U-3ARC
TRAINING WEBINAR #10

REFRIGERATION TROUBLESHOOTING

Hammadi FERJANI

19 June 2022

Troubleshooting methodology

A repairman who is looking for this finds himself
A repairman who finds this is looking for himself

Quick review of the refrigeration cycle

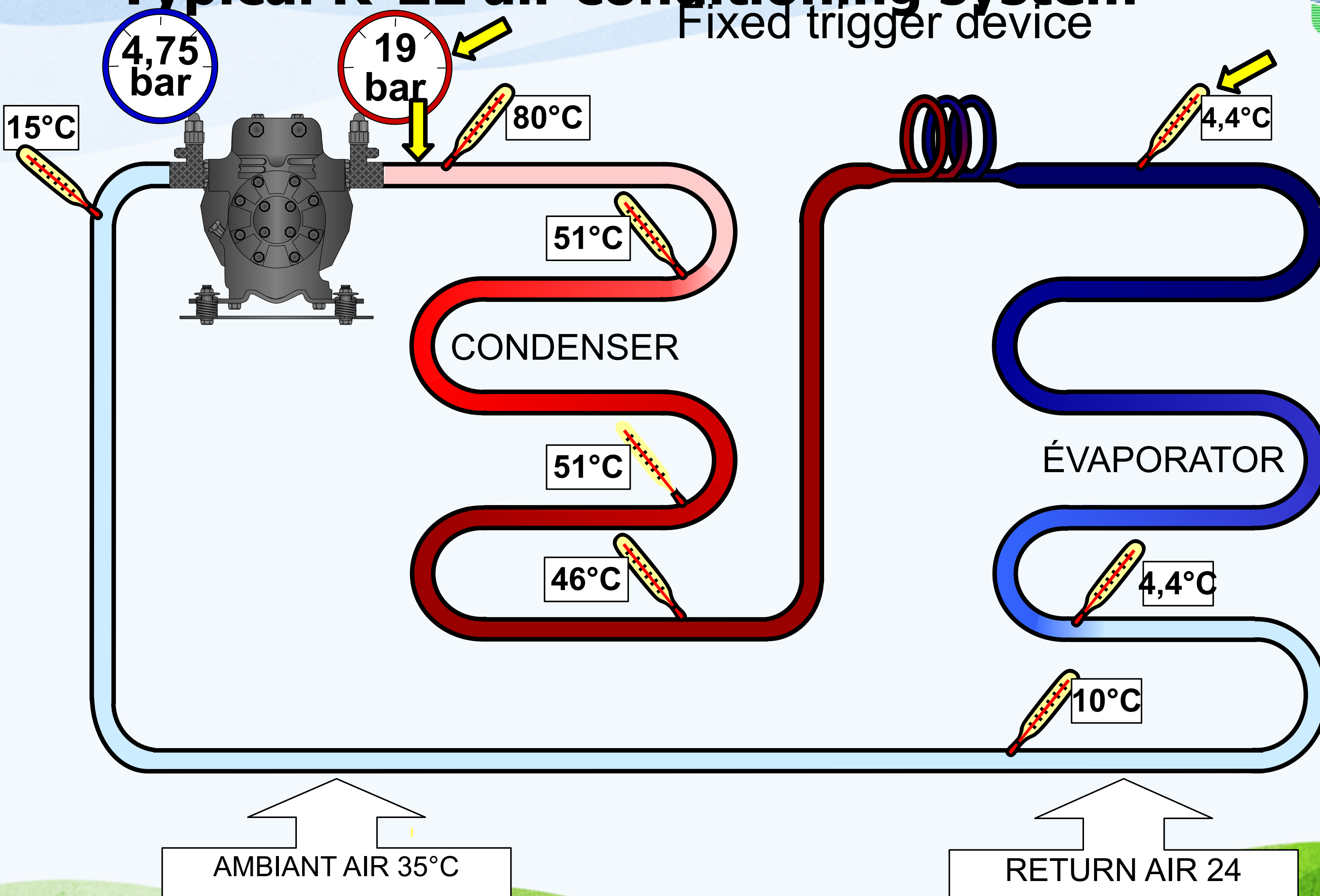
Before embarking on an installation, it is necessary to know it, to understand it. To do this we must use what nature has given us, that is to say our senses.

We will use to achieve this:

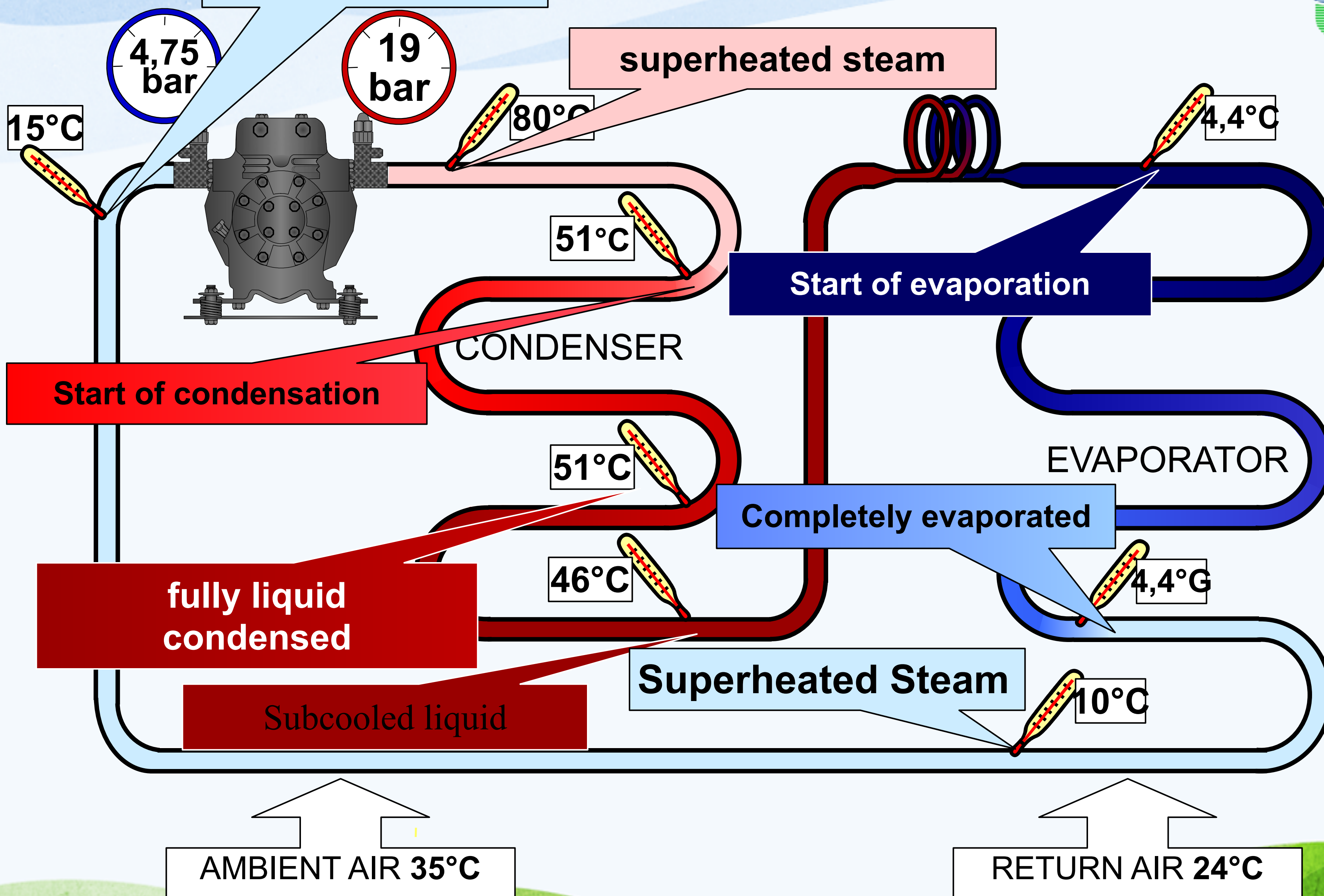
- **TOUCH**
- **THE SMELL**
- **VIEW**
- **HEARING**

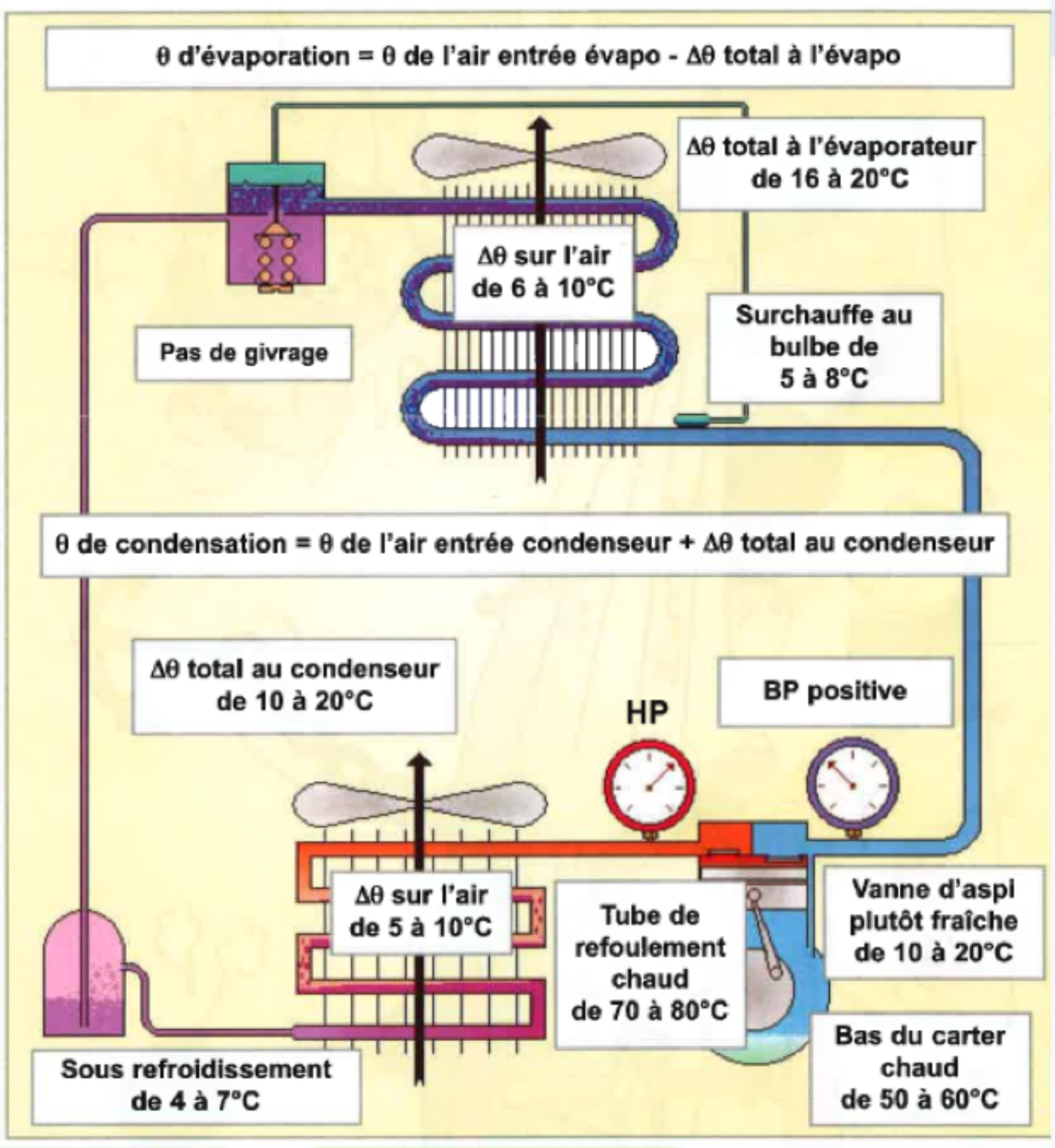
Thanks to them, in addition to a better approach to the breakdown, we will have a view of the operation of the correct installation. Because you have to understand the commands, controls, and security in place before you start troubleshooting.

Typical R-22 air conditioning system



Ty… air conditioning system

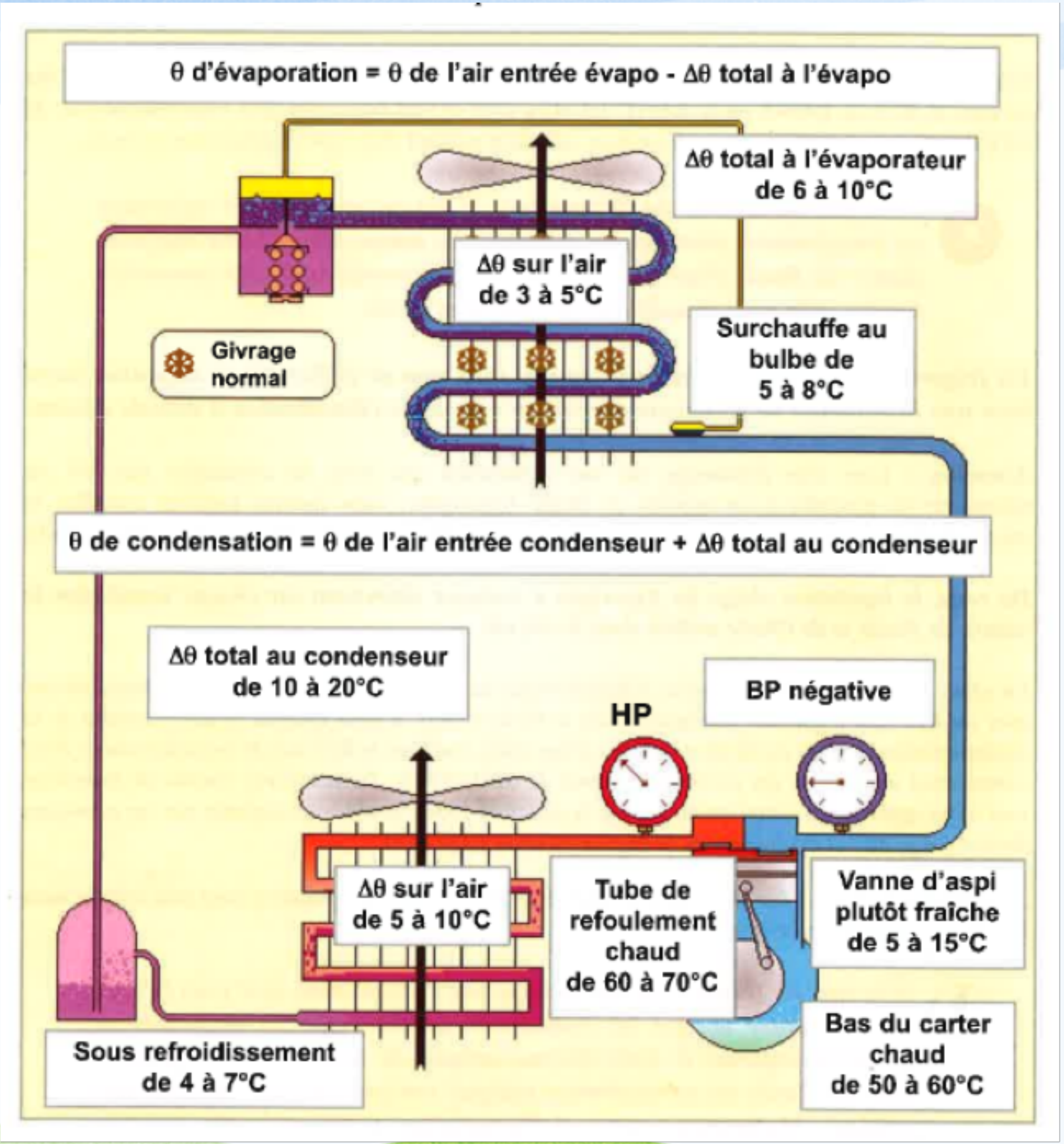




Classic commercial refrigeration installation

Indicative values of various normal operating parameters

Classic cold installation

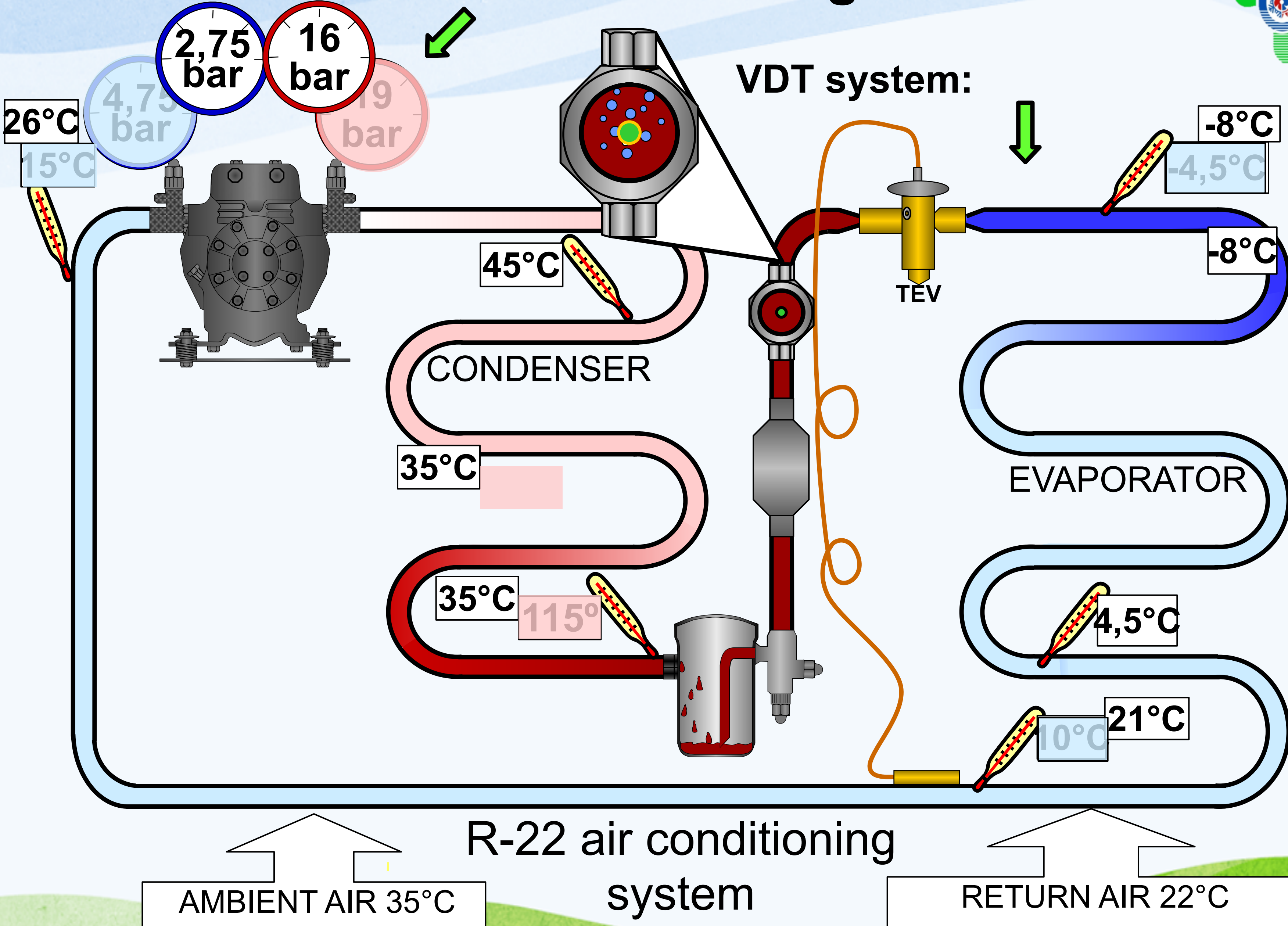


Indicative values of various normal operating parameters

Diagnosis of 8 refrigeration failures

1. Lack of refrigerant charge
2. Excess refrigerant charge
3. Condenser too small
4. Presence of incondensables in the circuit
5. Inefficient compressor
6. Regulator too small
7. Pre-expansion in the liquid line
8. Evaporator too small (dirty or icy, dirty filter or low airflow)

Lack of charge



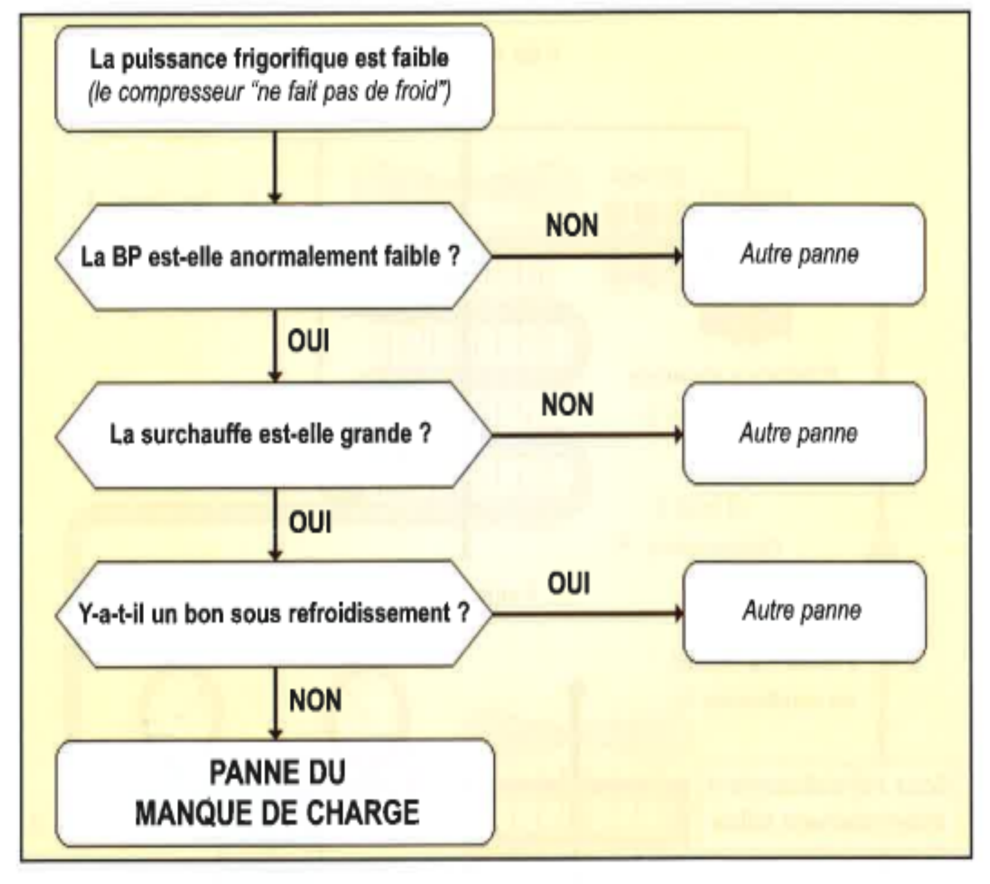
Lack of refrigerant charge

Interpretation

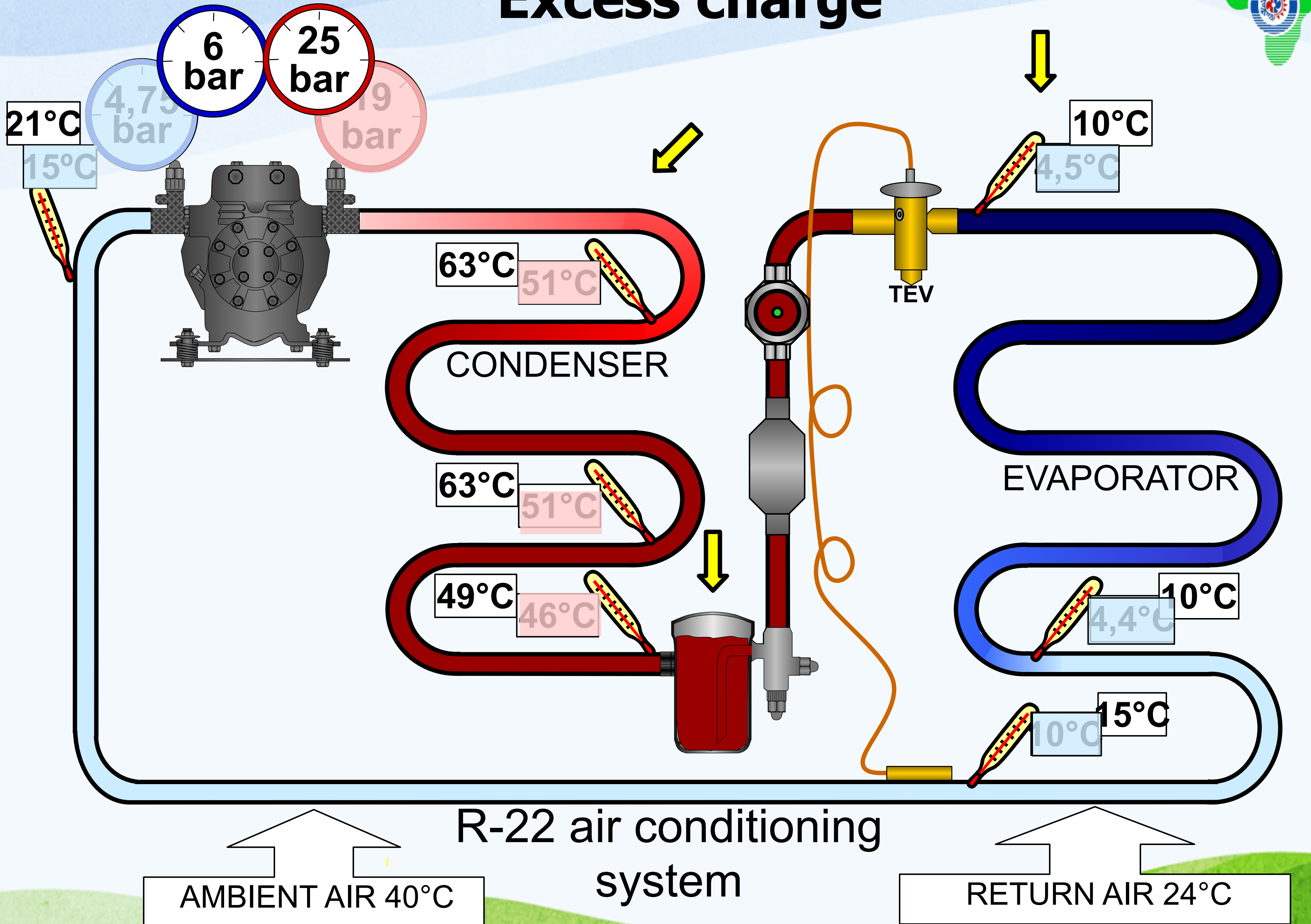
•The quantity of fluid reaching the evaporator is low: the cooling capacity drops (the air cools less) and the superheat increases.

•As the condenser receives less refrigerant, the condensation pressure drops and there is no accumulation of fluid: the subcooling is too low.

Summary of symptoms



Excess charge



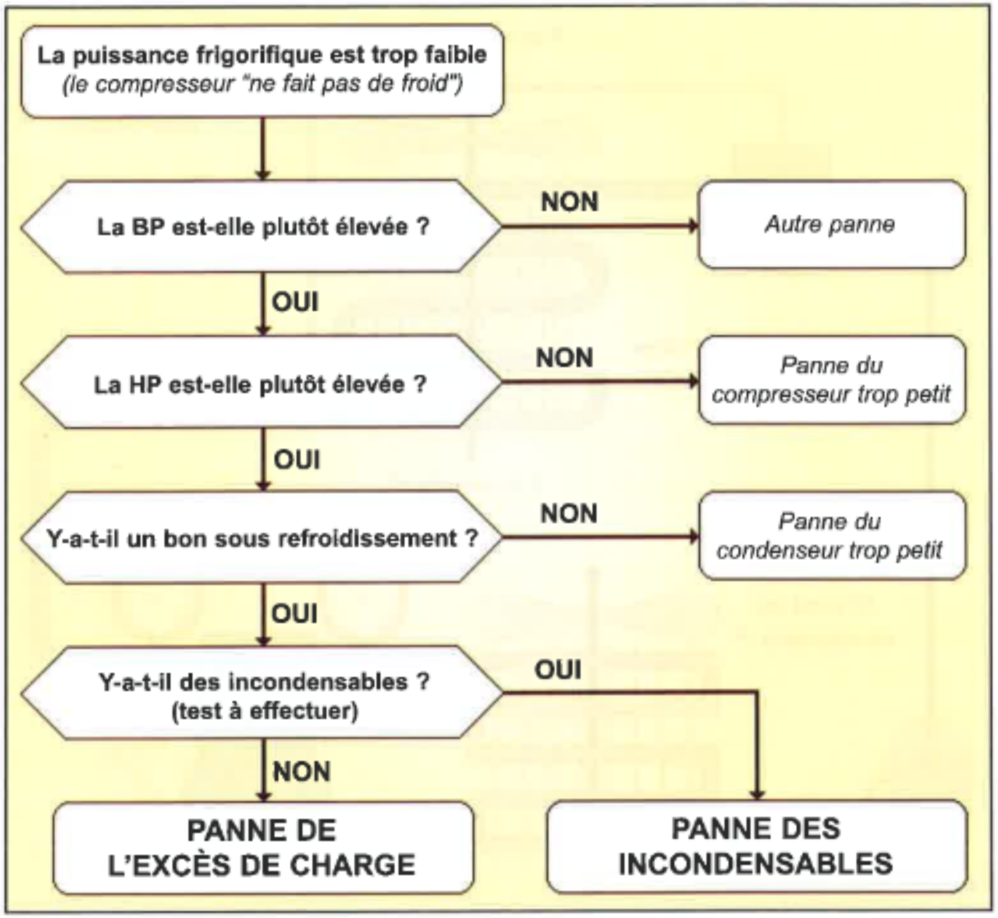
R-22 air conditioning system

Excès de charge

The results

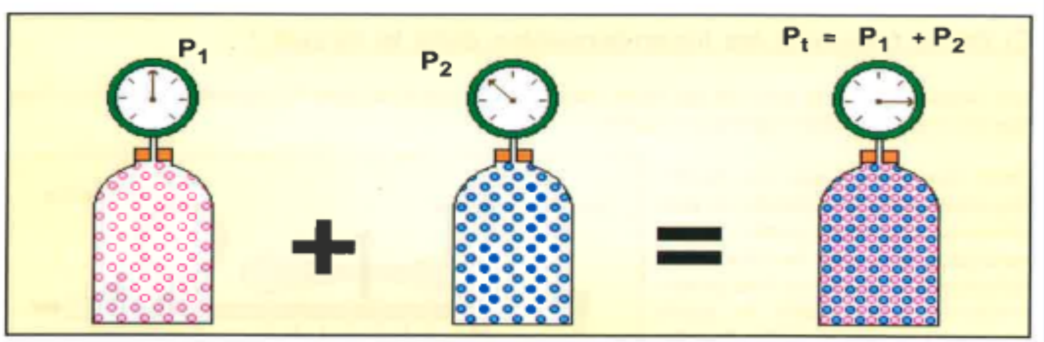
- The HP increases because the area used for condensation is reduced.
- The subcooling is rather high.
- The capacity of the compressor decreases, therefore the cooling capacity decreases and the intensity absorbed by the motor increases.
- The expansion valve injects more fluid into the evaporator, the BP increases
- Overheating is rather low.

Diagnostic methodology



Non-condensable presence test

Dalton's Law

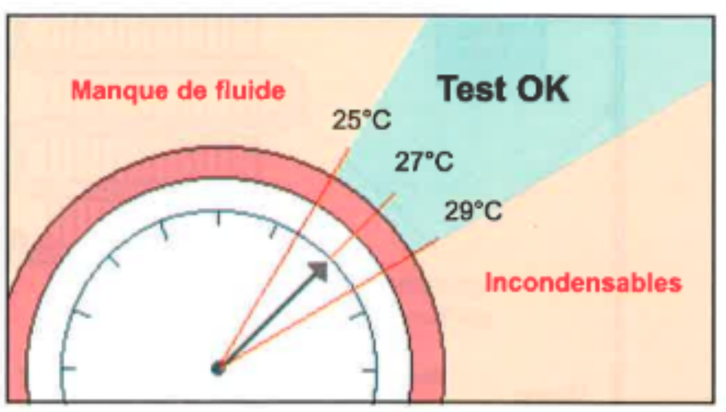


Non-condensables test / Procedure

Return all fluid to the bottle.

The LP drops and the LP pressure switch cuts the compressor.
Force the condenser fan to balance
the temperature of the air with that of the fluid.

If the indications of the manometer (temperature e
of the fluid) and the thermometer (temperature of
air) coincide to within 2°C, we can say
that there are no incondensables in the circuit.

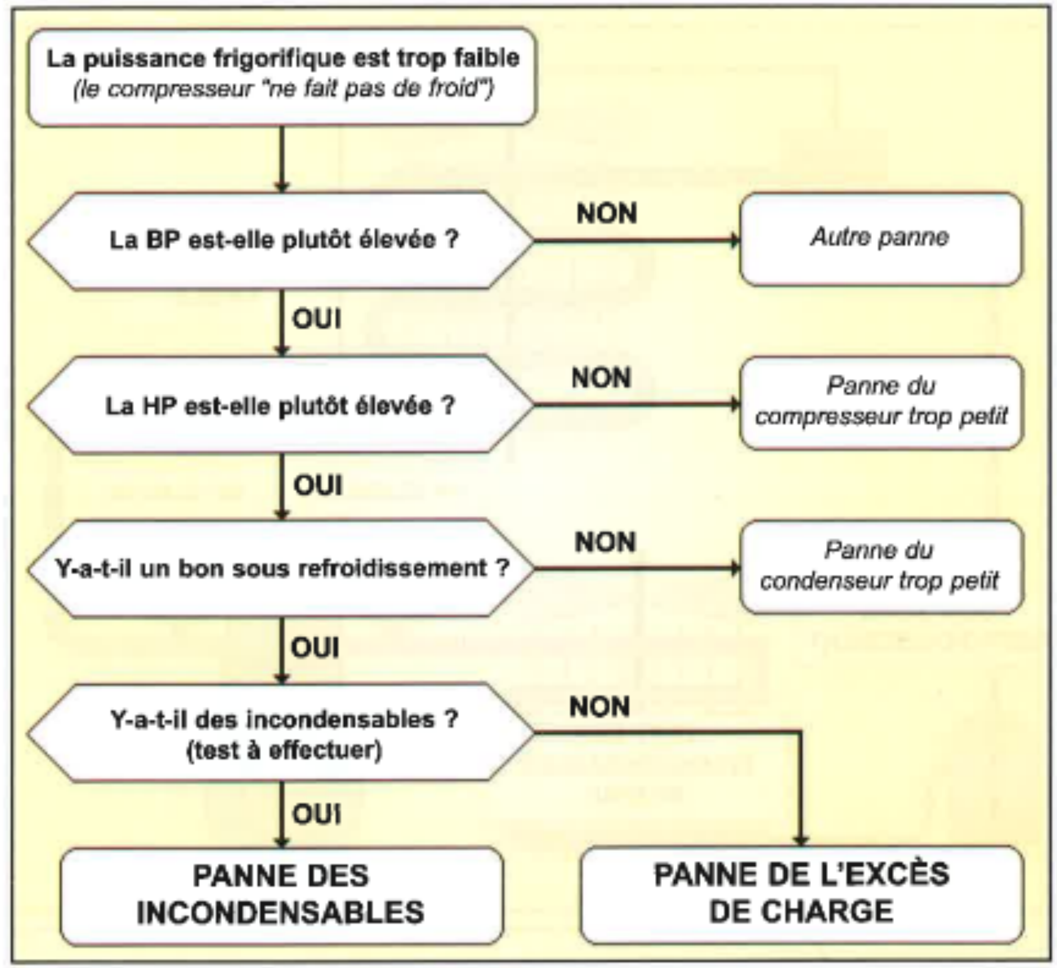


Presence of incondensables

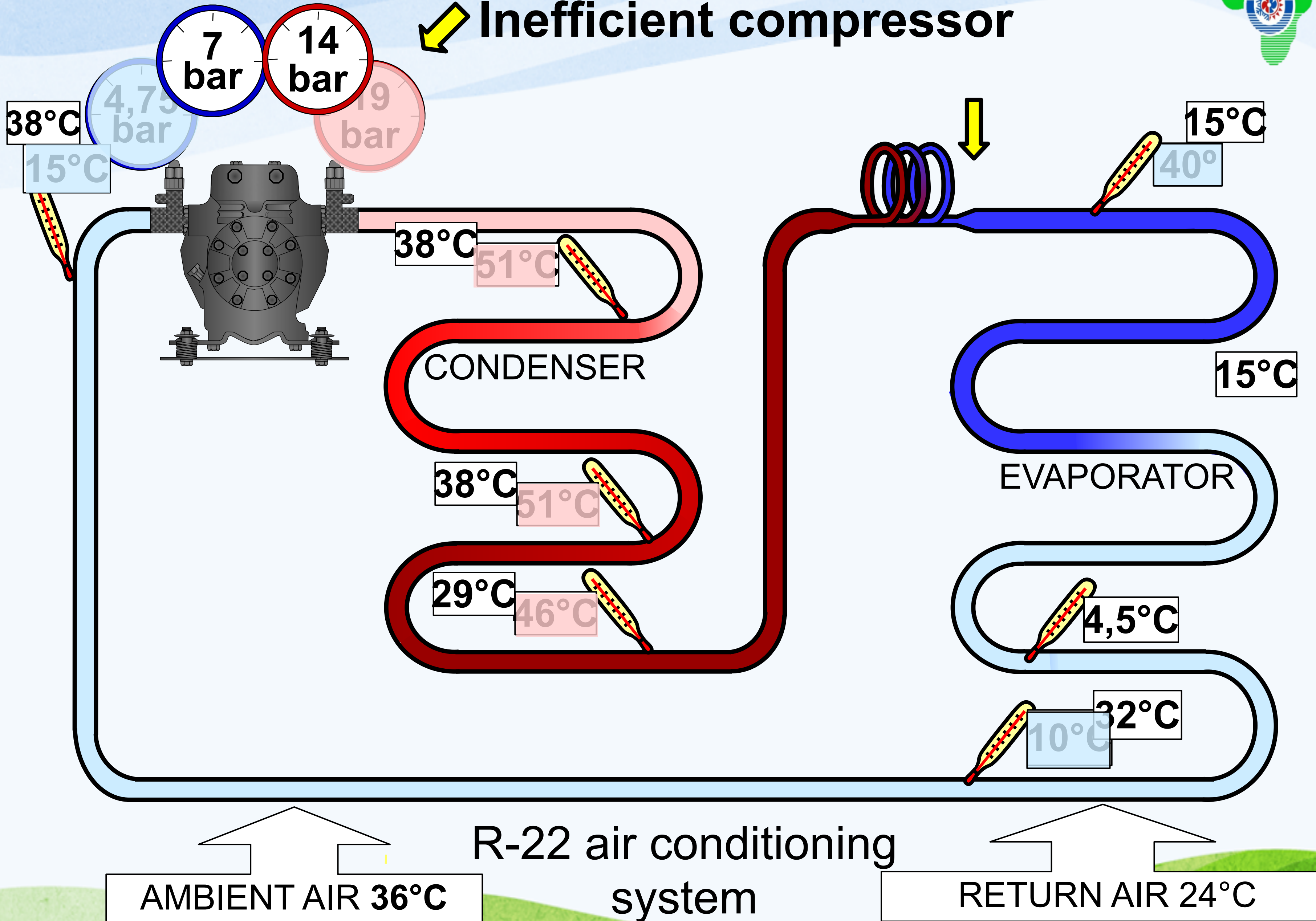
Interpretation

- The HP increases because the surface used for condensation is reduced, and the subcooling is rather high.
- The HP increases and the capacity of the compressor decreases, therefore the cooling capacity decreases and the intensity absorbed by the motor increases.
- The HP being high, the expansion valve injects more fluid into the evaporator, the BP
- increases and the overheating is rather low.

Troubleshooting methodology



Inefficient compressor



R-22 air conditioning system

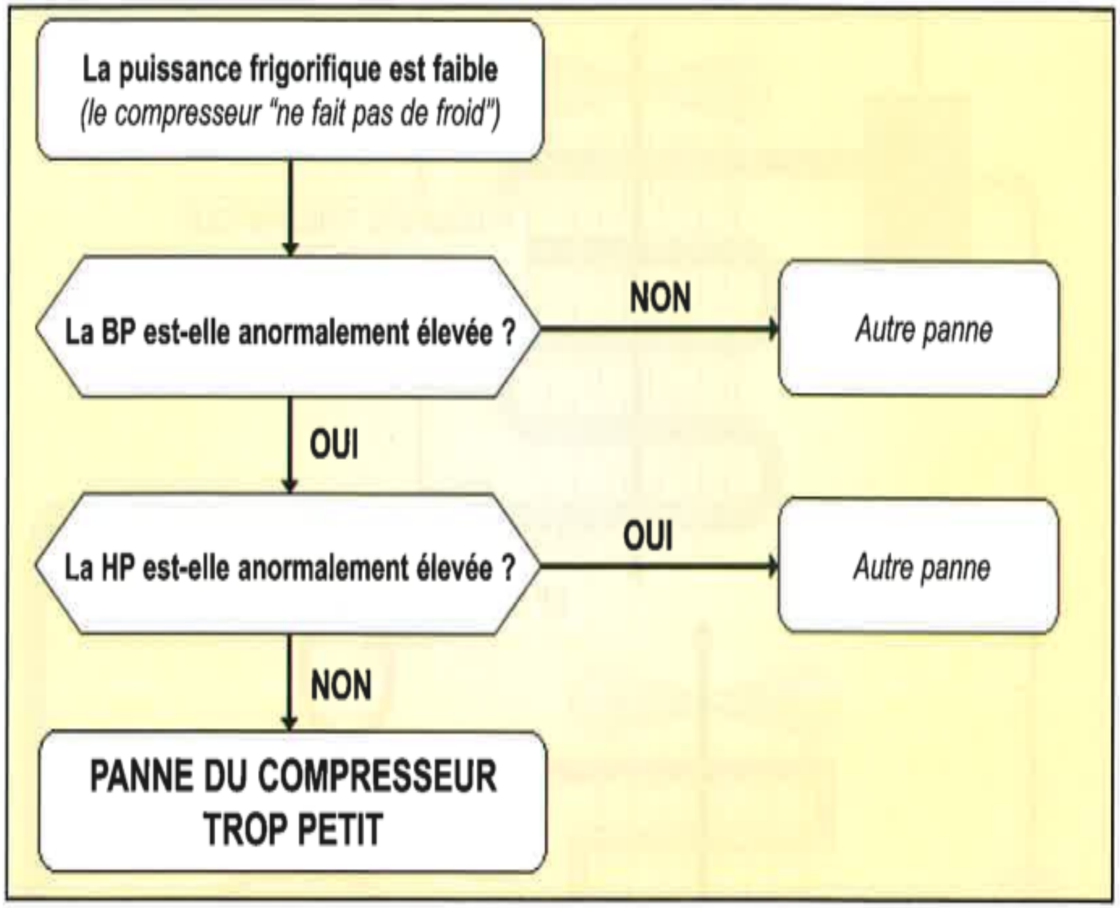
Inefficient compressor

Interpretation

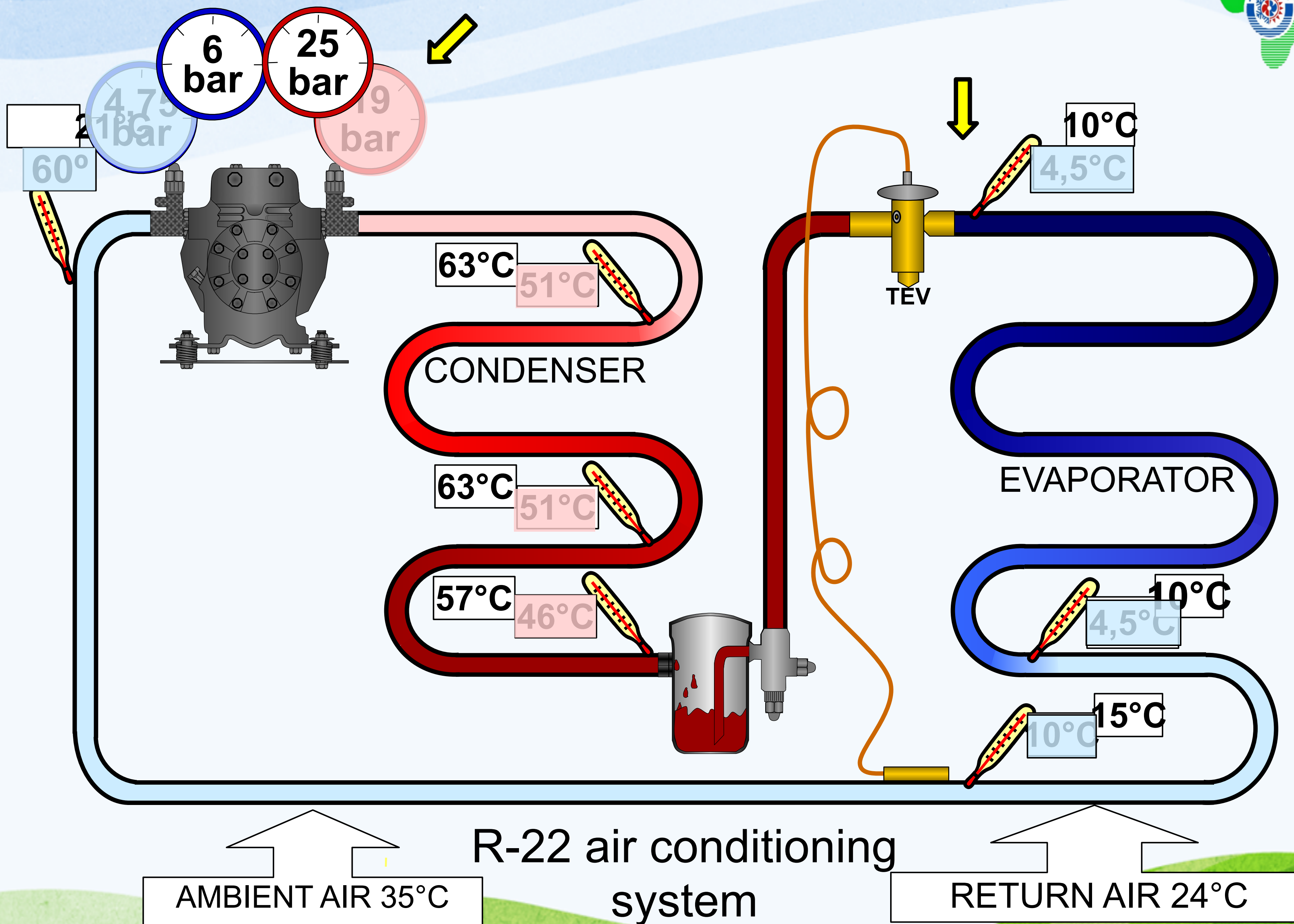
❑The compressor is small, it draws in less vapor than the evaporator produces. This is why the BP increases. The cooling capacity drops.

❑The amount of heat removed to the condenser drops and the HP drops.

Troubleshooting methodology



Condenser too small



Condenser too small

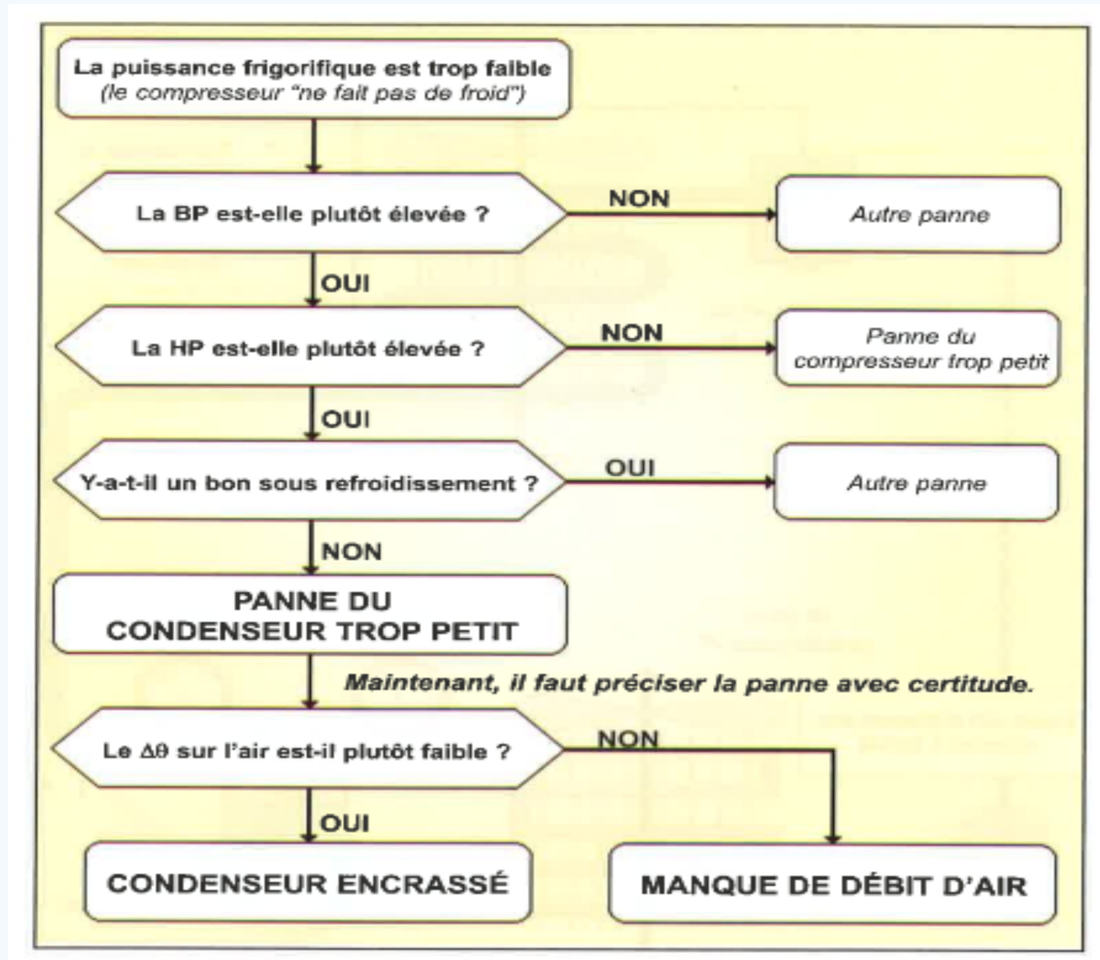
❑ Interpretation

❑The HP increases and the capacity of the compressor decreases, therefore the cooling capacity decreases and the intensity absorbed by the motor increases.

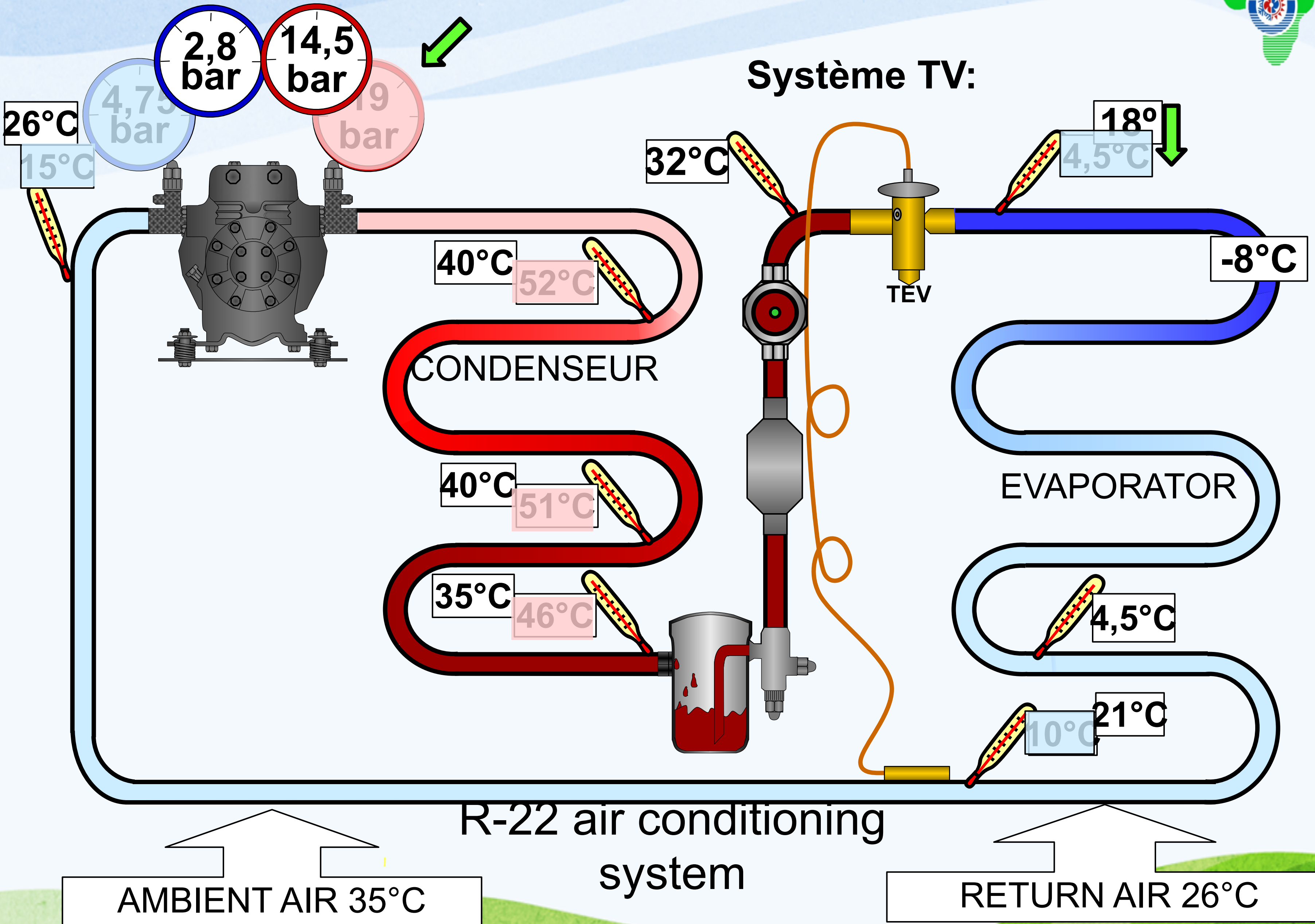
❑The HP being high, the expansion valve injects more fluid into the evaporator and the superheat is rather low.

The subcooling is low, in this case the condenser is dirty or

Troubleshooting methodology



Regulator too small



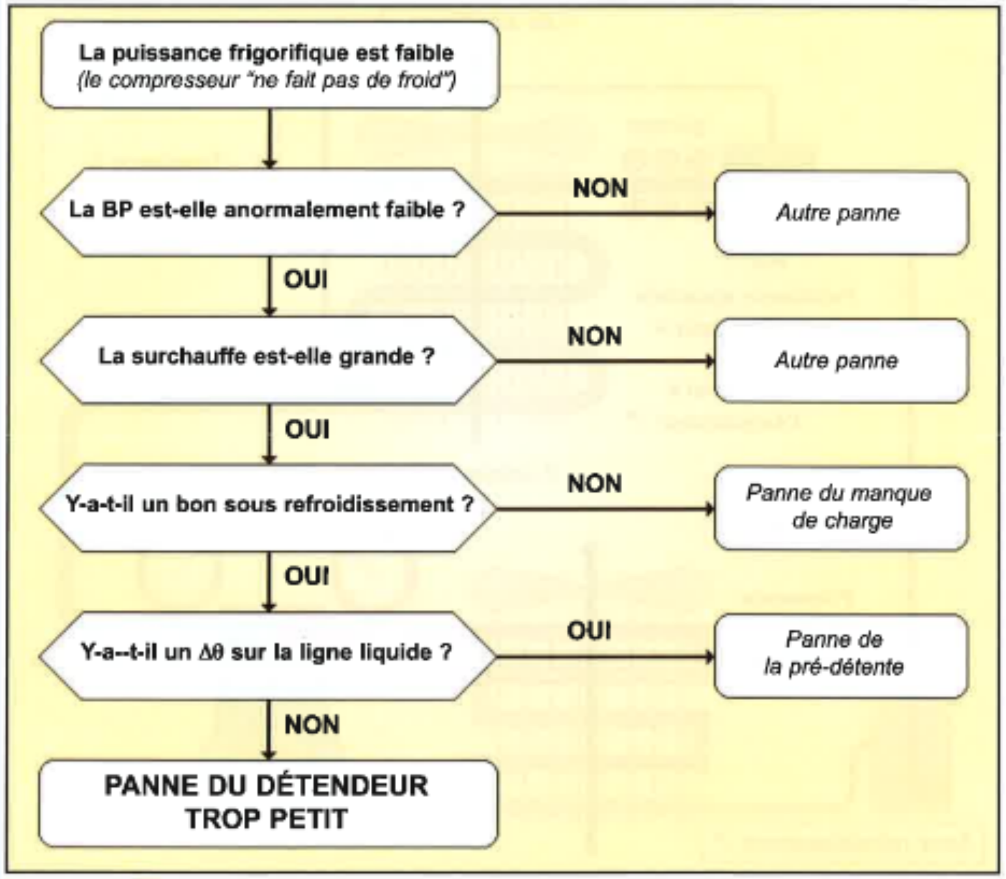
R-22 air conditioning system

Regulator too small

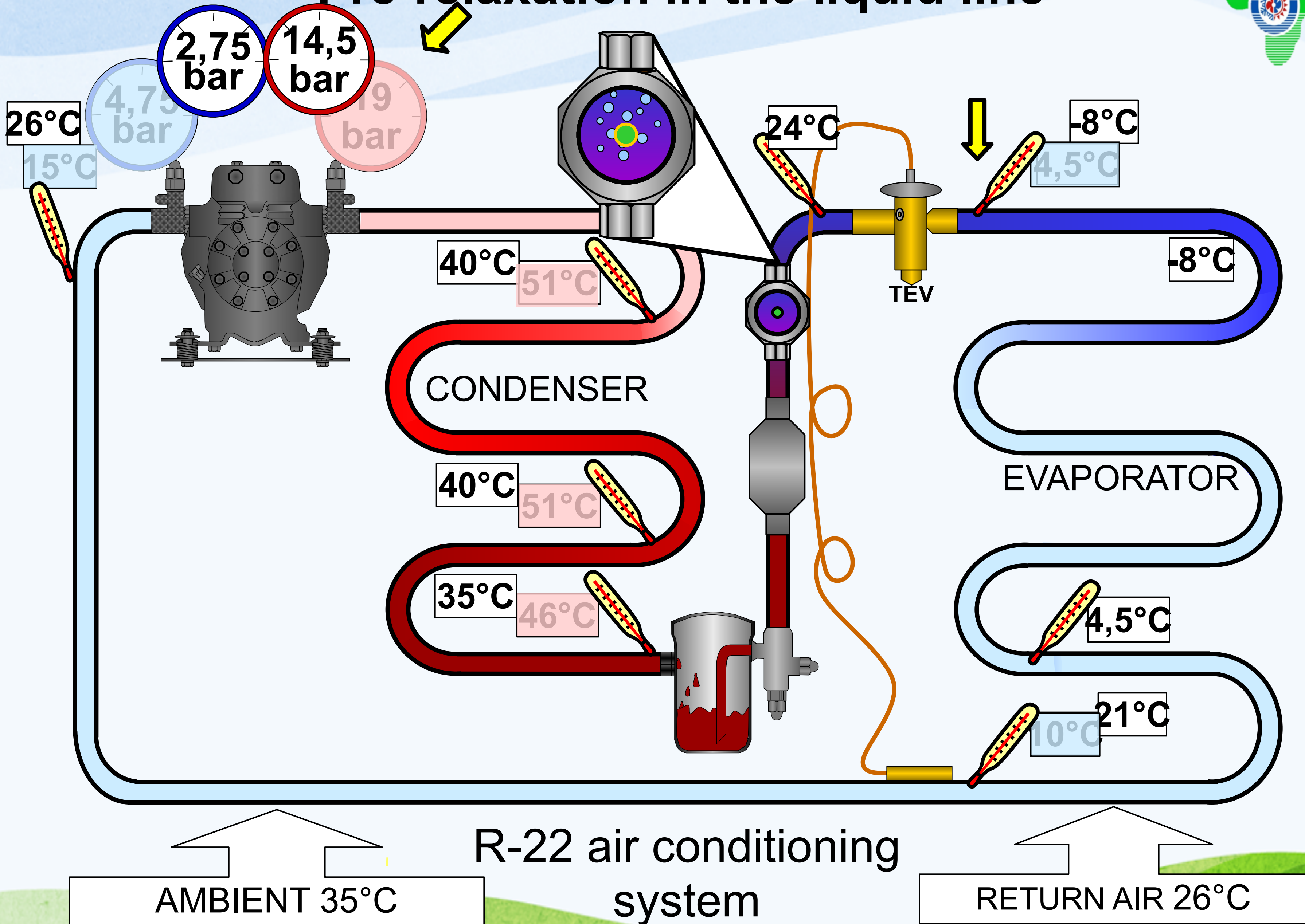
Interpretation

- ❑The quantity of fluid reaching the evaporator is low: the cooling capacity drops (the air cools less) and the superheat increases.
- ❑Since the condenser receives less cooling power to evacuate, it becomes overpowered and the refrigerant is well cooled and the condensation pressure drops. Less fluid in the evaporator results in more liquid in the condenser: Subcooling is good.

Troubleshooting methodology



Pre-relaxation in the liquid line



R-22 air conditioning system

Pre-relaxation in the liquid line

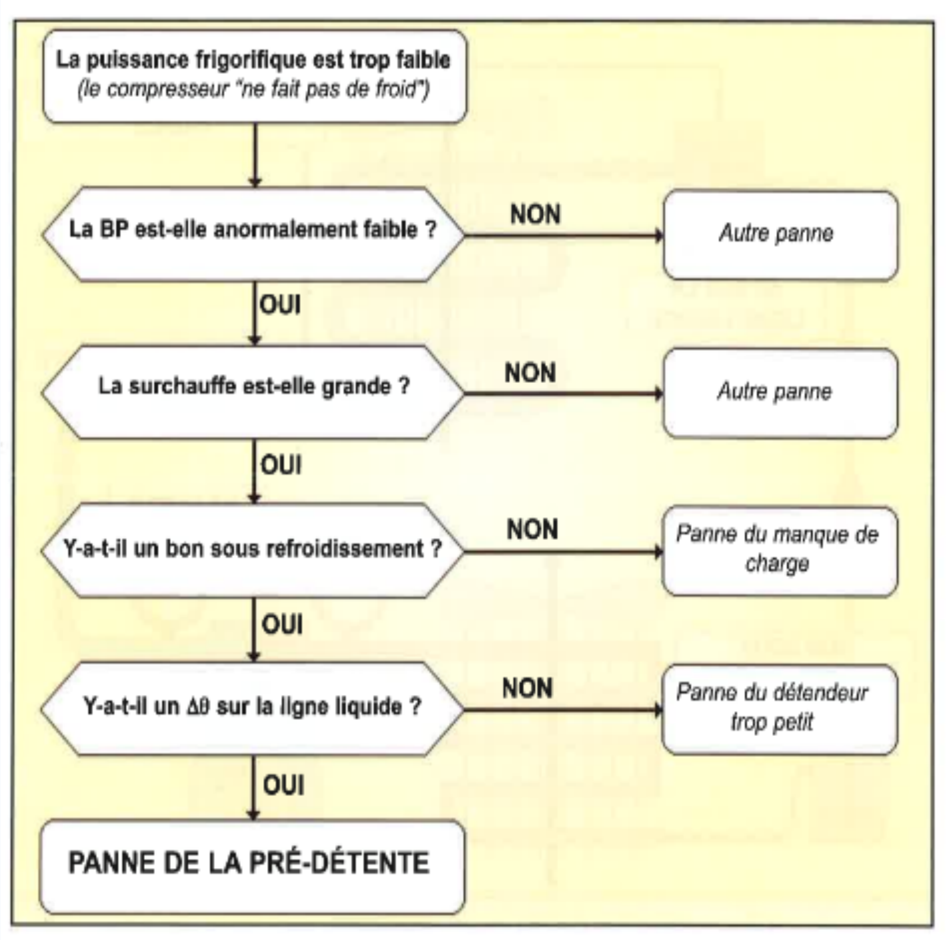
Interpretation

❑A significant pressure drop results in pre-expanding (part of the fluid evaporates). We also talk about gas flash on the liquid line. The drop in temperature on the liquid line is the main consequence of such a failure.

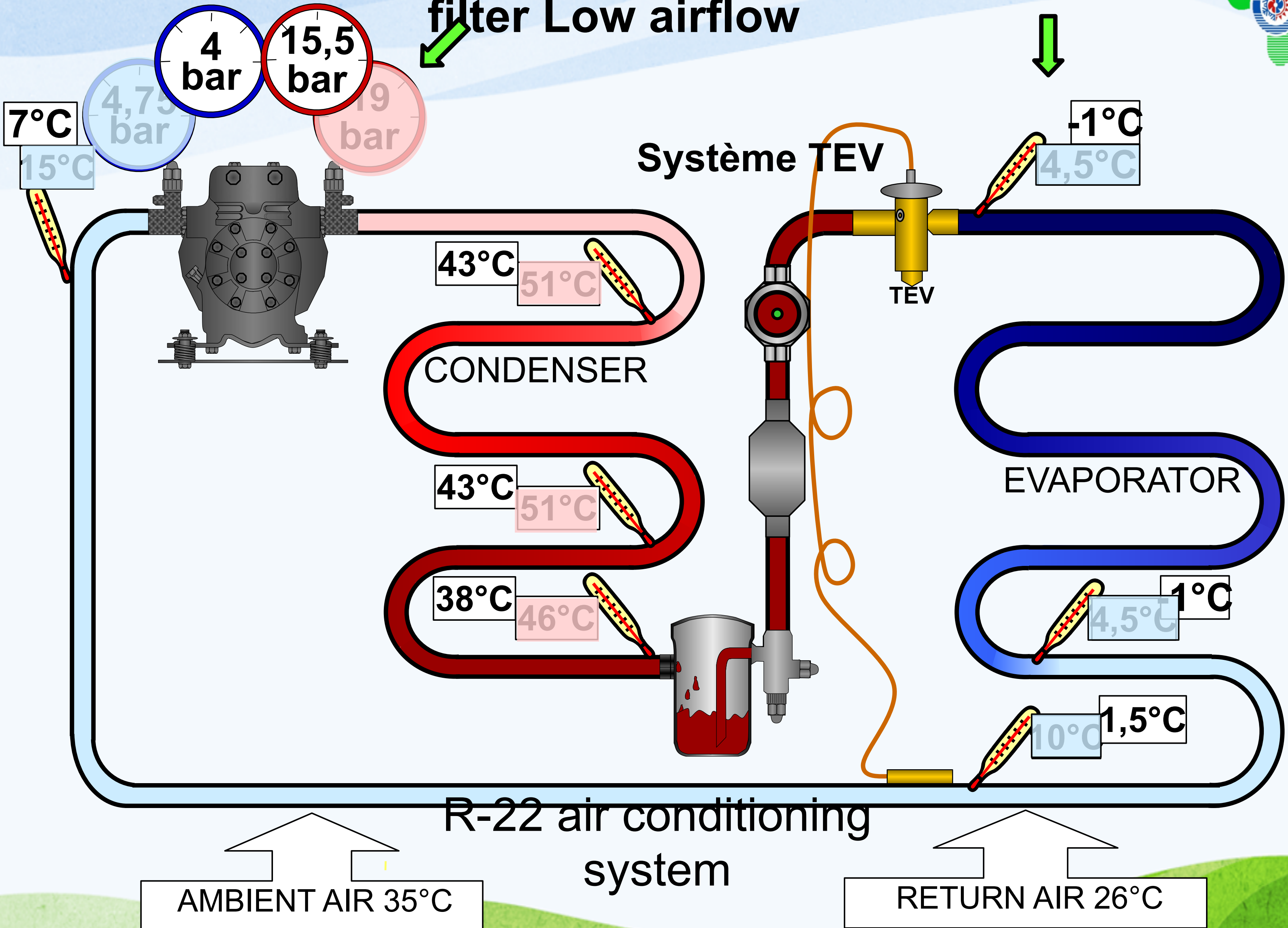
❑A drop in temperature on the liquid line leads to a pressure drop (loss of pressure), so the quantity of fluid reaching the expansion valve is low: the cooling capacity drops (the air cools less) and the overheating increases.

❑Since the condenser receives less cooling power to evacuate, it becomes overpowered and the refrigerant is well cooled and the condensation pressure drops. Less fluid in the evaporator results in more liquid in the condenser: Subcooling is good.

Troubleshooting methodology



Dirty or icy evaporator Dirty filter Low airflow



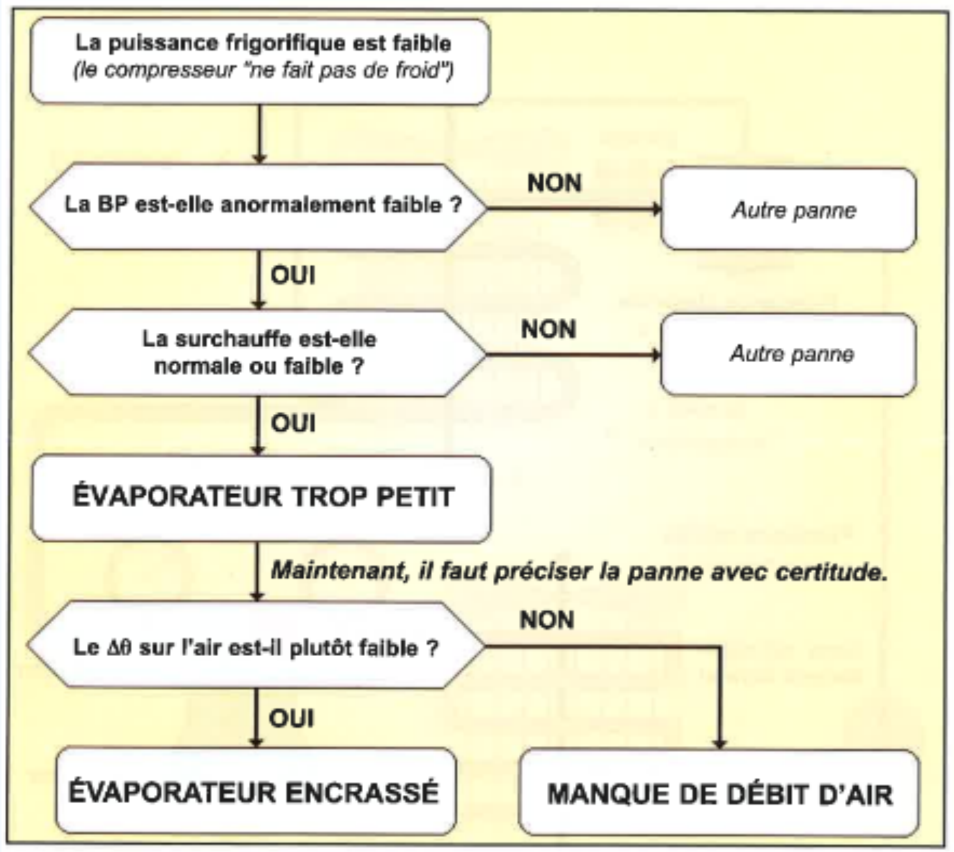
R-22 air conditioning system

Dirty or icy evaporator Dirty filter Low airflow

Interpretation (two possible cases):

- First case (D t° large air > 10°C): the failure is caused by a low air flow (the fan turbine slips). The low air speed and the latter remains much longer in contact with the evaporator.
- Second case (Small air D t° < 6°C): the cause of the fault is clogging of the evaporator (also dirty filters or crushed fins), the exchange of energy between the air and the refrigerant gets very badly, the air is less cooled.

Troubleshooting methodology



Get the right information

To diagnose a problem, you need to know:

The type of system

How it should work

How it currently works

The next slide is an example of a form that may be useful.

Pressions et températures:

(Facilite les calculs)

Design temp of box ________ Air temp. entering evaporator __A__ Air temp. entering the condenser __X__

Refrigerant Type ________ Suction: Pressure ______ Temp __B__ Condensing: Pressure ______ Temp __Y__

Evaporator TD __A-B__ Condenser Split __Y-X__

Temp. of suction line at TEV bulb (or coil outlet, if cap tube) __C__ Temp. of liquid line leaving condenser __Z__

Superheat (Suction line temp - Suction temp) __C-B__ Subcooling (Liq. line temp – cond. Temp) __Z-Y__

Composants et accessoires du système:

Cap Tube? ________ Exp. Valve? ________ Pumpdown Sol? ________ Evap below compressor? ________

Remote? ________ Where? ________ HPR? ________ Fan Cycle? ________ Ptrap? ________

Current Operation & Condition:

Evap. coil clean clear through? ________ Condenser clean clear through? ________ Drain clear? ________

Comp. cycling on L.P. control? ________ ,on H.P. control? ________ ,on Compr. O.L.? ________ Comp. noisy? ________

Sight glass full? ________ Door closed and gasket sealing? ________

Additional information relative to compressor operation:

Nameplate Amps (RLA) ____________ Actual Amps ____________

Nameplate Volts ____________ Actual Voltage @ comp. ____________ Actual Voltage on Startup ________

Informations supplémentaires relatives au fonctionnement du compresseur :

ssor ________

Exercice d’utilisation du tableau de diagnostic

Supposons les conditions suivantes d’un système problématique :

» Basse température de condensation

» Faible sous-refroidissement

» Basse température de l’évaporateur

» Surchauffe élevée

» Utilisez le graphique pour trouver le problème :

» Encerclez TOUS les X pour les conditions qui s’appliquent au système

» Totaliser les X dans chaque colonne

» Le problème est la colonne avec le plus de X

» Remarque: XCT s’applique uniquement aux systèmes de tubes de capillaire (dosage fixe)

» XEV s’applique uniquement aux systèmes TEV

Determine which symptoms apply, then circle all the X's in the row for each symptom.
Total all the X's in each column. The column with the most X's in the problem.

"X" by itself means Cap Tube and Expansion Valve symptoms are the same for that category.
"CT" means this symptom would be important in a Cap Tube "fixed metering device" system only.
"EV" means this symptom is important for an Expansion Valve system.

Diagnostic Chart

	Column Number ▶	1	2	3	4	5	6	7	8	9
Condensing Temperature = Ambient temperature + TD	***HIGH*** (10° higher than Normal)						X	X	X	X
Ex: Condensing temp. is low	NORMAL									
Standard Units = Ambient + 30°	***LOW*** (10° lower than Normal)	(X)	(X)	(X)	(X)	(X)				
Condenser SubCooling = Condensing temp. - Condenser Outlet temp.	***HIGH*** (Subcooling Above 20°)		X CT				X		X	X
Ex: Subcool is low	NORMAL	X	X EV		X	X		X		
Normal Subcooling = 10°	***LOW*** (Subcooling Below 5°)			(X)						
Evaporator Temperature = Air Entering Evaporator - TD	***HIGH*** (10° higher than Normal)				X			X CT	X CT	X CT
Ex: Evap temp. is low	NORMAL							X EV	X EV	X EV
TD for A/C (35°), R/I (15°), W/I (10°)	***LOW*** (10° lower than Normal)	(X)	(X)	(X)		(X)	(X)			
Evaporator Superheat = Evaporator temp. - Evap. Outlet temp.	***HIGH*** (5° higher than Normal)		(X)	(X)	(X)	(X)	(X)			
Ex: Superheat is high	NORMAL	X EV						X EV	X EV	X EV
Superheat = 10° (Approx.) Note: A/C can be 15° to 18° Superheat	***LOW*** (5° lower than Normal)	X						X CT	X CT	X CT
Ex: Sight glass is bubbling	FULL	X	X		X	X		X	X	X
	BUBBLING			↓		(X)	(X)			
	Total of Circled X's in each Column =	2	3	5	2	4	3			
	DIAGNOSIS (problem):	DIRTY ICED EVAP	REST TEV CAPT	LOW CHG	COMP VLVS	REST AFTR RECV	REST BEFR RECV	DIRTY COND	AIR IN SYSTEM	OVER CHG.

Printable Fact Sheets

The next two slides can be printed for use in the lab or on the job.

Hopefully they will be of help in diagnosing the system problem.

Déterminez quels symptômes s'appliquent, puis encerclez tous les X de la ligne pour chaque sympTotalisez tous les X dans chaque colonne. La colonne avec le plus de X est le problème.

« X » signifie en soi que les symptômes du tube de capuchon et de la soupape d'expansion sont les mêmes pour cette catégorie. « CT » signifie que ce symptôme serait important dans un système de « dispositif de mesure fixe » à tube capuchon seulement.
« EV » signifie que ce symptôme est important pour un système de détendeur.

Tableau de diagnostic

(pour les impressions)

	Numéro de colonne	1	2	3	4	5	6	7	8	9
Température de condensation = Température ambiante + TD Unités standard = Ambiante + 30°	ÉLEVÉ (10 ° plus élevé que la normale)						X	X	X	X
	NORMAL									
	FAIBLE (10° plus bas que la normale)	X	X	X	X	X				
Condenseur SubCooling = Température de condensation - Sortie du condenseur Sous-refroidissement normal = 10°	ÉLEVÉ(sous-refroidissement au-dessus de 20°)		X CT				X		X	X
	NORMAL	X	X EV		X	X		X		
	FAIBLE(sous-refroidissement en dessous de 5°)			X						
Température de l'évaporateur = Air entrant dans l'évaporateur - TD TD pour A/C (35°), R/I (15°), W/I (10°)	ÉLEVÉ (10 ° plus élevé que la normale)				X			X CT	X CT	X CT
	NORMAL							X EV	X EV	X EV
	FAIBLE (10° plus bas que la normale)	X	X	X		X	X			
Surchauffe de l'évaporateur =Température de l'évaporateur - Evap. Température de sortie. Surchauffe = 10 ° (environ)Remarque: La climatisation peut être de 15 ° à 18 ° Surchauffe	ÉLEVÉ (5 ° plus élevé que la normale)		X	X	X	X	X			
	NORMAL	X EV						X EV	X EV	X EV
	FAIBLE (5° plus bas que la normale)	X						X CT	X CT	X CT
VERRE DE VISION	COMPLET	X	X		X	X		X	X	X
	BOUILLONNEMENT			X		X	X			
Total des X encerclés dans chaque colonne =										
DIAGNOSTIC (problème) :		VAPE GLACÉE SALE	REST TEV CAPT	FAIBLE CHG	VLV COMP	REST après RECV	REST avant RECV	COND SALE	SYSTÈME AIR IN	SUR CHG.

Information système (pour les impressions)

Pressions et températures :

Température de consigne du local .... Air temp. entrant dans l'évaporateur .... Air.temp entrant dans le condenseur .... Type de réfrigérant .... aspiration: Pression .... Intérimaire................ ..... Condensation: Pression .... Intérimaire.......... .....

Évaporateur TD ....   Condenseur renversé ....

Température de la ligne d'aspiration à l'ampoule TEV (ou sortie de la bobine, si tube de bouchon) .... Température de la conduite de liquide sortant du condenseur .... Surchauffe (Ligne d'aspiration temp-Suction temp) .... Sous-refroidissement (Liq. Ligne temp-cond. Temp)..................................

Composants et accessoires du système :

Tube à capuchon?................ Ditendeur?............... Pumpdown Sol?........... Evap sous le compresseur?............ Lointain?.................. Où?............... RPH ?................ Cycle du ventilateur?................ P.trap?... ....

Fonctionnement et état actuels:

Evap. Bobine propre à travers?............ Condenseur propre clair à travers?................. Égoutter à blanc?................ Comp. cyclisme sur LP. Contrôle?.................., sur Compr. OL?............ Comp bruyant?.............. verre de vision plein?................ Porte fermée et étanchéité des joints?...............

Informations supplémentaires relatives au fonctionnement du compresseur :

Amplis de plaque signalétique (RAL).................. Ampères réels.................. ..... Plaque signalétique Volts...............................

Tension actuelle .... Tension du démarrage.................................. .....

Température de la conduite d'aspiration 3 "- 6" du compresseur......................... Température de la conduite de refoulement 3"- 6" du compresseur.......................

End
Repair
System issues