Application of BS 8489 to the Protection of Generator Enclosures

IWMA, BRE

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tyco Fire Protection Products

Agenda

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Generator Fire Characteristics

Machinery Space – Definition

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MACHINERY PROTECTION

Generator Enclosure & Fire Characteristics

Generator Enclosure Characteristics

20’ Container

Payload: 48,600lbs

Tare Weight: 5,015lbs

Cubic Capacity 1,164cu.ft

Exterior Dimensions

L: 20”

W: 8”

H: 8’6”

40’ Container

Payload: 80,350lbs

Tare Weight: 8,337lbs

Cubic Capacity 2,376cu.ft

Exterior Dimensions

L: 40”

W: 8”

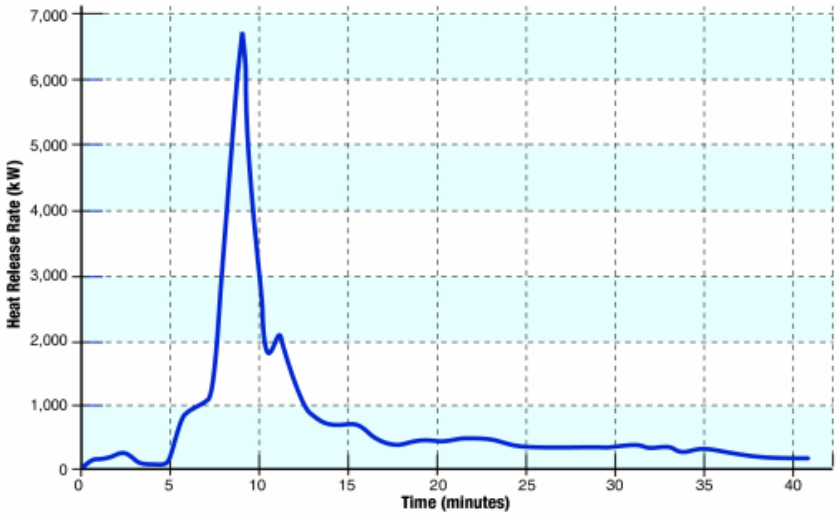
H: 8’6”

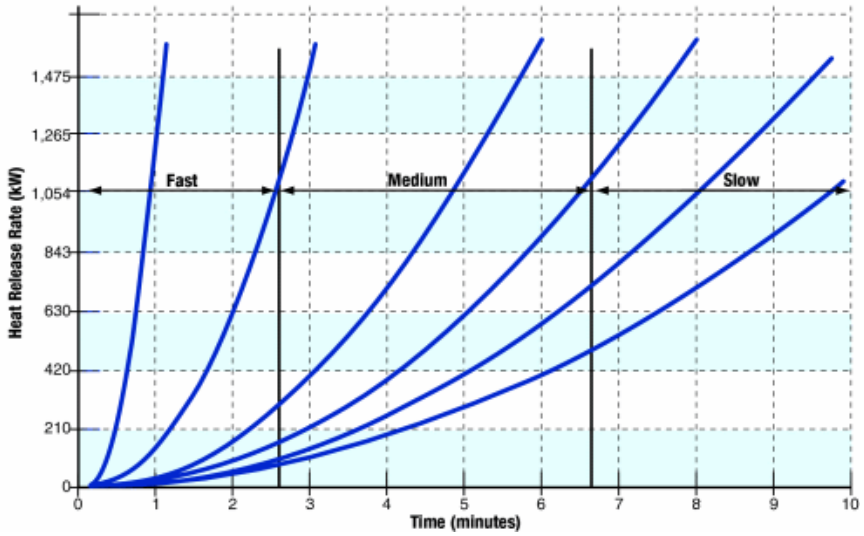
Generator Enclosure Characteristics

- Class B flammable or combustible liquids
- Flammable liquids under pressure
- Presence of hot surfaces
- Non-tight enclosures
- Ventilated enclosures
- Controlled Access

Generator Fire Characteristics

- Pool and spray fire
- Fast growing fire
- High heat release

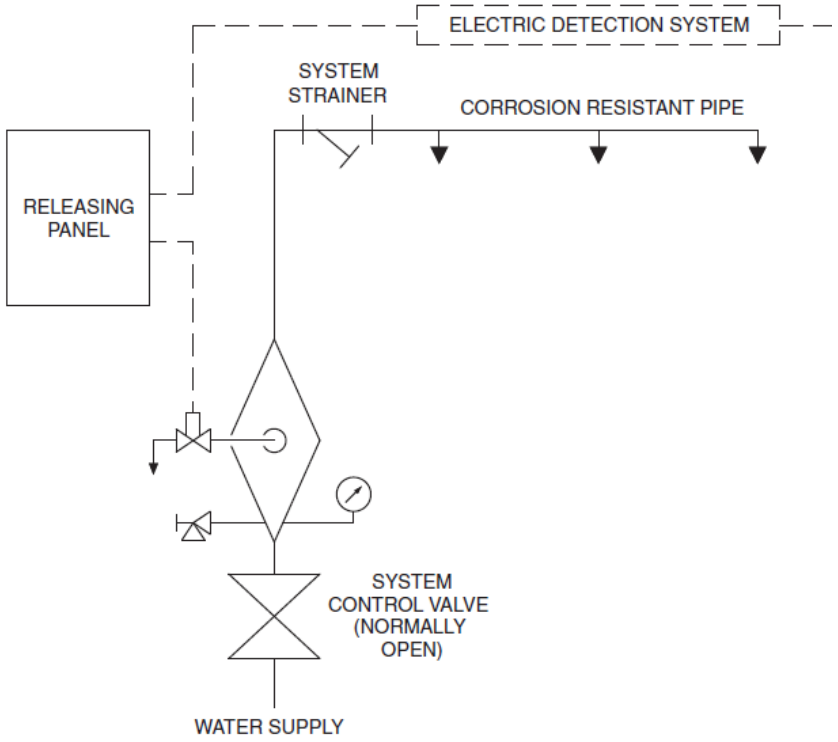




Generator Fire Characteristics

Deluge

- Class B
- Hydro-Carbon, high heat release
- Open Nozzles
- All nozzles discharge simultaneously
- Enclosure design area
- Enclosure volume and ventilation key design variables



Machinery Spaces - Definition

Machinery Spaces:

- Rooms with machinery such as oil pumps, oil tanks, fuel filters, generators, transformers vaults, gear boxes, drive shafts, lubrication skids, diesel engine driven generators, and other similar machinery using fuel and/or lubrication fluids with volatilities less than or equal to light diesel.

Special Machinery Spaces:

- Rooms with machinery such as internal combustion engines or other equipment using fuel and/or lubrication fluids with volatilities less than or equal to heptane, and incidental use or **storage of limited quantities of flammable liquids of not more than two 55 gal (208 l) drums**.

Turbine Enclosure:

- Combustion turbines with or without thermal insulation.

FM 5560 Approval Standard for Water Mist Systems

Fire Test Protocols

BS8489 – 1 – Fire Test Protocols

The water mist system is to be:

- Tested in accordance with a recognized test protocol;
- Published in a printed or online record by the testing laboratory.
- Use only components and equipment recognized by a testing laboratory
- Installed by trained personnel in accordance with the manufacturer's water mist system design and installation manual.

A match needs to be established between test conditions on which the testing is based and the conditions of the actual installation

Where a water mist system application is not covered by a recognized standard fire test, additional testing might be required to meet the requirements of the authority having jurisdiction (AHJ) .

BS8489 – 1 – Fire Test Protocols

- Fire Test Protocols
  - Robust, reliable, repeatable
  - Specific fire load
  - Specific risk geometry

- Matching the risk to the fire test protocol

a) Is the fuel similar to the test protocol (liquid or solid fuel, flash point, combustibility, quantity, arrangement)?

b) Is the compartment volume equal to or less than the volume of the test room?

c) Is the compartment height equal to or less than the test protocol?

d) Is the compartment ventilation conditions similar (presence of fans, forced ventilation, etc., area of openings, position of openings)?

e) are there more obstructions to the distribution of mist than the test protocol?

f) Is the duration of protection provided

BS8489 – 1 – Fire Test Protocols

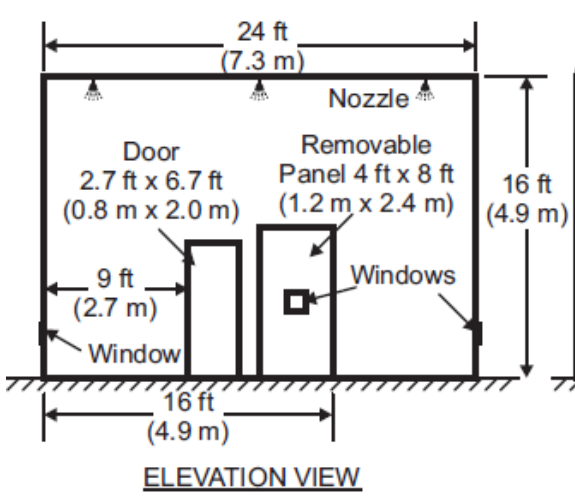
Deluge / Extinguishment Protocols:

Table 2 – Occupancy and acceptable fire test protocol of Class B and Class F fire hazards operated by a deluge system

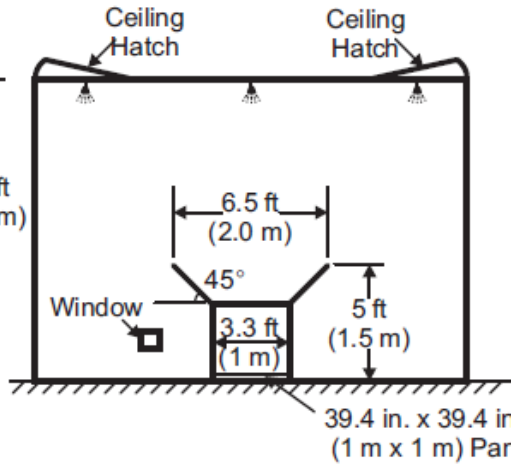
Occupancy	Fire test protocol
Machinery spaces ≤80 m^3	BS 8489-5 or FM 5560:2012, Appendix A
Machinery spaces ≤260 m^3	FM 5560:2012, Appendix C
Machinery spaces >260 m^3	FM 5560:2012, Appendix E
Combustion turbines ≤80 m^3	BS 8489-5 or FM 5560:2012, Appendix B
Combustion turbines ≤260 m^3	FM 5560:2012, Appendix D
Combustion turbines >260 m^3	FM 5560:2012, Appendix F
Industrial oil cookers	BS 8489-6 or FM 5560:2012, Appendix J
Pool and spray fires – local application	BS 8489-4 or FM 5560:2012, Appendix I

FM 5560 – Fire Test Protocol

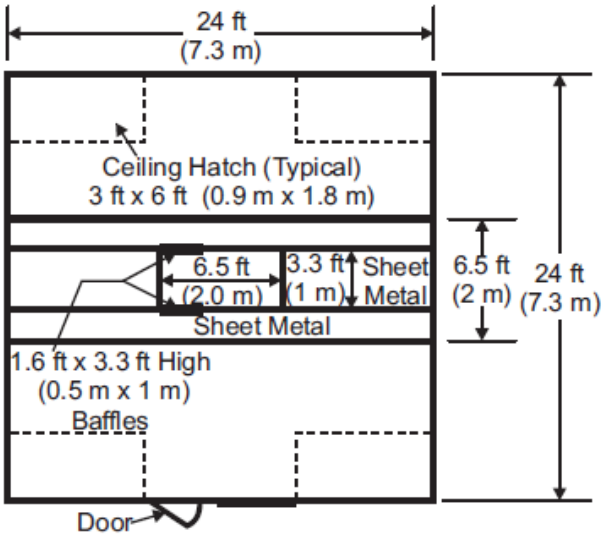
- Restricted Approval – 260m^3 : 7.3m x 7.3m x 4.9m
- 5m ceiling height
- Personnel Access door without locking mechanism
- Twelve test configurations
- Approval Criteria
  - Extinguishment



ELEVATION VIEW



SIDE VIEW



PLAN VIEW

FM 5560 – Fire Test Protocol

- Test 1 : Unshielded 1MW Heptane Spray Fire
- Test 2 : Shielded 1MW Heptane Spray Fire
- Test 3 : Shielded Heptane Pool Fire
- Test 4 : Shielded 2MW Heptane Spray Fire - Ventilated
- Test 5 : Shielded 2MW Heptane Spray Fire – Small Enclosure
- Test 6 : Unshielded 1MW Diesel Spray Fire
- Test 7 : Shielded 1MW Diesel Spray Fire
- Test 8 : Shielded Diesel Pool Fire
- Test 9 : Shielded 2MW Diesel Spray Fire – Ventilated
- Test 10 : Shielded 2MW Diesel Spray Fire – Small Enclosure
- Test 11 : Saturated Mat and Spray Fire
- Test 12 : Large Mat Pool Fire

FM 5560 – Fire Test Protocol

- Approval Criteria
  - Extinguish all fire tests with no manual intervention
  - Quickest 1.06 minutes
  - Slowest 4.49 minutes
- System supply shall be twice the worst case fire test result or 10 minutes, whichever is the largest
  - Machinery rundown time must be considered
- **Pass**

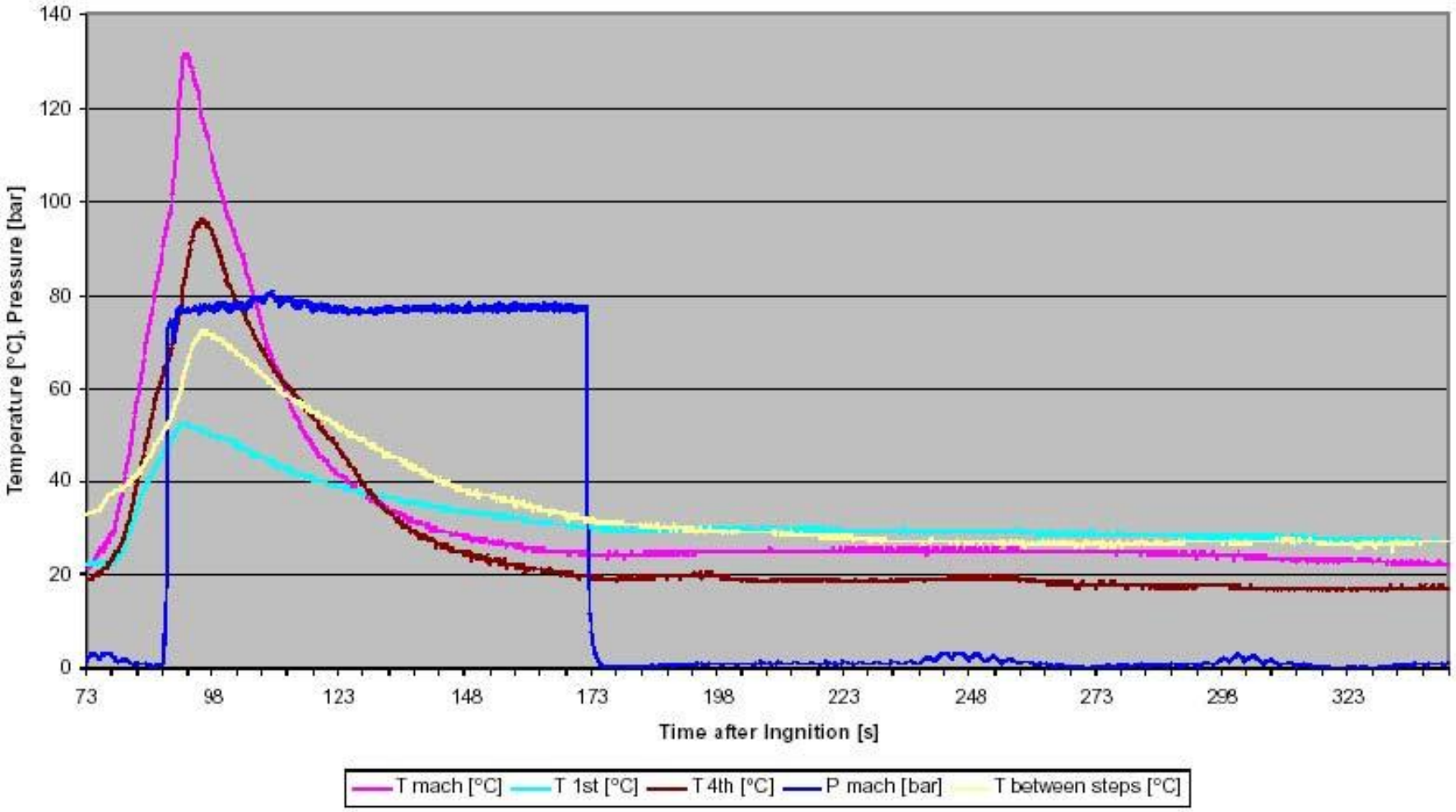
FM 5560 – Fire Test Protocol

- **Mandatory Interlocks**
  - Automatic Door Closures
  - Electrical Shutdown
  - Fuel Shutdown
  - Lubrication shutdown
  - Ventilation shutdown
  - Containment of flammable liquid releases

- **Mandatory Monitoring**
  - Nitrogen / Air pressure to a manned location

- **Mandatory Temperature**
  - +4^{o}C
  - +54.4^{o}C

FM 5560 – Fire Test Protocol



FM 5560 – Fire Test Protocol

FM APPROVED

Certificate of Compliance

WATER MIST SYSTEMS

This certificate is issued for the following:

General:	AQUAFOG Water Mist Design for Fire Protection of Machinery Spaces, Special Machinery Spaces and Turbine Enclosures not exceeding 260 m^3 (9175 ft^3) and a maximum ceiling height of 16.4 ft (5 m).
Water Mist System Type:	Pre-Engineered system single fluid system
Discharge Type:	Continuous discharge, decaying pressure
Min. Water Flow Rate (per nozzle):	Ceiling Nozzle: 1.16 gpm (4.4 Lpm) / Door Nozzle: 0.29 gpm (1.1 Lpm)
Min. Water Pressure (at nozzle)	Ceiling Nozzle: 725 psi (50 bar) / Door Nozzle: 725 psi (50 bar)
Temp. Installation Range:	40 to 130°F (4 to 54°C)
Provisions:	-Use of FM Approved fire detection equipment is required. -Required: Automatic door, ventilation closure devices, fuel shut off devices
Design, Installation, Operation, and Maintenance Manual:	Design Manual: AQUAFOG Water Mist Design for Fire Protection of Machinery Spaces, Special Machinery Spaces and Turbine Enclosures not exceeding 260 m^3 (9175 ft_3) in Accordance with FM Approvals Standard for Water Mist Systems, Class 5560 (MD-AG-04-IN), Revision 0. Installation, operation, and maintenance manual: Installation, Maintenance and User Manual for Water Mist Systems for the Protection of Machinery Spaces, Special Machinery Spaces and Turbine Enclosures not exceeding 260 m^3 (9175 ft^3) in Accordance with FM Approvals Standard for Water Mist Systems, Class 5560 (MU/AG/05/IN), Revision 0.

Prepared for: LPG Técnicas en Extinción de Incendios, S.L.,
C/ Mestre Joan Corrales, 107-109, 08950,
Esplugues de Llobregat Barcelona, Spain

FM Approvals confirms that the products above have been found to comply with the following standards:

FM Approvals Class 5560 – Approval Standard for Water Mist Systems, March 2009

Approval Identification: 3033088 Approval Granted: June 24, 2010

Said Approval is subject to satisfactory field performance, continuing follow-up Facilities and Procedures Audits, and strict conformity to the constructions as shown in the Approval Guide, an online resource of FM Approvals.

For more than 160 years FM Approvals has partnered with business and industry to reduce property losses.

6/24/10
Date

Richard B. Dunne
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Detection and Actuation

BS 8489-1 - Detection, Actuation and Control

- Detection
  - BS5839-1
  - Match characteristics of risk

Actuation & Control

- Indicate operation of system (BS5839-1)
- Indicate failure of supervised device
- Electrical actuation
  - BS7273-3 (Pre-action)
  - BS7273-5 (Except pre-action)
- Non-Electrical actuation
  - Subject to approval

BS 8489-1
System Design

AquaMist

BS 8489-1 - System Design

- Manufacturers Design and Installation Manual
  - Fire test protocol
  - Minimum and maximum heights
  - Minimum and maximum distance between nozzles
  - Minimum and maximum distance to walls
  - Positioning relative to ceiling
  - K factor
  - Minimum and maximum pressure

BS 8489-1 - System Design

- Duration
  - Deluge Systems
  - Twice time to extinguish fire and prevent re-ignition as established in the test
  - Minimum:

Table 3 – Occupancy, operating volume and discharge duration for Class B and Class F fire hazards operated by a deluge system

Occupancy	Operating volume	Minimum discharge duration (min)
Machinery spaces	<80 m^3	10
Machinery spaces	<260 m^3	10
Machinery spaces	>260 m^3	60[A)]
Combustion turbines	<80 m^3	10
Combustion turbines	<260 m^3	10
Combustion turbines	>260 m^3	60[A)]
Industrial oil cookers	As per test protocol	10
Pool and spray fires – local application	As per test protocol	10

[A)] Unless verified as lower according to certification against fire protocol.

BS 8489-1 - System Design

- Approval
  - FM5560
  - LPS 1283
  - Alternative equivalent
- Nozzles
  - Corrosion resistant material
  - Marked
    - Manufacturer
    - Model
    - Year of Manufacturer/
    - k-factor

BS 8489-1 - System Design

- Pipe
  - Approved to maximum design pressure
  - Identified BS 1710
  - Stainless Steel 316 (or equivalent)
  - Copper BS EN 1057
  - Galvanised Steel BS EN 10255
  - A strainer, and downstream test valve, should be fitted at the termination of the galvanized piping upstream of the piping feeding the nozzles.
  - CPVC

BS 8489-1 - System Design

- Pipe supports
  - ISO 6182-11
- Pipework
  - Minimise exposure to damage
  - Air vents
  - System drains
  - Suitably earthed

Maximum spacing of fixings for copper and stainless steel pipework

Nominal diameter mm	Horizontal run m	Vertical run m
12	1.2	1.8
16	1.5	2.1
22	1.8	2.4
28	1.8	2.4
35	2.4	3.0
42	2.4	3.0
54	2.7	3.0

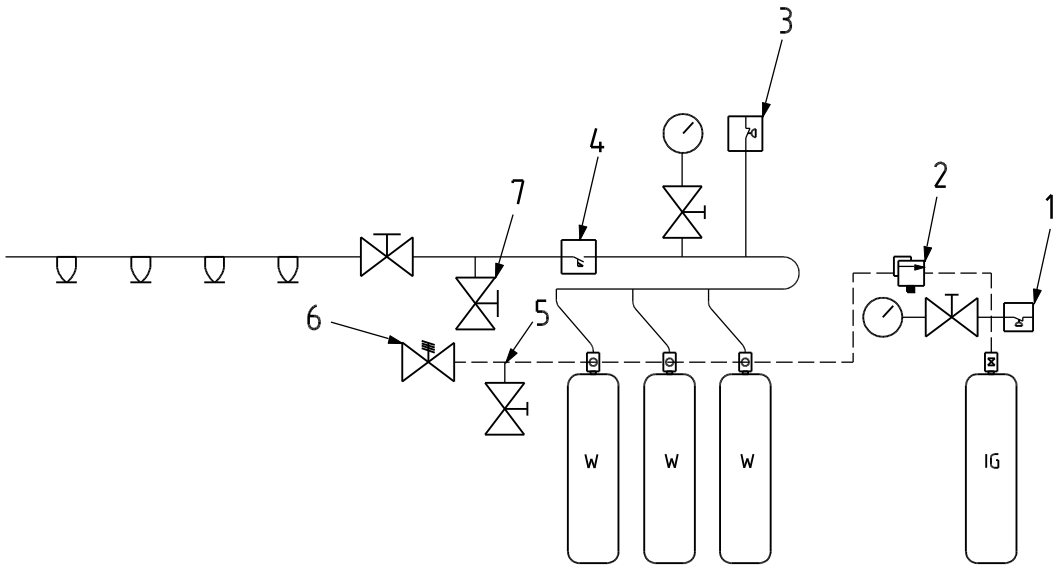
Maximum spacing of fixings for steel pipework

Nominal diameter mm	Horizontal run m	Vertical run m
15	1.8	2.4
20	2.4	3.0
25	2.4	3.0
32	2.7	3.0
40	3.0	3.6
50	3.0	3.6
80	3.6	4.5

Maximum spacing of fixings for CPVC pipework

Nominal diameter mm	Horizontal run m	Vertical run m
12	0.6	1.2
15	0.8	1.6
22	0.8	1.6
28	0.9	1.8
32	1.0	2.0
40	1.05	2.1
50	1.2	2.4
65	1.35	2.7
80	1.5	3.0

BS 8489-1 - System Design



Key

1 Propellant low pressure switch
2 Propellant regulator
3 System low pressure switch
4 System flow switch
5 Propellant vent valve
6 Propellant safety vent
7 System drain valve

Nozzle
Isolation valve
Stop valve
System drain valve

Pressure gauge

W Water cylinder

IG Inert gas cylinder

BS 8489-1 - Commissioning

General

- Pipe is clean and free of debris
- End of line test valve discharge
- Checked against design documentation
- Visual inspection

Pipework

- 1.5 x maximum working pressure for 2 hours with no loss
- Dry pipe
  - 2.5 bar air test for 24 hours with no loss greater than 0.15 bar
  - 60 second water delivery

BS 8489-1 - Commissioning

Detection and Actuation

- BS 8489-1
- BS 7273-3
- BS 7273-5
- Function check all valves

Documentation

- Completion certificate
- Pressure test certificate
- Conformation of pipe cleaning
- O&M
- As installed drawings

Thank you