FACULTAD DE INGENIERIA
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UNIVERSIDAD NACIONAL AUTÓNOMA

Al Pasante señor JOSE ENRIQUE HERNANDEZ AGUILAR,
P r e s e n t e .

En atención a su solicitud relativa, me es grato transcribir a usted a continuación el tema que aprobado por esta Dirección propuso el Profesor Ing. Francisco Garza Maldonado, para que lo desarrolle como tesis en su Examen Profesional de Ingeniero CIVIL.

"CALCULO DE TUBERIAS PARA ALIMENTACION DE AGUA EN EDIFICIOS"

1. Introducción.
2. Fórmula de Manning.
3. Fórmula de Hazen-Williams.
4. Comparación de resultados.

Ruego a usted se sirva tomar debida nota de que en cumplimiento de lo especificado por la Ley de Profesiones, deberá prestar Servicio Social durante un tiempo mínimo de seis meses como requisito indispensable para sustentar Examen Profesional; así como de la disposición de la Dirección General de Servicios Escolares en el sentido de que se imprima en lugar visible de los ejemplares de la tesis, el título del trabajo realizado.

A t e n t a m e n t e
"POR MI RAZA HABLARA EL ESPIRITU"
Cd. Universitaria, 30 de abril de 1981
EL DIRECTOR

ING. JAVIER JIMENEZ ESPRIU

JJE/OBLH/ser

I N D I C E

1

INTRODUCCION

Cuando un líquido circula por un tubo, sufre pérdidas en su energía; éstas pérdidas se deben a las siguientes causas:

1) Pérdidas por fricción.

2) Pérdidas por entrada.

3) Pérdidas por salida.

4) Pérdidas por súbito ensanchamiento del tubo.

5) Pérdidas por súbita contracción del tubo.

6) Pérdidas por obstrucciones en el tubo (válvulas, etc.).

7) Pérdidas por cambio de dirección en la circulación.

Generalmente la pérdida más importante es la debida a la fricción, aunque en ciertos casos, algunas de las otras pueden ser de importancia, y en otros pueden incluso no existir; por ejemplo, si la tubería no tiene codos, no hay pérdidas por cambio de dirección.

En cada caso particular, las que tienen mayor valor se les llama pérdidas principales, y las que tienen valores pequeños, que a veces pueden despreciarse, se llaman pérdidas secundarias.

Cuando la tubería es de gran longitud, la pérdida de carga por fricción es la principal, y llega a ser tan grande que a veces pueden despreciarse las demás por ser muy pequeñas comparada con ella.

Las pérdidas por fricción en una tubería depen -- den de:

1) El material de que está hecho el tubo.

2) El estado ó edad de la tubería.

3) La longitud de la tubería.

4) El diámetro del tubo.

5) La velocidad de circulación del líquido.

En el presente trabajo, se analizan las pérdidas por fricción en tuberías de diámetros pequeños que van -- desde las 6.3 mm (1/4") hasta los 304.8 mm (12").

Estas tuberías se emplean, principalmente, en -- las instalaciones hidráulicas en edificios y los diámetros de las tuberías, se diseñan de tal manera que las velocidades quedan comprendidas entre 1 y 3 m/s aunque se debe te-

ner cuidado de no llegar a los extremos, ya que el tener velocidades de 1 m/s, significa que la tubería está ligeramente sobrediseñada y podrían emplearse diámetros más pequeños con el consecuente ahorro en el costo del material. A velocidades de 3 m/s, se producen ruidos en las tuberías al paso del agua que sería muy recomendable evitar en ciertos tipos de edificios. (Por ejemplo, en un hotel u hospital).

Para calcular las pérdidas por fricción en las tuberías existen varias fórmulas. En éste trabajo, se emplean las fórmulas de Manning y la de Hazen-Williams únicamente, estableciéndose comparaciones entre una y otra fórmula en el capítulo 4.

2

FORMULA DE MANNING

La fórmula de Manning, que se emplea en el diseño de canales, es la siguiente:

$$V=\frac{1}{n} \quad r^{2/3} \quad s^{1/2} \quad \text{.....(1)}$$

en donde:

V velocidad $^{m}/_{s}$

n coeficiente de rugosidad.

r radio hidráulico.

s pendiente hidráulica.

Si al tubo se le considera como un canal de -- sección circular, en el cual circula el líquido a tubo lleno, el radio hidráulico se calculará así:

$$r = \frac{A}{p}$$

en donde:

A= área de la sección.

y

p= perímetro mojado.

Además, sabemos que:

$$A = \frac{\pi D^2}{4}$$

y ..... (2)

$$p = \pi D$$

Sustituyendo y simplificando, el radio hidráulico queda así:

$$r = \frac{\pi D^2}{4\pi D}$$

$$r = \frac{D}{4} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Para calcular las pérdidas por fricción en una tubería mediante la fórmula de Manning, se empleará la siguiente fórmula:

$$Q = v \times A \quad \ldots\ldots\ldots\ldots\ldots (4)$$

Sustituyendo 1, 2 y 3 en 4.

Tenemos que:

$$Q = \frac{A}{n} \quad r^{2/3} \quad s^{1/2}$$

$$Q = \frac{\pi D^2}{4n} \quad \left(\frac{D}{4}\right)^{2/3} \quad s^{1/2}$$

$$Q = \frac{0.312}{n} \quad D^{8/3} \quad s^{1/2}$$

pero:

$$s = \frac{h_f}{L}$$

$$Q = \frac{0.312}{n} \quad D^{8}/_{3} \quad \left(\frac{h_f}{L}\right)^{1}/_{2}$$

Finalmente para calcular las pérdidas y obtener los resultados en porcentaje, se supondrá una L= 100 m.

Despejando a h_f , tenemos:

$$h_f{}^{1}/_{2} = \frac{Q L^{1}/_{2}\ n}{0.312\ D^{8}/_{3}}$$

$$h_f = \left(\frac{Q L^{1}/_{2}\ n}{0.312\ D^{8}/_{3}}\right)^{2}$$

pero como L= 100; $L^{1}/_{2} = 10$.

$$h_f = \frac{(32.051\ Qn)}{D^{8/3}}$$

en donde:

h_f pérdidas por fricción % (1m. por cada 100 - metros de tubería).

Q gasto en M^3/S

n coeficiente de rugosidad.

D diámetro del tubo en metros.

El coeficiente de rugosidad n, depende del material de que esté hecho el tubo.

En la tabla siguiente, se presentan los valores que Horton dá al coeficiente de rugosidad (n).

VALORES DE n DADOS POR HORTON PARA SER EMPLEADOS EN LA FORMULA MANNING.

SUPERFICIE	CONDICIONES DE LAS PAREDES			
	PERFECTAS	BUENAS	MEDIANAMENTE BUENAS	MALAS
Tubería fierro forjado negro comercial.	.012	.013	.014	.015
Tubería fierro forjado galvanizado comercial.	.013	.014	.015	.017
Tubería de latón o vidrio.	.009	.010	.011	.013
Tubería acero remachado en espiral.	.013	.015	.017	-
Tubería de barro vitrificado.	.010	.013	.015	.017
Tubos comunes de barro para drenaje.	.011	.012	.014	.017
Tuberías de concreto.	.012	.013	.015	.016
Tuberías de duela.	.010	.011	.012	.013

En éste trabajo, se emplearán los siguientes -- valores de n:

n= 0.009

n= 0.012

n= 0.014

El primero y el tercer valor de n, correspon-- den a tuberías de cobre y fierro galvonizado, respectivamente.- Las tuberías hechas con estos materiales, son las que se usan en las instalaciones hidráulicas en los_ edificios.

TUBERIA DE 6.35 MM (1/4 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 0.316 CENTIMETROS CUADRADOS

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
0.029	0.947	39.1	69.6	94.7
0.030	0.978	41.8	74.3	101.2
0.031	1.010	44.5	79.2	107.8
0.032	1.042	47.3	84.2	114.6
0.033	1.073	50.3	89.4	121.7
0.034	1.105	53.3	94.7	129.0
0.035	1.136	56.4	100.2	136.4
0.036	1.168	59.5	105.9	144.1
0.037	1.199	62.8	111.7	152.0
0.038	1.231	66.1	117.6	160.1
0.039	1.273	69.6	123.7	168.4
0.040	1.294	73.1	130.0	177.0
0.041	1.326	76.7	136.4	185.7
0.042	1.357	80.4	143.0	194.7
0.043	1.389	84.2	149.7	203.8
0.044	1.420	88.1	156.6	213.2
0.045	1.452	92.0	163.7	222.8
0.046	1.484	96.1	170.9	236.2
0.047	1.515	100.2	178.2	242.6
0.048	1.547	104.4	185.7	252.8
0.049	1.578	108.8	193.4	263.2
0.050	1.610	113.1	201.2	273.9
0.051	1.641	117.6	209.2	284.7
0.052	1.673	122.2	217.3	295.8
0.053	1.705	126.9	225.6	307.0
0.054	1.736	131.6	234.0	318.5
0.055	1.768	136.4	242.6	330.2
0.056	1.799	141.4	251.3	342.1
0.057	1.831	146.4	260.2	354.2

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
0.058	1.863	151.4	269.3	366.5
0.059	1.894	156.6	278.5	379.1
0.060	1.926	161.9	287.8	391.8
0.061	1.957	167.2	297.4	404.8
0.062	1.989	172.7	307.0	417.9
0.063	2.020	178.2	316.9	431.3
0.064	2.052	183.8	326.8	444.9
0.065	2.084	189.5	337.0	458.7
0.066	2.115	195.3	347.3	472.7
0.067	2.147	201.2	357.7	486.9
0.068	2.178	207.2	368.3	501.3
0.069	2.210	213.2	379.1	516.0
0.070	2.241	219.3	390.0	530.8
0.071	2.273	225.6	401.0	545.9
0.072	2.305	231.9	412.3	561.2
0.073	2.336	238.3	423.6	576.6
0.074	2.368	244.8	435.2	592.3
0.075	2.399	251.3	446.8	608.2
0.076	2.431	258.0	458.7	624.3
0.077	2.462	264.7	470.7	640.7
0.078	2.494	271.6	482.8	657.2
0.079	2.526	278.5	495.1	673.9
0.080	2.557	285.5	507.6	690.9
0.081	2.589	292.6	520.2	708.1
0.082	2.620	299.8	533.0	725.4
0.083	2.652	307.0	545.9	743.0
0.084	2.683	314.4	559.0	760.8
0.085	2.715	321.8	572.2	778.8
0.086	2.747	329.4	585.6	797.0
0.087	2.778	337.0	599.1	815.5
0.088	2.810	344.7	612.8	834.1
0.089	2.841	352.5	626.7	853.0
0.090	2.873	360.3	640.7	872.0

PERDIDA DE CARGA POR FRICCION

GASTO L/SEG	VELOC M/SEG	(%) n=0.009	n=0.012	n=0.014
0.091	2.905	368.3	654.8	891.3
0.092	2.936	376.4	669.1	910.8
0.093	2.968	384.5	683.6	930.5
0.094	2.999	392.7	698.2	950.4
0.095	3.031	401.0	713.0	970.5
0.096	3.062	409.4	727.9	990.8
0.097	3.094	417.9	743.0	1011.4
0.098	3.126	426.5	758.3	1032.1
0.099	3.157	435.2	773.7	1053.1
0.100	3.189	443.9	789.2	1074.2

TUBERIA DE 9.52 MM (3/8 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 0.712 CENTIMETROS CUADRADOS

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
0.050	0.701	12.6	22.2	30.2
0.054	0.757	14.5	25.9	35.3
0.058	0.813	16.8	29.9	40.7
0.062	0.870	19.2	34.2	46.5
0.066	0.926	21.8	38.7	52.7
0.070	0.982	24.5	43.6	59.3
0.074	1.038	27.4	48.7	66.3
0.078	1.094	30.4	54.1	73.7
0.082	1.150	33.6	59.8	81.4
0.086	1.206	37.0	65.8	89.6
0.090	1.263	40.5	72.0	98.1
0.094	1.319	44.2	78.6	107.0
0.098	1.375	48.0	85.4	116.3
0.102	1.431	52.0	92.6	126.0
0.106	1.487	56.2	100.0	136.1
0.110	1.543	60.5	107.6	146.5
0.114	1.599	65.0	115.6	157.4
0.118	1.656	69.7	123.9	168.6
0.122	1.712	74.5	132.4	180.3
0.126	1.768	79.4	141.3	192.3
0.130	1.824	84.6	150.4	204.7
0.134	1.880	89.9	159.8	217.5
0.138	1.936	95.3	169.5	230.7
0.142	1.992	100.9	179.4	244.2
0.146	2.048	106.7	189.7	258.2
0.150	2.105	112.6	200.2	272.5
0.154	2.161	118.7	211.0	287.3
0.158	2.217	124.9	222.1	302.4
0.162	2.273	131.3	233.5	317.9

PERDIDA DE CARGA POR FRICCION

GASTO L/SEG	VELOC M/SEG	(%) n=0.009	n=0.012	n=0.014
0.166	2.329	137.9	245.2	333.8
0.170	2.385	144.6	257.2	350.1
0.174	2.441	151.5	269.4	366.7
0.178	2.498	152.6	282.0	383.8
0.182	2.554	165.8	294.8	401.2
0.186	2.610	173.2	307.9	419.1
0.190	2.666	180.7	321.3	437.3
0.194	2.722	188.4	334.9	455.9
0.198	2.778	196.2	348.9	474.9
0.202	2.834	204.2	363.1	494.3
0.206	2.890	212.4	377.7	514.1
0.210	2.947	220.7	392.5	534.2
0.214	3.003	229.2	407.6	554.8
0.218	3.059	237.9	423.0	575.7
0.222	3.115	246.7	438.6	597.0
0.226	3.171	255.7	454.6	618.7
0.230	3.227	264.8	470.8	640.8
0.234	3.283	274.1	487.3	663.3
0.238	3.340	283.5	504.1	686.2
0.242	3.396	293.2	521.2	709.4
0.246	3.452	302.9	538.6	733.1

TUBERIA DE 12.70 MM (1/2 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 1.266 CENTIMETROS CUADRADOS

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
0.100	0.789	10.7	19.1	26.1
0.105	0.828	11.9	21.1	28.7
0.110	0.868	13.0	23.2	31.6
0.115	0.907	14.2	25.3	34.5
0.120	0.947	15.5	27.6	37.6
0.125	0.986	16.8	29.9	40.8
0.130	1.026	18.2	32.4	44.1
0.135	1.065	19.6	34.9	47.6
0.140	1.105	21.1	37.6	51.1
0.145	1.144	22.6	40.3	54.9
0.150	1.184	24.2	43.1	58.7
0.155	1.223	25.9	46.1	62.7
0.160	1.263	27.6	49.1	66.8
0.165	1.302	29.3	52.2	71.1
0.170	1.341	31.1	55.4	75.4
0.175	1.381	33.0	58.7	79.9
0.180	1.420	34.9	62.1	84.6
0.185	1.460	36.9	65.6	89.3
0.190	1.499	38.9	69.2	94.2
0.195	1.539	41.0	72.9	99.3
0.200	1.578	43.1	76.7	104.4
0.205	1.618	45.3	80.6	109.7
0.210	1.657	47.6	84.6	115.1
0.215	1.697	49.8	88.7	120.7
0.220	1.736	52.2	92.8	126.4
0.225	1.776	54.6	97.1	132.2
0.230	1.815	57.1	101.5	138.1
0.235	1.855	59.6	105.9	144.2
0.240	1.894	62.1	110.5	150.4

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
0.245	1.934	64.7	115.1	156.7
0.250	1.973	67.4	119.9	163.2
0.255	2.012	70.1	124.7	169.8
0.260	2.052	72.9	129.7	176.5
0.265	2.091	75.8	134.7	183.4
0.270	2.131	78.6	139.8	190.4
0.275	2.170	81.6	145.1	197.5
0.280	2.210	84.6	150.4	204.7
0.285	2.249	87.6	155.8	212.1
0.290	2.289	90.7	161.3	219.6
0.295	2.328	93.9	167.0	227.3
0.300	2.378	97.1	172.7	235.0
0.305	2.407	100.4	178.5	242.9
0.310	2.447	103.7	184.4	251.0
0.315	2.486	107.1	190.4	259.1
0.320	2.526	110.5	196.5	267.4
0.325	2.565	114.0	202.7	275.8
0.330	2.605	117.5	208.9	284.4
0.335	2.644	121.1	215.3	293.1
0.340	2.683	124.7	221.8	301.9
0.345	2.723	128.4	228.4	310.9
0.350	2.762	132.2	235.0	319.9
0.355	2.802	136.0	241.8	329.1
0.360	2.841	139.8	248.7	338.5
0.365	2.881	143.8	255.6	347.9
0.370	2.920	147.7	262.7	357.5
0.375	2.960	151.8	269.8	367.3
0.380	2.999	155.8	277.1	377.1
0.385	3.039	160.0	284.4	387.1
0.390	3.078	164.1	291.8	397.2
0.395	3.118	168.4	299.4	407.5
0.400	3.157	172.7	307.0	417.9
0.405	3.197	177.0	314.7	428.4

PERDIDA DE CARGA POR FRICCION

GASTO L/SEG	VELOC M/SEG	(%) n=0.009	n=0.012	n=0.014
0.410	3.236	181.4	322.5	439.0
0.415	3.276	185.9	330.5	449.8
0.420	3.315	190.4	338.5	460.7
0.425	3.354	194.9	346.6	471.8
0.430	3.394	199.5	354.8	482.9
0.435	3.433	204.2	363.1	494.2
0.440	3.473	208.9	371.5	505.6
0.445	3.512	213.7	380.0	517.2
0.450	3.552	218.5	388.6	528.9

TUBERIA DE 19.04 MM (3/4 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 2.850 CENTIMETROS CUADRADOS

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
0.25	0.877	7.7	13.7	18.7
0.26	0.912	8.3	14.9	20.3
0.27	0.947	9.0	16.0	21.9
0.28	0.982	9.7	17.3	23.5
0.29	1.017	10.4	18.5	25.2
0.30	1.052	11.1	19.8	27.0
0.31	1.087	11.9	21.2	28.8
0.32	1.122	12.7	22.6	30.7
0.33	1.157	13.5	24.0	32.7
0.34	1.192	14.3	25.5	34.7
0.35	1.227	15.2	27.0	36.8
0.36	1.263	16.0	28.6	38.9
0.37	1.298	17.0	30.2	41.1
0.38	1.333	17.9	31.8	43.3
0.39	1.368	18.8	33.5	45.7
0.40	1.403	19.8	35.3	48.0
0.41	1.438	20.8	37.1	50.5
0.42	1.473	21.9	38.9	53.0
0.43	1.508	22.9	40.8	55.5
0.44	1.543	24.0	42.7	58.1
0.45	1.578	25.1	44.7	60.8
0.46	1.613	26.2	46.7	63.5
0.47	1.648	27.4	48.7	66.3
0.48	1.684	28.6	50.8	69.2
0.49	1.719	29.8	53.0	72.1
0.50	1.754	31.0	55.1	75.1
0.51	1.789	32.2	57.4	78.1
0.52	1.824	33.5	59.6	81.2
0.53	1.859	34.8	62.0	84.4

CARGA L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
0.54	1.894	36.2	64.3	87.6
0.55	1.929	37.5	66.7	90.8
0.56	1.964	38.9	69.2	94.2
0.57	1.999	40.3	71.7	97.6
0.58	2.034	41.7	74.2	101.0
0.59	2.070	43.2	76.8	104.6
0.60	2.105	44.7	79.4	108.1
0.61	2.140	46.2	82.1	111.8
0.62	2.175	47.7	84.8	115.5
0.63	2.210	49.2	87.6	119.2
0.64	2.245	50.8	90.4	123.0
0.65	2.280	52.4	93.2	126.9
0.66	2.315	54.0	96.1	130.8
0.67	2.350	55.7	99.1	134.8
0.68	2.385	57.4	102.0	138.9
0.69	2.420	59.1	105.1	143.0
0.70	2.455	60.8	108.1	147.2
0.71	2.491	62.6	111.2	151.4
0.72	2.526	64.3	114.4	155.7
0.73	2.561	66.1	117.6	160.1
0.74	2.596	68.0	120.8	164.5
0.75	2.631	69.8	124.1	169.0
0.76	2.666	71.7	127.5	173.5
0.77	2.701	73.6	130.8	178.1
0.78	2.736	75.5	134.3	182.8
0.79	2.771	77.5	137.7	187.5
0.80	2.806	79.4	141.2	192.3
0.81	2.841	81.4	144.8	197.1
0.82	2.876	83.5	148.4	202.0
0.83	2.912	85.5	152.0	207.0
0.84	2.947	87.6	155.7	212.0
0.85	2.982	89.7	159.5	217.1

PERDIDA DE CARGA POR FRICCION

GASTO L/SEG	VELOC M/SEG	(%) n=0.009	n=0.012	n=0.014
0.86	3.017	91.8	163.2	222.2
0.87	3.052	93.9	167.0	227.4
0.88	3.087	96.1	170.9	232.6
0.89	3.122	98.3	174.8	238.0
0.90	3.157	100.5	178.8	243.7
0.91	3.192	102.8	182.8	248.8
0.92	3.227	105.1	186.8	254.3
0.93	3.262	107.4	190.9	259.8
0.94	3.297	109.7	195.0	265.5
0.95	3.333	112.0	199.2	271.1

TUBERIA DE 25.40 MM (1 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 5.067 CENTIMETROS CUADRADOS

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
0.30	0.592	2.4	4.2	5.8
0.32	0.631	2.7	4.8	6.6
0.34	0.670	3.0	5.5	7.4
0.36	0.710	3.4	6.1	8.3
0.38	0.749	3.8	6.8	9.3
0.40	0.789	4.2	7.6	10.3
0.42	0.828	4.7	8.3	11.4
0.44	0.868	5.1	9.2	12.5
0.46	0.907	5.6	10.0	13.7
0.48	0.947	6.1	10.9	14.9
0.50	0.986	6.6	11.8	16.1
0.52	1.026	7.2	12.8	17.5
0.54	1.065	7.8	13.8	18.8
0.56	1.105	8.3	14.9	20.3
0.58	1.144	9.0	16.0	21.7
0.60	1.184	9.6	17.1	23.3
0.62	1.223	10.2	18.2	24.9
0.64	1.263	10.9	19.4	26.5
0.66	1.302	11.6	20.7	28.2
0.68	1.341	12.3	22.0	29.9
0.70	1.381	13.1	23.3	31.7
0.72	1.420	13.8	24.6	33.5
0.74	1.460	14.6	26.0	35.4
0.76	1.499	15.4	27.4	37.4
0.78	1.539	16.2	28.9	39.4
0.80	1.578	17.1	30.4	41.4
0.82	1.618	18.0	32.0	43.5
0.84	1.657	18.8	33.5	35.7
0.86	1.697	19.8	35.2	47.9
0.88	1.736	20.7	36.8	50.1

CARGA L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
0.90	1.776	21.6	38.5	52.4
0.92	1.815	22.6	40.2	54.8
0.94	1.855	23.6	42.0	57.2
0.96	1.894	24.6	43.8	59.7
0.98	1.934	25.7	45.7	62.2
1.00	1.973	26.7	47.5	64.7
1.02	2.012	27.8	49.5	67.4
1.04	2.052	28.9	51.4	70.0
1.06	2.091	30.0	53.4	72.7
1.08	2.131	31.2	55.5	75.5
1.10	2.170	32.3	57.5	78.3
1.12	2.210	33.5	59.7	81.2
1.14	2.249	34.7	61.8	84.1
1.16	2.289	36.0	64.0	87.1
1.18	2.328	37.2	66.2	90.2
1.20	2.368	38.5	68.5	93.2
1.22	2.407	39.8	70.8	96.4
1.24	2.447	41.1	73.1	99.6
1.26	2.486	42.5	75.5	102.8
1.28	2.526	43.8	77.9	106.1
1.30	2.565	45.2	80.4	109.4
1.32	2.605	46.6	82.9	112.8
1.34	2.644	48.0	85.4	116.3
1.36	2.683	49.5	88.0	119.8
1.38	2.723	50.9	90.6	123.3
1.40	2.762	52.4	93.2	126.9
1.42	2.802	53.9	95.9	130.6
1.44	2.841	55.5	98.7	134.3
1.46	2.881	57.0	101.4	138.1
1.48	2.920	58.6	104.2	141.9
1.50	2.960	60.2	107.0	145.7
1.52	2.999	61.8	109.9	149.6

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
1.54	3.039	63.4	112.8	153.6
1.56	3.078	65.1	115.8	157.6
1.58	3.118	66.8	118.8	161.7
1.60	3.157	68.5	121.8	165.8
1.62	3.197	70.2	124.9	170.0
1.64	3.236	72.0	128.0	174.2
1.66	3.276	73.7	131.1	178.5
1.68	3.315	75.5	134.3	182.8
1.70	3.354	77.3	137.5	187.2

TUBERIA DE 31.74 MM (1 1/4 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 7.917 CENTIMETROS CUADRADOS

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
0.60	0.757	2.9	5.2	7.0
0.63	0.795	3.2	5.7	7.8
0.66	0.833	3.5	6.3	8.5
0.69	0.871	3.8	6.8	9.3
0.72	0.909	4.2	7.5	10.2
0.75	0.947	4.5	8.0	11.0
0.78	0.985	4.9	8.8	11.9
0.81	1.023	5.3	9.4	12.9
0.84	1.060	5.7	10.2	13.9
0.87	1.098	6.1	10.9	14.9
0.90	1.136	6.5	11.7	15.9
0.93	1.174	7.0	12.5	17.0
0.96	1.212	7.5	13.3	18.1
0.99	1.250	7.9	14.1	19.3
1.02	1.288	8.4	15.0	20.5
1.05	1.326	8.9	15.9	21.7
1.08	1.364	9.4	16.8	22.9
1.11	1.401	10.0	17.8	24.2
1.14	1.439	10.5	18.8	25.6
1.17	1.477	11.1	19.8	26.9
1.20	1.515	11.7	20.8	28.3
1.23	1.553	12.3	21.9	29.8
1.26	1.591	12.9	22.9	31.2
1.29	1.629	13.5	24.0	32.7
1.32	1.667	14.1	25.2	34.3
1.35	1.705	14.8	26.3	35.9
1.38	1.743	15.5	27.5	37.5
1.41	1.780	16.1	28.7	39.1
1.44	1.818	16.8	30.0	40.8

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
1.47	1.856	17.5	31.2	42.5
1.50	1.894	18.3	32.5	44.3
1.53	1.932	19.0	33.8	46.1
1.56	1.970	19.8	35.2	47.9
1.59	2.008	20.5	36.6	49.8
1.62	2.046	21.3	37.9	51.7
1.65	2.084	22.1	39.4	53.6
1.68	2.121	22.9	40.8	55.6
1.71	2.159	23.8	42.3	57.6
1.74	2.197	24.6	43.8	59.6
1.77	2.235	25.5	45.3	61.7
1.80	2.273	26.3	46.9	63.8
1.83	2.311	27.2	48.4	65.9
1.86	2.349	28.1	50.0	68.1
1.89	2.387	29.0	51.7	70.3
1.92	2.425	30.0	53.3	72.6
1.95	2.464	30.9	55.0	74.9
1.98	2.500	31.9	56.7	77.2
2.01	2.538	32.9	58.4	79.6
2.04	2.575	33.8	60.2	82.0
2.07	2.614	34.8	62.0	84.4
2.10	2.652	35.9	63.8	86.9
2.13	2.690	36.9	65.6	89.4
2.16	2.728	37.9	67.5	91.9
2.19	2.766	39.0	69.4	94.5
2.22	2.803	40.1	71.3	97.1
2.25	2.841	41.2	73.3	99.7
2.28	2.879	42.3	75.2	102.4
2.31	2.917	43.4	77.2	105.1
2.34	2.955	44.5	79.2	107.9
2.37	2.993	45.6	81.3	110.6
2.40	3.031	46.9	83.3	113.5
2.43	3.069	48.0	85.4	116.3
2.46	3.107	49.2	87.6	119.2

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
2.49	3.145	50.4	89.7	122.1
2.52	3.182	51.7	91.9	125.1
2.55	3.220	52.9	94.1	128.1
2.58	3.258	54.2	96.3	131.1
2.61	3.296	55.4	98.6	134.2
2.64	3.334	56.7	100.9	137.3
2.67	3.372	58.0	103.2	140.4
2.70	3.410	59.3	105.5	143.6

TUBERIA DE 38.09 MM (1 1/2 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 11.4 CENTIMETROS CUADRADOS

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
0.90	0.789	2.4	4.4	6.0
0.94	0.824	2.7	4.8	6.5
0.98	0.859	2.9	5.2	7.1
1.02	0.894	3.2	5.6	7.7
1.06	0.929	3.4	6.1	8.3
1.10	0.964	3.7	6.6	9.0
1.14	0.999	4.0	7.1	9.6
1.18	1.035	4.2	7.6	10.3
1.22	1.070	4.5	8.1	11.0
1.26	1.105	4.8	8.6	11.8
1.30	1.140	5.2	9.2	12.5
1.34	1.175	5.5	9.8	13.3
1.38	1.210	5.8	10.4	14.1
1.42	1.245	6.2	11.0	15.0
1.46	1.280	6.5	11.6	15.8
1.50	1.315	6.9	12.3	16.7
1.54	1.350	7.3	12.9	17.6
1.58	1.385	7.6	13.6	18.6
1.62	1.420	8.0	14.3	19.5
1.66	1.456	8.4	15.0	20.5
1.70	1.491	8.9	15.8	21.5
1.74	1.526	9.3	16.5	22.6
1.78	1.561	9.7	17.3	23.6
1.82	1.596	10.2	18.1	24.6
1.86	1.631	10.6	18.9	25.7
1.90	1.666	11.1	19.7	26.9
1.94	1.701	11.5	20.6	28.0
1.98	1.736	12.0	21.4	29.2
2.02	1.771	12.5	22.3	30.4

PERDIDAS POR FRICCION

GASTO L/SEG	VELOC M/SEG	(%) n=0.009	n=0.012	n=0.014
2.06	1.806	13.0	23.2	31.6
2.10	1.841	13.5	24.1	32.8
2.14	1.877	14.1	25.0	34.1
2.18	1.912	14.6	26.0	35.4
2.22	1.947	15.1	26.9	36.7
2.26	1.982	15.7	27.9	38.0
2.30	2.017	16.2	28.9	39.4
2.34	2.052	16.8	29.9	40.8
2.38	2.087	17.4	31.0	42.2
2.42	2.122	18.0	32.0	43.6
2.46	2.157	18.6	33.1	45.1
2.50	2.192	19.2	34.2	46.5
2.54	2.227	19.8	35.3	48.0
2.58	2.226	20.5	36.4	49.6
2.62	2.298	21.1	37.5	51.1
2.66	2.333	21.7	38.7	52.7
2.70	2.368	22.4	39.9	54.3
2.74	2.403	23.1	41.1	55.9
2.78	2.438	23.8	42.3	57.6
2.82	2.473	24.4	43.5	59.2
2.86	2.508	25.1	44.7	60.9
2.90	2.543	25.9	46.0	62.6
2.94	2.578	26.6	47.3	64.4
2.98	2.613	27.3	48.6	66.1
3.02	2.648	28.0	49.9	67.9
3.06	2.683	28.8	51.2	69.7
3.10	2.719	29.5	52.6	71.6
3.14	2.754	30.3	53.9	73.4
3.18	2.780	31.1	55.3	75.3
3.22	2.824	31.9	56.7	77.2
3.26	2.859	32.7	58.1	79.2
3.30	2.894	33.5	59.6	81.1

PERDIDA DE CARGA POR FRICCION

GASTO L/SEG	VELOC M/SEG	(%) n=0.009	n=0.012	n=0.014
3.34	2.920	34.3	61.0	83.1
3.38	2.964	35.1	62.5	85.1
3.42	2.999	36.0	64.0	87.1
3.46	3.034	36.8	65.5	89.2
3.50	3.069	37.7	67.0	91.3
3.54	3.105	38.5	68.6	93.3
3.58	3.140	39.4	70.1	95.5
3.62	3.175	40.3	71.7	97.6
3.66	3.210	41.2	73.3	99.8
3.70	3.245	42.1	74.9	102.0
3.74	3.280	43.0	76.5	104.2

TUBERIA DE 50.8 MM (2 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 20.268 CENTIMETROS CUADRADOS

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
1.90	0.937	2.3	4.2	5.8
1.96	0.967	2.5	4.5	6.1
2.02	0.996	2.7	4.8	6.5
2.08	1.026	2.8	5.1	6.9
2.14	1.055	3.0	5.4	7.3
2.20	1.085	3.2	5.7	7.7
2.26	1.115	3.3	6.0	8.2
2.32	1.144	3.5	6.3	8.6
2.38	1.174	3.7	6.6	9.1
2.44	1.203	3.9	7.0	9.5
2.50	1.233	4.1	7.3	10.0
2.56	1.263	4.3	7.7	10.5
2.62	1.292	4.5	8.1	11.0
2.68	1.322	4.7	8.4	11.5
2.74	1.351	4.9	8.8	12.0
2.80	1.381	5.2	9.2	12.5
2.86	1.411	5.4	9.6	13.1
2.92	1.440	5.6	10.0	13.7
2.98	1.470	5.8	10.4	14.2
3.04	1.499	6.1	10.9	14.8
3.10	1.529	6.3	11.3	15.4
3.16	1.559	6.6	11.7	16.0
3.22	1.588	6.8	12.2	16.6
3.28	1.618	7.1	12.7	17.2
3.34	1.647	7.4	13.1	17.9
3.40	1.677	7.6	13.6	18.5
3.46	1.707	7.9	14.1	19.2
3.52	1.736	8.2	14.6	19.9
3.58	1.766	8.5	15.1	20.5

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
3.64	1.795	8.7	15.6	21.2
3.70	1.825	9.0	16.1	21.9
3.76	1.855	9.3	16.6	22.7
3.82	1.885	9.6	17.2	23.4
3.88	1.914	9.9	17.7	24.1
3.94	1.943	10.3	18.3	24.9
4.00	1.973	10.6	18.8	25.7
4.06	2.003	10.9	19.4	26.4
4.12	2.032	11.2	20.0	27.2
4.18	2.062	11.6	20.6	28.0
4.24	2.091	11.9	21.2	28.8
4.30	2.121	12.2	21.8	29.7
4.36	2.151	12.6	22.4	30.5
4.42	2.180	12.9	23.0	31.3
4.48	2.210	13.3	23.6	32.2
4.54	2.239	13.6	24.3	33.1
4.60	2.269	14.0	24.9	34.0
4.66	2.299	14.4	25.6	34.8
4.72	2.328	14.7	26.3	35.7
4.78	2.358	15.1	26.9	36.7
4.84	2.387	15.5	27.6	37.6
4.90	2.417	15.9	28.3	38.5
4.96	2.447	16.3	29.0	39.5
5.02	2.476	16.7	29.7	40.4
5.08	2.506	17.1	30.4	41.4
5.14	2.535	17.5	31.1	42.4
5.20	2.565	17.9	31.9	43.4
5.26	2.595	18.3	32.6	44.4
5.32	2.624	18.7	33.4	45.4
5.38	2.654	19.2	34.1	46.5
5.44	2.683	19.6	34.9	47.5
5.50	2.713	20.0	35.7	48.6

GASTO	VELOC	PERDIDA DE CARGA POR FRICCION (%)		
L/SEG	M/SEG	n=0.009	n=0.012	n=0.014
5.56	2.743	20.5	36.4	49.6
5.62	2.772	20.9	37.2	50.7
5.68	2.802	21.4	38.0	51.8
5.74	2.832	21.8	38.8	52.9
5.80	2.861	22.3	39.7	54.0
5.86	2.891	22.8	40.6	55.1
5.92	2.920	23.2	41.3	56.3
5.98	2.950	23.7	42.2	57.4
6.04	2.980	24.2	43.0	58.6
6.10	3.009	24.7	43.9	59.7
6.16	3.039	25.1	44.7	60.9

TUBERIA DE 63.49 MM (2 1/2 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO =31.669 CENTIMETROS CUADRADOS

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
3.0	0.947	1.8	3.2	4.3
3.1	0.978	1.9	3.4	4.6
3.2	1.010	2.0	3.6	5.0
3.3	1.042	2.1	3.9	5.3
3.4	1.073	2.3	4.1	5.6
3.5	1.105	2.4	4.3	5.9
3.6	1.136	2.6	4.6	6.3
3.7	1.168	2.7	4.9	6.6
3.8	1.199	2.9	5.1	7.0
3.9	1.231	3.0	5.4	7.4
4.0	1.263	3.2	5.7	7.8
4.1	1.294	3.3	6.0	8.2
4.2	1.326	3.5	6.3	8.6
4.3	1.357	3.7	6.6	9.0
4.4	1.389	3.9	6.9	9.4
4.5	1.420	4.0	7.2	9.8
4.6	1.452	4.2	7.5	10.3
4.7	1.484	4.4	7.9	10.7
4.8	1.515	4.6	8.2	11.2
4.9	1.547	4.8	8.6	11.7
5.0	1.578	5.0	8.9	12.2
5.1	1.610	5.2	9.3	12.7
5.2	1.641	5.4	9.7	13.2
5.3	1.673	5.6	10.0	13.7
5.4	1.705	5.8	10.4	14.2
5.5	1.736	6.1	10.8	14.7
5.6	1.768	6.3	11.2	15.3
5.7	1.799	6.5	11.6	15.8
5.8	1.831	6.7	12.0	16.4

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
5.9	1.863	7.0	12.5	17.0
6.0	1.894	7.2	12.9	17.5
6.1	1.926	7.5	13.3	18.1
6.2	1.957	7.7	13.8	18.7
6.3	1.989	8.0	14.2	19.4
6.4	2.020	8.2	14.7	20.0
6.5	2.052	8.5	15.1	20.6
6.6	2.084	8.7	15.6	21.2
6.7	2.115	9.0	16.1	21.9
6.8	2.147	9.3	16.6	22.6
6.9	2.178	9.6	17.0	23.2
7.0	2.210	9.8	17.5	23.9
7.1	2.241	10.1	18.1	24.6
7.2	2.273	10.4	18.6	25.3
7.3	2.305	10.7	19.1	26.0
7.4	2.336	11.0	19.6	26.7
7.5	2.368	11.3	20.2	27.4
7.6	2.399	11.6	20.7	28.2
7.7	2.431	11.9	21.2	28.9
7.8	2.462	12.2	21.8	29.7
7.9	2.494	12.6	22.4	30.5
8.0	2.526	12.9	22.9	31.2
8.1	2.557	13.2	23.5	32.0
8.2	2.589	13.5	24.1	32.8
8.3	2.620	13.9	24.7	33.6
8.4	2.652	14.2	25.3	34.4
8.5	2.683	14.5	25.9	35.3
8.6	2.715	14.9	26.5	36.1
8.7	2.747	15.2	27.1	36.9
8.8	2.778	15.6	27.8	37.8
8.9	2.810	16.0	28.4	38.7
9.0	2.841	16.3	29.0	39.5

GASTO	VELOC	PERDIDA DE CARGA POR FRICCION (%)		
L/SEG	M/SEG	n=0.009	n=0.012	n=0.014
9.1	2.873	16.7	29.7	40.4
9.2	2.905	17.0	30.3	41.3
9.3	2.936	17.4	31.0	42.2
9.4	2.968	17.8	31.7	43.1
9.5	2.999	18.2	32.4	44.1
9.6	3.031	18.6	33.0	45.0
9.7	3.062	19.0	33.7	45.9
9.8	3.094	19.4	34.4	46.9
9.9	3.126	19.7	35.1	47.9
10.0	3.157	20.2	35.9	48.8
10.1	3.189	20.6	36.6	49.8

TUBERIA DE 76.19 MM (3 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 45.603 CENTIMETROS CUADRADOS

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
2.0	0.438	0.3	0.5	0.7
2.2	0.482	0.3	0.6	0.8
2.4	0.526	0.4	0.7	1.0
2.6	0.570	0.5	0.9	1.2
2.8	0.613	0.5	1.0	1.4
3.0	0.657	0.6	1.2	1.6
3.2	0.701	0.7	1.3	1.8
3.4	0.745	0.8	1.5	2.1
3.6	0.789	0.9	1.7	2.3
3.8	0.833	1.1	1.9	2.6
4.0	0.877	1.2	2.1	2.9
4.2	0.920	1.3	2.3	3.2
4.4	0.964	1.4	2.6	3.5
4.6	1.008	1.6	2.8	3.9
4.8	1.052	1.7	3.1	4.2
5.0	1.096	1.9	3.3	4.6
5.2	1.140	2.0	3.6	4.9
5.4	1.184	2.2	3.9	5.3
5.6	1.227	2.3	4.2	5.7
5.8	1.271	2.5	4.5	6.2
6.0	1.315	2.7	4.8	6.6
6.2	1.359	2.9	5.2	7.1
6.4	1.403	3.1	5.5	7.5
6.6	1.447	3.3	5.9	8.0
6.8	1.491	3.5	6.2	8.5
7.0	1.534	3.7	6.6	9.0
7.2	1.578	3.9	7.0	9.5
7.4	1.622	4.1	7.4	10.1
7.6	1.666	4.4	7.8	10.6

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
7.8	1.710	4.6	8.2	11.2
8.0	1.754	4.8	8.6	11.8
8.2	1.798	5.1	9.1	12.4
8.4	1.841	5.3	9.5	13.0
8.6	1.885	5.6	10.0	13.6
8.8	1.929	5.9	10.5	14.3
9.0	1.973	6.1	11.0	14.9
9.2	2.017	6.4	11.4	15.6
9.4	2.061	6.7	12.0	16.3
9.6	2.105	7.0	12.5	17.0
9.8	2.148	7.3	13.0	17.7
10.0	2.192	7.6	13.5	18.4
10.2	2.236	7.9	14.1	19.2
10.4	2.280	8.2	14.6	19.9
10.6	2.324	8.5	15.2	20.7
10.8	2.368	8.9	15.8	21.5
11.0	2.412	9.2	16.4	22.3
11.2	2.455	9.5	17.0	23.1
11.4	2.499	9.9	17.6	24.0
11.6	2.543	10.2	18.2	24.8
11.8	2.587	10.6	18.9	25.7
12.0	2.631	11.0	19.5	26.6
12.2	2.675	11.3	20.2	27.5
12.4	2.719	11.7	20.8	28.4
12.6	2.762	12.1	21.5	29.3
12.8	2.806	12.5	22.2	30.2
13.0	2.850	12.9	22.9	31.2
13.2	2.894	13.3	23.6	32.2
13.4	2.938	13.7	24.3	33.1
13.6	2.982	14.1	25.1	34.1
13.8	3.026	14.5	25.8	35.2
14.0	3.069	14.9	26.6	36.2

PERDIDA DE CARGA POR FRICCION

GASTO L/SEG	VELOC M/SEG	(%) n=0.009	n=0.012	n=0.014
14.2	3.113	15.4	27.3	37.2
14.4	3.157	15.8	28.1	38.3
14.6	3.201	16.2	28.9	39.4
14.8	3.245	16.7	29.7	40.4
15.0	3.289	17.1	30.5	41.5
15.2	3.333	17.6	31.3	42.7
15.4	3.376	18.1	32.2	43.8
15.6	3.420	18.5	33.0	44.9
15.8	3.464	19.0	33.9	46.1
16.0	3.508	19.5	34.7	47.3
16.2	3.552	20.0	35.6	48.5

TUBERIA DE 101.60 MM (4 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 81.073 CENTIMETROS CUADRADOS

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
6.0	0.740	0.5	1.0	1.4
6.3	0.777	0.6	1.1	1.5
6.6	0.814	0.7	1.2	1.7
6.9	0.851	0.7	1.3	1.8
7.2	0.888	0.8	1.5	2.0
7.5	0.925	0.9	1.6	2.2
7.8	0.962	1.0	1.7	2.4
8.1	0.999	1.0	1.9	2.6
8.4	1.036	1.1	2.0	2.8
8.7	1.073	1.2	2.2	3.0
9.0	1.110	1.3	2.3	3.2
9.3	1.147	1.4	2.5	3.4
9.6	1.184	1.5	2.6	3.6
9.9	1.221	1.6	2.8	3.9
10.2	1.258	1.7	3.0	4.1
10.5	1.295	1.8	3.2	4.3
10.8	1.332	1.9	3.4	4.6
11.1	1.369	2.0	3.6	4.9
11.4	1.406	2.1	3.8	5.1
11.7	1.443	2.2	4.0	5.4
12.0	1.480	2.3	4.2	5.7
12.3	1.517	2.4	4.4	6.0
12.6	1.554	2.6	4.6	6.3
12.9	1.591	2.7	4.8	6.6
13.2	1.628	2.8	5.1	6.9
13.5	1.665	3.0	5.3	7.2
13.8	1.702	3.1	5.5	7.5
14.1	1.739	3.2	5.8	7.9
14.4	1.776	3.4	6.0	8.2

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
14.7	1.813	3.5	6.3	8.6
15.0	1.850	3.7	6.5	8.9
15.3	1.887	3.8	6.8	9.3
15.6	1.924	4.0	7.1	9.6
15.9	1.961	4.1	7.4	10.0
16.2	1.998	4.3	7.6	10.4
16.5	2.035	4.4	7.9	10.8
16.8	2.072	4.6	8.2	11.2
17.1	2.109	4.8	8.5	11.6
17.4	2.146	4.9	8.8	12.0
17.7	2.183	5.1	9.1	12.4
18.0	2.220	5.3	9.4	12.9
18.3	2.257	5.5	9.8	13.3
18.6	2.294	5.6	10.1	13.7
18.9	2.331	5.8	10.4	14.2
19.2	2.368	6.0	10.7	14.6
19.5	2.405	6.2	11.1	15.1
19.8	2.442	6.4	11.4	15.6
20.1	2.479	6.6	11.8	16.1
20.4	2.516	6.8	12.1	16.5
20.7	2.553	7.0	12.5	17.0
21.0	2.590	7.2	12.9	17.5
21.3	2.627	7.4	13.2	18.0
21.6	2.664	7.6	13.6	18.5
21.9	2.701	7.8	14.0	19.1
22.2	2.738	8.1	14.4	19.6
22.5	2.775	8.3	14.8	20.1
22.8	2.812	8.5	15.2	20.7
23.1	2.849	8.7	15.6	21.2
23.4	2.886	9.0	16.0	21.8
23.7	2.923	9.2	16.4	22.3
24.0	2.960	9.4	16.8	22.9

PERDIDA DE CARGA POR FRICCION

GASTO L/SEG	VELOC M/SEG	(%) n=0.009	n=0.012	n=0.014
24.3	2.997	9.7	17.2	23.5
24.6	3.034	9.9	17.7	24.1
24.9	3.071	10.2	18.1	24.7
25.2	3.108	10.4	18.5	25.3
25.5	3.145	10.7	19.0	25.9
25.8	3.182	10.9	19.4	26.5
26.1	3.219	11.2	19.9	27.1
26.4	3.256	11.4	20.4	27.7
26.7	3.293	11.7	20.8	28.4
27.0	3.330	12.0	21.3	29.0
27.3	3.367	12.2	21.8	29.7

TUBERIA DE 152.39 MM (6 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 182.414 CENTIMETROS CUADRADOS

GASTO L/SEG	VELOC M/SEG	PERDIDAS POR FRICCION (%) n=0.009	n=0.012	n=0.014
19.0	1.041	0.6	1.2	1.6
19.5	1.068	0.7	1.2	1.7
20.0	1.096	0.7	1.3	1.8
20.5	1.123	0.7	1.4	1.9
21.0	1.151	0.8	1.4	2.0
21.5	1.178	0.8	1.5	2.1
22.0	1.206	0.9	1.6	2.2
22.5	1.233	0.9	1.7	2.3
23.0	1.260	1.0	1.7	2.4
23.5	1.288	1.0	1.8	2.5
24.0	1.315	1.0	1.9	2.6
24.5	1.343	1.1	2.0	2.7
25.0	1.370	1.1	2.1	2.8
25.5	1.397	1.2	2.1	2.9
26.0	1.425	1.2	2.2	3.0
26.5	1.452	1.3	2.3	3.2
27.0	1.480	1.3	2.4	3.3
27.5	1.507	1.4	2.5	3.4
28.0	1.534	1.4	2.6	3.5
28.5	1.562	1.5	2.7	3.7
29.0	1.589	1.5	2.8	3.8
29.5	1.617	1.6	2.9	3.9
30.0	1.644	1.7	3.0	4.1
30.5	1.672	1.7	3.1	4.2
31.0	1.699	1.8	3.2	4.4
31.5	1.726	1.8	3.3	4.5
32.0	1.754	1.9	3.4	4.6
32.5	1.781	2.0	3.5	4.8
33.0	1.809	2.0	3.6	4.9

PERDIDA DE CARGA POR FRICCION

GASTO L/SEG	VELOC M/SEG	(%) n=0.009	n=0.012	n=0.014
33.5	1.836	2.1	3.7	5.1
34.0	1.863	2.1	3.8	5.3
34.5	1.891	2.2	4.0	5.4
35.0	1.918	2.3	4.1	5.6
35.5	1.946	2.3	4.2	5.7
36.0	1.973	2.4	4.3	5.9
36.5	2.000	2.5	4.4	6.1
37.0	2.028	2.5	4.6	6.2
37.5	2.055	2.6	4.7	6.4
38.0	2.083	2.7	4.8	6.6
38.5	2.110	2.8	4.9	6.7
39.0	2.137	2.8	5.1	6.9
39.5	2.165	2.9	5.2	7.1
40.0	2.192	3.0	5.3	7.3
40.5	2.220	3.1	5.5	7.5
41.0	2.247	3.1	5.6	7.7
41.5	2.275	3.2	5.8	7.8
42.0	2.302	3.3	5.9	8.0
42.5	2.329	3.4	6.0	8.2
43.0	2.357	3.5	6.2	8.4
43.5	2.384	3.5	6.3	8.6
44.0	2.412	3.6	6.5	8.8
44.5	2.439	3.7	6.6	9.0
45.0	2.466	3.8	6.8	9.2
45.5	2.494	3.9	6.9	9.4
46.0	2.521	4.0	7.1	9.7
46.5	2.549	4.0	7.2	9.9
47.0	2.576	4.1	7.4	10.1
47.5	2.603	4.2	7.6	10.3
48.0	2.631	4.3	7.7	10.5
48.5	2.658	4.4	7.9	10.7
49.0	2.686	4.5	8.0	11.0
49.5	2.713	4.6	8.2	11.2

PERDIDA DE CARGA POR FRICCION

GASTO L/SEG	VELOC M/SEG	(%) n=0.009	n=0.012	n=0.014
50.0	2.741	4.7	8.4	11.4
50.5	2.768	4.8	8.5	11.6
51.0	2.795	4.9	8.7	11.9
51.5	2.823	5.0	8.9	12.1
52.0	2.850	5.1	9.1	12.3
52.5	2.878	5.2	9.2	12.6
53.0	2.905	5.3	9.4	12.8
53.5	2.932	5.4	9.6	13.1
54.0	2.960	5.5	9.8	13.3
54.5	2.987	5.6	10.0	13.6
55.0	3.015	5.7	10.2	13.8
55.5	3.042	5.8	10.4	14.1
56.0	3.069	5.9	10.5	14.4
56.5	3.097	6.0	10.7	14.6
57.0	3.124	6.1	10.9	14.9

TUBERIA DE 203.20 MM (8 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 324.292 CENTIMETROS CUADRADOS

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
30.0	0.925	0.3	0.6	0.8
31.0	0.955	0.3	0.6	0.9
32.0	0.986	0.4	0.7	1.0
33.0	1.017	0.4	0.7	1.0
34.0	1.048	0.4	0.8	1.1
35.0	1.079	0.5	0.8	1.2
36.0	1.110	0.5	0.9	1.2
37.0	1.140	0.5	0.9	1.3
38.0	1.171	0.5	1.0	1.4
39.0	1.202	0.6	1.1	1.5
40.0	1.233	0.6	1.1	1.5
41.0	1.264	0.6	1.2	1.6
42.0	1.295	0.7	1.2	1.7
43.0	1.325	0.7	1.3	1.8
44.0	1.356	0.7	1.4	1.9
45.0	1.387	0.8	1.4	2.0
46.0	1.418	0.8	1.5	2.0
47.0	1.449	0.9	1.6	2.1
48.0	1.480	0.9	1.6	2.2
49.0	1.510	0.9	1.7	2.3
50.0	1.541	1.0	1.8	2.4
51.0	1.572	1.0	1.8	2.5
52.0	1.603	1.1	1.9	2.6
53.0	1.634	1.1	2.0	2.7
54.0	1.665	1.1	2.1	2.8
55.0	1.695	1.2	2.1	2.9
56.0	1.726	1.2	2.2	3.1
57.0	1.757	1.3	2.3	3.2
58.0	1.788	1.3	2.4	3.3
59.0	1.819	1.4	2.5	3.4

PERDIDA DE CARGA POR FRICCION

GASTO L/SEG	VELOC M/SEG	(%) n=0.009	n=0.012	n=0.014
60.0	1.850	1.4	2.6	3.5
61.0	1.881	1.5	2.7	3.6
62.0	1.911	1.5	2.7	3.8
63.0	1.942	1.6	2.8	3.9
64.0	1.973	1.6	2.9	4.0
65.0	2.004	1.7	3.0	4.1
66.0	2.035	1.7	3.1	4.3
67.0	2.066	1.8	3.2	4.4
68.0	2.096	1.8	3.3	4.5
69.0	2.127	1.9	3.4	4.7
70.0	2.158	2.0	3.5	4.8
71.0	2.189	2.0	3.6	4.9
72.0	2.220	2.1	3.7	5.1
73.0	2.251	2.1	3.8	5.2
74.0	2.281	2.2	3.9	5.4
75.0	2.312	2.2	4.0	5.5
76.0	2.343	2.3	4.1	5.7
77.0	2.374	2.4	4.3	5.8
78.0	2.405	2.4	4.4	6.0
79.0	2.436	2.5	4.5	6.1
80.0	2.466	2.6	4.6	6.3
81.0	2.497	2.6	4.7	6.4
82.0	2.528	2.7	4.8	6.6
83.0	2.559	2.8	5.0	6.8
84.0	2.590	2.8	5.1	6.9
85.0	2.621	2.9	5.2	7.1
86.0	2.651	3.0	5.3	7.3
87.0	2.682	3.0	5.4	7.4
88.0	2.713	3.1	5.6	7.6
89.0	2.744	3.2	5.7	7.8
90.0	2.775	3.3	5.8	8.0
91.0	2.806	3.3	6.0	8.1

PERDIDA DE CARGA POR FRICCION

CARGA L/SEG	VELOC M/SEG	(%) n=0.009	n=0.012	n=0.014
92.0	2.836	3.4	6.1	8.3
93.0	2.867	3.5	6.2	8.5
94.0	2.898	3.6	6.4	8.7
95.0	2.929	3.6	6.5	8.9
96.0	2.960	3.7	6.6	9.1
97.0	2.991	3.8	6.8	9.3
98.0	3.021	3.9	6.9	9.4
99.0	3.052	4.0	7.1	9.6
100.0	3.083	4.0	7.2	9.8
101.0	3.114	4.1	7.4	10.0

TUBERIA DE 254.00 MM (10 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 506.707 CENTIMETROS CUADRADOS

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
40.0	0.789	0.1	0.3	0.4
42.0	0.828	0.2	0.3	0.5
44.0	0.868	0.2	0.4	0.5
46.0	0.907	0.2	0.4	0.6
48.0	0.947	0.2	0.5	0.6
50.0	0.986	0.3	0.5	0.7
52.0	1.026	0.3	0.5	0.8
54.0	1.065	0.3	0.6	0.8
56.0	1.105	0.3	0.6	0.9
58.0	1.144	0.4	0.7	1.0
60.0	1.184	0.4	0.7	1.0
62.0	1.223	0.4	0.8	1.1
64.0	1.263	0.5	0.9	1.2
66.0	1.302	0.5	0.9	1.3
68.0	1.341	0.5	1.0	1.3
70.0	1.381	0.6	1.0	1.4
72.0	1.420	0.6	1.1	1.5
74.0	1.460	0.6	1.2	1.6
76.0	1.499	0.7	1.2	1.7
78.0	1.539	0.7	1.3	1.8
80.0	1.578	0.7	1.4	1.9
82.0	1.618	0.8	1.4	2.0
84.0	1.657	0.8	1.5	2.1
86.0	1.697	0.9	1.6	2.2
88.0	1.736	0.9	1.7	2.3
90.0	1.776	1.0	1.7	2.4
92.0	1.815	1.0	1.8	2.5
94.0	1.855	1.0	1.9	2.6
96.0	1.894	1.1	2.0	2.7

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
98.0	1.934	1.1	2.1	2.8
100.0	1.973	1.2	2.2	3.0
102.0	2.012	1.2	2.2	3.1
104.0	2.052	1.3	2.3	3.2
106.0	2.091	1.3	2.4	3.3
108.0	2.131	1.4	2.5	3.5
110.0	2.170	1.5	2.6	3.6
112.0	2.210	1.5	2.7	3.7
114.0	2.249	1.6	2.8	3.9
116.0	2.289	1.6	2.9	4.0
118.0	2.328	1.7	3.0	4.1
120.0	2.368	1.7	3.1	4.3
122.0	2.407	1.8	3.2	4.4
124.0	2.447	1.9	3.3	4.6
126.0	2.486	1.9	3.5	4.7
128.0	2.526	2.0	3.6	4.9
130.0	2.565	2.1	3.7	5.0
132.0	2.605	2.1	3.8	5.2
134.0	2.644	2.2	3.9	5.3
136.0	2.683	2.2	4.0	5.5
138.0	2.723	2.3	4.2	5.7
140.0	2.762	2.4	4.3	5.8
142.0	2.802	2.5	4.4	6.0
144.0	2.841	2.5	4.5	6.2
146.0	2.881	2.6	4.7	6.4
148.0	2.920	2.7	4.8	6.5
150.0	2.960	2.7	4.9	6.7
152.0	2.999	2.8	5.1	6.9
154.0	3.039	2.9	5.2	7.1
156.0	3.078	3.0	5.3	7.3
158.0	3.118	3.1	5.5	7.5
160.0	3.157	3.1	5.6	7.6

PERDIDA DE CARGA POR FRICCION

GASTO L/SEG	VELOC M/SEG	(%) n=0.009	n=0.012	n=0.014
162.0	3.197	3.2	5.7	7.8
164.0	3.236	3.3	5.9	8.0
166.0	3.276	3.4	6.0	8.2
168.0	3.315	3.5	6.2	8.4
170.0	3.354	3.5	6.3	8.6
172.0	3.394	3.6	6.5	8.8
174.0	3.433	3.7	6.6	9.1
176.0	3.473	3.8	6.8	9.3
178.0	3.512	3.9	7.0	9.5
180.0	3.552	4.0	7.1	9.7
182.0	3.591	4.1	7.3	9.9

TUBERIA DE 304.8 MM (12 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 729.658 CENTIMETROS CUADRADOS

GASTO L/SEG	VELOC M/SEG	PERDIDA DE CARGA POR FRICCION (%) n=0.009	n=0.012	n=0.014
70.0	0.950	0.2	0.4	0.5
72.0	0.986	0.2	0.4	0.6
74.0	1.014	0.2	0.4	0.6
76.0	1.041	0.3	0.5	0.6
78.0	1.069	0.3	0.5	0.7
80.0	1.096	0.3	0.5	0.7
82.0	1.123	0.3	0.5	0.7
84.0	1.151	0.3	0.5	0.8
86.0	1.178	0.3	0.6	0.8
88.0	1.206	0.3	0.6	0.8
90.0	1.233	0.3	0.6	0.9
92.0	1.260	0.3	0.7	0.9
94.0	1.288	0.4	0.7	1.0
96.0	1.315	0.4	0.7	1.0
98.0	1.343	0.4	0.8	1.0
100.0	1.370	0.4	0.8	1.1
102.0	1.397	0.4	0.8	1.1
104.0	1.425	0.5	0.9	1.2
106.0	1.452	0.5	0.9	1.2
108.0	1.480	0.5	0.9	1.3
110.0	1.507	0.5	1.0	1.3
112.0	1.534	0.5	1.0	1.4
114.0	1.562	0.6	1.0	1.4
116.0	1.589	0.6	1.1	1.5
118.0	1.617	0.6	1.1	1.5
120.0	1.644	0.6	1.2	1.6
122.0	1.672	0.6	1.2	1.6
124.0	1.699	0.7	1.2	1.7
126.0	1.726	0.7	1.3	1.8

PERDIDA DE CARGA POR FRICCION

GASTO L/SEG	VELOC M/SEG	(%) n=0.009	n=0.012	n=0.014
128.0	1.754	0.7	1.3	1.8
130.0	1.781	0.7	1.4	1.9
132.0	1.809	0.8	1.4	1.9
134.0	1.836	0.8	1.5	2.0
136.0	1.863	0.8	1.5	2.1
138.0	1.891	0.8	1.5	2.1
140.0	1.918	0.9	1.6	2.2
142.0	1.946	0.9	1.6	2.2
144.0	1.973	0.9	1.7	2.3
146.0	2.000	1.0	1.7	2.4
148.0	2.028	1.0	1.8	2.4
150.0	2.055	1.0	1.8	2.5
152.0	2.083	1.0	1.9	2.6
154.0	2.110	1.1	1.9	2.6
156.0	2.137	1.1	2.0	2.7
158.0	2.165	1.1	2.0	2.8
160.0	2.192	1.2	2.1	2.9
162.0	2.220	1.2	2.1	2.9
164.0	2.247	1.2	2.2	3.0
166.0	2.275	1.2	2.3	3.1
168.0	2.302	1.3	2.3	3.2
170.0	2.329	1.3	2.4	3.2
172.0	2.357	1.3	2.4	3.3
174.0	2.384	1.4	2.5	3.4
176.0	2.412	1.4	2.5	3.5
178.0	2.439	1.4	2.6	3.6
180.0	2.466	1.5	2.7	3.6
182.0	2.494	1.5	2.7	3.7
184.0	2.521	1.5	2.8	3.8
186.0	2.549	1.6	2.8	3.9
188.0	2.576	1.6	2.9	4.0
190.0	2.603	1.6	3.0	4.1

PERDIDA DE CARGA POR FRICCION

GASTO L/SEG	VELOC M/SEG	(%) n=0.009	n=0.012	n=0.014
192.0	2.631	1.7	3.0	4.1
194.0	2.658	1.7	3.1	4.2
196.0	2.686	1.8	3.2	4.3
198.0	2.713	1.8	3.2	4.4
200.0	2.741	1.8	3.3	4.5
202.0	2.768	1.9	3.4	4.6
204.0	2.795	1.9	3.4	4.7
206.0	2.823	1.9	3.5	4.8
208.0	2.850	2.0	3.6	4.9
210.0	2.878	2.0	3.6	5.0
212.0	2.905	2.1	3.7	5.1
214.0	2.932	2.1	3.8	5.2
216.0	2.960	2.1	3.8	5.3
218.0	2.987	2.2	3.9	5.4
220.0	3.015	2.2	4.0	5.5
222.0	3.042	2.3	4.1	5.6
224.0	3.070	2.3	4.2	5.7
226.0	3.097	2.4	4.3	5.8

3

FORMULA DE HAZEN - WILLIAMS

La fórmula de Hazen-Williams es comúnmente empleada para el cálculo de tuberías.

Dicha fórmula es la siguiente:

$$Q = 405\ C\ D^{2.63}\ s^{0.54}$$

en donde:

Q gasto en galones / día.

C coeficiente de la capacidad hidráulica del conducto.

D diámetro del conducto en pulgadas.

s gradiente hidráulico.

La fórmula anterior, al "traducirla" al sistema métrico decimal, se transforma en:

$$Q = 35.834 \times \bar{10}^{7} \quad C \; D^{2.63} \quad s^{0.54}$$

en donde:

Q gasto en l/seg.

D diámetro del conducto en mm.

Para el presente trabajo, se empleó la fórmula de Hazen-Williams en un sistema mixto de unidades, es decir, el gasto adopta unidades del sistema métrico decimal (l/seg) y el diámetro, unidades del sistema inglés (pulgadas). La fórmula empleada tendrá, por lo

tanto, la siguiente forma:

$$Q = 0.0177435938\ C\ D^{2.63}\ S^{0.54}$$

En donde Q y D tienen las unidades arriba citadas.

La constante C, que como ya se dijo antes, es el coeficiente de la capacidad hidráulica del conducto, es adimensional y depende del material de que esté fabricado el tubo. Asimismo, C depende de la edad que tenga la tubería.

La siguiente tabla, contiene los valores de C para los diferentes materiales de fabricación del conducto, así como para distintas edades.

VALORES DEL COEFICIENTE C PARA DIFERENTES MATERIALES Y CONDICIONES DE LOS CONDUCTOS.

MATERIAL	CONDICION	C
Fierro Fundido	Nuevo	130
	5 años de edad	120
	10 " " "	110
	20 " " "	100
	30 " " "	90
	40 " " "	80
Acero Revestido, juntas soldadas	Nuevo	140
	Edad incierta	100
Acero Revestido, juntas remachadas	Nuevo	110
	Edad incierta	90
Concreto	Nuevo	140
	Edad incierta	130
Duela do Madera	Promedio	130
Asbesto-Cemento y plástico.	Nuevo	140
	Edad incierta	130
Vitrificado	Promedio	110

TUBERIA DE 6.35 MM (1/4 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 0.316 CENTIMETROS CUADRADOS

PERDIDA DE CARGA EN PORCENTAJE (1 M POR C/100 M)

GASTO	VELOC	V A L O R E S D E " C "						
L/SEG	M/SEG	80	90	100	110	120	130	140
0.030	0.978	71.9	57.8	47.5	39.8	33.9	29.2	25.5
0.031	1.010	76.2	61.3	50.4	42.2	35.9	31.0	27.0
0.032	1.042	80.7	64.9	53.4	44.7	38.1	32.8	28.6
0.033	1.073	85.3	68.5	56.4	47.3	40.2	34.7	30.2
0.034	1.105	90.0	72.3	59.5	49.9	42.4	36.6	31.9
0.035	1.136	94.8	76.2	62.7	52.5	44.7	38.5	33.6
0.036	1.168	99.7	80.2	66.0	55.3	47.0	40.6	35.3
0.037	1.199	104.8	84.2	69.3	58.1	49.4	42.6	37.1
0.038	1.231	109.9	88.4	72.7	60.9	51.9	44.7	39.0
0.039	1.263	115.2	92.6	76.2	63.9	54.4	46.9	40.8
0.040	1.294	120.6	97.0	79.8	66.9	56.9	49.1	42.8
0.041	1.326	126.1	101.4	83.4	69.9	59.5	51.3	44.7
0.042	1.357	131.7	105.9	87.1	73.0	62.2	53.6	46.7
0.043	1.389	137.5	110.5	90.9	76.2	64.9	55.9	48.7
0.044	1.420	143.3	115.2	94.8	79.4	67.6	58.3	50.8
0.045	1.452	149.3	120.0	98.7	82.8	70.4	60.7	52.9
0.046	1.484	155.3	124.9	102.7	86.1	73.3	63.2	55.1
0.047	1.515	161.5	129.9	106.8	89.5	76.2	65.7	57.3
0.048	1.547	167.8	134.9	111.0	93.0	79.2	68.3	59.5
0.049	1.578	174.2	140.1	115.2	96.6	82.2	70.9	61.8
0.050	1.610	180.7	145.3	119.5	100.2	85.3	73.5	64.1
0.051	1.641	187.3	150.6	123.9	103.9	88.4	76.2	66.4
0.052	1.673	194.1	156.0	128.4	107.6	91.6	78.9	68.8
0.053	1.705	200.9	161.5	132.9	111.4	94.8	81.7	71.2
0.054	1.736	207.9	167.1	137.5	115.2	98.1	84.6	73.7
0.055	1.768	214.9	172.8	142.1	119.1	101.4	87.4	76.2
0.056	1.799	222.1	178.5	146.9	123.1	104.8	90.3	78.7
0.057	1.831	229.3	184.4	151.7	127.1	108.2	93.3	81.3

GASTO L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
0.058	1.863	236.7	190.3	156.6	131.2	111.7	96.3	83.9
0.059	1.894	244.2	196.3	161.5	135.4	115.2	99.3	86.6
0.060	1.926	251.8	202.4	166.5	139.6	118.8	102.4	89.3
0.061	1.957	259.5	208.6	171.6	143.9	122.4	105.6	92.0
0.062	1.989	267.3	214.9	176.8	148.2	126.1	108.7	94.8
0.063	2.020	275.2	221.3	182.0	152.6	129.9	112.0	97.6
0.064	2.052	283.2	227.7	187.3	157.0	133.6	115.2	100.4
0.065	2.084	291.4	234.2	192.7	161.5	137.5	118.5	103.3
0.066	2.115	299.6	240.9	198.2	166.1	141.4	121.9	106.2
0.067	2.147	307.9	247.6	203.7	170.7	145.3	125.3	109.2
0.068	2.178	316.4	254.4	209.3	175.4	149.3	128.7	112.2
0.069	2.210	324.9	261.2	214.9	180.1	153.3	132.2	115.2
0.070	2.241	333.6	268.3	220.6	184.9	157.4	135.7	118.3
0.071	2.273	342.3	275.3	226.4	189.8	161.5	139.3	121.4
0.072	2.305	351.2	282.3	232.3	194.7	165.7	142.9	124.5
0.073	2.336	360.1	289.5	238.2	199.7	169.9	146.5	127.7
0.074	2.368	369.2	296.8	244.2	204.7	174.2	150.2	130.9
0.075	2.399	378.4	304.2	250.3	209.8	178.5	153.9	134.2
0.076	2.431	387.6	311.7	256.4	214.9	182.9	157.7	137.5
0.077	2.462	397.0	319.2	262.6	220.1	187.3	161.5	140.8
0.078	2.494	406.5	326.8	268.9	225.4	191.8	165.4	144.2
0.079	2.526	416.1	334.5	275.2	230.7	196.3	169.3	147.6
0.080	2.557	425.7	342.3	281.6	236.0	200.9	173.2	151.0
0.081	2.589	435.5	350.2	288.1	241.5	205.5	177.2	154.5
0.082	2.620	445.4	358.1	294.6	247.0	210.2	181.2	158.0
0.083	2.652	455.4	366.2	301.2	252.5	214.9	185.3	161.5
0.084	2.683	465.5	374.3	307.9	258.1	219.7	189.4	165.1
0.085	2.715	475.7	382.5	314.7	263.7	224.5	193.5	168.7
0.086	2.747	486.0	390.7	321.5	269.4	229.3	197.7	172.4
0.087	2.778	496.4	399.1	328.3	275.2	234.2	202.0	176.1
0.088	2.810	506.9	407.5	335.3	281.0	239.2	206.2	179.8
0.089	2.841	517.5	416.1	342.3	286.9	244.2	210.6	183.5
0.090	2.873	528.2	424.7	349.4	292.8	249.3	214.9	187.3
0.091	2.905	539.0	433.3	356.5	298.8	254.4	219.3	191.2

GASTO L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
0.092	2.936	549.9	442.1	363.7	304.9	259.5	223.7	195.0
0.093	2.968	560.9	451.0	371.0	311.0	264.3	228.2	198.9
0.094	2.999	572.0	459.9	378.4	317.1	269.9	232.7	2o2.9
0.095	3.031	583.2	468.9	385.8	323.3	271.2	237.3	206.9
0.096	3.062	594.5	478.0	393.2	329.6	280.5	241.9	210.9
0.097	3.094	605.9	487.1	400.8	335.9	285.9	246.5	214.9
0.098	3.126	617.4	496.4	408.4	342.3	291.4	251.2	219.0
0.099	3.157	629.0	505.7	416.1	348.7	296.8	255.9	223.1
0.100	3.189	640.7	515.1	423.8	355.2	302.3	260.7	227.3

TUBERIA DE 9.52 MM (3/8 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 0.712 CENTIMETROS CUADRADOS

PERDIDA DE CARGA EN PORCENTAJE (1 M POR C/100 M)

GASTO	VELOC	V A L O R E S D E " C "						
L/SEG	M/SEG	80	90	100	110	120	130	140
0.050	0.701	24.1	19.4	16.0	13.4	11.4	9.8	8.5
0.054	0.757	27.8	22.4	18.4	15.4	13.1	11.3	9.8
0.058	0.813	31.8	25.5	21.0	17.6	15.0	12.9	11.2
0.062	0.870	36.0	28.9	23.8	19.9	17.0	14.6	12.7
0.066	0.926	40.4	32.5	26.7	22.4	19.0	16.4	14.3
0.070	0.982	45.1	36.2	29.8	25.0	21.2	18.3	16.0
0.074	1.038	49.9	40.1	33.0	27.7	23.5	20.3	17.7
0.078	1.094	55.1	44.3	36.4	30.5	26.0	22.4	19.5
0.082	1.150	60.4	48.6	40.0	33.5	28.5	24.6	21.4
0.086	1.206	66.0	53.0	43.6	36.6	31.1	26.8	23.4
0.090	1.263	71.8	57.7	47.5	39.8	33.9	29.2	25.4
0.094	1.319	77.8	62.5	51.5	43.1	36.7	31.6	27.6
0.098	1.375	84.1	67.6	55.6	46.6	39.6	34.2	29.8
0.102	1.431	90.5	72.8	59.9	50.2	42.7	36.8	32.1
0.106	1.487	97.2	78.1	64.3	53.9	45.9	39.5	34.5
0.110	1.543	104.1	83.7	68.9	57.7	49.1	42.3	36.9
0.114	1.599	111.2	89.4	73.6	61.7	52.5	45.2	39.4
0.118	1.656	118.6	95.3	78.4	65.7	55.9	48.2	42.0
0.122	1.712	126.1	101.4	83.4	69.9	59.5	51.3	44.7
0.126	1.768	133.9	107.6	88.6	74.2	63.2	54.5	47.5
0.130	1.824	141.9	114.1	93.8	78.6	66.9	57.7	50.3
0.134	1.880	150.1	120.6	99.3	83.2	70.8	61.0	53.2
0.138	1.936	158.5	127.4	104.8	87.8	74.8	64.5	56.2
0.142	1.992	167.1	134.3	110.5	92.6	78.8	68.0	59.2
0.146	2.048	175.9	141.4	116.3	97.5	83.0	71.6	62.4
0.150	2.105	184.9	148.7	122.3	102.5	87.3	75.2	65.6
0.154	2.161	194.2	156.1	128.4	107.6	91.6	79.0	68.9
0.158	2.217	203.6	163.7	134.7	112.9	96.1	82.8	72.2
0.162	2.273	213.3	171.5	141.1	118.2	100.6	86.8	75.6
0.166	2.329	223.1	179.4	147.6	123.7	105.3	90.8	79.1

GASTO L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
0.170	2.385	233.2	187.5	154.2	129.3	110.0	94.9	82.7
0.174	2.441	243.5	195.7	161.0	135.0	114.9	99.0	86.3
0.178	2.498	253.9	204.2	168.0	140.8	119.8	103.3	90.0
0.182	2.554	254.6	212.7	175.0	146.7	124.9	107.6	93.8
0.186	2.610	275.5	221.5	182.2	152.7	130.0	112.1	97.7
0.190	2.666	286.5	230.4	189.5	158.5	135.2	116.2	101.6
0.194	2.722	297.8	239.4	197.0	165.1	140.5	121.2	105.2
0.198	2.778	309.3	248.7	204.6	171.5	145.9	125.8	109.7
0.202	2.834	321.0	258.0	212.3	177.9	151.5	130.6	113.8
0.206	2.890	332.8	267.6	220.2	184.5	157.1	135.4	118.0
0.210	2.947	344.9	277.3	228.1	191.2	162.7	140.3	122.3
0.214	3.003	357.2	287.2	236.2	198.0	168.5	145.3	126.7
0.218	3.059	369.6	297.2	244.5	204.9	174.4	150.4	131.1
0.222	3.115	382.3	307.4	252.9	211.9	180.4	155.5	135.6
0.226	3.171	395.1	317.7	261.4	219.1	186.5	160.8	140.1
0.230	3.227	408.2	328.2	270.0	226.3	192.6	166.1	144.8
0.234	3.283	421.4	338.8	278.8	233.7	198.9	171.5	149.5
0.238	3.340	434.9	349.6	287.7	241.1	205.2	176.9	154.2
0.242	3.396	448.5	360.6	296.7	248.7	311.6	182.5	159.1
0.246	3.452	462.3	371.7	305.8	256.3	318.2	188.1	164.0

TUBERIA DE 12.70 MM (1/2") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 1.266 CENTIMETROS CUADRADOS

PERDIDA DE CARGA EN PORCENTAJE (1 M C/100 M)

GASTO	VELOC	V A L O R E S D E " C "						
L/SEG	M/SEG	80	90	100	110	120	130	140
0.100	0.789	21.5	17.2	14.2	11.9	10.1	8.7	7.6
0.105	0.828	23.5	18.9	15.5	13.0	11.1	9.5	8.3
0.110	0.868	25.6	20.6	16.9	14.2	12.1	10.4	9.1
0.115	0.907	27.8	22.3	18.4	15.4	13.1	11.3	9.8
0.120	0.947	30.1	24.2	19.9	16.7	14.2	12.2	10.6
0.125	0.986	32.5	26.1	21.5	18.0	15.3	13.2	11.5
0.130	1.026	34.9	28.1	23.1	19.3	16.4	14.2	12.4
0.135	1.065	37.4	30.1	24.7	20.7	17.6	15.2	13.2
0.140	1.105	40.1	32.2	26.5	22.2	18.9	16.3	14.2
0.145	1.144	42.7	34.4	28.3	23.7	20.1	17.4	15.1
0.150	1.184	45.5	36.6	30.1	25.2	21.5	18.5	16.1
0.155	1.223	48.4	38.9	32.0	26.8	22.8	19.7	17.1
0.160	1.263	51.3	41.2	33.9	28.4	24.2	20.8	18.2
0.165	1.302	54.3	43.7	45.9	30.1	25.6	22.1	19.2
0.170	1.341	57.4	46.1	38.0	31.8	27.1	23.3	20.3
0.175	1.381	60.6	48.7	40.1	33.6	28.6	24.6	21.5
0.180	1.420	63.8	51.3	42.2	35.4	30.1	25.9	22.6
0.185	1.460	67.1	54.0	44.4	37.2	31.7	27.3	23.8
0.190	1.499	70.5	56.7	46.6	39.1	33.3	28.7	25.0
0.195	1.539	74.0	59.5	48.9	41.0	34.9	30.1	26.2
0.200	1.578	77.6	62.4	51.3	43.0	36.6	31.5	27.5
0.205	1.618	81.2	65.3	53.7	45.0	38.3	33.0	28.8
0.210	1.657	84.9	68.3	56.2	47.1	40.1	34.5	30.1
0.215	1.697	88.7	71.3	58.7	49.2	41.8	36.1	31.4
0.220	1.736	92.6	74.4	61.2	51.3	43.7	37.6	32.8
0.225	1.776	96.5	77.6	63.8	53.5	45.5	39.2	34.2
0.230	1.815	100.5	80.8	66.5	55.7	47.4	40.9	35.6
0.235	1.855	104.6	84.1	69.2	58.0	49.3	42.5	37.1
0.240	1.894	108.8	87.4	71.9	60.3	51.3	44.2	38.5
0.245	1.934	113.0	90.8	74.7	62.6	53.3	46.0	40.1

GASTO L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
0.250	1.973	117.3	94.3	77.6	65.0	55.3	47.7	41.6
0.255	2.012	121.7	97.8	80.5	67.4	55.4	49.5	43.1
0.260	2.052	126.1	101.4	83.4	69.9	59.5	51.3	44.7
0.265	2.091	130.7	105.1	86.4	72.4	61.6	53.1	46.3
0.270	2.131	135.3	108.8	89.5	75.0	63.8	55.0	48.0
0.275	2.170	140.0	112.5	92.6	77.6	66.0	56.9	49.6
0.280	2.210	144.7	116.3	95.7	80.2	68.3	58.9	51.3
0.285	2.249	149.5	120.2	98.9	82.9	70.5	60.8	53.0
0.290	2.289	154.4	124.1	102.1	85.6	72.9	62.8	54.7
0.295	2.328	159.4	128.1	105.4	88.4	75.2	64.8	56.5
0.300	2.368	164.4	132.2	108.8	91.1	77.6	66.9	58.3
0.305	2.407	169.6	136.3	112.1	94.0	80.0	69.0	60.1
0.310	2.447	174.7	140.5	115.6	96.9	82.4	71.1	62.0
0.315	2.486	180.0	144.7	119.0	99.8	84.9	73.2	63.8
0.320	2.526	185.3	149.0	122.6	102.7	87.4	75.4	65.7
0.325	2.565	190.7	153.3	126.1	105.7	90.0	77.6	67.6
0.330	2.605	196.2	157.7	129.8	108.8	92.6	79.8	69.6
0.335	2.644	201.7	162.2	133.4	111.8	95.2	82.1	71.5
0.340	2.683	207.3	166.7	137.1	114.9	97.8	84.3	73.5
0.345	2.723	213.0	171.3	140.9	118.1	100.5	86.7	75.5
0.350	2.762	218.8	175.9	144.7	121.3	103.2	89.0	77.6
0.355	2.802	224.6	180.6	148.6	124.5	106.0	91.4	79.6
0.360	2.841	230.5	185.3	152.5	127.8	108.8	93.8	81.7
0.365	2.881	236.5	190.1	156.4	131.1	111.6	96.2	83.9
0.370	2.920	242.5	195.0	160.4	134.4	114.4	98.6	86.0
0.375	2.960	248.6	199.9	164.4	137.8	117.4	101.1	88.2
0.380	2.999	254.8	204.8	168.5	141.2	120.3	103.6	90.3
0.385	3.039	261.0	209.8	172.6	144.7	123.2	106.2	92.6
0.390	3.078	267.3	214.9	176.8	148.2	126.1	108.8	94.8
0.395	3.118	273.7	220.1	181.0	151.7	129.2	111.4	97.1
0.400	3.157	280.2	225.2	185.3	155.3	132.2	114.0	99.4
0.405	3.197	286.7	230.5	189.6	158.9	135.3	116.6	101.7
0.410	3.236	293.3	235.8	194.0	162.6	138.4	119.3	104.0
0.415	3.276	299.9	241.1	198.4	166.3	141.5	122.0	106.4

GASTO	VELOC	VALORES DE "C"						
L/SEG	M/SEG	80	90	100	110	120	130	140
0.420	3.315	306.7	246.5	202.8	170.0	144.7	124.8	108.8
0.425	3.354	313.4	252.0	207.3	173.8	147.9	127.5	111.2
0.430	3.394	320.3	257.5	211.9	177.3	151.1	130.3	113.6
0.435	3.433	327.2	263.1	216.5	181.4	154.4	133.1	116.1
0.440	3.473	334.2	268.7	221.1	185.3	157.7	136.0	118.5
0.445	3.512	341.3	274.4	225.8	189.2	161.1	138.9	121.1
0.450	3.552	348.4	280.2	230.5	193.2	164.4	141.8	123.6

TUBERIA DE 19.04 MM (3/4 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 2.850 CENTIMETROS CUADRADOS

PERDIDA DE CARGA EN PORCENTAJE (1 M POR C/100 M)

GASTO	VELOC	V A L O R E S D E " C "						
L/SEG	M/SEG	80	90	100	110	120	130	140
0.25	0.877	16.2	13.0	10.7	9.0	7.6	6.6	5.7
0.26	0.912	17.5	14.0	11.5	9.7	8.2	7.1	6.2
0.27	0.947	18.7	15.1	12.4	10.4	8.8	7.6	6.6
0.28	0.982	20.0	16.1	13.2	11.1	9.4	8.1	7.1
0.29	1.017	21.4	17.2	14.1	11.8	10.1	8.7	7.6
0.30	1.052	22.8	18.3	15.1	12.6	10.7	9.2	8.0
0.31	1.087	24.2	19.5	16.0	13.4	11.4	9.8	8.6
0.32	1.122	25.7	20.6	17.0	14.2	12.1	10.4	9.6
0.33	1.157	27.2	21.8	18.0	15.1	12.8	11.0	9.6
0.34	1.192	28.7	23.1	19.0	15.9	13.5	11.7	10.2
0.35	1.227	30.3	24.4	20.0	16.8	14.3	12.3	10.7
0.36	1.263	31.9	25.7	21.1	17.7	15.1	13.0	11.3
0.37	1.298	33.6	27.0	22.2	18.6	15.8	13.6	11.9
0.38	1.333	35.3	28.4	23.3	19.6	16.6	14.3	12.5
0.39	1.368	37.1	29.8	24.5	20.5	17.5	15.1	13.1
0.40	1.403	38.8	31.2	25.7	21.5	18.3	15.8	13.7
0.41	1.438	40.7	32.7	26.9	22.5	19.2	16.5	14.4
0.42	1.473	42.5	34.2	28.1	23.6	20.0	17.3	15.1
0.43	1.508	44.4	35.7	29.4	24.6	20.9	18.0	15.7
0.44	1.543	46.3	37.3	30.6	25.7	21.8	18.8	16.4
0.45	1.578	48.3	38.8	31.9	26.8	22.8	19.6	17.1
0.46	1.613	50.3	40.5	33.3	27.9	23.7	20.5	17.8
0.47	1.648	52.4	42.1	34.6	29.0	24.7	21.3	18.5
0.48	1.684	54.5	43.8	36.0	30.2	25.7	22.1	19.3
0.49	1.719	56.6	45.5	37.4	31.4	26.7	23.0	20.0
0.50	1.754	58.7	47.2	38.8	32.5	27.7	23.9	20.8
0.51	1.789	60.9	49.0	40.3	33.8	28.7	24.8	21.6
0.52	1.824	63.2	50.8	41.8	35.0	29.8	25.7	22.4
0.53	1.859	65.4	52.6	43.3	36.3	30.9	26.6	23.2

GASTO L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
0.54	1.894	67.7	54.5	44.8	37.5	31.9	27.5	24.0
0.55	1.929	70.1	56.3	46.3	38.8	33.1	28.5	24.8
0.56	1.964	72.5	58.3	47.9	40.2	44.2	29.5	25.7
0.57	1.999	74.9	60.2	49.5	41.5	35.3	30.4	26.5
0.58	2.034	77.3	62.2	51.1	42.9	36.5	31.4	27.4
0.59	2.070	79.8	64.2	52.8	44.2	37.6	32.5	28.3
0.60	2.105	82.4	66.2	54.5	45.6	38.8	33.5	29.2
0.61	2.140	84.9	68.3	56.2	47.1	40.0	34.5	30.1
0.62	2.175	87.5	70.4	57.9	48.5	41.3	35.6	31.0
0.63	2.210	90.1	72.5	59.6	50.0	42.5	36.7	31.9
0.64	2.245	92.8	74.6	61.4	51.4	43.8	37	32.9
0.65	2.280	95.5	76.8	63.2	52.9	45.1	38.8	33.9
0.66	2.315	98.3	79.0	65.0	54.5	46.3	40.0	34.8
0.67	2.350	101.0	81.2	66.8	56.8	47.7	41.1	35.8
0.68	2.385	103.8	83.5	68.7	57.6	49.0	42.2	36.8
0.69	2.420	106.7	85.8	70.6	59.1	50.3	43.4	37.8
0.70	2.455	109.6	88.1	72.5	60.7	51.7	44.6	38.8
0.71	2.491	112.5	90.4	74.4	62.4	53.1	45.7	39.9
0.72	2.526	115.4	92.8	76.4	64.0	54.5	47.0	40.9
0.73	2.561	118.4	95.2	78.3	65.6	55.9	48.2	42.0
0.74	2.596	121.5	97.6	80.3	67.3	57.3	49.4	43.1
0.75	2.631	124.5	100.1	82.4	69.0	58.7	50.6	44.1
0.76	2.666	127.6	102.6	84.4	70.7	60.2	51.9	45.2
0.77	2.701	130.7	105.1	86.5	72.5	61.7	53.2	46.3
0.78	2.736	133.9	107.7	88.6	74.2	63.2	54.5	47.5
0.79	2.771	137.1	110.2	90.7	76.0	64.7	55.8	48.6
0.80	2.806	140.3	112.8	92.8	77.8	66.2	57.1	49.8
0.81	2.841	143.6	115.4	95.0	79.6	67.7	58.4	50.9
0.82	2.876	146.9	118.1	97.2	81.4	69.3	59.7	52.1
0.83	2.912	150.2	120.8	99.4	83.3	70.9	61.1	53.3
0.84	2.947	153.6	123.5	101.6	85.1	72.5	62.5	54.5
0.85	2.982	157.0	126.2	103.8	87.0	74.1	63.9	55.7
0.86	3.017	160.4	129.0	106.1	88.9	75.7	65.3	56.9
0.87	3.052	163.9	131.8	108.4	90.9	77.3	66.7	58.1

GASTO	VELOC	VALORES DE "C"						
L/SEG	M/SEG	80	90	100	110	120	130	140
0.88	3.087	167.4	134.6	110.7	92.8	79.0	68.1	59.4
0.89	3.122	171.0	137.5	113.1	94.8	80.7	69.5	60.6
0.90	3.157	174.5	140.3	115.4	96.8	82.4	71.0	61.9
0.91	3.192	178.2	143.2	117.8	98.8	84.1	72.5	63.2
0.92	3.227	181.8	146.2	120.2	100.8	85.8	74.0	64.5
0.93	3.362	185.5	149.1	122.7	102.8	87.5	75.4	65.8
0.94	3.297	189.2	152.1	125.1	104.9	89.3	77.0	67.1
0.95	3.333	192.9	155.1	127.6	107.0	91.0	78.5	68.4

TUBERIA DE 25.4 MM (1") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 5.067 CENTIMETROS CUADRADOS.

PERDIDA DE CARGA EN PORCENTAJE (1 M POR C/100 M)

GASTO	VELOC	V A L O R E S D E " C "						
L/SEG	M/SEG	80	90	100	110	120	130	140
0.300	0.592	5.6	4.5	3.7	3.1	2.6	2.2	1.9
0.320	0.631	6.3	5.0	4.1	3.5	2.9	2.5	2.2
0.340	0.670	7.0	5.7	4.6	3.9	3.3	2.8	2.5
0.360	0.710	7.8	6.3	5.2	4.3	3.7	3.2	2.7
0.380	0.749	8.7	7.0	5.7	4.8	4.1	3.5	3.0
0.400	0.789	9.5	7.7	6.3	5.3	4.5	3.8	3.3
0.420	0.828	10.4	8.4	6.9	5.8	4.9	4.2	3.7
0.440	0.868	11.4	9.1	7.5	6.3	5.3	4.6	4.0
0.460	0.907	12.4	9.9	8.2	6.8	5.8	5.0	4.4
0.480	0.947	13.4	10.7	8.8	7.4	6.3	5.4	4.7
0.500	0.986	14.4	11.6	9.5	8.0	6.8	5.8	5.1
0.520	1.026	15.5	12.5	10.3	8.6	7.3	6.3	5.5
0.540	1.065	16.6	13.4	11.0	9.2	7.8	6.7	5.9
0.560	1.105	17.8	14.3	11.8	9.9	8.4	7.2	6.3
0.580	1.144	19.0	15.3	12.6	10.5	8.9	7.7	6.7
0.600	1.184	20.2	16.3	13.4	11.2	9.5	8.2	7.2
0.620	1.223	21.5	17.3	14.6	11.9	10.1	8.7	7.6
0.640	1.263	22.8	18.3	15.1	12.6	10.7	9.3	8.1
0.660	1.302	24.2	19.4	16.0	13.4	11.4	9.8	8.5
0.680	1.341	25.5	20.5	16.9	14.1	12.0	10.4	9.0
0.700	1.381	27.0	21.7	17.8	14.9	12.7	10.9	9.5
0.720	1.420	28.4	22.8	18.8	15.7	13.4	11.5	10.0
0.740	1.460	29.9	24.0	19.7	16.5	14.1	12.1	10.6
0.760	1.499	31.4	25.2	20.8	17.4	14.8	12.7	11.1
0.780	1.539	32.9	26.5	21.8	18.2	15.5	13.4	11.7
0.800	1.578	34.5	27.8	22.8	19.1	16.3	14.0	12.2
0.820	1.618	36.1	29.1	23.9	20.0	17.0	14.7	12.8
0.840	1.657	37.8	30.4	25.7	20.9	17.8	15.4	13.4
0.860	1.697	39.5	31.7	26.1	21.9	18.5	16.0	14.0

GASTO	VELOC	VALORES DE "C"						
L/SEG	M/SEG	80	90	100	110	120	130	140
0.880	1.736	41.2	33.1	27.2	22.8	19.4	16.7	14.6
0.900	1.776	43.0	34.5	28.4	23.8	20.2	17.5	15.2
0.920	1.815	44.7	36.0	29.6	24.8	21.1	18.2	15.8
0.940	1.855	46.6	37.4	30.8	25.8	21.9	18.9	16.5
0.960	1.894	48.4	38.9	32.0	26.8	22.8	29.7	17.1
0.980	1.934	50.3	40.4	33.3	27.9	23.7	20.4	17.8
1.000	1.973	52.2	42.0	34.5	28.9	24.6	21.2	18.5
1.020	2.012	54.2	43.5	35.8	30.0	25.5	22.0	19.2
1.040	2.052	56.2	45.1	37.1	31.1	26.5	22.8	19.9
1.060	2.091	58.2	46.8	38.5	32.2	27.4	23.6	20.6
1.080	2.131	60.2	48.4	39.8	33.4	28.4	24.5	21.3
1.100	2.170	62.3	50.1	41.2	34.5	29.4	25.3	22.1
1.120	2.210	64.4	51.8	42.6	35.7	30.4	26.2	22.8
1.140	2.249	66.6	53.5	44.0	36.9	31.4	27.1	23.6
1.160	2.289	68.8	55.3	45.5	38.1	32.4	28.0	24.4
1.180	2.328	71.0	57.1	46.9	39.3	33.5	28.9	25.1
1.200	2.368	73.2	58.9	48.4	40.6	34.5	29.8	25.9
1.220	2.407	75.5	60.7	49.9	41.8	35.6	30.7	26.7
1.240	2.447	77.8	62.5	51.5	43.1	36.7	31.6	27.6
1.260	2.486	80.1	64.8	53.0	44.4	37.8	32.6	28.4
1.280	2.526	82.5	66.3	54.6	45.7	37.9	33.6	29.2
1.300	2.565	84.9	68.3	56.2	47.1	40.1	34.5	30.1
1.320	2.605	87.4	70.2	57.8	48.4	41.2	35.5	31.0
1.340	2.644	89.8	72.2	59.4	49.8	42.4	36.5	31.8
1.360	2.683	92.3	74.2	61.1	51.2	43.5	37.5	32.7
1.380	2.723	94.9	76.3	62.7	52.6	44.7	38.6	33.6
1.400	2.762	97.4	78.3	64.4	54.0	46.0	49.6	34.5
1.420	2.802	100.0	80.4	66.1	55.4	47.2	40.7	35.4
1.440	2.841	102.6	82.5	67.9	56.9	48.4	41.7	36.4
1.460	2.881	105.3	84.7	69.6	58.4	49.7	42.8	37.3
1.480	2.920	108.0	86.8	71.4	59.9	50.9	43.9	38.3
1.500	2.960	110.7	89.0	73.2	61.4	52.2	45.0	49.2
1.520	2.999	113.5	91.2	75.0	62.9	53.5	46.1	40.2
1.540	3.039	116.2	93.4	76.9	64.4	54.8	47.3	41.2

GASTO	VELOC	VALORES DE "C"						
L/SEG	M/SEG	80	90	100	110	120	130	140
1.560	3.078	119.1	95.7	78.7	66.0	56.2	48.4	42.2
1.580	3.118	121.9	98.0	80.6	67.6	57.5	49.6	43.2
1.600	3.157	124.8	100.3	82.5	69.2	58.9	50.7	44.2
1.620	3.197	127.7	102.6	84.4	70.8	60.2	51.9	45.3
1.640	3.236	130.6	105.0	86.4	72.4	61.6	53.1	46.3
1.660	3.276	133.6	107.4	88.3	74.0	63.0	54.3	47.4
1.680	3.315	136.6	109.8	90.3	75.7	64.4	55.5	48.4
1.700	3.354	139.6	112.2	92.3	77.4	65.9	56.8	49.5

TUBERIA DE 31.75 MM (1 1/4 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 7.917 CENTIMETROS CUADRADOS

PERDIDA DE CARGA EN PORCENTAJE (L.M POR C/100 M)

GASTO	VELOC	V A L O R E S D E " C "						
L/SEG	M/SEG	80	90	100	110	120	130	140
0.60	0.757	6.8	5.5	4.5	3.7	3.2	2.7	2.4
0.63	0.795	7.4	6.0	4.9	4.1	3.5	3.0	2.6
0.66	0.833	8.1	6.5	5.4	4.5	3.8	3.3	2.8
0.69	0.871	8.8	7.1	5.8	4.9	4.1	3.6	3.1
0.72	0.909	9.5	7.7	6.3	5.3	4.5	3.9	3.4
0.75	0.947	10.3	8.3	6.8	5.7	4.8	4.2	3.6
0.78	0.985	11.1	8.9	7.3	6.1	5.2	4.5	3.9
0.81	1.023	11.9	9.5	7.8	6.6	5.6	4.8	4.2
0.84	1.060	12.7	10.2	8.4	7.0	6.0	5.1	4.5
0.87	1.098	13.6	10.9	9.0	7.5	6.4	5.5	4.8
0.90	1.136	14.5	11.6	9.5	8.0	6.8	5.9	5.1
0.93	1.174	15.4	12.3	10.1	8.5	7.2	6.2	5.4
0.96	1.212	16.3	13.1	10.8	9.0	7.7	6.6	5.7
0.99	1.250	17.3	13.9	11.4	9.5	8.1	7.0	6.1
1.02	1.288	18.2	14.7	12.0	10.1	8.6	7.4	6.4
1.05	1.326	19.2	15.5	12.7	10.7	9.1	7.8	6.8
1.08	1.364	20.3	16.3	13.4	11.2	9.5	8.2	7.2
1.11	1.401	21.3	17.1	14.1	11.8	10.0	8.7	7.5
1.14	1.439	22.4	18.0	14.8	12.4	10.6	9.1	7.9
1.17	1.477	23.5	18.9	15.5	13.0	11.1	9.5	8.3
1.20	1.515	24.7	19.8	16.3	13.7	11.6	10.0	8.7
1.23	1.553	25.8	20.7	17.1	14.3	12.2	10.5	9.1
1.26	1.591	27.0	21.7	17.8	14.9	12.7	11.0	9.5
1.29	1.629	28.2	22.7	18.6	15.6	13.3	11.4	10.0
1.32	1.667	29.4	23.7	19.5	16.3	13.9	11.9	10.4
1.35	1.705	30.7	24.7	20.3	17.0	14.5	12.5	10.9
1.38	1.743	32.0	25.7	21.1	17.7	15.1	13.0	11.3
1.41	1.780	33.3	26.7	22.0	18.4	15.7	13.5	11.8

GASTO L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
1.44	1.818	34.6	27.8	22.9	19.2	16.3	14.0	12.2
1.47	1.856	35.9	28.9	23.8	19.9	16.9	14.6	12.7
1.50	1.894	37.3	30.0	24.7	20.7	17.6	15.2	13.2
1.53	1.932	38.7	31.1	25.6	21.4	18.2	15.7	13.7
1.56	1.970	40.1	32.2	26.5	22.2	18.9	16.3	14.2
1.59	2.008	41.6	33.4	27.5	23.0	19.6	16.9	14.7
1.62	2.046	43.0	34.6	28.4	23.8	20.3	17.5	15.2
1.67	2.084	44.5	35.8	29.4	24.7	21.0	18.1	15.8
1.68	2.121	46.0	37.0	30.4	25.5	21.7	18.7	16.3
1.71	2.159	47.6	38.2	31.4	26.4	22.4	19.3	16.8
1.74	2.197	49.1	39.5	32.5	27.2	23.2	20.0	17.4
1.77	2.235	50.7	40.8	33.5	28.1	23.9	20.6	18.0
1.80	2.273	52.3	42.1	34.6	29.0	24.7	21.3	18.5
1.83	2.311	53.9	43.4	35.7	29.9	25.4	21.9	19.1
1.86	2.349	55.6	44.7	36.8	30.8	26.2	22.6	19.7
1.89	2.387	57.3	46.0	37.9	31.7	27.0	23.3	20.3
1.92	2.425	59.0	47.4	39.0	32.7	27.8	24.0	20.9
1.95	2.462	60.7	48.8	40.1	33.6	28.6	24.7	21.5
1.98	2.500	62.4	50.2	41.3	34.6	29.4	25.4	22.1
2.01	2.538	64.2	51.6	42.4	35.6	30.3	26.1	22.7
2.04	2.576	66.0	53.0	43.6	36.6	31.1	26.8	23.4
2.07	2.614	67.8	54.5	44.8	37.6	32.0	27.6	24.0
2.10	2.652	69.6	56.0	46.0	38.6	32.8	28.3	24.7
2.13	2.690	71.5	57.5	47.3	39.6	33.7	29.1	25.3
2.16	2.728	73.3	59.0	48.5	40.6	34.6	29.8	26.0
2.19	2.766	75.2	60.5	49.8	41.7	35.5	30.6	26.7
2.22	2.803	77.2	62.0	51.0	42.8	36.4	31.4	27.3
2.25	2.841	79.1	63.6	52.3	43.8	37.3	32.2	28.0
2.28	2.879	81.1	65.2	53.6	44.9	38.2	33.0	28.7
2.31	2.917	83.1	66.8	54.9	46.0	39.2	33.8	29.4
2.34	2.955	85.1	68.4	56.3	47.1	40.1	34.6	30.1
2.37	2.993	87.1	70.0	57.6	48.3	41.1	35.4	30.9
2.40	3.031	89.2	71.7	59.0	49.4	42.1	36.3	31.6
2.43	3.069	91.2	73.3	60.3	50.6	43.0	37.1	32.3

GASTO L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
2.46	3.107	93.3	75.0	61.7	51.7	44.0	37.9	33.1
2.49	3.145	95.4	76.7	63.1	52.9	45.0	38.8	33.8
2.52	3.182	97.6	78.5	64.5	54.1	46.8	39.7	34.6
2.55	3.220	99.8	80.2	66.0	55.3	47.1	40.6	35.4
2.58	3.258	101.9	82.0	67.4	56.5	48.1	41.5	36.1
2.61	3.296	104.1	83.7	68.9	57.7	49.1	42.4	36.9
2.64	3.334	106.4	85.5	70.3	59.0	50.2	43.3	37.7
2.67	3.372	108.6	87.3	71.8	60.2	51.2	44.2	38.5
2.70	3.410	110.9	89.2	73.3	61.5	52.3	45.1	39.3

TUBERIA DE 38.09 MM (1 1/2") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 11.4 CENTIMETROS CUADRADOS

PERDIDA DE CARGA EN PORCENTAJE (1 M POR C/100 M)

GASTO	VELOC	V A L O R E S D E " C "						
L/SEG	M/SEG	80	90	100	110	120	130	140
0.90	0.789	5.9	4.7	3.9	3.3	2.8	2.4	2.1
0.94	0.824	6.4	5.2	4.2	3.5	3.0	2.6	2.2
0.98	0.859	6.9	5.6	4.6	3.8	3.2	2.8	2.4
1.02	0.894	7.5	6.0	4.9	4.1	3.5	3.0	2.6
1.06	0.929	8.0	6.4	5.3	4.4	3.8	3.2	2.8
1.10	0.964	8.6	6.9	5.7	4.7	4.0	3.5	3.0
1.14	0.999	9.2	7.4	6.1	5.1	4.3	3.7	3.2
1.18	1.035	9.8	7.9	6.5	5.4	4.6	4.0	3.4
1.22	1.070	10.4	8.4	6.9	5.8	4.9	4.2	3.7
1.26	1.105	11.1	8.9	7.3	6.1	5.2	4.5	3.9
1.30	1.140	11.7	9.4	7.8	6.5	5.5	4.7	4.1
1.34	1.175	12.4	10.0	8.2	6.9	5.8	5.0	4.4
1.38	1.210	13.1	10.5	8.7	7.3	6.2	5.3	4.6
1.42	1.245	13.8	11.1	9.1	7.7	6.5	5.6	4.9
1.46	1.280	14.6	11.7	9.6	8.1	6.9	5.9	5.1
1.50	1.315	15.3	12.3	10.1	8.5	7.2	6.2	5.4
1.54	1.350	16.1	12.9	10.6	8.9	7.6	6.5	5.7
1.58	1.385	16.9	13.6	11.1	9.3	7.9	6.8	6.0
1.62	1.420	17.7	14.2	11.7	9.8	8.3	7.2	6.2
1.66	1.456	18.5	14.9	12.2	10.2	8.7	75	6.5
1.70	1.491	19.3	15.5	12.8	10.7	9.1	7.8	6.8
1.74	1.526	20.2	16.2	13.2	11.2	9.5	8.2	7.1
1.78	1.561	21.1	16.9	13.9	11.7	9.9	8.5	7.4
1.82	1.596	21.9	17.6	14.5	12.1	10.3	8.9	7.8
1.86	1.631	22.8	18.4	15.1	12.6	10.8	9.3	8.1
1.90	1.676	23.8	19.1	15.7	13.2	11.2	9.6	8.4
1.94	1.701	24.7	19.9	16.3	13.7	11.6	10.0	8.7
1.98	1.736	25.7	20.6	17.0	14.2	12.1	10.4	9.1
2.02	1.771	26.6	21.4	17.6	14.7	12.5	10.8	9.4

GASTO L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
2.06	1.806	27.6	22.2	18.2	15.3	13.0	11.2	9.8
2.10	1.841	28.6	23.0	18.9	15.8	13.5	11.6	10.1
2.14	1.877	29.6	23.8	19.6	16.4	14.0	12.0	10.5
2.18	1.912	30.7	24.6	20.3	17.0	14.4	12.5	10.8
2.22	1.947	31.7	25.5	21.0	17.6	14.9	12.9	11.2
2.26	1.982	32.8	26.4	21.7	18.2	15.4	13.3	11.6
2.30	2.017	33.9	27.2	22.4	18.8	16.0	13.8	12.0
2.34	2.052	35.0	28.1	23.1	19.4	16.5	14.2	12.4
2.38	2.087	36.1	29.0	23.9	20.0	17.0	14.7	12.8
2.42	2.122	37.2	29.9	24.6	20.6	17.5	15.1	13.2
2.46	2.157	38.4	30.8	25.4	21.3	18.1	15.6	13.6
2.50	2.192	39.5	31.8	26.1	21.9	18.6	16.1	14.0
2.54	2.227	40.7	32.7	26.9	22.6	19.2	16.5	14.4
2.58	2.262	41.9	33.7	27.7	23.2	19.8	17.0	14.8
2.62	2.298	43.1	34.7	28.5	23.9	20.3	17.5	15.3
2.66	2.333	44.4	35.7	29.3	24.6	20.9	18.0	15.7
2.70	2.368	45.6	36.7	30.1	25.3	21.5	18.5	16.1
2.74	2.403	46.9	37.7	31.0	26.0	22.1	19.0	16.6
2.78	2.438	48.1	38.7	31.8	26.7	22.7	19.6	17.0
2.82	2.473	49.4	39.7	32.7	27.4	23.3	20.1	17.5
2.86	2.508	50.7	40.8	33.5	28.1	23.9	20.6	18.0
2.90	2.543	52.1	41.8	34.4	28.8	24.5	21.2	18.4
2.94	2.578	53.4	42.9	35.3	29.6	25.2	21.7	18.9
2.98	2.613	54.8	44.0	36.2	30.3	25.8	22.3	19.4
3.02	2.648	56.1	45.1	37.1	31.1	26.5	22.8	19.9
3.06	2.683	57.5	46.2	38.0	31.9	27.1	23.4	20.4
3.10	2.719	58.9	47.4	39.0	32.6	27.8	23.9	20.9
3.14	2.754	60.3	48.5	39.9	33.4	28.4	24.5	21.4
3.18	2.789	61.8	49.6	40.8	34.2	29.1	25.1	21.9
3.22	2.824	63.2	50.8	41.8	35.0	29.8	25.7	22.4
3.26	2.859	64.7	52.0	42.8	35.8	30.5	26.3	22.9
3.30	2.894	66.1	53.2	43.7	36.7	31.2	26.9	23.4
3.34	2.929	67.6	54.4	44.7	37.5	31.9	27.5	24.0
3.38	2.964	69.2	55.6	45.7	38.3	32.6	28.1	24.5

GASTO L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
3.42	2.999	70.7	56.8	46.7	39.2	33.3	28.7	25.0
3.46	3.034	72.2	58.1	47.8	40.0	34.1	29.4	25.6
3.50	3.069	73.8	59.3	48.8	40.9	34.8	30.0	26.1
3.54	3.105	75.3	60.6	49.8	41.8	35.5	30.6	26.7
3.58	3.140	76.9	61.8	50.9	42.6	36.3	31.3	27.3
3.62	3.175	78.5	63.1	51.9	43.5	37.0	31.9	27.8
3.66	3.210	80.1	64.4	53.0	44.4	37.8	32.6	28.4
3.70	3.245	81.8	65.7	54.1	45.3	38.6	33.2	29.0
3.74	3.280	83.4	67.1	55.2	46.2	49.3	33.9	29.6

TUBERIA DE 50.8 MM (2 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 20.268 CENTIMETROS CUADRADOS

PERDIDA DE CARGA EN PORCENTAJE (1 M POR C/100 M)

GASTO L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
1.90	0.937	5.8	4.7	3.8	3.2	2.7	2.3	2.0
1.96	0.967	6.2	4.9	4.1	3.4	2.9	2.5	2.2
2.02	0.996	6.5	5.2	4.3	3.6	3.1	2.6	2.3
2.08	1.026	6.9	5.5	4.5	3.8	3.2	2.8	2.4
2.14	1.055	7.3	5.8	4.8	4.0	3.4	2.9	2.5
2.20	1.085	7.6	6.1	5.0	4.2	3.6	3.1	2.7
2.26	1.115	8.0	6.5	5.3	4.4	3.8	3.2	2.8
2.32	1.144	8.4	6.8	5.6	4.7	4.0	3.4	3.0
2.38	1.174	8.9	7.1	5.9	4.9	4.2	3.6	3.1
2.44	1.203	9.3	7.5	6.2	5.2	4.4	3.8	3.3
2.50	1.233	9.7	7.8	6.4	5.4	4.6	4.0	3.4
2.56	1.263	10.2	8.2	6.7	5.6	4.8	4.1	3.6
2.62	1.292	10.6	8.5	7.0	5.9	5.0	4.3	3.8
2.68	1.322	11.0	8.9	7.3	6.1	5.2	4.5	3.9
2.74	1.351	11.5	9.2	7.6	6.4	5.4	4.7	4.1
2.80	1.381	12.0	9.7	7.9	6.7	5.7	4.9	4.3
2.86	1.411	12.5	10.0	8.2	6.9	5.9	5.1	4.4
2.92	1.440	13.0	10.4	8.6	7.2	6.1	5.3	4.6
2.98	1.470	13.5	10.8	8.9	7.5	6.4	5.5	4.8
3.04	1.499	14.0	11.2	9.2	7.7	6.6	5.7	4.9
3.10	1.529	14.5	11.7	9.6	8.0	6.8	5.9	5.1
3.16	1.559	15.0	12.1	9.9	8.3	7.1	6.1	5.3
3.22	1.588	15.6	12.5	10.3	8.6	7.3	6.3	5.5
3.28	1.618	16.1	12.9	10.6	8.9	7.6	6.5	5.7
3.34	1.647	16.7	13.4	11.0	9.2	7.9	6.8	5.9
3.40	1.677	17.2	13.8	11.4	9.5	8.1	7.0	6.1
3.46	1.707	17.8	14.3	11.8	9.9	8.4	7.2	6.3
3.52	1.736	18.3	14.8	12.1	10.1	8.7	7.5	6.5
3.58	1.766	18.9	15.2	12.5	10.5	8.9	7.7	6.7

CARGA L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
3.64	1.795	19.5	15.7	12.9	10.8	9.2	7.9	6.9
3.70	1.825	20.1	16.2	13.3	11.2	9.5	8.2	7.1
3.76	1.855	20.7	16.7	13.7	11.5	9.8	8.4	7.3
3.82	1.884	21.4	17.2	14.1	11.0	10.1	8.7	7.6
3.88	1.914	22.0	17.7	14.5	12.2	10.4	8.9	7.8
3.94	1.943	22.6	18.2	15.0	12.5	10.7	9.2	8.0
4.00	1.973	23.2	18.7	15.4	12.9	11.0	9.5	8.2
4.06	2.003	23.9	19.2	15.8	13.3	11.3	9.7	8.5
4.12	2.032	24.6	19.8	16.2	13.6	11.6	10.0	8.7
4.18	2.062	25.2	20.3	16.7	14.0	11.9	10.3	8.9
4.24	2.091	25.9	20.8	17.1	14.4	12.2	10.5	9.2
4.30	2.121	26.6	21.4	17.6	14.7	12.5	10.8	9.4
4.36	2.151	27.3	21.9	18.0	15.1	12.9	11.1	9.7
4.42	2.180	28.0	22.5	18.5	15.5	13.2	11.4	9.9
4.48	2.210	28.7	23.1	19.0	15.9	13.5	11.7	10.2
4.54	2.239	29.4	23.6	19.5	16.3	13.9	12.0	10.4
4.60	2.269	30.1	24.2	19.9	16.7	14.2	12.3	10.7
4.66	2.299	30.9	24.8	20.4	17.1	14.5	12.6	10.9
4.72	2.328	31.6	25.4	20.9	17.5	14.9	12.9	11.2
4.78	2.358	32.4	26.0	21.4	17.9	15.3	13.2	11.5
4.84	2.387	33.1	26.6	21.9	18.4	15.6	13.5	11.7
4.90	2.417	33.9	27.2	22.4	18.8	16.0	13.8	12.0
4.96	2.447	34.7	27.9	22.9	19.2	16.3	14.1	12.3
5.02	2.476	35.3	28.5	23.4	19.6	16.7	14.4	12.5
5.08	2.506	36.2	29.1	24.0	20.1	17.1	14.7	12.8
5.14	2.535	37.0	29.8	24.5	20.5	17.5	15.1	13.1
5.20	2.565	37.8	30.4	25.0	21.0	17.9	15.4	13.4
5.26	2.595	38.6	31.1	25.6	21.4	18.2	15.7	13.7
5.32	2.624	39.5	31.7	26.1	21.9	18.6	16.0	14.0
5.38	2.654	40.3	32.4	26.6	22.3	19.0	16.4	14.3
5.44	2.683	41.1	33.1	27.2	22.8	19.4	16.7	14.6
5.50	2.713	42.0	33.7	27.8	23.3	19.8	17.1	14.9
5.56	2.743	42.8	34.4	28.3	23.7	20.2	17.4	15.2
5.62	2.772	43.7	35.1	28.9	24.2	20.6	17.8	15.5

GASTO L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
5.68	2.802	44.4	35.8	29.5	24.7	21.0	18.1	15.8
5.74	2.832	45.4	36.5	30.0	25.2	21.4	18.5	16.1
5.80	2.861	46.3	37.2	30.6	25.7	21.8	18.8	16.4
5.86	2.891	47.2	38.0	31.2	26.2	22.3	19.2	16.7
5.92	2.920	48.1	38.7	31.8	26.7	22.7	19.6	17.1
5.98	2.950	49.0	39.4	32.4	27.1	23.1	19.9	17.4
6.04	2.980	49.9	40.1	33.0	27.7	23.6	20.3	17.7
6.10	3.009	50.8	40.9	33.6	28.2	24.0	20.7	18.0
6.16	3.039	51.8	41.6	34.2	28.7	24.4	21.1	18.4

TUBERIA DE 63.50 MM (2 1/2 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 31.669 CENTIMETROS CUADRADOS

PERDIDA DE CARGA EN PORCENTAJE (1 M POR C/100 M)

GASTO	VELOC	VALORES DE "C"						
L/SEG	M/SEG	80	90	100	110	120	130	140
3.0	0.947	4.6	3.7	3.0	2.5	2.1	1.8	1.6
3.1	0.978	4.8	3.9	3.2	2.7	2.3	2.0	1.7
3.2	1.010	5.2	4.1	3.4	2.8	2.4	2.1	1.8
3.3	1.042	5.5	4.4	3.6	3.0	2.5	2.2	1.9
3.4	1.073	5.8	4.6	3.8	3.2	2.7	2.3	2.0
3.5	1.105	6.1	4.9	4.0	3.4	2.8	2.4	2.1
3.6	1.136	6.4	5.1	4.2	3.5	3.0	2.6	2.2
3.7	1.168	6.7	5.4	4.4	3.7	3.2	2.7	2.4
3.8	1.199	7.1	5.7	4.7	3.9	3.3	2.9	2.5
3.9	1.231	7.4	6.0	4.9	4.1	3.5	3.0	2.6
4.0	1.263	7.8	6.3	5.1	4.3	3.7	3.1	2.7
4.1	1.294	8.2	6.6	5.4	4.5	3.8	3.3	2.9
4.2	1.326	8.5	6.9	5.6	4.7	4.0	3.4	3.0
4.3	1.357	8.9	7.2	5.9	4.9	4.2	3.6	3.1
4.4	1.389	9.3	7.5	6.1	5.1	4.4	3.8	3.3
4.5	1.420	9.7	7.8	6.4	5.4	4.6	3.9	3.4
4.6	1.452	10.1	8.1	6.7	5.6	4.8	4.1	3.6
4.7	1.484	10.5	8.5	7.0	5.8	4.9	4.3	3.7
4.8	1.515	11.0	8.8	7.2	6.1	5.1	4.4	3.9
4.9	1.547	11.4	9.1	7.5	6.3	5.3	4.6	4.0
5.0	1.578	11.8	9.5	7.8	6.5	5.6	4.8	4.2
5.1	1.610	12.3	9.9	8.1	6.8	5.8	5.0	4.3
5.2	1.641	12.7	10.2	8.4	7.0	6.0	5.1	4.5
5.3	1.673	13.2	10.6	8.7	7.3	6.2	5.3	4.6
5.4	1.705	13.6	11.0	9.0	7.5	6.4	5.5	4.8
5.5	1.736	14.1	11.3	9.3	7.8	6.6	5.7	5.0
5.6	1.768	14.6	11.7	9.6	8.1	6.9	5.9	5.1
5.7	1.799	15.1	12.1	10.0	8.3	7.1	6.1	5.3

GASTO L/SEG	VELOC M/SEG	V A L O R E S D E " C " 80	90	100	110	120	130	140
5.8	1.831	15.6	12.5	10.3	8.6	7.3	6.3	5.5
5.9	1.863	16.1	12.9	10.6	8.9	7.6	6.5	5.7
6.0	1.894	16.6	13.3	11.0	9.2	7.8	6.7	5.9
6.1	1.926	17.1	13.7	11.3	9.5	8.0	6.9	6.0
6.2	1.957	17.6	14.2	11.7	9.8	8.3	7.1	6.2
6.3	1.989	18.2	14.6	12.0	10.0	8.5	7.4	6.4
6.4	2.020	18.7	15.0	12.4	10.3	8.8	7.6	6.6
6.5	2.052	19.2	15.5	12.7	10.7	9.1	7.8	6.8
6.6	2.084	19.8	15.9	13.1	11.0	9.3	8.0	7.0
6.7	2.115	20.4	16.4	13.5	11.3	9.6	8.3	7.2
6.8	2.147	20.9	16.8	13.8	11.6	9.9	8.5	7.4
6.9	2.178	21.5	17.3	14.2	11.9	10.1	8.7	7.6
7.0	2.210	22.1	17.8	14.6	12.2	10.4	9.0	7.8
7.1	2.241	22.7	18.2	15.0	12.6	10.7	9.2	8.0
7.2	2.273	23.3	18.7	15.4	12.9	11.0	9.4	8.2
7.3	2.305	23.9	19.2	15.8	13.2	11.3	9.7	8.4
7.4	2.336	24.5	19.7	16.2	13.6	11.5	9.9	8.7
7.5	2.368	25.1	20.2	16.6	13.9	11.8	10.2	8.9
7.6	2.339	25.7	20.7	17.0	14.2	12.1	10.4	9.1
7.7	2.431	26.4	21.2	17.4	14.6	12.4	10.7	9.3
7.8	2.462	27.0	21.7	17.8	14.9	12.7	11.0	9.5
7.9	2.494	27.7	22.2	18.3	15.3	13.0	11.2	9.8
8.0	2.526	28.3	22.7	18.7	15.7	13.3	11.5	10.0
8.1	2.557	29.0	23.3	19.1	16.0	13.6	11.8	10.2
8.2	2.589	29.6	23.8	19.6	16.4	14.0	12.0	10.5
8.3	2.620	30.3	24.4	20.0	16.8	14.3	12.3	10.7
8.4	2.652	31.0	24.9	20.5	17.2	14.6	12.6	11.0
8.5	2.683	31.7	25.5	21.0	17.5	14.9	12.9	11.2
8.6	2.715	32.4	26.0	21.4	17.9	15.2	13.1	11.4
8.7	2.747	33.1	26.6	21.9	18.3	15.6	13.4	11.7
8.8	2.778	33.8	27.1	22.3	18.7	15.9	13.7	12.0
8.9	2.810	34.5	27.7	22.8	19.1	16.3	14.0	12.2
9.0	2.841	35.2	28.3	23.3	19.5	16.6	14.3	12.5
9.1	2.873	35.9	28.9	23.8	19.9	16.9	14.6	12.7

GASTO	VELOC	VALORES DE "C"						
L/SEG	M/SEG	80	90	100	110	120	130	140
9.2	2.905	36.7	29.5	24.3	20.3	17.3	14.9	13.0
9.3	2.936	37.4	30.1	24.7	20.7	17.6	15.2	13.3
9.4	2.968	38.2	30.7	25.2	21.1	18.0	15.5	13.5
9.5	2.999	38.9	31.3	25.7	21.6	18.4	15.8	13.8
9.6	3.031	39.7	31.9	26.2	22.0	18.7	16.1	14.1
9.7	3.062	40.5	32.5	26.8	22.4	19.1	16.4	14.3
9.8	3.094	41.2	33.2	27.3	22.9	19.4	16.8	14.6
9.9	3.126	42.0	33.8	27.8	23.3	19.8	17.1	14.9
10.0	3.157	42.8	34.4	28.3	23.7	20.2	17.4	15.2
10.1	3.189	43.6	35.0	28.8	24.2	20.6	17.7	15.4

TUBERIA DE 76.19 MM (3 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 45.603 CENTIMETROS CUADRADOS

PERDIDA DE CARGA EN PORCENTAJE (1M POR C/100 M)

GASTO	VELOC	VALORES DE "C"						
L/SEG	M/SEG	80	90	100	110	120	130	140
2.0	0.438	0.9	0.7	0.6	0.5	0.4	0.3	0.3
2.2	0.482	1.0	0.8	0.7	0.6	0.5	0.4	0.3
2.4	0.526	1.2	1.0	0.8	0.7	0.6	0.5	0.4
2.6	0.570	1.4	1.1	0.9	0.8	0.7	0.6	0.5
2.8	0.613	1.6	1.3	1.1	0.9	0.8	0.6	0.6
3.0	0.657	1.9	1.5	1.2	1.0	0.9	0.7	0.6
3.2	0.701	2.1	1.7	1.4	1.2	1.0	0.8	0.7
3.4	0.745	2.4	1.9	1.6	1.3	1.1	0.9	0.8
3.6	0.789	2.6	2.1	1.7	1.4	1.2	1.1	0.9
3.8	0.833	2.9	2.3	1.9	1.6	1.4	1.2	1.0
4.0	0.877	3.2	2.6	2.1	1.8	1.5	1.3	1.1
4.2	0.920	3.5	2.8	2.3	1.9	1.6	1.4	1.2
4.4	0.964	3.8	3.1	2.5	2.1	1.8	1.5	1.3
4.6	1.008	4.2	3.3	2.7	2.3	1.9	1.7	1.5
4.8	1.052	4.5	3.6	3.0	2.5	2.1	1.8	1.6
5.0	1.096	4.9	3.9	3.2	2.7	2.3	1.9	1.7
5.2	1.140	5.2	4.2	3.4	2.9	2.4	2.1	1.8
5.4	1.184	5.6	4.5	3.7	3.1	2.6	2.3	2.0
5.6	1.227	6.0	4.8	4.0	3.3	2.8	2.4	2.1
5.8	1.271	6.4	5.1	4.2	3.5	3.0	2.6	2.3
6.0	1.315	6.8	5.5	4.5	3.8	3.2	2.7	2.4
6.2	1.359	7.2	5.8	4.8	4.0	3.4	2.9	2.6
6.4	1.403	7.7	6.2	5.1	4.2	3.6	3.1	2.7
6.6	1.447	8.1	6.5	5.4	4.5	3.8	3.3	2.9
6.8	1.491	8.6	6.9	5.7	4.7	4.0	3.5	3.0
7.0	1.534	9.1	7.3	6.0	5.0	4.3	3.7	3.2
7.2	1.578	9.6	7.7	6.3	5.3	4.5	3.9	3.4
7.4	1.622	10.0	8.1	6.6	5.6	4.7	4.1	3.6
7.6	1.666	10.6	8.5	7.0	5.8	5.0	4.3	3.7

GASTO L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
7.8	1.710	11.1	8.9	7.3	6.1	5.2	4.5	3.9
8.0	1.754	11.6	9.3	7.7	6.4	5.5	4.7	4.1
8.2	1.798	12.2	9.8	8.0	6.7	5.7	4.9	4.3
8.4	1.841	12.7	10.2	8.4	7.0	6.0	5.2	4.5
8.6	1.885	13.3	10.7	8.8	7.4	6.3	5.4	4.7
8.8	1.929	13.9	11.2	9.2	7.7	6.5	5.6	4.9
9.0	1.973	14.5	11.6	9.6	8.0	6.8	5.9	5.1
9.2	2.017	15.1	12.1	10.0	8.3	7.1	6.1	5.3
9.4	2.061	15.7	12.6	10.4	8.7	7.4	6.4	5.5
9.6	2.105	16.3	13.1	10.8	9.0	7.7	6.6	5.8
9.8	2.148	16.9	13.6	11.2	9.4	8.0	6.9	6.0
10.0	2.192	17.6	14.1	11.6	9.7	8.3	7.1	6.2
10.2	2.236	18.3	14.7	12.1	10.1	8.6	7.4	6.5
10.4	2.280	18.9	15.2	12.5	10.5	8.9	7.7	6.7
10.6	2.324	19.6	15.6	13.0	10.9	9.2	8.0	6.9
10.8	2.368	20.3	16.3	13.4	11.2	9.6	8.2	7.2
11.0	2.412	21.0	16.9	13.9	11.6	9.9	8.5	7.4
11.2	2.455	21.7	17.5	14.4	12.0	10.2	8.8	7.7
11.4	2.499	22.4	18.0	14.8	12.4	10.6	9.1	7.9
11.6	2.543	23.2	18.6	15.3	12.8	10.9	9.4	8.2
11.8	2.587	23.9	19.2	15.8	13.2	11.3	9.7	8.5
12.0	2.631	24.7	19.8	16.3	13.7	11.6	10.0	8.7
12.2	2.675	25.5	20.5	16.8	14.1	12.0	10.3	9.0
12.4	2.719	26.2	21.1	17.3	14.5	12.4	10.7	9.3
12.6	2.762	27.0	21.7	17.9	15.0	12.7	11.0	9.6
12.8	2.806	27.8	22.4	18.4	15.4	13.1	11.3	9.9
13.0	2.850	28.6	23.0	18.9	15.9	13.5	11.6	10.1
13.2	2.894	29.5	23.7	19.5	16.3	13.9	12.0	10.4
13.4	2.938	30.3	24.3	20.0	16.8	14.3	12.3	10.7
13.6	2.982	31.1	25.0	20.6	17.2	14.7	12.7	11.0
13.8	3.026	32.0	25.7	21.2	17.5	15.1	13.0	11.3
14.0	3.069	32.9	26.4	21.7	18.2	15.5	13.4	11.6
14.2	3.113	33.7	27.1	22.3	18.7	15.9	13.7	11.9

GASTO L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
14.4	3.157	34.6	27.8	22.9	19.2	16.3	14.1	12.3
14.6	3.201	35.5	28.5	23.5	19.7	16.7	14.4	12.6
14.8	3.245	36.4	29.3	24.1	20.2	17.2	14.8	12.9
15.0	3.289	37.3	30.0	24.7	20.7	17.6	15.2	13.2
15.2	3.333	28.3	30.8	25.3	21.2	18.0	15.6	13.6
15.4	3.376	39.2	31.5	25.9	21.7	18.5	15.9	13.9
15.6	3.420	40.1	32.3	26.5	22.2	18.9	16.3	14.2
15.8	3.464	41.1	33.0	27.2	22.8	19.4	16.7	14.6
16.0	3.508	42.1	33.8	27.8	23.3	19.8	17.1	14.9
16.2	3.552	43.1	34.6	28.5	23.9	20.3	17.5	15.3

TUBERIA DE 101.6 (4 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO 81.073 CENTIMETROS CUADRADOS

PERDIDA DE CARGA EN PORCENTAJE (4 M POR C/100 M)

GASTO L/SEG	VELOC M/SEG	V A L O R E S D E " C "						
		80	90	100	110	120	130	140
6.0	0.740	1.7	1.3	1.1	0.9	0.8	0.7	0.6
6.3	0.777	1.8	1.5	1.2	1.0	0.8	0.7	0.6
6.6	0.814	2.0	1.6	1.3	1.1	0.9	0.8	0.7
6.9	0.851	2.2	1.7	1.4	1.2	1.0	0.9	0.7
7.2	0.888	2.3	1.9	1.5	1.3	1.1	0.9	0.8
7.5	0.925	2.5	2.0	1.7	1.4	1.2	1.0	0.9
7.8	0.962	2.7	2.2	1.8	1.5	1.3	1.1	0.9
8.1	0.999	2.9	2.3	1.9	1.6	1.4	1.2	1.0
8.4	1.036	3.1	2.5	2.1	1.7	1.5	1.2	1.1
8.7	1.073	3.3	2.7	2.2	1.8	1.6	1.3	1.2
9.0	1.110	3.5	2.8	2.3	2.0	1.7	1.4	1.2
9.3	1.147	3.8	3.0	2.5	2.1	1.8	1.5	1.3
9.6	1.184	4.0	3.2	2.6	2.2	1.9	1.6	1.4
9.9	1.221	4.2	3.4	2.8	2.3	2.0	1.7	1.5
10.2	1.258	4.5	3.6	3.0	2.5	2.1	1.8	1.6
10.5	1.295	4.7	3.8	3.1	2.6	2.2	1.9	1.7
10.8	1.332	5.0	4.0	3.3	2.7	2.3	2.0	1.7
11.1	1.369	5.2	4.2	3.5	2.9	2.5	2.1	1.8
11.4	1.406	5.5	4.4	3.6	3.0	2.6	2.2	1.9
11.7	1.443	5.8	4.6	3.8	3.2	2.7	2.3	2.0
12.0	1.480	6.0	4.9	4.0	3.3	2.8	2.4	2.1
12.3	1.517	6.3	5.1	4.2	3.5	3.0	2.6	2.2
12.6	1.554	6.6	5.3	4.4	3.7	3.1	2.7	2.3
12.9	1.591	6.9	5.6	4.6	3.8	3.3	2.8	2.4
13.2	1.628	7.2	5.8	4.8	4.0	3.4	2.9	2.5
13.5	1.665	7.5	6.1	5.0	4.1	3.5	3.1	2.7
13.8	1.702	7.9	6.3	5.2	4.3	3.7	3.2	2.8
14.1	1.739	8.2	6.6	5.4	4.5	3.8	3.3	2.9
14.4	1.776	8.5	6.8	5.6	4.7	4.0	3.4	3.0

GASTO L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
14.7	1.813	8.8	7.1	5.8	4.9	4.2	3.6	3.1
15.0	1.850	9.2	7.4	6.1	5.1	4.3	3.7	3.2
15.3	1.887	9.5	7.6	6.3	5.3	4.5	3.9	3.4
15.6	1.924	9.9	7.9	6.5	5.5	4.6	4.0	3.5
15.9	1.961	10.2	8.2	6.8	5.7	4.8	4.1	3.6
16.2	1.998	10.6	8.5	7.0	5.9	5.0	4.3	3.7
16.5	2.035	10.9	8.8	7.2	6.1	5.2	4.4	3.9
16.8	2.072	11.3	9.1	7.5	6.3	5.3	4.6	4.0
17.1	2.109	11.7	9.4	7.7	6.5	5.5	4.7	4.1
17.4	2.146	12.1	9.7	8.0	6.7	5.7	4.9	4.3
17.7	2.183	12.5	10.0	8.2	6.9	5.9	5.1	4.4
18.0	2.220	12.9	10.3	8.5	7.1	6.1	5.2	4.5
18.3	2.257	13.3	10.7	8.8	7.3	6.2	5.4	4.7
18.6	2.294	13.7	11.0	9.0	7.6	6.4	5.5	4.8
18.9	2.331	14.1	11.3	9.3	7.8	6.6	5.7	5.0
19.2	2.368	14.5	11.7	9.6	8.0	6.8	5.9	5.1
19.5	2.405	14.9	12.0	9.9	8.3	7.0	6.0	5.3
19.8	2.442	15.4	12.3	10.2	8.5	7.2	6.2	5.4
20.1	2.479	15.8	12.7	10.4	8.7	7.4	6.4	5.6
20.4	2.516	16.2	13.0	10.7	9.0	7.6	6.6	5.7
20.7	2.553	16.7	13.4	11.0	9.2	7.9	6.8	5.2
21.0	2.590	17.1	13.8	11.3	9.5	8.1	7.0	6.1
21.3	2.627	17.6	14.1	11.6	9.7	8.3	7.1	6.2
21.6	2.664	18.1	14.5	11.9	10.0	8.5	7.3	6.4
21.9	2.701	18.5	14.9	12.2	10.2	8.7	7.5	6.6
22.2	2.738	19.0	15.3	12.6	10.5	8.9	7.7	6.7
22.5	2.775	19.5	15.6	12.9	10.8	9.2	7.9	6.9
22.8	2.812	20.0	16.0	13.2	11.1	9.4	8.1	7.1
23.1	2.849	20.4	16.4	13.5	11.3	9.6	8.3	7.2
23.4	2.886	20.9	16.8	13.8	11.6	9.9	8.5	7.4
23.7	2.923	21.4	17.2	14.2	11.9	10.1	8.7	7.6
24.0	2.960	21.9	17.6	14.5	12.2	10.3	8.9	7.8
24.3	2.997	22.5	18.1	14.8	12.4	10.6	9.1	7.9

GASTO L/SEG	VELCC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
24.6	3.034	23.0	18.5	15.2	12.7	10.8	9.3	8.1
24.9	3.071	23.5	18.9	15.5	13.0	11.1	9.5	8.3
25.2	3.108	24.0	19.3	15.9	13.3	11.3	9.8	8.5
25.5	3.145	24.4	19.7	16.2	13.6	11.6	10.0	8.7
25.8	3.182	25.1	20.2	16.6	13.9	11.8	10.2	8.9
26.1	3.219	25.6	20.6	17.0	14.2	12.1	10.4	9.1
26.4	3.256	26.2	21.0	17.3	14.5	12.3	10.6	9.3
26.7	3.293	26.7	21.5	17.7	14.8	12.6	10.9	9.5
27.0	3.330	27.3	21.9	18.1	15.1	12.9	11.1	9.7
27.3	3.367	27.9	22.4	18.4	15.4	13.1	11.3	9.9

GASTO L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
33.5	1.836	5.6	4.5	3.7	3.1	2.6	2.3	2.0
34.0	1.863	5.8	4.6	3.8	3.2	2.7	2.3	2.0
34.5	1.891	5.9	4.8	3.9	3.3	2.8	2.4	2.1
35.0	1.918	6.1	4.9	4.0	3.4	2.9	2.5	2.1
35.5	1.946	6.3	5.0	4.1	3.5	2.9	2.5	2.2
36.0	1.973	6.4	5.2	4.2	3.6	3.0	2.6	2.3
36.5	2.000	6.6	5.3	4.4	3.6	3.1	2.7	2.4
37.0	2.028	6.8	5.4	4.5	3.7	3.2	2.7	2.4
37.5	2.055	6.9	5.6	4.6	3.8	3.3	2.8	2.4
38.0	2.083	7.1	5.7	4.7	3.9	3.3	2.9	2.5
38.5	2.110	7.3	5.9	4.8	4.0	3.4	2.9	2.6
39.0	2.137	7.5	6.0	4.9	4.1	3.5	3.0	2.6
39.5	2.165	7.6	6.1	5.0	4.2	3.6	3.1	2.7
40.0	2.192	7.8	6.3	5.2	4.3	3.7	3.2	2.8
40.5	2.220	8.0	6.4	5.3	4.4	3.8	3.2	2.8
41.0	2.247	8.2	6.6	5.4	4.5	3.9	3.3	2.9
41.5	2.275	8.4	6.7	5.5	4.6	3.9	3.4	3.0
42.0	2.302	8.6	6.9	5.7	4.7	4.0	3.5	3.0
42.5	2.329	8.8	7.0	5.8	4.8	4.1	3.5	3.1
43.0	2.357	9.0	7.2	5.9	4.9	4.2	3.6	3.2
43.5	2.384	9.1	7.3	6.0	5.0	4.3	3.7	3.2
44.0	2.412	9.3	7.5	6.2	5.2	4.4	3.8	3.3
44.5	2.439	9.5	7.7	6.3	5.3	4.5	3.9	3.4
45.0	2.466	9.7	7.8	6.4	5.4	4.6	3.9	3.4
45.5	2.494	9.9	8.0	6.7	5.5	4.7	4.0	3.5
46.0	2.521	10.1	8.2	6.7	5.6	4.8	4.1	3.6
46.5	2.549	10.4	8.3	6.8	5.7	4.9	4.2	3.7
47.0	2.576	10.6	8.5	7.0	5.8	5.0	4.3	3.7
47.5	2.603	10.8	8.7	7.1	6.0	5.1	4.4	3.8
48.0	2.631	11.0	8.8	7.2	6.1	5.2	4.5	3.9
48.5	2.658	11.2	9.0	7.4	6.2	5.3	4.5	3.9
49.0	2.686	11.4	9.2	7.5	6.3	5.4	4.6	4.0
49.5	2.713	11.6	9.3	7.7	6.4	5.5	4.7	4.1
50.0	2.741	11.8	9.5	7.8	6.6	5.6	4.8	4.2

TUBERIA DE 159.4 MM (6 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 182.414 CENTIMETROS CUADRADOS

PERDIDA DE CARGA EN PORCENTAJE (1 MPOR C/100 M)

GASTO	VELOC	V A L O R E S D E " C "						
L/SEG	M/SEG	80	90	100	110	120	130	140
19.0	1.041	1.9	1.6	1.3	1.1	0.9	0.8	0.7
19.5	1.068	2.0	1.6	1.3	1.1	1.0	0.8	0.7
20.0	1.096	2.1	1.7	1.4	1.2	1.0	0.9	0.7
20.5	1.123	2.2	1.8	1.5	1.2	1.0	0.9	0.8
21.0	1.151	2.4	1.9	1.5	1.3	1.1	0.9	0.8
21.5	1.178	2.5	2.0	1.6	1.3	1.1	1.0	0.9
22.0	1.206	2.6	2.1	1.7	1.4	1.2	1.0	0.9
22.5	1.233	2.7	2.1	1.8	1.5	1.2	1.1	0.9
23.0	1.260	2.8	2.2	1.8	1.5	1.3	1.1	1.0
23.5	1.288	2.9	2.3	1.9	1.6	1.4	1.2	1.0
24.0	1.315	3.0	2.4	2.0	1.7	1.4	1.2	1.1
24.5	1.343	3.1	2.5	2.1	1.7	1.5	1.3	1.1
25.0	1.370	3.3	2.6	2.1	1.8	1.5	1.3	1.1
25.5	1.397	3.4	2.7	2.2	1.9	1.6	1.4	1.2
26.0	1.425	3.5	2.8	2.3	1.9	1.6	1.4	1.2
26.5	1.452	3.6	2.9	2.4	2.0	1.7	1.4	1.3
27.0	1.480	3.8	3.0	2.5	2.1	1.8	1.5	1.3
27.5	1.507	3.9	3.1	2.6	2.1	1.8	1.6	1.4
28.0	1.534	4.0	3.2	2.7	2.2	1.9	1.6	1.4
28.5	1.562	4.2	3.3	2.7	2.3	1.9	1.7	1.5
29.0	1.589	4.3	3.5	2.8	2.4	2.0	1.7	1.5
29.5	1.617	4.4	3.6	2.9	2.4	2.1	1.8	1.6
30.0	1.644	4.6	3.7	3.0	2.5	2.1	1.8	1.6
30.5	1.672	4.7	3.8	3.1	2.6	2.2	1.9	1.7
31.0	1.699	4.9	3.9	3.2	2.7	2.3	2.0	1.7
31.5	1.726	5.0	4.0	3.3	2.8	2.4	2.0	1.8
32.0	1.754	5.2	4.1	3.4	2.9	2.4	2.1	1.8
32.5	1.781	5.3	4.3	3.5	2.9	2.5	2.1	1.9
33.0	1.809	5.5	4.4	3.6	3.0	2.6	2.2	1.9

GASTO L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
33.5	1.836	5.6	4.5	3.7	3.1	2.6	2.3	2.0
34.0	1.863	5.8	4.6	3.8	3.2	2.7	2.3	2.0
34.5	1.891	5.9	4.8	3.9	3.3	2.8	2.4	2.1
35.0	1.918	6.1	4.9	4.0	3.4	2.9	2.5	2.1
35.5	1.946	6.3	5.0	4.1	3.5	2.9	2.5	2.2
36.0	1.973	6.4	5.2	4.2	3.6	3.0	2.6	2.3
36.5	2.000	6.6	5.3	4.4	3.6	3.1	2.7	2.4
37.0	2.028	6.8	5.4	4.5	3.7	3.2	2.7	2.4
37.5	2.055	6.9	5.6	4.6	3.8	3.3	2.8	2.4
38.0	2.083	7.1	5.7	4.7	3.9	3.3	2.9	2.5
38.5	2.110	7.3	5.9	4.8	4.0	3.4	2.9	2.6
39.0	2.137	7.5	6.0	4.9	4.1	3.5	3.0	2.6
39.5	2.165	7.6	6.1	5.0	4.2	3.6	3.1	2.7
40.0	2.192	7.8	6.3	5.2	4.3	3.7	3.2	2.8
40.5	2.220	8.0	6.4	5.3	4.4	3.8	3.2	2.8
41.0	2.247	8.2	6.6	5.4	4.5	3.9	3.3	2.9
41.5	2.275	8.4	6.7	5.5	4.6	3.9	3.4	3.0
42.0	2.302	8.6	6.9	5.7	4.7	4.0	3.5	3.0
42.5	2.329	8.8	7.0	5.8	4.8	4.1	3.5	3.1
43.0	2.357	9.0	7.2	5.9	4.9	4.2	3.6	3.2
43.5	2.384	9.1	7.3	6.0	5.0	4.3	3.7	3.2
44.0	2.412	9.3	7.5	6.2	5.2	4.4	3.8	3.3
44.5	2.439	9.5	7.7	6.3	5.3	4.5	3.9	3.4
45.0	2.466	9.7	7.8	6.4	5.4	4.6	3.9	3.4
45.5	2.494	9.9	8.0	6.7	5.5	4.7	4.0	3.5
46.0	2.521	10.1	8.2	6.7	5.6	4.8	4.1	3.6
46.5	2.549	10.4	8.3	6.8	5.7	4.9	4.2	3.7
47.0	2.576	10.6	8.5	7.0	5.8	5.0	4.3	3.7
47.5	2.603	10.8	8.7	7.1	6.0	5.1	4.4	3.8
48.0	2.631	11.0	8.8	7.2	6.1	5.2	4.5	3.9
48.5	2.658	11.2	9.0	7.4	6.2	5.3	4.5	3.9
49.0	2.686	11.4	9.2	7.5	6.3	5.4	4.6	4.0
49.5	2.713	11.6	9.3	7.7	6.4	5.5	4.7	4.1
50.0	2.741	11.8	9.5	7.8	6.6	5.6	4.8	4.2

GASTO L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
50.5	2.768	12.1	9.7	8.0	6.7	5.7	4.9	4.3
51.0	2.795	12.3	9.9	8.1	6.8	5.8	5.0	4.3
51.5	2.823	12.5	10.1	8.3	6.9	5.9	5.1	4.4
52.0	2.850	12.7	10.2	8.4	7.1	6.0	5.2	4.5
52.5	2.878	13.0	10.4	8.6	7.2	6.1	5.3	4.6
53.0	2.905	13.2	10.6	8.7	7.3	6.2	5.4	4.7
53.5	2.932	13.4	10.8	8.9	7.4	6.3	5.4	4.7
54.0	2.960	13.7	11.0	9.0	7.6	6.4	5.5	4.8
54.5	2.987	13.9	11.2	9.2	7.7	6.5	5.6	4.9
55.0	3.015	14.1	11.4	9.3	7.8	6.7	5.7	5.0
55.5	3.042	14.4	11.6	9.4	8.0	6.8	5.8	5.1
56.0	3.070	14.6	11.7	9.5	8.1	7.0	5.9	5.2
56.5	3.097	14.8	11.9	9.7	8.2	7.1	6.0	5.3
57.0	3.124	15.1	12.1	9.9	8.3	7.2	6.1	5.4

TUBERIA DE 203.2 MM (8 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 324.292 CENTIMETROS CUADRADOS

PERDIDA DE CARGA EN PORCENTAJE (1 M POR C/100 M)

GASTO	VELOC	VALORES DE "C"						
L/SEG	M/SEG	80	90	100	110	120	130	140
30.0	0.925	1.1	0.9	0.7	0.6	0.5	0.4	0.4
31.0	0.955	1.2	0.9	0.8	0.6	0.5	0.5	0.4
32.0	0.986	1.2	1.0	0.8	0.7	0.6	0.5	0.4
33.0	1.017	1.3	1.1	0.9	0.7	0.6	0.5	0.5
34.0	1.048	1.4	1.1	0.9	0.8	0.6	0.6	0.5
35.0	1.079	1.5	1.2	1.0	0.8	0.7	0.6	0.5
36.0	1.110	1.6	1.2	1.0	0.9	0.7	0.6	0.5
37.0	1.140	1.6	1.3	1.1	0.9	0.8	0.7	0.6
38.0	1.171	1.7	1.4	1.1	0.9	0.8	0.7	0.6
39.0	1.202	1.8	1.5	1.2	1.0	0.8	0.7	0.6
40.0	1.233	1.9	1.5	1.2	1.0	0.9	0.8	0.7
41.0	1.264	2.0	1.6	1.3	1.1	0.9	0.8	0.7
42.0	1.295	2.1	1.7	1.4	1.1	1.0	0.8	0.7
43.0	1.325	2.2	1.7	1.4	1.2	1.0	0.9	0.8
44.0	1.356	2.3	1.8	1.5	1.2	1.1	0.9	0.8
45.0	1.387	2.4	1.9	1.6	1.3	1.1	0.9	0.8
46.0	1.418	2.5	2.0	1.6	1.4	1.2	1.0	0.9
47.0	1.449	2.6	2.1	1.7	1.4	1.2	1.0	0.9
48.0	1.480	2.7	2.2	1.8	1.5	1.2	1.1	0.9
49.0	1.510	2.8	2.2	1.8	1.5	1.3	1.1	1.0
50.0	1.541	2.9	2.3	1.9	1.6	1.4	1.2	1.0
51.0	1.572	3.0	2.4	2.0	1.7	1.4	1.2	1.0
52.0	1.603	3.1	2.5	2.1	1.7	1.5	1.2	1.1
53.0	1.634	3.2	2.6	2.1	1.8	1.5	1.3	1.1
54.0	1.665	3.3	2.7	2.2	1.8	1.6	1.3	1.2
55.0	1.695	3.5	2.8	2.3	1.9	1.6	1.4	1.2
56.0	1.726	3.6	2.9	2.4	2.0	1.7	1.4	1.2
57.0	1.757	3.7	3.0	2.4	2.0	1.7	1.5	1.3

GASTO L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
58.0	1.788	3.8	3.1	2.5	2.1	1.8	1.5	1.3
59.0	1.819	3.9	3.2	2.6	2.2	1.8	1.6	1.4
60.0	1.850	4.1	3.3	2.7	2.2	1.9	1.6	1.4
61.0	1.881	4.2	3.4	2.8	2.3	2.0	1.7	1.5
62.0	1.911	4.3	3.5	2.9	2.4	2.0	1.7	1.5
63.0	1.942	4.5	3.6	2.9	2.5	2.1	1.8	1.6
64.0	1.973	4.6	3.7	3.0	2.5	2.2	1.9	1.6
65.0	2.004	4.7	3.8	3.1	2.6	2.2	1.9	1.7
66.0	2.035	4.9	3.9	3.2	2.7	2.3	2.0	1.7
67.0	2.066	5.0	4.0	3.3	2.8	2.3	2.0	1.8
68.0	2.096	5.1	4.1	3.4	2.8	2.4	2.1	1.8
69.0	2.127	5.3	4.2	3.5	2.9	2.5	2.1	1.8
70.0	2.158	5.4	4.4	3.6	3.0	2.5	2,2	1.9
71.0	2.189	5.6	4.5	3.7	3.1	2.6	2.2	2.0
72.0	2.220	5.7	4.6	3.8	3.2	2.7	2.3	2.0
73.0	2.251	5.9	4.7	3.9	3.2	2.8	2.4	2.1
74.0	2.281	6.0	4.8	4.0	3.3	2.8	2.4	2.1
75.0	2.312	6.2	5.0	4.1	3.4	2.9	2.5	2.2
76.0	2.343	6.3	5.1	4.2	3.5	3.0	2.6	2.2
77.0	2.374	6.5	5.2	4.3	3.6	3.0	2.6	2.3
78.0	2.405	6.6	5.3	4.4	3.7	3.1	2.7	2.3
79.0	2.436	6.8	5.5	4.5	3.8	3.2	2.7	2.4
80.0	2.466	6.9	5.6	4.6	3.8	3.3	2.8	2.4
81.0	2.497	7.1	5.7	4.7	3.9	3.3	2.9	2.5
82.0	2.528	7.3	5.8	4.8	4.0	3.4	2.9	2.6
83.0	2.559	7.4	6.0	4.9	4.1	3.5	3.0	2.6
84.0	2.590	7.6	6.1	5.0	4.2	3.6	3.1	2.7
85.0	2.621	7.8	6.2	5.1	4.3	3.7	3.1	2.7
86.0	2.651	8.0	6.4	5.3	4.4	3.7	3.2	2.8
87.0	2.682	8.1	6.5	5.4	4.5	3.8	3.3	2.9
88.0	2.713	8.3	6.7	5.5	4.6	3.9	3.4	2.9
89.0	2.744	8.5	6.8	5.6	4.7	4.0	3.4	3.0
90.0	2.775	8.7	7.0	5.7	4.8	4.1	3.5	3.1

GASTO L/SEG	VELOC M/SEG	VALORES DE "C"						
		80	90	100	110	120	130	140
91.0	2.806	8.8	7.1	5.8	4.9	4.2	3.6	3.1
92.0	2.836	9.0	7.2	6.0	5.0	4.2	3.7	3.2
93.0	2.867	9.2	7.4	6.1	5.1	4.3	3.7	3.2
94.0	2.898	9.4	7.5	6.2	5.2	4.4	3.8	3.3
95.0	2.929	9.6	7.7	6.3	5.3	4.5	3.9	3.4
96.0	2.960	9.8	7.8	6.4	5.4	4.6	4.0	3.4
97.0	2.991	9.9	8.0	6.6	5.5	4.7	4.0	3.5
98.0	3.021	10.1	8.1	6.7	5.6	4.8	4.1	3.6
99.0	3.052	10.3	8.3	6.8	5.7	4.9	4.2	3.6
100.0	3.083	10.5	8.5	7.0	5.8	5.0	4.3	3.7
101.0	3.114	10.7	8.6	7.1	5.9	5.0	4.3	3.8

TUBERIA DE 254.0 MM. (10 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO = 506.707 CENTIMETROS CUADRADOS

PERDIDA DE CARGA EN PORCENTAJE (1 M POR C/100 M)

GASTO	VELOC	VALORES DE " C "						
L/SEG	M/SEG	80	90	100	110	120	130	140
40.0	0.789	0.6	0.5	0.4	0.3	0.3	0.2	0.2
42.0	0.828	0.7	0.5	0.4	0.4	0.3	0.3	0.2
44.0	0.868	0.7	0.6	0.5	0.4	0.3	0.3	0.2
46.0	0.907	0.8	0.6	0.5	0.4	0.4	0.3	0.3
48.0	0.947	0.9	0.7	0.6	0.5	0.4	0.3	0.3
50.0	0.986	0.9	0.8	0.6	0.5	0.4	0.4	0.3
52.0	1.026	1.0	0.8	0.7	0.5	0.5	0.4	0.3
54.0	1.065	1.1	0.9	0.7	0.6	0.5	0.4	0.4
56.0	1.105	1.2	0.9	0.8	0.6	0.5	0.5	0.4
58.0	1.144	1.3	1.0	0.8	0.7	0.6	0.5	0.4
60.0	1.184	1.4	1.1	0.9	0.7	0.6	0.5	0.5
62.0	1.223	1.4	1.1	0.9	0.8	0.7	0.6	0.5
64.0	1.263	1.5	1.2	1.0	0.8	0.7	0.6	0.5
66.0	1.302	1.6	1.3	1.1	0.9	0.7	0.6	0.6
68.0	1.341	1.7	1.4	1.1	0.9	0.8	0.7	0.6
70.0	1.381	1.8	1.4	1.2	1.0	0.8	0.7	0.6
72.0	1.420	1.9	1.5	1.3	1.0	0.9	0.8	0.7
74.0	1.460	2.0	1.6	1.3	1.1	0.9	0.8	0.7
76.0	1.499	2.1	1.7	1.4	1.2	1.0	0.8	0.8
78.0	1.539	2.2	1.8	1.5	1.2	1.0	0.9	0.8
80.0	1.578	2.3	1.9	1.5	1.3	1.1	0.9	0.8
82.0	1.618	2.4	2.0	1.6	1.3	1.1	1.0	0.8
84.0	1.657	2.5	2.0	1.7	1.4	1.2	1.0	0.9
86.0	1.697	2.7	2.1	1.8	1.5	1.2	1.1	0.9
88.0	1.736	2.8	2.2	1.8	1.5	1.3	1.1	1.0
90.0	1.776	2.9	2.3	1.9	1.6	1.4	1.2	1.0
92.0	1.815	3.0	2.4	2.0	1.7	1.4	1.2	1.1
94.0	1.855	3.1	2.5	2.1	1.7	1.5	1.3	1.1

GASTO L/SEG	VELOC M/SEG	V A L O R E S D E " C "						
		80	90	100	110	120	130	140
96.0	1.894	3.3	2.6	2.2	1.8	1.5	1.3	1.1
98.0	1.934	3.4	2.7	2.2	1.9	1.6	1.4	1.2
100.0	1.973	3.5	2.8	2.3	1.9	1.7	1.4	1.2
102.0	2.012	3.7	2.9	2.4	2.0	1.7	1.5	1.3
104.0	2.052	3.8	3.0	2.5	2.1	1.8	1.5	1.3
106.0	2.091	3.9	3.2	2.6	2.2	1.8	1.6	1.4
108.0	2.131	4.1	3.3	2.7	2.2	1.9	1.6	1.4
110.0	2.170	4.2	3.4	2.8	2.3	2.0	1.7	1.5
112.0	2.210	4.4	3.5	2.9	2.4	2.0	1.8	1.5
114.0	2.249	4.5	3.6	3.6	2.5	2.1	1.8	1.6
116.0	2.289	4.7	3.7	3.1	2.5	2.2	1.9	1.6
118.0	2.328	4.8	3.9	3.2	2.7	2.3	1.9	1.7
120.0	2.368	5.0	4.0	3.3	2.7	2.3	2.0	1.7
122.0	2.407	5.1	4.1	3.4	2.8	2.4	2.1	1.8
124.0	2.447	5.3	4.2	3.5	2.9	2.5	2.1	1.9
126.0	2.486	5.4	4.4	3.6	3.0	2.5	2.2	1.9
128.0	2.526	5.6	4.5	3.7	3.1	2.6	2.3	2.0
130.0	2.565	5.8	4.6	3.8	3.2	2.7	2.3	2.0
132.0	2.605	5.9	4.8	3.9	3.3	2.8	2.4	2.1
134.0	2.644	6.1	4.9	4.0	3.4	2.9	2.5	2.1
136.0	2.683	6.3	5.0	4.1	3.5	2.9	2.5	2.2
138.0	2.723	6.4	5.2	4.2	3.6	3.0	2.6	2.3
140.0	2.762	6.6	5.3	4.4	3.7	3.1	2.7	2.3
142.0	2.802	6.8	5.5	4.5	3.8	3.2	2.7	2.4
144.0	2.841	7.0	5.6	4.6	3.8	3.3	2.8	2.5
146.0	2.881	7.1	5.7	4.7	3.9	3.4	2.9	2.5
148.0	2.920	7.3	5.9	4.8	4.1	3.4	3.0	2.6
150.0	2.960	7.5	6.0	5.0	4.2	3.5	3.0	2.6
152.0	2.999	7.7	6.2	5.1	4.3	3.6	3.1	2.7
154.0	3.039	7.9	6.3	5.2	4.4	3.7	3.2	2.8
156.0	3.078	8.1	6.5	5.3	4.5	3.8	3.3	2.9
158.0	3.118	8.3	6.6	5.5	4.6	3.9	3.4	2.9
160.0	3.157	8.5	6.8	5.6	4.7	4.0	3.4	3.0

GASTO L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
162.0	3.197	8.7	7.0	5.7	4.8	4.1	3.5	3.1
164.0	3.236	8.9	7.1	5.9	4.9	4.2	3.6	3.1
166.0	3.276	9.1	7.3	6.0	5.0	4.3	3.7	3.2
168.0	3.315	9.3	7.5	6.1	5.1	4.4	3.8	3.3
170.0	3.354	9.5	7.6	6.3	5.2	4.5	3.8	3.3
172.0	3.394	9.7	7.8	6.4	5.4	4.6	3.9	3.4
174.0	3.433	9.9	8.0	6.5	5.5	4.7	4.0	3.5
176.0	3.473	10.1	8.1	6.7	5.6	4.8	4.1	3.6
178.0	3.512	10.3	8.3	6.8	5.7	4.9	4.2	3.6
180.0	3.552	10.5	8.5	7.0	5.8	5.0	4.3	3.7
182.0	3.591	10.8	8.6	7.1	6.0	5.1	4.4	3.8

TUBERIA DE 304.79 MM (12 ") DE DIAMETRO

AREA DE LA SECCION DEL TUBO 729.658 CENTIMETROS CUADRADOS

PERDIDA DE CARGA EN PORCENTAJE (1 M POR C/100 M)

GASTO	VELOC	V A L O R E S D E " C "						
L/SEG	M/SEG	80	90	100	110	120	130	140
70.0	0.959	0.7	0.6	0.5	0.4	0.3	0.3	0.2
72.0	0.986	0.8	0.6	0.5	0.4	0.3	0.3	0.3
74.0	1.014	0.8	0.6	0.5	0.5	0.4	0.3	0.3
76.0	1.041	0.9	0.7	0.6	0.5	0.4	0.3	0.3
78.0	1.069	0.9	0.7	0.6	0.5	0.4	0.3	0.3
80.0	1.096	0.9	0.7	0.6	0.5	0.4	0.3	0.3
82.0	1.123	1.0	0.8	0.6	0.5	0.4	0.4	0.3
84.0	1.151	1.0	0.8	0.7	0.6	0.5	0.4	0.3
86.0	1.178	1.1	0.9	0.7	0.6	0.5	0.4	0.4
88.0	1.206	1.1	0.9	0.7	0.6	0.5	0.4	0.4
90.0	1.233	1.2	0.9	0.8	0.6	0.5	0.5	0.4
92.0	1.260	1.2	1.0	0.8	0.7	0.6	0.5	0.4
94.0	1.288	1.3	1.0	0.8	0.7	0.6	0.5	0.4
96.0	1.315	1.3	1.1	0.9	0.7	0.6	0.5	0.5
98.0	1.343	1.4	1.1	0.9	0.8	0.6	0.6	0.5
100.0	1.370	1.4	1.1	0.9	0.8	0.7	0.6	0.5
102.0	1.397	1.5	1.2	1.0	0.8	0.7	0.7	0.5
104.0	1.425	1.5	1.2	1.0	0.8	0.7	0.6	0.5
106.0	1.452	1.6	1.3	1.0	0.9	0.7	0.6	0.5
108.0	1.480	1.7	1.3	1.1	0.9	0.8	0.7	0.6
110.0	1.507	1.7	1.4	1.1	0.9	0.8	0.7	0.6
112.0	1.534	1.8	1.4	1.2	1.0	0.8	0.7	0.6
114.0	1.562	1.8	1.5	1.2	1.0	0.9	0.7	0.6
116.0	1.589	1.9	1.5	1.2	1.0	0.9	0.8	0.7
118.0	1.617	2.0	1.6	1.3	1.1	0.9	0.8	0.7
120.0	1.644	2.0	1.6	1.3	1.1	0.9	0.8	0.7
122.0	1.672	2.1	1.7	1.4	1.1	1.0	0.8	0.7
124.0	1.699	2.2	1.7	1.4	1.2	1.0	0.9	0.7

GASTO L/SEG	VELOC M/SEG	VALORES DE "C" 80	90	100	110	120	130	140
126.0	1.726	2.2	1.8	1.5	1.2	1.0	0.9	0.8
128.0	1.754	2.3	1.8	1.5	1.3	1.1	0.9	0.8
130.0	1.781	2.4	1.9	1.5	1.3	1.1	0.9	0.8
132.0	1.809	2.4	1.9	1.6	1.3	1.1	1.0	0.8
134.0	1.836	2.5	2.0	1.6	1.4	1.2	1.0	0.9
136.0	1.863	2.6	2.1	1.7	1.4	1.2	1.0	0.9
138.0	1.891	2.6	2.1	1.7	1.4	1.2	1.1	0.9
140.0	1.918	2.7	2.2	1.8	1.5	1.3	1.1	0.9
142.0	1.946	2.8	2.2	1.8	1.5	1.3	1.1	1.0
144.0	1.973	2.8	2.3	1.9	1.6	1.3	1.1	1.0
146.0	2.000	2.9	2.3	1.9	1.6	1.4	1.2	1.0
148.0	2.028	3.0	2.4	2.0	1.6	1.4	1.2	1.0
150.0	2.055	3.1	2.5	2.0	1.7	1.4	1.2	1.1
152.0	2.083	3.2	2.5	2.1	1.7	1.5	1.3	1.1
154.0	2.110	3.2	2.6	2.1	1.8	1.5	1.3	1.1
156.0	2.133	3.3	2.6	2.2	1.8	1.5	1.3	1.2
158.0	2.165	3.4	2.7	2.2	1.9	1.6	1.4	1.2
160.0	2.192	3.5	2.8	2.3	1.9	1.6	1.4	1.2
162.0	2.220	3.6	2.8	2.3	2.0	1.7	1.4	1.2
164.0	2.247	3.6	2.9	2.4	2.0	1.7	1.5	1.3
166.0	2.275	3.7	3.0	2.4	2.0	1.7	1.5	1.3
168.0	2.302	3.8	3.0	2.5	2.1	1.8	1.5	1.3
170.0	2.329	3.9	3.1	2.6	2.1	1.8	1.6	1.4
172.0	2.357	4.0	3.2	2.6	2.2	1.9	1.6	1.4
174.0	2.384	4.1	3.3	2.7	2.2	1.9	1.6	1.4
176.0	2.412	4.1	3.3	2.7	2.3	1.9	1.7	1.5
178.0	2.439	4.2	3.4	2.8	2.3	2.0	1.7	1.5
180.0	2.466	4.3	3.5	2.8	2.4	2.0	1.7	1.5
182.0	2.494	4.4	3.5	2.9	2.4	2.1	1.8	1.5
184.0	2.521	4.5	3.6	3.0	2.5	2.1	1.8	1.6
186.0	2.549	4.6	3.7	3.0	2.5	2.2	1.9	1.6
188.0	2.576	4.7	3.8	3.1	2.6	2.2	1.9	1.6
190.0	2.603	4.8	3.8	3.2	2.6	2.2	1.9	1.7
192.0	2.631	4.9	3.9	3.2	2.7	2.3	2.0	1.7

GASTO L/SEG	VELOC M/SEG	VALORES DE "C"						
		80	90	100	110	120	130	140
194.0	2.658	5.0	4.0	3.3	2.7	2.3	2.0	1.7
196.0	2.686	5.1	4.1	3.3	2.8	2.4	2.0	1.8
198.0	2.713	5.2	4.1	3.4	2.8	2.4	2.1	1.8
200.0	2.741	5.3	4.2	3.5	2.9	2.5	2.1	1.8
202.0	2.768	5.4	4.3	3.5	3.0	2.5	2.2	1.9
204.0	2.795	5.5	4.4	3.6	3.0	2.6	2.2	1.9
206.0	2.823	5.6	4.5	3.7	3.1	2.6	2.2	2.0
208.0	2.850	5.7	4.5	3.7	3.1	2.7	2.3	2.0
210.0	2.878	5.8	4.6	3.8	3.2	2.7	2.3	2.0
212.0	2.905	5.9	4.7	3.9	3.2	2.8	2.4	2.1
214.0	2.932	6.0	4.8	3.9	3.3	2.8	2.4	2.1
216.0	2.960	6.1	4.9	4.0	3.4	2.8	2.5	2.1
218.0	2.987	6.2	5.0	4.1	3.5	2.9	2.5	2.2
220.0	3.015	6.3	5.0	4.1	3.5	2.9	2.5	2.2
222.0	3.042	6.4	5.1	4.2	3.5	3.0	2.6	2.2
224.0	3.070	6.5	5.2	4.3	3.6	3.0	2.7	2.3
226.0	3.097	6.6	5.2	4.3	3.6	3.1	2.7	2.3

4

COMPARACION DE RESULTADOS

Las fórmulas de Manning y Hazen-Williams, pueden usarse, indistintamente, en el cálculo de tuberías. En éste capítulo, se compararán los resultados obtenidos entre una y otra fórmula.

No obstante que sólo se usan el cobre y el fierro galvanizado en las instalaciones hidráulicas en edificios (n= 0.009 y n= 0.014 respectivamente), se empleó

también el coeficiente de rugosidad n= 0.012, que corresponde a una tubería de concreto, con el objeto de tener más [illegible].

En la siguiente tabla, se establecen las equivalencias de los coeficientes de rugosidad (n) y el de capacidad hidráulica (C) para los diferentes materiales:

MATERIAL	n	C
Cobre	0.009	140
Concreto	0.012	130
Fierro Galvanizado	0.014	100

Con estas equivalencias, ya se pueden comparar las pérdidas por fricción calculadas con las dos fórmulas.

Para comparar los resultados, se tomarán, al azar, 3 valores diferentes de gasto para los siguientes diámetros: 1/2", 1", 4", 8" y 12".

Al primer renglón de pérdidas, le corresponderán las calculadas con la fórmula de Manning y al segundo, las calculadas con la fórmula de Hazen-Williams.

Se debe recordar que las pérdidas están anotadas en porcentaje (%), el gasto en l/seg. y la velocidad en $^{m}/_{seg}$.

DIAMETRO DE 1/2"

GASTO	VELOC.	COBRE	CONCRETO	FO. GALV.
0.170	1.341	31.1	55.4	75.4
		20.3	23.3	36.9
0.210	1.657	47.6	84.6	115.1
		30.1	34.5	56.2
0.380	2.999	115.8	277.1	377.1
		90.3	103.6	168.5

DIAMETRO DE 1"

GASTO	VELOC.	COBRE	CONCRETO	FO. GALV.
0.70	1.381	13.1	23.3	31.7
		9.5	10.9	17.8
1.20	1.776	38.5	68.5	93.2
		25.9	29.8	48.6
1.50	2.960	60.2	107.0	145.7
		39.2	45.0	73.2

DIAMETRO DE 4"

GASTO	VELOC.	COBRE	CONCRETO	FO. GALV.
12.0	1.480	2.3	4.2	5.4
		2.1	2.4	4.0
18.0	2.220	5.3	9.4	12.9
		4.5	5.2	8.5
24.3	2.997	9.7	17.2	23.5
		7.9	9.1	14.8

DIAMETRO DE 8"

GASTO	VELOC.	COBRE	CONCRETO	FO. GALV.
50.0	1.541	1.0	1.8	2.4
		1.0	1.1	1.9
70.0	2.158	2.0	3.5	4.8
		1.9	2.2	3.6
91.0	2.806	3.3	6.0	8.1
		3.1	3.6	5.8

DIAMETRO DE 12"

GASTO	VELOC.	COBRE	CONCRETO	FC. GALV.
94.0	1.286	0.4	0.7	1.0
		0.4	0.5	0.9
118.0	1.617	0.6	1.1	1.5
		0.7	0.8	1.3
140.0	1.918	0.9	1.6	2.2
		0.9	1.1	1.8
160.0	2.192	1.2	2.1	2.9
		1.2	1.4	2.2
200.00	2.741	1.8	3.3	4.5
		1.8	2.1	3.5

Es evidente que las pérdidas calculadas por --- Manning, son mayores para cualquier diámetro de tubería, pero debe observarse lo siguiente:

1) Para tuberías de fierro galvanizado las pérdidas calculadas por Manning, son del orden de más del -

doble de las calculadas por Hazen-Williams para las tuberías de 1/4" hasta 1 1/4" de diámetro, inclusive.

A medida que el diámetro de la tubería aumenta, la diferencia entre las pérdidas calculadas tiende a disminuir, como puede observarse fácilmente en la tubería de 12" de diámetro, en donde las pérdidas son casi iguales para velocidades del orden de 1 m/s, en donde la diferencia entre las pérdidas es aponas de 0.1 %, aunque ésta diferencia aumenta con la velocidad ya que para velocidades del ordon de 3 m/s, la diferencia es ya de 1.4 % más para las calculadas por Manning.

2) Para tuberías de concreto, sucedo algo similar a las de fierro galvanizado.

3) Para tuberías de cobro de diámetro menor de

1", la diferencia entre las pérdidas, a velocidades de 1^m/seg., es más o menos importante, principalmente para las de $^1/4$" y $^3/8$" de diámetro. Pero para tuberías de más de 1" de diámetro, las pérdidas calculadas por Manning son casi iguales a las calculadas por Hazen-Williams para la misma velocidad de 1^m/s, pero al aumentar la velocidad, la diferencia se hace más grande, siendo las pérdidas calculadas por Manning las mayores.

Para tuberías de 6" de diámetro en adelante, la diferencia entre las pérdidas es mínima y en algunos casos (como puede verse en las tuberías de 10" y 12") y a velocidades de 1 a 2.5^m/s, las pérdidas calculadas por Manning llegan a ser menores, aunque sólo sea en 0.1 %; pero, en general, se puede afirmar que las pérdidas son iguales en tuberías de 10" y 12" y a velocidades menores ó iguales a 2.5^m/seg. A velocidades mayores, las pérdidas por Manning tienden a crecer un po-

co más que las de Hazen-Jilliams aunque, se insiste, la diferencia es mínima.

Para finalizar, se puede decir que para tuberías de $^{1}/_{4}$" a 6" de diámetro, se recomienda usar la fórmula de Hazen-Williams, ya que da pérdidas menores. Para tuberías de más de 6", se puede usar cualquiera de las dos fórmulas.

B I B L I O G R A F I A

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