VESDA | ASD Design Concept

xtralis®

Agenda

CONTENTS

- Introduction to Xtralis
- Introduction to Aspirating Smoke Detection (ASD) and Main Applications
- Product Overview (VESDA and VESDA-E)
- **System Design and Practical Exercise (Concept, Layout AutoCAD, ASPIRE Software)**
- Installation Details
- Commissioning, Testing and Maintenance (Live Demo with VSC Software)
- Test for Certification

Module Objectives

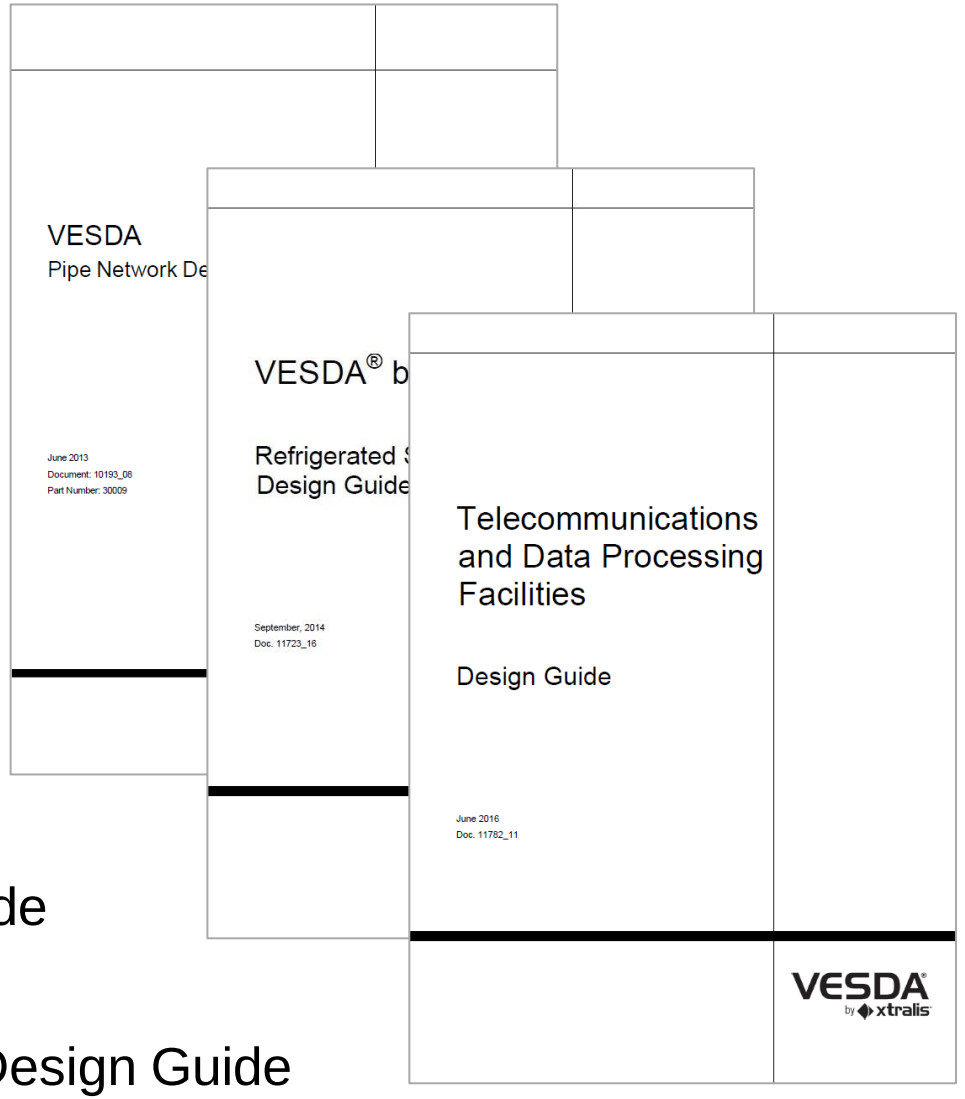
ASD System Design & Practical Exercise

Things you will learn:

- **The differences between UL268 6th Edition and UL268 7th Edition**
- Which information needed to start design
- Compare between traditional smoke detection design and ASD design
- Customizing design related to codes and standards for each region or application
- Creating a design concept layout
- Converting the design layout into ASPIRE calculation
- Generating the required reports from the ASPIRE software

VESDA Design Guides*

- Introduction to the VESDA System Design Manual
- VESDA Pipe Network Design Guide
- Warehouses Design Guide
- Clean Rooms Design Guide
- Refrigerated Storage Design Guide
- Substations Design Guide
- Rail Cars Design Guide
- Design Guideline for Aircraft Hangars
- Power Generation Facilities Design Guide
- High Technology Manufacturing Facilities Design Guide
- Correctional Facilities Design Guide
- Telecommunications and Data Processing Facilities Design Guide

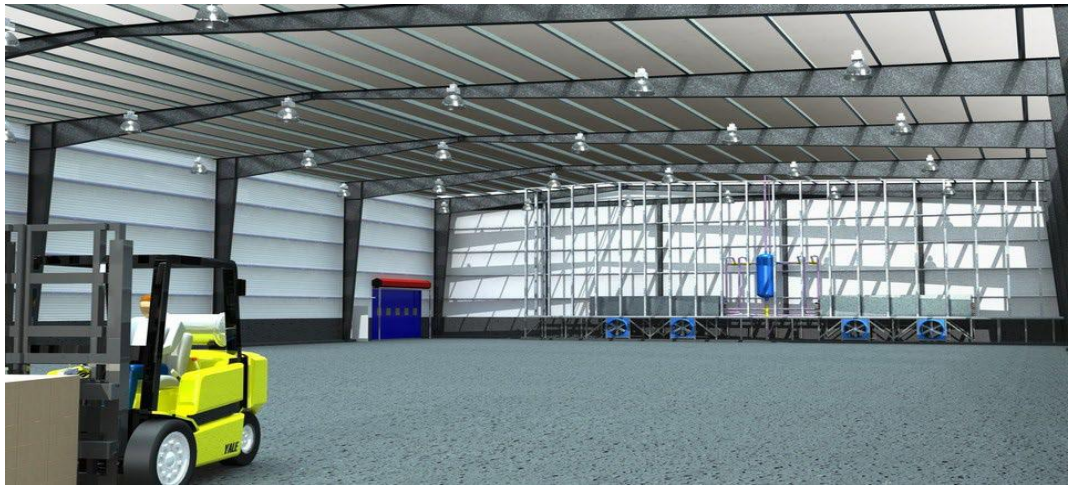


*** All guides are available on Xtralis website**

Gathering Site Information

- Purpose of the site/type of application
- Site layout and measurements
  (coverage area, ceiling shape, number of layers)
- Site construction
  (obstructions, air movement, decoration)
- Regulatory requirements
- Ambient conditions (Environment Parameters)

Think in 3 Dimensions

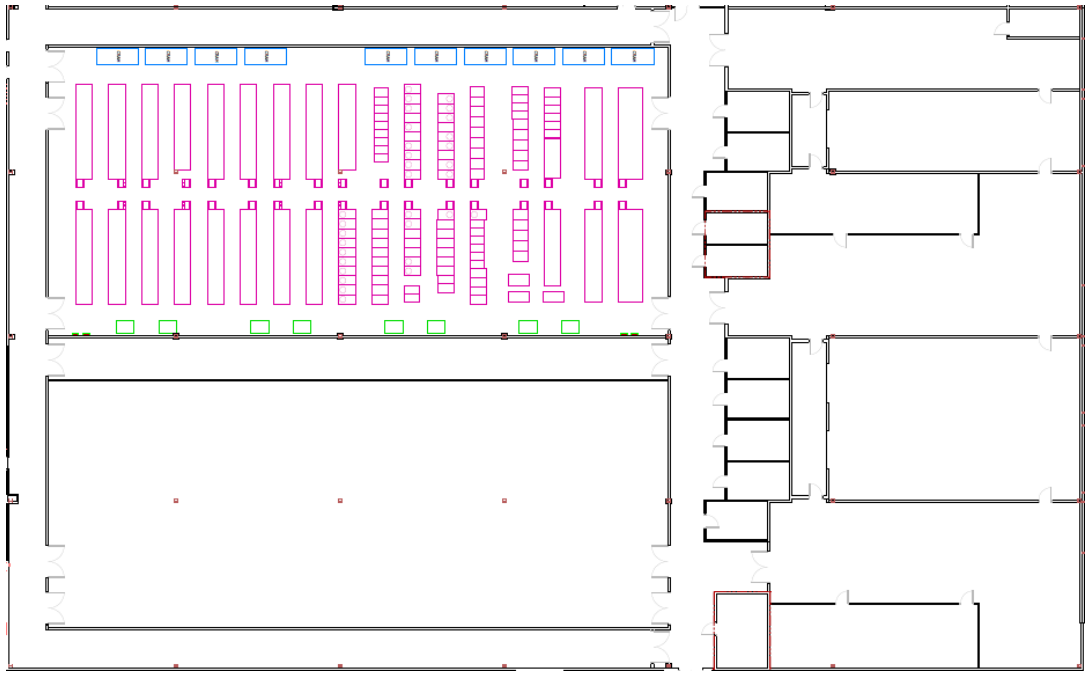


xtralis

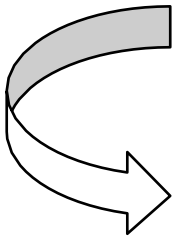
Air Sampling Methods

When designing a pipe network utilizing the VESDA product line, the key issues to consider are:

- Is it new project?
- Which room(s) need protection?
- Do the air handling units need protection?
- Do any specific objects need protection?
- Local Codes and Standards apply

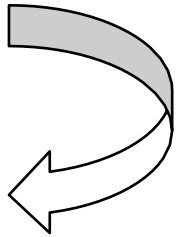


Why to Think in 3 Dimensions?

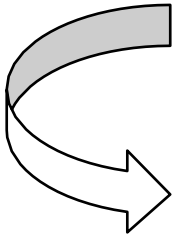


VESDA detector location is an important factor in the design

VESDA detector is connected to the pipes network



Sample points are located on the pipes network



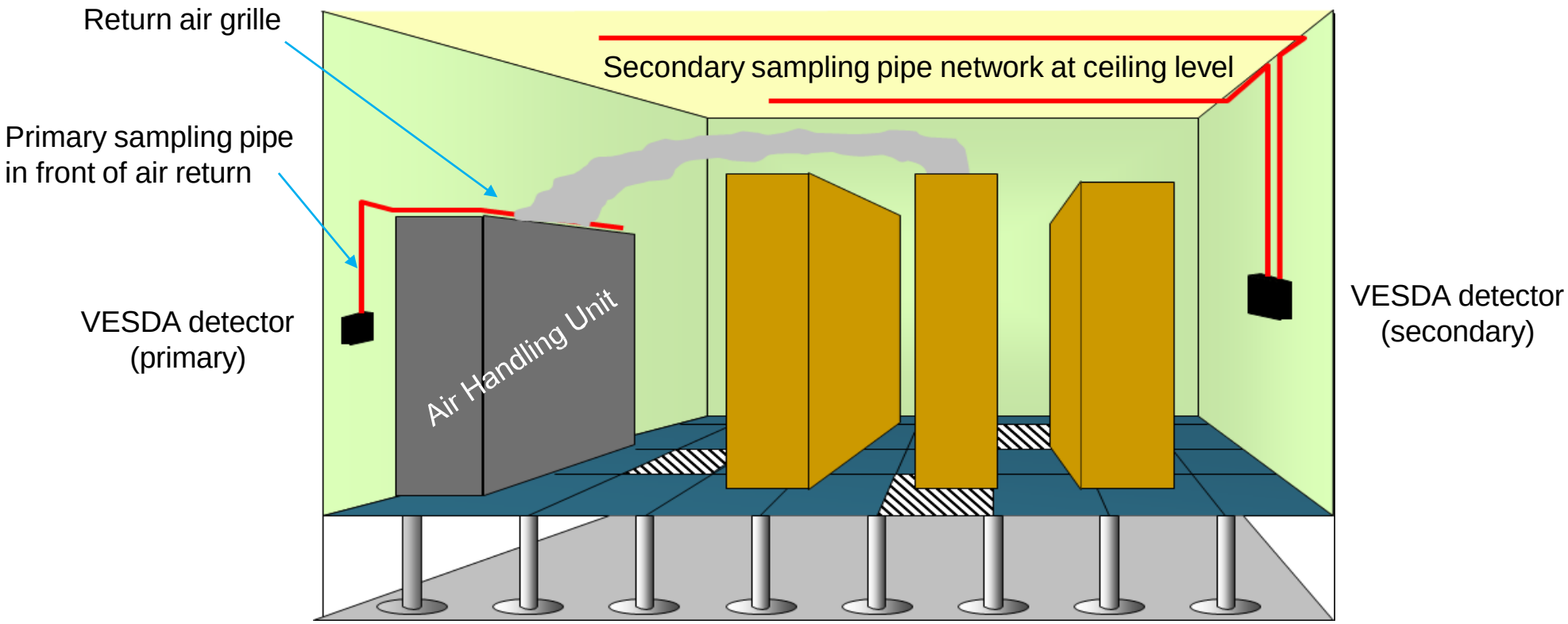
Sample points are the smoke detection points

THEY ARE ALL CONNECTED

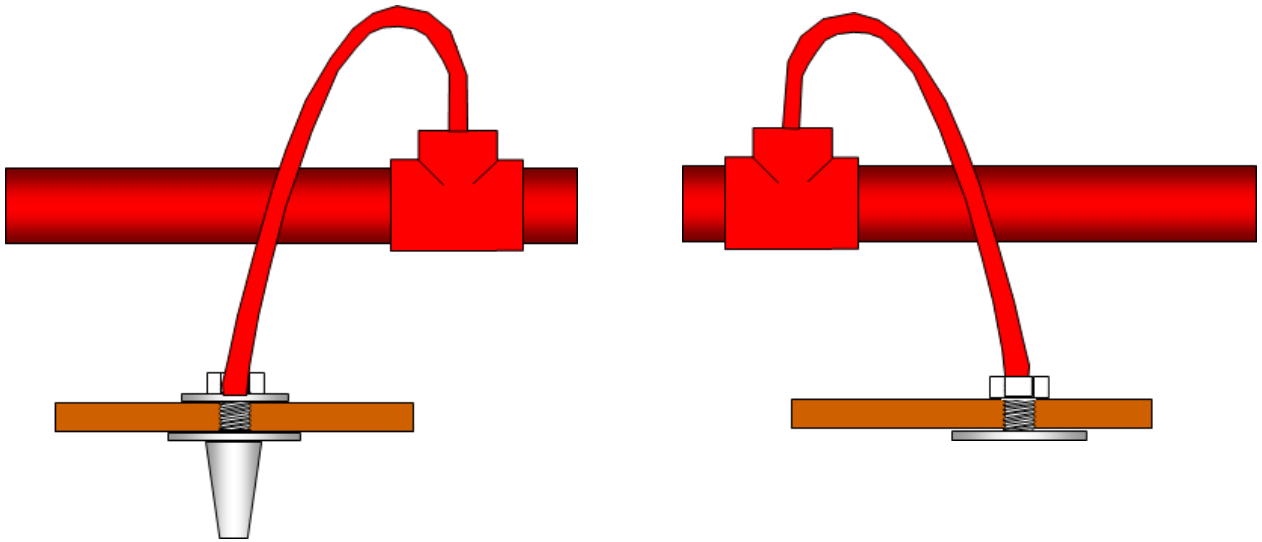
What is Primary & Secondary Detection?

Primary: Where the smoke will travel to when air circulation system is operating

Secondary: **Where smoke is likely to travel when air circulation system is shut down or not installed**



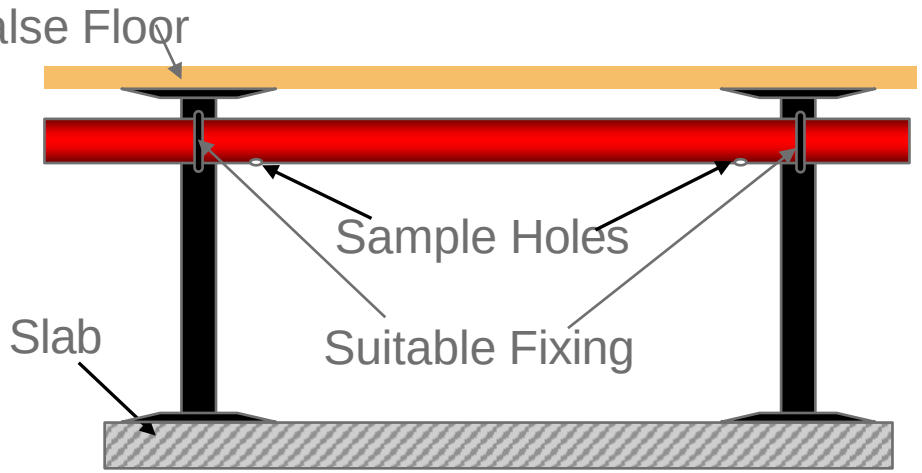
Sampling Methods – Ceiling

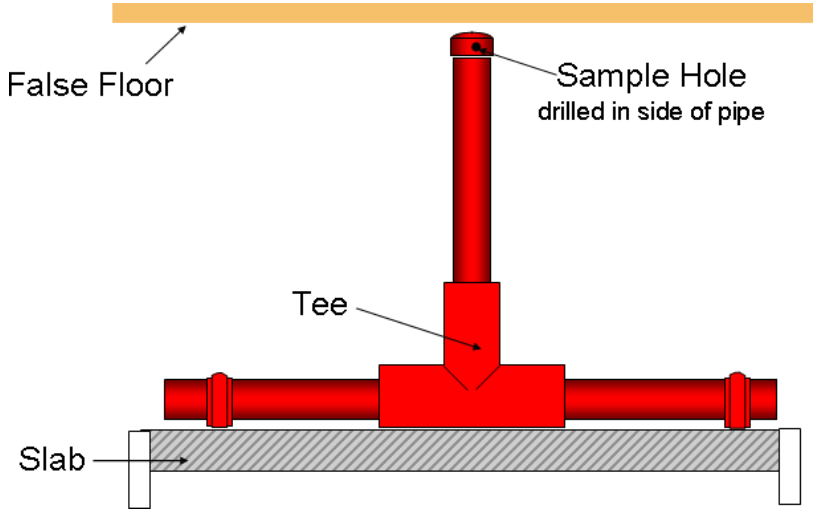


Capillary for Below False Ceiling Protection or in-cabinet protection

Direct Hole – Main Void Protection

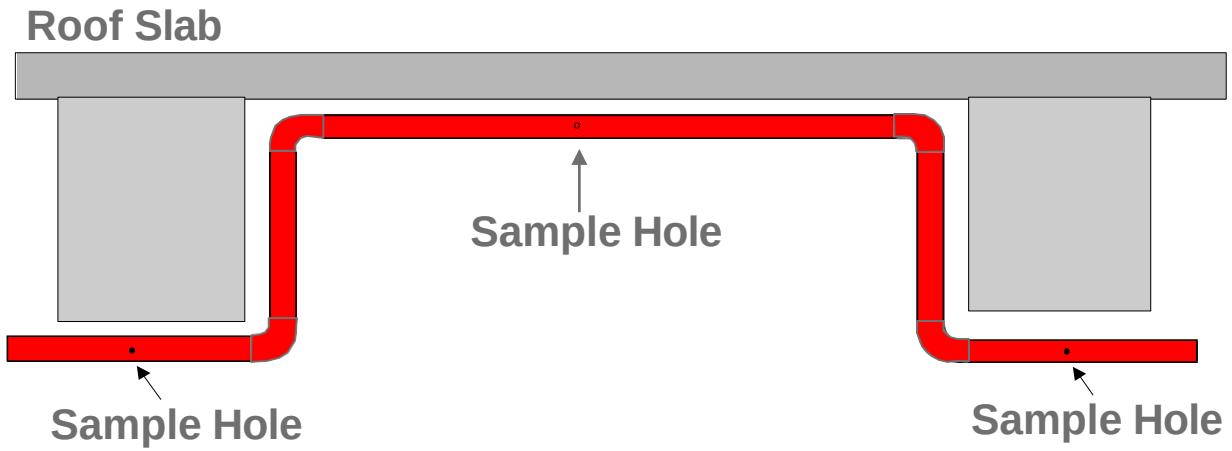
Sampling Methods - Under False Floor





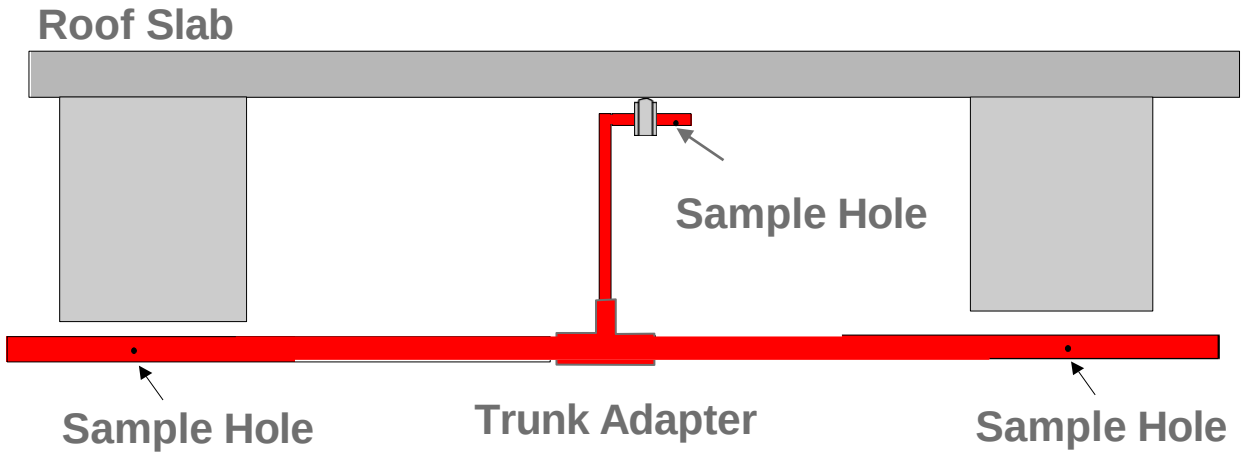
Pipe must be located in the top 10% of the floor void

Sampling Methods - Inter Beam



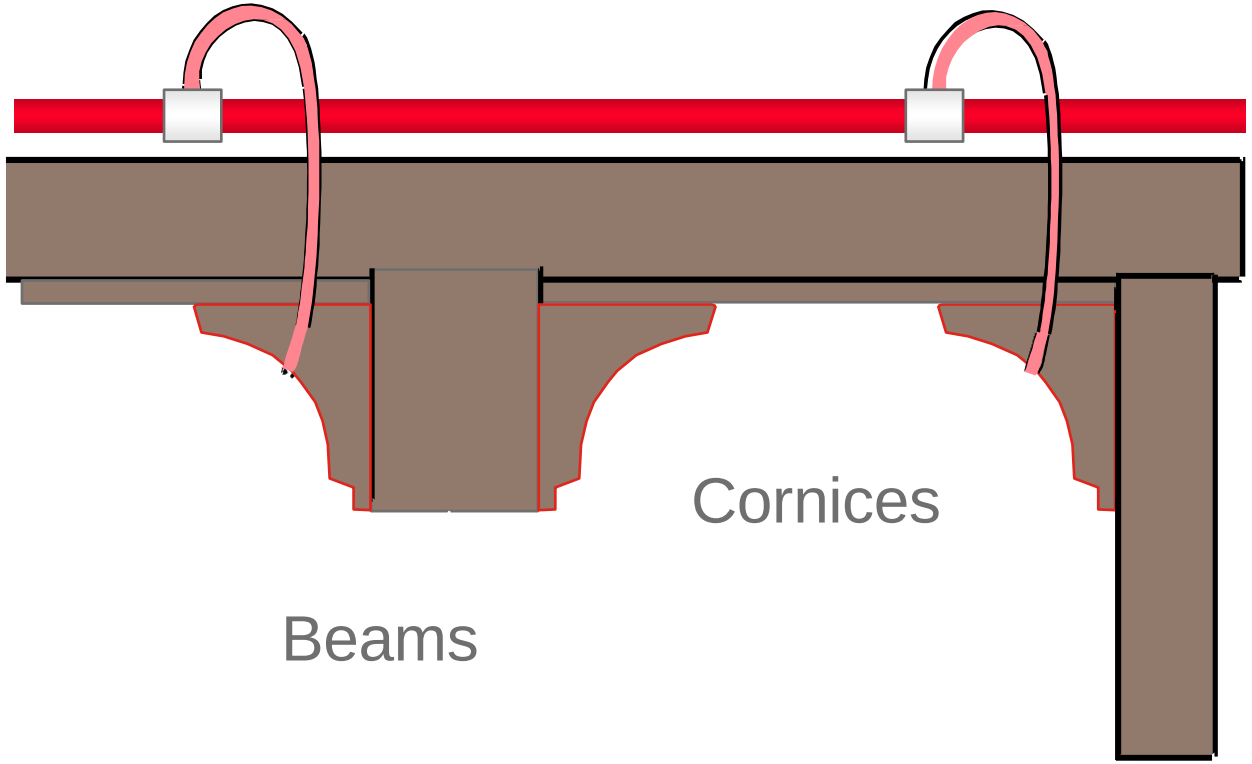
Option 1

Option 2

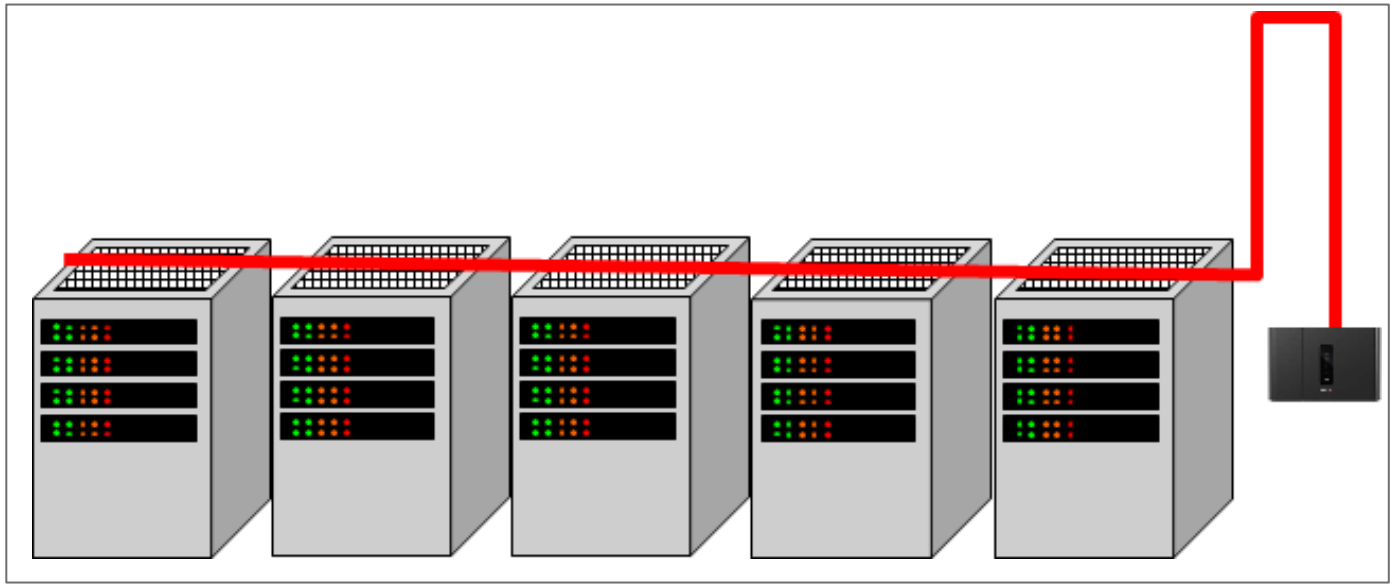


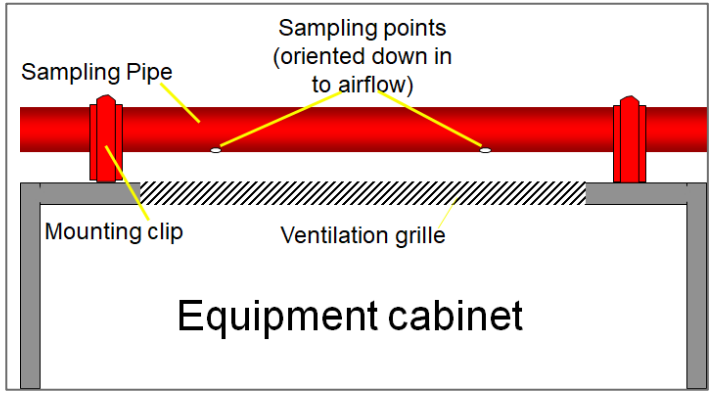
Sampling Methods - Concealed

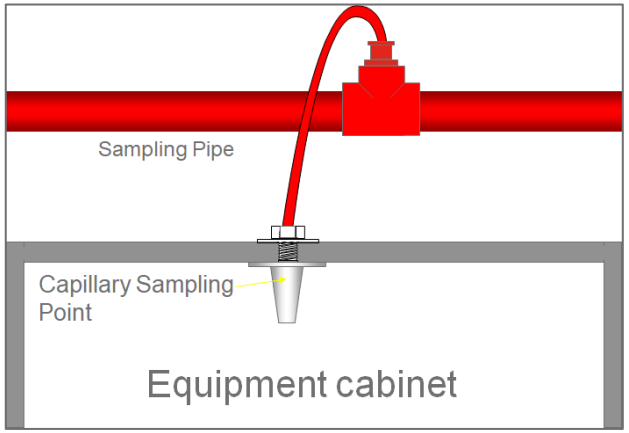
Capillary tubes runs above the ceiling and enter the fire zone through a small hole in the cornice



Sampling Methods - Cabinets Protection

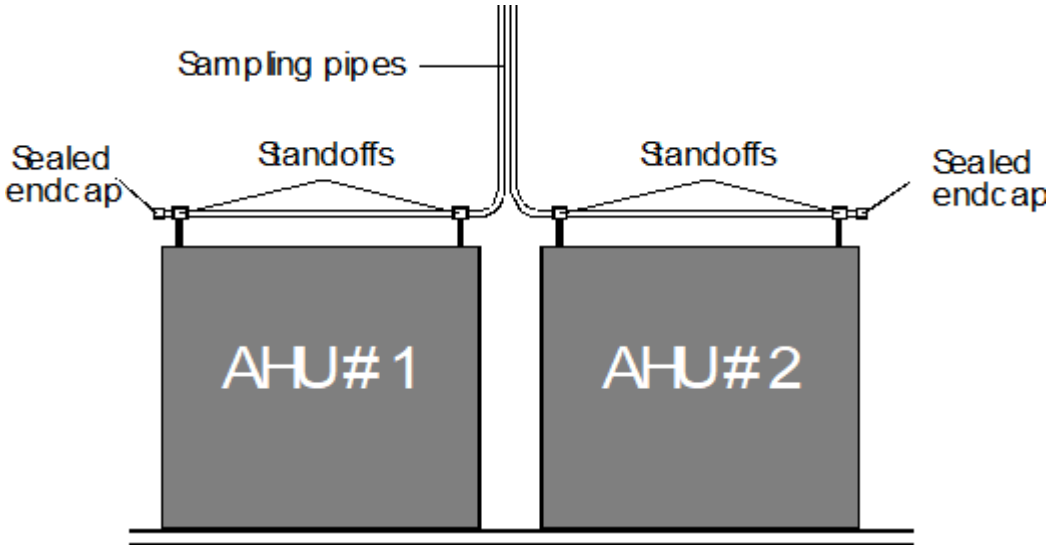


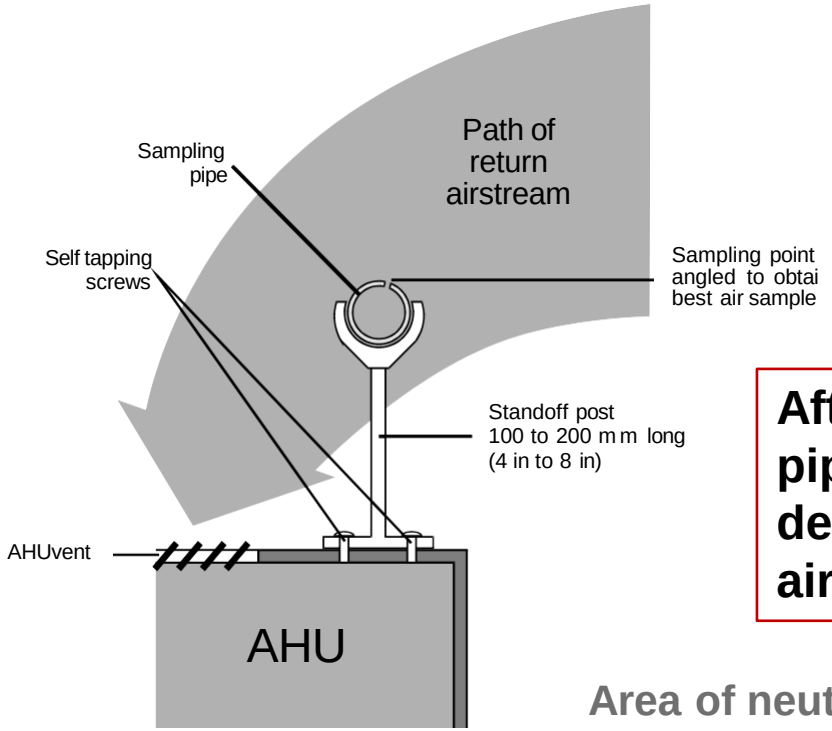




Alternatively, VEA would allow indication of individual cabinets

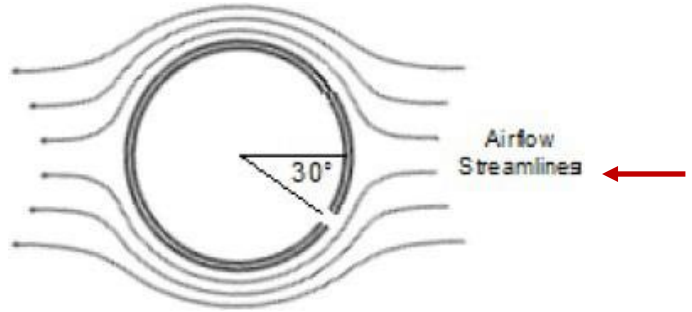
Sampling Methods - Return Air Grille





After drilling, rotate the pipes to around 30 degrees away from airflow path

Area of neutral pressure at 20-45° to the airflow



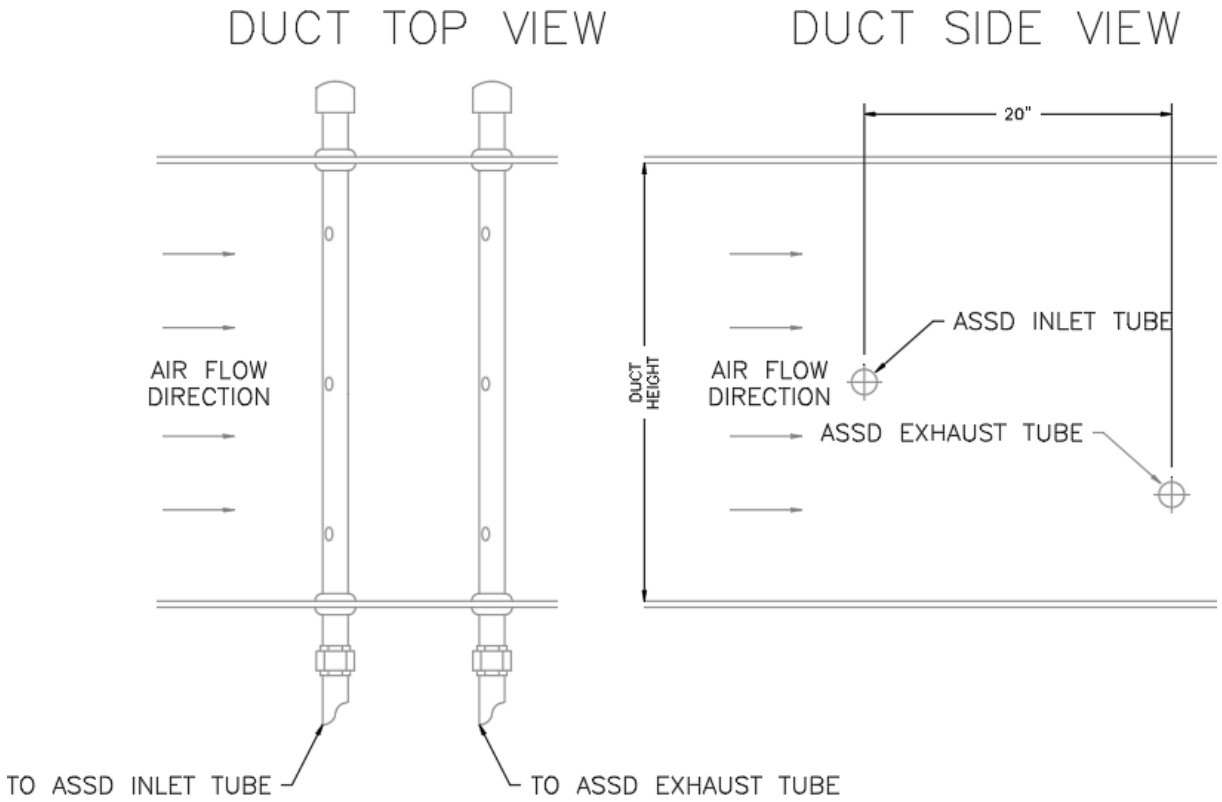
✓ **VESDA with 4 pipes should not Monitor more the Four AHU units**

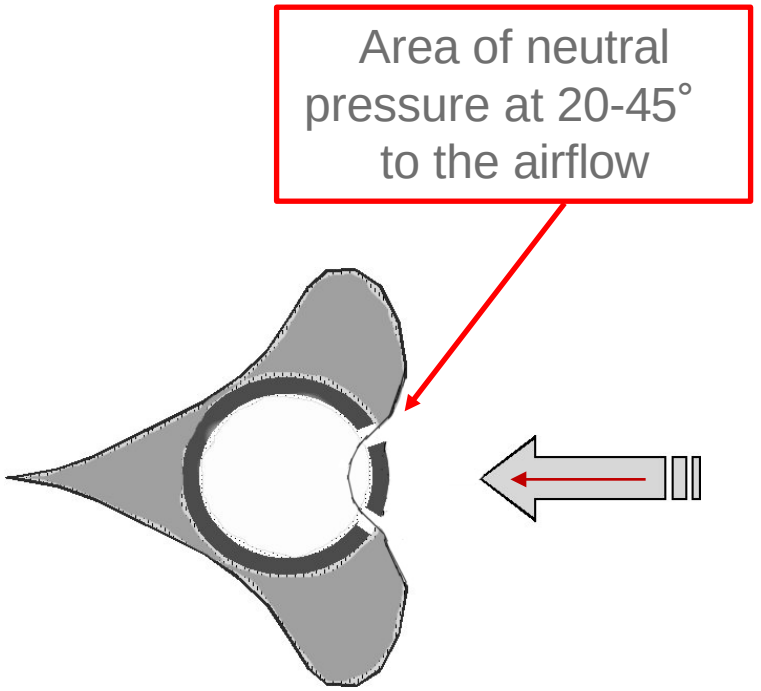
✗ Using single pipe for multiple AHU units protection

As per NFPA 76 and BS6266 as an example recommend a maximum area of coverage per sampling hole of 4 ft^2. (2 linear feet in any direction)

xtralis

Sampling Methods - Duct





As per Duct application notes, number of holes and their diameters based on duct width (Doc# 35424)

Actual Site Sampling Methods

VESDA Leading the Way on UL268 7th Edition

- The introduction of UL268 7th Edition introduces a new level of performance for smoke detectors aiming at improving building occupants' **life safety** and **reducing nuisance alarms**, taking effect from **30th Jun 2024**

- **NEW UL268 7th Edition REQUIREMENTS**

  The key changes of the UL268 7th Edition are the introduction of three new tests:

  - **Cooking nuisance** alarm test to replicate common cooking nuisance events
  - **Smouldering** polyurethane foam test, and
  - **Flaming** polyurethane foam test to replicate common furniture fires

- The new tests are intended to represent smoke profiles of **modern building fires** and drive technological advancements in reliable smoke detection to **distinguish** between **real threats** and **nuisance** sources.

- The new requirements present greater challenges in smoke detection and in particular for the Aspirating Smoke Detection (ASD) technology due to its fundamental principle of operation requiring time to **transport smoke** from the farthest sampling point to the detector via a pipe network.

VESDA Leading the Way on UL268 7th Edition

- **VESDA-E DIFFERENTIATION**
  - VESDA-E has set a new benchmark for reliable and effective smoke detection in the fire industry using its patented **Flair™ detection technology**.
  - Flair combines **CMOS imaging** with **multi-directional** laser light scattering to enable particle type characterisation, for the **earliest** possible **warning** of a fire threat whilst **minimising nuisance** alarms at the same time.
- **WAY FORWARD**
  - With the Flair detection technology, the VEU, VEP, VES detectors have been **listed** to UL268 7th Edition.
  - Despite the challenging requirements imposed by the new standard, these detectors will continue to provide **superior** performance reaffirming the leading detection capability of VESDA-E.
  - Furthermore, the VEA and VLF-500 have also achieved **compliance** with the UL268 7th Edition.
  - **Early introduction** is planned to further cement our pole position as the world leader of the aspirating smoke detection technology and being at the forefront of all global certification compliance.

xtralis

UL268 7th Edition – “Open” vs “Special”

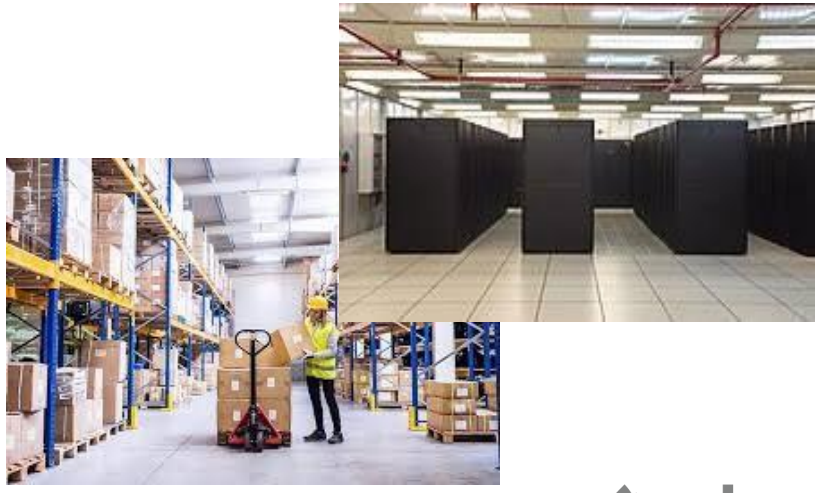
AD was instrumental in working with UL to clarify Detection Modes under the new standard for the overall benefit of the industry

OPEN AREA APPLICATIONS

- Used in applications where nuisance sources (cooking) are expected
- Examples include kitchens, cafeteria, food courts and other areas where cooking appliances are used
- Detectors are **not** permitted to signal an alarm under nuisance conditions

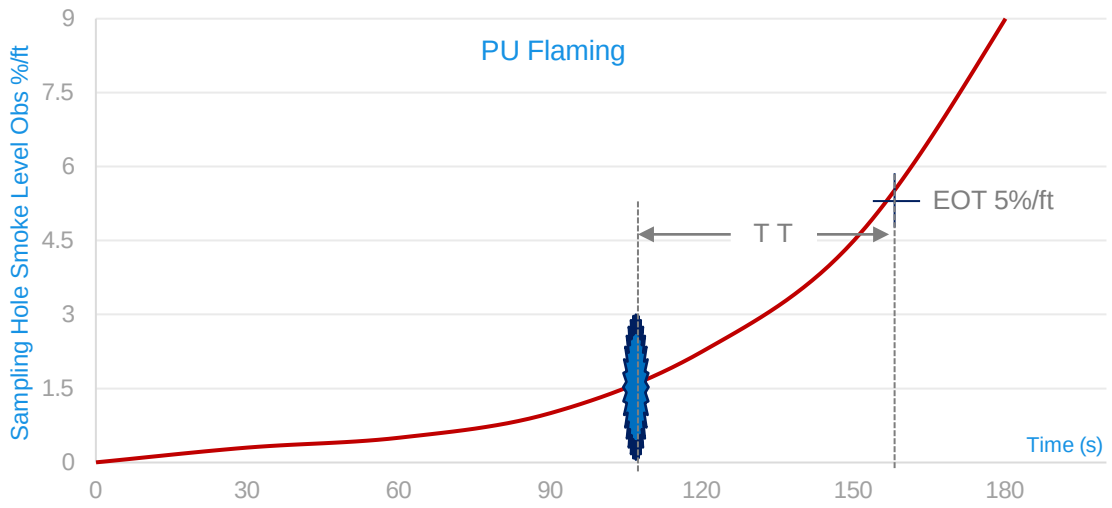
SPECIAL APPLICATIONS

- Used in applications where early warning is paramount and nuisance sources are **not** expected
- Examples include Datacentres, computer rooms, Telecom, warehouses, logistics, transport, utilities, power gen etc.
- Detectors need **not** comply with nuisance alarm requirements hence this mode is unsuitable for areas where cooking activities take place

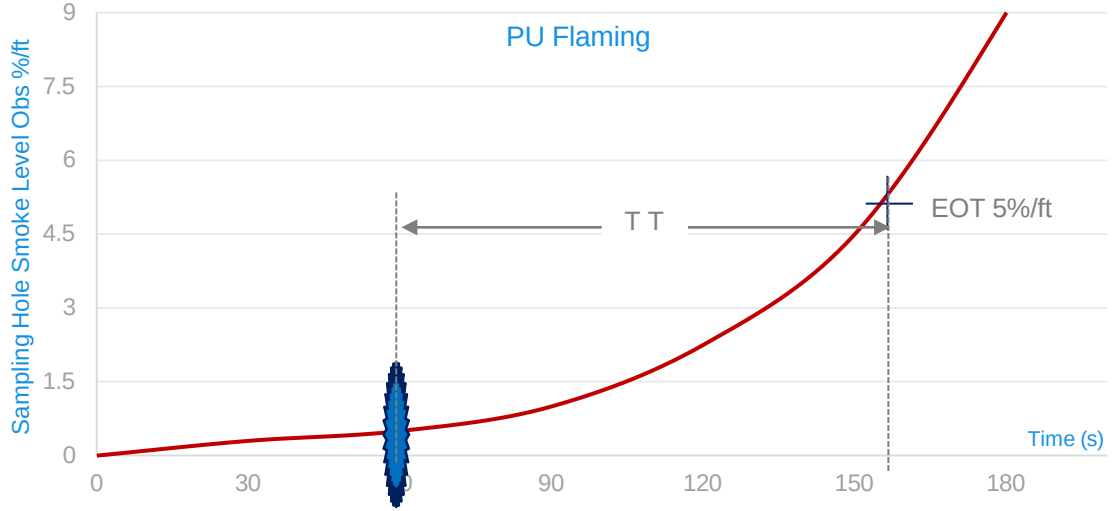


UL7th Edition – Sampling Hole Sensitivity Determination (PU Flaming Test)

- **Open Area – Sampling Hole Sensitivity (max TT)**
  - Lower boundary: ~1.5%ft (No alarm for Burger Test)
  - Upper boundary: ~3%/ft (account for transport time)



- **Special Application – Sampling Hole Sensitivity (max TT)**
  - Lower boundary: 0.003%ft
  - Upper boundary: ~0.45%/ft (account for transport time)

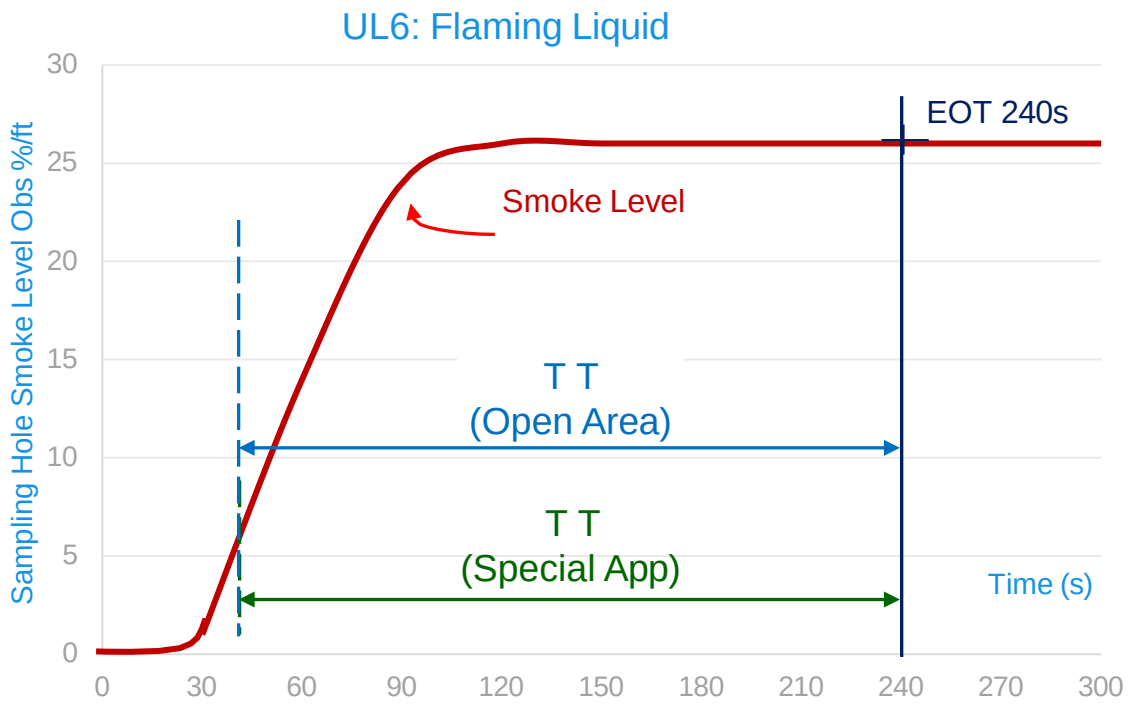


UL7 PU Flaming Test Characteristics

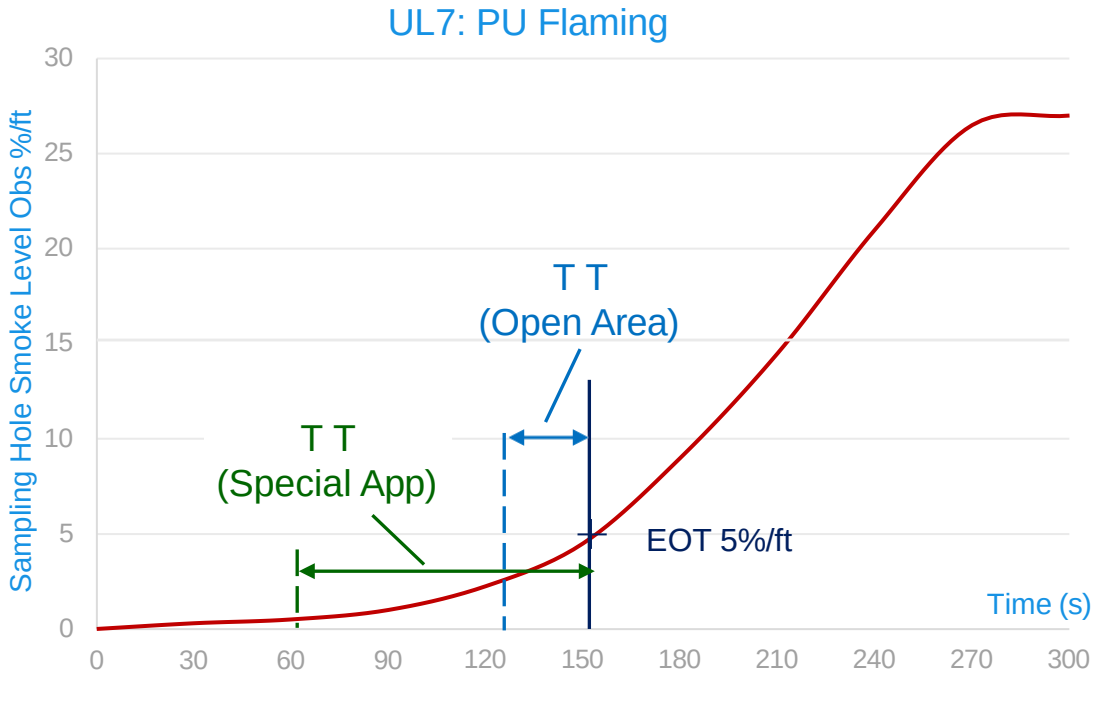
- Smoke profile initially slow developing
- Steep smoke rise before EOT
- EOT: 5%/ft

UL268 6th vs 7th Edition – Smoke Profiles

- **UL 268 6th Edition**
  - Steep rise in smoke level early in test
  - Smoke level becomes asymptotic mid-test
  - EOT: 240s (~25%/ft smoke level)



- **UL 268 7th Edition**
  - Smoke profile initially slow developing
  - Steep smoke rise before EOT
  - EOT: 5%/ft



UL268 7th Edition – Change in Smoke Transport Time

- Under UL268 6th Edition a standard smoke transport time of 120 seconds applied to all products
- Under UL268 7th Edition each product has its own smoke transport time for Open Area and Special Applications

Product	Application	Hole Sensitivity	Max Transport Time (sec)
VEP-1	Open Area	(1.551%/ft to 3.160%/ft)	**49**
	Special	(0.003%/ft to 0.460%/ft)	**90**
VEP	Open Area	(1.551%/ft to 3.160%/ft)	**45**
	Special	(0.003%/ft to 0.460%/ft)	**85**
VES	Open Area	(1.551%/ft to 3.160%/ft)	**40**
	Special	(0.003%/ft to 0.460%/ft)	**64**
VEU	Open Area	(1.551%/ft to 3.160%/ft)	**50**
	Special	(0.003%/ft to 0.460%/ft)	**85**
VLF-500	Open Area	(2.188%/ft to 3.160%/ft)	**24**
	Special	(0.003%/ft to 0.460%/ft)	**47**
VEA	Open Area	(2.509%/ft)	**51**
	Special	(0.490%/ft to 2.509%/ft)	**79**

UL268 7th Edition – Impact to Pipe Length & Holes

Detector designs subject to UL268 7th Edition requirements (transport time, sensitivity):

- **Minimal** deployment **impact** to **branched** pipe lengths and associated max number of holes
- VEA maintains **same** number and length of capillary tubes

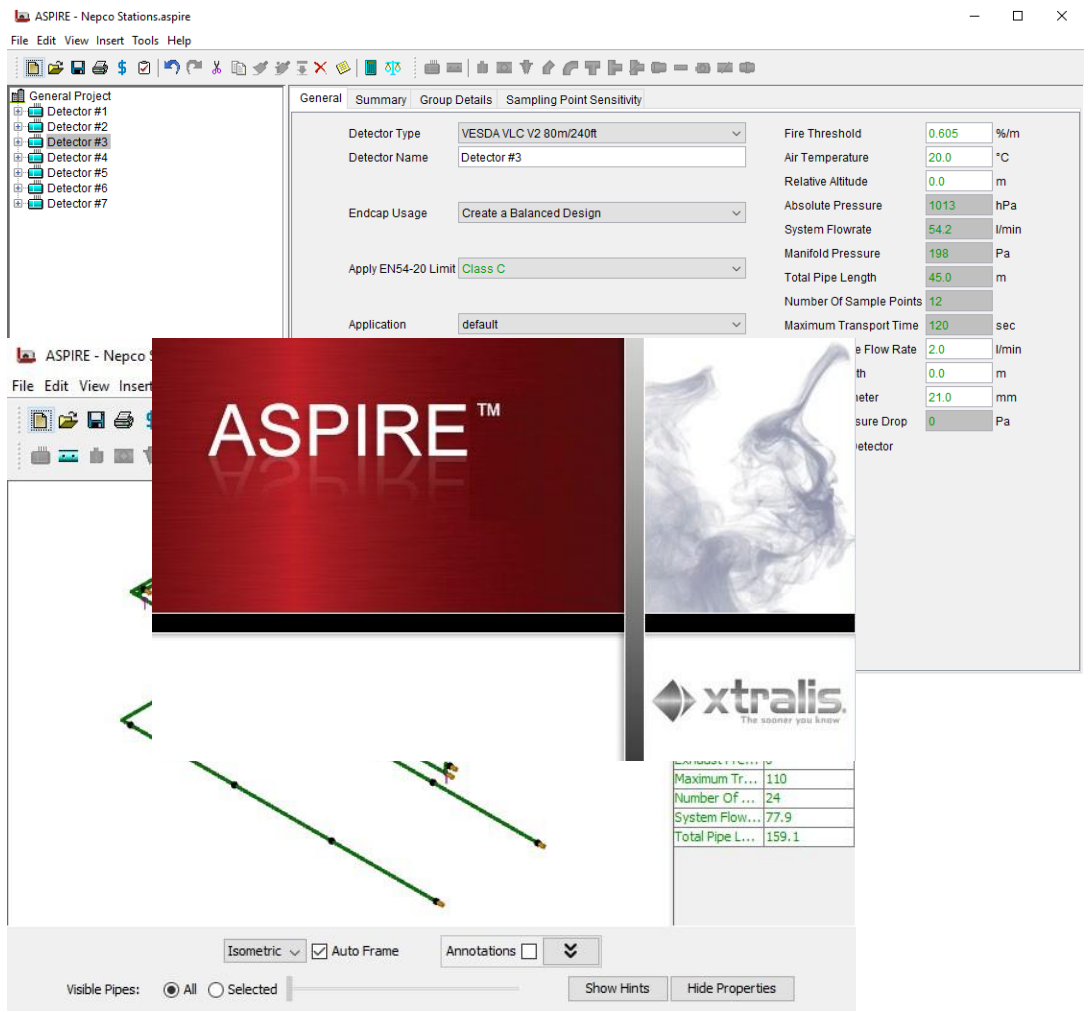
Product	BRANCHED PIPE NETWORKS			
	UL268 6th Edition (Old)		UL268 7th Edition	
	Max Pipe Length	Max No of Holes	Max pipe Length	Max No of Holes
VEP-1*	130m (426ft)	45	130m (426ft)	22
VEP*	560m (1837ft)	100	470m (1542ft)	80
VES*	560m (1837ft)	100	520m (1706ft)	98
VEU*	800m (2624ft)	100	610m (2001ft)	96
VLF-500*	60m (196ft)	24	60m (196ft)	16

* Detection Mode: Special Applications

Product	CAPILLARY NETWORKS			
	UL268 6th Edition (Old)		UL268 7th Edition	
VEA#	100m (328ft)	40	100m (328ft)	40

Detection Mode: Special Applications

ASPIRE Software



A calculation tool used to ensure optimum design of VESDA aspirating smoke detection pipe networks.

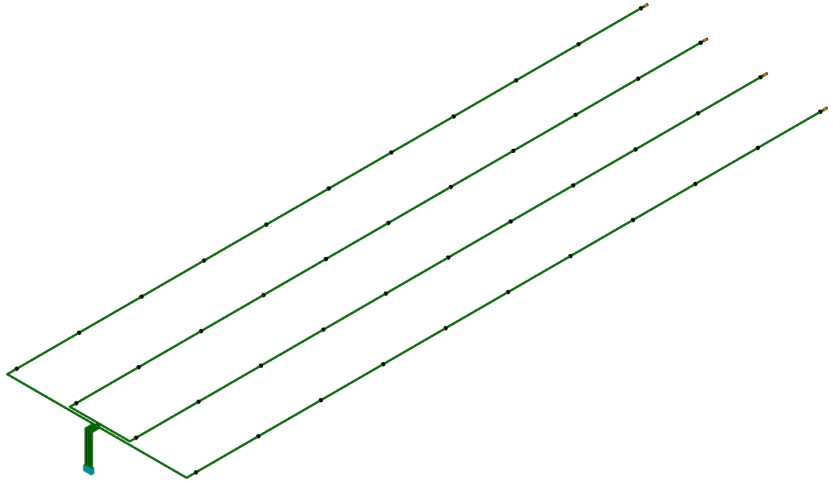
Below parameters must comply with the local standards that are applicable for area and application:

- Transport time
- Balance
- Sampling Point Sensitivity
- Sampling Point Pressures

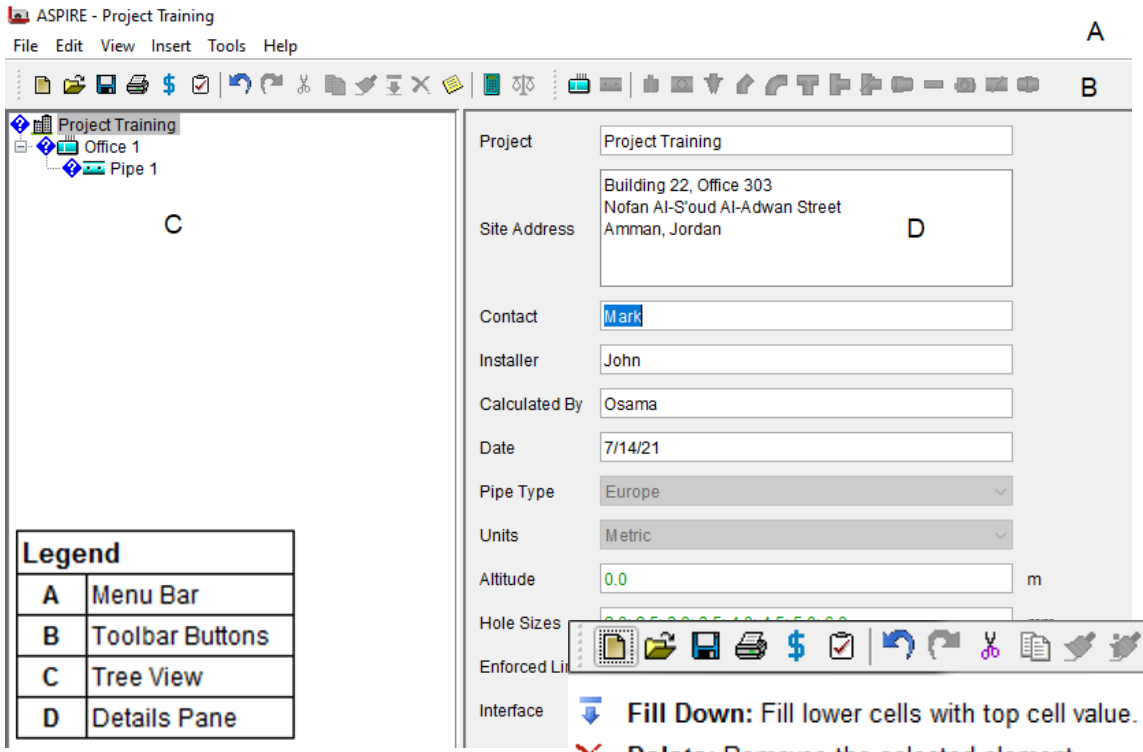
ASPIRE Tool

- ASPIRE supports UL268 7th Edition requirements:
  - *Open Area / Special Application* designs
  - Maximum Smoke Transport Times
  - Holes' Sensitivity
  - Maximum Dilution
  - Minimum Balance (Open Area)

- Supported Detectors:
  - VEU
  - VEP
  - VEP-1
  - VES
  - VLF-500



ASPIRE Software



Legend	
A	Menu Bar
B	Toolbar Buttons
C	Tree View
D	Details Pane

Add Detector: This button allows you to add a detector to your site design.

Add Pipe: This button allows you to add extra pipes to a detector in your site design.

Add Hole: This button lets you add a hole to your pipe run.

Add Capillary: This button lets you add a capillary to your pipe network design.

Add HASP: This button lets you add a Heat Activated Sampling Point.

Add 45° Elbow: This button lets you add an elbow to your pipe network design.

Add Bend: This button lets you add a bend to your pipe network design.

Add Small Radius Bend: This button lets you add a small radius bend to your pipe network design.

Add T Piece: This button lets you add a T piece to your pipe network design.

Add Reducer: This button lets you add a pipe reducer to connect different sized pipes.

Fill Down: Fill lower cells with top cell value.

Delete: Removes the selected element.

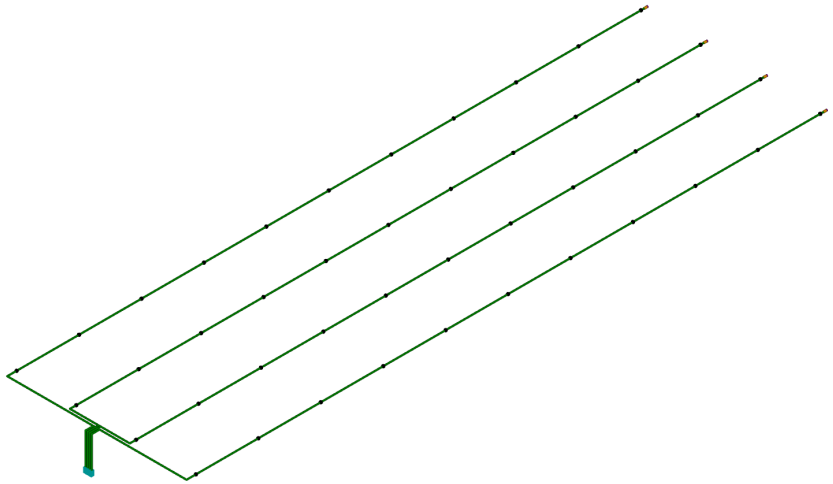
Edit Note: This button allows you to add notes to any element of the pipe network design.
These notes will be included in the IDP (Installation Data Pack) which can be given to the installers.
Use notes to name and help the installers distinguish between different pipes.

Calculate: Once you have made changes to your pipe network click this button to recalculate all of the ASPIRE figures based on your current parameters.

Auto Balance: If you have entered the details of your proposed design and the calculate function is returning **Amber/Orange** or **Red** results, selecting this button will cause ASPIRE to automatically adjust hole size settings to see if a valid configuration is possible that satisfies the design constraints. Auto Balance will test a variety of hole sizes, endcap sizes and fire thresholds.

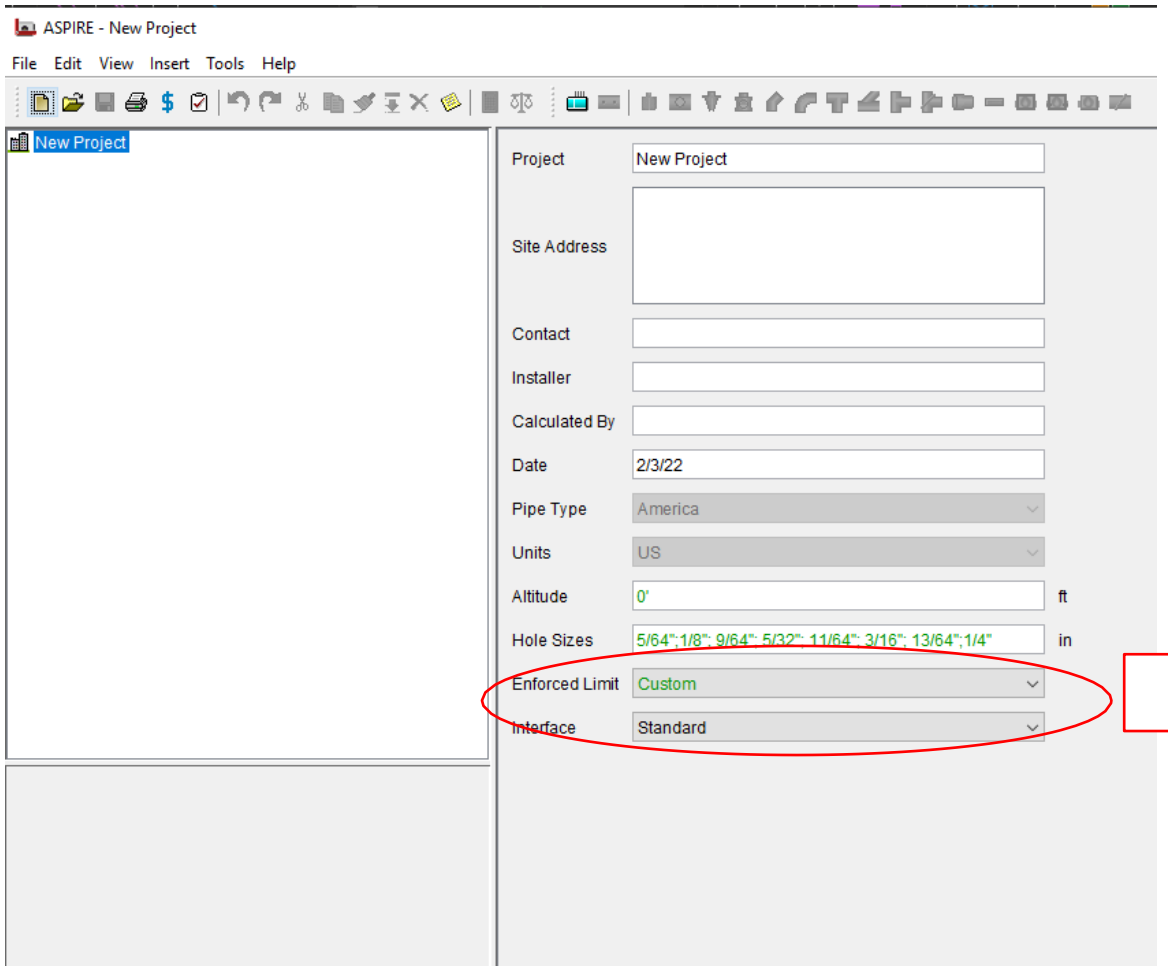
New ASPIRE Parameters

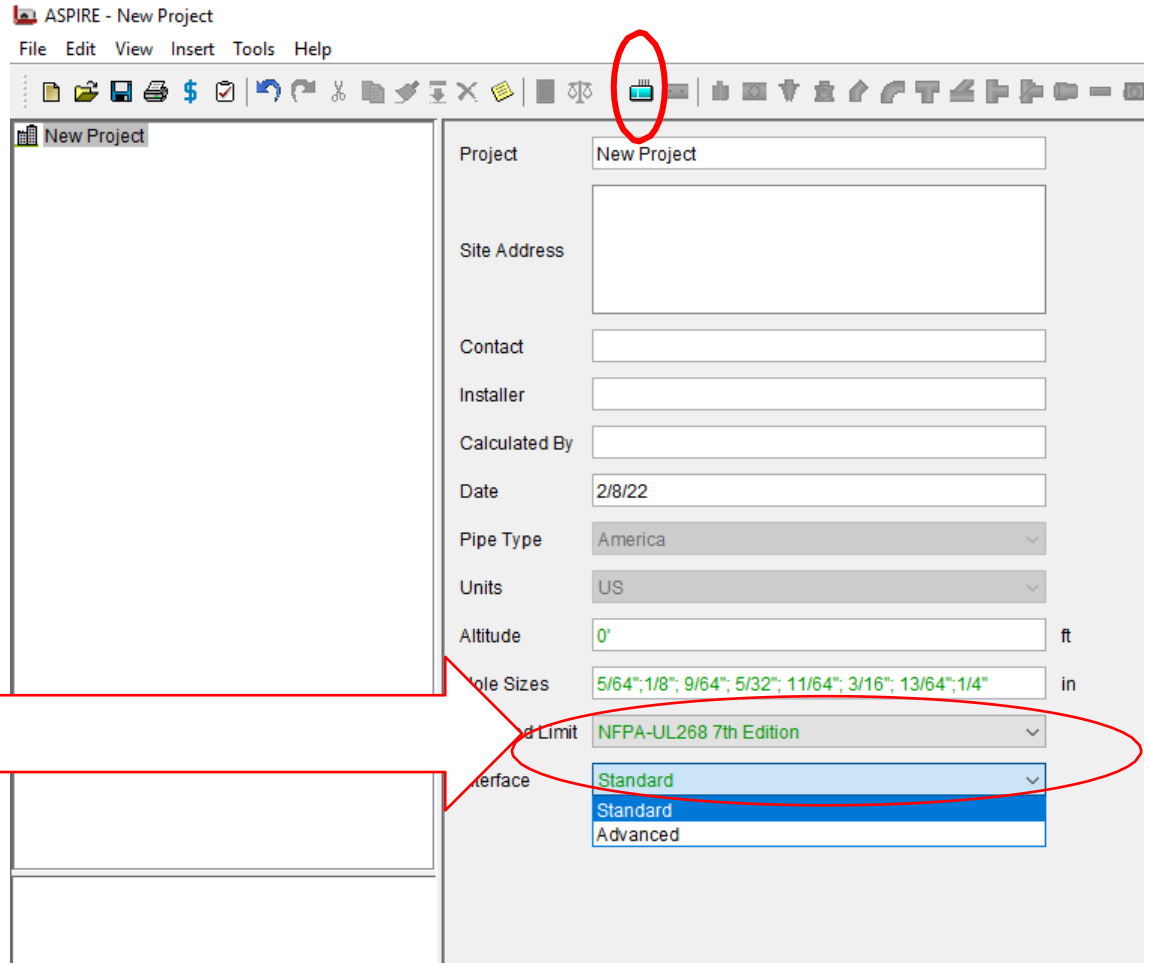
- Detection Modes:
  - Open Area (Below 300fpm)
  - Open Area (300-4000fpm)
  - Special Applications High Sens (Below 300fpm)
  - Special Applications High Sens (300-4000fpm)
  - Special Applications Low Sens (Below 300fpm)
  - Special Applications Low Sens (300-4000fpm)
  - DUCT
  - NFPA 76 – EWFD
  - NFPA 76 – VEWFD



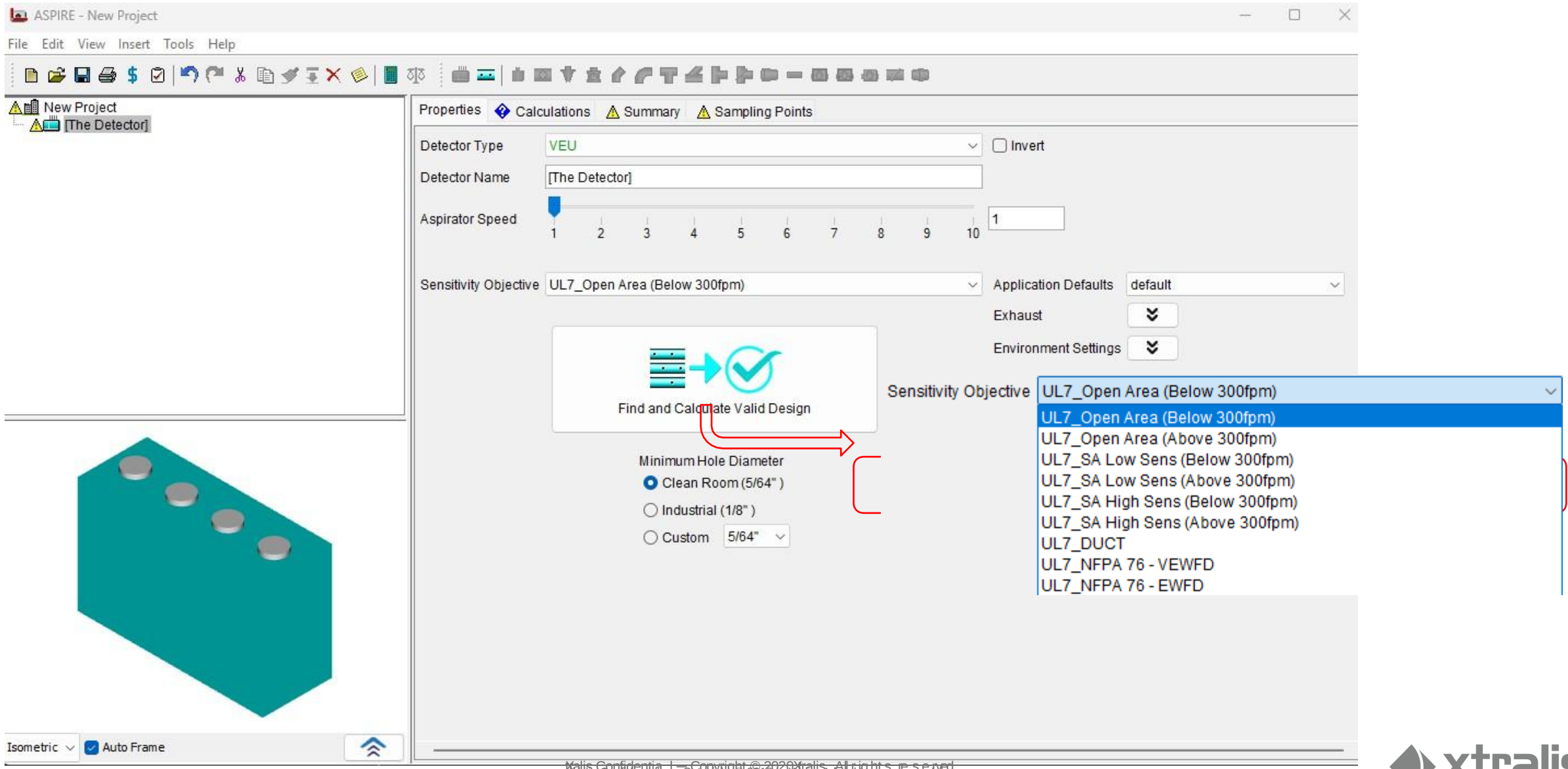
- Changes for UL 7th Edition:
  - A rule for the Hole Sensitivity range
  - Maximum Transport Time rule
  - Minimum Balance rule (only for Open Area)
  - Maximum Dilution rule

UL268 7th Edition Standard Interface



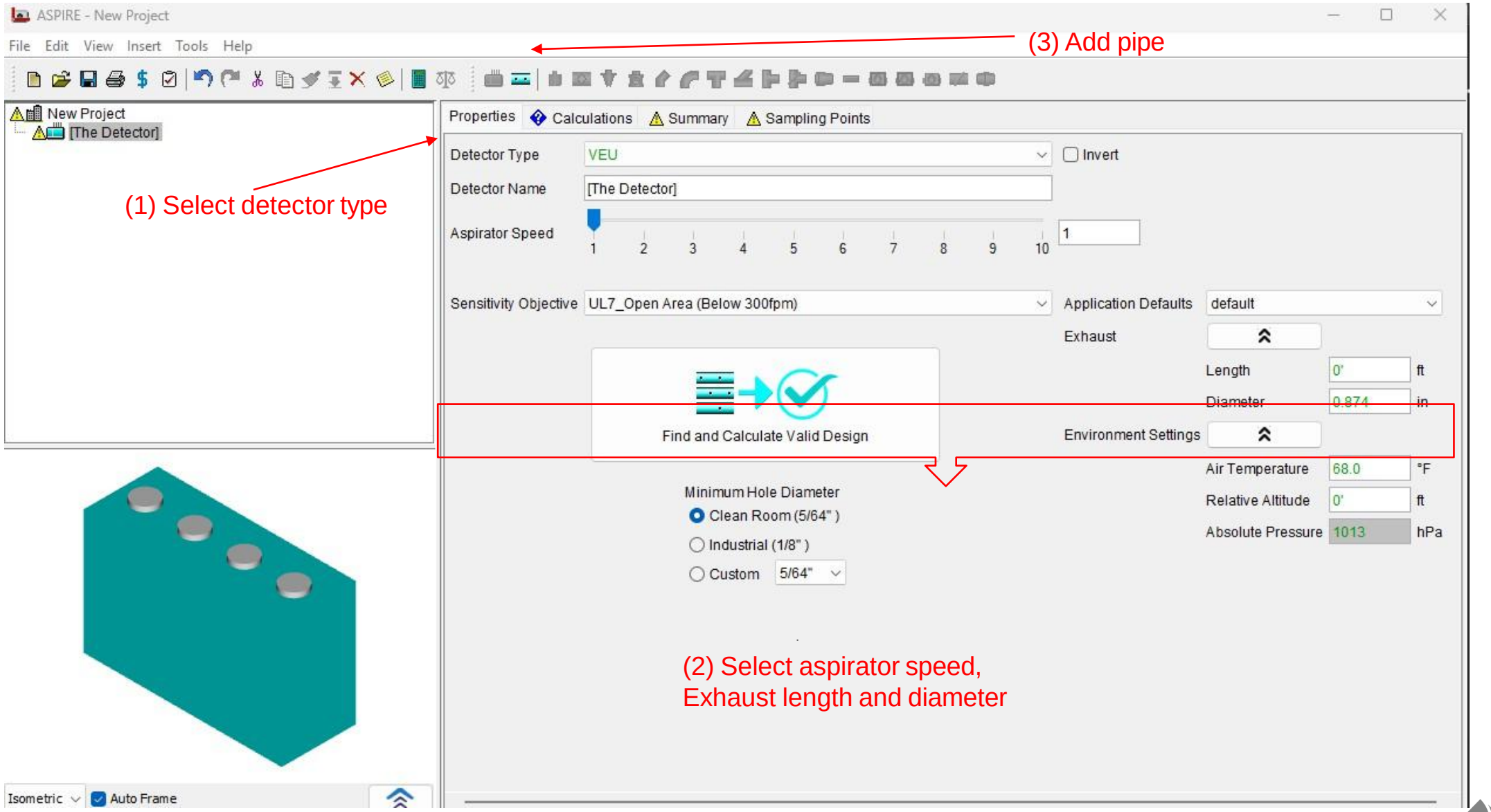


UL268 7th Edition (Standard interface) Properties tab



Xtralis Confidential – Copyright © 2018 by Xtralis. All rights reserved.

UL268 7th Edition (Standard interface) – New Detector

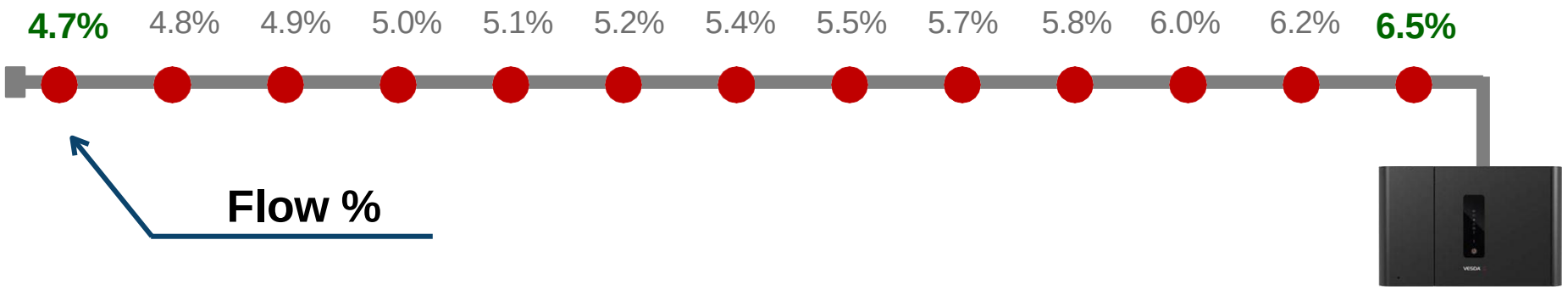


ASPIRE – System Balance

FLOW BALANCE = $\frac{\text{LEAST FLOW \%}}{\text{HIGHEST FLOW \%}}$

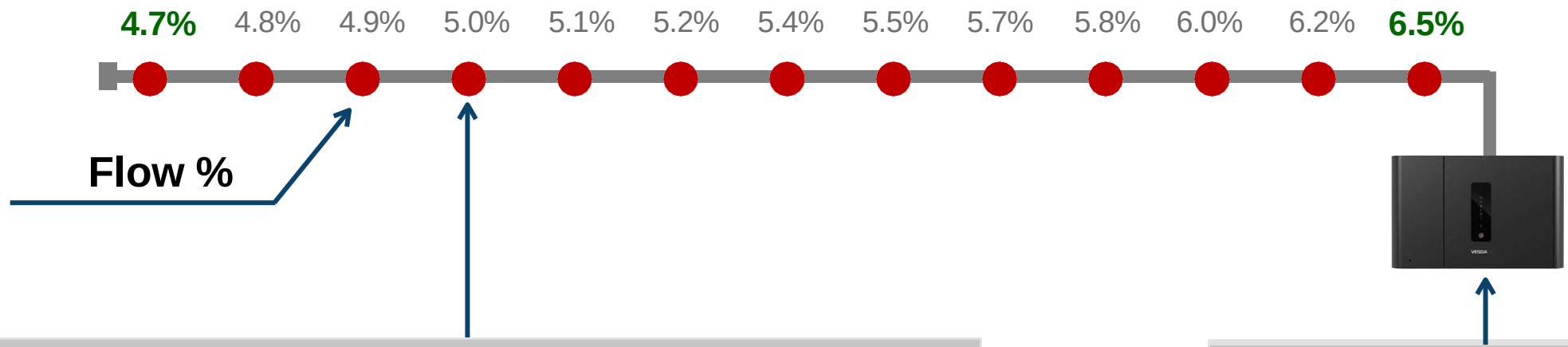
TARGET BALANCE >= 70%

BALANCE = $\frac{4.7}{6.5}$ X 100 = 72%



ASPIRE – Hole Sensitivity

ASD Sensitivity: How much smoke at a single SP, with clean air at all others, to cause an alarm at the detector

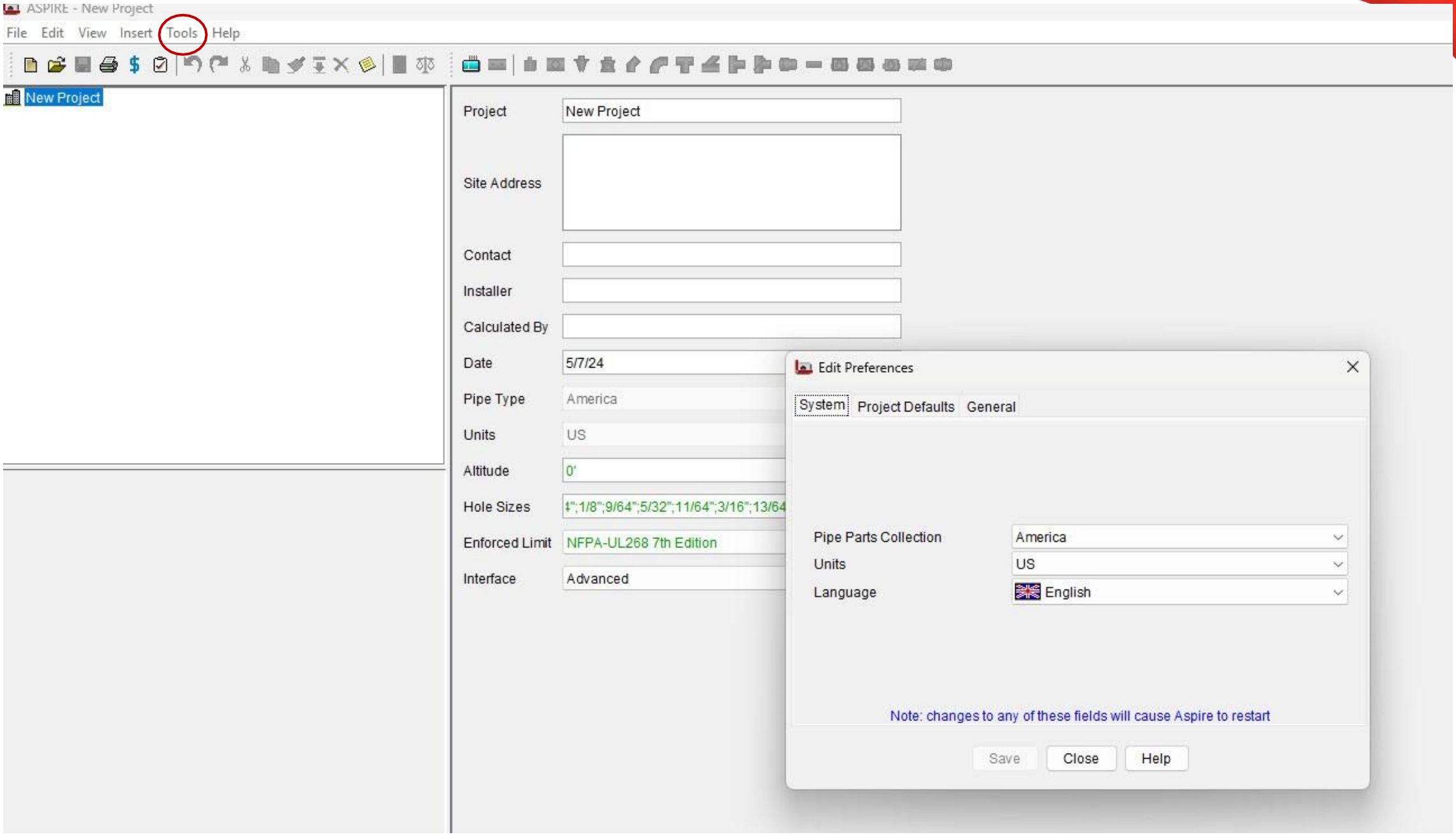


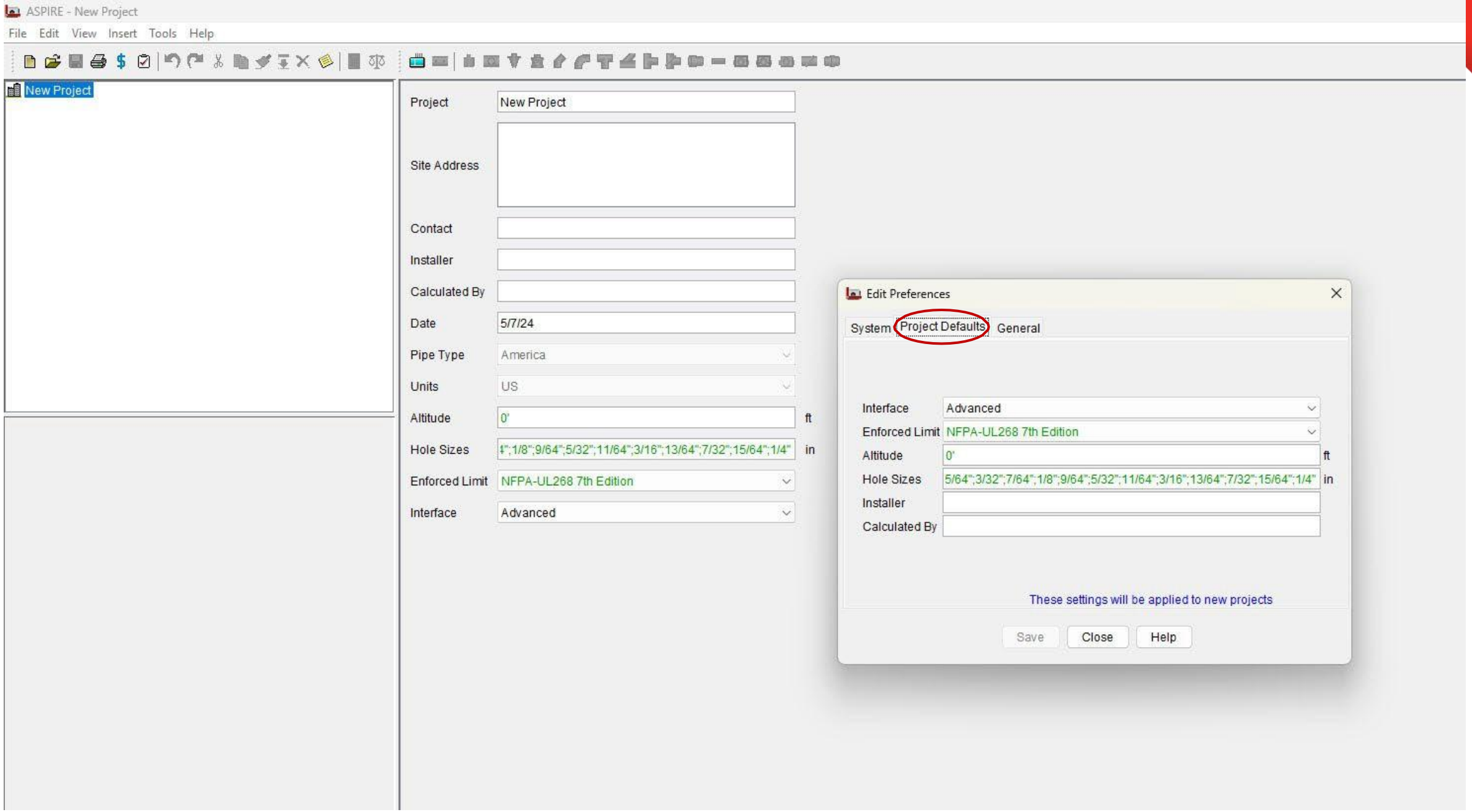
HOLE SENSITIVITY

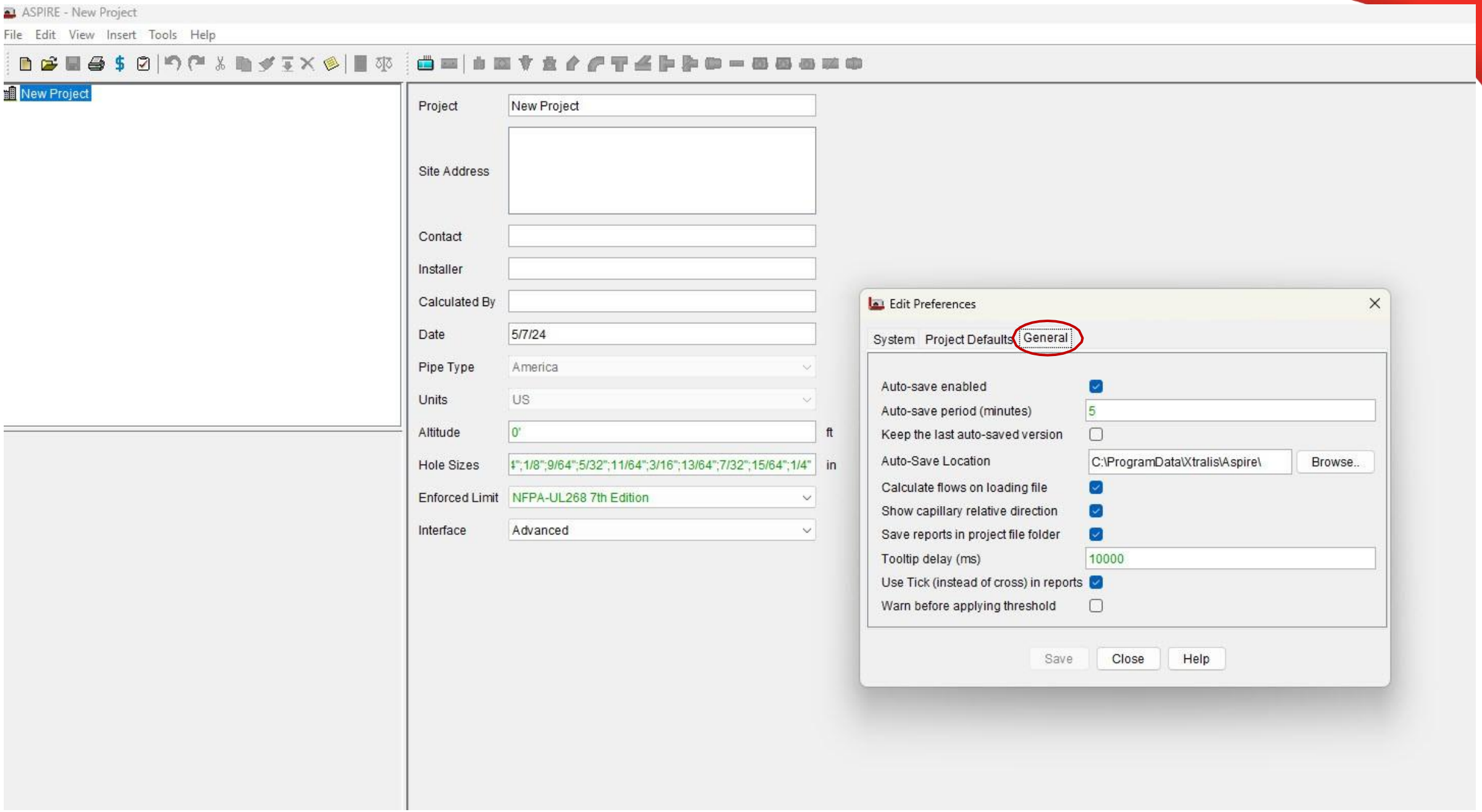
$$\frac{\text{Detector F1 Sensitivity}}{\text{Sample Point Flow \%}} = \frac{0.1}{0.05} = 2.0\%\ \text{Obs/m}\ (0.6\%\ \text{Obs/ft})$$

Detector Sensitivity

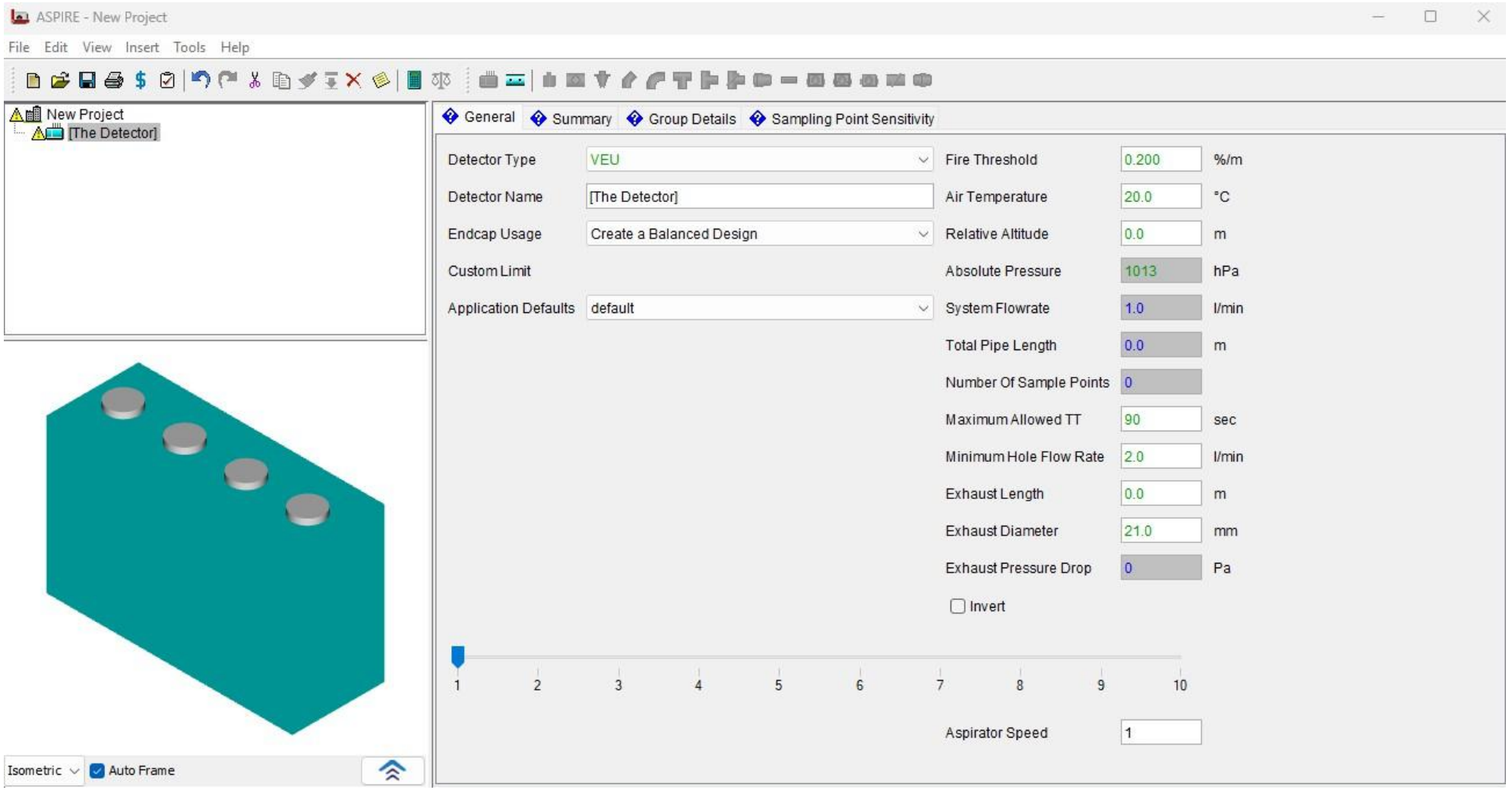
F1=0.1% Obs/m
(0.03% Obs/ft)







Advanced Interface



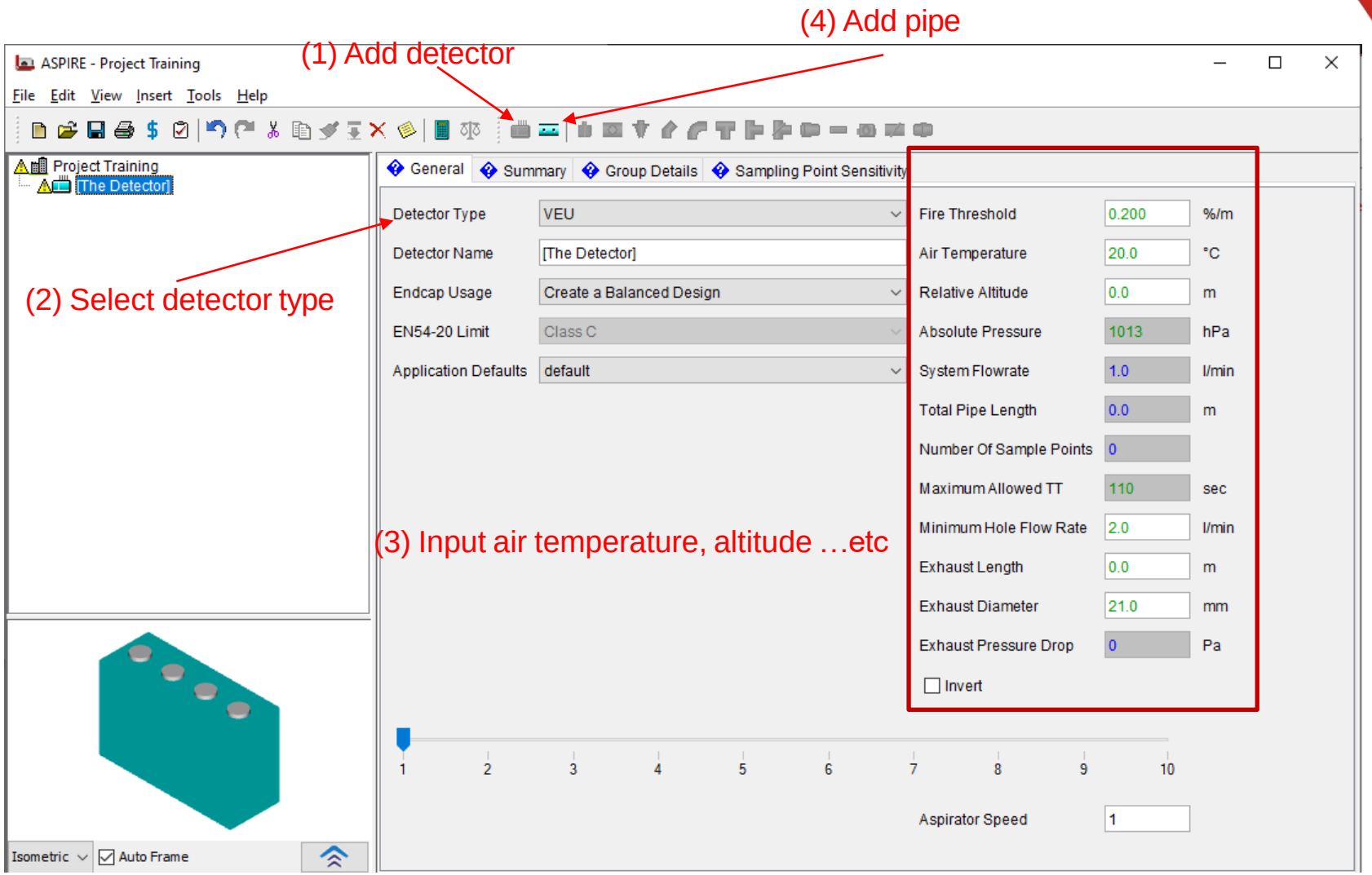
The General Tab of the Detector View - New Detector

1) Press on “Add detector”

2) Select detector type

3) Input air temperature value, altitude and other parameters

4) Add first pipe

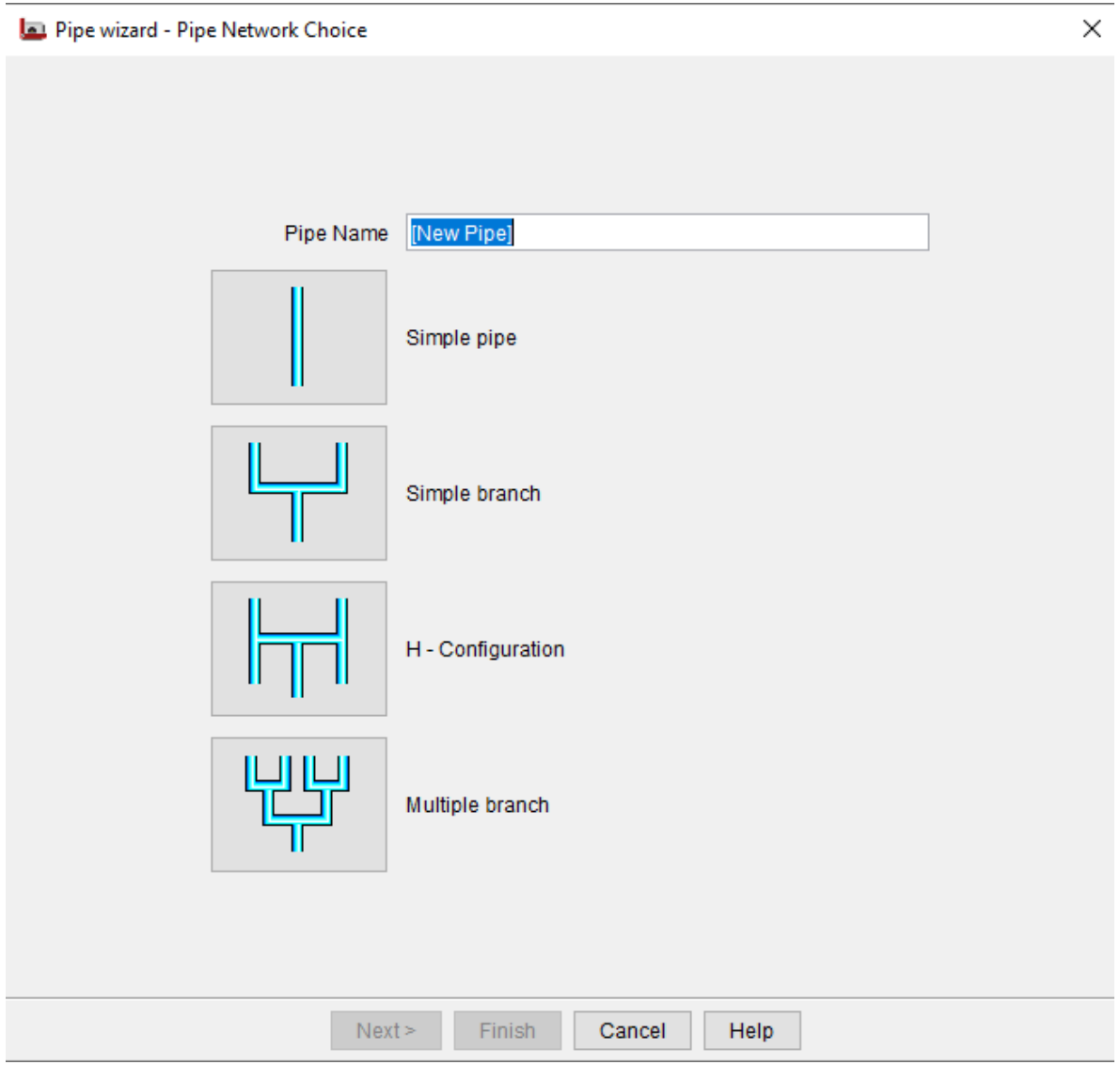


Pipe Wizard – Pipe Network Choice

Enter a name and select which type of pipe is to be added to the detector.

- **Simple Pipe.**
- **Simple branch.**
- **H - configuration.**
- **Multiple Branch.**

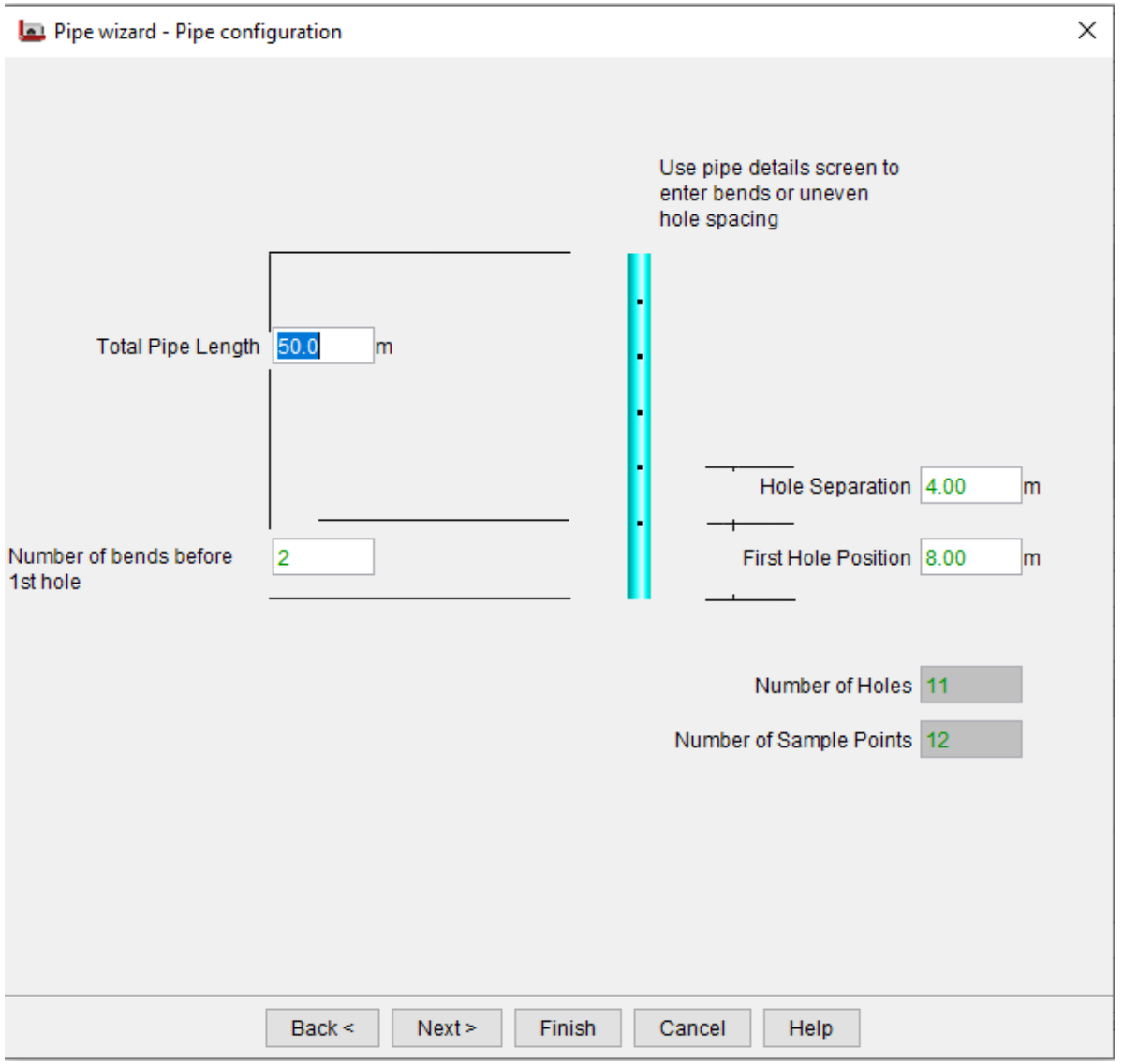
For example, we choose Simple pipe.



Pipe Wizard – Pipe Network Choice

Settings allow you to configure a pipe which may have bends but does not split into more than one pipe

- **Total Pipe Length.**
- **Number of bends before the first hole.**
- **First Hole Position.**
- **Hole Separation.**
- **Number of Holes.**
- **Number of Sample Points.**

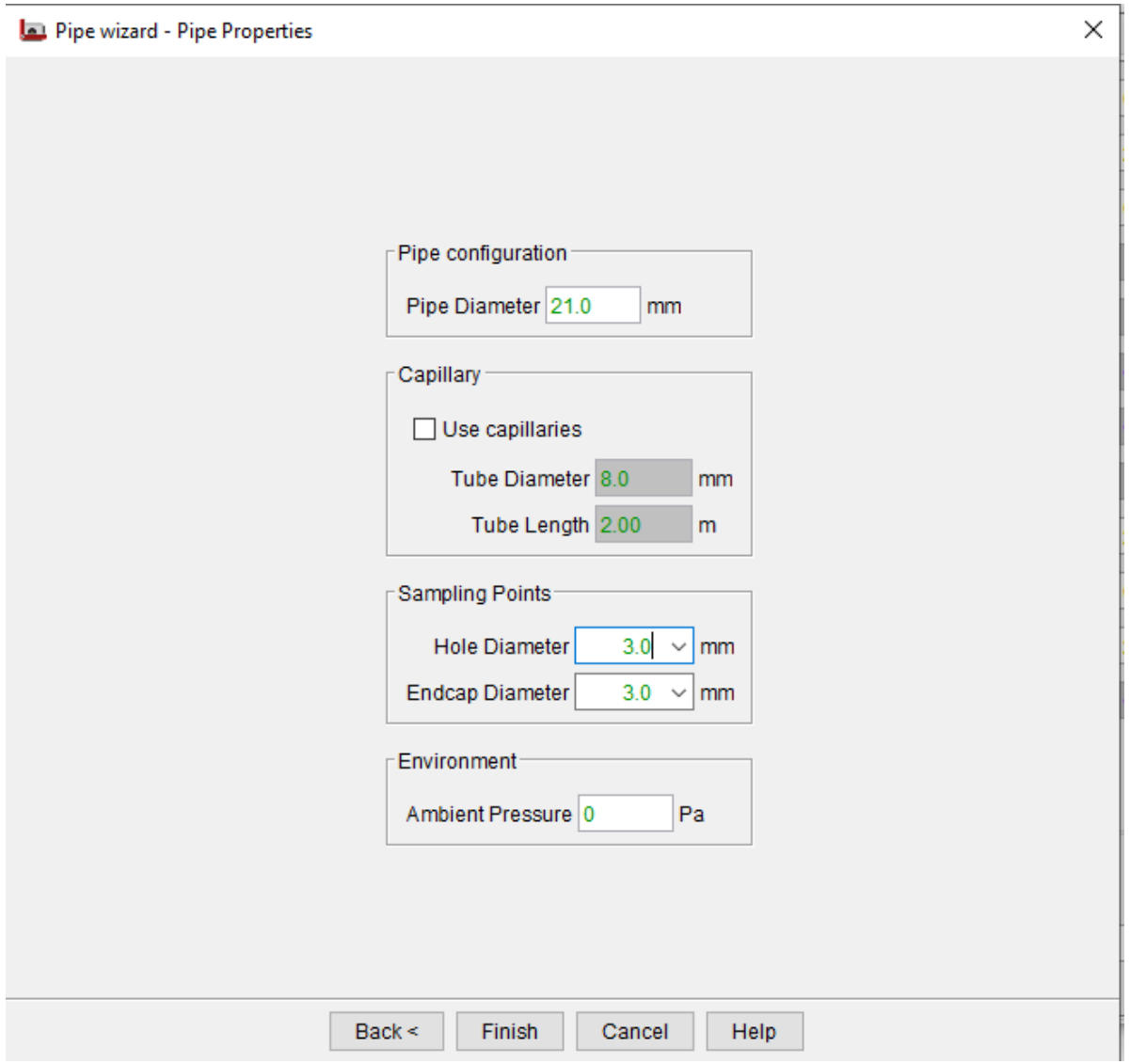


Pipe Wizard – Pipe Network Choice

When you press on Next, this Window will appear to configure:

- **Pipe Diameter.**
- **Capillary Diameter & Capillary Length (if you are using it).**
- **Hole Diameter & Endcap Diameter.**
- **Ambient Pressure.**

Finish: Selecting this button will cause the Pipe Wizard to automatically accept the default values for any Pipe Wizard options which you have not already set.



The Pipe View

ASPIRE - Project Training

File Edit View Insert Tools Help

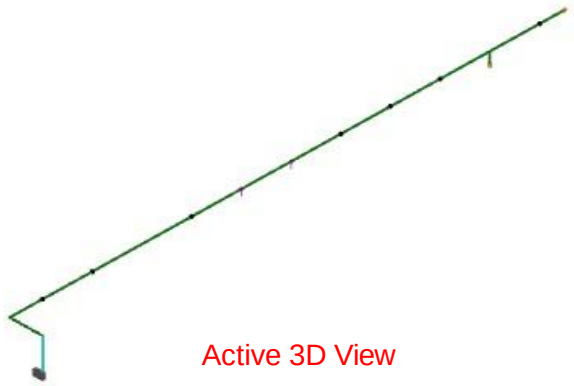
Project Training
Office
[New Pipe]
Section1
Section2

Total Pipe Length 51.0 m Sector Pressure 301 Pa Pipe Flowrate 54.0 l/min

Ambient Pressure 0 Pa Number of Sample Points 11 Fill Down

Item	Type	Direction	Absolute Distance	Relative Distance	Hole Diameter	Tube Length	Transport Time	Pressure	Flow	Flow%	Dilution	Hole Sensitivity	Pipe Diameter	Tube Diameter	Intersection Pressure
	Bend 90	L	2.67	2.67											
	Bend 90	F	5.34	2.67											
1:Section0-1	Hole		8.00	2.66	3.0		7	236	6.0	11.1	9	5.644	21.0		
1:Section0-2	Hole		12.00	4.00	3.0		8	211	5.7	10.5	10	5.972	21.0		
1:Section0-3	Hole		20.00	8.00	3.0		12	171	5.1	9.5	11	6.633	21.0		
1:Section0-4	Capillary		24.00	4.00	3.0	2.00	15	120	4.9	9.1	11	6.921	21.0	8.0	156
1:Section0-5	Capillary		28.00	4.00	3.0	2.00	17	110	4.7	8.7	11	7.216	21.0	8.0	145
1:Section0-6	Hole		32.00	4.00	3.0		18	136	4.6	8.4	12	7.436	21.0		
1:Section0-7	Hole		36.00	4.00	3.0		21	129	4.4	8.2	12	7.638	21.0		
1:Section0-8	Hole		40.00	4.00	3.0		24	124	4.3	8.1	12	7.799	21.0		
	Drop Pipe	D	44.00	4.00	3.0	1.00	32	120	5.0	9.3		6.736		21.0	
1:Section0-9	Hole		48.00	4.00	3.0		34	118	4.2	7.9	13	7.996	21.0		
1:Section0-10	Endcap		50.00	2.00	3.0		41	117	5.0	9.2	11	6.815	21.0		

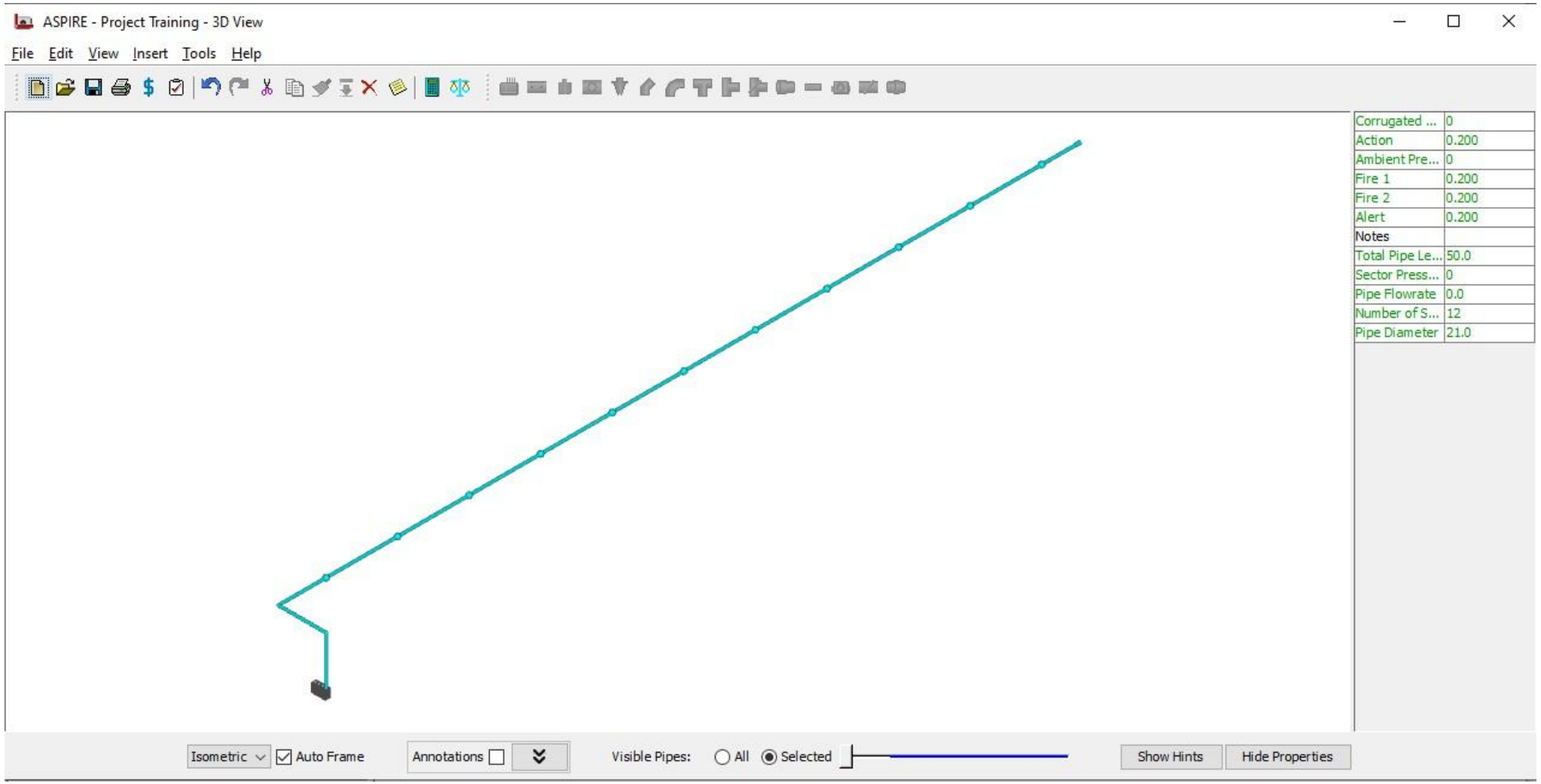
Pipe Section
Fittings
Direction
Absolute Distance
Relative Distance
Hole Size
Capillary Tube length
Transport time
Pressure
Flow
Flow%
Dilution
Hole Sensitivity
Pipe Diameter
Capillary Diameter
Intersection Pressure



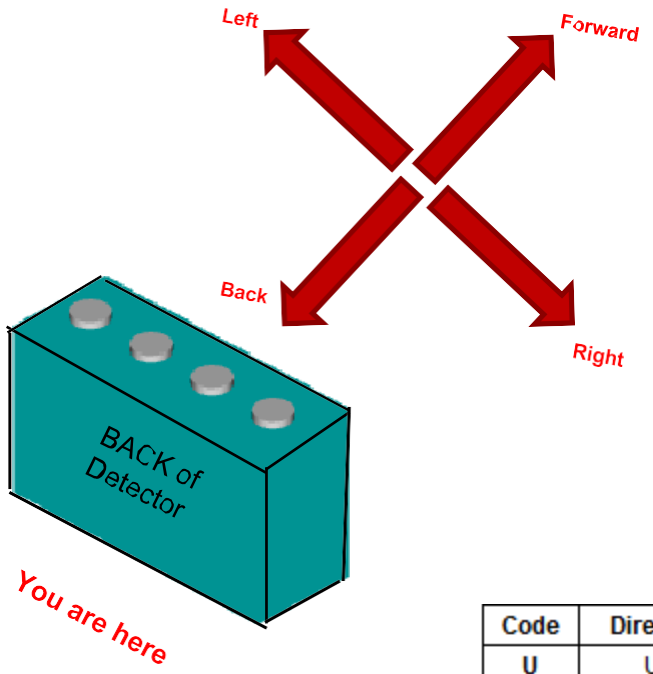
Active 3D View

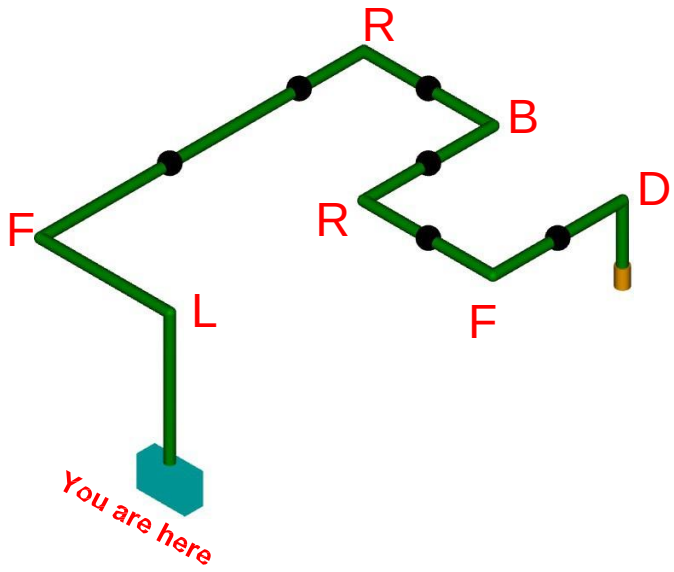
Isometric Auto Frame

The Pipe View



Directions

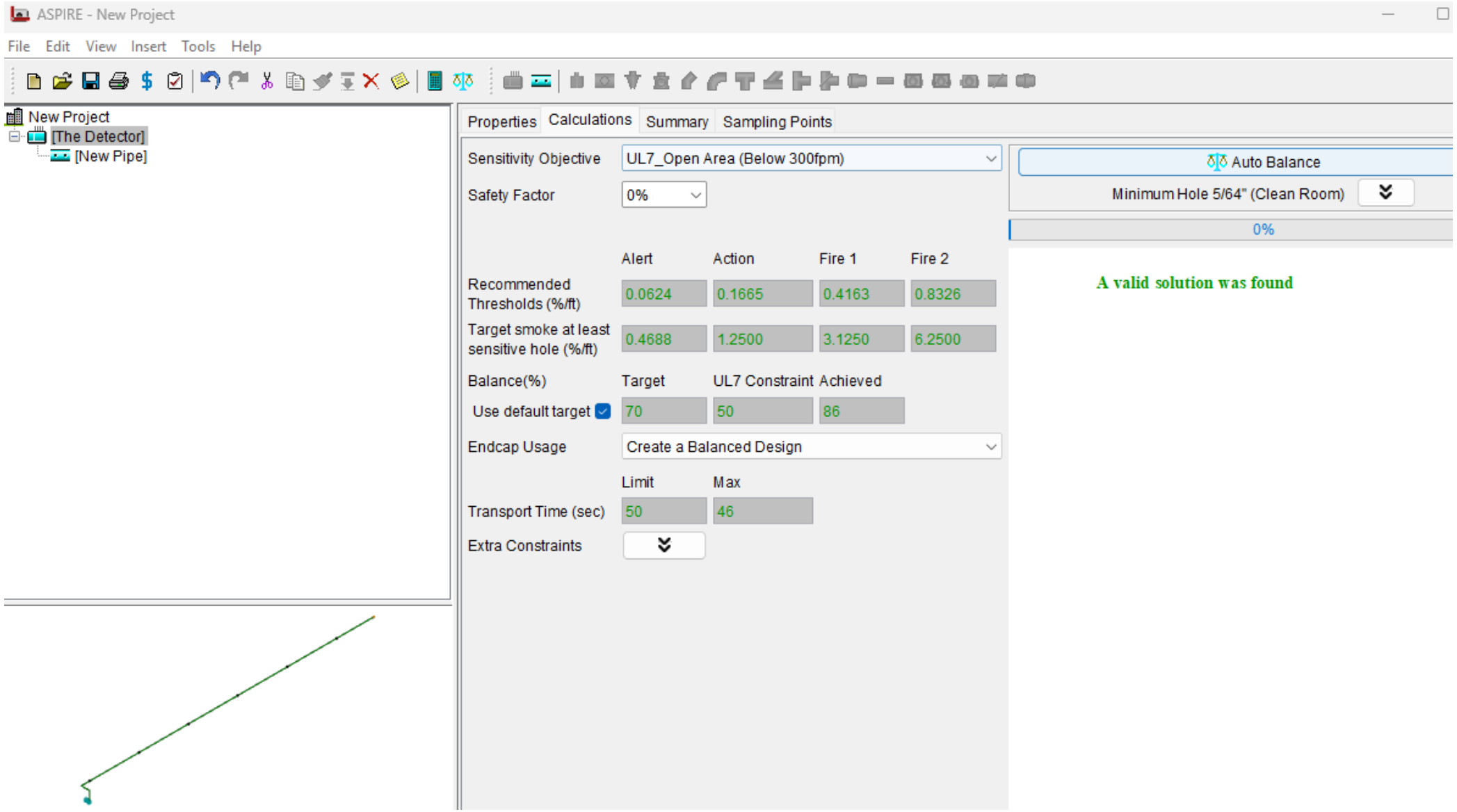




Code	Direction
U	Up
D	Down
L	Left
R	Right
F	Forward
B	Back

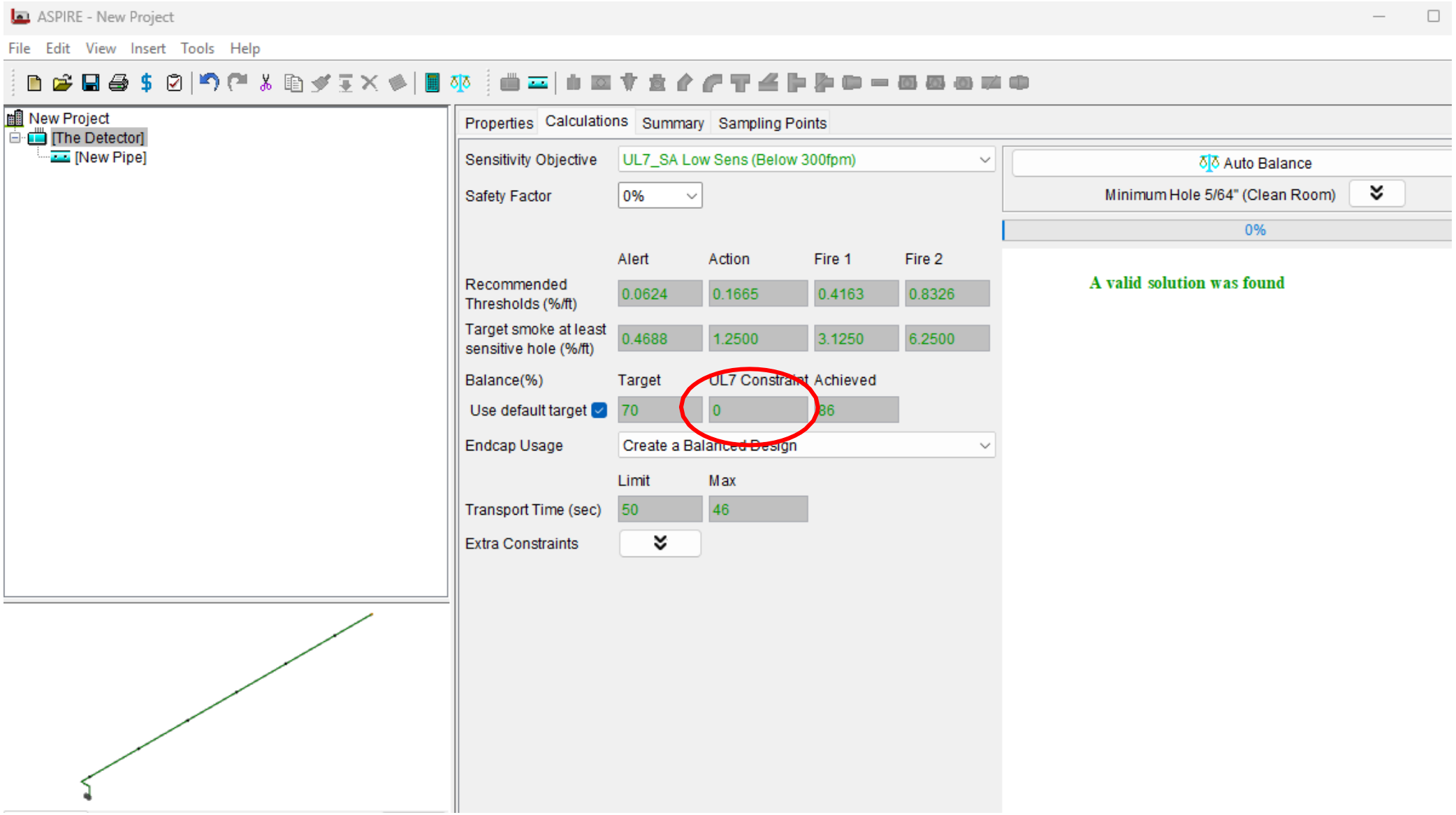
Bend or Elbow Direction

Calculations Tab



Xtralis Confidential | Copyright © 2018 by Xtralis. All rights reserved.

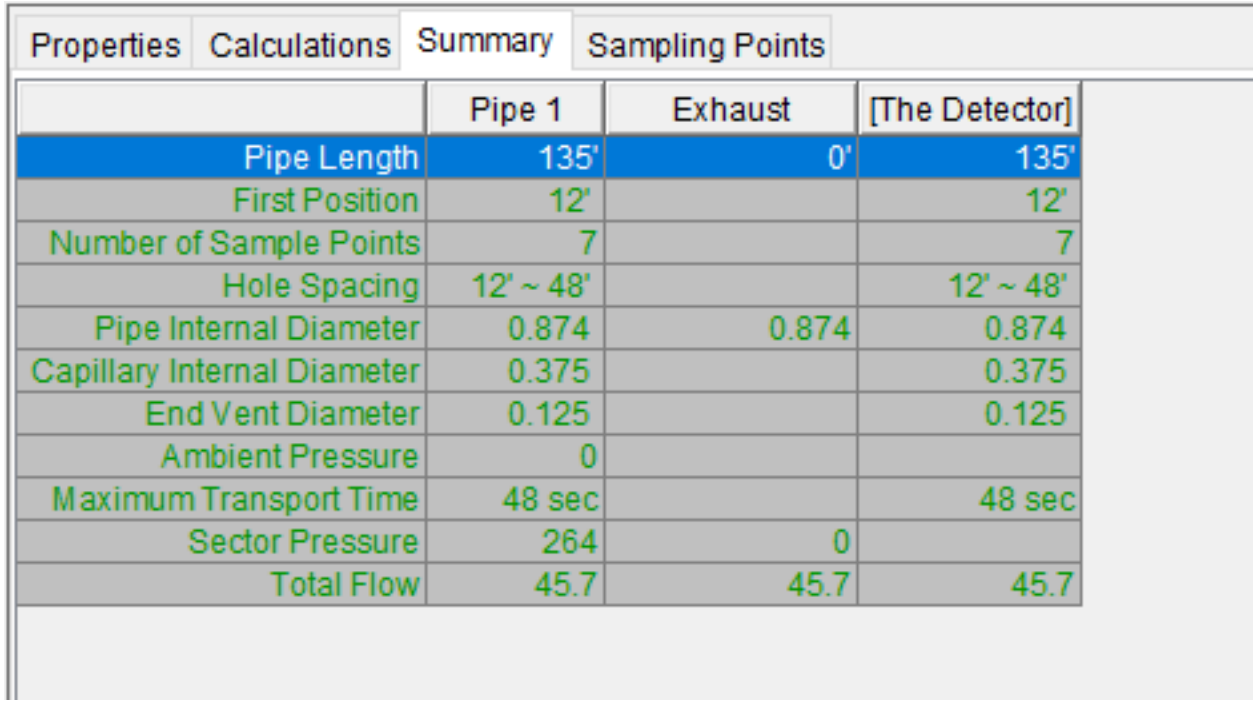
Calculations Tab



Summary Tab

The pipe summary tab displays the current pipe configuration. This tab gives a summary of the pipe network connected to the detector.

- **Pipe Length**
- **First Position**
- **Number of Sample Points**
- **Hole Spacing**
- **Pipe Internal Diameter**
- **Capillary Internal Diameter**
- **End Vent Diameter**
- **Ambient Pressure**
- **Maximum Transport Time**
- **Sector Pressure**
- **Total Flow**



	Pipe 1	Exhaust	[The Detector]
Pipe Length	135'	0'	135'
First Position	12'		12'
Number of Sample Points	7		7
Hole Spacing	12' ~ 48'		12' ~ 48'
Pipe Internal Diameter	0.874	0.874	0.874
Capillary Internal Diameter	0.375		0.375
End Vent Diameter	0.125		0.125
Ambient Pressure	0		
Maximum Transport Time	48 sec		48 sec
Sector Pressure	264	0	
Total Flow	45.7	45.7	45.7

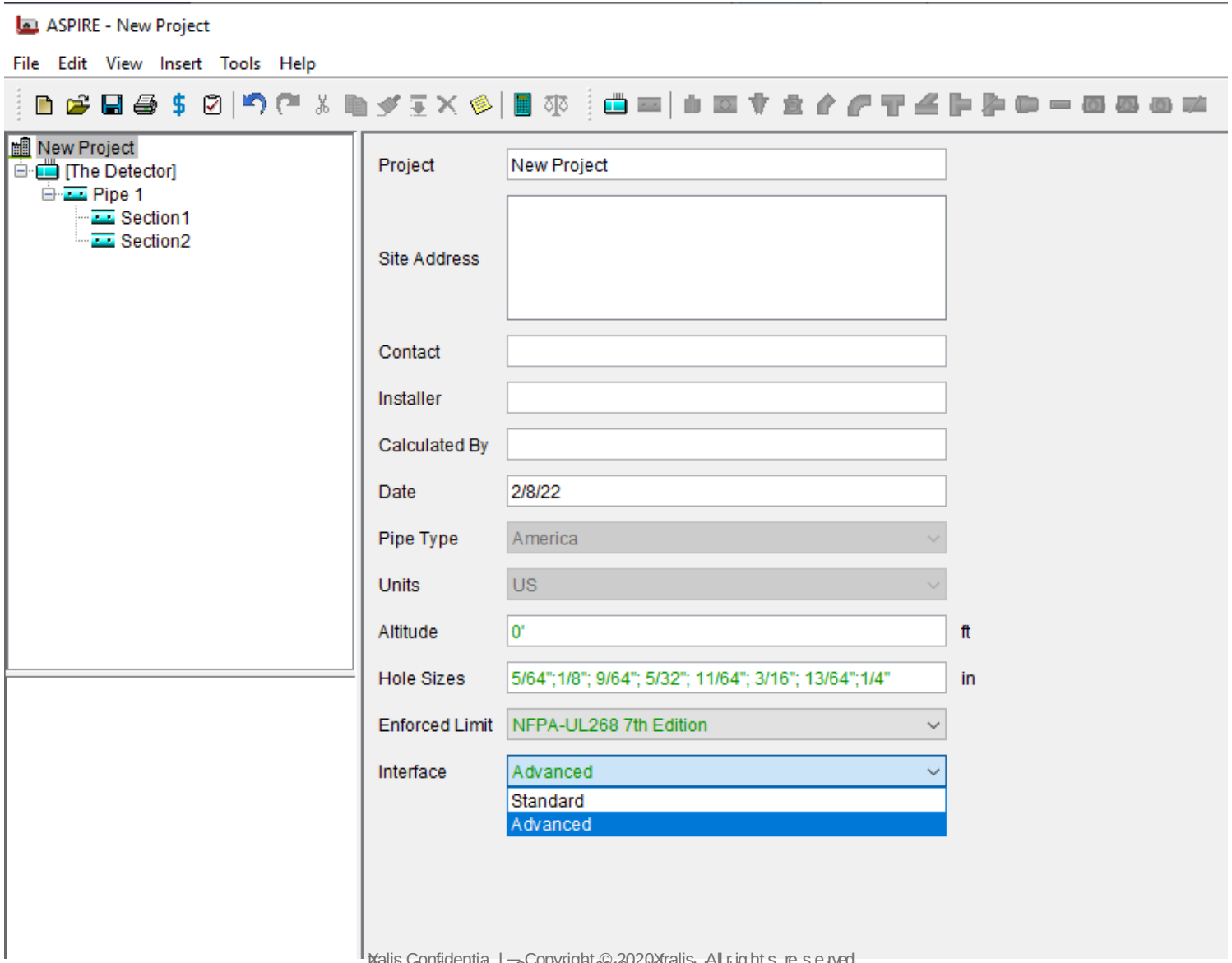
Xtralis Confidential – Copyright © 2018 by Xtralis. All rights reserved

Sampling Points Tab

Properties | Calculations | Summary | Sampling Points

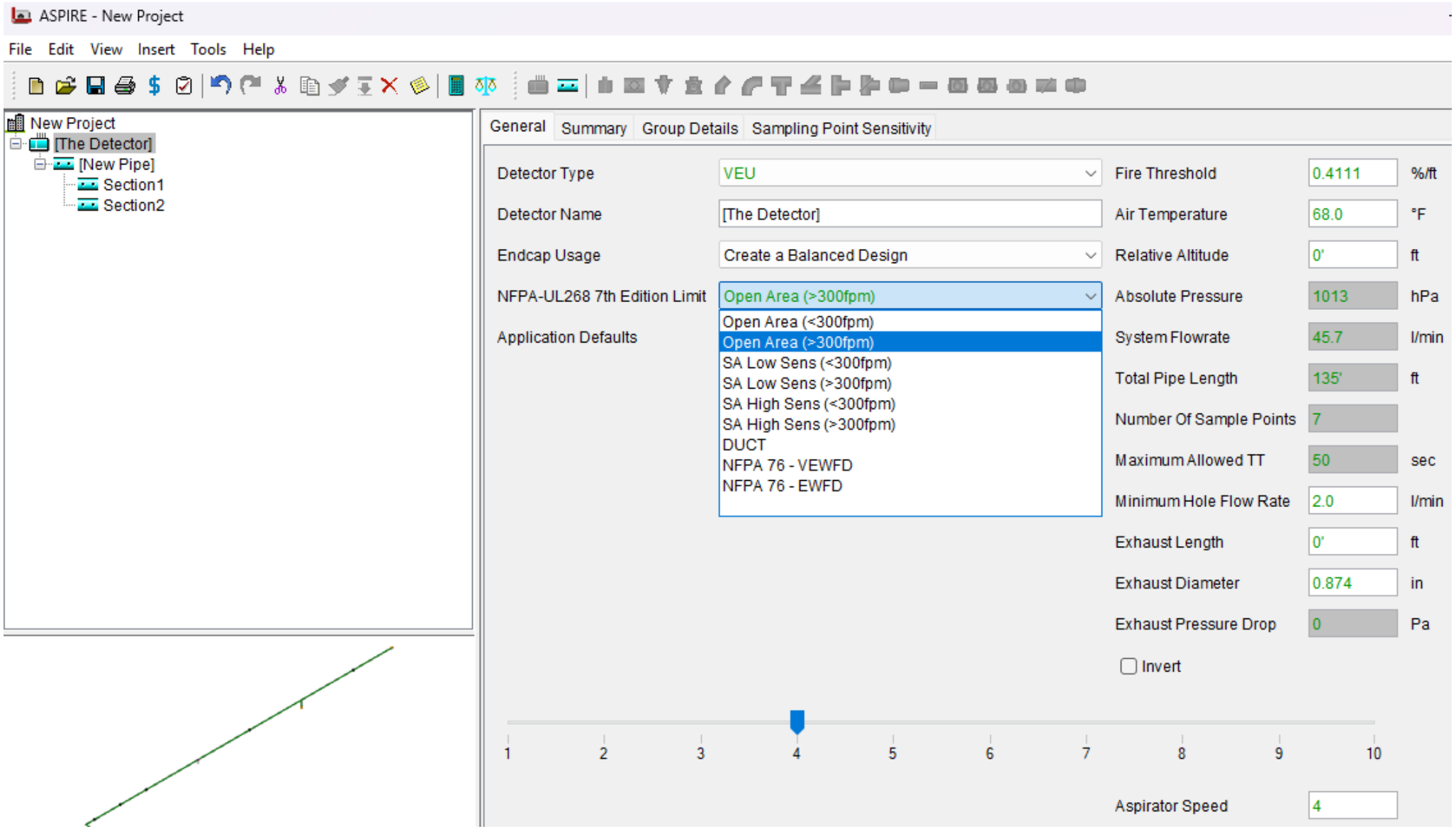
	Alert Sensitivity	Action Sensitivity	Fire Sensitivity	Fire2 Sensitivity	Pressure	Transport Time	Hole Diameter	Flow	Flow%	Dilution	Tube Diamet	Tube Length
1:Section0-1	0.0628	0.1683	0.4215	0.8429	243	6	1/8"	6.7	14.6	7		
1:Section0-2	0.0643	0.1724	0.4316	0.8632	232	8	1/8"	6.5	14.3	7		
1:Section0-3	0.0654	0.1754	0.4393	0.8785	224	9	1/8"	6.4	14.0	7		
1:Section0-4	0.0606	0.1625	0.4068	0.8136	193	14	1/8"	6.9	15.1	7	0.375	6'
1:Section0-5	0.0685	0.1838	0.4602	0.9203	204	20	1/8"	6.1	13.4	7		
1:Section1-1	0.0597	0.1601	0.4009	0.8018	199	33	1/8"	7.0	15.4	7		
1:Section0-6	0.0698	0.1871	0.4684	0.9367	197	48	1/8"	6.0	13.2	8		

UL268 7th Edition (Advanced interface)



Xtralis Confidential – Copyright © 2018 by Xtralis. All rights reserved.

Advanced interface



Xtralis Confidential – Copyright © 2018 by Xtralis. All rights reserved.

Group Details

General | Summary | Group Details | Sampling Point Sensitivity

Add | Delete | Rename | Endcap Usage | Create

	Hole Sensitivity	Flow	Pressure	Transport Time	Hole Diameter	[Default Group]
Aggregate smoke from holes						☑
Group Type						
Max Target Aggregate Sensitivity						0.4424
Min Target Aggregate Sensitivity						0.3799
Contribution ratio(%)						100
Applied Max Aggregate Sensitivity						0.4424
Applied Min Aggregate Sensitivity						0.3799
Target Suction Pressure						25
Target Balance						70
Exclude from Autobalance						☐
1:Section0-1	2.8120	6.7	243	6	1/8"	◉
1:Section0-2	2.8795	6.5	232	8	1/8"	◉
1:Section0-3	2.9307	6.4	224	9	1/8"	◉
1:Section0-4	2.7143	6.9	193	14	1/8"	◉
1:Section0-5	3.0702	6.1	204	20	1/8"	◉
1:Section1-1	2.6748	7.0	199	33	1/8"	◉
1:Section0-6	3.1249	6.0	197	48	1/8"	◉
Number of holes						7
Flow Share(%)						100
Aggregate Sensitivity						0.4112
Balance(%)						86
Suction pressure (least)						193

xtralis

Sampling Point Sensitivity

General | Summary | Group Details | Sampling Point Sensitivity

	Alert	Action	Fire 1	Fire 2
Display Threshold	☐	☐	☑	☐
Alarm Threshold Setting			0.4111	
NFPA-UL268 7th Edition Limit			Open Area (>300fpm)	
Target Hole Sensitivity			3.1250	
Nuisance Hole Sensitivity			1.5625	
UL7 Constraint Balance				
Maximum Transport Time				
1:Section0-1				
1:Section0-2				
1:Section0-3				
1:Section0-4				
1:Section0-5				
1:Section1-1				
1:Section0-6				
Class Achieved				
Hole Aggregation (to achieve Target...			1	
Alarm threshold needed (to achieve ...			0.4111	
Safety Factor (% reduction in alarm t...			0%	
Alarm threshold to be applied			0.4111	
Apply Alarm Threshold			Apply	

Open Area (>300fpm)
- Open Area (<300fpm)
- Open Area (>300fpm)
- SA Low Sens (<300fpm)
- SA Low Sens (>300fpm)
- SA High Sens (<300fpm)
- SA High Sens (>300fpm)
- DUCT
- NFPA 76 - VEWFD
- NFPA 76 - EWFD

xtralis

Minimum flow percentage requirement

Scenario 1: Increase sample hole diameter.

- Increasing the sample hole diameter would increase the flow percentage: In below example increase sample hole diameter from 1/8” to 9/64”

Type	Direction	Absolute Distance	Relative Distance	Hole Diameter	Tube Length	Transport Time	Pressure	Flow	Flow%	Dilution
2-way Valve		2'	2'							
Bend 90	F	12'	10'							
Bend 90	R	13'	1'							
Bend 90	F	22' 4"	9' 4"							
Bend 90	R	54' 9 1/2"	32' 5 1/2"							
Bend 90	D	57' 1/2"	2' 3"							
Bend 90	F	61' 1/2"	4'							
Tee	L	61' 6 1/2"	6"							
Bend 90	F	62' 6 1/2"	1'							
Socket Union		63' 2"	7 1/2"							
Hole		63' 9 1/2"	7 1/2"	1/8"		15	30	2.4	1.7	57
Hole		65' 9 1/2"	2'	1/8"		16	30	2.3	1.7	58
Hole		67' 9 1/2"	2'	1/8"		17	29	2.3	1.7	58
Hole		69' 9 1/2"	2'	1/8"		19	29	2.3	1.7	58
Hole		71' 9 1/2"	2'	1/8"		21	29	2.3	1.7	59
Hole		73' 9 1/2"	2'	1/8"		25	29	2.3	1.7	59
Hole		75' 9 1/2"	2'	1/8"		32	29	2.3	1.7	59
Endcap		76' 3 1/2"	6"	0"						

Type	Direction	Absolute Distance	Relative Distance	Hole Diameter	Tube Length	Transport Time	Pressure	Flow	Flow%	Dilution
2-way Valve		2'	2'							
Bend 90	F	12'	10'							
Bend 90	R	13'	1'							
Bend 90	F	22' 4"	9' 4"							
Bend 90	R	54' 9 1/2"	32' 5 1/2"							
Bend 90	D	57' 1/2"	2' 3"							
Bend 90	F	61' 1/2"	4'							
Tee	L	61' 6 1/2"	6"							
Bend 90	F	62' 6 1/2"	1'							
Socket Union		63' 2"	7 1/2"							
Hole		63' 9 1/2"	7 1/2"	9/64"		14	26	2.6	2.0	51
Hole		65' 9 1/2"	2'	9/64"		15	26	2.6	1.9	52
Hole		67' 9 1/2"	2'	9/64"		17	26	2.6	1.9	52
Hole		69' 9 1/2"	2'	9/64"		18	25	2.6	1.9	52
Hole		71' 9 1/2"	2'	9/64"		20	25	2.6	1.9	53
Hole		73' 9 1/2"	2'	9/64"		23	25	2.6	1.9	53
Hole		75' 9 1/2"	2'	9/64"		30	25	2.6	1.9	53
Endcap		76' 3 1/2"	6"	0"						

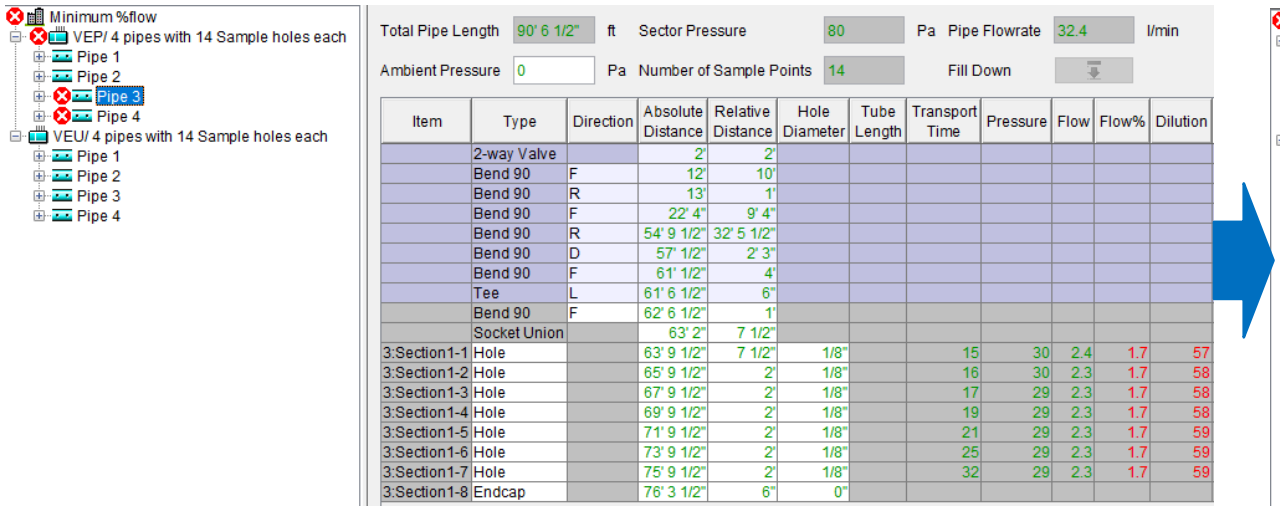
Minimum flow percentage requirement

Scenario 2: Change Piping network design

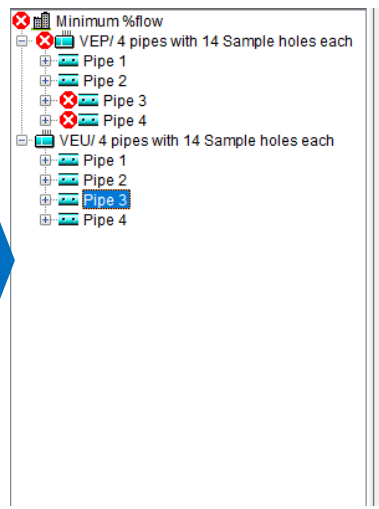
- Either decrease number of sample holes per pipe or split these sample holes into 2 pipes.

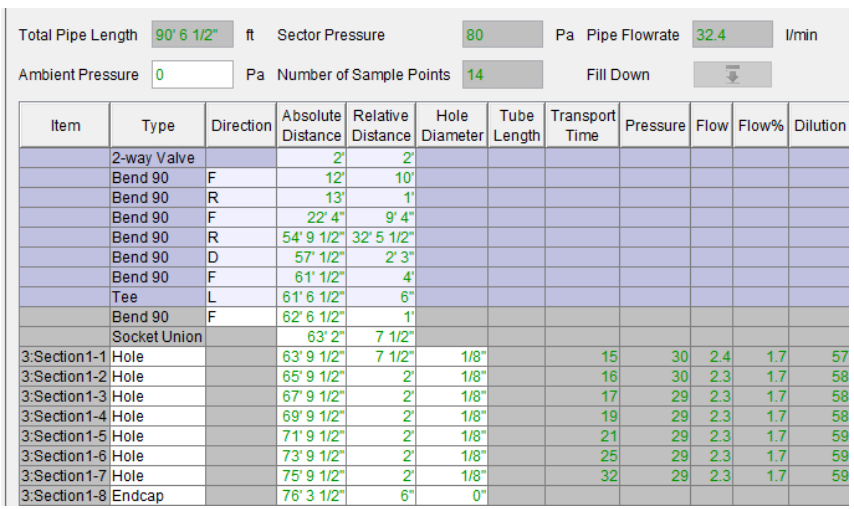
Scenario 3: Upgrade detector

- In below example shows upgrading detector from VEP to VEU.



Item	Type	Direction	Absolute Distance	Relative Distance	Hole Diameter	Tube Length	Transport Time	Pressure	Flow	Flow%	Dilution
	2-way Valve		2'	2'							
	Bend 90	F	12'	10'							
	Bend 90	R	13'	1'							
	Bend 90	F	22' 4"	9' 4"							
	Bend 90	R	54' 9 1/2"	32' 5 1/2"							
	Bend 90	D	57' 1/2"	2' 3"							
	Bend 90	F	61' 1/2"	4'							
	Tee	L	61' 6 1/2"	6"							
	Bend 90	F	62' 6 1/2"	1'							
	Socket Union		63' 2"	7 1/2"							
3:Section1-1	Hole		63' 9 1/2"	7 1/2"	1/8"		15	30	2.4	1.7	57
3:Section1-2	Hole		65' 9 1/2"	2'	1/8"		16	30	2.3	1.7	58
3:Section1-3	Hole		67' 9 1/2"	2'	1/8"		17	29	2.3	1.7	58
3:Section1-4	Hole		69' 9 1/2"	2'	1/8"		19	29	2.3	1.7	58
3:Section1-5	Hole		71' 9 1/2"	2'	1/8"		21	29	2.3	1.7	59
3:Section1-6	Hole		73' 9 1/2"	2'	1/8"		25	29	2.3	1.7	59
3:Section1-7	Hole		75' 9 1/2"	2'	1/8"		32	29	2.3	1.7	59
3:Section1-8	Endcap		76' 3 1/2"	6"	0"						

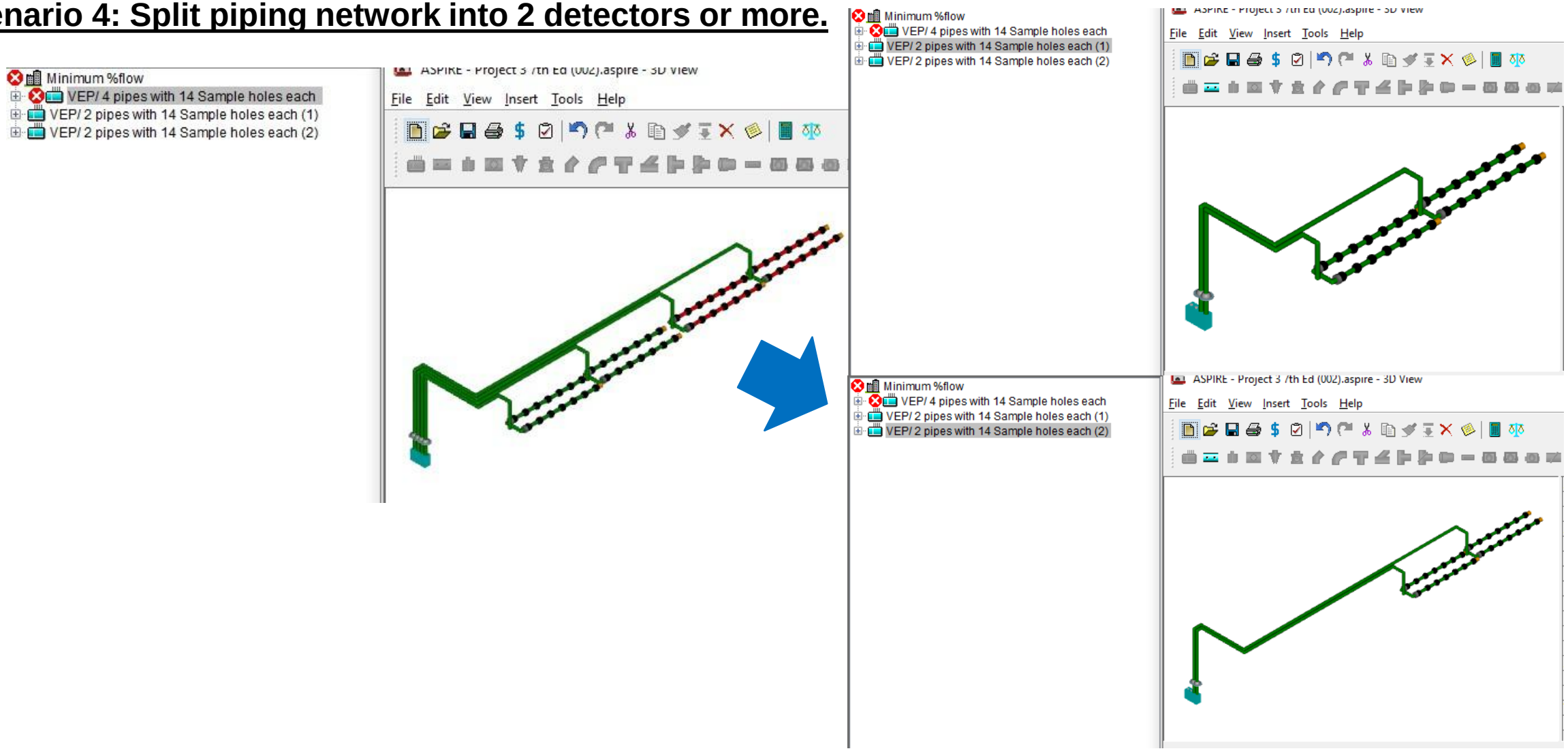




Item	Type	Direction	Absolute Distance	Relative Distance	Hole Diameter	Tube Length	Transport Time	Pressure	Flow	Flow%	Dilution
	2-way Valve		2'	2'							
	Bend 90	F	12'	10'							
	Bend 90	R	13'	1'							
	Bend 90	F	22' 4"	9' 4"							
	Bend 90	R	54' 9 1/2"	32' 5 1/2"							
	Bend 90	D	57' 1/2"	2' 3"							
	Bend 90	F	61' 1/2"	4'							
	Tee	L	61' 6 1/2"	6"							
	Bend 90	F	62' 6 1/2"	1'							
	Socket Union		63' 2"	7 1/2"							
3:Section1-1	Hole		63' 9 1/2"	7 1/2"	1/8"		15	30	2.4	1.7	57
3:Section1-2	Hole		65' 9 1/2"	2'	1/8"		16	30	2.3	1.7	58
3:Section1-3	Hole		67' 9 1/2"	2'	1/8"		17	29	2.3	1.7	58
3:Section1-4	Hole		69' 9 1/2"	2'	1/8"		19	29	2.3	1.7	58
3:Section1-5	Hole		71' 9 1/2"	2'	1/8"		21	29	2.3	1.7	59
3:Section1-6	Hole		73' 9 1/2"	2'	1/8"		25	29	2.3	1.7	59
3:Section1-7	Hole		75' 9 1/2"	2'	1/8"		32	29	2.3	1.7	59
3:Section1-8	Endcap		76' 3 1/2"	6"	0"						

Minimum flow percentage requirement

Scenario 4: Split piping network into 2 detectors or more.



Minimal Impact of UL268 7th Edition on technical spec and installations

Overall minimal impact on detectors' performance in actual field installations

- **Actual Projects Comparison**
  - Designs for 400 detectors across 75 actual projects in various applications compared for UL268 6th vs 7th ed

- Open Area (<300fpm)
  - 75% of detectors assessed complied to 7th edition with minimum changes
  - 14% of detectors assessed required an upgrade to a higher detector for greater flowrate
  - 11% of detectors assessed required an extra detector

- Special Application – High Sensitivity (300-4000fpm)
  - 96% of detectors assessed complied to 7th edition with minimum changes
  - 4% of detectors assessed required an upgrade to a higher detector for greater flowrate

RETROFIT Service and Support

- With the UL268 7th Edition, needs to transition to the new standard once detectors have either failed or cannot be supported by spare parts. Transitioning to the new standard for retrofit opportunities will fit one of the following scenarios.

Scenario 1: System with minimum changes

- To satisfy one to one replacement:

1. The total pipe length and number of sampling hole must remain the same
2. The sampling hole size can be altered
3. Smoke transport time within the limit for a selected UL 7th detector

Scenario 2: Upgrade Detector

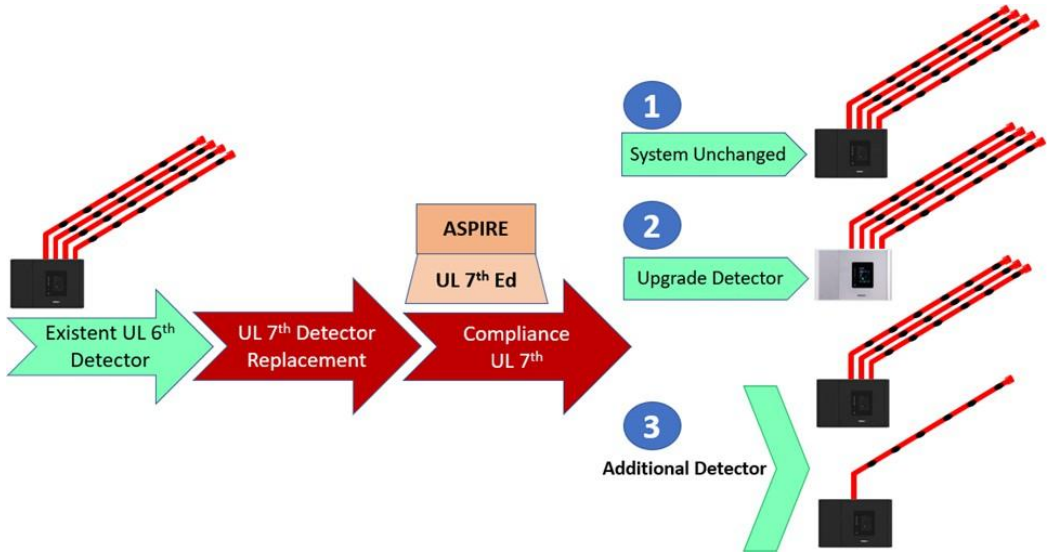
- Higher performance VESDA-E variant allow:

1. Can increase pipe length and number of sampling hole
2. The sampling hole size can be altered
3. Smoke transport time within the limit for a selected UL 7th detector

Scenario 3: Additional Detector

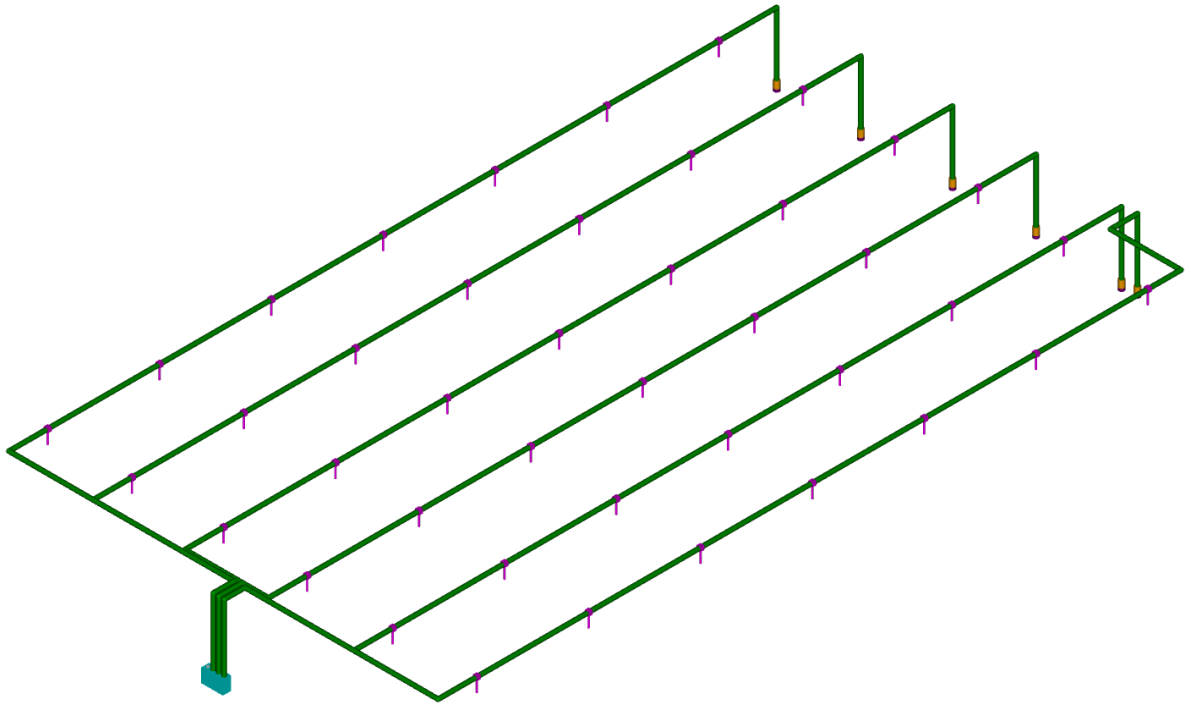
- Two UL 7th Edition detectors share the pipe network:

1. Split and share the pipe network between detectors
2. The sampling hole size can be altered
3. Smoke transport time within the limit with a selected UL 7th Edition detector



Real Case Study #1: Data Center – North America

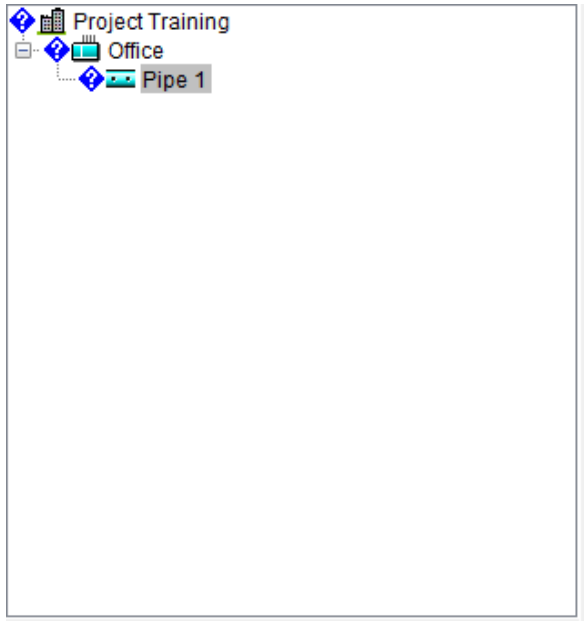
- Type of detector: VEP - Aspirator Speed 5
- Type of detection: Ceiling detection
- Number of sample holes: 42
- Coverage area per hole: 182 ft^2
- Maximum pipe length: 209 ft

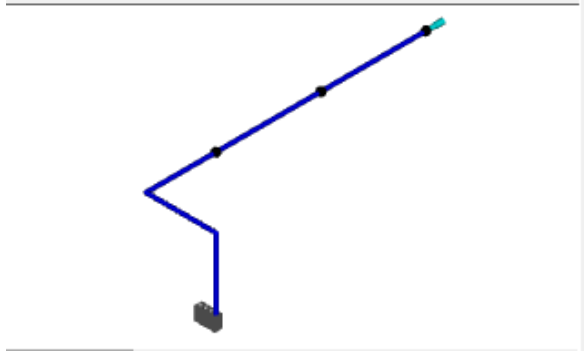


Existing detector system complies with UL 7th Edition criteria (VEWFD) with minimum work (sample holes diameters)

Endcap, Water Trap & Test Point

At the end of each pipe, you can select the Endcap, Water Trap or Test point depending on the design and specification required.





Total Pipe Length 16.0 m Sector Pressure 273 Pa Pipe Flowrate

Ambient Pressure 0 Pa Number of Sample Points 3 Fill Down

Item	Type	Direction	Absolute Distance	Relative Distance	Hole Diameter	Transport Time	Tube Length
	Bend 90	L	2.67	2.67			
	Bend 90	F	5.34	2.67			
1:Section0-1	Hole		8.00	2.66	3.0	8	
1:Section0-2	Hole		12.00	4.00	3.0	11	
1:Section0-3	Hole		16.00	4.00	3.0	16	
1:Section0-4	Endcap		16.50	0.50	0.0		

Endcap
Water Trap
Test Point

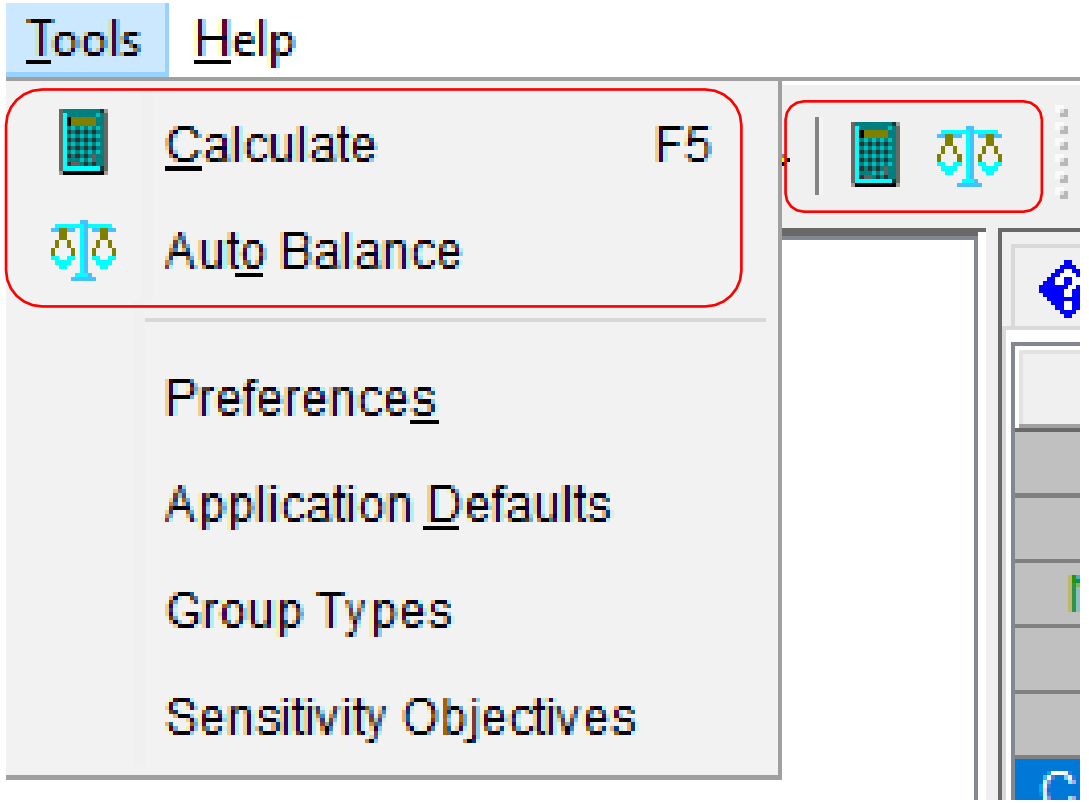
Calculate and Auto balance

Calculate: Once you have made changes to your pipe network you can recalculate the flows and pressures by selecting this option.

** **Auto Balance**: This is one of the main features of ASPIRE. Once you have built your basic pipe network design for the site you can use this feature to automatically set your hole sizes.

After calculate the detector different figures appear in different colors:

- **Green**
- **Blue**
- **Red**
- **Amber/Orange**
- **Black**



** NOT recommended

The Pipe Summary Tab of the Detector View

The pipe summary tab displays the current pipe configuration. This tab gives a summary of the pipe network connected to the detector.

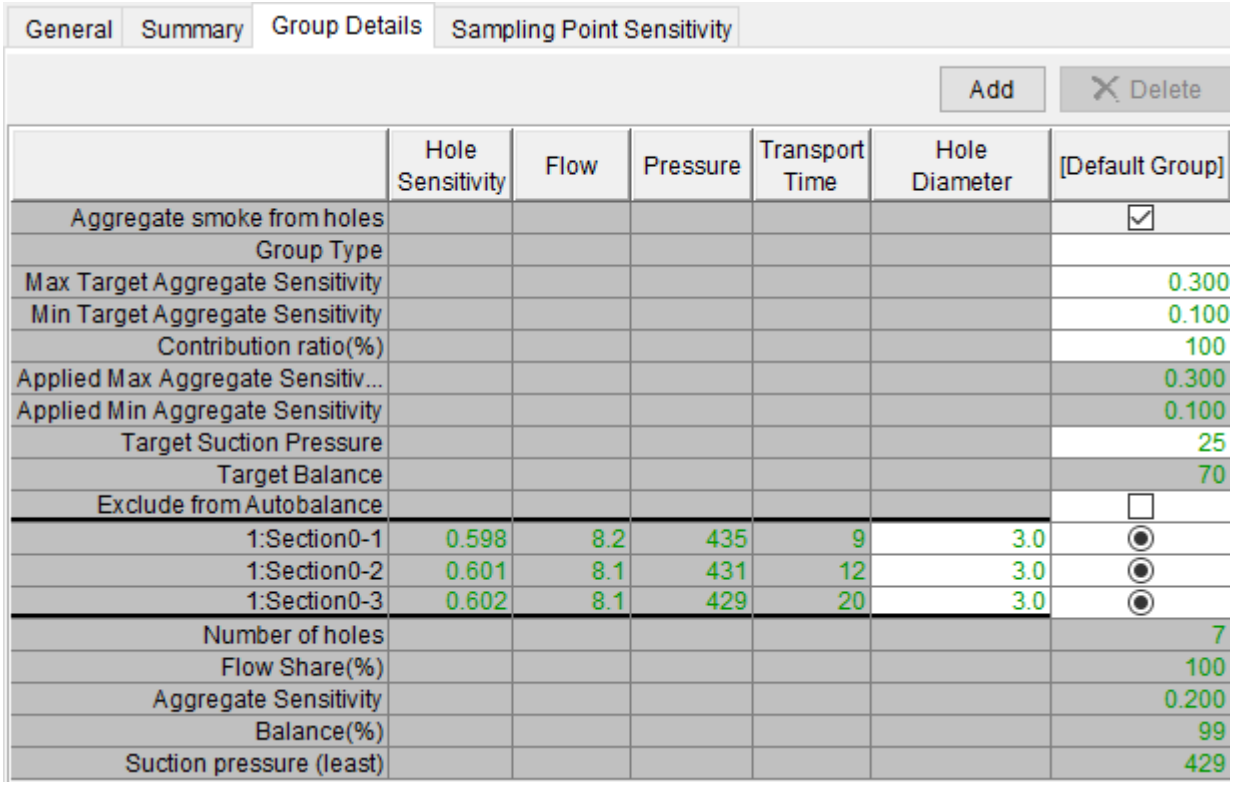
- **Pipe Length**
- **First Position**
- **Number of Sample Points**
- **Hole Spacing**
- **Pipe Internal Diameter**
- **Capillary Internal Diameter**
- **End Vent Diameter**
- **Ambient Pressure**
- **Maximum Transport Time**
- **Sector Pressure**
- **Total Flow**

General | Summary | Group Details | Sampling Point Sensitivity

	Pipe 1	Exhaust	Office
Pipe Length	16.0	0.0	16.0
First Position	8.0 m		8.0 m
Number of Sample Points	3		3
Hole Spacing	4.0 m		4.0 m
Pipe Internal Diameter	21.0 mm	21.0	21.0 mm
Capillary Internal Diameter			
End Vent Diameter			
Ambient Pressure	0		
Maximum Transport Time	20 sec		20 sec
Sector Pressure	451	0	
Total Flow	24.4	24.4	24.4

The Group Details Tab of the Detector View

The Group Details tab is used to create groups of sampling holes that work together to simulate a large, more sensitive sampling point.



	Hole Sensitivity	Flow	Pressure	Transport Time	Hole Diameter	[Default Group]
Aggregate smoke from holes						☑
Group Type						
Max Target Aggregate Sensitivity						0.300
Min Target Aggregate Sensitivity						0.100
Contribution ratio(%)						100
Applied Max Aggregate Sensitiv...						0.300
Applied Min Aggregate Sensitivity						0.100
Target Suction Pressure						25
Target Balance						70
Exclude from Autobalance						☐
1:Section0-1	0.598	8.2	435	9	3.0	◉
1:Section0-2	0.601	8.1	431	12	3.0	◉
1:Section0-3	0.602	8.1	429	20	3.0	◉
Number of holes						7
Flow Share(%)						100
Aggregate Sensitivity						0.200
Balance(%)						99
Suction pressure (least)						429

The Sampling Point Sensitivity Tab of the Detector View

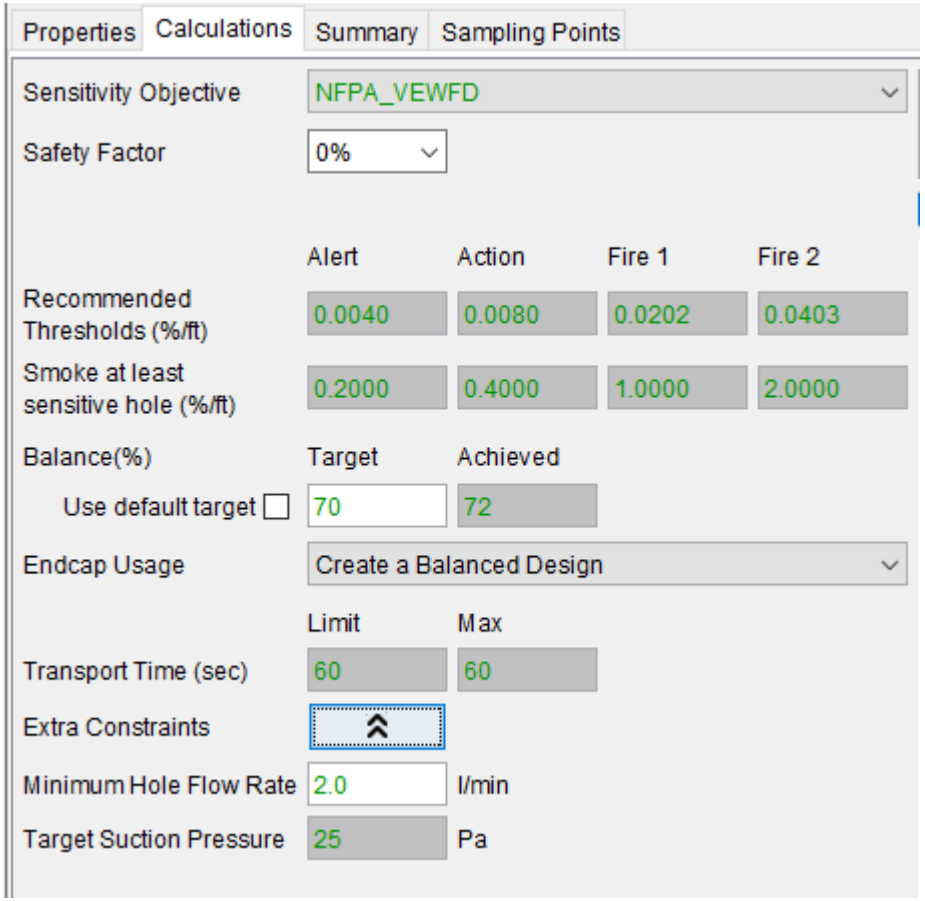
General | Summary | Group Details | Sampling Point Sensitivity

	Alert	Action	Fire 1	Fire 2
Display Threshold	☐	☐	☑	☐
Alarm Threshold Setting			0.4188	
NFPA-UL268 7th Edition Limit			SA Low Sens (<300fpm)	
Target Hole Sensitivity			3.1250	
Nuisance Hole Sensitivity				
UL7 Constraint Balance				
Maximum Transport Time			50	
1:Section0-1			2.7530	
1:Section0-2			2.8802	
1:Section0-3			2.9802	
1:Section0-4			3.0470	
1:Section0-5			3.0952	
1:Section0-6			3.1244	
1:Section0-7			2.6971	
Class Achieved				
Hole Aggregation (to achieve Target...			1	
Alarm threshold needed (to achieve ...			0.4188	
Safety Factor (% reduction in alarm t...			0%	
Alarm threshold to be applied			0.4188	
Apply Alarm Threshold			Apply	

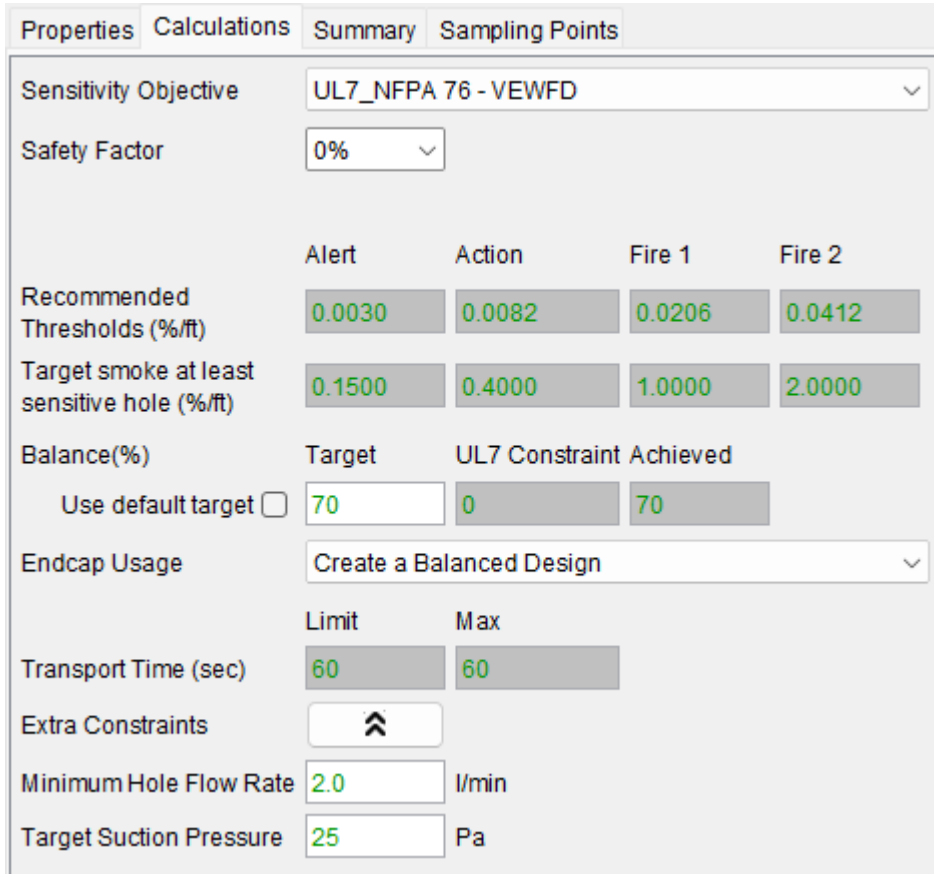
xtralis

Real Case Study #1: Data Center – North America

UL268 6th Edition



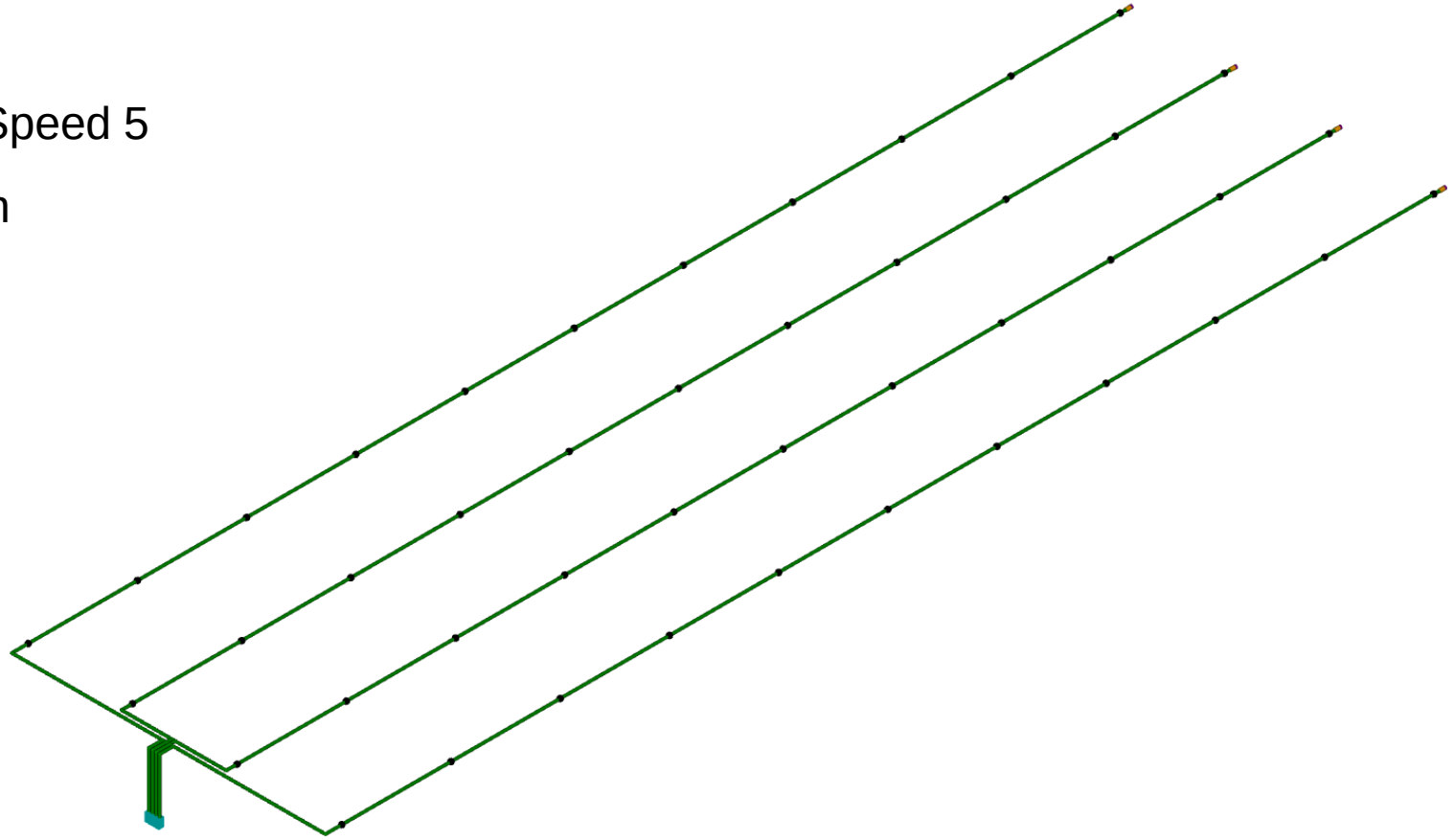
UL268 7th Edition



Xtralis Confidential – Copyright © 2018 by Xtralis. All rights reserved

Real Case Study #2: Warehouse – North America

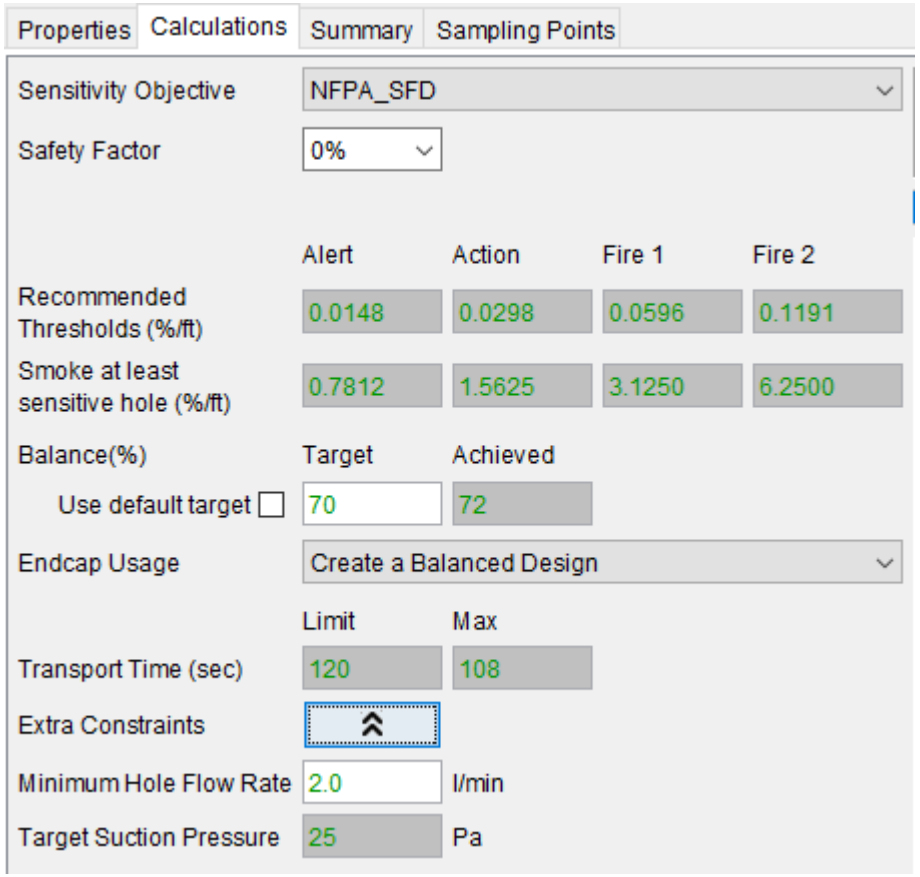
- Type of detector: VEP - Aspirator Speed 5
- Type of detection: Ceiling detection
- Number of sample holes: 44
- Coverage area per hole: 400 ft^2
- Maximum pipe length: 245 ft



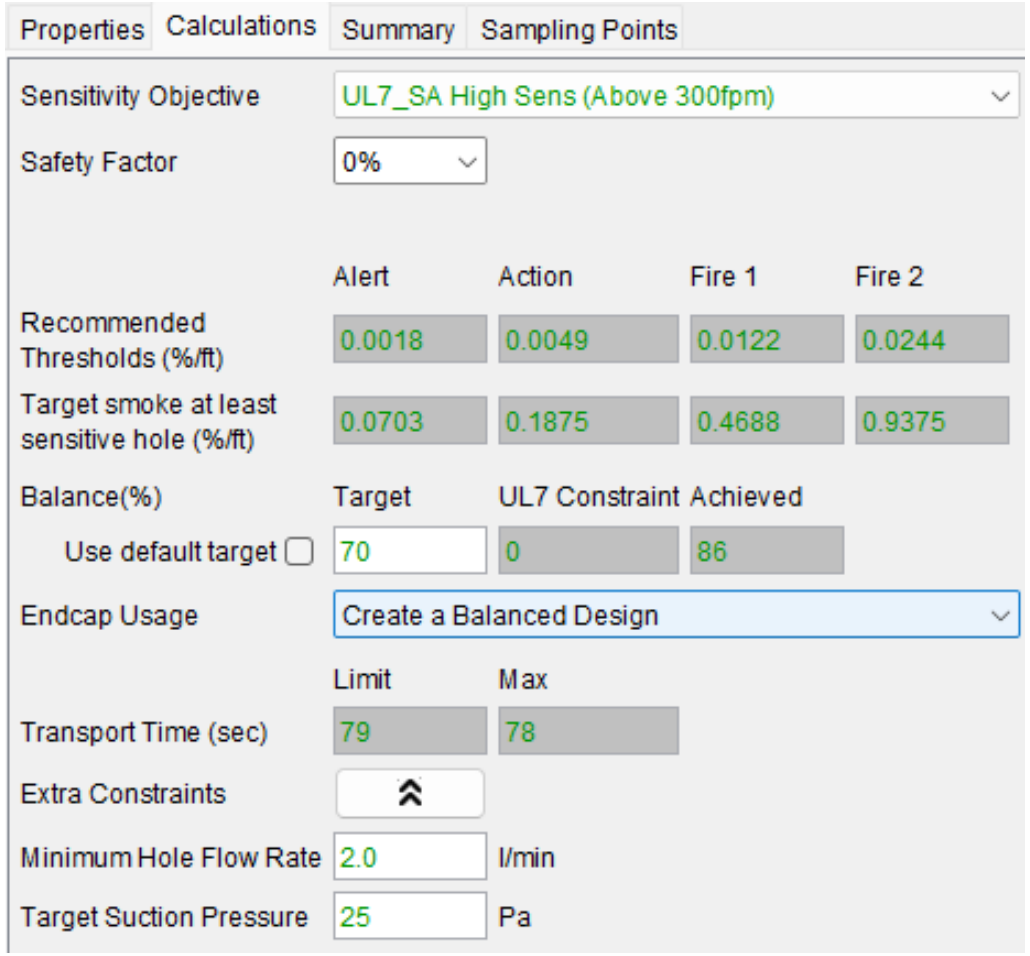
Existing detector system does not meet UL268 7th Edition requirements (Special Application High Sens – Above 300fpm)
For UL268 7th Edition compliance (Upgrade VEP to VEU)

Real Case Study #2: Warehouse – North America

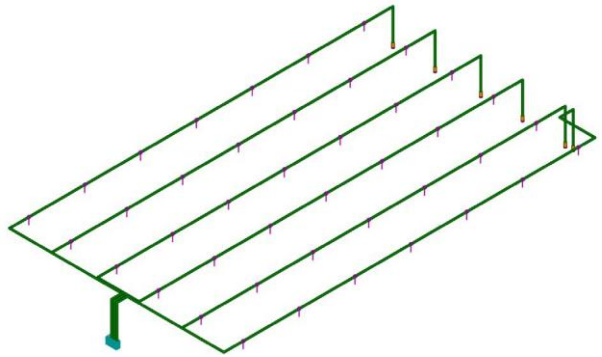
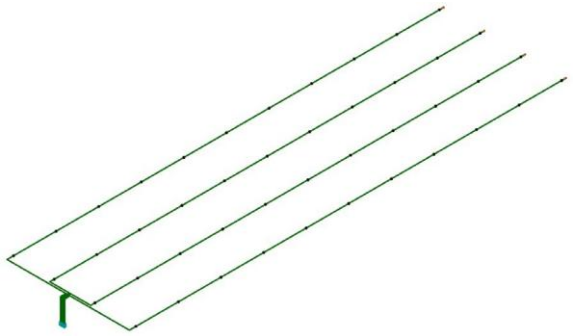
UL268 6th Edition



UL268 7th Edition



Case Studies – Summary

Case Study	UL6th Edition Summary	UL7th Edition Summary
Data Center 	• Application : Data Center – North America • Type of detector : VEP - Aspirator Speed 5 • Type of detection: Ceiling detection • Number of sample holes : 42 • Coverage area per hole : 182 ft^2 • Maximum pipe length : 209 ft	• Detector comply with UL 7th Edition by changing the sample hole diameters without reducing number of sample holes or adding more detectors. • Sensitivity increase almost 100% • Achieved balance increased from 72% to 76%. • Transportation time, pipes airflow and pressure remain almost same.
Museum 	• Type of detector: VEP - Aspirator Speed 5 • Type of detection: Ceiling detection • Number of sample holes: 44 • Coverage area per hole: 400 ft2 • Maximum pipe length: 245 ft	• Despite altering the size of the sampling holes, detector could not achieve compliance to UL 7th. • To comply with UL 7th Edition ; upgrade VEP to VEU. • Transportation time is reduced, and sensitivity is become more sensitive

Summary

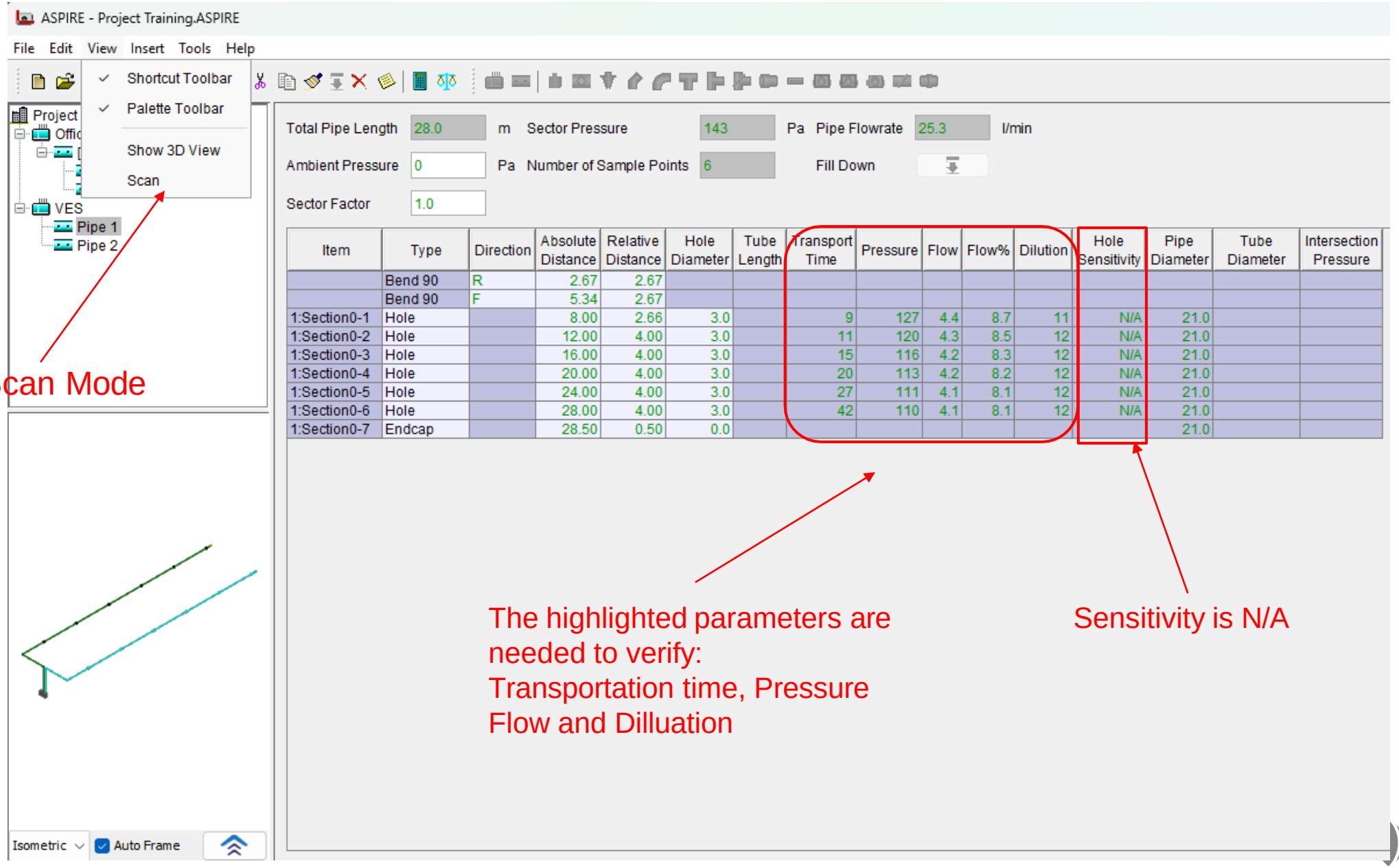
- UL268 7th Edition introduces a new level of performance for smoke detectors aiming at improving building occupants' life safety and reducing nuisance alarms

- VESDA-E differentiated value proposition ensures compliance with the UL268 7th Edition whilst providing reliable and effective smoke detection,
- In Open Area applications smoke detectors are not permitted to signal alarms from nuisance sources (cooking)

- In Special Applications early warning is paramount and nuisance sources are not expected

- ASPIRE pipe network design tool updated to support the UL268 7th Edition requirements

VES Scan & Non-Scan Modes

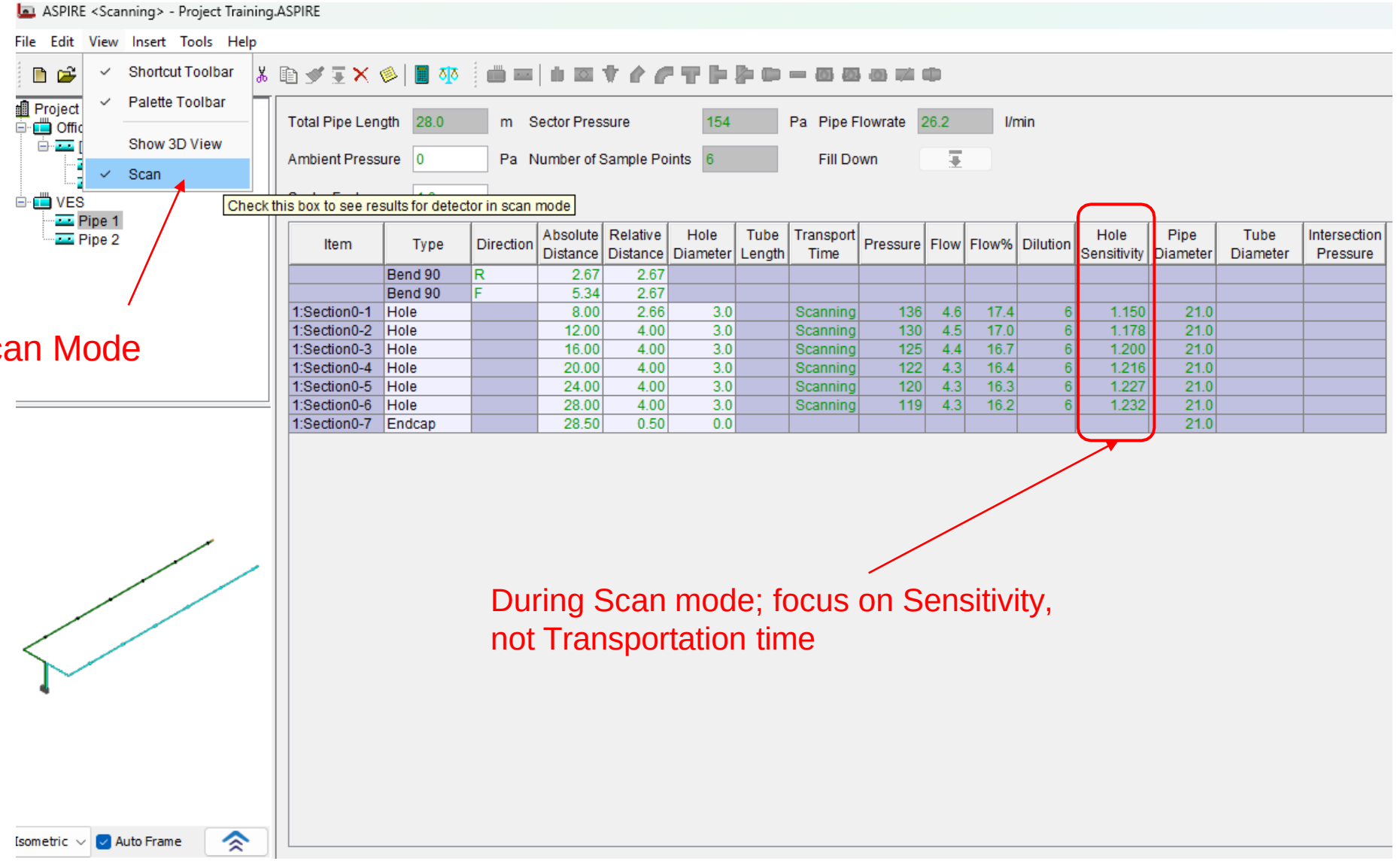


Non-Scan Mode

The highlighted parameters are needed to verify:
Transportation time, Pressure
Flow and Dilluation

Sensitivity is N/A

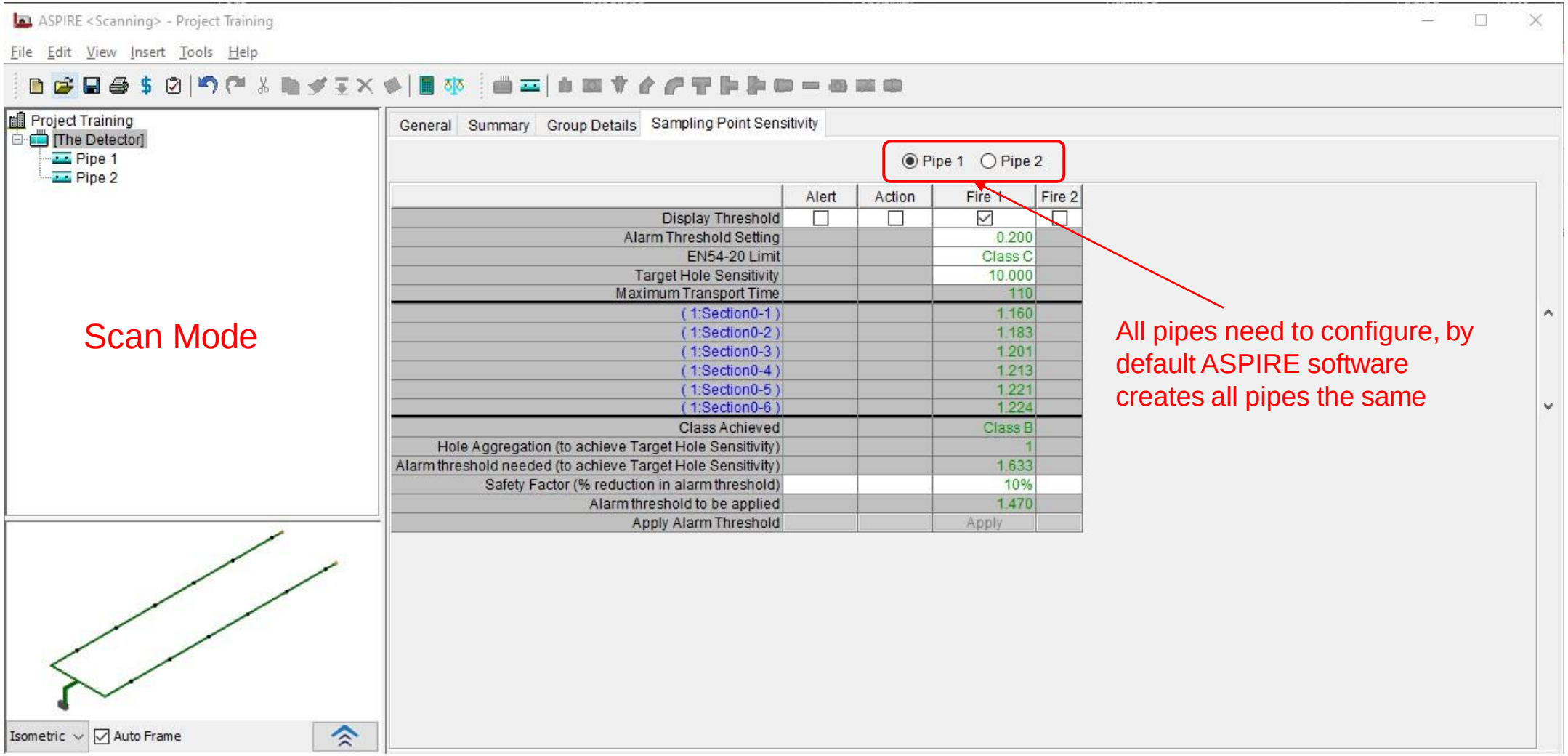
VES Scan & Non-Scan Modes



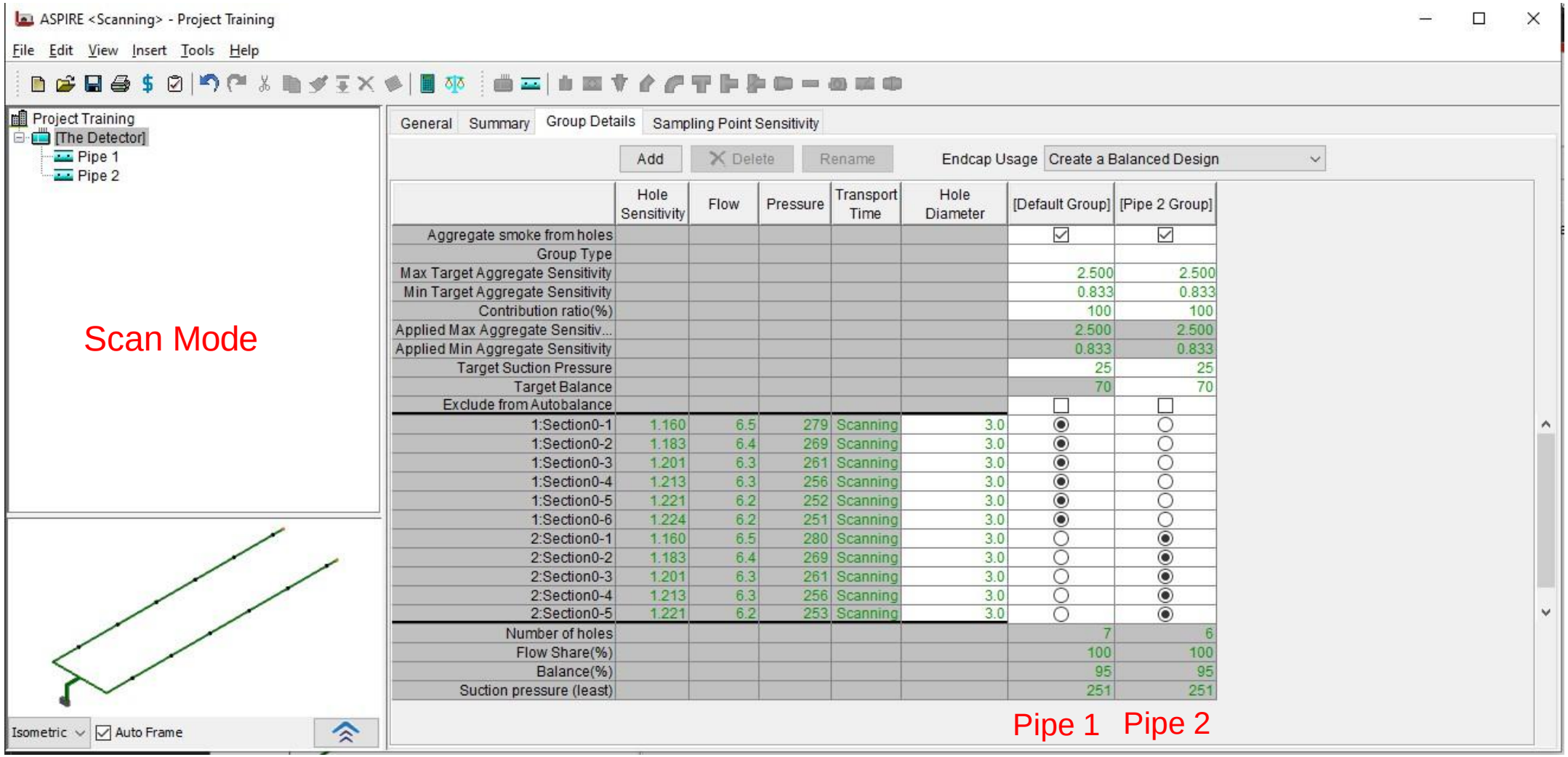
Scan Mode

During Scan mode; focus on Sensitivity, not Transportation time

VES Scan & Non-Scan Modes

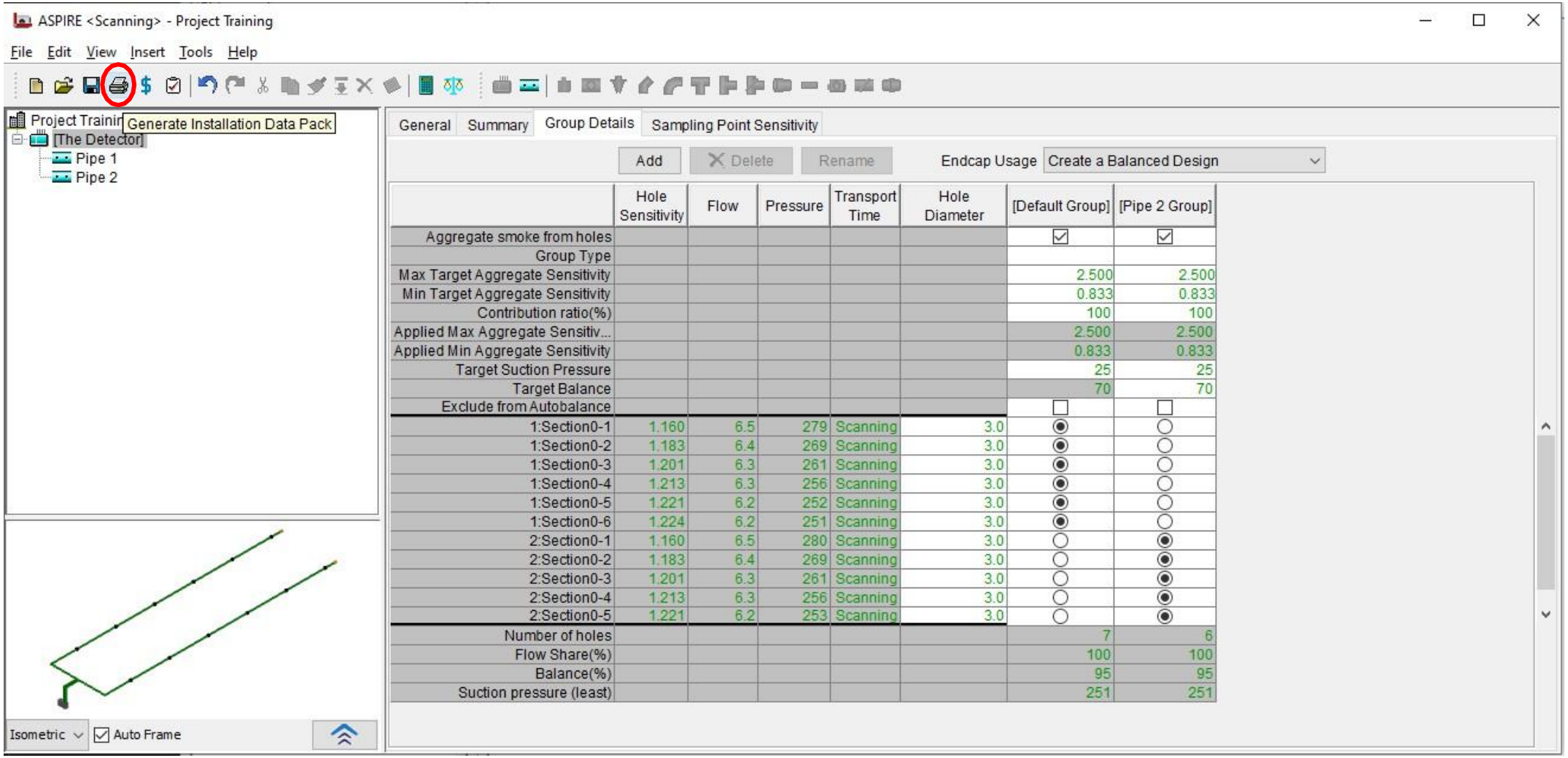


VES Scan & Non-Scan Modes



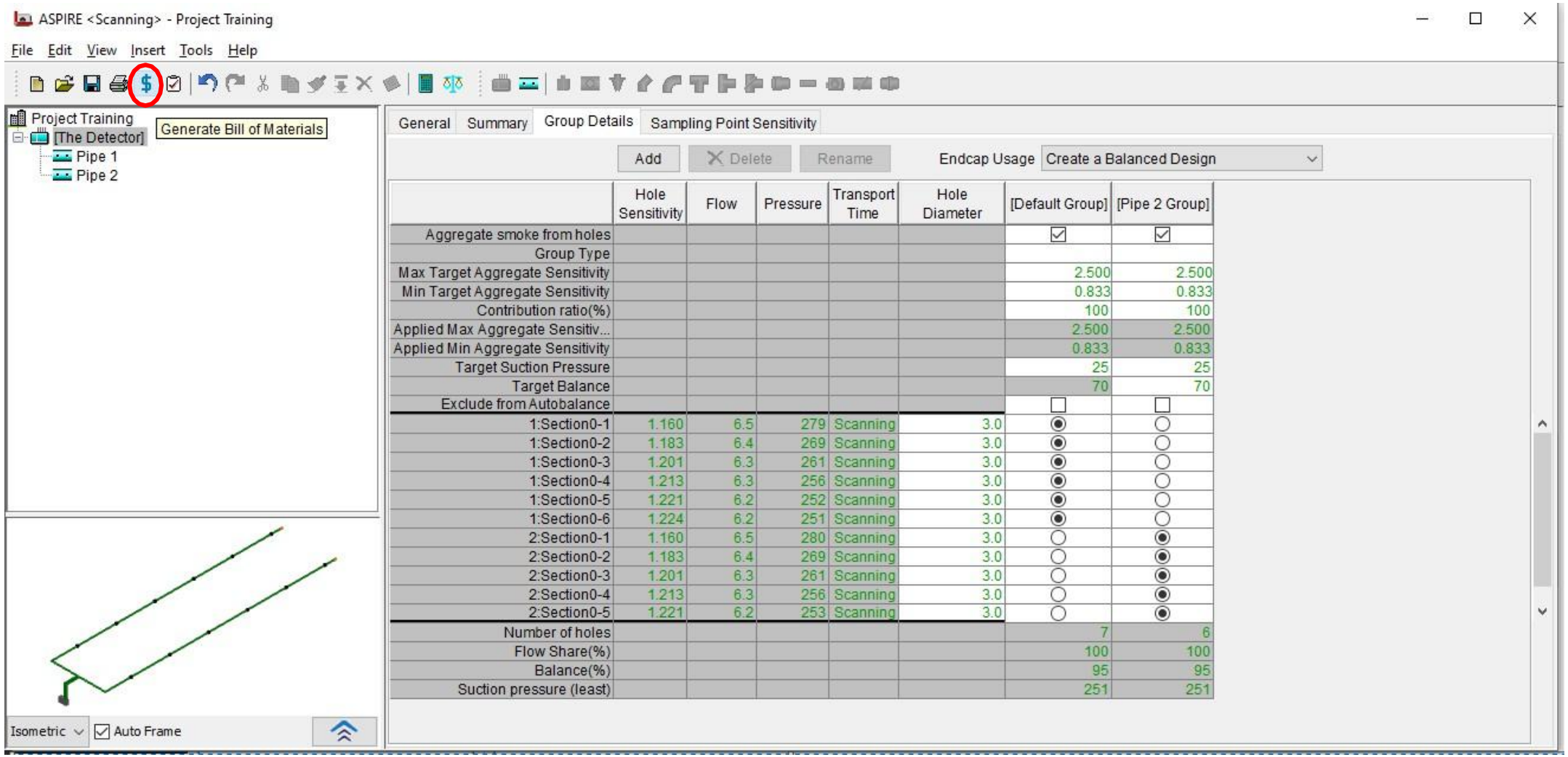
	Hole Sensitivity	Flow	Pressure	Transport Time	Hole Diameter	[Default Group]	[Pipe 2 Group]
Aggregate smoke from holes						☑	☑
Group Type							
Max Target Aggregate Sensitivity						2.500	2.500
Min Target Aggregate Sensitivity						0.833	0.833
Contribution ratio(%)						100	100
Applied Max Aggregate Sensitiv...						2.500	2.500
Applied Min Aggregate Sensitivity						0.833	0.833
Target Suction Pressure						25	25
Target Balance						70	70
Exclude from Autobalance						☐	☐
1:Section0-1	1.160	6.5	279	Scanning	3.0	◉	○
1:Section0-2	1.183	6.4	269	Scanning	3.0	◉	○
1:Section0-3	1.201	6.3	261	Scanning	3.0	◉	○
1:Section0-4	1.213	6.3	256	Scanning	3.0	◉	○
1:Section0-5	1.221	6.2	252	Scanning	3.0	◉	○
1:Section0-6	1.224	6.2	251	Scanning	3.0	◉	○
2:Section0-1	1.160	6.5	280	Scanning	3.0	○	◉
2:Section0-2	1.183	6.4	269	Scanning	3.0	○	◉
2:Section0-3	1.201	6.3	261	Scanning	3.0	○	◉
2:Section0-4	1.213	6.3	256	Scanning	3.0	○	◉
2:Section0-5	1.221	6.2	253	Scanning	3.0	○	◉
Number of holes						7	6
Flow Share(%)						100	100
Balance(%)						95	95
Suction pressure (least)						251	251

IDP (Installation Data Pack)



	Hole Sensitivity	Flow	Pressure	Transport Time	Hole Diameter	[Default Group]	[Pipe 2 Group]
Aggregate smoke from holes						☑	☑
Group Type							
Max Target Aggregate Sensitivity						2.500	2.500
Min Target Aggregate Sensitivity						0.833	0.833
Contribution ratio(%)						100	100
Applied Max Aggregate Sensitiv...						2.500	2.500
Applied Min Aggregate Sensitivity						0.833	0.833
Target Suction Pressure						25	25
Target Balance						70	70
Exclude from Autobalance						☐	☐
1:Section0-1	1.160	6.5	279	Scanning	3.0	◉	○
1:Section0-2	1.183	6.4	269	Scanning	3.0	◉	○
1:Section0-3	1.201	6.3	261	Scanning	3.0	◉	○
1:Section0-4	1.213	6.3	256	Scanning	3.0	◉	○
1:Section0-5	1.221	6.2	252	Scanning	3.0	◉	○
1:Section0-6	1.224	6.2	251	Scanning	3.0	◉	○
2:Section0-1	1.160	6.5	280	Scanning	3.0	○	◉
2:Section0-2	1.183	6.4	269	Scanning	3.0	○	◉
2:Section0-3	1.201	6.3	261	Scanning	3.0	○	◉
2:Section0-4	1.213	6.3	256	Scanning	3.0	○	◉
2:Section0-5	1.221	6.2	253	Scanning	3.0	○	◉
Number of holes						7	6
Flow Share(%)						100	100
Balance(%)						95	95
Suction pressure (least)						251	251

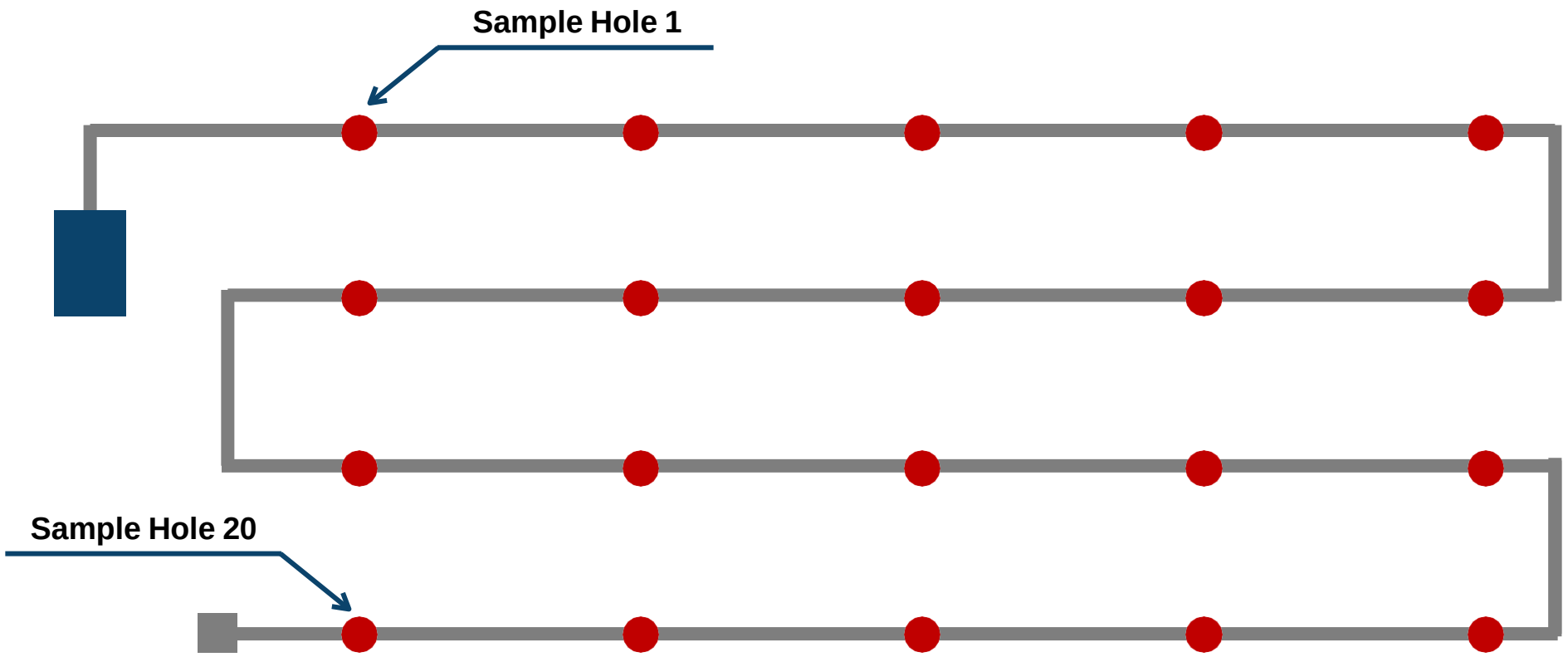
BOM (Bill of Materials)



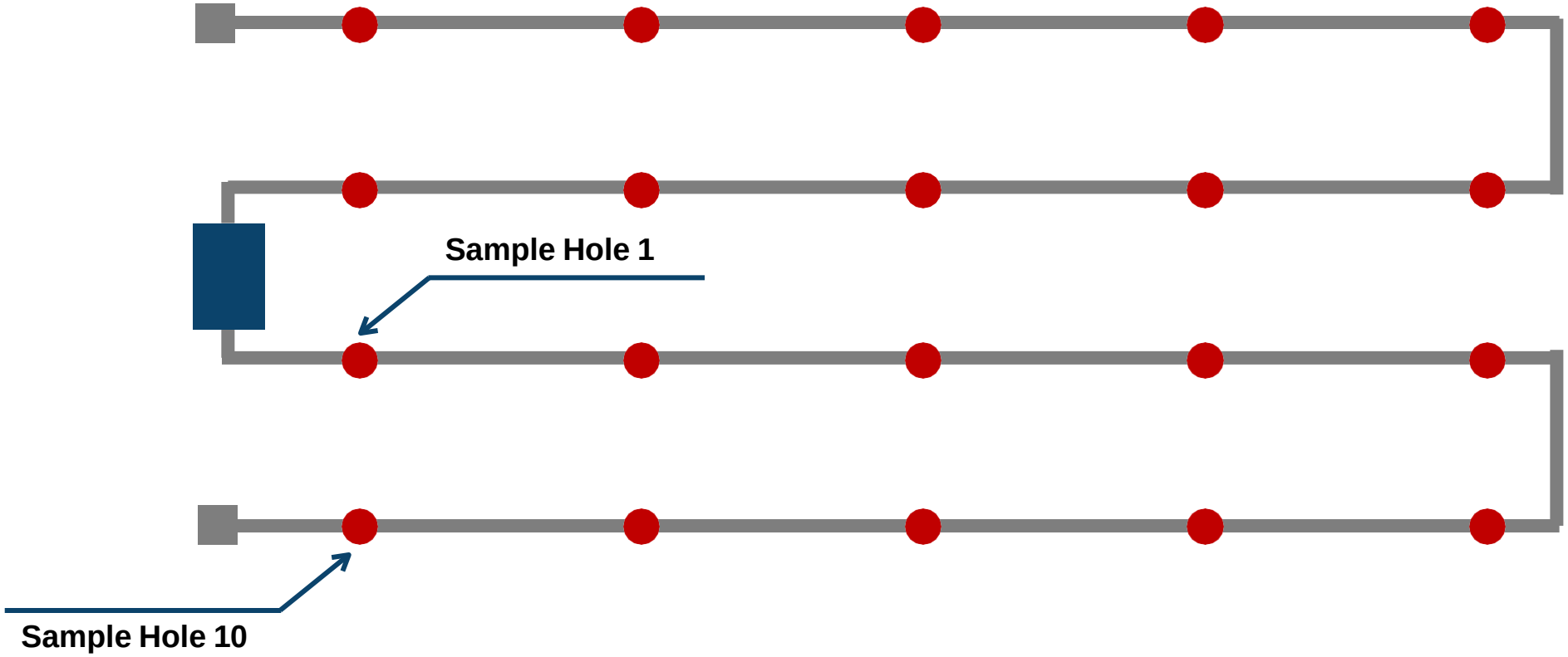
	Hole Sensitivity	Flow	Pressure	Transport Time	Hole Diameter	[Default Group]	[Pipe 2 Group]
Aggregate smoke from holes						☑	☑
Group Type							
Max Target Aggregate Sensitivity						2.500	2.500
Min Target Aggregate Sensitivity						0.833	0.833
Contribution ratio(%)						100	100
Applied Max Aggregate Sensitiv...						2.500	2.500
Applied Min Aggregate Sensitivity						0.833	0.833
Target Suction Pressure						25	25
Target Balance						70	70
Exclude from Autobalance						☐	☐
1:Section0-1	1.160	6.5	279	Scanning	3.0	◉	○
1:Section0-2	1.183	6.4	269	Scanning	3.0	◉	○
1:Section0-3	1.201	6.3	261	Scanning	3.0	◉	○
1:Section0-4	1.213	6.3	256	Scanning	3.0	◉	○
1:Section0-5	1.221	6.2	252	Scanning	3.0	◉	○
1:Section0-6	1.224	6.2	251	Scanning	3.0	◉	○
2:Section0-1	1.160	6.5	280	Scanning	3.0	○	◉
2:Section0-2	1.183	6.4	269	Scanning	3.0	○	◉
2:Section0-3	1.201	6.3	261	Scanning	3.0	○	◉
2:Section0-4	1.213	6.3	256	Scanning	3.0	○	◉
2:Section0-5	1.221	6.2	253	Scanning	3.0	○	◉
Number of holes						7	6
Flow Share(%)						100	100
Balance(%)						95	95
Suction pressure (least)						251	251

REFER TO ASPIRE PRODUCT GUIDE FOR MORE INFORMATION

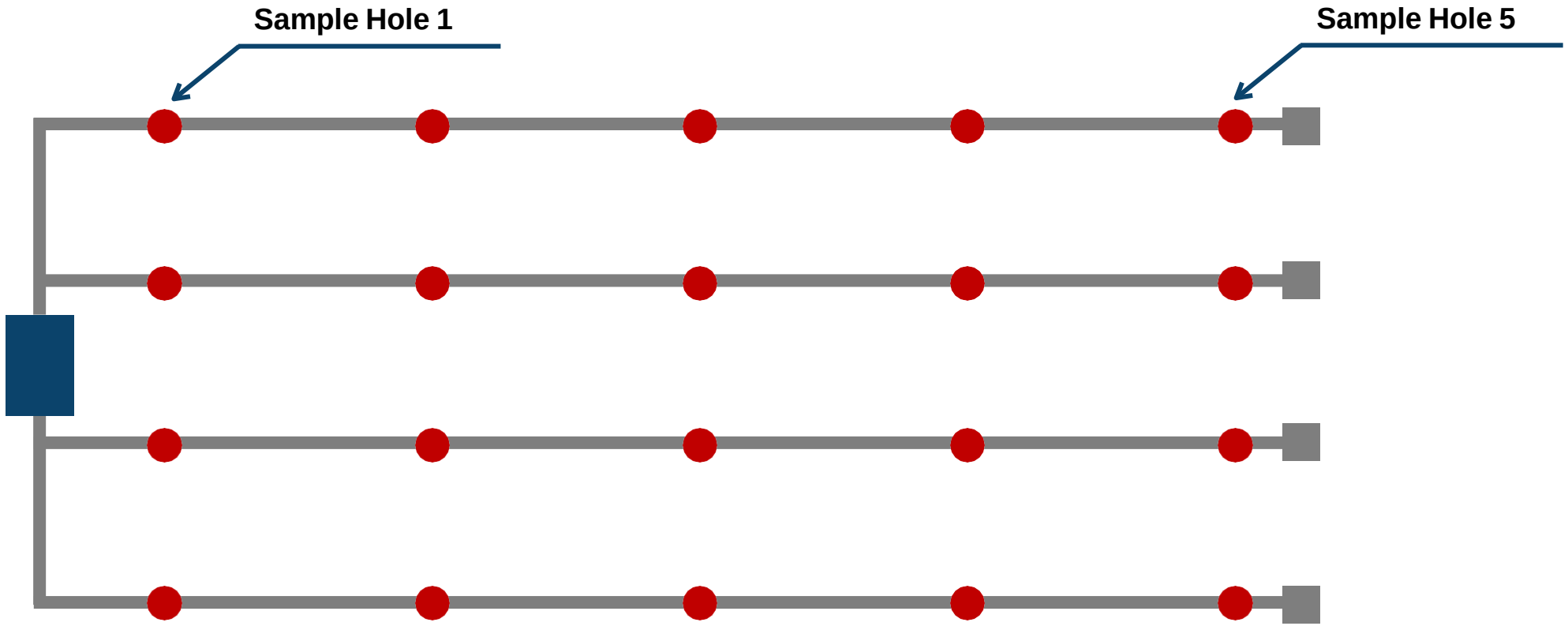
Designing – One Pipe



Designing – Two Branches or Two Pipes



Designing – Four Branches or Four Pipes



Design Example - Metric

If a new project received with Information as below:

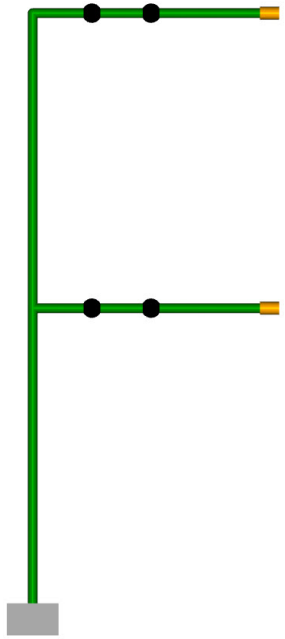
- Clean Store Application
- Flat Ceiling (No Drop Beams and No Slopes within Ceiling)
- Detector Location As per Recommended
- Local code requirement: NFPA 72 (For this example only, apply similar for other regions)
- Ceiling Height = 20 ft.
- Area Dimensions are 45m X 24m (150 ft. X 80 ft.)

Design, Calculations and BOM needed.

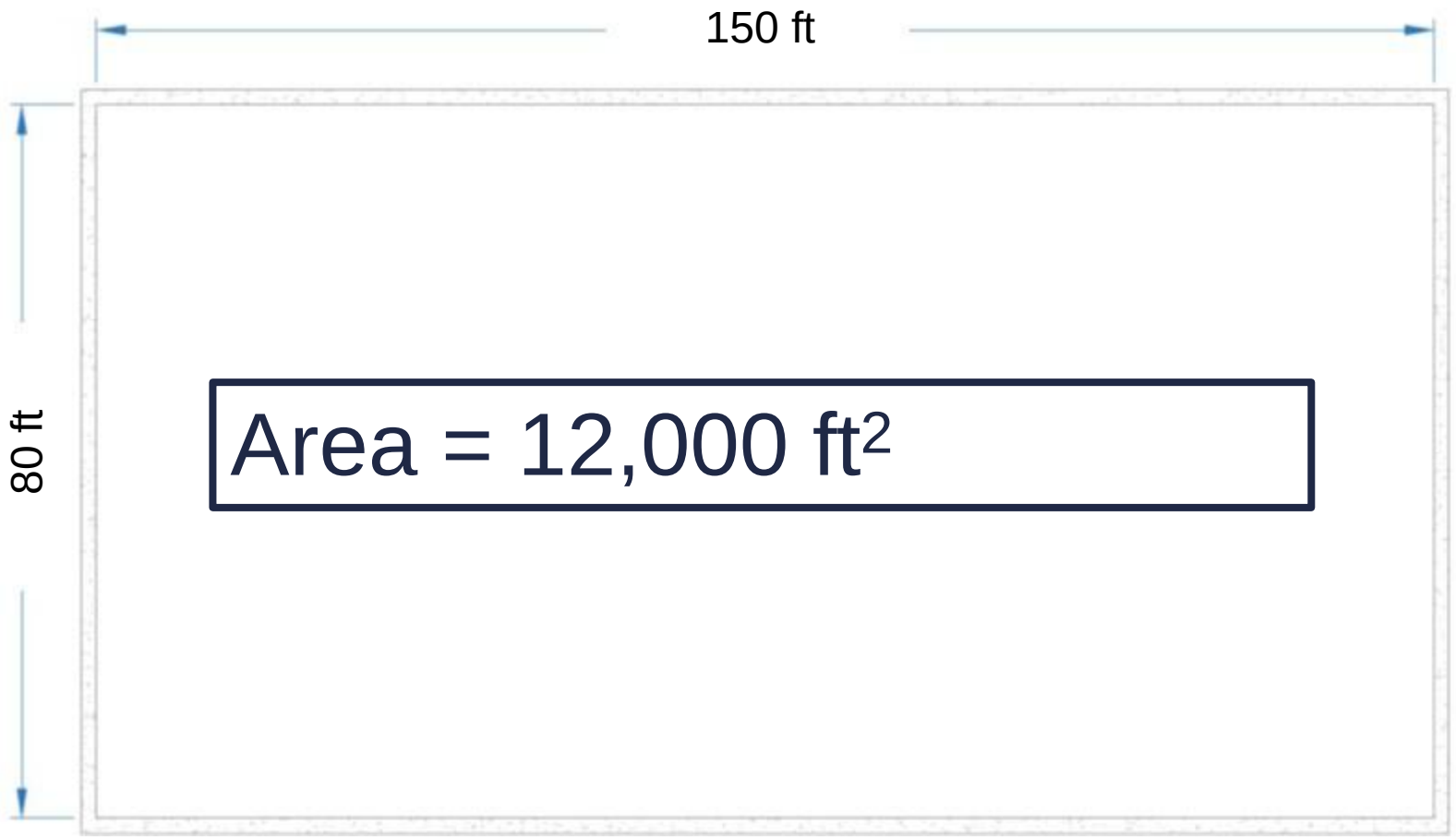
Aspire 3 Lab #1 - Letter F

This beginning exercise is a good overall introduction to navigating within Aspire. We will add a detector & pipe, add holes, and a tricky fitting called a VP-TEE: T piece. I call this a Thru-T, and it is how we add some branching, drop-pipes, and J-Hooks for getting up into beam pockets.

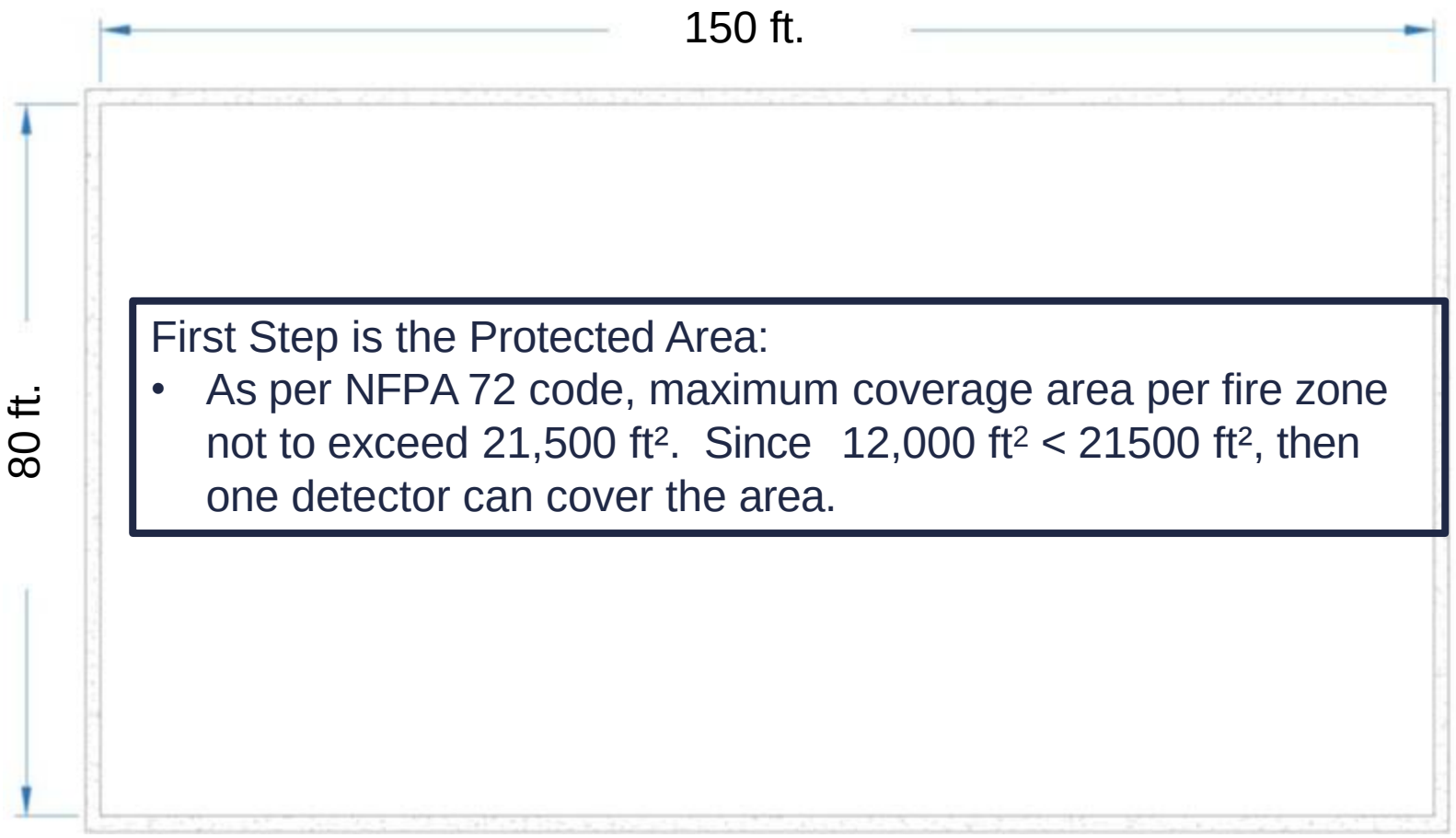
New Project - Advanced - UL268 7th Version
ADD: VEP-1p Right-click (RC) Detector and RENAME "Letter F"
UL268 7th - SA Lo Sens <300 FPM
ADD: Pipe - Simple Pipe - 1 bend FINISH
Click: (Under "TYPE") next to top hole DELETE all holes (**NOTE**: you cannot delete the EC)
Double-click (DC) DIRECTION and choose R RELATIVE DISTANCE = 50 EC = 30
Click bottom section of pipe ADD: Thru-T CLICK + IN TREE VIEW (**NOTE**: Sections 1 & 2)
Click Section 2 TURN Drop Pipe = R
Click Section 1 Click EC Relative Distance = 30' Click EC ADD: Hole
Click Section 2 Click EC ADD: Hole
Calculate



Design Practice



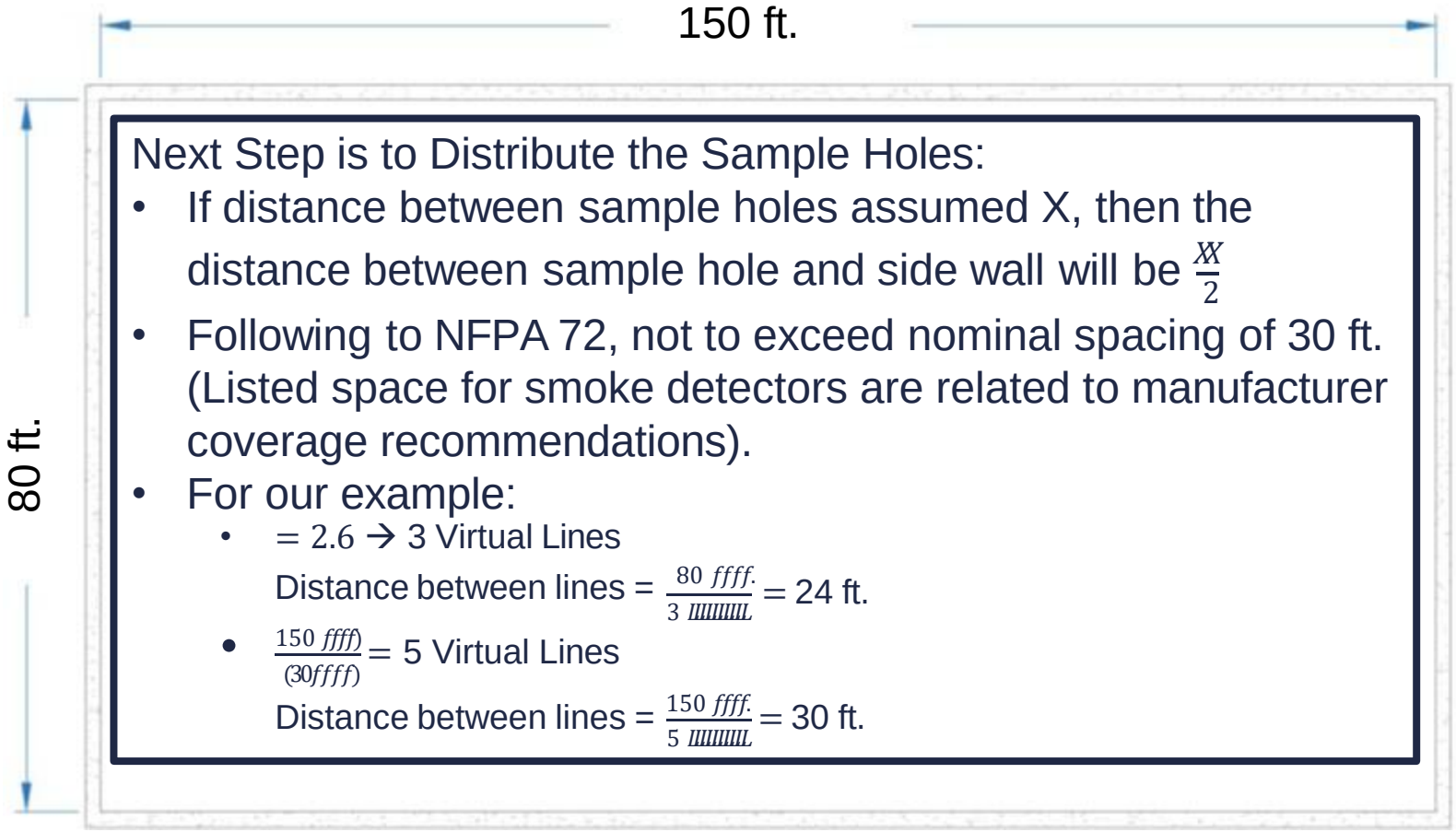
Design Practice



First Step is the Protected Area:

- As per NFPA 72 code, maximum coverage area per fire zone not to exceed 21,500 ft². Since 12,000 ft² < 21500 ft², then one detector can cover the area.

Design Practice



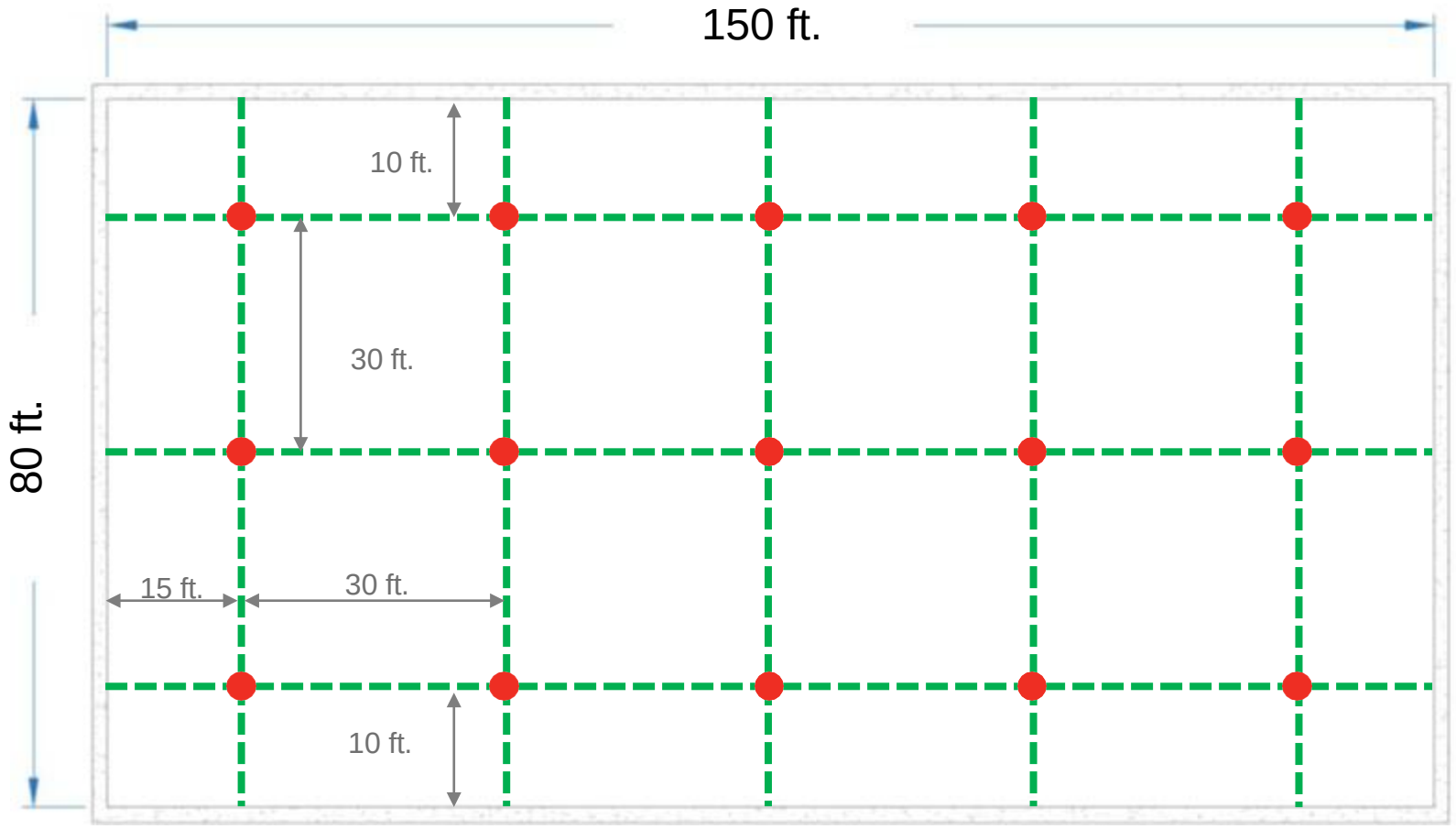
Next Step is to Distribute the Sample Holes:

- If distance between sample holes assumed X, then the distance between sample hole and side wall will be $\frac{XX}{2}$
- Following to NFPA 72, not to exceed nominal spacing of 30 ft. (Listed space for smoke detectors are related to manufacturer coverage recommendations).
- For our example:
  - $= 2.6$ → 3 Virtual Lines

    Distance between lines = $\frac{80\ ffff.}{3\ lllllllll} = 24$ ft.
  - $\frac{150\ ffff)}{(30ffff)} = 5$ Virtual Lines

    Distance between lines = $\frac{150\ ffff.}{5\ lllllllll} = 30$ ft.

Design Practice



Design Practice

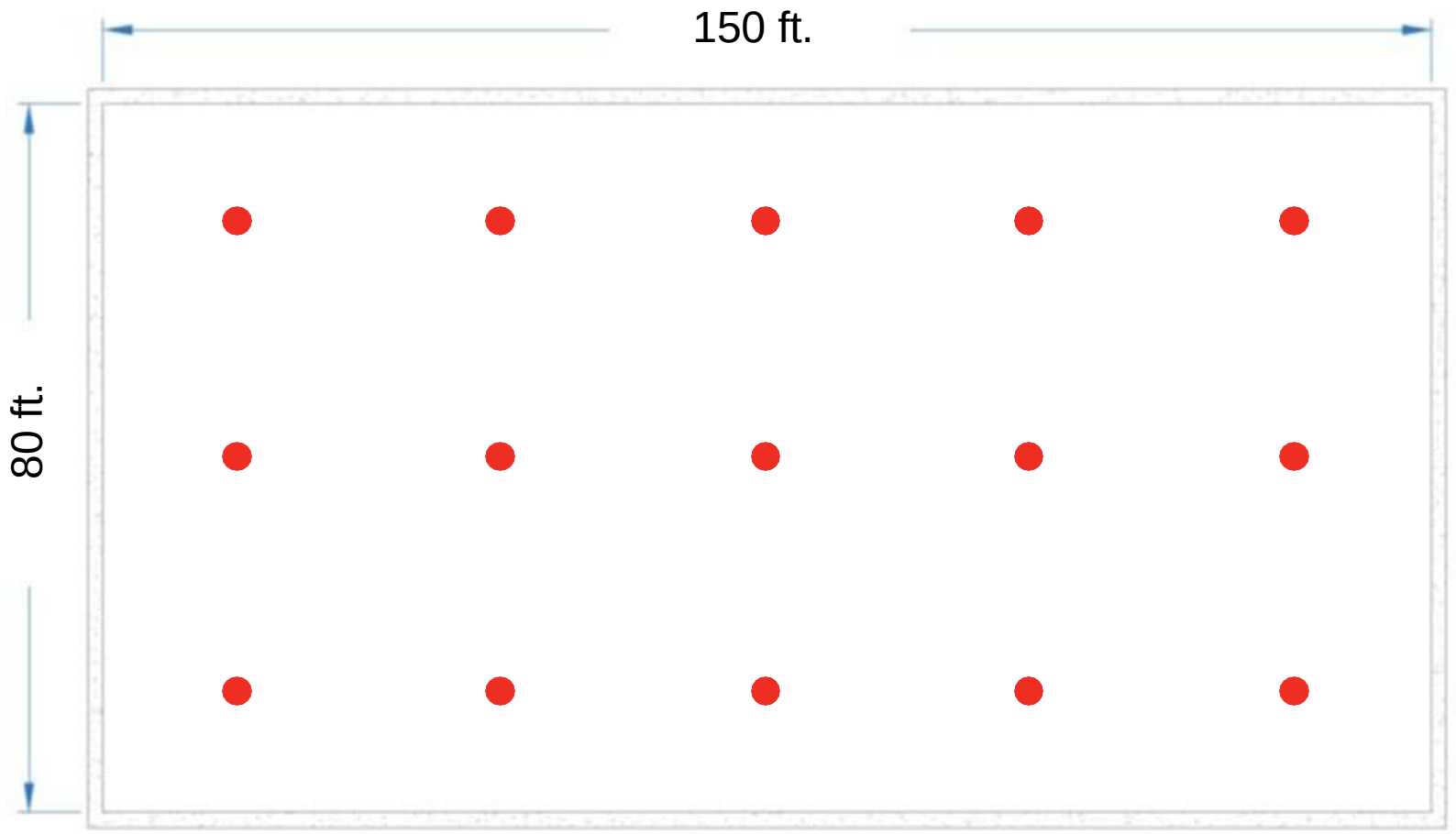
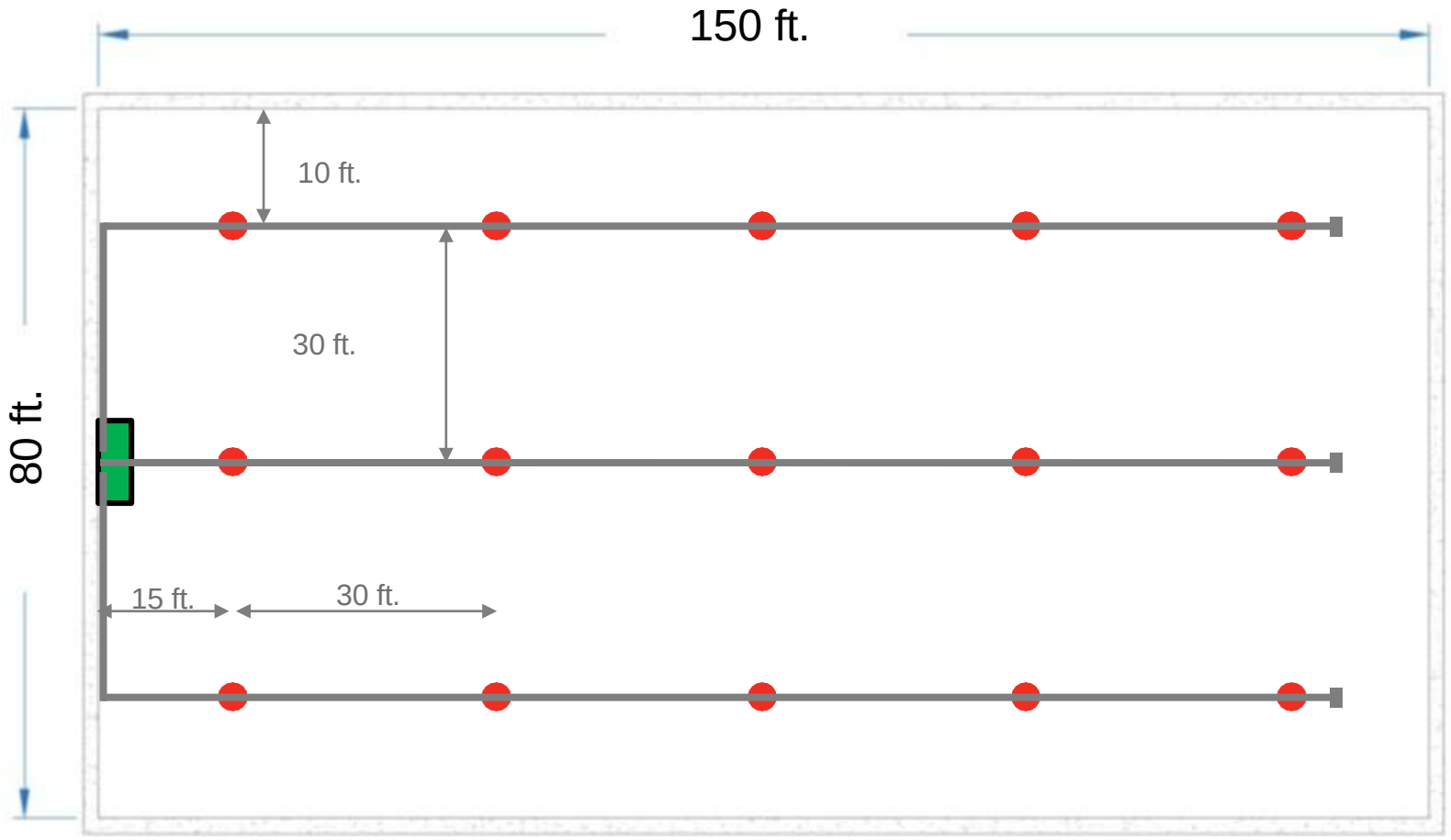
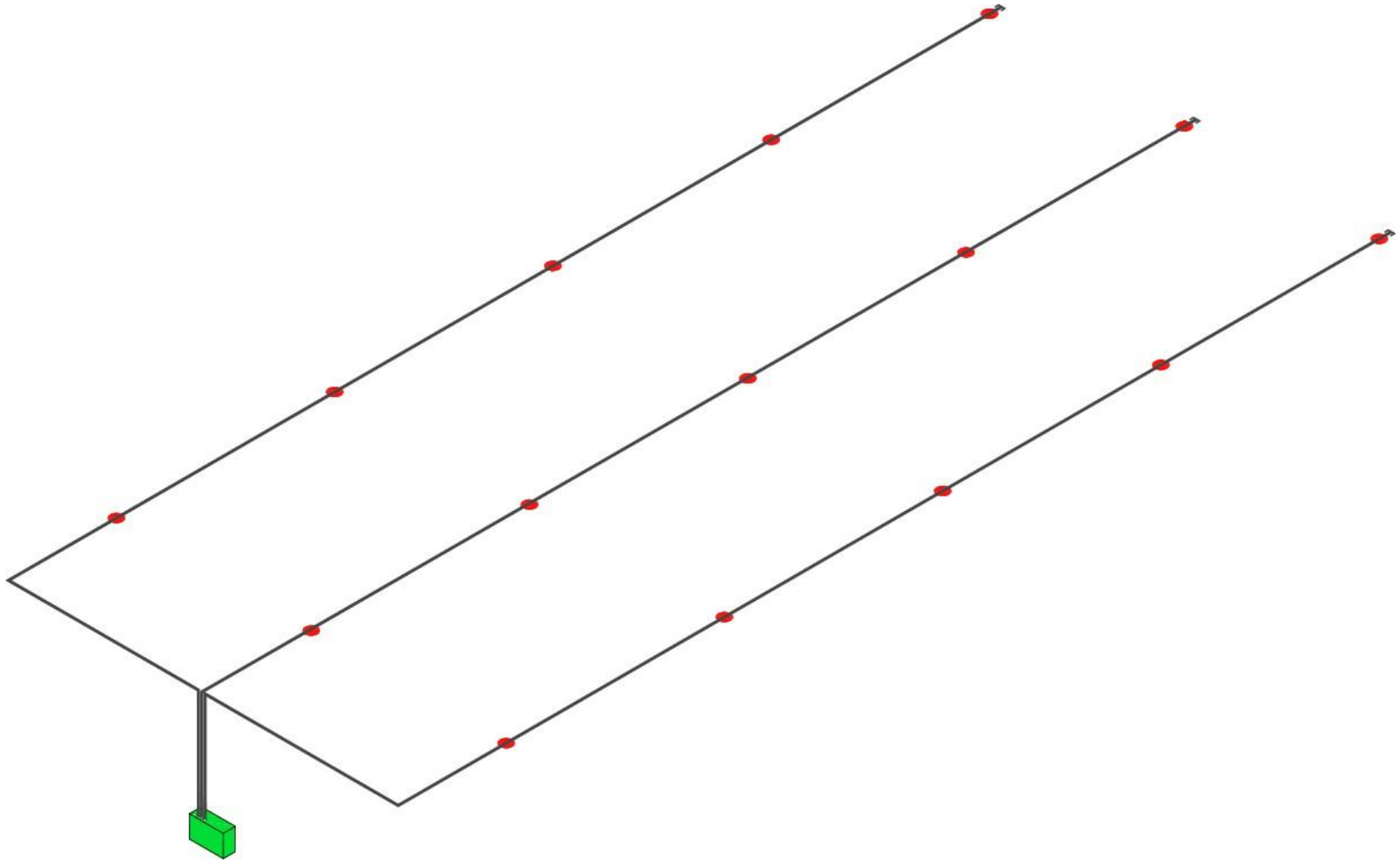


Figure it Out

10ft rise to ceiling **Don’t forget test points**



Design Practice



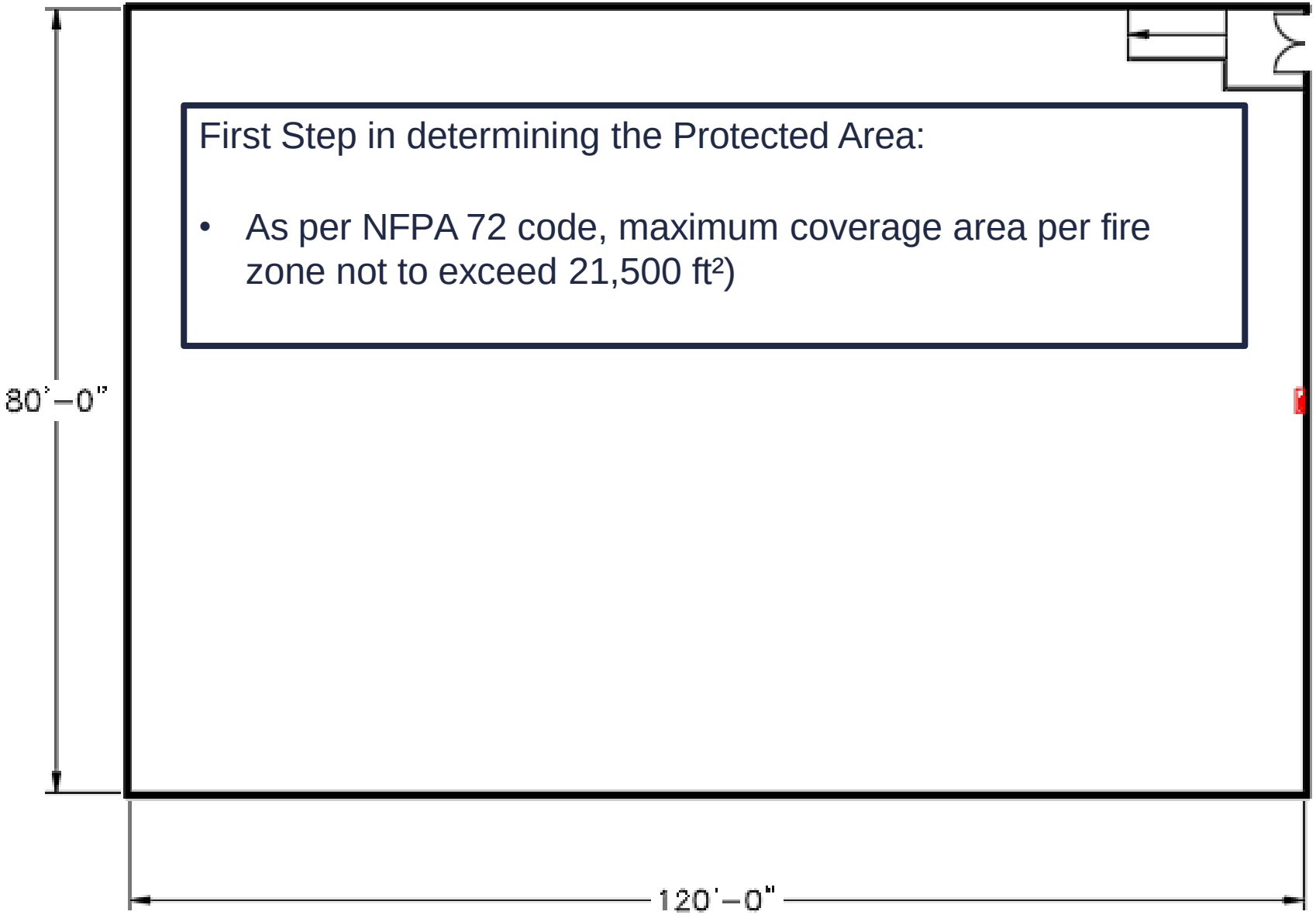
Design Example - Imperial

If a new project received with Information as below:

- Data Center A
- Area Dimensions are 120 ft. X 80 ft.
- Tee Bar Ceiling Height = 10 ft.
- Detector Location As per Recommended
- Local code requirement: EWFD (Early Warning Fire Detection) with coverage sample holes not more than 400 sq.ft

Design, Calculations and BOM needed.

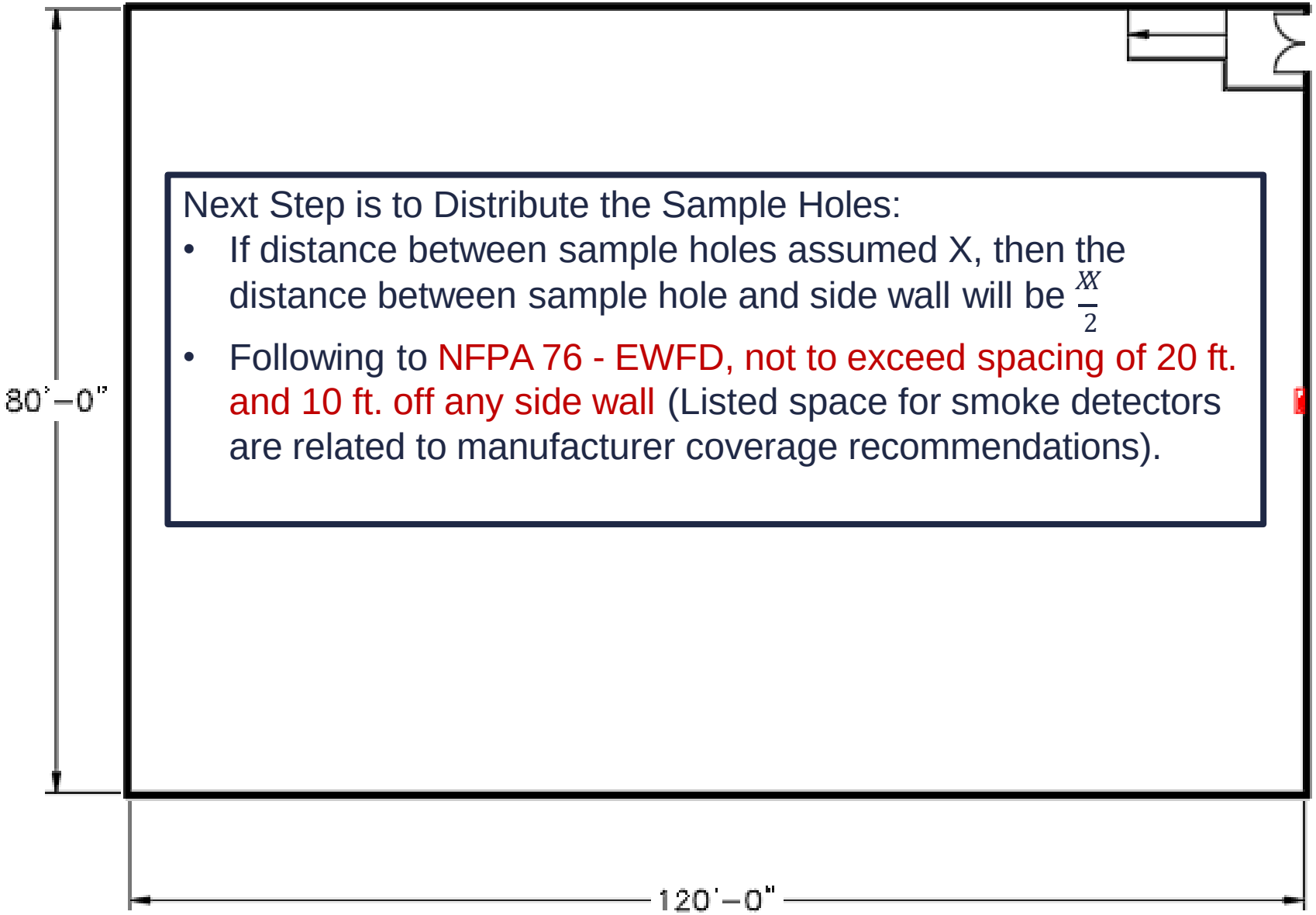
Design Practice



First Step in determining the Protected Area:

- As per NFPA 72 code, maximum coverage area per fire zone not to exceed 21,500 ft²)

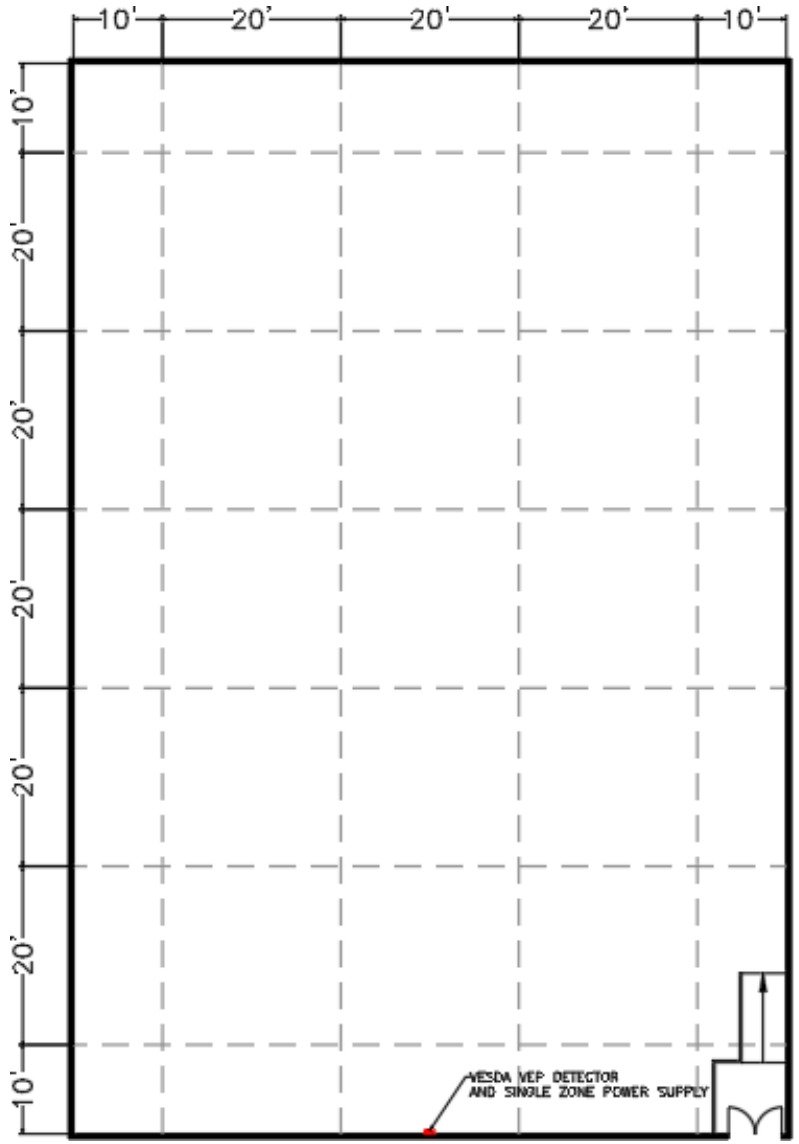
Design Practice

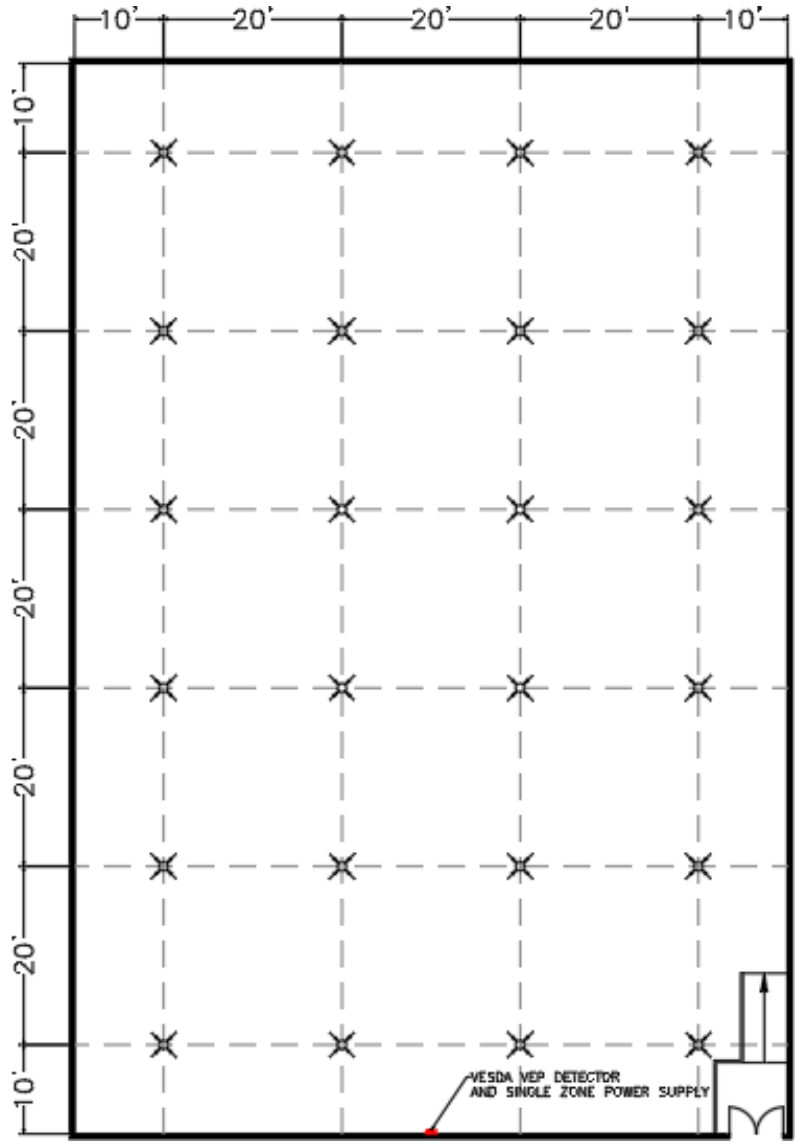


Next Step is to Distribute the Sample Holes:

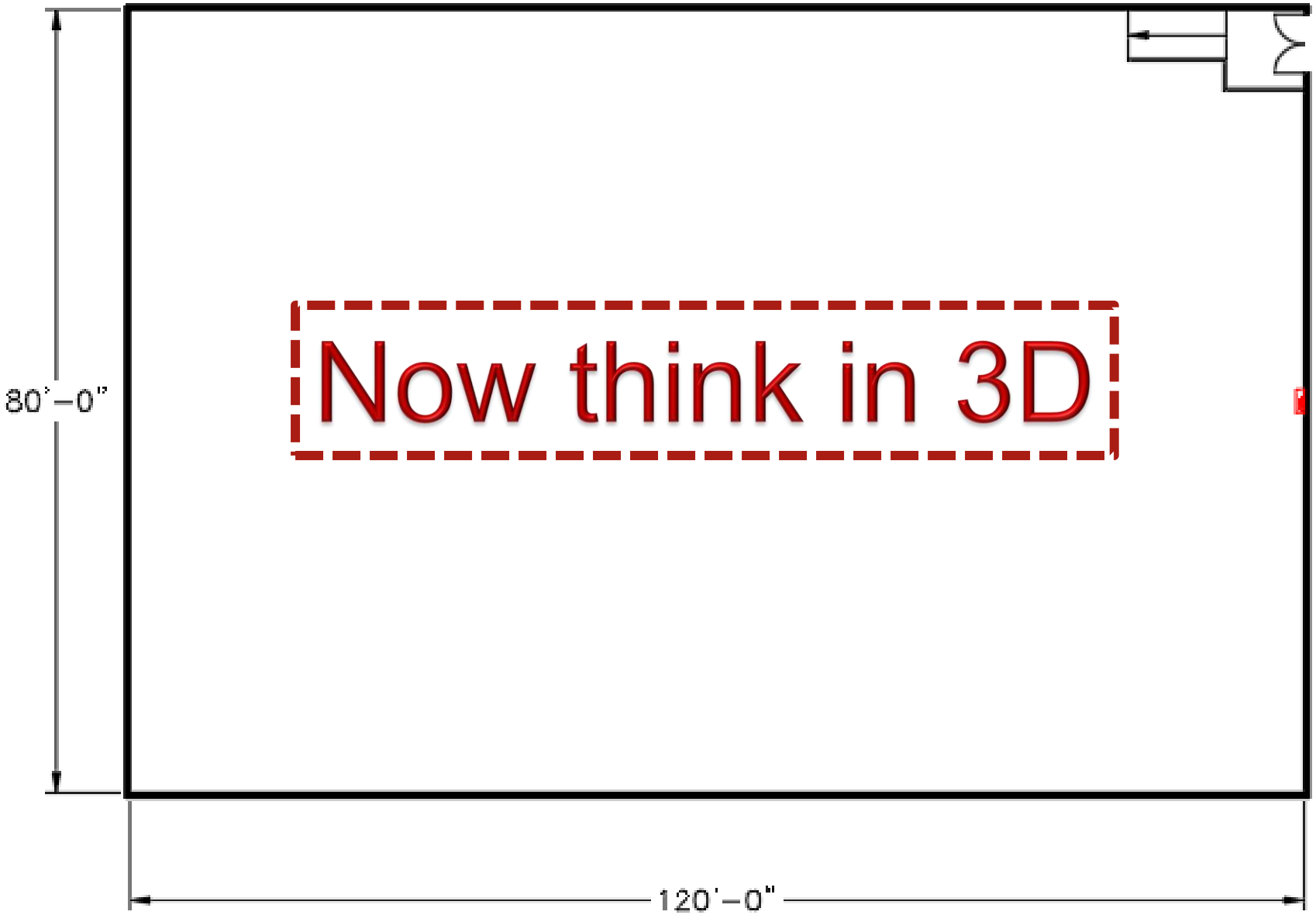
- If distance between sample holes assumed X, then the distance between sample hole and side wall will be $\frac{XX}{2}$
- Following to NFPA 76 - EWFD, not to exceed spacing of 20 ft. and 10 ft. off any side wall (Listed space for smoke detectors are related to manufacturer coverage recommendations).

Design Practice

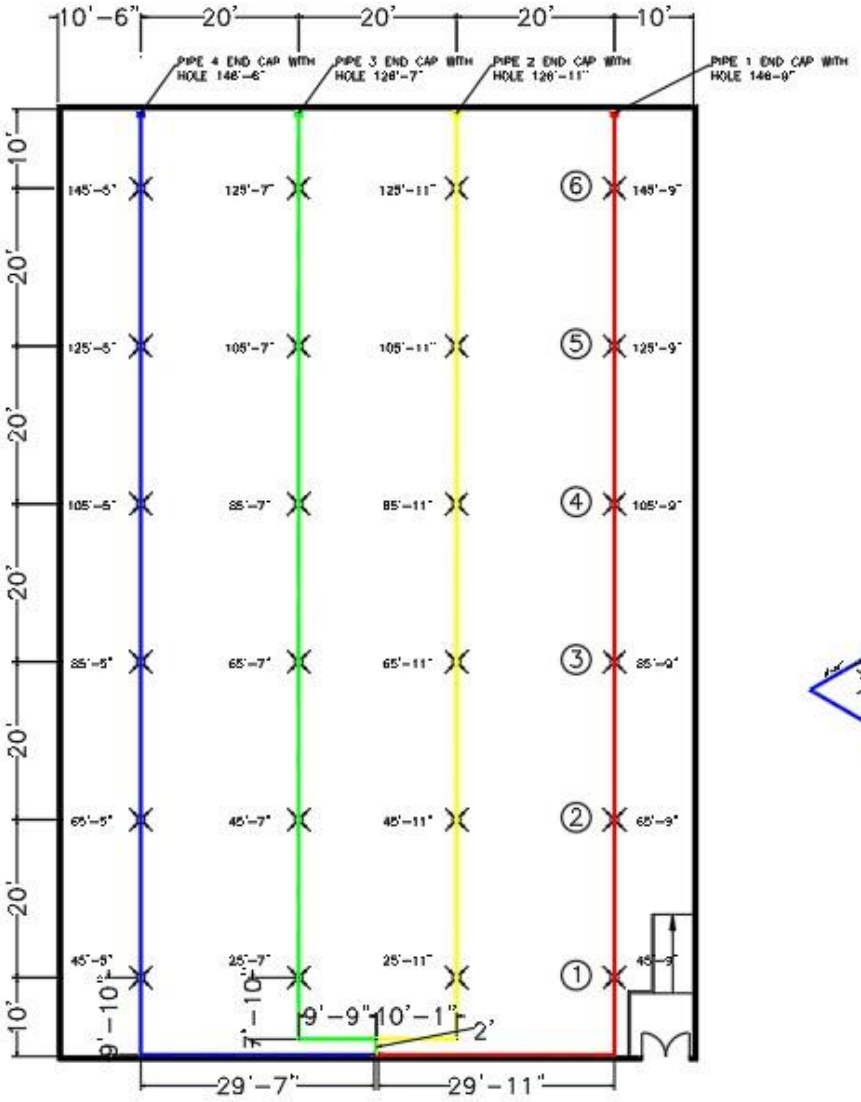


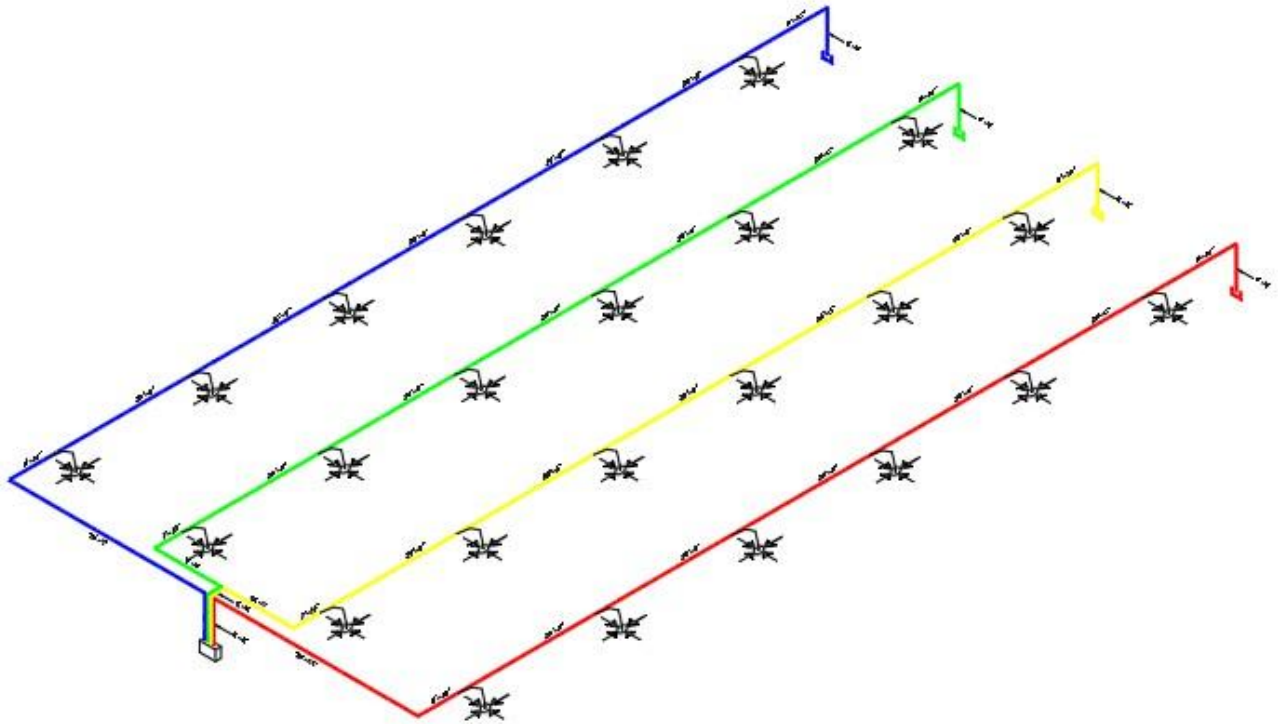


Design Practice

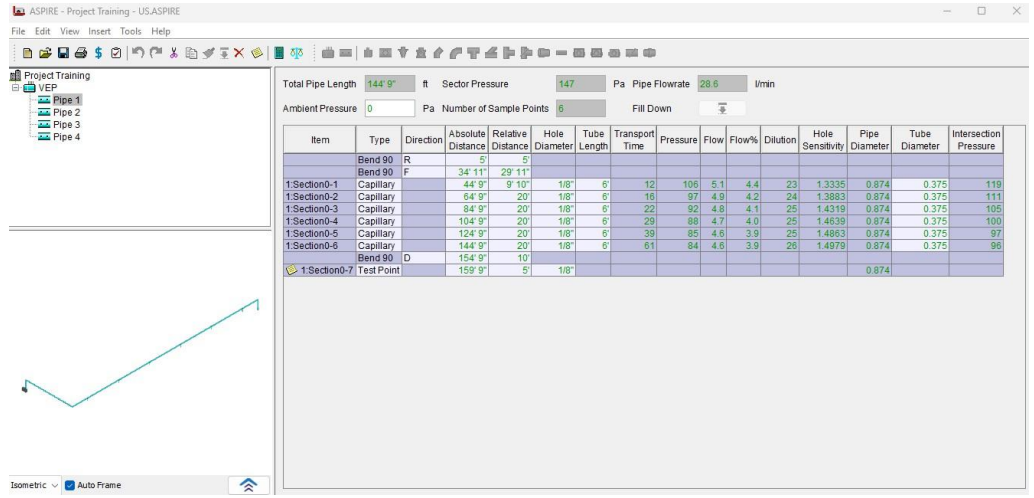


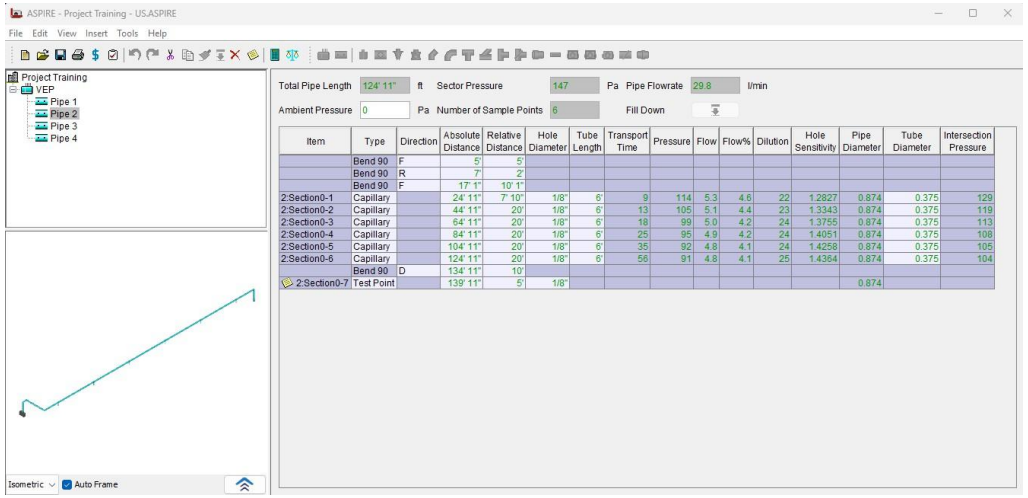
Design Practice

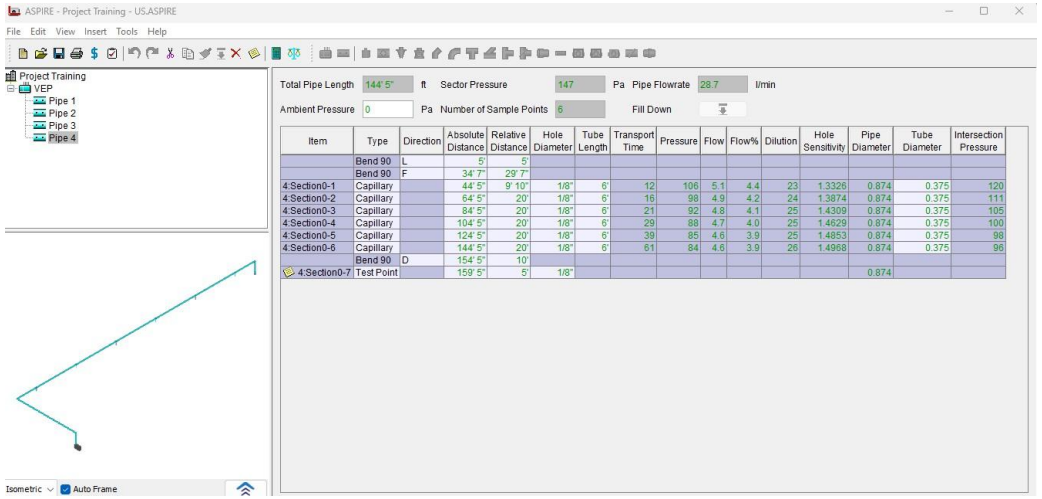


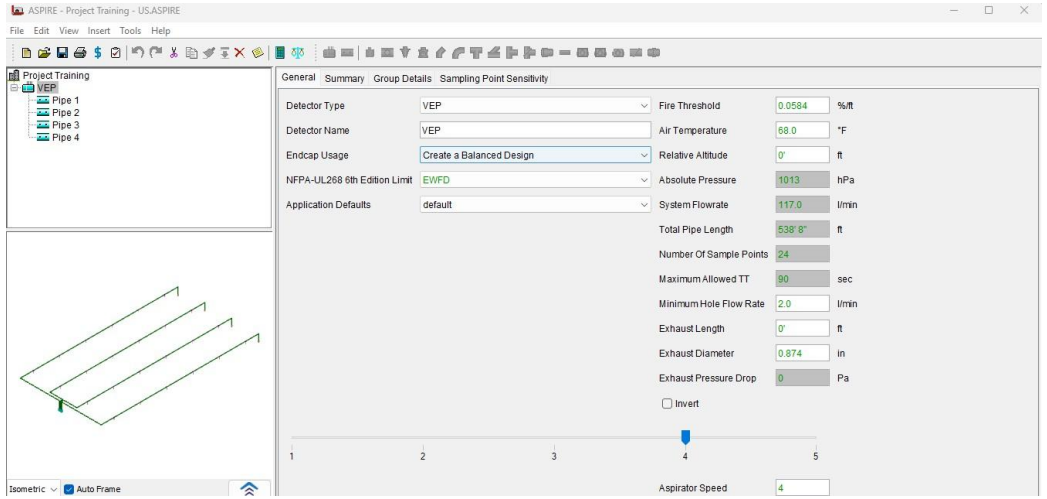


On Aspire Software (US measurement)









Designing and Codes

Example US:

NFPA 72 (2019) Reference Points

6. Air Sampling–Type Smoke Detector

1. General.

1. In the absence of specific performance based design criteria, each sampling port of an air sampling–type smoke detector shall be treated as a spot-type smoke detector for the purpose of location and spacing in accordance with 17.7.3.

2. Pipe Network.

1. Maximum air sample transport time from the farthest sampling port to the detector shall not exceed 120 seconds.

2. Sampling pipe networks shall be designed on the basis of, and shall be supported by, computer based fluid dynamics design calculations to ensure required performance.

3. The sampling pipe network design calculations shall include pressure, volumetric flow, and alarm sensitivity at each sampling port.

4. Software applications for the design of pipe networks shall be listed for use with the manufacturer’s equipment.

Designing and Codes

Example US:

NFPA 72 (2019) Reference Points

17.7.3.6.2.7 If provided, test ports at the end (most remote location) of a pipe run installed in the pipe network solely for the purpose of validating consistency in performance (also referred to as benchmark test points) shall be included in the design calculations and allowed, but not required, to comply with the requirements of 17.7.3.6.2.

17.7.3.6.2.9 Pipe network materials, sizing and installation shall be in accordance with the manufacturer's published requirements and suitable for use in the environment in which they are installed.

17.7.3.6.2.10 Where used, capillary tubing shall be sized and affixed in accordance with the manufacturer's published instructions and computer-based design calculations.

3. Installation and Spacing

1. Air sampling pipe network fittings shall be installed air tight and permanently affixed.

2. Sampled air shall be exhausted to a lessor or equal pressure zone. The pressure differential between the sampled air and detector exhaust shall not exceed the manufacturer's published instructions.

3. Supports for sampling pipe shall be in accordance with the air sampling-type smoke detector manufacturer's published instructions.

Designing and Codes

Example US:

NFPA 76 – UL6th Edition

		VEWFD (Very Early Warning Fire Detection)	EWFD (Early Warning Fire Detection)	SFD (Standard Fire Detection)
Sensitivity at each port/ sensor		1.0% obs/ft.	1.5% obs/ft.	2.5% obs/ft.
Coverage	Open Area	200 sq. ft.	400 sq. ft.	900 sq. ft.
	Return Air Grille	4 sq. ft. (Grille Area)	Duct Detection	Duct Detection
Transport Time		60 Seconds	90 Seconds	120 Seconds

* Detector sensitivity is determined by ASPIRE to be verified as per local codes.
** Smoke thresholds listed within the ASPIRE calculation are a guide only and are bound by a standard range. Exact smoke thresholds setting are to be modified and made suitable for the environment in which the detector in installed.

Designing and Codes

Example US:

NFPA 76 – UL7th Edition

- Under UL268 6th Edition a standard smoke transport time of 120 seconds applied to all products
- Under UL268 7th Edition each product has its own smoke transport time for Open Area and Special Applications

Product	Application	Hole Sensitivity	Max Transport Time (sec)
VEP-1	Open Area	(1.551%/ft to 3.160%/ft)	49
	Special	(0.003%/ft to 0.460%/ft)	90
VEP	Open Area	(1.551%/ft to 3.160%/ft)	45
	Special	(0.003%/ft to 0.460%/ft)	85
VES	Open Area	(1.551%/ft to 3.160%/ft)	40
	Special	(0.003%/ft to 0.460%/ft)	64
VEU	Open Area	(1.551%/ft to 3.160%/ft)	50
	Special	(0.003%/ft to 0.460%/ft)	85
VLF-500	Open Area	(2.188%/ft to 3.160%/ft)	24
	Special	(0.003%/ft to 0.460%/ft)	47
VEA	Open Area	(2.509%/ft)	51
	Special	(0.490%/ft to 2.509%/ft)	79

Designing and Codes

Example Global Summary: Smoke Detector Height Limits

Country	Document	Year	Ceiling Height Limitation			Notes
			Point Type	Aspirator Type	Beam Type	
UK	BS 5839-1	2013	Refer to Table 2			Other requirements for property protection are also stipulated
Germany	VdS 2095	2010	12 m (39 ft.)	12 m (39 ft.)	16 m (52.5ft)	Ceiling heights exceeding 12 m (39 ft.) required a second level of detectors. Beams and aspirator type detection preferred when proved with fire test.
Germany	DIN VDE 0833-2	2009	12 m (39 ft.)	20 m (65.6 ft.)	16 m (52.5ft)	Point detectors for ceilings heights of 12-16m (39 - 52.5 ft.) or use of beam detectors for ceiling heights of 16-29m (52.5- 95.1 ft.) requires fire test. Ceiling heights exceeding 20 m (65.6 ft.) require multiple layers of detectors.
Netherlands	NEN2525+ C1	2010	12m (39 ft.)	45 m (147 ft.)	Single layer: 12m (39 ft.) Second layer: 25m (82 ft.)	Beam detectors at ceiling heights of 12-25 m (39–82 ft.) require a second layer detection. Point detectors for ceiling heights 12-16 m (39-52 ft.) requires a successful fire test demonstration. Aspirating detectors always requires a successful fire test demonstration.
France	R7	2014	12 m (39 ft.)	12 m (39 ft.)	12 m (39 ft.)	For ceiling heights exceeding 12 m (39 ft.), 2 layers of detection may be needed pending the results of a risk analysis.
Denmark	DBI 232	2016	-	11 m (36 ft.)	11 m (36 ft.)	For ceiling heights exceeding 11 m (36 ft.) multiple layers of detectors are required with not more than 11 m between the protection layers.
USA	NFPA 72	2016	No prescriptive limitation; however, must account for stratification.			Limited by the lack of test data at other heights
Australia	AS 1670.1	2015	12.0 m (39 ft.)	12.0 m (39 ft.)	12.0 m (39 ft.)	Higher ceiling heights require engineering analysis
Middle East	NFPA 72	Refer to above line for USA.				
Hong Kong	BS 5839-1	2002	12.5 m (41 ft.)	12.5 m (41 ft.)	-	If the ceiling height exceeded 12.5m then other types of detector (e.g. beam detector) should be installed according to BS 5839 requirements.
European Union	CEN/TS 54-14	2004	11 m (36 ft.)	-	25 m (82 ft.)	Beam detectors at ceiling heights of 12-25 m (39–82 ft.) require a second layer detection.

Summary

System Design and Practical Exercise

- Gathering information (site layout and dimensions, ceiling type, layer of protection, needed classification, any local codes, environment parameters, specifications, scope of work, required areas, detector location, network options and special site requirements).
- Creating basic layout with sampling locations, connecting sample points using pipes
- Start thinking with 3D design & layout instead of 2D as conventional spot type
- Dealing with special applications (clean rooms → harsh environments)
- Using AutoCAD and ASPIRE calculation for detailed design
- Generating (IDP and BOQ) from ASPIRE software