

# Apprenticeship and Industry Training

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## Field Heat Treatment Technician Competency Profile

20908.1 (2008)

Alberta 



Apprenticeship  
and Industry  
Training

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## **Occupation Certification**

Requirements for certification—including the content and delivery of technical training—are developed and updated by the Alberta Apprenticeship and Industry Training Board on the recommendation of the Field Heat Treatment Occupation Training Committee.

The graduate of the Field Heat Treatment Technician apprenticeship program is a certified journey person who will be able:

- Use heat treatment equipment to apply heat to materials in order to change a material's properties.
- Use their knowledge of the properties of heat, industry codes and specifications to determine how heat treatment will be applied in order to achieve the desired result.
- Maintain records and issue documentation or certification for heat treatment procedures performed.
- Transport and set up heat treatment equipment on site.
- Coordinate activities with other trades and occupations on site.
- Perform assigned tasks in accordance with quality and production standards required by industry.

## **Apprenticeship and Industry Training System**

### **Industry-Driven**

Alberta's apprenticeship and industry training system is an industry-driven system that ensures a highly skilled, internationally competitive workforce in more than 50 designated trades and occupations. This workforce supports the economic progress of Alberta and its competitive role in the global market. Industry (employers and employees) establishes training and certification standards and provides direction to the system through an industry committee network and the Alberta Apprenticeship and Industry Training Board. The Alberta government provides the legislative framework and administrative support for the apprenticeship and industry training system.

### **Alberta Apprenticeship and Industry Training Board**

The Alberta Apprenticeship and Industry Training Board provides a leadership role in developing Alberta's highly skilled and trained workforce. The board's primary responsibility is to establish the standards and requirements for training and certification in programs under the Apprenticeship and Industry Training Act. The board also provides advice to the Minister of Advanced Education on the needs of Alberta's labour market for skilled and trained workers, and the designation of trades and occupations.

The thirteen-member board consists of a chair, eight members representing trades and four members representing other industries. There are equal numbers of employer and employee representatives.

### **Industry Committee Network**

Alberta's apprenticeship and industry training system relies on a network of industry committees, including local and provincial apprenticeship committees in the designated trades, and occupational committees in the designated occupations. The network also includes other committees such as provisional committees that are established before the designation of a new trade or occupation comes into effect. All trade committees are composed of equal numbers of employer and employee representatives. The industry committee network is the foundation of Alberta's apprenticeship and industry training system.

### **Occupational Committees**

The board establishes an occupational committee for each occupation. The Board appoints industry representatives, and, on the occupational committee's recommendation, a presiding officer - each for a maximum of three terms of up to three years. An occupational committee will likely have from 3 to 9 members.

Occupation committees make recommendations to the board in respect of any matter concerning training and certification in their occupation, including:

- standards and requirements for certification in their occupation
- examinations in their occupation
- designation of trades and occupations
- recognition of certificates as equivalent to an occupational certification in their occupation

**Provisional Committee**

The board established a provisional committee to review the application for the designation of this occupation and to make recommendations in respect of the application. When the designation of the occupation comes into effect, the provisional committee expires and is replaced by an occupational committee.

**Field Heat Treatment Technician Occupational Committee Members at the time of publication.**

MacAulay, Kenneth .....	Presiding Officer
Coutu, Robert .....	Edmonton.....Employer
Martens, Gordon .....	Edmonton.....Employer
Paul, George .....	Edmonton.....Employer
Fong, David.....	Edmonton.....Employee
Tetzlaff, Noel .....	Edmonton.....Employee
Yearley, Lance .....	Edmonton.....Employee

**Alberta Government**

Alberta Advanced Education works with industry, employer and employee organizations and technical training providers to:

- facilitate industry’s development and maintenance of training and certification standards
- provide registration and counselling services to apprentices and employers
- coordinate technical training in collaboration with training providers
- certify apprentices and others who meet industry standards

**Safety**

It is imperative that all parties are aware of circumstances that may lead to injury or harm.

Safe learning experiences and healthy environments can be created by controlling the variables and behaviors that may contribute to or cause an incident or injury. By practicing a safe and healthy attitude, everyone can enjoy the benefit of an incident and injury free environment.

**Alberta Apprenticeship and Industry Training Board Safety Policy**

The Alberta Apprenticeship and Industry Training Board fully supports safe learning and working environments and encourages the teaching of proper safety procedures both within trade specific training and in the workplace.

Trade specific safety training is an integral component of technical training, while ongoing or general non-trade specific safety training remains the responsibility of the employer and the employee as required under workplace health and safety legislation.

## **Workplace Responsibilities**

The employer is responsible for:

- training employees and apprentices in the safe use and operation of equipment
- providing and maintaining safety equipment, protective devices and clothing
- enforcing safe working procedures
- providing safeguards for machinery, equipment and tools
- observing all accident prevention regulations
- The employee and apprentice are responsible for:
  - working in accordance with the safety regulations pertaining to the job environment
  - working in such a way as not to endanger themselves, fellow employees or apprentices

## **Workplace Health and Safety**

A tradesperson is often exposed to more hazards than any other person in the work force and therefore should be familiar with and apply the Occupational Health and Safety Act, Regulations and Code when dealing with personal safety and the special safety rules that apply to all daily tasks.

Workplace Health and Safety (Alberta Employment, Immigration and Industry) conducts periodic inspections of workplaces to ensure that safety regulations for industry are being observed.

Additional information is available at [www.worksafely.org](http://www.worksafely.org)

### **Procedures for Recommending Revisions to the Competency Profile**

Advanced Education has prepared this course outline in partnership with the Field Heat Treatment Technician Provincial Apprenticeship Committee.

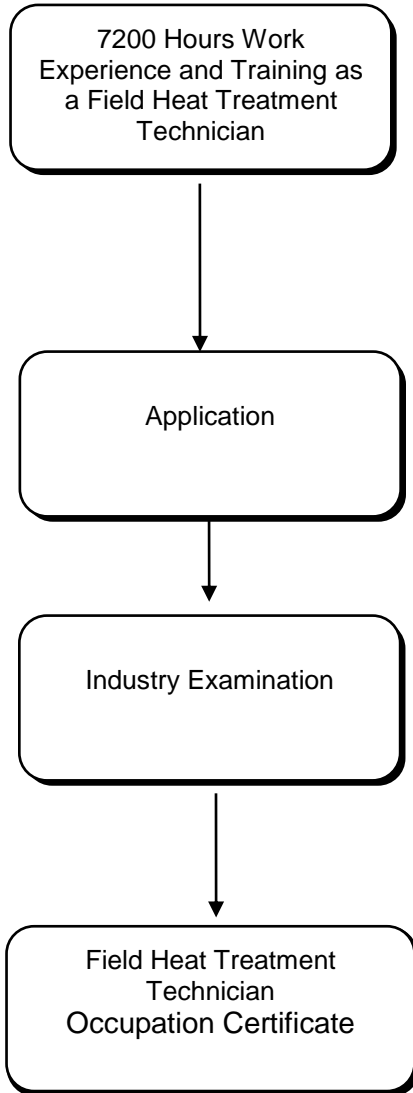
This course outline was approved on June 27, 2008 by the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. The valuable input provided by representatives of industry and the institutions that provide the technical training is acknowledged.

Any concerned individual or group in the province of Alberta may make recommendations for change by writing to:

Field Heat Treatment Technician Provincial Apprenticeship Committee  
c/o Industry Programs and Standards  
Apprenticeship and Industry Training  
Advanced Education  
10th floor, Commerce Place  
10155 102 Street NW  
Edmonton AB T5J 4L5

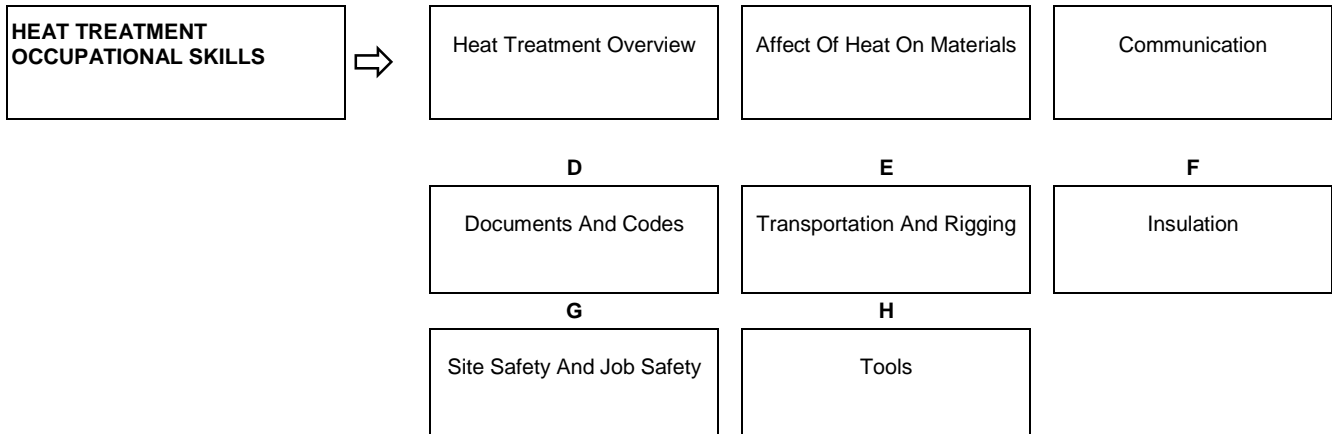
It is requested that recommendations for change refer to specific areas and state references used. Recommendations for change will be placed on the agenda for regular meetings of the Field Heat Treatment Technician Provincial Apprenticeship Committee.

## Field Heat Treatment Technician Occupation Requirements for Certification

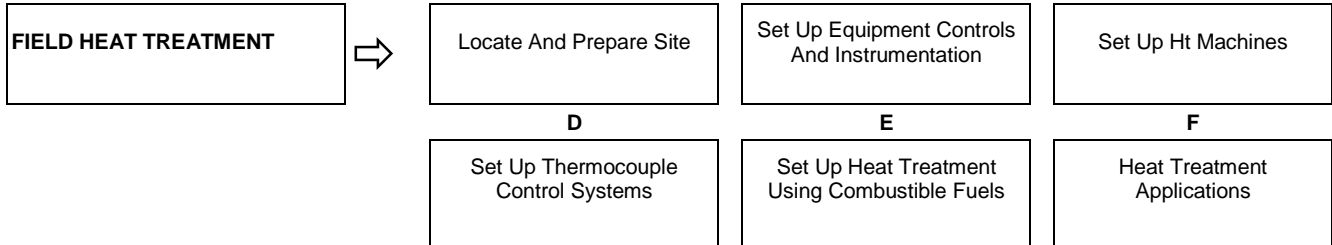


## Field Heat Treatment Technician Competency Profile

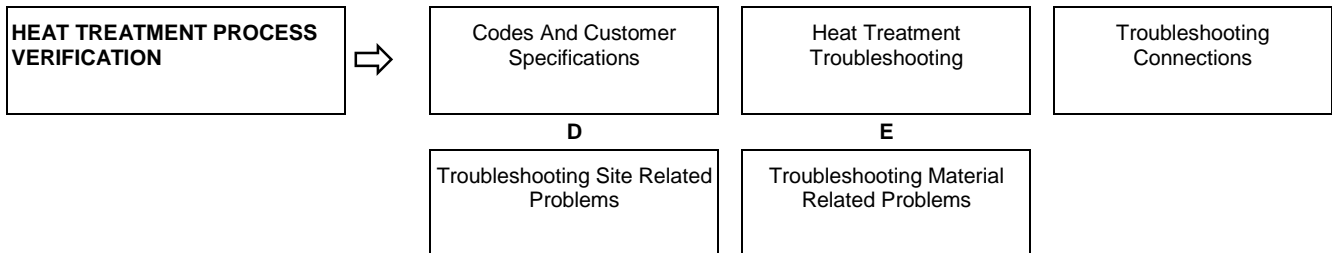
### SECTION ONE



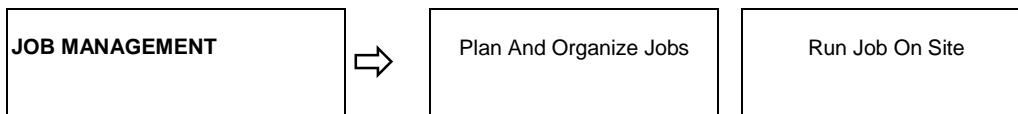
### SECTION TWO



### SECTION THREE



### SECTION FOUR





## Field Heat Treatment Technician COMPETENCIES

A CERTIFIED FIELD HEAT TREATMENT TECHNICIAN SHOULD BE ABLE TO PERFORM THE FOLLOWING COMPETENCIES.

### SECTION ONE: ..... HEAT TREATMENT OCCUPATIONAL SKILLS

***Occupational skills are the skills and knowledge needed by field heat treatment technicians to perform heat treatment tasks and activities. The technician must be knowledgeable on the affect of heat on materials, the use, maintenance and repair of heat treatment equipment, codes, standards and specifications for heat treating materials, safety , occupational legislation, hazardous materials legislations applicable to their assigned tasks and the site they are working.***

#### A. Heat Treatment Overview

***Competency: Describe how heat energy is transmitted for the purpose of field heat treatment***

1. Describe what heat energy is and how heat energy is transferred from hot to cold.
2. Measure heat, convert units of heat measurement used in industry.
3. Use trade math to calculate area, volume, density, ratios, rates, trade formulas.
4. Describe the effect of material type, thickness, alloy composition etc. on heat transfer.
5. Predict the rate and quantity of heat energy transferred by convection, conduction, or radiation.
6. Describe why pre weld heat treatment is done.
7. Describe post weld heat treatment is done.
8. Describe heat treatment using combustible fuels.
9. Describe heat treatment using heating elements.
10. Describe heat treatment by induction.
11. Describe heat treatment using programmers.
12. Describe temporary furnaces.
13. Describe the application of insulation for heat treatment.
14. Describe why it may be necessary to heat treat materials.

#### B. Affect of Heat Treatment on Materials

***Competency: Describe how heat effects the materials commonly treated in field heat treatment***

1. Describe changes to material properties through the application of heat treatment.
2. Describe weld stress relieving.
3. Describe pre heat and post heat for welding.
4. Describe how heat treatment is used for hardening or annealing.
5. Describe how heat treatment is used for degassing.
6. Describe how heat treatment is used for curing.
7. Describe heat expansion and contraction.
8. Describe how heat treatment may improve a material's resistance to corrosion.
9. Describe the effect of temperature on strength of materials.

10. Describe how heat treatment may affect the machinability of materials.
11. Describe how industry codes and client specifications are used by field heat treatment technicians.

### C. Communication

**Competency: Use written and verbal communication skills to communicate with workers, clients and supervisors.**

1. Maintain files, personal time sheets, job sheets, record of time worked per job or task.
2. Document the procedure according to job requirements.
3. Describe process for obtaining variances or modification of procedures if required.
4. Prepare written reports such as progress reports, incident reports, non conformance reports, etc.
5. Uses Personal Computers for email and standard business/office software.
6. Apply training and coaching skills for one to one training other field heat treatment technicians.
7. Act as company representative with clients, other trades and crafts, suppliers etc.
8. Uses verbal communication and listening skills.

### D. Documentation and Codes

**Competency: Use codes and specifications, and complete required documentation**

1. Use job drawings, prints and specifications to determine the site locations and procedures required.
2. Create simple sketches and schematic drawings in the field to describe, or clarify instructions or procedures.
3. Create schematic circuit and block diagrams showing heat treatment electrical circuits.
4. Calculate power requirements, predicted expansion and contraction amounts, time and materials, area, volume, density, ratios, rates, using trade math formulas etc.
5. Describe the role of governing bodies and codes for heat treatment in North America.
6. Describe customer specifications for heat treatment.
7. Select or design the appropriate heat treatment procedure in accordance with specifications and codes.
8. Verify that heat treatment was done according to the specified code or specification.
9. Document procedures performed and transmit required documentation to client.
10. Maintain log books and shift reports.
11. Complete calibration certificates and conformance certificates.

### E. Transport and Rigging

**Competency: Describe how equipment is loaded, unloaded, secured for transportation to and from a job site, including rigging for hoisting.**

1. Describe securing heat treatment equipment and supplies for transportation to a job site.
2. Describe the transportation of dangerous goods requirements for heat treatment equipment for heat treatment equipment classed as dangerous goods.
3. Describe training and certification requirements for transporting equipment (where applicable).

4. Describe how the equipment and supplies used for heat treatment should be rigged for hoisting if applicable.

#### F. Insulation

**Competency:** *Be able to select, handle and store insulating materials.*

1. Describe insulation materials used for heat treatment.
2. Describe the characteristics and insulating properties of insulation types used for heat treatment.
3. Describe considerations for storing insulation types used for heat treatment.
4. Describe handling and disposal requirements for insulation.

#### G. Site Safety and Job Safety

**Competency:** *Work safe at all times.*

1. Describe the worker's responsibility for safety.
2. Select and use required and or appropriate PPEs.
3. Describe safe lifting and handling procedures.
4. Describe training and certification requirements for site and job specific safety procedures such as exposure to hazardous substances, working in confined spaces, heights, operating equipment etc.
5. Describe requirements for hazardous materials storage, transport, disposal, spills etc.
6. Describe fire prevention and control for heat treatment.
7. Describe how a job site is safely secured for workers and personnel in the vicinity, such as through the use of barriers, shielding, lockouts etc.
8. Describe the requirements for identifying, assessing and minimizing hazards associated with heat treatment.
9. Describe the hazards specific to heat treatment equipment.

#### H. Use Tools Required to Set Up, Repair, Maintain Heat Treatment Equipment.

**Competency:** *Uses tools for moving, assembling, disassembling, calibrating and repairing heat treatment equipment*

1. Use appropriate hand tools for assembling and disassembling heat treatment equipment.
2. Use instruments to measure temperature.
3. Use electrical test meters to measure voltage, amperage and resistance.
4. Use portable computers or digital process controllers, programmed for heat treatment applications.
5. Use thermocouple attachment unit (TAU) and or stud gun.
6. Operates loaders or forklifts for moving heat treatment equipment.
7. Operates trucks, trailers, vehicles with air brakes as required, in accordance with all applicable regulations for transporting heat treatment equipment to and from work sites.

**SECTION TWO: .....FIELD HEAT TREATMENT**

***Field heat treatment skills are the skills and knowledge required to locate, prepare set up perform and remove heat treatment equipment at a site.***

**A. Locate and Prepare Site for Heat Treatment**

***Competency: Prepare for heat treatment.***

1. Locate heat treatment site on job site.
2. Describe when venting and purging needs to be done.
3. Ensure the site is secured and all appropriate protection is in place.
4. Verify that all required access to power, scaffolding, lighting, weather protection etc., is available or set up.
5. Ensure area to be heated is cleaned vented or purged as required.
6. Assemble/disassemble isolate components to be heated as required.
7. Remove or protect combustible materials or materials subject to heat damage.
8. Describe certification requirements for hooking heat treatment equipment up to electrical power sources or sources of fuel.
9. Identify heat sinks, geometry, need for support, expansion allowance.
10. Set up for expansion and contraction when performing heat treatment
11. Provide support as required for objects to be heat treated; including, temporary saddles internal braces and stiffeners, skirt areas, temporary furnace piping, overhanging piping, etc.

**B. Set Up Heat Treatment Equipment Controls and Instrumentation**

***Competency: Setup and calibrate heat treatment equipment and recorders.***

1. Describe heat treatment power supplies.
2. Describe the heat treatment machine.
3. Determine and set up zones.
4. Set up control panel for a heat treatment.
5. Assemble, power source, elements, cabling, recorders for a heat treatment application.
6. Calibrate or align process controllers.
7. Operate power supplies for heat treatment equipment.
8. Operate mobile self contained heat treatment units.
9. Operate portable electrical generators for heat treatment equipment.
10. Monitor sensors to ensure temperature and time are applied as specified.
11. Set up programmers and remote operated heat treatment systems.
12. Set up burners, blowers, sensors, controls etc. as required for heat treatment with combustible fuels.
13. Construct temporary furnaces.
14. Apply temporary insulation required for heat treatment.
15. Repair and maintain heat treatment equipment.
16. Download heat treatment process data to digital storage or portable computers

**C. Set Up Heat Treatment (HT) Machines.**

**Competency:** *Set up electrically powered field heat treatment equipment.*

1. Describe single phase, three phase and direct current.
2. Describe voltage drop, resistance and amperage.
3. Calculate power requirements using volts, ohms, amps and watts.
4. For heater types describe construction, voltages, currents, and applications.
5. Describe heater ratings, watt-density.
6. Describe electrical transformers, rectifiers and reactors.
7. Describe non North American standards for voltage, frequency and phase as they apply to heat treatment.
8. Describe the operation of the six way heat treating machine.
9. Set up a six way machine for multiple zones and zone control.
10. Describe the twin heat module.
11. Describe the use of low voltage power and considerations for duty cycle when using low voltage.
12. Set up twin heat module for a heat treatment operation.
13. Calculate power requirements given temperature requirements and the materials to be heated.
14. Calculate electrical flow in circuits or at a given point in a circuit using voltage, resistance, and amperage.
15. Select wire gage based circuit requirements (amps and length).
16. Describe element selection and placement.
17. Describe flexible heating pads.
18. Describe finger heaters.
19. Describe channel heaters.
20. Describe custom made heaters.

**D. Set Up Thermocouple Control Systems**

**Competency:** *Be able to set up the control, instrumentation circuits.*

1. Describe heating and control circuits.
2. Wire up control circuits using schematic diagrams.
3. Describe thermocouple placement for sheath, beaded and spot welded types.
4. Describe the operation of thermocouples.
5. Describe thermocouple types and their characteristics (E, J, K, R, S, T, etc.)
6. Select the required thermocouple for the application.
7. Fasten, secure, and weld thermocouples on work piece.
8. Connect thermocouples into controller and or recorder circuits.
9. Select and apply insulation as required.

**E. Set Up for Heat Treatment Using Combustible Fuels.**

**Competency:** *Be able to set up for treatment using combustible fuels as heat source.*

1. Describe the characteristics of fuels used for heat treatment.
2. Describe combustion equipment including, gages, hoses, couplings, igniters, vaporizers, burners and blowers.
3. Assemble and disassemble equipment used for combustion.
4. Conduct bubble tests, sniffer tests, etc. to ensure equipment is assembled correctly.
5. Describe the principles and operation of flues.
6. Describe thermocouple placement requirements to control and verify heat treatment process.
7. Set up controllers for heat treatment using combustion.
8. Verify operation of equipment prior to use.
9. Describe permits, barriers, emergency procedures, fire extinguisher requirements and evacuation strategies.

**F. Heat Treatment Applications**

**Competency:** *Perform all heat treatment operations.*

1. Apply heat treatment for degassing or bake outs.
2. Use heat treatment equipment for line or ground thaw.
3. Use heat treatment equipment for drying refractories or curing coatings.
4. Perform pre weld heat treatment for common piping configurations.
5. Perform post weld heat treatment for common piping configurations.
6. Perform pre and post weld heat treatment for weldments, and castings.
7. Perform pre and post weld heat treatment for spheres, vertical and horizontal vessels.
8. Describe heat gradients and the chimney effect when heat treating vessels.
9. Set up heat treatment equipment to compensate for complex geometry.
10. Describe how heat treatment equipment is used to preheat boilers etc. to prepare for start up.
11. Use induction for heat treatment
12. Use combustible fuels for heat treatment
13. Use temporary or stationary furnaces for heat treatment.
14. Perform hardness tests.

## SECTION THREE: .....HEAT TREATMENT PROCESS VERIFICATION.....

***Process verification or ‘troubleshooting’ are the competencies required by field heat treatment technicians to ensure that a given heat treatment is being administered as specified by code or specifications. A field heat treatment technician must be prepared at any stage of a heat treatment to use a variety of strategies, corrective actions or intervention to ensure that a heat treatment is done according to specification.***

**A. Code/Customer Requirements for the Heat Treating Application**

***Competency: Ensure the required code or customer or vendor specifications are followed and documented.***

1. Ensure that all the needed forms, documents, code books or reference materials are available for a specified heat treatment.
2. Verify that set up matches code or customer requirements.
3. Verify that documents are completed and filed according to the job requirements.
4. Complete required certificates, tags, markers, etc. and placed according to site or job requirements.

**B. Heat Treatment Troubleshooting**

***Competency: Recognize, identify and solve problems when performing heat treatment.***

1. Monitor controls to verify times and temperatures are as required by job specifications.
2. Describe time temperature recording.
3. Describe recorder operation and distribution of recorder charts.
4. Describe ‘overshoots’ and the effect on heat treatment operations.
5. Identify when the heat treatment in process requires corrective action.
6. Identify the cause of out of specification temperature.
7. Select the appropriate corrective action to solve the problem.
8. Assess whether the action taken has corrected the problem.

**C. Troubleshooting Connections**

***Competency: Diagnose and correct faulty control, instrument, and HT machine connections.***

1. Describe the effect of thermocouple faults or wiring faults on equipment readings.
2. Troubleshoot heater and control circuits using test equipment.
3. Identify and correct circuit faults
4. Identify and repair or replace faulty equipment.

**D. Troubleshooting Site Related Problems**

***Competency: Diagnose and correct site related heat treatment problems.***

1. Describe the effects of wind, rain, etc. on heat treatment.
2. Describe the effects of water or other substances in the lines to be heat treated.
3. Locate and describe the effect of heat sinks on heat treatment.
4. Describe the effect of position (i.e. vertical or horizontal, above or below) on heat treatment.

5. Identify site related causes of out of specification or incorrect heat treatment.
6. Determine procedures to correct site related problems.

**E. Troubleshooting Material Related Problems**

**Competency:** *Diagnose and correct problems related to material and or construction.*

1. Identify problems that occur as a result of material composition (type of material), thickness, shape etc.
2. Determine procedures to compensate for material related problems on a heat treatment.

**SECTION FOUR: .....JOB MANAGEMENT**

***Field heat treatment technicians must be able to plan and manage a heat treatment job from start to finish, obtain equipment, personnel, material, assistance from other trades and occupations, and document completed procedures.***

**A. Plan and Organize Job**

**Competency:** *Be able to plan and schedule a job.*

1. Use job information to make labour, equipment, and material lists for a job.
2. Plan, coordinate and arrange for personnel, equipment, and material to be available on site for the dates required.
3. Arrange for required site services, such as scaffolding, weather protection, lighting, power and storage.

**B. Run Job on Site**

**Competency:** *Be able to supervise/manage a heat treatment job.*

1. Document job information such as time and materials used for a job.
2. Complete forms lists etc., related to procedures performed.
3. Participate in job site meetings, such as safety meetings, or meetings with clients, other trades etc.
4. Be able to complete an accident report or investigation.





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