

Triumph Stag A/C restore and conversion to R134A

By Henri Van Triest with many contributions by Mel Hildebrandt

1 Before you begin

The following assumes you have read and understood the article on the Stag air conditioning in the TSC Stag news magazine, summer 2022.

Secondly, you have read and understood the main elements of the work mentioned in the article including the fascia (Section 76.46.01 of the ROM)

It is not necessary to remove the evaporator. With the evaporator still in the car, be prepared to work in a crowded environment, and that is an understatement. Also, you will need to remove the radiator to gain access to the condenser. Removing the hood (bonnet) is easy and recommended for better access but not necessary.

Thirdly, you have read and understand how the A/C system works as described in the ROM.

And at last, you are prepared to invest in the necessary tools and parts and have the motivation to get your Stag's air conditioning system back in working order.

The writers did not have any previous experience with classic car air conditioning but the book by Rob Siegel:

“Just Needs a Recharge: The Hack Mechanic Guide to Vintage Air Conditioning”

Is a must for all information related to vintage air conditioning. Buying, reading and understanding before you begin is indispensable. Available from many sources for 30\$

2 The Evaporator

The condition of the evaporator is crucial. If it leaks or if the area in the central console containing the plenum, the flaps and the vacuum controls is rusted through, think twice before undertaking the job and do not start the job unless you have all the parts.

It is essential to visually check the central console for damage, deterioration or rust.

One of our members obtained four units from fellow members and struggled to make one working unit out of them.

The evaporator has to be pressure tested before doing any further work.

Evaporators are no longer available. If the evaporator is found to leak, the only source would be other TSC members or a wreck.

To pressure test the evaporator you have to invest in test equipment. Evidently, if you can find a friendly A/C shop with all the equipment and willing to do the test, you will save some money.

You will need a Nitrogen cylinder, nitrogen regulator, nitrogen fill for the bottle, A/C manifold and adapters to connect the test equipment to the evaporator.

Note that this equipment is required anyway for testing the final installation unless once more you can find a friendly A/C shop to test, evacuate and recharge the system for less money than the cost of the equipment

1. Nitrogen cylinder and nitrogen

Some welding shops rent nitrogen bottles but generally you bring an empty bottle, they give you another one already filled.

Just Google “20 CuFt Nitrogen cylinder”. Fill at local welding supply

Example of possible source:

https://gascylindersource.com/shop/nitrogen-cylinders/20-cu-ft-steel-nitrogen-cylinder/?gclid=CjwKCAjwoMSWBhAdEiwAVJ2ndlsf-dr5_pGquiAf2GyhysP1e7FluBLfLMsoJRouIVl_ru4VBTvCBoc-4wQAvD_BwE

2. Nitrogen Regulator, from Amazon



BETOOLL Nitrogen Regulator with 0-400 PSI Delivery Pressure Equipment Brass Inlet Outlet Connection Gauges

Visit the BETOOLL Store
★★★★★ 1,140 ratings

#1 Best Seller in Welding Gas Regulators

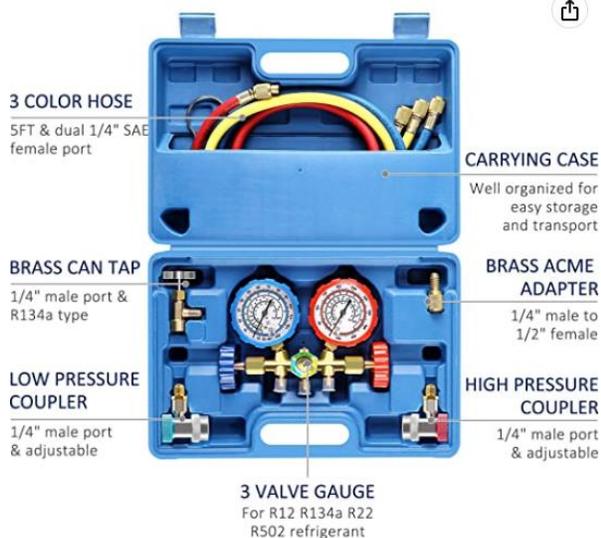
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- Nitrogen Regulator, Delivery Pressure 0-4000 PSI.

3. A/C Manifold set, from Amazon



Just an example, there are many, many available from Amazon. Make certain to purchase one with at least 5ft hoses and with the blue gauge with a maximum of app 350 psi. This gives you a wider negative pressure scale, useful during the evacuating process later. Some sets are sold with identical ranges on the blue and red scale and with short hoses, you will need long hoses to work in comfort later. Check carefully from the many manifolds offered.

This one came complete with all adapters for pressure testing, evacuating and recharging the system, even a can tap.

Before purchasing, check local auto parts stores, some might have them in their tool loan program.

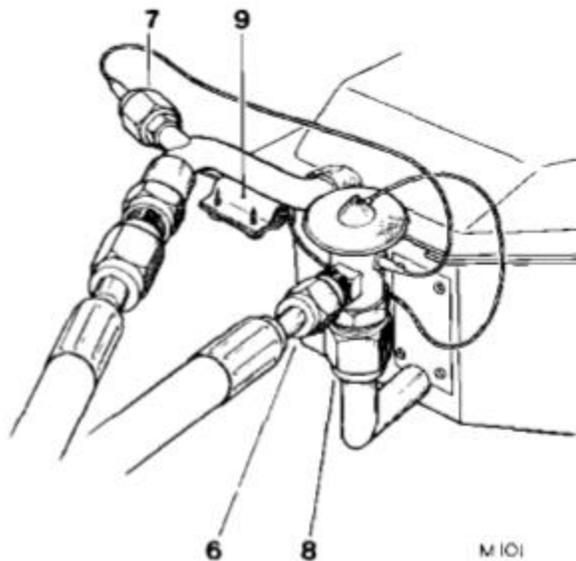
Once more, it is essential to pressure test the evaporator before doing any other work.

The evaporator has an input and an output connection and a connection for the capillary of the expansion valve. The input is where the expansion valve is installed.

To pressure test the evaporator, you have to have access to the ports to connect the test equipment and you will need adapters to do so.

The pressure test should be maintained for at least 24 hours. Observe the blue gauge, it should remain stable over the period. Small changes can be due to the fluctuating temperature in the garage, lower temperatures decrease the pressure slightly.

If your car still has the old hoses installed, you can test before removing the fascia, see item a) below.



4. Adapters

To perform the pressure test you need a set of adapters to link the manifold to the evaporator.

- a) The old hoses, from the evaporator to the suction input of the compressor and from the receiver/dryer to the evaporator are still installed.

Disconnect the hoses from the compressor and the receiver drier.

Plug for the #10 (5/8) hose, ACE hardware, p/n 41212.

Adapter #6 (3/8) hose to 1/4", ACE hardware, p/n 41166.

This adapts the end of the hose to the 1/4 "blue line of the manifold.

This test the complete circuit to and from the evaporator. If the pressure holds, the evaporator is leak free. If it leaks, it is still possible the leak is not in the evaporator but in the hoses.

- b) The hoses have been removed and the expansion valve is still connected to the evaporator. Fascia removed to gain access

Cap for the #10 (5/8) outlet of the evaporator, ACE hardware p/n 41209

Swivel link connected to the expansion valve, ACE hardware p/n 47211 (3/8x3/8 flare)

Adapter 3/8 flare to 1/4" to blue manifold line ACE hardware p/n 41166

- c) Bare evaporator.

Cap 1/4 "for the capillary connection, ACE hardware p/n 47196

Cap for the #10 (5/8) outlet of the evaporator, ACE hardware p/n 41209

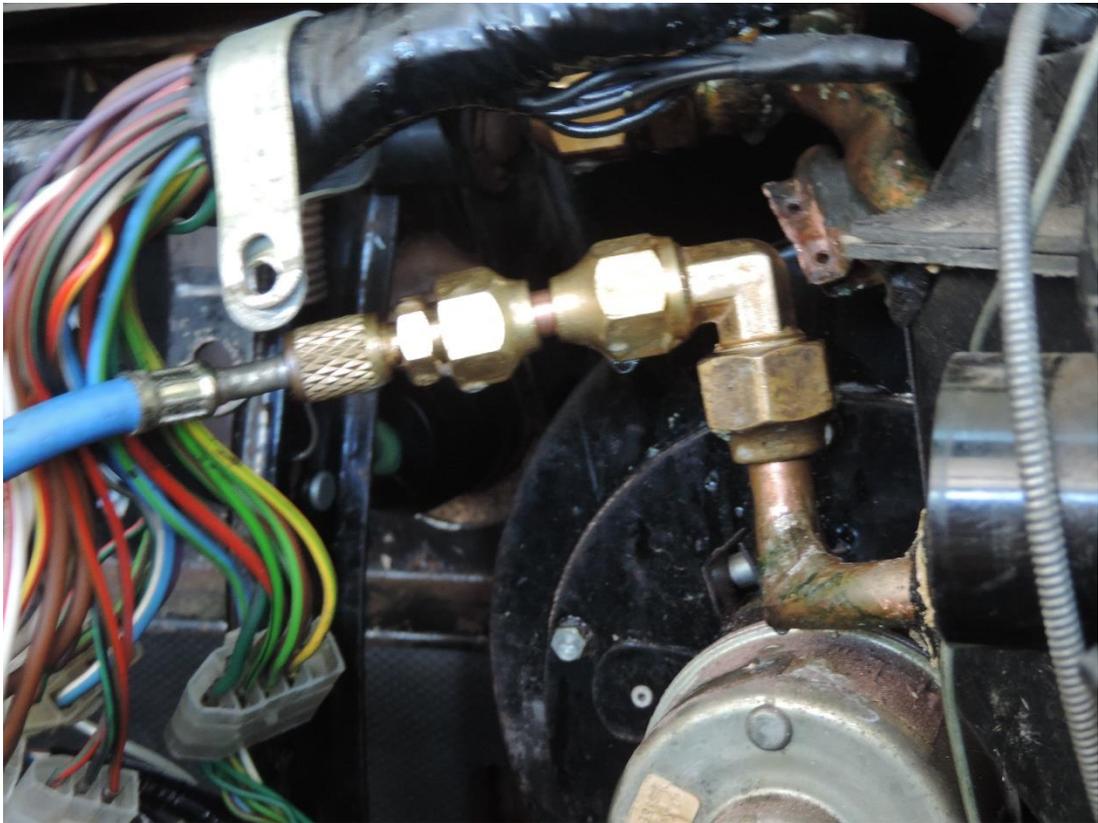
Elbow to replace the expansion valve (1/2"x1/2") ACE hardware p/n 41205

Swivel to convert 1/2" to 3/8", ACE p/n 47213

Adapter to convert 3/8" to 1/4" to blue manifold hose ACE hardware p/n 41166.

The illustrations below shows this case, expansion valve removed, test of the evaporator on its own. This is the test that, if successful guarantees a leak free evaporator.

Observe to tighten the flare side of the fittings to the correct torque. Incorrectly tightened fittings may leak and should not be confused with evaporator leaks.



Flare fittings require a lot of torque, O ring fittings are better and throughout the system we will use O ring fittings.

However, the evaporator has flare fittings, you will also need adapters to convert to O rings.

3 The Expansion valve

Expansion valve are generally trouble free but it is not possible to reliably test an expansion valve on a non-working system.

Expansion valves are cheap, price is not an issue. However, removing the expansion valve and fitting a new one requires some dexterity:

-Capillary cap is difficult to access

-Removing the two screws holding the capillary tube bulb is a pain. You may drill them out after having removed the expansion valve by cutting the capillary tube. Use some self-tapping screws when refitting.

-The insulation cork around the valve is difficult to remove and applying new cork is not easy.

-Accessing and tightening the large nut to the evaporator is difficult and lots of care is required not to damage the evaporator tubing.

So this becomes a personal decision.

Expansion valves are readily available but a word of warning here. The ones on Amazon have very long capillary tubes. There is very little room to fit and it is a bit of a struggle to fit the extra lengths comfortably. However, the expansion bulb is filled with a gas mixture specifically for R134A.

Napa sells expansion valves which are identical to the original ones, made in Germany. I suspect they are really NOS and I have no idea how many they still have in stock. I opted for those because of the shorter capillary tube. According to Siegel's book there really is not much of a difference between the two types of bulb gases.

NAPA 207356



If you want the exact gas for R134A look at Readyair 4680 or Four seasons 38725, also available from Amazon but be prepared for the hassle to coil up the capillary tubes.

4 Pressure testing notes

Required torque for fittings

□ FITTING TORQUE VALUES

TUBE SIZE	THREAD SIZE		TORQUE VALUE (FT/LB)		
	INCH	METRIC	FLARES	O-RING	METRIC
1/4"	7/16"	M12	10-15	5-10	5-10
3/8"	5/8"	M16, M18	20-25	10-15	10-20
3/8"	11/16"	M20	25-30	10-15	15-25
1/2"	3/4"	M20	35-40	15-20	15-25
5/8"	7/8"	M22, M24	50-60	20-30	20-35
3/4"	1 1/16"	M27	70-80	25-35	25-40
SWITCHES	3/8"	M10, M12	5-10	5-10	5-10

The above values are "rule of thumb" and may vary for various applications.

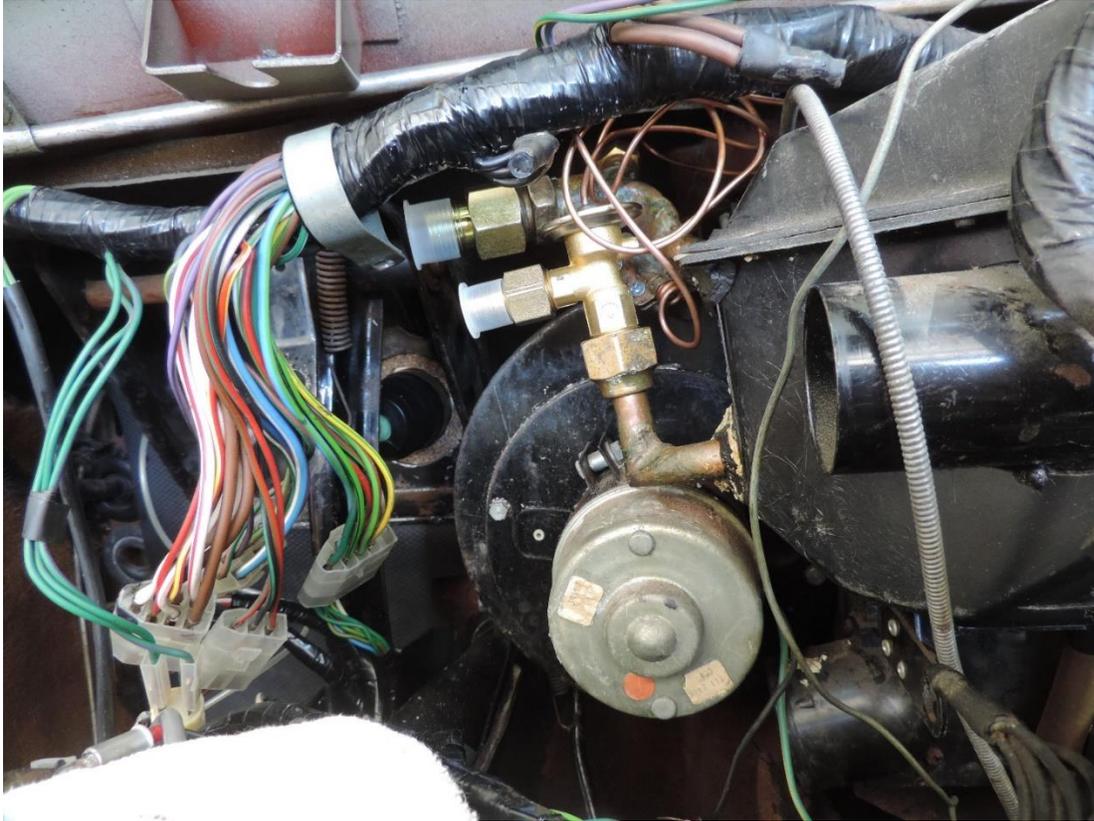
Use Nylog as mentioned in Siegel's book. Also, use copper washers on the flare fittings (F10-3101, F10-3102, F10-3103 from coldhose.com).

Leave the system under pressure for 48 hours. Even if no leaks, you will see small pressure reading differences depending on the temperature in the garage. Higher temperatures increase the pressure.

You now have the evaporator tested and leak free. It is not possible to repair a leaky evaporator unless the leak would be in the copper tubing which might be repaired by soldering.

5 Last items around the evaporator

Fit the flare to O ring adapters. Coldhose ATC2606 for #6 and ATC2609 for #10.



You have to make a final pressure test once the whole system is installed and before refitting the fascia.

Mind the tightening torque on the flares, tight is really tight although the copper washers help. Lubricate the threads and flare surface with Nylog before assembling. For O-ring fittings it should be hand tight plus 1/4 turn. Be sure to lubricate the O-ring and threads with Nylog before assembling.

6 The Condenser

Exact fit parallel flow condensers are not available for the Stag. The original condenser is 10x22”.

The closest appears to be 11x20”. The surface is thus identical, 220 sqin.

Just Google “condenser 11x20” and take your pick on what is available. Coldhose offers one, part number 44-1120.

If your existing fans still function, you can attach their frame to the new condenser and then directly to the factory condenser mounting brackets. Otherwise, you will need to make up some brackets to fit new fans to the condenser.

On two installations, one reused the old fans and the other one used new fans.

Performance wise there appears to be no difference. Power drawn is similar.

Removing the brackets holding the original fans to the car is a bit of work but totally self-explanatory

1. Using the original fans

Only 4 small brackets are required to fix the new condenser to the fans

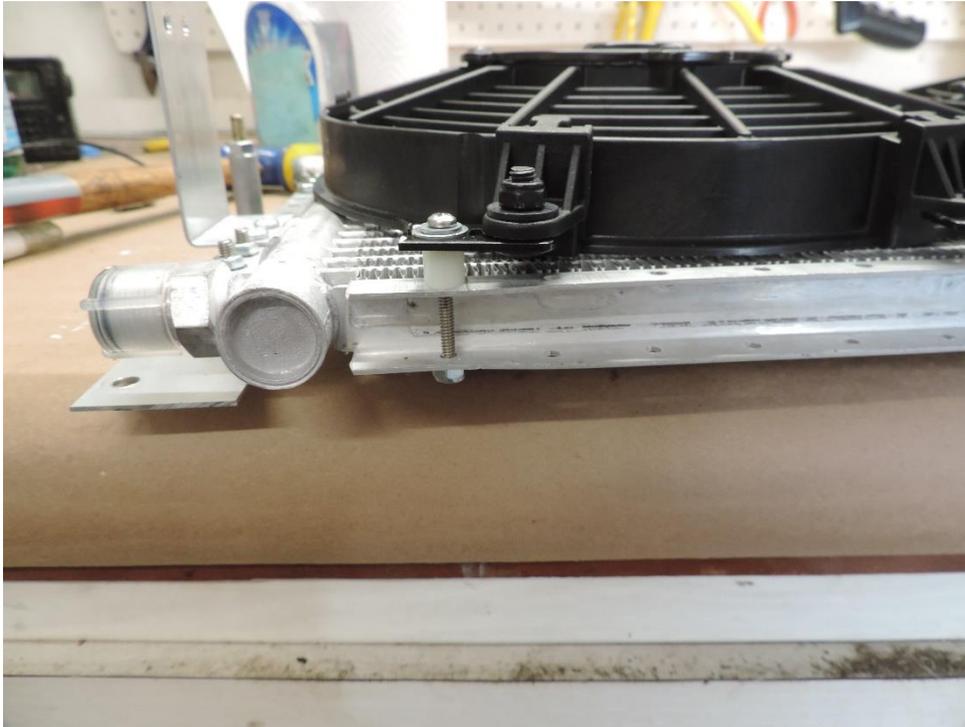


5. Using new fans

This is a far more complex installation since new brackets have to be made to fix the condenser to the original brackets.

The brackets are made using two aluminum strips, 1 foot long and 1.75" wide, 1/16" thick. The spacers are 5/16" OD, 15/16" long, for #10 screws. Readily available, McMaster-Carr is a good source.

The attached pictures illustrate how the condenser is mounted on the brackets and how the brackets are then mounted on the original LH and RH brackets in the car.



You will see the fans are slightly over the collector tubing of the condenser. Fit some nylon spacers to raise the fans slightly and make them parallel to the condenser surface.

Not visible on the picture, under the fans is a strip of this material

 **3M 08612 Windo Weld Round Ribbon Sealer, 3/8 inch x 15 ft Kit**
Brand: 3M
★★★★★ 1,109 ratings | 57 answered questions

Style: **Kit**

Size: **3/8 in x 15 ft**

Color: Factory
Brand: 3M
Item Package Quantity: 1

This closes the gap between the fan and the condenser to avoid air leakage.

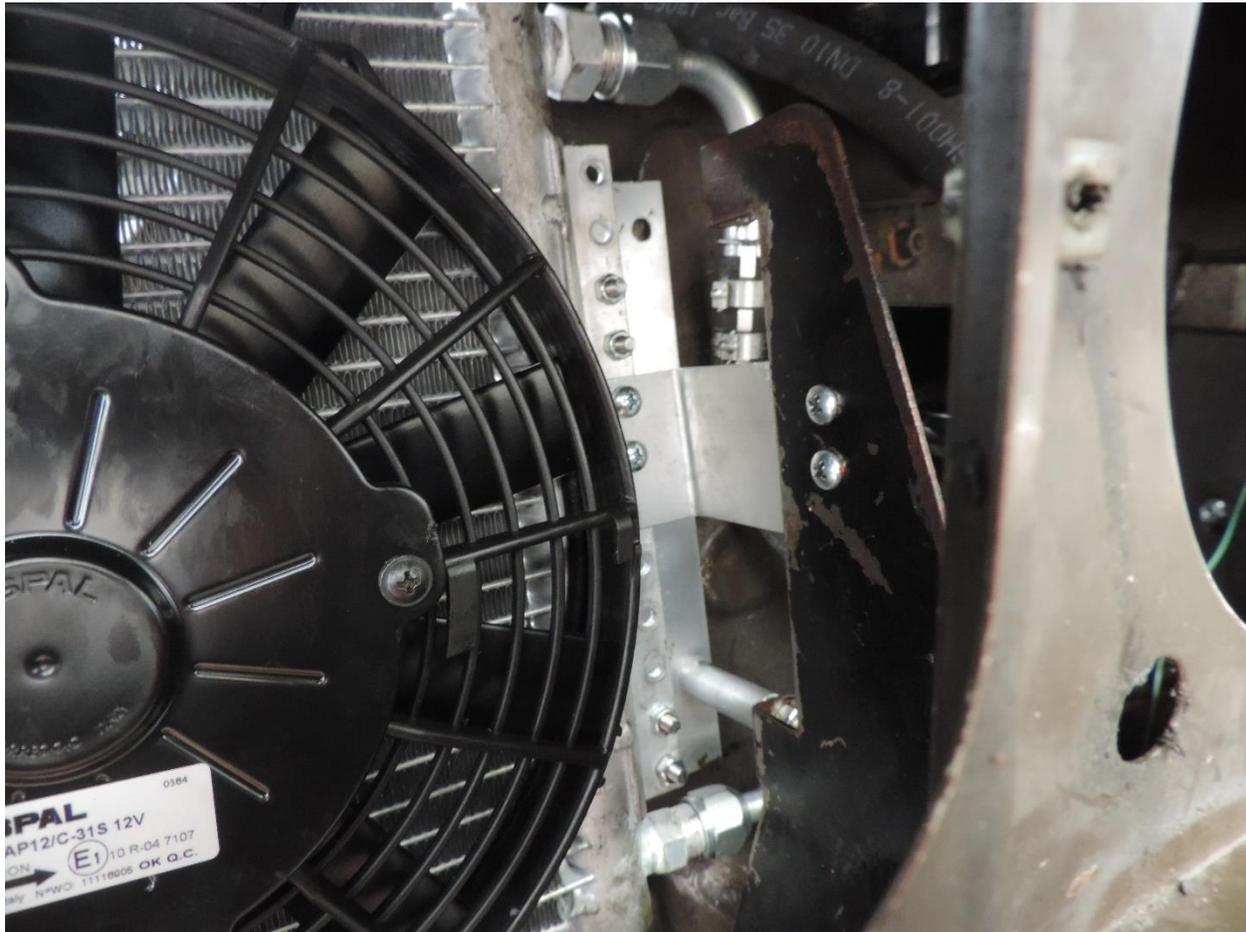


The fans are SPAL fans VA07-AP12/C-31S or 30100381, 9" diameter.

Some words of warning:

You must order the real SPAL brackets as well..

Order 8, part number 30130011 from a1electric.com. You can bend and saw the brackets to size to fit



The above photo shows the inlet and outlet fittings of the condenser. Note the outlet to the receiver is a very tight fit, just keep this in mind already. Will document this more in the section on the hoses and fittings. Do not install the Condenser yet!!

7 The Compressor

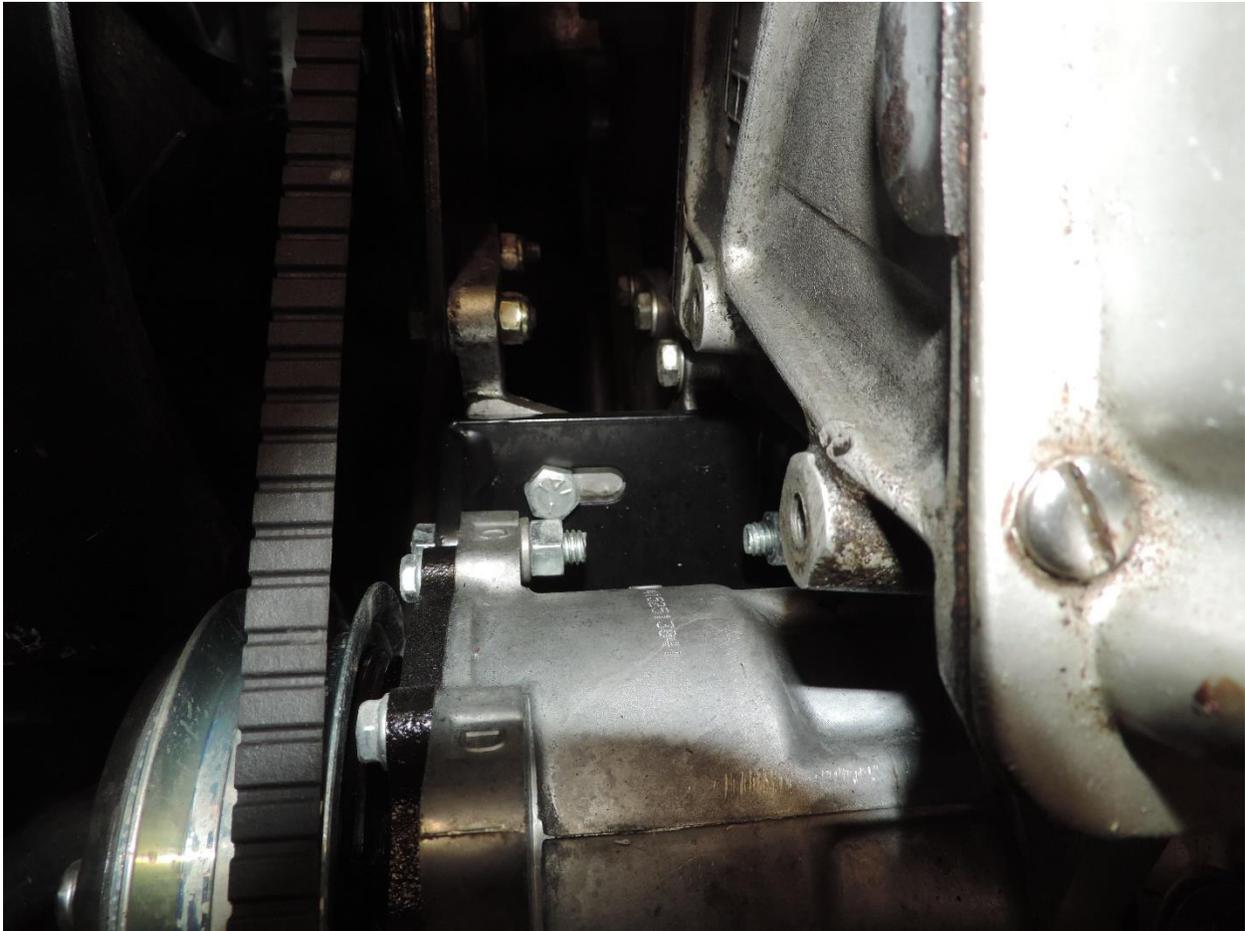
Do not reuse the York compressor, use a new Sanden compressor. Removing the overflow tank gives you more space to work.

There are many Chinese knock-offs available, but spend the extra money and buy a genuine Sanden compressor. Coldhose, part number 91-4001X. The Sanden reference is SD7H15 or 4663-6000. Beware of look-alike compressors. This one has the correct #8 and #10 O-ring fittings on top, connecting to the hose fittings in a similar way as in the original installation. To fit the compressor to the original bracket, you will need an adapter.



Just Google “York to Sanden compressor adapter”. Available from many sources

Buy from Coldhose.com and order together with the other components, saves on shipping. The bracket fits only one way.



The above picture shows how the bracket fits on the aluminum bracket and the compressor. Note the bracket is slid completely to the rear in order to align the pulleys. To achieve this you will have to cut out a notch of the bracket, about 1 ½ “long and ½” wide. Otherwise the bracket hits the engine before it can be slid completely backwards. The material is soft steel.

You will have to fit the compressor to the adapter and to the aluminum bracket with the whole assembly out of the car. Leave the bolts passing through compressor/adapter/bracket a bit loose to allow correct alignment of the pulleys. The bolts can be tightened with some short wrenches.

I found correct alignment with the compressor completely slid back. Different brackets might be slightly different, check clearly for alignment of the compressor pulley to the crankshaft pulley

After installing the compressor tighten the bolts very, very well.

8 The Receiver drier

Get rid of the Ranco unit as described in the Stag News article.

Sources, but not limited to, they are abundantly available, Coldhose 192-8257. You also need a binary switch, 119-9900.

It is easier to remove the overflow bottle, if not already removed when you fitted the compressor.

Buy second, but cheaper receiver/drier, 192-8254. This one has no switch port but will be discarded.

Reason being that you will have to build the hoses with the fittings “to measure”, cutting them to the right lengths as you go along and make a trial fit. The receiver drier cannot be left open for more than 15 minutes. Use the cheaper one to do the trial fit, check everything is OK, remove the cheaper one and quickly fit the real one, with all the other hoses already fitted and immediately pressure test the system.

9 The hoses and fittings

The original hoses and fittings were of the flare type. Replace all the hoses With O ring fittings. The flare fittings of the evaporator were converted, see the section on the evaporator.

There are various types of fittings available. Siegel recommends the Beadlock types. However, you need some expensive tools to fit the fittings to the hoses and the equipment is bulky.

Use Eaton EZ Lock fittings and Eaton GH001 reduced diameter hoses (also marketed as Aeroquip or Evercool). Less investment in tools, and the smaller diameter makes fitting easier.

You will need two tools:

-A hose cutter. Do not cut hoses with anything else than a true hose cutter. Cuts have to be clean and straight



 Gates 91153 Hand Held Hose Cutter
Brand: Gates
★★★★★ 678 ratings | 9 answered questions

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-Pliers for the Eaton fittings. Eaton offers them at a very high price. Got them from Amazon and they work perfectly at a fraction of the price. The pliers can also release the clamp by reversing the direction of the jaw, which is a nice feature if you need to reposition an angled fitting.



 Astro 9406F Hose Clamp Clic-R Collar Pliers
Visit the Astro Pneumatic Tool Store
★★★★★ 3,418 ratings

\$21¹¹

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Style: Clic-R Collar

When making/installing the hoses, lubricate the hose end of the fitting with Nylog to make insertion easier. You have to ensure the fittings are properly angled. If it is a hose with two straight fittings at each end, no worries. If only one is angled, no worries except when tightening them up, you have to tighten the angled one first, in the right direction, before tightening the straight one.

If both fittings are angled, ensure they are fitted with the correct offset angle between both sides. Only the #8 hose, from compressor discharge, high pressure to condenser, has two 90 degree fittings.

Grease the green O rings and the fitting ends lightly with Nylog before tightening.

To fit the hoses, use the following sequence:

1. #10 hose, evaporator outlet (top) to low pressure side of compressor.
Fit the straight fitting on one end of the hose, feed the end without the fitting through the top opening in the bulkhead, and tighten the evaporator end.
Loosely fit the low pressure fitting to the compressor, check length to fit, cut, fit the fitting to the open end and tighten.
2. #6 hose, evaporator inlet (bottom) to receiver drier.
Same process, straight coupling first, 90 degree next. I left a large length to clear the area where the Ranco unit was fitted. This to create room for a possible header tank installation later.
3. #8 and #6 hoses from the condenser to the receiver drier and the compressor.
Fit a 90 degree fitting to the #8 hose and a straight fitting to the #6 hose.
Alternatively you can use 90 degree fittings for both. By orienting the condenser with the #8 fitting on the bottom the bends of the flex hoses are minimalized. Tighten them to the condenser and

then feed the hoses through the holes in the front bulkhead. This is a bit of a juggle, trying to fit the condenser with the hoses and then fitting the bracket, but persevere and then cut to size and fit the other hose end.

Remember to exchange the receiver drier and pressure test immediately. Before fitting the second receiver drier, screw in the binary switch.

The next page shows all data relevant to the fittings

Instructions on how to fit the Eaton fittings can be found on their website

<https://www.eaton.com/content/dam/eaton/hydraulics/hose-tubing-fittings-and-connectors/aeroquip-performance-products/eaton-ez-clip-hose-assembly-system-brochure-eeqotbb002e-en-us.pdf>

hose size	Used for	Hose ID	Hose OD Eaton	Fitting (tube) size	torque O ring ft-lbs	length	Hose end 1	Hose end 2
#6	Condenser to receiver	5/16"	14.7 mm	3/8"	10-15	3'	90 deg, EZ1321KIT	EZ1301kit, straight or 90 deg, see parts list
#6	Receiver to evaporator, input to expansion valve via adapter	5/16"	14.7mm	3/8"	10-15	6'	90 deg, EZ1321KIT	EZ1301kit, straight
#8	Compressor (discharge) to condenser	13/32"	17.8mm	1/2"	15-20	6'	90 deg with high pressure port, EZ1322-KIT	90 deg , EZ1322KIT
#10	Evaporator output via adapter to compressor (suction)	1/2"	19.8mm	5/8"	20-30	6'	90 deg with low pressure port, EZ-1323KIT	EZ1303KIT, straight

Torque for O ring fittings achieved also by hand tight and 1/4 turn

Hoses are sold by the foot, in 3' lengths. Order #6 hose as one 9'

length

The above assumes the Flare to O ring adapters on the evaporator have been fitted with the correct flare torque

part numbers are from

coldhose.com

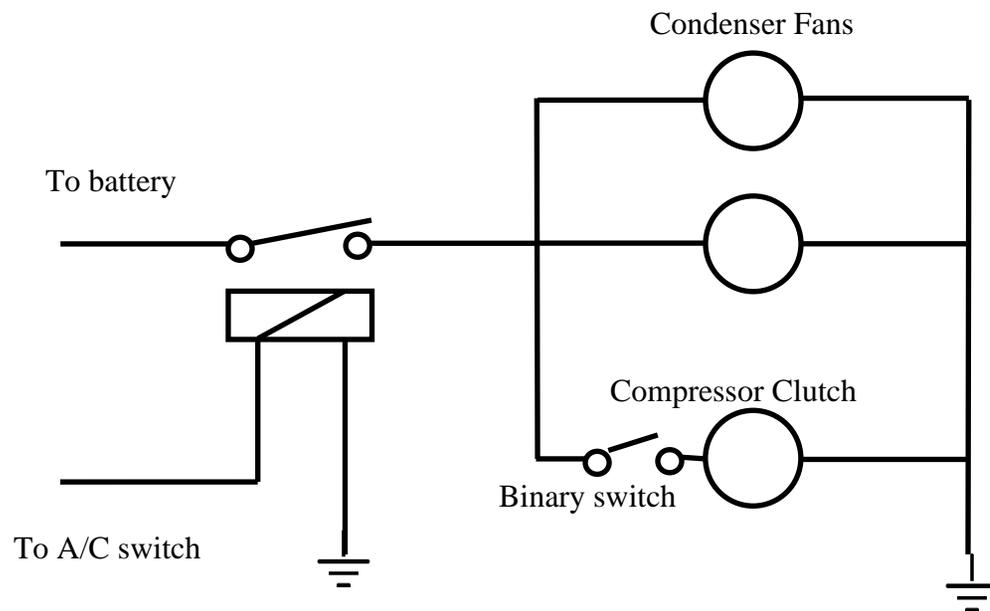
10 Electrical

Theoretically it is possible to just connect the compressor clutch and binary switch using the existing wiring. Some connector changes between the old fans and the new fans are then the only thing you have to change.

Practically speaking you really want to have full voltage available for the fans and the clutch. Lucas wiring sizes are on the marginal side. The SPAL fans draw app 5 A each and the compressor clutch app 4 A. A total of around 15 A. If the fans are not fed with full 12V voltage they will move less air. The compressor clutch requires at least 7.5 volts to operate properly. Even if you kept the old fans, running a direct feed is the best way to go.

Install a relay. Any standard 12V 30A relay will do. Feed the relay directly from the battery with a 12 gauge wire. All other wiring sizes can be 14 gauge

The diagram below is the basic layout. Please contact me if you are not familiar with electrics, will provide detailed schematic for Bosch type relays.



11 Pressure testing, evacuation and charging

Just follow the instructions in Siegel's book. They are very detailed and there is no need to reiterate.

The necessary adapters to fit to the high and low pressure ports are included in the manifold kit.

Do not skip on a pressure test of the completely installed system and definitely before replacing the fascia!!!!

Also, beware of your test equipment. If the adapters are not correctly fitted or leaky you might think there is an issue where there is none!!

You need a vacuum pump. I bought a reasonably priced one from Amazon. Just search for Vacuum Pump Automotive. You need one rated for at least 3.5 CFM and 5 Pa. Many are available.



12 Parts list

The nitrogen bottle, its filling and the nitrogen pressure reducer are not included in the list. If you cannot find an A/C shop to do the test and have to buy them, allow app an additional \$150 in the cost.

Item Description	Used For	Quan	Source	Part Number	Price Ea \$	Price Ext \$
EZ Clip Pliers	Clamp hose fittings	1	Amazon.com	Astro 9406F	14.99	14.99
Multipurpose 6061 aluminum, 1/16" thick, 12"x12"	Condenser brackets	1	Amazon.com		14.99	14.99
Spacer, aluminum, 3/8" OD, 15/16" Long, for #10 screw, 10-pack	Condenser brackets	1	Amazon.com	371510RSA	4.78	4.78
Nylog Blue sealant	Lubricating fittings	1	Amazon.com	RT201B	13.43	13.43
Manifold with gauges and hoses	Testing, charging, evacuating	1	Amazon.com	OMT 3 way	41.39	41.39
Vacuum Pump (1/4 HP 3.5CFM) and Manifold Gauge Set	Evacuation, leak detection, charging	1	Amazon.com	Vivo Home	125.99	125.99
Big Blu Microleak Detector	Leak detection	1	Amazon.com		16.39	16.39
Binary switch	Replaces Ranco unit	1	Coldhose.com	119-9900	9.99	9.99
Receiver-Drier w/switch port	Receiver-drier	1	Coldhose.com	192-8257	22.99	22.99
Condenser, Parallel Flow 11x20	Top discharge #8, Bottom inlet #6	1	Coldhose.com	44-1120	80.00	80.00
Compressor, Sanden model SD7H15, double v-belt pulley, 4 amps	Discharge #8, Suction #10	1	Coldhose.com	91-4001X	299.99	299.99
#6 Flare to O-ring adapter	Expansion valve	1	Coldhose.com	ATC2606	2.72	2.72
#10 Flare to O-ring adapter	Evaporator outlet	1	Coldhose.com	ATC2609	5.35	5.35
#6 End fitting #2 straight	Expansion valve inlet	1	Coldhose.com	EZ1301KIT	14.35	14.35
#10 End fitting #2 straight	Evaporator outlet	1	Coldhose.com	EZ1303KIT	20.16	20.16
#6 End fitting #2 90 degree (see note)	Condenser outlet	1	Coldhose.com	EZ1321KIT	19.62	19.62
#6 End fitting #1 90 degree	Receiver/Drier inlet	1	Coldhose.com	EZ1321KIT	19.62	19.62
#6 End fitting #1 90 degree	Receiver/Drier outlet	1	Coldhose.com	EZ1321KIT	19.62	19.62
#8 End fitting #1 90 degree with service port	Compressor discharge	1	Coldhose.com	EZ1322-3KIT	40.47	40.47
#8 End fitting #2 90 degree	Condenser inlet	1	Coldhose.com	EZ1322KIT	23.00	23.00
#10 End fitting #1 90 degree with service port	Compressor suction	1	Coldhose.com	EZ1323-3KIT	35.77	35.77
#6 Copper flared sealing washer	Expansion valve	1	Coldhose.com	F10-3101	1.29	1.29
#8 Copper flares sealing washer	Expansion valve	1	Coldhose.com	F10-3102	1.29	1.29
#10 Copper flared sealing washer	Evaporator outlet	1	Coldhose.com	F10-3103	1.29	1.29
Cork tape, 30 feet	Insulation of expansion valve and lines	1	Coldhose.com	MT0450	25.99	25.99
Hose cutter	Hoses to length	1	Coldhose.com	MT1033	19.99	19.99
#10 Aeroquip Hose	Evaporator to Compressor suction	6	Coldhose.com	EBH10	7.31	43.86
#6 Aeroquip Hose	Condenser to Receiver/Drier	3	Coldhose.com	EBH6	5.08	15.24
#6 Aeroquip Hose	Receiver/Drier to Expansion Valve	6	Coldhose.com	EBH6	5.08	30.48
#8 Aeroquip Hose	Compressor discharge to Condenser	6	Coldhose.com	EBH8	6.53	39.18
O-ring assortment	Needed for the hose fittings	1	Coldhose.com	O-6125	1.99	1.99
Bulkhead grommet	Bulkhead and firewall	4	Coldhose.com	G101	1.05	4.20
York to Sanden conversion bracket	Engine	1	Coldhose.com	2400	64.99	64.99
Cap for capillary 1/4"	Evaporator testing	1	Acehardware.com	47196	3.59	3.59
Cap for #10	Evaporator testing	1	Acehardware.com	41209	1.79	1.79
Elbow 1/2x1/2	Evaporator testing	1	Acehardware.com	41205	6.49	6.49
Swivel 1/2x3/8	Evaporator testing	1	Acehardware.com	47213	9.99	9.99
adapter 3/8x1/4	Evaporator testing	1	Acehardware.com	41166	3.59	3.59

Options and alternatives						
Condenser Fan, pusher, 9 inch, CFM530, 80 watts (6.7 amps)		2	Coldhose.com	CF0009	30.99	61.98
OR						
Condenser Fan, pusher, 9 inch, SPAL, CFM590, 78 watts (6.5 amps)		2	a1electric.com	30130010	88.56	177.12
Bracket and strap kit, SPAL fan		2	a1electric.com	30130011	18.66	37.32
Expansion Valve	Evaporator	1	Napa.com	TEM 207356	32.99	32.99
Aluminum strip 1/16x13/4x1 foot	Condenser Mounting brackets	2	McMaster-Carr	8975K204	3.17	6.34

Note:

For the # 6 fitting from the condenser outlet you can opt for either a straight connection or a 90 degree connection. Using a 90 degree fitting and inverting the condenser simplifies the routing of the hoses.

Using a straight connection, delete one 90 degree fitting and add one straight fitting

Disclaimer:

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