DuPont™ ISCEON® 9 Series

REFRIGERANTS

Technical Information

DuPont™ ISCEON® MO59 (R-417A)
DuPont™ ISCEON® MO79 (R-422A)

Properties, Uses, Storage, and Handling

DUPONT®

The miracles of science™

DuPont™ ISCEON® MO59 and DuPont™ ISCEON® MO79
Properties, Uses, Storage, and Handling

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Introduction

Background

R-22 (HCFC-22) has been used in a wide variety of refrigeration, industrial cooling, air conditioning, and heating applications for over five decades. In some regions of the world, the production and/or use of these products has been phased out. In other regions these products will be phased out in the near future. In preparation for this phase-out, DuPont offers DuPont™ ISCEON® MO59 and DuPont™ ISCEON® MO79 as alternatives to R-22 and R-502 in certain applications.

ISCEON® MO59 and MO79 Refrigerant Descriptions

ISCEON® MO59 is a ternary blend of HFC-134a, HFC-125 and HC-600 that has been developed as a zero ODP retrofit refrigerant for HCFC-22 in air conditioning and some medium and high temperature refrigeration applications.

ISCEON® MO79 is a ternary blend of HFC-134a, HFC-125 and HC-600a that has been developed as a zero ODP replacement for HCFC-22, CFC-502, and HCFC-containing blends in a wide variety of low and medium temperature refrigeration applications.

The compositions of ISCEON® MO59 and MO79 are as follows (wt%):

	HFC-125	HFC-134a	butane	Isobutane
ISCEON® MO59	46.6	50	3.4	–
ISCEON® MO79	85.1	11.5	–	3.4

Table 1 lists the chemical names and formulae of the components that make up ISCEON® MO59 and MO79.

Performance Comparison

Tables 2 through **6** provide performance comparisons of ISCEON® MO59 vs. HCFC-22, and ISCEON® MO79 vs. HCFC-22 and CFC-502. This information is based on field experience, calorimeter testing, and thermodynamic property data. Broad field experience has shown that ISCEON® MO59 provides performance that meets customer requirements in most properly retrofitted systems. ISCEON® MO59 provides required cooling capacity in most systems; however, some systems may experience reduced capacity. ISCEON® MO59 has been shown to offer energy savings in some systems. Actual performance depends on system design and operating conditions.

ISCEON® MO79 provides improved cooling capacity and energy efficiency over HCFC-22 in many systems, especially at low temperature conditions. It also provides comparable cooling capacity and energy efficiency to R-404A. Actual performance depends on a number of system design and operating conditions. ISCEON® MO79 operates at significantly lower discharge temperatures vs. HCFC-22.

Table 2
Performance – ISCEON® MO59

	HCFC-22	ISCEON® MO59
Compressor Discharge Temperature, °C (°F)	96 (204)	72 (161)
Compressor Discharge Pressure, kPa abs (psia)	1770 (257)	1630 (236)
Temperature Glide, °C (°F)	0 (0)	3 (5)

Test Conditions:
43°C (110°F) Condenser
4°C (40°F) Evaporator

Table 1
Components of ISCEON® MO59 and MO79

Component	Chemical Name	Formula	CAS Number	Molecular Weight
HFC-125	Pentafluoroethane	CF_3CHF	354-33-6	120
HFC-134a	1,1,1,2-Tetrafluoroethane	CF_3CH_2F	811-97-2	102
Butane	n-propane	C_4H_{10}	106-97-8	58
Isobutane	2-methyl propane	C_4H_{10}	75-28-5	58

Table 3
Performance – ISCEON® MO59

	HCFC-22	ISCEON® MO59
Compressor Discharge Temperature, °C (°F)	*135 (275)	104 (219)
Compressor Discharge Pressure, kPa abs (psia)	1770 (257)	1630 (236)
Temperature Glide, °C (°F)	0 (0)	3 (5)

* Assumes auxiliary cooling to limit compressor discharge temperature.

Test Conditions:

43°C (110°F) Condenser

–18°C (0°F) Evaporator

The cooling capacity of ISCEON® MO59 will range from 5 to 15% lower than HCFC-22. Experience indicates many air-to-air systems typically have 10–15% more capacity than required.

Table 4
Performance – ISCEON® MO79

	HCFC-22	CFC-502	ISCEON® MO79
Compressor Discharge Temperature, °C (°F)	96 (204)	76 (169)	69 (156)
Compressor Discharge Pressure, kPa abs (psia)	1770 (257)	1930 (280)	2120 (308)
Temperature Glide, °C (°F)	0 (0)	0 (0)	3 (5)

Test Conditions:

43°C (110°F) Condenser

4°C (40°F) Evaporator

Table 5
Performance – ISCEON® MO79

	HCFC-22	CFC-502	ISCEON® MO79
Compressor Discharge Temperature, °C (°F)	*135 (275)	132 (270)	114 (238)
Compressor Discharge Pressure, kPa abs (psia)	1770 (257)	1930 (280)	2120 (308)
Temperature Glide, °C (°F)	0 (0)	0 (0)	1 (2)

* Assumes auxiliary cooling to limit compressor discharge temperature.

Test Conditions:

43°C (110°F) Condenser

–29°C (–20°F) Evaporator

Table 6
Cooling Capacity vs. HCFC-22

	At 40°F (4°C) Evaporator Temp.	At 0°F (–18°C) Evaporator Temp.	At –20°F (–29°C) Evaporator Temp.
CFC-502	0–5% lower	5–10% higher	10–15% higher
ISCEON® MO79	0–5% lower	5–10% higher	10–15% higher

Table 7
General Property Information, ISCEON® MO59 and MO79

Physical Property	Unit	ISCEON® MO59 (R-417A)	ISCEON® MO79 (R-422A)
Molecular Weight	g/mol	109	116
Vapor Pressure at 77°F (25°C)	kPa abs psia	985 143	1274 185
Boiling Point (1 atm.)	°C °F	–39 –39	–47 –52
Critical Temperature	°C °F	87.1 188.8	71.7 161.1
Critical Pressure	kPa abs psia	4039 585.6	3750 543.6
Critical Density	kg/m^3 lb/ft^3	520 32.5	538 33.6
Liquid Density at 25°C (77°F)	kg/m^3 lb/ft^3	1149 71.7	1136 70.9
Density, Satd. Vapor at 25°C (77°F)	kg/m^3 lb/ft^3	47.7 2.98	74.3 4.64
Specific Heat, Satd. Liquid at 25°C (77°F)	kJ/kg·K Btu/lb·F	1.446 0.346	1.446 0.346
Specific Heat, Vapor at 25°C (77°F) (1 atm.)	kJ/kg·K Btu/lb·F	0.856 0.205	0.832 0.199
Heat of Vaporization at Normal Boiling Point	kJ/kg Btu/lb	197.9 85.1	175.8 75.6
Thermal Conductivity at 25°C (77°F)			
Liquid	W/m·K Btu/hr·ft·F	0.0714 0.0413	0.0602 0.0348
Vapor (1 atm.)	W/m·K Btu/hr·ft·F	0.0143 0.00827	0.0144 0.00834
Viscosity at 25°C (77°F)			
Liquid	MPa·s	0.163	0.143
Vapor (1 atm.)	MPa·s	0.0122	0.0127
Flammability Limit in Air (1 atm.)	vol%	none	none
Ozone Depletion Potential	CFC-11 = 1.0	0	0
Global Warming Potential	CO_2 = 1	1950	2530
TSCA Inventory Status	Included	Yes	Yes
Inhalation Exposure Limit*	ppm (8 and 12 hr. TWA)	1000	1000

* The exposure limit is calculated based on the DuPont Acceptable Exposure Limit (AEL) for each component of the refrigerant blend. AEL is an airborne exposure limit established by DuPont that specifies time-weighted average concentrations to which nearly all workers may be repeatedly exposed without adverse effects during 8 and 12 hour workday and a 40-hour work week.

Physical Properties

General physical properties for ISCEON® MO59 and MO79 are shown in **Table 7**.

Additional physical property data may be found in other DuPont publications. Thermodynamic properties booklets are also available for ISCEON® MO59 and MO79 in both English and metric units.

Chemical/Thermal Stability

Stability with Metals

Stability tests for refrigerants with metals are typically performed in the presence of refrigeration lubricants. This test is run in sealed glass tubes at temperatures much higher than those encountered in refrigeration and air conditioning systems and is therefore referred to as an accelerated aging test. Results of sealed tube stability tests for HCFC-22/mineral oil and alkylbenzene lubricants have shown long-term stability in contact with copper, steel, and aluminum. And the fact that HCFC-22/mineral oil and alkylbenzene systems have been performing in the field in air conditioner and refrigeration systems for the last 50 years verifies the results from these stability tests.

HFC refrigerants (R-134a, R-404A, R-407C and R-410A) with polyol esters (POEs) have been used successfully in a wide variety of refrigeration and air conditioning applications since the early 1990s. This extensive use has demonstrated that these refrigerants and lubricants provide acceptable system stability. ISCEON® MO59 and MO79 contain HFC-134a, HFC-125 (which are used as components in several HFC refrigerant blends) and a small amount of hydrocarbon. Field performance of ISCEON® MO59 and MO79 with traditional lubricants and POEs, as well as demonstrated HFC and HCFC performance indicate acceptable chemical stability in the presence of common metals used in refrigeration and air conditioner systems.

Thermal Decomposition

Like HCFC-22, CFC-502, and other HCFCs, ISCEON® MO59 and MO79 refrigerants will decompose when exposed to high temperature or flame sources. Decomposition may produce toxic and irritating compounds, such as hydrogen fluoride. The decomposition products released will irritate the nose and throat. Therefore, it is important to prevent exposure to decomposition products by following DuPont Material Safety Data Sheet (MSDS) recommendations for handling.

Compatibility Concerns If HCFC-22 or CFC-502 and ISCEON® MO59 or MO79 Are Mixed

HCFC-22 or CFC-502 and these refrigerants are chemically compatible with each other. This means they do NOT react with each other and form other compounds. However, when these refrigerants are mixed by accident or deliberately, they will form mixtures that can be difficult to separate. Mixtures of HCFC-22 or CFC-502 and these refrigerants cannot be separated in on-site recycle machines or in typical facilities of an off-site reclaimer. These mixtures will have to be disposed of by incineration.

Also, mixtures of HCFC-22 or CFC-502 and ISCEON® MO59 or MO79 refrigerants will have performance properties different than either refrigerant alone. Therefore, we do not recommend mixing HCFC-22 and these refrigerants in any system.

Materials Compatibility

Because these refrigerants will be used in many different applications, it is important to review materials of construction for compatibility when designing new equipment, retrofitting existing equipment, or preparing storage and handling facilities. The following compatibility data is for ISCEON® MO59 and MO79 with some elastomers and plastics commonly found in air conditioning and refrigeration systems.

Compatibility with Elastomers

Compatibility results are listed in **Table 8** for ISCEON® MO59 with 3GS mineral oil and ISO 32 POE, in the presence of elastomers. **Table 9** presents similar data for ISCEON® MO79. It should be recognized that these data reflect compatibility in sealed tube tests, and that refrigerant compatibility in real systems can be influenced by the actual operating conditions, the nature of the polymers used, compounding formulations of the polymers, and the curing or vulcanization processes used to create the polymer. Polymers should always be tested under actual operating conditions before reaching final conclusions about their suitability.

The data shown in **Tables 8** and **9** are based on samples of each elastomer subjected to aging in a sealed tube in the presence of the refrigerant and lubricant (50/50 vol. %). The aging occurred for two weeks at room temperature. Physical properties of the sample elastomers were measured before aging, and were re-measured after aging (measurements were taken 24 hours after removal from the refrigerant/lubricant mixture).

Compatibility with Plastics

Compatibility results are listed in **Table 10** for ISCEON® MO59 with 3GS mineral oil and ISO 32 POE, in the presence of plastics. **Table 11** presents similar data for ISCEON® MO79 It should be recognized that these data reflect compatibility in sealed tube tests, and that refrigerant compatibility in real systems can be influenced by the actual operating conditions, the nature of the plastics used, and the actual product formulations. Plastics should always be tested under actual operating conditions before reaching final conclusions about their suitability.

Table 8
Compatibility of ISCEON® MO59 With Selected Elastomers

ISCEON® MO59 With POE 32

Elastomer	Ranking	Avg. Linear Swell, %	Avg. Durometer Unit Change	Avg. Weight Change, %
Neoprene WRT	1a	–0.6	1.5	–0.4
HNBR	1c	4.7	–8.0	13.1
NBR	1a	0.9	–5.0	3.0
EPDM	1a	0.3	3.0	1.0

ISCEON® MO59 With 3GS

Elastomer	Ranking	Avg. Linear Swell, %	Avg. Durometer Unit Change	Avg. Weight Change, %
Neoprene WRT	1b	4.4	–1.0	9.9
HNBR	2c	5.0	–6.5	16.1
NBR	1b	2.8	–9.5	7.6
EPDM	2c	11.1	–15.0	42.9

Ranking is based on the appearance and the overall physical property changes.

Appearance
- 1: No Change
- 2: Moderate surface change
- 3: Severe surface change with oil bleeding

Physical Property change
- a: No change
- b: Moderate physical property change
- c: Severe physical property change

Table 9
Compatibility of ISCEON® MO79 With Selected Elastomers

ISCEON® MO79 With POE 32

Elastomer	Ranking	Avg. Linear Swell, %	Avg. Durometer Unit Change	Avg. Weight Change, %
Neoprene WRT	1a	–0.9	2.0	–0.3
HNBR	1b	3.7	–6.5	12.5
NBR	1a	2.0	–6.0	2.7
EPDM	1a	–0.3	2.5	–0.8
Silicone	3b	3.5	–15.5	10.3

ISCEON® MO79 With 3GS

Elastomer	Ranking	Avg. Linear Swell, %	Avg. Durometer Unit Change	Avg. Weight Change, %
Neoprene WRT	1b	2.6	–4.0	8.8
HNBR	3c	5.7	–8.5	16.9
NBR	1b	3.0	–8.5	7.2
EPDM	1c	11.4	–14.0	42.9
Silicone	1b	5.1	–9.0	9.1

Ranking is based on the appearance and the overall physical property changes.

Appearance
- 1: No Change
- 2: Moderate surface change
- 3: Severe surface change with oil bleeding

Physical Property change
- a: No change
- b: Moderate physical property change
- c: Severe physical property change

Table 10
Compatibility of ISCEON® MO59 With Selected Plastics

ISCEON® MO59 With POE 32

Plastic	Ranking	Avg. Weight Change, %
Polyester (TPME)	1c	3.17
Nylon	1a	–0.17
Epoxy	1a	0.45

ISCEON® MO59 With 3GS

Plastic	Ranking	Avg. Weight Change, %
Polyester (TPME)	1c	4.95
Nylon	1a	–0.06
Epoxy	1a	0.29

Ranking is based on the appearance and the overall physical property changes.

Appearance
- 1: No Change
- 2: Moderate surface change
- 3: Severe surface change with oil bleeding

Physical Property change
- a: No change
- b: Moderate physical property change
- c: Severe physical property change

Table 11
Compatibility of ISCEON® MO79 With Selected Plastics

ISCEON® MO79 With POE 32

Plastic	Ranking	Avg. Weight Change, %
Polyester (TPME)	1c	3.38
Nylon	1a	–0.06
Epoxy	1a	0.42
Polyethylene	1a	0.32
Polyimide	1a	0.23

ISCEON® MO79 With 3GS

Plastic	Ranking	Avg. Weight Change, %
Polyester (TPME)	1c	5.15
Nylon	1a	0.1
Epoxy	1a	0.27
Polyethylene	1a	0.66
Polyimide	1a	0.13

Ranking is based on the appearance and the overall physical property changes.

Appearance
- 1: No Change
- 2: Moderate surface change
- 3: Severe surface change with oil bleeding

Physical Property change
- a: No change
- b: Moderate physical property change
- c: Severe physical property change

The data shown in **Tables 10** and **11** is based on samples of each plastic subjected to aging in a sealed tube in the presence of the refrigerant and lubricant (50/50 vol. %). The aging occurred for two weeks at room temperature. Physical properties of the sample plastics were measured before aging, and were re-measured after aging (measurements were taken 24 hours after removal from the refrigerant/lubricant mixture).

Compatibility with Desiccants

In refrigeration systems, keeping the refrigerant and lubricant free of moisture is very important. Dryers filled with moisture-absorbing desiccant are typically used to prevent moisture accumulation.ISCEON® MO59 and MO79 are compatible with driers used for other standard HFC refrigerants.

Lubricants

Lubricant return to the compressor is required to provide proper lubrication. One factor that affects oil return is the liquid-phase lubricant/refrigerant miscibility, particularly at evaporator temperatures. Miscibility is the ability of two liquids to mix and form a single liquid phase— similar to water and alcohol. Ideally, the lubricant/ refrigerant pair have sufficient miscibility or mutual solubility to allow the lubricant to flow and return to the compressor. Even if the lubricant/ refrigerant pair are not miscible (two liquid phases form) in the evaporator, they may still have some degree of solubility. Solubility of refrigerant in lubricant lowers lubricant viscosity, which helps it flow through the evaporator and return to the compressor. This is why many refrigeration systems can operate properly, even though the lubricant and refrigerant are immiscible (yet partially soluble) at evaporation temperatures. Other factors, such as refrigerant vapor velocity and system geometry, play key roles in lubricant return. Overall, it is important to note that lubricant/refrigerant miscibility is helpful, but not necessarily essential for proper system operation.

ISCEON® MO59 and MO79 each contain 3.4 wt.% hydrocarbon as one of their components. When these refrigerants are used with mineral oil or alkylbenzene (AB), the hydrocarbon will dissolve in the lubricant and reduce the oil viscosity in the evaporator. This, in turn will greatly improve oil return to the compressor.

Lubricant selection is based on many factors, including compressor wear characteristics, material compatibility, and lubricant/refrigerant miscibility (which can affect oil return to the compressor). **ISCEON® MO59 and MO79 are compatible with traditional and new lubricants. Field experience has shown that ISCEON® MO59 and MO79 will work successfully with the existing mineral oil or AB in most systems.** In systems where oil return is a potential concern such as flooded evaporators or in systems where the suction line accumulator acts as a low pressure receiver, replacement of all or part (~25%) of the compressor oil charge with a polyol ester oil (approved by the compressor OEM) is recommended.

Safety

Decomposition

What causes decomposition?

Refrigerants will decompose when exposed to high temperatures from flames or electric resistance heaters. Decomposition may produce toxic and irritating compounds, such as hydrogen chloride and hydrogen fluoride.

How can I tell if a refrigerant has decomposed?

The strong odors released from the decomposed refrigerant will irritate the nose and throat. The irritating fumes released from decomposition will provide early warning and will likely result in an attempt to evacuate the area. Follow all DuPont recommendations for refrigerant handling to prevent refrigerant decomposition and other hazards.

Are decomposition products hazardous?

Yes. The acidic vapors produced are dangerous and the area should be evacuated immediately and ventilated to prevent exposure to personnel. Anyone exposed to the decomposition products should be taken to fresh air and medical treatment sought immediately. The exposure area should not be re-entered until it is deemed safe by the appropriate authorities.

Inhalation Toxicity

Are ISCEON® refrigerants toxic?

These refrigerants have an excellent safety profile and can be safely used when they are handled in accordance with DuPont recommendations, and when exposures are maintained at or below recommended exposure limits, such as the DuPont Acceptable Exposure Limit (AEL).

What is an AEL?

An AEL is an acceptable exposure limit established by DuPont. AELs specify a time-weighted average (TWA) airborne concentration for which nearly all workers may be repeatedly exposed without adverse effects during an 8- or 12-hour day or 40-hour work-week, throughout a working lifetime. In practice, short-term exposures should not exceed three times the established exposure limit (AEL, PEL, TLV, or other index), or 1,250 ppm, – for more than 30 total minutes during a workday, **whichever is lower.**

What is a STEL or EEL?

A short-term exposure limit (STEL) is a 15-minute TWA exposure which should not be exceeded at any time during the work day. Emergency exposure limits (EEL) specify airborne concentrations for brief periods which should not result in permanent adverse health effects during emergencies. EELs are established by DuPont for time periods of up to one hour. These limits should be considered as aids in planning for emergencies or spills, but should not be considered a substitute for proper engineering controls. For the Suva® refrigerants, an EEL has been set only for Suva® 123. The EEL is 1,000 ppm with a ceiling limit (a concentration which must not be exceeded) of 2,500 ppm.

What are common symptoms of overexposure?

Inhaling high concentrations of refrigerant vapors may with time,cause temporary central nervous system depression with narcosis (sleepiness), lethargy, and weakness. Other effects that may occur include dizziness, a feeling of well-being or intoxication, and a loss of coordination. Continued inhalation of refrigerant vapors at high concentrations may produce heartbeat irregularities (cardiac sensitization), unconsciousness and, with gross overexposure, even death.

A person experiencing **any** of the initial symptoms should be moved to fresh air immediately and kept calm and quiet. If not breathing, give artificial respiration. If breathing is difficult, use oxygen. Call a physician immediately.

What is cardiac sensitization?

As with many other halocarbons or hydrocarbons, inhalation of high concentrations of these refrigerants in the presence of high blood levels of the body's adrenaline may result in serious heart irregularities and possible death, an effect known as cardiac sensitization.

In experimental cardiac sensitization screening studies, test animals were exposed to various levels of refrigerant vapor followed by injection of high levels of epinephrine (adrenaline). Cardiac sensitization associated with ISCEON® refrigerant components is well above any concentrations expected in the workplace, and ranges from 20,000 to 150,000 ppm or higher in laboratory animals. By comparison, a cardiac sensitization response is observed with CFC-11 and CFC-12 under similar experimental conditions at approximately 5,000 and 50,000 ppm and higher, respectively.

Because of possible disturbances of cardiac rhythm, catecholamine drugs such as epinephrine should be considered only as a last resort in life-threatening emergencies.

Can inhaling these refrigerant vapors cause suffocation?

If a large release of refrigerant occurs, vapors can concentrate near the floor or in low areas and displace available oxygen, causing suffocation. In the event of a large spill or leak, always wear proper respiratory and other personal protective equipment. Use self-contained breathing apparatus or an airline respirator when entering confined areas such as tanks or basement areas where vapors may have accumulated. Test all work areas for available oxygen using appropriate monitoring equipment before entering. Place a second employee outside the work area when you enter, and use a lifeline to that employee.

How can I work safely on systems in enclosed areas?

1. Make sure all relief and purge vent piping is routed outdoors, and away from all air intakes to the building.

2. Make certain the area is well ventilated. Use auxiliary ventilation such as blowers or fans, if necessary, to disperse refrigerant vapors.

3. Test the work area for available oxygen before entering enclosed areas. **Do not use a leak monitor to test for oxygen.** A refrigerant leak detector will not tell you if adequate oxygen is present to sustain life.

4. Install refrigerant leak detection and oxygen monitoring equipment in the work areas. For a discussion of leak detection equipment, see DuPont technical bulletin ARTD-27A. Also, refer to ASHRAE Standard 15–1994, "Safety Code for Mechanical Ventilation," for ventilation and air monitoring requirements for equipment rooms.

What should I do if a large refrigerant leak or spill occurs?

Do not attempt to enter the area to repair equipment until the vapors are dispersed, OR until you are equipped with proper breathing apparatus. Evacuate everyone until the area has been ventilated. Use blowers or fans to circulate air at the floor level and in any basement or low areas.

Is the deliberate inhalation of these refrigerant dangerous?

Intentional misuse or deliberate inhalation of these refrigerants may disrupt heart rhythm and **cause death without warning.** This practice is extremely dangerous.

Can I smell these refrigerants?

Most refrigerants have such a faint odor that they can be difficult to detect even at dangerous levels. Do not use smell as a test for safe levels of refrigerants in a work area. Frequent leak checks and air monitoring are the only adequate ways to determine that areas are safe for entry and work.

Skin and Eye Contact

Is skin or eye contact with these refrigerants hazardous?

At room temperature, these refrigerant vapors have little effect on skin or eyes.

Always wear protective clothing, including long-sleeve clothing and gloves, when there is a risk of exposure to liquid refrigerants. Protection should include goggles and face shield to protect the eyes. If liquid refrigerant enters your eyes, flush them with plenty or water, then seek medical attention immediately.

Is frostbite a possible hazard?

In liquid form, these refrigerants can freeze skin or eyes on contact, causing frostbite. If you are splashed with liquid, immediately remove all clothing that contains refrigerant to prevent additional freezing. Soak the exposed area in lukewarm water, not cold or hot. Do not use dressings or ointments. Then seek medical attention immediately.

Flammability

Although butane and isobutane are flammable compounds, ISCEON® MO59 and MO79 are formulated such that they remain nonflammable during shipping, handling, storage, use, and if they leak from a unit. These refrigerants are classified as A1 refrigerants by ASHRAE. Also, they have been confirmed as practically nonflammable (the same as R-22 or R-502) by Underwriters Laboratories, Inc. (USA) and both are on their list of recognized refrigerants.

Combustibility of ISCEON® MO59 and MO79

ISCEON® MO59 and MO79 are not flammable in air at temperatures up to 100°C (212°F) at atmospheric pressure. However, mixtures of these refrigerants with high concentrations of air at elevated pressure and/or temperature can become combustible in the presence of an ignition source. They can also become combustible in an oxygen enriched environment (oxygen concentrations greater than that in air). Whether a mixture containing ISCEON® MO59 or MO79 and air, or ISCEON® MO59 or MO79 in an oxygen enriched atmosphere becomes combustible depends on the interrelationship of 1) the temperature, 2) the pressure, and 3) the proportion of oxygen in the mixture. In general, ISCEON® MO59 and MO79 should not be allowed to exist with air above atmospheric pressure or at high temperatures; or in an oxygen enriched environment. **For example: these refrigerants should NOT be mixed with air under pressure for leak testing or other purposes.**

Refrigerants should not be exposed to open flames or electrical heating elements. High temperatures and flames can cause the refrigerants to decompose, releasing toxic and irritating fumes. In addition, a torch flame can become dramatically larger or change color if used in high concentrations of many refrigerants including R-502 or R-22, as well as many other refrigerants. This flame enhancement can cause surprise or even injury. Always recover refrigerants, evacuate equipment, and ventilate work areas properly before using any open flames.

Based on the above information, the following operating practices are recommended.

- Do Not Mix With Air For Leak Testing
  - Equipment should never be leak tested with a pressurized mixture of ISCEON® MO59 or MO79 and air. Pressurized mixtures of dry nitrogen and ISCEON® MO59 or MO79 can be used for leak testing.
- Bulk Delivery and Storage
  - Tanks should normally be evacuated prior to initial filling, and should never be filled while under positive air pressure.
  - Tank pressure should never be allowed to exceed the maximum allowable working pressure when filling with ISCEON® MO59 or MO79. Relief devices on either the tanks or the supply system should be present and in good operating condition.
  - Tank pressures should be monitored routinely.
  - Air lines should never be connected to storage tanks.
- Filling and Charging Operations
  - Before evacuating cylinders or refrigeration equipment, any remaining refrigerant should be removed by a recovery system.
  - Vacuum pump discharge lines should be free of restrictions that could increase discharge pressures and result in the formation of combustible mixtures.
  - Cylinders or refrigeration equipment should be evacuated at the start of filling, and should never be filled while under positive air pressure.
  - Filled cylinders should periodically be analyzed for air (nonabsorbable gas or NAG).
- **Refrigerant Recovery Systems.** Efficient recovery of refrigerant from equipment or containers requires evacuation at the end of the recovery cycle. Suction lines to a recovery compressor should be periodically checked for leaks to prevent compressing air into the recovery cylinder during evacuation. In addition, the recovery cylinder pressure should be monitored, and evacuation stopped in the event of a rapid pressure rise indicating the presence of air.

The recovery cylinder contents should then be analyzed for NAG, and the recovery system leak checked if air is present. Do not continue to evacuate a refrigeration system that has a major leak.

Air Monitors and Leak Detection

Service personnel have used leak detection equipment for years when servicing equipment. Leak detectors exist not only for pinpointing specific leaks, but also for monitoring an entire room on a continual basis for the absence of oxygen or presence of refrigerant. There are several reasons for leak pinpointing or area monitoring, including: conservation of refrigerants, protection of valuable equipment, reduction of fugitive emissions, and protection of employees.

Prior to the purchase of a detector or monitor, make sure you consider your requirements or criteria for the monitor such as sensitivity, detection limits, and selectivity.

Types of Detectors

Using selectivity as a criteria, leak detectors can be placed into one of three categories: nonselective, halogen-selective, or compound-specific. In general, as the specificity of the monitor increases, so does the complexity and cost. Other methods used to find leaks are to add fluorescent additives to the system or coat the suspect area with a soapy-water solution and look for soap bubbles.

A detailed discussion of leak detection is given in bulletin ARTD-27A.

Nonselective Detectors

Nonselective detectors are those that will detect any type of emission or vapor present, regardless of its chemical composition. These detectors are typically quite simple to use, very durable, inexpensive, and usually portable. However, their inability to be calibrated, long-term drift, lack of selectivity, and lack of sensitivity limit their use for area monitoring.

Halogen-Selective Detectors

Halogen-selective detectors use a specialized sensor that allows the monitor to detect compounds containing fluorine, chlorine, bromine, and iodine without interference from other species. The major advantage of such a detector is a reduction in the number of "nuisance alarms"—false alarms caused by the presence of some compound in the area other than the target compound.

These detectors are typically easy to use, feature higher sensitivity than the nonselective detectors (detection limits are typically <5 ppm when used as an area monitor and <0.05 oz/yr when used as a leak pinpointer), and are very durable. In addition, due to the partial specificity of the detector, these instruments can be calibrated easily.

Compound-Specific Detectors

The most complex detectors, which are also the most expensive, are compound-specific detectors. These units are typically capable of detecting the presence of a single species without interference from other compounds.

Fluorescent Additives (UV Dyes)

Fluorescent additives have been used in refrigeration systems for several years. These additives, invisible under ordinary lighting, but visible under ultraviolet (UV) light, are used to pinpoint leaks in systems. The additives are typically placed into the refrigeration lubricant when the system is serviced. Leaks are detected by using a UV light to search for additive that has escaped from the system. The color of the additive when subjected to UV light is normally a bright green or yellow and is easily seen.

As a leak pinpointer, fluorescent additives work very well, because large areas can be rapidly checked by a single individual. And, the recent introduction of battery-powered UV lights has made this task even simpler. Leak rates of less than 0.25 oz/yr can be found with the additives. The only drawback to the use of additives is that some areas may be visually unobservable due to cramped spaces.

One cautionary note concerning the use of fluorescent additives: the compatibility of the specific additive with the lubricant and refrigerant should be tested prior to use. For detailed information about which lubricants and refrigerants have been tested with which additives, contact the fluorescent additive manufacturers.

Storage and Handling

Shipping Containers in the U.S.

ISCEON® MO59 and MO79 refrigerant blends are refrigerant gases. According to the U.S. Department of Transportation (DOT), a nonflammable refrigerant gas is defined as a nonflammable material having an absolute pressure greater than 40 psi at 21°C (70°F) and/or an absolute pressure greater than 104 psi at 54°C (130°F).

The appropriate DOT designations for these refrigerantsare as follows:

Proper shipping name for ISCEON® MO59: Refrigerant Gas, N.O.S. (contains pentafluoroethane and 1,1,1,2-tetrafluoroethane).

Proper shipping name for ISCEON® MO79: Refrigerant Gas, N.O.S. (contains pentafluoroethane and 1,1,1,2-tetrafluoroethane)

Hazard class: Nonflammable Gas

UN/NA no.: UN 1078

In the U.S., two different types of containers can be used to ship ISCEON® MO59; their water capacity, dimensions, and DOT specifications are provided in **Table 12**.

Table 12
Specifications of U.S. Shipping Containers for DuPont™ ISCEON® MO59

Water Capacity	Dimensions	DOT Specification
30 lb	10 x 10 x 17 in (box)	39
123 lb	55 in H x 10 in OD	4BW400

The 30 lb cylinder, known as a Dispose A Can® (DAC), fits into a box that measures 10 x 10 x 17 in. "Dispose A Can" is the DuPont registered trade name for this type of single-use container. The DAC valve will be standard for ISCEON® MO59 or MO79.

In the U.S., two different types of containers can be used to ship ISCEON® MO79; their water capacity, dimensions, and DOT specifications are provided in **Table 13**.

Table 13
Specifications of U.S. Shipping Containers for DuPont™ ISCEON® MO79

Water Capacity	Dimensions	DOT Specification
30 lb	10 x 10 x 17 in (box)	39
123 lb	55 in H x 10 in OD	4BW400

Shipping Containers Outside of the U.S.

For information on shipping containers in your specific region, contact your local DuPont refrigerant distributor.

Bulk Storage Systems

DuPont can supply storage systems to its ISCEON® MO59 and MO79 customers. The systems are prefabricated, tested, and ready to install on-site. The units are designed to optimize economy, efficiency, and safety in the storage and dispensing of these refrigerants. The delivered systems include all components, such as storage tanks, pumps, piping, valves, motors, and gauges, as an integrated unit. All systems are equipped with the DuPont Fluorochemical Emission Elimination Delivery (FEED) system to prevent emissions during deliveries and with dual pumps to provide an installed spare. The units are skid-mounted and require only placement on a concrete pad and connection to electrical and process systems.

A typical bulk storage system is shown in **Figure 1**.

Your DuPont Marketing Representative can arrange for guidance on site selection, purchase, installation, start-up, and maintenance.

Converting Bulk Storage Tanks from HCFC-22 to ISCEON® MO59 and MO79

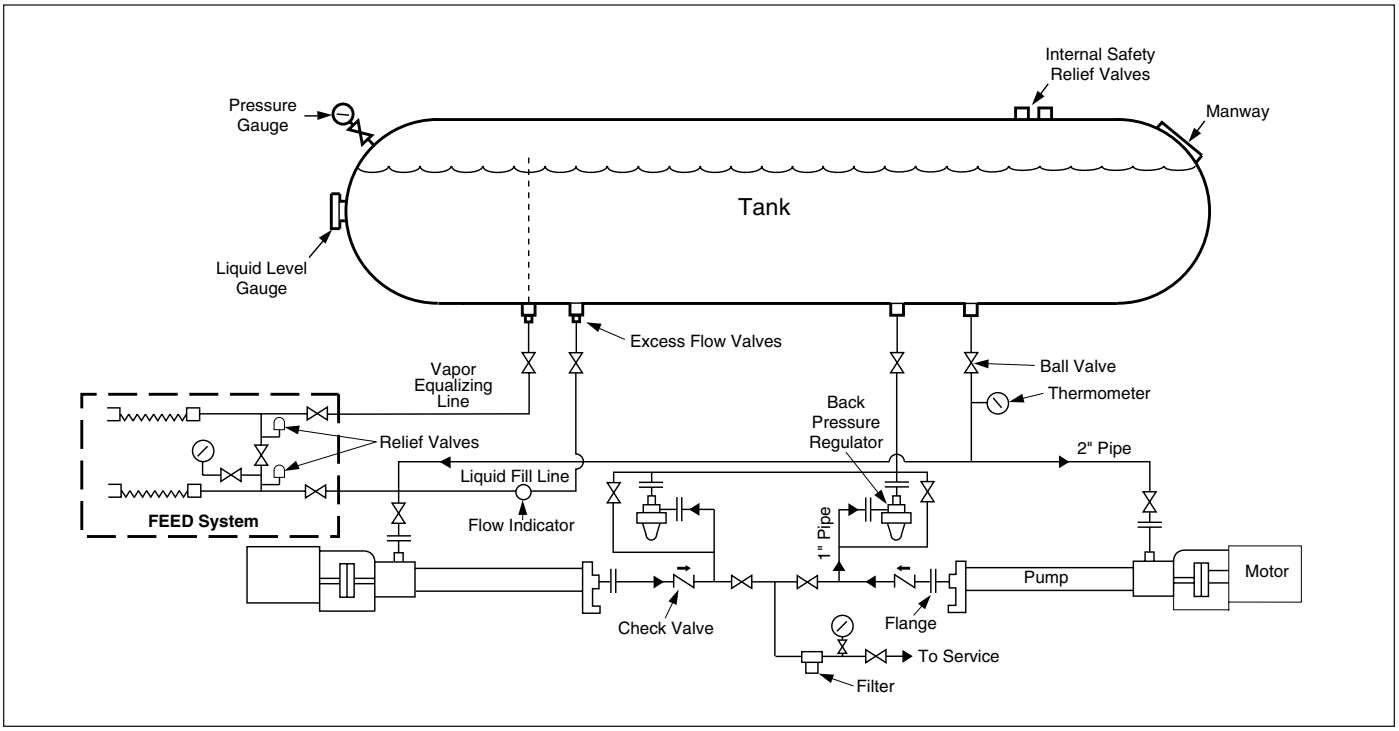
Before switching from HCFC-22 to either of these refrigerants, the existing storage equipment must be checked to verify that it is adequate. Storage tanks built to the specifications of the American Society of Mechanical Engineers (ASME) Pressure Vessel Code are required to have a metal nameplate indicating each tank's maximum allowable working pressure (MAWP). The rating must be 235 psig (1712 kPa abs) or higher for ISCEON® MO59 service. The rating must be 305 psig (2192 kPa abs) or higher for ISCEON® MO79 service. The set pressure and capacity of the relief devices on the top of the tanks must also be verified and changed, if necessary.

Note: Some bulk storage tanks currently in service for HCFC-22 are NOT suitable for ISCEON® MO79 due to an inadequate pressure rating.

Table 14
U.S. Package Offering for DuPont™ ISCEON® MO59 and DuPont™ ISCEON® MO79

			Net Weight (lb) of ISCEON® MO59 and ISCEON® MO79	
Refrigerant	Color	PMS #	30 lb Water Capacity	125 lb Water Capacity
ISCEON® MO59	Green	354	25	110
ISCEON® MO79	Yellow	128	24	100

Figure 1. Typical Bulk Storage System



If suitable,we recommend that storage tanks be completely emptied of all HCFC-22 liquid and vapor before introducing ISCEON® MO59 or MO79. In general, converting a storage tank from HCFC-22 requires:

1. Removing HCFC-22 from the storage tank, lines and equipment.
2. Evacuating the storage tank to 25 in of mercury vacuum (16.7 kPa abs) and purging with compressed dry nitrogen.
3. Making necessary repairs to the tank after initial evacuation and purging.
4. Repeating step 2 until HCFC-22 and moisture analyses are within acceptable limits.
5. Refilling system with the appropriate refrigerant (ISCEON® MO59 or MO79).

The preceding is a simplified outline of what is actually a lengthy procedure. Your DuPont Marketing Representative can assist in obtaining the equipment, instrumentation, and technical assistance to safely and effectively make the conversion.

Material Compatibility Concerns

Most metal components suitable for use with HCFC22 are also compatible with ISCEON® MO59 and MO79, including standard types of carbon steel, aluminum, and copper. Some elastomeric or nonmetallic components suitable for HCFC-22 may not be adequate. Therefore, all elastomeric or nonmetallic components throughout the system must be identified and their compatibility with ISCEON® MO59 and MO79 verified. See Material Compatibility section. For complete reliability, any component that cannot be properly identified should be replaced.

In a fluorocarbon storage system, elastomers are most commonly found in:

- Packing and seats of manual valves
- Pressure-relief device seats
- Flange and man-way gaskets
- Mechanical pump seals
- Wet-end pump gaskets and O-rings
- Filter O-rings
- Sight-flow indicator gaskets
- Back-pressure regulator diaphragms and O-rings

Handling Precautions for ISCEON® MO59 and MO79 Shipping Containers

The following rules for handling these refrigerants containers are strongly recommended:

- Use personal protective equipment, such as side shield glasses, gloves, and safety shoes when handling containers.
- Avoid skin contact with liquid refrigerant, because it may cause frostbite.
- Never heat a container to a temperature higher than 52°C (125°F).
- Never apply direct flame or live steam to a container or valve.
- Never refill disposable cylinders with anything. The shipment of refilled disposable cylinders is prohibited by DOT regulations.
- Never refill returnable cylinders without DuPont consent. DOT regulations forbid transportation of returnable cylinders refilled without DuPont authorization.
- Never use a lifting magnet or sling (rope or chain) when handling containers. A crane may be used when a safe cradle or platform is used to hold the container.
- Never use container for rollers, supports, or any purpose other than to store these refrigerants.
- Protect containers from any object that will result in cut or other abrasion in the surface of the metal.
- Never tamper with the safety devices in the valves or containers.
- Never attempt to repair or alter containers or valves.
- Never force connections that do not fit. Make sure the threads on the regulators or other auxiliary equipment are the same as those on the container valve outlet.
- Keep valves tightly closed, and valve caps and hoods in place when the containers are not in use.
- Store containers under a roof to protect them from weather extremes.
- Use a vapor recovery system to collect refrigerant vapors from lines after unloading a container.

Recovery, Reclamation, Recycle, and Disposal

Recovery

Recovery refers to the removal of ISCEON® MO59 and MO79 from equipment and collection in an appropriate external container. As defined by the Air Conditioning and Refrigeration Institute (ARI), a U.S. organization, recovery does not involve processing or analytical testing. These refrigerants may be recovered from refrigeration equipment using permanent on-site equipment or one of the portable recovery devices now on the market. The portable devices contain a small compressor and an air-cooled condenser and may be used for vapor or liquid recovery. At the end of the recovery cycle, the system is evacuated to remove vapors. In the United States, the Environmental Protection Agency (EPA) sets standards for recovery equipment. Before purchasing a specific recovery unit, check with the manufacturer to be sure that it can be used to recover these refrigerants.

Reclamation

Reclamation refers to the reprocessing of used ISCEON® MO59 and MO79 to new product specifications. Quality of reclaimed product is verified by chemical analysis. In the United States, these refrigerants are included in the DuPont refrigerant reclamation program. Contact DuPont or one of its refrigerant distributors for further information.

Reclamation offers advantages over on-site refrigerant recycling procedures, because these systems cannot guarantee complete removal of contaminants. Putting refrigerants that do not meet new product specifications back into expensive equipment may cause damage.

Recycle

Refrigerant recycle refers to the reduction of used refrigerant contaminants using devices that reduce oil, water, acidity, and particulates. Recycle is usually a field or shop procedure with no analytical testing of refrigerant. Before using one of these devices with ISCEON® MO59 and MO79, consult the manufacturer to confirm compatibility.

Disposal

Disposal refers to the destruction of used ISCEON® MO59 and MO79. Disposal may be necessary when these refrigerants have become badly contaminated with other products and no longer meets the acceptance specifications of DuPont or other reclaimers. Licensed waste disposal firms are available for this purpose. Be sure to check the qualifications of any firm before sending them used ISCEON® MO59 and MO79.

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