

Facilities Management  
Labor Trades and Crafts  
Trainee Program  
Preventive Maintenance  
PMT-I

Name: \_\_\_\_\_

Date Started: \_\_\_\_\_

Completion Date: \_\_\_\_\_

Copy to official record: \_\_\_\_\_

## Introduction

Throughout this entire training program, this qualification booklet will be paramount to your success. It will require signatures of qualified people to ensure that you are fully trained throughout your qualification process. The goal of this program is to provide you with the best training opportunities available so that you may meet the State of Colorado minimum requirements for a Pipe Mechanical Trades I position. This booklet will be broken down into three main sections for each competency.

1. Fundamentals – This is a fundamental understanding of various core competencies / subjects. Book learning and classes will give you a fundamental knowledge of areas related to this section of your training program.
2. Systems Knowledge (Watch stations)– In the various areas of study you will be required to fully understand mechanical systems as they relate to a Pipe mechanical Trades I position. This is accomplished through on the job training and one on one training time with qualified subject matter experts in the field. Each topic in this section will require hands on training and the signature of a qualified person.
3. Practical exams – The final qualifying factor related to this training program will be practical exams. This is a demonstrated understanding of each competency and a real time demonstration of fundamental systems knowledge. You will have to satisfactorily perform the actual duties as performed by other maintenance technicians. Examples could include changing oil on a compressor, amping out a motor, or troubleshooting and root cause determination of bearing failures.

## Trainee

Your supervisor will tell you which areas you are to complete and in what order. You will also have vast sources of information and resources at your disposal. The entire shop is filled with subject matter experts; each of them is here to help you succeed, use them! I encourage you to ask questions, remember that there are no stupid questions, so if in doubt, ask. Working directly with PMT I's on a daily basis will provide you the insight and training that you will need to succeed in the systems knowledge portion of this program. Your supervisor will also provide you with subject information in the form of textbooks, publications, journals, or industry related articles. If you have any questions or are unable to locate references, contact your supervisor, PMT I, Journeyman or qualifier. Good Luck!

***It must be noted that completion of this training does not ensure immediate qualification for a PMT-I position. The candidate must meet all "State of Colorado" minimum requirements for job description D6C1TX as referenced in Appendix A.***

## Table of Competencies:

### Section 1: Safety:

1. Asbestos
2. Confined Space
3. Rigging
4. Personal Protective Equipment
5. Ladder Safety
6. Chemical Safety
7. Hearing Conservation
8. Lock-out/Tag-out Procedures
9. Basic Emergency Procedures
10. Respirator
11. Construction site access
12. Proper Tie-off procedures
13. Material Safety Data Sheets (MSDS)
14. Basic electrical safety

### Section 2: Mechanical Systems - HVAC:

1. Air Handlers
2. Air Filtration
3. Understanding coils
  - Piping configurations
  - Freeze protection
4. Pumps
  - Proper isolation
  - Lubrication
  - Inspection
  - Vibration analysis
  - Troubleshooting
  - Installation
  - Harmonics
  - Redundancy
5. Variable Frequency Drives (VFD's)
6. HOA Settings
7. Andover / Building Automation
  - Basic understanding
  - What to look for in the field
  - Call in's

- Building critical systems
  - OIT / Campus critical systems
  - Alarms
  - Direct digital controls or pneumatics
8. Drive systems
- Belts
    - Selection
    - Tensioning methods
    - Sizing
    - Alignment
    - Wear
  - Sheaves
    - Wear
    - How to replace
    - Selection
    - Type
    - Sizing
    - Ordering
    - Proper installation
  - Bearings
    - Inspection
    - Replacement
    - Types
    - Ordering
    - Proper installation
9. Chillers
10. Condensers
11. Split systems
12. Evaporative cooling
13. Cooling Towers
14. Controls
- Pneumatics
  - DDC
  - Fail to open/close
15. Flat Plate
16. VAV

Section 3: Mechanical systems - Air Compressors:

1. How to properly isolate
2. Troubleshooting

3. Small repairs
4. Inspections
5. Types
  - Sullair
  - Kaeser
  - Quincy
  - Atlas Copco
  - Reciprocating

#### Section 4: Mechanical Systems – Steam:

1. Basic Steam Knowledge
2. Low/medium/high pressures
3. Condensate systems
4. Steam Traps
  - Types
  - Maintenance
  - Alerts
5. Pressure reducing stations
6. Load shedding

#### Section 5: Trade Specific HVAC Training:

1. Thermodynamics
2. OHMS Law
3. Basic Refrigeration
4. Electrical Meter proficiency
5. Fluid Movement
  - Air
  - Liquid
6. Pressure / Temperature relationship
7. Types of heat transfer
8. Principles of evaporation
9. Air Balancing

#### Section 6: Trade Specific Electrical Training:

1. Troubleshooting motors
2. Motor Bearings
3. Electrical 101
4. Amping Motors
5. Electrical connections

### Section 7: Trade Specific Plumbing Training:

1. Backflow
2. Soldering techniques
3. Water filtering systems
4. Drains
  - Sanitary
  - Storm
5. Plumbing 101
6. Vacuum Pumps

### Section 8: General Trades Knowledge:

1. Cleanroom and lab entry protocol
2. Animal Labs
3. Cold rooms
4. Outage notification process
5. Hot work permits
6. Contractors
7. Daily Operations Control Center routine

### Section 9: Emergency Procedures:

1. Operations Control Center procedures
2. Essential services
3. PDPS
4. Who to contact in emergency situations

### Section 10 Computer skills:

1. FAMIS Work Order Management system
  - Time entry
  - Work orders
  - Other FAMIS Modules
  - Material issuance
  - Procurement
  - Notes
2. Microsoft Word
3. Microsoft Excel
4. Skill-soft Computer based Training
  - Discrimination and harassment
  - Fiscal ethics

- Fiscal Responsibilities

# Fundamentals

In this portion of your training plan you will be answering relevant questions to each section in the table of competencies. You will be required to answer these questions accurately, so take your time and detail full and complete answers. There are several resources at your disposal, so use them. Upon completion of this fundamentals section, you will be ready for the systems / watch station's section (hands on training) where you will obtain signatures from qualified technicians in the Pipe Mechanical Trades community. Gaining a fundamental understanding of how a PMT-I operates daily will provide you with insight and knowledge that will become the backbone of your career in the Trades Department.

## Section 1: Safety

1. Who is the Safety Officer for Facilities Management? What is their phone number and e-mail?
2. Where is the Safety Officer's office located?
3. What does OSHA stand for, and is the campus governed by OSHA?
4. Define Asbestos -
5. Who is in charge of the campus asbestos program?
6. What do you do if you encounter asbestos in the workplace?
7. As related to safety, what is a Confined Space?
8. What equipment is required to be used prior to entry into a confined space?
9. Facilities Management has a confined space program – Outline the basics of this program –
10. What is an air monitor and where can these be located?
11. How often are air monitors required to be calibrated?

12. What is rigging, and why is it important to your job as a PMT-I?
13. What does PPE stand for?
14. Provide seven examples of PPE?
15. Name three kinds of ladders that are used in the Trades Department?
16. Explain in detail what the 4-1 rule as it is applied to ladder safety?
17. Is it okay to use a step ladder as an extension ladder if the height to travel is less than six feet? Explain your answer.
18. How far does an extension ladder need to extend pass the level of the working surface?
19. Suppose you are working and come across a chemical spill – what do you do?
20. What kind of PPE is required when handling chemicals for water treatment?
21. Where can you find information for the proper PPE when handling chemicals?
22. What are the two primary types of water treatment chemicals that are used in the Trades Department on campus? What does each do?
23. What is hearing conservation?
24. According to OSHA, at what decibel level is hearing protection required?

25. Is there ever a need to use double hearing protection? Explain your answer in detail.

26. What is Lock out / Tag out?

27. Why is Lock out / Tag out used?

28. Once a system is locked out, who may remove the lock and tag?

29. Related to lock out / tag out – Suppose three separate people are working on cleaning a cooling tower, explain who is required to lock the cooling tower out, and why?

30. What is a hasp used for in regard to lock out / tag out?

31. There are various devices used to lock out different types of equipment, where are these located?

32. You are working in the field and witness an emergency:

– What do you do?

Write down contact information for the following:

- Operations Control Center –
- PDPS -
- Control room –
- Environmental Health and safety -
- Trades Asst. Director -
- Associate Director –
- Director

33. In what situations would you use a respirator in the field?

34. What steps must be taken before you can wear a respirator?

35. You are scheduled to go on a construction site walk through, what required items should you to have with you?
36. Explain what a safety harness is, and what it is used for?
37. Are safety harnesses one size fits all?
38. What is a safety lanyard – explain the relationship between a safety harness and a safety lanyard?
39. If you are working on a rooftop, under what circumstances should you use a safety harness?
40. Regarding safety – explain what it means to be safely tied off?
41. What does MSDS stand for?
42. You are working in the field and spill acetone on your hand, where would you go to find the MSDS for this?
43. On campus what is considered:
- Low voltage
  - Medium voltage
  - High voltage
44. What voltage is in a typical wall outlet?
45. How would you determine if a circuit is energized?

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## Section 2: Mechanical systems – HVAC

1. Describe in detail what an air handler is and the various sections associated with air handlers?
  
2. Describe how supply and exhaust are controlled and why this is so important, particularly in lab settings.
  
3. Air filtration is a critical part of this job, concerning air filtration, what does a “MERV” rating mean and why is it so important?
  
4. In what circumstances would charcoal filtration be used on campus?
  
5. Explain the differences between these types of filters, be sure to include efficiencies where applicable:
  - Washable
  - Standard capacity
  - High Capacity
  - Disposable fiber glass
  - HEPA
  - Headered filters
  - Box type filters
  - Pre filters
  - Intermediate filters
  - Final filters
  
6. In regard to coils, describe the difference between a steam coil and a coil that uses hot water heat transfer medium?
  
7. Describe the basic piping configuration for a steam coil?

8. Describe the basic piping configuration for a water coil?
9. In regard to coils, describe what freeze protection is, and where it is typically located?
10. Explain what high static discharge is in air handling systems?
11. Why do cooling coils have catch basins under them?
12. You have had a repair done on a cooling coil. It is up to you to re-fill the system, why is it important to get all of the air out of the system?
13. What does the term hydronics mean?
14. How would you remove the air from a hydronics system?
15. In regard to pumps, explain how to properly isolate a pump prior to maintenance?
16. Suppose you were doing a pump inspection and saw some black dust underneath the coupling, what could this indicate?
17. Explain the proper way to lubricate an oil reservoir pump?
18. Explain the proper way to lubricate a grease based pump?
19. Describe the procedure involved in a proper pump inspection?

20. What is vibration analysis and what is it used for?
  
21. You have been called out to check out a faulting pump, what would you do to trouble-shoot the pump?
  
22. What things would you look for to ensure that a pump was properly installed?
  
23. Why would it be important to have pump redundancy?
  
24. Describe what harmonics is as it is related to pumps?
  
25. What does VFD stand for?
  
26. Describe the basic operation of a VFD?
  
27. What is considered a "hard start" on equipment?
  
28. On many pieces of equipment you will see the letters "HOA" on the operating switch. What do these letters mean, and where do these switches typically stay?
  
29. What does Andover mean to you?
  
30. Describe the basic functions of an Andover system.
  
31. In the field, how do you determine if a piece of equipment is controlled by Andover?

32. Suppose you were doing a PM that required you to shut down an air handler, who would you inform prior to shutting off the power?

33. Name some critical building systems that could be affected by preventive maintenance operations?

34. There are several critical systems on campus that are governed by the Office of Information Technology (OIT) – Name some of them.

35. Why would the Andover system have alarm points in the field?

36. Name 10 points that could be alarmed by Andover in the field?

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37. What does “DDC” stand for?

38. Concerning drive systems, belts serve a large portion of our equipment. Name three main types of belts that we use on campus, and provide a brief description of each.

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39. Explain in detail the following things about belts:

- Explain how to select the proper belt for replacement.
- How would you cross reference belt sizes, should a particular size be out of stock?
- Explain step by step how to properly tension a belt.
- Explain how to size a belt
- Describe how you would determine if a belt requires replacement.

40. What is a sheave?

41. Explain in detail the following things about sheaves:

- Describe how you would determine if a sheave was wearing properly.
- Describe the process for determining when a sheave requires replacement.
- How do you replace a sheave?
- What is an "A" sheave?
- What is a "B" sheave?
- Suppose the serial numbers are worn off the old sheave, how would you select the proper type of sheave?
- How do you size sheaves?
- What is the proper procedure for ordering a sheave?

- Explain in detail how to properly install a sheave.
- There are two utilized ways to properly align a sheave in the PM shop. Name both ways and explain how each is done.

42. Explain in detail the following things about bearings:

- How can you tell that a bearing needs replacement?
- Do bearings get replaced in sets, or do they get replaced individually?
- How do you properly lubricate a bearing?
- How do you identify imminent/potential failures in a bearing?
- How do you order bearing replacements?
- Explain the process for the installation of new bearings.
- Suppose some old bearings failed and you had to replace them. Upon taking them off, the shaft underneath was scored, what do you do?

43. What is a chiller, and how does it work?

44. List the components on the condensing side of a chiller system.

45. Related to chillers, what maintenance responsibilities does the PM shop accomplish?

46. What is involved in punching chiller tubes? Detail this procedure below.
  
47. Explain how to properly lubricate the umbilical for a tube punching machine. How often should this be accomplished?
  
48. What procedure can be done to determine the wall thickness of tubes inside a chiller?
  
49. What steps would you take to properly clean a condenser?
  
50. Describe what a split coil is on a condenser.
  
51. What chemical is used to clean condensers?
  
52. Define what a split system is?
  
53. What is evaporative cooling?
  
54. Concerning an evaporative cooler – How does it work?
  
55. What are some problems commonly associated with evaporative cooling?
  
56. Define an air wash? What does it do?
  
57. How do you determine the proper water flow on an air wash system?

58. Suppose you had to replace the media in an air wash, what specifics would you define prior to ordering the media?
59. What is the purpose of a cooling tower?
60. Cooling towers operate under what basic principle?
61. What maintenance is accomplished by the PM shop on cooling towers?
62. Looking at a cooling tower how can you evaluate whether you have an effective water treatment program?
63. How often would you change the oil in a cooling tower motor?
64. What keeps cooling towers from freezing in the winter?
65. What are controls?
66. What is the typical voltage for DDC controls?
67. Describe how pneumatic controls work.
68. Define what a flat plate heat exchanger is, and how it works.
69. What is a VAV box and how does it work?

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### **Section 3 Mechanical Systems Air Compression**

1. Name at least five brands of compressors that we use on campus.
2. Describe in detail how you would properly isolate an air compressor for service?
3. You have been dispatched to troubleshoot why a compressor is short cycling – what would you do to investigate the problem?
4. One byproduct of compressing air is?
5. On a monthly air compressor PM, describe what is done.
6. Describe what an air dryer is, and how it works.
7. On campus, our compressed air systems typically have a filter after the compressor and after the dryer. Describe what type of filter these are, what level of filtration (micron number) is in each location. What color code is each type of filter element?
8. What is a membrane dryer? What maintenance is involved with these?
9. Is air considered a utility on campus?
10. Describe the process of changing the oil in a standard reciprocating compressor.

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#### **Section 4: Mechanical Systems: Steam Basics**

1. Describe the basic characteristics of steam.
  - What is steam?
  
  - What is steam used for?
  
  - Where is steam generated on campus?
  
  - At what temperature is steam generated?
  
2. What at what pressures are the following defined on campus:
  - Low Pressure Steam
  
  - Medium Pressure Steam
  
  - High Pressure Steam
  
3. What is a condensate system, and what is its purpose?
  
4. Is condensate corrosive? Explain your answer.
  
5. What is the purpose of a steam trap?
  
6. Name three kinds of steam traps.
  
7. Do steam traps require maintenance?
  
8. What is a trap alert used for?
  
9. How do we currently monitor campus steam traps to ensure they are all functional?

10. Describe what a steam pressure reduction station is, and how it works.

11. What does the term load shedding mean?

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### **Section 5: Trade Specific Knowledge (HVAC)**

1. Define Thermodynamics, as how it would relate to HVAC systems.
2. What is OHM's law?
3. Describe the basic refrigeration cycle. Include the four major components of a refrigeration system. Further define where the high and low pressure sides of the system are, and which components rest in each area. Provide a basic drawing in the space below which substantiates your findings.
4. Describe basic liquid movement both air and fluid.
5. Heat always flows from \_\_\_\_\_ to \_\_\_\_\_?
6. Describe the pressure temperature relationship. Include why this is so important in the HVAC field.
7. Describe the principle of evaporation?

8. What is the purpose of air balancing? Why do we do it?

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**Section 6: Trade specific knowledge: Electrical**

1. How would you troubleshoot an electrical motor?
2. What can you use to determine if electrical motor bearings have failed?
3. Describe the proper technique for amping out a motor.
4. Why is it important to ensure that electrical connections are always tight?

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**Section 7: Trade Specific Knowledge: Plumbing/Piping**

1. What is a backflow device and why do we use these on campus?
  
2. According to campus mechanical standards, what is the only permissible type of copper used on campus?
  
3. Name four different types of copper available for purchase today.
  
4. Suppose that your supervisor sent you into the field to solder up a drain line. Name all of the tools and materials that you would need.
  
5. You are walking on campus and see a drain that has a picture of a fish on it. What does this mean?
  
6. Pertaining to drains on campus; what does sanitary mean?
  
7. Concerning piping. Differentiate the piping associated with a steam coil and a water coil. Be detailed and explain why the difference.
  
8. Suppose you find a clogged sink, who do you call?
  
9. What is the purpose of having vacuum pumps on campus?
  
10. What can be put down a drain?

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### **Section 8: General Trades Knowledge**

1. Describe the unique characteristics of a cold room / constant temperature room.
2. You have been dispatched to troubleshoot a critical system in a laboratory environment. Describe exactly what you do.
3. There are specific criteria that must be followed prior to animal lab entry. Describe these criteria.
4. What protocols are required for clean room entry? What about your tools?
5. What is the outage notification process?
6. Who is involved in the outage notification process?
7. What is a hot work permit, and where should it be used?
8. You have work that needs to be accomplished by a contractor – how do you proceed?
9. Describe the basic operations of the Operations Control Center.

**Completion of Fundamentals Section**

**Scheduler / Planner Signature**

Signature \_\_\_\_\_ Date \_\_\_\_\_

**Supervisor's Signature**

Signature \_\_\_\_\_ Date \_\_\_\_\_

# Systems (Watch Stations)

In this section of your training you will be one on one with Pipe Mechanical Tradesman. You will have the opportunity to ask questions and get your hands on the tools, materials and the equipment. It is in this section of your training that you will gain systems based knowledge. You will gain an understanding of how systems operate, why they are set up the way they are, and the downstream effects of shutting things off. This “On the Job Training” is an instrumental part of your success. Once a technician is comfortable in your ability to accomplish a given task, you will answer any questions that they have related to the subject. If satisfied, you will obtain the signature of the appropriate technician. All signatures must be filled in prior to acceptance of the final level of this program. In the final section of your training, you will be required to satisfactorily complete practical exams that are designed around both the fundamental and workstations sections of this program.

## **Watch Stations Section 1: Safety**

1. Proper confined space entry – Demonstrate how to properly enter a confined space. What is needed, what equipment to use, and proper techniques.

Signature \_\_\_\_\_ Date \_\_\_\_\_

2. Demonstrate the proper use of Personal Protective Equipment on a daily basis.

Signature \_\_\_\_\_ Date \_\_\_\_\_

3. Using rigging techniques, demonstrate knot tying ability and how to properly hoist tools and materials up and down from a rooftop or elevated position.

Signature \_\_\_\_\_ Date \_\_\_\_\_

4. Ladder use. Demonstrate the proper techniques for each type of ladder used by the PM shop. Speak to all rules and regulations regarding ladder safety.

Signature \_\_\_\_\_ Date \_\_\_\_\_

5. Identify the chemicals that are used in water treatment. Identify the hazards associated with each. Demonstrate how to safely move these chemicals to point of use.

Signature\_\_\_\_\_ Date\_\_\_\_\_

6. Demonstrate how to properly lock out / tag out a piece of equipment. Ensure that it is de-energized properly. Explain line of sight as it relates to lock out / tag out. Demonstrate same day procedures as well as overnight procedures.

Signature\_\_\_\_\_ Date\_\_\_\_\_

7. Identify each shops lock colors and relay them to the technician.

Signature\_\_\_\_\_ Date\_\_\_\_\_

8. Explain basic emergency procedures to the Supervisor.

Signature\_\_\_\_\_ Date\_\_\_\_\_

9. Detail where a respirator would be needed in the field, and demonstrate the proper technique to perform a fit test with a respirator.

Signature\_\_\_\_\_ Date\_\_\_\_\_

10. Show the proper entry methods to enter a construction site. All facets should be discussed. Include PPE, communications, or other equipment.

Signature\_\_\_\_\_ Date\_\_\_\_\_

11. Demonstrate how to proper put on and adjust a safety harness.

Signature\_\_\_\_\_ Date\_\_\_\_\_

12. Perform a pre-work inspection on a safety harness and lanyard.

Signature\_\_\_\_\_ Date\_\_\_\_\_

13. Demonstrate proper tie off techniques for rooftops or elevated positions.

Signature \_\_\_\_\_ Date \_\_\_\_\_

14. Look up a chemical in the MSDS and explain what each section means.

Signature \_\_\_\_\_ Date \_\_\_\_\_

15. Demonstrate the proper way to use an electrical meter.

Signature \_\_\_\_\_ Date \_\_\_\_\_

16. Show how to determine if a circuit is completely de-energized.

Signature \_\_\_\_\_ Date \_\_\_\_\_

**Watch Stations Section 2: Mechanical Systems HVAC**

1. Describe each section of an air handler. What each section's purpose is, and how it works.

Signature \_\_\_\_\_ Date \_\_\_\_\_

2. Show the proper way to change air filters. Explain gasketing and clips.

Signature \_\_\_\_\_ Date \_\_\_\_\_

3. Demonstrate how the filter order is generated and create a filter order three months in a row. In this process explain and demonstrate what happens if a filter on your calendar does not require changing. Update all associates paperwork.

Signature \_\_\_\_\_ Date \_\_\_\_\_

4. Successfully perform the monthly filter PM

Signature \_\_\_\_\_ Date \_\_\_\_\_

5. Explain what a MERV rating is and why it is so important to campus air quality.

Signature \_\_\_\_\_ Date \_\_\_\_\_

6. Explain to the technician how old air filters are disposed of.

Signature \_\_\_\_\_ Date \_\_\_\_\_

7. Demonstrate to the technician what pressure drop is across a filter bank. Demonstrate how pressure drop is associated with filter changes.

Signature \_\_\_\_\_ Date \_\_\_\_\_

8. Identify a magnahelic; demonstrate what it does and how to calibrate it.

Signature \_\_\_\_\_ Date \_\_\_\_\_

9. Besides visually, how can you determine if a coil is plugged? Demonstrate how this is done.

Signature \_\_\_\_\_ Date \_\_\_\_\_

10. Demonstrate how to properly clean a coil.

Signature \_\_\_\_\_ Date \_\_\_\_\_

11. Physically show the difference between a cooling coil and a steam coil.

Signature \_\_\_\_\_ Date \_\_\_\_\_

12. Concerning coils, how do you remove calcite buildup? Perform this function.

Signature \_\_\_\_\_ Date \_\_\_\_\_

13. Show your technician where the freeze protection is in an air handling system. Also show where high static switches are and demonstrate how to reset them.

Signature \_\_\_\_\_ Date \_\_\_\_\_

14. Properly accomplish annual air cleaning and light check PM.

Signature \_\_\_\_\_ Date \_\_\_\_\_

15. Demonstrate the proper way to isolate a pump for maintenance.

Signature \_\_\_\_\_ Date \_\_\_\_\_

16. Demonstrate the proper way to lubricate both oil based and grease based pumps.

Signature \_\_\_\_\_ Date \_\_\_\_\_

17. Perform a proper inspection on a pump.

Signature \_\_\_\_\_ Date \_\_\_\_\_

18. On an operational pump demonstrate the use of a vibration analysis machine. Show all applicable points to take a reading. Physically take readings and explain the outcome to your technician.

Signature \_\_\_\_\_ Date \_\_\_\_\_

19. Troubleshoot a pump that has low flow or other mechanical issues.

Signature \_\_\_\_\_ Date \_\_\_\_\_

20. Demonstrate to a technician, what can cause harmonics in pumps, and why they should be eliminated.

Signature \_\_\_\_\_ Date \_\_\_\_\_

21. Shutdowns an air handler using the variable frequency drive (VFD) and start it back up using the VFD.

Signature \_\_\_\_\_ Date \_\_\_\_\_

22. Demonstrate your knowledge of what HOA means on an air handler and place the unit in the proper position.

Signature \_\_\_\_\_ Date \_\_\_\_\_

23. Demonstrate to the technician that a piece of mechanical equipment is controlled by Andover in the field.

Signature \_\_\_\_\_ Date \_\_\_\_\_

24. Cycle a piece of equipment through the building automation system by communicating with the HVAC control room.

Signature \_\_\_\_\_ Date \_\_\_\_\_

25. Perform call-ins to the control room for an entire route of rotating equipment.

Signature \_\_\_\_\_ Date \_\_\_\_\_

26. Identify building critical systems are relay these to the technician.

Signature \_\_\_\_\_ Date \_\_\_\_\_

27. Describe what an Andover alarm is, and physically identify several types of alarms in a given building.

Signature \_\_\_\_\_ Date \_\_\_\_\_

28. Demonstrate downstream effects to your technician. Describe what can happen if you shut down a piece of equipment and what effects that has to building occupants.

Signature \_\_\_\_\_ Date \_\_\_\_\_

29. Physically show if a piece of equipment is DDC or pneumatically controlled.

Signature \_\_\_\_\_ Date \_\_\_\_\_

30. Explain to the technician what “failure to open” and “failure to close” means. In Colorado, explain what failure positions are set for heating or cooling systems.

Signature \_\_\_\_\_ Date \_\_\_\_\_

31. Demonstrate how to determine if a drive belt requires replacement.

Signature \_\_\_\_\_ Date \_\_\_\_\_

32. Select the proper belt for a replacement. Order the belt through the procurement system, install and properly tension it.

Signature \_\_\_\_\_ Date \_\_\_\_\_

33. Identify whether a sheave needs replacement. Demonstrate the proper procedure to ensure accurate ordering of the sheave. Order the sheave through the procurement system and properly install it.

Signature \_\_\_\_\_ Date \_\_\_\_\_

34. Demonstrate how to align a sheave using a both accepted techniques.

Signature \_\_\_\_\_ Date \_\_\_\_\_

35. Using a vibration analysis tool to identify a potential bearing failure.

Signature \_\_\_\_\_ Date \_\_\_\_\_

36. Replace a bearing. Properly size, order and install bearings on a fan.

Signature \_\_\_\_\_ Date \_\_\_\_\_

37. Properly shutdown and isolate a chiller and associated equipment for “punching tubes” maintenance.

Signature \_\_\_\_\_ Date \_\_\_\_\_

38. Punch the tubes on a chiller.

Signature \_\_\_\_\_ Date \_\_\_\_\_

39. Clean a condenser. Follow all procedures on the "Air conditioner PM."

Signature \_\_\_\_\_ Date \_\_\_\_\_

40. Verify the proper water level and make adjustments to an evaporative cooler.

Signature \_\_\_\_\_ Date \_\_\_\_\_

41. Explain to the technician the functionality of a flat plate heat exchanger.

Signature \_\_\_\_\_ Date \_\_\_\_\_

42. Identify and explain to the technician how a VAV box works.

Signature \_\_\_\_\_ Date \_\_\_\_\_

**Watch Stations Section 3: Mechanical Systems: Air Compression**

1. Demonstrate how to properly isolate an air compressor for service.

Signature\_\_\_\_\_ Date\_\_\_\_\_

2. Perform monthly air compressor PM on :

Reciprocating compressor - Signature\_\_\_\_\_ Date\_\_\_\_\_

Kaeser compressor - Signature\_\_\_\_\_ Date\_\_\_\_\_

Atlas Copco Compressor - Signature\_\_\_\_\_ Date\_\_\_\_\_

Sullair Compressor - Signature\_\_\_\_\_ Date\_\_\_\_\_

Gardner of Denver - Signature\_\_\_\_\_ Date\_\_\_\_\_

3. Change the oil in a compressor

Signature\_\_\_\_\_ Date\_\_\_\_\_

4. Proper dispose of use oil per campus procedures.

Signature\_\_\_\_\_ Date\_\_\_\_\_

5. Perform a service check on a dehydrator.

Signature\_\_\_\_\_ Date\_\_\_\_\_

6. Change out pre and post in-line air filters on a compressed air system.

Signature\_\_\_\_\_ Date\_\_\_\_\_

**Watch Stations Section 4: Steam**

1. Demonstrate a basic understand of a steam system by physically tracing out a small system and detailing what each component is, and how they work.

Signature\_\_\_\_\_ Date\_\_\_\_\_

2. Identify steam traps in the field and explain what type they are and how they operate.

Signature\_\_\_\_\_ Date\_\_\_\_\_

3. Do the quarterly PM on steam traps with the Pipe shop.

Signature\_\_\_\_\_ Date\_\_\_\_\_

4. Identify and describe a condensate system, including a pump to the technician. Describe what the function of the system is and how it works.

Signature\_\_\_\_\_ Date\_\_\_\_\_

**Watch Stations Section 5: Trade specific qualifications (HVAC)**

1. Demonstrate the use of a refractometer to the technician.

Signature\_\_\_\_\_ Date\_\_\_\_\_

2. Complete the Monthly Computer Room Air Conditioner (CRAC) PM with technician.

Signature\_\_\_\_\_ Date\_\_\_\_\_

3. Demonstrate the proper use of an electrical meter.

Signature\_\_\_\_\_ Date\_\_\_\_\_

4. Using your knowledge from the fundamentals section, use your refrigeration drawing and identify the physical components of it in the field.

Signature\_\_\_\_\_ Date\_\_\_\_\_

5. Understanding the pressure/temperature relationship. Identify where “changes of state” take place in a typical refrigeration system.

Signature\_\_\_\_\_ Date\_\_\_\_\_

6. Clean a cooling tower.

Signature\_\_\_\_\_ Date\_\_\_\_\_

7. Clean an air cooled chiller.

Signature\_\_\_\_\_ Date\_\_\_\_\_

8. Give physical examples in the field of the three types of heat transfer.

Signature\_\_\_\_\_ Date\_\_\_\_\_

9. Explain to a technician how a “delta T” is accomplished through evaporation.

Signature\_\_\_\_\_ Date\_\_\_\_\_

10. Lubricate the umbilical section of a tube punching machine.

Signature \_\_\_\_\_ Date \_\_\_\_\_

11. Calibrate a thermostat.

Signature \_\_\_\_\_ Date \_\_\_\_\_

12. Demonstrate the proper use of refrigerant gauges.

Signature \_\_\_\_\_ Date \_\_\_\_\_

**Watch Stations Section 6: Trade Specific Training (Electrical)**

1. Troubleshoot an electrical motor.

Signature\_\_\_\_\_ Date\_\_\_\_\_

2. Amp out a motor.

Signature\_\_\_\_\_ Date\_\_\_\_\_

3. Tighten electrical connections.

Signature\_\_\_\_\_ Date\_\_\_\_\_

4. Demonstrate a basic understanding of electrical systems to the technician.

Signature\_\_\_\_\_ Date\_\_\_\_\_

**Watch Stations Section 7: Trade Specific Knowledge (Plumbing)**

1. Demonstrate to the technician how a backflow device works.

Signature\_\_\_\_\_ Date\_\_\_\_\_

2. Demonstrate solder capability by passing a copper test in

- ¾ Inch Signature\_\_\_\_\_ Date\_\_\_\_\_
- 1 ½ inch Signature\_\_\_\_\_ Date\_\_\_\_\_
- 2 inch Signature\_\_\_\_\_ Date\_\_\_\_\_

3. Demonstrate a basic knowledge of how a Reverse Osmosis water system works.

Signature\_\_\_\_\_ Date\_\_\_\_\_

4. Accomplish a monthly PM on vacuum pumps.

Signature\_\_\_\_\_ Date\_\_\_\_\_

5. Identify to the technician what a “sanitary” drain is and what a “storm” drain is.

Signature\_\_\_\_\_ Date\_\_\_\_\_

**Watch Stations Section 8: General Trades Knowledge**

1. Go through proper clean room entry protocol.

Signature\_\_\_\_\_ Date\_\_\_\_\_

2. Demonstrate to the technician everything that is required prior to entering a lab.

Signature\_\_\_\_\_ Date\_\_\_\_\_

3. Attend animal lab entry training.

Signature\_\_\_\_\_ Date\_\_\_\_\_

4. Demonstrate knowledge of the mechanical side of a constant temperature room and a cold room.

Signature\_\_\_\_\_ Date\_\_\_\_\_

5. Demonstrate the proper way to create an "outage notification."

Signature\_\_\_\_\_ Date\_\_\_\_\_

6. Create and use a hot- work permit.

Signature\_\_\_\_\_ Date\_\_\_\_\_

7. Demonstrate the knowledge of when a contractor needs to be used against when a job should be accomplished in house.

Signature\_\_\_\_\_ Date\_\_\_\_\_

8. Create and use a confined space report.

Signature\_\_\_\_\_ Date\_\_\_\_\_

9. Fill out all required paperwork for hazardous waste disposal.

Signature\_\_\_\_\_ Date\_\_\_\_\_

10. Attend core safety training.

Signature\_\_\_\_\_ Date\_\_\_\_\_

11. Define to the supervisor:

- Building Proctor
- Building user
- Lab technician
- Professor
- Chair
- Customer

Signature\_\_\_\_\_ Date\_\_\_\_\_

12. Attend Defensive driving.

Signature\_\_\_\_\_ Date\_\_\_\_\_

**Watch Stations Section 9: Emergency Procedures**

1. Learn, qualify for, and work a shift in the building operations control room.

Signature\_\_\_\_\_ Date\_\_\_\_\_

2. Learn, qualify for, and work a shift at the "Service/Operations" center.

Signature\_\_\_\_\_ Date\_\_\_\_\_

3. Demonstrate knowledge of what to do in an emergency situation.

Signature\_\_\_\_\_ Date\_\_\_\_\_

4. Describe to the Supervisor what "Essential Services" is, and why it is so important for the Trades Department.

Signature\_\_\_\_\_ Date\_\_\_\_\_

5. Demonstrate the protocol for being called in during a snow storm

Signature\_\_\_\_\_ Date\_\_\_\_\_

**Watch Stations Section 10: Computer skills**

1. Demonstrate how to acquire a work order from a zone's work order "Que."

Signature\_\_\_\_\_ Date\_\_\_\_\_

2. Complete timecards that contain route work orders.

Signature\_\_\_\_\_ Date\_\_\_\_\_

3. Look up a work order that is not assigned to you.

Signature\_\_\_\_\_ Date\_\_\_\_\_

4. Perform a material issuance request.

Signature\_\_\_\_\_ Date\_\_\_\_\_

5. Perform a purchase requisition request.

Signature\_\_\_\_\_ Date\_\_\_\_\_

6. Properly close out a work order following all steps. Customer contact, closing comments, child work order creation...

Signature\_\_\_\_\_ Date\_\_\_\_\_

7. Update the notes section of a work order.

Signature\_\_\_\_\_ Date\_\_\_\_\_

8. Demonstrate a basic understanding of Microsoft Word.

Signature\_\_\_\_\_ Date\_\_\_\_\_

9. Demonstrate a basic understanding of Microsoft Excel.

Signature\_\_\_\_\_ Date\_\_\_\_\_

10. Update a Filter calendar.

Signature\_\_\_\_\_ Date\_\_\_\_\_

11. Complete the following computer based training:

- Discrimination and harassment
- Fiscal ethics
- Fiscal responsibility

Signature\_\_\_\_\_ Date\_\_\_\_\_

12. Complete an electronic vacation / leave request.

Signature\_\_\_\_\_ Date\_\_\_\_\_

**Completion of Watch Stations Section**

**Scheduler / Planner Signature**

Signature \_\_\_\_\_ Date \_\_\_\_\_

**Supervisor's Signature**

Signature \_\_\_\_\_ Date \_\_\_\_\_

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## **Practical Exams**

This is the final section of this training program. In this section you will be required to pass practical exams administered directly by the supervisor. The objective is to address any areas that may not have been comprehended during both the fundamentals and the watch stations sections of this program. You must pass all practical exams and acquire the supervisor's signature for each exam. The supervisor may decide to add additional exams based on diversity of work throughout your training program.

1. Perform all aspects of PM 132 – Filter change.

Supervisor's Signature \_\_\_\_\_ Date \_\_\_\_\_

2. Perform all aspects of PM 195 – Rotating equipment.

Supervisor's Signature \_\_\_\_\_ Date \_\_\_\_\_

3. Perform a nitrite test on a closed loop heating system.

Supervisor's Signature \_\_\_\_\_ Date \_\_\_\_\_

4. Define initial and loaded pressure drop limits for pre-filters and final air filters.

Supervisor's Signature \_\_\_\_\_ Date \_\_\_\_\_

5. Describe the operation of a basic refrigeration cycle and refer your description to actual equipment in the field.

Supervisor's Signature \_\_\_\_\_ Date \_\_\_\_\_

6. Complete PM 293 - Annual air conditioning PM. Include all sections of the system.

Supervisor's Signature \_\_\_\_\_ Date \_\_\_\_\_

7. Perform a proper lock-out / tag-out.

Supervisor's Signature \_\_\_\_\_ Date \_\_\_\_\_

8. Perform a seasonal start-up / shut-down on all campus water features.

Supervisor's Signature \_\_\_\_\_ Date \_\_\_\_\_

9. Perform a seasonal start-up / shutdown on campus evaporative cooling systems including air washes.

Supervisor's Signature \_\_\_\_\_ Date \_\_\_\_\_

10. Complete all aspects of PM 62 – Punching chiller tubes.

Supervisor's Signature \_\_\_\_\_ Date \_\_\_\_\_

11. Demonstrate all “PM shop” applicable sections of the FAMIS work order system.

Supervisor's Signature \_\_\_\_\_ Date \_\_\_\_\_

12. Demonstrate that you can complete a monthly filter order, updating all applicable online calendars and cards as appropriate.

Supervisor's Signature \_\_\_\_\_ Date \_\_\_\_\_

13. Obtain your CFC universal refrigerant license.

Supervisor's Signature \_\_\_\_\_ Date \_\_\_\_\_

14. Describe and provide examples of the pressure / temperature relationship.

Supervisor's Signature \_\_\_\_\_ Date \_\_\_\_\_

15. Describe the purpose of a sonoxide unit. Describe how it works, and what the optimal pressure is in this type of system.

Supervisor's Signature \_\_\_\_\_ Date \_\_\_\_\_

16. Create a child work order for another shop and follow up from start to finish what work you are asking to be completed.

Supervisor's Signature \_\_\_\_\_ Date \_\_\_\_\_

**Completion of Practical exams**

Supervisor's Signature \_\_\_\_\_ Date \_\_\_\_\_

**Completion of Training Program**

\_\_\_\_\_ has completed all aspects of the PM shop trainee program.

PM Shop Planner / Scheduler \_\_\_\_\_ Date \_\_\_\_\_

PM Shop Supervisor \_\_\_\_\_ Date \_\_\_\_\_

Assistant Trades Director Signature \_\_\_\_\_ Date \_\_\_\_\_

Facility Operations Director \_\_\_\_\_ Date \_\_\_\_\_

HR Representative (record entry) \_\_\_\_\_ Date \_\_\_\_\_



**D6C – PIPE/ MECHANICAL TRADES**

Title/Class Code	Education and Experience	Substitutions
<p><b>PIPE/ MECHANICAL TRADES I</b></p> <p><b>D6C1TX</b></p>	<p>Two years of progressively responsible pipe and/or mechanical trades experience related to the work assignment.</p> <p><b>Necessary Special Requirements:</b></p> <p>Some positions must possess and maintain a Commercial Driver's License class B or higher, with proper endorsements; must be able to work rotating shift assignment and overtime as needed; must be physically able to perform strenuous physical labor at high altitudes over 11,000 feet.</p>	<p>At the agency's discretion, successful completion of a formalized plumbing, pipefitting, steamfitting, or heating, ventilation and air conditioning apprenticeship program, or higher level, non-correspondence course work in the same fields from an accredited vocational school or university may substitute for the experience on a year-for-year basis.</p>
<p><b>PIPE/ MECHANICAL TRADES II</b></p> <p><b>D6C2XX</b></p>	<p>Four years of progressively responsible pipe and/or mechanical experience related to the work assignment.</p> <p><b>Necessary Special Requirements:</b></p> <p>Some positions require possession of a current, journey-level plumber license issued by the State of Colorado. Some positions must possess and maintain a Commercial Driver's License class B or higher, with proper endorsements; must be able to work rotating shift assignment and overtime as needed; must be physically able to perform strenuous physical labor at high altitudes over 11,000 feet.</p>	<p>At the agency's discretion, successful completion of a formalized plumbing, pipefitting, steamfitting, or heating, ventilation and air conditioning apprenticeship program, or higher level, non-correspondence course work in the same fields from an accredited vocational school or university may substitute for the experience on a year-for-year basis. At the agency's discretion, a journey level plumber license can substitute for the required experience. At the agency's discretion, demonstrated proficiency on position competencies may substitute for the required experience.</p>
<p><b>PIPE/ MECHANICAL TRADES III</b></p> <p><b>D6C3XX</b></p>	<p>Four years of progressively responsible pipe and/or mechanical experience related to the work assignment.</p> <p><b>Necessary Special Requirements:</b></p> <p>Some positions require possession of a current, journey-level plumber license issued by the State of Colorado. Some positions must possess and maintain a Commercial Driver's License class B or higher, with proper endorsements; must be able to work rotating shift assignment and overtime as needed; must be physically able to perform strenuous physical labor at high altitudes over 11,000 feet.</p>	<p>At the agency's discretion, successful completion of a formalized plumbing, pipefitting, steamfitting, or heating, ventilation and air conditioning apprenticeship program, or higher level, non-correspondence course work in the same fields from an accredited vocational school or university may substitute for the experience on a year-for-year basis. At the agency's discretion, a journey level plumber license can substitute for the required experience. At the agency's discretion, demonstrated proficiency on position competencies may substitute for the required experience.</p>

