

**Service
Manual**

Service manual for products using R32

Preface

The Montreal Protocol regulates ozone-depleting HCFCs and calls for a complete phase-out of HCFCs by 2020 for developed states and by 2030 for developing states. The developing states have a longer span until the complete phase-out and HCFC-22 is still in common use, but a switchover in refrigerant is expected to start from 2013, when the gradual reduction in HCFCs is to come into action. Switchover to “ozone-friendly” HFCs is also in progress in developed states; however, since HFCs are one of the greenhouse gases (GHG) contributing to global warming, they are a target of emission reduction as per the Kyoto Protocol.

As an alternative to HCFC-22 in developing states and to introduce a refrigerant with less global warming potential* (GWP) in developed states, Daikin adopted R32.

* Global warming potential: A relative measure used to define the impacts of emissions of different GHGs will have on global warming.

Based on a comprehensive consideration of refrigerants' GWP, safety in terms of flammability and toxicity, energy efficiency of air-conditioning systems using the refrigerant, and the cost of the refrigerant itself, Daikin, as a leader in the air-conditioning system industry, decided to develop and product air-conditioning systems that use R32 as refrigerant.

R32 is a safe, efficient refrigerant that has a lower environmental burden than R410A as well as good economic efficiency. The adoption of R32 will not only contribute to environmental conservation owing to its low GWP, but also offer air-conditioning systems COP (Coefficient of performance) improvement and higher efficiency while reducing refrigerant charging amount due to the nature of the refrigerant.

In this manual, we included information on the installation and maintenance of our air-conditioning systems that use R32 as refrigerant. We hope this manual will be a useful resource for you.

(This manual is created based on information as of March, 2015, and the content is subject to change.)

Contents

1. Overview of R32-Using Systems	2
2. Properties of Refrigerants	4
3. Properties of Refrigerant Oils	8
4. Explanation of Refrigerant Cylinders	9
5. Service Tools for R32	10
6. R32 Unit Installation and Service	
1) Three Basic Rules of Refrigerant Piping	12
2) Troubleshooting	13
3) Safety Precautions: What If	14
 <Reference>	
1) Thermodynamic Properties of R32	16
2) Safety Data Sheet	18

1. Overview of R32-Using Systems

There is no major difference in specifications between the R32 and R410A units, but there is a difference in pressure and refrigerant oil used between the R32 and R22 units.

	HFC units	HFC units	HCFC units
Refrigerant name	R32	R410A	R22
Composing substances	Single-component refrigerant	Quasi-azeotropic Mixture (R32:R125 = 50:50 wt%)	Single-component refrigerant
Standard design pressure	RA: 4.17 MPa G PA: 4.0 MPa G or 3.6MPa	RA: 4.17 MPa G PA: 4.0 MPa G or 3.8 MPa G	2.75 MPa G
Refrigerant oil	Synthetic oil (ether)	Synthetic oil (ether)	Mineral oil (suniso)

Refrigerant piping consists of copper/steel pipes, joints, and other fittings. All components must be selected and installed in conformity with the standards pertaining to the Refrigeration Safety Regulation.
Same piping as for R410A can be used.

■ R32-related Regulations

<As of March, 2015>

ISO5419, ISO817 & EN378

Field	International	Europe	US
Refrigerant Classification	ISO817	-NA- (based on ISO)	ASHRAE 34 UL 2182
Usage Restriction for Safety	ISO5149	EN378 Under revision	ASHRAE 15
	IEC60335-2-40 Under revision	EN60335-2-40 Based on IEC	UL 207 UL 250 UL 471 UL 474 UL 484 UL 984 UL 1995 UL 60335-2-40

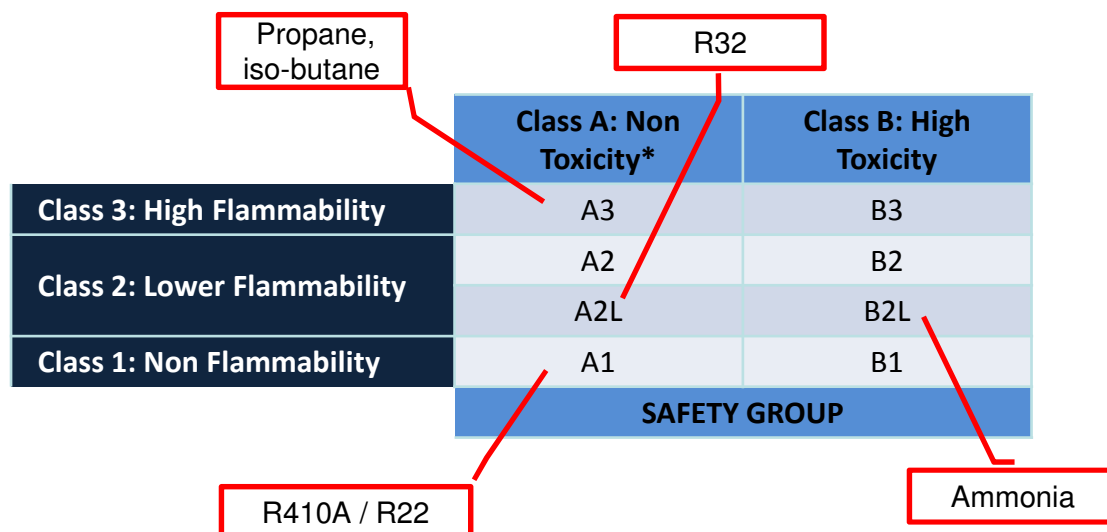
Under ASHRAE 34 and draft ISO 817, **R32 is a slightly flammable gas**, it will only burn when concentration is between lower & upper flammable limits (LFL & UFL).

	Lower flammable limit	Upper flammable limit
R32 concentration	13,3%	29,3%

CERI + Kayak Japan 2011

R32 is rated A2L, meaning slightly flammable since the burning velocity is rather low and non toxic

Class 1	Class 2L	Class 2	Class 3
Not flammable	Slightly flammable burning velocity ≤10 cm/s	Low flammable	Highly flammable
R744 (CO ₂)	R717 (Ammonia)	R152a	R290
R410A	R32 R1234yf/ze		R600a



*Class A signifies refrigerants for which toxicity has not been identified at concentrations less than or equal to 400 ppm

2. Properties of Refrigerants

■ Refrigerant Properties of R32

Major refrigerant properties of R32 are summarized in the chart below.

	R32	R410A	R22
Formula	CH ₂ F ₂	CH ₂ F ₂ /CHF ₂ CF ₃	CHCLF ₂
Composition (Mixture ratio: wt%)	Single component	R32/R125 (50/50 wt%)	Single component
Boiling temperature (°C)	- 51.7	- 51.5	- 40.8
Pressure (physical property) *1	3.14	3.07	1.94
Capacity (physical property) *2	160	141	100
COP (physical property) *3	95	91	100
Ozone depletion potential (ODP)	0	0	0.055
Global warming potential (GWP) *4	675	2090	1810
Flammability (Ashrae 34 & draft ISO817)	Slightly flammable (A2L)	Not flammable (A1)	No flammable (A1)
Toxicity	No	No	No

*1: Physical property value under a temperature condition of 50°C

*2: Temperature condition: 0/50°C; the values are relative values based on R22 as 100

*3: Te/Tc/SC/SH = 5/50/3/0°C

*4: GWP = Global warming potential; values are specified in IPCC 4th Assessment Report

■ Flammability of R32

R32 may burn slightly when all of the following condition (gas concentration, ignition energy) are met, but pose no risk under the normal usage conditions for air-conditioning equipment and work environment.

[Concentration Condition (Upper & Lower Concentration Limits)]

	Lower limit	Upper limit	Notes
R32 combustion concentration	13.3 %	29.3 %	CERI + Kayak Japan ('11)

If ignition energy is applied while in the gas concentration range (between upper and lower limit), R32 may burn.
However, this gas concentration condition is a level at which oxygen deficiency can occur (oxygen concentration of 18% or below) and thus is not an environment in which people generally work.

[Ignition Energy]

- Value for minimum energy with which the gas may ignite

	Min. ignition energy (Unit: mJ)	Notes
R32	30 – 100 (From DuPont June 2010 AIChE article report)	With static electricity or electronic lighters (energy: several mJ), minimum ignition energy is not attained
Ref: Propane	0.25	May ignite even with static electricity

R32 does not ignite with
static charge generated by
human contact.

<Reference: Static electricity energy>

Static electricity energy (mJ)	Symptom of electric shock
0.05	No sensation
0.45	Prickling sensation
1.25	Pain extending from palm to forearm

- No possibility of ignition by spark in the machine or in the magnetic switch on a power panel

Even if a spark exceeding the minimum ignition energy was generated in the magnetic switch, with the actual electrical parts (electromagnetic switch with cover), **there is no flame propagation in R32 (no flame spreading)**.

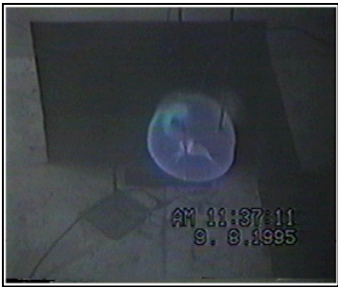
- If the distance between the electrodes and the wall is within 4 mm in an enclosed space, there is test data that indicates no flame propagation.

<Source: National Institute of Advanced Industrial Science and Technology (AIST) report>

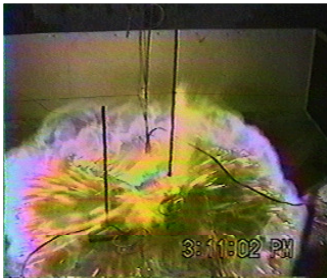
R32 does not ignite with actual electrical parts.

By way of experiment, the following shows how R32 acts when ignited and combusted when the conditions for flammability are met.

[How R32 Burns (Flame Propagation)]



When R32 is ignited

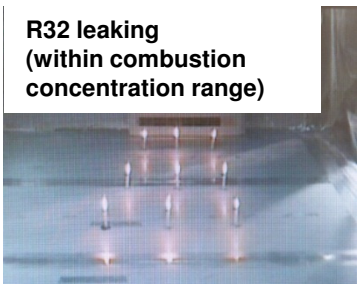


When propane is ignited

	Burning speed (Unit: cm/s)
R32	6.7
Propane	46.4

Even if R32 gets ignited, the risk of pressure rise (= explosive force) is low due to its slow flame propagation (slow burning).

[Change of Flame When There is R32 Leakage]



When leakage occurs, an area of concentration forms immediately below the leaking part and up to a certain height above the floor in the vicinity of the leak. The picture shows the change in the flames (flame propagation).

Using lighters and burners commonly used at work, the experiment shows an upward spread of flames but no flame propagation in the horizontal and downward directions. When the naked pilot flames are extinguished, the upward flame propagation disappears.

R32 combustion does not occur under normal usage conditions for air-conditioning equipment or in a normal work environment. However, it is important to keep away ignition source (open flame) so as to prevent generating R32 combustion concentration conditions, hence reducing the risk of combustion occurrence with the awareness that R32 is slightly flammable.

Therefore, ensure that the following **instructions** are strictly observed **when handling R32 and other HFCs**:

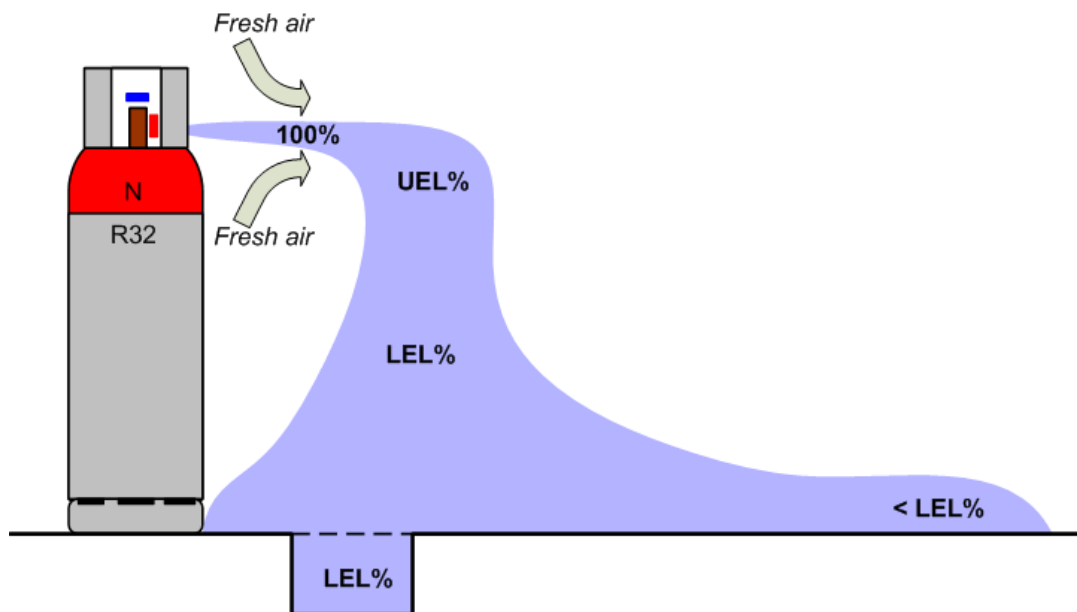
- R32 and other HFCs are heavier than air, and therefore they are inclined to settle near the floor surface.

If the gas fills up the room or the bottom part of a room, it may also cause oxygen deficiency and may reach its combustion concentration.

In order to prevent oxygen deficiency and R32 combustion, keep the room well-ventilated for a healthy work environment.

In particular, using HFCs in a basement room or confined area creates a higher risk; be sure to furnish the room with local exhaust ventilation.

If a refrigerant leak is confirmed in a room or an inadequately ventilated location, do not use a flame until the area has been ventilated appropriately and the work environment has been improved.



- The same applies in case of brazing, ensure appropriate ventilation to prevent oxygen deficiency and R32 combustion.
Check that there are no dangerous or combustible items nearby, and ensure a fire extinguisher is close at hand.
- If the gas comes into contact with open flame or metal (or other material) heated to over 300 to 400°C, it will cause thermal decomposition, possibly producing toxic gas. Do not allow the gas to come into contact with such objects.
Toxic gas generation is the same with R410A, R22, etc., and not limited to R32.
- Keep a sufficient distance away from causes of fire (ignition sources) such as gas-burning equipment and electric heaters in places where installation, repairs, or similar work on air-conditioning equipment is performed.

3. Properties of Refrigerant Oils

R32 lacks compatibility with mineral oil (SUNISO) and reduces oil return performance, so to ensure compatibility ether oil (a synthetic oil) has been selected as the refrigerant oil for R32 units.

Ether oil is thus used as the refrigerant oil for both R32 and R410A units, but product names are different as indicated in the table below.

	Synthetic oil	Synthetic oil	Mineral oil
	Ether oil	Ether oil	
Unit (Manufacturer)	FW68DA (Idemitsu Kosan)	FVC68D FVC50K (Idemitsu Kosan)	SUNISO 4GS (Japan Sun Oil Company)
Applicable refrigerant (Daikin products)	R32	R410A	R22

■ Contamination Control (Preventing Impurity Contamination)

- Contamination control (preventing impurity contamination) for R32 refrigerant oil (ether oil) is the same as R410A.
- Reuse of existing piping in R32 room air conditioners is the same as R410A room air conditioners, and reuse of existing piping is possible with the same method.
For details, check the catalogs and specifications for the products. (When the inside of the existing piping is extremely dirty, you must clean the pipes or replace the dirty pipes with new ones.)

4. Explanation of Refrigerant Cylinders

■ Specifications of Refrigerant Cylinders

- Red shoulder (flammable gas).
- Left thread (an adapter piece is required to connect manifold).
- Minimum test pressure = 48 bar.
- Fill rate for recovery bottles for R32 is 60%.

■ Handling of Refrigerant Cylinders

● Laws and Regulations

As liquefied gas, R32 is covered in the High Pressure Gas Safety Act. Therefore, refer to the High Pressure Gas Safety Act before use. The High Pressure Gas Safety Act sets forth standards that must be followed to prevent disasters that may be caused by high-pressure gases.

● Handling of Vessels

R32, being a high-pressure gas, is supplied in a pressure vessel. The vessel itself is highly safe, but handling it without proper care may damage the vessel, which may result in unexpected accidents. Take due care to protect pressure vessels from dropping, being knocked down, impacts, and rolling.

● Storage

Likewise other high-pressure gases, R32 should be preserved and stored in accordance with the standards established by laws and regulations. (Cool, dark place that is well-ventilated, with a temperature of 40°C or lower; Implementation of fall-prevention devices, etc.)

● Caution for health and hygiene

Refer to the MSDS on the back of this book (Reference).

5. Service Tools for R32

[If Switching Over from R22]

R32 has a higher pressure than R22 (approx. 1.6 times), and the refrigerant oil used with R32 is ether oil instead of the SUNISO oil used with R22. If inappropriate oil is mixed with the refrigerant, it might cause sludge and other problems; therefore, service tools used with R22, such as the gauge manifold and charge hose, cannot be shared with R32.

Always use dedicated tools for R32.

[If Switching Over from R410A]

Because R32 has approximately the same pressure as R410A, the refrigerant oil is also ether oil, and it can be accommodated with the same contamination control (preventing impurity contamination) as R410A without a large difference, **tools that are used with R410A can be shared with R32 after confirmation from tooling supplier.**

■ Tool Compatibility

Tool	R32	R410A	R22
Gauge manifold	Sharable when temperature is recalculated		
Charge hose	Sharable		
Weighing instrument	Sharable		
Pipe bender	Sharable		
Pipe cutter	Sharable		
Flaring tool	Sharable *1		
Torque wrench	Sharable *2		
Cylinder cap	Sharable		
Vacuum pump	Sharable *3		
Refrigerant recovery system	Sharable *4		
Refrigerant recovery cylinder	48 bar	40 bar	
Electric gas leak detector	Sharable *5		

*1: R22 type can be used for R32 & R410A by changing the work process.

*2: Dimension of width across flats of flare nut is different between R32 & R410A and R22 (4/8" and 5/8" only. Other flare nuts can be shared.)

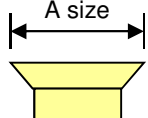
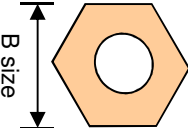
*3: When using an R22 type for R32 & R410A, use with a reverse flow preventive adapter.

*4: HFC recovery systems can be shared if they have been certified by the manufacturers to be supporting the relevant HFCs.

*5: Even if a detector supports R22, if the detector does not support HFC (R32, R410A), it cannot be shared. Always check with the tooling manufacturer.

■ Explanation of Tools for R32

Tools pictured are provided for purpose of example only. For more information about specific tools, contact the air-conditioning and refrigeration service tool dealer.

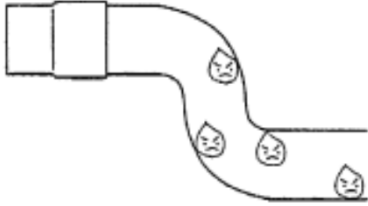
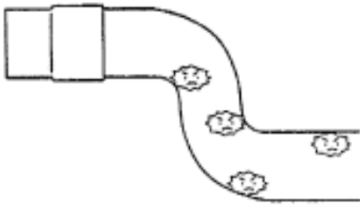
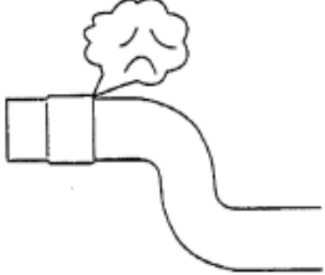
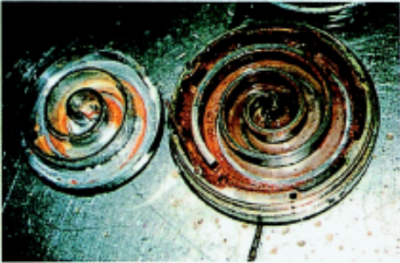
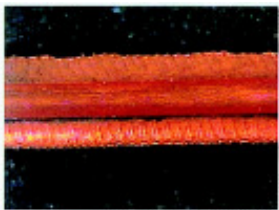
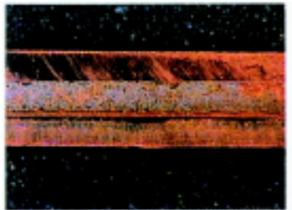
Tool	Information
Gauge manifold 	● Supports R32 (R410A) pressure - If the gauge manifold supports R410A, it can also be used with R32 if the temperature is recalculated. - High-pressure gauge: -0.1 to 5.3 MPa - Low-pressure gauge: -0.1 to 3.8 MPa ● Bore of connecting portion uses 5/16" flare screw
Charge hose 	● Supports R32 (R410A) pressure - If the charge hose supports R410A, it can also be used with R32. ● Bore of connecting portion uses 5/16" flare screw
Weighing instrument 	● Used for measuring of weight, the weighing instrument can be shared with HFCs (R32, R410A) and conventional refrigerants (R22, etc.)
Pipe bender 	● Can be shared between R32, R410A, and conventional refrigerants (R22, etc.)
Pipe cutter 	● Can be shared between R32, R410A, and conventional refrigerants (R22, etc.)
Flaring tool 	● Supports flare size (A size) for R32 (R410A) - If the flaring tool supports R410A, it can also be used for R32. - Flare size is different between R22 and R32 (R410A) 
Torque wrench 	● Supports flare nut width across flats (B size) for R32 (R410A) - If the torque wrench supports R410A, it can also be used for R32. - Width across flats is different between R22 and R32 (R410A) for 4/8" and 5/8" - No change in tightening torque value. 
Cylinder cap 	● Inner diameter of the part that connects to the hose is 5/16" flare thread. - If the size supports R410A type, it can also be used for R32 type.
Vacuum pump 	● Equipped with oil backflow prevention function (In the case of using a vacuum pump without reverse flow preventive function, use only after connecting it to a reverse flow preventive vacuum adapter.)
Refrigerant recovery system 	● Supports R32 (R410A) pressure - If the system supports R410A and has been certified for use with R32, it can also be used with R32.
Refrigerant recovery cylinder 	● For R32 (R410A), only the recovery cylinders with pressure resistance to 48 bar can be used. Keep in mind that the bottle might have left thread. In that case, an adapter piece is necessary.
Electric gas leak detector 	● Can be used with R32, R410A, and conventional refrigerants (R22, etc.) - Check what types of refrigerant the detector can be used with. - Detectors that can be used with R410A can also be used for R32 if approval from tooling manufacturer. - Even if a detector supports conventional refrigerants (R22, etc.), it cannot be used for R32 and R410A if it does not support use with HFCs. - Torch type models cannot be used.

6. R32 Unit Installation and Service

1) Three basic rules of refrigerant piping

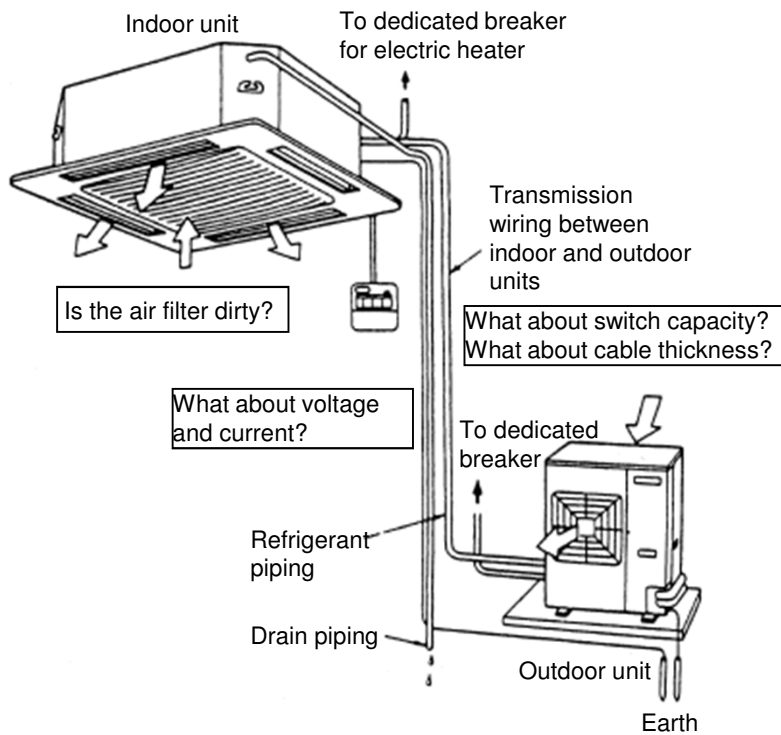
Following the Three Basic Rules of Refrigerant Piping

The three basic rules of refrigerant piping must be followed when servicing and installing refrigerant piping.

	(1) Drying (no moisture)	(2) Cleaning (free of contamination)	(3) Tightening (air-tightness)
	There shall be no moisture in the pipe.	There shall be no dust in the pipe.	There shall be no refrigerant leak.
Item			
Cause	- Water entering from outside, such as rain. - Moisture due to dew condensation occurring inside the pipe.	- Oxidized film generated during brazing. - Entering of foreign items such as dust, particles and oil from outside.	- Insufficient brazing - Inadequate flaring or insufficient tightening torque. - Inadequate tightening of flange connection.
Problem	- Clogging of expansion valve, capillary tube, etc. - Insufficient cooling or heating. - Degradation of refrigerant oil. - Malfunction of compressor.	- Clogging of expansion valve, capillary tube, etc. - Insufficient cooling or heating. - Degradation of refrigerant oil. - Malfunction of compressor.	- Gas shortage - Insufficient cooling or heating. - Temperature increasing of discharge gas. - Degradation of refrigerant oil. - Malfunction of compressor.
	<For reference>  Compressor is corroded due to moisture.  Not clogged  Clogged Capillary is clogged with dust.		
Preventive measure	Pipe preparation ↓ Flushing ↓ Vacuum drying	- Same as the items on the left. - Do not use tools or devices previously used with a different type of refrigerant.	- Follow the basic brazing procedure - Follow the basic flaring procedure. - Follow the basic flange connection procedure. - Conduct an air-tightness test (gas leak check).

2) Troubleshooting

<Check items for service>



<Relationship of operating state, pressure, and operating current of air-conditioning system>

Measured from 15-20 minutes or more after operation starts.

When cooling

Air-Conditioner Status	Low Pressure	High Pressure	Running Current
Air Filter Fouling	Lower	Lower	Lower
Short Circuit of Indoor Unit Inlet/Outlet Air	Lower	Lower	Lower
Outdoor Unit Fin Fouling	Higher	Higher	Higher
Short Circuit of Outdoor Unit Inlet/Outlet Air	Higher	Higher	Higher
Air Mixed in Refrigerant	Higher	Higher	Higher
Water Mixed in Refrigerant	*1 Lower	Lower	Lower
Dirt Mixed in Refrigerant	*2 Lower	Lower	Lower
Lack of Refrigerant (Gas)	Lower	Lower	Lower
Unsatisfactory Compression	*3 Lower	Lower	Lower

When heating

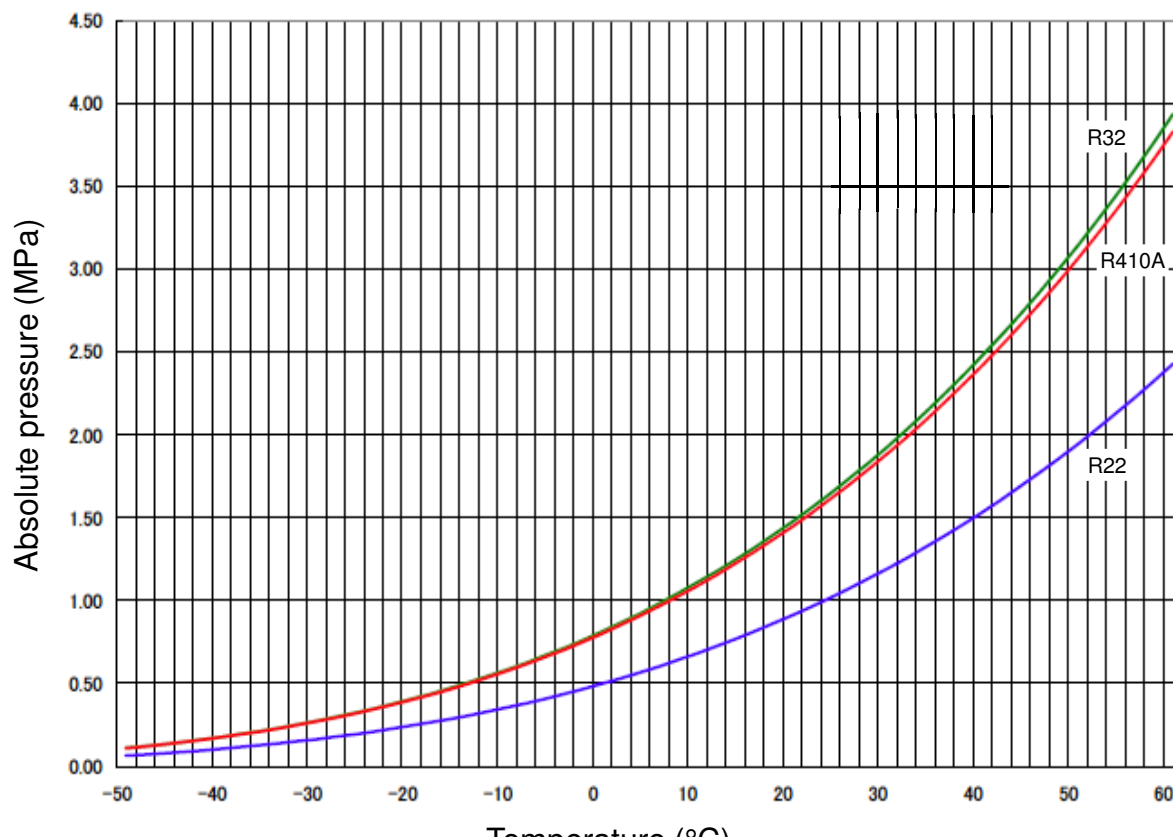
Air-Conditioner Status	Low Pressure	High Pressure	Running Current
Air Filter Fouling	Higher	Higher	Higher
Short Circuit of Indoor Unit Inlet/Outlet Air	Higher	Higher	Higher
Outdoor Unit Fin Fouling	Lower	Lower	Lower
Short Circuit of Outdoor Unit Inlet/Outlet Air	Lower	Lower	Lower
Air Mixed in Refrigerant	Higher	Higher	Higher
Water Mixed in Refrigerant	*1 Lower	Lower	Lower
Dirt Mixed in Refrigerant	*2 Lower	Lower	Lower
Lack of Refrigerant (Gas)	Lower	Lower	Lower
Unsatisfactory Compression	*3 Lower	Lower	Lower

*1 Water in the refrigerant freezes inside the capillary tube or expansion valve, and is basically the same phenomenon as pump down.

*2 Dirt in the refrigerant clogs filters inside the piping, and is basically the same phenomenon as pump down.

*3 Pressure differential between high and low pressure becomes slight.

<Refrigerant Properties of R32, R410A, and R22 (Pressure-Temperature Graph)>



3) Safety Precautions: **WHAT IF**

- When executing a repair indoors

Make sure that there is always forced (fan) ventilation (+ 500 m³/h) to guarantee the supply of fresh air and extraction of R32 out of the room to avoid concentration rise above the LFL.



- When executing a repair outdoors

Forced ventilation is only required when there is a possibility of refrigerant accumulation due to the surrounding walls, or when unit is installed in a pit.

- Accidental release of R32

Ensure enough ventilation.

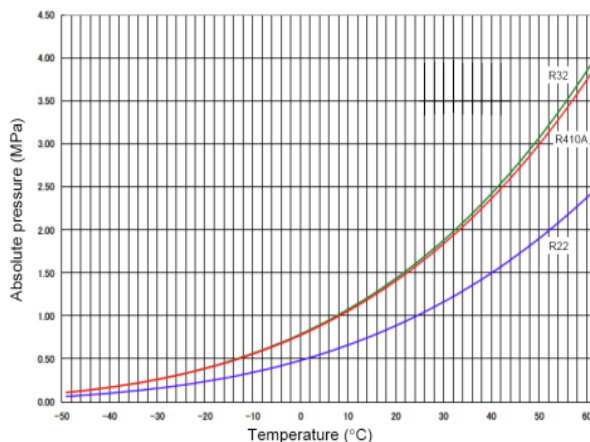
Cut all power to the unit and try to extinguish any open flame when any accidental release of R32 should occur.

Evacuate the room and wait to return to the unit until all refrigerant has evaporated and evacuated.

- Air inside the refrigerant system

Air (Oxygen) must be avoided at all times inside any refrigerant circuit.

- It is strongly advised to measure the saturated pressure/temperature when a unit has been pumped down or when there is any doubt that air might have entered the system.
- Use the pressure/temperature graph to verify that any other gas has entered the system.

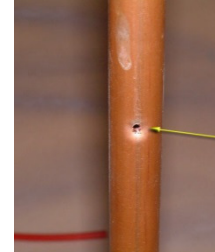


● R32 blocked inside the refrigerant system

Always verify if refrigerant might be trapped inside the refrigerant circuit by flushing with nitrogen prior to brazing works + **assure** that **nitrogen flow** comes through.

→ Recover the refrigerant to verify the recovered quantity with the charged quantity.

→ Always cut out the parts that need to be repaired.



→ If cutting out the parts is impossible, then puncture the pipe.

● Additional precautions

Precautions when performing electrical work or replacing electric components.

- Keep a sufficient distance away from causes of fire (ignition sources) such as gas burning equipment and electric heaters in places where installation, repairs, or similar work on air-conditioning equipment is performed.
- Check that there are no dangerous or combustible items nearby, and ensure a **fire extinguisher is close** at hand.
- If the gas comes into contact with open flame or other material heated to > 300 to 400°C, it will cause thermal decomposition, possibly producing toxic gas.
- Toxic gas generation is the same with R410A, R22 and not limited to R32.

Replace spare parts specified by manufacturer

- Do not try to modify or to add any inductive/capacitance loads to the circuit.
- Replace components only with parts specified by the manufacturer.

Cautions during vacuuming and charging

- Do not overfill the refrigeration system.
- Ensure that contamination of different refrigerants does not occur when using charging equipment.

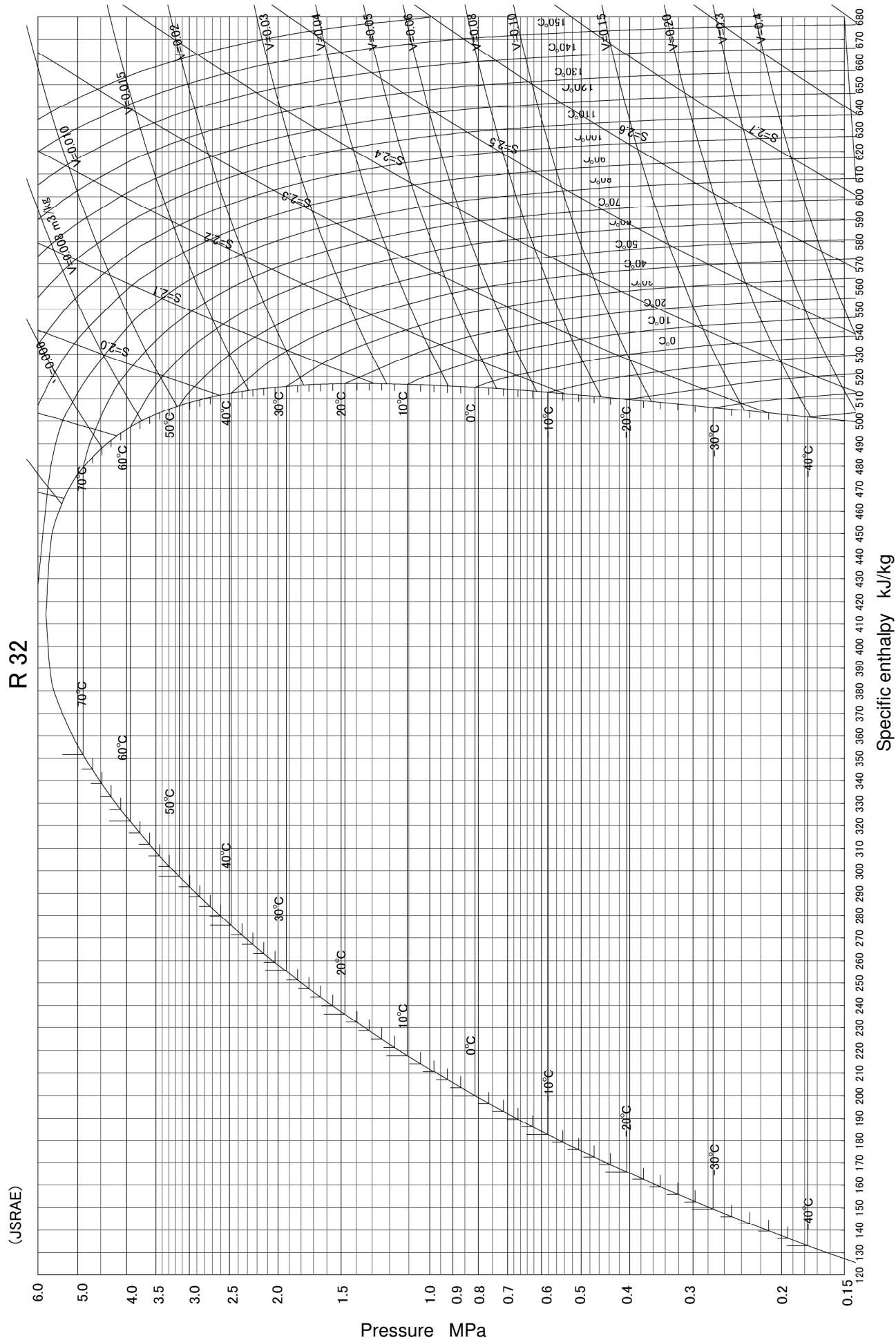
Reference 1

■ Thermodynamic Properties of R32 <R32 Saturation Chart>

R32 Thermodynamic Properties (Saturation Chart)

Temperature	Pressure	Specific volume		Specific enthalpy		Specific enthalpy	
Inserted function t °C	PsT(T) p MPa	VfT(T) v' m ³ /kg	VPT(P,T) v'' m ³ /kg	HfT(T) h' kJ/kg	HPT(P,T) h'' kJ/kg	SfT(T) s' kJ/(kg·K)	SPT(P,T) s'' kJ/(kg·K)
-50	0.1101	0.000828	0.30944	117.22	497.27	0.6683	2.3714
-48	0.1216	0.000831	0.28188	120.40	498.26	0.6824	2.3607
-46	0.1340	0.000835	0.25722	123.60	499.23	0.6965	2.3502
-44	0.1474	0.000839	0.23513	126.80	500.17	0.7105	2.3399
-42	0.1619	0.000843	0.21528	130.01	501.11	0.7244	2.3298
-40	0.1774	0.000847	0.19743	133.23	502.02	0.7382	2.3200
-38	0.1941	0.000851	0.18133	136.45	502.91	0.7519	2.3103
-36	0.2120	0.000856	0.16680	139.69	503.78	0.7655	2.3008
-34	0.2311	0.000860	0.15365	142.93	504.63	0.7791	2.2916
-32	0.2516	0.000864	0.14173	146.18	505.47	0.7926	2.2824
-30	0.2734	0.000869	0.13091	149.45	506.27	0.8060	2.2735
-28	0.2967	0.000873	0.12107	152.72	507.06	0.8193	2.2647
-26	0.3216	0.000878	0.11211	156.01	507.83	0.8326	2.2561
-24	0.3480	0.000883	0.10393	159.31	508.57	0.8458	2.2476
-22	0.3760	0.000888	0.09646	162.62	509.28	0.8589	2.2392
-20	0.4058	0.000892	0.08963	165.94	509.97	0.8720	2.2310
-18	0.4373	0.000897	0.08337	169.28	510.64	0.8850	2.2229
-16	0.4707	0.000903	0.07762	172.63	511.28	0.8979	2.2149
-14	0.5060	0.000908	0.07234	175.99	511.89	0.9109	2.2070
-12	0.5433	0.000913	0.06749	179.37	512.47	0.9237	2.1992
-10	0.5826	0.000918	0.06301	182.76	513.02	0.9365	2.1915
-8	0.6241	0.000924	0.05889	186.18	513.54	0.9493	2.1839
-6	0.6679	0.000930	0.05508	189.60	514.03	0.9620	2.1764
-4	0.7139	0.000936	0.05155	193.05	514.49	0.9747	2.1690
-2	0.7623	0.000942	0.04829	196.52	514.91	0.9874	2.1616
0	0.8131	0.000948	0.04527	200.00	515.30	1.0000	2.1543
2	0.8665	0.000954	0.04246	203.50	515.65	1.0126	2.1471
4	0.9225	0.000960	0.03986	207.03	515.96	1.0252	2.1399
6	0.9811	0.000967	0.03743	210.58	516.24	1.0377	2.1327
8	1.0426	0.000974	0.03518	214.15	516.47	1.0503	2.1256
10	1.1069	0.000981	0.03308	217.74	516.66	1.0628	2.1185
12	1.1742	0.000988	0.03112	221.36	516.80	1.0753	2.1114
14	1.2445	0.000995	0.02929	225.01	516.903	1.0878	2.1043
16	1.3179	0.001003	0.02758	228.68	516.953	1.1003	2.0972
18	1.3946	0.001011	0.02598	232.39	516.952	1.1128	2.0902
20	1.4746	0.001019	0.02448	236.12	516.90	1.1253	2.0831
22	1.5579	0.001027	0.02307	239.89	516.79	1.1378	2.0760
24	1.6448	0.001036	0.02175	243.69	516.62	1.1503	2.0688
26	1.7353	0.001045	0.02051	247.53	516.39	1.1629	2.0616
28	1.8295	0.001055	0.01935	251.40	516.09	1.1755	2.0544
30	1.9275	0.001064	0.01826	255.32	515.72	1.1881	2.0471
32	2.0294	0.001074	0.01722	259.28	515.29	1.2007	2.0397
34	2.1353	0.001085	0.01625	263.28	514.77	1.2134	2.0322
36	2.2454	0.001096	0.01533	267.34	514.17	1.2262	2.0246
38	2.3597	0.001108	0.01447	271.45	513.49	1.2391	2.0169
40	2.4783	0.001120	0.01365	275.61	512.71	1.2520	2.0091
42	2.6014	0.001133	0.01287	279.84	511.82	1.2650	2.0011
44	2.7292	0.001146	0.01214	284.13	510.83	1.2781	1.9929
46	2.8616	0.001160	0.01144	288.50	509.72	1.2914	1.9845
48	2.9989	0.001175	0.01078	292.95	508.48	1.3048	1.9759
50	3.1412	0.001192	0.01015	297.49	507.10	1.3183	1.9670
52	3.2887	0.001209	0.00955	302.12	505.57	1.3321	1.9578
54	3.4415	0.001227	0.00897	306.87	503.86	1.3461	1.9482
56	3.5997	0.001247	0.00843	311.74	501.95	1.3603	1.9382
58	3.7635	0.001269	0.00790	316.75	499.82	1.3749	1.9277
60	3.9332	0.001293	0.00740	321.93	497.44	1.3898	1.9166
62	4.1089	0.001320	0.00691	327.30	494.76	1.4052	1.9048
64	4.2909	0.001349	0.00644	332.90	491.73	1.4211	1.8922
66	4.4793	0.001383	0.00598	338.78	488.26	1.4377	1.8785
68	4.6745	0.001422	0.00553	345.02	484.25	1.4553	1.8634
70	4.8768	0.001469	0.00508	351.73	479.52	1.4740	1.8464
78.105	5.7826	0.00236	0.00236	414.15	414.15	1.6487	1.6487

Thermodynamic Properties of R32 <Pressure-Enthalpy Graph>





Safety data sheet

according to 1907/2006/EC, Article 31

Printing date 06.01.2015

Version number 1

Revision: 06.01.2015

SECTION 1: Identification of the substance/mixture and of the company/undertaking

- **Product identifier**
- **Trade name:** HFC-32
- **CAS Number:**
75-10-5
- **EC number:**
200-839-4
- **Registration number** 01-2119471312-47-0010
- **Relevant identified uses of the substance or mixture and uses advised against**
No further relevant information available.
- **Application of the substance / the mixture** Refrigerant
- **Details of the supplier of the safety data sheet**
- **Supplier:**
DAIKIN CHEMICAL EUROPE GmbH
Immermannstraße 65 d, 40210 Düsseldorf, GERMANY
Phone: (+49) 211-179225-0
- **Manufacturer:**
DAIKIN Industries, LTD. Chemicals Division
Umeda Center Bldg., 4-12, Nakazaki-Nishi2-chome, Kita-Ku,
Osaka, 530-8323 Japan
Tel.: (+81) 6 6373 4345, Fax: (+81) 6 6373 4281
DAIKIN FLUOROCHEMICALS (CHINA) CO.LTD.
Changshu International Chemical Industrial Park Haiyu Town,
Changshu, Jiangsu 215522, China
Tel.: (+86) 512 5232 2266
- **Further information obtainable from:** sales@daikinchem.de
- **Emergency telephone number:** During normal opening times: +49 211 179225-0

SECTION 2: Hazards identification

- **Classification of the substance or mixture**
- **Classification according to Regulation (EC) No 1272/2008**



GHS02 flame

Flam. Gas 1 H220 Extremely flammable gas.



GHS04 gas cylinder

Press. Gas H280 Contains gas under pressure; may explode if heated.

- **Classification according to Directive 67/548/EEC or Directive 1999/45/EC**



F+; Extremely flammable

R12: Extremely flammable.

- **Information concerning particular hazards for human and environment:**

The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.

- **Classification system:**

The classification is according to the latest editions of the EU-lists, and extended by company and literature data.

Safety data sheet

according to 1907/2006/EC, Article 31

Printing date 06.01.2015

Version number 1

Revision: 06.01.2015

Trade name: HFC-32

- **Label elements**
- **Labelling according to Regulation (EC) No 1272/2008**
The substance is classified and labelled according to the CLP regulation.
- **Hazard pictograms**



GHS02 GHS04

- **Signal word** Danger
- **Hazard statements**
H220 Extremely flammable gas.
H280 Contains gas under pressure; may explode if heated.
- **Precautionary statements**
P210 Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P377 Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381 Eliminate all ignition sources if safe to do so.
P410+P403 Protect from sunlight. Store in a well-ventilated place.
P403 Store in a well-ventilated place.
P501 Dispose of contents/container in accordance with local/regional/national/international regulations.
- **Other hazards**
- **Results of PBT and vPvB assessment**
- **PBT:** Not PBT
- **vPvB:** Not vPvB

SECTION 3: Composition/information on ingredients

- **Chemical characterization: Substances**
- **CAS No. Description**
75-10-5 Difluoromethane
- **Identification number(s)**
- **EC number:** 200-839-4

SECTION 4: First aid measures

- **Description of first aid measures**
- **General information:** Seek immediate medical advice.
- **After inhalation:**
Take affected persons into fresh air and keep quiet.
Supply fresh air or oxygen; call for doctor.
In case of unconsciousness place patient stably in side position for transportation.
- **After skin contact:**
Immediately wash with water and soap and rinse thoroughly.
In cases of frost bites, rinse with plenty of water. Do not remove clothing.
- **After eye contact:** Rinse opened eye for several minutes under running water. Then consult a doctor.
- **After swallowing:** If symptoms persist consult doctor.
- **Information for doctor:** Do not administer catecholamines.
- **Most important symptoms and effects, both acute and delayed**
Frost bites
Dizziness

Safety data sheet

according to 1907/2006/EC, Article 31

Printing date 06.01.2015

Version number 1

Revision: 06.01.2015

Trade name: HFC-32

- **Hazards** Danger of disturbed cardiac rhythm.
- **Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

SECTION 5: Firefighting measures

- **Extinguishing media**
- **Suitable extinguishing agents:**
CO₂, powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
- **For safety reasons unsuitable extinguishing agents:** Water with full jet
- **Special hazards arising from the substance or mixture**
Hydrogen fluoride (HF)
Formation of toxic gases is possible during heating or in case of fire.
- **Advice for firefighters**
- **Protective equipment:**
Do not inhale explosion gases or combustion gases.
Wear self-contained respiratory protective device.
Wear fully protective suit.

SECTION 6: Accidental release measures

- **Personal precautions, protective equipment and emergency procedures**
Ensure adequate ventilation
Keep people at a distance and stay on the windward side.
Wear protective equipment. Keep unprotected persons away.
- **Environmental precautions:**
Suppress gases/fumes/haze with water spray.
Do not allow to enter sewers/ surface or ground water.
- **Methods and material for containment and cleaning up:**
Allow to evaporate.
Ensure adequate ventilation.
- **Reference to other sections**
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

SECTION 7: Handling and storage

- **Handling:**
- **Precautions for safe handling**
Store in cool, dry place in tightly closed receptacles.
Open and handle receptacle with care.
Waste air is to be released into the atmosphere only via suitable separators.
Ensure good ventilation/exhaustion at the workplace.
- **Information about fire - and explosion protection:**
Do not spray onto a naked flame or any incandescent material.
Keep ignition sources away - Do not smoke.
Protect against electrostatic charges.
Use only in explosion protected area.
Use explosion-proof apparatus / fittings and spark-proof tools.

Safety data sheet

according to 1907/2006/EC, Article 31

Printing date 06.01.2015

Version number 1

Revision: 06.01.2015

Trade name: HFC-32

- **Conditions for safe storage, including any incompatibilities**
- **Storage:**
- **Requirements to be met by storerooms and receptacles:**
 - Store in a cool location.
 - Store only in unopened original receptacles.
- **Information about storage in one common storage facility:**
 - Store away from flammable substances.
 - Store away from oxidizing agents.
- **Further information about storage conditions:**
 - Storage temperature max. 40 °C
 - Keep container tightly sealed.
 - Do not seal receptacle gas tight.
 - Protect from heat and direct sunlight.
 - Store in a cool place. Heat will increase pressure and may lead to the receptacle bursting.
 - Store only outside or in explosion proof rooms.
- **Specific end use(s)** No further relevant information available.

SECTION 8: Exposure controls/personal protection

- **Additional information about design of technical facilities:** No further data; see item 7.
- **Control parameters**
- **Ingredients with limit values that require monitoring at the workplace:** Not required.

· DNELs

Inhalative	DNEL - general population	750 mg/m ³ (long-term exposure) (systemic effects)
	DNEL - worker	7035 mg/m ³ (long-term exposure) (systemic effects)

· PNECs

PNEC	0.142 mg/l (freshwater) (aqua)
	0.534 mg/kg dw (freshwater) (sediment)
	1.42 mg/l (intermittent release) (aqua)

- **Additional information:** The lists valid during the making were used as basis.
- **Exposure controls**
- **Personal protective equipment:**
- **General protective and hygienic measures:**
 - Wash hands before breaks and at the end of work.
 - Keep away from foodstuffs, beverages and feed.
 - Do not inhale gases / fumes / aerosols.
 - Avoid skin contact with the liquefied material.
 - Keep away from tobacco products.
- **Respiratory protection:** Use suitable respiratory protective device in case of insufficient ventilation.
- **Protection of hands:**



Protective gloves

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation

Safety data sheet

according to 1907/2006/EC, Article 31

Printing date 06.01.2015

Version number 1

Revision: 06.01.2015

Trade name: HFC-32

Material of gloves

Leather gloves

The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application.

Penetration time of glove material

The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.

Eye protection:



Tightly sealed goggles

Body protection: Protective work clothing

SECTION 9: Physical and chemical properties

Information on basic physical and chemical properties

General Information

Appearance:

Form:

Liquefied gas

Colour:

Colourless

Odour:

Odourless

Odour threshold:

Not determined.

pH-value:

Not determined.

Change in condition

Melting point/Melting range:

- 136 °C

Boiling point/Boiling range:

- 51.6 °C

Flash point:

Not applicable.

Flammability (solid, gaseous):

Highly flammable.

Decomposition temperature:

Not determined.

Self-igniting:

530 °C (1018 hPa)

Danger of explosion:

Not determined.

Explosion limits:

Lower:

13.8 Vol %

Upper:

29.9 Vol %

Vapour pressure at 25 °C:

1701 kPa

Density at 25 °C:

0.0021 g/cm³

Solubility in / Miscibility with water at 25 °C:

1680 mg/l

Partition coefficient (n-octanol/water) at 25 °C: 0.21 log POW

Viscosity:

Dynamic:

Not determined.

Safety data sheet

according to 1907/2006/EC, Article 31

Printing date 06.01.2015

Version number 1

Revision: 06.01.2015

Trade name: HFC-32

Kinematic:

Not determined.

· Solvent content:

VOC (EC)

· Other information:

No further relevant information available.

SECTION 10: Stability and reactivity

- **Reactivity**
- **Chemical stability**
- **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
- **Possibility of hazardous reactions**
 - Reacts with alkaline metals.
 - Reacts with earth alkaline metals.
 - Reacts with powdered metals.
- **Conditions to avoid** Exposure to open flame or higher temperatures. Oxidants
- **Incompatible materials:** No further relevant information available.
- **Hazardous decomposition products:** Hydrogen fluoride

SECTION 11: Toxicological information

· **Information on toxicological effects**

· **Acute toxicity:**

· **LD/LC50 values relevant for classification:**

Inhalative	LC50/4 h	1107000 mg/m ³ (rat) (OECD 403)
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· **Primary irritant effect:**

· **on the skin:** No irritant effect known

· **on the eye:** No irritant effect known

· **Sensitization:** No sensitizing effects known.

· **Additional toxicological information:**

Cardiotoxicity: NOAEC (inhalation): 735000 mg/m³ (dog)

No cardiac sensitisation potential of HFC-32 (up to 35% v/v in air) to adrenaline in dogs.

· **Repeated dose toxicity** NOAEC (inhalation): 105000 mg/m³ (rat) (OECD 413)

· **CMR effects (carcinogenicity, mutagenicity and toxicity for reproduction)**

Mutagenicity:

Ames test: negative (OECD 471)

In vitro mammalian chromosome aberration test: negative (OECD 473)

Mammalian erythrocyte micronucleus test: negative (OECD 474)

Toxicity for reproduction:

NOAEC (inhalation): 208000 mg/m³ (mouse) (OECD 478; read across)

Developmental toxicity:

NOAEC (inhalation): 105000 mg/m³ (rat)

SECTION 12: Ecological information

· **Toxicity**

· **Aquatic toxicity:**

EC50/96 h	142 mg/l (algae) (QSAR)
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LC50/48 h	652 mg/l (daphnia) (QSAR)
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Safety data sheet

according to 1907/2006/EC, Article 31

Printing date 06.01.2015

Version number 1

Revision: 06.01.2015

Trade name: HFC-32

LC50/96 h 1507 mg/l (fish) (QSAR)

Persistence and degradability

Not easily biodegradable
5% after 28 days (OECD 301 D)

Behaviour in environmental systems:

Components: Half-life in air: 1237 days

Bioaccumulative potential

Due to the distribution coefficient n-octanol/water an accumulation in organisms is not expected.

Mobility in soil No further relevant information available.

Other information:

Koc = 1.49 - 21-73 (QSAR)

log Koc = 0.17 - 1.34 (QSAR)

Additional ecological information:

General notes:

Ozone depleting potential (ODP): 0

Global warming potential (GWP): 650

Water hazard class 1 (German Regulation) (Self-assessment): slightly hazardous for water

Do not allow undiluted product or large quantities of it to reach ground water, water course or sewage system.

Results of PBT and vPvB assessment

PBT: Not PBT

vPvB: Not vPvB

Other adverse effects No further relevant information available.

SECTION 13: Disposal considerations

Waste treatment methods

Recommendation

Must be specially treated adhering to official regulations.

Can be reused after reprocessing.

Uncleaned packaging:

Recommendation: Disposal must be made according to official regulations.

SECTION 14: Transport information

UN-Number

ADR, IMDG, IATA

UN3252

UN proper shipping name

ADR

3252 DIFLUOROMETHANE (REFRIGERANT GAS R 32)

IMDG, IATA

DIFLUOROMETHANE (REFRIGERANT GAS R 32)

Transport hazard class(es)

ADR

Class

2 2F Gases.

IMDG, IATA

Class

2 Gases.

Packing group

ADR, IMDG, IATA

Void

Safety data sheet

according to 1907/2006/EC, Article 31

Printing date 06.01.2015

Version number 1

Revision: 06.01.2015

Trade name: HFC-32

· Environmental hazards:	
· Marine pollutant:	No
· Special precautions for user	Warning: Gases.
· Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code	Not applicable.
· Transport/Additional information:	
· ADR	
· Limited quantities (LQ)	0
· Excepted quantities (EQ)	Code: E0 Not permitted as Excepted Quantity
· Transport category	2
· Tunnel restriction code	B/D
· IMDG	
· Excepted quantities (EQ)	Code: E1 Maximum net quantity per inner packaging: 30 ml Maximum net quantity per outer packaging: 1000 ml
· UN "Model Regulation":	UN3252, DIFLUOROMETHANE (REFRIGERANT GAS R 32), 2

SECTION 15: Regulatory information

- **Safety, health and environmental regulations/legislation specific for the substance or mixture**
- **Labelling according to Regulation (EC) No 1272/2008**
The substance is classified and labelled according to the CLP regulation.
- **Hazard pictograms**



GHS02 GHS04

- **Signal word** Danger
- **Hazard statements**
H220 Extremely flammable gas.
H280 Contains gas under pressure; may explode if heated.
- **Precautionary statements**
P210 Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P377 Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381 Eliminate all ignition sources if safe to do so.
P410+P403 Protect from sunlight. Store in a well-ventilated place.
P403 Store in a well-ventilated place.
P501 Dispose of contents/container in accordance with local/regional/national/international regulations.
- **Chemical safety assessment:** A Chemical Safety Assessment has been carried out.

SECTION 16: Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

Safety data sheet
according to 1907/2006/EC, Article 31

Printing date 06.01.2015

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Trade name: HFC-32

· **Contact:** sales@daikinchem.de

· **Abbreviations and acronyms:**

RID: Règlement international concernant le transport des marchandises dangereuses par chemin de fer (Regulations Concerning the International Transport of Dangerous Goods by Rail)

ICAO: International Civil Aviation Organization

ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)

IMDG: International Maritime Code for Dangerous Goods

IATA: International Air Transport Association

GHS: Globally Harmonized System of Classification and Labelling of Chemicals

EINECS: European Inventory of Existing Commercial Chemical Substances

CAS: Chemical Abstracts Service (division of the American Chemical Society)

VOC: Volatile Organic Compounds (USA, EU)

DNEL: Derived No-Effect Level (REACH)

PNEC: Predicted No-Effect Concentration (REACH)

LC50: Lethal concentration, 50 percent

LD50: Lethal dose, 50 percent

Flam. Gas 1: Flammable gases, Hazard Category 1

Press. Gas: Gases under pressure: Compressed gas

· *** Data compared to the previous version altered.**

Warning



- Daikin products are manufactured for export to numerous countries throughout the world. Prior to purchase, please confirm with your local authorised importer, distributor and/or retailer whether this product conforms to the applicable standards, and is suitable for use, in the region where the product will be used. This statement does not purport to exclude, restrict or modify the application of any local legislation.
- Ask a qualified installer or contractor to install this product. Do not try to install the product yourself. Improper installation can result in water or refrigerant leakage, electrical shock, fire or explosion.
- Use only those parts and accessories supplied or specified by Daikin. Ask a qualified installer or contractor to install those parts and accessories. Use of unauthorised parts and accessories or improper installation of parts and accessories can result in water or refrigerant leakage, electrical shock, fire or explosion.
- Read the User's Manual carefully before using this product. The User's Manual provides important safety instructions and warnings. Be sure to follow these instructions and warnings.

If you have any enquiries, please contact your local importer, distributor and/or retailer.

Dealer

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