

... 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 : 2
Contract : 5568
Data File : Immucell system #2 storage rm. 210.WXF

HYDRAULIC CALCULATIONS
for

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

Design

Remote area number: 2
Remote area location: LEVEL 2 STORAGE #210
Occupancy classification: OH2
Density: 0.2 - Gpm/SqFt
Area of application: 1516 - SqFt
Coverage per sprinkler: 125 - SqFt
Type of sprinklers calculated: 5.6K BRASS UPRIGHT
No. of sprinklers calculated: 16
In-rack demand: - GPM
Hose streams: 250 - GPM
Total water required (including hose streams): 652.37 - GPM @ 53.64 - Psi
Type of system: WET
Volume of dry or preaction system: - Gal

Water supply information

Date: 07-12-2016
Location: FLOW HYDRANT LOCATED ON WELCH ST. & CADDIE ST.
Source: EASTERN FIRE

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.)

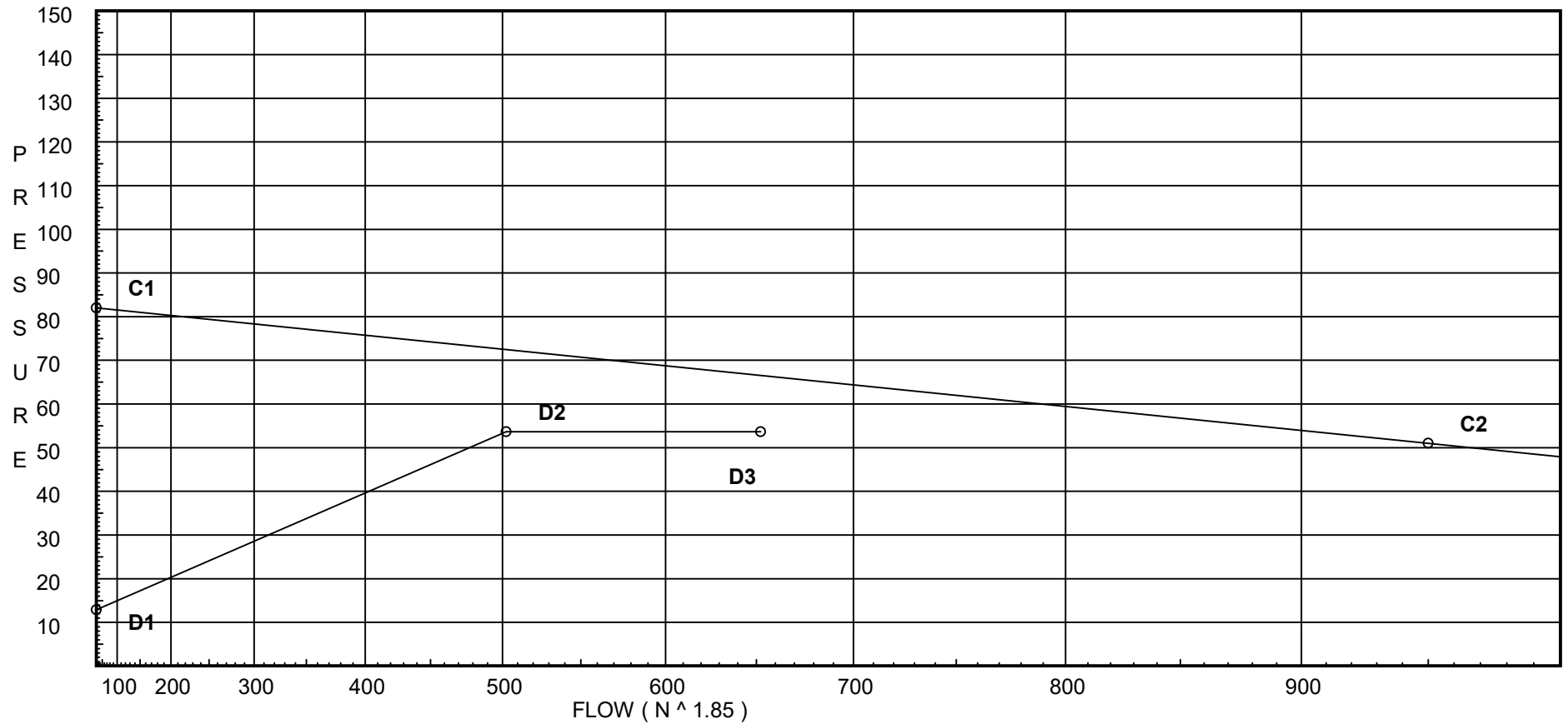
Water Supply Curve C

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

Demand:
D1 - Elevation : 12.919
D2 - System Flow : 502.371
D2 - System Pressure : 53.635
Hose (Demand) : 150
D3 - System Demand : 652.371
Safety Margin : 12.898



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
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.
61	130.36	5.6	18.09	na	23.82	0.2	70	7.0
62	130.36	5.6	18.12	na	23.84	0.2	70	7.0
63	130.36	5.6	18.27	na	23.94	0.2	70	7.0
HS2	130.36		18.54	na	50.0			
64	130.36	5.6	19.05	na	24.44	0.2	70	7.0
65	130.36	5.6	19.37	na	24.65	0.2	70	7.0
66	130.36		21.34	na				
67	130.36		22.44	na				
68	130.36		23.82	na				
69	130.36		26.87	na				
70	129.83		27.48	na				
TOR2	129.7		30.6	na				
HDR1	107.0		43.37	na	50.0			
BFP	102.0		46.3	na				
BASE	100.0		51.69	na				
TEST	100.0		53.64	na	150.0			
71	130.36	5.6	19.88	na	24.97	0.2	105	7.0
72	130.36	5.6	20.9	na	25.6	0.2	105	7.0
73	130.36	5.6	22.19	na	26.38	0.2	125	7.0
74	129.83	5.6	19.93	na	25.0	0.2	125	7.0
75	129.83	5.6	20.0	na	25.04	0.2	125	7.0
76	129.83		20.39	na				
77	129.83		21.23	na				
78	129.83		23.04	na				
79	129.83	5.6	20.03	na	25.06	0.2	125	7.0
80	129.83	5.6	20.1	na	25.11	0.2	125	7.0
81	129.83	5.6	20.86	na	25.58	0.2	125	7.0
82	129.83	5.6	20.93	na	25.62	0.2	125	7.0
83	129.83	5.6	22.64	na	26.65	0.2	125	7.0
84	129.83	5.6	22.72	na	26.69	0.2	125	7.0

The maximum velocity is 17.98 and it occurs in the pipe between nodes 78 and 70

Final Calculations - Hazen-Williams - 2007

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Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftg's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
61 to 62	23.82	2.157 120.0		0.0	5.000	18.090			K Factor = 5.60	
62 to 63	23.82	0.0054		0.0	5.000	0.027			Vel = 2.09	
62 to 63	23.83	2.157 120.0		0.0	8.000	18.117			K Factor = 5.60	
63 to HS2	47.65	0.0194		0.0	8.000	0.155			Vel = 4.18	
63 to HS2	23.94	2.157 120.0		0.0	6.458	18.272			K Factor = 5.60	
HS2 to 64	71.59	0.0410		0.0	6.458	0.265			Vel = 6.29	
HS2 to 64	50.00	2.635 120.0	I	8.237	4.042	18.537			Qa = 50.00	
64 to 65	121.59	0.0414		0.0	12.279	0.508			Vel = 7.15	
64 to 65	24.44	2.635 120.0		0.0	5.630	19.045			K Factor = 5.60	
65 to 66	146.03	0.0581		0.0	5.630	0.327			Vel = 8.59	
65 to 66	24.65	2.635 120.0	2I	16.474	9.000	19.372			K Factor = 5.60	
66 to 67	170.68	0.0775		0.0	25.474	1.973			Vel = 10.04	
66 to 67	24.96	2.635 120.0		0.0	11.000	21.345				
67 to 68	195.64	0.0996		0.0	11.000	1.096			Vel = 11.51	
67 to 68	25.60	2.635 120.0		0.0	11.000	22.441				
68 to 69	221.24	0.1252		0.0	11.000	1.377			Vel = 13.02	
68 to 69	26.39	2.635 120.0	J	14.827	4.970	23.818				
69 to 70	247.63	0.1542		0.0	19.797	3.052			Vel = 14.57	
69 to 70	0.0	4.26 120.0		0.0	25.420	26.870				
70 to TOR2	247.63	0.0148		0.0	25.420	0.230			Vel = 5.57	
70 to TOR2	204.74	4.26 120.0	2I J	18.434 21.067	28.260 39.501	27.477 0.056				
TOR2 to HDR1	452.37	0.0453		0.0	67.761	3.070			Vel = 10.18	
TOR2 to HDR1	0.0	4.26 120.0	B S	15.8 28.968	20.000 44.768	30.603 9.831				
HDR1 to BFP	452.37	0.0453		0.0	64.768	2.934			Vel = 10.18	
HDR1 to BFP	50.00	4.26 120.0	I G	9.217 2.633	2.000 11.850	43.368 2.166			Qa = 50.00	
BFP to BASE	502.37	0.0549		0.0	13.850	0.761			Vel = 11.31	
BFP to BASE	0.0	4.26 120.0	Zma I	0.0 9.217	2.000 9.217	46.295 4.780			* Fixed Loss = 3.914	
BASE to TEST	502.37	0.0550		0.0	11.217	0.617			Vel = 11.31	
BASE to TEST	0.0	6.16 140.0	3I J	43.037 35.864	200.000 83.205	51.692 0.0				
TEST to 71	502.37	0.0069		4.304	283.205	1.943			Vel = 5.41	
71 to 66	150.00 652.37					53.635			Qa = 150.00 K Factor = 89.08	
71 to 66	24.97	1.049 120.0	T	5.0	2.490	19.876			K Factor = 5.60	
66 to 66	24.97	0.1961		0.0	7.490	1.469			Vel = 9.27	

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 24.97						21.345		K Factor = 5.40	
72 to 67	25.60 25.6	1.049 120.0 0.2055	T	5.0 0.0 0.0	2.490 5.000 7.490	20.902 0.0 1.539			K Factor = 5.60	Vel = 9.50
	0.0 25.60						22.441		K Factor = 5.40	
73 to 68	26.38 26.38	1.049 120.0 0.2172	T	5.0 0.0 0.0	2.490 5.000 7.490	22.191 0.0 1.627			K Factor = 5.60	Vel = 9.79
	0.0 26.38						23.818		K Factor = 5.41	
74 to 75	25.00 25.0	2.157 120.0 0.0058		0.0 0.0 0.0	11.500 0.0 11.500	19.930 0.0 0.067			K Factor = 5.60	Vel = 2.19
75 to 76	25.04 50.04	2.157 120.0 0.0212	I	4.307 0.0 0.0	14.170 4.307 18.477	19.997 0.0 0.392			K Factor = 5.60	Vel = 4.39
76 to 77	50.17 100.21	2.157 120.0 0.0766		0.0 0.0 0.0	11.000 0.0 11.000	20.389 0.0 0.843				Vel = 8.80
77 to 78	51.20 151.41	2.157 120.0 0.1645		0.0 0.0 0.0	11.000 0.0 11.000	21.232 0.0 1.810				Vel = 13.29
78 to 70	53.33 204.74	2.157 120.0 0.2874	J	10.461 0.0 0.0	4.970 10.461 15.431	23.042 0.0 4.435				Vel = 17.98
	0.0 204.74						27.477		K Factor = 39.06	
79 to 80	25.06 25.06	2.157 120.0 0.0059		0.0 0.0 0.0	11.500 0.0 11.500	20.031 0.0 0.068			K Factor = 5.60	Vel = 2.20
80 to 76	25.11 50.17	2.157 120.0 0.0213	J	10.461 0.0 0.0	3.170 10.461 13.631	20.099 0.0 0.290			K Factor = 5.60	Vel = 4.40
	0.0 50.17						20.389		K Factor = 11.11	
81 to 82	25.58 25.58	2.157 120.0 0.0062		0.0 0.0 0.0	11.500 0.0 11.500	20.860 0.0 0.071			K Factor = 5.60	Vel = 2.25
82 to 77	25.62 51.2	2.157 120.0 0.0221	J	10.461 0.0 0.0	3.170 10.461 13.631	20.931 0.0 0.301			K Factor = 5.60	Vel = 4.50
	0.0 51.20						21.232		K Factor = 11.11	
83 to 84	26.65 26.65	2.157 120.0 0.0066		0.0 0.0 0.0	11.500 0.0 11.500	22.640 0.0 0.076			K Factor = 5.60	Vel = 2.34

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	*****
84	26.69	2.157	J	10.461	3.170	22.716		K Factor = 5.60	
to		120.0		0.0	10.461	0.0			
78	53.34	0.0239		0.0	13.631	0.326		Vel = 4.68	
	0.0								
	53.34					23.042		K Factor = 11.11	