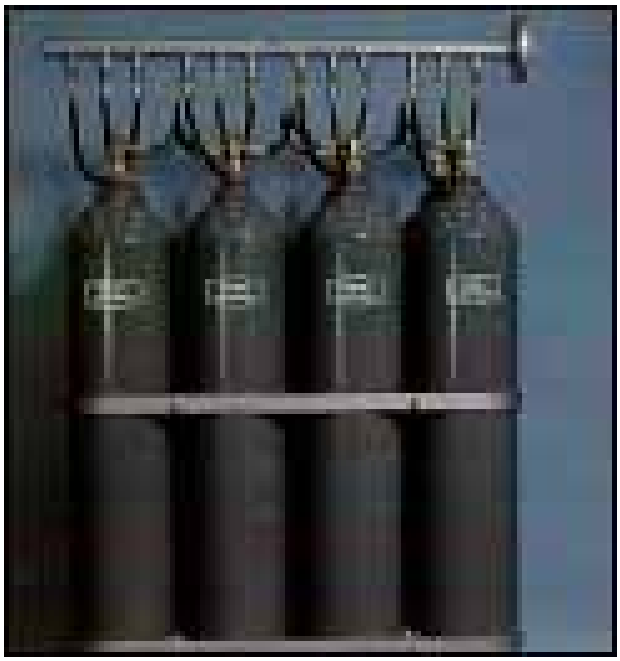
FIRE AND SECURITY

Heien Larssen

CO2 High Pressure Extinguishing System



Multiple area, pneumatic Users Manual 70150-G4

Protecting life, environment and property...

AUTRONICA

Amendments

AMENDMENT INCORPORATION RECORD		
Amendment Number	**Brief Description of Content**	**Name of Person Incorporating Amendment**
1 2005-10-06	Updated to AFS standard	
2		
3		
4		
5		
6		
7		
8		
9		
10		

Table of Contents

1 FOREWORD

1.1 Supplier address and contact:

Supplier:
Autronica Fire and Security AS
Division Maritme
Address:
Industriveien 7,
N-3430 Spikkestad,
Norway
Phone:
+ 47 31 29 55 00
Telefax:
+ 47 31 29 55 01
Contact spares
Sales support department
Contact service
Sales support department

2 GENERAL DESCRIPTION.

2.1.1 Carbon dioxide high pressure system.

Carbon dioxide is a colourless, odourless, electrically non-conductive gas that is a suitable medium for extinguishing fires. Liquid carbon dioxide forms dry ice snow when released directly into the atmosphere.

Physical properties:

Molecular weight	44,0
Density at 0 ^{O}C/1 Bar	2,0 kg/m^3
Specific gravity	1,5
1 kg CO2 = 0,56m3 at 1 atm.	

Carbon dioxide extinguishes fire by reducing the oxygen level, the vapour phase of the fuel or both in the air to the point where combustion stops. Carbon dioxide is present in the atmosphere at an average of 0,03 % per m^3. It is also a normal end product of human and animal metabolism. Carbon dioxide influence certain vital functions in a number of important ways, including control of respiration, dilation and constriction of the vascular system - particularly the cerebrum and the pH value of the body.

The concentration of carbon dioxide in the air governs the rate at which carbon dioxide is released from the lungs at thus affects the concentration of carbon dioxide in the blood and tissues. An increased concentration of carbon dioxide in air can, therefore, become dangerous due to a reduction in the rate of release of carbon dioxide from the lungs and decrease oxygen intake.

2.1.2 Use limitations.

Carbon dioxide fire extinguishing systems are useful to extinguish fires in specific hazards areas, and in occupancies where an inert electrically non-conductive medium is essential or desirable.

Some of the most important types of hazards and equipment that carbon dioxide systems protect, may include:

- Flammable liquid materials.
- Electrical hazards, such as transformers, oil switches and circuit breakers, rotating equipment, and electronic equipment.
- Engines utilising gasoline and other flammable liquid fuels.
- Ordinary combustibles such as paper, wood and textiles.
- Hazardous solids.

The discharge of liquid carbon dioxide is known to produce electrostatic charges which, under certain conditions, could create a spark. Carbon dioxide fire extinguishing systems protecting areas where explosive atmosphere could exist shall utilise metal nozzles and shall be properly grounded. In addition, objects exposed to discharge from carbon dioxide nozzles shall be grounded to dissipate possible electrostatic charges.

Carbon dioxide will not extinguish 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.
- The CO_2 fire extinguishing effect will be reduced by fire in wood, paper and textile.

Note. The system is only to be used for fire extinguishing and not for other purposes, due to the electrostatic ignition hazard.

2.1.3 Quality

Carbon dioxide used for initial supply and replenishment must be of good commercial grade, free of water and other contaminants that might cause container corrosion or interfere with free discharge through nozzle orifices. In general carbon dioxide obtained by converting dry ice to liquid will not be satisfactory unless it is properly processed to remove excess water and oil.

2.1.4 Types of fires.

Surface fires are the most common hazard particularly, adaptable to extinguishing by total flooding systems. They are subject to prompt extinguishing when carbon dioxide is quickly introduced into the enclosure in sufficient quantity to overcome leakage and provide an extinguishing concentration for the particular material involved.

For deep-seated fires, the required extinguishing concentration shall be maintained for a sufficient period of time to allow the smouldering to be extinguished and the material to cool down to a point at which re-ignition will not occur when the inert atmosphere is dissipated.

It is necessary to inspect the hazard in every event immediately thereafter to make sure that the extinguishing is complete and to remove any material involved in the fire. Where the quantity of extinguishing medium is required to protect more than one space, the quantity of the medium available does not have to be more than the largest quantity required.

2.1.5 CO_2 - Cylinder Bank.

The fire-extinguishing medium shall be stored in a room that is situated in a safe and accessible position and shall be effectively ventilated to the satisfaction of the Authorities. Any entrance to such a storage room must preferably be from the open deck and in any case shall be independent of the protected space. Access doors shall open outwards, and bulkheads walls and deck including doors and other means of closing any opening therein, which from the boundaries between such rooms and adjoining enclosed spaces must be gas tight.

2.1.6 Leakage and Ventilation.

Since the efficiency of carbon dioxide systems depends upon the maintenance of the extinguishing concentration of carbon dioxide, leakage of gas from the space shall be kept to a minimum and compensated for by applying extra gas where required. Means shall be provided to close all openings, which can admit air to or allow gas to escape from a protected space.

2.1.7 Personal protection and safety aspects.

The CO_2 - gas reduce the human ability to utilise oxygen from the air, and becomes gradually more dangerous with increased concentration.

CO_2 concentration up to 6-7 % of the net volume is normally harmless to most people, but should be avoided.

The CO_2 concentration after one discharge of the fire extinguishing system will be minimum 30 % of the net volume, and will be fatal for human.

Means shall be provided for automatically giving audible warning the release of fire-extinguishing medium into any space in which personnel normally works or to which they have access. The alarm shall be operated for a suitable period before the medium is released.

2.2 Equipment data.

2.2.1 Fastening assembly for 67,5 l CO_2 - Cylinders.

Cylinder clamps:

Material	: Impregnated wood
Type	: For 2, 3 and 4 cylinders.
Dimension	: Front and back bar 73 x 48 mm Centre bar 98 x 48 mm
Bolts:	
Material	: Steel
Dimension	: M16
Length 1 Row	: 450 mm
2 Rows	: 760 mm
3 Rows	: 1077 mm
Nuts:	
Material	: Steel
Dimension	: M16
Standard	: DIN 934
Washer:	
Material	: Steel
Dimension	: 50 x 50 x 18 x 5
Standard	: Square washer, galvanised.

2.2.2 CO_2 - Cylinder.

Size	: 67,5 litre
Filling weight	: 45 Kg.
Dimension	: ø 267 mm x 1605 mm +/- 20 mm
Total weight	: 125 Kg +/- 5 Kg.
Cylinder valve	: Pneumatic.
Bursting disc	: 190 Bar +/- 5 Bar
Cylinder threads	: W27,8 DIN 477
Cylinder valve inlet	: W28,8 DIN 477
Cylinder valve outlet	: W 21,8 x 1/14''
Material cylinder	: 34CrMo4
Material cylinder valve	: Cast Brass
Finish cylinder	: Grey
Storage pressure at 21^{O}C	: 58,6 Bar.
Test pressure	: 250 Bar.
Manufacturing standard	: 84/525 EEC
Siphon tube	: ø 16 x 2 mm

2.2.3 Supply cabinet.

Dimension	:	380 mm x 210 mm x 600 mm
Material	:	Steel
Finish	:	Grey
Weight	:	30 Kg
Degree of protection	:	IP 65
Pilot cylinder	:	2 Off
Material cylinder	:	34CrMo4
Pilot cylinder size	:	0,67 l.
Filling weight	:	0,44 Kg. CO_2
Material cylinder valve	:	Cast Brass
Storage pressure at 21^{O}C	:	58,6 Bar
Test pressure	:	250 Bar
Manufacturing standard	:	84/525 EEC
Pilot line connection	:	8 mm Compression Coupling.

2.2.4 Supply cabinet with time delay.

Dimension	:	380 mm x 210 mm x 600 mm
Material	:	Steel
Finish	:	Grey
Weight	:	30 Kg
Degree of protection	:	IP 65
Pilot cylinder	:	2 Off
Material cylinder	:	34CrMo4
Pilot cylinder size	:	0,67 l.
Filling weight	:	0,44 Kg. CO_2
Material cylinder valve	:	Cast Brass
Storage pressure at 21^{O}C	:	58,6 Bar
Test pressure	:	250 Bar
Manufacturing standard	:	84/525 EEC
Accumulator cylinder	:	2 Off
Material cylinder	:	34CrMo4
Accumulator cylinder size	:	0,67 l.
Test pressure	:	250 Bar
Manufacturing standard	:	84/525 EEC
Pneumatic timer	:	1 Off
Material pneumatic timer	:	Brass
Adjustable range	:	20 - 60 seconds.
Pilot line connection	:	8 mm Compression Coupling.

2.2.5 Valve release cabinet

Dimension	:	200 mm x 150 mm x 300 mm
Material	:	Steel
Finish	:	Grey
Weight	:	5 Kg
Degree of protection	:	IP 65
Release valve	:	2 Off
Material release valve	:	Steel
Dimension release valve	:	DN 8 (1/4'')
Micro switch	:	2 Off, NO / NC
Micro switch rating	:	4 Amp / 250 Vac
Pilot line connection	:	8 mm Compression Coupling.

2.2.6 Typhoon alarm siren with solenoid valve and filter.

Typhoon:

Dimension	:	ø 125 mm x 215 mm x 175 mm
Material horn	:	Brass / Plastic
Finish	:	Black
Tone frequency	:	800 - 900 Hz.
Sound level	:	130 dB A at 1 meter.

Solenoid valve:

Dimension	:	1/2''	
Inlet / Outlet connection	:	1/2'' BSP Female.	
Voltage	:	24 V DC	220 VAC
Part no.	:	308501	308502
Power consumption	:	9 W nominal.	
Solenoid valve material	:	Brass	
Maximum air pressure	:	12 Bar	
Cable entry	:	1 x PG 13	

Filter

Dimension	:	1/2''
Inlet / Outlet dimension	:	1/2'' BSP Female.
Material housing	:	Bronze
Material filter	:	Stainless steel.
Total Weight	:	2,6 Kg

2.2.7 Electric alarm siren.

Type	:	A100DC	A112DC	A121DC	A112AC
Voltage	:	24 V DC	24 V DC	24V DC	220 V AC
Current consumption	:	19 mA	200mA	950 mA	60mA
Sound level at 1 m.	:	104 dB	112 dB	121 dB	112 dB
Weight	:	0,26 Kg	2,0 Kg	2,1 Kg	2,3 Kg
Dimension A100 DC	:	87 mm x 87 mm x 77 mm			
Dimension A112 DC	:	168 mm x 168 mm x 156 mm			
Dimension A 121 DC	:	190 mm x 190 mm x 184 mm			
Sound frequency	:	300 Hz - 2900 Hz (Adjustable tone)			
Material	:	Taxlan free ABS			

Finish	:	Red
Cable entry A100	:	1 x 20 mm
Cable entry A112 & A121	:	2 x 20 mm

2.2.8 Electric alarm siren for hazardous area.

Type	:	BExS110D024	BExS110D220
Voltage	:	24VDC	220VAC
Current consumption	:	195 mA	56 mA
Sound level	:	110dB(A)@1m	
Weight	:	3,2 Kg	3,4kg
Dimension	:	L 262,6 mm x ø181mm	
Sound frequency	:	1000 Hz (tone 1)	
Material	:	Seawater resistant aluminium LM6	
Finish	:	Red	
Cable entry	:	2 x M20 cable inlets where one are blinded.	
Degree of protection	:	IP 66 & IP 67	
Explosion protection	:	II 2 G Eex d IIC T4 (Zone 1 and 2)	

2.2.9 Pneumatic operated master valve, DN 25 - DN 50.

General:

Type	:	DN 25	DN 32	DN 40	DN 50
Length	:	573 mm	576 mm	584 mm	586 mm
Width	:	111,5 mm	111,5 mm	122 mm	133 mm

Valve:

Type	:	Ball valve, full bore.
Pressure rating	:	PN 160
Inlet connection	:	BSP Female.
Outlet connection	:	Plain pipe end for welding or threading.
Material housing	:	Steel
Material ball	:	Stainless steel.
Material gasket	:	Delrin

Power cylinder:

Type	:	Pneumatic, manual return.
Material	:	Steel
Pressure class	:	PN 100
Inlet connection	:	3/8'' Flexible hose.

Limit switch:

Quantity	:	2 Off
Rating	:	10 A (4 A) 380 VAC (DC)
Contacts	:	NO / NC
Cable entry	:	1 x PG 11.

2.2.10 Pneumatic operated master valve, DN 65 - DN 100

General:

Type	:	DN 65	DN 80	DN 100
Length	:	734 mm	746,5 mm	764 mm
Width	:	345 mm	370 mm	457,5 mm
Weight	:	35,0 Kg	43,0 Kg	60,0 Kg

Valve:

Type	:	Ball valve, full bore.
Pressure rating	:	PN 160.
Inlet connection	:	DIN 2638 PN 160.
Outlet connection	:	Plain pipe end for welding or threading.
Material housing	:	Steel ASTM A 105.
Material ball and stem	:	Stainless steel. AISI 316.
Material gasket	:	Delrin.
Fire safe	:	Acc. to BS 6755 Part 2, 1987.

Power cylinder:

Type	:	Pneumatic, manual return.
Material	:	Steel
Pressure class	:	PN 100
Inlet connection	:	3/8'' Flexible hose.

Limit switch:

Quantity	:	2 Off
Rating	:	10 A (4 A) 380 VAC (DC)
Contacts	:	NO / NC
Cable entry	:	1 x PG 11.

2.2.11 CO_2 - Manifold pressure gauge.

Type	:	Bourdon	Bourdon
Mounting	:	Direct, Male BSP Bottom.	Direct, Male BSP Bottom.
Weight	:	0,6 Kg.	0,6 Kg.
Accuracy	:	+/- 1% Of full scale.	+/- 1% Of full scale.
Connection size	:	1/2'' BSP	1/2'' BSP
Material housing/body	:	Stainless steel/Brass.	Stainless steel/Brass
Dial type	:	Linear	Linear
Dial size	:	100 mm	100 mm
Scale range	:	0 - 160 Bar	0 – 160 Bar
Indication needle	:	Single	Double

2.2.12 CO_2 - Shore connection / Air blowing through valve with check valve

Length	:	150 mm
Width	:	50 mm
Height	:	100 mm
Weight	:	1,5 Kg

Valve

Type	:	Ball valve, full bore.
Pressure rating	:	PN 160.
Inlet connection	:	BSP Female
Outlet connection	:	NPT Male
Dimension	:	DN 20 (3/4'')
Material housing	:	Steel
Material ball and stem	:	Stainless steel.
Material gasket	:	Delrin.
Fire safe	:	

Check valve.

Type	:	Ball
Material housing	:	Brass
Material ball	:	Stainless steel.

2.2.13 CO_2 - Manifold relief valve.

Type	:	Spring return.
Pressure rating	:	PN 413
Inlet connection	:	NPT Male
Outlet connection	:	NPT Female
Dimension	:	DN 8 (1/4'')
Material housing	:	Stainless steel AISI 316
Material bonnet	:	Stainless steel AISI 316
Material bonnet / seat seal	:	Viton
Material stem seal	:	TFE Coated viton
Orifice	:	3,6 mm
Width	:	41 mm
Height	:	98,5 mm
Weight	:	0,194 Kg

2.2.14 CO_2 - Discharge hose

Description	:	1 / 2 Rows	3rd. Row
Length	:	350 mm	650 mm
Weight	:	0,35 Kg.	0,40 Kg.
Type	:	DN 15 (1/2'') High pressure rubber hose.	
Pressure rating	:	PN 100	
Bursting pressure	:	600 Bar	
Inlet connection	:	W21,8x1/14'' Female	
Outlet connection	:	1/2'' BSP Male	
Material hose	:	Nitril rubber	
Material couplings	:	Steel	

2.2.15 CO_2 - Pilot hose

Description	:	Betw. cyls.	Betw. rows.	Conn. to pilot line
Length	:	303 mm	500 mm	350mm
Weight	:	0,20 Kg.	0,30 Kg.	0,25kg
Type	:	DN 10 (3/8'') High pressure rubber hose.		
Pressure rating	:	PN 100		
Bursting pressure	:	1000 Bar		
Inlet connection	:	3/8'' BSP Male		
Outlet connection	:	3/8'' BSP Male		
Material hose	:	Nitril rubber		
Material couplings	:	Steel		
Connection to pilot line	:	ø8mm cutting ring connection (304010.1)		

2.2.16 CO_2 - Nozzle

Description	:	DN 15 (1/2'')	DN 20 (3/4'')
Height	:	20 mm	22 mm
Across flats (Hex)	:	25 mm	30 mm
Weight	:	0,10 Kg.	0,15 Kg.
Inlet connection	:	1/2'' BSP Male	3/4'' BSP Male
Material	:	Brass	

2.2.17 Non - Return valve system.

Weight	:	1 Kg.

Non - Return valves.

Quantity	:	2 Off
Type	:	Spring return
Material	:	Steel
Pressure rating	:	PN 100

Compression fitting.

Type	:	Single ferule.
Dimension	:	8 mm
Material	:	Steel

Flexible hoses.

Quantity	:	2 Off
Length	:	303 mm

Type	:	DN 10 (3/8'') High pressure rubber hose.
Pressure rating	:	PN 100
Bursting pressure	:	1000 Bar
Inlet connection	:	3/8'' BSP Male
Outlet connection	:	3/8'' BSP Male
Material hose	:	Nitril rubber
Material couplings	:	Steel

Bleeder valve.

Dimension	:	1/4''
Inlet connection	:	BSP Male
Material	:	Brass

2.2.18 Pressure switch with manual reset.

Type	:	Pressure
Mounting	:	Direct, Male BSP.
Weight	:	
Connection size	:	1/2'' BSP
Material housing	:	Brass
Material piston	:	Brass
Pressure class	:	PN 100
Switch rating	:	10 A (4A) 380 VAC (DC)
Cable entry	:	1 x PG 11
Switch	:	1 x NO / 1 x NC

2.2.19 CO_2 - Manifold check valve.

Type	:	Ball
Mounting	:	Direct.
Weight	:	0,15 Kg.
Connection size inlet	:	1/2'' BSP
Connection size outlet	:	3/4'' NPT
Material housing	:	Brass
Material ball	:	Stainless steel AISI 304
Material sealing	:	Nitril rubber O - Ring
Pressure class	:	PN 100

2.2.20 CO_2 - Manifold.

Dimension	:	DN 20 - DN 100
Socket	:	3/4'' NPT Female.
Flange	:	DIN 2637 PN 100
Pipe	:	DIN 2442
Material	:	St. 35.8 DIN 17175
Pressure class	:	PN 100
Test pressure	:	According to class.
Surface treatment	:	Hot dipped galvanised.

2.2.21 CO_2 - Cylinder weighing device.

Scale	:	0 - 200 Kg.
Scale dimension	:	
Material	:	Steel
Supplied with	:	Lifting arm. Chain, l = 1 meter. CO_2 - Cylinder lifting bracket. Lifting hook.

2.2.22 CO_2 - Cylinder weighing device type Kidde Deugra.

Scale	:	0 - 200 Kg.
Material	:	Steel
Supplied with	:	Lifting arm. Chain, l = 1 meter. CO_2 - Cylinder lifting bracket. Lifting hook.

3 TECHNICAL DESCRIPTION.

3.1 General.

The system is used where there is a requirement for protection of two or more areas, and where the CO_2 - cylinders are located in a central CO_2 - room.

3.2 Design.

The system is designed to supply CO_2 - concentration sufficient to achieve extinguishing only and in accordance with the authorities having jurisdiction. Each of the protected areas are fitted with a master valve and a valve release cabinet.

The CO_2 - system is of the total flooding type protecting two or more areas onboard.

The CO_2 - cylinders are located inside a CO_2 - room together with the master valves, the supply cabinet and the valve release cabinets.

On systems required release from more than one place a set of supply cabinet and valve release cabinets will be located in another place such as fire station, for remote operation of the system or/and in CO2 room.

The CO_2 - gas is distributed to the different protected areas by a piping system, including separate master valves for each area.

A number of CO_2 - nozzles are fitted inside each protected area. The nozzles are evenly distributed throughout the area. Nozzles area also installed below floor plates wherever required distributing CO_2 - gas to that volume.

One or more audible alarms are installed inside the protected area warning the personnel to evacuate upon activation of the system.

3.3 Fastening assemblies for CO_2 - Cylinders.

The fastening assemblies supplied consist of wooden bars, M16 steel bolts, M16 Nuts and M16 square washers. It is 9 different standard assemblies:

1 Row for 2 Cylinder’s	Totally 2 Cylinder’s.
1 Row for 3 Cylinder’s	Totally 3 Cylinder’s.
1 Row for 4 Cylinder’s	Totally 4 Cylinder’s.
2 Row for 2 Cylinder’s	Totally 4 Cylinder’s.
2 Row for 3 Cylinder’s	Totally 6 Cylinder’s.
2 Row for 4 Cylinder’s	Totally 8 Cylinder’s.
3 Row for 2 Cylinder’s	Totally 3 Cylinder’s.
3 Row for 3 Cylinder’s	Totally 6 Cylinder’s.
3 Row for 4 Cylinder’s	Totally 9 Cylinder’s.

3.4 CO_2 - Cylinder's.

The cylinder's supplied for high pressure carbon dioxide systems are manufactured in accordance with European Standards.

Pressure testing from factory is 250 Bar, and all cylinders are supplied with a third party verification certificate.

The following standard sizes are available:

0,67 litre with 0,44 kg. CO_2 - gas.

2,00 litre with 1,30 kg. CO_2 - gas.

9,00 litre with 6,00 kg. CO_2 - gas.

67,50 litre with 45,00 kg. CO_2 - gas.

80,00 litre with 53,00 kg. CO_2 - gas.

Standard colour supplied is grey. Other colours like red and black are available upon request.

Cylinders for storage of fire extinguishing mediums and associated pressure components shall be designed in accordance with pressure codes of practice to the satisfaction of the authorities having jurisdiction.

The filling ration of CO_2 - Cylinders shall not exceed 0,67 kg/l..

The CO_2 - Cylinders shall be stored in an effectively ventilated room. Means shall be available for the personnel to safely check the quantity of medium in the cylinders.

The CO_2 - cylinders are located inside a central CO_2 - room that require sufficient ventilation in accordance with the authorities having jurisdiction. All the CO_2 - cylinder's are of equal filling and pressurisation, 58,6 Bar at 21 ^{O}C.

The CO_2 - cylinders are equipped with a pneumatic operated CO_2 - valve that will be operated from a release cabinet. Means are also provided for manual release by a handle fitted on top of the CO_2 - cylinder valve.

3.5 Supply cabinet / Valve release cabinet.

On vessels where the CO_2 - Room is readily accessible, one release station may be acceptable.

The means of control of the CO_2 - system will be simple to operate. It is grouped together in as few locations as possible, and will not be cut of by a fire in a protected space.

At each location it will be a clear instruction related to operation of the system.

3.5.1 Supply cabinet.

The system consists of one supply cabinet, which is used for supplying pilot pressure to the various valve release cabinets. The cabinet is normally locked, and a key is located inside each of the valve release cabinets.

The supply cabinet has two pilot cylinders, (one main and one spare), one accumulator cylinder, one adjustable time delay unit, one pressure gauge and a bleeding valve. Each pilot cylinder is supplied with 0,44 kg. CO_2 - gas.

The adjustable time delay unit is pre-set from the manufacturer in accordance with the requirements from the authorities having jurisdiction. The time delay can be set between 20 - 60 seconds.

The bleeding valve is fitted to avoid accidental release of the system upon a small leakage in the pilot cylinder valve. Upon full CO_2 - pressure the valve will close.

3.5.2 Valve release cabinet.

The valve release cabinet (one for each area protected) consist of two release valves (One for activating the CO_2 - cylinder's and one for opening of the CO_2 - master valve), two limit switches (one for starting the alarm siren and for ventilation shut down).

By opening the valve release cabinet the alarm siren inside the protected area will sound and the ventilation will be shut down.

3.6 Alarm sirens.

Opening the valve release cabinet or the master valve will activate the alarm sirens. The alarm siren can either be an electronic siren or an air operated typhoon siren.

The power supply to the electronic alarm siren is from the emergency power supply system.

The air supply to the air operated typhoon siren is from the starting air receivers. A solenoid valve is installed on the line. Maximum air pressure to the alarm siren is 12 Barg. The power supply to the solenoid valve is from the emergency power supply system.

All the alarm sirens is operated on either 24 VDC or 220 VAC. Other voltages are available upon request.

The sound level of the different alarm sirens is to be minimum 5 dB A above the highest sound level in the area they are fitted. It is also important the frequency is different than the frequency on the equipment in the area it self.

3.7 Master valves.

One master valve for each protected area is to be fitted. The master valve is located in the CO_2 - room and is operated from the control station. The valves can also be remotely operated from a fire station or from a release station at the entrance to the protected area. The valves are operated pneumatically using CO_2 - pressure.

The valves are made of steel with stainless steel ball and PTFE gaskets. The valves are supplied with the following end connections.

Size	High pressure side	Low pressure side
DN 25 - DN 50	BSPP Female threads	Pipe end for welding.
DN 65 - DN 100	Flanged, PN 160, DIN2638	Pipe end for welding.

All valves supplied are full bores.

The master valves are fitted with one pneumatic piston and two limit switches. One limit switch is for start of alarm siren's and the other one is for ventilation shut down.

The master valve is operated from the valve release cabinet, using CO_2 - gas as pilot pressure. This pilot pressure is distributed to the pneumatic piston, which again is opening the master valve.

The master valve can also be opened manually, even fully pressurised. By opening the valve manually the two limit switches will start the alarm sirens and shut down the ventilation.

3.8 CO_2 - Manifold pressure gauge.

Inside the CO_2 - room a pressure gauge is fitted to the collector pipe between the CO_2 - manifold and the CO_2 - master valve assembly. The scale is 0 - 160 Bar and is 100 mm dia. The process connection is 1/2'' BSP Male. Material is Stainless steel housing with brass process connection.

3.9 CO_2 -shore connection / Air blowing through valve.

Inside the CO_2 - room a CO_2 - shore connection / Air blowing through valve is fitted to the collector pipe between the CO_2 - manifold and the CO_2 - master valve assembly. This CO_2 - shore connection / Air blowing through valve enable the service personnel or the crew to blow through the piping with air. It is also possible to connect an external CO_2 - gas source if additional CO_2 - gas is required to extinguish a fire.

The valve is a 3/4'' BSP female, full bore, ball valve made of steel. The valve is supplied with a check valve made from brass and a 3/4'' coupling which shall be welded to the collector pipe.

3.10 CO_2 Manifold relief valve:

Inside the CO_2 - room a relief valve is fitted to the collector pipe between the CO_2 - manifold and the CO_2 - master valve assembly. By an over-pressure in the CO_2 - manifold / collector pipe the over-pressure will be evacuated into free air, avoiding the manifold and or the master valves to be destroyed.

The valve is made from stainless steel and is supplied with a 1/4'' NPT Male threads on the inlet. The outlet is 1/4'' NPT Female. The valve is adjusted with a set point of 120 Bar.

3.11 Flexible hoses.

Tree main types of flexible hoses are supplied. One hose is for connection between the CO_2 - cylinder valve and the CO_2 - manifold check valve. The 2nd type is pilot hose for interconnection between the CO_2 - cylinders as a pilot manifold and the last type is pilot hose for connection between ø8mm pilot tube and pneumatic actuator on CO_2 cylinder.

All 3 types are Type approved.

3.11.1 CO_2 - Discharge hose.

The CO_2 - discharge hose is supplied in two different lengths. One is 350 mm long, which is used on one row and two row's systems. The second hose is 650 mm long and is used for the third row on a three row system.

The hoses are made of synthetic rubber with two wire cords. The couplings are made from mild steel. The end connections is 1/2'' BSP Male on the manifold side and W21,8x1/14'', swivel coupling on the CO_2 - valve side.

3.11.2 CO_2 - Pilot hose.

The CO_2 - pilot hoses for interconnection between the cylinders is supplied in two different lengths. One is 303 mm long, which is used between cylinders in one row. The second hose is 500 mm long and is used for interconnection at the end, between two rows.

The hoses are made of synthetic rubber with two wire cords. The couplings are made from mild steel. The end connections are 3/8'' BSP Male swivel coupling on both ends.

As the coupling is supplied with cutting edges, gaskets are not required.

The CO_2 - pilot hose for connection between ø8mm pilot tubes and CO_2 – cylinder valve is delivered in 350mm length.

The hose is made of synthetic rubber with two wire cords. The couplings are made from mild steel. The end connection to cylinder valve is 3/8'' BSP Male swivel coupling and the other end is ø8mm cutting ring connection.

3.12 CO_2 - Discharge nozzles.

CO_2 - Nozzles are supplied in three sizes, 1/2'', 3/4'' and 1''. The material is brass and the end connection is BSP Female threads. The nozzles are drilled in accordance with the hydraulic calculation.

3.13 Non - Return valve, system.

Where various areas are protected, and the number of cylinder's to be discharged into each area is different, a Non - Return valve system is required. This to make sure that only the number of cylinder's required is released.

The Non - Return valve system consist of two non - return valves, two flexible hoses and a bleeder valve interconnected by 8 mm compression fittings. All end connections are 3/8'' BSP male, so that it fits directly into the CO_2 - cylinder valve.

3.14 Pressure switch.

On systems, which require a signal upon discharge of CO_2 - gas, a pressure switch unit is supplied.

The pressure switch includes a pressure cylinder made from brass ,a limit switch with double pole change over contacts and a steel bracket. The limit switch has a reset button which has to be pulled to rest the signal.

The process connection is 1/2'' BSP male.

3.15 CO_2 - Manifold check valve.

The CO_2 - manifold is supplied with a manifold check valve made from brass. The valve is fitted to avoid both back pressure into the CO_2 - cylinder valves and to avoid accidental discharge of CO_2 - gas into the CO_2 - room if a CO_2 - cylinder is removed.

The process connection is 3/4'' NPT male downstream and 1/2'' BSP female upstream.

3.16 CO_2 - Manifolds.

The CO_2 - manifolds supplied in various sizes. Each manifold is tailor-made for each system.

The end connections are as follows.

DN 20 - DN 100 Flanged, DIN std, PN 100.

The manifolds are manufactured using high-pressure steel pipe. They are hot dipped galvanised after completion of welding.

All manifolds are pressures tested in accordance with class requirements.

3.17 CO_2 - cylinder weighing device.

A CO_2 - cylinder-weighing device is supplied where required. The weighing device consist of a 0 - 200 Kg scale weight including necessary brackets and a chain which makes it possible to adjust the lifting height.

4 INSTALLATION INSTRUCTION.

4.1 The main equipment installed in the CO_2 - room.

The following equipment is normally installed in the CO_2 - room.

- CO_2 - cylinders.
- CO_2 - master valves.
- CO_2 - manifold with check valves.
- CO_2 - discharge hose.
- CO_2 - pilot hose.
- CO_2 - cylinder fastening assembly.
- Supply cabinet.
- Valve release cabinets.
- CO_2 - Manifold pressure gauge.
- CO_2 - Manifold relief valve.
- CO_2 - shore connection / Air blowing through valve.
- CO_2 - Cylinder weighing device.

Before starting the installation this procedure shall be read carefully.

Please pay attention to the following:

The CO_2 - gas is extremely dangerous to human life. Due to this make sure that the cap on the CO_2 - valve outlet is fitted and that the protective cap on the CO_2 – cylinder is properly installed before any handling of the CO_2 - cylinder's take place.

Always leave the CO_2 - room door in open position while present. Keep the CO_2 - cylinder's properly secured by the cylinder clamps or provisional fastening assembly to avoid CO_2 - cylinder's falling. A breathing apparatus for each person in the CO_2 - room should be available at any time.

4.1.1 CO_2 - Cylinder fastening assembly.

The CO_2 - cylinders shall be installed in accordance with the CO_2 - room arrangement drawings submitted by Autronica Fire and Security AS.

The CO_2 - cylinder's shall be properly fastened using the supplied cylinder clamps and in accordance with the drawings referred to herein.

The CO_2 - cylinder's shall be installed on a wooden bed (48mm x 148 mm) bolted to the deck structure. The wooden bed is supplied by the yard.

Autronica Fire and Security AS, supplies the following equipment:

- Wooden bars.
- M16 Bolts.
- M16 Nuts.
- 16 mm Washer.

The following equipment shall be supplied by yard.

- 48 mm x 148 mm Wooden bed.
- 50 mm x 75 mm x 5 mm Angel for Rear support.

The following drawings shall be used during installation.

Description	**Drawing number**
CO_2 - cylinder bank, one row.	Attachment 1.
CO_2 - cylinder bank, two rows.	Attachment 2.
CO_2 - cylinder bank, three rows.	Attachment 3.

During installation the centre distance between the cylinders should be checked. Make sure that the distance is 300 mm. If this distance is incorrect the manifold will not fit.

4.1.2 CO_2 - Manifold.

The manifold shall be installed in accordance with drawing no. 33716 - C3 and in accordance with the system drawing for the project.

The manifold is supplied with the manifold check valve installed (Part no. 303001) and it is pressure tested in accordance with class requirements.

The height from the bottom of the cylinders to the check valve shall be 1750 mm. If the cylinders are installed on a 48 mm wooden bed the height from deck level to the check valve shall be 1800 mm.

Three main types of manifolds are supplied.

- One row. Ref. Attachment 1.
- Two rows. Ref. Attachment 2.
- Three rows. Ref. Attachment 3.

4.1.3 CO_2 - Discharge hose.

When the installation of the manifold is finalised, install the DN (1/2'') discharge hose into the manifold check valve. The hose shall be tightened up to avoid leakage's.

Do not connect the discharge hose to the CO_2 - valve outlet before the commissioning is finalised.

When the commissioning is finalised, remove the CO_2 - cylinder valve outlet cap and connect the discharge hose. Tighten up.

Reference is also made to attachment 4.

4.1.4 CO_2 - Pilot hose.

Remove the CO_2 - cylinder cap. Check that the CO_2 - valves are properly secured.

Connect the flexible hose between the pneumatic actuators on the actual cylinders and tighten up.

The flexible pilot hose is supplied in tree lengths.

The flexible pilot hose, which shall be installed between the CO2 - cylinders on the same row, is 303 mm long.

The flexible hose, which is used as interconnection between two rows, is 500 mm long.

The flexible hose, which is used as interconnection between ø8mm pilot line and cylinder bank, is 350mm long.

Reference is also made to attachment 5.

Connect the flexible hose with ø8mm cutting ring connection to pilot line and the other end to the first CO_2 – cylinder according to CO_2 room arrangement drawing.

4.1.5 Non - Return valve system.

When the number of cylinders to be discharged into each area is different, a Non Return Valve System is required. This has to be installed in accordance with the system drawing.

Reference is also made to Attachment 6.

4.1.6 Master valve.

The master valve shall be installed in accordance with the CO_2 - room arrangement drawing or the system drawing.

The master valves are supplied from Autronica Fire and Security AS in the following types.

DN 25 - DN 50 High pressure side.

On the high pressure side the end connection is BSP female threads. The collector pipe from the CO_2 - manifold to the master valves are to be manufactured by the yard. The end connection on the collector pipe for the dimensions mentioned above need to be BSP Male threads. Install the master valve to the pipe. PTFE Tape to be used on the threads.

DN 25 - DN 50 Low pressure side.

On the low pressure side the valve is supplied with a plain pipe end. The yard connection can either be by welding or the pipe end can be threaded. Make sure that the valve handle is pointing downwards.

DN 65 - DN 100 High pressure side.

On the high pressure side the end connection is flanged, PN 160, DIN 2638. The collector pipe from the CO_2 - manifold to the master valves are to be manufactured by the yard. The end connection on the collector pipe for the dimensions mentioned above need to be flanged, PN 160, DIN 2638. Install the master valve to the pipe.

DN 65 - DN 100 Low pressure side.

On the low pressure side the valve is supplied with a plain pipe end. The yard connection can either be by welding or flanged. Make sure that the valve handle is pointing downwards.

Pneumatic piston.

The valves supplied are fitted with a pneumatic piston for remote operation.

The piston is supplied with a flexible hose. This hose shall be connected to the tube coming from the valve release cabinet. The end connection on the flexible hose is 3/8'' BSP male swivel coupling. Length of hose is 303 mm.

The pneumatic piston is also supplied with two limit switches, one for start of alarm sirens and one for ventilation shut down. The limit switches accept cable with outside diameter max. 11mm.The connection of the switches has to be in accordance with the wiring diagrams.

Reference is also made to Attachment no. 15 / 16.

Make sure that no obstruction is causing the valve handle or the piston not to open fully.

4.1.7 CO_2 - Manifold pressure gauge.

The pressure gauge shall be installed on the collector pipe between the CO_2 - manifold and the CO_2 - master valves.

A 1/2'' BSP coupling shall be welded to the collector pipe. Add PTFE tape or Loctite 577 to the pressure gauge process connection and tighten up.

Make sure that the pressure gauge is easily visible.

Reference is also made to attachment 7.

4.1.8 CO_2 - Manifold relief valve.

The relief valve shall be installed on the collector pipe between the CO_2 - manifold and the CO_2 - master valves.

A 1/4'' NPT coupling shall be welded to the collector pipe. Add PTFE tape or Loctite 577 to the relief valve process connection and tighten up.

Reference is also made to attachment 8.

4.1.9 CO_2 - Shore connection / Air blowing through valve.

The CO_2 - shore connection / Air blowing through valve shall be installed on the collector pipe between the CO_2 - manifold and the CO_2 - master valves.

A 3/4'' BSP nipple shall be welded to the collector pipe. Add PTFE tape or Loctite 577 to the valve process connection and tighten up.

Reference is also made to attachment 9.

4.1.10 Pressure switch with manual reset.

The pressure switch shall be installed on the collector pipe between the CO_2 - manifold and the CO_2 - master valves or downstream of the CO_2 - master valves if a separate signal from each zone is required. This will be shown on the system drawing.

A 1/2'' BSP coupling shall be welded to the pipe. Add PTFE tape or Loctite 577 to the pressure switch process connection and tighten up.

If the switch has to be installed on the bulk head a 12 mm tube has to be installed between the switch and the CO_2 - pipe.

The switch has a double pole change over contact and one cable entry accepting cable diameter 11 mm.

Reference is also made to attachment 10.

4.1.11 CO_2 - Cylinder weighing device.

The weighing device is supplied with a weight including necessary equipment for lifting the CO_2 - cylinders. A steel bar dimensioned for a load of minimum 200 kg. point load has to be welded above each cylinder row. Minimum height from deck to the steel bar is 2100 mm.

Reference is also made to Attachment 11.

4.2 Installation inside the protected area.

The following equipment is normally installed inside the protected area.

- Piping.
- CO_2 - Nozzles.
- Alarms.

4.2.1 Piping.

The piping has to be installed in accordance with the general arrangement and the isometric piping drawing.

The piping has to be securely supported to avoid any damages upon release of a CO_2 - system. Upon supporting the pipes, the direction of flow should be considered, to avoid any elbows and/or Tee's to be blown off.

All pipes used shall be made from steel and the minimum dimensions has to be in accordance with the below table.

Nominal diameter		External Diameter	Minimum wall thickness		Minimum inside dia.
mm	Inch	mm	From CO_2 - cylinder to main valve	From main valve to nozzles	mm
15	1/2''	21,3	3,2	2,6	13
20	3/4''	26,0	3,2	2,6	19
25	1''	33,7	4,0	3,2	25
32	1 1/4''	42,4	4,0	3,2	32
40	1 1/2''	48,3	4,0	3,2	38
50	2''	60,3	4,5	3,6	50
65	2 1/2''	76,1	5,0	3,6	65
80	3''	88,9	5,6	4,0	76
100	4''	114,3	7,1	4,5	101
125	5''	139,7	8,0	5,0	123
150	6''	168,3	8,8	5,6	150

Table 4.2.1-1

The piping has to be pressure tested when the installation is completed as follows.

Class	From CO_2 -cylinder to main valve/pilot tube.	From main valve to nozzles
Det Norske Veritas	150 Bar.	10 Bar. (Air)
Lloyds Register of shipping	190 Bar.	50 Bar. (Hydraulic)
American bureau of shipping	150 Bar.	50 Bar. (Hydraulic)
Bureau Veritas	128 Bar.	7 Bar. (Air)
Germanish Lloyds	150 Bar.	10 Bar. (Air)
Russian Register of Shipping	240 Bar.	50 Bar. (Hydraulic)

Table 4.2.1-2

Flag	From CO_2 -cylinder to main valve/pilot tube.	From main valve to nozzles
Nor/NIS	150 Bar.	7-10 Bar. (Air)
Swedish	150 Bar.	50 Bar. (Hydraulic)
Danish	150 Bar.	50 Bar. (Hydraulic)
Finnish	150 Bar.	50 Bar. (Hydraulic)

Table 4.2.1-3

4.2.2 CO_2 - Nozzles.

The CO_2 - Nozzles shall be installed in accordance with the general arrangement drawing and the isometric piping drawing.

The nozzles are supplied with BSP Female threads in three dimensions.

-1'' BSP

- 3/4'' BSP

- 1/2'' BSP

Each branch of the piping has to end with a BSP threaded nipple. Dimension to be the same as for the nozzle.

Please note that the nozzle will have different bore. The actual bore is stamped on each nozzle. The nozzles have to be fitted in accordance with the applicable drawings. All nozzles shall be directed vertically.

Reference is also made to attachment 12.

4.2.3 Alarms.

Two main types of alarms are supplied. These are as follows.

- Air operated typhoons.

- Electric operated sirens.

The alarm sirens should generally be located nearby the entrances to the protected area.

Power supply to the alarm sirens shall be from the Main and Emergency power supply on board.

Air operated typhoons.

The air operated typhoon siren is supplied as one unit including solenoid valve. The air to the typhoon shall be from the starting air receivers. The end connection on the typhoon is 1/2'' BSP female.

The cable for the solenoid valve shall be 1 x 2 x 1,5 mm^2 ship cable. Maximum outside diameter to be 11 mm.

Two standard voltages are supplied, 24 VDC or 220 VAC.

Please refer to wiring diagram or the solenoid name plate for correct voltage, as faulty voltage can destroy the solenoid.

Note that maximum operating air pressure is 12 Bar. If the starting air pressure is higher a pressure reducing valve has to be fitted.

The typhoon siren is supplied with a steel bracket with two holes each 12 mm. The bracket shall be securely supported to the bulkhead using minimum 10 mm bolts.

Some of the authorities are requiring additional air receivers located outside the protected area if the starting air receiver is located inside.

Electric alarm sirens.

The electric alarm sirens are generally of the electronic type, with adjustable sound and frequency. The sirens are normally supplied pre- adjusted. At site adjustment may be necessary to achieve a sufficient volume of the sound.

The cable for the siren shall be 1 x 2 x 1,5 mm^2 ship cable. Maximum outside diameter to be 11 mm.

Two standard voltages are supplied, 24 VDC or 220 VAC.

Please refer to wiring diagram or the siren name plate for correct voltage, as faulty voltage can destroy the solenoid.

The siren is supplied with two holes for supporting, each 6,5 mm dia. Minimum 5 mm bolts to be used for supporting the siren to the bulkhead.

Electric alarm siren for Hazardous area.

The electric alarm siren for Hazardous area is supplied 2 pcs M20 cable inlets where one is plugged.

Two standard voltages are supplied, 24 VDC or 220 VAC.

Please refer to wiring diagram or the siren nameplate for correct voltage, as faulty voltage can destroy the solenoid.

The siren is supplied with three holes for supporting, each 7 mm dia. Minimum 4 mm bolts to be used for supporting the siren to the bulkhead.

4.3 Release station.

The control station consist of one supply cabinet and one valve release cabinet for each zone. The release station shall be located in accordance with the general arrangement drawings and the CO_2 - Room arrangement drawing.

4.3.1 Supply cabinet.

The supply cabinet shall be supported to the bulkhead using the 4 holes drilled in the back plate of the cabinet. M8 bolts to be used.

It shall be connected to the valve release cabinet using 8 x 1mm instrument tube. (Ref. 4.3.3). The 8mm-compression coupling is located at the bottom of the cabinet.

Reference is also made to Attachment 13.

4.3.2 Valve release cabinet.

The supply cabinet shall be supported to the bulkhead using the 4 holes drilled in the back plate of the cabinet. M8 bolts to be used.

It shall be connected to the supply cabinet, CO_2 - cylinders and the master valve using 8x1mm-instrument tube. (Ref. 4.3.3). The 8mm compression coupling for the pilot pressure inlet is located at the bottom of the cabinet and the pilot pressure outlet to the CO_2 - cylinder's and the master valve is at the top.

The valve release cabinet has two limit switches, one for start of alarm siren and one for ventilation shut down. Two cable gland PG 16, bottom entry are fitted.

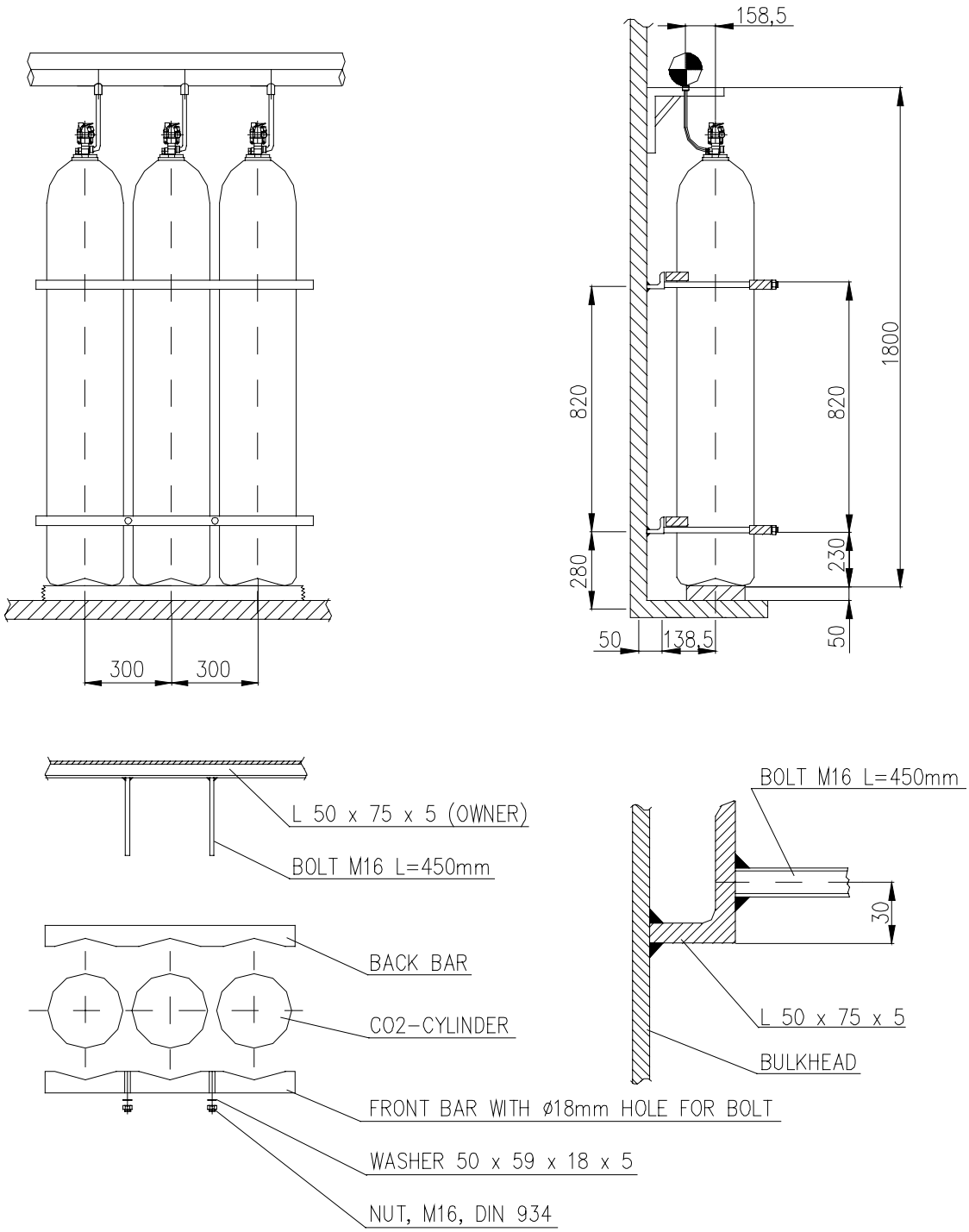
Reference is also made to Attachment 13/15/16.

4.3.3 Pilot tube.

The pilot tube shall as a minimum be ø 8x1mm high-pressure steel instrument tube.

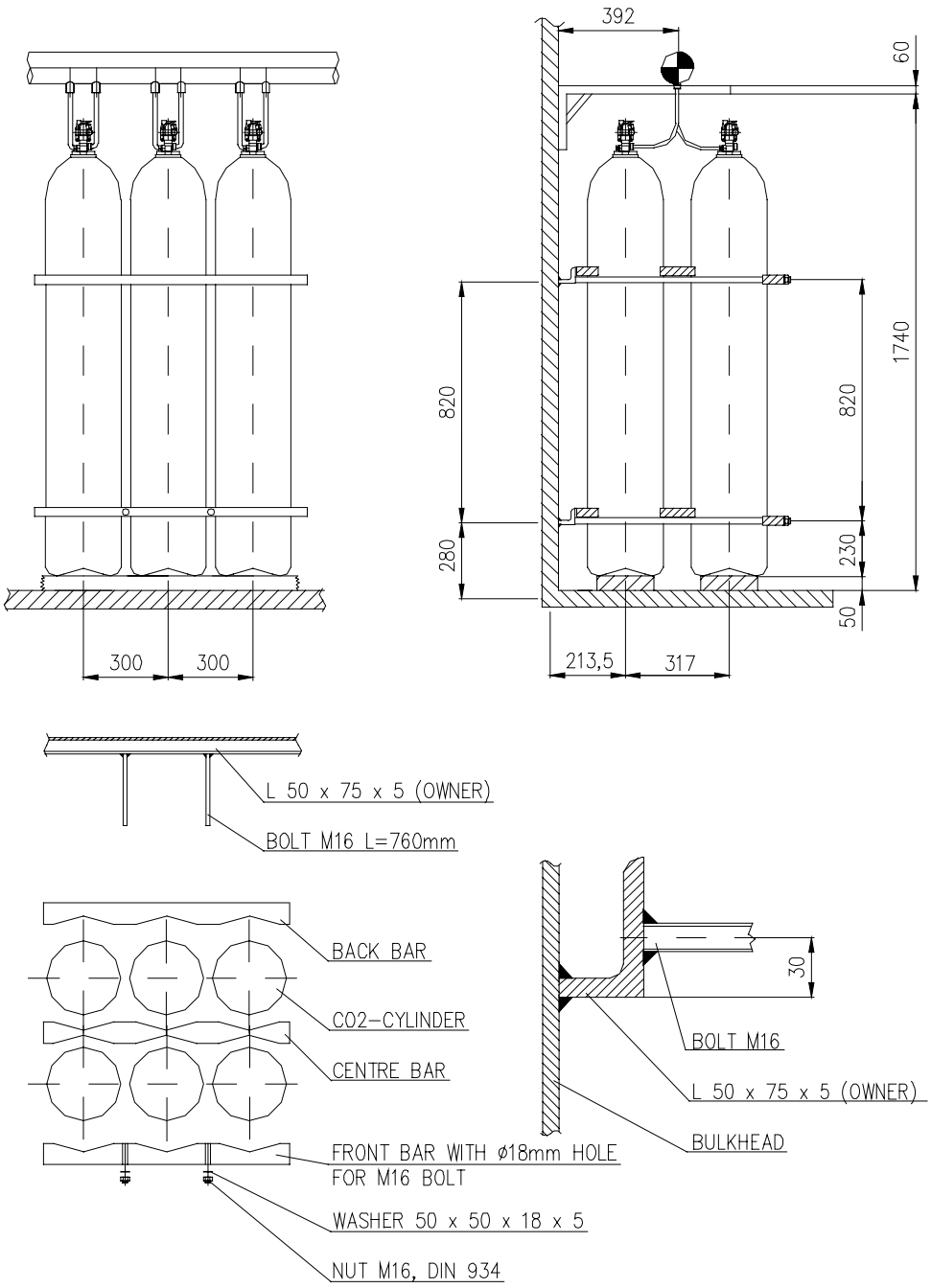
Upon completion the installation shall be pressure tested in accordance with table 4.2.1-2

CO_2 - Cylinder battery, 1 Row



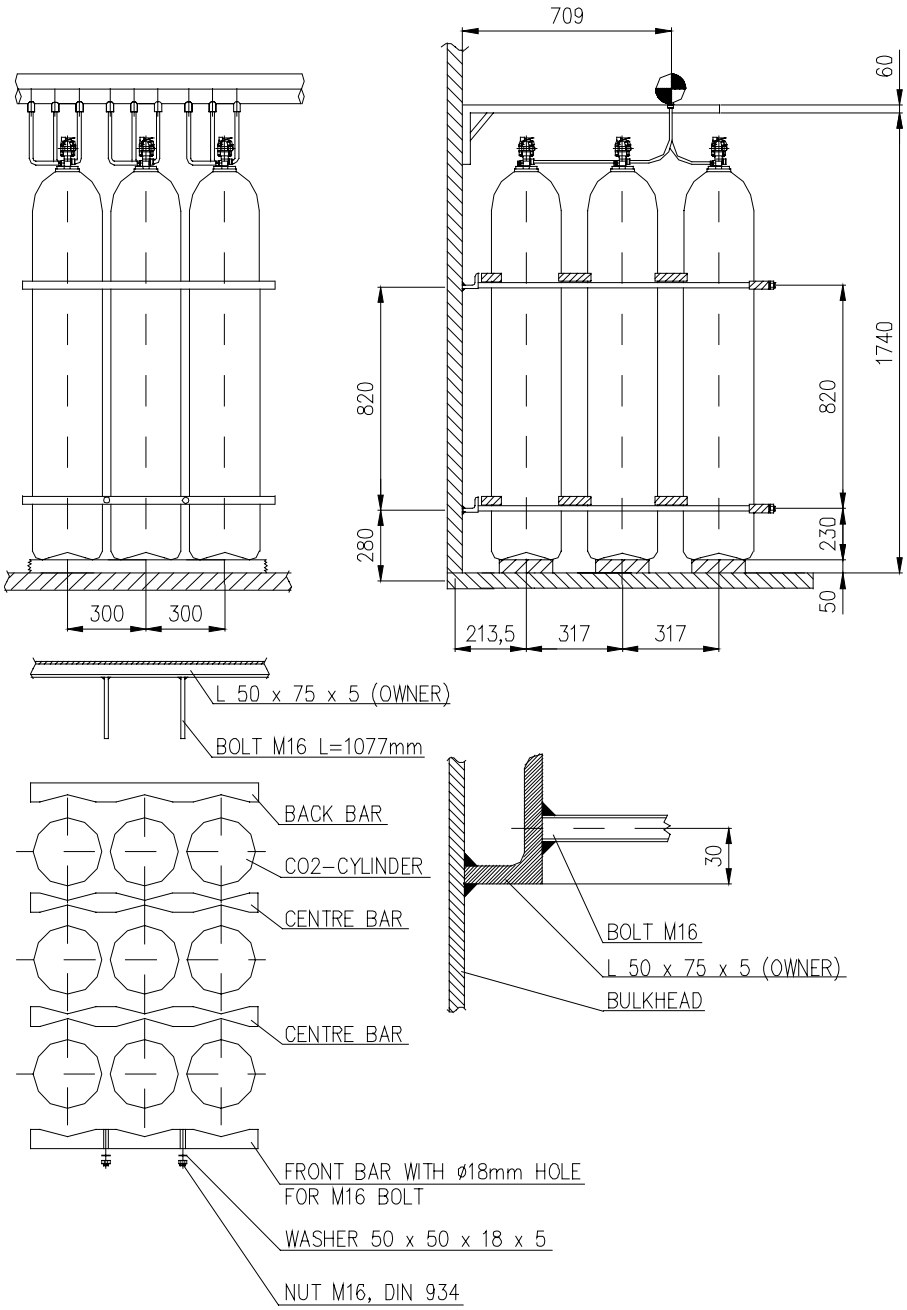
Attachment 1

CO_2 - Cylinder battery, 2 Row's



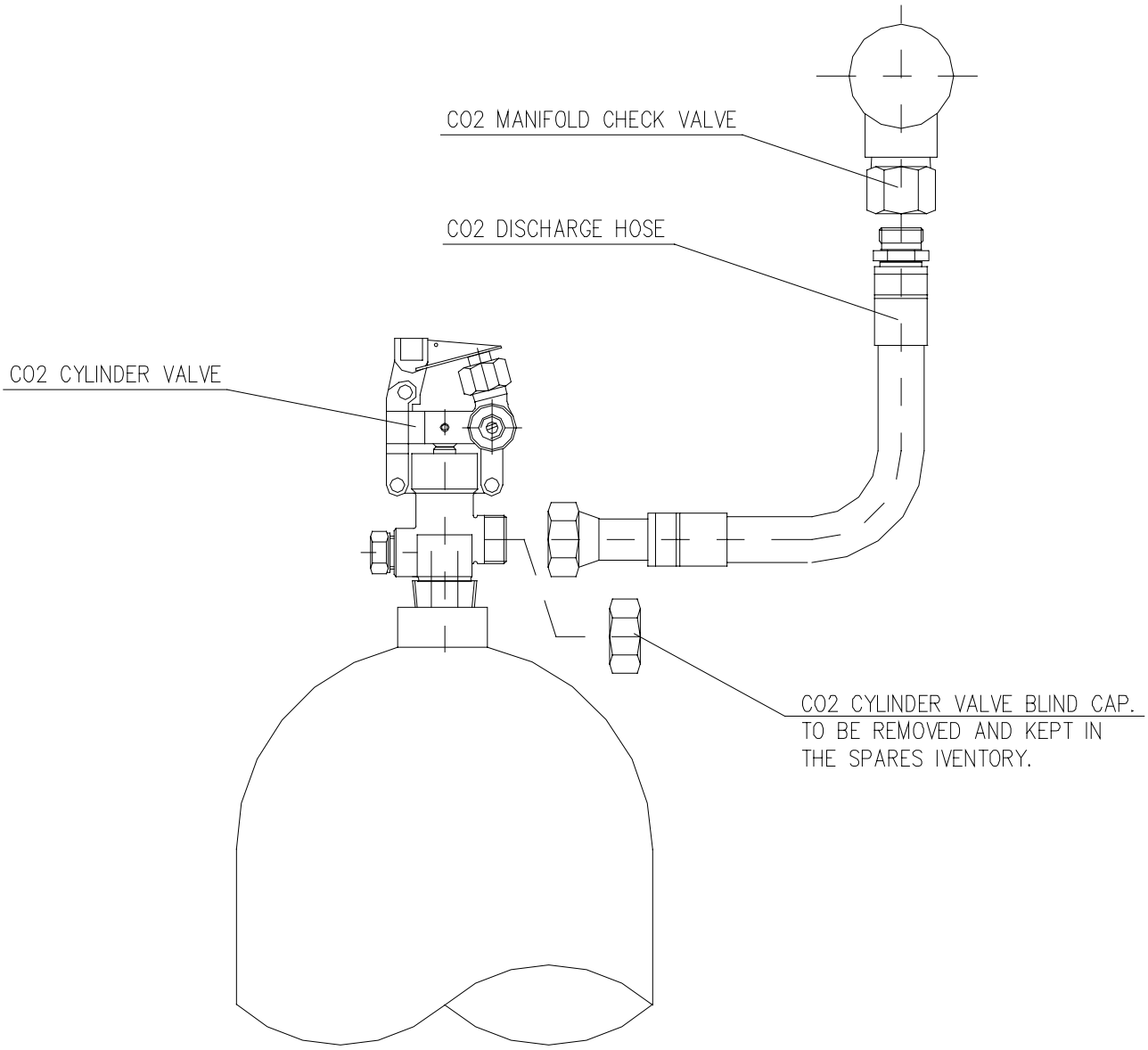
Attachment 2

CO_2 - Cylinder battery, 3 Row's



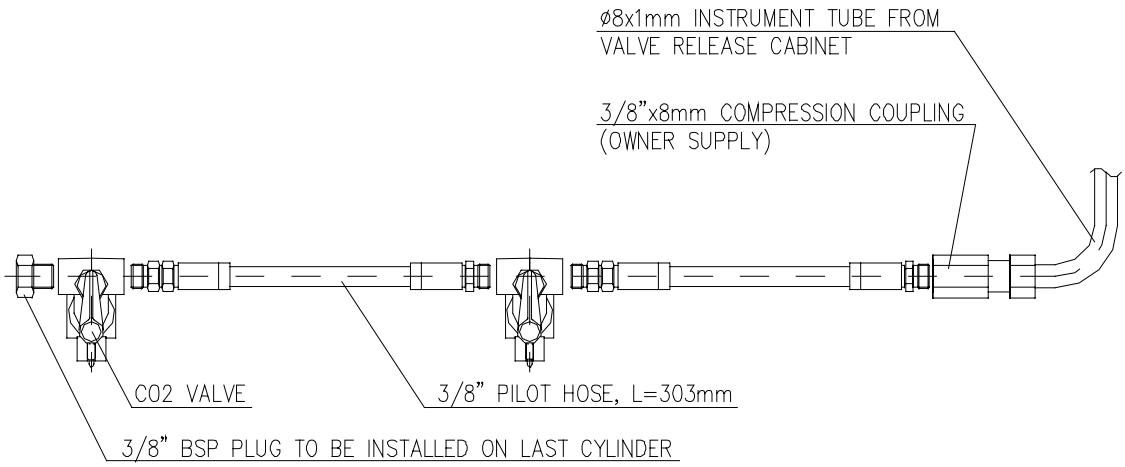
Attachment 3

CO_2 - Discharge hose

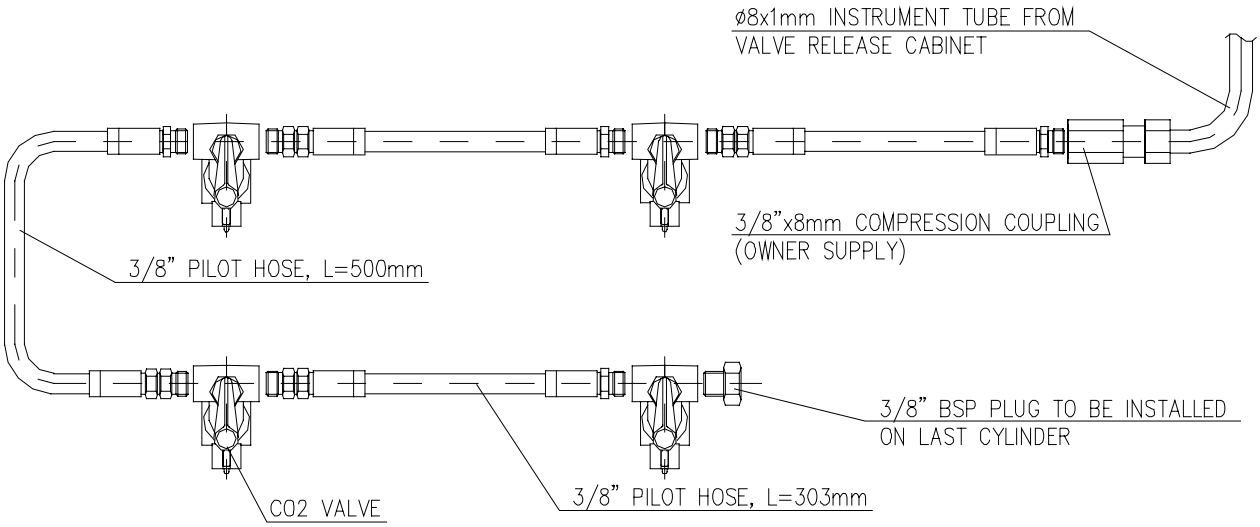


Attachment 4

Pilot manifold



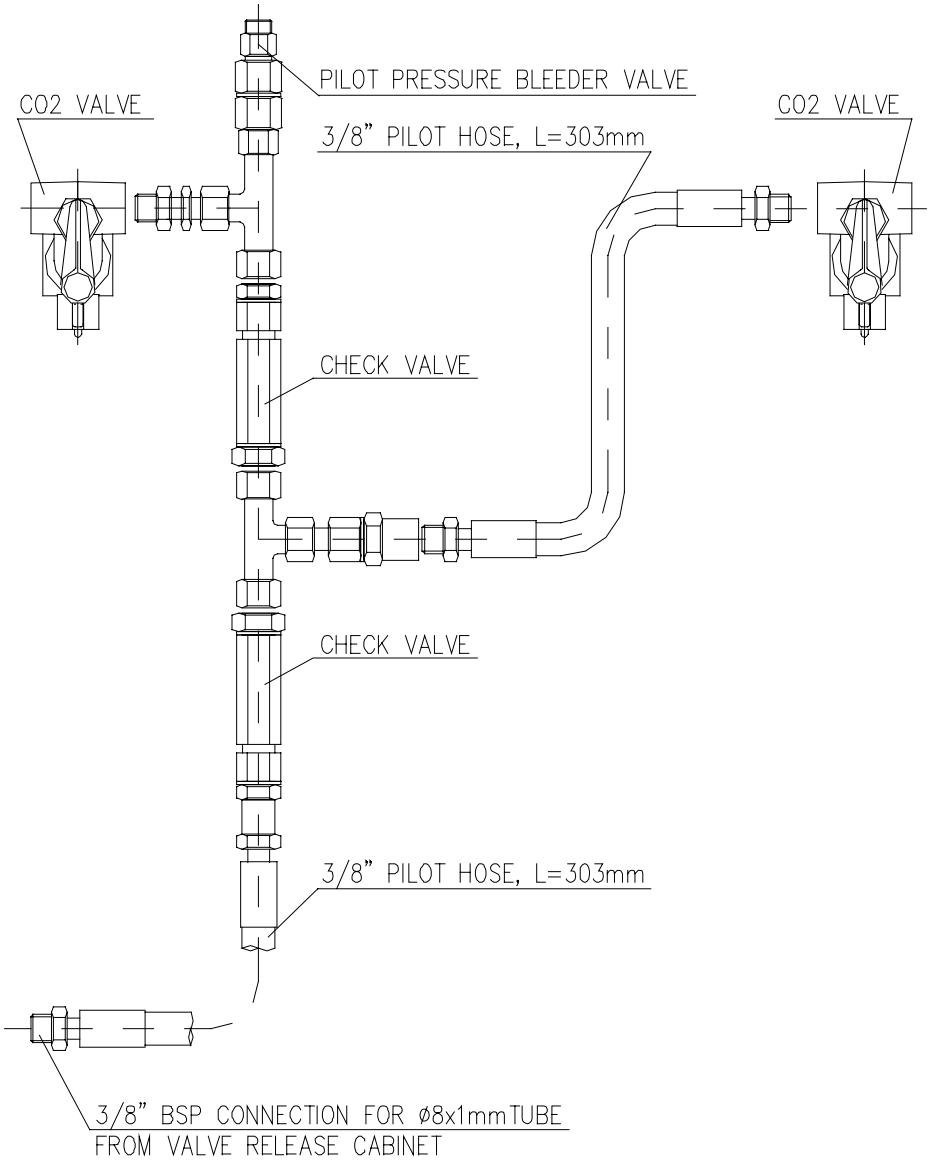
PILOT MANIFOLD FOR 1 ROW



PILOT MANIFOLD FOR 2/3 ROWS

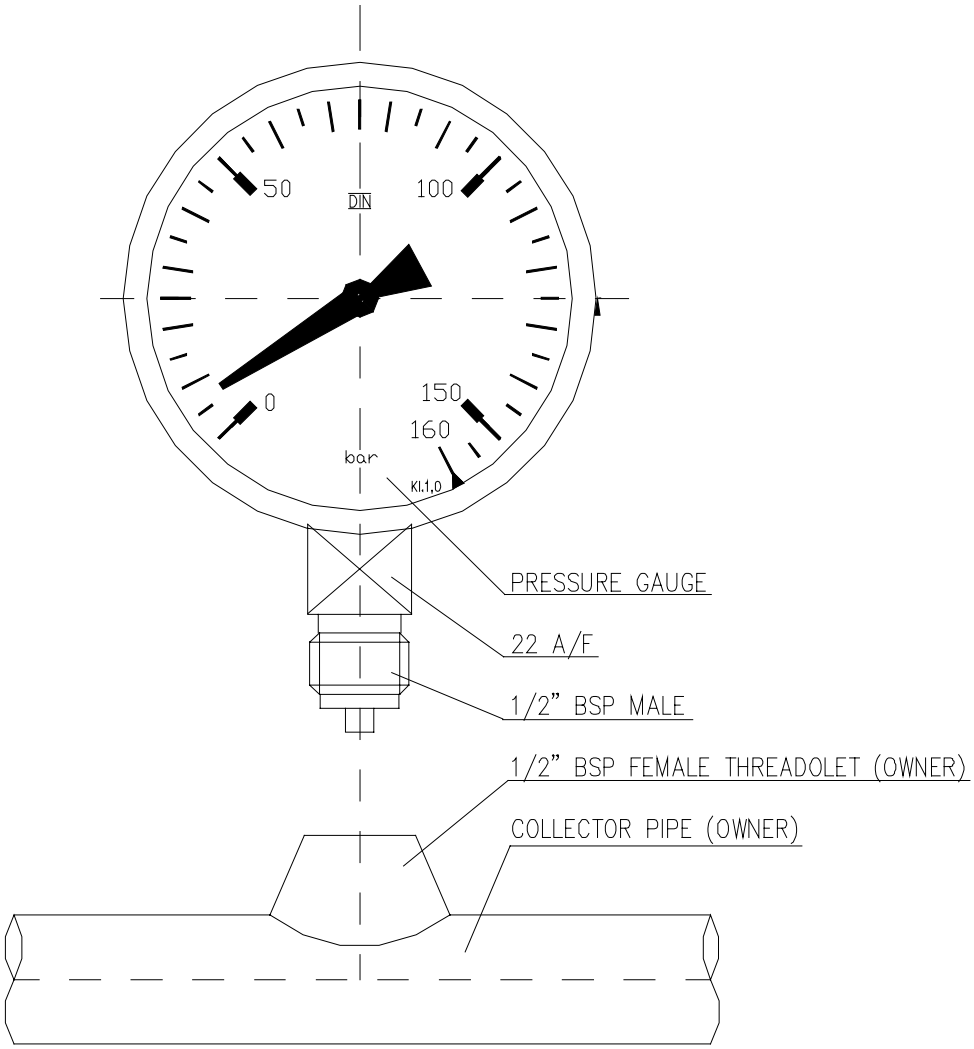
Attachment 5

Non return valve, System



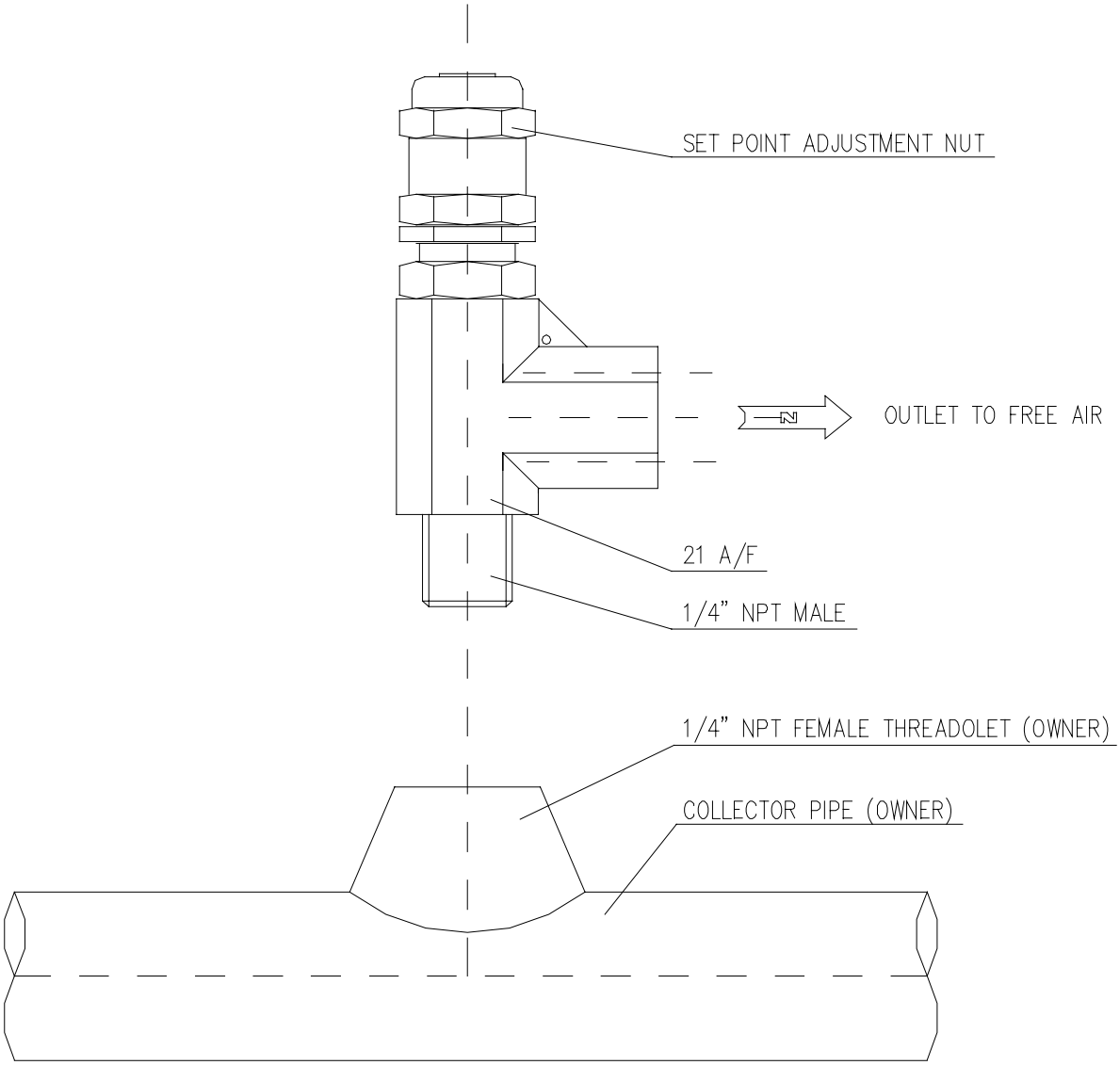
Attachment 6

Pressure gauge



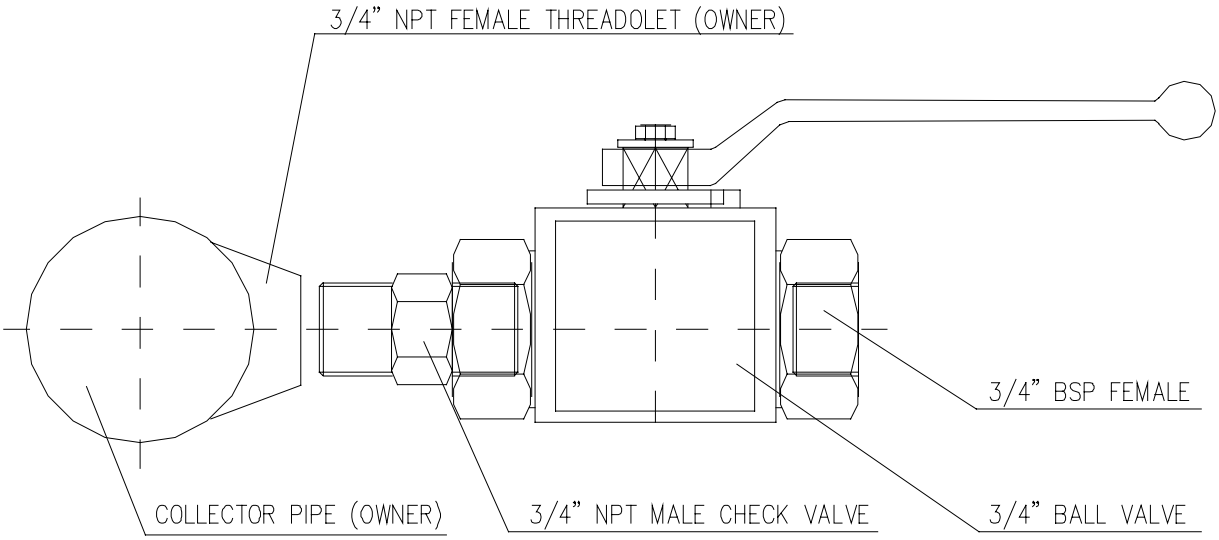
Attachment 7

CO_2 - Manifold relief valve



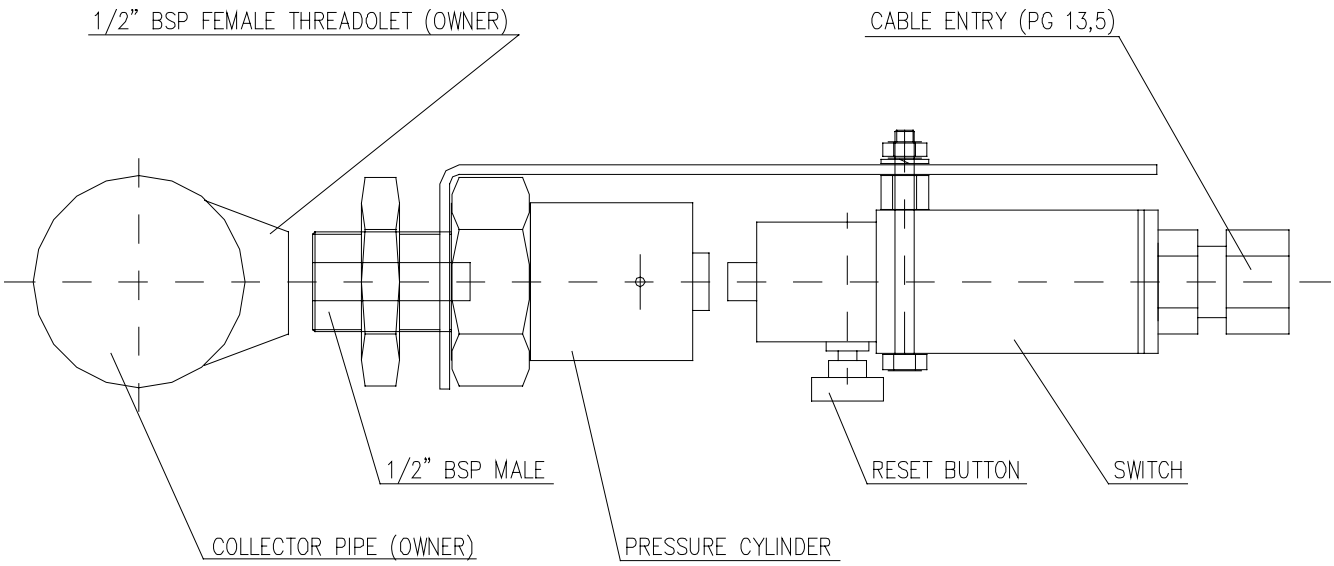
Attachment 8

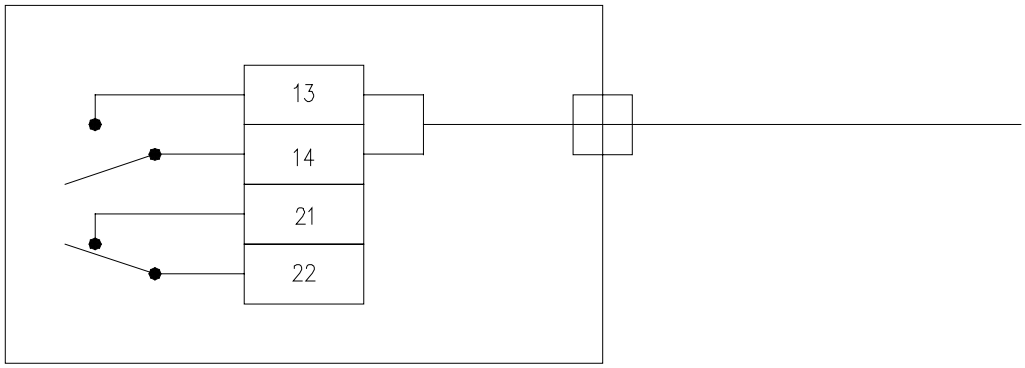
CO_2 - Shore connection / Air blowing through valve



Attachment 9

Pressure switch

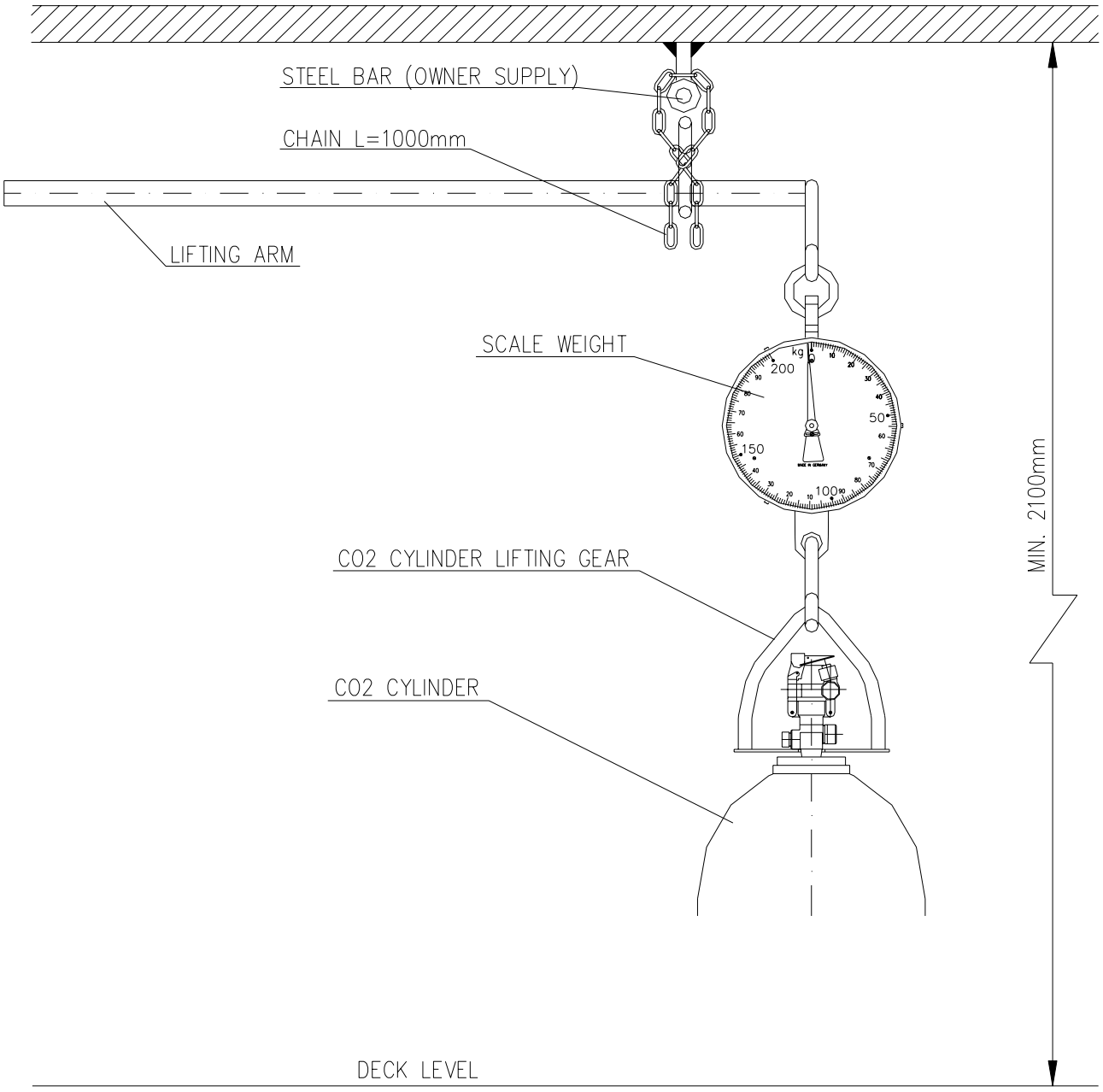




LIMIT SWITCH CONTACT POSITION

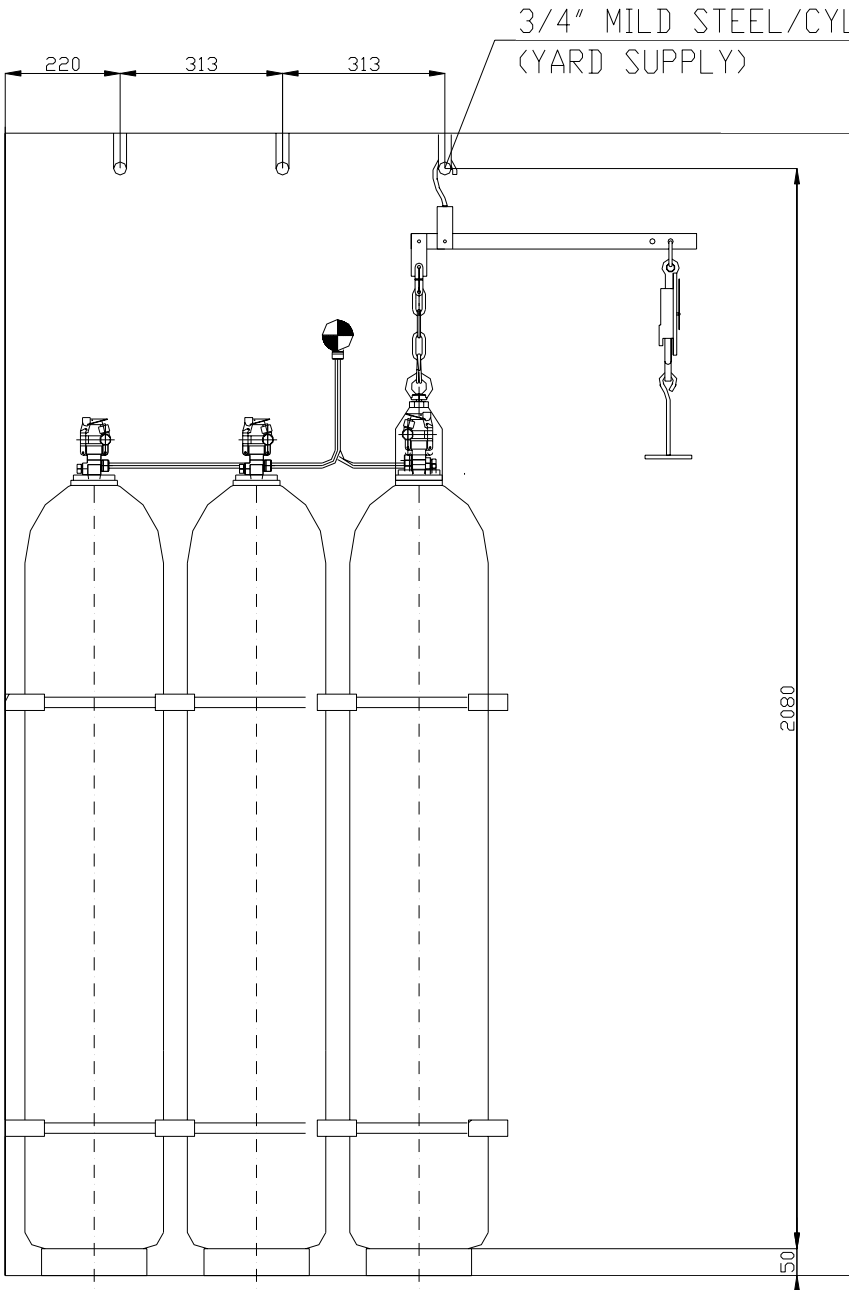
Attachment 10

Weighing device HL Standard



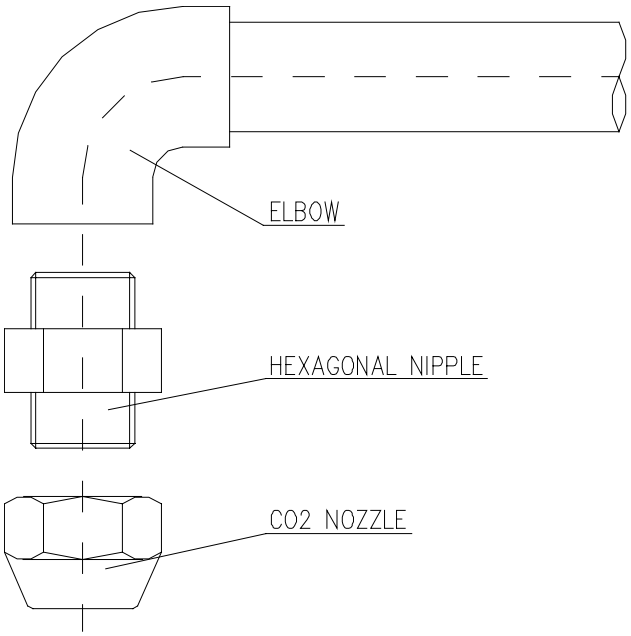
Attachment 11

Weighing device type Kidde Deugra

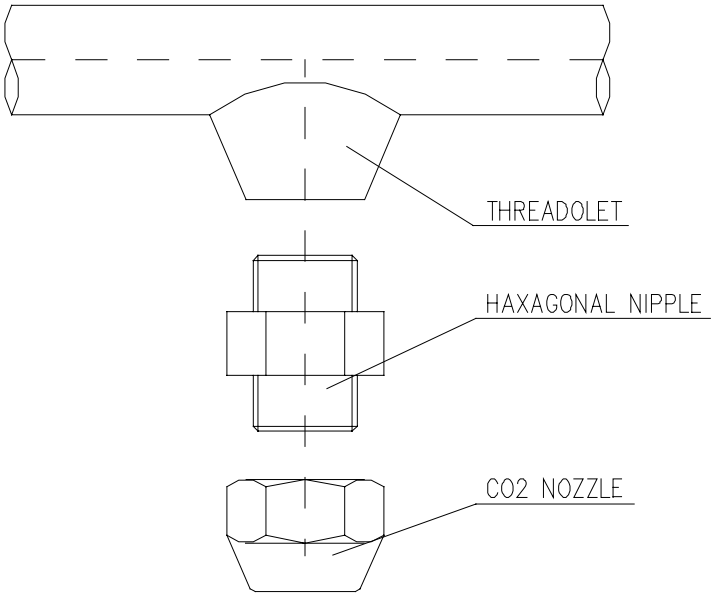


Attachment 10.2

CO_2 - Nozzles



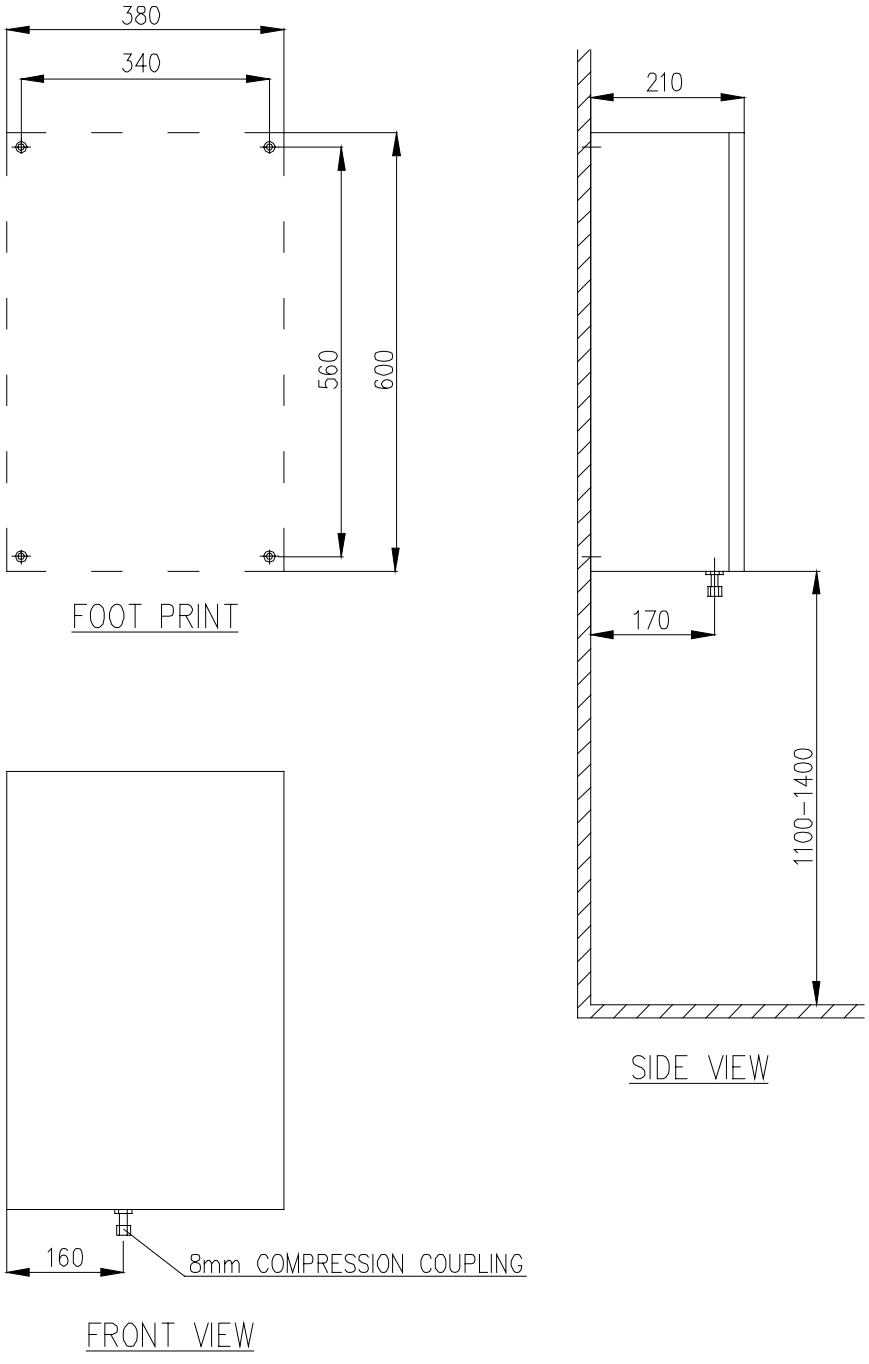
CO2 NOZZLE AT THE END OF THE PIPE



CO2 NOZZLE FITTED TO THE PIPE LINE

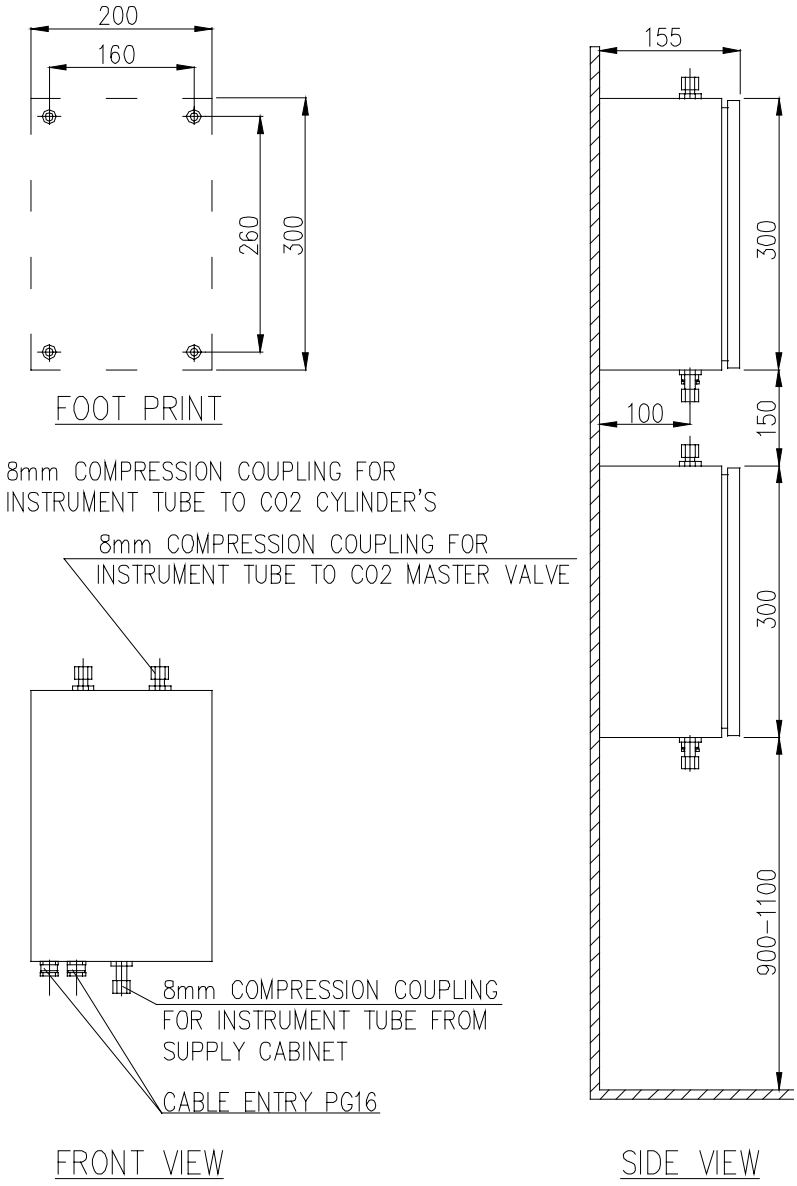
Attachment 12

Supply cabinet



Attachment 13

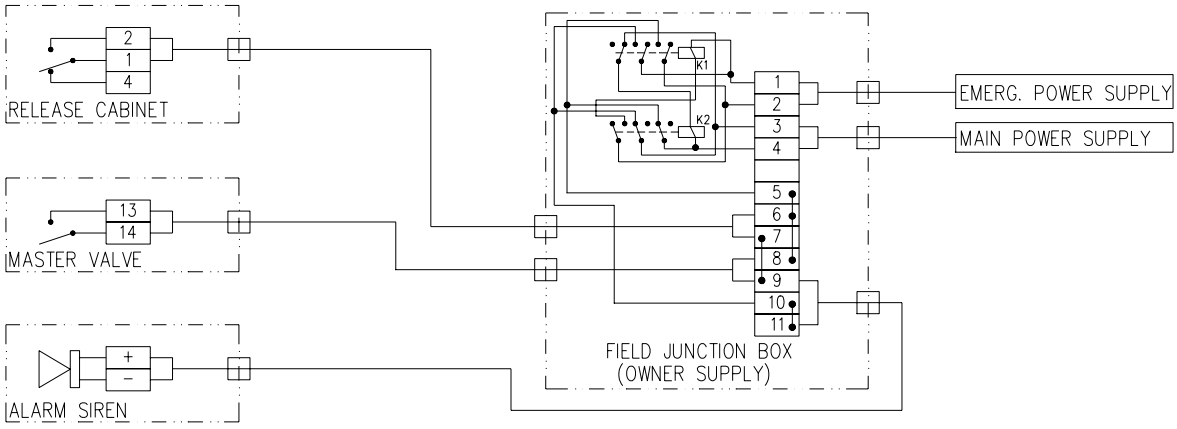
Valve release cabinet



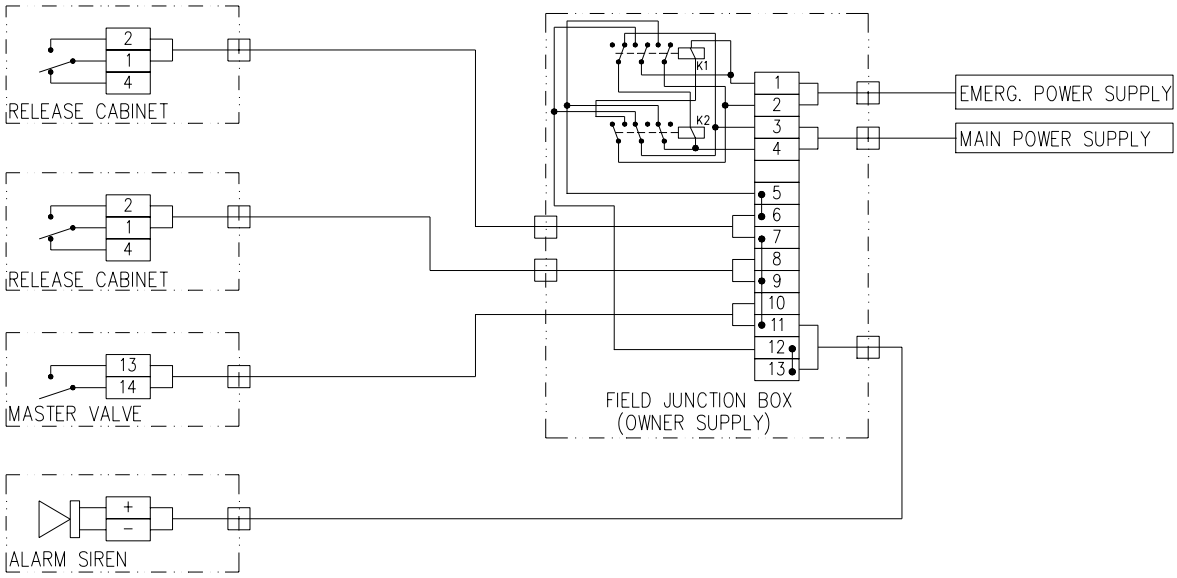
Attachment 14

Wiring diagram - Alarm siren

ONE RELEASE STATION



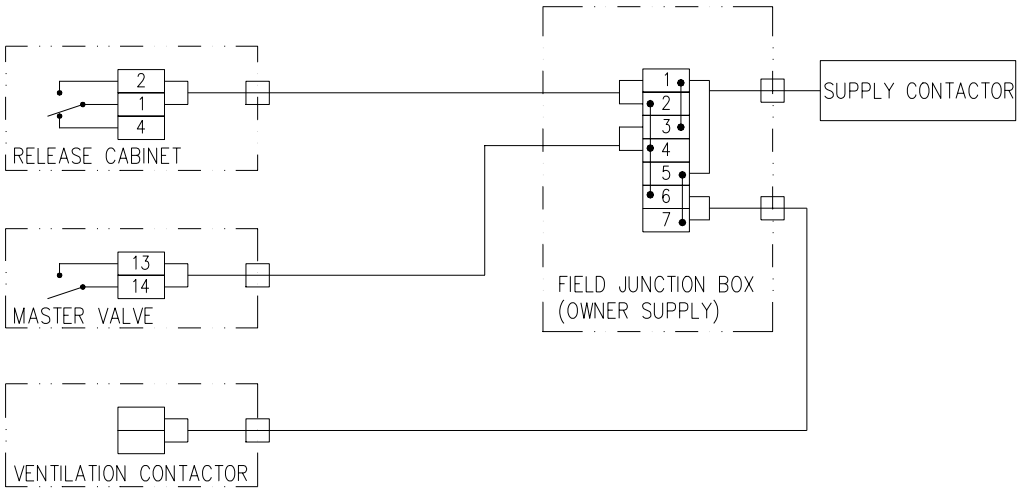
TWO RELEASE STATION'S



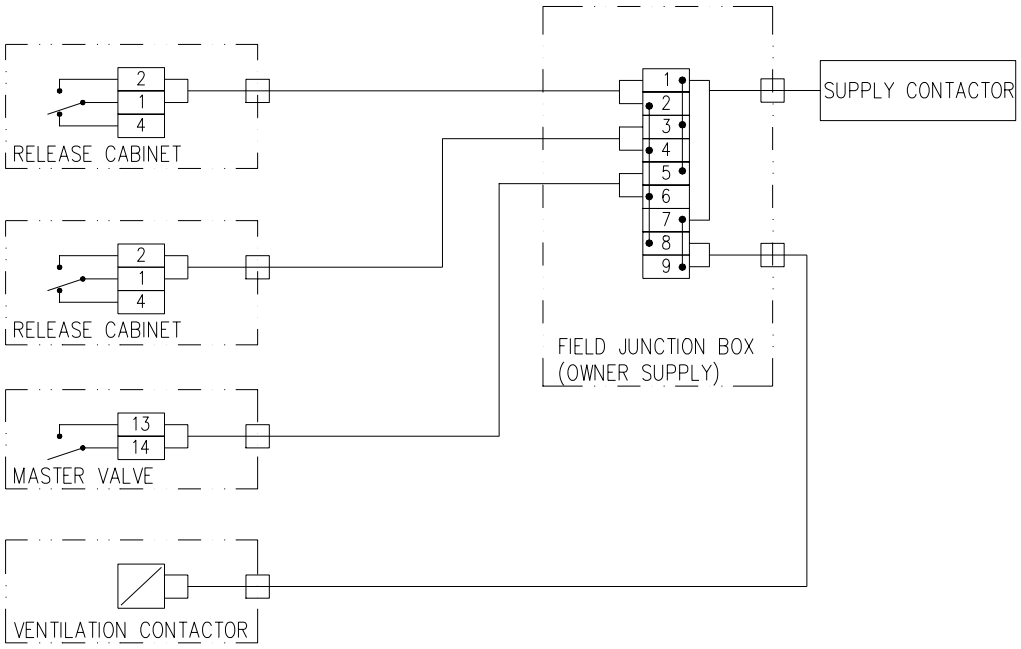
Attachment 15

Wiring diagram - Ventilation shut down

ONE RELEASE STATION



TWO RELEASE STATION'S



Attachment 16

5 OPERATION INSTRUCTION.

5.1 General.

All personnel shall be trained with respect to all procedures related to a CO_2 - fire extinguishing system. It is also important to respect and to take notice of the CO_2 - alarm. The area shall be evacuated immediately. The CO_2 - gas is a suffocating gas that by 8% mixture is dangerous to people. By discharge of a CO_2 - fire extinguishing system the mixture will be minimum 30%.

5.2 Release of the system using the supply cabinet and the valve release cabinet.

Each cabinet is fitted with an instruction sign pointing out the steps to operate the system. The system shall be operated in the following manner.

1. Open the door to the valve release cabinet for the actual room on fire.
2. The alarm siren will start and the ventilation will stop.
3. Evacuate the protected area.

   Be sure that no personnel are left inside.
4. Open both the ball valves inside the valve release cabinet.
5. Use the key located inside the valve release cabinet to open the supply cabinet.
6. Open one of the pilot cylinders. After a pre - set time (Normally 20 - 30 seconds the pressure gauge shall show approximately 50 Bar). By low pressure open the other pilot cylinder.
7. The system is now released, the required number of CO_2 - cylinder's has been operated and the master valve to the area protected has been opened.

If the release station is located in another location than the CO_2 - cylinder's you shall go to the CO_2 - room and check that the correct number of cylinder's has been released and that the correct master valve has been operated.

Number of cylinder's to be released is described on the instruction posted onboard.

5.3 Manual release by operating the Master valve and the CO_2 - cylinder valves.

If the CO_2 - pilot cylinders are empty the system can be operated manually as follows.

1. Evacuate the protected space.

   Be sure that no personnel are left inside.

2. Open the master valve to the actual room.

   Alarm siren will start and the ventilation will stop.

3. Open the required number of CO_2 - cylinders as described on the instruction.

   The valves are operated using the lever on top of the CO_2 - cylinder valve.

4. The system is now operated.

5.4 Important notice and safety instruction.

5.4.1 General

The systems are manual mode, meaning that the release of CO_2 will be under the control of the person in charge in the event of fire.

5.4.2 Escape ways, emergency routines.

The following general safety requirements should be considered when making Emergency Safety Routines at Site:

The steps and safeguards necessary to prevent injury or death to personnel in areas whose atmosphere will be made hazardous by the discharge of CO_2 may include the following:

(a) Provision of adequate aisle ways and routes of exit and keeping them clear at all times.

(b) Provision of emergency lighting and directional signs as necessary to ensure quick, safe evacuation.

(c) Provision of alarms within such areas that will operate immediately upon detection of the fire and activation of the CO_2 - system.

(d) Provision of only outward swinging self-closing doors at exists from hazardous areas, and, where such doors are latched, provision of panic hardware.

(e) Provision of continuous alarms at entrances to such areas until the atmosphere has been restored to normal.

(f) Provision of warning and instruction signs at entrances to and inside such areas. These signs should inform persons in or entering the protected area that a CO_2 system is installed, and may contain additional instructions pertinent to the conditions of the hazard.

(g) Provision for prompt discovery and rescue of persons rendered unconscious in such areas. This may be accomplished by having such areas searched immediately by trained personnel equipped with proper breathing equipment. Self-contained breathing equipment and personnel trained in its use, and in rescue practices, including artificial respiration, should be readily available.

(h) Provision of instruction and drills of all personnel within or in the vicinity of such areas, including maintenance or construction people who may be brought into the area, to ensure their correct action when CO_2 protective equipment operates.

(I) Provision of means for prompt ventilation of such areas. Forced ventilation will often be necessary. Care should be taken to really dissipate hazardous atmospheres and not merely move them to another location.

(j) Provision of such other steps and safeguards that a careful study of each particular situation indicates are necessary to prevent injury or death.

5.4.3 Before release.

Check the following before release:

- The size of the fire. Is it more adequate to use a hand extinguisher?
- Personnel. Evacuate all personnel.
- Doors. Check that all doors are closed and that all other air leaks are stopped.

5.4.4 After release.

Immediate warning should be given to proper site safety personnel after CO_2 has been released mechanically. Please check site routines and note the following points:

a) Controls that correct amount of CO_2 have been released. Please note that cylinders may also be released by pushing valve lever on each cylinder head.

b) Before entering room make sure to:

- Cut power supply if possible.
- Wear a breathing apparatus.
- Carry a safety axe and an ABE hand extinguisher.

c) Do not enter fire room alone. When entering keep doors closed and check as follows:

- Check for people.
- Localise where fire started.

d) Ventilate room thoroughly before permitting people to enter without breathing apparatus.

e) Change CO_2 cylinders with spare located on the skid. Spare cylinders may also be used if system in service did not extinguish fire properly.

f) Refill CO_2 cylinders immediately.

g) Reset timer valve (See release test).

6 MAINTENANCE INSTRUCTION

6.1 Introduction.

Procedures laid down in this manual should be followed strictly. If deviations from this procedures are made H-L should be informed as this may result in system failure.

6.2 Precautions.

Make sure that all personnel are informed that the CO_2 - system shall be tested, and the none are left in the protected space as an accidental release of CO_2 will be life threatening to personnel in the flooded area.

Check that the ventilation is running.

6.3 Periodical control of the CO_2 - system.

The CO_2 - system shall be tested and certified by the manufacturer or by representative authorised by him as follows.

Passenger ships / Onshore installations. : Every year

Commercial ships : Every second year

6.3.1 CO_2 - gas content.

Using a liquid level indicator can check liquid level on the cylinders, if available on board. If liquid level is below required level according to bar chart the cylinder must be weighed. Please note that level varies with temperature.

If a liquid level indicator is not available the cylinders has to be weighed. The total weight shall be as stamped on the cylinders. The total content of CO_2 - gas in the system shall be within a limit of +/- 10%.

If the weight is to low the cylinder must be sent to for recharging.

Bar chart for liquid level, reference is made chapter 6.7

6.3.2 CO_2 - Cylinder valves.

Check cylinder valves for damages. If a damage is observed the cylinder has to be taken on-shore for repair.

6.3.3 CO_2 - discharge hose.

The connections between the CO_2 - cylinder valve and the manifold shall be checked for leakage as follows.

Pressurise the manifold by compressed air, 6 - 10 Bar. Check for leakage. If a leakage is observed try to tighten the coupling, or if necessary replace the hose with one from the spare stored on board.

If all connections are tight, continue as follows.

Open and close quickly each CO_2 - cylinder valve manually by using the handle. The pressure gauge will indicate 50 - 55 Bar. Check again for possible leakage and tighten if necessary.

6.3.4 CO_2 - Manifold.

Check all connection on the CO_2 - manifold for leakage's. All leaks have to be tightened.

6.3.5 CO_2 - master valve.

Open the CO_2 - master valve by hand. CO_2 - gas from the manifold will be blown through the piping to the protected space. The alarm siren will start and the ventilation will stop.

6.3.6 Ventilation.

Re - start the ventilation to the area protected.

NOTE : The CO_2 - Content shall be checked before the area is entered.

6.3.7 CO_2 - Pilot hose.

The following action has to be executed before the pilot manifold / flexible hoses are pressure- tested.

Remove all CO_2 - Discharge hoses and install the blind cap on all the CO_2 - cylinder valves.

Remove the flexible hose to the pneumatic operated master valve and blind the hose.

Apply Nitrogen pressure to the pilot manifold using Nitrogen. Test pressure to be 100 Bar. Check for leakage. All leakage shall be tightened and damaged flexible hoses shall be replaced.

6.3.8 Instruction signs and operating instructions.

Check that all instruction signs and operating instructions are in good condition and properly fastened.

6.3.9 CO_2 - Cylinder clamps.

Check that all cylinders are properly secured and that all clamps are tightened.

6.3.10 CO_2 - Pilot cylinders.

The CO_2 - pilot cylinders shall be removed from the release cabinet and weighed. The gross weight shall be as stamped on the cylinder neck. The pilot cylinder shall be refilled if 10% or more of the gas has leaked out.

6.3.11 CO_2 - Pipes / CO_2 - Nozzles

All CO_2 - Pipes to the protected areas shall be blown through with instrument air or equal. Pressure to be 6 - 10 Bar. Some Classification Societies and Flag States requires 50 bar Hydraulic pressure test with water of this piping and it is very important that all water is drained out after the pressure test. The complete pipe must be dried and blown through with dry air/N2 after the pressure test.

A piece of tape to be fitted to all nozzle openings. Connect air source to the air blowing through valve. Open the master valve to the protected area and pressurise the piping. Check that the tape has been blown off from all the nozzles.

6.4 Monthly check.

The CO_2 - System should be checked once a month as follows.

6.4.1 CO_2 - Discharge hose / Pilot hoses.

All flexible hoses should be checked visually that they are free from wear and tear.

6.4.2 CO_2 - Cylinder valves.

All CO_2 - valves should be checked visually that they are closed and that they are in proper condition.

6.4.3 CO_2 - piping / master valves.

Check that the manifold pressure is zero and that the master valves are closed.

6.4.4 CO_2 - Cylinders.

Check that the CO_2 - cylinders are securely clamped and that they are in proper condition with respect to surface finish.

6.4.5 CO_2 - Alarms / Ventilation stop.

Check the alarm sirens and the ventilation stop by opening the release cabinet door(s) and the Master valve(s).

6.4.6 Improper function / Damaged items.

Any item which has an improper function or is damaged shall be repaired or replaced immediately.

6.5 System testing.

The installation is intended for CO_2 ''Total flooding'' Fire extinguishing system in Machinery spaces category A and Cargo spaces. In addition local systems can be installed for Paint stores and for Galley hoods among others.

WARNING!

All CO_2 - cylinder valve's shall be sealed with the cap supplied with the CO_2 -cylinder's from the filling station. This to secure that no CO_2 - Gas will leak out by an accidental release.

6.5.1 Hydraulic pressure test of pipes inside the CO_2 - Room.

All pre - welded manifolds from CO_2 - cylinders to the CO_2 - master valves shall be hydraulic pressure-tested in accordance with table 4.2.1-2. The pressure test should be carried out using fresh water.

Make sure that all the water has been properly dried out after the test and then be sure that the pipes are dry before installation on board. This is important as any water left in the pipe will freeze upon an CO_2 - discharge and the ice can clog the CO_2 - nozzles.

NOTE:

All pre - welded manifolds supplied by Heien - Larssen are pressure tested to the pressure required by the various class authorities. The authorities issue a certificate in question for the specific project.

6.5.2 Leakage test, CO_2 - pipes downstream master valves.

1. Blank off all nozzle outlets with pipe caps in the protected space.
2. Connect an air source with 7 - 10 Bar pressure to the air blowing through valve in the CO_2 - room and keep the master valves shut. (Some Classification Societies and Flag States requires 50 bar Hydraulic pressure test with water of this piping and it is very important that all water is drained out after the pressure test. The complete pipe must be dried and blown through with dry air/N2 after the pressure test).
3. Open the air blowing through valve and pressurise the manifold inside the CO_2 - room. Check for leakage.
4. Open the master valve to the protected space. This will pressurise the piping to the machinery space. Check for leakage.
5. After completion of the test re-install all the CO_2 - nozzles.
6. When the installation of the CO_2 - nozzles are completed, put a small piece of tape on each CO_2 - nozzle. Pressurise the CO_2 - manifold with air, 7 - 10 Bar and open the CO_2 - master valve.

Continue to the protected space and check that all the tape has been blown off.

7. Check that the nameplates on the master valves for the protected spaces are correct by opening the valves one by one and blow through the CO_2 - pipeline by compressed air.

6.5.3 Release test.

All the CO_2 - cylinder valves shall be kept with the blind cap installed.

1. Open and close each CO_2 - cylinder valve manually and check that all caps are tight.
2. Connect a Nitrogen cylinder fitted with a pressure reducing valve to the flexible hose inside the supply cabinet/release cabinet.. The flexible hose shall be disconnected from the CO_2 - pilot cylinder.
3. Open the Nitrogen cylinder valve and adjust the outlet pressure to 50 Bar.
4. Open both valves in the valve release cabinet or the release cabinet.
5. CO_2 - cylinders and the CO_2 - master valve for the actual area will be activated after a time delay of 20 - 30 seconds.
6. Check that the required number of CO_2 - cylinders has been activated and that the correct Master valve has operated.
7. Reset the timer valve by disconnecting the flexible hose from the accumulator cylinder and open the N2 pressure in 1 – 2 seconds. The piston in the timer valve will then be pressed to correct position. Close the N2 valve again and connect the flexible hose to the accumulator again.
8. Disconnect the Nitrogen test cylinder and reconnect the CO2 start cylinders in release locker. Make sure that all the pilot pressure has been relieved.
9. Close all the CO_2 - cylinder valves.

6.5.4 Leakage test of CO_2 - cylinder valves.

1. When the above test's has been completed the cap's on the CO_2 - cylinder valves shall be turned one turn. This to evacuate the pressure behind.
2. Tighten up the cap and wait for 5 minutes.
3. Remove the cap.
4. If the CO_2 - valve is leaking a small hiss will sound. If a leakage is detected install the cap again and open the CO_2 - cylinder valve. Turn the hex nut on top of the CO_2 - cylinder valve a 1/4 turn clockwise and close the valve. Repeat the test.

Do not tight the valve so hard that it get destroyed or invalidate the pneumatic operation.

6.5.5 Leakage test of connection between the CO_2 - cylinder valve and the manifolds.

Warning!

Keep the CO_2 - master valves secured and the valve release cabinets / Release cabinet's locked. The yard is responsible for warning all personnel that the CO_2 - system is being commissioned.

1. Connect all CO_2 - discharge hoses.
2. Pressurise the CO_2 - Manifold through the CO2 - shore connection valve using Nitrogen cylinder with pressure reducing valve adjusted to 50 bar outlet pressure.
3. Open and close each CO_2 - cylinder valve and check for leakage.
4. Upon completion of the test close the Nitrogen cylinder valve. Discharge the pressure to an unmanned area by opening the master valve.

Do not keep the pressure in the manifold for more than 5 minutes as there is a diffusion in the flexible hoses. If they are pressurised for a longer period they may be destroyed.

6.5.6 Test of ventilation shut down.

The ventilation shut down will be activated by either of the below mentioned systems.

Make sure that the ventilation is running.

Activated by the CO_2 - release cabinet.

1. Open the release cabinet door.
2. Check that the ventilation fans have stopped.
3. Close the release cabinet door.

Activated by the CO_2 - master valve.

1. Open the CO_2 - master valve manually.
2. Check that the ventilation fans have stopped.
3. Close the CO_2 - master valve.

NOTE!

This test shall be carried out for all area's protected which has a shut down signal connected.

6.5.7 Test of alarm sirens.

The alarm sirens will be activated by either of the below mentioned systems.

Activated by the CO_2 - release cabinet.

1. Open the release cabinet door.
2. Check that the alarm sirens are sounding.
3. Close the release cabinet door.

Activated by the CO_2 - master valve.

1. Open the CO_2 - master valve manually.
2. Check that the alarm sirens are sounding.
3. Close the CO_2 - master valve.

Important note!

All the alarm siren's should be tested during the sea trial to verify that the sound level is acceptable for the area they are installed in, when all the machinery's are in normal operation.

NOTE!

This test shall be carried out for all area's protected which has a shut downsignal connected.

6.5.8 Test of pressure switch.

Some systems may have a pressure switch installed on the CO_2 - manifold. It can also be one pressure switch for each of the protected areas installed downstream of the CO2 - master valves. The pressure switch may be connected to several different functions. This can be as follows.

1. Start of alarm sirens warning personnel that the CO_2 - manifold is pressurised.
2. Giving an alarm to the main control system that the CO_2 - system has been activated

These functions should be checked upon execution of the release test as described in chapter 6.5.5.

6.5.9 Final check before leaving the CO_2 system in normal operation.

The following shall be checked before the system is left in normal operation.

* CO_2 - cylinder caps are stored in a box inside the CO_2 - room.
* Operating instruction is installed in the CO_2 - room.
* Operating instruction is installed in the wheelhouse.
* Operating instruction is installed in the engine control room or fire station.
* All entrances to the protected areas are equipped with warning signs.
* All release lockers are equipped with engraved instruction signs.
* Pilot cylinders in the release lockers are connected.
* Timer valve is reset.
* Release locker doors are closed and secured.
* CO_2 - master valves are unsecured and closed.
* The key for the CO_2 - release locker are handed over to the officer in charge.
* CO_2 - valves are unsecured and in closed position.

6.6 Refilling of CO_2 - Cylinder's.

6.6.1 General.

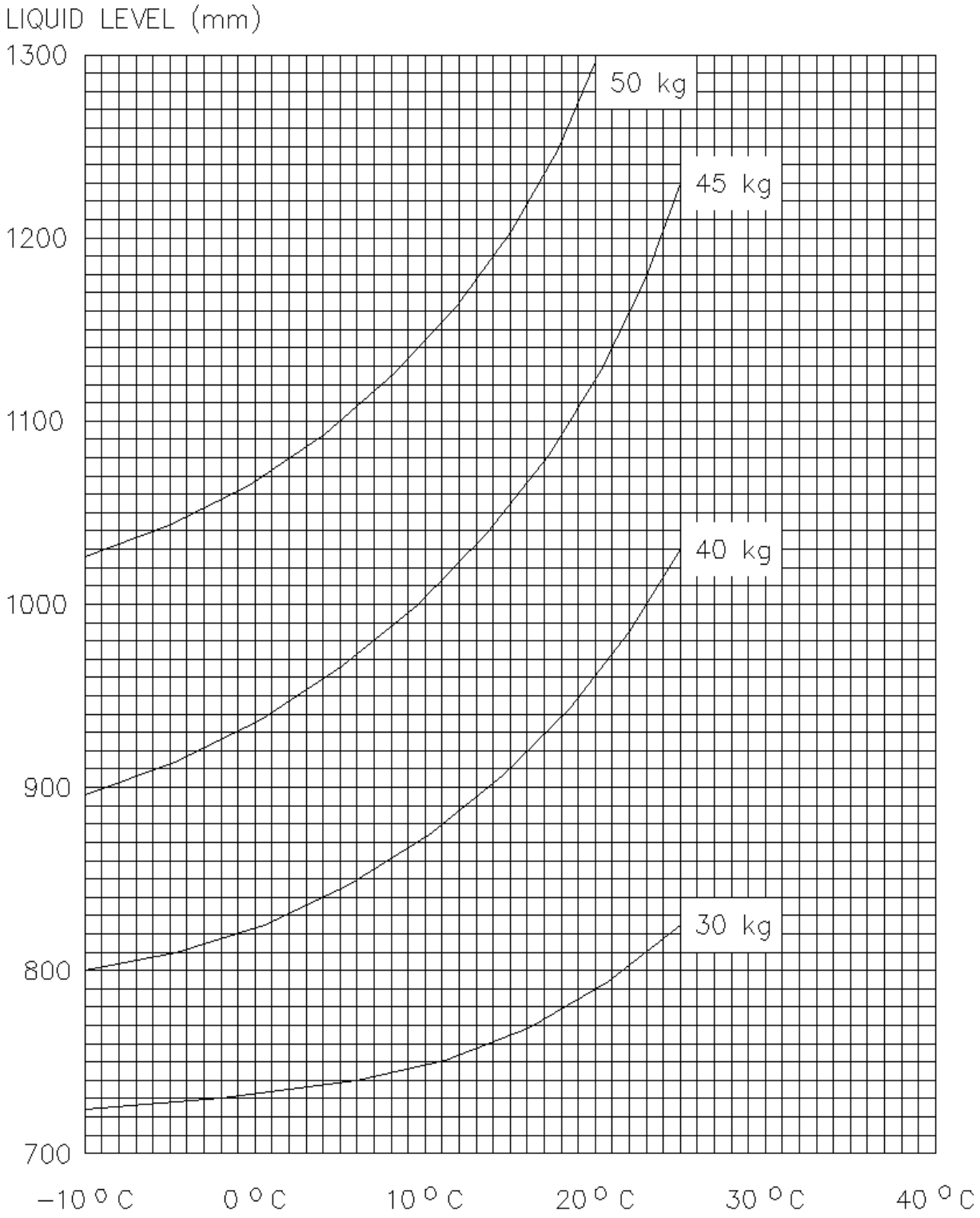
Upon a discharge of the system, the CO_2 - cylinders should be refilled immediately. This should be carried out as follows.

6.6.2 Removal of cylinders.

1. Disconnect the 1/2" Discharge hose.
2. Plug the CO_2 - valve outlet.
3. Disconnect the pilot manifold.
4. Install the cylinder valve protection cap.
5. Remove the cylinder clamping.
6. Ship the cylinder to an authorised gas filling station.

6.6.3 Installation of refilled cylinders.

1. Fasten the cylinder with the cylinder clamps.
2. Re - connect the pilot manifold.
3. Remove the CO_2 - valve outlet plug.
4. Re - connect the 1/2" Discharge hose.



LIQUID LEVEL BAR CHART

67,5 L CO^2 - CYLINDER - OUTSIDE DIAMETER 267 mm