ANSUL® ANSUL FIRE PROTECTION
MARINETTE, WI 54143-2542

MATERIAL SAFETY DATA SHEET

INERGEN
QUICK IDENTIFIER (In Plant Common Name)

Manufacturer's Name:	ANSUL FIRE PROTECTION	Emergency Telephone No.:	CHEMTREC (800) 424-9300
Address:	One Stanton Street, Marinette, WI 54143-2542	Other Information Calls:	(715) 735-7411
Prepared By:	Safety and Health Department	Date Prepared:	January 23, 1995

SECTION 1 — IDENTITY

Common Name: (used on label) (Trade Name and Synonyms)	INERGEN	CAS No.:	N/A
Chemical Name:	Mixture of Inert Gases and Carbon Dioxide	Chemical Family:	Inert Gases: Nitrogen, Argon Nonmetallic Oxide: Carbon Dioxide
Formula:	52% N_2, 40% Ar and 8% CO_2		

SECTION 2 — INGREDIENTS

PART A — HAZARDOUS INGREDIENTS

Principal Hazardous Component(s) (chemical and common name(s)):	%	CAS No.	ACGIH TLV	Acute Toxicity Data
None				

PART B — OTHER INGREDIENTS

Other Component(s) (chemical and common name(s)):	%	CAS No.		Acute Toxicity Data
Nitrogen	52	7727-37-9	N/A	None
Argon	40	7440-37-1	N/A	None
Carbon Dioxide	8	124-38-9	5000 ppm	ihl-hmn LC_{LO} 100,000 ppm/ 1 min

SECTION 3 — PHYSICAL AND CHEMICAL CHARACTERISTICS (Fire and Explosion Data)

Boiling Point:	−320 °C			Specific Gravity (H_2O = 1):	.084 lbs./ft.^{3}	Vapor Pressure (mm Hg):	2205 psi @ 70 °F
Percent Volatile by Volume (%):	100	Vapor Density (Air = 1):	1.0	Evaporation Rate (= 1):	N/A Gas at room temperature.		
Solubility in Water:	Slight			Reactivity in Water:	No		
Appearance and Odor:	Colorless gas with no odor.						
Flash Point:	None	Flammable Limits in Air % by Volume:	N/A	Extinguisher Media:	N/A	Auto-Ignition Temperature:	N/A
Special Fire Fighting Procedures:	Though gas cylinders are equipped with pressure and temperature relief devices, they should be removed from high temperatures or fire to avoid risk of rupture.						
Unusual Fire and Explosion Hazards:	None						

SECTION 4 — PHYSICAL HAZARDS

Stability:	Unstable ☐ Stable ☒	Conditions to Avoid:	None
Incompatibility (Materials to Avoid):	Does not apply		
Hazardous Decomposition Products:	None		
Hazardous Polymerization:	May Occur ☐ Will Not Occur ☒	Conditions to Avoid:	N/A

SECTION 5 — HEALTH HAZARDS

Threshold Limit Value:	No TLV value cited, material can be an asphyxiant
Routes of Entry: Eye Contact:	Non irritating gas
Skin Contact:	Non irritating gas
Inhalation:	Not an asphyxiant at its normal design concentration of 34 – 70% V/V
Ingestion:	Non irritating gas
Signs and Symptoms: Acute Overexposure:	Dizziness, disorientation, loss of motor control
Chronic Overexposure:	Dizziness, disorientation, loss of motor control
Medical Conditions Generally Aggravated by Exposure:	Not determined at this time. Suspect respiratory impairment.
Chemical Listed as Carcinogen or Potential:	National Toxicology Program: Yes ☐ No ☒ I.A.R.C. Monographs: Yes ☐ No ☒ OSHA: Yes ☐ No ☒

SECTION 6 — EMERGENCY AND FIRST AID PROCEDURES

Eye Contact:	Avoid direct contact of high pressure gas discharge – use safety glasses.
Skin Contact:	Avoid direct contact of high pressure, cold gas with skin – wear gloves.
Inhalation:	Avoid direct inhalation of undiluted gas – gas mixture is an asphyxiant.
Ingestion:	N/A

SECTION 7 — SPECIAL PROTECTION INFORMATION

Respiratory Protection (Specify Type):	The normal discharge of INERGEN at its designed concentration between 34 – 70% V/V in a fixed enclosure does not present any hazard. Any exposure outside of these limits should result in the use of self-contained breathing apparatus. Respirators will not function in O_2 deficient atmospheres.		
Ventilation:	Local Exhaust: As required	Mechanical (General):	As required
Protective Gloves:	Loose fitting gloves of impermeable materials such as leather. Leather work gloves are recommended when handling compressed gas cylinders.	Eye Protection:	Chemical goggles or safety glasses recommended.
Other Protective Clothing or Equipment:	None		

SECTION 8 — SPECIAL PRECAUTIONS AND SPILL/LEAK PROCEDURES

Precautions to be Taken in Handling and Storage:	Normal precautions for handling high pressure gas
Other Precautions:	None
Steps to be Taken in Case Material is Released or Spilled:	None, material is a mixture of normal atmospheric gases
Waste Disposal Methods:	Not applicable, material is a mixture of normal atmospheric gases.

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM RATINGS

HAZARD INDEX:	
4 Severe Hazard	
3 Serious Hazard	1 HEALTH
2 Moderate Hazard	0 FLAMMABILITY
1 Slight Hazard	0 REACTIVITY
0 Minimal Hazard	

N/A = Not Applicable NDA = No Data Available

Inergen™

UPDATE

VOL. 1, NO. 3

INERGEN UL Testing Successful

Recently, Ansul received a letter from Underwriters Laboratories confirming that we have successfully completed the testing required for the UL listing of INERGEN systems. This testing included components, area coverage, fire extinguishment, and flow verification vs. design.

With just a few loose ends to tie up, we fully anticipate receiving the formal UL listing in November. Watch your mail for the upcoming announcement ! ! !

An Updated Report on Halons and the Environment

Volume No. 3 is designed to update our customers on the issue of Halon 1301 as it affects ozone depletion, the latest findings on Halon replacements, and recommendations on disposition of existing Halon 1301 Systems.

This edition contains a generic background history of Halon 1301, including its properties, uses and applications. It is necessary to present this information so as to lay a foundation for the final recommendations.

Since it is generic in nature, there will be specific issues and questions which are not covered. We urge you to contact Ansul or an Authorized INERGEN Systems Distributor with your questions so that we can help you in your particular application.

There are many factors to be considered in selecting an alternative agent and it is not possible to mention all of them in this UPDATE. Price should not be a deciding factor; prices may vary considerably from what they are today as markets develop for each of the various proposed agents. Of greater concern should be:

- Safety of the occupants of the protected area
- Ability of the agent to control potential fire damage
- Future availability of the alternative agent
- Compliance with health and environmental regulations

Comparing agent effectiveness can be complex and advice should be sought from knowledgeable fire protection professionals.

Halon 1301 Features and Benefits

For almost thirty years, Halon 1301 has been the best and only acceptable fire extinguishant for the protection of high value areas such as computer rooms, telecommunication facilities, museums, libraries, etc. The reason behind its popularity has been its features which, to this day, remain unmatched . . .Halon 1301 is a nontoxic, electrically nonconductive, noncorrosive, clean, clear, odorless, tasteless gas. It extinguishes fires in seconds and is usually discharged at the fire's incipient stage before temperatures become excessive.

The benefits were obvious. . .damage to equipment was minimal, and downtime (most importantly) was negligible.

While Halon 1301 systems were not meant to replace water sprinkler systems, they were important because sprinklers reacted too slowly to prevent serious damage to the tapes, disks, computers and switches.

There are some computer manufacturers who discouraged the use of Halon systems stating that computer equipment could be immersed in water without suffering any damage. They neglected, however, to take into account the impurities that build up in a piping system, the amount of downtime required to dry out and clean up the machines, the damage to papers and files, and the electrical problems which would occur with water in the underfloor spaces, etc.

Fire sprinkler heads are designed to open at 140 to 160 degrees fahrenheit. What is important to realize is that before the fuse in the head can reach its design temperature of 140 or 160 degrees, the air temperature in the room will already have reached a temperature of over 600 degrees.

Memory is lost at 120 degrees or more; computer components will deform at 300 degrees. All is lost by the time the water sprinkler can react. The room or building will be saved; but the equipment will be lost! Downtime can also be critical to an operation. While it is true that water (clean water) will not damage a computer, the drying out and cleanup could take four to five days.

Cost History

In the early seventies, the average Halon system cost in the range of $2.50 per cubic foot of protected space for a total flooding system. As the market developed and reached its peak in the eighties, the cost dropped to $1.00 or $1.25 per cubic foot.

For reasons to be explained in the following articles, the price is now on the increase with the cost of Halon 1301 increasing from $6.00 in the 1970's to between $15.00 and $20.00 per pound in the 1990's.

Environmental Issues

Some years ago, scientists theorized that CFC's (Chlorinated Hydrocarbons) were responsible for increases in depletion of the earth's protective ozone layer over the South Pole. As time passed, the theory gave way to genuine concern which led to

(Continued on Page 2)

If the Halon 1301 system is to be replaced immediately:

- Contact Ansul or an Authorized INERGEN Systems Distributor to discuss available options.
- Make arrangements for transferring the Halon 1301 to another end-user with a more critical need.

If the Halon 1301 system is to be replaced after the system is discharged:

- Consult with Ansul or an Authorized INERGEN Systems Distributor to define which agent/system should be substituted.

Conclusion:

In light of the recent Montreal Protocol mandate that calls for a ban on the production and sale of Halon 1301 by the end of 1993, Halon 1301 users must begin to seriously consider their options.

Regardless of which agent end-users wish to install or whether they remove or keep an existing Halon 1301 system, a concentrated effort should be made to reduce the incidences of false or unwanted agent discharges. This is obvious in the case of Halons which will become increasingly more expensive, and ultimately, irreplaceable. Better and more frequent training of personnel should be provided to reduce accidental discharges and service and maintenance of traditional fire and smoke detection systems should be made more frequently.

Finally, the need for a clean, dry, colorless, odorless equipment-friendly and nontoxic agent has not changed with the demise of Halon 1301. INERGEN agent and agents like them are still the answer to fast, clean fire extinguishment for high-value areas.

INERGEN Update is published for distributors, customers and friends of Ansul Fire Protection, Marinette, Wisconsin 54143-2542, Telephone 715-735-7411.

INERGEN Update
ANSUL FIRE PROTECTION
ONE STANTON STREET
MARINETTE, WI 54143-2542

FIRST CLASS MAIL

MATERIAL SAFETY DATA SHEET

NATIONAL WELDERS

MAJOR SUPPLIERS OF CRYOGENICS AND WELDING EQUIPMENT

NU001002
National Welders
P.O. Box 31007
Charlotte, NC 28231, 704-333-5475
Emergency Telephone: 800-866-4422
ChemTrec: 800-424-9300

Issued: JANUARY 1, 1991

SECTION 1. MATERIAL IDENTIFICATION

PRODUCT NAME	CAS #
Argon	7440-37-1
TRADE NAME AND SYNONYMS	**DOT I.D. NO.**
Argon, Argon, compressed	UN 1006
CHEMICAL NAME AND SYNONYMS	**DOT HAZARD CLASS**
Argon	Nonflammable Gas
FORMULA / **CHEMICAL FAMILY**	**DESCRIPTION**
AR / Rare Gas	Obtained commercially during liquid-air manufacture. This monatomic inert gas is supplied as liquid or compressed gas in steel cylinders or (Continued Page 4)

NATIONAL FIRE PROTECTION ASSOCIATION CODE 704

HMIS
H: 1
F: 0
R: 0
S: 0

SECTION 2. HEALTH HAZARD INFORMATION

TIME WEIGHTED AVERAGE EXPOSURE LIMIT Argon is defined as a simple asphyxiant. Oxygen levels should be maintained at greater than 18 molar percent at normal atmospheric pressure which is equivalent to a partial pressure of 135 mm Hg.

(Continued Page 4)

SYMPTOMS OF EXPOSURE

Effects of exposure to high concentrations so as to displace the oxygen in air necessary for life may include any, all, or none of the

* Loss of balance or dizziness;
* Tightness in the frontal area of the forehead;
* Tingling in the tongue, fingertips or toes;
* Weakened speech leading to the inability to utter sounds;
* Rapid reduction in the ability to perform movements;
* Reduced consciousness of the surroundings;
* Loss of tactile sensations;
* Heightened mental activity.

It should be recognized that it is possible that none of the above symptoms may occur in argon asphyxia so that there are no definite warning symptoms.

TOXICOLOGICAL PROPERTIES Argon is nontoxic but the liberation of a large amount in a confined area could displace the amount of oxygen in air necessary to support life.

Carcinogenicity: The NTP, IARC, and OSHA do not list argon as a carcinogen.

RECOMMENDED FIRST AID TREATMENT PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVEREXPOSURE TO ARGON. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS.

Inhalation: Conscious persons should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area, given mouth-to-mouth resuscitation and supplemental oxygen. Further treatment should (Continued Page 4)

SECTION 3, PHYSICAL DATA

BOILING POINT -302.6°F (-185.9°C)	LIQUID DENSITY AT BOILING POINT 87 lb/ft^3 (1393 kg/m^3)
VAPOR PRESSURE @ 70°F (21.1°C): Above the critical temp. of -188.1°F (-122.3°C)	GAS DENSITY AT 70°F, 1 OTM .1034 lb/ft^3 (1.656 kg/m^3)
SOLUBILITY IN WATER Very slightly	FREEZING POINT -308.9°F (-189.4°C)
EVAPORATION RATE N/A	SPECIFIC GRAVITY (AIR = 1) 1.38

APPEARANCE AND ODOR
Colorless, odorless gas

SECTION 4. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: N/A AUTO IGNITION TEMPERATURE: N/A	FLAMMABLE UNITS % BY VOLUME N/A
EXTINGUISHING MEDIA Nonflammable, inert gas	ELECTRICAL CLASSIFICATION Nonhazardous
SPECIAL FIREFIGHTING PROCEDURES N/A	UNUSUAL FIRE AND EXPLOSION HAZARDS

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS OR GASES
N/A

SECTION 5. REACTIVITY DATA

STABILITY Unstable ☐ Stable ☒ CONDITIONS TO AVOID: N/A	HAZARDOUS POLYMERIZATION May Occur ☐ Will Not Occur ☒ CONDITIONS TO AVOID: N/A
INCOMPATIBILITY (Materials to Avoid) None	HAZARDOUS DECOMPOSITION PRODUCTS None

SECTION 6. SPILL, LEAK AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Evacuate all personnel from affected area. Use appropriate protective equipment. If leak is in container or container valve, contact your closest supplier location or call the emergency nuber listed herin.
SARA 313 Chemical Release Right-To-Know = RQ - None

WASTE DISPOSAL: Do not attempt to dispose of waste or unused quantities. Return in the shipping container properly labeled, with any valve outlet plugs or caps secured and valve protection cap in place to your supplier. For emergency disposal assistance, contact your closest supplier or call the emergency number listed herein.

SECTION 7. SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION: Positive pressure air line with mask or self-contained breathing apparatus should be available for emergency use.

VENTILATION See Page 4	LOCAL EXHAUST See Ventilation Page 4	
	MECHANICAL N/A	OTHER N/A
PROTECTIVE GLOVES Any material		EYE PROTECTION Safety goggles or glasses

OTHER PROTECTIVE EQUIPMENT
Safety shoes

SECTION 8. SPECIAL PRECAUTIONS AND COMMENTS

SPECIAL LABELING INFORMATION

DOT Shipping Name: Argon or Argon, compressed DOT Hazard Class: Nonflammable Gas
DOT Shipping Label: Nonflammable Gas I.D. No.: UN1006

SPECIAL HANDLING RECOMMENDATIONS Use only well ventilated areas. Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure reducing regulator when connecting cylinder to lower pressure (<3,000 psig) piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder.

For additional recommendations, consult Compressed Gas Association's Pamphlets P-1, P-9, P-14 and Safety Bulletin SB-2

SPECIAL STORAGE RECOMMENDATIONS Protect cylinders from physical damage. Store in cool, dry, well ventilated area away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 130°F (54°C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in - first out" inventory system to prevent full cylinders being stored for excessive periods of time.

For additional recommendations, consult Compressed Gas Association's Pamphlyets P-1, P-9, P-14 and Safety Gulletin SB-2.

SPECIAL PACKAGING RECOMMENDATIONS

Argon is noncorrosive and may be used with any common structural material.

OTHER RECOMMENDATIONS OR PRECAUTIONS

Compressed gas cylinders should not be refilled except by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner or with his (written) consent is a violation of Federal Law (49CFR).

SPECIAL NOTES:

SPECIAL NOTES:

SECTION 1 - MATERIAL IDENTIFICATION: (Continued from Page 1)

DESCRIPTION: tubes. Used as an inert gas shield in arc welding processes; in electric and specialized light bulbs (neon, flourescent, sodium vapor), thermometers above mercury, rectifier tubes, ionization and particle counters, plasma jet torches (with hydrogen), furnace brazing, titanium and zirconium refining, Geiger-counting tubes, lasers, decarburization of stainless steel (AOD process), flushing molten metals (steel) to remove dissolved gases; as inert gas or atmosphere in miscible applications; and for determining the geologic age of minerals and meteors.

SECTION 2 - HEALTH HAZARD INFORMATION: (Continued from Page 1)

TIME WEIGHTED AVERAGE EXPOSURE LIMIT:

1989 OSHA PEL	1989-90 ACGIH TLV
None established	TLV-TWA (Simple Asphyxiant): Maintain at least 18% by volume oxygen at normal atmospheric pressure (pO_2 = 135 torr)
1988 NIOSH REL	1985-86 Toxicity Data
None established	None listed

RECOMMENDED FIRST AID TREATMENT: be symptomatic and supportive.

SECTION 7 - SPECIAL PROTECTION INFORMATION: (Continued from Page 2)

VENTILATION: To prevent accumulation of high concentrations so as to reduce the oxygen level in the air to less than 18 molar percent.

SUMMARY: UL FIRE TEST RESULTS INERGEN™ FIRE EXTINGUISHING AGENT

ANSUL FIRE PROTECTION, MARINETTE, WI 54143-2542 WHITE PAPER 1006

INTRODUCTION

Described in this paper are the fire extinguishment tests required by the UL interpretation and application of Underwriters Laboratories Standard 1058 as part of the listing process for clean agent fire extinguishant systems. These extinguishment tests conducted under "worst-case" conditions are conducted by fire equipment manufacturers under the direction and supervision of Underwriters Laboratories Incorporated (UL).

INERGEN extinguishing agent has passed all required fire tests including Class A and B fire extinguishment, nozzle area coverage, height coverage, hardware component and agent flow.

This paper summarizes these fire extinguishment testing requirements and reports the listing results for INERGEN fire extinguishing agent and suppression systems hardware (EX-4510).

BACKGROUND

Underwriters Laboratories (UL) Standard 1058, Halogenated Agent Extinguishing System Units contains the basic requirements for the construction and operation of halogenated agent fire extinguishing systems and automatic extinguisher units intended to be used in accordance with NFPA 12A Standard for Halon 1301 Fire Extinguishing Systems. UL-1058 covers component evaluation, system performance and fire extinguishment tests; and is currently being modified for use in evaluating both in-Kind and not in-Kind replacements for Halon 1301. Required fire extinguishment tests include nozzle area coverage, height coverage, Class A fires (wood crib), Class B fires (n-heptane), hardware components and agent flow.

EXTINGUISHMENT TESTS: CLASS A FIRES

Wood crib fire tests were conducted in a 10' x 10' x 12' high 1200 $ft.^3$ (3 x 3 x 3.7 m – 4 m^3) draft-free room provided with a means of observing the wood crib during the test. Adjustable vents on opposite walls near the floor and ceiling provided adequate ventilation during the fire's preburn. Three oxygen probes were located at the base, midsection and top side of the test enclosure to measure oxygen levels within the test enclosures. The oxygen level inside the test enclosure was maintained at not less than 20% prior to initiation of the system discharge. The system piping arrangement provided the design minimum nozzle pressure. The test cylinder(s) were conditioned at 70 °F (21 °C) for 16 hours prior to the test. The tests were conducted at agent concentrations equal to extinguishing concentrations: hence agent concentrations did not include the 20% safety factor required by the NFPA. Discharge times, extinguishment times, and nozzle pressure were monitored and recorded.

Wood cribs consisted of four layers of six, trade size 2" x 2" x 18" long (5.1 x 5.1x 45.7 cm) kiln-dried spruce or fir lumber having a moisture content between 9% and 13%. Alternate layers consisted of wood members placed at right angles to each other and the individual wood members were evenly spaced to form a square. Wood members were either stapled or nailed together.

Ignition of the wood crib was achieved by burning 1/4 gallon (.95 L) of commercial grade n-heptane in a square steel pan measuring 2.5 $ft.^2$ (.23 m^2) in area; the crib was centered 12 inches (30.5 cm) above the top of the pan. The n-heptane was ignited and the wood crib exposed to the fuel fire for 3 to 3.5 minutes. The crib was then allowed to burn for an additional 2.5 to 3 minutes resulting in a total preburn of 6 minutes. The crib was then placed on a test stand, approximately 20 to 23 inches (50.8 – 58.4 cm) above the floor and positioned in the center of the enclosure. The enclosure was then sealed, ventilation equipment shut down, and the system discharge initiated. A soak period of 10 minutes from the end of system discharge was allowed before opening the test enclosure. The crib was then removed from the enclosure and observed. No combustion or re-ignition of the burned wood crib or free burning embers were permitted.

EXTINGUISHMENT TESTS: CLASS B FIRES

Class B fire extinguishment tests were conducted in a draft-free room measuring 10' x 10' x 12' high 1200 $ft.^3$ (3 x 3 x 3.7 m – 4 m^3), equipped with a means for observing the fire during the test. Adjustable vents were provided on opposite walls near the floor and ceiling to maintain adequate ventilation during the fire's preburn. Three oxygen probes were located at the base, midsection and top side of the test enclosure to

measure oxygen levels within the test enclosure. The oxygen level inside the test enclosure was maintained at not less than 20% prior to initiation of the system discharge. The system piping arrangement provided the design minimum nozzle pressure. The test cylinder(s) were conditioned at 70 °F (21 °C) for 16 hours prior to the test. Tests were performed with the agent concentrations equal to extinguishing concentrations; hence agent concentrations did not include the 20% safety factor required by the NFPA. Discharge and extinguishment times, and nozzle pressure were monitored and recorded.

The fuel source was contained in a 2.5 ft.^{2} (.23 m^2) steel pan, 6 inches deep located in the center of the enclosure. The test fuel was n-heptane. The test fuel consisted of a minimum 2 inch (5.1 cm) layer of the commercial grade fuel located 2 inches below the top edge of the pan (corresponding to 2 inches of freeboard). The fuel was ignited and allowed a preburn of 30 seconds. The enclosure was then sealed, ventilation equipment shut down, and the system discharge initiated. The fire must be extinguished within 30 seconds after the end of the system discharge.

AREA COVERAGE TESTS

The test enclosure size is choosen by the manufacturer at the limits to be placed in the design manual. For INERGEN agent, the test enclosure consisted of a 32' x 32' x 8" high 683 ft.^{3} (9.8 x 9.8 x .2 cm – 19.3 m^3) structure of commercial grade 3/8 inch plywood. Tests were performed using total flooding nozzles under conditions of minimum temperature and pressure. The test cylinder(s) were conditioned at the design minimum temperature for 16 hours prior to the test. The tests are conducted at agent concentrations equal to extinguishing concentrations. Agent concentrations do not include the 20% safety factor required by the NFPA.

Five three-inch diameter cans are used; each is at least 4 inches high (10.2 cm) filled with n-heptane to within 2 inches (5.1 cm) of the top edge are utilized. The cans are placed within 2 inches of the corners of the test enclosure and directly behind a baffle installed between the floor and ceiling in the center of the enclosure. The baffle is perpendicular to the direction of nozzle discharge and is 20% of the length or width of the enclosure. The n-heptane is ignited and allowed a 30 second preburn, after which the system discharge initiated. All five fires must be extinguished within 30 seconds from the end of system discharge.

HEIGHT COVERAGE TESTS

The test enclosure height is choosen by the manufacturer at the limits to be placed in the design manual. For INERGEN agent, the height coverage tests were conducted in a draft-free room measuring 10' x 10' x 12' (3 x 3 x 3.7 m) equipped with a means for observing the fire during the test. Adjustable vents are provided on opposite walls near the floor and ceiling to maintain adequate ventilation during the fire's preburn. Three oxygen probes were located at the base, midsection and top side of the test enclosure to measure oxygen levels within the test enclosure. The oxygen level inside the test enclosure was maintained at not less than 20% prior to initiation of the system discharge.Tests were performed under conditions of minimum temperature and pressure. The test cylinder(s) were conditioned at the design minimum temperature for 16 hours prior to the test. The tests were conducted at agent concentrations equal to extinguishing concentrations: hence agent concentrations did not include the 20% safety factor required by the NFPA. Discharge and extinguishment times, and nozzle pressure were also monitored and recorded.

Four three-inch diameter cans (at least 4 inches (10.2 cm) high, filled with n-heptane to within 2 inches (5.1 cm) of the top edge of the can) are placed on the floor of the enclosure within 2 inches of the corners of the test enclosure. Four three-inch diameter cans filled with n-heptane are also located within 2 inches of the corners at a height of approximately 12 inches (30.5 cm) below the ceiling of the enclosure. The n-heptane is ignited and allowed a 30 second preburn after which the enclosure is sealed and the system discharge activated. All eight fires must be extinguished within 30 seconds of the end of system discharge.

Fire extinguishment tests currently required under the interpretation and application of UL Standard 1058 are summarized in Table 1.

EXTINGUISHING TEST RESULTS

INERGEN extinguishing agent has passed all of the fire tests required by UL interpretation and application of UL Standard 1058. The results of the Underwriters Laboratories fire testing employing the methods described within are outlined below.

Class A Fire Extinguishment Tests: Wood crib fires were extinguished at INERGEN agent concentrations of 31.5% by volume. Extinguishment was achieved at 2175 psi (14997 kPa) cylinder pressure with a nozzle pressure of 325 psi (2241 kPa).

Class B Fire Extinguishment Tests: Pan fires of n-heptane were extinguished at INERGEN agent concentrations of 31.5% by volume. Extinguishment was achieved at 2175 psi (14997 kPa) cylinder pressure with a nozzle pressure of 325 psi (2241 kPa).

Nozzle Area Coverage Tests: INERGEN agent concentration of 31.5% was determined at a hazard and agent temperature of 70 °F (21 °C) and a nozzle pressure of 325 psi (2241 kPa). All fires in the nozzle area coverage test were then extinguished within 30 seconds after the end of discharge with the same system configuration with the hazard at 70 °F (21 °C) and the cylinders conditioned to 32 °F (0 °C).

Height Coverage Tests: INERGEN agent concentration of 31.5% was determined at a hazard and agent temperature of 70 °F (21 °C) and a nozzle pressure of 325 psi (2241 kPa). All fires in the height coverage test were then extinguished within 30 seconds after the end of discharge with the same system configuration with the hazard at 70 °F (21 °C) and the cylinders conditioned to 32 °F (0 °C).

REVISED U.L. STANDARD 1058 FIRE TEST REQUIREMENTS

TEST	TEST CONDITIONS	PASS/FAIL CRITERIA	TEST RESULTS
CLASS A	10' x 10' x 12' enclosure (3 x 3 x 3.7 m) Minimum nozzle pressure (325 psi (2241 kPa)) Oxygen level not less than 20% 6 minute pre-burn Wood crib 18" x 18" x 6" (45.7 x 45.7 x 15.2 cm) 10 minute soak	Fire extinguished No re-ignition No free-burning embers	Passed at 31.5% by volume
CLASS B	10' x 10' x 12' enclosure (3 x 3 x 3.7 m) Minimum nozzle pressure (325 psi (2241 kPa)) Oxygen level not less than 20% 2.5 $ft.^2$ pan (.23 m^2) 30 second pre-burn	Fire extinguished within 30 seconds after system discharge	Passed n-heptane at 31.5%
AREA COVERAGE	32' x 32' x 8" enclosure (9.9 x 9.8 x .2 cm) Minimum design temperature (32 °F (0 °C)) 3" n-heptane cans in corners and behind baffle 30 second pre-burn	All fires extinguished within 30 seconds after system discharge	Passed at 31.5% by volume
HEIGHT OF ENCLOSURE	10' x 10' x desired height (3x3 m) Minimum design temperature (32 °F (0 °C)) 3" (7.6 cm) n-heptane cans in all eight corners 30 second pre-burn	All fires extinguished within 30 seconds after system discharge	Passed for 12' (3.7 cm) ceiling at 31.5% by volume

TABLE 1

CONCLUSION

INERGEN extinguishing agent has proven to be a long term, people compatible, efficient and environment friendly replacement for Halon 1301 in total flooding applications. INERGEN agent has received the approval of governmental and industry regulatory agencies. Under the US EPA's SNAP program, INERGEN agent has been accepted for use in total flood applications either normally occupied or normally non-occupied with no restrictions or use conditions. INERGEN agent is also included in the NFPA 2001 standard entitled, "Clean Agent Extinguishing Systems." INERGEN agent has passed all the tests required for a suppression system listing by Underwriters Laboratories in interpretation and application of UL Standard 1058, including the extinguishment of Class A fires, Class B fires, nozzle area coverage, height coverage tests, hardware component and agent flow testing.

INERGEN extinguishing agent is the world's most widely accepted and utilized replacement agent for Halon 1301. In addition to successfully completing the required fire tests for an Underwriters Laboratories listing (EX-4510), INERGEN agent has also obtained numerous International approvals from governing bodies such as Ministries of Health, Worker Safety, Maritime, Environmental Affairs and Insurance authorities.

UNDERWRITERS LABORATORIES REFERENCE NUMBERS:

FILE NUMBER: EX-4510

PROJECT NUMBERS: **93NK 29232**
92NK 04635
92NK 27530

ANSUL®

SAFEGUARDING LIFE, PROPERTY AND THE ENVIRONMENT

ANSUL FIRE PROTECTION, ONE STANTON STREET, MARINETTE, WI 54143-2542

A Grinnell® COMPANY