DENSO

Practical tips on AC service and compressor replacement

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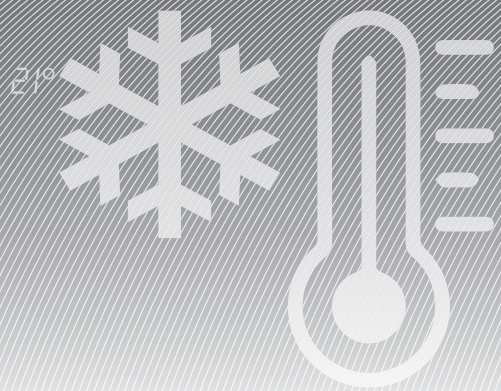
Driven by Quality



Content

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7 steps of AC Repair

A thorough air-conditioning service will take between 45 minutes and one hour and should comprise at least these 7 basic steps:

STEP 1 - When receiving the car from your customer the first and very important step is to confirm operation and performance of the air conditioning system. Clarify the date and scope of the last maintenance and confirm whether there are any complaints or problems such as noticeable decrease in performance, noise or bad smell in the interior. Check A/C cooling performance by measuring the air outlet temperature in order to have a precise reference value for later when performing the final check.

STEP 2 - Identify the refrigerant inside the system. 'Drop in' or imitation refrigerants can easily reduce performance and damage the system components, such as your compressor.

STEP 3 - Identify the quality of the refrigerant and oil. Many times improper oils are used and improper or too much UV leak detection fluid is used. This does reduce lifetime of your compressor and is one of the main reasons why compressors fail. Moreover, check if there is water or other contaminants in your refrigerant.

STEP 4 - Check if the vehicle is equipped with an interior filter and if this filter needs replacement. When an interior filter is not replaced in time, the airflow going into your interior is reduced and in some severe cases even blocked. Not only cooling performance will reduce, but also the air flow resistance increases the load on the blower motor and thereby reducing the life expectancy of the blower motor or causing damage to the blower motor speed controller.

STEP 5 - Check for refrigerant leakage. As there is not one perfect method for leak test best practice is to combine two or thre different methods. You can use an electronic gas leak detector, an UV leak detector (light + goggles) or specific leak detection equipment consisting of special electronic detector and special gas (nitrogen/hydrogen).

STEP 6 - Check the state of the system parts. Check parts, hoses and connections if there is any damage, such as stone hitting, corrosion or dirt. Not only check the outside surface, but more important, check between the condenser and radiator. When vehicles get older dirt accumulates between condenser and radiator and restricts air flow. This will increase condensing pressure and reduce lifetime of hoses and compressor.

STEP 7 - Test air-conditioning system for proper operation. When checking the system operation, you not only test performance, but also check for noise, operation of condenser fan and air flow, air mixing (heating and cooling) and a bad smell in the interior when in A/C mode.

Equipment and tools necessary for A/C maintenance:

1. Sight glass: used to determine refrigerant and oil quality. A sample is taken from the air-conditioning system, which gives a clear view if there is any contamination or too much UV dye or wrong oil.

2. Leak detection: using UV leak dye and UV leak detector (light + goggles) only is not sufficient. The UV detection dye is mixed with oil which means the leak must be big enough to leak oil as well, therefore it is not possible to detect all leaks and additional gas leak detection is necessary e.g. through the hydrogen method with electronic gas leak detector and forming gas.

3. Thermometer: preferable with 2 probes for measuring DeltaT and with the possibility to connect tube clamp for measuring tube temperatures.

4. PWM signal generator: variable compressors are many times controlled using an electronic valve. This valve is operated using a PWM signal. To simulate this signal and check operation and maximum performance of the compressor a signal simulator is necessary.

5. Flushing equipment (separate unit, not included in the automatic filling station!): variable compressors are many times controlled using an electronic valve. This valve is operated using a PWM signal. To simulate this signal and check operation and maximum performance of the compressor a signal simulator is necessary.

6. Oil and UV injection kits: for each type of oil and UV dye, a separate injection kit is necessary to charge oil to the system.

7. A/C service station: the type of charging equipment depends on user preference. You can choose automatic, semi-automatic or manual equipment, for performance it does not matter which you choose. If you are well experienced manual equipment is the best choice to make. More important than the type of equipment is regular maintenance and calibration, which are highly sensitive to contamination.

INVESTMENT IN A/C SERVICE EQUIPMENT PAYS OFF!

As an expert in Air-Conditioning, DENSO recognises that the investment needed to carry out effective service and repair is not only essential but also at considerable cost. All your equipment needs maintenance and some calibration. Yes, this will cost money but it will deliver a return on investment. It is estimated that no maintenance or calibration of tools and equipment results in approximately fifteen percent of all air conditioning system failures. These type of failures are not covered under warranty by any of your suppliers and therefore end up on your own expense

Sight glass analysis will help you diagnose the failure:

Refrigerant R134a
mixed with
- DENSO ND8 (PAG46)

Clear mixture with slight streaks.

Refrigerant R134a
mixed with
- DENSO ND8 (PAG46)
- UV Leak Dye

All liquids are mixed with each other.

Refrigerant R134a
mixed with
- Universal Oil (PAO68)

Clear liquids that do not mix with each other.

Refrigerant R134a
mixed with
- DENSO ND8 (PAG46)
- Universal Oil (PAO68)

R134a and PAG46 Oil are mixed. PAO68 Oil floats on top. Slight milky appearance.

Refrigerant R134a
mixed with
- DENSO ND8 (PAG46)
- DENSO ND11
(POE-Insulating Oil)

All liquids are mixed with each other. Slight milky appearance.

Refrigerant R134a
mixed with
- DENSO ND8 (PAG46)
- UV Leak Dye
- Universal Oil (PAO68)

R134a, PAG46 Oil and UV leak dye are mixed. PAO68 Oil floats on top. Slight milky/coloured appearance.

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2

Compressor Failure Analysis

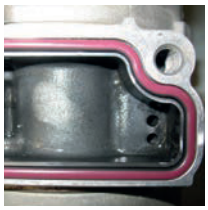
To determine which repair procedure to use, first check how clean the refrigeration circuit is. After removing the defective compressor, check the intake opening, outlet opening and outlet hose. Depending on the situation found, use procedure 1, 2, 3 or 4.

Contamination due to wear particles

The suction port of is dirty and black

Problem description: No variable displacement or compressor seizure.
Cause of failure: Insufficient cleaning of refrigerant cycle and/or not all required parts replaced.
Resulting in: Dirt particles travel through the system and re-enter the compressor resulting in bad lubrication or clogged control valve.

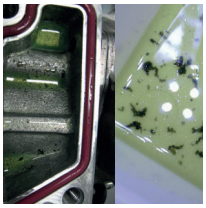
REPAIR PROCEDURE 3



Discharge port is black and discolored

Problem description: No variable displacement or compressor seizure.
Cause of failure: Low refrigerant amount or partially blocked refrigerant cycle.
Resulting in: Insufficient oil return resulting in bad lubrication and overheating of the compressor.

REPAIR PROCEDURE 2



Rubber particles at suction and discharge port

Problem description: No variable displacement or compressor seizure.
Cause of failure: Deterioration of rubber hose due to ageing of or a reaction with conditioners, sealers or flushing agents.
Resulting in: Rubber material travels through the refrigerant cycle resulting in blockage and compressor failure.

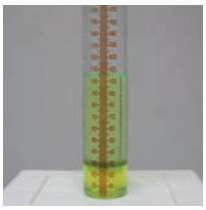
REPAIR PROCEDURE 3

Mechanical wear (metallic)

Problem description: No variable displacement, system blocked or compressor seized.
Cause of failure: PAO oil has been filled into the refrigerant circuit. PAG oil and PAO oil do not mix, a paraffin-like substance forms.
Resulting in: Blockage of the compressor control valve or the refrigerant circuit.

REPAIR PROCEDURE 3

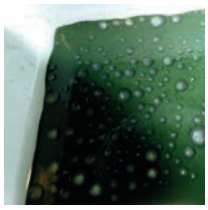
Contamination due to too much or incorrect compressor oil, refrigerant, leak stop or other additives:



Clear separation of two different oil substances; one transparent and the other not

Problem description: No variable displacement, system blockage or compressor seizure
Cause of failure: PAO oil added to the refrigerant cycle. ND-oils and PAO oil do not mix and will cause creation of paraffin like substance.
Resulting in: Clogging of control valve and/or refrigerant cycle.

REPAIR PROCEDURE 2



Clear separation of two different oil liquids; one is forming droplets on the other

Problem description: Excessive noise and/or compressor seizure.
Cause of failure: POE oil added to the refrigerant cycle. ND-oil 8 & ND-oil 12 do not mix properly with ND-oil 11.
Resulting in: A high percentage of POE will reduce lubrication performance.

REPAIR PROCEDURE 2

Rubber seals are swollen and do not fit in the original position

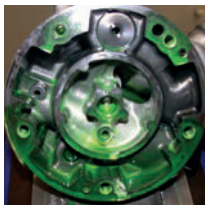
Problem description: No variable displacement and/or system leakage.
Cause of failure: a) The system was charged with the wrong type of refrigerant.
b) Additives (conditioners) or wrong type flushing agents were used.
Resulting in: The refrigerant, oil, additive or flushing agent resulted in swelling of the rubber seals.

REPAIR PROCEDURE 2 + new O-rings

A hardened or a gel like substance inside the oil or suction port

Problem description: No variable displacement, system blockage or compressor seizure.
Cause of failure: Leak stop additive or conditioner added to the refrigerant cycle.
Resulting in: 1) No oil return and no lubrication of inner parts.
2) Excessive engine rpm at first time of operation provides insufficient time for oil and refrigerant to mix before returning to the compressor.

REPAIR PROCEDURE 2 + new O-rings



Too much or poor UV dye

Problem description: Insufficient power, compressor is noisy, compressor is seized up.
Cause of failure: Too much UV dye or poor quality UV dye. In principle, only a maximum of 5% of the total oil quantity of UV dye that complies with SAE J2297 should be added.
Resulting in: Liquid hammer with too much UV dye or insufficient lubrication with poor quality.

REPAIR PROCEDURE 2

Liquid hammer

Problem description: Lack of power, compressor is making noises, compressor is seized.
Cause of failure: Too much compressor oil or refrigerant in the air conditioning system due to incorrect filling leads to liquid hammer.
Resulting in: Valve and swash plate are damaged in the compressor.

REPAIR PROCEDURE 2

Defect on the pulley:

Broken hub limiter of the DL-Pulley

Problem description: No compressor operation.
Cause of failure: a) Too high internal friction or complete seizure.
b) Liquid lock.
c) Alternator free run pulley seized, broken belt tensioner, crankshaft damper or dual mass flywheel.
Resulting in: a+b) For safety reasons the limiter of the pulley hub will break instead of drive belt.
c) Excessive drive belt movement results in negative force to the compressor pulley.

a+b) **REPAIR PROCEDURE 2**
c) **REPAIR PROCEDURE 1**

Cracked or shattered plastic pulley

Problem description: Drive belt noise or drive belt disengaged.
Cause of failure: a) Incorrect removal or installation of the drive belt.
b) Hitting of the DL-pulley before or after installation.
Resulting in: Excessive force was applied to the pulley resulting in cracks or shattering of the pulley.

REPAIR PROCEDURE 1

Other failures:

Compressor seizure

Problem description: Drive belt noise or drive belt disengaged.
Cause of failure: Insufficient lubrication caused by system blockage or no run in procedure.
Resulting in: a) No oil return and no lubrication of inner parts.
b) Excessive engine rpm at first time of operation provides insufficient time for oil and refrigerant to mix before returning to the compressor.

REPAIR PROCEDURE 2

Flushing the refrigerant cycle:

The long service life of a compressor is only guaranteed if the correct amount of oil recommended by DENSO is in the system.
In the case of contamination by foreign oil or additives, e.g. the wrong or too much UV dye, the refrigeration circuit must be flushed before new parts are installed. If there are leak stop, imitation refrigerants or heavy contamination, flushing is no longer sufficient and the entire system must be replaced. When flushing the refrigeration cycle, we recommend the use of a flushing device with refrigerant. The use of of an air conditioning service station is not recommended. Flushing is required under the following conditions:
1. too much oil or incorrect oil type.
2. too much or unauthorised UV dye.
3. unclear how much oil remains in the refrigeration circuit.
4. oil additives (flushing is NOT possible with leak stop). All parts must be replaced!
5. dirt in the refrigeration cycle, e.g. black residue. (In case of heavy contamination, flushing is not possible and all parts must be must be replaced).

Run-in procedure:

After installing a new compressor, it is important to observe the running-in procedure described below. The purpose of this is to distribute the This is to distribute the compressor oil and start lubrication in order to prevent damage immediately after installation.
1. set the temperature to max. cooling.
2. switch the fan to maximum speed
3 Start the engine and keep the engine speed at idle.
4. switch on the air conditioning for at least 5 minutes. DO NOT INCREASE THE ENGINE SPEED!
5. after 5 minutes, the compressor oil, which is initially only in the compressor, will have spread throughout the system.
The engine speed can now be safely increased and the air conditioning system tested.

Repair procedures:

REPAIR PROCEDURE 1: Flushing is not necessary ' Remove excess oil from the new compressor.
> *Condition:* The system is clean, the correct type of oil is in the circuit, the correct amount and type of UV leak dye is used and there are no other additives in the refrigeration circuit.
> *Installation instructions:* See the spare parts table to find out which parts need to be replaced.
Use the following calculation to determine the amount of oil to be removed from the compressor.
A = Total amount of oil from new compressor.
B = Quantity of oil drained from old compressor.
C = Quantity to be removed from the new compressor.
Formula for calculating the amount of oil to be removed from the new compressor: A-B=C

REPAIR PROCEDURE 2: Flushing is required to remove excess or incorrect oil or unauthorised additives.
> *Condition:* Incorrect oil or additives detected, the refrigerant circuit is clean, no black particles or metal particles detected.
> *Installation instructions:* Refer to the spare parts table to find out which parts need to be replaced. Do not remove any oil from the new compressor. Refer to the vehicle manufacturer's specifications to determine whether oil needs to be added (for some applications, e.g. one/two-evaporator circuits, may be necessary).

REPAIR PROCEDURE 3: Flushing is required to remove dirt; black particles have been found.
> *Condition:* Black particles are found in the cooling circuit.
> *Installation instructions:* Refer to the spare parts table to find out which parts need to be replaced. Clean the remaining parts of the refrigeration circuit by flushing. Do not remove any oil from the new compressor. Refer to the car manufacturer's specifications to determine whether oil needs to be added (may be necessary for some applications, e.g. one/two-evaporator circuits).

REPAIR PROCEDURE 4: Flushing is not possible; replace all parts of the refrigeration circuit.
> *Condition:* Black sludge and metal particles are found in the refrigeration circuit, leak stop is found in the refrigeration cycle.
> *Installation instructions:* Replace all parts. It is not possible to clean the refrigeration cycle. Do not remove any oil from the new compressor. Refer to the vehicle manufacturer's specifications to determine whether oil needs to be added (for some applications, e.g. one/two evaporator circuits, may be necessary).

Spare parts table for compressor replacement / instructions for flushing				
Parts to be replaced	Repair procedure			
	Procedure 1	Procedure 2	Procedure 3	Procedure 4
O-Ring Set	o	o	o	o
Receiver drier	o	o	o	o
Dryer cartridge	o	o	o	o
Accumulator tank	o	o	o	o
Compressor	o	o	o	o
Expansion Valve			o	o
Orifice tube			o	o
Condenser			o	o
Discharge hose			o	o
Suction hose				o
All Tubes				o
Evaporator				o
Flushing	not needed	needed	needed	not possible

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3

Compressor oil: all you need to know

All DENSO A/C Compressors are delivered as complete assemblies, pre-filled with the correct type of compressor oil.

The purpose of compressor oil is to lubricate and cool the moving parts of the compressor. The oil film also protects the rubber seals in refrigerant lines and connections reducing the amount of refrigerant leaking out. However, there are huge differences in compressor oil types and quality. To guarantee proper oil circulation in the refrigerant cycle, the compressor oil has to be pressure and temperature resistant in all operating conditions. Garages should only fill the compressor with refrigerator oil approved by either the car or compressor manufacturer, and should also avoid using universal or multi-grade oils.

Beware of Universal Oil!

Insufficient lubrication due to universal oil is the second most common reason for A/C compressor failure

Analysis of DENSO A/C Compressor warranty claims show that in a quarter of all cases garages did not use the correct PAG-oil that is needed for DENSO Compressors. The use of incorrect oils, such as universal oils or oil mixtures, inevitably leads to seizure and damage. This is because universal oils, often preferred by garages, are PAO-oils or mineral oils with a different viscosity to that of synthetic PAG-oils. PAO-oils do not mix well with PAG-oils and with refrigerant R134a or R1234yf, leading to poor lubrication and increased wear. Furthermore, the different viscosities cause a thinner oil film to form between the cylinder and piston, leading to seizure or the reduction in the life expectancy of the compressor. To identify the correct oil type always refer to the compressor identification label, either attached to the rear or side of the compressor. The new label will also display the amount of oil inside the new compressor. In some cases this can be differ from the vehicle specifications! Therefore always check car manufacturer data.

Ensure the correct amount of oil is used

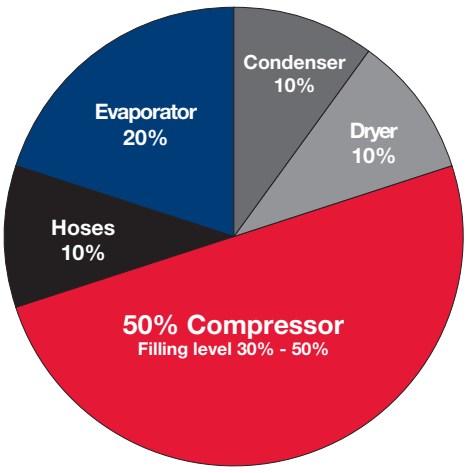
Essential action when removing a compressor:

1. After recovery of refrigerant: When removing refrigerant, some compressor oil will be mixed with the refrigerant and will be removed from the refrigerant circuit together with the refrigerant. It is essential that this oil is drained off at the A/C service station and its volume measured precisely. The volume drained need to be charged to the refrigerant cycle when refilling with refrigerant.

2. After removal of the old compressor: Drain the oil from the compressor and measure the amount. Check the compressor installation guide for the appropriate oil drain procedure.

Caution! Between 30-50% of the total oil quantity should be drained. Otherwise, the system could be overcharged from refilling with too much compressor oil or UV leak dye during A/C service. 3 to 5cc of UV leak dye is tolerated for systems up to 1000 gram of refrigerant!

Oil distribution within the A/C system (reference values, varying depending on outside temperature and engine load).



For more information: www.denso-am.eu

Compressor installation tips:

All DENSO A/C Compressors are complete assemblies, pre-filled with the right type of compressor oil.

1. If the system has been flushed: Original DENSO Compressors which are delivered with the correct amount of oil can be installed directly. Turn the compressor systematically by hand to distribute oil evenly. This will avoid damage when the compressor starts moving or during start-up.

2. If flushing of the system is NOT required: Use the following calculation to confirm the correct amount of oil to remove from the new DENSO A/C Compressor.

Calculation to confirm the correct amount of oil: A – B = C
A = Total oil amount in new DENSO compressor
B = Amount of oil drained fromthe old compressor
C = Amount of oil to remove fromnewcompressor

Calculation example:
The total amount of oil in the new compressor (A) is 120 cm³. The oil amount drained from the old compressor (B) is 50 cm³. The amount of oil to remove (C) from the new compressor is A-B, 120-50= 70 cm³.

	A	120 cm³ (Oil level in new compressor)
-	B	50 cm³ (Amount of oil drained from the old compressor)
=	C	70 cm³ (Amount of oil to remove from new compressor)

3. For some applications it is necessary to add oil. For example, where there is one and the same part number for Single and Dual evaporator cycles or when the oil quantity of the new compressor differs from the vehicle specifications. If this is the case, always check the car manufacturer data to confirm the correct oil amount. Never add oil directly into the compressor, always add it to the condenser, receiver dryer or second evaporator cycle.

What you need to know about DENSO compressor oils!

Part 3 Storage & Handling

In the first publication we have explained the basic differences between DENSO ND-oils and (ordinary) PAG oils. In the second part we have more deeply explained the properties of ND-oils against ordinary PAG oils and in this bulletin we explain how to store and handle the Denso ND oils.

This time we will also include ND-oil 11, which is used in the DENSO electric driven Scroll compressors.

DND08250	DND12250	DND11250
ND-OIL 8 R134A	ND-OIL 12 R134A & R1234YF	ND-OIL 11 R134A & R1234YF
		

ND-oil 11

ND-oil 11 is a so called Polyol Ester Oil. (POE oil) ND-oil 11 is used in the DENSO electric driven scroll compressors, because POE oils have a very high isolation resistance. POE oil is less hygroscopic, compared with PAG oils. However, POE- and PAG oil react differently on water ingress. PAGs are hygroscopic and therefore absorb water from their environment, and they have high water saturation points. Hence this ingressed water hydrogen bonds directly to the PAG molecules without causing a chemical reaction. This hydrogen-bonding prevents water from freely existing in the system and reacting with system components, so the bonded water molecules will not contribute to problems such as metal corrosion. The same cannot be said of POEs. As water inevitably ingresses into the system, POEs are likely to undergo a reverse esterification reaction, like any other ester. This reverse esterification reduces the POE back into its constituent acidic and alcoholic components, which then go on to attack metallic and rubber components, causing corrosion. Furthermore, these contaminants are particularly disadvantageous in new R1234yf systems because of the instability of the refrigerant. The alcoholic and, most notably, the acidic contaminants further chemically destabilize the R1234yf in the system, with predictable consequences to system stability and lifespan.

Storage

Denso ND-oils are only sold in steel cans, with steel caps, to prevent moisture ingress. ND-oils needs to be stored in a dry place. Immediately close the cans after use, to reduce moisture ingress to a minimum.

Shelf life

Compressor oils in general have a limited shelf live. The shelf life for DENSO ND-oils is:

SHELF LIFE: 36 MONTHS

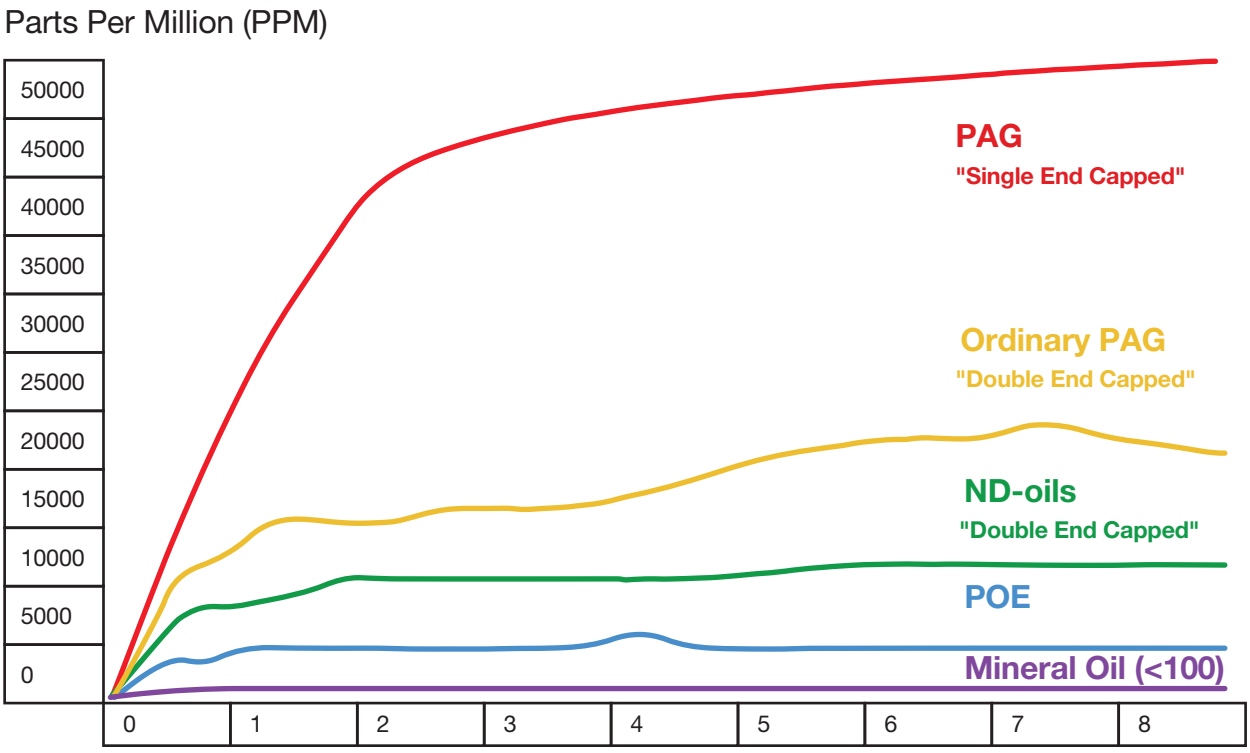
SHELF LIFE: 36 MONTHS

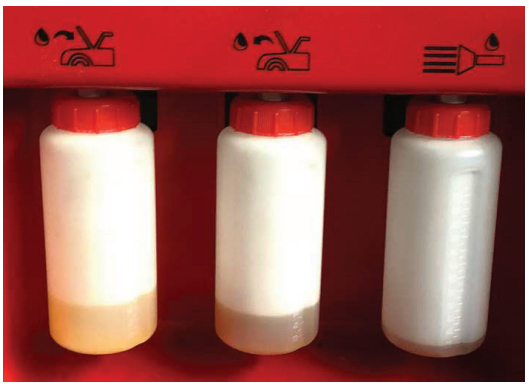
SHELF LIFE: 36 MONTHS

Expiry date is printed on the label of the cans

Production code is printed on the bottom of the cans

Hygroscopicity



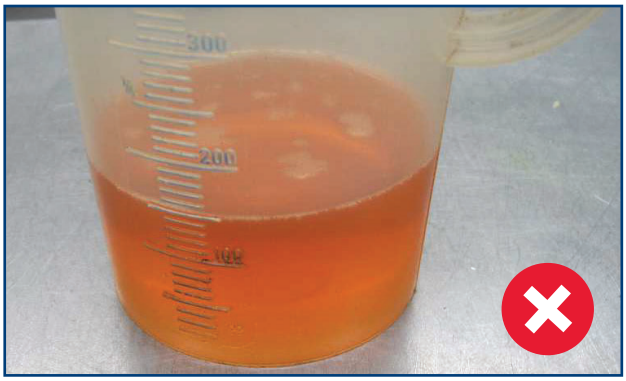


Ordinary filling bar

Most A/C refilling machines are using plastic bottles for fresh oil, old oil and UV-Dye. The problem is that most of those plastic bottles have a connection to the open air, which causes the oil to absorb moisture and age faster. In the diagram you can clearly see what the effect is on the moisture content of the oils after .. days. The maximum moisture content is 800 ppm.

Handling the oils

ND-oil: Clear & Transparent



ND-oil: saturated with moisture

To keep the moisture level as low as possible, it is important to refresh the oil on a daily basis and clean the fresh oil container thoroughly, before adding new oil. The oil film inside the fresh oil container contains a lot of moisture, so cleaning before topping up is important. Compressor oil which looks like brandy is saturated with moisture. When the refilling machine is “parked” in the corner of the workshop, after the A/C season is finished, don’t forget to empty and clean the oil bottles.

Oil type?

Oil type?

Another important thing is that in many cases there is no indication of which type of oil is used in the plastic bottle for fresh oil. This easily can lead to mistakes with filling oil in the A/C system. Especially when hybrid or electric vehicles are also serviced with the same machine.

Copper plating

Copper plating is a condition in which metal parts in the compressor become coated / plated with copper. This condition is often observed in compressors which have a high moisture content in the A/C system.

One possible cause of copper plating is that as moisture (water) combines with the refrigerant, it forms an acidic solution; this chemical may then dissolve or leach copper from other components in the A/C system which are copper or contain copper-based alloys such as brass or bronze. The method by which the copper is deposited on metallic parts of the compressor (i.e. Races, Bearings, Centering ball, Fixed gear etc) is not known for certain, but this occurrence would have to be facilitated by the circulation of refrigerant, oil and moisture in the A/C system. Although copper plating alone does not cause a specific failure of the compressor, the conditions under which it is likely to occur are very detrimental to compressor durability.

Moisture Contamination occurs as a result of moisture being allowed to enter and remain in the A/C System. This condition can be caused by the following:

> System leaks
> Improper Vacuuming of A/C system
> Contaminated system components
> Contaminated refrigerant and / or oil
> Use of cheap imitation oils
> Saturated or malfunctioning receiver dryer

Copper and / or brass A/C components, like evaporators and tubing can mainly be found in bus or agricultural applications.

Conclusion

After reading this bulletin, you could have the impression that ND-oil 11 (POE oil) is of a lower quality then ND-oil 8 and ND-oil 12 (PAG oil). This is certainly not the case. All three oil types meets the high quality requirements of DENSO. As explained earlier, a POE oil is used for his high insolation property, because the electric motor of the E-compressor is cooled with a mix of refrigerant and (POE) oil. Moisture ingress will greatly reduce this high insolation property of the oil. For this reason a POE oil requires even a better care during storage and handling then their stablemates ND-oil 8 & ND-oil 12. In particular in combination with R1234yf type refrigerant as this type of refrigerant is less chemical stable.

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5

Compressor oils and refrigerants

Mixing old and new

> Since 1 January 2017, all new produced vehicles reaching Europe, are equipped with R1234yf refrigerant. This also meant a change in compressor oil. DENSO's A/C experts explain which mixtures will work and how to avoid causing costly damage by using incorrect oils.

New requirements

R1234yf type refrigerant was introduced in January 2017 for all new produced vehicles with destination Europe. These vehicles will now be seen more and more in the independent after market, so it is key the independent workshops are aware of the differences in compressor oils between R134a & R1234yf.

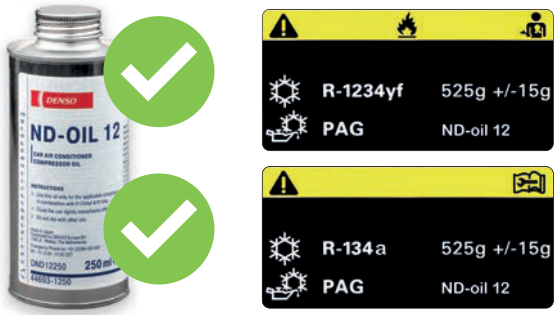
In with the new

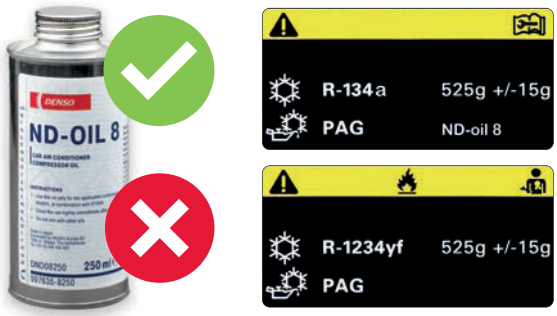
DENSO uses ND-oil 8 for its R134a type refrigerant compressors, a PAG 46 oil. The new refrigerant type uses ND-oil 12, also a PAG 46 oil but with additives specifically for the R1234yf type refrigerant.

However, this doesn't mean the two oils are interchangeable; while ND-oil 12 can be used for both R134a and R1234yf, it doesn't work the other way around and ND-oil 8 cannot be used for R1234yf type refrigerant.

It can get confusing with the number of different compressors, each with a specific DENSO oil. To clear this up, there is an overview of different types of DENSO oils for R134a and R1234yf type refrigerants which are available to the aftermarket on the following page.

ND-OIL 8, 250CC	ND-OIL 11, 250CC	ND-OIL 12, 250CC
DENSO P/N DND08250	DENSO P/N DND11250	DENSO P/N DND12250
Available in 250 ml	Erhältlich im 250ml-Gebinde	Available in 250 ml
		
PAG 46-Öl für R134a	POE oil for R134a & R1234yf	PAG 46 oil for R134a & R1234yf (ND-oil 12 has additives which ND-oil 8 does not have)
DENSO ND-oil 8 is used in piston and rotary type (scroll & SV) compressors with R134a type refrigerant	DENSO ND-oil 11 is used in the electric driven scroll compressors with either R134a or R1234yf type refrigerant	DENSO ND-oil 12 is used in piston and rotary type (scroll) compressors with either R1234yf or R134a type refrigerant





Mixing oils

While mixing A /C compressor oils is usually not recommended, as it can lead to A /C compressor damage and failure, the new ND-oil 12 can be used with both R1234yf and the old R134a type refrigerants.

However, once A /C systems have been upgraded to R1234yf type refrigerants, A /C compressors pre-filled with ND-oil 8 can no longer be used in the system. When R1234yf type refrigerant comes in contact with ND-oil 8, it will decompose and resin parts of the A /C system will start to deteriorate, so it is never recommended to use ND-oil 8 in combination with R1234yf type refrigerant.

The new ND-oil 12 can be used in R134a type refrigerant systems without needing to flush the system and remove the remaining ND-oil 8 from the A /C system, though technicians must make sure there is no dirt in the A /C system.

Important
Always check the compressor installation guide for the right installation procedure. You will find a flyer with the QR code, linking to the Compressor installation Guide in the box of each new compressor. The installation guide is as well available in TecDoc and in the download section of our website: **www.denso-am.eu**.

Installation note: A /C Compressor types 5SE/SL

The A/C-system system must be flushed.

- All DENSO IAM compressors are pre-filled with the correct type of oil (ND oil 8 or ND oil 12). In many cases, this pre-fill quantity is the right amount of oil for the whole A/C system. Check the car manufacturer data to confirm that the pre-fill quantity of the new compressor agrees with the vehicle specifications.
- Most of the 5 SE/SL-type compressors do not have an oil drain plug. This means that the oil quantity cannot be adjusted before installing the new compressor to the vehicle. To use the full amount of oil from the new compressor, the A/C system must be flushed with refrigerant to remove all old oil.
- If the new compressor is installed without flushing the A/C system, there is a risk of liquid lock, due to too much oil in the A/C system.

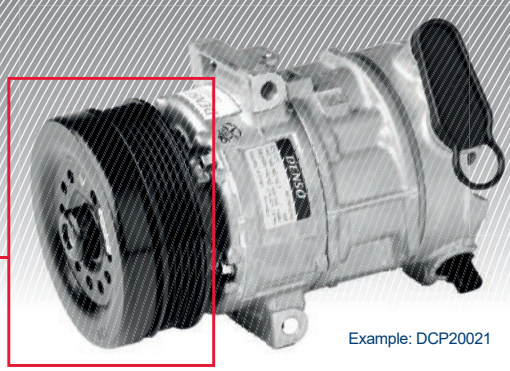
This is a risk to consider for most of the 5SE/SL-type DENSO compressors.

Part numbers & application overview

DENSO P/N	Oil Type	Oil Quantity	Refrigerant	Applications
DCP01015	DENSO ND-ÖI 8	80cc	R134a	ALFA Mito / FIAT Bravo / LANCIA Delta
DCP05022	DENSO ND-ÖI 8	90cc	R134a	MINI
DCP06022	DENSO ND-ÖI 8	120cc	R134a	DODGE Caliber / CHRYSLER
DCP09002	DENSO ND-ÖI 8	90cc	R134a	FIAT Marea
DCP09008	DENSO ND-ÖI 8	90cc	R134a	FIAT Bravo
DCP09016	DENSO ND-ÖI 8	90cc	R134a	FIAT Doblo
DCP09017	DENSO ND-ÖI 8	90cc	R134a	FIAT Grande Punto

DENSO P/N	Oil Type	Oil Quantity	Refrigerant	Applications
DCP09020	DENSO ND-ÖI 8	90cc	R134a	ALFA ROMEO Mito
DCP09032	DENSO ND-ÖI 8	80cc	R134a	ALFA ROMEO Mito / FIAT Grande Punto
DCP11008	DENSO ND-ÖI 8	150cc	R134a	ASTON MARTIN DB9
DCP13005	DENSO ND-ÖI 8	110cc	R134a	FIAT Grande Punto
DCP13010	DENSO ND-ÖI 8	80cc	R134a	FIAT Bravo / LANCIA Delta
DCP17054	DENSO ND-ÖI 8	90cc	R134a	SMART Roadster
DCP17056	DENSO ND-ÖI 8	90cc	R134a	SMART Forfour
DCP20021	DENSO ND-ÖI 8	40cc	R134a	OPEL Corsa D
DCP20021K	DENSO ND-ÖI 8	40cc	R134a	OPEL Corsa D
DCP20023	DENSO ND-ÖI 8	80cc	R134a	OPEL Corsa D
DCP21012	DENSO ND-ÖI 8	80cc	R134a	PEUGEOT 508
DCP21015	DENSO ND-ÖI 8	80cc	R134a	PSA 208 / 2008 / C3 / DS3
DCP21016	DENSO ND-ÖI 12	110cc	R1234yf	PSA 208 / 308 II / 2008 / 3008 / 5008 I / C3 III / C4 II / DS3 / DS4 / DS5
DCP21021	DENSO ND-ÖI 12	110cc	R1234yf	PSA Partner / Berlingo
DCP21022	DENSO ND-ÖI 12	110cc	R1234yf	PSA 3008 / 5008 I / Partner / Berlingo (B9) / C4 II / DS4 / DS5
DCP21025	DENSO ND-ÖI 12	110cc	R1234yf	PSA DS3 / 2008
DCP45003	DENSO ND-ÖI 8	80cc	R134a	MITSUBISHI Colt
DCP47009	DENSO ND-ÖI 12	80cc	R1234yf	SUZUKI SX4 S-Cross
DCP47010	DENSO ND-ÖI 12	80cc	R1234yf	SUZUKI Vitara
DCP50001	DENSO ND-ÖI 8	60cc	R134a	TOYOTA Yaris
DCP50009	DENSO ND-ÖI 8	60cc	R134a	TOYOTA Yaris
DCP50035	DENSO ND-ÖI 8	90cc	R134a	TOYOTA RAV 4 III
DCP50114	DENSO ND-ÖI 8	90cc	R134a	TOYOTA Corolla
DCP50120	DENSO ND-ÖI 8	90cc	R134a	TOYOTA Avensis
DCP50121	DENSO ND-ÖI 8	90cc	R134a	TOYOTA Avensis
DCP50122	DENSO ND-ÖI 8	90cc	R134a	TOYOTA Corolla
DCP50123	DENSO ND-ÖI 8	90cc	R134a	TOYOTA Avensis
DCP50124	DENSO ND-ÖI 8	90cc	R134a	TOYOTA Avensis
DCP50240	DENSO ND-ÖI 8	60cc	R134a	TOYOTA Yaris
DCP50242	DENSO ND-ÖI 8	60cc	R134a	TOYOTA Yaris
DCP50243	DENSO ND-ÖI 8	60cc	R134a	TOYOTA Yaris
DCP50248	DENSO ND-ÖI 8	60cc	R134a	TOYOTA Yaris II
DCP50249	DENSO ND-ÖI 8	60cc	R134a	TOYOTA Auris (E15)
DCP50250	DENSO ND-ÖI 8	60cc	R134a	TOYOTA Yaris
DCP50251	DENSO ND-ÖI 8	60cc	R134a	TOYOTA Verso / Yaris
DCP50252	DENSO ND-ÖI 8	60cc	R134a	TOYOTA Verso / Yaris
DCP50300	DENSO ND-ÖI 8	60cc	R134a	TOYOTA Auris
DCP50301	DENSO ND-ÖI 8	60cc	R134a	TOYOTA RAV 4 III
DCP50304	DENSO ND-ÖI 8	60cc	R134a	TOYOTA Auris / Corolla / Urban Cruiser
DCP50305	DENSO ND-ÖI 8	60cc	R134a	TOYOTA Yaris / Auris / Corolla
DCP50308	DENSO ND-ÖI 8	80cc	R134a	TOYOTA Auris (E18) / Corolla (E18)
DCP50309	DENSO ND-ÖI 8	80cc	R134a	TOYOTA Auris (E18) / Corolla (E18)
DCP50314	DENSO ND-ÖI 8	90cc	R134a	TOYOTA Auris (E18)

Damper Limiter - Pulley



Example: DCP20021

Failure of Damper Limiter-Pulleys

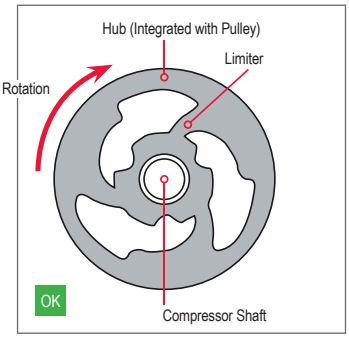
for external controlled compressors

This technical information will help you to detect a failure of the DL pulley on externally controlled compressors. DL pulleys are pulleys with overload protection and vibration damping.

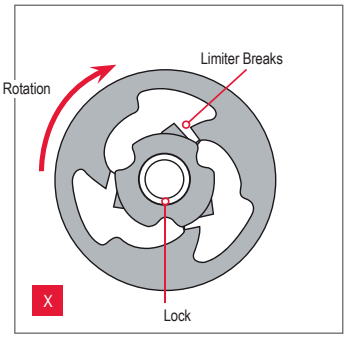
Purpose of the limiter and (optional) mass damper

The limiter of the DL-Pulley is a safety mechanism, which prevents the multi belt from breaking, after, for example, the compressor is locked. When the limiter breaks, the pulley can run freely, so the multi belt will not lose his drive function. The mass damper is (optional) installed too dampen variations in engine speed.

Limiter - OK



Limiter - NG



Why do limiters break or does the (optional) mass damper comes loose?

The main reasons, why the limiter of the DL-pulley breaks or the mass damper comes loose are,
1. Excessive negative force on the DL-pulley, due to too much drive belt movement.
2. Continuously changing force on the DL-pulley, due to severe rotation speed fluctuation.
3. Excessive force on the DL-pulley, due to too much engine torque.

4. Liquid lock of the compressor, due to excessive refrigerant, incorrect charging of refrigerant, expansion valve problems or too much compressor oil.
5. Too much friction of internal compressor parts.
6. Vacuum lock, caused by running the engine, when the refrigerant system is vacuumed.

Explanation

1. Negative force, caused by the drive belt, is one of the main issues. This negative force can be caused by several parts of the accessory belt drive system.

   ### How to check?

   Carry out inspection with the engine idling, engine speed increase and engine speed decrease. Check by visual inspection, if the drive belt has too much movement. In case of too much belt movement, inspection and / or replacement of the following parts is required.
   • Various pulley's, like alternator free run pulley, crankshaft pulley and idler pulley
   • Automatic belt tensioner (check the damper)
   • Dual mass flywheel
   Do not install imitation parts!

2. Severe rotational speed fluctuation of the engine can be caused by the fuel injection system, ignition system, exhaust emission control system or camshaft timing. (rough idling – rough running)

3. Too much engine torque, due to enhanced torque output. (chip tuning)

4. Liquid lock is usually caused by charging a liquid refrigerant to the low pressure side, of the vehicle A/C system. Another cause could be the creation of "refrigerant mist" inside the low pressure side of the A/C system, which ultimately, also can cause liquid lock of the A/C compressor. This creation of mist is usually caused by a faulty expansion valve or excessive amount of refrigerant. Too much compressor oil is another reason, which can cause liquid lock. All new DENSO compressors are pre-filled with compressor oil. Please read the "Compressor Installation Guide" very carefully, before replacing the compressor. The "Compressor Installation Guide" is enclosed with the new compressor or can be downloaded, in different languages, from the DENSO After Market website. www.denso-am.eu

5. Too much friction of internal compressor parts, can be caused by the use of the wrong type of compressor oil, too much or wrong UV-dye, insufficient oil and refrigerant amount or insufficient cleaning of the refrigerant cycle. For details, see "Compressor Installation Guide"

6. Vacuum lock can be caused when the A/C system in under vacuum and the engine is started. Because of the vacuum in the A/C system, the swash plate, inside the compressor is moved over the maximum displacement position. When the engine is running in this condition, the pistons will hit the front end of the drive plate and the compressor locks.

DENSO

8

VAG compressor consolidation: DENSO's approach

Applicable products are the DCP32045, DCP32060, DCP02030, DCP02050 and DCP32003.

This bulletin explains why DENSO will not consolidate DCP32045 for other VAG applications.

DCP32045

DCP32020

Background

At DENSO we regularly receive questions as to why we do not consolidate certain compressors as seen elsewhere in the aftermarket. Consolidation can result in benefits relating to price, cataloguing and stock management, and it is certainly very attractive for expensive products like compressors. However, the impact on the A / C system and the car's performance can be significant. As the leading thermal systems OEM supplier and one of the largest automotive parts manufacturers in the world, DENSO has the in-depth knowledge to make the appropriate decision on whether a compressor consolidation should be executed or not.

We will use the technical features of the DCP32045 and four similar VAG compressors to explain why we recommend installing the right compressor for these VAG applications.

Specifications DCP32045

DCP32045


DCP32060	DCP02030
6SES14C	6SEU14C
	
DCP02050	**DCP32003**
6SEU14C	7SEU16C
	

The DCP32060, DCP02030, DCP02050 and DCP32003 compressors are not interchangeable with the DCP32045.

Compressor differences

This overview indicates differences in compressor type, displacement, DL-Pulley type, limiter and oil quantity.

Part number	DCP32045	DCP32060	DCP02030	DCP02050	DCP32003	Consolidate? (Yes / No)
Compressor type	7SEU17C	6SES14C	6SEU14C	6SEU14C	7SEU16C	No
Displacement	170cc	140cc	140cc	140cc	160cc	No
DL-Pulley type	B-PC	AS	B-PC	B-PC	R-SC	No
Limiter part number	1630	2280	1780	1630	1311	No
Oil quantity	140cc	110cc	90cc	90cc	180cc	No

Why is consolidation of the DCP32045 (7SEU17C) not possible?

> Every limiter is designed for a specific vehicle application, according to car manufacturer specifications. The limiter of the DCP32045 releases at a higher torque than a limiter used for other compressors. It is therefore possible that the limiter may not perform as intended and in the case of a compressor lock, slipping of the V-belt cannot be avoided. This could result in a V-belt cracking which can cause other problems such as loss of power steering, loss of engine cooling and loss of battery charge.

> The limiter of the DCP32045 (7SEU17C) is not designed for vehicles with higher torque fluctuations. It is possible that the limiter could release due to these engine-specific torque fluctuations resulting in a damaged compressor.

> The pulley of the DCP32045 (7SEU17C) is not designed for applications with higher torque fluctuations and this could reduce the durability of the pulley (damper elements).

> The DCP32045 compressor has no Variable Suction Throttle (VST) and therefore suction noise can occur if the original application has a VST.

> In comparison to a 6SE type compressor, a DCP32045 (7SEU17C) needs more engine power. This will reduce engine efficiency and result in higher fuel consumption or reduced performance of the vehicle.

DCP32020 Features and Comparison:

DCP32020

DCP32005

6SEU14C

DCP27001

6SEU12C

DCP27002

6SEU14C

The DCP32005, DCP27001 and DCP27002 compressors listed on the right cannot be replaced by the DCP32020.
The table below shows the technical features in comparison.

Compressor differences

The table shows differences in compressor type, displacement, pulley type, overload protection, oil quantity and control valve connection location.

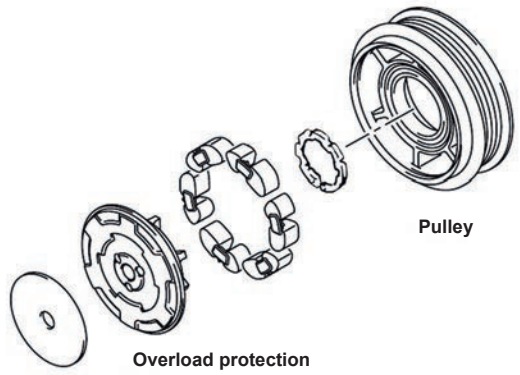
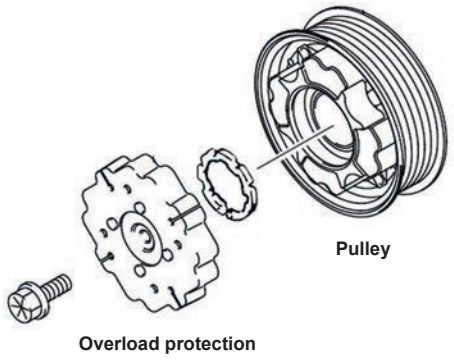
Part No.	DCP32020	DCP32005	DCP27001	DCP27002	Consolidate (Yes/No)
Compressor type	6SEU14C	6SEU14C	6SEU12C	6SEU12C	No
Displacement	140ccm	140ccm	120ccm	120ccm	No
Pulley-Type	B-PC	B-PC	R-SC	R-SC	No
Overload protection	1780	1780	1300	1300	No
Oil quantity	80cc	80cc	140cc	140cc	No
Location of the connection	Rear	At the top	Rear	At the top	No

This is why the DCP32020 (6SEU14C) cannot be consolidated:

> The overload protection of the DCP32020 (6SEU14C) is not designed for vehicles with large torque fluctuations. Therefore, the overload protection could trip/break due to motor-specific torque fluctuations. In this case the compressor would have to be replaced again.
> Furthermore, the vibration damper in the pulley of the DCP32020 (6SEU14C) is not designed for applications with larger torque fluctuations. Therefore, its durability cannot be ensured.
> The displacement of the DCP32020 is 140ccm whereas that of the DCP27001 & DCP27002 is 120ccm. However, the remaining components of the air conditioning system are precisely designed to the performance specifications of the compressor. At best, this only leads to reduced cooling performance.

You can find further practical tips on-line at www.denso-am.eu

Example of technical differences in overload protection:

B-PC		R-SC	
DCP32020 & DCP32005		DCP27001 & DCP27002	
			
B	Adhesive connection: metal / plastic (type of overload protection)	**R**	Friction connection: Vulcanized (type of overload protection)
P	Plastic (pulley material)	**S**	Metal (pulley material)
C	Vibration damper	**C**	Vibration damper

Make sure you have the right compressor on VAG vehicle models!

Application examples of the compressors mentioned:

Make	Model	Correct Compressor
AUDI	A3 (8P) 1.6 (05/03-05/05)	DCP32003
SEAT	IBIZA III (6L) 1.4 16V (02/02-04/04)	DCP27001
SEAT	IBIZA III (6L) 1.4 16V (05/04-03/05)	DCP27002
SKODA	FABIA I (6Y) 1.2 (07/01-07/04)	DCP27002
SKODA	OCTAVIA II 1.9 TDI (1Z) (09/04-12/10)	DCP32003
SKODA	FABIA II 1.2 (01/07-12/14)	DCP32020
SKODA	OCTAVIA III (5E) 2.0 TDI (11/12-)	DCP32060
VW	CADDY III (2K, 2C) 1.9 TDI (04/04-08/10)	DCP02030
VW	GOLF VI (5K, AJ5) 1.4 (10/08-11/12)	DCP02030
VW	POLO (6R, 6C) 1.4 (03/09-05/14)	DCP02030
VW	GOLF VI (5K, AJ5) 1.6 TDI (07-08-07/13)	DCP02050
VW	PASSAT (362, 365) 2.0 TDI (08/10-12/14)	DCP02050
VW	TIGUAN (5N) 2.0 TDI 4motion (09/07-07/18)	DCP02050
VW	POLO (9N) 1.4 TDI (10/01-06/05)	DCP27001
VW	POLO (9N) 1.9 TDI (10/01-05/05)	DCP27001

Make	Model	Correct Compressor
VW	POLO (9N) 1.2 12V (10/01-07/07)	DCP27002
VW	TOURAN (1T1, 1T2) 2.0 TDI (08/03-05/10)	DCP32003
VW	GOLF IV (1J, 1E) 1.9 TDI (02/02-06/06)	DCP32003
VW	FOX (5Z) 1.2 (04/05-07/11)	DCP32005
VW	POLO (9N) 1.4 16V (04/05-05/05)	DCP32005
VW	POLO (6R, 6C) 1.2 (06/09-)	DCP32005
VW	POLO (9N) 1.2 (01/02-05/07)	DCP32020
VW	POLO (9N) 1.4 16V (05/06-11/09)	DCP32020
VW	GOLF V (1K) 1.6 (01/04-11/08)	DCP32045
VW	TIGUAN (5N) 2.0 TDI 4motion (09/07-07/18)	DCP32045
VW	TOURAN (1T1, 1T2) 1.9 TDI (08/03-05/10)	DCP32045
VW	PASSAT (3G) 2.0 TDI (06/15-)	DCP32060
VW	GOLF VII (5G, BA5) 1.2 TSI 16V (08/12-)	DCP32060
VW	GOLF Sportsvan (AM1) 1.4 TSI (04/14-)	DCP32060

Further details about DENSO's thermal program can be found on-line at www.denso-am.eu in the current TecDoc or from your DENSO Aftermarket contact.

DENSO

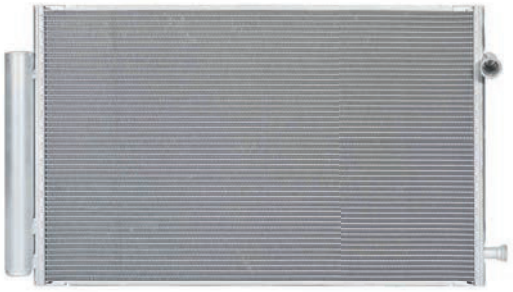
9

Condenser contamination:

Serious effects on the climate system

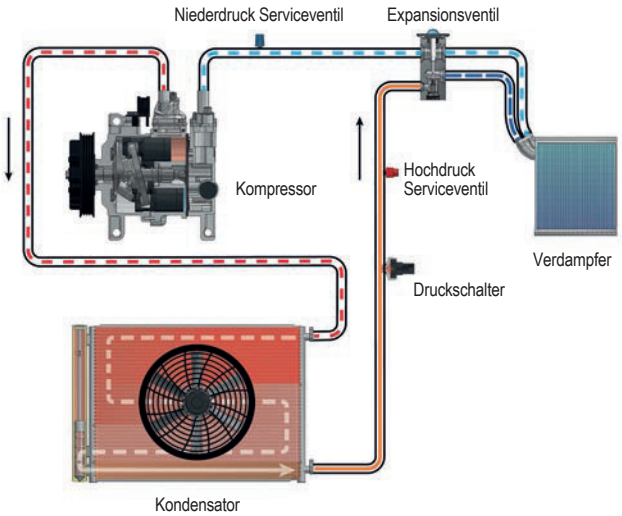
The condenser:
Important component of the air conditioning system

The condenser is a heat exchanger that goes to air conditioning of the vehicle. It sits in the engine compartment in the front area of the vehicle and has the task of keeping the hot, under high. Pressurized refrigerant coming from the compressor liquefy. This hot gas flows through the condenser, where it is caused by the wind, which also flows through the condenser flows, is cooled and liquefied.

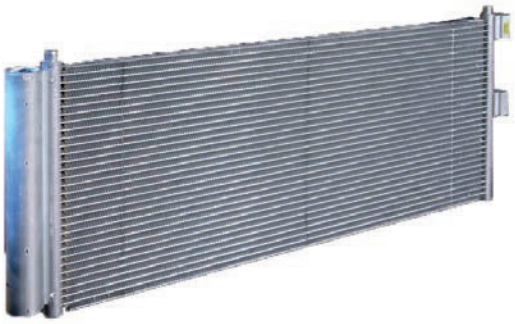


Pressure equalization in the air conditioning system
Compressor protection

The refrigerant heat is dissipated via the condenser fins and pipes. How well the refrigerant liquefies depends on the cooling or, to put it another way: the better the hot, gaseous refrigerant is cooled down in the condenser, the more liquid is produced. Since liquids have a smaller volume than gases, the pressure in the air conditioning system drops. This protects the compressor. The lower the high pressure in the system, the less load is placed on the compressor and the less wear there is. Especially in summer when temperatures are persistently high, the reduced cooling of the refrigerant can lead to a permanently higher pressure and thus to a permanently high load on the compressor. Then there is condenser contamination that slowly develops over the years. Added to this, which results in lower cooling performance, this can become a serious problem and lead to the failure of the Compressor lead.



Trend: ever smaller designs with ever higher efficiency



A comparison with a 1 euro coin illustrates the the size of the tiny condenser cooling capillary.

Delicate, tiny cooling capillary

Condensers are increasingly becoming a wearing part! Basically, the structure of a condenser is similar to that of a radiator. However, it has to withstand higher internal pressures (up to 34 bar), as is typical for air conditioning systems.

Modern multiflow condensers are becoming increasingly compact and more space-saving. To make them more powerful despite their smaller size more powerful, their cooling tubes and fins are becoming fins are becoming more and more filigree. This allows the cooling surface and thus the heat dissipation capacity can be maximised.

Reduced cooling capacity due to damaged and clogged condenser tubes

Over time, dirt collects between the condenser and cooler. This blocks the air flow through the condenser and thus reduces its cooling capacity. Therefore condensers should be cleaned regularly, at least every two years. be cleaned. In addition to dirt on the condenser surface leaks can also minimise the cooling capacity of the gas in the system. Due to its installation position in the front area of the engine compartment, depending on the use of the vehicle depending on the use of the vehicle, dead insects in conjunction with road salt and water lead to increased oxidation of the aluminium flat tubes, so that leaks can occur after just four or five years can occur.

Dirt build-up between radiator and condenser

Serious consequences of clogged and damaged condensers:

Permanently increased system load (pressure & temperature)

Increasing fuel consumption

Premature wear of compressor and components

Due to the poorer cooling, the pressure and compression temperature are permanently at a higher level - a strain on the entire system. The older the vehicles, the older the hose connections. Over time, they become porous and fine rubber particles become detached. As the compressed hot gas from the compressor shoots into the condenser at high pressure, such debris ends up in the condenser and gradually begins to clog the tiny cooling channels. The more of the fine condenser cooling capillaries are blocked, the more cooling surface is lost and the condensation process is minimized. Due to the incompletely condensed hot gas, the pressure in the air conditioning system remains at a permanently higher level and the boiling temperature in the evaporator is higher than intended. This not only reduces the cooling capacity the compressor has to work against increasingly higher pressures and is exposed to premature wear. As the compressor has to use more energy to work, a blocked condenser also has the effect of increasing fuel consumption. also has the effect of increasing fuel consumption.

Multiflow condensers cannot be flushed!

As this condenser contamination or clogging is caused by abrasion, i.e. solid particles particles, the problem cannot be solved by flushing. This is because it is not possible to rinse out solid particles. The flushing agent flows along the path of least resistance, i.e. also around blockages (see cross-section of the cooling fins on the right). Flushing with refrigerant only removes liquids (oils/UV contrast agents/sealants) from the air conditioning system. sealant) are flushed out of the air conditioning system. Sticking particles not only reduce the cooling capacity of the condenser. They can become loose during system operation and be sucked in by the compressor, where they cause further problems. lead to further problems. If, for example, the compressor is replaced but the contamination in the condenser is not condenser, it is very likely that new compressor problems will occur within a short time. compressor problems within a short time. Due to the increasingly sophisticated design and the gradual problems caused by clogging, condensers have become wearing parts.

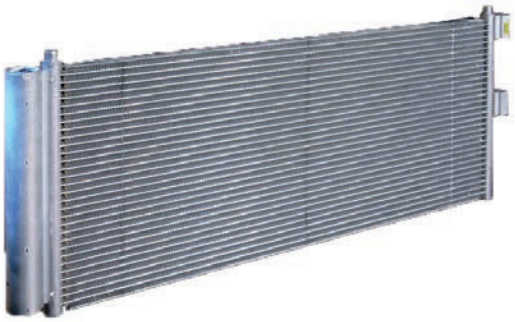
Cross-section through the condenser tubes

Caution: The multiflow condenser MUST be replaced if there is rubber wear!

If rubber wear is found in the air conditioning system, the multi-flow condenser must always be replaced in addition to other repair procedures. A visual inspection of the high-pressure and suction side of the compressor and the sight glass analysis of the refrigerant and compressor oil provide information on this.

Rubber wear in the air conditioning system

Condensers from DENSO
100% OE quality, high vehicle coverage, attractive prices



- 100% OE quality, strictly according to vehicle specification manufactured
- Integrate seamlessly into the vehicle air conditioning system
- Durable thanks to high-quality aluminium construction
- Optimised heat exchange thanks to superior fin design
- Require less energy from the compressor and contribute to more economical fuel consumption
- Maximum reliability for the maintenance and repair of of complex air conditioning and engine cooling systems

The aftermarket programme from Europe's leading manufacturer of thermal systems for original equipment opens up with 70% market coverage, opens up great business potential.

The TOP sellers at a glance:

DENSO part no.	Application example
DCN09045	FORD Ka (RU8) 1.2 (08-)
DCN50041	TOYOTA Auris (NRE15_, ZZE15_, ADE15_, ZRE15_, NDE15_) 1.4 VVTi (07-12)
DCN01004	OPEL Corsa D 1.2 (06-)
DCN28002	PORSCHE 911 (996) 3.4 Carrera (97-01)
DCN16001	SMART Fortwo Coupe (451) 1.0 (451.331, 451.380) (07-)
DCN47005	OPEL Agila (B) (H08) 1.2 (08-)
DCN32063	VW Transporter V Bus (7HB, 7HJ, 7EB, 7EJ, 7EF) 2.0 TDI (09-)
DCN09018	FIAT Doblo Box Body / Estate (263) 1.3 D Multijet (10-)
DCN12003	IVECO Daily III Box Body / Estate 35 S 13 V, 35 C 13 V (99-)
DCN17035	MERCEDES-BENZ GLK (X204) 220 CDI 4-matic (204.984, 204.997) (08-)
DCN23026	RENAULT Twingo II (CN0_) 1.2 16V (CN04, CN0A, CN0B) (07-)
DCN28001	PORSCHE 911 Convertible (964) 3.6 Carrera (89-94)
DCN02044	AUDI A4 Avant (8K5, B8) 2.0 TDI (08-15)
DCN09044	FIAT 500L 1.4 (12-)
DCN20009	OPEL Zafira B (A05) 1.8 (05-)
DCN13110	OPEL Corsa D 1.2 (06-)
DCN32032	VW Touran (1T1, 1T2) 1.9 TDI (03-10)
DCN50101	TOYOTA Yaris (SCP9_, NSP9_, KSP9_, NCP9_, ZSP9_) 1.0 VVT-i (05-)
DCN35001	DAIHATSU Materia (M4_) 1.5 (06-)
DCN17006	MERCEDES-BENZ B-Klasse (W245) B 160 (245.231) (09-11)
DCN05102	MINI (R56) Cooper (06-)
DCN47007	SUZUKI Swift IV (FZ, NZ) 1.2 (10-)
DCN32013	VW Passat Variant (365) 2.0 TDI (10-14)

Extract Model coverage of the DENSO condenser programme in OE quality.

Fiat	91,8 %
Toyota	83,7 %
Audi	80,7 %
VW	78,1 %
Mercedes	75,6 %
Skoda	74,8 %
BMW	70,4 %
Seat	68,8%
Rest	60,7 %
Opel	59,0 %
Porsche	48,5 %

Further details on DENSO's condensers programme are also available online at www.denso-am.eu, in TecDoc or contact your DENSO Aftermarket contact.

Compete with the best in the industry at the DENSO League of True Mechanics!

- **The free learning platform offers in-depth technical knowledge about vehicles, maintenance, repairs and the DENSO product portfolio**
- **Digital training programmes developed by experts**
- **The top annual winners are rewarded with attractive prizes at the end of each season**

With the "League of True Mechanics", DENSO has developed a digital training programme to keep dealers, workshop employees and all those interested in automotive technology up to date on DENSO products and technologies. Interactive e-learning courses containing learning materials and exam units are continuously published in the online academy. Integrated gamification principles motivate and support learning.

After passing the final exam of a course, participants receive a personalised certificate. The best participants in each season are entered into the "Hall of Fame". In addition the annual winners are rewarded with attractive prizes.

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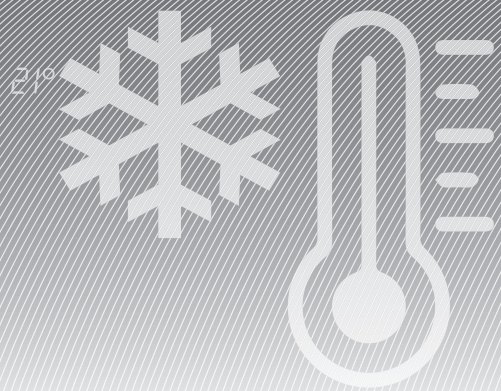

Do you still need more information?

. . . Scan the QR code and download the full version of DENSO AC installation manual

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