

Failure Mode Analysis

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What is Failure Mode Analysis?

- Looking at the compressor to determine what was the cause of the failure.

Why do we need to conduct Failure Mode Analysis?

- Helps us fix the system to prevent further damage.
- Helps understand what we need to do.

How do we conduct a Failure Mode Analysis?

- Open the compressor.
- Examine the compressor and analysis the broken pieces.

Common Failures

Failures can be caused at 2 different times of a compressors life

- During Installation
- During Operation

The following slides will examine the common failures at each of the individual stages

Common Failures – During Installation

<i>Error</i>	<i>Failure mode</i>
Damage to pipe fittings, threads, and O-rings	Refrigerant leaks
Damage to rotor or armature	Noise, burned clutch, rotor bearing collapsed
Crack on ear mount	Refrigerant leaks, mounting failure
Wrong coil polarity	No clutch engagement – diode failure
Inadequate refrigerant charge	Compressor seizure
Insufficient oil amount	Compressor seizure

Common Failures – During Operation

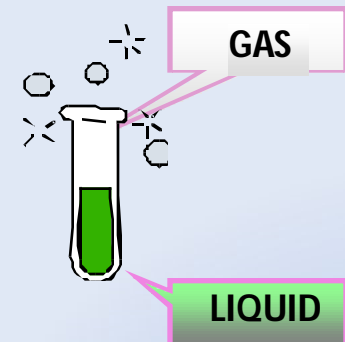
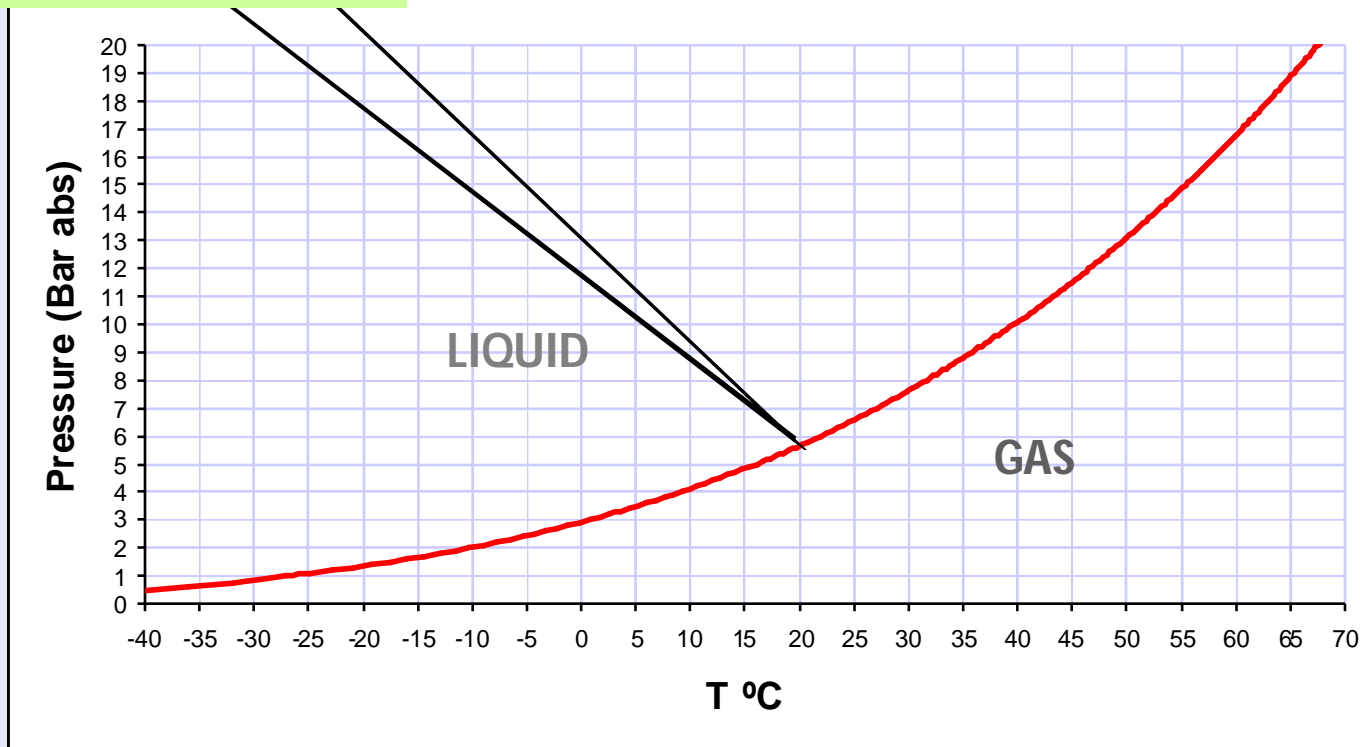
<i>Error</i>	<i>Failure mode</i>
Expansion Valve problems	Compressor seizure
Obstructed hoses/pipes	Compressor seizure
Leaks through porosity	Compressor seizure

Common Failures – During Operation

The pressure switch on high pressure side may not protect in case of small leak

The pressure curve in static circuit depends only on the ambience temperature

Vapour pressure R134a



Common Failures – During Operation

Contamination

- Particles introduced during installation
- System was not flushed before installation of compressor
- Defective receiver dryer/ accumulator, desiccant



Common Failures – During Operation

Accumulation of liquid refrigerant in the compressor

- Noise, burned clutch
- Washout
- Piston damage

Presence of moisture

- Acid formation, corrosion
- TXV blockage



Compressor Teardown Procedure

When tearing down a compressor to determine failure mode, it is important to follow the correct procedure. These procedures ensure that nothing will be missed and that the correct diagnosis is found.

Item		Check Point
1	Check body for damages	hits, corrosion, overheat
2	Check electrical connection	Wire cut, original connector
3	Check ports	O-rings, threads, particles
4	Check clutch air gap	Between 0.4mm to 0.8mm
5	Check armature plate	Leaf spring, deformation, overheating
6	Check pulley	Hit marks, noise, smooth rotation
7	Check coil	Resistance, diode
8	Check oil plug	Torque 15Nm
9	Check oil quality	Color
10	Check compressor shaft rotation	Smooth rotation

Compressor Teardown Procedure

Item		Check Point
11	Remove armature plate	Surface not glassed
12	Remove Pulley	Check snap ring fitment
13	Remove Coil	Check snap ring fitment
14	Remove felt ring	Not saturated with oil
15	Remove cylinder head	- Check for even torque - Check liquid line, signs of overheating
16	Check valve plate	Check deformation, overheating, particles
17	Check pistons	Overheating, particles
18	Open front housing	- Check for even torque - O-rings, particles, overheating
19	Pull out pistons	piston rings, centering ball, gears
20	Cylinder block	Particles, cracks

Lets take a look at some examples

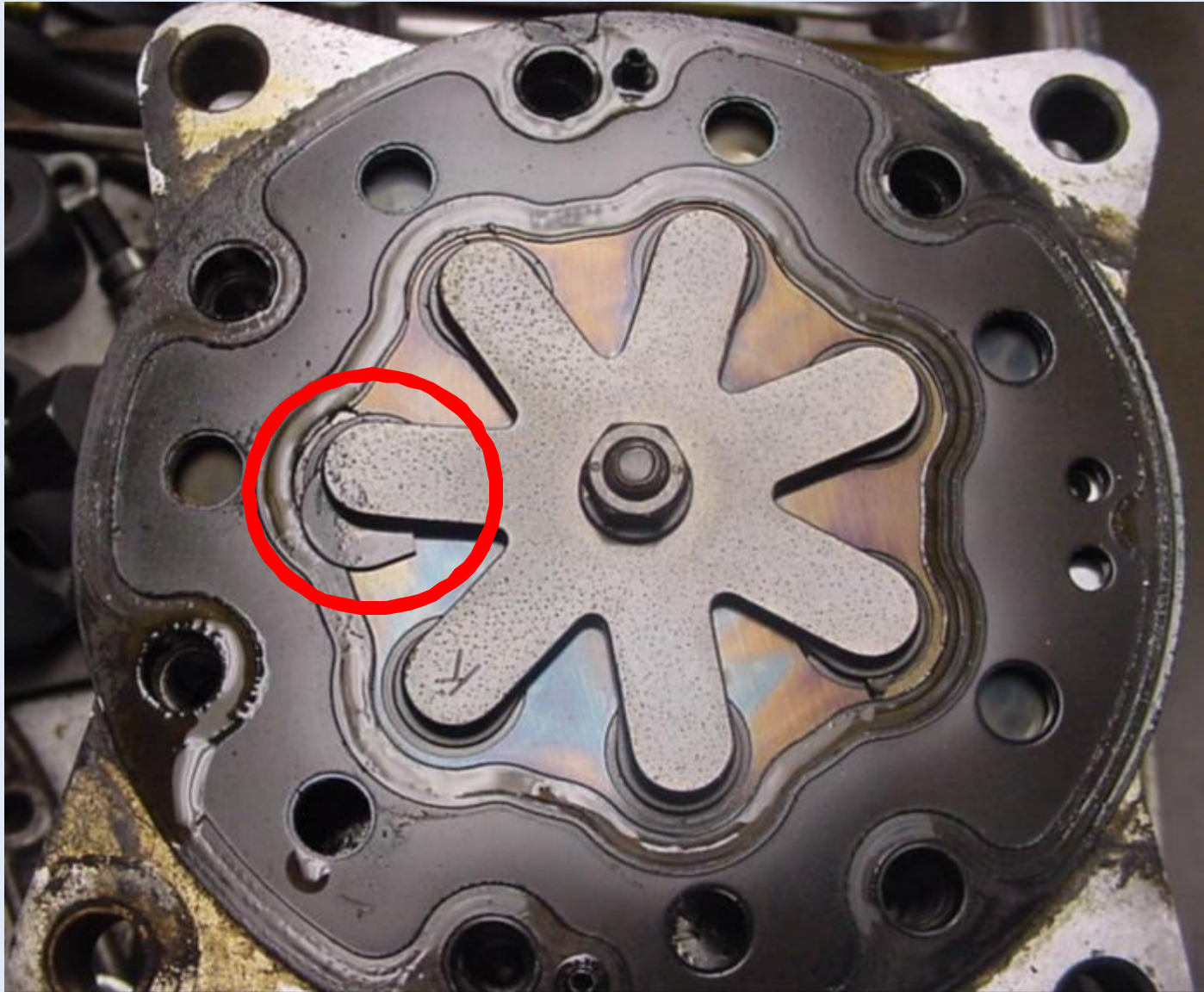
How this will work

- 1: We will see a set of pictures representing the same problem.
- 2: We will discuss what we see on every picture.
- 3: At the end we will discuss the problem.

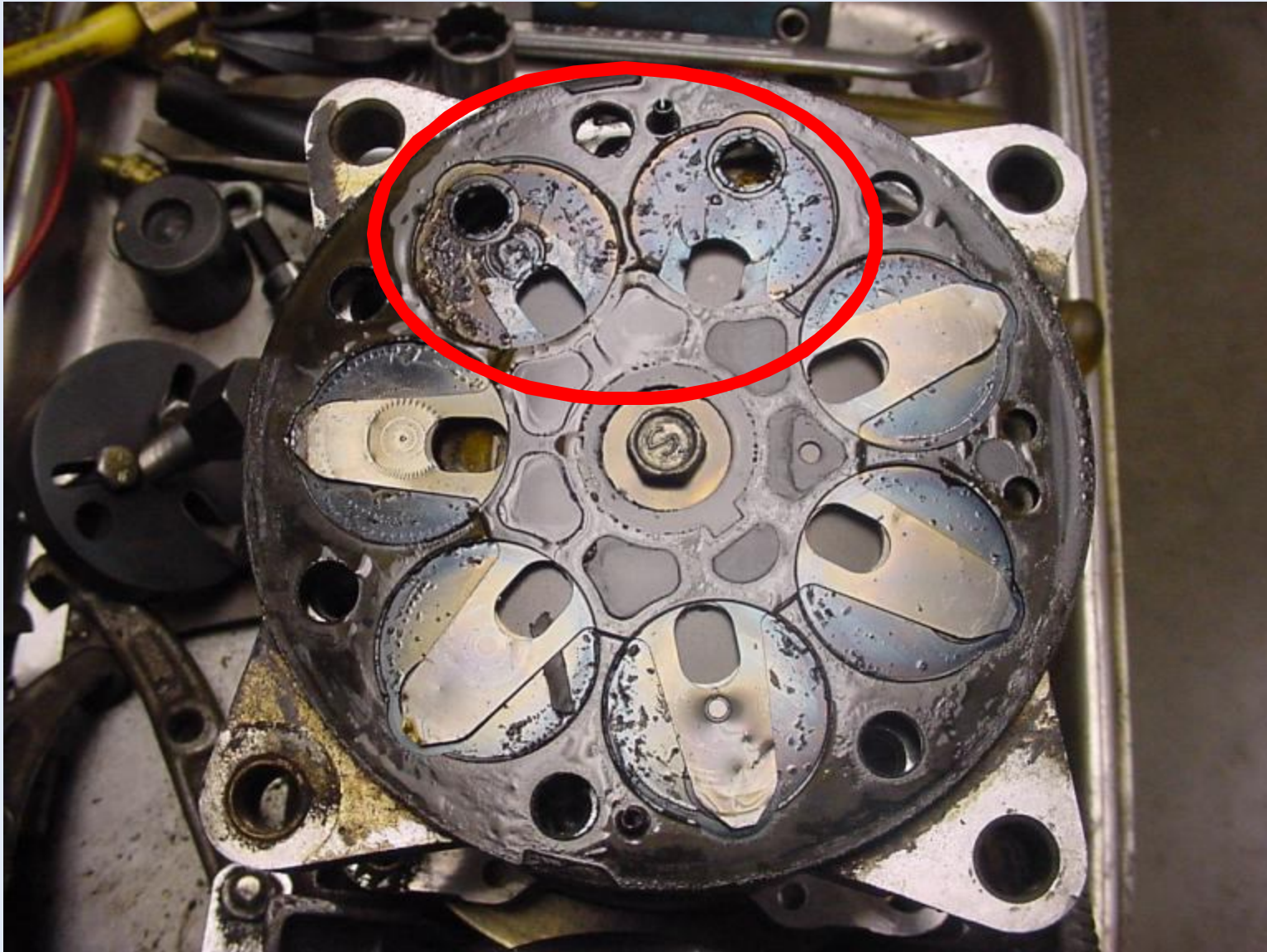
Failure Mode Analysis



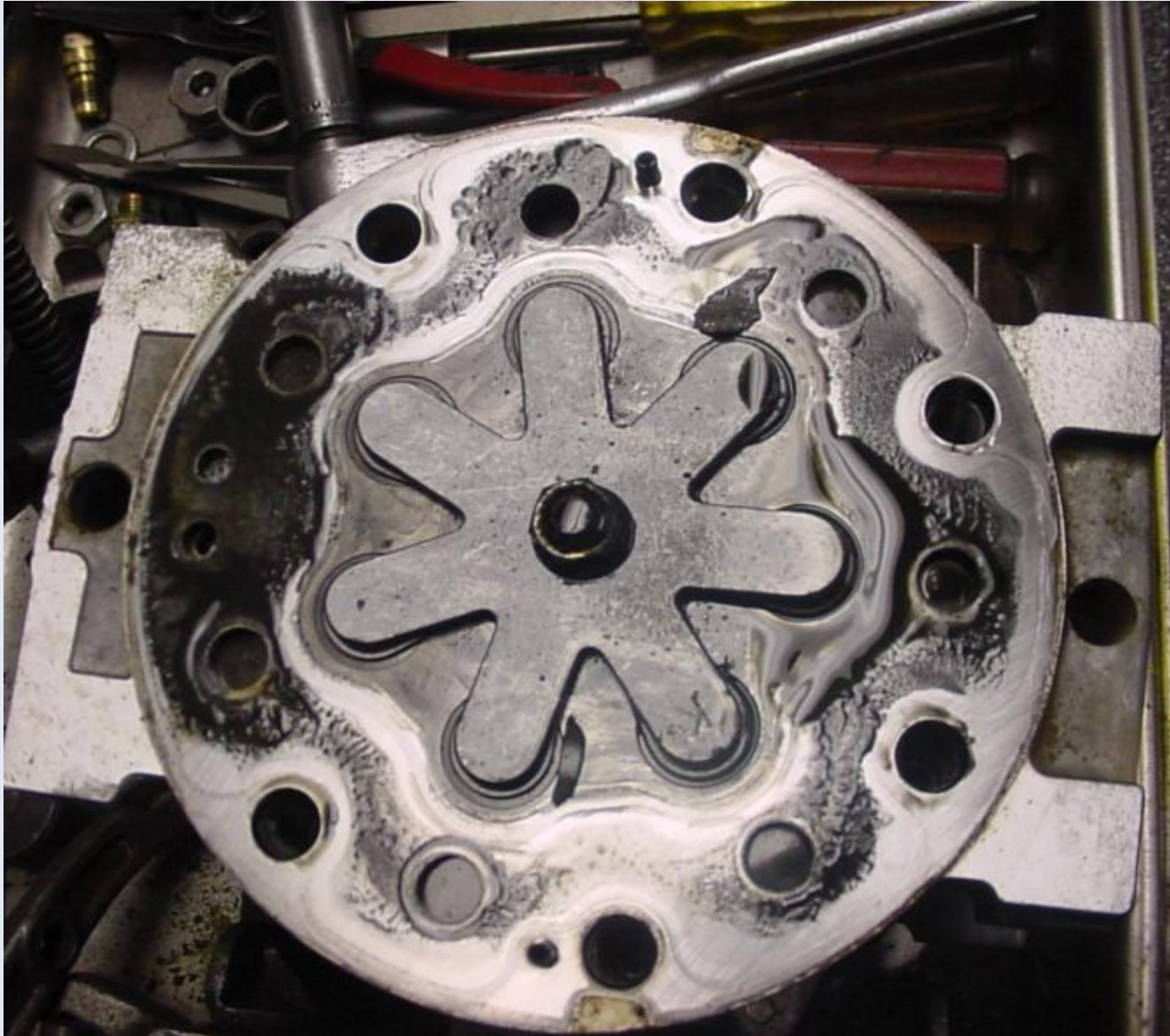
Failure Mode Analysis



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Failure Mode Analysis



What do you think is the problem?

- Overheating.
- Overheating occurs when there is a lack of oil in the compressor.

What could cause low oil amount?

- Liquid compression.
- System blockage.

Lets go to the next set

Failure Mode Analysis



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What do you think is the problem?

- Moisture in system.
- Moisture + Oil + Refrigerant + Heat will cause acid to form and corrode lines and compressor .

How to avoid this issue?

- Vacuum.
- Replace receiver dryer every time the system is opened.

Failure Mode Analysis



Failure Mode Analysis



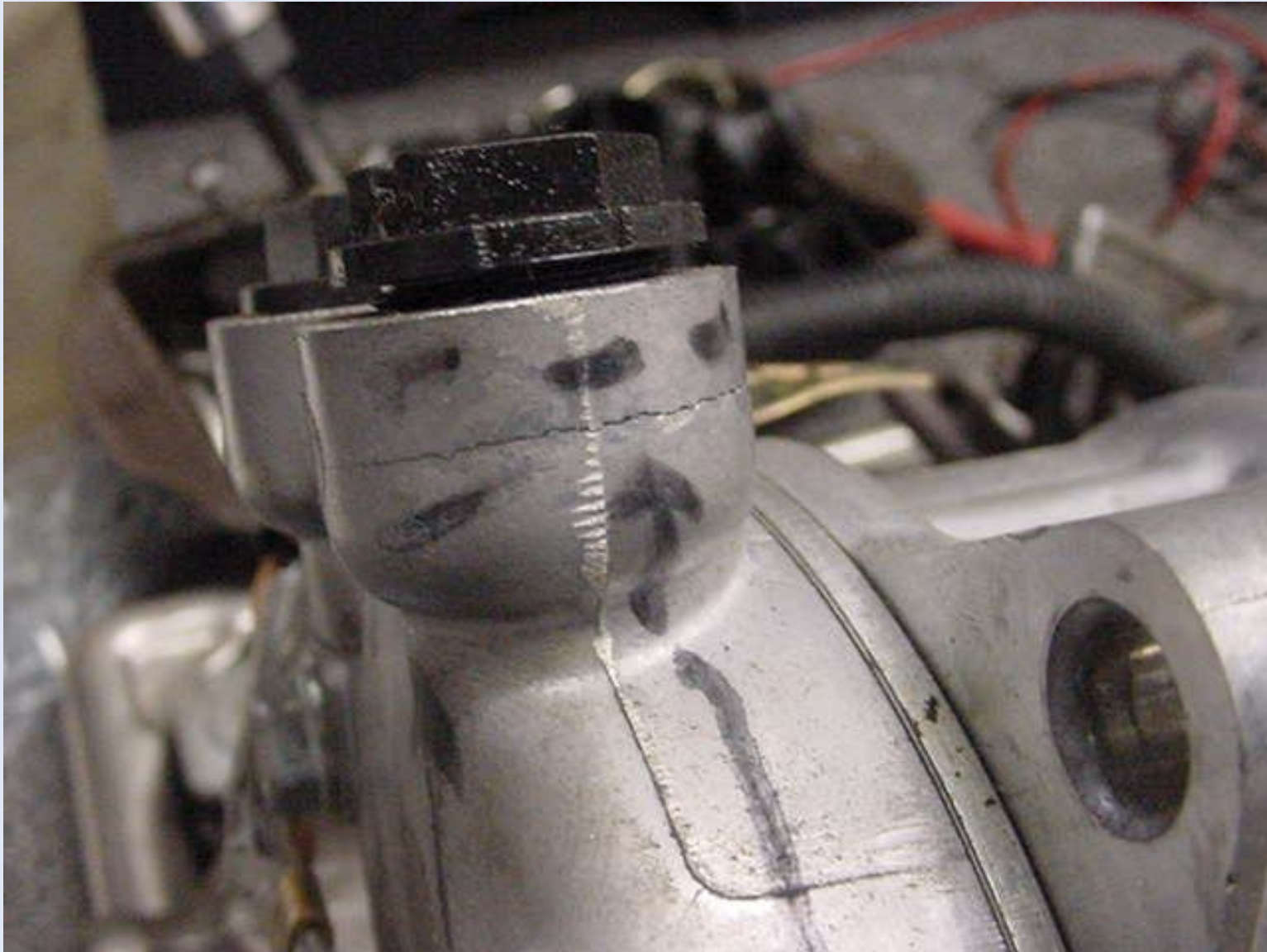
What do you think is the problem?

- Dye non-compatibility.

How to avoid this issue?

- Check for compatibility.
- Research receiver dryer.

Failure Mode Analysis



Failure Mode Analysis



Failure Mode Analysis



Failure Mode Analysis



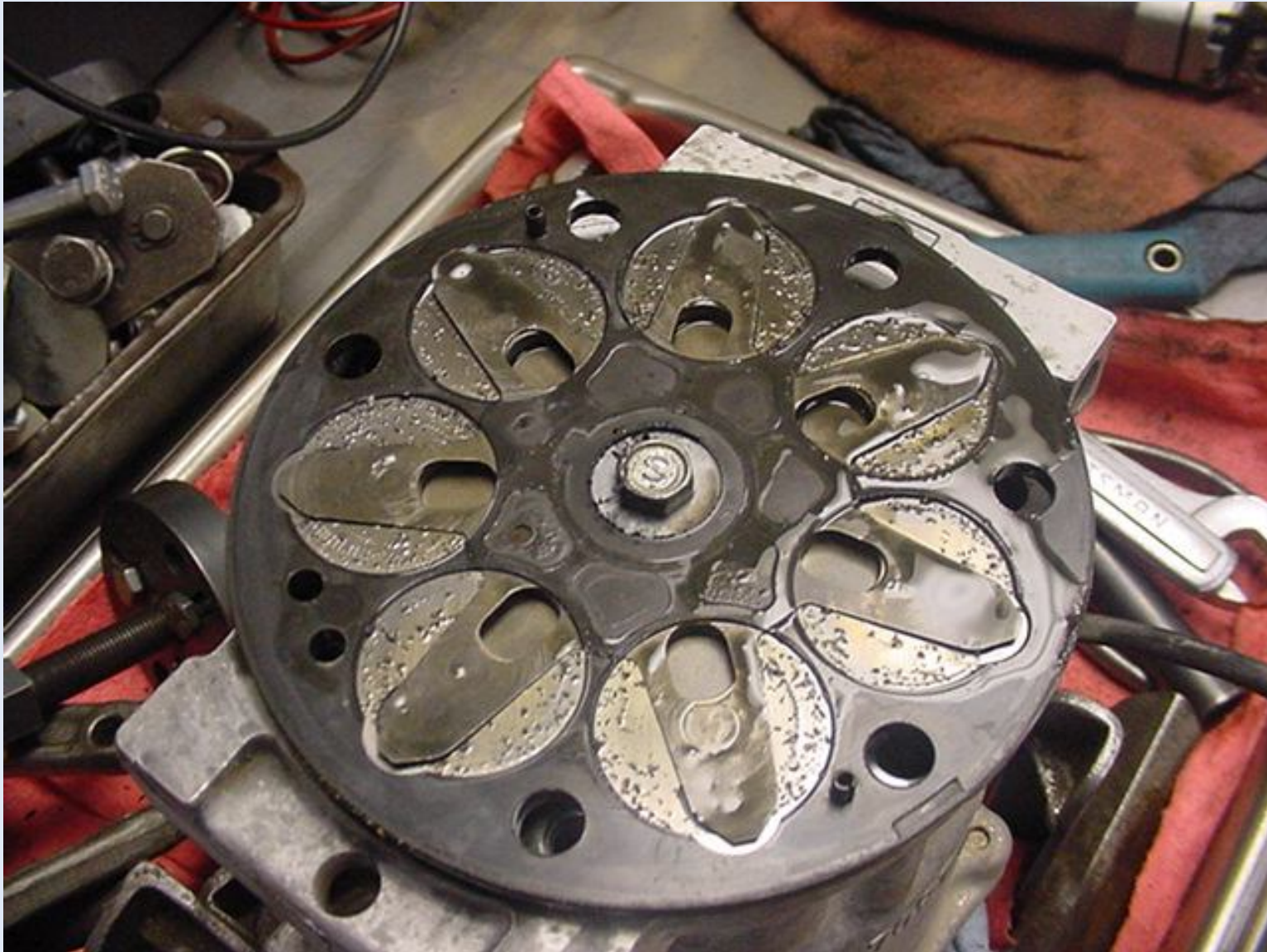
What do you think is the problem?

- Improper installation.
- Too much torque when installing ports.

How to avoid this issue?

- Use torque wrench.

Failure Mode Analysis



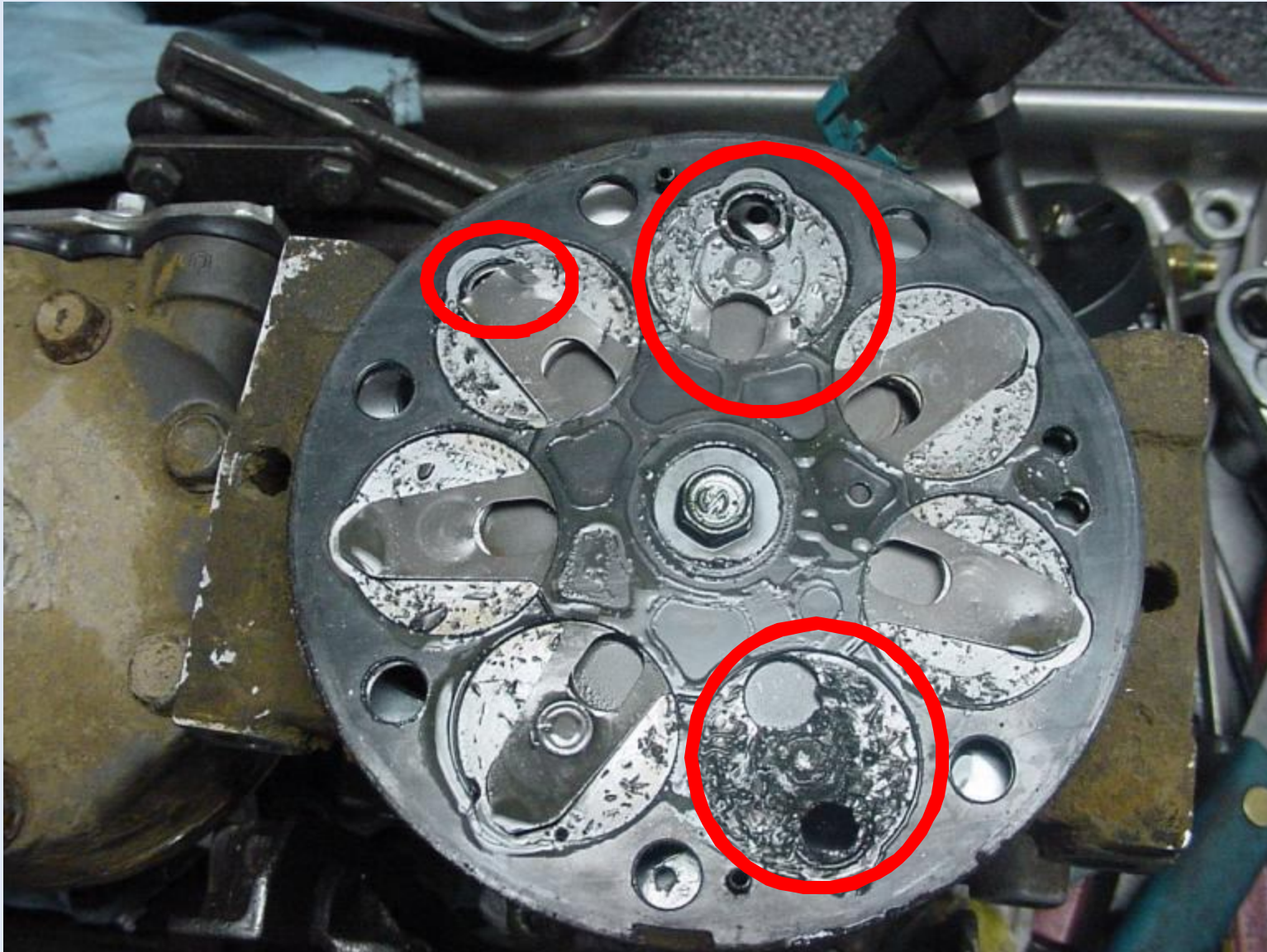
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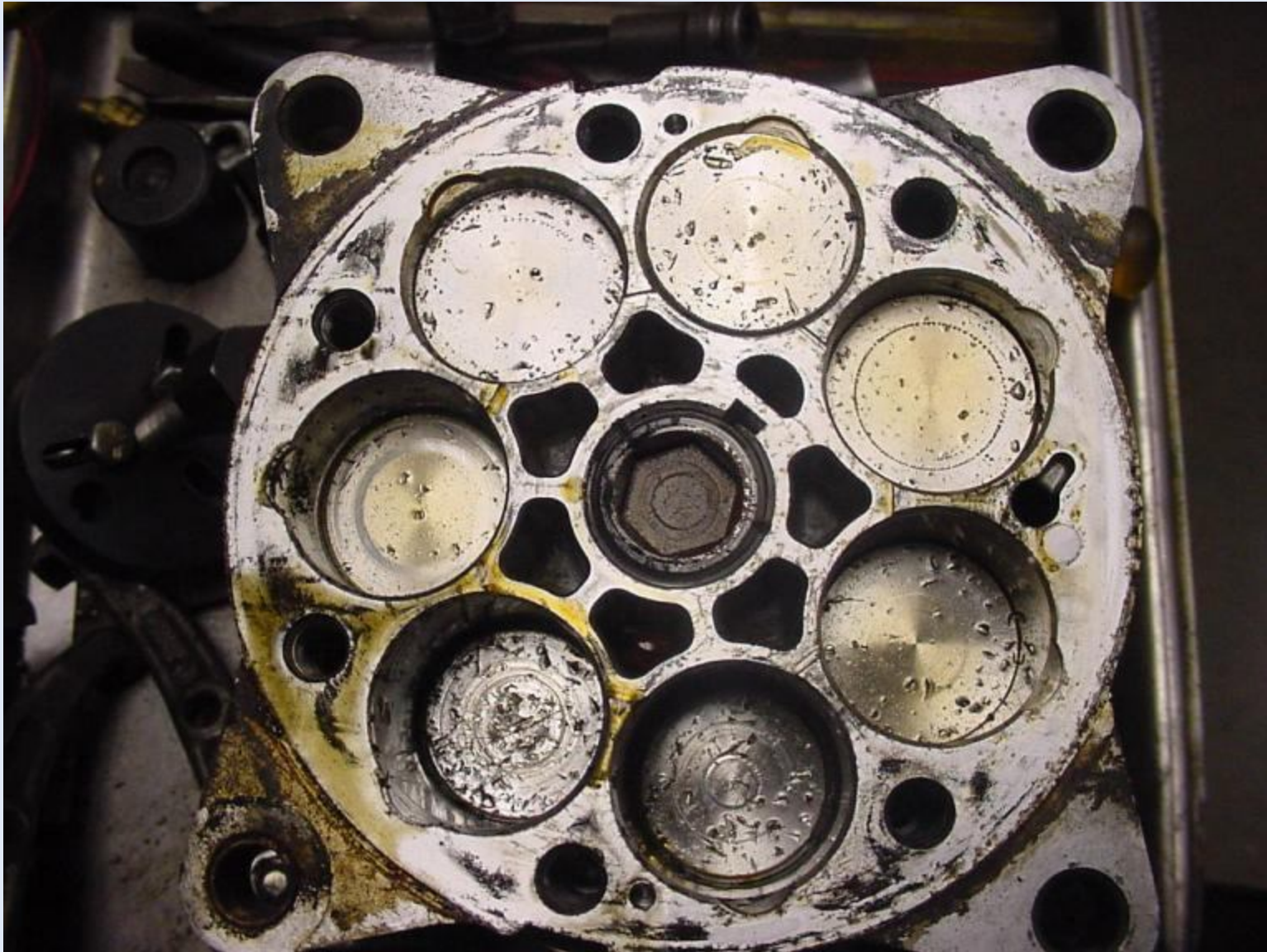
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What do you think is the problem?

- Contamination.
- Partials from other components and past failures.

How to avoid this issue?

- Flush system before installing new component.
- Replace broke components.

DIAGNOSIS BY OIL COLOR

Clear oil or oil
with UV tracer :
Compressor
probably inside
O.K.



Silver-grey oil :
Foreign particle
from A/C System
or internal seizure

Black oil : AC
system
overheated due
to malfunction
of condenser,
defect pressure
switch or lack of
refrigerant



Orange oil :
Contamination
with humidity

