THE ULTIMATE GUIDE TO ASPIRATING SMOKE DETECTION UNDER UL 268 7TH EDITION

KEY STEPS TO SELECTING AND DESIGNING AN ASD SYSTEM ACCORDING TO THE LATEST UL STANDARD

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Smoke detector regulations are about to change substantially, as the new UL 268 7th Edition standard is on the horizon, with a transition date set for 30 June 2024. This new Edition is a significant shift from the previous version, requiring an improved performance from smoke detection systems. This guide illustrates how to achieve optimal Aspirating Smoke Detection (ASD) performance while complying with UL 268 7th Edition.

Some of the most significant updates introduced by the new standard include a focus on reducing nuisance alarms, particularly in cooking environments. There is also a focus on increasing protection from rapidly escalating fires fueled by synthetic materials, like polyurethane.

Even though the regulators have allowed some time for the transition, early adoption can benefit users. This guide illustrates how using aspirating detectors that comply with UL 268 7th Edition will result in optimal reliability and reduced nuisance alarms.

WHAT IS UL 268, AND WHY IS IT CHANGING?

UL 268 7th Edition is the latest standard for smoke detectors from Underwriters Laboratories, which is being adopted by regulatory authorities worldwide, including the National Fire Protection Association (NFPA). This global acceptance directly impacts smoke detector manufacturers and users in regions from North America to the Middle East and Asia Pacific.

The new standard has been under development for several years as researchers sought to identify the most effective ways to detect fires in modern structures and reduce nuisance alarms simultaneously. Their studies identified polyurethane foam, used in modern furniture, as a new fire risk for buildings. This synthetic material burns with unique characteristics and contributes to a fire's propagation speed and intensity. Polyurethane foam can smolder or burst into flame, and modern smoke detectors must be capable of detecting these combustion modes. Fires fueled by synthetic materials also spread faster than those involving traditional materials.

This standard aims to provide better protection against these modern fire hazards. For example, previous Editions of UL 268 used only Ponderosa Pine as the standard for smoke detection under smoldering conditions. But polyurethane has a much steeper curve in terms of obscuration, as seen in Figure 1.

The difference in fire escalation with synthetic materials is stark. While a person had 17 minutes to escape a fire 40 years ago, that time to escape is down to 3 minutes today. Therefore, early detection of synthetic material fires is vital.[2]

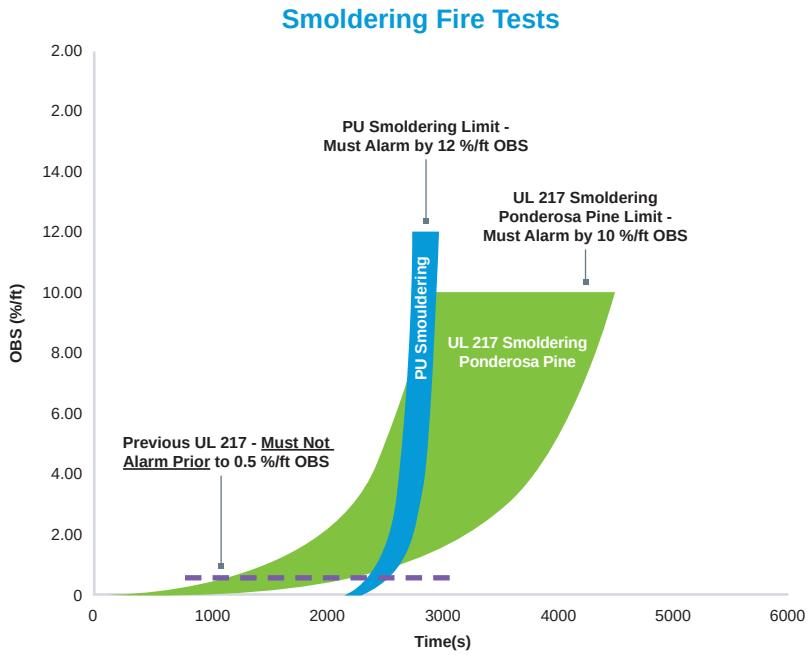

Figure 1 - Comparison of PU and Ponderosa Pine for smoldering[1]

Research from the NFPA shows that almost three out of five home fire deaths were caused by fires in properties without smoke alarms or having non-functional smoke alarms. The most common cause of non-function is lack of power, as users sometimes deliberately disconnect batteries or power sources to avoid nuisance alarms. In a survey conducted by the NFPA, 63% of respondents said that the last time their smoke alarm sounded was during regular cooking.[3] Fumes from cooking have similar characteristics to smoke - leading to the implementation of the hamburger test to check a smoke detector's response to cooking fumes. UL 268 7th Edition seeks to improve smoke detection methods to reduce nuisance alarms.

UL 268 7TH EDITION: WHAT'S NEW?

There are more than 250 changes in the UL 268 7th Edition compared to the previous version. These changes include the need for sensors to distinguish between different fire and smoke signatures and respond to the specific hazard.[4]

To deal with the issue of nuisance alarms, as well as the new materials found in modern buildings, the 7th Edition introduces three new tests that smoke detection devices must pass to comply:

- The cooking nuisance alarm test replicates the fumes produced by cooking that sometimes trigger false detection events to eliminate the source of the nuisance alarm. This test uses a hamburger patty as the cooking sample.
- The smoldering polyurethane foam test replicates the conditions where furniture smolders without producing open flames. This test is in addition to previous smoldering fire tests using Ponderosa Pine.
- The flaming polyurethane test replicates the conditions where furniture containing this material burns in a full-blown fire. This test replaces the test designed to replicate a liquid heptane fire characterized by black smoke.[5]

The new requirements in UL 268 7th Edition are particularly challenging for ASD technology. These devices have a fundamental operating principle of transporting smoke from the farthest sampling point to the detector via a pipe network, which takes some time. This delay makes it difficult to meet the competing objectives of early warning and reducing nuisance alarms. The more sensitive the smoke detector, the more likely that nuisance alarms will occur. But a lower sensitivity system will not provide the very-early-warning required for synthetic material fires. To mitigate this problem, UL 268 7th Edition sets different requirements for two typical applications.

Open Areas have the potential for nuisance sources of alarms, like cooking. Kitchens, cafeterias, food courts, and any other area with cooking appliances fall into this category. UL 268 7th Edition requires smoke detectors not to generate an alarm under nuisance conditions for Open Area applications.

Special Applications have a paramount requirement for early warning, while nuisance sources are not expected in these environments. Data centers, computer rooms, telecoms, warehouses, logistics, transport, utilities, power gen, and others fall into this category. Special Application smoke detectors need not comply with nuisance alarm requirements; therefore, this mode is unsuitable for cooking areas.

UL 268 7TH EDITION – NEW REQUIREMENTS FOR ASD

One significant change from UL 268 6th Edition to UL 268 7th Edition relates to transport times. Under 6th Edition, a standard smoke transport time up to 120 seconds (NFPA 120s Max) applies to all ASD products. However, under 7th Edition, each product has specific performance requirements, which differ for Open Areas and Special Applications. Hole sensitivity has a similar breakdown of requirements per product and per application. Maximum transport times in open areas are much lower than those for special applications, while hole sensitivity thresholds for special applications are much lower, as shown in the table below for Xtralis ASD units.

Product	Application	Hole Sensitivity	Max Transport Time (sec)
VEP-1	Open Area	5%/m to 10%/m (1.551%/ft to 3.160%/ft)	49
	Special	0.01%/m to 1.5%/m (0.003%/ft to 0.460%/ft)	90
VEP	Open Area	5%/m to 10%/m (1.551%/ft to 3.160%/ft)	45
	Special	0.01%/m to 1.5%/m (0.003%/ft to 0.460%/ft)	85
VES	Open Area	5%/m to 10%/m (1.551%/ft to 3.160%/ft)	40
	Special	0.01%/m to 1.5%/m (0.003%/ft to 0.460%/ft)	64
VEU	Open Area	5%/m to 10%/m (1.551%/ft to 3.160%/ft)	50
	Special	0.01%/m to 1.5%/m (0.003%/ft to 0.460%/ft)	85
VLF-500	Open Area	7%/m to 10%/m (1.524%/ft to 3.049%/ft)	24
	Special	0.01%/m to 1.5%/m (0.003%/ft to 0.457%/ft)	47
VEA	Open Area	Fixed 8.0%/m (2.509%/ft)	51
	Special	1.6%/m to 8.0%/m (0.490%/ft to 2.509%/ft)	79

For the latest data please refer to the product guide (PG)
Table sourced from PG on February 2024

Xtralis VESDA-E uses a patented Flair™ detection technology, which combines CMOS imaging with multi-directional laser light scattering for particle characterization enabling the system to differentiate between smoke particles and nuisance particles. This minimization of nuisance alarms allows users to maximize the device sensitivity for early warning of a fire threat. Simulating the performance of VESDA-E detectors with the UL 268 7th Edition criteria allows users to determine the maximum pipe length and number of holes for each product. As can be seen from the table below, there are minimal differences for VEP, VES, VEU, and VLF-500 products compared to UL6 versions.

Product	Branched Pipe Network			
	UL268 6th Ed (Old)		UL268 7th Ed	
	Max pipe Length	Max No of Holes	Max pipe Length	Max No of Holes
VEP-1	130m	45	130m	22
VEP	560m	100	470m	80
VES	560m	100	520m	98
VEU	800m	100	610m	96
VLF-500	60m	24	60m	16

Note: Detection mode is Special Applications

All three VESDA-E models, VEU, VEP, and VES have already been listed to UL 268 7th Edition and VEA, and VLF-500 models have also achieved compliance. This early availability of technology from Xtralis allows users time to migrate to systems that meet the requirements well in advance of the transition date for UL 268 7th Edition.

ACHIEVING VERY-EARLY-WARNING DETECTION UNDER UL 268 7TH EDITION

Very-early-warning is a requirement for Special Applications, like warehouses or data centers. UL7's separation of categories allows users to ignore the nuisance alarm criteria used for Open Areas, which makes a substantial difference in performance. A comparison between the settings required for Open Areas versus Special Applications is shown on the smoke density curves below. To pass the burger test and avoid nuisance alarms during cooking, the lower threshold for Open Areas must be raised to 1.5% resulting in a short transfer time (TT), as shown in Figure 2 below. However, when that nuisance alarm restriction is removed for Special Applications, the low threshold can be reduced for maximum sensitivity, allowing extended transport times, as shown in Figure 3 below.

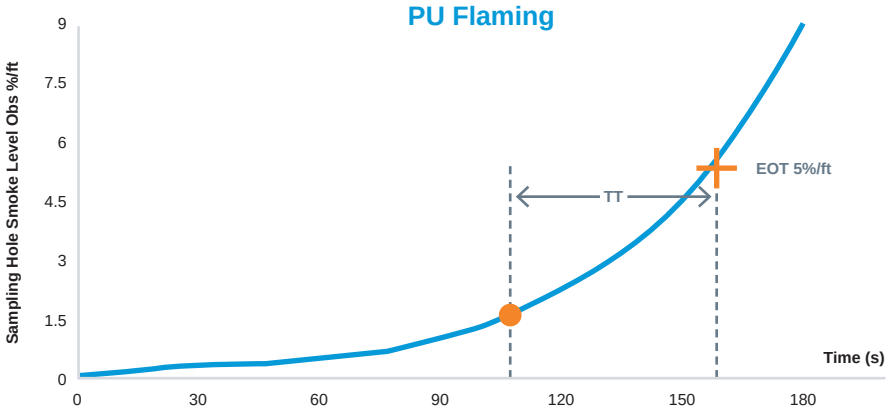

Figure 2 - Open Area PU Flaming Test

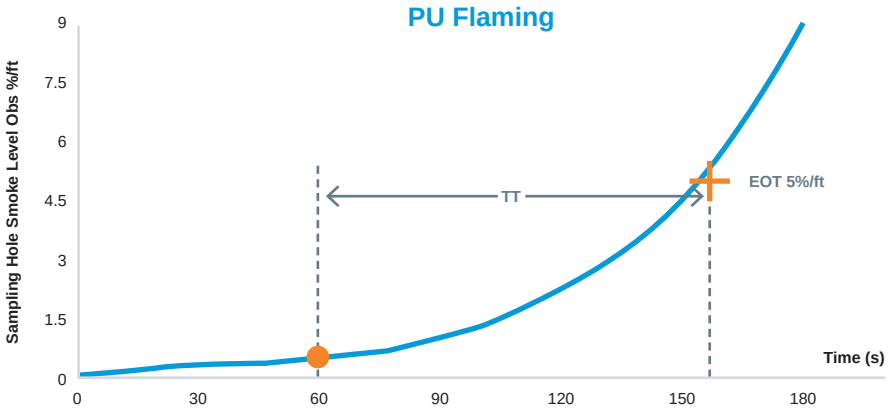

Figure 3 - Special Applications PU Flaming Test

Special Application smoke detectors can pick up the earliest possible warning of smoke. Xtralis VESDA-E designs allow for industry-leading ratios for number of sampling holes per pipe. Even with the stringent requirements of UL 268 7th Edition, Xtralis continues to supply best-in-class performance due to its patented technology.

KEY STEPS TO OPTIMAL ASD DESIGN UNDER UL 268 7TH EDITION

The first step is to select the applicable standard for the pipe network design – in our case UL 268 7th Edition with a standard interface. Then click the add detector button from the toolbar.

1. SELECT STANDARD

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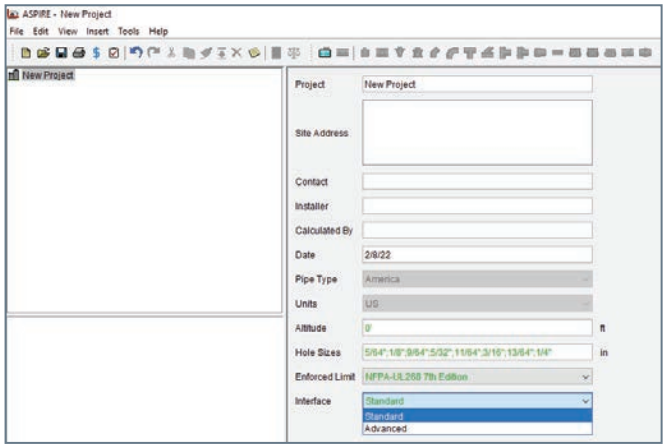
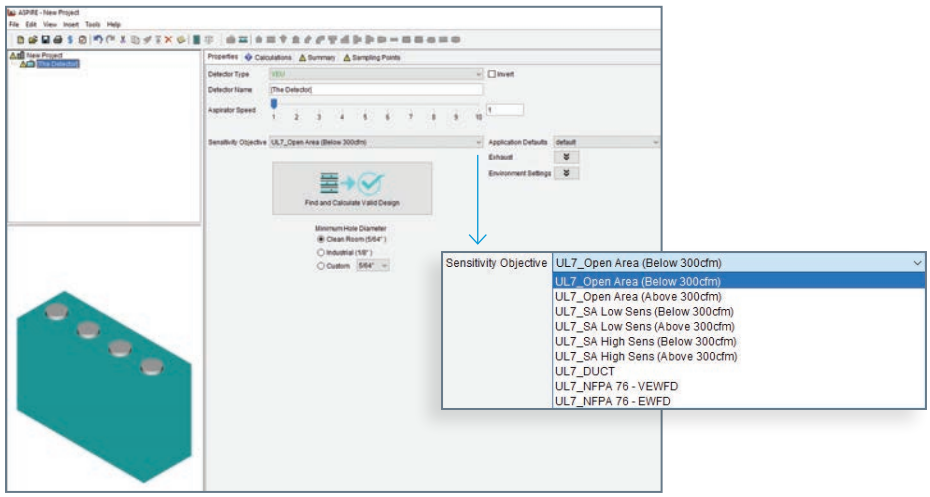


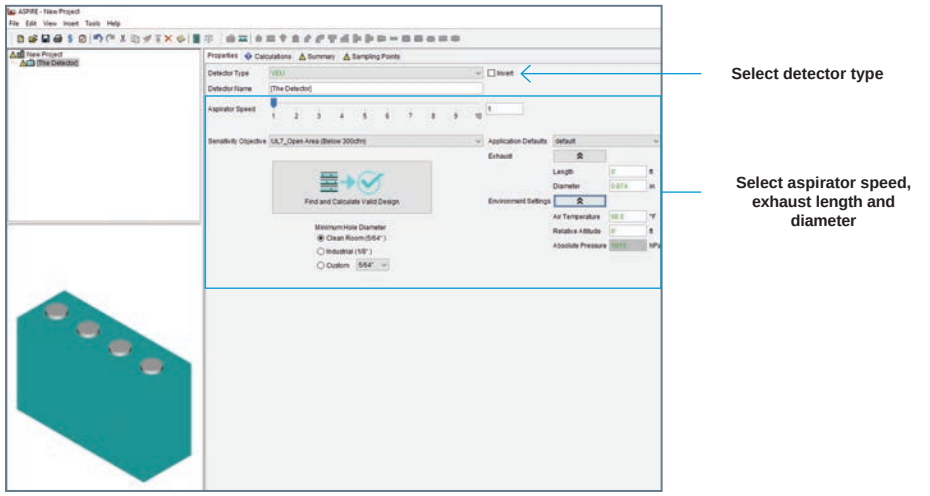
2. CHOOSE THE APPLICATION

The next step is to configure the properties of the device. Start with the Sensitivity Objective, which specifies whether it is an Open Area or Special Application. Other options include Duct, VEWFD, or EWFD.



3. COMPLETE THE PROPERTIES TAB

On the properties tab, you can also select the detector type and the aspirator speed for detectors which have four pipe inlets. Enter the exhaust settings, then click the add pipe button in the toolbar.



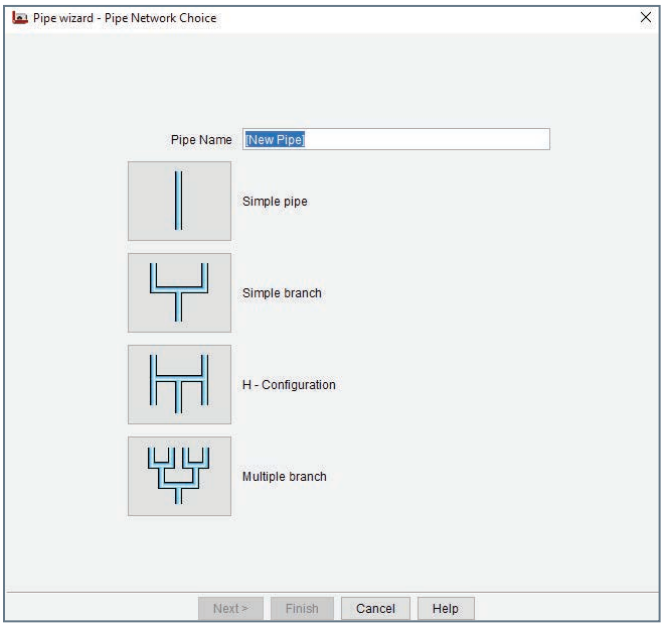
4. CHOOSE A PIPE NETWORK

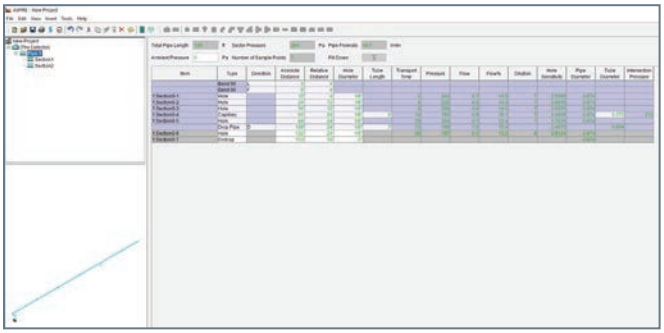
A pipe wizard pop-up menu will appear on the screen. Give your pipe a name, and then select the configuration. Simple pipes can have multiple bends, and branches can be added later. Simple branches are best to fill a section of a room not covered by other pipework. H configurations are for smaller rooms, and multiple branch configurations are suitable for large rooms or rooms with odd shapes.

After choosing the configuration, the wizard will lead the user to select several other parameters, including:

- Total pipe length
- First hole position
- Hole separation
- Number of holes
- Pipe diameter
- Hole diameter
- Ambient pressure

At this point, a summary screen will appear with the pipe properties and the details for each section. Users can make any necessary manual adjustments, like modifying hole diameters if some holes are different sizes.

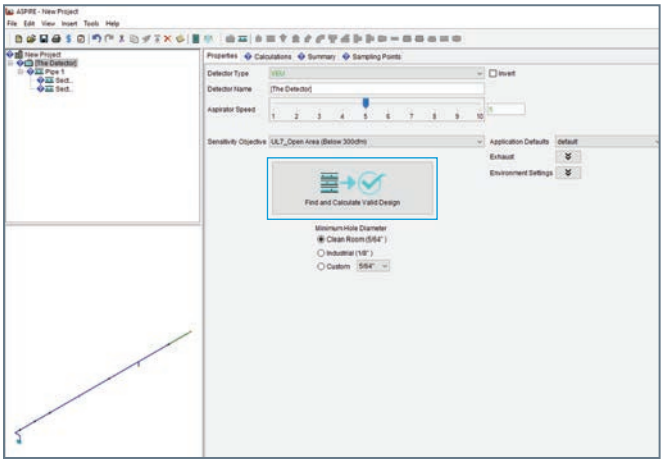


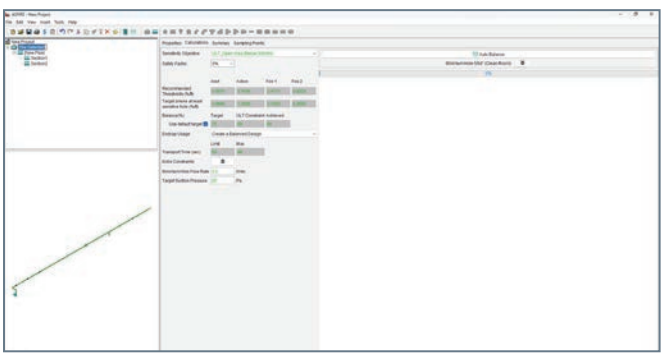


5. CALCULATE

After specifying the pipe, click on the “Find and Calculate Valid Design” button.

ASPIRE brings up the results of its calculations showing whether a valid solution was found. Results include recommended thresholds and a minimum balance constraint, as required by UL7 for Open Areas. This screen also shows the maximum transport time in seconds.





SUCCESSFUL IMPLEMENTATION OF UL 268 7TH EDITION IN AN ASD SYSTEM

CASE STUDY

A North American Data Center was using VEP detectors with an aspiration speed of 5. The system was configured for ceiling detection with 42 holes, a coverage area per hole of 182 ft², and a maximum pipe length of 209 ft. Running calculations through ASPIRE selecting UL6 first and then UL7, yielded the following results.

In this case, sample hole diameters were adjusted without reducing the number of sample holes or adding more detectors. The sensitivity of the system increased by almost 100% and the achieved balance increased from 72% to 76%. Transportation Time, pipe airflow, and pressure remained almost the same. This is a typical scenario where an existing installation can be made to comply with UL7 with minor adjustments.

UL 268 6th Edition

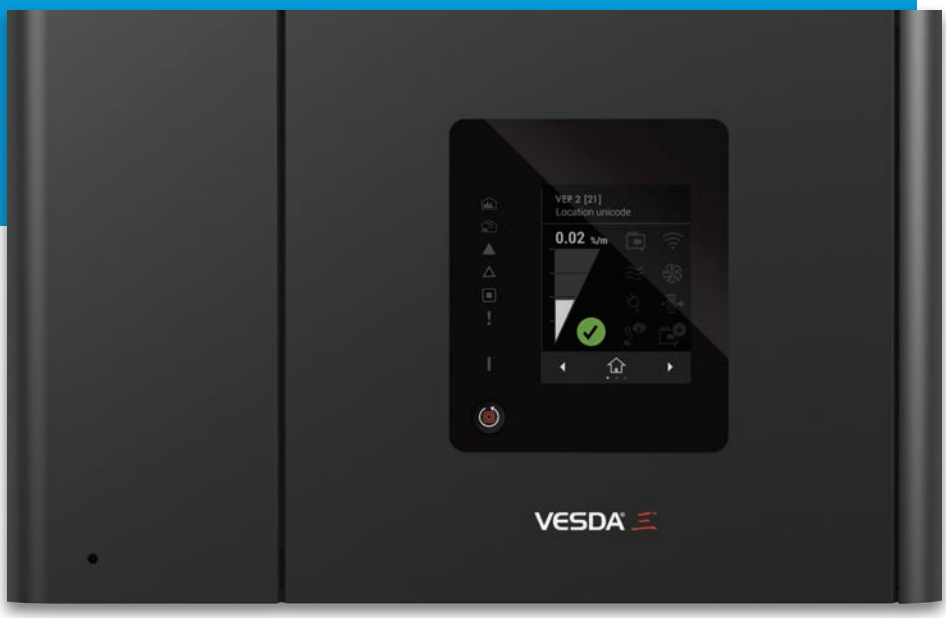
Properties | Calculations | Summary | Sampling Points

Sensitivity Objective	NFPA_VEWFD			
Safety Factor	0%			
	Alert	Action	Fire 1	Fire 2
Recommended Thresholds (%/ft)	0.0040	0.0080	0.0202	0.0403
Smoke at least sensitive hole (%/ft)	0.2000	0.4000	1.0000	2.0000
Balance(%)	Target	Achieved		
Use default target ☐	70	72		
Endcap Usage	Create a Balanced Design			
	Limit	Max		
Transport Time (sec)	60	60		
Extra Constraints	⌃⌃			
Minimum Hole Flow Rate	2.0	l/min		
Target Suction Pressure	25	Pa		

UL 268 7th Edition

Properties | Calculations | Summary | Sampling Points

Sensitivity Objective	UL7_NFPA 76 - VEWFD			
Safety Factor	0%			
	Alert	Action	Fire 1	Fire 2
Recommended Thresholds (%/ft)	0.0016	0.0038	0.0097	0.0193
Target smoke at least sensitive hole (%/ft)	0.0760	0.1875	0.4688	0.9377
Balance(%)	Target	UL7 Constraint	Achieved	
Use default target ☐	70	0	70	
Endcap Usage	Create a Balanced Design			
	Limit	Max		
Transport Time (sec)	60	60		
Extra Constraints	⌃⌃			
Minimum Hole Flow Rate	2.0	l/min		
Target Suction Pressure	25	Pa		



CONCLUSION

UL 268 7th Edition is a long-awaited revision to the smoke detector standard applied by regulators around the world. There are several changes in this revision compared to the previous version, the most significant being associated with a focus on reducing nuisance alarms and providing better protection from fires fueled by synthetic materials.

Nuisance alarms in cooking areas are the main reason users disconnect their smoke detectors, leaving them without protection in the case of an actual fire. UL7 demands that smoke detectors eliminate nuisance alarms for these applications. On the other hand, the presence of synthetic materials in furniture and buildings is creating new fire risks not adequately addressed by the previous version of the standard. UL7 adds new tests for polyurethane smoldering and flaming fires to ensure

that smoke detectors are sensitive to these new risks.

Xtralis has introduced a roadmap for the transition from UL6 to UL7 on 30 June 2024. This roadmap includes listed devices like the VESDA-E range of products. Our ASPIRE software is already configured for UL7, so every application can be checked for compliance with the standard well in advance of the transition date.

Contact Xtralis to discuss your smoke detector system and how we can help you prepare for the introduction of UL 268 7th Edition.

ABOUT XTRALIS

Xtralis is a leading global provider of powerful solutions for very early & reliable detection of smoke, fire, and gas threats. Our technologies prevent disasters by giving users time to respond before life, critical infrastructure or business continuity is compromised.We protect highly valuable and irreplaceable assets and infrastructure belonging to the world's top governments and businesses.

To learn more, please visit us at www.xtralis.com

[1] *IAFC, Smoke Alarms and Detectors UL Standards For Safety – UL 217 and UL 268, 2019, [accessed December 19, 2022]*
[2] *Close Your Door, Fire is Getting Faster, [accessed December 19, 2022]*
[3] *NFPA, Smoke Alarms in US Home Fires, 2021, [accessed December 19, 2022]*
[4] *SDM, What You Need to Know About the New Smoke Detector Standards, 2020, [accessed December 19, 2022]*
[5] *SDM, What You Need to Know About the New Smoke Detector Standards, 2020, [accessed December 19, 2022]*