

#1 problem

fluid	PA-PB		SW WATER*(-) D1		CASE 1 OR CASE 2 SW*(+) D2		SW WATER*(+) D1*(+) D2*(+) D3			
			SW WATER	(-) D1	CASE 1 OR CASE 2 SW	(+) D2	SW WATER	(+) D1	(+) D2	(+) D3
	PSI	LB/FT^2	LB/FT^3	FT	LB/FT^3	FT	LB/FT^3	FT	FT	FT
case 1: gasoline	2.7177	391.3488	62..4	4.15256	42.4	0.84744	62.4	4.15256	0.84744	6
case 2: mercury	2.7177	391.3488	62..4	5.02166	844.9	-0.021659808	62.4	5.02166	-0.021659808	6

Q		FLOW VELOCITY		PIPE DIAMETER
GAL/MIN	FT^3/S	M/S	FT/S	FT
30	0.066815	3	9.84252	0.092969258
DN 15 schedule 40 "letter c"				0.0518
DN 20 schedule 40 "letter c"				0.0687
DN 25 schedule 40 "letter c"				0.0874
DN 32 schedule 40 "letter c"				0.115
DN 40 schedule 40 "letter c"				0.1342

NR=VD/V				D/E		FRICTION	hL2 (total energy lost)						height	h1 (pump delivered)	Pipe size
V	D	V	NR	E	D/E	f	entrance loss(hL)	fully open gate valve	swing check valve	filter	pipe 1	pipe 2	exit loss		
9.84252	0.092969	0.000036	25418.1	0.00015	619.7951	0.028242826	0.752136646	0.3398794	4.2484928	2.7829056	4.5697824	9.1395649	1.5042733	19	46.906818
9.84252	0.0518	0.000036	14162.29	0.00015	345.3333	0.033398307	0.752136646	0.4019214	5.0240181	2.7829056	9.6988767	19.397753	1.5042733	19	68.260762
9.84252	0.0687	0.000036	18782.81	0.00015	458	0.030746442	0.752136646	0.3700084	4.6251052	2.7829056	6.732322	13.464644	1.5042733	19	55.963717
9.84252	0.0874	0.000036	23895.45	0.00015	582.6667	0.028728423	0.752136646	0.3457232	4.3215399	2.7829056	4.9445536	9.8891073	1.5042733	19	48.484793
9.84252	0.115	0.000036	31441.38	0.00015	766.6667	0.026662505	0.752136646	0.3208616	4.0107694	2.7829056	3.4876255	6.9752511	1.5042733	19	42.321449
9.84252	0.1342	0.000036	36690.73	0.00015	894.6667	0.025597295	0.752136646	0.3080426	3.8505327	2.7829056	2.8692494	5.7384989	1.5042733	19	39.674889
1st calculation (1st half)															

2nd calculation						1st calculation (2nd half)				
Pipe size	height	P3/SG*SW	V^2/2*g	hL3	P3	Pa (power delivered)	convert to watt	convert to kilowatt	Pa (hp)	if efficiency is 82%
	3	57.408	1.504273291	13.014487	-661.269	195.56695	265.18879	0.2651888	0.3555763	0.4336296
DN 15 schedule 40	3	57.408	1.504273291	18.205623	-959.2817	284.59721	385.91381	0.3859138	0.5174495	0.6310359
DN 20 schedule 40	3	57.408	1.504273291	15.207155	-787.1457	233.32757	316.39218	0.3163922	0.4242319	0.517356
DN 25 schedule 40	3	57.408	1.504273291	13.395102	-683.1193	202.14595	274.10991	0.2741099	0.3675381	0.4482172
DN 32 schedule 40	3	57.408	1.504273291	11.913312	-598.0527	176.44934	239.2653	0.2392653	0.320817	0.3912402
DN 40 schedule 40	3	57.408	1.504273291	11.282117	-561.8171	165.41513	224.30291	0.2243029	0.3007548	0.3667741
DN 50 schedule 40	3	57.408	1.504273291	13.014487	-561.8171	165.41513	224.30291	0.2243029	0.3007548	0.3667741
DN 65 schedule 40	3	57.408	1.504273291	13.014487	-561.8171	165.41513	224.30291	0.2243029	0.3007548	0.3667741
DN 80 schedule 40	3	57.408	1.504273291	13.014487	-561.8171	165.41513	224.30291	0.2243029	0.3007548	0.3667741

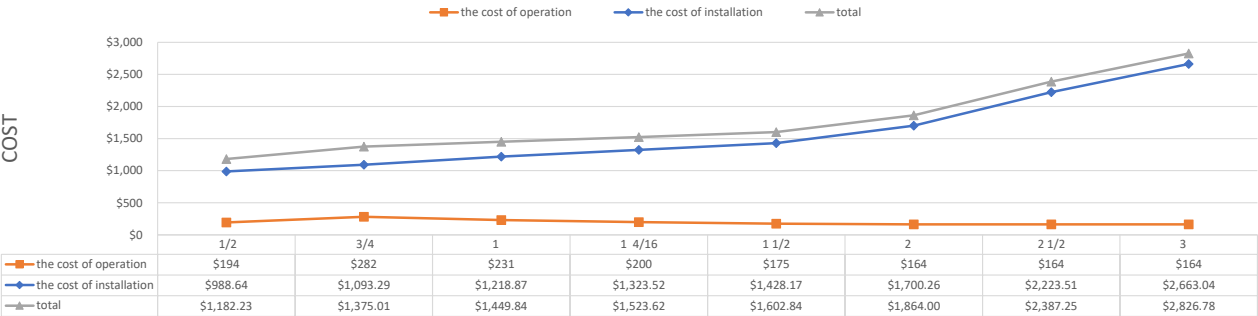
online - pay labor costs of about \$2.50 per linear foot for small size pipe to about \$4 for larger pipe.
online - pipeline transportation generally ranges between \$2 and \$4 per barrel

The Cost of Installation									
Pipe size	Pipe nominal size (in)	Cost per 6 ft	(total pipe length/6) * cost	labor	transportation	pump cost 40%	15% extra unforeseen costs	total-15% extra unforeseen costs	grand total
DN 15 schedule 40	½	\$12.95	\$168.35	\$312.00	\$312.00	\$67.34	\$128.95	\$859.69	\$988.64
DN 20 schedule 40	¾	\$17.95	\$233.35	\$312.00	\$312.00	\$93.34	\$142.60	\$950.69	\$1,093.29
DN 25 schedule 40	1	\$23.95	\$311.35	\$312.00	\$312.00	\$124.54	\$158.98	\$1,059.89	\$1,218.87
DN 32 schedule 40	1 ¼	\$28.95	\$376.35	\$312.00	\$312.00	\$150.54	\$172.63	\$1,150.89	\$1,323.52
DN 40 schedule 40	1 ½	\$33.95	\$441.35	\$312.00	\$312.00	\$176.54	\$186.28	\$1,241.89	\$1,428.17
DN 50 schedule 40	2	\$46.95	\$610.35	\$312.00	\$312.00	\$244.14	\$221.77	\$1,478.49	\$1,700.26
DN 65 schedule 40	2 ½	\$71.95	\$935.35	\$312.00	\$312.00	\$374.14	\$290.02	\$1,933.49	\$2,223.51
DN 80 schedule 40	3	\$92.95	\$1,208.35	\$312.00	\$312.00	\$483.34	\$347.35	\$2,315.69	\$2,663.04

The Cost of Operation			
Pipe size	Pipe nominal size (in)	kilowatt	\$730 per kW
DN 15 schedule 40	$\frac{1}{2}$	0.27	\$194
DN 20 schedule 40	$\frac{3}{4}$	0.39	\$282
DN 25 schedule 40	1	0.32	\$231
DN 32 schedule 40	$1 \frac{1}{4}$	0.27	\$200
DN 40 schedule 40	$1 \frac{1}{2}$	0.24	\$175
DN 50 schedule 40	2	0.22	\$164
DN 65 schedule 40	$2 \frac{1}{2}$	0.22	\$164
DN 80 schedule 40	3	0.22	\$164

Total Cost				
Pipe size	Pipe nominal size (in)	the cost of installation	the cost of operation	total
DN 15 schedule 40	1/2	\$988.64	\$194	\$1,182.23
DN 20 schedule 40	3/4	\$1,093.29	\$282	\$1,375.01
DN 25 schedule 40	1	\$1,218.87	\$231	\$1,449.84
DN 32 schedule 40	1 4/16	\$1,323.52	\$200	\$1,523.62
DN 40 schedule 40	1 1/2	\$1,428.17	\$175	\$1,602.84
DN 50 schedule 40	2	\$1,700.26	\$164	\$1,864.00
DN 65 schedule 40	2 1/2	\$2,223.51	\$164	\$2,387.25
DN 80 schedule 40	3	\$2,663.04	\$164	\$2,826.78

OPERATION AND INSTALLATION COST GRAPH



PIPE NOMINAL SIZE (IN)