Fire and Life Safety Analysis of Cal Poly Engineering IV, Business in Amarillo, TX and Costco

FPE 596

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Keywords: Performance-based, Prescribed, NFPA, IBC, Calculation, Calculate, Code

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Introduction

The main fire protection disciplines - Egress Analysis and Design, Fire Detection, Alarm and Communication Systems, Water-based Fire Suppression Systems and Structural Fire Protection - are covered in this report.

For Egress Analysis and Design, the California Polytechnic State University's Engineering IV building was analyzed and covered in the first portion of this report. The building was analyzed against the 2015 edition of NFPA 101 and the 2015 edition of the International Building Code. It is a typical university engineering building with classrooms, professors' offices and some laboratories. The occupancies, the occupant load, exit widths, exit lengths and number of exits were all reviewed against the code requirements. The building mostly met the code requirements. Then, the information used for the prescribed requirements was used to calculate the egress times from the facility to find it had acceptable times to evacuate.

The California Polytechnic State University's Engineering IV building was also reviewed for the Structural Fire Protection requirements. The structure was reviewed against the code of record for the facility which is the 2000 edition of the International Building Code and the 2001 edition of the California Fire Code. The building was constructed as a Type II-A facility which meets the code requirements for this type of facility and the required fire barriers were in the correct locations to delay and/contain fire spread to allow safe egress from the facility. Then, the fire resistance time was calculated to determine if the construction met the required fire resistant time for the facility. The way the building was constructed exceeded the required fire resistant time.

A warehouse facility in Amarillo, TX was analyzed for Fire Detection, Alarm and Communication System requirements. The facility was reviewed against the requirements in current editions of NFPA 72, NFPA 90A and NFPA 101. Most of the facility met the prescribed requirements in the codes but a couple of areas did not. Then, the activation time of the sprinklers was calculated and the performance of the horns and strobes was calculated to see if the current locations met the performance-based requirements. There were a couple of areas that met the prescribed code requirements but would not meet the performance-

based requirements, as well as, areas that would need slight adjustments to meet the performance-based requirements.

For the Water-based Fire Suppression Systems analysis, a suppression system was designed for a Costco to meet the requirements from the 2013 edition of NFPA 13 with the water supply given since there wasn't a current suppression system design. Then, the information from the Costco was used to calculate the egress time from the facility. The calculated egress time was compared to the smoke and temperature levels at head height to determine if the occupants would have enough time to egress safely for three different fire scenarios. For all three scenarios, the smoke level reach head height at the exits before the facility was completely evacuated.

Egress Analysis and Design

Purpose

The purpose of this analysis is to evaluate California Polytechnic State University's Engineering IV building's egress design and occupant loads against the 2015 Life Safety Code (NFPA 101) and 2015 International Building Code (IBC).

Background

The Engineering IV building construction drawings were plotted on July 23rd, 2007. It is entirely new construction. It is a three-story teaching and research laboratory building with two elevators, three exterior stairwells and one interior stairwell. The building is constructed of steel brace frames, concrete filled metal decks. The exterior walls are constructed of steel stud frame walls faced with fiber reinforced cementitious panel and metal panel siding. The roof is modified bituminous membrane roof on rigid insulation.

Classification of Construction

Engineering IV is a three-story structure, standing 56 ft. tall and is constructed of Type II (fire resistant) construction, according to the drawings from Table 6A from the CFC. The structural frame (columns and primary floor beams), floor decks and secondary beams at floors have a fire resistance rating of 2-hours. The roof deck has a fire resistance rating of 1-hour. The secondary beams at the roof have a fire resistance rating 1 ½-hours. The primary beams at the roof have a fire resistance rating of 2 ½-hours. The roof beams are sprayed with an extra amount of lightweight concrete in addition to the insulation already installed to get an extra ½ hour fire resistance. Exterior doors and windows need to be protected if the spacing from the property line is less than 20 ft.

According to the drawings the construction of Engineering IV is to be four-stories or less, to be a height equal to or less than 160 ft. and is required to be Type II construction with an automatic fire suppression system throughout. To meet these construction requirements the exterior bearing walls, interior bearing walls, structural frame, shaft enclosures floor and floor/ceilings are required to have a 2-hour fire resistance rating. To achieve the 2-hour rating, all structural steel and decking are covered with lightweight concrete with a thickness to meet a 2-hour rating. The exterior nonbearing walls, permanent partitions and roof and roof/ceilings are required to have a 1-hour fire resistance rating. To achieve the 1-hour rating, all structural steel and decking are covered with lightweight concrete with a thickness to meet a 1-hour rating, and the permanent partitions are constructed of one layer on each side of Type ‘X’ 5/8” gypsum board or two layers on each side of Type ‘X’ 5/8” gypsum board with fiberglass batting insulation (plenum rated) to meet at least a 1-hour rating. A-3 occupancies have a maximum floor area requirement of 29,000 ft.² with an allowance to double that area for multistory and an allowance to double the basic floor area and multistory allowance for three 60 ft. separation sideyards for a total floor area requirement of 119,600 ft.² and B occupancy have a maximum floor area requirement of 39,900 ft.² with an allowance to double that area for multistory and an allowance to double the basic floor area and multistory allowance for three 60 ft. separation sideyards for a total floor area requirement of 159,600 ft.².

Code Requirements

The occupant loads for this facility is to be calculated using Table 1004.1.2 from the 2015 IBC and Table 7.3.1.2 from the 2015 NFPA 101. Table A.7.6 *Common Path, Dead-End, and Travel Distance Limits* was used to calculate the common path, dead-end and travel distances and shown in Table 1 of this report as well as the exit width requirements in Table 2.

Table 1: NFPA 101 Table A.7.6 Exit Limits

NFPA 101 Table A.7.6									
	Common Path Limit			**Dead-End Limit**			**Travel Distance Limit**		
	Code	Actual	Location	Code	Actual	Location	Code	Actual	Location
Business	100 ft	73.92 ft	1st floor northwest corner in office area	50 ft	73.92 ft	1st floor northeast corner in office area	300 ft	73.92 ft	1st floor northeast corner in office area
Storage	100 ft	33.5 ft	Room 117 and 119	100 ft	33.5 ft	Rooms 117 and 119	400 ft	33.5 ft	Rooms 117 and 119
Assembly	20/75 ft*	51.67 ft	Room 223C 11 people < 50 people	20 ft	0 ft	Nowhere	250 ft	58.63 ft	Room 304
Industrial	100 ft	25 ft	Room 114	50 ft	0 ft	Nowhere	250 ft	7 ft	Rooms 215 and 315
*For common path serving >50 persons, 20 ft (6.1m); for common path serving ≤50 persons, 75 ft (23 m)									
Exit	That portion of a means of egress that is separated from all other spaces of the building or structure by construction, location or equipment as required to provide a protected way of travel to the exit discharge.								
Common Path of Travel	The portion of exit access that must be traversed before two separate and distinct paths of travel to two exits are available.								
Travel Distance Termination	Point at which the exit begins.								
7.1.3.2 Exit (1)	The separation shall have a minimum 1-hour fire resistance rating where the exit connects three or fewer stories.								

Table 2: NFPA 101 Table 7.3.3.1 Exit Widths

NFPA 101 Table 7.3.3.1					
	Occupant Load	Stairways Capacity Factor	Required width	Level Components and Ramps Capacity Factor	Required width
1st Floor	752	0.3 in/person	225.6 in	0.2 in/person	150.4 in
2nd Floor	506	0.3 in/person	151.8 in	0.2 in/person	101.2 in
3rd Floor	358	0.3 in/person	107.4 in	0.2 in/person	71.6 in
	Stair #1 Widths	Stair #2 Widths	Stair #3 Widths	Stair #4 Widths	Total Stair Width
1st Floor	66 in	66 in	83 in	66 in	Not Required
2nd Floor	66 in	66 in	68 in	66 in	198 in
3rd Floor	66 in		81 in	66 in	132 in
	Exit Widths				
1st Floor	577.96 in				
2nd Floor	Drawings do not show door opening dimensions at the bottom of the stairwells.				
3rd Floor	Drawings do not show door opening dimensions at the bottom of the stairwells.				

The occupant loads were calculated per IBC and are shown in Tables 3 through 6 and Figures 1 through 6 below.

Table 3: First Floor Occupant Load per IBC

Room #	Square footage		Occupancy Classification	Load Factor	Occupancy Load		Business (B) 50 ft²/person	Business (B) 100 ft²/person	Business (B) fixed seating	Storage (S-2)	Assembly (A-3)	Industrial (U)	Bathroom
1st Floor													
101	1,779	ft²	Business (B)	50 ft²/person	36	people	36						
102	3,389	ft²	Business (B)	50 ft²/person	68	people	68						
102A	450	ft²	Storage (S-2)	500 ft²/person	1	person				1			
102B	312	ft²	Business (B)	100 ft²/person	3	people		3					
102C	Part of 102B												
103A	419	ft²	Business (B)	100 ft²/person	4	people		4					
104	930	ft²	Business (B)	50 ft²/person	19	people	19						
105	2,513	ft²	Business (B)	50 ft²/person	50	people	50						
105A	Part of 105												
105B	Part of 105												
105C	Part of 105												
106	3,504	ft²	Assembly (A-3)	15 ft²/person	234	people					234		
107			Industrial (U)	100 ft²/person	1	person						1	
108			Storage (S-2)	500 ft²/person	1	person				1			
109			Industrial (U)	100 ft²/person	1	person						1	
110			Industrial (U)	100 ft²/person	1	person						1	
111			Industrial (U)	100 ft²/person	1	person						1	
112			Bathroom		12	people							12
113			Bathroom		12	people							12
114			Industrial (U)	100 ft²/person	1	person						1	
115	533	ft²	Business (B)	100 ft²/person	5	people		5					
116	1,188	ft²	Business (B)	50 ft²/person	24	people	24						
117	313	ft²	Storage (S-2)	500 ft²/person	1	person				1			
118	1,188	ft²	Business (B)	50 ft²/person	24	people	24						
119	313	ft²	Storage (S-2)	500 ft²/person	1	person				1			
120	1,353	ft²	Business (B)	50 ft²/person	27	people	27						
121	1,188	ft²	Business (B)	50 ft²/person	24	people	24						
122	121	ft²	Business (B)	100 ft²/person	1	person		1					
123	125	ft²	Business (B)	100 ft²/person	1	person		1					
124	122	ft²	Business (B)	100 ft²/person	1	person		1					
125	125	ft²	Business (B)	100 ft²/person	1	person		1					
126	127	ft²	Business (B)	100 ft²/person	1	person		1					
127	125	ft²	Business (B)	100 ft²/person	1	person		1					
128	121	ft²	Business (B)	100 ft²/person	1	person		1					
129	122	ft²	Business (B)	100 ft²/person	1	person		1					
130	2,835	ft²	Business (B)	50 ft²/person	57	people	57						
131	1,404	ft²	Business (B)	50 ft²/person	28	people	28						
132	982	ft²	Business (B)	50 ft²/person	20	people	20						
133	422	ft²	Business (B)	50 ft²/person	8	people	8						
134	1,312	ft²	Business (B)	50 ft²/person	26	people	26						
135	1,216	ft²	Business (B)	50 ft²/person	24	people	24						
136	1,477	ft²	Business (B)	50 ft²/person	30	people	30						
							465	20	0	4	234	5	24

465	20	0	4	234	5	24	**752**	**Total Occupant Load for 1st Floor**

Table 4: Second Floor Occupant Load per IBC

2nd Floor													
201	294	ft²	Business (B)	100 ft²/person	3	people		3					
202	209	ft²	Business (B)	100 ft²/person	2	people		2					
203	734	ft²	Business (B)	100 ft²/person	7	people		7					
204	859	ft²	Business (B)	50 ft²/person	17	people	17						
205	1,418	ft²	Business (B)	50 ft²/person	28	people	28						
206	1,107	ft²	Business (B)	50 ft²/person	22	people	22						
208	1,964	ft²	Business (B)	50 ft²/person	39	people	39						
209	1,995	ft²	Business (B)	50 ft²/person	40	people	40						
210	175	ft²	Business (B)	100 ft²/person	2	people		2					
211	390	ft²	Business (B)	100 ft²/person	4	people		4					
212	643	ft²	Business (B)	50 ft²/person	13	people	13						
213			Storage (S-2)	500 ft²/person	1	person				1			
214			Industrial (U)	100 ft²/person	1	person						1	
215			Industrial (U)	100 ft²/person	1	person						1	
216			Bathroom		12	people							12
217			Bathroom		12	people							12
218			Storage (S-2)	500 ft²/person	1	person				1			
219	356	ft²	Business (B)	100 ft²/person	4	people		4					
220	2,013	ft²	Business (B)	50 ft²/person	40	people	40						
221	1,039	ft²	Business (B)	50 ft²/person	21	people	21						
222	726	ft²	Business (B)	50 ft²/person	15	people	15						
223	700	ft²	Business (B)	100 ft²/person	7	people		7					
223A			Business (B)	100 ft²/person	1	person		1					
223B			Business (B)	100 ft²/person	1	person		1					
223C	158	ft²	Assembly (A-3)	15 ft²/person	11	people					11		
223D			Storage (S-2)	500 ft²/person	1	person				1			
224	660	ft²	Business (B)	Fixed seating	33	people			33				
225	264	ft²	Business (B)	100 ft²/person	3	people		3					
226	121	ft²	Business (B)	100 ft²/person	1	person		1					
227	125	ft²	Business (B)	100 ft²/person	1	person		1					
228	125	ft²	Business (B)	100 ft²/person	1	person		1					
229	125	ft²	Business (B)	100 ft²/person	1	person		1					
230	127	ft²	Business (B)	100 ft²/person	1	person		1					
231	125	ft²	Business (B)	100 ft²/person	1	person		1					
232	121	ft²	Business (B)	100 ft²/person	1	person		1					
233	122	ft²	Business (B)	100 ft²/person	1	person		1					
234	147	ft²	Business (B)	100 ft²/person	1	person		1					
235	147	ft²	Business (B)	100 ft²/person	1	person		1					
236	147	ft²	Business (B)	100 ft²/person	1	person		1					
237	1,006	ft²	Business (B)	50 ft²/person	20	people	20						
238	594	ft²	Business (B)	50 ft²/person	12	people	12						
239	1,145	ft²	Business (B)	50 ft²/person	23	people	23						
240	1,173	ft²	Business (B)	50 ft²/person	23	people	23						
241	2,361	ft²	Business (B)	50 ft²/person	47	people	47						
242	634	ft²	Business (B)	Fixed seating	28	people			28				
							360	45	61	3	11	2	24

360	45	61	3	11	2	24	**506**	**Total Occupant Load for 2nd Floor**

Table 5: Third Floor Occupant Load per IBC

3rd Floor													
301	567	ft²	Business (B)	100 ft²/person	6	people		6					
302	231	ft²	Business (B)	100 ft²/person	2	people		2					
303	187	ft²	Business (B)	100 ft²/person	2	people		2					
304	185	ft²	Assembly (A-3)	15 ft²/person	12	people					12		
305	196	ft²	Business (B)	100 ft²/person	2	people		2					
306	213	ft²	Business (B)	100 ft²/person	2	people		2					
307	233	ft²	Assembly (A-3)	15 ft²/person	16	people					16		
308	322	ft²	Business (B)	100 ft²/person	3	people		3					
309	205	ft²	Business (B)	100 ft²/person	2	people		2					
310	504	ft²	Assembly (A-3)	15 ft²/person	34	people					34		
311	170	ft²	Business (B)	100 ft²/person	2	people		2					
312	195	ft²	Business (B)	100 ft²/person	2	people		2					
313			Storage (S-2)	500 ft²/person	1	person				1			
314			Industrial (U)	100 ft²/person	1	person						1	
315			Industrial (U)	100 ft²/person	1	person						1	
316			Bathroom		12	people							12
317			Bathroom		12	people							12
318			Storage (S-2)	500 ft²/person	1	person				1			
319			Storage (S-2)	500 ft²/person	1	person				1			
320	507	ft²	Business (B)	100 ft²/person	5	people		5					
321	1,273	ft²	Business (B)	50 ft²/person	25	people	25						
322	1,273	ft²	Business (B)	50 ft²/person	25	people	25						
323	1,782	ft²	Business (B)	50 ft²/person	36	people	36						
324	147	ft²	Business (B)	100 ft²/person	1	people		1					
325	147	ft²	Business (B)	100 ft²/person	1	people		1					
326	147	ft²	Business (B)	100 ft²/person	1	people		1					
327	1,781	ft²	Business (B)	50 ft²/person	36	people	36						
328	886	ft²	Business (B)	50 ft²/person	18	people	18						
329	1,144	ft²	Business (B)	50 ft²/person	23	people	23						
330	1,121	ft²	Business (B)	50 ft²/person	22	people	22						
331	755	ft²	Business (B)	Fixed seating	33	people			33				
332	521	ft²	Business (B)	50 ft²/person	10	people	10						
333	422	ft²	Business (B)	50 ft²/person	8	people	8						
							203	31	33	3	62	2	24

203	31	33	3	62	2	24	**358**	**Total Occupant Load for 3rd Floor**

Table 6: Color Coding and Total Occupant Load for the Building

									1616	**Total Occupant Load for Building**		
Color Codes	Business (B) 50 ft²/person	Business (B) 100 ft²/person	Business (B) fixed seating	Storage (S-2)	Assembly (A-3)	Industrial (U)	Bathroom	Exit				

Figure 1: East Half of the First Floor Occupant Load

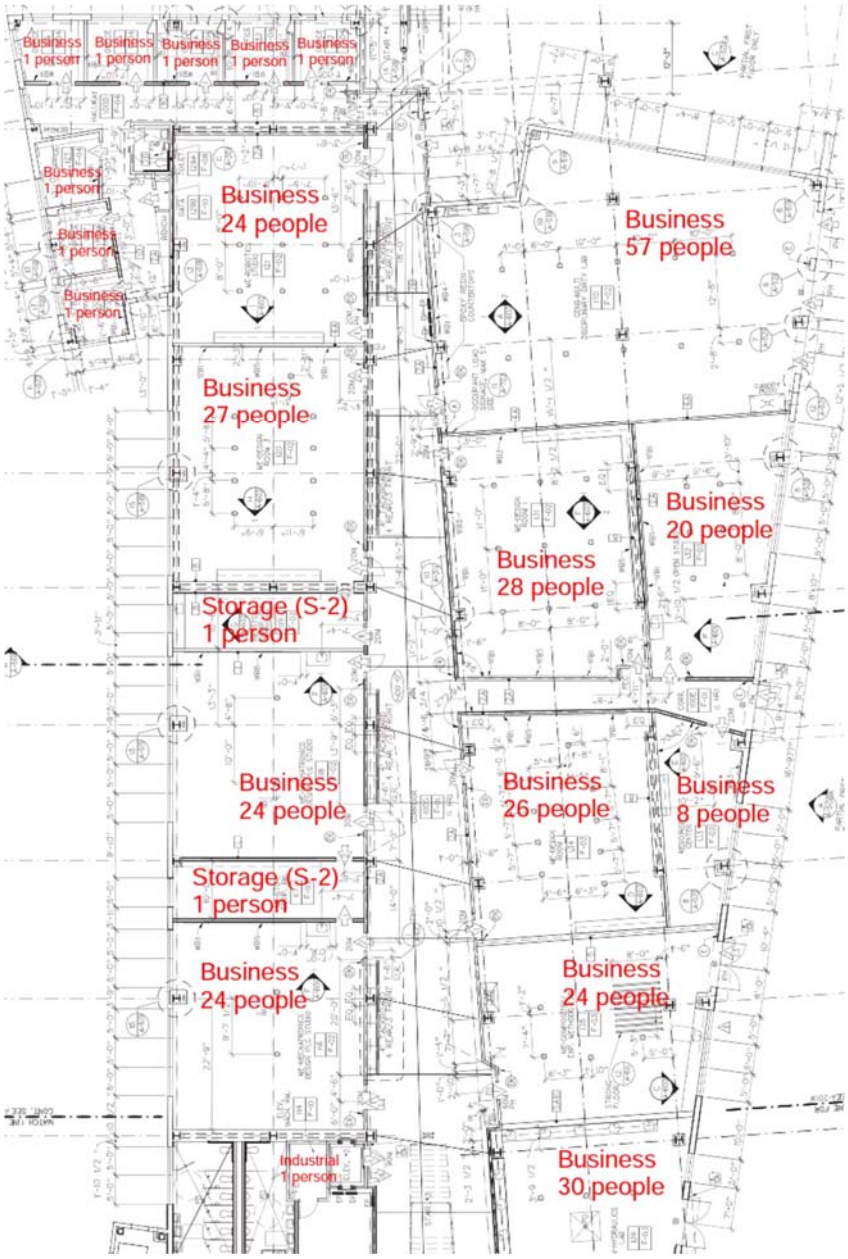


Figure 2: West Half of the First Floor Occupant Load

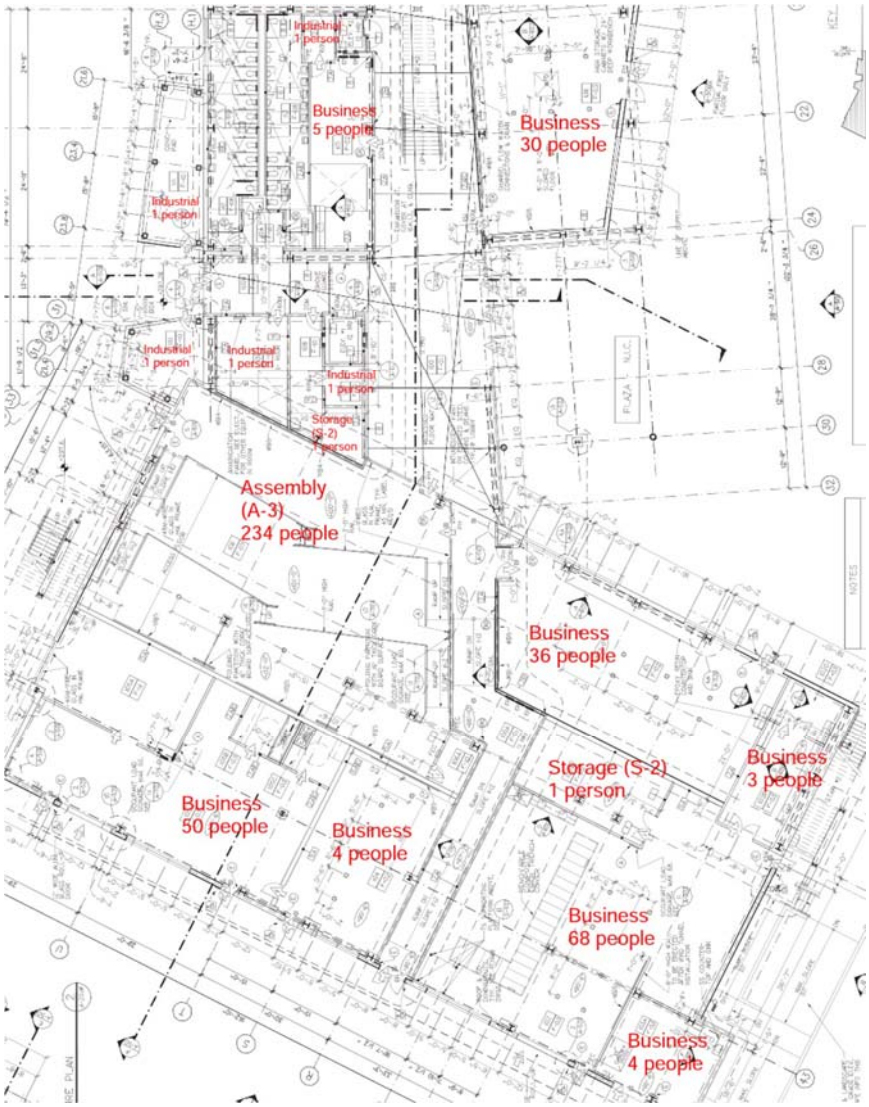


Figure 3: East Half of the Second Floor Occupant Load

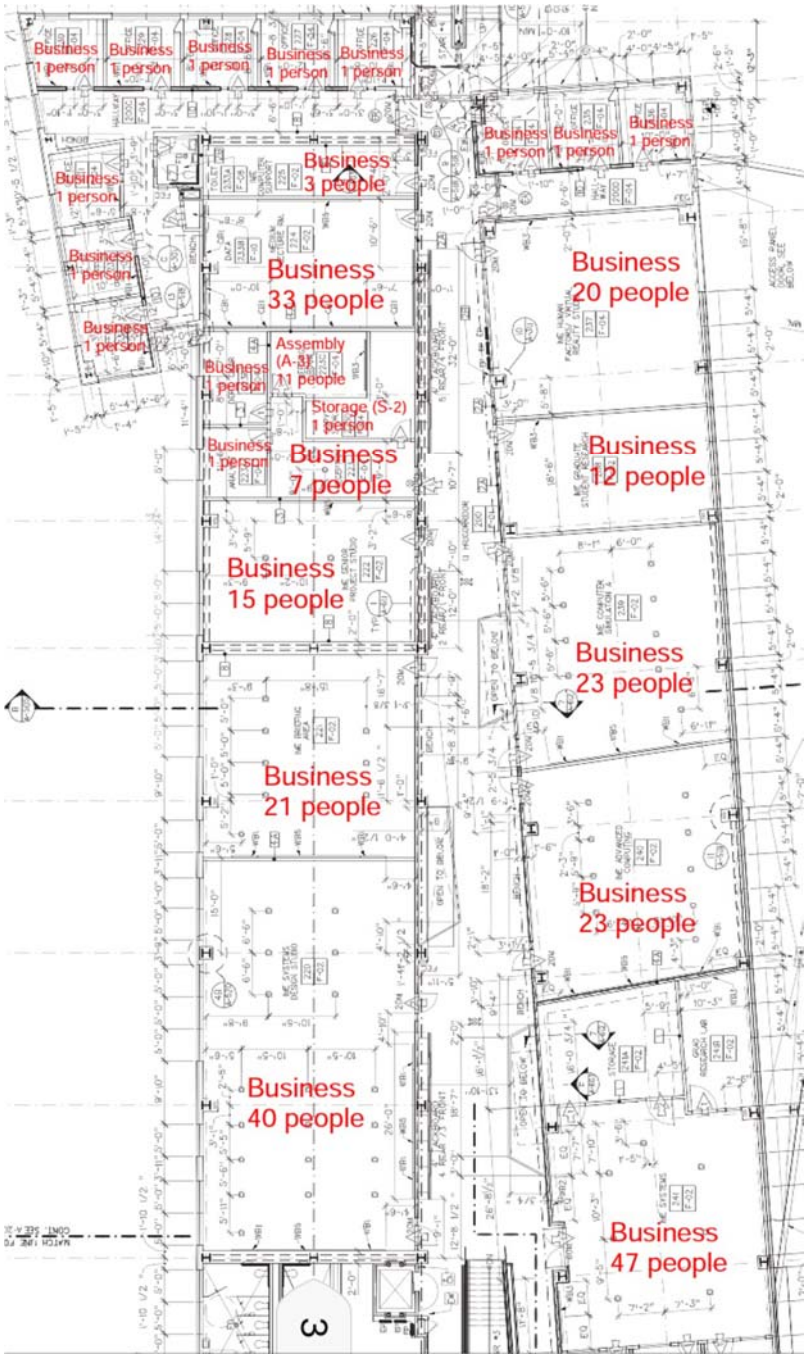


Figure 4: West Half of the Second Floor Occupant Load

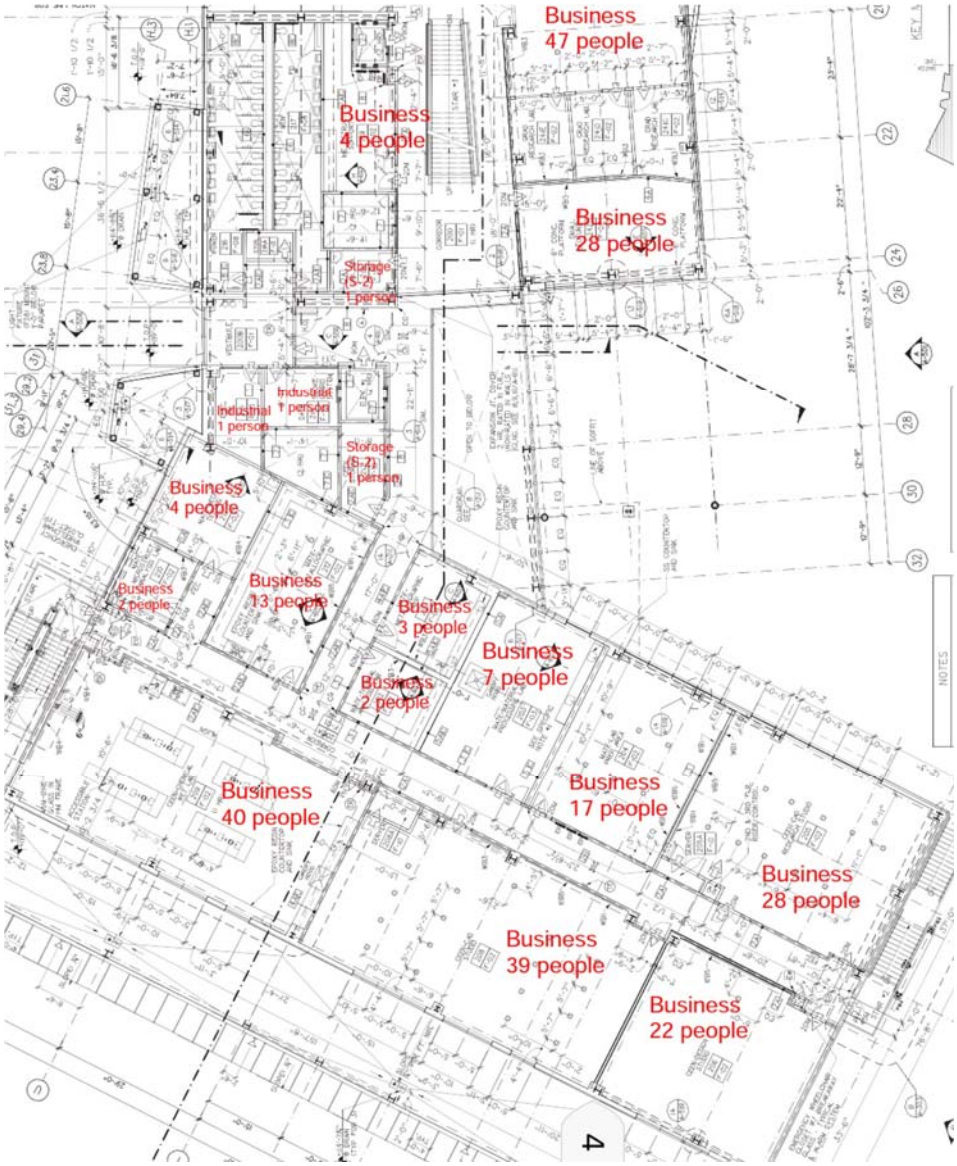


Figure 5: East Half of the Third Floor Occupant Load

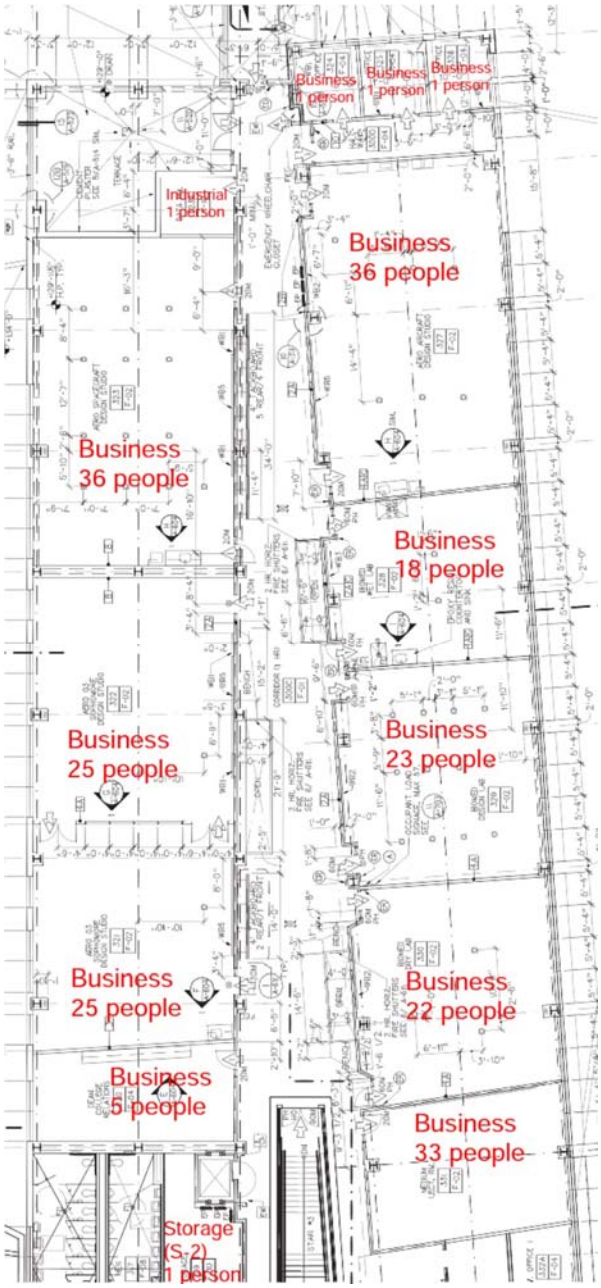
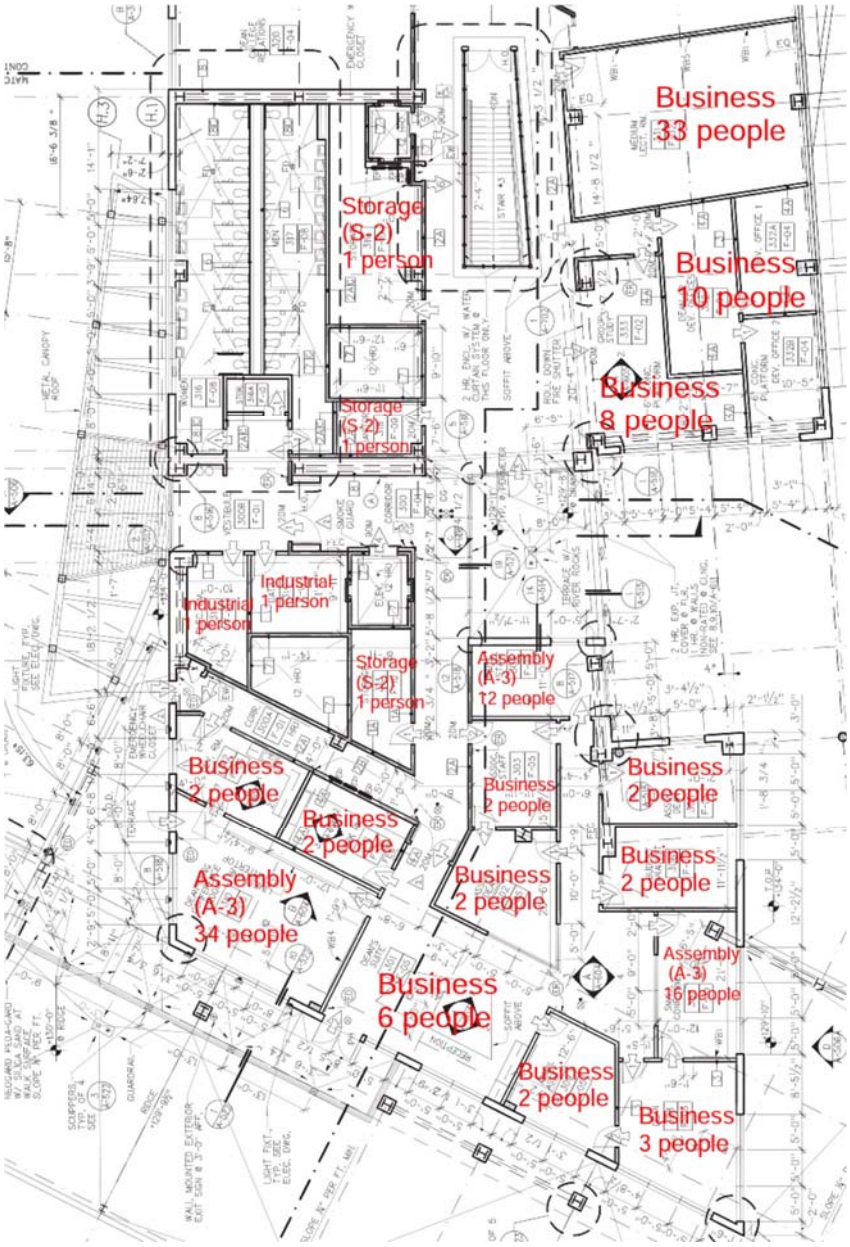


Figure 6: West Half of the Third Floor Occupant Load



Performance of Means of Egress

The current configuration of the means of egress has the following minimum exit widths:

- Stairways Capacities
  - 0.3 in/person
    - First floor: 218.4 in.
    - Second floor: 144.6 in.
    - Third floor: 100.2 in
- Level Components and Ramps
  - 0.2 in/person
    - First floor: 145.6 in.
    - Second floor: 96.4 in.
    - Third floor: 66.8 in.

Per these required widths and the occupant loads for each floor (728 people for the first floor, 482 people for the second floor and 334 people for the third floor), it will take 10.3 minutes to evacuate Stair #1, 10.4 minutes to evacuate Stair #2, 12.9 minutes to evacuate Stair #3 and 9.5 minutes to evacuate Stair #4. This is adequate time to evacuate the facility safely. These calculations are shown in Table 7 through 9 below.

Table 7: Egress Time Calculations

Assumptions					
Stair #1	We				
First floor is 15 ft.					
Second floor is 15 ft.					
Landings are 13 ft. x 9 ft.					
Intermediate landings are 13 ft. x 6.5 ft.					
Stair total length is 12 ft each (4 total)		%		ft2	people
Effective Width of Stairs	66	54	0.247706422	3743.8349	83.2293578
Effective Width of Entry door 3rd floor	64	52	0.346666667	5239.52	**116.48**
Effective Width of Entry door 2rd floor	36	24	0.1875	90.9375	90.9375
Stair #2	We				
First floor is 15 ft.					
Second floor is 15 ft.					
Landing is 7 ft.					
Stair total length is 12 ft each (2 total)		%		ft2	people
Effective Width of Stairs	66	54	0.247706422	3743.8349	83.2293578
Effective Width of Entry door 2rd floor	36	24	0.1875	90.9375	90.9375
Stair #3	We				
First floor is 15 ft.					
Second floor is 15 ft.					
Landings are 7 ft. x 7 ft.					
Stair total length is 12 ft each (4 total)		%		ft2	people
Effective Width of Stairs	68	56	0.256880734	3882.4954	86.31192661

Table 8: Egress Time Calculations Continued

Effective Width of Entry door 3rd floor	80	74	0.493333333	7456.24	165.76
Effective Width of Entry door 2rd floor	68	56	0.4375	212.1875	**212.1875**

Stair #4 We
First floor is 15 ft.
Second floor is 15 ft.

Landings are 13 ft. x 9 ft.
Intermediate landings are 13 ft. x 7 ft.
Stair total length is 12 ft each (4 total)

		%	ft2	people
Effective Width of Stairs	66	54	0.247706422	3743.8349	83.2293578
Effective Width of Entry door 3rd floor	36	24	0.16	2418.24	53.76
Effective Width of Entry door 2rd floor	36	24	0.1875	90.9375	**90.9375**

Stair riser is 7.0 and the tread is 11 in

1st floor exit doors

3rd floor evacuation		Stair #1	Stair #3	Stair #4
Fs=(1-aD)kD (stairs)	a=	2.86 ft/min	2.86 ft/min	2.86 ft/min
	D=	0.022231 person/ft2	0.022231 person/ft2	0.022231 person/ft2
	k=	212	212	212
		4.4133263 person/min/ft	4.4133263 person/min/ft	4.4133263 person/min/ft
Fc=FsWe (stairs)	Fs=	4.4133263 person/min/ft	4.4133263 person/min/ft	4.4133263 person/min/ft
	We=	4.5 ft	4.6666667 ft	4.5 ft
		19.859968 person/min	**20.595523** person/min	19.859968 person/min
Fs=(1-aD)kD (doors)	a=	2.86 ft/min	2.86 ft/min	2.86 ft/min
	D=	0.022231 person/ft2	0.022231 person/ft2	0.022231 person/ft2
	k=	275	275	275
		5.7248336 person/min/ft	5.7248336 person/min/ft	5.7248336 person/min/ft
Fc=FsWe (doors)	Fs=	4.4133263 person/min/ft	4.4133263 person/min/ft	4.4133263 person/min/ft
	We=	4.3333333 ft	6.1666667 ft	2 ft
		19.124414 person/min	27.215512 person/min	**8.8266526** person/min
S=k-akD		198.52087 ft/min	198.52087 ft/min	198.52087 ft/min
Floor-to-floor travel distance	SQRT((15^2)+(12^2))	19.209373 ft	19.209373 ft	19.209373 ft
plus landings (d)	13ft	32.209373 ft	26.209373 ft	32.209373 ft
Person per floor travel time (d/S)		0.1622468 min/floor	0.1320233 min/floor	0.1622468 min/floor
Exit time to stairwell (occp. Load /Fc)		6.0906442 min/floor	8.0483512 min/floor	6.0906442 min/floor
Exit time from stairwell		**6.4151377 min**	**8.3123977 min**	**6.4151377 min**

2rd floor evacuation		Stair #1	Stair #2	Stair #3	Stair #4
Fs=(1-aD)kD (stairs)	a=	2.86 ft/min	2.86 ft/min	2.86 ft/min	2.86 ft/min
	D=	0.0201672 person/ft2	0.0201672 person/ft2	0.0201672 person/ft2	0.0201672 person/ft2
	k=	212	212	212	212
		4.4133263 person/min/ft	4.4133263 person/min/ft	4.4133263 person/min/ft	4.4133263 person/min/ft
Fc=FsWe (stairs)	Fs=	4.4133263 person/min/ft	4.4133263 person/min/ft	4.4133263 person/min/ft	4.4133263 person/min/ft
	We=	4.5 ft	4.5 ft	4.6666667 ft	4.5 ft
		19.859968 person/min	19.859968 person/min	20.595523 person/min	19.859968 person/min
Fs=(1-aD)kD (doors)	a=	2.86 ft/min	2.86 ft/min	2.86 ft/min	2.86 ft/min
	D=	0.0201672 person/ft2	0.0201672 person/ft2	0.0201672 person/ft2	0.0201672 person/ft2
	k=	275	275	275	275
		5.7248336 person/min/ft	5.7248336 person/min/ft	5.7248336 person/min/ft	5.7248336 person/min/ft
Fc=FsWe (doors)	Fs=	4.4133263 person/min/ft	4.4133263 person/min/ft	4.4133263 person/min/ft	4.4133263 person/min/ft

Table 9: Egress Time Calculations Continued

	We=	2 ft	2 ft	4.6666667 ft	2 ft
		8.8266526 person/min	8.8266526 person/min	20.595523 person/min	8.8266526 person/min
S=k-akD		199.77225 ft/min	199.77225 ft/min	199.77225 ft/min	199.77225 ft/min
Floor-to-floor travel distance plus landings (d)	SQRT((15^2)+(12^2)) 13ft	19.209373 ft 32.209373 ft	19.209373 ft 26.209373 ft	19.209373 ft 26.209373 ft	19.209373 ft 32.209373 ft
Person per floor travel time (d/S)		0.1612305 min/floor	0.1311963 min/floor	0.1311963 min/floor	0.1612305 min/floor
Exit time to stairwell (occp. Load /Fc)		10.302603 min/floor	10.302603 min/floor	10.302603 min/floor	10.302603 min/floor
Exit time from stairwell		10.463834 min	10.4338 min	10.4338 min	10.463834 min
Fsm=[(Fsd*Wed)+(Fss*Wes)]/Wes	Fsd=	5.7248336 person/min/ft		5.7248336 person/min/ft	5.7248336 person/min/ft
	Wed=	2 ft		4.6666667 ft	2 ft
	Fss=	4.4133263 person/min/ft		4.4133263 person/min/ft	4.4133263 person/min/ft
	Wes=	4.5 ft		4.6666667 ft	4.5 ft
		6.9576968 person/min/ft		10.13816 person/min/ft	6.9576968 person/min/ft
Total exit time		10.297645 min	10.4338 min	12.929333 min	9.4818418 min

Summary

The Engineering IV building of California Polytechnic State University meets the minimum requirements of the 2015 Editions of NFPA 101 and IBC in the area of egress requirements, except the dead-end corridor on the first floor in the northeast office area. The dead-end length is approximately 74 ft and NFPA 101 requires a dead-end corridor of no longer than 50 ft for business occupancies per Section 38.2.5.2.1. The width of stairwell doors were not examined due to the lack of dimension provided on the drawings. The assumption is the required exit widths are met and the occupants will have the required minimum time to egress the facility completely due to the facility having automatic fire suppression installed throughout and the means of egress is separated from the rest of the facility by a 2-hour fire resistant barrier.

Structural Fire Protection

Purpose

The purpose of this analysis is to evaluate California Polytechnic State University's Engineering IV building's structural design and fire protection structural features against the 2001 California Fire Code (CFC) and 2000 International Building Code (IBC), which are the codes of record for this facility.

Background

The Engineering IV building construction drawings were plotted on July 23rd, 2007. It is entirely new construction. It is a three-story teaching and research laboratory building with two elevators, three exterior stairwells and one interior stairwell. The building is constructed of steel brace frames and concrete filled metal decks. The exterior walls are constructed of steel stud frame walls faced with fiber reinforced cementitious panel and metal panel siding. The roof is modified bituminous membrane roof on rigid insulation.

Classification of Construction

Engineering IV is a three-story structure, standing 56 ft. tall and is constructed of type of Type II (fire resistant) construction, according to the drawings from Table 6A from the CFC. The structural frame (columns and primary floor beams), floor decks and secondary beams at floors have a fire resistance rating of 2-hours. The roof deck has a fire resistance rating of 1-hour. The secondary beams at the roof have a fire resistance rating 1 ½-hours. The primary beams at the roof have a fire resistance rating of 2 ½-hours. The roof beams are sprayed with an extra amount of lightweight concrete, in addition to the insulation already installed to get an extra ½ hour fire resistance. Exterior doors and windows need protection if the spacing from the property line is less than 20 ft. Engineering IV has a total floor area of 104,631 ft.², 17,441 ft.² of A-3 (Group A, assembly, Division 3 per CFC) occupancy and 87,190 ft.² of B (Group B, business, per CFC) occupancy.

According to the drawings, the construction of Engineering IV is to be 4 stories or less, to be a height equal to or less than 160 ft. and is required to be Type II construction with an automatic fire suppression system throughout. To meet these construction requirements the exterior bearing walls, interior bearing walls, structural frame, shaft enclosures floor and floor/ceilings are required to have a 2-hour fire resistance rating. To achieve the 2-hour rating, all structural steel and decking are covered with lightweight concrete with a thickness to meet a 2-hour rating. The exterior nonbearing walls, permanent partitions and roof and roof/ceilings are required to have a 1-hour fire resistance rating. To achieve the 1-hour rating, all structural steel and decking are covered with lightweight concrete with a thickness to meet a 1-hour rating, and the permanent partitions are constructed of one layer on each side of Type ‘X’ 5/8” gypsum board or two layers on each side of Type ‘X’ 5/8” gypsum board with fiberglass batting insulation (plenum rated) to meet at least a 1-hour rating. A-3 occupancies have a maximum floor area requirement of 29,000 ft.² with an allowance to double that area for multistory and an allowance to double the basic floor area and multistory allowance for three 60 ft. separation sideyards for a total floor area requirement of 119,600 ft.² and B occupancies have a maximum floor area requirement of 39,900 ft.² with an allowance to double that area for multistory and an allowance to double the basic floor area and multistory allowance for three 60 ft. separation sideyards for a total floor area requirement of 159,600 ft.².

Code Requirements

Per Table 503 of the 2000 IBC, the height and building area limitations for an A-3 occupancy of Type II-A is three stories and 15,500 ft.² per floor for a total of 46,500 ft.². For a B occupancy of Type II-A a maximum of five stories and 37,500 ft.² per floor for a total of 187,500 ft.². A Type II-A construction per Tables 601 and 602 of the IBC requires structural framing (including columns, girders and trusses) to be 1-hour fire resistance rated, bearing walls (exterior and interior) to be 1-hour fire resistance rated, floor construction (including supporting beams and joists) to be 1-hour fire resistance rated, roof construction (including supporting beams and joists) to be 1-hour fire resistance rated and nonbearing walls and partitions (exterior and interior) to be 1-hour fire resistance rated. To get at least a 2-hour fire resistance rating on structural steel, the structural steel needs to have a thickness of a maximum of 2 ½ inches of concrete to a minimum of 1 inch per Table 719.1(1). To get a 1-hour fire resistance rating for partition walls, the wall needs to have at least one layer of Type 'X' 5/8" gypsum board per Table 719.1(2).

Performance of Coverings

Below are the calculations showing whether the depth of spray on lightweight concrete will meet the required fire resistant rating.

- $R = [C_1 (W/D) + C_2] h$
  - Table 4-11.3 of Section 4 Chapter 11 from the 4th edition of the SFPE Handbook of Fire Protection Engineering.
- $h = R / [C_1 (W/D) + C_2]$
  - $D = 4a + 2b - 2c$
    - From Figure 4-11.10 of Section 4 Chapter 11 from the 4th edition of the SFPE Handbook of Fire Protection Engineering.
  - $D = 3b_f + 2d – 2t_w$
    - From Figure 4-11.11 of Section 4 Chapter 11 from the 4th edition of the SFPE Handbook of Fire Protection Engineering.
- Columns are W14x68 I-beams

- Beams are W24x55 and W24x62
  - R = 2 hr
  - W14x68 column
  - W = 68 lbs/ft
  - D = 4a + 2b - 2c
    - a = 10 in
    - b = 14 in
    - c = 1/4 in
    - D = 4(10 in) + 2(14 in) – 2(1/4 in)
    - D = 67.5 in
  - W/D = (68 lbs/ft) / (67.5 in)
  - W/D = 1.007 lbs/ft * in
  - C_1 = 1.05
  - C_2 = 0.6
    - These are the example factors from the SFPE Handbook. The C-factors vary depending on the material used.
  - h = (2 hr) / [(1.05) * (1.007 lbs/ft * in) + (0.6)]
  - h = 1.21 in of spray-applied cementitious materials at a minimum for W14x68 columns.

For the 2-hour fire resistance rating on structural steel, it needs to have a thickness of a maximum of 2 ½ inches of concrete exceeds the required depth, but the minimum of 1 inch does not meet the required depth.

- $h = R / [C_1 (W / D) + C_2]$
  - R = 1 hr
  - W14x68 column
  - W = 68 lbs/ft
  - D = 4a + 2b - 2c
    - a = 10 in
    - b = 14 in
    - c = 1/4 in
    - D = 4(10 in) + 2(14 in) – 2(1/4 in)
    - D = 67.5 in
  - W/D = (68 lbs/ft) / (67.5 in)
  - W/D = 1.007 lbs/ft * in
  - C_1 = 1.05

- $C_2 = 0.6$
  - These are the example factors from the SFPE Handbook. The C-factors vary depending on the material used.
- h = (1 hr) / [(1.05) * (1.007 lbs/ft * in) + (0.6)]
- h = 0.60 in of spray-applied cementitious materials at a minimum for W14x68 columns.

The 1-hour fire resistance rating on structural steel, the structural steel need to have a thickness of a maximum of 2 ½ inches of concrete and a minimum of 1 inch exceeds the required depth.

- $h = R / [C_1 (W / D) + C_2]$
  - R = 2 hr
  - W24x55 column
  - W = 55 lbs/ft
  - $D = 3b_f + 2d – 2t_w$
    - $b_f = 7$ in
    - d = 23 5/8 in
    - $t_w = 3/16$ in
    - D = 3(7 in) + 2(23 5/8 in) – 2(3/16 in)
    - D = 67.875 in
  - W/D = (55 lbs/ft) / (67.875 in)
  - W/D = 0.81 lbs/ft * in
  - $C_1 = 1.05$
  - $C_2 = 0.6$
    - These are the example factors from the SFPE Handbook. The C-factors vary depending on the material used.
  - h = (2 hr) / [(1.05) * (0.81 lbs/ft * in) + (0.6)]
  - h = 1.37 in. of spray-applied cementitious materials at a minimum for W24x55 columns.

The 2-hour fire resistance rating on structural steel, the structural steel need to have a thickness of a maximum of 2 ½ inches of concrete exceeds the required depth, but the minimum of 1 inch does not meet the required depth.

- $h = R / [C_1 (W / D) + C_2]$
  - R = 1 hr
  - W24x55 column
  - W = 55 lbs/ft
  - $D = 3b_f + 2d – 2t_w$
    - b_f = 7 in
    - d = 23 5/8 in
    - t_w = 3/16 in
    - D = 3(7 in) + 2(23 5/8 in) – 2(3/16 in)
    - D = 67.875 in
  - W/D = (55 lbs/ft) / (67.875 in)
  - W/D = 0.81 lbs/ft * in
  - C_1 = 1.05
  - C_2 = 0.6
    - These are the example factors from the SFPE Handbook. The C-factors vary depending on the material used.
  - h = (1 hr) / [(1.05) * (0.81 lbs/ft * in) + (0.6)]
  - h = 0.69 in. of spray-applied cementitious materials at a minimum for W24x55 columns

The 1-hour fire resistance rating on structural steel, the structural steel need to have a thickness of a maximum of 2 ½ inches of concrete and a minimum of 1 inch exceeds the required depth.

- $h = R / [C_1 (W / D) + C_2]$
  - R = 2 hr
  - W24x62 column
  - W = 62 lbs/ft
  - $D = 3b_f + 2d – 2t_w$
    - b_f = 7 in
    - d = 23 3/4 in
    - t_w = 7/16 in

        - D = 3(7 in) + 2(23 3/4 in) – 2(7/16 in)
        - D = 67.625 in
    - W/D = (62 lbs/ft) / (67.625 in)
    - W/D = 0.92 lbs/ft * in
    - C_1 = 1.05
    - C_2 = 0.6
        - These are the example factors from the SFPE Handbook. The C-factors vary depending on the material used.
    - h = (2 hr) / [(1.05) * (0.92 lbs/ft * in) + (0.6)]
    - h = 1.28 in. of spray-applied cementitious materials at a minimum for W24x62 columns

The 2-hour fire resistance rating on structural steel, the structural steel need to have a thickness of a maximum of 2 ½ inches of concrete exceeds the required depth, but the minimum of 1 inch does not meet the required depth.

- $h = R / [C_1 (W / D) + C_2]$
    - R = 1 hr
    - W24x62 column
    - W = 62 lbs/ft
    - $D = 3b_f + 2d – 2t_w$
        - b_f = 7 in
        - d = 23 3/4 in
        - t_w = 7/16 in
        - D = 3(7 in) + 2(23 3/4 in) – 2(7/16 in)
        - D = 67.625 in
    - W/D = (62 lbs/ft) / (67.625 in)
    - W/D = 0.92 lbs/ft * in
    - C_1 = 1.05
    - C_2 = 0.6
        - These are the example factors from the SFPE Handbook. The C-factors vary depending on the material used.
    - h = (1 hr) / [(1.05) * (0.92 lbs/ft * in) + (0.6)]
    - h = 0.64 in. of spray-applied cementitious materials at a minimum for W24x62 columns

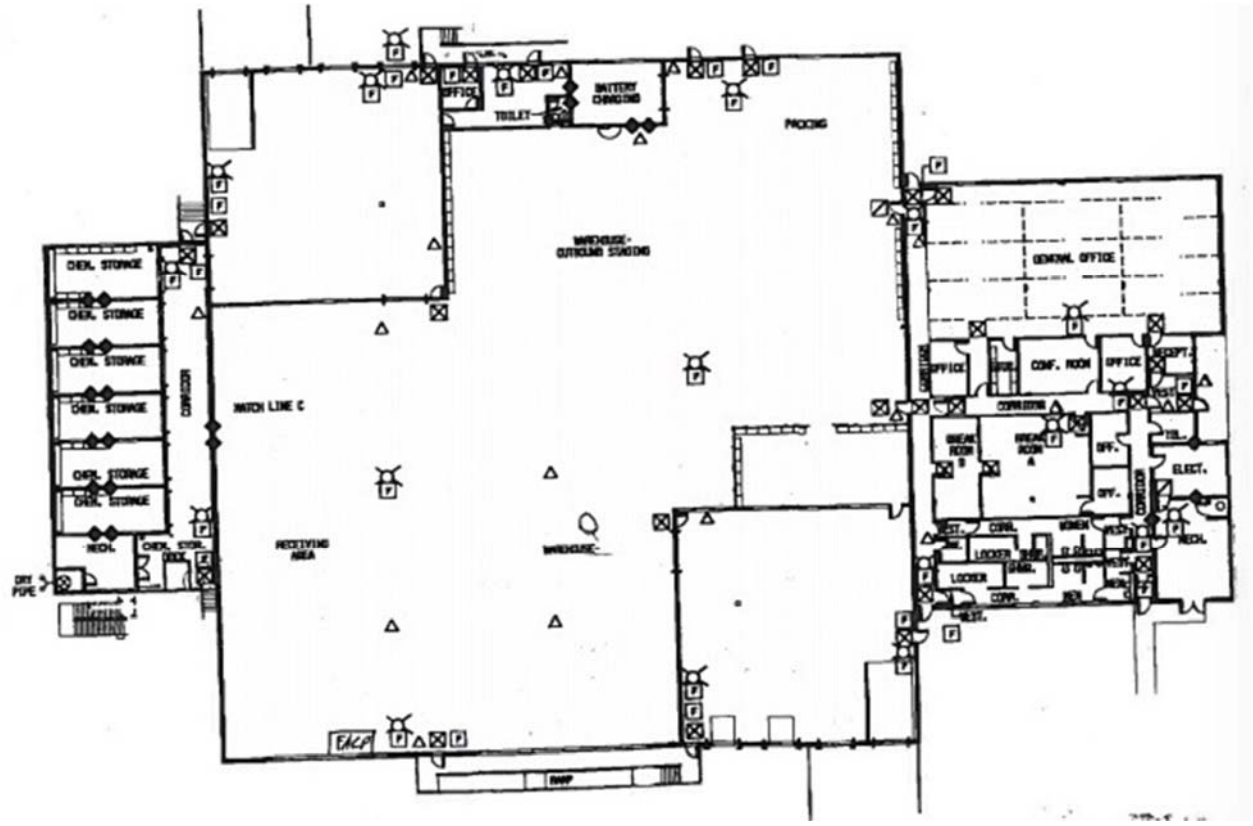
The 1-hour fire resistance rating on structural steel, the structural steel need to have a thickness of a maximum of 2 ½ inches of concrete and a minimum of 1 inch exceeds the required depth.

Permanent partitions are constructed of one or two layers on each side of Type 'X' 5/8" gypsum board with fiberglass batting insulation to meet at least a 1-hour fire resistant rating. One layer of Type 'X' 5/8" gypsum board is required to achieve a 1-hour fire resistant rating per Table 719.1(2) of the IBC.

Summary

This analysis was completed to prove the current construction of the Engineering IV building met the required fire resistance. The Engineering IV building of California Polytechnic State University far exceeded the minimum requirements of 2000 IBC and 2001 CFC in the area of structural fire protection requirements and meets the performance required depth to achieve the fire resistant ratings.

Fire Detection, Alarm and Communication Systems



I have contacted multiple places in Amarillo, TX where I am currently living, trying to get a copy of their fire alarm drawings and calculations. All of the property owners I contacted would not give me their drawing and/or calculations due to security reasons or they didn't keep a record of them, opting for the designers/maintenance group to keep them instead. The designers/maintenance groups would not release the drawings and/or calculations to me. I could only get one property owner to send me any drawings that I could use. The property owner required I remove any labels or identifying marks and change the location of certain aspects of the system for security reasons. They also would not send me the calculations, other building information, product data or specifications. I did walkdown the building to get a feeling for the facility. With the large amount of information that I was unable to obtain, I supplemented with equipment I have worked with in the past and/or made some assumptions. I will not state whether an assumptions has been made or how the system is actually installed or designed as agreed upon with the property owner for security purposes.

Background

The type of system is a proprietary system that communicates to a supervising location constantly attended and the signals are automatically recorded and are under control of the building owner. The operating characteristics of the fire alarm system are mainly to monitor the fire suppression system, shut off the air handling units and notify the occupants. The panel is a Notifier FireWarden-50(E) and is located on the south wall in the west corner. The initiation devices in the facility are System Sensor WFDN Series waterflow detectors installed on the fire suppression system risers, System Sensor DNR duct smoke detectors in the air handling units, System Sensor PIBV2 supervisory switches on the outside PIVs and riser OS&Y valves, a System Sensor EPS10-1 alarm pressure switch on the wet system riser, Notifier NOT-BG12LX addressable manual pull stations located at all exterior exits and fire suppression sprinklers at ceiling level. Notifier SpectraAlart Advance Horn/Strobe notification devices are located in the Chemical Storage Corridor, Outbound Staging area, Receiving Area, Office area, Packing area, General Office area, General Office Corridor, Break Room area, outside the Locker Room areas in the Corridors, Mechanical Room and Reception Area.

Code Requirements

The current location, spacing and placement of the sprinklers, supervisory switches, manual pull stations and smoke detectors meets the requirements of NFPA 72, the National Fire Alarm and Signaling Code Sections 23.3.3.1, 23.8.5.6.1 and 23.8.5.6.1. The current location, spacing and placement of the sprinklers and supervisory switches meet the requirements of NFPA 13, The Standard for the Installation of Sprinkler Systems. The current location, spacing and placement of the manual pull stations meet the requirements of NFPA 72 Sections 17.14.5, 17.14.8.2 and 17.14.8.4 as well as the requirement in NFPA 101, Life Safety Code Section 9.6.2.7. The current location, spacing and placement of the duct detectors meet the requirements of NFPA 72 Section 23.8.5.4.6.1 and NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems Sections 6.4.2.1 and 6.4.3.1.

The wall mounted horn/strobe notification devices located in the Chemical Storage Corridor, Outbound Staging area, Receiving Area, Office area, Packing area, General Office area, General Office Corridor, Break Room area, outside the Locker Room areas in the Corridors, Mechanical Room and Reception Area meet the height and spacing requirements called out in NFPA 72 Section 18.5.5.1 and NFPA 72 Sections 18.5.5.4.1, 18.5.5.4.3, 18.5.5.5.1 and 18.5.5.5.5 except for in the rooms located in the Outbound Staging area and the Receiving Area and the Corridor in the General Office area. The rooms located in the Outbound Staging area and the Receiving Area need to have the notification devices on opposite walls to meet the requirements, not adjacent. In the Corridor, another horn/strobe device should be added to the middle of the corridor to not exceed the 100 ft spacing requirement in NFPA 72 Section 18.5.5.5.5. The ceiling mounted horn/strobe notification devices located in the Outbound Staging area and the Receiving Area meet the requirements called out in NFPA 72 Sections 18.5.5.3, 18.5.5.4.1 and 18.5.5.4.7.

Fire Scenarios and Calculations

There are three fire scenarios chosen for this facility. The first fire could start in the warehouse area. This area contains a substantial amount of ordinary combustibles, which are typical of any storage shipping area. Combustibles include paper, cardboard boxes, wood shelving with books, plastic chairs, plastic computer housings, plastic binders filled with paper, plastic bins, etc. Potential ignition sources include electrical malfunctions, an overloaded power strip and light ballasts. This area has a continuity of combustibles to support fire spread. Smoke and fire gases would migrate to adjacent corridors through the door openings, louvers, and open vents in the ceiling. The sprinklers installed in this area are Tyco ESFR-17, RTI of 100 m^2-sec^2 with an activation temperature of 212°F (100°C). The sprinklers will activate at approximately 304 seconds according to the attached DETACH model. The fire had a heat release rate of approximately 4,344 kW.

- Sprinklers are Tyco ESFR-17, RTI of 100 m^2-sec^2, activation temperature of 212^{o}F (100^{o}C)
- Per DETACH model activation time of 304 seconds and heat release rate of 4,344 kW.

Figure 7: DETACT Graph for Warehouse Fire

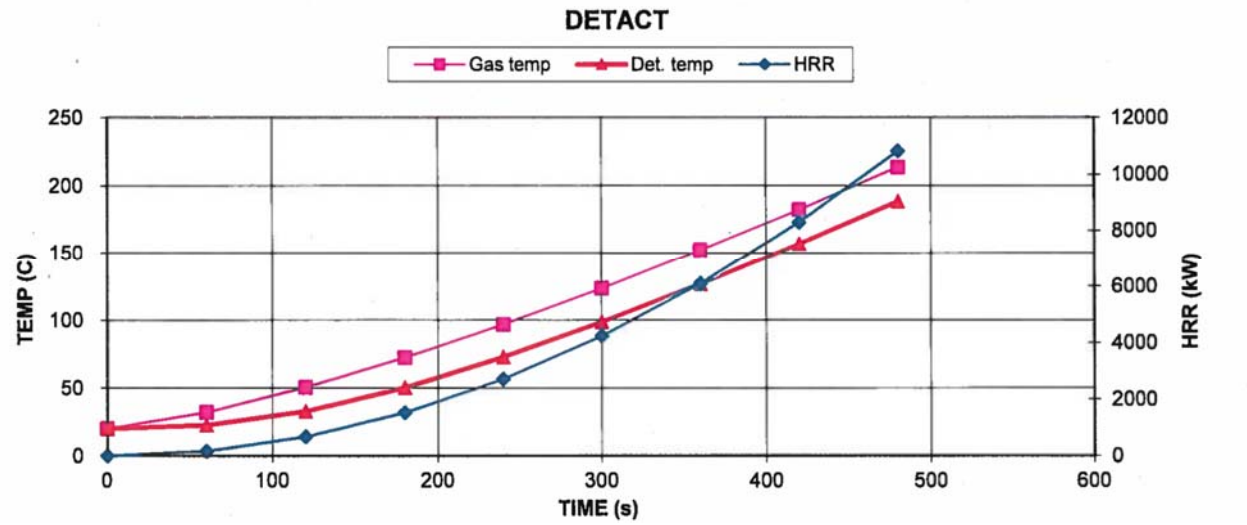


Figure 8: DETACT Inputs for Warehouse Fire

INPUT PARAMETERS			CALCULATED PARAMETERS		
Calculation reset	1	0 or 1	R/H	0.5	-
Ceiling height (H)	6.096	m	W/H	8.85	-
Room width (W)	53.95	m	Temperature factor	0.4762	-
Radial distance (R)	3.048	m	Velocity factor	0.3564	-
Ambient temperature (To)	20	C	Calculation time (t)	501	s
Actuation temperature (Ta)	100	C	Fire HRR (Q)	11797	kW
Rate of rise rating (ROR)	8.3	C/min	Gas temperature (Tg)	225.02	C
Response time index (RTI)	100	(m-s)1/2	Gas velocity (Ug)	4.4408	m/s
Fire growth power (n)	2	-	ROR at detector	32.739	C/min
Fire growth coefficient (k)	0.047	kW/s^n	Detector temp (Td)	199.68	C
Fire location factor (kLF)	1	-	Detection trigger	198	425

Representative t2 coeff.	k
Slow	0.003
Medium	0.012
Fast	0.047
Ultrafast	0.400

CALCULATION RESULTS	FT	ROR	
Transport lag time (tl)	14	14	s
Detection time (td)	304	77	s
HRR at detection (Qd)	4344	279	kW
HRR w/transport lag (Ql+d)	4765	393	kW

< Press PgDn key for additional results >

A second fire could start in the office area. This area contains a substantial amount of ordinary combustibles, which are typical of any office area. Combustibles include paper, cardboard boxes, wood shelving with books, plastic chairs, plastic computer housings, plastic binders filled with paper, plastic bins, etc. Potential ignition sources include electrical malfunctions, an overloaded power strip and light ballasts. This area has a continuity of combustibles to

support fire spread. Smoke and fire gases would migrate to adjacent corridors through the door openings, louvers, and open vents in the ceiling. The sprinklers installed in this area are Tyco TY-B, RTI of 125 m^2-sec^2 with an activation temperature of 155°F (68°C). The sprinklers will activate at approximately 194 seconds according to the attached DETACH model. The fire had a heat release rate of approximately 1,769 kW.

- Sprinklers are Tyco TY-B, RTI of 125 m^2-sec^2, activation temperature of 155°F (68°C)
- Per DETACH model activation time of 194 seconds and heat release rate of 1,769 kW.

Figure 9: DETACT Graph for Office Area Fire

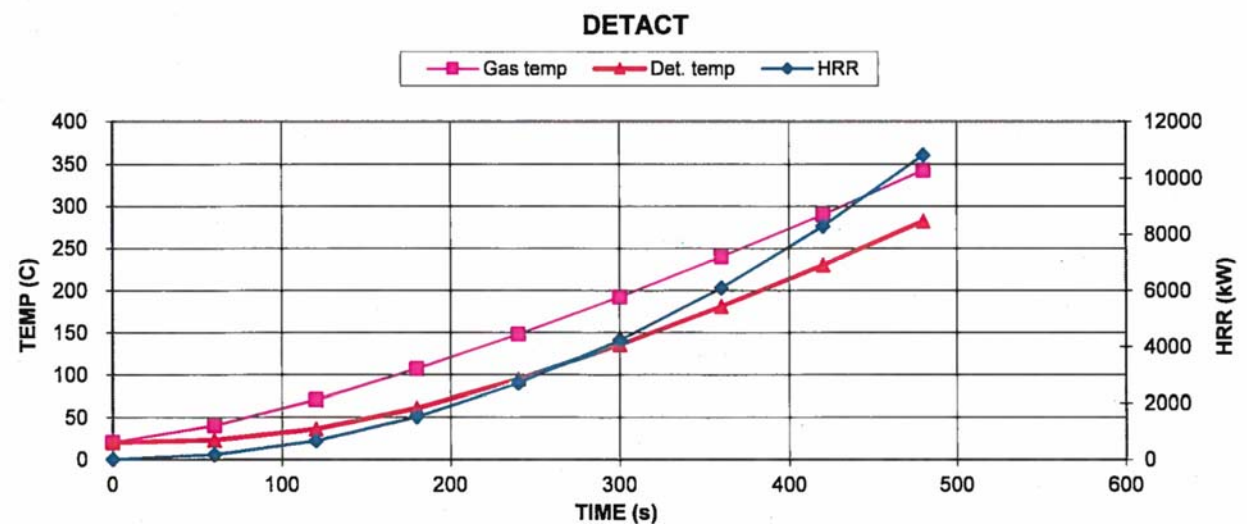


Figure 10: DETACT Inputs for Office Area Fire

INPUT PARAMETERS			CALCULATED PARAMETERS		
Calculation reset	1	0 or 1	R/H	0.8333	-
Ceiling height (H)	3.6576	m	W/H	2.0833	-
Room width (W)	7.62	m	Temperature factor	0.3388	-
Radial distance (R)	3.048	m	Velocity factor	0.2328	-
Ambient temperature (To)	20	C	Calculation time (t)	501	s
Actuation temperature (Ta)	68	C	Fire HRR (Q)	11797	kW
Rate of rise rating (ROR)	8.3	C/min	Gas temperature (Tg)	361.7	C
Response time index (RTI)	125	(m-s)1/2	Gas velocity (Ug)	3.4399	m/s
Fire growth power (n)	2	-	ROR at detector	54.385	C/min
Fire growth coefficient (k)	0.047	kW/s^n	Detector temp (Td)	301.52	C
Fire location factor (kLF)	1	-	Detection trigger	308	438

Representative t2 coeff.	k
Slow	0.003
Medium	0.012
Fast	0.047
Ultrafast	0.400

CALCULATION RESULTS	FT	ROR	
Transport lag time (tl)	15	15	s
Detection time (td)	194	64	s
HRR at detection (Qd)	1769	193	kW
HRR w/transport lag (Ql+d)	2044	290	kW

< Press PgDn key for additional results >

A third fire could start in the mechanical room. A fire in this area would be initiated from one of the pieces of equipment. An electrical malfunction or light ballast could also cause a fire. There is not a significant amount of combustibles in the mechanical room. The sprinklers installed in this area are Tyco TY-B, RTI of 125 m^2-sec^2 with an activation temperature of 286°F (141°C). The sprinklers will activate at approximately 308 seconds according to the attached DETACH model. The fire had a heat release rate of approximately 4,459 kW.

- Sprinklers are Tyco TY-B, RTI of 125 m^2-sec^2, activation temperature of 286°F (141°C)
- Per DETACH model activation time of 308 seconds and heat release rate of 4,459 kW.

Figure 11: DETACT Graph for Mechanical Room Fire

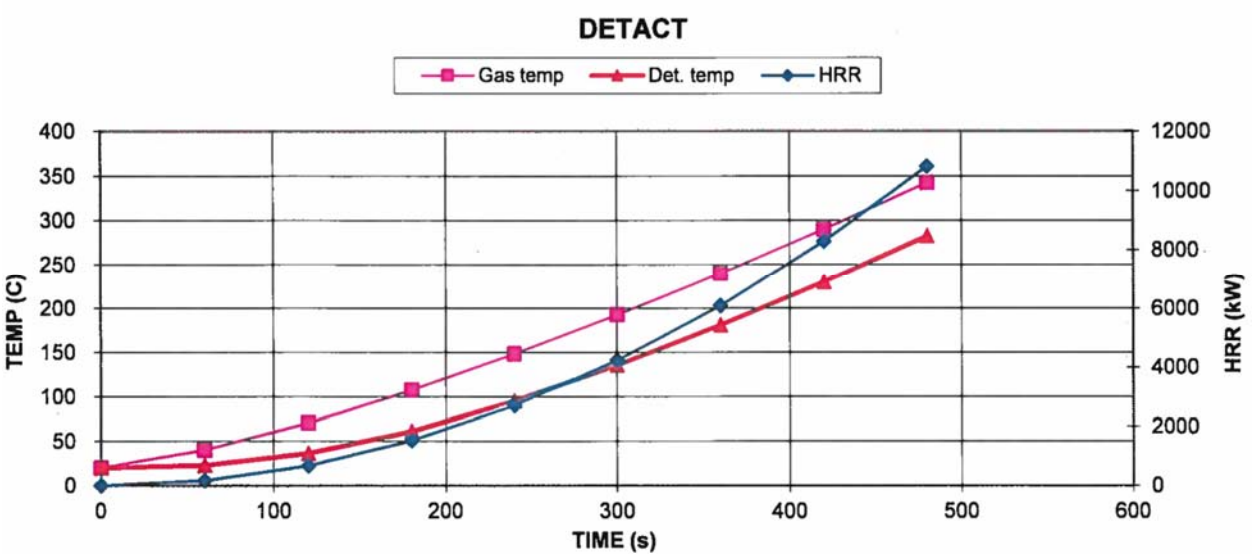


Figure 12: DETACT Inputs for Mechanical Room Fire

DETACT.XLS: Estimate of the response time of ceiling mounted fire detectors

INPUT PARAMETERS			CALCULATED PARAMETERS		
Calculation reset	1	0 or 1	R/H	0.8333	-
Ceiling height (H)	3.6576	m	W/H	2.25	-
Room width (W)	8.2296	m	Temperature factor	0.3388	-
Radial distance (R)	3.048	m	Velocity factor	0.2328	-
Ambient temperature (To)	20	C	Calculation time (t)	501	s
Actuation temperature (Ta)	141	C	Fire HRR (Q)	11797	kW
Rate of rise rating (ROR)	8.3	C/min	Gas temperature (Tg)	361.7	C
Response time index (RTI)	125	(m-s)1/2	Gas velocity (Ug)	3.4399	m/s
Fire growth power (n)	2	-	ROR at detector	54.385	C/min
Fire growth coefficient (k)	0.047	kW/s^n	Detector temp (Td)	301.52	C
Fire location factor (kLF)	1	-	Detection trigger	194	438

Representative t2 coeff.	k
Slow	0.003
Medium	0.012
Fast	0.047
Ultrafast	0.400

CALCULATION RESULTS	FT	ROR	
Transport lag time (tl)	15	15	s
Detection time (td)	308	64	s
HRR at detection (Qd)	4459	193	kW
HRR w/transport lag (Ql+d)	4889	290	kW

< Press PgDn key for additional results >

Performance of the System

I was not provided the current dB levels of the notification appliances or what they were designed to. There are calculations in the appendixes showing what dB levels would be required to meet the audible level code requirements. I was able to obtain the candela levels of the notification appliances installed. All of the areas meet the code requirements for visibility except the General Office area, General Office corridor, the room in the Receiving Area, Outbound Staging Office area and the room in the Outbound Staging area. These calculations are shown below.

Performance Calculations

Audible

- $L_w = L + 20 \log_{10} r + 11$ dB
- $L_{P1} = L_w + C_3 + C_4 + C_5$
  - $L_w = L_{P1} – (C_3 + C_4 + C_5)$
  - C_3 = Table 4-1.19 from the SFPE Handbook of Fire Protection Engineering fourth edition.
  - C_4 = Table 4-1.20 from the SFPE Handbook of Fire Protection Engineering fourth edition.
  - C_5 = Table 4-1.21 from the SFPE Handbook of Fire Protection Engineering fourth edition.
- $L_{P2} = L_w + C_1 + C_2$
  - $L_w = L_{P2} – (C_1 + C_2)$
  - C_1 = Table 4-1.17 from the SFPE Handbook of Fire Protection Engineering fourth edition.
  - C_2 = Table 4-1.18 from the SFPE Handbook of Fire Protection Engineering fourth edition.
- Storage areas requirements L_{P1} and L_{P2} = 95 dB
- All other areas requirements L_{P1} and L_{P2} = 90 dB

- Chemical Storage Corridor
  - The horn/strobe device located at the south end
    - $L_w = L_{P1} – (C_3 + C_4 + C_5)$
    - L_w = (95 dB) - [(-3 dB) + (-8 dB) + (-11 dB)]
      - L_w = 117 dB
      - It would need a sound power level of 117 dB for a maximum distance of 40 ft from the device, two-directional and medium finish.
  - The horn/strobe device located at the north end.
    - $L_w = L_{P1} – (C_3 + C_4 + C_5)$
    - L_w = (95 dB) - [(0 dB) + (-8 dB) + (-11 dB)]
      - L_w = 114 dB
      - It would need a sound power level of 114 dB for a maximum distance of 40 ft from the device, single directional and medium finish.
- Room in Outbound Staging area
  - The horn/strobe device located at the west wall.
    - $L_w = L_{P2} – (C_1 + C_2)$
    - L_w = (95 dB) – [(5 dB) + (-39 dB)]
      - L_w = 129 dB
      - It would need a sound power level of 129 dB for a maximum distance of 75 ft from the device and more than one meter away from one other surface.
  - The horn/strobe device located at the north wall.
    - $L_w = L_{P2} – (C_1 + C_2)$
    - L_w = (95 dB) – [(5 dB) + (-37 dB)]
      - L_w = 127 dB
      - It would need a sound power level of 127 dB for a maximum distance of 55 ft from the device and more than one meter away from one other surface.

- Outbound Staging Office Area
  - $L_w = L_{P2} – (C_1 + C_2)$
  - $L_w = (90\ dB) – [(7\ dB) + (-33\ dB)]$
    - $L_w = 116\ dB$
    - It would need a sound power level of 116 dB for a maximum distance of 55 ft from the device and closer than one meter away from one other surface.
- Room in Receiving Area
  - The horn/strobe device located at the west wall.
    - $L_w = L_{P2} – (C_1 + C_2)$
    - $L_w = (95\ dB) – [(5\ dB) + (-37\ dB)]$
      - $L_w = 127\ dB$
      - It would need a sound power level of 127 dB for a maximum distance of 55 ft from the device and more than one meter away from one other surface.
  - The horn/strobe device located at the east wall.
    - $L_w = L_{P2} – (C_1 + C_2)$
    - $L_w = (95\ dB) – [(5\ dB) + (-35\ dB)]$
      - $L_w = 125\ dB$
      - It would need a sound power level of 125 dB for a maximum distance of 50 ft from the device and more than one meter away from one other surface.
- Outbound Staging area
  - The horn/strobe device located at the south wall.
    - $L_w = L_{P2} – (C_1 + C_2)$
    - $L_w = (95\ dB) – [(5\ dB) + (-33\ dB)]$
      - $L_w = 123\ dB$
      - It would need a sound power level of 123 dB for a maximum distance of 35 ft from the device and more than one meter away from one other surface.

- The horn/strobe device located on the ceiling on the west side.
  - $L_w = L_{P2} – (C_1 + C_2)$
  - L_w = (95 dB) – [(5 dB) + (-35 dB)]
    - L_w = 125 dB
    - It would need a sound power level of 125 dB for a maximum distance of 45 ft from the device and more than one meter away from one other surface.
- The horn/strobe device located on the ceiling on the east side.
  - $L_w = L_{P2} – (C_1 + C_2)$
  - L_w = (95 dB) – [(5 dB) + (-37 dB)]
    - L_w = 127 dB
    - It would need a sound power level of 127 dB for a maximum distance of 55 ft from the device and more than one meter away from one other surface.
- The horn/strobe device located at the north wall.
  - $L_w = L_{P2} – (C_1 + C_2)$
  - L_w = (95 dB) – [(5 dB) + (-33 dB)]
    - L_w = 123 dB
    - It would need a sound power level of 123 dB for a maximum distance of 35 ft from the device and more than one meter away from one other surface.

- General Office Corridor
  - The horn/strobe device located at the south end.
    - $L_w = L_{P1} – (C_3 + C_4 + C_5)$
    - L_w = (90 dB) - [(0 dB) + (-8 dB) + (-14 dB)]
      - L_w = 112 dB
      - It would need a sound power level of 112 dB for a maximum distance of 55 ft from the device, single directional and medium finish.

        - The horn/strobe device located at the north end.
            - $L_w = L_{P1} – (C_3 + C_4 + C_5)$
            - L_w = (90 dB) - [(0 dB) + (-8 dB) + (-14 dB)]
                - L_w = 112 dB
                - It would need a sound power level of 112 dB for a maximum distance of 55 ft from the device, single directional and medium finish.
    - Reception Area Corridor
        - The horn/strobe device located at the north end.
            - $L_w = L_{P1} – (C_3 + C_4 + C_5)$
            - L_w = (90 dB) - [(0 dB) + (-8 dB) + (-10 dB)]
                - L_w = 108 dB
                - It would need a sound power level of 108 dB for a maximum distance of 27 ft from the device, single directional and medium finish.
        - The horn/strobe device located at the south end.
            - $L_w = L_{P1} – (C_3 + C_4 + C_5)$
            - L_w = (90 dB) - [(0 dB) + (-8 dB) + (-10 dB)]
                - L_w = 108 dB
                - It would need a sound power level of 108 dB for a maximum distance of 27 ft from the device, single directional and medium finish.
    - Mechanical Room
        - $L_w = L_{P2} – (C_1 + C_2)$
        - L_w = (95 dB) – [(5 dB) + (-33 dB)]
            - L_w = 123 dB
            - It would need a sound power level of 123 dB for a maximum distance of 27 ft from the device and more than one meter away from one other surface.
    - Break Room A
        - $L_w = L_{P2} – (C_1 + C_2)$
        - L_w = (90 dB) – [(5 dB) + (-33 dB)]
            - L_w = 118 dB
            - It would need a sound power level of 118 dB for a maximum distance of 25 ft from the device and more than one meter away from one other surface.

- General Office area
  - $L_w = L_{P2} – (C_1 + C_2)$
  - $L_w = (90\ dB) – [(5\ dB) + (-39\ dB)]$
    - $L_w = 124\ dB$
    - It would need a sound power level of 124 dB for a maximum distance of 75 ft from the device and more than one meter away from one other surface.

Visible

- $I=Ed^2$
- Chemical Storage Corridor
  - (0.0375 lumens/ft^2) x (15 ft x 89 ft) = <u>50.06 candela</u>
  - Two horn/strobe devices at 30 cd for a total of 60 cd meeting the 50.06 cd required to meet the 0.0375 lumens/ft^2 requirement from NFPA 72 Section 18.5.5.6.1.
- Room in Outbound Staging area
  - (0.0375 lumens/ft^2) x (55 ft x 75 ft) = <u>154.69 candela</u>
  - Two horn/strobe devices at 75 cd for a total of 150 cd not meeting the 154.69 cd required to meet the 0.0375 lumens/ft^2 requirement from NFPA 72 Section 18.5.5.6.1. The horn/strobe devices should be located on opposite walls for best performance.
- Outbound Staging Office Area
  - (0.0375 lumens/ft^2) x (17 ft x 25 ft) = <u>15.94 candela</u>
  - One horn/strobe device at 15 cd for a total of 15 cd not meeting the 15.94 cd required to meet the 0.0375 lumens/ft^2 requirement from NFPA 72 Section 18.5.5.6.1.
- Room in Receiving Area
  - (0.0375 lumens/ft^2) x (55 ft x 75 ft) = <u>154.69 candela</u>
  - Two horn/strobe devices at 75 cd for a total of 150 cd not meeting the 154.69 cd required to meet the 0.0375 lumens/ft^2 requirement from NFPA 72 Section 18.5.5.6.1.
- Outbound Staging area
  - (0.0375 lumens/ft^2) x (5,310 ft^2 + 7,080 ft^2 + 7,140 ft^2) = <u>732.38 candela</u>
  - Four horn/strobe devices at 185 cd for a total of 740 cd meeting the 732.38 cd required to meet the 0.0375 lumens/ft^2 requirement from NFPA 72 Section 18.5.5.6.1.

- General Office Corridor
  - (0.0375 lumens/ft^2) x (10 ft x 109 ft) = 40.88 candela
  - Two horn/strobe devices at 15 cd for a total of 30 cd not meeting the 40.88 cd required to meet the 0.0375 lumens/ft^2 requirement from NFPA 72 Section 18.5.5.6.1. This doesn't meet the requirement of NFPA 72 Section 18.5.5.5.5.
- Reception Area Corridor
  - (0.0375 lumens/ft^2) x (10 ft x 54 ft) = 20.25 candela
  - Two horn/strobe device at 15 cd for a total of 30 cd meeting the 20.25 cd required to meet the 0.0375 lumens/ft^2 requirement from NFPA 72 Section 18.5.5.6.1.
- Mechanical Room
  - (0.0375 lumens/ft^2) x (25 ft x 27 ft) = 25.31 candela
  - One horn/strobe device at 30 cd for a total of 30 cd meeting the 25.31 cd required to meet the 0.0375 lumens/ft^2 requirement from NFPA 72 Section 18.5.5.6.1.
- Break Room A
  - (0.0375 lumens/ft^2) x (25 ft x 25 ft) = 23.44 candela
  - One horn/strobe device at 30 cd for a total of 30 cd meeting the 23.44 cd required to meet the 0.0375 lumens/ft^2 requirement from NFPA 72 Section 18.5.5.6.1.
- General Office area
  - (0.0375 lumens/ft^2) x (42 ft x 75 ft) = 118.13 candela
  - One horn/strobe device at 115 cd for a total of 115 cd not meeting the 118.13 cd required to meet the 0.0375 lumens/ft^2 requirement from NFPA 72 Section 18.5.5.6.1.

Proposed intelligibility for a voice system.

TABLE S2.2 *Examples of Typical 4-in. Speaker Coverage for Varying Ceiling Heights*

Ceiling Height	Coverage Diameter	Coverage Area
	Listener Height = 5 ft	
8 ft	7.7 ft	46 ft^2
10 ft	12.8 ft	129 ft^2
12 ft	17.9 ft	252 ft^2
14 ft	23.0 ft	417 ft^2
16 ft	28.2 ft	623 ft^2
18 ft	33.3 ft	870 ft^2
20 ft	38.4 ft	1158 ft^2
	Listener Height = 1.5 m	
2.5 m	2.6 m	5.1 m^2
3 m	3.8 m	11.6 m^2
3.5 m	5.1 m	20.6 m^2
4 m	6.4 m	32.2 m^2
4.5 m	7.7 m	46.3 m^2
5 m	9.0 m	63.0 m^2
5.5 m	10.2 m	82.3 m^2
6 m	11.5 m	104.2 m^2

Source: NEMA Standards Publication SB 50-2008, *Emergency Communications Audio Intelligibility Applications Guide,*

- Chemical Storage Corridor
  - Ceiling height = 12 ft
  - 15 ft x 89 ft = 1,335 ft^2
  - 1,335 ft^2 / 252 ft^2 of coverage per 4-in. speaker = 5.3 speakers
  - 6 speakers
- Room in Outbound Staging area
  - Ceiling height = 20 ft
  - 55 ft x 75 ft = 4,125 ft^2
  - 4,125 ft^2 / 1,158 ft^2 of coverage per 4-in. speaker = 3.56 speakers
  - 4 speakers
- Outbound Staging Office Area
  - Ceiling height = 20 ft
  - 17 ft x 25 ft = 450 ft^2
  - 450 ft^2/ 1,158 ft^2 of coverage per 4-in. speaker = 0.39 speakers
  - 1 speakers
- Room in Receiving Area
  - Ceiling height = 20 ft
  - 55 ft x 75 ft = 4,125 ft^2
  - 4,125 ft^2 / 1,158 ft^2 of coverage per 4-in. speaker = 3.56 speakers
  - 4 speakers

- Outbound Staging area
    - Ceiling height = 20 ft
    - 5,310 ft^2 + 7,080 ft^2 + 7,140 ft^2 = 19,530 ft^2
    - 19,530 ft^2 / 1,158 ft^2 of coverage per 4-in. speaker = 16.87 speakers
    - 17 speakers
- General Office Corridor
    - Ceiling height = 12 ft
    - 10 ft x 109 ft = 1,090 ft^2
    - 1,090 ft^2 / 252 ft^2 of coverage per 4-in. speaker = 4.33 speakers
    - 5 speakers
- Reception Area Corridor
    - Ceiling height = 12 ft
    - 10 ft x 54 ft = 540 ft^2
    - 540 ft^2 / 252 ft^2 of coverage per 4-in. speaker = 2.14 speakers
    - 3 speakers
- Mechanical Room
    - Ceiling height = 12 ft
    - 25 ft x 27 ft = 675 ft^2
    - 675 ft^2 / 252 ft^2 of coverage per 4-in. speaker = 2.68 speakers
    - 3 speakers
- General Office area
    - Ceiling height = 12 ft
    - 81 ft x 40 ft = 3,240 ft^2
    - 3,240 ft^2 / 252 ft^2 of coverage per 4-in. speaker = 12.86 speakers
    - 13 speakers

The calculated secondary power supply requirement for the alarm system is 8.15 amp hours. This calculation is below. The secondary power supply is two 18 amp hour batteries located in the fire alarm panel cabinet. These batteries provide 36 amp hours and the system requires 8.15 amp hours to meet the requirements of NFPA 72. These batteries also provide a safety factor of 27.85 amp hours.

Table 10: Secondary power supply requirements for the fire alarm system

			Supervisory Current (amps)		Alarm Current (amps)	
Equipment	**Description**	**Quantity**	**Unit**	**Total**	**Unit**	**Total**
EPS10-1	Pressure	1	0.01	0.01	0.01	0.01
NOT-BG12LX	Pull station	15	0.000375	0.005625	0.005	0.075
DNR	Duct	2	0	0	0.012	0.024
WFDN	Waterflow	4	0.01	0.04	0.01	0.04
PIBV2	Supervisory	4	0.01	0.04	0.01	0.04
SpectrAlert Advance	H/S (15 cd)	4	0.01	0.01	0.103	0.412
SpectrAlert Advance	H/S (30 cd)	4	0.01	0.04	0.126	0.504
SpectrAlert Advance	H/S (75 cd)	4	0.01	0.04	0.181	0.724
SpectrAlert Advance	H/S (115 cd)	1	0.01	0.01	0.229	0.229
SpectrAlert Advance	H/S (185 cd)	4	0.01	0.04	0.309	1.236
FireWarden t-50(E)	Panel	1	0.003	0.003	0.003	0.003
RC-100R	Relay	2	0	0	0.0065	0.0013
Notification Circuits		1	0.0025	0.0025	0.0025	0.0025
Subtotals (amps)				0.271125		3.3125

Time factor	24 hours of standby (amp hours)	6.507	
	5 minutes of alarm (amp hours)		0.011502
System Amp Hours			6.518502
25% Derating			1.629625
Total Amp Hours			8.148127
Batteries provided	2	18 (amp)	36 (amp)
Available spare capacity			27.851877

Summary

This facility meets the code requirements of placement for the notification devices and initiation devices. It would require some modification to meet the performance requirements, but it should meet the intent of the system to detect and notify the occupants of a fire situation.

Water-based Fire Suppression Systems

Facility Description and Location

This a Costco located in Sacramento, CA. Costco is a “membership warehouse club, dedicated to bringing our members the best possible prices on quality brand-name merchandise. With hundreds of locations worldwide, Costco provides a wide selection of merchandise, plus the convenience of specialty departments and exclusive member services, all designed to make your shopping experience a pleasurable one.”

This facility is a single level Class VI Commodity selling an assortment of products in bulk quantities.

Applicable Codes

Since the purpose of this report is solely to design a fire suppression system the only applicable code would be the National Fire Protection Association's Standard for the Installation of Sprinkler Systems (NFPA 13) the 2013 edition.

Construction

This building is of a general "box store" construction with 130,227 ft^2 of sales floor. The roof height is 25 ft 4 in tall.

Assumptions

There were several assumptions made with this design. Here is a list of the major assumptions.

- Class VI Commodities per NFPA 13 Section 5.6.3.4.1(3).
- Flat ceiling with no skylights at an elevation of 24 ft 6 in.
- The columns have fireproofing wrapping.
- Storage up to 20 ft with racks to 15 ft.
- The racks are gridded.
- Systems can only cover a maximum of 40,000 ft^2 per NFPA 13 Section 8.2.1(4).
- Since ESFR sprinklers are being used, only ceiling level sprinklers are required per NFPA 13 Table 16.2.3.1.
- Since ESFR sprinklers are being used, the hose stream allowance is 500 gpm per NFPA 13 Table 12.8.6.1.
- Since ESFR 25.2 K-factor sprinklers are being used, the minimum operating pressure is 15 psi per NFPA 13 Table 12.8.6.1.
- Since ESFR sprinklers are being used, "the design area shall consist of the most hydraulically demanding area of 12 sprinklers, consisting of four sprinklers on each of three branchlines" per NFPA 13 Section 16.2.3.5.

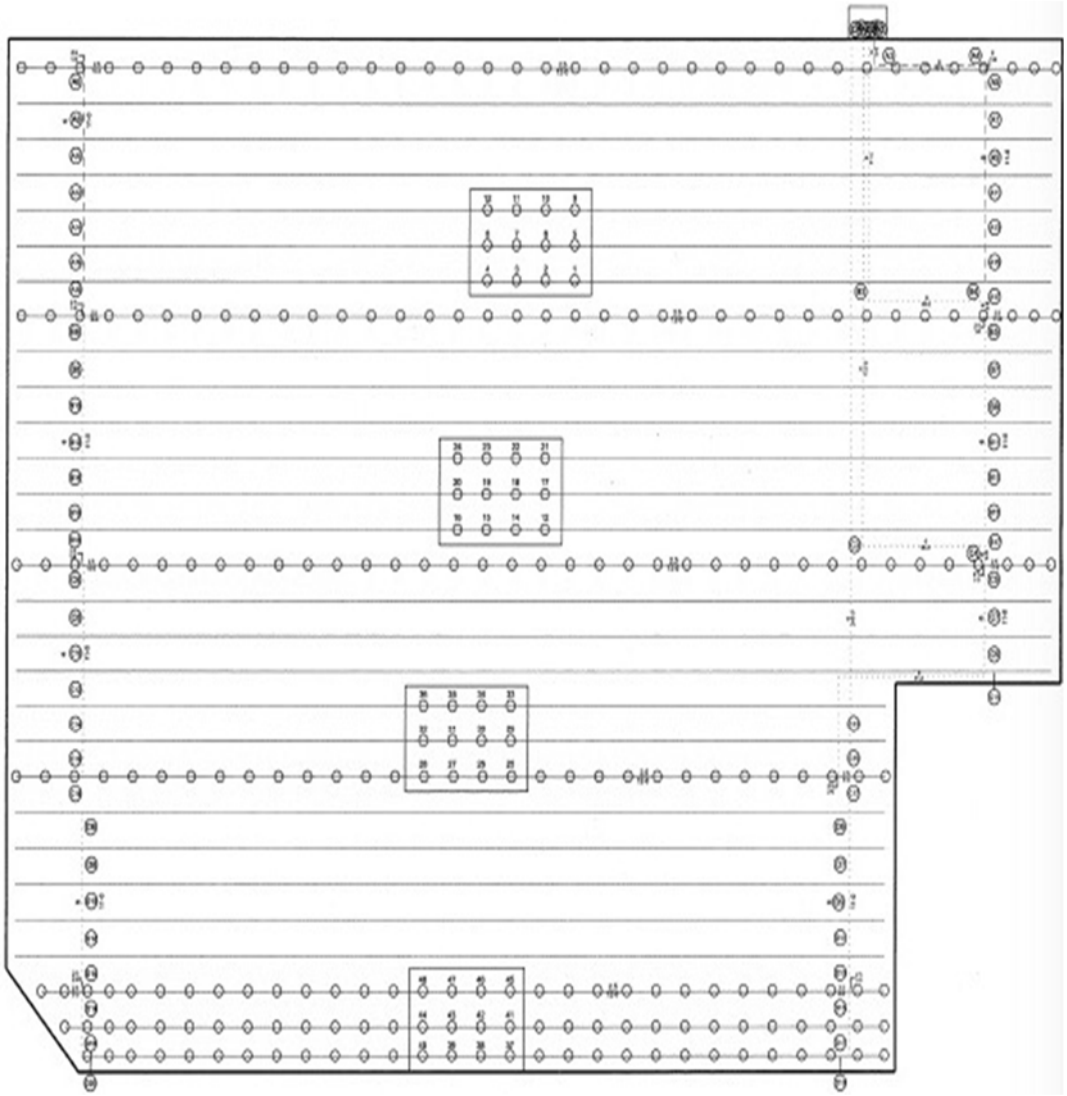
Water Supply Information

The water supply information was provided for this project and is located at the Base of the Riser (BOR).

- Static of 80 psi
- Residual of 60 psi
- Flow of 1,000 gpm

System Information

Figure 13: Costco Sprinkler Layout



General Sprinkler System Information:

- All piping is Schedule 40 black steel.
- All fittings are Victaulic fire protection fittings for a typical Schedule 40 black steel wet system.
- All sprinklers are Tyco Fire Protection Products Model ESFR-25 SIN TY9226 Early Suppression, Fast Response Pendent Sprinklers 25.2 K-factor. See Appendixes for the data sheet.
- The pump is a Peerless Horizontal Fire Pump rated flow 1,250 gpm at 90 psi. See Appendix for general information.
- All waterflow alarm switches and tamper switches are Potter Electric Signal Company.

System A:

- Flow required at the Base of the Riser (BOR) is 1,682.6 gpm.
- Pressure required at the Base of the Riser (BOR) is 20.0 psi.
- Flow required at the pump is 1,182.7 gpm.
- Pressure required at the pump is 72.1 psi.
- Safety factor of 7.6 psi (28%).
- Total hose stream is 500 gpm.
- Minimum operating pressure from sprinklers is 15 psi.
- Minimum flow from sprinklers 97.6 gpm.
- Number of sprinklers operating is 12.
- Operating density is 0.75 gpm/ft^2.
- Coverage area per sprinkler is 132 ft^2.
- Spacing between branchlines is 11 ft.
- Spacing between sprinklers is 12 ft.
- Area of application is 1,584 ft^2.
- Located closest to the riser (top of the store).

System B:

- Flow required at the Base of the Riser (BOR) is 1,682.7 gpm.
- Pressure required at the Base of the Riser (BOR) is 20.0 psi.
- Flow required at the pump is 1,182.7 gpm.
- Pressure required at the pump is 75.96 psi.
- Safety factor of 7.6 psi (28%).
- Total hose stream is 500 gpm.
- Minimum operating pressure from sprinklers is 15 psi.
- Minimum flow from sprinklers 97.6 gpm.
- Number of sprinklers operating is 12.
- Operating density is 0.75 gpm/ft^2.
- Coverage area per sprinkler is 132 ft^2.
- Spacing between branchlines is 11 ft.
- Spacing between sprinklers is 12 ft.
- Area of application is 1,584 ft^2.
- Located second closest to the riser (middle of the store).

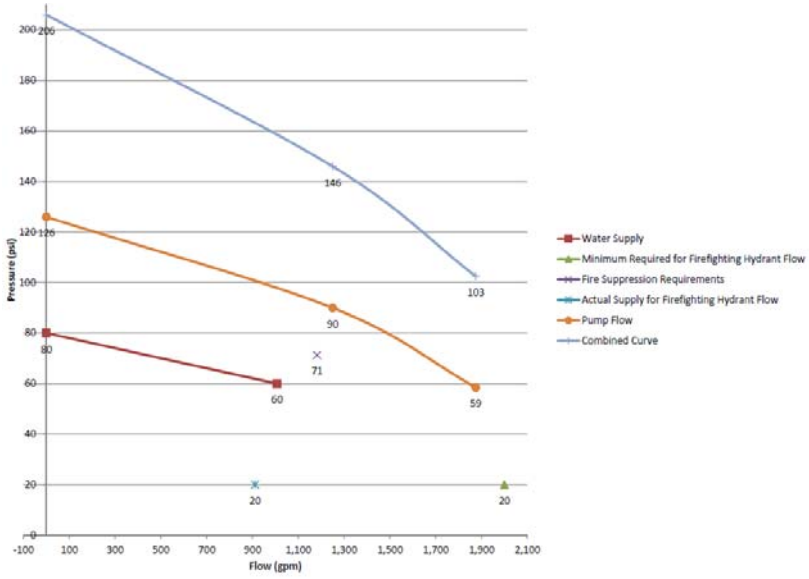
System C:

- Flow required at the Base of the Riser (BOR) is 1,683.7 gpm.
- Pressure required at the Base of the Riser (BOR) is 20.0 psi.
- Flow required at the pump is 1,183.7 gpm.
- Pressure required at the pump is 71.3 psi.
- Safety factor of 7.6 psi (29%).
- Total hose stream is 500 gpm.
- Minimum operating pressure from sprinklers is 15 psi.
- Minimum flow from sprinklers 97.6 gpm.
- Number of sprinklers operating is 12.
- Operating density is 0.75 gpm/ft^2.
- Coverage area per sprinkler is 132 ft^2.
- Spacing between branchlines is 11 ft.
- Spacing between sprinklers is 12 ft.
- Area of application is 1,584 ft^2.
- Located second farthest to the riser (middle of the store).

System D:

- Flow required at the Base of the Riser (BOR) is 1,681.7 gpm.
- Pressure required at the Base of the Riser (BOR) is 20.0 psi.
- Flow required at the pump is 1,181.8 gpm.
- Pressure required at the pump is 71.35 psi.
- Safety factor of 7.7 psi (28%).
- Total hose stream is 500 gpm.
- Minimum operating pressure from sprinklers is 15 psi.
- Minimum flow from sprinklers 97.6 gpm.
- Number of sprinklers operating is 12.
- Operating density is 0.75 gpm/ft^2.
- Coverage area per sprinkler is 132 ft^2.
- Spacing between branchlines is 11 ft.
- Spacing between sprinklers is 12 ft.
- Area of application is 1,584 ft^2.
- Located farthest to the riser (bottom of the store).

Figure 14: System D Water Supply Graph



Summary

This system was designed to meet the minimum requirements called out in NFPA 13 and also include a safety factor to allow the water supply to deteriorate over time if the area has more demands on the water supply in the future.

Fire Model of Egress Time for Costco

Model Information

Fire Dynamic Simulator (FDS) fire models were completed for three different fire scenarios. The first scenario was a fire in the Stock Room, the second on the Sales Floor and the third is an arson fire where three different fires are started throughout the store. The fire size used for these models was a polyethylene trash barrels in cardboard cartons with a peak heat release rate of 28,900kW/m^2 and a peak time of 578 seconds according to Table 3-1.9 of the fourth edition of the SFPE Handbook. Solid blocks were used for the mechanize racks due to limited modeling time with a 1 m^2 burner. The models were calculated to 10 minutes after fire ignition also due to limited modeling time. The models also have a head level of 6 ft. 6 in.

Egress Time

The calculated approximate egress time from the sales floor for the maximum occupant load at the worst case scenario travel distance and aisle widths is eight minutes. The calculated approximate egress time from the stock room for the maximum occupant load at the worst case scenario travel distance and aisle widths is 9.5 minutes. These calculations are shown below. Per Table 3-12.2 of the fourth edition of the SFPE Handbook, there is a delay time to start evacuation after the notification is initiated. This value per the table for one-story department store is 0.9 minutes as the worst case scenario.

Figure 15: Costco Egress Drawing

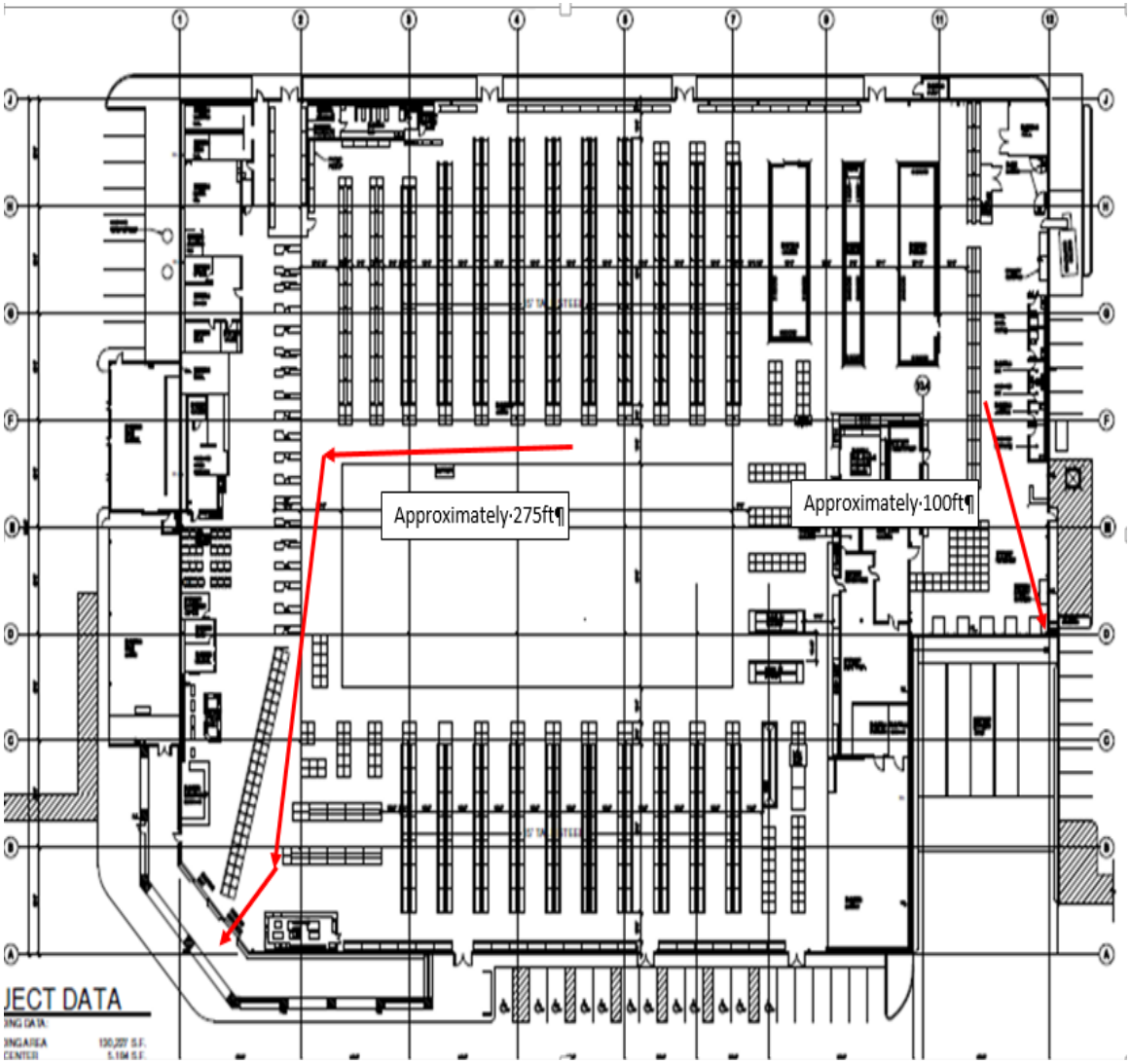


Table 11: Costco Egress Time Calculation

Mercantile occ NFPA 101	0.2 in/person					
Sales floor area	106,240 ft^2					
Storage floor area	13,736 ft^2					
Sales floor occ load	3,541 people					
Storage floor occ load	46 people					
Rack Corridor effective width	6.67 ft					
Door Sale width	59.02 ft					
Door Sales effective width W_e	58.02 ft					
Door Storage width	0.76 ft	Use 3 ft				
Door Storage effective width W_e	-0.24 ft	Use 2 ft				
Sales floor corridors				Storage floor corridor		
S=k-akD	k=	275		S=k-akD	k=	275
	a=	2.86 ft/min			a=	2.86 ft/min
	D=	0.033 persons/ft^2			D=	0.033 persons/ft^2
	S=	248.78 persons/ft/min			S=	272.38 persons/ft/min
$F_s=(1-aD)kD$	F_s=	8.29 persons/ft/min		$F_s=(1-aD)kD$	F_s=	0.91 persons/ft/min
TT(travel time) = [d(distance)*F_s]/Occ load	d=	275 ft		TT(travel time) = [d(distance)*F_s]/Occ load	d=	275 ft
	TT=	0.64 min			TT=	0.64 min
$F_c=F_sW_e$	F_c=	55.29 persons/min		$F_c=F_sW_e$	F_c=	6.05 persons/min
Sales floor doors				Storage floor doors		
S=k-akD	k=	275		S=k-akD	k=	275
	a=	2.86 ft/min			a=	2.86 ft/min
	D=	0.033 persons/ft^2			D=	0.033 persons/ft^2
	S=	248.78 persons/ft/min			S=	272.38 persons/ft/min
$F_s=(1-aD)kD$	F_s=	8.29 persons/ft/min		$F_s=(1-aD)kD$	F_s=	0.91 persons/ft/min
$F_c=F_sW_e$	F_c=	481.17 persons/min		$F_c=F_sW_e$	F_c=	1.82 persons/min
$t_p=P/F_c$	t_p=	7.36 min		$t_p=P/F_c$	t_p=	7.56 min
t(total time)=TT+t_p	t=	8.00 min		t(total time)=TT+t_p	t=	9.55 min

Stock Room Model

It takes approximately 3.1 minutes for the sprinklers to activate according to the Stock Room model. The total egress time for this model from the Sales Floor is 12 minutes and from the Stock Room is 13.5 minutes. Per the model, the main exit from the Sales Floor is obscured around the 6 minute marker, thus requiring occupants to find alternate exits. The model shows the smoke level would not reach head level by the 10 minute mark. The model also showed how a large, flat, non-obstructed ceiling allowed the heat to dissipate across the building very easily.

Figure 16: Stock Room Model

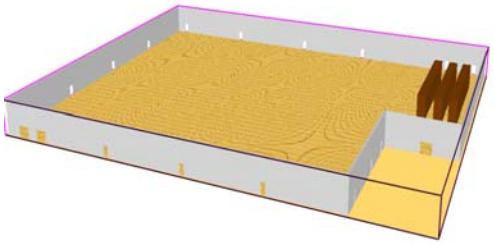


Figure 17: Stock Room Model

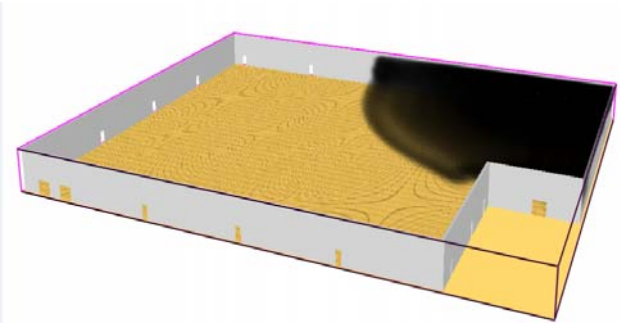


Figure 18: Stock Room Model

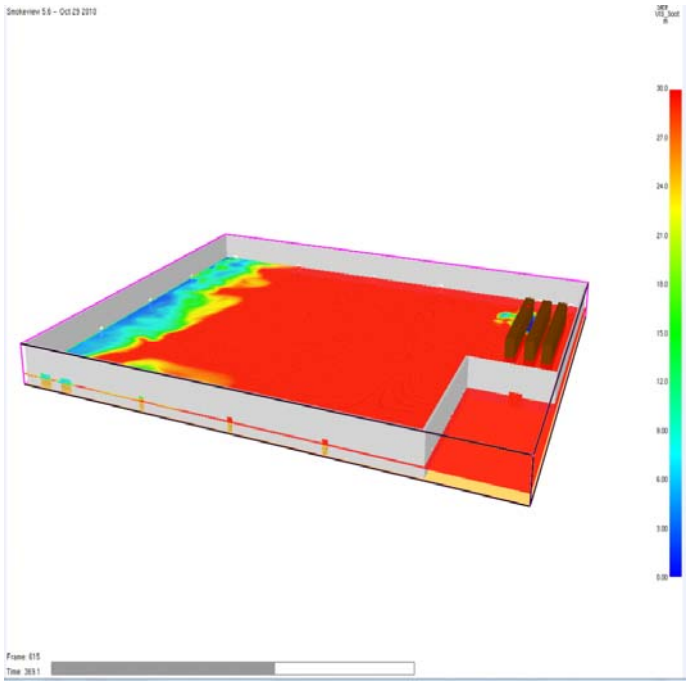


Figure 19: Stock Room Model

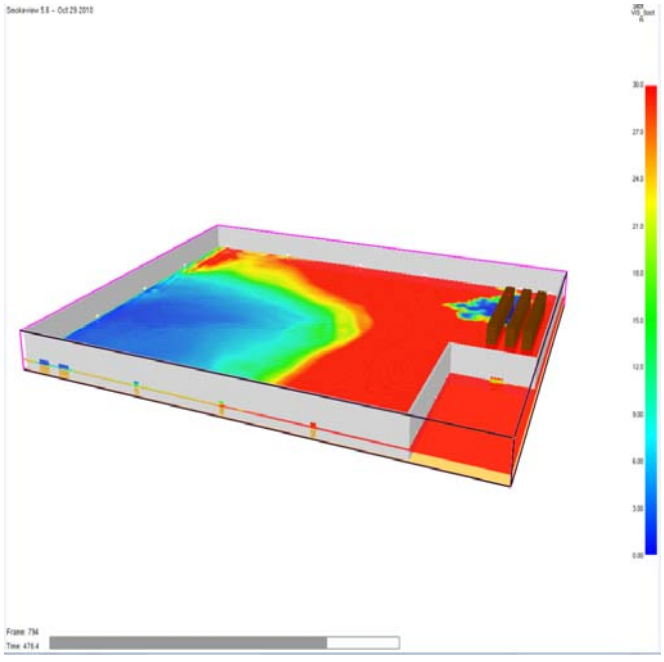


Figure 20: Stock Room Model Sprinkler Activation Graph

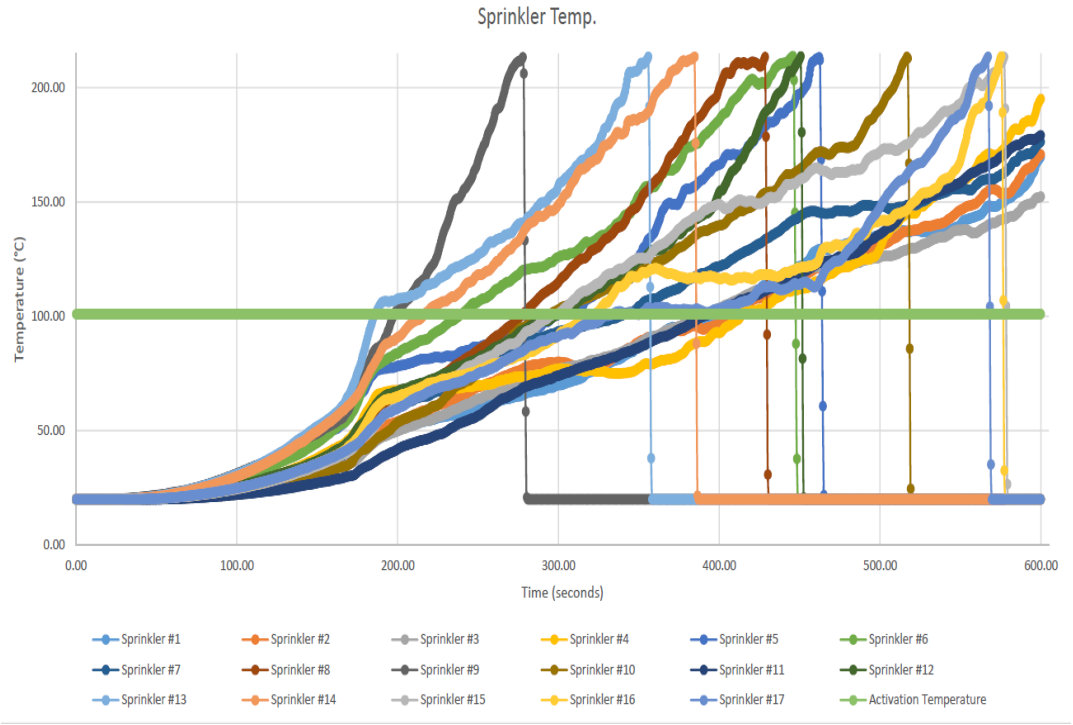
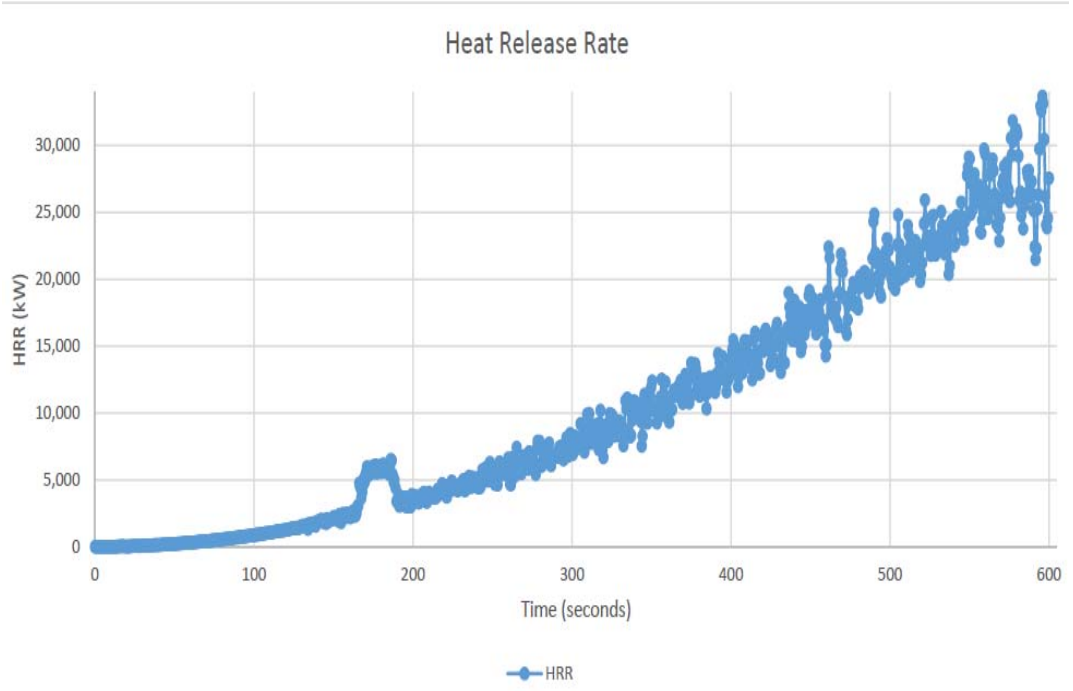


Figure 21: Stock Room Model Heat Release Rate Graph



Sales Floor Model

The sprinklers activate at approximately 2.68 minutes according to the Sales Floor model. The total egress time for this model from the Sales Floor is 11.58 minutes and from the Stock Room is 13.08 minutes. Per the model, the front exits of the store are obscured around the 5.8 minute marker, thus requiring occupants to find alternate exits.

Figure 22: Sales Floor Model

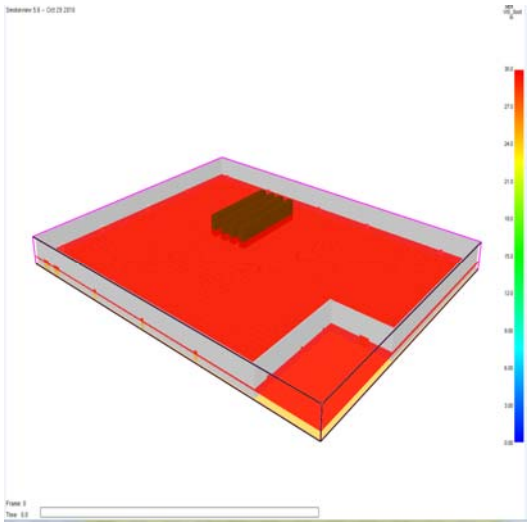


Figure 23: Sales Floor Model

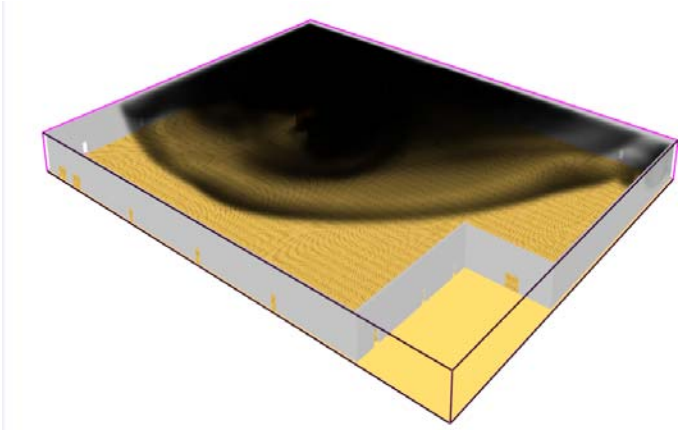


Figure 24: Sales Floor Model

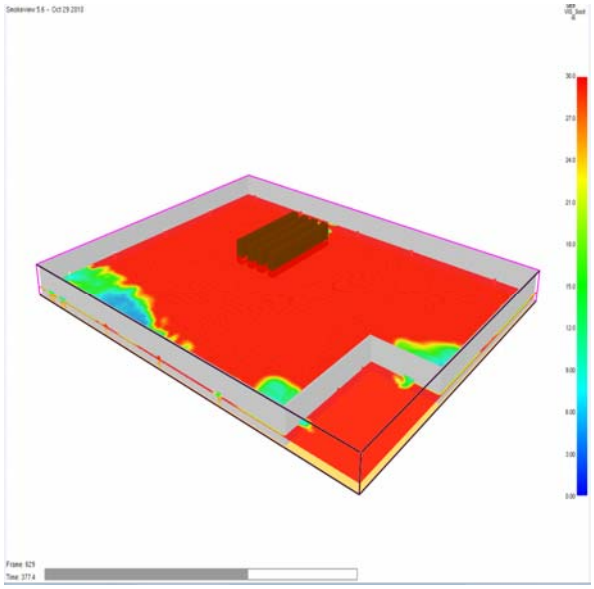


Figure 25: Sales Floor Model

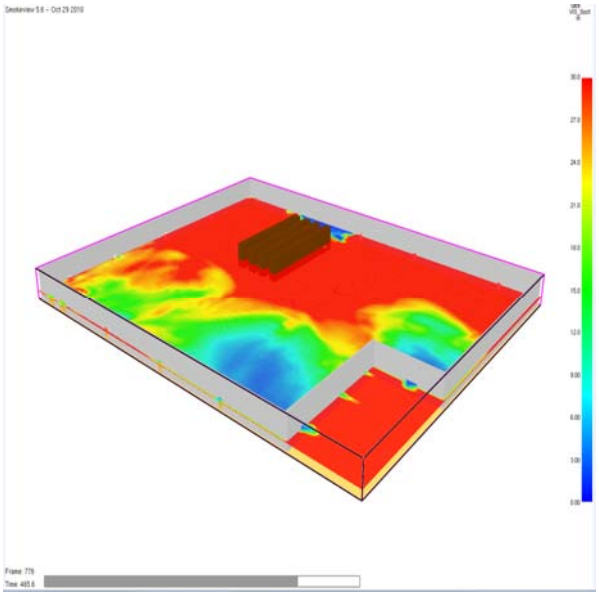


Figure 26: Sales Floor Model Sprinkler Activation Graph

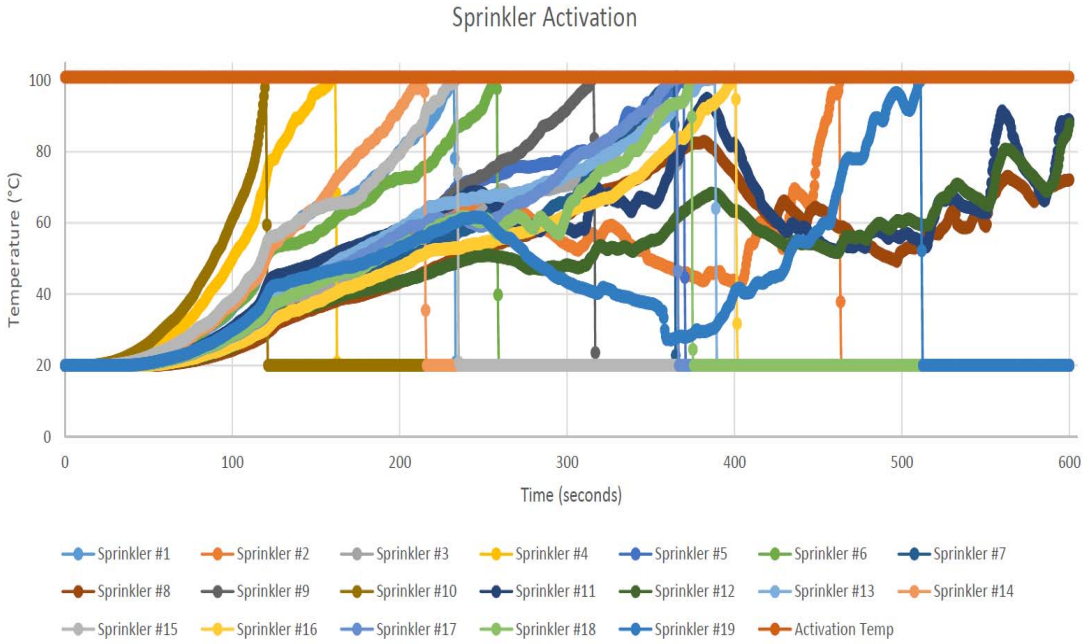
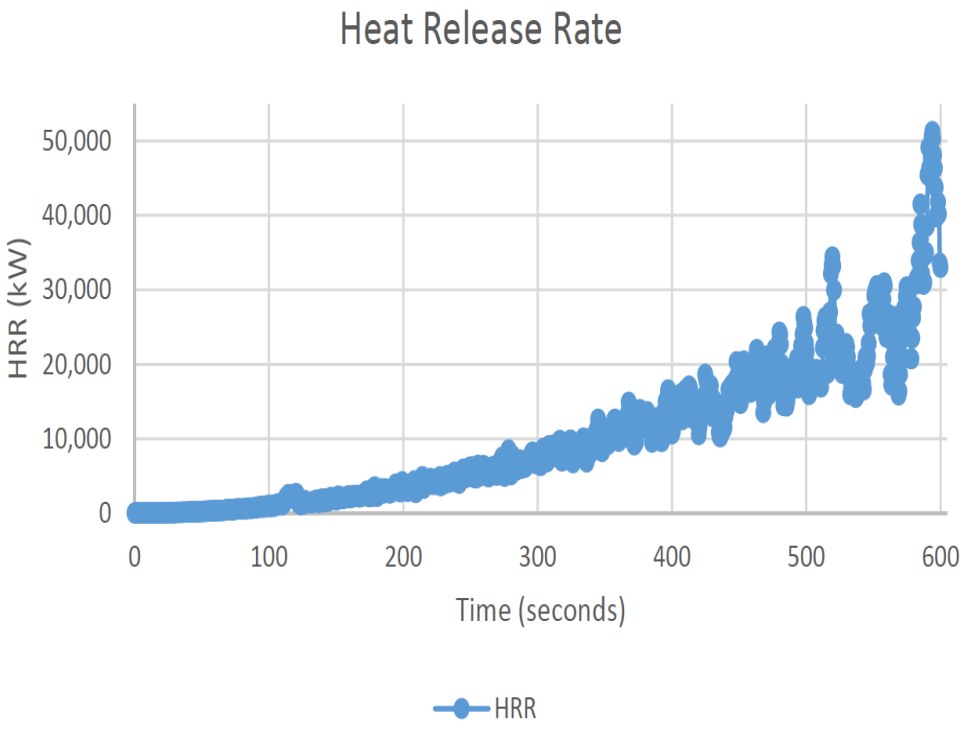


Figure 26: Sales Floor Model Heat Release Rate Graph



Arson Fire Model

It takes approximately 2.68 minutes for the sprinklers to activate according to the Arson Fire model. The total egress time for this model from the Sales Floor is 11.58 minutes and from the Stock Room is 13.08 minutes. Per the model, the back exits of the store are obscured around the two minute marker. Around the 4.5 minute marker, all exits are completely engulfed in smoke, thus not allowing all of the occupants to evacuate the facility before being exposed to smoke. The model also showed how a large, flat, non-obstructed ceiling allowed the heat to dissipate across the building very easily.

Figure 27: Arson Model

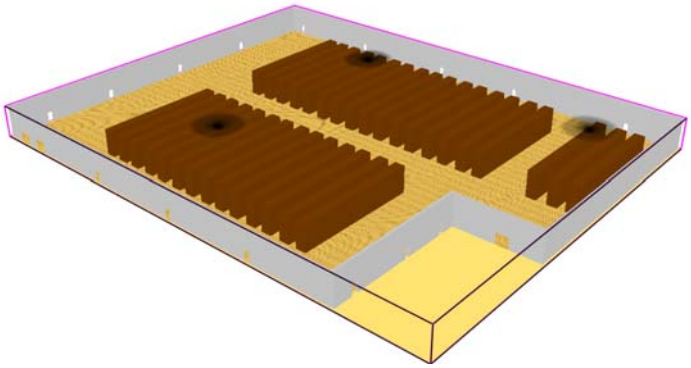


Figure 28: Arson Model

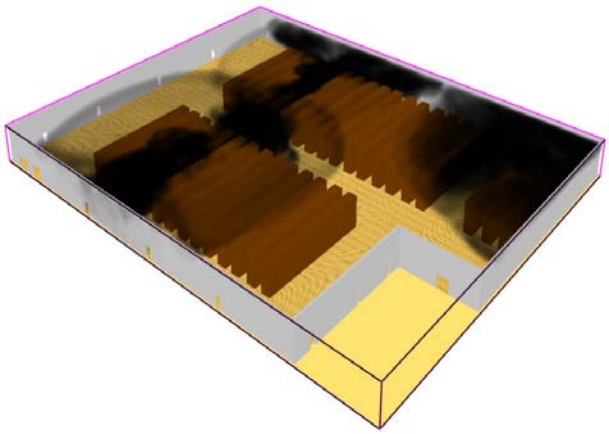


Figure 29: Arson Model

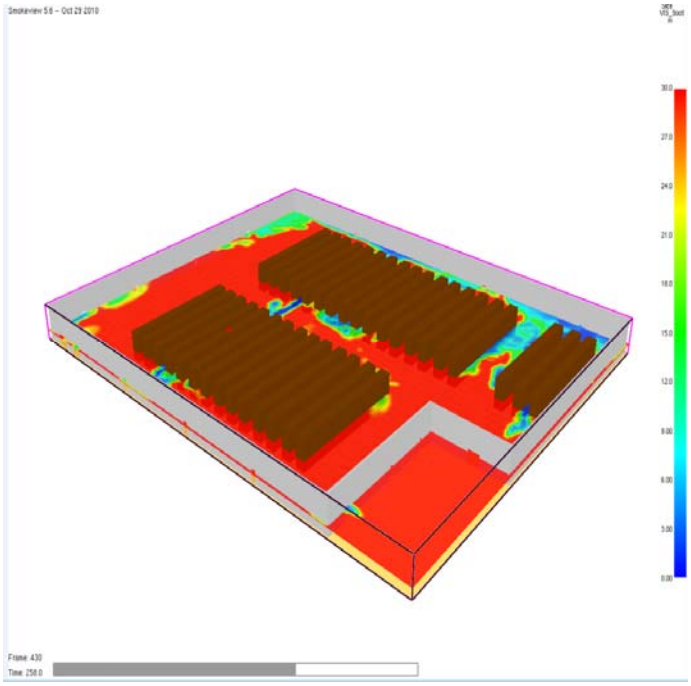


Figure 30: Arson Model

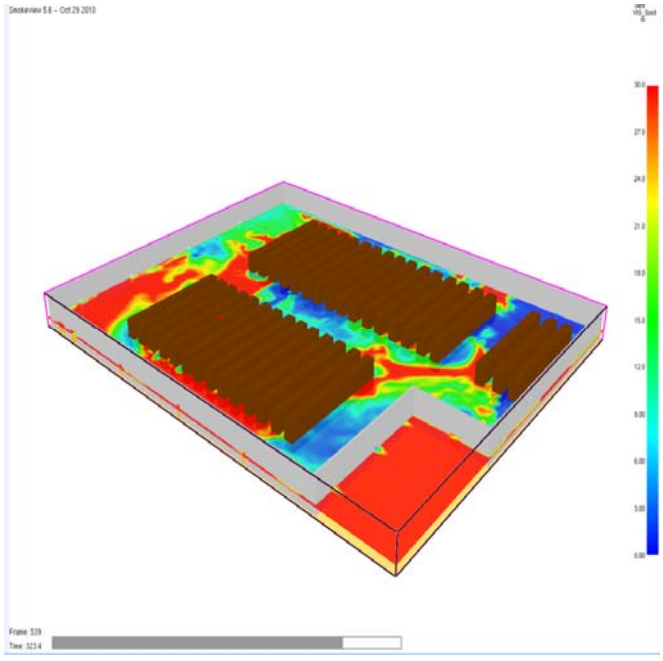


Figure 31: Arson Model Sprinkler Activation Graph

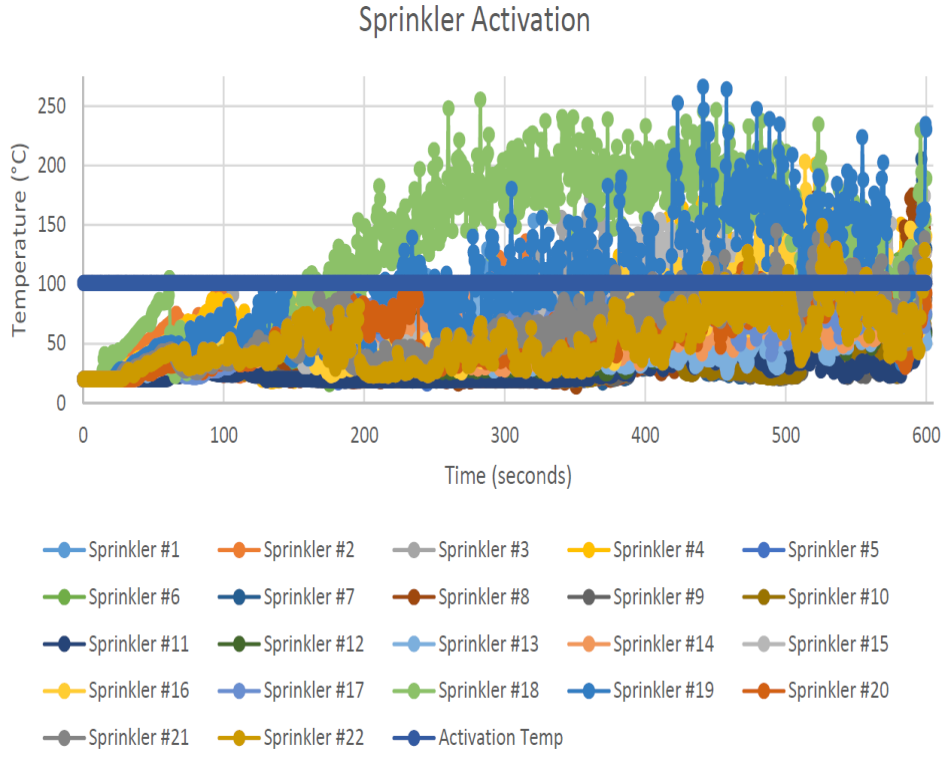
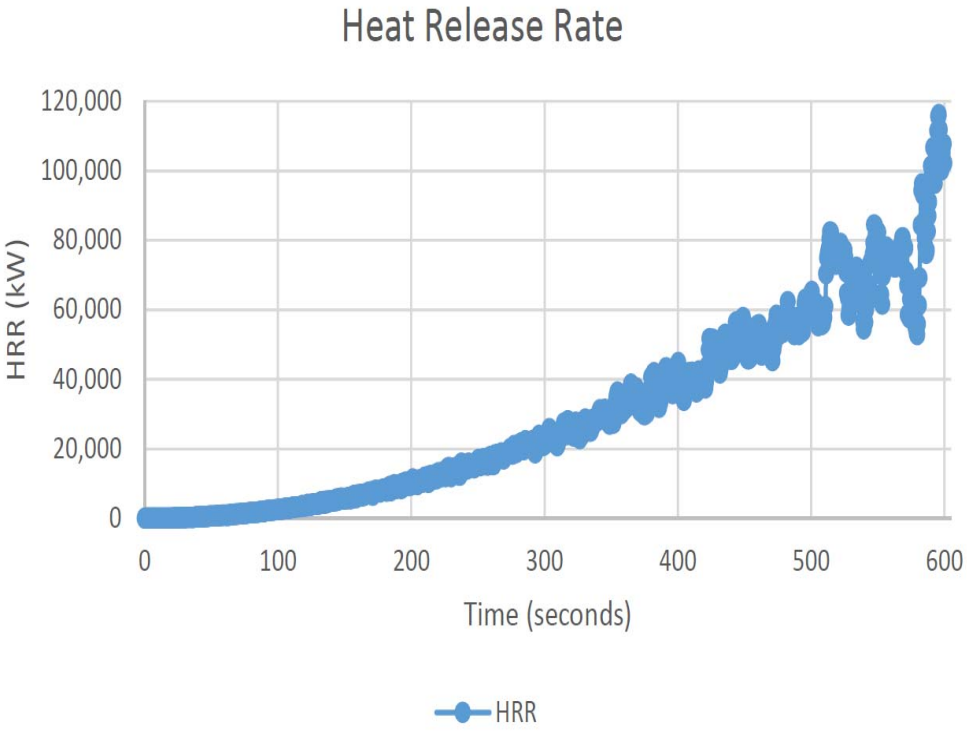


Figure 32: Arson Model Heat Release Rate Graph



Summary

The objective of the model scenarios chosen was to prove the current exit configuration would allow all the occupants to exit before the smoke level dropped low enough to obstruct the exits at head height. The worst case scenario for these three situations would be an arson fire which current codes do not normally protect against. For all three scenarios, the smoke level reached head height at the exits before the facility was complete evacuated, obstructing certain exits. This will affect the exit times and the facility will not be completely evacuated before occupants will be exposed to smoke. A more accurate model would be to run for a longer time and have the egress times in an egress model instead of hand calculations to see what would happen when certain exits are obstructed. This was not completed due to limited access to a modeling computer. To have enough time to evacuate all the occupants, the travel distance would need to be decreased.

Closing Summary

All of these facilities meet most of the current code requirements and may or may not meet their code of record. Most of these facilities meet the performance-based requirements, as well. All of these facilities were trying to meet the intent of the code, but all of them have issues with the design in some way or another. All of the designs were intended to keep people safe during a fire situation. The designs of all of these facilities show the current codes need to be updated to keep up with current fuel loads for the occupancies and more designs should look into trying to implement performance-based approaches for certain design aspects. Either just following the prescribed code requirements or just following the performance-based approach does not always create the most fire safe buildings.

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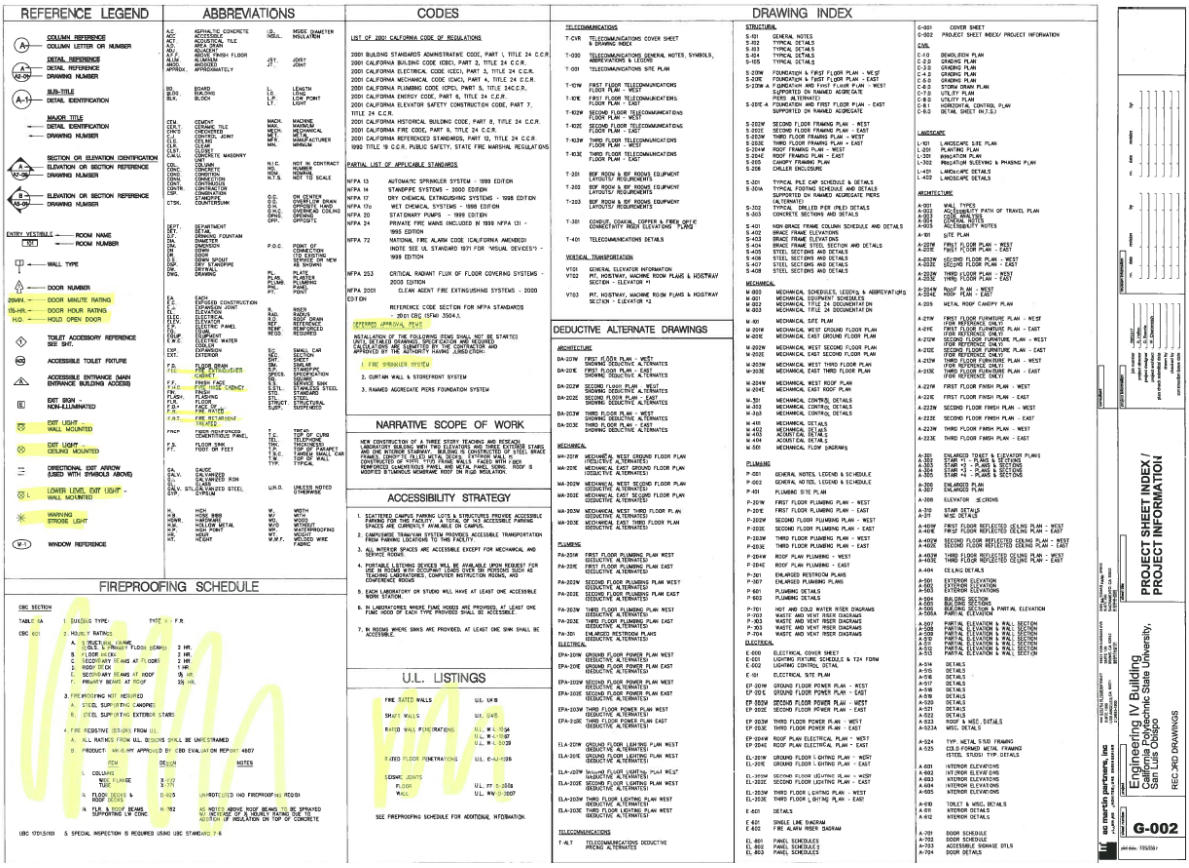
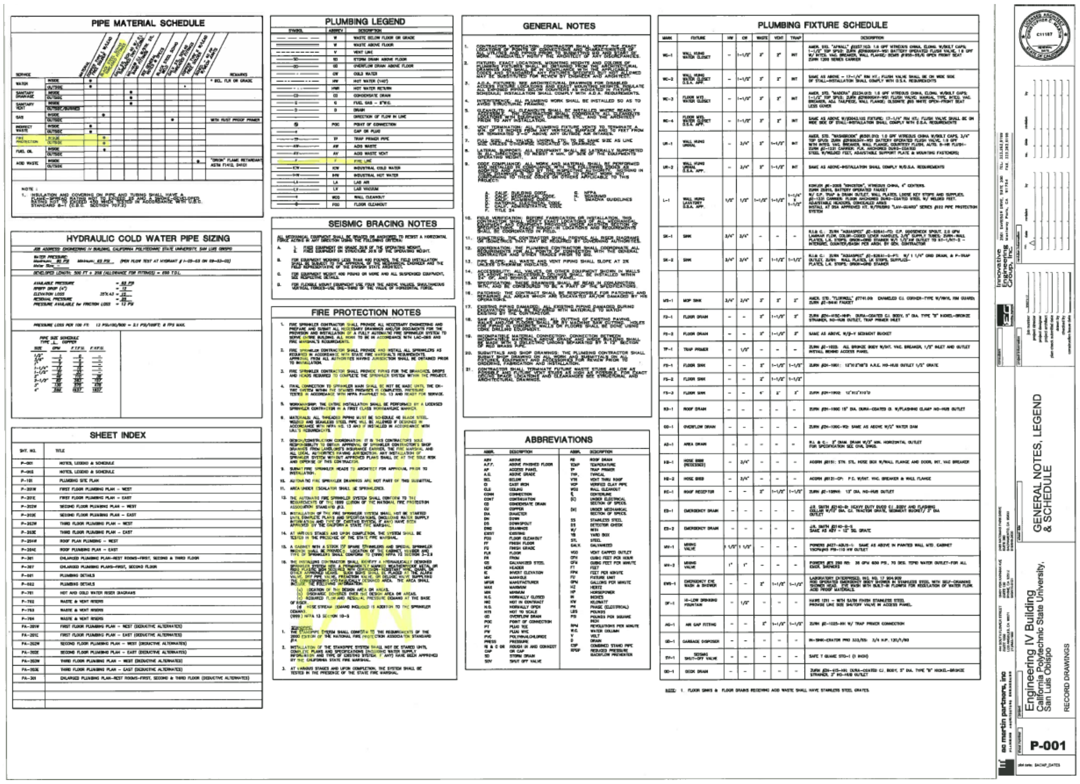
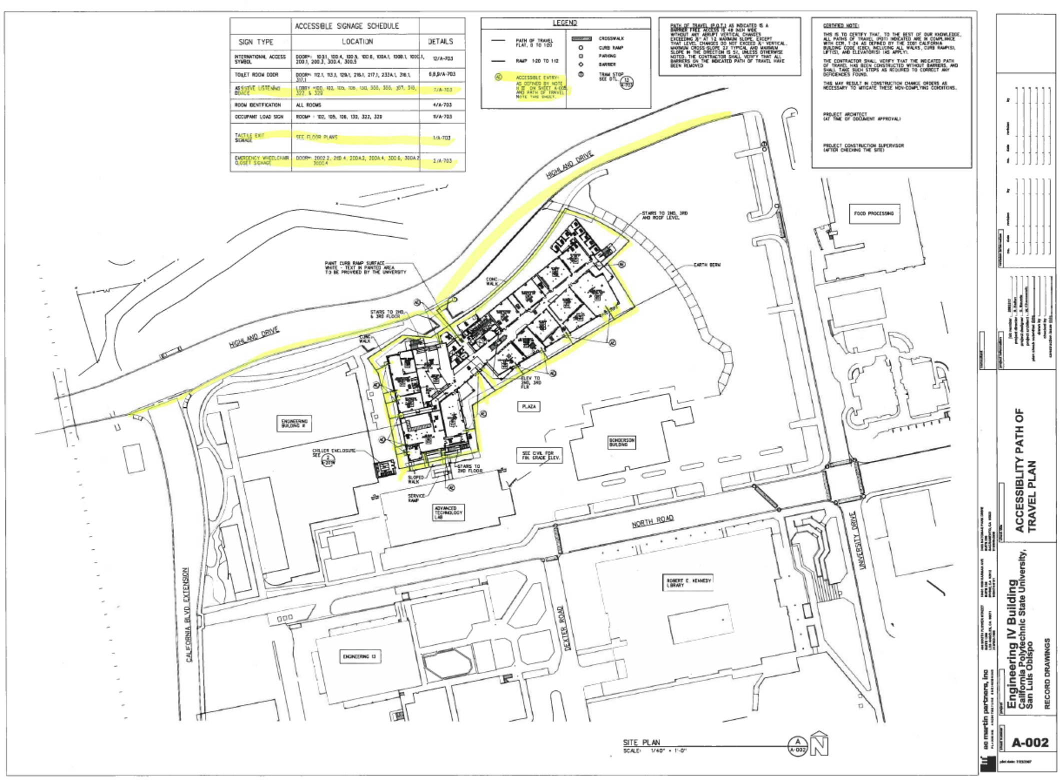
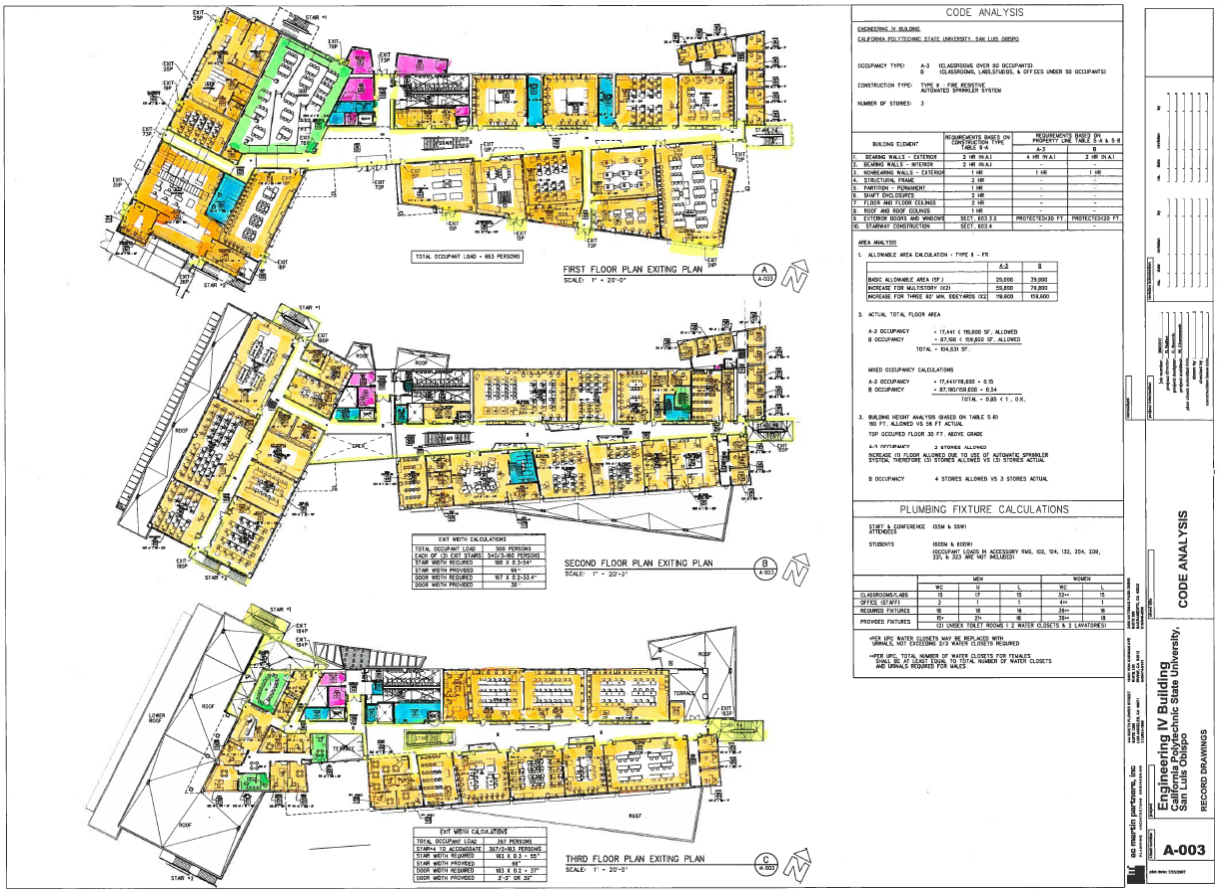
Egress Appendix

Drawings




PIPE MATERIAL SCHEDULE
PLUMBING LEGEND
GENERAL NOTES
PLUMBING FIXTURE SCHEDULE
SEISMIC BRACING NOTES
HYDRAULIC COLD WATER PIPE SIZING
FIRE PROTECTION NOTES
SHEET INDEX
ABBREVIATIONS
Engineering IV Building
California Polytechnic State University, San Luis Obispo
RECORD DRAWINGS
GENERAL NOTES, LEGEND & SCHEDULE
P-001


ACCESSIBLE SIGNAGE SCHEDULE
LEGEND
HIGHLAND DRIVE
NORTH ROAD
PLAZA
SITE PLAN
Engineering IV Building
California Polytechnic State University, San Luis Obispo
RECORD DRAWINGS
ACCESSIBLITY PATH OF TRAVEL PLAN
A-002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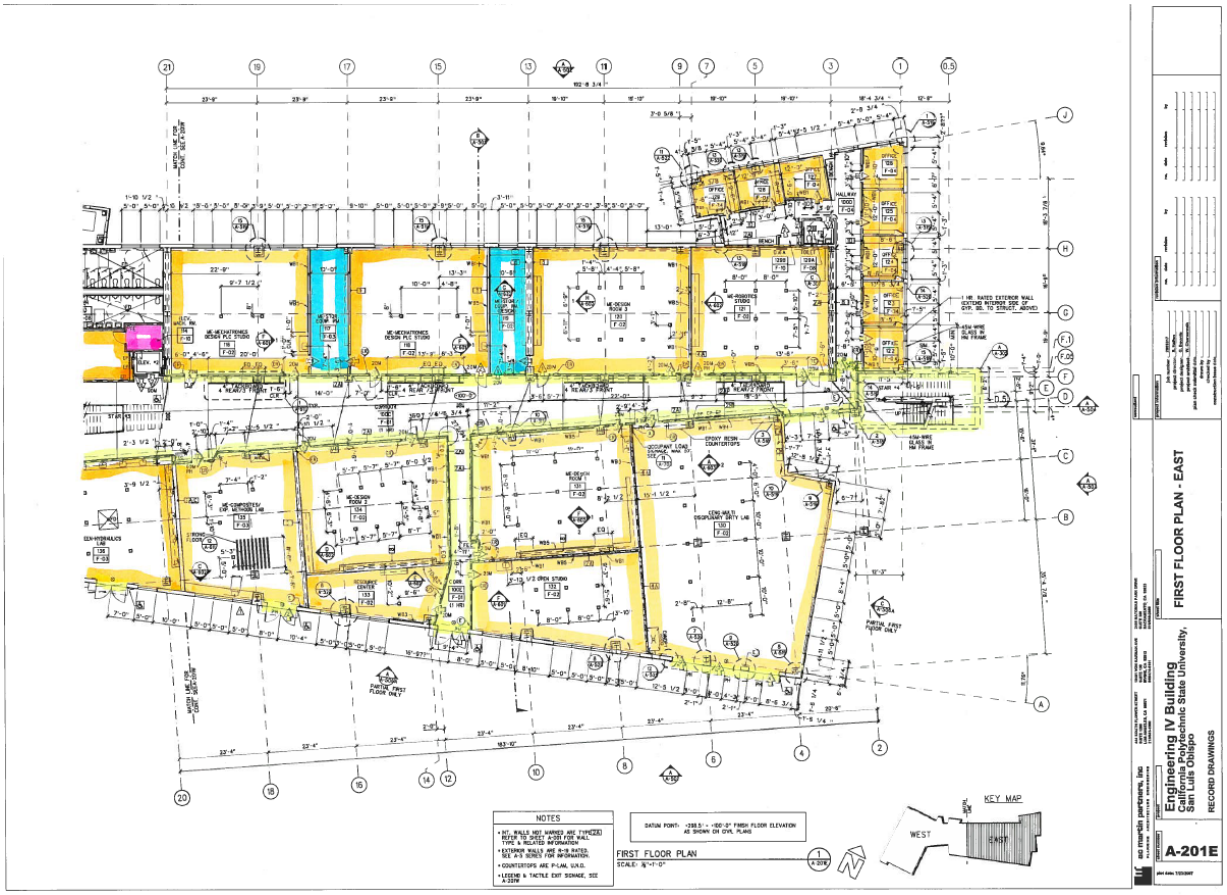
SCALE: 1" = 20'-0"
SECOND FLOOR PLAN EXITING PLAN
SCALE: 1" = 20'-0"
THIRD FLOOR PLAN EXITING PLAN
SCALE: 1" = 20'-0"
CODE ANALYSIS
PLUMBING FIXTURE CALCULATIONS
Engineering IV Building
California Polytechnic State University,
San Luis Obispo
RECORD DRAWINGS
A-003


FIRST FLOOR PLAN - EAST
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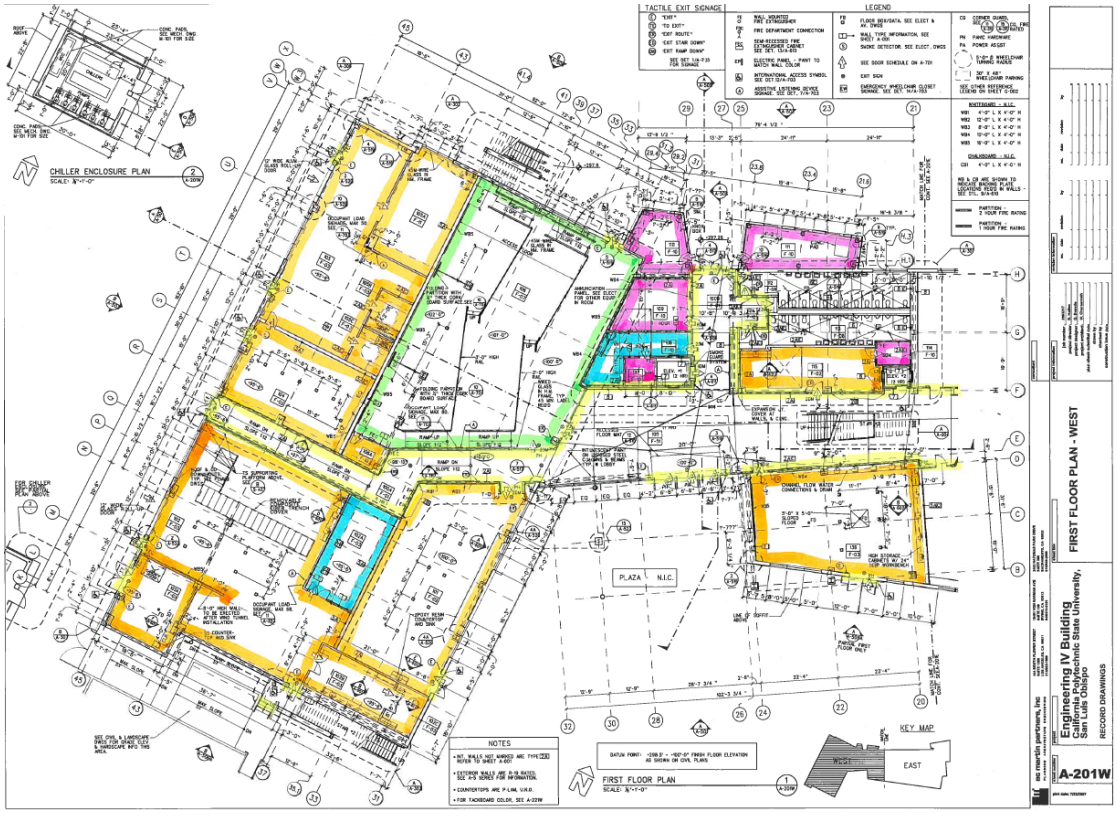
California Polytechnic State University, San Luis Obispo
RECORD DRAWINGS
A-201E
FIRST FLOOR PLAN
NOTES
KEY MAP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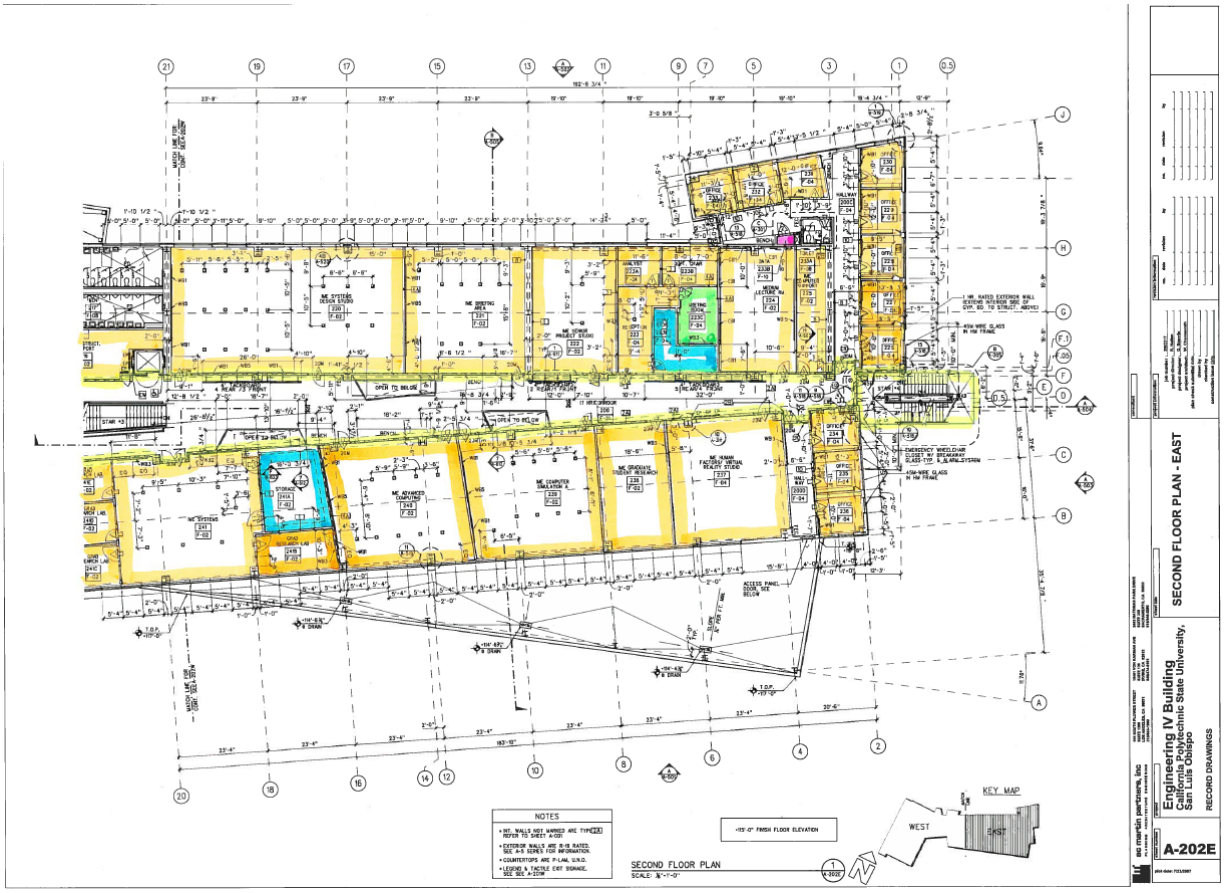
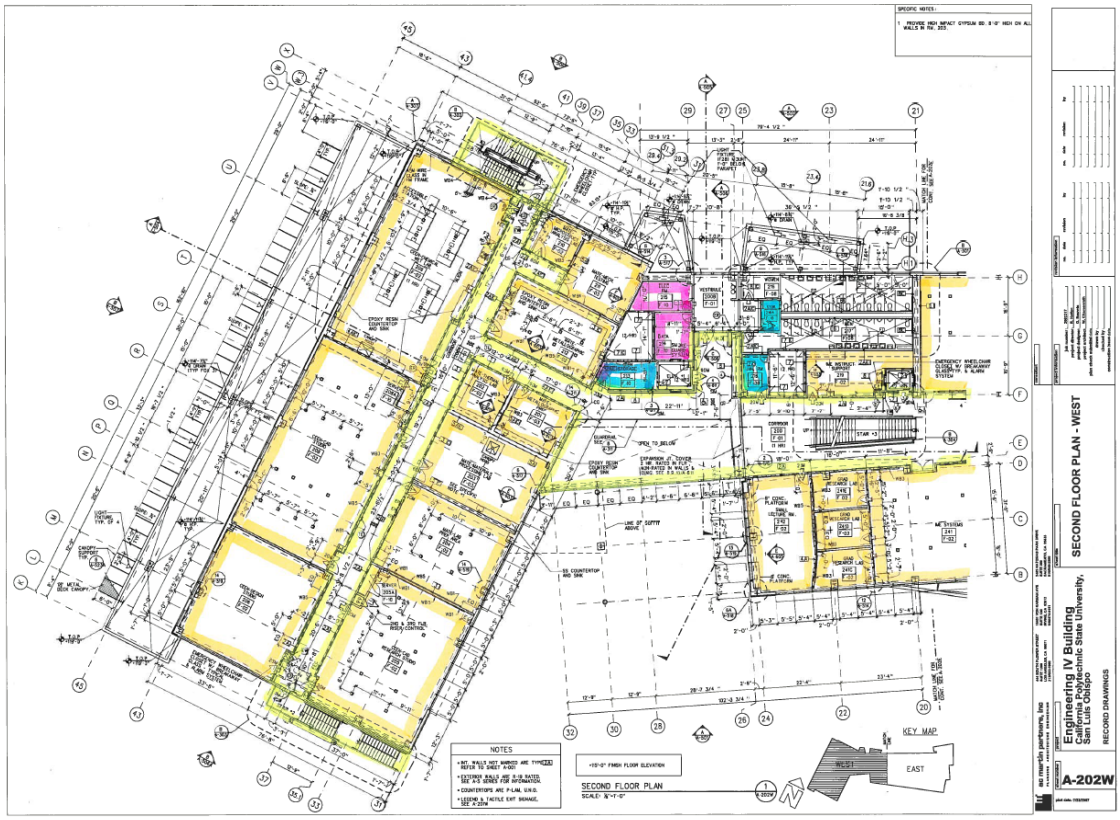
California Polytechnic State University, San Luis Obispo
RECORD DRAWINGS
A-201W
CHILLER ENCLOSURE PLAN
FIRST FLOOR PLAN
NOTES
KEY MAP


SECOND FLOOR PLAN - EAST
Engineering IV Building
California Polytechnic State University,
San Luis Obispo
RECORD DRAWINGS
A-202E
NOTES
KEY MAP
SECOND FLOOR PLAN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California Polytechnic State University,
San Luis Obispo
RECORD DRAWINGS
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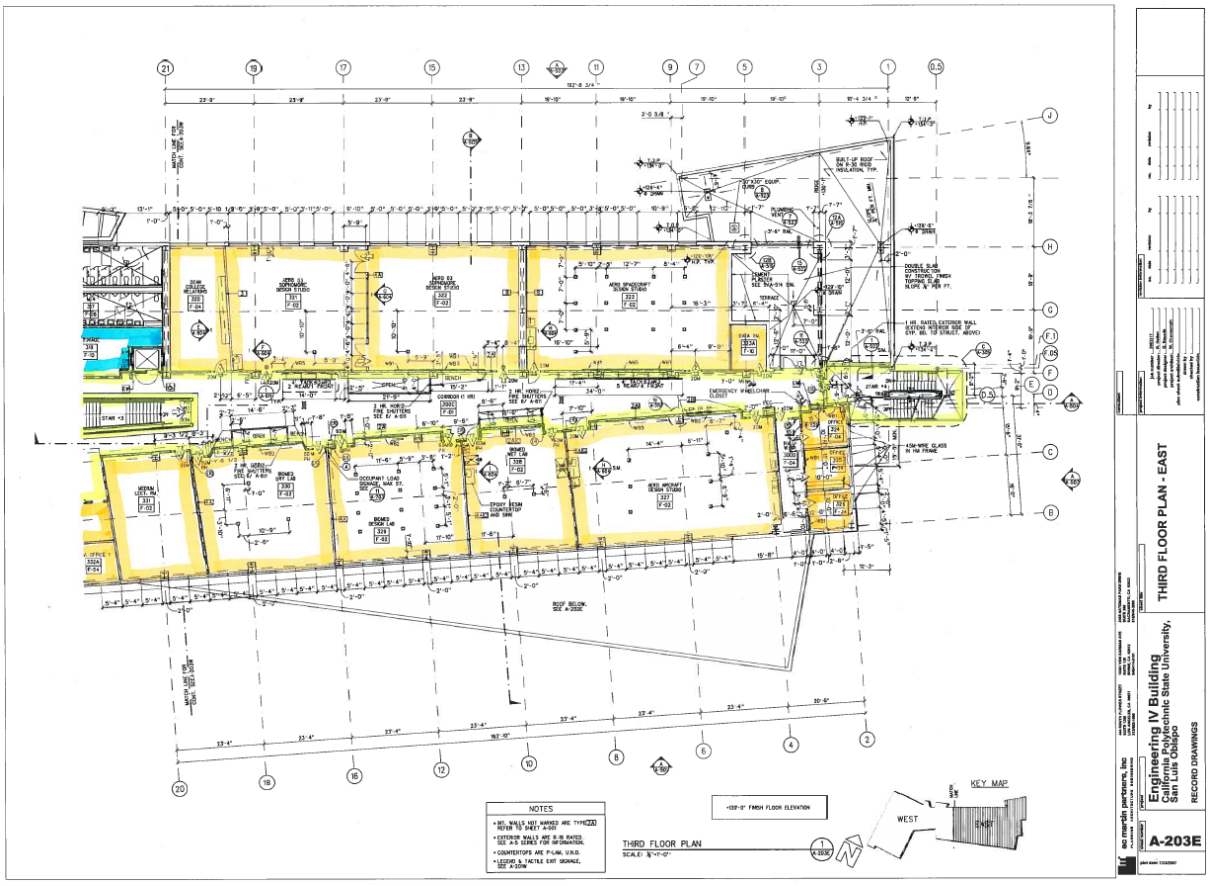
NOTES
KEY MAP
SECOND FLOOR PLAN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California Polytechnic State University, San Luis Obispo
RECORD DRAWINGS
A-203E
THIRD FLOOR PLAN
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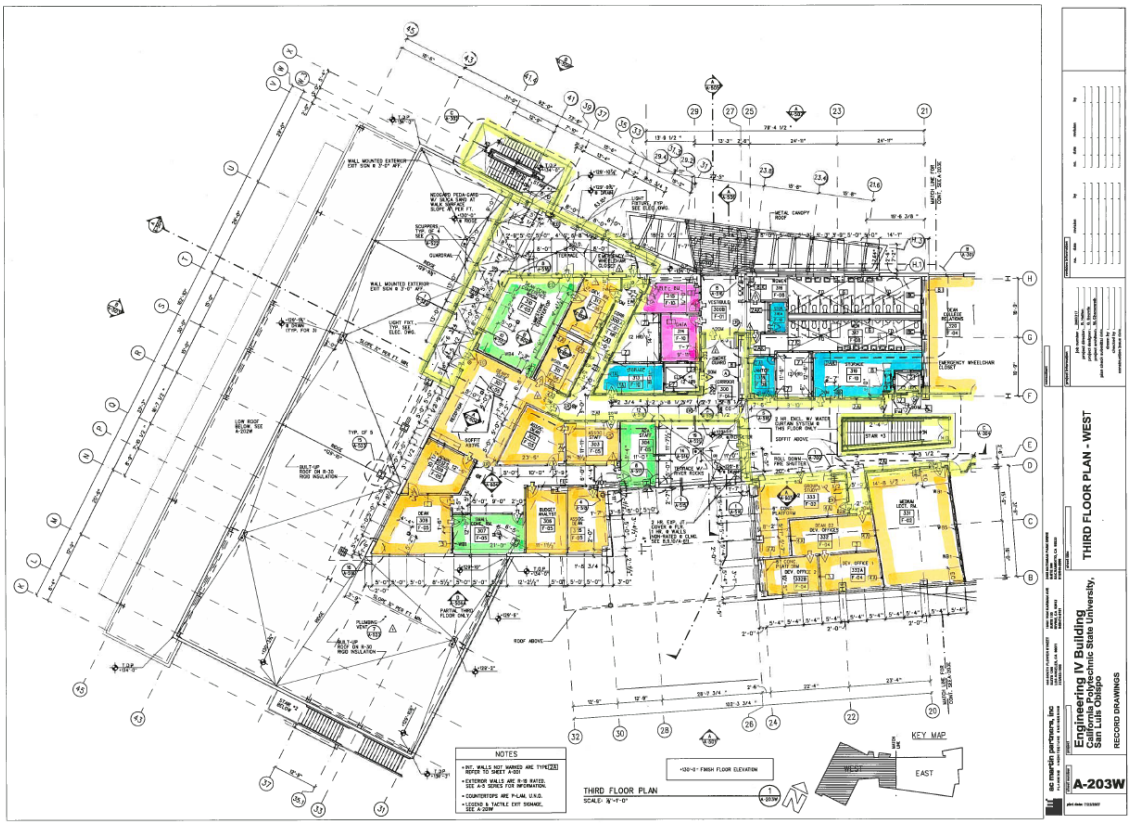
WEST
EAST
NOTES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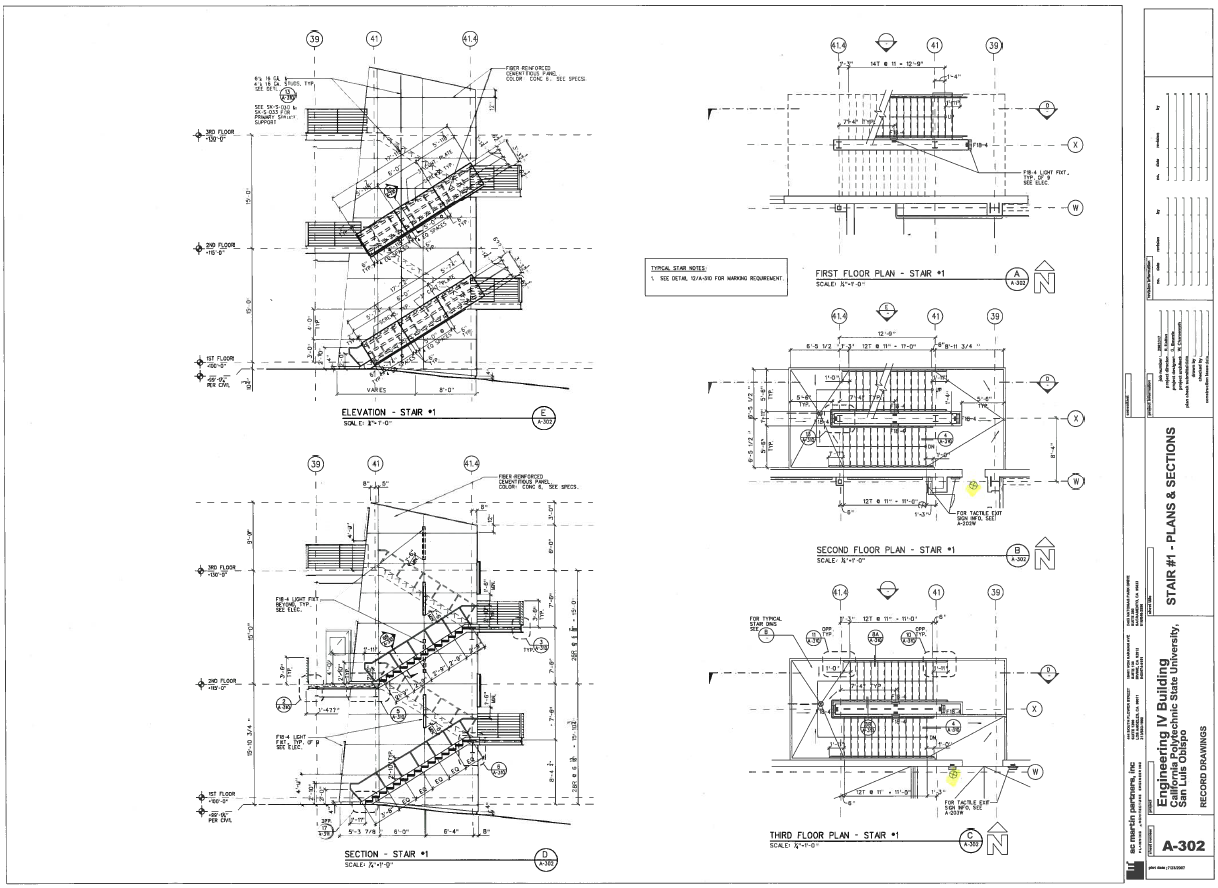
Engineering IV Building
California Polytechnic State University, San Luis Obispo
RECORD DRAWINGS
A-203W
THIRD FLOOR PLAN
KEY MAP
WEST
EAST
NOTES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SECOND FLOOR PLAN - STAIR *1
THIRD FLOOR PLAN - STAIR *1
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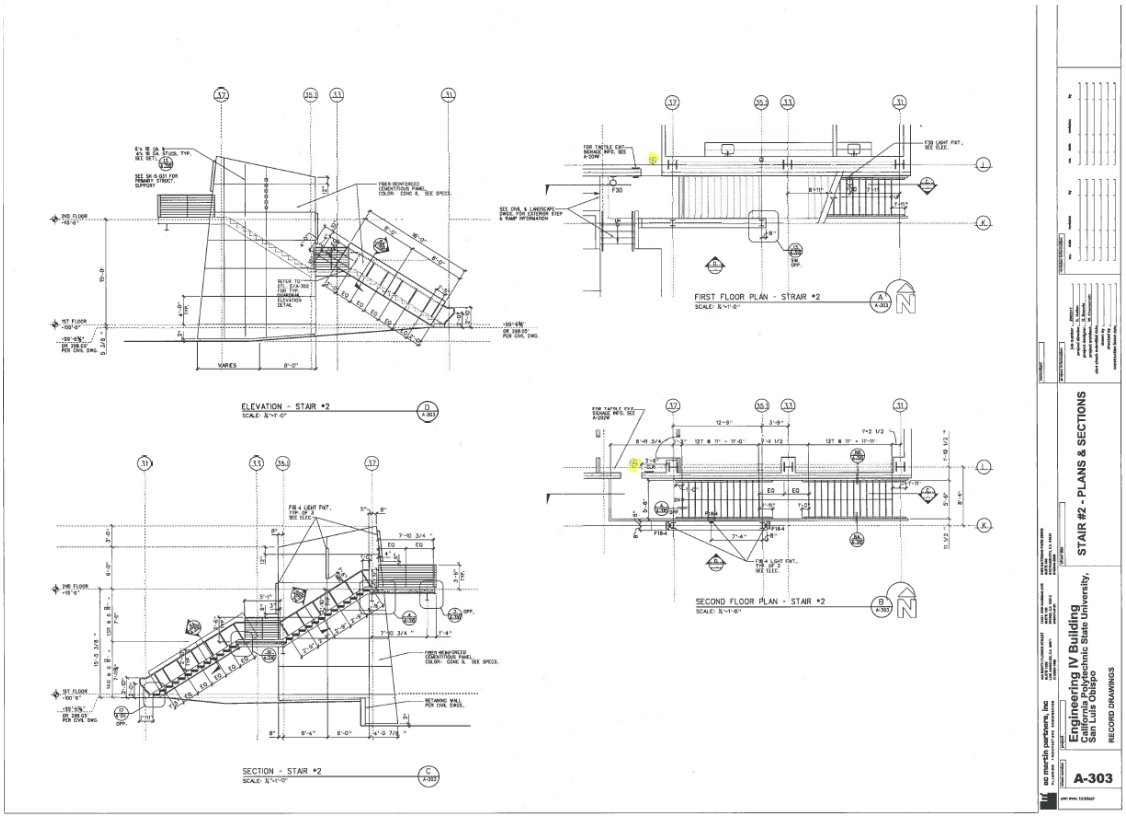
TYPICAL STAIR NOTES:
1. SEE DETAIL 12/A-310 FOR MARKING REQUIREMENT.
STAIR #1 - PLANS & SECTIONS
Engineering IV Building
California Polytechnic State University,
San Luis Obispo
RECORD DRAWINGS
A-302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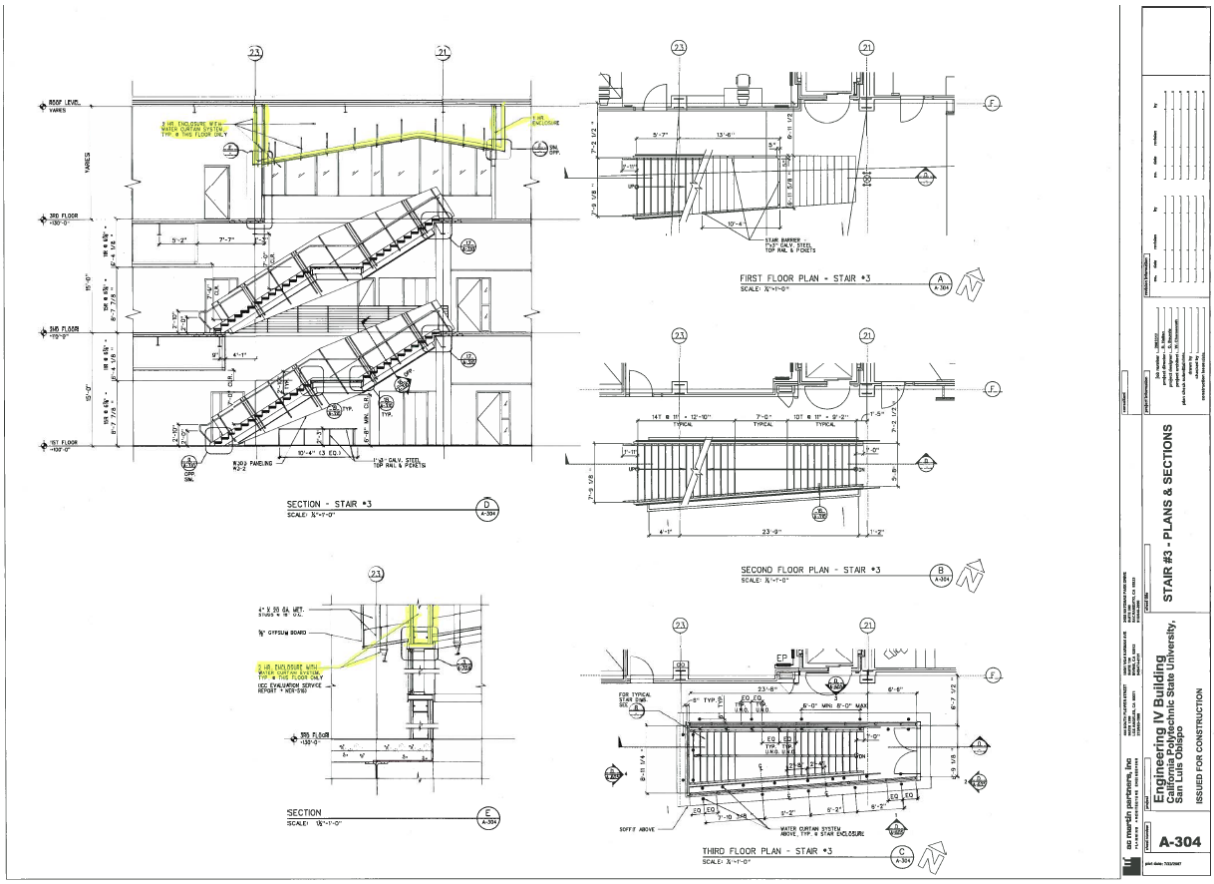
SECTION - STAIR *2
STAIR #2 - PLANS & SECTIONS
Engineering IV Building
California Polytechnic State University,
San Luis Obispo
RECORD DRAWINGS
A-303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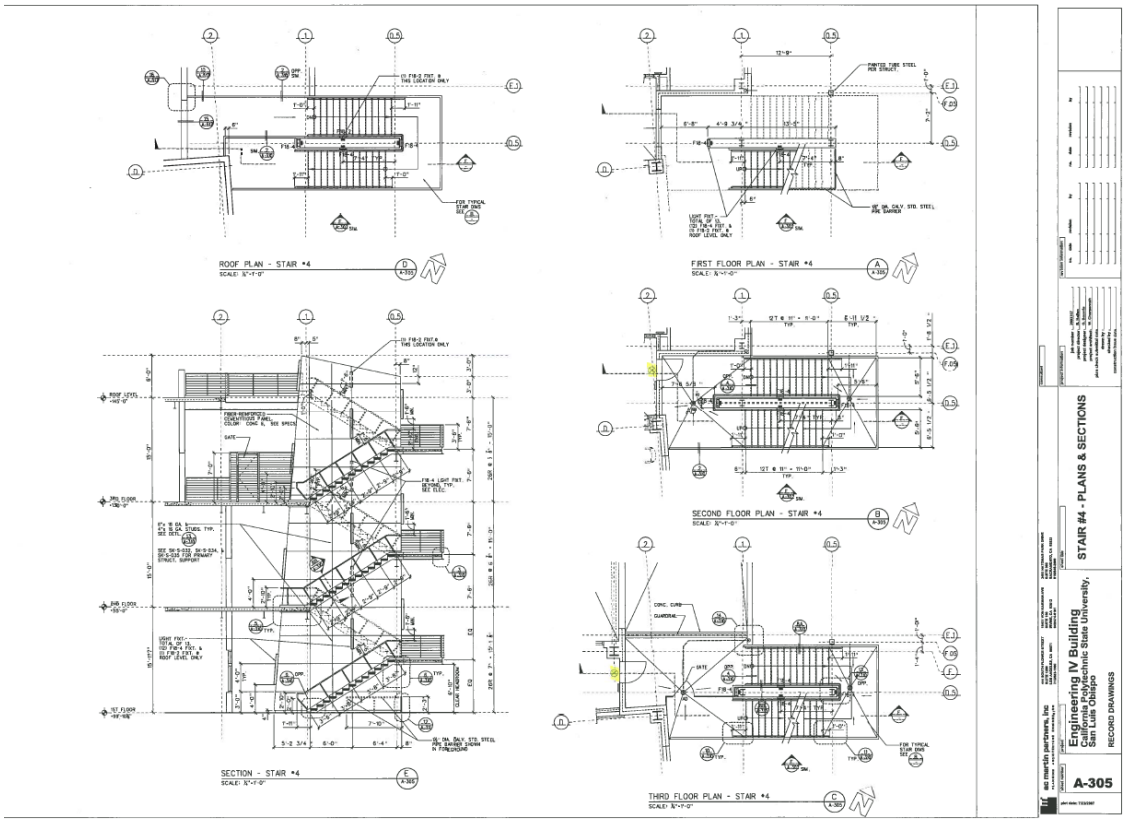
THIRD FLOOR PLAN - STAIR #3
SECTION
STAIR #3 - PLANS & SECTIONS
Engineering IV Building
California Polytechnic State University, San Luis Obispo
ISSUED FOR CONSTRUCTION
A-304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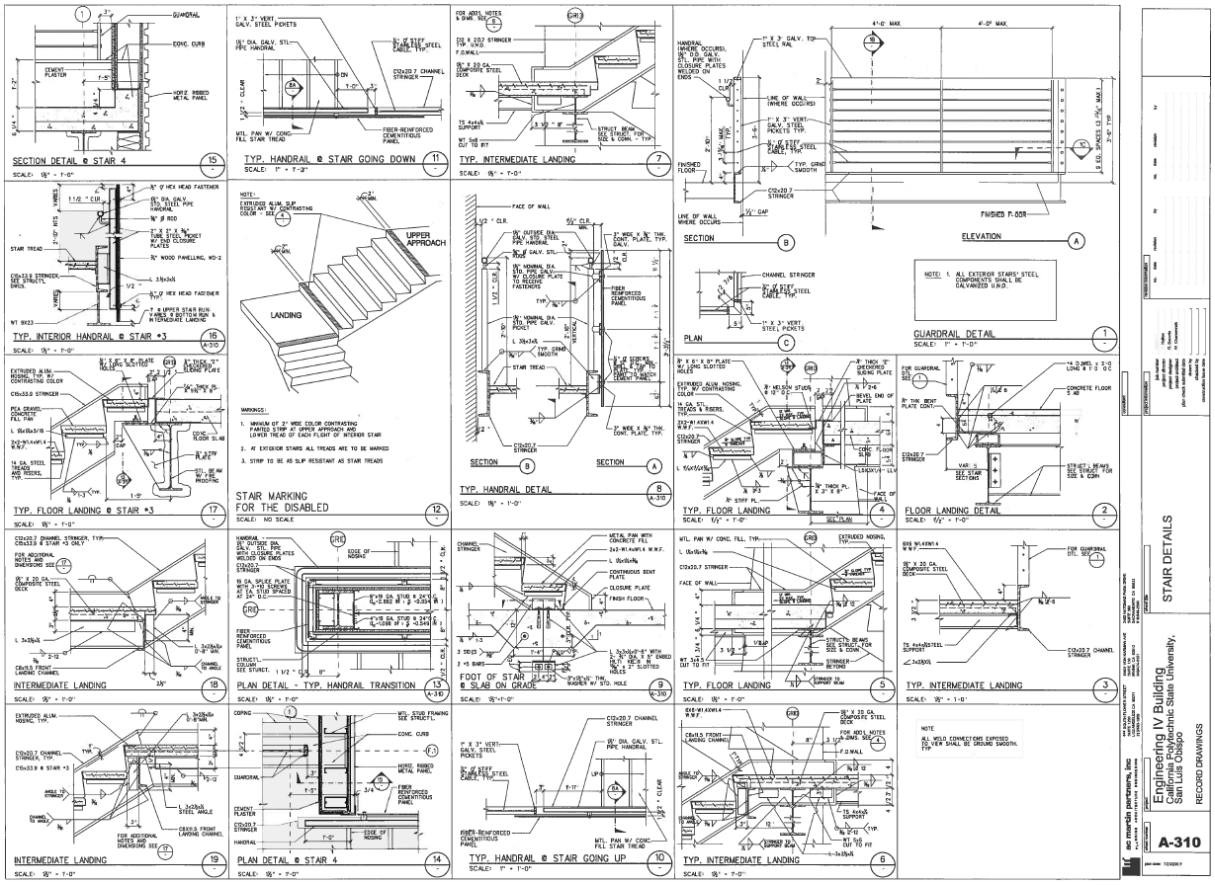
Engineering IV Building
California Polytechnic State University, San Luis Obispo
RECORD DRAWINGS
A-305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TYP. INTERMEDIATE LANDING
TYP. INTERIOR HANDRAIL @ STAIR #3
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TYP. HANDRAIL DETAIL
SECTION
ELEVATION
PLAN
GUARDRAIL DETAIL
TYP. FLOOR LANDING @ STAIR #3
TYP. FLOOR LANDING
FLOOR LANDING DETAIL
INTERMEDIATE LANDING
PLAN DETAIL - TYP. HANDRAIL TRANSITION
FOOT OF STAIR @ SLAB ON GRADE
TYP. FLOOR LANDING
TYP. INTERMEDIATE LANDING
INTERMEDIATE LANDING
PLAN DETAIL @ STAIR 4
TYP. HANDRAIL @ STAIR GOING UP
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California Polytechnic State University, San Luis Obispo
RECORD DRAWINGS
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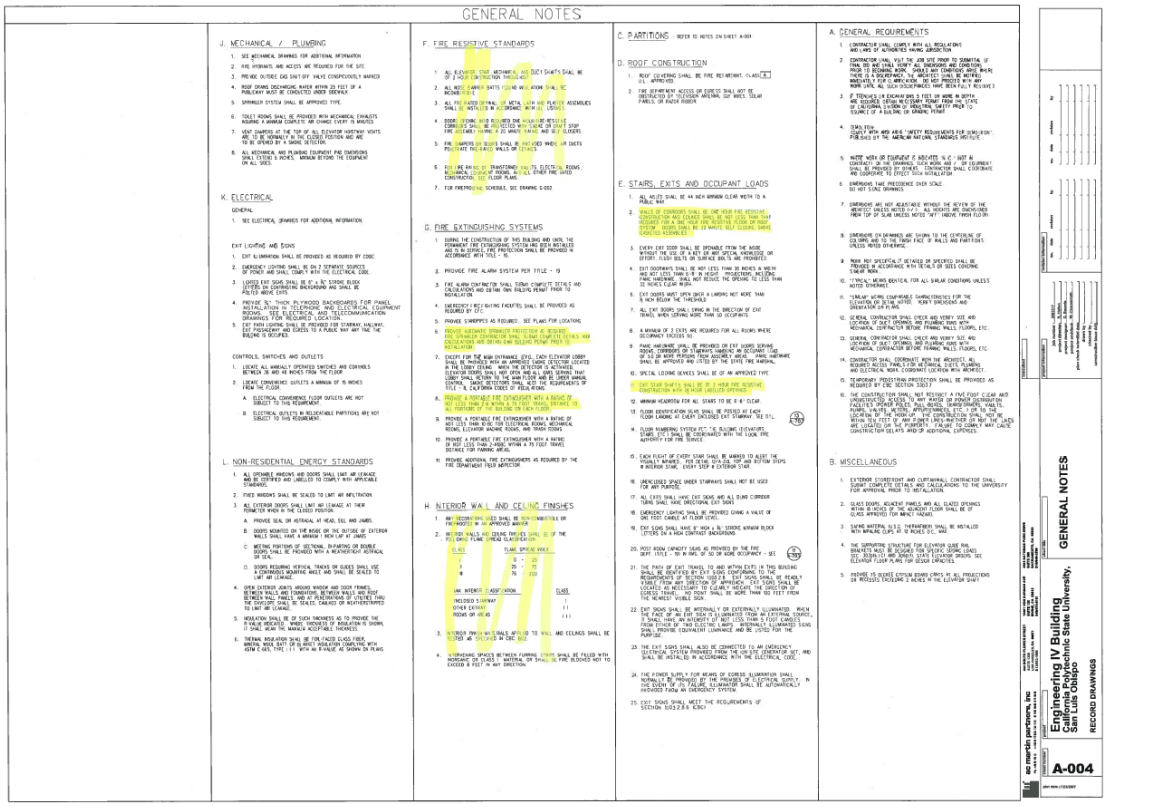
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K. ELECTRICAL
L. NON-RESIDENTIAL ENERGY STANDARDS
F. FIRE RESISTIVE STANDARDS
G. FIRE EXTINGUISHING SYSTEMS
H. INTERIOR WALL AND CEILING FINISHES
C. PARTITIONS
D. ROOF CONSTRUCTION
E. STAIRS, EXITS AND OCCUPANT LOADS
A. GENERAL REQUIREMENTS
B. MISCELLANEOUS
GENERAL NOTES
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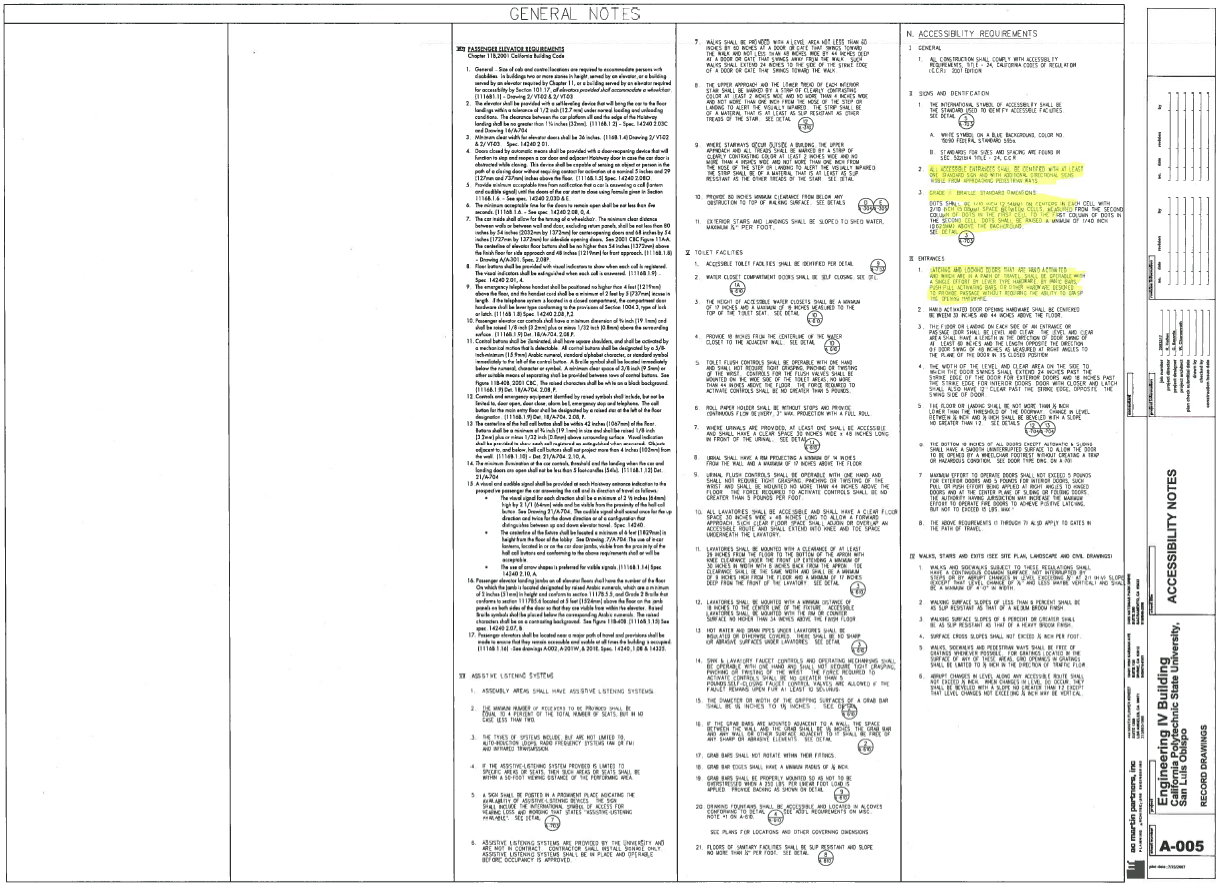
California Polytechnic State University, San Luis Obispo
RECORD DRAWINGS
A-004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RECORD DRAWINGS
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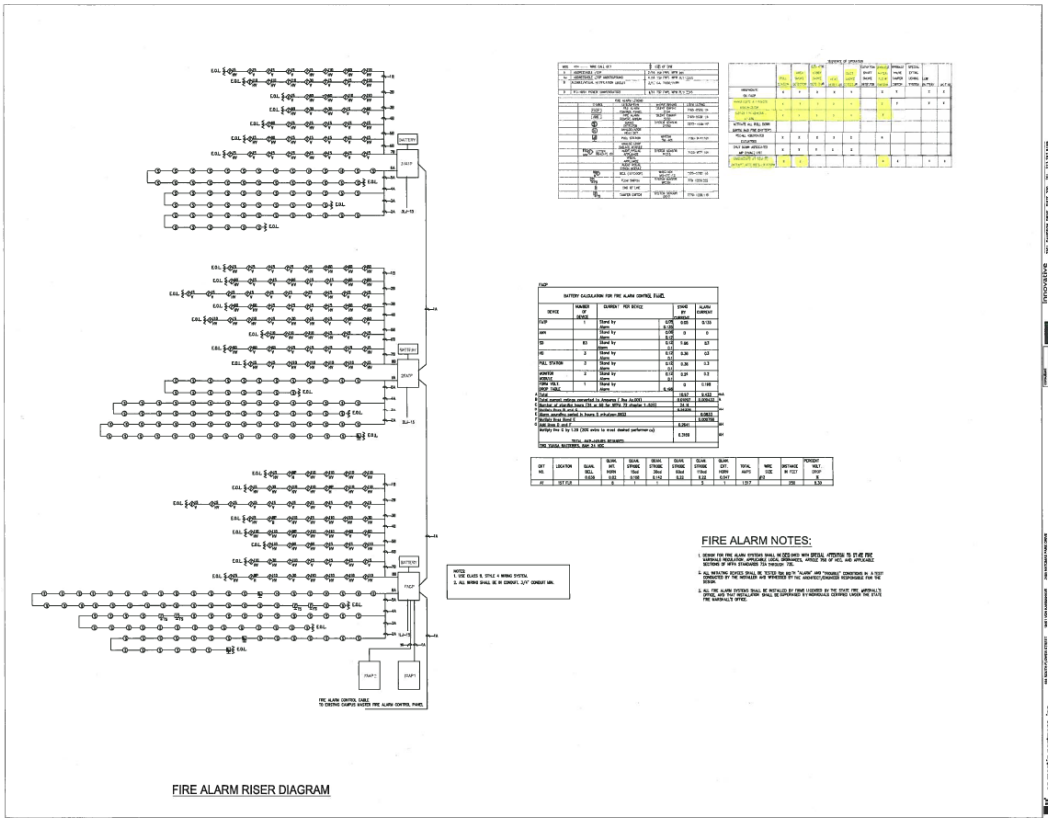
FIRE ALARM RISER DIAGRAM
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FIRE ALARM RISER DIAGRAM
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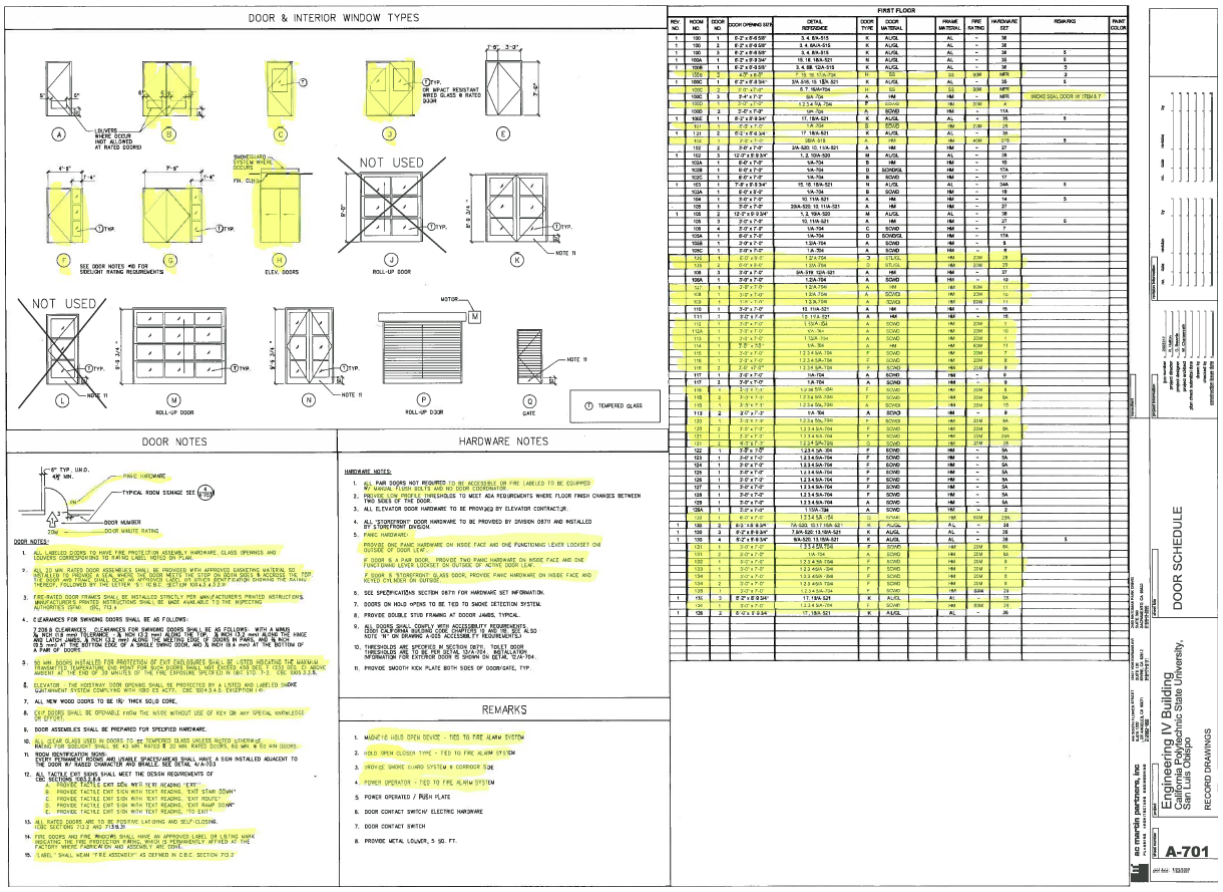
California Polytechnic State University, San Luis Obispo
RECORD DRAWINGS
E-602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HARDWARE NOTES
REMARKS
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DOOR SCHEDULE
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California Polytechnic State University,
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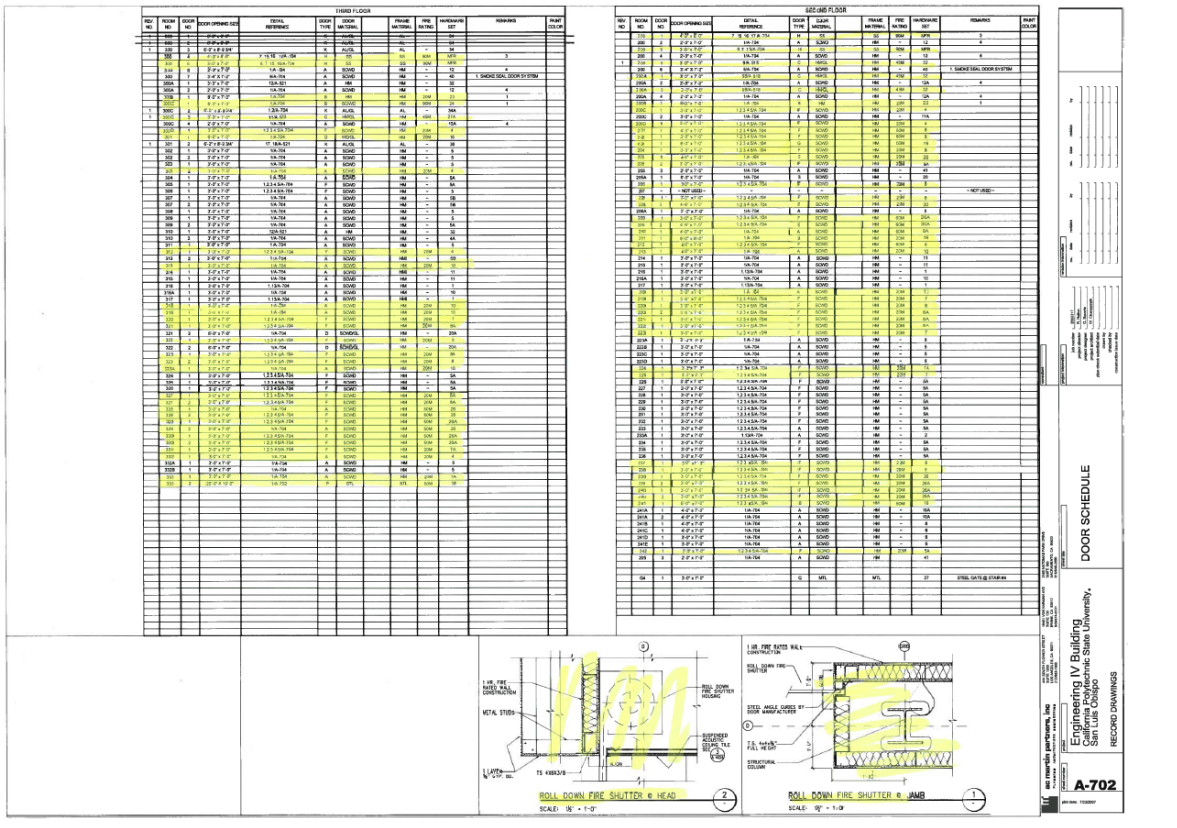
RECORD DRAWINGS
A-701


THIRD FLOOR
SECOND FLOOR
DOOR SCHEDULE
Engineering IV Building
California Polytechnic State University,
San Luis Obispo
RECORD DRAWINGS
A-702
ROLL DOWN FIRE SHUTTER @ HEAD
ROLL DOWN FIRE SHUTTER @ JAMB

Structural Appendixes

Fireproofing Schedule

FIREPROOFING SCHEDULE

CBC SECTION

TABLE 6A — 1. BUILDING TYPE: TYPE II - F.R.

CBC 601 — 2. HOURLY RATINGS

A.	STRUCTURAL FRAME (COLS. & PRIMARY FLOOR BEAMS)	2 HR.
B.	FLOOR DECKS	2 HR.
C.	SECONDARY BEAMS AT FLOORS	2 HR.
D.	ROOF DECK	1 HR.
E.	SECONDARY BEAMS AT ROOF	1½ HR.
F.	PRIMARY BEAMS AT ROOF	2½ HR.

3. FIREPROOFING NOT REQUIRED

A. STEEL SUPPORTING CANOPIES

B. STEEL SUPPORTING EXTERIOR STAIRS

4. FIRE RESISTIVE DESIGNS FROM U.L.

A. ALL RATINGS FROM U.L. DESIGNS SHALL BE UNRESTRAINED

B. PRODUCT: MK-6/HY APPROVED BY ICBO EVALUATION REPORT 4607

ITEM	DESIGN	NOTES
i. COLUMNS		
WIDE FLANGE	X-772	
TUBE	X-771	
ii. FLOOR DECKS & ROOF DECKS	D-925	UNPROTECTED (NO FIREPROOFING REQ'D)
iii. FLR. & ROOF BEAMS SUPPORTING LW CONC.	N-782	AS NOTED ABOVE ROOF BEAMS TO BE SPRAYED W/ INCREASE OF ½ HOURLY RATING DUE TO ADDITION OF INSULATION ON TOP OF CONCRETE

UBC 1701.5(10) — 5. SPECIAL INSPECTION IS REQUIRED USING UBC STANDARD 7-6

Applicable Codes

CODES

LIST OF 2001 CALFORNIA CODE OF REGULATIONS

2001 BUILDING STANDARDS ADMINISTRATIVE CODE, PART I, TITLE 24 C.C.R.
2001 CALIFORNIA BUILDING CODE (CBC), PART 2, TITLE 24 C.C.R.
2001 CALIFORNIA ELECTRICAL CODE (CEC), PART 3, TITLE 24 C.C.R.
2001 CALIFORNIA MECHANICAL CODE (CMC), PART 4, TITLE 24 C.C.R.
2001 CALIFORNIA PLUMBING CODE (CPC), PWRT 5, TITLE 24C.C.R.
2001 CALIFORNIA ENERGY CODE, PART 6, TITLE 24 C.C.R.
2001 CALIFORNIA ELEVATOR SAFETY CONSTRUCTION CODE, PART 7, TITLE 24 C.C.R.
2001 CALIFORNIA HISTORICAL BUILDING CODE, PART 8, TITLE 24 C.C.R.
2001 CALIFORNIA FIRE CODE, PART 9, TITLE 24 C.C.R.
2001 CALIFORNIA REFERENCED STANDARDS, PART 12, TITLE 24 C.C.R.
1990 TITLE 19 C.C.R. PUBLIC SAFETY, STATE FIRE MARSHAL REGULATIONS

BUILDING ELEMENT	REQUIREMENTS BASED ON CONSTRUCTION TYPE TABLE 6-A	REQUIREMENTS BASED ON PROPERTY LINE TABLE 5-A & 5-B	
		A-3	B
1. BEARING WALLS - EXTERIOR	2 HR (N.A.)	4 HR (N.A.)	2 HR (N.A.)
2. BEARING WALLS - INTERIOR	2 HR (N.A.)	-	-
3. NONBEARING WALLS - EXTERIOR	1 HR	1 HR	1 HR
4. STRUCTURAL FRAME	2 HR	-	-
5. PARTITION - PERMANENT	1 HR	-	-
6. SHAFT ENCLOSURES	2 HR	-	-
7. FLOOR AND FLOOR CEILINGS	2 HR	-	-
8. ROOF AND ROOF CEILINGS	1 HR	-	-
9. EXTERIOR DOORS AND WINDOWS	SECT. 603.3.2	PROTECTED<20 FT.	PROTECTED<20 FT.
10. STAIRWAY CONSTRUCTION	SECT. 603.4	-	-

Code Analysis

CODE ANALYSIS

ENGINEERING IV BUILDING

CALIFORNIA POLYTECHNIC STATE UNIVERSITY, SAN LUIS OBISPO

OCCUPANCY TYPE: A-3 (CLASSROOMS OVER 50 OCCUPANTS)
B (CLASSROOMS, LABS,STUDIOS, & OFFICES UNDER 50 OCCUPANTS)

CONSTRUCTION TYPE: TYPE II - FIRE RESISTIVE
AUTOMATED SPRINKLER SYSTEM

NUMBER OF STORIES: 3

BUILDING ELEMENT	REQUIREMENTS BASED ON CONSTRUCTION TYPE TABLE 6-A	REQUIREMENTS BASED ON PROPERTY LINE TABLE 5-A & 5-B	
		A-3	B
1. BEARING WALLS - EXTERIOR	2 HR (N.A.)	4 HR (N.A.)	2 HR (N.A.)
2. BEARING WALLS - INTERIOR	2 HR (N.A.)	-	-
3. NONBEARING WALLS - EXTERIOR	1 HR	1 HR	1 HR
4. STRUCTURAL FRAME	2 HR	-	-
5. PARTITION - PERMANENT	1 HR	-	-
6. SHAFT ENCLOSURES	2 HR	-	-
7. FLOOR AND FLOOR CEILINGS	2 HR	-	-
8. ROOF AND ROOF CEILINGS	1 HR	-	-
9. EXTERIOR DOORS AND WINDOWS	SECT. 603.3.2	PROTECTED<20 FT.	PROTECTED<20 FT.
10. STAIRWAY CONSTRUCTION	SECT. 603.4	-	-

2. ACTUAL TOTAL FLOOR AREA

A-3 OCCUPANCY = 17,441 < 119,600 SF. ALLOWED
B OCCUPANCY = 87,190 < 159,600 SF. ALLOWED
TOTAL - 104,631 SF.

MIXED OCCUPANCY CALCULATIONS

A-3 OCCUPANCY = 17,441/119,600 = 0.15
B OCCUPANCY = 87,190/159,600 - 0.54
TOTAL = 0.65 < 1 , O.K.

3. BUILDING HEIGHT ANALYSIS (BASED ON TABLE 5-B)
160 FT. ALLOWED VS 56 FT ACTUAL

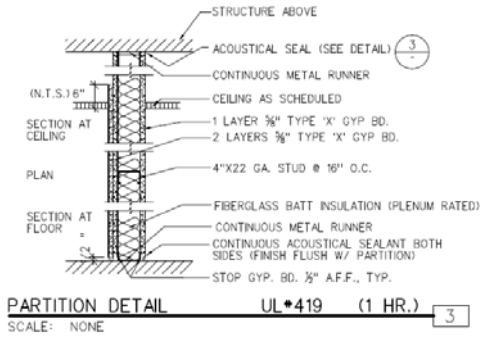
TOP OCCUPIED FLOOR 30 FT. ABOVE GRADE

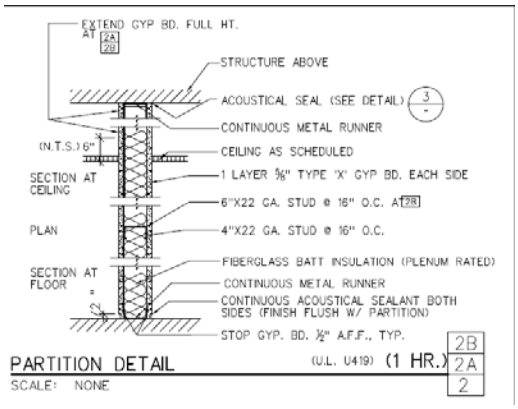
A-3 OCCUPANCY 2 STORIES ALLOWED

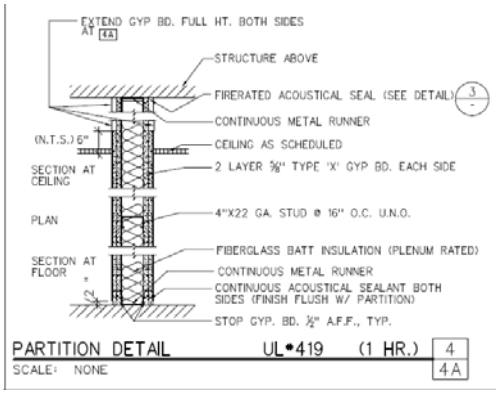
INCREASE (1) FLOOR ALLOWED DUE TO USE OF AUTOMATIC SPRINKLER SYSTEM, THEREFORE (3) STORIES ALLOWED VS (3) STORIES ACTUAL

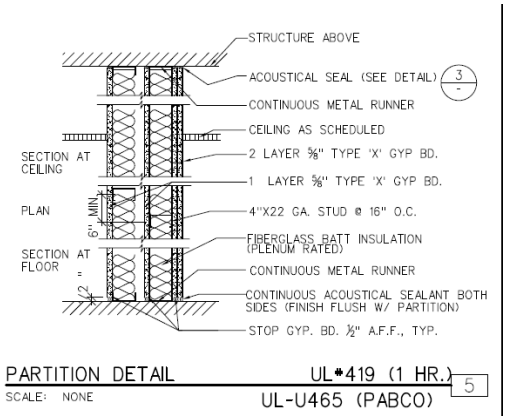
B OCCUPANCY 4 STORIES ALLOWED VS 3 STORIES ACTUAL

Drawing Details



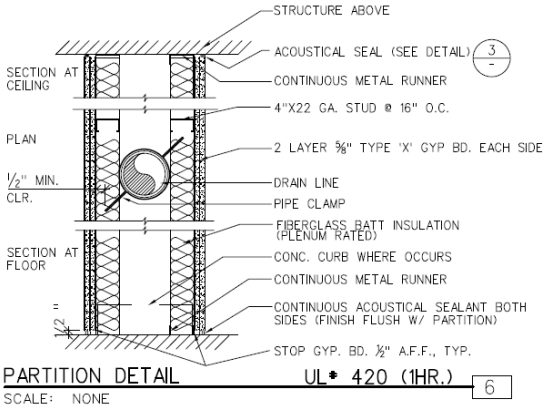






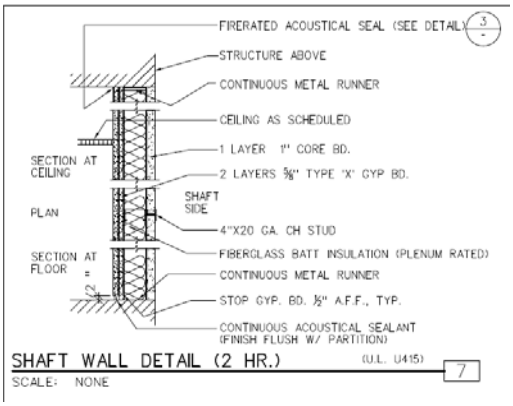
PARTITION DETAIL UL#419 (1 HR.) 5

SCALE: NONE UL-U465 (PABCO)



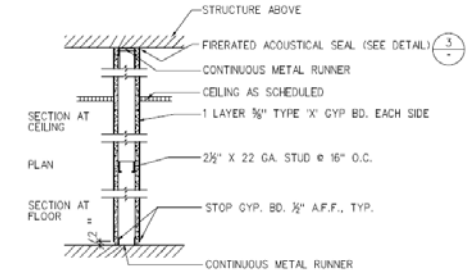
PARTITION DETAIL UL# 420 (1HR.) 6

SCALE: NONE



SHAFT WALL DETAIL (2 HR.) (U.L. U415) 7

SCALE: NONE



PARTITION DETAIL (U.L. U419) (1 HR.) 9

SCALE: NONE

NOTES FOR INTERIOR WALLS:

1. SEE PLANS FOR LOCATION OF RATED ROOMS AND WALLS MARKED ═══
2. PROVIDE TYPE "X" GYPSUM BOARD AT ALL WALLS.
3. PROVIDE STIFFENERS, BACKING, BACK-UP PLATES & BRACING PER DTL. 9/A-610 14/A-610 FOR SUPPORT OF TOILET ROOM FIXTURES, CABINETS, COUNTERS, CHALK BOARDS, WHITE BOARDS, AND DRINKING FOUNTAINS OR OTHER EQUIPMENT.
4. EXTEND ALL STUDS AND WALL MATERIALS TO STRUCTURE ABOVE UNLESS OTHERWISE INDICATED.
5. PROVIDE HORIZONTAL BRIDGING @ 4'-0" O.C. OR METAL TIE BACK BRACKETS FOR FURRED WALLS OVER 10'-0" IN HEIGHT. METAL TIE BACK BRACKETS SHALL BE ATTACHED TO ADJACENT WALL.
6. STEEL STUD PLUMBING CHASE WALLS SHALL HAVE OPPOSING STUD ROWS BRACED TOGETHER @ 4'-0" O.C. MAXIMUM.
7. TERMINATE FIRE RATED PARTITIONS AT STRUCTURE ABOVE.
8. NON-LOAD BEARING INTERIOR PARTITION DEGISN IS BASED ON THE FOLLOWING CRITERIA:
   A. MAXIMUM ALLOWABLE DEFLECTION:
      1. FOR GYPSUM BOARD WALL - L /240
      2. FOR CERAMIC TILE OR STONE VENEERED AND PLASTER WALLS - L /360
      3. SPANS NOTED ON WALL TYPES ARE L /240 U.N.O.
   B. 5 PSF UNIFORM LOAD APPLIED PERPENDICULAR TO PARTITION.
9. ALL DIMENSION ARE TO FINISH FACE OF WALLS (GYPSUM BOARD, CERAMIC TILE NATURAL STONE, ETC.) U.N.O.
10. USE WATER RESISTANT GYPSUM BOARD IN ALL JANITOR'S ROOMS, MECHANICAL ROOMS AND TOILET ROOMS.
11. PROVIDE FOR SLAB DEFLECTION AT TOP OF ALL WALLS. SEE DTL. 3/A-001 2/A-001
12. WALL TYPE MARKED XXIC DENOTES CONCRETE CURB PER DET. 4/A-001
13. STAGGER WALL OUTLETS PER DETAIL 9/A-311
14. PROVIDE 4" HIGH STENCIL LETTERING INDICATING WALL RATINGS (1 HOUR AND 2 HOUR) @ 11'-0" AFF, 20'-0" INTERVALS.

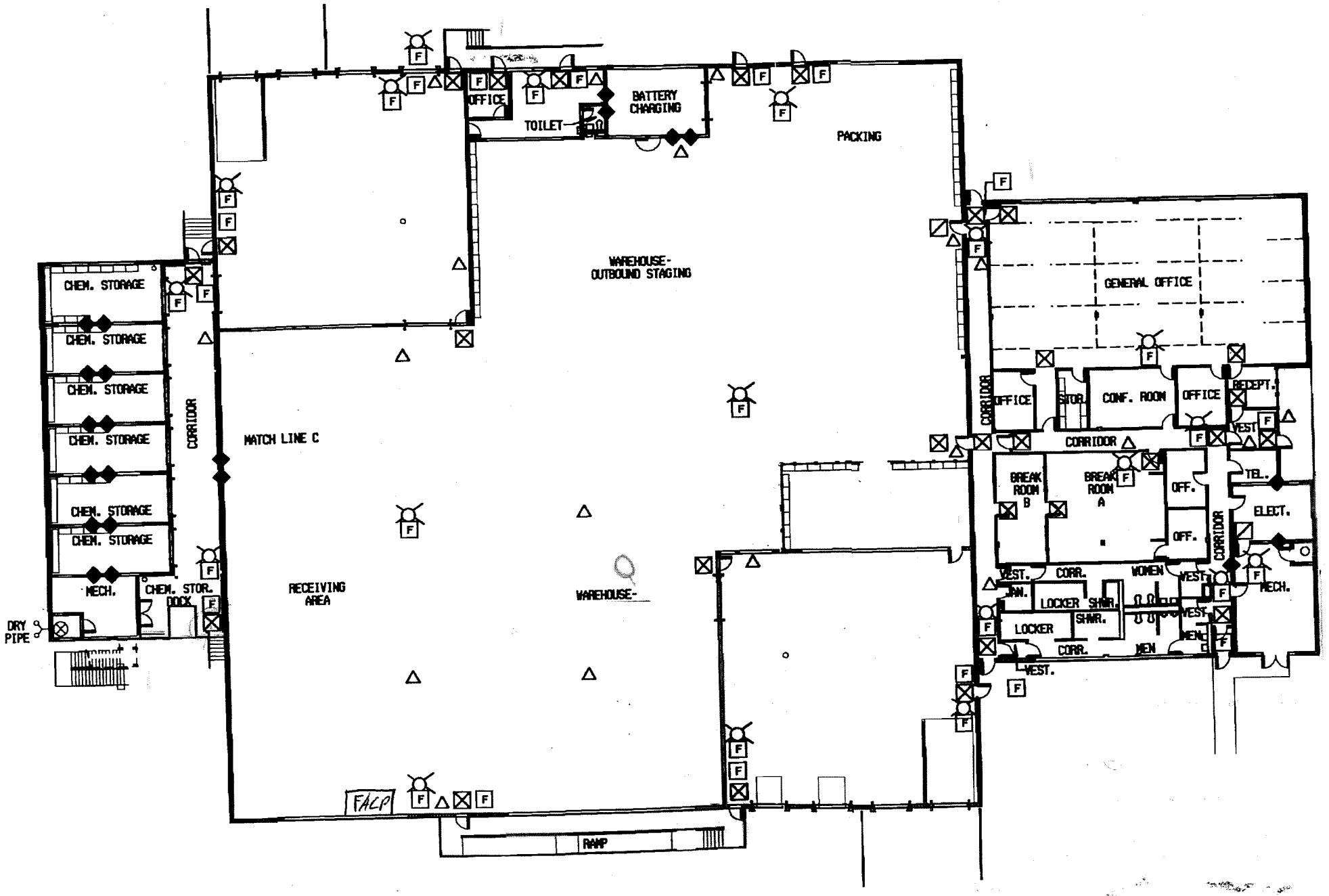
U.L. LISTINGS

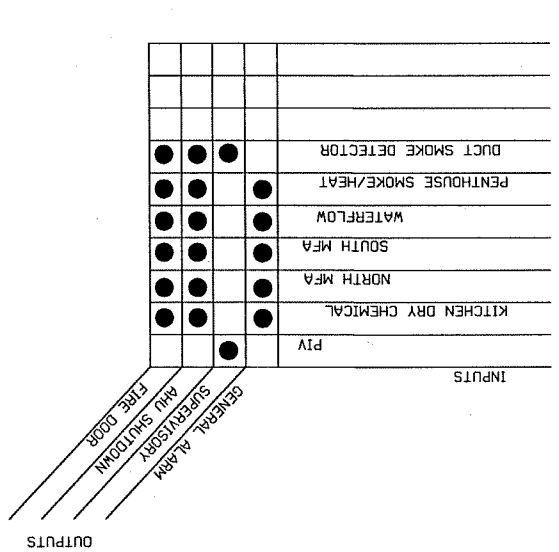
FIRE RATED WALLS	U.L. U419
SHAFT WALLS	U.L. U415
RATED WALL PENETRATIONS	U.L. W-L-1054 U.L. W-L-1067 U.L. W-L-5029
RATED FLOOR PENETRATIONS	U.L. C-AJ-1226
SEISMIC JOINTS	
FLOOR	U.L. FF-D-2009
WALL	U.L. WW-D-2007

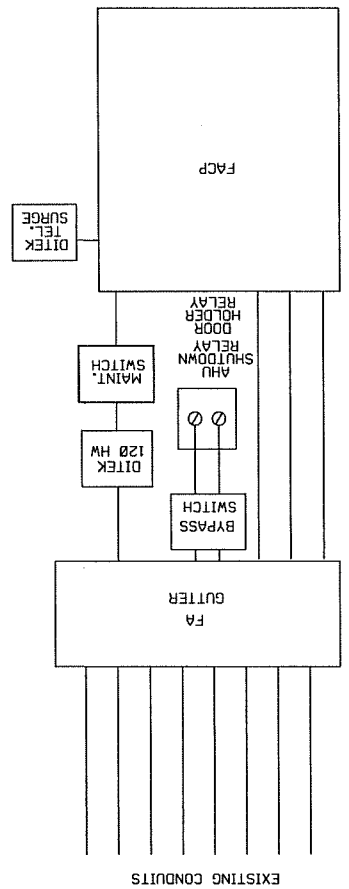
SEE FIREPROOFING SCHEDULE FOR ADDITIONAL INFORMATION.

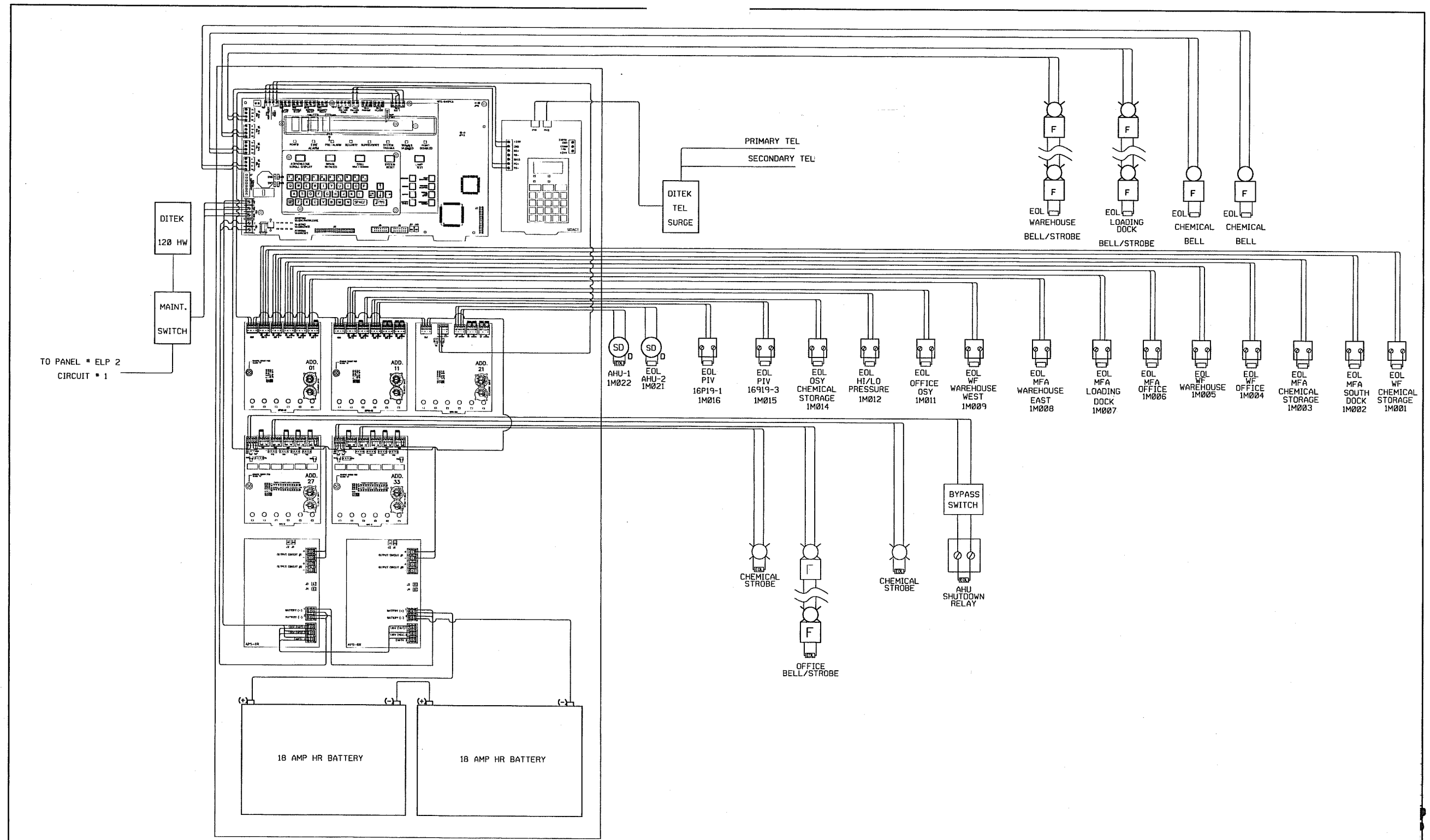
Detection Alarm and Communication Appendixes

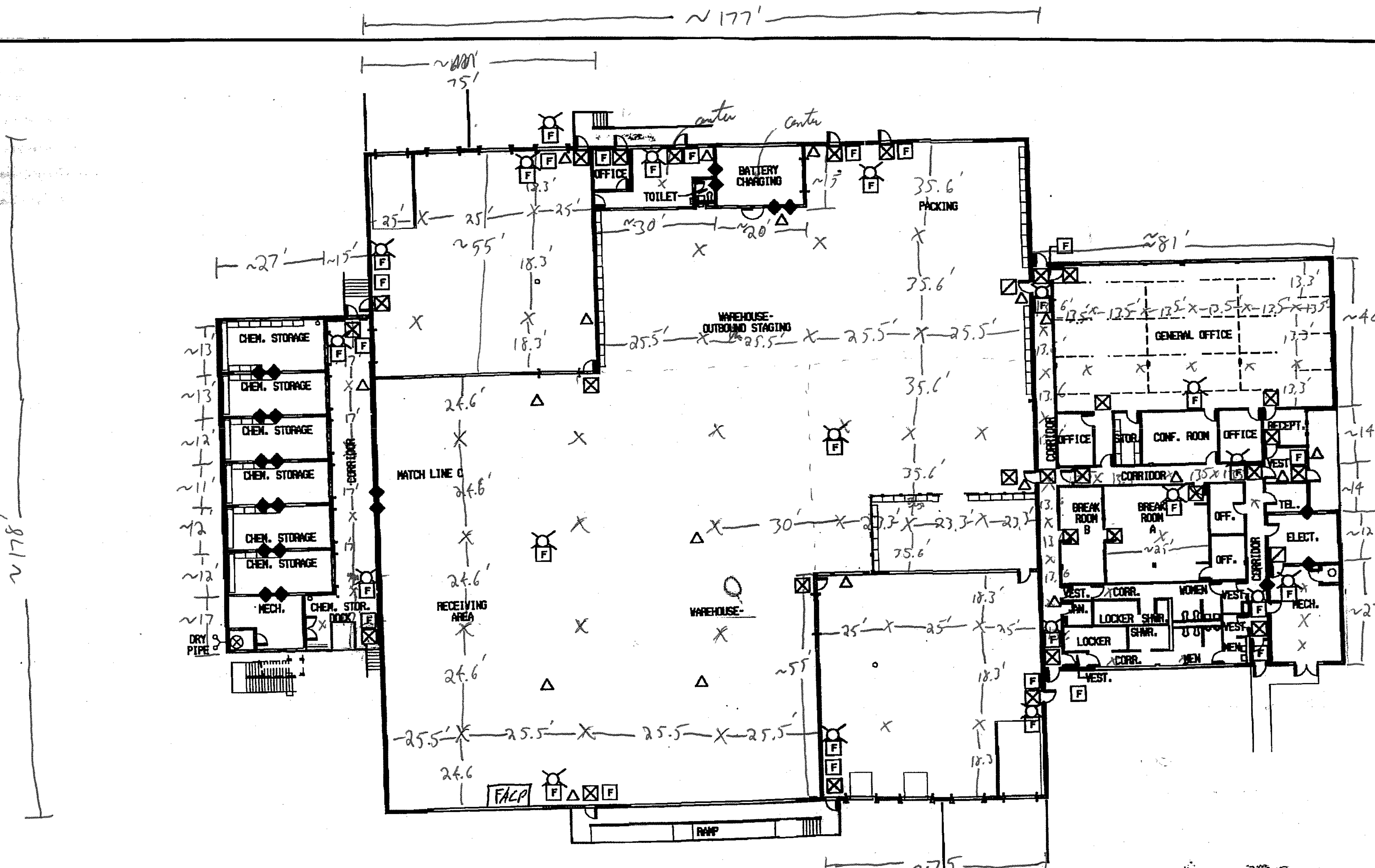
The following pages contain all the attachments for this project.


OFFICE
TOILET
BATTERY CHARGING
PACKING
WAREHOUSE-
OUTBOUND STAGING
GENERAL OFFICE
CHEM. STORAGE
CHEM. STORAGE
CHEM. STORAGE
CHEM. STORAGE
CHEM. STORAGE
CHEM. STORAGE
MECH.
CHEM. STOR.
DOCK
DRY PIPE
CORRIDOR
MATCH LINE C
RECEIVING AREA
WAREHOUSE-
FACP
RAMP
OFFICE
STOR.
CONF. ROOM
OFFICE
RECEPT.
VEST
CORRIDOR
BREAK ROOM B
BREAK ROOM A
OFF.
OFF.
TEL.
ELECT.
CORRIDOR
VEST.
JAN.
CORR.
WOMEN
VEST.
LOCKER
SHWR.
LOCKER
SHWR.
MECH.
CORR.
MEN
VEST.
VEST.
VEST.
FH WATER MAIN (HIGH PRESSURE)
W WATER MAIN (LOW PRESSURE)
X FENCE
POST INDICATOR AND VALVE
FIRE HYDRANT
FIRE DEPT. CONNECT.
FREE STAND FIRE DEPT. CONNECT.
SPRINKLER RISER
FCP FIRE ALARM CONTROL PANEL
FIRE WALL RATING (# OF ◆ = # OF HRS)
EXTERIOR/INTERIOR WALLS
MOVEABLE PARITIONS/BOUNDARIES
MANUAL PULL STATION
FIRE ALARM BELL
ILLUMINATED EXIT SIGN
FIRE EXTINGUISHER
NON ILLUMINATED EXIT SIGN
E FLRSCT LIGHT/EMER. LIGHT


INPUTS
PIV
KITCHEN DRY CHEMICAL
NORTH MFA
SOUTH MFA
WATERFLOW
PENTHOUSE SMOKE/HEAT
DUCT SMOKE DETECTOR
OUTPUTS
GENERAL ALARM
SUPERVISORY
AHU SHUTDOWN
FIRE DOOR


FACP
DITEK TEL. SURGE
FA GUTTER
BYPASS SWITCH
AHU SHUTDOWN RELAY
DOOR HOLDER RELAY
MAINT. SWITCH
DITEK 120 HW
EXISTING CONDUITS


DITEK
120 HW
MAINT.
SWITCH
TO PANEL # ELP 2
CIRCUIT # 1
PRIMARY TEL
SECONDARY TEL
DITEK
TEL
SURGE
ADD.
01
ADD.
11
ADD.
21
ADD.
27
ADD.
33
APS-6R
APS-6R
EOL
WAREHOUSE
BELL/STROBE
EOL
LOADING
DOCK
BELL/STROBE
EOL
CHEMICAL
BELL
EOL
CHEMICAL
BELL
SD
AHU-1
1M022
SD
EOL
AHU-2
1M021
EOL
PIV
16P19-1
1M016
EOL
PIV
16P19-3
1M015
EOL
OSY
CHEMICAL
STORAGE
1M014
EOL
HI/LO
PRESSURE
1M012
EOL
OFFICE
OSY
1M011
EOL
WF
WAREHOUSE
WEST
1M009
EOL
MFA
WAREHOUSE
EAST
1M008
EOL
MFA
LOADING
DOCK
1M007
EOL
MFA
OFFICE
1M006
EOL
WF
WAREHOUSE
1M005
EOL
WF
OFFICE
1M004
EOL
MFA
CHEMICAL
STORAGE
1M003
EOL
MFA
SOUTH
DOCK
1M002
EOL
WF
CHEMICAL
STORAGE
1M001
CHEMICAL
STROBE
OFFICE
BELL/STROBE
CHEMICAL
STROBE
BYPASS
SWITCH
AHU
SHUTDOWN
RELAY
18 AMP HR BATTERY
18 AMP HR BATTERY



—FH— WATER MAIN (HIGH PRESSURE)
—W— WATER MAIN (LOW PRESSURE)
—X— FENCE
POST INDICATOR AND VALVE
FIRE HYDRANT
FIRE DEPT. CONNECT.
FREE STAND FIRE DEPT. CONNECT.
SPRINKLER RISER
FCP FIRE ALARM CONTROL PANEL
FIRE WALL RATING (# OF ◆ = # OF HRS)

EXTERIOR/INTERIOR WALLS
MOVEABLE PARITIONS/BOUNDARIES
MANUAL PULL STATION
FIRE ALARM BELL
ILLUMINATED EXIT SIGN
FIRE EXTINGUISHER
NON ILLUMINATED EXIT SIGN
FLRSCT LIGHT/EMER. LIGHT

X Speaker for voice system

FireWarden-50(E)

Intelligent Addressable FACP with Built-In Communicator

NOTIFIER® by Honeywell

Addressable Fire Alarm Control Panels

General

The **NOTIFIER FireWarden-50 (NFW-50)** is a Fire Alarm Control Panel (FACP) and Digital Alarm Communicator/Transmitter (DACT) combined into one circuit board. This compact, intelligent addressable control panel supports up to 50 addressable devices in any combination of detectors or modules. With an extensive list of powerful features, the FireWarden-50 programs just like FireWarden-100 products, yet fits into applications previously served only by conventional panels.

The FireWarden-50's integral DACT transmits system status (alarms, troubles, AC loss, etc.) to a Central Station via the public switched telephone network. It also allows remote and local programming of the control panel using the PS-Tools Upload/Download utility. In addition, the control panel may be programmed or interrogated off-site via the public switched telephone network. Any personal computer with Windows™ 95 or greater, and compatible modem with a speed of 14.4 kbps or faster and Upload/Download software, may serve as a Service Terminal. This allows download of the entire program or upload of the entire program, history file, walk-test data, current status and system voltages.

The power supply and all electronics are contained on a single circuit board supported on a new quick install chassis and housed in a metal cabinet. Available accessories include local and remote upload/download software, remote annunciators, and reverse polarity/city box transmitter. (4XTM)

The FireWatch Series internet monitoring modules IPDACT-2 and IPDACT-2UD permit monitoring of alarm signals over the Internet, saving the monthly cost of two telephone lines. Although not required, the secondary telephone line may be retained providing backup communication over the public switched telephone line.

NOTE: *Unless otherwise specified, the term FireWarden-50 is used in this data sheet to refer to both the FireWarden-50 and the FireWarden-50E FACPs. For FireWarden-50C, refer to DN-60446.*

Features

- Listed to UL Standard 864, 9th edition.
- Auto-program (learn mode) reduces installation time. Reports two devices set to the same address.
- On-board DACT.
- Two independently programmable Style Z (Class A) or Style Y (Class B) NAC circuits.
- Selectable strobe synchronization for System Sensor, Wheelock, and Gentex devices.
- Remote Acknowledge, Silence, Reset and Drill via addressable monitor modules.
- Two programmable relays and one fixed trouble relay.
- Built-in Programmer.
- Telephone Line Active LEDs.
- EIA-232 PC interface.
- Integral 80-character LCD display with backlighting.
- Real-time clock/calendar with automatic daylight savings control.
- History file with 500 event capacity.
- Automatic detector sensitivity testing (NFPA 72 compliant).
- Automatic device type-code verification.

- Point trouble identification.
- Waterflow selection per module point.
- Alarm verification selection per detector point.
- Maintenance alert warns when smoke detector dust accumulation is excessive.
- One-person audible or silent walk test with walk-test log and printout.
- System alarm verification selection per detector point.
- PAS (Positive Alarm Sequence) and Pre-signal per point (NFPA 72 compliant).
- Up to eight ANN-BUS annunciators
- Remote Acknowledge, Alarm Silence, Reset and Drill via addressable modules or remote annunciator.
- Upload/Download (local or remote) of program and data via integral DACT.

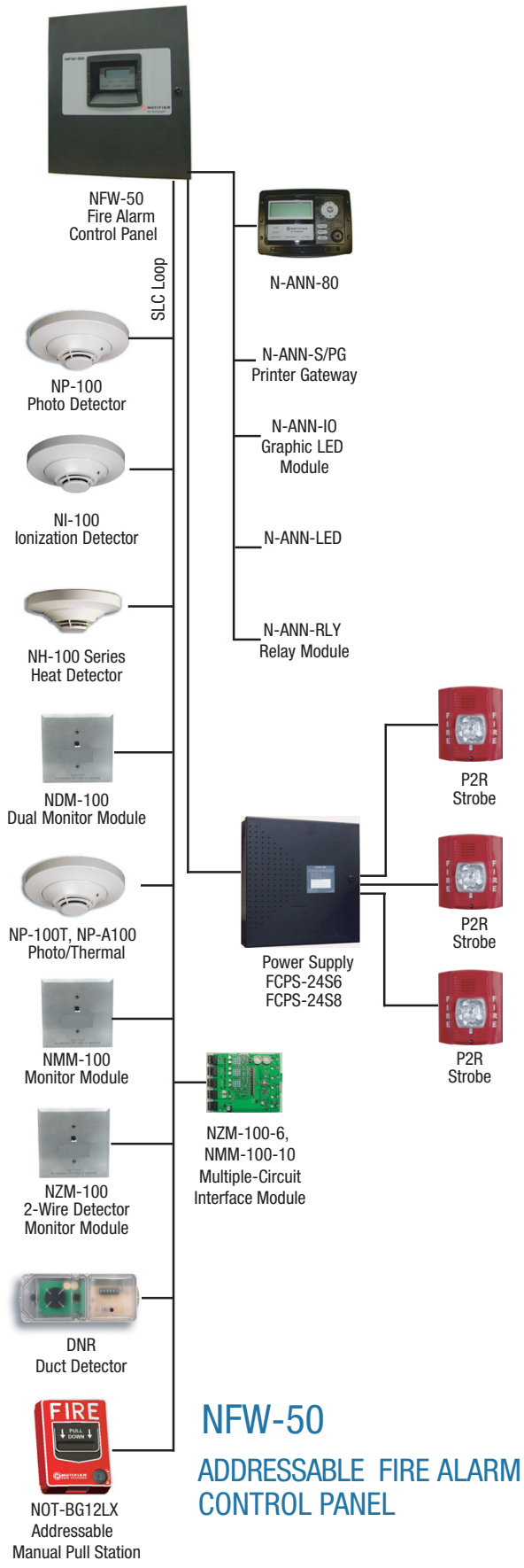
SLC COMMUNICATION LOOP

- Single addressable SLC loop which meets NFPA Style 4, 6 and 7 requirements.
- 50 addressable device capacity (any combination of addressable detectors and modules).
- Compatible with NOTIFIER FireWarden addressable devices (refer to the *FireWarden SLC Wiring Manual*).

NOTIFICATION APPLIANCE CIRCUITS (NACS)

- Two independently programmable output circuits. Circuits can be configured for the following outputs:
  - **Style Y** (Class B)
  - **Style Z** (Class A)
  - **Door Holder Service** (cannot be used for notification appliances)
  - **Aux Power Source** (cannot be used for notification appliances)
- Silence Inhibit and Autosilence timer options.
- Continuous, March Time, Temporal or California code for main circuit board NACs with two-stage capability.
- Selectable strobe synchronization per NAC.
- 2.5 A total power for NACs.

NOTE: *Maximum or total 24VDC system power shared between all NAC circuits and the ANN-BUS is 2.7 A.*



NFW-50

ADDRESSABLE FIRE ALARM CONTROL PANEL

PROGRAMMING AND SOFTWARE

- Autoprogram (learn mode) reduces installation time.
- Custom English labels (per point) may be manually entered or selected from an internal library file.
- Two programmable Form-C relay outputs.
- 20 software zones.
- Continuous fire protection during online programming at the front panel.
- Program Check automatically catches common errors not linked to any zone or input point.
- **OFFLINE PROGRAMMING:** Create the entire program in your office using PS-Tools, Windows®-based software package, and upload/download system programming locally. PS-Tools is available on www.magni-fire.com.

User interface

LED INDICATORS

- AC Power (green)
- Fire Alarm (red)
- Supervisory (yellow)
- Trouble (yellow)
- Alarm Silenced signals (yellow)

KEYPAD

- 16 key alpha-numeric pad
- Acknowledge/Step
- Alarm Silenced
- Drill (Manual Evacuate)
- Reset (lamp test)

Product Line Information

NFW-50: Combination DACT/Fire Alarm Control Panel with one SLC loop. Includes main circuit board with display, chassis with transformer, backbox with door, plastic bag containing screws, cables, key, etc., manual. *(For NFW-50C, refer to DN-60446.)*

NFW-50E: Same as NFW-50, but operates at 240 VAC.

NFW-50R: Same as NFW-50, with red backbox and door.

DP-51050B: Optional dress panel for NFW-50 (black).

DP-51050: Optional dress panel for the NFW-50R (red).

TR-CE-B: Optional trim ring for semi-flush mounting. (Black. For red, order **TR-CE**.)

BB-XP: Optional cabinet for one or two modules.

BB-25: Optional cabinet for up to six modules mounted on CHS-6 chassis.

BB-26: Battery backbox, holds up to two 25 AH batteries and CHG-75.

NFS-LBB: Battery box, houses two 55 AH batteries

CHS-6: Chassis, mounts up to six multi-modules in a BB-25 cabinet.

CHG-75: Battery charger for lead-acid batteries with a rating of 25 to 75 AH.

CHG-120: Remote battery charging system for lead-acid batteries with a rating of 55 to 120 AH. Requires additional NFS-LBB for mounting.

***NOTE:** CHG-120 or CHG-75 required for batteries larger than 18AH.*

BAT Series: Batteries, see data sheet DN-6933.

PRT/PK-CABLE: Cable printer/personal computer interface cable.

PRN-6: UL listed compatible event printer. Uses tractor-fed paper.

IPDACT, IPDACT-2/2UD Internet Monitoring Module: Mounts in bottom of enclosure with optional mounting kit (PN IPBRKT). Connects to primary and secondary DACT telephone output ports for internet communications over customer provided ethernet internet connection. Requires compatible Teldat Visoralarm Central Station Receiver. Can use DHCP or static IP. *(See data sheet dn-60408 for more information.)*

IPBRKT: Mounting kit for IPDACT-2/2UD in common enclosure.

IPSPLT: Y-adaptor option allows connection of both panel dialer outputs to one IPDACT-2/2UD cable input.

AC-TRMBLK: AC Terminal Block mounts to a metal bracket, in turn, mounts to the FACP chassis. Use AC-TRMBLK when wire nuts are not allowed for AC connections to the transformer.

OPTIONAL MODULES

4XTM Reverse Polarity Transmitter Module: Provides a supervised output for local energy municipal box transmitter, alarm and trouble. Includes a disable switch and disable trouble LED.

ANN-SEC: Optional secondary ANN-BUS interface module. *Note: Used only with firmware 3.0 or higher.*

COMPATIBLE ANNUNCIATORS

N-ANN-80(-W): Remote LCD annunciator mimics the information displayed on the FACP LCD display. Recommended wire type is un-shielded. (Basic model is black; order -W for white; see DN-7114.)

N-ANN-I/O: LED Driver Module provides connections to a user supplied graphic annunciator. (See DN-7105.)

N-ANN-LED: Annunciator Module provides three LEDs for each zone: Alarm, Trouble, and Supervisory. Ships with red enclosure. *(See DN-60242.)*

N-ANN-RLED: Provides alarm (red) indicators for up to 30 input zones or addressable points. *(See DN-60242.)*

N-ANN-RLY: Relay Module provides 10 programmable Form-C relays. Can be mounted inside the cabinet. (See DN-7107.)

N-ANN-S/PG: Serial/Parallel Printer Gateway module provides a connection for a serial or parallel printer. *(See DN-7103.)*

ADDRESSABLE DEVICES

All feature a polling LED and rotary switches for addressing.

NI-100: Addressable low-profile ionization smoke detector.

NP-100: Addressable low-profile photoelectric smoke detector.

NP-100T: Addressable low-profile photoelectric smoke detector with thermal sensor.

NP-100R: Remote test capable addressable photoelectric smoke detector for use with DNR(W) duct detector housing.

NH-100: Fast-response, low-profile heat detector.

NH-100R: Fast-response, low-profile heat detector with rate-of-rise option.

NH-100H: Fast-response, low-profile heat detector that activates at 190°F/88°C.

NP-A100: Addressable low-profile multi-sensor detector.

DNR: InnovairFlex low-flow non-relay duct-detector housing. (Order NP-100R separately.)

DNRW: InnovairFlex low-flow non-relay duct-detector housing, with NEMA-4 rating. Watertight. (Order NP-100R separately.)

NMM-100: Addressable Monitor Module for one zone of normally-open dry-contact initiating devices. Mounts in standard 4.0" (10.16 cm.) box. Includes plastic cover plate and end-of-line resistor. Module may be configured for either a Style B (Class B) or Style D (Class A) IDC.

NDM-100: Dual Monitor Module. Same as NMM-100 except it provides two Style B (Class B) only IDCs.

NMM-100P: Miniature version of NMM-100. Excludes LED and Style D option. Connects with wire pigtails. May mount in device backbox.

NZM-100A: Similar to NMM-100A. Addressable Monitor Module for one zone of conventional two-wire detectors. Requires resettable 24 VDC power. Refer to the *Device Compatibility Document* for listed compatible devices and quantity limitation.

NZM-100-6: Six-zone interface module. Mount one or two modules in a BB-XP cabinet (optional). Mount up to six modules on a CHS-6 chassis in a BB-25 cabinet.

NMM-100-10: Ten-input monitor module. Mount one or two modules in a BB-2 cabinet (optional). Mount up to six modules on a CHS-6 chassis in a BB-25 cabinet.

NC-100: Addressable Control Module for one Style Y/Z (Class B/A) zone of supervised polarized Notification Appliances. Mounts directly to a 4.0" (10.16 cm.) electrical box. Notification Appliance Circuit option requires external 24 VDC to power notification appliances.

NC-100R: Addressable relay module containing two isolated sets of Form-C contacts, which operate as a DPDT switch. Mounts directly to a 4.0" (10.16 cm.) box, surface mount using the SMB500.

NOT-BG12LX: Addressable manual pull station with interface module mounted inside.

N100-ISO: Fault Isolator Module.

SMB500: Used to mount all modules except the NMM-100P.

NOTE: *For more information on Compatible Addressable Devices for use with the FireWarden-50, see the following data sheets (document numbers): N100-ISO (DN-6994), NP-100 series (DN-6995), NI-100 (DN-6996), NH-100/NH-100R (DN-6997), DNR/InnovairFlex (DN-60424, DN-60429), NP-A100 (DN-6998), NMM-100/NMM-100P/NDM-100/NZM-100 (DN-6999), NC-100 (DN-7000), NC-100R (DN-60383), NMM-100-10 (DN-6990), and NOT-BG12LX (DN-7001).*

ADDRESSABLE DEVICE ACCESSORIES

End-of-Line Resistor Assembly (R-47K and R-3.9K): The 47k ohm assembly supervises the NMM-100-10, NDM-100, NMM-100P, and NC-100 module circuits. The 3.9k ohm assembly supervises the NZM-100-6 module circuit. These resistors are included with each module.

Power Supervision Relay: Supervises the power to 4-wire smoke detectors and notification appliances.

Wiring Requirements

While shielded wire is not required, it is recommended that all SLC wiring be twisted-pair to minimize the effects of electrical interference. Refer to the panel manual for wiring details.

SYSTEM SPECIFICATIONS

System Capacity

- Intelligent Signalling Line Circuits 1
- Addressable device capacity 50
- Programmable software zones 20
- Annunciators 8

Electrical Specifications

AC Power: FireWarden-50: 120 VAC, 60 Hz, 3.0 A. FireWarden-50E: 240 VAC, 50 Hz, 1.5 A. Wire size: minimum 14 AWG (2.00 mm2) with 600 V insulation. Nonpower-limited, supervised.

Battery: Two 12 V 18 AH lead-acid batteries. Battery Charger Capacity: 7-18 AH (FireWarden-50 cabinet holds maximum of two 18 AH batteries.)

Communication Loop: Supervised and power-limited.

Notification Appliance Circuits: Terminal Block provides connections for two NACs, Style Y (Class B) or Style Z (Class A). Special Application power. Power-limited, supervised circuitry. Maximum signaling current per circuit: 2.5 A. End-of-Line Resistor: 4.7k ohm, ½ watt (P/N 71252 UL listed) for Style Y (Class B) NAC. Refer to the *NOTIFIER Device Compatibility Document* for listed compatible devices.

Two Programmable Relays and One Fixed Trouble Relay: Contact rating: 2.0 A @ 30 VDC (resistive), 0.5 A @ 30 VAC (resistive). Form-C relays, nonpower-limited, nonsupervised.

Cabinet Specifications

Door: 19.26" (48.92 cm.) high x 16.82" (42.73 cm.) wide x 0.72" (1.82 cm.) deep. **Backbox:** 19.00" (48.26 cm.) high x 16.65" (42.29 cm.) wide x 5.25" (13.34 cm.) deep. **Trim Ring (TR-CE/B):** 22.00" (55.88 cm.) high x 19.65" (49.91 cm.) wide.

Shipping Specifications

Weight: 26.9 lbs. (12.20 kg.) **Dimensions:** 20.00” (50.80 cm.) high x 22.5” (57.15 cm.) wide x 8.5” (21.59 cm.) deep.

Temperature and Humidity Ranges

This system meets NFPA requirements for operation at 0 – 49°C/32 – 120°F and at a relative humidity 93% ± 2% RH (noncondensing) at 32°C ± 2°C (90°F ± 3°F). However, the useful life of the system's standby batteries and the electronic components may be adversely affected by extreme temperature ranges and humidity. Therefore, it is recommended that this system and its peripherals be installed in an environment with a normal room temperature of 15 – 27°C/60 – 80°F.

NFPA Standards

The FireWarden-50 complies with the following NFPA 72 Fire Alarm Systems requirements:

- **LOCAL** (Automatic, Manual, Waterflow and Sprinkler Supervisory).
- **AUXILIARY** (Automatic, Manual and Waterflow) (requires 4XTM).
- **REMOTE STATION** (Automatic, Manual and Waterflow) (Where a DACT is not accepted, the alarm, trouble and supervisory relays may be connected to UL 864 listed transmitters. For reverse polarity signaling of alarm and trouble, 4XTM is required.)
- **PROPRIETARY** (Automatic, Manual and Waterflow).
- **CENTRAL STATION** (Automatic, Manual and Waterflow, and Sprinkler Supervised).
- **OT, PSDN** (Other Technologies, Packet-switched Data Network)

Agency Listings and Approvals

The listings and approvals below apply to the basic FireWarden-50 control panel. In some cases, certain modules may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **UL:** S635
- **FM approved**
- **CSFM:** 7165-0028:239
- **MEA:** 442-06-E Vol. 2

NOTE: *See DN-60446 for ULC-listed model.*

ISO 9001 CERTIFIED ENGINEERING & MANUFACTURING QUALITY SYSTEMS

This document is not intended to be used for installation purposes.
We try to keep our product information up-to-date and accurate.
We cannot cover all specific applications or anticipate all requirements.
All specifications are subject to change without notice.

Made in the U.S. A.

For more information, contact Notifier. Phone: (203) 484-7161, FAX: (203) 484-7118.
www.notifier.com

NOT-BG12LX

Addressable Manual Pull Station

NOTIFIER® by Honeywell

Intelligent/Addressable Devices

General

The Notifier NOT-BG12LX is a state-of-the-art, dual-action (i.e., requires two motions to activate the station) pull station that includes an addressable interface for FireWarden series intelligent control panels, and the NSP-25 panel. Because the NOT-BG12LX is addressable, the control panel can display the exact location of the activated manual station. This leads fire personnel quickly to the location of the alarm.

Features

- Maintenance personnel can open station for inspection and address setting without causing an alarm condition.
- Built-in bicolor LED, which is visible through the handle of the station, flashes in normal operation and latches steady red when in alarm.
- Handle latches in down position and the word “ACTIVATED” appears to clearly indicate the station has been operated.
- Captive screw terminals wire-ready for easy connection to SLC loop (accepts up to 12 AWG/3.25 mm² wire).
- Can be surface mounted (with SB-10 or SB-I/O) or semi-flush mounted. Semi-flush mount to a standard single-gang, double-gang, or 4" (10.16 cm) square electrical box.
- Smooth dual-action design.
- Meets ADAAG controls and operating mechanisms guidelines (Section 4.1.3[13]); meets ADA requirement for 5 lb. maximum activation force.
- Highly visible.
- Attractive shape and textured finish.
- Key reset.
- Includes Braille text on station handle.
- Optional trim ring (BG12TR).
- Meets UL 38, Standard for Manually Actuated Signaling Boxes.

Construction

Shell, door, and handle are molded of durable polycarbonate material with a textured finish.

Specifications

- **Shipping Weight:** 9.6 oz. (272.15 g)
- **Normal operating voltage:** 24 VDC.
- **Maximum SLC loop voltage:** 28.0 VDC.
- **Maximum SLC standby current:** 375 µA.
- **Maximum SLC alarm current:** 5 mA.
- **Temperature Range:** 32°F to 120°F (0°C to 49°C)
- **Relative Humidity:** 10% to 93% (noncondensing)
- **For use indoors in a dry location**

Installation

The NOT-BG12LX will mount semi-flush into a single-gang, double-gang, or standard 4" (10.16 cm) square electrical outlet box, or will surface mount to the model SB-10 or SB-I/O surface backbox. If the NOT-BG12LX is being semi-flush mounted, then the optional trim ring (BG12TR) may be used.

The NOT-BG12LX
Addressable Manual Pull Station

The BG12TR is usually needed for semi-flush mounting with 4" (10.16 cm) or double-gang boxes (not with single-gang boxes).

Operation

Pushing in, then pulling down on the handle causes it to latch in the down/activated position. Once latched, the word “ACTIVATED” (in bright yellow) appears at the top of the handle, while a portion of the handle protrudes from the bottom of the station. To reset the station, simply unlock the station with the key and pull the door open. This action resets the handle; closing the door automatically resets the switch.

Each manual station, on command from the control panel, sends data to the panel representing the state of the manual switch. Two rotary decimal switches allow address settings (1 – 99 on NFW2-100/NFW2-100C, 1 – 50 for NFW-50/NFW-50C).

Architectural/Engineering Specifications

Manual Fire Alarm Stations shall be non-coded, with a key-operated reset lock in order that they may be tested, and so designed that after actual Emergency Operation, they cannot be restored to normal except by use of a key. An operated station shall automatically condition itself so as to be visually detected as activated. Manual stations shall be constructed of red-colored polycarbonate material with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in white letters, 1.00 inches (2.54 cm) or larger. Stations shall be suitable for surface mounting on matching backbox SB-10 or SB-I/O; or semi-flush mounting on a standard single-gang, double-gang, or 4" (10.16 cm) square electrical box, and shall be installed

within the limits defined by the Americans with Disabilities Act (ADA) or per national/local requirements. Manual Stations shall be Underwriters Laboratories listed.

Manual stations shall connect with two wires to one of the control panel SLC loops. The manual station shall, on command from the control panel, send data to the panel representing the state of the manual switch. Manual stations shall provide address setting by use of rotary decimal switches.

Product Line Information

NOT-BG12LX: Dual-action addressable pull station. Includes key locking feature. (Listed for Canadian and non-Canadian applications.)

SB-10: Surface backbox; metal.

SB-I/O: Surface backbox; plastic.

BG12TR: Optional trim ring.

17021: Keys, set of two.

Agency Listings and Approvals

In some cases, certain modules or applications may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **UL/ULC Listed:** S692 (listed for Canadian and non-Canadian applications).
- **MEA:** 67-02-E Vol. IV.
- **CSFM: 7150-0028:0199.**
- **FM Approved.**

Patented: U.S. Patent No. D428,351; 6,380,846; 6,314,772; 6,632,108.

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SpectrAlert® Advance

Selectable Output Notification Appliances

NOTIFIER® by Honeywell

Audio/Visual Devices

General

SpectrAlert® Advance selectable-output horns, strobes and horn/strobes are rich with features guaranteed to cut installation times and maximize profits. The SpectrAlert Advance series of notification appliances is designed to simplify your installations, with features such as: plug-in designs, instant feedback messages to ensure correct installation of individual devices, and eleven field-selectable candela settings for wall and ceiling strobes and horn/strobes.

More specifically, when installing Advance products, first attach a universal mounting plate to a four-inch square, four-inch octagon, or double-gang junction box. The two-wire mounting plate attaches to a single-gang junction box.

Then, connect the notification appliance circuit wiring to the SEMS terminals on the mounting plate.

Finally, attach the horn, strobe, or horn/strobe to the mounting plate by inserting the product's tabs in the mounting plate's grooves. The device will rotate into position, locking the product's pins into the mounting plate's terminals. The device will temporarily hold in place with a catch until it is secured with a captured mounting screw.

SpectrAlert Advance products allow you to choose:

- 12 or 24 volts.
- 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177, or 185 candela by way of a rear-mounted slide switch and front viewing window.
- Horn tones and volume by way of a rotary switch.

The SpectrAlert Advance series includes outdoor notification appliances. Outdoor strobes and horn/strobes (two-wire and four-wire) are available for wall or ceiling. Outdoor horns are available for wall only. All System Sensor outdoor products are rated between –40°C and 66°C in wet or dry applications.

Models available:

- Indoor wall-mount: horn, strobe, 2-wire horn/strobe, 4-wire horn/strobe.
- Indoor ceiling-mount: strobe, 2-wire horn/strobe, 4-wire horn/strobe.
- Outdoor wall-mount: horn, strobe, 2-wire horn/strobe, 4-wire horn/strobe.
- Outdoor ceiling-mount: strobe, 2-wire horn/strobe, 4-wire horn/strobe.

Features

- Plug-in design.
- Same mounting plate for wall- and ceiling-mount units.
- Shorting spring on mounting plate for continuity check before installation.
- Captive mounting screw.
- Tamper-resistance capability.
- Field-selectable candela settings on wall and ceiling units: 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177, 185.
- Automatic selection of 12 or 24 volt operation at 15 and 15/75 candela.
- Outdoor wall and ceiling products.
- Outdoor products rated from –40°C and 66°C.

7087pho1.jpg

Indoor Ceiling Horn/Strobe

7087pho4.jpg

Outdoor Ceiling Strobe

7087pho3.jpg

Indoor Wall Horn/Strobe

7087pho2.jpg

Indoor Ceiling Strobe


7087pho5.jpg

Indoor Wall Horn

7087pho6.jpg

Outdoor Wall Strobe

- Outdoor products rainproof per UL50 (NEMA 3R) and weatherproof per NEMA 4X, IP56
- Minimal intrusion into the backbox.
- Horn rated at 88+ dbA at 16 volts.
- Rotary switch for tone selection.
- Three horn volume settings.
- Electrically compatible with existing SpectrAlert products.

Engineering Specifications

SpectrAlert Advance horns, strobes, and horn/strobes mount to a standard 10.16 x 10.16 x 3.81 cm backbox, 10.16 cm octagonal backbox, or a double-gang backbox. Two-wire products mount to a single-gang 5.08 x 10.16 x 4.763 cm backbox. A universal mounting plate shall be used for mounting ceiling and wall products. The notification appliance circuit wiring shall terminate at the universal mounting plate. Also, SpectrAlert Advance products, when used with the Sync•Circuit™ Module accessory, shall be powered from a non-coded notification appliance circuit output and shall operate on a nominal 12 or 24 volts. When used with the Sync•Circuit Module, 12-volt rated notification appliance circuit outputs shall operate between 9 and 17.5 volts; 24-volt rated notification appliance circuit outputs shall operate between 17 and 33 volts. Indoor SpectrAlert Advance products shall operate between 0°C and 49°C from a regulated DC, or full-wave-rectified, unfiltered power supply. Strobes and horn/strobes shall have field-selectable candela settings including 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177, 185.

STROBE

The strobe shall be a System Sensor SpectrAlert Advance Model _____ listed to CAN/ULC S5512 and shall be approved for fire protective service. The strobe shall be wired

as a primary-signaling notification appliance and comply with the Americans with Disabilities Act requirements for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system.

HORN/STROBE COMBINATION

The horn/strobe shall be a System Sensor SpectrAlert Advance Model _____ listed to CAN/ULC S5512 and shall be approved for fire protective service. The horn/strobe shall be wired as a primary-signaling notification appliance and comply with the Americans with Disabilities Act requirements for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. The horn shall have three audibility options and an option to switch between a Temporal 3 pattern and a Non-Temporal (continuous) pattern. These options are set by a multiple position switch. On four-wire products, the strobe shall be powered independently of the sounder. The horn on horn/strobe models shall operate on a coded or non-coded power supply.

OUTDOOR PRODUCTS

SpectrAlert Advance outdoor horns, strobes and horn/strobes shall be listed for outdoor use by ULC and shall operate between –40°C and 66°C. The products shall be listed for use with a System Sensor outdoor/weatherproof backbox with half-inch and three-fourths-inch conduit entries.

SYNCHRONIZATION MODULE

The module shall be a System Sensor Sync•Circuit MDL3RA or MDL3WA listed to ULC and shall be approved for fire protective service. The module shall synchronize SpectrAlert strobes at 1 Hz and horns at Temporal 3. Also, while operating the strobes, the module shall silence the horns on horn/strobe models over a single pair of wires. The module shall mount to a 11.906 x 11.906 x 5.398 cm backbox. The module shall also control two Style Y (class B) circuits or one Style Z (Class A) circuit. The module shall synchronize multiple zones. Daisy-chaining two or more synchronization modules together will synchronize all the zones they control. The module shall not operate on a coded power supply.

Operating Specifications

- **Standard operating temperature:** 0°C to 49°C.
- **K Series operating temperature:** –40°C to 66°C.
- **Humidity range:** 10% to 93% non-condensing (indoor products).
- **Strobe flash rate:** 1 flash per second.
- **Nominal voltage:** regulated 12 VDC/FWR or regulated 24 VDC/FWR. ***NOTE:*** *Full Wave Rectified (FWR) voltage is a non-regulated, time-varying power source that is used on some power supply and panel outputs.*
- **Operating voltage range:** 8 V to 17.5 V (12 V nominal); or 16 V to 33 V (24 V nominal). ***NOTE:*** *P, S, PC, and SC products will operate at 12 V nominal only for 15 cd and 15/75 cd.*
- **Input terminal wire gauge:** 12 to 18 AWG (3.31 to 0.821 mm²).
- **Ceiling-mount dimensions (including lens):** 17.3 cm diameter x 6.4 cm deep.
- **Wall-mount dimensions (including lens):** 14.2 cm H x 11.9 cm W x 6.4 cm D.
- **Horn dimensions:** 14.2 cm H x 11.9 cm W x 3.3 cm D.

Agency Listings and Approvals

The listings and approvals below apply to SpectrAlert Advance Selectable Output Notification Devices. In some cases, certain modules may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **UL Listed:** S4011
- **ULC Listed:** S5512
- **FM Approved**
- **MEA:** 452-05-E
- **CSFM:** 7125-1653:0186 (indoor strobes); 7125-1653:0188 (horn strobes, chime strobes); 7135-1653:0189 (horns, chimes)

Strobe Current Draw, ULC Maximum (mA RMS)

Candela		8 – 17.5 V		16 – 33 V	
		DC	FWR	DC	FWR
Standard Candela Range	15	123	128	66	71
	15/75	142	148	77	81
	30	NA	N/A	94	96
	75	NA	NA	158	153
	95	NA	NA	181	176
	110	NA	NA	202	195
	115	NA	NA	210	205
High Candela Range	135	NA	NA	228	207
	150	NA	NA	246	220
	177	NA	NA	281	251
	185	NA	NA	286	258

Horn Current Draw, ULC Maximum (mA RMS)

Sound Pattern	dB	8 – 17.5 V		16 – 33 V	
		DC	FWR	DC	FWR
Temporal	High	57	55	69	75
Temporal	Medium	44	49	58	69
Temporal	Low	38	44	44	48
Non-temporal	High	57	56	69	75
Non-temporal	Medium	42	50	60	69
Non-temporal	Low	41	44	50	50
Coded	High	57	55	69	75
Coded	Medium	44	51	56	69
Coded	Low	40	46	52	50

Horn and Horn/Strobe Rotary Switch Setting

Setting	Repetition Rate	dB Level
1	Temporal horn	High
2	Temporal horn	Medium
3	Temporal horn	Low
4	Normal horn	High
5	Normal horn	Medium
6	Normal horn	Low
7*	Externally coded	High
8*	Externally coded	Medium
9*	Externally coded	Low

***NOTE:** Settings 7, 8, and 9 are not available on 2-wire horn/strobe.*

Horn and Horn/Strobe Output (dBA)

Switch Position	Sound Pattern	dB	8 – 17.5 V		16 – 33 V	
			DC	FWR	DC	FWR
1	Temporal	High	96	93	101	99
2	Temporal	Medium	89	89	95	95
3	Temporal	Low	86	87	91	92
4	Non-temporal	High	90	86	96	93
5	Non-temporal	Medium	82	82	90	89
6	Non-temporal	Low	79	80	86	86
7*	Coded	High	90	87	96	93
8*	Coded	Medium	82	82	90	89
9*	Coded	Low	78	80	86	86

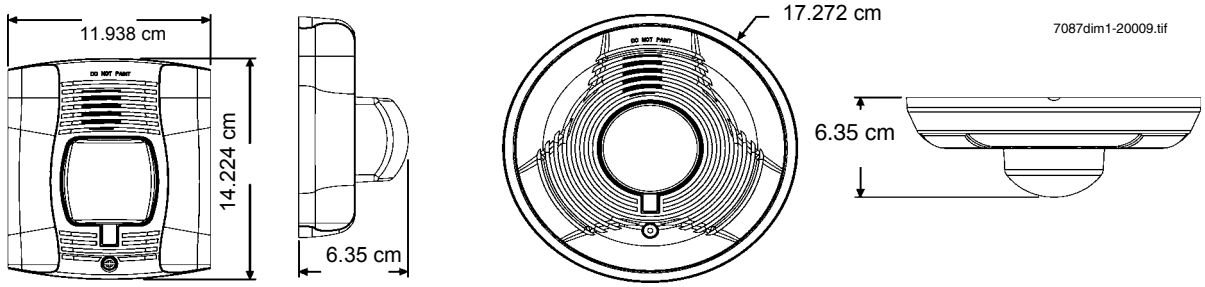
***NOTE:** Settings 7, 8, and 9 are not available on 2-wire horn/strobe.*

Two-Wire Horn/Strobe, *STANDARD* Candela Range (15 – 115 cd), ULC Maximum Current Draw (mA RMS)

Input, Sound Pattern, dB Level	8 – 17.5 V		16 – 33 V						
	15	15/75	15	15/75	30	75	95	110	115
Input, Temporal, High	137	147	79	90	107	176	194	212	218
Input, Temporal, Medium	132	144	69	80	97	157	182	201	210
Input, Temporal, Low	132	143	66	77	93	154	179	198	207
Input, Non-temporal, High	141	152	91	100	116	176	201	221	229
Input, Non-temporal, Medium	133	145	75	85	102	163	187	207	216
Input, Non-temporal, Low	131	144	68	79	96	156	182	201	210
Input, Temporal, High	136	155	88	97	112	168	190	210	218
Input, Temporal, Medium	129	152	78	88	103	160	184	202	206
Input, Temporal, Low	129	151	76	86	101	160	184	194	201
Input, Non-temporal, High	142	161	103	112	126	181	203	221	229
Input, Non-temporal, Medium	134	155	85	95	110	166	189	208	216
Input, Non-temporal, Low	132	154	80	90	105	161	184	202	211

Two-Wire Horn/Strobe, *HIGH* Candela Range (135 – 185 cd), ULC Maximum Current Draw (mA RMS)

Input	16 – 33 V				Input	16 – 33 V			
	135	150	177	185		135	150	177	185
Temporal, High	245	259	290	297	Temporal, High	215	231	258	265
Temporal, Medium	235	253	288	297	Temporal, Medium	209	224	250	258
Temporal, Low	232	251	282	292	Temporal, Low	207	221	248	256
Non-temporal, High	255	270	303	309	Non-temporal, High	233	248	275	281
Non-temporal, Medium	242	259	293	299	Non-temporal, Medium	219	232	262	267
Non-temporal, Low	238	254	291	295	Non-temporal, Low	214	229	256	262



Ordering Information

Model	Description	Model	Description
WALL HORN/STROBES		***CEILING HORN/STROBES***	
P2RA	2-wire horn/strobe, standard cd, red.	**PC2RKA**	2-wire horn/strobe, standard cd, red, outdoor.
P2RHA	2-wire horn/strobe, high cd, red.	**PC2RHKA**	2-wire horn/strobe, high cd, red, outdoor.
P2RKA	2-wire horn/strobe, standard cd, red, outdoor	**PC2WA**	2-wire horn/strobe, standard cd, white.
P2RHKA	2-wire horn/strobe, high cd, red, outdoor.	**PC2WHA**	2-wire horn/strobe, high cd, white.
P2WA	2-wire horn/strobe, standard cd, white.	**PC4RKA**	4-wire horn/strobe, standard cd, red, outdoor.
P2WHA	2-wire horn/strobe, high cd, white.	**PC4RHKA**	4-wire horn/strobe, high cd, red, outdoor.
P4RA	4-wire horn/strobe, standard cd, red.	**PC4WA**	4-wire horn/strobe, standard cd, white.
P4RHA	4-wire horn/strobe, high cd, red.	**PC4WHA**	4-wire horn/strobe, high cd, white.
P4RKA	4-wire horn/strobe, standard cd, red, outdoor.	***HORNS***	
P4RHKA	4-wire horn/strobe, high cd, red, outdoor.	**HRA**	Horn, red.
P4WA	4-wire horn/strobe, standard cd, white.	**HRKA**	Horn, red, outdoor.
P4WHA	4-wire horn/strobe, high cd, white.	**HWA**	Horn, white.
ACCESSORIES		***WALL STROBES***	
BBS-2A	Backbox skirt, wall, red.	**SRA**	Strobe, standard cd, red.
BBSW-2A	Backbox skirt, wall, white.	**SRHA**	Strobe, high cd, red.
BBSC-2A	Backbox skirt, ceiling, red.	**SRKA**	Strobe, standard cd, red, outdoor.
BBSCW-2A	Backbox skirt, ceiling, white.	**SRHKA**	Strobe, high cd, red, outdoor.
WTPA	Flush mount, weatherproof plate, red	**SWA**	Strobe, standard cd, white.
WTPWA	Flush mount, weatherproof plate, white	**SWHA**	Strobe, high cd, white.
TR-HSA	Trim Ring, Red, package of 5	***CEILING STROBES***	
TRW-HSA	Trim Ring, White, package of 5	**SCRKA**	Strobe, standard cd, red, outdoor.
TRC-HSA	Trim Ring Ceiling, Red, package of 5	**SCRHKA**	Strobe, high cd, red, outdoor.
TRCW-HSA	Trim Ring Ceiling, White, package of 5	**SCWA**	Strobe, standard cd, white.
		SCWHA	Strobe, high cd, white.

NOTE: *For strobes and horn/strobes, add suffix "-F" for French or "-B" for Bilingual.*

NOTE: **"High cd" refers to strobes that include 135, 150, 177, and 185 candela settings. "Standard cd" refers to strobes that include 15, 15/75, 30, 75, 95, 110, and 115 candela settings.*

NOTE: *All outdoor models ("K(A)" suffix) include a plastic weatherproof backbox.*

NOTE: *Add "-R" to models for weatherproof replacement device (no back box included). Only for use with weatherproof outdoor flush mounting plate, WTPA and WTPWA.*

NOTE: *Add "P" to model for plain housing (No "FIRE" marking on the cover.)*

For more information, contact Notifier.
(888) 289-1114
10 Whitmore Road
Woodbridge, Ontario L4L 7Z4
www.notifier.com

NC-100R(A)

Relay Module for FireWarden Series Panels

NOTIFIER® by Honeywell

Addressable

General

The **NC-100R(A)** Addressable Relay Module provides NOTIFIER's **FireWarden Series** intelligent control panels with two isolated sets of Form-C dry-contact outputs for activating a variety of auxiliary devices, such as fans, dampers, door holders, control equipment, etc. Addressability allows the dry contact to be activated, either manually or through panel programming, on a select basis.

NC-100R(A)

Features

- Built-in type identification automatically identifies these devices to the control panel.
- Internal circuitry and relay powered directly by two-wire SLC loop.
- Integral LED "blinks" green each time a communication is received from the control panel and turns on in steady when activated.
- High noise immunity (EMF/RFI).
- Wide viewing angle of LED.
- SEMS screws with clamping plates for wiring ease.
- Direct Decade entry of address: 01 – 99 with the FireWarden-100-2(C) and 01 – 50 with the FireWarden-50(C).

Applications

The NC-100R(A) may be programmed to operate dry contacts for door holders, Air Handling Unit shutdown, etc., and to reset four-wire smoke detector power.

Construction

- The face plate is made of off-white heat-resistant plastic.
- Controls include two rotary switches for direct-dial entry of address setting.
- The NC-100R(A) provides two Form-C dry contacts that switch together.

Operation

Each NC-100R(A) uses one of the addresses on a SLC loop. It responds to regular polls from the control panel and reports its type and status. The LED blinks with each poll received. On command, it activates its internal relay.

Rotary switches set a unique address for each module. The address may be set before or after mounting. The built-in TYPE CODE (not settable) will identify the module to the control panel.

Specifications

Normal operating voltage: 15 to 32 VDC.

Maximum SLC current draw: 6.5 mA (LED).

Average operating current: 230 µA direct poll (CLIP mode), 255 µA group poll with LED flashing.

EOL resistance: not used.

Temperature range: 32°F to 120°F (0°C to 49°C).

Humidity range: 10% to 93% non-condensing.

Dimensions: 4.5" (11.43 cm) high x 4" (10.16 cm) wide x 1.25" (3.175 cm) deep. Mounts to a 4" (10.16 cm) square x 2.125" (5.398 mm) deep box.

Relay Contact Ratings

Load Description	Application	Maximum Voltage	Current Rating
Resistive	Non-Coded	30 VDC	3.0 A
Resistive	Coded	30 VDC	2.0 A
Resistive	Non-Coded	110 VDC	0.9 A
Resistive	Non-Coded	125 VAC	0.9 A
Inductive (L/R=5ms)	Coded	30 VDC	0.5 A
Inductive (L/R=2ms)	Coded	30 VDC	1.0 A
Inductive (PF=0.35)	Non-Coded	125 VAC	0.5 A

Agency Listings and Approvals

In some cases, certain modules may not be listed by certain approval agencies, or listing may be in process. Consult factory for latest listing status.

- **UL/ULC Listed:** S635.
- **CSFM approved:** file 7300-0028:230.
- **FM approved.**
- **MEA approved:** file 72-01-E, Vol. 2.

Product Line Information

NC-100R: Intelligent addressable relay module.

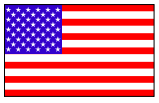
NC-100RA: Intelligent addressable relay module, ULC listed model.

SMB500: Optional surface-mount backbox.

NOTE: *For installation instructions, see document I56-2593-001 and refer to the SLC Wiring Manual, document 52304.*

ISO 9001 CERTIFIED
ENGINEERING & MANUFACTURING
QUALITY SYSTEMS

This document is not intended to be used for installation purposes.
We try to keep our product information up-to-date and accurate.
We cannot cover all specific applications or anticipate all requirements.
All specifications are subject to change without notice.



Made in the U.S. A.

For more information, contact Notifier. Phone: (203) 484-7161, FAX: (203) 484-7118.
www.notifier.com

INSTALLATION AND MAINTENANCE INSTRUCTIONS

Innovair flex™

SYSTEM SENSOR®

3825 Ohio Avenue, St. Charles, Illinois 60174
1-800-SENSOR2, FAX: 630-377-6495
www.systemsensor.com

DNR Duct Smoke Detector

SPECIFICATIONS

Operating Temperature:	–4° to 158° F (–20° to 70° C); 32° F to 120° F (0° C to 49° C) with module installed in the DNR
Storage Temperature:	–22° to 158° F (–30° to 70° C)
Humidity:	0% to 93% Relative Humidity Non-condensing
Air Velocity:	100 to 4000 ft./min. (0.5 to 20.3 m/sec.)
Rectangular Footprint Dimensions:	14.38 in L × 5 in W × 2.5 in D (37 cm L × 12.7 cm W × 6.36 cm D)
Square Footprint Dimensions:	7.75 in L × 9 in W × 2.5 in D (19.7 cm L × 22.9 cm W × 6.35 cm D)
Weight:	1.6 pounds; 0.73 kg

Electrical (See applicable detector head installation manual for electrical specifications. Use the Base/Sensor Cross Reference chart at http:\\www.systemsensor.com to determine applicable sensor head.)

Table of Contents **Page**

BEFORE INSTALLING

Read the System Sensor Guide for *Proper Use of Smoke Detectors in Duct Applications* (A05-1004), which provides detailed information on detector spacing, placement, zoning, wiring, and special applications. Copies of this manual are available online at www.systemsensor.com. NFPA Standards 72 and 90A should also be referenced for detailed information.

NOTICE: This manual shall be left with the owner/user of this equipment.
IMPORTANT: This detector must be tested and maintained regularly following NFPA 72 requirements. The detector should be cleaned at least once a year.

[1]LIMITATIONS OF DUCT SMOKE DETECTORS

⚠WARNING

The National Fire Protection Association has established that DUCT DETECTORS MUST NOT BE USED AS A SUBSTITUTE FOR OPEN AREA DETECTOR PROTECTION as a means of providing life safety. Nor are they a substitute for early warning in a building's regular fire detection system.

System Sensor supports this position and strongly recommends that the user read NFPA Standards 90A, 72, and 101. The DNR Air Duct Smoke Detectors are listed per UL 268A.

This device will not operate without electrical power. Fire situations may cause an interruption of power. The system safeguards should be discussed with your local fire protection specialist.

This device will not sense smoke unless the ventilation system is operating and the cover is installed.

For this detector to function properly, it MUST be installed according to the instructions in this manual. Furthermore, the detector MUST be operated within ALL electrical and environmental specifications listed in this manual and the sensor head installation manual. Failure to comply with these requirements may prevent the detector from activating when smoke is present in the air duct.

ACCESSORY CURRENT LOADS AT 24 VDC		
DEVICE	**STANDBY**	**ALARM**
RA400Z/RA100Z	0mA	12mA Max.
RTS451/RTS151	0mA	12mA Max.
RTS451KEY/RTS151KEY	0mA	12mA Max.

[2]GENERAL DESCRIPTION

Smoke introduced into this air duct system will be distributed throughout the entire building. Smoke detectors designed for use in air duct systems are used to sense the presence of smoke in the duct.

Model DNR Air Duct Smoke Detector utilizes photoelectric technology for the detection of smoke. This detection method, when combined with an efficient housing design, samples air passing through the duct and allows detection of a developing hazardous condition. When sufficient smoke is sensed, an alarm signal is initiated at the fire control panel monitoring the detector, and appropriate action can be taken to shut off fans, blowers, change over air handling systems, etc. These actions can facilitate the management of toxic smoke and fire gases throughout the areas served by the duct system.

The DNR incorporates a sensor cover tamper feature that provides a trouble signal at the panel immediately if the cover is removed or improperly installed. Proper installation of the sensor cover removes the trouble condition.

When programmed with the system control panel, two LEDs on each duct smoke detector light to provide local visible indication.

The DNR provides a remote alarm output for use with auxiliary devices, such as the RA400Z/RA100Z remote LED annunciator, as well as remote test capability with the RTS451/RTS151 or RTS451KEY/RTS151KEY Remote Test Stations.

[2.1] DETECTOR FEATURE SET

– Utilizes plug-in head
– Sampling tubes install from front and rear
– Compatible with existing accessories
– Able to address detector per code switches on sensor head.

[3]CONTENTS OF THE DUCT SMOKE DETECTOR KIT

1. Sensor/power side and covers (use appropriate sensor per the system control panel)
2. Three #10 sheet metal screws for mounting
3. Drilling template
4. One sampling tube end cap
5. One plastic exhaust tube

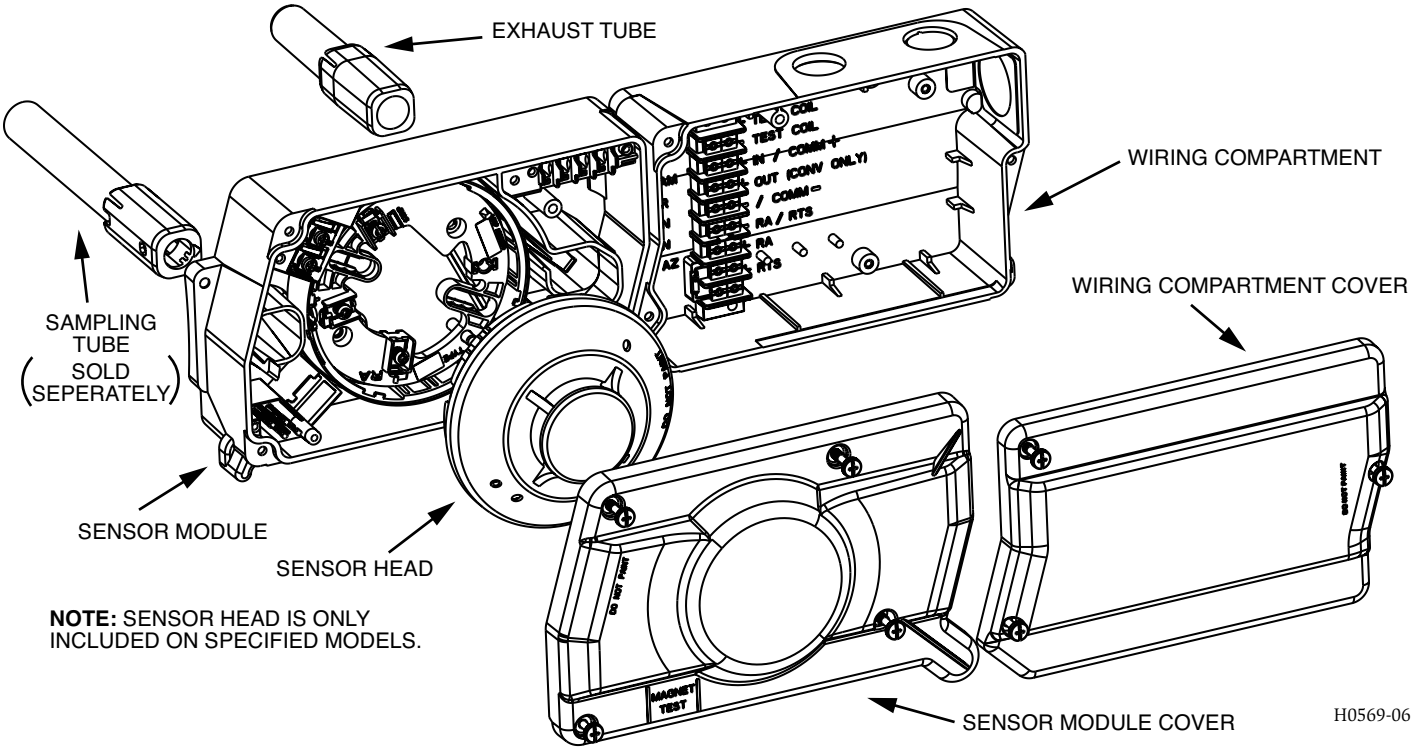
NOTE: A DST sampling tube must be ordered to complete the installation. It must be the correct length for the width of the duct where it will be installed. See Table 1 on page 3 to determine the inlet tube required for different duct widths.

[4]DETECTOR INSTALLATION

[4.1]VERIFY DUCT AIR FLOW DIRECTION AND VELOCITY

Model DNR detectors are designed to be used in air handling systems having air velocities of 100 to 4000 feet per minute. Duct widths from 6 inches to 12 feet can be accommodated. Be sure to check engineering specifications to ensure that the air velocity in the duct falls within these parameters. If necessary, use a velocity meter (anemometer) to check the air velocity in the duct.

FIGURE 1. EXPLODED VIEW OF DUCT SMOKE DETECTOR COMPONENTS:



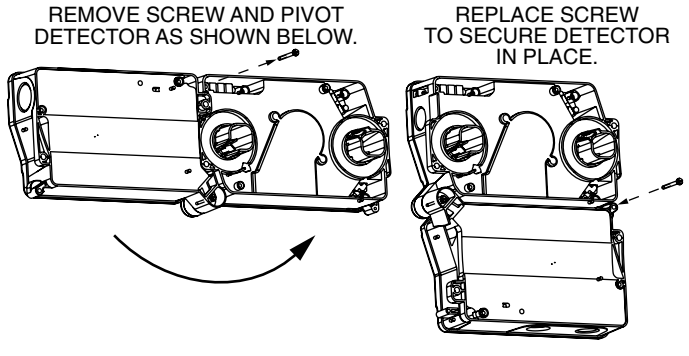
[4.2]DETERMINE MOUNTING LOCATION AND CONFIGURATION

On ducts wider than 18 inches it is recommended that the detector be mounted downstream of a bend, obstruction in the duct, or the supply or return air inlet.

Exception: Installation of duct detectors can be on or within a commercial packaged rooftop heating and air-conditioning system, fire/smoke dampers and economizers. They may be mounted in either the supply and/or return air section as determined by local code.

Once a suitable location is selected, determine if the detector is to be mounted in a side-by-side "rectangular" configuration or a top-over-bottom "square" configuration as shown in Figure 2. If mounting in the square configuration, remove the rear attachment screw, rotate the unit at hinge, and replace the screw into the new attachment hole as shown in Figure 2. Do NOT remove the hinge screw during this process. Final installation approval shall be based upon passing differential pressure and smoke entry tests described in the Measurement Tests section.

FIGURE 2:



[4.3]DRILL THE MOUNTING HOLES

Remove the paper backing from the mounting template supplied. Affix the template to the duct at the desired mounting location. Make sure the template lies flat and smooth on the duct.

[4.3.1]FOR RECTANGULAR SIDE-BY-SIDE MOUNTING CONFIGURATION:

Center punch at (4) target centers: (2) "A" for sampling tubes and (2) "B" for the rectangular configuration mounting tabs as shown on mounting template. Drill pilot holes at target "A" centers and cut two 1.375 inch diameter holes using a $1\frac{3}{8}$-inch hole saw or punch. Drill .156 inch diameter holes using a $\frac{5}{32}$ inch drill at target "B" centers.

[4.3.2]FOR SQUARE TOP-OVER-BOTTOM MOUNTING CONFIGURATION:

Center punch at (4) target centers: (2) "A" for sampling tubes and (2) "C" for the square configuration mounting tabs as shown on mounting template. Drill pilot holes at target "A" centers and cut two 1.375 inch diameter holes using a $1\frac{3}{8}$-inch hole saw or punch. Drill .156 inch diameter holes using a $\frac{5}{32}$ inch drill at target "C" centers. If desired, drill an additional .156 inch hole at the location of one of the mounting tabs on the lower housing.

[4.4]SECURE THE DUCT DETECTOR TO THE DUCT

Use two (rectangular configuration) or three (square configuration) of the provided sheet metal screws to screw the duct detector to the duct.

CAUTION: Do not overtighten the screws.

[5]SAMPLING TUBE INSTALLATION

[5.1]SAMPLING TUBE SELECTION

The sampling tube must be purchased separately. Order the correct length, as specified in Table 1, for width of the duct where it will be installed. The sampling tube length must extend at least $\frac{2}{3}$ across the duct width for optimal performance.

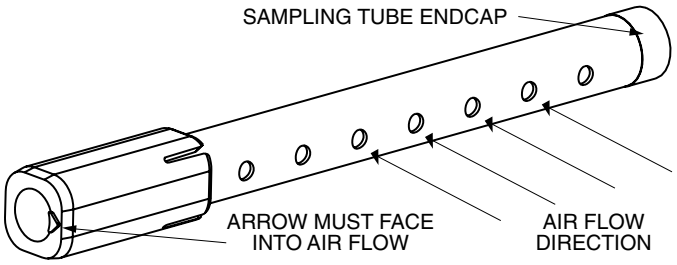
The sampling tube is always installed with the air inlet holes facing into the air flow. To assist proper installation, the tube's connector is marked with an arrow. Make sure the sampling tube is mounted so that the arrow points into the airflow as shown in Figure 3. Mounting the detector housing in a vertical orientation is acceptable provided that the air flows directly into the sampling tube holes as indicated in Figure 3. The sampling tube and exhaust tube can be mounted in either housing connection as long as the exhaust tube is mounted downstream from the sampling tube.

TABLE 1. SAMPLING TUBES RECOMMENDED FOR DIFFERENT DUCT WIDTHS:

Outside Duct Width	Sampling Tube Recommended*
Up to 1 ft.	DST1
1 to 2 ft.	DST1.5
2 to 4 ft.	DST3
4 to 8 ft.	DST5
8 to 12 ft.	DST10 (2-piece)

*Must extend a minimum of ⅔ the duct width

FIGURE 3. AIR DUCT DETECTOR SAMPLING TUBE:



H0551-00

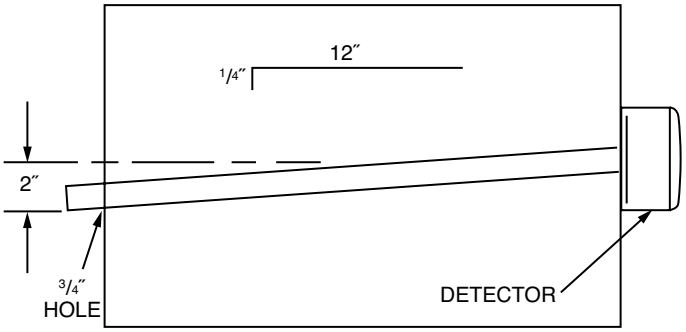
CAUTION: The sampling tube end cap, included with the detector, is critical to proper operation of the duct smoke detector. The end cap is needed to create the proper air flow to the sensor of the duct smoke detector. Once any sampling tube length adjustments are made, plug the end of the sampling tube with the provided end cap.

A plastic exhaust tube is included with the unit to be installed if needed. Install into the housing connection that is downstream from the sampling tube connection. The exhaust tube can be installed from the front of the detector or the back. A longer 1 foot exhaust tube, model ETX, is available as an accessory in cases where the molded exhaust tube does not extend at least 2 inches into the duct.

[5.2]SAMPLING TUBE INSTALLATION

1. For tubes shorter than the width of the duct, slide the sampling tube, with installed end cap, into the housing connection that meets the airflow first. Position the tube so that the arrow points into the airflow as shown in Figure 3. Per NFPA sampling tubes over 3 feet long should be supported at the end opposite of the duct detector. In ducts wider than 8 feet, work must be performed inside the duct to couple the other section of the sampling tube to the section already installed using the ½ inch conduit fitting supplied. Make sure that the holes on both sections of the air inlet sampling tube are lined up and facing into the airflow.
2. For tubes longer than the width of the air duct, the tube should extend out of the opposite side of the duct. Drill a ¾ inch hole in the duct opposite the hole already cut for the sampling tube. Ensure that the sampling tube is angled downward from the duct smoke detector to allow for moisture drainage away from the detector. The sampling tube should be angled at least ¼" downward for every 12" of duct width per Figure 4.There should be 10 to 12 holes spaced as evenly as possible across the width of the duct. If there are more than 2 holes in the section of the tube extending out of the duct, select a shorter tube using Table 1. Otherwise, trim the tube to leave approximately 1 to 2 inches extending outside the duct. Plug the end with the end cap and tape closed any holes in the protruding section of the tube. Be sure to seal the duct where the tube protrudes.

FIGURE 4.



H0215-00

NOTE: Air currents inside the duct may cause excessive vibration, especially when the longer sampling tubes are used. In these cases, a 3 inch floor flange (available at most plumbing supply stores) may be used to fasten the sampling tube to the other side of the duct. When using the flange/connector mounting technique, drill a 1 to 1 ¼ inch hole where the flange will be used

[5.3]MODIFICATIONS OF SAMPLING TUBES

There may be applications where duct widths are not what is specified for the installation. In such cases, it is permissible to modify a sampling tube that is longer than necessary to span the duct width.

Use a 0.193-inch diameter (#10) drill and add the appropriate number of holes so that the total number of holes exposed to the air flow in the duct is 10 to 12. Space the additional holes as evenly as possible over the length of the tube.

CAUTION: This procedure should only be used as a temporary fix. It is not intended as a permanent substitute for ordering the correct length tubes.

[5.4]REMOTE SAMPLING TUBE INSTALLATION

The detector arrangement can also incorporate the remote mounting of the sampling tube and/or exhaust tube. In this case both the detector, sampling tube and exhaust tube (if included) should be rigidly mounted to withstand the pressure and vibrations caused by the air velocity. The location of the detector's sampling tube should be such that there is uniform airflow in the cross section area.

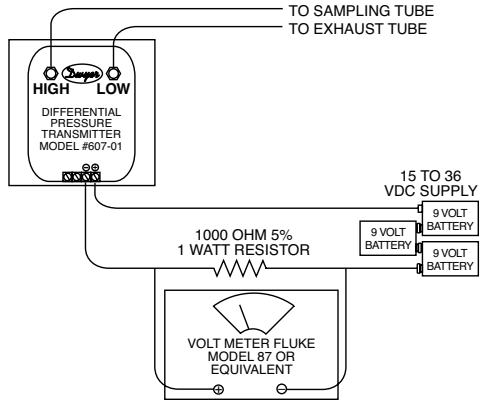
Pressure differential across the sampling and exhaust ports in the detector housing shall be verified to be between 0.01 and 1.11 inches of water. Do so by measuring the pressure difference between the inlet and outlet ports on the detector housing using a manometer as described in the Measurement Tests sectiont of this manual.

[6]MEASUREMENT TESTS

[6.1]AIR FLOW

The DNR is designed to operate over an extended air speed range of 100 to 4000 FPM. To verify sufficient sampling of ducted air, turn the air handler on and use a manometer to measure the differential pressure between the two sampling tubes. The differential pressure should measure at least 0.01 inches of water and no more than 1.11 inches of water. Because most commercially available manometers cannot accurately measure very low pressure differentials, applications with less than 500 FPM of duct air speed may require one of the following: 1) the use of a current-sourcing pressure transmitter (Dwyer Series 607) or 2) the use of aerosol smoke, see below for test descriptions.

FIGURE 5. PROCEDURE FOR VERIFYING AIR FLOW:



H0163-01

[6.2]LOW FLOW AIR FLOW TEST USING DWYER SERIES 607 DIFFERENTIAL PRESSURE TRANSMITTER

Verify the air speed of the duct using an anemometer. Air speed must be at least 100 FPM. Wire the Dwyer transmitter as shown in **Figure 5**. Connect the leads of the meter to either side of the 1000Ω resistor. Allow unit to warm up for 15 seconds. With both HIGH and LOW pressure ports open to ambient air, measure and record the voltage drop across the 1000Ω resistor (measurement 1), 4.00 volts is typical. Using flexible tubing and rubber stoppers, connect the HIGH side of the transmitter to the sampling tube of the duct smoke detector housing, and the LOW side of the transmitter to the exhaust tube of the duct smoke detector housing. Measure and record the voltage drop across the 1000Ω resistor (measurement 2). Subtract the voltage recorded in measurement 1 from the voltage recorded in measurement 2. If the difference is greater than 0.15 volts, there is enough air flow through the duct smoke detector for proper operation.

[7]FIELD WIRING; INSTALLATION GUIDELINES

All wiring must be installed in compliance with the National Electrical Code and the local codes having jurisdiction. Proper wire gauges should be used. The conductors used to connect smoke detectors to control panels and accessory devices should be color-coded to prevent wiring mistakes. Improper connections can prevent a system from responding properly in the event of a fire.

For signal wiring (the wiring between detectors or from detector to auxiliary devices), it is usually recommended that single conductor wire be no smaller than 18 gauge. The duct smoke detector terminals accommodate wire sizes up to 12 gauge. Flexible conduit is recommended for the last foot of conduit; solid conduit connections may be used if desired.

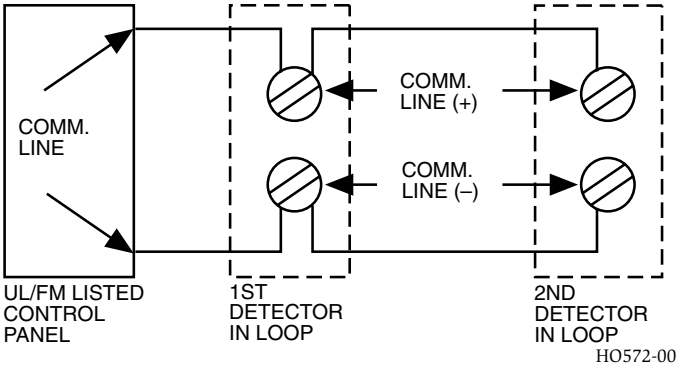
Duct smoke detectors and alarm system control panels have specifications for Signaling Line Circuit (SLC) wiring. Consult the control panel manufacturer's specifications for wiring requirements before wiring the detector loop.

[7.1]WIRING INSTRUCTIONS

Disconnect power from the communication line before installing the DNR duct smoke detector.

The DNR detectors are designed for easy wiring. The housing provides a terminal strip with clamping plates. Wiring connections are made by sliding the bare end under the plate, and tightening the clamping plate screw. See **Figure 6** on below for system wiring.

FIGURE 6. SYSTEM WIRING DIAGRAM FOR DNR:

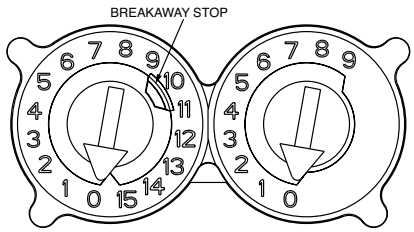


HO572-00

[7.2] SET THE ADDRESS

Set the desired address on the sensor head code wheel switches. on the back of the sensor head.

FIGURE 7. ROTARY ADDRESS SWITCHES



HO112-00

Note: Some panels support extended addressing. In order to set the sensor above the address number 99 on compatible systems, carefully remove the stop on the left hand rotary switch with pliers as shown in Figure 7.

NOTE: Verify sensor cover gasket is properly seated on cover prior to cover installation

[8] VERIFICATION OF OPERATION

[8.1]INSTALL THE COVER

Install the covers making sure that the cover fits into the base groove. Tighten the seven screws that are captured in the covers. Note that the cover must be properly installed for proper operation of the sensor.

[8.2] POWER THE UNIT

Activate the communication line on terminals COM + and COM –.

[8.3] DETECTOR CHECK

Standby – If programmed by the system control panel, look for the presence of the flashing LEDs through the transparent housing cover. The LED will flash with each communication.

Trouble – If programmed by the system control panel and the detector LEDs do not flash, then the detector lacks power (check wiring, missing or improperly placed cover, panel programming, or power supply), the sensor head is missing (replace), or the unit is defective (return for repair).

[8.4]DUCT SMOKE DETECTOR TEST & MAINTENANCE PROCEDURES

Test and maintain duct smoke detectors as recommended in NFPA 72. The tests contained in this manual were devised to assist maintenance personnel in verification of proper detector operation.

Before conducting these tests, notify the proper authorities that the smoke detection system will be temporarily out of service. Disable the zone or system under test to prevent unwanted alarms.

[8.4.1]TEST THE UNIT

1. M02-04-00 Magnet Test (not included) – This sensor can be functionally tested with a test magnet. The test magnet electronically simulates smoke in the sensing chamber, testing the sensor electronics and connections to the control panel.
2. Remote Test Accessory – The use of a remote accessory for visible indication of power and alarm is recommended.

   Verify system control panel alarm status and control panel execution of all intended auxiliary functions (i.e. fan shutdown, damper control, etc.).

   Two LEDs on the sensor are controlled by the panel to indicate sensor status. Coded signals, transmitted from the panel, can cause the LEDs to blink, latch on, or latch off. Refer to the control panel technical documentation for sensor LED operation and expected delay to alarm.

[8.4.2] THE DETECTOR MUST BE RESET BY THE SYSTEM CONTROL PANEL

[8.4.3] SMOKE RESPONSE TEST

To determine if smoke is capable of entering the sensing chamber, visually identify any obstructions. Close cover tamper terminals on sensor side of housing to ensure communication to panel. Plug the exhaust and sampling tube holes to prevent ducted air from carrying smoke away from the detector head, then blow smoke such as cigarette, cotton wick, or punk directly at the head to cause an alarm. REMEMBER TO REMOVE THE PLUGS AFTER THIS TEST, OR THE DETECTOR WILL NOT FUNCTION PROPERLY.

[8.4.4]SMOKE ENTRY TEST USING AEROSOL SMOKE

This test is intended for low-flow systems (100-500 FPM). If the air speed is greater than 500 FPM, use a conventional manometer to measure differential pressure between the sampling tubes, as described under Measurement Tests on Page 3.

Drill a ¼-inch hole 3 feet upstream from the duct smoke detector. With the air handler on, measure the air velocity with an anemometer. Air speed must be at least 100 FPM. Spray aerosol smoke* into the duct through the ¼-inch hole for five seconds. Wait two minutes for the duct smoke detector to alarm. If the duct smoke detector alarms, air is flowing through the detector. Remove the duct smoke detector cover and blow out the residual aerosol smoke from the chamber and reset the duct smoke detector at the panel. Use duct tape to seal the aerosol smoke entry hole. Remember to replace the cover after the test or the detector will not function properly.

*Aerosol smoke can be purchased from Home Safeguard Industries at homesafeguard.com, model 25S Smoke Detector Tester, and Chekkit Smoke Detector Tester model CHEK02 and CHEK06 available from SDi. When used properly, the canned smoke agent will cause the smoke detector to go into alarm. Refer to the manufacturer's published instructions for proper use of the canned smoke agent.

⚠CAUTION

Canned aerosol simulated smoke (canned smoke agent) formulas will vary by manufacturer. Misuse or overuse to these products may have long term adverse effects on the smoke detector. Consult the canned smoke agent manufacturer's published instructions for any further warnings or caution statements.

[9]DETECTOR CLEANING PROCEDURES

Notify the proper authorities that the smoke detector system is undergoing maintenance, and that the system will temporarily be out of service. Disable the zone or system undergoing maintenance to prevent unwanted alarms and possible dispatch of the fire department.

[9.1]DETECTOR SENSOR

1. Remove the sensor to be cleaned from the system.
2. Remove the sensor cover by pressing firmly on each of the four removal tabs that hold the cover in place.
3. Vacuum the screen carefully without removing it. If further cleaning is required continue with Step 4, otherwise skip to Step 7.
4. Remove the chamber cover/screen assembly by pulling it straight out.
5. Use a vacuum cleaner or compressed air to remove dust and debris from the sensing chamber.
6. Reinstall the chamber cover/screen assembly by sliding the edge over the sensing chamber. Turn until it is firmly in place.
7. Replace the cover using the LEDs to align the cover and then gently pushing it until it locks into place.
8. Reinstall the detector.

[9.2]REINSTALLATION

1. Reinstall the detector in its housing.
2. Restore system power.
3. Perform Detector Check.
4. Notify the proper authorities testing has been completed and the smoke detector system is back in operation.

[10]SENSOR REPLACEMENT

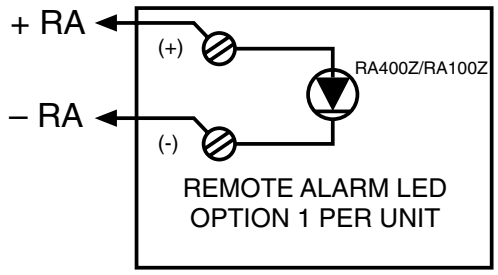
1. Remove the sensor head by rotating counterclockwise.
2. Pull gently to remove it.
3. To replace the sensor head, align the mounting features and rotate clockwise into place.

[11] OPTIONAL ACCESSORIES

Optional accessories include RA400Z/RA100Z, RTS451/RTS151 and RTS451KEY/RTS151KEY.

NOTE: Ensure blue wire always remains connected to RA + on the field connector side of the terminal block.

FIGURE 8. WIRING DIAGRAM FOR DNR TO RA400Z/RA100Z:



H0570-03

Note: If using a RA400Z, the tab should be broken for use with the intelligent duct smoke detector. If using RA100Z, ensure that jumper is removed.

The RTS451/RTS151/RTS451KEY/RTS151KEY Remote Test Station facilitates test of the alarm capability of the duct smoke detector. These accessories provide the stimulus to initiate an alarm condition at the detector. The DNR duct smoke detector must be reset by the system control panel.

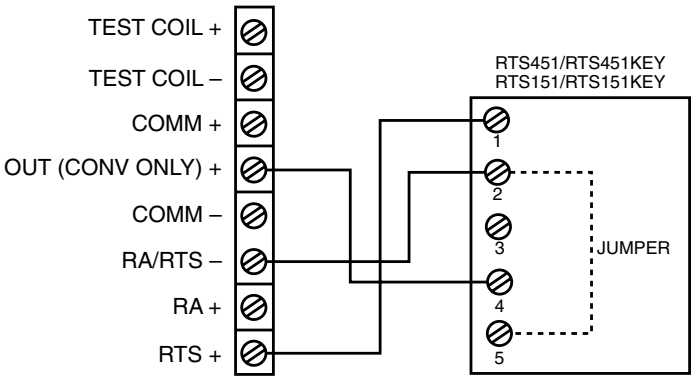
[11.1] OPTION 1: REMOTE TEST USING SENSOR WITH REMOTE TEST CAPABILITY (WITHOUT A TEST COIL):

A sensor with suffix "R" is available for use inside the DNR. Suffix "R" represents a head with Remote Test Capability. Using this head inside the DNR eliminates the need for a test coil when wired to a RTS451/RTS151/RTS451KEY/RTS151KEY Remote Test Station.

To install the RTS451/RTS151/RTS451KEY/RTS151KEY, using the sensor with remote test capability connect the device as shown in **Figure 9**; wire runs must be limited to 25 ohms or less per interconnecting wire.

NOTE: Resistor assembly must be in place between RA + and OUT + inside the DNR for Remote Test function to operate.

FIGURE 9. RTS451/RTS451KEY/RTS151/RTS151KEY USING SENSOR WITH REMOTE TEST CAPABILITY



H0633-00

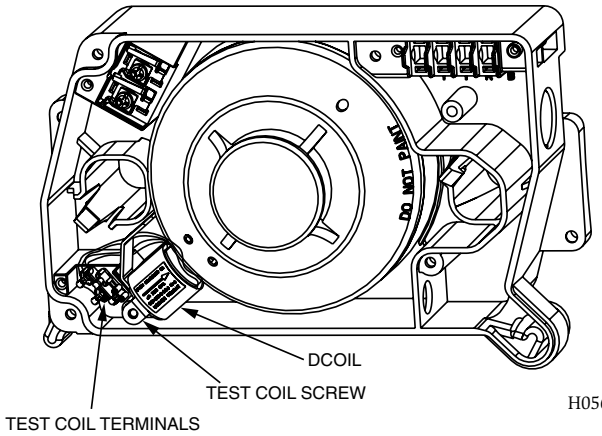
[11.2] OPTION 2: REMOTE TEST USING A TEST COIL:

The use of a remote test station requires the installation of an accessory coil, part number DCOIL, sold separately.

1) Install DCOIL in housing pocket insuring that arrow is pointing toward detector
2) Install DCOIL mounting screw
3) Connect each DCOIL lead to a Test Coil Terminal

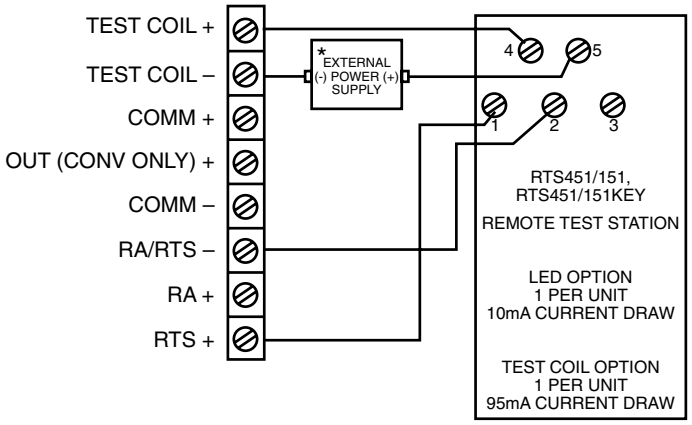
See **Figure 10** below for reference.

FIGURE 10. DNR USING A TEST COIL



H0561-01

FIGURE 11. WIRING DIAGRAM FROM DNR TO RTS451/RTS151/ RTS451KEY/RTS151KEY USING A TEST COIL:



H0571-07

NOTE: The RTS451/151, RTS451/151KEY test coil circuit requires an external 24 VDC power supply which must be UL listed.

[11.3] ADDITIONAL MODULE OPTION

The DNR can also accommodate a relay or control module (sold separately) within the power board side of the housing. The relay or control module must be listed as compatible to the fire alarm control panel.

Physical Module Mounting

1) Remove the breakaway tabs at the four corners of the module
2) Locate the module at right most corner of the power board. The upper left corner mounting hole of the module will align with a screw boss in the housing.
3) Install a #8 × ⅜″ Plastite screw at the screw boss location

Note: See the corresponding module Installation Instructions for general description, control panel compatibility, wiring and ratings.

Please refer to insert for the Limitations of Fire Alarm Systems

THREE-YEAR LIMITED WARRANTY

System Sensor warrants its enclosed product to be free from defects in materials and workmanship under normal use and service for a period of three years from date of manufacture. System Sensor makes no other express warranty for the enclosed product. No agent, representative, dealer, or employee of the Company has the authority to increase or alter the obligations or limitations of this Warranty. The Company's obligation of this Warranty shall be limited to the replacement of any part of the product which is found to be defective in materials or workmanship under normal use and service during the three year period commencing with the date of manufacture. After phoning System Sensor's toll free number 800-SENSOR2 (736-7672) for a Return Authorization number, send defective units postage prepaid to: System Sensor, Returns Department, RA #_____, 3825 Ohio Avenue, St. Charles, IL 60174. Please include a note describing the malfunction and suspected cause of failure. The Company shall not be obligated to replace units which are found to be defective because of damage, unreasonable use, modifications, or alterations occurring after the date of manufacture. In no case shall the Company be liable for any consequential or incidental damages for breach of this or any other Warranty, expressed or implied whatsoever, even if the loss or damage is caused by the Company's negligence or fault. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This Warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

EPS10-1 and EPS10-2 Alarm Pressure Switches

System Sensor EPS10 Series switches are designed for use in wet, dry, deluge, and pre-action automatic sprinkler systems to indicate a discharge from a sprinkler.

Features

- Sensitivity adjustment wheel, no special tools required
- Reinforced diaphragm resists pressure spikes
- Two conduit entrances
- Both one- and two-switch models available

The EPS10-1 has a single SPDT switch while the EPS10-2 model contains two SPDT switches. The EPS10 Series features field adjustable pressure sensitivity to provide an alarm response between 4 and 20 psi. It is factory set to respond at 4 – 8 psi on rising or falling pressure. The pressure adjustment wheel requires no special tools and does not affect switch synchronization on the EPS10-2. The EPS10 Series switches are NEMA 4 rated.

Agency Listings

LISTED S739

FM APPROVED 0X0A7.AY 0D3A3.AY

ULC C5169

LPCB

7770-1209:147

VdS G4020028-27

Specifications, EPS10-1 and EPS10-2

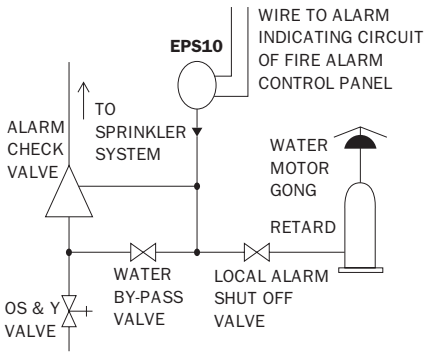
Architectural/Engineering Specifications EPS10-1 (SPDT), EPS10-2 (2/SPDT)

Model shall be an EPS10-1 or EPS10-2 pressure type waterflow switch as manufactured by System Sensor of St. Charles, IL. They shall be installed on the sprinkler system with connection as shown on the drawings and/or as specified herein. Pressure switches shall be of the bellows-activated type. Switches shall have a maximum service pressure rating of 300 psi and shall be factory adjusted to operate at a pressure of 4 – 8 psi. There shall be one (1) or two (2) SPDT contacts rated at 10.0 Amp @ 125/250 VAC and 2.5 Amp @ 6/12/24 VDC. The contractor shall furnish and install, where indicated on the plans, pressure switches according to appropriate NFPA standards. Switches shall be provided with a ½˝ NPT male pressure connection to be connected to the alarm check valve of a “wet” sprinkler system, into the intermediate chamber of a “dry” system, or to a pre-action or deluge valve. They shall be activated by any flow of water equal to or in excess of the discharge from one sprinkler head. Switches shall provide 1 knockout type and 1 open hole for ½˝ conduit fitting attachment and a ground screw provision for electrical grounding. The switch enclosure shall be weatherproof and carry a UL 4x/NEMA 4 rating when used with proper electrical fittings and conduit. The cover shall incorporate tamper-resistant screws. The unit shall be listed by Underwriters Laboratories, Inc. and approved by Factory Mutual.

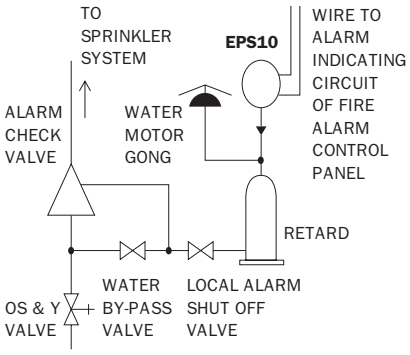
Specifications, EPS10-1 and EPS10-2 (continued)

Physical/Operating Specifications			
Maximum Operating Pressure	300 psi	**Operating Temperature Range**	Indoor or outdoor use: –40°F to 160°F (–40°C to 71°C)
Maximum Adjustment Pressure Range	4 to 20 psi	**Cover Tamper Switch**	UL Models: Optional P/N 546-8000 ULC Models: Factory Installed
Differential	Approximately 3 psi throughout range	**Enclosure**	Rated UL 4x, NEMA 4 for indoor or outdoor use
Factory Setting	Operates at rising pressure 4 to 8 psi	**Shipping Weight**	1.2 lbs. (.54 Kg)
Switch Contact Ratings	EPS10-1: One set SPDT (Form C) EPS10-2: Two sets SPDT (Form C) 10.0 A, ½ HP @ 125/250 VAC 2.5 A @ 6/12/24 VDC	**Service Use**	Automatic Sprinkler: NFPA 13 One or Two Family Dwelling: NFPA 13D Residential Occupancies up to 4 Stories: NFPA 13R National Fire Alarm Code: NFPA 72
Pressure Connection	½˝ NPT male glass reinforced nylon	**Warranty**	3 years
Dimensions	5.12˝ H × 3.325˝ W × 4.250˝ L (13.0 cm × 8.4 cm × 10.8 cm)		

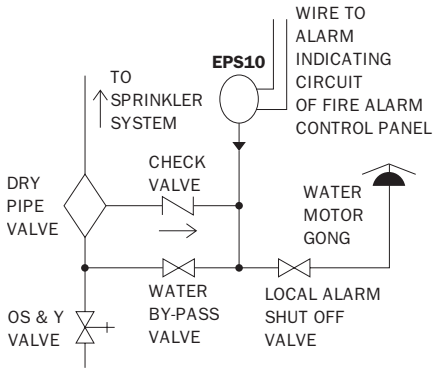
Typical Sprinkler Applications



WET SYSTEM

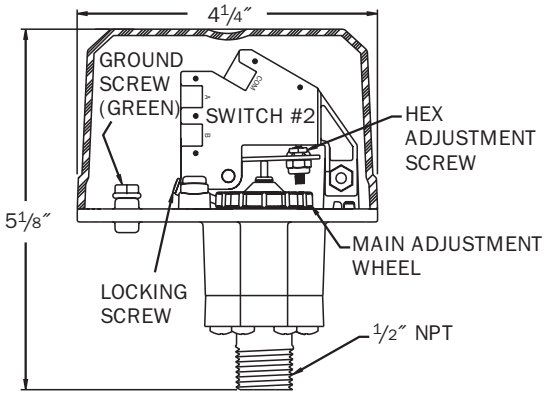


WET SYSTEM

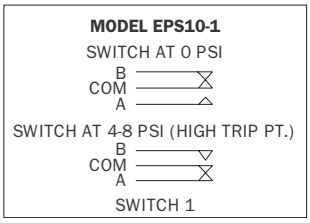


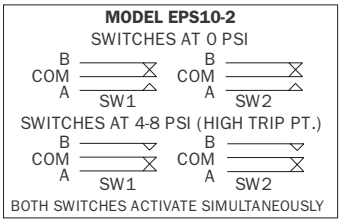
DRY SYSTEM

Pressure Switch Basic Dimensions



Electrical Connections





Ordering Information

Part No.	Description
EPS10-1	Alarm Waterflow Pressure Switch, One SPDT, 4–20 PSI
EPS10-2	Alarm Waterflow Pressure Switch, Two SPDT, 4–20 PSI
EPSA10-1	ULC/Canadian Version
EPSA10-2	ULC/Canadian Version
Replacement Parts	
S07-66-02	Replacement Tamper Screws for Cover of EPS
WFDW	Replacement Tamper Proof Wrench for Cover of EPS
546-8000	Cover Tamper Switch for EPS Series

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Model ESFR-17
16.8 K-factor Upright Sprinkler
Early Suppression, Fast Response

General Description

TYCO Model ESFR-17 Upright Sprinklers are Early Suppression, Fast Response (ESFR) sprinklers having a nominal K-factor of 16.8 (Ref. Figure 1). They are suppression mode sprinklers that are especially advantageous as a means of eliminating in-rack sprinklers when protecting high-piled storage.

Model ESFR-17 Sprinklers are primarily used for ceiling-only sprinkler protection of (but not limited to) the following storage applications:

- most encapsulated or non-encapsulated common materials including cartoned, unexpanded plastics
- cartoned, expanded plastics
- some storage arrangements of rubber tires and roll paper

For more specific criteria, refer to Table A in this technical data sheet as well as the applicable design standard.

The Model ESFR-17 Upright Sprinklers provide the system designer with an upright option to the traditional pendent ESFR Sprinklers. With a K-factor of 16.8, Model ESFR-17 Sprinklers provide system designers with hydraulic and sprinkler placement options not presently available to traditional ESFR Sprinklers having a K-factor of 14.0. In particular, the Model ESFR-17 Upright Sprinklers are designed to operate at substantially lower-end head pressures compared to ESFR Sprinklers with 14.0 K-factors. This feature offers flexibility when sizing system piping and positioning the system piping with respect to the ceiling.

Applications for the TYCO ESFR Sprinklers are expanding beyond currently recognized installation standards. For information on research fire tests that may be acceptable to an authority having jurisdiction, contact Tyco Fire Protection Products (TFPP) Technical Services.

NOTICE

The Model ESFR-17 Upright Sprinklers described herein must be installed and maintained in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (NFPA), in addition to the standards of any authorities having jurisdiction (e.g., FM Global). Failure to do so may impair the performance of these devices.

The owner is responsible for maintaining their fire protection system and devices in proper operating condition. Contact the installing contractor or product manufacturer with any questions.

In all cases, the appropriate NFPA or FM Global installation standard must be referenced to ensure applicability and to obtain complete installation guidelines. The general guidelines in this data sheet are not intended to provide complete installation criteria.

IMPORTANT

Always refer to Technical Data Sheet TFP700 for the "INSTALLER WARNING" that provides cautions with respect to handling and installation of sprinkler systems and components. Improper handling and installation can permanently damage a sprinkler system or its components and cause the sprinkler to fail to operate in a fire situation or cause it to operate prematurely.

Sprinkler Identification Number (SIN)

TY7126

Technical Data

Approvals
FM Approved
CE Certified (Certificate of Conformity 1725-CPD-H0012)

Maximum Working Pressure
175 psi (12,1 bar)

Pipe Thread Connections
3/4 Inch NPT or ISO 7-R 3/4

Discharge Coefficient
K=16.8 gpm/psi$^{1/2}$ (241,9 lpm/bar$^{1/2}$)

Temperature Ratings
165°F (74°C) and 212°F (100°C)

Finish
Natural Brass

Physical Characteristics

Frame	Brass
Deflector	Copper
Compression Screw	Stainless Steel
Hook	MONEL
Strut	MONEL
Link Assembly	Solder, Nickel
Button	Brass
Sealing Assembly	Beryllium Nickel w/TEFLON
Ejection Spring	INCONEL
Deflector Nut	Brass

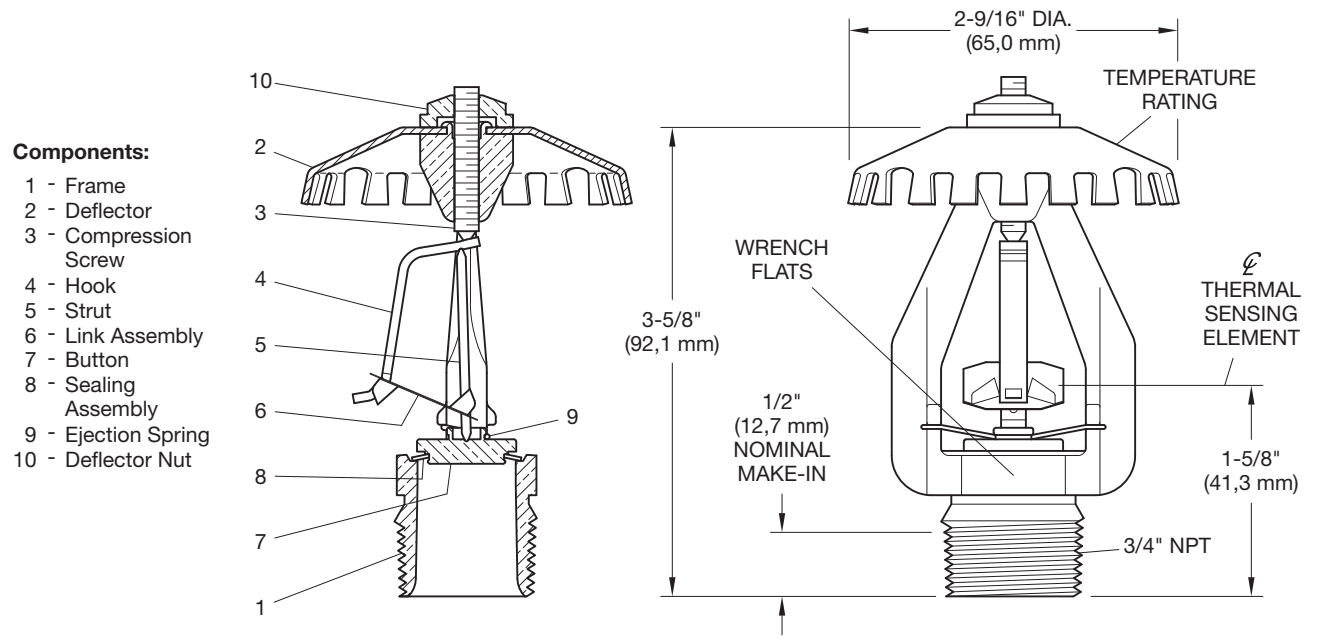

FIGURE 1
MODEL ESFR-17 UPRIGHT SPRINKLER, 16.8K
EARLY SUPPRESSION, FAST RESPONSE

Design Criteria

The following general guidelines provided for the TYCO Model ESFR-17 Upright Sprinklers may be used for quick reference.

The National Fire Protection Association (NFPA) and FM Global (FM Approvals) provide installation standards that must be used to properly design an automatic sprinkler system utilizing Early Suppression, Fast Response (ESFR) Sprinklers. The guidelines provided by NFPA and FM Global may differ; consequently, the appropriate standard must be used for a given installation.

In all cases, the appropriate NFPA or FM Global installation standard must be referenced to ensure applicability and to obtain complete installation guidelines, since the following general guidelines are not intended to provide complete installation criteria.

In addition to this technical data sheet, the following data sheets describe other TYCO ESFR Sprinklers:

- **TFP312**
  Model ESFR-25 (TY9226)
  K=25.2 Pendent Sprinkler
- **TFP315**
  Model ESFR-17 (TY7226)
  K=16.8 Pendent Sprinkler
- **TFP318**
  Model ESFR-1 (TY6226)
  K=14.0 Pendent Sprinkler

System Type
Wet Pipe

Roof Construction
Unobstructed or obstructed construction (e.g., smooth ceiling, bar joists, beam and girder, and so forth)

Where the depths of the solid structural members (e.g., beams and stem) exceed 12 inches (302 mm), install ESFR Sprinklers in each channel formed by the structural members.

Ceiling Slope
Maximum 2 inch rise for 12 inch run (16.7%)

Maximum Coverage Area
100 ft.^{2} (9,3 m^2)

In some cases, the installation standards permit a greater coverage area.

Minimum Coverage Area
64 ft.^{2} (5,8 m^2) per
NFPA 13 / FM Global 2-0

Maximum Spacing
12 feet (3,7 m) for building heights up to 30 feet (9,1 m)

10 feet (3,1 m) for building heights greater than 30 feet (9,1 m)

Minimum Spacing
8 feet (2,4 m)

Minimum Clearance to Commodity
36 inches (914 mm)

NFPA 13
Deflector-to-Ceiling Distance
3 to 12 inches (76,2 to 304 mm)

FM Global
Centerline of Thermal Sensing Element-to-Ceiling Distance
Refer to FM Global 2-0 for Storage Sprinklers.

Obstructions below Upright ESFR Sprinklers, Including Branchlines
Per the requirements of FM, obstructions below upright ESFR Sprinklers can be ignored as follows

- open-web bar joists or trusses having chords no more than 4 inches (102 mm) wide
- bridging or wind bracing no more than 4 inches (102 mm) wide
- individual pipes and conduit 4 inches (102 mm) diameter or less 3 inch [DN80] pipe size or less will not require sprigs)
- individual groups of smaller pipe or conduit having a total width of 4 inches or less

Operation

The fusible link assembly is comprised of two link halves that are joined together by a thin layer of solder. When the rated temperature is reached, the solder melts and the two link halves separate, activating the sprinkler and flowing water.

Storage Type	NFPA	FM Global
Open Frame (i.e., no solid shelves) Single, Double, Multiple-Row, or Portable Rack Storage of Class I-IV and Group A or B Plastics	Refer to NFPA 13 Chapters 16 and 17	Refer to FM 2-0 and 8-9
Solid Pile or Palletized Storage of Class I-IV and Group A or B Plastics	Refer to NFPA 13 Chapters 14 and 15	Refer to FM 2-0 and 8-9
Idle Pallet Storage	Refer to NFPA 13 Chapter 12	Refer to FM 2-0, 8-9, and 8-24
Rubber Tire Storage	Refer to NFPA 13 Chapter 18	Refer to FM 2-0 and 8-9
Roll Paper Storage (Refer to the standard)	Refer to Chapter 13 Chapter 19	Refer to FM 8-21
Flammable/Ignitable Liquid Storage (Refer to the standard)	N/A	Refer to FM 7-29
Aerosol Storage (Refer to the standard)	N/A	N/A
Automotive Components in Portable Racks (Control mode only; refer to the standard)	N/A	N/A

N/A – Not Applicable

TABLE A
MODEL ESFR-17 UPRIGHT SPRINKLER
COMMODITY SELECTION AND DESIGN CRITERIA OVERVIEW

Installation

TYCO Model ESFR-17 Early Suppression, Fast Response 16.8K Upright Sprinklers must be installed in accordance with this section.

General Instructions

Avoid damage to the fusible Link Assembly during installation by using the Frame arms only to handle the sprinkler (i.e., do not apply pressure to the fusible Link Assembly) and by using the appropriate sprinkler wrench. Failure to do so can lead to an unstable link assembly and premature activation of the sprinkler. Damaged sprinklers must be replaced.

A leak-tight 3/4 inch NPT sprinkler joint should be obtained by applying a minimum-to-maximum torque of 10 to 20 lbs.-ft. (13,4 to 26,8 Nm). Higher levels of torque can distort the sprinkler inlet with consequent leakage or impairment of the sprinkler.

Note: *Install the Model ESFR-17 Upright Sprinkler in the Upright position (Ref. Figure 2).*

Step 1. With pipe thread sealant applied, hand-tighten the sprinkler into the sprinkler fitting. Do not apply pressure to the Link Assembly, and handle the Model ESFR-17 Sprinkler only by the Frame arms.

Step 2. Wrench-tighten the Model ESFR-17 Upright Sprinkler using only the W-Type 21 Sprinkler Wrench (Ref. Figure 2) and by fully engaging (seating) the wrench on the sprinkler wrench flats (Ref. Figure 1).

Step 3. After installation, inspect the Link Assembly of each Model ESFR-17 Sprinkler for damage. In particular, verify that the Link Assembly and Hook are positioned as illustrated in Figure 1, and that the Link Assembly is not bent, creased, or forced out of normal position in any way. Replace damaged sprinklers.

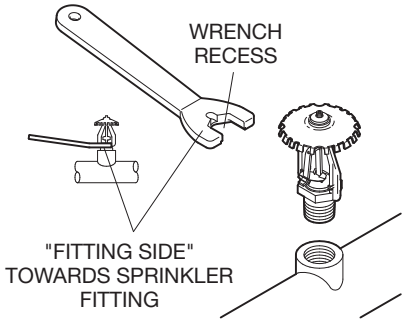

FIGURE 2
W-TYPE 21
SPRINKLER WRENCH

Care and Maintenance

TYCO Model ESFR-17 Early Suppression, Fast Response 16.8K Upright Sprinklers must be maintained and serviced in accordance with this section.

Before closing a fire protection system main control valve for maintenance work on the fire protection system that it controls, permission to shut down the affected fire protection system must be obtained from the proper authorities and notify all personnel who may be affected by this action.

Sprinklers which are found to be leaking or exhibiting visible signs of corrosion must be replaced.

Automatic sprinklers must never be painted, plated, coated, or otherwise altered after leaving the factory. Modified sprinklers must be replaced. Sprinklers that have been exposed to corrosive products of combustion, but have not operated, should be replaced if they cannot be completely cleaned by wiping the sprinkler with a cloth or by brushing it with a soft bristle brush.

Care must be exercised to avoid damage to the sprinklers before, during, and after installation. Sprinklers damaged by dropping, striking, wrench twist/slippage, or the like, must be replaced. Also, replace any sprinkler that has a cracked bulb or that has lost liquid from its bulb (Ref. Installation Section).

The owner is responsible for the inspection, testing, and maintenance of their fire protection system and devices in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (e.g., NFPA 25), in addition to the standards of any authorities having jurisdiction. Contact the installing contractor or product manufacturer with any questions.

Automatic sprinkler systems are recommended to be inspected, tested, and maintained by a qualified Inspection Service in accordance with local requirements and/or national codes.

Limited Warranty

For warranty terms and conditions, visit www.tyco-fire.com.

Ordering Procedure

Contact your local distributor for availability. When placing an order, indicate the full product name and part number (P/N).

Sprinkler Assemblies
Specify: Model ESFR-17 Early Suppression, Fast Response 16.8K Upright Sprinklers (TY7126), (specify temperature rating), with Natural Brass finish, P/N (specify):

165°F (74°C) . . . . . .P/N 58-447-1-165
212°F (100°C) . . . . . .P/N 58-447-1-214

Special Order
Sprinkler Assemblies with ISO 7-1 Thread Connection
Specify: Model ESFR-17 Early Suppression, Fast Response 16.8K Upright Sprinklers (TY7126) with ISO 7-1 thread connection, (specify temperature rating), with Natural Brass finish, P/N (specify):

165°F (74°C) . . . . . P/N 58-448-1-165
212°F (100°C) . . . . . P/N 58-448-1-214

Sprinkler Wrench
Specify: W-Type 21 Sprinkler Wrench, P/N 56-001-0-686

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tyco Fire Protection Products

Series TY-B, 5.6 K-factor Upright, Pendent, and Recessed Pendent Sprinklers Standard Response, Standard Coverage

General Description

The TYCO Series TY-B, 5.6 K-factor, Upright (TY315) and Pendent (TY325) Sprinklers described in this data sheet are standard response, standard coverage, decorative 5 mm glass bulb type spray sprinklers designed for use in light, ordinary, or extra hazard, commercial occupancies such as banks, hotels, shopping malls, factories, refineries, and chemical plants.

The recessed version of the Series TY-B Pendent Sprinkler, where applicable, is intended for use in areas with a finished ceiling. This recessed pendent sprinkler uses one of the following:

- A two-piece Style 15 Recessed Escutcheon with recessed adjustment up to 5/8 inch (15,9 mm) from the flush pendent position.
- A two-piece Style 20 Recessed Escutcheon with recessed adjustment up to 1/2 inch (12,7 mm) from the flush pendent position.

The adjustment provided by the Recessed Escutcheon reduces the accuracy to which the fixed pipe drops to the sprinklers must be cut.

Intermediate level versions of Series TY-B Sprinklers are described in Technical Data Sheet TFP352. Sprinkler guards and shields are described in Technical Data Sheet TFP780.

IMPORTANT

Always refer to Technical Data Sheet TFP700 for the "INSTALLER WARNING" that provides cautions with respect to handling and installation of sprinkler systems and components. Improper handling and installation can permanently damage a sprinkler system or its components and cause the sprinkler to fail to operate in a fire situation or cause it to operate prematurely.

NOTICE

The Series TY-B Sprinklers described herein must be installed and maintained in compliance with this document, as well as with the applicable standards of the National Fire Protection Association, in addition to the standards of any other authorities having jurisdiction. Failure to do so may impair the performance of these devices.

The owner is responsible for maintaining their fire protection system and devices in proper operating condition. The installing contractor or sprinkler manufacturer should be contacted with any questions.

Sprinkler Identification Numbers (SINs)

TY315 . . . . . Upright 5.6K, 1/2˝ NPT
TY325 . . . . . Pendent 5.6K, 1/2˝ NPT

Technical Data

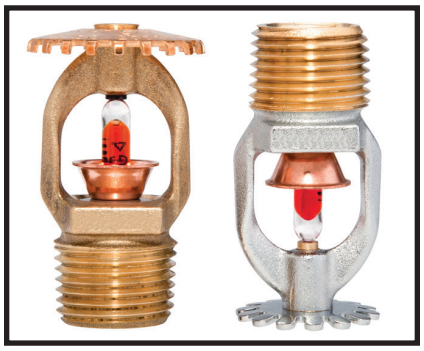
Approvals
UL and C-UL Listed
FM, LPCB, and VdS Approved
CE Certified

Sprinklers with Polyester Finish are UL and C-UL Listed as Corrosion-Resistant Sprinklers.

Maximum Working Pressure
175 psi (12.1 bar)
250 psi (17.2 bar)*

* The maximum working pressure of 250 psi (17.2 bar) only applies to the listing by Underwriters Laboratories, Inc. (UL).

Discharge Coefficient
K = 5.6 GPM/psi$^{1/2}$ (80,6 LPM/bar$^{1/2}$)



Temperature Ratings
135°F (57°C)
155°F (68°C)
175°F (79°C)
200°F (93°C)
286°F (141°C)
360°F (182°C)†

† UL, C-UL, and VdS Approved only

Finishes
Sprinkler: Refer to Table A

Recessed Escutcheon: White Coated, Chrome Plated, or Brass Plated

Physical Characteristics

Frame	Bronze
Button	Brass/Copper
Sealing Assembly	Stainless Steel w/TEFLON
Bulb	Glass
Compression Screw	Bronze
Deflector	Bronze

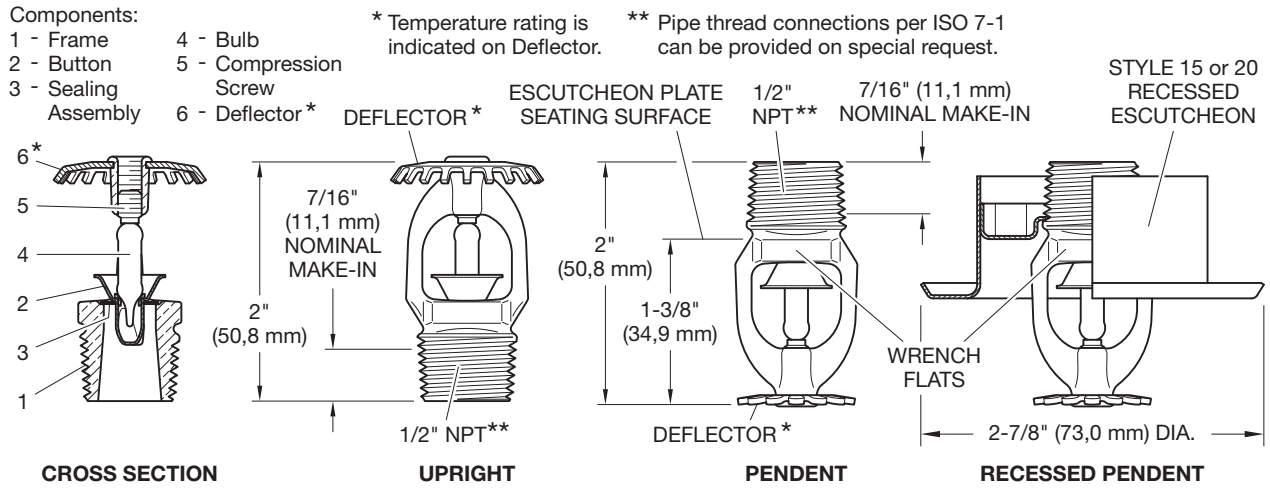


FIGURE 1
SERIES TY-B UPRIGHT (TY315) AND PENDENT (TY325) SPRINKLERS
5.6 K-FACTOR, 1/2 INCH NPT, STANDARD RESPONSE

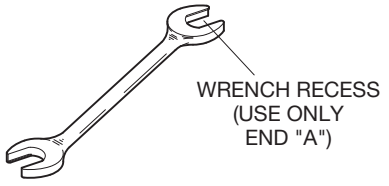


FIGURE 2
W-TYPE 6
SPRINKLER WRENCH

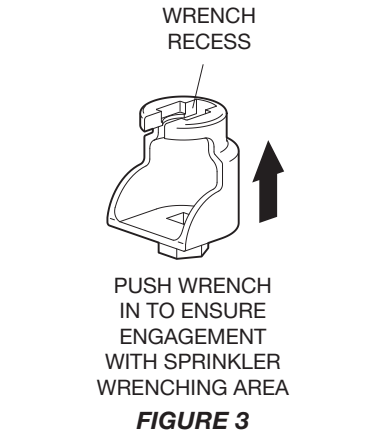


FIGURE 3
W-TYPE 7 RECESSED
SPRINKLER WRENCH

Operation

The glass bulb contains a fluid which expands when exposed to heat. When the rated temperature is reached, the fluid expands sufficiently to shatter the glass bulb, allowing the sprinkler to activate and water to flow.

Design Criteria

The TYCO Series TY-B, 5.6 K-factor, Upright (TY315) and Pendent (TY325) Sprinklers are intended for fire protection systems designed in accordance with the standard installation rules recognized by the applicable Listing or Approval agency (e.g., UL Listing is based on the requirements of NFPA 13, and FM Approval is based on the requirements of the FM Loss Prevention Data Sheets). Only the Style 15 or Style 20 Recessed Escutcheon, as applicable, is to be used for recessed pendent installations.

Installation

The TYCO Series TY-B, 5.6 K-factor, Upright (TY315) and Pendent (TY325) Sprinklers must be installed in accordance with this section.

General Instructions
Do not install any bulb type sprinkler if the bulb is cracked or there is a loss of liquid from the bulb. With the sprinkler held horizontally, a small air bubble should be present. The diameter of the air bubble is approximately 1/16 inch (1,6 mm) for the 135°F (57°C) to 3/32 inch (2,4 mm) for the 360°F (182°C) temperature ratings.

A leak-tight 1/2 inch NPT sprinkler joint should be obtained by applying a minimum-to-maximum torque of 7 to 14 ft.-lbs. (9,5 to 19,0 Nm). Higher levels of torque may distort the sprinkler inlet and cause leakage or impairment of the sprinkler.

Do not attempt to compensate for insufficient adjustment in the escutcheon plate by under- or over-tightening the sprinkler. Readjust the position of the sprinkler fitting to suit.

Upright and Pendent Sprinklers
The Series TY-B Upright and Pendent Sprinklers must be installed in accordance with the following instructions.

Step 1. Install pendent sprinklers in the pendent position; install upright sprinklers in the upright position.

Step 2. With pipe-thread sealant applied to the pipe threads, hand-tighten the sprinkler into the sprinkler fitting.

Step 3. Tighten the sprinkler into the sprinkler fitting using only the W-Type 6 Sprinkler Wrench (Figure 2). With reference to Figure 1, apply the W-Type 6 Sprinkler Wrench to the wrench flats. Torque sprinklers 7 to 14 ft.-lbs. (9,5 to 19,0 Nm).

Recessed Pendent Sprinklers
The Series TY-B Recessed Pendent Sprinklers must be installed in accordance with the following instructions.

Step A. After installing the Style 15 or Style 20 Mounting Plate, as applicable, over the sprinkler threads and with pipe-thread sealant applied to the pipe threads, hand-tighten the sprinkler into the sprinkler fitting.

Step B. Tighten the sprinkler into the sprinkler fitting using only the W-Type 7 Recessed Sprinkler Wrench (Figure 3). With reference to Figure 1, apply the W-Type 7 Recessed Sprinkler Wrench to the sprinkler wrench flats. Torque sprinklers 7 to 14 ft.-lbs. (9,5 to 19,0 Nm).

Step C. After the ceiling is installed or the finish coat is applied, slide on the Style 15 or Style 20 Closure over the Series TY-B Sprinkler and push the Closure over the Mounting Plate until its flange contacts the ceiling.

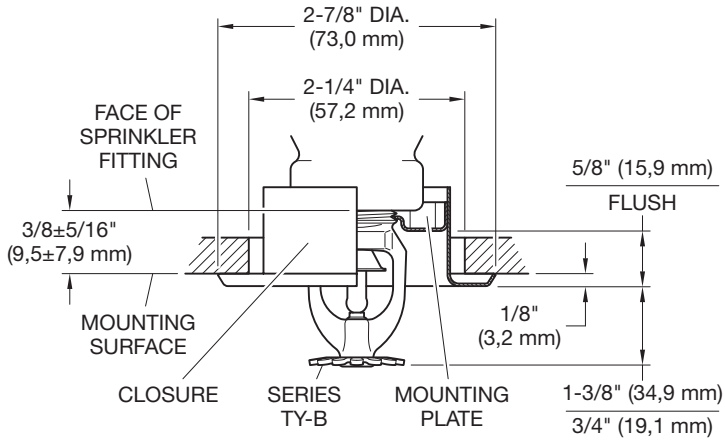


FIGURE 4
SERIES TY-B RECESSED PENDENT SPRINKLER ASSEMBLY (TY325) WITH TWO-PIECE 5/8 INCH TOTAL ADJUSTMENT STYLE 15 RECESSED ESCUTCHEON

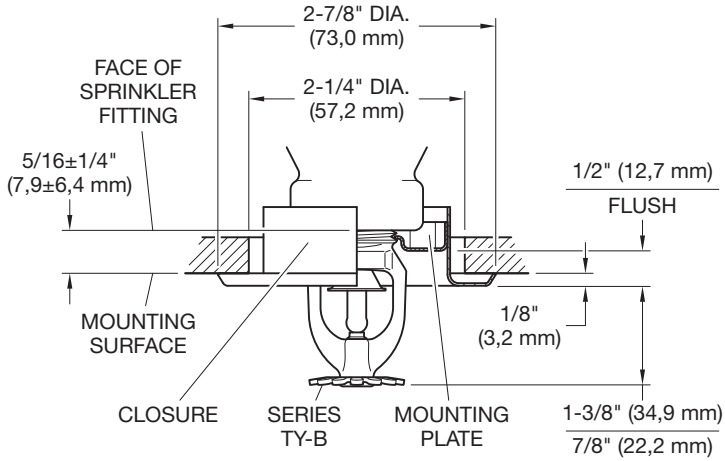


FIGURE 5
SERIES TY-B RECESSED PENDENT SPRINKLER ASSEMBLY (TY325) WITH TWO-PIECE 1/2 INCH TOTAL ADJUSTMENT STYLE 20 RECESSED ESCUTCHEON

Care and Maintenance

The TYCO Series TY-B, 5.6 K-factor, Upright (TY315) and Pendent (TY325) Sprinklers must be maintained and serviced in accordance with this section.

Before closing a fire protection system main control valve for maintenance work on the fire protection system that it controls, obtain permission to shut down the affected fire protection system from the proper authorities and notify all personnel who may be affected by this action.

Absence of the outer piece of an escutcheon, which is used to cover a clearance hole, can delay sprinkler operation in a fire situation.

The owner must assure that the sprinklers are not used for hanging any objects and that the sprinklers are only cleaned by means of gently dusting with a feather duster; otherwise, non-operation in the event of a fire or inadvertent operation may result.

Sprinklers which are found to be leaking or exhibiting visible signs of corrosion must be replaced.

Automatic sprinklers must never be painted, plated, coated, or otherwise altered after leaving the factory. Modified sprinklers must be replaced. Sprinklers that have been exposed to corrosive products of combustion, but have not operated, should be replaced if they cannot be completely cleaned by wiping the sprinkler with a cloth or by brushing it with a soft bristle brush.

Care must be exercised to avoid damage to the sprinklers - before, during, and after installation. Sprinklers damaged by dropping, striking, wrench twist/slippage, or the like, must be replaced. Also, replace any sprinkler that has a cracked bulb or that has lost liquid from its bulb. (Ref. Installation Section.)

Thereafter, annual inspections per NFPA 25 are required; however, instead of inspecting from the floor level, a random sampling of close-up visual inspections should be made.

The owner is responsible for the inspection, testing, and maintenance of their fire protection system and devices in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (e.g., NFPA 25), in addition to the standards of any other authorities having jurisdiction. Contact the installing contractor or sprinkler manufacturer regarding any questions.

Automatic sprinklers are recommended to be inspected, tested, and maintained by a qualified Inspection Service in accordance with local requirements and/or national codes.

P/N* 77 – XXX – X – XXX

		SIN
570	5.6K UPRIGHT (1/2˝ NPT)	TY315
571	5.6K PENDENT (1/2˝ NPT)	TY325

* Use suffix "I" for ISO 7-1 connection; for example, 77-570-4-175-I

	SPRINKLER FINISH
1	NATURAL BRASS
3	PURE WHITE (RAL9010)** POLYESTER
4	SIGNAL WHITE (RAL9003) POLYESTER
9	CHROME PLATED

** Eastern Hemisphere sales only

	TEMPERATURE RATINGS
135	135°F (57°C)
155	155°F (68°C)
175	175°F (79°C)
200	200°F (93°C)
286	286°F (141°C)
360	360°F (182°C)
000	OPEN***

*** OPEN indicates sprinkler assembly without Glass Bulb, Button, and Sealing Assembly

TABLE A
SERIES TY-B UPRIGHT AND PENDENT SPRINKLERS
PART NUMBER SELECTION

Limited Warranty

For warranty terms and conditions, visit www.tyco-fire.com.

Ordering Procedure

Contact your local distributor for availability. When placing an order, indicate the full product name and Part Number (P/N).

Sprinkler Assemblies with NPT Thread Connections
Specify: Series TY-B Upright or Pendent (specify) Sprinkler, SIN (specify), K=5.6, Standard Response, (specify) temperature rating, (specify) finish, P/N (specify, refer to Table A)

Recessed Escutcheon
Specify: Style 15 Recessed Escutcheon with (specify*) finish, P/N (specify*)

Specify: Style 20 Recessed Escutcheon with (specify*) finish, P/N (specify*)

* Refer to Technical Data Sheet TFP770

Sprinkler Wrench
Specify: W-Type 6 Sprinkler Wrench, P/N 56-000-6-387

Specify: W-Type 7 Sprinkler Wrench, P/N 56-850-4-001

tyco Fire Protection Products

PIBV2
Supervisory Switch

System Sensor's PIBV2 supervisory switch monitors the open position of post indicator and butterfly control valves.

Features

- NEMA 3R rated enclosure
- Bi-directional actuator
- Easy single side conduit entry
- Adjustable length actuator with breakaway feature
- Built to accommodate up to 12 AWG wire
- Two sets of SPDT contacts enclosed in a durable terminal block
- 100 percent synchronization activates alarm panel and local bell simultaneously
- Operating temperature range –40°F to 120°F (–40°C to 49°C)
- Tamper resistant cover screws

Robust Construction: The PIBV2's rugged housing is intended for indoor and outdoor use. When installed with the actuator in the vertical position, the PIBV2 is NEMA 3R rated per UL.

Application Flexibility: The PIBV2 features a flexible design, which accommodates post indicator, butterfly, and many other types of wall post, recessed wall post and pressure reducing valves. The PIBV2's unique bi-directional actuator allows the unit to be installed in either rising or falling flag installations.

Simplified Installation: Installation is made easier with the PIBV2's single side conduit entrance. By providing a direct conduit pathway to the electrical source, right angle fittings are not required. Installation is further simplified by the PIBV2's adjustable length actuator with a convenient breakaway feature for installation on shorter valves. This eliminates the need for cutting the shaft.

Reliable Performance: The PIBV2 has 100 percent synchronization which activates the alarm panel and local bell simultaneously. In addition, the switch is designed to operate in temperatures ranging from –40°F to 120°F (–40°C to 49°C). The PIBV2 is equipped with tamper resistant cover screws to prevent unauthorized entry. Inside, two sets of SPDT (Form C) synchronized switches are enclosed in a durable terminal block to assure reliable performance.

Agency Listings

S739 CS169 7770-1653:118 OW6A8.AY 167-93E

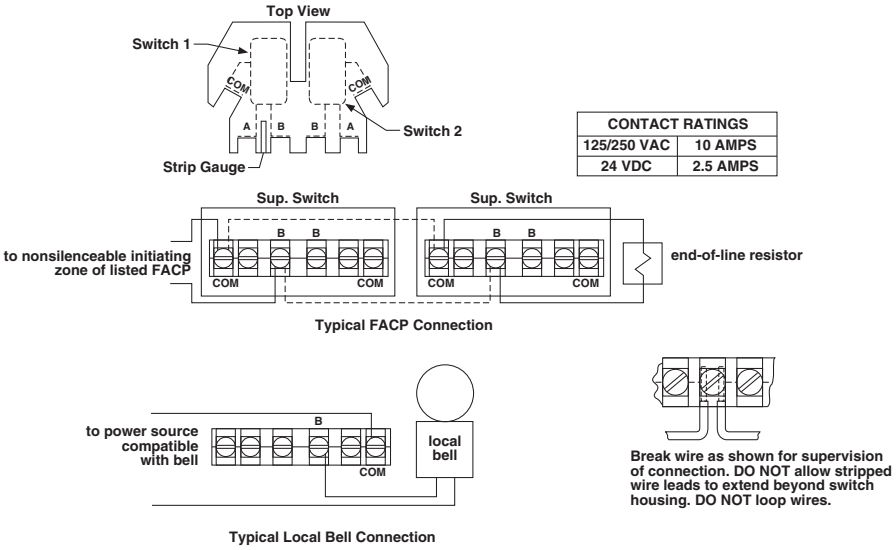
PIBV2 Specifications

Architectural/Engineering Specifications

Model shall be model number PIBV2 Post Indicator Butterfly Valve supervisory switch as manufactured by System Sensor. PIBV2 shall be installed on each valve as designated on the drawings and/or as specified herein. Switches shall be mounted so as not to interfere with the normal operation of the valve and shall be adjusted to operate within two revolutions of the valve control or when the valve flag has moved no more than one-fifth of the distance from its normal position. The mechanism shall be contained in a weatherproof die cast metal housing, which shall provide a side entrance for ½˝ conduit and incorporate a ½˝ NPT nipple for attachment to the valve body. A grounding provision is provided. The switch assembly shall include two switches each with a rated capacity of 10 Amp @ 125/250V AC and 2.5 Amp @ 24V DC. The cover shall contain tamper-resistant screws for which a security wrench will be provided with each switch. PIBV2 shall be Underwriters Laboratories listed for indoor or outdoor use. The PIBV2 shall be Factory Mutual, CSFM, and MEA approved.

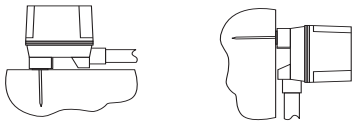
Physical Specifications		Operating Specifications	
Overall Switch Dimensions	4¼˝H × 3½˝W × 3¼˝D (10.8cm × 8.9cm × 8.2cm)	**Contact Ratings**	Two sets of SPDT (Form C) 10.0 A @ 125/250V AC; 2.5 @ 6/12/24V DC
Shipping Weight	2 lbs. (0.9 kg)	**Enclosure Rating**	UL indoor/outdoor NEMA 3R when mounted with the actuator vertical
Operating Temperature Range	–40°F to 120°F (–40°C to 49°C)	**Cover Tamper Switch**	Standard with ULC model Optional for UL model, part no. 546-7000
Maximum Stem Extension	3⁵⁄₃₂˝ (8.0 cm)	**Service Use**	Automatic Sprinkler: NFPA 13 One or Two Family Dwelling: NFPA 13D Residential Occupancies up to 4 stories: NFPA 13R National Fire Alarm code: NFPA 72
Mounting	½˝ NPT nipple	**Warranty**	3 years
Conduit Entrances	One single side open for ½˝ conduit	**U.S. Patent No.**	5,213,205

Electrical Connections for PIBV2



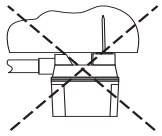
PIBV2 Mounting

The following are examples of acceptable mounting positions:



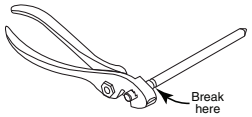
Actuator Vertical (Down) Actuator Horizontal

The following mounting position is not acceptable:



Actuator Vertical (Pointing Up)

Actuating Arm Breakaway Feature:



Ordering Information

Part No.	Description
PIBV2	Post Indicator/Butterfly valve supervisory switch
PIBV2A	Post Indicator/Butterfly valve supervisory switch (ULC model)
Accessories	
A3010-00	Replacement hardware kit (wrenches, screw pack)
546-7000	Cover tamper switch kit
S07-66-XX	Tamper screws for cover
WFDW	Replacement tamper proof wrench for cover
HEXW	Replacement hex wrench

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A05-0197-009 • 11/06 • #1676

WFDN Series Waterflow Detector

The System Sensor WFDN series is compatible with schedule 7 through 40 steel pipe, for sizes 2 in. through 4 in. and compatible with schedule 10 through 40 steel pipe, sizes 5 in. through 8 in., and can be mounted in a vertical or horizontal position.

Features

- New directional cover allows installers and inspectors to easily see the direction of flow
- UL-listed models are NEMA 4 rated
- New cover provides a better seal, is lighter weight, not painted and corrosion resistant
- Sealed retard mechanism immune to dust and other contaminants
- Less exposed metal reduces shock hazard, plastic cover acts as insulator and is resistant to arcing
- Visual switch activation
- Audible switch activation (73 dBA)
- Field-replaceable timer/switch assembly
- Accommodates up to 12 AWG wire
- Switch Synchronization activates both alarm panel and local bell or horn strobe
- Tamper-resistant cover screws
- Improved water sealing
- Reduced product weight
- Wire-ready terminals
- Improved wiring with new terminal block layout
- Snap-in optional cover tamper switch
- Improved timer repeatability and accuracy

Agency Listings

c UL us LISTED
S739

FM APPROVED
3051266

MADE IN THE USA

The new **WFDN Series** waterflow detectors from **System Sensor** consists of a rugged, NEMA 4-rated enclosure that is more damage resistant than previous metal designs. The waterflow detector is designed for both indoor and outdoor use, with the widest available temperature range, from 32°F to 150°F. They are also approved for installation on the widest range of pipe schedules, sizes 2 in. through 4 in. are approved for installation on pipe schedules 7 through 40.

UL-listed models are equipped with tamper-resistant cover screws to prevent unauthorized entry. Inside, two sets of SPDT (Form C) synchronized switches are enclosed in a durable terminal block with new layout designed to make wiring easy with wire ready terminals, COM terminals are on a different elevation, large barrier between switches and easy to read raised textured lettering all make wiring easy. An optional cover tamper switch is available, securely snaps into place, no tools required.

The WFDN series incorporates a mechanical time delay feature, which minimizes the risk of false alarm due to pressure surges or air trapped in the fire sprinkler system. The larger and easy to turn timer dial makes setting the waterflow detector easy with high contrast pad printed markings. The dial offers three tabs to help with turning, with one larger tab located on the dial position for approximately 60 seconds, a notch is also indicated on the dial to locate approximately 30 seconds making setting the detector in dimmly lit locations easy.

The WFDN series is designed for accuracy and repeatability. The detector also offers improved performance during vibration in riser applications where detectors are exposed to a large in rush of water.

Waterflow Detector Specifications

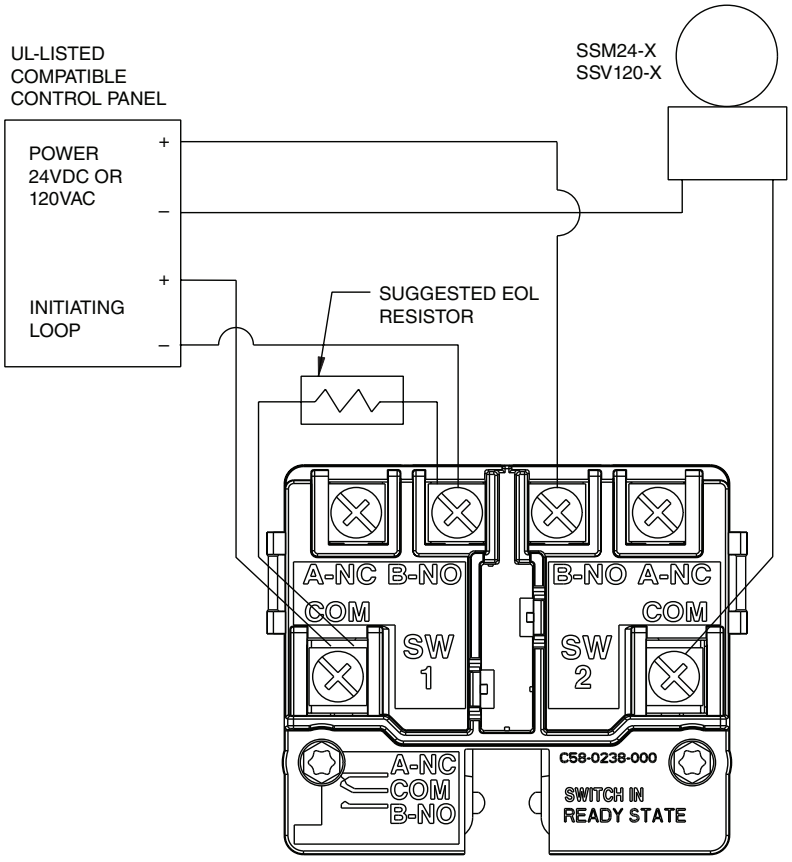
Engineering Specifications

Vane-type waterflow detectors shall be installed on system piping as designated on the drawing and/or as specified herein. Detectors shall mount on any clear pipe span of the appropriate nominal size, either a vertical upflow or horizontal run, at least 6 in. from any fittings that may change water direction, flow rate, or pipe diameter or no closer than 24 in. from a valve or drain. Detectors shall have a sensitivity in the range of 4 to 10 gallons per minute and a static pressure rating of 450 psi for 2 in. – 8 in. pipes. The detector shall respond to waterflow in the specified direction after a preset time delay that is field adjustable. The delay mechanism shall be a sealed mechanical pneumatic unit with visual and audible indication of actuation. The actuation mechanism shall include a ethylene vinyl acetate vane inserted through a hole in the pipe and connected by a mechanical linkage to the delay mechanism. Outputs shall consist of dual SPDT switches (Form C contacts). Two conduit entrances for standard fittings of commonly used electrical conduit shall be provided on the detectors. A grounding provision is provided. Unless noted, enclosures shall be NEMA 4 listed by Underwriters Laboratories Inc. All detectors shall be listed by Underwriters Laboratories Inc. for indoor or outdoor use.

Standard Specifications

Static Pressure Rating	450 PSI	**Operating Temperature Range**	32°F to 150°F (0°C to 66°C)
Maximum Surge	18 Feet Per Second (FPS)	**Enclosure Rating***	NEMA 4 – suitable for indoor/outdoor use
Triggering Threshold Bandwidth (Flow Rate)	4–10 GPM	**Cover Tamper Switch**	Standard with ULC models, optional for UL models, part no. CTS
Conduit Entrances	Two openings for ½ in. conduit. One open, one knock-out type	**Service Use**	Automatic Sprinkler: NFPA-13 One or Two Family Dwelling: NFPA 13D Residential Occupancies up to 4 Stories: NFPA 13R National Fire Alarm Code: NFPA-72
Contact Ratings	Two sets of SPDT (Form C) 10.0 A, ½ HP @ 125/250 VAC 2.5 A @ 6/12/24 VDC	**Warranty**	3 Years
Compatible Pipe	Steel water pipe, schedule 7 through 40*		

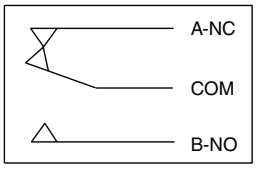
WFDN Field Wiring Diagram



NOTE: COMMON AND B-NO CONNECTIONS WILL CLOSE WHEN VANE IS DEFLECTED, I.E., WHEN WATER IS FLOWING. DUAL SWITCHES PERMIT APPLICATIONS TO BE COMBINED ON A SINGLE DETECTOR.

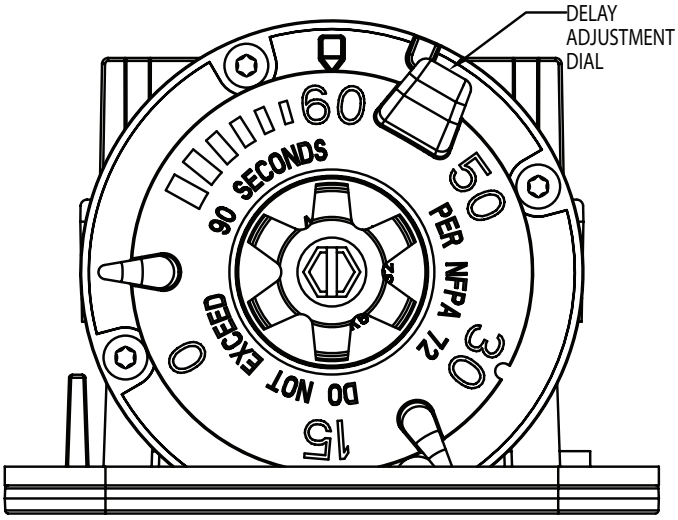
CONTACT RATINGS	
125/250 VAC	10 AMPS
24 VDC	2.5 AMPS

SCHEMATIC OF INDIVIDUAL SWITCH IN "NO WATERFLOW" CONDITION



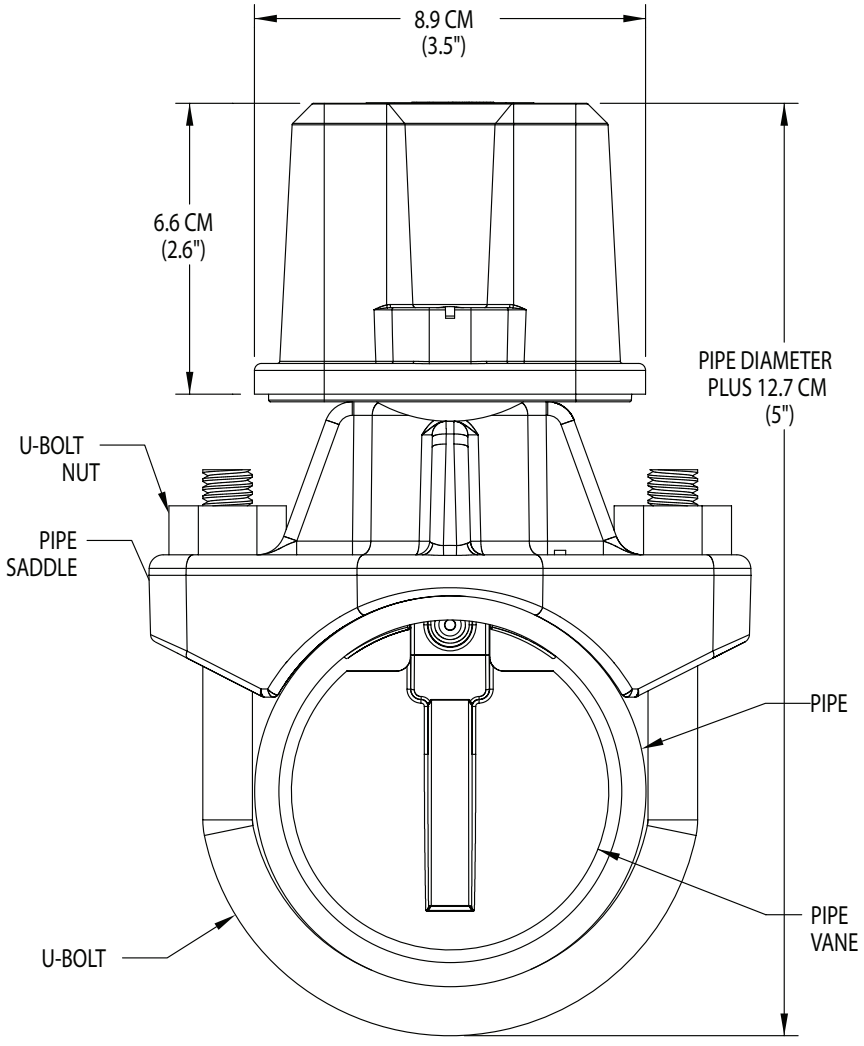
BREAK WIRE AS SHOWN FOR SUPERVISION OF CONNECTION. DO NOT ALLOW STRIPPED WIRE LEADS TO EXTEND BEYOND SWITCH HOUSING. DO NOT LOOP WIRES.

Delay Adjustment Dial



NOTE: RETARD TIME MAY EXCEED 90 SECONDS. ADJUST AND VERIFY THAT TIME DOES NOT EXCEED 90 SECONDS. NUMBER ON DIAL IS APPROXIMATE TIME DELAY IN SECONDS

Overall Dimensions, Installed



OVERALL WIDTH = PIPE DIAMETER + 6.4 CM (2.5")

Ordering Information				
UL Model	**ULC Model**	**Pipe Size**	**Hole Size**	**Shipping Weights**
WFD20N	WFD20NA	2 in.	1¼ in.	2.6 lbs.
WFD25N	WFD25NA	2½ in.	1¼ in.	2.6 lbs.
WFD30N	WFD30NA	3 in.	2 in.	3.1 lbs.
WFD40N	WFD40NA	4 in.	2 in.	4.0 lbs.
WFD50N	WFD50NA	5 in.	2 in.	4.9 lbs.
WFD60N	WFD60NA	6 in.	2 in.	5.6 lbs.
WFD80N	WFD80NA	8 in.	2 in.	7.3 lbs.
Accessories				
FS-RT	Delay mechanism and switch assembly			
CTS	Tamper-proof switch kit			
WFDW	Tamper-proof wrench for cover			

* 2 in. - 4 in. rated for use with Schedule 7 through 40 pipe, 6 in. - 8 in. rated for use with Schedule 10 through 40 pipe.

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WFDS36702 • 7/14

Table 14.3.1 Visual Inspection

	Component	Initial Acceptance	Periodic Frequency	Method	Reference
1.	All equipment	X	Annual	Ensure there are no changes that affect equipment performance. Inspect for building modifications, occupancy changes, changes in environmental conditions, device location, physical obstructions, device orientation, physical damage, and degree of cleanliness.	14.3.4
2.	Control equipment:				
	(a) Fire alarm systems monitored for alarm, supervisory, and trouble signals			Verify a system normal condition.	
	(1) Fuses	X	Annual		
	(2) Interfaced equipment	X	Annual		
	(3) Lamps and LEDs	X	Annual		
	(4) Primary (main) power supply	X	Annual		
	(5) Trouble signals	X	Semiannual		
	(b) Fire alarm systems unmonitored for alarm, supervisory, and trouble signals			Verify a system normal condition.	
	(1) Fuses	X	Weekly		
	(2) Interfaced equipment	X	Weekly		
	(3) Lamps and LEDs	X	Weekly		
	(4) Primary (main) power supply	X	Weekly		
	(5) Trouble signals	X	Weekly		
3.	Reserved				
4.	Supervising station alarm systems — transmitters			Verify location, physical condition, and a system normal condition.	
	(a) Digital alarm communicator transmitter (DACT)	X	Annual		
	(b) Digital alarm radio transmitter (DART)	X	Annual		
	(c) McCulloh	X	Annual		
	(d) Radio alarm transmitter (RAT)	X	Annual		
	(e) All other types of communicators	X	Annual		
5.	In-building fire emergency voice/alarm communications equipment	X	Semiannual	Verify location and condition.	
6.	Reserved				
7.	Reserved				
8.	Reserved				
9.	Batteries			Inspect for corrosion or leakage. Verify tightness of connections. Verify marking of the month/year of manufacture (all types).	10.6.10
	(a) Lead-acid	X	Monthly	Visually inspect electrolyte level.	
	(b) Nickel-cadmium	X	Semiannual		
	(c) Primary (dry cell)	X	Monthly		
	(d) Sealed lead-acid	X	Semiannual		
10.	Reserved				

(continues)

Table 14.3.1 *Continued*

	Component	Initial Acceptance	Periodic Frequency	Method	Reference
11.	Remote annunciators	X	Semiannual	Verify location and condition.	
12.	Notification appliance circuit power extenders	X	Annual	Verify proper fuse ratings, if any. Verify that lamps and LEDs indicate normal operating status of the equipment.	10.6
13.	Remote power supplies	X	Annual	Verify proper fuse ratings, if any. Verify that lamps and LEDs indicate normal operating status of the equipment.	10.6
14.	Transient suppressors	X	Semiannual	Verify location and condition.	
15.	Reserved				
16.	Fiber-optic cable connections	X	Annual	Verify location and condition.	
17.	Initiating devices			Verify location and condition (all devices).	
	(a) Air sampling				
	(1) General	X	Semiannual	Verify that in-line filters, if any, are clean.	17.7.3.6
	(2) Sampling system piping and sampling ports	X		Verify that sampling system piping and fittings are installed properly, appear airtight, and are permanently fixed. Confirm that sampling pipe is conspicuously identified. Verify that sample ports or points are not obstructed.	17.7.3.6
	(b) Duct detectors				
	(1) General	X	Semiannual	Verify that detector is rigidly mounted. Confirm that no penetrations in a return air duct exist in the vicinity of the detector. Confirm the detector is installed so as to sample the airstream at the proper location in the duct.	17.7.5.5
	(2) Sampling tube	X		Verify proper orientation. Confirm the sampling tube protrudes into the duct in accordance with system design.	17.7.5.5
	(c) Electromechanical releasing devices	X	Semiannual		
	(d) Fire extinguishing system(s) or suppression system(s) switches	X	Semiannual		
	(e) Manual fire alarm boxes	X	Semiannual		
	(f) Heat detectors	X	Semiannual		
	(g) Radiant energy fire detectors	X	Quarterly	Verify no point requiring detection is obstructed or outside the detector's field of view.	17.8
	(h) Video image smoke and fire detectors	X	Quarterly	Verify no point requiring detection is obstructed or outside the detector's field of view.	17.7.7; 17.11.5
	(i) Smoke detectors (excluding one- and two-family dwellings)	X	Semiannual		
	(j) Projected beam smoke detectors	X	Semiannual	Verify beam path is unobstructed.	
	(k) Supervisory signal devices	X	Quarterly		
	(l) Waterflow devices	X	Quarterly		
18.	Reserved				

Table 14.3.1 *Continued*

	Component	Initial Acceptance	Periodic Frequency	Method	Reference
19.	Combination systems			Verify location and condition (all types).	
	(a) Fire extinguisher electronic monitoring device/systems	X	Semiannual		
	(b) Carbon monoxide detectors/systems	X	Semiannual		
20.	Fire alarm control interface and emergency control function interface	X	Semiannual	Verify location and condition.	
21.	Guard's tour equipment	X	Semiannual	Verify location and condition.	
22.	Notification appliances			Verify location and condition (all appliances).	
	(a) Audible appliances	X	Semiannual		
	(b) Audible textual notification appliances	X	Semiannual		
	(c) Visible appliances				
	(1) General	X	Semiannual		18.5.5
	(2) Candela rating	X		Verify that the candela rating marking agrees with the approved drawings.	18.5.5
23.	Exit marking audible notification appliances	X	Semiannual	Verify location and condition.	
24.	Reserved				
25.	Area of refuge two-way communication system	X	Annual	Verify location and condition.	
26.	Reserved				
27.	Supervising station alarm systems — receivers				
	(a) Signal receipt	X	Daily	Verify receipt of signal.	
	(b) Receivers	X	Annual	Verify location and normal condition.	
28.	Public emergency alarm reporting system transmission equipment			Verify location and condition.	
	(a) Publicly accessible alarm box	X	Semiannual		
	(b) Auxiliary box	X	Annual		
	(c) Master box				
	(1) Manual operation	X	Semiannual		
	(2) Auxiliary operation	X	Annual		
29.	Reserved				
30.	Mass notification system				
	(a) Monitored for integrity			Verify a system normal condition.	
	(1) Control equipment				
	(i) Fuses	X	Annual		
	(ii) Interfaces	X	Annual		
	(iii) Lamps/LED	X	Annual		
	(iv) Primary (main) power supply	X	Annual		
	(2) Secondary power batteries	X	Annual		
	(3) Initiating devices	X	Annual		
	(4) Notification appliances	X	Annual		

(continues)

Table 14.3.1 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method	Reference
30. Mass notification system *(continued)*				
(b) Not monitored for integrity; installed prior to adoption of the 2010 edition			Verify a system normal condition.	
(1) Control equipment				
(i) Fuses	X	Semiannual		
(ii) Interfaces	X	Semiannual		
(iii) Lamps/LED	X	Semiannual		
(iv) Primary (main) power supply	X	Semiannual		
(2) Secondary power batteries	X	Semiannual		
(3) Initiating devices	X	Semiannual		
(4) Notification appliances	X	Semiannual		
(c) Antenna	X	Annual	Verify location and condition.	
(d) Transceivers	X	Annual	Verify location and condition.	

14.3.2 Devices or equipment that is inaccessible for safety considerations (e.g., continuous process operations, energized electrical equipment, radiation, and excessive height) shall be permitted to be inspected during scheduled shutdowns if approved by the authority having jurisdiction.

14.3.3 Extended intervals shall not exceed 18 months.

14.3.4 The visual inspection shall be made to ensure that there are no changes that affect equipment performance.

14.4 Testing.

14.4.1 Initial Acceptance Testing.

14.4.1.1 All new systems shall be inspected and tested in accordance with the requirements of Chapter 14.

14.4.1.2 The authority having jurisdiction shall be notified prior to the initial acceptance test.

14.4.2* Reacceptance Testing.

14.4.2.1 When an initiating device, notification appliance, or control relay is added, it shall be functionally tested.

14.4.2.2 When an initiating device, notification appliance, or control relay is deleted, another device, appliance, or control relay on the circuit shall be operated.

14.4.2.3 When modifications or repairs to control equipment hardware are made, the control equipment shall be tested in accordance with Table 14.4.3.2, items 1(a) and 1(d).

14.4.2.4 When changes are made to site-specific software, the following shall apply:

(1) All functions known to be affected by the change, or identified by a means that indicates changes, shall be 100 percent tested.
(2) In addition, 10 percent of initiating devices that are not directly affected by the change, up to a maximum of 50 devices, also shall be tested and correct system operation shall be verified.
(3) A revised record of completion in accordance with 7.5.6 shall be prepared to reflect these changes.

14.4.2.5 Changes to the system executive software shall require a 10 percent functional test of the system, including a test of at least one device on each input and output circuit to verify critical system functions such as notification appliances, control functions, and off-premises reporting.

14.4.3* Test Methods.

14.4.3.1* At the request of the authority having jurisdiction, the central station facility installation shall be inspected for complete information regarding the central station system, including specifications, wiring diagrams, and floor plans that have been submitted for approval prior to installation of equipment and wiring.

14.4.3.2* Systems and associated equipment shall be tested according to Table 14.4.3.2.

Table 14.4.3.2 was revised by tentative interim amendments (TIAs). See page 1.

Table 14.4.3.2 Testing

Component	Initial Acceptance	Periodic Frequency	Method
1. All equipment	X		See Table 14.3.1.
2. Control equipment and transponder			
(a) Functions	X	Annually	Verify correct receipt of alarm, supervisory, and trouble signals (inputs); operation of evacuation signals and auxiliary functions (outputs); circuit supervision, including detection of open circuits and ground faults; and power supply supervision for detection of loss of ac power and disconnection of secondary batteries.
(b) Fuses	X	Annually	Verify rating and supervision.
(c) Interfaced equipment	X	Annually	Verify integrity of single or multiple circuits providing interface between two or more control units. Test interfaced equipment connections by operating or simulating operation of the equipment being supervised. Verify signals required to be transmitted at the control unit.
(d) Lamps and LEDs	X	Annually	Illuminate lamps and LEDs.
(e) Primary (main) power supply	X	Annually	Disconnect and test all secondary (standby) power under maximum load, including all alarm appliances requiring simultaneous operation. Reconnect all secondary (standby) power at end of test. Test redundant power supplies separately.
3. Fire alarm control unit trouble signals			
(a) Audible and visual	X	Annually	Verify operation of control unit trouble signals. Verify ring-back feature for systems using a trouble-silencing switch that requires resetting.
(b) Disconnect switches	X	Annually	If control unit has disconnect or isolating switches, verify performance of intended function of each switch. Verify receipt of trouble signal when a supervised function is disconnected.
(c) Ground-fault monitoring circuit	X	Annually	If the system has a ground detection feature, verify the occurrence of ground-fault indication whenever any installation conductor is grounded.
(d) Transmission of signals to off-premises location	X	Annually	Actuate an initiating device and verify receipt of alarm signal at the off-premises location. Create a trouble condition and verify receipt of a trouble signal at the off-premises location. Actuate a supervisory device and verify receipt of a supervisory signal at the off-premises location. If a transmission carrier is capable of operation under a single- or multiple-fault condition, activate an initiating device during such fault condition and verify receipt of an alarm signal and a trouble signal at the off-premises location.
4. Supervising station alarm systems — transmission Equipment			
(a) All equipment	X	Annually	[a]Test all system functions and features in accordance with the equipment manufacturer's published instructions for correct operation in conformance with the applicable sections of Chapter 26. Except for DACT, actuate initiating device and verify receipt of the correct initiating device signal at the supervising station within 90 seconds. Upon completion of the test, restore the system to its functional operating condition. If test jacks are used, conduct the first and last tests without the use of the test jack.
(b) Digital alarm communicator transmitter (DACT)	X	Annually	Except for DACTs installed prior to adoption of the 2013 edition of NFPA 72 that are connected to a telephone line (number) that is also supervised for adverse conditions by a derived local channel, ensure connection of the DACT to two separate means of transmission. Test DACT for line seizure capability by initiating a signal while using the telephone line (primary line for DACTs using two telephone lines) for a telephone call. Ensure that the call is interrupted and that the communicator connects to the digital alarm receiver. Verify receipt of the correct signal at the supervising station. Verify each transmission attempt is completed within 90 seconds from going off-hook to on-hook.

(continues)

Table 14.4.3.2 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
4. Supervising station alarm systems — transmission Equipment			
(b) Digital alarm communicator transmitter (DACT) *(continued)*			Disconnect the telephone line (primary line for DACTs using two telephone lines) from the DACT. Verify indication of the DACT trouble signal occurs at the premises fire alarm control unit within 4 minutes of detection of the fault. Verify receipt of the telephone line trouble signal at the supervising station. Restore the telephone line (primary line for DACTs using two telephone lines), reset the fire alarm control unit, and verify that the telephone line fault trouble signal returns to normal. Verify that the supervising station receives the restoral signal from the DACT. Disconnect the secondary means of transmission from the DACT. Verify indication of the DACT trouble signal occurs at the premises fire alarm control unit within 4 minutes of detection of the fault. Verify receipt of the secondarey means trouble signal at the supervising station. Restore the secondary means of transmission, reset the fire alarm control unit, and verify that the trouble signal returns to normal. Verify that the supervising station receives the restoral signal from the secondary transmitter. Cause the DACT to transmit a signal to the DACR while a fault in the telephone line (number) (primary line for DACTs using two telephone lines) is simulated. Verify utilization of the secondary communication path by the DACT to complete the transmission to the DACR.
(c) Digital alarm radio transmitter (DART)	X	Annually	Disconnect the primary telephone line. Verify transmission of a trouble signal to the supervising station by the DART occurs within 4 minutes.
(d) McCulloh transmitter	X	Annually	Actuate initiating device. Verify production of not less than three complete rounds of not less than three signal impulses each by the McCulloh transmitter. If end-to-end metallic continuity is present and with a balanced circuit, cause each of the following four transmission channel fault conditions in turn, and verify receipt of correct signals at the supervising station: (1) Open (2) Ground (3) Wire-to-wire short (4) Open and ground If end-to-end metallic continuity is not present and with a properly balanced circuit, cause each of the following three transmission channel fault conditions in turn, and verify receipt of correct signals at the supervising station: (1) Open (2) Ground (3) Wire-to-wire short
(e) Radio alarm transmitter (RAT)	X	Annually	Cause a fault between elements of the transmitting equipment. Verify indication of the fault at the protected premises, or transmission of trouble signal to the supervising station.
(f) Performance-based technologies	X	Annually	Perform tests to ensure the monitoring of integrity of the transmission technology and technology path. Where a single communications path is used, disconnect the communication path. Manually initiate an alarm signal transmission or allow the check-in (handshake) signal to be transmitted automatically.[b] Verify the premises unit annunciates the failure within 200 seconds of the transmission failure. Restore the communication path. Where multiple communication paths are used, disconnect both communication paths. Manually initiate an alarm signal transmission. Verify the premises control unit annunciates the failure within 200 seconds of the transmission failure. Restore both communication paths.
5. Emergency communications equipment			
(a) Amplifier/tone generators	X	Annually	Verify correct switching and operation of backup equipment.
(b) Call-in signal silence	X	Annually	Operate/function and verify receipt of correct visual and audible signals at control unit.
(c) Off-hook indicator (ring down)	X	Annually	Install phone set or remove phone from hook and verify receipt of signal at control unit.
(d) Phone jacks	X	Annually	Visually inspect phone jack and initiate communications path through jack.

Table 14.4.3.2 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
(e) Phone set	X	Annually	Activate each phone set and verify correct operation.
(f) System performance	X	Annually	Operate the system with a minimum of any five handsets simultaneously. Verify voice quality and clarity.
6. Engine-driven generator	X	Monthly	If an engine-driven generator dedicated to the system is used as a required power source, verify operation of the generator in accordance with NFPA 110, *Standard for Emergency and Standby Power Systems,* by the building owner.
7. Secondary (standby) power supply[c]	X	Annually	Disconnect all primary (main) power supplies and verify the occurrence of required trouble indication for loss of primary power. Measure or verify the system's standby and alarm current demand and verify the ability of batteries to meet standby and alarm requirements using manufacturer's data. Operate general alarm systems a minimum of 5 minutes and emergency voice communications systems for a minimum of 15 minutes. Reconnect primary (main) power supply at end of test.
8. Uninterruptible power supply (UPS)	X	Annually	If a UPS system dedicated to the system is used as a required power source, verify by the building owner operation of the UPS system in accordance with NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems.*
9. Battery tests			Prior to conducting any battery testing, verify by the person conducting the test, that all system software stored in volatile memory is protected from loss.
(a) Lead-acid type			
(1) Battery replacement	X	Annually	Replace batteries in accordance with the recommendations of the alarm equipment manufacturer or when the recharged battery voltage or current falls below the manufacturer's recommendations.
(2) Charger test	X	Annually	With the batteries fully charged and connected to the charger, measure the voltage across the batteries with a voltmeter. Verify the voltage is 2.30 volts per cell ±0.02 volts at 77°F (25°C) or as specified by the equipment manufacturer.
(3) Discharge test	X	Annually	With the battery charger disconnected, load test the batteries following the manufacturer's recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full fire alarm load connected to the battery.
(4) Load voltage test	X	Semiannually	With the battery charger disconnected, load test the batteries following the manufacturer's recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full fire alarm load connected to the battery. Verify the battery does not fall below 2.05 volts per cell under load.
(5) Specific gravity	X	Semiannually	Measure as required the specific gravity of the liquid in the pilot cell or all of the cells. Verify the specific gravity is within the range specified by the manufacturer. Although the specified specific gravity varies from manufacturer to manufacturer, a range of 1.205–1.220 is typical for regular lead-acid batteries, while 1.240–1.260 is typical for high-performance batteries. Do not use a hydrometer that shows only a pass or fail condition of the battery and does not indicate the specific gravity, because such a reading does not give a true indication of the battery condition.
(b) Nickel-cadmium type			
(1) Battery replacement	X	Annually	Replace batteries in accordance with the recommendations of the alarm equipment manufacturer or when the recharged battery voltage or current falls below the manufacturer's recommendations.
(2) Charger test[d]	X	Annually	With the batteries fully charged and connected to the charger, place an ampere meter in series with the battery under charge. Verify the charging current is in accordance with the manufacturer's recommendations for the type of battery used. In the absence of specific information, use 1/30 to 1/25 of the battery rating.
(3) Discharge test	X	Annually	With the battery charger disconnected, load test the batteries following the manufacturer's recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full fire alarm load connected to the battery.
(4) Load voltage test	X	Semiannually	With the battery charger disconnected, load test the batteries following the manufacturer's recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full fire alarm load connected to the battery. Verify the float voltage for the entire battery is 1.42 volts per cell, nominal, under load. If possible, measure cells individually.

(continues)

Table 14.4.3.2 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
9. Battery tests *(continued)*			
(c) Sealed lead-acid type			
(1) Battery replacement	X	Annually	Replace batteries in accordance with the recommendations of the alarm equipment manufacturer or when the recharged battery voltage or current falls below the manufacturer's recommendations.
(2) Charger test	X	Annually	With the batteries fully charged and connected to the charger, measure the voltage across the batteries with a voltmeter. Verify the voltage is 2.30 volts per cell ±0.02 volts at 77°F (25°C) or as specified by the equipment manufacturer.
(3) Discharge test	X	Annually	With the battery charger disconnected, load test the batteries following the manufacturer's recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full fire alarm load connected to the battery.
(4) Load voltage test	X	Semiannually	Verify the battery performs under load, in accordance with the battery manufacturer's specifications.
10. Public emergency alarm reporting system — wired system	X	Daily	Manual tests of the power supply for public reporting circuits shall be made and recorded at least once during each 24-hour period. Such tests shall include the following: (1) Current strength of each circuit. Changes in current of any circuit exceeding 10 percent shall be investigated immediately. (2) Voltage across terminals of each circuit inside of terminals of protective devices. Changes in voltage of any circuit exceeding 10 percent shall be investigated immediately. (3)[e] Voltage between ground and circuits. If this test shows a reading in excess of 50 percent of that shown in the test specified in (2), the trouble shall be immediately located and cleared. Readings in excess of 25 percent shall be given early attention. These readings shall be taken with a calibrated voltmeter of not more than 100 ohms resistance per volt. Systems in which each circuit is supplied by an independent current source (Forms 3 and 4) require tests between ground and each side of each circuit. Common current source systems (Form 2) require voltage tests between ground and each terminal of each battery and other current source. (4) Ground current reading shall be permitted in lieu of (3). If this method of testing is used, all grounds showing a current reading in excess of 5 percent of the supplied line current shall be given immediate attention. (5) Voltage across terminals of common battery on switchboard side of fuses. (6) Voltage between common battery terminals and ground. Abnormal ground readings shall be investigated immediately. Tests specified in (5) and (6) shall apply only to those systems using a common battery. If more than one common battery is used, each common battery shall be tested.
11. Remote annunciators	X	Annually	Verify the correct operation and identification of annunciators. If provided, verify the correct operation of annunciator under a fault condition.
12. Reserved			
13. Reserved			
14. Reserved			
15. Conductors — metallic			
(a) Stray voltage	X	N/A	Test all installation conductors with a volt/ohmmeter to verify that there are no stray (unwanted) voltages between installation conductors or between installation conductors and ground. Verify the maximum allowable stray voltage does not exceed 1 volt ac/dc, unless a different threshold is specified in the published manufacturer's instructions for the installed equipment.
(b) Ground faults	X	N/A	Test all installation conductors, other than those intentionally and permanently grounded, for isolation from ground per the installed equipment manufacturer's published instructions.
(c) Short-circuit faults	X	N/A	Test all installation conductors, other than those intentionally connected together, for conductor-to-conductor isolation per the published manufacturer's instructions for the installed equipment. Also test these same circuits conductor-to-ground.

Table 14.4.3.2 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
(d) Loop resistance	X	N/A	With each initiating and indicating circuit installation conductor pair short-circuited at the far end, measure and record the resistance of each circuit. Verify that the loop resistance does not exceed the limits specified in the published manufacturer's instructions for the installed equipment.
(e) Circuit integrity	X	N/A	For initial and reacceptance testing, confirm the introduction of a fault in any circuit monitored for integrity results in a trouble indication at the fire alarm control unit. Open one connection at not less than 10 percent of the initiating devices, notification appliances and controlled devices on every initiating device circuit, notification appliance circuit, and signaling line circuit. Confirm all circuits perform as indicated in Sections 23.5, 23.6, and 23.7.
	N/A	Annually	For periodic testing, test each initiating device circuit, notification appliance circuit, and signaling line circuit for correct indication at the control unit. Confirm all circuits perform as indicated in Sections 23.5, 23.6, and 23.7.
16. Conductors — nonmetallic			
(a) Fiber optics	X	N/A	Test the fiber-optic transmission line by the use of an optical power meter or by an optical time domain reflectometer used to measure the relative power loss of the line. Test result data must meet or exceed ANSI/TIA 568-C.3, *Optical Fiber Cabling Components Standard*, related to fiber-optic lines and connection/splice losses and the control unit manufacturer's published specifications.
(b) Circuit integrity	X	N/A	For initial and reacceptance testing, confirm the introduction of a fault in any circuit monitored for integrity results in a trouble indication at the fire alarm control unit. Open one connection at not less than 10 percent of the initiating devices, notification appliances, and controlled devices on every initiating device circuit, notification appliance circuit, and signaling line circuit. Confirm all circuits perform as indicated in Sections 23.5, 23.6, and 23.7.
	N/A	Annually	For periodic testing, test each initiating device circuit, notification appliance circuit, and signaling line circuit for correct indication at the control unit. Confirm all circuits perform as indicated in Sections 23.5, 23.6, and 23.7.
17. Initiating devices[f]			
(a) Electromechanical releasing device			
(1) Nonrestorable-type link	X	Annually	Verify correct operation by removal of the fusible link and operation of the associated device. Lubricate any moving parts as necessary.
(2) Restorable-type link[g]	X	Annually	Verify correct operation by removal of the fusible link and operation of the associated device. Lubricate any moving parts as necessary.
(b) Fire extinguishing system(s) or suppression system(s) alarm switch	X	Annually	Operate the switch mechanically or electrically and verify receipt of signal by the fire alarm control unit.
(c) Fire–gas and other detectors	X	Annually	Test fire–gas detectors and other fire detectors as prescribed by the manufacturer and as necessary for the application.
(d) Heat detectors			
(1) Fixed-temperature, rate-of-rise, rate of compensation, restorable line, spot type (excluding pneumatic tube type)	X	Annually (see 14.4.4.5)	Perform heat test with a listed and labeled heat source or in accordance with the manufacturer's published instructions. Assure that the test method for the installed equipment does not damage the nonrestorable fixed-temperature element of a combination rate-of-rise/fixed-temperature element detector.
(2) Fixed-temperature, nonrestorable line type	X	Annually	Do not perform heat test. Test functionality mechanically and electrically. Measure and record loop resistance. Investigate changes from acceptance test.
(3) Fixed-temperature, nonrestorable spot type	X	See Method	After 15 years from initial installation, replace all devices or have 2 detectors per 100 laboratory tested. Replace the 2 detectors with new devices. If a failure occurs on any of the detectors removed, remove and test additional detectors to determine either a general problem involving faulty detectors or a localized problem involving 1 or 2 defective detectors. If detectors are tested instead of replaced, repeat tests at intervals of 5 years.
(4) Nonrestorable (general)	X	Annually	Do not perform heat tests. Test functionality mechanically and electrically.
(5) Restorable line type, pneumatic tube only	X	Annually	Perform heat tests (where test chambers are in circuit), with a listed and labeled heat source or in accordance with the manufacturer's published instructions of the detector or conduct a test with pressure pump.

(continues)

Table 14.4.3.2 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
17. Initiating devices[f]			
(d) Heat detectors *(continued)*			
(6) Single- and multiple-station heat alarms	X	Annually	Conduct functional tests according to manufacturer's published instructions. Do not test nonrestorable heat detectors with heat.
(e) Manual fire alarm boxes	X	Annually	Operate manual fire alarm boxes per the manufacturer's published instructions. Test both key-operated presignal and general alarm manual fire alarm boxes.
(f) Radiant energy fire detectors	X	Semiannually	Test flame detectors and spark/ember detectors in accordance with the manufacturer's published instructions to determine that each detector is operative. Determine flame detector and spark/ember detector sensitivity using any of the following: (1) Calibrated test method (2) Manufacturer's calibrated sensitivity test instrument (3) Listed control unit arranged for the purpose (4) Other approved calibrated sensitivity test method that is directly proportional to the input signal from a fire, consistent with the detector listing or approval If designed to be field adjustable, replace detectors found to be outside of the approved range of sensitivity or adjust to bring them into the approved range. Do not determine flame detector and spark/ember detector sensitivity using a light source that administers an unmeasured quantity of radiation at an undefined distance from the detector.
(g) Smoke detectors — functional test			
(1) In other than one- and two-family dwellings, system detectors	X	Annually	[h]Test smoke detectors in place to ensure smoke entry into the sensing chamber and an alarm response. Use smoke or a listed and labeled product acceptable to the manufacturer or in accordance with their published instructions. Other methods listed in the manufacturer's published instructions that ensure smoke entry from the protected area, through the vents, into the sensing chamber can be used.
(2) Single- and multiple-station smoke alarms connected to protected premises systems	X	Annually	Perform a functional test on all single- and multiple-station smoke alarms connected to a protected premises fire alarm system by putting the smoke alarm into an alarm condition and verifying that the protected premises system receives a supervisory signal and does not cause a fire alarm signal.
(3) System smoke detectors used in one- and two-family dwellings	X	Annually	Conduct functional tests according to manufacturer's published instructions.
(4) Air sampling	X	Annually	Test with smoke or a listed and labeled product acceptable to the manufacturer or in accordance with their published instructions. Test from the end sampling port or point on each pipe run. Verify airflow through all other ports or points.
(5) Duct type	X	Annually	In addition to the testing required in Table 14.4.3.2(g)(1) and Table 14.4.3.2(h), test duct smoke detectors that use sampling tubes to ensure that they will properly sample the airstream in the duct using a method acceptable to the manufacturer or in accordance with their published instructions.
(6) Projected beam type	X	Annually	Test the detector by introducing smoke, other aerosol, or an optical filter into the beam path.
(7) Smoke detector with built-in thermal element	X	Annually	Operate both portions of the detector independently as described for the respective devices.
(8) Smoke detectors with control output functions	X	Annually	Verify that the control capability remains operable even if all of the initiating devices connected to the same initiating device circuit or signaling line circuit are in an alarm state.
(h) Smoke detectors — sensitivity testing			
In other than one- and two-family dwellings, system detectors	N/A	See 14.4.4.3	[i]Perform any of the following tests to ensure that each smoke detector is within its listed and marked sensitivity range: (1) Calibrated test method (2) Manufacturer's calibrated sensitivity test instrument (3) Listed control equipment arranged for the purpose

Table 14.4.3.2 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
			(4) Smoke detector/control unit arrangement whereby the detector causes a signal at the control unit when its sensitivity is outside its listed sensitivity range (5) Other calibrated sensitivity test method approved by the authority having jurisdiction
(i) Carbon monoxide detectors/carbon monoxide alarms for the purposes of fire detection	X	Annually	Test the devices in place to ensure CO entry to the sensing chamber by introduction through the vents, to the sensing chamber of listed and labeled product acceptable to the manufacturer or in accordance with their published instructions.
(j) Initiating devices, supervisory			
(1) Control valve switch	X	Annually	Operate valve and verify signal receipt to be within the first two revolutions of the handwheel or within one-fifth of the travel distance, or per the manufacturer's published instructions.
(2) High- or low-air pressure switch	X	Annually	Operate switch and verify receipt of signal is obtained where the required pressure is increased or decreased a maximum 10 psi (70 kPa) from the required pressure level.
(3) Room temperature switch	X	Annually	Operate switch and verify receipt of signal to indicate the decrease in room temperature to 40°F (4.4°C) and its restoration to above 40°F (4.4°C).
(4) Water level switch	X	Annually	Operate switch and verify receipt of signal indicating the water level raised or lowered a maximum 3 in. (70 mm) from the required level within a pressure tank, or a maximum 12 in. (300 mm) from the required level of a nonpressure tank. Also verify its restoral to required level.
(5) Water temperature switch	X	Annually	Operate switch and verify receipt of signal to indicate the decrease in water temperature to 40°F (4.4°C) and its restoration to above 40°F (4.4°C).
(k) Mechanical, electrosonic, or pressure-type waterflow device	X	Semiannually	Water shall be flowed through an inspector's test connection indicating the flow of water equal to that from a single sprinkler of the smallest orifice size installed in the system for wet-pipe systems, or an alarm test bypass connection for dry-pipe, pre-action, or deluge systems in accordance with NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.*
(l) Multi-sensor fire detector or multi-criteria fire detector or combination fire detector	X	Annually	Test each of the detection principles present within the detector (e.g., smoke/heat/CO, etc.) independently for the specific detection principle, regardless of the configuration status at the time of testing. Also test each detector in accordance with the published manufacturer's instructions. Test individual sensors together if the technology allows individual sensor responses to be verified. Perform tests as described for the respective devices by introduction of the physical phenomena to the sensing chamber of element, and an electronic check (magnets, analogue values, etc.) is not sufficient to comply with this requirement. Confirm the result of each sensor test through indication at the detector or control unit. Where individual sensors cannot be tested individually, test the primary sensor.[j] Record all tests and results.
18. Special hazard equipment			
(a) Abort switch (dead-man type)	X	Annually	Operate abort switch and verify correct sequence and operation.
(b) Abort switch (recycle type)	X	Annually	Operate abort switch and verify development of correct matrix with each sensor operated.
(c) Abort switch (special type)	X	Annually	Operate abort switch and verify correct sequence and operation in accordance with authority having jurisdiction. Observe sequencing as specified on as-built drawings or in system owner's manual.
(d) Cross-zone detection circuit	X	Annually	Operate one sensor or detector on each zone. Verify occurrence of correct sequence with operation of first zone and then with operation of second zone.
(e) Matrix-type circuit	X	Annually	Operate all sensors in system. Verify development of correct matrix with each sensor operated.
(f) Release solenoid circuit[k]	X	Annually	Verify operation of solenoid.
(g) Squibb release circuit	X	Annually	Use AGI flashbulb or other test light approved by the manufacturer. Verify operation of flashbulb or light.
(h) Verified, sequential, or counting zone circuit	X	Annually	Operate required sensors at a minimum of four locations in circuit. Verify correct sequence with both the first and second detector in alarm.
(i) All above devices or circuits or combinations thereof	X	Annually	Verify supervision of circuits by creating an open circuit.

(continues)

Table 14.4.3.2 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
19. Combination systems			
(a) Fire extinguisher electronic monitoring device/system	X	Annually	Test communication between the device connecting the fire extinguisher electronic monitoring device/system and the fire alarm control unit to ensure proper signals are received at the fire alarm control unit and remote annunciator(s) if applicable.
(b) Carbon monoxide[l] device/system	X	Annually	Test communication between the device connecting the carbon monoxide device/system and the fire alarm control unit to ensure proper signals are received at the fire alarm control unit and remote annunciator(s) if applicable.
20. Interface equipment[m]	X	See 14.4.4.4	Test interface equipment connections by operating or simulating the equipment being supervised. Verify signals required to be transmitted are received at the control unit. Test frequency for interface equipment is the same as the frequency required by the applicable NFPA standard(s) for the equipment being supervised.
21. Guard's tour equipment	X	Annually	Test the device in accordance with the manufacturer's published instructions.
22. Alarm notification appliances			
(a) Audible[n]	X	N/A	For initial and reacceptance testing, measure sound pressure levels for signals with a sound level meter meeting ANSI S1.4a, *Specifications for Sound Level Meters,* Type 2 requirements. Measure sound pressure levels throughout the protected area to confirm that they are in compliance with Chapter 18. Set the sound level meter in accordance with ANSI S3.41, *American National Standard Audible Evacuation Signal,* using the time-weighted characteristic F (FAST).
	N/A	Annually	°For periodic testing, verify the operation of the notification appliances.
(b) Audible textual notification appliances (speakers and other appliances to convey voice messages)	X	N/A	For initial and reacceptance testing, measure sound pressure levels for signals with a sound level meter meeting ANSI S1.4a, *Specifications for Sound Level Meters,* Type 2 requirements. Measure sound pressure levels throughout the protected area to confirm that they are in compliance with Chapter 18. Set the sound level meter in accordance with ANSI S3.41, *American National Standard Audible Evacuation Signal,* using the time-weighted characteristic F (FAST). Verify audible information to be distinguishable and understandable and in compliance with 14.4.11.
	N/A	Annually	°For periodic testing, verify the operation of the notification appliances.
(c) Visible	X	N/A	Perform initial and reacceptance testing in accordance with the manufacturer's published instructions. Verify appliance locations to be per approved layout and confirm that no floor plan changes affect the approved layout. Verify that the candela rating marking agrees with the approved drawing. Confirm that each appliance flashes.
	N/A	Annually	For periodic testing, verify that each appliance flashes.
23. Exit marking audible notification appliance	X	Annually	Perform tests in accordance with manufacturer's published instructions.
24. Emergency control functions[p]	X	Annually	For initial, reacceptance, and periodic testing, verify emergency control function interface device activation. Where an emergency control function interface device is disabled or disconnected during initiating device testing, verify that the disabled or disconnected emergency control function interface device has been properly restored. [
25. Area of refuge two-way communication system	X	Annually	At a minimum, test the two-way communication system to verify operation and receipt of visual and audible signals at the transmitting and receiving unit respectively. Operate systems with more than five stations with a minimum of five stations operating simultaneously. Verify voice quality and clarity.
26. Special procedures			
(a) Alarm verification	X	Annually	Verify time delay and alarm response for smoke detector circuits identified as having alarm verification.
(b) Multiplex systems	X	Annually	Verify communications between sending and receiving units under both primary and secondary power. Verify communications between sending and receiving units under open-circuit and short-circuit trouble conditions.

Table 14.4.3.2 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
			Verify communications between sending and receiving units in all directions where multiple communications pathways are provided. If redundant central control equipment is provided, verify switchover and all required functions and operations of secondary control equipment. Verify all system functions and features in accordance with manufacturer's published instructions.
27. Supervising station alarm systems — receiving equipment			
(a) All equipment	X	Monthly	Perform tests on all system functions and features in accordance with the equipment manufacturer's published instructions for correct operation in conformance with the applicable sections of Chapter 26. Actuate initiating device and verify receipt of the correct initiating device signal at the supervising station within 90 seconds. Upon completion of the test, restore the system to its functional operating condition. If test jacks are used, perform the first and last tests without the use of the test jack.
(b) Digital alarm communicator receiver (DACR)	X	Monthly	Disconnect each transmission means in turn from the DACR, and verify audible and visual annunciation of a trouble signal in the supervising station. Cause a signal to be transmitted on each individual incoming DACR line (path) at least once every 6 hours (24 hours for DACTs installed prior to adoption of the 2013 edition of *NFPA 72*). Verify receipt of these signals.
(c) Digital alarm radio receiver (DARR)	X	Monthly	Cause the following conditions of all DARRs on all subsidiary and repeater station receiving equipment. Verify receipt at the supervising station of correct signals for each of the following conditions: (1) AC power failure of the radio equipment (2) Receiver malfunction (3) Antenna and interconnecting cable failure (4) Indication of automatic switchover of the DARR (5) Data transmission line failure between the DARR and the supervising or subsidiary station
(d) McCulloh systems	X	Monthly	Test and record the current on each circuit at each supervising and subsidiary station under the following conditions: (1) During functional operation (2) On each side of the circuit with the receiving equipment conditioned for an open circuit Cause a single break or ground condition on each transmission channel. If such a fault prevents the functioning of the circuit, verify receipt of a trouble signal. Cause each of the following conditions at each of the supervising or subsidiary stations and all repeater station radio transmitting and receiving equipment; verify receipt of correct signals at the supervising station: (1) RF transmitter in use (radiating) (2) AC power failure supplying the radio equipment (3) RF receiver malfunction (4) Indication of automatic switchover
(e) Radio alarm supervising station receiver (RASSR) and radio alarm repeater station receiver (RARSR)	X	Monthly	Cause each of the following conditions at each of the supervising or subsidiary stations and all repeater station radio transmitting and receiving equipment; verify receipt of correct signals at the supervising station: (1) AC power failure supplying the radio equipment (2) RF receiver malfunction (3) Indication of automatic switchover, if applicable
(f) Private microwave radio systems	X	Monthly	Cause each of the following conditions at each of the supervising or subsidiary stations and all repeater station radio transmitting and receiving equipment; verify receipt of correct signals at the supervising station: (1) RF transmitter in use (radiating) (2) AC power failure supplying the radio equipment (3) RF receiver malfunction (4) Indication of automatic switchover

(continues)

Table 14.4.3.2 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
27. Supervising station alarm systems — receiving equipment *(continued)*			
(g) Performance-based technologies	X	Monthly	Perform tests to ensure the monitoring of integrity of the transmission technology and technology path. Where a single communications path is used, disconnect the communication path. Verify that failure of the path is annunciated at the supervising station within 60 minutes of the failure (within 5 minutes for communication equipment installed prior to adoption of the 2013 edition of *NFPA 72*). Restore the communication path. Where multiple communication paths are used, disconnect both communication paths and confirm that failure of the path is annunciated at the supervising station within not more than 6 hours of the failure (within 24 hours for communication equipment installed prior to adoption of the 2013 edition of *NFPA 72*). Restore both communication paths.
28. Public emergency alarm reporting system transmission equipment			
(a) Publicly accessible alarm box	X	Semiannually	Actuate publicly accessible initiating device(s) and verify receipt of not less than three complete rounds of signal impulses. Perform this test under normal circuit conditions. If the device is equipped for open circuit operation (ground return), test it in this condition as one of the semiannual tests.
(b) Auxiliary box	X	Annually	Test each initiating circuit of the auxiliary box by actuation of a protected premises initiating device connected to that circuit. Verify receipt of not less than three complete rounds of signal impulses.
(c) Master box			
(1) Manual operation	X	Semiannually	Perform the tests prescribed for 28(a).
(2) Auxiliary operation	X	Annually	Perform the tests prescribed for 28(b).
29. Low-power radio (wireless systems)	X	N/A	The following procedures describe additional acceptance and reacceptance test methods to verify wireless protection system operation: (1) Use the manufacturer's published instructions and the as-built drawings provided by the system supplier to verify correct operation after the initial testing phase has been performed by the supplier or by the supplier's designated representative. (2) Starting from the functional operating condition, initialize the system in accordance with the manufacturer's published instructions. Confirm the alternative communications path exists between the wireless control unit and peripheral devices used to establish initiation, indication, control, and annunciation. Test the system for both alarm and trouble conditions. (3) Check batteries for all components in the system monthly unless the control unit checks all batteries and all components daily.
30. Mass notification systems			
(a) Functions	X	Annually	At a minimum, test control equipment to verify correct receipt of alarm, supervisory, and trouble signals (inputs); operation of evacuation signals and auxiliary functions (outputs); circuit supervision, including detection of open circuits and ground faults; and power supply supervision for detection of loss of ac power and disconnection of secondary batteries.
(b) Fuses	X	Annually	Verify the rating and supervision.
(c) Interfaced equipment	X	Annually	Verify integrity of single or multiple circuits providing interface between two or more control units. Test interfaced equipment connections by operating or simulating operation of the equipment being supervised. Verify signals required to be transmitted at the control unit.
(d) Lamps and LEDs	X	Annually	Illuminate lamps and LEDs.
(e) Primary (main) power supply	X	Annually	Disconnect all secondary (standby) power and test under maximum load, including all alarm appliances requiring simultaneous operation. Reconnect all secondary (standby) power at end of test. For redundant power supplies, test each separately.
(f) Audible textual notification appliances (speakers and other appliances to convey voice messages)	X	Annually	Measure sound pressure level with a sound level meter meeting ANSI S1.4a, *Specifications for Sound Level Meters,* Type 2 requirements. Measure and record levels throughout protected area. Set the sound level meter in accordance with ANSI S3.41, *American National Standard Audible Evacuation Signal,* using the time-weighted characteristic F (FAST). Record the maximum output when the audible emergency evacuation signal is on. Verify audible information to be distinguishable and understandable.

Table 14.4.3.2 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
(g) Visible	X	Annually	Perform test in accordance with manufacturer's published instructions. Verify appliance locations to be per approved layout and confirm that no floor plan changes affect the approved layout. Verify that the candela rating marking agrees with the approved drawing. Confirm that each appliance flashes.
(h) Control unit functions and no diagnostic failures are indicated	X	Annually	Review event log file and verify that the correct events were logged. Review system diagnostic log file; correct deficiencies noted in file. Delete unneeded log files. Delete unneeded error files. Verify that sufficient free disk space is available. Verify unobstructed flow of cooling air is available. Change/clean filters, cooling fans, and intake vents.
(i) Control unit reset	X	Annually	Power down the central control unit computer and restart it.
(j) Control unit security	X	Annually	If remote control software is loaded onto the system, verify that it is disabled to prevent unauthorized system access.
(k) Audible/visible functional test	X	Annually	Send out an alert to a diverse set of predesignated receiving devices and confirm receipt. Include at least one of each type of receiving device.
(l) Software backup	X	Annually	Make full system software backup. Rotate backups based on accepted practice at site.
(m) Secondary power test	X	Annually	Disconnect ac power. Verify the ac power failure alarm status on central control equipment. With ac power disconnected, verify battery voltage under load.
(n) Wireless signals	X	Annually	Check forward/reflected radio power is within specifications.
(o) Antenna	X	Annually	Check forward/reflected radio power is within specifications. Verify solid electrical connections with no observable corrosion.
(p) Transceivers	X	Annually	Verify proper operation and mounting is not compromised.

[a]Some transmission equipment (such as but not limited to cable modems, fiber-optic interface nodes, and VoIP interfaces) are typically powered by the building's electrical system using a standby power supply that does not meet the requirements of this Code. This is intended to ensure that the testing authority verifies full standby power as required by Chapter 10. Additionally, refer to Table 14.4.3.2, Items 7 through 9 for secondary power supply testing.

[b]The automatic transmission of the check-in (handshake) signal can take up to 60 minutes to occur.

[c]See Table 14.4.3.2, Item 4(a) for the testing of transmission equipment.

[d]Example: 4000 mAh × 1/25 = 160 mA charging current at 77°F (25°C).

[e]The voltmeter sensitivity has been changed from 1000 ohms per volt to 100 ohms per volt so that the false ground readings (caused by induced voltages) are minimized.

[f]Initiating devices such as smoke detectors used for elevator recall, closing dampers, or releasing doors held in the open position that are permitted by the Code *(see* NFPA *101, Life Safety Code, 9.6.3)* to initiate supervisory signals at the fire alarm control unit (FACU) should be tested at the same frequency (annual) as those devices when they are generating an alarm signal. They are not supervisory devices, but they initiate a supervisory signal at the FACU.

[g]Fusible thermal link detectors are commonly used to close fire doors and fire dampers. They are actuated by the presence of external heat, which causes a solder element in the link to fuse, or by an electric thermal device, which, when energized, generates heat within the body of the link, causing the link to fuse and separate.

[h]Note, it is customary for the manufacturer of the smoke detector to test a particular product from an aerosol provider to determine acceptability for use in smoke entry testing of their smoke detector/ smoke alarm. Magnets are not acceptable for smoke entry tests.

[i] There are some detectors that use magnets as a manufacturer's calibrated sensitivity test instrument.

[j]For example, it might not be possible to individually test the heat sensor in a thermally enhanced smoke detector.

[k]Manufacturer's instructions should be consulted to ensure a proper operational test. No suppression gas or agent is expected to be discharged during the test of the solenoid. See Test Plan of 14.2.10.

[l]Testing of CO device should be done to the requirements of NFPA 720, *Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment.*

[m]A monitor module installed on an interface device is not considered a supervisory device and therefore not subject to the quarterly testing frequency requirement. Test frequencies for interface devices should be in accordance with the applicable standard. For example, fire pump controller alarms such as phase reversal are required to be tested annually. If a monitor module is installed to identify phase reversal on the fire alarm control panel, it is not necessary to test for phase reversal four times a year.

[n]Chapter 18 would require 15 dB over average ambient sound for public mode spaces. Sometimes the ambient sound levels are different from what the design was based upon. Private operating mode would require 10 dB over average ambient at the location of the device.

[o]Where building, system, or occupancy changes have been observed, the owner should be notified of the changes. New devices might need to be installed and tested per the initial acceptance testing criteria.

[p]See A.14.4.3.2, and Table 14.4.3.2, Item 24.

Water-based Fire Suppression Appendixes

The following pages contain all the attachments for this project.

CONSOLIDATED NUCLEAR SECURITY, LLC (CNS)
P.O. BOX 30020, MAIL DROP 12-106
AMARILLO,TX 79120-0020

HYDRAULIC CALCULATIONS FOR
Bainbridge
Cal Poly 523
Project

DRAWING NUMBER: 1 DATE: MAR 16, 2015

-DESIGN DATA-

REMOTE AREA NUMBER: A REMOTE AREA LOCATION: Top

OCCUPANCY CLASSIFICATION: Class IV Commodity
DENSITY: 0.75 gpm/sq. ft.
AREA OF APPLICATION: 1,584 sq. ft.

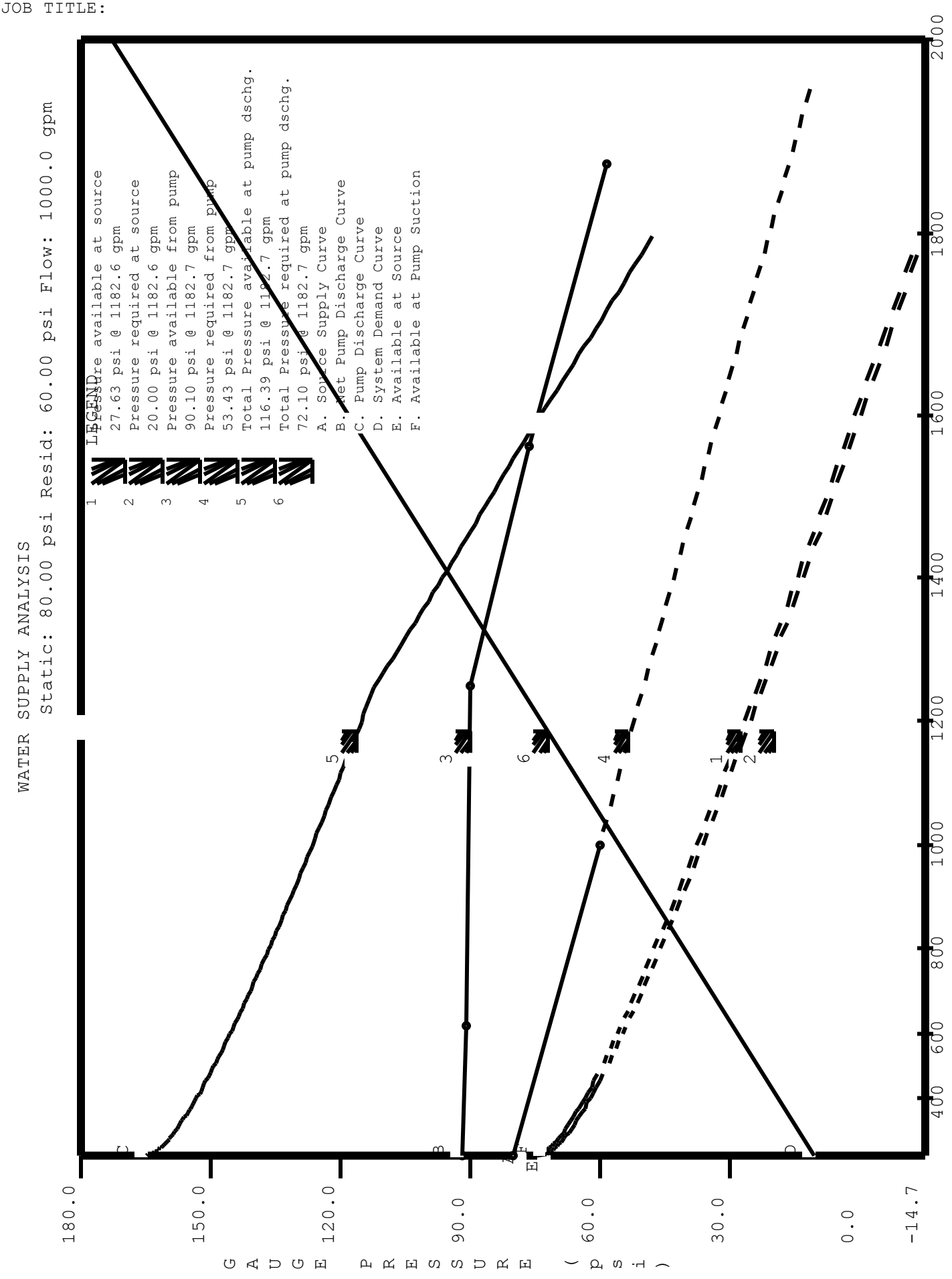
COVERAGE PER SPRINKLER: 132 sq. ft.
TYPE OF SPRINKLERS CALCULATED: ESFR EC 25.2k
NUMBER OF SPRINKLERS CALCULATED: 12

HOSE-STREAM DEMAND: 500 gpm
TOTAL WATER REQUIRED (INCLUDING HOSE): 1682.6 gpm
FLOW AND PRESSURE (AT BASE OF RISER):1682.6 gpm @ 20.0 psi

TYPE OF SYSTEM: WET
WATER SUPPLY
Static: 80.0 psi Residual: 60.0 psi Flow: 1000 gpm
Source Elevation Relative to Finished Flow Level: 0 ft.

Calculations performed by HASS under license # 16110635 ,
granted by HRS SYSTEMS, INC.
(Notes continue after pipe calculations results.)

DATE: 3/16/2015 N:\MY DOCUMENTS\CAL POLY\WATER-BASED\SYSTEM A.SDF
JOB TITLE:



DATE: 3/16/2015 N:\MY DOCUMENTS\CAL POLY\WATER-BASED\SYSTEM A.SDF
JOB TITLE:

NFPA WATER SUPPLY DATA

SOURCE NODE TAG	STATIC PRESS. (PSI)	RESID. PRESS. (PSI)	@ FLOW (GPM)	AVAIL. PRESS. (PSI)	@ TOTAL DEMAND (GPM)	REQ'D PRESS. (PSI)
BOR	80.0	60.0	1000.0	27.6	1682.6	20.0

Required pressure is 7.6 psi (28%) less than available pressure.

AGGREGATE FLOW ANALYSIS:

TOTAL FLOW AT SOURCE	1682.6 GPM
TOTAL HOSE STREAM ALLOWANCE AT SOURCE	500.0 GPM
OTHER HOSE STREAM ALLOWANCES	0.0 GPM
TOTAL DISCHARGE FROM ACTIVE SPRINKLERS	1182.6 GPM

NODE ANALYSIS DATA

NODE TAG	ELEVATION (FT)	NODE TYPE	PRESSURE (PSI)	DISCHARGE (GPM)	NOTES
A1	3.0	- - - -	71.6	- - -	
A2	24.0	- - - -	58.5	- - -	
A3	24.0	- - - -	57.5	- - -	
A4	24.0	- - - -	54.6	- - -	
A5	24.0	- - - -	53.9	- - -	
A6	24.0	- - - -	31.2	- - -	
A7	24.0	- - - -	53.4	- - -	
A8	24.0	- - - -	31.2	- - -	
A9	24.0	- - - -	53.1	- - -	
A10	24.0	- - - -	31.2	- - -	
A11	24.0	- - - -	52.8	- - -	
A12	24.0	- - - -	31.1	- - -	
A13	24.0	- - - -	52.6	- - -	
A14	24.0	- - - -	31.0	- - -	
A15	24.0	- - - -	52.5	- - -	
A16	24.0	- - - -	31.0	- - -	
A17	24.0	- - - -	52.5	- - -	
A18	24.0	- - - -	31.0	- - -	
1	24.0	K=25.20	15.9	100.4	
2	24.0	K=25.20	15.1	97.8	
3	24.0	K=25.20	15.0	97.6	
4	24.0	K=25.20	15.2	98.3	
5	24.0	K=25.20	15.9	100.4	
6	24.0	K=25.20	15.1	97.8	
7	24.0	K=25.20	15.0	97.6	
8	24.0	K=25.20	15.2	98.3	
9	24.0	K=25.20	15.9	100.5	
10	24.0	K=25.20	15.1	97.9	
11	24.0	K=25.20	15.0	97.7	
12	24.0	K=25.20	15.2	98.4	
PI	3.0	- - - -	18.7	- - -	
PO	3.0	- - - -	72.1	- - -	

DATE: 3/16/2015 N:\MY DOCUMENTS\CAL POLY\WATER-BASED\SYSTEM A.SDF
JOB TITLE:

NODE ANALYSIS DATA

NODE TAG	ELEVATION (FT)	NODE TYPE	PRESSURE (PSI)	DISCHARGE (GPM)	NOTES
BOR	0.0	SOURCE	20.0	1182.6	

NFPA PIPE DATA

Pipe Tag / Frm Node / To Node	El (ft)	K-fac PT	Add Fl (q) Tot.(Q)	Add Fl To Node/ Disch	Nom ID Act ID	Fit: Eq.Ln. (ft.)	L F T	C Pf/ft.	(Pt) (Pe) (Pf)	Notes
Pipe: 1		Source	0.0				3.00	120	1.3	
BOR	0.0	20.0	1182.6	PO	8.000	----	0.00		-1.3	
PI	3.0	18.7	1182.6		7.981		3.00	0.013	0.0	
Pipe: 1b		0.0	0.0	Fire Pump Rating			Avail.	Req'd.		
PI	3.0	18.7	1182.6	A1		gpm: 1250.0	1182.7	1182.7		
PO	3.0	72.1	1182.7			psi: 90.0	90.1	53.4		
User Defined Five Point Pump Curve:										
gpm:		0.0	625.0	1250.0	1562.5	1875.0				
psi:		91.8	90.9	90.0	76.5	58.5				
Pipe: 1c		0.0	0.0				8.00	120	0.5	
PO	3.0	72.1	1182.6	A2	8.000	T:35.0	35.00		0.0	
A1	3.0	71.6	1182.6		7.981		43.00	0.013	0.5	
Pipe: 1a		0.0	0.0			T:30.0	21.00	120	13.0	
A1	3.0	71.6	1182.6	A3	6.000	G: 3.0	61.00		-9.1	
A2	24.0	58.5	1182.6		6.065	A:28.0	82.00	0.048	3.9	
Pipe: 2		0.0	0.0				8.00	120	1.1	
A2	24.0	58.5	1182.6	A4	6.000	E:14.0	14.00		0.0	
A3	24.0	57.5	1182.6		6.065		22.00	0.048	1.1	
Pipe: 3		0.0	0.0				46.00	120	2.9	
A3	24.0	57.5	1182.6	A5	6.000	E:14.0	14.00		0.0	
A4	24.0	54.6	1182.6		6.065		60.00	0.048	2.9	
Pipe: 4		0.0	1060.4	A7			1.00	120	0.7	
A4	24.0	54.6	122.2	A6	6.000	E:14.0	14.00		0.0	
A5	24.0	53.9	1182.6		6.065		15.00	0.048	0.7	
Pipe: 5		0.0	0.0				371.00	120	22.6	
A5	24.0	53.9	122.2	A8	2.500	2T:24.0	24.00		0.0	
A6	24.0	31.2	122.2		2.469		395.00	0.057	22.6	
Pipe: 6		0.0	243.2	A10			371.00	120	22.2	
A7	24.0	53.4	-122.2	A6	2.500	2T:24.0	24.00		0.0	
A8	24.0	31.2	121.0		2.469		395.00	0.056	22.2	
Pipe: 7		0.0	363.2	A12			371.00	120	21.9	
A9	24.0	53.1	-243.2	A8	2.500	2T:24.0	24.00		0.0	
A10	24.0	31.2	120.0		2.469		395.00	0.055	21.9	
Pipe: 8		0.0	484.6	A14			371.00	120	21.7	
A11	24.0	52.8	-363.2	A10	2.500	T:12.0	12.00		0.0	
A12	24.0	31.1	121.4		2.469		383.00	0.057	21.7	

DATE: 3/16/2015 N:\MY DOCUMENTS\CAL POLY\WATER-BASED\SYSTEM A.SDF
JOB TITLE:

Pipe Tag / Frm Node / To Node	El (ft)	K-fac / PT	Add Fl (q) / Tot.(Q)	Add Fl To Node/ Disch	Nom ID / Act ID	Fit: Eq.Ln. (ft.)	L / F / T	C / Pf/ft.	(Pt) / (Pe) / (Pf)	Notes
		25.20	100.5	Disch						
Pipe: 9			0.0				182.50	120	36.7	
A13	24.0	52.6	132.4	10	2.500	T:12.0	12.00		0.0	
9	24.0	15.9	232.9		2.469		194.50	0.189	36.7	
		25.20	97.9	Disch						
Pipe: 9A			0.0				12.00	120	0.8	
9	24.0	15.9	34.5	11	2.500	----	0.00		0.0	
10	24.0	15.1	132.4		2.469		12.00	0.066	0.8	
Pipe: 9B		25.20	97.7	Disch			12.00	120	0.1	
10	24.0	15.1	-63.3	12	2.500	----	0.00		0.0	
11	24.0	15.0	34.5		2.469		12.00	0.006	0.1	
Pipe: 9C		25.20	97.7	Disch			12.00	120	0.2	
12	24.0	15.2	-34.5	10	2.500	----	0.00		0.0	
11	24.0	15.0	63.3		2.469		12.00	0.017	0.2	
		25.20	98.4	Disch						
Pipe: 9D			0.0				152.50	120	15.8	
A14	24.0	31.0	63.3	11	2.500	T:12.0	12.00		0.0	
12	24.0	15.2	161.6		2.469		164.50	0.096	15.8	
Pipe: 9E		25.20	100.4	Disch			182.50	120	36.7	
A15	24.0	52.5	132.2	6	2.500	T:12.0	12.00		0.0	
5	24.0	15.9	232.6		2.469		194.50	0.189	36.7	
Pipe: 10		25.20	97.8	Disch			12.00	120	0.8	
5	24.0	15.9	34.4	7	2.500	----	0.00		0.0	
6	24.0	15.1	132.2		2.469		12.00	0.066	0.8	
Pipe: 10A		25.20	97.6	Disch			12.00	120	0.1	
6	24.0	15.1	-63.2	8	2.500	----	0.00		0.0	
7	24.0	15.0	34.4		2.469		12.00	0.005	0.1	
Pipe: 10B		25.20	97.6	Disch			12.00	120	0.2	
8	24.0	15.2	-34.4	6	2.500	----	0.00		0.0	
7	24.0	15.0	63.2		2.469		12.00	0.017	0.2	
Pipe: 10C		25.20	98.3	Disch			152.50	120	15.8	
A16	24.0	31.0	63.2	7	2.500	T:12.0	12.00		0.0	
8	24.0	15.2	161.5		2.469		164.50	0.096	15.8	
Pipe: 10D		25.20	100.4	Disch			182.50	120	36.6	
A17	24.0	52.5	132.2	2	2.500	T:12.0	12.00		0.0	
1	24.0	15.9	232.6		2.469		194.50	0.188	36.6	
Pipe: 10E		25.20	97.8	Disch			12.00	120	0.8	
1	24.0	15.9	34.4	3	2.500	----	0.00		0.0	
2	24.0	15.1	132.2		2.469		12.00	0.066	0.8	

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JOB TITLE:

Pipe Tag / Frm Node / To Node	El (ft)	K-fac / PT	Add Fl (q) / Tot.(Q)	Add Fl To Node/ Disch	Nom ID / Act ID	Fit: Eq.Ln. (ft.)	L / F / T	C / Pf/ft.	(Pt) / (Pe) / (Pf)	Notes
Pipe: 11		25.20	97.6	Disch			12.00	120	0.1	
2	24.0	15.1	-63.2	4	2.500	----	0.00		0.0	
3	24.0	15.0	34.4		2.469		12.00	0.005	0.1	
Pipe: 11A		25.20	97.6	Disch			12.00	120	0.2	
4	24.0	15.2	-34.4	2	2.500	----	0.00		0.0	
3	24.0	15.0	63.2		2.469		12.00	0.017	0.2	
Pipe: 11B		25.20	98.3	Disch			152.50	120	15.8	
A18	24.0	31.0	63.2	3	2.500	T:12.0	12.00		0.0	
4	24.0	15.2	161.5		2.469		164.50	0.096	15.8	
Pipe: 12		0.0	939.5	A9			11.00	120	0.4	
A5	24.0	53.9	121.0	A8	6.000	----	0.00		0.0	
A7	24.0	53.4	1060.4		6.065		11.00	0.039	0.4	
Pipe: 13		0.0	819.4	A11			11.00	120	0.3	
A7	24.0	53.4	120.0	A10	6.000	----	0.00		0.0	
A9	24.0	53.1	939.5		6.065		11.00	0.031	0.3	
Pipe: 14		0.0	698.0	A13			11.00	120	0.3	
A9	24.0	53.1	121.4	A12	6.000	----	0.00		0.0	
A11	24.0	52.8	819.4		6.065		11.00	0.024	0.3	
Pipe: 15		0.0	465.2	A15			11.00	120	0.2	
A11	24.0	52.8	232.9	9	6.000	----	0.00		0.0	
A13	24.0	52.6	698.0		6.065		11.00	0.018	0.2	
Pipe: 16		0.0	232.6	A17			11.00	120	0.1	
A13	24.0	52.6	232.6	5	6.000	----	0.00		0.0	
A15	24.0	52.5	465.2		6.065		11.00	0.009	0.1	
Pipe: 17		0.0	0.0				11.00	120	0.0	
A15	24.0	52.5	232.6	1	6.000	----	0.00		0.0	
A17	24.0	52.5	232.6		6.065		11.00	0.002	0.0	
Pipe: 18		0.0	243.2	A10			11.00	120	0.0	
A6	24.0	31.2	-121.0	A7	6.000	----	0.00		0.0	
A8	24.0	31.2	122.2		6.065		11.00	0.001	0.0	
Pipe: 19		0.0	363.2	A12			11.00	120	0.0	
A8	24.0	31.2	-120.0	A9	6.000	----	0.00		0.0	
A10	24.0	31.2	243.2		6.065		11.00	0.003	0.0	
Pipe: 20		0.0	484.6	A14			11.00	120	0.1	
A10	24.0	31.2	-121.4	A11	6.000	----	0.00		0.0	
A12	24.0	31.1	363.2		6.065		11.00	0.005	0.1	
Pipe: 21		0.0	323.0	A16			11.00	120	0.1	
A12	24.0	31.1	161.6	12	6.000	----	0.00		0.0	
A14	24.0	31.0	484.6		6.065		11.00	0.009	0.1	

Pipe Tag / Frm Node / To Node	El (ft)	K-fac / PT	Add Fl (q) / Tot.(Q)	Add Fl To Node/ Disch	Nom ID / Act ID	Fit: Eq.Ln. (ft.)	L / F / T	C / Pf/ft.	(Pt) / (Pe) / (Pf)	Notes
Pipe: 22		0.0	161.5	A18			11.00	120	0.0	
A14	24.0	31.0	161.5	8	6.000	----	0.00		0.0	
A16	24.0	31.0	323.0		6.065		11.00	0.004	0.0	
Pipe: 23		0.0	0.0				11.00	120	0.0	
A16	24.0	31.0	161.5	4	6.000	----	0.00		0.0	
A18	24.0	31.0	161.5		6.065		11.00	0.001	0.0	

NOTES (HASS):

(1) Calculations were performed by the HASS 8.4 computer program
under license no. 16110635 granted by
HRS Systems, Inc.
208 Southside Square
Petersburg, TN 37144
(931) 659-9760

(2) The system has been calculated to provide an average
imbalance at each node of 0.007 gpm and a maximum
imbalance at any node of 0.114 gpm.

(3) Total pressure at each node is used in balancing the system.
Maximum water velocity is 15.6 ft/sec at pipe 9.

(4) The Minimum pump suction pressure under maximum
calculated demand is 18.66 (psi)

(5) Items listed in bold print on the cover sheet

are automatically transferred from the calculation report.

(6) Available pressure at source node BOR under full flow conditions is
14.18 psi compared to the minimum required pressure of 20.00 psi.

(7) PIPE FITTINGS TABLE

Pipe Table Name: STANDARD.PIP

CONSOLIDATED NUCLEAR SECURITY, LLC (CNS)
P.O. BOX 30020, MAIL DROP 12-106
AMARILLO,TX 79120-0020

HYDRAULIC CALCULATIONS FOR
Bainbridge
Cal Poly 523
Project

DRAWING NUMBER: 1 DATE: MAR 16, 2015

-DESIGN DATA-

REMOTE AREA NUMBER: B REMOTE AREA LOCATION: Mid Top

OCCUPANCY CLASSIFICATION: Class IV Commodity
DENSITY: 0.75 gpm/sq. ft.
AREA OF APPLICATION: 1,584 sq. ft.

COVERAGE PER SPRINKLER: 132 sq. ft.
TYPE OF SPRINKLERS CALCULATED: ESFR EC 25.2k
NUMBER OF SPRINKLERS CALCULATED: 12

HOSE-STREAM DEMAND: 500 gpm
TOTAL WATER REQUIRED (INCLUDING HOSE): 1682.7 gpm
FLOW AND PRESSURE (AT BASE OF RISER):1682.7 gpm @ 20.0 psi

TYPE OF SYSTEM: WET
WATER SUPPLY
Static: 80.0 psi Residual: 60.0 psi Flow: 1000 gpm
Source Elevation Relative to Finished Flow Level: 0 ft.

Calculations performed by HASS under license # 16110635 ,
granted by HRS SYSTEMS, INC.
(Notes continue after pipe calculations results.)

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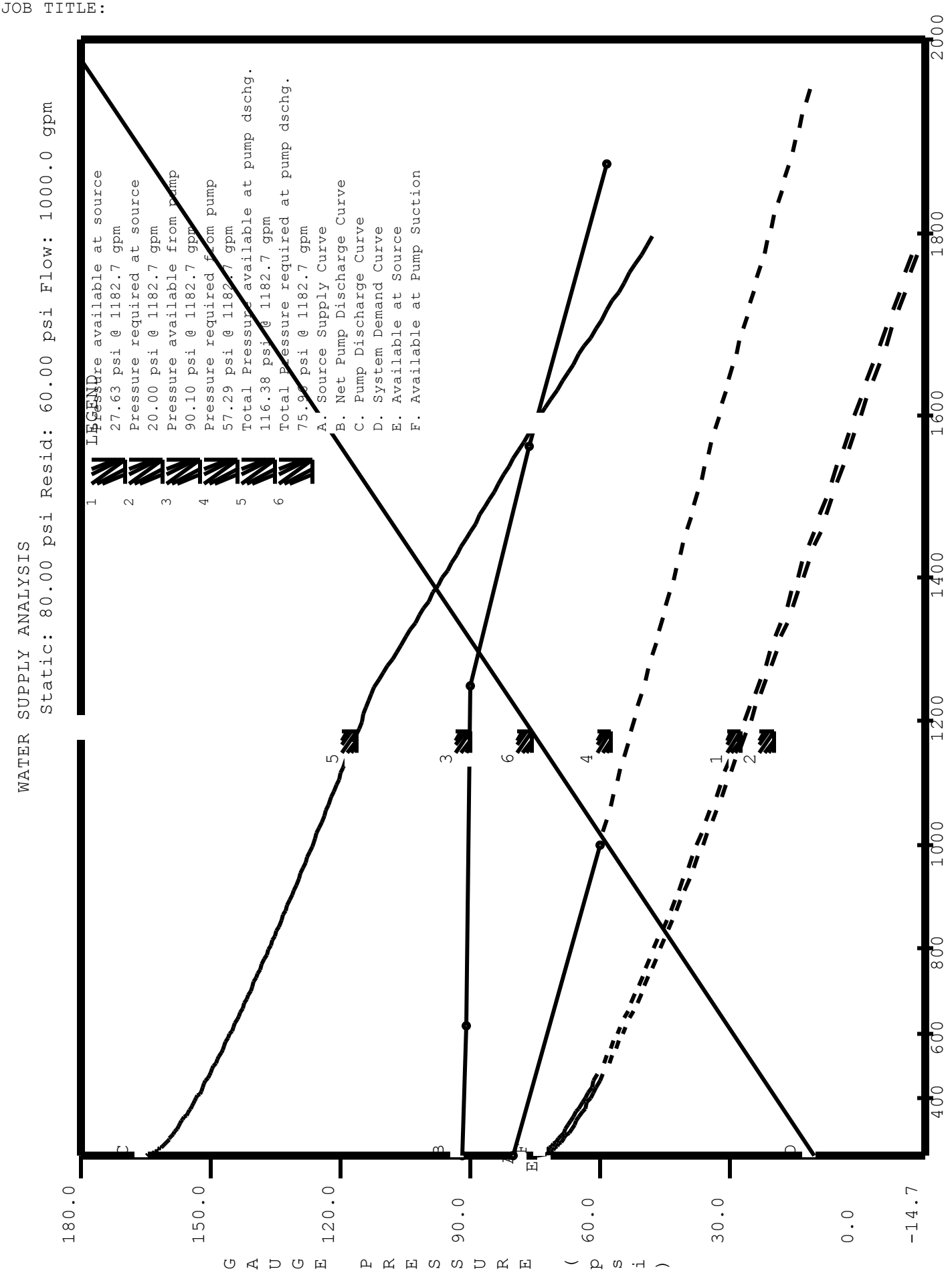
JOB TITLE:



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JOB TITLE:

NFPA WATER SUPPLY DATA

SOURCE NODE TAG	STATIC PRESS. (PSI)	RESID. PRESS. (PSI)	@ FLOW (GPM)	AVAIL. PRESS. (PSI)	@ TOTAL DEMAND (GPM)	REQ'D PRESS. (PSI)
BOR	80.0	60.0	1000.0	27.6	1682.7	20.0

Required pressure is 7.6 psi (28%) less than available pressure.

AGGREGATE FLOW ANALYSIS:

TOTAL FLOW AT SOURCE	1682.7 GPM
TOTAL HOSE STREAM ALLOWANCE AT SOURCE	500.0 GPM
OTHER HOSE STREAM ALLOWANCES	0.0 GPM
TOTAL DISCHARGE FROM ACTIVE SPRINKLERS	1182.7 GPM

NODE ANALYSIS DATA

NODE TAG	ELEVATION (FT)	NODE TYPE	PRESSURE (PSI)	DISCHARGE (GPM)	NOTES
B1	3.0	- - - -	75.4	- - -	
B2	24.0	- - - -	62.4	- - -	
B3	24.0	- - - -	57.8	- - -	
B4	24.0	- - - -	54.8	- - -	
B5	24.0	- - - -	53.9	- - -	
B6	24.0	- - - -	31.2	- - -	
B7	24.0	- - - -	53.5	- - -	
B8	24.0	- - - -	31.2	- - -	
B9	24.0	- - - -	53.2	- - -	
B10	24.0	- - - -	31.2	- - -	
B11	24.0	- - - -	52.9	- - -	
B12	24.0	- - - -	31.1	- - -	
B13	24.0	- - - -	52.7	- - -	
B14	24.0	- - - -	31.0	- - -	
B15	24.0	- - - -	52.6	- - -	
B16	24.0	- - - -	31.0	- - -	
B17	24.0	- - - -	52.6	- - -	
B18	24.0	- - - -	30.9	- - -	
13	24.0	K=25.20	15.9	100.4	
14	24.0	K=25.20	15.1	97.8	
15	24.0	K=25.20	15.0	97.6	
16	24.0	K=25.20	15.2	98.3	
17	24.0	K=25.20	15.9	100.4	
18	24.0	K=25.20	15.1	97.8	
19	24.0	K=25.20	15.0	97.6	
20	24.0	K=25.20	15.2	98.3	
21	24.0	K=25.20	15.9	100.5	
22	24.0	K=25.20	15.1	97.9	
23	24.0	K=25.20	15.0	97.7	
24	24.0	K=25.20	15.2	98.4	
PI	3.0	- - - -	18.7	- - -	
PO	3.0	- - - -	76.0	- - -	

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JOB TITLE:

NODE ANALYSIS DATA

NODE TAG	ELEVATION (FT)	NODE TYPE	PRESSURE (PSI)	DISCHARGE (GPM)	NOTES
BOR	0.0	SOURCE	20.0	1182.7	

DATE: 3/16/2015 N:\My Documents\Cal Poly\Water-based\System B.sdf
JOB TITLE:

NFPA PIPE DATA

Pipe Tag / Frm Node / To Node	El (ft)	K-fac / PT	Add Fl (q) / Tot.(Q)	Add Fl To Node/ Disch	Nom ID / Act ID	Fit: Eq.Ln. (ft.)	L / F / T	C / Pf/ft.	(Pt) (Pe) (Pf)	Notes
Pipe: 1		Source	0.0				3.00	120	1.3	
BOR	0.0	20.0	1182.6	PO	8.000	----	0.00		-1.3	
PI	3.0	18.7	1182.7		7.981		3.00	0.013	0.0	
Pipe: 2		0.0	0.0	Fire Pump Rating			Avail.	Req'd.		
PI	3.0	18.7	1182.7	B1	gpm: 1250.0		1182.7	1182.7		
PO	3.0	76.0	1182.7		psi: 90.0		90.1	57.3		
User Defined Five Point Pump Curve:										
gpm:		0.0	625.0	1250.0	1562.5	1875.0				
psi:		91.8	90.9	90.0	76.5	58.5				
Pipe: 1c		0.0	0.0				8.00	120	0.5	
PO	3.0	76.0	1182.7	B2	8.000	T:35.0	35.00		0.0	
B1	3.0	75.4	1182.7		7.981		43.00	0.013	0.5	
Pipe: 24		0.0	0.0			T:30.0	21.00	120	13.0	
B1	3.0	75.4	1182.7	B3	6.000	G: 3.0	61.00		-9.1	
B2	24.0	62.4	1182.7		6.065	A:28.0	82.00	0.048	3.9	
Pipe: 25		0.0	0.0				81.50	120	4.6	
B2	24.0	62.4	1182.7	B4	6.000	E:14.0	14.00		0.0	
B3	24.0	57.8	1182.7		6.065		95.50	0.048	4.6	
Pipe: 26		0.0	0.0				48.00	120	3.0	
B3	24.0	57.8	1182.7	B5	6.000	E:14.0	14.00		0.0	
B4	24.0	54.8	1182.7		6.065		62.00	0.048	3.0	
Pipe: 27		0.0	1060.1	B7			4.50	120	0.9	
B4	24.0	54.8	122.5	B6	6.000	E:14.0	14.00		0.0	
B5	24.0	53.9	1182.7		6.065		18.50	0.048	0.9	
Pipe: 28		0.0	0.0				371.00	120	22.7	
B5	24.0	53.9	122.5	B8	2.500	2T:24.0	24.00		0.0	
B6	24.0	31.2	122.5		2.469		395.00	0.058	22.7	
Pipe: 29		0.0	243.8	B10			371.00	120	22.3	
B7	24.0	53.5	-122.5	B6	2.500	2T:24.0	24.00		0.0	
B8	24.0	31.2	121.3		2.469		395.00	0.056	22.3	
Pipe: 30		0.0	364.2	B12			371.00	120	22.0	
B9	24.0	53.2	-243.8	B8	2.500	2T:24.0	24.00		0.0	
B10	24.0	31.2	120.4		2.469		395.00	0.056	22.0	
Pipe: 31		0.0	483.9	B14			371.00	120	21.8	
B11	24.0	52.9	-364.2	B10	2.500	2T:24.0	24.00		0.0	
B12	24.0	31.1	119.7		2.469		395.00	0.055	21.8	

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JOB TITLE:

Pipe Tag / Frm Node / To Node	El (ft)	K-fac / PT	Add Fl (q) / Tot.(Q)	Add Fl To Node/ Disch	Nom ID / Act ID	Fit: Eq.Ln. (ft.)	L / F / T	C / Pf/ft.	(Pt) (Pe) (Pf)	Notes
		25.20	100.5	Disch						
Pipe: 31A			0.0				182.50	120	36.8	
B13	24.0	52.7	132.6	22	2.500	T:12.0	12.00		0.0	
21	24.0	15.9	233.1		2.469		194.50	0.189	36.8	
		25.20	97.9	Disch						
Pipe: 32			0.0				12.00	120	0.8	
21	24.0	15.9	34.7	23	2.500	----	0.00		0.0	
22	24.0	15.1	132.6		2.469		12.00	0.067	0.8	
Pipe: 32A		25.20	97.7	Disch			12.00	120	0.1	
22	24.0	15.1	-63.0	24	2.500	----	0.00		0.0	
23	24.0	15.0	34.7		2.469		12.00	0.006	0.1	
Pipe: 32B		25.20	97.7	Disch			12.00	120	0.2	
24	24.0	15.2	-34.7	22	2.500	----	0.00		0.0	
23	24.0	15.0	63.0		2.469		12.00	0.017	0.2	
		25.20	98.4	Disch						
Pipe: 32C			0.0				152.50	120	15.8	
B14	24.0	31.0	63.0	23	2.500	T:12.0	12.00		0.0	
24	24.0	15.2	161.4		2.469		164.50	0.096	15.8	
Pipe: 32D		25.20	100.4	Disch			182.50	120	36.7	
B15	24.0	52.6	132.5	18	2.500	T:12.0	12.00		0.0	
17	24.0	15.9	232.9		2.469		194.50	0.189	36.7	
Pipe: 32E		25.20	97.8	Disch			12.00	120	0.8	
17	24.0	15.9	34.6	19	2.500	----	0.00		0.0	
18	24.0	15.1	132.5		2.469		12.00	0.067	0.8	
Pipe: 33		25.20	97.6	Disch			12.00	120	0.1	
18	24.0	15.1	-63.0	20	2.500	----	0.00		0.0	
19	24.0	15.0	34.6		2.469		12.00	0.006	0.1	
Pipe: 33A		25.20	97.6	Disch			12.00	120	0.2	
20	24.0	15.2	-34.6	18	2.500	----	0.00		0.0	
19	24.0	15.0	63.0		2.469		12.00	0.017	0.2	
Pipe: 33B		25.20	98.3	Disch			152.50	120	15.7	
B16	24.0	31.0	63.0	19	2.500	T:12.0	12.00		0.0	
20	24.0	15.2	161.3		2.469		164.50	0.096	15.7	
Pipe: 33C		25.20	100.4	Disch			182.50	120	36.7	
B17	24.0	52.6	132.4	14	2.500	T:12.0	12.00		0.0	
13	24.0	15.9	232.8		2.469		194.50	0.189	36.7	
Pipe: 33D		25.20	97.8	Disch			12.00	120	0.8	
13	24.0	15.9	34.6	15	2.500	----	0.00		0.0	
14	24.0	15.1	132.4		2.469		12.00	0.066	0.8	

Pipe Tag / Frm Node / To Node	El (ft)	K-fac / PT	Add Fl (q) / Tot.(Q)	Add Fl To Node/ Disch	Nom ID / Act ID	Fit: Eq.Ln. (ft.)	L / F / T	C / Pf/ft.	(Pt) (Pe) (Pf)	Notes
Pipe: 33E		25.20	97.6	Disch			12.00	120	0.1	
14	24.0	15.1	-63.0	16	2.500	----	0.00		0.0	
15	24.0	15.0	34.6		2.469		12.00	0.006	0.1	
Pipe: 34		25.20	97.6	Disch			12.00	120	0.2	
16	24.0	15.2	-34.6	14	2.500	----	0.00		0.0	
15	24.0	15.0	63.0		2.469		12.00	0.017	0.2	
Pipe: 34A		25.20	98.3	Disch			152.50	120	15.7	
B18	24.0	30.9	63.0	15	2.500	T:12.0	12.00		0.0	
16	24.0	15.2	161.2		2.469		164.50	0.096	15.7	
Pipe: 35		0.0	938.8	B9			11.00	120	0.4	
B5	24.0	53.9	121.3	B8	6.000	----	0.00		0.0	
B7	24.0	53.5	1060.1		6.065		11.00	0.039	0.4	
Pipe: 36		0.0	818.5	B11			11.00	120	0.3	
B7	24.0	53.5	120.4	B10	6.000	----	0.00		0.0	
B9	24.0	53.2	938.8		6.065		11.00	0.031	0.3	
Pipe: 37		0.0	698.7	B13			11.00	120	0.3	
B9	24.0	53.2	119.7	B12	6.000	----	0.00		0.0	
B11	24.0	52.9	818.5		6.065		11.00	0.024	0.3	
Pipe: 38		0.0	465.7	B15			11.00	120	0.2	
B11	24.0	52.9	233.1	21	6.000	----	0.00		0.0	
B13	24.0	52.7	698.7		6.065		11.00	0.018	0.2	
Pipe: 39		0.0	232.8	B17			11.00	120	0.1	
B13	24.0	52.7	232.9	17	6.000	----	0.00		0.0	
B15	24.0	52.6	465.7		6.065		11.00	0.009	0.1	
Pipe: 40		0.0	0.0				11.00	120	0.0	
B15	24.0	52.6	232.8	13	6.000	----	0.00		0.0	
B17	24.0	52.6	232.8		6.065		11.00	0.002	0.0	
Pipe: 41		0.0	243.8	B10			11.00	120	0.0	
B6	24.0	31.2	-121.3	B7	6.000	----	0.00		0.0	
B8	24.0	31.2	122.5		6.065		11.00	0.001	0.0	
Pipe: 42		0.0	364.2	B12			11.00	120	0.0	
B8	24.0	31.2	-120.4	B9	6.000	----	0.00		0.0	
B10	24.0	31.2	243.8		6.065		11.00	0.003	0.0	
Pipe: 43		0.0	483.9	B14			11.00	120	0.1	
B10	24.0	31.2	-119.7	B11	6.000	----	0.00		0.0	
B12	24.0	31.1	364.2		6.065		11.00	0.005	0.1	
Pipe: 44		0.0	322.5	B16			11.00	120	0.1	
B12	24.0	31.1	161.4	24	6.000	----	0.00		0.0	
B14	24.0	31.0	483.9		6.065		11.00	0.009	0.1	

Pipe Tag / Frm Node / To Node	El (ft)	K-fac / PT	Add Fl (q) / Tot.(Q)	Add Fl To Node/ Disch	Nom ID / Act ID	Fit: Eq.Ln. (ft.)	L / F / T	C / Pf/ft.	(Pt) (Pe) (Pf)	Notes
Pipe: 45		0.0	161.2	B18			11.00	120	0.0	
B14	24.0	31.0	161.3	20	6.000	----	0.00		0.0	
B16	24.0	31.0	322.5		6.065		11.00	0.004	0.0	
Pipe: 46		0.0	0.0				11.00	120	0.0	
B16	24.0	31.0	161.2	16	6.000	----	0.00		0.0	
B18	24.0	30.9	161.2		6.065		11.00	0.001	0.0	

NOTES (HASS):

(1) Calculations were performed by the HASS 8.4 computer program
under license no. 16110635 granted by
HRS Systems, Inc.
208 Southside Square
Petersburg, TN 37144
(931) 659-9760

(2) The system has been calculated to provide an average
imbalance at each node of 0.004 gpm and a maximum
imbalance at any node of 0.071 gpm.

(3) Total pressure at each node is used in balancing the system.
Maximum water velocity is 15.6 ft/sec at pipe 31A.

(4) The Minimum pump suction pressure under maximum
calculated demand is 18.66 (psi)

(5) Items listed in bold print on the cover sheet

are automatically transferred from the calculation report.

(6) Available pressure at source node BOR under full flow conditions is
15.64 psi compared to the minimum required pressure of 20.00 psi.

(7) PIPE FITTINGS TABLE

Pipe Table Name: STANDARD.PIP

CONSOLIDATED NUCLEAR SECURITY, LLC (CNS)
P.O. BOX 30020, MAIL DROP 12-106
AMARILLO,TX 79120-0020

HYDRAULIC CALCULATIONS FOR
Bainbridge
Cal Poly 523
Project

DRAWING NUMBER: 1 DATE: MAR 17, 2015

-DESIGN DATA-

REMOTE AREA NUMBER: C REMOTE AREA LOCATION: Mid Bottom

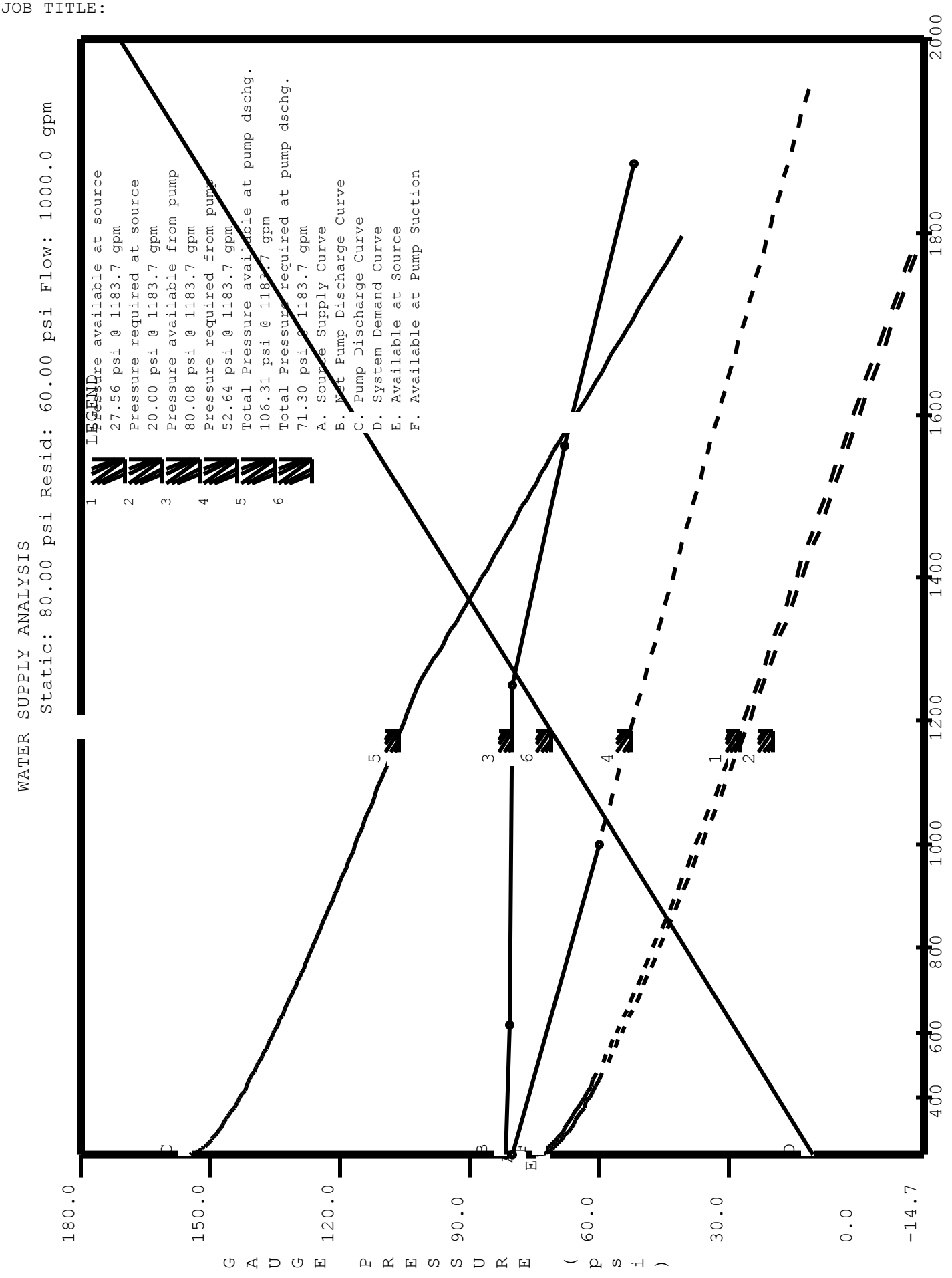
OCCUPANCY CLASSIFICATION: Class IV Commodity
DENSITY: 0.75 gpm/sq. ft.
AREA OF APPLICATION: 1,584 sq. ft.

COVERAGE PER SPRINKLER: 132 sq. ft.
TYPE OF SPRINKLERS CALCULATED: ESFR EC 25.2k
NUMBER OF SPRINKLERS CALCULATED: 12

HOSE-STREAM DEMAND: 500 gpm
TOTAL WATER REQUIRED (INCLUDING HOSE): 1683.7 gpm
FLOW AND PRESSURE (AT BASE OF RISER):1683.7 gpm @ 20.0 psi

TYPE OF SYSTEM: WET
WATER SUPPLY
Static: 80.0 psi Residual: 60.0 psi Flow: 1000 gpm
Source Elevation Relative to Finished Flow Level: 0 ft.

Calculations performed by HASS under license # 16110635 ,
granted by HRS SYSTEMS, INC.
(Notes continue after pipe calculations results.)


WATER SUPPLY ANALYSIS
Static: 80.00 psi Resid: 60.00 psi Flow: 1000.0 gpm
LEGEND
1 Pressure available at source
27.56 psi @ 1183.7 gpm
2 Pressure required at source
20.00 psi @ 1183.7 gpm
3 Pressure available from pump
80.08 psi @ 1183.7 gpm
4 Pressure required from pump
52.64 psi @ 1183.7 gpm
5 Total Pressure available at pump dschg.
106.31 psi @ 1183.7 gpm
6 Total Pressure required at pump dschg.
71.30 psi @ 1183.7 gpm
A. Source Supply Curve
B. Net Pump Discharge Curve
C. Pump Discharge Curve
D. System Demand Curve
E. Available at Source
F. Available at Pump Suction
GAUGE PRESSURE (psi)
180.0
150.0
120.0
90.0
60.0
30.0
0.0
-14.7
400
600
800
1000
1200
1400
1600
1800
2000

DATE: 3/17/2015 N:\MY DOCUMENTS\CAL POLY\WATER-BASED\SYSTEM C.SDF
JOB TITLE:

NFPA WATER SUPPLY DATA

SOURCE NODE TAG	STATIC PRESS. (PSI)	RESID. PRESS. (PSI)	@ FLOW (GPM)	AVAIL. PRESS. (PSI)	@ TOTAL DEMAND (GPM)	REQ'D PRESS. (PSI)
BOR	80.0	60.0	1000.0	27.6	1683.7	20.0

Required pressure is 7.6 psi (27%) less than available pressure.

AGGREGATE FLOW ANALYSIS:

TOTAL FLOW AT SOURCE	1683.7 GPM
TOTAL HOSE STREAM ALLOWANCE AT SOURCE	500.0 GPM
OTHER HOSE STREAM ALLOWANCES	0.0 GPM
TOTAL DISCHARGE FROM ACTIVE SPRINKLERS	1183.7 GPM

NODE ANALYSIS DATA

NODE TAG	ELEVATION (FT)	NODE TYPE	PRESSURE (PSI)	DISCHARGE (GPM)	NOTES
C1	3.0	- - - -	70.8	- - -	
C2	24.0	- - - -	60.7	- - -	
C3	24.0	- - - -	52.6	- - -	
C4	24.0	- - - -	49.5	- - -	
C5	24.0	- - - -	48.5	- - -	
C6	24.0	- - - -	27.7	- - -	
C7	24.0	- - - -	48.1	- - -	
C8	24.0	- - - -	27.7	- - -	
C9	24.0	- - - -	47.7	- - -	
C10	24.0	- - - -	27.6	- - -	
C11	24.0	- - - -	47.5	- - -	
C12	24.0	- - - -	27.6	- - -	
C13	24.0	- - - -	45.5	- - -	
C14	24.0	- - - -	27.5	- - -	
C15	24.0	- - - -	45.4	- - -	
C16	24.0	- - - -	27.5	- - -	
C17	24.0	- - - -	45.4	- - -	
C18	24.0	- - - -	27.4	- - -	
25	24.0	K=25.20	16.0	100.7	
26	24.0	K=25.20	15.1	97.9	
27	24.0	K=25.20	15.0	97.6	
28	24.0	K=25.20	15.2	98.1	
29	24.0	K=25.20	16.0	100.8	
30	24.0	K=25.20	15.1	97.9	
31	24.0	K=25.20	15.0	97.6	
32	24.0	K=25.20	15.2	98.1	
33	24.0	K=25.20	16.0	100.9	
34	24.0	K=25.20	15.1	98.0	
35	24.0	K=25.20	15.0	97.7	
36	24.0	K=25.20	15.2	98.2	
PI	3.0	- - - -	18.7	- - -	
PO	3.0	- - - -	71.3	- - -	

DATE: 3/17/2015 N:\MY DOCUMENTS\CAL POLY\WATER-BASED\SYSTEM C.SDF
JOB TITLE:

NODE ANALYSIS DATA

NODE TAG	ELEVATION (FT)	NODE TYPE	PRESSURE (PSI)	DISCHARGE (GPM)	NOTES
BOR	0.0	SOURCE	20.0	1183.7	

NFPA PIPE DATA

Pipe Tag / Frm Node / To Node	El (ft)	K-fac / PT	Add Fl (q) / Tot.(Q)	Add Fl To Node/ Disch	Nom ID / Act ID	Fit: Eq.Ln. (ft.)	L / F / T	C / Pf/ft.	(Pt) / (Pe) / (Pf)	Notes
Pipe: 1		Source	1183.6	PO			3.00	120	1.3	
BOR	0.0	20.0	0.2		8.000	----	0.00		-1.3	
PI	3.0	18.7	1183.7		7.981		3.00	0.013	0.0	
Pipe: 1a		0.0	0.0	Fire Pump Rating			Avail.	Req'd.		
PI	3.0	18.7	1183.7	C1		gpm: 1250.0	1183.7	1183.7		
PO	3.0	71.3	1183.6			psi: 80.0	80.1	52.6		
User Defined Five Point Pump Curve:										
gpm:		0.0	625.0	1250.0	1562.5	1875.0				
psi:		81.6	80.8	80.0	68.0	52.0				
Pipe: 1B		0.0	0.0				8.00	120	0.5	
PO	3.0	71.3	1183.7	C2	8.000	T:35.0	35.00		0.0	
C1	3.0	70.8	1183.7		7.981		43.00	0.013	0.5	
Pipe: 2		0.0	0.0			E:18.0	21.00	120	10.0	
C1	3.0	70.8	1183.7	C3	8.000	G: 4.0	53.00		-9.1	
C2	24.0	60.7	1183.7		7.981	A:31.0	74.00	0.013	0.9	
Pipe: 3		0.0	0.0				156.00	120	8.2	
C2	24.0	60.7	1183.7	C4	6.000	E:14.0	14.00		0.0	
C3	24.0	52.6	1183.7		6.065		170.00	0.048	8.2	
Pipe: 49		0.0	0.0				50.00	120	3.1	
C3	24.0	52.6	1183.7	C5	6.000	E:14.0	14.00		0.0	
C4	24.0	49.5	1183.7		6.065		64.00	0.048	3.1	
Pipe: 50		0.0	1066.8	C7			6.00	120	1.0	
C4	24.0	49.5	116.9	C6	6.000	E:14.0	14.00		0.0	
C5	24.0	48.5	1183.7		6.065		20.00	0.048	1.0	
Pipe: 51		0.0	0.0				371.00	120	20.8	
C5	24.0	48.5	116.9	C8	2.500	2T:24.0	24.00		0.0	
C6	24.0	27.7	116.9		2.469		395.00	0.053	20.8	
Pipe: 52		0.0	232.4	C10			371.00	120	20.4	
C7	24.0	48.1	-116.9	C6	2.500	2T:24.0	24.00		0.0	
C8	24.0	27.7	115.6		2.469		395.00	0.052	20.4	
Pipe: 53		0.0	347.0	C12			371.00	120	20.1	
C9	24.0	47.7	-232.4	C8	2.500	2T:24.0	24.00		0.0	
C10	24.0	27.6	114.6		2.469		395.00	0.051	20.1	
Pipe: 54		0.0	460.9	C14			371.00	120	19.9	
C11	24.0	47.5	-347.0	C10	2.500	2T:24.0	24.00		0.0	
C12	24.0	27.6	113.9		2.469		395.00	0.050	19.9	

Pipe Tag / Frm Node / To Node	El (ft)	K-fac / PT	Add Fl (q) / Tot.(Q)	Add Fl To Node/ Disch	Nom ID / Act ID	Fit: Eq.Ln. (ft.)	L / F / T	C / Pf/ft.	(Pt) / (Pe) / (Pf)	Notes
		25.20	100.9	Disch						
Pipe: 55			0.0				134.50	120	29.5	
C13	24.0	45.5	140.3	34	2.500	T:12.0	12.00		0.0	
33	24.0	16.0	241.2		2.469		146.50	0.202	29.5	
		25.20	98.0	Disch						
Pipe: 55A			0.0				12.00	120	0.9	
33	24.0	16.0	42.3	35	2.500	----	0.00		0.0	
34	24.0	15.1	140.3		2.469		12.00	0.074	0.9	
Pipe: 55B		25.20	97.7	Disch			12.00	120	0.1	
34	24.0	15.1	-55.5	36	2.500	----	0.00		0.0	
35	24.0	15.0	42.3		2.469		12.00	0.008	0.1	
Pipe: 55C		25.20	97.7	Disch			12.00	120	0.2	
36	24.0	15.2	-42.3	34	2.500	----	0.00		0.0	
35	24.0	15.0	55.5		2.469		12.00	0.013	0.2	
		25.20	98.2	Disch						
Pipe: 55D			0.0				128.50	120	12.3	
C14	24.0	27.5	55.5	35	2.500	T:12.0	12.00		0.0	
36	24.0	15.2	153.7		2.469		140.50	0.088	12.3	
Pipe: 55E		25.20	100.8	Disch			134.50	120	29.5	
C15	24.0	45.4	140.1	30	2.500	T:12.0	12.00		0.0	
29	24.0	16.0	240.9		2.469		146.50	0.201	29.5	
Pipe: 56		25.20	97.9	Disch			12.00	120	0.9	
29	24.0	16.0	42.2	31	2.500	----	0.00		0.0	
30	24.0	15.1	140.1		2.469		12.00	0.074	0.9	
Pipe: 56A		25.20	97.6	Disch			12.00	120	0.1	
30	24.0	15.1	-55.5	32	2.500	----	0.00		0.0	
31	24.0	15.0	42.2		2.469		12.00	0.008	0.1	
Pipe: 56B		25.20	97.6	Disch			12.00	120	0.2	
32	24.0	15.2	-42.2	30	2.500	----	0.00		0.0	
31	24.0	15.0	55.5		2.469		12.00	0.013	0.2	
Pipe: 56C		25.20	98.1	Disch			128.50	120	12.3	
C16	24.0	27.5	55.5	31	2.500	T:12.0	12.00		0.0	
32	24.0	15.2	153.6		2.469		140.50	0.087	12.3	
Pipe: 56D		25.20	100.7	Disch			134.50	120	29.4	
C17	24.0	45.4	140.0	26	2.500	T:12.0	12.00		0.0	
25	24.0	16.0	240.8		2.469		146.50	0.201	29.4	
Pipe: 56E		25.20	97.9	Disch			12.00	120	0.9	
25	24.0	16.0	42.1	27	2.500	----	0.00		0.0	
26	24.0	15.1	140.0		2.469		12.00	0.074	0.9	

Pipe Tag / Frm Node / To Node	El (ft)	K-fac / PT	Add Fl (q) / Tot.(Q)	Add Fl To Node/ Disch	Nom ID / Act ID	Fit: Eq.Ln. (ft.)	L / F / T	C / Pf/ft.	(Pt) (Pe) (Pf)	Notes
Pipe: 57		25.20	97.6	Disch			12.00	120	0.1	
26	24.0	15.1	-55.5	28	2.500	----	0.00		0.0	
27	24.0	15.0	42.1		2.469		12.00	0.008	0.1	
Pipe: 57A		25.20	97.6	Disch			12.00	120	0.2	
28	24.0	15.2	-42.1	26	2.500	----	0.00		0.0	
27	24.0	15.0	55.5		2.469		12.00	0.013	0.2	
Pipe: 57B		25.20	98.1	Disch			128.50	120	12.3	
C18	24.0	27.4	55.5	27	2.500	T:12.0	12.00		0.0	
28	24.0	15.2	153.6		2.469		140.50	0.087	12.3	
Pipe: 57C		0.0	951.3	C9			11.00	120	0.4	
C5	24.0	48.5	115.6	C8	6.000	----	0.00		0.0	
C7	24.0	48.1	1066.8		6.065		11.00	0.040	0.4	
Pipe: 57D		0.0	836.7	C11			11.00	120	0.4	
C7	24.0	48.1	114.6	C10	6.000	----	0.00		0.0	
C9	24.0	47.7	951.3		6.065		11.00	0.032	0.4	
Pipe: 57E		0.0	722.8	C13			11.00	120	0.3	
C9	24.0	47.7	113.9	C12	6.000	----	0.00		0.0	
C11	24.0	47.5	836.7		6.065		11.00	0.025	0.3	
Pipe: 57F		0.0	481.6	C15			71.00	120	1.9	
C11	24.0	47.5	241.2	33	6.000	2E:28.0	28.00		0.0	
C13	24.0	45.5	722.8		6.065		99.00	0.019	1.9	
Pipe: 62		0.0	240.8	C17			11.00	120	0.1	
C13	24.0	45.5	240.9	29	6.000	----	0.00		0.0	
C15	24.0	45.4	481.6		6.065		11.00	0.009	0.1	
Pipe: 63		0.0	0.0				11.00	120	0.0	
C15	24.0	45.4	240.8	25	6.000	----	0.00		0.0	
C17	24.0	45.4	240.8		6.065		11.00	0.003	0.0	
Pipe: 64		0.0	232.4	C10			11.00	120	0.0	
C6	24.0	27.7	-115.6	C7	6.000	----	0.00		0.0	
C8	24.0	27.7	116.9		6.065		11.00	0.001	0.0	
Pipe: 65		0.0	347.0	C12			11.00	120	0.0	
C8	24.0	27.7	-114.6	C9	6.000	----	0.00		0.0	
C10	24.0	27.6	232.4		6.065		11.00	0.002	0.0	
Pipe: 66		0.0	460.9	C14			11.00	120	0.1	
C10	24.0	27.6	-113.9	C11	6.000	----	0.00		0.0	
C12	24.0	27.6	347.0		6.065		11.00	0.005	0.1	
Pipe: 67		0.0	307.2	C16			11.00	120	0.1	
C12	24.0	27.6	153.7	36	6.000	----	0.00		0.0	
C14	24.0	27.5	460.9		6.065		11.00	0.008	0.1	

Pipe Tag / Frm Node / To Node	El (ft)	K-fac / PT	Add Fl (q) / Tot.(Q)	Add Fl To Node/ Disch	Nom ID / Act ID	Fit: Eq.Ln. (ft.)	L / F / T	C / Pf/ft.	(Pt) (Pe) (Pf)	Notes
Pipe: 68		0.0	153.6	C18			11.00	120	0.0	
C14	24.0	27.5	153.6	32	6.000	----	0.00		0.0	
C16	24.0	27.5	307.2		6.065		11.00	0.004	0.0	
Pipe: 69		0.0	0.0				11.00	120	0.0	
C16	24.0	27.5	153.6	28	6.000	----	0.00		0.0	
C18	24.0	27.4	153.6		6.065		11.00	0.001	0.0	

NOTES (HASS):

(1) Calculations were performed by the HASS 8.4 computer program
under license no. 16110635 granted by
HRS Systems, Inc.
208 Southside Square
Petersburg, TN 37144
(931) 659-9760

(2) The system has been calculated to provide an average
imbalance at each node of 0.003 gpm and a maximum
imbalance at any node of 0.053 gpm.

(3) Total pressure at each node is used in balancing the system.
Maximum water velocity is 16.2 ft/sec at pipe 55.

(4) The Minimum pump suction pressure under maximum
calculated demand is 18.66 (psi)

(5) Items listed in bold print on the cover sheet

are automatically transferred from the calculation report.

(6) Available pressure at source node BOR under full flow conditions is
16.53 psi compared to the minimum required pressure of 20.00 psi.

(7) PIPE FITTINGS TABLE

Pipe Table Name: STANDARD.PIP

CONSOLIDATED NUCLEAR SECURITY, LLC (CNS)
P.O. BOX 30020, MAIL DROP 12-106
AMARILLO,TX 79120-0020

HYDRAULIC CALCULATIONS FOR
Bainbridge
Cal Poly 523
Project

DRAWING NUMBER: 1 DATE: MAR 17, 2015

-DESIGN DATA-

REMOTE AREA NUMBER: D REMOTE AREA LOCATION: Bottom

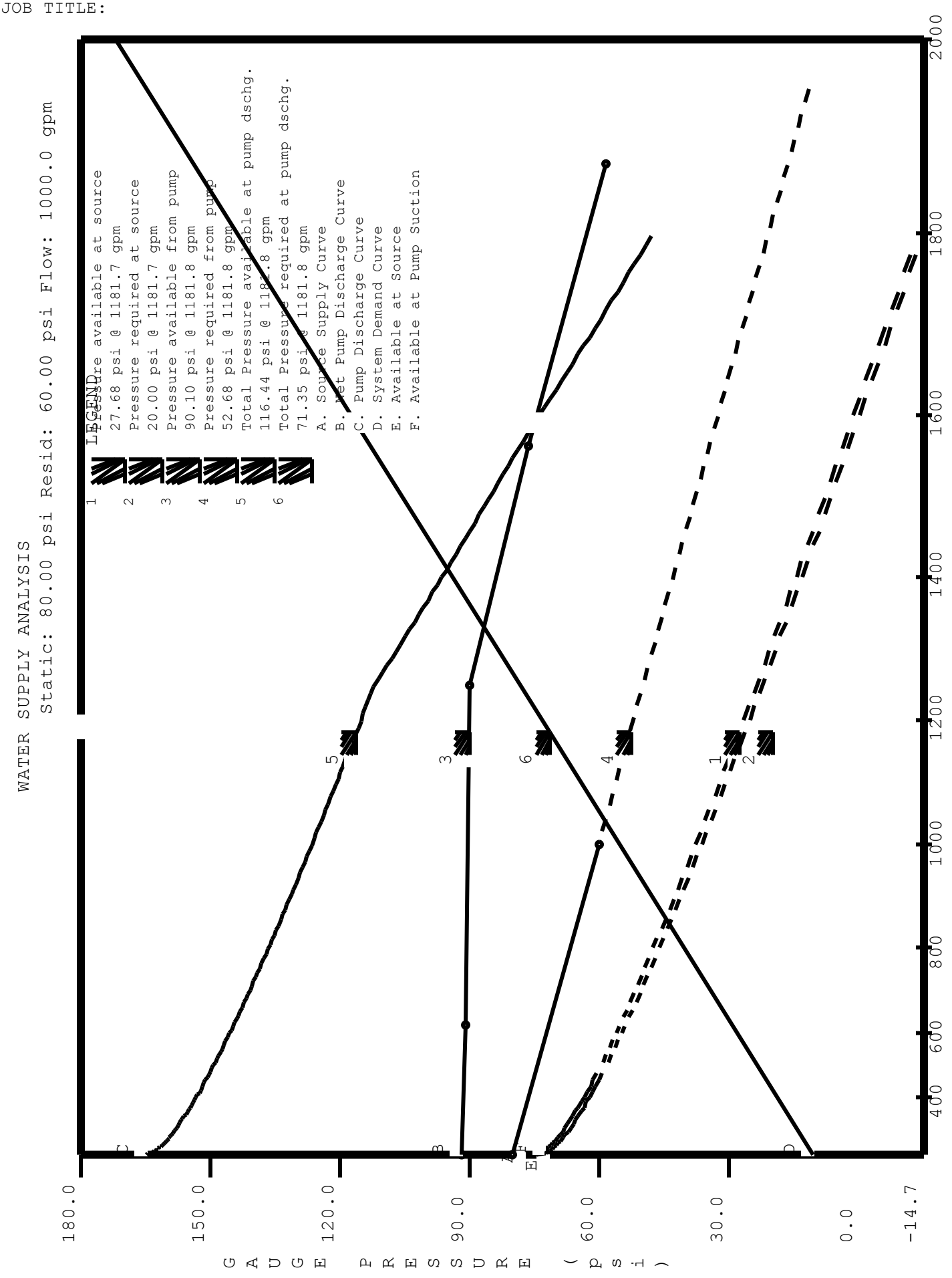
OCCUPANCY CLASSIFICATION: Class IV Commodity
DENSITY: 0.75 gpm/sq. ft.
AREA OF APPLICATION: 1,584 sq. ft.

COVERAGE PER SPRINKLER: 132 sq. ft.
TYPE OF SPRINKLERS CALCULATED: ESFR EC 25.2k
NUMBER OF SPRINKLERS CALCULATED: 12

HOSE-STREAM DEMAND: 500 gpm
TOTAL WATER REQUIRED (INCLUDING HOSE): 1681.7 gpm
FLOW AND PRESSURE (AT BASE OF RISER):1681.7 gpm @ 20.0 psi

TYPE OF SYSTEM: WET
WATER SUPPLY
Static: 80.0 psi Residual: 60.0 psi Flow: 1000 gpm
Source Elevation Relative to Finished Flow Level: 0 ft.

Calculations performed by HASS under license # 16110635 ,
granted by HRS SYSTEMS, INC.
(Notes continue after pipe calculations results.)


WATER SUPPLY ANALYSIS
Static: 80.00 psi Resid: 60.00 psi Flow: 1000.0 gpm
LEGEND
1 Pressure available at source
27.68 psi @ 1181.7 gpm
2 Pressure required at source
20.00 psi @ 1181.7 gpm
3 Pressure available from pump
90.10 psi @ 1181.8 gpm
4 Pressure required from pump
52.68 psi @ 1181.8 gpm
5 Total Pressure available at pump dschg.
116.44 psi @ 1181.8 gpm
6 Total Pressure required at pump dschg.
71.35 psi @ 1181.8 gpm
A. Source Supply Curve
B. Net Pump Discharge Curve
C. Pump Discharge Curve
D. System Demand Curve
E. Available at Source
F. Available at Pump Suction
GAUGE PRESSURE (psi)
180.0
150.0
120.0
90.0
60.0
30.0
0.0
-14.7
400
600
800
1000
1200
1400
1600
1800
2000

DATE: 3/17/2015 N:\MY DOCUMENTS\CAL POLY\WATER-BASED\SYSTEM D.SDF
JOB TITLE:

NFPA WATER SUPPLY DATA

SOURCE NODE TAG	STATIC PRESS. (PSI)	RESID. PRESS. (PSI)	@ FLOW (GPM)	AVAIL. PRESS. (PSI)	@ TOTAL DEMAND (GPM)	REQ'D PRESS. (PSI)
BOR	80.0	60.0	1000.0	27.7	1681.7	20.0

Required pressure is 7.7 psi (28%) less than available pressure.

AGGREGATE FLOW ANALYSIS:

TOTAL FLOW AT SOURCE	1681.7 GPM
TOTAL HOSE STREAM ALLOWANCE AT SOURCE	500.0 GPM
OTHER HOSE STREAM ALLOWANCES	0.0 GPM
TOTAL DISCHARGE FROM ACTIVE SPRINKLERS	1181.7 GPM

NODE ANALYSIS DATA

NODE TAG	ELEVATION (FT)	NODE TYPE	PRESSURE (PSI)	DISCHARGE (GPM)	NOTES
D1	3.0	- - - -	70.8	- - -	
D2	24.0	- - - -	57.8	- - -	
D5	24.0	- - - -	45.6	- - -	
D6	24.0	- - - -	30.7	- - -	
D7	24.0	- - - -	45.2	- - -	
D8	24.0	- - - -	30.7	- - -	
D9	24.0	- - - -	44.8	- - -	
D10	24.0	- - - -	30.7	- - -	
D11	24.0	- - - -	44.5	- - -	
D12	24.0	- - - -	30.6	- - -	
D13	24.0	- - - -	44.3	- - -	
D14	24.0	- - - -	30.6	- - -	
D15	24.0	- - - -	44.1	- - -	
D16	24.0	- - - -	30.4	- - -	
D17	24.0	- - - -	44.0	- - -	
D18	24.0	- - - -	30.4	- - -	
D19	24.0	- - - -	44.0	- - -	
D20	24.0	- - - -	30.4	- - -	
37	24.0	K=25.20	15.7	99.9	
38	24.0	K=25.20	15.0	97.7	
39	24.0	K=25.20	15.0	97.6	
40	24.0	K=25.20	15.3	98.5	
41	24.0	K=25.20	15.7	99.9	
42	24.0	K=25.20	15.0	97.7	
43	24.0	K=25.20	15.0	97.6	
44	24.0	K=25.20	15.3	98.5	
45	24.0	K=25.20	15.8	100.0	
46	24.0	K=25.20	15.1	97.8	
47	24.0	K=25.20	15.0	97.7	
48	24.0	K=25.20	15.3	98.6	
PI	3.0	- - - -	18.7	- - -	
PO	3.0	- - - -	71.3	- - -	

DATE: 3/17/2015 N:\MY DOCUMENTS\CAL POLY\WATER-BASED\SYSTEM D.SDF
JOB TITLE:

NODE ANALYSIS DATA

NODE TAG	ELEVATION (FT)	NODE TYPE	PRESSURE (PSI)	DISCHARGE (GPM)	NOTES
BOR	0.0	SOURCE	20.0	1181.7	

DATE: 3/17/2015 N:\MY DOCUMENTS\CAL POLY\WATER-BASED\SYSTEM D.SDF
JOB TITLE:

NFPA PIPE DATA

Pipe Tag / Frm Node / To Node	El (ft)	K-fac / PT	Add Fl (q) / Tot.(Q)	Add Fl To Node/ Disch	Nom ID / Act ID	Fit: Eq.Ln. (ft.)	L / F / T	C / Pf/ft.	(Pt) (Pe) (Pf)	Notes
Pipe: 1		Source	0.0				3.00	120	1.3	
BOR	0.0	20.0	1181.7	PO	8.000	----	0.00		-1.3	
PI	3.0	18.7	1181.7		7.981		3.00	0.013	0.0	
Pipe: 2		0.0	0.0	Fire Pump Rating			Avail.	Req'd.		
PI	3.0	18.7	1181.7	D1		gpm: 1250.0	1181.8	1181.8		
PO	3.0	71.3	1181.8			psi: 90.0	90.1	52.7		
User Defined Five Point Pump Curve:										
gpm:		0.0	625.0	1250.0	1562.5	1875.0				
psi:		91.8	90.9	90.0	76.5	58.5				
Pipe: 1c		0.0	0.0				8.00	120	0.5	
PO	3.0	71.3	1181.7	D2	8.000	T:35.0	35.00		0.0	
D1	3.0	70.8	1181.7		7.981		43.00	0.013	0.5	
Pipe: 70		0.0	0.0			T:30.0	21.00	120	13.0	
D1	3.0	70.8	1181.7	D5	6.000	G: 3.0	61.00		-9.1	
D2	24.0	57.8	1181.7		6.065	A:28.0	82.00	0.048	3.9	
Pipe: 73		0.0	1075.9	D7			240.00	120	12.2	
D2	24.0	57.8	105.8	D6	6.000	E:14.0	14.00		0.0	
D5	24.0	45.6	1181.7		6.065		254.00	0.048	12.2	
Pipe: 74		0.0	0.0				316.00	120	14.9	
D5	24.0	45.6	105.8	D8	2.500	2T:24.0	24.00		0.0	
D6	24.0	30.7	105.8		2.469		340.00	0.044	14.9	
Pipe: 75		0.0	209.9	D10			316.00	120	14.5	
D7	24.0	45.2	-105.8	D6	2.500	2T:24.0	24.00		0.0	
D8	24.0	30.7	104.1		2.469		340.00	0.043	14.5	
Pipe: 76		0.0	312.6	D12			316.00	120	14.1	
D9	24.0	44.8	-209.9	D8	2.500	2T:24.0	24.00		0.0	
D10	24.0	30.7	102.7		2.469		340.00	0.042	14.1	
Pipe: 77		0.0	414.3	D14			316.00	120	13.9	
D11	24.0	44.5	-312.6	D10	2.500	2T:24.0	24.00		0.0	
D12	24.0	30.6	101.7		2.469		340.00	0.041	13.9	
Pipe: 77A		0.0	515.4	D16			316.00	120	13.7	
D13	24.0	44.3	-414.3	D12	2.500	2T:24.0	24.00		0.0	
D14	24.0	30.6	101.1		2.469		340.00	0.040	13.7	
		25.20	100.0	Disch						
Pipe: 78			0.0				151.50	120	28.3	
D15	24.0	44.1	122.2	46	2.500	T:12.0	12.00		0.0	
45	24.0	15.8	222.3		2.469		163.50	0.173	28.3	

Pipe Tag / Frm Node / To Node	El (ft)	K-fac / PT	Add Fl (q) / Tot.(Q)	Add Fl To Node/ Disch	Nom ID / Act ID	Fit: Eq.Ln. (ft.)	L / F / T	C / Pf/ft.	(Pt) (Pe) (Pf)	Notes
		25.20	97.8	Disch						
Pipe: 78A			0.0				12.00	120	0.7	
45	24.0	15.8	24.4	47	2.500	----	0.00		0.0	
46	24.0	15.1	122.2		2.469		12.00	0.057	0.7	
Pipe: 79		25.20	97.7	Disch			12.00	120	0.0	
46	24.0	15.1	-73.3	48	2.500	----	0.00		0.0	
47	24.0	15.0	24.4		2.469		12.00	0.003	0.0	
Pipe: 79A		25.20	97.7	Disch			12.00	120	0.3	
48	24.0	15.3	-24.4	46	2.500	----	0.00		0.0	
47	24.0	15.0	73.3		2.469		12.00	0.022	0.3	
		25.20	98.6	Disch						
Pipe: 79B			0.0				128.50	120	15.1	
D16	24.0	30.4	73.3	47	2.500	T:12.0	12.00		0.0	
48	24.0	15.3	171.9		2.469		140.50	0.108	15.1	
Pipe: 79C		25.20	99.9	Disch			151.50	120	28.3	
D17	24.0	44.0	122.1	42	2.500	T:12.0	12.00		0.0	
41	24.0	15.7	222.0		2.469		163.50	0.173	28.3	
Pipe: 79D		25.20	97.7	Disch			12.00	120	0.7	
41	24.0	15.7	24.3	43	2.500	----	0.00		0.0	
42	24.0	15.0	122.1		2.469		12.00	0.057	0.7	
Pipe: 79E		25.20	97.6	Disch			12.00	120	0.0	
42	24.0	15.0	-73.3	44	2.500	----	0.00		0.0	
43	24.0	15.0	24.3		2.469		12.00	0.003	0.0	
Pipe: 80		25.20	97.6	Disch			12.00	120	0.3	
44	24.0	15.3	-24.3	42	2.500	----	0.00		0.0	
43	24.0	15.0	73.3		2.469		12.00	0.022	0.3	
		25.20	98.5	Disch						
Pipe: 80A			0.0				128.50	120	15.1	
D18	24.0	30.4	73.3	43	2.500	T:12.0	12.00		0.0	
44	24.0	15.3	171.8		2.469		140.50	0.108	15.1	
Pipe: 80B		25.20	99.9	Disch			151.50	120	28.3	
D19	24.0	44.0	122.0	38	2.500	T:12.0	12.00		0.0	
37	24.0	15.7	222.0		2.469		163.50	0.173	28.3	
Pipe: 80C		25.20	97.7	Disch			12.00	120	0.7	
37	24.0	15.7	24.3	39	2.500	----	0.00		0.0	
38	24.0	15.0	122.0		2.469		12.00	0.057	0.7	
Pipe: 80D		25.20	97.6	Disch			12.00	120	0.0	
38	24.0	15.0	-73.3	40	2.500	----	0.00		0.0	
39	24.0	15.0	24.3		2.469		12.00	0.003	0.0	

Pipe Tag / Frm Node / To Node	El (ft)	K-fac / PT	Add Fl (q) / Tot.(Q)	Add Fl To Node/ Disch	Nom ID / Act ID	Fit: Eq.Ln. (ft.)	L / F / T	C / Pf/ft.	(Pt) / (Pe) / (Pf)	Notes
Pipe: 80E		25.20	97.6	Disch			12.00	120	0.3	
40	24.0	15.3	-24.3	38	2.500	----	0.00		0.0	
39	24.0	15.0	73.3		2.469		12.00	0.022	0.3	
Pipe: 81		25.20	98.5	Disch			128.50	120	15.1	
D20	24.0	30.4	73.3	39	2.500	T:12.0	12.00		0.0	
40	24.0	15.3	171.7		2.469		140.50	0.108	15.1	
Pipe: 82		0.0	971.8	D9			11.00	120	0.4	
D5	24.0	45.6	104.1	D8	6.000	----	0.00		0.0	
D7	24.0	45.2	1075.9		6.065		11.00	0.040	0.4	
Pipe: 83		0.0	869.1	D11			11.00	120	0.4	
D7	24.0	45.2	102.7	D10	6.000	----	0.00		0.0	
D9	24.0	44.8	971.8		6.065		11.00	0.033	0.4	
Pipe: 84		0.0	767.3	D13			11.00	120	0.3	
D9	24.0	44.8	101.7	D12	6.000	----	0.00		0.0	
D11	24.0	44.5	869.1		6.065		11.00	0.027	0.3	
Pipe: 85		0.0	666.2	D15			11.00	120	0.2	
D11	24.0	44.5	101.1	D14	6.000	----	0.00		0.0	
D13	24.0	44.3	767.3		6.065		11.00	0.022	0.2	
Pipe: 86		0.0	444.0	D17			11.00	120	0.2	
D13	24.0	44.3	222.3	45	6.000	----	0.00		0.0	
D15	24.0	44.1	666.2		6.065		11.00	0.017	0.2	
Pipe: 87		0.0	222.0	D19			11.00	120	0.1	
D15	24.0	44.1	222.0	41	6.000	----	0.00		0.0	
D17	24.0	44.0	444.0		6.065		11.00	0.008	0.1	
Pipe: 88		0.0	0.0				11.00	120	0.0	
D17	24.0	44.0	222.0	37	6.000	----	0.00		0.0	
D19	24.0	44.0	222.0		6.065		11.00	0.002	0.0	
Pipe: 89		0.0	209.9	D10			11.00	120	0.0	
D6	24.0	30.7	-104.1	D7	6.000	----	0.00		0.0	
D8	24.0	30.7	105.8		6.065		11.00	0.001	0.0	
Pipe: 90		0.0	312.6	D12			11.00	120	0.0	
D8	24.0	30.7	-102.7	D9	6.000	----	0.00		0.0	
D10	24.0	30.7	209.9		6.065		11.00	0.002	0.0	
Pipe: 91		0.0	414.3	D14			11.00	120	0.0	
D10	24.0	30.7	-101.7	D11	6.000	----	0.00		0.0	
D12	24.0	30.6	312.6		6.065		11.00	0.004	0.0	
Pipe: 92		0.0	515.4	D16			11.00	120	0.1	
D12	24.0	30.6	-101.1	D13	6.000	----	0.00		0.0	
D14	24.0	30.6	414.3		6.065		11.00	0.007	0.1	

Pipe Tag / Frm Node / To Node	El (ft)	K-fac / PT	Add Fl (q) / Tot.(Q)	Add Fl To Node/ Disch	Nom ID / Act ID	Fit: Eq.Ln. (ft.)	L / F / T	C / Pf/ft.	(Pt) (Pe) (Pf)	Notes
Pipe: 93		0.0	343.5	D18			11.00	120	0.1	
D14	24.0	30.6	171.9	48	6.000	----	0.00		0.0	
D16	24.0	30.4	515.4		6.065		11.00	0.010	0.1	
Pipe: 94		0.0	171.7	D20			11.00	120	0.1	
D16	24.0	30.4	171.8	44	6.000	----	0.00		0.0	
D18	24.0	30.4	343.5		6.065		11.00	0.005	0.1	
Pipe: 95		0.0	0.0				11.00	120	0.0	
D18	24.0	30.4	171.7	40	6.000	----	0.00		0.0	
D20	24.0	30.4	171.7		6.065		11.00	0.001	0.0	

NOTES (HASS):

(1) Calculations were performed by the HASS 8.4 computer program
under license no. 16110635 granted by
HRS Systems, Inc.
208 Southside Square
Petersburg, TN 37144
(931) 659-9760

(2) The system has been calculated to provide an average
imbalance at each node of 0.007 gpm and a maximum
imbalance at any node of 0.117 gpm.

(3) Total pressure at each node is used in balancing the system.
Maximum water velocity is 14.9 ft/sec at pipe 78.

(4) The Minimum pump suction pressure under maximum
calculated demand is 18.66 (psi)

(5) Items listed in bold print on the cover sheet

are automatically transferred from the calculation report.

(6) Available pressure at source node BOR under full flow conditions is
13.92 psi compared to the minimum required pressure of 20.00 psi.

(7) PIPE FITTINGS TABLE

Pipe Table Name: STANDARD.PIP

Model ESFR-25
Early Suppression, Fast Response Pendent Sprinklers
25.2 K-factor

General Description

The TYCO Model ESFR-25 Pendent Sprinklers are Early Suppression, Fast Response Sprinklers" having a nominal K-factor of 25.2. (Refer to Figure 1.) They are suppression-mode sprinklers that are especially advantageous as a means of eliminating the use of in-rack sprinklers when protecting high-piled storage.

The Model ESFR-25 Sprinklers are primarily used for ceiling-only sprinkler protection of (but not limited to) the following storage applications:

- Most encapsulated or non-encapsulated common materials including cartoned, unexpanded plastics
- Uncartoned (exposed) expanded plastics in accordance with NFPA 13 and FM Global standards
- Some storage arrangements of rubber tires, roll paper, flammable liquids, aerosols, and automotive components

For more specific criteria, refer to Table A as well as the applicable design standard.

The Model ESFR-25 Pendent Sprinklers provide the system designer with hydraulic and sprinkler placement options not presently available to the traditional ESFR sprinklers having nominal K-factors of 14.0 and 16.8. In particular, the Model ESFR-25 Sprinkler has been designed to operate at substantially lower-end head pressures, as compared to ESFR Sprinklers having nominal K-factors of 14.0 and 16.8. This feature offers flexibility when sizing system piping, as well as possibly reducing or eliminating the need for a system fire pump.

Also, Model ESFR-25 Sprinklers permit use of a maximum deflector-to-ceiling distance of 18 inches (460 mm) versus 14 inches (356 mm). Additionally, a storage arrangement of 40 ft. (12,2 m) with a ceiling height of 45 ft. (13,7 m) does not require in-rack sprinklers as do other ESFR Sprinklers having nominal K-factors of 14.0 and 16.8.

The Model ESFR-25 Sprinklers are listed by Underwriters Laboratories (UL) for specific applications with a maximum storage height of 43 ft. (13,1 m) with a maximum ceiling height of 48 ft. (14,6 m) without the requirement for in-rack sprinklers. Refer to the Specific Application Listing (UL) for the design criteria.

Applications for the TYCO ESFR Sprinklers are expanding beyond currently recognized installation standards. For information on research fire tests (e.g., with flammable liquids and aerosols) that may be acceptable to an authority having jurisdiction, contact the Technical Services department.

IMPORTANT

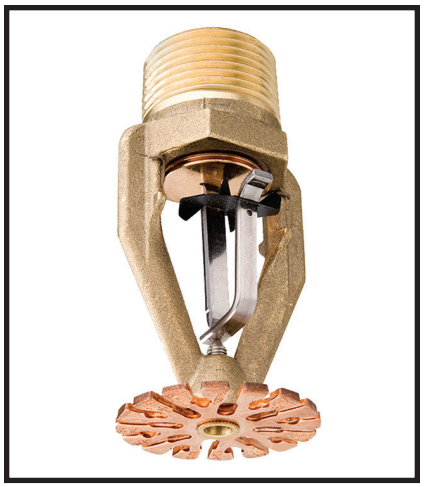
Always refer to Technical Data Sheet TFP700 for the "INSTALLER WARNING" that provides cautions with respect to handling and installation of sprinkler systems and components. Improper handling and installation can permanently damage a sprinkler system or its components and cause the sprinkler to fail to operate in a fire situation or cause it to operate prematurely.

NOTICE

The Model ESFR-25 Sprinklers described herein must be installed and maintained in compliance with this document, as well as with the applicable standards of the National Fire Protection Association, in addition to the standards of any authorities having jurisdiction (e.g., FM Global). Failure to do so may impair the performance of these devices.

The owner is responsible for maintaining their fire protection system and devices in proper operating condition. Contact the installing contractor or product manufacturer with any questions.

In all cases, the appropriate NFPA or FM installation standard, or other applicable standard, must be referenced to ensure applicability and to obtain complete installation guidelines. The general guidelines in this data sheet are not intended to provide complete installation criteria.



Sprinkler Identification Number (SIN)

TY9226

TY9226 is a re-designation for C9226, G8441, and S8010.

Technical Data

Approvals
UL and C-UL Listed
FM Approved
VdS Approved
LPCB Approved (094b/01 and 07l/01)
NYC under MEA 356-01-E
CE Certified Certificate of Conformity
1725-CPD-H0010

Maximum Working Pressure
175 psi (12,1 bar)

Pipe Thread Connections
1 inch NPT
ISO 7-R 1

Discharge Coefficient
K=25.2 gpm/psi$^{1/2}$
(362,9 lpm/bar$^{1/2}$)

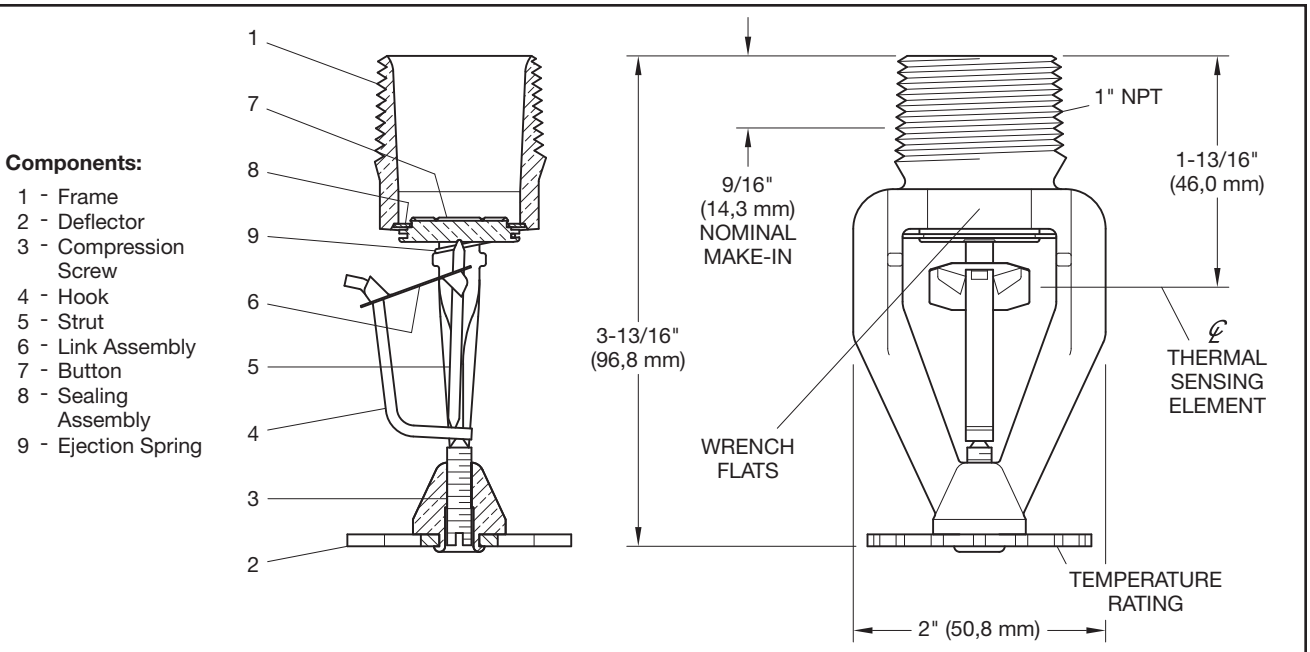


FIGURE 1
MODEL ESFR-25, EARLY SUPPRESSION, FAST RESPONSE PENDENT SPRINKLER 25.2 K-FACTOR

Temperature Ratings
165°F (74°C)
214°F (101°C)

Finish
Natural Brass

Physical Characteristics

Frame	Brass
Deflector	Bronze
Compression Screw	Stainless Steel
Hook	Monel
Strut	Monel
Link Assembly	Solder, Nickel
Button	Brass
Sealing Assembly	Beryllium Nickel w/TEFLON
Ejection Spring	Inconel

Design Criteria

The following general guidelines provided for the TYCO Model ESFR-25 Pendent Sprinklers can be used for a quick reference.

The National Fire Protection Association (NFPA) and FM Global (FM) provide installation standards that must be used to properly design an automatic sprinkler system utilizing Early Suppression, Fast Response (ESFR) Sprinklers. The guidelines provided by NFPA and FM may differ. Consequently, the appropriate standard must be used for a given installation.

In all cases, the appropriate NFPA or FM installation standard must be referenced to ensure applicability and to obtain complete installation guidelines.

The following general guidelines are not intended to provide complete installation criteria.

In addition to this data sheet, the following data sheets describe other TYCO ESFR Sprinklers:

- **TFP315** — Model ESFR-17 (TY7226), K=16.8 Pendent Sprinkler
- **TFP316** — Model ESFR-17 (TY7126), K=16.8 Upright Sprinkler
- **TFP318** — Model ESFR-1 (TY6226), K=14.0 Pendent Sprinkler

System Type
Wet pipe system

Roof Construction
Unobstructed or obstructed construction (e.g., smooth ceiling, bar joists, beam and girder, and so forth). Where the depths of the solid structural members (e.g., beams and stem) exceed 12 inches (302 mm), install ESFR Sprinklers in each channel formed by the structural members.

Ceiling Slope
Maximum 2 inch rise for 12 inch run (16.7%)

Maximum Coverage Area
100 ft^2 (9,3 m^2). In some cases, the installation standards permit a greater coverage area.

Minimum Coverage Area
64 ft^2 (5,8 m^2) per NFPA 13/FM 2-0

Maximum Spacing
12 feet (3,7 m) for building heights up to 30 feet (9,1 m)

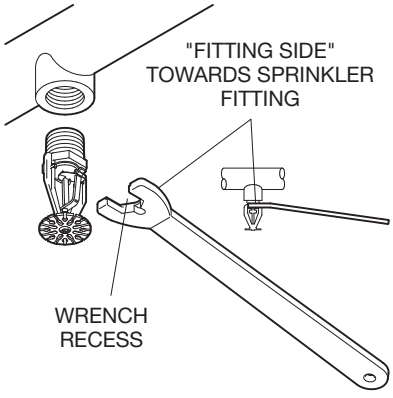


FIGURE 2
W-TYPE 1
SPRINKLER WRENCH

10 feet (3,1 m) for building heights greater than 30 feet (9,1 m). In some cases, installation standards permit a greater spacing.

Minimum Spacing
8 feet (2,4 m)

Minimum Clearance to Commodity
36 inches (914 mm)

Deflector-to-Ceiling Distance
NFPA – 6 to 18 inches (152 to 457 mm)

Centerline of Thermal Sensing Element-to-Ceiling Distance
FM – See FM 2-0 for Storage Sprinklers.

Storage Type	NFPA	FM
Open Frame (that is, no solid shelves) Single, Double, Multiple-Row, or Portable Rack Storage of Class I-IV and Group A or B Plastics	Refer to NFPA 13, Chapters 16 and 17	Refer to FM 2-0 and 8-9
Solid Pile or Palletized Storage of Class I-IV and Group A or B Plastics	Refer to NFPA 13, Chapters 14 and 15	Refer to FM 2-0 and 8-9
Idle Pallet Storage	Refer to NFPA 13, Chapter 12	Refer to FM 2-0, 8-9, and 8-24
Rubber Tire Storage	Refer to NFPA 13, Chapter 18	Refer to FM 2-0 and 8-9
Roll Paper Storage (Refer to the Standard)	Refer to NFPA 13, Chapter 19	Refer to FM 8-21
Flammable/Ignitable Liquid Storage (Refer to the Standard)	Refer to NFPA 30	Refer to FM 7-29
Aerosol Storage (Refer to the Standard)	Refer to NFPA 30B	Refer to FM 7-31
Automotive Components in Portable Racks (Control mode only; refer to the Standard)	Refer to NFPA 13, Chapter 20	N/A

N/A = Not Applicable

TABLE A
COMMODITY SELECTION AND DESIGN CRITERIA OVERVIEW FOR MODEL ESFR-25 PENDENT SPRINKLERS

Specific Application Listing (UL)

The TYCO Model ESFR-25 Pendent Sprinklers are listed by Underwriters Laboratories for Specific Applications with a ceiling height greater than 45 ft. (13,7 m) up to and including 48 ft. (14,6 m), and a storage arrangement up to and including 43 ft. (13,1 m), the following guideline are provided for the TYCO Model ESFR-25 Pendent Sprinklers:

Sprinkler Position
Pendent, frame arms aligned with pipe, deflectors parallel with ceiling or roof.

System Type
Wet pipe system only

Maximum Area of Coverage
100 ft^2 (9,3 m^2)
In some cases, the installation standards permit a greater coverage area.

Minimum Area of Coverage
64 ft^2 (5,8 m^2) according to NFPA 13

Maximum Slope Ceiling
2 inch rise for 12 inch run (16.7%)

Maximum Spacing
10 ft. (3,1 m)
In some cases, the installation standards permit a greater spacing.

Minimum Spacing
8 ft. (2,4 m)

Temperature Rating
214°F (101°C)

Deflector Distance from Walls
Minimum of 4 inches (102 mm) from walls but no more than 1/2 the allowable distance permitted between sprinklers

Deflector to Top of Storage
Minimum of 36 inches (914 mm)

Deflector to Ceiling Distance
6 to 14 inches (152 to 356 mm)

Maximum Ceiling Height
48 ft. (14,6 m)

Maximum Storage Height
43 ft. (13,1 m)

Storage Arrangement
Palletized, solid piled, open frame, single row, or double row

Commodity
Class I-IV
Cartoned, unexpanded plastic

Sprinkler System Design
NFPA 13 for ESFR Sprinklers based upon 45 psi (3,1 bar) design pressure, 169 gpm (640 lpm) with 12 sprinkler remote area

Minimum Aisle Width
8 ft (2,4 m)

Operation

The fusible link assembly is comprised of two link halves that are joined together by a thin layer of solder. When the rated temperature is reached, the solder melts and the two link halves separate, activating the sprinkler and flowing water.

Installation

The TYCO Model ESFR-25 Pendent Sprinklers must be installed in accordance with this section.

General Instructions
Damage to the fusible Link Assembly during installation can be avoided by handling the sprinkler by the frame arms only (that is, do not apply pressure to the fusible Link Assembly), and by using the appropriate sprinkler wrench. Failure to do so can lead to an unstable link assembly and premature activation of the sprinkler. Damaged sprinklers must be replaced.

A leak-tight 1 inch NPT sprinkler joint should be obtained by applying a minimum-to-maximum torque of 20 to 30 ft.-lbs. (26,8 to 40,2 Nm). Higher levels of torque can distort the sprinkler inlet with consequent leakage or impairment of the sprinkler.

Step 1. Install the Model ESFR-25 Pendent Sprinkler in the pendent position (Figure 2).

Step 2. With pipe-thread sealant applied, hand-tighten the sprinkler into the sprinkler fitting. Do not apply pressure to the Link Assembly, and handle the Model ESFR-25 Pendent Sprinkler only by the Frame arms.

Step 3. Wrench-tighten the Model ESFR-25 Pendent Sprinkler using only the W-Type 1 Sprinkler Wrench (Figure 2) and by fully engaging (seating) the wrench on the sprinkler wrench flats (Figure 1).

Step 4. After installation, inspect the Link Assembly of each Model ESFR-25 Pendent Sprinkler for damage. In particular, verify that the Link Assembly and Hook are positioned as illustrated in Figure 1, and that the Link Assembly is not bent, creased, or forced out of normal position in any way. Replace damaged sprinklers.

Care and Maintenance

The TYCO Model ESFR-25 Pendent Sprinklers must be maintained and serviced in accordance with this section.

Before closing a fire protection system main control valve for maintenance work on the fire protection system that it controls, permission to shut down the affected fire protection system must be obtained from the proper authorities and notify all personnel who may be affected by this action.

Sprinklers which are found to be leaking or exhibiting visible signs of corrosion must be replaced.

Automatic sprinklers must never be painted, plated, coated, or otherwise altered after leaving the factory. Modified sprinklers must be replaced. Sprinklers that have been exposed to corrosive products of combustion, but have not operated, should be replaced if they cannot be completely cleaned by wiping the sprinkler with a cloth or by brushing it with a soft bristle brush.

Care must be exercised to avoid damage to the sprinklers before, during, and after installation. Sprinklers damaged by dropping, striking, wrench twist/slippage, or the like, must be replaced. Also, replace any sprinkler that has a cracked bulb or that has lost liquid from its bulb. (Ref. Installation Section.)

The owner is responsible for the inspection, testing, and maintenance of their fire protection system and devices in compliance with this document, as well as with the applicable standards of the National Fire Protection Association (e.g., NFPA 25), in addition to the standards of any authorities having jurisdiction. Contact the installing contractor or product manufacturer with any questions.

Automatic sprinkler systems are recommended to be inspected, tested, and maintained by a qualified Inspection Service in accordance with local requirements and/or national codes.

Limited Warranty

For warranty terms and conditions, visit www.tyco-fire.com.

Ordering Procedure

Contact your local distributor for availability. When placing an order, indicate the full product name and Part Number (P/N).

Sprinkler Assemblies
Specify: Model ESFR-25 (TY9226), K=25.2, Early Suppression, Fast Response Pendent Sprinkler with (specify) temperature rating, natural brass, P/N (specify)

165°F (74°C) . . . . . .P/N 58-441-1-165
214°F (101°C) . . . . . .P/N 58-441-1-214

Special Order Sprinkler Assemblies with ISO 7-1 Thread Connections
Specify: Model ESFR-25 (TY9226), K=25.2, Early Suppression, Fast Response Pendent Sprinkler with ISO 7-1 thread connection, (specify) temperature rating, natural brass, P/N (specify)

165°F (74°C) . . . . . P/N 58-442-1-165
214°F (101°C) . . . . . P/N 58-442-1-214

Sprinkler Wrench
Specify: W-Type 1 Sprinkler Wrench, P/N 56-872-1-025

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A formidable team of industry experts for *your unique fire pump solution.*

Peerless Fire Pump Units and Enclosed Packaged Systems

Thousands of Peerless Pump installations (UL, ULC or FM approved) deliver superior fire protection to facilities worldwide. For over eighty years Peerless Pump has been offering complete service, from engineering assistance to in-house fabrication to field start-up. Products are designed from a broad selection of pumps, drives, controls, baseplates and accessories. Fire pump choices include horizontal split case, in-line and end suction centrifugal, as well as vertical turbines pumps.

1

The Right Solution for Reliability

Reliability is one of the hallmarks of Peerless Pump technology, and it's built into every aspect of our distinctive pump designs. Our mindset is to construct pumps of the highest quality by paying attention to the details and investing in innovative research and development.

Building contractors, specifying engineers and facility managers alike trust the recognized global leader in pump technology and solutions. They look to Grundfos' expertise in developing new and improved ways to meet water and energy challenges in commercial buildings. Arriving at a solution that works requires the merging of many professional skill sets. Choosing Grundfos as your partner extends beyond sale and delivery and offers a unique collaborative partnership.

Providing Pumping Solutions to the Global Commercial / Fire Market, Peerless Can Fulfill Your Requirements:

- Recognized leader in the fire pump industry
- Thousands of installations of all sizes and types
- Represented by fully qualified personnel in most major U.S. and international cities
- Complete in-house fabrication capabilities
- Mechanical-run test capabilities
- Horizontal models for capacities to 5,000 gpm
- Vertical models for capacities to 5,000 gpm
- In-line models for capacities to 1,500 gpm
- End suction models for capacities to 500 gpm
- Drives: electric motor or diesel engine
- Basic units, packaged systems, and engineered enclosures

A unique collaborative partnership that extends beyond the sale and delivery

Custom Designs

Engineered designs for unusual applications have always been a specialty for Grundfos. From submersibles to end-suction pumps, no application is beyond our technical expertise. Drawing upon our many years of engineering and manufacturing experience is the best way to solve your difficult application, whether it's temperature extremes, or complex configurations.

Anticipating the future

Grundfos invests 5% of its annual revenue into research and development, with nearly 18,000 employees in 55 countries, dedicated to addressing the challenges of tomorrow, today.

Our Competencies

With the most efficient selections and superior local representation, we endeavor to partner with the fire protection contracting community to create the best value possible for each project.

Our long history of innovation in engineered pump systems for building management has opened doors and created a sizeable opportunity for optimizing installations in commercial structures.

Peerless Pump offers both modular and integrated solutions that further simplify installations and commissioning. These reliable solutions are a result of producing the most optimized pump hydraulics, hydraulics and accessories to make everything work holistically while communicating efficiently with the central system controller.

A recognized global leader

in fire pump systems and accessories.

The Full Range of Possibilities

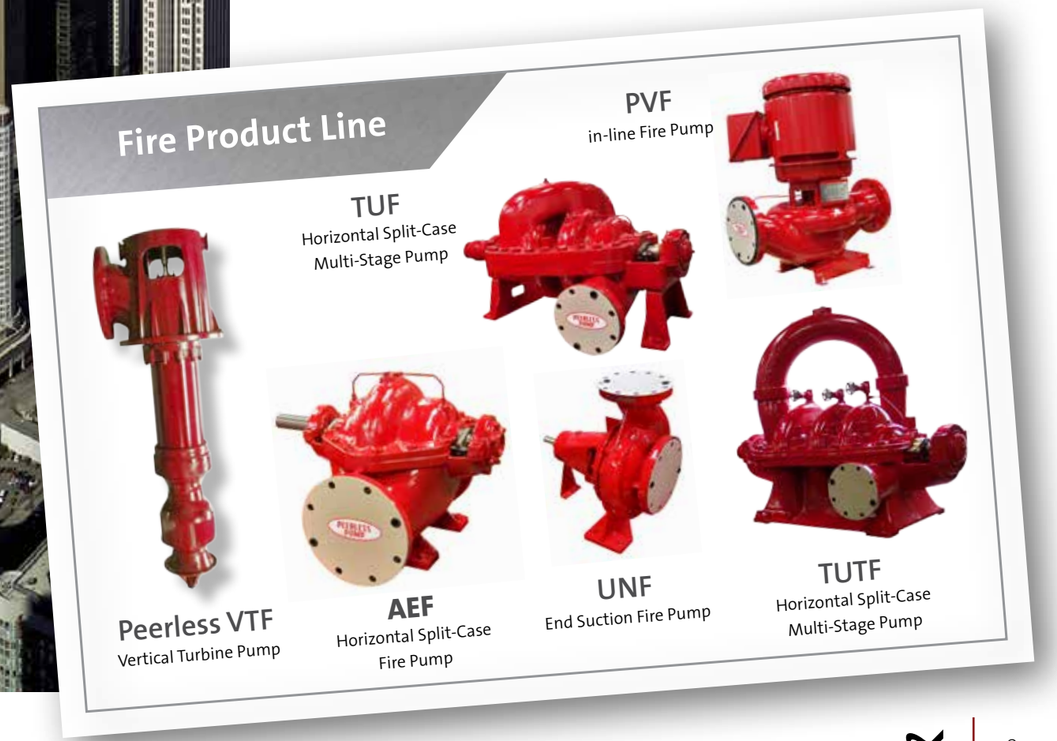
Grundfos offers total fire pumping solutions on any scale. Our expertise in the full range of fire pump products and application areas in the commercial buildings sector can be tailored to your specific requirements.

The Peerless Pump Fire Pump Units, Systems, and Enclosed Packaged Systems

Applications vary from small, basic electric motor units to diesel engine driven, enclosed, packaged systems. Standard units are designed to handle fresh water, but special materials are available for sea water applications.

Each enclosed pumping solution is typically a one-of-a-kind, configured by Peerless engineers to meet a specific application and operating condition.

Peerless Pump - A reliable global solution to commercial building and industrial applications

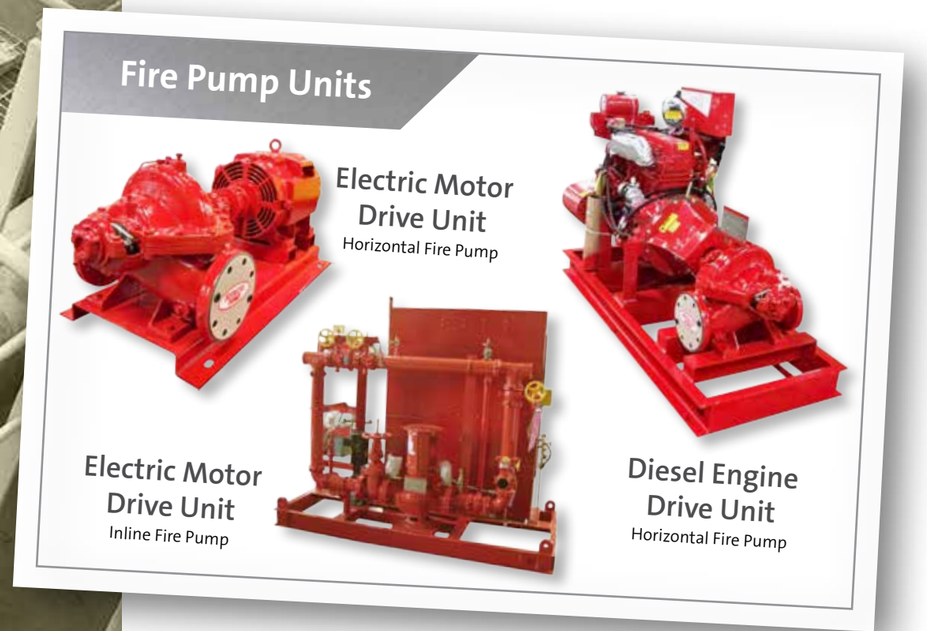


Ft. Wayne Hill Treatment Facility, Gwinnett County, GA

A Reliable Answer to Commercial Building Solutions

Peerless Pump can help you solve your unique needs and challenges, ensuring that the necessary fire protection water flow will meet facility demands and regulations when called upon. This is achieved by using a proven range of durable, horizontal, inline, end suction and vertical turbine pumps. These pumps are uniquely designed to deliver by reacting automatically to changing demands and conditions. To suit each situation, we supply the expertise to ensure that pumps and motors or engines are applied correctly.

Proven pumping systems for changing and demanding conditions



The PES Advantage:

Peerless Engineered Systems (PES) has the capability to design and build a system to meet your customized needs. We will review your requirements and design a system that is right for you. If you are looking for simple solutions to complex problems, PES has the answer. Let us build your Packaged System so you can focus on the rest of your project.

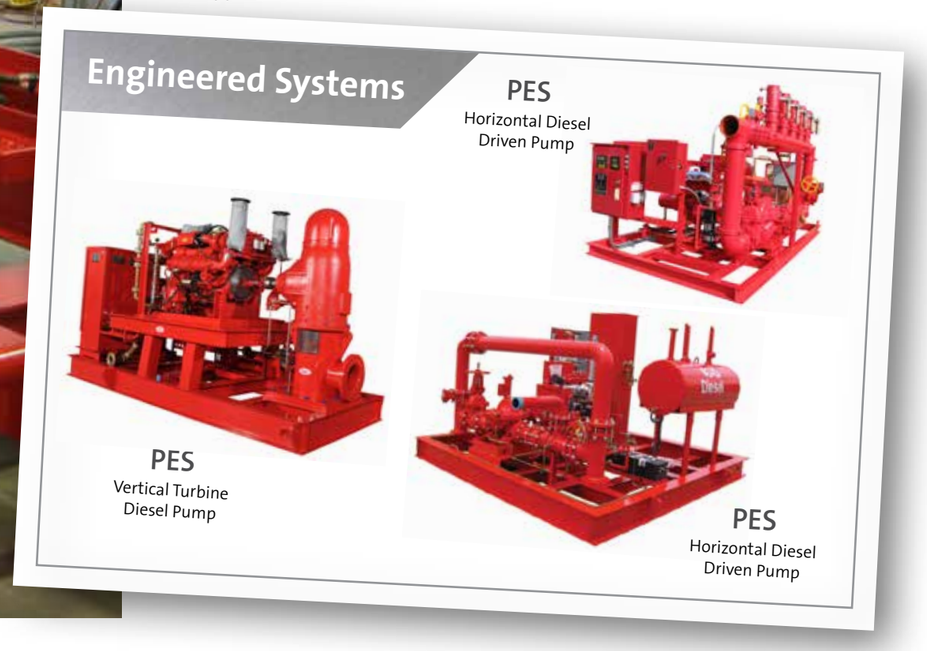
NOTE: For detailed information on selection, performance ratings, and dimensions of Peerless fire pump products and systems refer to your local Peerless Pump representative.

The Peerless Pump Fire Pump Units and Enclosed Packaged Systems

Thousands of Peerless Pump installations (UL, ULC or FM approved) deliver superior fire protection to facilities worldwide. For over eighty years Peerless Pump has been offering complete service, from engineering assistance to in-house fabrication to field start-up. Products are designed from a broad selection of pumps, drives, controls, baseplates and accessories. Pump choices include horizontal, in-line and end suction centrifugal fire pumps as well as vertical turbines

State of the art engineered systems arrive ready to install

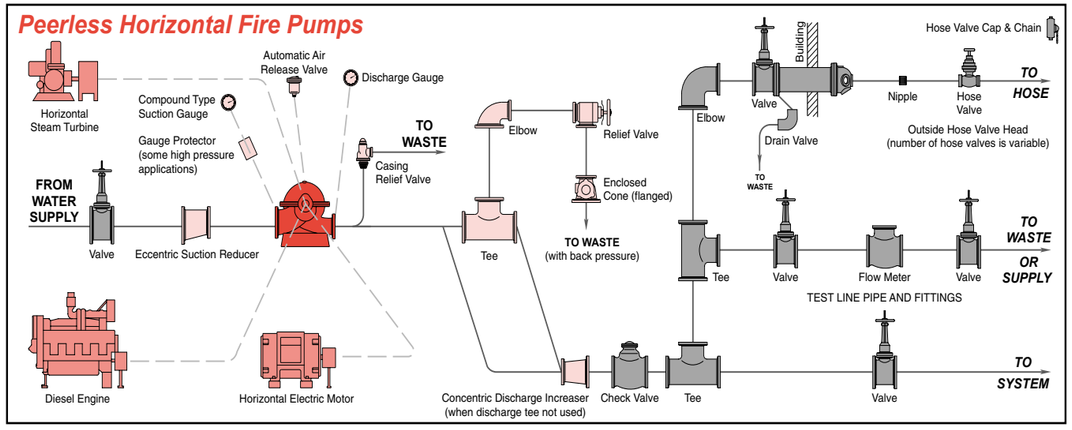
Applications vary from small, basic electric motor units to diesel engine driven, enclosed, packaged systems. Standard units are designed to handle fresh water, but special materials are available for sea water applications.

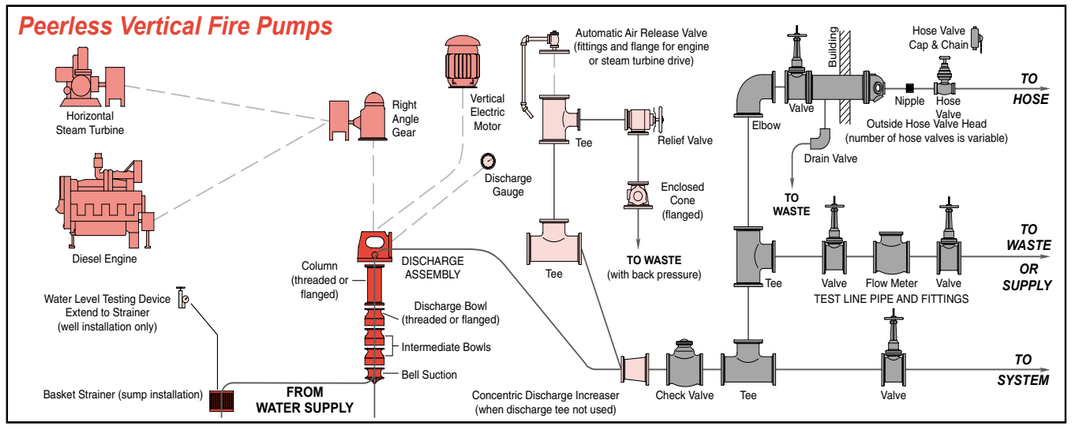


Accessories

To meet the rigorous requirements of the NFPA 20 standards, certain accessories are required for all fire pump installations. They will vary, however, to fit the needs of each individual installation and the requirements of the local authority having jurisdiction. Peerless Pump provides a wide range of fire pump fittings which include: concentric discharge increaser, casing relief valve, eccentric suction reducer, increasing discharge tee, overflow cone, hose valve head, hose valves, hose valve caps and chains, suction and discharge gauges, relief valve, automatic air release valve, flow meter, and ball drip valve. No matter what the requirements, Peerless Pump has a complete line of accessories available and can satisfy the requirements of each installation.

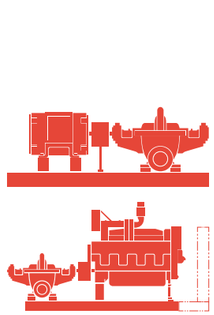
The charts below graphically illustrate the many accessories as well as the optional drives that are available with all Peerless fire pumps and packaged systems.

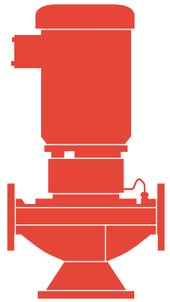


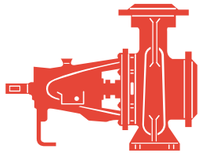


Peerless Fire Product Line

Features and Specifications







	Horizontal Fire Pumps, UL Listed, ULC Listed and FM Approved	In-Line Fire Pumps, UL and ULC Listed	End Suction Fire Pumps, UL Listed and FM Approved	Vertical Fire Pumps UL Listed, ULC Listed and FM Approved
Type	Horizontal centrifugal pumps with appropriate fittings for providing water supply to fire protection systems in buildings, plants and yards. Types AF, ADF, AEF, TUF, TUTF.	Compact in-line centrifugal fire pumps with appropriate fittings for providing water supply to fire protection systems in buildings, plants and yards. Type PVF.	End suction centrifugal fire pumps with appropriate fittings for providing water supply to fire protection systems in buildings, plants and yards. Type UNF.	Vertical turbine pumps with appropriate fittings for providing water supply to fire protection systems in buildings, plants and yards.
Capacities	250 to 5,000 gpm (57 to 1,136 m^3/hr)	50 to 1,500 gpm (11 to 341 m^3/hr)	Up to 1,500 gpm (341 m^3/hr)	250 to 5,000 gpm (57 to 1,136 m^3/hr)
Head	92 to 1178 feet (28 to 359 meters)	Up to 406 feet (123 meters)	Up to 367 feet (112 meters)	92 to 1,176 feet (28 to 359 meters)
Pressure	Up to 640 psi (45 kg/cm^2, 4,414 kPa)	Up to 175 psi (12 kg/cm^2, 1,207 kPa)	Up to 159 psi (11.2 kg/cm^2, 1,096 kPa)	Up to 500 psi (35.15 kg/cm^2, 3,515 kPa)
Horsepower	Up to 800 hp (597 kW)	Up to 125 hp (93 kW)	Up to 210 hp (157 kW)	Up to 600 hp (448 kW)
Drives	Horizontal electric motors, and diesel engines	Vertical close coupled electric motors	Horizontal electric motors and diesel engines	Vertical electric motors and diesel engines with right angle gears
Liquids Pumped	Water.	Water.	Water.	Water.
Temperature	Ambient within the limits for satisfactory equipment operation.	Ambient within the limits for satisfactory equipment operation.	Ambient within the limits for satisfactory equipment operation.	Up to 115°F (46°C)
Materials of Construction	Cast iron, bronze fitted as standard. Optional materials available for sea water applications.	Cast iron, bronze fitted.	Cast iron, bronze fitted.	Cast iron, bronze fitted as standard. Optional materials available for sea water applications.

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Grundfos is guided by a desire to use technology in innovative ways to support a growing and fast-changing world. We are conscious of the impact our activities can have on people and the environment, and this is precisely why we put sustainability first. From our perspective, sustainability is a healthy mix of responsible stewardship, common sense and good business.

- To be sure that we have enough clean water tomorrow, we should look to more efficient water use today.
- By reducing energy costs on pumping systems, we play our part in conserving resources and making our North American pump and pumping solutions more competitive on local and global markets.

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Table 5.1.1.2 Summary of Sprinkler System Inspection, Testing, and Maintenance

Item	Frequency	Reference
Inspection		
Gauges (dry, preaction, and deluge systems)	Weekly/quarterly	5.2.4.2, 5.2.4.3, 5.2.4.4
Control valves		Table 13.1.1.2
Waterflow alarm devices	Quarterly	5.2.5
Valve supervisory signal devices	Quarterly	5.2.5
Supervisory signal devices (except valve supervisory switches)	Quarterly	5.2.5
Gauges (wet pipe systems)	Quarterly	5.2.4.1
Hydraulic nameplate	Quarterly	5.2.6
Buildings	Annually (prior to freezing weather)	4.1.1.1
Hanger/seismic bracing	Annually	5.2.3
Pipe and fittings	Annually	5.2.2
Sprinklers	Annually	5.2.1
Spare sprinklers	Annually	5.2.1.4
Information sign	Annually	5.2.8
Fire department connections		Table 13.1.1.2
Valves (all types)		Table 13.1.1.2
Obstruction, internal inspection of piping	5 years	14.2
Heat trace	Per manufacturer's requirements	5.2.7
Test		
Waterflow alarm devices		
Mechanical devices	Quarterly	5.3.3.1
Vane and pressure switch–type devices	Semiannually	5.3.3.2
Valve supervisory signal devices		Table 13.1.1.2
Supervisory signal devices (except valve supervisory switches)		Table 13.1.1.2
Main drain		Table 13.1.1.2
Antifreeze solution	Annually	5.3.4
Gauges	5 years	5.3.2
Sprinklers (extra-high or greater temperature solder type)	5 years	5.3.1.1.1.4
Sprinklers (fast-response)	At 20 years and every 10 years thereafter	5.3.1.1.1.3
Sprinklers	At 50 years and every 10 years thereafter	5.3.1.1.1
Sprinklers	At 75 years and every 5 years thereafter	5.3.1.1.1.5
Sprinklers (dry)	At 10 years and every 10 years thereafter	5.3.1.1.1.6
Sprinklers (in harsh environments)	5 years	5.3.1.1.2
Valves (all types)		Table 13.1.1.2
Valve status test		13.3.1.2.1
Maintenance		
Valves (all types)		Table 13.1.1.2
Low-point drains (dry pipe system)		13.4.4.3.2
Sprinklers and automatic spray nozzles protecting commercial cooking equipment and ventilation systems	Annually	5.4.1.9
Investigation		
Obstruction		14.3

Table 5.5.1 Summary of Component Replacement Action Requirements

Component	Adjust	Repair/ Recondition	Replace	Required Action
Water Delivery Components				
Pipe and fittings affecting less than 20 sprinklers	X	X	X	Inspect for leaks at system working pressure
Pipe and fittings affecting more than 20 sprinklers	X	X	X	Hydrostatic test in conformance with NFPA 13, *Standard for the Installation of Sprinkler Systems*
Sprinklers, less than 20	X		X	Inspect for leaks at system working pressure
Sprinklers, more than 20	X		X	Hydrostatic test in conformance with NFPA 13
Fire department connections	X	X	X	See Chapter 13
Antifreeze solution	X		X	Inspect freezing point of solution Inspect for leaks at system working pressure
Alarm and Supervisory Components				
Vane-type waterflow	X	X	X	Operational test using inspector's test connection
Pressure switch–type waterflow	X	X	X	Operational test using the inspector's test connection or alarm bypass test valve
Water motor gong	X	X	X	Operational test using inspector's test connection
High and low air pressure switch	X	X	X	Operational test of high and low settings
Valve supervisory signal initiating device	X	X	X	Test for conformance with NFPA 13 and/or *NFPA 72, National Fire Alarm and Signaling Code*
Detection system (for deluge or preaction system)	X	X	X	Operational test for conformance with NFPA 13 and/or *NFPA 72*
Status-Indicating Components				
Gauges			X	Verify at 0 bar (0 psi) and system working pressure
Testing and Maintenance Components				
Air compressor	X	X	X	Operational test for conformance with NFPA 13
Automatic air maintenance device	X	X	X	Operational test for conformance with NFPA 13
Main drain	X	X	X	Main drain test
Auxiliary drains	X	X	X	Inspect for leaks at system working pressure; main drain test
Inspector's test connection	X	X	X	Inspect for leaks at system working pressure; main drain test
Structural Components				
Hanger/seismic bracing	X	X	X	Inspect for conformance with NFPA 13
Pipe stands	X	X	X	Inspect for conformance with NFPA 13
Informational Components				
Identification signs	X	X	X	Inspect for conformance with NFPA 13 and this standard
Hydraulic design information sign	X	X	X	Inspect for conformance with NFPA 13 and this standard
General information sign	X	X	X	Inspect for conformance with this standard

Chapter 6 Standpipe and Hose Systems

6.1 General.

6.1.1 Minimum Requirements.

6.1.1.1 This chapter shall provide the minimum requirements for the routine inspection, testing, and maintenance of standpipe and hose systems.

6.1.1.2 Table 6.1.1.2 shall be used to determine the minimum required frequencies for inspection, testing, and maintenance.

6.1.2 Table 6.1.2 shall be used for the inspection, testing, and maintenance of all classes of standpipe and hose systems.

6.1.3 Checkpoints and corrective actions outlined in Table 6.1.2 shall be followed to determine that components are free of corrosion, foreign material, physical damage, tampering, or other conditions that adversely affect system operation.

6.1.4 Valves and fire department connections shall be inspected, tested, and maintained in accordance with Chapter 13.

6.1.5 The procedures outlined in Chapter 14 shall be followed where there is a need to conduct an obstruction investigation.

6.1.6 Where the inspection, testing, and maintenance of standpipe and hose systems results or involves a system that is out of service, the impairment procedures outlined in Chapter 15 shall be followed.

6.1.7 Where approved by the authority having jurisdiction, existing hose shall be permitted to be removed and shall not be recorded as a deficiency.

6.2 Inspection.

6.2.1 Components. Components of standpipe and hose systems shall be visually inspected annually or as specified in Table 6.1.1.2.

6.2.2 Gauges.

6.2.2.1 Gauges on automatic wet and semiautomatic dry standpipe systems shall be inspected quarterly to ensure that they are in good condition and that normal water supply pressure is being maintained.

Table 6.1.1.2 Summary of Standpipe and Hose Systems Inspection, Testing, and Maintenance

Item	Frequency	Reference
Inspection		
Control valves		Table 13.1.1.2
Pressure-regulating devices		Table 13.1.1.2
Piping	Annually	6.2.1
Hose connections		Table 13.1.1.2]
Cabinet	Annually	NFPA 1962
Gauges	Weekly/quarterly	6.2.2
Hose	Annually	NFPA 1962
Hose storage device	Annually	NFPA 1962
Hose nozzle	Annually and after each use	NFPA 1962
Hydraulic design information sign	Annually	6.2.3
Hose valves		Table 13.1.1.2
Hose connection		Table 13.1.1.2
Test		
Waterflow alarm devices		Table 13.1.1.2
Valve supervisory devices		Table 13.1.1.2
Supervisory signal devices (except valve supervisory switches)		Table 13.1.1.2
Hose storage device	Annually	NFPA 1962
Hose	5 years/3 years	NFPA 1962
Pressure control valve		Table 13.1.1.2
Pressure-reducing valve		Table 13.1.1.2
Hydrostatic test	5 years	6.3.2
Flow test	5 years	6.3.1
Main drain test		Table 13.1.1.2
Hose valves		Table 13.1.1.2
Hose connections		Table 13.1.1.2
Valve status test		13.3.1.2.1
Maintenance		
Hose connections	Annually	Table 6.1.2
Valves (all types)	Annually/as needed	Table 13.1.1.2
Hose valves		Table 13.1.1.2

Table 6.1.2 Standpipe and Hose Systems

Component/Checkpoint	Corrective Action
Hose Connections	
Cap missing	Replace
Fire hose connection damaged	Repair
Valve handles missing	Replace
Cap gaskets missing or deteriorated	Replace
Valve leaking	Close or repair
Visible obstructions	Remove
Restricting device missing	Replace
Manual, semiautomatic, or dry standpipe — valve does not operate smoothly	Lubricate or repair
Piping	
Damaged piping	Repair
Control valves damaged	Repair or replace
Missing or damaged pipe support device	Repair or replace
Damaged supervisory signal initiating device	Repair or replace
Hose	
Inspect	Remove and inspect the hose, including gaskets, and rerack or rereel at intervals in accordance with NFPA 1962, *Standard for the Care, Use, Inspection, Service Testing, and Replacement of Fire Hose, Couplings, Nozzles, and Fire Hose Appliances*
Mildew, cuts, abrasions, and deterioration evident	Replace with listed lined, jacketed hose
Coupling damaged	Replace or repair
Gaskets missing or deteriorated	Replace
Incompatible threads on coupling	Replace or provide thread adapter
Hose not connected to hose rack nipple or valve	Connect
Hose test outdated	Retest or replace in accordance with NFPA 1962
Hose Nozzle	
Hose nozzle missing	Replace with listed nozzle
Gasket missing or deteriorated	Replace
Obstructions	Remove
Nozzle does not operate smoothly	Repair or replace
Hose Storage Device	
Difficult to operate	Repair or replace
Damaged	Repair or replace
Obstruction	Remove
Hose improperly racked or rolled	Remove
Nozzle clip in place and nozzle correctly contained?	Replace if necessary
If enclosed in cabinet, will hose rack swing out at least 90 degrees?	Repair or remove any obstructions
Cabinet	
Inspect overall condition for corroded or damaged parts	Repair or replace parts; replace entire cabinet if necessary
Difficult to open	Repair
Cabinet door will not open fully	Repair or move obstructions
Door glazing cracked or broken	Replace
If cabinet is break-glass type, is lock functioning properly?	Repair or replace
Glass break device missing or not attached	Replace or attach
Not properly identified as containing fire equipment	Provide identification
Visible obstructions	Remove
All valves, hose, nozzles, fire extinguisher, etc., easily accessible	Remove any material not related

Table 6.5.1 Summary of Component Replacement Action Requirements

Component	Adjust	Repair	Replace	Required Action
Water Delivery Components				
Control valves	X	X	X	See Chapter 13
Hose valve pressure-regulating devices	X	X	X	See Chapter 13
System pressure-regulating devices	X	X	X	See Chapter 13
Piping	X	X	X	Hydrostatic test in conformance with NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*
Fire hose			X	No action required
Fire hose		X		Perform hydrostatic test in accordance with NFPA 1962
Hose valve	X	X	X	See Chapter 13
Fire department connections	X	X	X	See Chapter 13
Backflow prevention device	X	X	X	See Chapter 13
Alarm and Supervisory Components				
Vane-type waterflow	X	X	X	Operational test using inspector's test connection
Pressure switch–type waterflow	X	X	X	Operational test using inspector's test connection
Water motor gong	X	X	X	Operational test using inspector's test connection
Valve supervisory device	X	X	X	Operational test for receipt of alarms and verification of conformance with NFPA 14 and/or NFPA 72, *National Fire Alarm and Signaling Code*
Status-Indicating Components				
Gauges			X	Verify at 0 psi (0 bar) and system working pressure
System Housing and Protection Components				
Cabinet	X	X	X	Verify compliance with NFPA 14
Hose storage rack	X	X	X	Verify compliance with NFPA 14
Testing and Maintenance Components				
Drain riser	X	X	X	Inspect for leaks while flowing from connection above the repair
Auxiliary drains	X	X	X	Inspect for leaks at system working pressure
Main drain	X	X	X	Inspect for leaks and residual pressure during main drain test
Structural Components				
Hanger/seismic bracing	X	X	X	Verify conformance with NFPA 14
Pipe stands	X	X	X	Verify conformance with NFPA 14
Informational Components				
Identification signs	X	X	X	Verify conformance with NFPA 14
Hydraulic placards	X	X	X	Verify conformance with NFPA 14

Chapter 7 Private Fire Service Mains

7.1 General.

7.1.1 Minimum Requirements.

7.1.1.1 This chapter shall provide the minimum requirements for the routine inspection, testing, and maintenance of private fire service mains and their appurtenances.

7.1.1.2 Table 7.1.1.2 shall be used to determine the minimum required frequencies for inspection, testing, and maintenance.

7.1.2 Valves and Connections. Valves and fire department connections shall be inspected, tested, and maintained in accordance with Chapter 13.

7.1.3 Obstruction Investigations. The procedures outlined in Chapter 14 shall be followed where there is a need to conduct an obstruction investigation.

Table 8.1.2 Alternative Fire Pump Inspection, Testing, and Maintenance Procedures

Complete as Applicable	Visual Inspection	Inspect	Change	Clean	Test	Frequency
Pump System						
Pump bearings		X				Annually
Lubricate pump bearings			X			As needed
Inspect pump shaft end play		X				Annually
Inspect accuracy of pressure gauges and sensors		X	X			Annually (replace or recalibrate when 5% out of calibration)
Inspect pump coupling alignment		X				Annually
Wet pit suction screens		X		X		After each pump operation
Mechanical Transmission						
Lubricate coupling			X			Annually
Lubricate right-angle gear drive			X			Annually
Electrical System						
Exercise isolating switch and circuit breaker					X	Monthly
Trip circuit breaker (if mechanism provided)					X	Annually
Operate manual starting means (electrical)					X	Semiannually
Inspect and operate emergency manual starting means (without power)	X				X	Annually
Tighten electrical connections as necessary		X				Annually
Lubricate mechanical moving parts (excluding starters and relays)		X				Annually
Calibrate pressure switch settings		X				Annually
Grease motor bearings		X				Annually
			X			Annually or as needed
Voltmeter and ammeter for accuracy (5%)		X				Annually
Any corrosion on printed circuit boards (PCBs)	X					Annually
Any cracked cable/wire insulation	X					Annually
Any leaks in plumbing parts	X					Annually
Any signs of water on electrical parts	X					Annually
Diesel Engine System						
Fuel						
Tank level	X	X				Weekly
Tank float switch	X				X	Weekly
Solenoid valve operation	X				X	Weekly
Strainer, filter, or dirt leg, or combination thereof				X		Quarterly
Water and foreign material in tank				X		Annually
Water in system		X		X		Weekly
Flexible hoses and connectors	X					Weekly
Tank vents and overflow piping unobstructed		X			X	Annually
Piping	X					Annually
Lubrication system						
Oil level	X	X				Weekly
Oil change			X			50 hours or annually
Oil filter(s)			X			50 hours or annually
Lube oil heater		X				Weekly
Crankcase breather	X		X	X		Quarterly

Table 8.1.2 *Continued*

Complete as Applicable	Visual Inspection	Inspect	Change	Clean	Test	Frequency
Cooling system						
Level	X	X				Weekly
Antifreeze protection level					X	Semiannually
Antifreeze		X				Annually
Adequate cooling water to heat exchanger		X				Weekly
Rod out heat exchanger				X		Annually
Water pump(s)	X					Weekly
Condition of flexible hoses and connections	X	X				Weekly
Jacket water heater		X				Weekly
Inspect duct work, clean louvers (combustion air)	X	X	X			Annually
Water strainer				X		Quarterly
Exhaust system						
Leakage	X	X				Weekly
Drain condensate trap		X				Weekly
Insulation and fire hazards	X					Quarterly
Excessive back pressure					X	Annually
Exhaust system hangers and supports	X					Annually
Flexible exhaust section	X					Semiannually
Battery system						
Electrolyte level		X				Weekly
Terminals clean and tight	X	X				Quarterly
Case exterior clean and dry	X	X				Monthly
Specific gravity or state of charge					X	Monthly
Charger and charge rate	X					Monthly
Equalize charge		X				Monthly
Clean terminals				X		Annually
Cranking voltage exceeds 9 volts on a 12 volt system or 18 volts on a 24 volt system		X				Weekly
Electrical system						
General inspection	X					Weekly
Tighten control and power wiring connections		X				Annually
Wire chafing where subject to movement	X	X				Quarterly
Operation of safeties and alarms		X			X	Semiannually
Boxes, panels, and cabinets				X		Semiannually
Circuit breakers or fuses	X	X				Monthly
Circuit breakers or fuses			X			Biennially
Voltmeter and ammeter for accuracy (5%)		X				Annually
Any corrosion on printed circuit boards (PCBs)	X					Annually
Any cracked cable/wire insulation	X					Annually
Any leaks in plumbing parts	X					Annually
Any signs of water on electrical parts	X					Annually

(2) Pump test device(s)
(3) Pump relief valve and piping (where maximum pump discharge pressure exceeds the rating of the system components or the driver is of variable speed)
(4) Alarm sensors and indicators
(5) Right-angle gear sets (for engine-driven vertical shaft turbine pumps)
(6) Pressure maintenance (jockey) pump and accessories

8.1.6 Water Supply to Pump Suction.

8.1.6.1 The suction supply for the fire pump shall provide the required flow at a gauge pressure of 0 psi (0 bar) or higher at the pump suction flange to meet the system demand.

8.1.6.2 Those installations for which NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, permitted negative suction gauge pressures at the time of pump installation, where the system demand still can be met by the pump and water supply, shall be considered to be in compliance with 8.1.6.

8.1.7 Energy Source. The energy sources for the pump driver shall supply the necessary brake horsepower of the driver so that the pump meets system demand.

8.1.8 Driver. The pump driver shall not overload beyond its rating (including any service factor allowance) when delivering the necessary brake horsepower.

Table 8.1.1.2 Summary of Fire Pump Inspection, Testing, and Maintenance

Item	Frequency	Reference
Inspection		
Pump house, heating ventilating louvers	Weekly	8.2.2(1)
Fire pump system	Weekly	8.2.2
Test		
Pump operation		
No-flow condition		8.3.1
Diesel engine–driven fire pump	Weekly	
Electric motor–driven fire pump	See 8.3.1.2	
Flow condition	Annually	8.3.3
Fire pump alarm signals	Annually	8.3.3.5
Maintenance		
Hydraulic	Annually	8.5
Mechanical transmission	Annually	8.5
Electrical system	Varies	8.5
Controller, various components	Varies	8.5
Motor	Annually	8.5
Diesel engine system, various components	Varies	8.5

8.1.9* Controller. Automatic and manual controllers for applying the energy source to the driver shall be capable of providing this operation for the type of pump used.

8.1.10 Impairments. The procedures outlined in Chapter 15 shall be followed where an impairment to protection occurs.

8.2 Inspection.

8.2.1 The purpose of inspection shall be to verify that the pump assembly appears to be in operating condition and is free from physical damage.

8.2.2* The pertinent visual observations specified in the following checklists shall be performed weekly:

(1) Pump house conditions as follows:
   (a) Heat is adequate, not less than 40°F (4°C) for pump room with diesel engine–driven pumps with engine heaters.
   (b) Heat is adequate, not less than 70°F (21°C) for pump room with diesel engine–driven pumps without engine heaters.
   (c) Ventilating louvers are free to operate.

(2) Pump system conditions as follows:
   (a) Pump suction and discharge and bypass valves are fully open.
   (b) Piping is free of leaks.
   (c) Suction line pressure gauge reading is within acceptable range.
   (d) System line pressure gauge reading is within acceptable range.
   (e) Suction reservoir has the required water level.
   (f) Wet pit suction screens are unobstructed and in place.
   (g) Waterflow test valves are in the closed position.

(3) Electrical system conditions as follows:
   (a) Controller pilot light (power on) is illuminated.
   (b) Transfer switch normal pilot light is illuminated.
   (c) Isolating switch is closed — standby (emergency) source.
   (d) Reverse phase alarm pilot light is off, or normal phase rotation pilot light is on.
   (e) Oil level in vertical motor sight glass is within acceptable range.
   (f) Power to pressure maintenance (jockey) pump is provided.

(4) Diesel engine system conditions as follows:
   (a) Fuel tank is at least two-thirds full.
   (b) Controller selector switch is in auto position.
   (c) Batteries' (2) voltage readings are within acceptable range.
   (d) Batteries' (2) charging current readings are within acceptable range.
   (e) Batteries' (2) pilot lights are on or battery failure (2) pilot lights are off.
   (f) All alarm pilot lights are off.
   (g) Engine running time meter is reading.
   (h) Oil level in right angle gear drive is within acceptable range.
   (i) Crankcase oil level is within acceptable range.
   (j) Cooling water level is within acceptable range.
   (k) Electrolyte level in batteries is within acceptable range.
   (l) Battery terminals are free from corrosion.
   (m) Water-jacket heater is operating.

(5)*Steam system conditions: Steam pressure gauge reading is within acceptable range.

8.3* Testing.

8.3.1 Frequency.

8.3.1.1* A non-flow test shall be conducted for diesel engine–driven fire pumps without recirculating water back to the pump suction on a test frequency in accordance with 8.3.1.1.1 or 8.3.1.1.2.

8.3.1.1.1 Except as permitted in 8.3.1.1.2, a weekly test frequency shall be required.

8.3.1.1.2* The test frequency shall be permitted to be established by an approved risk analysis.

Table 8.6.1 Summary of Component Replacement Testing Requirements

Component	Adjust	Repair	Rebuild	Replace	Test Criteria
Fire Pump System					
Entire pump assembly				X	Perform acceptance test in accordance with NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*
Impeller/rotating assembly		X		X	Perform acceptance test in accordance with NFPA 20
Casing		X		X	Perform acceptance test in accordance with NFPA 20 with alignment inspection
Bearings				X	Perform annual test in accordance with 8.3.3
Sleeves				X	Perform annual test in accordance with 8.3.3
Wear rings				X	Perform annual test in accordance with 8.3.3
Main shaft		X		X	Perform annual test in accordance with 8.3.3
Packing	X			X	Perform test in accordance with 8.3.2
Mechanical Transmission					
Gear right angle drives		X	X	X	Perform acceptance test in accordance with NFPA 20
Drive coupling	X	X	X	X	Perform test in accordance with 8.3.3 with alignment inspection (ROC 112]
Electrical System/Controller					
Entire controller				X	Perform acceptance test in accordance with NFPA 20
Electronic component or module that can prevent the controller from starting or running			X	X	Perform acceptance test in accordance with NFPA 20
Electronic component or module that will not prevent the controller from starting or running			X	X	Perform weekly test in accordance with NFPA 25
Plumbing part				X	Perform weekly test in accordance with NFPA 25
Isolating switch				X	Perform test in accordance with 8.3.2 and exercise six times
Circuit breaker	X				Perform six momentary starts in accordance with NFPA 20
Circuit breaker				X	Perform a 1-hour full-load current test in accordance with 8.3.3, including six starts at peak load
Electrical connections	X				Perform test in accordance with 8.3.2
Main contactor		X		X	Perform test in accordance with 8.3.3 with six starts
Power monitor				X	Perform six operations of the circuit breaker/isolation switch disconnect (cycle the power on/off)
Start relay				X	Perform test in accordance with 8.3.2 with six starts
Pressure switch	X			X	Perform test in accordance with 8.3.2 and exercise six times automatically
Pressure transducer	X			X	Perform six automatic no-load starts
Manual start or stop switch				X	Perform six operations under load
Transfer switch — load carrying parts		X	X	X	Perform a 1-hour full-load current test, six starts at peak horsepower load, and transfer from normal power to emergency power and back one time
Transfer switch — no-load parts		X	X	X	Perform six no-load operations of transfer of power

Table 8.6.1 *Continued*

Component	Adjust	Repair	Rebuild	Replace	Test Criteria
Electric Motor Driver					
Electric motor		X	X	X	Perform acceptance test in accordance with 8.3.3, including alignment tests
Motor bearings				X	Perform annual test in accordance with 8.3.3
Incoming power conductors				X	Perform a 1-hour full-load current test including six starts at peak load
Diesel Engine Driver					
Entire engine			X	X	Perform acceptance test in accordance with NFPA 20
Fuel transfer pump	X		X	X	Perform test in accordance with 8.3.2
Fuel injector pump or ECM	X			X	Perform test in accordance with 8.3.3
Fuel system filter		X		X	Perform test in accordance with 8.3.2
Combustion air intake system		X		X	Perform test in accordance with 8.3.2
Fuel tank		X		X	Perform test in accordance with 8.3.2
Cooling system		X	X	X	Perform test in accordance with 8.3.3
Batteries		X		X	Perform start/stop sequence in accordance with NFPA 25
Battery charger		X		X	Perform test in accordance with 8.3.2
Electric system		X		X	Perform test in accordance with 8.3.2
Lubrication filter/oil service		X		X	Perform test in accordance with 8.3.2
Steam Turbines					
Steam turbine		X		X	Perform acceptance test in accordance with NFPA 20
Steam regulator or source upgrade		X		X	Perform acceptance test in accordance with NFPA 20
Positive Displacement Pumps					
Entire pump				X	Perform acceptance test in accordance with NFPA 20
Rotors				X	Perform annual test in accordance with 8.3.3
Plungers				X	Perform annual test in accordance with 8.3.3
Shaft				X	Perform annual test in accordance with 8.3.3
Driver		X	X	X	Perform acceptance test in accordance with NFPA 20
Bearings				X	Perform annual test in accordance with 8.3.3
Seals				X	Perform test in accordance with 8.3.2
Pump House and Miscellaneous Components					
Baseplate		X			Perform test in accordance with 8.3.2 with alignment inspection
Baseplate				X	Perform test in accordance with 8.3.3 with alignment inspection
Foundation		X	X	X	Perform test in accordance with 8.3.2 with alignment inspection
Suction/discharge pipe		X		X	Perform visual inspection in accordance with 8.2.2
Suction/discharge fittings		X		X	Perform visual inspection in accordance with 8.2.2
Suction/discharge valves		X	X	X	Perform operational test in accordance with 13.3.3.1

Table 13.1.1.2 Summary of Valves, Valve Components, and Trim Inspection, Testing, and Maintenance

Item	Frequency	Reference
Inspection		
Control Valves		
Sealed	Weekly	13.3.2.1
Locked or electrically supervised	Monthly	13.3.2.1.1
Valve Supervisory Signal Initiating Device	Quarterly	13.3.2.1.2
Alarm Valves		
Exterior	Monthly	13.4.1.1
Interior	5 years	13.4.1.2
Strainers, filters, orifices	5 years	13.4.1.2
Check Valves		
Interior	5 years	13.4.2.1
Preaction/Deluge Valves		
Enclosure (during cold weather)	Daily/weekly	13.4.3.1
Exterior	Monthly	13.4.3.1.6
Interior	Annually/5 years	13.4.3.1.7
Strainers, filters, orifices	5 years	13.4.3.1.8
Dry Pipe Valves/ Quick-Opening Devices		
Gauges	Weekly/monthly	13.4.4.1.2.4, 13.4.4.1.2.5
Enclosure (during cold weather)	Daily/weekly	13.4.4.1.1
Exterior	Monthly	13.4.4.1.4
Interior	Annually	13.4.4.1.5
Strainers, filters, orifices	5 years	13.4.4.1.6
Pressure-Reducing and Relief Valves		
Sprinkler systems	Quarterly	13.5.1.1
Hose connections	Annually	13.5.2.1
Hose racks	Annually	13.5.3.1
Fire pumps		
Casing relief valves	Weekly	13.5.7.1, 13.5.7.1.1
Pressure-relief valves	Weekly	13.5.7.2, 13.5.7.2.1
Backflow Prevention Assemblies		
Reduced pressure	Weekly/monthly	13.6.1
Reduced-pressure detectors	Weekly/monthly	13.6.1
Fire Department Connections	Quarterly	13.7.1
Testing		
Main Drains	Annually/quarterly	13.2.5, 13.2.5.1, 13.3.3.4
Gauges	5 years	13.2.7.2
Waterflow Alarms	Quarterly/semiannually	13.2.6
Control Valves		
Position	Annually	13.3.3.1
Operation	Annually	13.3.3.1
Supervisory	Semiannually	13.3.3.5
Preaction/Deluge Valves		
Priming water	Quarterly	13.4.3.2.1
Low air pressure alarms	Quarterly/annually	13.4.3.2.13, 13.4.3.2.14
Full flow	Annually	13.4.3.2.2
Air leakage	3 years	13.4.3.2.6

Table 13.1.1.2 *Continued*

Item	Frequency	Reference
Dry Pipe Valves/ Quick-Opening Devices		
Air leakage	3 years	13.4.4.2.9
Priming water	Quarterly	13.4.4.2.1
Low air pressure alarm	Quarterly	13.4.4.2.6
Quick-opening devices	Quarterly	13.4.4.2.4
Trip test	Annually	13.4.4.2.2
Full flow trip test	3 years	13.4.4.2.2.2
Pressure-Reducing and Relief Valves		
Sprinkler systems	5 years	13.5.1.2
Circulation relief	Annually	13.5.7.1.2
Pressure relief valves	Annually	13.5.7.2.2
Hose connections	5 years	13.5.2.2
Hose racks	5 years	13.5.3.2
Backflow Prevention Assemblies	Annually	13.6.2
Maintenance		
Control Valves	Annually	13.3.4
Preaction/Deluge Valves	Annually	13.4.3.3.2
Dry Pipe Valves/ Quick-Opening Devices	Annually	13.4.4.3

13.2 General Provisions.

13.2.1 The property owner or designated representative shall have manufacturers' literature available to provide specific instructions for inspecting, testing, and maintaining the valves and associated equipment.

13.2.2 All pertinent personnel, departments, authorities having jurisdiction, or agencies shall be notified that testing or maintenance of the valve and associated alarms is to be conducted.

13.2.3* All system valves shall be protected from physical damage and shall be accessible.

13.2.4 Before opening a test or drain valve, it shall be verified that adequate provisions have been made for drainage.

13.2.5* Main Drain Test. A main drain test shall be conducted annually for each water supply lead-in to a building water-based fire protection system to determine whether there has been a change in the condition of the water supply.

13.2.5.1 Where the lead-in to a building supplies a header or manifold serving multiple systems, a single main drain test shall be permitted.

13.2.5.2 In systems where the sole water supply is through a backflow preventer and/or pressure-reducing valves, the main drain test of at least one system downstream of the device shall be conducted on a quarterly basis.

13.2.5.3 When there is a 10 percent reduction in full flow pressure when compared to the original acceptance test or previously performed tests, the cause of the reduction shall be identified and corrected if necessary.

13.2.6 Alarm Devices.

13.2.6.1 Mechanical waterflow alarm devices, including but not limited to water motor gongs, shall be tested quarterly.

13.2.6.2 Vane-type and pressure switch–type waterflow devices shall be tested semiannually.

13.2.7 Gauges.

13.2.7.1 Gauges shall be inspected monthly to verify that they are in good condition and that normal pressure is being maintained.

13.2.7.1.1 Where other sections of this standard have different frequency requirements for specific gauges, those requirements shall be used.

13.2.7.2 Gauges shall be replaced every 5 years or tested every 5 years by comparison with a calibrated gauge.

13.2.7.3 Gauges not accurate to within 3 percent of the full scale shall be recalibrated or replaced.

13.2.8 Records. Records shall be maintained in accordance with Section 4.3.

13.3 Control Valves in Water-Based Fire Protection Systems.

13.3.1* Each control valve shall be identified and have a sign indicating the system or portion of the system it controls.

13.3.1.1 Systems that have more than one control valve that must be closed to work on a system shall have a sign on each affected valve referring to the existence and location of other valves.

13.3.1.2* When a normally open valve is closed, the procedures established in Chapter 15 shall be followed.

13.3.1.2.1 When the valve is returned to service, a valve status test (either main or sectional drain, as appropriate) shall be conducted to determine that the valve is not closed.

13.3.1.3 Each normally open valve shall be secured by means of a seal or a lock or shall be electrically supervised in accordance with the applicable NFPA standards.

Table 13.8.1 Summary of Component Replacement Action Requirements

Component	Adjust	Repair/ Recondition	Replace	Inspection, Test, and Maintenance Procedures
Water delivery components				
Post indicator and wall indicator valves	X	X	X	(1) Inspect for leaks at system pressure (2) Perform full operational test conforming to 13.3.3.1 (3) Perform spring torsion inspection conforming to 13.3.3.1 and 13.3.3.2 (4) Verify target visibility at shut and full open position (5) Test supervisory device (6) Main drain test
Control valves other than post indicator and wall indicator valves	X	X	X	(1) Inspect for leaks at system pressure (2) Perform full operational test conforming to 13.3.3.1 (3) Perform spring torsion inspection for OS&Y valves conforming to 13.3.3.2 (4) Verify supervisory device (5) Main drain test
Alarm check valve	X	X	X	(1) Inspect for leaks at system pressure per 13.4.1 (2) Test all alarms and supervisory signals affected by the alarm valve (3) Main drain test
Dry pipe valve	X	X	X	(1) Inspect for leaks at system pressure (2) Trip test per 13.4.4.2 (3) Inspect condition of valve seat (4) Test all dry pipe system alarms and supervisory signals (5) Main drain test
Deluge/preaction valve	X	X	X	(1) Inspect for leaks at system pressure per 13.4.3 (2) Trip test (3) Inspect condition of valve seat (4) Test all deluge/preaction system alarms and supervisory signals (5) Main drain test
Quick-opening device	X	X	X	(1) Inspect for leaks at system pressure per 13.4.4.2.2 (2) Trip test (3) Main drain test
Pressure-regulating device — hose valves	X	X	X	(1) Inspect for leaks at system pressure per 13.5.1 (2) Full flow test (3) Main drain test (Only when a control valve has been closed)
Pressure-regulating devices — other than hose valves	X	X	X	(1) Inspect for leaks at system pressure per Section 13.5 (2) Test pressure setting with full flow and without flow (3) Test supervisory device and alarm (4) Main drain test
Hose valve	X	X	X	(1) Inspect for leaks at system pressure per 13.5.6 (2) Main drain test

(continues)

Table 13.8.1 *Continued*

Component	Adjust	Repair/ Recondition	Replace	Inspection, Test, and Maintenance Procedures
Backflow prevention device	X	X	X	(1) Inspect for leaks at system pressure per Section 13.6 (2) Forward flow test per 13.6.2.1 (3) Test supervisory device and alarm (4) Main drain test
Check valves	X	X	X	(1) Inspect for leaks at system pressure per 13.4.2 (2) Inspect for leaking through check valve (3) Main drain test
Fire department connection	X	X		(1) Inspect for leaks at system pressure per Section 13.7 (2) Main drain test (Only when a control valve has been closed)
Fire department connection — sprinkler system(s)			X	(1) Isolate and hydrostatic test for 2 hours at 150 psi (10 bar) (2) Main drain test (Only when a control valve has been closed)
Fire department connection — other than sprinkler system(s)			X	(1) Isolate and hydrostatic test for 2 hours at 50 psi (3.5 bar) above the normal working pressure [200 psi (14 bar) minimum] (2) Main drain test (Only when a control valve has been closed)
Strainers	X	X	X	Inspect and clean in accordance with manufacturer's instructions
Main drain valves	X	X	X	Main drain test per 13.2.5
Gauges			X	Calibrate per 13.2.7
Alarm and supervisory components				
Alarm device	X	X	X	Test for conformance with NFPA 13 and/or *NFPA 72*
Supervisory device	X	X	X	Test for conformance with NFPA 13 and/or *NFPA 72*
System protection components				
Pressure relief valve — fire pump installation	X	X	X	See 8.3.3.3 and 13.5.7
Pressure relief valve — other than fire pump installation			X	Verify relief valve is listed or approved for the application and set to the correct pressure
Informational components				
Identification signs	X	X	X	Inspect for compliance with NFPA 13 and 13.3.1

Modeling Appendixes

The following pages contain all the attachments for this project.

HRR for Arson Fire Model

s	kW	kW	kW	kW	kg/s
FDS_HRR_	HRR	RAD_LOSS	CONV_LOS	COND_LOS	BURN_RATE
0	0	0	0	0	0
0.63	0	0	-1322.68	0	0
1.26	0	0	-1322.68	0	0
1.89	0.01	0	-1322.67	0	0
2.53	0.03	0	-1322.65	0	0
3.16	0.06	0	-1322.61	0	0
3.79	0.11	0.01	-1322.57	0	0
4.42	0.17	0.01	-1322.52	0	0
5.05	0.26	0.06	-1322.48	0.01	0
5.68	0.37	0.12	-1322.43	0.01	0
6.31	0.53	0.17	-1322.32	0.04	0
6.63	0.7	0.24	-1322.21	0.04	0
7.26	0.96	0.32	-1322.04	0.09	0
7.89	1.52	0.5	-1321.65	0.14	0
8.52	2.54	0.85	-1320.95	0.2	0
9.16	4.49	1.5	-1319.62	0.42	0
9.79	8.18	2.76	-1317.1	0.68	0
10.42	15.03	5.12	-1312.47	0.95	0
11.05	26.91	9.08	-1304.3	2.28	0
11.68	44.11	14.85	-1292.5	3.68	0
12.31	61.15	20.83	-1281.09	5.11	0
12.63	67.88	22.29	-1275.6	8.8	0
13.26	69.32	23.32	-1275.16	8.85	0
13.89	69.8	22.82	-1274.24	12.71	0
14.52	64.01	20.58	-1278.13	14.28	0
15.16	57.16	17.74	-1282.39	15.76	0
15.79	58.71	17.88	-1281.02	18.06	0
16.42	59.73	18.29	-1280.52	18.6	0
17.05	64.34	19.68	-1277.28	19.12	0
17.68	76.16	23.98	-1269.59	19.89	0
18.31	89.24	28.44	-1260.77	20.73	0
18.63	96.88	31.17	-1255.78	21.57	0
19.26	100.17	31.95	-1253.26	22.77	0.01
19.89	98.52	31.43	-1254.63	24.04	0.01
20.52	98.19	30.69	-1254.45	26.49	0.01
21.15	106.39	32.91	-1248.46	28.06	0.01
21.79	119.9	38	-1239.92	29.64	0.01
22.42	134.31	42.71	-1230.06	33.1	0.01
23.05	145.3	46.44	-1222.77	35.02	0.01
23.68	149.53	47.77	-1220.04	36.96	0.01
24.31	148.51	46.65	-1220.22	39.91	0.01
24.63	147.65	46.71	-1221.4	40.09	0.01
25.26	150.45	46.99	-1219.04	43.47	0.01
25.89	161.08	50.46	-1211.91	45.36	0.01

Sprinkler Temperatures in Arson Fire Model

s	Sprinkler #1 C	Sprinkler #2 C	Sprinkler #3 C	Sprinkler #4 C	Sprinkler # C	Sprinkler # C	Sprinkler # C
FDS Time	SPRK0202020	SPRK0402030	SPRK0202020	SPRK0402030	SPRK0202(	SPRK0402(	SPRK02030
0.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
0.63	20.00	20.00	20.00	20.00	20.00	20.00	20.00
1.26	20.00	20.00	20.00	20.00	20.00	20.00	20.00
1.89	20.00	20.00	20.00	20.00	20.00	20.00	20.00
2.53	20.00	20.00	20.00	20.00	20.00	20.00	20.00
3.16	20.00	20.00	20.00	20.00	20.00	20.00	20.00
3.79	20.00	20.00	20.00	20.00	20.00	20.00	20.00
4.42	20.00	20.00	20.00	20.00	20.00	20.00	20.00
5.05	20.00	20.00	20.00	20.00	20.00	20.00	20.00
5.68	20.00	20.00	20.00	20.00	20.00	20.00	20.00
6.31	20.00	20.00	20.00	20.00	20.00	20.00	20.00
6.63	20.00	20.00	20.00	20.00	20.00	20.00	20.00
7.26	20.00	20.00	20.00	20.00	20.00	20.00	20.00
7.89	20.00	20.00	20.00	20.00	20.00	20.00	20.00
8.52	20.00	20.00	20.00	20.00	20.00	20.00	20.00
9.16	20.00	20.00	20.00	20.00	20.00	20.00	20.00
9.79	20.00	20.00	20.00	20.00	20.00	20.00	20.00
10.42	20.00	20.00	20.00	20.00	20.00	20.00	20.00
11.05	20.00	20.00	20.00	20.00	20.00	20.00	20.00
11.68	20.00	20.00	20.00	20.00	20.00	20.00	20.00
12.31	20.00	20.00	20.00	20.00	20.00	20.00	20.00
12.63	20.00	20.00	20.00	20.00	20.00	20.00	20.00
13.26	20.00	20.00	20.00	20.00	20.00	20.00	20.00
13.89	20.00	20.00	20.00	20.00	20.00	20.00	20.00
14.52	20.00	20.00	20.00	20.00	20.00	20.00	20.00
15.16	20.00	20.02	20.00	20.00	20.00	20.00	20.00
15.79	20.01	20.09	20.00	20.00	20.00	20.00	20.00
16.42	20.02	20.46	20.00	20.00	20.00	20.00	20.00
17.05	20.08	21.42	20.00	20.00	20.00	20.00	20.00
17.68	20.29	23.09	20.01	20.01	20.00	20.00	20.00
18.31	20.80	25.25	20.01	20.01	20.00	20.00	20.00
18.63	21.44	26.96	20.01	20.01	20.00	20.00	20.00
19.26	22.32	28.49	20.01	20.01	20.00	20.00	20.00
19.89	23.74	29.98	20.01	20.03	20.00	20.00	20.00
20.52	25.23	30.60	20.01	20.10	20.00	20.00	20.00
21.15	26.52	30.32	20.03	20.34	20.00	20.00	20.00
21.79	27.38	29.40	20.08	20.95	20.00	20.00	20.00
22.42	27.72	28.31	20.21	22.14	20.00	20.00	20.00
23.05	27.62	27.57	20.52	23.99	20.00	20.00	20.00
23.68	27.29	27.72	21.14	26.30	20.00	20.01	20.00
24.31	27.04	29.04	22.18	28.52	20.00	20.01	20.00
24.63	27.09	30.62	23.25	29.78	20.00	20.01	20.00
25.26	27.47	32.30	24.54	30.34	20.01	20.01	20.00

HRR for Stock Room Fire Model

s	kW	kW	kW	kW	kg/s
FDS_HRR_	HRR	RAD_LOSS	CONV_LOS	COND_LOS	BURN_RATE
0	0	0	0	0	0
0.72	0	0	-1322.68	0	0
1.45	0	0	-1322.68	0	0
1.81	0	0	-1322.68	0	0
2.53	0.01	0	-1322.67	0	0
3.25	0.01	0	-1322.67	0	0
3.61	0.02	0	-1322.66	0	0
4.34	0.03	0	-1322.65	0	0
5.06	0.05	0	-1322.63	0	0
5.42	0.07	0	-1322.61	0	0
6.14	0.1	0.01	-1322.59	0	0
6.87	0.13	0.02	-1322.56	0	0
7.23	0.17	0.04	-1322.55	0	0
7.95	0.23	0.06	-1322.51	0.01	0
8.67	0.33	0.11	-1322.46	0.02	0
9.04	0.45	0.15	-1322.38	0.04	0
9.76	0.63	0.21	-1322.26	0.04	0
10.48	1.02	0.33	-1321.99	0.09	0
10.84	1.47	0.49	-1321.68	0.1	0
11.57	2.19	0.71	-1321.17	0.2	0
12.29	3.76	1.24	-1320.09	0.32	0
12.65	5.63	1.9	-1318.84	0.45	0
13.37	8.6	2.87	-1316.77	0.73	0
14.1	14.71	4.99	-1312.65	1.01	0
14.46	21.19	6.95	-1307.98	2.19	0
15.18	29.16	9.86	-1302.76	2.23	0
15.9	38.98	12.88	-1295.73	4.25	0
16.26	43.28	14.51	-1292.97	4.28	0
16.99	43.77	14.2	-1292.1	6.44	0
17.71	42.18	13.48	-1293.02	7.52	0
18.07	37.33	11.76	-1296.35	8.62	0
18.79	32.15	9.57	-1299.56	9.3	0
19.52	27.1	7.54	-1302.8	9.97	0
19.88	23.94	6.38	-1304.93	10.35	0
20.6	22.59	6.05	-1305.99	10.34	0
21.32	23.11	6.4	-1305.83	9.78	0
21.69	25.3	7.17	-1304.36	9.79	0
22.41	30.08	8.99	-1301.32	9.21	0
23.13	40.82	12.66	-1294.05	9.39	0
23.49	51.82	16.53	-1286.73	9.58	0
24.22	63.26	20.27	-1278.81	10.61	0
24.94	73.44	23.98	-1272.17	11.68	0
25.3	74.73	23.4	-1270.24	14.38	0
26.02	69.37	22.09	-1274.55	14.49	0

Sprinkler Temperatures in Stock Room Model

s	Sprinkler # C	Sprinkler # C	Sprinkler # C	Sprinkler # C	Sprinkler # C	Sprinkler # C	Sprinkler # C	Sprinkler # C	Sprinkler # C
FDS Time	SPRK1000	SPRK1000	SPRK1000	SPRK1000	SPRK1000	SPRK1000	SPRK1000	SPRK1000	SPRK1000
0	20	20	20	20	20	20	20	20	20
0.72	20	20	20	20	20	20	20	20	20
1.45	20	20	20	20	20	20	20	20	20
1.81	20	20	20	20	20	20	20	20	20
2.53	20	20	20	20	20	20	20	20	20
3.25	20	20	20	20	20	20	20	20	20
3.61	20	20	20	20	20	20	20	20	20
4.34	20	20	20	20	20	20	20	20	20
5.06	20	20	20	20	20	20	20	20	20
5.42	20	20	20	20	20	20	20	20	20
6.14	20	20	20	20	20	20	20	20	20
6.87	20	20	20	20	20	20	20	20	20
7.23	20	20	20	20	20	20	20	20	20
7.95	20	20	20	20	20	20	20	20	20
8.67	20	20	20	20	20	20	20	20	20
9.04	20	20	20	20	20	20	20	20	20
9.76	20	20	20	20	20	20	20	20	20
10.48	20	20	20	20	20	20	20	20	20
10.84	20	20	20	20	20	20	20	20	20
11.57	20	20	20	20	20	20	20	20	20
12.29	20	20	20	20	20	20	20	20	20
12.65	20	20	20	20	20	20	20	20	20
13.37	20	20	20	20	20	20	20	20	20
14.1	20	20	20	20	20	20	20	20	20
14.46	20	20	20	20	20	20	20	20	20
15.18	20	20	20	20	20	20	20	20	20
15.9	20	20	20	20	20	20	20	20	20
16.26	20	20	20	20	20	20	20	20	20
16.99	20	20	20	20	20	20	20	20	20
17.71	20	20	20	20	20	20	20	20	20
18.07	20	20	20	20	20	20	20	20	20
18.79	20	20	20	20	20	20	20	20	20
19.52	20	20	20	20	20	20	20	20	20
19.88	20	20	20	20	20	20	20	20	20
20.6	20	20	20	20	20	20	20	20	20.01
21.32	20	20	20	20	20	20	20	20	20.01
21.69	20	20	20	20	20	20	20	20	20.02
22.41	20	20	20	20	20	20	20	20	20.03
23.13	20	20	20	20	20	20	20	20	20.06
23.49	20	20	20	20	20	20	20	20	20.07
24.22	20	20	20	20	20	20	20	20	20.09
24.94	20	20	20	20	20	20	20	20	20.12
25.3	20	20	20	20	20	20	20	20	20.13

HRR for Sales Floor Fire Model

s	kW	kW	kW	kW	kg/s
FDS_HRR_	HRR	RAD_LOSS	CONV_LOS	COND_LOS	BURN_RATE
0	0	0	0	0	0
0.63	0	0	-1322.68	0	0
1.26	0	0	-1322.68	0	0
1.89	0	0	-1322.68	0	0
2.53	0.01	0	-1322.67	0	0
3.16	0.02	0	-1322.66	0	0
3.79	0.03	0	-1322.65	0	0
4.42	0.05	0	-1322.63	0	0
5.05	0.07	0.02	-1322.63	0	0
5.68	0.1	0.03	-1322.61	0	0
6.31	0.14	0.05	-1322.59	0.01	0
6.63	0.18	0.06	-1322.56	0.01	0
7.26	0.25	0.08	-1322.52	0.02	0
7.89	0.42	0.14	-1322.41	0.04	0
8.52	0.76	0.25	-1322.17	0.05	0
9.16	1.45	0.49	-1321.71	0.13	0
9.79	2.78	0.94	-1320.79	0.22	0
10.42	5.32	1.82	-1319.07	0.31	0
11.05	9.78	3.31	-1316.01	0.79	0
11.68	16.07	5.43	-1311.71	1.3	0
12.31	21.85	7.44	-1307.82	1.81	0
12.63	24.38	8.01	-1305.78	3.14	0
13.26	27	9.11	-1304.22	3.17	0
13.89	25.27	8.23	-1305.15	4.69	0
14.52	20.01	6.36	-1308.7	5.16	0
15.16	18.81	5.78	-1309.4	5.65	0
15.79	16.28	4.72	-1310.98	6.23	0
16.42	16.91	4.96	-1310.58	6.28	0
17.05	19.74	5.97	-1308.72	6.33	0
17.68	24.45	7.67	-1305.62	6.42	0
18.31	30.39	9.77	-1301.69	6.64	0
18.63	34.56	11.27	-1298.95	6.87	0
19.26	37.06	11.99	-1297.14	7.39	0
19.89	37.07	12.01	-1297.21	7.94	0
20.52	34.64	10.93	-1298.69	9.04	0
21.15	33.8	10.42	-1299.14	9.57	0
21.79	35.94	11.17	-1297.75	10.09	0
22.42	40.43	12.64	-1294.7	11.06	0
23.05	45.96	14.63	-1291.09	11.61	0
23.68	50.58	16.29	-1288.1	12.17	0
24.31	52.79	16.84	-1286.47	13.11	0
24.63	53.13	17.06	-1286.43	13.18	0
25.26	53.38	16.89	-1286.08	14.36	0
25.89	55.08	17.37	-1284.93	15.08	0

Sprinkler Temperatures in Sales Floor Model

s	Sprinkler # C	Sprinkler # C	Sprinkler # C	Sprinkler # C	Sprinkler # C	Sprinkler # C	Sprinkler # C	Sprinkler # C	Sprinkler # C
FDS Time	SPRK0202(	SPRK0202(	SPRK0402(	SPRK0202(	SPRK0203(	SPRK0402(	SPRK0204(	SPRK1903(	SPRK0203(
0	20	20	20	20	20	20	20	20	20
0.63	20	20	20	20	20	20	20	20	20
1.26	20	20	20	20	20	20	20	20	20
1.89	20	20	20	20	20	20	20	20	20
2.53	20	20	20	20	20	20	20	20	20
3.16	20	20	20	20	20	20	20	20	20
3.79	20	20	20	20	20	20	20	20	20
4.42	20	20	20	20	20	20	20	20	20
5.05	20	20	20	20	20	20	20	20	20
5.68	20	20	20	20	20	20	20	20	20
6.31	20	20	20	20	20	20	20	20	20
6.63	20	20	20	20	20	20	20	20	20
7.26	20	20	20	20	20	20	20	20	20
7.89	20	20	20	20	20	20	20	20	20
8.52	20	20	20	20	20	20	20	20	20
9.16	20	20	20	20	20	20	20	20	20
9.79	20	20	20	20	20	20	20	20	20
10.42	20	20	20	20	20	20	20	20	20
11.05	20	20	20	20	20	20	20	20	20
11.68	20	20	20	20	20	20	20	20	20
12.31	20	20	20	20	20	20	20	20	20
12.63	20	20	20	20	20	20	20	20	20
13.26	20	20	20	20	20	20	20	20	20
13.89	20	20	20	20	20	20	20	20	20
14.52	20	20	20	20	20	20	20	20	20
15.16	20	20	20	20	20	20	20	20	20
15.79	20	20	20	20	20	20	20	20	20
16.42	20	20	20	20	20	20	20	20	20
17.05	20	20	20	20	20	20	20	20	20
17.68	20	20	20	20	20	20	20	20	20
18.31	20	20	20	20	20	20	20	20	20
18.63	20	20	20	20.01	20	20	20	20	20
19.26	20	20	20	20.01	20	20	20	20	20
19.89	20	20	20	20.02	20	20	20	20	20
20.52	20	20	20	20.04	20	20	20	20	20
21.15	20	20	20	20.06	20	20	20	20	20
21.79	20	20	20	20.09	20	20	20	20	20
22.42	20	20	20	20.13	20	20	20	20	20
23.05	20	20	20	20.17	20	20	20	20	20
23.68	20	20	20	20.22	20	20	20	20	20
24.31	20	20	20	20.27	20	20	20	20	20
24.63	20	20	20	20.31	20	20	20	20	20
25.26	20	20	20	20.35	20	20	20	20	20