INNOVATIVE DEVELOPMENT OF 500 PSIG DELIVERY SYSTEM FOR FK-5-1-12

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With the required phase-out of Halon 1301, the search for the direct replacement for Halon 1301 has eluded the fire protection industry until now. In the past decade several have offered acceptable solutions that meet the requirements of zero ozone depletion, life safety, and the protection of high value property.

FK-5-1-12 referred to in the international standards NFPA 2001 and the FDIS ISO 14520 (trade name 3M™ Novec™ 1230 Fire Protection Fluid), is replacing Halon 1301 in end use application, due to its zero ozone depletion potential, a global warming potential of one, and an atmospheric lifetime of only five days.

Manufacturers for total flooding systems using FK-5-1-12 have employed, as standard, cylinder storage pressures of 25 bar (360 psig) or 42 bar (600 psig). Previous Halon 1301 replacements required additional low pressure welded cylinders or high pressure spun steel cylinders along with new piping and nozzles, not allowing for a direct replacement.

The development of the SEVO Systems' 34.5 bar (500 psig) hardware designed for use with FK-5-1-12 provides for the first time a 1 to 1 cylinder replacement, in addition to utilizing the previously installed piping.

Testing has demonstrated that a SEVO, FM approved, increased pressure system, can replace a conventional 25 bar (360 psig) Halon 1301 system with only a nozzle and cylinder replacement in addition to the agent. By increasing the storage pressure in the cylinder, the system using FK-5-1-12 allows for additional pressure to reuse existing Halon 1301 piping while achieving the required minimum nozzle pressures.

This report summarizes four(4) Halon 1301 systems engineered at 25 bar (360 psig), 10.0-second discharge time, and average nozzle pressure of 4.5-7.6 bar (60-110 psig). Each application was designed for replacement with a SEVO 1230 increased pressure system while utilizing the existing halon piping. The Halon 1301 cylinders were

replaced 1 to 1 with SEVO 1230 cylinders filled with FK-5-1-12, requiring only new SEVO 1230 nozzles to achieve the approval requirements and the minimum required nozzle pressure.

INTRODUCTION

Since the developed countries' 1993 manufacturing phase out of substances that deplete the ozone layer per the Montreal Protocol, there has been, and continues to be, an effort to develop a direct one to one replacement for systems using Halon 1301 (bromotrifluoromethane). Some fire protection equipment manufacturers offered alternate technologies using hydrofluorocarbons (HFCs) or inert gases to replace previously protected hazards by Halon 1301. These new clean fire extinguishing agents require higher design concentrations and thus greater agent mass quantities to achieve comparable fire extinguishing performance to that of Halon when used in total flooding applications. This requires that the design of a fire suppression system must allow for larger quantities of agent than the initial Halon 1301 equipment provided. The storage cylinders require larger capacity and in the past, more cylinders. Substantial revisions to the delivery systems, nozzles and pipe are required to deliver the increased material quantity and in many cases, at an unacceptably long discharge time of greater than 10 seconds for systems employing halocarbon agents. The higher cost to revise and replace the Halon distribution systems and additional floor space required for additional cylinders have largely prevented many Halon 1301 protected applications from direct conversion.

A number of HFC clean agents have been used in standard 25 bar (360 psig) hardware to replace the Halon 1301 in existing applications. These higher Global Warming materials may require longer system discharge times. The inert gases require much higher operating pressures and therefore cannot be used in existing low pressure piping networks. There is a fast-approaching deadline for Halon 1301 removal and replacement and growing pressures to eliminate the worldwide use of high global warming agents. SEVO Systems introduced the first UL Listed product line designed with FK-5-1-12 at 25 bar (360 psig). Since 2001, SEVO Systems has strived to develop a TRUE RETROFIT SYSTEM, that is, a one to one cylinder replacement using existing installed Halon 1301 distribution piping. This is a solution that meets four primary principles:

(1) Replace agent supply with a one to one footprint,

(2) Minimal distribution pipe modifications,

(3) Replacement only of distribution nozzles,

(4) A resultant system that meets the fire suppression performance requirements by achieving the required discharge time, minimum distribution nozzle pressure and agent distribution per current approvals, listings, and standards.

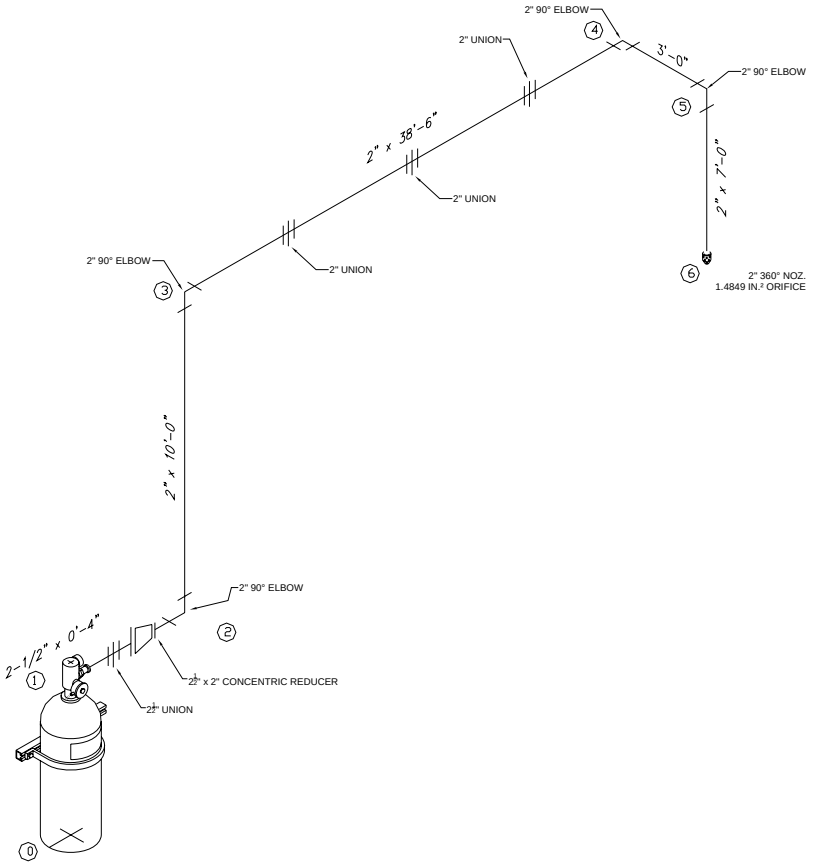
This paper discusses the development of an innovative delivery technology. The SEVO 1230 Retro, 34.5 bar (500 psig) delivery system was provided as a one to one cylinder retrofit using existing pipe in four systems. The maximum discharge time 10 seconds and a minimum nozzle pressure of 5.09 bar (73.8 psi) were achieved for each application.

EXAMPLES OF "TRUE RETROFIT" HALON REPLACEMENT

The following are examples where the TRUE RETROFIT concept can be applied.

First, consider a Class "C" 142 m^3 (5018 ft^3) hazard protected by an Ansul 6% Halon 1301 system. The initial system design calculations using Ansul's listed software calls for a 125 lb. Filled Halon 1301 cylinder using single 2" nozzle and pipe network. A design concentration of 6.0% for FK-5-1-12 fluid is used in this comparison.

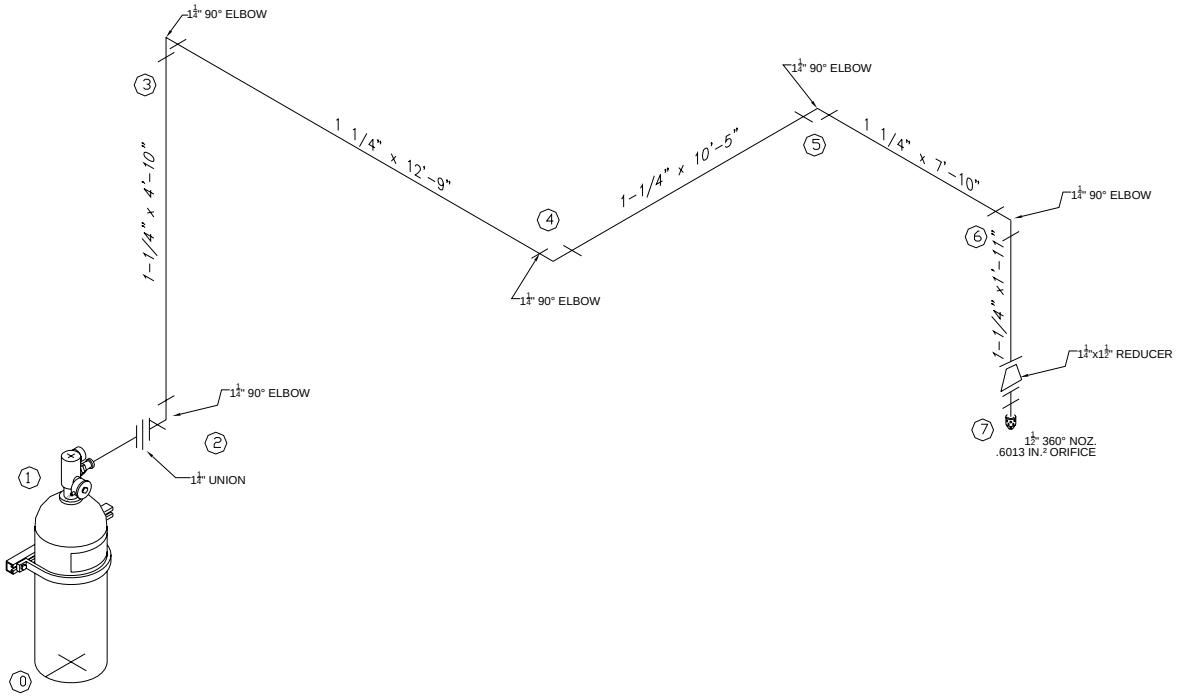
Detail: 1



Ansul 125lb Halon 1301 to SEVO 322lb FK-5-1-12							
Cylinder: 322 lb SEVO				Nozzle: 360 Central			
Size	PN	Volume	Agent Fill	Type	Size	Orifice Area	Drill
(lb)		(ft^3)	(lbs)		(in)	(in^2)	(in)
322	**140057TC**	**4.3**	**277**	**Central**	**2**	**1.4849**	**0.3438**

Second, consider the Class "A" 89 m^3 (3155 ft^3) hazard protected by a Chemetron 5% Halon 1301 system. The initial system was provided per the Beta pre-calc computer generated calculation using 65 lbs. filled Halon 1301 cylinder and a 1-1/4" nozzle with associated pipe network. A design concentration of 4.2% for FK-5-1-12 fluid is used in this comparison.

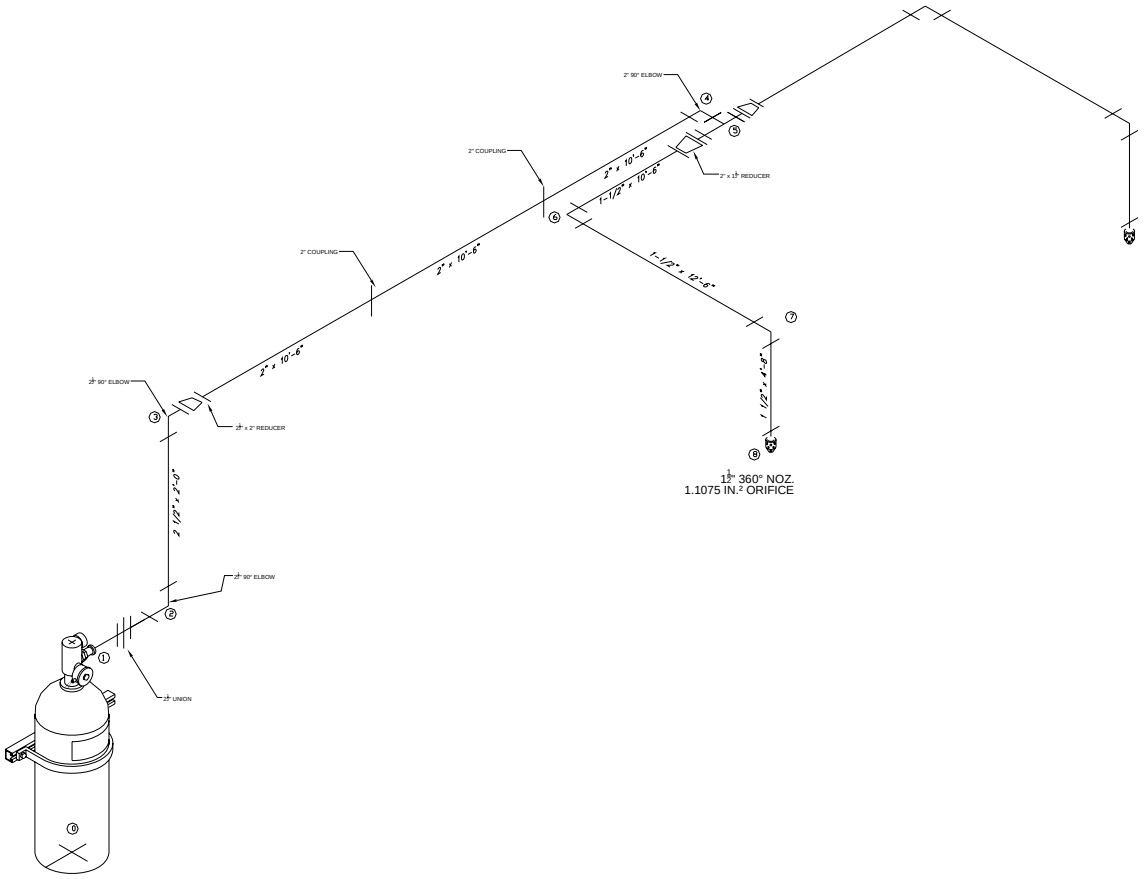
Detail: 2



Chemetron 65 lb. Halon 1301 to SEVO 164lb. FK-5-1-12							
Cylinder: 164 lb FFT				Nozzle: 360 Central			
Size	PN	Volume	Agent Fill	Type	Size	Orifice Area	Drill
(lb)		(ft^3)	(lbs)		(in)	(in^2)	(in)
164	**14817TC**	**2.19**	**120**	**Central**	**1.5**	**0.6013**	**0.2188**

Third, consider a Class "B" 205.6 m^3 (7,260 ft^3) hazard protected by a Fike 7% Halon 1301 system. The initial system was provided in accordance with Fike's pre-engineered Halon 1301 manual with 215 lb. Filled Halon 1301 cylinder using a 2" pipe network and 2) 1-1/2" nozzles. A design concentration of 5.85% for FK-5-1-12 fluid is used in this comparison.

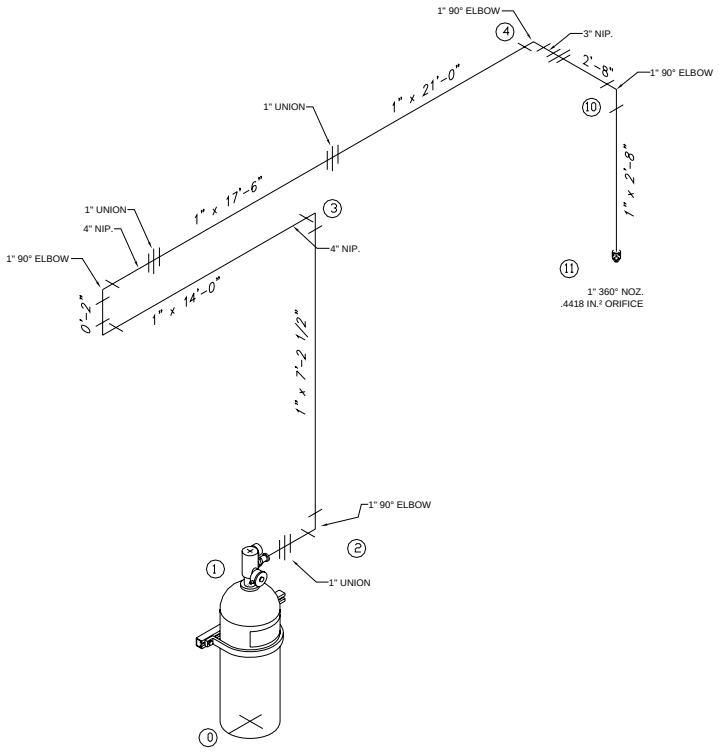
Detail: 3



Fike 215 lb Halon 1301 to SEVO 601 lb FK-5-1-12							
Cylinder: 601 lb SEVO				Nozzle: 360 Central (2)			
Size	PN	Volume	Agent Fill	Type	Size	Orifice Area	Drill
(lb)		(ft^3)	(lbs)		(in)	(in^2)	(in)
601	**14813TC**	**8.02**	**390**	**Central**	**1.5**	**0.856**	**0.2610**

Fourth, consider a Class "A" 41.2m^3 (1,456 ft^3) hazard protected by a Pyrotronics 5% system. The initial system design calculated per their approved software provided for a 30 lb. Filled Halon 1301 cylinder using a 1" pipe network and 1" nozzle. A design concentration of 4.2% for FK-5-1-12 fluid is used in this comparison.

Detail: 4



Pyrotronics 30 lb Halon 1301 to SEVO 76 lb FK-5-1-12							
Cylinder: 76 lb SEVO				Nozzle: 360 Central			
Size	PN	Volume	Agent Fill	Type	Size	Orifice Area	Drill
(lb)		(ft^3)	(lbs)		(in)	(in^2)	(in)
76	**140079TC**	**1.02**	**56**	**Central**	**1**	**0.3058**	**0.1560**

TABLE 1.1 SUMMARY HALON 1301 TO FK-5-1-12

TYPE	**CLASS "C"**		**CLASS "A"**		**CLASS "B"**		**CLASS "A"**	
Manufacturer	Ansul	SEVO	Chemetron	SEVO	Fike	SEVO	Pyrotronics	SEVO
Hazard Design	6.0%	6.0%	5.0%	4.20%	7.0%	5.85%	5.0%	4.20%
Hazard Size	5018	5018	3155	3155	7260	7260	1456	1456
Size / Fill (lbs)	200/125	322/277	65	164/120	215	601/390	30	76/56
Pipe size (in)	2	2	1.25	1.25	2.0/1.5	2.5/2.0/1.5	1	1
Pipe Equivalent length (ft)	75	77	73	75	105	114	115	117
Nozzle size (in.)	2	2	1.25	1.5	2) 1.5	2) 1.5	1	1
Average nozzle pressure (psig)	124	75	125	76.4	135	75.6	140	80.9
Discharge Time (s)	7.8	8.0	7.4	8.7	8.0	8.3	9.0	9.1

In each of the previous examples the SEVO 1230 delivery system provided for the retrofit of each manufacturer's Halon 1301 equipment by replacing the agent cylinder and nozzle only with only a minor revision of the initial pipe elevation. By increasing the pressure of the storage cylinder from 25 bar to 34.5 bar (360 psig to 500 psig) the agent flow rate is increased while maintaining the minimum required average nozzle pressure in accord with the system approval. The discharge time of 10 seconds is achieved using the existing Halon 1301 distribution pipe network.

INNOVATIVE DELIVERY SYSTEM

The essential elements of the SEVO Systems new innovative delivery hardware for FK-5-1-12 is outlined in the FM approved manual part no. SEVO-1230-500. The low vapor pressure of the FK-5-1-12 fluid can be utilized as a differentiating feature from that of

any other halon replacement, by super pressurizing the agent storage cylinder with nitrogen to 34.5 bar (500 psig), a TRUE RETROFIT of a Halon 1301 system with one using Novec 1230 fluid can be achieved.

The key innovation is the use of the standard welded 500 D.O.T/T.C low-pressure cylinder. SEVO is utilizing the low vapor pressure of the Novec 1230 fluid, which allows for safe use in welded cylinders at elevated pressure to achieve the TRUE RETROFIT. Appropriate limits are outlined in the SEVO 1230 Retro 1301 document.

The introduction of the SEVO retrofit product is scheduled for June 1, 2006. Flow calculation software is currently being developed which will accurately predict mass flow rate and pressure throughout the system. Extensive validation testing comparing most manufacturers' Halon 1301 software has been conducted. Approved software to be available late 2006.

SUMMARY

The retrofit of existing Halon 1301 total flooding system is now possible while using the existing halon pipe network. Delivering the agent quantity, achieving the design concentrations at the approved / listed nozzle pressure within the allowed discharge time of 10 seconds for FK-5-1-12 is now possible. This innovative development by SEVO Systems offers the first **ONE TO ONE HALON 1301 "TRUE RETROFIT" SOLUTION.** The SEVO 1230 system allows for employing existing Halon 1301 pipe networks while using the preferred second-generation fluid.

REFERENCES

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2. SEVO 1230-500 Manual, Design, Operation, Installation, and Maintance Manual, Fire Fluid Technologies, Lenexa, KS 2005.

3. 360 PSI Total Flooding Halon 1301 Fire Extinguishing Systems Design Manual, Kidde, 1972.

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5. Installation Instructions FiQuench Pre-engineered Halon 1301 System, 1986.

6. Pyr-a-lon 1301 Fire Extinguishing Systems, 1987.

7. Ansul Halon 1301 Total Flooding Design Manual, 1977.

8. SEVO 1230 Retro 1301, 2005.