MINISTÈRE DES PÊCHES ET DES OCÉANS

NGCC AMUNDSEN, PIERRE RADISSON ET DES GROSEILLIERS

CONTRAT # F3756-06M008/001/QCC

REMPLACEMENT DES SYTÈMES D'EXTINCTIONS AU HALON 1301 POUR DES SYSTÈMES D'EXTINCTIONS AU CO2

EN ANNEXE :

1) Calculs hydrauliques «AMUNDSEN»
   - Cofferdam
   - Fuel Pump
   - Helico Fuel Pump
2) Calculs hydrauliques «PIERRE RADISSON»
   - Cofferdam
   - Fuel Pump
   - Helico Fuel Pump
3) Calculs hydrauliques «DES GROSEILLIERS»
   - Cofferdam
   - Fuel Pump
4) Informations CO2
5) Dessins d'atelier (Voir Plan)

TRANSPORT CANADA TRANSPORTS CANADA
MARINE SAFETY SÉCURITÉ MARITIME
CANADA
Québec, QC

PAR :
S.E.N. INC.
269, boul. Bastien,
Québec (QC) G2B 1B1
T :(418) 842-2942
F :(418) 842-3413

Transport Canada Transports Canada
NOTED - NOTÉ
ON THE AUTHORITY OF THE CANADA SHIPPING ACT AND REGULATIONS MADE THEREUNDER.
EN VERTU DE LA LOI SUR LA MARINE MARCHANDE DU CANADA ET DES RÈGLEMENTS CONNEXES.
ON BEHALF OF THE BOARD OF STEAMSHIP INSPECTION. DEPARTMENT OF TRANSPORT.
POUR LE COMPTE DU BUREAU D'INSPECTION DES NAVIRES À VAPEUR. MINISTÈRE DES TRANSPORTS.
16 OCT. 2008
DATE

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Fire Systems
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High Pressure CO2 Hydraulic Flow Calculation Program
Input Data
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 3:57:26 PM
Location:	NGCC Amundsen	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Cofferdam	Revision:	

Data File Name: \\SEN-CLAUD\SharedDocs\AMUNDSEN cofferdam.CTH
Data File Units: U.S Standard

Cylinder Information

Amount of CO2 per Cylinder (lbs):	100.0	Storage Pressure:	750.00
Quantity of Cylinders:	3	Loss Factor (%):	5
Initial Pipe Temperature(F):	90.0	Pipe Length Factor:	1.20
Excluded Pipe Size 1:	1/4	Excluded Pipe Size 2:	5/16

Hazard Information

Hazard: COFFERDAM
Concentration Required: 34.00

Nozzle(s): 301 1/2 Orifice w/Cap
302 1/2 Orifice w/Cap

Hazard Type: TF Surface
Hazard Temp. (F): 90.0

Dimensions (ft): 22.0 X 16.8 X 14.9

Total Agent Required: 289.12 lbs

Piping Model

Section		Cyl			Pipe			Tees/	Flow Rate/
Start	End	Qty	Length	Elev.	Sch.	Size	90's	Valves	Fixed Code
1	2	1	0.0	6.0	40 T	1/2	0	None	0
2	3	3	4.0	0.0	40 T	0	1	None	0
3	4	0	35.5	6.0	40 T	0	3	None	0
4	5	0	5.0	0.0	40 T	0	0	Side	0
5	301	0	0.5	-0.5	40 T	0	1	None	R 173.47
4	6	0	6.5	0.0	40 T	0	0	Side	0
6	302	0	0.5	-0.5	40 T	0	1	None	R 173.47

Note 1: Under 'Flow Rate/Fixed Code', If 'R' precedes the value, the value indicates Flow Rate. If 'C' precedes the value, the value indicates Nozzle Code.

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High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 3:58:44 PM
Location:	NGCC Amundsen	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Cofferdam	Revision:	

System Information

Amount of CO2 per Cylinder (lbs):	100.0	Storage Pressure: PSIG	750.00
Quantity of Cylinders:	3	Initial Pipe Temperature (F):	90.
Total lbs of CO2:	300.0		
Excluded Pipe Size 1:	1/4	Excluded Pipe Size 2:	5/16

Hazard Information

Hazard: COFFERDAM
Concentration Required: 34.00

Nozzle(s): 301 1/2 Orifice w/Cap
302 1/2 Orifice w/Cap

Hazard Type: TF Surface
Hazard Temp. (F): 90.0

Dimensions (ft): 22.0 X 16.8 X 14.9

Total Agent Required: 289.12 lbs

Piping Model Results

Section		Pipe Size		Length	Elev	EQL	Section		Nozzle	Orifice
Start	End	(in)	sch	(ft)	(ft)	(ft)	Flow	PSIG	Flow	Code
1	2	* 1/2	T40	0.0	6.0	30.0	115.6	718.0	0.0	0.00
2	3	1	T80	4.0	0.0	6.6	346.9	712.0	0.0	0.00
3	4	1	T80	35.5	6.0	43.2	346.9	670.0	0.0	0.00
4	5	3/4	T40	5.0	0.0	9.5	173.5	664.0	0.0	0.00
5	301	3/4	T40	0.5	-0.5	2.7	173.5	662.0	173.5	8.79
4	6	3/4	T40	6.5	0.0	11.0	173.5	663.0	0.0	0.00
6	302	3/4	T40	0.5	-0.5	2.7	173.5	661.0	173.5	8.80

Average Discharge Times and Weight

Maximum Vapor Time is 5.0 seconds at Nozzle 302.

CO2	Weight (lbs)	Time (sec)
Vapor	13.0	4.9
Liquid	227.0	39.3
Total	240	44

Discharged 300 lbs including 60 lbs of residual vapor.

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High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 3:58:44 PM
Location:	NGCC Amundsen	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Cofferdam	Revision:	

Hazard and Nozzle Rate Information

Nozzle	Hazard Name	Vapor Time (sec)	Vapor lbs	Flow Rate lbs/min	Liquid Time (sec)	Liquid lbs	Residual lbs
301	COFFERDAM	4.8	6.4	173.5	39.4	113.8	30.0
302	COFFERDAM	5.0	6.6	173.5	39.2	113.3	30.0
Totals	COFFERDAM		13.0	346.9		227.0	60.0

Required: 34% in 1 Min: 289.1 lbs.
Actual: 1 Minute: 300.0 lbs.

Nozzle Information

Nozzle ID	Calc Code	Nozzle Description	Actual Code	Orifice Area (sq.in.)	Stock Number
301	8.79	ORIFICE WITH CAP (1/2 NPT)	9.0	0.0621	1-037-1308
302	8.8	ORIFICE WITH CAP (1/2 NPT)	9.0	0.0621	1-037-1308

Nozzle Summary

Item No.	Qty	Nozzle Description	Code	Stock Number
1	2	ORIFICE WITH CAP (1/2 NPT)	9.0	1-037-1308

Error messages

High Pressure CO2 Calculation Complete - Time : 03/10/08 3:58:08 PM
Calculation Performed with Version 10.0.1.18 Dated January 1, 2008
CO2 requirements conform to NFPA-12 Requirements.
Calculation is based on the use of A106/A53 piping.

High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 3:58:44 PM
Location:	NGCC Amundsen	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Cofferdam	Revision:	

Calculation by: S.E.N.INC
JEFF GOULET
269 BOUL. BASTIEN
QC QUEBEC G2B 1B1 CANADA
Telephone: 1-418-842-2942
Fax: 1-418-842-3413

High Pressure CO2 Hydraulic Flow Calculation Program
CO2 Requirement Calculation Printout
Chemetron HPCO2 Flow Calculation Software10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/11/08
Location:	NGCC Amundsen	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Cofferdam	Revision:	

<u>Hazard : COFFERDAM</u>
(Total Flood Application, Surface Fire)

<u>Dimensions:</u>
Total Volume = 5,507.04 Cu Ft

Concentration: 34%
(NFPA-12 Factor:0.050 lbs/cu ft)

Pounds required 275.35 lbs
Loss (5%) 13.77 lbs

Total Requirement 289.12 lbs

Pipe Length Factor : 1.20

Estimated Discharge Rate: 346.94 lbs/min
Use 2 - 1/2 Orifice w/Cap Nozzle(s)

1 (End of Requirements)

High Pressure CO2 Hydraulic Flow Calculation Program
Input Data
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 4:02:29 PM
Location:	NGCC Amundsen	Project Number:	F-3756-06M008/001/QCC.
Hazard Name:	Fuel pump	Revision:	

Data File Name: \\SEN-CLAUD\SharedDocs\AMUNDSEN Fuelpump.CTH
Data File Units: U.S Standard

Cylinder Information

Amount of CO2 per Cylinder (lbs):	100.0	Storage Pressure:	750.00
Quantity of Cylinders:	1	Loss Factor (%):	5
Initial Pipe Temperature(F):	90.0	Pipe Length Factor:	1.20
Excluded Pipe Size 1:	1/4	Excluded Pipe Size 2:	5/16

Hazard Information

Hazard: FUEL PUMP
Concentration Required: 34.00

Nozzle(s): 401 1/2 Orifice w/Cap
402 1/2 Orifice w/Cap

Hazard Type: TF Surface
Hazard Temp. (F): 90.0

Dimensions (ft): 18.0 X 6.5 X 12.8

Total Agent Required: 99.07 lbs

Piping Model

Section Start	End	Cyl Qty	Length	Elev.	Pipe Sch.	Size	90's	Tees/ Valves	Flow Rate/ Fixed Code
1	2	1	0.0	6.0	40 T	1/2	0	None	0
2	3	0	1.0	0.0	40 T	1/2	0	None	0
3	4	0	24.5	6.0	40 T	1/2	5	None	0
4	5	0	8.0	0.0	40 T	1/2	1	Side	0
5	401	0	0.5	-0.5	40 T	1/2	1	None	R 59.44
4	6	0	8.0	0.0	40 T	1/2	1	Side	0
6	402	0	0.5	-0.5	40 T	1/2	1	None	R 59.44

Note 1: Under 'Flow Rate/Fixed Code', If 'R' precedes the value, the value indicates Flow Rate. If 'C' precedes the value, the value indicates Nozzle Code.

High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software10.0.1.18

Project Name: Garde Côtière Canadienne
Location: NGCC Amundsen
Hazard Name: Fuel pump

Date: 03/11/08
Project Number: F-3756-06M008/001/QCC.
Revision:

System Information

Amount of CO2 per Cylinder (lbs): 100.0
Quantity of Cylinders: 1
Total lbs of CO2: 100.0
Excluded Pipe Size 1: 1/4

Storage Pressure (PSIG): 750.0
Initial Pipe Temperature(F): 90.0
Excluded Pipe Size 2: 5/16

Hazard Information

Hazard: FUEL PUMP
Concentration Required: 34.0

Hazard Type: TF Surface
Temperature (F): 90.0

Nozzle(s): 401 1/2 Orifice w/Cap
402 1/2 Orifice w/Cap

Dimensions (ft): 18.0 X 6.5 X 12.8

Piping Model Results

Section Start	End	Pipe Size (in)	sch	Length (ft)	Elev (ft)	EQL (ft)	Section Flow	PSIG	Nozzle Flow	Orifice Code
1	2	* 1/2	T40	0.0	6.0	30.0	118.9	716	0.0	0.00
2	3	* 1/2	T40	1.0	0.0	1.0	118.9	715	0.0	0.00
3	4	* 1/2	T40	24.5	6.0	32.8	118.9	680	0.0	0.00
4	5	* 1/2	T40	8.0	0.0	13.0	59.4	677	0.0	0.00
5	401	* 1/2	T40	0.5	-0.5	2.2	59.4	676	59.4	5.02
4	6	* 1/2	T40	8.0	0.0	13.0	59.4	677	0.0	0.00
6	402	* 1/2	T40	0.5	-0.5	2.2	59.4	676	59.4	5.02

High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/11/08
Location:	NGCC Amundsen	Project Number:	F-3756-06M008/001/QCC.
Hazard Name:	Fuel pump	Revision:	

Average Discharge Times and Weight

Maximum Vapor Time is 5.2 seconds at Nozzle 402.

CO_2	Weight (lbs)	Time (sec)
Vapor	4.7	5.2
Liquid	75.3	38.1
Total	80.0	43.2

Discharged 100 lbs including 20 lbs of residual vapor.

Hazard and Nozzle Rate Information

Nozzle	Hazard Name	Vapor Time(sec)	Vapor lbs	Flow Rate lbs/min	Liquid Time(sec)	Liquid lbs	Residual lbs
401	FUEL PUMP	5.2	2.3	59.4	38.1	37.7	10.0
402	FUEL PUMP	5.2	2.3	59.4	38.1	37.7	10.0
Totals	FUEL PUMP		4.7	118.9		75.3	20.0

Required:: 34% in 1 Min: 99.1 lbs.
Actual: 1 Minute: 100.0 lbs.

Nozzle Information

Nozzle ID	Calc Code	Nozzle Description	Actual Code	Orifice Area (sq.in.)	Stock Number
401	5.02	ORIFICE WITH CAP (1/2 NPT)	5.0	0.0192	1-037-1308
402	5.02	ORIFICE WITH CAP (1/2 NPT)	5.0	0.0192	1-037-1308

Nozzle Summary

Item No	Qty	Nozzle Description	Code	Stock Number
1	2	ORIFICE WITH CAP (1/2 NPT)	5.0	1-037-1308

High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/11/08
Location:	NGCC Amundsen	Project Number:	F-3756-06M008/001/QCC.
Hazard Name:	Fuel pump	Revision:	

Nozzle Summary (Continued)

Item No	Qty	Nozzle Description	Code	Stock Number

Error Messages

High Pressure CO2 Calculation Complete - Time : 03/11/08 9:38:06 AM
Calculation Performed with Version 10.0.1.18 Dated January 1, 2008
CO2 requirements conform to NFPA-12 Requirements.
Calculation is based on the use of A106/A53 piping.

Calculation performed with Agent Hydraulic Calculation Tool Version 10.0.1.18

Calculation Performed By: S.E.N.INC
JEFF GOULET
269 BOUL. BASTIEN
QC,QUEBEC G2B 1B1 - CANADA
Telephone: 1-418-842-2942
Fax: 1-418-842-3413

TIME AND DATE OF PRINTOUT 03/11/08 9:42:13 AM

High Pressure CO2 Hydraulic Flow Calculation Program
CO2 Requirement Calculation Printout
Chemetron HPCO2 Flow Calculation Software10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/11/08
Location:	NGCC Amundsen	Project Number:	F-3756-06M008/001/QCC.
Hazard Name:	Fuel pump	Revision:	

Hazard : FUEL PUMP
(Total Flood Application, Surface Fire)

Dimensions:
Total Volume = 1,497.60 Cu Ft

Concentration: 34%
(NFPA-12 Factor:0.063 lbs/cu ft)

Pounds required 94.35 lbs
Loss (5%) 4.72 lbs

Total Requirement 99.07 lbs

Pipe Length Factor : 1.20

Estimated Discharge Rate: 118.88 lbs/min
Use 2 - 1/2 Orifice w/Cap Nozzle(s)

1 (End of Requirements)

High Pressure CO2 Hydraulic Flow Calculation Program
Input Data
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 4:06:36 PM
Location:	NGCC Amundsen	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Hélicoptère fuel pump	Revision:	

Data File Name: \\SEN-CLAUD\SharedDocs\AMUNDSEN Helico Fuel Tank.CTH
Data File Units: U.S Standard

Cylinder Information

Amount of CO2 per Cylinder (lbs):	10.0	Storage Pressure:	750.00
Quantity of Cylinders:	1	Loss Factor (%):	5
Initial Pipe Temperature(F):	90.0	Pipe Length Factor:	1.20
Excluded Pipe Size 1:	1/4	Excluded Pipe Size 2:	5/16

Hazard Information

Hazard: HÉLICO FUEL PUMP
Concentration Required: 34.00

Hazard Type: TF Surface
Hazard Temp. (F): 90.0

Nozzle(s): 301 1/2 Orifice w/Cap

Dimensions (ft): 7.0 X 4.0 X 2.4

Total Agent Required: 5.08 lbs

Piping Model

Section		Cyl			Pipe			Tees/	Flow Rate/
Start	End	Qty	Length	Elev.	Sch.	Size	90's	Valves	Fixed Code
1	2	1	0.0	3.5	40 T	1/2	0	None	0
2	3	0	1.0	0.0	40 T	1/2	0	None	0
3	4	0	11.0	5.0	40 T	1/2	2	None	0
4	301	0	0.5	-0.5	40 T	1/2	1	None	R 10

Note 1: Under 'Flow Rate/Fixed Code', If 'R' precedes the value, the value indicates Flow Rate. If 'C' precedes the value, the value indicates Nozzle Code.

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High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 4:07:20 PM
Location:	NGCC Amundsen	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Hélicoptère fuel pump	Revision:	

System Information

Amount of CO2 per Cylinder (lbs):	10.0	Storage Pressure: PSIG	750.00
Quantity of Cylinders:	1	Initial Pipe Temperature (F):	90.
Total lbs of CO2:	10.0		
Excluded Pipe Size 1:	1/4	Excluded Pipe Size 2:	5/16

Hazard Information

Hazard: HÉLICO FUEL PUMP
Concentration Required: 34.00

Nozzle(s): 301 1/2 Orifice w/Cap

Hazard Type: TF Surface
Hazard Temp. (F): 90.0

Dimensions (ft): 7.0 X 4.0 X 2.4

Total Agent Required: 5.08 lbs

Piping Model Results

Section Start	Section End	Pipe Size (in)	sch	Length (ft)	Elev (ft)	EQL (ft)	Section Flow	PSIG	Nozzle Flow	Orifice Code
1	2	* 1/2	T40	0.0	3.5	30.0	10.0	748.0	0.0	0.00
2	3	* 1/2	T40	1.0	0.0	1.0	10.0	748.0	0.0	0.00
3	4	* 1/2	T40	11.0	5.0	14.3	10.0	746.0	0.0	0.00
4	301	* 1/2	T40	0.5	-0.5	2.2	10.0	746.0	10.0	1.70

Average Discharge Times and Weight

Maximum Vapor Time is 18.1 seconds at Nozzle 301.

CO2	Weight (lbs)	Time (sec)
Vapor	1.4	16.4
Liquid	6.6	39.8
Total	8	56

Discharged 10 lbs including 2 lbs of residual vapor.

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High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 4:07:20 PM
Location:	NGCC Amundsen	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Hélicoptère fuel pump	Revision:	

Hazard and Nozzle Rate Information

Nozzle	Hazard Name	Vapor Time (sec)	Vapor lbs	Flow Rate lbs/min	Liquid Time (sec)	Liquid lbs	Residual lbs
301	HÉLICO FUEL PUMP	18.1	1.4	10.0	39.8	6.6	2.0
Totals	HÉLICO FUEL PUMP		1.4	10.0		6.6	2.0
Required:	34% in 1 Min: 5.1 lbs.						
Actual:	1 Minute: 10.0 lbs.						

Nozzle Information

Nozzle ID	Calc Code	Nozzle Description	Actual Code	Orifice Area (sq.in.)	Stock Number
301	1.7	ORIFICE WITH CAP (1/2 NPT)	2.0	0.0031	1-037-1308

Nozzle Summary

Item No.	Qty	Nozzle Description	Code	Stock Number
1	1	ORIFICE WITH CAP (1/2 NPT)	2.0	1-037-1308

Calculation by: S.E.N.INC
JEFF GOULET
269 BOUL. BASTIEN
QC QUEBEC G2B 1B1 CANADA
Telephone: 1-418-842-2942
Fax: 1-418-842-3413

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High Pressure CO2 Hydraulic Flow Calculation Program
CO2 Requirement Calculation Printout
Chemetron HPCO2 Flow Calculation Software10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/11/08
Location:	NGCC Amundsen	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Hélicoptère fuel pump	Revision:	

Hazard : HÉLICO FUEL PUMP
(Total Flood Application, Surface Fire)

Dimensions:
Total Volume = 67.20 Cu Ft

Concentration: 34%
(NFPA-12 Factor:0.072 lbs/cu ft)

Pounds required 4.84 lbs
Loss (5%) .24 lbs

Total Requirement 5.08 lbs

Pipe Length Factor : 1.20

Estimated Discharge Rate: 6.1 lbs/min
Use 1 - 1/2 Orifice w/Cap Nozzle(s)

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High Pressure CO2 Hydraulic Flow Calculation Program
Input Data
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name: Garde Côtière Canadienne
Location: NGCC Pierre Radisson
Hazard Name: Cofferdam

Date: 03/10/08 4:24:49 PM
Project Number: F-3756-06M008/001/QCC
Revision:

Data File Name: \\SEN-CLAUD\SharedDocs\PIERRE RADISSON cofferdam.CTH
Data File Units: U.S Standard

Cylinder Information

Amount of CO2 per Cylinder (lbs):	100.0	Storage Pressure:	750.00
Quantity of Cylinders:	3	Loss Factor (%):	5
Initial Pipe Temperature(F):	90.0	Pipe Length Factor:	1.20
Excluded Pipe Size 1:	1/4	Excluded Pipe Size 2:	5/16

Hazard Information

Hazard: COFFERDAM
Concentration Required: 34.00

Nozzle(s): 301 1/2 Orifice w/Cap
302 1/2 Orifice w/Cap

Hazard Type: TF Surface
Hazard Temp. (F): 90.0

Dimensions (ft): 22.0 X 16.8 X 14.9

Total Agent Required: 289.12 lbs

Piping Model

Section		Cyl			Pipe			Tees/	Flow Rate/
Start	End	Qty	Length	Elev.	Sch.	Size	90's	Valves	Fixed Code
1	2	1	0.0	6.0	40 T	1/2	0	None	0
2	3	3	4.0	0.0	40 T	0	1	None	0
3	4	0	35.5	6.0	40 T	0	3	None	0
4	5	0	5.0	0.0	40 T	0	0	Side	0
5	301	0	0.5	-0.5	40 T	0	1	None	R 173.47
4	6	0	6.5	0.0	40 T	0	0	Side	0
6	302	0	0.5	-0.5	40 T	0	1	None	R 173.47

Note 1: Under 'Flow Rate/Fixed Code', If 'R' precedes the value, the value indicates Flow Rate. If 'C' precedes the value, the value indicates Nozzle Code.

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High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 4:25:18 PM
Location:	NGCC Pierre Radisson	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Cofferdam	Revision:	

System Information

Amount of CO2 per Cylinder (lbs):	100.0	Storage Pressure: PSIG	750.00
Quantity of Cylinders:	3	Initial Pipe Temperature (F):	90.
Total lbs of CO2:	300.0		
Excluded Pipe Size 1:	1/4	Excluded Pipe Size 2:	5/16

Hazard Information

Hazard: COFFERDAM
Concentration Required: 34.00

Hazard Type: TF Surface
Hazard Temp. (F): 90.0

Nozzle(s): 301 1/2 Orifice w/Cap
302 1/2 Orifice w/Cap

Dimensions (ft): 22.0 X 16.8 X 14.9

Total Agent Required: 289.12 lbs

Piping Model Results

Section Start	Section End	Pipe Size (in)	Pipe Size sch	Length (ft)	Elev (ft)	EQL (ft)	Section Flow	PSIG	Nozzle Flow	Orifice Code
1	2	* 1/2	T40	0.0	6.0	30.0	115.6	718.0	0.0	0.00
2	3	1	T80	4.0	0.0	6.6	346.9	712.0	0.0	0.00
3	4	1	T80	35.5	6.0	43.2	346.9	670.0	0.0	0.00
4	5	3/4	T40	5.0	0.0	9.5	173.5	664.0	0.0	0.00
5	301	3/4	T40	0.5	-0.5	2.7	173.5	662.0	173.5	8.79
4	6	3/4	T40	6.5	0.0	11.0	173.5	663.0	0.0	0.00
6	302	3/4	T40	0.5	-0.5	2.7	173.5	661.0	173.5	8.80

Average Discharge Times and Weight

Maximum Vapor Time is 5.0 seconds at Nozzle 302.

CO2	Weight (lbs)	Time (sec)
Vapor	13.0	4.9
Liquid	227.0	39.3
Total	240	44

Discharged 300 lbs including 60 lbs of residual vapor.

High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 4:25:18 PM
Location:	NGCC Pierre Radisson	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Cofferdam	Revision:	

Hazard and Nozzle Rate Information

Nozzle	Hazard Name	Vapor Time (sec)	Vapor lbs	Flow Rate lbs/min	Liquid Time (sec)	Liquid lbs	Residual lbs
301	COFFERDAM	4.8	6.4	173.5	39.4	113.8	30.0
302	COFFERDAM	5.0	6.6	173.5	39.2	113.3	30.0
Totals	COFFERDAM		13.0	346.9		227.0	60.0

Required: 34% in 1 Min: 289.1 lbs.
Actual: 1 Minute: 300.0 lbs.

Nozzle Information

Nozzle ID	Calc Code	Nozzle Description	Actual Code	Orifice Area (sq.in.)	Stock Number
301	8.79	ORIFICE WITH CAP (1/2 NPT)	9.0	0.0621	1-037-1308
302	8.8	ORIFICE WITH CAP (1/2 NPT)	9.0	0.0621	1-037-1308

Nozzle Summary

Item No.	Qty	Nozzle Description	Code	Stock Number
1	2	ORIFICE WITH CAP (1/2 NPT)	9.0	1-037-1308

Error messages

High Pressure CO2 Calculation Complete - Time : 03/10/08 4:24:59 PM
Calculation Performed with Version 10.0.1.18 Dated January 1, 2008
CO2 requirements conform to NFPA-12 Requirements.
Calculation is based on the use of A106/A53 piping.

High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 4:25:18 PM
Location:	NGCC Pierre Radisson	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Cofferdam	Revision:	

Calculation by: S.E.N.INC
JEFF GOULET
269 BOUL. BASTIEN
QC QUEBEC G2B 1B1 CANADA
Telephone: 1-418-842-2942
Fax: 1-418-842-3413

High Pressure CO2 Hydraulic Flow Calculation Program
CO2 Requirement Calculation Printout
Chemetron HPCO2 Flow Calculation Software10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/11/08
Location:	NGCC Pierre Radisson	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Cofferdam	Revision:	

Hazard : COFFERDAM
(Total Flood Application, Surface Fire)

Dimensions:
Total Volume = 5,507.04 Cu Ft

Concentration: 34%
(NFPA-12 Factor:0.050 lbs/cu ft)

Pounds required 275.35 lbs
Loss (5%) 13.77 lbs

Total Requirement 289.12 lbs

Pipe Length Factor : 1.20

Estimated Discharge Rate: 346.94 lbs/min
Use 2 - 1/2 Orifice w/Cap Nozzle(s)

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High Pressure CO2 Hydraulic Flow Calculation Program
Input Data
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 4:26:57 PM
Location:	NGCC Pierre Radisson	Project Number:	F-3756-06M008/001/QCC.
Hazard Name:	Fuel pump	Revision:	

Data File Name: \\SEN-CLAUD\SharedDocs\PIERRE RADISSON Fuelpump.CTH
Data File Units: U.S Standard

Cylinder Information

Amount of CO2 per Cylinder (lbs):	100.0	Storage Pressure:	750.00
Quantity of Cylinders:	1	Loss Factor (%):	5
Initial Pipe Temperature(F):	90.0	Pipe Length Factor:	1.20
Excluded Pipe Size 1:	1/4	Excluded Pipe Size 2:	5/16

Hazard Information

Hazard: FUEL PUMP
Concentration Required: 34.00

Nozzle(s): 401 1/2 Orifice w/Cap
402 1/2 Orifice w/Cap

Hazard Type: TF Surface
Hazard Temp. (F): 90.0

Dimensions (ft): 18.0 X 6.5 X 12.8

Total Agent Required: 99.07 lbs

Piping Model

Section Start	Section End	Cyl Qty	Length	Elev.	Pipe Sch.	Pipe Size	90's	Tees/ Valves	Flow Rate/ Fixed Code
1	2	1	0.0	6.0	40 T	1/2	0	None	0
2	3	0	1.0	0.0	40 T	1/2	0	None	0
3	4	0	24.5	6.0	40 T	1/2	5	None	0
4	5	0	8.0	0.0	40 T	1/2	1	Side	0
5	401	0	0.5	-0.5	40 T	1/2	1	None	R 59.44
4	6	0	8.0	0.0	40 T	1/2	1	Side	0
6	402	0	0.5	-0.5	40 T	1/2	1	None	R 59.44

Note 1: Under 'Flow Rate/Fixed Code', If 'R' precedes the value, the value indicates Flow Rate. If 'C' precedes the value, the value indicates Nozzle Code.

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High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 4:27:27 PM
Location:	NGCC Pierre Radisson	Project Number:	F-3756-06M008/001/QCC.
Hazard Name:	Fuel pump	Revision:	

System Information

Amount of CO2 per Cylinder (lbs):	100.0	Storage Pressure: PSIG	750.00
Quantity of Cylinders:	1	Initial Pipe Temperature (F):	90.
Total lbs of CO2:	100.0		
Excluded Pipe Size 1:	1/4	Excluded Pipe Size 2:	5/16

Hazard Information

Hazard: FUEL PUMP
Concentration Required: 34.00

Hazard Type: TF Surface
Hazard Temp. (F): 90.0

Nozzle(s): 401 1/2 Orifice w/Cap
402 1/2 Orifice w/Cap

Dimensions (ft): 18.0 X 6.5 X 12.8

Total Agent Required: 99.07 lbs

Piping Model Results

Section Start	Section End	Pipe Size (in)	sch	Length (ft)	Elev (ft)	EQL (ft)	Section Flow	PSIG	Nozzle Flow	Orifice Code
1	2	* 1/2	T40	0.0	6.0	30.0	118.9	716.0	0.0	0.00
2	3	* 1/2	T40	1.0	0.0	1.0	118.9	715.0	0.0	0.00
3	4	* 1/2	T40	24.5	6.0	32.8	118.9	680.0	0.0	0.00
4	5	* 1/2	T40	8.0	0.0	13.0	59.4	677.0	0.0	0.00
5	401	* 1/2	T40	0.5	-0.5	2.2	59.4	676.0	59.4	5.02
4	6	* 1/2	T40	8.0	0.0	13.0	59.4	677.0	0.0	0.00
6	402	* 1/2	T40	0.5	-0.5	2.2	59.4	676.0	59.4	5.02

Average Discharge Times and Weight

Maximum Vapor Time is 5.2 seconds at Nozzle 402.

CO2	Weight (lbs)	Time (sec)
Vapor	4.7	5.2
Liquid	75.3	38.1
Total	80	43

Discharged 100 lbs including 20 lbs of residual vapor.

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High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 4:27:27 PM
Location:	NGCC Pierre Radisson	Project Number:	F-3756-06M008/001/QCC.
Hazard Name:	Fuel pump	Revision:	

Hazard and Nozzle Rate Information

Nozzle	Hazard Name	Vapor Time (sec)	Vapor lbs	Flow Rate lbs/min	Liquid Time (sec)	Liquid lbs	Residual lbs
401	FUEL PUMP	5.2	2.3	59.4	38.1	37.7	10.0
402	FUEL PUMP	5.2	2.3	59.4	38.1	37.7	10.0
Totals	FUEL PUMP		4.7	118.9		75.3	20.0

Required: 34% in 1 Min: 99.1 lbs.
Actual: 1 Minute: 100.0 lbs.

Nozzle Information

Nozzle ID	Calc Code	Nozzle Description	Actual Code	Orifice Area (sq.in.)	Stock Number
401	5.02	ORIFICE WITH CAP (1/2 NPT)	5.0	0.0192	1-037-1308
402	5.02	ORIFICE WITH CAP (1/2 NPT)	5.0	0.0192	1-037-1308

Nozzle Summary

Item No.	Qty	Nozzle Description	Code	Stock Number
1	2	ORIFICE WITH CAP (1/2 NPT)	5.0	1-037-1308

Error messages

High Pressure CO2 Calculation Complete - Time : 03/10/08 4:27:03 PM
Calculation Performed with Version 10.0.1.18 Dated January 1, 2008
CO2 requirements conform to NFPA-12 Requirements.
Calculation is based on the use of A106/A53 piping.

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High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 4:27:27 PM
Location:	NGCC Pierre Radisson	Project Number:	F-3756-06M008/001/QCC.
Hazard Name:	Fuel pump	Revision:	

Calculation by: S.E.N.INC
JEFF GOULET
269 BOUL. BASTIEN
QC QUEBEC G2B 1B1 CANADA
Telephone: 1-418-842-2942
Fax: 1-418-842-3413

High Pressure CO2 Hydraulic Flow Calculation Program
CO2 Requirement Calculation Printout
Chemetron HPCO2 Flow Calculation Software10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/11/08
Location:	NGCC Pierre Radisson	Project Number:	F-3756-06M008/001/QCC.
Hazard Name:	Fuel pump	Revision:	

Hazard : FUEL PUMP
(Total Flood Application, Surface Fire)

Dimensions:
Total Volume = 1,497.60 Cu Ft

Concentration: 34%
(NFPA-12 Factor:0.063 lbs/cu ft)

Pounds required 94.35 lbs
Loss (5%) 4.72 lbs

Total Requirement 99.07 lbs

Pipe Length Factor : 1.20

Estimated Discharge Rate: 118.88 lbs/min
Use 2 - 1/2 Orifice w/Cap Nozzle(s)

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High Pressure CO2 Hydraulic Flow Calculation Program
Input Data
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 4:29:08 PM
Location:	NGCC Pierre Radisson	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Hélicoptère fuel pump	Revision:	

Data File Name: \\SEN-CLAUD\SharedDocs\PIERRE RADISSON Helico Fuel Tank.CTH
Data File Units: U.S Standard

Cylinder Information

Amount of CO2 per Cylinder (lbs):	10.0	Storage Pressure:	750.00
Quantity of Cylinders:	1	Loss Factor (%):	5
Initial Pipe Temperature(F):	90.0	Pipe Length Factor:	1.20
Excluded Pipe Size 1:	1/4	Excluded Pipe Size 2:	5/16

Hazard Information

Hazard: HÉLICO FUEL PUMP
Concentration Required: 34.00

Nozzle(s): 301 1/2 Orifice w/Cap

Hazard Type: TF Surface
Hazard Temp. (F): 90.0

Dimensions (ft): 7.0 X 4.0 X 2.4

Total Agent Required: 5.08 lbs

Piping Model

Section Start	Section End	Cyl Qty	Length	Elev.	Pipe Sch.	Pipe Size	90's	Tees/ Valves	Flow Rate/ Fixed Code
1	2	1	0.0	3.5	40 T	1/2	0	None	0
2	3	0	1.0	0.0	40 T	1/2	0	None	0
3	4	0	11.0	5.0	40 T	1/2	2	None	0
4	301	0	0.5	-0.5	40 T	1/2	1	None	R 10

Note 1: Under 'Flow Rate/Fixed Code', If 'R' precedes the value, the value indicates Flow Rate. If 'C' precedes the value, the value indicates Nozzle Code.

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High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne		Date:	03/10/08 4:29:39 PM
Location:	NGCC Pierre Radisson		Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Hélicoptère fuel pump		Revision:	

System Information

Amount of CO2 per Cylinder (lbs):	10.0	Storage Pressure: PSIG	750.00
Quantity of Cylinders:	1	Initial Pipe Temperature (F):	90.
Total lbs of CO2:	10.0		
Excluded Pipe Size 1:	1/4	Excluded Pipe Size 2:	5/16

Hazard Information

Hazard: HÉLICO FUEL PUMP
Concentration Required: 34.00

Nozzle(s): 301 1/2 Orifice w/Cap

Hazard Type: TF Surface
Hazard Temp. (F): 90.0

Dimensions (ft): 7.0 X 4.0 X 2.4

Total Agent Required: 5.08 lbs

Piping Model Results

Section Start	Section End	Pipe Size (in)	sch	Length (ft)	Elev (ft)	EQL (ft)	Section Flow	PSIG	Nozzle Flow	Orifice Code
1	2	* 1/2	T40	0.0	3.5	30.0	10.0	748.0	0.0	0.00
2	3	* 1/2	T40	1.0	0.0	1.0	10.0	748.0	0.0	0.00
3	4	* 1/2	T40	11.0	5.0	14.3	10.0	746.0	0.0	0.00
4	301	* 1/2	T40	0.5	-0.5	2.2	10.0	746.0	10.0	1.70

Average Discharge Times and Weight

Maximum Vapor Time is 18.1 seconds at Nozzle 301.

CO2	Weight (lbs)	Time (sec)
Vapor	1.4	16.4
Liquid	6.6	39.8
Total	8	56

Discharged 10 lbs including 2 lbs of residual vapor.

High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 4:29:39 PM
Location:	NGCC Pierre Radisson	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Hélicoptère fuel pump	Revision:	

Hazard and Nozzle Rate Information

Nozzle	Hazard Name	Vapor Time (sec)	Vapor lbs	Flow Rate lbs/min	Liquid Time (sec)	Liquid lbs	Residual lbs
301	HÉLICO FUEL PUMP	18.1	1.4	10.0	39.8	6.6	2.0
Totals	HÉLICO FUEL PUMP		1.4	10.0		6.6	2.0
Required:	34% in 1 Min: 5.1 lbs.						
Actual:	1 Minute: 10.0 lbs.						

Nozzle Information

Nozzle ID	Calc Code	Nozzle Description	Actual Code	Orifice Area (sq.in.)	Stock Number
301	1.7	ORIFICE WITH CAP (1/2 NPT)	2.0	0.0031	1-037-1308

Nozzle Summary

Item No.	Qty	Nozzle Description	Code	Stock Number
1	1	ORIFICE WITH CAP (1/2 NPT)	2.0	1-037-1308

Error messages

High Pressure CO2 Calculation Complete - Time : 03/10/08 4:29:12 PM
Calculation Performed with Version 10.0.1.18 Dated January 1, 2008
CO2 requirements conform to NFPA-12 Requirements.
Calculation is based on the use of A106/A53 piping.

High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 4:29:39 PM
Location:	NGCC Pierre Radisson	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Hélicoptère fuel pump	Revision:	

Calculation by: S.E.N.INC
JEFF GOULET
269 BOUL. BASTIEN
QC QUEBEC G2B 1B1 CANADA
Telephone: 1-418-842-2942
Fax: 1-418-842-3413

High Pressure CO_2 Hydraulic Flow Calculation Program
CO_2 Requirement Calculation Printout
Chemetron HPCO2 Flow Calculation Software10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/11/08
Location:	NGCC Pierre Radisson	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Hélicoptère fuel pump	Revision:	

Hazard : HÉLICO FUEL PUMP
(Total Flood Application, Surface Fire)

Dimensions:
Total Volume = 67.20 Cu Ft

Concentration: 34%
(NFPA-12 Factor:0.072 lbs/cu ft)

Pounds required 4.84 lbs
Loss (5%) .24 lbs

Total Requirement 5.08 lbs

Pipe Length Factor : 1.20

Estimated Discharge Rate: 6.1 lbs/min
Use 1 - 1/2 Orifice w/Cap Nozzle(s)

High Pressure CO2 Hydraulic Flow Calculation Program
Input Data
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 4:09:20 PM
Location:	NGCC Des Groseilliers	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Cofferdam	Revision:	

Data File Name: \\SEN-CLAUD\SharedDocs\DES GROSEILLIERS cofferdam.CTH
Data File Units: U.S Standard

Cylinder Information

Amount of CO2 per Cylinder (lbs):	100.0	Storage Pressure:	750.00
Quantity of Cylinders:	3	Loss Factor (%):	5
Initial Pipe Temperature(F):	90.0	Pipe Length Factor:	1.20
Excluded Pipe Size 1:	1/4	Excluded Pipe Size 2:	5/16

Hazard Information

Hazard: COFFERDAM
Concentration Required: 34.00

Nozzle(s): 301 1/2 Orifice w/Cap
302 1/2 Orifice w/Cap

Hazard Type: TF Surface
Hazard Temp. (F): 90.0

Dimensions (ft): 22.0 X 16.8 X 14.9

Total Agent Required: 289.12 lbs

Piping Model

Section Start	Section End	Cyl Qty	Length	Elev.	Pipe Sch.	Pipe Size	90's	Tees/ Valves	Flow Rate/ Fixed Code
1	2	1	0.0	6.0	40 T	1/2	0	None	0
2	3	3	4.0	0.0	40 T	0	1	None	0
3	4	0	35.5	6.0	40 T	0	3	None	0
4	5	0	5.0	0.0	40 T	0	0	Side	0
5	301	0	0.5	-0.5	40 T	0	1	None	R 173.47
4	6	0	6.5	0.0	40 T	0	0	Side	0
6	302	0	0.5	-0.5	40 T	0	1	None	R 173.47

Note 1: Under 'Flow Rate/Fixed Code', If 'R' precedes the value, the value indicates Flow Rate. If 'C' precedes the value, the value indicates Nozzle Code.

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High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 4:09:48 PM
Location:	NGCC Des Groseilliers	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Cofferdam	Revision:	

System Information

Amount of CO2 per Cylinder (lbs):	100.0	Storage Pressure: PSIG	750.00
Quantity of Cylinders:	3	Initial Pipe Temperature (F):	90.
Total lbs of CO2:	300.0		
Excluded Pipe Size 1:	1/4	Excluded Pipe Size 2:	5/16

Hazard Information

Hazard: COFFERDAM
Concentration Required: 34.00

Hazard Type: TF Surface
Hazard Temp. (F): 90.0

Nozzle(s): 301 1/2 Orifice w/Cap
302 1/2 Orifice w/Cap

Dimensions (ft): 22.0 X 16.8 X 14.9

Total Agent Required: 289.12 lbs

Piping Model Results

Section Start	Section End	Pipe Size (in)	Pipe Size sch	Length (ft)	Elev (ft)	EQL (ft)	Section Flow	PSIG	Nozzle Flow	Orifice Code
1	2	* 1/2	T40	0.0	6.0	30.0	115.6	718.0	0.0	0.00
2	3	1	T80	4.0	0.0	6.6	346.9	712.0	0.0	0.00
3	4	1	T80	35.5	6.0	43.2	346.9	670.0	0.0	0.00
4	5	3/4	T40	5.0	0.0	9.5	173.5	664.0	0.0	0.00
5	301	3/4	T40	0.5	-0.5	2.7	173.5	662.0	173.5	8.79
4	6	3/4	T40	6.5	0.0	11.0	173.5	663.0	0.0	0.00
6	302	3/4	T40	0.5	-0.5	2.7	173.5	661.0	173.5	8.80

Average Discharge Times and Weight

Maximum Vapor Time is 5.0 seconds at Nozzle 302.

CO2	Weight (lbs)	Time (sec)
Vapor	13.0	4.9
Liquid	227.0	39.3
Total	240	44

Discharged 300 lbs including 60 lbs of residual vapor.

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High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 4:09:48 PM
Location:	NGCC Des Groseilliers	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Cofferdam	Revision:	

Hazard and Nozzle Rate Information

Nozzle	Hazard Name	Vapor Time (sec)	Vapor lbs	Flow Rate lbs/min	Liquid Time (sec)	Liquid lbs	Residual lbs
301	COFFERDAM	4.8	6.4	173.5	39.4	113.8	30.0
302	COFFERDAM	5.0	6.6	173.5	39.2	113.3	30.0
Totals	COFFERDAM		13.0	346.9		227.0	60.0

Required: 34% in 1 Min: 289.1 lbs.
Actual: 1 Minute: 300.0 lbs.

Nozzle Information

Nozzle ID	Calc Code	Nozzle Description	Actual Code	Orifice Area (sq.in.)	Stock Number
301	8.79	ORIFICE WITH CAP (1/2 NPT)	9.0	0.0621	1-037-1308
302	8.8	ORIFICE WITH CAP (1/2 NPT)	9.0	0.0621	1-037-1308

Nozzle Summary

Item No.	Qty	Nozzle Description	Code	Stock Number
1	2	ORIFICE WITH CAP (1/2 NPT)	9.0	1-037-1308

Error messages

High Pressure CO2 Calculation Complete - Time : 03/10/08 4:09:25 PM
Calculation Performed with Version 10.0.1.18 Dated January 1, 2008
CO2 requirements conform to NFPA-12 Requirements.
Calculation is based on the use of A106/A53 piping.

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High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 4:09:48 PM
Location:	NGCC Des Groseilliers	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Cofferdam	Revision:	

Calculation by: S.E.N.INC
JEFF GOULET
269 BOUL. BASTIEN
QC QUEBEC G2B 1B1 CANADA
Telephone: 1-418-842-2942
Fax: 1-418-842-3413

High Pressure CO2 Hydraulic Flow Calculation Program
CO2 Requirement Calculation Printout
Chemetron HPCO2 Flow Calculation Software10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/11/08
Location:	NGCC Des Groseilliers	Project Number:	F-3756-06M008/001/QCC
Hazard Name:	Cofferdam	Revision:	

Hazard : COFFERDAM
(Total Flood Application, Surface Fire)

Dimensions:
Total Volume = 5,507.04 Cu Ft

Concentration: 34%
(NFPA-12 Factor:0.050 lbs/cu ft)

Pounds required 275.35 lbs
Loss (5%) 13.77 lbs

Total Requirement 289.12 lbs

Pipe Length Factor : 1.20

Estimated Discharge Rate: 346.94 lbs/min
Use 2 - 1/2 Orifice w/Cap Nozzle(s)

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High Pressure CO2 Hydraulic Flow Calculation Program
Input Data
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 6:05:05 PM
Location:	NGCC Des Groseilliers	Project Number:	F-3756-06M008/001/QCC.
Hazard Name:	Fuel pump	Revision:	

Data File Name: \\SEN-CLAUD\SharedDocs\DES GROSEILLIERS Fuelpump.CTH
Data File Units: U.S Standard

Cylinder Information

Amount of CO2 per Cylinder (lbs):	100.0	Storage Pressure:	750.00
Quantity of Cylinders:	1	Loss Factor (%):	5
Initial Pipe Temperature(F):	90.0	Pipe Length Factor:	1.20
Excluded Pipe Size 1:	1/4	Excluded Pipe Size 2:	5/16

Hazard Information

Hazard: FUEL PUMP
Concentration Required: 34.00

Nozzle(s): 401 1/2 Orifice w/Cap
402 1/2 Orifice w/Cap

Hazard Type: TF Surface
Hazard Temp. (F): 90.0

Dimensions (ft): 18.0 X 6.5 X 12.8

Total Agent Required: 99.07 lbs

Piping Model

Section Start	Section End	Cyl Qty	Length	Elev.	Pipe Sch.	Pipe Size	90's	Tees/ Valves	Flow Rate/ Fixed Code
1	2	1	0.0	6.0	40 T	1/2	0	None	0
2	3	0	1.0	0.0	40 T	1/2	0	None	0
3	4	0	24.5	6.0	40 T	1/2	5	None	0
4	5	0	8.0	0.0	40 T	1/2	1	Side	0
5	401	0	0.5	-0.5	40 T	1/2	1	None	R 59.44
4	6	0	8.0	0.0	40 T	1/2	1	Side	0
6	402	0	0.5	-0.5	40 T	1/2	1	None	R 59.44

Note 1: Under 'Flow Rate/Fixed Code', If 'R' precedes the value, the value indicates Flow Rate. If 'C' precedes the value, the value indicates Nozzle Code.

CHEMETRON
Fire Systems
A World of Protection

High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 6:05:43 PM
Location:	NGCC Des Groseilliers	Project Number:	F-3756-06M008/001/QCC.
Hazard Name:	Fuel pump	Revision:	

System Information

Amount of CO2 per Cylinder (lbs):	100.0	Storage Pressure: PSIG	750.00
Quantity of Cylinders:	1	Initial Pipe Temperature (F):	90.
Total lbs of CO2:	100.0		
Excluded Pipe Size 1:	1/4	Excluded Pipe Size 2:	5/16

Hazard Information

Hazard: FUEL PUMP
Concentration Required: 34.00

Nozzle(s): 401 1/2 Orifice w/Cap
402 1/2 Orifice w/Cap

Hazard Type: TF Surface
Hazard Temp. (F): 90.0

Dimensions (ft): 18.0 X 6.5 X 12.8

Total Agent Required: 99.07 lbs

Piping Model Results

Section Start	Section End	Pipe Size (in)	Pipe Size sch	Length (ft)	Elev (ft)	EQL (ft)	Section Flow	PSIG	Nozzle Flow	Orifice Code
1	2	* 1/2	T40	0.0	6.0	30.0	118.9	716.0	0.0	0.00
2	3	* 1/2	T40	1.0	0.0	1.0	118.9	715.0	0.0	0.00
3	4	* 1/2	T40	24.5	6.0	32.8	118.9	680.0	0.0	0.00
4	5	* 1/2	T40	8.0	0.0	13.0	59.4	677.0	0.0	0.00
5	401	* 1/2	T40	0.5	-0.5	2.2	59.4	676.0	59.4	5.02
4	6	* 1/2	T40	8.0	0.0	13.0	59.4	677.0	0.0	0.00
6	402	* 1/2	T40	0.5	-0.5	2.2	59.4	676.0	59.4	5.02

Average Discharge Times and Weight

Maximum Vapor Time is 5.2 seconds at Nozzle 402.

CO2	Weight (lbs)	Time (sec)
Vapor	4.7	5.2
Liquid	75.3	38.1
Total	80	43

Discharged 100 lbs including 20 lbs of residual vapor.

CHEMETRON
Fire Systems
A World of Protection

High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 6:05:43 PM
Location:	NGCC Des Groseilliers	Project Number:	F-3756-06M008/001/QCC.
Hazard Name:	Fuel pump	Revision:	

Hazard and Nozzle Rate Information

Nozzle	Hazard Name	Vapor Time (sec)	Vapor lbs	Flow Rate lbs/min	Liquid Time (sec)	Liquid lbs	Residual lbs
401	FUEL PUMP	5.2	2.3	59.4	38.1	37.7	10.0
402	FUEL PUMP	5.2	2.3	59.4	38 1	37.7	10.0
Totals	FUEL PUMP		4.7	118.9		75.3	20.0

Required: 34% in 1 Min: 99.1 lbs.
Actual: 1 Minute: 100.0 lbs.

Nozzle Information

Nozzle ID	Calc Code	Nozzle Description	Actual Code	Orifice Area (sq.in.)	Stock Number
401	5.02	ORIFICE WITH CAP (1/2 NPT)	5.0	0.0192	1-037-1308
402	5.02	ORIFICE WITH CAP (1/2 NPT)	5.0	0.0192	1-037-1308

Nozzle Summary

Item No.	Qty	Nozzle Description	Code	Stock Number
1	2	ORIFICE WITH CAP (1/2 NPT)	5.0	1-037-1308

Error messages

High Pressure CO2 Calculation Complete - Time : 03/10/08 6:05:09 PM
Calculation Performed with Version 10.0.1.18 Dated January 1, 2008
CO2 requirements conform to NFPA-12 Requirements.
Calculation is based on the use of A106/A53 piping.

High Pressure CO2 Hydraulic Flow Calculation Program
Results
Chemetron HPCO2 Flow Calculation Software Version 10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/10/08 6:05:43 PM
Location:	NGCC Des Groseilliers	Project Number:	F-3756-06M008/001/QCC.
Hazard Name:	Fuel pump	Revision:	

Calculation by: S.E.N.INC
JEFF GOULET
269 BOUL. BASTIEN
QC QUEBEC G2B 1B1 CANADA
Telephone: 1-418-842-2942
Fax: 1-418-842-3413

High Pressure CO2 Hydraulic Flow Calculation Program
CO2 Requirement Calculation Printout
Chemetron HPCO2 Flow Calculation Software10.0.1.18

Project Name:	Garde Côtière Canadienne	Date:	03/11/08
Location:	NGCC Des Groseilliers	Project Number:	F-3756-06M008/001/QCC.
Hazard Name:	Fuel pump	Revision:	

Hazard : FUEL PUMP
(Total Flood Application, Surface Fire)

Dimensions:
Total Volume = 1,497.60 Cu Ft

Concentration: 34%
(NFPA-12 Factor:0.063 lbs/cu ft)

Pounds required 94.35 lbs
Loss (5%) 4.72 lbs

Total Requirement 99.07 lbs

Pipe Length Factor : 1.20

Estimated Discharge Rate: 118.88 lbs/min
Use 2 - 1/2 Orifice w/Cap Nozzle(s)

SECTION NO. 3
PERSONNEL SAFETY

Carbon Dioxide (not to be confused with Carbon Monoxide) is only mildly toxic (poisonous). It does not carry oxygen in any form for sustaining human life; therefore, the principle action of Carbon Dioxide is to cause suffocation. The following human reactions have been determined by test:

(a) At concentrations of 3 to 4 per cent by volume in air, the breathing rate increases and headaches can be caused.

(b) At concentrations of 9 per cent by volume, personnel can lose consciousness within minutes, this being preceded by disorientation, visual disturbance, ringing in the ears, tremors, etc.

(c) At concentrations of about 20 per cent by volume, death will follow in 20 to 30 minutes.

The above effects are important to note because inexperienced personnel may fail to think clearly and take proper action if suddenly exposed to relatively low concentrations of Carbon Dioxide.

Any person overcome by Carbon Dioxide should be moved immediately to a location where plenty of fresh air is available, and artificial respiration applied as in the case of drowning. DO NOT USE Carbon Dioxide as a stimulant. An ammonia inhalant may be used and the person should be kept warm (by the application of friction and heat to the extremities). Call a physician or take the patient to a hospital for examination. Persons rendered unconscious by Carbon Dioxide can usually be revived without any permanent ill effects when promptly removed from such atmospheres.

Direct contact with liquid Carbon Dioxide will cause frostbite burns to the skin. Carbon Dioxide vaporizes rapidly therefore this hazard is generally limited to the immediate vicinity of the discharge nozzle.

The discharge of Carbon Dioxide will create a fog and this may seriously interfere with visibility during and immediately after the discharge period. The fog effect could last for several minutes.

If it is necessary to enter a space in which Carbon Dioxide has been discharged, a fresh air mask or other type of self-contained breathing apparatus should be worn. DO NOT USE a filter type of mask or a canister gas mask. No one should enter such a space without another person as observer and stand-by outside the space.

When all traces of the fire have been extinguished, and the possibility of re-ignition has been eliminated, thoroughly ventilate the space to make certain that only fresh air is in the space. When there is any question as to the amount of Carbon Dioxide present in a space, it is essential to test the atmosphere for possible presence of flammable vapours may result in an explosion.

In hazard areas where personnel could be present, suitable safeguards should be provided to ensure prompt evacuation and to prevent entry into such atmospheres. Such safety items as warning signs. Discharge delay devices, and pre-discharge alarms should be provided with all automatic Carbon Dioxide Systems - see Safety Suggestions.

SAFETY SUGGESTIONS

Safeguards must be taken to ensure the safety of personnel in areas where the atmosphere could be made hazardous by the discharge of Carbon Dioxide. The following list, which is strongly recommended, is generally taken from NFPA Std. 12 - Carbon Dioxide Extinguishing Systems.

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, with the discharge of the Carbon Dioxide and the activation of automatic door closures delayed for sufficient time to allow evacuation of the area before discharge begins.

d) Provision of only outward swinging self-closing doors at exits from hazard 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 Carbon Dioxide 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 persons 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 Carbon Dioxide 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. Carbon Dioxide is heavier than air.

j) Carbon Dioxide is much heavier than air and can collect in pits, cellars and low-lying areas. Care should be taken when entering such areas after Carbon Dioxide has been discharged.

k) Provision of means to lock off or disarm the system during periods of system inspection, maintenance, or modification.

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

SECTION NO. 4
DESCRIPTION OF PYRENE HPCO2 EQUIPMENT

CYLINDER ASSEMBLIES

The basic Pyrene cylinder assembly consists of a pressure vessel, a valve and siphon tube assembly, and a charge of carbon dioxide.

A variety of cylinder sizes are available. They are all designed to hold pressurized carbon dioxide in liquid form at atmospheric temperatures, corresponding to a nominal pressure of 850 psi at 70°F (58.6 bar at 21°C).

All cylinders are seamless and are manufactured and tested in accordance with the requirements of the Department of Transport (USA) and/or the Canadian Transport Commission, Specification 3AA-1800 or higher. Large cylinders having capacities of 50, 75 and 100 pounds are made of steel. Small cylinders, used for special applications, have capacities of 10, 15 and 20 pounds and may be made of aluminium or steel dependent on availability.

Except for special temperature conditions, all cylinders are filled to their specified weight in pounds of liquid carbon dioxide. Partial filling is not allowed.

The pressure inside the cylinder will vary as the temperature changes, see Fig No. 1. In general, the ambient storage temperature for standard cylinders used in 'local application' systems shall be between 32°F and 120°F (0°C and 49°C), and for standard cylinders used in 'total flooding' systems between 0°F and 130°F (-18°C and 54°C).

All cylinders use the Pyrene R1 type cylinder valve. Two models are available 1) Model R1M, master valve, 2) Model R1S, slave valve - see Fig No. 2. The RI valve is a pressure differential valve, and the valve disc is connected to a piston arrangement. The valve is held closed by the pressure of the contents inside the cylinder acting on the disc. To open the valve, pressure is diverted to the top of the piston, the piston area being larger than the disc area, the valve opens. A ball check is an integral part of the outlet port of the valve and prevents discharge while the cylinder is being transported and while it is disconnected from the system. A pressure relief safety disc is designed to release pressure should the cylinder be subjected to exceptionally high temperatures or other abnormal conditions.

The RIS valve can only be operated by backpressure from the discharge piping. The RIM valve has a pilot valve on the side of the valve which when operated allows pressure from inside the cylinder to be diverted on top of the piston. The RIM valve can be operated as a slave valve using backpressure from the discharge piping.

A rigid siphon tube is used in all cylinders to ensure liquid discharge. All cylinders must therefore be installed in the normal upright position.

PYRENE DISCHARGE BEND AND DISCHARGE ADAPTOR

The discharge bend is used to connect the cylinder valve outlet to the system manifold and discharge piping. The discharge bend must be used when cylinders are manifold together. It allows for the misalignment of the cylinders on installation and for ease of cylinder removal for maintenance. The cylinder end of the hose has a swivel connection for ease of installation, and a check valve. If a cylinder assembly is disconnected from the discharge bend, and if the system operates while the cylinder is disconnected, the check valve will ensure that appreciable carbon dioxide will not discharge from the disconnected discharge bend. The check valve also acts as an adaptor to hold the ball check in the outlet port of the cylinder valve open.

The discharge adaptor may be used as an alternative to the discharge bend for single cylinder systems. It holds the ball check in the discharge port of the cylinder valve open.

It is important that neither the bend nor the adaptor be mounted onto the cylinder valve until the cylinder is installed and secured in its bracket. These items <u>must not</u> be mounted onto the valve during transportation and storage. It is also important to note that piping must not be connected directly to the cylinder valve (i.e. without a discharge adaptor or bend). If this is done, the check valve in the discharge port of the cylinder valve would close on actuation and the system would <u>not</u> discharge.

PYRENE CYLINDER BRACKETS

The cylinders can be arranged to be bracketed to a wall or to be free standing when no wall is available. Straps and brackets for single cylinder installation are available from Pyrene. Frames for multiple cylinder installation can also be obtained through Pyrene.

For installation of one or two cylinders, a simple strap is available for fastening the cylinder to a wall -Data Fig No. 7. If no wall exists, a simple support can be built up from the floor.

For installation of 3 or more cylinders, refer to.

1) Typical single row, wall mounting - Fig No. 29
2) Typical double row, wall mounting - Fig No. 29A

The single row, wall-mounting arrangement is recommended for installations up to and including 5 cylinders.

Double row, free standing arrangements have the advantage, particularly for systems using main and reserve cylinders, and for joint systems, that any cylinder can be removed for recharging without disturbing the others. However, this arrangement requires two aisles and considerably more space.

The double row, wall-mounting arrangement is generally used when sufficient space is not available for a freestanding arrangement or for a single row wall mounting arrangement.

For marine applications, additional cylinder support is required. Two straps or sets of retainers must be used.

Brackets and rails to enable cylinders to be weighed in place without disconnecting them from the manifold can be incorporated see Fig No. 28. This provides uninterrupted fire protection, even while the cylinders are being weighed. They can be integral parts of freestanding brackets. The brackets for wall mounting are available from Pyrene.

The installer to suit the arrangement and the site conditions normally supplies all hardware.

PYRENE NOZZLES

Pyrene offers a range of nozzles to ensure the most efficient application of the gas. General discharge (total flooding) nozzles are used where an even distribution of gas is required throughout an enclosure, and directional type (local application) nozzles are utilized where a concentration of carbon dioxide is required on a particular surface or piece of equipment.

Nozzles are designed to discharge large volumes of carbon dioxide without freezing. In addition, for local application use, the velocity of discharge from the nozzle is reduced to prevent agitation and splatter of liquids and other hazardous materials being protected or adjacent to the nozzles.

The nozzle orifice size will vary dependent on the location of the nozzle in the system. It is important that nozzles are installed exactly as specified on the project drawings otherwise system performance will be jeopardized. The nozzle orifice identification number is stamped on the unit.

Baffle and vent type nozzles are used exclusively for total flooding installations - see Fig No. 19. "S" type nozzles may be used for total flooding installations, however, their cost normally restricts their use to local application installations - see Fig No. 19. The "S" nozzles may be fitted with flanges to enable them to be mounted onto sheet metal equipment enclosures and ductwork, and with frangible discs to prevent clogging of the orifice. Linear nozzles - Fig No. 19, are special local application nozzles for open tank protection, and are available to special order.

Special finishes for nozzles are available and will be provided to suit project requirements to special order.

PYRENE MANUAL CONTROL - LOCAL AND REMOTE

To actuate a carbon dioxide system manually only and locally at the cylinders, a manual actuator is used - see Fig No. 11. The actuator is screwed into the pilot valve port of the RIM cylinder valve. For systems with one or two cylinders interconnected, only one cylinder is required to have a manual actuator. For systems with three or more cylinders interconnected, two cylinders must have manual actuators, arranged for simultaneous operation.

The actuator has a hole in the side of the main body, fitted with a blank plug. This hole allows the actuator to be operated automatically by a pressure source or explosion-proof actuator cartridge, (Fig. No. 10C). The blank plug is removed only for connection of the pressure source; otherwise the plug must remain tightly connected at all times.

The hand lever on the manual actuator can be operated from a remote location. This is achieved by connecting a 1/16" diameter stainless steel cable to the end of the lever, and running the cable to a latch type pull box, using corner pulleys at each change in cable direction.

Utilizing a mechanical dual junction box, two remote pull boxes can be joined to operate one cylinder, or one remote pull box can be used to operate two separate manual actuators. Refer to Fig No. 18 for equipment details and for limitations on the allowable length of cable and maximum number of corner pulleys that can be used.

AUTOMATIC CONTROL - ELECTRIC

Electric actuation is achieved by using a solenoid actuator (Fig No. 10) for normal environments, and a cartridge with a rated solenoid valve for hazardous (explosion-proof) environments.

The solenoid actuator connects directly to the pilot valve of the RIM cylinder valve. In addition to electrical actuation, the unit can be operated using the manual-operating (override) lever. When operated the solenoid releases a latch and spring assembly to open the pilot valve of the cylinder valve. After operation, the reset stem must be turned with a wrench from the "released" to the "set" position.

Solenoid actuators operate one at a time. Each solenoid has a micro-switch, which operates after the solenoid releases, and transfers operating power to the next solenoid in line. Sufficient power is necessary only to operate one solenoid at a time, thereby keeping wire size to a minimum, and allowing up to 10 actuators to be connected on one circuit.

The solenoid actuator is available in three operating voltages - 24 VDC, 120 and 240 VAC. The 24 VDC unit is designed with additional electronic circuitry to allow supervision and activation from compatible control panels. The 120 and 240 VAC units are intended for direct connection to building power supplies, only when approved by the authority having jurisdiction.

The solenoid actuator has an aluminium housing. The unit has wire leads extending from the 1/2 inch threaded conduit connection. Suitable connectors, flexible metallic tubing, and a junction box should be installed for connecting the unit to field wiring. This unit must not be used in explosion-proof areas. For specific connection details refer to data sheet.

The nitrogen cartridge assembly with a solenoid control valve is used for explosive hazardous areas. When operated, the solenoid valve opens allowing the nitrogen to release. The nitrogen pressure is used to operate a manual actuator attached to a RIM cylinder valve. The solenoid can only be operated electrically, therefore, the manual actuator provides for manual override control.

The unit is intended for installation adjacent to the carbon dioxide cylinders, using standard small bore copper tubing and compression fittings. The tubing is pressurized only when the solenoid valve is opened.

The cartridge assembly is complete with a pressure gauge for ready maintenance.

EXTINGUISHMENT CONTROL PANEL

A panel should be used to control extinguishment, and provide continuous supervision. Other control panels providing fully supervised detection, signalling and extinguishment activation control, audible and visual annunciation of the system status, emergency back up power, and control of auxiliary equipment can be used. Refer to the respective control panel manufacturers Design and Operating Manual for details.

INITIATING DEVICES

Initiating devices (thermal detectors, smoke detectors, manual stations, etc.) shall be listed devices compatible with the control panel being utilized.

The Pyrene remote manual control station (manual station) – Fig No. 20 - enables an automatic system to be manually activated before an automatic detector operates. The remote electric control station comprises a switch mounted on a back plate with a hinged front plate. The front plate is a pull handle, and holds a push button type switch in the depressed position. Once pulled, the front plate remains hanging and requires a special tool to re-set. For additional protection against accidental operation, manual stations are available with a hinged plastic cover. The cover must be raised to obtain access to the front plate.

The Pyrene manual station is designed for semi-flush mounting, however, a box is available for surface mounting.

PYRENE PRESSURE OPERATED SWITCH

The Pyrene pressure-operated switch can be incorporated into a system to make or break an electric circuit. The switch operates when the carbon dioxide system discharges or when the delayed action device is initiated. Operation causes the switch contacts to reverse position. Units can be used to shut-down motors, pumps, fans and conveyors, to operate alarms, to release magnetic door holders, to provide confirmation of extinguishment system discharge, etc., automatically when carbon dioxide system discharges. See Fig No. 15.

The switch may be mounted in any position, but preferred installation is with the pressure connection (gas supply line) entering from the bottom. The switch enclosure is rated for standard and weatherproof conditions. When the line load of the equipment to be operated is greater than the switch rating, the switch should be used to break a relay holding coil circuit.

The pressure connection of the switch is connected to the discharge piping of the carbon dioxide system, (between the RIM valve and the time delay - see Fig No. 14) if used.

PYRENE PRESSURE RELEASE TRIP

The Pyrene pressure release trip can be used to mechanically release dampers, close doors, windows, louvers, fuel supply valves, to open dump valves, etc., automatically when carbon dioxide discharges. The equipment to be operated must be weight or spring loaded, or be pivoted off centre. See Fig No. 16.

Only the pressure release trips are supplied by Pyrene. Others shall provide all hardware and other equipment involved in the release function, unless specifically listed on the project drawings.

Cable from the equipment to be controlled is looped over the pressure release-operating stem. When the trip is operated, the stem retracts and the cable is released. The maximum load that can be hung on the stem is 75 pounds.

The pressure connection of the trip device is connected to the discharge piping of the carbon dioxide system, (between the RIM valve and the time delay - see Fig No. 14) if used.

PYRENE DISCHARGE (TIME) DELAY DEVICE

This device, also known as a delayed action device, is a pneumatic type unit and provides a delay of between 25 and 30 seconds in the discharge of the carbon dioxide. This delay period is generally sufficient to allow for evacuation of personnel from the fire area and/or the shutdown and run-down of equipment (fans, etc.).

The delay period can be by-passed, should it be assessed that it is safe or necessary to do so. A manual actuator or a solenoid actuator may be installed on the head of the delay device and when operated allows the carbon dioxide to by-pass the device chamber and flow directly to the RIM valve piston chamber.

In association with this delay device, pre-discharge alarms are required. These alarms can be either electric or gas operated. The connections for the pressure-operated switch for electric alarms, or for the siren for gas alarm, are taken from the upstream or inlet side of the delay device so that they are functioning during the delay period. If more than one gas-operated siren is used, insufficient carbon dioxide will be available from the supply line to the delayed action device and a separate small carbon dioxide cylinder must be used to supply the sirens. see Fig No. 13 & 14.

PYRENE GAS OPERATED SIREN

This unit sounds an alarm by means of carbon dioxide pressure, Fig No. 17. It is connected to the discharge piping of the system, or the supply pipe to the delayed action device, or to a separate independent carbon dioxide cylinder.

Sirens should be located throughout the hazard area, with due consideration to the normal background noise in the area, to ensure an audible alarm will be heard on the activation and discharge of the carbon dioxide system.

If a delayed action device is utilized, the siren must be located to operate (sound) before the delayed action device opens and the system discharges.

The alarm is independent of external power, however, the alarm will cease when the gas discharge has been completed. If it is desirable or necessary for the sirens to operate for a longer period of time than will be allowed by the system discharge time, a separate independent carbon dioxide cylinder must be used.

PYRENE STOP AND SELECTOR VALVE

The Pyrene RI valve may be used as a Stop Valve or as a Selector Valve. As a stop valve its function is to prevent the accidental or unwanted discharge of the carbon dioxide into the hazard area. As a selector valve, it is used in a "Joint System" to direct the flow of the carbon dioxide to one of several protected areas.

As a stop valve, if only one or two cylinders are utilized for a system, the RI valve is located in the main discharge pipeline. If three or more cylinders are utilized for a system, the RI valve is located in the manifold between the master and slave cylinders and up steam from the main discharge pipeline. The slave cylinders are operated only by back pressure created by the master cylinders, therefore, the slave cylinders being isolated from the master cylinders will not discharge and the system will not discharge until the Stop Valve is opened.

As a selector valve, the RI valve is located in the main feed pipe to the protected area. If the feed pipe is larger than the throughput of the RI valve, two RI valves may be used in parallel.

CYLINDER WEIGHING DEVICE

There is available a simplified arrangement for weighing cylinders in place without disconnecting them from the cylinder manifold. This provides uninterrupted fire protection, even while cylinders are being weighed.

A beam type weigh scale is used with a 10 to 1 ratio on the beam and a direct reading dial. When you pull down with a force of 15 lbs on the finger grip, the dial reads 150 lbs, (Fig. No. 28).

PROTECTIVE GUARDS AND SCREENS

Pyrene system components normally require no protective guards. Such enclosures, when required, shall be provided by others, unless specifically listed on the project drawings.

SECTION NO. 6
VERIFICATION AND TEST

GENERAL

Prior to placing the completed system in service, the installation should be inspected and tested to confirm:

1) Conformance to system design.

2) Suitability of piping, its correctness to project design, and its support and bracketing.

3) Conformance to the system operating sequence.

4) The suitability of the hazard environmental control, safety precautions, sealing, etc.

5) Compliance with the requirements of NFPA Std. 12 or other applicable standard.

In addition, a discharge test is strongly recommended in order to verify the total system operation, to ensure the required concentration is achieved, to determine the duration (soaking time) that the concentration is retained, to ensure acceptability of nozzle discharge, to check audibility of alarms, to ensure interlocks and all auxiliary equipment operate as required, and to allow personnel to become completely familiar with the discharging system and to practice response.

If a full discharge test is not performed, a "Puff" test, using a minimum of one cylinder, must be conducted. A full discharge test must be conducted for all "Extended Discharge" type systems.

PIPING

After the installation of the system piping is completed, and prior to the connection of the cylinders, nozzles and other equipment, the discharge piping should be blown out and then pressure tested for leakage. Plug or cap all piping outlets and apply 100 psi pressure with nitrogen or air for 10 minutes. Pressure drop shall not be greater than 5 psi after 10 minutes.

Check the pipe layout to ensure it agrees with the system layout drawings. Ensure pipe is adequately supported and braced.

Ensure all tubing used for the delayed action device and the explosion-proof cartridge actuator is installed correctly, and that all fittings are tight.

CYLINDERS

1) Inspect cylinders and ensure bracketing and cylinders are secure.
2) Check the contents of all cylinders for weight, using either a beam type scale or an approved liquid level gauge. The contents shall be within +/- 10% of the normal capacity.
3) Check cylinder discharge bends or adaptors for proper connection and tightness.
4) Ensure that appropriate identification, operating and warning signs are mounted or posted.

NOZZLES

Each nozzle has an orifice drilled to suit the specific location and discharge flow requirements. The orifice identification number is stamped on each nozzle; see the Data Sheets for location.

1) Verify that orifice sizes are as indicated on the project drawings and that the nozzles are orientated to discharge correctly.

2) Ensure that each nozzle pipe drop is bracketed or braced against the nozzle discharge thrust, and that the nozzle cannot swivel on its pipe fitting.

3) Check the cleanliness of the area to ensure that seals are not required to prevent orifices from clogging.

MANUAL CONTROL - LOCAL AND REMOTE CABLE TYPE

Ensure the manual actuators and the remote manual controls, for all parts of the system - master cylinders for main and reserve systems, all master cylinders in a joint system, selector and stop valves, and time delay devices - will be accessible during a fire.

*All testing should be carried out with the manual actuator disconnected from the cylinders, and other devices.

1) With the manual actuator disconnected from the cylinder or other device, pull the lock pin and operate the lever to verify the movement of the operating piston (1/8").

2) If a cable type remote control is utilized, pull handle in pull box and check pull, force and length of pull required. Also ensure that there is at least 9" of clear movement at the actuator.

3) Check to ensure that there is no binding of cable in the corner pulleys, and that the corner pulleys and conduit are securely fixed.

4) RESET pull box and affix a lead and wire seal. Ensure a lock pin is installed in the manual actuator and that the stem is retracted before reconnecting the actuator to the cylinder valve or other device. If a remote manual control is not used, secure the lock pin in the actuator with a lead and wire seal. If a remote manual control is used, remove the lock pin from the actuator after installation.

ELECTRIC ACTUATION

Perform all inspections and tests on the control panel, detectors, signals and other devices as specifically indicated in the specific equipment manufacturers manuals.

*Ensure the solenoid actuator connected is of the correct voltage for the service.

The solenoid actuators should be tested for correct movement of the operating piston, both electrically and manually. All testing should be carried out only after first ensuring that the lock pin on the manual operating lever is inserted and then removing solenoid actuator from the cylinder valve or other device (stop and selector valves, etc.).

Each solenoid actuator has a micro switch, which operates after the solenoid releases, and transfers operating power to the next solenoid on the circuit. A maximum of 10 actuators can be connected on a circuit. For details of the wire connections, wire lengths and wire size, see Data Sheet No. A107-009.

1) Verify that all actuators are disconnected from the cylinders and other devices, that the reset stem indicates the "SET" position, and that the operating piston is in the retracted position. For the 24 VDC units the control panel should indicate normal supervisory condition.

2) For the 24 VDC units, select the last solenoid (electrically) and expose wiring junction. Disconnect each wire in turn, both the connection to the control panel and the connection to the end of line device. Each wire disconnected should cause system trouble.

3) For all units, check that the ground wire is terminated and that the solenoid housing has been properly connected to ground.

4) With all solenoids connected electrically, operate the discharge circuit by actuating a manual station or firing a detector. (NOTE - Do not operate fixed temperature thermal detectors unless they are of the restorable type.) Ensure that all solenoids on the respective circuit operate. Verify that the operating piston has extended, and the reset stem has moved to the "Released" position. Reset all actuators and repeat for each initiating sequence and each discharge circuit.

5) On completion of all testing, and when the system is ready to be placed into service, reset all actuators and reconnect them to their respective cylinder valve or other device.

Check the pressure gauge on the explosion-proof cartridge actuator and ensure the cartridge is correctly filled.

OPTIONAL DEVICES

1) GAS OPERATED SIRENS Disconnect the siren from the discharge piping and connect to a small carbon dioxide cylinder. Operate the carbon dioxide cylinder and ensure all sirens operate and that the sound is readily heard throughout the protected space.

2) PRESSURE OPERATED SWITCHES to test the circuits and to ensure auxiliary functions operate correctly, either:

   a) Disconnect union at pressure connection, insert a small rod into the pressure connection of the cover plate and push against the piston to trip the switch. Push plunger down to reset switch.

   b) Remove the four cover screws and swing cover away from switch box. Manually operate interior toggle switch. After testing, ensure toggle is returned to normal stand-by position, and then reinstall cover plate.

3) PRESSURE RELEASE TRIP With a screwdriver or other blunt instrument manually push stem to the retracted position. Allow the cable to fall, and ensure the connected equipment operates as required.

4) DELAY ACTION DEVICE Disconnect the tubing from both the inlet and outlet ports of the device. Connect a small carbon dioxide cylinder with an on/off type control valve, to the inlet port of the device. Operate the carbon dioxide cylinder and check the time to when carbon dioxide discharges from the outlet port of the device.

CARBON DIOXIDE "PUFF" TEST

Disconnect all cylinders, except one master cylinder from the system. During this test ensure: -

1) Carbon dioxide does discharge from all nozzles.

2) There is no undue pipe movement.

3) All pressure-operated devices operate and that the connected equipment, alarms and other functions are controlled as required.

CARBON DIOXIDE DISCHARGE TEST

A full discharge test should be performed when there are doubts about the operation of the system, when any inspection indicates their advisability, for all extended discharge type systems, and when cylinders have been removed for hydrostatic testing. During this test: -

1) Make checks as indicated under "Puff" Test.

2) With a concentration meter, check the carbon dioxide concentrations achieved at several locations within the enclosure, and specifically adjacent to the primary hazard within the enclosure.

3) Check the discharge time.

4) Check the holding time, the length of time the carbon dioxide concentration is maintained.

5) Ensure that the enclosure is reasonably well sealed, and that there is no major leakage.

6) Ensure all alarms function for the required period of time and that they can be heard throughout the area.

SECTION NO. 7
AFTER OPERATION

AFTER A FIRE

1) DO NOT OPEN DOORS OR WINDOWS, OR REMOVE THE CARBON DIOXIDE FROM THE PROTECTED AREA UNTIL THE FIRE IS COMPLETELY OUT.

2) DO NOT ENTER THE AREA UNTIL THE CARBON DIOXIDE HAS BEEN REMOVED AND THE AREA VENTILATED. IF IT IS NECESSARY TO ENTER THE AREA WHILE IT STILL CONTAINS CARBON DIOXIDE, SELF-CONTAINED BREATHING APPARATUS SHALL BE USED. SEE SECTION NO. 3 - PERSONNEL SAFETY, OF THIS MANUAL.

In general, providing the system discharges during the early stages of the fire, and providing all plant shutdown functions are operated and safety precautions are taken, the fire will be extinguished within one minute of the end of discharge of the carbon dioxide. However, the area should be kept closed for at least fifteen (15) minutes following discharge to allow the area to cool, and to prevent re-ignition. For "Deep Seated" hazards, the space should be kept tightly closed for at least sixty (60) minutes following discharge.

To check if fire is out:

1) Look for smoke and steam coming from cracks around doors, windows, vents, etc.
2) Feel the doors and walls, if they are hot the fire is still burning or is in the cooling stage.
3) Listen for crackling sounds.

DO NOT ENTER AREA WITH A LIGHTED CIGARETTE OR OPEN FLAME AS FLAMMABLE VAPOURS MAY BE PRESENT WHICH COULD CAUSE REIGNITION OR AN EXPLOSION.

TO REFURBISH SYSTEM

HAVE THE SYSTEM COMPLETELY SERVICED BY A PYRENE APPROVED SERVICE AGENCY. AFTER OPERATION, THE SYSTEM SHOULD BE RECHARGED WITHOUT DELAY IN ORDER TO MAINTAIN PROTECTION.

1) Remove, inspect and recharge all cylinders. (Hydrostatic test required after 5 years)
2) Inspect the piping system and ensure pipe supports are still secure.
3) Inspect all components - nozzles, switches, detectors, alarms, etc. Replace all equipment that has been damaged, or that has been exposed to direct flame or excessive heat from the fire.
4) Reinstall system in accordance with the Installation Instructions - Section No. 5
5) Verify and test system in accordance with Section No. 6 of this manual.

SECTION NO. 8
MAINTENANCE

GENERAL

In order to ensure that the system has not been tampered with and is in a fully operational condition at all times, it must be inspected and tested on a regular basis by trained, competent, service personnel. In accordance with NFPA Std. No.12, insurance and other code requirements, all carbon dioxide systems shall be thoroughly inspected and tested annually by competent personnel. It is recommended that a Service and Maintenance Contract be established with an approved distributor of Pyrene equipment.

All persons who may be expected to inspect, test, maintain, or operate carbon dioxide fire suppression systems shall be thoroughly trained and kept thoroughly trained in the functions they are expected to perform.

MONTHLY INSPECTIONS

1) Check system components for mechanical damage and tampering. All system leads and wire seals should be intact.

2) Verify that egress is clear to allow safe evacuation of personnel from the hazard area, and safe access to the manual operating controls.

3) Ensure that there are no obstructions that would prevent system operation, or prevent proper distribution of carbon dioxide from discharge nozzles.

4) Check that all electrical circuits show normal. If a control panel is utilized, power lamp is on and all other lamps are off.

SEMI-ANNUAL INSPECTIONS

1) Perform all the monthly inspections.

2) Check if there have been any changes in the shape, size, contents or use of the protected space. Any changes will necessitate a review of the system design.

3) Check the cylinder contents (weight), this may be done by using a platform or beam scale or an approved liquid level gauge. Record weight on the cylinder tag or in the logbook. If the cylinder has a loss in net weight of more than 10 percent, it should be recharged or replaced. The cylinder full weight is stamped on the valve.

   * Check the date of the last hydrostatic test. If more than 12 years have elapsed since the last test, the cylinders shall be discharged and retested before being returned to service. It is recommended that a full discharge test be performed when cylinders are emptied for hydrostatic testing.

4) Examine cylinders, piping and nozzles for any evidence of corrosion or other physical damage.

5) Check cylinder bracketing, piping, pipe hangers and straps to ensure all are secure and suitably supported. This is particularly important where shock and vibration are encountered as a normal part of the environment (e.g. on board ships, etc.).

6) Ensure discharge nozzles are still located as originally installed, that the nozzle discharge orifices are clear and unobstructed, and that the nozzles are properly positioned and aligned. Ensure seals are used where necessary.

7) Remove manual actuators from all cylinders and other devices they operate and operate the hand lever. The actuator should operate freely and the operating stem should travel 1/8".

<u>CAUTION:</u> - When two actuators are connected together, both actuators must be removed from the equipment they control, before testing.

8) If a remote manual cable control is utilized, ensure the actuators are removed from the equipment they control, and operate all cable controls by pulling cable at pull box to ensure freedom of movement and travel. Both main and reserve actuator cables should be operated, if utilized. Check condition of conduit and corner pulleys.

9) Inspect and clean all fire detectors. Check sensitivity and adjust smoke detectors.

10) If system is automatically actuated but does not have a control panel: -

a) Operate all initiating devices (detectors, manual stations, etc.), one at a time, and ensure respective actuators operate. This check should be made for both main and reserve banks of cylinders, if utilized. Reset solenoid actuators after each initiating device is operated.

b) Verify that all electric alarm signals function, and can be heard throughout the protected space. This should be done in the normal working environment with normal background noises in place.

11) If system has an extinguishment control panel, refer to the panel manufacturers' instruction manual for maintenance procedures. This testing must include but should not be limited to the operation of all alarm initiating devices, alarm signals, panel operating sequences, extinguishment initiating operation, and auxiliary control functions. Check supervision of all circuits.

<u>NOTE:</u> Before testing ensure all solenoid actuators and solenoid control valves have been disconnected. For solenoid actuators verify that the stem travels 1/8" when operated.

12) Confirm operation of all auxiliary and supplementary components such as time delays, pressure operated switches, release trips, damper releases, shut-off valves, etc. by manual operation, where possible. Pressure operated time delays (delayed action devices) and gas-operated sirens should be checked using a carbon dioxide portable extinguisher as a pressurizing source.

ENSURE ALL EQUIPMENT IS RESET AND ALL COMPONENTS ARE LEFT IN NORMAL "STANDBY" CONDITION ON COMPLETION OF TESTING.

CYLINDER TESTING

Carbon dioxide cylinders are required to be tested to verify cylinder strength in accordance with the following requirements in NFPA Std.12.

1) Carbon dioxide cylinders shall not be recharged without a hydrostatic test (and stamping) if more than 5 years have elapsed from the date of the last hydrostatic test.

2) Cylinders continuously in service without discharging may be retained in service for a maximum of 12 years from date of last hydrostatic test. At the end of 12 years, they shall be discharged and retested before being returned to service.

   NOTE: Transporting charged carbon dioxide cylinders that have not been hydrostatically tested within 5 years may be illegal. Check your local regulations.