



**... Fire Protection by Computer Design**

High Tech Fire Protection  
PO Box 156  
Minot, ME 04258  
(207) 998-2551

Job Name : Clerestory Calc.  
Building : Patrons Oxford Offices  
Location : 97 Technology Park Drive  
System : NFPA 13  
Contract : 020416-1  
Data File : Clerestory Calc.wxf

Hydraulic Design Information Sheet

Name - Clerestory Calc. Date - 10/31/2016  
 Location - 97 Technology Park Drive  
 Building - Patrons Oxford Offices System No. - NFPA 13  
 Contractor - High Tech Fire Protection Contract No. - 020416-1  
 Calculated By - Jeremy A Foss Drawing No. - FP-1.2  
 Construction: (X) Combustible ( ) Non-Combustible Ceiling Height - 30'  
 Occupancy - Atrium

S (X) NFPA 13 (X) Lt. Haz. Ord.Haz.Gp. ( ) 1 ( ) 2 ( ) 3 ( ) Ex.Haz.  
 Y ( ) NFPA 231 ( ) NFPA 231C ( ) Figure Curve

S Other

T Specific Ruling Made By Date

	Area	Density	System Type	Make
M	Area of Sprinkler Operation - 1500		Sprinkler/Nozzle	
	Density - .1		(X) Wet	Make Reliable
D	Area Per Sprinkler - 72		( ) Dry	Model F1FR 56
E	Elevation at Highest Outlet - 29.500		( ) Deluge	Size 1/2"
S	Hose Allowance - Inside - 0		( ) Preaction	K-Factor 5.6
I	Rack Sprinkler Allowance - 0		( ) Other	Temp.Rat.200
G	Hose Allowance - Outside - 100			

N Note

Calculation Flow Required - 610 Press Required - 79  
 Summary C-Factor Used: 120 Overhead 140 Underground

W	Water Flow Test:	Pump Data:	Tank or Reservoir:
A	Date of Test - 08/09/2016		Cap. -
T	Time of Test -	Rated Cap.-	Elev.-
E	Static Press - 86	@ Press -	
R	Residual Press - 82	Elev. -	Well
	Flow - 1383		Proof Flow
S	Elevation - -1		

P Location - Test Hydrant Located on Technology Park Drive 650' from Site

P Source of Information - Portland Water District

C	Commodity	Class	Location
O	Storage Ht.	Area	Aisle W.
M	Storage Method:	%	Palletized % Rack
M	( ) Single Row	( ) Conven. Pallet	( ) Auto. Storage ( ) Encap.
S	( ) Double Row	( ) Slave Pallet	( ) Solid Shelf ( ) Non
T	( ) Mult. Row		( ) Open Shelf

R K Flue Spacing Clearance:Storage to Ceiling  
 A Longitudinal Transverse

E Horizontal Barriers Provided:

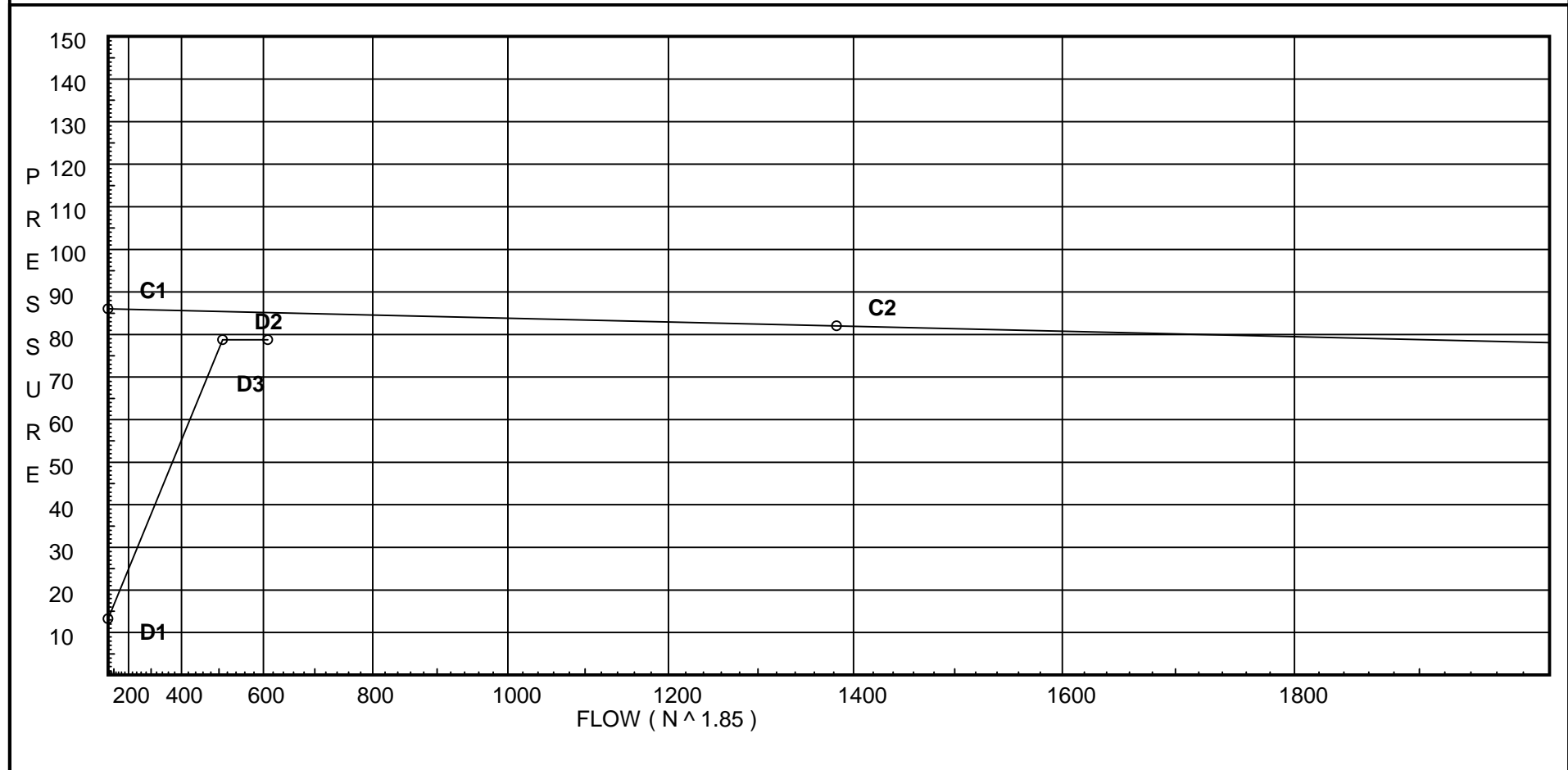
# Water Supply Curve (C)

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City Water Supply:  
C1 - Static Pressure : 86  
C2 - Residual Pressure: 82  
C2 - Residual Flow : 1383

Demand:  
D1 - Elevation : 13.210  
D2 - System Flow : 509.134  
D2 - System Pressure : 78.769  
Hose ( Demand ) : 100  
D3 - System Demand : 609.134  
Safety Margin : 6.354



# Fittings Used Summary

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Fitting Legend		½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24	
Abbrev.	Name																					
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	
F	NFPA 13 45' Elbow	1	1	1	1	2	2	3	3	3	4	5	7	9	11	13	17	19	21	24	28	
Fsp	Flow Switch Potter VSR	Fitting generates a Fixed Loss Based on Flow																				
G	NFPA 13 Gate Valve	0	0	1	1	1	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13	
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	
U	45' EII Firelock #003	0	0	0	0	0	1.8	2.2	2.6	0	3.4	4.2	5	5	0	0	0	0	0	0	0	
V	90' EII Firelock #001	0	0	0	0	3.5	3.5	4.3	5	0	6.8	8.5	10	13	0	0	0	0	0	0	0	
X	90'Tee-BranchFirelock002	0	0	0	0	8.5	8.5	10.8	13	0	16	21	25	33	0	0	0	0	0	0	0	
Zib	Wilkins 350A	Fitting generates a Fixed Loss Based on Flow																				

## Units 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.
201	30.0	5.6	8.49	na	16.32	0.1	120	7.0
202	30.0	5.6	9.57	na	17.32	0.1	120	7.0
A1	30.0		10.26	na				
203	29.5	5.6	7.0	na	14.82	0.1	72	7.0
A3	29.5		7.46	na				
204	30.0	5.6	7.49	na	15.33	0.1	72	7.0
A4	30.0		7.66	na				
205	29.5	5.6	7.34	na	15.17	0.1	72	7.0
A5	29.5		8.1	na				
A6	30.0		8.31	na				
206	30.0	5.6	8.46	na	16.29	0.1	72	7.0
A7	30.0		9.8	na				
207	29.5	5.6	9.17	na	16.96	0.1	72	7.0
208	29.5	5.6	10.32	na	17.99	0.1	72	7.0
209	29.5	5.6	9.39	na	17.16	0.1	72	7.0
210	29.5	5.6	10.57	na	18.2	0.1	72	7.0
211	29.5	5.6	9.74	na	17.47	0.1	72	7.0
212	29.5	5.6	10.95	na	18.53	0.1	72	7.0
213	29.5	5.6	9.81	na	17.54	0.1	72	7.0
214	29.5	5.6	11.04	na	18.61	0.1	72	7.0
215	29.5	5.6	11.06	na	18.62	0.1	72	7.0
216	29.5	5.6	12.43	na	19.74	0.1	72	7.0
217	29.5	5.6	12.08	na	19.46	0.1	72	7.0
218	29.5	5.6	13.56	na	20.62	0.1	72	7.0
219	29.5	5.6	11.62	na	19.09	0.1	72	7.0
220	29.5	5.6	13.05	na	20.23	0.1	72	7.0
221	29.5	5.6	11.32	na	18.84	0.1	72	7.0
222	29.5	5.6	12.71	na	19.97	0.1	72	7.0
223	29.5	5.6	12.52	na	19.82	0.1	72	7.0
224	29.5	5.6	12.68	na	19.94	0.1	72	7.0
225	29.5	5.6	10.73	na	18.35	0.1	144	7.0
226	29.5	5.6	12.06	na	19.45	0.1	144	7.0
227	29.5	5.6	10.44	na	18.1	0.1	72	7.0
228	29.5	5.6	11.74	na	19.19	0.1	72	7.0
A20	0.0		25.38	na				
A2	29.5		11.06	na				
A8	29.5		11.11	na				
A9	29.5		11.22	na				
A10	29.5		11.49	na				
A11	29.5		11.91	na				
A12	29.5		12.0	na				
A13	29.5		13.5	na				
A21	29.5		13.31	na				
A19	29.5		13.33	na				
A18	29.5		13.58	na				
A17	29.5		13.6	na				
A16	29.5		13.81	na				
A15	29.5		14.17	na				
A14	29.5		14.73	na				
Z1	29.5		17.03	na				
Z2	29.5		21.01	na				
Z3	22.5		31.59	na				
Z4	22.5		39.01	na				
Z5	22.5		45.4	na				
Z6	22.5		41.26	na				
Z7	22.5		43.67	na				
B3	22.5		48.46	na				
B4	22.5		49.92	na				
X1	22.5		50.57	na				
X2	10.5		56.95	na				
X3	10.5		59.15	na				
X4	10.5		61.24	na				
TOR	10.5		63.55	na				
BOR	4.0		69.73	na				
BASE	1.0		76.97	na				

# Flow Summary - Standard

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Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
H1	2.0		77.03	na				
H2	-1.0		78.53	na				
TEST	-1.0		78.77	na	100.0			

The maximum velocity is 29.95 and it occurs in the pipe between nodes Z1 and Z2

# 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	*****
201	16.32	1.049		0.0	12.000	8.494			K Factor = 5.60	
to		120.0		0.0	0.0	0.0				
202	16.32	0.0893		0.0	12.000	1.072			Vel = 6.06	
202	17.32	1.38	1E	3.0	4.800	9.566			K Factor = 5.60	
to		120.0		0.0	3.000	0.0				
A1	33.64	0.0896		0.0	7.800	0.699			Vel = 7.22	
A1	0.0	1.38	1T	6.0	0.500	10.265				
to		120.0		0.0	6.000	0.217				
A2	33.64	0.0895		0.0	6.500	0.582			Vel = 7.22	
	0.0									
	33.64					11.064			K Factor = 10.11	
203	14.82	1.049	1E	2.0	4.200	7.000			K Factor = 5.60	
to		120.0		0.0	2.000	0.0				
A3	14.82	0.0747		0.0	6.200	0.463			Vel = 5.50	
A3	0.0	1.049	1T	5.0	0.500	7.463				
to		120.0		0.0	5.000	-0.217				
A4	14.82	0.0747		0.0	5.500	0.411			Vel = 5.50	
	0.0									
	14.82					7.657			K Factor = 5.36	
204	15.33	1.049		0.0	2.100	7.490			K Factor = 5.60	
to		120.0		0.0	0.0	0.0				
A4	15.33	0.0795		0.0	2.100	0.167			Vel = 5.69	
A4	14.81	1.38		0.0	8.900	7.657				
to		120.0		0.0	0.0	0.0				
A6	30.14	0.0731		0.0	8.900	0.651			Vel = 6.47	
	0.0									
	30.14					8.308			K Factor = 10.46	
205	15.17	1.049	1E	2.0	7.700	7.338			K Factor = 5.60	
to		120.0		0.0	2.000	0.0				
A5	15.17	0.0780		0.0	9.700	0.757			Vel = 5.63	
A5	0.0	1.049	1T	5.0	0.500	8.095				
to		120.0		0.0	5.000	-0.217				
A6	15.17	0.0782		0.0	5.500	0.430			Vel = 5.63	
A6	30.14	1.38		0.0	1.000	8.308				
to		120.0		0.0	0.0	0.0				
206	45.31	0.1550		0.0	1.000	0.155			Vel = 9.72	
206	16.29	1.61	1E	4.0	6.300	8.463			K Factor = 5.60	
to		120.0		0.0	4.000	0.0				
A7	61.6	0.1295		0.0	10.300	1.334			Vel = 9.71	
A7	0.0	1.61	1T	8.0	0.500	9.797				
to		120.0		0.0	8.000	0.217				
A8	61.6	0.1294		0.0	8.500	1.100			Vel = 9.71	
	0.0									
	61.60					11.114			K Factor = 18.48	
207	16.96	1.049		0.0	12.000	9.169			K Factor = 5.60	
to		120.0		0.0	0.0	0.0				
208	16.96	0.0958		0.0	12.000	1.150			Vel = 6.30	

# 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	*****
208 to A9	17.99 34.95	1.38 120.0 0.0962	1T	6.0 0.0 0.0	3.400 6.000 9.400	10.319 0.0 0.904			K Factor = 5.60 Vel = 7.50	
	0.0 34.95						11.223		K Factor = 10.43	
209 to 210	17.16 17.16	1.049 120.0 0.0981		0.0 0.0 0.0	12.000 0.0 12.000	9.390 0.0 1.177			K Factor = 5.60 Vel = 6.37	
210 to A10	18.20 35.36	1.38 120.0 0.0982	1T	6.0 0.0 0.0	3.400 6.000 9.400	10.567 0.0 0.923			K Factor = 5.60 Vel = 7.58	
	0.0 35.36						11.490		K Factor = 10.43	
211 to 212	17.47 17.47	1.049 120.0 0.1014		0.0 0.0 0.0	12.000 0.0 12.000	9.736 0.0 1.217			K Factor = 5.60 Vel = 6.49	
212 to A11	18.54 36.01	1.38 120.0 0.1015	1T	6.0 0.0 0.0	3.400 6.000 9.400	10.953 0.0 0.954			K Factor = 5.60 Vel = 7.72	
	0.0 36.01						11.907		K Factor = 10.44	
213 to 214	17.54 17.54	1.049 120.0 0.1021		0.0 0.0 0.0	12.000 0.0 12.000	9.815 0.0 1.225			K Factor = 5.60 Vel = 6.51	
214 to A12	18.61 36.15	1.38 120.0 0.1023	1T	6.0 0.0 0.0	3.400 6.000 9.400	11.040 0.0 0.962			K Factor = 5.60 Vel = 7.75	
	0.0 36.15						12.002		K Factor = 10.43	
215 to 216	18.62 18.62	1.049 120.0 0.1140		0.0 0.0 0.0	12.000 0.0 12.000	11.061 0.0 1.368			K Factor = 5.60 Vel = 6.91	
216 to A13	19.75 38.37	1.38 120.0 0.1143	1T	6.0 0.0 0.0	3.400 6.000 9.400	12.429 0.0 1.074			K Factor = 5.60 Vel = 8.23	
	0.0 38.37						13.503		K Factor = 10.44	
217 to 218	19.46 19.46	1.049 120.0 0.1238		0.0 0.0 0.0	12.000 0.0 12.000	12.079 0.0 1.485			K Factor = 5.60 Vel = 7.22	
218 to A14	20.63 40.09	1.38 120.0 0.1239	1T	6.0 0.0 0.0	3.400 6.000 9.400	13.564 0.0 1.165			K Factor = 5.60 Vel = 8.60	
	0.0 40.09						14.729		K Factor = 10.45	



# 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	*****
219	19.09	1.049		0.0	12.000	11.619			K Factor = 5.60	
to		120.0		0.0	0.0	0.0				
220	19.09	0.1193		0.0	12.000	1.432			Vel = 7.09	
220	20.23	1.38	1T	6.0	3.400	13.051			K Factor = 5.60	
to		120.0		0.0	6.000	0.0				
A15	39.32	0.1196		0.0	9.400	1.124			Vel = 8.43	
	0.0									
	39.32					14.175			K Factor = 10.44	
221	18.84	1.049		0.0	12.000	11.317			K Factor = 5.60	
to		120.0		0.0	0.0	0.0				
222	18.84	0.1165		0.0	12.000	1.398			Vel = 6.99	
222	19.97	1.38	1T	6.0	3.400	12.715			K Factor = 5.60	
to		120.0		0.0	6.000	0.0				
A16	38.81	0.1166		0.0	9.400	1.096			Vel = 8.32	
	0.0									
	38.81					13.811			K Factor = 10.44	
223	19.82	1.049	1T	5.0	3.400	12.524			K Factor = 5.60	
to		120.0		0.0	5.000	0.0				
A17	19.82	0.1280		0.0	8.400	1.075			Vel = 7.36	
	0.0									
	19.82					13.599			K Factor = 5.37	
224	19.94	1.049	1T	5.0	1.900	12.682			K Factor = 5.60	
to		120.0		0.0	5.000	0.0				
A18	19.94	0.1296		0.0	6.900	0.894			Vel = 7.40	
	0.0									
	19.94					13.576			K Factor = 5.41	
225	18.35	1.049		0.0	12.000	10.732			K Factor = 5.60	
to		120.0		0.0	0.0	0.0				
226	18.35	0.1109		0.0	12.000	1.331			Vel = 6.81	
226	19.45	1.38	1T	6.0	5.400	12.063			K Factor = 5.60	
to		120.0		0.0	6.000	0.0				
A19	37.8	0.1111		0.0	11.400	1.267			Vel = 8.11	
	0.0									
	37.80					13.330			K Factor = 10.35	
227	18.10	1.049		0.0	12.000	10.442			K Factor = 5.60	
to		120.0		0.0	0.0	0.0				
228	18.1	0.1082		0.0	12.000	1.298			Vel = 6.72	
228	19.18	1.38	1E	3.0	5.000	11.740			K Factor = 5.60	
to		120.0		0.0	3.000	12.776				
A20	37.28	0.1084		0.0	8.000	0.867			Vel = 8.00	
A20	0.0	1.38	1T	6.0	0.500	25.383				
to		120.0		0.0	6.000	-12.776				
A21	37.28	0.1083		0.0	6.500	0.704			Vel = 8.00	
	0.0									
	37.28					13.311			K Factor = 10.22	

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A2 to A8	33.64	2.635 120.0 0.0038		0.0	13.200	11.064 0.0				
A8 to A9	33.64	0.0038		0.0	13.200	0.050		Vel =	1.98	
A8 to A9	61.61	2.635 120.0	1U	3.02	1.100	11.114 0.0				
A9 to A10	95.25	0.0265		0.0	4.120	0.109		Vel =	5.60	
A9 to A10	34.94	2.635 120.0		0.0	5.700	11.223 0.0				
A10 to A11	130.19	0.0468		0.0	5.700	0.267		Vel =	7.66	
A10 to A11	35.37	2.635 120.0		0.0	5.700	11.490 0.0				
A11 to A12	165.56	0.0732		0.0	5.700	0.417		Vel =	9.74	
A11 to A12	36.00	2.635 120.0		0.0	0.900	11.907 0.0				
A12 to A13	201.56	0.1056		0.0	0.900	0.095		Vel =	11.86	
A12 to A13	36.15	2.635 120.0		0.0	10.500	12.002 0.0				
A13 to Z1	237.71	0.1430		0.0	10.500	1.501		Vel =	13.99	
A13 to Z1	38.37	2.635 120.0	1X	14.827	3.900	13.503 0.0				
Z1	276.08	0.1886		0.0	18.727	3.531		Vel =	16.24	
	0.0 276.08					17.034		K Factor =	66.89	
A21 to A19	37.28	2.635 120.0		0.0	4.000	13.311 0.0				
A19 to A18	37.28	0.0048		0.0	4.000	0.019		Vel =	2.19	
A19 to A18	37.80	2.635 120.0	1U	3.02	11.500	13.330 0.0				
A18 to A17	75.08	0.0169		0.0	14.520	0.246		Vel =	4.42	
A18 to A17	19.94	2.635 120.0		0.0	0.900	13.576 0.0				
A17 to A16	95.02	0.0256		0.0	0.900	0.023		Vel =	5.59	
A17 to A16	19.82	2.635 120.0		0.0	5.700	13.599 0.0				
A16 to A15	114.84	0.0372		0.0	5.700	0.212		Vel =	6.76	
A16 to A15	38.81	2.635 120.0		0.0	5.700	13.811 0.0				
A15 to A14	153.65	0.0639		0.0	5.700	0.364		Vel =	9.04	
A15 to A14	39.32	2.635 120.0		0.0	5.700	14.175 0.0				
A14 to Z1	192.97	0.0972		0.0	5.700	0.554		Vel =	11.35	
A14 to Z1	40.08	2.635 120.0	1X	14.827	1.900	14.729 0.0				
Z1	233.05	0.1378		0.0	16.727	2.305		Vel =	13.71	
	0.0									

# Final Calculations - Hazen-Williams

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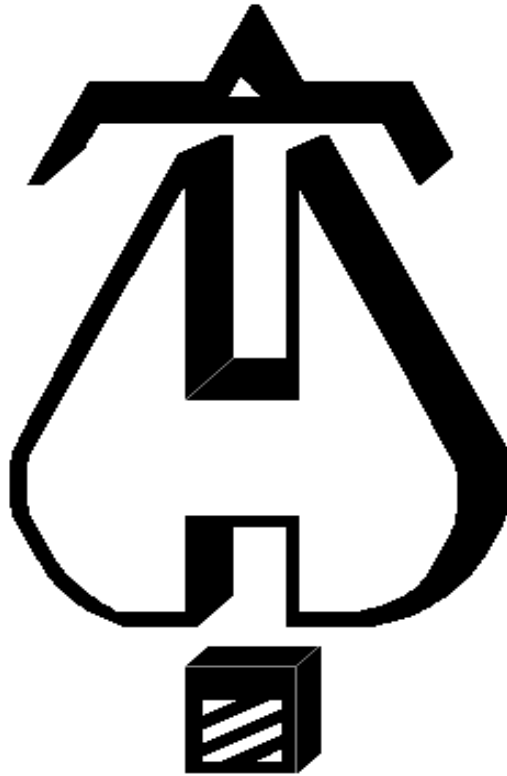
Hyd. Ref. Point	Qa Qt	Dia. "C" Pf/Ft	Fitting or Eqv.	Ln.	Pipe Ftng's Total	Pt Pe Pf	Pt Pv Pn	*****	Notes	*****
	233.05					17.034			K Factor = 56.47	
Z1 to Z2	509.13	2.635 120.0	1V	5.903	0.900	17.034 0.0				
	509.13	0.5849		0.0	6.803	3.979			Vel = 29.95	
Z2 to Z3	0.0	2.635 120.0	1V	5.903	7.000	21.013 3.032				
	509.13	0.5849		0.0	12.903	7.547			Vel = 29.95	
Z3 to Z4	0.0	3.26 120.0	1X	17.471	18.300	31.592 0.0				
	509.13	0.2074		0.0	35.771	7.420			Vel = 19.57	
Z4 to Z5	-198.72	3.26 120.0	1U 1V	3.494	66.700	39.012 0.0				
	310.41	0.0831		0.0	76.914	6.388			Vel = 11.93	
Z5 to B4	0.0	3.26 120.0	1X	17.471	36.900	45.400 0.0				
	310.41	0.0831		0.0	54.371	4.516			Vel = 11.93	
	0.0 310.41					49.916			K Factor = 43.94	
Z4 to Z6	198.72	3.26 120.0	1U 1V	3.494	51.500	39.012 0.0				
	198.72	0.0364		0.0	61.714	2.246			Vel = 7.64	
Z6 to Z7	0.0	3.26 120.0	1U 1V	3.494	56.000	41.258 0.0				
	198.72	0.0364		0.0	66.214	2.410			Vel = 7.64	
Z7 to B3	0.0	3.26 120.0	2U 1V	6.989	117.900	43.668 0.0				
	198.72	0.0364		0.0	131.609	4.790			Vel = 7.64	
B3 to B4	0.0	3.26 120.0	1U 1X	3.494	19.100	48.458 0.0				
	198.72	0.0364		0.0	40.065	1.458			Vel = 7.64	
	0.0 198.72					49.916			K Factor = 28.13	
B4 to X1	509.13	4.26 120.0	1V	8.954	2.700	49.916 0.0				
	509.13	0.0564		0.0	11.654	0.657			Vel = 11.46	
X1 to X2	0.0	4.26 120.0	1V	8.954	12.000	50.573 5.197				
	509.13	0.0564		0.0	20.954	1.182			Vel = 11.46	
X2 to X3	0.0	4.26 120.0	1X	21.067	18.000	56.952 0.0				
	509.13	0.0564		0.0	39.067	2.202			Vel = 11.46	
X3 to X4	0.0	4.26 120.0	1X	21.067	15.900	59.154 0.0				
	509.13	0.0564		0.0	36.967	2.084			Vel = 11.46	
X4 to TOR	0.0	4.26 120.0	1X 1V	21.067	11.000	61.238 0.0				
	509.13	0.0564		0.0	41.021	2.312			Vel = 11.46	

# Final Calculations - Hazen-Williams

High Tech Fire Protection  
Clerestory Calc.

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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	*****
TOR to BOR	0.0 509.13	4.26 120.0 0.0565	1Fsp 0.0 0.0	6.500 0.0 6.500	63.550 5.815 0.367		* Fixed loss = 3 Vel = 11.46		
BOR to BASE	0.0 509.13	4.26 120.0 0.0563	1Zib 0.0 0.0	3.000 0.0 3.000	69.732 7.071 0.169		* Fixed loss = 5.772 Vel = 11.46		
BASE to H1	0.0 509.13	8.27 140.0 0.0017	1E 28.468 2F 28.468 1G 6.326 1T 55.354	175.000 118.616 293.616	76.972 -0.433 0.492		Vel = 3.04		
H1 to H2	0.0 509.13	12.34 140.0 0.0002	4F 81.265 1T 93.767 0.0	650.000 175.032 825.032	77.031 1.299 0.197		Vel = 1.37		
H2 to TEST	0.0 509.13	6.16 140.0 0.0070	1E 20.084 1G 4.304 0.0	10.000 24.388 34.388	78.527 0.0 0.242		Vel = 5.48		
	100.00 609.13				78.769		Qa = 100.00 K Factor = 68.63		



... **Fire Protection by Computer Design**

High Tech Fire Protection  
PO Box 156  
Minot, ME 04258  
(207) 998-2551

Job Name : Work Stations Above Ceiling Calc.  
Building : Patrons Oxford Offices  
Location : 97 Technology Park Drive  
System : NFPA 13  
Contract : 020416-1  
Data File : Work Stations Above Ceiling Calc.wxf

Hydraulic Design Information Sheet

Name - Work Stations Above Ceiling Calc. Date - 10/31/2016  
 Location - 97 Technology Park Drive  
 Building - Patrons Oxford Offices System No. - NFPA 13  
 Contractor - High Tech Fire Protection Contract No. - 020416-1  
 Calculated By - Jeremy A Foss Drawing No. - FP-1.2  
 Construction: (X) Combustible ( ) Non-Combustible Ceiling Height - 9'-8"  
 Occupancy - Office Space

S (X) NFPA 13 (X) Lt. Haz. Ord.Haz.Gp. ( ) 1 ( ) 2 ( ) 3 ( ) Ex.Haz.  
 Y ( ) NFPA 231 ( ) NFPA 231C ( ) Figure Curve

S Other

T Specific Ruling Made By Date

	Area	Density	System Type	Make
M	Area of Sprinkler Operation - 1,000		Sprinkler/Nozzle	
	Density - .1		(X) Wet	Make Reliable
D	Area Per Sprinkler - 196		( ) Dry	Model KFR-CCS 56
E	Elevation at Highest Outlet - 22.500		( ) Deluge	Size 1/2"
S	Hose Allowance - Inside - 0		( ) Preaction	K-Factor 5.6
I	Rack Sprinkler Allowance - 0		( ) Other	Temp.Rat.212
G	Hose Allowance - Outside - 100			

N Note

Calculation Flow Required - 366 Press Required - 62  
 Summary C-Factor Used: 120 Overhead 140 Underground

W	Water Flow Test:	Pump Data:	Tank or Reservoir:
A	Date of Test - 08/09/2016		Cap. -
T	Time of Test -	Rated Cap.-	Elev.-
E	Static Press - 86	@ Press -	
R	Residual Press - 82	Elev. -	Well
	Flow - 1383		Proof Flow
S	Elevation - -1		

P Location - Test Hydrant Located on Technology Park Drive 650' from Site

P Source of Information - Portland Water District

C	Commodity	Class	Location
O	Storage Ht.	Area	Aisle W.
M	Storage Method:	%	Palletized % Rack
M	( ) Single Row	( ) Conven. Pallet	( ) Auto. Storage ( ) Encap.
S	( ) Double Row	( ) Slave Pallet	( ) Solid Shelf ( ) Non
T	( ) Mult. Row		( ) Open Shelf

R K Flue Spacing Clearance:Storage to Ceiling  
 A Longitudinal Transverse

E Horizontal Barriers Provided:

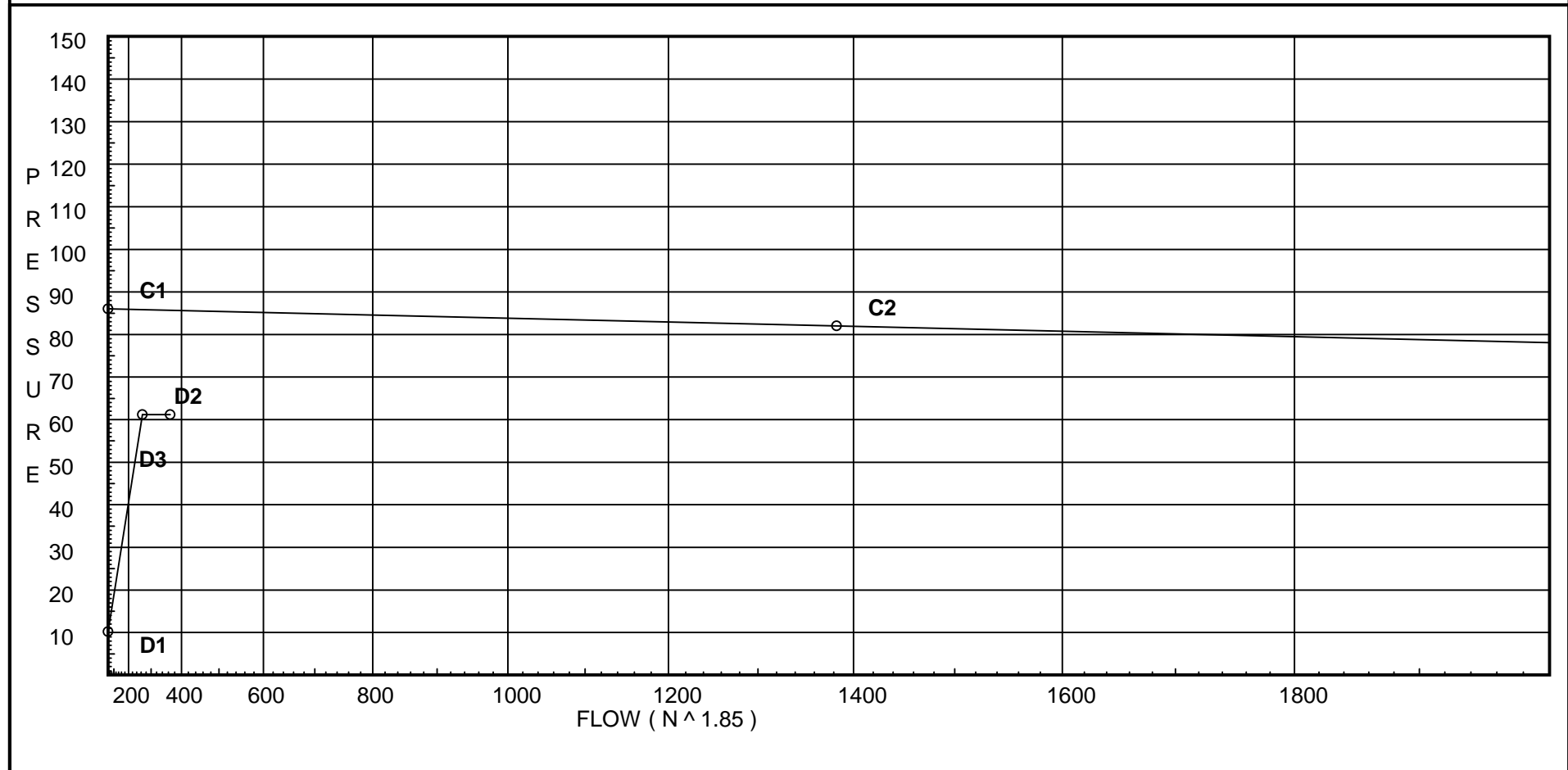
# Water Supply Curve (C)

High Tech Fire Protection  
Work Stations Above Ceiling Calc.

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City Water Supply:  
C1 - Static Pressure : 86  
C2 - Residual Pressure: 82  
C2 - Residual Flow : 1383

Demand:  
D1 - Elevation : 10.178  
D2 - System Flow : 265.894  
D2 - System Pressure : 61.151  
Hose ( Demand ) : 100  
D3 - System Demand : 365.894  
Safety Margin : 24.507



# Fittings Used Summary

High Tech Fire Protection  
Work Stations Above Ceiling Calc.

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Fitting Legend		½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
Abbrev.	Name																				
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
F	NFPA 13 45' Elbow	1	1	1	1	2	2	3	3	3	4	5	7	9	11	13	17	19	21	24	28
Fsp	Flow Switch Potter VSR	Fitting generates a Fixed Loss Based on Flow																			
G	NFPA 13 Gate Valve	0	0	1	1	1	1	1	1	1	2	2	3	4	5	6	7	8	10	11	13
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
U	45' EII Firelock #003	0	0	0	0	0	1.8	2.2	2.6	0	3.4	4.2	5	5	0	0	0	0	0	0	0
V	90' EII Firelock #001	0	0	0	0	3.5	3.5	4.3	5	0	6.8	8.5	10	13	0	0	0	0	0	0	0
X	90'Tee-BranchFirelock002	0	0	0	0	8.5	8.5	10.8	13	0	16	21	25	33	0	0	0	0	0	0	0
Zib	Wilkins 350A	Fitting generates a Fixed Loss Based on Flow																			

## Units 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

High Tech Fire Protection  
Work Stations Above Ceiling Calc.

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Node No.	Elevation	K-Fact	Pt Actual	Pn	Flow Actual	Density	Area	Press Req.
DP1	1.0	5.6	12.25	na	19.6	0.1	196	7.0
DP2	1.0	5.6	12.25	na	19.6	0.1	196	7.0
401	22.5	K = K @ EQ01	14.12	na	19.6			
402	22.5	K = K @ EQ02	15.63	na	20.35			
403	22.5	K = K @ EQ02	21.24	na	23.72			
405	22.5	K = K @ EQ01	15.72	na	20.68			
404	22.5	K = K @ EQ02	16.76	na	21.07			
B1	22.5		23.87	na				
406	22.5	K = K @ EQ02	38.88	na	32.09			
407	22.5	K = K @ EQ02	38.84	na	32.08			
408	22.5	K = K @ EQ02	38.83	na	32.07			
409	22.5	K = K @ EQ02	38.83	na	32.08			
B2	22.5		38.84	na				
410	22.5	K = K @ EQ02	39.02	na	32.15			
B3	22.5		40.31	na				
Z7	22.5		39.3	na				
Z6	22.5		39.87	na				
Z4	22.5		40.34	na				
Z5	22.5		41.0	na				
B4	22.5		41.46	na				
X1	22.5		41.66	na				
X2	10.5		47.21	na				
X3	10.5		47.88	na				
X4	10.5		48.5	na				
TOR	10.5		49.2	na				
BOR	4.0		55.12	na				
BASE	1.0		60.01	na				
H1	2.0		59.72	na				
H2	-1.0		61.08	na				
TEST	-1.0		61.15	na	100.0			

The maximum velocity is 22.61 and it occurs in the pipe between nodes B1 and B2

# Final Calculations - Hazen-Williams

High Tech Fire Protection  
Work Stations Above Ceiling Calc.

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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	*****
DP1 to EQ01	19.60 19.6	1.049 120.0 0.1254	2E 1T	4.0 5.0 0.0	2.500 9.000 11.500	12.250 0.433 1.442		K Factor = 5.60		
	0.0 19.60						14.125		K Factor = 5.22	
DP2 to EQ02	19.60 19.6	1.049 120.0 0.1254	1E 2T	2.0 10.0 0.0	2.500 12.000 14.500	12.250 0.433 1.818		K Factor = 5.60		
	0.0 19.60						14.501		K Factor = 5.15	
401 to 402	19.60 19.6	1.049 120.0 0.1253		0.0 0.0 0.0	12.000 0.0 12.000	14.125 0.0 1.504		K Factor @ node EQ01		Vel = 7.28
402 to 403	20.35 39.95	1.049 120.0 0.4680		0.0 0.0 0.0	12.000 0.0 12.000	15.629 0.0 5.616		K Factor @ node EQ02		Vel = 14.83
403 to B1	23.72 63.67	1.38 120.0 0.2916	1T	6.0 0.0 0.0	3.000 6.000 9.000	21.245 0.0 2.624		K Factor @ node EQ02		Vel = 13.66
	0.0 63.67						23.869		K Factor = 13.03	
405 to 404	20.68 20.68	1.049 120.0 0.1384		0.0 0.0 0.0	7.500 0.0 7.500	15.722 0.0 1.038		K Factor @ node EQ01		Vel = 7.68
404 to B1	21.07 41.75	1.049 120.0 0.5078	1T	5.0 0.0 0.0	9.000 5.000 14.000	16.760 0.0 7.109		K Factor @ node EQ02		Vel = 15.50
B1 to B2	63.67 105.42	1.38 120.0 0.7411	1T	6.0 0.0 0.0	14.200 6.000 20.200	23.869 0.0 14.970				Vel = 22.61
	0.0 105.42						38.839		K Factor = 16.92	
406 to 407	-58.91 -58.91	3.26 120.0 -0.0039		0.0 0.0 0.0	8.000 0.0 8.000	38.875 0.0 -0.031		K Factor @ node EQ02		Vel = 2.26
407 to 408	32.08 -26.83	3.26 120.0 -0.0008		0.0 0.0 0.0	12.000 0.0 12.000	38.844 0.0 -0.010		K Factor @ node EQ02		Vel = 1.03
408 to 409	32.07 5.24	3.26 120.0 0.0		0.0 0.0 0.0	12.000 0.0 12.000	38.834 0.0 0.0		K Factor @ node EQ02		Vel = 0.20
409 to B2	32.08 37.32	3.26 120.0 0.0017		0.0 0.0 0.0	3.000 0.0 3.000	38.834 0.0 0.005		K Factor @ node EQ02		Vel = 1.43
B2 to 410	105.42 142.74	3.26 120.0 0.0198		0.0 0.0 0.0	9.000 0.0 9.000	38.839 0.0 0.178				Vel = 5.49

# Final Calculations - Hazen-Williams

High Tech Fire Protection  
Work Stations Above Ceiling Calc.

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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	*****
410 to B3	32.15 174.89	3.26 120.0 0.0287	1U 1V	3.494 6.72 0.0	34.900 10.214 45.114	39.017 0.0 1.296		K Factor @ node EQ02		
B3 to B4	0.0 174.89	3.26 120.0 0.0287	1U 1X	3.494 17.471 0.0	19.100 20.965 40.065	40.313 0.0 1.151		Vel = 6.72		
	0.0 174.89					41.464		K Factor = 27.16		
406 to Z7	91.01 91.01	3.26 120.0 0.0086	1U 1V	3.494 6.72 0.0	39.000 10.214 49.214	38.875 0.0 0.422		Vel = 3.50		
Z7 to Z6	0.0 91.01	3.26 120.0 0.0086	1U 1V	3.494 6.72 0.0	56.000 10.214 66.214	39.297 0.0 0.569		Vel = 3.50		
Z6 to Z4	0.0 91.01	3.26 120.0 0.0086	1U	3.494 0.0 0.0	51.500 3.494 54.994	39.866 0.0 0.472		Vel = 3.50		
Z4 to Z5	0.0 91.01	3.26 120.0 0.0086	1U 1V	3.494 6.72 0.0	66.700 10.214 76.914	40.338 0.0 0.660		Vel = 3.50		
Z5 to B4	0.0 91.01	3.26 120.0 0.0086	1X	17.471 0.0 0.0	36.900 17.471 54.371	40.998 0.0 0.466		Vel = 3.50		
	0.0 91.01					41.464		K Factor = 14.13		
B4 to X1	265.89 265.89	4.26 120.0 0.0170	1V	8.954 0.0 0.0	2.700 8.954 11.654	41.464 0.0 0.198		Vel = 5.99		
X1 to X2	0.0 265.89	4.26 120.0 0.0169	1V	8.954 0.0 0.0	12.000 8.954 20.954	41.662 5.197 0.355		Vel = 5.99		
X2 to X3	0.0 265.89	4.26 120.0 0.0169	1X	21.067 0.0 0.0	18.000 21.067 39.067	47.214 0.0 0.662		Vel = 5.99		
X3 to X4	0.0 265.89	4.26 120.0 0.0170	1X	21.067 0.0 0.0	15.900 21.067 36.967	47.876 0.0 0.627		Vel = 5.99		
X4 to TOR	0.0 265.89	4.26 120.0 0.0169	1X 1V	21.067 8.954 0.0	11.000 30.021 41.021	48.503 0.0 0.695		Vel = 5.99		
TOR to BOR	0.0 265.89	4.26 120.0 0.0169	1Fsp	0.0 0.0 0.0	6.500 0.0 6.500	49.198 5.815 0.110		* Fixed loss = 3 Vel = 5.99		
BOR to BASE	0.0 265.89	4.26 120.0 0.0170	1Zib	0.0 0.0 0.0	3.000 0.0 3.000	55.123 4.831 0.051		* Fixed loss = 3.532 Vel = 5.99		

# Final Calculations - Hazen-Williams

High Tech Fire Protection  
Work Stations Above Ceiling Calc.

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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	*****
BASE to H1	0.0 265.89	8.27 140.0 0.0005	1E 2F 1G 1T	28.468 28.468 6.326 55.354	175.000 118.616 293.616	60.005 -0.433 0.148		Vel = 1.59	
H1 to H2	0.0 265.89	12.34 140.0 0.0001	4F 1T	81.265 93.767	650.000 175.032	59.720 1.299		Vel = 0.71	
H2 to TEST	0.0 265.89	6.16 140.0 0.0021	1E 1G	20.084 4.304	10.000 24.388	61.079 0.0		Vel = 2.86	
	100.00 365.89					61.151		Qa = 100.00 K Factor = 46.79	