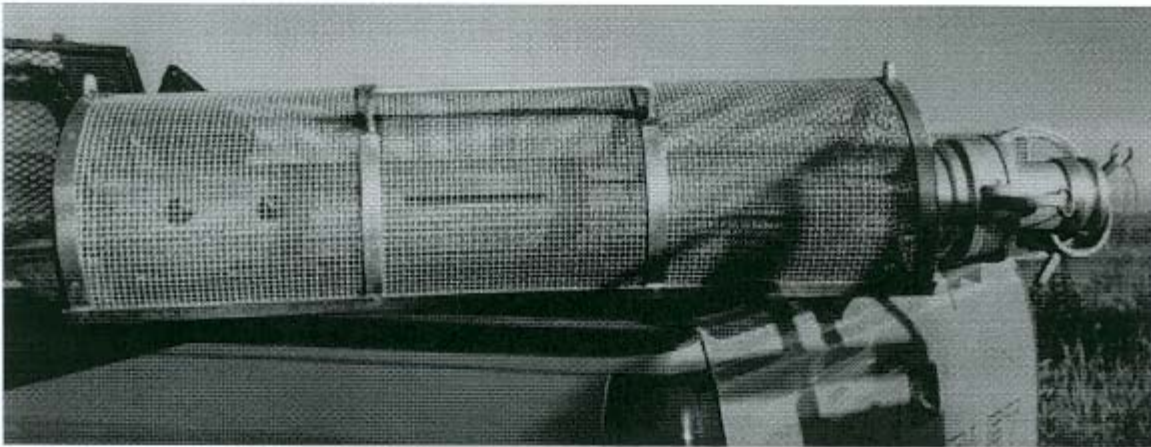


Technical Report No. 97-8

Water Intake Structures

**An Alternative to Traditional Screened-Box
Enclosures For The Protection of Fish**



Alaska Department of Fish and Game

Habitat and Restoration Division

Janet Kowalski, Director



March 20, 1998

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Water Intake Structures

An Alternative to Traditional Screened-Box Enclosures For the Protection of Fish

Prepared By

Robert F. "Mac" McLean

Technical Report 97-8

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March 20, 1998

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ACKNOWLEDGEMENTS

Prototype development and testing of the alternative water intake structure was a cooperative project between the Alaska Department of Transportation and Public Facilities (ADOT&PF), Northern Regional Office, and the Alaska Department of Fish and Game (ADF&G), Habitat and Restoration Division, Northern Region. ADOT&PF's support for applied research is commended and greatly appreciated. The new water intake structures address both ADF&G's fish intake, entrapment, and impingement concerns and ADOT&PF's operational need for light-weight, readily-deployable structures.

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Greg Zimmerman, Environmental Analyst, Northern Region

Special thanks is given to Fairbanks Welding and Fabrication for their assistance in fabricating the various prototypes.

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Abstract - Light-weight, easily-deployable, four-inch (101.6 mm) and six-inch (152.4 mm) screened aluminum water pump intake cylinders were evaluated for risk of fish entrainment, entrapment, and impingement. The intake cylinders incorporate an off-round design, solid bottom, 0.25-inch (6.35 mm) outer screen surface, and a perforated inner aluminum sleeve. The cylinders are designed to rest on the channel bottom in riffle-sections which weaker-swimming fish typically do not occupy. The intake cylinders align longitudinally with the channel current to facilitate self-cleaning and flushing. Design flows for the four-inch (101.6 mm) and six-inch (152.4 mm) pumps were 600 gpm (37.85 l/s) and 1,200 gpm (75.7 l/s), respectively. Approach water velocities for the second-generation six-inch (152.4 mm) and first-generation four-inch (101.6 mm) pump intake cylinders were non-detectable across the outer screen surface using a pygmy gurley velocity meter.

Key Words: Water Intake, Water Withdrawal, Entrainment, Entrapment, Impingement, Mitigation.

INTRODUCTION

In 1995, the Alaska Department of Transportation and Public Facilities (ADOT&PF), Dalton Highway Maintenance Section, and the Alaska Department of Fish and Game (ADF&G), Habitat and Restoration Division, Northern Region, initiated a two-year cooperative research effort to develop alternatives to traditional box water intake structures. This research was needed to address the identified problems with traditional screened boxes and a joint desire to protect fisheries resources consistent with the requirements of Alaska Statute 16.05.870.

Water intake structures used by the ADOT&PF and other contractors typically are constructed of heavy-gauge angle iron with galvanized mesh screen. For typical water intake volumes, these structures are approximately 3 foot (0.91 m) by 3 foot (0.91 m) by 3 foot (0.91 m) in dimension. In shallow waterbodies the boxes can only be installed in naturally occurring deep pools or excavated sumps within the stream channel. Yet placement of the boxes in these locations increases the risk of fish entrainment, impingement, and entrapment because most young-of-the-year salmonids occupy backwater and low velocity pool habitats. Traditional water intake boxes are heavy and cumbersome to move, generally requiring two people to off-load or reposition. Due to recent budget cuts to the Northern Region ADOT&PF, only one equipment operator is available for every 40 miles (64.4 km) of road. The traditional screened box enclosure is no longer practical for existing staffing levels.

BACKGROUND

Water withdrawals from fish-bearing waters pose potential problems to both adult and juvenile fish swimming in the proximity of an intake structure. Although most water withdrawals use a screened intake (rock guard) to avoid entraining gravel or debris, the relatively large mesh size allows entrainment of fry and juvenile fish into the pump. At high flow rates, the approach velocity across the screen surface can draw fish up against and hold them against the screen surface, resulting in suffocation or physical damage.

To avoid impacts, particularly to newly-hatched juveniles and weak-swimming fish, ADF&G encourages the following in-priority alternatives to instream, screened water intake structures:

- ◆ identify and withdraw water from non-fish bearing waterbodies;
- ◆ use well points, off-channel sumps, and infiltration galleries; and
- ◆ schedule maintenance and construction activities during time periods when water is plentiful and younger life-stages of fish are not present.

In many instances there may not be an alternative to instream water withdrawal. In these instances, various intake design criteria have been developed by other investigators, largely as off-shoots of fish enclosure designs for water irrigation intakes based on vertical screen faces. A common criteria adopted by the Department of Fisheries and Oceans Canada specifies a gross screen area of 10ft.² (0.929 m²) for each cubic foot per second (cfs) (28.3 l/s) pumped for manually cleaned screens. All screens must have at least 50% open area to reduce head loss and minimize velocities at the screen opening (Clay, 1961).

After an extensive literature review, ADF&G developed five different maximum screen mesh size and approach water velocity criteria for various fish species and life stages (Sundberg, 1986). These criteria are presented in Table 1 and range from a conservative approach velocity of 0.1 fps (3.048 cm/s) and a 0.04 inch (1.02 mm) mesh screen for newly-hatched whitefish fry to a fairly liberal 2.0 fps (60.96 cm/s) approach velocity and 0.25 inch (6.35 mm) mesh hardware cloth for adult salmon, whitefish, and Dolly Varden (Arctic char). ADF&G's current criteria (1986 to present) are based on the size and swimming abilities of the fish species present and are enforced through Fish Habitat Permits issued under AK Statute 16.05.870 ... 16.05.900. In most instances, multiple species and size classes of fish are present in a waterbody and the most restrictive criteria is used.

Several problems have been identified by ADOT&PF and other contractors with use of the large screened intake boxes:

- ◆ the physical shape of traditional screened boxes requires operators to place the box in habitats known to attract and hold vulnerable fry and juvenile fish. Because this occurs, ADOT & PF and other contractors are required to use the more restrictive criteria for juvenile fish. It also places juvenile fish at increased risk;
- ◆ in shallow streams, the large size of traditional screened boxes requires sub-excavation of the stream channel bottom to completely submerge the box. This results in additional habitat degradation and potential channel alteration;
- ◆ large screen faces oriented perpendicular to the water flow are subject to fouling with organic debris and require frequent cleaning; and
- ◆ large-screen box structures are difficult for one person to physically handle.

TABLE 1. ADF&G. Maximum Allowable Screen Mesh Size and Water Intake Velocities Through a Screened Intake for Water Withdrawals in Anadromous Waters (For Withdrawals Up To 5 Cubic Feet Per Second).

Criteria	Group A	Group B	Group C	Group D	Group E
Screen Mesh (inches / mm)	0.04 in. 1.0 mm	0.04 in. 1.0 mm	0.1 in. 2.4 mm	0.25 in. 6.4 mm	0.25 in. 6.4 mm
Water Velocity ^{1/} (fps / cm/s)	0.1 fps 3.05 cm/s	0.5 15.24 cm/s	0.5 15.24 cm/s	2.0 60.96 cm/s	n/a n/a
Group A	Fry Stage: whitefish.				
Group B	Juvenile Stage: smelt, whitefish. Fry or Juvenile Stage: sheefish, pink salmon, chum salmon.				
Group C	Juvenile Stage: coho salmon, chinook salmon, sockeye salmon, Dolly Varden (Arctic char), rainbow trout (steelhead), cutthroat trout.				
Group D	Adult Stage: whitefish, Dolly Varden (Arctic char).				
Group E	Adult Stage: chinook salmon, coho salmon, sockeye salmon, chum salmon, pink salmon. <i>These criteria shall be used to prevent entrapment of Group E fish in off-stream pumping ponds. No velocity criteria apply.</i>				
^{1/} Water velocity measured on the downstream side of the screened enclosure.					

MATERIALS AND METHODS

Responding to the need to develop a more portable water intake structure that allowed placement in less sensitive fish habitats, ADF&G and ADOT&PF teamed together in 1996 to find an acceptable alternative to traditional screened box enclosures. Initial ideas were derived from the following three sources and converged to form the foundation for design of the current prototypes:

- ◆ an ADF&G conceptual modification of a water intake structure first observed in use in the Nome mining district;
- ◆ a report provided by ADOT&PF Technology Transfer depicting a water intake sleeve for use in beaver pond water level regulation prepared by Clemson University, 1993; and from
- ◆ Dean Bailey, Foreman, Chandalar Maintenance Station, ADOT&PF, and Earl Hahn, Foreman, Coldfoot Maintenance Station, ADOT&PF, who advanced the concept of using perforated, spent mortar shells (recycled from avalanche control) for water intake enclosures.

Six-Inch Pump - First Generation. The first generation six-inch (152.4 mm) diameter pump intake prototype was a 4 ft. (1.22 m) long, eight-inch (203.2 mm) diameter, slotted Schedule 40 aluminum pipe placed on-center within a 1.6 foot (48.77 cm) diameter, 1/4-inch (6.35 mm) stainless steel mesh-covered outer sleeve (Figure 1). Inner pipe slot and hole dimensions and spacing were optimized to disperse water flows equally across the distal to proximal length of inner sleeve while maintaining hydraulic capacity. Cut out dimensions for the inner pipe sleeve are shown in Appendix A in both ft./lb. and S.I. units. The distal end was capped to prevent fish that might congregate in the back eddy that forms at the downstream end of the intake cylinder from impinging on the screen surface.

The first prototype was taken to ADOT&PF's Northern Region annual foreman's meeting in Valdez in Spring 1997 for critique and evaluation. Several modifications were recommended by ADOT&PF field staff and incorporated in the second prototypes.

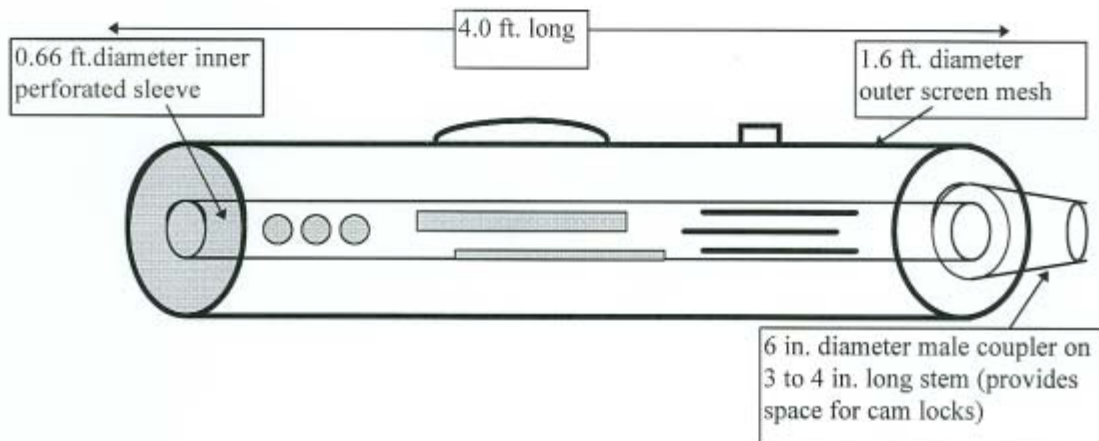


Figure 1. First Generation Six-Inch Pump Water Intake Cylinder.

Six-Inch Pump - Second Generation. The second generation six-inch (152.4 mm) pump intake prototype was constructed in 1997. This prototype consisted of a 4.0 ft. (1.22 m) long, six-inch (152.4 mm) diameter slotted aluminum pipe (Schedule 40) placed off-center within a 1.3 ft. (39.62 cm) diameter partially squashed 1/4-inch (6.35 mm) mesh covered outer sleeve (Figure 2). The center pipe was placed 1.3 in. (33.02 mm) above a flat, solid aluminum plate 0.9 feet (27.43 cm) wide by 4.0 ft. (1.22 m) long. The center pipe was separated from the outer screen along its sides and top by 0.35 ft (10.67 cm). The effective outer mesh face was 2.75 ft. (0.84 m) by 4.0 ft. (1.22 m) with an additional screen opening of 0.978 ft.² (908.56 cm²) at the proximal end. Three-by-three stainless steel wire mesh (wire diameter = 0.08 in.(2.03 mm); 0.253 in. (6.43 mm) opening) with an effective open area of 57.6% was used for the outer screen covering.

Total effective outer screen area was 11.98 ft.² (1.11 m²). Cut-out dimensions for the inner pipe sleeve are shown in Appendix B in both ft./lb. and S.I. units. Deployed weight was 71 lbs (32.21 kg).

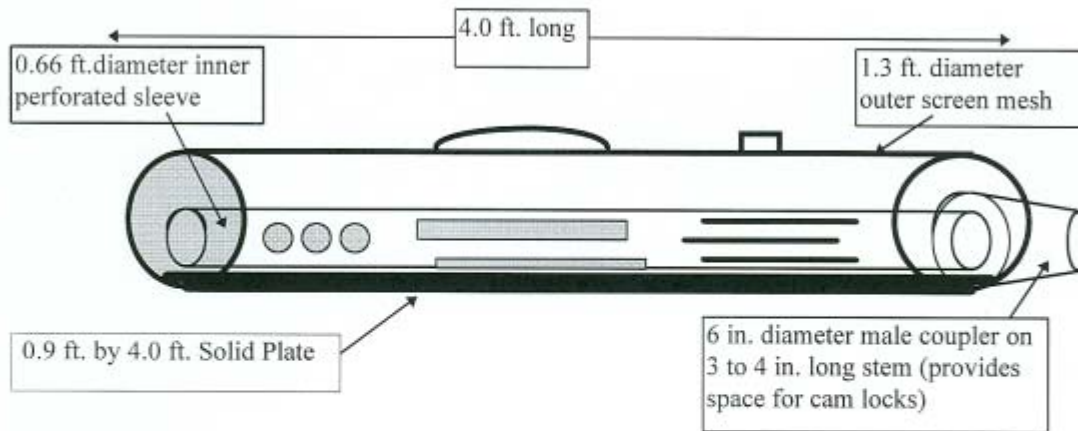


Figure 2. Second Generation Six-Inch Pump Water Intake Cylinder.

Four-Inch Pump. A four-inch (101.6 mm) pump prototype also was constructed in 1997. This prototype consisted of a 4.0 ft. (1.22 m) long, four-inch (101.6 mm) diameter slotted aluminum pipe (Schedule 40) placed off-center within a 1.05 ft. (32 cm) diameter partially squashed 1/4-inch (6.35 mm) stainless steel mesh-covered outer sleeve (Figure 3). The center pipe was placed 0.75 inches (19.05 mm) above a 0.85 ft. (25.91 cm) wide by 4.0 ft. (1.22 m) long flat, solid aluminum plate. The center pipe was separated from the outer screen along its sides and top by 0.35 ft (10.67 cm). The effective outer mesh face was 2.2 ft. (0.67 m) by 4 ft. (1.22 m) with an additional screen opening of 0.669 ft.² (621.50 cm²) at the proximal end. Three-by-three stainless steel wire mesh (wire diameter = 0.08 in. (2.03 mm); 0.253 in. (6.43 mm) opening) with an effective open area of 57.6% was used for the outer screen covering.

Total effective outer screen area was 9.47 ft.² (0.88 m²). Cutout dimensions for the inner pipe sleeve are shown in Appendix C in both ft./lb. and S.I. units. Deployed weight was 34 lbs. (15.42 kg).

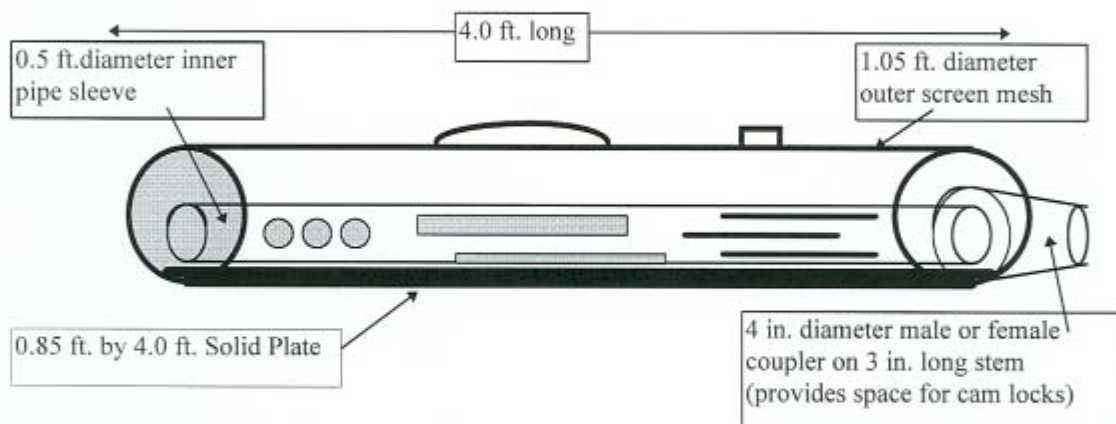


Figure 3. First Generation Four-Inch Pump Water Intake Cylinder.

Field Test Methodology. Prototypes were field evaluated for pumping capacity and screen approach water velocities. All testing was completed by ADF&G and ADOT&PF staff at the Fairbanks International Airport float plane pond.

Approach water velocities were measured immediately adjacent to the outer screen mesh surface with a Teledyne Gurley Model 625F Pygmy water current meter rated to measure velocities between 0.05 fps (1.5 cm/s) to 3.0 fps (91.44 cm/s).

A six-inch (152.5 mm) by six-inch (152.4 mm) Gorman-Rupp self-priming centrifugal pump, Model CE6A60-4039D diesel pump was used for testing the six-inch (152.4 mm) diameter first and second generation pump intake cylinders. The cylinder was tested at a rated pumping capacity of approximately 1,200 gpm (75.7 l/s).

The four-inch (101.6 mm) diameter first generation pump intake cylinder was tested using a Wacker PT4B gasoline centrifugal trash pump with a maximum rated capacity of 740 gpm (46.68 l/s). Estimated rated pumping capacity during testing was 600 gpm (37.85 l/s).

Performance curves for both pumps are provided in Appendix D.

RESULTS

First Generation Six-Inch Cylinder: The first generation six-inch (152.4 mm) pump intake prototype was field tested on July 23, 1996, at the Fairbanks International Airport float plane pond. Approach water velocities were non-detectable with the pygmy gurley water velocity meter at the proximal end of the cylinder and within the center one-third of the cylinder.

Approach water velocities at the distal end adjacent to the 1-5/8 inch (41.28 mm) circular holes in the inner pipe sleeve fluctuated between below detection to a maximum of 0.17 fps (5.18 cm/s).

Water was pumped through the screened intake for approximately 40 minutes. During this period, slight organic fouling of the screen surface was noted on the bottom half of the distal 1/3 segment.

Second Generation Six-Inch Cylinder: The second generation six-inch (152.4 mm) pump intake prototype was field tested on August 25, 1997. These tests also were conducted at the Fairbanks International Airport float plane pond. Approach water velocities across the entire screen surface were non-detectable with the pygmy gurley water velocity meter.

A 2 ft. (60.96 cm) by 1 ft. (30.48 cm), 1.5 millimeter thick plastic garbage bag was placed over the outer screen in the proximal 1/3 segment, the middle 1/3 segment, and the distal

1/3 segment of the intake cylinder. The plastic bag reduced the effective screen surface by approximately 17%, yet did not adhere firmly to the screen surface in the proximal 1/3 and middle 1/3 segments. In the distal 1/3 segment, the plastic bag adhered to the screen surface but dislodged readily when tugged gently by hand. To further evaluate the distal 1/3 segment, grass blades approximately 0.5 ft. (15.24 cm) long were placed against the screen. Inducing a slight current (running my hand underwater or moving through the water column adjacent to the intake cylinder in my hip boots) washed the grass blades off the screen surface.

The cylinder was elevated to the water surface so that the top of the cylinder was just covered by water. This test was designed to mimic actual field conditions with a maximum channel water depth of 1.3 ft. (39.62 cm). At full pumping capacity, no cavitation was observed.

Water was pumped through the screened intake for approximately 25 minutes. Although the float pond had some floating and benthic organic debris (leaves, sedges, and upland grasses), no organic fouling of the screen surface was noted during the test period.

First Generation Four-Inch Cylinder: The four-inch (101.6 mm) pump intake prototype also was field tested on August 25, 1997, at the Fairbanks International Airport float plane pond. Approach water velocities across the entire screen surface were non-detectable with the pygmy gurley water velocity meter.

A 1.5 ft. (45.72 cm) by 1 ft. (30.48 cm), 1.5 millimeter thick, plastic garbage bag (a portion of the original plastic bag used in the six-inch test) was placed over the outer screen in the proximal 1/3 segment, the middle 1/3 segment, and the distal 1/3 segment of the intake cylinder. The plastic bag reduced the effective screen surface by approximately 16%, yet did not adhere firmly to the screen surface in any of the segments. A sweep of the hand underwater near the cylinder readily swept the plastic bag away from the screen surface and it floated away in the water column. To further evaluate the cylinder, grass blades approximately 0.5 ft. (15.24 cm) long were placed against the screen. Inducing a slight current (running my hand underwater or moving through the water column in my hip boots) washed the grass blades off the screen surface.

The cylinder was elevated to the water surface so that the top of the cylinder was just covered by water. This test was designed to mimic actual field conditions with a maximum channel water depth of 1.05 ft. (32 cm). At full pumping capacity, no cavitation was observed.

Water was pumped through the screened intake for approximately 20 minutes. Although the float pond had some floating and benthic organic debris (leaves, sedges, and upland grasses), no organic fouling of the screen surface was noted during the test period.

DISCUSSION

The cylindrical water intake structures are designed for installation in shallow, swift portions of flowing waterbodies which Group A and B fry and juvenile fish typically do not use as preferred habitats. The cylinders are designed to align parallel with the stream current. This maintains flushing flows along the length of the screen thereby minimizing fouling and potential impingement of fish against the screen surface.

Correctly positioned in portions of flowing waterbodies where Group A and B fry and juvenile fish are not present, the 1/4 inch (6.35 mm) screen meets ADF&G's mesh requirements for Group C (yearling), D, and E fish. Installation of the intake cylinder in waters containing Group C young-of-the-year coho, chinook, sockeye, or Dolly Varden (Arctic char) immediately after their emergence from the gravels in the spring will require wrapping the cylinder with 0.1 in. (2.54 mm) mesh hardware cloth to prevent entrainment of fish through the screen. Installation of the intake cylinder in pools or sluggish waters containing Group A and B fish requires wrapping the cylinder with 0.04 in. (1.02 mm) hardware cloth. This will reduce the effective screen area. Further testing is needed to evaluate impacts on pumping rates and effective approach water velocities using smaller mesh sizes.

FUTURE DEVELOPMENT AND TESTING

A third generation six-inch (152.4 mm) diameter pump water intake cylinder has been constructed using 1/8 inch thick aluminum pipe in lieu of the Schedule 40 pipe used in the first and second generation prototypes. All other design criteria for the third generation cylinder were identical to the second generation cylinder. Deployed weight of the third generation cylinder is 25.4 lbs. (11.52 kg). Field testing will occur in Summer 1998.

Prototype units have been deployed to ADOT&PF field maintenance camps for further testing in 1998. Additional prototypes using a 0.1 inch (2.54 mm) mesh outer screen surface will be developed in 1998 and evaluated. We are attempting to obtain a velocity meter with a lower minimum detection limit and greater precision to complete additional testing in 1998.

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- Sundberg, Kim. 1986. Rationale for (Proposed) Water Intake Standards (5 AAC 94.270) For Water Withdrawal Operations. Alaska Department of Fish and Game, Habitat Division. Juneau, AK. 8 p.



Figure 4. Photograph of Second Generation Six-Inch Pump Water Intake Cylinder.



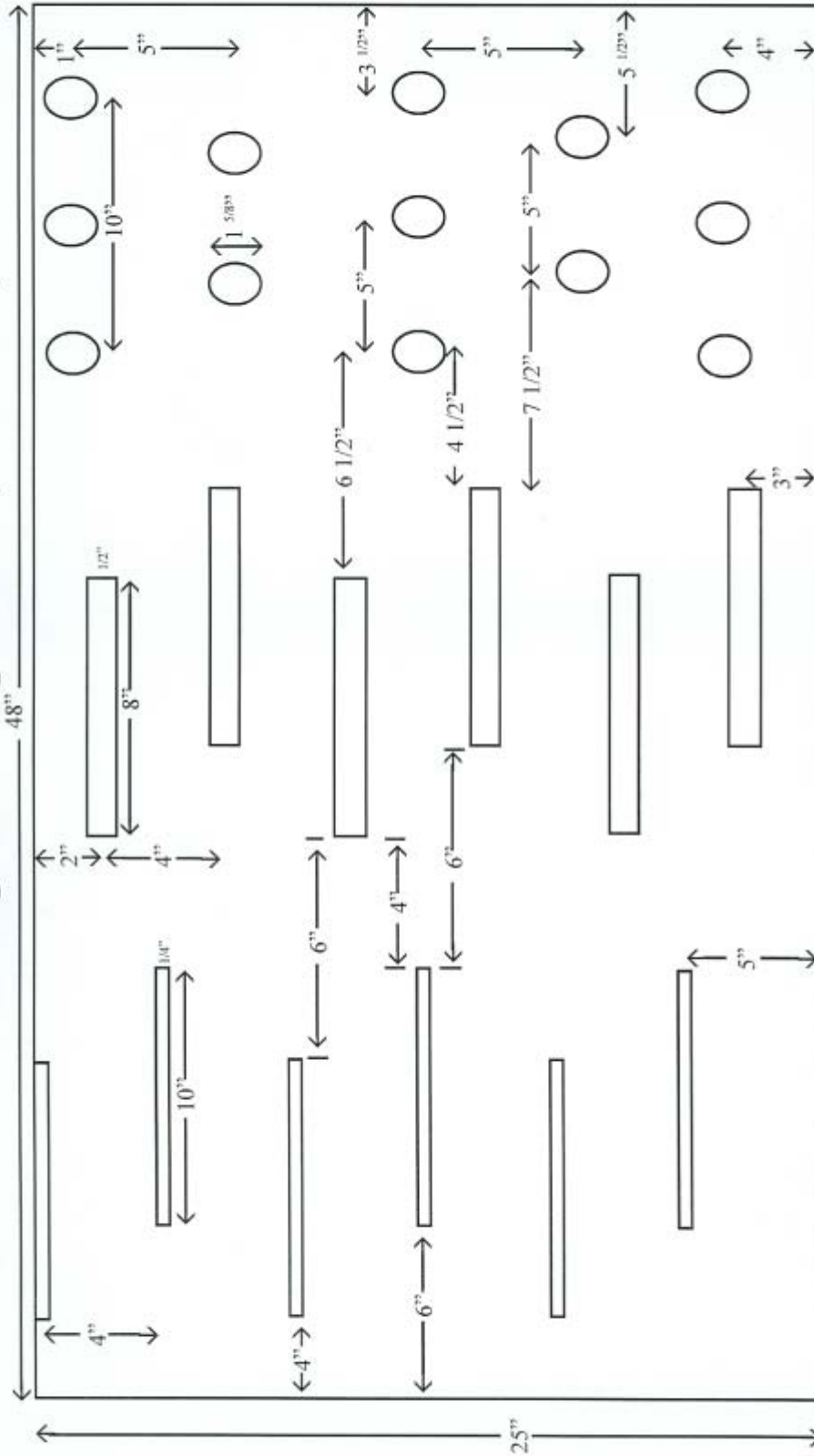
Figure 5. Photograph of First Generation Four-Inch Pump Water Intake Cylinder.

APPENDIX A

Inner Pipe Sleeve Cut-Out Diagram for First Generation Six-Inch Pump Water Intake Cylinder

First Generation Water Intake Cylinder

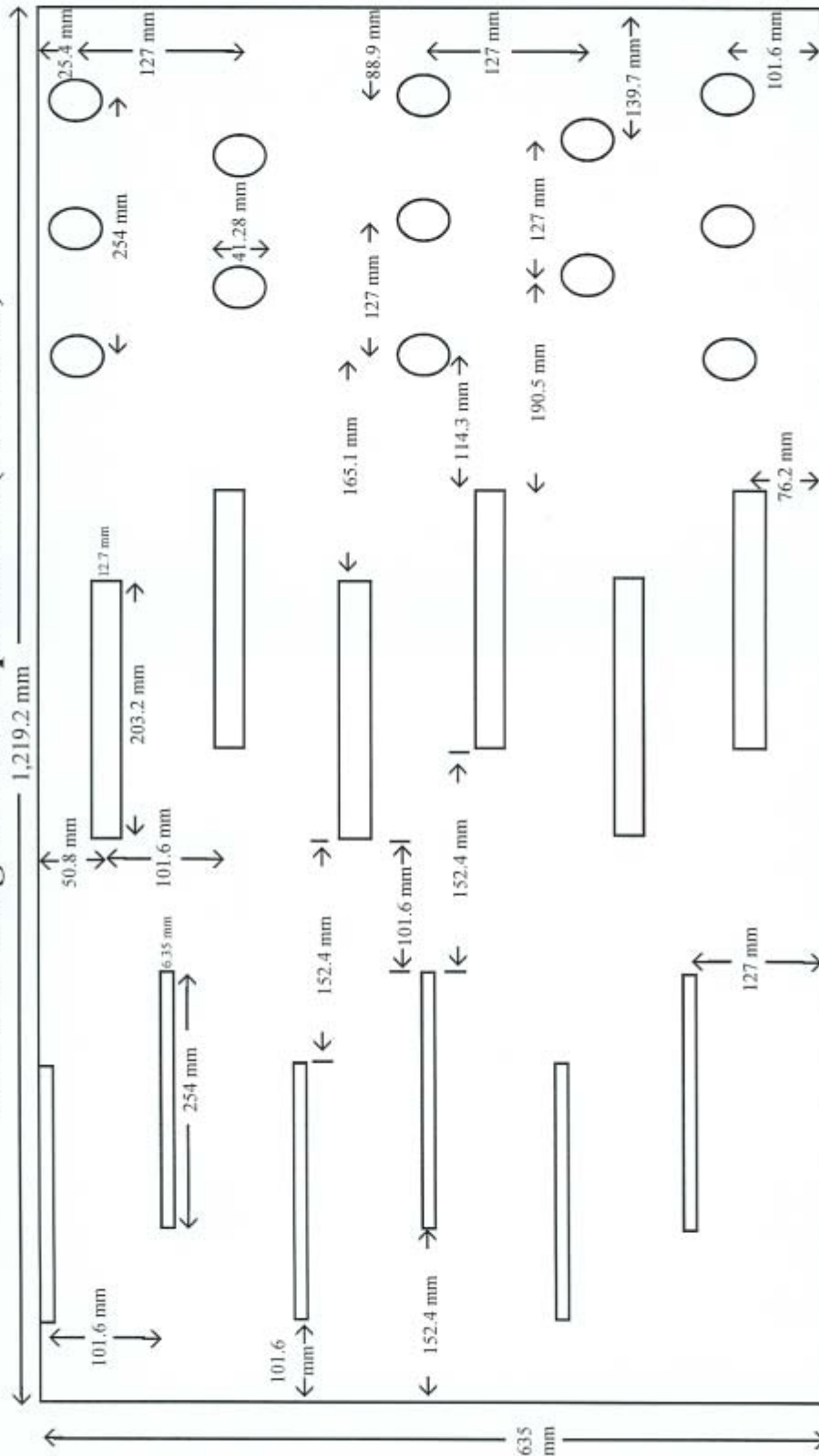
Cut-Out Diagram for Pipe Sleeve (ft./lb. units)



Proximal End **8 Inch (203.2 mm) Diameter Aluminum Pipe** Distal End

First Generation Water Intake Cylinder

Cut-Out Diagram for Pipe Sleeve (S.I. units)



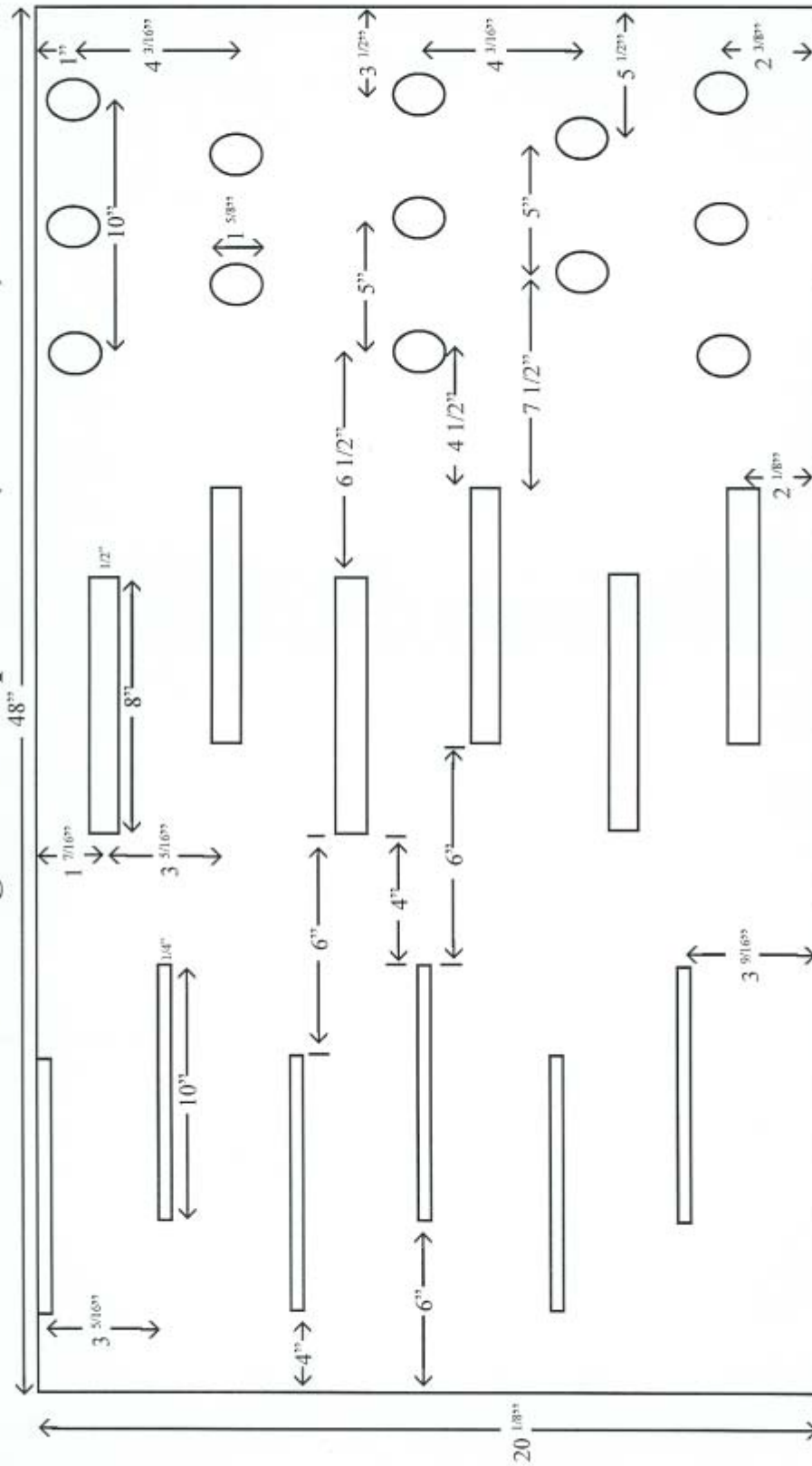
8 Inch (203.2 mm) Diameter Aluminum Pipe

APPENDIX B

Inner Pipe Sleeve Cut-Out Diagram for Second Generation Six-Inch Pump Water Intake Cylinder

Second Generation Water Intake Cylinder

Cut-Out Diagram for Pipe Sleeve (ft./lb. units)



Distal End

6 Inch (152.4 mm) Diameter Aluminum Pipe

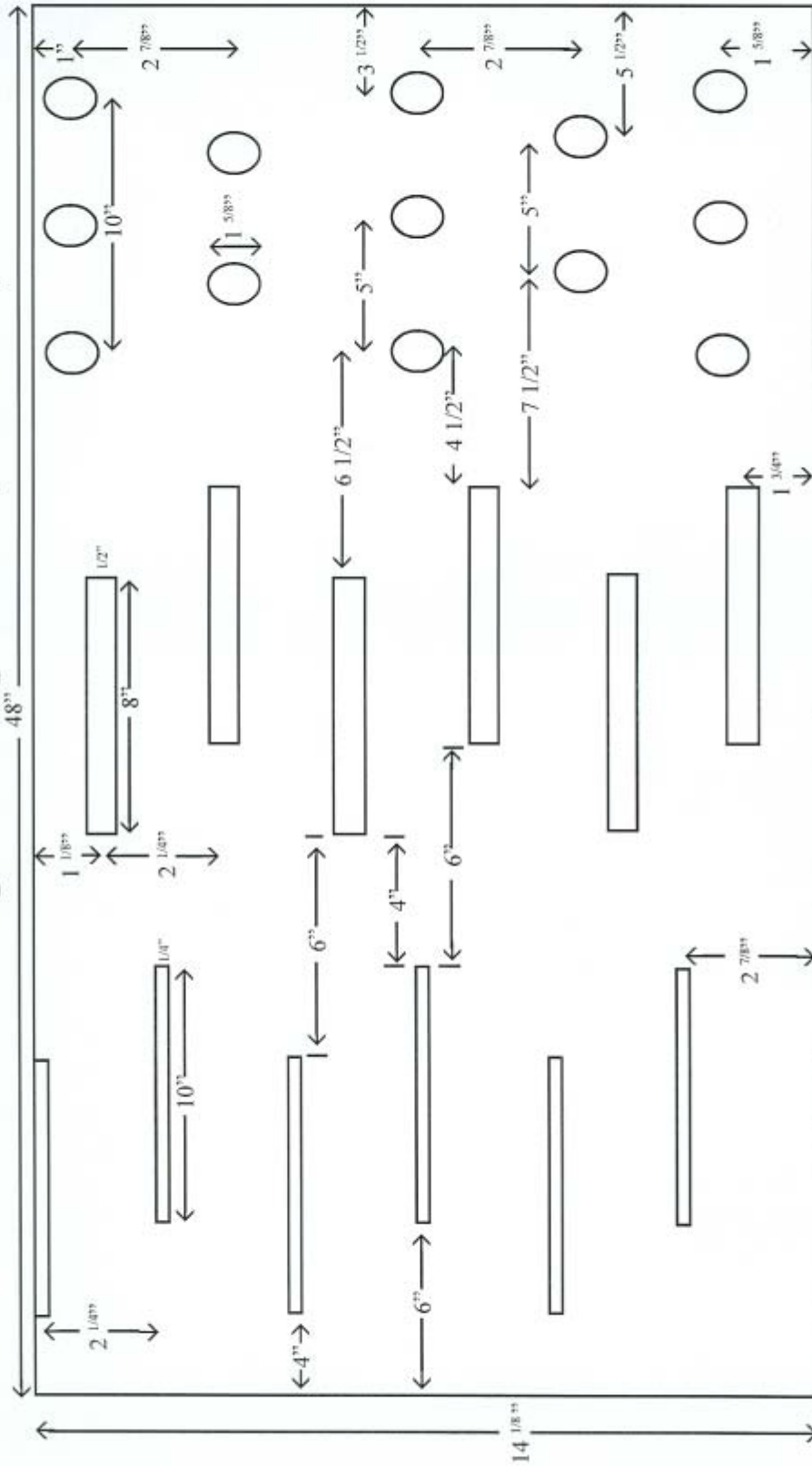
Proximal End

APPENDIX C

Inner Pipe Sleeve Cut-Out Diagram for First Generation Four-Inch Pump Water Intake Cylinder

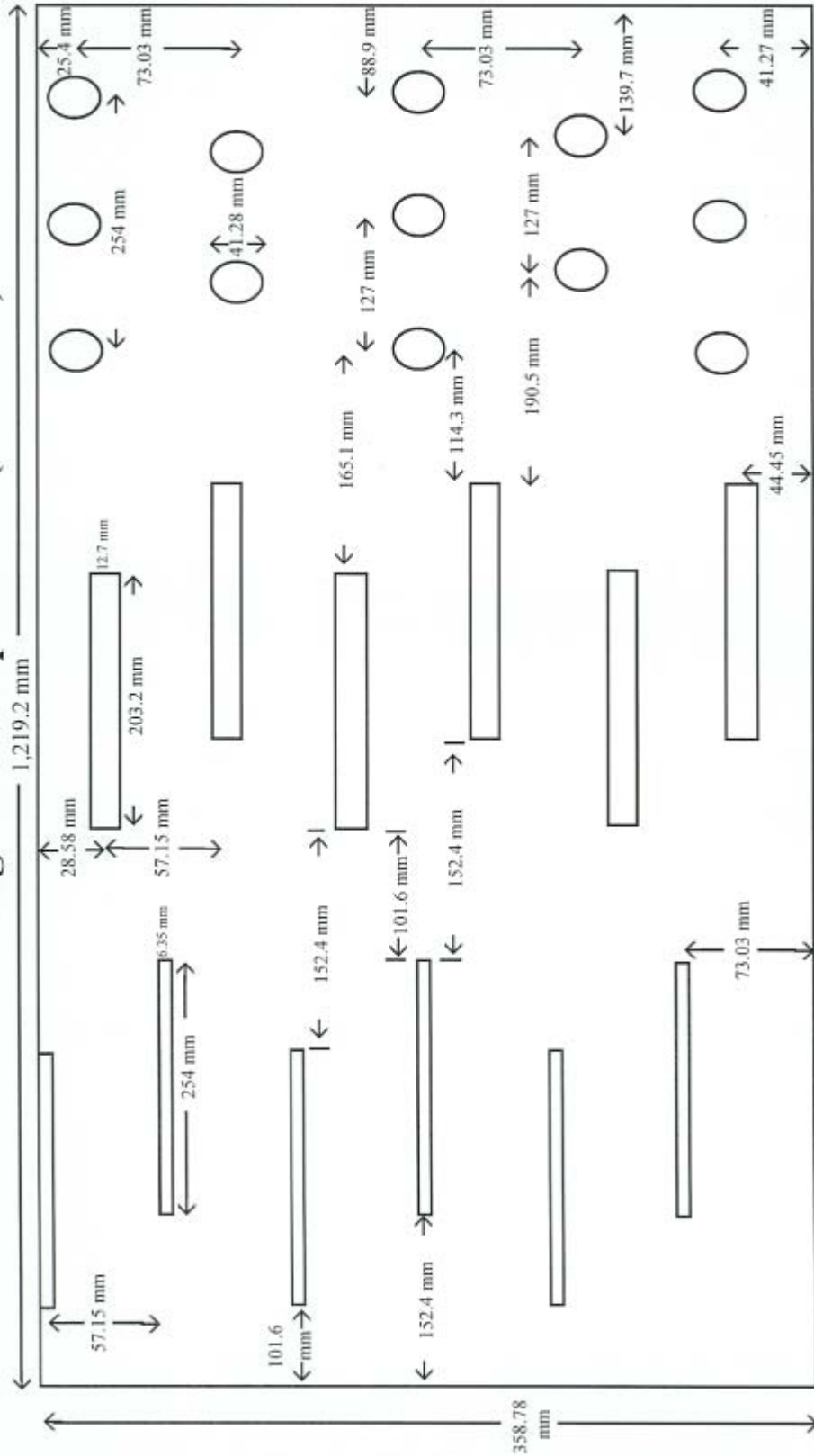
First Generation Water Intake Cylinder

Cut-Out Diagram for Pipe Sleeve (ft./lb. units)



First Generation Water Intake Cylinder

Cut-Out Diagram for Pipe Sleeve (S.I. units)



Proximal End 4 Inch (101.6 mm) Diameter Aluminum Pipe Distal End

APPENDIX D

Water Pump Performance Charts

TRASH PUMPS

CENTRIFUGAL TRASH PUMPS — 2"

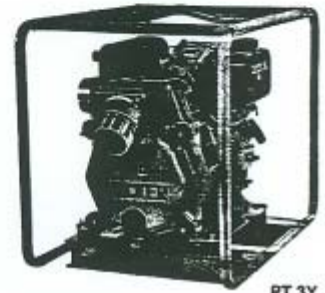
model	suction/ discharge (in)	max. head (ft)	max. discharge (gpm)	engine	power (hp)	weight (lb)
PT 2A	2	100	205	Honda Gasoline	5.5	134
PT 2B	2	100	205	Briggs & Stratton I/C Gasoline	5	133
PT 2R	2	100	205	Robin Sovereign Gasoline	6	136
PT 2Y	2	88	150	Yanmar Diesel	4.7	145



PT 2A

CENTRIFUGAL TRASH PUMPS — 3"

PT 3A	3	95	425	Honda Gasoline	8.0	164
PT 3B	3	95	425	Briggs & Stratton I/C Gasoline	8.0	155
PT 3V	3	95	425	Vanguard Gasoline	9	177
PT 3Y	3	82	350	Yanmar Diesel	6.7	187



PT 3Y

CENTRIFUGAL TRASH PUMPS — 4"

PT 4B	4	105	740	Briggs & Stratton I/C Gasoline	16	361
PTS 4H*	4	82	625	Hatz Diesel	12	550

*With electric start.



PTS 4H

CENTRIFUGAL TRASH PUMP — 6"

PT 6 LT	6	100	1300	Lombardini Diesel	32.5	2400
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Specifications may change due to continuous product development.



ACE

Self Priming Centrifugal Pump

Diesel Engine Driven

Model CE6A60-4039D

Size 6" x 6"

CERTIFIED
PERFORMANCE

70 MT

Total Head		CAPACITY OF PUMP IN U.S. GALLONS PER MINUTE AT CONTINUOUS PERFORMANCE				
P.S.I.	Feet					
58	136	460	460	460	460	460
52	120	520	650	745	745	745
30	100	660	785	960	1090	1090
35	80	750	920	1090	1300	1340
26	60	795	1030	1215	1370	1465
17	40	810	1065	1275	1435	1565
Suction lift		25'	20'	15'	10'	5'

PUMP SPECIFICATIONS

Size: 6" [152.4 mm] x 6" [152.4 mm] N.P.T.-Female

Casing: Gray Iron No. 30

(Maximum Operating Pressure 90 psi. [620 kPa])

Impeller: Open Type, Two Vanes,

Ductile Iron No. 60-40-18

(Handles 3" [76.2 mm] Dia. Spherical Solids)

Impeller Shaft: Stainless Steel No. 17-4 PH

Wear Plate-Replaceable: Steel No. 1026

Cover Plate-Removable: Gray Iron No. 30 (50 lbs. [22.7 kg.])

Intermediate Bracket: Gray Iron No. 30

Seal Plate: Gray Iron No. 30

Seal: Mechanical Oil-Lubricated Double Floating Self-Aligning.

Rotating and Stationary Faces are Silicon Carbide.

Stationary Seat is Stainless Steel No. 316.

Elastomers are Viton. Cage and Spring are

Stainless Steel No. 18-8. Maximum Temperature

of Liquid Pumped is 160°F [71°C].*

* Consult factory for applications with liquids in excess of temperature indicated.

Shaft Sleeve: Alloy Steel No. 4130

Flap Valve: Neoprene with Steel Reinforcing

Radial Bearing: Open Ball

Thrust Bearing: Open Double Ball

Bearing Lubrication: Oil

Flanges: Gray Iron No. 30

Gaskets: Compressed Synthetic Fibers; Teflon

O-Rings: Buna-N

Hardware: Standard Plated Steel

Standard Equipment:

Hoisting Bail

Skid Base

90° Discharge Elbow

Strainer

Oil Level Sight Gauge

Pressure Relief Valve: Brass

Optional Equipment:

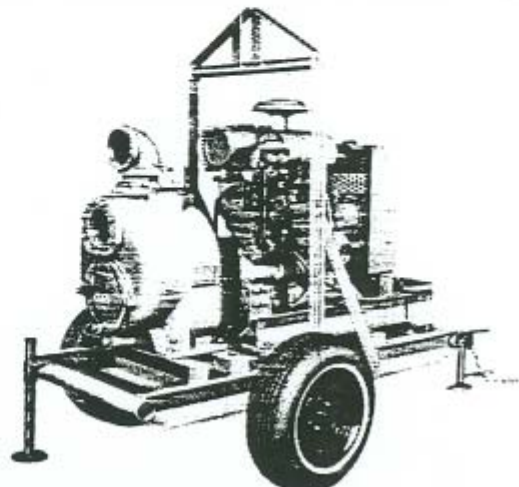
2 Wheel Truck Assy with Pneumatic Tires, P235/75R15

Battery

Over the Road Trailer (Meets D.O.T. Requirements)

Austempered Ductile Iron Impeller

Hardened Steel Wear Plate



ENGINE SPECIFICATIONS

Model: John Deere 4039D

Type: Four Cylinder, Four Cycle,

Liquid Cooled Diesel Engine

Displacement: 239 Cu. In. [3.9 L]

Governor: Mechanical

Lubrication: Forced Circulation

Air Cleaner: Dry Type

Oil Reservoir: 9 U.S. Quarts [8.5 L]

Fuel Tank: 38.9 U.S. Gallons [147.2 L]

Operating Time; Full Load: 13.04 Hours

Starter: 12 Volt Electric

Standard Features:

Safety Shut Down Switches for Low Oil Pressure and High Coolant Temperature

Instrument Panel with Temp. Gauge, Oil pressure Gauge, Ammeter, Hourmeter & Tachometer

Muffler with Guard and Weather Cap

JOHN DEERE PUBLISHED PERFORMANCE:

Max. Cont. B.H.P. 71 @ 2200 RPM

Max. Dyn. B.H.P. 80 @ 2500 RPM

WARNING

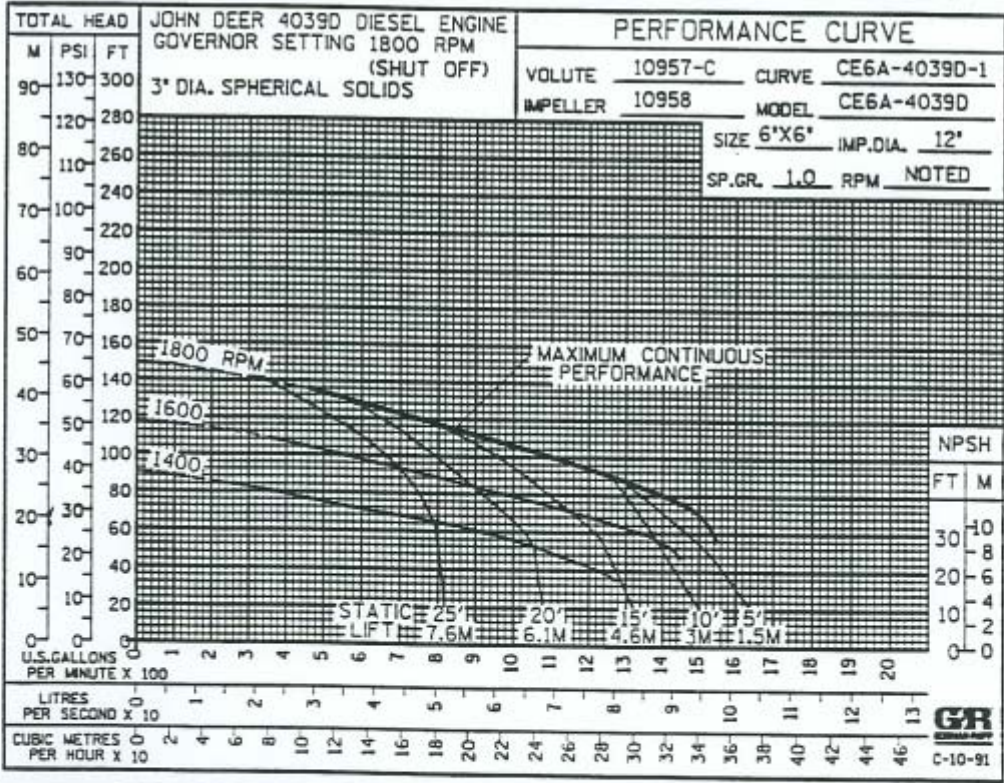
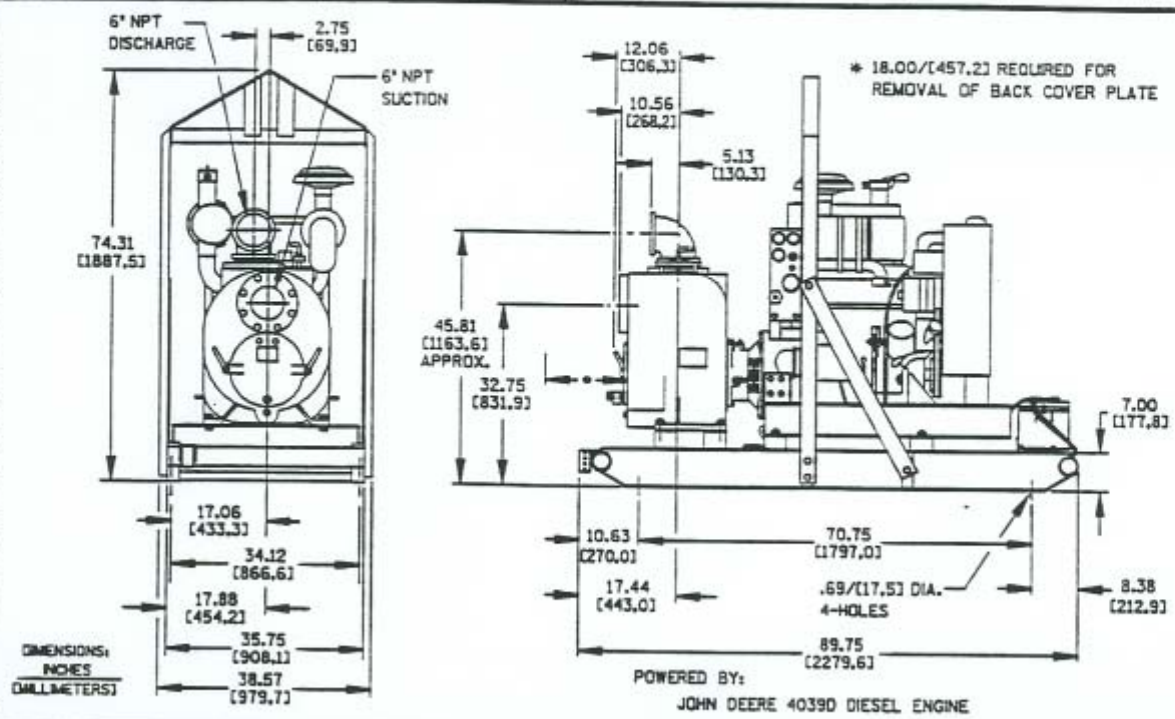
DO NOT USE IN EXPLOSIVE
ATMOSPHERE OR FOR PUMPING
VOLATILE FLAMMABLE LIQUIDS

THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO

GORMAN-RUPP OF CANADA LIMITED • ST. THOMAS, ONTARIO, CANADA

Printed in U.S.A.

Specification Data	OVERALL DIMENSIONS and WEIGHTS APPROXIMATE	SKID BASE		2-WHEEL
		NET WEIGHT: 2780 LBS. [1261 KG.]	2960 LBS. [1343 KG.]	
SECTION 45, PAGE 1530		SHIPPING WEIGHT: 2905 LBS. [1318 KG.]	2960 LBS. [1343 KG.]	
		EXPORT CRATE SIZE: 172 CU. FT. [4.9 CU. M.]	190 CU. FT. [5.4 CU. M.]	



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