Steamfitter-Pipefitter

NOC 7252

Introduction

Steamfitters and pipefitters lay out, assemble, fabricate, maintain, troubleshoot and repair piping systems carrying water, steam, chemicals and fuel in heating, cooling, lubricating and other process piping systems. Steamfitters and pipefitters are employed in maintenance departments of factories, plants and similar establishments, by pipefitting and sprinkler contractors, or they may be self-employed.

The most important Essential Skills for Steamfitter-Pipefitter are:

- Document Use
- Numeracy

Document Sections

- Reading Text
- Document Use
- Writing
- Numeracy
- Oral Communication
- Thinking Skills
    - Problem Solving
    - Decision Making
    - Critical Thinking
    - Job Task Planning and Organizing
    - Significant Use of Memory
    - Finding Information
- Working with Others
- Computer Use
- Continuous Learning
- Notes

A. Reading Text

Reading Text

Tasks	Complexity Level	Examples
Typical	1 to 3	Steamfitter-Pipefitter • read minutes of project meetings or memos to stay current on decisions and be aware of changes on the project. (1) • read equipment warranties to understand what kind of situations can invalidate the warranties. (2) • read manufacturers' manuals and instructions for technical information on equipments and fittings to understand their design, recommendations for use, installation, troubleshooting, and/or maintenance. This includes reading paragraphs of text with accompanying diagrams, charts, and graphs. (3) • refer to and read pipefitting textbooks to understand when a specific system is appropriate and to review technical procedure (e.g., refrigeration, super heated water, ground heat). The text is of technical nature, may be several paragraphs in length, and is supplemented and illustrated with diagrams, charts, and graphs. (4)
Most Complex	4	• refer to and read multiple professional codes such as the Construction Security Code or High Pressure Welding Code to ensure that the process they follow meet the industry requirements while ensuring safety for the workers. These codes are complex and lengthy, written for legal purposes, use technical jargon, and require interpretation. (4)

Reading Summary

The symbol √ is explained in the Use of Symbols section.

	Purpose for Reading			
Type of Text	**To scan for specific information/To locate information**	**To skim for overall meaning, to get the 'gist'**	**To read the full text to understand or to learn**	**To read the full text to critique or to evaluate**
Forms	√	√		
Labels	√			
Notes, Letters, Memos	√	√	√	
Manuals, Specifications, Regulations	√	√	√	
Reports, Books, Journals	√			

B. Document Use

Document Use

Tasks	Complexity Level	Examples
Typical	2 to 4	Steamfitter-Pipefitter • read work schedules for projects to plan their own work and understand what coordination is required with other trades. (2) • reference equipment catalogues to locate parts. (2) • scan workplace signs, labels, Workplace Hazardous Material Information System's (WHMIS) symbols and Material Safety Data Sheets (MSDS) to obtain information about security requirements and hazardous products. (2) • consult Pipefitters' Handbook to obtain information on measurement, type of materials and pipe sizing, as well as, mathematical formulae for calculations required. The Handbook is a key resource for every job as it contains charts and tables with the necessary information they require on a regular basis. (3) • refer to and read tables in high-pressure vessel manuals to ascertain the temperatures, pressures and expansions required. (3)
Most Complex	4	• interpret and take measurements from mechanical drawings of several pages to identify how to install the equipment for steam heating systems, to review the specifications for the project, and to extract the information needed to make calculations. The drawings are three dimensional, contains multiples pieces of information (e.g., elevation, equipment), are drawn to scale, and include colour coding, and require a certain level of prior training for interpretation. (4) • interpret schematic diagrams and three-dimensional drawings to understand the routing of piping through below-ground and above-ground conduits and to identify possible interference. (4) • interpret three-dimensional structural and architectural plans to ensure that the piping does not interfere with an existing structure (e.g., beam). (4)

Examples

- may draw a rough sketch of a complete piping installation to help an apprentice understand the piping system through which steam will travel.
- make sketches of pipes with instructions for the welders.
- make sleeving drawings to show how to make holes in the concrete.
- may create blueprints by entering all the necessary dimensions in a drawing software (i.e., Autocad).
- may create spool sheet indicating all the measurements between two points.

Document Use Summary

- Read signs, labels or lists.
- Complete forms by marking check boxes, recording numerical information or entering words, phrases, sentences or text of a paragraph or more. The list of specific tasks varies depending on what was reported.
- Read completed forms containing check boxes, numerical entries, phrases, addresses, sentences or text of a paragraph or more. The list of specific tasks varies depending on what was reported.
- Read tables, schedules or other table-like text (e.g., read work shift schedules).
- Enter information on tables, schedules or other table-like text.
- Obtain specific information from graphs or charts.
- Interpret information on graphs or charts.
- Construct or draw graphs or charts.
- Recognize common angles such as 15, 30, 45 and 90 degrees.
- Draw, sketch or form common shapes such as circles, triangles, spheres, rectangles, squares, etc.
- Interpret scale drawings (e.g. blueprints or maps).
- Take measurements from scale drawings.
- Read assembly drawings (e.g. those found in service and parts manuals).
- Create assembly drawings.
- Read schematic drawings (e.g. electrical schematics).
- Create schematic drawings.
- Make sketches.
- Obtain information from sketches, pictures or icons (e.g., computer toolbars).

C. Writing

Writing

Tasks	Complexity Level	Examples
Typical Most Complex	1 2	Steamfitter-Pipefitter • write lists of all materials and fittings needed for a job to provide input to the foreperson for order forms. (1) • complete forms to request materials. (1) • keep a daily log to record measurements and reminders. (1) • write an incident or accident report, using a standard form, where they may have to write one paragraph or more describing the incident or accident. (2) , (rarely)

Writing Summary

The symbol √ is explained in the Use of Symbols section.

	Purpose for Writing						
Length	**To organize/ to remember**	**To keep a record/to document**	**To inform/ to request information**	**To persuade/ to justify a request**	**To present an analysis or comparison**	**To present an evaluation or critique**	**To entertain**
Text requiring less than one paragraph of new text	√	√	√				
Text rarely requiring more than one paragraph		√					
Longer text							

D. Numeracy

The symbol √ is explained in the Use of Symbols section.

Numeracy

Tasks	Complexity Level	Examples
√ Data Analysis Math √ Numerical Estimation	2 to 3 2	Steamfitter-Pipefitter • organize their daily activities and coordinate with other trades to accomplish the assigned work. (Money Math), (1) • use plumb bob to centre a pipe over a hole. (Measurement and Calculation Math), (1) • convert length measurements from International System of Measures to Imperial measurement system and vice-versa. For example, some pipes might be supplied in Imperial measurements while the drawings are prepared in SI units. (Measurement and Calculation Math), (2) • take the temperature of condensate on the inlet and outlet of a steam trap using a temperature sensor then compare the readings to the manufacturer's data and steam tables to see if the trap is passing excessive steam when troubleshooting the equipment or verifying that the system maximizes steam consumption and efficiency. (Measurement and Calculation Math), (2) • use algebraic equations to calculate the expansion or contraction of piping material due to changes of temperature to decide if they need to add an expansion loop or joint in order to minimize the stress on the piping system. When using formulas, steamfitters-pipefitters must be able to work unknowns, flip the formula around, and in some cases, they may have to develop a formulae. (Measurement and Calculation Math), (3) • calculate the total volume capacity of the piping to determine the quantity of anti-freeze required to be added in the system. In order to accomplish this, steamfitters-pipefitters must first calculate the volume of each component of the system using its appropriate formula because each pipe is of different sizes and shapes (e.g., cylinder, rectangular tank), then add the volumes together; based on this total volume and the pre-determined ratio, steamfitters-pipefitters then calculate the amount of anti-freeze needed. This task

		is complicated by the multiple calculations that must be reconciled and the occasional need to work with hemispheric lens when dealing with irregular shapes such as a propane or expansion tank. (Measurement and Calculation Math), (4) • use trigonometry to calculate offsets and rolling offsets when installing fittings in piping systems. For example, steamfitters-pipefitters would first determine the offset distance and the change in elevation to calculate the hypotenuse based on those two sides using the Pythagorean formula to obtain the side opposite for the run, then refer to trigonometry tables or use their calculators to obtain the sine of the fitting angle to determine the length of pipe required. (Measurement and Calculation Math), (4) • may identify the acceptable level of particles per million in the piping system. (Data Analysis Math), (1) • may take a series of pH readings to make sure the level is within the parameters for that type of boiler (i.e., not too acidic or caustic). Steamfitters-pipefitters would use an electronic pH test kit to obtain the readings, calculate the average, and then compare it to the standard acceptable range. (Data Analysis Math), (2) • may take a Total Dissolve Solid (TDS) readings using an electronic conductivity device and comparing them to acceptable operating practices to see if calibration of the system is required. (Data Analysis Math), (2) • take and compare several pressure readings when conducting and performing tests for start up and commissioning of the system to ensure they have the correct pressure and to calculate flow through the system. (Data Analysis Math), (3) • may take numerous pressure and temperature readings across pump exchangers, boilers, etc. to determine if the equipment is performing adequately and if balancing of the system is required. (Data Analysis Math), (3) • estimate quantity of materials required to ensure sufficient quantities when installing a piping system. (Numerical Estimation), (2) • estimate the time required to replace a valve or rig a piece of fabricated pipe onto a higher line. (Numerical Estimation), (2)

Math Skills Summary

a. Mathematical Foundations Used

The symbol √ is explained in the Use of Symbols section.

Mathematical Foundations Used

Code	Tasks	Examples
	Number Concepts	
√	Whole Numbers	Read and write, count, round off, add or subtract, multiply or divide whole numbers. For example, counting the number of pipes that need to be hoisted.
√	Integers	Read and write, add or subtract, multiply or divide integers. For example, measuring plus and minus temperatures or measuring elevation above and below grade.
√	Rational Numbers - Fractions	Read and write, add or subtract fractions, multiply or divide by a fraction, multiply or divide fractions. For example, measuring the thickness of a pipe with the Imperial measurement system or measuring gaps of welding between two pipes (e.g., 1/8 inch).
√	Rational Numbers - Decimals	Read and write, round off, add or subtract decimals, multiply or divide by a decimal, multiply or divide decimals. Use decimals mainly to refer to dollars and cents. For example, measuring the distance centre-to-centre using millimetres or metres.
√	Rational Numbers - Percent	Read and write percents, calculate the percent one number is of another, calculate a percent of a number. For example, installing a system with 10% glyco mixed with water or when testing the equipment and only partially filling it (75% capacity).
√	Equivalent Rational Numbers	Convert between fractions and decimals or percentages. Convert between decimals and percentages. For example, when using two different chemicals, one given as a ratio (1 in 20 mixture) and the other one as a percentage (10%), one chemical must be converted or when converting the thickness of a blade from 1/8 of an inch to .125.
√	Other Real Numbers	Use powers and roots, scientific notation, significant digits. For example, calculating he volume of a cylinder using the formulae: diameter2 x .7854 x height.

Code	Tasks	Examples
		Patterns and Relations
√	Equations and Formulae	Solve problems by constructing and solving equations with one unknown. Use formulae by inserting quantities for variables and solving. Write, simplify and solve two variable algebraic problems. For example, determining the strength required for a pipe support based on weight and volume or calculating the expansion based on the length of the pipe and the outside diameter using the expansion loop formula (length of pipe = 6.16 x square root of outside diameter multiplied by the expansion in inches).
√	Use of Rate, Ratio and Proportion	Use a rate showing comparison between two quantities with different units. Use a ratio showing comparison between two quantities with the same units. For example, filling a tank taking into consideration the weight per volume (i.e., pounds per gallons).or identifying acceptable level of particles per million in the piping system. Using scale drawings.
		Shape and Spatial Sense
√	Measurement Conversions	Perform measurement conversions. For example, converting between blueprints drawn using the International System of Measures and manufacturer's measurements for a part given in Imperial measurements.
√	Areas, Perimeters, Volumes	Calculate areas. Calculate perimeters. Calculate volumes. For example, calculating the volume of boilers and piping system.
√	Geometry	Use geometry. For example, sketching a pipe or measuring angles to cut piping to specifications.
√	Trigonometry	Use trigonometry. For example, calculating offsets. Recognizing common angles. Drawing, sketching and forming common forms and figures.

Code	Tasks	Examples
	Statistics and Probability	
√	Summary Calculations	Calculate averages. Calculate rates other than percentages. Calculate proportions or ratios. For example, testing the system for start up.

b. How Calculations are Performed

- In their heads.
- Using a pen and paper.
- Using a calculator.

c. Measurement Instruments Used

- Time. For example, using a watch or stopwatch.
- Distance or dimension. For example, using a measuring tape, callipers, laser level, straight edge, or string.
- Temperature. For example, using the thermometer, electronic sensors, or gauge.
- Pressure. For example, using a manometer or pressure gauge.
- Angles. For example, using a plumb bob or protactors.
- Electrical Resistance (Ohms). For example, using a multimeter.
- Electrical Intensity (Amperes). For example, using a multimeter.
- Use the SI (metric) measurement system.
- Using the imperial measurement system.

E. Oral Communication

Oral Communication

Tasks	Complexity Level	Examples
Typical	1 to 3	Steamfitter-Pipefitter • may speak with vendors to order materials. (1) • interact with colleagues and supervisors at project meetings to discuss specific problems. (1) • interact with other pipefitters working on different systems to coordinate and ensure the two systems can meet at the correct location. (2) • communicate with contractor or foreperson/supervisor to obtain information about deadlines for receiving materials, to raise and discuss safety issues, and/or to inform of potential delays. (2) • talk to engineer to discuss a potential problem and identify a solution (e.g., concerning the location and cause of steam leaks, piping size incorrect for the process). (2) • talk with the Technical Standards and Safety Authority (TSSA) representative once the system is finished to ensure it meets certification requirements (especially for a high-pressure system). (2) • interact with other tradespersons such as welders and plumbers to coordinate tasks or to make requests (e.g., tell the welder what materials to use). It is important to communicate well with other trades especially when working in confined areas where safety can become an issue. (3) • interact with apprentices to provide mentorship. (3)
Most Complex	3	

Modes of Communication Used

- In person.
- Using a telephone.
- Using a two-way radio or other such means.
- Using specialized communications signals. For example, hand signals.

Environmental Factors Affecting Communication

Steamfitters-pipefitters work in a very noisy environment. The sound of machinery is constant, along with noise from grinders, drills and cutting machines. Steamfitters-pipefitters are often required to wear masks because of dust and fumes and ear protection because of noise. This may impede oral communication. They shout over the noise and may communicate with hand signals, particularly when using hoisting equipment.

Oral Communication Summary

The symbol √ is explained in the Use of Symbols section.

	Purpose for Oral Communication (Part I)					
Type	**To greet**	**To take messages**	**To provide /receive information, explanation, direction**	**To seek, obtain information**	**To co-ordinate work with that of others**	**To reassure, comfort**
Listening (little or no interaction)						
Speaking (little or no interaction)						
Interact with co-workers			√	√	√	
Interact with those you supervise or direct			√	√	√	
Interact with supervisor/ manager			√	√	√	
Interact with peers and colleagues from other organization						
Interact with customers/ clients/ public						
Interact with suppliers, servicers			√	√		
Participate in group discussion			√	√	√	
Present information to a small group						
Present information to a large group						

The symbol √ is explained in the Use of Symbols section.

	Purpose for Oral Communication (Part II)					
Type	**To discuss (exchange information, opinions)**	**To persuade**	**To facilitate, animate**	**To instruct, instill understanding, knowledge**	**To negotiate, resolve conflict**	**To entertain**
Listening (little or no interaction)						
Speaking (little or no interaction)						
Interact with co-workers	√					
Interact with those you supervise or direct				√		
Interact with supervisor/ manager	√					
Interact with peers and colleagues from other organization						
Interact with customers/ clients/ public						
Interact with suppliers, servicers						
Participate in group discussion	√				√	
Present information to a small group						
Present information to a large group						

F. Thinking Skills

1. Problem Solving

Problem Solving

Tasks	Complexity Level	Examples
Typical	2	Steamfitter-Pipefitter • often find that space it too tight to work. They have to rebuild the fittings on the floor, raising it only when substantially complete. (2) • disagree with an engineer about specifications, such as whether an expansion joint needs two guides or one. They ask the engineer to put the requirement in writing so that they are able to show inspectors that they were following specified directions if a problem arises later. (2) • have to move heavy pieces of equipment such as a 40-ton boiler in small confined spaces. They need to identify the tools required to move, come up with a strategy and coordinate with co-workers to minimize damages to the current structure. (2)
Most Complex	3	• often work with extreme temperatures and pressures, as a result, pipe movement becomes problematic. In such cases they have to do several shut down procedures because there are a lot of safety points they need to look at. (2) • encounter failure in pipe. In that situation, they need to shut off the steam, identify the reason why it failed and consult with the engineer to determine the proper course of action to rectify the situation. (3) • during testing, detect errors such as a pipe that was incorrectly measured. In that case, they must refabricate the pipe. This is why inspections and testing are important steps for quality control. (3)

2. Decision Making

Decision Making

Tasks	Complexity Level	Examples
Typical	2 to 3	Steamfitter-Pipefitter • decide how to organize their time and what order of tasks will be most efficient when performing maintenance functions for a steam heating system. (2) • decide how to configure pipes when only flowcharts are available and there are no diagrams. It is important to take the accurate measurements to ensure everything fits once it is welded; otherwise they must start again. (3) • decide how to relocate piping when there is interference with another system (e.g., sprinkler). They identify the location, measurements, height, distance, elevation and/or compatibility of materials. (3)
Most Complex	3	

3. Critical Thinking

Critical Thinking information was not collected for this profile.

4. Job Task Planning and Organizing

Job Task Planning and Organizing

Complexity Level	Description
3	Own job planning and organizing • Steamfitters-pipefitters receives the initial information regarding the work that needs to be accomplished by the general contractor or foreperson who assigns the work, identifies the available areas where the work can be done on the job site and coordinates all the trades on the job site. Once the information is received from the foreperson, the steamfitters-pipefitters define the steps needed for their part of the job and identify a plan to accomplish the task as well as coordinate with the other trades. Tasks being performed present a number of planning challenges, including frequent interruptions for testing and coordination with other trades as very often specific or unique pipes need to be designed and fitted. Sequencing, scheduling and coordinating are very important when several trades are involved in a project. • Steamfitters-pipefitters may plan several days to weeks in advance depending on the project. They need to plan carefully for the availability of fittings, materials and trades. They may need to plan for considerable overtime hours, especially in cases where a company has a shutdown for steam refit to be done. Working nights and weekends is not unusual in these circumstances and more careful planning is needed to maximize the limited time of the shutdown. Planning and organizing for others • Planning and organizing the work of others is not a primary responsibility of the occupation. Usually that task fall under the responsibility of the foreperson for a given worksite. In some cases, steamfitters-pipefitters may supervise some of the work performed by welders, pipe insulators, control pipefitters, or electricians. They may also act as mentors and supervise apprentices.

5. Significant Use of Memory

Examples

- remember the assigned tasks and directive for the day.
- remember the measurement of the elbow required for a certain size of pipe.
- remember standard measurements for frequently used parts/materials.
- remember where to find specific code requirements for a given system (e.g., Food, Drugs and Beverage Sanitary Code).

6. Finding Information

Finding Information

Tasks	Complexity Level	Examples
Typical	1	Steamfitter-Pipefitter • review blueprints, schematic diagrams, shop drawings, and specifications to find information about steam heating systems. (1) • refer to the Pipefitters' Handbook or catalogues to find product-specific information. (1)
More Complex	2	• use the Workplace Hazardous Material Information System to find information regarding safety issues. (1) • refer to the various code documents/books to identify the requirements of a given system (e.g., Medical Gas Code, Ultra High Purity norms). (1) • read steamfitting training manuals to find general information about various piping systems they are less familiar with. (2)

G. Working with Others

Working with Others

Complexity Level	Description
3	Steamfitters-pipefitters work with others most of the time. They liaise with other pipefitters to make sure that fittings and hangers are available and are put up. They work mainly with welders to assemble fittings prior to welding but may also work with pipe insulators and electricians. They coordinate the arrival times of crane operators when necessary. They work closely with apprentices to obtain assistance and to offer both technical training and safety information. Coordination of work with others is a key facet of the job.

Participation in Supervisory or Leadership Activities

- Participate in formal discussions about work processes or product improvement.
- Have opportunities to make suggestions on improving work processes.
- Monitor the work performance of others.
- Inform other workers or demonstrate to them how tasks are performed.
- Orient new employees.
- Assign routine tasks to other workers.
- Assign new or unusual tasks to other workers.
- Identify training that is required by, or would be useful for, other workers.

H. Computer Use

Computer Use

Tasks	Complexity Level	Examples
Typical	1	Steamfitter-Pipefitter • may use communications software for e-mail purpose or use the Internet to look up material information or to order materials on-line with wholesellers. (1)
Most Complex	2	• use a spreadsheet to keep track of materials (e.g., ordered, shipped, received). (2) • may use computer-assisted design software such as Autocad to input measurements taken on the job site to generate drawings or ACORN for piping design. (2)

Computer Use Summary

- Use a spreadsheet.
- Use computer-assisted design, manufacture or machining.
- Use communications software.

I. Continuous Learning

How Learning Occurs

Learning may be acquired:

- As part of regular work activity.
- From co-workers.
- Through training offered in the workplace.
- Through reading or other forms of self-study
  - on worker's own time.
  - using materials available through work.
  - using materials obtained through a professional association or union.
  - using materials obtained on worker's own initiative.
- Through off-site training
  - during working hours at no cost to the worker.
  - with costs paid by the worker.

J. Other Information

In addition to collecting information for this Essential Skills Profile, our interviews with job incumbents also asked about the following topics.

Physical Aspects
Steamfitters-pipefitters lift pipes and materials weighing several hundred pounds, relying upon a partner or lifting equipment to assist. They have to lift, carry and hold equipment and materials. There is a great deal of walking, climbing on a scaffold, crawling, and kneeling. They may have to enter confined spaces and descend into manholes. They may have to perform such activities as drilling, grinding, tightening pipes and welding. They are subjected to extremes of temperatures.

Attitudes
The steamfitters-pipefitters interviewed felt that job incumbents should be flexible, patient and adaptable since no two jobs are alike. They must like challenges, have a strong personal discipline and a high level of commitment to quality work. They must possess an ability to visualise and problem-solve, as well as strong skills for measurements, mathematics and mechanics. They must be comfortable working with their hands, be healthy and in good physical shape as manual labour is an integral part of this occupation. They need to get along well with co-workers and be able to work in a team environment.

Future Trends Affecting Essential Skills
New technology in piping connectors is constantly arriving on the market making the steamfitters-pipefitters' work easier (e.g., hydraulic system) while at the same time increasing their training requirements as the materials become more specialized. All these changes mandate the requirements for more highly skilled steamfitters-pipefitters at an earlier point in their careers. They need to possess a more in-depth knowledge of quality control procedures to meet international standards (ISO 9000). As the governments keep increasing stricter safety, health and environment regulations, steamfitters-pipefitters must keep current on a large number of regulations and codes. Also, as a result of downsizing and smaller crew sizes, steamfitters-pipefitters are put in a supervisory role earlier in their careers Although there is currently minimal use of computers in this occupation, over the next few years a rise in their use is expected: Computers will become more available on job site to facilitate communication and access to information. Also, more steamfitters-pipefitters are becoming more knowledgeable about drawing software (such as AutoCAD), especially in fabrication shops. As a result of an increasing trend towards the use of modulation units and kits, fabrication shops have a pressing need to hire more steamfitters-pipefitters skilled in the use of drawing software to meet the demands of international markets. As present steamfitters retire there will be an increasing need for new steamfitters to maintain the buildings that are presently heated by steam; however, fewer steamfitters are entering the occupation because of newer mode of heating, such as hot water or glycol-based systems. At the same time that the number of steamfitters-pipefitters is declining, there are greater inspection controls and a more intensive reliance on specifications. This means there will be an increased emphasis on document use (including more complex diagrams) and more technical reading.

K. Notes

This profile is based on interviews with job incumbents across Canada and validated through consultation with industry experts across the country.
For information on research, definitions, and scaling processes of Essential Skills Profiles, please consult the Readers' Guide to Essential Skills Profiles (http://www.hrsdc.gc.ca/eng/jobs/les/profiles/readersguide.shtml).