

# R-410a

## Voluntary Technician Certification



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## INTRODUCTION

Today, more than ever before, air conditioning and refrigeration technicians must engage in environmentally safe practices. Increased regulation in recent years has led to significant changes in the HVAC industry, including a trend towards using non-ozone-depleting refrigerants. One of the more popular and efficient of these non-ozone depleting refrigerants is called **R-410A**. As more companies make the shift away from R-22 to R-410A, the demand for technicians who are certified as a Type II or Universal technician and trained to work with this chemical is rapidly growing.

Although R-410A certification is not yet mandatory, it is becoming a common requirement for many companies' employees. It is important to note that there are significant liabilities associated with not having this certification, as R410-A operates at much higher pressures than R-22 and is not safe to use in the same operating systems. The use of R410-A will **always** require some change in the system design. Additionally, failure to obtain R410-A certification represents a potential loss of business to technicians, as the use of R-410A is on the rise.

The purpose of this manual is twofold: to prepare you for the certification exam for handling R410-A and also to act as an on-the-job safety aid in working with this high-pressure chemical.

### WHAT IS R-410a?

Under the Montreal Protocol, the U.S. agreed to gradually phase out its use and production of ozone-depleting substances, including the refrigerant R-22. The terms of this agreement state that as of **January 1, 2010**, the U.S. may no longer produce R-22 for new

equipment. Companies may continue to produce R-22 for existing equipment until **January 1, 2020**. After this date, however, only R-22 that has been recovered and recycled may legally be used; chemical manufacturers will no longer be able to produce R-22 even for existing equipment.

Chemical manufacturing companies are responding to this required phasing out of R-22 by producing alternative refrigerants. Of these alternatives, R-410a is currently the best option. R-410a does not contribute to the depletion of the ozone layer, and is thus in accordance with the Montreal Protocol and a safer option than R-22. Additionally, R-410a is more cost efficient to produce than R-22.

#### **Characteristics of R-410a**

R-410a, which is also commonly called Suva 410a, AZ20, or Puron, has the following important characteristics, which will be addressed in more detail later in this manual:

- HFC (Hydrofluorocarbon) refrigerant, similar to R-134A and R-12
- Azeotropic mixture of HFC-32 and HFC-125; it is a near azeotrope
- Essentially behaves like a pure refrigerant and can safely be repeatedly topped off
- 1.6 to 1.8 times the pressure of R-22 (must be used with new operating systems that can sustain this high pressure)
- Denser and carries a higher caloric heat load than R-22
- More environmentally friendly than R-22, but is still deadly in confined spaces
- Requires the use of POE oils, which absorb moisture quickly. Therefore, it is important to prevent moisture from reaching the oil.

Due to its higher pressure and cooling capacity, **R-410A may not be used in systems that were designed for use with R-22**. It is therefore not considered a drop-in substitute for R-

22. Instead, R-410A may only be used with systems designed specifically for this higher-pressure refrigerant. It is important that no part designed for R-22 is used with R-410a.

## **SPECIAL CONSIDERATIONS**

When using R-410a special considerations should be taken when using the following systems components:

### ▶ **Compressors**

Only compressors with thicker, stronger walls that are capable of handling the high pressures associated with R-410a should be used. A scroll compressor is ideal for this purpose. The valves should open at a pressure between 550 and 625 psig, as compared to the 375 to 450 psig range associated with R-22 systems.

### ▶ **Driers**

Zeolites, a common type of drier for most other types of refrigerant, also work well with R-410a. The metal shell that holds the drier, however, must be specifically made for R-410a; the shell must be thicker and rated for higher pressures. Do not use a filter-drier with rated working pressures of less than 600 psig. A Filter-drier is required for every unit. In order to remove a filter-drier, a tubing cutter (not a torch flame) should be used in order to prevent moisture from being absorbed into the system.

### ▶ **Thermostatic Expansion Valve (TXV)**

Only R-410a rated TXV thermal expansion valves and approved piston metering devices should be used. Do not use any R-22 rated valve, metering device, or capillary tube coil.

► **Pressure Switches**

R-410a pressure switches must have a different high-low pressure range than those of R-22 systems. The recommended high-pressure control settings are a cut-out pressure of 610 psig and a cut-in pressure of about 500 psig. The low-pressure control setting should have a cut-out pressure of 50 psig.

**SPECIAL SERVICE EQUIPMENT NEEDED FOR R-410A**

► **Cylinders**

Although different manufacturers' colors may vary slightly, most R-410a cylinders are light pink in color. R410-a cylinders are made from thicker metal to withstand higher pressure, and must be rated for a service pressure of 400 psig. Additionally, these cylinders are leak-tested at 500 psig. Each cylinder includes a pressure release device or safety valve in order to prevent explosions. As temperatures increase and liquid moves into the vapor space in the cylinder, these safety valves release pressure to prevent rupture. These valves are very important and should never be tampered with, as explosions are extremely dangerous.

► **Disposable Cylinders**

Disposable cylinders should be emptied of **all** contents using a recovery device.

**Cylinders that contain just a small amount of refrigerant have the same pressure as a full cylinder** and may explode if exposed to high temperatures.

Once the cylinder is completely empty, open the valve to let in air. Then, while the valve is open, puncture the cylinder so that it may not be reused. **Disposable cylinders should never be refilled.**

► **Refillable Cylinders**

Reusable or refillable cylinders, also called recovery tanks, are regulated by the Department of Transportation (DOT) and may be used for the transportation of R-410a. These cylinders are gray with a painted yellow shoulder at the top and 12 inches down the side. Different types of refrigerants should never be mixed in a recovery tank, and cannot be reclaimed once they have been mixed. It is recommended that separate recovery tanks be used for refrigerants that have been recovered and recycled versus refrigerant that has only been recovered and not recycled.

R-410a recovery tanks must have a rupture disk rating of at least 400 psig. Not all recovery tanks can handle this pressure, so it is important to make sure any tank used in the recovery of R-410a meets this rating. Additionally, the **recovery tanks must satisfy DOT requirements of either 4BA400 or 4BW400**. Recovery tanks should never be filled to more than 80% of its rated capacity.

► **Manifold Gauge Sets**

Any manifold gauge and hose set should be specifically designed for use with R-410a, with 800 psi working pressures and 4000 psi burst pressure. The set should also have a 0 to 800 psi high-side gauge and a low side gauge from 30" vacuum to 250 psi, with 500 psi retardation feature, which slows the progress of the gauge indicator needle.

▶ **Vacuum Pumps**

R-410a vacuum pumps should be a two-stage model that can pull down to at least 400 to 500 microns. A micron gauge must be used and triple evacuation is the best method.

▶ **POE Oil**

Only POE, or polyolester, oil should be used with R-410a because of its superior lubricating ability. POE oils are highly hygroscopic, which means they quickly absorb and retain moisture. For this reason, it is important that moisture be kept away from the oil. This can be achieved by careful handling, storing the oil in a metal container, transferring it with an oil pump, and keeping the container sealed except when absolutely necessary.

There are different types of POE oil and they should never be mixed; make sure you know which type is used in each system. Replacement oil should contain maximum moisture content of 50 PPM, which is less than 50 drops of water for every 12 gallons of oil. Recommended topping-off POE oils are:

- Mobile EAL ARTIC 22 CC or
- ICI EMKARATE RL 32CF

Please also note that a vacuum pump alone will not remove water from the system. Instead, there may need to be multiple drier changes in order to ensure the proper water PPM.

▶ **Recovery Machines**

Recovery procedures for R-410a are the same as those for R-22, but only recovery machines and cylinders certified for use with R-410a should be used.



## EVACUATION REQUIREMENTS

### Recovery and Recycle Requirements

#### *Equipment*

If your recovery or recycling equipment was built or imported on or after November 15, 1993, the unit must be certified by an EPA approved third party equipment-testing program. This certification requirement also covers “home made” systems. EPA maintains a list of approved devices and the devices must be retested every three years. Recovery/recycle units manufactured after November 15, 1993 are mandated to be equipped with low loss fittings to make it easier to remove refrigerants. Recovery and recycle equipment manufactured after November 15, 1993 need to meet more stringent levels of evacuation than recovery/recycle equipment manufactured before November 15, 1993. (See Table 1 ) It is NOT a requirement for recovery/recycle units to handle more than one type of refrigerant or to have an oil separator.

**TABLE 1. Required Levels of Evacuation for Appliances**

Type of air conditioning or refrigeration equipment	Inches of vacuum (relative to standard atmospheric pressure) using recovery equipment manufactured	
	Before 11/15/93	On or after 11/15/93
HCF-22 system or isolated component normally containing less than 200 pounds of refrigerant	0	0
HCFC-22 system or isolated component normally containing 200 pounds or more refrigerant	4" Hg VAC	10" Hg
Other high pressure equipment or isolated component normally containing less than 200 pound of refrigerant such as R-410a	4" Hg VAC	10" Hg
Other high pressure equipment or isolated component normally containing 200 pounds or more of refrigerant such as R-410a	4" Hg VAC	15" Hg
Very high pressure equipment	0	0
Low pressure equipment	25" Hg	25 mm Hg absolute or 29" Hg

#### **LEAK DETECTION**

Pressurized nitrogen may be used as a trace gas with any R-410a system and should be checked before charging any system leak. Once you have built up and isolated the system, wait a few minutes to see if system pressure rises. If it does, this may indicate

that refrigerant is trapped in the oil, there is a leak in the system, or the liquid refrigerant has not yet boiled off

## **SAFETY GUIDELINES**

Manufacturers of R-410a recommend reading the Material Safety Data Sheets (MSDS) before handling R-410a. R-410a can be safely used in all of its intended applications when handled in accordance with the MSDS. We have included below some additional safe handling and troubleshooting guidelines.

- ▶ **Inhalation:** Inhalation of R-410a in low concentration may cause irritation, while irritation at high concentrations may result in asphyxiation or arrhythmia (irregular heart rate). Asphyxiation, or death from lack of oxygen, can occur when the R-410a concentration reduces oxygen levels by 14-16%. Anyone exposed to inhalation of high concentrations of R-410a should be given medical attention immediately.
- ▶ **Skin and Eye Contact:** Both goggles and Butyl line gloves should be worn when handling R-410a. R-410a vapors can irritate the skin and eyes. In liquid form, R-410a can freeze skin and eyes on contact. In the event of contact with skin or eyes, flush the area with large amounts of lukewarm water for at least 15 minutes, lifting eyelids occasionally, and seek medical attention.
- ▶ **Refrigerant Leaks:** If a large release of R-410a vapor occurs, the area should be evacuated immediately. Vapor will likely concentrate near the floor because it is heavier than the air around it. Once the area is evacuated, it must be ventilated using blowers or fans to circulate the air at floor level.

- ▶ **Flammability:** According to ASHREA Standard 34, R-410a is classified in safety group A1/A1, meaning it is non-flammable at 1 atmospheric pressure (101/3 kPA) and 64° Fahrenheit (18°C). Additionally, the U.S. Department of Transportation considers R-410a non-flammable and without flame limits.
- ▶ **Combustibility:** Although R-410 is non-flammable at normal temperatures and pressures, it can become combustible under pressure when mixed with air. Leak checking can be performed safely with a mixture of R-410a and nitrogen, but should never be performed with a mixture of R-410a and air, as this can lead to combustion.
- ▶ **Thermal Stability:** Cylinders should not be exposed to temperatures greater than 125° Fahrenheit (52°C) or stored in direct sunlight. It is important to avoid exposing R-410a to very high temperatures, which may produce toxic and irritating compounds. In this situation, pungent odors may be released, irritating the nose and throat. Under normal operating conditions, however, R-410a is stable.
- ▶ **Storage and Handling:** R-410a has about 1.6 times higher vapor pressure than most other refrigerants used today. Specific cylinders, as described earlier, made to withstand this higher pressure should be used. Again, any shipping, storage, or recovery cylinder should have a minimum service pressure of 400 PSIG rating and are pink in color. Cylinders should be secured in place to prevent tipping, falling, rolling, or accidentally striking each other or any other object. Caps should be kept in place until cylinder is in use. Valves should be tightly closed. If

the cylinder valve is broken off, rapid release of high pressure can propel the cylinder and potentially cause serious injury.

Appendix A:

## Temperature Pressure Chart

Temp. (°F)	CFC 11	CFC 12	CFC 500	CFC 502	HCFC 22	HCFC 123	HFC 134A	HFC 410A
-50	<b>28.9</b>	<b>15.4</b>		0.0	<b>6.2</b>			
-45	<b>28.7</b>	<b>13.3</b>		2.0	<b>2.7</b>			
-40	<b>28.4</b>	<b>11.0</b>	<b>7.9</b>	4.3	0.5	<b>28.8</b>	<b>14.7</b>	
-35	<b>28.1</b>	<b>8.4</b>	<b>4.8</b>	6.7	2.5	<b>28.6</b>	<b>12.3</b>	
-30	<b>27.8</b>	<b>5.5</b>	<b>1.4</b>	9.4	4.8	<b>28.3</b>	<b>9.8</b>	
-25	<b>27.4</b>	<b>2.3</b>	<b>1.1</b>	12.3	7.3	<b>28.1</b>	<b>6.8</b>	21.4
-20	<b>27.</b>	0.6	3.1	15.5	10.1	<b>27.7</b>	<b>3.8</b>	25.9
-15	<b>26.5</b>	2.4	5.4	19.0	13.1	<b>27.3</b>	0.0	30.8
-10	<b>26.0</b>	4.5	7.8	22.8	16.4	<b>26.9</b>	1.8	36.1
-5	<b>25.4</b>	6.7	10.4	26.9	20.0	<b>26.4</b>	4.1	41.9
0	<b>24.7</b>	9.2	13.3	31.2	23.9	<b>25.8</b>	6.3	48.2
5	<b>24.0</b>	11.8	16.4	36.0	28.1	<b>25.2</b>	9.1	55
10	<b>23.1</b>	14.6	19.8	41.1	32.7	<b>24.5</b>	11.6	62.3
15	<b>22.1</b>	17.7	23.4	46.6	37.7	<b>23.7</b>	15.1	70.2
20	<b>21.1</b>	21.0	27.3	52.4	43.0	<b>22.8</b>	18.0	78.7
25	<b>19.9</b>	24.6	31.6	58.7	48.7	<b>21.8</b>	22.1	87.8
30	<b>18.6</b>	28.5	36.1	65.4	54.8	<b>20.7</b>	25.6	97.5
35	<b>17.2</b>	32.6	41.0	72.6	61.4	<b>19.5</b>	30.4	107.9
40	<b>15.6</b>	37.0	46.2	80.2	68.5	<b>18.1</b>	34.5	118.9
45	<b>13.9</b>	41.7	51.8	87.7	76.0	<b>16.6</b>	40.0	130.7
50	<b>12.0</b>	46.7	57.6	96.9	84.0	<b>15.0</b>	44.9	143.3
55	<b>10.0</b>	52.0	64.1	109.7	92.5	<b>13.1</b>	51.2	156.6
60	<b>7.7</b>	57.7	71.0	115.6	101.6	<b>11.2</b>	56.9	170.7
65	<b>5.3</b>	63.8	78.1	125.8	111.2	<b>9.0</b>	64.0	185.2
70	<b>2.6</b>	70.2	85.8	136.6	121.4	<b>6.6</b>	70.7	201.5
75	0.1	77.0	93.5	147.9	132.2	<b>4.1</b>	78.6	218.2
80	1.6	84.2	102.5	159.9	143.6	<b>1.3</b>	86.4	235.9
85	3.2	91.8	111.5	172.5	155.6	0.9	95.2	254.6
90	5.0	99.8	121.2	185.8	168.4	2.5	104.2	274.3
95	6.8	108.3	131.3	199.7	181.8	4.2	113.9	295
100	8.9	117.2	141.9	214.4	195.9	6.1	124.3	316.9
105	11.1	126.6	153.1	229.7	210.7	8.1	134.9	339.9
110	13.4	136.4	164.9	245.8	226.3	10.2	146.8	364.1
115	15.9	146.8	177.4	266.1	242.7	12.6	158.4	389.6
120	18.5	157.7	190.3	280.3	259.9	15.0	171.9	416.4
125	21.3	169.1	204.0	301.3	227.9	17.7	184.5	444.5
130	24.3	181.0	218.2	318.0	296.8	20.5	199.8	474.
135	27.4	193.5	231.8	338.1	316.5	23.5	213.5	505
140	30.8	206.6		359.2	337.2	26.7	230.5	537.6
145	34.4	220.3		381.1	358.8	30.2	245.6	
150	38.2	234.6		404.0	381.5	33.8	264.4	

