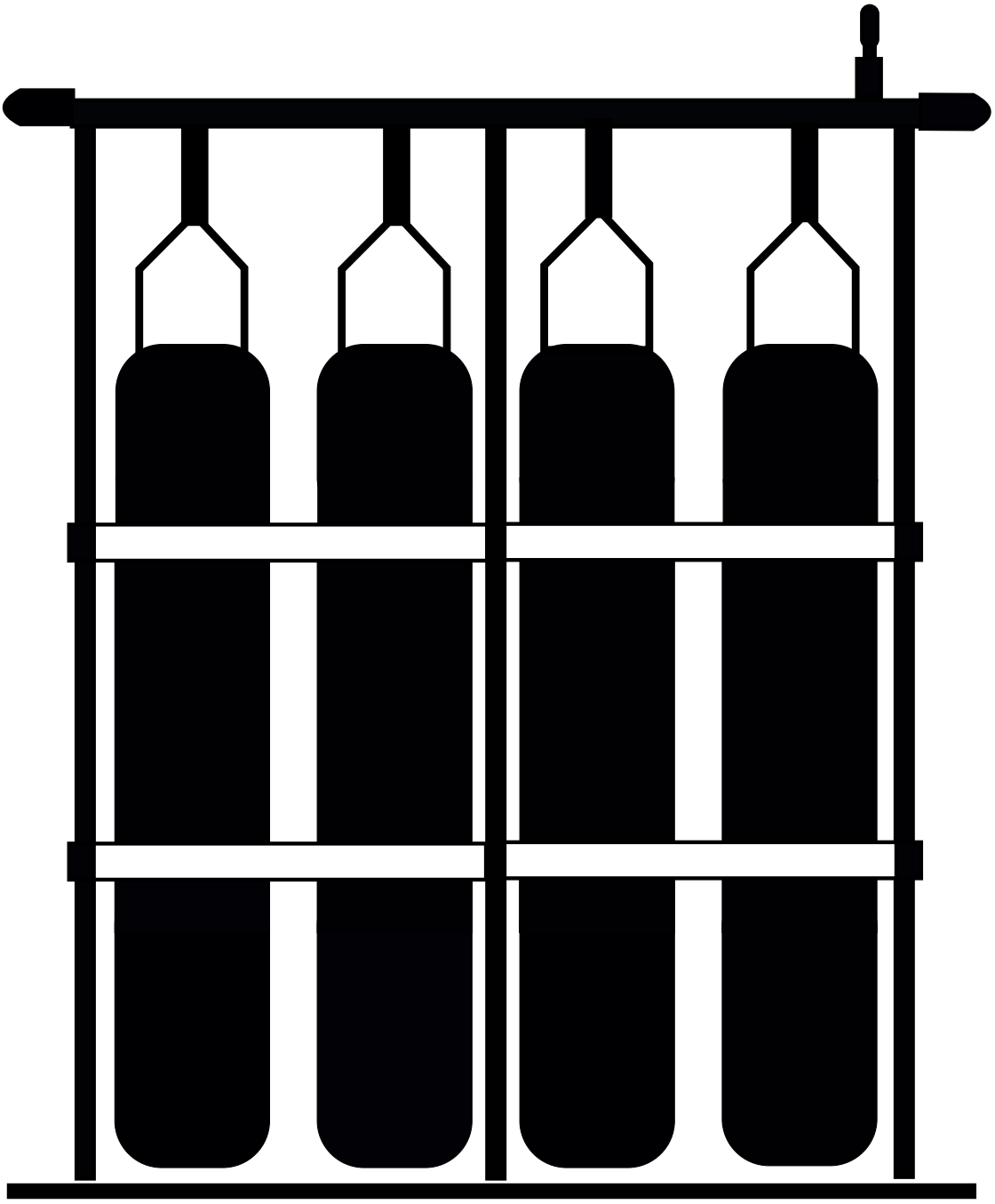
CARBON DIOXIDE FIRE SUPPRESSION SYSTEMS WITH VDS APPROVED MECHANICAL WEIGHING DEVICE

HYGOOD

DESIGN AND INSTALLATION MANUAL



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Johnson Controls

Use this manual with the HYGOOD® Carbon Dioxide (CO_2) Fire Suppression System. These systems are specifically engineered for total flooding and local applications in either unoccupied or occupied areas. Planning, design, installation, operation, recharge, and maintenance of the system must conform to the limitations detailed in this manual. An individual holding a valid certification from a CO_2 system training programme with training to plan, install, and maintain the CO_2 system shall install and maintain this system.

Those who design, install, operate, reset, inspect, maintain, and recharge these systems must read this entire manual. Specific sections are of particular interest depending upon one's responsibilities.

As with all electrical, mechanical, pneumatic equipment, the system requires periodic care to provide maximum assurance that it operates effectively and safely. Inspection frequency shall be performed consistently, depending on operating and environmental conditions. Maintenance shall be performed semiannually, or more frequently, depending on operating and environmental conditions.

The application and use of the CO_2 system is limited to the applications and uses described in this manual. For other applications, contact an Authorized CO_2 Distributor, Territory Manager, or the Technical Services Department.

Note: The converted values in this document are provided for dimensional reference only and do no reflect an actual measurement.

DISCLAIMER:

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All instructions contained herein relate to a typical installation.

Date: 2020-MAR-23
Part No.: 14A-46H

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⚠ DANGER

Indicates a hazardous situation in which a person ***will*** **experience serious personal injury or death** if the situation is not avoided.

⚠ WARNING

Indicates a hazardous situation in which a person ***could*** **experience serious personal injury or death** if the situation is not avoided.

⚠ CAUTION

Indicates a hazardous situation in which a person **could experience minor or moderate personal injury** if the situation is not avoided.

CAUTION

Addresses practices not related to personal injury, such as a system part malfunctioning, property damage, or system failure.

NOTICE

Addresses general practices or observations related to system function that are not related to personal injury.

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2020-03	–	First revision

Date	Page	Revision
2020-03	–	First revision

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INTRODUCTION

Designers and installers of carbon dioxide fire suppression equipment must use this manual. This manual provides general information on carbon dioxide and its use in fire suppression systems and gives more detailed information covering the design, installation, testing, and servicing of these systems.

The manual describes the minimum requirements for the design of local application and total flooding systems. This manual does not describe explosion suppression systems or marine systems. While this manual does not specifically exclude inerting systems, these applications require additional considerations. If in doubt, contact the Product Manager. If a carbon dioxide fire suppression system is not designed and installed to the parameters set out in this manual, the manufacturer cannot guarantee the correct operation of the system.

This manual contains the best information available at the time of publication. Users of this manual must have sufficient experience of fixed fire suppression systems to enable the correct interpretation of the contents.

The correct system design, installation, and maintenance are fundamental to the safe and effective use of any gaseous fire suppression system.

APPROVALS

The carbon dioxide system is based on a number of components approved or listed by VdS in Germany.

TEMPERATURE RANGE

Johnson Controls design and test the components to operate in the temperature range -20 °C to 50 °C, or as stated in separate component listings.

For systems designed in accordance with *VdS 2093*, the room temperature in the CO_2 storage area shall not fall below 0 °C or exceed 35 °C.

BS 5306-4 recommends ambient storage temperatures of between -18 °C to 46 °C for total flooding systems, and between 0 °C to 46 °C for local application systems.

If it is likely that the ambient storage temperature is below 0 °C, then *ISO 6183:2009* recommends that special measures such as insulation may be required.

GENERAL INFORMATION

Carbon dioxide systems utilise either high pressure storage in the form of one or more containers, or low pressure storage in the form of refrigerated bulk storage vessels. This manual provides information on high pressure storage systems only.

High pressure storage containers hold pressurised CO_2 in liquid form at a nominal pressure of 58.6 bar at 21 ºC. All handling and installation procedures of high pressure CO_2 equipment must be carried out by personnel experienced in working with this type of equipment.

DESCRIPTION OF CO_2 SYSTEMS

Carbon dioxide fire suppression systems suppress fires involving flammable liquids, gases, and electrical equipment. To suppress a fire, CO_2 reduces the oxygen levels required for a sustainable combustion. A space filled with CO_2 concentration sufficient to suppress a fire does not contain enough oxygen levels to support life.

⚠ DANGER

Do not enter or remain in a CO_2 discharged space.

A system comprises of a single container or a bank of containers connected to a system of pipework and nozzles. CO_2 liquefies under pressure. Steel containers fitted with a specially designed quick opening valve contain the liquefied CO_2. When the valve opens, liquefied CO_2 flows into the distribution pipework. This pipework directs the CO_2 to one or more nozzles in the protected area where the discharging liquid rapidly expands to a gas. The discharged CO_2 appears as a fog that temporarily reduces visibility.

Use CO_2 fire suppression systems in the following instances:

- To suppress fires in hazards or equipment that require an electrically non-conductive medium.
- Where the cleaning up procedures of foam, water, or powder do not apply, or raise concerns.

CO_2 PROPERTIES

Under normal conditions, CO_2 is a colourless, odourless, electrically non-conductive gas with a density around 50% greater than air. CO_2 liquefies through compression and cooling. It converts to a solid state through further cooling and expansion. CO_2 cannot exist as a liquid above its critical temperature of 31 ºC or at a pressure below 4.1 bar.

For fire suppression applications, CO_2 contains the following advantages:

- Non-corrosive
- No residue to clean up after the fire
- Does not conduct electricity
- Suitable for use on live electrical hazards
- Provides pressure for discharge through pipes and nozzles
- Penetrates and spreads to all parts of a hazard

HANDLING OF PRESSURISED CONTAINERS

The *Fire Industry Association (FIA) Guidance Document for the Safe Handling of Pressurised Container Assemblies Used in Fire Extinguishing Systems* gives an overview of best safety practices for practitioners that handle pressurised container assemblies as part of fixed fire fighting systems. The guidance applies to the transportation, handling, installation, commissioning, maintenance, and removal of pressurised container assemblies.

HEALTH AND SAFETY

The atmosphere we breathe contains approximately 0.03% CO_2 (300 ppm). This level naturally increases inside occupied enclosed spaces where industrial processes take place. Humans exhale CO_2, and without adequate ventilation, the CO_2 level in a room can increase to 0.3% or more. A maximum tolerated level of 0.5% (5000 ppm) applies for people at work during an eight hour day.

As the CO_2 concentration in the atmosphere increases, air is displaced. This introduces a corresponding reduction in the available oxygen. This causes drowsiness and impaired co-ordination. Further increases of up to 3% causes laboured breathing, an increased pulse rate, and headaches. Above this level, breathing difficulties become more pronounced and a likely loss of consciousness. Concentrations in excess of 10% are highly dangerous.

CO_2 fire suppression systems are designed to achieve concentrations in excess of 30% by volume.

⚠ DANGER

Avoid the accidental release of CO_2. Exercise care at all times when attending to CO_2 systems and control equipment. Personnel **must** be evacuated from the protected area before flooding it with CO_2.

Electrical time delays apply to some areas. In the following circumstances, fit mechanical time delays:

- In uncontrolled or vulnerable areas with mechanical manual release devices.
- In areas with a mechanical means of release.

Fit stop valves on all systems protecting normally occupied areas or any other areas where egress causes difficulty. During discharge, consider that CO_2 may flow to adjacent low level areas such as cellars, basements, or pits, for example.

NOISE

Discharge of a CO_2 system can cause noise loud enough to startle personnel, but ordinarily insufficient to cause traumatic injury.

TURBULENCE

High velocity discharge from nozzles may dislodge substantial objects directly in the path of the discharge. General turbulence in the enclosure may move light objects, such as unsecured paper. Clip ceiling tiles in the vicinity of the nozzles to prevent dislodgement during the discharge.

LOW TEMPERATURE

Direct contact with vapourising liquid CO_2 causes a strong chilling effect on objects and can cause frostbite burns to the skin. The liquid phase vapourises rapidly when mixed with air and limits the hazard to the immediate vicinity of the discharge nozzle.

VISIBILITY

Upon discharge, the resulting condensation of water vapour reduces visibility, especially in humid atmospheres.

EXITS

Provide adequate means of escape from the protected area. Doors should open outwards and self close. They should be arranged to open easily from the inside. Fit any that require securing with escape overrides.

POST DISCHARGE VENTILATION

In order to allow for the ventilation of CO_2 and the post fire atmosphere, the hazard area requires a normally closed means of ventilation with extract arrangements, as with any gaseous suppression system. Any mechanical ventilation provided should not form part of the normal ventilation system. Position controls for the ventilation system outside the protected enclosure and they should be key operated. In some circumstances, doors and windows may provide the normally closed means of ventilation.

POST DISCHARGE CONDENSATION

Following a system discharge, condensation may form on the external surface of the system pipework which could accumulate and drip. The *Fire Industry Association (FIA) Guidance Document* recommends taking precautionary measures where this may have an impact, such as on sensitive or energised equipment. These measures include insulation of affected pipe sections, use of drip trays, or the re-routing of pipework to prevent the occurrence of dripping to mitigate its impact.

FIRST AID

Section 8 - Appendix contains a Material Safety Data Sheet, for reference only. Use the following link for the most up-to-date information:

www.FireProductsds.com

AGENT PHYSICAL PROPERTIES

TABLE 1-1: CARBON DIOXIDE PHYSICAL PROPERTIES

Chemical structure	CO_2
Chemical name	Carbon Dioxide
Molecular weight	44 g/mol
Boiling point	-1.4 ºC
Critical temperature	31 ºC
Critical pressure	73 bar
Density	Solid: 1562 kg/m^3 Liquid: 1032 kg/m^3 at -20 ºC Gas: 1.98 kg/m^3 at 0 ºC and 1 atm 1.87 kg/m^3 at 15 ºC and 1 atm
Vapour pressure	19.70 bar at -20 ºC 33.80 bar at 0 ºC 56.28 bar at 20 ºC 71.10 bar at 30 ºC

USE AND LIMITATIONS

Carbon dioxide fire suppression systems are effective on Class A, B, and C fires. Carbon dioxide does not suppress fires where the following materials are actively involved in the combustion process:

- Chemicals containing their own oxygen supply, such as cellulose nitrate
- Reactive metals such as sodium, potassium, magnesium, titanium, and zirconium
- Metal hydrides

NOTES:

DESIGN STANDARDS

The information contained in this manual follows these standards:

- *BS 5306: Part 4: 2001 - Specification for Carbon Dioxide Systems*
- *BS 5306: Part 0: 2011 - Guide for Selection of Installed Systems and other Fire Equipment*
- *NFPA 12: 2018 - Standard on Carbon Dioxide Extinguishing Systems*
- *VdS 2093: 2009-06 - CO_2 Fire Extinguishing Systems. Planning and Installation*

This manual aims to give a basic understanding of the design of CO_2 systems. Users must familiarise themselves with the applicable standard, as the success of the system depends on the use of correct design concentrations and application rates which can vary between standards.

DETERMINATION OF CO_2 QUANTITY

Before commencing with the design of any CO_2 system, the designer must determine a minimum of the following details:

- Enclosure or hazard dimensions.
- Specific details of the hazard, such as fuel types, chemicals, and excessive fire load, for example.
- The minimum and maximum temperatures of the hazard enclosure.
- Confirmation of the integrity of the protected space (total flooding systems).
- Details of the ventilation system.
- Intended occupancy of the enclosure or hazard area.
- Storage container location. This should ideally be outside the protected enclosure, but not exposed to weather or other potential hazards. Take account of floor loading details.
- Details of relevant national laws or requirements, such as TRG 280 in Germany, for example.

In determining the required quantity of CO_2, assess the protected hazard correctly. The designer shall use the following points as a guide.

Determining if the hazard requires a total flooding or local application system

A **total flooding system** protects enclosed hazards and discharges CO_2 into a room or enclosure to develop a predetermined concentration throughout the entire space. A total flooding system's efficiency depends on maintaining a suppression concentration long enough to ensure the suppression of all smouldering and the cooling of combustible material, to prevent reignition. Before or in conjunction with the discharge of CO_2, shut down ventilation fans and dampers.

A **local application system** protects non-enclosed hazards, or sufficiently enclosed, to conform to the requirements for total flooding systems. A local application system utilises a pipework and nozzle layout specifically designed to discharge CO_2 directly into the fire.

CO_2 SYSTEM DESIGN ACCORDING TO *NFPA 12* AND *BS 5306-4*

The design section covers the *NFPA 12* and *BS 5306-4* standards.

The system design is generally divided into *Surface Fires* and *Deep Seated Fires* for total flooding systems, and *Rate by Volume* and *Rate by Area* for local application systems.

Surface or deep-seated fire hazards

A surface fire usually involves flammable liquids, gases, or solids unlikely to become deep-seated. Such applications usually use a concentration of 34%. This may require adjustments to take special conditions into account.

A deep-seated fire usually involves solids subject to smouldering and likely to produce glowing embers. Typical concentrations range from 50% up to 75%. As with surface fire hazards, the CO_2 quantities may require adjustments to take special conditions into account.

Total flooding systems - surface fires

For surface fires, the design concentration shall be achieved within 1 minute.

The following calculation determines the CO_2 quantity required for the protection of hazards involving surface fires:

Basic quantity (gross volume x volume factor)

x material conversion factor

+ loss through unclosable openings

+ loss through forced ventilation

+ high / low temperature allowance

= Total quantity of CO_2 required

1. Determine the gross room volume. The net volume can only be considered if there are permanent impermeable building structures within the area.
2. Multiply the gross volume by the appropriate volume factor from Table 2-1 to give the basic CO_2 quantity (kg).

TABLE 2-1: VOLUME FACTORS (*BS 5306: PART 4*)

Space volume (m^3)	Volume factor (kg/m^3)
≤ 4	1.15
>4 ≤ 14	1.07
>14 ≤ 45	1.01
>45 ≤ 126	0.90
>126 ≤ 1400	0.80
> 1400	0.74

3. For materials requiring a design concentration over 34%, the basic CO_2 quantity calculated in Step 2 shall be increased by multiplying this quantity by the appropriate conversion factor given in Table 2-4 (*BS 5306-4*) or Graph 1-1 (*NFPA 12*).
4. Add extra CO_2 to account for any unclosable openings. CO_2 loss shall be compensated for by an additional quantity equal to the anticipated loss during a 1 minute period.

The following equation can be used to calculate the rate of CO_2 loss, assuming that there is sufficient leakage in the upper part of the enclosure to allow for free ingress of air:

$$R = 60\ CpA\ \sqrt{\frac{2g(P_1 - P_2)^h}{P_1}}$$

where:

R = rate of CO_2 (kg/min)

C = CO_2 concentration fraction

p = density of CO_2 vapour (kg/m^3)

A* = area of opening [m^2 (flow coefficient included)]

g = gravitational constant (9.81 m/s^2)

p_1 = density of atmosphere (kg/m^2)

p_2 = density of surrounding air (kg/m^3)

h = static head between opening and top of enclosure (m)

* If there are openings in the walls only, *NFPA 12* states that the area of the wall openings can be divided by 2 for calculations because it is presumed that fresh air can enter through one half of the openings and that protective gas exits through the other half (*NFPA 12 Section A.5.5.2*).

If the quantity of CO_2 required for compensation exceeds the basic quantity of CO_2 required for flooding without leakage, the system shall be designed for local application.

5. Where forced air ventilating systems are involved, they shall preferably be shut down and/or closed, before or simultaneously with the start of the CO_2 discharge, or additional compensating gas shall be provided.

   For ventilating systems that cannot be shut down, additional CO_2 shall be added to the space through the regular distribution system in an amount computed by multiplying the volume moved during the liquid discharge period by the volume factor. This shall be multiplied by the material conversion factor when the design concentration is greater than 34%.

   CO_2 ventilation loss = ventilation volume (m^3/min) x volume factor (kg/m^3) x material conversion factor x liquid discharge time (min)

6. Add extra CO_2 if the area contains hazards with an increased fire risk. Table 2-4 lists the conversion factors. Add extra CO_2 to compensate for any abnormal temperature conditions using the following procedure:
   a. **BS 5306-4:** Where the normal temperature of the enclosure is above 100 °C, 2% carbon dioxide shall be added for each additional 5 °C above 100 °C.

      NFPA 12: Where the normal temperature of the enclosure is above 200 °F (93 °C), 1% carbon dioxide shall be added for each additional 5 °F above 200 °F (93 °C).

      The design discharge period shall not include the additional quantity of carbon dioxide.

   b. **BS 5306-4:** Where the normal temperature of the enclosure is below -20 °C, 2% carbon dioxide shall be added for each additional 1 °C below -20 °C.

      NFPA 12: Where the normal temperature of the enclosure is below 0 °F (-18 °C), 1% carbon dioxide shall be added for each additional 1 °F below 0 °F.

CO_2 SYSTEM DESIGN ACCORDING TO *NFPA 12* AND *BS 5306-4* (Continued)

Total flooding systems - surface fires (Continued)

The design discharge period shall include the additional quantity of carbon dioxide, to compensate for the lower expansion rate at a reduced temperature.

Any interconnected volumes must be considered and extra CO_2 provided if any of the interconnected areas require higher concentrations. Use the higher concentration throughout interconnected hazards.

Total flooding systems - deep-seated fires

For deep-seated fires, the design concentration shall be achieved within 7 minutes, but the rate shall not be less than that required to develop a concentration of 30% within 2 minutes.

Note: Table 2-1-Volume Factors does not apply to deep-seated fires and shall not be used.

The following calculation determines the CO_2 quantity required for the protection of hazards involving deep-seated fires:

1. Determine the gross room volume. The net volume can only be considered if there are permanent impermeable building structures within the area.
2. Multiply the gross volume by the appropriate hazard flooding factor from Table 2-2.

CO_2 quantities for deep-seated hazards are based on reasonably tight enclosures. Give special consideration to possible leakage sites. No allowances for leakage are included within the basic flooding factors (Table 2-2). Design the system and enclosure so that the concentration is held for at least 20 minutes. Ventilation fans should be switched off and dampers closed in conjunction with the discharge of CO_2.

Table 2-2 lists the hazard factors from *BS 5306: Part 4*. The data in the table uses an expansion ratio of 0.52m^3/kg at a temperature of 10 °C. Agree flooding factors for other deep-seated fires with the appropriate authority having jurisdiction (AHJ) before adoption.

TABLE 2-2: HAZARD FACTORS (*BS 5306: PART 4*)

Hazard	Examples	Design concentration (%)	Flooding factor (kg/m^3)	Notes
Electrical equipment	Enclosed rotating equipment Dry electrical wiring Electrical insulating materials	50	1.35	
Electronic data processing installation	Central processing area and equipment	53	1.50	Refer to *BS 6266*
	Data processing Tape controlled machinery and tape storage Service voids	68	2.25	
Stores	Record storage and archives for paper documents	65	2.00	
	Fur storage vaults and dust collectors	75	2.70	

Table 2-3 lists the flooding factors for specific hazards from *NFPA 12*.

TABLE 2-3: HAZARD FACTORS (*NFPA 12: 2018*)

Specific hazard	Design concentration (%)	Flooding factor (kg/m^3)
Dry electrical hazards in general: (Spaces less than 56.6 m^3)	50	1.60
Dry electrical hazards in general: (Spaces greater than 56.6 m^3)	50	1.33 (91 kg minimum)
Record (bulk paper) storage, ducts, and covered trenches	65	2.00
Fur storage vaults and dust collectors	75	2.66

CO_2 SYSTEM DESIGN ACCORDING TO *NFPA 12* AND *BS 5306-4* (Continued)

Table 2-4 lists the minimum carbon dioxide concentrations and, where the design concentration is over 34%, the appropriate material conversion factors from *BS 5306: Part 4*.

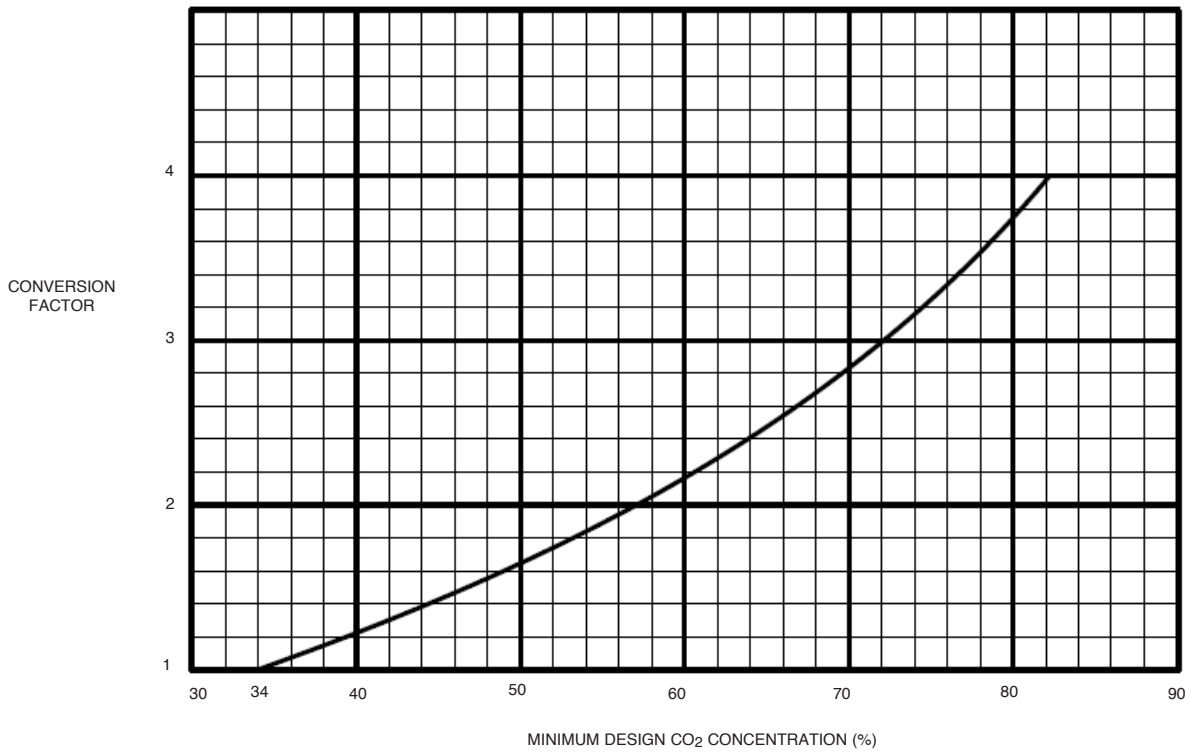
For materials not given in this table, the minimum carbon dioxide concentration shall be obtained from a recognised source or determined by testing.

TABLE 2-4: MINIMUM DESIGN CONCENTRATIONS AND MATERIAL CONVERSION FACTORS (*BS 5306: PART 4* AND *NFPA 12: 2018*)

Material	Minimum design CO_2 concentration (%)	Material conversion factor	Material	Minimum design CO_2 concentration (%)	Material conversion factor
Acetylene	66	2.5	Ethylene dichloride	25 (34***)	1.0
Acetone	31 (34*)	1.0	Ethylene oxide	53	1.75
Benzol, benzene	37	1.1	Hexane	35	1.1
Butane	34	1.0	Hydrogen	75	3.3
Buta-1, 3-diene	41	1.3	Isobutane	36	1.1
Carbon disulphide	72	3.0	Kerosene	34	1.0
Carbon monoxide	64	2.4	Methane	30 (34****)	1.0
Coal gas or natural gas	37	1.1	Methanol	40	1.2
Cyclopropane	37	1.1	Pentane	35	1.1
Diethyl ether	46 (40**)	1.5	Petroleum spirit	34	1.0
Dowtherm	46	1.5	Propane	36	1.1
Ethane	40	1.2	Propene	36	1.1
Ethanol	43	1.3	Quenching, lubricating oils	34	1.0
Ethylene	49	1.6	–	–	–
Notes:	* *NFPA 12: 2018* gives a minimum design CO_2 concentration of 34% for acetone. ** *NFPA 12: 2018* gives a minimum design CO_2 concentration of 40% for diethyl ether. *** *NFPA 12: 2018* gives a minimum design CO_2 concentration of 34% for ethyl dichloride. **** *NFPA 12: 2018* gives a minimum design CO_2 concentration of 34% for methane.				

CO_2 SYSTEM DESIGN ACCORDING TO *NFPA 12* AND *BS 5306-4* (Continued)

Graph 1-1 shows the material conversion factors from *NFPA 12*. These conversion factors must be used for all materials requiring a design concentration over 34%.



GRAPH 1-1
MATERIAL CONVERSION FACTOR GRAPH
E000939

CO_2 SYSTEM DESIGN ACCORDING TO *NFPA 12* AND *BS 5306-4* (Continued)

Other considerations for surface fire and deep-seated hazards

When designing a CO_2 total flooding suppression system for surface fire and deep-seated hazards, consider the following points:

Excess pressure venting

When CO_2 discharges from nozzles into an enclosure, it rapidly expands to mix with the air in the room. Leakages around doors and windows often provide sufficient pressure relief without the need for special arrangements. However, airtight enclosures may require provisions for excessive pressure venting. For further details, reference the *ISO* standard *PD CEN ISO TS 21805: 2019.*

Discharge times

Surface fire hazards shall achieve the design concentration within 1 minute. Deep-seated fire hazards shall achieve the design concentration within 7 minutes, but the discharge rate must achieve a concentration of at least 30% within 2 minutes. To simplify system design, a discharge time of 4 minutes achieves the requirements outlined previously.

Container storage

Store the containers between temperatures of -20 ºC and 50 ºC unless the system design specifies operation outside this range. For systems designed in accordance with *VdS 2093*, the room temperature in the CO_2 storage area shall not fall below 0 °C or exceed 35 °C.

Store the containers outside the protected enclosure, in a separate enclosure that is easily accessible in the event of a fire, and protected against access by unauthorised personnel. No other combustible materials or goods should be stored in this area. The container storage area should be located as close to the protected enclosure as possible, and have sufficient electrical illumination.

Nozzles

Position the nozzles uniformly on the ceiling of an enclosure to ensure a satisfactory distribution of CO_2, if possible. Alternatively, position them around the perimeter at a high level, depending on the room dimensions.

For CO_2 total flooding systems, no strict rules govern the number of nozzles to apply to any type of hazard. However, nozzle spacing depends on a number of factors, such as room height and flow rate. Generally, nozzles cover an area of 30 m^2, and have a maximum protection height of 5 m.

For additional information, refer to page 2-16.

LOCAL APPLICATION SYSTEMS

When designing CO_2 local application systems, consider the following points:

Three dimensional or flat hazard areas

For three dimensional or irregularly shaped hazard areas, the *Rate by Volume* method normally determines CO_2 quantities. Where the hazard consists of flat or horizontal surfaces, use the *Rate by Area* method of calculation.

For local application CO_2 systems, the minimum effective liquid discharge time for the calculated CO_2 quantity shall be 30 seconds.

The hazard shall be so isolated from other hazards or combustibles that a fire cannot spread outside of the protected area. The hazard includes all associated materials or equipment that could extend a fire outside or lead fire into the protected area. Where adjacent hazards cannot be isolated and fire spreading is likely, they shall be treated as one hazard.

Local application systems - rate by volume

To calculate the CO_2 quantity required, use the following methodology:

1. Determine the assumed volume. The CO_2 quantity is based on the volume of an assumed enclosure surrounding the actual hazard. The assumed walls and ceiling of the enclosure are to be at least 600 mm from the actual hazard, unless real walls are involved. The actual hazard area must include all areas of possible leakage, splash, or spillage.

   The assumed enclosure must include a real closed floor unless special considerations are made to account for openings in the floor. This is because CO_2 is heavier than air and would be lost from the enclosure at floor level at an excessive rate. No deductions for solid objects are to be made within the assumed enclosure.

   A minimum dimension of 1.2 m shall be used in calculating the volume of the assumed enclosure, giving a minimum volume of 1.728 m^3.

   If the hazard is subject to winds or forced draughts, the assumed volume shall be increased to compensate for the losses on the windward side.

2. Multiply the assumed volume by the required system discharge rate.

   The system discharge rate shall be at least 4 kg/min per cubic metre of assumed volume for enclosures where actual walls completely surround the hazard. The discharge rate is proportionally adjusted up to 16 kg/min per cubic metre of assumed volume for enclosures with no walls.

3. Multiply the discharge rate (Step 2) by the discharge time.

   The discharge time shall normally be 0.5 minutes. For certain applications, such as where the hazard involves liquids with autoignition temperatures lower than their boiling temperatures, the minimum discharge time should be 3 minutes.

   Note: The extended discharge time is intended to maintain a suppressing concentration until the fuel has cooled below its autoignition temperature. Add extra CO_2 if the area contains hazards with an increased fire risk. Table 2-4 lists the conversion factors.

CO_2 SYSTEM DESIGN ACCORDING TO *NFPA 12* AND *BS 5306-4* (Continued)

Local application systems - rate by volume (Continued)

4. Multiply the calculated CO_2 quantity (Step 3) by 1.4.

   Add 40% to the calculated quantity to determine the nominal container storage capacity since only the liquid portion of the discharge is effective.

Nozzles shall be located and directed so as to retain the discharged CO2 in the hazard area.

Nozzles shall be located so as to compensate for any possible effects of air currents, winds, or forced draughts.

The nozzle quantity must be sufficient to discharge at least the design quantity during the liquid phase within 30 seconds. The discharge time comprising the gas and liquid phase shall not exceed 40 seconds.

Local application systems – rate by area

Contact the Technical Services Department for support with regards to the design of local application systems using the Rate by Area method. Local requirements must also be considered.

Section 8-Appendix lists some details on the Rate by Area method according to *NFPA 12* and *BS 5306-4*.

CO_2 SYSTEM DESIGN ACCORDING TO *VdS 2093*

The design section covers the *VdS 2093* standard.

CO_2 design quantity

The CO_2 design quantity required for the individual flooding or calculation zone is to be determined in accordance with the following formula for total flooding and local application systems:

$$Q_{IG} = K_B \cdot (K_G \cdot V_R + K_A \cdot A_R) = K_B \cdot \left(0.75 \ \frac{kg}{m^3} \cdot V_R + 0.2 \ \frac{kg}{m^2} \cdot A_R \right)$$

where:

$V_R = V + V_Z - V_G$

with the following definitions:

K_B: concentration factor

K_G: minimum basis CO_2 quantity (0.75 kg/m^3)

V_R: hazard volume (m^3)

K_A: *surface constant*, reflects the CO_2 loss through leakages at the hazard boundary (0.2 kg/m^2)

A_R: = A + 30 x A0

A: hazard boundary area (m^2), sum of the surfaces of all walls, ceiling and floor forming the boundaries of the enclosure, including any open areas

A_0: unclosable openings (m^2)

The surface constant K_A may be reduced if the build-up and maintenance of the CO_2 concentration is ensured by more favourable building physical conditions and evidenced by a total flooding with concentration measurement. The design quantity, however, shall be at least as great as the volume term $K_B \cdot 0.75 \cdot V_R$ in the above formula.

If $0.75 \cdot V_R + 0.2$ m $\cdot A > 1.1 \cdot V_R$, the CO_2 quantity determined with the following equation may be used as upper limit for the design quantity:

$$Q_{max} = C_{IG} \cdot K_B \cdot \left(1.1 \ \frac{kg}{m^3} \cdot V_R + 0.2 \ \frac{kg}{m^2} \cdot 30 \cdot A_O \right)$$

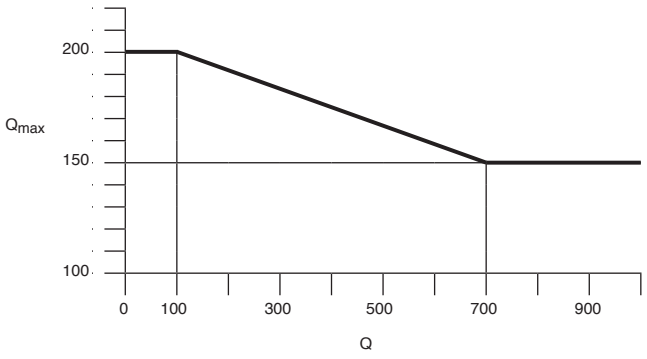
In this equation A shall be used and **not** $A_R = A + 30 \cdot A_O$.

The additional quantity to compensate for openings ($C_{IG} \cdot K_B \cdot 0.2 \cdot 30 \cdot A_O$) is required in any case.

In systems with several flooding zones, the zone with the greatest required design quantity is relevant.

The maximum permitted CO_2 design quantity to be discharged into one flooding zone of total flooding systems is specified in Figure 2-1.

If dangerous pressurisation occurs in the flooding zone during the discharge of CO_2, appropriate pressure relief openings shall be provided.



Note: Q_{max} = Maximum CO_2 design quantity in % of calculated design quantity

Q = Calculated CO_2 design quantity in kg

FIGURE 2-1
MAXIMUM CO_2 DESIGN QUANTITY
E000969

CO_2 SYSTEM DESIGN ACCORDING TO *VdS 2093* (Continued)

Influence of fuel and certain facilities

Where several materials are available in the calculation zone, the highest concentration factor K_B shall be applied in the calculation. Where the tables do not specify the K_B factor for the fuel or the facility requiring protection, the competent authority shall be consulted.

Where electrical switch and distribution rooms are always flooded together with the false floor underneath, the entire flooding zone shall be classified as the electrical switch and distribution room.

Due to the large number of different varnishes and solvents that are not always clearly identifiable, varnish storages shall have a K_B factor of at least 1.3. Higher factors (for example, 1.6 for methanol) shall be applied only if the substances are processed and stored pure. Where cartons are available, the K_B factor shall be 2.25. Wooden pallets and individual paper webs in storages are allowed.

The K_B factor of 2.25 for combustibles that could form deep-seated fires do not need to be applied for the following listed solid combustibles:

- Single paper webs (in printing and foaming machines)
- Paper intermediate layers in the storage of solids of fire Class B
- Wooden pallets in Class B storage of combustible products with non-combustible packaging (no stacks or piles of empty pallets)

If a room temperature in the flooding zone of less than -20 °C is to be expected, the design quantity shall be increased by 2% of the calculated design quantity per °C below –20 °C.

If the temperature is expected to drop excessively due to a high design quantity of CO_2 in the flooding zone (for example, with concentration factor K_B=2.25), the increased design quantity required for reaching the extinguishing gas concentration shall be taken into account in the calculation.

TABLE 2-6: CONCENTRATION FACTORS K_B FOR CLASS A HAZARDS

Material	K_B factor	CO_2 concentration in volume % within 4 minutes[2]	O_2 concentration in volume % within 4 minutes[2]	CO_2 concentration in volume % within 1 minute	O_2 concentration in volume % within 1 minute
Cotton[1]	2.00	57	9.1	34	13.8
Paper, corrugated cardboard[1]	2.25	61	8.2	34	13.8
Plastic materials (granulate)[1]	2.00	57	9.1	34	13.8
Polystyrene	1.00	-	-	34	13.8
Polyurethane	1.00	-	-	34	13.8
Cellulose[1]	2.25	61	8.2	34	13.8
Notes:	1. During 20 minutes, the O_2 concentration shall not exceed 13.8 volume %. 2. At an arbitrary point of time within the first 4 minutes, the specified value shall be achieved. The CO_2 concentration shall exceed the appropriate value and the oxygen concentration shall fall below the appropriate value.				

CO_2 SYSTEM DESIGN ACCORDING TO *VdS 2093* (Continued)

TABLE 2-7: CONCENTRATION FACTORS K_B FOR SPECIAL HAZARDS

Material	K_B factor	CO_2 concentration in volume % within 4 minutes[5]	O_2 concentration in volume % within 4 minutes[5]	CO_2 concentration in volume % within 1 minute	O_2 concentration in volume % within 1 minute
Electrical switch and distribution rooms[1]	1.20	40	12.6	34	13.8
Electronic data processing systems[1]	2.25	61	8.2	34	13.8
IT rooms (engine rooms)[1, 3]	1.50	47	11.2	34	13.8
Control room of high-rack storage[1, 3]	1.50	47	11.2	34	13.8
Paint shops and drying systems[4]	1.20	-	-	40	12.6
Generators including cooling systems[1, 2]	2.00	57	9.1	34	13.8
Cable rooms, cable floors and cable ducts[1]	1.50	47	11.2	34	13.8
Oil-filled transformers[1]	2.00	57	9.1	34	13.8
Dry-type transformers	1.20	40	12.6	34	13.8
Textile machines[1]	2.00	57	9.1	34	13.8
Notes:	1. For 10 minutes, the O_2 concentration shall not exceed 13.8 Vol. %. 2. The holding time shall be extended until the generators have been disabled. 3. Paper shall be only processed, not stored. 4. Where paints or solvents requiring a higher K_B factor than 1.2 are used, the design of the suppression system shall be based on this higher K_B factor. The appropriate concentration values specified in columns 5 and 6 shall be adjusted accordingly. 5. At an arbitrary point of time within the first 4 minutes, the specified value shall be achieved. The CO_2 concentration shall exceed the appropriate value and the oxygen concentration shall fall below the appropriate value.				

CO_2 SYSTEM DESIGN ACCORDING TO *VdS 2093* (Continued)

TABLE 2-8: CONCENTRATION FACTORS K_B FOR GASES AND LIQUIDS

Material	K_B factor	CO_2 concentration in Volume %(1)	O_2 concentration in Volume %
Acetone	1.0	34	13.8
Acetylene	2.57	66	7.1
Aviation gasoline	1.06	36	13.4
Benzene	1.1	37	13.2
Butadiene	1.26	41	12.3
Butane	1.0	34	13.8
Butanol	1.6	49	10.7
Butene-1	1.1	37	13.2
Carbon disulphide	3.03	72	5.9
Carbon monoxide	2.43	64	7.6
Coal or natural gas	1.1	37	13.2
Cyclopropene	1.1	37	13.2
Diesel, petrol	1.0	34	13.8
Diethyl ether / Ethyl ether	1.2	40	12.6
Dimethyl ether	1.22	40	12.5
Ethane	1.22	40	12.5
Ethyl alcohol	1.2	40	12.6
Ethylene	1.6	49	10.7
Ethylene dichloride	1.0	34	13.8
Ethylene oxide	1.8	53	9.8
Gasoline	1.0	34	13.8
n-Heptane	1.0	34	13.8
Hexane	1.1	37	13.2
Hydrogen	3.3	75	5.3
Hydrogen sulphide	1.06	36	13.4
Isobutane	1.06	36	13.4
Isobutylene	1.0	34	13.8
Isobutyl formate	1.0	34	13.8
JP-4	1.06	36	13.4
Kerosene	1.0	34	13.8
Methane	1.0	34	13.8
Methyl acetate	1.03	35	13.6
Methyl alcohol	1.6	49	10.7
Methyl butane-1	1.06	36	13.4
Methyl ethyl ketone	1.22	40	12.5
Methyl formate	1.18	39	12.8
n-Octane	1.03	35	13.6
Natural gas	1.1	37	13.2
Para dichloride benzene	1.47	46	11.3
Pentane	1.1	37	13.2
Propane	1.06	36	13.4
Propylene	1.06	36	13.4
Toluene	1.0	34	13.8
Quench/lube oils	1.0	34	13.8

Notes: 1. The CO_2 concentration shall be achieved within the discharge time.

CO_2 SYSTEM DESIGN ACCORDING TO *VdS 2093* (Continued)

Enclosure surface of the calculation zone

The entire enclosure surface of the calculation zone (A) shall be inserted in the formula as per the following specification.

For **total flooding systems** the enclosure surface of the calculation zone is the sum of the surfaces of all walls, ceilings, and floor forming the boundaries of the enclosure, including any opening surfaces. This applies analogously to the protection of enclosed equipment.

For **equipment protection** (object protection) of only partly or non-enclosed equipment, the non-closeable openings of the calculation zone shall be supplemented – for determining the enclosure surface – by imaginary boundary surfaces to fulfill the conditions.

The imaginary boundary surfaces shall be chosen such that only simple geometries ensue, such as cuboids, cylinders, and spherical segments. The number of imaginary boundary surfaces shall be as small as possible.

The calculation zone comprising both effective and imaginary boundary surfaces shall at least comprise the entire zone to be protected by the CO_2 system.

The floor area shall exist in all cases. If the calculation does not include the closed floor, the authority shall be consulted.

For the calculation of the CO_2 design quantity for container-like equipment, such as quench oil tanks or spark erosion machines, the empty container shall be taken as the calculation zone.

CO_2 storage quantity

The CO_2 storage quantity shall be equal to the design quantity calculated for the flooding zone with the highest suppressant demand plus the following supplementary quantities:

<u>For total flooding systems</u>

For systems with up to 19 containers:

10% of sum of largest design quantity to balance filling and tapping tolerances as well as residual gas

($Q_{STORAGE} = 1.1 \times Q_{DESIGN}$).

For systems with 20 or more containers:

5% of sum of greatest design quantity

($Q_{STORAGE} = 1.05 \times Q_{DESIGN}$).

<u>For local application systems</u>

Add 30% to the design quantity, because only the liquid portion of the CO_2 discharge is effective for local application.

For systems with up to 19 containers:

$Q_{STORAGE} = 1.4 \times Q_{DESIGN}$

For systems with 20 or more containers:

$Q_{STORAGE} = 1.35 \times Q_{DESIGN}$

Discharge time

The discharge times shall be determined as follows:

If $0.75 \cdot (V - V_G) > 0.2\ m \cdot A_R$

The application is total flooding and the discharge time shall be 60 seconds.

If $0.75 \cdot (V - V_G) \leq 0.2\ m \cdot A_R$

The application shall be local application and the system shall discharge at least the design quantity during the liquid phase within 25 to 30 seconds. The discharge time comprising gas and liquid phase shall not exceed 40 seconds. The gas phase shall be determined based on the most unfavourable conditions (highest pipework temperature). In the case of pipework sections leading outdoors, the heating caused by sunlight shall be taken into consideration.

Nozzle arrangement

For total flooding systems, the nozzles shall be arranged within the calculation zone. Wherever possible, this also applies to equipment protection systems (object protection). Only where this is impossible due to the combustible materials dispersion when the CO_2 is discharged or mandatory operational reasons, the nozzles may also be positioned outside the calculation zone. In these cases the spacing between the nozzles and the boundary surfaces of the calculation zone shall be as small as possible, it shall not exceed 1.0 m. In order to adhere to this maximum spacing it may be necessary to extend the calculation zone accordingly. The nozzles shall be arranged such that preferably the entire CO_2 design quantity is discharged into the flooding zone, even in the case of equipment protection systems.

In rooms higher than 5.0 m, the nozzles providing general CO_2 distribution shall not only be arranged in the upper part under the ceiling of the room to be protected, but also at approximately one third of the room height. The lower nozzles shall discharge approximately 35% of the required CO_2 design quantity into the flooding zone.

The protection of rooms higher than 10 m and areas for which an extended discharge is provided shall be agreed with the competent authority.

Special types of occupancies/equipment

For the protection of special equipment such as rooms for data processing systems (IT), false floors, enclosed hardening plants for heating and cooling, deep fat fryers, rotary printing presses, painting cabins, and local suppression systems for electrostatic coating systems, refer to the *VdS2093* chapter 10 or contact the Technical Services Department.

CONNECTED RESERVES

The system can accommodate connected reserves. The means to achieve this normally occurs through a duplicate bank of agent containers connected into a common manifold. All parts of the storage system duplicate, but the pipework system from the container storage area and the discharge nozzles are normally common.

STOP VALVES AND SELECTOR VALVE SYSTEMS

The system can accommodate stop valves and selector valves. Both types of arrangement create closed sections of pipework and require pressure relieving devices. The methodology used to achieve the many configurations possible require the use of non-return valves and pilot line bleed valves strategically positioned in the pneumatic control system.

ESTIMATING PIPE SIZE

For estimating purposes, use Table 2-9 as a guide in the selection of pipe sizes based on flow rate. Use a carbon dioxide computer programme to perform accurate hydraulic pipe size calculations.

DESIGN DRAWINGS

Following receipt of instructions from the client to proceed with an installation, prepare the system layout drawings containing a minimum of the following information:

- Extent of the protected enclosure
- Details of the hazards
- Location of CO_2 containers and associated equipment
- Layout and size of pipework
- Position of nozzles and orifice areas and codes
- Calculations for the determining of the CO_2 quantity

Submit drawings to the client for approval. Installation must only proceed against the approved drawings.

TABLE 2-9: PIPE DIAMETERS FOR ESTIMATION

Flow rate (kg/min)	Estimated pipe diameter (mm)
0 – 45	10
45 – 68	15
68 – 136	20
136 – 227	25
227 – 409	32
409 – 545	40
545 – 909	50
909 – 1363	65
1363 – 2272	80
2272 – 3300	100

ROOM INTEGRITY AND PRESSURISATION

The successful performance of a CO_2 fire suppression system largely depends on the integrity of the protected enclosure. It is a requirement to perform a room integrity test on any protected enclosure to establish the total equivalent leakage area and to predict the enclosure's ability to retain fire suppression agent. The required retention time varies depending on the particulars of the hazard but is not normally less than 10 minutes. Longer retention times, for example, may be necessary if enclosures contain hazards that may readily become deep seated.

In considering room integrity, the designer should consider that the discharge of CO_2 into an enclosure gives rise to a change in the pressure within that enclosure. Under some conditions, this could affect the structural integrity of the enclosure.

In some cases, the protected enclosure requires a pressure relief vent and in all cases the client must be made aware of the pressurisation level expected, from calculation, within the enclosure.

For CO_2 systems that are not VdS approved systems, the natural leakiness of the enclosure may form the basis for these calculations, but that can only be accurately assessed with the room integrity test equipment. When conducting this test, look for the minimum amount of leakage and not the maximum amount of leakage, as required with a standard room integrity test. The two tests differ as the doors surrounding the protected room are left closed, as opposed to being held open during a standard room integrity test.

In order to calculate the venting area, if the vent path cannot go direct to atmosphere, cascading the pressure through one or more rooms before exiting to atmosphere may need to occur. Gas and smoke passes through these rooms during this action. The client must be aware of this action in case of any problems that might arise.

The formula provided does not give an accurate indication of vent sizes for this operation. Refer to *PD CEN ISO TS 21805: 2019*, or refer to the Johnson Controls Technical Department in your area.

Note: It is the client's responsibility to determine the enclosure strength and not the fire protection system supplier. The client must advise the allowable pressure differential that the enclosure can withstand without sustaining damage.

As a guide, in the UK it is expected that normal block work construction can withstand 500 Pa while lightweight structures such as stud portioning can withstand 250 Pa. Certain structures, particularly suspended ceilings may have limits as low as 100 Pa. Refer to *PD CEN ISO TS 21805: 2019.*

If the client does not communicate the allowable pressure that the enclosure can withstand, obtain the client's acceptance of the proposed figures used.

DETECTION AND CONTROL SYSTEMS

In case of electrical triggering of the gas suppression system, an automatic fire detection system shall be used. Unless otherwise stated, for VdS approved systems, the guidelines for fire detection systems *(VdS 2095)* as well as the guidelines for the triggering of suppression systems *(VdS 2496)* shall be met.

The CO_2 VdS approved system requires the use of a VdS approved suppressant release panel together with VdS approved ancillaries. The components listed below are approved by VdS for use with a high pressure CO_2 system.

DETECTION AND CONTROL SYSTEMS (Continued)

TABLE 2-10: VdS APPROVED COMPONENTS

Component Designation	VdS-Approval No.
Electrical control panel FAST 2000/2	G 215098 and G 203051
Control control panel FAST 2000/2	G 215097 and G 297006
Control module	–
Automatic detectors	–
Manual release device	–
Manual release device HM/1/22/17/00	G 206129
Manual release device HM /1/11/17/00	G 205018
Manual release device C31, dC31	G 207079
Acoustical alarm	–
Yodalarm YO3; YO5	G 28702
Sounder DS 5; DS 10	G 28609
Sounder PA Serie	G 212115
Sounder SON F1	G 209080
Acust./opt Signal device PA Serie PA x 1-05	G 212188
Signal device PA Serie PA10, PA20	G 212191
Signal device BE - Serie	G 209081
Signal device CS200	G 209123
Acoustic/opt Signal device SQG3 / SQG3/AV	–
Signal device EMA 1224 B4…	G 211048
Signal device WSO-xxlyy, WSS-ss-lyy, BSO..., BSS…	G 212158
Signal device YL5	G 28702
Visual alarm	–
Optical Signal device PY X-S-05	G 212186
Acoustic signal device	Roshni LP
Acoustic signal device	Roshni LP Solista
Acoustic signal device	Flashni
Acoustic signal device	Squashni
Acoustic signal device	Symphoni Low Power
Acoustic signal device	Symphoni High Power
Optical alarm device	Solex 3, 10, 15

DETECTION AND CONTROL SYSTEMS (Continued)

TABLE 2-11: SIGNAL FROM CONTROL PANEL TO CARBON DIOXIDE FIRE SUPPRESSION SYSTEM

Data	COMPONENT TO BE CONTROLLED			
	SF-2 Electrical Actuator	SMV-1 Stepper Motor	Acoustic Alarm (Supervised)	Acoustic Alarm (Non–supervised)
Technical data sheet number	DS 253	DS 253	According to manufacturer's data sheet	
Operating mode	NC	NC	According to manufacturer's certificate	
Current	0.625 A	0.625 A		
Protection class	IP65	IP54		
Voltage	24 V +15%/-20%	24 V +15%	24 VDC	24 VDC / 230 VAC
Duty cycle (general)	100%	100%	100%	100%
Start of signal	$t_{on} = 0 + t_d$	$t_{on} = 0$	$t_{on} = 0$	$t_{on} = 0$
End of Signal	$t_{off} = t_d$ +10s	$t_{off} = t_d$	$t_{off} = \infty$	$t_{off} = \infty$
Control modules (FAST 2000/2 or FAST Compact/2)	LM32ET LM32TXT EM32T EM32TER	LM32SCT + AM32 LM32TXT + AM32 EM32STE + AM32	LM32ET LM32TXT	IO32T IO32TXT +Relays
Reset conditions	The reset lock is part of approval of EST according to EN 12094-1. When system is released a reset through the control panel is impossible (locked) until the suppression time is over. The suppression time is variable and is defined by the necessities on site.			
Comment	After system reset through the control panel the SF-2 has to be reset manually.	Delay time 10 s to 60 s After system reset through the control panel the SMV-1 has to be reset manually.	Reset manually only after the discharge	
	t_{on} = 0 (without delay) t_{off} = Shutdown t_d = Delay time (0 to 60 s, variable) NC = Normally Closed			

ELECTRICAL EARTHING AND SAFETY CLEARANCES

The installation pipework shall be earthed. If necessary, potential equalisation conductors (regarding non-conductive pipe joints, for example) between all pipes shall be provided or the installation shall be earthed at different points (auxiliary equipotential bonding).

It is recommended that the cross section of the potential equalisation conductor shall be at least half as large as the cross section of the biggest protective grounding, at least 6 mm^2 Cu or equal conductance.

Adequate earthing of CO_2 systems, wherever located, minimises the risk of electrostatic discharge.

Provide sufficient clearance if exposed electrical conductors are present.

FLOW CALCULATIONS

Introduction and installation

CO_2 engineered systems use a VdS developed flow calculation programme. The programme contains flow calculation routines developed to accurately predict the flow of CO_2 through a system of pipework and to determine the piping and nozzle orifice sizing. As part of the Johnson Controls licensing agreement, the programme is copy protected. For additional licences, contact Customer Services.

COMPLETING THE SYSTEM DESIGN

Once the programme has completed its calculations, stating adequate discharge results, and the Design Engineer has taken account of any Warning Flags, the appropriate discharge nozzles are to be ordered using the calculated orifice drill sizes.

NOZZLE DRILLING DETAILS

Johnson Controls supply nozzles in 3/8 in., 1/2 in., and 3/4 in. sizes, in both Total Flood and Local Application versions. The flow calculation programme's print out specifies the drill sizes. When ordering, quote the nozzle part number and drill size.

Stainless steel (SS316) versions of these CO_2 nozzles may be available upon request. Contact Customer Services, if required.

TOTAL FLOODING NOZZLES

When installing nozzles for total flooding systems, the following rules should be followed:

- Position the nozzles uniformly on the ceiling of the enclosure.
- 30 m² coverage for each nozzle.
- 6 m maximum spacing between nozzles.
- Not more than 3 m from a wall or major obstruction.
- 5 m maximum room height for each nozzle.
- Try not to locate the nozzle near an unclosable opening, unless using for screening.
- Make certain nothing interferes with the discharge pattern of the nozzle.
- Make certain the nozzle is not located so that it causes an unduly splash of flammable liquids or creates dust clouds that might extend the fire, create an explosion, or otherwise adversely affect the contents of the enclosure.

PIPEWORK AND FITTINGS

Employ the correct grade and size of pipework and fittings in the system. Construct the distribution piping downstream from the CO_2 valve to withstand the maximum downstream pressure as determined by the flow calculation.

The *Fire Industry Association (FIA) Guidance Document for Pipework* recommends best practice for practitioners that install pipework for Gaseous Fixed Fire Fighting Systems.

VdS APPROVED SYSTEMS - PIPEWORK AND FITTINGS

For VdS approved systems, pipes and pipe joints shall be made of metal and able to withstand the anticipated pressures (see Table 2-12) and low temperatures.

The pipework shall be subjected to a conformity assessment procedure in accordance with the Pressure Equipment Directive. For pipework according to Article 3, Clause 3 Pressure Equipment Directive, the installer shall issue a confirmation stating that the pipework complies with good engineering practice. At least the following technical requirements shall be fulfilled. Pipes shall be dimensioned in accordance with either of the following:

- *AD 2000 (Arbeitsgemeinschaft Druckbehälter* – Working Group for Pressure Vessels) with special consideration of W4 – Non-alloy and alloy steel pipes – and W10 – Materials for low temperatures, ferrous materials.
- *EN 13480*

Only pipes according to Table 2-12 shall be used.

The dimensions shall be in accordance with *EN 10220*. If the pipes according to Table 2-12 are to be used as threaded pipes also, the wall thicknesses shall be adjusted accordingly.

The allowable operating pressure in pipes shall not be exceeded. If required, relief valves shall be fitted.

If there is a danger of CO_2 enclosing in a pipe segment, causing an unallowable increase of internal pressure, this section shall be protected with a safety valve.

With ferritic materials, a corrosion supplement of 1 mm shall be added. This corrosion supplement is not necessary in the following conditions:

- The pipes have a zinc coating in accordance with *EN 10240*.
- The pipes are not subjected to any negative influences from the ambient atmosphere.

The minimum pipe wall thickness for the pipework supplying the suppression gas (core diameter for threaded pipes) is 2 mm, for precision steel pipes 1.5 mm. Precision steel pipes of nominal width 10 mm shall have a minimum pipe wall thickness of 1.0 mm. If an appropriate procedure verifies that the dimensional stability is not at risk, complying with these wall thicknesses is not mandatory.

The quality of the pipes used in accordance with Table 2-12 shall be evidenced by factory test certificates or certificates of compliance with the order as specified in *EN 10204*.

The stamp marking on the pipe material with inspection certificate 3.1 shall not be lost during processing. If required, the stamp marking shall be transferred to separated sections (transfer of identification). An unambiguous assignment of the units to the submitted certificates in accordance with *EN 10204* shall be possible.

PIPEWORK AND FITTINGS (Continued)

TABLE 2-12: MINIMUM REQUIREMENTS FOR PIPE FITTINGS (FOR VdS APPROVED SYSTEMS)

System Section	Allowable operating pressure in bar	Test pressure in bar[2]	Pipe quality in accordance with	Certificate in accordance with EN 10204
High pressure systems between container and selector valve[1]	120[1,2]	172[3]	EN 10216-1 Seamless non-alloy steel tubes with specified room temperature properties Quality TR2 EN 10216-2 Seamless non-alloy steel tubes with specified elevated temperature properties EN 10216-3 Seamless alloy fine grain steel tubes EN 10216-4 Seamless non-alloy and alloy steel tubes with specified low temperature properties EN 10216-5 Seamless stainless steel tubes EN 10217-1 Welded non-alloy steel tubes with specified room temperature properties EN 10217-2 Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties EN 10217-3 Welded alloy fine grain steel tubes EN 10217-4 Electric welded non-alloy steel tubes with specified low temperature properties EN 10217-7 Welded stainless steel tubes EN 10305-1 Steel tubes for precision applications technical delivery conditions for seamless cold-drawn tubes EN 10305-2 Steel tubes for precision applications technical delivery conditions for welded cold-drawn tubes	Inspection certificate 3.1
High pressure systems downstream of selector valve	60[4]	86[3]	EN 10216-1 Seamless non-alloy steel tubes with specified room temperature properties Quality TR2 EN 10216-2 Seamless non-alloy steel tubes with specified elevated temperature properties EN 10216-3 Seamless alloy fine grain steel tubes EN 10216-4 Seamless non-alloy and alloy steel tubes with specified low temperature properties EN 10216-5 Seamless stainless steel tubes EN 10217-1 Welded non-alloy steel tubes with specified room temperature properties	Factory test certificate 2.2

TABLE 2-12: MINIMUM REQUIREMENTS FOR PIPE FITTINGS (Continued)

System Section	Allowable operating pressure in bar	Test pressure in bar[2]	Pipe quality in accordance with	Certificate in accordance with EN 10204
High pressure systems downstream of selector valve	60[4]	86[3]	EN 10217-2 Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties EN 10217-3 Welded alloy fine grain steel tubes EN 10217-4 Electric welded non-alloy steel tubes with specified low temperature properties EN 10217-7 Welded stainless steel tubes EN 10305-1 Steel tubes for precision applications technical delivery conditions for seamless cold-drawn tubes EN 10305-2 Steel tubes for precision applications technical delivery conditions for welded cold-drawn tubes	Factory test certificate 2.2
Low pressure systems downstream of container valve	25	40[3]	EN 10216-1 Seamless non-alloy steel tubes with specified room temperature properties Quality TR2 EN 10216-2 Seamless non-alloy steel tubes with specified elevated temperature properties EN 10216-3 Seamless alloy fine grain steel tubes EN 10216-4 Seamless non-alloy and alloy steel tubes with specified low temperature properties EN 10216-5 Seamless stainless steel tubes EN 10217-1 Welded non-alloy steel tubes with specified room temperature properties EN 10217-2 Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties EN 10217-3 Welded alloy fine grain steel tubes EN 10217-4 Electric welded non-alloy steel tubes with specified low temperature properties EN 10217-7 Welded stainless steel tubes EN 10305-1 Steel tubes for precision applications technical delivery conditions for seamless cold-drawn tubes EN 10305-2 Steel tubes for precision applications technical delivery conditions for welded cold-drawn tubes	Factory test certificate 2.2

TABLE 2-12: MINIMUM REQUIREMENTS FOR PIPE FITTINGS (Continued)

System Section	Allowable operating pressure in bar	Test pressure in bar[2]	Pipe quality in accordance with	Certificate in accordance with EN 10204
High pressure systems downstream of selector valve	60[4]	86[3]	EN 10217-2 Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties EN 10217-3 Welded alloy fine grain steel tubes EN 10217-4 Electric welded non-alloy steel tubes with specified low temperature properties EN 10217-7 Welded stainless steel tubes EN 10305-1 Steel tubes for precision applications technical delivery conditions for seamless cold-drawn tubes EN 10305-2 Steel tubes for precision applications technical delivery conditions for welded cold-drawn tubes	Factory test certificate 2.2
Low pressure systems downstream of container valve	25	40[3]	EN 10216-1 Seamless non-alloy steel tubes with specified room temperature properties Quality TR2 EN 10216-2 Seamless non-alloy steel tubes with specified elevated temperature properties EN 10216-3 Seamless alloy fine grain steel tubes EN 10216-4 Seamless non-alloy and alloy steel tubes with specified low temperature properties EN 10216-5 Seamless stainless steel tubes EN 10217-1 Welded non-alloy steel tubes with specified room temperature properties EN 10217-2 Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties EN 10217-3 Welded alloy fine grain steel tubes EN 10217-4 Electric welded non-alloy steel tubes with specified low temperature properties EN 10217-7 Welded stainless steel tubes EN 10305-1 Steel tubes for precision applications technical delivery conditions for seamless cold-drawn tubes EN 10305-2 Steel tubes for precision applications technical delivery conditions for welded cold-drawn tubes	Factory test certificate 2.2

TABLE 2-12: MINIMUM REQUIREMENTS FOR PIPE FITTINGS (Continued)

System Section	Allowable operating pressure in bar	Test pressure in bar[2]	Pipe quality in accordance with	Certificate in accordance with EN 10204
Malleable cast iron fittings[5]	120 (at -50 °C)	172[3]	EN 10242 Threaded pipe fittings in malleable cast iron Allowable materials: - white malleable cast iron acc. EN 1562 from EN-GJMW-400-5 Material no. EN-JM1030 - black malleable cast iron acc. EN 1562 from EN-GJMB-450-6 Material no. EN-JM1140	Factory test certificate 2.2
Distribution pipe and pilot lines	Design pressure	1.43-fold of design pressure[3]	EN 10305-1 Steel tubes for precision applications Technical delivery conditions for seamless cold-drawn tubes EN 10305-2 Steel tubes for precision applications technical delivery conditions for welded cold-drawn tubes	

Notes:

1. This pressure corresponds to the pressure in the container at a temperature of 35 °C and a filling degree of 0.75.
2. The operating pressure shall not be exceeded, not even due to leakages of the container valves. If required, safety valves shall be fitted. If there is a risk of CO_2 being enclosed in a pipe segment, thus unduly increasing the internal pressure, this section shall be protected by means of a safety valve.
3. The leakage test of the pipes shall be an internal pressure test carried out with water in accordance with the delivery standard, or else another equivalent test. The requirements of the Pressure Equipment Directive shall be fulfilled.
4. The design pressure of 60 bar for open pipework results from the operating experience gained with CO_2 suppression systems.
5. Malleable cast iron fittings shall be designed at least for an operating pressure of 120 bar and an operating temperature of -50 °C. Where the manufacturer releases fittings especially for the application in an individual test procedure, the manufacturer shall mark each fitting at least with a red dot and the letter D.

EQUIPMENT CONFIGURATIONS

A fixed CO_2 fire suppression system contains numerous components that allow assembly in various configurations. This provides the system designer with a flexible system. The equipment outlined in this section provides sufficient details for most system design requirements. Figure 3-1 and Figure 3-2 illustrate typical layouts for the two most common container arrangements.

CONTAINER BANK OF EIGHT OR LESS CONTAINERS

Electrical operation with local manual control

A container bank consists of a master container and up to seven subordinate containers. Both the master and subordinate containers hold the same contents. Pressure released at the opening of the master container is directed toward the pneumatic actuators of the subordinate containers. This pressure operates all valves simultaneously. Master containers use 128-20 valves and subordinate containers use 110-00 valves.

The pneumatic release system incorporates a non-return valve to maintain the optimal pressure level to activate all containers. The pneumatic release system also incorporates a device to safely vent residual pressure in the pneumatic release circuit.

The control panel, through a solenoid valve, may actuate the system automatically. For manual actuation, complete the following steps:

1. Access the master container release.
2. Remove the safety seal.
3. Pull the lever.

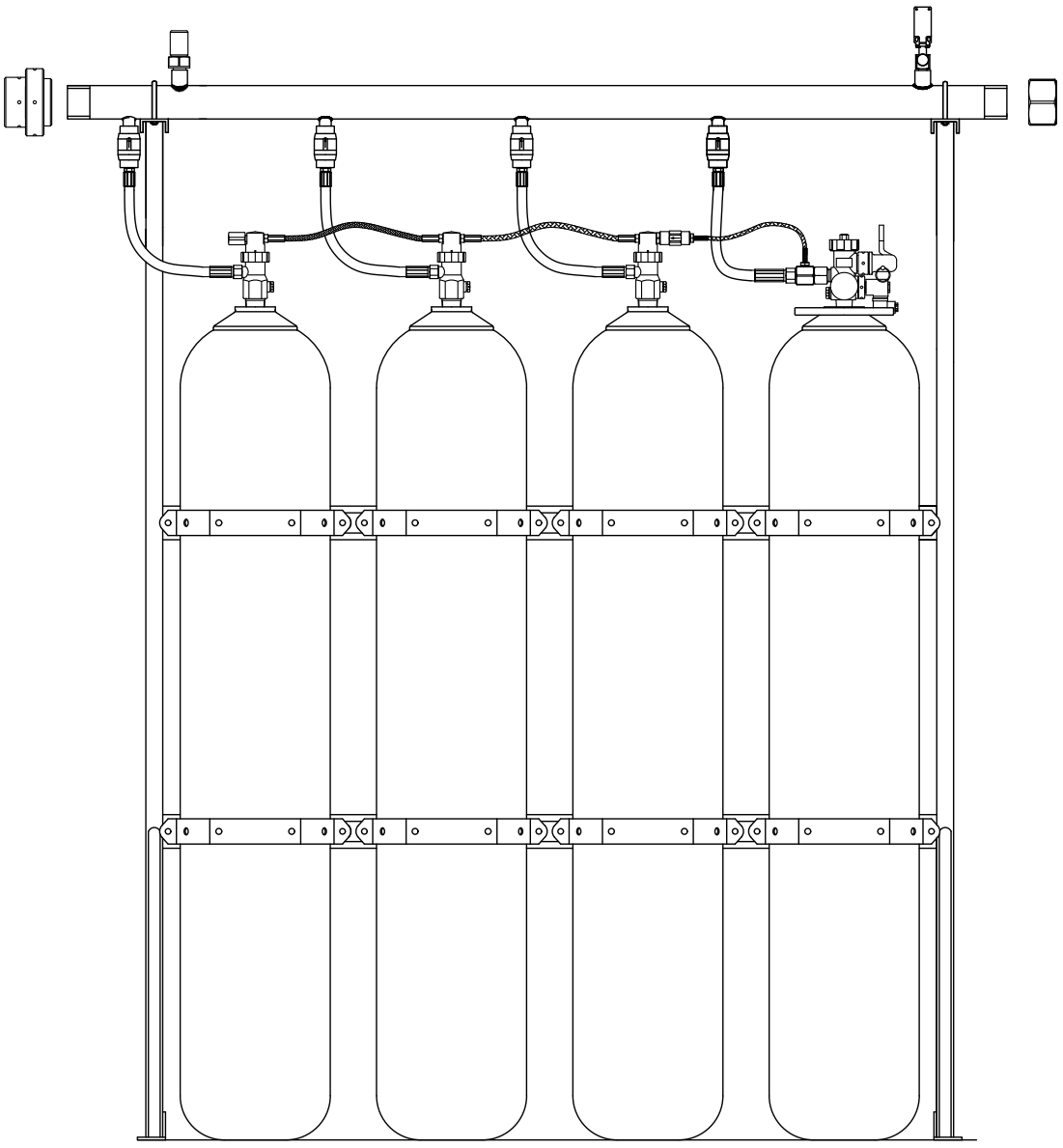


FIGURE 3-1
TYPICAL MASTER CONTAINER SYSTEM ARRANGEMENT
(BANK OF EIGHT OR LESS CO_2 CONTAINERS)
E001161

CONTAINER BANK OF NINE OR MORE CONTAINERS

Container banks incorporating nine or more containers require a pilot container to pneumatically operate the CO_2 system. The nitrogen pressure released from the pilot container on actuation operates the pneumatic actuators on each of the subordinate containers. The pilot container uses the 128-90 valve and the subordinate containers use 110-00 valves.

The pilot container includes a bleed valve to avoid actuation in the event of a micro leak or other unintentional pressure build-up. The last container in the bank includes a decompression screw to safely release pressure from the actuation line following a system discharge.

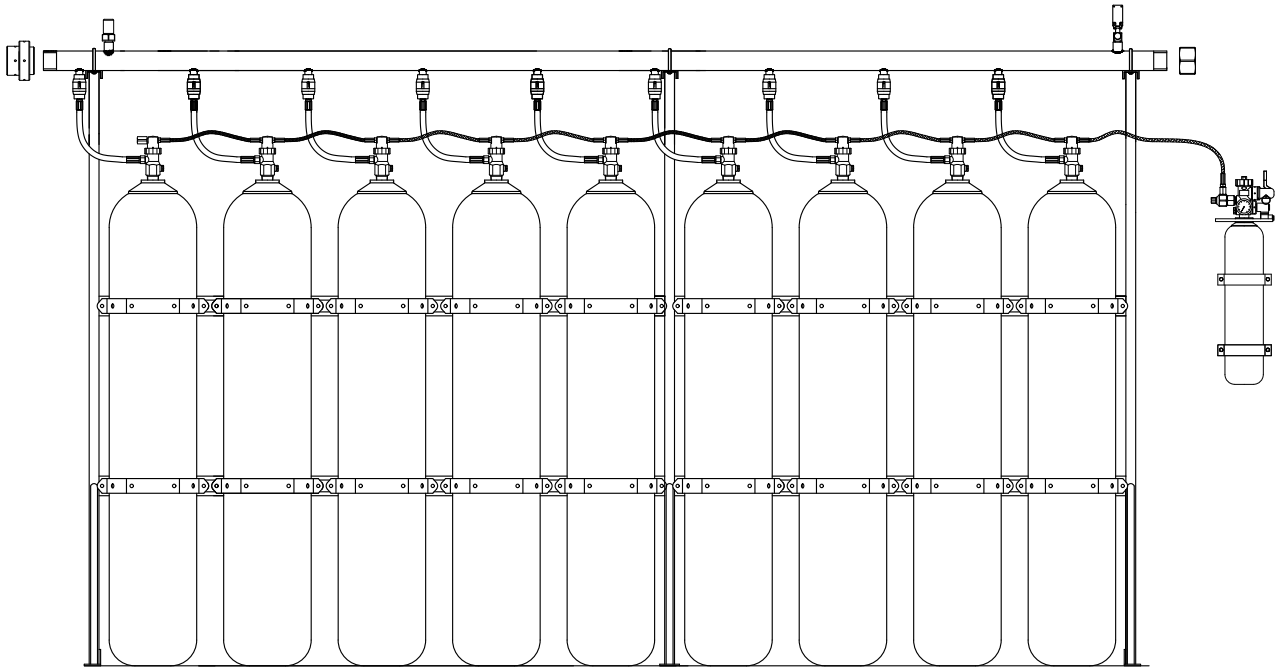


FIGURE 3-2
TYPICAL PILOT CONTAINER SYSTEM ARRANGEMENT (BANK OF NINE OR MORE CO_2 CONTAINERS)
E001161

CONTAINER BANKS WITH SELECTOR VALVES

Selector valves can be incorporated into a CO_2 system in order to protect multiple hazards from a single bank of containers. Figure 3-3 shows a system where four containers can discharge into either one of two hazards. The selector valve pneumatically operates through the use of a pilot container. Selector valves are installed onto specially designed selector valve manifolds that connect to the CO_2 manifold and the system pipework through the use of union connectors.

The design requirements may permit the use of primary and reserve storage systems with selector valves.

A selector valve system includes a pilot container. The control panel and solenoid valve allow automatic actuation of the system. A selector valve system also allows for manual actuation. In the event of automatic actuation, the pilot container solenoid valve, solenoid valves, and the selector valve manual release activate simultaneously.

In the event of manual actuation, personnel must access the solenoid valve and selector valve manual release protecting the hazard zone. To actuate the system manually, complete the following steps:

1. Remove the safety seal.
2. Pull the fitted lever.
3. Later, remove the safety seal on the pilot container manual release lever and pull the lever.

Container banks with selector valve systems and container banks incorporating nine or more containers require a pilot container.

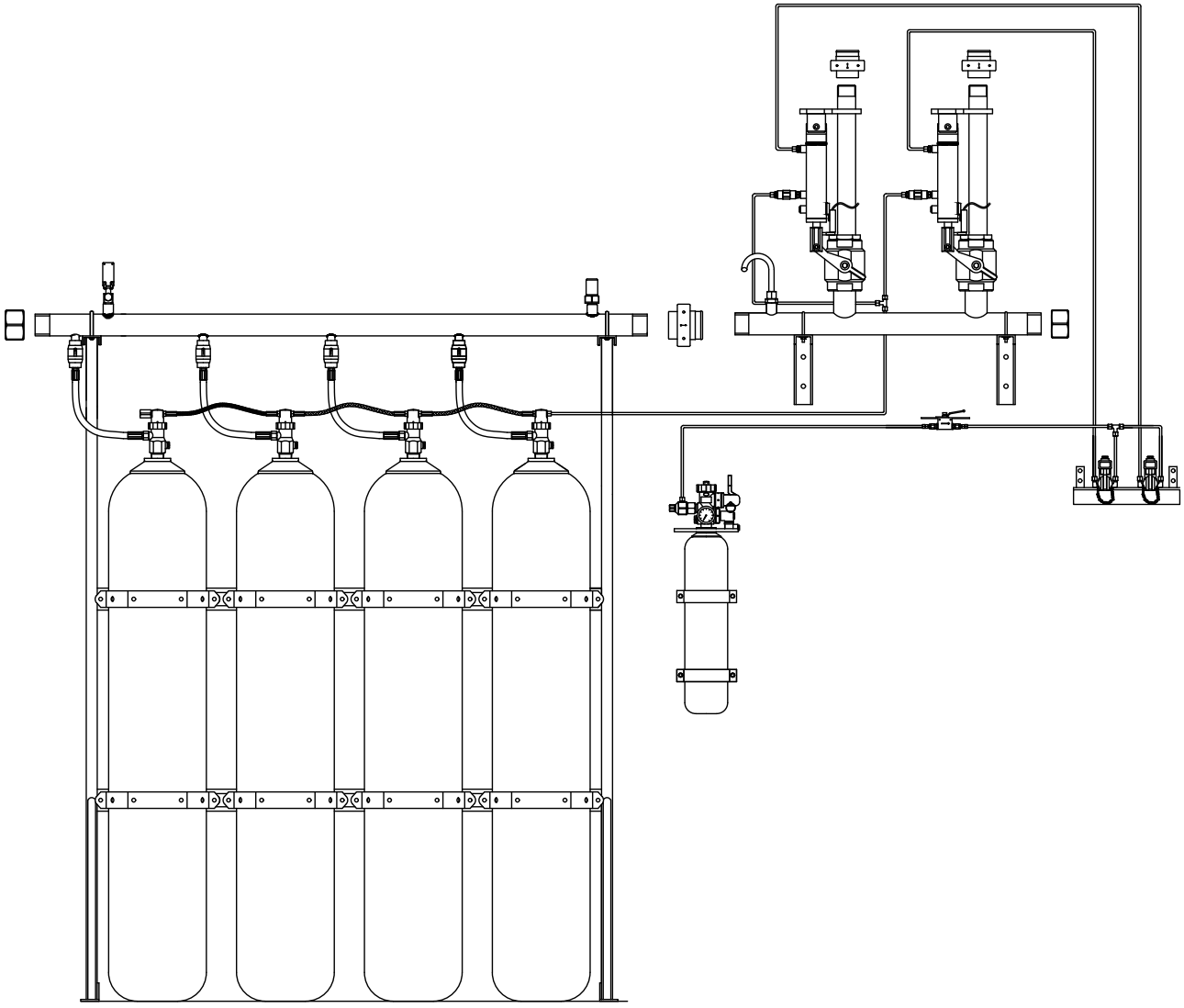


FIGURE 3-3
TYPICAL SELECTOR VALVE SYSTEM ARRANGEMENT (EQUAL SIZE RISKS)
E001159

CONTAINER BANKS WITH WEIGHING SYSTEMS

To monitor the level of CO_2 content within each CO_2 container it must be weighed. Mechanical weighing device systems allow the continuous monitoring of each container within the bank. In case of a leakage or discharging of containers, the weighing device system gives a visual indication or with the addition of micro switches, alarm monitoring through external systems, such as a control panel or main control system.

The VdS weighing device connects directly onto each container flange, and so no modification of the valve or the pneumatic actuation line is required.

The mechanical weighing device is only suitable for 67 L containers.

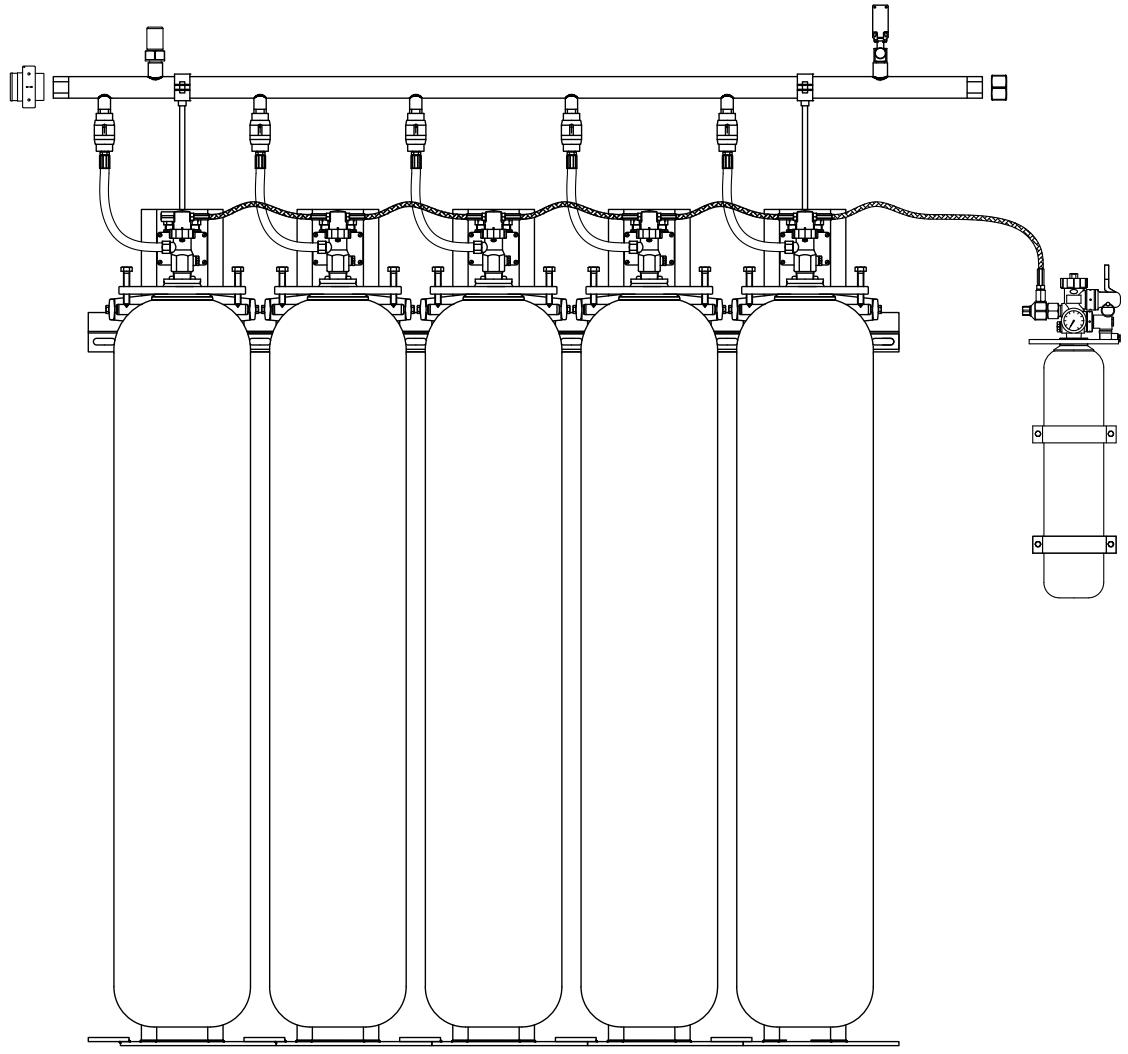


FIGURE 3-4
TYPICAL CO_2 SYSTEM ARRANGEMENT WITH WEIGHING SYSTEM (PILOT CONTAINER ACTUATION METHOD)
E001152

SELF-CONTAINED CONTAINER

For self-contained container configurations, the system consists of only one container. The container holds the suppression agent. The valve incorporates all actuation and discharge release systems. The valve uses the pressure in the container to open. This system consists of a fitted manual and electrical solenoid valve actuation system. If required for special applications, the system can actuate pneumatically.

5 L, 13.4 L, 26.8 L, 40.2 L, and 67 L self-contained container sizes are available, and these are fitted with a 128-20 valve. The valve incorporates micro leakage proof actuation devices and a safety disc to prevent over pressurisation of the container. A control panel through a solenoid valve may activate self-contained containers automatically. For manual actuation, complete the following steps:

1. Access the manual release lever.
2. Remove the safety seal and pull the lever.

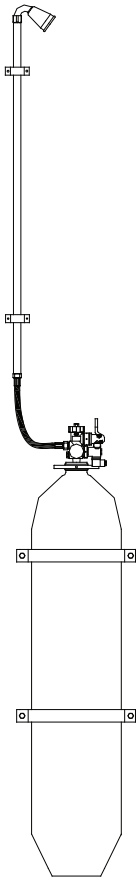


FIGURE 3-5
CO_2 SINGLE CONTAINER SYSTEM
E000564

NOTES:

EQUIPMENT DESCRIPTIONS

Equipment description	Part No.
67 L master container assembly (128-20 valve and no solenoid) for VdS weighing device - 45 kg CO_2 fill	71104051H
67 L master container assembly (128-20 valve with solenoid) for VdS weighing device - 45 kg CO_2 fill	71104047H
67 L master container assembly (128-20 valve and no solenoid) for VdS weighing device - 50 kg CO_2 fill	71104052H
67 L master container assembly (128-20 valve with solenoid) for VdS weighing device - 50 kg CO_2 fill	71104048H
67 L master container assembly (128-20 valve and no solenoid) - 45 kg CO_2 fill	71104005H
67 L master container assembly (128-20 valve with solenoid) - 45 kg CO_2 fill	71104006H
67 L master container assembly (128-20 valve and no solenoid) - 50 kg CO_2 fill	71104009H
67 L master container assembly (128-20 valve with solenoid) - 50 kg CO_2 fill	71104010H
40.2 L master container assembly (128-20 valve with solenoid) - 27 kg CO_2 fill	70104018H
40.2 L master container assembly (128-20 valve with solenoid) - 30 kg CO_2 fill	70104020H
26.8 L master container assembly (128-20 valve with solenoid) - 18 kg CO_2 fill	70104014H
26.8 L master container assembly (128-20 valve with solenoid) - 20 kg CO_2 fill	70104016H
13.4 L master container assembly (128-20 valve with solenoid) - 9 kg CO_2 fill	70104010H
13.4 L master container assembly (128-20 valve and no solenoid) - 10 kg CO_2 fill	70104011H
13.4 L master container assembly (128-20 valve with solenoid) - 10 kg CO_2 fill	70104012H
5 L master container assembly (128-20 valve and no solenoid) - 3 kg CO_2 fill	70104007H
5 L master container assembly (128-20 valve with solenoid) - 3 kg CO_2 fill	70104008H
67 L subordinate container assembly (110-00 valve) - 45 kg CO_2 fill	71104007H
67 L subordinate container assembly (110-00 valve) - 50 kg CO_2 fill	71104011H
40.2 L subordinate container assembly (110-00 valve) - 27 kg CO_2 fill	70104057H
40.2 L subordinate container assembly (110-00 valve) - 30 kg CO_2 fill	70104058H
Container label (HYGOOD CO_2)	35116400
Pilot container label	35116425
CO_2 master valve, type 128-20, with solenoid	2000262V.SOL
CO_2 master valve, type 128-20, without solenoid (blind cap)	2000262V.BLC
CO_2 subordinate valve, type 110-00	20002260
CO2 master container flange for use with VdS weighing device	161110021
CO_2 master container diverter	91104001
Pneumatic actuator, 3 way, 1/4 in. blind cap	30100106
Pneumatic actuator, 2 way	30100102
Actuation hose, 1/4 in. x 1/4 in. x 350 mm	30500041
Actuation hose, 1/4 in. x 1/4 in. x 700 mm	30522001
500 mm R1 Flexible discharge hose	91116048
350 mm R1 Flexible discharge hose	91116049
350 mm R2 Flexible discharge hose	30521041
310 mm R2 Flexible discharge hose	30504311
6 mm Copper nickel pipe (6 × 4 mm)	30804068
6 mm Half hard pipe - 3 m	308.002.002
6 mm Compression tee	30880015
6 mm Stud coupling (1/4 in. BSPT × 6 mm)	30880007
1/4 in. BSP socket (1/4 in. BSPP hose - female / female)	30880008
1/4 in. Dowty seal	31199816
1/4 in. Bull nose adaptor	30880009
6 mm Straight coupling	30880020
Decompression screw	30027301
Discharge pressure switch	30330010
Odouriser assembly	35116701
Total flood nozzle 3/8 in. 360° drilled (includes nozzle filter)	30460000
Total flood nozzle 1/2 in. 360° drilled (includes nozzle filter)	30460001
Total flood nozzle 3/4 in. 360° drilled	30460002
Total flood nozzle (SS316 stainless steel) 3/8 in. 360° drilled (includes nozzle filter)	30460000SS316
Total flood nozzle (SS316 stainless steel) 1/2 in. 360° drilled (includes nozzle filter)	30460001SS316
Total flood nozzle (SS316 stainless steel) 3/4 in. 360° drilled	30460002SS316

EQUIPMENT DESCRIPTIONS

Equipment description	Part No.
CO_2 local application nozzle with zinc plated steel cone 3/8 in. drilled (includes nozzle filter)	30460038
CO_2 local application nozzle with zinc plated steel cone 1/2 in. drilled (includes nozzle filter)	30460012
CO_2 local application nozzle with zinc plated steel cone 3/4 in. drilled	30460034
CO_2 local application nozzle with SS316 stainless steel cone 3/8 in. drilled (includes nozzle filter)	30460038SS316
CO_2 local application nozzle with SS316 stainless steel cone 1/2 in. drilled (includes nozzle filter)	30460012SS316
CO_2 local application nozzle with SS316 stainless steel cone 3/4 in. drilled	30460034SS316
3/8 in. nozzle filter - SS316 stainless steel	30210838SS316
1/2 in. nozzle filter - SS316 stainless steel	30210812SS316
Hexagonal bracket (for 67 L CO_2 container)	30626711
Hexagonal bracket (for 5 L and 13.4 L CO_2 container)	30621310
Hexagonal bracket (for 26.8 L and 40.2 L CO_2 container)	30625010
Bridging bracket for 2 container	36116313
Bridging bracket for 3 container	36116314
Bridging bracket for 4 container	36116315
Bridging bracket for 5 container	36116316
Bridging bracket for 6 container	36116317
Telescopic vertical column	36116019
Accessories for 2 lateral vertical column	36116020
Accessories for central vertical column	36116022
Manifold seat, single row, without weighing device	94116000
Double telescopic vertical column	36116004
Accessories for 2 double telescopic vertical column	36116005
Accessories for central telescopic vertical column	36116006
Manifold seat, double row, without weighing device	94116001
Weighing column (post)	K02400086
Weighing device, type WEH-1	K02401786
Surweights - each (2 required per container)	K02401876
Counterweight bar	K02401936
RS3 Loss indicator switch (VdS)	K02462736
RS4 Loss indicator switch (VdS, used with FAST 2000 only)	K02462756
Manifold support, single row, VdS	130640006
Manifold support, double row, VdS	130009200
1 in. Clamp for manifold support single row weighing VdS (TW)	30009206
1 1/2 in. Clamp for manifold support single row weighing VdS (TW)	30009208
2 in. Clamp for manifold support single row weighing VdS (TW)	30009209
3 in. Clamp for manifold support single row weighing VdS (TW)	30009211
4 in. Clamp for manifold support single row weighing VdS (TW)	30009212
3/4 in. to 4 in. U-bolt for manifold support double row weighing VdS (TW)	30600050 to 30600120
1/2 in. CO_2 check valve	20006054
Single row CO_2 manifold, 25 mm (1 in.) diameter (40 L / 67L) without weighing device	38021022 to 38021062
Single row CO_2 manifold, 40 mm (1 1/2 in.) diameter (40 L / 67 L) without weighing device	38021024 to 38021124
Single row CO_2 manifold, 50 mm (2 in.) diameter (40 L / 67 L) without weighing device	38021045 to 38021155
Double row CO_2 manifold, 25 mm (1 in.) diameter (40 L / 67 L) without weighing device	39021042 to 39021082
Double row CO_2 manifold, 40 mm (1 1/2 in.) diameter (40 L / 67 L) without weighing device	39021064 to 39021144
Double row CO_2 manifold, 50 mm (2 in.) diameter (40 L / 67 L) without weighing device	39021065 to 39021205
Double row CO_2 manifold, 80 mm (3 in.) diameter (40 L / 67 L) without weighing device	39021167 to 39021207
Single row CO_2 manifold, 25 mm (1 in.) diameter (67 L) with weighing device	38021022 to 38021062
Single row CO_2 manifold, 40 mm (1 1/2 in.) diameter (67 L) with weighing device	38021024 to 38021124
Single row CO_2 manifold, 50 mm (2 in.) diameter (67 L) with weighing device	38021045 to 38021155
Double row CO_2 manifold, 25 mm (1 in.) diameter (67 L) with weighing device	39021042 to 39021082
Double row CO_2 manifold, 40 mm (1 1/2 in.) diameter (67 L) with weighing device	39021064 to 39021144
Double row CO_2 manifold, 50 mm (2 in.) diameter (67 L) with weighing device	39021065 to 39021205
Double row CO_2 manifold, 80 mm (3 in.) diameter (67 L) with weighing device	39021167 to 39021207

EQUIPMENT DESCRIPTIONS

Equipment description	Part No.
Selector valve 25 mm (1 in.) with solenoid actuator and manual release	445044
Selector valve 40 mm (1 1/2 in.) with solenoid actuator and manual release	445046
Selector valve 50 mm (2 in.) with solenoid actuator and manual release	445047
Selector valve 80 mm (3 in.) with solenoid actuator and manual release	445049
Selector valve 100 mm (4 in.) with solenoid actuator and manual release	445050
Selector valve 25 mm (1 in.) with solenoid actuator and blind cap (no manual release)	442796
Selector valve 40 mm (1 1/2 in.) with solenoid actuator and blind cap (no manual release)	442798
Selector valve 50 mm (2 in.) with solenoid actuator and blind cap (no manual release)	442799
Selector valve 80 mm (3 in.) with solenoid actuator and blind cap (no manual release)	442801
Selector valve 100 mm (4 in.) with solenoid actuator and blind cap (no manual release)	442802
Selector valve microswitch	30116011
Selector valve solenoid with manual release	30130253V
Selector valve solenoid only with blind cap	30130255V
Selector valve solenoid mounting bracket (2 solenoids)	30650022
Selector valve solenoid mounting bracket (3 solenoids)	30650013
Selector valve solenoid mounting bracket (4 solenoids)	30650014
Selector valve manifold - 25 mm (1 in.) diameter	36222000 to 36622222
Selector valve manifold - 40 mm (1 1/2 in.) diameter	36244000 to 36644444
Selector valve manifold - 50 mm (2 in.) diameter	36255000 to 36655555
Selector valve manifold - 80 mm (3 in.) diameter	36277000 to 36677777
Selector valve manifold - 100 mm (4 in.) diameter	36288000 to 36688888
Selector valve manifold outlet nipple - 25 mm (1 in.) diameter	94116022
Selector valve manifold outlet nipple - 40 mm (1 1/2 in.) diameter	94116024
Selector valve manifold outlet nipple - 50 mm (2 in.) diameter	94116025
Selector valve manifold outlet nipple - 80 mm (3 in.) diameter	94116027
Selector valve manifold outlet nipple - 100 mm (4 in.) diameter	94116028
Manifold drop section - 25 mm (1 in.) diameter - 900 mm pipe centres	19263002
Manifold drop section - 40 mm (1 1/2 in.) diameter - 900 mm pipe centres	19263004
Manifold drop section - 50 mm (2 in.) diameter - 900 mm pipe centres	19263005
Manifold drop section - 80 mm (3 in.) diameter - 900 mm pipe centres	19263007
Manifold drop section - 100 mm (4 in.) diameter - 900 mm pipe centres	19263008
Manifold drop section - 25 mm (1 in.) diameter - 1500 mm pipe centres	19263010
Manifold drop section - 40 mm (1 1/2 in.) diameter - 1500 mm pipe centres	19263012
Manifold drop section - 50 mm (2 in.) diameter - 1500 mm pipe centres	19263013
Manifold drop section - 80 mm (3 in.) diameter - 1500 mm pipe centres	19263015
Manifold drop section - 100 mm (4 in.) diameter - 1500 mm pipe centres	19263016
Union connector - 25 mm (1 in.) diameter - NPT to NPT	30888002
Union connector - 40 mm (1 1/2 in.) diameter - NPT to NPT	30888004
Union connector - 50 mm (2 in.) diameter - NPT to NPT	30888005
Union connector - 80 mm (3 in.) diameter - NPT to NPT	30888007
Union connector - 100 mm (4 in.) diameter - NPT to NPT	30888008
Union connector - 25 mm (1 in.) diameter - NPT to BSPT	30888028
Union connector - 40 mm (1 1/2 in.) diameter - NPT to BSPT	30888030
Union connector - 50 mm (2 in.) diameter - NPT to BSPT	30888031
Union connector - 80 mm (3 in.) diameter - NPT to BSPT	30888033
Union connector - 100 mm (4 in.) diameter - NPT to BSPT	30888034
Spare o-ring for 25 mm (1 in.) union connector	22000524
Spare o-ring for 40 mm (1 1/2 in.) union connector	22000527
Spare o-ring for 50 mm (2 in.) union connector	22000528
Spare o-ring for 80 mm (3 in.) union connector	22000530
Spare o-ring for 100 mm (4 in.) union connector	22000531

EQUIPMENT DESCRIPTIONS

Equipment description	**Part No.**
Manifold burst disc assembly	200CD190
Pressure relief valve	62104001
Vent valve	302700014
Pilot line non-return valve	20006020
Lock-off assembly	302.200.072
Lock-off assembly limit switch	K02462526
Lock-off assembly limit switch and fixing kit	K02462876
Lock-off unit	62114001
3 L Pilot container - standard	70100075
13 L Pilot container - standard	70100082
50 L Pilot container - standard	70121011
3 L Pilot container - VdS	170100075
13 L Pilot container - VdS	170103015
3 L Pilot container - VdS - for SF-2 or SMV-1 use	170100077
13 L Pilot container - VdS - for SF-2 or SMV-1 use	170103017
3 L Pilot container (SF-2 or SMV-1)	170100077
13 L Pilot container (SF-2 or SMV-1)	170103017
Actuation coupling for stepper motor and SF-2 actuator	130850006
Solenoid (master container and pilot container)	3023024B
128-90 Pilot container valve	29012804.SOL and 29012804.BLC
Solenoid valve	2000262V.SOL
Pilot container pressure gauge	42116061
Manual actuator	30180APB
SMV-1 Stepper motor	K02413976
SF-2 Electrical actuator	K02460326
1/4 in. Bleed valve	302.200.075
Pilot valve adaptor	35116381
Test and relief unit (pre-1)	K02424666
Pilot line test device	62108523
Pneumatic time delay and siren	70100120
MX-1 Pneumatic siren assembly	860050
Silencer for MX-1 siren	877120
C Spanner Dia 35 mm to 60 mm, pin Dia 4 mm	35017401
C Spanner Dia 60 mm to 90 mm, pin Dia 5 mm	35017402
C Spanner Dia 90 mm to 155 mm, pin Dia 6 mm	35017403
C Spanner Dia 165 mm to 230 mm, pin Dia 10 mm	35017404
CO_2 Manual release caution plate - English	314.200.002
CO_2 Manual release caution plate - Spanish	63013065
CO_2 Door caution plate - English	314.200.001
CO_2 Door caution plate - Spanish	63013064
Thermometer	K0.240.070.6

NOTES:

CO_2 HIGH PRESSURE CONTAINER ASSEMBLY

Carbon dioxide fire suppression systems are configured around a range of container and valve assemblies. Each basic assembly consists of the following components:

- Container
- Valve assembly
- Syphon tube
- Transport cap
- Container labels

Johnson Controls can supply each master container with either a fitted solenoid or a fitted blanking cap on the solenoid port. Johnson Controls provide each assembly filled with CO_2 to either one of two possible fill ratios. Tables 4-1, 4-2, and 4-3 list the fill details and weights for each type and size of container. Table 4-4 lists the dimensions for each assembly.

- Containers are designed, manufactured, and marked in accordance with *EN 1964 Part 1* and *2010/35/EC* and are pressure tested to 250 bar. All containers are fitted with labels providing safety, maintenance, and pressure temperature information.
- Containers are coloured black to *RAL 9005* on the body with an olive grey neck to *RAL 7037*.
- Do not subject containers to direct sunlight or adverse weather conditions. Do not position containers where water can accumulate around the base.
- Do not install the containers within the hazard area requiring protection, if possible. If the system design specifies locating the containers within the hazard area, locate a remote mechanical manual release unit outside the hazard area in addition to any electrical controls.
- Do not exceed the specified capacity. Exceeding the capacity causes a pressure increase due to a rise in temperature. This can cause the safety disc to rupture.
- *BS 5355 (EN 13096:2003, EN13099:2003)* defines climatic area class E as a geographical region where the maximum temperature shade is equal to or greater than 52.5 ºC. Locate the container as close to the hazard as possible. Protect the container from high ambient temperatures and from radiant sources of heat, such as radiation of direct sunlight.

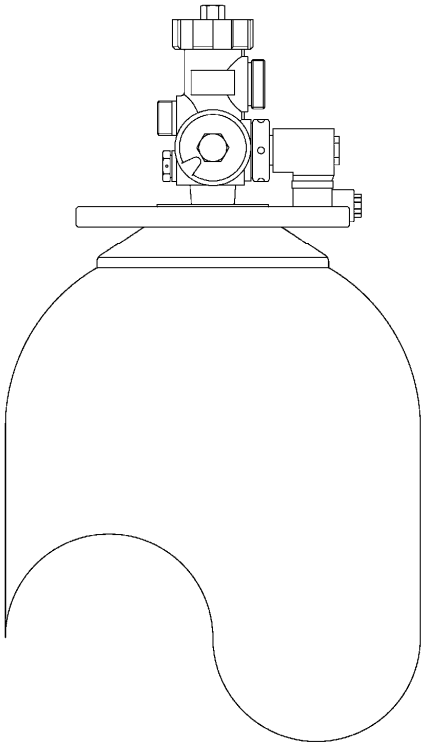


FIGURE 4-1
CO_2 HIGH PRESSURE CONTAINER ASSEMBLY
025784

CO_2 HIGH PRESSURE CONTAINER ASSEMBLY (Continued)

- CO_2 container and valve assemblies are available in a range of sizes and options dependent upon the system requirements and design.
- Two types of CO_2 fills are available, 0.75 kg/L and 0.67 kg/L fills. According to *ISO 6183:2009,* the maximum ambient temperature for 0.75 kg/L CO_2 fills is 40 °C, whereas for 0.67 kg/L CO_2 fills it is 49 °C.

Note: Local regulations or the authority having jurisdiction (AHJ) may recommend lower maximum temperatures.

- There are also a range of CO_2 master container and valve assemblies designed for use with the VdS approved weighing device, and a range where the weighing of master containers is not available.
- The 67 L subordinate containers can be used with or without the VdS approved weighing device.
- The weight of each CO_2 container can vary and this weight is stamped onto the neck of the container. The following tables give values based upon the maximum and minimum container weights, and include transport protection cap and container flange weights.

TABLE 4-1: MASTER CONTAINER AND VALVE ASSEMBLIES FOR USE WITH THE VdS WEIGHING DEVICE

Part No.	Container size (L)	CO_2 fill (kg)	Valve fitted with solenoid	Min. tare weight (kg)	Max. tare weight (kg)	Min. gross weight (kg)	Max. gross weight (kg)
71104051H	67	45	No	78.6	93.6	123.6	138.6
71104047H	67	45	Yes	78.6	93.6	123.6	138.6
71104052H	67	50	No	78.6	93.6	128.6	143.6
71104048H	67	50	Yes	78.6	93.6	128.6	143.6

TABLE 4-2: MASTER CONTAINER AND VALVE ASSEMBLIES FOR USE WITHOUT THE VdS WEIGHING DEVICE

Part No.	Container size (L)	CO_2 fill (kg)	Valve fitted with solenoid	Min. tare weight (kg)	Max. tare weight (kg)	Min. gross weight (kg)	Max. gross weight (kg)
71104005H	67	45	No	79.1	94.1	124.1	139.1
71104006H	67	45	Yes	79.1	94.1	124.1	139.1
71104009H	67	50	No	79.1	94.1	129.1	144.1
71104010H	67	50	Yes	79.1	94.1	129.1	144.1
70104018H	40.2	27	Yes	46.9	64.9	73.9	91.9
70104020H	40.2	30	Yes	46.9	64.9	76.9	94.9
70104013H	26.8	18	No	33.7	47.7	51.7	65.7
70104014H	26.8	18	Yes	33.7	47.7	51.7	65.7
70104015H	26.8	20	No	33.7	47.7	53.7	67.7
70104016H	26.8	20	Yes	33.7	47.7	53.7	67.7
70104009H	13.4	9	No	16.8	21.8	25.8	30.8
70104010H	13.4	9	Yes	16.8	21.8	25.8	30.8
70104011H	13.4	10	No	16.8	21.8	26.8	31.8
70104012H	13.4	10	Yes	16.8	21.8	26.8	31.8
70104007H	5	3	No	10.6	12.8	13.6	15.8
70104008H	5	3	Yes	10.6	12.8	13.6	15.8

TABLE 4-3: SUBORDINATE CONTAINER AND VALVE ASSEMBLIES

Part No.	Container size (L)	CO_2 fill (kg)	Min. tare weight (kg)	Max. tare weight (kg)	Min. gross weight (kg)	Max. gross weight (kg)
71104007H	67	45	74.1	89.1	119.1	134.1
71104011H	67	50	74.1	89.1	124.1	139.1
70104057H	40.2	27	42.1	60.1	69.1	87.1
70104058H	40.2	30	42.1	60.1	72.1	90.1

CO_2 HIGH PRESSURE CONTAINER ASSEMBLY (Continued)

For container and valve assembly details, see Figure 4-2 and Figure 4-3.

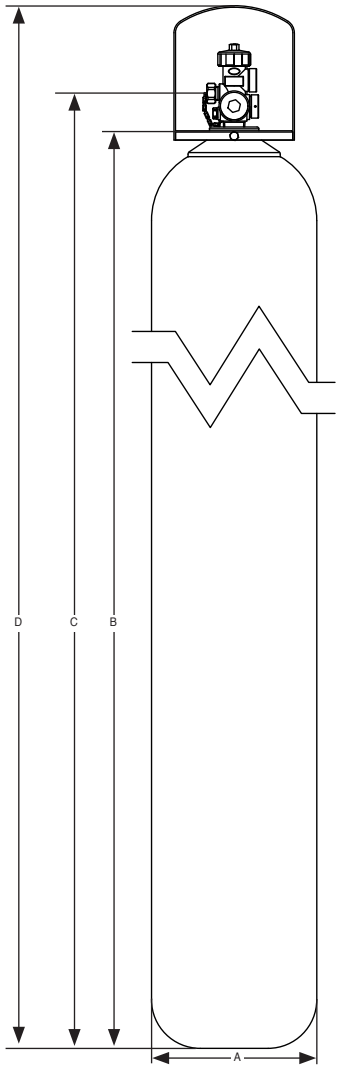


FIGURE 4-2
MASTER CONTAINER ASSEMBLY (128-20 VALVE)
025294

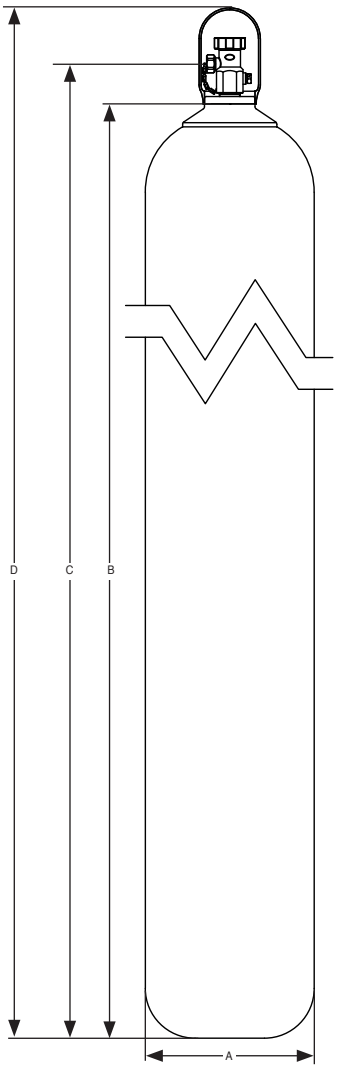


FIGURE 4-3
SUBORDINATE CONTAINER ASSEMBLY (110-00 VALVE)
025840

TABLE 4-4: CONTAINER ASSEMBLY DIMENSIONS

Container size (L)	Container assembly type	Dimension A (mm)	Dimension B (mm)	Dimension C (mm)	Dimension D (mm)
67	Master	267	1500	1555.5	1688
67	Subordinate	267	1500	1560	1627
40.2	Master	229	1205	1260.5	1393
40.2	Subordinate	229	1205	1265	1332
26.8	Master	229	855	910.5	982
13.4	Master	140	1065	1120.5	1192
5	Master	140	450	505.5	577

CONTAINER LABEL

The container label details the container part number, charge pressure, tare weight, fill weight, gross weight, and fill date. When applied to the container surface, and to avoid possible tampering, the label cannot be removed intact.

Technical information

Part No.:	35116400
Material:	PVC with adhesive backing
Overall size:	289 mm × 202 mm
Weight:	0.0558 kg
Languages:	English (GB), Spanish (ES), French (FR), and German (DE)

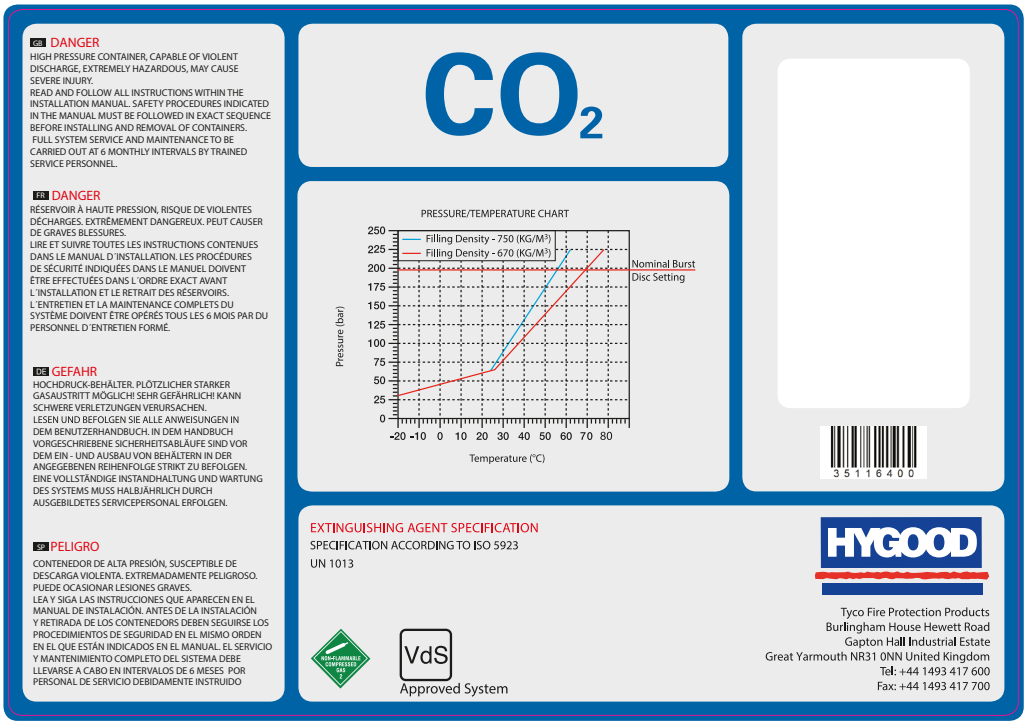


FIGURE 4-5
CO_2 CONTAINER LABEL
E001415

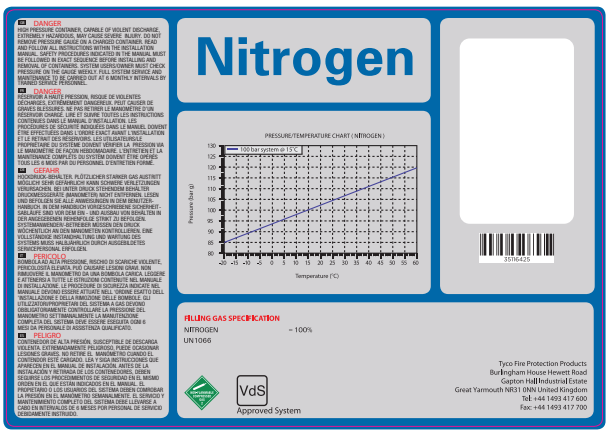


FIGURE 4-4
NITROGEN CONTAINER LABEL
025686

Technical information

Part No.:	35116425
Material:	PVC with adhesive backing
Overall size:	193 mm × 135 mm
Weight:	0.037 kg
Language translations:	English (GB), Spanish (ES), French (FR), German (DE), and Italian (IT)

128-20 CO_2 MASTER CONTAINER VALVE (Assembly Part No. 2000262V.SOL and 2000262V.BLC)

The CO_2 master 128-20 container valve is a quick action valve operated through a local manual actuator, pneumatic actuator, or electrically through a solenoid.

All valves include a recoil cap screwed onto the CO_2 valve discharge outlet. Remove this only when connecting the container to the pipework system and refit immediately when disconnecting the container from the pipework regardless of whether the container is full or empty.

The 128-20 valve is factory-fitted to the master container and is supplied with either a solenoid (Part No. 2000262V.SOL) or a blind cap in place of the solenoid (Part No. 2000262V. BLC).

The CO_2 master 128-20 container valve includes a safety burst disc. It ruptures at approximately 190 bar. If a manual release lever (Part No. 30180APB) is required, this must be ordered separately.

⚠ WARNING

If the manual actuator (Part No. 30180APB) is not required to be fitted to the 128-20 master container valve, then the manual actuator port blind cap (Part No. 3087008B) and o-ring (Part No. 22001505) must be fitted to this port to ensure the correct operation of the valve. The manual actuator port blind cap and o-ring is supplied fitted to the valve.

Operating instructions

The container valve operates through manual or solenoid actuation. The container valve operates automatically upon actuation and discharges CO_2 through the piping system into the protected area. After discharge, the valve requires refurbishment before refilling.

Maintenance instructions

Refurbish the valve after each discharge or after the hydro-static pressure testing of the container.

Technical information

Part No.:	2000262V.SOL (with solenoid) 2000262V.BLC (without solenoid, with blind cap)
Body material:	Brass
Thread type:	1 in. NPT
Outlet connection:	W21.7 DIN 477
Outlet safety cap material:	Brass
Maximum working pressure:	166 bar 140 bar (according to VdS)
Free flow cross sectional area:	50.26 mm^2
Actuation port connection:	1/8 in. NPT
Burst disc rating:	190 bar +/- 10 bar
Working temperature range:	-20 °C to 50 °C
Weight:	2.4 kg
Approvals and listings:	VdS
Certification:	EN 12094-4
CE certification number:	0786-CPR-30062
CE marking requirements:	Manufacturer, Part No., Serial No, CE_{0786}
Valve marking part number:	2000262V (base valve without solenoid or blind cap)
Method of marking:	Engraving
Valve type:	Type 2 (with rigid, straight diptube)
Overall size:	148 mm x 90 mm
Solenoid Part No.:	3023024B

Location on system

The 128-20 container valve connects to the master CO_2 container.

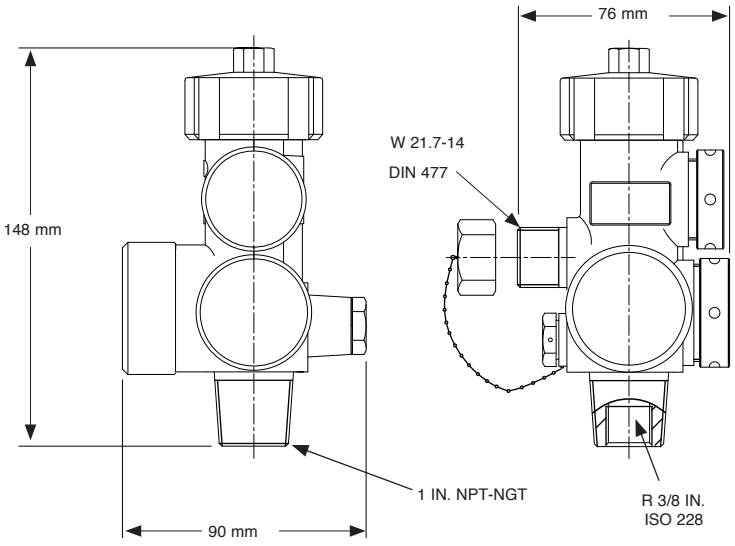


FIGURE 4-6
128-20 CONTAINER VALVE
025613

110-00 CO_2 SUBORDINATE CONTAINER VALVE (Assembly Part No. 20002260)

The CO_2 subordinate 110-00 container valve is a quick action valve operated by a pneumatic actuator.

All valves include a recoil cap screwed onto the CO_2 valve discharge outlet. Remove this only when connecting the container to the pipework system and refit immediately when disconnecting the container from the pipework regardless of whether the container is full or empty.

The 110-00 valve is factory-fitted to the subordinate container and is actuated by either the master CO_2 container or the pilot container, depending upon the system configuration.

Location on system

The 110-00 container valve connects to the subordinate CO_2 container.

Operating instructions

The container valve operates through pneumatic actuation. The container valve operates automatically upon actuation and discharges CO_2 through the piping system into the protected area. After discharge, the valve requires refurbishment before refilling.

Maintenance instructions

Refurbish the valve after each discharge or after the hydrostatic pressure testing of the container.

Technical information

Body material:	Brass
Thread type:	1 in. NPT
Outlet connection:	W21.7 DIN 477
Outlet safety cap material:	Brass
Maximum working pressure:	166 bar 140 bar (according to VdS)
Free flow cross sectional area:	113 mm^2
Burst disc port connection:	1/8 in. NPT
Burst disc rating:	190 bar +/- 10 bar
Working temperature range:	-20 °C to 50 °C
Weight:	1.4 kg
Approvals and listings:	VdS
Certification:	EN 12094-4
CE certification number:	0786-CPR-30061
CE marking requirements:	Manufacturer, Part No., Serial No, CE_{0786}
Valve marking part number:	2000262V (base valve without solenoid or blind cap)
Method of marking:	Engraving
Valve type:	Type 2 (with rigid, straight diptube)
Overall size:	114 mm x 52 mm

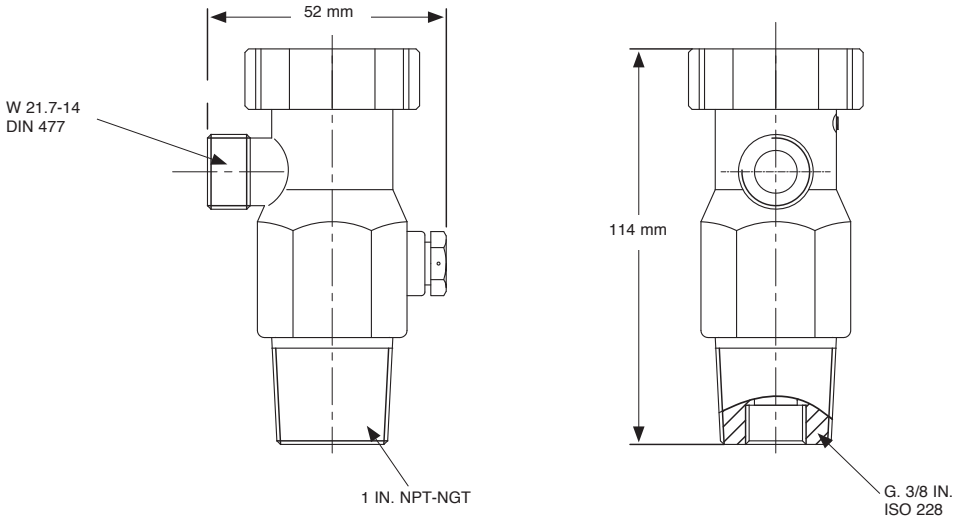


FIGURE 4-7
110-00 SUBORDINATE CONTAINER VALVE
025614

MASTER CONTAINER FLANGE FOR USE WITH VdS WEIGHING DEVICE (Part No. 161110021)

The master container assemblies for use with the VdS weighing device (see Table 4-1 on page 4-7) are supplied with a two-piece container flange designed specifically for use with the WEH-1 weighing device.

The larger flange piece (1) must face the weighing device and the post (back of the container) and the smaller flange piece (2) must face the front of the container, in order for the weighing device to operate correctly.

Note: This flange is required only for master container assemblies that use the VdS weighing device. It is not necessary to install this flange type on the subordinate container assemblies, although it is compatible if it is required.

Technical information

Material:	Zinc coated steel flanges
Container connection:	W80 x 2.309
M8 x 30 bolt torque:	27 N•m
Overall size:	248 mm x 155 mm x 15 mm
Weight:	2.14 kg

Location on system

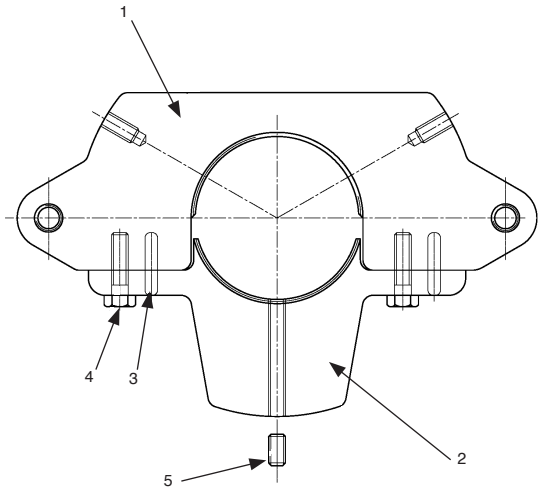
The master container flange fits onto the neck ring of the master container assembly when the VdS weighing device is required. The WEH-1 weighing device connects onto the container flange.

Operating instructions

Once installed, the master container flange requires no operating instructions.

Maintenance instructions

If faults or suspected faults arise, contact customer services to organise a replacement part.



Item	Description
1	Larger flange half (rear of container)
2	Smaller flange half (front of container)
3	Cylindrical pin (Dia 6 mm x 30 mm)
4	Bolt (M8 x 30)
5	Stud (M8 x 16)

FIGURE 4-8
MASTER CONTAINER VALVE
E001074

CO_2 MASTER CONTAINER DIVERTER (Part No. 91104001)

For container banks of eight or less containers, without use of selector valves, a master container can be used. When a master container is used, the diverter is connected to the outlet of the 128-20 master container valve in order for CO_2 pressure to divert along the actuation line to operate the pneumatic actuators on the subordinate containers.

Technical information

Material:	Steel
Container valve connection:	DIN 477 W21.7 Female
Discharge hose connection:	DIN 477 W21.7 Male
Actuation hose connection:	G 1/4 in. Female
Weight:	0.263 kg
Overall size:	63.5 mm x 39 mm

Location on system

The master container diverter connects to the outlet of 128-20 master container valve.

Operating instructions

The master container diverter is a pressure connector and requires no operating instructions.

Maintenance instructions

If faults or suspected faults arise, contact customer services to organise a replacement part.

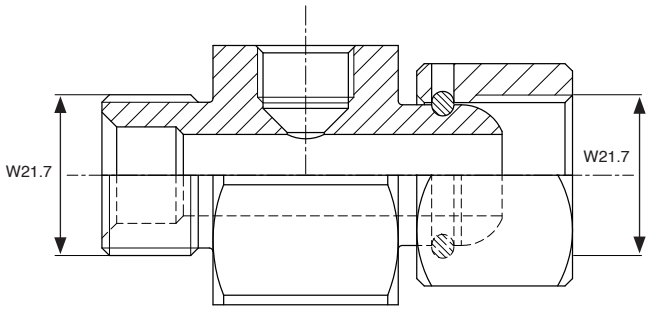


FIGURE 4-9
CO_2 MASTER CONTAINER DIVERTER
025841

PNEUMATIC ACTUATOR
(Part No. 30100106 - Pneumatic actuator, 3 way, 1/4 in. blind cap
Part No. 30100102 - Pneumatic actuator, 2 way)

The pneumatic actuator is installed onto the 110-00 subordinate container valve, and is used to pneumatically actuate the subordinate container. It is available in a 3-way or a 2-way version. The 3-way version includes a blind cap to plug the unused port, if required. The 3-way pneumatic actuator is only used on double row systems, and must be installed on every fifth container in the bank to connect the front row to the back row. The 2-way pneumatic actuator is used in all other instances.

Technical information

Part No.:	30100102 (2 way) 30100106 (3 way, with blind cap)
Body material:	Brass
Piston material:	Brass
Valve connection:	Not threaded
Inlet connections:	1/4 in. BSPP
Outlet safety cap material:	Brass
Maximum working pressure:	140 bar
Minimum trigger pressure:	14 bar
Nominal trigger pressure:	56 bar (without pilot container)
	100 bar (with pilot container)
Maximum trigger pressure:	140 bar
Working temperature range:	-20 °C to 50 °C
Weight:	0.227 kg (Part No. 30100102)
	0.231 kg (Part No. 30100106)
Approvals and listings:	VdS
Certification:	EN 12094-4
CE certification number:	0786-CPR-30061
CE marking requirements:	Manufacturer, Part No., Serial No, CE_{0786}
Method of marking:	Engraving
Overall size:	43 mm x Dia 37.2 mm

Location on system

The pneumatic actuator connects to the top of the 110-00 subordinate container valve and is secured in place by the 110-00 valve top cap.

Operating instructions

The pneumatic actuator operates through pressure received from a hose connection from either the master container or pilot container. When operated, the pneumatic actuator requires manual resetting before refitting to the CO_2 subordinate container valve.

Maintenance instructions

If faults or suspected faults arise, contact customer services to organise a replacement part.

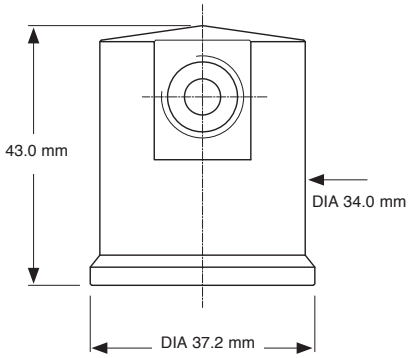


FIGURE 4-10
2-WAY PNEUMATIC ACTUATOR
025615

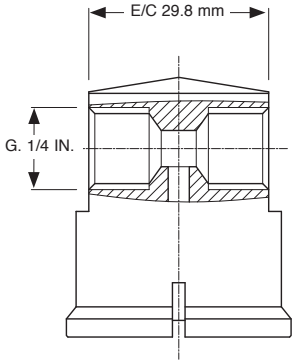


FIGURE 4-11
3-WAY PNEUMATIC ACTUATOR
025615

ACTUATION HOSES

Actuation hoses connect between pneumatic actuators, the pilot container, and the master container diverter. Johnson Controls supply two lengths; 350 mm and 700 mm. The hose contains brass male swivel ends and when fitting to the pneumatic actuators, requires no sealing tape. Avoid twisting the hose during installation.

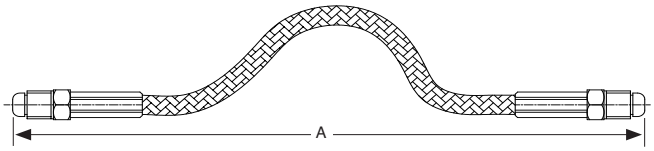


FIGURE 4-12
ACTUATION HOSES
025315

TABLE 4-5: ACTUATION HOSE DETAILS

Part No.	Length Dimension A	Weight	Container
30500041	350 mm	0.105 kg	Subordinate to subordinate (within same row)
30522001	700 mm	0.137 kg	Pilot to subordinate, and subordinate to subordinate (between rows)

Technical information

Hose construction:	Stainless steel wire braid PTFE liner
Connection:	1/4 in. BSPP Male swivel union (brass)
Internal hose inner diameter:	5.8 mm to 6.2 mm
Connection inner diameter:	4 mm
Maximum working pressure:	260 bar
Minimum burst pressure:	700 bar
Bend angle:	360°
Minimum bend radius:	30 mm
Approvals and listings:	VdS
Certification:	EN 12094-8
CE certification number:	0786-CPR-30099
Year of CE marking:	2009
CE marking requirements:	Manufacturer, Part No., batch number, working pressure, hose type, CE_{0786}
Method of marking:	Engraving
Weight:	0.10 kg (Part No. 30500041) 0.14 kg (Part No. 30522001)
Type of connector:	Type 3

Location on system

The actuation hoses fit between the pneumatic actuators, the pilot container and the master CO_2 container. For installation instructions, see Section 5 - Installing the Actuation Hoses.

Operating instructions

The actuation hose is a pressure connector and requires no operating instructions.

Maintenance instructions

If faults or suspected faults arise, contact customer services to organise a replacement part.

FLEXIBLE DISCHARGE HOSE (R1/R2)

The discharge hoses connect between the 110-00 container valve outlet and the manifold check valve or between the master container diverter and the manifold check valve. The hoses have a 1/2 in. nominal diameter. They are made from synthetic rubber with one (R1) or two (R2) mid-metal braid and an outer layer of synthetic rubber resistant to weathering.

Each discharge hose comes with a 1/2 in. Dowty seal (Part No. 95108015) on the male threaded connection.

Location on system

The discharge hoses connect between the 110-00 container valve outlet and the manifold check valve or between the master container diverter and the manifold check valve.

Operating instructions

The discharge hose is a pressure connector and requires no operating instructions.

Maintenance instructions

If faults or suspected faults arise, contact customer services to organise a replacement part.

TABLE 4-6: DISCHARGE HOSE DETAILS

Part No.	Dimension A length (mm)	Hose type	Weight (kg)	Container
91116048	500	R1	0.455	Subordinate to 1/2 in. check valve (with mechanical weighing device) Master (single) container to system pipework (without mechanical weighing device)
91116049	350	R1	0.375	Master container diverter to 1/2 in. check valve (with mechanical weighing device)
30521041	350	R2	0.456	Subordinate to check valve (without mechanical weighing device) Master (single) container to system pipework (without mechanical weighing device)
30504311	310	R2	0.430	Master container diverter to 1/2 in. check valve (without mechanical weighing device)

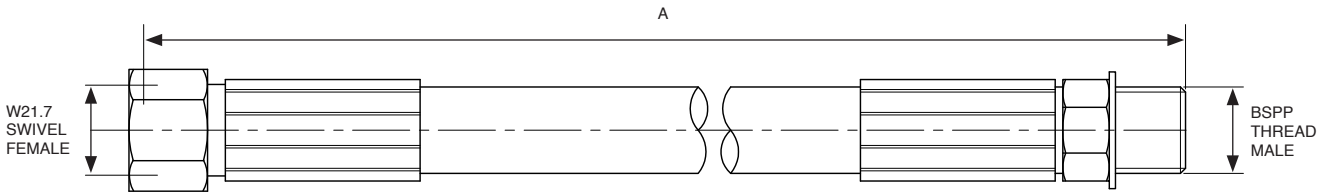


FIGURE 4-13
FLEXIBLE DISCHARGE HOSE
025842

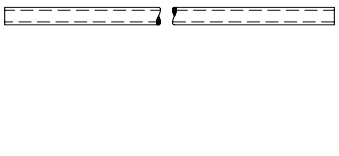
Technical information

Type:	R1	R2
Hose construction:	Single steel wire braid R1SC liner	Twin steel wire braid R2 (EN 853) liner
Connections:	1/2 in. BSPP fixed Male x W21.7 swivel Female	1/2 in. BSPP fixed Male x W21.7 swivel Female
Maximum working pressure:	155 bar	241 bar
Bend angle:	360°	360°
Minimum bending radius:	100 mm	178 mm
Approvals and listings:	VdS	VdS
Certification:	EN 12094-8	EN 12094-8
CE certification number:	0786-CPR-30123	0786-CPR-30098
CE marking requirements:	Manufacturer, Part No., batch number, working pressure, CE_{0786}	Manufacturer, Part No., batch number, working pressure, CE_{0786}
Method of marking:	Engraving	Engraving
Type of connector:	Type 1	Type 1

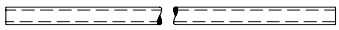
ACTUATION COMPONENTS

This section lists typical examples of fittings required for the actuation system and does not limit the use of other acceptable fittings.

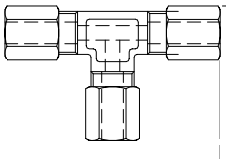
6 mm Copper nickel pipe

Part No.	Description	Picture	Technical information	
30804068	The copper nickel pipe (suitable for bending) connects pressure activated devices to the system, such as subordinate containers and a pressure switch, for example.	 025023	Material:	Copper tube
			Specification:	EN 12449 CW024A
			Max. working pressure:	160 bar
			Dimensions:	6 mm (+/- 0.05) x 1 mm
			Supplied length:	Cut to a maximum length of 10 m
			Weight:	Approx. 0.11 kg/m

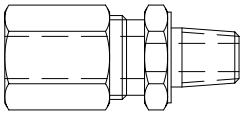
6 mm Half hard pipe

Part No.	Description	Picture	Technical information	
308.002.002	Where the system requires extensive actuation runs, the installer can use 6 mm half hard copper pipe. Johnson Controls supply this in 3 m lengths. It is unsuitable for bending.	 025023	Material:	Copper tube
			Specification:	EN 12449 CW024A
			Max. working pressure:	160 bar
			Supplied length:	3 m
			Weight:	0.43 kg

6 mm Compression tee

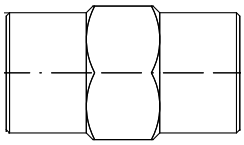
Part No.	Description	Picture	Technical information	
30880015	The 6 mm compression tee primarily connects pilot lines from one subordinate container to the next.	 025024	Material:	Brass (Body) Brass (Olive) Brass (Nut)
			Connection:	6 mm DIN 2353 compression fittings
			Max. working pressure:	550 bar
			Overall size:	45 mm × 30 mm
			Weight:	0.04 kg

6 mm Stud coupling

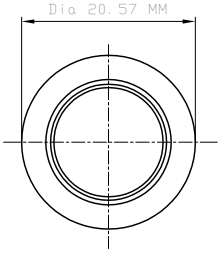
Part No.	Description	Picture	Technical information	
30880007	The pilot line uses 6 mm stud coupling with copper nickel pipe. The stud coupling fits into the pneumatic actuator. It comes supplied with the pilot containers and fits into the pilot valve adaptor (Part No. 35116381) as an alternative to the pilot actuation hose.	 025025	Material:	Brass (Body) Brass (Olive) Brass (Nut)
			Connection:	1/4 in. BSPT
			Max. working pressure:	150 bar
			Overall size:	33.5 mm × 16 mm
			Weight:	0.024 kg

ACTUATION COMPONENTS (Continued)

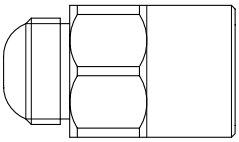
1/4 in. BSP socket

Part No.	Description	Picture	Technical information	
30880008	On systems using both 6 mm copper nickel pipe and flexible actuation hoses, a 1/4 in. BSP socket makes the connection. One side of the socket connects to the actuation hose (Part No. 30506014 for 550 mm or 30522001 for 700 mm). The other side of the socket connects to the pilot line copper nickel pipe through the 1/4 in. BSPT × 6 mm stud coupling (Part No. 30880007).	 025758	Material:	Brass
			Connection:	1/4 in. BSPP Female
			Overall size:	35 mm × 20 mm hex
			Weight:	0.057 kg

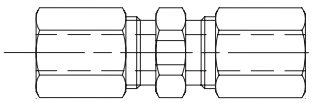
1/4 in. Dowty seal

Part No.	Description	Picture	Technical information	
31199816	The Dowty seal adaptor seals component assemblies.	 E000704	Material:	Nitrile and steel
			Hardness:	85 ± 5 shore A
			Overall size:	2.03 mm × Dia 20.57 mm
			Weight:	0.005 kg

1/4 in. Bull nose adaptor

Part No.	Description	Picture	Technical information	
30880009	The 1/4 in. bull nose adaptor can be used for a flexible actuation hose connection to the selector valves when copper piping is not required. The 1/4in. Dowty seal (Part No. 31199816) should be used to complete the connection.	 025773	Material:	Brass
			Connection:	G 1/4 in. Male x G 1/4 in. Female
			Overall size:	26 mm x Dia 18 mm
			Weight:	0.06 kg

6 mm Straight coupling

Part No.	Description	Picture	Technical information	
30880020	The 6 mm straight coupling connects the 6 mm copper pipe.	 025832	Material:	Brass
			Connection:	6 mm DIN 2353 compression fittings
			Maximum working pressure:	150 bar
			Overall size:	32 mm × 11 mm
			Weight:	0.026 kg

DECOMPRESSION SCREW
(Part No. 30027301)

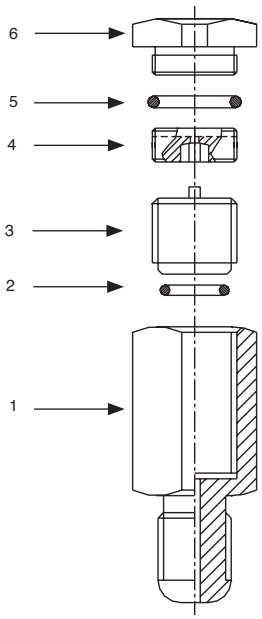
The pneumatic actuation line retains pressure from the pilot container after the container bank actuates. To enable the safe release of the pressure, a decompression screw is fitted to the last pneumatic actuator. It can be fitted to either free port with the 1/4 in. blind cap being fitted to the unused port.

After discharge, follow these steps to release the nitrogen trapped in the pneumatic actuation line:

1. Remove the safety cap.
2. Remove the internal cap using a flat screwdriver.
3. Reverse the internal cap and reinstall into the decompression screw with the hexagon facing outwards. Tighten very slowly using a 5 mm Allen wrench. Pressure begins to escape from the pneumatic actuation line as you tighten.
4. After venting all internal pressure, unscrew the internal cap, and reinstall in its original position.
5. Refit the safety cap ensuring that the o-ring stays within its groove.

Technical information

Body:	Brass
Internal parts:	Nitrile
Connection:	1/4 in. BSPP
Test pressure:	420 bar
Working pressure:	140 bar
Overall size:	68 mm × 23.5 mm (hex 22 mm)
Weight:	0.23 kg
Marking:	Manufacturer, Part No., UL, serial number, working pressure
Method of marking:	Engraving



Item	Description
1	Decompression screw body
2	O-ring
3	Valve core
4	Internal cap
5	O-ring
6	Safety cap

FIGURE 4-14
DECOMPRESSION SCREW
025354

DISCHARGE PRESSURE SWITCH (Part No. 30330010)

The pressure switch is mounted in the distribution pipework and provides an electrical indication of the release of CO_2, or may perform ventilation shutdowns or other interlock functions. The pressure switch requires manual resetting following operation.

The discharge pressure switch requires a minimum pressure of 10 bar to ensure correct operation. The switch contains normally open and normally closed contacts.

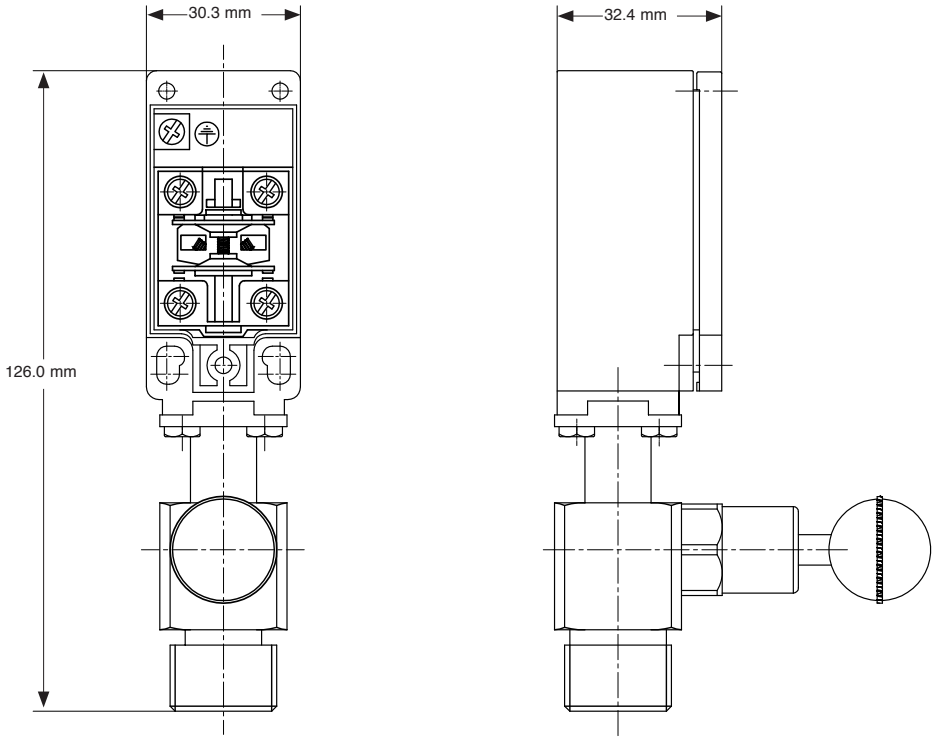


FIGURE 4-15
DISCHARGE PRESSURE SWITCH
025305

Technical information

Locking system:	Brass
Electrical box system:	Duraluminium
Connection:	1/2 in. BSPT
Set point:	10 bar rising at 20 °C (with manual reset)
Working temperature range:	–25 °C to 80 °C –20 °C to 50 °C (EN 12094-10)
Maximum working pressure:	370 bar
Weight:	0.41 kg
Maximum current:	6 A
Maximum voltage:	250 VDC 500 VAC
Ingress protection class:	IP65
Conformity:	UL-580
Approvals and listings:	LPCB and VdS
Marking:	Manufacturer, Part No., serial number, working pressure
Method of marking	Engraving
Overall size:	126 mm × 30.3 mm × 32.4 mm

Location on system

The discharge pressure switch connects to either the manifold or the discharge pipework.

Operating instructions

The discharge pressure switch works within the pre-determined system operating conditions. The switch requires manual resetting following operation.

Maintenance instructions

To reset after activation, pull and release the knob on the side of the unit.

ODOURISER
(Part No. 35116701)

The odouriser is used to inject a small amount of citrus odour into the carbon dioxide while flowing through the piping network. When the carbon dioxide discharges into the hazard area, it carries a scent of citrus with it. This scent warns personnel entering the hazard area that the area contains carbon dioxide and precautions must be taken.

Carbon dioxide at concentrations well below those used in fire-fighting systems, present an immediate life safety hazard.

Precautions include immediate evacuation and for personnel not to enter the area without self-contained breathing apparatus', until the area is thoroughly ventilated and declared safe by a competent authority.

Technical information

Connection:	1/2 in. BSPT Male
Weight:	0.36 kg
Temperature range:	-20°C to +50°C
Maximum allowable pressure:	140 bar
Minimum operating pressure:	15 bar
Odourising fluid:	Citronella (10 ml)
Dimensions:	Dia 38 mm x 88 mm

Note: One odouriser is required per 1000 kg of CO_2.

Location on system

The odouriser must be connected to the distribution pipework downstream of the manifolds.

The number of odourisers required is determined from the CO_2 quantity delivered to the protected area. Where this exceeds the limit of 1000 kg of CO_2, add more odourisers as required.

When a system utilises selector valves, the required number of odourisers must be installed in the pipework downstream of each selector valve to ensure odourant is added to each protected zone.

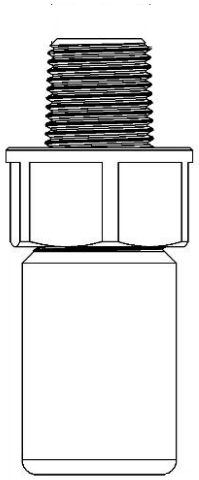


FIGURE 4-16
ODOURISER
E001133

Operating instructions

Upon discharge of CO_2 into the distribution pipework, the seal on the odouriser breaks, automatically releasing the liquid odourant into the discharging CO_2 flow stream without any intervention required. The odourant atomises following discharge from the CO_2 nozzle and the vapourised CO_2 detected through a smell.

Once used, replace the odouriser. Refilling is not possible or recommended.

Maintenance instructions

1. Check that the correct number of odourisers are fitted for the quantity of agent.
2. Check that the odouriser is fitted tightly.
3. Verify that the suppression system has not been operated. If in doubt, remove the odouriser from the pipework and visually check that the seal is not split or broken.

Replace the odouriser after each suppression system discharge. No repairing, refilling, or overhauling the odouriser is permitted.

Note: One extra odouriser is used for every 1000 kg of CO_2 above the initial 1000 kg.

TOTAL FLOODING NOZZLES

Total flooding CO_2 nozzles are available in three sizes, each in a 360° pattern to uniformly distribute agent throughout the hazard area. All nozzles are specifically drilled to suit the individual design requirements.

Two types of total flooding CO_2 nozzles are available; chrome-nickel plated brass nozzles or SS316 stainless steel versions. These nozzles do not have an orifice plate. Nozzles with a drill size of less than 3 mm require a nozzle filter.

The 3/8 in. nozzles are supplied complete with a 3/8 in. nozzle filter (Part No. 30210838SS316). The 1/2 in. nozzles are not supplied with a nozzle filter, but one is available if required (Part No. 30210812SS316).

Note: The allowable drilling increments are 0.1 mm. For VdS system approval, nozzle openings smaller than 7 mm^2 in diameter are not permitted. This means that the minimum drill size is 3.0 mm.

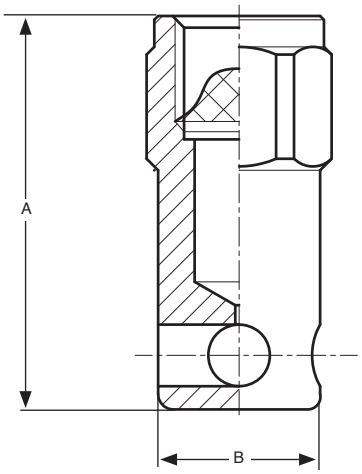


FIGURE 4-17
CO_2 TOTAL FLOODING NOZZLE
025790

TABLE 4-7: TOTAL FLOODING NOZZLE DETAILS

Nozzle size	Part No.	Nozzle material	Nozzle height (Dim A)	Nozzle Dia. (Dim B)	Nozzle includes filter	Minimum nozzle drill size	Maximum nozzle drill size
3/8 in.	30460000	Chrome-nickel plated brass	51 mm	21 mm	Yes	1.0 mm (with filter)	9.5 mm
1/2 in.	30460001	Chrome-nickel plated brass	53 mm	22 mm	Yes	1.0 mm (with filter)	9.5 mm
3/4 in.	30460002	Chrome-nickel plated brass	59 mm	28 mm	No	3.0 mm	17.0 mm
3/8 in.	30460000SS316	SS316 stainless steel	51 mm	21 mm	Yes	1.0 mm (with filter)	9.5 mm
1/2 in.	30460001SS316	SS316 stainless steel	53 mm	22 mm	Yes	1.0 mm (with filter)	9.5 mm
3/4 in.	30460002SS316	SS316 stainless steel	59 mm	28 mm	No	3.0 mm	17.0 mm

Technical information

Material:	Chrome-nickel plated brass or SS316 stainless steel
Thread type:	BSPP
Nozzle thread sizes:	3/8 in., 1/2 in. and 3/4 in.
Nozzle type:	4 port (360°)
Maximum protection height:	5 m
Maximum area coverage:	30 m^2
Maximum working pressure:	140 bar
Orientation:	Pendant
Nozzle spanner flats:	A/F 22 mm (3/8 in. nozzle) A/F 26 mm (1/2 in. nozzle) A/F 30 mm (3/4 in. nozzle)
Certification:	EN 12094-7
CE certification number:	0786-CPR-30012
CE marking requirements:	Manufacturer, Part No., serial number, CE_{0786}
Method of marking:	Engraving

Location on system

The discharge nozzles fit at the end of the discharge pipework.

Maintenance instructions

Inspect the nozzles for dust and debris every six months, and clean out where necessary. If any doubt exists concerning the integrity of the pipework, arrange for purging.

Remove the nozzles and the nozzle filter mesh to check for debris following the purge. In case of faults or suspected faults, contact customer services to organise a replacement part.

LOCAL APPLICATION NOZZLES

The CO_2 local application nozzle is available in three sizes and two material types. All nozzles are specifically drilled to suit the individual design requirements. One material type uses a chrome-nickel plated brass nozzle with a zinc plated steel cone, and the other material type uses an SS316 stainless steel nozzle and cone.

These nozzles do not have an orifice plate. Nozzles with a drill size of less than 3 mm require a nozzle filter.

The 3/8 in. nozzles are supplied complete with a 3/8 in. nozzle filter (Part No. 30210838SS316). The 1/2 in. nozzles are supplied with a 1/2 in. nozzle filter (Part No. 30210812SS316).

Note that *EN 12094-7* is only applicable to total flood nozzles and not local application nozzles.

Note: The allowable drilling increments are 0.1 mm. For VdS system approval, nozzle openings smaller than 7 mm^2 in diameter are not permitted, this means that the minimum drill size is 3.0 mm.

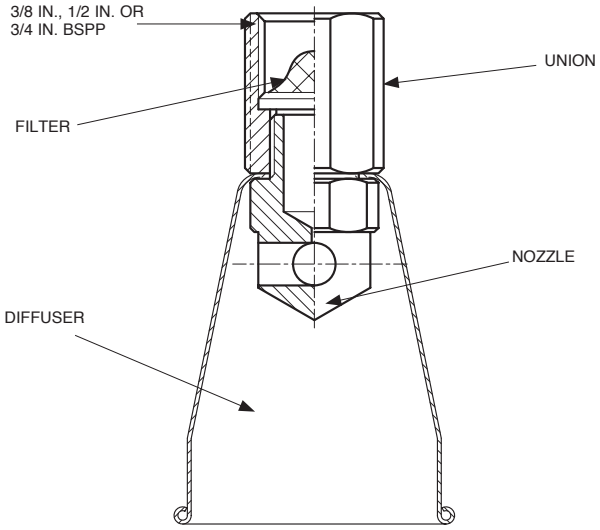


FIGURE 4-18
CO_2 LOCAL APPLICATION NOZZLE
025790

TABLE 4-8: LOCAL APPLICATION NOZZLE DETAILS

Nozzle size	Nozzle Part No.	Nozzle material	Total height (Dim A)	Nozzle cone dia. (Dim B)	Nozzle includes filter	Minimum nozzle drill size	Maximum nozzle drill size
3/8 in.	30460038	Chrome-nickel plated brass	117 mm	69 mm	Yes	1.0 mm (with filter)	9.5 mm
1/2 in.	30460012	Chrome-nickel plated brass	122 mm	69 mm	Yes	1.0 mm (with filter)	9.5 mm
3/4 in.	30460034	Chrome-nickel plated brass	140 mm	82 mm	No	3.0 mm	17.0 mm
3/8 in.	30460038SS316	SS316 stainless steel	117 mm	69 mm	Yes	1.0 mm (with filter)	9.5 mm
1/2 in.	30460012SS316	SS316 stainless steel	122 mm	69 mm	Yes	1.0 mm (with filter)	9.5 mm
3/4 in.	30460034SS316	SS316 stainless steel	140 mm	82 mm	No	3.0 mm	17.0 mm

Technical information

Nozzle body material:	Brass or SS316 stainless steel
Diffuser/Cone material:	Zinc plated steel or SS316 stainless steel
Union material:	Brass or SS316 stainless steel
Thread type:	BSPP
Nozzle thread sizes:	3/8 in., 1/2 in. and 3/4 in.
Nozzle type:	4 port 360°
Maximum protection height:	5 m
Maximum area coverage:	30 m^2
Maximum working pressure:	140 bar
Orientation:	Pendant
Nozzle spanner flats:	A/F 22 mm (3/8 in. nozzle) A/F 26 mm (1/2 in. nozzle) A/F 32 mm (3/4 in. nozzle)
Nozzle marking:	Manufacturer, Part No., serial number
Method of marking:	Engraving

Location on system

The discharge nozzles fit at the end of the discharge pipework.

Maintenance instructions

Inspect the nozzles for dust and debris every six months, and clean out where necessary. If any doubt exists concerning the integrity of the pipework, arrange for purging.

Remove the nozzles and the nozzle filter mesh to check for debris following the purge. In case of faults or suspected faults, contact customer services to organise a replacement part.

CONTAINER BRACKETS - SINGLE ROW WITHOUT WEIGHING DEVICES

When a single row CO_2 container installation is required without any weighing devices, the following modular bracket system must be used. The bracket system is floor mounted, with a wall mounted manifold support.

Two hexagonal brackets support each container.

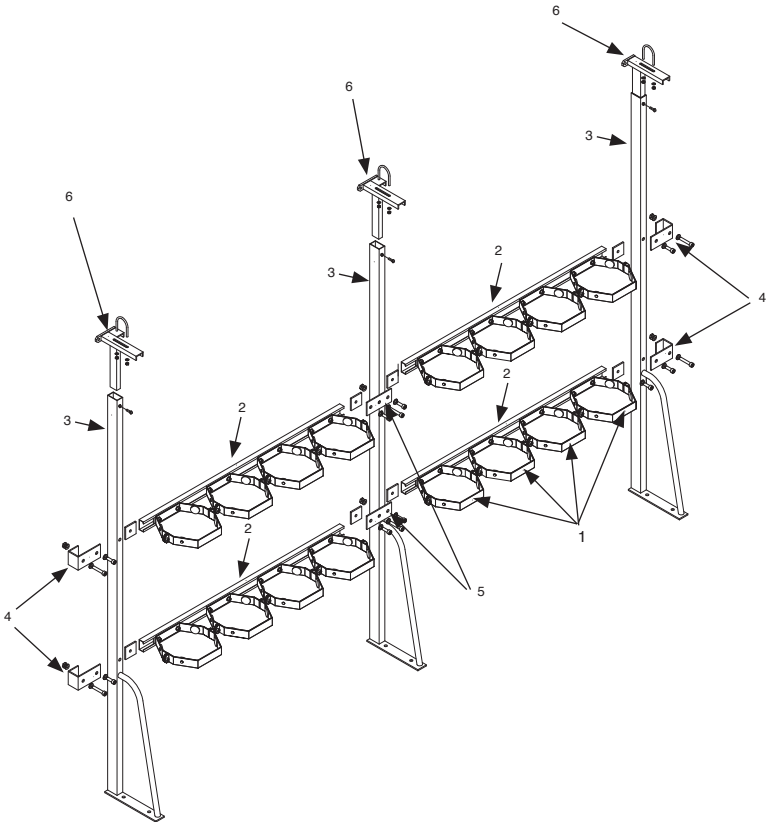


FIGURE 4-19
CO_2 SINGLE ROW WITHOUT WEIGHING DEVICE
025791

TABLE 4-9: CO_2 SINGLE ROW WITHOUT WEIGHING DEVICE DETAILS

Item	Part No.	Description	Quantity required
1	30626711	Hexagonal bracket (67 L container)	2 for each container
	30621310	Hexagonal bracket (5 L and 13.4 L container)	
	30625010	Hexagonal bracket (26.8 L and 40.2 L container)	
2	36116313	Bridging bracket for 2 container	See Figure 4-20
	36116314	Bridging bracket for 3 container	
	36116315	Bridging bracket for 4 container	
	36116316	Bridging bracket for 5 container	
	36116317	Bridging bracket for 6 container	
3	36116019	Telescopic vertical column	See Figure 4-20
4	36116020	Accessories for 2 lateral vertical column	1
5	36116022	Accessories for central vertical column	See Figure 4-20
6	94116000	Manifold seat, single row, without weighing device	See Figure 4-20

CONTAINER BRACKETS - SINGLE ROW WITHOUT WEIGHING DEVICES (Continued)

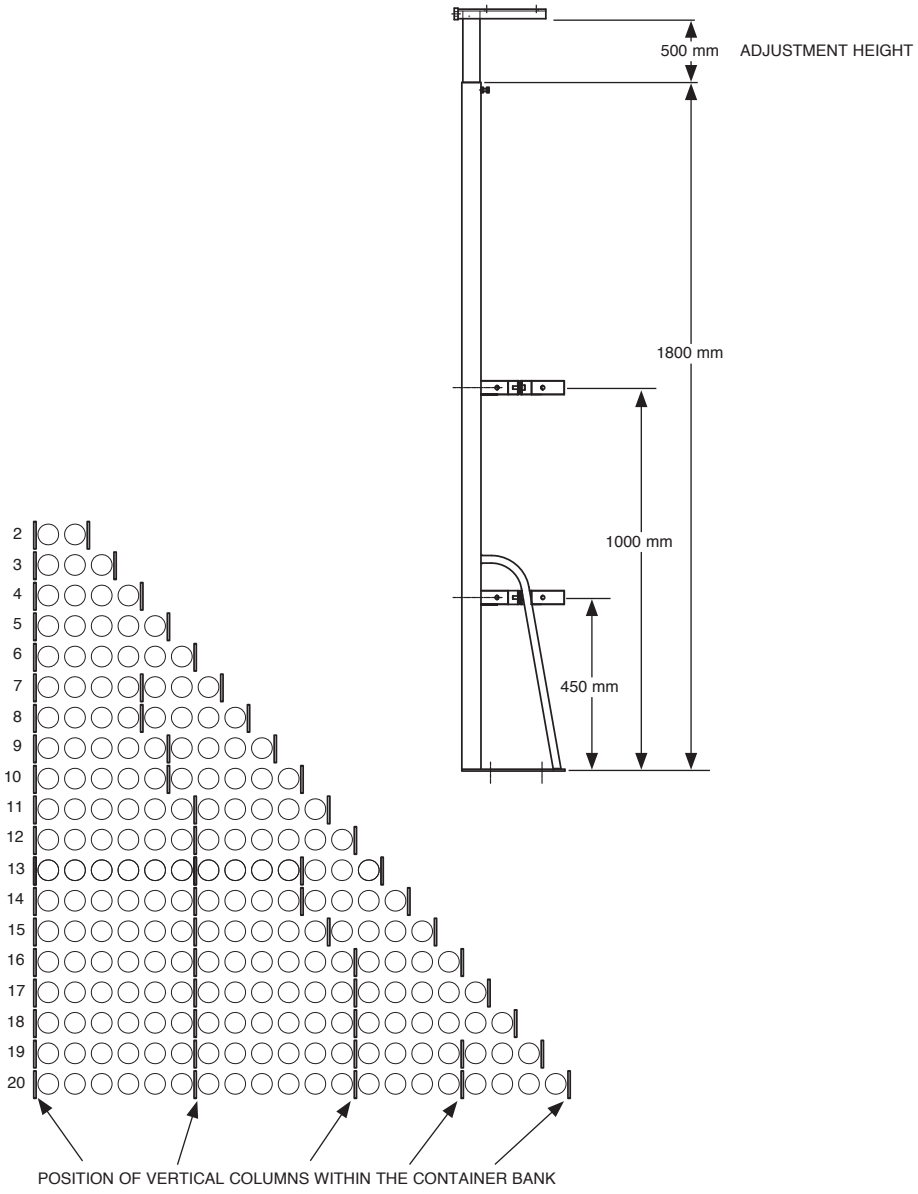


FIGURE 4-20
SYSTEM ARRANGEMENT EXAMPLE
025792

CONTAINER BRACKETS - DOUBLE ROW WITHOUT WEIGHING DEVICES

When a double row 67 L CO_2 container installation is required without any weighing devices, the following modular bracket system must be used. The bracket system is floor mounted, with the manifold support being wall mounted.

Each 67 L container is supported by two hexagonal brackets.

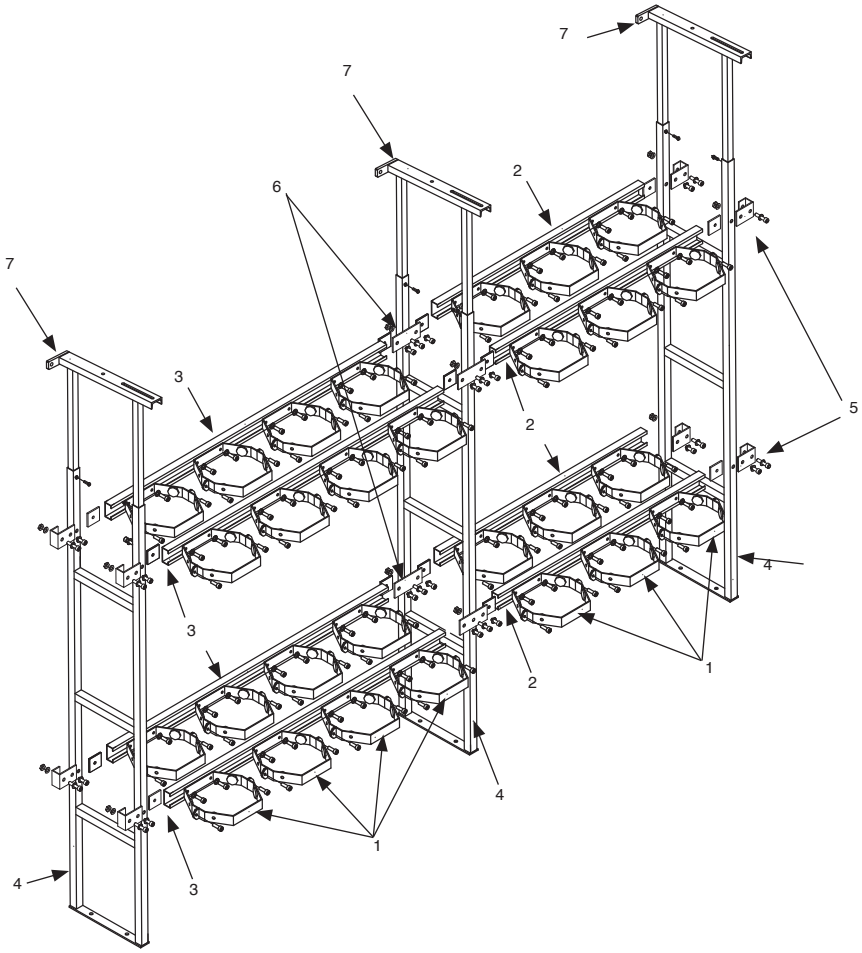


FIGURE 4-21
CO_2 DOUBLE ROW WITHOUT WEIGHING DEVICE
025793

TABLE 4-10: CO_2 DOUBLE ROW WITHOUT WEIGHING DEVICE DETAILS

Item	Part No.	Description	Quantity required
1	30626711	Hexagonal bracket (67 L container)	2 for each container
3	36116313	Bridging bracket for 2 container	See Figure 4-22
	36116314	Bridging bracket for 3 container	
	36116315	Bridging bracket for 4 container	
	36116316	Bridging bracket for 5 container	
	36116317	Bridging bracket for 6 container	
4	36116004	Double telescopic vertical column	See Figure 4-22
5	36116005	Accessories for 2 double telescopic vertical column	See Figure 4-22
6	36116006	Accessories for central telescopic vertical column	1
7	94116001	Manifold seat, double row, without weighing device	See Figure 4-22

CONTAINER BRACKETS - DOUBLE ROW WITHOUT WEIGHING DEVICES (Continued)

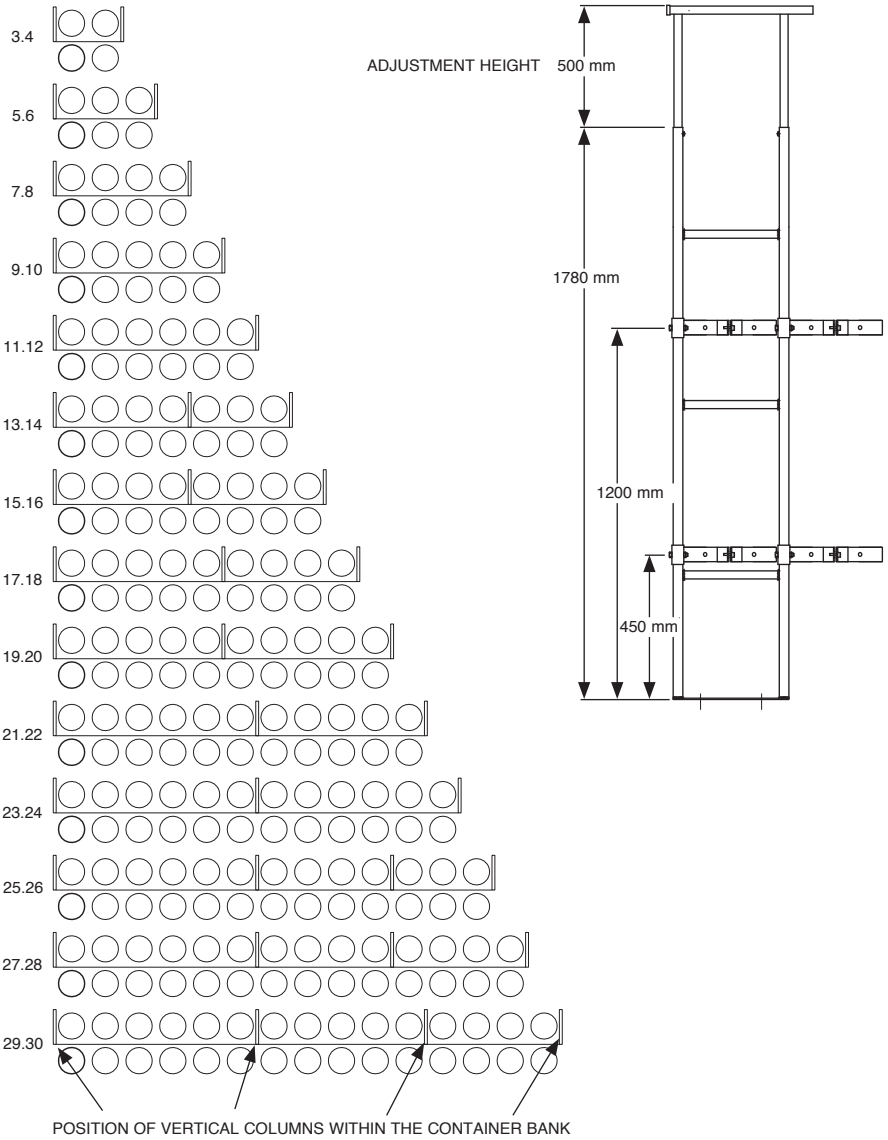


FIGURE 4-22
SYSTEM ARRANGEMENT EXAMPLE
025794

VdS APPROVED WEIGHING DEVICE

The mechanical weighing device is used for the permanent monitoring of the CO_2 containers. One weighing column and one WEH-1 weighing device support each container.

The mechanical weighing device requires that the master container assembly (128-20 valve) is fitted with the two piece (TW) container flange (Part No. 161110021).

NOTICE

It is essential that the correct master container is ordered (see Table 4-11). This flange is supplied as part of the master container assembly for use with the VdS mechanical weighing device.

The mechanical weighing device requires special single row and double row manifolds, and uses a different bracket arrangement to the container banks not requiring a mechanical weighing device.

TABLE 4-11: CO_2 WEIGHING DEVICE DETAILS

Item	Part No.	Description
1	71104051	67 L master container, 128-20, 45 kg, for VdS weighing device
	71104047	67 L master container, 128-20, 45 kg, with solenoid valve for VdS weigh device
	71104052	67 L master container, 128-20, 50 kg, for VdS weighing device
	71104048	67 L master container, 128-20, 50 kg, with solenoid valve for VdS weigh device
2	71104007	67 L subordinate container, 110-00, 45 kg
	71104011	67 L subordinate container, 110-00, 50 kg
3	161110021	Container flange, 128/110 w80 zinc coated (TW) – master container only
4	91116048	Discharge hose 1/2 in. R1 X 500 mm (valve to CV, with VdS weigh device)
	91116049	Discharge hose 1/2 in. R1 X 350 mm (used master only, with VdS weigh device)
5	88021XXX	Single row manifold, VdS weighing device, 67 L
	89021XXX	Double row manifold, VdS weighing device, 67 L
6	K02400086	Weighing column set, VdS
7	K02401786	Weighing device, type WEH-1
8	K02401876	Surweights - each (2 required for each container)
9	K02401936	Counterweight (suspension) bar for weighing device
10	K02462736	Loss indicator RS3, VdS
11	K02462756	Loss indicator RS4, VdS (used with FAST 2000 only)
12	130640006	Manifold support, single row, VdS
13	130009200	Manifold support, double row, VdS
14	30009205 to 30009212	3/4 in. to 4 in. Clamp for manifold support single row weighing VdS (TW)
15	30600050 to 30600120	3/4 in. to 4 in. U bolt for manifold support double row weighing VdS (TW)

VdS APPROVED WEIGHING DEVICE (Continued)

For double row systems, the manifold supports and U bolts (items 13 and 15) should be positioned at each end of the container bank, and have a maximum spacing of 10 containers (1.5 m).

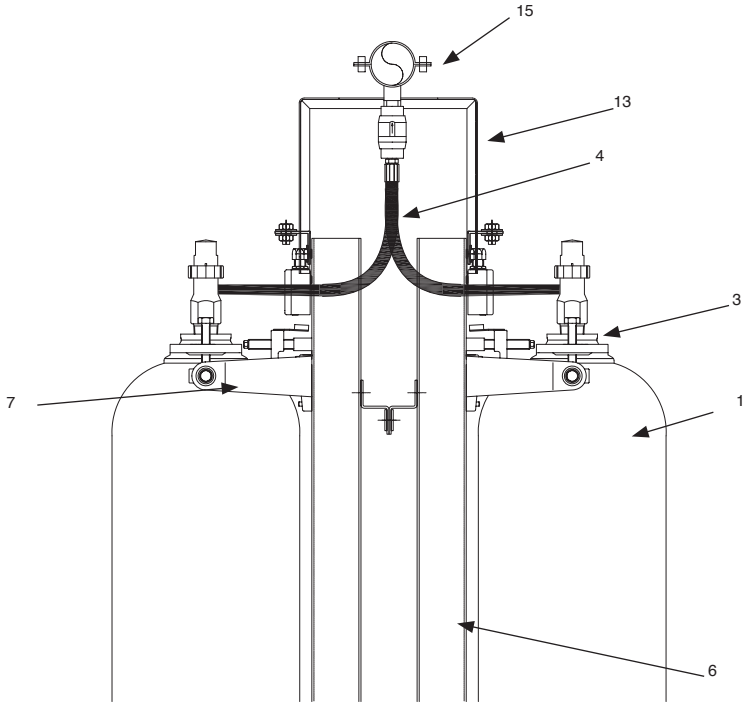


FIGURE 4-23
VdS APPROVED WEIGHING DEVICE SET-UP
025795

For single row systems, the manifold supports and clamps (items 12 and 14) should be positioned at each end of the container bank, and have a maximum spacing of five containers (1.5 m).

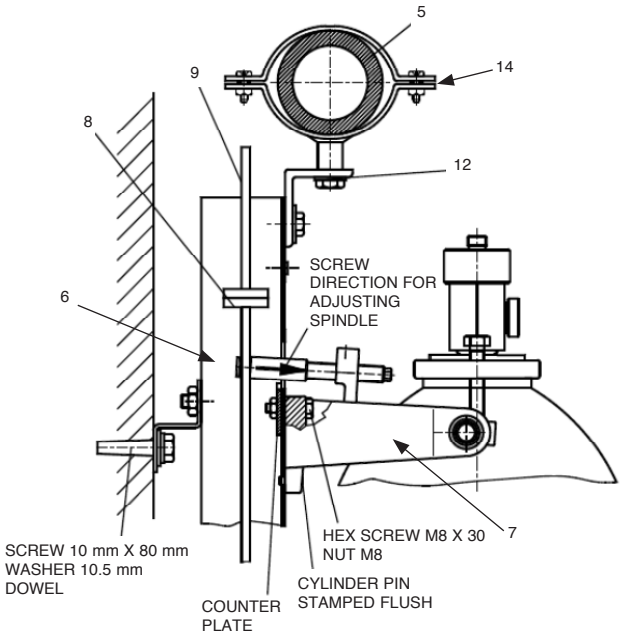


FIGURE 4-24
WEIGHING DEVICE SCHEMATIC
025796

WEH-1 WEIGHING DEVICE (Part No. K02401786)

- The mechanical weighing device is used for the permanent monitoring of CO_2 containers.
- The WEH-1 weighing device is installed onto the weighing column (Part No. K02400086).
- Once installed, the CO_2 container to be monitored freely suspends onto the weighing device, with the surweights (Part No. K02401876) on the counterweight bar (Part No. K02401936) providing the counterweight to keep it suspended. To adjust finely, turn the adjusting spindle.
- The spindle intersects the top of the hole in the weighing column to indicate 100% weight.
- In the event of weight loss, the CO_2 container moves upwards, causing the spindle to move downwards. When the spindle intersects the bottom of the hole in the weighing column, a 10% weight loss is indicated.

Technical information

Material:	Brass (adjustment spindle)
	Coated steel (counterweight bar)
	Galvanised steel (surweights)
	Galvanised cast iron (rest of weighing device)
Weight:	Approximately 2.6 kg
Certification:	EN 12094-11
CE Certification number:	0786-CPR-30049

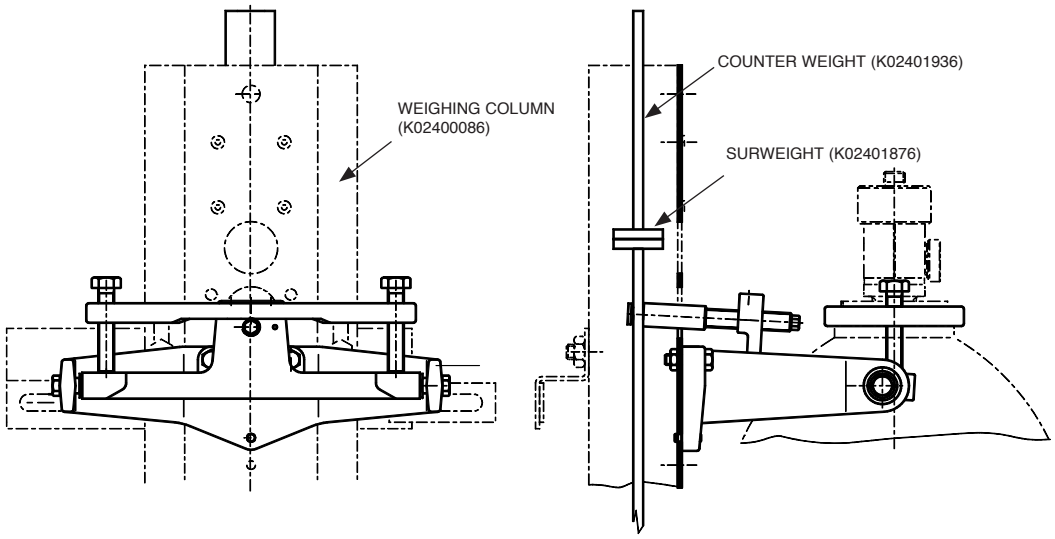


FIGURE 4-25
WEH-1 WEIGHING DEVICE
(SHOWING LOCATION ON WEIGHING COLUMN)
E001076

WEIGHING COLUMN
(Part No. K02400086)

The weighing column (Part No. K02400086) for the mechanical weighing device is supplied with all the fixings (Kit Part No. K02401786) required to install it.

Technical information

Material:	Steel, powder coated RAL 3000
Weight:	9.8 kg

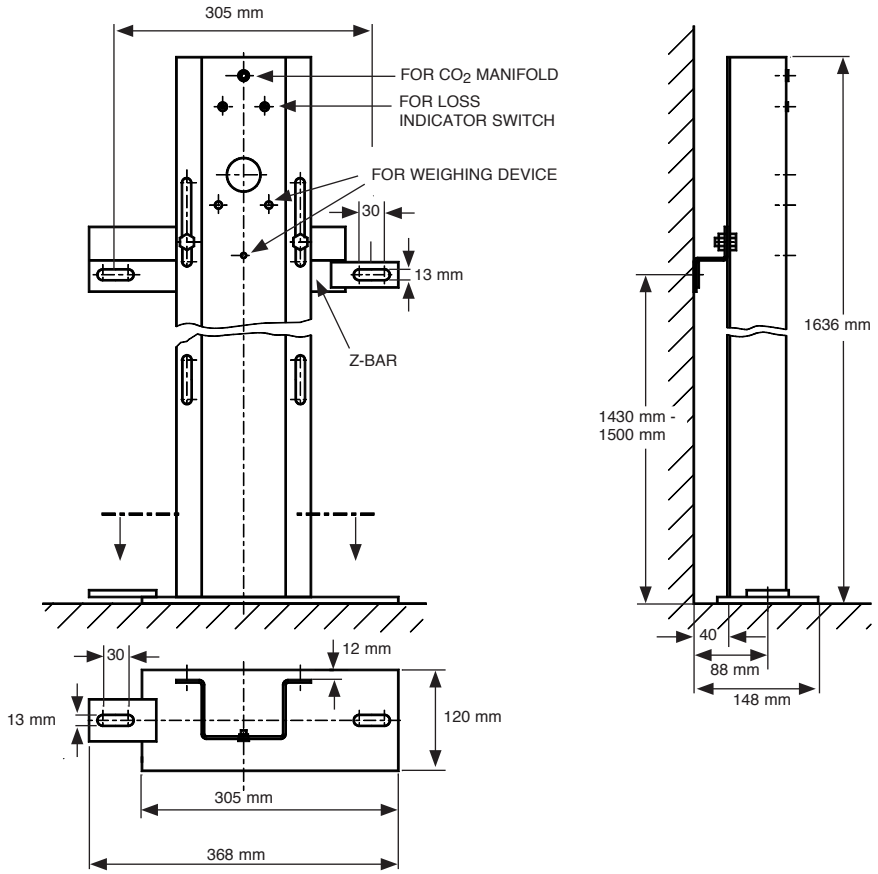


FIGURE 4-26
WEIGHING COLUMN
E001077

RS3 LOSS INDICATOR SWITCH (Part No. K02462736)

In the event of weight loss, the RS3 loss indicator gives an electrical signal through the fault-line to the fault-indication module of the fire detection central unit. At the same time, a yellow LED lights up to give a visual indication. The mounting set consists of a switch, an operating magnet and mounting screws.

Technical information

Housing material:	ABS
Weight:	0.19 kg
Ingress Protection class:	IP54
Cable gland:	2 x PG 9 for cable 6 mm to 9 mm diameter

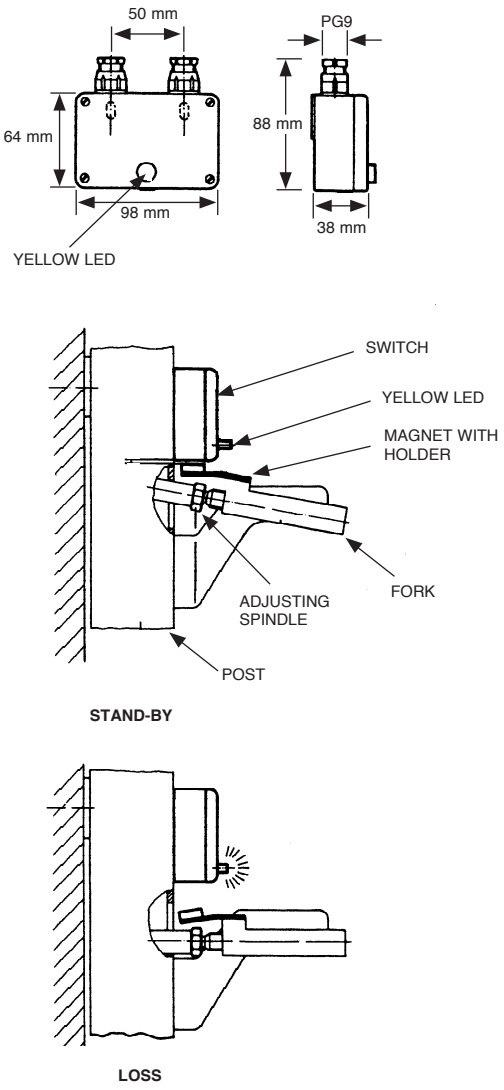


FIGURE 4-27
RS3 LOSS INDICATOR SWITCH
E001078

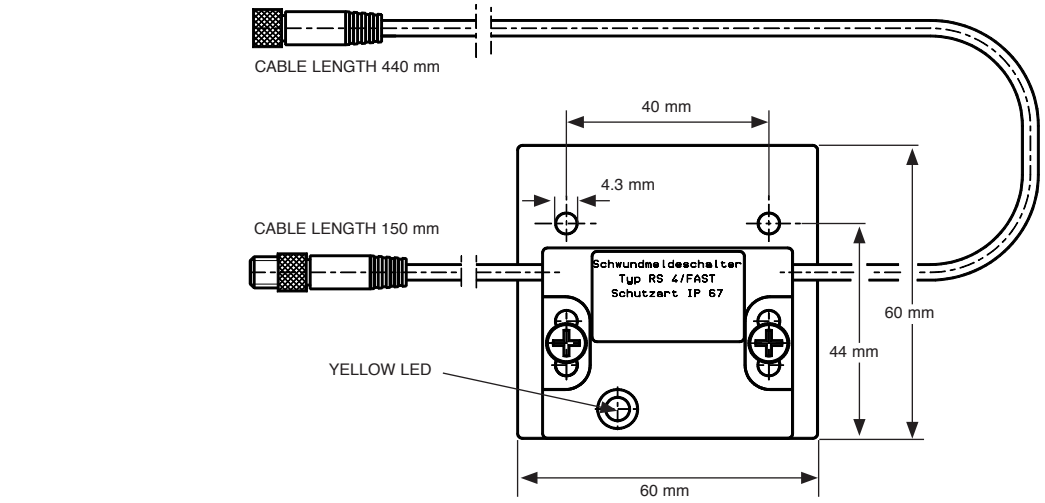
RS4 LOSS INDICATOR SWITCH - FAST CONTROL PANEL (Part No. K02462756)

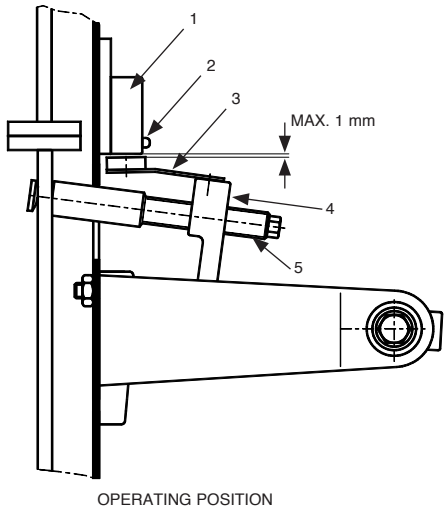
In the event of weight loss, the RS4 loss indicator gives and electrical signal through the fault-line to the fault-indication module of the fire detection central unit. At the same time, a yellow LED lights up to give a visual indication. The mounting set consists of a switch, an operating magnet, and mounting screws.

Note: The RS4 loss indicator is designed for CO_2 systems that utilise a FAST control panel.

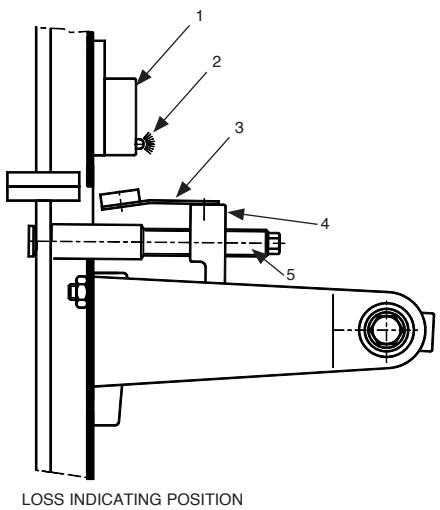
Technical information

Material:	Plastic
Weight:	0.11 kg
Ingress Protection class:	IP67





OPERATING POSITION



LOSS INDICATING POSITION

Item	Description
1	Switch
2	LED (yellow)
3	Magnet with fixation
4	Balancing fork
5	Adjusting spindle

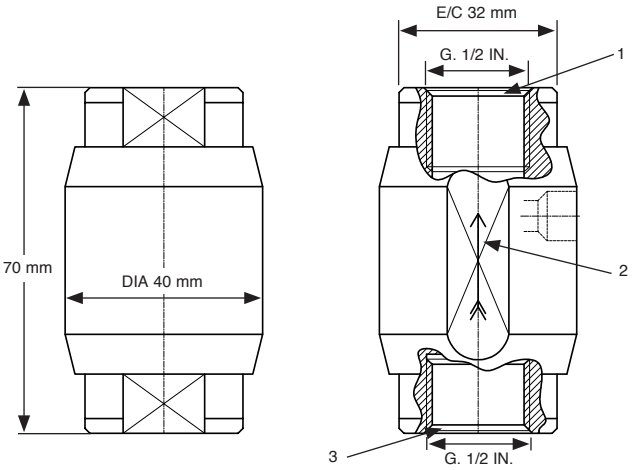
FIGURE 4-28
RS4 (FAST) LOSS INDICATOR SWITCH
E001078

1/2 IN. CO_2 CHECK VALVE (Part No. 20006054)

The CO_2 check valve connects the discharge hose to the manifold inlet. It opens automatically upon system discharge and closes at the end of the discharge. The body is marked with a direction of flow arrow.

NOTICE

It is essential that the check valve is installed in the correct orientation, with the head of the arrow pointing to the manifold connection.



Item	Description
1	Manifold connection
2	Direction of flow arrow
3	Container connection

FIGURE 4-29
CO_2 CHECK VALVE
025797

Technical information

Body:	Brass
Inner ball:	Nylon
Weight:	0.475 kg
Maximum working pressure:	140 bar
Free cross-sectional area:	176.7 mm^2
Certification:	EN 12094-13
CE certification number:	0786-CPR-30031

CO_2 MANIFOLDS - INSTALLATIONS WITHOUT A WEIGHING DEVICE

CO_2 manifolds connect containers in the CO_2 container bank to the supply pipe, or to the selector valve manifold, when required. Manifolds are manufactured from Schedule 80 pipe and painted with a matt black synthetic primer with anticorrosive pigments (activated zinc phosphate). Johnson Controls pressure test the manifolds to 250 bar and supply them with an NPT Male thread at each end. The manifold includes a 3000 lb threaded cap to blank off one end.

To join any standard manifolds together for a particular installation or container bank configuration, use the available union connectors. Use the union connector to fasten the discharge pipework to the end of the manifold. For ease of transport and installation, the manifolds are split into sections with a maximum length of 3 m. Union connectors are welded to the ends of each split section to enable reassembly.

A numerical or alphabetical identifier marks each side of the joint to ensure correct assembly during installation. A plugged port is included for the discharge pressure switch (Part No. 30330010) and the odouriser assembly (Part No. 42278). Both 1/2 in. plugs (Part No. 3080039) are included with the manifold and do not need to be ordered separately.

Single and double row manifolds are available for use with the 67 L and 40 L CO_2 containers only.

Double row manifolds are supplied with a single 1/2 in. BSPP plug (Part No. 30390159) in order to blank off one of the inlet connections for installations with odd numbers of containers. For installations with even numbers of containers, this plug is not required.

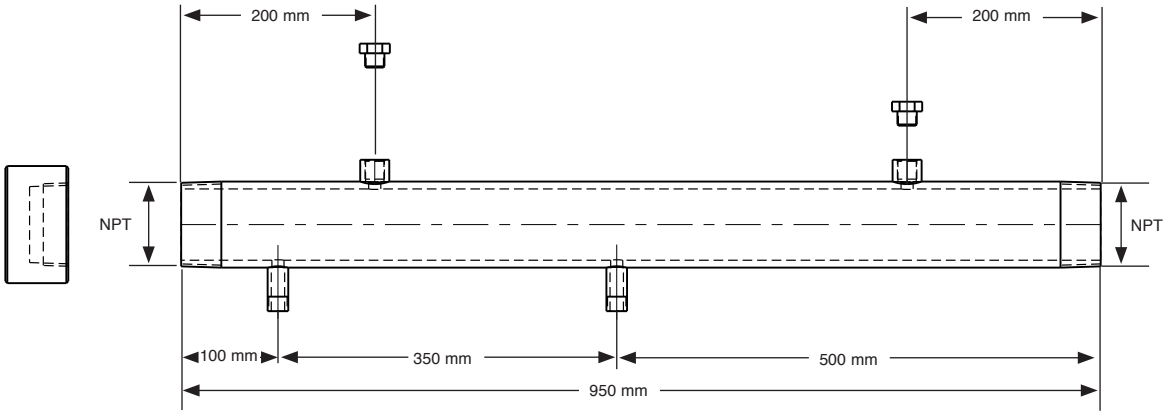


FIGURE 4-30
SINGLE ROW CO_2 MANIFOLD (TWO PORT) FOR SYSTEMS WITHOUT A WEIGHING DEVICE
025628

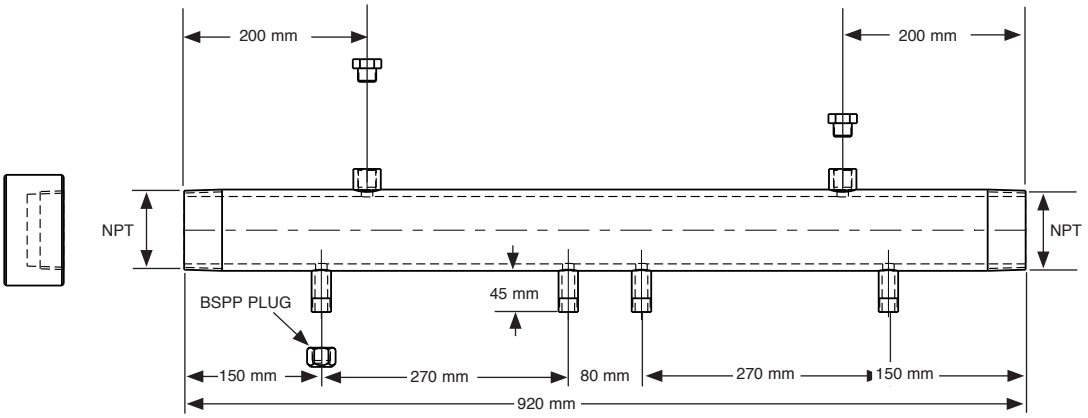


FIGURE 4-31
DOUBLE ROW CO_2 MANIFOLD (FOUR PORT) FOR SYSTEMS WITHOUT A WEIGHING DEVICE
025628

CO_2 MANIFOLDS - INSTALLATIONS WITHOUT A WEIGHING DEVICE

Table 4-12 lists standard part numbers for single row manifolds suitable for use with 67 L and 40 L CO_2 containers and Table 4-13 lists standard part numbers for double row manifolds suitable for use with 40 L and 67 L CO_2 containers. If the system design requires a larger number of ports for manifolds, contact Customer Services to confirm availability.

Technical information

Material:	Steel Schedule 80
Specification:	ASTM A106 GR. B
Finish:	Painted, black (RAL 9005)
Test pressure:	250 bar
Pressure switch port:	G 1/2 in. Female
Odouriser assembly port:	G 1/2 in. Female
Outlet connections:	NPT threads
Inlet connections:	G 1/2 in. male
Supplied length:	Maximum 3 m length sections 950 mm (2 port – single row) 1300 mm (3 port – single row) 1650 mm (4 port – single row) 2000 mm (5 port – single row) 2350 mm (6 port – single row) 2700 mm (7 port – single row) 920 mm (3-4 port – double row) 1270 mm (5-6 port – double row) 1620 mm (7-8 port – double row) 1970 mm (9-10 port – double row) 2320 mm (11-12 port – double row) 2670 mm (13-14 port – double row)

TABLE 4-12: MANIFOLD PART NUMBERS - SINGLE ROW 40 L AND 67 L CONTAINERS WITHOUT WEIGHING DEVICE

Manifold size (mm/in.)	25 mm (1 in.)	40 mm (1 1/2 in.)	50 mm (2 in.)
2 port	38021022	38021024	–
3 port	38021032	38021034	–
4 port	38021042	38021044	38021045
5 port	38021052	38021054	38021055
6 port	38021062	38021064	38021065
7 port	–	38021074	38021075
8 port	–	38021084	38021085
9 port	–	38021094	38021095
10 port	–	38021104	38021105
11 port	–	38021114	38021115
12 port	–	38021124	38021125
13 port	–	–	38021135
14 port	–	–	38021145
15 port	–	–	38021155

TABLE 4-13: MANIFOLD PART NUMBERS - DOUBLE ROW 40 L AND 67 L CONTAINERS WITHOUT WEIGHING DEVICE

Manifold size (mm/in.)	25 mm (1 in.)	40 mm (1 1/2 in.)	50 mm (2 in.)	80 mm (3 in.)
3-4 port	39021042	–	–	–
5-6 port	39021062	39021064	39021065	–
7-8 port	39021082	39021084	39021085	–
9-10 port	–	39021104	39021105	–
11-12 port	–	39021124	39021125	–
13-14 port	–	39021144	39021145	–
15-16 port	–	–	39021165	39021167
17-18 port	–	–	39021185	39021187
19-20 port	–	–	39021205	39021207

CO_2 MANIFOLDS - INSTALLATIONS WITH A WEIGHING DEVICE

CO_2 manifolds connect containers in the CO_2 container bank to the supply pipe, or to the selector valve manifold, when required. Manifolds are manufactured from Schedule 80 pipe and painted with a matt black synthetic primer with anticorrosive pigments (activated zinc phosphate). Johnson Controls pressure test the manifolds to 180 bar and supply them with an NPT Male thread at each end. The manifold includes a 3000 lb threaded cap to blank off one end.

To join any standard manifolds together for a particular installation or container bank configuration, use the available union connectors. The union connector connects the discharge pipework to the end of the manifold. For ease of transport and installation, the manifolds are split into sections with a maximum length of 3 m.

Union connectors are welded to the ends of each split section to enable reassembly. A numerical or alphabetical identifier marks each side of the joint to ensure correct assembly during installation. A plugged port is included for the discharge pressure switch (Part No. 30330010) and the odouriser assembly (Part No. 42278). Both 1/2 in. plugs (Part No. 3080039) are included with the manifold and do not need to be ordered separately.

Single and double row manifolds are available for use with 67 L CO_2 containers only.

Double row manifolds are supplied with a single 1/2 in. BSPP plug (Part No. 30390159) in order to blank off one of the inlet connections for installations with odd numbers of containers. For installations with even numbers of containers, this plug is not required.

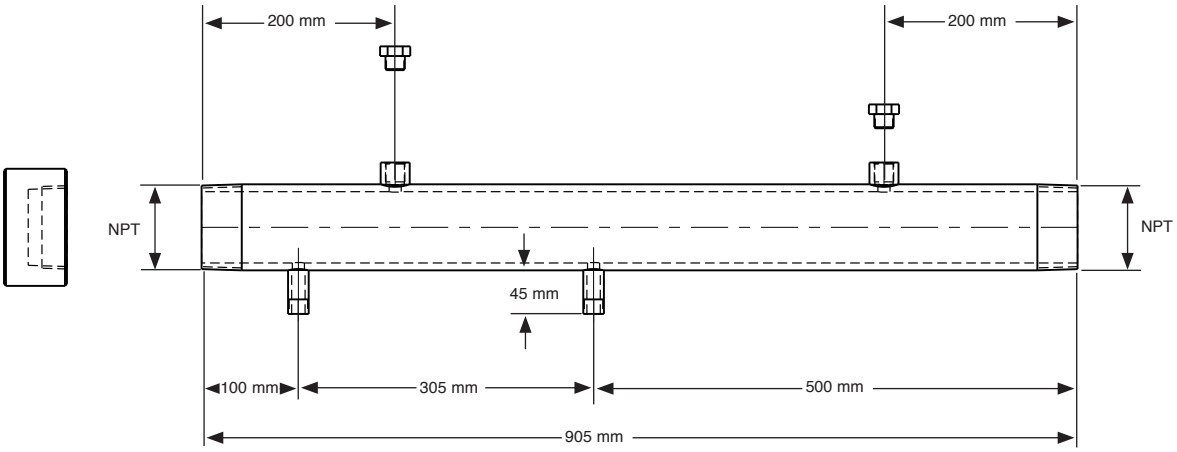


FIGURE 4-32
SINGLE ROW CO_2 MANIFOLD (TWO PORT) FOR SYSTEMS WITH A WEIGHING DEVICE
025800

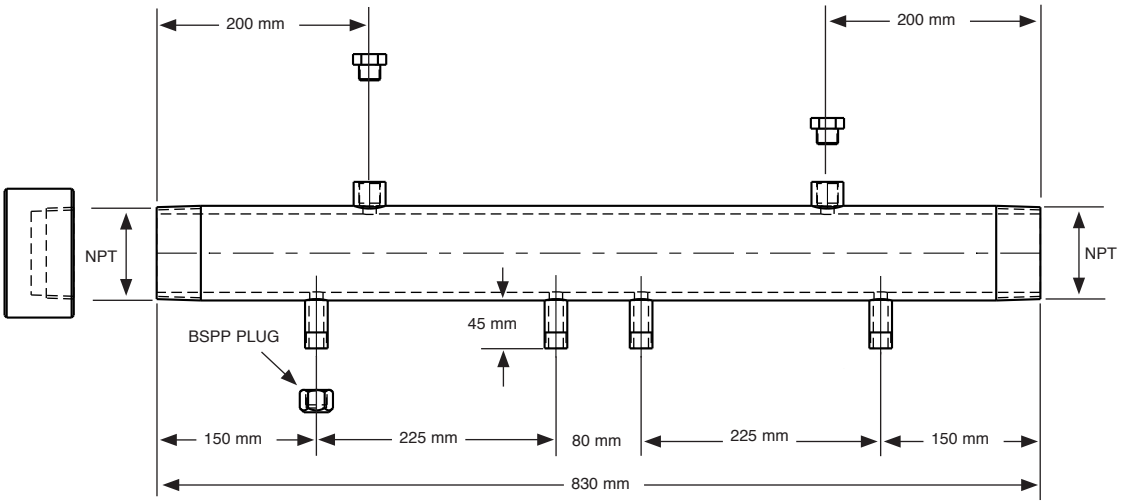


FIGURE 4-33
DOUBLE ROW CO_2 MANIFOLD (FOUR PORT) FOR SYSTEMS WITH A WEIGHING DEVICE
025801

CO_2 MANIFOLDS - INSTALLATIONS WITH A WEIGHING DEVICE

Table 4-14 lists standard part numbers for single row manifolds suitable for use with 67 L CO_2 containers and Table 4-15 lists standard part numbers for double row manifolds suitable for use with 67 L CO_2 containers. If the system design requires a larger number of ports for manifolds, contact Customer Services to confirm availability.

Technical information

Material:	Steel Schedule 80
Specification:	ASTM A106 GR. B
Finish:	Painted, black (RAL 9005)
Test pressure:	250 bar
Pressure switch port:	G 1/2 in. Female
Odouriser assembly port:	G 1/2 in. Female
Outlet connections:	NPT threads
Inlet connections:	G 1/2 in. male
Supplied length:	Maximum 3 m length sections 905 mm (2 port – single row) 1210 mm (3 port – single row) 1515 mm (4 port – single row) 1820 mm (5 port – single row) 2125 mm (6 port – single row) 2430 mm (7 port – single row) 2735 mm (8 port – single row) 830 mm (3-4 port – double row) 1135 mm (5-6 port – double row) 1440 mm (7-8 port – double row) 1745 mm (9-10 port – double row) 2050 mm (11-12 port – double row) 2355 mm (13-14 port – double row) 2660 mm (15-16 port – double row)

TABLE 4-14: MANIFOLD PART NUMBERS - SINGLE ROW 67 L CONTAINERS WITH A WEIGHING DEVICE

Manifold size (mm/in.)	25 mm (1 in.)	40 mm (1 1/2 in.)	50 mm (2 in.)
2 port	38021022	38021024	–
3 port	38021032	38021034	–
4 port	38021042	38021044	38021045
5 port	38021052	38021054	38021055
6 port	38021062	38021064	38021065
7 port	–	38021074	38021075
8 port	–	38021084	38021085
9 port	–	38021094	38021095
10 port	–	38021104	38021105
11 port	–	38021114	38021115
12 port	–	38021124	38021125
13 port	–	–	38021135
14 port	–	–	38021145
15 port	–	–	38021155

TABLE 4-15: MANIFOLD PART NUMBERS - DOUBLE ROW 67 L CONTAINERS WITH A WEIGHING DEVICE

Manifold size (mm/in.)	25 mm (1 in.)	40 mm (1 1/2 in.)	50 mm (2 in.)	80 mm (3 in.)
3-4 port	39021042	–	–	–
5-6 port	39021062	39021064	39021065	–
7-8 port	39021082	39021084	39021085	–
9-10 port	–	39021104	39021105	–
11-12 port	–	39021124	39021125	–
13-14 port	–	39021144	39021145	–
15-16 port	–	–	39021165	39021167
17-18 port	–	–	39021185	39021187
19-20 port	–	–	39021205	39021207

SELECTOR VALVE

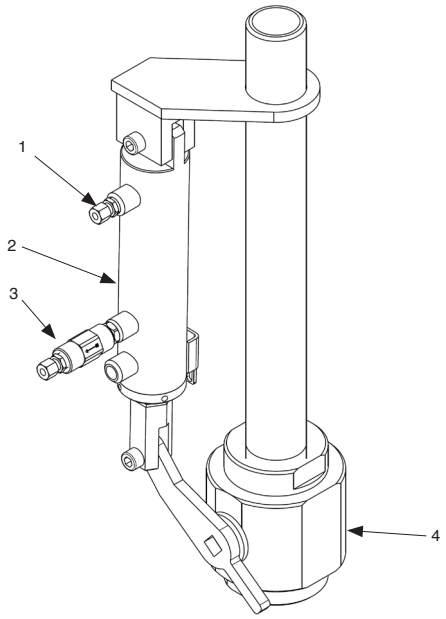
The selector valve applies to applications where multiple areas require protection from a single bank of containers. The valves pneumatically operate through a pilot container. Selector valves can be installed outside of the protected space (remotely) and adjacent to the container bank, as shown in Figure 4-35. If installation outside of the protected space (remotely) is required, then the decompression screw (Part No. 30027301) and 1/4 in. Dowty Seal (Part No. 31199816) must be installed on the outlet of the selector valve.

The pressure enters through the inlet port (see Figure 4-34). When the selector valve opens fully, the contained pressure exits through the outlet port. Pressure from the bottom port connects through a suitable pilot line to operate the appropriate number of containers required to protect a particular hazard. Figure 4-35 illustrates a typical selector valve system.

A typical system operates in the following sequence:

1. The fire detection system in one of the protected hazards operates.
2. The fire detection system sends a fire signal to the solenoid on the pilot container and it operates.
3. Simultaneously, a signal operates a second solenoid that connects to the pilot line from the pilot container. This second solenoid opens and pilot container pressure passes to the appropriate selector valve.
4. The selector valve piston operates and opens the selector valve. When the piston is at its fullest travel, the selector valve is fully open.
5. Pressure passes from a port in the bottom of the piston to the container bank. This pressure operates the container bank and inert agent discharges through the selector valve into the hazard.

Note: The unit comes with a non-return valve. Order union connectors to connect the selector valves to the pipework separately.



Item	Description
1	Inlet port
2	Pneumatic cylinder
3	Outlet port
4	Valve

FIGURE 4-34
SELECTOR VALVE
025740

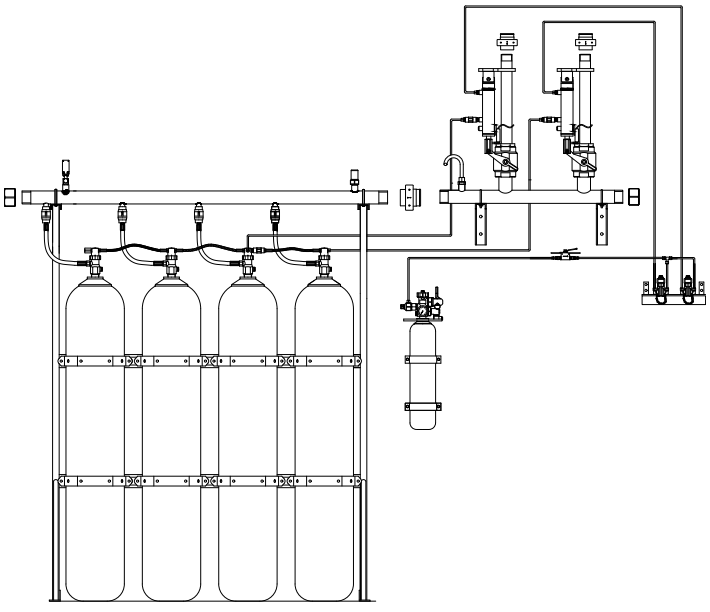


FIGURE 4-35
SELECTOR VALVE SYSTEM (UNEQUAL SIZE RISKS)
E001162

SELECTOR VALVE (Continued)

Location on system

The selector valve fits to the selector valve manifold. For installation steps, see Section 4 - Installing the Selector Valve.

Maintenance instructions

If faults or suspected faults arise, contact customer services to organise a replacement part.

Factory testing

Each selector valve is function tested five times at the minimum actuation pressure of 60 bar to confirm the correct operation (open and closing) of the valve and the time taken to complete this operation. Each selector valve is also hydrostatically tested to 210 bar.

Technical information

Valve bore size:	20 mm to 100 mm
Valve construction:	Full bore
Valve connection (threaded):	Threaded NPT Female inlet NPT Male outlet
Pneumatic port connection:	1/4 in. BSPP
Working temperature range:	–20 °C to 50 °C
Mounting position:	Horizontal or vertical
Nominal actuation pressure:	100 bar
Maximum working pressure:	140 bar
Minimum actuation pressure:	60 bar
Maximum actuation pressure:	115 bar
Approvals and listings:	VdS
Certification:	EN 12094-5
CE certification number:	0786-CPR-30199
Year of CE marking:	2010
CE marking requirements:	Manufacturer, Part No., DNXX, serial number, CE_{0786}

TABLE 4-16: SELECTOR VALVE

Selector valve assembly with manual release	Selector valve assembly with blind caps*	Size mm (in.)	Dimensions (length × width) (mm)	Weight (kg)
445044	442796	25 (1)	524 × 203	8.8
445046	442798	40 (1 1/2)	543 x 243	13.0
445047	442799	50 (2)	560 × 256	17.0
445049	442801	80 (3)	612 × 310	33.9
445050	442802	100 (4)	748 × 363	58.0

* For VdS system approval, manual release devices cannot be used and so blind caps are substituted.

Note: With each selector valve shipping assembly, the selector valve solenoid actuator (Part No. 30130253V or 30130255V), non-return valve, and appropriate fittings come with the selector valve. Order selector valve solenoid brackets separately.

Selector valve ancillaries (ordered separately)

Johnson Controls provide a selector valve microswitch (Part No. 30116011) and when fitted, electronically signals that the selector valve operates.

Johnson Controls provide a lever (Part No. 20010013) to manually close the selector valve after operation.

⚠ WARNING

When mounting the selector valve, sufficient clearance must be allowed for operating the manual lever.

Pneumatic cylinder volumes

The volume of a pneumatic cylinder on a 3/4 in. to 3 in. selector valve is equivalent to 14 m of 1/4 in. O.D. pneumatic actuation line tubing. For a 4 in. selector valve, the volume equates to 32 m of tubing. Deduct these volumes from the total allowable volume of pneumatic actuation line when using a selector valve in a system. Refer to the installation instructions for selector valves in Section 4 - Installing the Selector Valve.

SELECTOR VALVE ASSEMBLY CONTENTS

Each selector valve shipping assembly includes the following components:

- Selector valve
- Selector valve solenoid
- Non-return valve
- Appropriate pipe fittings

Order the selector valve solenoid brackets (see Table 4-19) and union connectors (see Table 4-23) separately.

TABLE 4-17: CONTENTS OF SELECTOR VALVE SHIPPING ASSEMBLIES (SOLENOID WITH MANUAL RELEASE)

		Contents within the selector valve assembly (solenoid with manual release)				
Selector valve size - mm (in.)	**Selector valve assembly**	**Selector valve**	**Selector valve solenoid (Manual release)**	**Non-return valve**	**6 mm O.D. (outer diameter) tube fittings**	**1/4 in. Dowty (bonded) seal**
	Part No.	**Part No.**	**Part No.**	**Part No.**	**Part No.**	**Part No.**
25 (1)	445044	21100060V	30130253V	20006020	2 × 309.010.008	2 × 31199816
40 (1 1/2)	445046	21100080V				
50 (2)	445047	21100090V				
80 (3)	445049	62116004V				
100 (4)	445050	62116005V				

TABLE 4-18: CONTENTS OF SELECTOR VALVE SHIPPING ASSEMBLIES (SOLENOID ONLY WITH BLIND CAPS)

		Contents Within the selector valve assembly (solenoid only with blind cap)				
Selector valve size - mm (in.)	**Selector valve assembly**	**Selector valve**	**Selector valve solenoid (Blind cap)**	**Non-return valve**	**6 mm O.D. tube fittings**	**1/4 in. Dowty (bonded) seal**
	Part No.	**Part No.**	**Part No.**	**Part No.**	**Part No.**	**Part No.**
25 (1)	442796	21100060V	30130255V	20006020	2 × 309.010.008	2 × 31199816
40 (1 1/2)	442798	21100080V				
50 (2)	442799	21100090V				
80 (3)	442801	62116004V				
100 (4)	442802	62116005V				

SELECTOR VALVE MICROSWITCH (Part No. 30116011)

The microswitch, when fitted to the selector valve, electronically signals that the selector valve operates.

When the selector valve opens, the detector screw makes contact with the plunger on the microswitch. An electrical signal is then sent to the panel to indicate that the selector valve is open.

The microswitch is supplied with the detector screw and required fixings.

Technical information

Type:	Modular pre-wired switch with plunger
Housing:	Metal housing, 20 mm fixing points
Contact block:	1 NO + 1 NC snap action
Cable:	PVC Cable, 5 x 0.75 mm^2 2.0 m Length
Ingress Protection class:	IP67 (EN 60529) and IP69K (ISO 26053)
Switch type:	Positive opening (IEC 60947-5-1)
Thermal current (Ith):	10 A
Rated insulation voltage (Ui):	250 VAC
Fuse:	10 A 500 V type gG
Conformity:	Low Voltage Directive (2014/35/EU)
	EMC Directive (2014/30/EU)
	RoHS Directive (2011/65/EU)

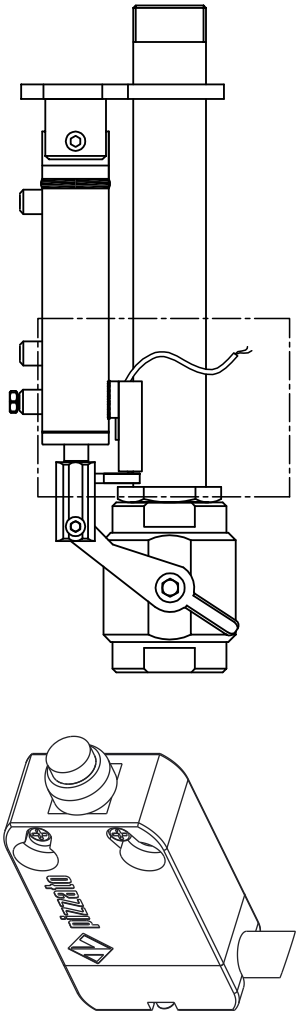


FIGURE 4-36
SELECTOR VALVE MICROSWITCH
E001080

SELECTOR VALVE SOLENOID AND BRACKETS

(Part No. 30130253V - Solenoid with manual release)
(Part No. 30130255V - Solenoid only with blind cap)

The selector valve solenoid fits between the pilot container and selector valve. A pneumatic release occurs when the solenoid receives an electrical signal from the fire detection control panel. The electrical signal to the solenoid must be maintained for the duration of the system actuation.

Johnson Controls offers selector valve solenoids as standard with manual release or solenoid operation only, and supply them as part of the selector valve shipping assembly. For further details, see Table 4-17. The manual release includes a steel safety pin to prevent accidental manual release. The manual release operating pin stays in the fire position and requires manual resetting before refitting to the solenoid. The actuation disc requires replacement following the operation of the manual release when installed on the solenoid.

Table 4-19 lists the brackets available to mount the selector valve solenoid. The selector valve shipping assembly does not include the brackets. Order these separately, depending upon the system design requirements.

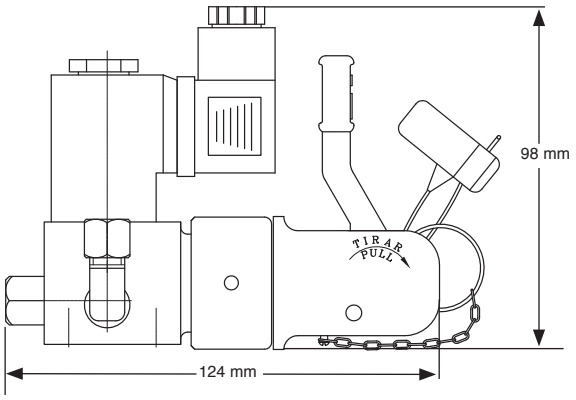


FIGURE 4-37
SELECTOR VALVE SOLENOID COMPLETE WITH MANUAL RELEASE
025741

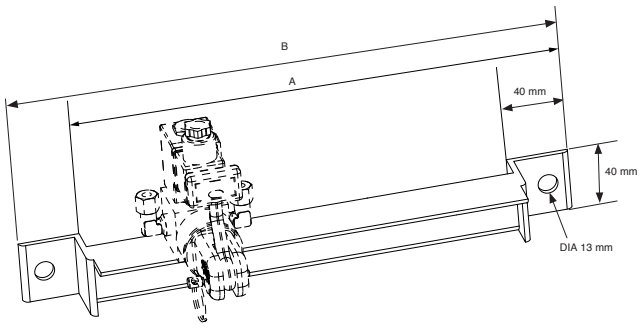


FIGURE 4-38
SELECTOR VALVE SOLENOID BRACKETS
025320

Technical information

Actuation type:	Manual Electrical via solenoid (normally closed)
Reset method:	Manually
Connection:	6 mm stud coupling
Voltage:	24 VDC ± 15%
Maximum working pressure:	166 bar
Consumption:	13 W
Minimum duration of trigger signal:	Continuous duty
Electrical connection:	DIN Plug
Protection:	IP 65
Working temperature range:	–20 °C to 50 °C
Weight:	0.25 kg
Approvals and listings:	VdS
Certification:	EN 12094-4
CE certification number:	0786-CPR-30139
CE marking requirements:	Manufacturer, serial number, voltage, current, CE_{0786}
Method of marking:	Stamp

Note: * For VdS system approval, manual release devices cannot be used and so blind caps are substituted.

TABLE 4-19: SELECTOR VALVE SOLENOID MOUNTING BRACKET

Part No.	Description	Hole centres Dimension A	Overall length Dimension B
30650022	Selector valve solenoid mounting bracket (2 solenoids)	330 mm	360 mm
30650013	Selector valve solenoid mounting bracket (3 solenoids)	475 mm	505 mm
30650014	Selector valve solenoid mounting bracket (4 solenoids)	620 mm	650 mm

⚠ WARNING

Failure to replace the actuation disc following operation and/or resetting the manual release prior to fitting onto the solenoid, could result in the system discharging into the wrong hazard and not enough agent discharging into the required hazard area.

SELECTOR VALVE MANIFOLDS

Use selector valve manifolds to fit selector valves to CO_2 container banks. Johnson Controls supply two to six ports and 3/4 in. to 4 in. sizes to connect all selector valve types. They are supplied painted with a matt black synthetic primer with anticorrosive pigments (activated zinc phosphate). The manufacturer uses schedule 80 pipe to create the manifolds and pressure tests them to 250 bar. All connections are NPT.

The manifolds include a plugged port for the pressure relief valve (Part No. 62104001), a requirement of VdS approved systems. The selector valve manifolds also include a 3000 lb pressure rated threaded cap to blank off one end of the manifold.

Technical information

Material:	Schedule 80 steel
Specification:	ASTM A106 GR. B
Finish:	Painted, black (RAL 9005)
Test pressure:	250 bar
Pressure relief valve port:	G 1/2 in.
Pipe connections:	NPT thread
Supplied length:	800 mm (2 port) 1150 mm (3 port) 1500 mm (4 port) 1850 mm (5 port) 2200 mm (6 port)

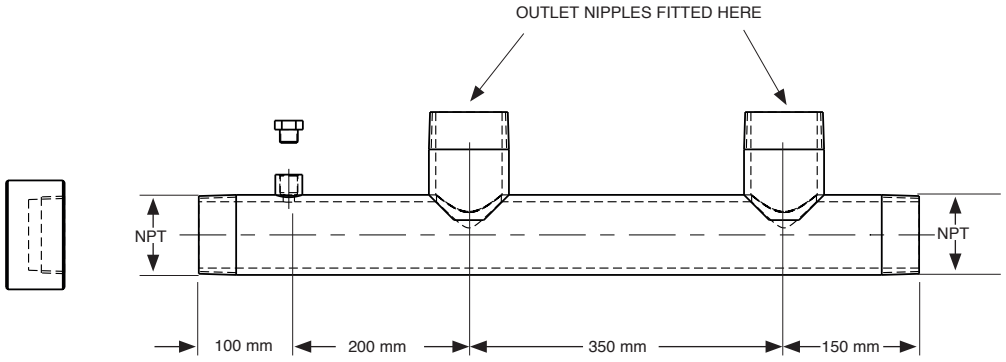


FIGURE 4-39
SELECTOR VALVE MANIFOLD (TWO PORT)
E001222

TABLE 4-20: SELECTOR VALVE MANIFOLD

Manifold size mm (in.)	2 Port	3 Port	4 Port	5 Port	6 Port
25 (1)	36222000	36322200	36422220	36522222	36622222
40 (1 1/2)	36244000	36344400	36444440	36544444	36644444
50 (2)	36255000	36355500	36455550	36555555	36655555
80 (3)	36277000	36377700	36477770	36577777	36677777
100 (4)	36288000	36388800	36488880	36588888	36688888

TABLE 4-21: SELECTOR VALVE OUTLET NIPPLE PART NUMBERS

Outlet nipple size mm (in.)	Part No.
25 (1)	94116022
40 (1 1/2)	94116024
50 (2)	94116025
80 (3)	94116027
100 (4)	94116028

An appropriate number and size of selector valve manifold outlets (see Table 4-21) must be specified on the order, not ordered as separate line items, according to the number and size of selector valves to be fitted to the selector valve manifold.

MANIFOLD DROP SECTIONS

Manifold drop sections can connect the selector valve manifold to the main system manifold where an insufficient ceiling height occurs. The drop sections give a drop of 900 mm or 1500 mm from pipe centres and contain NPT connections. They are supplied painted with a matt black synthetic primer with anticorrosive pigments (activated zinc phosphate).

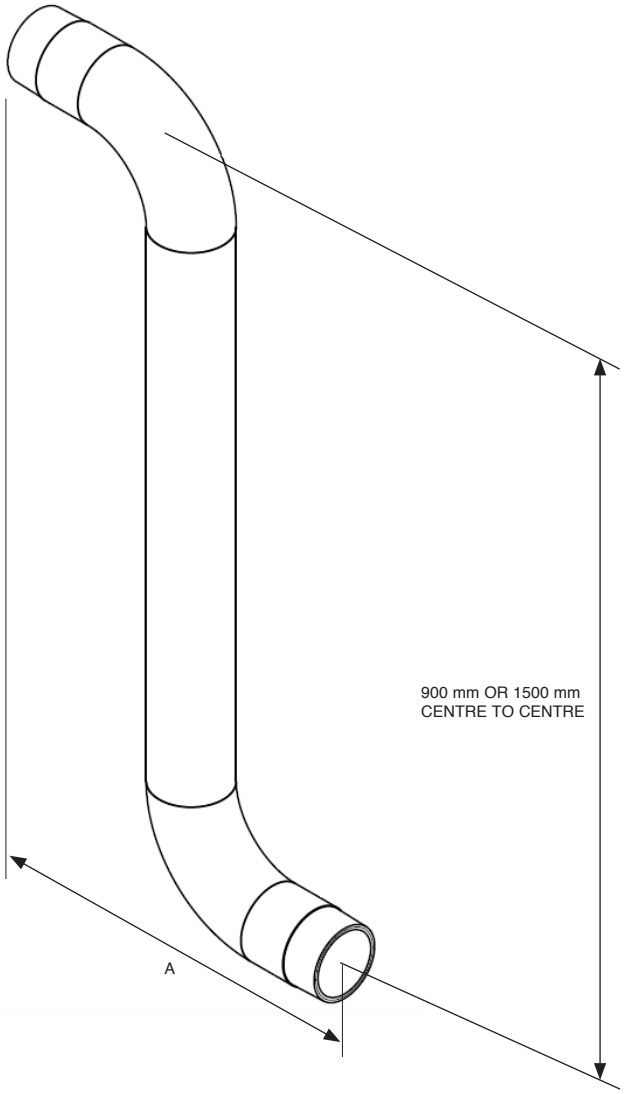


FIGURE 4-40
MANIFOLD DROP SECTIONS
025756

TABLE 4-22: MANIFOLD DROP SECTION PART NUMBERS

Drop section size (mm / in.)	900 mm Centres	1500 mm Centres	Width Diminsion A
25 (1 in)	19263002	19263010	310 mm
40 (1 1/2)	19263004	19263012	363 mm
50 (2)	19263005	19263013	413 mm
80 (3)	19263007	19263015	518 mm
100 (4)	19263008	19263016	620 mm

Technical information

Material:	Schedule 80 steel
Specification:	ASTM A106 GR. B
Finish:	Painted, black (RAL 9005)
Test pressure:	250 bar
Connections:	NPT thread

UNION CONNECTORS

Union connectors connect selector valve manifolds, drop sections, and manifolds together, and connect selector valves to pipework. Table 4-23 lists the available options. Johnson Controls supply two types of union connectors; NPT to NPT and NPT to BSPT. NPT to NPT connect selector valve manifolds, drop sections, and manifolds. NPT to BSPT connect to BSPT pipework. The arrow on the connector marks the flow direction.

25 mm (1 in.) to 50 mm (2 in.) union connectors have a maximum working pressure of 370 bar and 65 mm (2 1/2 in.) to 100 mm (4 in.) union connectors have a maximum working pressure of 240 bar.

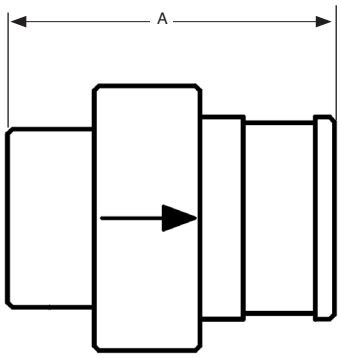


FIGURE 4-41
UNION CONNECTOR
025755

TABLE 4-23: UNION CONNECTOR PART NUMBERS

Connector size (mm/in.)	NPT to NPT (Female)	NPT to BSPT (Female)	Weight kg	C spanner required	Length Dimension A
25 (1)	30888002	30888028	0.8	35 mm to 60 mm (Part No. 35017401)	72.5 mm
40 (1 1/2)	30888004	30888030	1.5	60 mm to 90 mm (Part No. 35017402)	81.8 mm
50 (2)	30888005	30888031	3.0	60 mm to 90 mm (Part No. 35017402) - side sections 90 mm to 155 mm (Part No. 35017403) - centre section	93.4 mm
80 (3)	30888007	30888033	5.8	90 mm to 155 mm (Part No. 35017403) - side sections 155 mm to 230 mm (Part No. 35017404) - centre section	119.5 mm
100 (4)	30888008	30888034	8.3	155 mm to 230 mm (Part No. 35017404)	123.3 mm

Technical information

Material:	Steel and nitrile
Specification:	ASTM A105
Marking: (20 mm to 40 mm union connectors)	Part No., nominal size, direction of flow, serial number, working pressure
CE marking requirements: (50 mm to 100 mm union connectors)	Part No., nominal size, direction of flow, serial number, working pressure, CE

Spare o-rings

Spare o-rings are available for the union connectors, should they become lost or damaged.

TABLE 4-24: SPARE O-RINGS

Connector size (mm)	Part No.
25	22000524
40	22000527
50	22000528
80	22000530
100	22000531

MANIFOLD BURST DISC ASSEMBLY (Part No. 200CD190)

The safety disc can automatically relieve pressure in the pipework system. A closed section of pipe requires a safety disc between the container valves and selector valves.

The outlet from the safety disc must pipe to the atmosphere, away from personnel. The system design must incorporate a manual by-pass valve into the pressure relief arrangements to safely vent trapped CO_2 to the atmosphere. Ensure that the manifold burst disc orients in the proper direction with the burst disc outside of the pipework.

Technical information

Material:	Brass
Connection:	1/2 in. NPT × 1/2 in. NPT Male
Burst pressure:	190 bar (+/-10 bar)
Overall size:	49 mm × 28 mm
Weight:	0.12 kg
Certification:	PED (2014/68/EU)
PED notified body:	TÜV Nord (CE 0045)

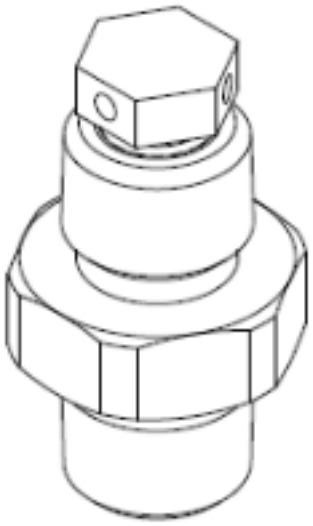


FIGURE 4-42
PRESSURE RELIEF VALVE

PRESSURE RELIEF VALVE (Part No. 62104001)

The pressure relief valve can automatically relieve pressure in the pipework system. It normally fits in all closed sections of the pipework, such as between the container and stop valve, for example. It is factory set to 160 bar.

Technical information

Material:	Stainless steel 1.4104
Connection:	G 1/2 in. Male inlet G 1/2 in. Female outlet
Overall length:	199 mm
Weight:	1.0 kg
Set pressure:	160 bar
Certification:	PED (2014/68/EU)
Approval:	TÜV Nord (CE 0045)

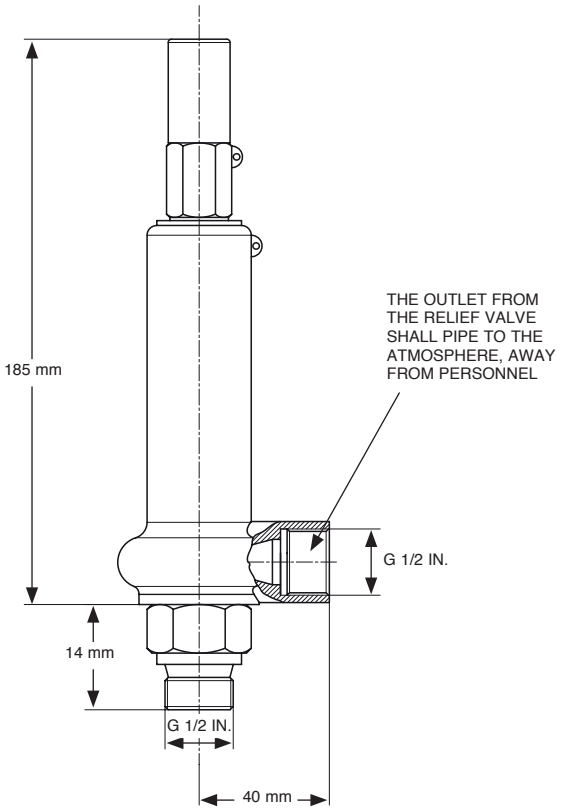


FIGURE 4-43
PRESSURE RELIEF VALVE
025803

VENT VALVE
(Part No. 302700014)

The vent valve allows for the safe venting of CO_2 to the atmosphere if it becomes trapped within a closed pipework system. The vent valve is fitted with two limit switches to monitor a valve open or a valve closed indication. The valve is provided with a locking bracket into which a standard padlock may be fitted.

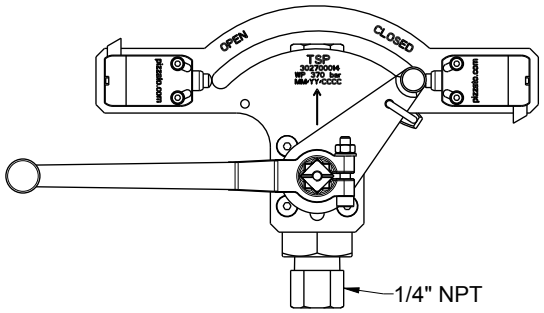


FIGURE 4-44
VENT VALVE
E000923

Technical information

Ball valve body:	1.0737
Ball valve connection:	3/4 in. NPT Female
Vent valve assembly connection:	1/2 in. NPT Female (3/4 in. x 1/2 in. adaptor both sides)
Operation voltage:	250 VAC (50 Hz) / 24 VDC
Ingress protection:	IP67 and IP69K
Switch indication:	Valve open (OPEN) Valve closed (CLOSED)
Working pressure:	370 bar
Working temperature range:	-20 °C to 50 °C
Additional feature:	Pad lockable
Overall size:	215 mm x 110 mm x 82 mm
Weight:	2.3 kg

PILOT LINE NON-RETURN VALVE (Part No. 20006020)

The CO_2 system incorporates a pilot line non-return valve if a requirement arises to either maintain pressure in a particular section of the pilot line or to ensure that nitrogen pressure from the pilot container operates the correct CO_2 containers.

For example, a system using selector valves requiring differing containers for each risk uses the pilot line non-return valve. This ensures that the pilot pressure opens only the correct bank of containers and the correct selector valve.

Johnson Controls supply various adaptors to fit the pilot line non return valve. For further details, see Section 5 - Installation.

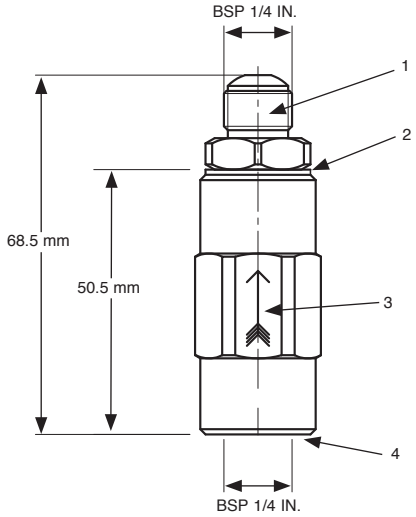
Note: The non-return valve is marked with the part number of the body (20006025), not the part number of the assembly (20006020) with the 1/4 in. Male adaptor.

⚠ WARNING

Do not remove the male adaptor as supplied.

Technical information

Body:	Brass
Size:	1/4 in.
Typical working pressure:	100 bar at 20 °C
Maximum working pressure:	240 bar
Working temperature range:	–20 °C to 50 °C
Minimum opening pressure:	3.6 bar
Minimum system operating pressure:	5.5 bar
Weight:	0.150 kg
Approvals and listings:	VdS
Certification:	EN 12094-13
CE marking requirements:	Manufacturer, Part No., 1/4 in., working pressure, direction of flow, serial number, CE_{0786}
Valve marking part number:	20006025 (Base non-return valve without 1/4 in. Male adaptor)
Method of marking:	Engraving
CE certification number:	0786-CPR-30036
Inlet connection:	1/4 in. BSPP Female
Outlet connection:	1/4 in. BSSP Male (through adaptor)
Free cross section area:	15.9 mm^2



Item	Description
1	Male adaptor 1/4 in. (part of assembly)
2	Dowty seal
3	Working position
4	Inlet valve connection

FIGURE 4-45
PILOT LINE NON-RETURN VALVE
025752

LOCK-OFF ASSEMBLY
(Part No. 302.200.072)

The lock-off unit can lock the suppression process and release it again. The lock-off unit consists of a 2/2-directional ball valve with a relief bore hole and built-on parts. The device can contain two inbuilt switches to monitor the two positions. Order these switches individually (Part No. K02462526) or as part of a fixing kit (Part No. K02462876). In either case, order two sets. The padlock enclosed with the product can secure each of the end positions. The ball valve must be installed so that it points in the correct direction. The package includes an enclosed fixing bracket and screws, together with two adapters. The two adaptors (Part No. 309.010.010) included with the assembly provide a connection between the lock-off unit and the 6 mm copper nickel pipe actuation arrangement.

Note: The 2/2 directional ball valve consists of two switching positions.

Technical information

Nominal diameter:	DN 8
Maximum operating pressure:	240 bar
Test pressure:	315 bar
Material:	Steel, nickel-plated
Weight:	0.8 kg
Approval:	VdS
Identification marking:	CE
Certification body:	0786-VdS
CE certification number:	0786-CPR-30020

Maintenance instructions

The lock-off unit requires no maintenance, if used properly. Replace damaged lock-off units immediately. Follow the warnings in the operating instructions for the suppression system. If faults or suspected faults arise, contact customer services to organise a replacement part.

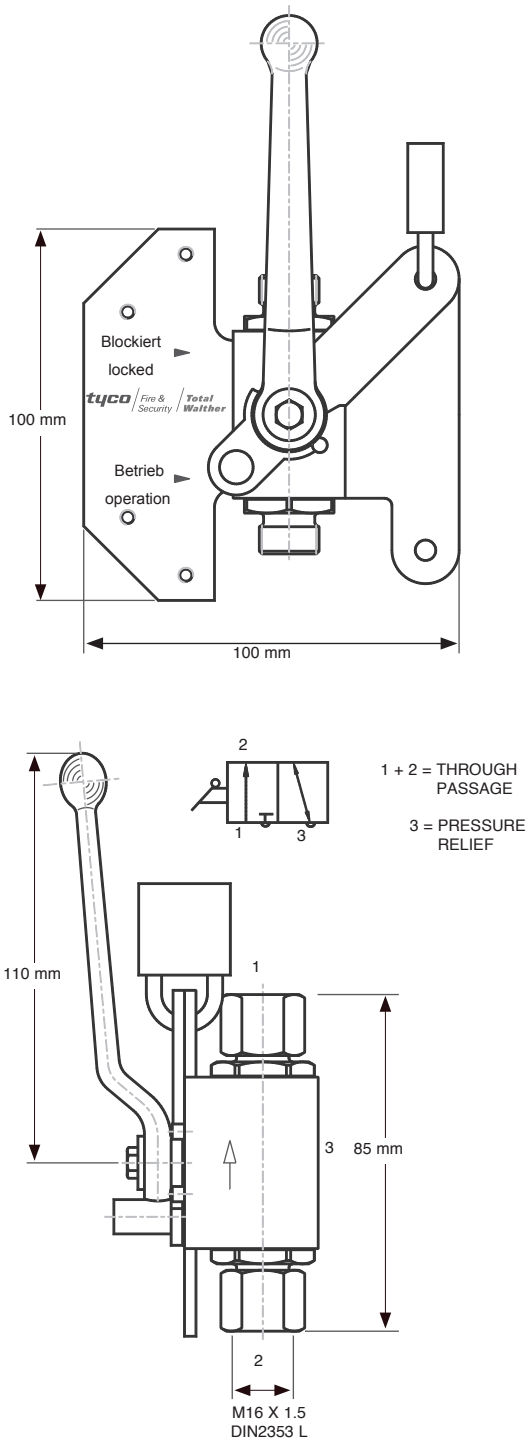


FIGURE 4-46
LOCK-OFF ASSEMBLY
025811

Note: This figure does not show adaptors.

LIMIT SWITCH WITH INTEGRATED LED

The lock-off assembly (Part No. 302.200.072) can be fitted with two limit switches to give a valve open or valve closed indication.

These switches are not compatible with the selector valve, and are designed solely for the lock-off unit.

Each limit switch can be ordered individually on its own (Part No. K02462526), or individually as part of a set with the appropriate fixings (Part No. K02462876) depending upon customer preference.

Technical information

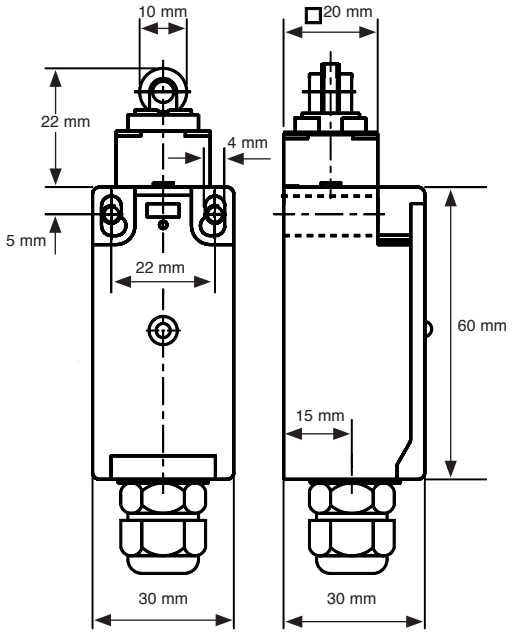
Nominal voltage:	20 VDC
Alarm current:	20 mA (external limited)
Contact:	1 NC / 1 NO
Protection:	IP 65
Ambient temperature:	–30 °C to +85 °C
Cable gland:	1 × PG11 with duplex cable joint 2 × Dia 6 mm
Weight:	0.1 kg

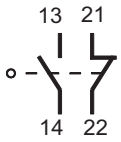
Technical information for Switch without LED element (removed)

Nominal voltage:	500 V
Permanent current:	6 A - 230 VAC-11 10 A - 24 VDC-11

Alternative limit switch set (Part No. K02462876)

Limit switch:	K02462526 (x1)
Screw M4 × 30:	K00501236 (x2)
Washer B 4, 3:	K00641060 (x2)
Hex nut M4:	K00612930 (x2)





Terminal arrangement

FIGURE 4-47
LIMIT SWITCH WITH INTEGRATED LED
025664

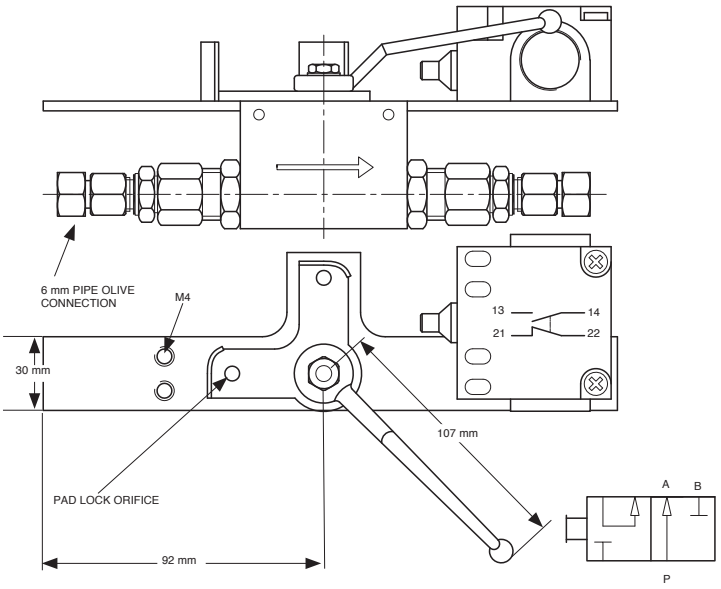
LOCK-OFF UNIT
(Part No. 62114001)

The lock-off unit locks and releases the pneumatic actuation line process. Install it between the pilot container and the master CO_2 container. The lock-off unit consists of a 2/2 directional ball valve with a relief bore hole and built-on parts. A micro switch (Part No. 30114000) pre-assembled onto the unit can monitor the open (operation) position. If the closed (isolation) position requires monitoring, order an additional micro switch and fixings separately. The padlock enclosed with the product secures each of the end positions. Install the ball valve so that it points in the correct direction. The packaging includes a fixing bracket, screws, and two adapters.

Order the following components separately to monitor the closed (isolation) position.

TABLE 4-25: LOCK-OFF UNIT PART DETAILS

Part No.	Description	Quantity
30114000	Lock-off Microswitch	1
35116057	Screw M4 × 25	2



Item	Description
A	Output
B	Vent
P	Input

FIGURE 4-48
LOCK-OFF UNIT
025634

Technical information

Nominal diameter:	DN 6
Operating pressure:	140 bar (2031 psi)
Temperature range:	–30 °C to 80 °C
Material:	Steel, nickel-plated
Weight:	0.8 kg
Approval:	VdS
Identification marking:	CE
Certification body:	0786-VdS
CE certification number:	0786-CPR-30007
Micro switch protection class:	IP67
Micro switch contact material:	Silver
Micro switch contacts:	1 NO / 1 NC
Micro switch nominal current:	4 A 230 VAC; 1 A 24 VDC
Micro switch short-circuit current:	1000 A
Micro switch cable entry:	2 × M20 × 1.5

PILOT CONTAINER

Johnson Controls provide three sizes of pilot container; 3 L, 13 L, and 50 L charged with nitrogen to 100 bar. Pilot containers pneumatically operate a CO_2 system. They can also operate selector valves, if fitted to the system. Table 4-26 lists the maximum number of CO_2 containers that the pilot containers can operate.

Do not remove the factory-fitted solenoid valve on site for testing purposes. The pilot container comes with a solenoid, manual actuator, contacted pressure gauge, mounting brackets, outlet adaptor, 700 mm actuation hose, 1/4 in. BSPT Male to 6 mm compression adaptor, and a bleed valve (with 1/4 in. bonded seal).

3 L and 13 L pilot containers are also available for VdS approved systems where manual release devices cannot be used. These two pilot containers come with a solenoid, contacted pressure gauge, mounting brackets, outlet adaptor, 1/4 in. BSPT Male to 6 mm compression adaptor, and a bleed valve (with 1/4 in. bonded seal). A blind cap is supplied fitted to the manual actuation port.

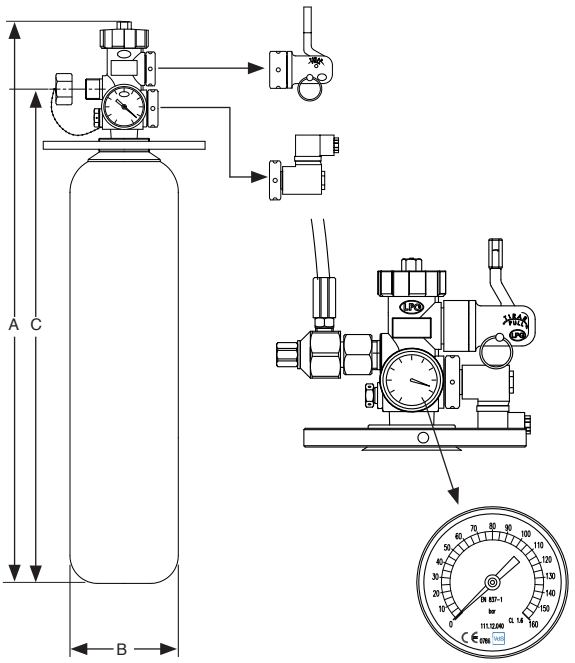


FIGURE 4-49
PILOT CONTAINER DETAILS
025307

Technical information

Gas type:	Nitrogen
Container pressure:	100 bar
Container test pressure:	300 bar
Pressure gauge:	0 bar to 160 bar
Working temperature range:	–20 °C to 50 °C
Actuation method:	Manual* / electrical
Bracket type:	Wall mounted (3 L) Floor mounted (13 L and 50 L)
Part number on label:	703033N2 (3 L) 170103014 (13 L) 26809 (50 L)

Note: 0 bar to 160 bar pressure gauge complete with a contact switch set to signal if the container pressure drops to 90 bar.

TABLE 4-26: PILOT CONTAINER DETAILS

Part No.	Container size (L)	Height Dim. A (mm)	Dia. Dim. B (mm)	Height Dim. C (mm)	Max. number of containers operated	Max. pilot line length (6 mm O/D pipe)	Min. nitrogen quantity (kg)	Notes
70100075	3	635	100	550	40	50 m	0.3	
70100082	13	1210	140	1120	150	125 m	1.5	
70121011	50	1620	229	1535	200	165 m	2.0	
170100075*	3	635	100	550	40	50 m	0.3	*For VdS system approval, manual release devices cannot be used and so blind caps are substituted.
170103015*	13	1210	140	1120	150	125 m	1.5	

Note: The maximum number of containers operated column applies to single hazard systems (no selector valves).

⚠ WARNING

If the manual actuator (Part No. 30180APB) is not required to be fitted to the pilot container valve, then the manual actuator port blind cap (Part No. 3087008B) and o-ring (Part No. 22001505) must be fitted to this port to ensure the correct operation of the valve.

PILOT CONTAINER FOR SF-2 OR SMV-1

Johnson Controls provide two sizes of pilot container designed for use with the SF-2 electrical actuator or the SMV-1 time delay; 3 L and 13 L charged with nitrogen to 100 bar. Pilot containers pneumatically operate a CO_2 system. Table 4-27 lists the maximum number of CO_2 containers that the pilot containers can operate.

These pilot containers come complete with a contacted pressure gauge, mounting brackets, outlet adaptor, 1/4 in. BSPT Male to 6 mm compression adaptor, and a bleed valve (with 1/4 in. bonded seal).

As these pilot containers are intended for VdS approved systems, they are supplied without a manual actuator. A blind cap is fitted to the solenoid actuation port (bottom actuation port on the valve), and this should not be removed. The blind cap on the upper actuation port should be kept in place until either the SF-2 electrical actuator or the SMV-1 time delay is fitted.

The actuation coupling (Part No. 130850006) connects the SF-2 electrical actuator or the SMV-1 time delay to the pilot container. Order the actuation coupling as a separate item.

Once activated, **it is not possible to interrupt the total discharge** of the containers.

Technical information

Gas type:	Nitrogen
Container pressure:	100 bar
Container test pressure:	300 bar
Pressure gauge:	0 bar to 160 bar
Working temperature range:	–20 °C to 50 °C
Actuation method:	Electrical (through SF-2 or SMV-1)
Bracket type:	Wall mounted (3 L) Floor mounted (13 L)

Note: 0 bar to 160 bar pressure gauge complete with a contact switch set to signal if the container pressure drops to 90 bar.

TABLE 4-27: PILOT CONTAINER DETAILS

Part No.	Container size (L)	Height Dim. A (mm)	Diameter Dim. B (mm)	Height Dim. C (mm)	Maximum number of containers operated	Maximum pilot line length (6 mm O/D pipe)
170100077	3	635	100	550	40	50 m
170103017	13	1210	140	1120	150	125 m

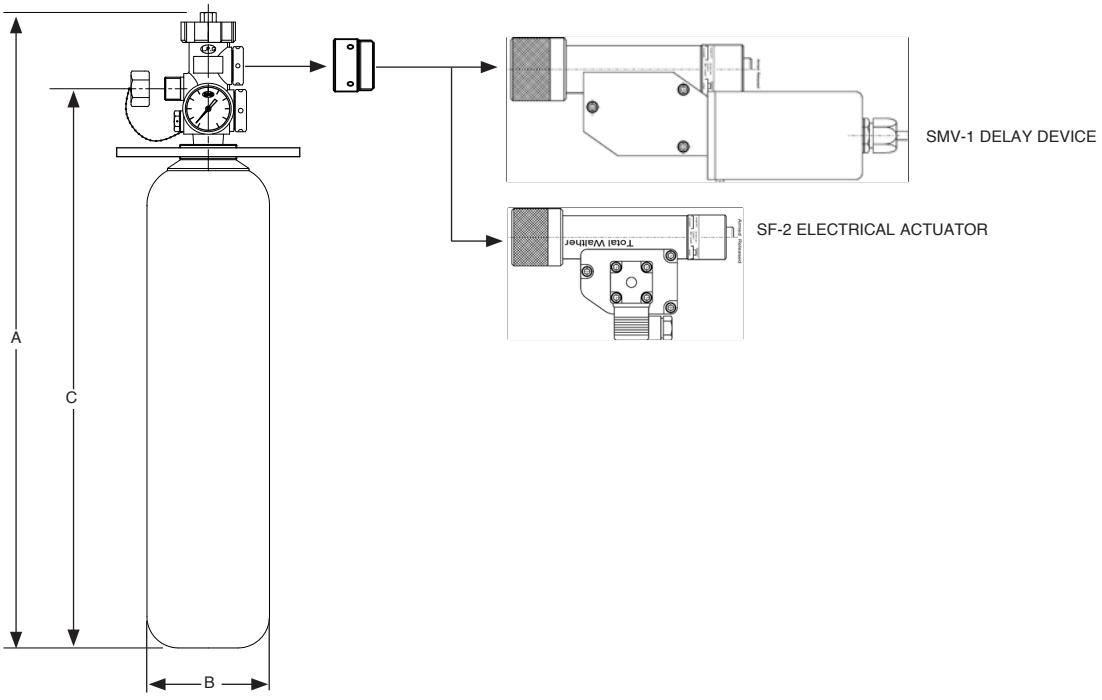


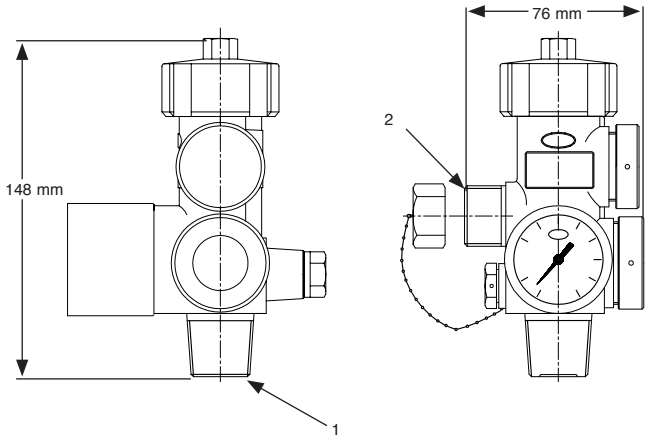
FIGURE 4-50
PILOT CONTAINER FOR SF-2 OR SMV-1
025852

128-90 PILOT CONTAINER VALVE (Assembly Part No. 29012804.SOL and 29012804.BLC)

The pilot 128-90 container valve is a quick action valve that can be operated through a local manual actuator, or electrically thorough a solenoid, the SMV-1 stepper motor, or the SF-2 electrical actuator.

The 128-90 valve is factory-fitted to the pilot container and is supplied with either a solenoid (Part No. 29012804.SOL) or a blind cap in place of the solenoid (Part No. 29012804.BLC).

The 128-90 valve includes a safety burst disc. It ruptures at approximately 270 bar.



Item	Description
1	W 28.8-14 DIN 477
2	W 21.7-14 DIN 477

FIGURE 4-51
PILOT CONTAINER VALVE 128-90
025358

Technical information

Maximum working pressure:	166 bar
Minimum working pressure:	6 bar
Working temperature:	–20 °C to 50 °C
Safety bursting disc:	270 bar ± 10 bar
Weight:	1.95 Kg
Connection thread:	W28.8 DIN 477
Manual release port:	M30 × 1.5
Solenoid valve port:	M36 × 1.5
Free flow cross sectional area:	50.26 mm^2
Overall size:	148 mm × 76 mm
Outlet port:	W21.7 DIN 477
CE certification number:	0786-CPR-30062
Valve type:	Type 2
Body:	Brass
Piston:	Brass
Approvals and listings:	LPCB and VdS
Certification:	EN 12094-4
CE marking requirements:	Manufacturer, Part No., serial number, voltage, current, CE0786
Valve marking part number:	2901280B
Method of marking:	Stamp

SOLENOID VALVE (Part No. 2000262V.SOL)

The solenoid comes factory-fitted to the 128-20 master container valve (Part No. 2000262V.SOL) or the 128-90 pilot container valve.

The solenoid is not polarity sensitive, and so positive supply from the control panel can be connected to either terminal, with the reverse for the negative supply.

⚠ WARNING

Should the solenoid valve malfunction in any way, return the complete pilot container or master container to Johnson Controls. Do not attempt to remove the solenoid valve on site.

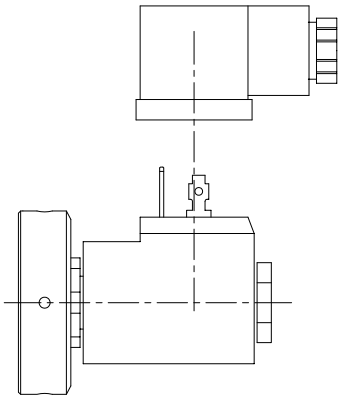


FIGURE 4-52
SOLENOID VALVE
025308

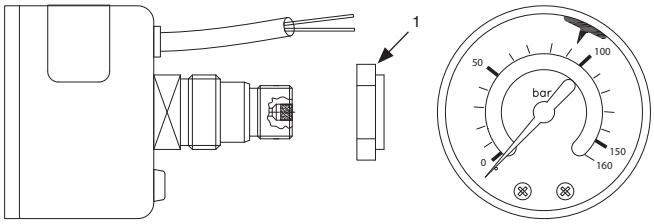
Technical information

Actuation type:	Solenoid (normally closed)
Reset method:	Automatic
Connection:	Factory fitted
Voltage:	24 VDC (20.4 to 27.6)
Maximum working pressure:	166 bar
Consumption:	13 W (low temperature) 11 W (nominal) 10 W (high temperature)
Minimum duration of trigger signal:	Continuous duty
Electrical connection:	3 pin PG9 (DIN 40430) conduit thread DIN plug connector
Protection:	IP 65
Working temperature range:	–20 °C to 50 °C
Weight:	0.25 kg
Approvals and listings:	LPCB and VdS
Certification:	EN 12094-4
CE certification number:	0786-CPR-30062
CE marking requirements:	Manufacturer, Part No., serial number, voltage, current, CE0786
Working:	Normally closed
Solenoid marking part number:	3023024B
Method of marking:	Laser

PILOT CONTAINER PRESSURE GAUGE (Part No. 42116061)

The pilot container is supplied factory fitted with a 0 bar to 160 bar pressure gauge complete with a contact switch set to signal if the container pressure drops to 90 bar.

Alternatively, order this gauge separately for on-site fitting, if necessary.



Item	Description
1	Fixing nut

FIGURE 4-53
PILOT CONTAINER PRESSURE GAUGE
025350

Technical information

Type:	Bourdon tube pressure gauge
Entry:	Back axial
Measurement system:	Copper alloy
Movement:	Copper alloy
Nominal size:	DN40 (1.6 in.)
Units of outer scale:	Bar
Units of inner scale:	psi
Connection:	M10 × 1 DIN13
Case:	Stainless steel
Ingress Protection Class:	IP 54
Window:	Polycarbonate
Restrictor:	Brass Dia 0.5 mm
Accuracy:	+/– 1.6%
Language:	English
Working temperature range:	–20 °C to 50 °C (–4 °F to 122 °F)
Pressure range:	0 bar to 160 bar (0 psi to 2321 psi)
Nominal working pressure: (Charge pressure)	100 bar (1450 psi)
Maximum operating pressure:	113.6 bar (1648 psi)
Setpoint:	90 bar (1306 psi)
Voltage:	4.5 VDC to 24 VDC
Current:	5 mA to 100 mA
Maximum consumption:	2.4 W
Approvals and listings:	VdS
Certification:	EN 12094-10
CE certification number:	0786-CPR-30089
Year of CE Marking:	2009
CE marking requirements:	Manufacturer's mark, 30517443, bar (psi), CL1.6, CE_{0832}
Method of marking:	Part of gauge artwork
Weight:	0.05 kg (0.11 lb)
Gauge Part No.:	30116054
Fixing nut number:	30210808
O-ring Part No.:	22000502
Protector Part No.:	61110006 (required when gauge is not factory fitted)

Note: The contacted pressure gauge is designated *Normally Open* under zero pressure (container empty) and as such is *Normally Closed* under the nominal working pressure.

The contact breaks (opens) on falling pressure.

NOTICE

The set point of the contacted pressure gauge is 90 bar giving an indication of a 10% loss in pressure as required by VdS system rules. At low temperatures, the developed pressure of nitrogen can fall below 90 bar giving the impression that the container pressure is low. For this reason, the effects of low temperatures should be taken into account. For installations susceptible to low temperatures, the use of temperature controlled areas for container storage should be considered.

Location on system

The pressure gauge fits to the pilot container discharge valve.

Operating instructions

The pressure gauge works within the pre-determined system operating conditions.

Maintenance instructions

If faults or suspected faults arise, contact customer services to organise a replacement part. If pressure drops to 90 bar when adjusted for temperature, refill or replace the container. End users must check pressure gauges weekly. Pressure gauges are field replaceable.

MANUAL ACTUATOR (Part No. 30180APB)

The manual actuator can be fitted to the 128-20 master container valve or the 128-90 pilot container valve, depending upon the system design, enabling mechanical operation of the system at the container position. A steel safety pin prevents accidental manual release. Remove the steel safety pin to use the local manual actuator. After removing the steel safety pin, manual operation pull the lever in the direction indicated by the arrow embossed on the unit's body for manual actuation. The unit fits directly onto the pilot container for the pneumatic actuation of the CO_2 container valve.

⚠ WARNING

Failure to reset the actuator prior to fitting onto the container valve results in the immediate operation of the pilot container and the potentially hazardous discharge of the container.

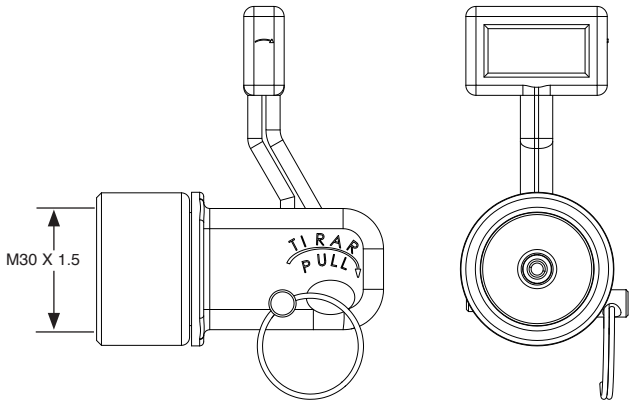


FIGURE 4-54
MANUAL ACTUATOR
025303

Technical information

Body:	Brass
Safety pin:	Steel
Lever:	Brass
Swivel nut:	Brass
Nominal stroke:	6 mm
Connection:	M30 × 1.5 Female
Minimum / Nominal / Maximum trigger pressure:	Non applicable
Weight:	0.49 kg
Working temperature range:	–20 °C to 50 °C
Testing of actuator:	Possible
Approvals and listings:	LPCB and VdS
Certification:	EN 12094-4
CE certification number:	0786-CPR-30062
Year of CE marking:	2012
CE marking requirements:	Manufacturer, Part No., serial number, CE_{0786}
Method of marking:	Engraving
Overall size:	82 mm × 72 mm

Location on system

The manual actuator connects to the actuation port on the side of the 128-20 master container valve or the 128-90 pilot container valve.

Installation instructions

Install the manual actuator directly to the pilot container using the 35 mm to 60 mm **C spanner** (Part No. 35017401). Turn the C spanner slowly until resistance is felt. From this point, turn for a further 60°.

Operating instructions

Remove the safety pin and apply pressure to the handle. The local manual actuator operating pin stays in the fire position and requires manual resetting before refitting to the discharge valve.

Maintenance instructions

Remove the manual actuator assembly from the pilot container valve. Remove the safety pin and pull the lever. Verify the correct functionality of the actuator (strike knob latches, free movement of the pin, and nominal fire position). Reset the actuation pin and refit the safety pin. Reinstall onto the pilot container valve. If faults or suspected faults arise, contact customer services to organise a replacement part.

SMV-1 STEPPER MOTOR (Part No. K02413976)

The SMV-1 stepper motor is an electro-mechanical delay device that connects to the pilot container through the actuation coupling (Part No. 13085006). The SMV-1 begins delayed actuation of the pilot container after receiving a 24 VDC nominal voltage signal from the FAST 2000 control panel. Upon receipt of the signal the stepper motor runs the appropriate number of revolutions to give the correct delay time, the spring accumulator then releases. With this force, the operating pin of the SMV-1 stepper motor actuates the actuation coupling (Part No. 13085006) that in turn results in the immediate operation of the pilot container.

Technical information

Nominal voltage:	24 VDC
Power consumption:	15 W
Duty cycle:	100% ED
Impact force:	560 N
Working temperature range:	-20 °C to +50 °C
Protection class:	IP54
Delay time:	10 s to 60 s
Materials:	Aluminium, stainless steel, copper based alloys, plastics
Weight:	2.5 kg
Weight of tensioner:	0.25 kg
Installing position:	See figure
Approvals and listings:	VdS G 302010
Marking:	CE
Marking position:	See year of construction
CE certification number:	0786 - CPD - 30073

Location on system

The SMV-1 stepper motor is connected to the pilot container through the actuation coupling (Part No. 13085006).

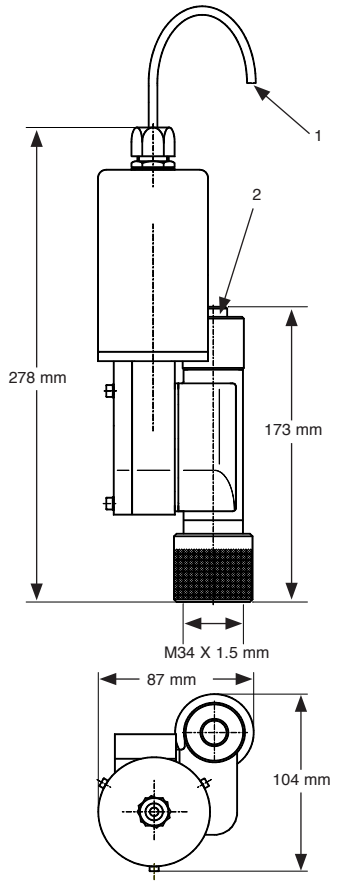
Operating instructions

The SMV-1 stepper motor operates after receiving a 24 VDC nominal voltage signal from the panel.

Maintenance instructions

The SMV-1 stepper motor should be subject to normal maintenance cycles, including installation tightness, functional tests, checking the adjusted delay time and correct tensioning.

If faults or suspected faults arise, contact customer services to organise a replacement part.



Item	Description
1	Connection cable - 2 m long
2	Indicator pin

FIGURE 4-55
SMV-1 STEPPER MOTOR
025809

SF-2 ELECTRICAL ACTUATOR (Part No. K02460326)

The SF-2 electrical actuator connects to the pilot container through the actuation coupling (Part No. 130850006) and allows electrical actuation of the container by means of the FAST 2000 control panel or by a push button release. The tensioner is a component of the electrical actuator and does not need to be ordered separately.

Technical data

Nominal voltage:	24 VDC
Power consumption:	15 W
Duty cycle:	100% ED
Impact force:	~ 560 N
Protection class:	IP 65
Ambient temperature:	-20 °C to +40°C
Cable gland:	M16 x 1.5
Cable diameter:	Dia 5 to Dia 10 mm
Coupler socket:	DIN 43650
Weight:	0.95 kg

Location on system

The SF-2 electrical actuator is connected to the pilot container through the actuation coupling (Part No. 130850006).

Operating instructions

The SF-2 electrical actuator operates after receiving a 24 VDC nominal voltage signal from the panel, or by pressing the push button release.

Maintenance instructions

If faults or suspected faults arise, contact customer services to organise a replacement part.

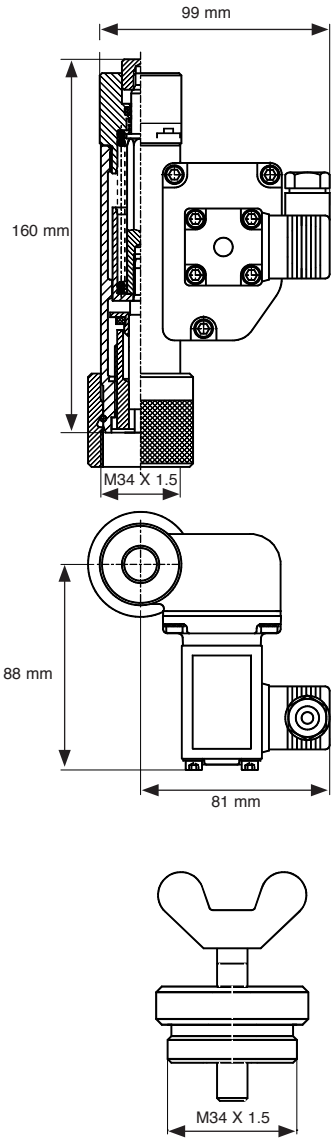


FIGURE 4-56
SF-2 ELECTRICAL ACTUATOR AND TENSIONER
025787

1/4 IN. BLEED VALVE (Part No. 302.200.075)

The CO_2 system incorporates a bleed valve in the actuation line of systems where an unintentional build-up of pressure, perhaps through a leak, may arise. The device should automatically relieve pressure caused from small leaks but seal to completely prevent loss of actuation pressure when the pilot container operates.

As an option on single hazard system, this can fit on the last pneumatic actuator. When installing the bleed valve, use a 1/4 in. bonded seal (Part No. 31199816).

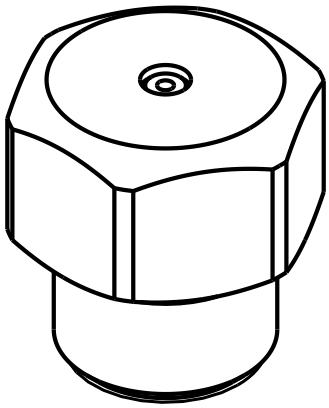


FIGURE 4-57
1/4 IN. BLEED VALVE
025743

Technical information

Body:	Stainless steel
Internal parts:	Stainless steel
Connection:	1/4 in. BSPP Male
Minimum activation pressure:	10 bar
Maximum working pressure:	370 bar
Weight:	0.02 kg
Approvals and listings:	VdS
Marking:	Manufacturer, Part No., serial number, working pressure
Method of marking:	Engraving
Overall size:	A/F 16 mm × 19 mm

PILOT VALVE ADAPTOR (Part No. 35116381)

The pilot container valve adaptor connects the valve to the pilot actuation hose or tubing and bleed valve.

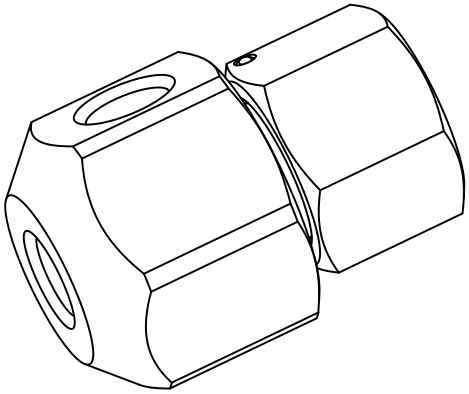


FIGURE 4-58
PILOT VALVE ADAPTOR
025357

Technical information

Body:	Steel (zinc coated)
Internal parts:	Steel (zinc coated)
Pilot valve connection:	W 21.7 DIN 477
Outlet connections:	Two 1/4 in. BSPP ports
Maximum working pressure:	120 bar
Overall size:	53.5 mm × 39 mm
Weight:	0.26 kg

TEST AND RELIEF UNIT (PRE-1) (Part No. K02424666)

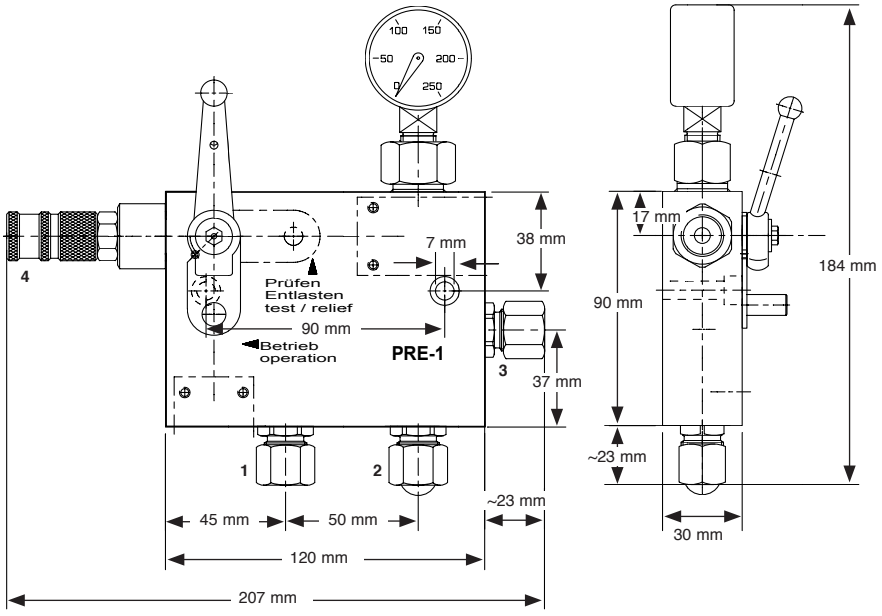
The test and relief unit (PRE-1) is used to function test the pneumatic actuation line within selector valve systems. It can also vent the pilot and actuation line after use when the 50 L pilot container is used.

The unit can be equipped with micro switches (Part No. K02462876) to supervise each switch position. For further details, see Section 3 - Limitswitch with Integrated LED on page 4-52.

The inlet (Item 2, Figure 4-59) must be sealed onsite with the 14 mm diameter ball (Part No. K0 242 405 6) that is supplied with the PRE-1 unit. Spare balls are available for the PRE-1 unit, should they become lost or damaged.

Technical information

Materials:	Aluminium and Steel (corrosion protected)
Maximum operating pressure:	240 bar
Test pressure:	320 bar
Temperature range:	-20 °C to +45 °C
Weight:	Approximately 1.3 kg



Item	Description
1	Connection from the main alarm control panel
2	Connection from the standby alarm control panel
3	Connection to the pilot or actuation line
4	Connection to the test container or relief pipework

FIGURE 4-59
TEST AND RELIEF UNIT (PRE-1)
025844

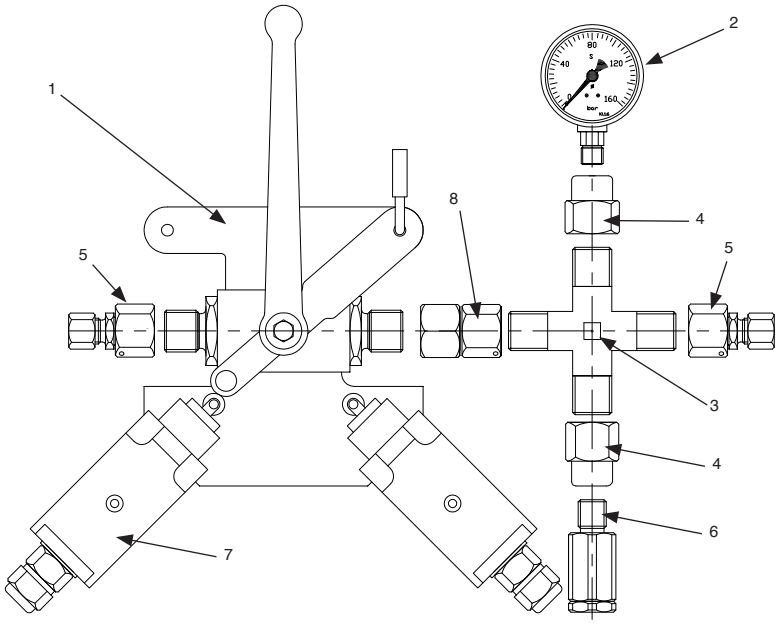
PILOT LINE TEST DEVICE
(Part No. 62108523)

The pilot line test device is installed into the 6 mm copper pipe actuation line and can be used to separately test each group of containers actuated at the same time. The pressure gauge is used to indicate whether the required pneumatic triggering pressure has been achieved.

The test device is protected against unauthorised operation by means of a padlock. The unit is equipped with two micro switches (Part No. K02462876) to supervise each switch position.

Technical information

Pressure gauge:	0 bar to 160 bar
Decompression screw:	Part No. 30027301
Inlet and outlet connections:	6 mm compression



Item	Position
1	Lock-off (VdS)
2	Pressure gauge
3	Equal cross
4	1/4 in. BSP Female coupling
5	10 mm Female swivel
6	Decompression screw
7	Limit switch set
8	10 mm O.D. straight swivel

FIGURE 4-60
PILOT LINE TEST DEVICE
025845

PNEUMATIC TIME DELAY AND SIREN (Part No. 70100120)

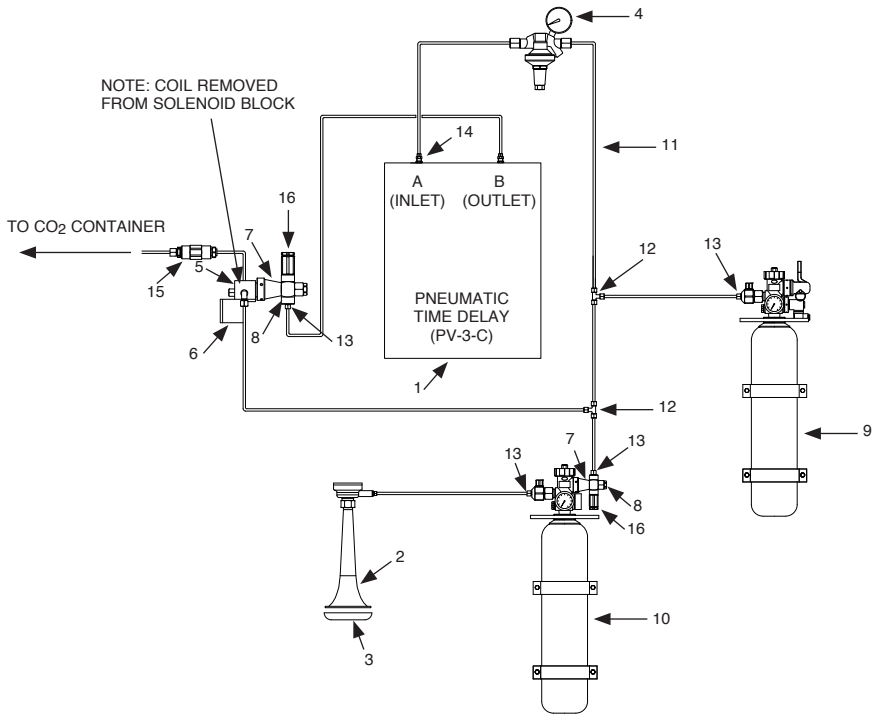
A pneumatic time delay should be used for all CO_2 systems that protect *Normally Occupied* spaces with total flooding systems, or local application systems where the discharge exposes personnel to concentrations of CO_2 in excess of 7.5%. These are areas where it is necessary to evacuate personnel prior to the discharge of a CO_2 system.

The pneumatic time delay unit is factory set for a 30 second delay but can be continuously varied between 3 to 100 seconds if required. The time delay unit is installed in the pilot container actuation line, and is activated by pressure from the pilot container following system actuation.

Additional sirens and silencers can be ordered separately if required for the system installation.

Note: The siren requires CO_2 to operate. The CO_2 modular container includes a pressure gauge purely to give a visual indication that the container is pressurised. Internal pressure does not depend on the quantity of CO_2 contained.

Note: The selector valve solenoid (item 5) should not be electrically connected, and so the coil should be removed from the block.



Item	Description	Part No.	Quantity
1	Pneumatic time delay assembly (PV-3-C)	888537	1
2	Pneumatic siren assembly (MX-1)	860050	1
3	Silencer for MX-1 siren	877120	1
4	0 to 200 bar regulator, set at 25 bar output	26977	1
5	Selector valve solenoid (with blind cap)	30130255V	1
6	Selector valve solenoid mounting bracket	30650022	1
7	Pneumatic cone	30027201	2
8	Tee for pneumatic cone	35116429	2
9	3 L pilot container, 100 bar Nitrogen	70100075	1
10	3 L modular container, 2 kg CO_2	70100119	1
11	6 mm copper pipe	30804068	3 m
12	6 mm compression tee	30880015	2
13	1/4 in. BSPT x 6 mm copper pipe stud coupling	30880007	4
14	10 mm x 6 mm copper pipe coupling	309.010.010	1
15	1/4 in. non-return valve	20006020	1
16	Decompression screw	30027301	2

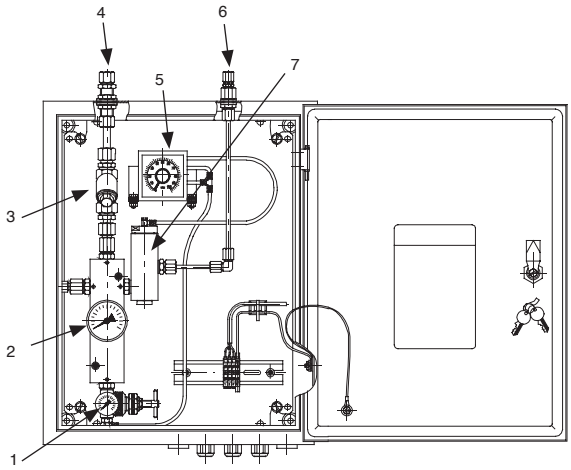
FIGURE 4-61
PNEUMATIC TIME DELAY AND SIREN
025846

PNEUMATIC TIME DELAY AND SIREN (Continued)

The PV-3-C pneumatic time delay assembly is factory set for a 30 second delay but can be continuously varied between 3 to 100 seconds if required.

Technical information

Housing material:	Enamelled sheet steel
Housing colour:	RAL7032 - pebble grey
Installation:	Wall-mounted, through 4 fixing holes
Working pressure:	25 bar
Temperature range:	0 °C to 50 °C
Delay time:	3 s to 100 s (Factory set to 30 s)
Overall size:	500 mm x 400 mm x 200 mm
Ingress Protection class:	IP 54 (indoor installation only)
Thread connection:	For precision-drawn steel pipe
Door switch:	1 x change-over
Certification:	EN 12094-2
CE certification number:	0786-CPD-30039
Weight:	17 kg (approximate)



Item	Description
1	Pressure reducer
2	Pressure gauge
3	Strainer
4	Gas supply connection (for precision steel pipe 10 x 1)
5	Pneumatic timer, delay time
6	Selector valve connection (for precision steel pipe 6 x 1)
7	Pneumatic valve

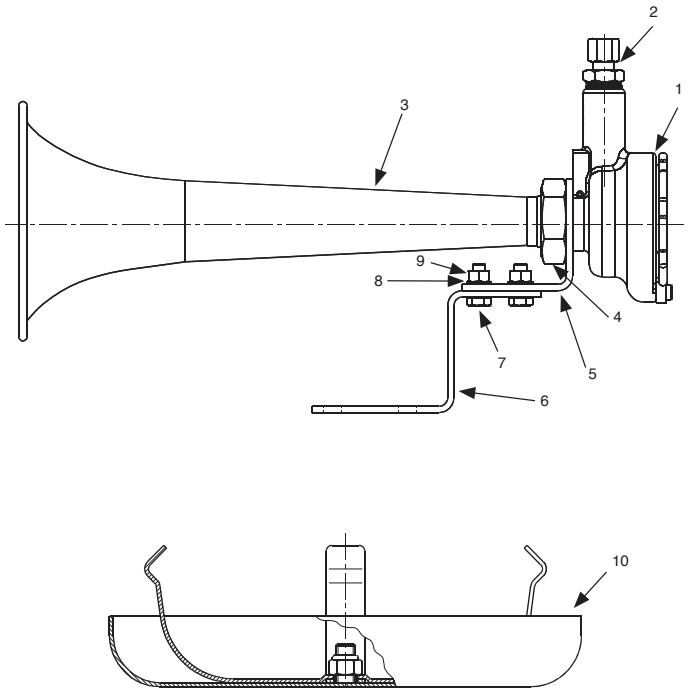
FIGURE 4-62
PNEUMATIC TIME DELAY PV-3-C COMPONENTS
E001040

PNEUMATIC SIREN ASSEMBLY (MX-1) AND SILENCER (Part No. 860050 - MX-1 pneumatic siren assembly) (Part No. 877120 - Silencer for MX-1 siren)

The MX-1 pneumatic siren assembly is a pneumatically operated alarm device which acts as a warning to persons prior to the discharge of the CO_2 into the hazard area. It is intended for indoor use only.

Technical information

Operating pressure:	8 bar to 70 bar Overpressure-proof up to 140 bar
Temperature range:	-20 °C to +300 °C
Connection:	For precision-drawn steel pipe
Installation orientation:	Sound outlet pointing downward
CO_2 pilot container consumption:	Approximately 2350 g / 30 min Approximately 2950 g / 60 min
CO_2 consumption at constant 70 bar:	147 g/min
Certification:	EN 12094-12
CE certification number:	0786-CPD-30126
Siren assembly weight:	1.15 kg
Silencer weight:	0.12 kg



Item	Description
1	Housing
2	Screw fitting
3	Horn
4	Locknut (M24 x 1.5 mm)
5	Small fastening bracket
6	Large fastening bracket
7	Hexagon cap screw (M6 x 16)
8	Lock washers (A6)
9	Hexagon nut
10	Silencer (Part No. 877120)

FIGURE 4-63
PNEUMATIC SIREN ASSEMBLY AND SILENCER
E001042

PNEUMATIC SIREN ASSEMBLY (MX-1) AND SILENCER (Continued)

Note: The following graphs were determined as part of laboratory testing. Real values may differ slightly.

⚠ WARNING

A high sound level is generated close to the siren horn at operating pressure. Inform personnel when conducting a function test.

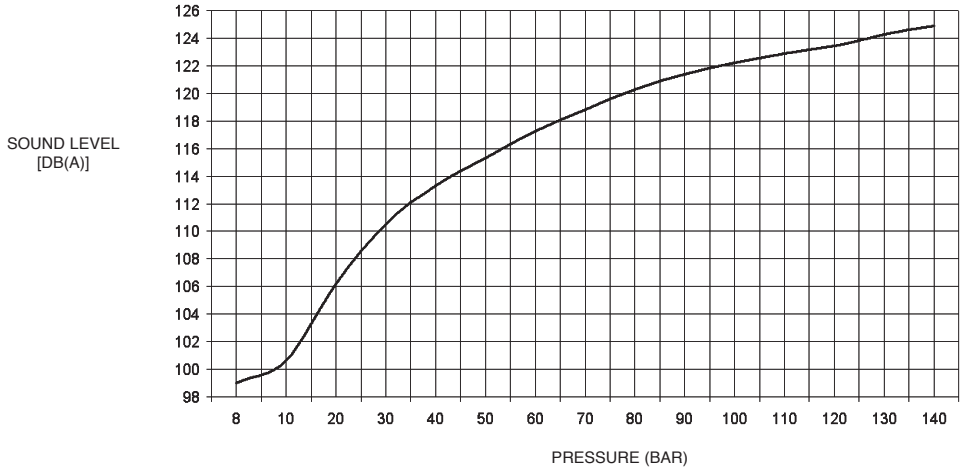


FIGURE 4-64
A-WEIGHTED SOUND LEVEL OVER PRESSURE RANGE
E001044

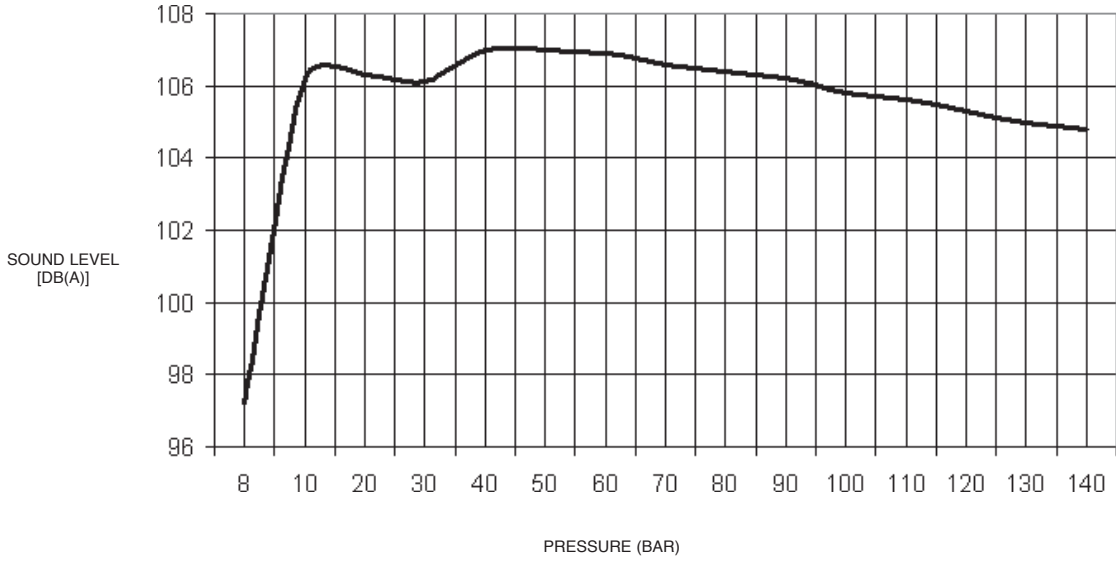


FIGURE 4-65
A-WEIGHTED SOUND LEVEL OVER PRESSURE RANGE WITH SILENCER
E001044

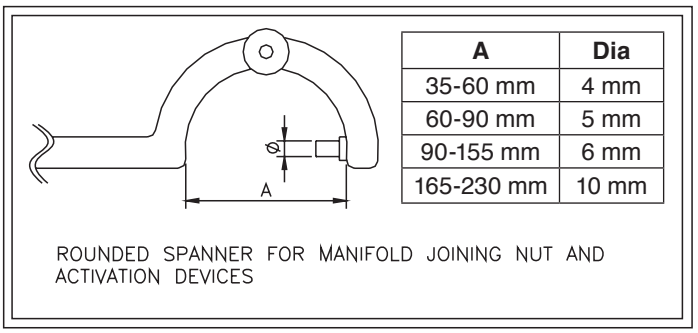
SPECIAL TOOLS

Personnel involved in the installation, maintenance, and inspection of this system may use specialised tools to attach or tighten various components. Table 4-28 lists the tools required.

TABLE 4-28: SPECIAL TOOLS

Part No.	Description
35017401	C spanner Dia 35 mm to 60 mm, Pin Dia 4 mm
35017402	C spanner Dia 60 mm to 90 mm, Pin Dia 5 mm
35017403	C spanner Dia 90 mm to 155 mm, Pin Dia 6 mm
35017404	C spanner Dia 165 mm to 230 mm, Pin Dia 10 mm





A	Dia
35-60 mm	4 mm
60-90 mm	5 mm
90-155 mm	6 mm
165-230 mm	10 mm

FIGURE 4-66
C SPANNER
025355

MANUAL RELEASE CAUTION PLATE

The manual release caution plate provides instructions to personnel on the use of manual controls. Fix one plate adjacent to all positions from where the manual release of CO_2 occurs.

Technical information

Part No.:	314.200.002 (EN) 63013065 (ES)
Material:	White PVC
Colours:	Black, white, and red
Overall size:	210 mm x 75 mm

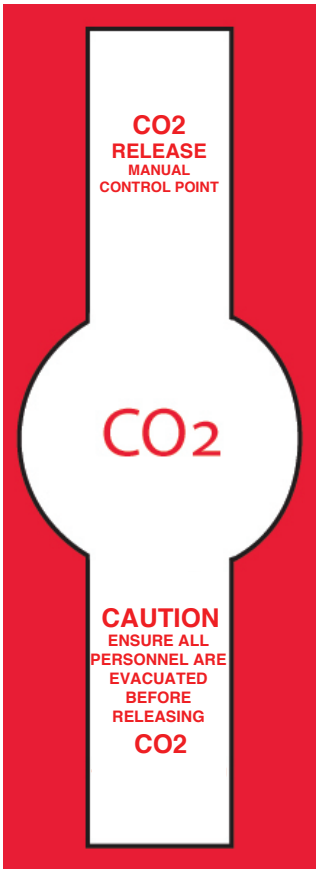


FIGURE 4-67
MANUAL RELEASE CAUTION PLATE
025645

DOOR CAUTION PLATE

The door caution plate provides instructions to personnel who may enter a CO_2 protected area. Fix one plate to all entrance doors into a CO_2 protected area.

Technical information

Part No.:	314.200.001 (EN) 63013064 (ES)
Material:	White PVC
Colours:	Black, white, and yellow
Overall Size:	210.0 mm x 210.0 mm

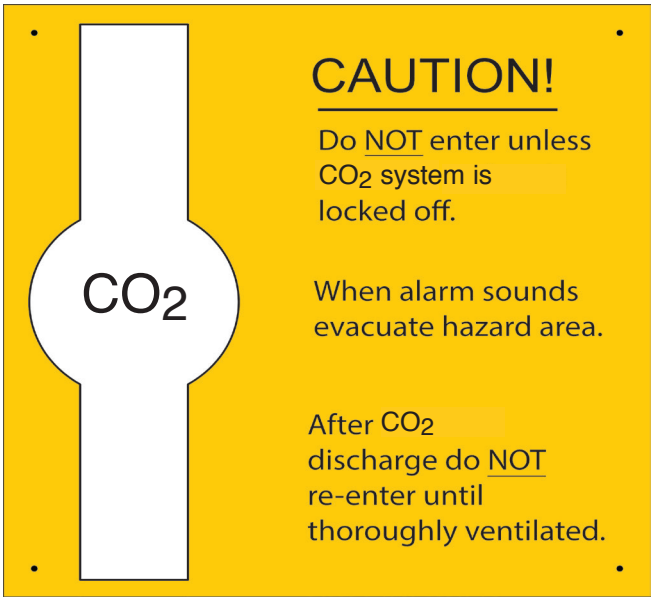


FIGURE 4-68
DOOR CAUTION PLATE
025646

THERMOMETER
(Part No. K0.240.070.6)

The thermometer indicates the maximum and minimum temperatures within the storage location which for systems designed in accordance with VdS 2093 must be maintained between 0 ˚C and 35 ˚C.

The thermometer is supplied with fixing screws for wall mounting.

Technical information

Material:	Aluminium
Size:	220 mm x 50 mm x 20 mm
Type:	Mercury-free with push button
Weight:	0.130 kg

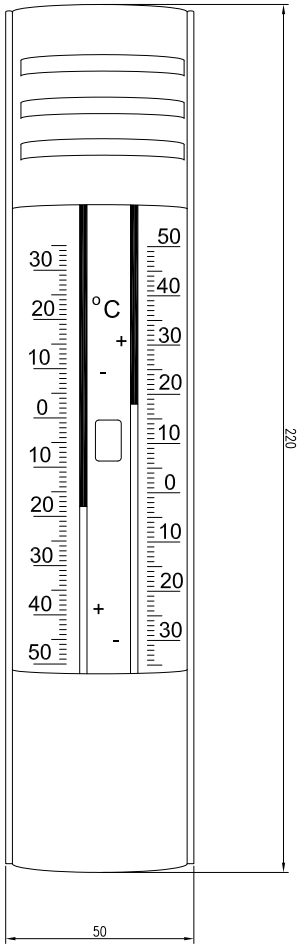


FIGURE 4-69
THERMOMETER
025066

NOTES:

INSTALLATION

This section provides general guidance on the installation of CO_2 fire suppression systems. Before installing this system, complete the following steps:

- Personnel with previous experience with this equipment, or similar equipment, must conduct installation steps.
- Wear appropriate items of safety equipment such as safety shoes when conducting installation work.
- Install the equipment in accordance with an approved drawing.

⚠ CAUTION

It is not permitted for changes to equipment, pipework, or nozzle positions to be made without the authority of the suppression system's Design Engineer.

HANDLING OF PRESSURISED CONTAINERS

It is recommended that the best safety practices given in the *Fire Industry Association (FIA) Guidance Document for The Safe Handling of Pressurised Container Assemblies Used in Fire Extinguishing Systems* are followed, especially in regards to the transportation, handling, installation, commissioning, maintenance and removal of pressurised container assemblies.

DELIVERY AND HANDLING OF EQUIPMENT

When receiving the equipment necessary to install the CO_2 fire suppression system, complete the following steps:

1. Check all equipment delivered against the delivery note. Notify the supplier immediately if any discrepancies arise between the equipment received and that indicated on the delivery note.
2. Store all equipment in a dry room at a temperature between -20 °C and 50 °C and protect from direct sunlight, until ready for installation. Keep containers upright and secure them so that they cannot fall over.

⚠ WARNING

Make no attempt to move CO_2 containers unless fitted with transport caps and anti-recoil caps.

3. Use a trolley to move the CO_2 containers. If raising containers, such as over steps, use appropriate lifting equipment. Do not roll or drop the containers into position in any circumstance.

Note: It is usual, but not essential, for the installation to start with fitting the containers.

⚠ WARNING

Until containers are fully connected into a complete pipework system and secured by the container bracketing, the valve transport cap must not be removed.

FIXING THE CONTAINERS (WHEN NO WEIGHING DEVICE IS REQUIRED)

To fix the containers, complete the following steps:

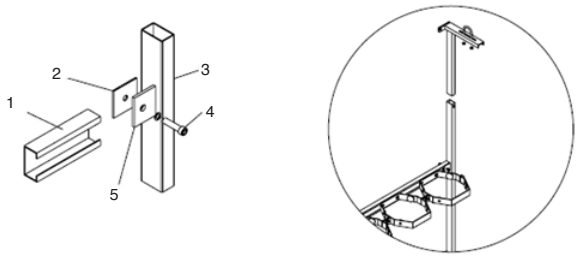
1. Construct the container bank to allow fitting to a wall or supporting structure.
2. Check that at least 300 mm free access exists at the ends of the container bank, and at least 1000 mm free access at the front of the bank.
3. Ensure the floors and walls are flat.

See Section 8 - Appendix for the various typical container bank and bracketing configurations.

Two options of installation are available when no weighing device is required; single row and double row.

Single row and double row CO_2 systems without weighing device

1. Clean the area where the bracketing system is going to be installed.
2. In accordance with system drawings, perform a bracket pre-installation on the floor, by laying out all of the components in their correct position. It is not necessary to mount the complete bracketing system. It is important to take into account the different fixings for each of the bracketing parts.
3. Once the pre-installation lay out has been completed, mount the first vertical columns to the wall and floor.
4. Connect the bridging brackets (crosspieces) between the first set of vertical columns, and loosely tighten the screws to aid positioning (see Figure 5-1).



Item	Description
1	Crosspiece
2	Tapped plate
3	Vertical column
4	Screw
5	Lug

FIGURE 5-1
CONNECTING THE CROSSPIECES
025804

5. Mount the next vertical column to the wall and floor, then tighten all of the screws connecting the bridging brackets (crosspieces) between the wall mounted vertical columns.
6. Repeat this process as appropriate for the remainder of the container bank. Ensure that all of the bracketing is correctly aligned to avoid distortion and movement out of position.

Single row and double row CO_2 systems without weighing device (Continued)

7. Mount the manifold seats directly onto the vertical supports. Consult the system drawing to ensure correct position of each manifold seat on the container bank.
8. Locate the manifold seats in the correct vertical position, taking into account the required height for the manifold in relation to the system pipework, and then tighten the screws.
9. Ensuring that the container valve protection caps are still fitted, install two CO_2 containers into the bracketing, one at each end of the bank. Orient the containers so that the container label faces forwards.
10. Fit the hexagonal brackets around the containers and connect them securely to the bridging brackets (crosspieces). Each container requires two hexagonal brackets.
11. Position the manifold onto the seats ensuring it is level, before fitting the manifold u-bolts to safely hold the manifold in place.
12. Loosely screw in the check valve (Part No. 20006054) and the appropriate discharge hose for the two container positions. Using the check valve and discharge hose as a reference, adjust the manifold and seats until the final position is determined. The CO_2 containers may need to be re-oriented slightly to obtain the final positioning. Once the final positions have been obtained, tighten all screws and connections and ensure that the bracketing is securely mounted.
13. Repeat the process of securely installing the remaining containers. For double row installations, ensure that the first (back) row is completely installed and secure, before installing the front row.

FIXING THE CONTAINERS (WHEN THE VdS WEIGHING DEVICE IS REQUIRED)

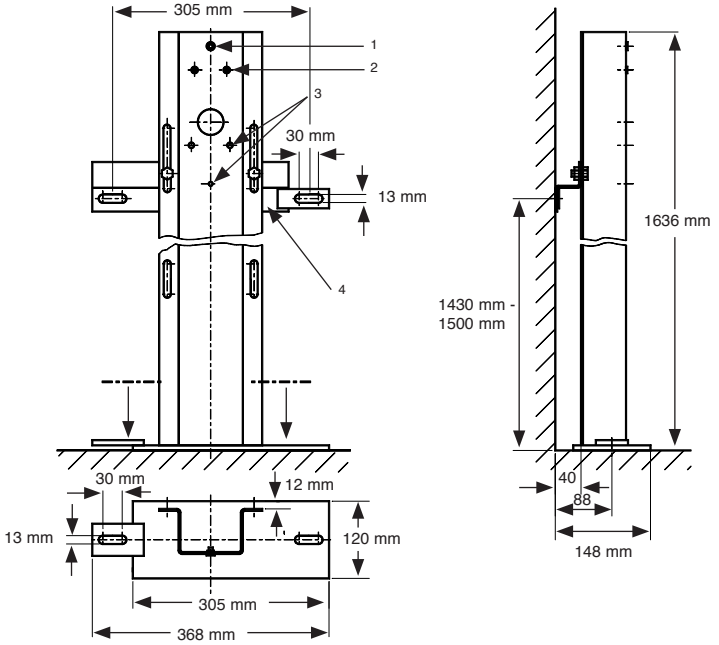
To fix the containers, complete the following steps:

1. Construct the container bank to allow fitting to a wall or supporting structure.
2. Check that at least 300 mm free access exists at the ends of the container bank, and at least 1000 mm free access at the front of the bank.
3. Ensure the floors and walls are flat.

Two installation options are available when the VdS weighing device is required; single row and double row.

Single row CO_2 systems with the VdS weighing device

1. Clean the area where the bracketing system is going to be installed.
2. Fit the WEH-1 weighing device (Part No. K02401786) to the weighing column (Part No. K02400086) using the three holes provided, and push the cylinder pin into the upright profile.
3. Unscrew the adjusting spindle from the scales bar as far as the hexagonal element.
4. Suspend the counterweight (suspension) bar (Part No. K02401936) in the adjustment spindle.
5. Position the weighing column against the wall in the correct location. Mark the wall and floor using the fixing holes.
6. Securely fix the weighing column to the wall and floor. The fixings are supplied with the WEH-1 weighing device.
7. Repeat the installation of the weighing column to the wall and floor for the rest of the container bank.



Item	Description
1	Entry for CO_2 manifold
2	Entry for loss indicator switch
3	Entry for weighing device
4	Z-bar

FIGURE 5-2
WEIGHING COLUMN INSTALLATION
025812

Single row CO_2 systems with the VdS weighing device (Continued)

8. Fit the single row manifold support (Part No. 130640006) to the top of the weighing columns. They should be positioned at each end of the container bank, and have a maximum spacing of 1.5 m (five containers).
9. Fit the appropriate size manifold clamp (Part No. 3009205 to 30009212) to the manifold support.
10. Position the manifold onto the manifold clamps ensuring that it is level, before tightening to safely hold the manifold in place.
12. Securely fit the check valves (Part No. 20006054) to the manifold inlets. For details, see Section 5 - Installing the 1/2 in. CO_2 Check Valve.
13. Fit the CO_2 container to the WEH-1 weighing device. Screw the flange onto the container neck ring.
14. Suspend the container by adjusting the support screws on the WEH-1 weighing device.
15. Push the two surweights (Part No. K02401876) onto the suspension weight until the adjusting spindle moves into the lower position.
16. Screw the adjusting spindle into the scales bar until it is in a position of horizontal free equilibrium.
17. Set the weight differential by screwing the adjusting spindle into the scales bar until it is in the upper position.
18. Test the device. Push the suspension weight downwards. When releasing, the adjustment spindle should return to the upper position autonomously. If possible, turn the adjusting spindle a quarter turn in the scales bar, inwards or outwards, and repeat the test.
19. Draw the sealing wire through the bore hole of the adjusting spindle and the bracket and seal.

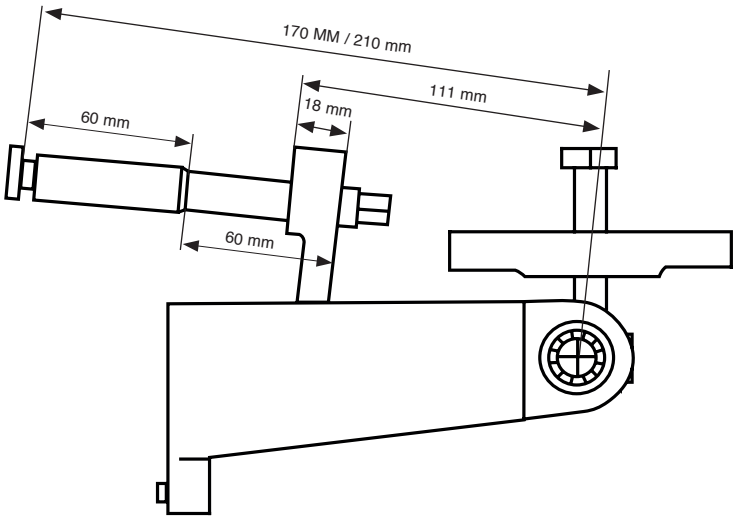


FIGURE 5-3
ADJUSTING SPINDLE
025818

Single row CO_2 systems with the VdS weighing device (Continued)

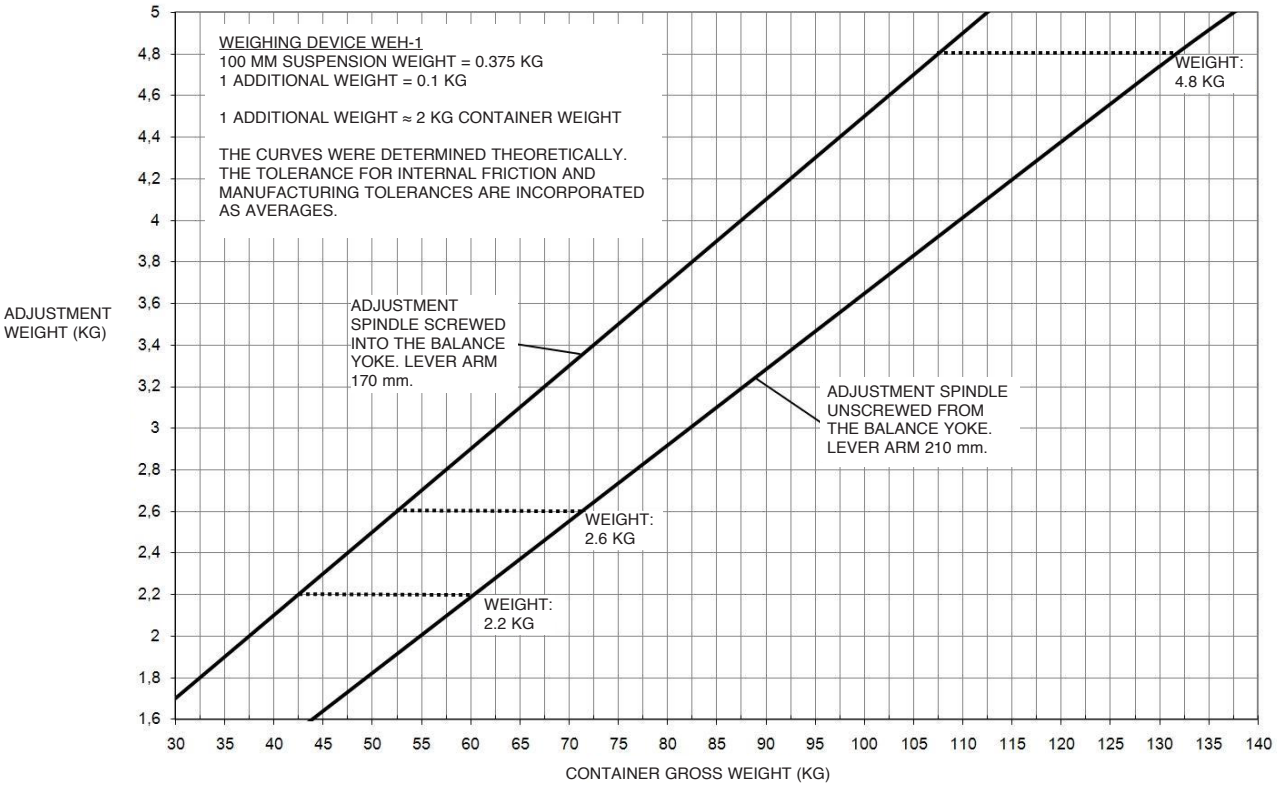


FIGURE 5-4
WEIGHING DEVICE, INSTALLATION AND ADJUSTMENT CHART
E000774

When setting up the weighing device and container assemblies, the tare weight must be taken into account. The suspension weight must be reduced accordingly or if necessary, the adjustment weight can be increased by adding additional weights to the suspension weight.

Figure 5-4 shows the relationship between the gross container weight and the adjustment weight. Refer to this figure as the basis for reducing the suspension weight or increasing the adjustment weight.

Double row CO_2 systems with the VdS weighing device

1. Clean the bracketing system's installation area.
2. Fit the WEH-1 weighing device (Part No. K02401786) to the weighing column (Part No. K02400086) using the three holes provided. Push the cylinder pin into the upright profile.
3. Unscrew the adjusting spindle from the scales bar as far as the hexagonal element.
4. Suspend the counterweight (suspension) bar (Part No. K02401936) in the adjustment spindle.
5. Position the weighing column in the correct location. Mark the wall and floor using the fixing holes.
6. Securely fix the weighing column to the floor and to the opposing weighing column. The fixings are supplied with the WEH-1 weighing device.
7. Repeat the installation of the weighing column to the floor and to the opposing weighing column for the rest of the container bank.
8. Fit the double row manifold support (Part No. 130009200) to the top of the opposing weighing columns. They should be positioned at each end of the container bank, and have a maximum spacing of 1.5 m (10 containers).
9. Position the manifold onto the manifold supports ensuring that it is level.
10. Fit the appropriate size manifold u-bolt (Part No. 30600050 to 30600120) over the manifold support, before tightening to safely hold the manifold in place.
11. Securely fit the check valves (Part No. 20006054) to the manifold inlets. For details, see Section 5 - Installing the 1/2 in. CO_2 Check Valve.
12. Fit the CO_2 container to the WEH-1 weighing device. Screw the flange onto the container neck ring.
13. Suspend the container by adjusting the support screws on the WEH-1 weighing device.
14. Push the two surweights (Part No. K02401876) onto the suspension weight until the adjusting spindle moves into the lower position.
16. Screw the adjusting spindle into the scales bar until it is in a position of horizontal free equilibrium.
17. Set the weight differential. Screw the adjusting spindle into the scales bar until it is in the upper position.
18. Test the device. Push the suspension weight downwards. When releasing, the adjustment spindle should return to the upper position autonomously. If possible, turn the adjusting spindle a quarter turn in the scales bar, inwards or outwards, and repeat the test.
19. Draw the sealing wire through the bore hole of the adjusting spindle and the bracket and seal.

INSTALLING AND REMOVING THE VdS WEIGHING DEVICE MASTER CONTAINER FLANGE

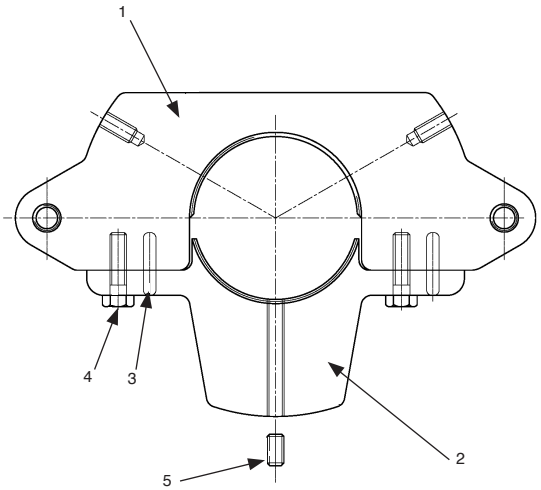
The master container assemblies for use with the VdS weighing device (see Table 4-1 on page 4-7) are all supplied with a two-piece container flange designed specifically for use with the WEH-1 weighing device.

If the flange needs to be removed for any reason, complete the following steps:

1. Loosen the stud (5).
2. Unscrew both bolts (4).
3. Remove the smaller flange half (2) by removing it from the larger flange half (1).

To assemble the flange onto the master container, complete the following steps:

1. Fit the two cylindrical pins (3) into the holes on the larger flange half (1).
2. Place the larger flange half onto the container, just above the container neck ring threads, then position the smaller flange half (2) onto it by locating the cylindrical pins into the holes of the smaller flange half.
3. Fix the two flange halves together by using the two bolts (item 4) and tighten to a torque of 27 N•m.
4. Once the flanges are assembled, screw onto the container neck thread slowly until hand tight, and then orient appropriately with the smaller flange half facing the front of the container.
5. Once correctly positioned secure the flange onto the container by tightening the stud (5).



Item	Description
1	Larger flange half (rear of container)
2	Smaller flange half (front of container)
3	Cylindrical pin (Dia 6 mm x 30 mm)
4	Bolt (M8 x 30)
5	Stud (M8 x 16)

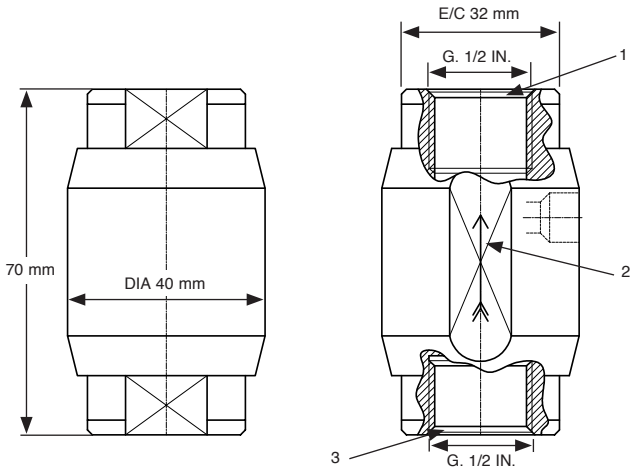
FIGURE 5-5
VdS WEIGHING FLANGE VALVE
E001074

INSTALLING THE 1/2 IN. CO_2 CHECK VALVE

Assemble the outlet of the check valves directly onto the manifold inlet. The body is marked with a direction of flow arrow. It is essential that it is installed in the correct orientation, with the head of the arrow pointing to the manifold connection.

To install the check valve, complete the following steps:

1. Install the wall or floor mounted bracketing along with the manifold.
2. Apply TEFLON (PTFE) tape to the male thread of the manifold inlet connection (port) to which the check valve is fitted. Do not apply TEFLON (PTFE) tape to the first two threads.
3. Ensuring that the direction of flow arrow on the body of the check valve is pointing to the manifold inlet connection (port), screw in firmly using a wrench or spanner.



Item	Description
1	Manifold connection
2	Working position
3	Container connection

FIGURE 5-6
CO_2 CHECK VALVE
025797

INSTALLING THE DISCHARGE HOSES

The discharge hose contains a fixed male thread on one end and a swivel female thread on the other.

Johnson Controls supply different types of discharge hose depending on the system requirements. For further details, see Section 4 – System Components. Each hose incorporates the same connections and only differs in length and hose material.

When installing the discharge hoses, follow these steps:

1. Secure the container with the hexagonal brackets or the WEH-1 weighing device as required for the system, before removing the transportation caps.
2. Screw the male end of the discharge hose into the check valve already installed onto the manifold. Ensure that the Dowty seal, supplied with the hose, is fitted on the male end first. This connection does not require thread sealant, because of the Dowty seal.
3. Remove the container valve outlet cap, and fit the female swivel end of the discharge hose on the container valve outlet. This joint does not require thread sealant.
4. Repeat the connection steps for the remaining containers.

INSTALLING THE ACTUATION COMPONENTS

Pilot container

A pilot container normally operates the CO_2 container bank. The pilot container contains nitrogen at 100 bar. Johnson Controls supply three pilot container sizes; 3 L, 13 L, and 50 L. All pilot containers are supplied with a contacted pressure gauge, solenoid, and manual actuator (standard pilot container) or blind cap fitted to the manual actuation port (VdS pilot container). Johnson Controls supply the contacted pressure gauge and solenoid factory fitted. The manual actuator requires fitting on site. When the pilot container operates, pressure flows to the pneumatic actuators fitted to the CO_2 container valves.

To install the pilot container, complete the following steps:

1. Fix the pilot container bracket to the wall.
2. Fit the pilot container to the bracket keeping the pressure gauge visible and the manual actuator easily accessible.
3. Remove the pilot valve top cap when fitting the control actuation hoses and the pneumatic actuators to the CO_2 container valves.

Note: If the unit accidentally operates through one of the actuation devices, the valve does not operate if the pilot container top cap is removed.

4. Fit the outlet adaptor (Part No. 35116381) to the outlet of the pilot container valve, ensuring that the side connection port is oriented as required for the installation.
5. From the outlet adaptor side connection port, fit either the actuation hose or the 1/4 in. BSPT Male to the 6 mm compression adaptor. The bleed valve (Part No. 302.200.075) and 1/4 in. bonded seal (Part No. 31199816) connect to the end port of the outlet adaptor.
6. Replace the pilot container top cap when all actuation devices are fitted to the container bank.

Installing the pilot container pressure gauge

Johnson Controls supply the pilot container pre-assembled with the pressure gauge installed.

Installing the pilot container manual actuator

- Install the manual actuator directly to the pilot container using the 35 mm to 60 mm **C spanner** (Part No. 35017401).
- Turn the C spanner slowly until you feel resistance. From this point, turn for a further 60°.

INSTALLING THE ACTUATION COMPONENTS (Continued)

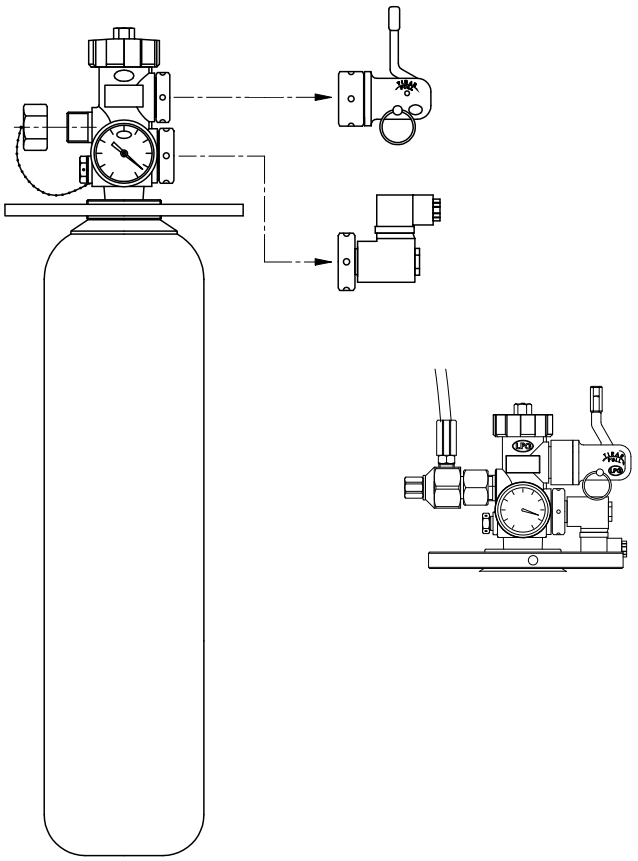


FIGURE 5-7
CO_2 PILOT CONTAINER AND VALVE
025328

Manual actuator lever

Use the manual actuator lever to manually actuate the pilot container. To install the manual actuator lever, complete the following steps:

1. Check the seals in the safety pin for damage and the correct location of the o-ring in its groove.
2. The release fits to the pilot container as indicated in Figure 5-7.
3. Before fitting, check that the pneumatic actuator pin is fully seated and read the caution statement on this page.
4. Using the 35 mm to 60 mm C Spanner (Part No. 35017401), tighten the actuator slowly until resistance is felt. From this point, turn for a further 60°.
5. The unit seals through its o-ring and requires no additional sealant.

⚠ CAUTION

Before installing the manual actuator onto the valve, check that the piston is fully seated inside its housing by pushing down with a screwdriver. Afterwards, check with a ruler that the needle has a 3.0 mm to 4.5 mm clearance as shown in Figure 5-9.

To manually activate the pilot container, complete the following steps:

1. Remove the safety pin.
2. Manually pull the lever backwards and downwards.

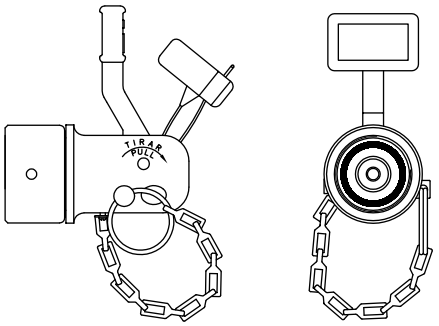


FIGURE 5-8
MANUAL ACTUATOR LEVER
025329

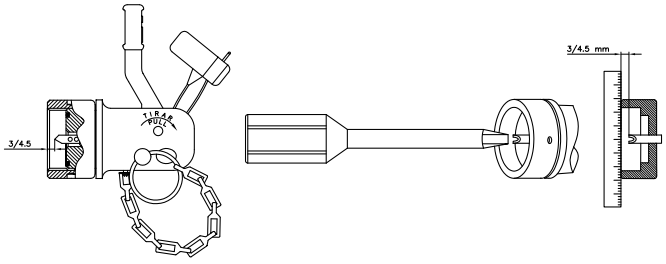


FIGURE 5-9
CHECKING MANUAL ACTUATOR PISTON
025329

INSTALLING THE ACTUATION COMPONENTS (Continued)

Actuation coupling for the SF-2 and SMV-1

The SF-2 electrical actuator and the SMV-1 stepper motor both connect to the pilot container through the actuation coupling (Part No. 130850006). To install the actuation coupling, complete the following steps:

1. Check the correct location of the o-ring in its groove.
2. The release fits to the pilot container. See Figure 5-11.
3. Before fitting, check that the pneumatic actuator pin is fully seated and read the caution statement on this page.
4. Using the 35 mm to 60 mm **C Spanner** (Part No. 35017401), tighten the actuation coupling slowly until you feel resistance. From this point, turn for a further 60°.
5. The unit seals through its o-ring and requires no additional sealant.

⚠ CAUTION

Before installing the actuation coupling onto the valve, check that the piston is fully seated inside its housing by pushing down with a screwdriver. Afterwards, check with a ruler that the needle has a 3.0 mm to 4.5 mm clearance as shown in Figure 5-10.

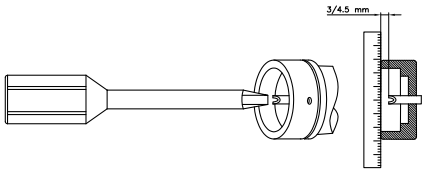


FIGURE 5-10
CHECKING ACTUATION COUPLING PISTON
025329

SF-2 electrical actuator

The SF-2 electrical actuator must be tensioned before it is fitted onto the actuation coupling (Part No. 130850006). To do this, complete the following steps:

1. Screw the tensioner into the connection thread.
2. Screw the wing screw in until you hear it engage.
3. Unscrew and remove the tensioner, and keep it safely with your tool.

Do not perform the electrical connection until the pneumatic actuation line for the whole system is complete.

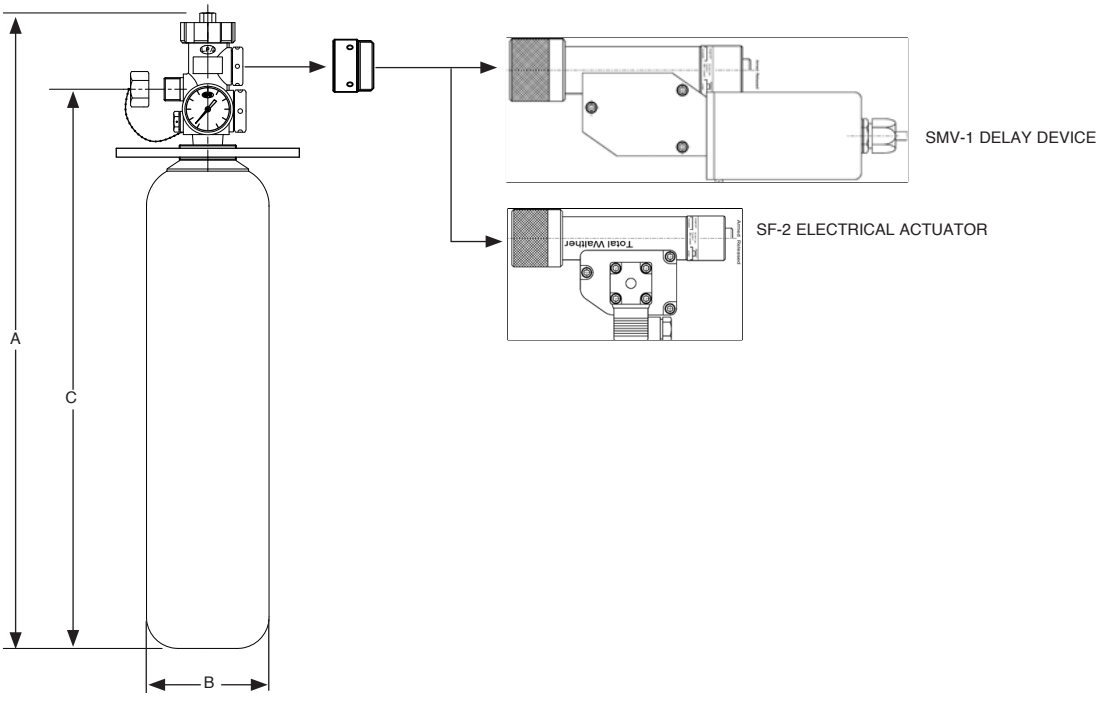


FIGURE 5-11
CHECKING ACTUATION COUPLING PISTON
025329

INSTALLING THE ACTUATION COMPONENTS (Continued)

SMV-1 stepper motor

The SMV-1 stepper motor must be tensioned before it is fitted onto the actuation coupling (Part No. 130850006). To do this, complete the following steps:

1. Screw the tensioner into the connection thread.
2. Screw the wing screw in until you hear it engage.
3. Unscrew and remove the tensioner, and keep it safely with your tool.

Do not perform the electrical connection until the pneumatic actuation line for the whole system is complete. The SMV-1 stepper motor must be connected to the programming interface (PSS-1) according to Figure 5-12 and connected to the control panel. Set all DIP switches to **on**.

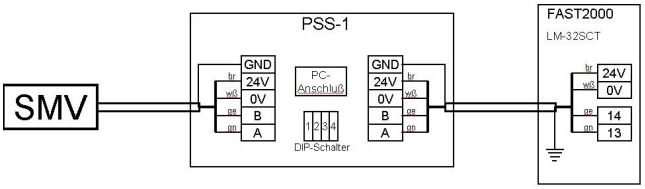


FIGURE 5-12
SMV-1 CONNECTIONS
E001154

The stepper motor delay is pre-set to a delay time of 30 seconds. If a different delay time is required, programme this into the PSS-1 using the instructions supplied with the SMV-1 stepper motor.

INSTALLING THE PRESSURE SWITCH WITH INTERLOCK

The pressure switch contains two sets of contacts; normally open and normally closed. Use the pressure switch to provide an electrical indication of the release of CO_2 or to perform ventilation shutdowns or other interlock functions. For CO_2 systems using a manifold, the pressure switch is installed on the 1/2 in. port of the manifold. For further information, see Section 4 - CO_2 Manifolds. For CO_2 systems not requiring manifolds, it is installed in the 1/2 in. connection of the appropriate discharge hose connector (Part No. 35116260 or 35116261).

To install the pressure switch, complete the following steps:

1. Apply a suitable pipe sealant to the threaded connection. Do not apply pipe sealant to the two first threads.
2. Tighten the union with a suitable spanner.
3. Refer to the electrical connection details in Section 5 - Installing the Electrical Components.

Note: Pull the knob on the side of the unit to reset the pressure switch after discharge.

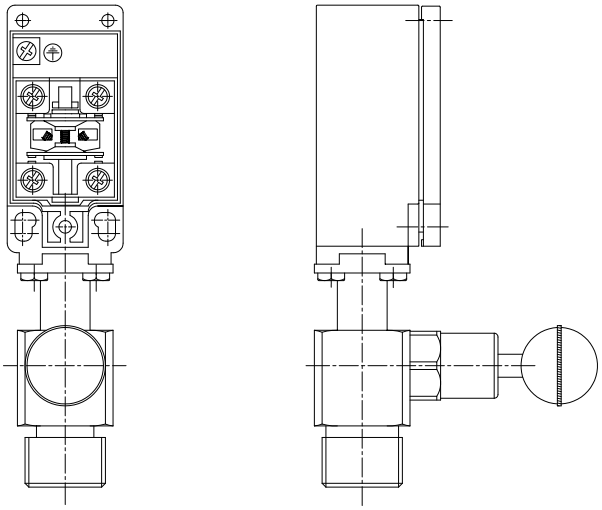


FIGURE 5-13
PRESSURE SWITCH WITH INTERLOCK
025330

INSTALLING THE SELECTOR VALVE

Selector valves contain threaded connections. They connect between the end of the discharge manifold and the discharge pipe system for a particular hazard. Use union adaptors to connect the selector valve to the manifold pipework.

Johnson Controls can provide selector valve manifolds designed for use with the selector valve. Alternatively, manifolds can be fabricated using special weldolets as specified in this manual. To install the selector valve, complete the following steps:

1. Fit the selector valve manifold to the end of the discharge manifold using the appropriate union connector (see page 4-46).
2. Fit the selector valve to the selector valve manifold.
3. Apply TEFLON tape (PTFE) to the male thread on the selector valve manifold outlet. Do not apply TEFLON (PTFE) tape to the first two threads.
4. Attach the 6 mm pneumatic actuation tubing to the inlet of the selector valve pneumatic piston.
5. Connect the 6 mm pneumatic actuation tubing to the outlet port of the pneumatic piston. Run the 6 mm pneumatic actuation line to the container bank to operate the appropriate number of CO_2 containers for the hazard.

⚠ CAUTION

The selector valve pneumatic piston pivots on its top mounting during actuation and the 6 mm pneumatic actuation line must flex to accommodate this movement. A pigtail (coil) in the pneumatic actuation line can suffice. Alternatively, use a suitable flexible hose. During the selector valve installation process, manually test the movement of each selector valve using the lever (Part No. 20010013). Open and close each selector valve to check for free movement of the selector valve. Ensure that no interference occurs with walls, pipework, and other equipment.

6. To connect the selector valve to the system pipework the appropriate union connector (see page 4-46) should be used.

INSTALLING THE SELECTOR VALVE MICROSWITCH

A selector valve microswitch (Part No. 30116011) is available. When fitted, it electronically signals that the selector valve has operated.

To assemble the microswitch, complete the following steps:

1. Attach the microswitch to the threaded plate using the M4 x 20 hexagonal screw applying a torque of between 2 N•m and 3 N•m. See Figure 5-14.
2. Mount the detector screw using the two M8 nuts provided.
3. Wire the microswitch according to Figure 5-15.

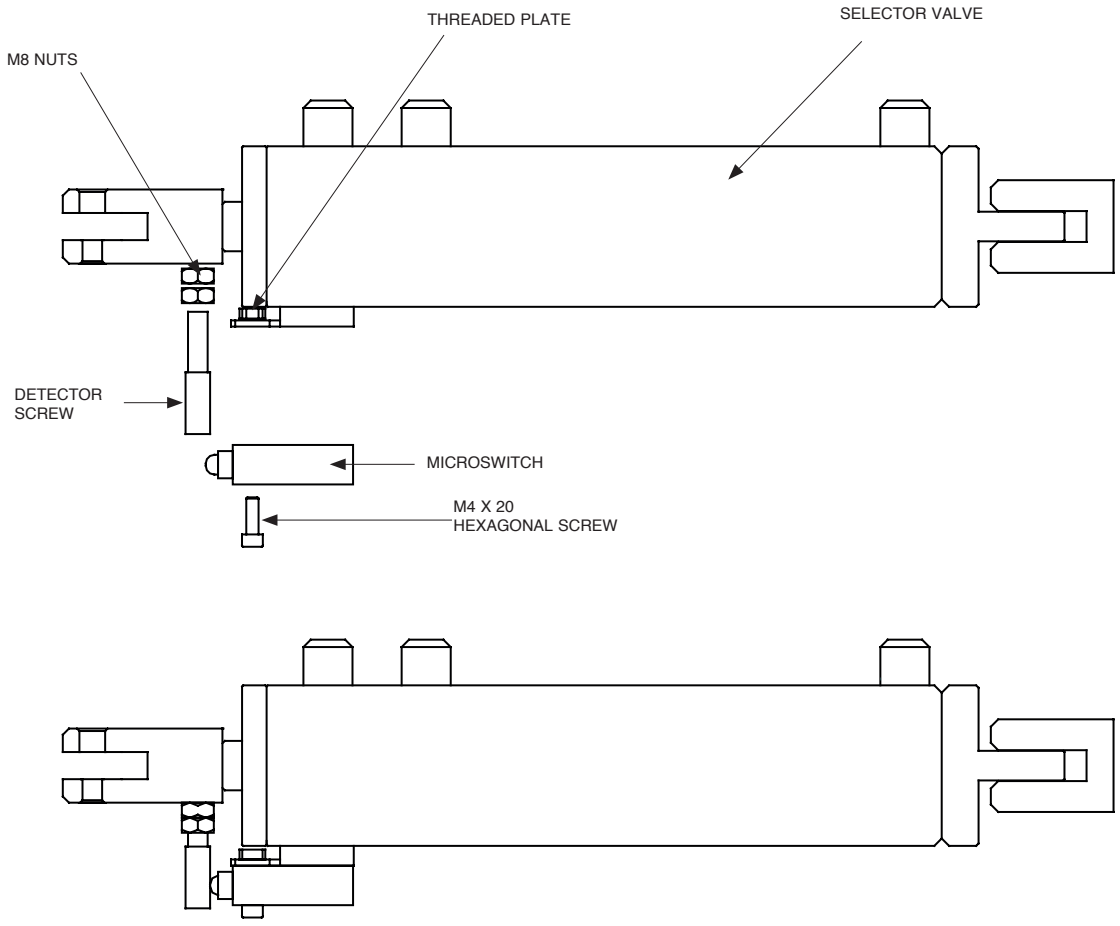


FIGURE 5-14
MICROSWITCH INSTALLATION
025671

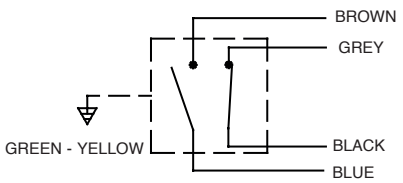


FIGURE 5-15
MICROSWITCH ELECTRICAL CONNECTION
025672

INSTALLING THE SELECTOR VALVE SOLENOID AND MANUAL ACTUATOR

Electrical and manual activation devices control the opening of the selector valves. Johnson Controls provide brackets to mount two, three, or four selector valve solenoids. The inlet pressure to the selector valve solenoid comes from the operation of the pilot container. The outlet pressure then opens the appropriate selector valve when the solenoid on the selector valve solenoid activates. Do not order this component separately as it comes with the selector valve.

To install the selector valve solenoid and manual actuator, complete the following steps:

1. Secure the bracket to the wall at an appropriate height to enable manual actuation.
2. Install the selector valve solenoids to the mounting bracket using the screws provided (see Figure 5-16).
3. Use actuation tubing to connect the outlet of the pilot container to the inlets of the selector valve solenoids.
4. 6 mm actuation piping then fits between the outlet of the selector valve solenoid and the inlet of the appropriate selector valve pneumatic piston.

⚠ CAUTION

It is essential to ensure that the pressure from the pilot container goes to the inlet part of the selector valve solenoid. If accidentally fitted to the outlet, the wrong selector valve could operate when the pilot container discharges. The inlet is marked **1**, and the outlet is marked **2**.

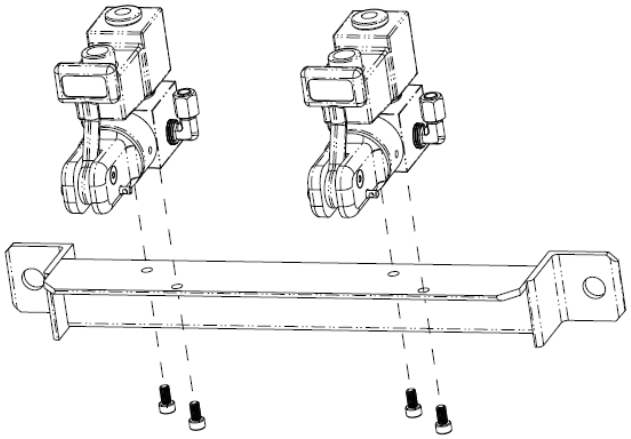


FIGURE 5-16
SOLENOID VALVE SOLENOID AND MANUAL
025331

RELEASE SYSTEMS FOR SELECTOR VALVES

Fitted selector valves to a CO_2 system can protect multiple hazards from a single bank of containers. Figure 5-17 shows a system where four containers can discharge into either one of two hazards. If a fire occurs in Area 1, the selector valve needs to operate. This releases four containers in the container bank. A typical system operates in the following sequence:

1. The fire detection system in Area 1 activates and sends a signal to the solenoid mounted on the pilot container. At the same time, the system sends an electrical signal to open the selector valve solenoid for Area 1.
2. The pilot container operates and sends pressure into the 6 mm actuation line and through the open selector valve solenoid for Area 1.
3. Pilot container pressure from the outlet of the open selector valve solenoid then flows to the inlet of the selector valve actuation piston.
4. This pressure operates the selector valve actuation piston and opens the selector valve.
5. When the selector valve fully opens, pilot line pressure flows from the exhaust port of the selector valve pneumatic piston and operates the containers in the container bank.

NOTICE

Only the configurations shown in this manual as the permitted variations to fit a non-return valve can be used. Failure to use the specified fittings may result in the pilot line non-return valve malfunctioning and therefore causing the suppression system operation to fail.

If the fire detection system detects a fire in Area 2, the following sequence occurs:

1. The fire detection system in that area sends a signal to operate the Area 2 selector valve solenoid.
2. The actuation pressure reaches containers 1, 2, and 3. The actuation line non-return valve prevents the pressure from reaching container 4. Consequently, only three containers discharge to Area 2.

Both the pilot container and the selector valve solenoid are fitted with manual actuators to operate the system in the event of an electrical failure. Figure 5-17 shows an installation where each hazard requires an unequal number of containers. The system design can allow the operation of any number of CO_2 containers to protect hazards of equal or unequal size. In these installations, the use of pilot line non-return valves control the number of containers discharged into a particular hazard.

The pilot line non-return valve is normally installed with its outlet fitted directly to the pneumatic actuator. It comes with an adaptor fitted to its outlet with the correct male thread to fit directly to the pneumatic actuator. This part requires no pipe sealant when fitting to the pneumatic actuator in this manner.

Note: This is the preferred method of installing a pilot line non-return valve and the designer should always try to configure the system in this manner.

Johnson Controls supply various adaptors to fit the pilot line non-return valve using pilot line hoses or 6 mm outer diameter (o/d) tubing if the preferred method does not suffice. This manual details the permitted variations to fit the pilot line non-return valve. See Table 5-1 for further details.

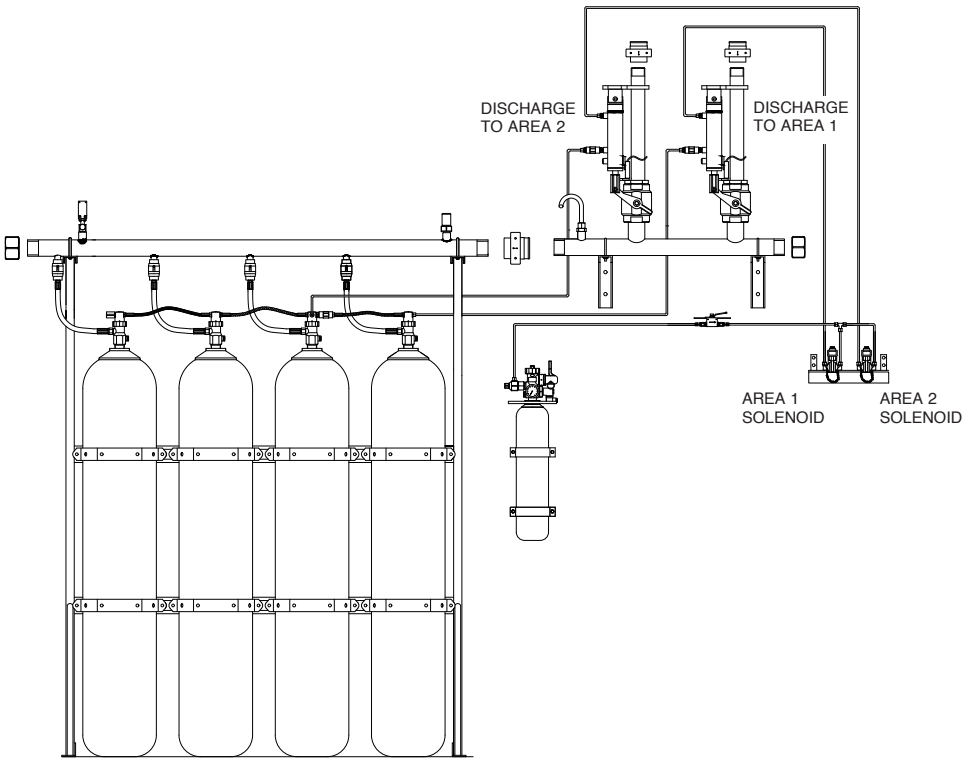


FIGURE 5-17
RELEASE SYSTEM FOR SELECTOR VALVES
E001162

RELEASE SYSTEMS FOR SELECTOR VALVES (Continued)

Pilot line non-return valve configurations

TABLE 5-1: RELEASE SYSTEM COMPONENTS

Configuration	Parts required	Comments
Actuation hose: Inlet to pilot line non-return valve. The outlet fits directly to a pneumatic actuator.	1 x part number 20006020 pilot line non-return valve.	No additional components required.
6 mm o/d copper tubing: Inlet to pilot line non-return valve. The outlet fits directly to a pneumatic actuator.	1 x part number 20006020 pilot line non-return valve. 1 x part number 30880007 6 mm o/d tubing male adaptor	Fit part number 3088007 to the inlet of the pilot line non-return valve.
Actuation hose: Inlet to pilot line non-return valve. The outlet is an actuation hose.	1 x part number 20006020 pilot line non-return valve 1 x part number 30880059 female/female actuation hose coupling.	Fit part number 30880059 to the outlet of the pilot line non-return valve.
6 mm o/d copper tubing: Inlet to pilot line non-return. The outlet is 6 mm o/d copper tubing.	1 x part number 20006020 pilot line non-return valve. 2 x part number 30880007 6 mm o/d tubing male adaptor.	Remove the adaptor supplied fitted to the pilot non-return valve outlet and fit part number 30880007 to both the inlet and outlet of the pilot container non-return valve.

Resetting selector valves

A lever (Part No. 20010013) is used to manually open and close the selector valve. During installation, test each selector valve for free movement by opening and closing it manually. Ensure that no interference occurs with walls, pipework, and other equipment.

To close the selector valve, complete the following steps:

1. Locate the connecting arm (1) at the bottom of the selector valve piston assembly.
2. Fit the handle onto the connecting arm.
3. Move the handle downward until the piston moves upward to its limitation.

To manually open the selector valve, complete the following steps:

1. Fit the handle onto the connecting arm.
2. Move the handle upward until the piston moves downward to its limitation and the selector valve fully opens.

If the selector valve piston is under pressure following pneumatic actuation, then this pressure first requires venting. To vent this pressure, complete the following steps:

1. Loosen the venting screw (2) on the back of the piston.
2. Using the handle, close the selector valve to vent the trapped pressure.
3. Ensure that the venting screw (2) is tightened back up following a full resetting of the selector valve.

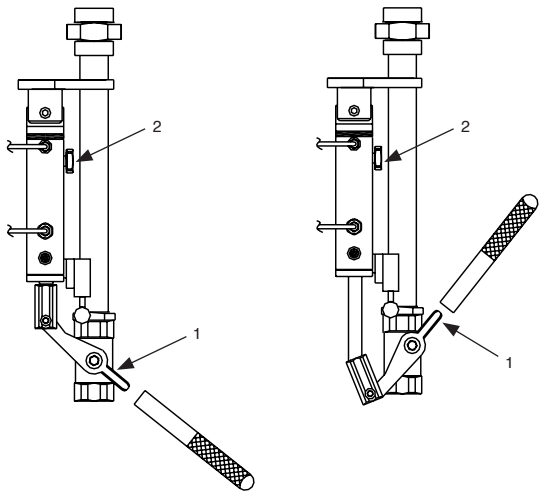


FIGURE 5-18
RESETTING SELECTOR VALVES
E001132

INSTALLING THE SOLENOID VALVE

The solenoid valve electrically operates the pilot container valve. The energised coil opens the solenoid valve. The pilot container internal pressure then opens the pilot container valve.

Johnson Controls supply the solenoid valve factory fitted to the pilot container. Do not electrically connect the unit until the system is ready for commissioning.

⚠ WARNING

In the event of a fault with the solenoid valve, return the complete pilot container to Johnson Controls. Do not attempt to remove the solenoid from the pilot container on site.

INSTALLING THE PNEUMATIC ACTUATORS

The pneumatic actuator is installed onto the 110-00 subordinate container valve, and is used to pneumatically actuate the subordinate container.

The 3-way pneumatic actuator (Part No. 30100106) is only used on double row systems, and must be installed on every fifth container in the bank to connect the front row to the back row. The decompression screw (Part No. 30027301) must also be installed at the end of the actuation line. See Figure 5-19.

The 2-way pneumatic actuator (Part No. 30100102) is used in all other instances.

To install the pneumatic actuator, complete the following steps:

1. Remove the top cap from the 110-00 subordinate container valve.
2. Insert the pneumatic actuator into the top cap.
3. Screw the top cap back onto the 110-00 subordinate container valve to hand tight. This connection does not require thread sealant.

⚠ CAUTION

Before fitting the 2-way or 3-way pneumatic actuator to the 110-00 subordinate container valve, ensure that the operating piston is fully retracted by pushing down on the piston. The operating piston must not be protruding from the pneumatic actuator.

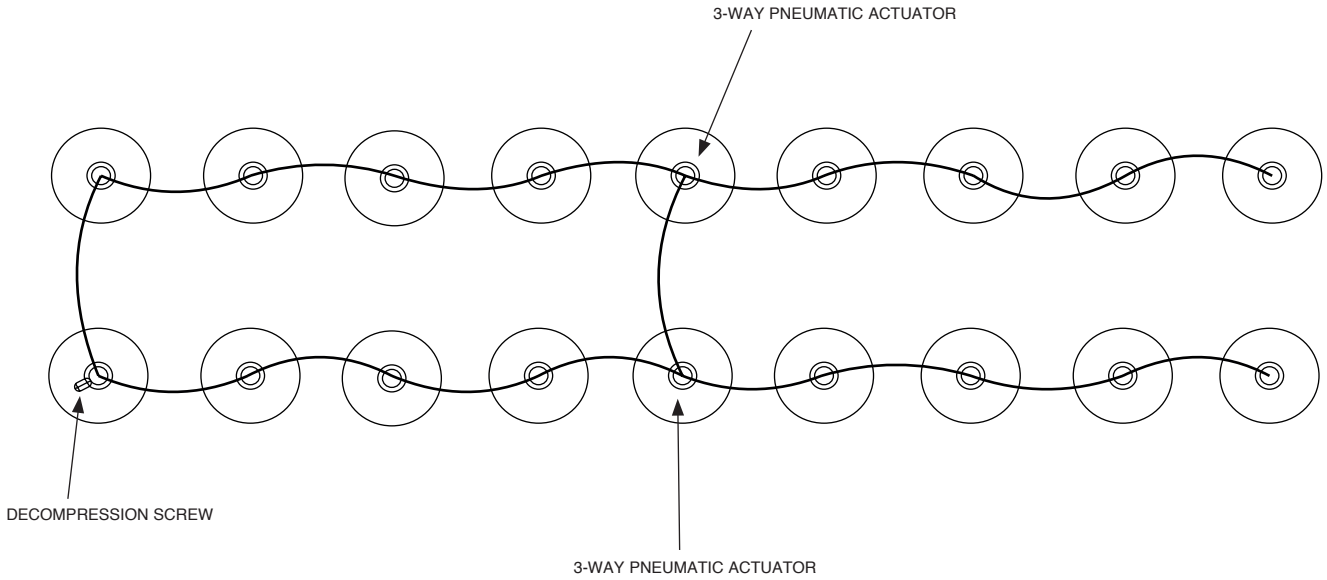


FIGURE 5-19
3-WAY PNEUMATIC ACTUATOR INSTALLATION
025819

INSTALLING THE CO_2 MASTER CONTAINER DIVERTER

The inlet of the CO_2 master container diverter (Part No. 91104001) is assembled directly onto the 128-20 master container valve outlet.

To install the diverter, complete the following steps:

1. Ensure that the master CO_2 container is secured with the hexagonal brackets or the WEH-1 weighing device as required for the system, before removing the transportation cap.
2. Remove the outlet cap from the 128-20 master container valve, and screw the swivel female end of the diverter onto the container valve outlet. This joint does not require thread sealant.
3. Screw the discharge hose onto the male end of the diverter. This joint does not require thread sealant.
4. Screw the actuation hose into the fixed 1/4 in. female thread to a torque of 10 N•m to 15 N•m. This joint does not require thread sealant.

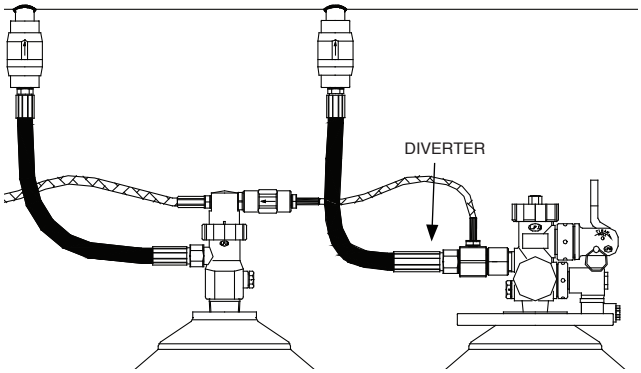


FIGURE 5-20
CO2 MASTER CONTAINER DIVERTER INSTALLED
E000560

INSTALLING THE ACTUATION HOSES

Use the 1/4 in. diameter hoses fitted with brass swivel ends to connect from the outlet of the pilot container to the inlet of the pneumatic actuator on the first CO_2 container. It also interconnects between the remainder of the pneumatic actuators fitted to the other containers in the container bank.

A 30 mm bending radius applies. Johnson Controls provides different lengths to suit various configurations of the container bank. For further details, see Section 4 – System Components.

To install the actuation hoses, complete the following steps:

1. Fit the actuation hoses between the pneumatic actuators fitted to the 110-00 subordinate container valve to a torque of 10 N•m to 15 N•m. Do not add any sealing compound.
2. Do not connect the actuation hose between the pilot container and the first container in the container bank until system commissioning commences.
3. For selector valve systems, configure the container bank with the various fittings and non-return valves required. For these systems, refer to the installation drawings for the correct configuration of the pneumatic actuation line.

Note: The fitting of hoses to the pneumatic actuators does not require sealant.

⚠ CAUTION

Avoid twisting the flexible hoses during assembly. Hold the hose fitting with pliers while tightening the swivel end of the hose into the pneumatic actuator.

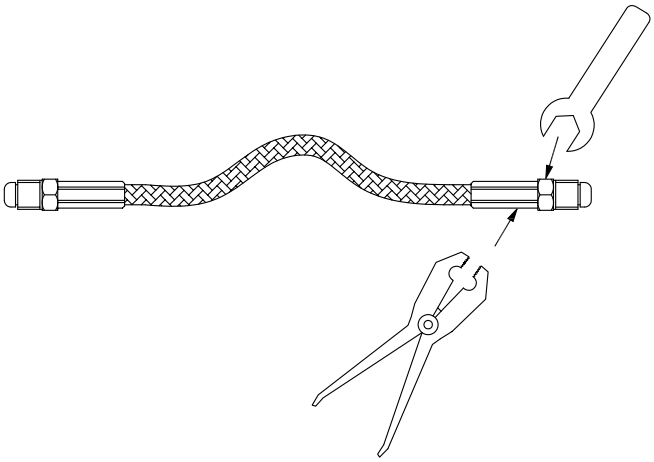


FIGURE 5-21
ACTUATION HOSE INSTALLATION
025335

INSTALLING THE ELECTRICAL COMPONENTS

Upon completion of the pneumatic actuation line installation, connect the various electrical components. This section describes the electrical connections for the various components.

> ***NOTICE***
>
> Remove the top cap on the pilot container valve while carrying out the electrical installation. This prevents the operation of the pilot container, if an accidental operation of the electrical solenoid occurs.

Installing the pressure switch

For a normally closed circuit, connect to the top two terminals, as shown in Figure 5-22. For a normally open circuit, connect to the bottom two terminals.

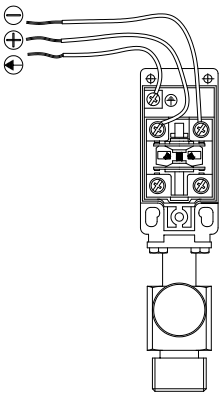


FIGURE 5-22
PRESSURE SWITCH ELECTRICAL INSTALLATION
025336

Installing the solenoid valve

To install the solenoid valve, complete the following steps:

1. Disconnect the electrical power supply before performing electrical connections and remove the top cap.
2. Remove the solenoid block from the solenoid valve body.
3. Connect the solenoid valve as shown in Figure 5-23.

Note: The solenoid is not polarity sensitive, and so positive supply from the control panel can be connected to either terminal, with the reverse for the negative supply.

4. After connection, place the top cap back on the pilot valve.
5. Keep the solenoid block removed from the solenoid valve body until commissioning begins.

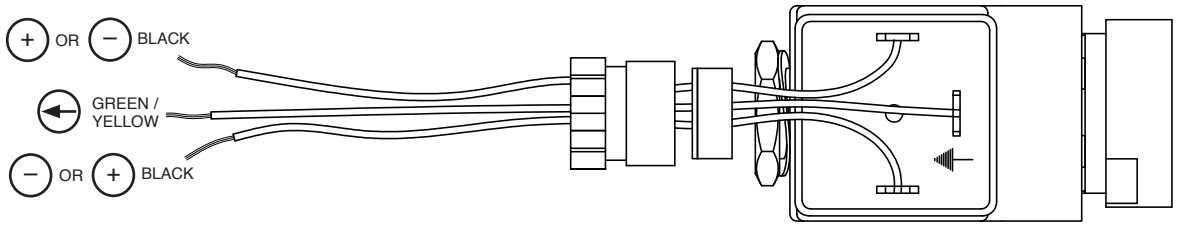
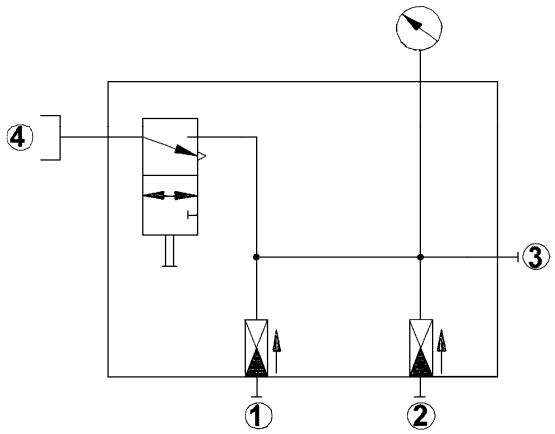


FIGURE 5-23
SOLENOID VALVE ELECTRICAL INSTALLATION
025337

INSTALLING THE TEST AND RELIEF UNIT (PRE-1)

Seal the inlet connection from the standby alarm control panel (2) on-site with the 14 mm diameter ball, which is supplied with the test and relief unit.

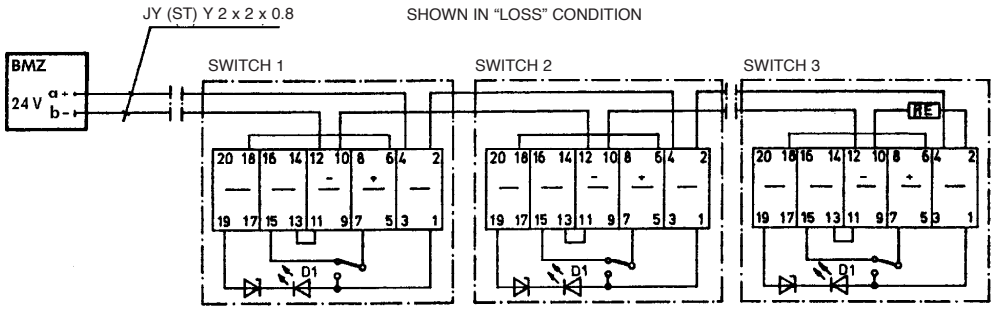
The test and relief unit (PRE-1) can be equipped with micro switches (Part No. K02462876) to supervise each switch position. For further details, see Section 4 - Limit Switch with Integrated LED on page 4-52.



Item	Description
1	Connection from the main alarm control panel
2	Connection from the standby alarm control panel
3	Connection to the pilot or actuation line
4	Connection to the test container or relief pipework

FIGURE 5-24
TEST AND RELIEF UNIT FUNCTIONAL DIAGRAM
E000775

INSTALLING THE RS3 LOSS INDICATOR SWITCH

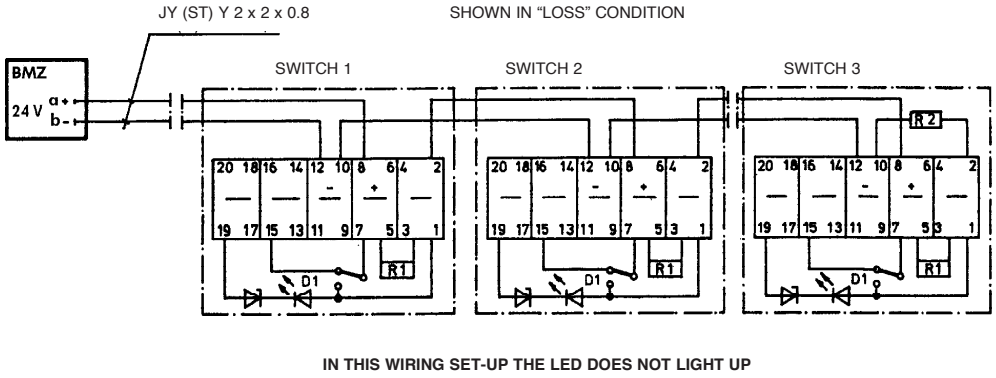


The end-of-line resistor (RE) is premounted to Terminal 2. In the last switch of a battery RE must be connected to Terminal 10. If not used, remove RE for interconnecting the next device.

FIGURE 5-25
RS3 CURRENT AMPLIFICATION
E001084

Technical information

Nominal voltage:	24 V
Current:	50 mA (maximum)



IN THIS WIRING SET-UP THE LED DOES NOT LIGHT UP

1. Remove the RE. R1 and R2 must be wired supplementary and corresponding to the fire alarm panel. R2 = EOL-resistor.
2. Remove the bridges from Terminal 11/13 and from Terminals 6/18.

FIGURE 5-26
RS3 CURRENT DEGRADATION
E001085

Technical information

Maximum voltage:	100 V
Maximum current:	0.5 A
Effective power:	5 W
Apparent power:	5 VA

INSTALLING THE RS4 LOSS INDICATOR SWITCH (FAST CONTROL PANEL)

Figure 5-27 shows the loss indication. The operating magnet opens the contact.

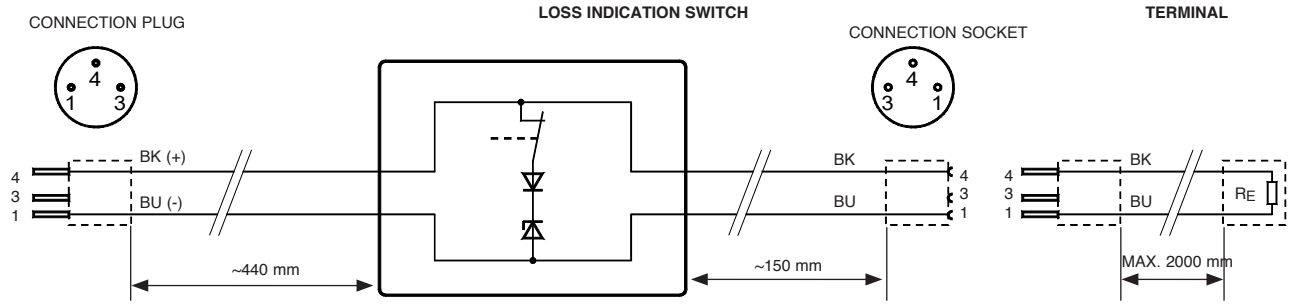


FIGURE 5-27
RS4 LOSS INDICATOR SWITCH (FAST CONTROL PANEL)
E001085

BU = Blue (-)

BK = Black (+)

RE = EOL resistor 3k3 up to 4k7

Accessories

- Terminal box: K02466726
  To connect the cable coming from the CIE, and to install the EOL resistor)
- Accessories for KM-4: K02410926
  Contains two pieces of cable, each 2000 mm in length. These are used for the terminal and connecting cable.

INSTALLING THE PNEUMATIC TIME DELAY AND SIREN

Installing the PV-3-C pneumatic time delay assembly

The pneumatic time delay assembly must be installed on a flat vertical surface, using the four fixing holes on the back of the housing.

The pressure reducer within the time delay assembly is set to 10 bar, and must not be changed.

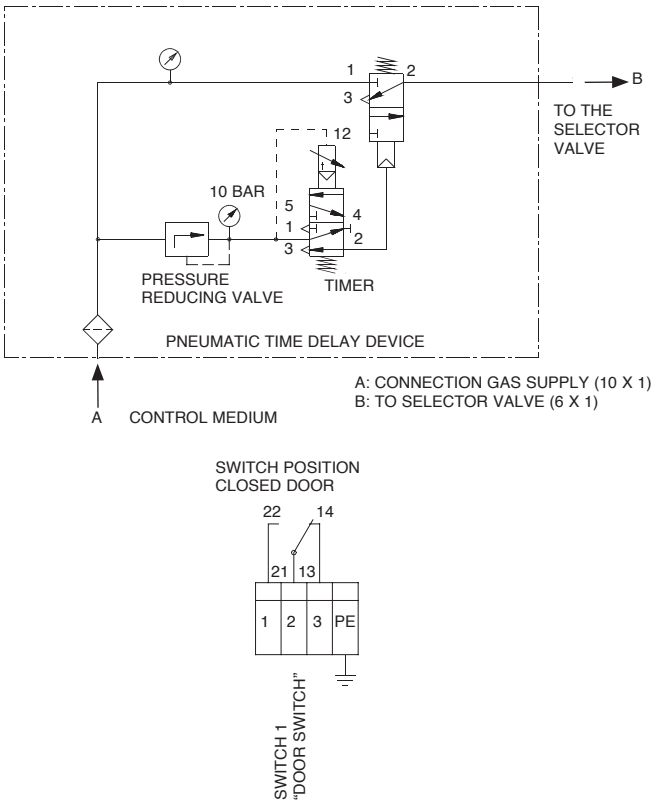


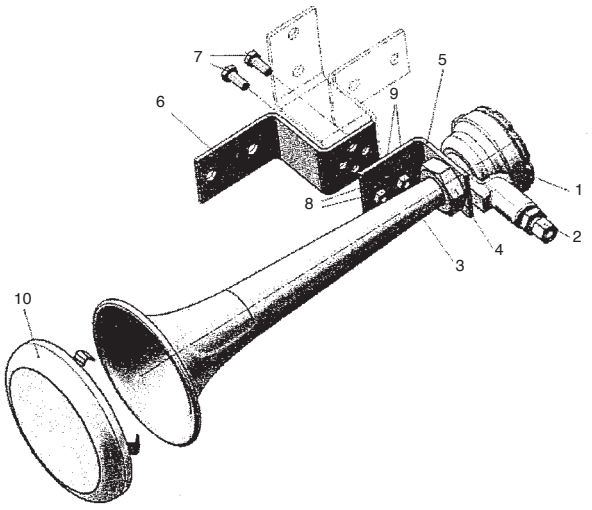
FIGURE 5-28
PNEUMATIC TIME DELAY
E001041

INSTALLING THE PNEUMATIC SIREN ASSEMBLY (MX-1) AND SILENCER

Note: The siren horn (3) and siren housing (1) are fixed and non-detachable.

To install the pneumatic siren assembly, complete the following steps:

1. Position the large fastening bracket (6) onto the small fastening bracket (5) and mount them together using the hexagon cap screws (7), lock washers (8) and hexagon nuts (9).
2. Tighten the lock nuts (4), to finish assembly of the fastening brackets.
3. To avoid ingress of dust, debris and other contaminants, ensure that the outlet points downwards.
4. Check the inlet lines are free of contaminants and blow out if necessary.
5. If the silencer is required, then fit to the siren horn with the clamping brackets.
6. The pneumatic siren assembly must be connected to a CO_2 supply, otherwise it could fail to operate.



Item	Description
1	Housing
2	Screw fitting
3	Horn
4	Locknut (M24 x 1.5 mm)
5	Small fastening bracket
6	Large fastening bracket
7	Hexagon cap screw (M6 x 16)
8	Lock washers (A6)
9	Hexagon nut
10	Silencer (Part No. 877120)

FIGURE 5-29
PNEUMATIC SIREN ASSEMBLY AND SILENCER
025848

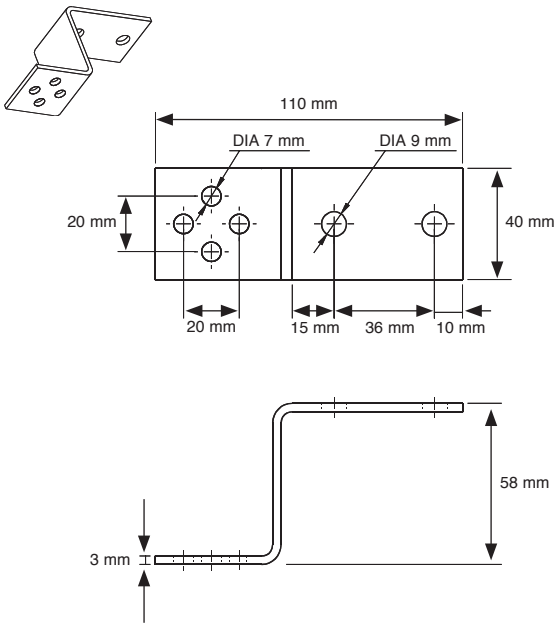


FIGURE 5-30
PNEUMATIC SIREN BRACKET DIMENSIONS
E001045

INSTALLING THE PIPE DISTRIBUTION SYSTEM

Install the discharge pipe system as indicated on the installation drawings. The maximum distance between two pipe fixings on the installed pipe shall not exceed the values listed in the following table.

TABLE 5-2: MAXIMUM PIPE SUPPORT SPACINGS

Nominal diameter (mm)	Nominal diameter (in.)	Maximum distance between supports (m)
10	3/8	1.0
15	1/2	1.5
20	3/4	1.8
25	1	2.1
32	1 1/4	2.4
40	1 1/2	2.7
50	2	3.4
65	2 1/2	3.5
80	3	3.7
100	4	4.3

When installing the pipe distribution system, complete the following steps:

- Place pipe fixings close to elbows and tees, where a change of the direction of the pipe takes place.
- Pipe fixings should connect the pipe system directly to the building structure. Other pipes and services should not support the system's suppression pipework.
  - Ensure the area that the pipe support is fixed to, is strong enough to take the load.
- Keep the distance between the nozzle and its pipe fixing as short as possible.
  - For nozzle sizes 25 mm and below, the maximum distance from the pipe fixing to the nozzle shall be 0.1 m.
  - For nozzle sizes above 25 mm, the maximum distance from the pipe fixing to the nozzle shall be 0.25 m.
- For pipe sizes up to 2 in. (DN50), support with 10 mm steel studding.
- For pipe sizes above 2 in. (DN50), support with 12 mm studding.

Upon completion of the pipework installation and nozzles, complete the following steps:

1. Purge the pipework to remove any cutting oil or swarf in the pipe system.
2. Disconnect the containers from the manifold.
3. Fit any plugs as necessary and purge the pipework with dry nitrogen.

NOTICE

Put bags over the nozzles to collect debris to minimise the discharge of oil and swarf.

4. If the pipework does not require purging at this stage, report this to the commissioning engineer. The commissioning engineer can make arrangements for this at the commissioning stage.

INSTALLING THE ODOURISER

- The odouriser must be connected to the distribution pipework downstream of the manifolds.
- The number of odourisers required is determined from the CO_2 quantity delivered to the protected area. Where this exceeds the limit of 1000 kg of CO_2, add more odourisers as required.
- When a system utilises selector valves, the required number of odourisers must be installed in the pipework downstream of each selector valve to ensure that odourant is added to each protected zone.



Arrows indicate flow direction

FIGURE 5-31
INSTALLING THE ODOURISER
E001083

- The odouriser must preferably be mounted to the underside of the distribution pipework. The arrows marked on the odouriser body indicate the best mounting approach. Alternatively, the odouriser may be installed on a 45° elbow, the fitting aligned with the direction of flow as shown in Figure 5-31.
- When fitting to a vertical section of pipe, fit the odouriser onto a 45° elbow, with the thread connection uppermost (Figure 5-31), or horizontally.
- When replacing an odouriser on an existing system, the odouriser may be installed in the same orientation as the original. This may not be in accordance with the arrows marked on the body. The dosing performance in any other orientation cannot be guaranteed.
- Do not install the odouriser where adverse environmental conditions are expected, particularly in acidic atmospheres.

Odouriser safety

⚠ CAUTION

The odouriser is a sealed device, retaining the odourant liquid internally, until released by the operation of the CO_2 system. If any odouriser is found to be leaking while in storage or transit, handle the fluid with care, avoiding skin and eye contact. Adhere with the precautions detailed on the Material Safety Data Sheet.

The odouriser contains a concentrated odourant liquid, that may be harmful in concentrate form. Do not deliberately puncture the internal seal, or attempt to dismantle the odouriser.

⚠ WARNING

If an odouriser is leaking, avoid direct contact of the liquid with skin or eyes. Do not ingest. Place the leaking odouriser into a sealed plastic bag and dispose of in accordance with the Material Safety Data Sheet. Observe all warnings stated on the MSDS in handling the liquid.

Do not use this odouriser on low pressure CO_2 systems where the CO_2 is stored in a refrigerated bulk tank.

Protect the odouriser from the ingress of foreign materials at all times.

Handle with care. Do not drop the odouriser.

Do not exceed the maximum working pressure. Do not install the odouriser on inert gas systems where it is exposed to the full container.

Do not exceed the maximum working pressure. Do not install the odouriser on inert gas systems where it will be exposed to full container pressure.

Replace the odouriser once used.

MANIFOLD BURST DISC AND VENT VALVE

The burst disc can automatically relieve pressure in the pipework system. It is required in a closed section of pipe between the container valves and selector valves.

The outlet from the burst disc must be piped to the atmosphere, away from personnel. The system design must incorporate a manual by-pass valve into the pressure relief arrangements to safely vent trapped CO_2 away to the atmosphere.

The vent valve must be pad-locked in the closed position under normal operating conditions and the monitoring switch connected to the panel to indicate the open or closed status of the vent valve. See Figure 5-32.

Installing the manifold burst disc

Orient the manifold burst disc in the proper direction with the burst disc outside of the system pipework, as shown in Figure 5-33.

To fit the manifold burst disc assembly, perform the following steps:

1. Apply PTFE tape to the male threads, ensuring that tape is not applied to the first two threads.
2. Screw the manifold burst disc assembly into position.
3. Tighten using a suitable wrench.

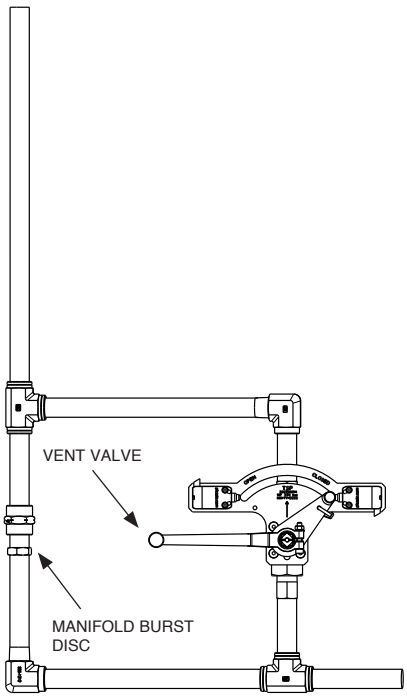


FIGURE 5-32
MANIFOLD BURST DISC AND VENT VALVE INSTALLATION
E001011

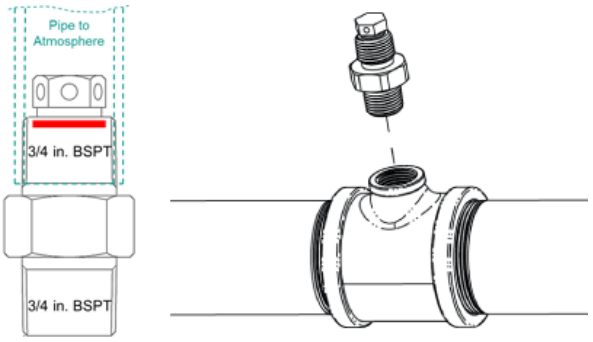


FIGURE 5-33
MANIFOLD BURST DISC
E001130

INSTALLING THE DISCHARGE NOZZLES

Two types of discharge nozzle are available, **total flooding** (which uniformly distributes CO_2 throughout the hazard area), and **local application** (which distributes CO_2 at a particular area).

For both types of discharge nozzle the minimum drill size is 1.0 mm, and a filter must be install in the nozzle for all drill sizes less than 3.0 mm.

The discharge nozzles come with this drill size stamped in its body. The installation drawing indicates both the position of the nozzle and its drill size. Before installing the discharge nozzles, complete the following steps:

1. Ensure the pipework supports have been fitted at the correct intervals and are adequate for purpose.
2. Install each nozzle in the position indicated in the installation drawing. The installation drawing must indicate the drill size.

⚠ CAUTION

It is essential that nozzles are fastened securely and that they never point directly at ceiling tiles. Never attach nozzles directly to the outlet of a container valve.

To fit the nozzle, complete the following steps:

1. Aim the nozzles in the correct alignment away from obstructions or barriers that could prevent the adequate distribution of the CO_2.
2. Apply pipe sealing compound to the male thread on a pipe or fitting ensuring that the first two threads have no sealant.
3. Screw the nozzle onto the male thread and tighten using a suitable wrench.
4. Ensure that the nozzle fits in accordance with the design requirements.

ACCESSORIES

Door notices and door warning signs

Warning notices are required at all exits and entrances to the protected area, ideally mounted on the door. Plates may be mounted with fasteners or attached using suitable adhesive.

Manual release notices and nameplates

Manual release notices are required at all manual actuators, remote manual actuators, control panels, and call points. Plates may be mounted with fasteners or attached using suitable adhesive.

COMMISSIONING

Use this section when commissioning CO_2 fire suppression systems. In addition, use the checklist in Section 8 - Appendix to carry out the commissioning process. The commissioning schedule covers the majority of the equipment and configurations likely to be encountered. Where appropriate, the commissioning process may require additional checks to those listed.

Before you begin commissioning, observe the following guidelines:

- Complete all sections. If not applicable, write **N/A** in the appropriate space.
- Personnel experienced in the commissioning of this type of equipment must carry out the commissioning of CO_2 systems.
- Check the container pressures adjusted for temperature for compliance.
- The responsible person must complete the schedule during the commissioning of all new systems and those that have been modified.

CHECKING THE PIPEWORK INTEGRITY

To check the integrity of the pipework, complete the following step:

- Pressure test the discharge pipework in accordance with the requirements of the applicable design standard.

TESTING THE DISCHARGE PRESSURE SWITCH

To test the electrical operation of the discharge pressure switch, complete the following steps:

1. Remove the cover of the discharge pressure switch exposing the wiring connections. See the following figure.
2. With the wiring to the unit still connected, remove the top body of the discharge pressure switch that contains the wiring terminals and the unit's microswitch. This exposes the bottom of the piston that operates the internal microswitch.
3. Push the exposed piston upwards to operate the microswitch with a screwdriver.
4. Check that the suppression releasing panel receives the appropriate signal.
5. Reassemble the discharge pressure switch and reset it. Pull out the knob set in its side to reset the discharge pressure switch.

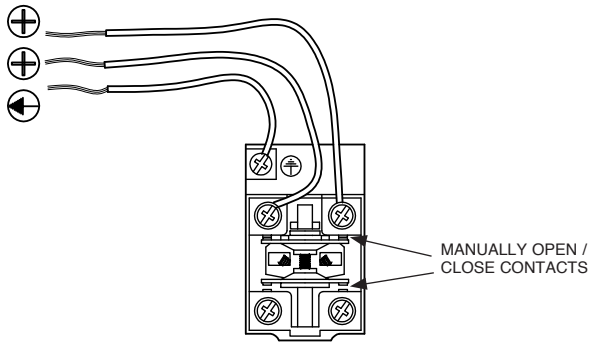


FIGURE 6-1
DISCHARGE PRESSURE SWITCH TEST
025356

TESTING THE PNEUMATIC ACTUATION LINE FOR SINGLE RISK AREA SYSTEMS

To test the pneumatic actuation line for single risk area systems, complete the following steps:

1. Remove the top cap from the master CO_2 container valve or the pilot container valve (as appropriate for the system design).
2. Disconnect the actuation hose or the 6 mm copper pipe from the outlet of the pilot container fitted between the pilot container and the first CO_2 container in the container bank, or from the diverter on the master CO_2 container (as appropriate for the system design).
3. Remove the pneumatic actuators from all CO_2 subordinate 110-00 container valves.
4. Holding each pneumatic actuator in hand, remove the internal piston with a pliers.

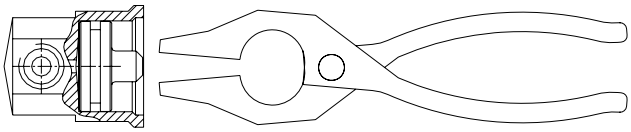


FIGURE 6-2
REMOVING THE INTERNAL PISTON
E001086

5. Turn over the piston assembly and reinsert it fully into the pneumatic actuator, before reinstalling back onto the container valve.

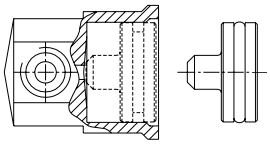


FIGURE 6-3
REINSERTING THE INTERNAL PISTON
E001086

6. Attach a nitrogen container fitted with a suitable pressure regulator and pressure relief valve (see Figure 6-5) to the actuation hose disconnected from the pilot container or from the diverter on the master CO_2 container (as appropriate for the system design).
7. Adjust the outlet pressure of the nitrogen pressure regulator to a minimum of 50 bar. Open the valve on the nitrogen container to apply pressure to the pneumatic actuation line.
8. Check for leaks. Apply a suitable leak detection spray to all of the joints in the pneumatic actuation line.
9. Close the valve on the nitrogen container and vent the pressure from the pneumatic actuation line.
10. Remove the pneumatic actuators from each CO_2 subordinate 110-00 container valve, and re-orient the piston within the head so that the piston stem is visible. Then, reinstall back onto the valve taking note of the following caution notice.

⚠ CAUTION

Before refitting the pneumatic actuators to the CO_2 valves, ensure that the piston is fully retracted within the pneumatic actuator, so that the piston stem does not extend beyond the bottom of the body, as shown in Figure 6-4.

TESTING THE PNEUMATIC ACTUATION LINE FOR SINGLE RISK AREA SYSTEMS (Continued)

11. Refit the actuation hose or the 6 mm copper pipe to the outlet of the pilot container or to the master CO_2 container diverter (as appropriate for the system design).
12. Refit the top caps to the CO_2 and pilot container valves to a torque of 33.9 N•m to 40.7 N•m.

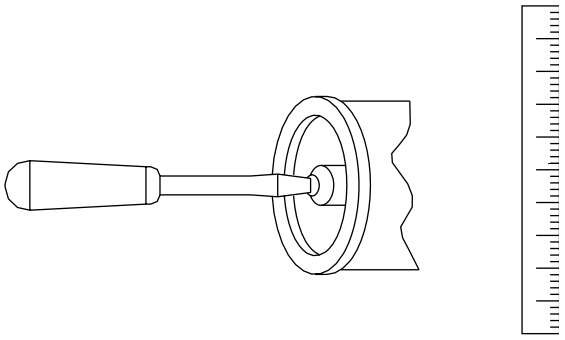
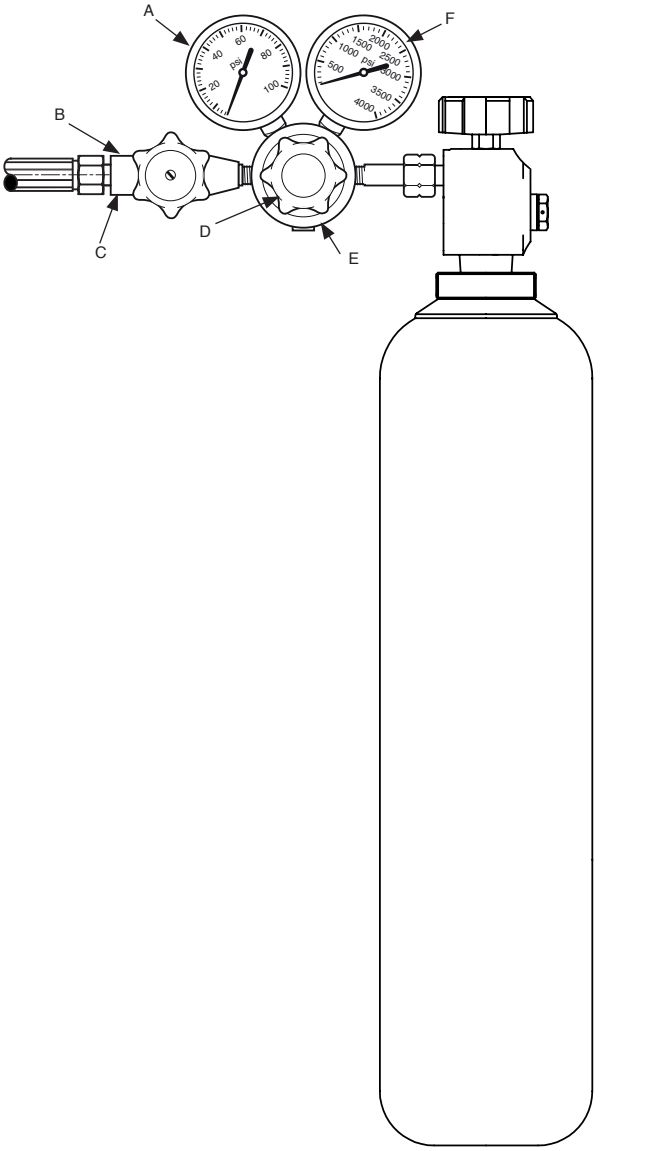


FIGURE 6-4
RESETTING THE PNEUMATIC ACTUATOR PISTON
E001087



Position	Description
A	Delivery pressure gauge
B	Outlet valve
C	Outlet port
D	Pressure adjusting knob
E	Regulator body
F	Inlet pressure gauge

FIGURE 6-5
CONNECTING THE NITROGEN CONTAINER TO THE PILOT LINE
025721

TESTING THE PNEUMATIC ACTUATION LINE FOR MULTI-HAZARD AREA SYSTEMS

To test the pneumatic actuation line for multi-hazard area systems, complete the following steps:

1. Remove the top caps from all CO_2 container valves and pilot container valves.
2. Disconnect the actuation hose or the 6 mm copper pipe from the outlet of the pilot container.
3. Remove the coil from the solenoid on the pilot container. See Figure 6-9.
4. Test the operation of each area's selector valve together with the pneumatic actuation line for the number of CO_2 containers designed to discharge into this area.
5. Remove the pneumatic actuators from all CO_2 containers.
6. Holding each pneumatic actuator in hand, remove the internal piston with a pliers.

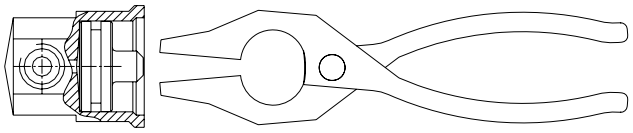


FIGURE 6-6
REMOVING THE INTERNAL PISTON
E001086

7. Turn over the piston assembly and reinsert it fully into the pneumatic actuator, before reinstalling back onto the container valve.

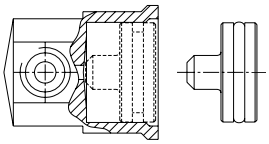


FIGURE 6-7
REINSTALLING THE INTERNAL PISTON
E001086

8. Attach a nitrogen container fitted with a suitable pressure regulator and pressure relief valve (see Figure 6-5) to the actuation hose disconnected from the pilot container.
9. Adjust the outlet pressure of the nitrogen pressure regulator to a minimum of 50 bar. Open the valve on the nitrogen container to apply pressure to the pneumatic actuation line.

Note: Pressure from the nitrogen container pressurises the actuation control piping up to the selector valve solenoids.

10. Check for leaks. Apply a suitable leak detection solution to all joints in the pneumatic actuation line from the pilot container to the selector valve solenoids.
11. Simulate a fire in a particular hazard area at the fire suppression system releasing control panel. This sends a signal to both the solenoid for the pilot container and also to the selector valve solenoid for this area.
12. Check that the pilot container solenoid's coil energised. Place the end of a screwdriver inside the coil. A magnetic force on the screwdriver should occur to signify an energised coil.
13. Check that the correct selector valve solenoid operated causing the correct selector valve to open.
14. Check for leaks. Apply a suitable leak detection solution to all joints in the pneumatic actuation line from the selector valve solenoid through the selector valve and up through the pneumatic actuation line to the pneumatic actuators.
15. Close the valve on the nitrogen container and vent the pressure from the pneumatic actuation line.
16. Inspect the pneumatic actuators on all CO_2 container valves. Check that only the pistons on the correct number of containers for the hazard area being tested have operated correctly.
17. Reset the suppression control panel.
18. Close the operated selector valve assembly manually.
19. Reset the operated pneumatic actuators.
20. Refit the pneumatic actuators.
21. Open the valve on the nitrogen container and repeat steps 9 to 20 for the next risk area.

Upon completion of all risk area testing, complete the following steps:

1. Remove the pneumatic actuators from each CO_2 container valve, and re-orient the piston within the head so that the piston stem is visible. Then, re-install back onto the valve taking note of the following caution notice.

⚠ WARNING

Before refitting the pneumatic actuators to the CO_2 valves, ensure that the piston is fully retracted within the pneumatic actuator, so that the piston stem does not extend beyond the bottom of the body, as shown in Figure 6-4.

2. Disconnect the nitrogen container and pressure regulator from the pneumatic actuation line.
3. Refit the coil to the solenoid on the pilot container.
4. Refit the top caps to the CO_2 and pilot container valves to a torque of 33.9 N•m to 40.7 N•m.

TESTING THE MASTER CONTAINER AND PILOT CONTAINER SOLENOID

To test the pilot container solenoid, complete the following steps:

1. Remove the master or pilot container valve top cap. See Figure 6-8.
2. Undo the solenoid coil retaining nut and remove the solenoid from its location on the centre stem of the housing. If the system contains more than one pilot container, repeat this step for every pilot container. See Figure 6-9.
3. Simulate a fire condition at the suppression control panel to energise the solenoid coil.
4. Check that the master or pilot container solenoid's coil energised. Place the end of a screwdriver inside the centre of the coil (see Figure 6-10). A magnetic force on the screwdriver should occur to signify an energised coil.

NOTICE

Time the duration of the activation of the solenoid coil to ensure that it remains energised for a minimum of three minutes. Note that the solenoid coil gradually heats up during this activation period.

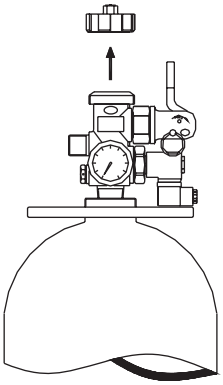


FIGURE 6-8
REMOVING MASTER AND PILOT VALVE TOP CAP
025359

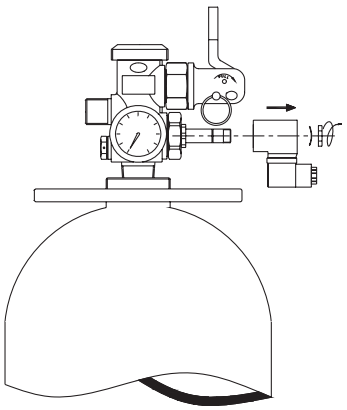


FIGURE 6-9
REMOVING THE MASTER AND PILOT VALVE SOLENOID
025360

5. Reset the fire suppression system releasing control panel and check with a screwdriver that it contains no residual magnetism.
6. Slowly replace the solenoid coil onto its stem. If the pilot container valve starts to leak through the pilot port in the top of the valve, remove the solenoid coil immediately. If a leakage occurs, check that the suppression releasing panel is correctly reset. If the problem persists after resetting the panel, contact the original equipment manufacturer's (OEM) Technical Department for assistance.
7. When the solenoid coil is in position on its stem, fit the holding nut and tighten with a suitable spanner.
8. Refit the top cap onto the master or pilot container valve.

⚠ WARNING

The pilot container is charged at 100 bar. The pilot container is supplied with the solenoid factory fitted. Under no circumstances attempt to remove the pilot container solenoid from the valve. In the event of a fault with the solenoid valve, return the complete pilot container with release solenoid to Johnson Controls.

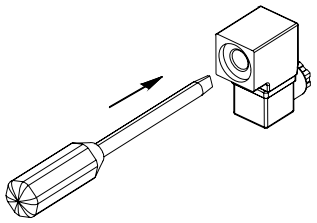


FIGURE 6-10
CHECKING THE SOLENOID OPERATION WITH A SCREWDRIVER
025343

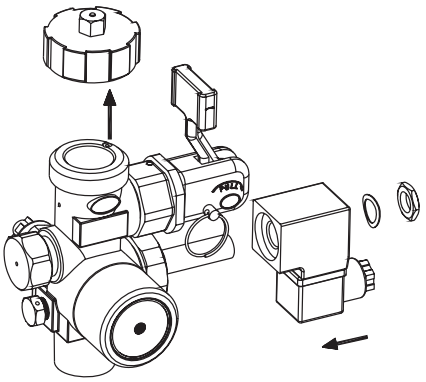


FIGURE 6-11
REASSEMBLING THE SOLENOID ONTO THE PILOT VALVE
025361

TESTING THE SF-2 ELECTRICAL ACTUATOR

To test the SF-2 electrical actuator, complete the following steps:

1. Remove the pilot container valve top cap. See Figure 6-8.
2. Disconnect the SF-2 electrical actuator from the actuation coupling (Part No. 130850006).
3. Simulate a fire condition at the suppression control panel to trigger the SF-2 electrical actuator.
4. Check that the release pin moves.

⚠ WARNING

Before refitting the SF-2 electrical actuator to the actuation coupling, ensure that it is fully reset by following the tensioning instructions.

5. Screw the tensioner into the SF-2 electrical actuator connection thread.
6. Screw the wing screw in until you hear it engage.
7. Unscrew and remove the tensioner, and keep it safely with your tool.
8. Reconnect the SF-2 electrical actuator onto the actuation coupling.
9. Refit the top cap to the pilot container valve to a torque of 33.9 N•m to 40.7 N•m.

TESTING THE SMV-1 STEPPER MOTOR

To test the SMV-1 stepper motor, complete the following steps:

1. Remove the pilot container valve top cap. See Figure 6-8.
2. Disconnect the SMV-1 stepper motor from the actuation coupling (Part No. 130850006).
3. Simulate a fire condition at the suppression control panel to trigger the stepper motor.
4. Check the delay time using a stop watch.
5. Check that the release pin moves.

⚠ CAUTION

Before refitting the SMV-1 stepper motor to the actuation coupling, ensure that it is fully reset.

6. Reset the FAST 200 control panel. Refer to the FAST 2000 manual.
7. Screw the tensioner into the SMV-1 stepper motor connection thread.
8. Screw the wing screw in until you hear it engage.
9. After 1 to 5 seconds, the stepper motor starts and the SMV-1 returns to its standby position.
10. After the stepper motor returns and stops, unscrew and remove the tensioner, and keep it safely with your tool.
11. Reconnect the SMV-1 stepper motor onto the actuation coupling.
12. Refit the top cap to the pilot container valve to a torque of 33.9 N•m to 40.7 N•m.

TESTING THE ROOM INTEGRITY

The successful performance of a gaseous total flooding system largely depends on the integrity of the protected enclosure. The installation of a gaseous total flooding system requires the performance of a room integrity test on any protected enclosure. The results of this test establish the total equivalent leakage area and the enclosure's ability to retain agent. The required retention time varies depending on the particulars of the hazard. A retention time of less than 10 minutes normally applies. Enclosures containing hazards that may readily become deep seated may require longer retention times. Use the procedure provided in *BS 5306-4*, *ISO 14520,* or *EN 15004*, depending on the design standard used for the system design, to perform the integrity test.

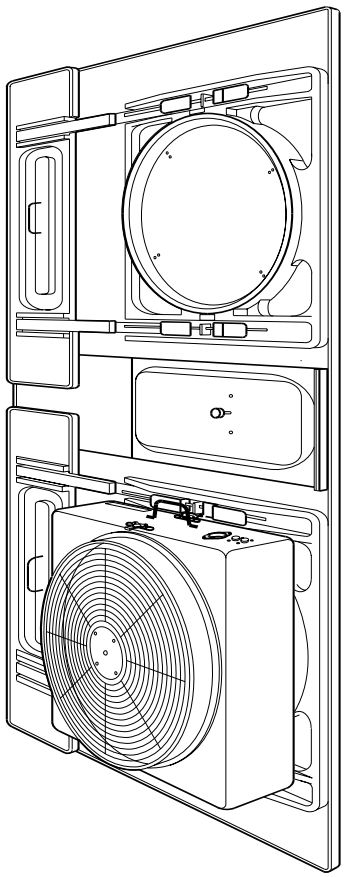


FIGURE 6-12
ROOM INTEGRITY TEST EQUIPMENT
025344

NOTES:

SERVICING AND MAINTENANCE

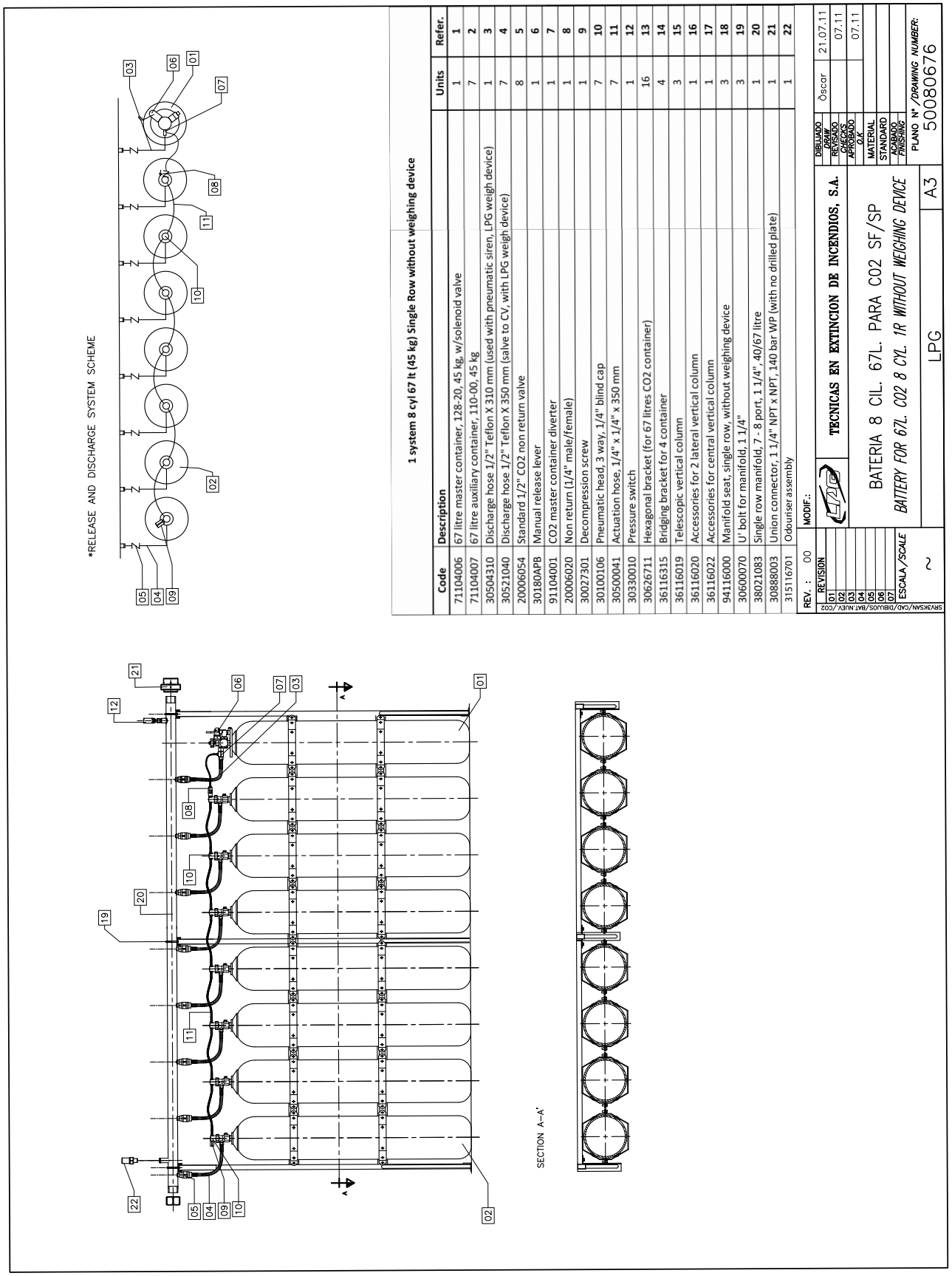
This section provides general guidance on the maintenance of CO_2 fire suppression systems. When performing maintenance tasks, follow these points:

- Perform maintenance as detailed at least every six months. Local conditions may indicate a need for more frequent visits.
- Persons with previous experience in the maintenance of this, or similar equipment, must conduct the maintenance of this equipment.
- Complete the servicing checklist during each visit. Hold a copy in the relevant project file for future reference. For an example of this checklist, see Section 8 - Appendix.
- Confirm the electrical and mechanical isolation of the suppression system before carrying out any checks. Remove all electrical and pneumatic actuators, if fitted.
- Upon completion of all checks, ensure all electrical, mechanical, and pneumatic actuators are reset and refitted.
- Test the pneumatic actuation tubing in accordance with the procedure detailed in Section 6 - Commissioning.
- Check the operation and resetting of electrical, pneumatic, and manual actuators as detailed in Section 6 - Commissioning.
- Obtain the signature of the customer's representative on the visit record and leave a copy with the customer on completion of the maintenance and servicing steps.
- If any part of the system remains inoperable, note this clearly on the visit record and inform the customer's representative when signing.

NOTES:

TYPICAL INSTALLATIONS

The section shows examples of the container bank and bracketing arrangements for CO_2 systems.



Code	Description	Units	Refer.
71104006	67 litre master container, 128-20, 45 kg, w/solenoid valve	1	1
71104007	67 litre auxiliary container, 110-00, 45 kg	7	2
30504310	Discharge hose 1/2" Teflon X 310 mm (used with pneumatic siren, LPG weigh device)	1	3
30521040	Discharge hose 1/2" Teflon X 350 mm (salve to CV, with LPG weigh device)	7	4
20006054	Standard 1/2" CO2 non return valve	8	5
30180APB	Manual release lever	1	6
91104001	CO2 master container diverter	1	7
20006020	Non return (1/4" male/female)	1	8
30027301	Decompression screw	1	9
30100106	Pneumatic head, 3 way, 1/4" blind cap	7	10
30500041	Actuation hose, 1/4" x 1/4" x 350 mm	7	11
30330010	Pressure switch	1	12
30626711	Hexagonal bracket (for 67 litres CO2 container)	16	13
36116315	Bridging bracket for 4 container	4	14
36116019	Telescopic vertical column	3	15
36116020	Accessories for 2 lateral vertical column	1	16
36116022	Accessories for central vertical column	1	17
94116000	Manifold seat, single row, without weighing device	3	18
30600070	U' bolt for manifold, 1 1/4"	3	19
38021083	Single row manifold, 7 - 8 port, 1 1/4", 40/67 litre	1	20
30888003	Union connector, 1 1/4" NPT x NPT, 140 bar WP (with no drilled plate)	1	21
315116701	Odouriser assembly	1	22

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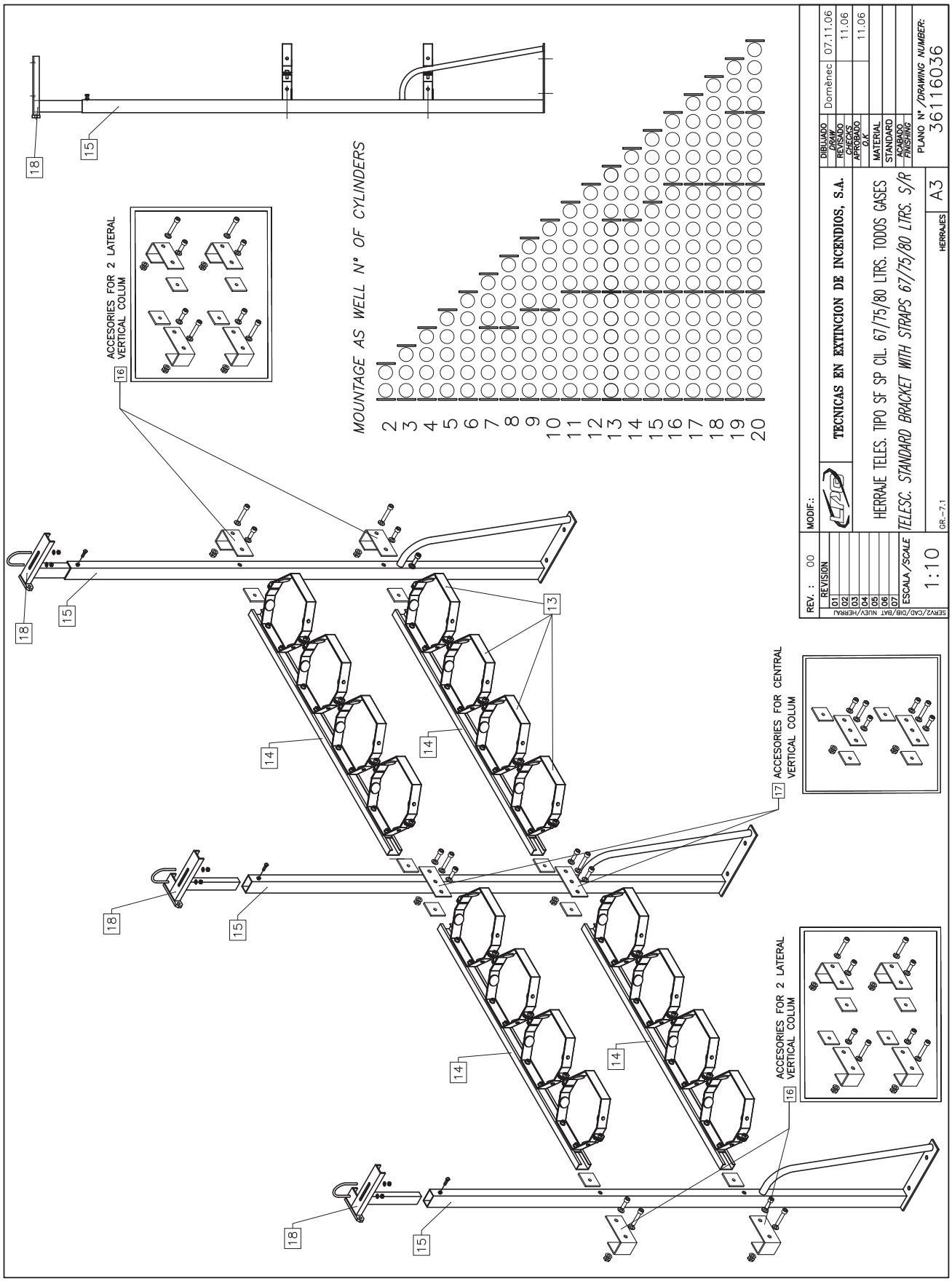
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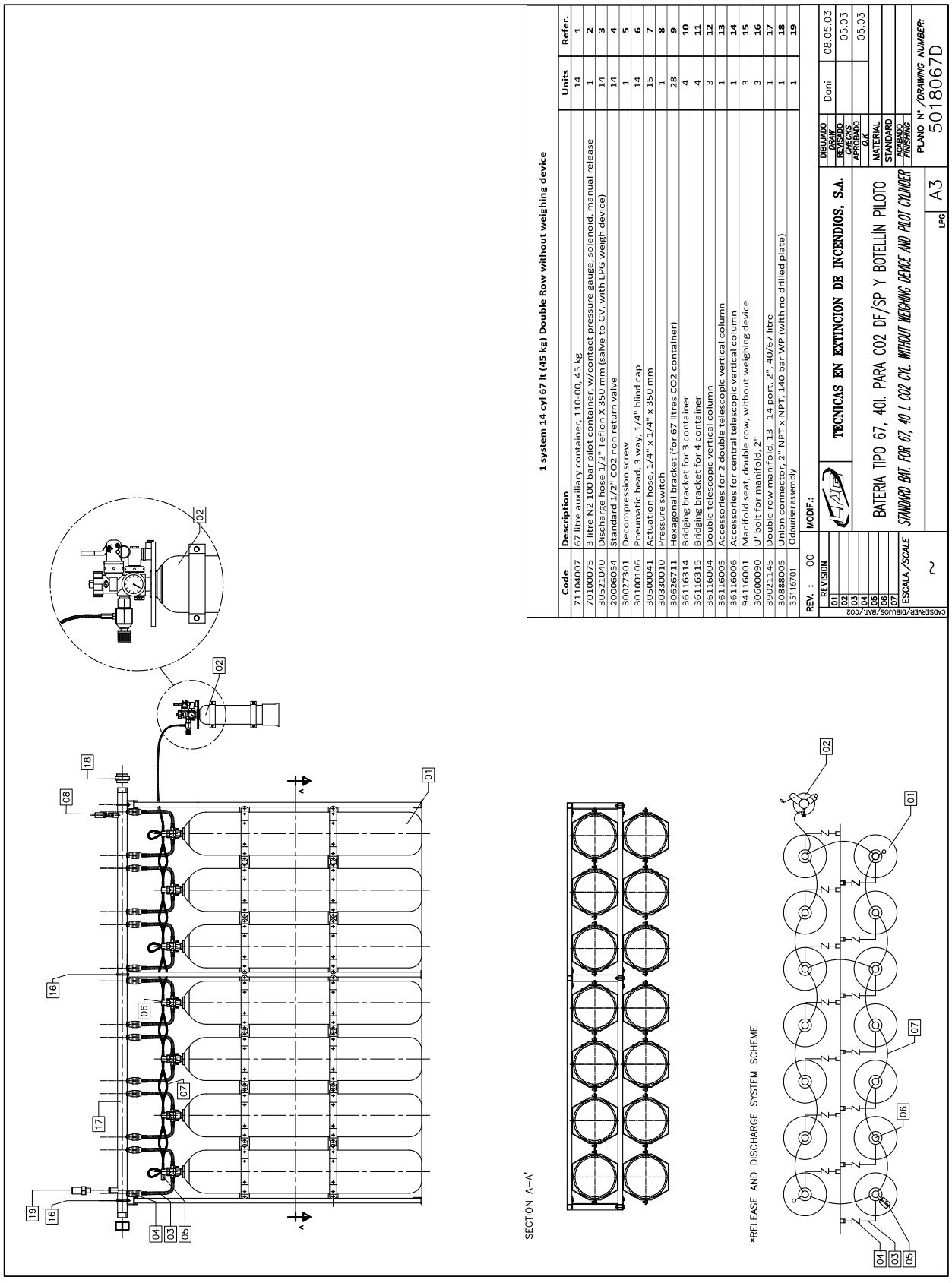
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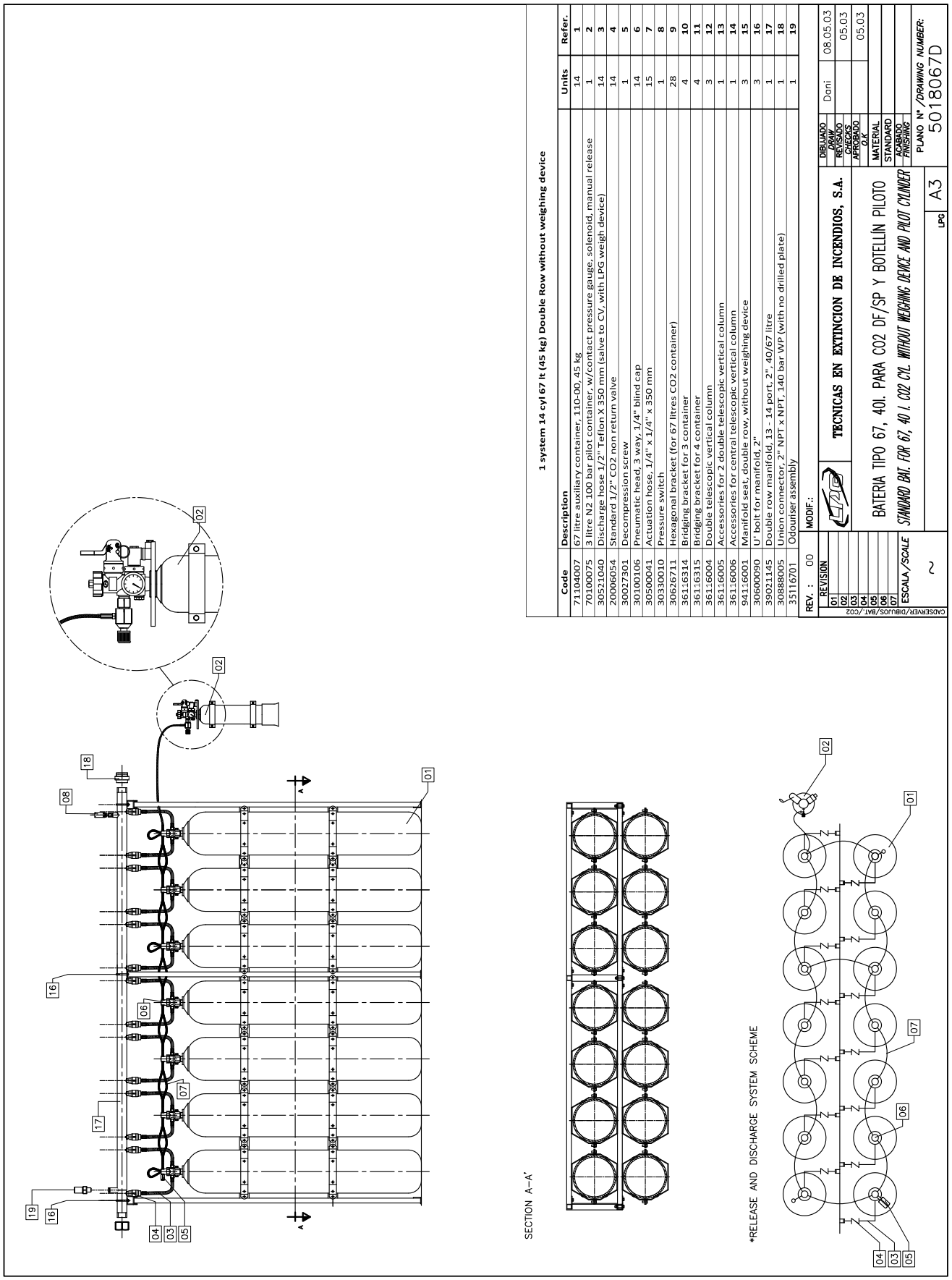
TYPICAL INSTALLATIONS (Continued)



TYPICAL INSTALLATIONS (Continued)



TYPICAL INSTALLATIONS (Continued)



CO_2 FIRE SUPPRESSANT AGENT MATERIAL SAFETY DATA SHEET (MSDS)

The MSDS document in this section is a sample reference only. Technically, MSDS information is country and language specific. Refer to the link below for the most recent and applicable version:

www.FireProductsds.com

Note: To find the MSDS, enter the part number of a product containing agent.

(FOR REFERENCE ONLY)

Safety Data Sheet

This safety data sheet complies with the requirements of: Regulation (EC) No. 1907/2006

Product name Carbon Dioxide

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product Identifier

Product code
Product name Carbon Dioxide

1.2. Relevant identified uses of the substance or mixture and uses advised against

Recommended use No information available

Uses advised against No information available

1.3. Details of the supplier of the safety data sheet

Company Name Tyco Fire Suppression & Building Products
1 Kopersteden
TJ Enschede, Netherlands
Telephone: 3153-428-4444

For further information, please contact

psra@tycofp.com

1.4. Emergency telephone number

CHEMTREC 800-424-9300 or 703-527-3887

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture
Regulation (EC) No 1272/2008
Gases Under Pressure - Compressed Gas - (H280)

2.2. Label Elements



Signal Word
WARNING

Hazard Statements
H280 - Contains gas under pressure; may explode if heated
EUH210 - Safety data sheet available on request

Precautionary Statements
P410 + P403 - Protect from sunlight. Store in a well-ventilated place

2.3. Other Hazards
The components in this formulation do not meet the criteria for classification as PBT or vPvB.

(FOR REFERENCE ONLY)

SECTION 3: Composition/information on ingredients

3.1 Substances

Not Applicable

3.2 Mixture

Chemical name	Index No	EC No	CAS No	weight-%	Classification according to Regulation (EC) No. 1272/2008 [CLP]	REACH registration number
Carbon Dioxide		204-696-9	124-38-9	90 - 100%	Not classified	no data available

Full text of H- and EUH-phrases: see section 16

SECTION 4: First aid measures

4.1. Description of first aid measures

Inhalation Remove to fresh air. If breathing is difficult, give oxygen. (Get medical attention immediately if symptoms occur.).

Skin contact Wash skin with soap and water. Get medical attention if irritation develops and persists.

Eye Contact Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a doctor.

Ingestion Rinse mouth. Do not induce vomiting without medical advice. If swallowed, call a poison control centre or physician immediately.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms Unconsciousness.

4.3. Indication of any immediate medical attention and special treatment needed

Note to doctors Treat symptomatically.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable Extinguishing Media
Product is extinguishing agent. Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable Extinguishing Media
None

5.2. Special hazards arising from the substance or mixture

None known.

(FOR REFERENCE ONLY)

Hazardous Combustion Products	Carbon oxides.

5.3. Advice for firefighters

Wear self-contained breathing apparatus and protective suit. Use personal protective equipment as required.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Ensure adequate ventilation, especially in confined areas.

Use personal protection recommended in Section 8.

6.2. Environmental precautions

Prevent further leakage or spillage if safe to do so. Prevent entry into waterways, sewers, basements or confined areas. See Section 12 for additional Ecological Information.

6.3. Methods and material for containment and cleaning up

Methods for Containment	Prevent further leakage or spillage if safe to do so.
Methods for Cleaning Up	Pick up and transfer to properly labelled containers.

6.4. Reference to other sections

See section 8 for more information. See section 13 for more information.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Advice on safe handling
Avoid contact with skin and eyes. Handle in accordance with good industrial hygiene and safety practice.

General hygiene considerations
Do not eat, drink or smoke when using this product. Handle in accordance with good industrial hygiene and safety practice.

7.2. Conditions for safe storage, including any incompatibilities

Storage Conditions
Keep containers tightly closed in a dry, cool and well-ventilated place.

7.3. Specific end use(s)

Specific Use(s)
Fire extinguishing agent.

Risk Management Methods (RMM)
The information required is contained in this Safety Data Sheet.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Exposure Limits

(FOR REFERENCE ONLY)

Chemical name	European Union	United Kingdom	France	Spain	Germany
Carbon Dioxide 124-38-9	TWA: 5000 ppm TWA: 9000 mg/m³	STEL: 15000 ppm STEL: 27400 mg/m³ TWA: 5000 ppm TWA: 9150 mg/m³	TWA: 5000 ppm TWA: 9000 mg/m³	TWA: 5000 ppm TWA: 9150 mg/m³	TWA: 5000 ppm TWA: 9100 mg/m³ Ceiling / Peak: 10000 ppm Ceiling / Peak: 18200 mg/m³
Chemical name	**Italy**	**Portugal**	**Netherlands**	**Finland**	**Denmark**
Carbon Dioxide 124-38-9	TWA: 5000 ppm TWA: 9000 mg/m³	STEL: 30000 ppm TWA: 5000 ppm TWA: 9000 mg/m³	TWA: 9000 mg/m³	TWA: 5000 ppm TWA: 9100 mg/m³	TWA: 5000 ppm TWA: 9000 mg/m³
Chemical name	**Austria**	**Switzerland**	**Poland**	**Norway**	**Ireland**
Carbon Dioxide 124-38-9	STEL 10000 ppm STEL 18000 mg/m³ TWA: 5000 ppm TWA: 9000 mg/m³	TWA: 5000 ppm TWA: 9000 mg/m³	STEL: 27000 mg/m³ TWA: 9000 mg/m³	TWA: 5000 ppm TWA: 9000 mg/m³	TWA: 5000 ppm TWA: 9000 mg/m³ STEL: 15000 ppm STEL: 27000 mg/m³

Derived No Effect Level (DNEL) No information available.

Predicted No Effect Concentration (PNEC) No information available.

8.2. Exposure controls

Engineering controls Ensure adequate ventilation, especially in confined areas.

Personal Protective Equipment

Eye/Face Protection Avoid contact with eyes. Tight sealing safety goggles.

Skin and Body Protection Suitable protective clothing.

Environmental exposure controls No information available.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical State Compressed Gas

Odour None **Colour** Colourless

Odour Threshold No data available

Property	Values	Remarks • Method
pH		No data available
Melting point/freezing point		No data available
Boiling point / boiling range	-1.4 °C	No data available
Flash Point		No data available
Evaporation Rate		No data available
Flammability (solid, gas)		No data available
Flammability limit in air		
Upper flammability limit:		No data available
Lower flammability limit:		No data available
Vapour Pressure		No data available
Vapour Density		No data available
Specific gravity		No data available
Water Solubility		No data available
solubility(ies)		No data available
Partition coefficient		No data available
Autoignition Temperature		No data available

(FOR REFERENCE ONLY)

Decomposition Temperature		No data available
Kinematic viscosity		No data available
Dynamic viscosity		No data available
Explosive Properties	No data available	
Oxidising Properties	No data available	

SECTION 10: Stability and reactivity

10.1. Reactivity

No data available.

10.2. Chemical stability

Stable under recommended storage conditions.

10.3. Possibility of hazardous reactions

None under normal processing.

Hazardous Polymerisation
Hazardous polymerisation does not occur.

10.4. Conditions to avoid

Extremes of temperature and direct sunlight.

10.5. Incompatible materials

Strong oxidising agents. Strong acids. Strong bases.

10.6. Hazardous decomposition products

Carbon oxides.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute Toxicity

Product information
Product does not present an acute toxicity hazard based on known or supplied information.

Inhalation	In high concentration the gas may cause a suffocation. Victim may not be aware of asphyxiation. In confined or poorly ventilated areas, vapours can readily accumulate and can cause unconsciousness and death.
Eye Contact	None known.
Skin contact	None known.
Ingestion	Not an expected route of exposure.

Unknown Acute Toxicity
100% of the mixture consists of ingredient(s) of unknown toxicity.

Skin Corrosion/Irritation	No information available.
Serious eye damage/eye irritation	No information available.
Sensitisation	No information available.

(FOR REFERENCE ONLY)

Germ Cell Mutagenicity	No information available.
Carcinogenicity	No information available.
Reproductive Toxicity	Lack of oxygen during pregnancy has produced developmental abnormalities in humans and experimental animals.
STOT - Single Exposure	No information available.
STOT - Repeated Exposure	No information available.
Symptoms	Unconsciousness.
Aspiration Hazard	No information available.

SECTION 12: Ecological information

12.1. Toxicity

12.2. Persistence and degradability

No information available.

12.3. Bioaccumulative potential

No information available.

12.4. Mobility in soil

No information available.

12.5. Results of PBT and vPvB assessment

The components in this formulation do not meet the criteria for classification as PBT or vPvB.

12.6. Other adverse effects

No information available

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste from Residues/Unused Products	Disposal should be in accordance with applicable regional, national and local laws and regulations.
Contaminated Packaging	Do not re-use container.

SECTION 14: Transport information

IMDG

14.1 UN/ID no	UN1013

(FOR REFERENCE ONLY)

14.2 Proper Shipping Name	Carbon dioxide
14.3 Hazard class	2.2
14.4 Packing group	NOT REGULATED
Description	UN1013, Carbon dioxide, 2.2
14.5 Marine Pollutant	Not Applicable
14.6 Special Provisions	None
EmS-No	F-C, S-V
14.7 Transport in Bulk According to Annex II of MARPOL 73/78 and the IBC CODE	No information available

RID

14.1 UN/ID no	UN1013
14.2 Proper Shipping Name	Carbon dioxide
14.3 Hazard class	2.2
Labels	2.2 (+13)
14.4 Packing group	NOT REGULATED
Description	UN1013, Carbon dioxide, 2.2 (13)
14.5 Environmental Hazard	Not Applicable
Classification Code	2A
14.6 Special Provisions	None

ADR

14.1 UN/ID no	UN1013
14.2 Proper Shipping Name	Carbon dioxide
14.3 Hazard class	2.2
Labels	2.2
14.4 Packing group	NOT REGULATED
Description	UN1013, Carbon dioxide, 2.2, (C/E)
14.5 Environmental Hazard	Not Applicable
14.6 Special Provisions	None
Classification Code	2A
Tunnel restriction code	(C/E)

ICAO (air)

14.1 UN/ID no	UN1013
14.2 Proper Shipping Name	Carbon dioxide
14.3 Hazard class	2.2
14.4 Packing group	NOT REGULATED
Description	UN1013, Carbon dioxide, 2.2
14.5 Environmental Hazard	Not Applicable
14.6 Special Provisions	None

IATA

14.1 UN/ID no	UN1013
14.2 Proper Shipping Name	Carbon dioxide
14.3 Hazard class	2.2
14.4 Packing group	NOT REGULATED
Description	UN1013, Carbon dioxide, 2.2
14.5 Environmental Hazard	Not Applicable
14.6 Special Provisions	None
ERG Code	2L

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

(FOR REFERENCE ONLY)

Germany
Water hazard class (WGK) Not defined

European Union

Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work

Authorisations and/or restrictions on use:
This product does not contain substances subject to authorisation (Regulation (EC) No. 1907/2006 (REACH), Annex XIV) This product does not contain substances subject to restriction (Regulation (EC) No. 1907/2006 (REACH), Annex XVII)

Persistent Organic Pollutants
Not Applicable

Ozone-depleting substances (ODS) regulation (EC) 1005/2009 Not Applicable

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Complies
ENCS	Complies
IECSC	Complies
KECL	Complies
PICCS	Complies
AICS	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances

15.2. Chemical safety assessment

Chemical safety assessments for substances in this mixture were not carried out.

SECTION 16: Other information

Key or legend to abbreviations and acronyms used in the safety data sheet

Legend
SVHC: Substances of Very High Concern for Authorisation:

Legend SECTION 8: Exposure controls/personal protection

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation

Revision date 26-Jan-2017

Revision note Not Applicable.

(FOR REFERENCE ONLY)

This material safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

End of Safety Data Sheet

CO_2
ODOURISER ASSEMBLY (PART NO. 35116701)
MATERIAL SAFETY DATA SHEET
(MSDS)

The MSDS document in this section is a sample reference only. Technically, MSDS information is country and language specific. Refer to the link below for the most recent and applicable version:

www.FireProductsds.com

Note: To find the MSDS, enter the part number of a product containing agent.

(FOR REFERENCE ONLY)

Safety Data Sheet

This safety data sheet complies with the requirements of: Regulation (EC) No. 1907/2006

Product name Odouriser (Citronella), 1/2" BSPT

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product Identifier

Product code	35116701
Product name	Odouriser (Citronella), 1/2" BSPT
Pure substance/mixture	Mixture

1.2. Relevant identified uses of the substance or mixture and uses advised against

Recommended use	No information available
Uses advised against	No information available

1.3. Details of the supplier of the safety data sheet

Company Name
Macron Safety Systems (UK) Ltd.
Burlingham House, Hewett Road
Gapton Hall Industrial Estate, Great Yarmouth
United Kingdom NR31 0NN
Telephone: +44 (0) 1493 417600

For further information, please contact

psra@tycofp.com

1.4. Emergency telephone number

CHEMTREC 001-800-424-9300 or 001-703-527-3887

National Poisons Information Centre (NPIC)
+353-1809 2566

SECTION 2: Hazards identification

(FOR REFERENCE ONLY)

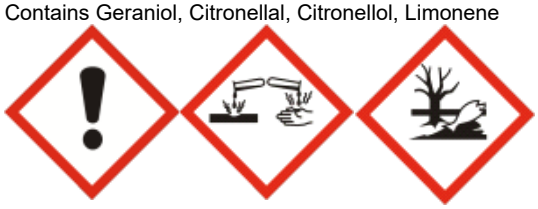
2.1. Classification of the substance or mixture

Regulation (EC) No 1272/2008

Skin Corrosion/Irritation - Category 2 - (H315)
Serious eye damage/eye irritation - Category 1 - (H318)
Skin Sensitisation - Category 1 - (H317)
Chronic Aquatic Toxicity - Category 2 - (H411)

2.2. Label Elements

Contains Geraniol, Citronellal, Citronellol, Limonene



Signal Word
DANGER

Hazard Statements
H315 - Causes skin irritation
H317 - May cause an allergic skin reaction
H318 - Causes serious eye damage
H411 - Toxic to aquatic life with long lasting effects
EUH208 - May produce an allergic reaction
Contains Farnesol, Geranial

Precautionary Statements
P264 - Wash face, hands and any exposed skin thoroughly after handling
P332 + P313 - If skin irritation occurs: Get medical advice/attention
P362 - Take off contaminated clothing and wash before re-use
P280 - Wear eye protection/ face protection
P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P310 - Immediately call a POISON CENTRE or doctor/physician
P261 - Avoid breathing dust/fume/gas/mist/vapours/spray
P272 - Contaminated work clothing should not be allowed out of the workplace
P280 - Wear protective gloves
P302 + P352 - IF ON SKIN: Wash with plenty of soap and water
P333 + P313 - If skin irritation or rash occurs: Get medical advice/attention
P321 - Specific treatment (see supplemental first aid instructions on this label)
P363 - Wash contaminated clothing before re-use
P273 - Avoid release to the environment
P391 - Collect spillage
P501 - Dispose of contents/ container to an approved waste disposal plant

2.3. Other Hazards

May be harmful in contact with skin. Toxic to aquatic life.

The components in this formulation do not meet the criteria for classification as PBT or vPvB.

SECTION 3: Composition/information on ingredients

3.1 Substances

Not Applicable

(FOR REFERENCE ONLY)

3.2 Mixture

Chemical name	Index No	EC No	CAS No	weight-%	Classification according to Regulation (EC) No. 1272/2008 [CLP]	REACH registration number
Citronellal		203-376-6	106-23-0	40 - 50%	Skin Irrit. 2 (H315) Skin Sens. 1 (H317) Aquatic Chronic 2 (H411)	no data available
Citronellol		203-375-0	106-22-9	20 - 30%	Skin Irrit. 2 (H315) Eye Irrit. 2A (H319) Skin Sens. 1 (H317)	no data available
Geraniol		203-377-1	106-24-1	10 - 20%	Skin Irrit. 2 (H315) Eye Dam. 1 (H318) Skin Sens. 1 (H317)	no data available
Limonene		227-813-5	5989-27-5	0 - 10%	Skin Irrit. 2 (H315) Skin Sens. 1 (H317) Aquatic Acute 1 (H400) Aquatic Chronic 1 (H410) Flam. Liq. 3 (H226)	no data available
Geranyl Acetate		203-341-5	105-87-3	0 - 10%	Aquatic Chronic 2 (H411)	no data available
Eugenol		202-589-1	97-53-0	0 - 10%	Skin Irrit. 2 (H315) Eye Irrit. 2A (H319) Skin Sens. 1 (H317)	no data available
Citronellyl Acetate		205-775-0	150-84-5	0 - 10%	Skin Irrit. 2 (H315) Aquatic Chronic 2 (H411)	no data available
Farnesol		225-004-1	4602-84-0	0 - 10%	Skin Irrit. 2 (H315) Eye Irrit. 2A (H319) Skin Sens. 1 (H317)	no data available
Geranial		205-476-5	141-27-5	0 - 10%	Skin Irrit. 2 (H315) Skin Sens. 1 (H317)	no data available

Full text of H- and EUH-phrases: see section 16

SECTION 4: First aid measures

4.1. Description of first aid measures

General Advice Call 911 or emergency medical service. Remove and isolate contaminated clothing and shoes.

Inhalation Remove to fresh air. If symptoms persist, call a doctor.

Skin contact Wash off immediately with plenty of water for at least 15 minutes. If skin irritation persists, call a doctor. Wash off immediately with soap and plenty of water.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. If

(FOR REFERENCE ONLY)

symptoms persist, call a doctor.

Ingestion Do NOT induce vomiting. Drink plenty of water. Immediate medical attention is not required. Rinse mouth.

Self-Protection of the First Aider Use personal protective equipment as required.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms Prolonged skin contact may defat the skin and produce dermatitis.

4.3. Indication of any immediate medical attention and special treatment needed

Note to doctors May cause sensitisation of susceptible persons.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable Extinguishing Media
Dry chemical, CO2, water spray or regular foam. Water spray, fog or regular foam. Move containers from fire area if you can do it without risk. Dyke fire-control water for later disposal.

Unsuitable Extinguishing Media
Do not scatter spilled material with high pressure water streams

5.2. Special hazards arising from the substance or mixture

Some may burn but none ignite readily. Those substances designated with a "P" may polymerise explosively when heated or involved in a fire. Some may be transported hot. In the event of fire and/or explosion do not breathe fumes. May cause sensitisation by inhalation and skin contact. Thermal decomposition can lead to release of irritating and toxic gases and vapours.

5.3. Advice for firefighters

Wear self-contained breathing apparatus and protective suit. Use personal protective equipment as required.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

Use personal protective equipment as required. Avoid contact with eyes and skin.

Use personal protection recommended in Section 8.

6.2. Environmental precautions

Prevent entry into waterways, sewers, basements or confined areas. Do not flush into surface water or sanitary sewer system. See Section 12 for additional Ecological Information.

6.3. Methods and material for containment and cleaning up

Methods for Containment Prevent further leakage or spillage if safe to do so.

Methods for Cleaning Up Soak up with inert absorbent material. Pick up and transfer to properly labelled containers. After cleaning, flush away traces with water. Prevent product from entering drains.

6.4. Reference to other sections

(FOR REFERENCE ONLY)

See section 8 for more information. See section 13 for more information.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Advice on safe handling
Use personal protective equipment as required. Ensure adequate ventilation, especially in confined areas.

General hygiene considerations
When using do not eat, drink or smoke. Wash contaminated clothing before re-use.

7.2. Conditions for safe storage, including any incompatibilities

Storage Conditions
Keep out of the reach of children. Keep container tightly closed. Keep containers tightly closed in a cool, well-ventilated place.

7.3. Specific end use(s)

Specific Use(s)
No information available.

Risk Management Methods (RMM)
The information required is contained in this Safety Data Sheet.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Exposure Limits

Chemical name	European Union	United Kingdom	France	Spain	Germany
Limonene 5989-27-5	-	-	TWA: 1000 mg/m³ STEL: 1500 mg/m³	S* TWA: 30 ppm TWA: 168 mg/m³	TWA: 5 ppm TWA: 28 mg/m³ Ceiling / Peak: 20 ppm Ceiling / Peak: 112 mg/m³ Skin
Chemical name	**Italy**	**Portugal**	**Netherlands**	**Finland**	**Denmark**
Limonene 5989-27-5	-	-	-	TWA: 25 ppm TWA: 140 mg/m³ STEL: 50 ppm STEL: 280 mg/m³	-
Chemical name	**Austria**	**Switzerland**	**Poland**	**Norway**	**Ireland**
Limonene 5989-27-5		STEL: 14 ppm STEL: 80 mg/m³ TWA: 7 ppm TWA: 40 mg/m³		TWA: 25 ppm TWA: 140 mg/m³ STEL: 37.5 ppm STEL: 175 mg/m³	

Derived No Effect Level (DNEL) No information available.

Predicted No Effect Concentration (PNEC) No information available.

8.2. Exposure controls

(FOR REFERENCE ONLY)

Product code 35116701 / **Product name** Odouriser (Citronella), 1/2" BSPT / **PAGE** 6 / 11

Engineering controls	Ensure adequate ventilation, especially in confined areas.
Personal Protective Equipment	
Eye/Face Protection	Avoid contact with eyes. Tight sealing safety goggles. DIN EN 166.
Hand protection	Wear protective natural rubber, nitrile rubber, Neoprene™ or PVC gloves. Gloves must conform to standard EN 374.
Skin and Body Protection	Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Respiratory Protection	In case of insufficient ventilation, wear suitable respiratory equipment. Wear a respirator conforming to EN 140 with Type A filter or better.
Environmental exposure controls	Do not allow into any sewer, on the ground or into any body of water.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical State	Liquid		
Odour	Characteristic	**Colour**	Light yellow
Odour Threshold	No data available		

Property	**Values**	**Remarks • Method**
pH		No data available
Melting Point / Freezing Point		No data available
Boiling point / boiling range		No data available
Flash Point		No data available
Evaporation Rate		No data available
Flammability (solid, gas)		No data available
Flammability limit in air		
Upper flammability limit:		No data available
Lower flammability limit:		No data available
Vapour Pressure		No data available
Vapour Density		No data available
Specific gravity		No data available
Water Solubility		No data available
solubility(ies)		No data available
Partition coefficient		No data available
Autoignition Temperature		No data available
Decomposition Temperature		No data available
Kinematic viscosity		No data available
Dynamic viscosity		No data available
Explosive Properties	No data available	
Oxidising Properties	No data available	
VOC content (%)	7.5	

SECTION 10: Stability and reactivity

10.1. Reactivity

No data available.

10.2. Chemical stability

Stable under normal conditions.

(FOR REFERENCE ONLY)

10.3. Possibility of hazardous reactions

None under normal processing.

10.4. Conditions to avoid

None known.

10.5. Incompatible materials

Strong oxidising agents. Strong acids. Strong bases.

10.6. Hazardous decomposition products

None under normal use conditions.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute Toxicity

Inhalation No data available.
Eye Contact Corrosive to the eyes and may cause severe damage including blindness.
Skin contact Irritating to skin.
Ingestion No data available.

The following values are calculated based on chapter 3.1 of the GHS document
ATEmix (dermal) 3,219.00 mg/kg

Component Information

Chemical name	Oral LD50	Dermal LD50	Inhalation LC50
Limonene	= 5200 mg/kg (Rat) = 4400 mg/kg (Rat)	> 5 g/kg (Rabbit)	

Skin Corrosion/Irritation Severe skin irritation.
Serious eye damage/eye irritation Risk of serious damage to eyes.
Sensitisation May cause sensitisation by skin contact.
Germ Cell Mutagenicity No information available.
Carcinogenicity No information available.

Reproductive Toxicity No information available.
STOT - Single Exposure No information available.
STOT - Repeated Exposure No information available.
Aspiration Hazard No information available.

SECTION 12: Ecological information

12.1. Toxicity

Toxic to aquatic life. Toxic to aquatic life with long lasting effects.

Chemical name	Algae/aquatic plants	Fish	Crustacea
Limonene	-	LC50 (96h) flow-through 0.619 -	-

(FOR REFERENCE ONLY)

		0.796 mg/L Pimephales promelas LC50 (96h) = 35 mg/L Oncorhynchus mykiss	

12.2. Persistence and degradability

No information available.

12.3. Bioaccumulative potential

No information available.

12.4. Mobility in soil

No information available.

12.5. Results of PBT and vPvB assessment

The components in this formulation do not meet the criteria for classification as PBT or vPvB.

12.6. Other adverse effects

No information available

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste from Residues/Unused Products	Disposal should be in accordance with applicable regional, national and local laws and regulations.
Contaminated Packaging	Improper disposal or reuse of this container may be dangerous and illegal.
OTHER INFORMATION	Waste codes should be assigned by the user based on the application for which the product was used.

SECTION 14: Transport information

IMDG

14.1 UN/ID no	UN3082
14.2 Proper Shipping Name	Other regulated substances, liquid, n.o.s. (Limonene)
14.3 Hazard class	9
14.4 Packing group	III
Description	UN3082, Other regulated substances, liquid, n.o.s. (Limonene), 9, III
14.5 Environmental Hazard	yes
14.6 Special Provisions	None
EmS-No	F-A, S-F
14.7 Transport in Bulk According to Annex II of MARPOL 73/78 and the IBC CODE	No information available

(FOR REFERENCE ONLY)

RID

14.1 UN/ID no	UN3082
14.2	
Proper Shipping Name	Other regulated substances, liquid, n.o.s. (Limonene)
14.3 Hazard class	9
14.4 Packing group	III
Description	UN3082, Other regulated substances, liquid, n.o.s. (Limonene), 9, III
14.5 Environmental Hazard	yes
Classification Code	M6
14.6 Special Provisions	None

ADR

14.1 UN/ID no	UN3082
14.2	
Proper Shipping Name	Other regulated substances, liquid, n.o.s. (Limonene)
14.3 Hazard class	9
Labels	9
14.4 Packing group	III
Description	UN3082, Other regulated substances, liquid, n.o.s. (Limonene), 9, III, (E)
14.5 Environmental Hazard	yes
14.6 Special Provisions	None
Classification Code	M6
Tunnel restriction code	(E)

ICAO (air)

14.1 UN/ID no	UN3082
14.2	
Proper Shipping Name	Other regulated substances, liquid, n.o.s. (Limonene)
14.3 Hazard class	9
14.4 Packing group	III
Description	UN3082, Other regulated substances, liquid, n.o.s. (Limonene), 9, III
14.5 Environmental Hazard	yes
14.6 Special Provisions	None

IATA

14.1 UN/ID no	UN3082
14.2	
Proper Shipping Name	Other regulated substances, liquid, n.o.s. (Limonene)
14.3 Hazard class	9
14.4 Packing group	III
Description	UN3082, Other regulated substances, liquid, n.o.s. (Limonene), 9, III
14.5 Environmental Hazard	yes
14.6 Special Provisions	None
ERG Code	9L

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

Chemical name	French RG number	Title
Limonene 5989-27-5	RG 84	-

Germany

Water hazard class (WGK)	Hazardous to water (WGK 2)

(FOR REFERENCE ONLY)

European Union

Take note of Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work

Authorisations and/or restrictions on use:
This product does not contain substances subject to authorisation (Regulation (EC) No. 1907/2006 (REACH), Annex XIV) This product does not contain substances subject to restriction (Regulation (EC) No. 1907/2006 (REACH), Annex XVII)

Persistent Organic Pollutants
Not Applicable

Ozone-depleting substances (ODS) regulation (EC) 1005/2009 Not Applicable

International Inventories

TSCA	Complies
DSL/NDSL	Complies
ENCS	Complies
IECSC	Complies
KECL	Does not comply
PICCS	Complies
AICS	Complies

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances

15.2. Chemical safety assessment

Chemical safety assessments for substances in this mixture were not carried out.

SECTION 16: Other information

Key or legend to abbreviations and acronyms used in the safety data sheet

Full text of H-Statements referred to under section 3
H411 - Toxic to aquatic life with long lasting effects
H315 - Causes skin irritation
H319 - Causes serious eye irritation
H317 - May cause an allergic skin reaction
H318 - Causes serious eye damage
H400 - Very toxic to aquatic life
H410 - Very toxic to aquatic life with long lasting effects
H226 - Flammable liquid and vapour

Legend
SVHC: Substances of Very High Concern for Authorisation:

(FOR REFERENCE ONLY)

Legend SECTION 8: Exposure controls/personal protection

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation

Revision date 07-Aug-2019

Revision note Not Applicable.

This material safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer
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End of Safety Data Sheet

COMMISSIONING TOOLS LIST

During the commissioning of CO_2 fire suppression systems, commissioning personnel may require some tools and other items to complete the relevant activities. Use the tools listed in Table 8-1 when performing commissioning activities.

TABLE 8-1: COMMISSIONING TOOLS LIST

Part No. (if applicable)	Description	Quantity	Notes and activities
-	Screwdriver set	1 complete set	Testing of the discharge pressure switch
-	Spanner / wrench / socket set	1 complete set	Installation and removal of components
-	Nitrogen container and regulator (minimum 10 bar for function testing) (minimum 100 bar for integrity testing)	1	Testing of the pneumatic actuation line and for pipework purging
-	Leak detection spray	To suit system design	Testing of the pneumatic actuation line
-	PTFE TEFLON tape	To suit system design	For manifold installation
35017401	C Spanner Dia 35 mm - 60 mm, Pin Dia 4 mm	2	For specific component installation and removal
35017402	C Spanner Dia 60 mm - 90 mm, Pin Dia 5 mm	2	For specific component installation and removal
35017403	C Spanner Dia 90 mm - 155 mm, Pin Dia 6 mm	2	For specific component installation and removal
35017404	C Spanner Dia 165 mm - 230 mm, Pin Dia 10 mm	2	For specific component installation and removal
-	Pipe sealing compound	To suit number of nozzles	For discharge nozzle installation
-	Nozzle bags	1 per discharge nozzle	To collect oil, swarf, and debris from the purging process
-	Torque wrench	2	To refit top caps (CO_2 valves and pilot valve)
	Allen key set	1 complete set	For selector valve resetting and neck-ring adjustment
	Pliers	2	To aid actuation hose installation
-	Thermometer	1	For correct pressure reading
-	Tape measure	1	Check that the protected area dimensions match the calculations and to ensure the correct position of the pipework and nozzles
-	Paint brush and touch-up paint (black – RAL 9005)	1	Touch up pipework if required
-	System drawings	-	Used to check the installation is correct and to drawing

SPARE PARTS

During installation and commissioning, some components may be lost, dropped, or damaged. Depending on the system size and design, installation and commissioning personnel shall keep some of the components listed in Table 8-2 available as spares to avoid any delays to the installation and commissioning phases.

TABLE 8-2: SPARE PARTS

Part No.	Description
30500041	Actuation hose, 1/4 in. x 1/4 in. x 350 mm
30522001	Actuation hose, 1/4 in. x 1/4 in. x 700 mm
3023024B	Solenoid (master container and pilot container)
30100106	Pneumatic actuator, 3 way, 1/4 in. blind cap
30100102	Pneumatic actuator, 2 way
91104001	CO_2 Master container diverter
20006054	1/2 in. CO_2 check valve
302.200.075	1/4 in. Bleed valve
30027301	Decompression screw
200CD190	Manifold burst disc
22000502	O-ring for 100 bar Nitrogen pilot container pressure gauge
31199816	1/4 in. Dowty seal
95108015	1/2 in. Dowty seal
2002066B	100 bar Nitrogen 128-90 valve, replacement top cap

COMMISSIONING SCHEDULE (EXAMPLE)

Client:	
Commissioned by:	
Address:	
Date:	
Project:	
Project reference:	
Address:	
Protected area:	

General instructions			
Step		**Complete**	**Notes**
1	Advise all personnel working in or near the protected area of audible or visual alarms.		
2	Advise the client of any equipment to be switched off during the tests.		
3	Remeasure the protected area and confirm that the quantity of agent supplied is adequate for the measured volume.		
4	Check that the system is installed in accordance with the drawings or note any changes to the system against the drawings.		
5	Before carrying out any further checks, ensure the suppression system is isolated electrically and mechanically. Remove all pneumatic actuators, if fitted.		

Electrical checklist - Systems with main and reserve containers			
1	Carry out the checks described on pages 8-29 to 8-30 with the changeover switch in the **main** position.		
2	Repeat these checks with the changeover switch in the **reserve** position.		

Electrical checklist - Systems with automatic electrical detection (coincidence operation)			
1	Place the system in automatic mode and check lamps are amber on control panel and all status units.		
2	Operate one detection zone.		
3	Check that the fire alarm sounds.		
4	Check that the suppressant release solenoid does not operate.		
5	Switch the system to manual mode and check that the lamps are green on the control panel and all status/indicator units.		
6	Operate the second detection zone.		
7	Check suppressant release solenoid does not operate.		
8	Switch the system to automatic mode with two detection zones still in alarm.		
9	Check that the evacuation alarm sounds.		
10	Check the A/C shutdowns.		
11	Check that the suppressant release solenoid operates after preset time delay.		
12	Check the operation of the ‘suppressant released’ pressure switch. Upon operation, check that red lamps are lit on the control panel and all status units.		
13	Reset the pressure switch and then reset the fire alarm system.		
14	Check the operation of each electrical manual release unit in turn.		
15	Check the fire alarm and evacuation alarm sounds.		
16	Check that the suppressant release solenoid operates after preset time delay.		
17	Reset the system. Ensure the appropriate washers are refitted to the manual release units.		

COMMISSIONING SCHEDULE (Continued)			
Step		**Complete**	**Notes**
18	If the system is in compliance with *CEN regulations (UK/EEC)*, fire detection components shall be approved in accordance with the relevant part of *EN 54* or *EN 12094*.		
19	If the system is in compliance with *CEN regulations (UK/EEC),* manual operating devices shall be approved in accordance with *EN 12094-3*.		
20	If the system is in compliance with *CEN regulations (UK/EEC)*, electrical automatic control and delay devices shall be approved in accordance with *EN 12094-1*.		

Electrical checklist - Systems with automatic electrical detection (single zone operation)			
Step		**Complete**	**Notes**
1	Place the system in manual mode and check that lamps are green on the control panel and all status units.		
2	Operate the detection system.		
3	Check that the fire alarm sounds.		
4	Check that the suppressant release solenoid does not operate.		
5	Switch the system to automatic mode with the detection system still in alarm and the check lamps are amber on the control panel and all status units.		
6	Check the evacuation alarm sounds.		
7	Check the A/C shutdowns.		
8	Check that the suppressant release solenoid operates after the preset time delay.		
9	Check the operation of the ‘suppressant released’ pressure switch. Upon operation, check that the red lamps are lit on the control panel and all status / indicator units.		
10	Reset the pressure switch and then reset the fire alarm system.		
11	Check the operation of each electrical manual release unit in turn.		
12	Check that the fire alarm and evacuation alarm sound.		
13	Check that the suppressant release solenoid operates after the preset time delay.		
14	Reset the system.		

Electrical checklist - Systems with electrical manual release only			
Step		**Complete**	**Notes**
1	Operate each electrical manual release unit in turn.		
2	Check fire alarm and evacuation alarm sounds.		
3	Check all A/C shutdowns.		
4	Check that the suppressant release solenoid operates after the preset time delay.		
5	Check the operation of the ‘suppressant released’ pressure switch. Upon operation, check that the red lamps are lit on the control panel, if applicable, and on all status / indicator units.		
6	Reset the pressure switch and then reset the fire alarm system. Ensure appropriate washers are refitted to the manual release units.		

COMMISSIONING SCHEDULE (Continued)

Electrical checklist - Systems with hold switches			
Step		**Complete**	**Notes**
1	With the system is in an inactive state, depress the hold switch. Check that a system fault generates.		
2	Initiate the suppressant release sequence and during the delay period, depress the hold switch. Check that the release sequence is interrupted and the solenoid does not operate.		
3	Release the hold switch and check that the preset time delay restarts from zero and after the preset time delay solenoid operates.		
4	If the system is in compliance with *CEN regulations (UK/EEC),* electrical automatic control and delay devices shall be approved in accordance with *EN 12094-1*.		

Electrical checklist - Systems with abort switches			
Step		**Complete**	**Notes**
1	With system is in an inactive state, depress the abort switch. Check that a system fault generates.		
2	With the system in automatic mode, initiate the suppressant release sequence and during the delay period, depress the abort switch. Check that the release sequence is interrupted and the solenoid does not operate.		
3	Check that the system status reverts to manual mode after the operation of the abort switch.		
4	If the system is in compliance with *CEN regulations (UK/EEC),* stop devices shall be approved in accordance with *EN 12094-3*.		

Other items			
Step		**Complete**	**Notes**
1	Detach the solenoid flexible lead and check that the system fault is generated.		
2	Check that the adequate and appropriate visual and audible warning devices are incorporated into the system.		
3	Record the time delay. This should not normally exceed 30 seconds but must be adequate for safe exiting from the protected area.		
4	Confirm that all A/C systems link into the suppression system to shutdown prior to or upon release of gas and these have been checked.		

COMMISSIONING SCHEDULE (Continued)

Mechanical checklist - Pipework and nozzles			
Step		**Complete**	**Notes**
1	Check that pipes and fittings are to the correct standard.		
2	Check that pipework supports have been fitted at the correct intervals and are adequate for purpose.		
3	Check that all nozzles are fitted in accordance with the design requirements and are aimed in the correct alignment away from obstructions or barriers that could prevent adequate distribution or mixing of the gas.		
4	Check that all pipes and nozzles are adequately braced against the reaction to discharge.		
5	Check that the pipework has been painted and is properly identified.		
6	Purge the pipework to confirm it is continuous and free from debris.		
7	Remove the nozzles to check they are free of debris following the purge.		
8	Conduct a pressure test of the pipework in accordance with the requirements of the applicable design standard.		
9	Steps 6 to 8 may be omitted from the commissioning procedure if written evidence is available that the pipework was purged and pressure tested at an appropriate stage during installation.		
10	Check that dust caps are fitted, if required.		
11	If the nozzle drill size is 3 mm or less, ensure that the nozzle filter is included for non-VdS approved systems only.		
12	Check that dirt traps have been installed, where required.		

Mechanical checklist - Containers			
Step		**Complete**	**Notes**
1	Check that the containers are safe from mechanical damage, corrosion, or unauthorised interference.		
2	Check that the container brackets are fitted and all bolts are tightened.		
3	Check that all containers are fitted with instruction plates properly completed.		

Record CO_2 container details here:					
Area protected	**Containers**		**Weight (kg)**	**Temp (°C)**	**Corrections required (Yes / No)**
	Size (L)	**Serial number**			

COMMISSIONING SCHEDULE (Continued)

Record pilot container details here:

Area Protected	Containers		Pilot Gas	Pressure (bar)	Temp (°C)	Corrections Required (Yes / No)
	Size (L)	Serial number				

Ancillary equipment			
Step		**Complete**	**Notes**
1	Check that all 'suppressant released' pressure switches are fitted and are securely fixed to wall.		
2	Check that all pressure trips are fitted in the correct plane and are securely fixed.		
3	Check that the pneumatic actuation tubing is firmly fixed.		
4	Check that all pneumatic actuation tubing connections are tight.		
5	Check that all pneumatic actuation lines, pressure switches, and pressure trips operate at 60 bar using a Nitrogen container fitted with a suitable pressure regulator.		
6	Check the integrity of all pneumatic actuation lines by pressurising to 100 bar using a Nitrogen container fitted with a suitable pressure regulator. Check all joints for leaks with a suitable leak detection spray.		
7	Check that any dampers close and fibreglass curtains drop correctly to fully cover the openings.		
8	Check that supervisory pressure switches are fitted to the pilot containers.		
9	Check that the solenoid flexible lead is correctly fitted and secured using a fixing screw.		
10	Upon completion of all checks, ensure that the solenoid coil is not energised and then refit to the pilot container solenoid.		
11	On systems utilising a local manual actuator, check that the safety pin is fitted.		
12	Ensure the local manual actuator is reset and fit to the master container. Ensure it is tightened correctly.		
13	On systems utilising remote mechanical manual release, check that the unit operates correctly. After checking, ensure that the seals are replaced and upon completion, ensure that the safety pin is removed and a shear strap fitted in the mechanical manual release device.		
14	On systems utilising remote pneumatic manual release units, check that a safety pin is fitted.		
15	Ensure the pneumatic actuators are reset and fit to containers as required. Ensure they are tightened correctly.		
16	Check that door caution plates are fitted at all doors into the protected areas.		
17	Check that manual release caution plates are fitted at all manual control points.		

COMMISSIONING SCHEDULE (Continued)

Enclosure integrity			
Step		**Complete**	**Notes**
1	Record whether a Room Integrity Test has been performed on the protected area.		
2	If not, visually inspect the perimeter of the area and record any leakage areas.		
3	If so, record whether a satisfactory retention time was obtained.		
4	If a Room Integrity Test has not been performed, this must be brought to the customer's attention.		

Completion			
Step		**Complete**	**Notes**
1	On completion, ensure the client is informed of any outstanding actions on their part and confirm these actions in writing.		
2	Obtain the signature of the client's representative on the handover certificate and leave a copy for the client.		

SERVICING AND MAINTENANCE SCHEDULE (EXAMPLE)

Client:	
Serviced by:	
Address:	
Date:	
Project:	
Project reference:	
Address:	
Protected area:	

General instructions			
Steps		**Complete**	**Notes**
1	Advise all personnel working in or near the protected area of possible audible or visual alarms.		
2	Advise the client of any equipment to be switched off during the tests.		
3	Check that the character of the hazard has not altered. If in doubt, contact the Suppression Design Engineer.		
4	Before carrying out any further checks, ensure the suppression system is isolated electrically and mechanically. Remove all electrical or pneumatic actuators, if fitted.		

Electrical checklist - Systems with main and reserve containers			
Steps		**Complete**	**Notes**
1	Carry out checks described in pages 8-35 to 8-36 with the changeover switch in **main** position.		
2	Repeat above checks with the changeover switch in **reserve** position.		

Electrical checklist - Systems with automatic electrical detection (coincidence operation)			
Steps		**Complete**	**Notes**
1	Place the system in automatic mode and that the check lamps are amber on the control panel and all status units.		
2	Operate one detection zone.		
3	Check that the fire alarm sounds.		
4	Check that the suppression release solenoid does not operate.		
5	Switch the system to manual mode and check that the lamps are green on the control panel and on all status units.		
6	Operate the second detection zone.		
7	Check that the suppression release solenoid does not operate.		
8	Switch the system to automatic mode with two detection zones still in alarm.		
9	Check that the evacuation alarm sounds.		
10	Check the A/C shutdowns.		
11	Check that the suppression release solenoid operates after the preset time delay.		
12	Check the operation of the ‘suppressant released’ pressure switch. Upon operation, check that the red lamps are lit on the control panel and on all status units.		
13	Reset the pressure switch and then reset the fire alarm system.		
14	Check the operation of each electrical manual release unit in turn.		

SERVICING AND MAINTENANCE SCHEDULE (Continued)

Electrical checklist - Systems with automatic electrical detection (coincidence operation)			
Steps		**Complete**	**Notes**
15	Check fire alarm and evacuation alarm sounds.		
16	Check suppression release solenoid operates after preset time delay.		
17	Reset system. Ensure seals are refitted to manual release units.		

Electrical checklist - Systems with automatic electrical detection (single zone operation)			
Steps		**Complete**	**Notes**
1	Place the system in manual mode and check that the lamps are green on the control panel and on all status units.		
2	Operate the detection system.		
3	Check that the fire alarm sounds.		
4	Check the suppression release solenoid does not operate.		
5	Switch the system to automatic mode with the detection system still in alarm and check that the lamps are amber on the control panel and on all status units.		
6	Check the evacuation alarm sounds.		
7	Check the A/C shutdowns.		
8	Check that the suppression release solenoid operates after the preset time delay.		
9	Check the operation of the ‘suppressant released’ pressure switch. Upon operation check that the red lamps are lit on the control panel and on all status and indicator units.		
10	Reset the pressure switch and then reset the fire alarm system.		
11	Check the operation of each electrical manual release unit in turn.		
12	Check that the fire alarm and evacuation alarm sounds.		
13	Check that the suppression release solenoid operates after the preset time delay.		
14	Reset the system. Ensure that the seals are refitted to the manual release units.		

Electrical checklist - Systems with electrical manual release only			
Steps		**Complete**	**Notes**
1	Operate each electrical manual release unit in turn.		
2	Check that the fire alarm and evacuation alarm sounds.		
3	Check all A/C shutdowns.		
4	Check that the suppression release solenoid operates after the preset time delay.		
5	Check the operation of the suppression released pressure switch. Upon operation, check that the red lamps are lit on the control panel, if applicable, and on all status units.		
6	Reset the pressure switch and then reset the fire alarm system. Ensure appropriate washers are refitted to the manual release units.		

SERVICING AND MAINTENANCE SCHEDULE (Continued)

Electrical checklist - Systems with hold switches			
Steps		**Complete**	**Notes**
1	With systems in an inactive state, depress the hold switch. Check that a system fault generates.		
2	Initiate the suppressant release sequence and during the delay period, depress the hold switch, check that the release sequence is interrupted and the solenoid does not operate.		
3	Release the hold switch and check that the preset time delay restarts from zero and after the preset time delay, the solenoid operates.		

Electrical checklist - Systems with abort switches			
Steps		**Complete**	**Notes**
1	With the system in an inactive state, depress the abort switch. Check that a system fault generates.		
2	With the system in automatic mode, initiate the suppressant release sequence and during the delay period, depress the abort switch. Check that the release sequence is interrupted and the solenoid does not operate.		
3	Check that the system status reverts to manual mode after the operation of the abort switch.		

Other items			
Steps		**Complete**	**Notes**
1	Detach the solenoid flexible lead and check that a system fault generates.		
2	Check that adequate and appropriate visual and audible warning devices are incorporated into the system.		
3	Record the time delay. This should not normally exceed 30 seconds but must be adequate for safe exiting from the protected area.		
4	Confirm that all A/C systems are linked into the suppression system to shutdown prior to, or upon release of gas and these have been checked.		

SERVICING AND MAINTENANCE SCHEDULE (Continued)

Mechanical checklist - Pipework and nozzles			
Steps		**Complete**	**Notes**
1	Check that the pipework has not been altered or tampered with since the last visit.		
2	Check that pipework supports have been fitted at the correct intervals and are adequate for the purpose.		
3	Check that all nozzles are fitted in accordance with the design requirements and are aimed in the correct alignment away from obstructions or barriers that could prevent adequate distribution or mixing of the gas.		
4	Check that all pipes and nozzles are adequately braced against the reaction to discharge.		
5	Check that the pipework has been painted and properly identified.		
6	If any doubt exists concerning the integrity of the pipework, arrange for it to be purged. Remove the nozzles and check they are free of debris following the purge.		
7	Check that dust caps are fitted, if required. If not, check the nozzles for blockages. If in doubt, purge the system.		

Mechanical checklist - Containers			
Steps		**Complete**	**Notes**
1	Check that containers are safe from mechanical damage, corrosion, or unauthorised interference.		
2	Check that container brackets are fitted and that all bolts are tightened.		
3	Check that all containers are fitted with instruction plates properly completed.		
4	Note any containers requiring a hydrostatic test.		

Record CO_2 container details here:

Area protected	**Containers**		**Weight (kg)**	**Temperature (°C)**	**Corrections required (Yes / No)**
	Size (L)	**Serial number**			

SERVICING AND MAINTENANCE SCHEDULE (Continued)

Record pilot container details here:

Area protected	Containers		Pilot gas	Pressure (bar)	Temp °C	Corrections required (Yes / No)
	Size (L)	Serial number				

Ancillary equipment			
Steps		**Complete**	**Notes**
1	Check that all 'suppressant released' pressure switches are fitted and are securely fixed to the wall.		
2	Check that all pressure trips are fitted in the correct plane and are securely fixed.		
3	Check that the pneumatic actuation tubing is firmly fixed.		
4	Check that all pneumatic actuation tubing connections are tight.		
5	Check that all pneumatic actuation lines, pressure switches, and pressure trips operate at 60 bar using a Nitrogen container fitted with a suitable pressure regulator.		
6	Check that any dampers close and that fibreglass curtains drop correctly to fully cover the openings.		
7	Check that the solenoid flexible lead is correctly fitted and secured using a fixing screw.		
8	Upon completion of all checks, ensure that the solenoid is reset and tightened correctly.		
9	Check that the safety pin is fitted to the local manual actuator.		
10	Ensure that the local manual actuator is reset and fits to the master container. Ensure it is tightened correctly.		
11	On systems utilising a local manual actuator, check that the safety pin is fitted.		
12	Ensure the pneumatic actuators are reset and fit to the containers, as required, and ensure they are tightened correctly.		
13	On systems utilising remote mechanical manual release, check for satisfactory operation of the unit. After checking, ensure appropriate washers are replaced. Upon completion, ensure a shear strap is fitted in the mechanical manual release device.		
14	On systems utilising remote pneumatic manual release units, check that the safety pin is fitted.		
15	Check that door caution plates are fitted at all doors into the protected areas.		
16	Check that manual release caution plates are fitted at all manual control points.		

SERVICING AND MAINTENANCE SCHEDULE (Continued)

Enclosure integrity			
Step		**Complete**	**Notes**
1	Record whether a Room Integrity Test has been performed on the protected area.		
2	If not, visually inspect the perimeter of the area and record any leakage areas.		
3	If so, record whether a satisfactory retention time was obtained.		

Completion			
Step		**Complete**	**Notes**
1	On completion of the visit, ensure the client is informed of any equipment or deficiencies requiring attention and that details are recorded on the docket.		
2	Obtain the signature of the client's representative on the docket and leave a copy for the client.		

LOCAL APPLICATION SYSTEMS - RATE BY AREA

Contact the Technical Services Department for support with regards to the design of local application systems using the Rate by Area method. Local requirements must also be considered.

The CO_2 quantity required using the rate by area method is calculated based on the total discharge rate of a nozzle arrangement sited to cover the entire hazard area. The area covered by each nozzle and the CO_2 quantity required by that nozzle increases as the distance of the nozzle from the hazard surface increases.

Where coated surfaces require protection the nozzles are permitted to cover an area 40% greater than the listings given for liquid surfaces. A coated surface is defined as a surface designed for drainage so that pools of liquid do not accumulate over an area greater than 10% of the protected area. A drip board is an example of a coated surface. Two dimensional surfaces are not more than 0.6 m high.

Hazards involving deep layer flammable liquid fires shall have a minimum freeboard of 150 mm to prevent splashing and to retain a surface concentration when CO_2 is applied. A dip tank is an example of a liquid surface.

The coverage areas are based on nozzles being installed centrally, at 90° from the plane of the surface to be protected. The installation of nozzles at an angle affects the area of coverage, and the aiming point then depends on the discharge angle. Angled nozzles shall be aimed at a point measured from the near side of the area protected by the nozzle, the location of which is calculated by multiplying the fractional aiming factor in Table 8-3 by the width of the area protected by the nozzle.

Calculate the final CO_2 design quantity using the following procedure:

1. Multiply the total of the discharge rate for all the individual nozzles in the system (kg/min) by the liquid discharge time in minutes.

   The total rate of discharge for local application systems shall be the sum of the individual rates of all the nozzles used on the system. The discharge time is normally 0.5 minutes, but for certain applications, such as where the hazard involves liquids with autoignition temperatures much lower than their boiling temperatures, the minimum discharge time should be 3 minutes.

   Note: The extended discharge time is intended to maintain a suppressing concentration until the fuel has cooled below its autoignition temperature.

2. Add extra CO_2 if the area contains hazards with an increased fire risk. Table 2-4 lists the conversion factors.

3. Multiply the calculated CO_2 quantity (Step 1 and 2) by 1.4.

   Add 40% to the calculated quantity to determine the nominal container storage capacity since only the liquid portion of the discharge is effective.

Table 8-3 lists the aiming factors for nozzles installed at an angle, based on 150 mm freeboard.

TABLE 8-3: AIMING FACTORS

Discharge angle	Aiming factor
45° to 60°	0.25
60° to 75°	0.25 to 0.375
75° to 90°	0.375 to 0.5
90° (perpendicular)	0.5 (centre)

Note: The discharge angle is calculated from the plane of the hazard surface.

NOTES: