Suppliers:

Andritz Hydrosieve:

Andritz Separation  
1010 Commercial Blvd. South  
Arlington, TX 76001

AMT 394A-95 Pump:

Ferguson Plumbing  
1520 W Wishkah St  
Aberdeen, WA 98520

MP Pumps ChemFlo 5 Pump:

MP Pumps  
34800 Bennett Fraser  
MI, 48026-1686

Teledyne Isco Sampler:

Whitney Equipment Company Inc.  
16120 Woodinville-Redmond Rd NE Ste 3  
Woodinville, WA 98072

Equipment Warranties:

Andritz Hydrosieve: Used, no warranty

AMT 394A-95 Pump: 12 month limited warranty

MP Pumps ChemFlo 5 Pump: 12 month limited warranty

Teledyne Isco Sampler: One year limited warranty

Documents discussing warranties are included in *Appendix C for applicable equipment*.

Equipment Catalogues:

Andritz Hydrosieve: <https://www.andritz.com/group-en>

AMT 394A-95 Pump Website: <http://amtpumps.com/site/>

MP Pumps ChemFlo 5 Pump Website: <https://mppumps.com/>

**WAC 173-240-150(2)(m) - Emergency plans and procedures.**

Emergency response procedures are outlined in the Spill Prevention and Countermeasure Control (SPCC) plan and the Stormwater Pollution Prevention Plan (SWPPP) located on site.

In general, discharges from the site will be controlled by the safest and most practical means available, using the following procedures.

1. Stop and control the discharge by either turning valves off, blocking a leak, or ceasing wastewater-producing activities in the plant.
2. Cover the catch basins or drain with spill control mats or surround with absorbent booms to prevent liquids from entering the storm water management system.
3. Build barriers or dams with booms or absorbent to prevent the spill from spreading.
4. Absorb spilled material with absorbent or pump the material into empty drums.
5. Spill cleanup materials (including any contaminated soils) will be characterized and sent offsite for appropriate disposal according to State and Federal regulations.
6. Correct or repair the equipment or container to eliminate the condition causing the release.
7. As needed, perform the appropriate agency notifications. Call Southwest Region Ecology office at (360) 407-6300 and the Washington Emergency Management Division at 1-800-258-5990 and the National Response Center at 1-800-424-8802

*Appendix A: Plans and Specifications Submittal for  
Wastewater Modifications Coast Seafoods Company,  
South Bend, Washington*



September 12, 2017

Don Reif  
Environmental Engineer – Water Quality Program  
Department of Ecology  
PO Box 47775  
Olympia, WA 98504-7775

**Re: Plans and Specifications Submittal for Wastewater Modifications  
Coast Seafoods Company, South Bend, Washington**

Dear Mr. Reif,

On behalf of Coast Seafoods Company (Facility), SLR International Corporation (SLR) has prepared the following Plans and Specifications submittal to the Washington State Department of Ecology (Ecology) to meet the requirements of WAC 173-240-140 in support of modifications to the Facility wastewater treatment system described in the approved December 2016 Engineering Report. The Engineering Report was prepared in response to the Ecology Water Compliance Inspection Report (Inspection Report), dated October 11, 2016.

The following cites the requirements in WAC 173-240-140 (shown in grey italic text) and summarizes the information provided in this letter and its attachments.

**WAC 173-240-140**

***Plans and specifications.***

*(1) Upon request of the owner the department may, at its discretion, allow submission of conceptual plans for industrial facilities, as noted in WAC 173-240-110(5). Two copies of the plans and specifications must be submitted to the department for approval before the start of construction.*

*(2) The plans and specifications shall include the following information together with any other relevant data as requested by the department:*

*(a) Repeat presentation of the basic engineering design criteria from the engineering report.*

The following are the criteria developed for the wastewater modifications at the Facility as presented in the Engineering Report:

- Minimize introduction of bird droppings into wastewater collection streams to reduce fecal coliform concentrations
- Limit long term ponding and/or contact of wastewater with solids on unpaved surfaces

- Capture precipitation falling on the shell conveyor
- Treat wastewater to meet the Permit Limits for fecal coliform
- Provide a means of recording volumes discharged to reliably report maximum daily flow

Table 1 below presents statistical representations of Permit Limit exceedances with maximum sample results from July 2011 to May 2016.

Table 1: Fecal Coliform Permit Limit Exceedances:

FECAL COLIFORM EXCEEDANCES		AVERAGE MONTHLY	MAXIMUM DAILY
Number of Exceedances Reported on DMRs		32	25
Permit Limit	# col/100 mL	200	400
Average Exceedance		17,142	21,856
Maximum Exceedance		280,000	280,000
Median Exceedance		1,400	1,800
85 <sup>th</sup> Percentile Exceedance		22,700	28,000
Required Reduction from 85 <sup>th</sup> Percentile Exceedance		99.1%	98.6%

*(b) If there are any deviations from the concepts of the engineering report, an explanation of the changes that includes as much detail as would have been provided in an engineering report.*

- No deviations from the concepts of the approved Engineering Report are anticipated

*(c) The plan and section drawings of major components, such as the treatment units, pump stations, flow measuring devices, sludge handling equipment, and influent and effluent piping. Foundations or soil preparation or both should be shown for major structures.*

- The process flow diagram provided in the approved Engineering Report has been updated for clarity and included in the Plans & Specifications submittal package
- The following detail drawings are included in the Plans & Specifications submittal package:
  - Spray bar collection detail (Figure 5)
  - Conveyor collection trough detail (Figure 6)
  - Recycle tank detail (Figure 7)
  - Wastewater collection slab and foundation design detail (prepared by MET Engineering PLLC)

- Manufacturer cut sheets for the following equipment have been provided:
  - Hydrosieve
  - Recycle tank
  - Sump and recycle tank pumps
  - Level Sensors
  - Digital Controller
  - Autosampler
- Detail drawings include:
  - Material specification,
  - Notes regarding construction methods and sequencing, and
  - Required inspections (as necessary)

*(d) A general site drawing that shows the location with respect to the entire plant site and a detailed site drawing that shows the component siting.*

- The site location map and site plan drawings (Figures 1 & 3) provided in the approved Engineering Report have been included in the Plans & Specifications submittal package

*(e) A schematic drawing that shows flows that include: In plant collection, and wastewater pumping, treatment, and discharge.*

- The process flow diagram provided in the approved Engineering Report has been updated for clarity and included in the Plans & Specifications submittal package

*(f) A hydraulic profile that shows head under maximum flows. This requirement may be waived where the three step submission of documents has been waived under WAC 173-240-110(5).*

- A hydraulic grade line drawing (Figure 4) has been prepared and included in the Plans & Specifications submittal package

*(g) Instrumentation, controls, and sampling schematics.*

- The process flow diagram provided in the approved Engineering Report has been updated for clarity and included in the Plans & Specifications submittal package
- A control narrative has been prepared and included in the Plans & Specifications submittal package

*(h) General operating procedures, such as startup, shutdown, spills, etc.*

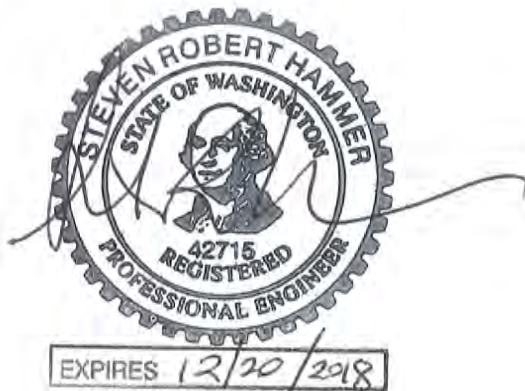
- System startup and shutdown procedures are described in the control narrative.

- Spills of floating liquids will be retained in the sump by the maximum drawdown level above the pump; this function will be included in the site SPCC Plan and the Operation and Maintenance Manual required by WAC 173-240-150
- Construction activities (mobilization, demobilization, laydown, protection of existing features, etc.) have been addressed by general construction notes (Figure 0) submitted under WAC 173-240-140 (2) "any other relevant data as requested by the department"

The P.E. seal by Steven Hammer of SLR applies to the environmental engineering facets of the design only. Structural engineering design for the slab and foundation was completed by MET Engineering PLLC of Aberdeen, WA, and has been sealed by the P.E. who completed that design.

If you have any questions, please feel free to contact us at 503-723-4423.

Sincerely,  
**SLR International Corporation**



A handwritten signature in black ink, appearing to read "Justin Moman".

Steven Hammer, P.E.  
Principal Engineer

Justin Moman, P.E.  
Associate Engineer

cc Tony Dal Ponte  
Max Hepburn  
Michael Roberts

Enc Figures  
Manufacturer Cut Sheets  
Foundation Details  
Control Narrative

## WASTEWATER TREATMENT EQUIPMENT AND CONTROL NARRATIVE

### Summary

The process wastewater treatment system (WWTS) at the Coast Seafoods facility is designed to remove solids, treat for fecal coliform, and maintain discharge to the Willapa River (River) to within Permit limits. The major components of the system include:

- Collection Sump & Pumps
- Hydrosieve
- Recycle / Treatment Tank & Pumps
- Disinfectant Treatment Unit
- Autosampler
- Discharge Flow Meter
- Meter Head / Data Logger
- Outfall
- River Make-Up Water System

The following narrative describes wastewater collection and treatment equipment, as proposed for installation at the facility:

Process wastewater from the Coast Seafoods facility (Facility) drains through pipes below the main building into an existing collection sump (Sump) near the shell wash hopper. This vault also collects process wastewater and incidental runoff from the spray bar / shell conveyer trough and the paved area surrounding the shell washing hopper.

Wastewater collected in the Sump is transferred to the hydrosieve by submersible trash pumps for solids removal before draining to the recycle / treatment tank (Tank) upon which the hydrosieve is installed. In addition, wastewater collected from the Shell Wash Hopper (Hopper) is collected at the sieve and plumbed directly to the hydrosieve, bypassing the Sump. Solids removed by the hydrosieve are collected in a portable bin and disposed as solid waste.

Wastewater in the Tank is treated by injection of disinfectant by a disinfectant treatment unit into the Tank. The disinfectant reduces fecal coliform concentrations in wastewater. The treated wastewater is recirculated to the Hopper, using existing piping currently used to supply river water to the shell wash operation. Recycling of the wastewater to the hopper results in continuous disinfection of the recycled wastewater and also reduces the volume of wastewater generated by displacing the need for river water in the shell wash operation.

River make-up water is supplied as necessary through the existing intake pump and piping. Check valves are installed to prevent backflow of river water into the Tank; river water is only pumped up to the Hopper.

Following treatment of the wastewater within the Tank, the treated wastewater is either utilized in the shell wash operation, as described, or when the Tank is receiving high enough flows of wastewater from the Sump, discharged to the existing outfall to the River through an overflow in



# WASTEWATER TREATMENT EQUIPMENT AND CONTROL NARRATIVE

(continued)

the Tank. Wastewater discharging to the River is sampled via the autosampler and flow data is collected from the flow meter head by the data logger.

## General Description of Equipment and Instrumentation

Float-type level switches and analog level sensors will be monitored to effectively move process wastewater through the system and control pump operations. Monitoring equipment will be located in the Sump and the Tank. Pumps will be new self-priming centrifugal pumps installed in parallel to a common header with intakes located in the Sump and Tank. All pumps will be controlled by Variable Frequency Drives (VFD). The control system may provide data logging functions to assist in operation and maintenance. This function may also be used for required monitoring sufficiently to meet permit conditions.

## General Description of Control Scheme

1. The WWTS will be controlled by monitoring equipment to control pumping operations at the Sump and Tank.
2. A series of pumps will be operated to move water through the system at the required flow rate to minimize pump cycles and limit discharge to the River by recycling wastewater to the shell wash operation.
3. Level switches and analog level sensors installed in the Sump and Tank will be monitored to control pump operations and speeds to move wastewater through the system and to the outfall.
4. The disinfectant treatment unit will provide chemical injection to the Tank to treat for fecal coliform in wastewater recycled to the Hopper and discharged to the outfall.
5. The river water supply piping will be modified to transfer treated wastewater to the shell wash operation, allow incidental use of the existing river water intake for make-up wash water, and to prevent discharge of wastewater through the intake pipe.
6. Wastewater discharging to the outfall will be sampled by the autosampler to meet permit conditions.
7. The discharge flow meter will be monitored to log the discharge to meet permit conditions.
8. The WWTS will undergo commissioning to ensure that all equipment is correctly calibrated and operational according to the system design.
9. All equipment to be certified by all applicable codes, standards, and certifications.

## System Component Operations

### Pumps

Duplexed pumps to alternate operation based on run cycles and/or level demand as determined by monitoring of the analog level sensor. Float-type level switches to be used as redundant monitoring parameters to control pump operation and to indicate upset events. The pump switch will occur as determined by on-site staff. The switch shall not be made if a pump is running, but shall be made the next time the pump cycles off. One VFD to be used to run both

# WASTEWATER TREATMENT EQUIPMENT AND CONTROL NARRATIVE

(continued)

pumps and the power from the VFD to be switched with motor rated relays or other approved method.

## Collection Sump & Pumps

1. Process wastewater enters the Sump.
2. Main sump pump activates as the level in the Sump reaches the preset pump activation level and water is transferred to the hydrosieve for solids removal.
3. Pump speed to be adjusted by the VFD as determined by the level sensor and shall not exceed the maximum effective flow-through rate of the hydrosieve.
4. Pumping activity ceases when the maximum preset drawdown is indicated by the level sensor.
5. The preset speeds of the VFD to be determined by the system flow characteristics and the pump motor requirements, but is not anticipated to be lower than 50% of the pump motor design speed.

## Hydrosieve

1. Process wastewater is transferred to the hydrosieve where solids are screened out while wastewater passes through to the Recycle / Treatment Tank.
2. Solids are diverted to a collection bin for disposal.

## Recycle / Treatment Tank & Pumps

1. Screened wastewater is transferred to the Recycle / Treatment Tank from the hydrosieve for accumulation, treatment, and storage, as needed, prior to either reuse in the shell wash operation via the Tank pumps or discharge to the River through an overflow.
2. Wastewater within the Tank will be treated by the disinfectant treatment unit, as determined by Facility personnel through system monitoring.
3. The Tank pumps are activated, as determined by the Tank level sensor, to transfer the treated water for use in the shell wash operations at a rate controlled by the VFD.
  - a. The existing river water supply piping will be utilized to transfer treated wastewater to the shell wash operation.
  - b. Wastewater used for shell washing will re-enter the WWTS through the hydrosieve.
  - c. Residual disinfectant (if any) will also be re-introduced to the WWTS.
4. Discharge to the River is initiated as the level in the Tank rises to or above the level of the overflow pipe and gravity flow to the outfall.
  - a. Prior to discharge to the River through the outfall, the discharged water will be sampled via the autosampler and measured via the meter head/data logger.

## Disinfectant Treatment Unit

1. Wastewater in the Recycle / Treatment Tank will be treated through chemical injection of disinfectant to reduce fecal coliform concentrations.

## WASTEWATER TREATMENT EQUIPMENT AND CONTROL NARRATIVE

(continued)

2. The treatment unit will consist of a chemical metering pump, bulk disinfectant storage vessel, and monitoring equipment.
  - a. Monitoring equipment to consist of manual and automated (as available) sampling ports for monitoring of previously treated wastewater returning to the Tank and wastewater in the Tank to determine dosing requirements.
3. Dosing rates of disinfectant are to be evaluated by Facility personnel during system commissioning and on an ongoing basis to ensure reduction of fecal coliform concentrations in wastewater discharged through the outfall to below permit limits.

### River Make-Up Water System

1. The modification to the existing river water supply piping for the shell wash operation will include:
  - a. Accommodations to draw river water through the existing intake for incidental make-up wash water in the event that treated wastewater is not available.
  - b. Means of preventing discharge of wastewater through the existing intake during normal operations.

### **System Startup and Shutdown**

Startup procedure consists of activating the system by turning on breakers supplying power to the pumps, controls, and monitoring equipment as well as by placing digital controllers in RUN mode. Wastewater-generating processes may commence after all equipment is powered and in RUN mode.

The system must be active while wastewater-generating processes are ongoing and shutdown must be preceded by termination of all such processes. Shutdown procedure consists of placing digital controllers in STOP mode and (if required) by turning off breakers supplying power to the pumps, control equipment, and monitoring equipment.

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GENERAL

1. ALL CONSTRUCTION WORK SHALL COMPLY WITH THE REQUIREMENTS OF THE LATEST APPLICABLE CODES AND BE COMPLETED ACCORDING TO ACCEPTED INDUSTRY STANDARDS. CONTRACTOR SHALL PAY FOR AND OBTAIN ALL NECESSARY PERMITS, LICENSES, AND INSPECTIONS.
2. CONTRACTOR SHALL COMPLY WITH ALL LAWS, ORDINANCES, RULES, AND REGULATIONS APPLICABLE TO THE WORK. SHOULD CONTRACTOR DISCOVER THAT THE DRAWINGS DO NOT COMPLY WITH APPLICABLE LAWS, ORDINANCES, RULES, AND REGULATIONS, THE ENGINEER SHALL BE NOTIFIED IMMEDIATELY OF THE VARIANCE. IF CONTRACTOR PERFORMS ANY WORK KNOWING IT TO BE CONTRARY TO ANY LAWS, ORDINANCES, RULES, OR REGULATIONS, CONTRACTOR SHALL BEAR ALL RESPONSIBILITY AND COSTS ARISING THEREFROM. THESE SPECIFICATIONS AND DRAWINGS OUTLINE THE MINIMUM REQUIREMENTS FOR CONSTRUCTION.
3. INFORMATION REGARDING EXISTING CONDITIONS HAS BEEN DETERMINED AS REASONABLY AS POSSIBLE, BUT MAY NOT BE SHOWN EXACTLY OR COMPLETELY. CONTRACTOR SHALL REPORT ANY DISCREPANCIES TO THE ENGINEER. ALL ITEMS INDICATED TO BE CONFIRMED OR VERIFIED SHALL BE DONE SO BY CONTRACTOR PRIOR TO COMMENCING WITH THE SPECIFIED WORK.
4. CONTRACTOR SHALL PROTECT ALL EXISTING STRUCTURES, FINISHES, EQUIPMENT, AND FURNISHINGS SCHEDULED TO REMAIN. REPAIR AND/OR REPLACEMENT OF DAMAGED MATERIALS WILL BE THE RESPONSIBILITY OF CONTRACTOR. RESTORATION SHALL MATCH ORIGINAL UNDISTURBED CONDITIONS.
5. PRODUCTION EQUIPMENT AND CRITICAL INFRASTRUCTURE TO FACILITY OPERATIONS MUST BE PROTECTED. WORK NEAR PRODUCTION EQUIPMENT MUST BE DONE IN COOPERATION WITH FACILITY STAFF.
6. ALL NEW MATERIALS, WORK AND FINISHES SHALL MATCH EXISTING UNDISTURBED MATERIALS AND WORK OF SIMILAR FUNCTION AND FINISHES EXCEPT WHERE MORE RIGID REQUIREMENTS ARE SPECIFIED OR ARE REQUIRED BY APPLICABLE CODES. REPAIR, PATCH, AND REPLACE ALL EXISTING WORK DAMAGED DUE TO THIS WORK INCLUDING SURFACES AND FINISHES DISTURBED BY PLUMBING, MECHANICAL, FIRE SPRINKLER OR ELECTRICAL WORK, TO MATCH ORIGINAL UNDISTURBED CONDITIONS.
7. CONTRACTOR SHALL PROVIDE AND ENSURE ALL WORK COMPLIES WITH ALL APPLICABLE STANDARDS, CODES, AND PRACTICES.

SPECIFICATIONS

A. GENERAL REQUIREMENTS:

PERMITS, INSPECTIONS, AND TESTS: IF CONSTRUCTION PERMITS ARE REQUIRED, CONTRACTOR SHALL ENSURE THAT ALL PERMITS HAVE BEEN OBTAINED. CONTRACTOR SHALL POST ALL PERMITS AND COORDINATE ALL INSPECTIONS AND TESTS, AS REQUIRED, WITH LOCAL AUTHORITIES AND THE ENGINEER.

1. PROTECTION OF EXISTING FACILITIES:
- a. SEE GENERAL NOTE 5.
- b. CONTRACTOR IS RESPONSIBLE FOR PROTECTION OF ALL FACILITIES, UTILITIES, STRUCTURES, AND FEATURES ON THE PROPERTY OR NEARBY THAT ARE TO REMAIN IN-PLACE AFTER COMPLETION OF THE PROJECT.
- c. NO EXCAVATION SHALL BE PERFORMED UNTIL SITE UTILITIES HAVE BEEN FIELD LOCATED BY A PRIVATE UTILITY LOCATING COMPANY AND FACILITY STAFF APPROVE EXCAVATION LOCATION. CONTRACTOR SHALL ALSO NOTIFY PUBLIC UTILITY LOCATE SERVICES. CONTRACTOR SHALL TAKE THE NECESSARY PRECAUTIONS TO ENSURE NO DAMAGE OCCURS TO EXISTING STRUCTURES AND UTILITIES. DAMAGE TO EXISTING STRUCTURES AND UTILITIES RESULTING FROM CONTRACTOR'S OPERATIONS SHALL BE REPAIRED AT NO ADDITIONAL COST TO THE FACILITY. UTILITIES ENCOUNTERED THAT WERE NOT PREVIOUSLY SHOWN OR OTHERWISE LOCATED SHALL NOT BE DISTURBED WITHOUT APPROVAL FROM THE ENGINEER.
2. VERIFICATION:
- a. ALL DETAILS HAVE NOT BEEN PROVIDED ON THESE DRAWINGS. IT SHALL BE CONTRACTOR'S RESPONSIBILITY, PRIOR TO SUBMITTING A BID, TO VERIFY DETAILS NOT SHOWN ON THE DRAWINGS.
- b. DIMENSIONS, ELEVATIONS, AND COORDINATES SHALL BE VERIFIED BY CONTRACTOR PRIOR TO CONSTRUCTION.
- c. CONTRACTOR SHALL REPORT ALL CONFLICTS, ERRORS, OR DISCREPANCIES DISCOVERED ON THE DRAWINGS TO ENGINEER BEFORE PROCEEDING WITH THE AFFECTED WORK.
3. COORDINATION WITH FACILITY OPERATIONS AND NEIGHBORING PROPERTIES:

THE SITE IS AN OPERATING SEAFOOD PROCESSING FACILITY AND IS IN THE VICINITY OF SEVERAL COMMERCIAL PROPERTIES. EXCAVATION CONTRACTOR SHALL COORDINATE WORK IN STAGES TO MINIMIZE DISRUPTION TO FACILITY OPERATIONS. EXCAVATION WORK SHALL BE STAGED AND CONDUCTED AS QUICKLY AS POSSIBLE TO MINIMIZE DISRUPTION.

4. SAFETY:
- a. CONTRACTOR SHALL COMPLY WITH ALL FACILITY SAFETY TRAINING

CONTRACTOR IS RESPONSIBLE FOR RESEARCHING AND UNDERSTANDING ALL SITE-SPECIFIC REQUIREMENTS.

- b. CONTRACTOR SHALL BE RESPONSIBLE FOR CONDUCTING THE WORK IN A SAFE MANNER AND SHALL TAKE REASONABLE PRECAUTIONS TO ENSURE THE SAFETY AND PROTECTION OF WORKERS, PROPERTY, AND THE GENERAL PUBLIC.
- c. ALL CONSTRUCTION SHALL BE CONDUCTED IN ACCORDANCE WITH THE LATEST APPLICABLE REQUIREMENTS, CODES, AND REGULATIONS.
- d. CONTRACTOR SHALL DETERMINE THE SAFETY HAZARDS INVOLVED IN CONDUCTING THE WORK AND THE PRECAUTIONS NECESSARY TO CONDUCT THE WORK SAFELY.
- e. IF CONTRACTOR IS UNSURE AS TO ANY SPECIAL HAZARDS WHICH MAY BE UNIQUE TO THE WORK, IT SHALL BE CONTRACTOR'S RESPONSIBILITY TO DETERMINE SUCH INFORMATION PRIOR TO BEGINNING THE WORK.
5. CLEANING:
- a. CONTRACTOR SHALL THOROUGHLY CLEAN THE AREAS PRIOR TO DEMOBILIZING, AND SHALL DISPOSE OF ALL TRASH AND WASTE CONSTRUCTION MATERIAL OFF SITE.
- b. ALL AREAS IN WHICH WORK IS PERFORMED WILL BE LEFT IN A CONDITION AT LEAST EQUAL TO THAT PRIOR TO COMMENCING THE WORK.
- c. CONTRACTOR WILL DISPOSE OF ALL CONSTRUCTION DEBRIS ON A DAILY BASIS AND KEEP THE SITE NEAT AND ORDERLY.
- d. CONTRACTOR SHALL CONDUCT A FINAL SITE WALK-THROUGH WITH THE DESIGNATED FACILITY REPRESENTATIVE TO VERIFY THAT THE ABOVE REQUIREMENTS HAVE BEEN COMPLETED TO THE OWNER'S SATISFACTION.

6. ON-SITE FACILITIES:

THE FOLLOWING ARRANGEMENTS AND SERVICES SHALL BE MADE DURING THE CONSTRUCTION PHASE:

- a. ACCESS – SITE IS AN OPERATING SEAFOOD PRODUCTION FACILITY. CONTRACTOR SHALL MAKE NECESSARY ARRANGEMENTS FOR DELIVERY OF EQUIPMENT AND MATERIALS TO THE SITE, DETERMINE THE CONDITION AND AVAILABILITY OF PUBLIC ROADS, ACCESS, AND RIGHTS-OF-WAY, AND OF RESTRICTIONS, BRIDGE LOAD LIMITS, AND OTHER LIMITATIONS AFFECTING TRANSPORTATION AND INGRESS AND EGRESS FROM THE SITE. CONTRACTOR SHALL KEEP STREETS IN THE VICINITY OF THE SITE OPEN. CONTRACTOR WILL PROTECT SIDEWALKS, BIKE LANES, PEDESTRIAN WALKWAYS, AND ACCESS TO THE SITE FIRE HYDRANTS. CONTRACTOR WILL ERECT AND MAINTAIN BARRIERS OR FENCES, AS REQUIRED BY THE FACILITY OR APPLICABLE CODES AND REGULATIONS TO SECURE THE SITE AND PROVIDE SAFEGUARDS AROUND ALL WORK ZONES.
- b. PARKING – CONTRACTOR SHALL COORDINATE AVAILABLE PARKING AREAS WITH THE FACILITY.
- c. LAY-DOWN – LAY-DOWN AREA WILL BE AVAILABLE, BUT WILL BE LIMITED TO IMMEDIATE NEEDS. THE AVAILABILITY OF THE AREA FOR STORAGE OF MATERIALS, SUCH AS SPOIL AND BACKFILL, WILL BE AT THE FACILITY'S DISCRETION. CONTRACTOR SHALL VERIFY THIS AVAILABILITY OF STORAGE SPACE FOR THIS TYPE OF MATERIAL WITH THE OWNER PRIOR TO INITIATING THE WORK.
- d. SANITARY FACILITIES – CONTRACTOR SHALL PROVIDE SANITARY FACILITIES FOR THEIR PERSONNEL FOR THE DURATION OF THE PROJECT.
- e. POWER – CONTRACTOR SHALL EVALUATE THE EXISTING ELECTRICAL SERVICE FOR CONSTRUCTION REQUIREMENTS AND SHALL COORDINATE WITH FACILITY STAFF FOR THE PROVISION OF ANY SPECIAL REQUIREMENTS.
- f. DRINKING WATER – CONTRACTOR SHALL PROVIDE DRINKING WATER FOR THEIR EMPLOYEES.
- g. CONSTRUCTION WATER – CONTRACTOR SHALL PROVIDE CONSTRUCTION WATER AS NECESSARY.
- h. COMPRESSED AIR – COMPRESSED AIR IS NOT AVAILABLE AT THE SITE.

i. TRASH – CONTRACTOR IS RESPONSIBLE FOR DISPOSAL OF DOMESTIC TRASH AND ALL WASTE CONSTRUCTION MATERIALS.

j. NOISE CONTROL – CONTRACTOR WILL COMPLY WITH ALLOWABLE CONSTRUCTION NOISE REGULATIONS, AND WILL EQUIP INTERNAL COMBUSTION ENGINES WITH EFFECTIVE MUFFLERS.

k. FIRE PREVENTION – CONTRACTOR WILL TAKE STEPS TO PREVENT FIRES.

7. SECURITY AND WORK HOURS:

- a. CONTRACTOR SHALL PROVIDE SECURITY DURING CONSTRUCTION AS NECESSARY TO CONTROL ACCESS TO THE CONSTRUCTION AREAS.
- b. CONTRACTOR WILL BE RESPONSIBLE FOR SECURING TOOLS, EQUIPMENT,

AND MATERIAL. ENGINEER AND FACILITY SHALL NOT BE LIABLE FOR CONTRACTOR'S TOOLS, EQUIPMENT, AND MATERIAL.

c. CONTRACTOR WILL HAVE ACCESS TO THE SITE ONLY DURING HOURS APPROVED BY FACILITY.

d. PRODUCT DELIVERY, SHIPMENTS, AND/OR HANDLING MAY REQUIRE THAT PARTS OF THE FACILITY ARE NOT ACCESSIBLE. THESE EVENTS OCCUR FREQUENTLY AND CONTRACTOR WILL HAVE TO ACCOMMODATE THESE SCHEDULE INTERRUPTIONS.

e. ABSOLUTELY NO DRUGS, ALCOHOL, FIREARMS, OR EXPLOSIVES WILL BE ALLOWED ON-SITE.

- f. IF HAZARDOUS MATERIALS ARE BROUGHT ON-SITE, THE FACILITY REQUIRES SAFETY DATA SHEETS (SDS) FOR THESE MATERIALS PRIOR TO THEIR DELIVERY.
- g. IN EMERGENCY SITUATIONS RESULTING FROM THE WORK, WHERE LIFE OR PROPERTY ARE ENDANGERED, CONTRACTOR SHALL IMMEDIATELY TAKE ACTION. ANY COSTS INCURRED BY THE FACILITY IN RECTIFYING EMERGENCY SITUATIONS CAUSED BY NEGLIGENCE OF CONTRACTOR SHALL BE PAID FOR BY CONTRACTOR.

B. MATERIALS

CONTRACTOR SHALL MEET THE FOLLOWING REQUIREMENTS OF THIS SECTION AS APPLICABLE TO THE WORK IT IS REQUESTED TO PERFORM.

1. GENERAL:
- a. WORK SHALL BE PERFORMED IN A PROFESSIONAL MANNER WITH NEW MATERIALS. PIPING AND CONDUIT RUNS SHALL BE LEVEL, PLUMB, AND SQUARE, PROPERLY SUPPORTED, AND INSTALLED IN SUCH A WAY AS TO MINIMIZE MAINTENANCE AND SAFETY DIFFICULTIES. FLANGES, UNIONS AND PULL BOXES SHALL BE INSTALLED AS NECESSARY TO FACILITATE MAINTENANCE.
- b. ALL ELECTRICAL EQUIPMENT SHALL CONFORM TO THE LATEST PUBLISHED INDUSTRY STANDARDS AND SPECIFICATIONS.
- c. ALL EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS AND REQUIREMENTS.
- d. CONTRACTOR SHALL OBTAIN, AT OWN EXPENSE, COPIES OF ALL CURRENT CODES, REGULATIONS, AND STANDARD SPECIFICATIONS OF ALL AUTHORITIES HAVING JURISDICTION AND WHICH HAVE BEEN REFERRED TO HEREIN.
2. CONCRETE REPAIR, JOINT SEALING, AND COATINGS/LINING SYSTEMS: SEE DRAWINGS WHERE APPLICABLE.
3. PIPING, FITTINGS, BOLTS/NUTS, AND OTHER MECHANICAL SYSTEMS SHALL MATCH FACILITY STANDARDS. SEE DRAWINGS FOR ADDITIONAL DETAILS.

C. EXECUTION:

1. PIPE INSTALLATION:
- a. PIPE SUPPORTS SHALL WITHSTAND THE DEAD LOADS IMPOSED BY THE WEIGHT OF THE PIPE SYSTEM (FILLED WITH WATER). COMMERCIAL PIPE SUPPORTS AND HANGERS SHALL HAVE A MINIMUM SAFETY FACTOR OF 5.
2. EXCAVATION:
- a. CONTRACTOR SHALL LOCATE ALL EXISTING ABOVE AND BELOW GROUND UTILITIES AS DESCRIBED IN THE GENERAL REQUIREMENTS AND SPECIFICATIONS. CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR ANY DAMAGE TO ABOVE OR BELOW GROUND UTILITIES, STRUCTURES, OR FACILITIES.
- b. CONTRACTOR SHALL DEWATER ALL PIPE TRENCHES AND VAULT EXCAVATIONS, IF NECESSARY, AND SHALL BE SOLELY RESPONSIBLE FOR HANDLING, STORAGE, AND DISPOSAL OF COLLECTED WATER.
- c. CONTRACTOR SHALL PREVENT EXCAVATIONS FROM WEAKENING SURROUNDING AREAS OR DAMAGING STRUCTURES FROM SETTLEMENT, HORIZONTAL MOVEMENT, OR OTHER FACTORS. CONTRACTOR SHALL IMMEDIATELY REPORT ANY DAMAGE TO THE FACILITY AND REPAIR SUCH DAMAGE AT CONTRACTOR'S EXPENSE.

3. STOCKPILING:

a. CONTRACTOR SHALL TEMPORARILY STOCKPILE EXCAVATED SOIL ONTO 10 MIL POLYETHYLENE SHEETING OR LINED CONTAINERS IN AN AREA APPROVED BY THE FACILITY.

- b. STOCKPILES SHALL BE BERMED AND COVERED TO PROTECT MATERIALS FROM PRECIPITATION, STORMWATER, TIDEWATER, AND SURFACE WATER UNTIL REQUIRED FOR BACKFILL OR OFF-SITE DISPOSAL IS ARRANGED BY CONTRACTOR. ALL COVER SHEETING SHALL BE WEIGHTED AND TIED DOWN. STOCKPILES AND CONTAINERS WILL BE LOCATED OUT OF THE WAY OF VEHICLE AND FOOT TRAFFIC.
4. DUST, MUD, AND DEBRIS CONTROL:

- a. CONTRACTOR SHALL TAKE ALL NECESSARY MEASURES TO CONTROL DUST

AND THE DEPOSITING OF MUD AND OTHER DEBRIS CAUSED BY THE WORK BEING CARRIED OUT, INCLUDING ON ADJACENT PROPERTIES AND ROADWAYS AND RESULTING FROM MATERIAL TRANSPORT ROUTES.

b. CONTRACTOR WILL BE RESPONSIBLE FOR ALL DAMAGE RESULTING FROM DUST PRODUCED BY CONTRACTOR OPERATIONS FROM THE TIME THAT WORK OF ANY DESCRIPTION IS COMMENCED UNTIL ALL WORK IS COMPLETED AND ACCEPTED BY THE FACILITY.

5. EROSION AND SEDIMENTATION CONTROL AND MAINTAINING SURFACE DRAINAGE:

a. CONTRACTOR SHALL PREPARE AND SUBMIT AN EROSION AND SEDIMENT CONTROL PLAN, AS REQUIRED BY APPLICABLE CODES AND REGULATIONS AND/OR THE FACILITY, DOCUMENTING THE BEST MANAGEMENT PRACTICES (BMPS) AND CONTROLS THAT WILL BE IMPLEMENTED DURING SITE WORK.

b. EROSION/SEDIMENT CONTROLS MAY INCLUDE SILT FENCING, STRAW WADDLES, WHEEL WASH, AND GRAVELED CONSTRUCTION ACCESS AREAS.

c. THE PLAN SHALL ALSO INCLUDE PROCEDURES FOR MONITORING, DUST CONTROL, STORAGE OF MATERIALS, STORAGE AND ON-SITE DISPENSING OF FUELS AND MOTOR OILS, AND SPILL CONTROLS.

d. CONTRACTOR SHALL MINIMIZE THE LENGTH OF TIME THE DISTURBED WORK AREA IS EXPOSED TO POTENTIAL EROSION BY PROPER SCHEDULING, LIMITING WORK AREA, AND RESTORATION OF DISTURBED AREAS.

6. BEDDING, BACKFILLING, AND COMPACTION:

- a. CONTRACTOR SHALL NOT DELIVER BACKFILL MATERIALS WITHOUT FACILITY APPROVAL OF THE MATERIAL.
- b. EXCAVATED SOIL MAY BE USED FOR BACKFILL MATERIAL IF APPROVED BY THE FACILITY. IMPORTED FILL MATERIAL SHALL MEET SPECIFICATIONS ON DRAWINGS THE MATERIAL SHALL CONTAIN NO ORGANIC MATTER OR SOFT FRIABLE PARTICLES.
- c. PIPE BEDDING SHALL PROVIDE CONTINUOUS SUPPORT FOR THE PIPE. BEDDING SHALL BE PLACED IN LAYERS OF 2 INCHES MAXIMUM LOOSE THICKNESS AND COMPACTED TO 90% COMPACTION. BEDDING PLACED WITHIN 12 INCHES OF THE PIPE SHALL BE COMPACTED BY HAND TAMPING EQUIPMENT OR VIBRATORY COMPACTION EQUIPMENT ONLY.

d. FILL PLACED GREATER THAN 12 INCHES ABOVE PIPING SHALL BE COMPACTED TO 95% MAXIMUM DRY DENSITY.

e. CONTRACTOR SHALL WARRANTY ALL COMPACTION TO NOT SETTLE FOR A PERIOD OF 1 YEAR. WE ANTICIPATE THAT THIS WILL REQUIRE COMPACTION TO 95% AT THE TOP TWO FEET OF BACKFILL.

7. TESTING:

a. CONTRACTOR SHALL CONDUCT ALL TESTS NECESSARY TO DEMONSTRATE THE INTEGRITY OF THE FINISHED PIPING AND EQUIPMENT INSTALLATION TO THE APPROVAL OF THE FACILITY. CONTRACTOR WILL NOT BE RESPONSIBLE FOR TESTING EQUIPMENT SUPPLIED BY OTHERS FOR PROPER FUNCTION, BUT IS REQUIRED TO TEST EQUIPMENT TO VERIFY THAT ALL PLUMBING INSTALLED BY CONTRACTOR FUNCTIONS AS INTENDED.

COAST SEAFOODS COMPANY  
1200 ROBERT BUSH DRIVE  
SOUTH BEND, WA

Report

WASTEWATER PLANS & SPECIFICATIONS

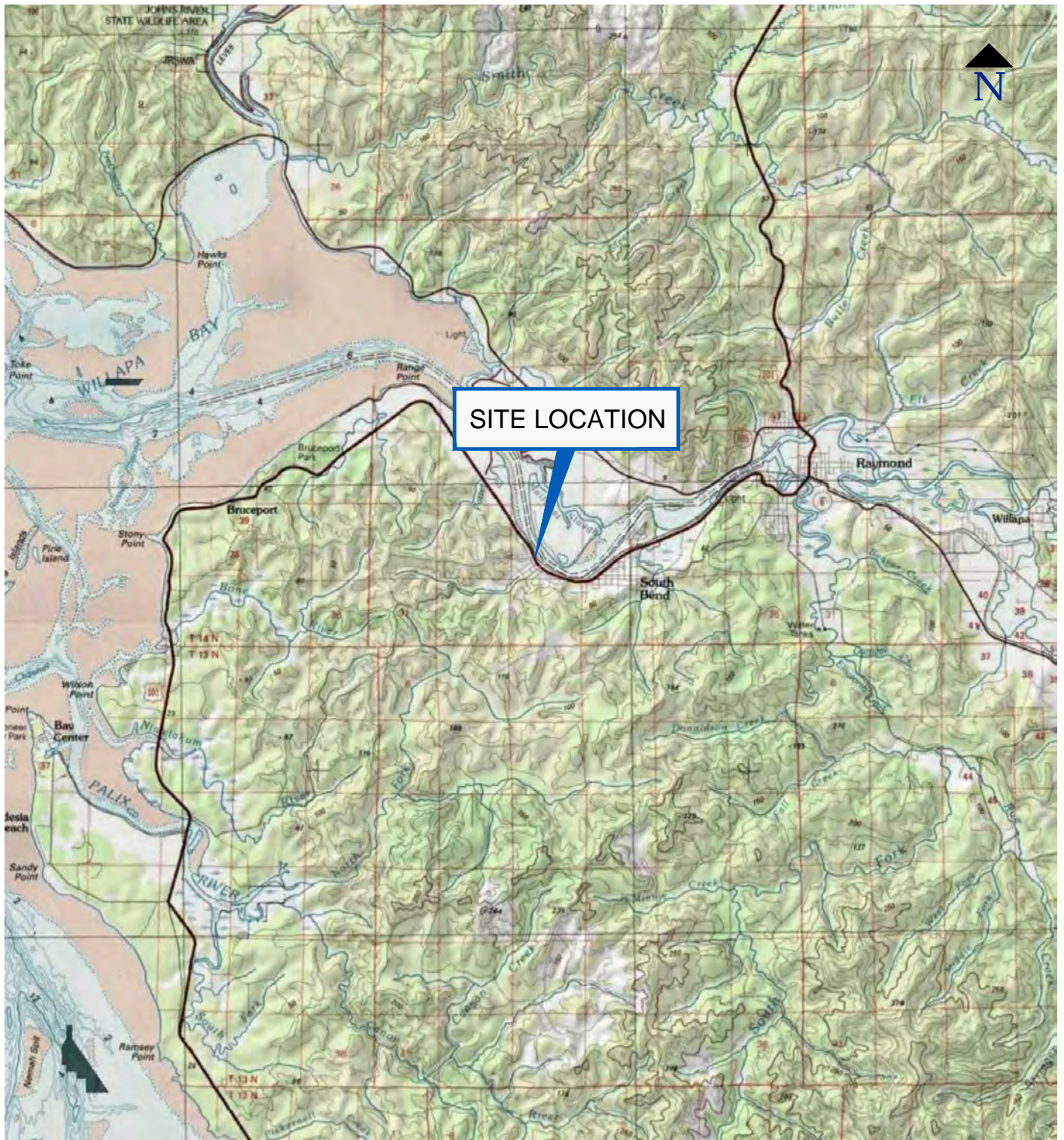
Drawing

CONSTRUCTION NOTES

Date	September 7, 2017	Scale	AS SHOWN	Figure No.
File Name	Coast Seafoods WW_JUL17	Project No.	108.01472.00027	0







COAST SEAFOODS COMPANY  
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WASTEWATER PLANS & SPECIFICATIONS

Drawing

SITE LOCATION MAP

Date September 7, 2017

Scale AS SHOWN

Fig. No.

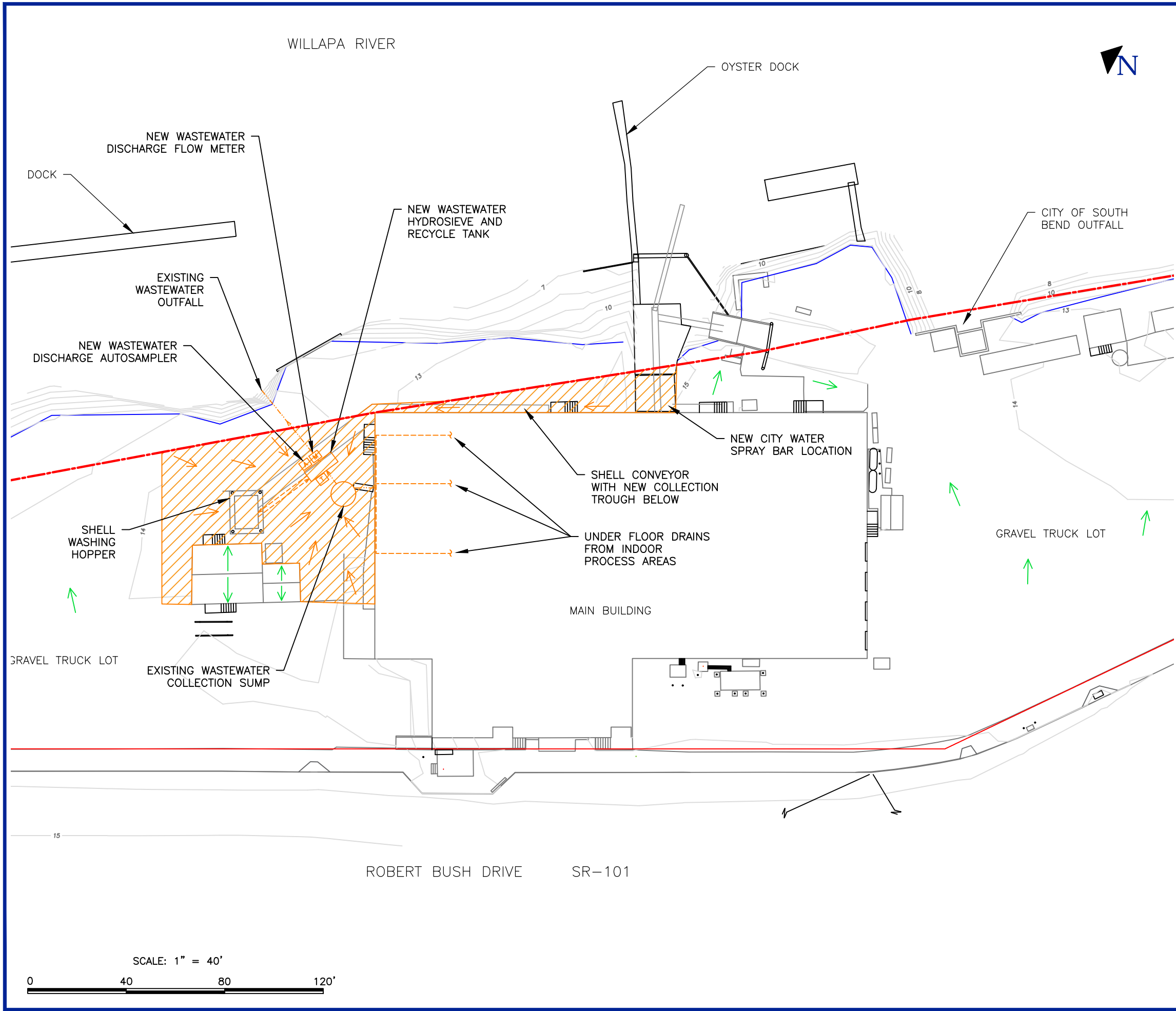
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Project No. 108.01472.00027

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NOTES

1. NEW CONTAINMENT SLAB TO BE CONSTRUCTED IN PROCESS WASTEWATER AREA NORTH OF MAIN BUILDING
2. PLANT DISCHARGE AND INCIDENTAL DRAINAGE FROM WASTEWATER SLAB TO BE TRANSFERRED TO WASTEWATER RECYCLE TANK
3. HYDROSIEVE SOLIDS TO DROP INTO TOTE OR SIMILAR RECEPTACLE.
4. RECYCLE TANK CONTENTS TO BE TRANSFERRED TO SHELL WASHING OPERATION AND RETURNED TO THE TANK
5. NEW CONVEYOR TROUGH AND SPRAY BAR AREA TO DRAIN TO WASTEWATER COLLECTION SUMP
6. EXCESS WASTEWATER WILL DISCHARGE FROM THE FACILITY THROUGH AN OVERFLOW IN THE RECYCLE TANK
7. PERACETIC ACID UNIT WILL DOSE THE RECYCLE TANK TO REDUCE THE CONCENTRATION OF FECAL COLIFORM COLONIES, WITH CONTACT TIME ACHIEVED IN THE RECYCLE TANK AND THE SHELL WASH RECIRCULATION LOOP
8. SOLIDS WILL BE ROUTINELY REMOVED FROM TANKS AND SUMPS FOR DISPOSAL
9. DISCHARGE FLOW RATES WILL BE RECORDED BY A DATALOGGING METER
10. COMPLIANCE SAMPLES WILL BE COLLECTED BY A NEW AUTOSAMPLER FROM THE DISCHARGE LINE

LEGEND

- PROPERTY BOUNDARY (ASSUMED)
- TOP OF BANK
- RIGHT-OF-WAY
- EXISTING EQUIPMENT AND FEATURES
- PROCESS WASTEWATER EQUIPMENT AND DRAINAGE AREAS
- UNDERGROUND PROCESS WASTEWATER PIPING
- ABOVE GROUND PROCESS WASTEWATER PIPING
- PROCESS WASTEWATER DIRECTION OF FLOW
- ONSITE STORMWATER DIRECTION OF FLOW
- OFFSITE STORMWATER DIRECTION OF FLOW
- CONTOUR LINE
- [M] FLOW METER
- [MH] METER HEAD
- [T] FECAL COLIFORM TREATMENT UNIT
- [A] AUTOSAMPLER

COAST SEAFOODS COMPANY  
1200 ROBERT BUSH DRIVE  
SOUTH BEND, WA

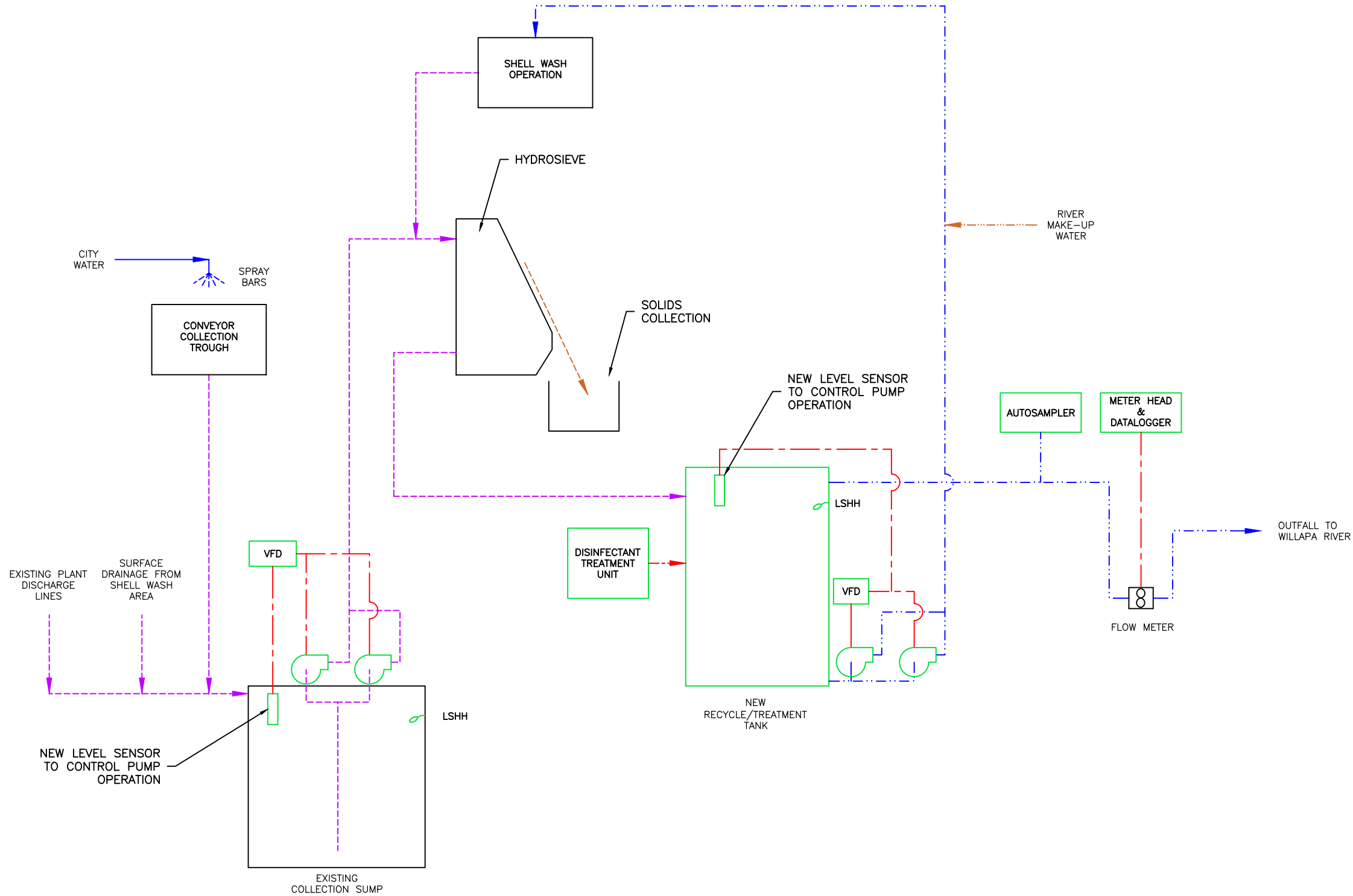
Report  
WASTEWATER PLANS & SPECIFICATIONS

Drawing  
WWTS UPGRADES

Date	September 7, 2017	Scale	AS SHOWN	Figure No.	2
File Name	Coast Seafoods WW_JUL17	Project No.	108.01472.00027		



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#### NOTES

1. EQUIPMENT CONFIGURATION IS CONCEPTUAL
2. SUMP PUMPS TO BE AMT SELF-PRIMING TRASH PUMP
3. RECYCLE TANK PUMPS TO BE CHEMFLO CENTRIFUGAL PUMP

#### LEGEND

- EXISTING EQUIPMENT
- NEW EQUIPMENT
- UNTREATED WASTEWATER
- TREATED WASTEWATER
- CITY WATER
- RIVER WATER
- CHEMICAL PIPING
- NEW ELECTRICAL WIRING
- DIRECTION OF FLOW
- CENTRIFUGAL PUMP

COAST SEAFOODS COMPANY  
1200 ROBERT BUSH DRIVE  
SOUTH BEND, WA

Report

WASTEWATER PLANS & SPECIFICATIONS

Drawing

PROCESS FLOW DIAGRAM

Date September 7, 2017

Scale NOT TO SCALE

Figure No.

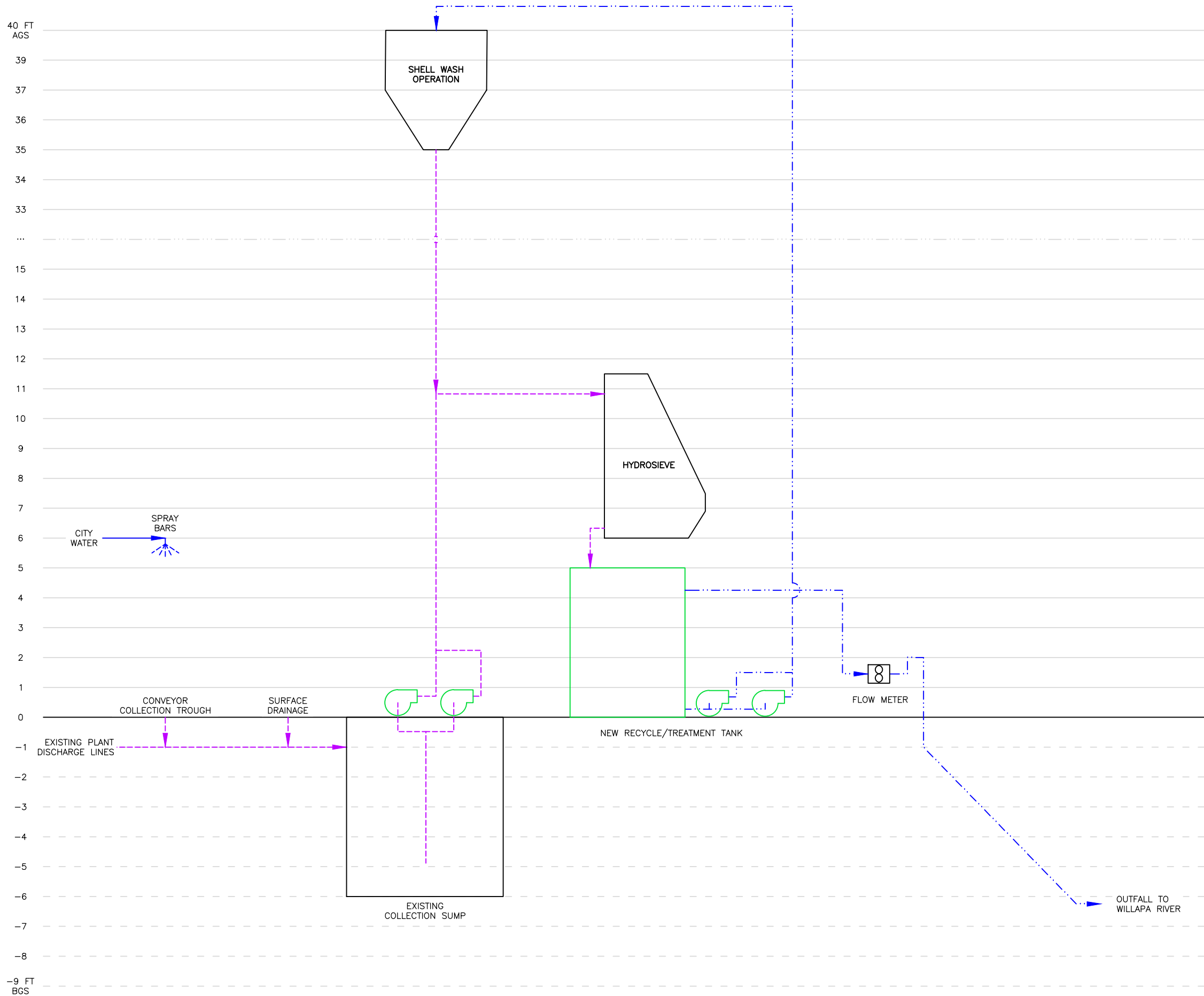
File Name Coast Seafoods WW\_JUL17

Project No. 108.01472.00027

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#### NOTES

1. CONFIGURATION IS CONCEPTUAL
2. EQUIPMENT IS NOT TO SCALE HORIZONTALLY
3. SPRAY BAR WATER IS COLLECTED FROM THE CONVEYORS

#### LEGEND

- EXISTING EQUIPMENT
- NEW EQUIPMENT
- UNTREATED WASTEWATER
- TREATED WASTEWATER
- CITY WATER
- DIRECTION OF FLOW

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Report  
WASTEWATER PLANS & SPECIFICATIONS

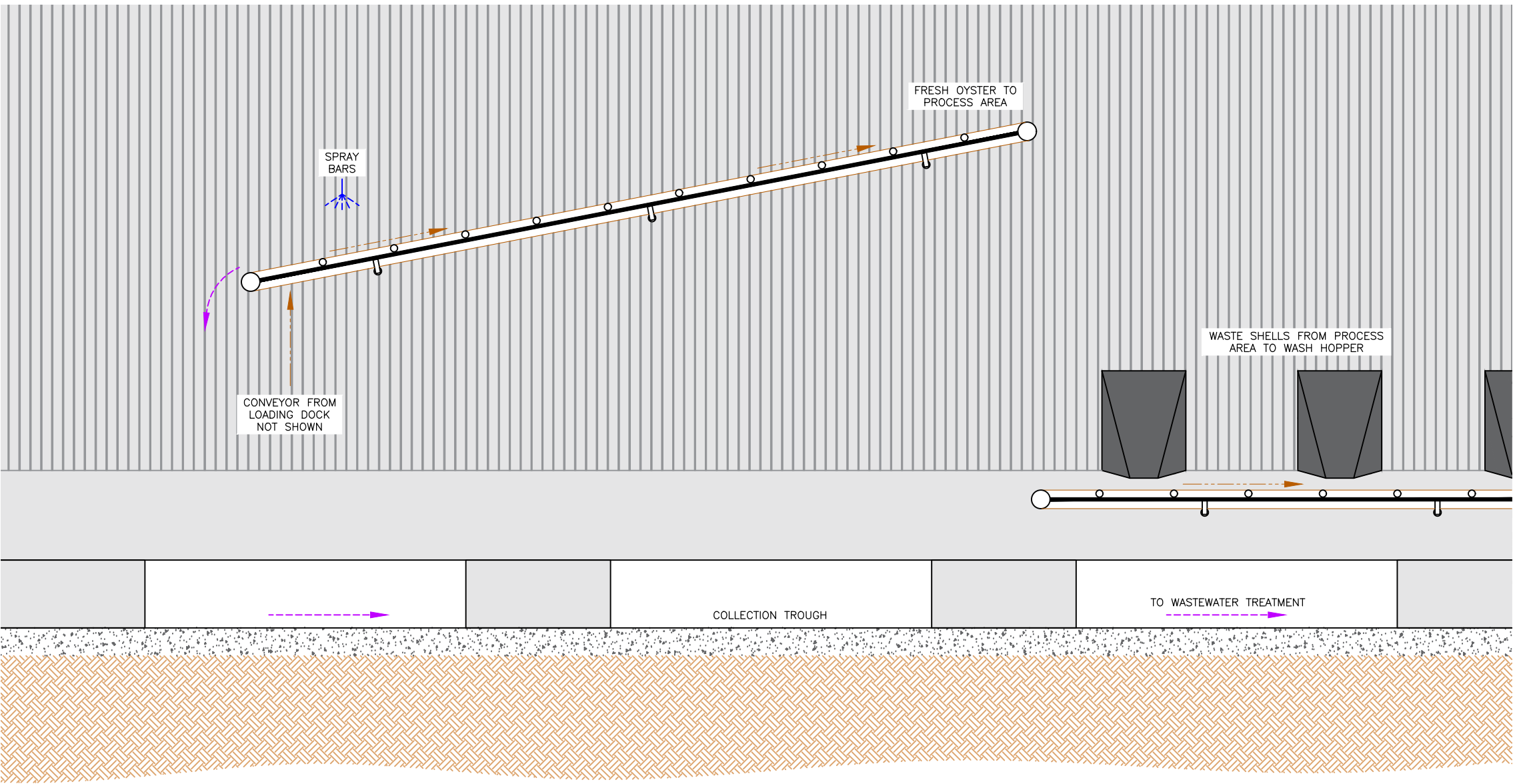
Drawing  
HYDRAULIC GRADE LINE

Date	September 7, 2017	Scale	AS SHOWN	Figure No.	4
File Name	Coast Seafoods WW_JUL17	Project No.	108.01472.00027		





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CONTINUED ON FIGURE 6 ➡

#### NOTES

1. CONFIGURATION IS CONCEPTUAL
2. SUPPORT BRACKETS AND SOME EQUIPMENT/FEATURES ARE NOT SHOWN
3. FOUNDATION DETAILS PREPARED BY OTHERS
4. SEE COLLECTION TROUGH DETAIL FOR ADDITIONAL INFORMATION

#### LEGEND

- EXISTING EQUIPMENT/BUILDING
- EXISTING SOIL
- NEW CONCRETE SLAB
- UNTREATED WASTEWATER
- SOLIDS
- DIRECTION OF FLOW

COAST SEAFOODS COMPANY  
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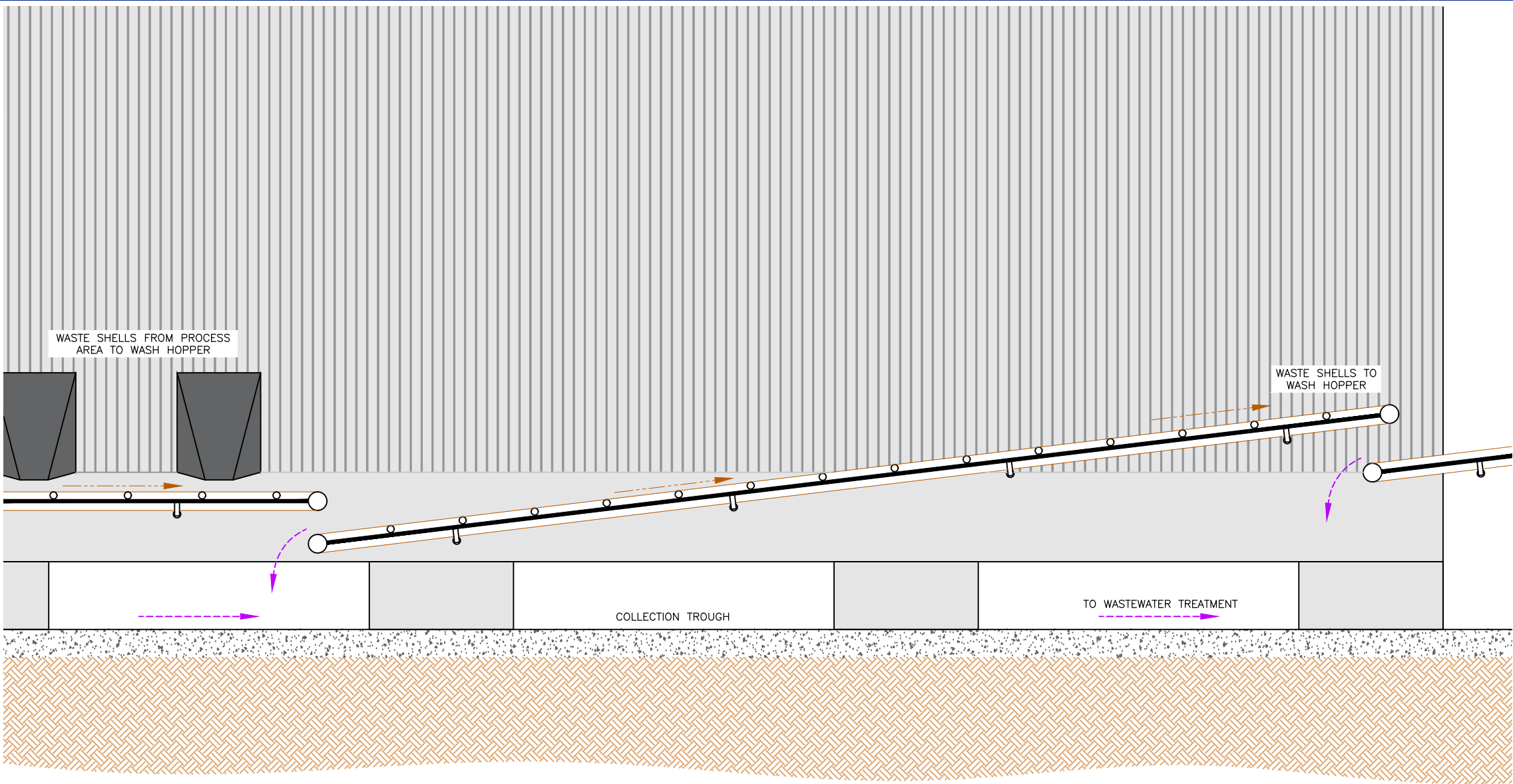
Report  
WASTEWATER PLANS & SPECIFICATIONS

Drawing  
SPRAY BAR COLLECTION DETAIL

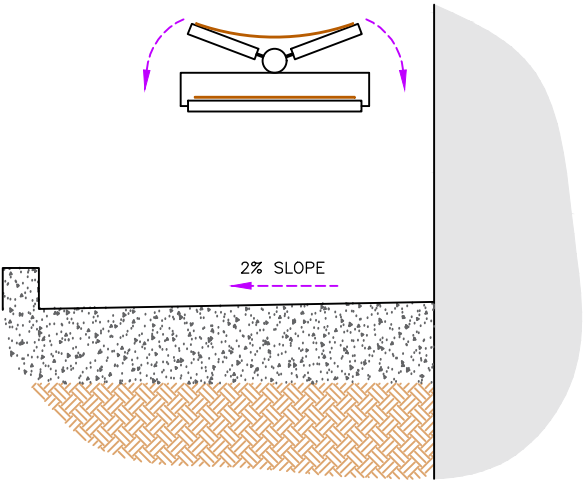
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File Name	Coast Seafoods WW_JUL17	Project No.	108.01472.00027		



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CONTINUED ON FIGURE 5



1  
6

CONVEYOR TROUGH SECTION

NOTES

1. CONFIGURATION IS CONCEPTUAL
2. SUPPORT BRACKETS AND SOME EQUIPMENT/FEATURES ARE NOT SHOWN
3. FOUNDATION DETAILS PREPARED BY OTHERS
4. COLLECTION TROUGH SLOPE TO BE 1% MINIMUM OR AS SHOWN

LEGEND

- EXISTING EQUIPMENT/BUILDING
- EXISTING SOIL
- NEW CONCRETE SLAB
- UNTREATED WASTEWATER
- SOLIDS
- DIRECTION OF FLOW

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SOUTH BEND, WA

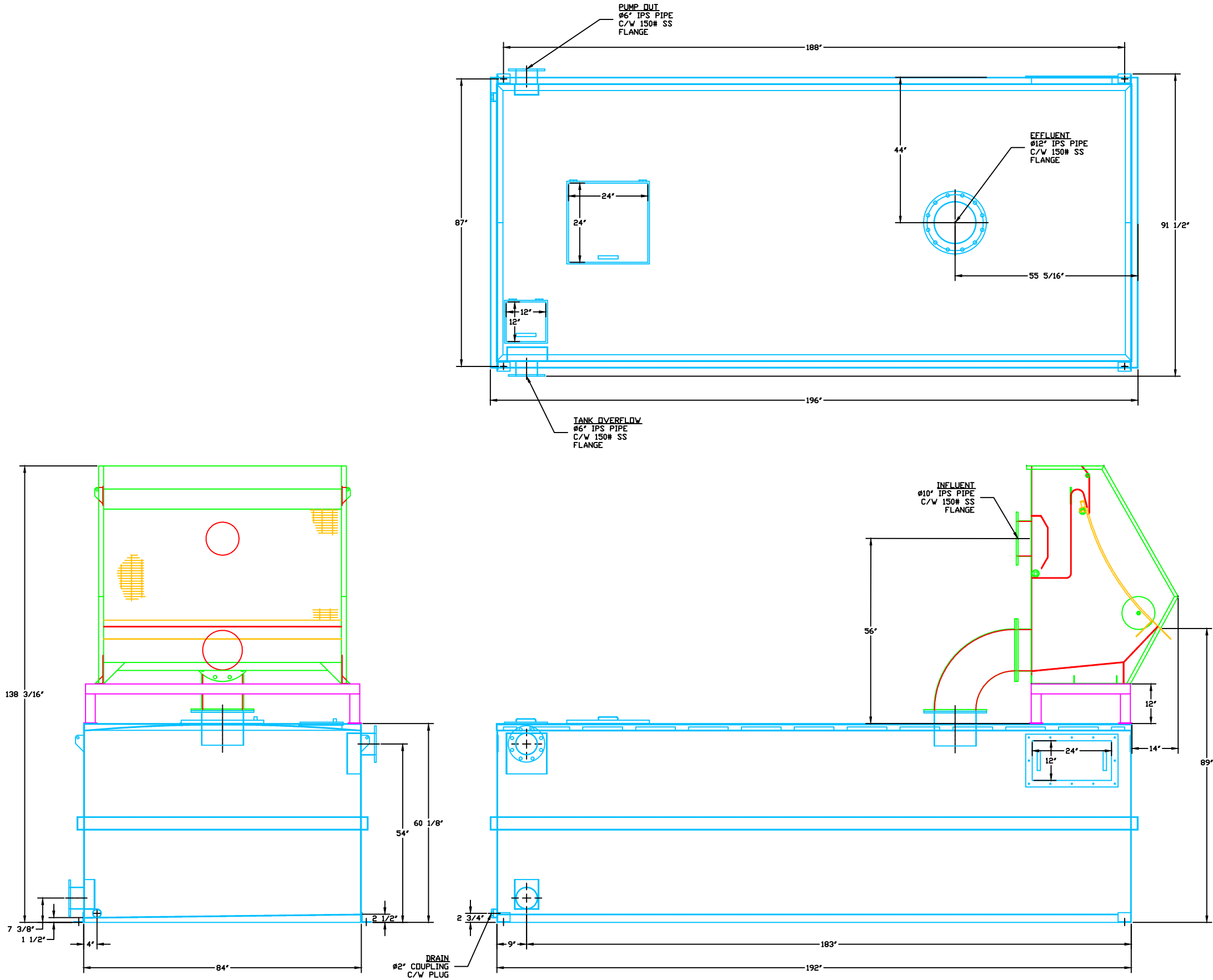
Report  
WASTEWATER PLANS & SPECIFICATIONS

Drawing  
CONVEYOR COLLECTION TROUGH DETAIL

Date	September 7, 2017	Scale	NOT TO SCALE	Figure No.	6
File Name	Coast Seafoods WW_JUL17	Project No.	108.01472.00027		



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NOTES

1. EQUIPMENT CONFIGURATION IS CONCEPTUAL.

LEGEND

- RECYCLE TANK
- HYDROSIEVE
- SUPPORT STRUCTURE

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Report  
WASTEWATER PLANS & SPECIFICATIONS

Drawing  
RECYCLE TANK DETAIL

Date	September 7, 2017	Scale	NOT TO SCALE	Figure No.	7
File Name	Coast Seafoods WW_JUL17	Project No.	108.01472.00027		





**8" SLAB DESIGN FOR RECYLED WASTEWATER CONTAINMENT SYSTEM**  
COAST SEAFOODS CO., PO BOX 166, SOUTH BEND, WA 98586

REFER TO SHEET 2.0  
FOR TRENCH CLEAN-  
OUT DETAIL

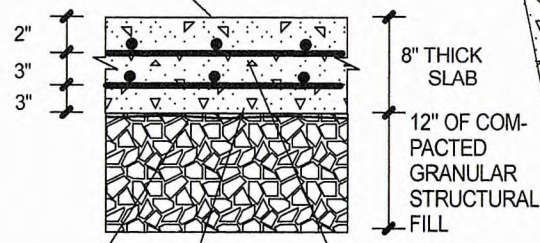
EXISTING  
CONVEYOR  
BELT

ABOVE GROUND  
SECONDARY  
WASTEWATER TANK  
w/TREATMENT  
(16' L x 5' W x 7' H)

CONCRETE COVERAGE  
AND ENCAPSULATION  
AREA (OUT TO PERIMETER  
AS SHOWN)

**TYPICAL 8" SLAB CROSS-SECTION**  
(CONCRETE & REBAR COVERAGE: A, B, C, D, E, & F)

CRACK CONTROL  
ZIP-STRIPS SHALL  
BE INSERTED @  
10' O.C. EA. WAY



2-LAYERS OF  
HEAVY-DUTY  
6-MIL VISQUEEN  
UNDER SLAB

5,000 PSI CONCRETE,  
7.5 SACK/YD MIX DESIGN,  
4" MAX. SLUMP, 5" WITH  
PLASTICIZER, 4 ± 1%  
AIR ENTRAINMENT, 80%  
COMPRESSIVE STRENGTH  
IN SEVEN DAYS.

DOUBLE REBAR MAT:  
#6 REBAR @ 12" O.C.  
EACH WAY - TYPICAL

DOUBLE REBAR MAT:  
#6 REBAR @ 8" O.C.  
EACH WAY FOR  
80,000 LB TRUCK  
DRIVEWAY AREAS

MINIMUM 2%  
DOWNWARD  
SLOPE

EXISTING 8' DIA.  
BELOW GROUND  
WASTEWATER  
SUMP TANK w/  
TREATMENT

REFER TO TYPICAL 8"  
SLAB CROSS-SECTION  
BELOW

MINIMUM 2%  
DOWNWARD  
SLOPE

80,000 LB  
ROLLING LOAD  
(16 WHEELER)

EXISTING 12" DIA.  
STEEL PILES  
(TOTAL OF 10)

WASH TOWER

MINIMUM 2%  
DOWNWARD  
SLOPE

SHELL TOWER

MINIMUM 2%  
DOWNWARD  
SLOPE

80,000 LB  
ROLLING LOAD  
(16 WHEELER)

REFER TO TYPICAL 8"  
SLAB CROSS-SECTION

80,000 LB  
ROLLING LOAD  
IN THIS AREA  
(16 WHEELER)

WIDTH OF CONTAINMENT SLAB: 61' - 0"

SOUTH SIDE OF EXISTING CONCR. BUILDING

REPLACE  
THIS SECTION  
OF RAMP

RAMP

LANDING

ELEVATION  
BENCHMARK:  
11' 0"

**ENGINEERING NOTES:**

1. 8" THICK SLAB HAS BEEN DESIGNED FOR **CONTAINMENT** OF WASTEWATER. (SELF SUPPORTED - NO CONNECTIONS TO EXISTING STRUCTURES (BLDGs, PIERS, PILES, ETC.)
2. MINIMUM 2% DOWNWARD GRADE ENSURES THAT ALL WASTEWATER IS DIRECTED TOWARD THE EXISTING 8' DIAMETER BELOW GROUND SUMP TANK.
3. TO PREVENT ANY WASTEWATER FROM ENTERING THE SUBGRADE SOILS, 2 LAYERS OF HEAVY DUTY 6-MIL VISQUEEN SHALL BE PLACED OVER THE SUBGRADE PRIOR TO THE CONCRETE POUR.
4. CONCRETE SLAB SHALL BE INSPECTED ON A QUARTERLY BASIS TO CHECK FOR ANY CRACKS ESPECIALLY WHERE HEAVY (80,000 LB) TRUCKS ARE LOCATED AS SHOWN AT THE BOTTOM OF THIS DRAWING.
5. CRACKS IN THE SLAB SHALL BE REPAIRED BY FILLING THE VOIDS WITH A WATERPROOF INDUSTRIAL GRADE SEALANT.
6. A POSITIVE 2% WASTEWATER FLOW TO THE 8' DIAMETER WASTEWATER SUMP TANK SHALL BE INSPECTED ON A QUARTERLY BASIS.
7. IF POSITIVE FLOW CANNOT BE MAINTAINED SUCH THAT ALL WASTEWATER FLOWS CANNOT BE DIRECTED TOWARD THE WASTEWATER CONCRETE VAULT, THEN THAT SECTION OF SLAB NOT MEETING THE 2% MINIMUM DOWNWARD GRADE SHALL BE REPLACED.
8. CRACK CONTROL ZIP-STRIPS SHALL BE INSERTED INTO THE CONCRETE SLAB DURING THE POUR AT 10' O.C. EA. WAY. THIS WILL EXPEDITE THE REPLACEMENT OF SLAB SECTIONS INSTEAD OF THE ENTIRE SLAB.
9. THE OBJECTIVE OF THIS REINFORCED 8" SLAB DESIGN IS TO **CONTAIN** ANY WASTEWATER AND DIRECT IT TO THE BELOW GROUND WASTEWATER VAULT.
10. NO CHANGES TO THIS DESIGN SHALL BE ALLOWED WITHOUT APPROVAL IN WRITING BY THIS ENGINEER.



September 11, 2017



1/8" = 1 FT

Prepared by: **MEI Engineering, PLLC**  
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Aug. 7, 2017 Meeting Site Visit on Tue. 8-1-2017  
Rev. Sept. 11, 2017 at 9:00 am

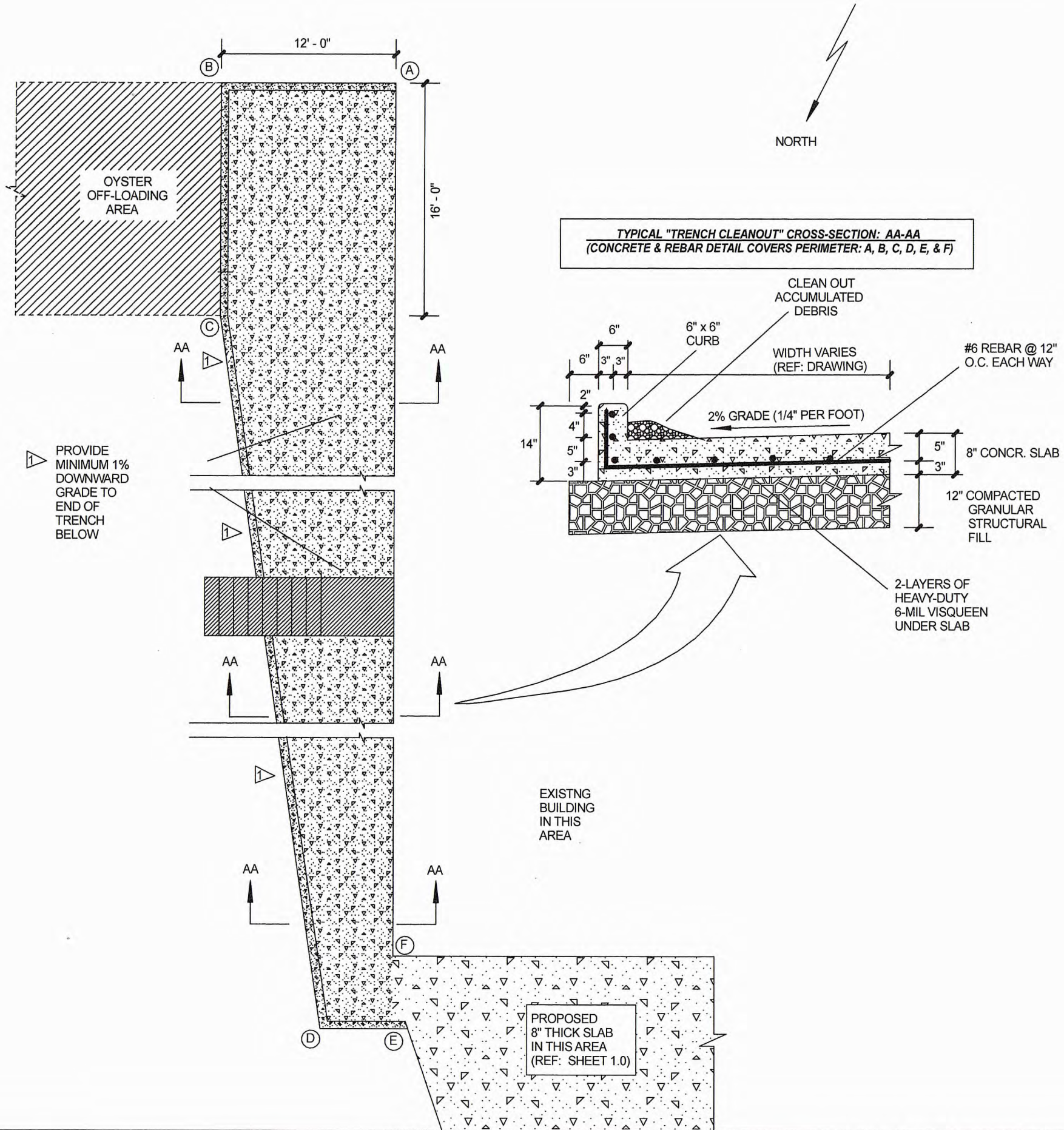
SHEET 1.0

WASTEWATER COLLECTOR DESIGN

Prepared for: Michael Roberts and Tracy Green



**TRENCH CLEANOUT DESIGN FOR WASTEWATER COLLECTION SYSTEM**  
COAST SEAFOODS CO., PO BOX 166,. SOUTH BEND, WA 98586



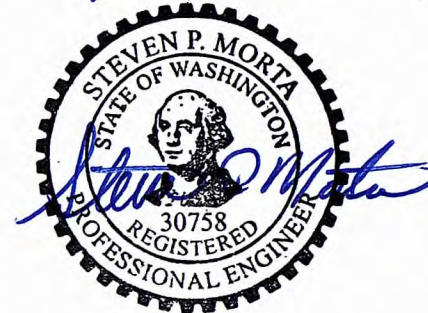
1/8" = 1 FT

Prepared by: <b>MET Engineering, PLLC</b> 1018 E. Wishkan St., Aberdeen, WA 98520 (360) 289-0958 c. (360) 861-8493 fax <a href="mailto:SMorta@aol.com">SMorta@aol.com</a>	Meeting Site Visit on Tue. 8-1-2017 at 9:00 am	SHEET 2.0
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**WASTEWATER COLLECTON SYSTEM  
TRENCH CLEANOUT DETAIL**

Prepared for: **Michael Roberts and Tracy Green**

September 11, 2017







**JWC**  
Environmental®

Trust Monster Quality™

**IPEC**™

## SHP SERIES PRESSURE SCREENS



### FEATURES

- 304 stainless steel construction
- pneumatic, oscillating spray system
- automatic timer
- total enclosure
- easily changed-out screens
- access doors
- adjustable header opening

### OPTION

- 316 stainless steel

SHP Series Pressure Screens utilize a fixed, curved, wedgewire screen surface that is positioned at a steep angle. The screen surface used for the SHP is wedgewire with slots oriented across the direction of flow. This unique wedgewire construction provides for an effective stripping of liquid facilitating solids removal of particles in the 0.002–0.006 inch range, and helps prevent blinding or plugging of the screen openings.

### METHOD OF OPERATION

Pressurized, incoming feed @ 5–15 psi is pumped into a header manifold. The slurry is directed onto the specially curved screen at a tangent. Separated solids move tangentially, downward on the surface of the screen to the discharge outlet. Liquid and finer solids pass through the screen and are discharged via the outlet.

The velocity of incoming material, combined with the shearing action of the screen, produces a positive separation of the material. Slot feed design prevents plugging by fibrous materials, and an oscillating shower, applied intermittently, insures the screen slots remain clean.

### HYDRAULIC CAPACITY

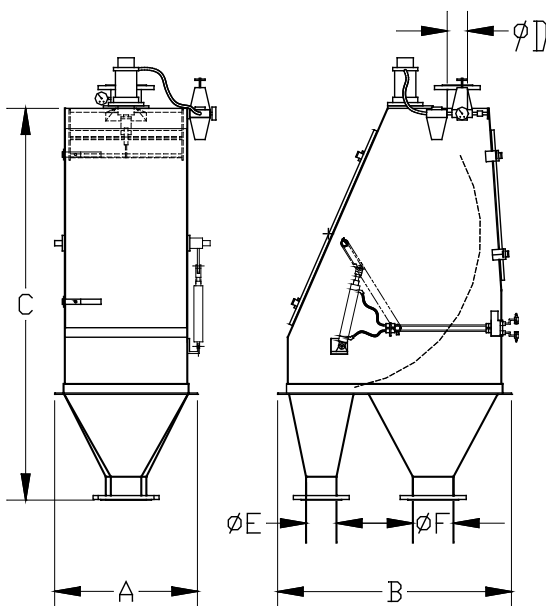
300 to 600 gpm (68 to 136 m<sup>3</sup>/hr) per single unit, depending on application.

### FLOW CAPACITY

The most important variables to be considered when determining flow capacity of each screen model are screen slot opening, solids concentration and solids characteristics.

### APPLICATIONS

- Pulp & Paper - white water, fibre recovery, vacuum seal water & fibre fractionation
- Chemical Processing - fiberglass recovery & synthetic fibre recovery
- Wet Milling - starch recovery



Models	Dimensions - inches (mm)					
	A	B	C	D	E	F
SHP 24 - Single Unit	29 (737)	46 (1168)	80 (2032)	3 (76)	6 (152)	8 (203)
SHP 48 - Double Unit	54.5 (1384)	46 (1168)	84.5 (2146)	6 (152)	8 (203)	10 (254)
SHP 72 - Triple Unit	74.5 (1892)	46 (1168)	84.5 (2146)	6 (152)	8 (203)	10 (254)

CONTACT JWC Environmental | IPEC

Toll Free: (800)663-8409 • Tel: (604)291-7150 • Fax: (604)291-7190 • Email: sales@jwce.com • Web Site: jwce.com

## V1000-4X

1/8 to 25 HP

NEMA 4X Current Vector Microdrive



### Washdown - Dust Tight!

The V1000-4X is a version of the standard V1000 in an integral enclosure that meets NEMA type 4X/12 *indoor use requirements*, UL type 4X/12 standards, and the IP66 rating of IEC 60529. This enclosure provides the protection required in tough washdown or dust-tight environments, common in Food and Beverage Processing, Packaging, Metal Machining, Woodworking, Pumping, Refrigeration, and Printing. The enclosure is epoxy-coated to protect against the harmful effects of sanitizing chemicals commonly used in food industries.

### Specifications

Item	Specification
Overload Capacity	150% Overload for 60 sec. (Heavy Duty) 120% Overload for 60 sec. (Normal Duty)
Output Frequency	0-400 Hz (higher frequencies available with custom software)
Control Methods	Open Loop Current Vector Control, V/f Control, PM Open Loop Vector Control Simple closed loop speed control available
Protective Design	NEMA Type 4X/IP66 (dust/water-proof)
Braking Transistor	Standard in all models
Braking Torque	20 - 40% increase with intelligent high-slip braking function
KEB Function	Uses mechanical energy to continue operation during momentary power failure, standard
Overvoltage Function	Prevention function for die-cushion in a hydraulic mechanical press and other applications
Maintenance	Elapsed timer assists in preventative maintenance for cooling fan, capacitors, and transistors Easily replaceable cooling fan
Global Certification	CE, UL, cUL, RoHS, TUV
Available I/O	(7) multi-function digital inputs (1) hardwire baseblock (2) multi-function analog inputs (1) multi-function pulse input (1) multi-function relay output (2) multi-function photo-coupler outputs (1) multi-function 0-10 Vdc analog output (1) multi-function pulse output
Network Communication	Standard: RS-422/485 MODBUS 115 kbps Optional: DeviceNet, EtherCAT, EtherNet/IP, MECHATROLINK-II, MECHATROLINK-III, Modbus TCP/IP, PROFIBUS-DP, PROFINET
Keypad Operator	Standard LED 5 digit display Optional multi-lingual, full-text remote LCD

### Features

- NEMA Type 4X/IP66 enclosure
- Corrosion-resistant
- Current vector control, open loop
- RoHS compliance
- On-line tuning
- Induction motor (IM) or permanent magnet synchronous motor (PM) operation
- Function Block Diagram (FBD) programming via DriveWorksEZ™
- Starting torque of 200% at 0.5 Hz
- Removable terminal block with parameter backup function
- “One-touch” copy function with verify
- Super-fast 2 ms scan cycle with dual CPU
- EN954-1 Safety Cat. 3, Stop Cat. 0
- Increased vibration resistance, from 20 Hz to 50 Hz (0.65G)
- 1 in 10,000 failure rate
- Swing PWM function to decrease noise at low carrier frequencies
- Pre-maintenance function
- Modbus communication
- MTBF: 28 years
- Short Circuit Current Rating (SCCR): 30kA rms symmetrical
- Common programming with all other Yaskawa drives

## V1000-4X

1/8 to 25 HP

### 200-240V / Single-Phase

Model Number CIMR-VU	Normal Duty		Heavy Duty		Dimensions (in.)		
	Rated Output Current (Amps)	HP	Rated Output Current (Amps)	HP	H	W	D
BA0001GAA	1.2	1/4	0.8	1/8	6.38	8.74	7.28
BA0002GAA	1.9	1/4	1.6	1/4			
BA0003GAA	3.3	3/4	3.0	1/2			
BA0006GAA	6.0	1	5.0	1	7.36	10.04	9.25
BA0010GAA	9.6	3	8.0	2			
BA0012GAA	12.0	3	11.0	3			

### 200-240V / Three-Phase

Model Number CIMR-VU	Normal Duty		Heavy Duty		Dimensions (in.)		
	Rated Output Current (Amps)	HP	Rated Output Current (Amps)	HP	H	W	D
2A0001GAA	1.2	1/4	0.8	1/8	6.38	8.74	7.28
2A0002GAA	1.9	1/4	1.6	1/4			
2A0004GAA	3.5	3/4	3.0	1/2			
2A0006GAA	6.0	1	5.0	1	7.36	10.04	9.25
2A0010GAA	9.6	3	8.0	2			
2A0012GAA	12.0	3	11.0	3			
2A0020GAA	19.6	5	17.5	5	11.42	16.54	12.01
2A0030GAA	30	10	25	7.5			
2A0040GAA	40	10	33	10			
2A0056GAA	56	20	47	15			
2A0069GAA	69	25	60	20		18.31	

### 380-480V / Three-Phase

Model Number CIMR-VU	Normal Duty		Heavy Duty		Dimensions (in.)		
	Rated Output Current (Amps)	HP	Rated Output Current (Amps)	HP	H	W	D
4A0001GAA	1.2	1/2	1.2	1/2	6.38	8.74	7.28
4A0002GAA	2.1	1	1.8	3/4			
4A0004GAA	4.1	2	3.4	2			
4A0005GAA	5.4	3	4.8	3	7.36	10.04	9.25
4A0007GAA	6.9	4	5.5	3			
4A0009GAA	8.8	5	7.2	4			
4A0011GAA	11.1	7.5	9.2	5			
4A0018GAA	17.5	10	14.8	10	11.42	16.54	12.01
4A0023GAA	23	15	18	10			
4A0031GAA	31	20	24	15			
2A0038GAA	38	25	31	20			

### Major Applications



Food & Beverage



Packaging



Pump



Conveyor

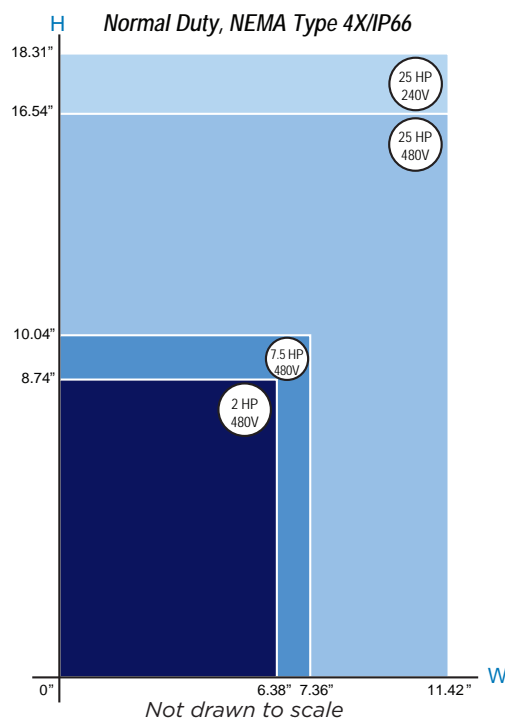


Industrial Washer



Refrigeration

### Size Comparison

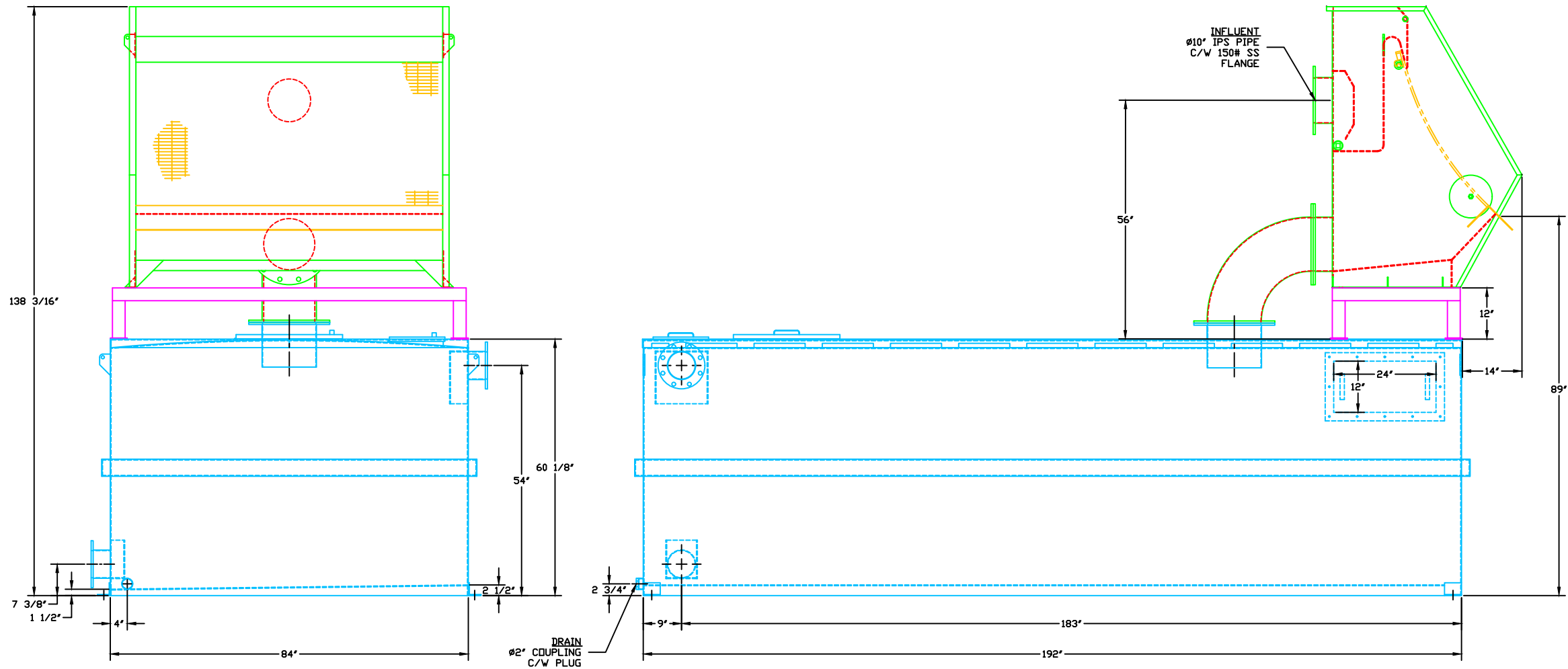
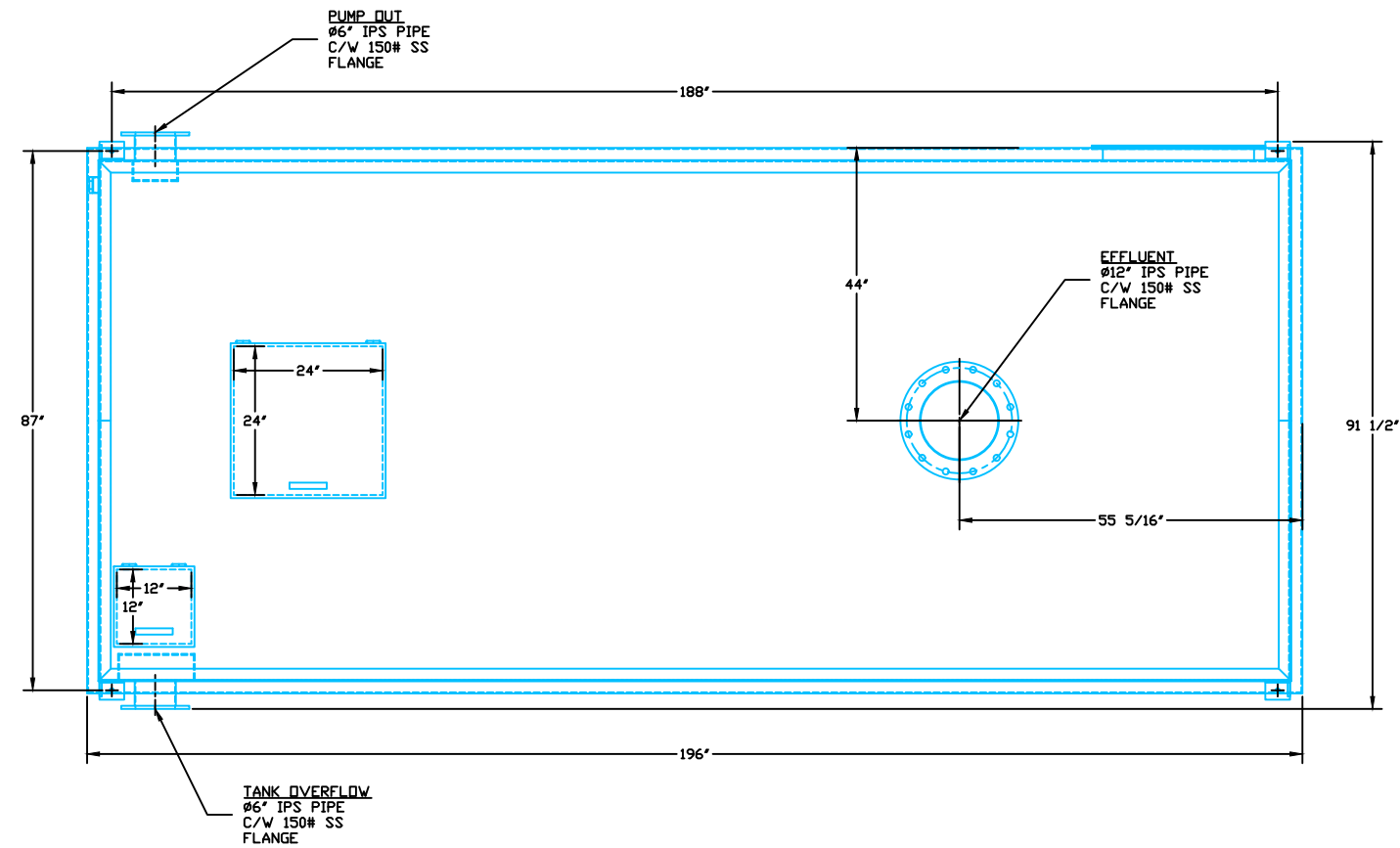


### Options\*

- 120 VAC Interface
- Network Communications: DeviceNet, EtherCAT, EtherNet/IP, MECHATROLINK-II, MECHATROLINK-III, Modbus TCP/IP, PROFIBUS-DP, PROFINET

\* Although the V1000-4X is compatible with most V1000 options, those options may not be waterproof. These options require special consideration regarding proper wiring techniques, including cable glands.





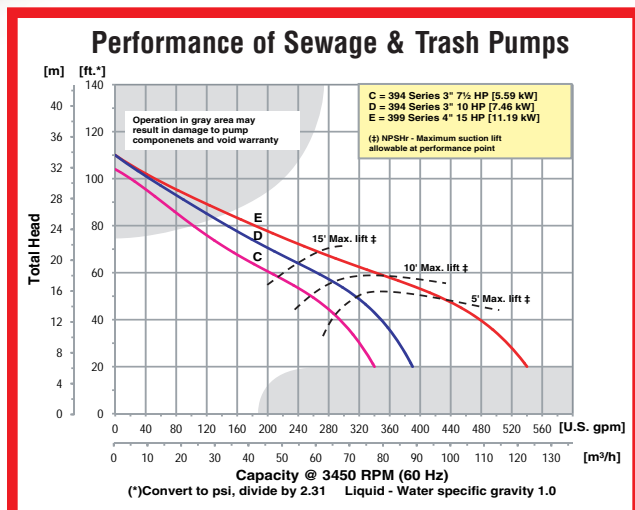
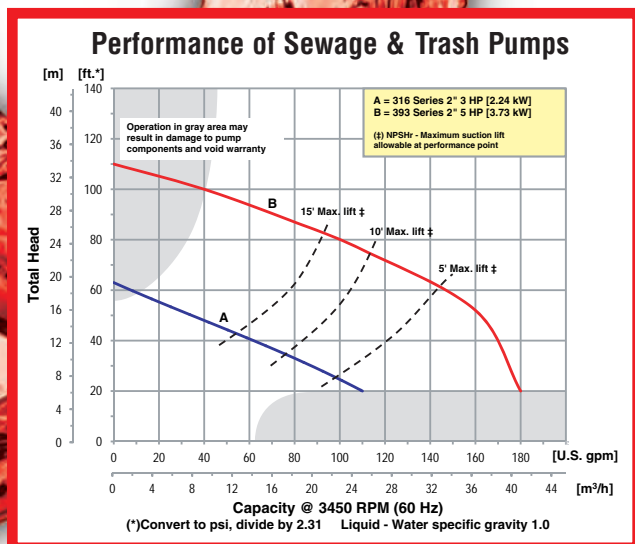
# COMPONENTS

ITEM	P/N	DESCRIPTION
1		<b>TANK</b> DIM: 192" L X 84" W X 60" H CONST.: 3/16" PLATE MATERIAL: 304 SS DRAIN: Ø2" FNPT C/W PLUG INFLUENT: Ø6" IPS PIPE C/W 150# FLANGE EFFLUENT: Ø6" IPS PIPE C/W 150# FLANGE OVERFLOW: Ø6" IPS PIPE C/W 150# FLANGE
2		<b>SHS 72 (EXISTING)</b> DIM: AS NOTED CONST.: 3/16" PLATE MATERIAL: 304 SS INFLUENT: Ø10" ID PIPE C/W 150# FLANGE EFFLUENT: Ø12" ID PIPE C/W 150# FLANGE NOTE: MODEL & DIMENSIONS TO BE CONFIRMED

SYM.	DESCRIPTION	DATE	BY
REVISIONS			
CUSTOMER:	TITLE:	<b>JWCC</b> JWC ENVIRONMENTAL CANADA ULC 2889 NORLAND AVE BURNABY BC CANADA V5B 3A9 1 800 663 8409	
PACIFIC SEAFOODS	SHS 72 C/W TANK		
PROJECT:			
****			
****			
QUOTE NO: 20161235	PROJECT: ****	SCALE:	
DRAWN: A.R.C.	CHK'D: A.R.I.	DWG. NO:	REV.
DATE: JUNE 28, 2017	DATE: JUNE 28, 2017	SHS72TANK	0

# Cast Iron Sewage & Trash Pumps

- **Cast Iron Construction**
- **Silicon Carbide/Viton® Mechanical Seal**
- **2", 3" & 4" NPT Ports Sizes**
- **Maximum Temperature 180° F**
- **Self-Priming to 20 Ft.**
- **Stainless Steel Semi-Open, Clog Resistant Impeller**
- **Buna-N Check Valve and O-Ring**
- **Removable Cast Iron Volute/Wearplate**
- **Easy Cleanout Design**
- **3" & 4" Models Feature Front Cleanout**
- **Pull-from-Rear Design**
- **Available with 3 to 15 HP Totally Enclosed Fan Cooled (TEFC) Electric Motors**



AMT Cast Iron Sewage/Trash pumps are designed for trouble free and economical handling of solids laden liquids and slurries. Pumps are available in three NPT port sizes: 2", 3" or 4". Cast iron construction with two vane stainless steel self-cleaning impellers, silicon carbide mechanical seals for abrasion resistance and Buna-N O-rings and check valves. Built-in check valve allows pump to reprime automatically in an open system without the foot valve. The solids handling capabilities of the pumps make them ideally suited for a variety of industrial applications including: sewage treatment, canneries, chemical processing, wineries, tanneries, meat packing, breweries, pulp, wood chips, process water, sludge and slime, waste water, white water and other applications. These sewage/trash pumps will easily handle liquids containing sewage, stones, sticks, mud and other solids. Minimum liquid requirement must be above 85% — maximum 15% solids. **Failure to do so may damage pump and void warranty.**

## Pump Dimensional & Specification Data

Model	HP	SUC*	DIS*	A**	B	C**	D	E	F	G	J**	K	L**	W**	H	Ship Wt. (Lbs.)
316B-95	3	2	2	2.4 [6.1]	2.1 [5.3]	3.8 [9.6]	3.5 [8.8]	4.7 [11.9]	3.1 [7.8]	6.1 [15.4]	11.1 [28.2]	2.4 [6.1]	20.3 [51.5]	9.3 [23.6]	8.8 [22.3]	94
316A-95	3	2	2	2.4 [6.1]	2.1 [5.3]	3.8 [9.6]	3.5 [8.8]	4.7 [11.9]	3.1 [7.8]	6.1 [15.4]	11.1 [28.2]	2.4 [6.1]	19.9 [50.5]	9.3 [23.6]	8.8 [22.3]	87
393B-95	5	2	2	3.7 [9.4]	2.1 [5.3]	5.5 [13.9]	5.2 [13.2]	4.7 [11.9]	3.1 [7.8]	6.9 [17.5]	14.8 [27.6]	4.4 [11.1]	27.4 [69.6]	13.4 [34.0]	10.0 [25.4]	189
393A-95	5	2	2	3.7 [9.4]	2.1 [5.3]	5.5 [13.9]	5.2 [13.2]	4.7 [11.9]	3.1 [7.8]	6.9 [17.5]	14.8 [27.6]	4.4 [11.1]	24.9 [63.2]	12.3 [31.2]	10.0 [25.4]	173
394B-95	7½	3	3	4.2 [10.6]	3.5 [8.8]	5.5 [13.9]	6.0 [15.2]	6.5 [16.5]	5.0 [12.7]	9.3 [23.6]	16.4 [41.6]	3.7 [9.4]	31.1 [79.0]	15.5 [39.4]	12.5 [31.7]	248
394A-95	7½	3	3	3.7 [9.4]	3.5 [8.8]	5.5 [13.9]	6.0 [15.2]	6.5 [16.5]	5.0 [12.7]	9.3 [23.6]	15.7 [39.7]	3.7 [9.4]	26.6 [67.5]	13.5 [34.3]	12.5 [31.7]	226
394F-95	10	3	3	4.2 [10.6]	3.5 [8.8]	7.0 [17.7]	6.1 [15.4]	9.0 [22.8]	8.8 [22.3]	12.5 [31.7]	19.7 [50.0]	3.7 [9.4]	34.3 [87.1]	15.5 [39.4]	15.1 [38.3]	450
394E-95	10	3	3	4.2 [10.6]	3.5 [8.8]	7.0 [17.7]	6.1 [15.4]	9.0 [22.8]	8.8 [22.3]	12.5 [31.7]	19.7 [50.0]	3.7 [9.4]	33.4 [84.8]	14.3 [36.3]	15.1 [38.3]	330
399C-95	15	4	4	4.2 [10.6]	3.5 [8.8]	7.0 [17.7]	6.1 [15.4]	9.0 [22.8]	8.8 [22.3]	12.5 [31.7]	19.7 [50.0]	3.7 [9.4]	33.4 [84.8]	14.3 [36.3]	15.1 [38.3]	350

(\*) Standard NPT (Female) pipe thread.

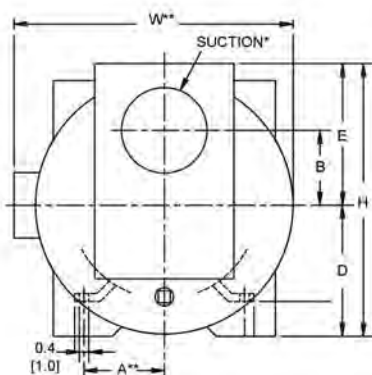
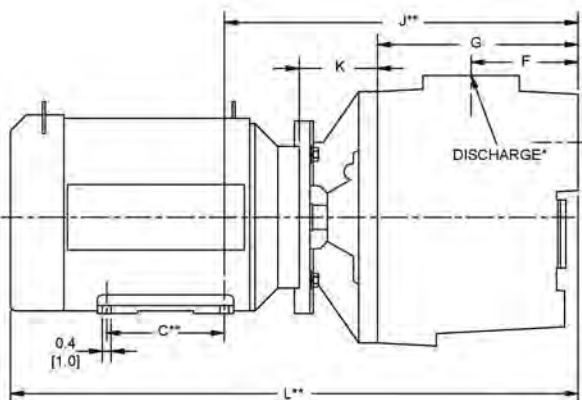
(\*\*) This dimension may vary due to motor manufacturer's specifications.

NOTE: Dimensions are in inches (centimeters) and have a tolerance of ±1/4".

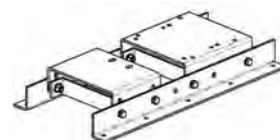
Model	Curve	HP	PH	ENC	Frame	Voltage @ 60 Hz +	Full Load Amps	Max Solids
316B-95 316A-95	A	3	1 3	TEFC	56J	230 230/460	16 8/4	1"
393B-95 393A-95	B	5	1 3	TEFC	184JM	230 230/460	20 17/9	1"
394B-95 394A-95	C	7½	1 3	TEFC	215JM 184JM	230 230/460	31 22/11	1½"
394F-95 394E-95	D	10	1 3	TEFC	215JM	230 230/460	40 26/13	1½"
399C-95	E	15	3	TEFC	215JM	230/460	47/24	2"

(+) 3-Phase models can also operate on 50 Hz (This will change full load amps and service factor, RPM and priming capabilities).

NOTE: Electric supply for ALL motors must be within ±10% of nameplate voltage rating (e.g. 230V ±10% = 207 to 253).



### Optional Mounting Base Model A200-90



## Standard Features

- Cast Iron Construction for Abrasive Resistance and Durability
- Silicon Carbide/Viton® Mechanical Seal
- Built-in Buna-N Check Valve
- Buna-N O-ring Casing Seal Reusable After Clean Out Maintenance
- Self-Cleaning Stainless Steel Impeller Resists Clogging and Wear
- Pull-from-Rear Design Permits Clean Out and Repair Without Removing Piping
- 3" & 4" Models Feature Front Cleanout
- Replaceable Cast Iron Volute/Wearplate Designed for Solids Handling
- Motor Includes Stainless Steel Shaft or Stainless Steel Shaft Sleeve
- Available with 3 to 15 HP Totally Enclosed Fan Cooled (TEFC) Electric Motors
- Single or Three Phase, 3450 RPM Motors
- Optional Mounting Base Available for 184/215 JM Frames
- Maximum Working Pressure 150 PSI
- Seal Flush Port Provided on 5 HP and Larger
- Optional Mounting Base Available
- QSP – Quick Ship Pump for Many Models

**Hazardous Duty/Xplosion Proof motors available from stock ranging from 1 to 10 HP; CALL FOR QUOTATION & LEAD TIME!**



# CHEMFLO 5

## 2" x 1-1/2" End Suction Centrifugal Pump

Made with high quality investment cast 316 stainless steel components, the ChemFlo® series of pumps are designed to be applied in a wide range of pumping applications where stainless steel is required.

The ChemFlo® 5 pumps utilize an enclosed impeller designed for achieving higher heads and efficiencies than a standard semi-open impeller. Multiple impeller trims allow the ChemFlo® 5 to meet most duty points up to 305 GPM and total head up to 157 feet. Several mechanical seal options are available in addition to the standard type 2100 carbon / ceramic / Viton mechanical seal.

ChemFlo® 5 pumps are offered in two configurations, pump (with motor) and PumPAK® (without motor) versions. Electric and hydraulic motors can be close coupled to ChemFlo® 5 pumps or pedestal mounted versions are also available for long coupling.



### Application

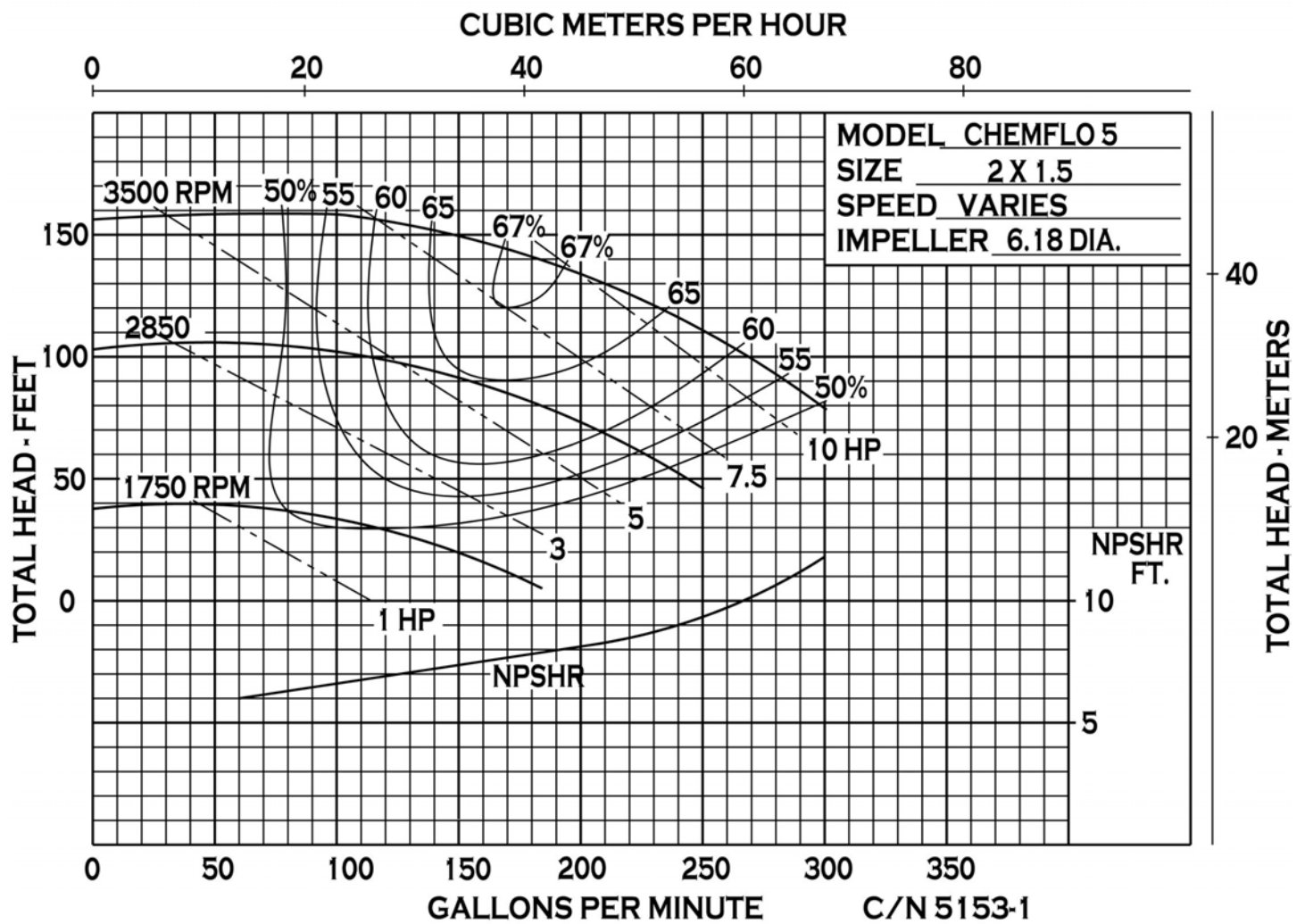
- Agricultural
- Commercial
- Industrial
- Marine
- OEM

### Drive Sleeve

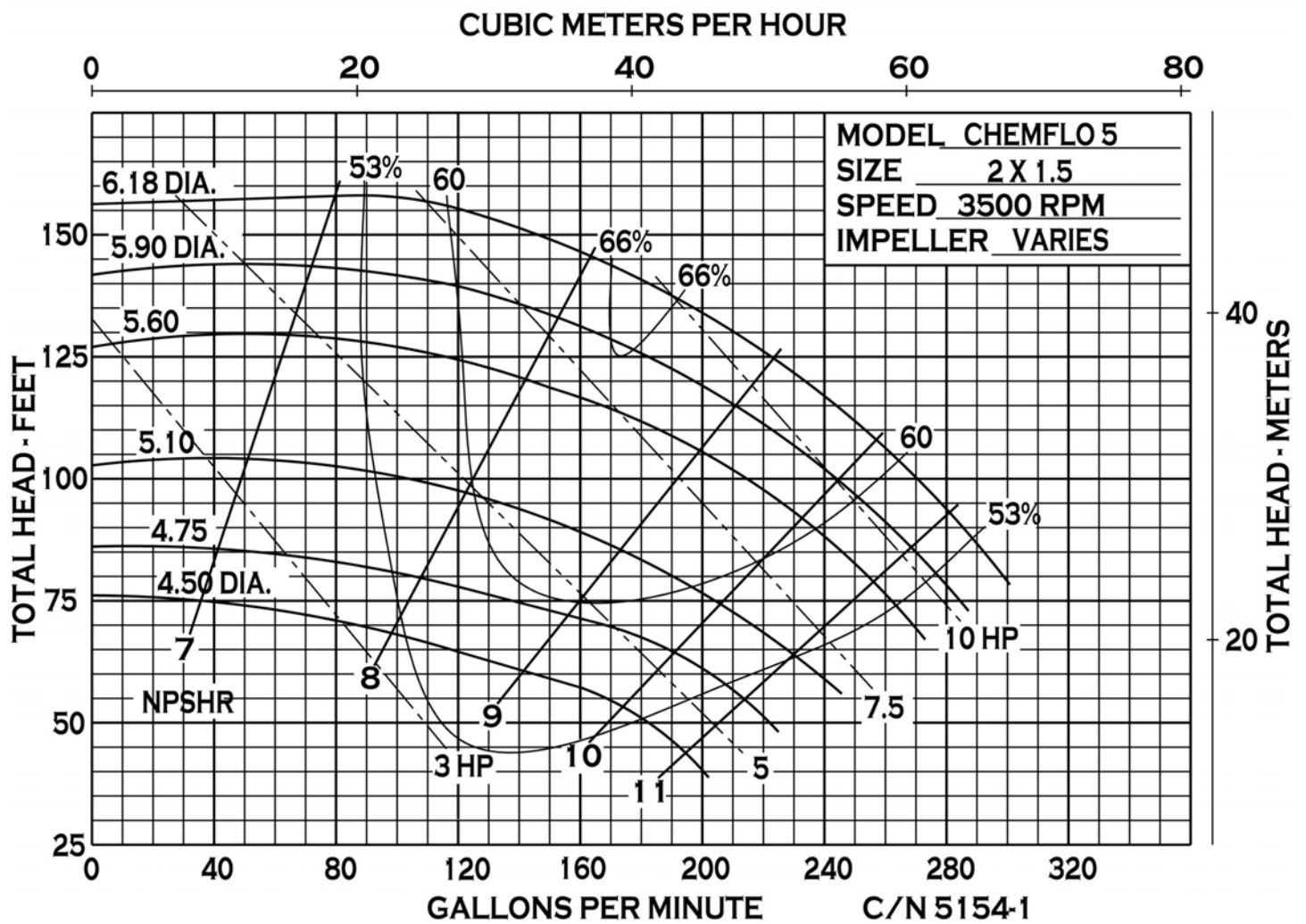
- 316 stainless steel

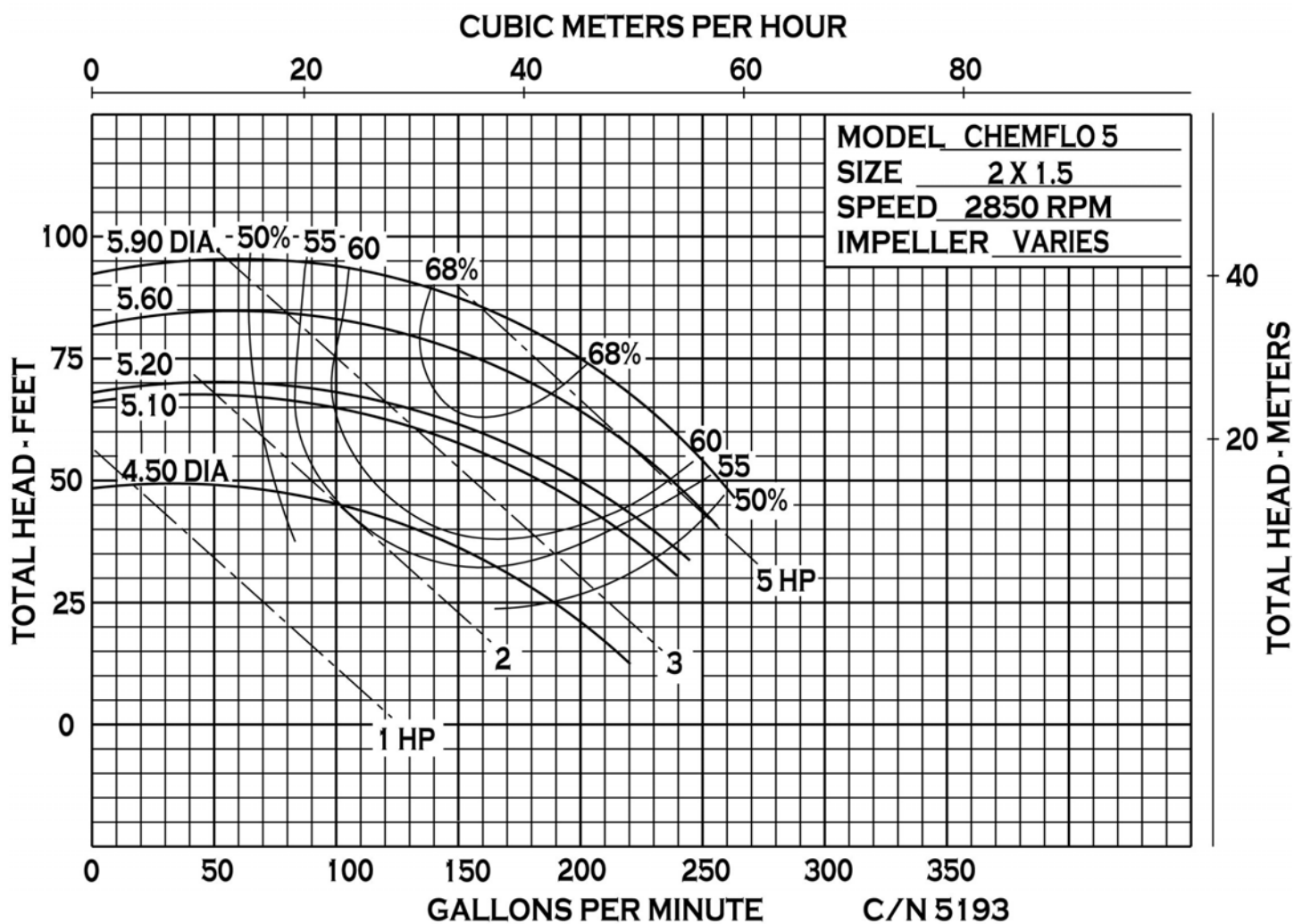
## SPECIFICATIONS:

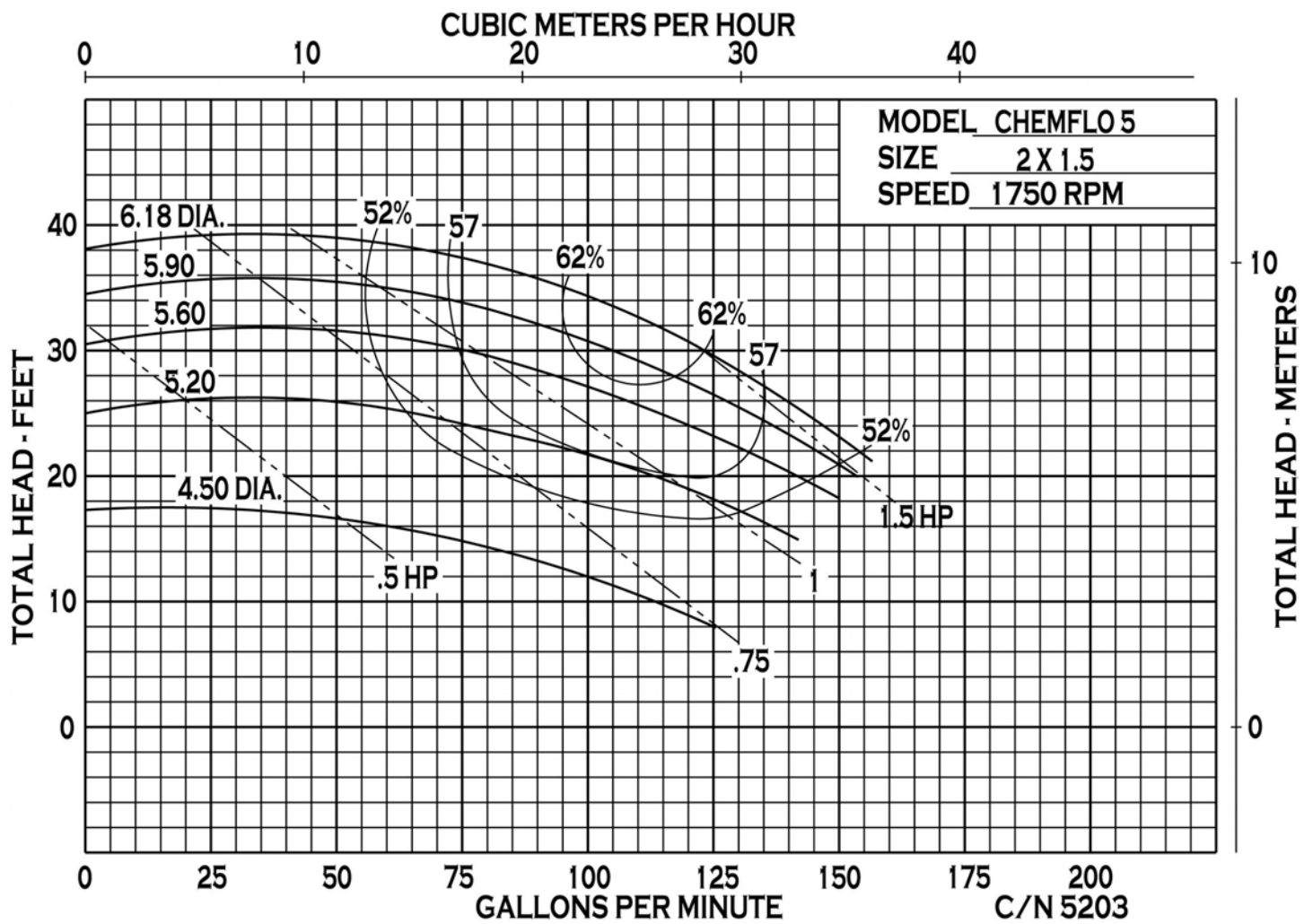
Suction And Discharge	2" x 1-1/2" ANSI 150# flange
Materials Of Construction	316 stainless steel
Flow	Up to 305 GPM
Head Feet	Up to 157'
Impeller	6.18" enclosed, cast 316 SS
Motor	Up to 10 HP
Drive Options	Close coupled 184TC, Close coupled 215TC, Close coupled 145TC, Pedestal, PumPAK® (without motor)
Seal	Special seal material combinations available (consult factory), Standard carbon / ceramic / Viton
Options	Hydraulic motor 1.16 cu. in., Hydraulic motor 1.59 cu. in., Tap for recirculation or seal flush



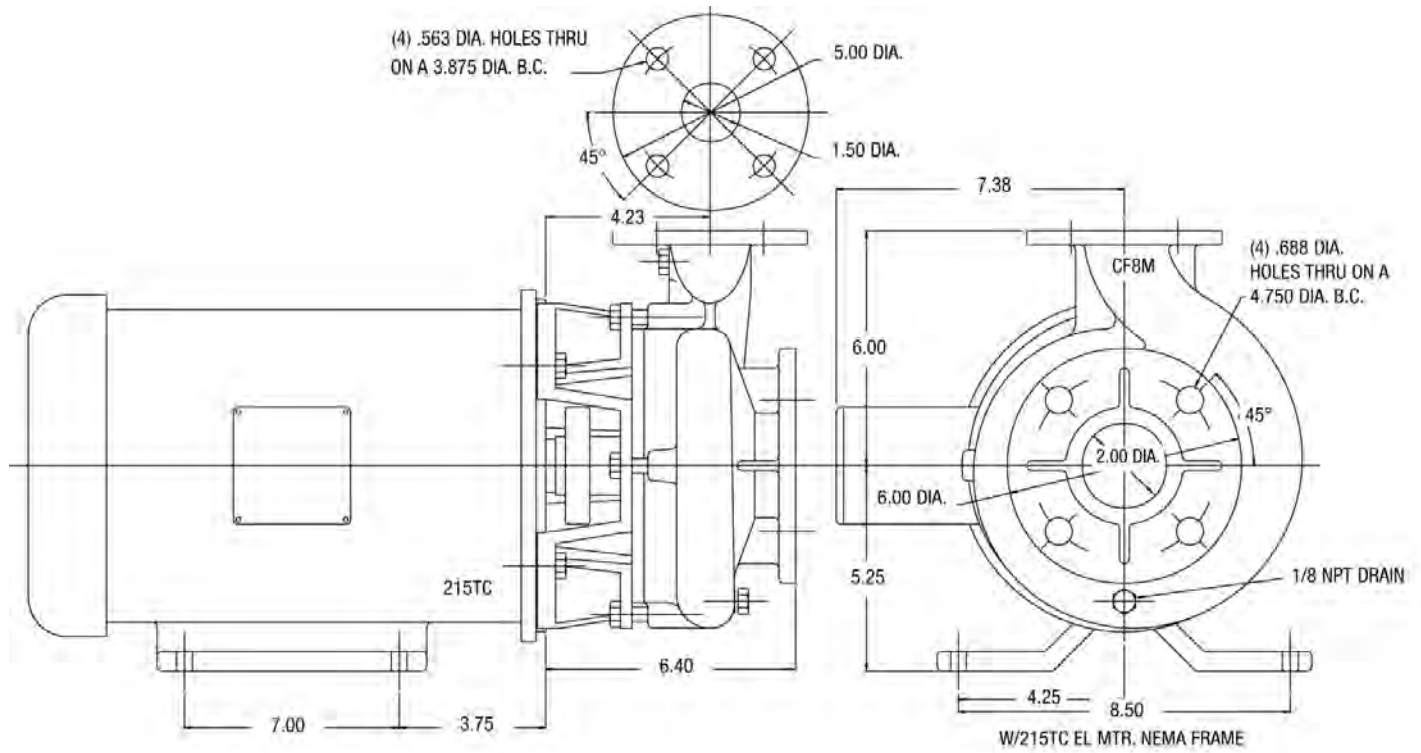


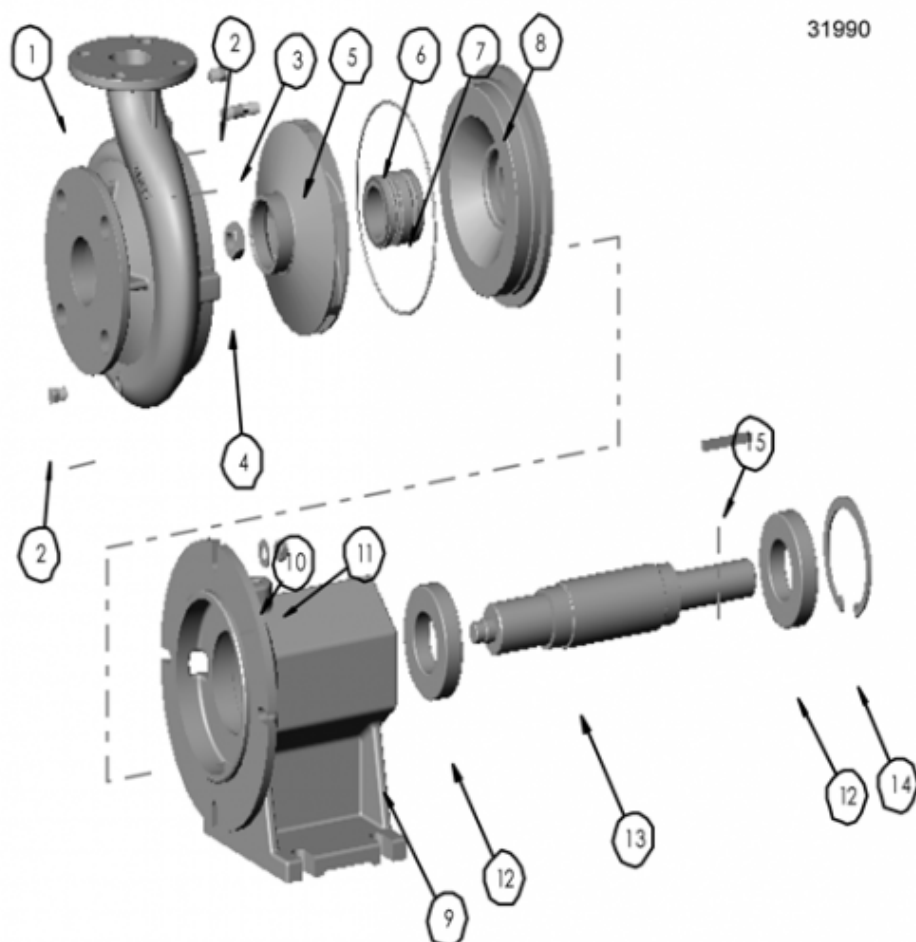








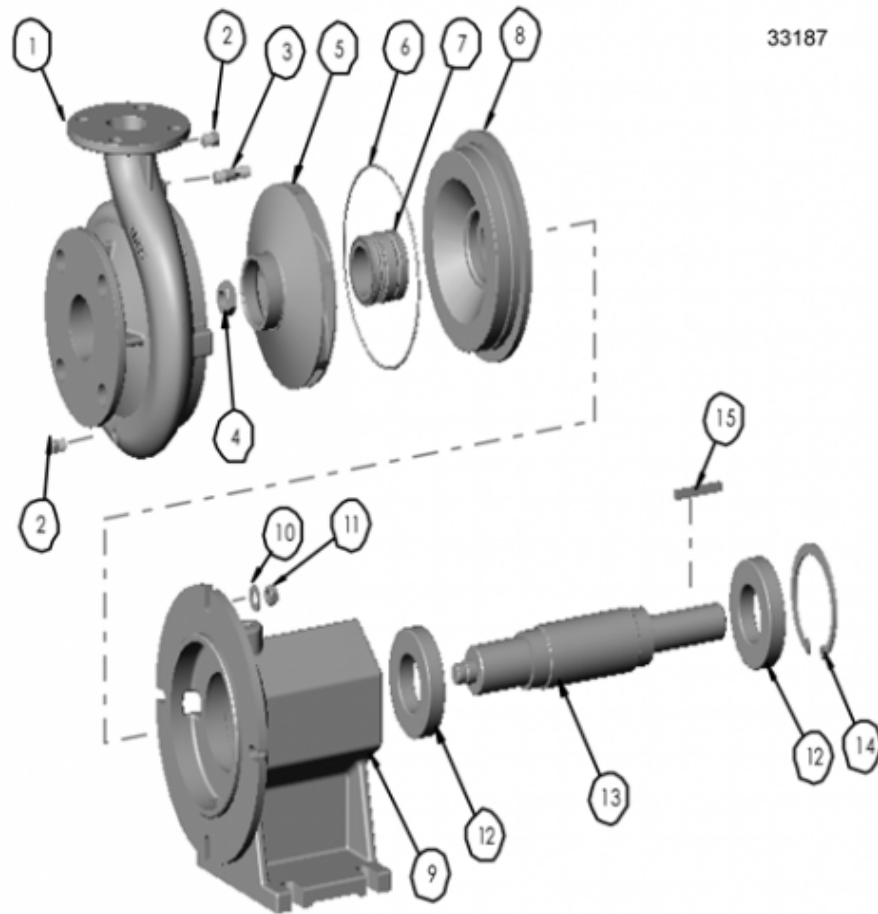




31990

ITEM NO.	PART NO.	DESCRIPTION	QTY.
1	31098	VOLUTE S.S.	1
2	21255	PIPE PLUG S.S.- 1/8" NPT	2
3	21261	STUD S.S.- 3/8-16 X 1 5/8"	4
4	29194	HEX JAM NUT S.S.- 5/8-18	1
5	31096	IMPELLER S.S.- 6.18" DIA.	1
6	31233	O-RING- VITON	1
7	31374	MECH. SEAL- 1.5" T-2100	1
8	31093	SEAL HOUSING S.S.	1
9	31656	BEARING HOUSING	1
10	28053	WASHER S.S.- 3/8	4
11	21268	HEX NUT S.S.- 3/8-16	4
12	31804	BALL BEARING	2
13	31802	DRIVE SHAFT S.S.	1
14	31803	SNAP RING	1
15	26796	SQUARE KEY- .25"	1

\*- RECOMMENDED REPLACEMENT PARTS



33187

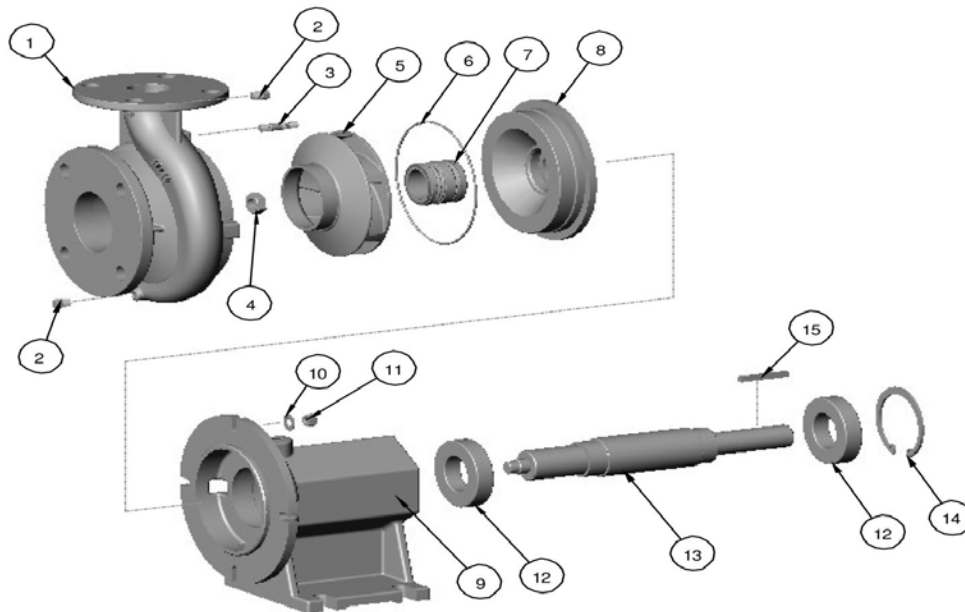
ITEM NO.	PART NO.	DESCRIPTION	QTY.
1	31098	VOLUTE S.S.	1
2	21255	PIPE PLUG S.S.- 1/8" NPT	2
3	21261	STUD S.S.- 3/8-16 X 1 5/8"	4
4	29194	HEX JAM NUT S.S.- 5/8-18	1
5	31461	IMPELLER S.S.- 4.50" DIA.	1
6	31233	O-RING- VITON	1
7	31374	MECH. SEAL- 1.5" T-2100	1
8	31093	SEAL HOUSING S.S.	1
9	31656	BEARING HOUSING	1
10	28053	WASHER S.S.- 3/8	4
11	21268	HEX NUT S.S.- 3/8-16	4
12	31804	BALL BEARING	2
13	31802	DRIVE SHAFT S.S.	1
14	31803	SNAP RING	1
15	26796	SQUARE KEY- .25"	1

\*- RECOMMENDED REPLACEMENT PARTS



## CHEMFLO 5 &amp; 6

## Pedestal Pump

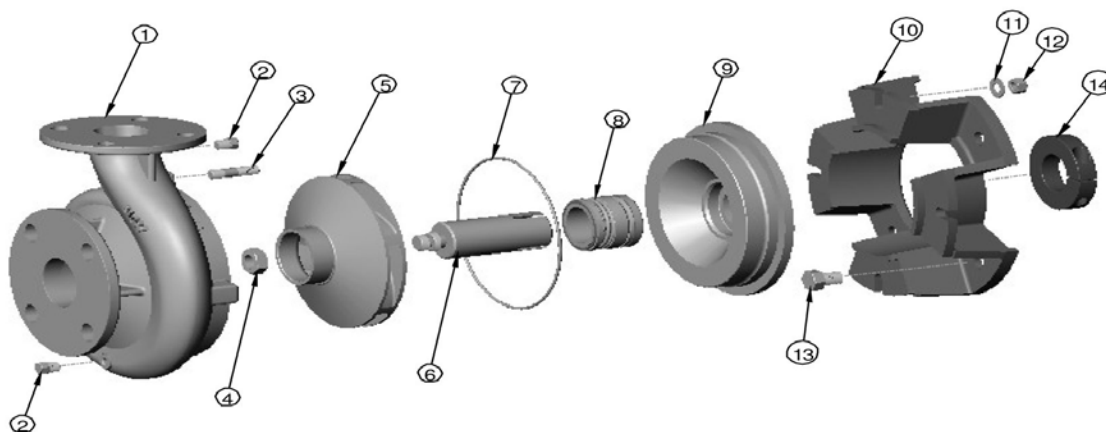


ITEM NO.	PART NO.	DESCRIPTION	QTY.
1	31098	VOLUTE S.S. CHEM 5      2 x 1.5	1
	31469	VOLUTE S.S. CHEM 6      3 x 2	1
2	21255	PIPE PLUG S.S.- 1/8" NPT	2
3	33161	STUD S.S.- 3/8-16 X 2	4
* 4	29194	HEX JAM NUT S.S.- 5/8-18	1
5	31096	IMPELLER S.S.- 6.18"      CF5	1
	31467	IMPELLER S.S.- 6.18"      CF6	1
* 6	31233	O-RING- VITON	1
* 7	31374	MECH. SEAL- 1.5" T-2100	1
8	31093	SEAL HOUSING S.S.	1
9	31656	BEARING HOUSING	1
10	28053	WASHER S.S.- 3/8	4
11	21268	HEX NUT S.S.- 3/8-16	4
* 12	31804	BALL BEARING	2
13	31802	DRIVE SHAFT S.S.	1
14	31803	SNAP RING	1
15	33232	SQUARE KEY- .25"	1

7089-A

## CHEMFLO 5 &amp; 6

Pumpak



ITEM NO.	PART NO.	DESCRIPTION	QTY.
1	31098	VOLUTE S.S. CHEM5 2 x 1.5	1
	31469	VOLUTE S.S. CHEM6 3 x 2	1
2	21255	PIPE PLUG S.S.- 1/8" NPT	2
3	33161	STUD S.S.- 3/8-16 X 2"	4
4	29194	HEX JAM NUT S.S.- 5/8-18	1
5	31096	IMPELLER S.S.- 6.18" CHEM 5	1
	31467	IMPELLER S.S.- 6.18" CHEM 6	1
6	31806	DRIVE SLEEVE S.S. 145TC	1
	31094	DRIVE SLEEVE S.S. 184TC	1
	31311	DRIVE SLEEVE S.S. 215TC	1
7	31233	O-RING- VITON	1
8	31374	MECH. SEAL- 1.5" T-2100	1
9	31093	SEAL HOUSING S.S. CHEM 5 & 6	1
10	31711	MOTOR ADAPTER- 145TC	1
	31091	MOTOR ADAPTER- 184T/215TC	1
11	28053	WASHER S.S.- 3/8"	4
12	21268	HEX NUT S.S.- 3/8-16	4
13	31235	CAP SCREW S.S.- 1/2-13	4
14	23039	CLAMP ASSY 1" 145TC	1
	31099	CLAMP - 1.38" 184TC	1
	31312	CLAMP- 1.5" 215TC	1

7090-A





Level



Pressure



Flow



Temperature

Liquid  
Analysis

Registration

Systems  
Components

Services



Solutions

## Technical Information

# Prosonic T FMU30

## Ultrasonic Level Measurement

Compact transmitters for non-contact level measurement of fluids, pastes and coarse bulk materials



### Application

- Continuous, non-contact level measurement in fluids, pastes, sullages and coarse bulk materials
- System integration via 4 to 20mA
- Maximum measuring range:
  - 1½" sensor: 5 m (16 ft) in fluids  
2 m (6 ft) in bulk materials
  - 2" sensor: 8 m (26 ft) in fluids  
3.5 m (11 ft) in bulk materials

### Features and benefits

- Quick and simple commissioning via menu-guided on-site operation with four-line plain text display; 7 languages selectable
- Envelope curves on the on-site display for simple diagnosis
- Linearization function (up to 32 points) for conversion of the measured value into any unit of length, volume or flow rate
- Non-contact measurement method minimizes service requirements
- Installation possible from thread G 1½" or NPT 1½" upwards
- Integrated temperature sensor for automatic correction of the temperature dependent sound velocity

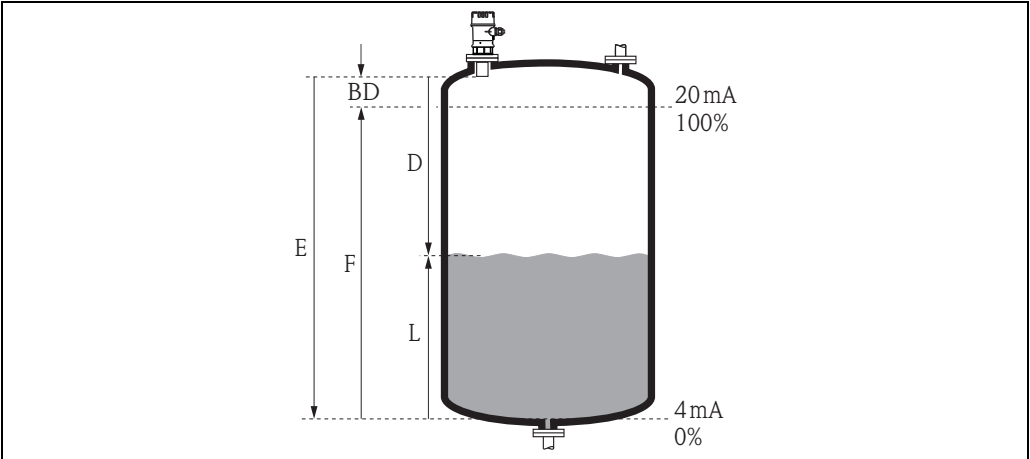
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## Function and system design

### Measuring principle



<i>BD</i>	<i>Blocking distance</i>	<i>D</i>	<i>Distance from sensor membrane - product surface</i>
<i>E</i>	<i>Empty distance</i>	<i>F</i>	<i>Span (full distance)</i>
<i>L</i>	<i>Level</i>		

Sensor	BD	Max. range fluids	Max. range bulk materials
1 1/2"	0.25 m (0.8 ft)	5 m (16 ft)	2 m (6.6 ft)
2"	0.35 m (1.1 ft)	8 m (26 ft)	3.5 m (11 ft)

### Time-of-flight method

The sensor of the instrument transmits ultrasonic pulses in the direction of the product surface. There, they are reflected back and received by the sensor. The instrument measures the time  $t$  between pulse transmission and reception. The instrument uses the time  $t$  (and the velocity of sound  $c$ ) to calculate the distance  $D$  between the sensor membrane and the product surface:

$$D = c \cdot t / 2$$

As the device knows the empty distance  $E$  from a user entry, it can calculate the level as follows:

$$L = E - D$$

An integrated temperature sensor (NTC) compensates for changes in the velocity of sound caused by temperature changes.

### Interference echo suppression

The interference echo suppression feature on the instrument ensures that interference echos (e.g. from edges, welded joints and installations) are not interpreted as a level echo.

### Calibration

Enter the empty distance  $E$  and the span  $F$  to calibrate the device.

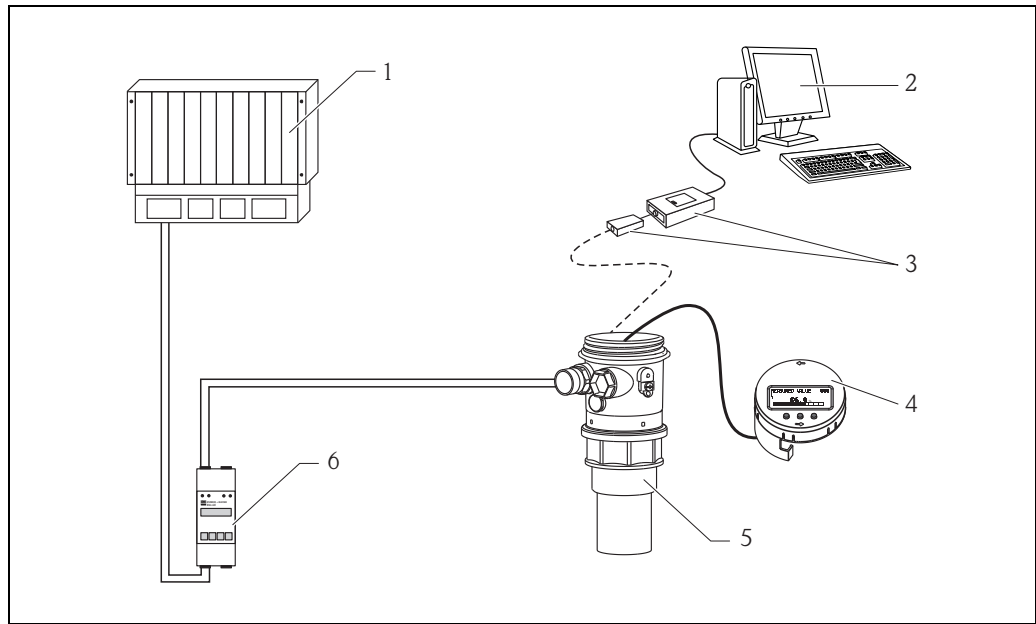
### Blocking distance

Span  $F$  may not extend into the blocking distance  $BD$ . Level echos within the blocking distance cannot be evaluated due to the transient characteristics of the sensor.



**Equipment architecture**

The complete measuring system consists of:



L00-FMU30xxx-14-00-06-xx-008


- 1 PLC (programmable logic controller)
- 2 Computer with operating tool (e.g. FieldCare)
- 3 Commubox FXA291 and ToF Adapter FXA291
- 4 Operating and display module
- 5 Prosonic FMU30
- 6 Transmitter power supply unit RMA42 or RN221N

**On-site operation**

- With display and operating module
- With a PC, Commubox FXA291 + ToF Adapter FXA291 and the operating software FieldCare

## Input

### Measured variable

The distance D between the sensor membrane and the product surface is measured, see also figure →  3.

Using the linearization function, the device uses D to calculate:

- Level L in any units
- Volume V in any units
- Flow Q across measuring weirs or open channels in any units

### Measuring range

The measuring range is limited by the range of a sensor. The sensor range is, in turn, dependent on the operating conditions. To estimate the actual range, proceed as follows (see also the calculation example in the diagram):

1. Determine which of the influences shown in the following table are appropriate for your process.
2. Add the corresponding attenuation values.
3. From the total attenuation, use the diagram to calculate the range.

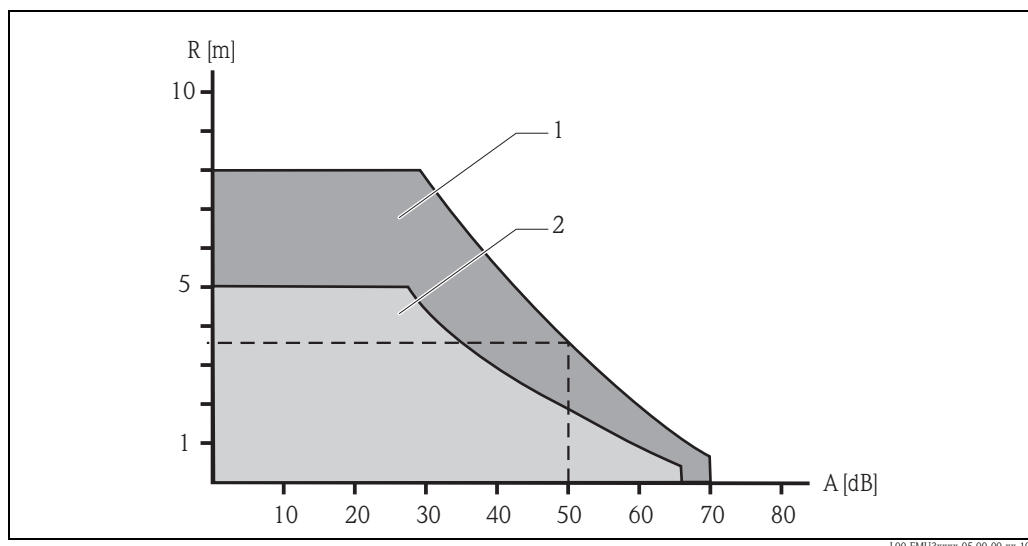
Fluid surface	Attenuation
Calm	0 dB
Waves	5 to 10 dB
Strong turbulence (e.g. stirrers)	10 to 20 dB
Foaming	Please contact your Endress+Hauser sales representative.

Bulk material surface	Attenuation
Hard, rough (e.g. rubble)	40 dB
Soft (e.g. peat, dust-covered clinker)	40 to 60 dB

Dust	Attenuation
No dust formation	0 dB
Little dust formation	5 dB
Heavy dust formation	5 to 20 dB

Filling curtain in detection range	Attenuation
None	0 dB
Small quantities	5 to 10 dB
Large quantities	10 to 40 dB

Temperature difference between sensor and product surface	Attenuation
to 20 °C (68 °F)	0 dB
to 40 °C (104 °F)	5 to 10 dB
to 60 °C (140 °F)	10 to 15 dB



1     Sensor 2"  
 2     Sensor 1½"  
 A     Attenuation (dB)  
 R     Range (m)

### Example

■ Strong turbulence surface	approx. 50 dB	
■ No dust formation	0 dB	
■ Filling curtain in detection range	10 dB	
■ Temperature diff. < 20 °C (68 °F)	0 dB	
	approx. 50 dB	⇒ range approx. 3.5 m (11 ft) for FMU30 2" sensor

These measuring conditions have been taken into account during the calculation of the maximum measuring range in solid applications.

### Operating frequency

1½" sensor	2" sensor
approx. 70 kHz	approx. 50 kHz

## Output

### Output signal

4 to 20 mA

### Signal on alarm

Error information can be accessed via the following interfaces:

- On-site display (error symbol, error code and plain text description)
- Current output, signal on error can be selected (e.g. according to NAMUR recommendation NE43)

### Output damping

Freely selectable, 0 to 255 s

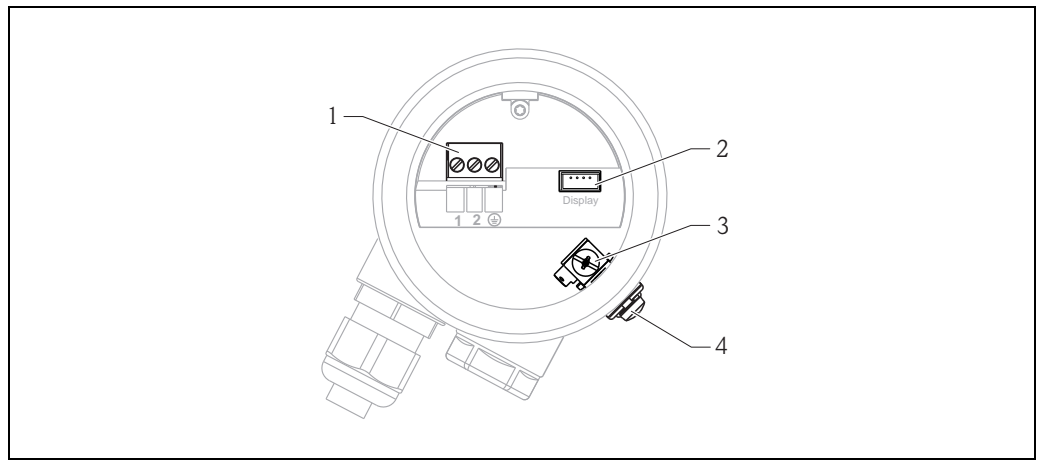
### Linearization

The linearization function of the instrument allows conversion of the measured value into any unit of length or volume. In open channels or measuring weirs, also a flow linearization is possible (calculation of the flow from the measured level). The linearization table for calculating the volume in an horizontal cylindrical tank is preprogrammed. You can also enter any number of other tables containing up to 32 value pairs either manually or semi-automatically (by filling the vessel under controlled conditions).

## Power supply

### Terminal compartment

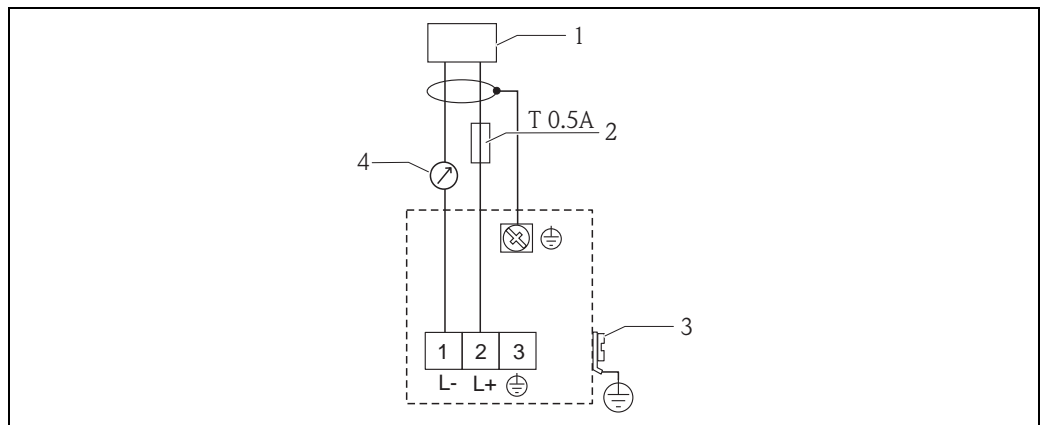
The terminals are located underneath the housing cover.



L00-FMU30xxx-04-00-00-xx-001

- 1 Terminals
- 2 Optional: display
- 3 Internal earth terminal
- 4 External earth terminal

### Terminal assignment



L00-FMU30xxx-04-00-00-de-015

- 1 Power
- 2 Fuse as per IEC 60127, T 0.5 A
- 3 Plant ground
- 3 4...20 mA

- Connect the connecting line to the screw terminals (line cross-sections of 0.25 to 2.5mm<sup>2</sup> (24...14 AWG)) in the terminal compartment.
- A standard installation cable is sufficient for the connection.
- Protective circuitry against reverse polarity, RFI and over-voltage peaks is built into the device (see also Technical Information TI00241F/00/EN "EMC Test Procedures")

<b>Supply voltage</b>	14-35 V
<b>Terminals</b>	Cable cross-section: 0.25 to 2.5 mm <sup>2</sup> (24 to 14 AWG)
<b>Cable entry</b>	G ½" or ½" NPT
<b>Cable gland</b>	M20x1.5 (recommended cable diameter 6 to 10 mm (0.24 to 0.39 in))
<b>Power consumption</b>	51 mW to 800 mW
<b>Current consumption</b>	3.6 to 22 mA

## Performance characteristics

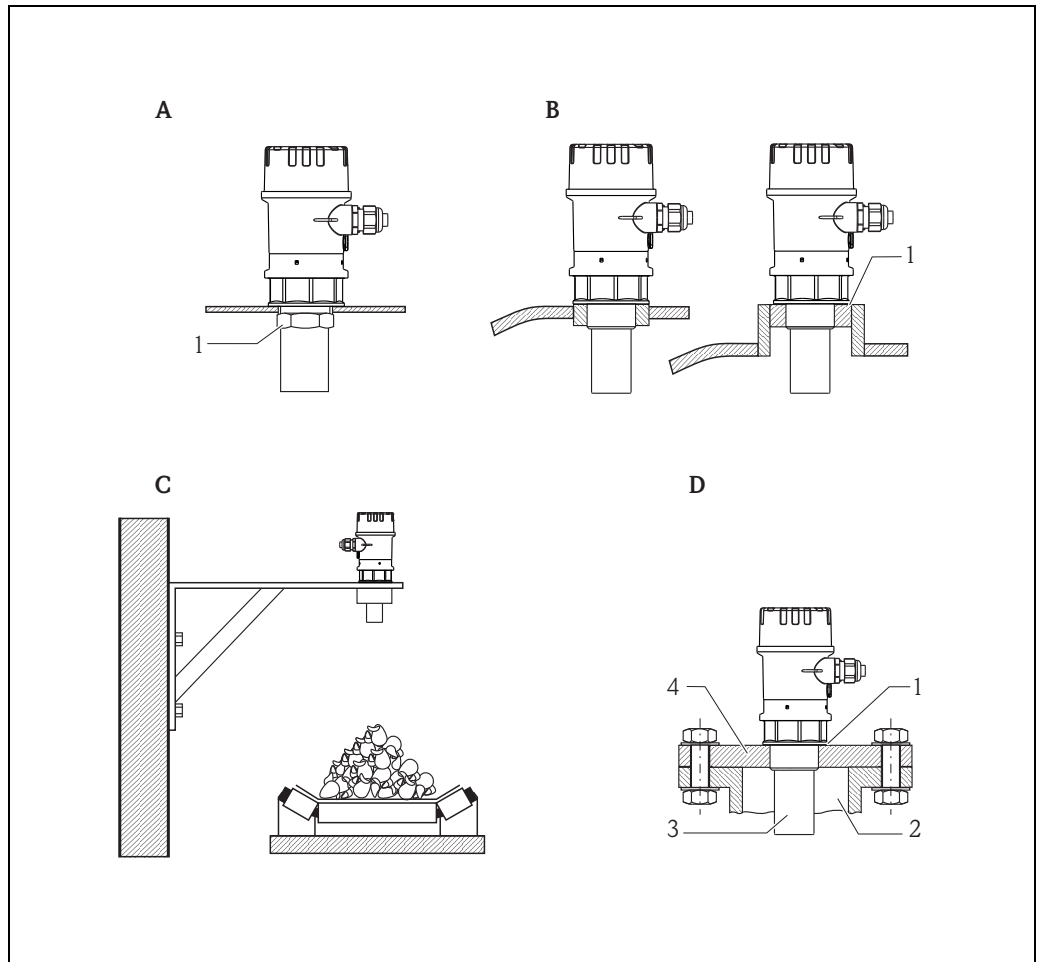
<b>Reaction time</b>	The reaction time depends on the parameter settings. The minimum value is: min. 2 s
<b>Reference operating conditions</b>	<ul style="list-style-type: none"> <li>■ Temperature = +20 °C (+68 °F)</li> <li>■ Pressure = 1013 mbar abs. (15 psi abs.)</li> <li>■ Humidity = 50 %</li> <li>■ Ideal reflective surface (e.g. calm, smooth fluid surface)</li> <li>■ No interference reflections within signal beam</li> <li>■ Set application parameters: <ul style="list-style-type: none"> <li>– Tank shape = dome ceiling</li> <li>– Medium property = liquid</li> <li>– process conditions = standard liquid</li> </ul> </li> </ul>
<b>Measured value resolution</b>	1 mm (0.04 in)
<b>Pulse frequency</b>	max. 0.5Hz The exact values are dependent on the type of device and the parameter settings.
<b>Maximum measuring error<sup>1) 2)</sup></b>	±0.2 % of the maximum span of the sensor
<b>Typical measuring error<sup>2)</sup></b>	Include linearity, repeatability, and hysteresis Better than: ±3 mm (±0.12 in) or 0.2 % of measuring distance*  * whichever is greater
<b>Influence of the vapor pressure</b>	<p>The vapor pressure at 20 °C (68 °F) gives a hint on the accuracy of the ultrasonic level measurement. If the vapor pressure at 20 °C (68 °F) is below 50 mbar (1 psi), ultrasonic level measurement is possible with a very high accuracy. This is valid for water, aqueous solutions, water-solid-solutions, dilute acids (hydrochloric acid, sulfuric acid, ...), dilute bases (caustic soda, ...), oils, greases, slurries, pastes, ...</p> <p>High vapor pressures or outgassing media (ethanol, acetone, ammonia, ...) can influence the accuracy. If conditions like these are present, please contact your Endress+Hauser sales representative.</p>

1) according to EN 61298-2

2) with reference operating conditions

## Installation

### Installation variants



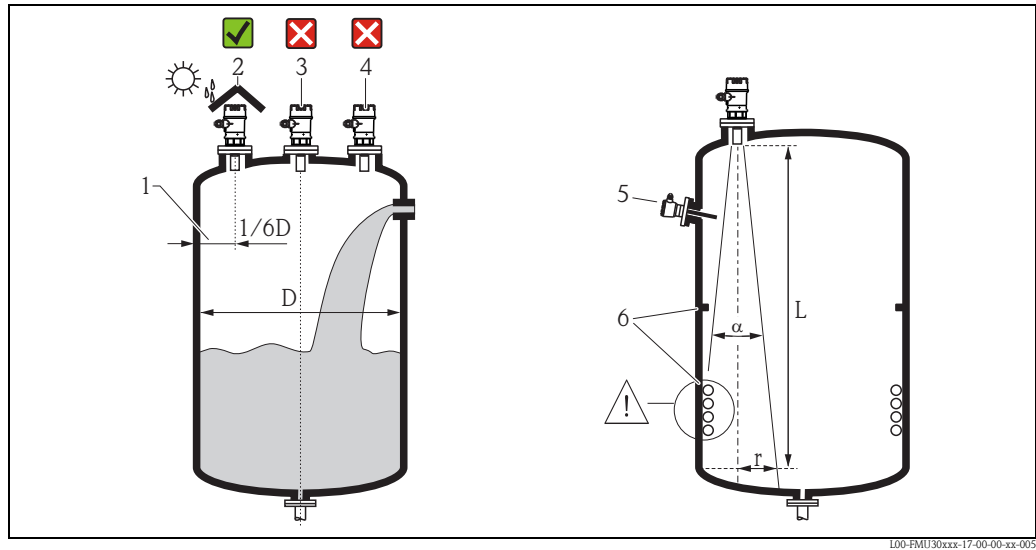
L00-FMU30xxx-17-00-00-xx-002

- A** Installation with counter nut  
 1 counter nut (PC) supplied for G1½ and G2 instruments
- B** Installation with sleeve  
 1 sealing (EPDM) supplied
- C** Installation with installation bracket
- D** Installation with screw in flange  
 1 sealing (EPDM) supplied  
 2 nozzle  
 3 sensor  
 4 screw in flange

For installation bracket or screw in flange → 22, "Accessories".



### Installation conditions for level measurements



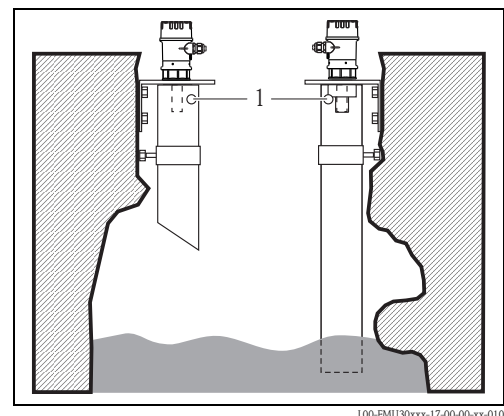
- Do not install the sensor in the middle of the tank (3). We recommend leaving a distance between the sensor and the tank wall (1) measuring  $1/6$  of the tank diameter.
- Protect the device against direct sun or rain (2) → 26 "Weather protection cover".
- Avoid measurements through the filling curtain (4).
- For solid application where bulk solid cones appear, align the sensor membrane perpendicular to the surface.
- Make sure that equipment (5) such as limit switches, temperature sensors, etc. are not located within the emitting angle  $\alpha$ . In particular, symmetrical equipment (6) such as heating coils, baffles etc. can influence measurement.
- Never install two ultrasonic measuring devices in a tank, as the two signals may affect each other.
- To estimate the detection range, use the 3 dB emitting angle  $\alpha$ .

Sensor	$\alpha$	$L_{\max}$	$r_{\max}$
1½"	11°	5 m (16 ft)	0.48 m (1.6 ft)
2"	11°	8 m (26 ft)	0.77 m (2.5 ft)

### Installation in narrow shafts

In narrow shafts with strong interference echoes, we recommend using an ultrasound guide pipe (e.g. PE or PVC wastewater pipe) with a minimum diameter of 100 mm (3.94 in).

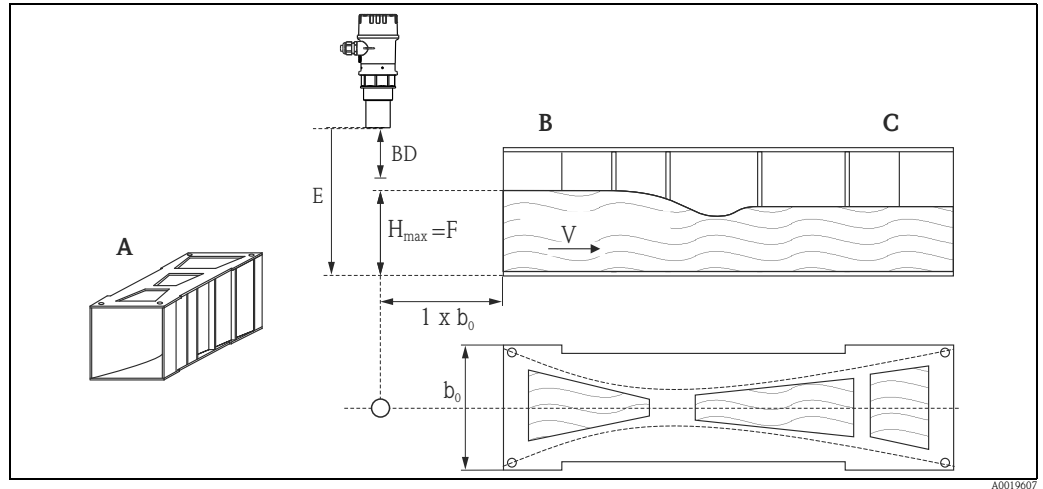
Make sure that the pipe is not soiled by accumulated dirt. If necessary, clean the pipe at regular intervals.



1 Venting hole

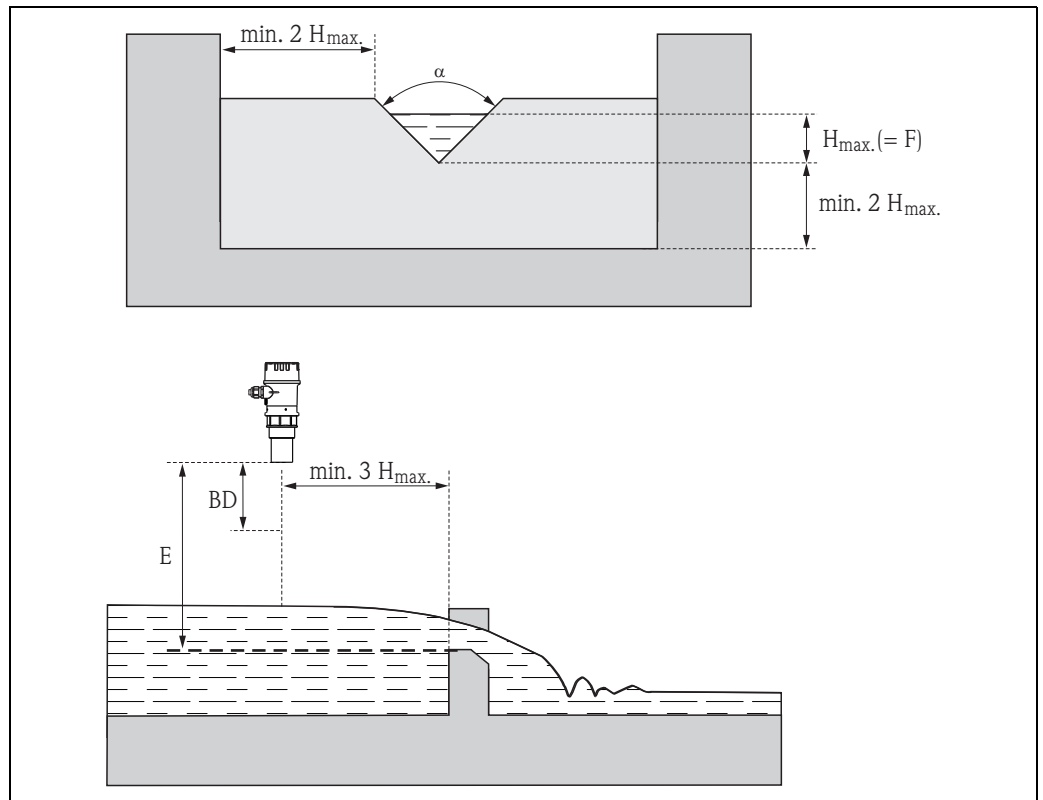
**Installation conditions for flow measurements**

- Install the instrument at the inflow side (B), as close above the maximum water level  $H_{\max}$  as possible (take into account the blocking distance BD).
- Position the instrument in the middle of the channel or weir.
- Align the sensor membrane parallel to the water surface.
- Keep to the installation distance of the channel or weir.

**Example: Khafagi-Venturi flume**

A Khafagi-Venturi flume  
B Inflow  
C Outflow

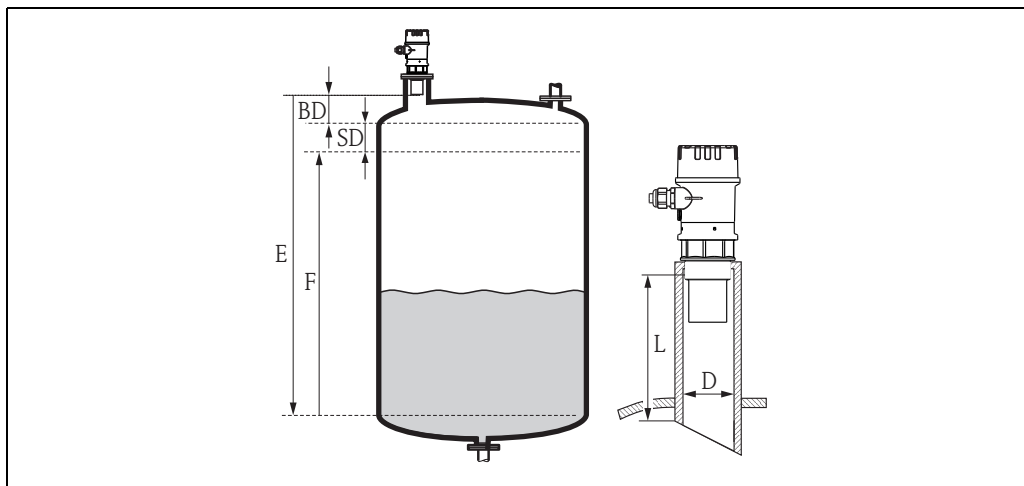
BD Blocking distance  
E Empty calibration  
F Full calibration  
V Direction of flow

**Example: Triangular weir**

BD Blocking distance  
E Empty calibration  
F Full calibration

### Blocking distance, nozzle installation

Install the instrument at a height so that the blocking distance BD is not undershot, even at maximum fill level. Use a pipe nozzle if you cannot maintain the blocking distance in any other way. The interior of the nozzle must be smooth and may not contain any edges or welded joints. In particular, there should be no burr on the inside of the tank side nozzle end. Note the specified limits for nozzle diameter and length. To minimise disturbing factors, we recommend an angled socket edge (ideally 45°).



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*BD* Blocking distance  
*SD* Safety distance  
*E* Empty calibration

*F* Full calibration (span)  
*D* Nozzle diameter  
*L* Nozzle length

Nozzle diameter	Maximum nozzle length mm (in)	
	1½" sensor	2" sensor
DN50/2"	80 (3.15)	—
DN80/3"	240 (9.45)	240 (9.45)
DN100/4"	300 (11.8)	300 (11.8)
DN150/6"	400 (15.7)	400 (15.7)
DN200/8"	400 (15.7)	400 (15.7)
DN250/10"	400 (15.7)	400 (15.7)
DN300/12"	400 (15.7)	400 (15.7)
<b>Sensor characteristics</b>		
Emitting angle $\alpha$	11°	11°
Blocking distance (m [ft])	0.25 (0.8)	0.35 (1.1)
Max. range (m [ft]) in liquids	5 (16)	8 (26)
Max. range (m [ft]) in solids	2 (6.6)	3.5 (11)


#### Caution!

If the blocking distance is undershot, it may cause device malfunction.

#### Note!

In order to notice if the level approaches the blocking distance, you can specify a safety distance (SD). If the level is within this safety distance, the instrument outputs a warning or alarm message.

## Environment

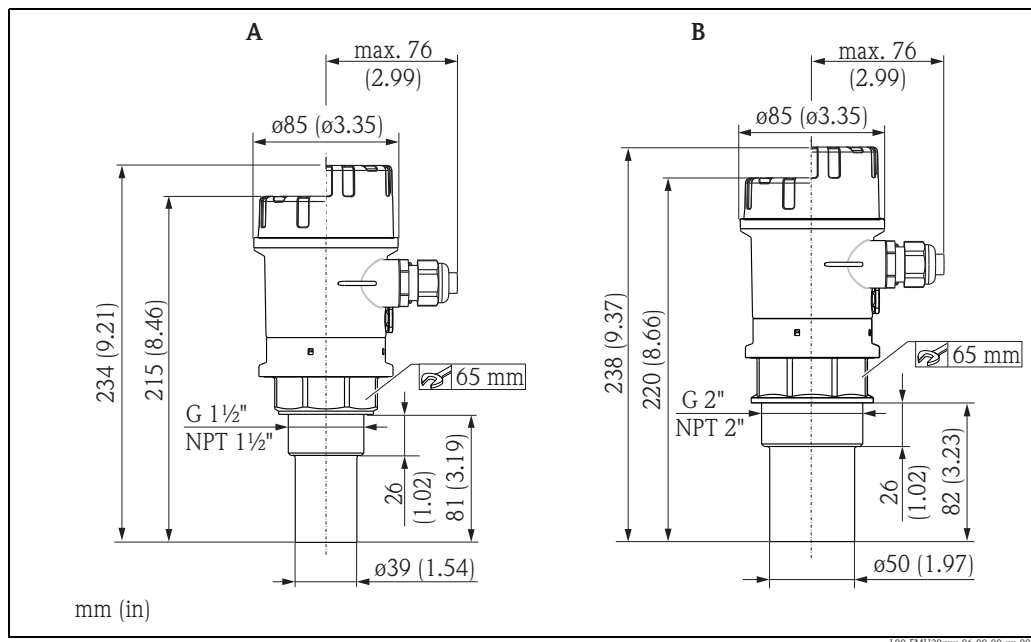
<b>Ambient temperature range</b>	–20 °C to +60 °C (–4 °F to +140 °F) Use a protective cover, in order to protect the sensor from direct sun or rain →  26, "Weather protection cover".
<b>Storage temperature</b>	–40 °C to +80 °C (–40 °F to +176 °F)
<b>Resistance to alternating temperature cycles</b>	To DIN EN 60068-2-14; Nb test : +60°C/–20°C (+140 °F/–4 °F), 0.5K/min, 100cycles
<b>Climate class</b>	DIN EN 60068-2-38 (Test Z/AD) DIN/IEC 68 T2-30Db
<b>Ingress protection</b>	<ul style="list-style-type: none"><li>■ With closed housing, tested according to<ul style="list-style-type: none"><li>– IP68, 24h at 1.83 m (6.0 ft) under water surface</li><li>– IP66</li></ul></li><li>■ With open housing: IP20 (also ingress protection of the display)</li></ul>
<b>Vibration resistance</b>	DIN EN 60068-2-64 / IEC 68-2-64: 20 to 2000 Hz, 1 (m/s <sup>2</sup> )/Hz; 3 x 100 min
<b>Electromagnetic compatibility (EMC)</b>	<ul style="list-style-type: none"><li>■ Electromagnetic compatibility to EN 61326. For details refer to the declaration of conformity.</li><li>■ With regard to interference immunity the requirements for "industrial environment" are met.</li><li>■ Influence of EMC &lt; 1 % FS</li></ul>

## Process

<b>Process temperature range</b>	–20°C to +60°C (–4 °F to +140 °F) A temperature sensor is integrated in the sensor for correction of the temperature-dependent time-of-flight.
<b>Process pressure range</b>	0.7 bar to 3 bar abs. (10.15 psi to 43.5 psi)

## Mechanical construction

### Design; dimensions



A Sensor 1 1/2"  
B Sensor 2"

### Weight

Sensor	Weight
1 1/2"	approx. 0.75 kg (1.65 lbs)
2"	approx. 0.8 kg (1.76 lbs)

### Housing design

#### Type of housing

F16 plastic housing

#### Cover

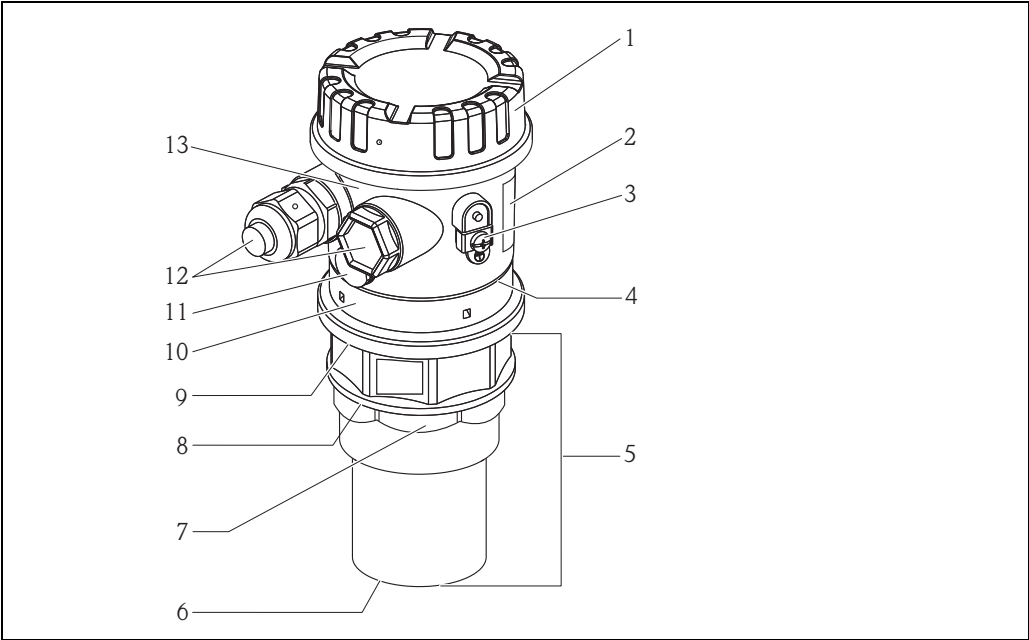
Plastic cover

- For version without on-site display (low, grey)
- For version with on-site display (high, transparent)

### Process connection

Sensor	Process connection
1 1/2"	<ul style="list-style-type: none"> <li>■ Thread G 1 1/2", PP</li> <li>■ Thread MNPT 1 1/2" - 11.5</li> </ul>
2"	<ul style="list-style-type: none"> <li>■ Thread 2", PP</li> <li>■ Thread MNPT 2" - 11.5</li> </ul>

Materials



L00-FMU3xxxx-16-00-00-xx-001

Pos.	Part	Material
1	Cover (grey)	PBT
	Cover (transparent)	PA
	O-ring	EPDM
2	Ground terminal: Screws Spring washer Clamp Holder	A2 A4 304 (1.4301) 301 (1.4310)
3	Nameplate	Polyester
4	O-ring	EPDM
5	Sensor (in contact with process)	PP
6	Matching Layer (in contact with process)	EPDM
7	Counter nut (in contact with process)	PC
8	Sealing (in contact with process)	EPDM
9	Sealing	EPDM
10	Adapter of housing	PBT GF 30-FR
11	Goretex filter	PBT-20GF / grey RAL7035
12	Cable gland	Polyamid (PA)
	Plug	PBT-GF30
13	Housing	PBT-FR

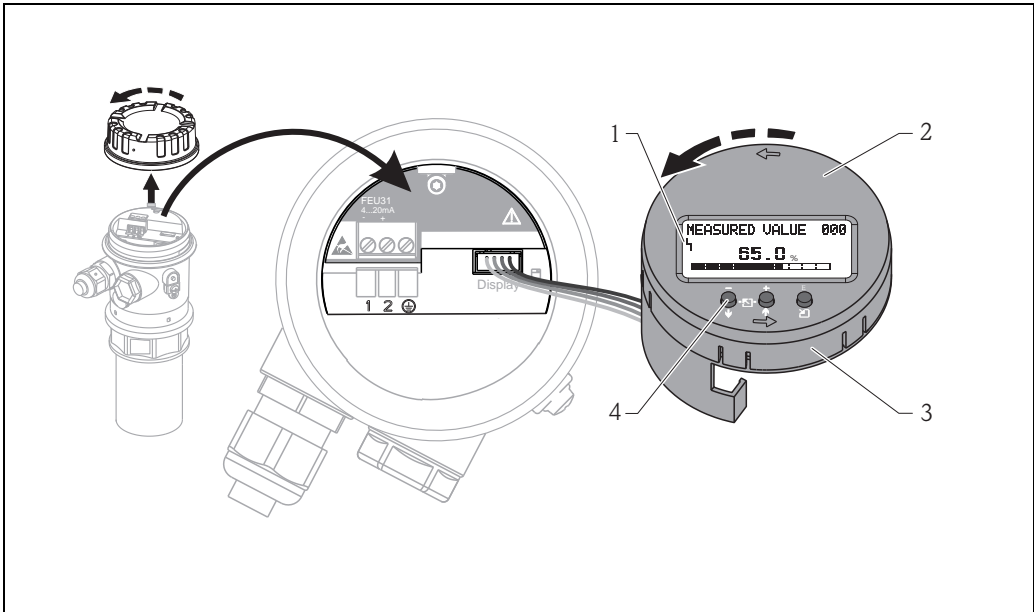
Note!  
The chemical compatibility of the sensors must be checked before installation with compatibility charts.



# Operability

## Display and operating elements

The LCD module for display and operation is located beneath the housing cover. Open the cover to operate the device.

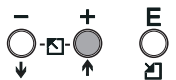

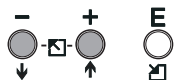


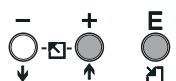
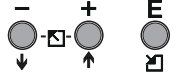


L00-FMU30xxx-07-05-xx-xx-000

- 1 Display symbol
- 2 Display (rotatable)
- 3 Plug-in module
- 4 Function keys

Symbol in display			
	continuous	flashing	
Meaning	Alarm	Warning	Security Locking

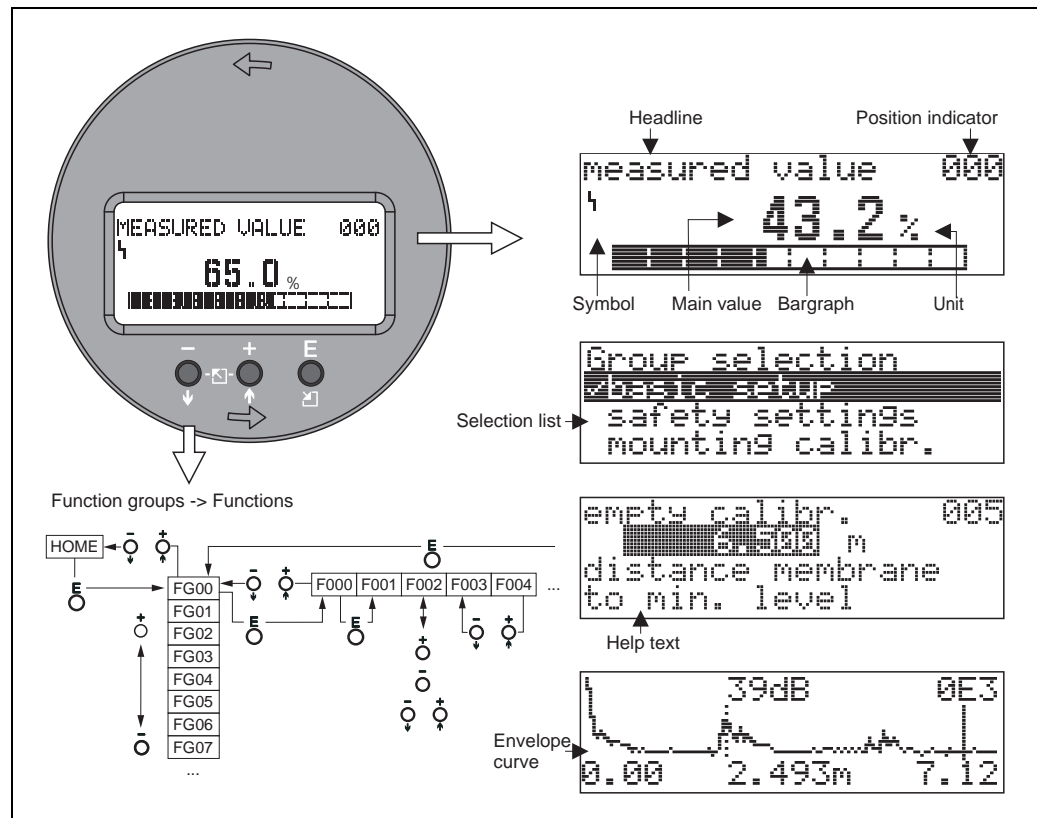
## Function of the keys

Key(s) (The keys to press are displayed in grey.)	Meaning
	Navigate upwards in the selection list Edit numeric value within a function
	Navigate downwards in the selection list Edit numeric value within a function
	Navigate to the left within a function group
	Navigate to the right within a function group, confirmation.
 or 	Contrast settings of the LCD
	Hardware lock / unlock After a hardware lock, an operation of the instrument via display or communication is not possible! The hardware can only be unlocked via the display. An unlock parameter must be entered to do so (unlock parameter: 100).

## On-site operation

## Operation

The LC-Display allows configuration via 3 keys directly at the instrument. All device functions can be set through a menu system. The menu consists of function groups and functions. Within a function, application parameters can be read or adjusted. The user is guided through a complete configuration procedure. For ease of operation can choose between 7 language: (de: german; en: english; es: spanish; fr: french; it: italian; ja: japanese; nl: dutch).



100-FMU30xxx-07-00-00-en-004

## Remote operation

## Operation with FieldCare

FieldCare is Endress+Hauser's FDT based Plant Asset Management Tool. It can configure all intelligent field devices in your plant and supports you in managing them. By using status information, it also provides a simple but effective means of checking their health.

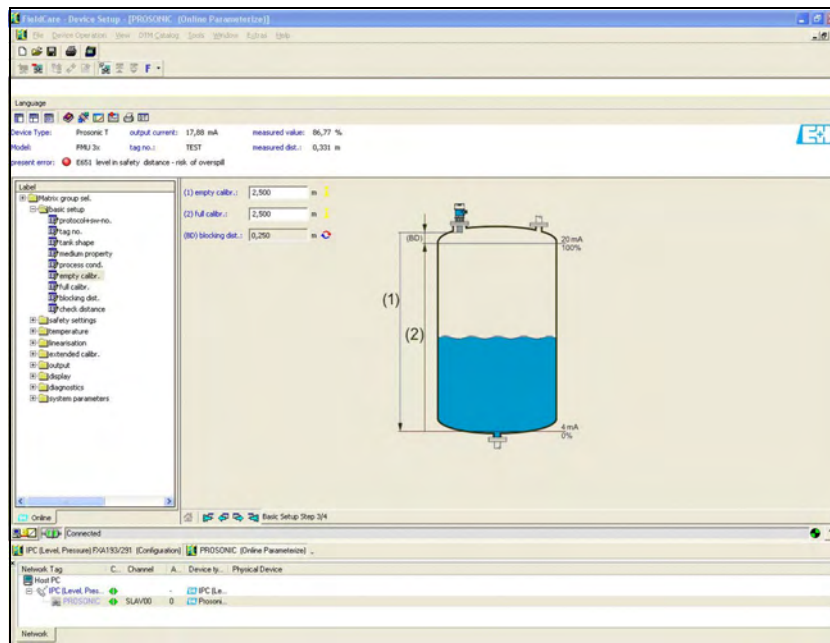
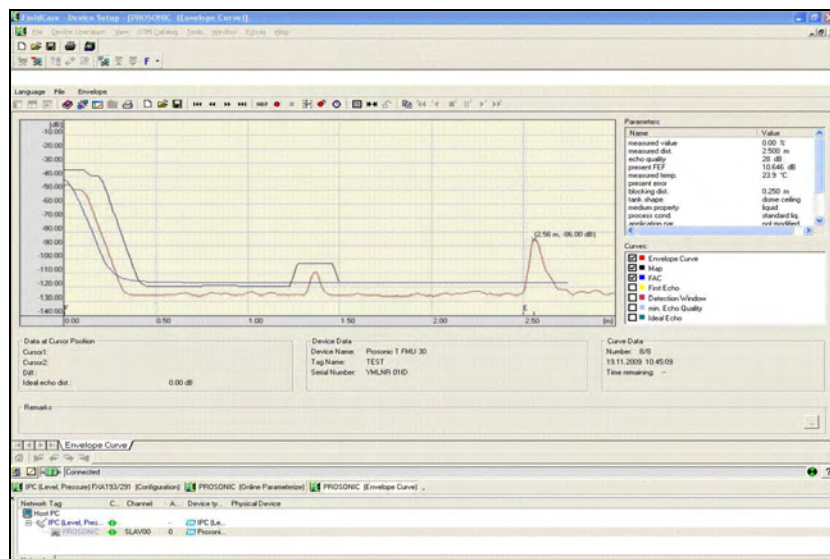
- Supports Ethernet, HART, PROFIBUS PA, FOUNDATION Fieldbus etc.
- Operates all Endress+Hauser devices
- Operates all third-party actuators, I/O systems and sensors supporting the FDT standard
- Ensures full functionality for all devices with DTMs
- Offers generic profile operation for any third-party fieldbus device that does not have a vendor DTM

Connection for FMU30:


- Commubox FXA291 and ToF adapter FXA291 (available as accessory)

Using the following functions:

- Signal analysis via envelope curve
- Linearization table (graphically supported creation, editing, importing and exporting)
- Loading and saving of instrument data (Upload/Download)
- Documentation of measuring point

*Menu-guided commissioning:**Signal analysis via envelope curve:*

## Certificates and Approvals

<b>CE mark</b>	The measuring system meets the legal requirements of the EC-guidelines. Endress+Hauser confirms the instrument passing the required tests by attaching the CE-mark.
<b>Ex approvals</b>	<ul style="list-style-type: none"> <li>■ ATEX</li> <li>■ IECE<sub>x</sub></li> <li>■ CSA C/US</li> <li>■ NEPSI</li> </ul> <p>Additional safety instructions must be observed for applications in hazardous areas. They are contained in the separate "Safety Instructions" (XA) document, which is included in the scope of delivery. Reference is made to the XA on the nameplate of the device.</p> <p>Note! Details on the available certificates as well as the associated XAs can be found in the Associated documentation chapter documentation →  27.</p>
<b>Ex approval</b>	The available certificates are listed in the ordering information. Note the associated safety instructions (XA) and control or installation drawings (ZD).
<b>External standards and guidelines</b>	<p><b>EN 60529</b> Protection class of housing (IP-code)</p> <p><b>EN 61326 series</b> EMC product family standard for electrical equipment for measurement, control and laboratory use</p> <p><b>NAMUR</b> User association for automation technology in process industries</p>

## Ordering information

### FMU30

Versions that mutually exclude one another are not marked.

<b>010</b>	<b>Approval:</b>	
	AA	Non-hazardous area
	BB	ATEX II 1/2G Ex ia IIC T5
	CA	CSA C/US General Purpose
	CB	CSA C/US IS C.I Div.1 Gr.A-D
	IB	IEC Ex zone 0/1, Ex ia IIC T5 Ga/Gb
	NB	NEPSI zone 0/1, Ex ia IIC T5 Ga/Gb
	99	Special version
<b>020</b>	<b>Display; Operating:</b>	
	G	W/o; via spare part display FMU30
	H	Envelope curve display on site; push button
	Y	Special version
<b>030</b>	<b>Electrical Connection:</b>	
	E	Gland M20, IP68
	F	Thread G1/2, IP68
	G	Thread NPT1/2, IP68
	Y	Special version
<b>040</b>	<b>Sensor; Max Range; Blocking Distance:</b>	
	AA	1-1/2"; 5m liquid/2m solid; 0.25m
	AB	2"; 8m liquid/3.5m solid; 0.35m
	YY	Special version
<b>050</b>	<b>Process Connection:</b>	
	GGF	Thread ISO228 G1-1/2, PP
	GHF	Thread ISO228 G2, PP
	RGF	Thread ANSI MNPT1-1/2, PP
	RHF	Thread ANSI MNPT2, PP
	YYY	Special version
<b>620</b>	<b>Accessory Enclosed:</b>	
	RA	UNI flange 2"/DN50/50, PP max 4bar abs/58psia, suitable for 2" 150lbs/DN50 PN16/10K 50
	RB	UNI flange 2"/DN50/50, PVDF max 4bar abs/58psia, suitable for 2" 150lbs/DN50 PN16/10K 50
	RC	UNI flange 2"/DN50/50, 316L max 4bar abs/58psia, suitable for 2" 150lbs/DN50 PN16/10K 50
	RD	UNI flange 3"/DN80/80, PP max 4bar abs/58psia, suitable for 3" 150lbs/DN80 PN16/10K 80
	RE	UNI flange 3"/DN80/80, PVDF max 4bar abs/58psia, suitable for 3" 150lbs/DN80 PN16/10K 80
	RF	UNI flange 3"/DN80/80, 316L max 4bar abs/58psia, suitable for 3" 150lbs/DN80 PN16/10K 80
	RG	UNI flange 4"/DN100/100, PP max 4bar abs/58psia, suitable for 4" 150lbs/DN100 PN16/10K 100
	RH	UNI flange 4"/DN100/100, PVDF max 4bar abs/58psia, suitable for 4" 150lbs/DN100 PN16/10K 100
	RI	UNI flange 4"/DN100/100, 316L max 4bar abs/58psia, suitable for 4" 150lbs/DN100 PN16/10K 100
	R9	Special version
<b>895</b>	<b>Marking:</b>	
	Z1	Tagging (TAG), see additional spec.

You can enter the versions for the specific feature in the following table. The versions entered make up the complete order code. Options which are mutually exclusive are not marked.

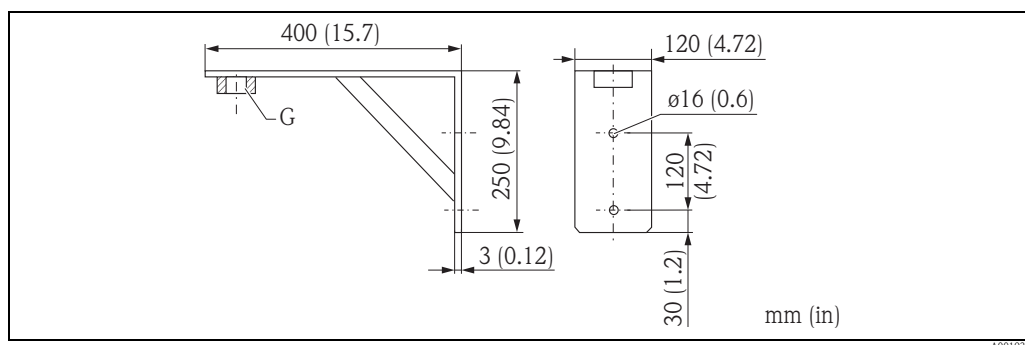
	<b>010</b>	<b>020</b>	<b>030</b>	<b>040</b>	<b>050</b>	<b>620</b>	<b>895</b>
FMU30 -							

Endress+Hauser supplies DIN/EN flanges made of stainless steel AISI 316L with the material number 1.4404 or 1.4435. With regard to their temperature stability properties, the materials 1.4404 and 1.4435 are grouped under 13E0 in EN 1092-1 Tab. 18. The chemical composition of the two materials can be identical.

**Scope of delivery**

- Instrument according to the version ordered
- Short instructions KA01054F; additional documentations on the supplied CD-ROM
- For certified instrument versions: Safety Instructions, Control- or Installation drawings
- Counter nut (PC): option 50, versions GGF/GHF, → 21 "Ordering information"
- Sealing ring (EPDM): option 50, versions GGF/GHF → 21 "Ordering information"
- For gland M20x1.5: 1 cable gland for 2-wire instruments  
The cable gland is mounted on delivery.

## Accessories

**Installation bracket**

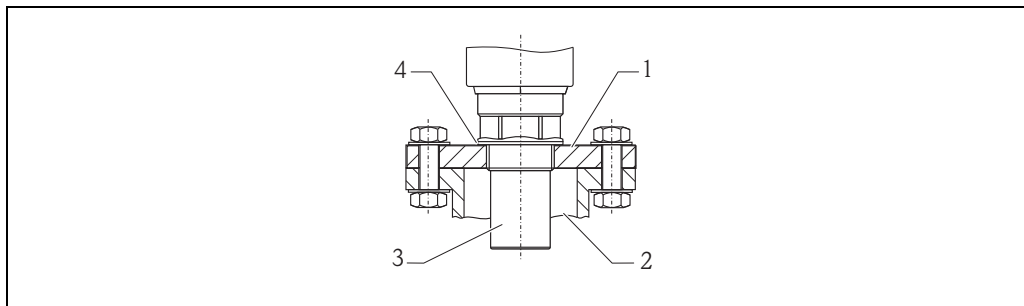
A0019346

Process connection	Order No.	Material	Weight
G 1½"	942669-0000	316 Ti (1.4571)	3.4 kg (7.5 lbs)
G 2"	942669-0001		

suited for NPT 1½" and 2" as well



## Screw in flange



- 1 Screw in flange  
 2 Nozzle  
 3 Sensor  
 4 Sealing ring EPDM (supplied)

## Screw in flange FAX50

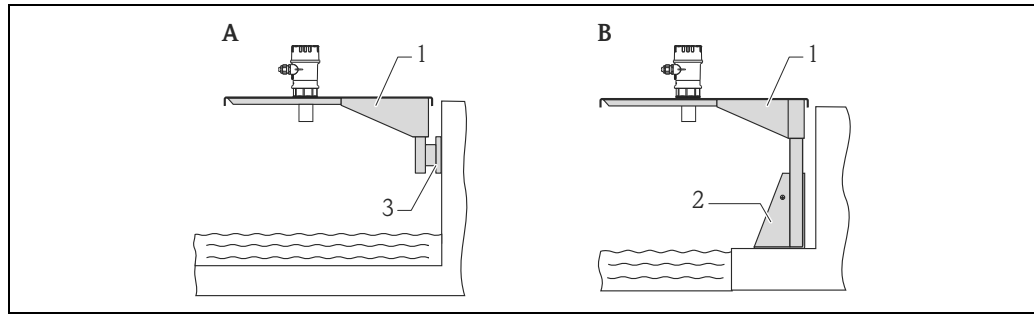
015	Material:
BR1	DN50 PN10/16 A, steel flange EN1092-1
BS1	DN80 PN10/16 A, steel flange EN1092-1
BT1	DN100 PN10/16 A, steel flange EN1092-1
JF1	2" 150lbs FF, steel flange ANSI B16.5
JG1	3" 150lbs FF, steel flange ANSI B16.5
JH1	4" 150lbs FF, steel flange ANSI B16.5
JK2	8" 150lbs FF, PP max 3bar abs/44psia flange ANSI B16.5
XIF	UNI flange 2"/DN50/50, PVDF max 4bar abs/58psia, suitable for 2" 150lbs/DN50 PN16/10K 50
XIG	UNI flange 2"/DN50/50, PP max 4bar abs/58psia, suitable for 2" 150lbs/DN50 PN16/10K 50
XIJ	UNI flange 2"/DN50/50, 316L max 4bar abs/58psia, suitable for 2" 150lbs/DN50 PN16/10K 50
XJF	UNI flange 3"/DN80/80, PVDF max 4bar abs/58psia, suitable for 3" 150lbs/DN80 PN16/10K 80
XJG	UNI flange 3"/DN80/80, PP max 4bar abs/58psia, suitable for 3" 150lbs/DN80 PN16/10K 80
XJJ	UNI flange 3"/DN80/80, 316L max 4bar abs/58psia, suitable for 3" 150lbs/DN80 PN16/10K 80
XKF	UNI flange 4"/DN100/100, PVDF max 4bar abs/58psia, suitable for 4" 150lbs/DN100 PN16/10K 100
XKG	UNI flange 4"/DN100/100, PP max 4bar abs/58psia, suitable for 4" 150lbs/DN100 PN16/10K 100
XKJ	UNI flange 4"/DN100/100, 316L max 4bar abs/58psia, suitable for 4" 150lbs/DN100 PN16/10K 100
XLF	UNI flange 6"/DN150/150, PVDF max 4bar abs/58psia, suitable for 6" 150lbs/DN150 PN16/10K 150
XLG	UNI flange 6"/DN150/150, PP max 4bar abs/58psia, suitable for 6" 150lbs/DN150 PN16/10K 150
XLJ	UNI flange 6"/DN150/150, 316L max 4bar abs/58psia, suitable for 6" 150lbs/DN150 PN16/10K 150
XMG	UNI flange DN200/200, PP max 4bar abs/58psia, suitable for DN200 PN16/10K 200
XNG	UNI flange DN250/250, PP max 4bar abs/58psia, suitable for DN250 PN16/10K 250
YYY	Special version
020	Sensor Connection:
A	Thread ISO228 G3/4
B	Thread ISO228 G1
C	Thread ISO228 G1-1/2
D	Thread ISO228 G2
E	Thread ANSI NPT3/4
F	Thread ANSI NPT1
G	Thread ANSI NPT1-1/2
H	Thread ANSI NPT2
Y	Special version

The filled in options result in the complete order code.

	015	020
FAX50 -		

For more information, see the documentation TI00426F/00/EN.

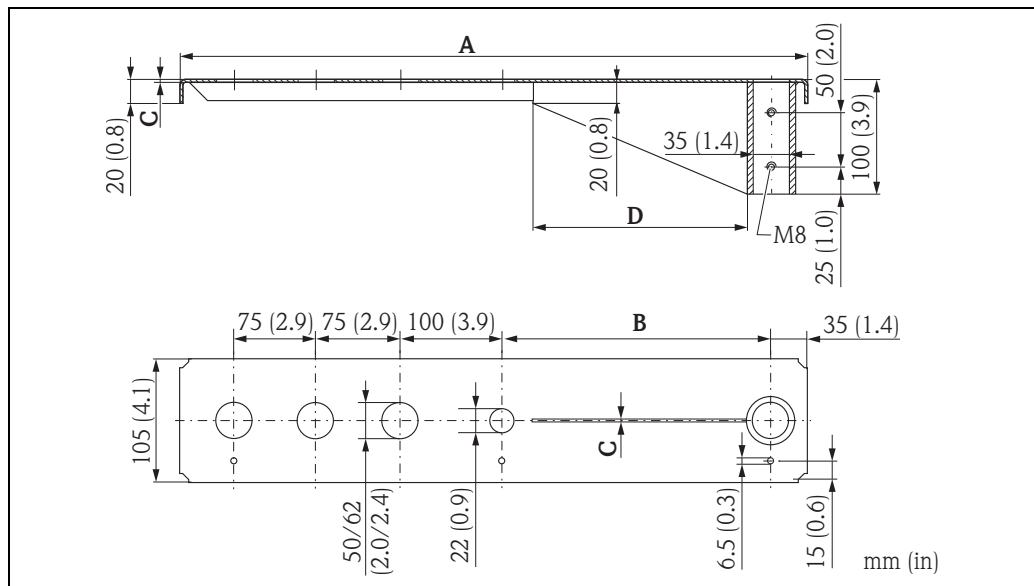
### Cantilever with mounting frame or wall bracket



A0019506

- A** Installation with cantilever and wall bracket  
**B** Installation with cantilever and mounting frame  
 1 Cantilever  
 2 Mounting frame  
 3 Wall bracket

### Cantilever



A0019349

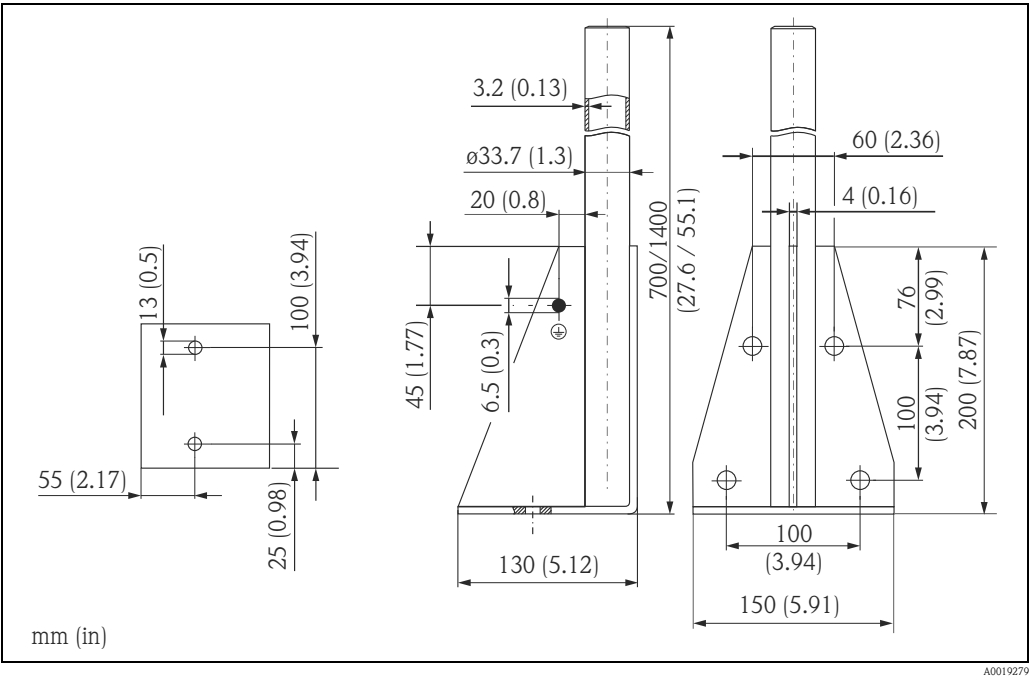
A	B	C	D	Weight	Sensor	Material	Order Code
585 (23)	250 (9.84)	2 (0.08)	200 (7.87)	1.9 kg (4.19 lbs)	1½"	316Ti (1.4571)	52014132
						galv. steel	52014131
					2"	316Ti (1.4571)	52014136
						galv. steel	52014135
1085 (42.7)	750 (29.5)	3 (0.12)	300 (11.8)	4.4 kg (9.7 lbs)	1½"	316Ti (1.4571)	52014134
						galv. steel	52014133
					2"	316Ti (1.4571)	52014138
						galv. steel	52014137

mm (in)

- The 50 mm (2.17 in) or 62 mm (2.44 in) orifices serve for the mounting of the 1½" or 2" sensor, respectively.
- The 22 mm (0.87 in) orifice may be used for an additional sensor.

Fixing screws are supplied.

Mounting Frame

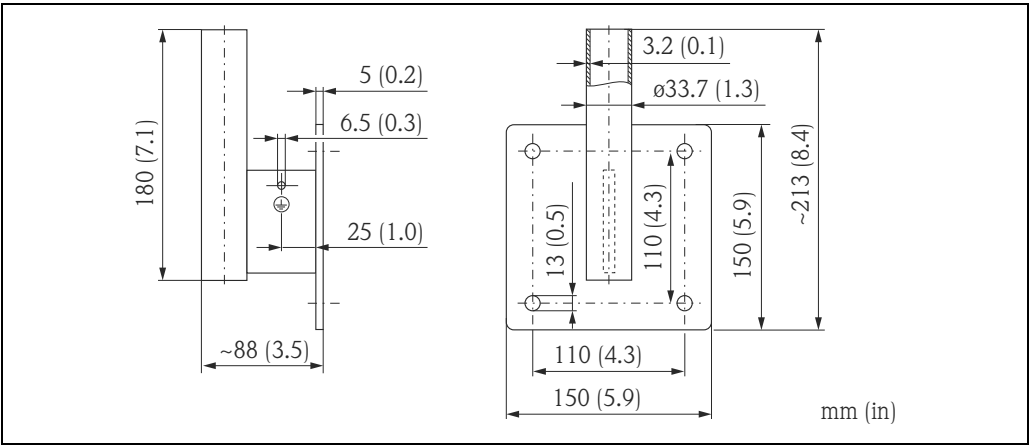


A0019279

Height	Material	Weight	Order Code
700 (27.6)	galv. steel	3.2 kg (7.06 lbs)	919791-0000
700 (27.6)	316Ti (1.4571)		919791-0001
1400 (55.1)	galv. steel	4.9 kg (10.08 lbs)	919791-0002
1400 (55.1)	316Ti (1.4571)		919791-0003

mm (in)

Wall Bracket

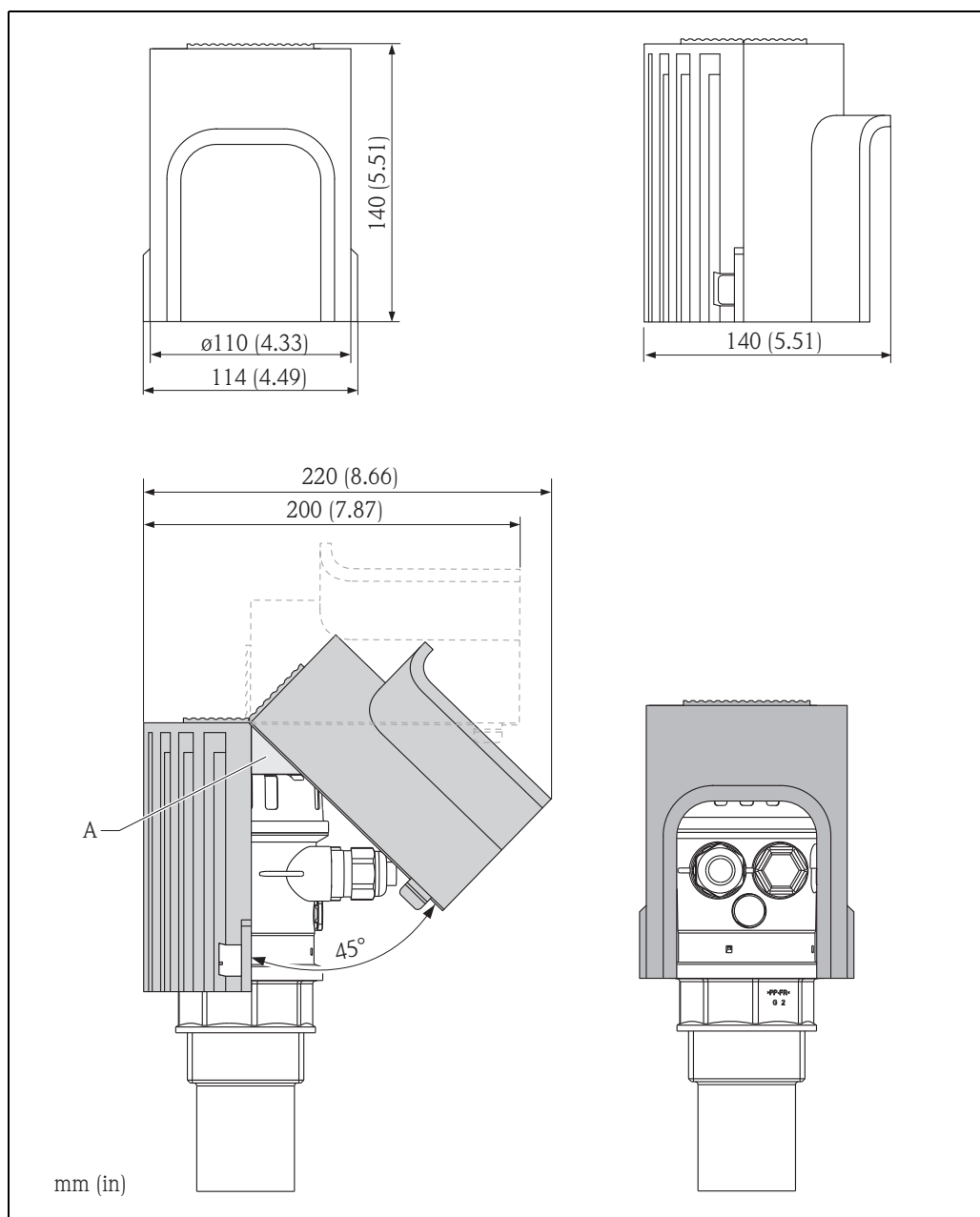


A0019350

Material	Weight	Order Code
galv. steel	1.4 kg (3.09 lbs)	919792-0000
316Ti (1.4571)		919792-0001

**Weather protection cover**

A Weather protection cover is recommended for outdoor mounting.



100-FMU30-00-00-00-xx-000

A Foam pad

Material	Order No.	Weight	Operating conditions
PBT, grey	71127762	240 g (8.46 oz)	-50 °C to +150 °C (-58 °F to +302 °F)

**Commubox FXA291**

The Commubox FXA291 connects Endress+Hauser field instruments via the service interface to the USB interface of a personal computer or a notebook. For details refer to TI00405C/07/EN.

Note!

For the FMU30 you need the "ToF Adapter FXA291" as an additional accessory.

**ToF Adapter FXA291**

The ToF Adapter FXA291 connects the Commubox FXA291 via the USB interface of a personal computer or a notebook to the FMU30.

For details refer to KA00271F/00/A2.

---

## Documentation

---

**Operating manual****BA00387F**

This instruction describe the installation and first commissioning of the instrument. From the operating menu, all functions are included, which are required for standard measurement tasks. Additional functions are not contained in the manual.

The documentation can be found on the supplied documentation CD. The documentation is also available via the Internet → siehe: [www.endress.com](http://www.endress.com) → Download.

**Description of device functions****BA00388F**

This contains a detailed description of all the functions of the instrument and is valid for all communication variants.

The documentation can be found on the supplied documentation CD. The documentation is also available via the Internet → [www.endress.com](http://www.endress.com) → Download.

**Short instructions****KA01054F**

is for rapid commissioning of the device. The instructions are attached to the device. The documentation can be found on the supplied documentation CD.

The documentation is also available via the Internet → [www.endress.com](http://www.endress.com) → Download.

**KA00290F**

can be found under the device housing cover.

The most important menu functions are summarised on this sheet. It is intended primarily as a memory jogger for users who are familiar with the operating concept of Endress+Hauser time-of-flight instruments.

**Safety Instructions**

Depending on the approval, the following Safety Instructions (XA) are supplied with the device. They are an integral part of the Operating Instructions.

Certificate/type of protection	Documentation	Order code	
		Feature	Version
ATEX II 1/2 G Ex ia IIC T5 Ga/Gb	XA01054F	10	BB
IECEx, Ex ia IIC T5 Ga/Gb			CB
Ex ia Class I, Division 1, Group A-D, T5 Class I, Zone 0, AEx/Ex ia IIC T5 Ga	XA01080F		IB
NEPSI Zone 0/1, Ex ia IIC T5 Ga/Gb	XA01264F		NB



For certified devices the relevant Safety Instructions (XA) are indicated on the nameplate.

---

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**Endress+Hauser**   
People for Process Automation



# DIGITAL CONTROLLER



## NOVA PD540 Series

### Instruction Manual

PD540 - PD549

#### PRECISION DIGITAL CORPORATION

233 South Street • Hopkinton MA 01748 USA  
Tel (800) 343-1001 • Fax (508) 655-8990

**PRECISION  
DIGITAL**



## Disclaimer

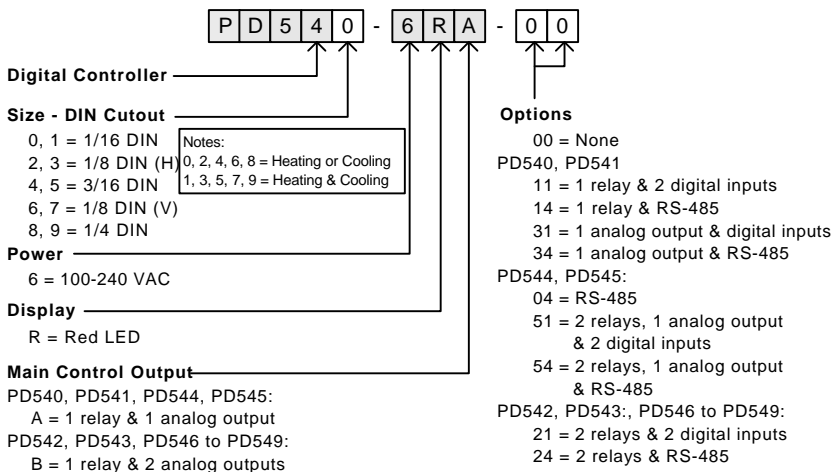
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<http://www.predig.com>

## Nova PD540 Series Model Number Guide



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## 1. Safety Guide and Specifications



The following safety symbols are used in this manual

- (1) This symbol notifies the user of specific information relating to the safe operation of the controller. Information noted with this symbol must be observed to protect the user from injury and to prevent damage to the product.
  - (A) For User: Be aware of this marking in the manual and refer to the explanation in the manual to prevent injury and damage.
  - (2) For Installer: Study the warnings marked to prevent injury and damage.



- (2) Functional earth terminal: This symbol indicates that the terminal must be connected to ground.



- (3) This symbol indicates additional information on the features of the product.



- (4) This symbol directs the reader to further information on the current topic.



### Precautions Regarding This Instruction Manual

- (1) This manual must be kept in the possession of the end user and in a suitable place for the operator to study and to check the functions of the product.
- (2) The installer and operator should carefully study and understand how to operate this product before use.
- (3) This manual describes the functions of the product. Precision Digital Corporation does not guarantee that the functions will suit a particular purpose.
- (4) The contents of this manual have been reviewed for accuracy and correctness. However, should any errors or omissions come to the attention of the user, contact technical support as listed on the back of this manual.



### Safety Procedures and Unauthorized Modification Warning

- (1) In order to protect this product and the system controlled by it against damage and ensure its safe use, make certain that all of the safety instructions and precautions in this manual are strictly adhered to.
- (2) Precision Digital Corporation does not guarantee safety if the products are not handled in accordance with this instruction manual.
- (3) If separate protection or safety circuits are to be installed in the system which is controlled by this product, ensure that such circuits are installed external to this product.
- (4) Do not make modifications or additions internally to the product. It may cause personal injury to the user or damage to the product.
- (5) Contact technical support as listed on the back of the manual for warranty and repair issues.
- (6) Exposure to excessive moisture, electrical overloads, or mechanical vibration may damage the product.



### Limited Liability

Precision Digital Corporation assumes no liability to any party for any loss or damage, direct or indirect, caused by the use of or any unpredictable defect of the product.



## Operational Environment Precautions

- (1) Only operate the controller when it is properly installed.
- (2) When installing the controller, select a location where:
  - Rear terminals are protected from accidental contact.
  - Mechanical vibrations are minimal.
  - No corrosive gas is present.
  - Temperature fluctuation is minimal.
  - Temperature can be maintained between 10 and 50 °C (50 and 110°F) with 20 to 90% RH.
  - No direct heat radiation is present.
  - High levels of electromagnetic interference are not present
  - The unit is not exposed to water.
  - No flammable materials are present.
  - Dust particles are not present in the air.
  - Exposure to ultraviolet rays is minimal.
  - Openings on the rear of the controller are not blocked.
- (3) This unit is suitable for installation in an environment classified as Pollution Degree 2.
- (4) This unit is designated as Installation Category II.
- (5) If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.
- (6) A switch or circuit-breaker acting as the disconnect device shall be included in the application or the installation.



## Controller Mounting Precautions

- Keep the input circuit wiring as far as possible away from power and ground circuits.
- Keep the units in 10 to 50°C (50 to 110°F) with 20% to 90% relative humidity (RH).  
The controller may need a warm up period to return to operating temperature ranges when below 10°C.
- To prevent electric shock, be sure to turn off the power source and circuit breaker before wiring.
- The power requirements are 100 to 240 VAC, 50/60 Hz, 10 VA max. Do not switch power supplies without first disconnecting the power supply.
- Follow the operating procedures and precautions in the manual to avoid fire, shock, damage to the unit, or injury. Follow the operations and mounting directions indicated in this manual.
- Always create a ground connection where indicated, however do not ground to gas pipes, water pipes, lightning rods, or other potentially hazardous metal objects.
- Do not apply power to the unit until all connections have been made.
- Do not cover the venting holes in the rear of the unit.

## 1.1 SPECIFICATIONS

*Except where noted all specifications apply to operation at 23°C.*

### General

DISPLAY	Dual 4 digits, red LED, -1999 to 9999			
	DIN Sizes	PV Display mm (inch)	SP Display mm (inch)	Weight g (oz)
	1/16	11.3 (0.45)	9.5 (0.37)	198 (7.0)
	3/16	14.0 (0.55)	12.0 (0.47)	324 (11.4)
	1/8 (H)	19.8 (0.78)	11.5 (0.45)	306 (10.6)
	1/8 (V)	13.6 (0.54)	10.5 (0.41)	304 (10.7)
	1/4	20.5 (0.81)	11.0 (0.43)	389 (13.7)
FRONT PANEL	1/16 & 1/8 DIN: IP65; 3/16 & 1/4 DIN: IP55			
SAMPLING TIME	250 ms			
OVERRANGE	Over range PV reads $\alpha\delta r$ , under range PV reads $-\alpha\delta r$			
PROGRAMMING METHODS	Four front panel buttons and Modbus			
PID ZONES	3 programmable PID zone ranges, 1 PID PV deviation zone			
NOISE FILTER	Programmable from 1 to 120			
CALIBRATION	All ranges are calibrated at the factory			
PASSWORD	Programmable password restricts modification of programmed settings			
POWER	100-240 VAC, 50/60 HZ, 10 Watts			
FUSE	Required fuse: UL Recognized, 1 A, 250 V, slow blow			
ISOLATION	2300 V input-to-output-to-power line; 4 kV relay output-to-input/output/power line			
NUMBER OF SET POINTS	4 programmable set points			
ENVIRONMENTAL	Operating temperature range: 10°C to 50°C (50°F to 110°F) Relative humidity: 20 to 90% non-condensing			
MOUNTING	1/16, 3/16, 1/8, or 1/4 DIN size cutout required Two panel mounting bracket assemblies provided One one-piece bracket provided for the PD540			
WARRANTY	Three years parts and labor			

## Process and Temperature Inputs

TEMPERATURE DRIFT	Refer to accuracy specifications below
DECIMAL POINT	Up to three decimal places for process inputs: 9.999, 99.99, 999.9, or 9999
REAR JUNCTION COMPENSATION	Automatic or off settings for temperature inputs. No user calibration required.
OFFSET ADJUSTMENT	Four programmable input bias zones
SENSOR BREAK DETECTION	Open sensor indicated by PV display flashing <b>5.0Pn</b> . All PID control outputs transmit at the user programmed percent of full output scale set in parameters Po and Poc. Up or down scale, user selectable; alarm relays will follow the up or down scale selection.
TRANSMITTER SUPPLY	14 to 18 VDC @ 20 mA; available at terminals OUT2 or OUT3, instead of a retransmitting analog output
UNIVERSAL INPUT TYPE AND ACCURACY	

		Temp Range (°C)	Temp Range (°F)	Accuracy*
Input Type	K1	-200 to 1370	-300 to 2500	> 0°C : ±0.1% FS ±1 digit < 0°C : ±0.2% FS ±1 digit
	K2	-199.9 to 999.9	0 to 2300	
	J	-199.9 to 999.9	-300 to 2300	
	T	-199.9 to 400.0	-300 to 750	
	B	0 to 1800	32 to 3300	> 400°C : ±0.15% FS ±1 digit < 400°C : ±5% FS ±1 digit
	R	0 to 1700	32 to 3100	
	S	0 to 1700	32 to 3100	> 0°C : ±0.1% FS ±1 digit < 0°C : ±0.2% FS ±1 digit
	E	-199.9 to 999.9	-300 to 1800	
	L	-199.9 to 900.0	-300 to 1600	
	U	-199.9 to 400.0	-300 to 750	
Thermocouple	N	-200 to 1300	-300 to 2400	> 0°C : ±0.1% FS ±1 digit < 0°C : ±0.25% FS ±1 digit
	W	0 to 2300	32 to 4200	
	Platinel II	0 to 1390	32 to 2500	±0.2% FS ±1 digit
	PtA	-199.9 to 850.0	-300 to 1560	±0.1% FS ±1 digit**
	PtB	-199.9 to 500.0	-199.9 to 999.9	
RTD	PtC	-19.99 to 99.99	-4.0 to 212.0	±0.2% FS ±1 digit
	JPtA	-199.9 to 500.0	-199.9 to 999.9	±0.1% FS ±1 digit**
	JPtB	-150.0 to 150.0	-199.9 to 300.0	
Process	0.4 to 2.0 V	0.400 to 2.000		±0.1% FS ±1 digit Display range can be scaled between -1999 and 9999.  4 to 20 mA Input To accept a 4 to 20 mA signal, select 0.4 to 2.0 VDC input and connect a 100 Ω resistor across the input terminals.
	1.000 to 5.000	1.000 to 5.000		
	0 to 10 V	0.00 to 10.00		
	-10 to 20 mV	-10.00 to 20.00		
	0 to 100 mV	0.0 to 100.0		

\*Performance within recommended operating conditions (10 to 50°C, 20 to 90% RH)

\*\*For a range scale of 0 to 100°C: +0.3°C +1 digit, and for a range scale of -100 to 100°C: +0.5°C +1 digit



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## Relay Outputs

---

RATINGS	Out1: 250 VAC @ 3 A or 30 VDC @ 3 A (resistive load) Sub1, Sub2: 250 VAC @ 1 A or 30 VDC @ 1 A (resistive load)
ELECTRICAL NOISE SUPPRESSION	A suppressor (snubber) should be connected to each relay contact switching inductive loads, to prevent disruption to the microprocessor's operation. Recommended suppressor value: 0.1 $\mu$ F/470 $\Omega$ , 250 VAC (PDX6901)
DEADBAND	For alarm operations, 0-100% of full scale, user selectable
HIGH OR LOW ALARM	User may program any relay for high or low trip point
DEVIATION ALARM	User may program any relay for a high, low, or range set point deviation alarm.
RELAY OPERATION	Any relay may be set as an alarm relay or for time proportional PID control.
TIME DELAY	0 to 99 minutes 59 seconds alarm trip delay user selectable for each alarm. Time proportional PID control relay activation time delay of 0 to 99 minutes 59 seconds user selectable.
FAIL-SAFE OPERATION	Programmable Independent for each alarm relay
AUTO INITIALIZATION	When power is applied to the controller, alarm relays will reflect the state of the input to the controller except standby alarms.

---

**Analog Outputs**

---

OUTPUT RANGE	Continuous PID or retransmitting: 4-20 mA (600 $\Omega$ maximum) Time Proportional PID: 15 VDC pulse (600 $\Omega$ minimum, current limited at 30 mA) high, less than 0.1 VDC low, cycle time 1 to 300 seconds, user selectable
SCALING RANGE	Retransmitting 4-20 mA outputs can be scaled for any display range low and high
ACCURACY	$\pm 0.1\%$ of full scale

---

**Digital Inputs**

---

CONFIGURATION	Two contacts, two operating modes
CONTACTS	Normally open switches (external excitation not required) or open collector transistor
OPEN CIRCUIT VOLTAGE	Approximately 5 VDC
LOGIC LEVELS	LO = 0 to 0.8 VDC, HI = 4.7 to 28 VDC
OPERATION MODES	Mode 1: Control output run/stop, selection of set point1 or 2 Mode 2: Selection of set points 1 to 4

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**Serial Communications**

---

PROTOCOLS	Modbus (ASCII, RTU), PC software, Sync (master/slave SP control)
UNIT ADDRESS	1 to 99 (Max 31 units connected)
BAUD RATE	600, 1200, 2400, 4800, 9600, 19200 bps, user selectable
RESPONSE TIME	0 to 100 ms delay response time 10 ms increments user selectable
DATA	7 or 8 bit user selectable
PARITY	None, even, or odd

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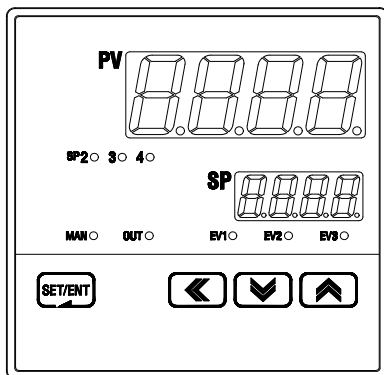
**Approvals**

---

UL RECOGNIZED	USA and Canada Process Control Equipment
UL FILE NUMBER	E244207
CE COMPLIANT	

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## 2. Front Panel Buttons and LED Indicators



### Control Keys

Key	Function
SET/ENT (ENTER)	Pressing SET/ENT key for at least 3 seconds switches between the operating display and parameter setup groups. This key is used to verify and bypass parameter settings in the parameter setup groups.
▲ / ▼ (UP/DOWN)	Used to change the value of digits when setting parameters. Used to move between parameter groups.
◀ (SHIFT)	Used to move to the next digit when setting parameters.

### LED Display

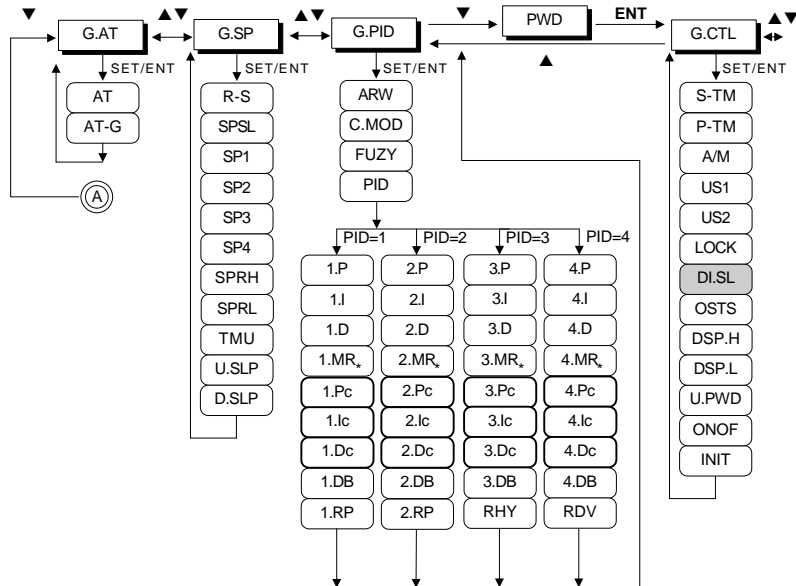
LED	Function
SP2, SP3, SP4 EV1, EV2, EV3 OUT MAN	LEDs activate when corresponding Set Point is selected for use. LEDs activate when corresponding relays energize. LED activated to display when control output is active. LED on when manual output control mode is selected. LED blinks during auto-tuning setup process.

### 3. Parameter Map



#### Pwd: Lockout Password

Use the ▲▼ arrows to enter the password and press the SET/ENT key. The default password is 0.



: Optional feature



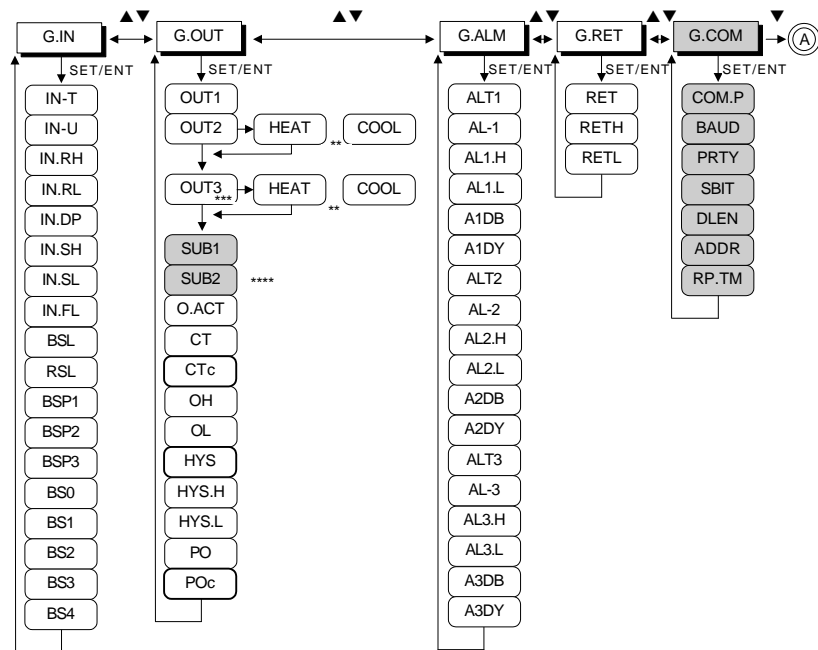
: Selection in H/C model controllers only (H/C models and ON/OFF mode display HYS)

\* : This setting is active only when integral time is 0 and Heat or Cool is selected.

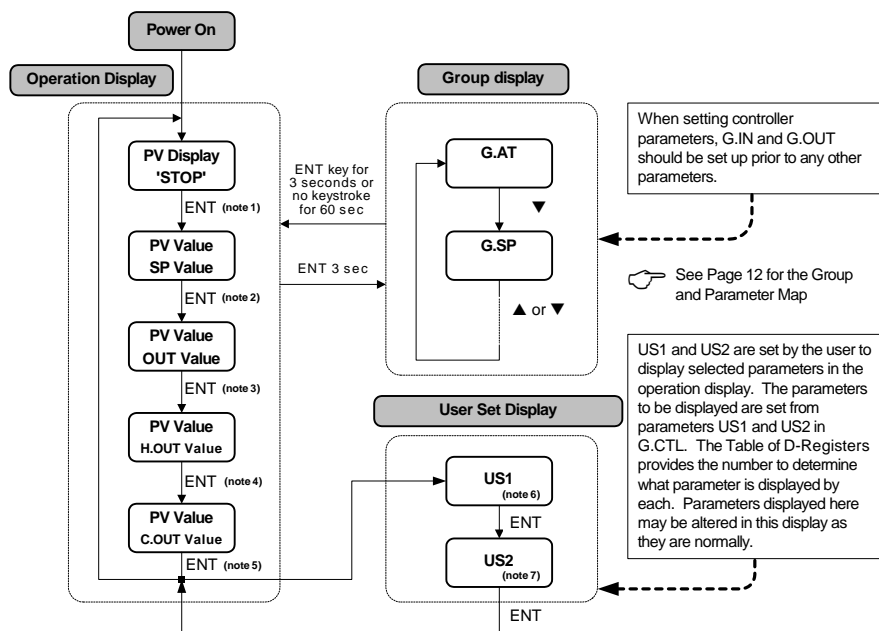
\*\* : Menu only used if OUT2 or OUT3 selected for Heat or Cool control

\*\*\* : OUT3 is an option for the PD540, PD541, PD544, and PD545, and standard on all other models

\*\*\*\* : Option not available on the PD540 or PD541



## 4. Operation Flow Chart



note 1: 'STOP' appears in the SP display when the controller has stopped operation due to running time parameters. The Set Point may be changed while in 'Stop' mode.

note 2: Operation Display-1 : Initial display after power on. Active Set Point may be changed through this menu.

note 3: Operation Display-2 : Output control display shows level of output as % of full output scale. May be set manually if output configured for manual operation.

note 4: Heating output display in Heating/Cooling models only.

note 5: Cooling output display in Heating/Cooling models only.

note 6: Only displayed when User Screen 1 is set in US1.

note 7: Only displayed when User Screen 2 is set in US2.



## 5. Controller Parameter Setup

### 5.1 Input Group (G.IN)

PV G.IN

Press SET/ENT key to select input group. Press press ▲ or ▼ key to cycle through groups as shown below. (Refer to parameter map in section 3.)

```

      G.AT  ▲▼ G.SP  ▲▼ G.PID  ▲▼ PWD  ▲▼ G.CTL  ▲▼ G.IN
      ▼ ↑
      G.COM  ▲▼ G.RET  ▲▼ G.ALM  ▲▼ G.OUT
    
```



Input group parameters should be established first, as changes to the input type may reset other parameter settings in other groups to their default value.

PV In-t

This parameter selects the type of input sensor used. Its default setting is type TC.K1. Refer to the following table showing the type of sensor inputs and select the desired input type.

**Table 1: Universal Input Selection**

display range : -5% to 105%

No.	TYPE	Temp.Range(°C)	Temp.Range(°F)	Group	DISP
1	K1	-200 to 1370	-300 to 2500	Thermocouple	EEK1
2	K2	-199.9 to 999.9	0 to 2300		EEK2
3	J	-199.9 to 999.9	-300 to 2300		EEJ
4	E	-199.9 to 999.9	-300 to 1800		EEE
5	T	-199.9 to 400.0	-300 to 750		EEt
6	R	0 to 1700	32 to 3100		EEr
7	B	0 to 1800	32 to 3300		EEb
8	S	0 to 1700	32 to 3100		EEs
9	L	-199.9 to 900.0	-300 to 1600		EEl
10	N	-200 to 1300	-300 to 2400		EEn
11	U	-199.9 to 400.0	-300 to 750		EEU
12	W	0 to 2300	32 to 4200		EEW
13	Platinel II	0 to 1390	32 to 2500	RTD (0.00385)	EEPL
14	PtA	-199.9 to 850.0	-300 to 1560		PEtA
15	PtB	-199.9 to 500.0	-199.9 to 999.9		PEtB
16	PtC	-19.99 to 99.99	-4.0 to 212.0	RTD (0.00392)	PEtC
17	JPtA	-199.9 to 500.0	-199.9 to 999.9		JPEtA
18	JPtB	-150.0 to 150.0	-199.9 to 300.0	VDC	JPEtB
19	0.4 to 2.0V	0.400 to 2.000V			2V
20	1 to 5V	1.000 to 5.000V			5V
21	0 to 10V	0.00 to 10.00V			10V
22	-10 to 20mV	-10.00 to 20.00mV		mVDC	20mV
23	0 to 100mV	0.0 to 100.0mV			100mV



**4-20 mA Input Selection:**

To accept a 4-20 mA signal, select 0.4 to 2.0 VDC input and connect a 100 Ω resistor across the input terminals.

	<p>This parameter sets the display temperature unit for °C or °F. Its default selection is °C. Refer to Table 1 when changing the temperature unit for the temperature input range.</p>
	<p>This parameter sets the high limit of the temperature display range (maximum temperature displayed). For mV and V inputs, this sets the value of the high input of the input scale defined in In.SH.</p>
	<p>This parameter sets the low limit of the temperature display range (minimum temperature displayed). For mV and V inputs, this sets the low input of the input scale defined in In.SL.</p>
	<p>This parameter sets the position of the decimal point for mV or V inputs. The position of the decimal point can be set as 9999, 999.9, 99.99, or 9.999. Its default set value is 1.</p>
	<p>This parameter sets the high limit of the mV or V display scale. This value will be displayed when the input is set to the high input established in In.rH. Its default value is 100.0.</p>
	<p>This parameter sets the low limit of the mV or V display scale. This value will be displayed when the input is set to the low input established in In.rL. Its default value is 0.0.</p>
	<p>This parameter sets the PV filter for stabilization from electromagnetic noise and interference. This will effect the rate of change of the PV display value. Its default setting is OFF, and can be set from 1 to 120 seconds.</p>
	<p>This parameter to establishes PV behavior when an open input sensor is detected. When BSL is set to UP, the PV operates as if at the high input range. When BSL is set to DOWN, the PV operates as if at the low input range. Its default setting is UP. In the case of mV or V inputs, the default setting is OFF. An open sensor check is not performed in 10 V, 20 mV, or 100 mV input settings.</p>
	<p>This parameter determines if RJC for thermocouple inputs is used. RJC can be turned on or off. Its default setting is ON.</p>
	<p>This parameter sets where the PV bias points occur. See Fig 1 and Fig 2 for further information about input bias operation.</p>
	<p>This parameter sets the bias value at the corresponding bias point input values. These parameters establish the value of the offset at each of the defined BSP1 - BSP3 points. See Fig 1 and Fig 2 for further information about input bias operation.</p>

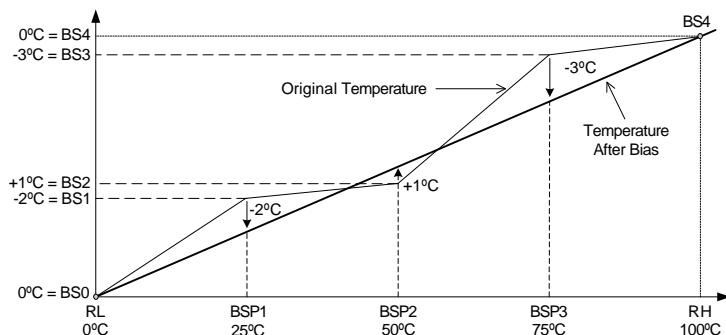


Fig 1: Temperature Bias

Example 1: The original temperature is shown within the range of 0°C (Range Low) and 100°C (Range High). Bias points have been used to adjust the displayed temperature as shown in the graph in Fig 1.

To establish this bias, the settings are shown below.

Temperature Settings to Establish Where the Bias Occurs				
RL	BSP1	BSP2	BSP3	RH
0°C	25°C	50°C	75°C	100°C
Bias Offset for Each Point				
BS0	BS1	BS2	BS3	BS4
0°C	-2°C	+1°C	-3°C	0°C

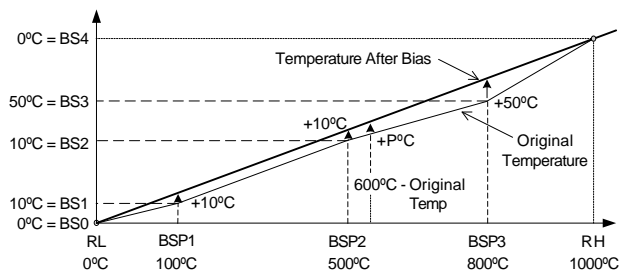


Fig 2: Bias Formula Calculation

Example 2: Temperature Bias Value (BS0 through BS4) = Temperature After Bias - Actual Temperature  
 Display temperature after bias at 600°C actual temperature = P

$$P = 600 + (600 - \text{BPS2}) \times \frac{\text{BS3} - \text{BS2}}{\text{BSP3} - \text{BSP2}} + \text{BS2}$$

$$P = 600 + (600 - 500) \times \frac{50 - 10}{800 - 500} + 10 = 623^\circ\text{C Temperature After Bias}$$

## Input Group Parameter Summary





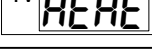
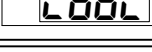


Display	Parameter	Setting Range	Unit	Default	Remark
IN-T	Input Type	Refer to Table 1: Universal Input Selection	ABS	TC.K1	
IN-U	Display Unit	°C / °F	ABS	°C	T/C, RTD
IN.RH	Max PV Display Range	Within sensor input range Refer to Table 1 INRH > INRL	AEU	1370	
IN.RL	Min PV Display Range		AEU	-200	
IN.DP	Decimal Point Position	0, 1, 2, or 3	ABS	1	mV, V
IN.SH	Max Input Value Scale	-1999 to 9999 INSH > INSL Decimal position determined by IN.DP	ABS	100.0	mV, V
IN.SL	Min Input Value Scale			0.0	mV, V
IN.FL	PV Filter	OFF, 1 to 120	sec	OFF	
BSL	Open Sensor Behavior	OFF, UP, DOWN	ABS	UP	Not Used for VDC Input
RSL	RJC Operation	ON, OFF	ABS	ON	Only Used for TC Input
BSP1	Reference Bias Point 1	AEU (0.0 to 100.0%), RL<BSP1<BSP2<BSP3<RH	AEU	AEU (100.0%)	
BSP2	Reference Bias Point 2	AEU (0.0 to 100.0%), RL<BSP1<BSP2<BSP3<RH	AEU	AEU (100.0%)	
BSP3	Reference Bias Point 3	AEU (0.0 to 100.0%), RL<BSP1<BSP2<BSP3<RH	AEU	AEU (100.0%)	
BS0	Bias Value for RL Point	GEU (-100.0 to 100.0%)	GEU	0	
BS1	Bias Value at BSP1	GEU (-100.0 to 100.0%)	GEU	0	
BS2	Bias Value at BSP2	GEU (-100.0 to 100.0%)	GEU	0	
BS3	Bias Value at BSP3	GEU (-100.0 to 100.0%)	GEU	0	
BS4	Bias Value at RH	GEU (-100.0 to 100.0%)	GEU	0	



There are two types of engineering units values used in the setting of parameters, absolute engineering units (AEU) and general engineering units (GEU). An AEU parameter is set using an absolute value engineering unit that represents a specific point, such as a specific temperature or voltage level. An GEU parameter is set using engineering units, however it is a general value, and not tied to any input or output level.

For example: When establishing input bias, parameter BSP1 sets the specific PV value where bias point one will occur. This parameter has a unit designation of AEU. BS1, the amount of offset at BSP1 is set in engineering units, however this parameter occurs at whatever BSP1 is set to, and therefore does not have an absolute setting related to any input or output, it is just the amount of offset at where BSP1 occurs. While one is related to an absolute input value, and the other stand alone value, both are set as engineering units, such as BSP1 set as 100°C and BS1 set as 3°C.

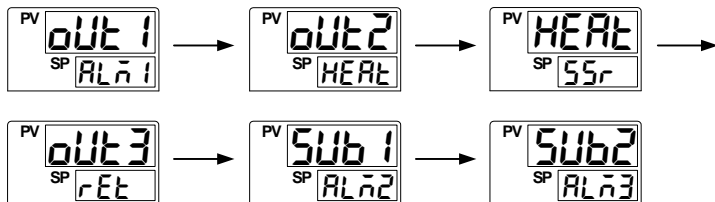
## 5.2 Output Group (G.OUT)

	<p>Press SET/ENT key to select input group. (Refer to parameter map in section 3.)</p> <pre>       ▲▼      ▲▼      ▲▼      ▲▼      ▲▼     G.AT ↔ G.SP ↔ G.PID ↔ PWD ↔ G.CTL ↔ G.IN       ▲      ▲▼      ▲▼      ▲▼      ▲▼       G.COM ↔ G.RET ↔ G.ALM ↔ <u>G.OUT</u>     </pre>
	<p>This parameter sets the type of operation for output 1. (OUT1: relay output) The output can be set to HEAT, COOL, ALM1, ALM2, ALM3, or RUN. Its default setting is ALM1. (COOL is displayed on H/C models only. Skip when ON/OFF Mode selected.)</p>
	<p>This parameter establishes the type of operation for output 2. (OUT2: 4-20 mA or voltage pulse) Settings can be HEAT, COOL, or RET (retransmitting). Its default setting is HEAT. (COOL is displayed on H/C models only.)</p>
	<p>This parameter establishes the type of operation for output 3. (OUT3: 4-20 mA or voltage pulse) Settings can be HEAT, COOL, or RET (retransmitting). Its default setting is HEAT. (COOL is displayed on H/C models only.) Valid for models with OUT3 only.</p>
	<p>This parameter selects the type of output signal for each analog output (OUT2 and OUT3) when they are set to HEAT. The outputs can be set to SSR (pulse output) or SCR (4-20 mA). Its default setting is SSR.</p>
	<p>This parameter selects the type of output signal for each analog output (OUT2 and OUT3) when they are set to COOL. The outputs can be set to SSR (pulse output) or SCR (4-20mA). Its default setting is SSR.</p>
	<p>This parameter sets the type of operation for auxiliary output 1 (SUB1: relay output) Output can be set to HEAT, COOL, ALM1, ALM2, ALM3, or RUN. Its default setting is ALM2. (COOL is displayed on H/C models only. Menu appears only on models with the SUB1 output option.)</p>
	<p>This parameter sets the type of operation for auxiliary output 2 (SUB2: relay output) Output can be set to HEAT, COOL, ALM1, ALM2, ALM3, or RUN. Its default setting is ALM2. (COOL is displayed on H/C models only. Menu appears only on models with the SUB2 output option.)</p>



## Output Group Menu Progression Example:

The following settings establish relay output 1 (OUT1) to trigger based on alarm 1, for analog output 2 (OUT2) to operate as a heating temperature controller outputting a voltage pulse, for analog output 3 (OUT 3) to output a retransmitting 4-20 mA signal, and for auxiliary relay outputs SUB1 and SUB2 to trigger with alarm 2 and alarm 3.



<div>PV</div> <div>0ACT</div>	<p>This parameter establishes reverse (REV) or forward (FWD) activation of the control outputs. In forward operation, the control outputs will be most active when the PV value is higher than the SP, as the controller acts to lower the PV. In reverse operation, the control outputs will be most active when the PV value is lower than the SP value, as the controller acts to increase the PV. The default setting is REV.</p>
<div>PV</div> <div>CT</div>	<p>This parameter establishes the cycle time for use with time-proportional PID relay or voltage pulse control when the outputs are set to HEAT or COOL. The cycle time can be set from 1 to 300 seconds. Its default setting is 2 seconds.</p>
<div>PV</div> <div>CTC</div>	<p>This parameter establishes the cycle time for cooling outputs if cooling (COOL) control is set up with time-proportional PID control in a H/C model. (Example: OUT1 = Cool, OUT2 or OUT3 = Cool and set to SSR, SUB1 or SUB2 = Cool) The cycle time can be set from 1 to 300 seconds. Its default setting is 2 seconds.</p>

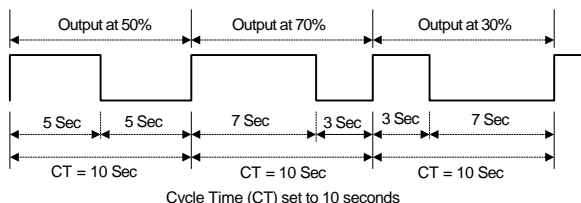


Fig 3: Time-Proportional PID Control Output

<div>PV</div> <div>OH</div>	<p>This parameter sets a high limit for the levels of the control output. This limits the output levels based on a percentage of their full scale. Its default setting is 100 (%).</p>
<div>PV</div> <div>OL</div>	<p>This parameter sets a low limit for the levels of the control output. This prevents the outputs from dropping below a certain level based on a percentage of their full scale. Its default setting is 0 (%). The outputs are limited by both the low and high limits.</p>
<div>PV</div> <div>HYS</div>	<p>This parameter sets hysteresis in case of On/Off control output mode in a H/C model.</p>
<div>PV</div> <div>HYS.H</div>	<p>This parameter sets the hysteresis high limit for on/off relay control mode in normal models (non-Heating/Cooling models).</p>
<div>PV</div> <div>HYS.L</div>	<p>This parameter sets the hysteresis low limit for on/off relay control mode in normal models (non-Heating/Cooling models).</p>

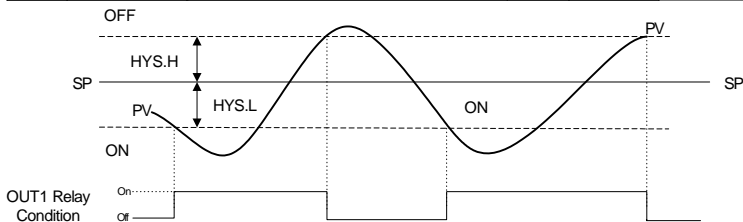


This parameter establishes the percent output transmitted by the control outputs when the controller is in STOP mode, or when an error condition occurs such as a PID algorithm error, A/D error, or open sensor error is detected.

This parameter establishes the percent output transmitted by the COOL control outputs in a Heating & Cooling controller model when the controller is in STOP mode, or when an error condition occurs.

### Output Group Parameter Summary

Display	Parameter	Setting Range	Unit	Default	Remark
OUT1	Select Output	HEAT, COOL, ALM1, ALM2, ALM3, RUN	ABS	ALM1	
OUT2	Select Output	HEAT, COOL, RET	ABS	HEAT	
OUT3	Select Output	HEAT, COOL, RET	ABS	RET	Models with OUT3 Only
HEAT	Select Output Type	SSR, SCR	ABS	SSR	When OUT 2, 3, Set for HEAT
COOL	Select Output Type	SSR, SCR	ABS	SSR	When OUT 2, 3, Set for COOL
SUB1	Select Output	HEAT, COOL, ALM1, ALM2, ALM3, RUN	ABS	ALM2	Option
SUB2	Select Output	HEAT, COOL, ALM1, ALM2, ALM3, RUN	ABS	ALM3	Option
O.ACT	Reverse and Forward	REV, FWD	ABS	REV	
CT	Cycle Time 1	1 to 300 sec	sec	2 sec	
CTc	Cycle Time 2	1 to 300 sec	sec	2 sec	H/C Models Only
OH	High Limit value of Output	OL + 1 digit to 105.0% HC models: 0 to 105.0%, however OH>OL	%	100.0%	
OL	Low Limit value of Output	-5.0% to OH setting HC Type: 0 to 105.0%, However OH>OL	%	0% H/C: 100.0%	
HYS	Hysteresis	0.0 to 10.0%	%	0.5%	H/C Models Only, On/Off Mode
HYS.H	Hysteresis High	GEU (0.0 to 10.0% of sensor range)	GEU	GEU (0.5%)	Relay Cutoff, ON/OFF Mode
HYS.L	Hysteresis Low	GEU (0.0 to 10.0% of sensor range)	GEU	GEU (0.5%)	Relay Activation, ON/OFF Mode
PO	Preset Output	-5.0 to 105.0% H/C Type : 0.0 to 105.0%	%	0.0%	
POc	Preset Output	0.0 to 105.0%	%	0.0%	H/C Models Only



Note: In H/C models, HYS.H and HYS.L replaced by HYS, and range high and low is 1/2 HYS setting

## 5.3 Control Group (G.CTL)

PV G.CTL

Press SET/ENT key to select control group. (Refer to parameter map in section 3.)

PV S-TM

This parameter establishes the delay time from power on to when the outputs are activated. This can be set from 0 to 99.95 (hours.minutes). Its default setting is OFF. See Fig. 4.

PV P-TM

This parameter establishes the running time for the controller outputs. P-TM can be set from 0 to 99.59 (hours.minutes). Its default setting is OFF. See Fig 4. Note that this time begins after the S-TM function.

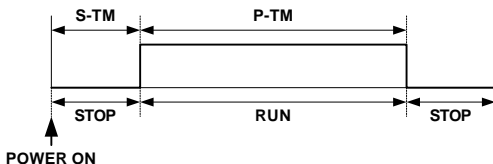


Fig 4: Output Delay and Timer Functions

PV A/P

This establishes the control mode as automatic (AUTO) or manual (MAN). When in manual mode, the output levels can be set by the user from the operation display, and the MAN LED will active on the front panel. The default setting is AUTO.

PV US1

PV US2

This parameter establishes the user screens for viewing, confirmation, and setup of commonly used parameters from the operation display. To add the parameter to the operation display, enter the corresponding number for the parameter from the Table of D-Registers as either US1 or US2. The default settings are OFF.

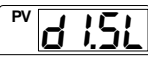
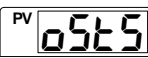
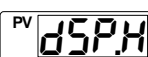
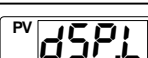

☞ See page 14 and the Operation Flow Chart for a map of the operation display.

PV LOCK

Turning ON this parameter locks all settings from being changed. This applies to the operation display functions, such as changing the set point, as well as setting group parameters. If ON, only the LOCK parameter may be changed. The default setting is OFF.


Table 2: DI Operation

DI.SL	DI1	DI2	Operation
OFF	-	-	DI Disabled
1	off	-	Stop
	on	-	Run
	-	off	SP1
	-	on	SP2
2	off	off	SP1
	on	off	SP2
	off	on	SP3
	on	on	SP4

	<p>This parameter establishes the operation of the digital input (DI) external contacts. The digital input operating configurations are shown in Table 2: DI Operation. This feature is only valid for models with digital inputs.</p>
	<p>When this parameter is on, the output settings will be displayed in the operation display. The settings of parameters OUT1, OUT2, OUT3, SUB1, and SUB2 will be shown. Only outputs built into the model being used will display. Its default setting is OFF.</p>
	<p>This parameter sets the high limit of the sensor input in the PV display. The PV value will not display higher than this limit, however the control functions will operate based on the actual input value.</p>
	<p>This parameter sets the low limit of the sensor input in the PV display. The PV value will not display lower than this limit, however the control functions will operate based on the actual input value.</p>
	<p>This parameter establishes the password for the controller. This password must be entered at the PWD screen before accessing the control group (G.CTL) or it will not access the setting groups after the PWD prompt. The default setting is "0". See the parameter map in section 3 for the location of the PWD prompt in the group menus.</p>



Be sure not to forget the password once it has been set. If the password is forgotten, contact technical support as listed on the back of this manual.

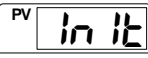
	<p>The parameter to set the control type for On/Off control mode in a Heating or Cooling standard controller. Control output is set to output 1 (Out1: Relay) when in On/Off mode. See hysteresis commands in the output group for operating the relay in On/Off mode.</p>
---	--



The 0n0F parameter does not appear in Heating and Cooling controllers. To set up a Heating and Cooling model for On/Off control, enter the  $\mathcal{G}P\ id$  (PID Group) and set parameters  $iP$  and  $iPc$  to 0.0.



See page 20 and 21 for more information on setting up On/Off control.

	<p>This parameter resets most parameters to their factory settings. To reset the controller, set this parameter to ON. After reset, it will return to the OFF setting.</p>
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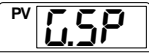
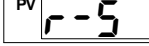










Most parameters will be reset to their default settings when the controller is initialized. Note the current settings before this is done so they can easily be restored after controller initialization.

**Control Group Parameter Summary**

Display	Parameter	Setting Range	Unit	Default	Remark
S-TM	Start Time Delay	Off (0.00) to 99.59 (hours.minutes)	Time	OFF	
P-TM	Process Run Time	Off (0.00) to 99.59 (hours.minutes)	Time	OFF	
A/M	Automatic/Manual	AUTO, MAN	ABS	AUTO	
US1	User Screen	Off, D-Register Number 1 to 1299	ABS	OFF	
US2	User Screen	Off, D-Register Number 1 to 1299	ABS	OFF	
LOCK	Parameter Lock	OFF, ON	ABS	OFF	
DI.SL	DI Selection	OFF, 1, 2	ABS	OFF	DI Option
OSTS	Output Status Display	OFF, ON	ABS	OFF	
DSP.H	Display High Limit	AEU (-5.0 to 105.0%), DSP.L<DSP.H	AEU	AEU (105.0%)	
DSP.L	Display Low Limit	AEU (-5.0 to 105.0%), DSP.L<DSP.H	AEU	AEU (-5.0%)	
U.PWD	User Password	0 to 9999	ABS	0	
ONOF	ON/OFF Mode	ON, OFF	ABS	OFF	Not in H/C Models
INIT	Factory Initialization	OFF, ON	ABS	OFF	

## 5.4 SP Group (G.SP)

	<p>Press SET/ENT key to select SP group. (Refer to parameter map in section 3.)</p> <pre>       G.AT ↔ <u>G.SP</u> ↔ G.PID ↔ PWD ↔ G.CTL ↔ G.IN       ↑      ▲      ▲      ▲      ▲      ▲       G.COM ↔ G.RET ↔ G.ALM ↔ G.OUT       ▲      ▲      ▲      ▲           </pre>
	<p>This parameter sets the running mode to RUN or STOP. In STOP mode, outputs are turned off, and no set point is maintained.</p>
	<p>This parameter selects which set point is active. There are four programmable set points, and one for use with SYNC-SLAVE communication. It can be set to RSP, SP1, SP2, SP3, or SP4. Its default setting is SP1.</p> <p><b>NOTE</b> When using the communication option for Sync-Slave control, the slave controllers must have SP5L set to RSP.</p>
 <p style="text-align: center;">:</p> 	<p>This parameter sets the value of each of the 4 programmable set points that can be selected to run. The parameter SP5L selects which set point to use.</p>
	<p>This parameter sets a high limit on what the set points can be programmed or changed to. This value may reset if the type of input is changed, or if parameter IN.RH or IN.RL (IN. SH or IN.SL if input type is mV or V) is changed.</p>
	<p>This parameter sets a low limit on what the set points can be programmed or changed to. This value may reset if the type of input is changed, or if parameter IN.RH or IN.RL (IN. SH or IN.SL if input type is mV or V) are changed.</p>
	<p>This parameter sets the time unit the controller uses for parameters with time components. This can be set to the format of HH.MM (hours.minutes) or MM.SS (minutes.seconds). Its default setting is HH.MM.</p> <p><b>NOTE</b> Parameters S-TM and P-TM are not linked to TMU. The time unit setting of those parameters is always HH.MM (hours.minutes).</p>
 	<p>This parameter to sets the SP to ascend or descend gradually over time, dependant on the new SP selected. U.SLP (rate of ascension) and D.SLP (rate of descent) are the rate of change over time (time units set by parameter TMU) of the set point when the set point is changed. When U.SLP and D.SLP is set to OFF, the new SP is set instantly. The default setting of U.SLP and D.SLP is OFF.</p>

**Set Point Group Parameter Summary**

Display	Parameter	Setting Range	Unit	Default	Remark
R-S	Run/Stop	RUN, STOP	ABS	RUN	
SPSL	SP Select	RSP, SP1, SP2, SP3, SP4	ABS	SP1	
SP1	Set Point 1	AEU (0.0 - 100.0% of input range)	AEU	AEU (Input Range Low)	
SP2	Set Point 2	AEU (0.0 - 100.0% of input range)	AEU	AEU (Input Range Low)	
SP3	Set Point 3	AEU (0.0 - 100.0% of input range)	AEU	AEU (Input Range Low)	
SP4	Set Point 4	AEU (0.0 - 100.0% of input range)	AEU	AEU (Input Range Low)	
SPRH	Set Point Range High	AEU (0.0 - 100.0% of input range)	AEU	AEU (Input Range High)	
SPRL	Set Point Range Low	AEU (0.0 - 100.0% of input range)	AEU	AEU (Input Range Low)	
TMU	Time Unit	HH.MM (hours.minutes), MM.SS (minutes.seconds)	ABS	HH.MM	
U.SLP	Rate of Change for SP Increase	OFF (0), GEU (0.0%+1digit to 100.0%) per minute or second	GEU	OFF (0)	
D.SLP	Rate of Change for SP Decrease	OFF (0), GEU (0.0%+1digit to 100.0%) per minute or second	GEU	OFF (0)	



## 5.5 PID Group (G.PID)



The PID group selection does not appear when the controller is operating in On/Off mode

<p>PV <b>GPI d</b></p>	<p>Press SET/ENT key to select PID group. (Refer to parameter map in section 3.)</p> <p style="text-align: center;">             G.AT ↔ G.SP ↔ <b>G.PID</b> ↔ PWD ↔ G.CTL ↔ G.IN              ↑                      ↔                      ↔                      ↔                      ↓              G.COM                      G.RET                      G.ALM                      G.OUT           </p>
<p>PV <b>ARW</b></p>	<p>The parameter sets the PV deviation width to prevent overshoot. When the control outputs reach this high limit value, they stop ordinary output action for integral control and use ARW (Anti-Reset Windup). When the setting is AUTO, this parameter is calculated automatically.</p>
<p>PV <b>Lnod</b></p>	<p>This parameter establishes the control mode. It can be set to Differential of Deviation Value (d. dB) or Process Variable (d. Pb). Deviation Value mode will reduce overshoot. Process Variable mode will more quickly raise and lower the PV. The default setting is d. dv.</p>
<p>PV <b>FUZY</b></p>	<p>This parameter activates the use of fuzzy logic. Fuzzy logic can be effective in suppressing overshoot and reducing PV variation that may occur once the PV has reached the SP. Refer to Fig 5: Overshoot Suppression with Fuzzy Logic.</p>

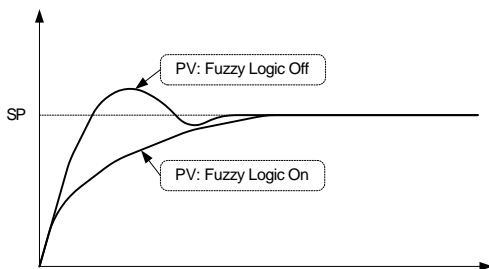


Fig 5: Overshoot Suppression with Fuzzy Logic

<p>PV <b>PI d</b></p>	<p>This parameter establishes the number of PID setting groups to be used in control output calculation. Up to 4 user defined groups of proportional, integral, and derivative value zones can be established. Use this setting to enter the setting menus for each PID group.</p>
<p>PV <b>IP</b></p>	<p>This parameter sets the proportional operation for PID control. Setting range of 1.P is 0.1 (H/C model: 0.0) to 999.9%. Its default setting is 10.0%.</p>

<div>PV</div> <div>11</div>	<p>This parameter sets the integration time for PID control. Setting ranges of 1.I are OFF or 1 to 6000 seconds. Its default setting is 120 seconds.</p>
<div>PV</div> <div>1d</div>	<p>The parameter to set derivation time for PID control. Setting ranges of 1.D are OFF or 1 to 6000 seconds. Its default setting is 30 seconds.</p>
<div>PV</div> <div>1r</div>	<p>The parameter to set the manual reset in the PID calculation. This setting only functions if the integral time setting is OFF. This setting always functions for H/C models.</p>
<div>PV</div> <div>1Pc</div>	<p>The parameter to set proportional operation for PID control for the cooling control in H/C models. Setting options are 0.0 (when using On/Off control) or 0.1 to 999.9%. Its default setting is 10.0%.</p>
<div>PV</div> <div>11 c</div>	<p>The parameter to set integral time for PID control for the cooling control in H/C models. Setting options are OFF or 1 to 6000 seconds. Its default setting is 120 seconds.</p>
<div>PV</div> <div>1dc</div>	<p>The parameter to set derivative time for PID control for the cooling control in H/C models. Setting options are OFF or 1 to 6000 seconds. Its default setting is 30 seconds.</p>
<div>PV</div> <div>1db</div>	<p>The parameter to set the dead band, in which there is no output from either the heating or cooling outputs. Refer to Fig 6, Fig 7, and Fig 8.</p>
<div>.</div>	<p>Note: The contents of PID Groups 2, 3, and 4 are the same as PID Group 1.</p>
<div>PV</div> <div>1rP</div>	<p>This parameter establishes the PV range of each of the 3 main PID zones. The range of PID zone 1 is IN.RL (IN.SL if set for mV or V input) to 1.RP. The range of PID zone 2 is 1.RP to 2.RP. The range of PID zone 3 is 2.RP to IN.RH (IN.SH if set for mV or V input).</p>
<div>PV</div> <div>2rP</div>	<p>This parameter establishes the range of each of the 3 main PID zones. The range of PID zone 1 is IN.RL (IN.SL if set for mV or V input) to 1.RP. The range of PID zone 2 is 1.RP to 2.RP. The range of PID zone 3 is 2.RP to IN.RH (IN.SH if set for mV or V input).</p>
<div>PV</div> <div>rHY</div>	<p>This parameter establishes the hysteresis width of the PID zone.</p>
<div>PV</div> <div>rdb</div>	<p>This parameter sets the range of deviation for PID zone 4. When the difference between the PV and SP is greater than this deviation range, the controller will utilize PID group 4 for PID settings. While the PV and SP are within this deviation difference, the controller will utilize whatever zone would normally be used based on the PV value.</p>

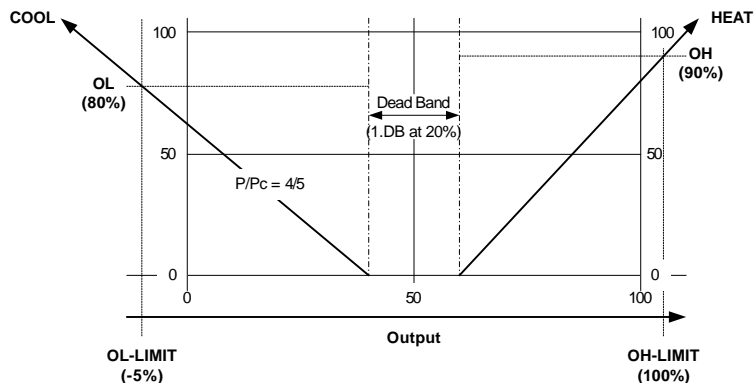


Fig 6: Heating and Cooling Outputs Using PID Control

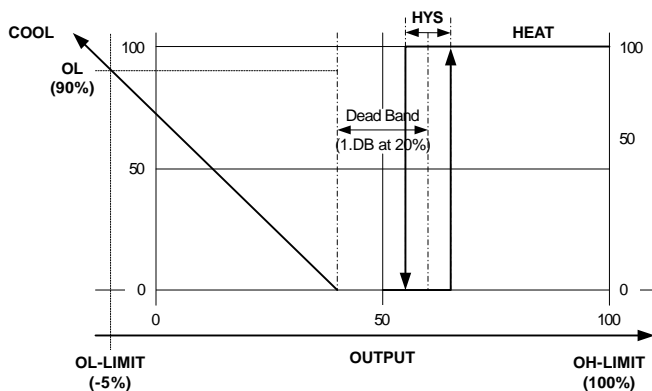


Fig 7: Heating On/OFF and Cooling PID Outputs

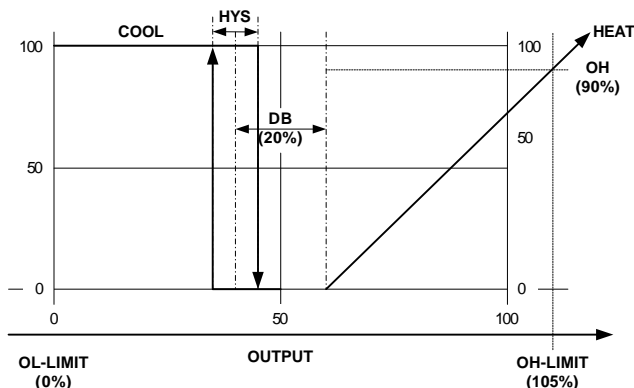


Fig 8: Heating PID and Cooling On/Off Outputs

## PID Group Parameter Summary

Display	Parameter	Setting Range	Unit	Default	Remarks
ARW	Anti-Reset Wind-Up	Auto or 50.0 to 200.0%	%	Auto	
C.MOD	Control Mode	Differential of Deviation Value (d. dV) or Process Variable (d. PV)	ABS	d. dV	
FUZY	Fuzzy	OFF, ON	ABS	OFF	
PID	PID Number	MENU (0), 1, 2, 3, or 4	ABS	MENU	
n.P	n.Proportional Band	0.1 (H/C Models:0.0) to 999.9%	%	10.0%	
n.I	n.Integral Time	OFF, 1 to 6000 seconds	sec	120 sec	
n.D	n.Derivative Time	OFF, 1 to 6000 seconds	sec	30 sec	
n.MR	n.Manual Reset	-5.0 to 105.0%	%	50.0%	Used if I=0, or H/C Model
n.Pc	n.Proportional Band for Cooling Side	0.0 (ON/OFF Control) or 0.1 to 999.9%	%	10.0%	H/C Models Only
n.Ic	n.Integral Time for Cooling Side	OFF, 1 to 6000 sec	sec	120 sec	H/C Models Only
n.Dc	n.Derivative Time for Cooling Side	OFF, 1 to 6000 sec	sec	30 sec	H/C Models Only
n.DB	n.Deadband	-100.0 to 50.0%	%	3.0%	H/C Models Only
1.RP	Reference Point 1	AEU (0.0%), $1.RP \leq 2.RP$	AEU	100.0%	PID Zone 1
2.RP	Reference Point 2	$1.RP \leq 2.RP \leq AEU$ (100.0%)	AEU	100.0%	PID Zone 2
RHY	Reference Hysteresis	GEU (0.0 to 10.0%)	GEU	0.3%	PID Zone 3
RDV	Reference Deviation	GEU (0.0 to 100.0%)	GEU	0.0%	PID Zone 4

## 5.6 Auto-Tuning Group (G.AT)



NOTE

AT group selection does not appear if operating in On/Off mode or when set for manual output control.

	<p>Press SET/ENT key to select AT group. (Refer to parameter map in section 3.)</p> <pre>           ▲▼   ▲▼   ▲▼   ▲▼   ▲▼   ▲▼       G.AT ↔ G.SP ↔ G.PID ↔ PWD ↔ G.CTL ↔ G.IN       ▲   ▲   ▲   ▲   ▲   ▲       ▼   ▼   ▼   ▼   ▼   ▼       G.COM ↔ G.RET ↔ G.ALM ↔ G.OUT           ▲▼   ▲▼   ▲▼   ▲▼         </pre>
	<p>The parameter to activate the auto-tuning function. When AT is set to ON, auto-tuning will begin (indicated by the MAN light blinking). This parameter cannot be used if the controller is in STOP mode.</p>



NOTE

### Auto-Tuning (AT)

The auto-tuning feature is used to let the controller measure process characteristics and automatically set the most appropriate values for the PID parameters. During the initial auto-tuning process, the control outputs will function in an On/Off condition, and the controller will use the responses to calculate the needed PID values. During this setup process, the MAN LED on the controller will blink.

Start the auto-tuning process after setting a desired set point. Auto-tuning will set the PID parameters for the PID zone which the set point is in, based on the PID reference point (RP) entered.

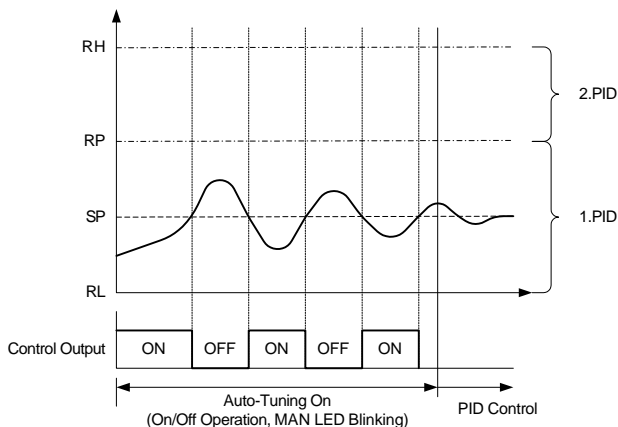


Fig 9: Auto-Tuning

**Auto-Tuning the Heating/Cooling Outputs:**

Auto-tuning of the heating/cooling outputs is the same process as the normal outputs. The PID heating/cooling parameters will be calculated. The parameters for the PID derivation time (1.D) will be the same for both the heating and cooling outputs.

**Display During Auto-Tuning:**

The MAN LED on the front panel will blink at a 500 ms time interval.

**Changing the Set Point During Auto-Tuning:**

If the set point is changed during the auto-tuning process, the original set point will be maintained for the duration of the auto-tuning process. After auto-tuning is complete, the controller will change to the new set point.

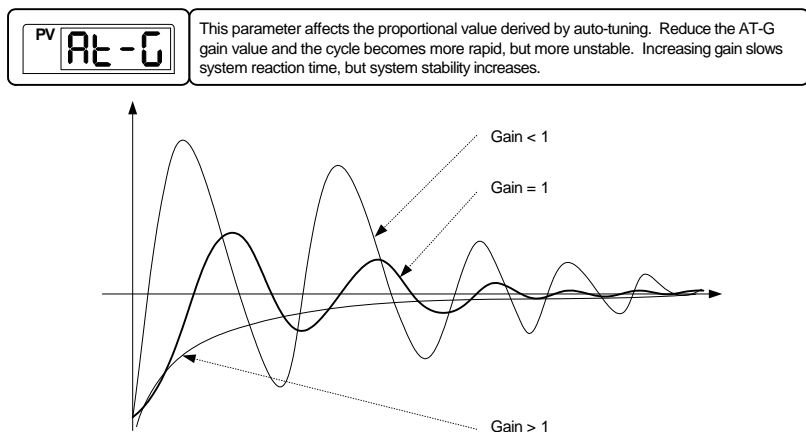
**Changing PID Parameters During Auto-Tuning:**

The PID values can be changed during the auto-tuning process. After auto-tuning is complete, it will then use the auto-tune calculated PID values. Values changed after auto-tuning will remain set until auto-tuning is run again.

**Auto-Tuning Interruptions or Errors:**

The auto-tuning process will end without effect for any of the following reasons:

- Auto-tuning forced to end (Example: Controller power down or stop condition)
- Open sensor (S.OPN) input error detected during the auto-tuning process
- Auto-tuning cycle exceeds 24 hours.
- Control changed to manual (MAN) operation during auto-tuning.



**Fig 10: Auto-Tuning Gain**

**Auto-Tuning Group Parameter Summary**

Display	Parameter	Setting Range	Unit	Default	Remark
AT	Auto-Tuning	OFF, ON	ABS	OFF	AT Activation
AT-G	AT Gain	0.1 to 10.0	ABS	1.0	Gain Value





Table 3: Alarm Selection

No.	Alarm Type	Operation		Standby		Display Data
		For	Rev	On	Off	
1	Absolute Value High Limit Alarm	✓		✓		AH.F
2	Absolute Value Low Limit Alarm	✓		✓		AL.F
3	High Limit Deviation Alarm	✓		✓		DH.F
4	Low Limit Deviation Alarm	✓		✓		DL.F
5	High Limit Deviation Alarm		✓	✓		DH.R
6	Low Limit Deviation Alarm		✓	✓		DL.R
7	High and Low Limit Deviation Alarm	✓		✓		DO.F
8	High and Low Limit Range Deviation Alarm	✓		✓		DI.F
9	Absolute Value High Limit Alarm		✓	✓		AH.R
10	Absolute Value Low Limit Alarm		✓	✓		AL.R
11	Absolute Value High Limit Alarm with Standby	✓			✓	AH.FS
12	Absolute Value Low Limit Alarm with Standby	✓			✓	AL.FS
13	High Limit Deviation Alarm with Standby	✓			✓	DH.FS
14	Low Limit Deviation Alarm with Standby	✓			✓	DL.FS
15	High Limit Deviation Alarm with Standby		✓		✓	DH.RS
16	Low Limit Deviation Alarm with Standby		✓		✓	DL.RS
17	High and Low Limit Deviation Alarm with Standby	✓			✓	DO.FS
18	High and Low Limit Range Deviation Alarm with Standby	✓			✓	DI.FS
19	Absolute Value High Limit Alarm with Standby		✓		✓	AH.RS
20	Absolute Value Low Limit Alarm with Standby		✓		✓	AL.RS

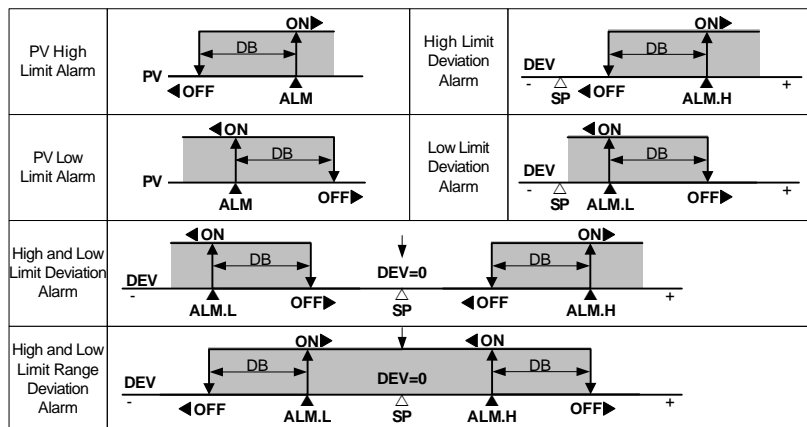


Fig 11: Alarm Operation

**Alarm Group Parameter Summary**

Display	Parameter	Setting Range	Unit	Default	Remark
ALT1	Alarm Type 1	Refer to Table 3: Alarm Selection	ABS	AH.F	
AL-1	Set Value of Alarm 1	AEU (-100.0 to 00.0%)	AEU	AEU (100.0%)	Absolute Value Alarm
AL1.H	High Deviation Limit of Alarm 1	GEU (-100.0 to 100.0%)	GEU	GEU (0.0%)	Deviation Alarm
AL1.L	Low Deviation Limit of Alarm 1	GEU (-100.0 to 100.0%)	GEU	GEU (0.0%)	Deviation Alarm
A1DB	Alarm 1 DB	GEU (0.0 to 100.0%)	GEU	GEU (0.5%)	
A1DY	Delay Time of Alarm 1	0.00 to 99.59	MM.SS	0.00	
ALT2	Alarm Type 2	Refer to Table 3: Alarm Selection	ABS	AH.F	
AL-2	Set Value of Alarm 2	AEU (-100.0 to 100.0%)	AEU	AEU (100.0%)	Absolute Value Alarm
AL2.H	High Deviation Limit of Alarm 2	GEU (-100.0 to 100.0%)	GEU	GEU (0.0%)	Deviation Alarm
AL2.L	Low Deviation Limit of Alarm 2	GEU (-100.0 to 100.0%)	GEU	GEU (0.0%)	Deviation Alarm
A2DB	Alarm 2 DB	GEU (0.0 to 100.0%)	GEU	GEU (0.5%)	
A2DY	Delay Time of Alarm 2	0.00 to 99.59	MM.SS	0.00	
ALT3	Alarm Type 3	Refer to Table 3: Alarm Selection	ABS	AH.F	
AL-3	Set Value of Alarm 3	AEU (-100.0 to 100.0%)	AEU	AEU (100.0%)	Absolute Value Alarm
AL3.H	High Deviation Limit of Alarm 3	GEU (-100.0 to 100.0%)	GEU	GEU (0.0%)	Deviation Alarm
AL3.L	Low Deviation Limit of Alarm 3	GEU (-100.0 to 100.0%)	GEU	GEU (0.0%)	Deviation Alarm
A3DB	Alarm 3 DB	GEU (0.0 to 100.0%)	GEU	GEU (0.5%)	
A3DY	Delay Time of Alarm 3	0.00 to 99.59	MM.SS	0.00	

## 5.8 Retransmission Group (G.RET)

PV

GrEt

Press SET/ENT key to select retransmission group. (Refer to parameter map.)

```

      ▲▼      ▲▼      ▲▼      ▲▼      ▲▼      ▲▼
      G.AT ↔ G.SP ↔ G.PID ↔ PWD ↔ G.CTL ↔ G.IN
      ▲       ▲       ▲       ▲       ▲       ▲
      ▼       ▼       ▼       ▼       ▼       ▼
      G.COM ↔ G.RET ↔ G.ALM ↔ G.OUT
      ▲       ▲       ▲       ▲
          
```

PV

rEt

This parameter sets the type of retransmission operation to use. Options are PV, SP, MV, and LPS. See notes below for an explanation of the retransmission types. The default setting is PV.

PV

rEtH

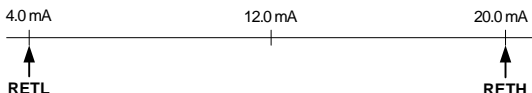
PV

rEtL

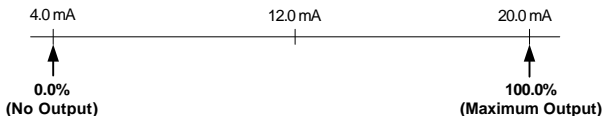
These parameters are used to scale the retransmitting output. They set the high and low limits for the retransmission output scale, as shown below. The retransmitting outputs will transmit 4 mA at the low limit (RETL) and 20 mA at the high limit (RETH) values. These limits are used when the retransmission type is set to PV or SP.

**PV and SP Type Retransmission Scale**

PV type retransmits based on the input value, SP retransmits based on the set point value.

**MV Type Retransmission Scale**

MV type retransmits based on the full scale output and what is currently being transmitted by the control outputs




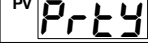



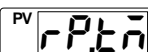
**LPS Type Retransmission**

LPS (Loop Power Supply) retransmitting outputs will transmit a 14-18 VDC @ 20 mA power supply output.

**Retransmission Group Parameter Summary**

Display	Parameter	Setting Range	Unit	Default	Remark
RET	Select Ret Type	PV, SP, MV, LPS	ABS	PV	
RETH	Ret Scale High Limit	T/C, RTD: INRH to INRL mV, V: INSH to INSL RETH > RETL	AEU	INRH	Only valid when RET is set to PV or SP
RETL	Ret Scale Low Limit		AEU	INRL	

## 5.9 Communication Group (G.COM)

	<p>Press SET/ENT key to select communication group. (Refer to parameter map.)</p> <pre>       ▲▼   ▲▼   ▲▼   ▲▼   ▲▼   ▲▼     G.AT ↔ G.SP ↔ G.PID ↔ PWD ↔ G.CTL ↔ G.IN       ▲   ▲   ▲   ▲   ▲   ▲       ↑   ↑   ↑   ↑   ↑   ↑     G.COM ↔ G.RET ↔ G.ALM ↔ G.OUT       ▲   ▲   ▲   ▲           </pre>
	<p>This parameter selects the type of communication protocol to be used.</p>
	<p>This parameter sets the communication speed (baud rate). The baud rate can be set at 600 to 19200 bps (bytes per second). The default setting is for 9600 bps.</p>
	<p>This parameter sets the communication parity. This can be set to NONE, EVEN, or ODD. The default setting is NONE.</p>
	<p>This parameter sets the communication stop bit. This can be set as 1 or 2. The default setting is 2.</p>
	<p>This parameter sets the communication data length. This can be set to 7 or 8. The default setting is 8. This parameter is not displayed when the communication protocol (COM.P) is set for MODBUS ASCII or RTU.</p>
	<p>This parameter sets the communication address for the controller. This can be set as 1 to 99 pcs address. Its default setting is 1.</p>
	<p>This parameter sets the communication response time. The RP.TM is the delay to return data to the upper level device after processing commands received from the upper level device. The setting RP.TM is based on the number of 10 ms intervals to delay (example: a setting of 2 will result in a 20 ms delay). If RP.TM is set to 0 it will immediately return a response once the command processing is complete.</p>

**Communication Group Parameter Summary**

Display	Parameter	Setting Range	Unit	Default	Remark
COM.P	Communication Protocol	PCC0, PCC1, Modbus ASCII, Modbus RTU, Sync-Master, Sync-Slave	ABS	PCC0	Option
BAUD	Baud Rate	600, 1200, 2400, 4800, 9600, 19200	ABS	9600	Option
PRTY	Parity	None, Even, Odd	ABS	None	Option
SBIT	Stop Bit	1, 2	ABS	1	Option
DLEN	Data Length	7, 8 (not used when set for MODBUS)	ABS	8	Option
ADDR	Address	1 to 99 (maximum of 31 connected at once)	ABS	1	Option
RP.TM	Response Time	0 to 10 (number of 10ms intervals)	ABS	0	Option

## 6. Error Display and Correction

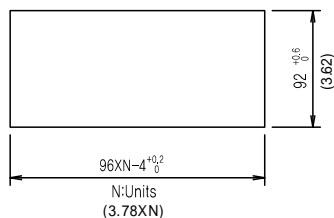
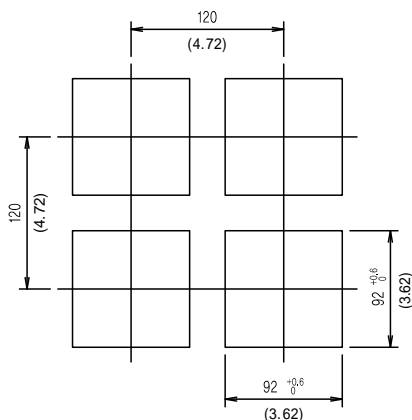
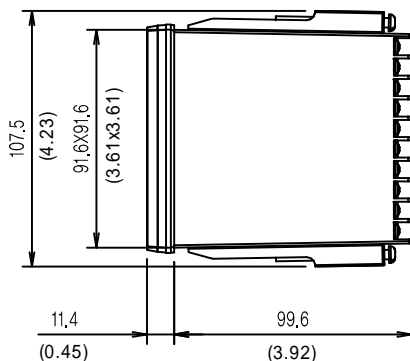
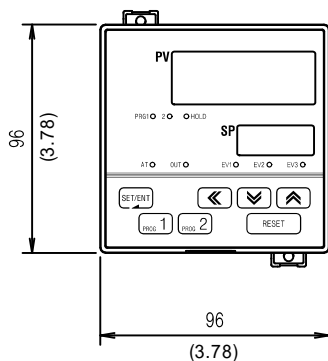
Error Message	Error Incident	Action Needed
E.SYS	EEPROM, Data Loss	Needs Repair
E.RJC	RJC Sensor Failure	Needs Repair
SP Decimal Flashing	Communication Failure	Check Comm Cable
S.OPN	Open Sensor Detected	Check Sensor
E.AT	Auto-Tune Timed Out (Over 24 Hours)	Check Process

## 7. Installation

### 7.1 Dimensions and Panel Cutouts

PD548-PD549

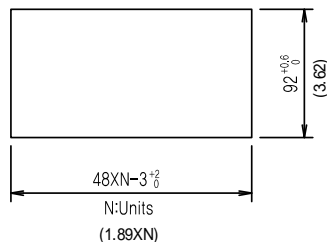
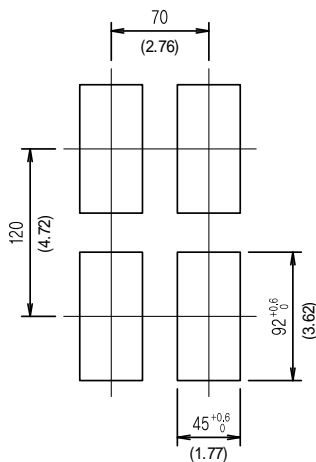
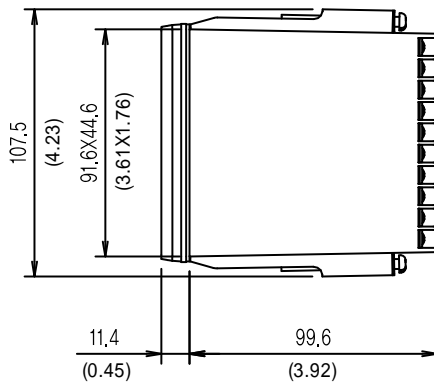
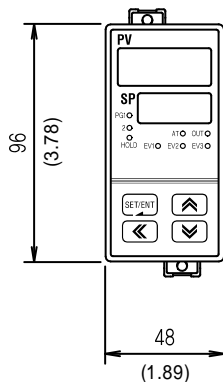
1/4 DIN



Units: mm  
(inch) - for reference only

## PD546-PD547

1/8 (V) DIN

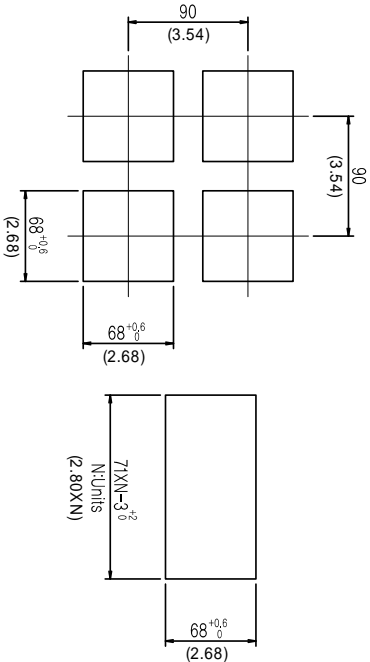
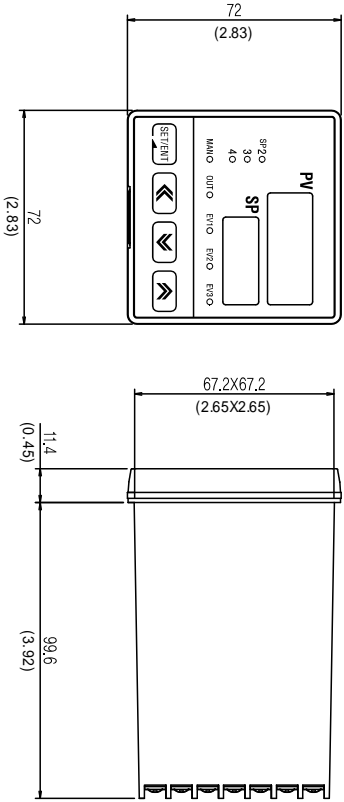


Units: mm  
(inch) - for reference only



PD544-PD545

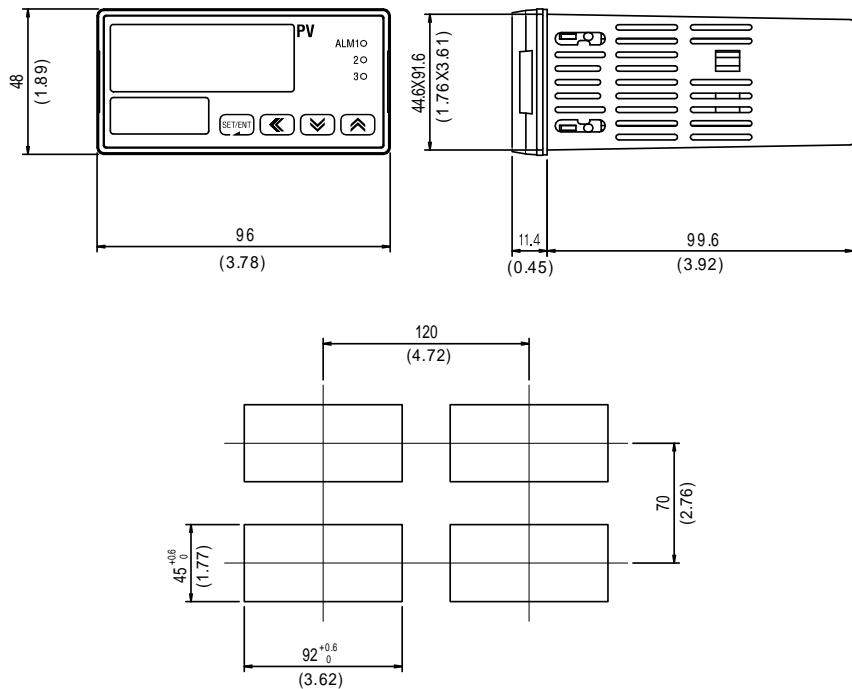
3 1/6 DIN



Units: mm  
(inch) - for reference only

PD542-PD543

1/8 (H) DIN



Units: mm  
(inch) - for reference only