Improving Summer Chinook Hatchery Broodstock Survival – Lower Puntledge Hatchery Chiller Design and Detailed Cost Estimate

10.Pun.04

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EXECUTIVE SUMMARY

Summer-run chinook salmon adults held at Fisheries and Oceans Puntledge Hatchery facilities during the summer are at risk of experiencing high pre-spawn mortality due to water quality problems. Both facilities rely on surface water from the Puntledge River which typically exceeds temperatures of 20 ^{o}C every summer, and can often reach 24 ^{o}C for extended periods during warm summers. These warm temperatures can induce stress and disease problems resulting in high mortalities.

As a solution to this ongoing problem, the hatchery has initiated a plan to transport all their summer chinook broodstock to other DFO hatcheries that have cooler water supplies. Presently, up to 300 summer chinook that arrive at the lower hatchery between mid-June and mid-July, when water temperatures are below 18 ^{o}C, are transported to Rosewall Hatchery. Broodstock taken to Rosewall are held in re-circulated pumped groundwater at a temperature of 8-10 ^{o}C where they consistently experience greater than 95% survival to the spawning stage. DFO has identified an alternative cool water supply at Big Qualicum Hatchery, south of Courtenay, which can provide water temperatures around 15 ^{o}C throughout the summer. With BCRP funds acquired by Project Watershed in 2010, two new holding tanks will be installed at Big Qualicum, allowing an additional 550 Puntledge summer chinook broodstock to be moved there.

To take full advantage of the Big Qualicum holding facility, adult chinook arriving at the lower Puntledge Hatchery when temperatures are over 18 ^{o}C need to be acclimatized to a cooler holding temperature before being transported. Once water temperatures at Puntledge Hatchery reach 17-18 ^{o}C, capture and transporting is stressful on the adults and can result in higher pre-spawn mortality.

PR Aqua (PRA), water treatment and aquaculture specialists in Nanaimo, was contracted in the summer of 2010 to develop a detailed design and cost estimate for equipment purchases, fabrication and installation of a of a chilled acclimation system for adult summer chinook at Puntledge Hatchery. Implementation of this project will increase summer chinook production and rebuild the early migrating component of the returns. The final design and cost estimate was submitted as a proposal submission to BCRP for the 2011/2012 funding cycle.

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1 INTRODUCTION

Since construction of the Puntledge River hydroelectric facilities in 1912, and expansion in the 1950's, fish populations in the river have been subjected to a variety of footprint impacts, as described in the Bridge-Coastal Fish and Wildlife Restoration Program (BCRP) Strategic Plan (BC Hydro 2000). Puntledge summer-run chinook salmon experienced significant declines after expansion, from a pre-expansion level of 3000 to an average of 400 through the 1960s and early 1970s. Despite over 50 years of considerable effort to rebuild this population to pre-hydro expansion levels, summer chinook returns remain well below target escapements. The population continues to be under significant threat due to loss of spring freshet flows, lack of suitable spawning habitat, reduced or delayed access to Comox Lake, high river water temperature, and seal predation.

The Puntledge River system is one of a few rivers on the east coast of Vancouver Island that supports both a summer and a fall run of chinook salmon. The two Puntledge chinook stocks likely originated from the same population, but the summer chinook are now genetically distinct from the fall chinook and from other chinook stocks in the Georgia Basin. They have been classified as a unique conservation unit under Fisheries and Oceans Canada (DFO) Wild Salmon Policy and it is currently a priority for DFO to develop a recovery plan for this stock. Predictive modelling of summer chinook recovery response to various changes in survival criteria (stress, predation, incubation, etc.) illustrates that hatchery enhancement, combined with other recovery actions in the watershed will continue to be a key component to the overall recovery of the summer chinook population to historical levels (Guimond and Sheng 2009).

1.1 Background

Puntledge summer chinook broodstock that are held at the Upper and Lower Puntledge hatcheries are at risk of experiencing high pre-spawn mortality due to water quality problems. Both facilities rely on surface water from Puntledge River which typically exceeds temperatures of 20 ^{o}C every summer, and can often reach 24 ^{o}C for extended periods during warm summers. This alone can induce stress and disease problems resulting in high mortalities. Historically, summer chinook broodstock were collected at the Upper Hatchery site where they held in earthen channels until they were spawned in October. The Upper Hatchery frequently experiences an added risk when the water surface of Comox Lake quickly warms on hot summer days. This causes gas

super-saturation in the epilimnion which drains into Puntledge River, and affects the upper hatchery water supply. In 2004, these two factors lead to the near complete mortality of all summer chinook broodstock holding at the Upper Hatchery (>900 adults).

Summer chinook broodstock are now captured at the Lower Puntledge Hatchery site. The facility has an aeration tower which maintains dissolved gases throughout the summer near 100% saturation. Capturing adults at the lower site rather than the upper hatchery theoretically doubles access to broodstock. The migration success rate to the lower hatchery is twice as high as to the upper site.

Summer chinook arriving at the lower hatchery between mid-June to mid-July, when water temperatures are below 18 ^{o}C, can be transported to Rosewall Hatchery. Broodstock taken to Rosewall are held in re-circulated pumped groundwater at a temperature of 8-10 ^{o}C. Survival consistently exceeds 95% to the spawning stage. Unfortunately the capacity of the site is only 300 adults. To accommodate the holding target requirement of 900 summer chinook broodstock at Rosewall Hatchery, additional well pumps, plumbing, rearing containers, an aeration tower and re-circulation pumps totaling approximately $2 million would need to be installed.

DFO has identified an alternative cool water supply at Big Qualicum Hatchery (BQ) located approximately 50 km south of Courtenay. The Facility operates on a deep water gravity fed water supply from Horne Lake that can provide water temperatures around 15 ^{o}C throughout the summer months. Trials completed in the summer of 2010 at BQ, indicated that Puntledge summer chinook broodstock survived at a rate of greater than 90%. This is consistent with radio-telemetry field studies over three years which demonstrated that chinook salmon holding in Comox Lake over the summer preferred temperatures averaging 15 ^{o}C and consistently survived at a rate of >95% to spawn. In 2010, BCRP provided funding to install two 9 m rearing tanks at BQ Hatchery to accommodate an additional 550 Puntledge summer chinook broodstock. The expansion will be completed in time for the 2011 return.

To take full advantage of the BQ holding facility, adult chinook arriving at the lower Puntledge Hatchery when temperatures are over 18 ^{o}C need to be acclimatized to a cooler holding temperature before being transported to BQ. Once water temperatures at Puntledge Hatchery reach 17-18 ^{o}C, capture and transporting is stressful on the adults and can result in higher pre-spawn mortality.

Field studies have concluded that summer chinook arriving into the Puntledge River prior to July have a migration success rate of nearly 100% to the upper hatchery

site (Guimond and Taylor 2010). In contrast, post-July entries have a success rate of only 50%. Based on this finding and with support from DFO-science staff, Puntledge Hatchery will now collect a higher proportion of early arriving adults for broodstock and will spawn this early component with only other early fish. It is predicted that this will rebuild the early migrating component of the returns. This timing shift can be accelerated if broodstock holding and spawning survival is significantly increased at the hatchery by utilizing a chiller so that all early arriving adults can be transported to Rosewall or BQ holding facilities. This strategy will ultimately improve summer chinook productivity by increasing migration success to the upper river and potentially into Comox Lake. Earlier arriving hatchery returns avoid the higher river temperatures that develop later in the summer and the peak recreational use period. Early upstream migrants are also better able to utilize the tail-end of spring freshet flows for upstream migration.

1.2 Goals and Objectives

The objective of the project is to complete a detailed design and an accurate cost estimate for equipment purchases, fabrication and installation of a chilled acclimation system for adult summer chinook at Puntledge Hatchery. Implementation of this project will increase chinook production, reduce the risk of selective mortality and genetic impacts due to severe temperature stress, help re-establish the differential run timing between summer and fall chinook by reducing the differentially higher mortality rate likely experienced by earlier arriving broodstock, reduce operating costs for DFO and B.C. Hydro at the Upper Hatchery Site, optimize use of an existing DFO facility and increase the rate of summer chinook recovery.

2 STUDY AREA

The Puntledge River watershed encompasses a 600 km^2 area west of the city of Courtenay (Figure 1). The lower Puntledge River flows from Comox Lake in a north-easterly direction for 14 km where it joins with the Tsolum River. Beyond this point, the river is named Courtenay River, and flows for another 2 km into the Strait of Georgia. The lower Puntledge Hatchery is located 6.6 km upstream of the estuary. A barrier fence across the river directs migrating fish into a fishway where they may proceed further into concrete raceways, or continue their migration upstream in the river depending on the hatchery's broodstock collection requirements.

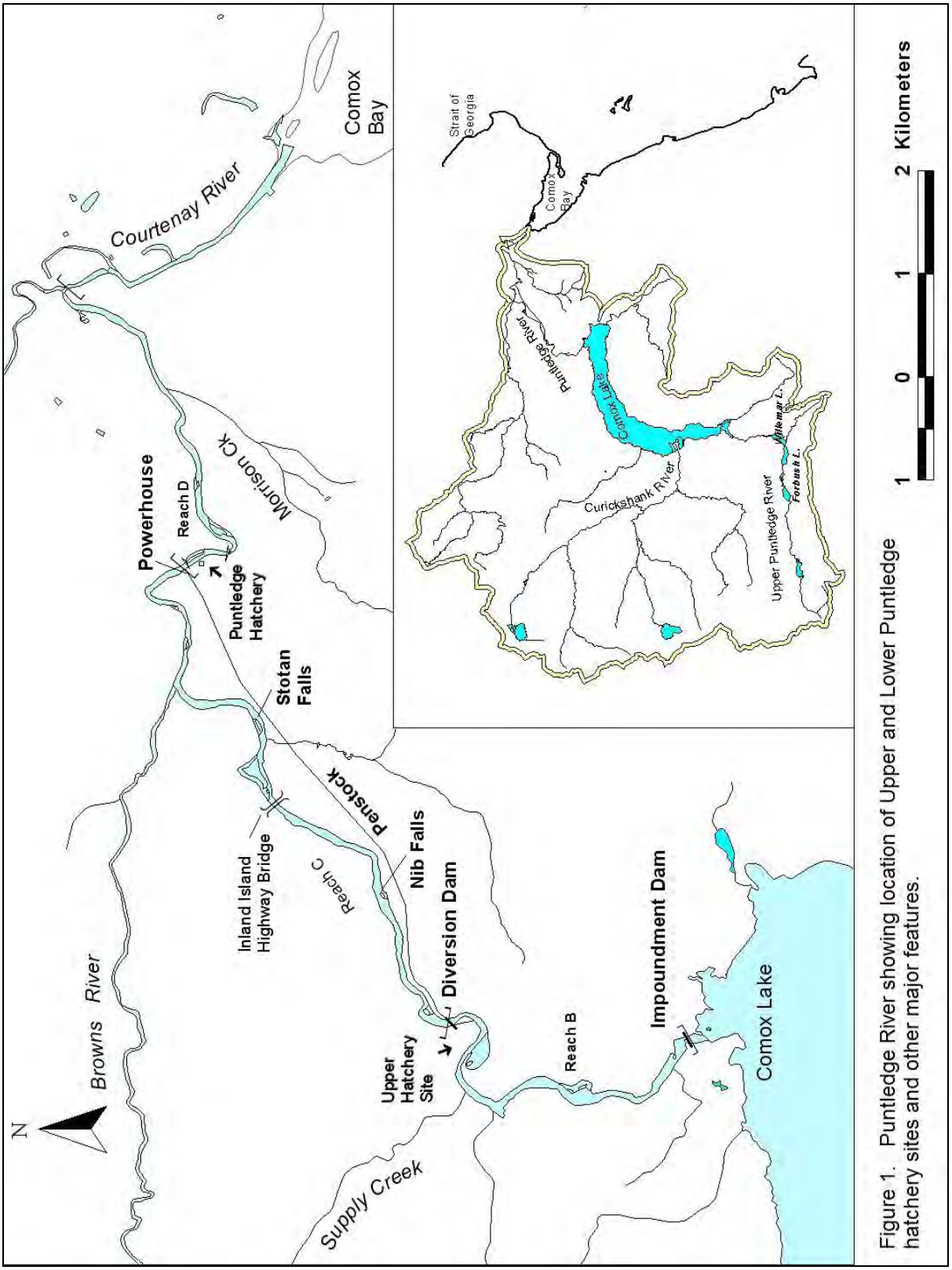

Figure 1. Puntledge River showing location of Upper and Lower Puntledge hatchery sites and other major features.

3 METHODS

3.1 Project Design and Planning

PR Aqua (PRA), water treatment and aquaculture specialists in Nanaimo, was contracted in the summer of 2010 to develop a detailed design and cost estimate for a chilling system at Puntledge Hatchery based on their preliminary proposal submission in November 2009. Between July and October, several teleconferences and on-site meetings between PRA, DFO and the project biologist were conducted to review the conceptualized design from 2009, address any new concerns or comments, discuss the scope of work, production parameters, water quality design constraints, site constraints and limitations, and project timeline.

3.2 Communications

A Communications Plan was implemented by staff of Comox Valley Project Watershed Society and the biologist to inform the public and local community of the project. This included an educational poster display, newsletter and press release. The material described the goal of improving summer chinook broodstock survival and overall stock production by cooling adults and transporting them to cool water holding facilities. The poster was presented at the Puntledge Hatchery Open House in October 2010, and at Project Watershed's headquarters. An article detailing the project was also included in Project Watershed's annual newsletter "Watershed News' distributed in January 2011, (Appendix A) and as a press release in local newspapers (Comox Valley Record and Comox Valley Echo). A more detailed Community Outreach Program associated with this and other BCRP projects in the Puntledge River watershed will be summarized in a separate report.

4 RESULTS AND DISCUSSION

In 2006, PR Aqua prepared a conceptual investigation on the feasibility of using water recycle technology to allow an effective water temperature control approach for holding summer chinook broodstock at Puntledge Hatchery. They provided 3 options, one of which focused on a water recycle system that would cool summer chinook adults in batches of ~100 fish throughout the migration period. These batches would then be

transported to other facilities with more suitable water temperatures for holding until the spawning period. This concept formed the basis for the current BCRP funded project to develop a more detailed chiller design and cost estimate (Appendix B).

Preliminary (2006) costs for this system were estimated at $315,000, requiring a 40 HP chiller to cool a maximum of 100 adults. However, during recent discussions between PRA and DFO it was decided that smaller batches of adults (maximum of 60) could more easily be transported using the facility's truck and transport tank system. This would result in a smaller volume of water to chill (15 m^3 versus 40 m^3 in the original concept) and thus a reduced chilling load (20 HP versus 40 HP).

Both the original concept and the present design incorporate the conversion of a portion of an existing raceway structure that is currently used to attract and hold returning adults at the hatchery, rather than constructing a new holding tank. This will minimize additional infrastructure costs and fish handling, since adults will not need to be manually moved to a secondary cooling tank. Only a small area at the upper end of the raceway and central swim channel would need to be modified to isolate the acclimation chamber. The chiller unit would be located on the adjacent pad at the upper end of the raceway in an enclosed shelter (Figure 2). Methods for incorporating the hatchery's Pescalator™ to move fish from the acclimation chamber and into a transport tank are included in the present design. This passive fish transport device uses an auger to gently lift fish and water simultaneously from the pond to the desired destination. This would minimize handling and thus further stress on adults.

Figure 2. Upper end of the Puntledge Hatchery raceway that would accommodate the chilled holding tank. The chiller unit would be located on the adjacent concrete pad.

Appendix C provides 4 holding tank (acclimation chamber) layout alternatives using the hatchery raceway that were reviewed by DFO and hatchery personnel. Option 4 was selected as the preferred layout and would provide the following features:

- The head end of the swim channel will be used for the acclimation chamber.
- Dam boards will fit into existing guides at a suitable point in the swim channel to section off a volume sufficient for acclimation requirements. The cold discharge water will overflow these dam boards and form part of the attraction flow.
- One of the ports between the raceway and swim channel will be used to direct raceway water to the downstream side of the dam boards to create sufficient flow for fish attraction. A device will be used to cause the attraction water to upwell in front of the dam boards. Fish will enter the acclimation chamber by jumping over the dam boards.
- At the upstream end of the acclimation chamber, one of the existing ports may be used for attachment of the bell end of the refurbished Pescalator which is to be used for removal of the fish from the acclimation chamber.

The water treatment system will cool water from ~22 ^{o}C to ~15 ^{o}C. The unit will re-circulate >90% of the total flow to the acclimation chamber, allowing the chiller to maintain the desired cool temperature in an energy and cost efficient manner. Less than 10% of the flow will be exchanged with fresh (ambient) water to reduce the buildup of ammonia and fine solids in the chamber. The small amount of cooled effluent will be discharged from the acclimation chamber into the swim channel in the centre of the raceway. This will create a temperature gradient as the cooler discharge water mixes with the warmer river water, attracting adults up the central swim channel and into the acclimation chamber. Once a batch of 60 adults have been cooled to the desired temperature they can be moved to Rosewall or BQ hatcheries where they can hold in cooler temperatures throughout the summer.

During September 2010, DFO conducted tests on summer chinook adults holding at Rosewall Hatchery to collect measurements of oxygen consumption and ammonia excretion. This information was provided to PR Aqua so that more detailed design parameters specific to unfed summer chinook adults could be used in the water quality modeling and analysis of a recirculation system (Appendix D). Most research in the literature has been conducted on Atlantic salmon.

Final drawings and a detailed design and cost estimate were completed by the end of October and submitted as a proposal submission to BCRP for the 2011/2012 funding cycle (Appendices E and F). The new design criteria (ammonia production,

maximum volume and chiller load) used in the development of the current acclimation system significantly reduced equipment and installation costs from $315,000 to ~$202,000.

5 ACKNOWLEDGEMENTS

This project was made possible through the financial support of the B.C. Hydro Bridge Coastal Fish and Wildlife Restoration Program (BCRP), and in-kind participation from Fisheries and Oceans Canada (DFO).

6 REFERENCES

B.C. Hydro. 2000. Bridge-Coastal Fish and Wildlife Restoration Program Strategic Plan. Prepared by Regional Consulting Ltd., Global Fisheries Consultants Ltd., D.B. Lister & Associates Ltd., and Summers Biological Services with mapping by GIS Innovations.

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APPENDICES

APPENDIX A: Confirmation of BCRP Recognition

Article in the Comox Valley Project Watershed Newsletter (January 2011) and local newspapers.

The Big Chill

Summer-run chinook salmon adults held at DFO's Puntledge Hatchery during the summer are at risk of dying before they spawn due to high water temperatures. The hatchery's water supply is obtained from the Puntledge River, which usually exceeds 20 ^{o}C in the summer, and sometimes reaches 24 ^{o}C. Such warm water induces stress and disease problems in adult salmon, leading to high mortality rates, poorer quality of eggs in the females that do survive, and lower survival rates for offspring.

As a solution to this ongoing problem, the hatchery has initiated a plan to transport all their summer chinook broodstock to other DFO hatcheries that have cooler water supplies. Over the past decade, a small portion of Puntledge summer chinook adults have been transported to Rosewall Hatchery and held in 8 ^{o}C groundwater-supplied holding tanks where they experience a very high (>95%) survival rate to spawning. Another cool water site exists at Big Qualicum Hatchery (Big Q) located approximately 50 km south of Courtenay. This hatchery operates on a deep water gravity-fed water supply from Horne Lake which provides water temperatures around 15.5 ^{o}C throughout the summer months. With FWCP funds acquired by Project Watershed in 2010, an additional two holding tanks will be installed at Big Q, allowing a larger portion of Puntledge summer chinook returns to be moved there.

Puntledge River temperatures in late June to early July can exceed 18 ^{o}C – a temperature that makes it too stressful and risky to handle and transport fish out of the hatchery. **To take full advantage of the other cool water holding facilities, a new chilled-water holding tank will be installed at Puntledge River hatchery in 2011. The tank will allow small batches of returning adult summer chinook to be acclimated to cooler temperatures and then transported south throughout the migration period.**

Increasing the survival of all hatchery broodstock, by holding them in cooler water, will increase overall summer chinook productivity helping to rebuild the population to their historical abundance.

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APPENDIX B. Design Proposal for Chilled Acclimation System at Puntledge Hatchery

November 10, 2009

Fisheries and Oceans Canada
1965 Island Diesel Way
Nanaimo, BC V9S 5W8

Attention: Mr. Mel Sheng

Re: Design Proposal for Chilled Acclimation System for Adult Chinook at Puntledge Hatchery

Dear Mr. Sheng,

Based on our assessment of your project needs, we are pleased to offer the following proposal associated with development of the design for a chilled water system for holding and acclimation of returning adult Chinook at the lower site of the Puntledge Hatchery.

Project Description

The Puntledge Fish Hatchery is an enhancement hatchery that accesses water from a BC Hydro penstock near Courtenay BC, and operates incubation and raceway facilities using a flow-through technology. In recent years, increasing temperatures in the Puntledge River and in the upper and lower hatchery sites have impacted the summer Chinook enhancement program significantly, resulting in high mortality of returning adult fish and low egg viability.

A study by PR Aqua in May 2006, and later revised in April 2009, provided a review of options for the chilled holding and/or acclimation of adult Summer Chinook at the lower site of Puntledge Hatchery. Fisheries and Oceans Canada has elected to pursue development of one of the options presented in that report (option 3). The selected option involves the creation of chilled water system in which small groups of returning adult Chinook may be acclimated to cooler temperatures throughout the migration period. Once each group of fish has been acclimated temperature, they may be transported off-site to a hatchery facility that has more suitable water temperatures.

The current design concept for the acclimation system is to convert a portion of the existing raceway structure currently used for attracting and holding the returning fish. By using the existing structure rather than constructing a new holding tank, fish handling and additional infrastructure costs will be minimized. The top end of the swim channel that is situated between the two raceways would be ideal for this purpose in terms of its size, its location, and its current function in adult fish handling. Only minor modifications are likely to be necessary in order to segregate a short section of the channel for the acclimation system.

Conceptually, a water treatment system, including pumping, gas transfer, solids removal, and chilling processes, would be added above grade and adjacent to the swim channel. The existing concrete pad located at the top end of the raceways would provide a flat surface of a sufficient size

for installation of the treatment system. The treatment system would be used to recycle a high portion of the total flow through the acclimation channel (>90%), allowing the chiller to maintain the desired cool temperature in an energy and cost efficient manner. A relatively small exchange of water (<10% of flow) would be required to prevent the accumulation of ammonia and fine solids within the acclimation system. This influent water flow would be added directly to the acclimation channel from the existing influent structure at the top end of the channel. An equivalent amount of chilled discharge water would pass over a weir at the tail end of the acclimation channel and would discharge through the existing attraction channel. As the discharge flow will be relatively cool compared to river water, it will create a temperature gradient in the swim channel that will assist in attraction of fish along the channel and into the acclimation system. From the acclimation channel, a brailer system will be required to remove the fish from the acclimation system for transport.

Figure 1 below summarizes the current concept for the acclimation system.

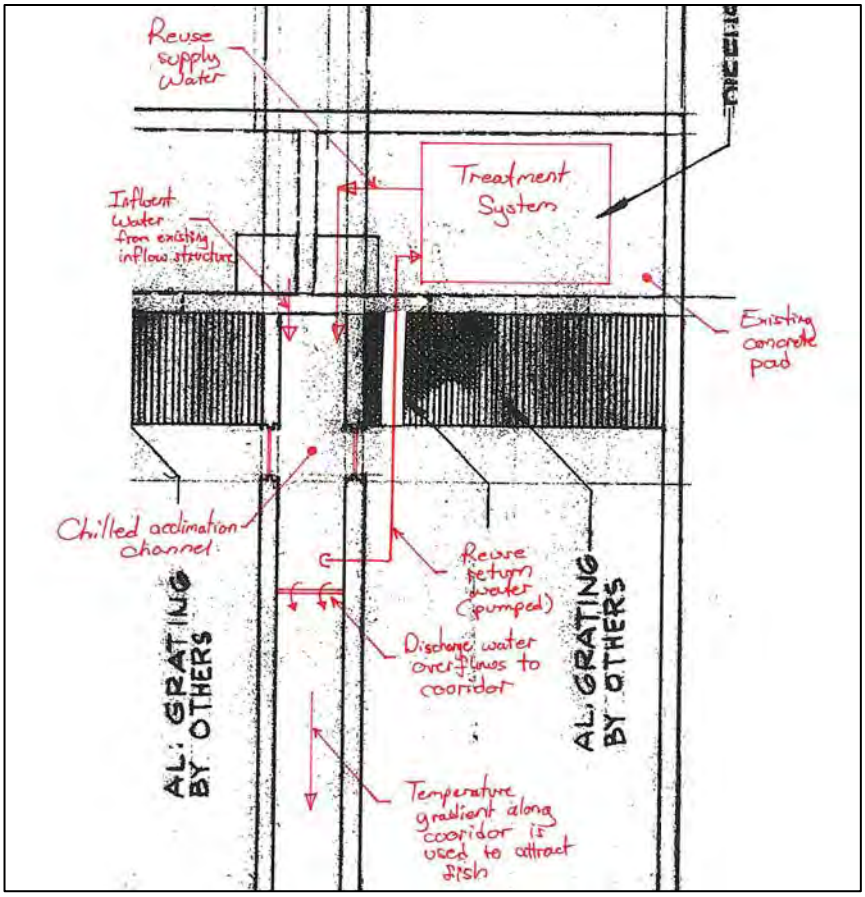


Figure 1: Concept sketch of the acclimation system.

Although the acclimation has been conceptualized by the previous study and through subsequent analysis by the hatchery personnel, design services are required to develop the design for implementation.

Project Approach

The goal of PR Aqua's design approach is to systematically progress the design, with regular opportunities for review by DFO to ensure that the solution will ultimately satisfy the technical, biological, and financial goals for the project. The phased design approach PR Aqua has developed for this project is outlined below.

Task 1: Schematic Design

The intent of the schematic design phase is to provide sufficient design detail to fix the project requirements, review process and layout options, and outline a solution. This process begins with a thorough review of biological, physical, and operational design criteria. PR Aqua will work closely with hatchery personnel to understand operational and risk tolerance preferences, and to set realistic design values. Potential water treatment strategies are reviewed and technologies are selected. The solution is then developed with sufficient detail to allow judgement of the technical and financial viability. This work involves the preparation of water quality models, preliminary equipment selections, process and layout diagrams, a hydraulic profile, and an estimate of both capital and operating costs.

Task 2: Detailed Design

Once the treatment strategy is defined, and the preliminary layout, operational plan, and budget are approved, PR Aqua will proceed on development of the selected design. The detailed design phase involves refinement of design calculations and component selections, and the thorough definition of the interfaces between components and of the system with the facility. The design drawings and equipment specifications produced will serve as the basis for the implementation phase.

Integrated Treatment Solution

At completion of the Detailed Design phase, PR Aqua will provide a proposal for an *Integrated Treatment Solution* which will include all of the equipment, design support, and field support services required to deliver the project. For an application of this scale, the equipment may often be packaged to include all water treatment components and controls, pre-plumbed and wired on integral equipment skids, but may also be provided as discrete components to be installed by others. Design support and field support services may include coordination and advising installation contractors, commissioning of equipment, functional testing of the system, and training of operators. It is PR Aqua's design philosophy to provide a complete solution and to provide support during installation and beyond commissioning to ensure the ultimate success of the project.

Scope of Services

PR Aqua proposes to undertake the following work:

Task 1: Schematic Design

1.01 Determine production parameters and water quality design constraints
1.02 Determine site constraints and limitations
1.03 Prepare mass balance models to set flow and treatment strategy
1.04 Review of suitable treatment technologies and processes
1.05 Prepare Process Flow Diagram (PFD)
1.06 Prepare preliminary process equipment sizing calculations
1.07 Prepare schematic layout and elevation diagrams
1.08 Perform preliminary hydraulic analysis
1.09 Prepare equipment capital and O&M cost estimate (class C)
1.10 Submit 30% design documents
1.11 Review with client and address comments

Task 2: Detailed Design

2.01 Finalize component selections and generate equipment schedule
2.02 Generate list of P&IC criteria and electrical requirements
2.03 Coordinate with facility personnel on integration with site electrical and alarm systems
2.04 Coordinate with facility personnel on layout and location of utility and water connections
2.05 Detailed design of modifications to existing raceway
2.06 Detailed design of treatment system
2.07 Perform detailed hydraulic analysis
2.08 Finalize pipe sizing and routing
2.09 Prepare detailed drawing package
2.10 Prepare equipment submittal package
2.11 Update equipment capital and O&M cost estimates (Class A)
2.12 Submit 90% design documents
2.13 Review with client and address comments
2.14 Submit 100% design documents
2.15 Submit proposal/quotation for Integrated Treatment Solution

Notes:

- All deliverables will be transmitted digitally in Adobe Acrobat (PDF) format.
- All final contract documents will bear the stamp of a registered Professional Engineer in British Columbia.
- Design work and capital cost estimates provided by PR Aqua are to be limited to the provision and assembly of the packaged treatment system. Cost estimates for installation of the equipment package, connection of utilities, or modification of existing infrastructure, mechanical, or electrical systems are not included in this scope of work.
- Operating and maintenance (O&M) cost estimates are to be limited to power use.
- An allowance has been made for two visits to the site for confirmation of dimensions and integration criteria, and for review of designs with hatchery personnel.
- Services provided by PR Aqua within this scope of work will be limited to the design of the aquaculture specialty systems, including fish culture and related water treatment equipment. The following services will not be included:
    - Environmental impact assessment or permitting requirements.
    - The layout, design or specification of buildings and related mechanical, electrical, structural systems.
    - Civil or geo-technical services including site survey, site drainage, soils studies or specification, and the design of foundations.
    - Structural engineering of foundations, pads, or modifications to existing raceways.
    - The design/specification of new systems or modifications to existing systems related to site electrical supply, distribution, or back-up generation.
    - Design of custom fish handling systems, such as the proposed brailer system for movement of the adult fish from the acclimation channel.

Timeline

The schedule for execution of the proposed services will be highly dependant on PR Aqua's backlog of work at time of project initiation. A potential timeline, including key design milestones, is presented below assuming eight week project duration. This schedule provides for reasonable allowances for data collection, design execution and for review periods following each deliverable. The schedule will be adjusted at project initiation and every attempt will be made by PR Aqua to accommodate any specific schedule needs.

Table 1: Estimated Project Timeline

Task	Duration (weeks)	Month 1				Month 2			
		Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8
Task 1: Schematic Design									
Submit 30% design documents	2.5								
Review period	1								
Task 2: Detailed Design									
Submit 90% design documents	3								
Review period	1								
Submit 100% design documents	0.5								

Design Fees

The fees for provision of the services described in the scope of work are as follows:

Table 2: Summary of Design Fees

Task Description		Senior Engineer	Project Engineer	Sr. Technologist	Fee per Task
		$ 174 /HR	$ 122 /HR	$ 108 /HR	
Task 1	Schematic Design	2	24	8	$ 4,140.00
Task 2	Detailed Design	6	40	40	$ 10,244.00
Sum of Work		**40**	**124**	**76**	$ 14,384.00
Expenses					$ 228.00
Total Fees					**$ 14,612.00**

Notes:

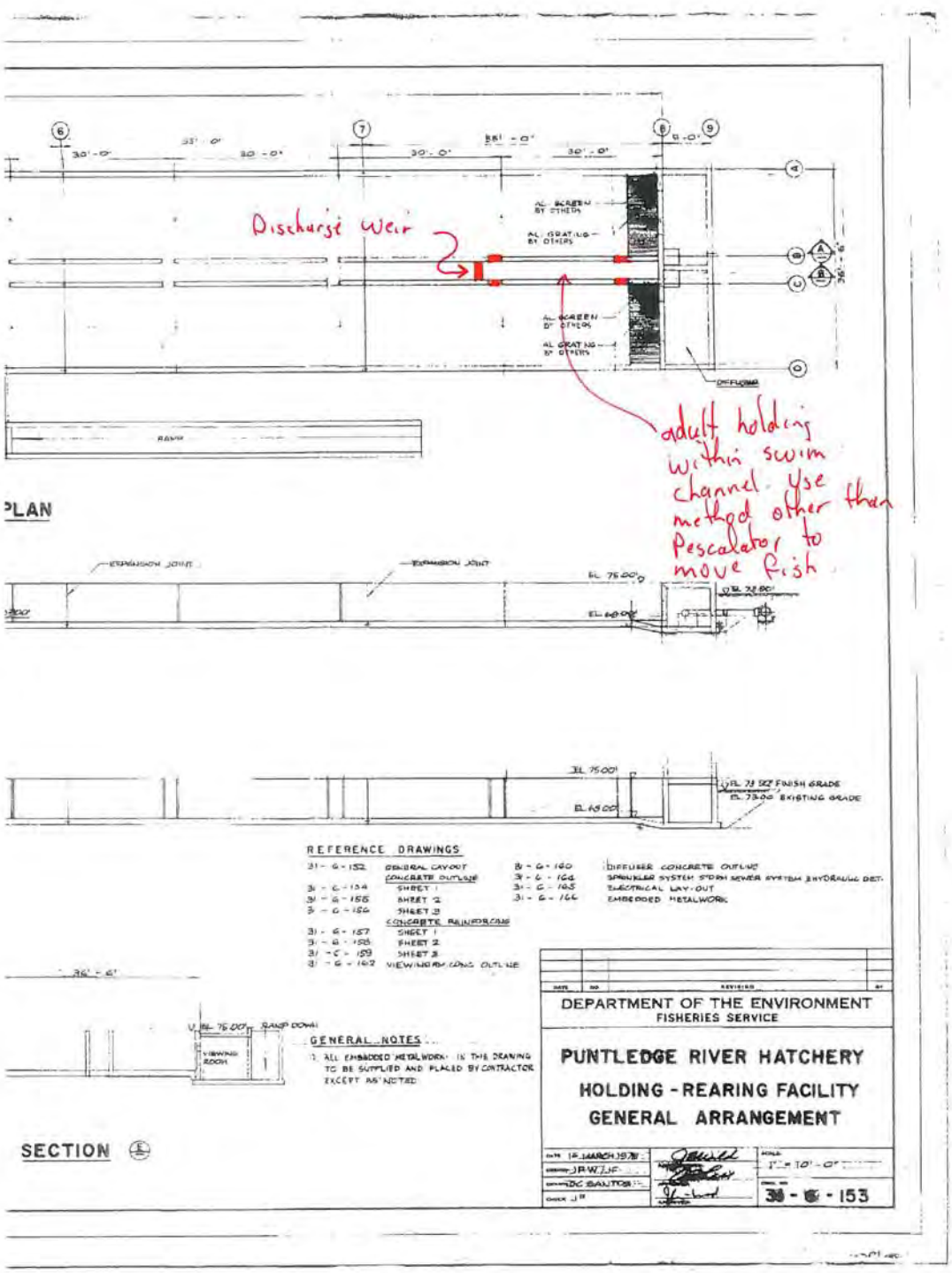
- The services are to be provided on a fixed prices basis and will be invoiced at the completion of each task in the amounts provided in the table above.
- The proposed fees exclude all applicable taxes and levies.
- If a change from the original design intent is made during the course of this contract, a **Change Order** form will be submitted. All change orders will require client approval prior to initiation of the additional services.
- Travel expenses, copying, courier and similar disbursements are included in the fee estimate and will not be billed separately unless otherwise stated. There may be additional charges for multiple copies of drawings or documents beyond those proposed in the project scope.

We trust that this proposal captures your immediate requirements at this stage of the project. We would look forward to having the opportunity to participate in the success of your project. Please contact us at your convenience to discuss this proposal.

Sincerely

KC Hosler, P.Eng. (BC)
Senior Engineer
PR Aqua
Advancing Sustainable Aquaculture

APPENDIX C. Sketches of Chilled Holding Tank Layout Alternatives



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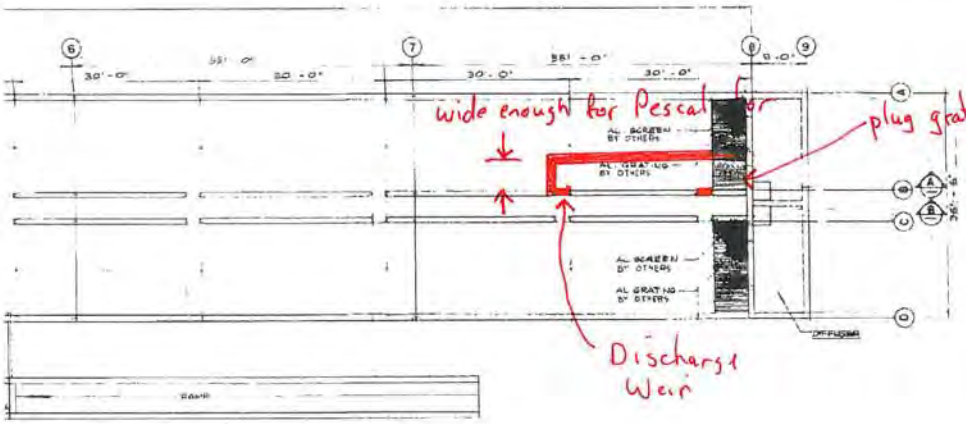
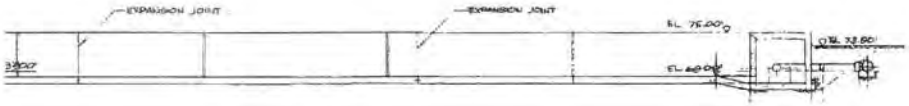
Alt #2



PLAN



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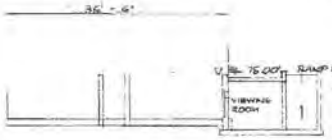
31 - C - 159	SHEET 3		
31 - G - 162	VIEWING ROOM CONC. OUTLINE		



SECTION (E)

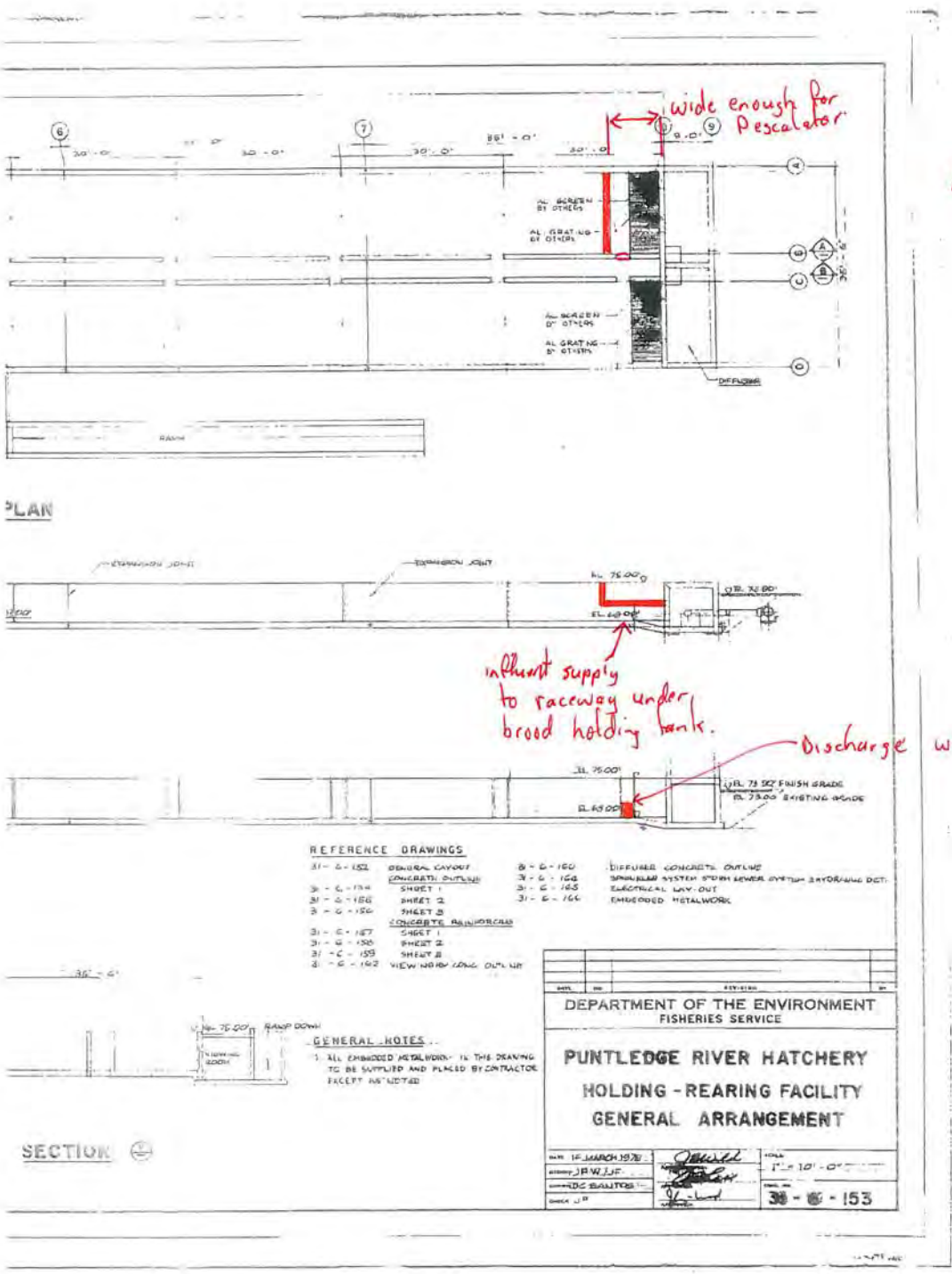
GENERAL NOTES

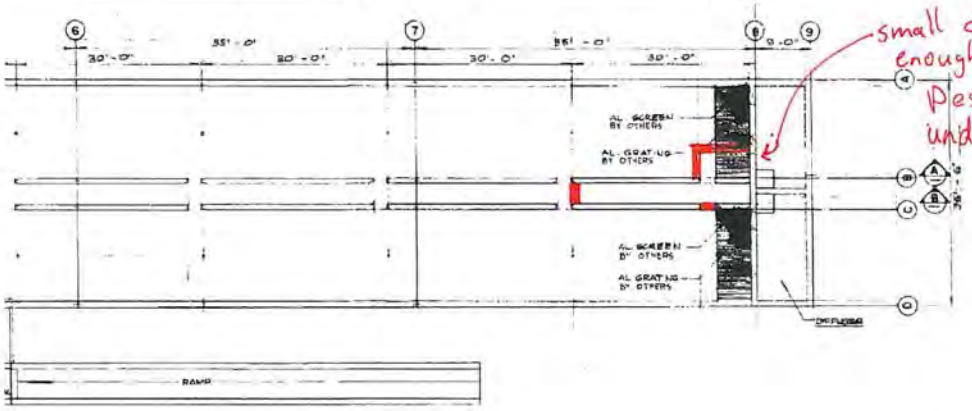
1) ALL EMBEDDED METALWORK IN THIS DRAWING TO BE SUPPLIED AND PLACED BY CONTRACTOR EXCEPT AS NOTED.

DEPARTMENT OF THE ENVIRONMENT
FISHERIES SERVICE

PUNTLEDGE RIVER HATCHERY
HOLDING - REARING FACILITY
GENERAL ARRANGEMENT

DATE 18 MARCH 1978		SCALE 1" = 10'-0"
DESIGN JRW, JJF		
DRAWN DC SANTOS		DWG. NO. 31 - G - 153
CHECK JP		

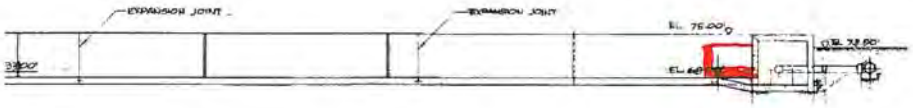

wide enough for Escalator
Alt #3
PLAN
influent supply to raceway under brood holding tanks.
Discharge weir
REFERENCE DRAWINGS
GENERAL NOTES
SECTION
DEPARTMENT OF THE ENVIRONMENT
FISHERIES SERVICE
PUNTLEDGE RIVER HATCHERY
HOLDING - REARING FACILITY
GENERAL ARRANGEMENT
1" = 10' - 0"
36 - 6 - 153

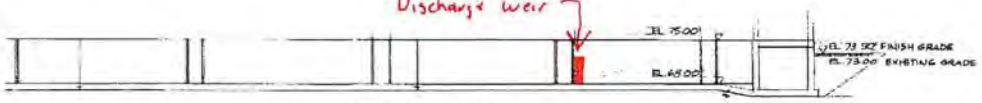


small chamber just large enough to hold the escalator. Plug grating underneath to stop influent flow

Alt. #4

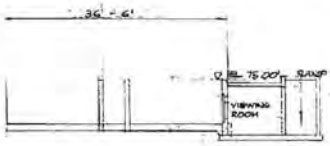
PLAN





REFERENCE DRAWINGS:

31-G-152	GENERAL LAYOUT	31-G-160	DIFFUSER CONCRETE OUTLINE
	CONCRETE OUTLINE	31-G-164	SPRINKLER SYSTEM, STORM SEWER SYSTEM & HYDRAULIC DET.
31-G-154	SHEET 1	31-G-165	ELECTRICAL LAY-OUT
31-G-155	SHEET 2	31-G-166	EMBEDDED METALWORK
31-G-156	SHEET 3		
	CONCRETE REINFORCING		
31-G-157	SHEET 1		
31-G-158	SHEET 2		
31-G-159	SHEET 3		
31-G-162	VIEWING ROOM CONC. OUTLINE		



GENERAL NOTES

1. ALL EMBEDDED METALWORK IN THIS DRAWING TO BE SUPPLIED AND PLACED BY CONTRACTOR EXCEPT AS NOTED.

SECTION (E)

DATE	NO	REVISION	BY

DEPARTMENT OF THE ENVIRONMENT
FISHERIES SERVICE

PUNTLEDGE RIVER HATCHERY
HOLDING - REARING FACILITY
GENERAL ARRANGEMENT

DATE 16 MARCH 1978		SCALE 1" = 10'-0"
DESIGN J.R.W. J.F.		
DRAWN D.C. SAUTOS		FINAL NO. 31-G-153
CHECK J.F.		

1631 Harold Road • Nanaimo, BC V9X 1T4
Ph:250.714.0141 • Fax:250.714.0171
Toll Free North America: 866.714.0141
www.praqua.com • info@praqua.com

2010-10-06

Appendix D Puntledge River Hatchery Summer Chinook Adult Chilling System Design Criteria

Facility Scale

Average Fish Size: 7.5 kg
Maximum number of fish per batch: 60
Maximum Biomass per batch: 450 kg
Design Density: 30 kg/m^3
Calculated Tank Volume Required: 15 m^3
Assumed oxygen consumption rate: 4 mg/kg/min
Calculated Design Oxygen consumption rate: 1800 mg/min
Assumed Ammonia production rate: 0.043 g N/kg fish/d
Calculated Design Ammonia production rate: 19.35 g N/d

Water Quality

Design Maximum Influent Water Temperature: 22ºC
Target Water Culture Temperature: 15ºC
Influent O_2 (at 22 deg C): 8.73 mg/L (assumed at saturation)
Influent CO_2 (at 22 deg C): 0.51 mg/L (assumed at saturation)
Influent pH: 7 (assumed)
Influent Alkalinity: 50 mg/L as $CaCO_3$ (assumed)
Design minimum O2 concentration: 7.05 (assumed 70% of saturation at 15 deg C)
Design maximum CO2 concentration: 15 mg/L

Site Conditions and Design Parameters

1. Water depth: Maximum channel depth is 2.1 m (7 feet). Minimum freeboard is 0.36 m (14 inches). Normal water operating depth is 1 m (3.3 feet). Anticipated holding tank water depth is 1.3 to 1.4 m (4.3 to 4.6 feet).
2. Width of swim up raceway: 41 inches
3. Transfer of Fish into and out of the Holding tank will be the responsibility of DFO (PRAqua will provide holding tank alternatives. See attached sketches).
4. Pumps: It is preferred that submersibles not be used.
5. Water treatment equipment must not block the access hatches leading into the raceway head boxes.
6. All equipment should be suitable for outdoor installation.
7. A pre-filtered pressurized supply of water is available from media filters used in the incubation system.

APPENDIX E. Puntledge Hatchery Chiller Design Equipment

PR AQUA SUBMITTAL SUMMARY SHEET
TO: COMOX VALLEY PROJECT WATERSHED SOCIETY
PROJECT #: 10.PUN.04.
PROJECT SITE: COURTENAY, BC
PROJECT NAME: LOWER PUNTLEDGE HATCHERY CHILLER DESIGN

SUBMITTAL#: 611-0.1_ A

EQUIPMENT NAME: INLET STRUCTURE

COMPONENT, MODEL, & TAG NO.:

COMPONENT	MODEL	TAG NO.
INLET STRUCTURE	CUSTOM 41 INCHES WIDE BY 12 INCHES HIGH	
FOOT VALVE	TBD	

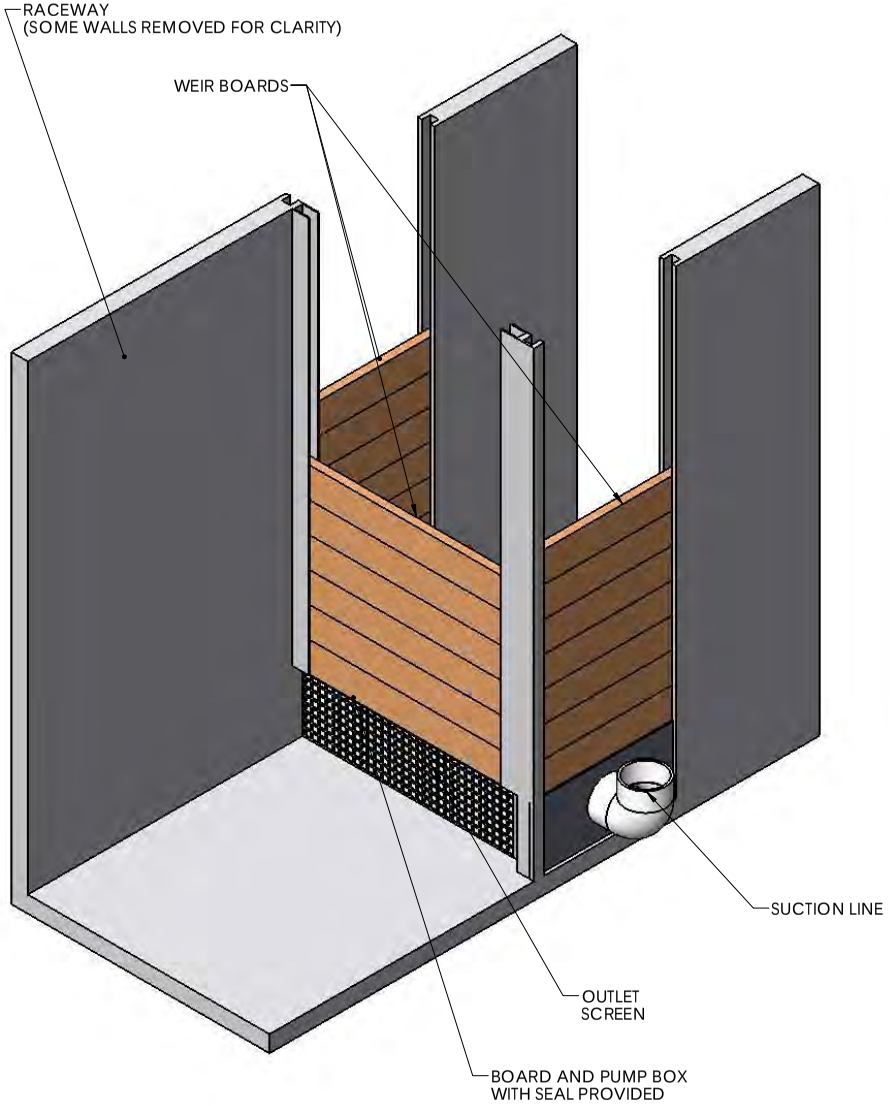
MANUFACTURER: PR AQUA SUPPLIES LTD.
1631 HAROLD ROAD
NANAIMO, BC V9X 1T4
CANADA
TEL: 250-714-0141

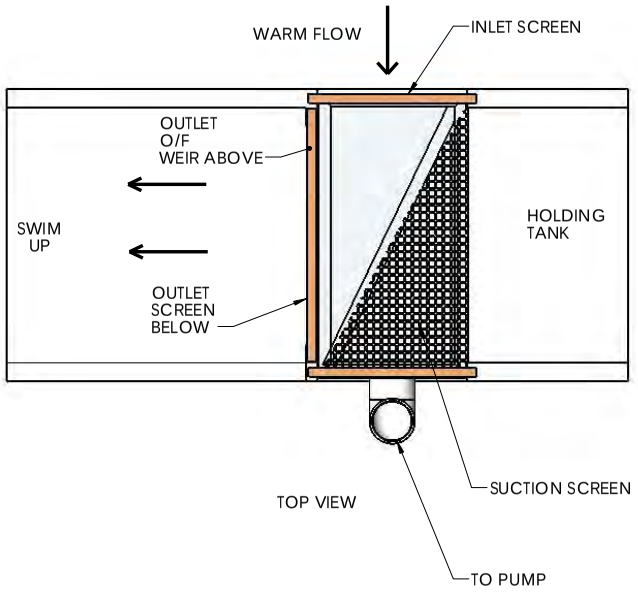
FEATURES:

- ✓ Screened pump intake.
- ✓ Screened method to gravity flow water from the adjacent raceway into the swim channel.

Product Data	
INLET SCREEN BOX	
Dimensions	41" W x 24" L x 12"H
Pumped Capacity	250 Gpm
Gravity Flow Capacity	600 Gpm
Materials of Construction	
Box	Marine grade aluminum
Screen	0.75" 125 flat diamond aluminum mesh
Seal	EPDM

1631 Harold Road • Nanaimo, BC V9X 1T4 • toll-free: 1-866-714-0141 • fax: (250) 714-0171
info@praqua.com • www.praqua.com





FABRICATION FRACTIONAL

TOLERANCES:
± 1/16"
UNLESS OTHERWISE SPECIFIED.
ANGLE
X.X ±0.25°
THIRD ANGLE PROJECTION

DESCRIPTION: *RACEWAY PUMPING INSERT*
PROJECT:
DESIGNED: XX
DRAWN: HV
APPROVED:
MATERIAL:
WEIGHT (LBS):
FINISH:

1631 Harold Road
Nanaimo, BC,
V9X 1T4 / Canada
Ph: (250) 714-0141
Fax:(250) 714-0171
PR Aqua

DATE: 27/10/2010
SCALE: NTS
UNITS: INCHES
PART NUMBER: REV. X011546-01
SHEET: 1 OF 1

PR AQUA SUBMITTAL SUMMARY SHEET
TO: COMOX VALLEY PROJECT WATERSHED SOCIETY
PROJECT #: 10.PUN.04.
PROJECT SITE: COURTENAY, BC
PROJECT NAME: LOWER PUNTLEDGE HATCHERY CHILLER DESIGN

SUBMITTAL#: 611-1.1_ A

EQUIPMENT NAME: REUSE PUMP

COMPONENT, MODEL, & TAG NO.:

COMPONENT	MODEL	TAG NO.
REUSE PUMP	PACO 3070-7; 2 HP/ 3 PHASE 250GPM AT 25 FT	
CONTROL PANEL	CUSTOM – ON/OFF CONTROL FOR PUMP CIRCUIT BREAKER FOR CHILLER INCLUDED NEMA 4X BOX	

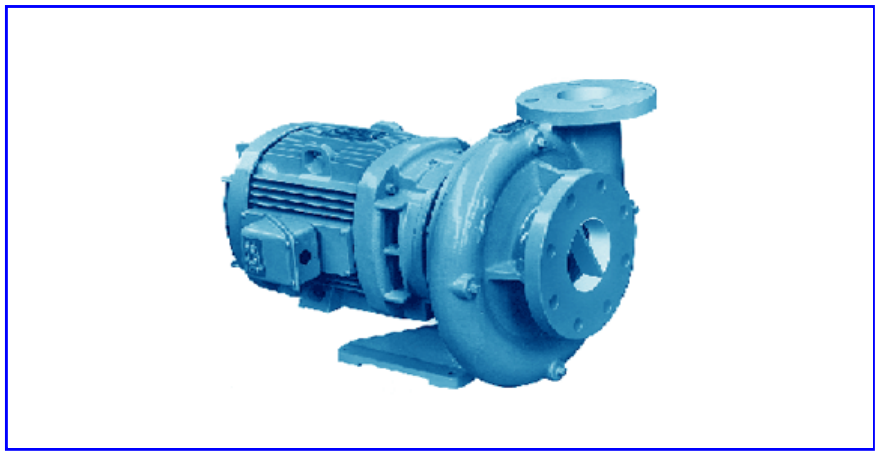
MANUFACTURER: GRUNDFOS CBS INC.
902 KOOMEY ROAD
BROOKSHIRE, TX 77423
USA
TEL: 281-994-2700

GRUNDFOS

LC 30707 Material Data Sheet

By:	
Date:	**10/29/2010**
Rev. #	

Project:	Tag #	P.O. #
Location:	Model: **30707**	Cust Ref#
Contractor:	Qty:	Agent/Rep:
Engineer:	Service:	Doc #



PACO type LC, single stage, end suction centrifugal pumps are designed and built for compactness, high performance, durability, and versatility of application.

The PACO close coupled design features a short shaft design for minimum overhang and minimum shaft deflection. All models may be mounted vertically or horizontally, with discharge connections available in several positions.

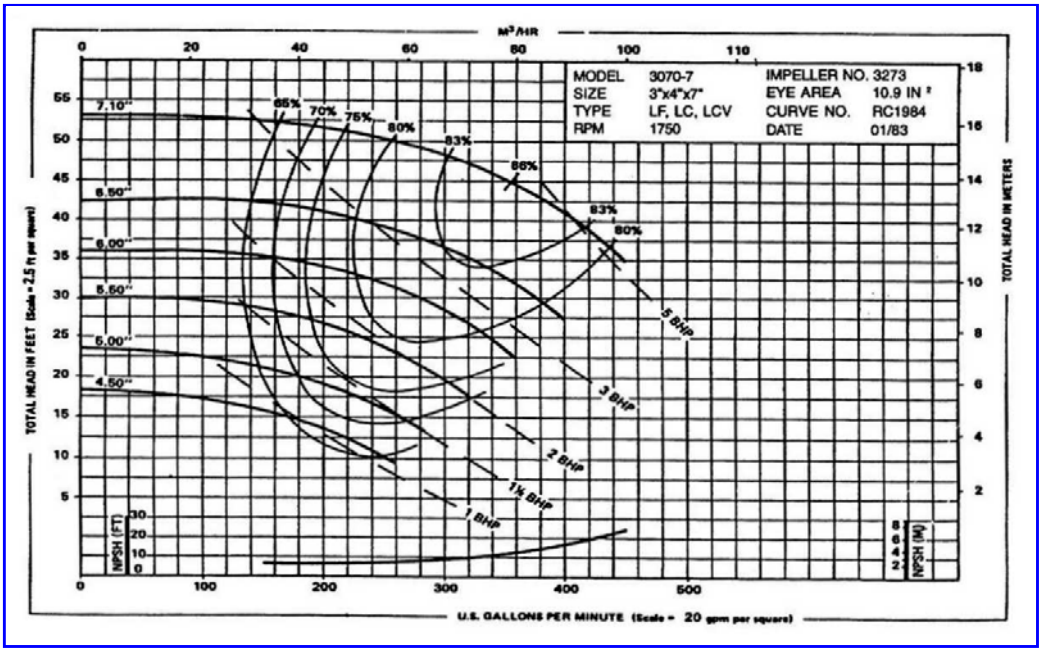
PACO type LC pumps emphasize standardization of parts and maximum interchangeability permitting the customer a minimum of stock parts and flexibility for future modification. The back pull out feature allows maintenance without disconnecting system piping.

Rotation Options	Clockwise	Impeller Washer	S.S., AISI-303
Base/Stand Type	Cast Iron Base	Impeller Key	Steel, AISI 1045
Connections	125# ANSI	Sleeve Material	Bronze, III932, C89835
Wear Ring Type	Case Wear Ring	Wear Ring Material	NiAl-Bronze, ASTM-B148, C95500
Pump Coatings	Standard Paint	Packing Gland	Not Applicable
NSF-50 Certification	Not Required	Lantern Ring	None
NSF-61 Certification	Not Required	Seal Type	Type 21
Motor Drip Canopy	Not provided	Seal Material	Ceramic/Carbon/Buna
Casing	Cast Iron, ASTM-A48, CL 30	O-Rings	Buna N
Motor Shaft	Steel, AISI 1045	Seal Flush Options	No External flush
Motor Bracket	Cast Iron, ASTM-A48, CL 30	Gaskets	Veg. Fiber
Impeller	Silicon Bronze, ASTM-B584, C87600	Casing Bolts	Steel, AISI 1045
Impeller Cap Screw	S.S., AISI-303	Comments	

GRUNDFOS

LC - 30707 - 1750 RPM - Performance Curve

Project:	Tag #	P.O. #	By:
Location:	Model: **30707**	Cust Ref#	Date: **10/29/2010**
Contractor:	Stages: **1**	Agent/Rep:	Rev. #
Engineer:	Service:	Doc #	Qty:



Conditions of Service			Motor Data		
Flow:	Temp:	Suct. Press:	HP: **2**	Voltage: **575**	Eff:
TDH:	S.G.:	Dis. Press:	RPM: **1750**	Phase: **Three phase**	S.F.: **1.15**
Fluid:	Visc.:	Diff. Press:	Encl.: **TEFC**	Hz: **60**	

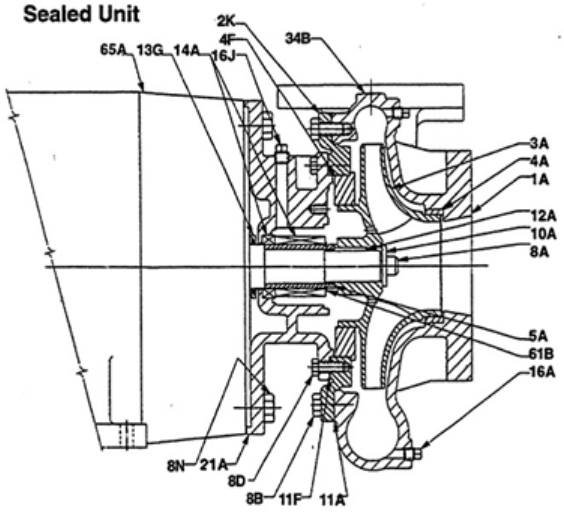
GRUNDFOS

LC Cross Section

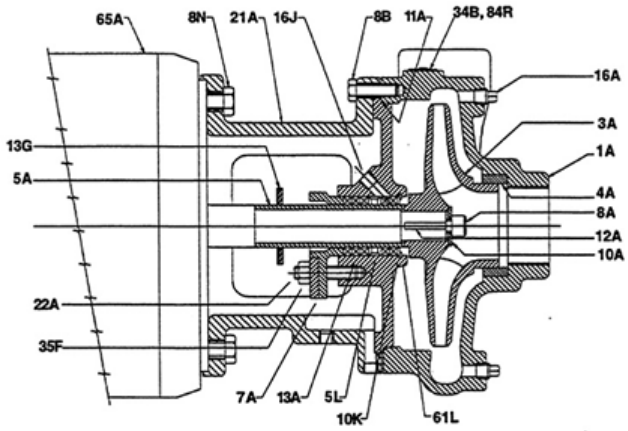
By:	
Date:	**10/29/2010**
Rev. #	

Project:	Tag #	P.O. #
Location:	Model: **30707**	Cust Ref#
Contractor:	Qty:	Agent/Rep:
Engineer:	Service:	Doc #

Sealed Unit



Packed Unit



Typical Flanged & Threaded Pumps With Mechanical Seals or Packing.

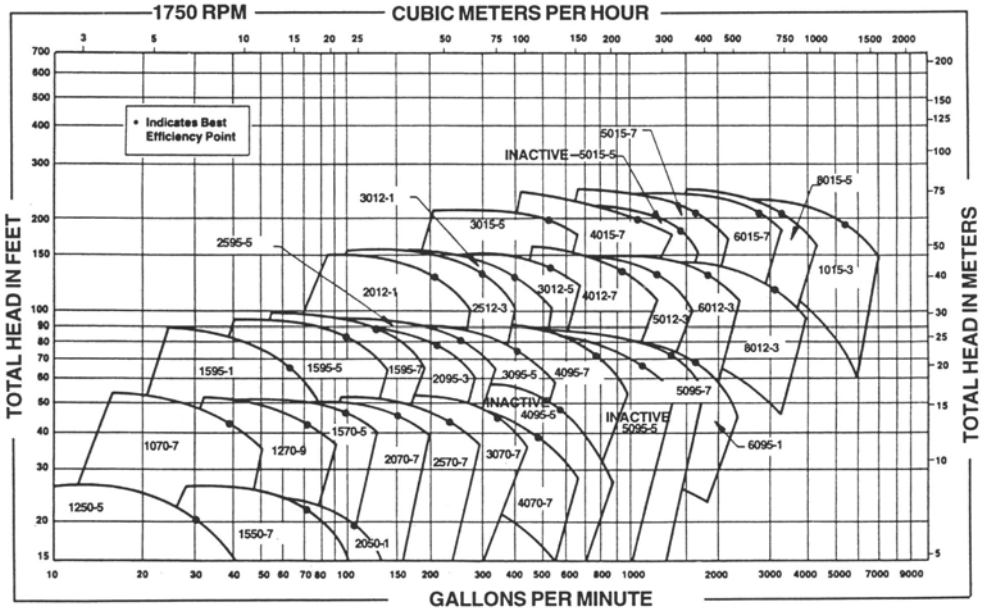
Key No.	Description
1A	Casing
2K	Backplate
3A	Impeller
4A	Front Case Wear Ring
4F	Rear Case Wear Ring
5A	Shaft Sleeve
*5L	Lantern Ring
*7A	Packing Gland
8A	Impeller Capscrew
8B	Capscrew, Casing
8D	Capscrew, Bracket
8N	Capscrew, Motor
10A	Washer, Impeller
*10K	Washer, Packing
11A	Gasket, Casing
11F	Gasket, Backplate
12A	Key
*13A	Packing
13G	Slinger
14A	Mechanical Seal
16A	Plug, Drain
16J	Plug, Stuffing Box
21A	Bracket
*22A	Stud, Packing Gland
34B	Nameplate
*35F	Nut, Packing Gland
61B	Snap Ring
*61L	Retaining Ring
65A	Motor
84R	Set Screws

*** Packed Pumps Only**

GRUNDFOS

LC - 30707 - Range Chart

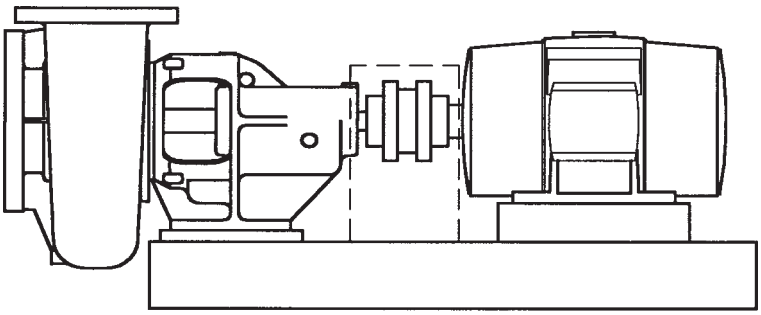
Project:	Tag #	P.O. #	By:
Location:	Model: **30707**	Cust Ref#	Date: **10/29/2010**
Contractor:	Stages:	Agent/Rep:	Rev. #
Engineer:	Service:	Doc #	Qty: **0**



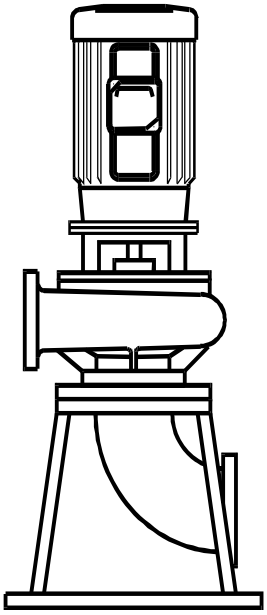
PACO PUMPS

INSTALLATION, OPERATING & MAINTENANCE INSTRUCTIONS

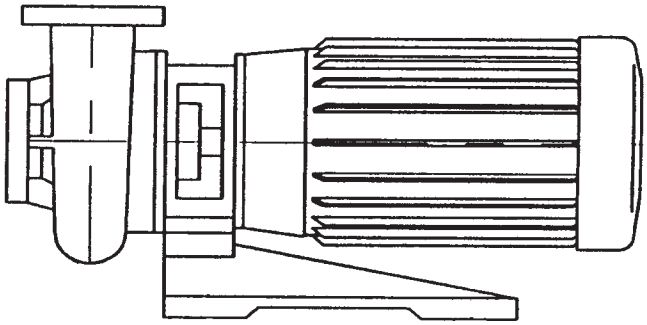
Type L End Suction Pumps



LF



LCV



LC

TABLE OF CONTENTS

CAUTIONS and WARNINGS are inserted at key points of this manual to provide check points for personnel and machinery safety. *CAUTIONS:* Apply to personnel. *WARNINGS:* Apply to personnel and machinery.

I. INSTALLATION-MECHANICAL

Read these instructions thoroughly before installing and operating your PACO Type L Centrifugal Pump. Successful operation depends on careful attention to the procedures described in Sections I, II, III and IV of this manual. Keep this instruction manual handy for future use.

A. PUMP IDENTIFICATION

- All PACO Pumps are identified by Catalog and Serial Numbers. These numbers are stamped on the pump nameplate (Fig.1 a) affixed to each pump volute casing, and should be referred to in all correspondence with the Company.

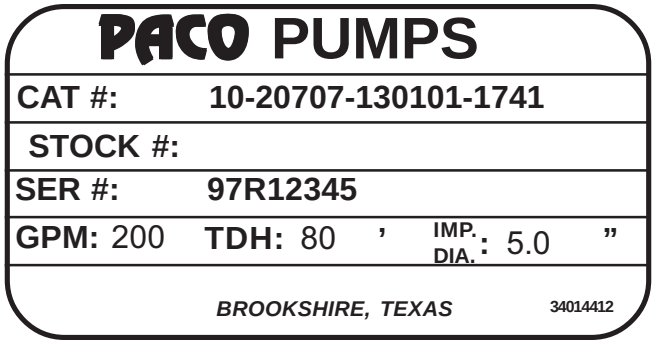


FIGURE 1a

B. RECEIVING

- Check pumping unit for shortage and damage immediately upon arrival. Pump accessories when required are packaged in a separate container and shipped with the unit.

- If equipment is damaged in transit, promptly report this to the carrier's agent. Make complete notations on the freight bill to speed satisfactory adjustment by the carrier.

- Unload and handle the unit with a sling. **Do not lift unit by eye bolts on the motor!**

C. TEMPORARY STORAGE

- If pump is not to be installed and operated soon after arrival, store it in a clean, dry area of moderate ambient temperature.

- Rotate the shaft by hand periodically to coat bearing with lubricant to retard oxidation and corrosion.

- Follow motor manufacturer's storage recommendations where applicable.

D. LOCATION

- Locate the pump as close to the suction supply as possible. Use the shortest and most direct suction piping practical. Refer to paragraph H. SUCTION (INLET) PIPING.

- Locate the pump below system level wherever possible. This will facilitate priming, assure a steady liquid flow, and provide a positive suction head.

- Make sure sufficient NPSH (Net Positive Suction Head) is provided at the suction end by considering the pump's location in relation to the entire system. Available NPSH must always equal or exceed required NPSH specified on the pump performance curve.

- Always allow sufficient accessibility for maintenance and inspection. Provide a clear space with ample head room for use of a hoist strong enough to lift the unit.

- Make sure a suitable power source is available for the pump motor. Electrical characteristics should match those specified on the motor data plate, within the limits covered in Sections II and III.

- Avoid pump exposure to sub-zero temperatures to prevent pump liquid from freezing. If freezing conditions exist during shutdown periods, see Sections IIIE and IIIF for specific recommendations.

E. HORIZONTAL PUMP FOUNDATION

- Horizontal pumps should be permanently installed on a firm, concrete foundation mounting pad of sufficient size to dampen any vibration and prevent any deflection or misalignment. The pad may float on springs or be a raised part of the equipment room floor. The foundation should be poured without interruption to 3/4 to 1-1/2 inches below the final pump elevation. The top surface should be well scored or grooved before the concrete sets to provide a suitable bonding surface for the grout. Anchor bolts should be set in pipe sleeves for positioning allowance, as shown in (Fig. 2a) on page 4. Allow enough bolt length for grout, lower base plate flange, nuts and washers. Allow the foundation to cure several days before proceeding with pump installation.

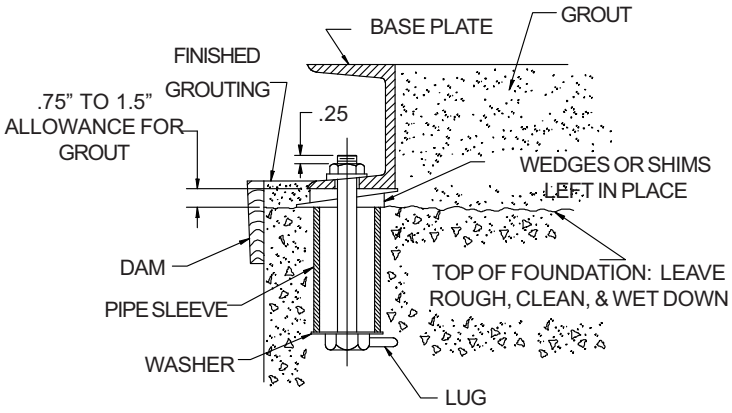


FIGURE 2a: Anchor Bolt Installation

F. SECURING THE BASE PLATE

- After the concrete pad has been poured and set, lower the pump base plate over the anchor bolts and rest it on loose adjustment wedges or shims placed near each anchor bolt and at intervals not to exceed 24" along each side.

  Shims or wedges must be placed to raise the bottom of the base 3/4" to 1-1/4" above the pad, allowing clearance for grout. Level the pump shaft, flanges, and base plate using a spirit level, adjusting the wedges or shims, as required.

- Check to make sure that the piping can be aligned to the pump flanges without placing any strain on either flange.

- After pump alignment has been established, put nuts on foundation bolts and tighten them just enough to keep the unit base plate from moving. Construct a form or dam around the concrete pad and pour grout in and around the pump base, as shown in (Fig. 2a). Grout compensates for uneven foundation, distributes the weight of the unit, and prevents shifting. Use an approved, nonshrinking grout (such as Embeco 636 by Master Builders, Cleveland, Ohio or equivalent). Allow at least 24 hours for this grout to set before proceeding with piping connections.

- After the grout has thoroughly hardened, check the foundation bolts and tighten if necessary. Recheck the pump alignment after the foundation bolts are secured.

G. VERTICAL MOUNTING INSTRUCTIONS

The PACO LCV Vertical Close Coupled pump need not be grouted to its foundation, but should be anchored with 4 anchor bolts set in concrete similar to the horizontal anchoring arrangement (Fig. 2a).

H. PIPING-GENERAL

- **Do not use pump as a support for piping!** Use pipe hangers or other supports at proper intervals to provide complete piping support near the pump.

- Both suction and discharge piping should be independently supported and properly aligned so that no strain is transmitted to the pump when flange bolts are tightened.

- Make sure piping is as straight as possible, avoiding unnecessary bends and fittings. Where necessary, use 45° or long-sweep 90° pipe fittings to decrease friction loss.

- Where flanged joints are used, make sure that inside diameters properly match and mounting holes are aligned.

- **Do not spring or force piping when making any connections!**

I. SUCTION (INLET) PIPING

The sizing and installation of suction piping is particularly important. It must be selected and installed in a manner that minimizes pressure loss and permits sufficient liquid flow into the pump during starting and operation. Many NPSH problems can be traced directly to improper design of suction piping systems. Observe the following precautions when installing suction piping:

- Suction piping should be as direct as possible, and ideally the length should be at least ten times the pipe diameter. Short suction piping can be the same diameter as the suction opening. Longer piping should be one or two sizes larger (depending on length), reducing to the diameter of the pump suction opening.

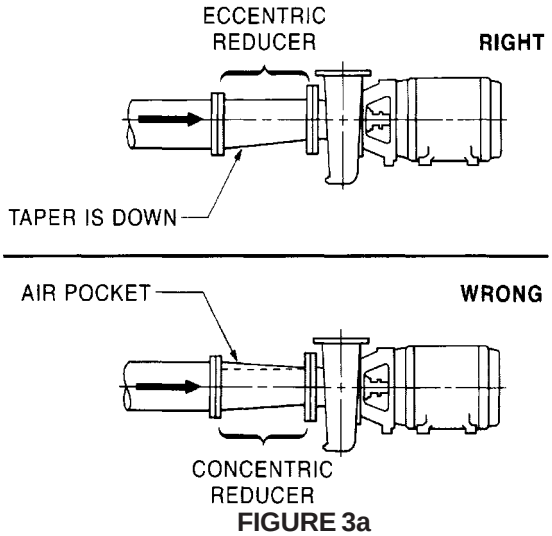


FIGURE 3a

- Use an eccentric reducer, with the eccentric side down (Fig. 3a) when reducing the pipe diameter to the diameter of suction opening.

- **At no point should suction piping be smaller in diameter than the pump suction opening.**

- Horizontal suction lines should follow an even gradient, if possible. A gradual upward slope to the pump is recommended for suction lift conditions, and a gradual downward slope for positive suction head.

- Avoid any high points, such as pipe loops (Fig. 4a), that may create air pockets and throttle the system or produce erratic pumping.

- Install a valve in the suction line to isolate the pump during shutdown and maintenance, and facilitate pump removal. Where two or more pumps are connected to the same suction line, install duplicate gate valves to isolate each pump from the line.

- Gate valves should always be installed in positions that avoid air pockets. Globe valves should not be used, particularly when NPSH is critical.

- During pumping operation, valves on suction line must always be at **FULL OPEN**.

- Properly sized pressure gauges can be installed in gauge taps on pump suction and discharge nozzles. Gauges enable the operator to monitor pump performance and determine that the pump conforms to the parameters of the performance curve. If cavitation, vapor binding, or other unstable operation occurs, pressure gauges will indicate wide fluctuation in suction and discharge pressures.

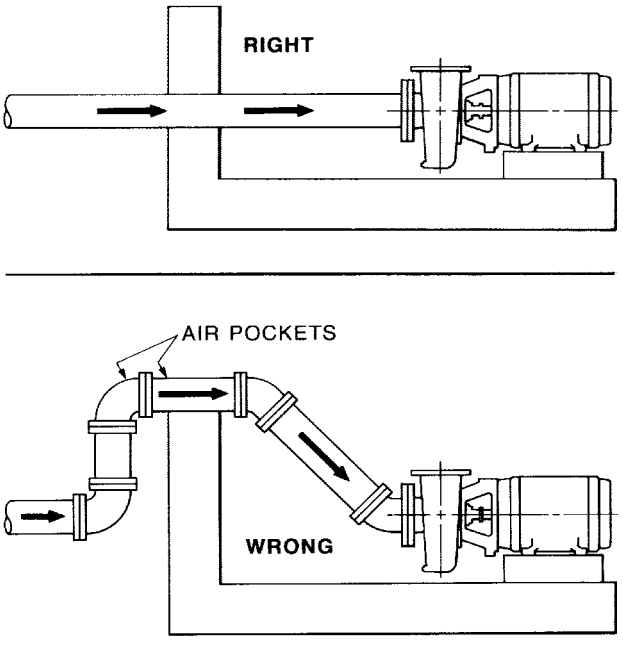


FIGURE 4a

J. DISCHARGE (OUTLET) PIPING

- Short discharge piping can be the same diameter as the pump discharge opening. Longer piping should be one or two sizes larger depending on length.

- An even gradient is best for long horizontal runs of discharge piping.

- Install a valve near the discharge opening to prime and start the pump. The discharge gate valve is also used to isolate the pump during shutdown, maintenance, and facilitate pump removal.

- Any high points in discharge piping may entrap air or gas and thus retard pump operation.

- If the possibility of liquid hammer exists, (i.e. check valves are used) close the discharge gate valve before pump shutdown.

K. SHAFT SEALING-GENERAL COMMENTS

- PACOoffers both mechanical seals and packed stuffing boxes as a means to seal the shaft. Pumps with stuffing boxes are normally packed before shipment. If the pump is installed within 60 days after shipment, the packing material will be in good condition for operation with a sufficient supply of lubrication. If the pump is stored for a longer period, it may be necessary to repack the stuffing boxes.

- The stuffing box must be supplied at all times with a source of clean, clear liquid to flush and lubricate the packing. When pumps are equipped with mechanical seals, no maintenance or adjustment is required. Mechanical seals are preferred to packing on most applications because they require less maintenance.

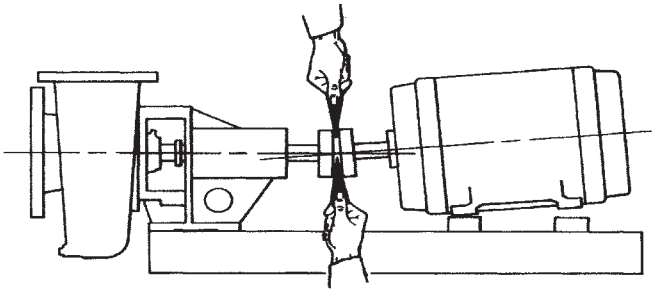
L. PACKING GLAND ADJUSTMENT

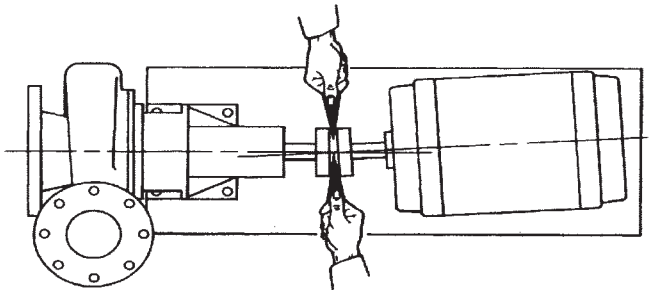
- With the pump running, the packing gland should be adjusted to permit 40 to 60 drops per minute leakage. This is required for shaft lubrication. After initial start up, additional packing and adjustment may be required. Pumps with mechanical seals require no adjustment.

M. MECHANICAL SEALS

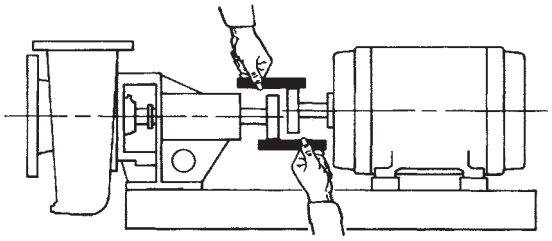
All PACO Type L pumps that are equipped with mechanical seals are matched to conditions for which the pump was sold. Observe the following precautions to avoid seal damage and obtain maximum seal life:

CHECKING ANGULAR ALIGNMENT





CHECKING PARALLEL ALIGNMENT



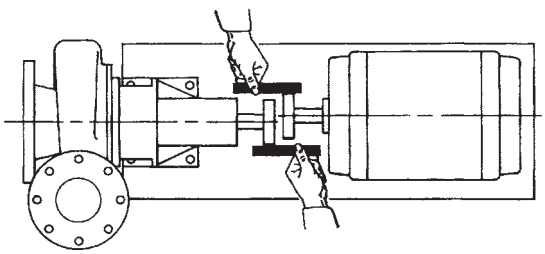


FIGURE 5a: Checking Alignment

- Do not exceed temperature or pressure limitations for the mechanical seal used.

- DO NOT RUN THE PUMP DRY OR AGAINST A CLOSED VALVE! Dry operation will cause seal failure within minutes.

- Clean and purge suction piping in new installations before installing and operating pump. Pipe scale, welding slag and other abrasives can cause rapid seal failure.

N. COUPLING ALIGNMENT

- The following anchoring and alignment procedure is typical and, if performed with care, should result in a smooth running, trouble-free installation.

- If the pump and motor were shipped mounted on the pump base as an assembly, remove the coupling guard.

- The pump and motor were accurately aligned at the factory, but handling during shipment usually alters this pre-alignment . Using a small straight edge and feeler gauges or a dial indicator, check for horizontal, vertical, and angular misalignment of the coupling hubs (Fig. 5a).

- Coupling alignment is proper when the dial indicator reads no more than .005" run out in any direction (or when the straight edge contacts both hubs evenly in both horizontal and vertical positions). If misalignment is detected, loosen the motor and shift or shim as necessary to re-align, then re-tighten bolts. **Always align the motor to the pump as piping strain will occur if the pump is shifted. *Never reposition pump on base!***

- After final piping connections to the pump have been made, motor wiring compared, correct rotation has been established, and piping filled with liquid, check shaft alignment once again.

- Leave the coupling guards off until the pump priming procedure is completed for a final shaft alignment check.

- To protect personnel from rotating machinery, **Always install coupling guards after installation is complete; before starting pump!**

II. INSTALLATION—ELECTRICAL

A. MOTORS, GENERAL

The motor control circuit must have the following compo-

nents in order to comply with the National Electrical Code.

- Motor Disconnecting Device: A motor disconnecting device must be installed that is capable of disconnecting both the controller (motor starter) and the motor from their source of power.

  The disconnecting device must be located so that the controller (motor starter) can be seen from the disconnecting means. In all cases, the distance from the disconnecting device to the controller must be less than 50'.

  In most installations the disconnecting device will be a circuit breaker or fusible disconnect switch.

- Motor short circuit and ground fault protection:

  Short circuit and ground fault protection are usually provided by means of a circuit breaker or fusible disconnect switch.

  The selection of the size of the circuit breaker or fuse must be in accordance with Section 430-52 and Table 430-152 of the National Electrical Code.

- Motor controller with running over current protection (magnetic starter):

  These components must be installed in accordance with applicable local and state electrical codes in addition to the National Electrical Code.

B. INSTALLATION WIRING

- Mount the control panel or motor starter(s) in close proximity to the pump to provide convenient control and ease of installation.

- Wire panel or starter(s) to motor(s) and pilot device(s): Wires to each motor must be sized for at least 125% of the motor nameplate full load amps. AWG #16 Type THW stranded wire is recommended for wiring of pilot devices (float switches).

- Check incoming power source to ensure that it is the same as the voltage and phase of the motors.

- Verify that the starters are suitable to operate the pump motors on voltage and phase that is available.

III. OPERATION

A. PRIMING

- The PACO Type L pump is not self-priming, and must be completely primed (filled with liquid) before starting.

- If the pump will operate with a positive suction head, prime by opening the suction valve and allowing liquid to enter pump casing. Open air vents at this time, and make sure all air is forced from pump by liquid before closing.

- Rotate the shaft by hand to free entrapped air from impeller passageways.

- If pump has a suction lift, priming must be accomplished by other methods. The use of foot valves or ejectors, or manual filling of the pump casing and suction line with liquid are possible methods suggested for this purpose.

- **CAUTION: Never run the pump dry in the hope that it will prime itself!** Serious damage to the mechanical seal will result.

B. PRE-START CHECKLIST

WARNING: In the interest of operator safety, the unit must not be operated above the nameplate conditions. Such operation could result in unit failure causing injury to operating personnel. Consult instruction book for proper operation and maintenance of the pump and its supporting components.

Make the following inspections before starting your Sulzer Type L pump:

- ☐ Make sure all wiring connections to the motor (and starting device) match the wiring diagram and produce clockwise rotation as viewed from the back of the motor.

- ☐ If the motor has been in storage for an extended length of time, either before or after installation, refer to motor instructions before starting.

- ☐ Check voltage, phase, and line circuit frequency with the motor data plate.

- ☐ Turn rotating element by hand to make sure it rotates freely.

- ☐ Tighten plugs in gauge and drain taps. If pump is fitted with pressure gauges, keep gauge cocks closed when not in use.

- ☐ Check suction and discharge piping for leaks, and make sure all flange bolts are securely tightened.

C. MOTOR ROTATION

CAUTION: Never check driver rotation unless pump and driver couplings are disconnected and physically separated. Failure to follow this instruction can result in serious damage to pump and driver if rotation is wrong.

After the unit has been wired and checked to insure that all components in the system (disconnect device, magnetic starters, pilot devices and motors) are properly connected, check motor rotation as follows:

- For 3 phase units only—momentarily energize the motors to ensure that the rotation is correct as indicated by the arrow cast into the pump volute. If rotation is incorrect, interchange two wires at the motor starter terminals T1 and T2.

- **IMPORTANT:** The pumps must not be operated while dry. Use extreme caution that motors are energized only momentarily to determine proper rotation.

D. STARTING THE PUMP

WARNING: The pump must not be operated without an approved coupling guard in place. Failure to observe this warning could result in injury to operating personnel.

- Install coupling guard on flexible coupled units.

- Fully open gate valve (if any) in suction line, and close gate valve in discharge line.

- Fill suction line with liquid and completely prime pump.

- Start the motor (pump).

- Immediately make a visual check of pump and suction piping for pressure leaks.

- Immediately after pump reaches full operating speed, slowly open the discharge gate valve until complete system flow is achieved.

- Check discharge piping for pressure leaks.

- If pump is fitted with pressure gauges, open gauge cocks and record pressure reading for future reference. Verify that the pump is performing in accordance with parameters specified on performance curve.

- Check and record voltage, amperage per phase, and kilowatts, if a wattmeter is available.

E. VOLTAGE REGULATION

The motor will operate satisfactorily under the following conditions for voltage and frequency variation, but not necessarily in accordance with the standards established for operation under rated conditions:

- The voltage variation may not exceed 10% above or below rating specified on the motor data plate.

- The frequency variation may not exceed 5% above or below motor rating.

- The sum of the voltage and frequency variations may not exceed 10% above or below motor rating, provided the frequency variation does not exceed 5%.

F. PUMP SHUTDOWN

The following shutdown procedures will apply in most normal shutdowns for the PACO Type L pump. If pump will be inoperative for an extended length of time, follow storage procedures in Section IC.

- Always close the discharge gate valve before stopping pump. Close valve slowly to prevent hydraulic shock.

- Cut power to motor.

G. SHORT DURATION SHUTDOWN

- For overnight or temporary shutdown periods under nonfreezing conditions, the pump may remain filled with liquid. Make sure the pump is fully primed before restarting.

- For short or frequent shutdown periods under freezing conditions, keep fluid moving within pump casing and insulate or heat pump exterior to prevent freezing.

H. EXTENDED PERIOD SHUTDOWN

- For long shutdown periods, or to isolate the pump for maintenance, close suction gate valve. If no suction valve is used and the pump has positive suction head, drain all liquid from suction line to terminate liquid flow into pump suction nozzle. Remove plugs in pump drain and vent taps, as required, and drain all liquid from the pump volute casing.

- If freezing conditions will exist during long shutdown periods, completely drain the pump and blow out all liquid passages and pockets with compressed air. Freezing of pump liquid can also be prevented by filling the pump with antifreeze solution.

IV. MAINTENANCE

WARNING: Do not attempt any maintenance, inspection, repair or cleaning in the vicinity of rotating equipment. Such action could result in personal injury to operating personnel.

Before attempting any inspection or repair on the pump, the driver controls must be in the "OFF" position, locked and tagged to prevent injury to personnel performing service on the pump.

A. MOTOR LUBRICATION

- To lubricate the motor while running or at rest, remove grease drain plug (if any) and filler plug on grease fitting. Grease with clean lubricant until grease appears at drain hole or along motor shaft.

MOTOR RPM	MOTOR HP	OPERATING CONDITIONS		
		STANDARD	SEVERE	EXTREME
1750 & BELOW	1/3-7-1/2	3 YRS.	1 YR.	6 MOS.
	10-40	1-3 YRS.	6MOS.-1 YR.	3 MOS.
	50-150	1 YR.	6 MOS.	3 MOS.
	200 & UP	1 YR.	6 MOS.	3 MOS.
ABOVE 1750	(ALL HP)	6 MOS.	3 MOS.	3 MOS.

STANDARD CONDITIONS:
8 Hours per day operation, normal or light loading, clean air, 100ºF, maximum ambient temperature.

SEVERE CONDITIONS:
Continuous 24-hour operation, shock loading or vibration, poor ventilation, 100º-150ºF, ambient temperature.

EXTREME CONDITIONS:
Continuous operation, heavy shock or vibration, dirt or dust in air, extreme ambient temperature.

TABLE 6a: Recommended Lubrication Periods.

One-half to one cubic inch of grease is sufficient for motors 5 HP and under, with proportionately more grease for greater HP motors.

- Most fractional and some integral frame motors have “sealed-for-life” bearings, and do not require further lubrication throughout motor life.

- Always follow motor manufacturer’s lubrication instructions, and periodically check grease fittings and drain plugs for leaks.

- If lubricating instructions do not accompany motor, refer to Table 6a for recommended lubrication periods.

- Table 7a lists recommended types of grease for both pump and motor lubrication. These types have all been thoroughly tested and should be used whenever possible.

B. PUMP LUBRICATION

- PACO Type LF pumps on horizontal bearing frames have bearing that may be sealed for life (requiring no lubrication), regreasable or oil lubricated.

MANUFACTURER	LUBRICANT
SHELL	DOLIUM® R™
EXXON	POLYREX®
CHEVRON	SRI GREASE NLGI 2
	BLACK PEARL - NLGI 2
PHILIPS	POLYTAC™
TEXACO	POLYSTAR RB

TABLE 7a

- To lubricate regreasable bearings, remove grease drain plug (if any) and filler plug. Add clean ball bearing lubricant until grease appears at drain hole or along shaft. On units with drain hole, all old grease can be purged out ahead of new. In such cases, the drain should be left unplugged for several minutes during pump operation to allow excess grease to be forced out.

- Lubricate bearing frame bearings at intervals of one to three months, depending on severity of environment. Pumps in a clean, dry, moderate temperature (100° F maximum) environment should be regreased at three month intervals. Too much grease can cause premature bearing failure—do not overgrease.

3. On those PACO Type LF Centrifugal End Suction pumps ordered with oil lubricated bearings, (Fig. 8a) a regular oil maintenance program must be enforced. Pumps with oil lubricated bearings are fitted with a transparent reservoir (constant level oiler) that maintains oil level about the centerline of the bearing. When necessary, the oil supply in the reservoir of the constant level oiler must be renewed.

- After the first 200 hours of operation the oil should be changed. To change the oil, remove the drain plug at the bottom of the bearing cover and the filler plug (that also acts as a vent plug) at the top of the housing. After draining oil, replace the fittings and refill with an acceptable oil selected from Table 9a. After the first oil change, the oil should be changed again at 2000 hours and then at intervals of 8000 hours or once yearly, thereafter.

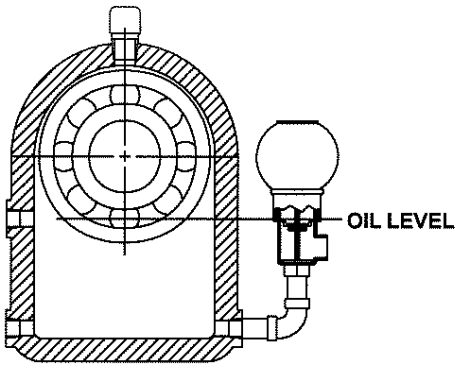


FIGURE 8a

LUBRICANT MANUFACTURER	BEARING OIL BRAND NAME
Aral Refining Co.	ARAL OIL CMU ARAL OIL TU 518
British Petroleum Co.	BP ENERGOL TH 100-HB
Calypsol Oil Company	CALYPSOL BISON OIL SR 25 or SR 36
Standard Oil Company	CHEVRON HYDRAULIC OIL 11 CIRCULATING OIL 45
Esso Corporation	ESSO-MAR 25 TERESSO 47 ESSTIC 50
Fina Oil Company	FINA HYDRAN 34 FINA CIRKAN 32
Gulf Refining Company	GULF HARMONY 47 GULF PARAMOUNT 45
Socony Mobil Oil Co.	VAC HLP 25 MOBILUX D.T.E. 25
Shell Oil Company	SHELL Tellus OIL 29
Sundco Oil Company	SUNVIS 821
The Texas Company	TEXACO Ursa Oil P 20 DEA VISCOBIL Sera 4
Wisura Refining Company	WISURA Norma 25 (36) WISURA Tempo 25 (36)

TABLE 9a: List of Acceptable Lube Oils

C. DISASSEMBLY OF PUMPS

(Refer to drawing on page 11).

- Complete disassembly instructions are outlined below. Proceed only as far as required to perform the maintenance work needed.
- Turn off power.
- Drain system. Flush, if necessary.
- Closed coupled units: Remove motor hold down bolts.

DISASSEMBLY OF LIQUID END.

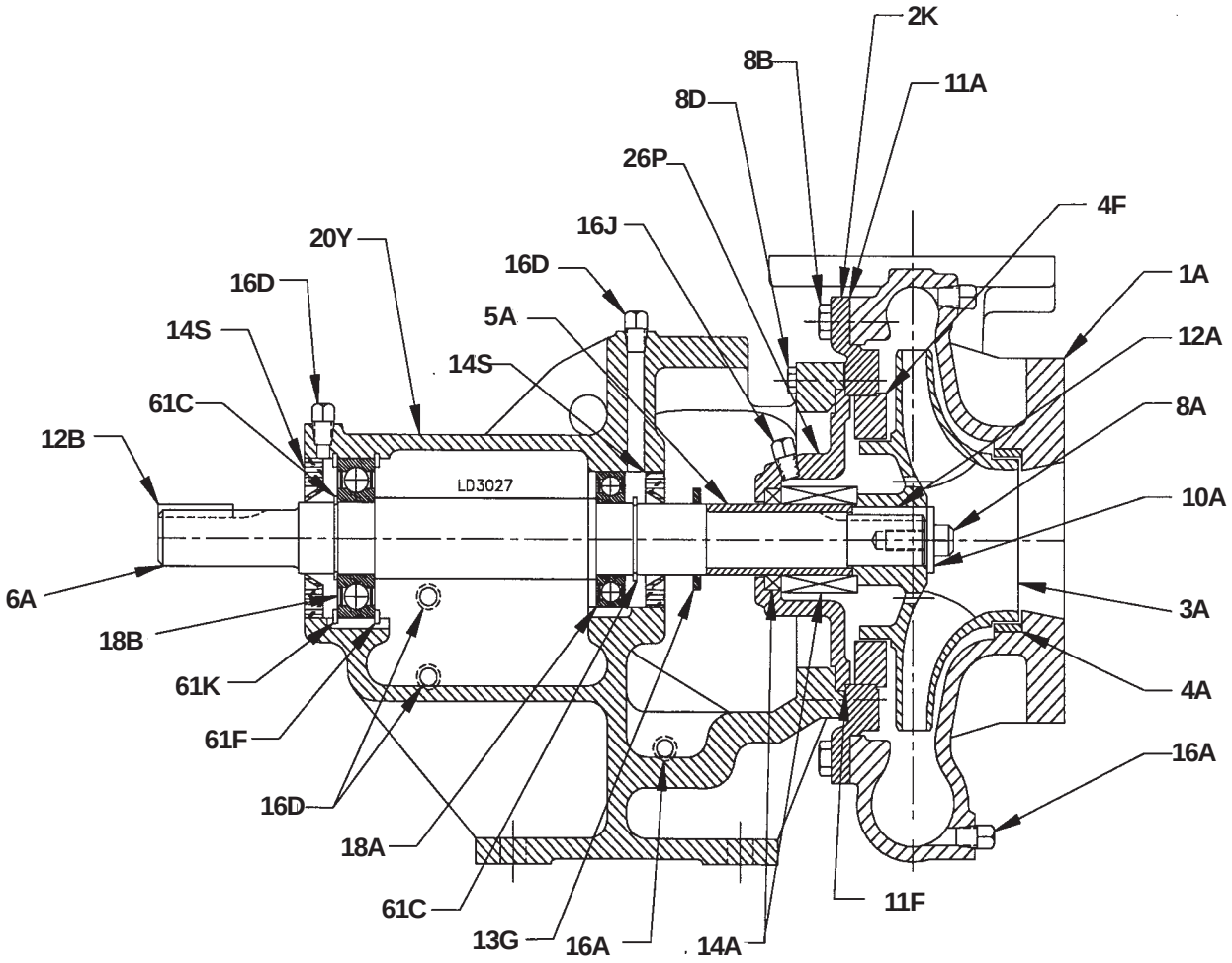
- Remove casing bolts (8B)
- Remove back pull-out bearing frame assembly (20Y) from casing (1A)
- Unscrew impeller nut (8A)
- **CAUTION: Do not insert screwdriver between impeller vanes to prevent rotation.** It may be necessary to use a strap wrench around the impeller or shaft to prevent rotation.
- Use appropriate size gear puller aligned behind impeller vanes to remove impeller (3A) from shaft (6A).
- Remove impeller key (12A).
- Remove backplate bolts (8D). Remove backplate (2K) and seal housing (26P).
- Place seal housing on flat surface and press out seal seat (14A).
- If shaft sleeve (5A) requires replacement, it must be evenly heated to approximately 350°F to loosen locktite. Twist sleeve off shaft (6A).

DISASSEMBLY OF BEARING FRAME.

- Remove slinger (13G).
- Remove grease seal(s), (14S) if any.
- Remove bearing house retaining ring (61K).
- Press or tap on the pump end of the bearing-shaft assembly until one bearing is out.
- When one bearing is out, remove second retaining ring (61F), then remove complete assembly from bearing housing.
- Remove shaft retaining ring (61C) and press off bearings.
- Press on new bearings. Remember to press only on inner race of bearing while pressing them on.
- Assemble frame in the reverse procedure used for disassembly.
- Observe the following when reassembling the bearing frame.

PACO PUMPS

TYPE LF, CROSS SECTION AND PARTS LIST



ITEM NO	PART NAME	ITEM NO	PART NAME	ITEM NO	PART NAME
1A	Casing	*10A	Washer, Packing	16L	Plug, Seal Chamber
2K	Backplate	10A	Washer, Impeller	18A	Bearing, Inboard
3A	Enclosed Impeller	11A	Gasket, Casing	18B	Bearing, Outboard
4A	Case Wear Ring	11F	Gasket, Backplate	20Y	Bearing Frame
**4F	Balance Ring	12A	Key, Impeller	*22A	Stud, Packing Gland
5A	Shaft Sleeve	12B	Key, Coupling	26P	Seal Housing
*5L	Lantern Ring	*13A	Packing	*26U	Packing Box
6A	Shaft	13G	Slinger	*35F	Nut, Packing Gland
*7A	Packing Gland	14A	Shaft Seal	61C	Snap Ring
8A	Cap Screw, Impeller	14S	Lip Seal	*61J	Snap Ring
8B	Cap Screw, Casing	16A	Plug, Drain	*Packed Pumps Only	
8D	Cap Screw, Brg. Frame	16D	Plug, Grease/Oil Filter	**If Applicable	

- Replace lip seals (14S) if worn or damaged.
- Replace bearings (18A), (18B) if loose, rough or noisy when rotated.
- Check shaft (6A) for runout at the sleeve (5A) area. Maximum permissible is .002" T.I.R.

D. REASSEMBLY OF PUMPS

- All parts should be cleaned before reassembly.
- Refer to parts list to identify required replacement items. Specify pump serial or catalog number when ordering parts.
- Reassembly is the reverse of disassembly.
- Observe the following when reassembling the liquid end:
- All mechanical seal components must be in good condition or leakage may result. Replacement of complete seal assembly is recommended.
- New shaft sleeves are installed by bonding to shaft with hydraulic setting locktite.

V. ORDERING PARTS

- **PACO Pumps** has over 175 years of experience in the design, manufacture, and application of centrifugal pumps and pumping systems. PACO's commitment to state-of-the-art pump design and quality manufacturing assures maximum user benefits with optimum equipment life at lower cost.
- PACO's commitment to their customers continues through an extensive service organization. Highly trained technicians can assist customers with initial startup, troubleshooting, repair, and system analysis.

PACO maintains an extensive stock of replacement parts and parts kits for our most popular model pumps. Shipment of these parts is normally made within three days after receipt of an order. On larger pumps, where it is impractical for our factory to inventory low usage parts, replacement parts are normally manufactured and shipped within 15 working days of receipt of an order. In order to reduce pump repair time and shorten inconvenient pump service interruptions, it is suggested that the pump user stock spare parts. For suggested spare parts see Replacement Parts Guide A1b.2, attached, and contact your local PACO Sales Representative (see back cover for the number of your nearest PACO Sales office). Since spare parts requirements and quantities vary for specific pump constructions, allow your PACO Representative to help in defining your spare part requirements. To ensure that the proper replacement parts are ordered for your particular pump model, when you call:

- Identify all pertinent data from the pump name plate (see Pump Identification). This should always include the pump Catalog or Model Number, and the pump Serial Number.
- For replacement impellers, also include from the nameplate the operating conditions (GPM and TDH) and the impeller diameter.
- Identify all parts by item number and description as indicated by the appropriate assembly drawing in this manual, for your particular pump model.

VI. TROUBLE SHOOTING

A.

SYMPTOMS	CAUSE CODE
Pump does not deliver any liquid at start-up.	1*2*3*4*5*6*7*8*9*10*11*14*16*17*22*23*24*34
Pump stops delivering liquid after start-up.	2*3*4*5*6*7*8*9*10*11*12*13*22*23*24*34
Pump overheats and/or ceases to deliver liquid.	1*3*9*10*11*21*22*27*29*30*31*33*34*40*41
Insufficient flow rate.	2*3*4*5*6*7*8*9*10*11*14*16*17*20*21*22*23*24*25*26*34
Excessive flow rate.	15*18*20*34
Discharge pressure is too high.	4*14*16*18*20*22*23*24*25*26*34
Shaft seal leaks appreciably, or the packing leaks excessively.	27*28*29*30*33*34*35*36*39*41
Shaft seal or packing fails prematurely.	12*13*27*28*29*30*33*34*35*36*37*38*39*41
Pump uses too much power.	15*16*18*19*20*23*25*27*28*31*33*34*35*37*38*44
Pump runs rough and noisily.	2*3*4*5*6*7*8*9*10*11*15*17*18*21*23*24*27*28*29*30*31*32*33*34*40*41*42*45*46*
Bearings overheat and/or fail prematurely.	27*28*29*30*31*32*33*34*40*41*42*43*44*45*46

B. POSSIBLE CAUSES

1. The pump has not been properly bled of air.
2. The pump suction line have not been completely primed.
3. The suction head (NPSHR) required by the pump is too high, or the net positive suction head available (NPSHA) at your facility is too low.
4. The fluid pumped contains too much entrained air or gas.
5. There are air pockets in the suction line.
6. An entry of air has suddenly occurred in the suction line.
7. An entry of air past the shaft seal into the pump has occurred.
8. The inlet of the suction line is insufficiently submerged.
9. The suction valve is closed or only partially open.
10. The suction strainer is clogged with dirt or debris.
11. The foot valve is clogged or undersized.
12. Little or no cooling fluid supplied to the shaft seals.
13. The lantern ring is not positioned opposite the flushing inlet thereby restricting fluid flow.
14. Pump drive rotational speed too low.
15. Pump drive rotational speed too high.
16. Pump rotation wrong or impeller installed backwards.
17. Total head of installation (back Pressure) higher than rated total head of the pump.
18. Total head of installation (back Pressure) lower than rated total head of the pump.
19. Density of fluid pumped differs from that specified when the pump was purchased.
20. Viscosity of fluid pumped differs from that specified when the pump was purchased.
21. The pump is operating at too low a rate of flow (The discharge valve may be throttled too much).
22. If pumps are operating in parallel, the pump characteristics may not be suitable for parallel operation.
23. The impeller may be clogged with debris.
24. The impeller may be damaged.
25. The casing and impeller wear rings may be excessively worn.

TROUBLE SHOOTING-POSSIBLE CAUSES (Cont'd)

26. There may be internal leakage from the discharge to the suction compartments as the result of internal gasket failure.

27. There may be a misalignment of the pump shaft.

28. The shaft may chatter because it is bent.

29. The pump may run rough due to improper balancing of the impeller.

30. The shaft may not be running due to worn bearings.

31. The impeller may be rubbing against the inside of the case.

32. The concrete pad might not be of sufficient size to provide pump stability.

33. The pump may have become misaligned during installation.

34. The operating conditions of the installation do not agree with the data specified when the pump was purchased.

35. The shaft seal may be incorrectly installed, or the stuffing box has not been packed correctly.

36. The shaft sleeve may be scored or pitted in the region of the packing due to dirt or abrasive matter in the flushing fluid.

37. Excessive tightening of the packing gland may block the flushing port thereby diminishing the sealing fluid flow.

38. Packing material may have become wedged or extruded between the shaft and the bottom of the stuffing housing due to excessive clearance on the packing backup washer.

39. The mechanical seal may have been damaged by running dry.

40. There may be excessive axial thrust (side loading) due to improper impeller central alignment.

41. The bearings may be worn.

42. The bearings may have been damaged during installation and/or dirt or other foreign matter may have entered the bearings during greasing or oiling.

43. Excessive greasing may cause the bearings to overheat.

44. Inadequate lubrication may be causing bearing failure.

45. Dirt may have entered the bearings past the O-Rings.

46. Moisture may have entered the bearing housing causing the bearings to rust.

Terms And Conditions Of Sale

SECTION 1: THE CONTRACT

The Contract shall be comprised of the following terms, together with such terms and conditions as are set forth in Seller's written proposal or quotation (the "Quotation"), including any documents, drawings or specifications incorporated therein by reference, and any additional or different terms proposed in Buyer's purchase order (the "Purchase Order") that are accepted by Seller in writing, which together shall constitute the entire agreement between the parties, provided, however, that preprinted terms on Buyer's purchase order or invoice shall not apply and Seller gives notice of objection to such terms. An offer by Seller in its Quotation that does not stipulate an acceptance date is not binding. This Contract shall be deemed to have been entered into upon written acknowledgment of the Purchase Order by an officer or authorized representative of Seller, which may not be modified, supplemented, or waived except in a writing executed by an authorized representative of the party to be bound.

SECTION 2: PRICE

The price quoted in the Quotation shall be the Purchase Price unless otherwise agreed in the Purchase Order. The Purchase Price for equipment shall include packing for shipment. Field Services shall be provided at Seller's standard rates. All other costs, including packing for storage, freight, insurance, taxes, customs duties and import/export fees, or any other item not specified in the Contract, shall be paid by Buyer unless separately stated in the Quotation and included in the price quoted. Any sales, use, or other taxes and duties imposed on the transaction or the equipment supplied shall be paid or reimbursed by Buyer.

SECTION 3: PAYMENT TERMS

Payment shall be due within 30 days of the date of Seller's invoice in U.S. funds unless otherwise agreed. If Buyer does not observe the agreed dates of payment, Buyer shall pay interest to Seller on overdue amounts at a rate that is the higher of: 9% per annum or a rate 5% in excess of the rate borne from time to time by new issues of six-month United States Treasury bills. Seller shall be entitled to issue its invoice for the Purchase Price for equipment upon the earlier of shipment, or notice to Buyer that Seller is ready to ship, and for services, upon completion. If the Purchase Price exceeds $250,000 USD, Buyer shall pay the Purchase Price in Progress payments as follows: Fifteen percent (15%) upon submittal of general arrangement drawings, thirty five percent (35%) after receipt of first Bowl Casting, twenty percent (20%) after first case/bowl hydro test or bowl machining and thirty percent (30%) after notification of ready to ship.

SECTION 4: ACCEPTANCE AND INSPECTION

All equipment shall be finally inspected and accepted by Buyer within 14 days after delivery or such other period of time as is agreed in the Purchase Order. Buyer shall make all claims (including claims for shortages), excepting only those provided for under the warranty clause contained herein, in writing within such 14 day period or they are waived. Services shall be accepted upon completion. Buyer shall not revoke its acceptance. Buyer may reject the equipment only for defects that substantially impair its value, and Buyer's remedy for lesser defects shall be in accordance with Section 10, Warranty. If tests are made by Buyer to demonstrate the ability of the equipment to operate under the contract conditions and to fulfill the warranties in Section 10, Buyer is to make all preparations and incur all expenses incidental to such tests. Seller will have the right of representation at such tests at its expense, and the right to technically direct the operation of the equipment during such tests, including requiring a preliminary run for adjustments.

SECTION 5: TITLE AND RISK OF LOSS

Full risk of loss (including transportation delays and losses) shall pass to Buyer upon delivery, regardless of whether title has passed to Buyer, transport is arranged or supervised by Seller, or start-up is carried out under the direction or supervision of Seller. Delivery shall be ex works, INCOTERMS 2000. Loss or destruction of the equipment or injury or damage to the equipment that occurs while the risk of such loss or damage is borne by Buyer does not relieve Buyer of its obligation to pay Seller for the equipment.

SECTION 6: PATENT OR TRADEMARK INFORMATION

If the equipment sold hereunder is to be prepared or manufactured according to Buyer's specifications, Buyer shall indemnify Seller and hold it harmless from any claims or liability for patent or trademark infringement on account of the sale of such goods.

SECTION 7: CHANGES

Buyer may request, in writing, changes in the design, drawings, specifications, shipping instructions, and shipment schedules of the equipment. As promptly as practicable after receipt of such request, Seller will advise Buyer what amendments to the Contract, if any, may be necessitated by such requested changes, including but not limited to amendment of the Purchase Price, specifications, shipment schedule, or date of delivery. Any changes agreed upon by the parties shall be evidenced by a Change Order signed by both parties.

SECTION 8: CANCELLATION OR TERMINATION

Buyer shall have the right to cancel the Contract upon 15 days' prior written notice to Seller, and Seller shall stop its performance upon the receipt of such notice except as otherwise agreed with Buyer. If Buyer cancels the Contract, it shall pay: (a) the agreed unit price for equipment or components completed and delivered, (b) additional material and labor costs incurred, and for engineering services supplied by Seller with respect to the canceled items, which shall be charged to Buyer at Seller's rates in effect at the time of cancellation, but which shall not exceed the contract price for such items, and (c) such other costs and expenses, including cancellation charges under subcontracts, as Seller may incur in connection with such cancellation or termination.

SECTION 9: DELIVERY AND DELAYS

Seller shall use its best efforts to meet quoted delivery dates, which are estimated based on conditions known at the time

of quotation. Seller shall not be liable for any nonperformance, loss, damage, or delay due to war, riots, fire, flood, strikes or other labor difficulty, governmental actions, acts of God, acts of the Buyer or its customer, delays in transportation, inability to obtain necessary labor or materials from usual sources, or other causes beyond the reasonable control of Seller. In the event of delay in performance due to any such cause, the date of delivery or time for completion will be extended to reflect the length of time lost by reason of such delay. Seller shall not be liable for any loss or damage to Buyer resulting from any delay in delivery.

SECTION 10: WARRANTY

Seller warrants that the equipment or services supplied will be free from defects in material, and workmanship for a period of 12 months from the date of initial operation of the equipment, or 18 months from the date of shipment, whichever shall first occur. In the case of spare or replacement parts manufactured by Seller, the warranty period shall be for a period of six months from shipment. Repairs shall be warranted for 12 months or, if the repair is performed under this warranty, for the remainder of the original warranty period, whichever is less. Buyer shall report any claimed defect in writing to Seller immediately upon discovery and in any event, within the warranty period. Seller shall, at its sole option, repair the equipment or furnish replacement equipment or parts thereof, at the original delivery point. Seller shall not be liable for costs of removal, reinstallation, or gaining access. If Buyer or others repair, replace, or adjust equipment or parts without Seller's prior written approval, Seller is relieved of any further obligation to Buyer under this section with respect to such equipment or parts. The repair or replacement of the equipment or spare or replacement parts by Seller under this section shall constitute Seller's sole obligation and Buyer's sole and exclusive remedy for all claims of defects. SELLER MAKES NO OTHER WARRANTY OR REPRESENTATION OF ANY KIND WITH RESPECT TO THE EQUIPMENT OR SERVICES OTHER THAN AS SPECIFIED IN THIS SECTION 10. ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY DISCLAIMED.

For purposes of this Section, the equipment warranted shall not include equipment, parts, and work not manufactured or performed by Seller. With respect to such equipment, parts, or work, Seller's only obligation shall be to assign to Buyer any warranty provided to Seller by the manufacturer or supplier providing such equipment, parts or work.

No equipment furnished by Seller shall be deemed to be defective by reason of normal wear and tear, failure to resist erosive or corrosive action of any fluid or gas, Buyer's failure to properly store, install, operate or maintain the equipment in accordance with good industry practices or specific recommendations of Seller, or Buyer's failure to provide complete and accurate information to Seller concerning the operational application of the equipment.

SECTION 11: TECHNICAL DOCUMENTS

Technical documents furnished by Seller to Buyer, such as drawings, descriptions, designs and the like, shall be deemed provided to Buyer on a confidential basis, shall remain Seller's exclusive property, shall not be provided in any way to third parties, and shall only be used by Buyer for purposes of installation, operation and maintenance. Technical documents submitted in connection with a Quotation that does not result in a Purchase Order shall be returned to Seller upon request.

SECTION 12: LIMITATION OF LIABILITY

Seller shall in no event be liable for any consequential, incidental, indirect, special or punitive damages arising out of the Contract, or out of any breach of any of its obligations hereunder, or out of any defect in, or failure of, or malfunction of the equipment, including but not limited to, claims based upon loss of use, lost profits or revenue, interest, lost goodwill, work stoppage, impairment of other equipment, environmental damage, nuclear incident, loss by reason of shutdown or nonoperation, increased expenses of operation, cost of purchase of replacement power or claims of Buyer or customers of Buyer for service interruption whether or not such loss or damage is based on contract, tort (including negligence and strict liability) or otherwise.

Seller's maximum liability under this Contract shall not exceed the Purchase Order amount of the equipment or portion thereof upon which such liability is based. All such liability shall terminate upon the expiration of the warranty period, if not sooner terminated.

SECTION 13: THIS COMPANY IS AN EQUAL OPPORTUNITY EMPLOYER

This agreement incorporates by reference applicable provisions and requirements of Executive Order 11246 and FAR Section 52.222-26 (covering race, color, religion, sex and national origin); the Vietnam Era Veterans Readjustment Assistance Act of 1974 and FAR Section 52.222-35 (covering special disabled and Vietnam era veterans); and the Rehabilitation Act of 1973 and FAR Section 52.222-36 (covering handicapped individuals). By acceptance of this agreement Buyer certifies that it does not and will not maintain any facilities in a segregated manner, or permit its employees to perform their services at any location under its control where segregated facilities are maintained, and further that appropriate physical facilities are maintained for both sexes. Buyer agrees that it will obtain a similar certificate prior to award of any nonexempt lower-tier subcontracts.

SECTION 14: LAW AND ARBITRATION

The Contract shall be governed by the law of the State of Texas. Any disputes arising out of this Contract shall be resolved by informal mediation in any manner that the parties may agree within 45 days of written request for mediation by one party to the other. Any dispute that cannot be resolved through mediation shall be resolved by binding arbitration conducted in English in Portland, Oregon under the Commercial Rules of the American Arbitration Association except as otherwise provided in this Section. The arbitration shall be conducted by three arbitrators chosen in accordance with said Rules. The arbitrators are not entitled to award damages in excess of compensatory damages. Judgment upon the award may be entered in any court having jurisdiction.

Check our worldwide offices at
www.paco-pumps.com

PR AQUA SUBMITTAL SUMMARY SHEET
TO: COMOX VALLEY PROJECT WATERSHED SOCIETY
PROJECT #: 10.PUN.04.
PROJECT SITE: COURTENAY, BC
PROJECT NAME: LOWER PUNTLEDGE HATCHERY CHILLER DESIGN

SUBMITTAL#: 611-2.1_ A

EQUIPMENT NAME: CHILLER

COMPONENT, MODEL, & TAG NO.:

COMPONENT	MODEL	TAG NO.
CHILLER	TI CHAF-14; 20 HP CHILLER AND CONTROLLER	

MANUFACTURER: UNIVERSAL MARINE INDUSTRIES
2790 SUNNYSIDE RD
ANMORE, BC V3H 3C8
CANADA
TEL: 604-469-6427

FEATURES:

- ✓ Titanium for durability.
- ✓ Galvanized outdoor hood for low maintenance.
- ✓ Air cooled.
- ✓ Integral controls.
- ✓ Semi-hermetic compressor.

Product Data	
CHILLER SYSTEM	
Model	Ti-CHAF-14
Dimensions	90" W x 40" L x 75" H
Capacity	20 Hp
Design Flow	150 Gpm
Pressure drop at design flow rate	1 psi
Material of Construction	Titanium (Heat Exchanger)
Inlet/Outlet	4" FL / 4" FL
Electrical	600V; 3 Phase; 60 Hz

Ti-CHAF Industrial Chiller Specifications

20 HP Water Chiller in Operation.

20 HP Water Chiller Mounted on SS Frame.

Ti-CHAF Industrial Chiller Specifications @ 3Ø [1]

Model #	Nominal HP	Amps @ VAC			Nominal Flow Rate US GPM [2]	Ship Wt (lbs)	Dimensions
		208-230Ø	460Ø	575Ø			L" x W" x H"
Ti-CHAF-12	10	43	21	17	75-150	1000	65"x38"x65"
Ti-CHAF-13	15	72	43	27	75-150	1450	89"x34"x68"
Ti-CHAF-14	20	76	39	32	75-150	1650	94"x44"x70"
Ti-CHAF-15	25	103	48	44	75-150	call umi	call umi
Ti-CHAF-16	30	119	57	46	75-150	call umi	call umi
Ti-CHAF-17	40	166	75	68	75-150	call umi	call umi
Ti-CHAF-18	50	185	91	80	75-150 (3)	call umi	call umi
Ti-CHAF-19	60	221	103	91	75-150 (3)	call umi	call umi
Ti-CHAF-20	70	279	124	118	75-150 (3)	call umi	call umi
Ti-CHAF-21	80	320	150	138	75-150 (3)	call umi	call umi

1. Specifications subject to change without notice. Dimensions available on request.
2. Flow rate requirements are relative to water temperature. As a rule, colder water requires higher flow.
3. 50-80 HP units utilize 2 heat exchangers, when plumbed in parallel the flow rate can be doubled .

PR AQUA SUBMITTAL SUMMARY SHEET
TO: COMOX VALLEY PROJECT WATERSHED SOCIETY
PROJECT #: 10.PUN.04.
PROJECT SITE: COURTENAY, BC
PROJECT NAME: LOWER PUNTLEDGE HATCHERY CHILLER DESIGN

SUBMITTAL#: 611-3.0_ A

EQUIPMENT NAME: CO2 STRIPPER

COMPONENT, MODEL, & TAG NO.:

COMPONENT	MODEL	TAG NO.
CO2 STRIPPER	CO2 STRIPPER 300	
BLOWER	FANTECH FR140	

MANUFACTURER: PR AQUA SUPPLIES LTD.
1631 HAROLD ROAD
NANAIMO, BC V9X 1T4
CANADA
TEL: 250-714-0141

CO_2 Stripper 300
Technical Specification

The PR Aqua CO_2 Stripper 300 gas treatment system is designed to deliver maximum value, performance, and security to aquaculture operators. Combining carbon dioxide removal and gas balancing in one rugged, compact unit, the unitized design is cost effective and durable for a long service life.

Features:

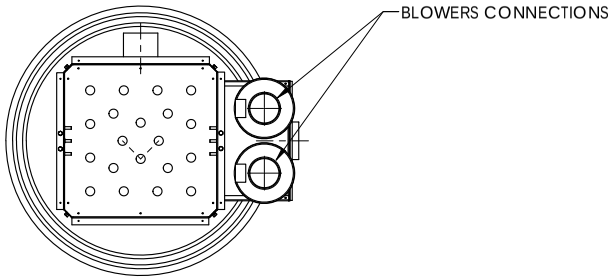
- ✓ Plug & Play design
- ✓ Durable aluminum construction
- ✓ Low head design for minimal energy costs
- ✓ Space-saving tower design
- ✓ Optional components available

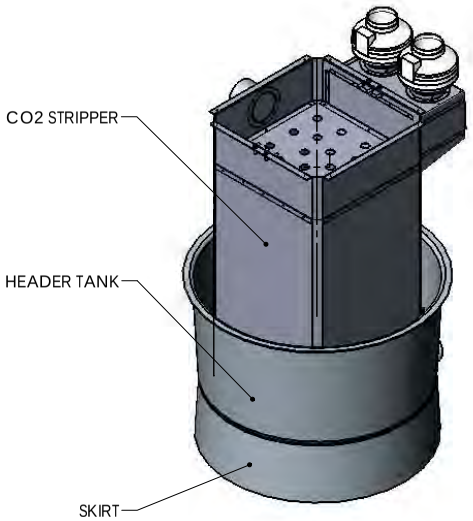
Application Data	
OxyTower System	
Design Flow	Max: 300 Gpm
Components	CO_2 Stripper, Blowers, Header Tank, Stand[1]

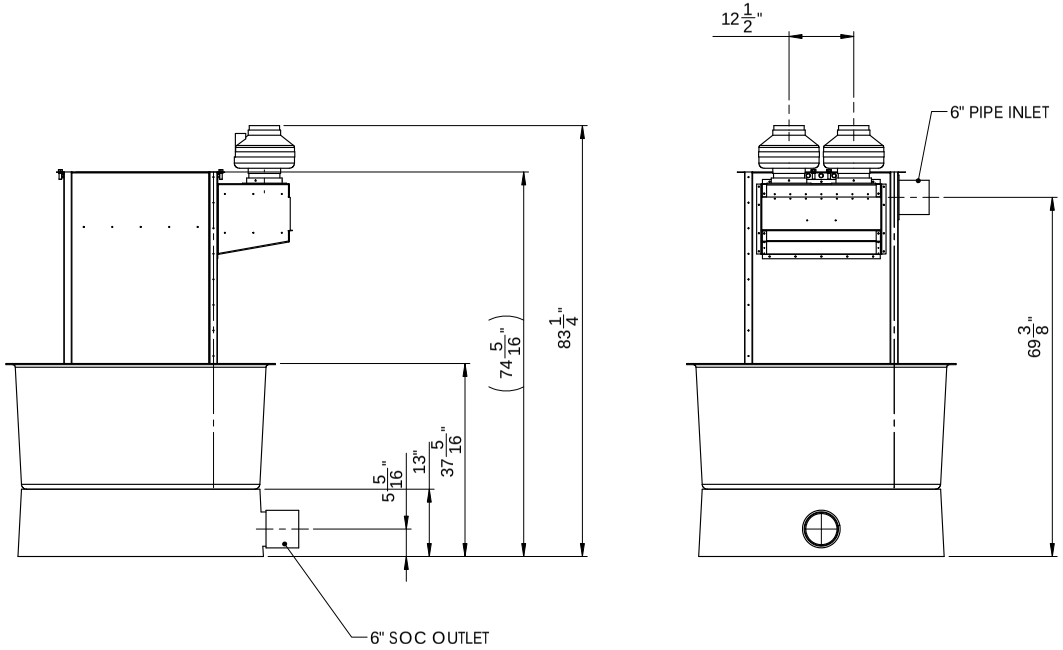
Component Product Data	
CO_2 Stripper	
Materials of Construction	
Body	Marine grade aluminum (5000 series)
Sealant	Urethane caulking
Water Nozzles	$C0_2$ Stripper: PVC or ABS (Crown)
Dimensions/Configuration	31" W x 31" L x 36" H including blower manifold
Inlet	6" diameter pipe gasket
Outlet	Open bottom on vessel discharges to header tank
Hydraulic Loading Rate	Max: 45 Gpm/ft^2 (1,833 Lpm/m^2)
Standing Head on Distribution Plate	6" at maximum flow
Air to Liquid Ratio	Min: 7.5
Design Air Flow	301 scfm
Water Fall Height	4'
Nozzles	Crown, ABS plastic
Media	N/A
Blower	
Model/Quantity	Two (2) Fantech FR140
Materials of Construction	UV protected thermoplastic resin
Inlet/Outlet	6" diameter / 6" diameter duct through backflow prevention damper
Air Flow	Suction through CO_2 Stripper and drift elimination media
Performance	320 scfm at 0.5" static WG (total for two blowers)
Electrical Supply	115V; 1-Phase; 60 Hz; 0.53 A (each)
Header Tank	
Materials of Construction	
Body	One piece contact molded FRP
Stand[1]	Marine grade aluminum (5000 series)
Dimensions/Configuration	Round 48" diameter x 36" high with integrated stand
Plumbing	
Outlet	6" PVC Sch 40 (SOC)
Over Flow	none

Note:
1. Bolt together field assembly

1631 Harold Road • Nanaimo, BC V9X 1T4 • toll-free: 1-866-714-0141 • fax: (250) 714-0171
info@praqua.com • www.praqua.com







FABRICATION FRACTIONAL

TOLERANCES:
± 1/16'
UNLESS OTHERWISE SPECIFIED.
ANGLE
X.X ±0.25°
THIRD ANGLE PROJECTION

DESCRIPTION: *CO2 STRIPPER ASSY*
PROJECT:
DESIGNED:
DRAWN: XX
APPROVED:
MATERIAL: N/A
WEIGHT (LBS): 234.18
FINISH: 0

1631 Harold Road
Nanaimo, BC,
V9X 1T4 / Canada
Ph: (250) 714-0141
Fax:(250) 714-0171
PR Aqua

DATE: 28/10/2010
SCALE: NTS
UNITS: INCHES
PART NUMBER: X011554-01
REV.
SHEET: 1 OF 1

FR Kits

Pictured from left to right: DLX150 – Dual Point Ventilation Kit; REG100L – Single Vent Light Kit. Additional kits (not pictured) are available.

DLX150

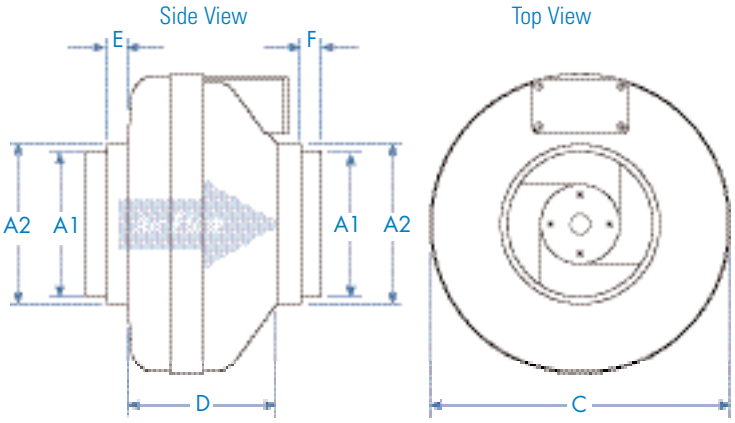
REG100L

Specifications

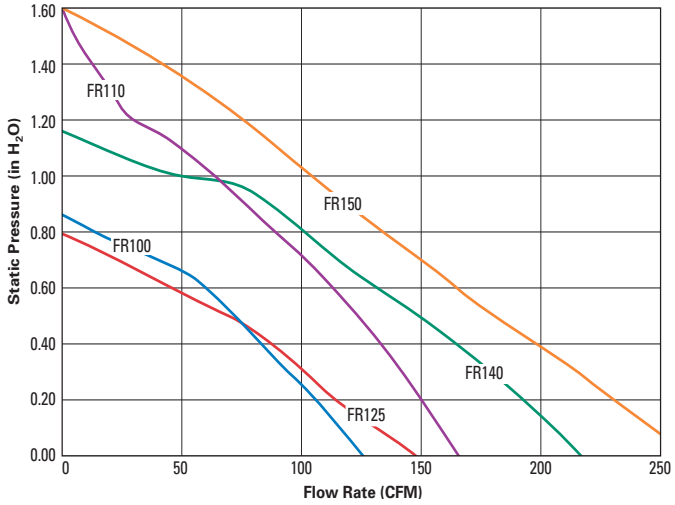
FR Series Dimensional Data

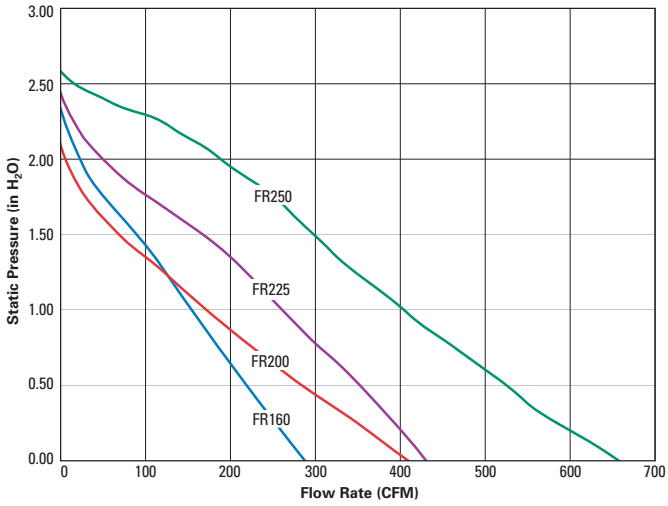
model	†A1	A2	C	D	E	F
FR 100	4	5	9½	6⅛	⅞	⅞
FR 110	4	5	9½	6⅛	⅞	⅞
FR 125	—	5	9½	6⅛	⅞	—
FR 140	6	6¼	11¾	5⅞	1	⅞
FR 150	6	6¼	11¾	5⅞	1	⅞
FR 160	6	6¼	11¾	6⅜	1	⅞
FR 200	8	10	13¼	6¼	1½	1½
FR 225	8	10	13¼	6¼	1½	1½
FR 250	—	10	13¼	6¼	1½	—

All dimensions in inches. † Duct connections are 1/8" smaller than duct size.



FR Series Air Performance Graphs





FR Series Performance Data

Fan Model	Energy Star	RPM	Volts	Rated Watts	Wattage Range	Max. Amps	Static Pressure in Inches W.G							Max. Ps	Duct Dia.
							0″	.2″	.4″	.6″	.8″	1.0″	1.5″		
FR 100	√	2900	115	19	13 – 19	0.18	122	100	78	55	15	—	—	0.87″	4″
FR 110	—	2900	115	80	62 – 80	0.72	167	150	133	113	88	63	4	1.60″	4″
FR 125	√	2950	115	18	15 – 18	0.18	148	120	88	47	—	—	—	0.79″	5″
FR 140	√	2850	115	61	47 – 62	0.53	214	190	162	132	99	46	—	1.15″	6″
FR 150	√	2750	120	71	54 – 72	0.67	263	230	198	167	136	106	17	1.58″	6″
FR 160	—	2750	115	129	103 – 130	1.14	289	260	233	206	179	154	89	2.32″	6″
FR 200	√	2750	115	122	106 – 128	1.11	408	360	308	259	213	173	72	2.14″	8″
FR 225	√	3100	115	137	111 – 152	1.35	429	400	366	332	297	260	168	2.48″	8″
FR 250	—	2850	115	241	146 – 248	2.40	649	600	553	506	454	403	294	2.58″	10″

FR Series performance is shown with ducted outlet. Per HVI's Certified Ratings Program, charted air flow performance has been derated by a factor based on actual test results and the certified rate at .2 inches WG.

Fantech FR Series Fans

Description

A centrifugal type exhaust/supply fan specifically designed for moderate size ventilation applications. The fan can be mounted in any angle at any point along the duct work and straight-through air flow design allows easy installation. By using FC type mounting clamps fan can easily be removed from duct work for service. Fans are constructed in accordance with standard dimensions for spiral duct eliminating the need for transition pieces. Fan motors are capable of operating in air stream temperatures up to 140^0 F. Motor bearings are permanently sealed, self lubricating ball type. All fans are 100% speed controllable through a decrease in the voltage by using a solid state or transformer type control. All FR Series fans are backed by **Fantech's Five Year Warranty.**

Guide Specifications for Model FR Inline Duct Fans

Supply, exhaust or return air inline fans shall be of the centrifugal, direct driven type.

Construction

Housing

- Fan housing shall be constructed of UV resistant ABS-PC blend thermo plastic.
- Fan shall be supplied with an integral external electrical terminal box with pre-wired terminal strip connections.
- Capacitor shall be provided and shall be located within the fan electrical terminal box for easy access.

Motor

- Motorized impeller shall be an external rotor type, class B insulation, totally enclosed PSC Type for maximum efficiency.
- Motor shall be a permanently sealed self lubricating ball bearing type.
- Motor shall be equipped with automatic reset thermal overload protection.
- Motor shall be acceptable for continuous duty.
- Sufficient service factor shall be provided to ensure long maintenance free operation over maximum load conditions.

Wheel

- Fan wheel shall be of the backward inclined centrifugal type with a well designed inlet venturi for maximum performance.
- Motorized impeller shall be both statically and dynamically balanced as one integral unit to provide for vibration free performance.

Performance

- Fan air flow performance shall be certified by HVI and licensed to bear the HVI Tested/Certified Performance Logo.

Code Approval

- Fan shall be tested and approved by UL and CSA (or equal) for safety.

FR Series shall be manufactured under the authority of Fantech, Inc., Sarasota, FL.

Fantech

United States 1712 Northgate Blvd. · Sarasota, FL 34234 · 1.800.747.1762 · www.fantech.net
Canada 50 Kanalflakt Way · Bouctouche, NB E4S 3M5 · 1.800.565.3548 · www.fantech.ca

Article #: 450418
Rev Date: 071007

Fantech

INSTALLATION AND MAINTENANCE INSTRUCTIONS FOR MODEL FR

INSTRUCTIONS POUR L'INSTALLATION ET L'ENTRETIEN DU MODÈLE FR

INSTRUCCIONES DE INSTALACION Y MANTENIMIENTO DEL MODELO FR

IMPORTANT: Read These Instructions Completely Before Installing Fan And Save These Instructions For Future Reference.

Items Included: One FR fan, one mounting bracket, mounting hardware

Regular Kits Also Include: Grill with mounting collar/backdraft damper combination, duct mounting clamps

Deluxe Kits Also Include: 2 Grills with mounting collar/backdraft damper combination, "wye" transition, duct mounting clamps, balancing damper

Additional Items Needed: Duct work, duct tape or mounting clamps, duct termination device (roof cap, louvered shutter, etc.)

Tools Required: Electric drill, drill bits, regular screwdriver, phillips screwdriver, razor knife, keyhole saw (optional)

Installing Mounting Bracket & Fan

1. When selecting fan mounting location, the following criteria should be considered: *a) mounting to minimize noise generated by fan operation; b) service accessibility*
   a) Mounting the fan as far as possible from the intake point will minimize fan operating noise from being transmitted back through the duct work. If the fan is to be used as a booster for moving the air between two rooms, a central point along the duct may be optimal. Insulated flexible type duct work (recommended for all bathroom exhaust applications) will result in much quieter operation. Fantech recommends minimum 8' of insulated flexible duct between any exhaust grill and fan for low noise level.
   b) Fan location should allow sufficient access for service.
2. Using the wood screws provided, attach the mounting bracket (NB or MB) to a support beam at the selected location. Fan mounting can be at any point along the duct and in any angle, however, vertical mounting is recommended to reduce condensation buildup in the fan. If a horizontal installation is necessary and condensation buildup may pose a problem, either wrap insulation around the fan or drill a ¼″ hole in the bottom of the housing (along with an NPT insert [by others] and drain tubing) allowing condensation to drain.
3. Attach fan to the mounting bracket with the sheet metal screws provided. Wiring box should be positioned for easy access. Bracket is provided with rubber vibration isolation grommets to prevent the transmission of sound through the structure. Be careful not to overtighten. Also, care should be taken not to strip the plastic housing. Screws are self tapping and do not require pilot holes. However, pilot holes (no larger than 3⁄32″) are recommended.
4. Connect duct work to inlet and outlet of fan using CB clamps or duct tape. When using insulated duct, it is recommended that the inner vinyl core be clamped or taped to the inlet and outlet and that the vapor barrier surrounding the insulation be duct taped to the fan housing.

   NOTE: Steps 2 & 3 may be reversed.

Mount Bracket (NB).

Mount Fan.

Mount Bracket (MB).

Mount Fan.

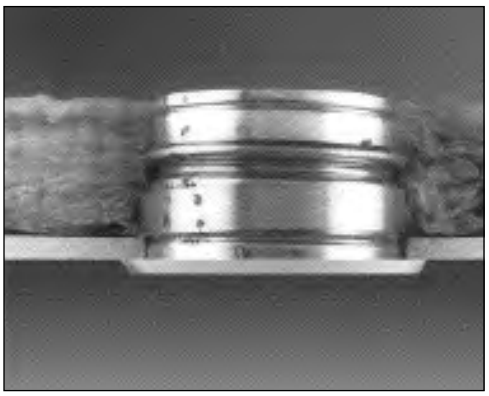
Installing DG Supply/Exhaust Grill

If a Vent/Light combination kit is purchased, the VLC vent/lights are supplied with a separate installation instruction replacing steps 1 through 4.

1. Select the grill mounting point within the area to be ventilated. To ease installation, locations of framing beams within the walls or joists supporting the ceiling should be considered. Collar/damper is provided with a perforated hanging strap for attachment directly to a beam or joist. Allow sufficient space between the collar/damper and the beam to attach the duct work. If the location of the grill does not allow direct attachment, a cross-member mounted to the framing should be used.
2. Place the mounting collar/damper in the selected location and trace a circle onto the surface. From the interior side of the room, cut through the surface. Please note: In order to assure a smoother finish when mounting through a sheetrock or tile type ceiling, it is recommended that a razor knife be used to make the cut.
3. From within the attic or crawl space, place the mounting collar into the hole until the edge of the collar is flush with the interior wall or ceiling surface. Attach collar to the support beam with the 2" wood screws provided. Attach duct work. Secure using CB or FC clamps and/or duct tape. When installing the damper into rigid type ducting, FC clamps or duct tape should be used.

   PLEASE NOTE: *When attaching flex duct to the collar/damper combination and an immediate elbow is necessary, be certain that the elbow is installed with a "soft" bend to allow damper blades to operate properly.*
4. Snap the grill into the mounting collar/damper. Grill should be pushed tightly into place for an airtight fit. If there is a gap between the collar and the ceiling it should be caulked to avoid air leakage. For subsequent cleaning the grill can be pulled out and cleaned.

Mount Collar



Side view grill and collar.

Installing DG Supply/Exhaust Grill

When installing a DLX kit, a balancing damper has been included to allow for adjustment of the system. The damper may be used where the grills will be connected using branches of unequal length or where the flow will need to be balanced for any reason.

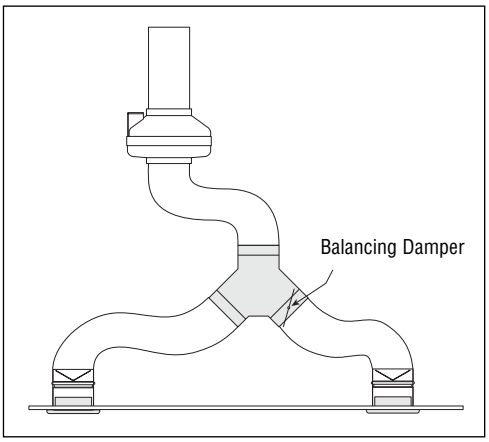
To Install The Damper:

1. The Damper must be installed on the branch with the least restriction. This is generally the duct that is shortest or has the fewest bends.
2. Drill a 5⁄16″ hole approximately 1½″ from the edge on the flat side of the wye.
3. Place the washer over the threaded shaft on the damper.
4. Insert the damper, shaft first, into the hole just drilled.
5. Attach the handle using the wing nut.
6. Adjust the damper to balance airflow and tighten the wing nut to secure.

Flexible Duct Installation Hints

Flexible insulated duct is strongly recommended where allowed by local code for bathroom exhaust applications, where ducting passes through unconditioned space or where noise is a factor. Failure to use insulation could result in excessive condensation buildup within the duct, and undesirable sound levels within the room. For the quietest possible installations, Fantech recommends a minimum of 8' of insulated flexduct between any exhaust grill and fan. When using flexible type duct work, duct should be stretched as tight and straight as possible. Failure to do so could result in dramatic loss of system performance. Flexible duct should be connected to the fan with CB type clamps or duct tape. All connections should be as airtight as possible to maximize system performance.

Wye with balancing damper.



FR Series Fan and balancing damper.

Warning

DO NOT CONNECT POWER SUPPLY until fan is completely installed. Make sure electrical service to the fan is locked in “OFF” position

1. All units are suitable for use with solid-state speed control.
2. This unit has rotating parts and safety precautions should be exercised during installation, operation and maintenance.
3. **CAUTION**: “For General Ventilation Use Only. Do Not Use To Exhaust Hazardous Or Explosive Materials And Vapors.”
4. **WARNING: To reduce the risk of fire, electrical shock, or injury to persons-observe the following:**
   a. Use this unit only in the manner intended by the manufacturer. If you have questions, contact the factory.
   b. Before servicing or cleaning, switch power off at service panel and lock service panel to prevent fan from being switched on accidentally.
   c. Installation work and electrical wiring must be done by qualified person(s) in accordance with all applicable codes and standards, including fire-rated construction.
   d. The combustion airflow needed for safe operation of fuel burning equipment may be affected by this unit's operation. Follow the heating equipment manufacturer's guidelines and safety standards such as those published by the National Fire Protection Association (NFPA), the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) and the local code authorities.
   e. When cutting or drilling into wall or ceiling, do not damage electrical wires or other hidden utilities.
   f. Exhaust fans must always be vented to the outdoors.
   g. Install fan at least five feet above the floor.
   h. Acceptable for use over a bathtub or shower.
   i. NEVER place a switch where it can be reached from a tub or shower.
5. **WARNING!** Check voltage at the fan to see if it corresponds to the motor nameplate.

GUARDS MUST BE INSTALLED WHEN FAN IS WITHIN REACH OF PERSONNEL OR WITHIN SEVEN (7) FEET OF WORKING LEVEL OR WHEN DEEMED ADVISABLE FOR SAFETY.

Liquid tight wiring – Top View
(For outside applications).

Romex wiring – Top View

Electrical Connection

1. Remove the screws securing the terminal box cover plate located on the side of the fan. All fan motor connections are pre-wired to an electrical terminal strip. A ⅜” romex type cable restraint connector will be needed to secure the wiring through the knockout provided on the side of the terminal box.
2. Bring incoming electrical service through the romex connector and the fan knockout. Be sure to place the connector nut over the wiring coming into the terminal box. There are two open ports on the terminal strip. Using a small regular screwdriver, tighten the neutral (white) wire of the incoming supply under the open terminal strip port labeled "N". Tighten the line (black) wire of the incoming supply under the open terminal strip port labeled "L". Since the fan motor is isolated within a plastic housing, grounding is not necessary.
3. Secure the romex connector. Secure the incoming supply with the romex connector. Replace the fan terminal box cover. All fan motor and capacitor connections have been pre-wired from the factory. No additional fan wiring is necessary.

Troubleshooting

If fan fails to operate, please check the following:

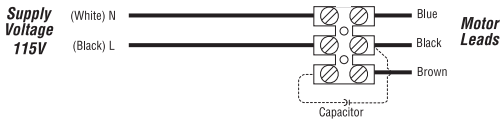
1. Consult wiring diagrams (see below) to assure proper connection.
2. Check motor lead wiring, capacitor leads and incoming supply leads to assure definite contact.
3. If possible, use a meter to test for continuity across the fan motor leads. In order to do this, the capacitor must be disconnected (do not test the capacitor - it will not meter continuity). If motor leads show continuity, consult factory for a replacement capacitor.

Maintenance Instructions

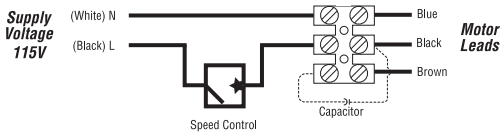
Since fan bearings are sealed and provided with an internal lubricating material, no additional lubrication is necessary.

Wiring Diagrams

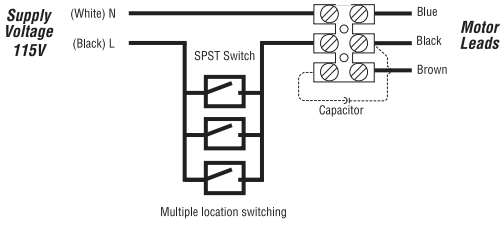
All Models
Without Motor Speed Controller



With Motor Speed Controller



Multiple Location Switching Wiring Diagram



Five (5) Year Warranty

This warranty supersedes all prior warranties

For factory return you must:

1) Have a return materials authorization (RMA) number. This number may be obtained by calling FANTECH, INC. at 1-800-747-1762. Please have bill of sale available.
2) The RMA number must be clearly displayed on the outside of the carton, or delivery will be refused.
3) All product being returned must be shipped prepaid and be accompanied with a copy of the bill of sale.
4) Product will be replaced/repaired and shipped back to buyer. No credits will be issued.

During the First Thirty (30) Days:

FANTECH, INC will repair or replace any part which has a factory defect in workmanship or material. Product may need to be returned to the FANTECH factory, together with a copy of the bill of sale and identified with RMA number.

During The First Three (3) Years

FANTECH, INC. will replace any product which has a factory defect in workmanship or material. Product must be returned to the FANTECH factory, together with bill of sale, and identified with an RMA number.

During Years Four (4) And Five (5):

FANTECH, INC. will repair or replace any product which has a factory defect in workmanship or material. Product must be returned to the FANTECH factory, together with a bill of sale, and identified with an RMA number.

The following warranties do not apply:

Damages from shipping, either concealed or visible. Claim must be filed with the carrier.

Damages resulting from improper wiring or installation.

Damages caused by acts of nature, or resulting from improper consumer procedures such as:

Improper maintenance,

Misuse, abuse, abnormal use, or accident, or

Incorrect electrical voltage or current.

Removal or alteration made on the FANTECH label control number or date of manufacture.

Any other warranty, expressed, written or implied, and to any consequential or incidental damages, loss of property, revenues, or profit, or costs of removal, installation or reinstallation, for any breach of warranty.

Warranty validation:

The end user must keep a copy of the bill of sale to verify purchase date.

Fantech

United States
1712 Northgate Blvd.,
Sarasota, FL. 34234
Phone: 800.747.1762; 941.309.6000
Fax: 800.487.9915; 941.309.6099
www.fantech.net; info@fantech.net

Canada
50 Kanalflakt Way,
Bouctouche, NB E4S 3M5
Phone: 800.565.3548; 506.743.9500
Fax: 877.747.8116; 506.743.9600
www.fantech.ca; info@fantech.ca

Article #: 301078
Item #: 401444
Rev Date: 012605

PR AQUA SUBMITTAL SUMMARY SHEET
TO: COMOX VALLEY PROJECT WATERSHED SOCIETY
PROJECT #: 10.PUN.04.
PROJECT SITE: COURTENAY, BC
PROJECT NAME: LOWER PUNTLEDGE HATCHERY CHILLER DESIGN

SUBMITTAL#: 611-5.0_ A

EQUIPMENT NAME: CONTROLLER

COMPONENT, MODEL, & TAG NO.:

COMPONENT	MODEL	TAG NO.
CONTROLLER	GF SIGNET 8900 SERIES MULTIPARAMETER CONTROLLER	
FLOW METER 1	GF SIGNET 515 FLOW SENSOR AND FITTING	
FLOW METER 2	GF SIGNET 2536 FLOW SENSOR AND FITTING	
TEMPERATURE SENSOR	GF SIGNET 2350-1 TEMPERATURE SENSOR	

MANUFACTURER: PR AQUA SUPPLIES LTD.
1631 HAROLD ROAD
NANAIMO, BC V9X 1T4
CANADA
TEL: 250-714-0141

SIGNET 8900 SERIES MULTI-PARAMETER CONTROLLER

Images shown are representative of the product family.Materials, sizes, and configurations may vary.

NEW!

FEATURES
• Measures flow, pH, ORP, conductivity, pressure, level and temperature.
• Accepts 4 to 20mA output devices when used with 8058 signal converter.
• Multi-language display.
• 1/4 DIN enclosure.
• Up to six input channels.
• Up to 4 analog inputs.
• Up to 8 relays.
• 12 to 24 VDC or 85 to 264 VAC power.
• Digital communication for improved noise tolerance, extended cable lengths, and easy wiring.
• Two BTU calculations.
• CE rating for heavy industry.

APPLICATIONS
• RO/DI system control.
• Media filtration.
• Pure water production.
• Demineralizers.
• Chemical processing.
• Metal and plastics finishing.
• Fume scrubbers.
• Proportional chemical addition.
• Cooling tower and boiler protection.
• Wastewater treatment.
• Aquatic animal life support systems.

ACCESSORY ITEMS
• Vacuum fluorescent display.
• Various plug-in modules.
• Power supply.

SPECIFICATIONS
• Modular configurability (completely field-
• commissionable).
• 2, 4 or 6 input channels.
• Input signal types: S3L™ (serial ASCII, TTL level 9600 bps). Frequency: 0 to 1500 Hz; Accuracy: 0.5% of reading.
• Number of relays supported: Available in pairs (0, 2, 4, 6 or 8 dry-contact or solid state).
• Number of analog outputs: Available in pairs (0, 2 or 4 active and/or passive 4 to 20 mA; and/or 0 to 5/10 VDC).
• Enclosure rating: NEMA 4X/IP65 (front face).
• Keypad: 4-buttons, highly tactile and audible, injection-molded silicone rubber seal.
• Display: Alphanumeric 2 x 16 back-lit LCD or vacuum fluorescent (VF) versions. 1 sec. update.
• Power requirements: Universal AC - 85 to 264 VAC, 50-60 Hz, 24 VA max. DC - 9.9 to 26.4 VDC unregulated, 0.7A max.
• Output power to sensors: 5 VDC up to 40 mA total.
• Terminal type: screw-clamp, removable.
• Ambient operating temperature: Back-lit LCD - 14Þ to 131ÞF; VF display - 14Þ to 122ÞF.
• Relative humidity: 0 to 95%, non-condensing.
• Maximum altitude: 6560 feet.

Signet 515 Rotor-X Paddlewheel Flow Sensors

Standard Sensor (with red cap)

Integral Sensor

Wet-Tap Sensor

Features

- **Operating range 0.3 to 6 m/s (1 to 20 ft/s)**
- **Wide turndown ratio of 20:1**
- **Highly repeatable output**
- **Simple, economical design**
- **Installs into pipe sizes DN15 to DN900 (½ to 36 in.)**
- **Self-powered/no external power required**
- **Test certificate included for -X0, -X1**
- **Chemically resistant materials**

Description

Simple to install with time-honored reliable performance, Signet 515 Rotor-X Paddlewheel Flow Sensors are highly repeatable, rugged sensors that offer exceptional value with little or no maintenance. The output signal of the Model 515 is a sinusoidal frequency capable of driving a self-powered flowmeter (Model 3-5090). The wide dynamic flow range of 0.3 to 6 m/s (1 to 20 ft/s) allows the sensor to measure liquid flow rates in full pipes and can be used in low pressure systems.

The Model 515 sensors are offered in a variety of materials for a wide range of pipe sizes and insertion configurations. The many material choices including PP and PVDF make this model highly versatile and chemically compatible to many liquid process solutions. Sensors can be installed in up to DN900 (36 in.) pipes using Signet's comprehensive line of custom fittings. These custom fittings, which include tees, saddles, and weldolets, seat the sensor to the proper insertion depth into the process flow. The sensors are also offered in configurations for wet-tap and intrinsically safe installation requirements.

Applications

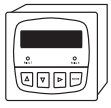
- **Pure Water Production**
- **Filtration Systems**
- **Chemical Production**
- **Liquid Delivery Systems**
- **Pump Protection**
- **Scrubber Systems**
- **Water Monitoring**
- **Not suitable for gases**

System Overview (For overview of Wet-Tap System, see 3519 product page)

Panel Mount

Signet Flow Instrument (sold separately)

5075 8150
5090 8550
5500 8900
5600



Pipe, Tank, Wall Mount

Signet Flow Instrument (sold separately)

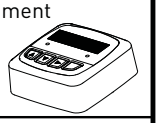
8150 8550

Signet Universal Adapter Kit (3-8050) (sold separately)

Integral Mount

Signet Flow Instrument (sold separately)

8150 8550



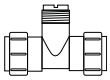
Signet Integral Adapter Kit (3-8051) (sold separately)

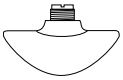
Signet Model 515 Standard or Wet-Tap (not shown) Flow Sensor

Signet Model 515 Standard or Wet-Tap (not shown) Flow Sensor

Signet Model 515 Integral Mount Flow Sensor

Signet Fittings* (sold separately)

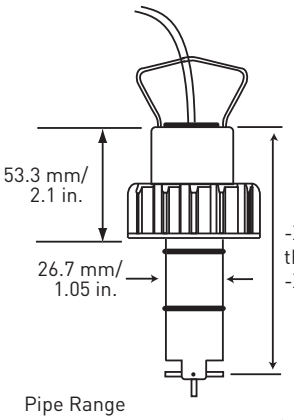




* See Fittings section for more information.

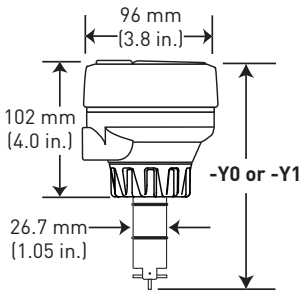
Dimensions

515 Standard Mount Sensor



Pipe Range
½ to 4 in.: **-X0** = 104 mm (4.1 in.)
5 to 8 in.: **-X1** = 137 mm (5.4 in.)
10 in. and up: **-X2** = 213 mm (8.4 in.)

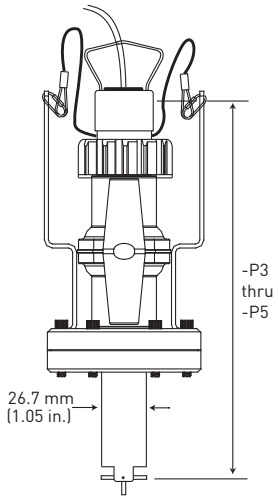
515 Integral Mount Sensor shown with Transmitter (sold separately)



Pipe Range
0.5 to 4 in. **-Y0** = 152mm (6.0 in.)
5 to 8 in. **-Y1** = 185mm (7.3 in.)

515 Wet-Tap Mount Sensor with 3519 Wet-Tap Valve

See more information on the 3519 Wet-Tap Valve, refer to the 3519 product page.



Pipe Range
½ to 4 in. **-P3** = 297 mm (11.7 in.)
5 to 8 in. **-P4** = 333 mm (13.1 in.)
10 in. and up **-P5** = 409 mm (16.1 in.)

Specifications

General

Operating Range:
0.3 to 6 m/s (1 to 20 ft/s)
Pipe Size Range:
DN15 to DN900 (½ to 36 in.)
Linearity:
±1% of max. range @ 25 °C (77 °F)
Repeatability:
±0.5% of max. range @ 25 °C (77 °F)
Min. Reynolds Number Required: 4500

Wetted Materials

- Sensor Body:
  Glass-filled PP (black) or PVDF (natural)
- O-rings:
  FPM (std)
  optional EPR (EPDM) or FFPM
- Rotor Pin:
  Titanium, Hastelloy-C or PVDF; optional Ceramic, Tantalum, or Stainless Steel
- Rotor:
  Black PVDF or Natural PVDF; optional Tefzel®, with or without Fluoroloy G® sleeve

Electrical

Frequency:
19.7 Hz per m/s nominal
(6 Hz per ft/s); sinusoidal
Amplitude:
3.3 V p/p per m/s nominal
(1 V p/p per ft/s)
Source Impedance: 8 KΩ
Cable Type:
2-conductor twisted pair with shield, 22 AWG
Cable Length:
7.6 m (25 ft) can be extended up to 60 m (200 ft) maximum

Max. Temperature/Pressure Rating Standard and Integral Sensor

- PP: 12.5 bar @ 20 °C,
  1.7 bar @ 90 °C
  (180 psi @ 68 °F, 25 psi @ 194 °F)
- PVDF: 14 bar @ 20 °C,
  1.4 bar @ 100 °C
  (200 psi @ 68 °F, 20 psi @ 212 °F)

Operating Temperature:

- PP: -18 °C to 90 °C (0°F to 194 °F)
- PVDF: -18 °C to 100 °C (0 °F to 212 °F)

Wet-Tap Sensor

- PP: 7 bar @ 20 °C, 1.4 bar @ 66 °C
  (100 psi @ 68 °F, 20 psi @ 150 °F)

Operating temperature:
-18 °C to 66 °C (0 °F to 150 °F)
Max. wet-tap sensor removal rating:
1.7 bar @ 22 °C (25 psi @ 72 °F)

See Temperature and Pressure Graphs for more information.

Shipping Weight

P51530-X0	0.454 kg	1.00 lb
P51530-X1	0.476 kg	1.04 lb
P51530-X2	0.680 kg	1.50 lb
P51530-X3	0.794 kg	1.75 lb
P51530-X4	0.850 kg	1.87 lb
P51530-X5	1 kg	2.20 lb
3-8510-X0	0.23 kg	.50 lb
3-8510-X1	0.23 kg	.50 lb

Standards and Approvals

- FM Class I, II, III/Div. 1/groups A-G
- RoHS compliant
- Manufactured under ISO 9001 for Quality and ISO 14001 for Environmental Management

Application Tips:

- Use the Conduit Adapter Kit to protect the cable-to-sensor connection when used in outdoor environments. See Accessories section for more information.
- Use a sleeved rotor in abrasive liquids to reduce wear.
- Sensor plug can be used to plug installation fitting after extraction of sensor from pipe.
- For liquids containing ferrous particles, use Signet Magmeters.
- For systems with components of more than one material, the maximum temperature/pressure specification must always be referenced to the component with the lowest rating.

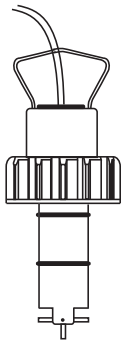
Please refer to Wiring, Installation, Accessories and Fittings sections for more information.

Ordering Information

Model 515 Standard Mount Paddlewheel

When choosing this style of sensor, the instrument can be mounted nearby on a pipe or wall or in a remote location up to 60 m/200 ft (standard cable length is 7.6 m/25 ft) by connecting the sensor through a standard 3-8050-1 universal junction box. Use Signet fittings for proper seating of the sensor into the process flow.

Model 515 Standard Paddlewheel Flow Sensor



Sensor Part Number			
P51530	Flow Sensor for use with remote mount instrument		
	Body/Rotor/Pin Material-Choose One*		
	- H	Polypropylene/Black PVDF/Hastelloy-C	
	- P	Polypropylene/Black PVDF/Titanium	
	- S	Polypropylene/Black PVDF/Natural PVDF	
	- T	Natural PVDF/Natural PVDF/Natural PVDF	
	- V	Natural PVDF/Natural PVDF/Hastelloy-C	
		Pipe Size - Choose One	
		0	½ to 4 in.
		1	5 to 8 in.
		2	10 to 36 in.
P51530	**- P**	**0**	**Example Part Number**

Mfr. Part No.*	Code
P51530-H0	**198 801 659**
P51530-P0	**198 801 620**
P51530-P1	**198 801 621**
P51530-P2	**198 801 622**
P51530-S0	**198 801 661**

Mfr. Part No.*	Code
P51530-T0	**198 801 663**
P51530-T1	**198 801 664**
P51530-V0	**198 801 623**
P51530-V1	**198 801 624**
P51530-V2	**198 801 625**

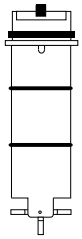
***Model 515 Ordering Notes**

1) Most common part number combinations shown. For all other combinations contact factory.
2) Other rotor and pin materials are available for purchase from the factory and can be easily replaced in the field. See Accessories section.

Model 515 Integral Mount Paddlewheel

When choosing this style of sensor, the instrument is mounted directly onto the sensor for a local display. See Guideline below for instructions.

Model 515 Integral Mount Paddlewheel Flow Sensor



Sensor Part Number			
3-8510	Flow Sensor for integral mounting on the 8150 or 8550 instrument using the 3-8051 adapter (instrument and adapter sold separately)		
	Body/Rotor/Pin Material-Choose One*		
	- P	Polypropylene/Black PVDF/Titanium	
	- T	Natural PVDF/Natural PVDF/Natural PVDF**	
	- V	Natural PVDF/Natural PVDF/Hastelloy-C**	
		Pipe Size - Choose One	
		0	½ to 4 in.
		1	5 to 8 in. (PP only)
3-8510	**- P**	**0**	**Example Part Number**

**PVDF available ½ in. to 4 in. only

Mfr. Part No.*	Code
3-8510-P0	**198 864 504**
3-8510-P1	**198 864 505**

Mfr. Part No.*	Code
3-8510-T0	**159 000 622**
3-8510-V0	**198 864 506**

Guideline: Combining a 515 Integral mount flow sensor with an integrally mounted instrument

Option 1

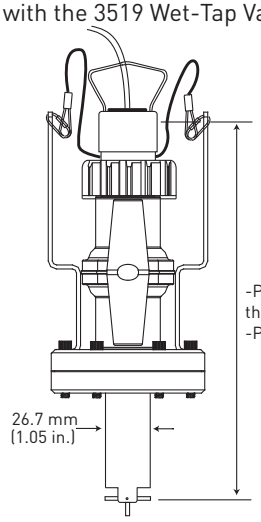
Once an integral mount sensor is chosen, it can be mounted directly to a field mount transmitter by following these guidelines:

a) Order the integral adapter kit 3-8051 (sold separately) to connect the sensor to an instrument.
b) Order a field mount transmitter (sold separately). The following part numbers are compatible: 3-8550-1, 3-8550-2, 3-8550-3, 3-8150-1.
c) Assembling the sensor with the integral adapter and instrument is quick and simple.

Option 2

These parts can also be ordered as an assembled part. See page 74 "Integral Mount" for more information.

Signet 515 Wet-Tap Sensor with the 3519 Wet-Tap Valve

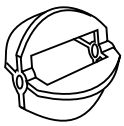


Pipe Range
½ to 4 in. **-P3** = 297 mm (11.7 in.)
5 to 8 in. **-P4** = 333 mm (13.1 in.)
10 in. and up **-P5** = 409 mm (16.1 in.)

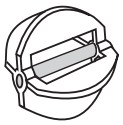
***Model 515 Ordering Notes**

1) Other rotor and pin materials are available for purchase from the factory and can be easily replaced in the field. See Accessories section.

Rotor

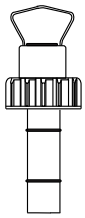


Rotor Pin

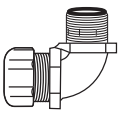


Sensor Cap

Sensor Plug



Conduit Adapter Kit



Ordering Information (continued)

Model 515 Wet-Tap Mount Paddlewheel Flow Sensor

When choosing this style of sensor, the instrument can be mounted nearby on a pipe or wall or in a remote location up to 60 m (200 ft) by connecting the sensor through a standard 3-8050-1 universal junction box. Standard cable length is 7.6 m (25 ft). This style of sensor uses the 3519 Wet-Tap valve only (see individual product page for more information).

Sensor Part Number			
P51530	Flow Sensor for wet-tap mounting with the 3519 Wet-Tap Valve (sold separately)		
	Body/Rotor/Pin Material*		
	- P	Polypropylene/Black PVDF/Titanium	
		Pipe Size - Choose One	
		3	½ to 4 in.
		4	5 to 8 in.
		5	10 to 36 in.
		↓	
P51530	**- P**	**3**	**Example Part Number**

Mfr. Part No.*	**Code**
P51530-P3	**198 840 310**
P51530-P4	**198 840 311**
P51530-P5	**198 840 312**

Guideline: Combining a 515 Wet-Tap Sensor with a 3519 Wet-Tap Valve

a) Sensor can be mounted in a 3519 Wet-Tap Valve (sold separately)
b) Assembling a sensor with a 3519 Wet-Tap valve is quick and simple. These parts can also be ordered as complete assemblies. See 3519 product page.

Accessories and Replacement Parts

Mfr. Part No.	**Code**	**Description**
Rotors		
M1538-2	**198 801 181**	Rotor, PVDF Black
P51547-3	**159 000 474**	Rotor, PVDF Natural
M1538-4	**198 820 018**	Rotor, Tefzel®
P51550-3	**198 820 043**	Rotor and pin (matched set), PVDF Natural
3-0515.322-1	**198 820 059**	Sleeved rotor, PVDF Black
3-0515.322-2	**198 820 060**	Sleeved rotor, PVDF Natural
3-0515.322-3	**198 820 017**	Sleeved rotor, Tefzel®
Rotor Pins		
M1546-1	**198 801 182**	Pin, Titanium
M1546-2	**198 801 183**	Pin, Hastelloy-C
M1546-3	**198 820 014**	Pin, Tantalum
M1546-4	**198 820 015**	Pin, Stainless Steel
P51550-3	**198 820 043**	Rotor and pin, PVDF Natural
P51545	**198 820 016**	Pin, Ceramic
O-Rings		
1220-0021	**198 801 186**	O-ring, FPM (2 required per sensor)
1224-0021	**198 820 006**	O-ring, EPR (EPDM) (2 required per sensor)
1228-0021	**198 820 007**	O-ring, FFPM (2 required per sensor)
Miscellaneous		
P31536	**198 840 201**	Sensor plug, Polypropylene
P31542	**198 801 630**	Sensor cap, Red
P31934	**159 000 466**	Conduit cap
P51589	**159 000 476**	Conduit adapter kit
5523-0222	**159 000 392**	Cable (per foot), 2 cond. w/shield, 22 AWG
3-8051	**159 000 187**	Transmitter integral adapter (for use with 8510 and 8512) (see system overview for graphics)
6400-9001	**159 001 466**	Intrinsic safety barriers (2 required)
3-8051-1	**159 000 753**	Universal junction box

3-0515.099 Rev A (01/10)

3401 Aerojet Avenue, El Monte, CA 91731-2882 U.S.A. • Tel. (626) 571-2770 • Fax (626) 573-2057 • www.gfsignet.com • e-mail: signet.ps@georgfischer.com

Signet 2536 Rotor-X Paddlewheel Flow Sensors

Standard Sensor (with blue cap)

Integral Sensor

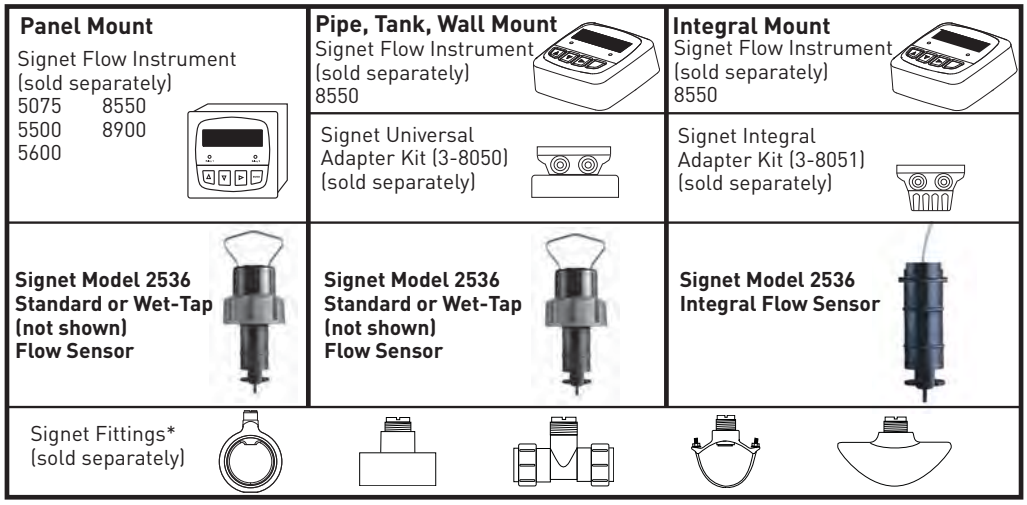
Wet-Tap Sensor

Description

Simple to install with time-honored reliable performance, Signet 2536 Rotor-X Paddlewheel Flow Sensors are highly repeatable, rugged sensors that offer exceptional value with little or no maintenance. The Model 2536 has a process-ready open collector signal with a wide dynamic flow range of 0.1 to 6 m/s (0.3 to 20 ft/s). The sensor measures liquid flow rates in full pipes and can be used in low pressure systems.

The Signet 2536 sensors are offered in a variety of materials for a wide range of pipe sizes and insertion configurations. The many material choices including PP and PVDF make this model highly versatile and chemically compatible to many liquid process solutions. Sensors can be installed in DN15 to DN900 (½ to 36 in.) pipes using Signet's comprehensive line of custom fittings. These custom fittings, which include tees, saddles, and weldolets, seat the sensor to the proper insertion depth into the process flow. The sensors are also offered in configurations for wet-tap installation requirements.

System Overview (For overview of Wet-Tap System, see 3519 product page)



*See Fittings section for more information.

Features

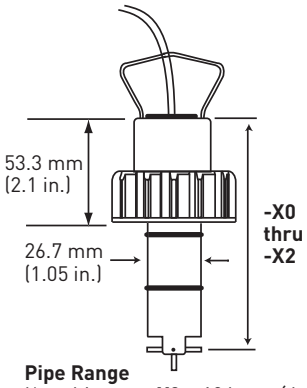
- **Operating range 0.1 to 6 m/s (0.3 to 20 ft/s)**
- **Wide turndown ratio of 66:1**
- **Open-collector output**
- **Simple, economical design**
- **Highly repeatable output**
- **Installs into pipe sizes DN15 to DN900 (½ to 36 in.)**
- **High resolution and noise immunity**
- **Test certificate included for -X0, -X1**
- **Chemically resistant materials**

Applications

- **Pure Water Production**
- **Filtration Systems**
- **Chemical Production**
- **Liquid Delivery Systems**
- **Pump Protection**
- **Scrubbers/Gas stacks**
- **Gravity Feed Lines**
- **Not suitable for gases**

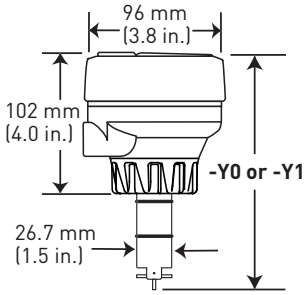
Dimensions

2536 Standard Mount Sensor



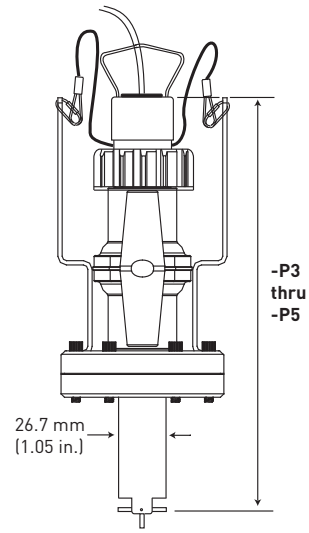
Pipe Range
½ to 4 in. **-X0** = 104 mm (4.1 in)
5 to 8 in. **-X1** = 137 mm (5.4 in.)
10 in. and up **-X2** = 213 mm (8.4 in.)

2536 Integral Mount Sensor shown with Transmitter (sold separately)



Pipe Range
½ to 4 in. **-Y0** = 152 mm (6.0 in.)
5 to 8 in. **-Y1** = 185 mm (7.3 in.)

2536 Wet-Tap Mount Sensor with 3519 Wet-Tap Valve
See 3519 product page for more information.



Pipe Range
½ to 4 in. **-P3** = 297mm (11.7 in.)
5 to 8 in. **-P4** = 333mm (13.1 in.)
10 in. and up **-P5** = 409mm (16.1 in.)

Specifications

General
Operating Range:
0.1 to 6 m/s (0.3 to 20 ft/s)
Pipe Size Range:
DN15 to DN900 (½ to 36 in.)
Linearity:
±1% of max. range @ 25 °C (77 °F)
Repeatability:
±0.5% of max. range @ 25 °C (77 °F)
Min. Reynolds Number Required: 4500

Wetted Materials
Sensor Body:
Glass-filled PP (black) or PVDF (natural)
O-rings:
FPM (std)
optional EPR (EPDM) or FFPM
Rotor Pin:
Titanium, Hastelloy-C or PVDF; optional Ceramic, Tantalum or Stainless Steel
Rotor:
Black PVDF or Natural PVDF; optional Tefzel®, with or w/o Fluoroloy G® sleeve for rotor pin

Electrical
Frequency: 49 Hz per m/s nominal (15 Hz per ft/s nominal)
Supply Voltage: 5 to 24 VDC ±10%, regulated
Supply Current: <1.5 mA @ 3.3 to 6 VDC
<20 mA @ 6 to 24 VDC
Output Type:
Open collector, sinking 10 mA max.
Cable Type:
2-conductor twisted pair with shield 22 AWG
Cable Length:
7.6 m (25 ft) can be extended up to 305 m (1,000 ft) maximum

Max. Temperature/Pressure Rating
Standard and Integral Sensor
- PP: 12.5 bar @ 20 °C, 1.7 bar @ 85 °C (180 psi @ 68 °F, 25 psi @185°F)
- PVDF: 14 bar @ 20 °C, 1.7 bar @ 85 °C (200 psi @ 68 °F, 25 psi @ 185 °F)

Operating Temperature:
- PP: -18 °C to 85 °C (0 °F to 185 °F)
- PVDF: -18 °C to 85 °C (0 °F to 185 °F)

Wet-Tap Sensor
PP: 7 bar @ 20 °C, 1.4 bar @ 66 °C (100 psi @ 68 °F, 20 psi @ 150 °F)
Operating Temperature:
-18 °C to 66 °C (0 °F to 150 °F)
Max. Wet-Tap Sensor Removal Rating:
1.7 bar @ 22 °C (25 psi @ 72 °F)

See Temperature and Pressure graphs for more information.

Shipping Weight

3-2536-X0	0.454 kg	1.00 lb
3-2536-X1	0.476 kg	1.04 lb
3-2536-X2	0.680 kg	1.50 lb
3-2536-X3	0.794 kg	1.75 lb
3-2536-X4	0.850 kg	1.87 lb
3-2536-X5	1 kg	2.20 lb
3-8512-X0	0.35 kg	0.77 lb
3-8512-X1	0.37 kg	0.81 lb

Standards and Approvals
- CE
- RoHS compliant
- Manufactured under ISO 9001 for Quality and ISO 14001 for Environmental Management

Application Tips
- Use the Conduit Adapter Kit to protect the cable-to-sensor connection when used in outdoor environments. See Accessories section for more information.
- Use a sleeved rotor in abrasive liquids to reduce wear.
- Sensor plug is used to plug installation fitting after extraction of sensor from pipe.
- For liquids containing ferrous particles, use Signet Magmeters.
- For systems with components of more than one material, the maximum temperature/pressure specification must always be referenced to the component with the lowest rating.

Please refer to Wiring, Installation, Accessories and Fittings sections for more information.

Ordering Information

Model 2536 Standard Mount Paddlewheel

When choosing this style of sensor, the instrument can be mounted nearby on a pipe or wall or in a remote location up to 305 m/1000 ft (standard cable length is 7.6 m/25 ft) by connecting the sensor through a standard 3-8050-1 universal junction box. Use Signet fittings for proper seating of the sensor into the process flow.

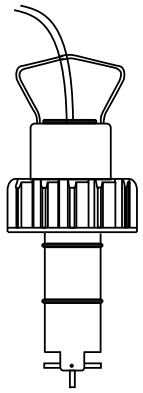
Sensor Part Number			
3-2536	Flow Sensor for use with remote mount instrument		
	Body/Rotor/Pin material - Choose One*		
	P	Polypropylene/Black PVDF/Titanium	
	T	Natural PVDF/Natural PVDF/Natural PVDF**	
	V	Natural PVDF/Natural PVDF/Hastelloy-C**	
		Pipe size - Choose One	
		0	0.5 to 4 in.
		1	5 to 8 in.
		2	10 to 36 in.
		↓	
3-2536	**- P**	**0**	**Example Part Number**

**PVDF available ½ in. to 4 in. only

Mfr. Part No.*	Code
3-2536-P0	**198 840 143**
3-2536-P1	**198 840 144**
3-2536-P2	**198 840 145**

Mfr. Part No.*	Code
3-2536-T0	**198 840 149**
3-2536-V0	**198 840 146**
3-2536-V1	**198 840 147**

Model 2536 Standard Paddlewheel Flow Sensor



***Model 2536 Ordering Notes**

1) Most common part number combinations shown. For all other combinations contact factory.
2) Other rotor and pin materials are available for purchase from the factory and can be easily replaced in the field. See Accessories section.

Model 2536 Integral Mount Paddlewheel

When choosing this style of sensor, the instrument is mounted directly onto the sensor for a local display. See Guidelines below for instructions.

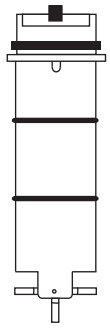
Sensor Part Number			
3-8512	Flow Sensor for integral mounting on the 8150 or 8550 instrument using the 3-8051 adapter (instrument and adapter sold separately)		
	Body/Rotor/Pin material-Choose one*		
	P	Polypropylene/Black PVDF/Titanium	
	T	Natural PVDF/Natural PVDF/Natural PVDF**	
	V	Natural PVDF/Natural PVDF/Hastelloy-C**	
		Pipe size - Choose one	
		0	½ to 4 in.
		1	5 to 8 in. (PP only)
		↓	
3-8512	**- V**	**0**	**Example Part Number**

**PVDF available ½ in. to 4 in. only

Mfr. Part No.*	Code
3-8512-P0	**198 864 513**
3-8512-P1	**198 864 514**

Mfr. Part No.*	Code
3-8512-T0	**198 864 518**
3-8512-V0	**198 864 516**

Model 2536 Integral Mount Paddlewheel Flow Sensor



Guidelines: Combining a 2536 integral mount flow sensor with an integrally mounted instrument

Option 1

Once an integral mount sensor is chosen, it can be mounted directly to a field mount transmitter by following these guidelines:

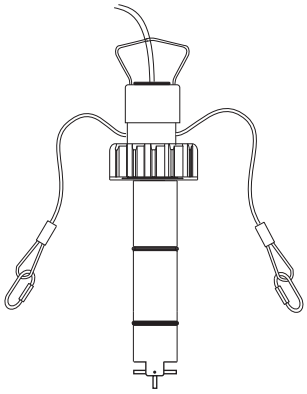
a) Order the integral adapter kit 3-8051 (sold separately) to connect the sensor to an instrument.
b) Order a field mount transmitter (sold separately). The following part numbers are compatible: 3-8550-1, 3-8550-2, 3-8550-3, 3-8150-1.
c) Assembling the sensor with the integral adapter and instrument is quick and simple.

Option 2

These parts can also be ordered as an assembled part. See page 74 "Integral Mount" for more information.

Ordering Information (continued)

Model 2536 Wet-Tap sensor



***Model 2536 Ordering Notes**

1) Other rotor and pin materials are available for purchase from the factory and can be easily replaced in the field. See Accessories section.

Model 2536 Wet-Tap Mount Paddlewheel Flow Sensor

When choosing this style of sensor, the instrument can be mounted nearby on a pipe or wall or in a remote location up to 1000 ft (305 m) by connecting the sensor through a standard 3-8050-1 universal junction box. Standard cable length is 7.6 m (25 ft). This style of sensor uses the 3519 Wet-Tap valve only (see individual product page for more information).

Sensor Part Number - Choose One			
3-2536	Flow Sensor for wet-tap mounting with the 3519 Wet-Tap Valve (sold separately)		
	Body/Rotor/Pin Material*		
	P	Polypropylene/Black PVDF/Titanium	
		Pipe Size - Choose One	
		3	½ to 4 in.
		4	5 to 8 in.
		5	10 to 36 in.
		↓	
3-2536	**- P**	**3**	**Example Part Number**

Mfr. Part No.*	Code
3-2536-P3	**159 000 758**
3-2536-P4	**159 000 759**
3-2536-P5	**159 000 760**

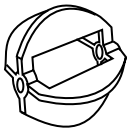
Guideline: Combining a 2536 Wet-Tap Sensor with a 3519 Wet-Tap Valve

a) Once a sensor is chosen, it can be mounted in a 3519 Wet-Tap Valve (sold separately)

b) Assembling a sensor with a 3519 Wet-Tap valve is quick and simple. These parts can also be ordered as complete assemblies. See 3519 product page.

Accessories and Replacement Parts

Rotor

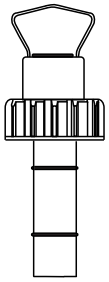


Rotor Pin

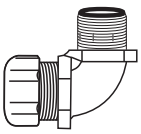
Sleeved Rotor (pin not included)

Sensor Cap

Sensor Plug



Conduit Adapter Kit



Mfr. Part No.	Code	Description
Rotors		
3-2536.320-1	**198 820 052**	Rotor, PVDF Black
3-2536.320-2	**159 000 272**	Rotor, PVDF Natural
3-2536.320-3	**159 000 273**	Rotor, Tefzel®
3-2536.321	**198 820 054**	Rotor and pin (matched set), PVDF Natural
3-2536.322-1	**198 820 056**	Sleeved rotor, PVDF Black
3-2536.322-2	**198 820 057**	Sleeved rotor, PVDF Natural
3-2536.322-3	**198 820 058**	Sleeved rotor, Tefzel®
Rotor Pins		
M1546-1	**198 801 182**	Pin, Titanium
M1546-2	**198 801 183**	Pin, Hastelloy-C
M1546-3	**198 820 014**	Pin, Tantalum
M1546-4	**198 820 015**	Pin, Stainless Steel
P51545	**198 820 016**	Pin, Ceramic
O-Rings		
1220-0021	**198 801 186**	O-ring, FPM (2 required per sensor)
1224-0021	**198 820 006**	O-ring, EPR (EPDM) (2 required per sensor)
1228-0021	**198 820 007**	O-ring, FFPM (2 required per sensor)
Miscellaneous		
P31536	**198 840 201**	Sensor plug, Polypropylene
P31542-3	**159 000 464**	Sensor cap, Blue
P31934	**159 000 466**	Conduit cap
P51589	**159 000 476**	Conduit adapter kit
5523-0222	**159 000 392**	Cable (per foot), 2 cond. w/shield, 22 AWG
3-8050	**159 000 184**	Universal mount kit
3-8051	**159 000 187**	Transmitter integral adapter (for use with 8510 and 8512)
3-8050-1	**159 000 753**	Universal junction box

3-2536.099 Rev A (01/10)

3401 Aerojet Avenue, El Monte, CA 91731-2882 U.S.A. • Tel. (626) 571-2770 • Fax (626) 573-2057 • www.gfsignet.com • e-mail: signet.ps@georgfischer.com

SIGNET TEMPERATURE SENSOR/TRANSMITTER

Images shown are representative of the product family.Materials, sizes, and configurations may vary.

FEATURES

- S^{3}L™ or 4 to 20mA output.
- One-piece injection molded Sygef® PVDF body.
- PT-1000 Platinum RTD.
- In-line or submersible.
- CE and UL listed.

APPLICATIONS

- Plating bath temperature control.
- Heat exchange monitor.
- R.O. system monitor.
- D.I. system monitor.
- Hot/cold mixing system monitor.
- Cooling loops.
- Effluent monitoring.
- HVAC.
- Chemical processing.

SPECIFICATIONS

- Output: S³L™ (2350-1, -2), 4 to 20mA (2350-3).
- Accuracy: ±0.9°F (±0.5°C).
- Response time: 10 secs.
- Repeatability: ±0.2°F (±0.1°C).
- Power requirements: S³L™ - 4.5 to 6.5 VDC < 1.5mA; 4 to 20mA - 9 to 26 VDC.
- Process and output connection: 3/4” NPT male thread.
- Cable type: PVC jacketed, 3-conductor with shield 22 AWG, Blk/Red/White/Shld.
- S³L™ output: Serial ASCII, TTL Level 9600 bps. Reverse polarity and short circuit protected.
- 4 to 20mA output accuracy: ±32µA.
- 4 to 20mA output resolution: <5µA.
- 4 to 20mA output span: 4 to 20mA factory calibrated 0° to 100°C.
- 4 to 20mA output max. loop impedance: 500O @ 12V, 325O @ 18V, 600O @ 24V.
- 4 to 20mA output update rate: <100µS.
- Operating temperature: 14° @ 232 PSI to 185°F @ 108 PSI (-10° @ 16 bar to 85°C @ 7.5 bar).
- Relative humidity: 0 to 95% non-condensing.

APPENDIX F. Puntledge Hatchery Chiller Design Drawings

FOR CONSTRUCTION

STANDARD ABBREVIATIONS

BF	BUTTER-FLY
B/W	BACK-WASH
CL	CENTER LINE
CLS	CUSTOM LIFE SUPPORT
CONC	CONCRETE
C/W	COMES WITH
DO	DISSOLVED OXYGEN
DR	DRAIN
ECC RED	ECCENTRIC REDUCER
EL	ELEVATION
ELB	ELBOW
E-STOP	EMERGENCY STOP
GO	GEAR OPERATED
LO	LEVER OPERATED
O/F	OVERFLOW
ORP	OXIDATION REDUCTION POTENTIAL
RED BUSH	REDUCER BUSHING
RECIRC	RECIRCULATION
REF	REFERENCE
T	TEMPERATURE
TCV	TEMPERATURE CONTROL VALVE
T.O.	TOP OF
U/S	UNDERSIDE

GENERAL NOTES

1. DIMENSIONS ARE IN FEET AND INCHES UNLESS OTHERWISE INDICATED. DIMENSIONS MARKED "REF" ARE REFERENCE DIMENSIONS, AND ARE TO BE CONFIRMED BEFORE CONSTRUCTION.
2. PRAQUA IS NOT RESPONSIBLE FOR VERIFYING THAT THE CONCRETE PAD OVER THE INLET STRUCTURE CAN SUPPORT THE AQUACULTURE EQUIPMENT. DFO WILL PROVIDE ANY GUIDANCE NEEDED TO VERIFY STRUCTURAL INTEGRITY. THE FOLLOWING ARE ESTIMATES OF THE DRY WEIGHTS OF WATER TREATMENT EQUIPMENT.
   A. CHILLER 1500 LB
   B. CO2 STRIPPER AND HEADER TANK 250 LB
3. DO NOT USE MECHANICAL EQUIPMENT AS SUPPORTS FOR PIPING WITHOUT MANUFACTURER'S APPROVAL. PIPE HANGERS AND OTHER SUPPORTS MUST BE INSTALLED AT INTERVALS APPROPRIATE TO THE PIPE DIAMETER AND TYPE.
4. ALL PLUMBING TO BE SHC 40 PVC UNLESS OTHERWISE NOTED.
5. ELECTRICAL SERVICES HAVE NOT BEEN IDENTIFIED WITHIN THIS DOCUMENT OTHER THAN AS SHOWN ON P&ID DRAWINGS. ALL ELECTRICAL SERVICES MUST BE INSTALLED ACCORDING TO APPROPRIATE CODES. PROVIDE ALL MATERIALS AND EQUIPMENT NEEDED TO PROVIDE POWER REQUIREMENTS TO THE EQUIPMENT SHOWN.
6. EQUIPMENT MUST BE SECURELY ANCHORED WHERE APPROPRIATE (I.E. NOT INLET BOX).

SHEET INDEX

Sheet Index	Revision No.	Title Line 1	Title Lines 2 & 3
611-001	0	Puntledge Hatchery	Schedules, Legends & Notes
611-101	0	Puntledge Hatchery	Equipment & Plumbing: Site Layout
611-102	0	Puntledge Hatchery	Equipment & Plumbing Layout
611-301	0	Puntledge Hatchery	Equipment & Plumbing Sections: Sheet 1
611-302	0	Puntledge Hatchery	Equipment & Plumbing Sections: Sheet 2
611-601	0	Puntledge Hatchery	Process Flow Diagram
611-602	0	Puntledge Hatchery	Process & Instrumentation Diagram (3 Sheets)

LEGEND FOR PROCESS & INSTRUMENTATION DIAGRAMS

VALVES

- GATE
- BUTTERFLY
- GLOBE
- BALL
- SWING CHECK
- PRESSURE RELIEF
- AIR AND/OR VACUUM RELEASE
- THREADED CAP

INSTRUMENT IDENTIFICATION LETTERS

	FIRST LETTER	SUCCEEDING LETTER(S)
E		SENSOR (PRIMARY ELEMENT)
F	FLOW RATE	
P	PRESSURE	
T	TEMPERATURE	TRANSMIT

PROCESS FLOW

- PRIMARY PROCESS FLOW
- SECONDARY PROCESS FLOW

CONNECTIVITY

- ANALOG SIGNAL (4-20 mA, ETC)
- SOFTWARE OR DATA LINK
- DISCRETE SIGNAL (ON/OFF, ETC)
- POWER SUPPLY, 1Ø GROUNDED
- POWER SUPPLY, 3Ø GROUNDED

EQUIPMENT

- FIELD MOUNTED INSTRUMENT
- MOUNTED ON PACKAGED EQUIPMENT
- MOTOR
- CENTRIFUGAL PUMP (DRY PIT)
- CENTRIFUGAL BLOWER OR FAN

INTERFACE SYMBOLS

PROCESS INTERFACE

S = SOURCE DRAWING NO.
D = DESTINATION DRAWING NO.

EQUIPMENT SCHEDULE

Equipment Name	Equipment Description	Qty	Manufacturer	Mfr / Model	Voltage (V)	Phase	Installed Power (kW)	Duty Power (kW)	Power Factor	Calc Current (Amps)
Inlet structure	Custom designed inlet structure	1	PRAqua	Custom product	NA	NA	NA	NA	NA	NA
Reuse Pump	pump at 250 gpm at 25 feet TDH	1	Paco	3070-7 2 HP	575	3	1.49	1.49	0.85	1.76
Chiller	20 HP Titanium Chiller & Controller	1	UMI	Ti-Chaf-14	575	3	14.92	14.92	0.90	16.67
CO2 stripper	Aluminum riveted no media	1	PRAqua	CO2 stripper 300 C/W 2 Blowers	115	1	0.12	0.12	0.90	1.18
Header Tank	4' diameter header tank on integral skirt	1	PRAqua	4' diameter culture tank c/w custom fittings	NA	NA	NA	NA	NA	NA
Influent Flow valve	2" Globe valve	1			NA	NA	NA	NA	NA	NA
Controller	Display screen	1	GF	GF Signet 8900 series multiparameter controller	115	1	0.70	0.70	0.90	6.76
Flow meter	Paddle wheel flow sensor	1	GF	GF Signet 515 flow sensor plus fitting	24 VDC	NA	NA	NA	NA	NA
Flow meter	Paddle wheel flow sensor	1	GF	GF Signet 2536 flow sensor plus fitting	24 VDC	NA	NA	NA	NA	NA
Temperature Sensor	temperature sensor	1	GF	GF Signet 2350-1 temperature sensor	24 VDC	NA	NA	NA	NA	NA
Electrical Control Panel	electrical control panel	1	Acorn	Custom product	575	3	16.41	16.41	0.90	18.33

NO.	DATE:	REVISION
0	25NOV10	ISSUED FOR CONSTRUCTION
A	26OCT10	ISSUED FOR INFORMATION

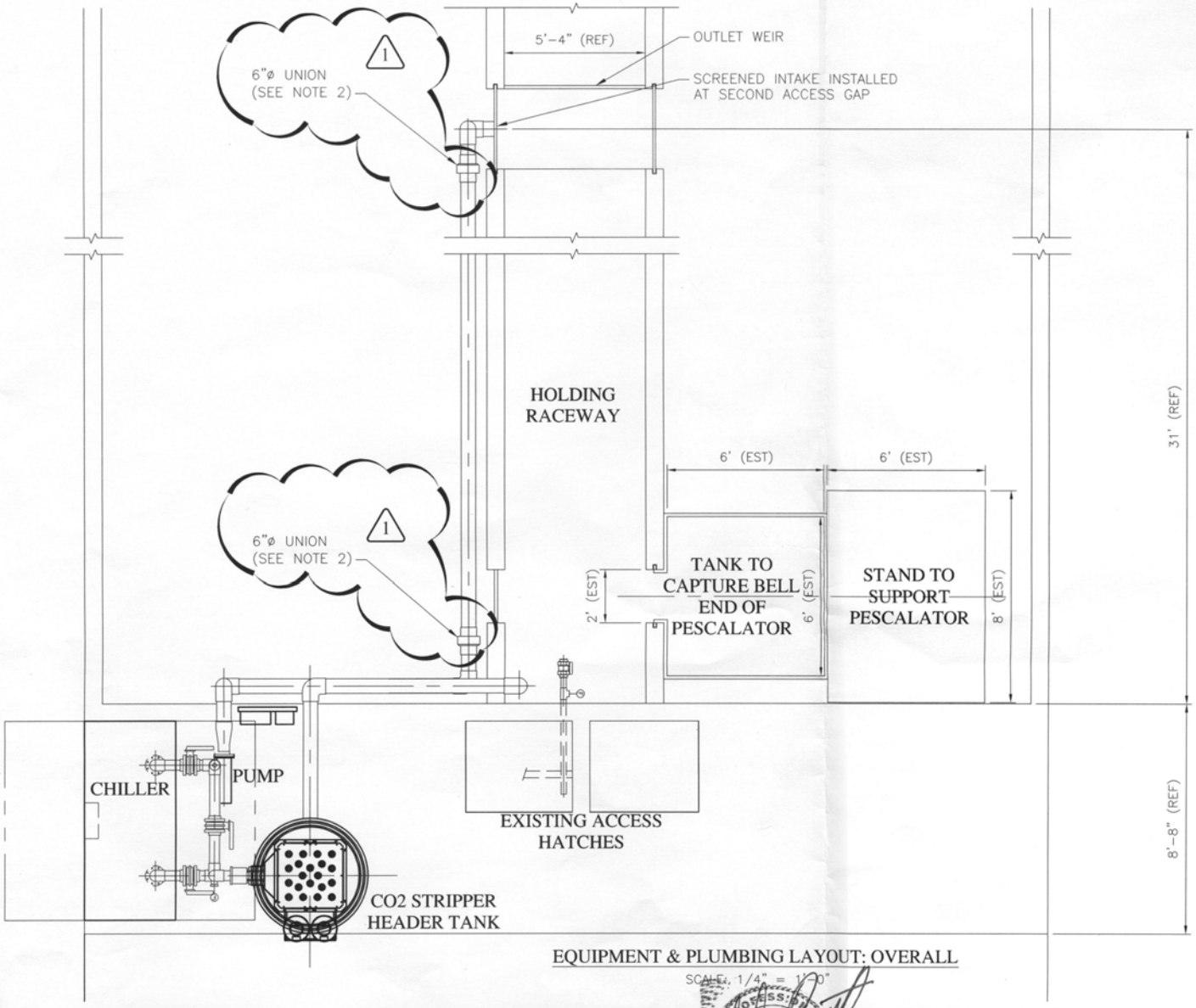
DRAWING IS ISSUED AS 280x430 MM [11"x17"]. IF LINE SHOWN ABOVE IS NOT 25.4 MM [1"] LONG, ACTUAL SCALE DIFFERS FROM STATED SCALE.

PR Aqua Ltd.
1635 Harold Road
Nanaimo, BC, Canada
V9X 1T4
PH: (250)714-0141, FAX: (250)714-0171

DEPARTMENT OF FISHERIES & OCEANS, CANADA
PUNTLEDGE HATCHERY
ADULT CHILLING
SCHEDULES, LEGEND & NOTES

DESIGNED: SKP	DRAWN: KCG	CHECKED: KDH
DATE: 19OCT10	SCALE: AS NOTED	APP'D: .
DWG. NO. 611-001		REV: 0

ID – T:\Projects\Wash U-St. Louis\St.Louis, MO\655-ZFish CLS\C-Development\Proj



EQUIPMENT & PLUMBING LAYOUT: OVERALL

SCALE: 1/4" = 1'-0"

FOR CONSTRUCTION

NOTES:

1. DIMENSIONS ARE IN FEET & INCHES. DIMENSIONS MARKED "REF" ARE REFERENCE DIMENSIONS AND ARE TO BE CONFIRMED BEFORE CONSTRUCTION.

1 2. INTENT OF UNIONS IS TO ENABLE REMOVAL OF INTAKE PIPE SECTION AS REQ'D FOR FACILITY OPERATIONS. EXACT LOCATIONS TO BE AS DIRECTED BY FOC STAFF.

NO.	DATE:	REVISION
1	22DEC10	ADDED TWO 6" UNIONS
0	25NOV10	ISSUED FOR CONSTRUCTION
A	29OCT10	ISSUED FOR INFORMATION

DRAWING IS ISSUED AS 280x430 MM [11"x17"]. IF LINE SHOWN ABOVE IS NOT 25.4 MM [1"] LONG, ACTUAL SCALE DIFFERS FROM STATED SCALE.

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DEPARTMENT OF FISHERIES & OCEANS, CANADA

PUNTLEDGE HATCHERY
ADULT CHILLING
EQUIPMENT & PLUMBING SITE PLAN

DESIGNED:	DRAWN:	CHECKED:
SKP	KCG	KDH
DATE: 19OCT10	SCALE: AS NOTED	APP'D: .
DWG. NO. 611-101		REV: 1

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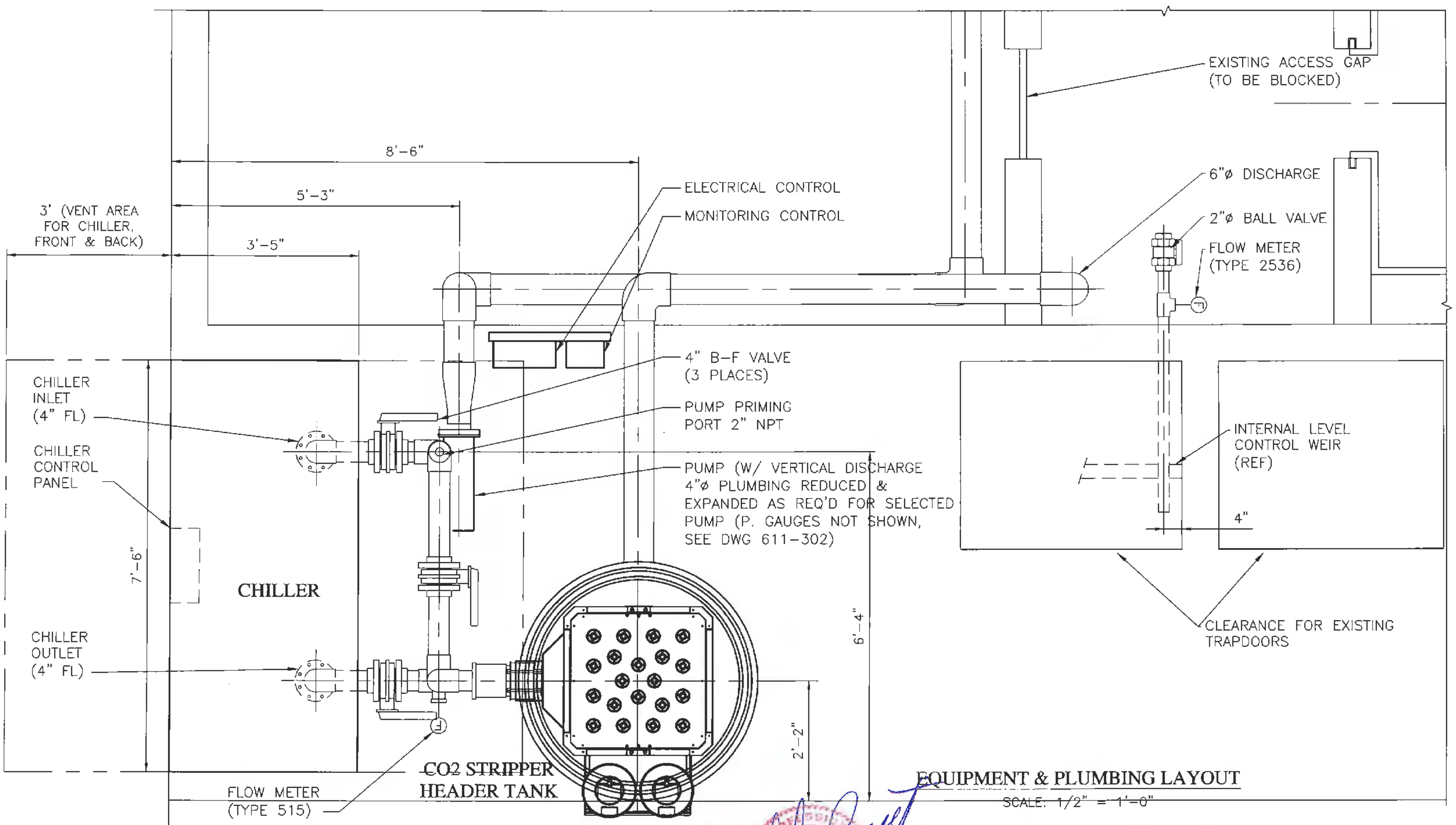

EQUIPMENT & PLUMBING LAYOUT
SCALE: 1/2" = 1'-0"

FOR CONSTRUCTION

NOTES:

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NO.	DATE:	REVISION
0	25NOV10	ISSUED FOR CONSTRUCTION
A	29OCT10	ISSUED FOR INFORMATION

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DEPARTMENT OF FISHERIES & OCEANS, CANADA

PUNTLEDGE HATCHERY
ADULT CHILLING
EQUIPMENT & PLUMBING LAYOUT

DESIGNED: SKP	DRAWN: KCG	CHECKED: KDH
DATE: 19OCT10	SCALE: AS NOTED	APP'D: .
DWG. NO. 611-102		REV: 0

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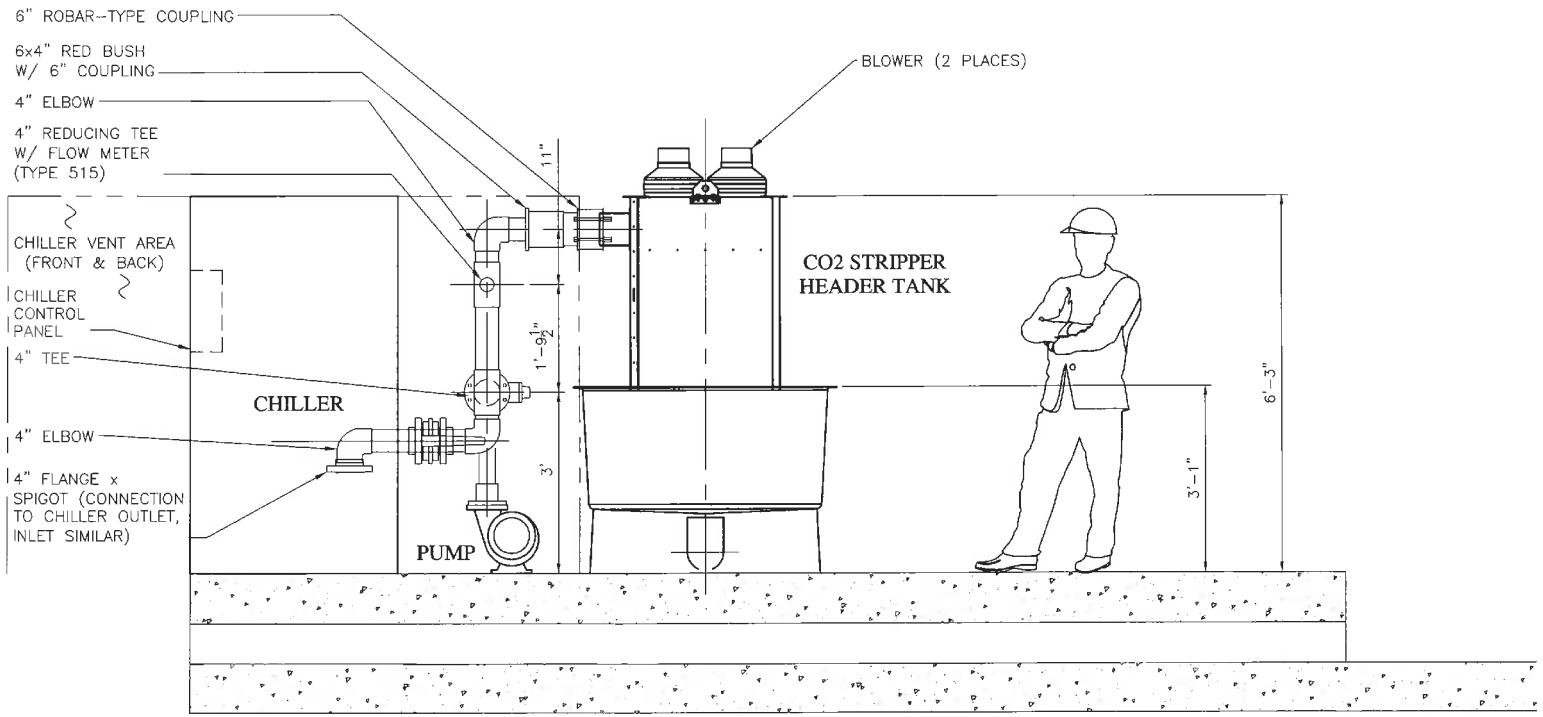

NOTES:

1. DIMENSIONS ARE IN FEET & INCHES. DIMENSIONS MARKED "REF" ARE REFERENCE DIMENSIONS AND ARE TO BE CONFIMRED BEFORE CONSTRUCTION.

EQUIPMENT & PLUMBING SECTION

SCALE: 1/2" = 1'-0"

FOR CONSTRUCTION

NO.	DATE:	REVISION
0	25NOV10	ISSUED FOR CONSTRUCTION
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PROFESSIONAL ENGINEER SEAL K. PIGGOTT # 28347 BRITISH COLUMBIA

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DEPARTMENT OF FISHERIES & OCEANS, CANADA

PUNTLEDGE HATCHERY
ADULT CHILLING
EQUIPMENT & PLUMBING SECTIONS: SHEET 1

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SKP	KCG	KDH
DATE:	SCALE:	APP'D:
19OCT10	AS NOTED	.
DWG. NO. 611-301		REV: 0

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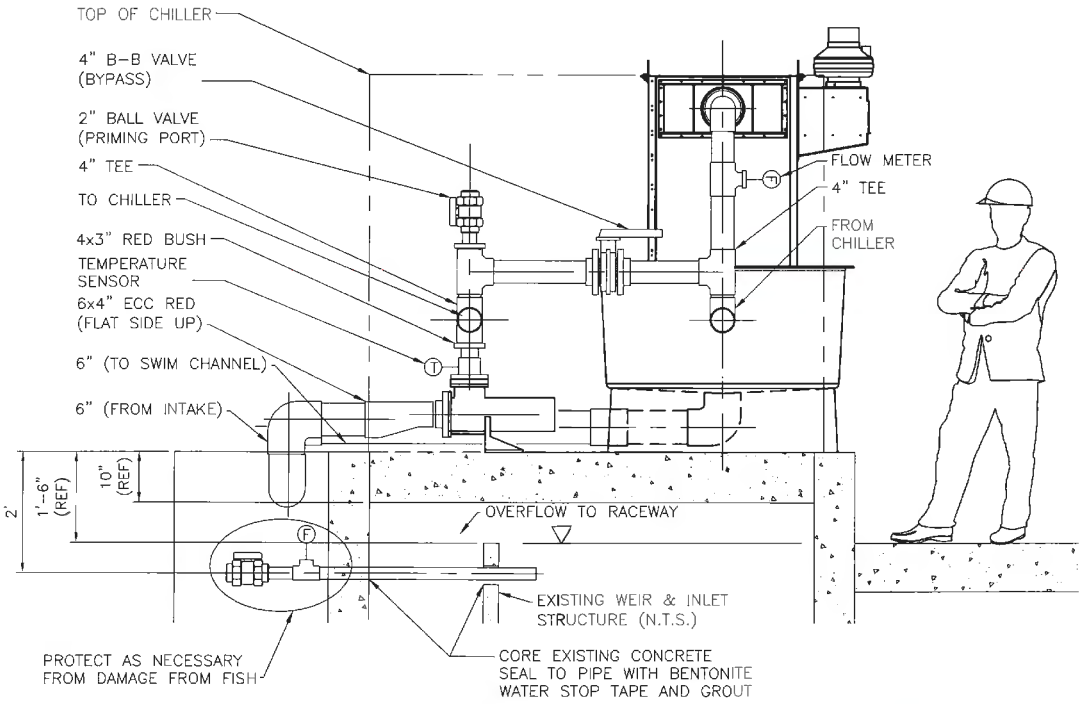
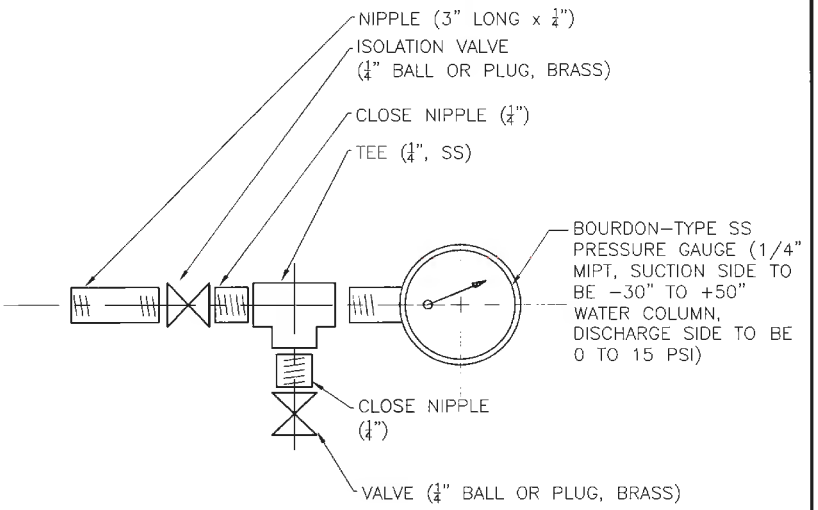


EQUIPMENT & PLUMBING SECTION

SCALE: 1/2" = 1'–0"



STANDARD PRESSURE GAGE ASSEMBLY

(ALL NIPPLES TO BE TYPE 316 STAINLESS STEEL)

NOTES:

1. DIMENSIONS ARE IN FEET & INCHES. DIMENSIONS MARKED "REF" ARE REFERENCE DIMENSIONS AND ARE TO BE CONFIMRED BEFORE CONSTRUCTION.

FOR CONSTRUCTION

NO.	DATE:	REVISION
0	25NOV10	ISSUED FOR CONSTRUCTION
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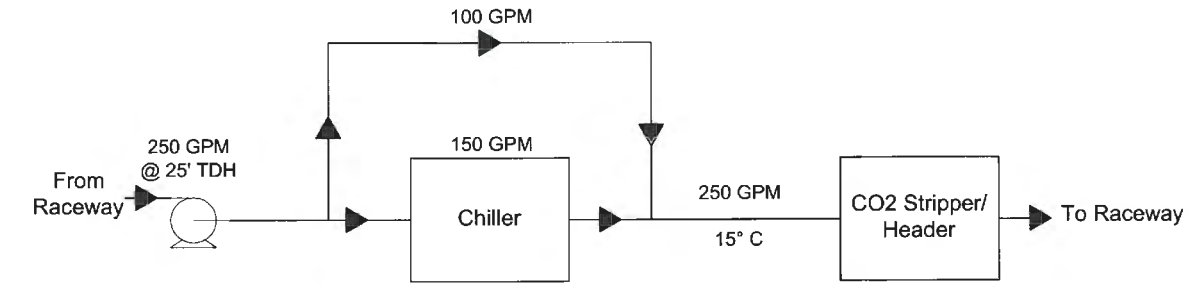
DEPARTMENT OF FISHERIES & OCEANS, CANADA

PUNTLEDGE HATCHERY
ADULT CHILLING
EQUIPMENT & PLUMBING SECTIONS: SHEET 2

DESIGNED:	DRAWN:	CHECKED:
SKP	KCG	KDH
DATE:	SCALE:	APP'D:
19OCT10	AS NOTED	.
DWG. NO. 611-302		REV: 0

ID - T:\Projects\Vash U-St. Louis\St.Louis, MO\655-2Fish CLSVC-Development\Drawings\Process\655-601_R0-PID HEATING.dwg - Thu, 30 Sep 2010 - 16:42



PROCESS FLOW DIAGRAM

FOR CONSTRUCTION

NO.	DATE:	REVISION
0	25NOV10	ISSUED FOR CONSTRUCTION
B	29OCT10	ISSUED FOR INFORMATION
A	12OCT10	ISSUED FOR INFORMATION

SEAL
K. K. PIGGOTT
28347
PROVINCE OF BRITISH COLUMBIA
2010 OCT 25

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DEPARTMENT OF FISHERIES & OCEANS, CANADA

PUNTLEDGE HATCHERY
ADULT CHILLING
PROCESS FLOW DIAGRAM

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DATE:	SCALE:	APP'D:
19OCT10	AS NOTED	.
DWG. NO. 611-601		REV: 0

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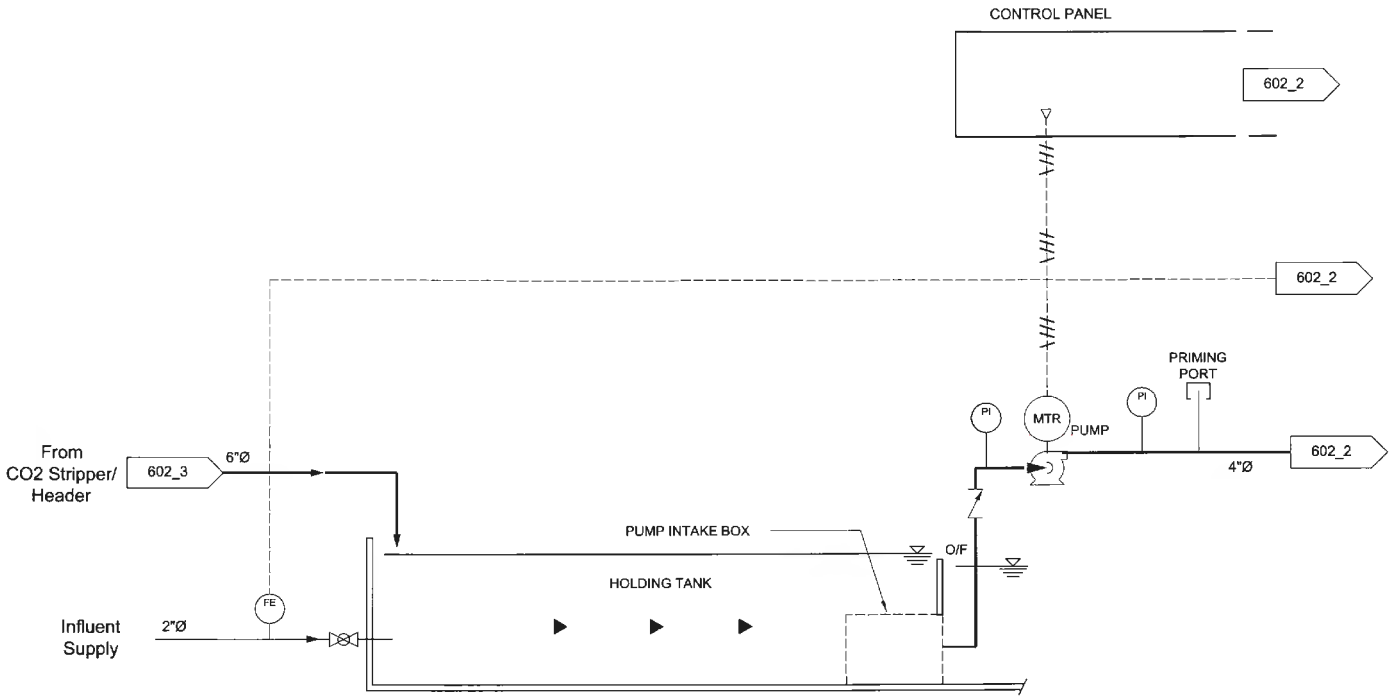

PROCESS & INSTRUMENTATION DIAGRAM -- SHEET 1

NO.	DATE:	REVISION
0	25NOV10	ISSUED FOR CONSTRUCTION
A	29OCT10	ISSUED FOR INFORMATION

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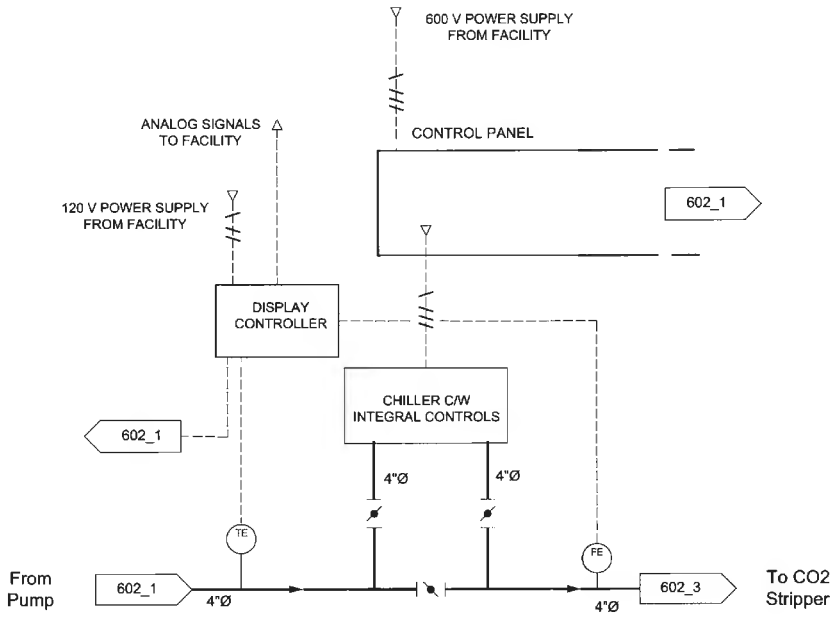
DEPARTMENT OF FISHERIES & OCEANS, CANADA

PUNTLEDGE HATCHERY
ADULT CHILLING
PROCESS & INSTRUMENTATION DIAGRAM

DESIGNED:	DRAWN:	CHECKED:
SKP	KCG	KDH
DATE:	SCALE:	APP'D:
19OCT10	AS NOTED	.
DWG. NO. 611-602_1/3		REV: 0

ID - T:\Projects\Vash U-St. Louis\St.Louis, MD\655-2Fish CLSVC-Development\Drawings\Process\655-602_80-PID HOLDING 1.dwg - Thu, 30 Sep 2010 - 16:42



PROCESS & INSTRUMENTATION DIAGRAM -- SHEET 2

FOR CONSTRUCTION

NO.	DATE:	REVISION
0	25NOV10	ISSUED FOR CONSTRUCTION
A	29OCT10	ISSUED FOR INFORMATION

S. K. PIGGOTT
28347
2010-11-25
ENGINEER

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DEPARTMENT OF FISHERIES & OCEANS, CANADA

PUNTLEDGE HATCHERY
ADULT CHILLING
PROCESS & INSTRUMENTATION DIAGRAM

DESIGNED:	DRAWN:	CHECKED:
SKP	KCG	KDH
DATE:	SCALE:	APP'D:
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DWG. NO. 611-602_2/3		REV: 0

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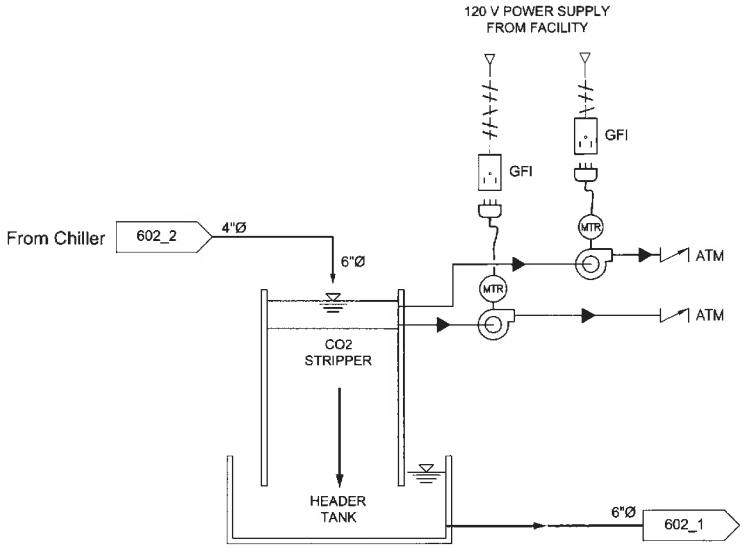

PROCESS & INSTRUMENTATION DIAGRAM -- SHEET 3

FOR CONSTRUCTION

NO.	DATE:	REVISION
0	25NOV10	ISSUED FOR CONSTRUCTION
A	29OCT10	ISSUED FOR INFORMATION

S. K. PIGGOTT # 29347 BRITISH COLUMBIA ENGINEER

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DEPARTMENT OF FISHERIES & OCEANS, CANADA

PUNTLEDGE HATCHERY
ADULT CHILLING
PROCESS & INSTRUMENTATION DIAGRAM

DESIGNED:	DRAWN:	CHECKED:
SKP	KCG	KDH
DATE:	SCALE:	APP'D:
19OCT10	AS NOTED	.
DWG. NO. 611-602_3/3		REV: 0

ID - T:\Projects\Vash U-St. Louis\St.Louis, MD\655-Fish CLS\C-Development\Drawings\Process\655-602_R0-PID HOLDING 1.dwg - Thu, 30 Sep 2010 - 16:42

APPENDIX G: BCRP Financial Statement

Project #: 10.PUN.04

INCOME	BUDGET			ACTUAL		
	BCRP	**Other (Cash)**	**Other (in-kind)**	**BCRP**	**Other (cash)**	**Other (in-kind)**
Total by Source	$19,145.50	$0	$2,420	$19,145.50	$0	$3,960
Grand Total Income (BCRP + Other)	**$21,565.50**			**$23,105.50**		
EXPENSES						
Project Personnel						
Biologist Project Supervisor	$1,800.00			$815.36		
Engineer (Contractor)	$15,105.00			$16,365.44		
DFO (Biologist & Engineer)			$1,000			$1,200.00
DFO (Hatchery personnel)			$1,200			$2,400.00
Communications	$225.00			$225.00		
Material and Equipment						
Mileage	$275.00			$0		
Administration						
Admin Fees (10%)	$1,740.50		$220.00	$1740.58		$360.00
Total Expenses	**$19,145.50**		**$2420**	**$19,146.38**	**$0**	**$3,960**
Grand Total Expenses (BCRP + others)	**$21,565.50**			**$23,106.38**		
Balance (Grand Total Income - Grand Total Expenses	**$0.00**			**- $0.88**		