NFPA Technical Committee on Water Mist Fire Suppression Systems (WAM-AAA)

NFPA 750 PRE-FIRST DRAFT MEETING AGENDA

September -22, 2020
11:00 am – 1:00 pm (EST)
Web/Teleconference

Tuesday, September 22, 2020

1. Call to Order -11:00 am (EST)
2. Introduction and Attendance
3. Review Agenda
4. Plumis Presentation
5. New Task Group Formation
   a. Plumis PI's (TG 5) (Addendum A)
   b. Viega PI's (TG 6) (Addendum A)
   c. NFPA 25 (TG 7) (Addendum B)
   d. Velocity Pressure Formula Metric Error (TG 8) (Addendum C)
   e. Revision of Metric conversion to harmonize with NFPA 13 (Addendum D)

6. Review of Task Groups/Public Inputs:
   a. Task Group 1 (14.2.4.2.4 move to Annex) Bob Ballard
   b. Task Group 2 (C.1.2) Ruediger Kopp
   c. Task Group 3 (Annex E) Gary Howe
   d. Task Group 4 (NFPA 20) Jerry Back
      i. Changes in NFPA 750
      ii. CI's in NFPA 20 (Addendum E)
7. Additional PI's submitted after closing date.
   a. Dan Hubert (2) (Addendum F)
   b. Ruediger Kopp(1) (Addendum G)
8. Closing Comments
9. Adjourn.

Addendum A

NFPA 750, Public Inputs

Public Input No. 3-NFPA 750-2020 [Section No. 2.3.6]

2.3.6 ULC Publications.

~~Underwriters Laboratories of Canada, 7 Underwriters Road, Toronto, ON M1R 3A9~~
~~.~~ ULC Standards, 171 Nepean Street, Suite 400, Ottawa Ontario K2P 0B4 , Canada .

CAN/ULC S524-14, *Standard for the Installation of Fire Alarm Systems*, 2014.

CAN/ULC S529-16, *Standard for Smoke Detectors for Fire Alarm Systems*, 2016.

Statement of Problem and Substantiation for Public Input

Reason: Update publication address.

Submitter Information Verification

Submitter Full Name: Kelly Nicolello
Organization: UL LLC
Street Address:
City:
State:
Zip:
Submittal Date: Tue Jun 16 13:08:57 EDT 2020
Committee: WAM-AAA

Public Input No. 5-NFPA 750-2020 [New Section after 3.3.25]

3.3.25.3 Directional Nozzle

A water mist nozzle which targets mist to the location of the fire once it has determined its location. These are typically open nozzles and are triggered by a detection system but are not for local application or deluge systems, instead, they address a number of potential risks within the nozzle's range.

Additional Proposed Changes

File Name	Description	Approved
SH14_AA_Picture.JPG	picture of spray head for illustration of directional nozzle	
SH14_AA_Multiroom_Spray_Head_Rev.01.PDF	Exploded image of spray head for illustration of directional nozzle	

Statement of Problem and Substantiation for Public Input

We manufacture a domestic water mist system that uses a directional nozzle. Whether this is an open nozzle with a directional spray assembly is up to the technical committee to agree. Either way, it is not an automatic nozzle and it is not an open nozzle for a fixed local application nor for a deluge system. It is effectively a zoned single nozzle activation system which directs the mist in direction of the fire.

The current list of nozzle and system definitions does not cater for our water mist implementation so this is an attempt to either slightly adjust existing definitions or to create new definitions so that it does.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 6-NFPA 750-2020 [Section No. 3.3.25.3]	talks about the same open nozzle x directional nozzle dilemma
Public Input No. 7-NFPA 750-2020 [New Section after 3.3.26.8]	
Public Input No. 12-NFPA 750-2020 [New Section after 3.3.25.3]	

Submitter Information Verification

Submitter Full Name: William Makant

Organization: Plumis Ltd UK

Affiliation: Plumis

Street Address:

City:

State:

Zip:

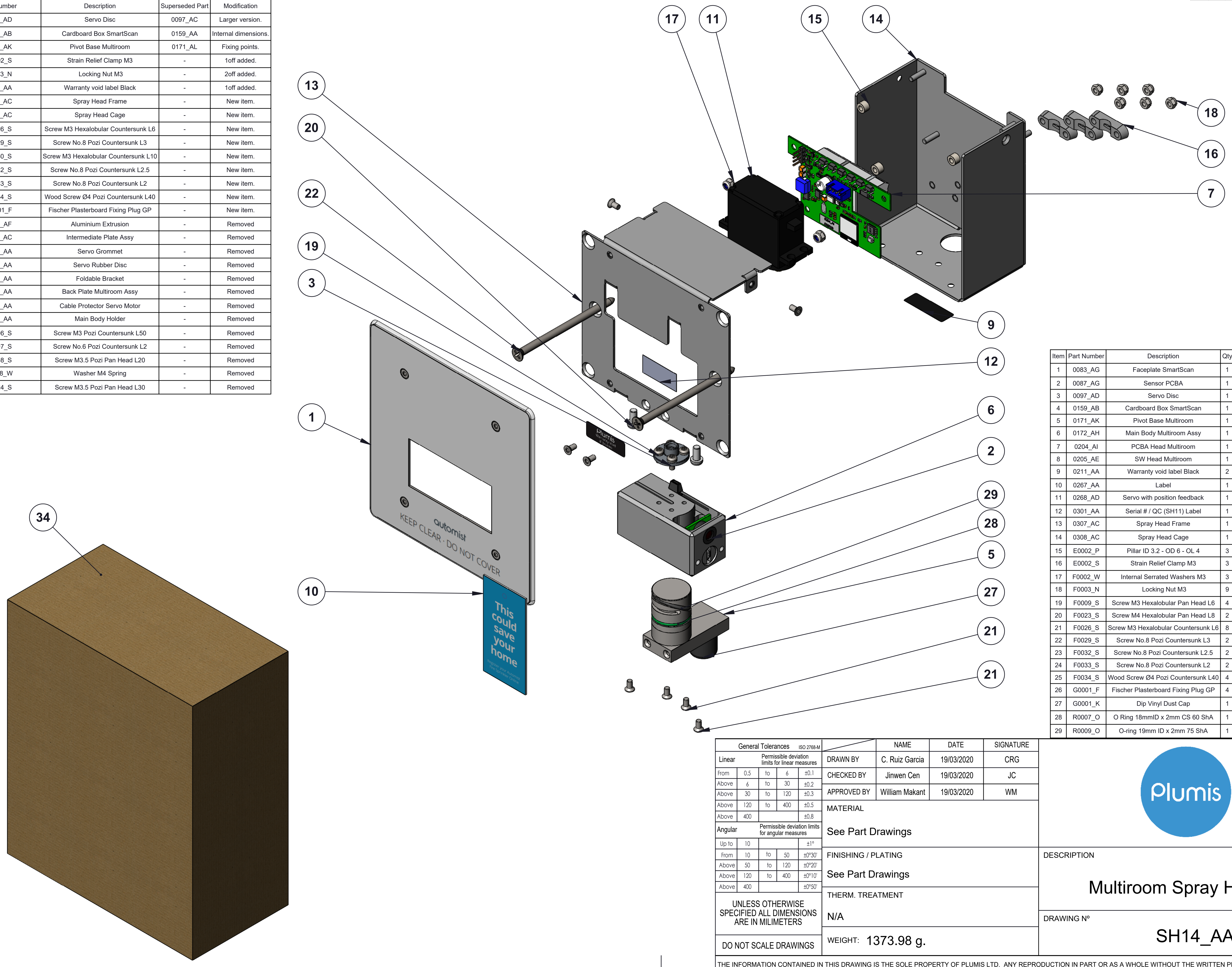
Submittal Date: Wed Jun 17 09:53:21 EDT 2020

Committee: WAM-AAA

automist
KEEP CLEAR · DO NOT COVER

VERSION CONTROL TABLE			
Previous Version: SH11_AN			
Part Number	Description	Superseded Part	Modification
0097_AD	Servo Disc	0097_AC	Larger version.
0159_AB	Cardboard Box SmartScan	0159_AA	Internal dimensions.
0171_AK	Pivot Base Multiroom	0171_AL	Fixing points.
E0002_S	Strain Relief Clamp M3	-	1off added.
F0003_N	Locking Nut M3	-	2off added.
0211_AA	Warranty void label Black	-	1off added.
0307_AC	Spray Head Frame	-	New item.
0308_AC	Spray Head Cage	-	New item.
F0026_S	Screw M3 Hexalobular Countersunk L6	-	New item.
F0029_S	Screw No.8 Pozi Countersunk L3	-	New item.
F0030_S	Screw M3 Hexalobular Countersunk L10	-	New item.
F0032_S	Screw No.8 Pozi Countersunk L2.5	-	New item.
F0033_S	Screw No.8 Pozi Countersunk L2	-	New item.
F0034_S	Wood Screw Ø4 Pozi Countersunk L40	-	New item.
G0001_F	Fischer Plasterboard Fixing Plug GP	-	New item.
0082_AF	Aluminium Extrusion	-	Removed
0084_AC	Intermediate Plate Assy	-	Removed
0096_AA	Servo Grommet	-	Removed
0098_AA	Servo Rubber Disc	-	Removed
0162_AA	Foldable Bracket	-	Removed
0264_AA	Back Plate Multiroom Assy	-	Removed
0275_AA	Cable Protector Servo Motor	-	Removed
0292_AA	Main Body Holder	-	Removed
F0006_S	Screw M3 Pozi Countersunk L50	-	Removed
F0007_S	Screw No.6 Pozi Countersunk L2	-	Removed
F0008_S	Screw M3.5 Pozi Pan Head L20	-	Removed
F0008_W	Washer M4 Spring	-	Removed
F0024_S	Screw M3.5 Pozi Pan Head L30	-	Removed

REVISIONS					
Zone	Rev.	Description	By	Date	Approved



Item	Part Number	Description	Qty	Material	Finishing
1	0083_AG	Faceplate SmartScan	1	AISI 304	Brushed
2	0087_AG	Sensor PCBA	1	--	--
3	0097_AD	Servo Disc	1	Aluminium	Clear Anodised
4	0159_AB	Cardboard Box SmartScan	1	Cardboard	--
5	0171_AK	Pivot Base Multiroom	1	AISI 304	--
6	0172_AH	Main Body Multiroom Assy	1	See Part Drawings	See Part Drawings
7	0204_AI	PCBA Head Multiroom	1	--	--
8	0205_AE	SW Head Multiroom	1	--	--
9	0211_AA	Warranty void label Black	2	Vynil sticker	--
10	0267_AA	Label	1	Custom Plastic	--
11	0268_AD	Servo with position feedback	1	--	--
12	0301_AA	Serial # / QC (SH11) Label	1	EML-HA(26,5X12)R SR	--
13	0307_AC	Spray Head Frame	1	DX51D Galvanised Steel	--
14	0308_AC	Spray Head Cage	1	DX51D Galvanised Steel	--
15	E0002_P	Pillar ID 3.2 - OD 6 - OL 4	3	Brass	--
16	E0002_S	Strain Relief Clamp M3	3	PA Type 6	--
17	F0002_W	Internal Serrated Washers M3	3	Plain Carbon Steel	--
18	F0003_N	Locking Nut M3	9	Plain Carbon Steel	Zinc & Clear Cr3
19	F0009_S	Screw M3 Hexalobular Pan Head L6	4	A2-70 Stainless Steel	--
20	F0023_S	Screw M4 Hexalobular Pan Head L8	2	Grade 4.8 Steel	Zinc & Clear Cr3
21	F0026_S	Screw M3 Hexalobular Countersunk L6	8	A2 SS	--
22	F0029_S	Screw No.8 Pozi Countersunk L3	2	A2 SS	--
23	F0032_S	Screw No.8 Pozi Countersunk L2.5	2	A2 SS	--
24	F0033_S	Screw No.8 Pozi Countersunk L2	2	A2 SS	--
25	F0034_S	Wood Screw Ø4 Pozi Countersunk L40	4	Zinc Plated	--
26	G0001_F	Fischer Plasterboard Fixing Plug GP	4	--	--
27	G0001_K	Dip Vinyl Dust Cap	1	Silicon Rubber	--
28	R0007_O	O Ring 18mmID x 2mm CS 60 ShA	1	Viton	--
29	R0009_O	O-ring 19mm ID x 2mm 75 ShA	1	Viton	--

General Tolerances ISO 2768-M

Linear				Permissible deviation limits for linear measures
From	0.5	to	6	±0.1
Above	6	to	30	±0.2
Above	30	to	120	±0.3
Above	120	to	400	±0.5
Above	400			±0.8
Angular				Permissible deviation limits for angular measures
Up to	10			±1°
From	10	to	50	±0°30'
Above	50	to	120	±0°20'
Above	120	to	400	±0°10'
Above	400			±0°50'

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN MILIMETERS

DO NOT SCALE DRAWINGS

	NAME	DATE	SIGNATURE
DRAWN BY	C. Ruiz Garcia	19/03/2020	CRG
CHECKED BY	Jinwen Cen	19/03/2020	JC
APPROVED BY	William Makant	19/03/2020	WM

MATERIAL

See Part Drawings

FINISHING / PLATING

See Part Drawings

THERM. TREATMENT

N/A

WEIGHT: 1373.98 g.

Plumis

DESCRIPTION

Multiroom Spray Head

DRAWING Nº

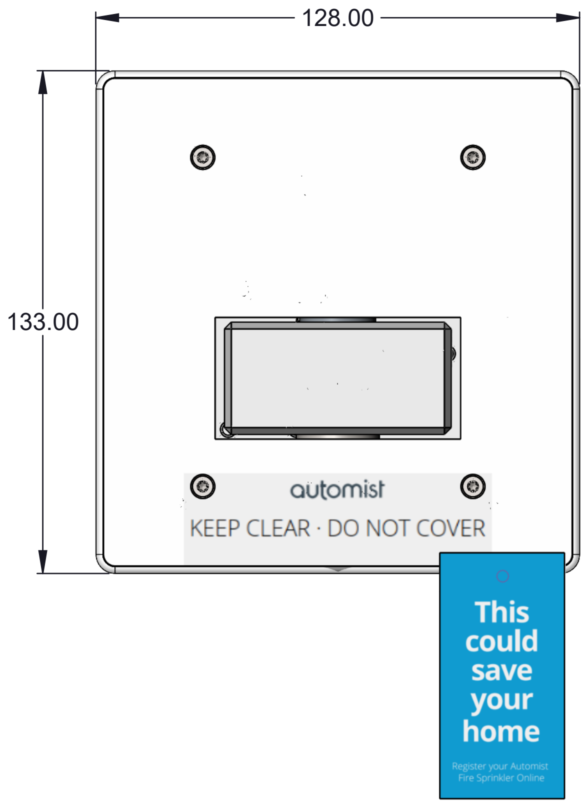
SH14_AA

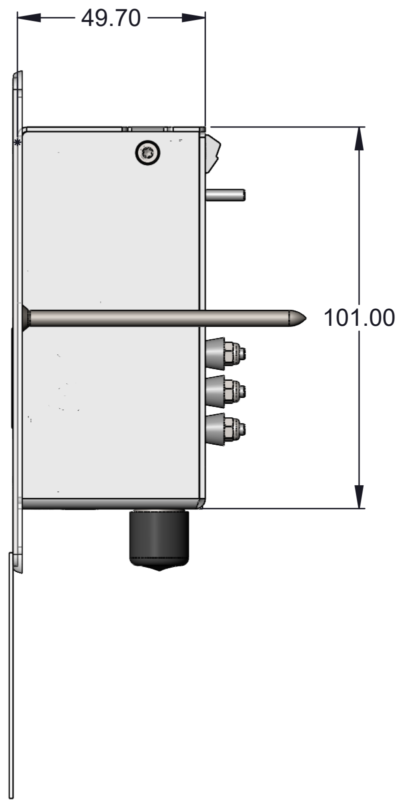
REVISION 01

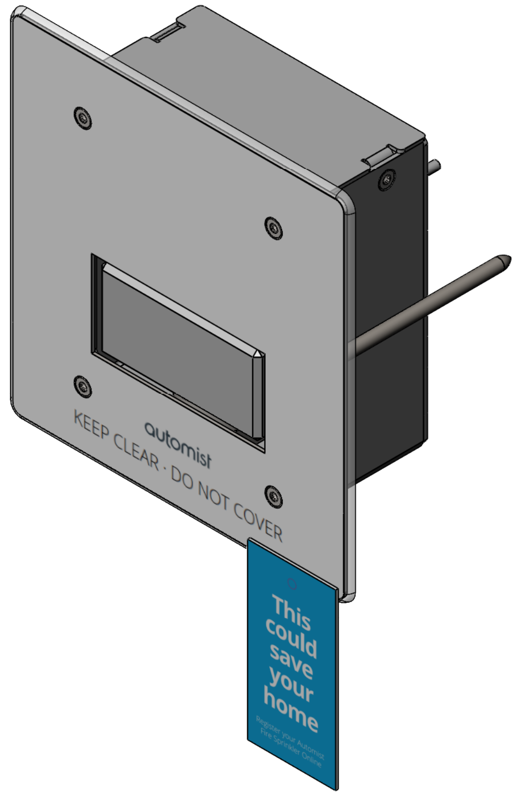
FORMAT A3

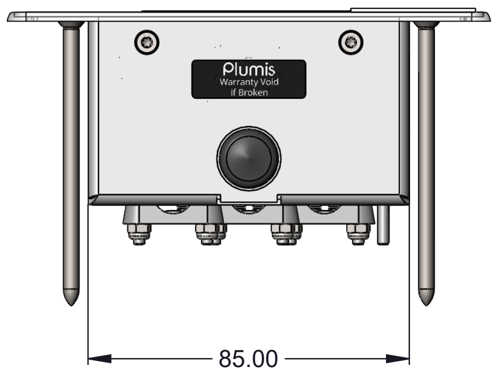
SCALE 1:2

PAGE 1 of 2









General Tolerances ISO 2768-M				
Linear	Permissible deviation limits for linear measures			
From	0.5	to	6	±0.1
Above	6	to	30	±0.2
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Above	400			±0,8
Angular	Permissible deviation limits for angular measures			
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From	10	to	50	±0°30'
Above	50	to	120	±0°20'
Above	120	to	400	±0°10'
Above	400			±0°50'

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CHECKED BY	Jinwen Cen	19/03/2020	JC
APPROVED BY	William Makant	19/03/2020	WM

MATERIAL
See Part Drawings

FINISHING / PLATING
See Part Drawings

THERM. TREATMENT
N/A

WEIGHT: 1373.98 g.

Plumis

DESCRIPTION
Multiroom Spray Head

DRAWING Nº
SH14_AA

REVISION
01

FORMAT
A3

SCALE
1:2

PAGE
2 of 2

Public Input No. 12-NFPA 750-2020 [New Section after 3.3.25.3]

Electronic Automatic Nozzle

A nozzle which release of water is made automatically by electronic means instead of by mechanical means.

Additional Proposed Changes

File Name	Description	Approved
SH14_AA_Multiroom_Spray_Head_Rev.01.PDF	Automist Hydra Spray head exploded view: electronic nozzle	
SUPDET_2017_ELECTRONIC_SPRINKLER_S17P4_Magnone_et_al.pdf	Electronic sprinklers SUPDET 2017	

Statement of Problem and Substantiation for Public Input

We manufacture a nozzle which electronically determines the fire location (using a thermopile sensor) and which also controls whether it is open or closed (using a servo motor controlled valve). This nozzle does fall within the existing definitions in NFPA 750. The proposed definitions are attempts at suggesting a definition for NFPA 750 which is also futureproof for other variations on the theme. Details of our product can be found on our website: www.plumis.com. Videos of the system in operation can be found at: https://www.youtube.com/user/PlumisAutomist.

The use of electronic nozzles is also being developed by Johnson Control with the use of solenoid activated nozzles through the use of detection systems so it is my assumption it will also be part of NFPA 13 at some point. Paper on electronic sprinklers attached to this comment. Consistency on the definitions between these standards is certainly welcome.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 5-NFPA 750-2020 [New Section after 3.3.25]	related to the same directional/targeted nozzle/system type
Public Input No. 6-NFPA 750-2020 [Section No. 3.3.25.3]	related to the same directional/targeted nozzle/system type
Public Input No. 7-NFPA 750-2020 [New Section after 3.3.26.8]	related to the same directional/targeted nozzle/system type

Submitter Information Verification

Submitter Full Name: William Makant
Organization: Plumis Ltd UK
Affiliation: Plumis
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jun 18 05:27:10 EDT 2020
Committee: WAM-AAA

VERSION CONTROL TABLE			
Previous Version: SH11_AN			
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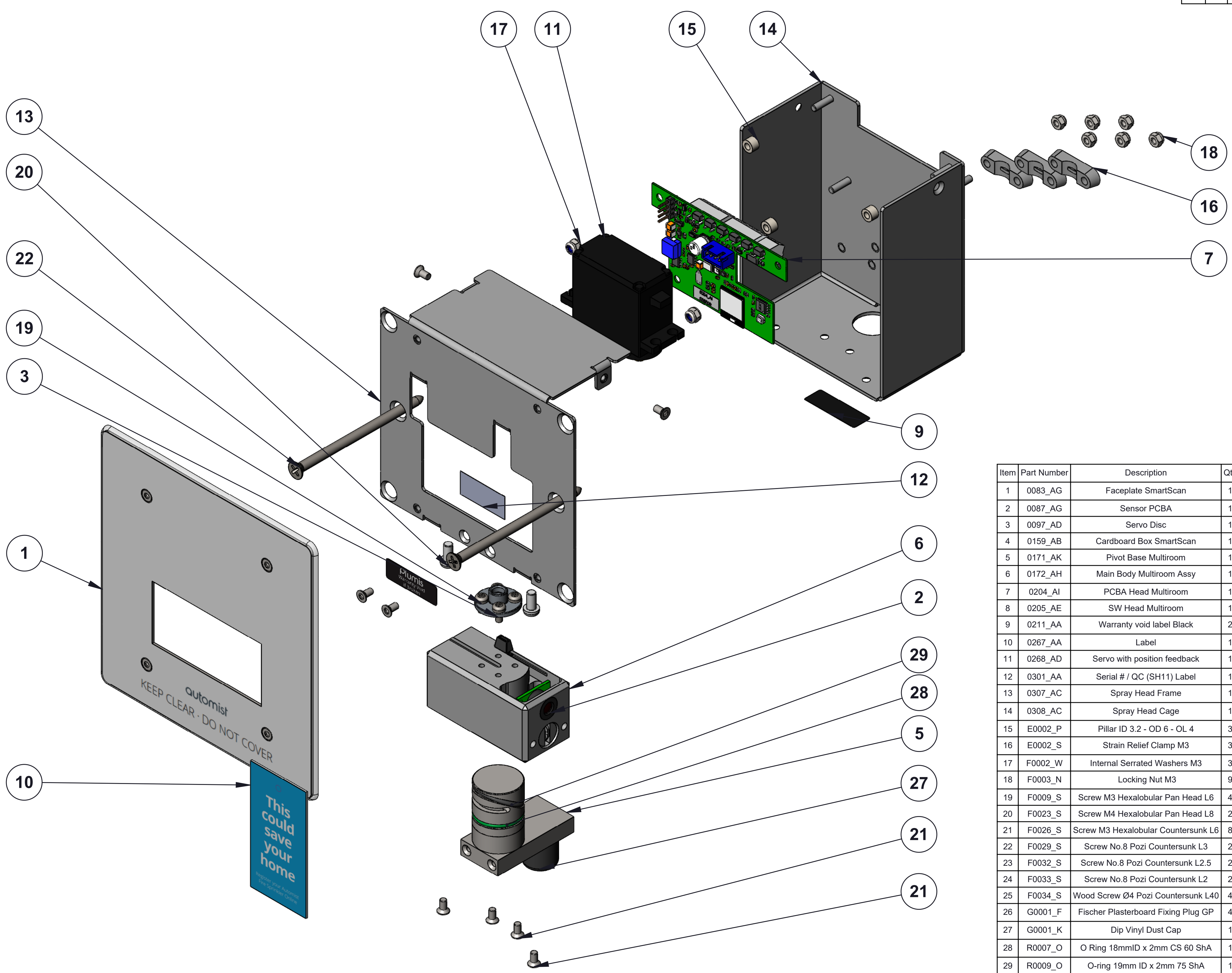
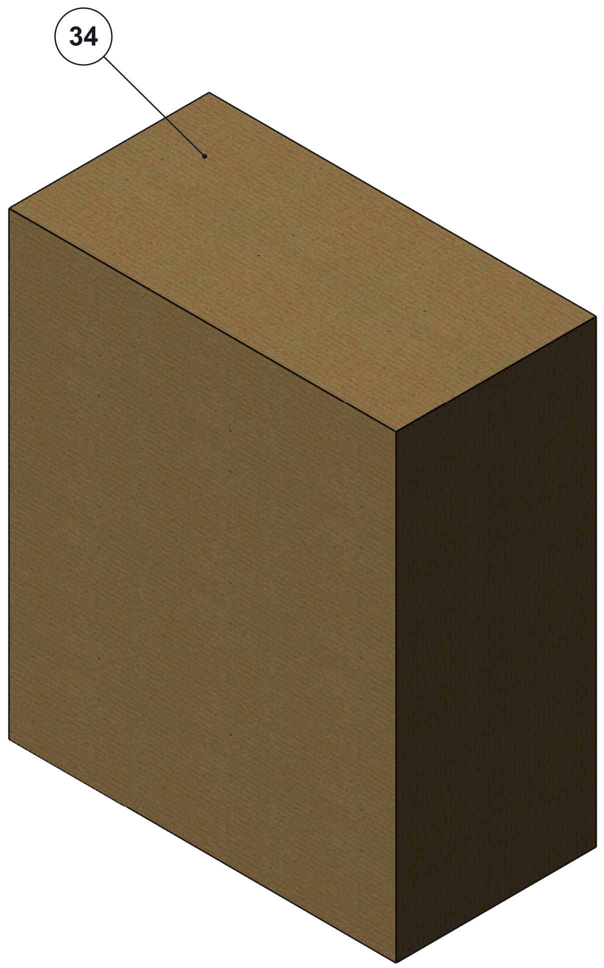
F0003_N	Locking Nut M3	-	2off added.
0211_AA	Warranty void label Black	-	1off added.
0307_AC	Spray Head Frame	-	New item.
0308_AC	Spray Head Cage	-	New item.
F0026_S	Screw M3 Hexalobular Countersunk L6	-	New item.
F0029_S	Screw No.8 Pozi Countersunk L3	-	New item.
F0030_S	Screw M3 Hexalobular Countersunk L10	-	New item.
F0032_S	Screw No.8 Pozi Countersunk L2.5	-	New item.
F0033_S	Screw No.8 Pozi Countersunk L2	-	New item.
F0034_S	Wood Screw Ø4 Pozi Countersunk L40	-	New item.
G0001_F	Fischer Plasterboard Fixing Plug GP	-	New item.
0082_AF	Aluminium Extrusion	-	Removed
0084_AC	Intermediate Plate Assy	-	Removed
0096_AA	Servo Grommet	-	Removed
0098_AA	Servo Rubber Disc	-	Removed
0162_AA	Foldable Bracket	-	Removed
0264_AA	Back Plate Multiroom Assy	-	Removed
0275_AA	Cable Protector Servo Motor	-	Removed
0292_AA	Main Body Holder	-	Removed
F0006_S	Screw M3 Pozi Countersunk L50	-	Removed
F0007_S	Screw No.6 Pozi Countersunk L2	-	Removed
F0008_S	Screw M3.5 Pozi Pan Head L20	-	Removed
F0008_W	Washer M4 Spring	-	Removed
F0024_S	Screw M3.5 Pozi Pan Head L30	-	Removed

REVISIONS					
Zone	Rev.	Description	By	Date	Approved





Item	Part Number	Description	Qty	Material	Finishing
1	0083_AG	Faceplate SmartScan	1	AISI 304	Brushed
2	0087_AG	Sensor PCBA	1	--	--
3	0097_AD	Servo Disc	1	Aluminium	Clear Anodised
4	0159_AB	Cardboard Box SmartScan	1	Cardboard	--
5	0171_AK	Pivot Base Multiroom	1	AISI 304	--
6	0172_AH	Main Body Multiroom Assy	1	See Part Drawings	See Part Drawings
7	0204_AI	PCBA Head Multiroom	1	--	--
8	0205_AE	SW Head Multiroom	1	--	--
9	0211_AA	Warranty void label Black	2	Vynil sticker	--
10	0267_AA	Label	1	Custom Plastic	--
11	0268_AD	Servo with position feedback	1	--	--
12	0301_AA	Serial # / QC (SH11) Label	1	EML-HA(26,5X12)R SR	--
13	0307_AC	Spray Head Frame	1	DX51D Galvanised Steel	--
14	0308_AC	Spray Head Cage	1	DX51D Galvanised Steel	--
15	E0002_P	Pillar ID 3.2 - OD 6 - OL 4	3	Brass	--
16	E0002_S	Strain Relief Clamp M3	3	PA Type 6	--
17	F0002_W	Internal Serrated Washers M3	3	Plain Carbon Steel	--
18	F0003_N	Locking Nut M3	9	Plain Carbon Steel	Zinc & Clear Cr3
19	F0009_S	Screw M3 Hexalobular Pan Head L6	4	A2-70 Stainless Steel	--
20	F0023_S	Screw M4 Hexalobular Pan Head L8	2	Grade 4.8 Steel	Zinc & Clear Cr3
21	F0026_S	Screw M3 Hexalobular Countersunk L6	8	A2 SS	--
22	F0029_S	Screw No.8 Pozi Countersunk L3	2	A2 SS	--
23	F0032_S	Screw No.8 Pozi Countersunk L2.5	2	A2 SS	--
24	F0033_S	Screw No.8 Pozi Countersunk L2	2	A2 SS	--
25	F0034_S	Wood Screw Ø4 Pozi Countersunk L40	4	Zinc Plated	--
26	G0001_F	Fischer Plasterboard Fixing Plug GP	4	--	--
27	G0001_K	Dip Vinyl Dust Cap	1	Silicon Rubber	--
28	R0007_O	O Ring 18mmID x 2mm CS 60 ShA	1	Viton	--
29	R0009_O	O-ring 19mm ID x 2mm 75 ShA	1	Viton	--

General Tolerances ISO 2768-M				
Linear	Permissible deviation limits for linear measures			
From	0.5	to	6	±0.1
Above	6	to	30	±0.2
Above	30	to	120	±0.3
Above	120	to	400	±0.5
Above	400			±0,8
Angular	Permissible deviation limits for angular measures			
Up to	10			±1°
From	10	to	50	±0°30'
Above	50	to	120	±0°20'
Above	120	to	400	±0°10'
Above	400			±0°50'

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN MILIMETERS

DO NOT SCALE DRAWINGS

	NAME	DATE	SIGNATURE
DRAWN BY	C. Ruiz Garcia	19/03/2020	CRG
CHECKED BY	Jinwen Cen	19/03/2020	JC
APPROVED BY	William Makant	19/03/2020	WM

MATERIAL

See Part Drawings

FINISHING / PLATING

See Part Drawings

THERM. TREATMENT

N/A

WEIGHT: 1373.98 g.

Plumis

DESCRIPTION

Multiroom Spray Head

DRAWING Nº

SH14_AA

REVISION

01

FORMAT

A3

SCALE

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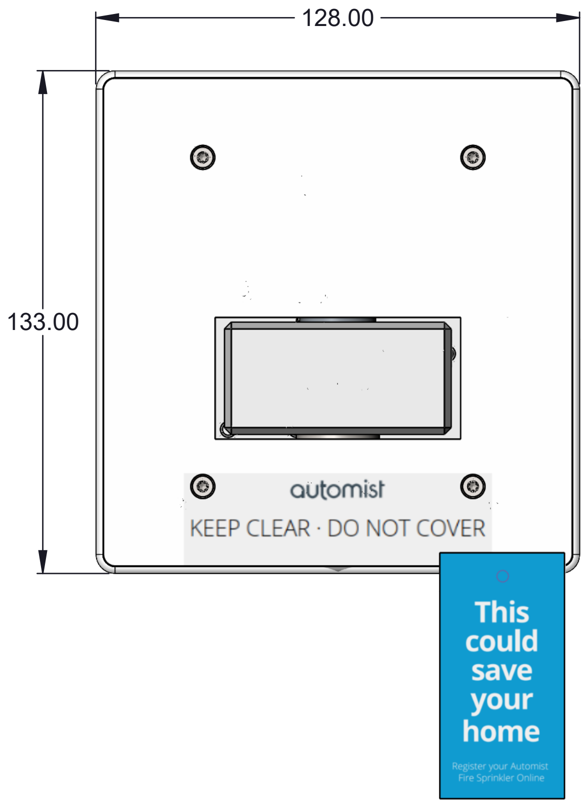
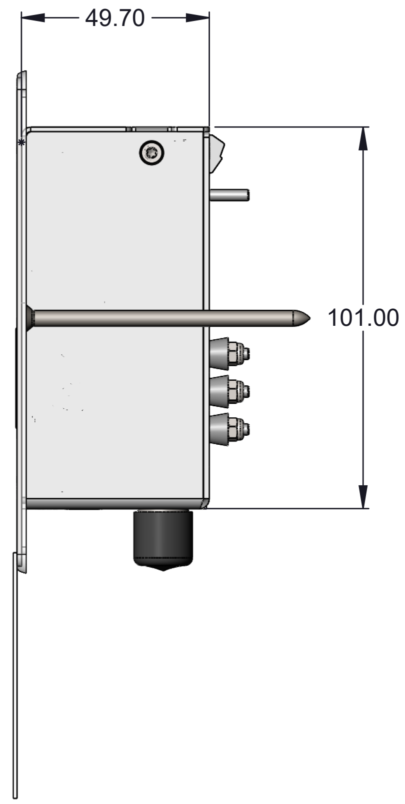
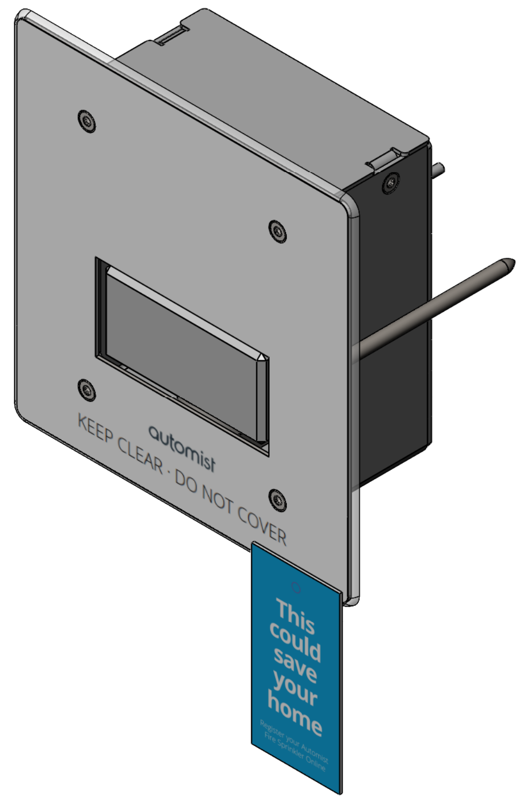
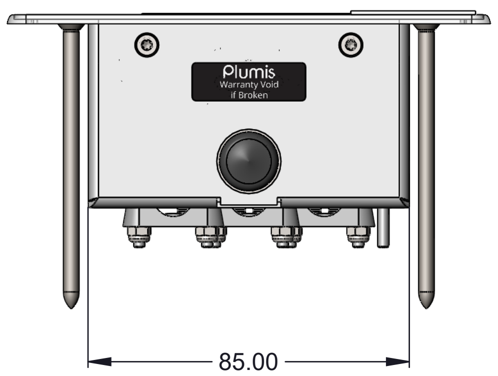
PAGE

1 of 2









General Tolerances				ISO 2768-M
Linear	Permissible deviation limits for linear measures			
From	0.5	to	6	±0.1
Above	6	to	30	±0.2
Above	30	to	120	±0.3
Above	120	to	400	±0.5
Above	400			±0,8
Angular	Permissible deviation limits for angular measures			
Up to	10			±1°
From	10	to	50	±0°30'
Above	50	to	120	±0°20'
Above	120	to	400	±0°10'
Above	400			±0°50'

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN MILIMETERS

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DRAWN BY	C. Ruiz Garcia	19/03/2020	CRG
CHECKED BY	Jinwen Cen	19/03/2020	JC
APPROVED BY	William Makant	19/03/2020	WM

MATERIAL

See Part Drawings

FINISHING / PLATING

See Part Drawings

THERM. TREATMENT

N/A

WEIGHT: 1373.98 g.

Plumis

DESCRIPTION

Multiroom Spray Head

DRAWING Nº

SH14_AA

REVISION	01
FORMAT	A3
SCALE	1:2
PAGE	2 of 2

Warehouse Protection of Exposed Expanded Group-A Plastics with Electronic Sprinkler Technology

Zachary L. Magnone, Jeremiah Crocker, Pedriant Peña
Tyco Fire Protection Products, Cranston, RI, USA

Abstract

The focus of the current work was to demonstrate that electric fire sprinklers operated by an "intelligent" electronic detection and control system could achieve adequate ceiling-only protection of exposed expanded group-A plastic commodities stored on racks without the need for additional engineering controls such as in-rack sprinklers or vertical barriers, and with significantly lower total water demand than current ceiling-only alternatives. A prototype system was assembled and a series of full scale fire tests were conducted. The results support a number of the potential benefits of electronic sprinkler technology as compared to existing mechanically operated fire sprinkler technology.

Keywords: Warehouse, Electronic Sprinkler, Exposed Plastics

Introduction

Since its invention in the late 1800's, the basic operating principles of automatic sprinkler technology have remained fundamentally unchanged. Automatic sprinklers utilize thermally responsive elements which mechanically operate once they achieve a specific fixed temperature. Arguably, the widespread adoption of the automatic sprinkler can be attributed to its simplicity since it requires no power beyond pressurized water and the presence of heat from a fire to operate. However, continued progress and modern construction practices have pushed automatic sprinkler technology to the limits of its practical use in many applications.

One specific application that exhibits the challenge to existing sprinkler technology is the modern warehouse. Growing demand for the storage of exposed plastic materials and the advent of modern lift technology allowing for higher storage heights have presented increasingly challenging fire hazards. Exposed expanded group-A plastics (EEP) present a particular challenge in that they produce fires that grow and spread much faster than similar products stored in cardboard containers, and similarly do not readily absorb water making fires difficult to contain. While recent advancements in the application of ESFR sprinkler technology have presented viable options for the protection of EEP materials, such systems require significant water demand and additional engineering controls such as vertical barriers between rack sections to slow lateral fire spread. These measures are necessary to mitigate the effects of uncertainty in sequence and location of sprinkler activation observed in full scale testing [1, 2]. Vertical barriers can be both expensive and intrusive to warehouse operations and the large water demand requirements can add significant infrastructure and installation cost to the sprinkler system.

The focus of the current work was to demonstrate that electric fire sprinklers operated by an "intelligent" electronic detection and control system could achieve adequate ceiling-only protection of exposed expanded group-A plastic commodities stored on racks without the need for additional engineering controls such as in-rack sprinklers or vertical barriers, and with significantly lower total water demand than current ceiling-only alternatives. The basic theory was that effective fire suppression performance could be achieved by simultaneously operating an array of sprinklers surrounding the point of fire origin during the early stages of fire development – thus maximizing the amount of water applied onto burning materials and pre-wetting adjacent unburned fuels to prevent lateral fire spread. An electronically operable sprinkler system was constructed using components that are readily available and commonly used in the fire protection industry and a series of full scale fire tests were conducted at the Underwriters Laboratories large burn lab facility in Northbrook, IL

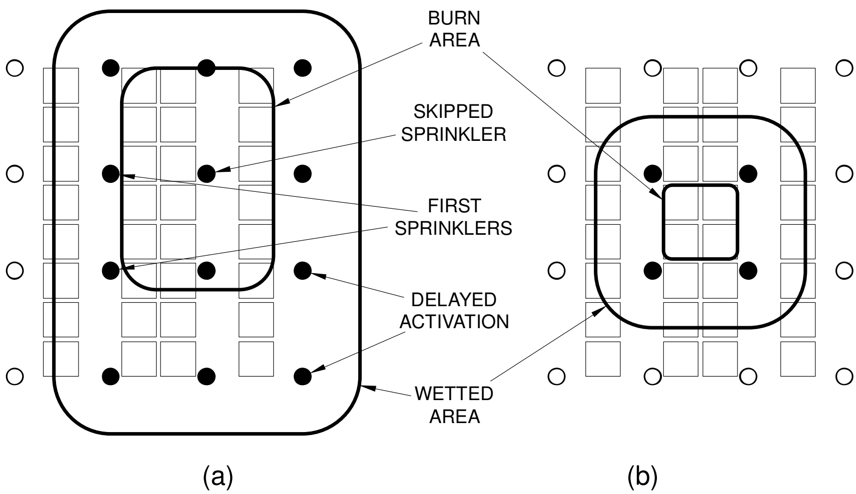


Fig. 1. (a) Typical sprinkler operation (b) Hypothetical future state.

Electronic Sprinkler System

The sprinkler used in the testing consisted of an existing commercially available ESFR sprinkler with a k-factor of 241.9 LPM/bar$^{1/2}$ (16.8 GPM/psi$^{1/2}$) that was modified to operate electrically. The detection and control system utilized standard addressable heat sensors that were hard-wired to a commercially available fire alarm control panel (FACP). There was a single heat sensor for each sprinkler. The FACP was programmed to operate up to 9 sprinklers simultaneously through basic control logic. Sprinklers were selected for operation using a sensitive rate-of-temperature-rise detection algorithm, and activated once specific triggering criteria were achieved. Fig. 2 shows a diagram of the electronic sprinkler system as tested.

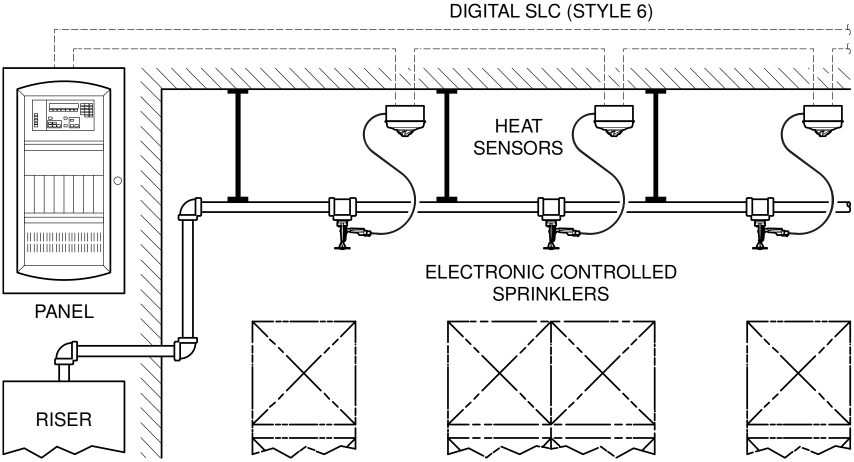


Fig. 2. Electronic sprinkler system overview as tested.

Fire Performance Evaluation

A series of four fire tests were conducted in UL LLC's large-scale fire test facility located in Northbrook, IL to evaluate the level of fire protection that could be achieved using the Electronic Sprinkler to protect a double-row rack storage arrangement of Exposed, Expanded Group A Plastic commodity. The test setup consisted of standard EEP commodity – polystyrene meat trays shrink wrapped on oak pallets – stored on double-row racks under a 10.7 meter (35 ft) and 12.2 meter (40 ft) smooth flat ceiling. Storage ranged from 4.6 meters (15 ft) to 9.1 meters (30 ft). Ignition location varied.

Sprinklers were installed 35.6 cm (14 in) from the ceiling and at a 3 meter (10 ft) spacing. Detectors were installed 30.5 cm (12 in) below the ceiling surface and 30.5 cm (12 in) laterally from each sprinkler.

Results

A summary of the test parameters and results is shown in Table 1.

Table 1a. Summary of test parameters and results SI units.

Test #	**Test 1**	**Test 2**	**Test 3**	**Test 4**
Test date	**9/25/2015**	**5/27/2016**	**6/2/2016**	**6/7/2016**
TEST PARAMETERS				
Storage Type	Double row rack			
Commodity Type	Exposed expanded Group A plastics			
Nominal Ceiling Height (m)	12.2	10.67	10.67	10.67
Nominal Storage Height (m)	9.14	9.14	9.17	4.57
Vertical Barrier	None			
Ignition Location	Under 1	Between 2	Between 4	Between 2
Aisle width (m)	1.22	2.44	2.44	2.44
Sprinkler spacing (m x m)	3.05 x 3.05	3.05 x 3.05	3.05 x 3.05	3.05 x 3.05
Sprinkler type	Electronic suppression	Electronic suppression	Electronic suppression	Electronic suppression
Sprinkler k-factor (LPM/bar$^{1/2}$)	241.9	241.9	241.9	241.9
Operating pressure (bar)	3.59	3.59	3.59	3.59
Sensor type	Heat detector	Heat detector	Heat detector	Heat detector
Sensor vertical distance from ceiling surface (cm)	7.62	30.48	30.48	30.48
Sensor horizontal distance from sprinkler location (cm)	30.48	30.48	30.48	30.48
TEST RESULTS				
Length of test (min)	31	31	31	31
First sprinkler activation (min:s)	0:43	0:44	0:45	0:43
Last sprinkler activation (min:s)	0:43	0:44	0:45	0:43
Number of sprinklers operated	9	9	9	9
Peak ceiling gas temperature above ignition (°C)	60	125	160	88
Maximum 1 min. avg. gas temp. above ignition (°C)	49	69	79	35
Peak steel temp. at ceiling above ignition (°C)	46	62	71	29
Max 1 min. avg. steel temp. above ignition (°C)	39	57	63	28
Fire spread across aisle?	YES*	NO	NO	NO
Sustained combustion at outer edges of target array?	YES*	NO	NO	NO
Fire spread to outer edges of main array	NO	NO	NO	NO

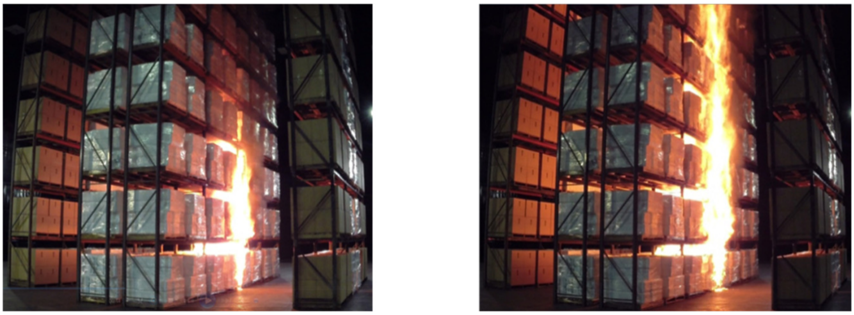
*Burn through of a single pallet at very bottom of target array ignited by falling debris from main array.

Table 1b. Summary of test parameters and results US customary units

Test #	**Test 1**	**Test 2**	**Test 3**	**Test 4**
Test date	**9/25/2015**	**5/27/2016**	**6/2/2016**	**6/7/2016**
TEST PARAMETERS				
Storage Type	Double row rack			
Commodity Type	Exposed expanded Group A plastics			
Nominal Ceiling Height (ft)	40	35	35	35
Nominal Storage Height (ft)	30	30	30	15
Vertical Barrier	None			
Ignition Location	Under 1	Between 2	Between 4	Between 2
Aisle width (ft)	4	8	8	8
Sprinkler spacing (ft x ft)	10 x 10	10 x 10	10 x 10	10 x 10
Sprinkler type	Electronic suppression	Electronic suppression	Electronic suppression	Electronic suppression
Sprinkler k-factor (gpm/psi$^{0.5}$)	16.8	16.8	16.8	16.8
Operating pressure (psi)	52	52	52	52
Sensor type	Heat detector	Heat detector	Heat detector	Heat detector
Sensor vertical distance from ceiling surface (in)	3	12	12	12
Sensor horizontal distance from sprinkler location (in)	12	12	12	12
TEST RESULTS				
Length of test (min)	31	31	31	31
First sprinkler activation (min:s)	0:43	0:44	0:45	0:43
Last sprinkler activation (min:s)	0:43	0:44	0:45	0:43
Number of sprinklers operated	9	9	9	9
Peak ceiling gas temperature above ignition (°F)	140	257	320	190
Maximum 1 min. avg. gas temp. above ignition (°F)	120	156	174	95
Peak steel temp. at ceiling above ignition (°F)	115	144	160	84
Max 1 min. avg. steel temp. above ignition (°F)	102	135	145	82
Fire spread across aisle?	YES*	NO	NO	NO
Sustained combustion at outer edges of target array?	YES*	NO	NO	NO
Fire spread to outer edges of main array	NO	NO	NO	NO

*Burn through of a single pallet at very bottom of target array ignited by falling debris from main array.

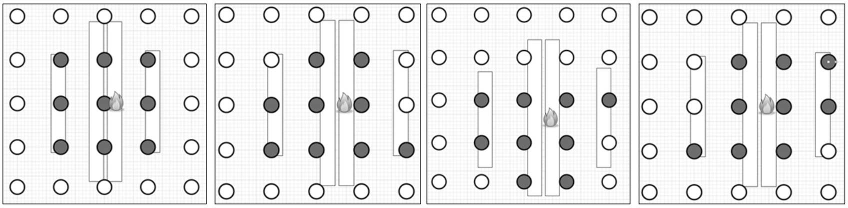
In all tests, 9 sprinklers operated simultaneously at or before the estimated time that the first 101 °C (214 °F) ESFR sprinkler activation would typically have been observed based on time and temperature comparisons against existing test data [3]. An example of the observed fire size at electronic sprinkler system activation as compared to the estimated fire size at first ordinary temperature ESFR sprinkler activation for test 2 is shown in Fig. 3



(a) (b)

Fig. 3. (a) Fire size at electronic sprinkler activation (b) Estimated fire size at typical 101°C (214°F) ESFR sprinkler activation.

In all tests, regardless of ignition location, sprinkler operating arrays were contiguous and roughly centered around the point of fire ignition and significant fire suppression was achieved within approximately 90 second from initial sprinkler operation.



(a) (b) (c) (d)

Fig. 4. (a)Test 1 activation pattern (b) Test 2 activation pattern (c) Test 3 activation pattern(d) Test 4 activation pattern.

In all tests the damage was limited to within 2 pallet loads laterally in either direction from ignition, well within the envelope of sprinkler operation with a significant wetted margin. In addition, the relative amount of damage was observed to be significantly less than that of similar tests conducted with ESFR sprinklers.

Minor aisle jump was observed in Test 1 only, and was principally caused by burning commodity falling into the narrow 1.2 m (4 ft) wide aisle and igniting a single pallet load on the target array opposite ignition. During the course of the test this single pallet load was partially consumed. Due in part to this observation, Tests 2 - 4 were conducted using a wider 2.4 m (8 ft) aisle.

Discussion

Based on the results of this study, the application of electronic sprinkler technology presents a number of potential benefits when compared to existing mechanically operated automatic fire sprinklers.

First, the sprinkler k-factor, pressure and spacing tested was selected to be comparable to existing prescriptive ceiling only ESFR sprinkler system designs for warehouses of a similar height, but lower commodity classification. The results of the test program demonstrated that existing systems designed based on similar parameters could be extended to protect EEP commodity without the need to upsize the system piping or water supply equipment. This could potentially minimize the costs associated with upgrading dated warehouse fire protection systems by maximizing the use of existing system infrastructure.

Second, through the simultaneous operation of an array of sprinklers surrounding the point of fire origin early in its development, the system was observed to provide a significant degree of fire suppression, preventing fire spread and limiting damage to the region proximal to the point of ignition. This observation coupled with the elimination of uncertainty associated with unintended thermo-mechanical sprinkler operation suggests the potential to substantially reduce the number of open sprinklers considered during the system design process – further reducing hydraulic demand and increasing system design flexibility. For example, ESFR sprinkler systems designed in accordance with NFPA 13 typically require at least 12 operating sprinklers be considered during the hydraulic design process [2]. This study suggests that number could be reduced to 9 or fewer for the electronic system tested.

Finally, the electronically controlled sprinkler system investigated in this study was configured such that the location of the heat sensors and the sprinkler were physically separated. In practice this could allow the detection system to be located and configured as to maximize detection performance, for instance proximal to the ceiling surface, and the sprinklers to be placed where they will provide the most effective fire suppression, for instance below obstructions to water discharge and/or proximal to the top of the protected commodity – providing a potential improvement in both system performance and installation flexibility.

Conclusion

The results of this investigation demonstrate that electric fire sprinklers operated by an “intelligent” electronic detection and control system can achieve adequate ceiling-only protection of exposed expanded group-A plastic commodities stored on racks without the need for additional engineering controls such as in-rack sprinklers or vertical barriers, and with lower total water demand than current ceiling-only alternatives. Critical to the observed performance improvements for EEP are the simultaneous activation of up to 9 fire sprinklers surrounding the point of fire ignition early in its development.

Acknowledgements

The authors would like to thank the team in the large burn laboratory at UL LLC for their support in coordinating and conducting the test program.

References

[1] UL LLC, "*Protection of Rack Stored Exposed Expanded Group A Plastics with ESFR Sprinklers and Vertical Barriers*" 2012, Fire Protection Research Foundation, Quincy, MA

[2] NFPA 13 Standard for the Installation of Sprinkler Systems, 2016 Edition, NFPA, Quincy, MA

[3] "*Sprinkler Protection Criteria for Exposed Expanded Group A Plastics Project Summary*" 2014, Fire Protection Research Foundation, Quincy, MA

Public Input No. 6-NFPA 750-2020 [Section No. 3.3.25.3]

3.3.25.3 Nonautomatic Water Mist Nozzles (Open).

Nozzles that operate as an entire system ~~or grouping~~ , grouping of nozzles or single nozzle , containing open orifices and activating the water flow to the nozzles by an independent detection system.

Statement of Problem and Substantiation for Public Input

We manufacture a domestic water mist system which uses directional open nozzles (with flow control provided by a valve upstream). Only one of the nozzles activates (always, electronically controlled by detection and targeting algorithm) so the change would allow this one nozzle activation system to be called an open nozzle system. I have also made an alternative edit which is to add the term directional nozzle. Happy with non-automatic (open nozzle) given it is not an automatic nozzle.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 5-NFPA 750-2020 [New Section after 3.3.25]	
Public Input No. 7-NFPA 750-2020 [New Section after 3.3.26.8]	
Public Input No. 12-NFPA 750-2020 [New Section after 3.3.25.3]	

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Public Input No. 7-NFPA 750-2020 [New Section after 3.3.26.8]

Targeted Water mist System

A system that uses open nozzles with directional spray head assemblies to spray water mist at a region of a compartment as opposed to the whole compartment or a to a fixed location.

Alternatively:

A system that uses a directional nozzle to spray water mist at a region of a compartment as opposed to the whole compartment or a to a fixed location.

Additional Proposed Changes

File Name	Description	Approved
product-208.jpg	Illustration of a targeted system	
1I5A7319.JPG	Illustration of the directional spray head assembly	

Statement of Problem and Substantiation for Public Input

We manufacture a watermist system which uses an open nozzle and is neither a deluge neither a local application system. Instead it uses a direction spray head to target water mist only in a region of a compartment, where the fire is, as opposed to the whole compartment or a predetermined area of the compartment (local application).

Our spray head could also be named a directional nozzle but the nozzle component itself is open and the valving is done within the spray assembly, so we would prefer the open nozzle classification. The system is atmospheric pressure when unactivated which aligns to the open nozzle concept. It is however, not a deluge system because only one nozzle outputs water in every fire event, as opposed to multiple.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 5-NFPA 750-2020 [New Section after 3.3.25]	related to the same directional head / targeted system
Public Input No. 6-NFPA 750-2020 [Section No. 3.3.25.3]	related to the same directional head / targeted system
Public Input No. 8-NFPA 750-2020 [New Section after 7.4]	
Public Input No. 11-NFPA 750-2020 [Section No. 6.10.3.5.6]	
Public Input No. 12-NFPA 750-2020 [New Section after 3.3.25.3]	

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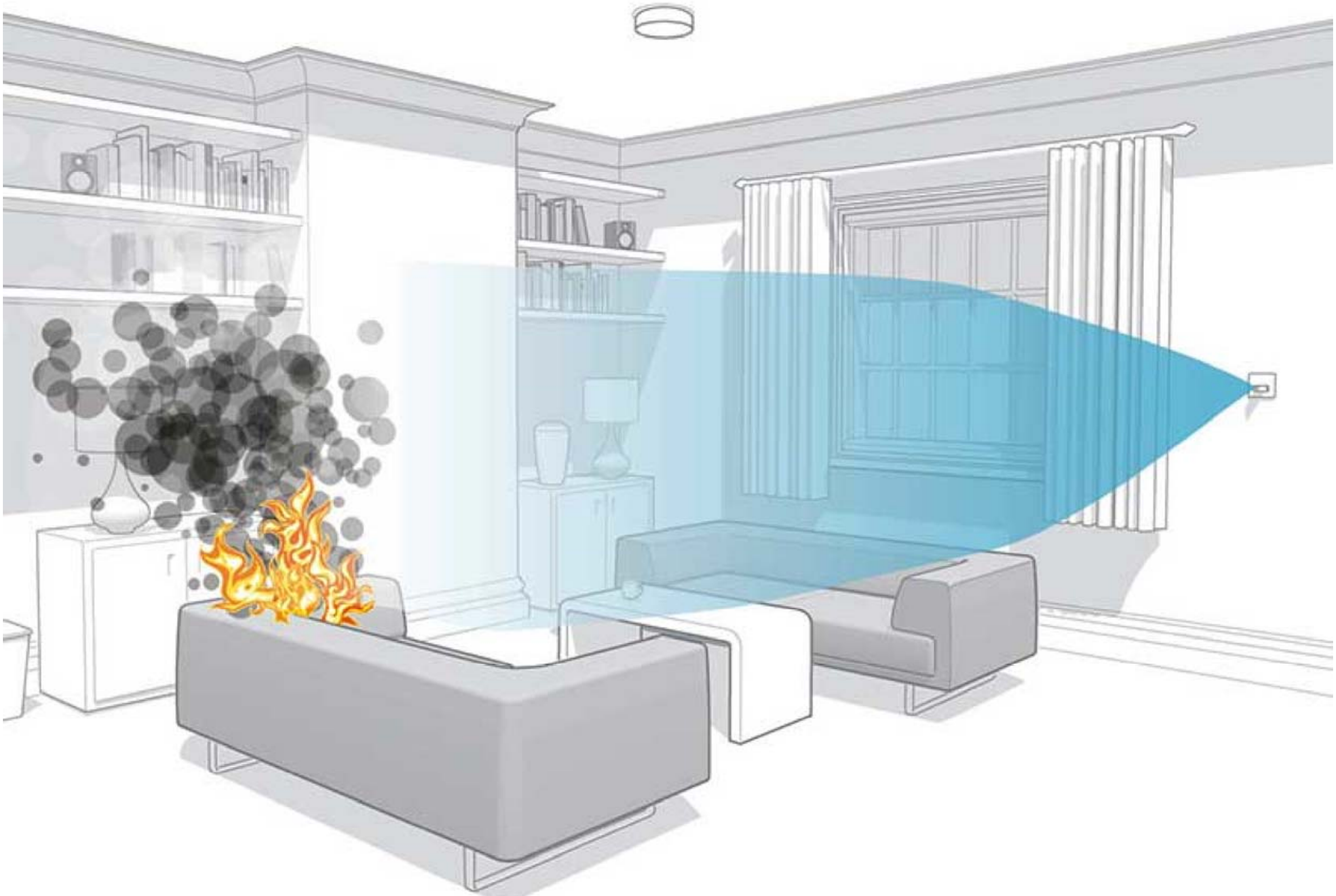


automist
KEEP CLEAR · DO NOT COVER

Public Input No. 9-NFPA 750-2020 [Section No. 6.3.1.2]

6.3.1.2

Wherever the word *pipe* is used, it shall be understood also to mean *tube* *or hose* .

Statement of Problem and Substantiation for Public Input

The way NFPA 750 defines pipes and tube suggests only rigid systems can be used. If the term hose is used (without removing the need for it to be Listed of its intended purpose) it better clarifies the ability to use flexible hoses in installations. An alternative is to state flexible tube instead of just tube in this section.

We manufacture a domestic water mist system with open nozzles which uses high pressure hoses instead of rigid pipes. It is our intention to have these Listed. The current definitions of NFPA 750 do not give us confidence these would be compliant to NFPA 750 even if Listed for their intended use.

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Public Input No. 16-NFPA 750-2020 [Section No. 6.3.3.1]

6.3.3.1

Pipe or tube used in low pressure water mist systems shall meet or exceed one of the standards in Table 6.3.3.1 or shall be in accordance with 6.3.2.

Table 6.3.3.1 Pipe or Tube Standards

Materials and Dimensions and Standard Titles	Standard No.	
Copper Tube (Drawn, Seamless)	-	
Standard Specification for Solder Metal [95-5 (Tin-Antimony-Grade 95TA)]	ASTM B32	
*Standard Specification for Seamless Copper Tube**	ASTM B75/B75M	
*Standard Specification for Seamless Copper Water Tube**	ASTM B88	
Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube	ASTM B251	
Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper-Alloy Tube	ASTM B813	
Specification for Filler Metals for Brazing and Braze Welding (Classification BCuP-3 or BCuP-4)	AWS A5.8M/A5.8	
Stainless Steel	**Standard Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General ServiceStandard** **Standard Specification for Welded Stainless Steel Mechanical Tubing**	ASTM A268/268M ASTM A554
Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service	ASTM A269/A269M	
Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service	ASTM A632	
Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products	ASTM A778/A778M	
Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service	ASTM A789/ A789M	

*Denotes pipe or tube suitable for bending *(see 6.3.6)* according to ASTM standards.

Statement of Problem and Substantiation for Public Input

Currently this table does not include ASTM A268 stainless steel tubing and ASTM A554 stainless steel pipe. Both are suitable for this application and provide corrosion resistance for a multitude of locations that may require such protection. The inclusion of these two standards will allow the designer additional options for materials in these type systems.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 17-NFPA 750-2020 [Section No. 6.4.2.1]	

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Public Input No. 17-NFPA 750-2020 [Section No. 6.4.2.1]

6.4.2.1

Fittings used in water mist systems shall meet or exceed the standards in Table 6.4.2.1 or shall be in accordance with 6.4.2.2.

Table 6.4.2.1 Fitting Standards

Materials and Dimensions and Standard Titles	**Standard No.**		
Copper	-		
Cast Copper Alloy Solder Joint Pressure Fittings	ANSI/ASME B16.18		
Wrought Copper and Copper Alloy Solder Joint Pressure Fittings	ANSI/ASME B16.22		
	_		
_	**Standard Specification for Metallic Press-Connect Fittings for Piping and Tubing Systems**	ASTM F3226	
Stainless Steel	-	Standard Specification for Metallic Press-Connect Fittings for Piping and Tubing Systems	ASTM F3226
Standard Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex) for Pressure-Containing Parts	ASTM A351/A351M		
Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings	ASTM A403/A403M		
Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures	ASTM A774/A774M		
Standard Specification for Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings	ASTM A815/A815M		

Statement of Problem and Substantiation for Public Input

Currently the fitting table does not recognize press-connect fittings which are different from traditional compression fittings as they are a permanent non-removable joint incorporating an elastomeric seal or an elastomeric seal and corrosion-resistant grip ring. The Joint is made with a pressing tool and jaw or ring approved by the fitting manufacturer. ASTM F3226 covers press fittings for copper pipe and tubing as well as stainless steel pipe and tubing along with other alloys.

Related Public Inputs for This Document

Related Input	**Relationship**
Public Input No. 16-NFPA 750-2020 [Section No. 6.3.3.1]	Piping/Tubing standards for stainless steel
Public Input No. 19-NFPA 750-2020 [Section No. 16.1.12.7]	

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Public Input No. 18-NFPA 750-2020 [Section No. 6.4.2.1]

6.4.2.1

Fittings used in water mist systems shall meet or exceed the standards in Table 6.4.2.1 or shall be in accordance with 6.4.2.2.

Table 6.4.2.1 Fitting Standards

Materials and Dimensions and Standard Titles	**Standard No.**		
Copper	-		
Cast Copper Alloy Solder Joint Pressure Fittings	ANSI/ASME B16.18		
Wrought Copper and Copper Alloy Solder Joint Pressure Fittings	ANSI/ASME B16.22		
	–	Approval Standard for Pipe Couplings and Fittings for Aboveground Fire Protection Service	FM 1920
Stainless Steel	-	Approval Standard for Pipe Couplings and Fittings for Aboveground Fire-Protection Service	FM 1920
Standard Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex) for Pressure-Containing Parts	ASTM A351/A351M		
Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings	ASTM A403/A403M		
Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures	ASTM A774/A774M		
Standard Specification for Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings	ASTM A815/A815M		

Statement of Problem and Substantiation for Public Input

The proposed addition of FM 1920 to both copper and stainless steel fittings provides direction to the user and designer that this is an acceptable standard for pipe fittings for above ground fire protection systems. This standards is widely used by manufacturer's to list their products to and should be included in the standard.

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Public Input No. 10-NFPA 750-2020 [Section No. 6.10.2.2]

6.10.2.2 Primary and Standby Power.

Adequate and reliable primary and 24-hour minimum standby sources of energy shall be used to provide for operation of the detection, signaling, control, and actuation requirements of the systems. This requirement does not apply to systems used to protect a single dwellings as an alternative to an NFPA 13D system.

Statement of Problem and Substantiation for Public Input

NFPA 13D systems are not required to have a power backup for the operation of pumps, when these exist. Given the type of application, this requirement should be consistent for the same types of dwellings so that backup power is not required if a system is used to protect a single dwelling.

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Public Input No. 11-NFPA 750-2020 [Section No. 6.10.3.5.6]

6.10.3.5.6

The requirements of 6.10.3.5 shall not apply to dry and wet pipe systems utilizing individual, thermally activated nozzles. The requirements of 6.10.3.5 shall not apply to single dwellings using a domestic system.

Statement of Problem and Substantiation for Public Input

Despite the common practice of using automatic nozzles in domestic applications and therefore the automatic exclusion from this requirement, the fact that it is a domestic application should also exclude the need for a manual release as it is not ideal that the system is easily activated by occupant tampering.

Our system, in the market, does not use automatic nozzles but are installed in domestic applications, and are activated automatically by other means, such as electronic means. These should also be excluded from the requirement of needing a manual emergency release.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 7-NFPA 750-2020 [New Section after 3.3.26.8]	related to the same targeted system

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Public Input No. 8-NFPA 750-2020 [New Section after 7.4]

Targeted systems

Targeted systems should use only open nozzles, activated by (a) detection system(s) to the zone and region of the compartment that has indicated there is a fire.

Additional Proposed Changes

File Name	Description	Approved
Directional_and_zones.jpg	Zones and targeting within a domestic property	

Statement of Problem and Substantiation for Public Input

Our product does not adequately fall within the scope of none of the current definitions of "system types". It is effectively a directional, targeted system which operates one nozzle through an open nozzle which is valved within the spray head assembly. Despite being an open nozzle it is neither a local application nor a deluge system. It is a local application for which the "locality" is chosen by a detection system and then the mist is directed only on the region of where the fire is.

Our system is a domestic system only and we would like to be able to a) declare it is within the scope of NFPA 750 b) be able to classify it adequately in NFPA 750 c) be able to educate stakeholders using NFPA 750 with applicable classifications for our product.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 7-NFPA 750-2020 [New Section after 3.3.26.8]	regarding the same targeted system query

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Six heads with one pump

Public Input No. 2-NFPA 750-2019 [Section No. 12.5.1.4.2]

12.5.1.4.2

The requirements of 12.5.1.4.1 shall not apply to nozzles with ~~multiple orifices and with~~ minimum waterway dimensions greater than ~~800 µm~~ 5mm per opening.

Statement of Problem and Substantiation for Public Input

Providing an exception for minimum waterway dimensions greater than 800 micrometers seems arbitrary. It was used as part of the original draft text, but there is no obvious technical reason. Possibly it was included based on the design and dimensions of water mist nozzles available at the time that the standard was written, it's not clear though. For some low pressure nozzles available now, their orifices can be larger than this limit which in theory means that they would not be required to provide strainers at the nozzles.

Water particulate is one source of blockages at nozzles. Installation methods and materials are also a source of blockages at nozzles, that can be more severe - things like pipe shavings, pipe sealing compound and Teflon tape. These can easily block holes several millimeters in diameter.

Increase the size limit for nozzles requiring strainers to align with NFPA 15 section 6.4.6.3 and FM Approval Standard 2021/2025 section 4.2.1 paragraph 1.

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Public Input No. 19-NFPA 750-2020 [Section No. 16.1.12.7]

16.1.12.7

Joints and connections in ASTM B88 tubing shall be brazed or shall be Press-connect fittings listed to ASTM F3226 .

Statement of Problem and Substantiation for Public Input

ASTM F3226 was developed in ASTM F25 Marine Machinery and Piping systems committee specifically for press-connect fittings. The addition of this standard and technology that is being proposed to be listed will provide the designers and installers a safe non-flammable installation method for water mist fire protection systems and has been reviewed and accepted by the marine industry stakeholders serving in ASTM F25 committee.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 17-NFPA 750-2020 [Section No. 6.4.2.1]	

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Public Input No. 13-NFPA 750-2020 [Section No. C.1.2]

C.1.2

Table C.1.2 identifies several organizations with wide international recognition that currently develop or administer test protocols for water mist fire suppression systems. The following sections provide brief descriptions of the scope of application and the acceptance criteria of the test protocols that are the basis for the 1998 listings for water mist systems. The testing laboratories can add or subtract certain fire tests, at their discretion, based on their interpretation of the system performance limits. The reader should refer to the original test protocols for complete test details.

Table C.1.2 Internationally Recognized Agencies with Published Fire Test Protocols for Water Mist Fire Protection Systems

Agency	Water Mist Fire Test Protocol
1. International Maritime Organization, London, England	IMO MSC/Circ. 668, *Alternative Arrangements for Halon Fire-Extinguishing Systems in Machinery Spaces and Pump-Rooms*.
	(a) Appendix A, "Component Manufacturing Standards of Equivalent Water-Based Fire Extinguishing Systems," 1994.
	(b) Appendix B, "Interim Test Method for Fire Testing Equivalent Water-Based Fire-Extinguishing Systems for Machinery Spaces of Category A and Cargo Pump-Rooms," 1994.
	As amended in MSC/Circ. 728, *Amendments to the Test Method for Equivalent Water-Based Fire-Extinguishing Systems for Machinery Spaces of Category A and Cargo Pump-Rooms Contained in MSC/Circ. 668*, Appendix B, June 1996.
	IMO Res. A.800 (19), *Revised Guidelines for Approval of Sprinkler Systems, Equivalent to That Referred to in SOLAS Regulation II-2/12*.
	(a) Appendix 1, "Component Manufacturing Standards for Water Mist Nozzles."
	(b) Appendix 2, "Fire Test Procedures for Equivalent Sprinkler Systems in Accommodation, Public Space and Service Areas on Passenger Ships," December 1995.
	International Code for Application of Fire Test Procedures, 2012.
2. FM Approvals, 1151 Boston-Providence Turnpike, P.O. Box 9102, Norwood, MA, 02062.	ANSI/FM Approvals 5560, *American National Standard for Water Mist Systems*, ~~December 2007~~ November 2017 .
	(a) Fire Tests for Water ~~Mists~~ Mist Systems for the Protection of Combustion Turbines with Volumes up to, and including, 2825 ft^3 (80 m^3)
	(b) Fire Tests for Water ~~Mists~~ Mist Systems for the Protection of Combustion Turbines with Volumes up to, and including, 9175 ft^3 (260 m^3)
	(c) Fire Tests for Water ~~Mists~~ Mist Systems for the Protection of Combustion Turbines with Volumes Exceeding 9175 ft^3 (260 m^3)
	(d) Fire Tests for Water ~~Mists~~ Mist Systems for the Protection of Wet Benches and Other Similar Processing Equipment
	(e) Fire Tests for Water ~~Mists~~ Mist Systems for the Protection of Local Applications
	(f) Fire Tests for Water ~~Mists~~ Mist Systems for the Protection of Industrial Oil Cookers
	(g) Fire Tests for Water ~~Mists~~ Mist Systems for the Protection of ~~Computer Room Sub Floors~~ Continuous Wood Board Presses
	(h) Fire Tests for Water Mist Systems for the Protection of Chemical Fume Hoods
	(i) Fire Tests for Water Mist Systems for the Protection of Data Processing Equipment Rooms/Halls - Above Raised Floor
	(j) Fire Tests for Water Mist Systems for the Protection of Data Processing Equipment Rooms/Halls - Below Raised Floor

Agency	Water Mist Fire Test Protocol
	(k) Scaling Methodology: Fire Tests for Water Mist Systems for the Protection of Combustion Turbines in Enclosures in 1/2-Scale
	FM Approvals Class Number 5560, *Approval Standard for Water Mist Systems*, ~~April 2016~~ January 2021 (TBD)
	(a) Fire Tests for Water ~~Mists~~ Mist Systems for the Protection of Machinery in Enclosures with Volumes not Exceeding 2825 ft^3 (80 m^3)
	(b) Fire Tests for Water ~~Mists~~ Mist Systems for the Protection of Combustion Turbines in Enclosures with Volumes not Exceeding 2825 ft^3 (80 m^3)
	(c) Fire Tests for Water ~~Mists~~ Mist Systems for the Protection of Machinery in Enclosures with Volumes not Exceeding 9175 ft^3 (260 m^3)
	(d) Fire Tests for Water ~~Mists Systems~~ Mist Systems for the Protection of Combustion Turbines in Enclosures with Volumes not Exceeding 9175 ft^3 (260 m^3)
	(e) Fire Tests for Water ~~Mists~~ Mist Systems for the Protection of Machinery in Enclosures with Volumes Exceeding 9175 ft^3 (260 m^3)
	(f) Fire Tests for Water ~~Mists~~ Mist Systems for the Protection of Combustion Turbines in Enclosures with Volumes Exceeding 9175 ft^3 (260 m^3)
	(g) Fire Tests for Water ~~Mists~~ Mist Systems for the Protection of ~~Light Hazard Occupancies~~ Non-Storage Occupancies, Hazard Category 1 (HC-1)
	(h) Fire Tests for Water ~~Mists~~ Mist Systems for the Protection of Wet Benches and Other Similar Processing Equipment
	(i) Fire Tests for Water ~~Mists~~ Mist Systems for the Protection of Local Applications
	(j) Fire Tests for Water ~~Mists~~ Mist Systems for the Protection of Industrial Oil Cookers
	(k) Fire Tests for Water ~~Mists~~ Mist Systems for the Protection of Continuous Wood Board Presses
	(l) Fire Tests for Water ~~Mists Systems~~ Mist Systems for the Protection of Chemical Fume Hoods
	(m) Fire Tests for Water ~~Mists~~ Mist Systems for the Protection of Data Processing Equipment Rooms/Halls – Above Raised Floor
	(n) Fire Tests for Water ~~Mists~~ Mist Systems for the Protection of Data Processing Equipment Rooms/Halls – Below Raised Floor
	(o) Scaling Methodology: Fire Tests for the Protection of Machinery and Combustion Turbines in Enclosures in ½-Scale
	(p) Fire Tests for Water Mist Systems for the Protection of Non-Storage Occupancies, Hazard Category 2 (HC-2) and Hazard Category 3 (HC-3)
3. UL LLC, Northbrook, IL, USA	ANSI/UL 2167, *Standard for Water Mist Nozzles for Fire Protection Service* [contents can be read from the standard]
4. CEN, Europe	CEN/TS 14972, *Fixed firefighting systems — Watermist systems — Design and installation* [contents can be read from the standard]

Statement of Problem and Substantiation for Public Input

Input is to update FM Approvals documents to the published (or soon to be published) versions. Please note FM 5560 with the additional fire test appendix for HC-2 and HC-3 is not published at the time of this input but is in the review process with an anticipated publish date of December 20 / January 21. Hence the revision date of "January 2021 (TBD)" in the input. The intent is that once the document is published the actual publish date can be included during the document cycle.

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Public Input No. 14-NFPA 750-2020 [Section No. C.3.8]

C.3.8 Light Hazard Occupancies.

Typical light hazard occupancies within the scope of this application are defined in FM Global Property Loss Prevention Data Sheet Number 3-26, *Fire Protection Water Demand for Nonstorage Sprinklered Properties*. The occupancies are defined as Hazard Category 1 (HC-1). Water mist systems tested for light hazard occupancies are not to be used to protect HC-2 , or HC-3 , or HC-4 occupancies. The applications are limited to ceiling heights of 2.4 m (8 ft) for restricted areas and 5 m (16 ft 5 in.) for unrestricted areas (refer to Section 1.9 of FM 5560, Definitions, “Light Hazard Occupancy,” for specific descriptions of restricted and unrestricted areas). The water supply must be capable of supplying 60 minutes of water to the hydraulically most remote nine automatic nozzles or all automatic nozzles within a 140 m^2 (1,500 ft^2) demand area, whichever is greater, for systems approved for the protection of unrestricted areas. For installations with less than 140 m^2 (1,500 ft^2) in area, the water supply are to be capable of supplying 60 minutes of water to all nozzles in the protected area. For systems approved for the protection of restricted areas, the water supply is to be capable of supplying 60 minutes of water to all automatic nozzles within the compartment. Consultation with FM Global Property Loss Prevention Data Sheet Number 4-2, *Water Mist Systems*, and FM Global Property Loss Prevention Data Sheet Number 3-26, *Fire Protection Water Demand for Nonstorage Sprinklered Properties,* is required for installation of these systems.

Statement of Problem and Substantiation for Public Input

Updated the text in this section to align with the addition of water mist systems being able to protect HC-2 and HC-3 occupancies provided they are tested for those specific occupancies.

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Public Input No. 15-NFPA 750-2020 [New Section after C.3.13]

C.3.14 Ordinary Hazard Occupancies.

Typical ordinary hazard occupancies within the scope of this application are defined in FM Global Property Loss Prevention Data Sheet Number 3-26, *Fire Protection Water Demand for Nonstorage Sprinklered Properties* . The occupancies are defined as Hazard Category 2 (HC-2) and Hazard Category 3 (HC-3). The water supply should be capable of supplying 60 minutes of water to the hydraulically most remote nozzles. The design area of the water mist system should be 1.5 times the number of operated nozzles during fire performance testing. Consultation with FM Global Property Loss Prevention Data Sheet Number 4-2, *Water Mist Systems* , and FM Global Property Loss Prevention Data Sheet Number 3-26, *Fire Protection Water Demand for Nonstorage Sprinklered Properties,* is required for installation of these systems.

Statement of Problem and Substantiation for Public Input

Adding new section to align with the updated FM Approvals standard which includes a new test appendix for ordinary hazards specifically HC-2 and HC-3 as referenced in FM Global Datasheet 3-26.

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Public Input No. 4-NFPA 750-2020 [Section No. E.1.2.12]

E.1.2.12 ULC Publications.

~~Underwriters Laboratories of Canada, 7 Underwriters Road, Toronto, ON M1R 3A9~~
ULC Standards, 171 Nepean Street, Suite 400, Ottawa Ontario K2P 0B4 , Canada .

CAN/ULC S524, *Standard for the Installation of Fire Alarm Systems*, 2014.

CAN/ULC S529, *Standard for Smoke Detectors for Fire Alarm Systems*, 2016.

Statement of Problem and Substantiation for Public Input

Reason: Update publication address.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 3-NFPA 750-2020 [Section No. 2.3.6]	

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Addendum B

NFPA 25

PI # A1

Section 12.3.6.1 of NFPA 25, 2020 edition is lacking in definitive direction to the reader:

***"12.3.6.1** Gas cylinders designed in accordance with U.S. Department of Transportation (DOT), Canadian Transport Commission (CTC) or similar containers shall not be recharged without retesting if more than 5 years has elapsed since the date of last test."*

Question: What is the requirement for "retesting"?

Possible Resolution:

***"*12.3.6.1** Gas cylinders designed in accordance with U.S. Department of Transportation (DOT), Canadian Transport Commission (CTC) or similar containers shall not be recharged without retesting in accordance with (or equal to) DOT 49 CFR 180.205 and 49 CFR 180.209 if more than 5 years has elapsed since the date of last test."

See – Excerpts from 49 CFR, 49CFR 180.205 – 209.

Excerpts from 49 CFR, 49CFR 180.205 – 209.

adversely react with the cylinder (e.g. chemical stress corrosion).

Condemn means a determination that a cylinder is unserviceable for the continued transportation of hazardous materials in commerce and that the cylinder may not be restored by repair, rebuilding, requalification, or any other procedure.

Defect means an imperfection requiring removal of a cylinder from service.

Elastic expansion means a temporary increase in a cylinder's volume, due to application of pressure, that is lost when pressure is released (elastic expansion = total expansion minus permanent expansion).

Filled or *charged* means an introduction or presence of a hazardous material in a cylinder.

Non-corrosive service means a hazardous material that, in the presence of moisture, is not corrosive to the materials of construction of a cylinder (including valve, pressure relief device, etc.).

Over-heated means a condition in which the temperature of any portion of an aluminum cylinder has reached 176°C (350°F) or higher, or in which the temperature of any portion of a steel or nickel cylinder has reached 343°C (650°F) or higher.

Permanent expansion means a permanent increase in a cylinder's volume after the test pressure is released.

Proof pressure test means a pressure test by interior pressurization without the determination of a cylinder's expansion.

Rebuild means the replacement of a pressure part (e.g. a wall, head, or pressure fitting) by welding.

Rejected cylinder means a cylinder that cannot be used for the transportation of a hazardous material in commerce without repair, rebuilding, and requalification.

Repair means a procedure for correction of a rejected cylinder that may involve welding.

Requalification means the completion of a visual inspection and/or the test(s) required to be performed on a cylinder to determine its suitability for continued service.

Requalification identification number or RIN means a code assigned by DOT to uniquely identify a cylinder requalification, repair, or rebuilding facility.

Test pressure means the pressure used for the requalification of a cylinder.

Total expansion means the total increase in a cylinder's volume due to application of the test pressure.

Visual inspection means an internal or external visual examination, or both, performed as part of the cylinder requalification process.

Volumetric expansion test means a pressure test to determine the total and permanent expansion of a cylinder at a given pressure. The *volumetric expansion test* is conducted using the water jacket or direct expansion methods:

(1) *Water jacket method* means a volumetric expansion test to determine a cylinder's total and permanent expansion by measuring the difference between the volume of water the cylinder externally displaces at test pressure and the volume of water the cylinder externally displaces at ambient pressure.

(2) *Direct expansion method* means a volumetric expansion test to calculate a cylinder's total and permanent expansion by measuring the amount of water forced into a cylinder at test pressure, adjusted for the compressibility of water, as a means of determining the expansion.

[Source Note: At 71 FR 33894, June 12, 2006, effective September 11, 2006, revised introductory text.]

§180.205 General requirements for requalification of specification cylinders.

(a) *General.* Each cylinder used for the transportation of hazardous materials must be an authorized packaging. To qualify as an authorized packaging, each cylinder must conform to this subpart, the applicable requirements specified in part 173 of this subchapter, and the applicable requirements of subpart C of part 178 of this subchapter.

(b) *Persons performing requalification functions.* No person may represent that a repair or requalification of a cylinder has been performed in accordance with the requirements in this subchapter unless that person holds a current approval issued under the procedural requirements prescribed in subpart I of part 107 of this chapter. No person may mark a cylinder with a RIN and a requalification date or otherwise represent that a DOT specification or special permit cylinder has been requalified unless all applicable requirements of this subpart have been met. A person who requalifies cylinders must maintain the records prescribed in §180.215 at each location at which it inspects, tests, or marks cylinders.

(c) *Periodic requalification of cylinders.* Each cylinder bearing a DOT specification marking must be requalified and marked as specified in the Requalification Table in this subpart. Each cylinder bearing a DOT special permit number must be requalified and marked in conformance with this section and the terms of the applicable special permit. No cylinder may be filled with a hazardous material and offered for transportation in commerce unless that cylinder has been successfully requalified and marked in accordance with this subpart. A cylinder may be requalified at any time during or before the month and year that the requalification is due. However, a cylinder filled before the requalification becomes due may remain in service until it is emptied. A cylinder with a specified service life may not be refilled and offered for transportation after its authorized service life has expired.

(1) Each cylinder that is requalified in accordance with the requirements specified in this section must be marked in accordance with §180.213.

(2) Each cylinder that fails requalification must be:

(i) Rejected and may be repaired or rebuilt in accordance with §180.211 or §180.212, as appropriate; or

(ii) Condemned in accordance with paragraph (i) of this section.

(3) For DOT specification cylinders, the marked service pressure may be changed upon approval of the Associate Administrator and in accordance with written procedures specified in the approval.

(4) For a specification 3, 3A, 3AA, 3AL, 3AX, 3AXX, 3B, 3BN, or 3T cylinder filled with gases in other than Division 2.2, from the first requalification due on or after December 31, 2003, the burst pressure of a CG–1, CG–4, or CG–5 pressure relief device must be at test pressure with a tolerance of plus zero to minus 10%. An additional 5% tolerance is allowed when a combined rupture disc is placed inside a holder. This requirement does not apply if a CG–2, CG–3 or CG–9 thermally activated relief device or a CG–7 reclosing pressure valve is used on the cylinder.

(d) *Conditions requiring test and inspection of cylinders.* Without regard to any other periodic requalification requirements, a cylinder must be tested and inspected in accordance with this section prior to further use if—

(1) The cylinder shows evidence of dents, corrosion, cracked or abraded areas, leakage, thermal damage, or any other condition that might render it unsafe for use in transportation;

(2) The cylinder has been in an accident and has been damaged to an extent that may adversely affect its lading retention capability;

(3) The cylinder shows evidence of or is known to have been over-heated; or

(4) The Associate Administrator determines that the cylinder may be in an unsafe condition.

(e) *Cylinders containing Class 8 (corrosive) liquids.* A cylinder previously containing a Class 8 (corrosive) liquid may not be used to transport a Class 2 material in commerce unless the cylinder is—

(1) Visually inspected, internally and externally, in accordance with paragraph (f) of this section and the inspection is recorded as prescribed in §180.215;

(2) Requalified in accordance with this section, regardless of the date of the previous requalification;

(3) Marked in accordance with §180.213; and

(4) Decontaminated to remove all significant residue or impregnation of the Class 8 material.

(f) *Visual inspection.* Except as otherwise provided in this subpart, each time a cylinder is pressure tested, it must be given an internal and external visual inspection.

(1) The visual inspection must be performed in accordance with the following CGA Pamphlets: C-6 for steel and nickel cylinders (IBR, see §171.7 of this subchapter); C-6.1 for seamless aluminum cylinders (IBR, see §171.7 of this subchapter); C-6.2 for fiber reinforced composite special permit cylinders (IBR, see §171.7 of this subchapter); C-6.3 for low pressure aluminum cylinders (IBR, see §171.7 of this subchapter); C-8 for DOT 3HT cylinders (IBR, see §171.7 of this subchapter); and C-13 for DOT 8 series cylinders (IBR, see §171.7 of this subchapter).

(2) For each cylinder with a coating or attachments that would inhibit inspection of the cylinder, the coating or attachments must be removed before performing the visual inspection.

(3) Each cylinder subject to visual inspection must be approved, rejected, or condemned according to the criteria in the applicable CGA pamphlet.

(4) In addition to other requirements prescribed in this paragraph (f), each specification cylinder manufactured of aluminum alloy 6351–T6 and used in self-contained underwater breathing apparatus (SCUBA), self-contained breathing apparatus (SCBA), or oxygen service must be inspected for sustained load cracking in accordance with Appendix C of this part at the first scheduled 5-year requalification period after January 1, 2007, and every five years thereafter.

(g) *Pressure test.*

(1) Unless otherwise provided, each cylinder required to be retested under this subpart must be retested by means suitable for measuring the expansion of the cylinder under pressure. Bands and other removable attachments must be loosened or removed before testing so that the cylinder is free to expand in all directions.

(2) The pressure indicating device of the testing apparatus must permit reading of pressures to within 1% of the minimum prescribed test pressure of each cylinder tested, except that for an analog device, interpolation to 1/2 of the marked gauge divisions is acceptable. The expansion-indicating device of the testing apparatus must also permit incremental reading of the cylinder expansion to 1% of the total expansion of each cylinder tested or 0.1 cc, whichever is larger. Midpoint visual interpolation is permitted.

(3) Each day before retesting, the retester shall confirm, by using a calibrated cylinder or other method authorized in writing by the Associate Administrator, that:

(i) The pressure-indicating device, as part of the retest apparatus, is accurate within ±1.0% of the prescribed test pressure of any cylinder tested that day. The pressure indicating device, itself, must be certified as having an accuracy of ±0.5%, or better, of its full range, and must permit readings of pressure from 90%–110% of the minimum prescribed test pressure of the cylinder to be tested. The accuracy of the pressure indicating device within the test system can be demonstrated at any point within 500 psig of the actual test pressure for test pressures at or above 3000 psig, or 10% of the actual test pressure for test pressures below 3000 psig.

(ii) The expansion-indicating device, as part of the retest apparatus, gives a stable reading of expansion and is accurate to ±1.0% of the total expansion of any cylinder tested or 0.1 cc, whichever is larger. The expansion-indicating device itself must have an accuracy of ±0.5%, or better, of its full scale.

(4) The test equipment must be verified to be accurate within ±1.0% of the calibrated cylinder's pressure and corresponding expansion values. This may be accomplished by bringing the pressure to a value shown on the calibration certificate for the calibrated cylinder used and verifying that the resulting total expansion is within ±1.0% of the total expansion shown on the calibration certificate. Alternatively, calibration may be demonstrated by bringing the total expansion to a known value on the calibration certificate for the calibrated cylinder used and verifying that the resulting pressure is within ±1.0% of the pressure

shown on the calibration certificate. The calibrated cylinder must show no permanent expansion. The retester must demonstrate calibration in conformance with this paragraph (g) to an authorized inspector on any day that it retests cylinders. A retester must maintain calibrated cylinder certificates in conformance with §180.215(b)(4).

(5) Minimum test pressure must be maintained for at least 30 seconds, and as long as necessary for complete expansion of the cylinder. A system check may be performed at or below 90% of test pressure prior to the retest. In the case of a malfunction of the test equipment, the test may be repeated at a pressure increased by 10% or 100 psig, whichever is less. This paragraph (g) does not authorize retest of a cylinder otherwise required to be condemned under paragraph (i) of this section.

(6) Training materials may be used for training persons who requalify cylinders using the volumetric expansion test method.

(h) *Cylinder rejection.* A cylinder must be rejected when, after a visual inspection, it meets a condition for rejection under the visual inspection requirements of paragraph (f) of this section.

(1) Except as provided in paragraphs (h)(3) and (h)(4) of this section, a cylinder that is rejected may not be marked as meeting the requirements of this section.

(2) The requalifier must notify the cylinder owner, in writing, that the cylinder has been rejected.

(3) Unless the cylinder is requalified in conformance with requirements in §180.211, it may not be filled with a hazardous material and offered for transportation in commerce where use of a specification packaging is required.

(4) A rejected cylinder with a service pressure of less than 900 psig may be requalified and marked if the cylinder is repaired or rebuilt and subsequently inspected and tested in conformance with—

(i) The visual inspection requirements of paragraph (f) of this section;

(ii) Part 178 of this subchapter and this part;

(iii) Any special permit covering the manufacture, requalification, and/or use of that cylinder; and

(iv) Any approval required under §180.211.

(i) *Cylinder condemnation.*

(1) A cylinder must be condemned when—

(i) The cylinder meets a condition for condemnation under the visual inspection requirements of paragraph (f) of this section.

(ii) The cylinder leaks through its wall.

(iii) Evidence of cracking exists to the extent that the cylinder is likely to be weakened appreciably.

(iv) For a DOT specification cylinder, other than a DOT 4E aluminum cylinder or a special permit cylinder, permanent expansion exceeds 10 percent of total expansion.

(v) For a DOT 3HT cylinder—

(A) The pressure test yields an elastic expansion exceeding the marked rejection elastic expansion (REE) value.

(B) The cylinder shows evidence of denting or bulging.

(C) The cylinder bears a manufacture or an original test date older than twenty-four years or after 4380 pressurizations, whichever occurs first. If a cylinder is refilled, on average, more than once every other day, an accurate record of the number of rechargings must be maintained by the cylinder owner or the owner's agent.

(vi) For a DOT 4E aluminum cylinder, permanent expansion exceeds 12 percent of total expansion.

(vii) For a DOT special permit cylinder, permanent expansion exceeds the limit in the applicable special permit, or the cylinder meets another criterion for condemnation in the applicable special permit.

(viii) For an aluminum or an aluminum-lined composite special permit cylinder, the cylinder is known to have been or shows evidence of having been over-heated.

(2) When a cylinder must be condemned, the requalifier must—

(i) Stamp a series of X's over the DOT specification number and the marked pressure or stamp "CONDEMNED" on the shoulder, top head, or neck using a steel stamp;

(ii) For composite cylinders, securely affix to the cylinder a label with the word "CONDEMNED" overcoated with epoxy near, but not obscuring, the original cylinder manufacturer's label; or

(iii) As an alternative to the stamping or labeling as described in this paragraph (i)(2), at the direction of the owner, the requalifier may render the cylinder incapable of holding pressure.

(3) No person may remove or obliterate the "CONDEMNED" marking. In addition, the requalifier must notify the cylinder owner, in writing, that the cylinder is condemned and may not be filled with hazardous material and offered for transportation in commerce where use of a specification packaging is required.

[Source Note: At 68 FR 24662, May 8, 2003, revised (c)(4), (f)(4), (g)(2), and (g)(3)(ii). At 68 FR 75764, December 31, 2003, revised (f)(1). At 70 FR 34077, June 13, 2005, revised (c)(2)(i), (i)(2) and (i)(3). At 70 FR 73166, December 9, 2005, revised section. At 71 FR 33894, June 12, 2006, effective September 11, 2006, revised section heading. At 71 FR 51128, August 29, 2006, effective January 1, 2007, revised (f)(4). At 73 FR 4720, January 28, 2008, effective October 1, 2008, added (g)(6). At 75 FR 53597, September 1, 2010, effective October 1, 2010, revised (g)(6).]

§180.207 Requirements for requalification of UN pressure receptacles.

(a) *General*.

(1) Each UN pressure receptacle used for the transportation of hazardous materials must conform to the requirements prescribed in paragraphs (a), (b) and (d) in §180.205.

(2) No pressure receptacle due for requalification may be filled with a hazardous material and offered for transportation in commerce unless that pressure receptacle has been successfully requalified and marked in accordance with this subpart. A pressure receptacle may be requalified at any time during or before the month and year that the requalification is due. However, a pressure receptacle filled before the requalification becomes due may remain in service until it is emptied.

(3) No person may requalify a UN composite pressure receptacle for continued use beyond its 15-years authorized service life. A pressure receptacle with a specified service life may not be refilled and offered for transportation after its authorized service life has expired unless approval has been obtained in writing from the Associate Administrator.

(b) *Periodic requalification of UN pressure receptacles*.

(1) Each pressure receptacle that is successfully requalified in accordance with the requirements specified in this section must be marked in accordance with §180.213. The requalification results must be recorded in accordance §180.215.

(2) Each pressure receptacle that fails requalification must be rejected or condemned in accordance with the applicable ISO requalification standard.

(c) *Requalification interval*. Each UN pressure receptacle that becomes due for periodic requalification must be requalified at the interval specified in the following table:

Table 1.—Requalification Intervals of UN Pressure Receptacles

Interval (years)	UN pressure receptacles/hazardous materials
10	Pressure receptacles for all hazardous materials except as noted below (also for dissolved acetylene, see paragraph (d)(3) of this section):
5	Composite pressure receptacles.
5	Metal hydride storage systems.

Table 1.—Requalification Intervals of UN Pressure Receptacles

Interval (years)	UN pressure receptacles/hazardous materials
5	Pressure receptacles used for: All Division 2.3 materials. UN1013, Carbon dioxide. UN1043, Fertilizer ammoniating solution with free ammonia. UN1051, Hydrogen cyanide, stabilized containing less than 3% water. UN1052, Hydrogen fluoride, anhydrous. UN1745, Bromine pentafluoride. UN1746, Bromine trifluoride. UN2073, Ammonia solution. UN2495, Iodine pentafluoride. UN2983, Ethylene Oxide and Propylene oxide mixture, not more than 30% ethylene oxide.
5	Pressure receptacles used for adsorbed gases.

(d) *Requalification procedures*. Each UN pressure receptacle that becomes due for requalification must be requalified at the interval prescribed in paragraph (c) of this section and in accordance with the procedures contained in the following standard, as applicable. When a pressure test is performed on a UN pressure receptacle, the test must be a water jacket volumetric expansion test suitable for the determination of the cylinder expansion or a hydraulic proof pressure test. The test equipment must conform to the accuracy requirements in §180.205(g). Alternative methods (*e.g.,* acoustic emission) or requalification procedures may be performed if prior approval has been obtained in writing from the Associate Administrator.

(1) Seamless steel: Each seamless steel UN pressure receptacle, including MEGC's pressure receptacles, must be requalified in accordance with ISO 6406 (IBR, *see* §171.7 of this subchapter). However, UN cylinders with a tensile strength greater than or equal to 950 MPa must be requalified by ultrasonic examination in accordance with ISO 6406.

(2) Seamless UN aluminum: Each seamless aluminum UN pressure receptacle must be requalified in accordance with ISO 10461 (IBR, see §171.7 of this subchapter).

(3) Dissolved acetylene UN cylinders: Each dissolved acetylene cylinder must be requalified in accordance with ISO 10462 (IBR, see §171.7 of this subchapter). The porous mass and the shell must be requalified no sooner than 3 years, 6 months, from the date of manufacture. Thereafter, subsequent requalifications of the porous mass and shell must be performed at least once every ten years.

(4) Composite UN cylinders: Each composite cylinder must be inspected and tested in accordance with ISO 11623 (IBR, see §171.7 of this subchapter).

(5) UN cylinders for adsorbed gases: Each UN cylinder for adsorbed gases must be inspected and tested in accordance with §173.302c and ISO 11513:2011 (IBR, see §171.7 of this subchapter).

[**Source Note:** At 71 FR 54397, September 14, 2006, effective October 1, 2006, revised (d) introductory text and (d)(1). At 76 FR 3389, January 19, 2011, added *Metal hydride storage systems* entry to (c) Table 1. At 80 FR 1168, January 8, 2015, effective January 1, 2015 added new (d)(5) and *Pressure receptacles used for adsorbed gases* entry to (c) Table 1.]

§180.209 Requirements for requalification of specification cylinders.

(a) *Periodic qualification of cylinders.* Each specification cylinder that becomes due for periodic requalification, as specified in the following table, must be requalified and marked in conformance with the requirements of this subpart. Requalification records must be maintained in accordance with §180.215. Table 1 follows:

Table 1.—Requalification of Cylinders[1]

Specification under which cylinder was made	Minimum test pressure (psig)[2]	Requalification period (years)
DOT 3	3000 psig	5
DOT 3A, 3AA	5/3 times service pressure, except noncorrosive service (*see* §180.209(g))	5, 10, or 12 (*see* §180.209(b), (e), (f), (h), and (j))
DOT 3AL	5/3 times service pressure	5, 10, or 12 (*see* §180.209(e), (j) and §180.209(m)[3])
DOT 3AX, 3AAX	5/3 times service pressure	5, 10 (see §180.209(e))
3B, 3BN	2 times service pressure (*see* §180.209(g))	5 or 10 (*see* §180.209(e), (f))
3E	Test not required.	
3HT	5/3 times service pressure	3 (*see* §§180.209(k) and 180.213(c))
3T	5/3 times service pressure	5
4AA480	2 times service pressure (*see* §180.209(g))	5 or 10 (*see* §180.209(e) or (h))
4B, 4BA, 4BW, 4B-240ET	2 times service pressure, except non-corrosive (*see* §180.209(g))	5, 10, or 12 (*see* §180.209(e), (f), and (j))
4D, 4DA, 4DS	2 times service	5
DOT 4E	2 times service pressure, except non-corrosive (*see* §180.209(g))	5 or 10 (*see* §180.209(e))
4L	Test not required.	
8, 8AL		10 or 20 (*see* §180.209(i))
Exemption or special permit cylinder	See current exemption or special permit	See current exemption or special permit
Foreign cylinder (*see* §173.301(j) of this subchapter for restrictions on use).	As marked on cylinder, but not less than 5/3 of any service or working pressure marking.	5 (*see* §§180.209(l) and 180.213(d)(2))

[1] Any cylinder not exceeding 2 inches outside diameter and less than 2 feet in length is excepted from volumetric expansion test.

[2] For cylinders not marked with a service pressure, see §173.301a(b) of this subchapter.

[3] This provision does not apply to cylinders used for carbon dioxide, fire extinguisher or other industrial gas service.

(b) *DOT 3A or 3AA cylinders.*

(1) A cylinder conforming to specification DOT 3A or 3AA with a water capacity of 56.7 kg (125 lb) or less that is removed from any cluster, bank, group, rack, or vehicle each time it is filled, may be requalified every ten years instead of every five years, provided the cylinder conforms to all of the following conditions:

(i) The cylinder was manufactured after December 31, 1945.

(ii) The cylinder is used exclusively for air; argon; cyclopropane; ethylene; helium; hydrogen; krypton; neon; nitrogen; nitrous oxide; oxygen; sulfur hexafluoride; xenon; chlorinated hydrocarbons, fluorinated hydrocarbons, liquefied hydrocarbons, and mixtures thereof that are commercially free from corroding components; permitted mixtures of these gases (*see* §173.301(d) of this subchapter); and permitted mixtures of these gases with up to 30 percent by volume of carbon dioxide, provided the gas has a dew point at or below minus (52°F) at 1 atmosphere.

(iii) Before each refill, the cylinder is removed from any cluster, bank, group, rack or vehicle and passes the hammer test specified in CGA Pamphlet C-6 (IBR, see §171.7 of this subchapter).

(iv) The cylinder is dried immediately after hydrostatic testing to remove all traces of water.

(v) The cylinder is not used for underwater breathing.

(vi) Each cylinder is stamped with a five-pointed star at least one-fourth of an inch high immediately following the test date.

(2) If, since the last required requalification, a cylinder has not been used exclusively for the gases specifically identified in paragraph (b)(1)(ii) of this section, but currently conforms with all other provisions of paragraph (b)(1) of this section, it may be requalified every 10 years instead of every five years, provided it is first requalified and examined as prescribed by §173.302a(b)(2), (3) and (4) of this subchapter.

(3) Except as specified in paragraph (b)(2) of this section, if a cylinder, marked with a star, is filled with a compressed gas other than as specified in paragraph (b)(1)(ii) of this section, the star following the most recent test date must be obliterated. The cylinder must be requalified five years from the marked test date, or prior to the first filling with a compressed gas, if the required five-year requalification period has passed.

(c) *DOT 4-series cylinders.* A DOT 4-series cylinder, except a 4L cylinder, that at any time shows evidence of a leak or of internal or external corrosion, denting, bulging or rough usage to the extent that it is likely to be weakened appreciably, or that has lost five percent or more of its official tare weight must be requalified before being refilled and offered for transportation. (Refer to CGA Pamphlet C-6 or C-6.3, as applicable, regarding cylinder weakening.) After testing, the actual tare weight must be recorded as the new tare weight.

(d) *Cylinders 5.44 kg (12 lb) or less* with service pressures of 300 psig or *less.* A cylinder of 5.44 (12 lb) or less water capacity authorized for service pressure of 300 psig or less must be given a complete external visual inspection at the time periodic requalification becomes due. External visual inspection must be in accordance with CGA Pamphlet C-6 or C-6.1 (IBR, see §171.7 of this subchapter). The cylinder may be proof pressure tested. The test is successful if the cylinder, when examined under test pressure, does not display a defect described in §180.205(i)(1)(ii) or (iii). Upon successful completion of the test and inspection, the cylinder must be marked in accordance with §180.213.

(e) *Proof pressure test.* A cylinder made in conformance with DOT Specifications 4B, 4BA, 4BW, or 4E protected externally by a suitable corrosion-resistant coating and used exclusively for non-corrosive gas that is commercially free from corroding components may be requalified by volumetric expansion testing or proof pressure testing every 10 years instead of every 5 years. When subjected to a proof pressure test, the cylinder must be carefully examined under test pressure and removed from service if a leak or defect is found.

(f) *Poisonous materials.* A cylinder conforming to specification DOT 3A, 3AA, 3B, 4BA, or 4BW having a service pressure of 300 psig or less and used exclusively for methyl bromide, liquid; mixtures of methyl bromide and ethylene dibromide, liquid; mixtures of methyl bromide and chlorpicrin, liquid; mixtures of methyl bromide and petroleum solvents, liquid; or methyl bromide and nonflammable, nonliquefied compressed gas mixtures, liquid; commercially free of corroding components, and protected externally by a suitable corrosion resistant coating (such as galvanizing or painting) and internally by a suitable corrosion resistant lining (such as galvanizing) may be tested every 10 years instead of every five years, provided a visual internal and external examination of the cylinder is conducted every five years in accordance with CGA Pamphlet C-6. The cylinder must be examined at each filling, and rejected if a dent, corroded area, leak or other condition indicates possible weakness.

(g) *Visual inspections.* A cylinder conforming to a specification listed in the table in this paragraph and used exclusively in the service indicated may, instead of a periodic hydrostatic test, be given a complete external visual inspection at the time periodic requalification becomes due. External visual inspection must be in accordance with CGA Pamphlet C-6 or C-6.3, as applicable (IBR, see §171.7 of this subchapter). When this inspection is used instead of hydrostatic pressure testing, subsequent inspections are required at five-year intervals after the first inspection. After May 31, 2004, inspections must be made only by persons holding a current RIN and the results recorded and maintained in accordance with §180.215. Records must include: date of inspection (month and year); DOT specification number; cylinder identification (registered symbol and serial number, date of manufacture, and owner); type of cylinder protective coating (including statement as to need of refinishing or recoating); conditions checked *(e.g.,* leakage, corrosion, gouges, dents or digs in shell or heads, broken or damaged footring or protective ring or fire damage); disposition of cylinder (returned to service, returned to cylinder manufacturer for repairs or condemned). A cylinder passing requalification by the external visual inspection must be marked in accordance with §180.213. Specification cylinders must be in exclusive service as shown in the following table:

Cylinders conforming to—	Used exclusively for—
DOT 3A, DOT 3AA, DOT 3A480X, DOT 4AA480	Anhydrous ammonia of at least 99.95% purity.
DOT 3A, DOT 3AA, DOT 3A480X, DOT 3B, DOT 4B, DOT 4BA, DOT 4BW.	Butadiene, inhibited, that is commercially free from corroding components.
DOT 3A, DOT 3A480X, DOT 3AA, DOT 3B, DOT 4AA480, DOT 4B, DOT 4BA, DOT 4BW.	Cyclopropane that is commercially free from corroding components.
DOT 3A, DOT 3AA, DOT 3A480X, DOT 4B, DOT 4BA, DOT 4BW, DOT 4E.	Chlorinated hydrocarbons and mixtures thereof that are commercially free from corroding components.
DOT 3A, DOT 3AA, DOT 3A480X, DOT 4B, DOT 4BA, DOT 4BW, DOT 4E.	Fluorinated hydrocarbons and mixtures thereof that are commercially free from corroding components.
DOT 3A, DOT 3AA, DOT 3A480X, DOT 3B, DOT 4B, DOT 4BA, DOT 4BW, DOT 4E.	Liquefied hydrocarbon gas that is commercially free from corroding components.
DOT 3A, DOT 3AA, DOT 3A480X, DOT 3B, DOT 4B, DOT 4BA, DOT 4BW, DOT 4E.	Liquefied petroleum gas that meets the detail requirements limits in Table 1 of ASTM 1835, Standard Specification for Liquefied Petro-leum (LP) Gases (incorporated by reference; see §171.7 of this sub-chapter) or an equivalent standard containing the same limits.
DOT 3A, DOT 3AA, DOT 3B, DOT 4B, DOT 4BA, DOT 4BW, DOT 4E	Methylacetylene-propadiene, stabilized, that is commercially free from corroding components.)
DOT 3A, DOT 3AA, DOT 3B, DOT 4B, DOT 4BA, DOT 4BW	Anhydrous mono, di,trimethylamines that are commercially free from corroding components.
DOT 4B240, DOT 4BW240	Ethyleneimine, stabilized.
DOT 4BW	Alkali metal alloys, liquid, n.o.s., Alkali metal dispersions or Alkaline earth metal dispersions, Potassium, Potassium Sodium alloys and Sodium that are commercially free of corroding components.

(h) *Cylinders containing anhydrous ammonia.* A cylinder conforming to specification DOT 3A, 3A480X, or 4AA480 used exclusively for anhydrous ammonia, commercially free from corroding components, and protected externally by a suitable corrosion- resistant coating (such as paint) may be requalified every 10 years instead of every five years.

(i) *Requalification of DOT-8 series cylinders.*

(1) Each owner of a DOT-8 series cylinder used to transport acetylene must have the cylinder shell and the porous filler requalified in accordance with CGA Pamphlet C-13 (IBR, see §171.7 of this subchapter). Requalification must be performed in accordance with the following schedule:

Date of cylinder manufacture	Shell (visual inspection) requalification		Porous filler requalification	
	Initial	Subsequent	Initial	Subsequent
Before January 1, 1991	Before January 1, 2001	10 years	Before January 1, 2011	Not required.
On or after January 1, 1991	10 years[1]	10 years	5 to 20 years[2]	Not required.

[1] Years from date of cylinder manufacture.

[2] No sooner than 5 years, and no later than 20 years from the date of manufacture.

(2) Unless requalified and marked in accordance with CGA Pamphlet C-13 before October 1, 1994, an acetylene cylinder must be requalified by a person who holds a current RIN.

(3) If a cylinder valve is replaced, a cylinder valve of the same weight must be used or the tare weight of the cylinder must be adjusted to compensate for valve weight differential.

(4) The person performing a visual inspection or requalification must record the results as specified in §180.215.

(5) The person performing a visual inspection or requalification must mark the cylinder as specified in §180.213.

(j) *Cylinder used as a fire extinguisher.* Only a DOT specification cylinder used as a fire extinguisher and meeting the requirements of §173.309(a) of this subchapter may be requalified in accordance with this paragraph (j).

(1) A DOT 4B, 4BA, 4B240ET or 4BW cylinder may be tested as follows:

(i) For a cylinder with a water capacity of 5.44 kg (12 lb) or less, by volumetric expansion test using the water jacket method or by proof pressure test. A requalification must be performed by the end of 12 years after the original test date and at 12-year intervals thereafter.

(ii) For a cylinder having a water capacity over 5.44 kg (12 lb)—

(A) *By proof pressure test.* A requalification must be performed by the end of 12 years after the original test date and at 7-year intervals; or

(B) *By volumetric expansion test using the water jacket method.* A requalification must be performed 12 years after the original test date and at 12-year intervals thereafter.

(2) A DOT 3A, 3AA, or 3AL cylinder must be requalified by volumetric expansion test using the water jacket method. A requalification must be performed 12 years after the original test date and at 12-year intervals thereafter.

(k) *3HT cylinders*. In addition to the other requirements of this section, a cylinder marked DOT–3HT must be requalified in accordance with CGA C–8 (IBR, see §171.7 of this subchapter).

(l) *Requalification of foreign cylinders filled for export.* A cylinder manufactured outside the United States, other than as provided in §§171.12(a) and 171.23(a) of this subchapter, that has not been manufactured, inspected, tested and marked in accordance with part 178 of this subchapter may be filled with compressed gas in the United States, and shipped solely for export if it meets the following requirements, in addition to other requirements of this subchapter:

(1) It has been inspected, tested and marked (with only the month and year of test) in conformance with the procedures and requirements of this subpart or the Associate Administrator has authorized the filling company to fill foreign cylinders under an alternative method of qualification; and

(2) It is offered for transportation in conformance with the requirements of §171.12(a)(4) or §171.23(a)(4) of this subchapter.

(m) *DOT–3AL cylinders manufactured of 6351–T6 aluminum alloy.* In addition to the periodic requalification and marking described in §180.205, each cylinder manufactured of aluminum alloy 6351–T6 used in self-contained underwater breathing apparatus (SCUBA), self-contained breathing apparatus (SCBA), or oxygen service must be requalified and inspected for sustained load cracking in accordance with the non-destructive examination method described in the following table. Each cylinder with sustained load cracking that has expanded into the neck threads must be condemned in accordance with §180.205(i). This provision does not apply to cylinders used for carbon dioxide, fire extinguisher or other industrial gas service.

Requalification and Inspection of DOT–3AL Cylinders Made of Aluminum Alloy 6351–T6

Requalification requirement	Examination procedure [1]	Sustained Load Cracking Condemnation Criteria [2]	Requalification period (years)
Eddy current examination combined with visual inspection.	Eddy current—In accordance with Appendix C of this part. Visual inspection—In accordance with CGA Pamphlet C–6.1 (IBR; see §171.7 of this subchapter).	Any crack in the neck or shoulder of 2 thread lengths or more.	5

[1] The requalifier performing eddy current must be familiar with the eddy current equipment and must standardize (calibrate) the system in accordance with the requirements provided in Appendix C to this part.

[2] The eddy current must be applied from the inside of the cylinder's neck to detect any sustained load cracking that has expanded into the neck threads.

[Source Note: At 68 FR 24662, May 8, 2003, revised table in (a)(1) and Note 2 following table, (b)(1)(iii), (e), (g) table, and redesignated (k) as (l) and added new (k). At 68 FR 48572, August 14, 2003, revised Note 2 to table in (i). At 68 FR 55544, September 26, 2003, revised (g). At 68 FR 75764, December 31, 2003, revised section. At 70 FR 73166, December 9, 2005, revised (a)(1) Table 1 entry for "Exemption cylinder." At 71 FR 51128, August 29, 2006, effective January 1, 2007, revised (a)(1) Table 1 entry for "DOT 3AL" and (a)(1) Table 1 footnote 2; and added (a)(1) Table 1 footnote 3 and (m). At 71 FR 54398, September 14, 2006, effective October 1, 2006, revised (a)(1) Table 1 entries for "4B, 4BA, 4BW, 4B-240ET" and "DOT 4E." At 72 FR 55696, October 1, 2007, revised (i)(1) table and (i)(1) table Notes 1 and 2. At 73 FR 57008, October 1, 2008, revised (l) introductory text and (l)(2). At 74 FR 53189, October 16, 2009, revised (a). At 81 FR 3685, January 21, 2016, effective February 22, 2016, revised (a) Table 1, footnote 2 to (a) Table 1, and (e); and added (g) table entry for "DOT 4BW." At 81 FR 35545, June 2, 2016, effective July 5, 2016, revised (j) introductory text.]

§180.211 Repair, rebuilding and reheat treatment of DOT-4 series specification cylinders.

(a) *General requirements for repair and rebuilding.* Any repair or rebuilding of a DOT 4-series cylinder must be performed by a person holding an approval as specified in §107.805 of this chapter. A person performing a rebuild function is considered a manufacturer subject to the requirements of §178.2(a)(2) and subpart C of part 178 of this subchapter. The person performing a repair, rebuild, or reheat treatment must record the test results as specified in §180.215. Each cylinder that is successfully repaired or rebuilt must be marked in accordance with §180.213.

(b) *General repair requirements.* Each repair of a DOT 4-series cylinder must be made in accordance with the following conditions:

(1) The repair and the inspection of the work performed must be made in accordance with the requirements of the cylinder specification.

(2) The person performing the repair must use the procedure, equipment, and filler metal or brazing material as authorized by the approval issued under §107.805 of this chapter.

(3) Welding and brazing must be performed on an area free from contaminants.

(4) A weld defect, such as porosity in a pressure retaining seam, must be completely removed before re-welding. Puddling may be used to remove a weld defect only by the tungsten inert gas shielded arc process.

(5) After removal of a non-pressure attachment and before its replacement, the cylinder must be given a visual inspection in accordance with §180.205(f).

(6) Reheat treatment of DOT 4B, 4BA or 4BW specification cylinders after replacement of non-pressure attachments is not required when the total weld material does not exceed 20.3 cm (8 inches). Individual welds must be at least 7.6 cm (3 inches) apart.

(7) After repair of a DOT 4B, 4BA or 4BW cylinder, the weld area must be leak tested at the service pressure of the cylinder.

(8) Repair of weld defects must be free of cracks.

(9) When a non-pressure attachment with the original cylinder specification markings is replaced, all markings must be transferred to the attachment on the repaired cylinder.

(10) Walls, heads or bottoms of cylinders with defects or leaks in base metal may not be repaired, but may be replaced as provided for in paragraph (d) of this section.

(c) *Additional repair requirements for 4L cylinders.*

(1) Repairs to a DOT 4L cylinder must be performed in accordance with paragraphs (a) and (b) of this section and are limited to the following:

(i) The removal of either end of the insulation jacket to permit access to the cylinder, piping system, or neck tube.

(ii) The replacement of the neck tube. At least a 13 mm (0.51 inch) piece of the original neck tube must be protruding above the cylinder's top end. The original weld attaching the neck tube

Addendum C

Velocity Pressure Formula

Respectful National Fire Protection Association (NFPA):

How do you do!

I have a question to reflect on the velocity pressure formula for metric units in NFPA750, Standard on Water Mist Fire Protection Systems, 2019 Edition.

The content on the velocity pressure formula for metric units in NFPA750, Standard on Water Mist Fire Protection Systems, 2019 Edition is as follows:

"**11.3.3 Velocity Pressure Formula. Velocity Pressure for water-filled pipe shall be determined on the basis of the following formula:**

(1) For SI units:

$$p_\upsilon = 5.61(10)^{-7}\frac{Q^2}{D^4} \qquad [11.3.3a]$$

where:

p_υ = velocity pressure (bar)

Q = flow (L/min)

D = inside diameter (mm)

…… "

Because I have doubts about the coefficient value of 5.61×10^{-7} in formula [11.3.3a], so I re-derived formula [11.3.3a]. The derivation can be done in three ways.

【1】

The derivation process of the first method is as follows:

The velocity pressure formula for water-filled pipe for metric units based on Bernoulli's Equation:

$$p_\upsilon = \frac{\upsilon^2}{2g} = \frac{\left(\frac{Q}{\frac{1}{4}\pi D^2}\right)^2}{2g}$$

$$p_\upsilon = \frac{8}{g\pi^2}\times\frac{Q^2}{D^4} \qquad (1)$$

where:

p_υ = velocity pressure (m H_2O)

υ = velocity (m/s)

g = acceleration of gravity (m/s^2)

Q = flow (m^3/s)

D = inside diameter (m)

When the unit of p_υ changes from m (water column) → bar, ∵ $1bar=10^5Pa=10^5\times\frac{1}{9.80665\times10^3}=\frac{10^2}{9.80665}$ m(H_2O), ∴conversion coefficient $k_1=\frac{10^2}{9.80665}$;

When the unit of Q changes from m^3/s→L/min, ∵ $1L/min=10^{-3}m^3/(60s)=10^{-3}/60\ m^3/s$, ∴ conversion coefficient $k_2=10^{-3}/60$;

When the unit of D changes from m→mm, ∵ $1mm=10^{-3}m$, ∴conversion coefficient $k_3=10^{-3}$;

At the same time, the unit of g remains unchanged.

By substituting the conversion coefficients k_1, k_2 and k_3 into formula (1), it is obtained that:

$$k_1\times p_\upsilon = \frac{8}{g\pi^2}\times\frac{k_2^2}{k_3^4}\times\frac{Q^2}{D^4}$$

$$p_\upsilon = \frac{8}{k_1 g \pi^2} \times \frac{k_2^2}{k_3^4} \times \frac{Q^2}{D^4}$$

$$p_\upsilon = \frac{8\times(\frac{10^{-3}}{60})^2}{\frac{10^2}{9.80665}\times 9.80665\times\pi^2\times(10^{-3})^4} \times \frac{Q^2}{D^4}$$

$$p_\upsilon = \mathbf{2.252} \times \frac{Q^2}{D^4} \qquad (2)$$

where:

p_υ = velocity pressure (bar)

Q = flow (L/min)

D = inside diameter (mm)

【2】

The derivation process of the second method is as follows:

The velocity pressure formula for water-filled pipe for International System of Units (for SI units) based on Bernoulli's Equation:

$$p_\upsilon = \frac{\rho\upsilon^2}{2} = \frac{\rho\times\left(\frac{Q}{\frac{1}{4}\pi D^2}\right)^2}{2}$$

$$p_\upsilon = \frac{8\rho}{\pi^2} \times \frac{Q^2}{D^4} \qquad (3)$$

where:

p_υ = velocity pressure (Pa)

ρ = density of water (kg/m^3)

υ = velocity (m/s)

Q = flow (m^3/s)

D = inside diameter (m)

When the unit of p_υ changes from Pa → bar, ∵1bar=10^5Pa, ∴conversion coefficient k_4= 10^5;

When the unit of Q changes from m^3/s→L/min, ∵1L/min=10^{-3}m^3/(60s)= 10^{-3}/60 m^3/s, ∴ conversion coefficient k_2=10^{-3}/60;

When the unit of D changes from m→mm, ∵1mm=10^{-3}m, ∴conversion coefficient k_3=10^{-3};

The density of the water taken is ρ=1000 kg/m^3 (Atmospheric pressure: atm=101325Pa, temperature: T=4℃)

By substituting the conversion coefficients k_4, k_2 and k_3 into formula (3), it is obtained that:

$$k_4 \times p_\upsilon = \frac{8\rho}{\pi^2} \times \frac{k_2^2}{k_3^4} \times \frac{Q^2}{D^4}$$

$$p_\upsilon = \frac{8\rho}{k_4\pi^2} \times \frac{k_2^2}{k_3^4} \times \frac{Q^2}{D^4}$$

$$p_\upsilon = \frac{8\times 1000}{10^5\times\pi^2} \times \frac{(\frac{10^{-3}}{60})^2}{(10^{-3})^4} \times \frac{Q^2}{D^4}$$

$$p_\upsilon = \mathbf{2.252} \times \frac{Q^2}{D^4} \qquad (2)$$

where:

p_υ = velocity pressure (bar)
Q = flow (L/min)
D = inside diameter (mm)

【3】

The derivation process of the third method is as follows:

According to Article 11.3.3 in NFPA750, Standard on Water Mist Fire Protection Systems, 2019 Edition, the velocity pressure formula for water-filled pipe for U.S. customary units is as follows:

$$p_\upsilon = \frac{0.001123Q^2}{D^4} \qquad [11.3.3b]$$

where:

p_υ = velocity pressure (psi)

Q = flow (gpm)

D = inside diameter (in.)

When the unit of p_υ changes from psi → bar, ∵ 1bar=10^5Pa，1psi=6894.757Pa，then 1bar = $\frac{10^5}{6894.757}$ psi； ∴conversion coefficient $k_5 = \frac{10^5}{6894.757}$ ；

When the unit of Q changes from gpm（gal/min）→L/min, ∵1L = $\frac{1}{3.785}$ gal, ∴conversion coefficient $k_6 = \frac{1}{3.785}$;

When the unit of D changes from in.→mm, ∵1mm=$\frac{1}{25.4}$ in., ∴conversion coefficient $k_7 = \frac{1}{25.4}$.

By substituting the conversion coefficients k_5, k_6 and k_7 into formula [11.3.3b], it is obtained that:

$$k_5 \times p_\upsilon = 0.001123 \times \frac{k_6^2}{k_7^4} \times \frac{Q^2}{D^4}$$

$$p_\upsilon = 0.001123 \times \frac{k_6^2}{k_5 \times k_7^4} \times \frac{Q^2}{D^4}$$

$$p_\upsilon = 0.001123 \times \frac{(\frac{1}{3.785})^2}{\frac{10^5}{6894.757} \times (\frac{1}{25.4})^4} \times \frac{Q^2}{D^4}$$

$$p_\upsilon = \mathbf{2.250} \times \frac{Q^2}{D^4} \qquad (2)$$

where:

p_υ = velocity pressure (bar)
Q = flow (L/min)
D = inside diameter (mm)

It can be seen that the derivation results of the three methods are basically the same, only the coefficient value is slightly different in the third digit after the decimal point. I think the coefficient value 2.252 is more accurate than 2.250.

Formula (2) is the expression of velocity pressure formula for metric units corresponding to formula [11.3.3a] derived by myself, in which the parameter units are the same as that in formula [11.3.3a].

It can be seen that the coefficient of 2.252 (2.250) in formula (2) is quite different from the coefficient of 5.61×10^{-7} in formula [11.3.3a]. Here are three examples to verify which one is right.

Example 1

Condition：conveying medium—water, Q=10L/s (600L/min), DN100 (steel pipe, inner diameter D=105mm), υ=1.15m/s.

1) The velocity pressure is calculated according to formula [11.3.3a]:

$$p_\upsilon = 5.61\times10^{-7}\times\frac{Q^2}{D^4} = 5.61\times10^{-7}\times\frac{600^2}{105^4} = 1.66\times10^{-9}(\text{bar})$$

$$= 1.66\times10^{-9}\times10.2=1.69\times10^{-8}\ (\text{m})$$

2) The velocity pressure is calculated according to formula (2):

$$p_\upsilon = 2.252\times\frac{Q^2}{D^4} = 2.252\times\frac{600^2}{105^4} = 6.67\times10^{-3}(\text{bar}) = 6.67\times10^{-3}\times10.2 = 0.068(\text{m})$$

3) The velocity pressure is calculated according to the definition formula of velocity pressure:

$$p_\upsilon = \frac{\upsilon^2}{2g} = \frac{1.15^2}{2\times9.80665} = 0.067(\text{m})$$

Example 2

Condition：conveying medium—water, Q=20L/s (1200L/min), DN125 (steel pipe, inner diameter D=130mm), υ=1.51m/s.

1) The velocity pressure is calculated according to formula [11.3.3a]:

$$p_\upsilon = 5.61\times10^{-7}\times\frac{Q^2}{D^4} = 5.61\times10^{-7}\times\frac{1200^2}{130^4} = 2.83\times10^{-9}(\text{bar})$$

$$= 2.83\times10^{-9}\times10.2=2.89\times10^{-8}\ (\text{m})$$

2) The velocity pressure is calculated according to formula (2):

$$p_\upsilon = 2.252\times\frac{Q^2}{D^4} = 2.252\times\frac{1200^2}{130^4} = 1.14\times10^{-2}(\text{bar}) = 1.14\times10^{-2}\times10.2 = 0.116(\text{m})$$

3) The velocity pressure is calculated according to the definition formula of velocity pressure:

$$p_\upsilon = \frac{\upsilon^2}{2g} = \frac{1.51^2}{2\times9.80665} = 0.116(\text{m})$$

Example 3

Condition：conveying medium—water, Q=30L/s(1800L/min), DN150 (steel pipe, inner diameter D=155mm), υ=1.59m/s.

1) The velocity pressure is calculated according to formula [11.3.3a]:

$$p_\upsilon = 5.61\times10^{-7}\times\frac{Q^2}{D^4} = 5.61\times10^{-7}\times\frac{1800^2}{155^4} = 3.15\times10^{-9}(\text{bar})$$

$$= 3.15\times10^{-9}\times10.2=3.21\times10^{-8}\ (\text{m})$$

2) The velocity pressure is calculated according to formula (2):

$$p_\upsilon = 2.252\times\frac{Q^2}{D^4} = 2.252\times\frac{1800^2}{155^4} = 1.26\times10^{-2}(bar) = 1.26\times10^{-2}\times10.2 = 0.129(m)$$

3) The velocity pressure is calculated according to the definition formula of velocity pressure:

$$p_\upsilon = \frac{\upsilon^2}{2g} = \frac{1.59^2}{2\times9.80665} = 0.129(m)$$

It can be seen from the above three examples that the calculation results of formula (2) are consistent with those of the definition formula of velocity pressure, while the calculation results of formula [11.3.3a] are inconsistent with those of the definition formula of velocity pressure. I speculate that the coefficient of 5.61×10^{-7} in formula [11.3.3a] may be wrong.

In addition, I also have deduced Darcy-Weisbach formula for metric units for the coefficient (2.252), Darcy-Weisbach formula for imperial units for the coefficient (0.000216), Reynolds number formula for metric units for the coefficient (21.22), Reynolds number formula for imperial units for the coefficient (50.6)〖see Table 11.2.1 of NFPA750, 2019 Edition〗 and the velocity pressure formula for imperial units for the coefficient (0.001123) 〖see formula [11.3.3b] of NFPA750, 2019 Edition〗, It has been confirmed that the values of these coefficients are all correct.

Let me try to restore the possible wrong derivation process of NFPA750, Standard on Water Mist Fire Protection Systems, 2019 Edition to formula [11.3.3a]:

First, Use formula [11.3.3b] as the velocity pressure formula for water-filled pipe for U.S. customary units.

Second, when the unit of p_υ changes from psi → bar, ∵1bar=10^5Pa, 1psi=6894.757Pa, then $1psi = \frac{6894.757}{10^5}$ bar; ∴conversion coefficient $k_8 = \frac{6894.757}{10^5}$;

When the unit of Q changes from gpm（gal/min）→L/min, ∵1 gal=3.785L, ∴conversion coefficient k_9 =3.785 ;

When the unit of D changes from in.→mm, ∵1 in.=25.4mm, ∴conversion coefficient k_{10}=25.4 .

By substituting the conversion coefficients k_8, k_9 and k_{10} into formula ［11.3.3b］, it is obtained that:

$$k_8\times p_\upsilon = 0.001123\times\frac{k_9^2}{k_{10}^4}\times\frac{Q^2}{D^4}$$

$$p_\upsilon = 0.001123\times\frac{k_9^2}{k_8\times k_{10}^4}\times\frac{Q^2}{D^4}$$

$$p_\upsilon = 0.001123\times\frac{3.785^2}{\frac{6894.757}{10^5}\times25.4^4}\times\frac{Q^2}{D^4}$$

$$p_\upsilon = \mathbf{5.606\times10^{-7}}\times\frac{Q^2}{D^4} \qquad (4)$$

where:

p_υ = velocity pressure (bar)

Q = flow (L/min)

D = inside diameter (mm)

The formula (4) is basically the same as the formula [11.3.3a], However, in the derivation process, the values of the conversion coefficients k_8, k_9, and k_{10} are all wrong, and their correct values shall be the reciprocal of k_8, k_9, and k_{10}.

In Article 11.3.3 and Table 11.2.1 of NFPA750, 2019 Edition, the wording " SI units (International System of Units)" is not rigorous. Because in the parameter units of relevant formulas, “min” and “L” are the units that can be used together with International System of Units, “bar” and “P(dynamic viscosity)” are the units temporarily used with International System of Units, while “mm” and “cP” are not units of International System of Units. Strictly speaking, these units do not belong to International System of Units. Therefore, it is suggested that the " SI units (International System of Units)" should be replaced by "**Metric Units**".

In Table 11.2.2 (a) of NFPA750, 2019 Edition, “design value of Epsilon” of Stainless steel pipe (= wrought iron pipe) is ε=0.0451. However, my calculation is as follows: ε=0.00015ft=0.0018in. =0.0018×25.4=0.04572 mm. Therefore, Could NFPA750, 2019 Edition change "0.0451" to "**0.0457**"? Second, the same problem exists in Table A.27.2.4.8.2 of NFPA13, Standard for the Installation of Sprinkler Systems, 2019 Edition, Could NFPA13, 2019 Edition change "0.045" to "**0.046**"? Third, In Table 11.2.2 (a) of NFPA750, 2019 Edition; for Stainless steel pipe (= wrought iron pipe) with ε = 0.00015ft, Factor C=**140**; but in Table A.27.2.4.8.2 of NFPA13, 2019 Edition; for Steel pipe (new) with same ε =0.0018in., Factor C=**143**; Why are the two Factor C inconsistent?

Hope to get an official reply to these situations from National Fire Protection Association (NFPA).

Good luck!

Zhang zhili

（Registered Fire Engineer, Senior Engineer, Professor）

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2020-07-21、22、24、27、28、29、30

08-08

Addendum D

Metric Conversion

Dimensions Found in NFPA 13-2016

Length					
.003”	.08 mm	7.5”	190 mm	26”	650 mm
.0315”	.8 mm	8”	200 mm	27.6”	690 mm
1/32”	0.8 mm	8.5”	215 mm	28”	700 mm
1/16”	1.6 mm	9”	225 mm	29”	725 mm
3/32”	2 mm	9.25”	230 mm	30”	750 mm
1/8”	3 mm	9.5”	240 mm	30.5”	765 mm
3/16”	5 mm	10”	250 mm	31”	775 mm
¼”	6 mm	11”	275 mm	32”	800 mm
5/16”	8 mm	11.5”	290 mm	33”	825 mm
3/8”	10 mm	12”	300 mm	35”	875 mm
½”	13 mm	12.25”	305 mm	35.4”	885 mm
17/32”	13 mm	12.5”	315 mm	36”	900 mm
9/16”	14 mm	12.75”	320 mm	37”	925 mm
5/8”	16 mm	14”	350 mm	38”	950 mm
¾”	19 mm	15”	375 mm	40”	1000 mm
7/8”	22 mm	15.5”	390 mm	42”	1050 mm
1”	25 mm	16”	400 mm	44”	1100 mm
1.5”	40 mm	16.25”	410 mm	47”	1175 mm
1.75”	45 mm	16.5”	415 mm	48”	1200 mm
2”	50 mm	17”	425 mm	54”	1350 mm
2.5”	65 mm	17.5”	440 mm	55”	1375 mm
2.75”	70 mm	18”	450 mm	57”	1425 mm
3”	75 mm	19”	475 mm	58”	1450 mm
3.5”	90 mm	20”	500 mm	66”	1650 mm
4”	100 mm	21”	525 mm	68”	1700 mm
4.5”	115 mm	22”	550 mm	72”	1800 mm
5”	125 mm	22.5”	565 mm	76”	1900 mm
5.5”	140 mm	23”	575 mm	78”	1950 mm
5.75”	145 mm	24”	600 mm	96”	2400 mm
6”	150 mm	25”	625 mm	102”	2550 mm
7”	175 mm	25.5”	640 mm	120”	3000 mm
				148”	3700 mm

Dimensions Found in NFPA 13-2016

Length					
3.5ft	1.1 m	10’-10”	3.3 m	22’-6”	6.9 m
3’-8”	1.1 m	11’-0”	3.4 m	24ft	7.3 m
4ft	1.2 m	11’-3”	3.4 m	25ft	7.6 m
4’-2”	1.3 m	11’-5”	3.5 m	25’-3”	7.7 m
4.5ft	1.4 m	11’-6”	3.5 m	26ft	7.9 m
4’-7”	1.4 m	11’-611/16”	3.5 m	27ft	8.2 m
4’-9”	1.4 m	11’-8”	3.6 m	28ft	8.5 m
5ft	1.5 m	12ft	3.7 m	28’-8”	8.7 m
5’-2”	1.6 m	12’-4”	3.8 m	29’-8”	9 m
5.5ft	1.7 m	13ft	4.0 m	30ft	9.1 m
5’-8”	1.7 m	13’-6”	4.1 m	32ft	10 m
5’-9 5/16”	1.8 m	13’-71/2”	4.2 m	33ft	10 m
6ft	1.8 m	13’-11”	4.2 m	35ft	11 m
6’-3”	1.9 m	14ft	4.3 m	36ft	11 m
6’-4”	1.9 m	14’-6”	4.4 m	40ft	12 m
6.5ft	2 m	15ft	4.6 m	41’-3”	13 m
6’-10”	2.1 m	15’-4”	4.7 m	45ft	14 m
7ft	2.1 m	16ft	4.9 m	50ft	15 m
7.5ft	2.3 m	16’-6”	5.0 m	51’-6”	16 m
7’-7”	2.3 m	16’-8”	5.1 m	55ft	17 m
7’-9”	2.4 m	17ft	5.2 m	60ft	18 m
8ft	2.4 m	18ft	5.5 m	65ft	20 m
8’-2”	2.5 m	18’-6”	5.6 m	70ft	21 m
8’-4”	2.5 m	19’-2”	5.8 m	75ft	23 m
8’-77/8”	2.6 m	19’-10”	6 m	76ft	23 m
9ft	2.7 m	19’-11”	6.1 m	80ft	24 m
9’-5”	2.9 m	20ft	6.1 m	100ft	30 m
9’-6”	2.9 m	20’-8”	6.3 m	200ft	61 m
10ft	3 m	21’-6”	6.6 m	250ft	76 m
10.5ft	3.2 m	21’-10”	6.7 m	300ft	91 m
10’-9”	3.3 m	22 ft	6.7 m	400ft	120 m

Dimensions Found in NFPA 13-2016

Area					
3.5 ft2	0.3 m2	256 ft2	24 m2	2,700 ft2	250 m2
6 ft2	0.6 m2	300 ft2	28 m2	2,734 ft2	255 m2
10 ft2	0.9 m2	306 ft2	28 m2	2,800 ft2	260 m2
12 ft2	1.1 m2	324 ft2	30 m2	3,000 ft2	280 m2
16 ft2	1.5 m2	395 ft2	37 m2	3,250 ft2	300 m2
18 ft2	1.7m2	400 ft2	37 m2	3,300 ft2	305 m2
20 ft2	1.9m2	450 ft2	42 m2	3,450 ft2	320 m2
24 ft2	2.2m2	504 ft2	47 m2	3,500 ft2	325 m2
25 ft2	2.3 m2	585 ft2	54 m2	3,600 ft2	335 m2
32 ft2	3.0 m2	600 ft2	56 m2	3,750 ft2	350 m2
50 ft2	4.6 m2	648 ft2	60 m2	3,900 ft2	360 m2
55 ft2	5.1 m2	700 ft2	65 m2	4,000 ft2	370 m2
64 ft2	5.9 m2	756 ft2	70 m2	4,100 ft2	380 m2
70 ft2	6.5 m2	768 ft2	71 m2	4,500 ft2	420 m2
80 ft2	7.4 m2	800 ft2	74 m2	4,800 ft2	445 m2
90 ft2	8.4 m2	1,000 ft2	93 m2	5,000 ft2	465 m2
100 ft2	9 m2	1,200ft2	112 m2	6,000 ft2	555 m2
110 ft2	10 m2	1,300 ft2	120 m2	6,400 ft2	595 m2
120 ft2	11 m2	1,365 ft2	125 m2	8,000 ft2	740 m2
124 ft2	12 m2	1,400 ft2	130 m2	8,800 ft2	820 m2
130 ft2	12 m2	1,500 ft2	140 m2	10,000 ft2	930 m2
144 ft2	13 m2	1,700 ft2	160 m2	13,100 ft2	1 215 m2
150 ft2	14 m2	1,800 ft2	165 m2	25,000 ft2	2 320 m2
168 ft2	16 m2	1,950 ft2	180 m2	40,000 ft2	3 720 m2
175 ft2	16 m2	2,000 ft2	185 m2	50,000 ft2	4 650 m2
196 ft2	18 m2	2,300 ft2	215 m2	52,000 ft2	4 830 m2
200 ft2	18 m2	2,500 ft2	230m2	100,000 ft2	9 230 m2
225 ft2	20 m2	2,535 ft2	235 m2		
250 ft2	23 m2	2,600 ft2	240 m2		

Dimensions Found in NFPA 13-2016

Volume			
1.76 cuin	28 ml	160 ft3	4.5 m3
15.5 ft3	0.5 m3	400 ft3	11 m3
17.4 ft3	0.5 m3	1,000 ft3	28 m3
17.6 ft3	0.5 m3	1,800 ft3	51 m3
20.7 ft3	0.6 m3	2,100 ft3	59 m3
21.1 ft3	0.6 m3	2,300 ft3	65 m3
22 ft3	0.6 m3	6,500 ft3	184 m3
100 ft3	2.8 m3	2.25M ft3	63,720 m3

Capacity	
16 oz.	0.5 l
32 oz.	1 l
1 gal	4 l
5 gal	20 l
40 gal	150 l
100 gal	380 l
150 gal	570 l
250 gal	950 l
500 gal	1900 l
750 gal	2850 l
300,000 gal	1,135,500 l

Drill Size	
3/32"	2,3 mm
1/8"	3,2 mm
3/8"	10 mm

Density of Cotton Bales	
22.0 lb/ft^3	350 kg/m^3
22.7 lb/ft^3	365 kg/m^3
24.2 lb/ft^3	390 kg/m^3
28.4 lb/ft^3	455 kg/m^3
28.7 lb/ft^3	460 kg/m^3
32.2 lb/ft^3	515 kg/m^3

Dimensions Found in NFPA 13-2016

Flow					
30 gpm	115 lpm	300 gpm	1150 lpm	1000 gpm	3800 lpm
15 gpm	57 lpm	400 gpm	1500 lpm	1500 gpm	5700 lpm
20 gpm	75 lpm	500 gpm	1900 lpm	1992 gpm	7540 lpm
50 gpm	190 lpm	600 gpm	2250 lpm	1993 gpm	7543 lpm
60 gpm	230 lpm	700 gpm	2650 lpm	2156 gpm	8160 lpm
100 gpm	380 lpm	750 gpm	2850 lpm	2575 gpm	9750 lpm
102.8 gpm	390 lpm	800 gpm	3050 lpm	4907 gpm	18,572 lpm
120 gpm	455 lpm	850 gpm	3200 lpm		
138 gpm	520 lpm	900 gpm	3400 lpm		
200 gpm	760 lpm				
215.8 gpm	815 lpm				
250 gpm	950 lpm				

Pressure			
5 psi	0.3 bar	75	5.2 bar
7	0.5 bar	90	6.2 bar
10	0.7 bar	100	6.9 bar
11	.8 bar	150	10 bar
15	1.0 bar	165	11 bar
20	1.4 bar	175	12 bar
22	1.5 bar	189	13 bar
25	1.7 bar	200	14 bar
30	2.1 bar	250	17 bar
35	2.4 bar	300	21 bar
50	3.4 bar	400	28 bar
63	4.3 bar		

Gauge	
12	2.8 mm
14	1.98 mm
16	1.57 mm
22	.78 mm
24	.63mm

Dimensions Found in NFPA 13-2016

Weight			
6 lb	2.7 kg	350 lb	160 kg
10 lb	4.5 kg	440 lb	200 kg
20 lb	9.1 kg	520 lb	235 kg
40 lb	18 kg	750 lb	340 kg
61 lb	27 kg	787 lb	355 kg
91 lb	41 kg	1200 lb	544 kg
131 lb	59 kg	1634 lb	740 kg
200 lb	91 kg	2000 lb	907 kg
250 lb	115 kg	2300 lb	1043 kg
		4000 lb	1815 kg

Velocity	
30 mph	49 km/h

Dimensions Found in NFPA 13-2016

Discharge Density			
gpm/ft2	mm/min	gpm/ft2	mm/min
.005	.2	.425	17.3
.05	2.04	.426	17.4
.1	4.1	.44	17.9
.15	6.1	.45	18.3
.16	6.5	.46	18.7
.17	7.0	.49	20
.18	7.3	.5	20.4
.19	7.7	.55	22.4
.2	8.2	.56	22.8
.21	8.6	.57	23.2
.225	9.2	.6	24.5
.24	9.8	.61	24.9
.25	10.2	.65	26.5
.26	10.6	.68	27.7
.28	11.4	.7	28.5
.29	11.8	.74	30.2
.3	12.2	.75	30.6
.31	12.6	.77	31.4
.32	13.0	.8	32.6
.33	13.4	.85	34.6
.34	13.9	.9	36.7
.35	14.3	.92	37.5
.37	15.1	.96	39.1
.375	15.3	1.1	44.8
.39	15.9	1.2	48.9
.4	16.3	6.0	245
.42	17.1	7.5	306

Addendum E

NFPA 20, Committee Inputs

Committee Input No. 74-NFPA 20-2019 [Section No. 4.5.1.1]

~~4.5.1.1~~ –

~~For water mist positive displacement pumping units, certified shop test data, including flow, pressure, and horsepower, shall be provided for each independent pump.~~

Submitter Information Verification

Committee: FIM-AAA

Submittal Date: Wed Nov 13 16:25:29 EST 2019

Committee Statement

Committee Statement: It would be enough to test (shop test) the hydraulic performance only with the whole pump unit, not with individual pumps. Water pumps are tested as a skid not as individual pumps.

Justification:

1. Testing each individual pumps separately doesn't bring much added value, as the whole pump unit performance is the only meaningful characteristic for WM-systems

2. When testing the whole PU, failure of any of the individual pumps will show up on the results. If one of the individual pumps fail to deliver rated values, it is not possible that one another delivers more than rated value and compensates the faulty one

3. Pipe sizing and connections in PU are designed for whole PU capacity, running with one single pump is less demanding (pressure losses)

4. Potential issues in NPSH doesn't show up when running a single pump, as the water supply capacity design is made for whole PU flow demand.

5. Testing of individual pumps on shop floor is also time consuming and add costs. As Marioff doesn't see the added technical value, Marioff opinion is that this is not needed and hurts the competitive position of WM system manufacturers on markets

Response Message: CI-74-NFPA 20-2019

Ballot Results

This item has not been balloted

4.5.1.1 ~~For water mist positive displacement pumping units, certified shop test data, including flow, pressure, and horsepower, shall be provided for each independent pump.~~

Rationale:

It would be enough to test (shop test) the hydraulic performance only with the whole pump unit, not with individual pumps. Water pumps are tested as a skid not as individual pumps.

Justification for this is:

1. Testing each individual pumps separately doesn't bring much added value, as the whole pump unit performance is the only meaningful characteristic for WM-systems
2. When testing the whole PU, failure of any of the individual pumps will show up on the results. If one of the individual pumps fail to deliver rated values, it is not possible that one another delivers more than rated value and compensates the faulty one
3. Pipe sizing and connections in PU are designed for whole PU capacity, running with one single pump is less demanding (pressure losses)
4. Potential issues in NPSH doesn't show up when running a single pump, as the water supply capacity design is made for whole PU flow demand.
5. Testing of individual pumps on shop floor is also time consuming and add costs. As Marioff doesn't see the added technical value, Marioff opinion is that this is not needed and hurts the competitive position of WM system manufacturers on markets

Committee Input No. 65-NFPA 20-2019 [Section No. 8.4.5]

8.4.5

Redundancy shall be built into the units such that failure of a line pressure sensor or primary control board will not prevent the system from ~~functioning as intended~~ working at its full capacity with manual operation .

Submitter Information Verification

Committee: FIM-AAA

Submittal Date: Wed Nov 13 13:36:46 EST 2019

Committee Statement

Committee Statement: Similarly as with traditional fire pumps, with PD water mist pumping units, the redundancy relies on manual operation of the pumps in case the pressure sensors or primary control board fails. Additionally the requirement for ensuring that the failure do not prevent manual operation is applicable for any systems.

Response Message: CI-65-NFPA 20-2019

Ballot Results

This item has not been balloted

8.4.5 *Redundancy shall be built into the controller such that failure of a line pressure sensor or primary control board will not prevent the system ~~from functioning as intended~~ ~~to~~ from working ~~with~~ at its full capacity with manual operation.*

Failed at Committee Meeting

Rationale:

Similarly as with traditional fire pumps, with PD water mist pumping units, the redundancy relies on manual operation of the pumps in case the pressure sensors or primary control board fails. Additionally the requirement for ensuring that the failure do not prevent manual operation is applicable for any systems.

Committee Input No. 71-NFPA 20-2019 [Section No. 8.5.7.2]

8.5.7.2

Water mist positive displacement pumping units that are designed and listed to alternate pressure maintenance duty between two or more pumps with variable speed pressure limiting control or that are designed and listed to have a redundant pump while only one pump is used for pressure maintenace duty , and that provide a supervisory signal wherever pressure maintenance is required more than two times in one hour or specified by the manufacturer , shall be permitted to maintain system pressure.

Supplemental Information

File Name	Description	Approved
CI-71.docx		

Submitter Information Verification

Committee: FIM-AAA

Submittal Date: Wed Nov 13 15:49:51 EST 2019

Committee Statement

Committee Statement: See Attachment

Response Message: CI-71-NFPA 20-2019

Ballot Results

This item has not been balloted

Rationale 8.5.7.2:

In case a redundant motor is allowed, the failure of the pump that is used for pressure maintenance duty, would not prevent system from starting operation automatically, neither would it not reduce total capacity. Thus in case the pressure maintenance duty alternation between two or more pumps was the reason to minimize the risk of failure of main pump, then the use of redundant pump shall meet the intended risk mitigation.

Supervisory signal from two maintenance duties in one hour do not indicate any intent to address any specific concerns. It is reasonable to have an assumption that the intent to give signal from 2 occasions in one hour, relates to concern, where the system might have more internal and/or external leakages than expected, causing pressure drop and more frequent pressure maintenance occasions.
To have signal from 2 occasions, do not have anything to do with the leakage amount in the system. Here's two examples of different system dynamics, thus demonstrating how different amount of air in the system will impact to the leakage rate per hour.

Pre assumptions:

- Ideal gas equation can be used.
- Impact of temperature change can be expected to be close to 0 (zero) as the impact of system pressure change is minimal compared to large surface of the piping network and to fast stabilization of the water and air temperature in the piping to ambient temperature around the piping.
- The thermal expanding of the water is insignificant to the thermal expanding of the air.
- Change of the piping volume (expanding connections, pipes etc.) due pressure change is insignificant to the thermal expanding of the air.
- Air do not escape from the piping system in the event of leakage.
- When air volume decreases certain amount, the same amount of water is added to the piping system.
- When air volume increases certain amount, the same amount of water is leaked out from the system.

Equations that will be used:
(1) $p_1V_1 = p_2V_2$
(2) $\delta V = V_2 - V_1$
Where,
p_1 is the pressure in the system, at standby.
V_1 is the air amount in the system at the standby pressure.
p_2 is the pressure in the system, when pressure maintenance pump starts or at ATM. ($p_1>p_2$)
V_2 is the air amount in the system at pressure p_2.
δV is the change of air amount volume which equals to the change of water amount in the system. It indicates the volume of the air that has been increased within the piping system. ($V_2>V_1$)

Case #1: Very small piping system. Few nozzles. Insignificant amount of trapped air ~1 liter at ATM.
Air amount as standby pressure:

$$V_1 = \frac{p_2V_2}{p_1} = \frac{1bar * 1l}{25bar} = 0,04\ l$$

When system is set to start pressure maintenance pump and 24 bar, thus the water that has leaked from the system is δV:

$$V_2 = \frac{p_1 V_1}{p_2} = \frac{25bar * 0{,}04l}{24bar} \approx 0{,}0417\ l$$

$$\delta V = V_2 - V_1 = 0{,}0417l - 0{,}04l = 0{,}0017l$$

Thus two pressure maintenance pumping occasions in one hour will signal for leakage in system that is 0,00333l $(2 * \delta V)$

Case #2: Large high rise building. Several nozzles and several sections at each floor. Very significant amount of trapped air ~7500 liter at ATM.
Air amount as standby pressure:

$$V_1 = \frac{p_2 V_2}{p_1} = \frac{1bar * 7500l}{25bar} = 300\ l$$

When system is set to start pressure maintenance pump and 24 bar, thus the water that has leaked from the system is δV:

$$V_2 = \frac{p_1 V_1}{p_2} = \frac{25bar * 300l}{24bar} \approx 312{,}5\ l$$

$$\delta V = V_2 - V_1 = 312{,}5l - 300l = 12{,}5\ l$$

Thus two pressure maintenance pumping occasions in one hour will signal for leakage in system that is 25l $(2 * \delta V)$

The leakage volume of water between cases 1 and 2 is 3754 times more water out from the system in case 2 than in case 1, when both gives supervisory signal from two maintenance pumping occasions.

3 ml vs. 25 l

Thus the requirement should be based on the each specific system characteristics (amount of air in the piping) and to the expected water leakage rate.

Let's say that there shall not be more leakage than 0,01 liter per hour. Otherwise supervisory signal shall be set. That would mean that:

Case 1:

$$\frac{V_{limit}/\mathrm{h}}{\delta V} = \frac{0{,}01l/\mathrm{h}}{0{,}0017l} \approx 5{,}88/\mathrm{h}$$

Thus the supervisory signal shall be set after 6 occasions per hour.

Case 2:

$$\frac{V_{limit}/\mathrm{h}}{\delta V} = \frac{0{,}01l/\mathrm{h}}{12{,}5l} \approx 0{,}0008/\mathrm{h} = 0{,}0192/d = 0{,}576/month\mathrm{h}$$

Thus the supervisory signal shall be set after 2 occasions per 2 months.

For the case 2, in might be reasonable to require better removal of the air, increased standby pressure and/or smaller gap between pressure maintenance limit and standby limit.

Case 2a:
Standby pressure is increased to 45 bar and pressure maintenance start pressure is set to 44,8 bar.
Thus,

$$V_1 = \frac{p_2 V_2}{p_1} = \frac{1bar * 7500l}{45bar} \approx 166{,}7\ l$$

$$V_2 = \frac{p_1 V_1}{p_2} = \frac{45bar * 166{,}7l}{44{,}8bar} \approx 167{,}4\ l$$

$$\delta V = V_2 - V_1 = 167{,}4 - 166{,}7l = 0{,}7\ l$$

$$\frac{V_{limit}/\mathrm{h}}{\delta V} = \frac{0{,}01l/\mathrm{h}}{0{,}7l} \approx 0{,}014/\mathrm{h} \approx 0{,}34/d = 2{,}4/week$$

Thus the supervisory signal shall be set after 3 occasions per one week.

Committee Input No. 72-NFPA 20-2019 [Section No. 8.5.7.3]

8.5.7.3

When in the pressure maintenance mode, water mist positive displacement pumping units used for pressure maintenance shall not ~~provide more than half of the nozzle flow of the~~ prevent start of automatic activation and operation within 60 seconds after the smallest system nozzle is discharged when the standby pressure is applied at the smallest nozzle.

Supplemental Information

File Name	Description	Approved
CI-72.docx		

Submitter Information Verification

Committee: FIM-AAA

Submittal Date: Wed Nov 13 16:08:27 EST 2019

Committee Statement

Committee Statement: See attached document

Response Message: CI-72-NFPA 20-2019

Ballot Results

This item has not been balloted

Rationale 8.5.7.3:

With the following large system example below, there is a reason, why the flow can be increased greatly from the current 50% limitation or the limit could be totally dismissed when the first pressure level is used with a timer to start pump unit operation and the pumping unit reaction times are tested and verified on site.
Key performance indicator in other approval authorities water mist related requirements is typically start of activation within 60 seconds from the discharged nozzle. This indicator ensures that the controller is able to distinguish between a need to maintain standby pressure and the need to start operation.

Example:

This requirement seems to be applicable in case the start of pump operation is based on further pressure drop. Example if p_s is standby pressure level and p_1 is pressure level, when pressure maintenance pump starts and p_2 is the pressure level, when pumping unit starts operation, $p_s > p_1 > p_2$. With Marioff systems, we use p_1 level the trigger pump unit activation in case pressure is not returned to p_s in predefined time. We have also p_2 in case the pressure maintenance pump or control circuit (VSD) has a failure to start fire pump(s).

Thus, when using p_1 with a timer to start the pump operation, the flow of pumping unit in pressure maintenance mode can be more than a flow through the smallest nozzle in certain system conditions.

Here's lengthy example of system dynamics to pump unit response time:

See system air amount related calculations from section 6.17 - supervisory signal.

Flow through small nozzle (k-factor 2.4) as standby-pressure (25 bar).

$$Q_{nozzle} = k * \sqrt{p} = 2{,}4 * \sqrt{25} = 12\ l/min$$

$$Q_{stdby\ pump} = \frac{Q_{nozzle}}{2} = \frac{12\ l/min}{2} = 6\ l/min$$

Let's take the example case #2:

$$\delta V = 12{,}5\ l$$

Which means that during each pressure maintenance period, the pump needs to push 12,5 liters of water to system.

With flow rate of 6 l/min, it takes 2 minutes and 5 seconds to elevate the pressure.

Marioff design commonly uses pressure maintenance time as indication of discharged nozzle. For example, in case the pressure maintenance lasts for more than 20 seconds, the system has discharged nozzle and pump unit shall start operation. Now, in case of huge system with the rule of maximum flow of 50% of smallest nozzle is applied, then the current design will need to wait 2 minutes and 15 seconds until pump unit will start operation.

For large systems with lots of air, pressure maintenance pump shall be allowed to provide more flow. Even more than 100% of smallest nozzle flow at standby pressure.

By using same assumptions and formulas as in section 6.17 - supervisory signal, we can calculate the time based on formula (1) below by using discharged nozzle k-factor and standby pump flow.

(1) $p_1 V_1 = p_2 V_2$

Precise calculation is made with an Excel tool and attached screenshot is provided from the tool that is used to calculate the pressure elevation times.

In case the standby pump flow in case #2 would be 200% of the nozzle flow, we'll have following times:
Time for standby pump to elevate pressure to stop limit when there is no discharged nozzles.

$$t_{0\ nozzle} = 30{,}8\ s$$

Time for standby pump to elevate pressure to stop limit when there is one small nozzle discharged.

$$t_{0\ nozzle} = 60{,}0\ s$$

When the allowed standby pumping time is set to e.g. 40 seconds, there will be 20 second marginal, until the pressure stop value is reached and the automatic activation is prevented until more nozzles open.

In case the standby pump flow in case #2 would be 100% of the nozzle flow, we'll have following times:
Time for standby pump to elevate pressure to stop limit when there is no discharged nozzles.

$$t_{0\ nozzle} = 60{,}8\ s$$

Time for standby pump to elevate pressure to stop limit when there is one small nozzle discharged.

$$t_{0\ nozzle} = 3\ \mathrm{h}$$

When the allowed standby pumping time is set to e.g. 70 seconds, which is too long time for detecting a real need for pump operation. With 100% flow, there cannot be any false stops (as it takes hours to stop unintentionally) but the operational response as weak.

In case the standby pump flow in case #2 would be 150% of the nozzle flow, we'll have following times:
Time for standby pump to elevate pressure to stop limit when there is no discharged nozzles.

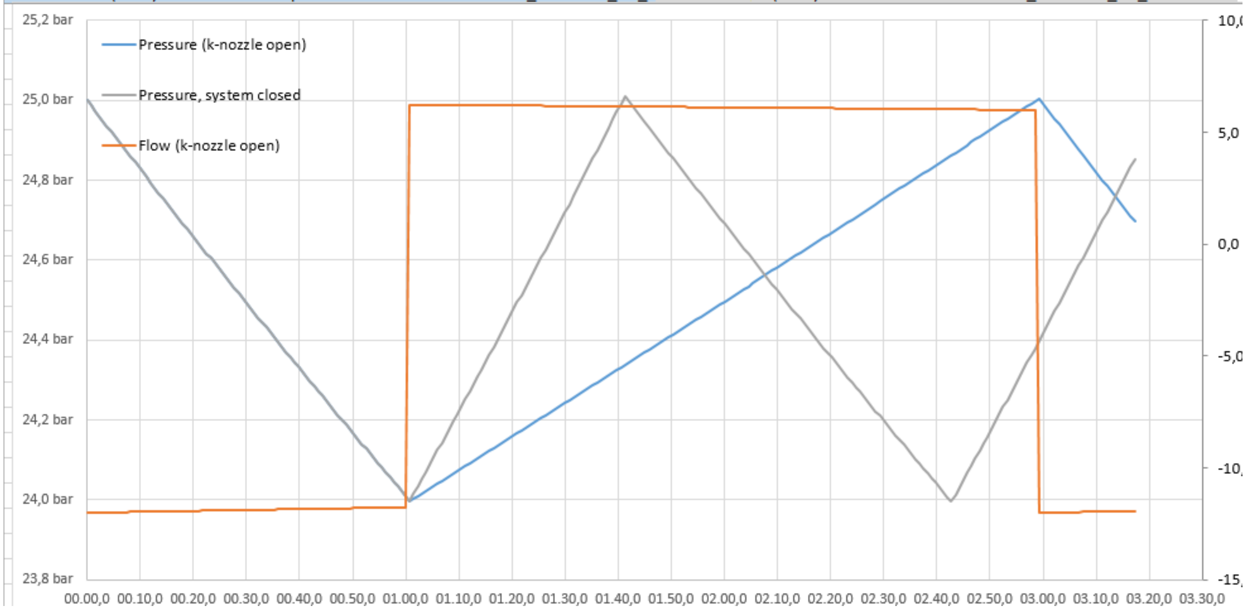
$$t_{0\ nozzle} = 40{,}5\ s$$

Time for standby pump to elevate pressure to stop limit when there is one small nozzle discharged.

$$t_{0\ nozzle} = 118{,}5\ s$$

Start P	Sprinkler k	Nozzle Q	Air amount @25bar	Standby flow	Standby pumping stopping times with:		
25,0 bar	2,4	12,0 lpm	300 l	18,0 lpm	Open nozzle	Closed system	Activation start time
Hysteresis	Elevation of sprinkle	Air amount @25bar	Air amount @25bar	Flow start delay	118,5 s	40,5 s	01:50,2
1,0 bar	0 m	300 l	300 l	50,0 s			

Sprinkler release								0 Nozzle case						
Pressure	Q (flow)	Nozzle Q	Pump Q	dV	V2	STD_PU	STD_PU_t	Pressure at	Q (flow)	dV	V2	STD_PU	STD_PU_t	Activation



When the allowed standby pumping time is set to e.g. 50 seconds, there will be 68 second marginal, until the pressure stop value is reached and the automatic activation is prevented until more nozzles open.
This has slightly slower response (25%) as with 200% is acquired but and the marginal to false stop is greatly larger (300%).

Committee Input No. 76-NFPA 20-2019 [New Section after 10.4.3.1]

10.4.3.1.1

Water Mist Positive Displacement Pumping Units shall be permitted to have overcurrent protective device for each individual motor driver.

Submitter Information Verification

Committee: FIM-AAA

Submittal Date: Wed Nov 13 16:35:18 EST 2019

Committee Statement

Committee Statement: Water mist system can have multiple motors driving multiple pumps where it would be necessary to provide overcurrent protection for each motor driver.

Response Message: CI-76-NFPA 20-2019

Ballot Results

This item has not been balloted

10.4.3.1.1 *- Water Mist Positive Displacement Pumping Units shall be permitted to have overcurrent protective device for each individual motor driver.*

Rationale:

Water mist system can have multiple motors driving multiple pumps where it would be necessary to provide overcurrent protection for each motor driver.

Committee Input No. 75-NFPA 20-2019 [New Section after 10.4.3.2]

10.4.3.2.1

Water Mist Positive Displacement Pumping Units shall not require an externally operable mechanical circuit breaker handle on the door of the enclosure for each individual motor driver, except where required in 10.4.2.2

Submitter Information Verification

Committee: FIM-AAA

Submittal Date: Wed Nov 13 16:27:46 EST 2019

Committee Statement

Committee Statement: The circuit breaker is only needed for the water mist positive displacement pumping unit and not for each individual motor. The same function can be obtained by a single external circuit breaker handle. Each individual motor would have its own internal circuit breaker for protection and disconnect if needed.

Response Message: CI-75-NFPA 20-2019

Ballot Results

This item has not been balloted

***10.4.3.2.1** Water Mist Positive Displacement Pumping Units shall not require an externally operable mechanical circuit breaker handle on the door of the enclosure for each individual motor driver, except where required in 10.4.2.2*

Rationale:

The circuit breaker is only needed for the water mist positive displacement pumping unit and not for each individual motor. The same function can be obtained by a single external circuit breaker handle. Each individual motor would have its own internal circuit breaker for protection and disconnect if needed.

Committee Input No. 84-NFPA 20-2019 [New Section after 10.4.4]

10.4.4.1

Water Mist Positive Displacement Pumping Units, with at least one redundant motor, shall be permitted to have overcurrent protective device for each individual motor driver and isolate a faulty motor to ensure continuous operation of the pumping unit.

(1) For a squirrel-cage motor, the device shall be of the time-delay type having tripping times as follows:

(a) Maximum 10 seconds at locked rotor current

(b) One minute at a maximum of 300 percent of motor full-load current

(2) There shall be visual means or markings clearly indicated on the device that proper settings have been made.

Submitter Information Verification

Committee: FIM-AAA

Submittal Date: Fri Nov 15 13:29:19 EST 2019

Committee Statement

Committee Statement: NFPA 20 current requirements assumes that this is a single pump operating to supply water flow to the system, where with multiple motors and pumps being located on the same unit for a water mist system can provide adequate compensation of flow for the single lost motor/pump.

Response Message: CI-84-NFPA 20-2019

Ballot Results

This item has not been balloted

10.4.4.1 *- Water Mist Positive Displacement Pumping Units, with at least one redundant motor, shall be permitted to have overcurrent protective device for each individual motor driver and isolate a faulty motor to ensure continuous operation of the pumping unit.*

(1) For a squirrel-cage motor, the device shall be of the time-delay type having tripping times as follows:

(a) Maximum 10 seconds at locked rotor current

(b) One minute at a maximum of 300 percent of motor full-load current

(2) There shall be visual means or markings clearly indicated on the device that proper settings have been made.

Rationale:

NFPA 20 current requirements assumes that this is a single pump operating to supply water flow to the system, where with multiple motors and pumps being located on the same unit for a water mist system can provide adequate compensation of flow for the single lost motor/pump.

Committee Input No. 77-NFPA 20-2019 [New Section after 10.4.5.6.1]

10.4.5.6.1

The operating coil shall be permitted to be supplied through a transformer when redundant transformers are provided as part of the control circuit.

Supplemental Information

File Name	Description	Approved
CI-77.docx		

Submitter Information Verification

Committee: FIM-AAA

Submittal Date: Wed Nov 13 16:37:13 EST 2019

Committee Statement

Committee Statement: For WMPDPU with two or more motors and pumps, the redundant transformer is good requirement to ensure reliability of electrical operation of motors in case of single point of failure. This could also be applied to any water pumping unit, not just water mist.

SEE ATTACHED DOCUMENT FOR FURTHER SUBSTANTIATION

Response Message: CI-77-NFPA 20-2019

Ballot Results

This item has not been balloted

10.4.5.6 *Operating Coils. For controllers of 500 V or less, the operating coil(s) for any motor contactor(s) and any bypass contactor(s), if provided, shall be supplied directly from the main power voltage and not through a transformer.*

10.4.5.6.1 *The operating coil shall be permitted to be supplied through a transformer when redundant transformers are provided as part of the control circuit.*

Rationale:

For WMPDPU with two or more motors and pumps, the redundant transformer is good requirement to ensure reliability of electrical operation of motors in case of single point of failure. This could also be applied to any water pumping unit, not just water mist.

Backup information:

Design study of one manufacturer that is FM approved, UL listed and the design is per NFPA 20. Schematic shown below in Figure 1.

Motor contactor (M1) has coil voltage up to 480 VAC, according to requirement in 10.4.5.6.
The coil is activated by power relay (CR4), which has coil operating voltage of 24 VAC.
The 24 VAC is transformed from the main voltage with transformer (XTR1).
Motor coil can be started either by control logic, main control board or by local soft panel in addition to the emergency start handle, according to 10.5.3.2 that by-passes the contactor coil operation.
Thus, regarding to the reliability, following components can break, causing the contactor coil to not to operate. Note, these components only disables one single motor, thus remaining motors (if any) will stay available:

- Contactor coil (1M)
- Power relay contacts (CR4)
- Power relay coil (CR4)
- Transformer (XTR1)
- I/O relay board (EB1)
- Programmable Logic Controller AND Soft Panel

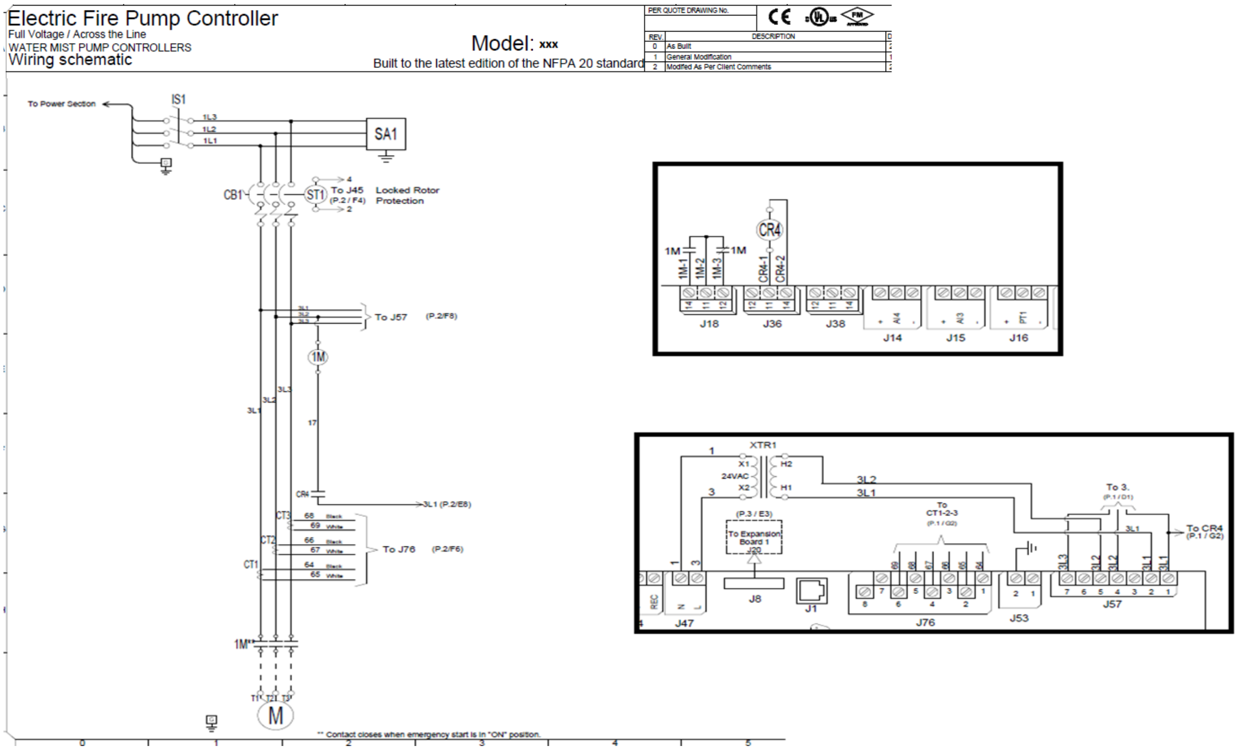


Figure 1 - design per NFPA 20

From reliability perspective to have contactor coil using the same voltage e.g. 24 VDC as the control components are using, would reduce the count of failure points. This is the list of possibly failing components in common Marioff design where 24 VDC is used for contactor coil, according to Figure 2:

- Contactor coil (K1)
- Transformer (G1) (in multi pump units the transformer failure would disable all pumps). Thus each motor control circuit needs to be isolated with a circuit breaker to protect power supply to remaining motor control circuits and redundant transformer is recommended for multi pump systems.
- Latching switch (S1) AND [I/O board (RQ3) OR Programmable Logic Controller]

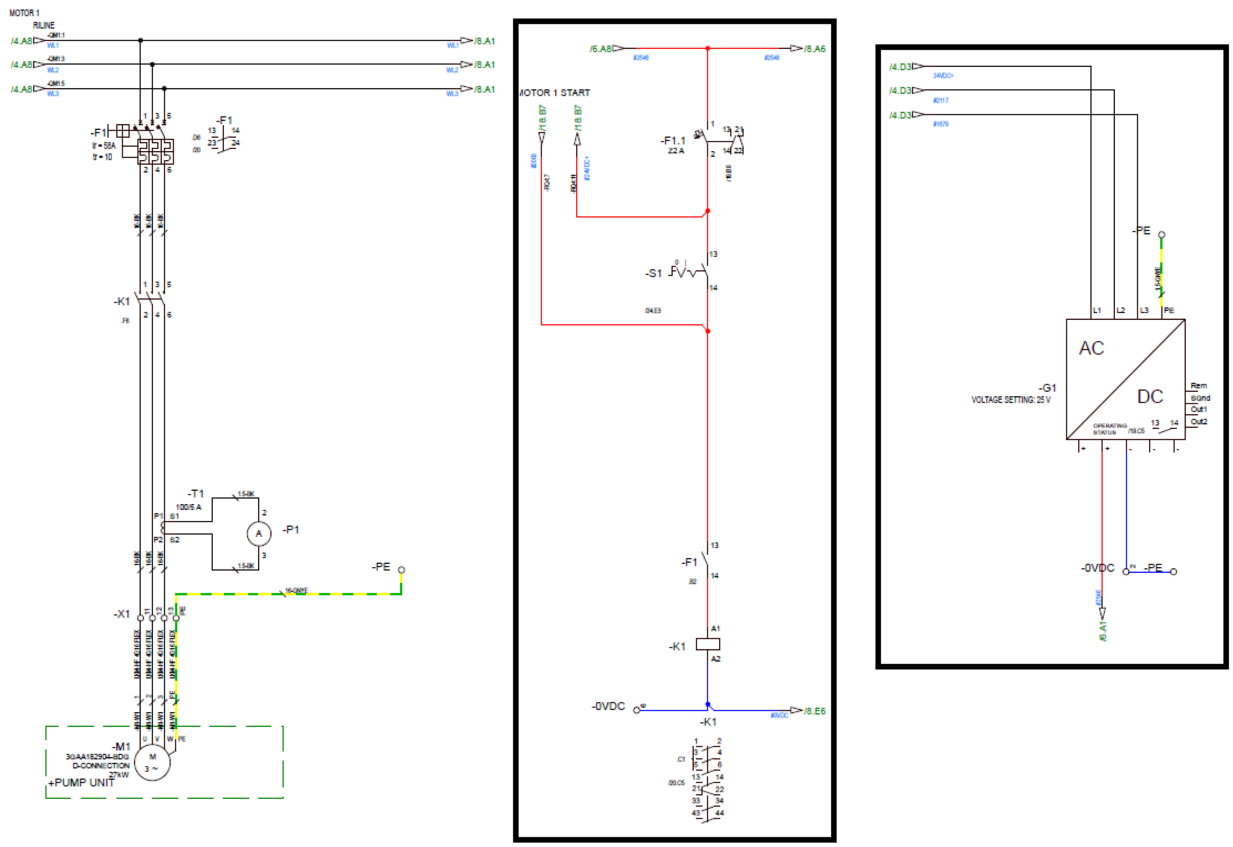


Figure 2 - Common Marioff motor control circuit

Committee Input No. 78-NFPA 20-2019 [New Section after 10.4.6.2.2]

10.4.6.2.3

The phase reversal requirements in 10.4.6.2.1, 10.4.6.2.2, and 10.4.7.2.3 shall not be applicable to piston or plunger type positive displacement pumps, or pumps that are able to deliver the required flow and pressure regardless of direction of rotation.

Submitter Information Verification

Committee: FIM-AAA

Submittal Date: Wed Nov 13 16:40:33 EST 2019

Committee Statement

Committee Statement: There are water mist pumps that are able to deliver the required flow and pressure regardless of direction of rotation of the driver motor, therefore these pumps would be unaffected by a phase reversal and need to be considered/included by the standard for these types of pump technologies.

Response Message: CI-78-NFPA 20-2019

Ballot Results

This item has not been balloted

Rationale 10.4.6.2.3:

There are water mist pumps that are able to deliver the required flow and pressure regardless of direction of rotation of the driver motor, therefore these pumps would be unaffected by a phase reversal and need to be considered/included by the standard for these types of pump technologies.

Committee Input No. 73-NFPA 20-2019 [New Section after 14.2.6.6.3.10]

14.2.6.6.3.11

For water mist positive displacement pumping unit, the automatic activation test shall be carried out by using the smallest system nozzle, at the most remote area, discharged from maintenance pressure and standby pressure or equal sized test orifice in pump unit test line. Pumping unit shall activate operation within 60 seconds from start of the discharge.

Submitter Information Verification

Committee: FIM-AAA

Submittal Date: Wed Nov 13 16:23:04 EST 2019

Committee Statement

Committee Statement: NFPA 20 chapter "14.2.6 Field Acceptance Test Procedures" do not have any requirements for the pump unit operation start time after smallest system nozzle discharge. For any systems, 60 second operation start time should be applicable.

NFPA 13 (Sprinkler systems) has the same 60s value, but only under “preaction”-systems NFPA 25 doesn’t say anything. NFPA 750 has also 60 s requirements under “preaction”-systems.

Response Message: CI-73-NFPA 20-2019

Ballot Results

This item has not been balloted

Rationale for 14.2.6.5.3.11

NFPA 20 chapter "14.2.6 Field Acceptance Test Procedures" do not have any requirements for the pump unit operation start time after smallest system nozzle discharge. For any systems, 60 second operation start time should be applicable.
NFPA 13 (Sprinkler systems) has the same 60s value, but only under “preaction”-systems NFPA 25 doesn’t say anything. NFPA 750 has also 60 s requirements under “preaction”-systems.

Addendum F

Dan Hubert PI's

PI # A2

Section 12.5.1.6 of NFPA 750, 2019 edition is lacking in definitive direction to the reader:

12.5.1.6 Filter Rating or Strainer Mesh Openings. *The maximum filter rating or strainer mesh opening shall not be greater than 80 percent of the minimum nozzle waterway dimension.*

Issue: The is no formal NFPA definition for the word "waterway" which makes it difficult to determine a quantitative value for the mesh sizing.

Potential Resolution:

Option 1: **12.5.1.6 Filter Rating or Strainer Mesh Openings.** The maximum filter rating or strainer mesh opening shall not be greater than 80 percent of the diameter of the smallest orifice (or opening) of the ~~minimum~~ nozzle waterway ~~dimension~~.
Or
Option 2: **12.5.1.6 Filter Rating or Strainer Mesh Openings**. The maximum filter rating or strainer mesh opening shall not be greater than 80 percent of the cross-sectional area of the smallest orifice (or opening) of the ~~minimum~~ nozzle waterway d~~imension~~.

PI # A3

11.2* Darcy–Weisbach Calculation Method for Intermediate and High Pressure, Single Fluid, Single Liquid Phase Systems.

11.2.1 *Pipe friction losses shall be determined by one of the following methods:*

(1) *Using the formulas in Table 11.2.1.*
(2) *Hydraulic calculations shall be permitted to be performed using the Hazen–Williams calculation method for intermediate and high pressure systems having a minimum 20 mm (3⁄4 in.) pipe size, provided that the maximum flow velocity through the system piping does not exceed 7.6 m/s (25 ft/sec).*

Here's my thoughts and concerns:

- I think the original intent was to allow the use of nominal ¾" pipe.
- All copper (B 88, B 280) and stainless steel tubing (A 213, A 249, A 269) is based on the exact tubing outside diameter; the OD of ¾" tubing has an exact measurement of 0.75". To determine the internal diameter of the tubing the wall thickness of the tubing is subtracted from the OD which this case will always be less than ¾", therefore ¾" tubing can never be used in accordance with NFPA 750.
- For A-312 stainless steel pipe the size designation is based on "nominal" pipe sizing with the OD of ¾" pipe being 1.050". The ID for schedule 40 pipe is 0.840" however the ID for schedule 80, 120 and 160 is less than 0.75"; in accordance with NFPA 750 they cannot be used ether.

Addendum G

Ruediger Kopp's PI

PI # A4

Section No. C.1.2

Related Public Input for This Document
Insertion to table C.1.2.

Agency

5. VdS , Cologne, Germany

Water Mist Fire Test Protocol

VdS 3883 Fire Test Protocols for Water Mist Systems, June 2020
(a) VdS 3883-1en, Fire Test Protocol for Water Mist Systems - Protection of Office Spaces and Accommodation Areas - June 2020
(b) VdS 3883-2en, Fire Test Protocol for Water Mist Systems - Protection of Office Spaces and Accommodation Areas with Water Mist Sidewall Nozzles - June 2020
(c) VdS 3883-3en, Fire Test Protocol for Water Mist Systems - Protection of False Ceilings and False Floors of OH Group 1 - June 2020
(d) VdS 3883-4en, Fire Test Protocol for Water Mist Systems - Protection of Car Parks - June 2020
(e) VdS 3883-5en, Fire Test Protocol for Water Mist Systems - Protection of Selected Sales and Storage Areas and Mechanical Floors - June 2020
(f) VdS 3883-6en, Fire Test Protocol for Water Mist Systems - Protection of Paint Booths - June 2020
(g) VdS 3883-7en, Fire Test Protocol for Water Mist Systems - Protection of Areas with Combustible Liquids - June 2020
(h) VdS 3883-8en, Fire Test Protocol for Water Mist Systems - Protection of Cable Ducts - June 2020

Statement of Problem and Substantiation for Public Input
Input is to update Table C.1.2. to published fire test protocols VdS 3883. These 8 fire test protocols have been published by VdS as part of VdS 3883 standard in June 2020. The fire test protocols shall be referenced in NFPA 750 since they have been used for system certification by several water mist system manufacturers.
The VdS 3883 fire test protocols are attached and are available for public download at the VdS webpage www.vds-shop.de/en.

Submitter Information Verification
Submitter Full Name: Ruediger Kopp
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State:
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Submittal Date: Mon Aug 10 09:22:31 EDT 2020
Committee: WAM-AAA

See - VDS Test Protocols PDF for additional Information