📄 LESSON PACKET

Refrigerant Gauges & Pressure-Temperature Relationships

TMM Academics – Sealed System Training

🔹 Lesson Overview

This lesson explains how refrigerant gauges work, how to read them correctly, and how to use pressure readings to determine system performance. Understanding gauges is essential for diagnosing sealed system issues and verifying proper operation.

🔹 1. Purpose of Refrigerant Gauges

Refrigerant gauges are used to:

- Measure system pressure
- Monitor system operation
- Assist in charging and recovery
- Diagnose system problems

👉 Gauges are one of the **most important tools in sealed system diagnostics**

🔹 2. Types of Gauges

Low Side (Compound Gauge)

- Reads **pressure and vacuum**
- PSI (positive pressure)
- Inches of vacuum (negative pressure)

High Side Gauge

- Reads **pressure only**
- Used for high-pressure side of system

👉 Low side = diagnostic tool
👉 High side = system performance reference

🔹 3. Understanding the Compound Gauge

The low side gauge is called a **compound gauge** because it measures:

- Positive pressure (PSI)
- Vacuum (inches of mercury)

Key Sections:

- Blue scale → PSI
- Green scale → Vacuum

👉 Vacuum is used during evacuation
👉 PSI is used during operation

🔹 4. Gauge Valve Operation (CRITICAL CONCEPT)

👉 **You DO NOT open valves to read pressure**

Why?

- Pressure flows directly to the gauge
- Opening valves allows refrigerant to move between ports

Valves are only opened when:

- Charging refrigerant
- Pulling vacuum
- Adding nitrogen
- Recovering refrigerant

👉 Gauges read pressure **even when valves are closed**

🔹 5. Saturation Temperature (Key Concept)

Inside the gauge:

- Colored scales represent refrigerants
- These show **temperature at a given pressure**

👉 This is called:

Saturation Temperature

Meaning:

At a given pressure, refrigerant will boil (or condense) at a specific temperature

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👉 Pressure = Temperature relationship

🔹 6. Pressure vs Temperature Relationship

This is the foundation of diagnostics:

- Pressure tells you the temperature of the refrigerant
- Temperature tells you if the system is operating correctly

Example:

If refrigerator target = **34°F**

- Evaporator must be colder
- Typically **10–15°F lower**

👉 Target evaporator temp ≈ 20–25°F

Then:

- Use PT chart
- Find pressure that matches that temperature

👉 That becomes your **expected system pressure**

🔹 7. Why Pressure Alone Is NOT Enough

Many beginners:

❌ “I have pressure, so system is good”

👉 That is incorrect

You must ask:

✓ What temperature am I trying to achieve?
✓ What pressure corresponds to that temperature?

👉 Only then can you determine if system is correct

🔹 8. Using Gauges for Diagnostics

Gauges help determine:

- Overcharge
- Undercharge
- Restrictions
- Compressor issues

Key Concept:

👉 Pressure must match expected temperature conditions

🔹 9. Gauge Calibration

Before using gauges:

- Needle must read **zero** when disconnected

If not:

- Adjust using calibration screw

👉 Inaccurate gauges = incorrect diagnosis

🔹 10. Using Gauges on Different Refrigerants

👉 Pressure is pressure (same reading across refrigerants)

BUT:

❗ Temperature will be different

Example:

- 40 PSI R134a ≠ 40 PSI R600a (temperature-wise)

👉 Always use:

- PT chart
- Or app

🔹 11. Charging Methods

Method 1 – Scale

- Most accurate
- Measures exact amount added

Method 2 – Dial-a-Charge

- Visual measurement
- Tracks refrigerant leaving container

👉 Both measure **quantity**, not performance

🔹 12. Dual Evaporator Systems (Advanced)

Modern systems may have:

- Multiple evaporators
- Step valves
- Variable speed compressors

Problem:

- Pressure readings become inconsistent

Solution:

👉 Force system into test mode
👉 Open all evaporators

Then:

- Take accurate readings

👉 Otherwise readings may be misleading

🔹 13. Hose & Connection Awareness

Common issues:

- Wrong hose end used
- Not depressing Schrader valve
- Dirty or damaged seals

👉 Results in:

❌ No flow
❌ False vacuum
❌ Incorrect charging

🔹 14. Tool Maintenance

Always check:

- Hose condition
- Seals
- Gauge calibration

👉 Faulty tools = faulty diagnosis

🔹 15. Key Takeaways

✓ Gauges measure pressure, not performance
✓ Pressure must be converted to temperature
✓ Always know target temperature first
✓ Valves stay closed when reading pressure
✓ Use PT relationship for diagnosis

📝 Review Questions

Multiple Choice

1. What does a compound gauge measure?
   A. Pressure only
   B. Vacuum only
   C. Pressure and vacuum
   D. Temperature only

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2. When should gauge valves be opened?
   A. When reading pressure
   B. Always
   C. During charging or vacuum
   D. Never

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3. What does saturation temperature represent?
   A. Air temperature
   B. Refrigerant boiling point at pressure
   C. Ambient temperature
   D. Compressor temperature

Short Answer

4. Why must the evaporator be colder than box temperature?

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5. Why is pressure alone not enough for diagnosis?

Scenario

6. You measure 25 PSI on a system.
   How do you know if this is correct?

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7. Your gauge does not read zero when disconnected.
   What should you do?

✅ Answer Key

1. C – Pressure and vacuum
2. C – During charging or vacuum
3. B – Refrigerant boiling point at pressure

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4. To absorb heat from the space

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5. Because pressure must match temperature conditions

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6. Compare to temperature using PT chart

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7. Calibrate the gauge