DuPont™ ISCEON® 9 Series

REFRIGERANTS

Technical Information

ART-46

Retrofit Guidelines for DuPont™ ISCEON® MO29 (R-422D) Refrigerant

IDS REFRIGERATION LIMITED

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Retrofit Guidelines for
DuPont™ ISCEON® MO29 Refrigerant

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IDS REFRIGERATION LIMITED

Introduction

DuPont™ ISCEON® MO29 (R-422D) is a non-ozone-depleting HFC Refrigerant designed to replace R22 in existing direct expansion (DX) medium- and low-temperature refrigeration systems and residential and commercial air conditioning (AC) equipment, including DX water chillers.

Field experience has shown that ISCEON® MO29 provides performance that meets customer requirements in most properly retrofitted systems. ISCEON® MO29 provides similar cooling capacity and energy efficiency to R22 in most systems, while operating at significantly lower compressor discharge temperature. Actual performance depends on system design and operating conditions.

ISCEON® MO29 is compatible with traditional and new lubricants; in most cases no change of lubricant type during retrofit is required. Oil return is determined by a number of operating and design conditions – in some systems with complex piping configurations or liquid reservoirs on the low pressure side, POE may need to be added. Minor equipment modifications (e.g., seal replacement) or expansion device adjustments may be required in some applications. **Systems using ISCEON® MO29 are easy to service. For most systems, should a refrigerant loss occur, the charge can be completed without the need to remove any residual refrigerant, and the system will then operate normally. The cause of the refrigerant loss should be investigated and corrected as soon as is possible.**

Note: When servicing critically charged systems, all of the refrigerant charge should be removed. This is the same practice recommended for HCFC-22.

General Considerations

The use of ISCEON® MO29 in the EU and EEA member countries is regulated under the terms of the Regulation 842/2006 (known as the "F Gas Regulation"), which requires regular leakage testing for systems using the designated substances. ISCEON® MO29 (R422D) is listed in the European Standard EN 378:2008 (Refrigerating and Heat Pump Systems – Safety and Environmental Requirements); Part 4 of this standard relates to retrofit activities.

Summary - Steps to Retrofit

The following provides a summary of the basic retrofit steps for ISCEON® MO29.

(Detailed discussion of each step is provided in this bulletin.)

1. Establish baseline performance with existing refrigerant. (See retrofit checklist (attached))
2. Remove all the old (R22 or other) refrigerant from the system into a recovery cylinder. Weigh the amount removed.
3. Replace the filter drier and critical elastomeric seals/gaskets.
4. Evacuate system and check for leaks.
5. Charge with ISCEON® MO29.
   - Remove liquid only from charging cylinder.
   - The initial charge amount should be approximately 85% of the standard charge for R22. The final charge amount will be approximately 95%.
6. Start up system, adjust TXV and/or charge size to achieve optimum superheat.
7. Monitor oil levels in compressor. Add oil as required to maintain proper levels
8. Label system showing the refrigerant (and any replacement lubricant) used. Update system log-book.

Retrofit Complete

Important Safety Information

Like CFCs and HCFCs, ISCEON® 9 Series refrigerants are safe to use when handled properly. However, any refrigerant can cause injury or even death when mishandled. Please review the following guidelines before using any refrigerant.

- Do not work in high concentrations of refrigerant vapors. Always maintain adequate ventilation in the work area. Do not breathe vapors. Do not breathe lubricant mists from leaking systems. Ventilate the area well after any leak before attempting to repair equipment.
- Do not use handheld leak detectors to check for breathable air in enclosed working spaces. These detectors are not designed to determine if the air is safe to breathe. Use oxygen monitors to ensure adequate oxygen is available to sustain life.
- Do not use flames or halide torches to search for leaks. Open flames (eg. Halide detection torches, or brazing torches) can release large quantities of acidic compounds in the presence of all refrigerants, and these compounds can be hazardous. Halide torches are not effective as leak detectors for HFC refrigerants; they detect the presence of Chlorine, which is not present in ISCEON® MO29, and consequently, these detectors will not detect the presence of this refrigerant. Use an electronic leak detector designed to find the refrigerants you are using.

  If you detect a visible change in the size or color of a flame when using brazing torches to repair equipment, stop work immediately and leave the area. Ventilate the work area well and stop any refrigerant leaks before resuming work. These flame effects may be an indication of very high refrigerant concentrations, and continuing to work without adequate ventilation may result in injury or death.

Note: Any refrigerant can be hazardous if used improperly. Hazards include liquid or vapor under pressure, and frostbite from the escaping liquid.

Overexposure to high concentrations of refrigerant vapor can cause asphyxiation and cardiac arrest. Please read all safety information before handling any refrigerant.

Refer to the ISCEON® MO29 Material Safety Data Sheet (MSDS) for more specific safety information. .DuPont Safety Bulletin AS-1 also gives additional information for safe handling of refrigerants.

Flammability

ISCEON® MO29 is non-flammable in air under normal conditions. However, this product when mixed with high concentrations of air or oxygen under elevated pressure can become combustible in the presence of an ignition source. This product should not be mixed with air to check for system leaks.

General Retrofit Information

Lubricants

Lubricant selection is based on many factors, including compressor wear characteristics, material compatibility, and lubricant/refrigerant solubility (which can affect oil return to the compressor). ISCEON® MO29 is compatible with traditional and new lubricants – in most retrofit situations with direct expansion systems no change of oil type is required.

Field experience has shown that ISCEON® MO29 will work successfully with the existing mineral (or alkyl-benzene) oil in most DX systems. In systems where oil return is a potential concern, such as systems where the suction line accumulator acts as a low pressure receiver, replacement of all, or part (~30%) of the compressor oil charge with an OEM approved polyol ester oil is recommended.

Filter Drier

Change the filter drier during the retrofit. This is a routine system maintenance practice. There are two types of filter driers commonly used, solid core and loose filled. Replace the drier with the same type currently in use in the system. The drier label will show which refrigerants can be used with that drier. Select a drier specified to work with HFC refrigerants. (Many driers sold today are “universal” – they will work with most fluorocarbon refrigerants.)

Elastomeric Seals/ Gaskets etc.

R22, and to a lesser extent R22 containing refrigerant blends, interacts relatively strongly with many elastomers causing significant swelling and often, over time, a measurable increase in hardness, etc. ISCEON® MO29 does not have such a strong effect on those elastomers commonly used in seals in refrigeration systems. A consequence of this is that, when replacing R22 (and, to a lesser extent, R22 containing blends) with ISCEON® MO29 in a system retrofit, it is possible for leaks to occur at Elastomeric seals that are exposed to the refrigerant. (This is not a problem attributable to the use of ISCEON® MO29. Such seal leaks have been reported when replacing R22 with other HFC refrigerants such as R407C or R404A.)

Leaks do not occur in every system retrofitted and, in practice, it is difficult to predict whether such leaks will occur.

(As a rule of thumb the older the system, the higher the probability that leaks will be observed after a retrofit.)

As a consequence it is recommended to change any system-critical seals (those which would require removal of the refrigerant charge to allow seal replacement e.g., liquid receiver, refrigerant high-pressure side, etc.) as a matter of course during the retrofit and to have spare seals for other components available during restart of the system. A rigorous leak check regime pre- and post- retrofit will minimize any refrigerant losses. All seals should be checked including manual valves, schrader valves, solenoid valves, sight glasses, electrical cable sealing grommets (on compressors), mechanical seals on open drive compressors, etc. Obviously any seals found to be leaking before the retrofit takes place should be replaced during the retrofit.

System Modifications

The compositions of the ISCEON® MO29 refrigerant has been selected to provide performance comparable to R22 in terms of both capacity and energy efficiency. As a result, minimal system modifications are anticipated with retrofitting.

ISCEON® MO29 is a near-azeotrope. The vapor composition in the refrigerant cylinder is different from the liquid composition. For this reason, ISCEON® MO29 should be transferred from the container from the liquid phase during system charging (or when transferring from one container to another).

In general, ISCEON® MO29 refrigerant is not recommended for use in centrifugal compressor systems or for chillers with flooded evaporators. Direct expansion systems with low pressure receivers may be retrofitted using ISCEON® MO29 but a single oil change to a POE oil of the same viscosity as the original oil type is required to ensure adequate oil management for this system configuration.

Note: ISCEON® MO29 should not be mixed with other refrigerants or additives that have not been clearly specified by DuPont or the system equipment manufacturer. Mixing this refrigerant with CFC or HCFC refrigerants, or mixing two different alternative refrigerants, may have an adverse effect on system performance. “Topping off” a CFC or HCFC refrigerant with any Suva® or ISCEON® 9 Series refrigerant is strictly not recommended.

System Superheat

Desired system performance after a retrofit with DuPont™ ISCEON® MO29 requires correct setting of the system superheat. This is discussed in the detailed retrofit procedures given below.

System Oil Management

In many situations, systems retrofitted with ISCEON® MO29 have operated routinely using the mineral oil or Alkyl benzene that was used with the original HCFC refrigerant. With complex systems, in a small number of cases, the oil may not return consistently to the compressor.

It is important that oil levels in the compressors be monitored during initial operation with the ISCEON® MO29. If the oil level falls below the minimum allowed, top up the oil to the minimum level with the existing oil type. Do not fill to maximum as the level may rise again.

Should the oil level fall continuously, or suffer large oscillations during an operating cycle, addition of POE lubricant has proven effective in restoring adequate oil return rates. POE lubricant should be progressively added to the system. An initial addition of 10-30% (of the total oil charge) should be made. This should be followed by further small increments until the oil level returns to normal.

It is important to ensure that, when adding POE oil to the system, the oil level (immediately after addition) is kept below the system mid-point (e.g. mid-sight glass) oil level.

It is also important to keep accurate records of how much oil is added to avoid over-filling.

Refrigerant Recovery Information

Most recovery or recycle equipment used for R22, can be used for ISCEON® MO29. Use standard procedures to avoid cross contamination when switching from one refrigerant to another. Most recovery or recycle machines can use the same compressor oil that was used for the HCFC refrigerant. However, some modifications may be necessary, such as a different kind of drier or a different moisture indicator. Consult the equipment manufacturer for specific recommendations.

Expected Performance After Retrofit

Table 1 shows approximate system performance changes following a retrofit and are general guidelines for system behavior. These values are based on field experience, calorimeter testing and thermodynamic property data; and assume equal compressor efficiency.

Cooling capacity and energy efficiency depend greatly on system design, operating conditions and the actual condition of the equipment. ISCEON® MO29 provides similar cooling capacity and energy efficiency to R22 in most systems while operating at significantly lower compressor discharge temperature. Actual performance depends on system design and operating conditions.

Table 1

ISCEON® MO29 Performance Compared to R22 in DX-systems

Performance with subcooling based on thermocycle calculations from calorimeter data and do not include heat transfer effects

	Refrigeration Low Temperature –32°C evaporator 41°C condenser 18°C return gas 6K subcooling [difference vs. R22]	Refrigeration Med Temperature –7°C evaporator 49°C condenser 18°C return gas 6K subcooling [difference vs. R22]	Air Conditioning +7°C evaporator 49°C condenser 18°C return gas 8K subcooling [difference vs. R22]
Discharge Temperature, K	–18	–36	-24
Discharge Pressure, kPa	+70	+90	+90
Refrigeration Cooling Capacity, %	+8	–5	-7%
Energy Efficiency, %	+14	Same	-2%

"+" represents an increase and "–" represents a decrease for ISCEON® MO29 vs. R22

R22 assumes demand cooling with discharge temperature controlled at 135°C

Detailed Retrofit Procedure for R22 in Direct Expansion Medium and Low Temperature Refrigeration Systems, Residential and Commercial Air-Conditioning

(Refer to the retrofit checklist on pages 7and 8 of this bulletin)

1. Establish baseline performance with R22. Collect system performance data while R22 is in the system. Check for correct refrigerant charge and operating conditions. The baseline data of temperatures and pressures at various points in the system (evaporator, condenser, compressor suction and discharge and calculation of superheat and subcool.) at normal operating conditions will be useful when optimizing operation of the system with the ISCEON® MO29. A System Data Sheet is included at the back of this bulletin to record baseline data.

2. Remove the existing R22 refrigerant from the system into a recovery cylinder. The existing charge should be removed from the system and collected in a recovery cylinder using a recovery device capable of pulling 10–15 in Hg vacuum (50–65) kPa absolute). If the recommended charge size for the system is not known, weigh the amount

of refrigerant removed. The initial quantity of ISCEON® MO29 to charge to the system can be estimated from this amount. (See step 5). Ensure that any residual refrigerant dissolved in the compressor oil is removed by holding the system under vacuum. Break the vacuum with dry nitrogen.

3. Replace the filter drier and critical elastomeric seals/gaskets etc

It is routine practice to replace the filter drier during system maintenance. Replacement filter driers are available that are compatible with ISCEON® MO29.

While the system is empty, check and replace any elastomeric seals that may be near the end of their serviceable life. Even if they were not previously leaking, the change of swell characteristics when changing to any new refrigerant (e.g., R22 to any HFC refrigerant) and the general disturbance to the system may cause worn seals to leak after retrofit. Although, in general, the same seal materials can be used with ISCEON® MO29 (refer to Compatibility Tables in the DuPont PUSH bulletin #K-10927) it has been observed as with other HFC based refrigerants that shrinkage of the original seal may occur after conversion causing refrigerant leakage (refer to the DuPont bulletin on HFC Compatibility with Elastomeric Seals #K-17335). Critical components commonly affected are Schrader core seals, liquid level receiver gaskets, solenoid valves, ball valves and flange seals but all external seals in contact with the refrigerant should be viewed as a potential leak source post retrofit. Field experience has shown that the older the system, the greater the likelihood of seal and gasket leaks. It is recommended to change any system critical seals (e.g., those which require removal of the refrigerant charge to allow seal replacement e.g., liquid receiver, condenser system) as a matter of course and to have spare seals for other components available during the retrofit should any seal failure occur Schrader valves can generally be changed in-situ, under pressure, using a special tool, and thus are not considered to be system critical. A rigorous leak check regime pre and post retrofit will minimize any refrigerant losses.

4. Evacuate system and check for leaks. Use normal service practices. To remove air or other non-condensables and any residual moisture from the system, evacuate the system to near full vacuum (29.9 in Hg vacuum [500 microns] or less than 0.1 kPa absolute), isolate the vacuum pump from the system and observe the vacuum reading. If the system does not maintain vacuum it is an indication that there might be a leak. Pressurise the system with nitrogen taking care not to exceed the system design maximum pressure and check for leaks. Do not use mixtures of air and refrigerant under pressure to check for leaks; these mixtures can be combustible. After leak checking with Nitrogen remove residual Nitrogen using a vacuum pump.

5 Charge with ISCEON® MO29. Remove liquid only from charging cylinder. (If the cylinder does not have a valve with a dip-tube invert the cylinder so that the valve is underneath the cylinder). The proper cylinder position for liquid removal is often indicated by arrows on the cylinder and cylinder box. Once Liquid is removed from the cylinder, the refrigerant can be allowed to enter the refrigeration system as liquid or vapor as desired. Use the manifold gauges or a throttling valve to flash the liquid to vapor if required.

WARNING: Do not charge liquid refrigerant into the compressor. This will cause serious irreversible damage!

In general, the refrigeration system will require less weight of the ISCEON® MO29 than of the original R22 charge, although some will require slightly more. The optimum charge will vary depending on the system design and operating conditions. The initial charge amount should be approximately 85% of the standard charge for R22. The final charge amount will usually be approximately 95%.

Note: For systems with a liquid refrigerant receiver charge the system to the normal refrigerant level in the receiver. These values apply provided no changes to mechanical components of the system (which could significantly affect the system’s internal volumetric capacity) will be made during the retrofit.

6. Start up system, adjust charge size (for systems without a liquid receiver).

Start the system and let conditions stabilize. If the system is undercharged (as indicated by the level of superheat at the evaporator exit, or by the amount of sub-cool at the condenser exit) add more ISCEON® MO29 in small amounts (still by transferring as liquid from the charging cylinder) until the system conditions reach the desired level. See the pressure-temperature charts in this bulletin to compare pressures and temperatures in order to calculate superheat or sub-cooling for the refrigerant you are using. Sight glasses in the liquid line can be used in most cases as a guide to system charge, but correct system charge must be determined by measuring system operating conditions (discharge and suction pressures, suction line temperature, compressor motor amps, superheat, etc.). Attempting to charge until the sight glass is “free of bubbles” may result in overcharging the refrigerant. Please read “How to Determine Suction Pressure, Superheat and Subcool.”

Ensuring that the correct compressor suction superheat is set is very important for reliable system operation with ISCEON® MO29. Experience has shown that superheat (at the compressor inlet) for ISCEON® MO29 should be the same as for the refrigerant being replaced.

WARNING: **Liquid refrigerant entering the compressor at any time during system operation can lead to compressor oil level problems and rapid compressor failure.**

7. Monitor oil levels.

During initial operation of the system it is very important to monitor the level of oil in the compressor (or compressor oil management system) to verify that oil is returning to the compressor in an adequate manner.

- If the oil level falls below the minimum allowed level, top up to the minimum level with the existing oil type. Do not fill to the maximum level as the level may rise again.
- Should the oil return appear to be erratic as evidenced by large swings in oil level during the refrigeration system cycle it is recommended that some of the oil be removed from the system and replaced with POE oil. Replacement of up to 30% of the oil with POE will help to restore oil return stability. The exact amount of oil to be changed will depend on the system itself (evaporating temperatures, physical geometry, etc.)

- POE lubricant should be progressively added to the system. An initial addition of 10 – 20% (of the total oil charge) should be made. This should be followed by small increments until the oil level returns to normal consistently throughout the refrigeration system operating cycle.
- It is important to ensure that, when adding POE oil to the system, the oil level (immediately after addition) is kept below the system mid-point (e.g. mid-sight glass) oil level.

8. **Label the system** to clearly and permanently show the refrigerant in the system and any oil(s) present in the system. It is most important that the change in refrigerant and any other component (including lubricating oil) changes be registered in the system documentation (log book).

IMPORTANT: Thoroughly leak check the system. As mentioned in step 3 it is possible that refrigerant leakage can occur during or immediately after a retrofit. Experience has shown that some leaks will not appear until after the new refrigerant has been charged to the system. Pay particular attention to Schrader valve core seals, solenoid valves and ball valve stems on the liquid high-pressure side.

Pressure/Temperature Charts

How to Read the Pressure/Temperature Chart

The following pages contain pressure/temperature charts for the refrigerants discussed in this bulletin. Three temperatures are shown at a given pressure:

- Saturated Liquid Temperature (Bubble Point)—In the condenser, this is the temperature at which the last bit of vapor has condensed. Below this temperature, the refrigerant will be subcooled liquid. This temperature should also be used when determining the pressure/temperature value of product stored in a refrigerant cylinder.
- Saturated Vapor Temperature (Dew Point)—In the evaporator, this is the temperature at which the last drop of liquid has just boiled. Above this temperature, the refrigerant will be superheated vapor.
- Average Coil Temperature (for ISCEON® MO29)—The evaporator and condenser will perform as if it is operating at this constant temperature. It is an average of the bubble and dew point temperatures determined from either the suction or condenser pressure. Use this average temperature to compare coil temperatures with the refrigerant you are replacing. **Note:** this is an approximation of the average temperature for low glide refrigerants.

How to Determine Suction Pressure, Superheat, and Subcool

Suction Pressure

Determine the expected evaporator temperature using the R22 (from the baseline data you collected prior to the retrofit). Find the same expected evaporator temperature in the Average Coil Temperature column for ISCEON® MO29. Note the corresponding pressure for this temperature. This is the approximate suction pressure at which the system should operate.

Superheat

Using the saturated vapor pressure tables for ISCEON® MO29, determine the saturated vapor temperature (dew point) for the measured suction pressure. Measure the temperature at the compressor inlet (suction) and subtract the previously determined dew point temperature for ISCEON MO29 to give the amount of vapor superheat.

Subcool

Using the saturated liquid pressure tables for ISCEON® MO29, determine the saturated liquid temperature (bubble point) for the measured condensing pressure (usually the high-side pressure). Measure the refrigerant liquid line temperature and subtract it from the previously determined bubble point temperature for ISCEON® MO29 to give the amount of liquid subcool.

Retrofit Checklists for Converting CFC or HCFC Systems to DuPont™ ISCEON® MO29

Retrofit Guidelines for
DuPont™ ISCEON® MO29 Refrigerant

Retrofit Check List: 1) Pre- and Post- Retrofit Checks

Pre-Retrofit Advance Preparation for Retrofit	**Check Complete**
1 Ensure the Retrofit Procedure has been read Clarify any doubts with DuPont Technical Services	
2 Check Service History log-book Recent refrigerant additions might signify system leaks Is current system design in agreement with log-book?	
3 Leak check system If leaks found schedule repair	
4 Check compressor oil management system design If no oil separator present oil level observation needed after retrofit	
5 System performance check: complete data sheet See Retrofit procedure p. 8 If obvious performance problem: Correct before retrofit (or plan to do it during retrofit)	
6 Identify system critical elastomeric seals See Retrofit Guidelines p.2	
7 Check Compressor oil condition If doubtful schedule change	
8 Ensure all needed materials will be available Seals, filter cores, etc. Recovery cylinder(s) Recovery machine, vacuum pump, Nitrogen Technical data: Retrofit Guidelines, PT data (Slide rules, etc.)	

Post-Retrofit Verification of system performance and integrity	**Check Complete**			
	24 hrs	48 hrs	72hrs	1 week
1 Observe compressor oil level Correct if needed (see Guidelines p 3)				
2 Measure Performance Data Use Data Sheet				
3 Carry out Leak check Correct any leaks found				

Retrofit Guidelines for
DuPont™ ISCEON® MO29 Refrigerant

Retrofit Check List: 2) Retrofit Progress Checks

Retrofit Steps	Check Complete
1 Recover old refrigerant using good refrigeration practice Use dedicated recovery cylinder(s) Weigh the recovered refrigerant De-gas the compressor oil using a vacuum pump	
2 Break the vacuum using dry nitrogen Minimise ingress of moist air into the system	
4 Change necessary mechanical components Filter/dryer Identified system critical elastomeric seals Replace oil if needed	
5 Evacuate system. Hold under vacuum. To remove moisture. Early indication of leaks (if vacuum does not hold)	
6 If indication of leak pressurise with Nitrogen. Locate leak(s). De-pressurise and correct Evacuate system. Hold under vacuum	
7 Charge with ISCEON®MO29 from liquid phase a) If system receiver - to normal level b) If no receiver - initial 90% of R22 charge	
8 Start system, measure performance data (See data sheet) Adjust refrigerant charge if needed Adjust superheat setting if needed	
10 Check Compressor oil levels Adjust if necessary	
11 Re-check system for refrigerant leaks	
12 Label System Refrigerant (and any added/changed oil) Update log-book	

System Data Sheet

Type of System/Location: ____

Equipment Mfg.:______________________________ Compressor Mfg.:______________________________

Model No.:______________________________ Model No.:______________________________

Serial No.:______________________________ Serial No.:______________________________

Date of Manufacture______________________________ Date of manufacture______________________________

Refrigerant Charge Size:______________________________ Lubricant Type: ______________________________

Lubricant Type/Charge Size:______________________________ Drier Mfg./ Model ______________________________ _

Drier Type (check one): Loose Fill:_____________

Solid Core:_____________

Condenser Cooling Medium (air/water): ____

Expansion Device (check one): Capillary Tube: ________ TXV: _______ Electronic ________

Expansion valve: Manufacturer: ______________________________ Model No:______________________________

Control/Set Point: ____

Location of Sensor: ____

Other System Controls (ex.: head press control), Describe:____

Performance Data (circle units used where applicable)

Date/Time					
Refrigerant					
Charge Size (kg)					
Ambient Temp. (°C)					
Compressor:					
Suction T (°C)					
Suction P (kPa)					
Discharge T (°C)					
Discharge P (kPa/)					
Evaporator:					
Coil Air/H_2O In T (°C)					
Coil Air/H_2O Out T (°C)					
Operating Service Temperature) (°C)					
Condenser:					
Coil Air/H_2O In T (°C)					
Coil Air/H_2O Out T (/°C)					
Superheat and Sub-Cool (derived values)					
Refrigerant T at Superheat Ctl. Pt (°C)					
Calculated Superheat (K)					
Exp. Device Inlet T (°C)					
Calculated sub-cool (K)					
Motor Amps (if pack: total)					
Comments:					

Table 2
Physical Properties of DuPont™ ISCEON® MO29

Physical Property	Unit	ISCEON® MO29	R22
Boiling Point (1 atm.)	°C	–43	–41
Vapor Pressure at 25°C	kPa absolute	1130	1041
Liquid Density at 25°C	kg/m^3	1144	1193
Density, Satd. Vapor at 25°C	kg/m^3	59.3	44.9
Ozone Depletion Potential	CFC11 = 1.0	0	0.05
Global Warming Potential	$CO_2 = 1$	2230	1700

Table 3
Composition of ISCEON® MO29 (Wt. %)

	HFC125	HFC134a	isobutane
ISCEON MO29	**65.1**	**31.5**	**3.4**

Appendix

Table 4

Pressure – Temperature Chart (SI Units): R22 and ISCEON® MO29

Pressure Bar (g)	R22 Sat. Temp °C	ISCEON® MO29 Sat. Liquid Temp °C	ISCEON® MO29 Sat. Vapor Temp °C	ISCEON® MO29 Avg. Coil Temp °C
–0.7	–64	–66	–60	–63
–0.6	–59	–61	–56	–58
–0.5	–55	–57	–52	–54
–0.4	–51	–54	–49	–51
–0.3	–48	–51	–46	–48
–0.2	–46	–48	–43	–46
–0.1	–43	–46	–41	–43
0	–41	–43	–39	–41
0.1	–39	–41	–37	–39
0.2	–37	–40	–35	–37
0.3	–35	–38	–33	–35
0.4	–34	–36	–31	–34
0.5	–32	–35	–30	–32
0.6	–31	–33	–28	–31
0.7	–29	–32	–27	–29
0.8	–28	–30	–26	–28
0.9	–26	–29	–25	–27
1	–25	–28	–23	–25
1.1	–24	–26	–22	–24
1.2	–23	–25	–21	–23
1.3	–22	–24	–20	–22
1.4	–21	–23	–19	–21
1.5	–20	–22	–18	–20
1.6	–18	–21	–17	–19
1.7	–17	–20	–16	–18
1.8	–17	–19	–15	–17
1.9	–16	–18	–14	–16
2	–15	–17	–13	–15
2.1	–14	–16	–12	–14
2.2	–13	–15	–11	–13
2.3	–12	–15	–11	–13
2.4	–11	–14	–10	–12
2.5	–10	–13	–9	–11
2.6	–10	–12	–8	–10
2.7	–9	–11	–8	–9
2.8	–8	–11	–7	–9
2.9	–7	–10	–6	–8
3	–7	–9	–5	–7
3.1	–6	–8	–5	–7
3.2	–5	–8	–4	–6
3.3	–4	–7	–3	–5

Pressure Bar (g)	R22 Sat. Temp °C	ISCEON® MO29 Sat. Liquid Temp °C	ISCEON® MO29 Sat. Vapor Temp °C	ISCEON® MO29 Avg. Coil Temp °C
3.4	–4	–6	–3	–5
3.5	–3	–6	–2	–4
3.6	–2	–5	–1	–3
3.7	–2	–4	–1	–3
3.8	–1	–4	0	–2
3.9	0	–3	0	–1
4	0	–3	1	–1
4.2	1	–1	2	0
4.4	3	0	3	2
4.6	4	1	4	3
4.8	5	2	6	4
5	6	3	7	5
5.2	7	4	8	6
5.4	8	5	9	7
5.6	9	6	10	8
5.8	10	7	11	9
6	11	8	11	10
6.2	12	9	12	11
6.4	13	10	13	12
6.6	14	11	14	13
6.8	15	12	15	13
7	15	13	16	14
7.2	16	14	17	15
7.4	17	14	18	16
7.6	18	15	18	17
7.8	19	16	19	18
8	20	17	20	18
8.2	20	18	21	19
8.4	21	18	21	20
8.6	22	19	22	21
8.8	23	20	23	21
9	23	21	24	22
9.5	25	22	25	24
10	27	24	27	25
10.5	29	26	29	27
11	30	27	30	29
11.5	32	29	32	30
12	33	30	33	32
12.5	35	32	35	33
13	36	33	36	35
13.5	38	35	37	36
14	39	36	39	37

Pressure Bar (g)	R22 Sat. Temp °C	ISCEON® MO29 Sat. Liquid Temp °C	ISCEON® MO29 Sat. Vapor Temp °C	ISCEON® MO29 Avg. Coil Temp °C
14.5	40	37	40	39
15	42	39	41	40
15.5	43	40	42	41
16	44	41	44	42
16.5	46	42	45	44
17	47	44	46	45
17.5	48	45	47	46
18	49	46	48	47
18.5	50	47	49	48
19	51	48	50	49
19.5	52	49	51	50
20	53	50	52	51
20.5	54	51	53	52
21	56	52	54	53
21.5	57	53	55	54
22	58	54	56	55
22.5	59	55	57	56
23	59	56	58	57
23.5	60	57	59	58
24	61	58	60	59
24.5	62	59	61	60
25	63	60	62	61
25.5	64	61	62	62
26	65	62	63	62
26.5	66	62	64	63
27	67	63	65	64
27.5	68	64	66	65
28	68	65	66	66
28.5	69	66	67	66
29	70	67	68	67
29.5	71	67	69	68
30	72	68	69	69
30.5	72	69	70	70
31	73	70	71	70
31.5	74	70	72	71
32	75	71	72	72
32.5	75	72	73	72
33	76	73	74	73
33.5	77	73	74	74
34	78	74	75	74
34.5	78	75	76	75
35	79			

Note: Saturated Liquid Temperature = Bubble Point
Saturated Vapor Temperature = Dew Poin

For more information and to find the location of your nearest DuPont ISCEON® refrigerants supplier please contact:
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