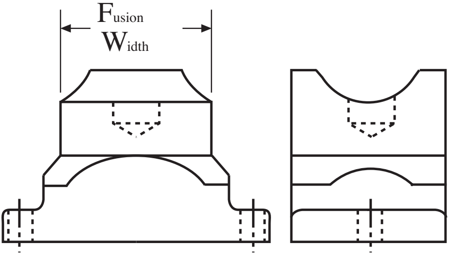
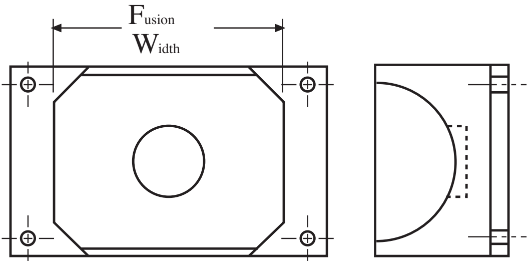
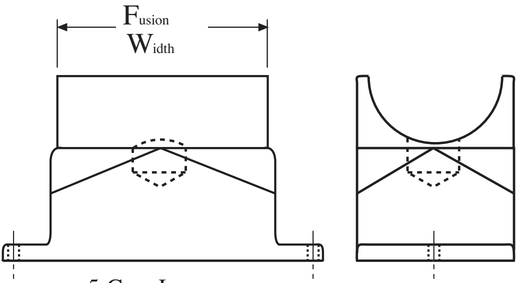
Saddle Fusion Procedures



1 - Concave (Small Round Base)

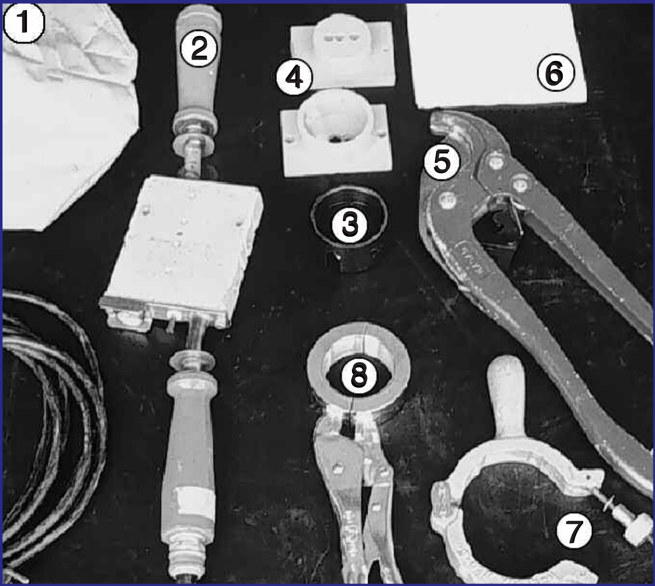


3 - Concave (Rectangular Base)



5 - Concave (Large Round Base)

Socket Tooling and Fusion Procedure



Nomenclature

1) Heater Sling
2) Heater
3) Chamfer Tool/Depth Gauge
4) Heater Adapters
5) Pipe Cutter
6) Clean Cloth
7) Fitting Holder
8) Cold Ring Clamp

ISCO INDUSTRIES

McELROY

Socket Tooling and Fusion Procedure

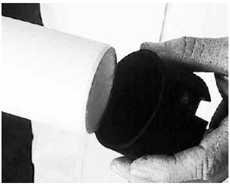
The theory of heat fusion is to heat two surfaces to a designed temperature, and then fuse them together by application of force. This pressure causes flow of the melted materials, which causes mixing and thus fusion. When the polyethylene material is heated, the molecular structure is transformed from a crystalline state into an amorphous condition. When fusion pressure is applied, the molecule from each polyethylene part mix. As the joint cools, the molecules return to their crystalline form, the original interfaces are gone, and the fitting and pipe have become one homogeneous unit.

The principle operations include:

Clamping	The pipe and fitting must be held firmly to allow all subsequent operations to take place.
Cleaning	The area of pipe that the fitting will come in contact with must be cleaned, as well as the base of the fitting.
Alignment	The fitting must be properly seated on the pipe for proper alignment.
Heating	A melt pattern must be formed that penetrates into the pipe and into the fitting.
Joining	The melt patterns must be joined with pressure. The pressure must be constant around the interface area.
Holding	The molten joint must be held immobile until adequately cooled.

Socket Fusion Tooling and Fusion Procedure

Prepare Pipe End



Cut off damaged or oval ends of pipe squarely with a pipe cutter.

Place the chamfering tool on end of pipe and turn to cut off sharp edge on top end of pipe.

Remove shavings and burrs inside pipe end.

Depth Gauge

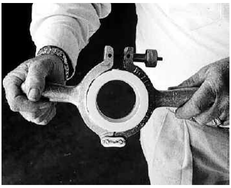
The chamfering tool is also a depth gauge for measuring the length of pipe that will go into the fitting.

Place chamfering tool on end of pipe.

Place cold ring clamp on pipe at the bottom of the chamfering tool.

Remove chamfering tool.

Secure 63 mm (2") And Larger Fittings



Place fitting in socket fitting holder.

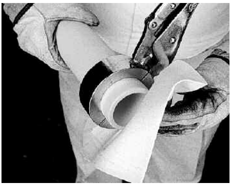
Tighten socket fitting holder around fitting.

Socket Fusion Tooling and Fusion Procedure

Clean Fitting And Pipe

Fitting and pipe must be clean and dry. Use a clean cloth to wipe the mating surfaces.

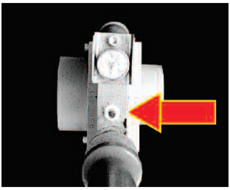
Notice:
Do not touch with hands.



Heater Is Not Explosive Proof

⚠ DANGER This heater is not explosion proof. Operation of heater in a hazardous environment without necessary safety precautions will result in explosion and death. If operating in a hazarduous environment the heater should be brought up to temperature in a safe environment, then unplugged before entering the hazarduous atmosphere for fusion.

Use a clean non-synthetic cloth to clean the heater adapter surfaces.



Old Style Heater

New Style Heater

Heater Temperature

⚠CAUTION Incorrect heating temperature can result in questionable fusion joints. Check socket faces periodically in multiple locations with a pyrometer and make necessary adjustments.

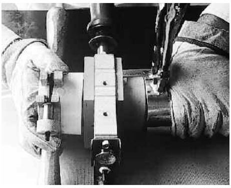
The non-stick coating on the heater adapters should be in good condition.

The socket faces of the heater must be at the correct temperature. Minimum 255° C (490° F), **Optimum 260° C (500**°) Maximum 265° C (510° F).

Important:
The dial thermometer on the heater indicates internal temperature. The dial thermometer can be used as reference once the surface temperature has been verified.

Socket Fusion Tooling and Fusion Procedure

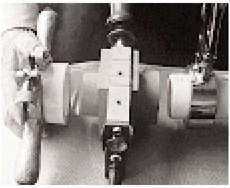
Heating The Pipe And Fittings



Firmly seat the socket fitting on the male adapter on the heater. Place the female adapter of the heater over the end of the pipe, firmly against the cold ring clamp. Heating time starts when the heater is bottomed out on the cold ring clamp. See chart on page 67 for proper heating time.

Notice: Do not twist fitting, pipe or heater.

Remove Heater



Snap the heater and fitting from the pipe by holding upper part of heater handle with one hand and tapping sharply on the handle with the other hand. Immediately remove fitting from heater.

Inspect Melt

Quickly inspect the heated parts to make sure all surfaces have been melted properly.

If melt is not complete, cut off melted pipe end. Use a new fitting and repeat preparation and heating process over again.

ISCO INDUSTRIES

Socket Fusion Tooling and Fusion Procedure

Fusion And Cooling

Within 3 seconds after the heater has been removed, firmly push the melted fitting squarely onto the pipe until it makes firm contact with the cold ring clamp.

Notice: Do not twist or rotate the fitting.

Hold the fitting firmly in place for the total cooling time. See chart on page 67 for proper cooling time. ***Pipe and fitting should be aligned straight with each other.***

Inspecting Fusion Joint

After completing the specified cooling and waiting time, remove the cold ring clamp and the socket fitting holder.

Inspect the joint. A good joint will have a uniform melt ring that is flat against the socket fitting and perpendicular to the pipe.

There should be no gaps or voids between the fitting and the pipe. If the joint is questionable refer to the Troubleshooting Guide (page 66) for possible cause and adjustments that can be done before next fusion.

Holding force may be relaxed when the cooling time ends. After an additional 3 minutes undisturbed cooling time, the Cold Ring Clamp can be removed. Allow an additional 10 minutes undisturbed cooling time before testing, backfilling, or stressing the joint.

Total Cooling Time equals time shown on chart (page 67) plus an additional 13 minutes.

Socket Fusion Tooling and Fusion Procedures

Troubleshooting Guide

Observed Condition	Possible Cause
No cold-ring impression in socket fitting melt bead	Depth gauge not used; Cold ring not used, or set at incorrect depth; Insufficient heat time
Gaps or voids around the pipe at socket fitting edge	Pipe or fitting removed straight from heater face (twisting or removing from heater face at an angle); Pipe or fitting not inserted straight into each other when fusing; joining together at an angle; Twisting while joining pipe and fitting together; Cold ring not used or set to deep
(When viewed from inside, or when qualifying lengthwise cut joint) wrinkled or collapsed pipe or tubing end	Incorrect heating sequence-always push the pipe or tubing into the heater after the fitting has been pushed on the heater (inserting the tubing first heats the tubing too long); Cold ring set too deep; Cold ring not used
(When qualifying lengthwise cut joint) voids in fusion bond area	Pipe or fitting not removed straight from heater face (twisting or removing from heater face at an angle); Pipe or fitting not inserted straight into each other when fusing; joining together at an angle; Twisting while joining pipe and fitting together; Cold ring not used or set too deep
(When qualifying lengthwise cut joint) Unbonded area on pipe or tubing at end of pipe or tubing	Cold ring not used or set too deep
(When qualifying lenghtwise cut joint) Socket melt extends past end of pipe or tubing	Cold ring set too shallow
Rough, sandpaper-like, bubbly, or pockmarked melt bead surface	Hydrocarbon contamination

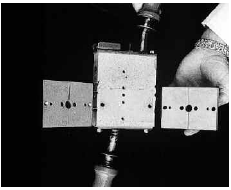
Socket Fusion Tooling and Fusion Procedures

Heating and Cooling Times

Pipe Size	PE 2406 (Yellow Pipe)		PE 80 (PE3408 Black Pipe)	
	Heating Time (Sec.)	Cooling Times (Sec.)*	Heating Time (Sec.)	Cooling Times (Sec.)*
20 mm (1/2" IPS)	6-7	20	9-10	30
25 mm (3/4" IPS)	8-10	20	12-14	30
32 mm (1" IPS)	10-12	30	15-17	40
40 mm (1-1/4" IPS)	12-14	30	18-21	40
50 mm (1-1/2" IPS)	14-17	30	20-23	40
63 mm (2" IPS)	16-19	30	24-28	40
90 mm (3"IPS)	20-24	40	28-32	50
110 mm (4"IPS)	24-29	40	32-37	50

* After an additional 3 minutes of undisturbed cooling time, the Cold Ring Clamp can be removed. After removing the Cold Ring Clamp allow an additional 10 minutes of undisturbed cooling time before testing, backfilling, or stressing the joint.

Installing Socket Fusion Heater Adapters



The heater body of this assembly is not coated. Coated heater adapters are available for all fusion applications.

Heater adapters are installed with Stainless Steel Cap Screws.

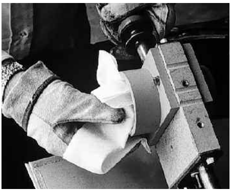
Care should be taken to assure that the heater adapters are seated on the heater body, and that there is no foreign matter trapped between these surfaces.

Important: Do not over-tighten the bolts.

The surface of the heater adapters are coated with an anti-stick coating.

Socket Fusion and Tooling Procedures

Clean Heater Surfaces



The heater adapters must be kept clean and free of any plastic build-up or contamination.

CAUTION Before and after each fusion is made, the surface of the heater adapters must be wiped with a clean, non-synthetic cloth.

Adjusting Heater Temperature

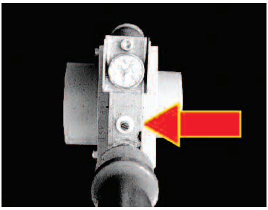
CAUTION Incorrect adjustment can result in injuries as well as machine damage. Follow these instructions carefully.

The heater thermoswitch adjustment shaft protrudes through the heater handle base.

Turn the adjustment shaft clockwise to lower temperature, counter clockwise to raise temperature.

Allow sufficient amount of time for unit to stabilize at the new temperature (5 to 10 minutes) after each adjustment.

One full turn equals approximately 38°C (100° F). (Old Style Heater)



Old Style Heater

New Style Heater

Reference Information: McElroy DataLogger™, Pendant/Coach™ Equipment & Fusion Pressure Charts

Reference

Power Requirements				
Machine	**Heater Power**	**Facer Power**	**Hydraulic**	**Min. Req. at sea Level**
MiniMc	300 Watt @ 120 VAC, 1Ph	Hand Operated	None	0.3 KW @ 120 VAC
No. 2LC	800 Watt @ 120 VAC, 1Ph	Hand Operated	None	0.8 KW @ 120 VAC
No. 2CU	800 Watt @ 120 VAC, 1Ph	Hand Operated	None	0.8 KW @120 VAC
Socket Fusion	2" - 800 Watt @ 120 VAC, 1Ph 4" - 1,200 Watt @ 120 VAC, 1Ph	Not Applicable	None	2" - Heater - 0.8 KW @120 VAC 4" - Heater - 2.5 KW @120 VAC
No. 14	1,200 Watt @ 120 VAC, 1Ph	7 Amps @ 120 VAC (Running) 22 Amps @ 120 VAC (Stall)	None	2.5 KW @120 VAC
Side-winder	2" - 800 Watt @ 120 VAC, 1Ph 4" - 1,200 Watt @ 120 VAC, 1Ph	Not Applicable	None	2" - Heater - 0.8 KW @120 VAC 4" - Heater - 2.5 KW @120 VAC
TracStar No. 28	1,750 Watt @ 120 VAC, 1Ph Saddle- 2,270 Watt @ 240 VAC, 1Ph	Hydraulic	Self-Contained	Self-Contained Gasoline
No. 28	1,750 Watt @ 120 VAC, 1Ph	Hydraulic	1 1/2HP, 1Ph @ 120 VAC	3.5 KW @120 VAC
No. 28 CU	1,750 Watt @ 120 VAC, 1Ph Saddle- 2,270 Watt @ 240 VAC	Hydraulic	1 1/2HP, 1Ph @ 120 VAC	4 KW @120 VAC
Mc. 28 Pitbull	1,750 Watt @ 120 VAC, 1Ph	Hydraulic	1 1/2HP, 1Ph @ 120 VAC	3.5 KW @120 VAC
TracStar No. 412	3,000 Watt @ 240 VAC, 1Ph	Hydraulic	Self-Contained	Self-Contained Diesel
No. 412	3,000 Watt @ 240 VAC, 1Ph	Hydraulic	Self-Contained	Self-Contained Gasoline
No. 412E	3,000 Watt @ 240 VAC, 1Ph	Hydraulic	3 HP, 3Ph @ 240 VAC	5.5 KW / 6.5 KVA @ 240 VAC 60Hz
TracStar No. 618	3,000 Watt @ 240 VAC, 1Ph	Hydraulic	Self-Contained	Self-Contained Diesel
No. 618	3,000 Watt @ 240 VAC, 1Ph	Hydraulic	Self-Contained	Self-Contained Gasoline
No. 618E	3,000 Watt @ 240 VAC, 1Ph	Hydraulic	5 HP, 3Ph @ 240 VAC	6.5 KW / 7.5 KVA @ 240 VAC 60Hz
TracStar 500	4,000 Watt @ 240 VAC, 1Ph	Hydraulic	Self-Contained	Self-Contained Diesel
No. 824	10,950 Watt @ 240 VAC, 3Ph	Hydraulic	7.5 HP, 3Ph @ 240 VAC	17.5 KW / 20 KVA @ 240 VAC 60Hz
TracStar 900	20,461 Watt @ 240 VAC, 3Ph	Hydraulic	Self-Contained	Self-Contained Diesel
No. 1236	20,461 Watt @ 240 VAC, 3Ph	Hydraulic	10 HP, 3Ph @ 240 VAC	30 KW / 30 KVA @ 240 VAC 60Hz
No. 1648	35,000 Watt @ 240 VAC, 3Ph	Hydraulic	10 HP, 3Ph @ 240 VAC	50 KW / 50 KVA @ 240 VAC 60Hz
No. 2065	65"- 38,437 Watt @ 240 VAC, 3Ph 48"- 35,000 Watt @ 240 VAC, 3Ph	Hydraulic	10 HP, 3Ph @ 240 VAC	50 KW / 50 KVA @ 240 VAC 60Hz

Reference

Pipe Size Reference Charts

Metric ISO Pipe Sizes		
Pipe	OD	Circumference
20 mm	0.79"	2.48"
25 mm	0.98"	3.09"
32 mm	1.26"	3.96"
50 mm	1.97"	6.18"
63 mm	2.48"	7.79"
75 mm	2.95"	9.28"
90 mm	3.54"	11.13"
100 mm	3.94"	12.37"
110 mm	4.33"	13.61"
125 mm	4.92"	15.46"
150 mm	5.91"	18.55"
160 mm	6.30"	19.79"
180 mm	7.09"	22.26"
200 mm	7.87"	24.74"
225 mm	8.86"	27.83"
250 mm	9.84"	30.92"
280 mm	11.02"	34.63"
315 mm	12.40"	38.96"
340 mm	13.39"	42.05"
355 mm	13.98"	43.91"
400 mm	15.75"	49.47"
450 mm	17.72"	55.66"
500 mm	19.69"	61.84"
560 mm	22.05"	69.26"
630 mm	24.80"	77.92"
710 mm	27.95"	87.82"
800 mm	31.50"	98.95"
900 mm	35.43"	111.32"
1000 mm	39.37"	123.68"
1200 mm	47.24"	148.42"
1400 mm	55.12"	173.16"
1600 mm	62.99"	197.90"

Metric JIS-1, 1U, 2, 3 Pipe Sizes		
Pipe	OD	Circumference
40 mm	1.89"	5.94"
50 mm	2.36"	7.41"
75 mm	3.50"	11.00"
100 mm	4.49"	14.10"
125 mm	5.51"	17.31"
150 mm	6.49"	20.39"
175 mm	7.48"	23.50"
200 mm	8.50"	26.70"
250 mm	10.51"	33.02"
300 mm	12.52"	39.33"
350 mm	14.57"	45.77"
400 mm	16.54"	51.96"

OD Pipe Sizes		
Pipe	OD	Circumference
2 5/8"	2.62"	8.25"
4 1/4"	4.25"	13.35"
6.27"	6.27"	19.70"
7 1/8"	7.12"	22.38"
21 1/2"	21.50"	67.54"

Reference

Pipe Size Reference Charts

IPS Pipe Sizes

Pipe	OD	Circumference
1/2"	0.84"	2.64"
3/4"	1.05"	3.30"
1"	1.32"	4.13"
1 1/4"	1.66"	5.22"
1 1/2"	1.90"	5.97"
2"	2.37"	7.46"
2 1/2"	2.87"	9.03"
3"	3.50"	11.00"
4"	4.50"	14.14"
5"	5.56"	17.47"
6"	6.63"	20.81"
8"	8.63"	27.10"
10"	10.75"	33.77"
12"	12.75"	40.06"
14"	14.00"	43.98"
16"	16.00"	50.27"
18"	18.00"	56.55"
20"	20.00"	62.83"
22"	22.00"	69.12"
24"	24.00"	75.40"
26"	26.00"	81.68"
28"	28.00"	87.96"
30"	30.00"	94.25"
32"	32.00"	100.53"
34"	34.00"	106.81"
36"	36.00"	113.10"
42"	42.00"	131.95"
48"	48.00"	150.80"
52"	52.00"	163.36"
54"	54.00"	169.65"
63"	63.00"	197.92"

DIPS Pipe Sizes

Pipe	OD	Circumference
3"	3.69"	12.44"
4"	4.80"	15.08"
6"	6.90"	21.68"
8"	9.05"	28.43"
10"	11.10"	34.87"
12"	13.20"	41.47"
14"	15.30"	48.07"
16"	17.40"	54.66"
18"	19.50"	61.26"
20"	21.60"	67.86"
24"	25.80"	81.05"
30"	32.00"	100.53"
36"	38.30"	120.32"
42"	44.50"	139.80"
48"	50.80"	159.59"
54"	57.10"	179.38"
60"	61.61"	193.55"
64"	65.64"	206.21"

CTS Pipe Sizes

Pipe	OD	Circumference
1/2"	0.63"	1.98"
3/4"	0.88"	2.75"
1"	1.13"	3.53"
1 1/4"	1.38"	4.32"
1 1/2"	1.63"	5.11"
2"	2.13"	6.68"

Hydraulic Fluid Characteristic Chart

The use of proper hydraulic oil is mandatory to achieve maximum performance and machine life. Hydraulic oil should have anti-wear and other special additives. The oil must meet 150 SSU at 38° C (100ºF), with the exception of a cold weather operation.

The following table specifies the oil temperature at various viscosities. Temperature rise of the hydraulic oil can vary from 1°C (30ºF) to about 21°C (70ºF) over the ambient temperature depending on the pressure setting, age of the pump, wind, etc. Mobile DTE 15M multi-grade hydraulic oil is installed at the factory. The advantage of this oil is a wider temperature range, however, this oil should not be used for continuous operation below -7°C (20ºF). For use in extremely cold ambient temperatures, we suggest Mobile DTE 11, which can be used to -26°C (-16ºF). This oil should not be used for continuous operation above 38°C (100ºF) (oil temperature).

Note: This chart is based on pump manufacturer recommendations of 100 to 4000 SSU limits.
Note: Temperatures shown are fluid temperatures - Not ambient temperatures.

Reference

Hydraulic Fluid Characteristic Chart				
Manufacturer	Fluid Name	SSU 100F	SSU 210F	V.I.
Chevron	Chevron 32 AW	173	45	100
	Chevron 46 AW	238	49	98
	Chervon 68 AW	335	54	99
Phillips	Magnus A32	170	45	101
	Magnus A46	225	48	98
	Magnus A68	350	54	98
Shell	Tellus T32	150	44	102
	Tellus T46	215	48	103
	Tellus T68	315	53	89
Sun	Sunvis 2105	206	52	167
	Sunvis 832	164	44	99
	Sunvis 846	236	49	98
	Sunvis 868	352	55	98
Unocal	Unax AW 32	150	44	107
	Unax AW 46	215	48	107
	Unax AW 68	315	54	107
Mobil	DTE 11M	87	40	145
	DTE 13M	165	48	140
	DTE 15M	225	53	140
	DTE 24	162	44	95
	DTE 25	227	47	95
	DTE 26	335	53	95
Exxon	Univis N-32	177	49	164
	Univis N-46	233	55	163
	Univis N-68	376	68	160

Reference

Hydraulic Fluid Characteristic Chart

-20ºF	-10ºF	0ºF	10ºF	30ºF	50ºF	70ºF	90ºF	110ºF	130ºF	150ºF	Range Fahrenheit
											15-125
											25-142
											34-155
											15-123
											24-136
											37-151
											-2-124
											7-135
											20-152
											5-140
											12-121
											23-136
											34-152
											12-125
											20-137
											30-152
											-27-87
											5-130
											5-140
											23-120
											37-137
											47-150
											5-140
											25-142
											34-155

Reference

TracStar® Pendant/ Coach Setup

To turn pendant on, turn key to right.
To turn pendant off, turn key to off.

Navigate using numeric keys, <+> and <-> keys, <=> key, and <c> key.

Password as shipped from McElroy, **123**.

Setup Fusion Parameters
When starting a job the screen should read time in upper left hand corner. 1 Setup, 2 Pressure, 3 Menu on left side of screen and Face, Soak, Fuse with pressure in center of screen.

Follow instructions on each screen for navigation instructions.
Select setup, press 1 on the keyboard.

C092 Parameters Screen
- Press + use parameters on screen
- Press - enter new parameters
- **If selected, then screen below will appear.**

D112 Select Pipe Material
- List of pipe manufacturers in programmed into Coach, Scroll through list using + or - key, make selection and press = key

S030 Heater Temperature
- Use Pipe manufacturers recommend temperature, type in temperature and press =
- Heater off set (-10 for T500, -60, for T900)
- Enter -, enter password, and enter 10 for T500 or 60 for T900

D140 Piston Area
- Press = to default to 6.010, or enter 4.71 for Pit Bull carriage, 15.32 (Orange Cylinders) or 29.44 (Green Cylinders) for T900

S014 Pipe Size
- Select IPS, DIPS, OD, mmOD using + or - to scroll up or down
- Type in pipe size press =

S018 Pipe Wall Thickness
- Select DR, WT, mmWT using + or - key to scroll
- Type in parameter selected, press =

D122 Heat (IFP)
- Type in 0, then press =, or enter pipe manufacturers IFP if required

D124 Soak (IFP)
- Press - to skip

D126 Fuse (IFP)
- Type in pipe manufacturers recommended IFP usually 75 and press =

D128 Cool (IFP)
- Press - to skip

C092 Parameter Screen
- To allow you to review parameters entered, press + if ok or - to change

S010 Drag (All pendant/coach units use 70 instead of 30)
- Press + to default to 70 (machine drag) or shift carriage selector valve to close and raise pressure. Using facer pressure valve, raise pressure until carriage starts to move slowly, shift carriage to neutral, let pressure stabilized
- press + and then = to set drag pressure

NOTE: Drag automatically added to Heat and Fuse pressure

Reference

TracStar® Pendant/Coach DataLogger Operation

DataLogger Operation
1ST Screen press 3 for Menu
M001 Main Menu
Press 2 for Datalogger mode
D001 Datalogger Menu
Press 1 to Log Data
C090 Identifications
+ To use data recorded on screen or - to enter new data
C100 Machine ID (if - pressed above)
Type in machine ID press =
C102 Employees No.
Type in employee ID press =
C104 Job No.
Type in Job No. press =
C106 Joint No.
Type in joint No. press =
C090 Indentifications
Press + if correct data or - to change
C092 Pipe Parameters
+ to use data or - to enter new data
(Refer to Setup Fusion Parameters if - selected)
D134 Drag Pressure
Refer to Drag Pressure Setup in Setup Fusion Parameters

Fusion Operation

D Screen
Press 4 to start Logging - Logging will flash on screen during fusion operation
D Screen
Press 6 to stop Datalogging - Stop logging before opening carriage or unclamping pipe
D150 Datalogging Stopped
Press + to view report or - to continue
D160 Print Report
Press + to print or - to continue
D170 Log another joint
Press + to Log another joint or - to stop
*** If + pressed then refer to C090, C092, and C134 above.

Reference

DataLogger™ Operation

Note: The use of a DataLogger™ **Will Not** stop you from using an improper joining procedure. The DataLogger™ merely logs data pertaining to the fusion(s). The DataLogger™ is an excellent QA/QC Tool. A stamping system should be used to tie the fusion bead to the DataLogger.™

Operation

To turn the unit On, press the F1 key.

To turn the unit Off, press the blue key once and then press F1 within 2 seconds.

Note: The Unit stays On as long as it is connected to the charger.

Connect to the Fusion Machine

The fusion machine must have the proper hydraulic quick disconnect for connecting the DataLogger™ pressure transducer.

Note: Make sure the hydraulic pump is turned off and the pressure is at 0 before connecting or disconnecting the DataLogger™.

Navigate using the Arrows Keys, BKSP Key, <Y> and <N> keys, Numeric Keys and the Enter Key.

Logging a fusion joint

When starting a job the screen should read 000 in the upper left corner. If it does not, press the <BKSP> key until it does. Press number selection to select language (i.e. (1) = English). Press <1> to Log Data.

Follow instructions on each screen for the machine and job data.

A list of machines is programmed into the DataLogger™; scroll down the list through the units and make your selection.

Select pipe wall

Select DR, or if unknown, measure the actual wall thickness (WT).

Calculate gauge pressure Press <Y>

Interfacial heat pressure	Usually enter <0> or Press <N> to skip.
Interfacial soak pressure	Usually enter <0> or Press <N> to skip.
Interfacial fusion pressure	Enter the Pipe Manufacturer's recommended interfacial pressure (i.e.) then press **Enter.**
Interfacial cool pressure	Usually the same as the fusion pressure or press <N> to skip this entry.
Verify Data	Screen #1 and #2 Verify Data entered is correct on Screen and press <Y>

Reference

DataLogger™ Operation

Drag Pressure

A drag value must be entered for each fusion. See fusion machine's operations manual, or the DataLogger™ manual for measuring drag. Enter the measured drag pressure and press **Enter.** If you just press **Enter**, a default drag value of 2 Bar (30 Psi) will be added to the DataLogger™.

Heater Temperature

Hold the infrared temperature probe against the coated area of the heater that the pipe will contact, and press **Enter** when the temperature stabilizes.

Prepare to Log Data

The pipe should be faced off and misalignment adjust ments should be made at this point.

Verify the correct fusion pressure has been set on the fusion machine. This is done by shifting the fusion unit into the fuse position on the hydraulic manifold block and bringing the faced pipe ends together. With fusion pressure still applied, check the calculated fusion pressure against the carriage pressure. Adjust the fusion pressure control valve on the hydraulic manifold block, as necessary, to achieve the same reading as the calculated fusion pressure shown on the DataLogger™.

Open the carriage enough to allow the heater to be placed on the guide rods, between the faced pipe ends, install heater and press <4> on the DataLogger™. Quickly bring the pipe endds agains the heater and follow the proper shift sequence on the fusion unit and the Pipe Manufacturer's recommendations for fusing pipe.

At the end of the cooling cycle press <6>, on the DataLogger™, before opening the fusion unit or shifting to a different pressure setting.
Important: follow the directions on the DataLogger™ screen to view the graph to ensure proper procedures were followed.

Recommended Precautions

Fully charge the DataLogger™ before each use for optimal battery performance.

Download the reports daily to a PC or printer to prevent data loss.
For more complete details of the DataLogger™ see the Instruction manual or call ISCO Industries, LLC

Reference

If your cylinders are yellow

Machines:
McElroy 250 and McElroy T-250
Cylinders: Yellow (Low Force) - 1077 mm² (1.67 in²) Piston Area
Heater Surface Temperature: 220°C Interfacial pressure: 5.2 bar
Note: Fusion pressure shown includes 2 Bar (30 psi) for system drag.

METRIC

Pipe Size	SDR								
	7.4	9	11	13.6	17	21	26	33	41
63	9.0	7.9	6.9	6.1	5.3	4.7	4.2	3.8	3.4
75	11.9	10.4	9.0	7.8	6.7	5.8	5.1	4.5	4.0
90	16.3	14.1	12.1	10.3	8.8	7.5	6.5	5.6	4.9
110	23.3	20.0	17.1	14.4	12.1	10.3	8.7	7.4	6.3
125	29.5	25.3	21.5	18.1	15.0	12.7	10.7	8.9	7.6
140	36.5	31.2	26.4	22.1	18.4	15.4	12.9	10.7	9.0
160	47.1	40.1	33.9	28.3	23.4	19.5	16.3	13.3	11.2
180	59.1	50.3	42.4	35.3	29.1	24.2	20.1	16.4	13.6
200	72.5	61.6	51.9	43.1	35.4	29.4	24.3	19.7	16.4
225	91.2	77.4	65.1	54.0	44.3	36.6	30.2	24.4	20.2
250	112.2	95.1	79.9	66.2	54.2	44.7	36.9	29.7	24.4

Reference

If your cylinders are green

Machines:
McElroy No. 412, McElroy No. 618, McElroy T-412, McElroy T-618 TracStar No.412, McElroy TracStar No. 618
Cylinders: Green (High Force) - 7600 mm² (11.78 in²) Piston Area
Heater Surface Temperature: 220°C Interfacial pressure: 5.2 bar
Note: Fusion pressure shown includes 2 Bar (30 psi) for system drag.

METRIC

Pipe Size	SDR 7.4	9	11	13.6	17	21	26	33	41
110	5.0	4.6	4.1	3.8	3.4	3.2	3.0	2.8	2.6
125	5.9	5.3	4.8	4.3	3.8	3.5	3.2	3.0	2.8
140	6.9	6.1	5.5	4.9	4.3	3.9	3.5	3.2	3.0
160	8.4	7.4	6.5	5.7	5.0	4.5	4.0	3.6	3.3
180	10.1	8.8	7.7	6.7	5.8	5.1	4.6	4.0	3.6
200	12.0	10.4	9.1	7.8	6.7	5.9	5.2	4.5	4.0
225	14.7	12.7	10.9	9.4	8.0	6.9	6.0	5.2	4.6
250	17.6	15.2	13.0	11.1	9.4	8.1	6.9	5.9	5.2
280	21.6	18.6	15.9	13.4	11.3	9.6	8.2	6.9	6.0
315	26.8	23.0	19.5	16.5	13.7	11.6	9.8	8.2	7.0
355	33.5	28.6	24.3	20.4	16.9	14.2	12.0	9.9	8.4
400	42.0	35.8	30.3	25.3	20.9	17.5	14.7	12.1	10.1
450	52.6	44.8	37.8	31.5	26.0	21.6	18.0	14.7	12.3

Reference

If your cylinders are orange

**Machines: McElroy No. 412, McElroy No. 618,
McElroy T-412, McElroy T-618,
McElroy T-500 Series II (Manifold Equipped)**
Cylinders: Orange (Medium Force) - 3877 mm^2 (6.00 in^2) Piston Area
Heater Surface Temperature: 220°C Interfacial pressure: 5.2 bar
Note: Fusion pressure shown includes 2 Bar (30 psi) for system drag.

METRIC

Pipe Size	SDR 7.4	9	11	13.6	17	21	26	33	41
110	7.9	7.0	6.2	5.5	4.8	4.3	3.9	3.5	3.2
125	9.7	8.5	7.4	6.5	5.6	5.0	4.4	3.9	3.6
140	11.6	10.1	8.8	7.6	6.5	5.7	5.0	4.4	4.0
160	14.5	12.6	10.9	9.3	7.9	6.9	6.0	5.2	4.6
180	17.9	15.4	13.2	11.2	9.5	8.2	7.0	6.0	5.2
200	21.6	18.6	15.9	13.4	11.3	9.6	8.2	6.9	6.0
225	26.8	23.0	19.5	16.5	13.7	11.6	9.8	8.2	7.0
250	32.6	27.9	23.6	19.8	16.5	13.9	11.7	9.7	8.2
280	40.4	34.5	29.2	24.4	20.2	16.9	14.2	11.7	9.8
315	50.6	43.1	36.4	30.3	25.0	20.9	17.4	14.2	11.9
355	63.7	54.2	45.6	38.0	31.2	26.0	21.5	17.5	14.6
400	80.4	68.2	57.4	47.7	39.1	32.4	26.8	21.7	18.0
450	101.2	85.8	72.1	59.8	49.0	40.5	33.4	26.9	22.2
500	124.4	105.5	88.6	73.4	60.0	49.5	40.7	32.8	26.9

Reference

If your cylinders are green

Machines: McElroy No. 824, McElroy No. 1236,
McElroy T-900 (Manifold Equipped)
Cylinders: Green (High Force) - 19000 mm² (29.44 in²)Piston Area
Heater Surface Temperature: 220°C Interfacial pressure: 5.2 bar
Note: Fusion pressure shown includes 2 Bar (30 psi) for system drag.

METRIC

Pipe Size	SDR								
	7.4	9	11	13.6	17	21	26	33	41
225	7.1	6.3	5.6	5.0	4.4	4.0	3.6	3.3	3.0
250	8.2	7.3	6.4	5.6	5.0	4.4	4.0	3.6	3.3
280	9.8	8.6	7.5	6.6	5.7	5.0	4.5	4.0	3.6
315	11.9	10.4	9.0	7.8	6.7	5.8	5.1	4.5	4.0
355	14.6	12.6	10.9	9.3	8.0	6.9	6.0	5.2	4.6
400	18.0	15.5	13.3	11.3	9.6	8.2	7.1	6.0	5.3
450	22.2	19.1	16.3	13.8	11.6	9.9	8.4	7.1	6.1
500		23.1	19.7	16.6	13.8	11.7	9.9	8.3	7.1
560			24.2	20.3	16.9	14.2	11.9	9.9	8.4
630			30.1	25.1	20.8	17.4	14.6	12.0	10.1
710				31.4	25.9	21.6	17.9	14.7	12.3
800					32.3	26.8	22.2	18.1	15.0
900					40.4	33.4	27.6	22.4	18.5

Reference

If your cylinders are orange

Machines: McElroy No. 824, McElroy No. 1236,
McElroy T-900 (Manifold Equipped)
Cylinders: Orange (Medium Force) - 9885 mm² (15.32 in²)Piston Area
Heater Surface Temperature: 220°C Interfacial pressure: 5.2 bar
Note: Fusion pressure shown includes 2 Bar (30 psi) for system drag.

METRIC

Pipe Size	SDR								
	7.4	9	11	13.6	17	21	26	33	41
225	11.7	10.2	8.9	7.7	6.6	5.8	5.1	4.4	4.0
250	14.0	12.1	10.5	9.0	7.7	6.7	5.8	5.0	4.4
280	17.1	14.7	12.7	10.8	9.1	7.8	6.8	5.8	5.1
315	21.1	18.1	15.5	13.1	11.0	9.4	8.0	6.8	5.9
355	26.2	22.5	19.1	16.1	13.5	11.4	9.7	8.1	6.9
400	32.7	28.0	23.7	19.9	16.6	13.9	11.7	9.7	8.3
450	40.9	34.9	29.5	24.7	20.4	17.1	14.3	11.8	9.9
500		42.6	36.0	30.0	24.8	20.6	17.2	14.1	11.8
560			44.6	37.1	30.5	25.4	21.1	17.2	14.3
630			55.9	46.5	38.1	31.6	26.1	21.2	17.5
710				58.5	47.9	39.6	32.6	26.4	21.7
800					60.3	49.7	40.9	32.9	27.0
900					75.7	62.4	51.2	41.1	33.7

Reference

If your cylinders are orange

Machines: McElroy No. 1648
Cylinders: Orange (Medium Force) - 9123 mm² (14.14 in²)Piston Area
Heater Surface Temperature: 220°C Interfacial pressure: 5.2 bar
Note: Fusion pressure shown includes 2 Bar (30 psi) for system drag.

METRIC

Pipe Size	SDR								
	7.4	9	11	13.6	17	21	26	33	41
450	44.2	37.6	31.8	26.6	22.0	18.4	15.3	12.6	10.6
500		46.0	38.8	32.3	26.7	22.2	18.5	15.1	12.6
560			48.2	40.1	32.9	27.3	22.7	18.4	15.3
630			60.4	50.2	41.1	34.1	28.1	22.8	18.8
710				63.2	51.7	42.7	35.2	28.4	23.4
800					65.1	53.7	44.2	35.5	29.1
900					81.9	67.4	55.4	44.4	36.3
1000					100.6	82.8	67.9	54.3	44.4
1200					144.0	118.3	96.9	77.4	63.0

Reference

If your cylinders are green

Machines: McElroy No. 1648, McElroy No. 2065
Cylinders: Green (High Force) - 20272 mm² (31.42 in²)iston Area
Heater Surface Temperature: 220°C Interfacial pressure: 5.2 bar
Note: Fusion pressure shown includes 2 Bar (30 psi) for system drag.

METRIC

Pipe Size	SDR								
	7.4	9	11	13.6	17	21	26	33	41
450	21.0	18.0	15.4	13.1	11.0	9.4	8.0	6.8	5.9
500		21.8	18.6	15.7	13.1	11.1	9.4	7.9	6.8
560			22.8	19.1	15.9	13.4	11.3	9.4	8.0
630			28.3	23.7	19.6	16.4	13.8	11.3	9.6
710				29.5	24.4	20.3	16.9	13.9	11.6
800					30.4	25.3	21.0	17.1	14.2
900					37.9	31.4	26.0	21.1	17.5
1000					46.4	38.4	31.6	25.6	21.1
1200					65.9	54.4	44.7	35.9	29.5
1600						95.1	77.9	62.3	50.8

Reference

Temperature Conversions			
Fahrenheit	Celsius	Fahrenheit	Celsius
0	-18	260	127
10	-12	270	132
20	-7	280	138
30	-1	290	143
40	4	300	149
50	10	310	154
60	16	320	160
70	21	330	165
80	27	340	171
90	32	350	176
100	38	360	182
110	43	370	188
120	49	380	193
130	54	390	199
140	60	400	204
150	65	410	210
160	71	420	215
170	77	430	221
180	82	440	226
190	88	450	232
200	93	460	238
210	99	470	243
220	104	480	249
230	110	490	254
240	115	500	260
250	121	510	265

Conversion Formulas				
Inches	X	25.40	=	Millimeters
Millimeters	X	0.03937	=	Inches
Feet	X	304.8	=	Millimeters
Millimeters	X	.003280839	=	Feet
SQ. Inches	X	645.16	=	SQ. Millimeters
SQ. Millimeters	X	.00155	=	SQ. Inches
Ounces(fluid) US	X	0.02957	=	Liters
Quarts	X	0.9463	=	Liters
Liters	X	1.057	=	Quarts
Gallons	X	3.785	=	Liters
Liters	X	0.2642	=	Gallons(fluid) US
Pounds	X	0.4536	=	Kilograms
Kilograms	X	2.205	=	Pounds
Bar	X	14.503	=	Psi
mPa	X	145.03	=	Psi
Kg/cm^2	X	14.223	=	Psi

Reference

References

1. Plastics Pipe Institute Technical Report-33. Generic Butt Fusion Joining Procedure for Polyethylene Gas Pipe, 2001

2. Plastics Pipe Institute Technical Report-41. Generic Saddle Fusion Joining Procedure for Polyethylene Gas Pipe, 2002

3. Plastics Pipe Institute. Polyethylene Joining Procedures, March 1998.

4. ASTM D2657-97. Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings. Volume 8.04. American Society of Testing and Materials. Baltimore, 2002.

5. ASTM F1056-97. Standard Specification for Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing and Fittings. Volume 8.04. American Society of Testing and Materials. Baltimore, 2002.

6. Pipeline Safety Regulations. U.S. Department of Transportation. CFR 49. Washington, 2002.

Notes

Notes

Acknowledgements

KWH Pipe
McElroy Manufacturing, Inc.
Performance Pipe™
Plastic Pipe Institute
Rinker Materials™
WL Plastics
Brand Names and product names are
trademarks of their respective owners.

APPENDIX I

Ballast Depth Localisation As-built

Ballast Blocks Position in Meliadine Lake Survey conducted on August 6, 2017			
Block	Feet dept	Feet clearance	Axe
1	2	0,5	Ouest
2	3	0	Ouest
3	7	1	Ouest
4	11	0	Ouest
5	12	0	Ouest
6	15	0	Ouest
7	16	0	Ouest
8	18	0	Ouest
9	18	0	Ouest
10	20	0	Ouest
11	20	0	Ouest
12	21	0	Ouest
13	21	0	Ouest
14	21	0	Ouest
15	21	0	Ouest
16	21	0	Ouest
17	21	0	Ouest
18	22	0	Ouest
19	22	0	Ouest
20	22	0	Ouest
21	23	0	Ouest
22	23	0	Ouest
23	23	0	Ouest
24	22	0	Ouest
25	22	0	Ouest
26	21	0	Ouest
27	21	0	Ouest
28	21	0	Ouest
29	21	0	Ouest
30	21	0	Ouest
31	21	0	Ouest
32	21	0	Ouest
33	22	0	Ouest
34	24	0	Ouest
35	25	0	Ouest
36	26	0	Ouest
37	30	0	Ouest
38	33	0	Ouest
39	34	0	Ouest
40	36	0	Ouest
41	31	0	Ouest
42	37	0	Ouest
43	37	0	Ouest
44	36	0	Ouest
45	36	0	Ouest
46	35	0	Sud
47	35	0	Sud
48	35	0	Nord
49	34	0	Nord

APPENDIX J
Diffuser Tideflex Valve Specifications

TETRA TECH

Red Valve Company, Inc.

700 N. Bell Avenue
Carnegie, PA 15106

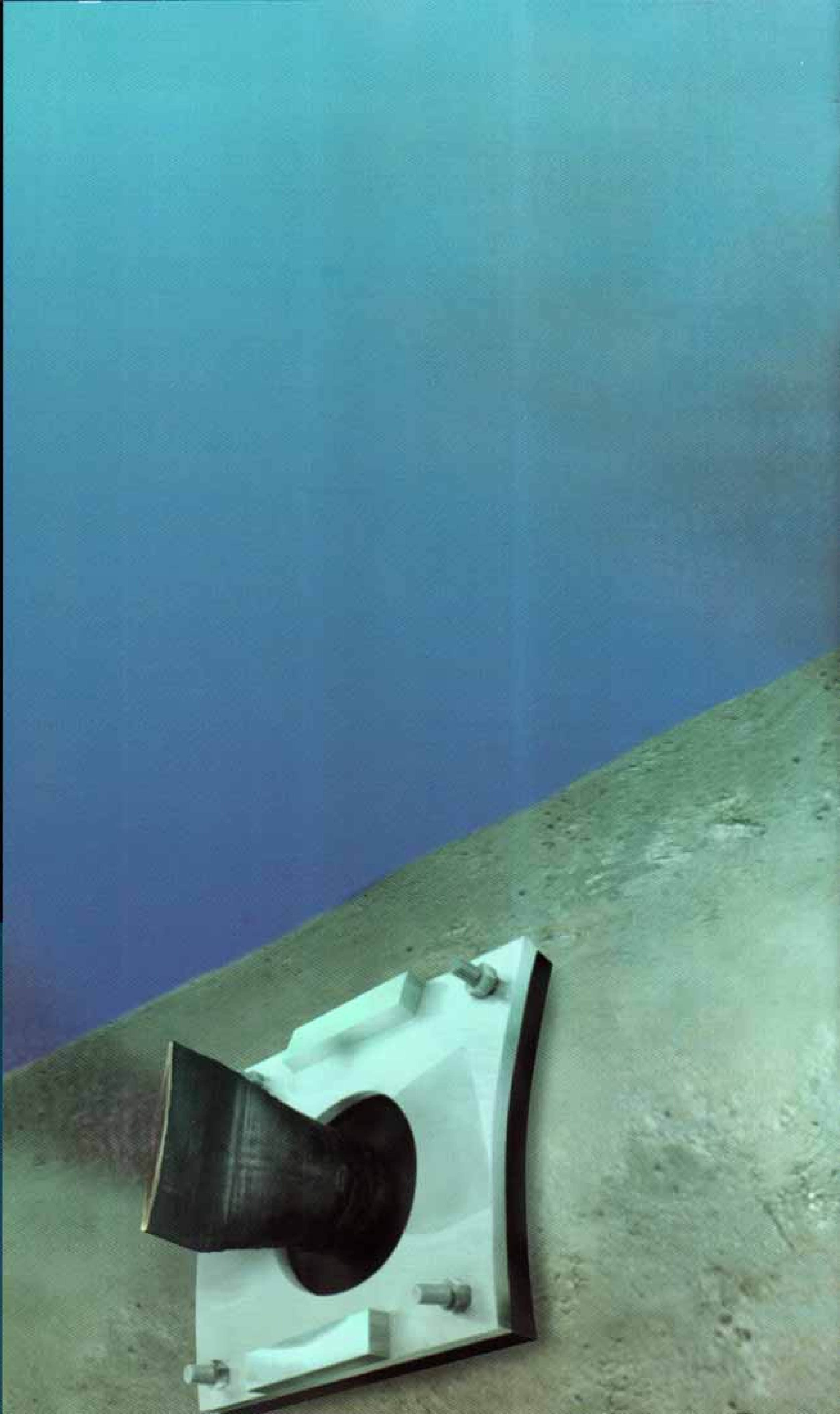
PHONE:
412/279-0044

FAX:
412/279-7878

www.redvalve.com

The information presented in this catalog is provided in good faith. Red Valve Company, Inc. reserves the right to modify or improve its design specifications without notice, and does not imply any guarantee or warranty for any of its products from reliance upon the information contained herein. All orders are subject to Red Valve's standard terms and warranty and are subject to final acceptance by Red Valve.

RVM 2/98 10M



300mm rubber risers with two 200mm Tideflex diffuser valves. Multiport risers achieve dilution while minimizing the number of risers.

Eighteen 8" series 35D valves with integral 90° elbows for effluent diffuser in Georgia.

RED VALVE HYDRAULIC DIFFUSER ANALYSIS

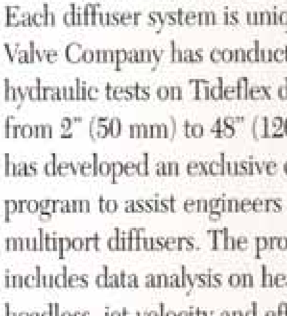
Your Partner in Engineering Design and Technical Analysis for Effluent Diffuser Systems.

Each diffuser system is unique. Red Valve Company has conducted extensive hydraulic tests on Tideflex diffuser valves from 2" (50 mm) to 48" (1200 mm) and has developed an exclusive computer program to assist engineers in designing multiport diffusers. The program includes data analysis on headloss, total headloss, jet velocity and effective open area. This data can be compared to conventional fixed-orifice diffuser designs to illustrate the hydraulic advantages of Tideflex valves (I).

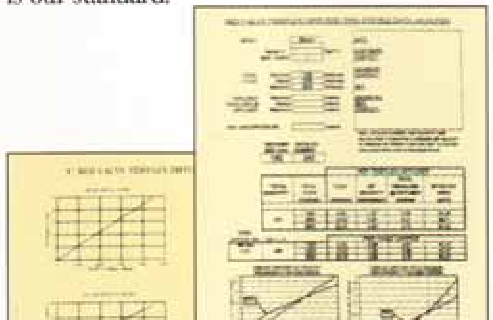
Also available for individual Tideflex valves are graphs of headloss, total headloss, jet velocity and effective open area organized in a "4-pack" format (II).

For a diffuser nozzle hydraulics analysis, please contact our engineering department.

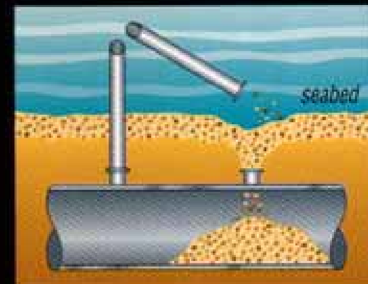
Your special diffuser valve design is our standard.



35 SQ square flange

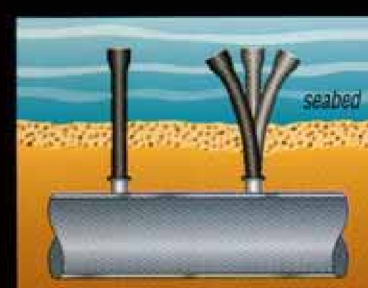


PROBLEM



Plastic and metal risers are rigid and are prone to being broken from diffuser pipeline.

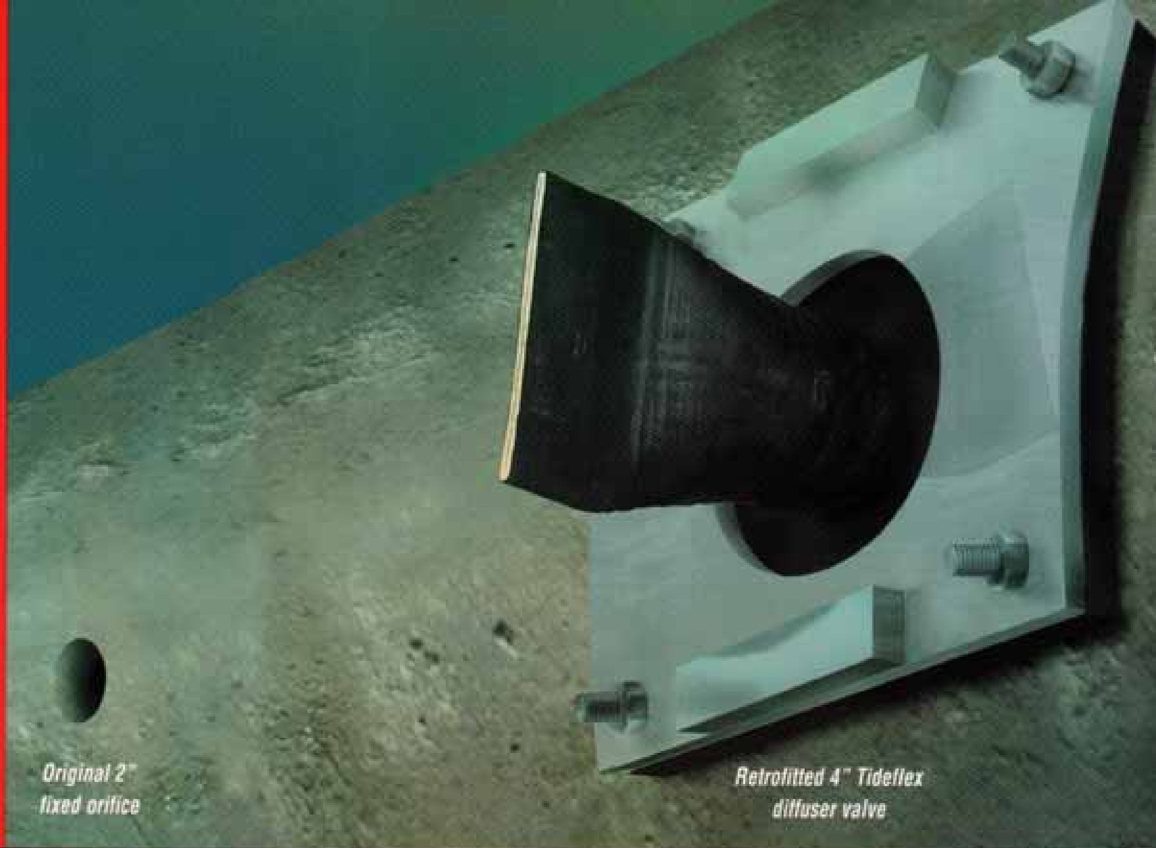
SOLUTION



Tideflex check valves with integral rubber risers and elbows are flexible, eliminating damage from boat anchors, nets and debris.

129 four-inch Tideflex valves with 16" square flanges were retrofitted over original 2" fixed-orifice ports on a reinforced concrete outfall in California.

The four-hole, square-flanged 35-SQ Tideflex reduces installation costs and minimizes stress on the outfall pipe.



RETROFITTING EXISTING DIFFUSER PIPELINES

Available with slip-on, circular-flanged and square-flanged fabricated connections, Tideflex diffuser valves can accommodate almost any effluent diffuser system.

The slip-on valves can be clamped to the outside diameter of riser pipes, and circular-flanged valves can be fastened to any flange, including ANSI and DIN drillings. The square-flanged valves can be fastened directly to the outside diameter of an outfall pipe.

Common for outfalls that rest on the riverbed or seabed unburied, the square-flanged valves have a four-hole arrangement, compared to an eight- or twelve-hole pattern, that minimizes localized stress and makes installation easier.

FLEXIBLE RISERS AND ELBOWS

The risers incorporated in buried diffusers are usually metal or plastic and, therefore, prone to being sheared from the outfall by impacting debris, anchors, nets, etc. These breaks allow considerable amounts of riverbed or seabed bottom material to backflow into the outfall.

Tideflex diffuser valves can be integrally fabricated with all-rubber risers and/or elbows. They are flexible, durable and designed to deflect and return when subjected to impact loads such as those from anchors and nets. Having Tideflex diffuser valves fabricated with rubber risers and elbows ensures only flexible components are above the seabed or riverbed, eliminating physical damage to the diffuser.

Tideflex diffuser valves can be retrofitted to any diffuser system operating at a reduced efficiency. They prevent backflow of sediment and salt water and optimize the hydraulics by generating higher jet velocity at low flow and providing a more uniform flow distribution. Tideflex diffuser valves are especially suited for emergency overflow outfalls or decommissioned outfalls since they are susceptible to severe intrusion and marine fouling.

TF-D

35D with 90° elbow

35D with 45° elbow

35D with rubber riser

12 six-inch Tideflex diffuser valves with integral three-foot- long rubber risers discharging to a shallow river.

A 30° orientation from the horizontal discharge angle enhances dilution from this pulp mill diffuser.

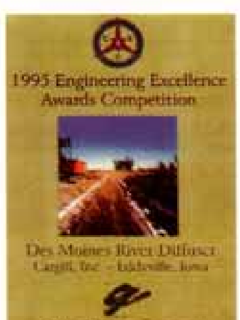
INLAND OUTFALLS

Outfalls that discharge to inland waters, such as rivers, streams and lakes, often exhibit problems with intrusion of sediment and debris into the diffuser. Incorporating Tideflex diffuser valves on new diffusers or retrofitting existing diffusers, prevents backflow and ensures the outfall will operate as initially designed.

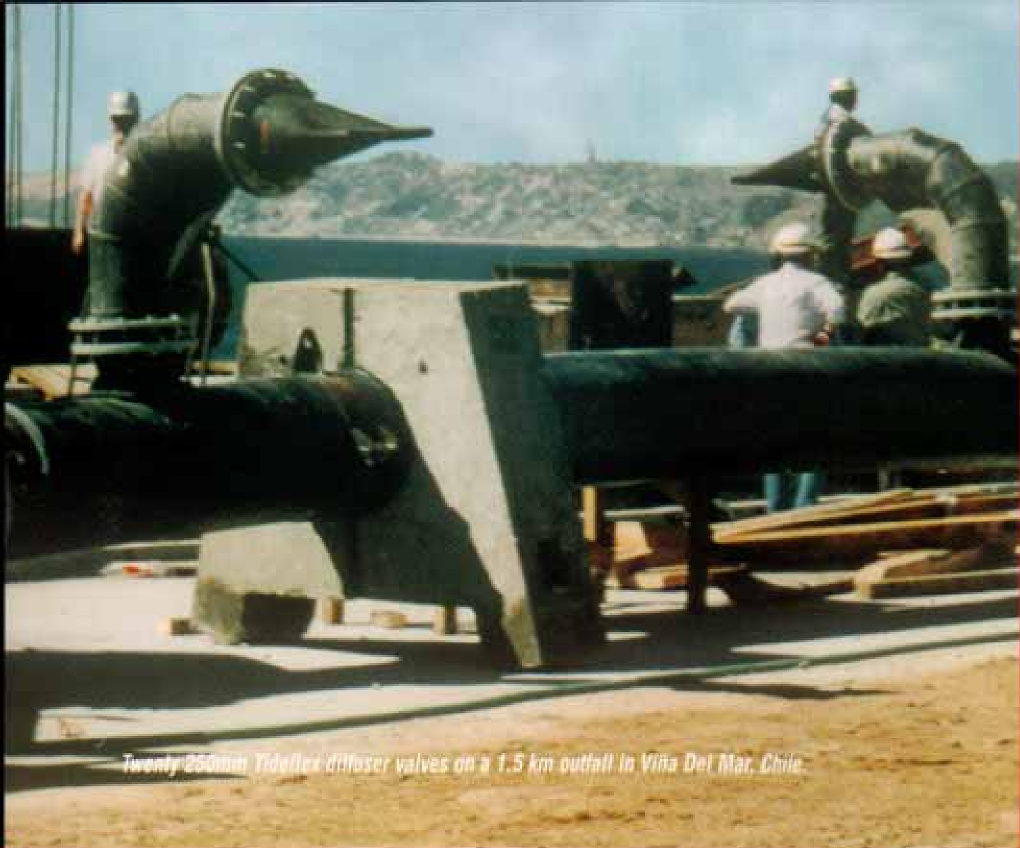
In addition, the effluent typically is the same density as the receiving water body, meaning there is no buoyancy difference to assist in increasing dilution. The receiving body in inland outfalls often has a limited assimilative capacity and a limited depth. Jet velocity, therefore, is critical, since it alone can optimize initial dilution.

The Tideflex diffuser valve's variable orifice enhances jet velocity throughout the range of flows. This, along with the elliptical plume of the Tideflex diffuser valve, improves overall dilution.

Tideflex diffuser valves assist municipal and industrial dischargers in meeting stringent typical water quality standards established by regulatory agencies. This not only includes bacterial standards for municipal wastewater, but toxic standards for industrial discharges as well. In addition, diffusers with Tideflex diffuser valves have also been installed at textile, pulp and paper, and dye plants specifically to disperse colored effluent to eliminate unsightly "slicks."



44 four-inch Tideflex diffuser valves installed on this award-winning diffuser system for a food processing plant discharging to the Des Moines River.



Twenty 250mm Tideflex diffuser valves on a 1.5 km outfall in Viña Del Mar, Chile.

Eighty 200mm Tideflex diffuser valves installed on multiport riser caps in Hong Kong.

MARINE OUTFALLS

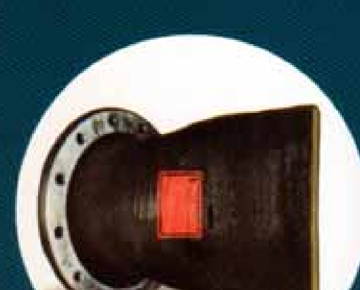
Effluent diffusers that discharge to oceans, estuaries and bays are faced with challenges of strong currents, waves, tides, sediment transport and boat traffic.

These conditions can result in intrusion of sediment and salt water into the outfall, which reduces the hydraulic capacity and dilution efficiency of the diffuser. Since salt water is usually heavier than effluent, it can intrude through the ports even while effluent is discharging.

Once salt water has entered the outfall, it can block numerous ports, imbalance the hydraulics, introduce sediment into the diffuser, promote marine fouling and cause effluent particles to floc and deposit on the bottom of the pipe.

Evacuating sediment from an outfall and rehabilitating the diffuser pipeline typically costs thousands, or even millions, of dollars for large ocean outfalls. Even more of a problem, however, than the expensive repairs is that, with conventional fixed-orifice diffusers, intrusion can recur, requiring continual, costly service.

Tideflex diffuser valves, however, with an all-elastomer "duckbill" design, prevent intrusion of salt water, sediment and debris and keep the outfall operating at peak hydraulic capacity and dilution efficiency. In addition, independent tests in Hong Kong have established that diffusers fitted with Tideflex diffuser valves purge salt water even at extremely low plant flow, allowing all ports to consistently flow. This is beneficial both for the commissioning of a new outfall and for an outfall that has been retrofitted with Tideflex diffuser valves.



Series 35-D

Industrial Discharge

- Pulp & Paper Mills
- Textile Mills
- Chemical Plants
- Dye Plants
- Food Processing Plants
- Power Plants

Tideflex Diffuser Valves:

- Prevent intrusion of debris, sediment, saltwater and aquatic life
- Provide proven long-term, maintenance-free service life
- Enhance jet velocity
- Improve initial dilution
- Provide a more uniform flow distribution across ports

Photo taken from Red Valve's effluent diffuser video, which reviews actual diver inspections of numerous worldwide outfalls.

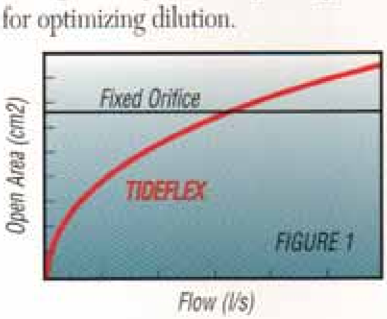
THE TIDEFLEX VARIABLE ORIFICE VS. FIXED-DIAMETER ORIFICE

VARIABLE AREA

In addition to preventing intrusion, backflow and clogging, Tideflex diffuser valves also enhance the hydraulics of multiport diffusers. Unlike fixed-diameter ports, in which the open area remains constant, Tideflex diffuser valves are inherently variable orifice by design. As Figure 1 illustrates, the open area increases as flow increases, and decreases as flow decreases.

ENHANCED JET VELOCITY

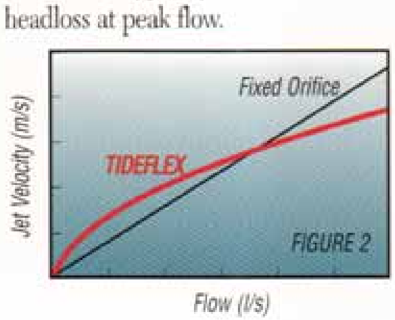
As Figure 2 illustrates, the Tideflex diffuser valve's variable orifice improves jet velocity, or momentum, providing as much as three times the jet velocity of fixed orifices at low flow. This is important because the jet velocity of the flow through each port is a key component for optimizing dilution.



REDUCED HEADLOSS

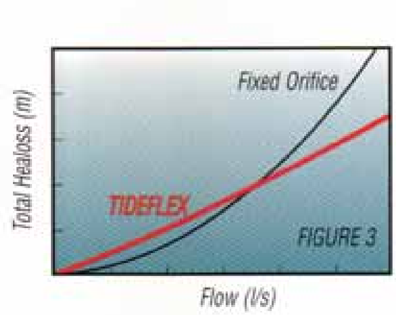
Figure 3 shows the headloss comparison of a fixed-diameter port and the Tideflex diffuser valve. The headloss of a fixed orifice is a function of the flow rate squared. The Tideflex diffuser valve's variable orifice generates less headloss at peak flow, increasing the peak capacity of the outfall, reducing the number of overflows and minimizing energy costs associated with pumps.

Able to meet jet velocity requirements often mandated by environmental agencies, Tideflex diffuser valves still generate an acceptable headloss at peak flow. Sizing fixed-orifice ports to generate a similar jet velocity at low plant flow, on the other hand, typically results in excessive headloss at peak flow.



ELLIPTICAL PLUME

Another advantage the Tideflex diffuser valve offers is its elliptical rather than circular-shaped plume. Independent testing in Oregon and Hong Kong found that this slot-type geometry is proven to provide superior dilution because the receiving water body can disperse the elliptical plume much more quickly than the circular plume. This benefit may be especially desirable for diffusers with stringent water quality standards at the Zone of Initial Dilution (ZID) or other mixing zone boundary.



Red Valve

Your Partner in Engineering, Design and Technical Analysis for Effluent Diffuser Systems

TIDEFLEX® DIFFUSER VALVES

Consulting engineers worldwide specify Red Valve Tideflex diffuser valves for superior performance on effluent diffuser applications.

Effluent outfalls typically incorporate multiport diffusers that discharge effluent over a wide area through numerous ports, rather than through one large open-ended pipe. Providing a cost-effective means of achieving high initial dilution, multiport diffusers minimize the impact of municipal and industrial discharges on the environment.

The most important item on an effluent diffuser system for controlling initial dilution is its port size. A diffuser system's ports ensure that peak flows can be discharged with a limited amount of driving head, ensuring that ports are the correct size and have the proper configuration is critical.

LIMITATIONS OF CONVENTIONAL MULTIPORT DIFFUSERS

The ports of conventional diffusers are holes that were cast or drilled into the outfall pipe, or risers extending from the crown. Referred to as "fixed-orifice" ports, these holes cannot prevent the intrusion of sand, mud, debris and saltwater into the diffuser pipe.

Sediment that enters the diffuser pipe reduces the hydraulic capacity of the outfall, leading to the need for additional pumping operations or causing overflows to bypass outfalls. Additionally, if the ports become blocked—even partially—by accumulating sediment, the diffuser will operate at a reduced dilution efficiency, creating a risk for permit noncompliance and higher bacterial or constituent concentrations on the shore.

TIDEFLEX MULTIPORT DIFFUSERS

Tideflex diffuser valves overcome the challenges associated with conventional multiport diffusers, enabling diffusers to operate at peak performance. Tideflex diffuser valves prevent intrusion of sediment and salt water and optimize diffuser hydraulics and, therefore, eliminate concerns of clogging. In addition, because the valves feature a non-mechanical, all-rubber construction, they will not corrode and remain unaffected by marine growth. Tideflex diffuser valves, virtually maintenance-free, have revolutionized effluent technology for marine and inland outfall lines in municipal and industrial applications.

Red Valve

TIDEFLEX® EFFLUENT DIFFUSER VALVES

APPENDIX K
Technical Memo
Effluent Discharge Modelling for the As-built Diffuser

To:	Blandine Arseneault	**Date:**	May 25, 2018
c:	Nigel Goldup, Josee Alarie	**Memo No.:**	01
From:	Aurelien Hospital and Jim Stronach	**File:**	ENG.EARC03076
Subject:	Effluent Discharge Modelling for the As-Built Diffuser at the Meliadine Gold Project, Nunavut.		

1.0 INTRODUCTION

Agnico Eagle Mines Limited (AEM) retained the services of Tetra Tech to carry out the planning and design works associated with the Water and Environment and the Civil Works components of the Meliadine Project, a gold mine located approximately 25 km north of Rankin Inlet, and 80 km southwest of Chesterfield Inlet in the Kivalliq Region of Nunavut.

This technical memo focuses on the as-built diffuser system that will discharge effluent into Meliadine Lake, as part of the effluent water outfall system. Tetra Tech previously prepared the design report (AEM N° 6515-E-132-005-132-REP-009) for the proposed diffuser system.

Construction and installation of the diffuser system occurred during the summer of 2017 during the first week of August. It was discovered after the installation that the bathymetry at the diffuser location is shallower than the original bathymetry provided by AEM at the diffuser design stage. AEM's field personnel supervised and managed the diffuser construction and installation.

Upon AEM discovering that the diffusor was installed within a shallower bathymetric regime than original design, Tetra Tech was requested to review and assess the anticipated performance of the as-built diffusor system on the potential changes of dilutions at the edge of the mixing zone. Accordingly, this technical memo summarises the results of the analytical work undertaken to assess these potential changes.

2.0 SUMMARY OF PROPOSED SYSTEM (DESIGN REPORT)

Methodology, numerical model and performance of the proposed system were presented in the design report (AEM N° 6515-E-132-005-132-REP-009). Key items are repeated here in this section to facilitate the reading of this technical memo.

Water directed to the collection pond 1 (CP-1) is treated in the Water Treatment Plant prior to being discharged into Meliadine Lake sub-basin through the diffuser system. The water management plan (AEM, Meliadine Gold Project Water Management Plan April 2015 Version 1, 6513-MPS-11) was approved by the Nunavut Water Board as part of the water licensing process. Configuration of the proposed diffuser was the following:

- Diffuser connecting with the outfall through a Tee connection (diffuser oriented NE-SW)
- Coordinates of the Tee: 6,898,150 N / 542,756 E (UTM Zone 15 V)
- Length of diffuser: 30 m;

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- Diameter of the diffuser: 400 mm OD / 355 mm ID
- Water depth at diffuser location: approximately 14.6 m
- Number of ports: 10 ports;
- Port diameter: 51 mm;
- Port spacing: 3 m;
- Tideflex valve mounted on top of diffuser pipe on each port to eliminate fish access;
- Vertical angle of valve: 45 degrees, pointing toward the southeast;
- Port height from lake bed: 1 m, corresponding to the approximate effluent exit height from lake bed.

Numerical modelling was conducted to assess dilutions of conventional constituents at the edge of the mixing zone. The 3D hydrodynamic model H3D was coupled with the US EPA Visual Plumes model. Visual Plumes simulated the behavior of the plume in the near field and passed conventional constituent concentration to the 3D H3D model, which then advects conventional constituents in the far field. This modelling framework involved a multi-year long simulation spanning 14 years: three years of pre-production, eight years of operation and three years of post-production.

The domain of the model is shown in Figure 1 below.

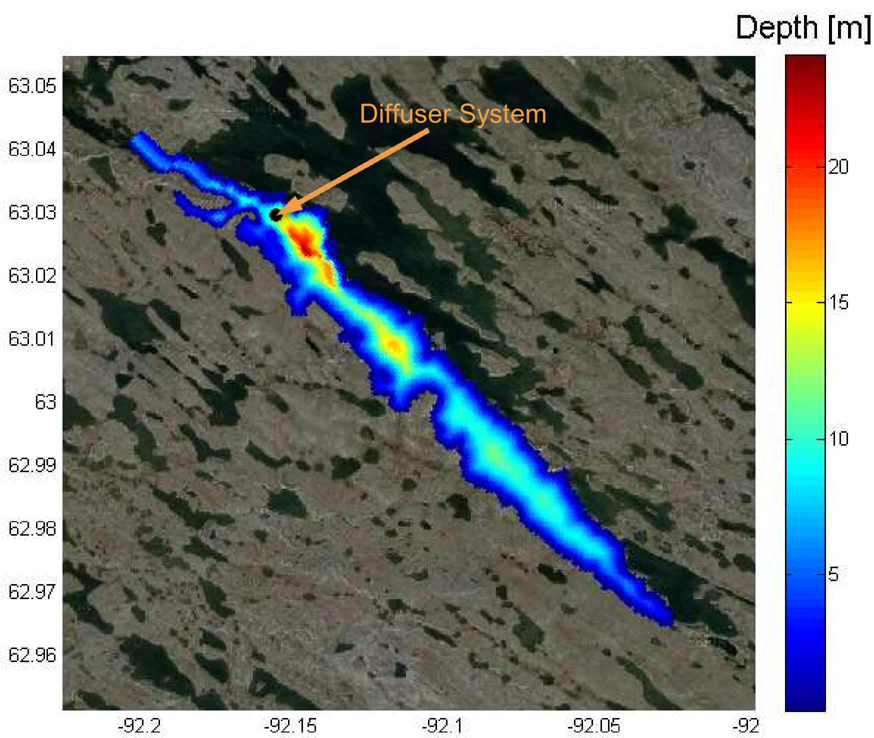

Figure 1: Meliadine Lake Model Domain

Monthly average concentrations for each constituent in the outfall stream were used to assess the build-up of conventional constituents in the Meliadine Lake sub-basin. Total conventional constituent concentrations were used (instead of just dissolved concentrations), which include both dissolved and particulate forms carried in the estimated TSS of 15 mg/L. The estimated monthly volumes of effluent released through the diffuser in Meliadine Lake for the base case scenario, i.e. mean precipitation years, are indicated in Table 1.

Table 1: Estimated Monthly Effluent Released for Simulated Base Case (Mean Precipitation Years)

Year	Volume of Effluent Released Over the Course of the Month [m^3 / calendar month]				
	June	July	August	September	October
Year -3	175,320	233,760	70,128	70,128	23,376
Year -2	175,320	163,632	81,816	70,128	23,376
Year -1	175,320	151,944	93,504	58,440	23,376
Year 1	175,320	268,824	116,880	93,504	35,064
Year 2	175,320	303,888	105,192	93,504	35,064
Year 3	175,320	292,200	105,192	163,632	70,128
Year 4	175,320	350,640	128,568	105,192	35,064
Year 5	175,320	350,640	128,568	93,504	35,064
Year 6	175,320	350,640	128,568	93,504	35,064
Year 7	175,320	350,640	128,568	93,504	35,064
Year 8	175,320	280,512	105,192	81,816	35,064
Year 9	175,320	292,200	116,880	93,504	35,064
Year 10	175,320	292,200	116,880	93,504	35,064
Year 11	175,320	280,512	116,880	93,504	35,064

Following the 14-year long simulation, results showed that the proposed diffuser would achieve dilutions that fall within the Site Specific Water Quality Objectives (SSWQO) and the Canadian Council of Ministers of the Environment guidelines (CCME) guidelines for all of the constituents. On this basis it was concluded that the proposed diffuser would allow AEM to meet water quality guidelines.

3.0 DEVIATIONS DURING CONSTRUCTION

Construction and installation were supervised by the AEM field engineer. Two deviations from the design were observed and recorded during the construction and outlined in Table 2. The two deviations associated with the as-built system represent a 42 m horizontal shift and a 3.2 m shallower depth.

Table 2: Effluent Water Outfall System Characteristics

Item	Proposed	Actual	Deviation
1) Location of Tee Connector for Diffuser System	(6,989,149.90N / 542,755.74E)	(6,989,147.41N / 542,797.91E)	42 m, mainly eastward
2) Depth of the Diffuser System at Tee Connector	14.60 m	11.39 m	3.21 m shallower

Deviation 2) indicated that the bathymetry used in the design report was erroneous near the diffuser. As a result, a new bathymetric survey was conducted in February 2018, but was restricted to the area around the diffuser, due to ice conditions. Results of this survey were the following:

Table 3: February 2018 Bathymetry Survey

Position	Coordinates	Bathymetry in Design Report (Model Cell)	Updated Bathymetry (Survey February 2018)	Difference between Design / New Survey
Tee-Connector Position in Design Report	6,989,149.90 N 542,755.74 E	14.60 m	11.95 m	-2.65 m
As-Built Tee-Connector Position	6,989,147.41 N 542,797.91 E	14.97 m	11.39 m	-3.58 m
As-Built North End of Diffuser	6,989,162.43 N 542,799.07 E	14.39 m	11.18 m	-3.21 m
As-Built South End of Diffuser	6,989,135.52 N 542,796.80 E	15.00 m	11.49 m	-3.51 m
East of As-Built Diffuser	6,989,143.08 N 542,844.80 E	15.18 m	10.95 m	-4.23 m

4.0 AS-BUILT SYSTEM PERFORMANCE

To assess the impact of these two deviations, the numerical modelling framework used in the design report (and summarized in Section 2.0) was used. This modelling framework incorporated the two deviations corresponding to the as-built system, to assess conventional constituent concentrations at the edge of the mixing zone as well as potential concentration build-up over time.

The model bathymetry was based on the original bathymetric survey, i.e. used in the design phase, but was updated at locations where new data was available. Hence, each relevant model grid cell indicated in Table 2 was updated with the February 2018 bathymetry survey. The method to assess conventional constituent concentrations at the edge of the mixing zone was the same as presented in the design report.

- A three-dimensional multi-year simulation covering a total period of 14 years of discharge through the diffuser (Year -3 to Year 11) was set up to assess conventional constituent build-up in the lake.

- Monthly average concentrations for each constituent in the outfall stream were used to assess the build-up of conventional constituents in the Meliadine Lake sub-basin. Total conventional constituent concentrations were used (instead of just dissolved concentrations), which include both dissolved and particulate forms carried in the estimated TSS of 15 mg/L.

- Scenario 1 (Base Case Scenario) was re-run, looking at the accumulation of conventional constituents over time for mean (i.e. normal) precipitations years. The inputs for Scenario 1 (environmental conditions, amount of effluent released…) are the same as in the design report, with the exception of the updated bathymetry.

Results of this simulation, which incorporates the two deviations of the as-built system, are as follows:

By the end of Year 11, concentrations of the conventional constituent, which entered at a concentration of 1 (unit-less), vary between 0.03 and 0.04 at the edge of the mixing zone, corresponding to a dilution of about 23:1 to 32:1. Minimum dilution, representing the maximum concentration, reached over the multi-year simulation was a 23:1 dilution, similar to the proposed system in the design report (23:1 in the design report).

Table 4 presents minimum dilutions obtained at the end of the first year of discharge and through the 14-year long simulation. The following can be noted:

- The smallest dilution obtained through the multi-year simulation is 23:1.
- No difference in the system performance between proposed and as-built system can be noted for the most stringent criterion, i.e. minimum dilution obtained over the multi-year simulation.
- However, because the water depth was reduced in the vicinity of the diffuser, the mixing of effluent with lake water was slightly affected on the short term and results in a 72:1 dilution obtained at the edge of the mixing zone after the first year in the as-built system, compared to a 73:1 dilution in the originally designed system. This slight change does not materially impact water quality, since constituent concentrations are below the CCME and SSWQO.

Conventional constituent concentrations corresponding to the most stringent dilution obtained through the multi-year simulation are shown in Table 5. Similar to the proposed system described in the design report, water quality guidelines are met with the modelled as-built diffuser system, even when including the effects of conventional constituent build-up due to lower flushing rates in the receiving environment compared to the design case.

Table 4: Dilutions for Proposed and As-Built System

	Scenario 1 Results for Proposed System (Design Report)	**Scenario 1 Results for As-Built System**
Minimum Dilution at the Edge of the Mixing Zone at the End of the First Year of Discharge	73:1	72:1
Minimum Dilution Obtained through the Multi-Year Simulation	23:1	23:1

Table 5: Simulated Conventional Constituent Levels for Proposed and As-Built – Base Case (Mean Precipitation Years)

			Monthly Average Constituent Concentration		
	CCME Guidelines [mg/L]	**SSWQO Guidelines [mg/L]**	**Proposed System (Design Report) Dilution of 23:1**	**As-Built System Dilution of 23:1**	**As-Built System Conformity**
Conventional Constituents					
Total Dissolved Solids	-		41.8	41.8	Yes

			Monthly Average Constituent Concentration		
	CCME Guidelines [mg/L]	**SSWQO Guidelines [mg/L]**	**Proposed System (Design Report) Dilution of 23:1**	**As-Built System Dilution of 23:1**	**As-Built System Conformity**
Total Suspended Solids	8		2.0	2.0	Yes
pH	-				Yes
Major Ions					
Chloride	120		6.9	6.9	Yes
Fluoride	0.12	2.8	0.03	0.03	Yes
Sodium	-		3.3	3.3	Yes
Sulphate	-		4.2	4.2	Yes
Nutrients					
Total Ammonia as Nitrogen	3.33		0.21	0.21	Yes
Nitrate Ion	13		0.34	0.34	Yes
Phosphorus (total)	0.03		0.02	0.02	Yes
Cyanides					
Total cyanide	-		0.0012	0.0012	Yes
Free cyanide	0.005		-	-	Yes
Metals					
Aluminum	0.1		0.05065	0.05065	Yes
Antimony	-		0.00021	0.00021	Yes
Arsenic	0.005	0.025	0.00799	0.00799	Yes
Barium	-		0.00766	0.00766	Yes
Cadmium	0.00005		0.00003	0.00003	Yes
Chromium	0.0089		0.00031	0.00031	Yes
Copper	0.002		0.00121	0.00121	Yes
Iron	0.3	1.06	0.09107	0.09107	Yes
Lead	0.001		0.00023	0.00023	Yes
Manganese	-		0.00796	0.00796	Yes
Mercury	0.000026		0.00001	0.00001	Yes
Molybdenum	0.073		0.00031	0.00031	Yes
Nickel	0.025		0.00070	0.00070	Yes
Selenium	0.001		0.00006	0.00006	Yes
Silver	0.00025		0.00005	0.00005	Yes
Thallium	0.0008		0.00002	0.00002	Yes
Uranium	0.015		0.00005	0.00005	Yes
Zinc	0.03		0.00184	0.00184	Yes

5.0 RECOMMENDATION AND CONCLUSION

As confirmed with the numerical simulation described above, both deviations in the as-built diffuser (horizontal shift and system in shallower water depth) result in water quality guidelines being met for all conventional constituents.

- Deviation #1: The shift of 42 m in the east direction does not impact the operation of the system. This deviation is very minimal. The most important design criteria was the orientation of the diffuser normal to the main axis of the lake. This configuration was kept. The 42 m shift still results in the system being in the same general area of Meliadine Lake sub-basin.

- Deviation #2: A 3.2 m depth difference was observed between the proposed and the actual diffuser depth. As described above, a recent depth sounding survey was conducted by Hamel Arpentage (February 2018) at five points in the vicinity of the diffuser (proposed and actual) to confirm the depth of the system. Following these depth soundings, an update of the model bathymetry, which was used during the design phase to assess concentrations of conventional constituents at the edge of the mixing zone, was conducted. To summarize, the model bathymetry was based on the original bathymetric survey, i.e. used in the design phase, but was updated at locations where new data was available. As confirmed with the numerical simulation described above, this vertical shift (reduction in water depth) still results in water quality guidelines being met for all conventional constituents, as summarized in Table 6 below.

Table 6: Comparison of Diffuser System Dilution Performance

Item	Minimum Dilution at the Edge of the Mixing Zone Obtained over 14-Years Simulation	
	Designed	**As-Built**
Base Case Scenario	23:1	23:1
Water Quality Guidelines	Met for all conventional constituents	Met for all conventional constituents

In light of the discrepancies between the original and new set of bathymetric data in the vicinity of the diffuser, it is recommended that AEM resurveys the entire Meliadine Lake sub-basin shown in Figure 1 to confirm bathymetry in the area of study.

6.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Agnico Eagle Mines Limited and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Agnico Eagle Mines Limited, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on the Use of this Document attached in the Appendix or Contractual Terms and Conditions executed by both parties.

7.0 CLOSURE

We trust this technical memo meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
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