

... Fire Protection by Computer Design

EASTERN FIRE
170 KITTYHAWK AVE. / P.O. BOX
AUBURN, ME , 04210
207-784-1507

Job Name : IMMUCELL
Building : 1 OF 2
Location : PORTLAND
System : 3
Contract : 5568
Data File : Immucell system #1 - recovery room.WXF

HYDRAULIC CALCULATIONS
for

Project name: IMMUCELL
Location: PORTLAND
Drawing no: 1 OF 2
Date: 2/28/17

Design

Remote area number: 3
Remote area location: LEVEL 1 RECOVERY RM.
Occupancy classification: OH2
Density: .2 - Gpm/SqFt
Area of application: 1540 - SqFt
Coverage per sprinkler: 130 - SqFt
Type of sprinklers calculated: RELIABLE G5-56 PENDENT
No. of sprinklers calculated: 16
In-rack demand: - GPM
Hose streams: 250 - GPM
Total water required (including hose streams): 673.67 - GPM @ 55.78 - Psi
Type of system: WET
Volume of dry or preaction system: - Gal

Water supply information

Date: 07-12-16
Location: FLOW HYDRANT LOCATED ON WELCH ST. & CADDIE ST.
Source: EASTERN FIRE PROTECTION

Name of contractor: EASTERN FIRE PROTECTION
Address: 170 KITTYHAWK AVE. / P.O. BOX 1390 / AUBURN, MAINE 04210
Phone number: 207-784-1507
Name of designer: RJP
Authority having jurisdiction: STATE FIRE MARSHAL
Notes: (Include peaking information or gridded systems here.)

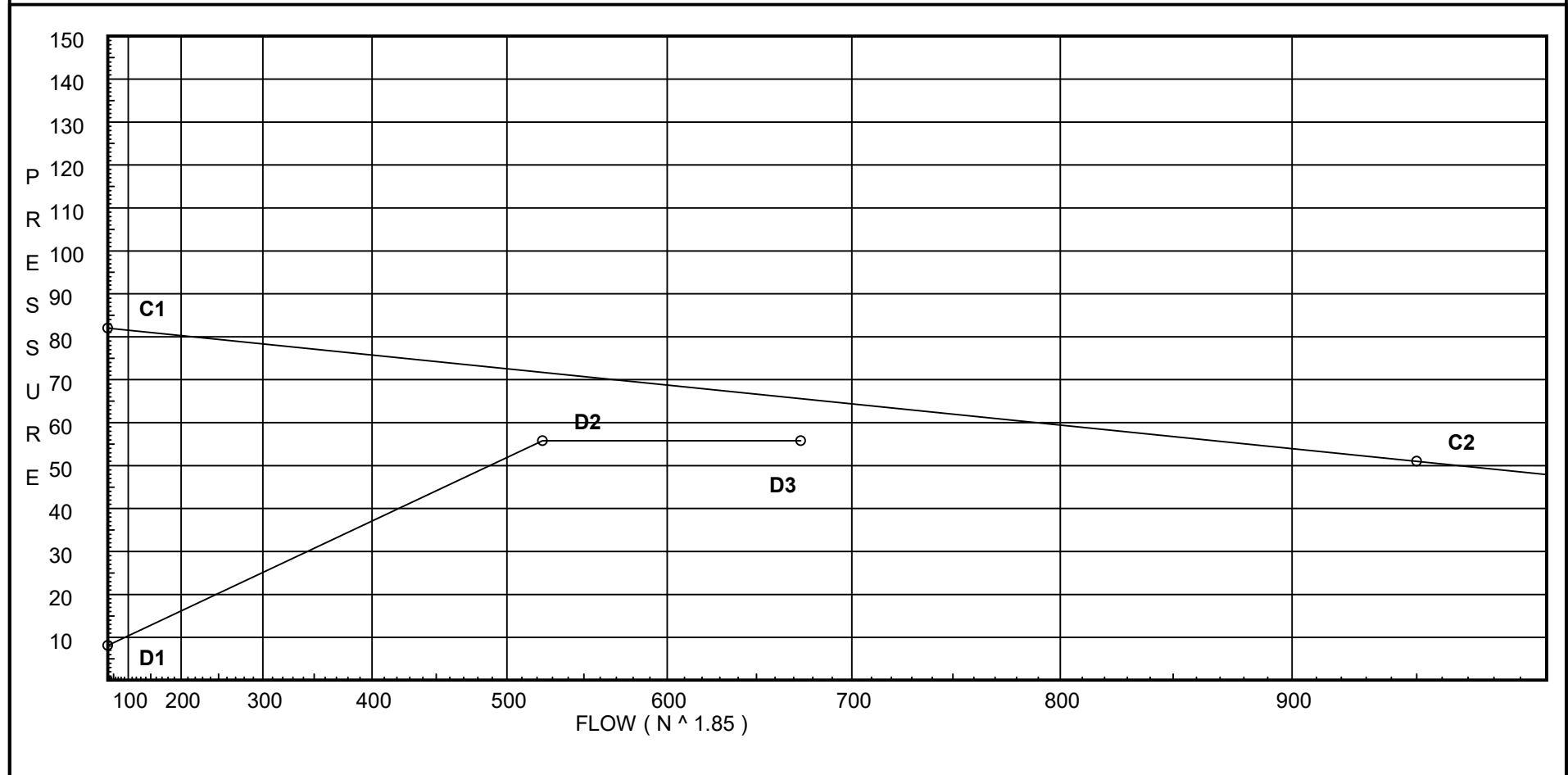
Water Supply Curve C

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City Water Supply:
C1 - Static Pressure : 82
C2 - Residual Pressure: 51
C2 - Residual Flow : 950

Demand:
D1 - Elevation : 8.138
D2 - System Flow : 523.669
D2 - System Pressure : 55.778
Hose (Demand) : 150
D3 - System Demand : 673.669
Safety Margin : 9.809



Fittings Used Summary

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Fitting Legend

Abbrev.	Name	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12	14	16	18	20	24
B	NFPA 13 Butterfly Valve	0	0	0	0	0	6	7	10	0	12	9	10	12	19	21	0	0	0	0	0
E	NFPA 13 90' Standard Elbow	1	2	2	3	4	5	6	7	8	10	12	14	18	22	27	35	40	45	50	61
G	NFPA 13 Gate Valve	0	0	0	0	0	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
I	90' Grvd-Vic Elbow #10	0	0	2	3	4	3.5	6	5	8	7	8.5	10	13	17	20	23	25	33	36	40
J	90'Tee-Branch Grv Vic #20	0	0	4.5	6	8	8.5	10.8	13	17	16	21	25	33	41	50	65	78	88	98	120
S	NFPA 13 Swing Check	0	0	5	7	9	11	14	16	19	22	27	32	45	55	65					
T	NFPA 13 90' Flow thru Tee	3	4	5	6	8	10	12	15	17	20	25	30	35	50	60	71	81	91	101	121
Zma	Maxim M200 Horz Butt	Fitting generates a Fixed Loss Based on Flow																			

Unit Summary

Diameter Units Inches
 Length Units Feet
 Flow Units US Gallons per Minute
 Pressure Units Pounds per Square Inch

Note: Fitting Legend provides equivalent pipe lengths for fittings types of various diameters. Equivalent lengths shown are standard for actual diameters of Sched 40 pipe and CFactors of 120 except as noted with *. The fittings marked with a * show equivalent lengths values supplied by manufacturers based on specific pipe diameters and CFactors and they require no adjustment. All values for fittings not marked with a * will be adjusted in the calculation for CFactors of other than 120 and diameters other than Sched 40 per NFPA.

Pressure / Flow Summary - STANDARD

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Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
DP02	0.0	5.6	20.25	na	25.2	0.2	126	7.0
EQ02	0.0		20.85	na				
DP01	0.0	5.6	20.25	na	25.2	0.2	126	7.0
EQ01	0.0		21.45	na				
1	118.79	K = K @ EQ02	20.85	na	25.2			
2	118.46		22.8	na				
3	118.46		23.0	na				
4	118.79	K = K @ EQ01	24.12	na	26.72			
5	120.71		24.54	na				
6	120.71		24.71	na				
7	120.71		25.62	na				
TI	111.0		32.7	na	50.0			
TOR1	107.0		40.77	na				
HDR1	107.0		44.57	na	50.0			
BFP	102.0		48.11	na				
BASE	100.0		53.68	na				
TEST	100.0		55.78	na	150.0			
8	118.79	K = K @ EQ02	21.03	na	25.31			
9	118.79	K = K @ EQ02	21.44	na	25.55			
10	118.46		22.74	na				
11	118.79	K = K @ EQ01	25.24	na	27.34			
12	118.79	K = K @ EQ02	21.13	na	25.37			
13	118.46		22.86	na				
14	118.46		23.06	na				
15	118.79	K = K @ EQ01	24.06	na	26.69			
16	120.71		24.49	na				
17	118.79	K = K @ EQ02	21.32	na	25.48			
18	118.79	K = K @ EQ02	21.65	na	25.68			
19	118.46		22.79	na				
20	118.79	K = K @ EQ01	25.18	na	27.31			
21	118.79	K = K @ EQ02	22.51	na	26.18			
22	118.46		24.32	na				
23	118.79	K = K @ EQ01	24.76	na	27.08			
24	118.79	K = K @ EQ02	23.06	na	26.51			
25	118.46		24.27	na				
26	118.79	K = K @ EQ01	25.41	na	27.43			
27	118.79	K = K @ EQ01	26.31	na	27.91			
28	120.71		25.59	na				
29	118.79	K = K @ EQ01	26.3	na	27.9			

The maximum velocity is 11.79 and it occurs in the pipe between nodes HDR1 and BFP

Final Calculations - Hazen-Williams - 2007

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Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
DP02 to EQ02	25.20 25.2	1.049 120.0 0.1997	E	2.0 0.0 0.0	1.000 2.000 3.000	20.250 0.0 0.599			K Factor = 5.60 Vel = 9.35	
	0.0 25.20					20.849			K Factor = 5.52	
DP01 to EQ01	25.20 25.2	1.049 120.0 0.1995	T	5.0 0.0 0.0	1.000 5.000 6.000	20.250 0.0 1.197			K Factor = 5.60 Vel = 9.35	
	0.0 25.20					21.447			K Factor = 5.44	
1 to 2	25.20 25.2	1.049 120.0 0.1996	E T	2.0 5.0 0.0	2.080 7.000 9.080	20.849 0.143 1.812			K Factor @ node EQ02 Vel = 9.35	
2 to 3	25.55 50.75	2.157 120.0 0.0218		0.0 0.0 0.0	9.000 0.0 9.000	22.804 0.0 0.196			Vel = 4.46	
3 to 4	25.31 76.06	2.157 120.0 0.0460	3I	12.922 0.0 0.0	14.500 12.922 27.422	23.000 -0.143 1.262			Vel = 6.68	
4 to 5	26.73 102.79	2.157 120.0 0.0804	J	10.461 0.0 0.0	5.083 10.461 15.544	24.119 -0.832 1.249			K Factor @ node EQ01 Vel = 9.02	
5 to 6	157.87 260.66	4.26 120.0 0.0163		0.0 0.0 0.0	10.500 0.0 10.500	24.536 0.0 0.171			Vel = 5.87	
6 to 7	107.19 367.85	4.26 120.0 0.0309	J	21.067 0.0 0.0	8.360 21.067 29.427	24.707 0.0 0.909			Vel = 8.28	
7 to TI	55.82 423.67	4.26 120.0 0.0401	2I	18.434 0.0 0.0	53.417 18.434 71.851	25.616 4.205 2.884			Vel = 9.54	
TI to TOR1	50.00 473.67	4.26 120.0 0.0493	4I	36.868 0.0 0.0	91.523 36.868 128.391	32.705 1.732 6.333			Qa = 50.00 Vel = 10.66	
TOR1 to HDR1	0.0 473.67	4.26 120.0 0.0493	B S J I	15.8 28.968 21.067 9.217	2.000 75.052 77.052	40.770 0.0 3.801			Vel = 10.66	
HDR1 to BFP	50.00 523.67	4.26 120.0 0.0593	2I G	18.434 2.633 0.0	2.000 21.067 23.067	44.571 2.166 1.369			Qa = 50.00 Vel = 11.79	
BFP to BASE	0.0 523.67	4.26 120.0 0.0594	Zma I	0.0 9.217 0.0	2.000 9.217 11.217	48.106 4.907 0.666			* Fixed Loss = 4.041 Vel = 11.79	
BASE to TEST	0.0 523.67	6.16 140.0 0.0074	3I J G	43.037 35.864 4.304	200.000 83.205 283.205	53.679 0.0 2.099			Vel = 5.64	
	150.00								Qa = 150.00	

Final Calculations - Hazen-Williams

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Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
	673.67					55.778			K Factor = 90.20	
8 to 3	25.31	1.049 120.0	E T	2.0 5.0	2.080 7.000	21.030 0.143			K Factor @ node EQ02	
	25.31	0.2012		0.0	9.080	1.827			Vel = 9.40	
	0.0 25.31					23.000			K Factor = 5.28	
9 to 10	25.55	1.049 120.0	2E	4.0 0.0	1.660 4.000	21.437 0.143			K Factor @ node EQ02	
	25.55	0.2048		0.0	5.660	1.159			Vel = 9.48	
10 to 2	0.0	2.157 120.0		0.0 0.0	10.500 0.0	22.739 0.0				
	25.55	0.0062		0.0	10.500	0.065			Vel = 2.24	
	0.0 25.55					22.804			K Factor = 5.35	
11 to 5	27.34	2.157 120.0	J	10.461 0.0	7.417 10.461	25.243 -0.832			K Factor @ node EQ01	
	27.34	0.0070		0.0	17.878	0.125			Vel = 2.40	
	0.0 27.34					24.536			K Factor = 5.52	
12 to 13	25.37	1.049 120.0	E T	2.0 5.0	0.830 7.000	21.133 0.143			K Factor @ node EQ02	
	25.37	0.2020		0.0	7.830	1.582			Vel = 9.42	
13 to 14	25.68	2.157 120.0		0.0 0.0	9.000 0.0	22.858 0.0				
	51.05	0.0220		0.0	9.000	0.198			Vel = 4.48	
14 to 15	25.48	2.157 120.0	3I	12.922 0.0	11.750 12.922	23.056 -0.143				
	76.53	0.0465		0.0	24.672	1.148			Vel = 6.72	
15 to 16	26.69	2.157 120.0	J	10.461 0.0	5.083 10.461	24.061 -0.832			K Factor @ node EQ01	
	103.22	0.0810		0.0	15.544	1.259			Vel = 9.06	
16 to 5	27.31	4.26 120.0		0.0 0.0	10.420 0.0	24.488 0.0				
	130.53	0.0046		0.0	10.420	0.048			Vel = 2.94	
	0.0 130.53					24.536			K Factor = 26.35	
17 to 14	25.48	1.049 120.0	E T	2.0 5.0	0.830 7.000	21.318 0.143			K Factor @ node EQ02	
	25.48	0.2037		0.0	7.830	1.595			Vel = 9.46	
	0.0 25.48					23.056			K Factor = 5.31	
18 to 19	25.68	1.049 120.0	2E	4.0 0.0	0.830 4.000	21.652 0.143			K Factor @ node EQ02	
	25.68	0.2066		0.0	4.830	0.998			Vel = 9.53	
19 to 13	0.0	2.157 120.0		0.0 0.0	10.500 0.0	22.793 0.0				
	25.68	0.0062		0.0	10.500	0.065			Vel = 2.25	

Final Calculations - Hazen-Williams

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Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
	0.0 25.68					22.858			K Factor = 5.37	
20 to 16	27.31	2.157 120.0	T	12.307 0.0	7.417 12.307	25.184 -0.832			K Factor @ node EQ01	
	27.31	0.0069		0.0	19.724	0.136			Vel = 2.40	
	0.0 27.31					24.488			K Factor = 5.52	
21 to 22	26.18	1.049 120.0	E T	2.0 5.0	0.830 7.000	22.505 0.143			K Factor @ node EQ02	
	26.18	0.2142		0.0	7.830	1.677			Vel = 9.72	
22 to 23	26.51	2.157 120.0	3I	12.922 0.0	11.750 12.922	24.325 -0.143				Vel = 4.63
	52.69	0.0233		0.0	24.672	0.576				
23 to 6	27.07	2.157 120.0	J	10.461 0.0	5.083 10.461	24.758 -0.832			K Factor @ node EQ01	
	79.76	0.0502		0.0	15.544	0.781			Vel = 7.00	
	0.0 79.76					24.707			K Factor = 16.05	
24 to 25	26.51	1.049 120.0	2E	4.0 0.0	0.830 4.000	23.065 0.143			K Factor @ node EQ02	
	26.51	0.2190		0.0	4.830	1.058			Vel = 9.84	
25 to 22	0.0	2.157 120.0		0.0 0.0	9.000 0.0	24.266 0.0				
	26.51	0.0066		0.0	9.000	0.059			Vel = 2.33	
	0.0 26.51					24.325			K Factor = 5.38	
26 to 6	27.43	2.157 120.0	J	10.461 0.0	7.417 10.461	25.414 -0.832			K Factor @ node EQ01	
	27.43	0.0070		0.0	17.878	0.125			Vel = 2.41	
	0.0 27.43					24.707			K Factor = 5.52	
27 to 28	27.91	2.157 120.0	J	10.461 0.0	5.083 10.461	26.314 -0.832			K Factor @ node EQ01	
	27.91	0.0073		0.0	15.544	0.113			Vel = 2.45	
28 to 7	27.91	4.26 120.0	J	21.067 0.0	2.140 21.067	25.595 0.0				
	55.82	0.0009		0.0	23.207	0.021			Vel = 1.26	
	0.0 55.82					25.616			K Factor = 11.03	
29 to 28	27.90	2.157 120.0	J	10.461 0.0	7.417 10.461	26.297 -0.832			K Factor @ node EQ01	
	27.9	0.0073		0.0	17.878	0.130			Vel = 2.45	
	0.0 27.90					25.595			K Factor = 5.51	