Fire Protection Mechanic

Occupational Analysis Report

January 2012

Commission
de la construction
du Québec

The purpose of this report is to describe as accurately as possible the fire protection mechanic trade as currently practiced in Québec's construction industry. It is a record of discussions held by a group of workers who met for the occasion after industry partners recommended them to the Commission de la construction du Québec for their expertise in the trade.

The occupational analysis is a first step in the definition of the competencies required for practicing the trade. This report becomes one of the reference and decision-making tools used by the Commission for teaching and learning purposes.

The present report does not bind the Commission in any way. It has no legal effect and is meant as a reflection of discussions held on the date of the analysis workshop.

ISBN 978-2-550-69181-5 (printed version)
ISBN 978-2-550-69180-8 (PDF)
Dépôt légal – Bibliothèque et Archives nationales du Québec, 2013

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The masculine gender is used generically
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ACKNOWLEDGEMENTS

Production of the present report was made possible by the collaboration and participation of many people. The Commission de la construction du Québec (CCQ) is grateful for the quality of the information provided by those consulted, and gives special thanks to the fire protection mechanics who so generously agreed to participate in the analysis workshop regarding their trade. The persons consulted are:

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The CCQ extends special thanks to the Commission de la santé et de la sécurité du travail, ASP Construction and their representative, Ms. Isabelle Dugré, for their collaboration in producing the occupational health and safety table appended to the present report.

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INTRODUCTION

In early 2009, the Direction de la formation professionnelle of the Commission de la construction du Québec (CCQ) launched a large-scale operation to review the occupational analyses[1] of all construction industry trades.

The CCQ undertook this operation for many reasons, particularly the following:

- the project to reform the construction workforce apprenticeship and management system, and the eventual design of qualitative apprenticeship booklets requiring a detailed description of each trade;
- the fact that most construction occupational analyses[2] had been conducted between 1987 and 1991 and had not been reviewed since;
- updates to vocational qualification examination question banks;
- implementation of Chapter 7 of the Agreement on Internal Trade (AIT) and of the Québec-France Understanding on the Mutual Recognition of Professional Qualifications.

These factors demonstrate the necessity of updating the occupational analyses in order to obtain a current and complete profile of the various trades in Quebec.

The occupational analysis of the fire protection mechanic trade belongs to this context[3]. Its purpose is to describe this trade as currently practiced by journeymen in the construction industry. The present report was written in order to collate and organize the information gathered during the occupational analysis workshop held in Laval on May 5 and 6, 2011.

This analysis aims to draw a portrait of the trade (tasks and operations) and its working conditions, and to identify the skills and behaviours required. The report of the occupational analysis workshop is an accurate reflection of the consensus reached by a group of workers in the fire protection mechanic trade. A special effort was made to include in this report all the data collected during the workshop and to ensure that the data accurately depict the realities of the trade analysed.

1. The terms “profession” and “trade” are considered synonymous.
2. Called “work situation analyses” at the time.
3. This occupational analysis was conducted according to the Cadre de référence et instrumentation pour l’analyse d’une profession produced in 2007 by the ministère de l’Éducation, du Loisir et du Sport (Direction générale de la formation professionnelle et technique) and the Commission des partenaires du marché du travail, ministère de l’Emploi et de la Solidarité sociale.

1. GENERAL CHARACTERISTICS OF THE TRADE

1.1 DEFINITION OF THE TRADE

According to the Regulation respecting the vocational training of workforce in the construction industry (Schedule A, section 6), the “fire protection mechanic” is:

> […] responsible for automatic sprinkler systems including their piping, devices, accessories and other apparatus used to prevent and fight fires.
>
> Performance of the work described in the first paragraph includes trade-related handling for the purposes of immediate and permanent installation.

The participants agree with the definition[4].

1.2 JOB TITLES

On construction sites, we mainly hear “sprinkler guys” in reference to workers in the trade. Nevertheless, the job title “fire protection mechanic,” found in the Regulation respecting the vocational training of workforce in the construction industry, will be used in the present report.

At times, particularly in the industrial sector, fire protection mechanics are confused with plumbers or pipe fitters, given that certain tasks of those two trades are sometimes similar to those of fire protection mechanics.

1.3 SECTORS OF ACTIVITY

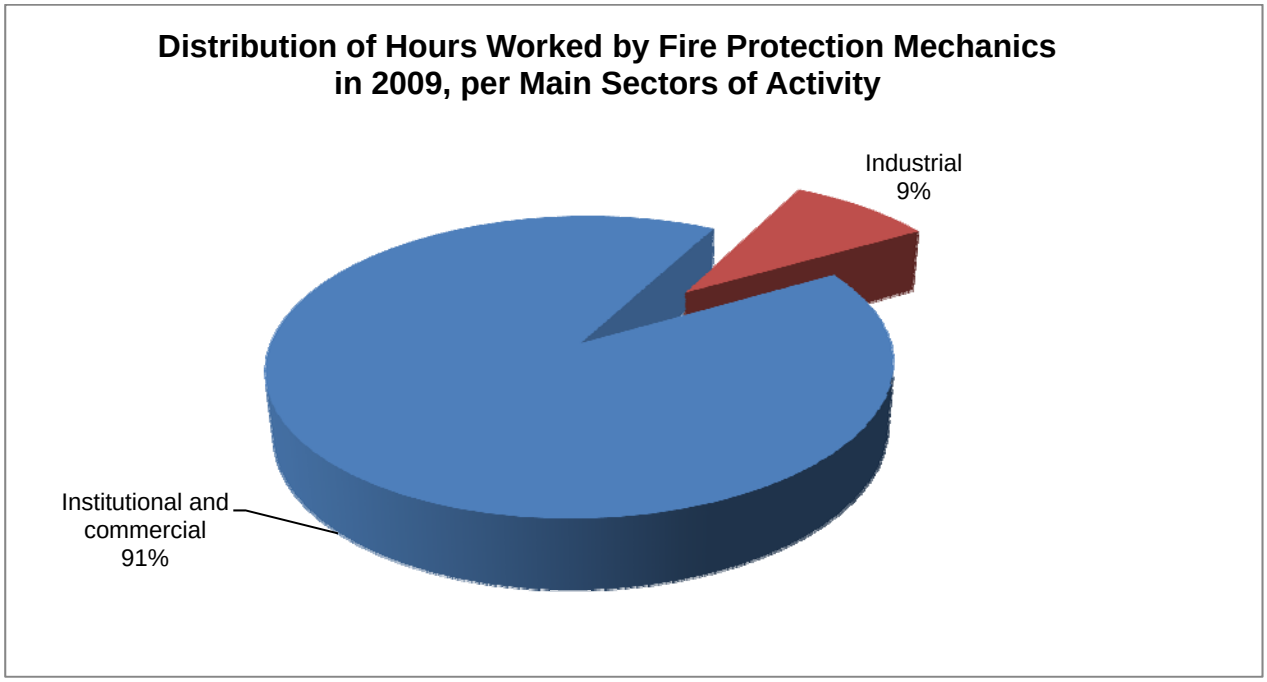
Fire protection mechanics are active mainly in two construction industry sectors:

- the industrial sector;
- the institutional and commercial sector.

4. Read on this subject the Professional Subcommittee’s comment in Annex 3.

The diagram below illustrates the allocation of all fire protection mechanics´ work time in those two sectors in Quebec for 2009[5].

Table 1.1 Workload of Fire Protection Mechanics



Following the presentation of the above diagram, we asked the participants to comment on the sectors in which they practice their trade. The table below presents the situation described by the fire protection mechanics attending the workshop, in comparison with workers in the trade generally.

Table 1.2 Work Time Allocated to Each Sector

Sector	Percentage of Work Time Allocated to Each Sector	
	All Fire Protection Mechanics in Quebec	Fire Protection Mechanics Attending the Meeting
Residential	–	1%
Institutional and commercial	91%	69%
Civil engineering and roads	–	–
Industrial	9%	30%

5. Commission de la construction du Québec, *Carrières construction*, 2010-2011 edition.

1.4 FIELD OF PRACTICE

The trade's field of practice is the construction industry. The Act respecting labour relations, vocational training, and workforce management in the construction industry (R.S.Q., c. R-20) defines construction as follows:

> […] the foundation, erection, maintenance, renewal, repair, alteration and demolition work on buildings and civil engineering works carried out on the job site itself and vicinity including the previous preparatory work on the ground;
>
> In addition, the word "construction" includes the installation, repair and maintenance of machinery and equipment, work carried out in part on the job site itself and in part in the shop, moving of buildings, transportation of employees, dredging, turfing, cutting and pruning of trees and shrubs and laying out of golf courses, but solely in the cases determined by regulation.

1.5 LEGISLATION AND REGULATIONS

Fire protection mechanics in the construction industry are subject to:

- the Act respecting labour relations, vocational training and workforce management in the construction industry (R.S.Q., c. R-20);
- the Regulation respecting the vocational training of workforce in the construction industry (R-20, r.6.2);
- the four sector-based collective agreements of the construction industry;
- the National Building Code (NBC);
- The Quebec Building Code, Chapter I, "Building";
- the Act Respecting Occupational Health and Safety (R.S.Q., c. S-2.1);
- the Safety Code for the construction industry (R.Q. c. S-2.1, r.6);
- municipal by-laws, if applicable.

In addition, the participants mentioned that they applied the standards of the following organizations:

- National Fire Protection Association (NFPA);
- Factory Mutual (FM);
- Insurers' Advisory Organization (IAO).

1.6 WORKING CONDITIONS[6]

The following information provides an overview of the conditions and context of the work of fire protection mechanics, as commented by the participants in the occupational analysis workshop. To obtain up-to-date and complete information that has legal effect, it is necessary to refer to the four collective agreements of the construction industry sectors.

Salary

The average annual salary of a journeyman having worked at least 500 hours in 2009 was $56,042. Moreover, 81% of fire protection mechanics declared at least 500 hours in 2009.

In May 2011, the hourly wage of a journeyman fire protection mechanic was as follows:

- Industrial: $34.01
- Institutional and commercial: $34.01
- Civil engineering and roads: $34.01
- Light residential: $31.91
- Heavy residential: $33.97

6. The general data on working conditions are taken from the four 2010-2013 collective agreements of the construction industry sectors, and from the following document, published by the Commission de la construction du Québec: *Carrières construction*, 2010-2011 edition.

Vacations and time off

Mandatory annual holidays of four weeks – two weeks in summer and two in winter at fixed periods determined in collective agreements – are the general rule in the construction industry. To avoid penalizing employers and employees experiencing special constraints, the industry's four collective agreements allow certain possibilities for changing the vacation periods prescribed by the general rule.

To these vacation periods are added eight not worked statutory holidays, as well as a lump sum for sick leaves not otherwise paid.

Pension plan

Construction industry workers participate in a pension plan. They retain their eligibility for this pension plan throughout their career in construction, even if they change employer, trade or sector.

Insurance

The group insurance plan (medications, illness, disability, death) is fully paid by employers. Workers (and their families, as the case may be) are eligible for it so long as they remain active in the construction industry and work the required number of hours, whether or not they change employer.

Physical requirements

The work requires substantial physical strength to lift the materials (e.g.: pipes) and equipment, which can easily exceed 100 lb. In theory, health and safety regulations, as well as lifting equipment, should limit the obligation to lift such loads; but in practice, contractors do not always have the necessary lifting equipment, or certain locations are not accessible for such equipment, so manual handling is necessary. The participants mentioned that efficient work methods facilitate teamwork and handling. In addition to physical strength, good endurance is necessary, since physical effort is often required over a lengthy period.

Work schedules

A 40-hour work week from Monday to Friday is the general rule in all construction industry sectors. The daily limit is 8 hours a day, except in the light residential sector, where it can be up to 10 hours within a 40-hour week.

To avoid penalizing employers and employees experiencing special constraints, the industry's four collective agreements allow many possibilities for changing the schedule prescribed by the general rule: compressed schedule, schedule shift, make-up time in the light residential sector, etc. These special schedules confer flexibility to the work schedules in effect in the construction industry.

Most of the time, fire protection mechanics follow the general rule of 40 hours a week from Monday to Friday. However, maintenance, rehabilitation, modification or repair work is often done outside clients' hours of activity, and thus during evenings or weekends.

Fire protection mechanics work mainly in their home region. But in some cases they have to work beyond them for a few weeks or even months. However, this is not a general rule – many fire protection mechanics have never worked outside their home region.

1.7 JOB MARKET ENTRY CONDITIONS[7]

To obtain the competency certificate-apprentice in the trade (CCA), candidates must present to the CCQ the original version of an academic transcript or apprenticeship transcript attesting that they have passed the course of study for the DEP in *Mécanique de protection contre les incendies*, as well as a guarantee of employment from an employer registered with the CCQ for at least 150 hours within a period of not more than three consecutive months.

Although the construction industry favours graduates for access to the trade, labour shortages may at times make it necessary for the CCQ to give non-graduates access to the fire protection mechanic trade.

7. Other conditions than those listed above may apply. For a complete list of conditions for entering the trade, see the Act respecting labour relations, vocational training and workforce management in the construction industry (R.S.Q., c. R-20). You can also consult the CCQ's website: http://www.ccq.org/E_CertificatsCompetence/E02_Apprenti.aspx?sc_lang=en&profil=GrandPublic.

Thus, candidates without a diploma are eligible to obtain a competency certificate-apprentice only during a labour shortage and must:

- supply proof that they have the academic prerequisites for the program leading to a DEP in the trade referred to in the application or pledge, by signing a consent letter, to take the necessary training to obtain those academic prerequisites;

- present a guarantee of employment produced during a labour-pool opening by an employer registered with the CCQ, for at least 150 hours over a period of at most three consecutive months.

The apprentice fire protection mechanic must have completed four apprenticeship periods of 2,000 hours each, for a total of 8,000 hours in his trade, in order to be eligible for the provincial qualification examination that leads to obtaining the competency certificate-journeyman for the trade. Credits are paid into the apprenticeship record book of an apprentice fire protection mechanic who has obtained his diploma.

Of the 11 fire protection mechanics attending the meeting, 5 obtained their DEP in *Mécanique de protection contre les incendies*.

Moreover, certain qualities are sought by employers hiring new fire protection mechanics. The following list presents the main qualities, in the order they were mentioned and not in order of importance:

- punctuality;
- honesty;
- resourcefulness;
- interest in their work;
- good knowledge of the various systems (particularly for the service).

1.8 PLACE OF WOMEN IN THE TRADE

Section 126.0.1 of the Act respecting labour relations, vocational training and workforce management in the construction industry pertains to women's access to the construction industry: "The Commission, after consultation with the Commission des droits de la personne et des droits de la jeunesse, shall develop measures to favour the access of women to and their maintenance and greater representation on the labour market in the construction industry."

According to the CCQ[8], in 2009, 2 women (out of 995 fire protection mechanics in total) were practicing the trade, i.e., 0.2%.

According to the participants, the necessary physical strength constitutes the only factor that may prevent a woman from practicing the trade.

1.9 CAREER PROSPECTS

With experience, fire protection mechanics who want to can become foremen, superintendents, or contractors. They can also specialize in inspection, fire-protection system repairs, or drawing fire-protection system plans. Finally, some can choose training or teaching in relation to the trade.

1.10 DEVELOPMENT OF THE TRADE

The following main changes have occurred in recent years:

- Plastic piping – less expensive and lighter – has been used in recent years and will be used more and more, in part because its installation is quicker and thus less costly (in salary) to contractors. This new product has led to work opportunities in the heavy residential sector.
- New systems (e.g.: pre-action) have appeared, and other will doubtless appear in coming years.
- Thinner steel is used for some piping systems, and this trend will continue.
- Demand for detection systems has increased.

8. Commission de la construction du Québec, *Carrières construction*, 2010-2011 edition.

Those changes have a major influence on the work methods, tools and equipment used by fire protection mechanics.

1.11 IMPACT OF ENVIRONMENTAL STANDARDS ON THE PRACTICE OF THE TRADE

Environmental standards have an impact on the fire protection mechanic's tasks, particularly on certain construction sites (e.g.: LEED[9]) where standards are especially strict. This is the case for trash sorting, system water recovery, etc.

9. *Leadership in Energy and Environmental Design*.

2. WORK DESCRIPTION

2.1 TASKS AND OPERATIONS

List of tasks

The following list presents the main tasks performed by fire protection mechanics. The order in which the tasks are presented does not necessarily reflect their importance in the trade.

Task 1 Install systems*

Task 2 Connect accessories to systems*

Task 3 Rehabilitate or modify systems*

Task 4 Inspect and maintain systems*

Task 5 Repair systems*

(*) Water, dry, pre-action, deluge, chemical, etc. fire-protection systems.

Table of tasks and operations

During the workshop, a table of tasks and operations performed by fire protection mechanics was proposed to the participants. After discussions, changes were made to the table. The final version is presented in the following pages.

Table 2.1 Tasks and Operations

TASKS	OPERATIONS					
1. INSTALL SYSTEMS*	1.1 Read the plans and specifications	1.2 Plan the work	1.3 Handle and prepare materials and equipment	1.4 Install underground piping and accessories	1.5 Install the supply system and accessories	1.6 Install the pumping system, controls and accessories
	1.7 Work up high at high heights, if applicable	1.8 Install anchors and supports	1.9 Install piping	1.10 Install activation system components	1.11 Install sprinklers	1.12 Install an anti-earthquake system
	1.13 Test the system, if applicable (hydrostatic tests)					
2. CONNECT ACCESSORIES TO SYSTEMS*	2.1 Read the plans and specifications	2.2 Install finishing accessories and components and activation panels	2.3 Make electrical connections, if applicable	2.4 Start up the system	2.5 Check the operation of the activation system (pre-action, deluge, chemical)	2.6 Perform tests on localized systems, if applicable
	2.7 Ensure the good operation of the entire system	2.8 Complete the work	2.9 Update the system's or building's plan, as built	2.10 Explain to personnel how to use the system	2.11 Produce reports	

(*) Water, dry, pre-action, deluge, chemical, etc. fire-protection systems.

TASKS	OPERATIONS					
3. **REHABILITATE OR MODIFY SYSTEMS***	3.1 Read the plans and specifications	3.2 Plan the work	3.3 Contact the alarm company, if applicable	3.4 Ensure that related or interrelated systems are neutralized	3.5 Drain the systems	3.6 Handle and prepare materials and equipment
	3.7 Work up high at high heights	3.8 Proceed with dismantling, if applicable	3.9 Install anchors and supports	3.10 Move piping and components	3.11 Install piping	3.12 Install an anti-earthquake system
	3.13 Install sprinklers	3.14 Repeat operations 2.2 to 2.10, if applicable	3.15 Test the modifications	3.16 Notify the central alarm station of the completion of work	3.17 Produce reports	3.18 Update the plan, as built
4. **INSPECT AND MAINTAIN SYSTEMS***	4.1 Read the work order	4.2 Meet the person responsible	4.3 Contact the alarm company, if applicable	4.4 Ensure that related or interrelated systems are neutralized	4.5 Inspect the premises	4.6 Check the condition and operation of components and accessories
	4.7 Perform the residual static test	4.8 Perform maintenance operations	4.9 Perform valve trip tests	4.10 Restart the system	4.11 Notify the central alarm station of the completion of work	4.12 Produce reports

TASKS	OPERATIONS					
5. **REPAIR SYSTEMS***	5.1 Read the work order	5.2 Meet the person responsible	5.3 Contact the alarm company, if applicable	5.4 Ensure that related or interrelated systems are neutralized	5.5 Check the system	5.6 Diagnose the problem
	5.7 Plan the work	5.8 Drain and isolate defective systems, if necessary	5.9 Make repairs	5.10 Restart the system	5.11 Notify the central alarm station of the completion of work	5.12 Complete the work
	5.13 Produce reports					

(*) Water, dry, pre-action, deluge, chemical, etc. fire-protection systems.

2.2 OPERATIONS, SUB-OPERATIONS AND CLARIFICATIONS

In the following pages are presented the sub-operations related to most of the operations[10], as well as a few clarifications made by the participants.

Table 2.2 Sub-Operations and Operation Clarifications

TASK 1 INSTALL SYSTEMS

Operations	Sub-Operations	Clarifications
1.1 Read the plans and specifications	1.1.1 Make sure to have the final version of the plans and specifications 1.1.2 Make sure that the plan is approved by an engineer 1.1.3 Check the plan's scale 1.1.4 Read the plan notes 1.1.5 Read the installation details 1.1.6 Check the engineer's requirements and the project's specifics (the specifications' special clauses)	Fire protection mechanics do not always have access to the specifications; in many cases, the latter are consulted only by foremen.
1.2 Plan the work	1.2.1 Track the routing of the piping system 1.2.2 Make sure that the installation is feasible 1.2.3 Coordinate with the other trades, if applicable 1.2.4 Draw a list of necessary materials 1.2.5 Plan for necessary specialized equipment 1.2.6 Estimate the necessary time for the work 1.2.7 Plan (with the general contractor) a storage area for materials and equipment 1.2.8 Determine the sequence of operations	Planning is done throughout the work, and adjustments must be made regularly. The fire protection mechanic must determine the need for assistance from other mechanics, depending on the scope of the work and on the schedule to be met.

10. The sequence of operations may vary.

TASK 1 INSTALL SYSTEMS

Operations		Sub-Operations		Clarifications
1.3	Handle and prepare materials and equipment	1.3.1	See to the safe storage of materials and equipment	For steel piping, in many companies the preparation is done in the workshop. The piping is then transported to the construction site; the fire protection mechanic then makes adjustments, as necessary, during the installation. Plastic piping is always prepared on the construction site.
		1.3.2	Check received materials and equipment	
		1.3.3	Order what is missing	
		1.3.4	Prepare the piping to be installed (cut, thread, bore, drill, install fittings, etc.)	
1.4	Install underground piping and accessories	1.4.1	Have a trench dug	The accessories are, for example, blocks, elbows, rods, concrete blocks, underground valves, valve indicators, etc. The accessories are used, among other things, for monitoring the system. For example, they are flow indicators, high and low pressure indicators, etc. Fire pumps, pressurization pumps, etc., may also be involved.
		1.4.2	Coordinate water shutdown with the municipality	
		1.4.3	Cut the piping to the desired length	
		1.4.4	Ensure that joints are well maintained	
		1.4.5	Anchor the pipe to the foundation, at the building's entrance	
		1.4.6	Test the piping before backfilling	
1.5	Install the supply system and accessories	Starting at the water inlet		The accessories are, for example, valves (water, air), backflow preventers, support pumps, etc. The sub-operations apply to all systems, except foam systems that do not require water.
		1.5.1	Install adjustable flanges	
		1.5.2	Install the backflow preventer	
		1.5.3	Install the sectional or main valve	
		1.5.4	Install the flow indicator	
		1.5.5	Install the flow test valve and the drain	
1.6	Install the pumping system, controls and accessories	1.6.1	Install the pump	The controls are essentially control valves.
		1.6.2	Install all accessories (jockey pump, pump test valve, siamese connection, generator or battery, etc.)	
		1.6.3	Install control panels	
1.7	Work up high at high heights, if applicable	1.7.1	Secure the premises	Aerial platforms and risers must be checked daily; an inspection report must be written.
		1.7.2	Establish a safety perimeter	
		1.7.3	Check the necessary type of equipment	
		1.7.4	Transport the equipment to the desired location	
		1.7.5	Raise and anchor the equipment	

TASK 1 INSTALL SYSTEMS

Operations	Sub-Operations	Clarifications
1.8 Install anchors and supports	1.8.1 Drill the material 1.8.2 Install an anchor, if applicable 1.8.3 Ensure that the piping has a pitch 1.8.4 Space the supports according to standards 1.8.5 Ensure that outlets are level	The type of anchor varies according to the material in which it is installed (concrete, steel, wood, gypsum, etc.). Anchors and supports are put in place as piping is installed.
1.9 Install piping	1.9.1 Position the pipe at the desired location 1.9.2 Secure the pipe in the anchors 1.9.3 Tighten the pipe firmly	The piping installed may be made of steel or plastic. Copper piping is also found in existing installations. When electrical detection systems (12 and 24 volts) are involved, threading, electrical pipes and accessories must be installed by the fire protection mechanic.
1.10 Install activation system components		The components are, for example, heat, smoke, UV ray, etc. detectors.
1.11 Install sprinklers	1.11.1 Install sprinklers 1.11.2 Install finishing plates and protective baskets	“Upright” sprinklers are installed at the same time as anchors and supports. “Pendant” sprinklers are installed after the ceiling is installed. Sprinklers are installed with special wrenches, specific to each manufacturer.
1.12 Install an anti-earthquake system	1.12.1 Install necessary anchors 1.12.2 Install the pipe	These systems are installed in regions exposed to seismic shocks. There are lateral and longitudinal seismic supports. The pipe is actually fastened to the building at a 45° or 60° angle.
1.13 Test the system, if applicable (hydrostatic tests)	1.13.1 Apply water or air pressure 1.13.2 Check piping resistance 1.13.3 Detect leaks, if applicable 1.13.4 Repair leaks, if applicable 1.13.5 Have the test report signed by the person responsible	For a test performed with water, pressure of 200 lb./in.^{2} is applied for 2 hours. For a test performed with air, pressure of 50 lb./in.^{2} is applied for 24 hours (NFPA standard).

TASK 2 CONNECT ACCESSORIES TO SYSTEMS

The participants comment that the sequence of operations may vary depending on the type of installation and on whether an existing or a new system is involved.

Operations	Sub-Operations	Clarifications
2.1 Read the plans and specifications	2.1.1 Make sure to have the final version of the plans and specifications 2.1.2 Make sure that the plan is approved by an engineer 2.1.3 Check the plan's scale 2.1.4 Read the plan notes 2.1.5 Read the installation details 2.1.6 Check the engineer's requirements and the project's specifics (the specifications' special clauses)	
2.2 Install finishing accessories and components and activation panels	2.2.1 Proceed with the installation 2.2.2 Label the piping, valves and drains	Finishing accessories and components are, for example, sprinkler plates, fire hose supports, fire extinguishers, etc.
2.3 Make electrical connections, if applicable	Electrical connections 2.3.1 Consult the data sheets of components to be connected 2.3.2 Consult the electrical plans 2.3.3 Assign components (activation panel) 2.3.4 Connect wires 2.3.5 Monitor connections in boxes	Fire protection mechanics make electrical connections for special systems (pre-action, deluge, foam, etc.). Connections are made at junction boxes and exclusively by means of terminal boards. Electricians make the electrical connections of other systems.
2.4 Start up the system	2.4.1 Fill the system at the municipality's pressure 2.4.2 Boost pressure in the sprinkler system 2.4.3 Open the alarm control 2.4.4 Adjust the pressure and flow	
2.5 Check the operation of the activation system (pre-action, deluge, chemical)	2.5.1 Drain the system's pipes, if applicable 2.5.2 Check the condition of components 2.5.3 Perform a trip test	The verification is to ensure that specifications are met.

TASK 2 CONNECT ACCESSORIES TO SYSTEMS

Operations	Sub-Operations	Clarifications
2.6 Perform tests on localized systems, if applicable	2.6.1 Open the inspection valve to release air from pipes 2.6.2 Open the water inlet valve partially 2.6.3 Re-shut the inspection valve when there is no longer any air 2.6.4 Check for defects	Tests are performed on localized systems – for example, only for one floor or section of the building. The main tests performed on systems by the mechanics are the following: hydrostatic, trip, pressure, water flow, smoke.
2.7 Ensure the good operation of the entire system		
2.8 Complete the work	2.8.1 Pick up materials and debris 2.8.2 Pick up equipment and tools 2.8.3 Pass the broom 2.8.4 Notify the client of the completion of work	The general contractor produces a list of defects at the completion of work; the fire protection mechanic must correct problems appearing on that list.
2.9 Update the system's or building's plan, as built		The fire protection mechanic performs this update freehand. Draughtsmen then produce a computerized version in the workshop.
2.10 Explain to personnel how to use the system	2.10.1 Explain how to read the pressure gauges 2.10.2 Explain the procedure in case of failure on the sprinklers' piping system	The duration of this operation may greatly vary (from thirty minutes to a few hours) according to the nature of the system and the work done. Explanations are given to one to four persons.
2.11 Produce reports		The reports contain data (pressure, flow, etc. readings), a list of installed components and work done, the duration of work, etc. Most companies have a form that the mechanics fill out by checking or entering data. The fire protection mechanic fills out the form by hand and then office personnel finalize the form.

TASK 3 REHABILITATE OR MODIFY SYSTEMS

Operations		Sub-Operations		Clarifications
3.1	Read the plans and specifications	3.1.1	Make sure to have the final version of the plans and specifications	In the case of minor work, plans and specifications are not always provided. And it is rare to have access to plans during service calls.
		3.1.2	Make sure that the plan is approved by an engineer	
		3.1.3	Check the plan's scale	
		3.1.4	Read the plan notes	
		3.1.5	Read the installation details	
		3.1.6	Check the engineer's requirements and the project's specifics (the specifications' special clauses)	
3.2	Plan the work	3.2.1	Track the routing of the piping system	
		3.2.2	Ensure the work is feasible	
		3.2.3	Coordinate with the other trades, if applicable	
		3.2.4	Draw a list of necessary materials	
		3.2.5	Plan for necessary specialized equipment	
		3.2.6	Estimate the necessary time for the work	
		3.2.7	Plan (with the general contractor) a storage area for materials and equipment	
3.3	Contact the alarm company, if applicable	3.3.1	Locate the fire alarm panel	The alarm company may be contacted by the client or the fire protection mechanic if the client so requests.
		3.3.2	Check whether the alarms are linked to central alarm stations	
		3.3.3	Identify yourself to the alarm company	
		3.3.4	Notify the alarm company of the start, nature and duration of the work	
		3.3.5	Enter the name or number of the alarm company attendant	
3.4	Ensure that related or interrelated systems are neutralized	3.4.1	Determine the zones to be neutralized	
		3.4.2	Ask the person responsible to ensure they are neutralized	

TASK 3 REHABILITATE OR MODIFY SYSTEMS

Operations	Sub-Operations	Clarifications
3.5 Drain the systems	3.5.1 Press the “Silence” button on the alarm panel to interrupt the sound signal 3.5.2 Shut the main valve 3.5.3 Close the alarm line 3.5.4 Shut the pressurization pump’s switch 3.5.5 Open the main drain	The fire protection mechanic drains the entire system or only one zone, as the case may be.
3.6 Handle and prepare materials and equipment	See operation 1.3.	See operation 1.3.
3.7 Work at high heights	See operation 1.7.	
3.8 Proceed with dismantling, if applicable	3.8.1 Delimit the work area 3.8.2 Secure the premises 3.8.3 Protect adjacent surfaces and materials 3.8.4 Plan for the handling of components to be removed 3.8.5 Remove the components	
3.9 Install anchors and supports		
3.10 Move piping and components		Before moving pipes or components, the fire protection mechanic must ensure that the changes meet the standards in effect and that the pipes or components moved will not interfere with the operation of other components.
3.11 Install piping		
3.12 Install an anti-earthquake system		
3.13 Install sprinklers		

TASK 3 REHABILITATE OR MODIFY SYSTEMS

Operations	Sub-Operations	Clarifications
3.14 Repeat operations 2.2 to 2.10, if applicable		
3.15 Test the modifications		The nature of the tests depends on the modifications made. The tests may be hydrostatic or operational.
3.16 Notify the central alarm station of the completion of work	3.16.1 Confirm the completion of work 3.16.2 Enter the name or number of the alarm company attendant	
3.17 Produce reports		
3.18 Update the plan, as built		

TASK 4 INSPECT AND MAINTAIN SYSTEMS

Operations	Sub-Operations	Clarifications
4.1 Read the work order	4.1.1 Find out about the work's location 4.1.2 Check required materials, tools and equipment (including safety equipment) 4.1.3 Find out about the necessary time (estimate) 4.1.4 Find out about special conditions, if applicable	
4.2 Meet the person responsible	4.2.1 Request that personnel be advised of the possibility of false alarms 4.2.2 Locate system components 4.2.3 Obtain information about the central alarm station 4.2.4 Obtain information about connections 4.2.5 Check if there have been changes	

TASK 4 INSPECT AND MAINTAIN SYSTEMS

Operations		Sub-Operations		Clarifications
4.3	Contact the alarm company, if applicable	4.3.1	Locate the fire alarm panel	
		4.3.2	Ensure that the alarm panel has not been triggered yet	
		4.3.3	Check whether the alarms are linked to central alarm stations	
		4.3.4	Identify yourself to the alarm company	
		4.3.5	Notify the alarm company of the start, nature and duration of the work	
		4.3.6	Enter the name or number of the alarm company attendant	
4.4	Ensure that related or interrelated systems are neutralized	4.4.1	Check with the person responsible whether the panel is linked to another panel in the building	
		4.4.2	Ask the person responsible to disarm the panel	
4.5	Inspect the premises	4.5.1	Conduct a visual inspection of all building premises to detect: – paint on the sprinklers; – missing plates; – broken supports; – design problems; – etc.	
		4.5.2	Ensure adequate lighting	
		4.5.3	Ensure that the system is well cleared	
		4.5.4	Ensure that access are well cleared	
		4.5.5	Note any anomaly	
4.6	Check the condition and operation of components and accessories	4.6.1	Check whether the type of equipment installed is appropriate for its usage	
		4.6.2	Ensure that each device works well	
		4.6.3	Ensure that all components are installed and operational	
		4.6.4	Check whether a backflow preventer is installed upstream of the system	

TASK 4 INSPECT AND MAINTAIN SYSTEMS

Operations		Sub-Operations		Clarifications
4.7	Perform the residual static test	4.7.1	Check the connection of the main drain's pipes	
		4.7.2	Ensure its drainage capacity	
		4.7.3	Ensure there is no risk of backflow by opening the main drain (moderately)	
		4.7.4	Take a pressure reading on the pressure gauge upstream of the alarm valve (residual)	
		4.7.5	Close the main drain and take a static reading of the system	
4.8	Perform maintenance operations			Maintenance operations apply to the compressor, tank, expansion chambers, the various components (e.g.: valves), to the flushing of low points, etc.
4.9	Perform valve trip tests	4.9.1	Check the accuracy of pressure gauges	
		4.9.2	Ensure that the inspection valve is operational	
		4.9.3	Ensure the good operation of the control valve	
		4.9.4	Check the operation of monitoring components (flow, high and low pressure, etc.)	
		4.9.5	Check the alarm delay, trip delay, etc.	
		4.9.6	Check the water motor gong, if applicable	
		4.9.7	Check the siamese connection	
		4.9.8	Check the main seat seal (according to standard NFPA-25)	

TASK 4 INSPECT AND MAINTAIN SYSTEMS

Operations	Sub-Operations	Clarifications
4.10 Restart the system	4.10.1 Drain the low points 4.10.2 Put the components back in normal operation 4.10.3 Ensure that flow switches are put back in operation 4.10.4 Build up pressure in the system 4.10.5 Notify the client's person responsible about the end of the inspection	
4.11 Notify the central alarm station of the completion of work	4.11.1 Ask the attendant about the signals received 4.11.2 Confirm the completion of work 4.11.3 Enter the attendant's name or number	
4.12 Produce reports	4.12.1 Note all failures noticed during the visual inspection 4.12.2 Note the result of sprinkler trip tests 4.12.3 Make recommendations to the client 4.12.4 Take samples (foam, glycol), if applicable	

TASK 5 REPAIR SYSTEMS

Operations	Sub-Operations	Clarifications
5.1 Read the work order	5.1.1 Find out about the work's location 5.1.2 Check required materials, tools and equipment (including safety equipment) 5.1.3 Find out about the necessary work duration (estimate) 5.1.4 Find out about special conditions, if applicable	

TASK 5 REPAIR SYSTEMS

Operations		Sub-Operations		Clarifications
5.2	Meet the person responsible	5.2.1	Request that personnel be advised of the possibility of false alarms	
		5.2.2	Locate system components	
		5.2.3	Obtain information about the central alarm station	
		5.2.4	Obtain information about connections	
		5.2.5	Check if there have been changes	
5.3	Contact the alarm company, if applicable	5.3.1	Locate the fire alarm panel	
		5.3.2	Ensure that the alarm panel has not been triggered yet	
		5.3.3	Check whether the alarms are linked to central alarm stations	
		5.3.4	Present yourself to the alarm company	
		5.3.5	Notify the alarm company of the start, nature and duration of the work	
		5.3.6	Enter the name or number of the alarm company attendant	
5.4	Ensure that related or interrelated systems are neutralized	5.4.1	Check with the person responsible whether the panel is linked to another panel in the building	
		5.4.2	Ask the person responsible to disarm the panel	
5.5	Check the system	5.5.1	Perform necessary tests	
		5.5.2	Check for a mechanical or electrical problem	
5.6	Diagnose the problem	5.6.1	Determine the cause of the problem (wear, manufacturing or installation defect, etc.)	In some cases, the problem has already been diagnosed, for example by the client's insurance company or by the client himself.

TASK 5 REPAIR SYSTEMS

Operations	Sub-Operations	Clarifications
5.7 Plan the work	5.7.1 Draw a list of components to be replaced 5.7.2 Make sure to have all necessary materials before starting the work 5.7.3 Assess the time required for repairs 5.7.4 Make sure the work is feasible 5.7.5 Determine the necessary number of mechanics 5.7.6 Determine the work schedule 5.7.7 Notify the municipality, if applicable (water service interruption) 5.7.8 Notify the client of the progress of the work	
5.8 Drain and isolate defective systems, if necessary	5.8.1 Close pumps and valves 5.8.2 Drain the system and, if applicable, the low points 5.8.3 Close or isolate the compressor, if applicable	
5.9 Make repairs	5.9.1 Install necessary tools and equipment 5.9.2 Remove the defective component(s) (valve, sprinkler, joint, pump, etc.) 5.9.3 Check peripheral components 5.9.4 Install the new component(s) 5.9.5 Uninstall necessary tools and equipment	
5.10 Restart the system	5.10.1 Boost pressures 5.10.2 Reopen all valves 5.10.3 Restart the pumps 5.10.4 Put the panel back in operation 5.10.5 Check the quality of repairs	

TASK 5 REPAIR SYSTEMS

Operations	Sub-Operations	Clarifications
5.11 Notify the central alarm station of the completion of work	5.11.1 Confirm the completion of work 5.11.2 Enter the attendant's name or number	
5.12 Complete the work	5.12.1 Pick up materials and debris 5.12.2 Pick up equipment and tools 5.12.3 Pass the broom 5.12.4 Notify the client of the completion of work	
5.13 Produce reports	5.13.1 Write a time sheet 5.13.2 Explain the work done 5.13.3 Draw a list of replaced materials and components	

2.3 ACHIEVEMENT CONDITIONS

Data on achievement conditions were collected for the fire protection mechanic trade as a whole. The data pertain to aspects such as work areas, work instructions, health and safety hazards, reference documents consulted, material resources used, etc.

Table 2.3 Achievement Conditions

ACHIEVEMENT CONDITIONS
Workplaces[11] Fire protection mechanics may work on construction sites, in any type of residential, industrial, institutional and commercial building. They may also work in mines, vehicles, refrigerated spaces, etc. They work mainly indoors (75% of their time), although in new construction, since they intervene at the very start of construction when buildings are not yet closed, they are exposed to outdoor temperatures.
Collaboration and supervision In larger companies, fire protection mechanics always work in teams of at least two mechanics, whereas in smaller companies, they are often alone. Most of the time, fire protection mechanics must demonstrate a lot of autonomy, because they work under foremen's supervision only on large construction sites that number many teams. So most often, they plan their work in collaboration with the general contractor or the project manager.
Instructions Fire protection mechanics receive verbal instructions from their supervisor, who is not necessarily present on the construction site, and from the general contractor or the project manager, or directly from the client. They also work according to work orders and plans, specifications and diagrams. In addition, during the work they may receive a notice that the plans have been changed.
Stress factors Fire protection mechanics must cope with the following main stress factors: – tighter and tighter production deadlines; – conducting hydrostatic tests, with related risks of damage or accidents; – delays of all kinds; – unforeseen events; – coordination with other trades; – working on systems that are several years old.

11. Non-exhaustive list.

ACHIEVEMENT CONDITIONS
References The main references used by fire protection mechanics are plans and specifications, data sheets of component and product manufacturers, (NFPA) standards for components, as well as sales and maintenance contracts.
Raw materials, tools and equipment Annex 1 of the present report contains a list of material resources used by fire protection mechanics in the practice of their trade.
Health and safety hazards According to the participants, fire protection mechanics are exposed to the following main health and safety hazards: – backache (weight of materials to be moved); – neck pain (work postures); – falls (stepladder, scaffold, riser); – hand injuries (fingers crushed between flanges); – eye injuries (particles of various materials during drilling, cutting, etc.); – injuries due to repetitive movements; – burns (heating equipment, coils); – hearing problems (construction site noises, impact drill); – cuts (grinder, grinding machine, saw); – contact with asbestos, silica, insulating foam and wool, solvents; – respiratory problems due to dust inhalation; – hazards related to propane, working in closed or confined spaces; – explosion hazards (pressurized pipes); – risks of the ground collapsing when underground pipes are installed; – hazards related to use of lifting devices (lift truck, gantry); – intoxication or asphyxia (release of gas, oxygen-poor air, etc.); – electrocution hazard. Moreover, Annex 2 of the present report contains a more detailed list of the main hazards related to the tasks and operations of the fire protection mechanic trade, as well as applicable preventive measures.

2.4 PERFORMANCE CRITERIA

Performance criteria were gathered for each task. They are used for assessing whether the tasks were performed satisfactorily. The criteria pertain to aspects such as the quantity and quality of work done, the observance of a work procedure, the attitudes adopted, etc.

To draw the list of criteria for each task, the participants worked in teams of two or three. Thus, certain criteria may at times be as relevant to other tasks as to those for which they have been retained.

Table 2.4 Performance Criteria

TASK 1 INSTALL SYSTEMS
Performance Criteria
– Observance of health and safety rules – Reading plans and specifications correctly – Planning the work productively – Efficient coordination with other trades – Carefully checking received materials and equipment – Meticulously checking attachments and the quality of joint insertions – Adjusting valves and flows appropriately – Installing the pump at the correct level – Solidly fastening pipes – Correct installation and appropriate spacing of supports – Taking the flow into account when installing the piping system – Well sealed and solid connecting joints – Handling and tightening sprinklers carefully – Compliant quantity of sprinklers – Observance of plans and specifications – Meeting standards in effect – Appropriate spacing, angle and direction of seismic supports – Conducting tests carefully – Sustained pace of work

TASK 2 CONNECT ACCESSORIES TO SYSTEMS

Performance Criteria

- Observance of health and safety rules du travail
- Reading plans and specifications correctly
- Using appropriate work techniques
- Correct use of appropriate tools and equipment
- Work cleanliness
- Observance of plans and specifications
- Meeting standards in effect
- Tight connections
- Sound application of basic principles of electricity
- Sound choice of cables and installing them correctly and aesthetically
- Following the procedure for restarting the system
- Meticulous detection of any anomaly
- Clear, accurate and reliable update of the plans in terms of changes made to the system
- Explaining to personnel fully, clearly and in plain language how to use the system
- Producing full, clear and accurate reports
- Sustained pace of work

TASK 3 REHABILITATE OR MODIFY SYSTEMS

Performance Criteria

- Observance of health and safety rules
- Reading plans and specifications correctly
- Correctly assessing the move's feasibility
- Correctly determining and strictly following the work procedure
- Correct use of appropriate tools and equipment
- Effectively communicating with the client's person responsible and with the alarm company
- No false alarm before the system is drained
- Correctly determining the work area
- Correctly interpreting data displayed on the panel
- Carefully checking received materials and equipment
- Sound choice of anchors
- Correct installation and appropriate spacing of supports
- Appropriate spacing, angle and direction of seismic supports
- Observance of plans and specifications
- Meeting standards in effect
- Conducting tests carefully
- Clear, accurate and reliable update of the plans in terms of changes made to the system
- Producing full, clear and accurate reports
- Sustained pace of work

TASK 4 INSPECT AND MAINTAIN SYSTEMS

Performance Criteria

- Observance of health and safety rules
- Meeting standards in effect
- Accurately interpreting the work order
- Professional communication and attitude with the client
- Reassuring attitude with the client
- Carefully checking that related or interrelated systems are neutralized
- Full tour of the building, including the roof space, crawl spaces, storage spaces, etc.
- Full, attentive and meticulous inspection of systems
- Applying an efficient checking method
- Work cleanliness
- Demonstrating in-depth knowledge of system operation
- Demonstrating foresight regarding backflow risks
- Making corrections and performing maintenance operations appropriately
- Attentively checking valve efficiency
- Meeting standards in effect
- Carefully conducting tests
- Accurately entering in the report the location of each component checked
- Producing full, clear and accurate reports
- Sustained pace of work

TASK 5 REPAIR SYSTEMS

Performance Criteria

- Observance of health and safety rules
- Meeting standards in effect
- Accurately interpreting the work order
- Professional communication and attitude with the client
- Reassuring attitude with the client
- Carefully checking that related or interrelated systems are neutralized
- Accurately determining the cause of the problem
- Correctly assessing the necessary work and its duration
- Checking the availability of required materials, tools and equipment before the start of work
- Clear information to the client about the work to be done
- Correctly draining the system causing the problem
- Making corrections appropriately
- Work cleanliness
- Meeting standards in effect
- Observance of the procedure for restarting the system
- Meticulous detection of any anomaly
- Clearly, accurately and faithfully updating plans regarding modifications to the system
- Producing full, clear and accurate reports
- Sustained pace of work

2.5 FUNCTIONS

Functions correspond to a set of related tasks. This set may be defined by the work's results or by a sequence of steps.

For the fire protection mechanic trade, two functions appear to stand out:

- A function related to **installation**, and grouping the following tasks:
  - Install systems;
  - Connect accessories to systems;
- A function related to **maintenance** and **repairs**, and grouping the following tasks:
  - Rehabilitate or modify systems;
  - Inspect and maintain systems;
  - Repair systems.

3. QUANTITATIVE DATA ON TASKS

3.1 OCCURRENCE

Occurrence data concern the percentage of fire protection mechanics[12] who perform a task in the same work environment. The data presented in the tables below are the average results of the workshop participants. However, they account for the use of time not only of the participants, but also of all fire protection mechanics working in the companies represented.

Table 3.1 Task Occurrence

	Task	Occurrence
1	Install systems	88.2%
2	Connect accessories to systems	66.4%
3	Rehabilitate or modify systems	65.9%
4	Inspect and maintain systems	44.6%
5	Repair systems	41.8%

3.2 WORK TIME

Work time, also expressed in percentages, represents the average time allocated to each task on an **annual** basis by the consulted participants.

Table 3.2 Work Time Allocated to Each Task

	Task	Work Time
1	Install systems	43.6%
2	Connect accessories to systems	11.2%
3	Rehabilitate or modify systems	23.2%
4	Inspect and maintain systems	11.4%
5	Repair systems	10.6%
		100.00%

12. Including apprentices.

In examining the work time allocation, we note that task 1, “Install systems,” ranks first (43.6%) in the work time of fire protection mechanics. Far behind comes task 3, “Rehabilitate or modify systems” (23.2%). The three other tasks each require less than 12% of the work time of fire protection mechanics, i.e., 11.4% (task 4, “Inspect and maintain systems”), 11.2% (task 2, “Connect accessories to systems”) and 10.6% (task 5, “Repair systems”).

3.3 IMPORTANCE AND DIFFICULTY OF TASKS

The **importance** of a task is estimated according to the more or less harmful consequences of performing a task poorly or not at all. The importance is assessed according to the following scale:

1. Not important at all: Poor execution of the task has no consequences on the quality of the result, the costs, health and safety, etc.
2. Not very important: Poor execution of the task could lead to minimal costs, a result of lesser quality, minor injury or accident hazards, etc.
3. Important: Poor execution of the task could lead to an unsatisfactory result, substantial additional costs, injuries, accidents, etc.
4. Very important: Poor execution of the task could lead to an unacceptable result and have very substantial consequences in terms of costs, safety, etc.

A task’s **difficulty** is assessed according to the following scale:

1. Very easy: The task involves little risk of error; it requires no notable physical or mental effort. Performing the task is less difficult than average.
2. Easy: The task involves a few risks of error; it requires minimal physical or mental effort.
3. Difficult: The task involves many risks of error; it requires a good physical or mental effort. Performing the task is more difficult than average.
4. Very difficult: The task involves a high risk of error; it requires substantial physical or mental effort. The task is among the most difficult in the trade.

The data presented in the table below are the average results of the workshop participants.

Table 3.3 Importance and Difficulty of Tasks

Task		Importance	Difficulty
1	Install systems	3.55	2.95
2	Connect accessories to systems	3.45	2.75
3	Rehabilitate or modify systems	3.27	2.90
4	Inspect and maintain systems	3.55	2.75
5	Repair systems	3.70	2.89

4. KNOWLEDGE, SKILLS AND ATTITUDES

The occupational analysis enabled us to specify some of the knowledge, skills and attitudes necessary for performing the tasks. Those qualities are transferable, i.e., applicable to a variety of tasks and situations.

The following pages present the knowledge, skills and attitudes that, according to the participants, are considered essential for performing the tasks of the fire protection mechanic trade.

4.1 KNOWLEDGE

Communication

A fire protection mechanic is in contact with a variety of persons, for example clients, co-workers, workers in other trades, etc. So he must be able to establish harmonious relations and show respect for those with whom he has to work.

Electricity

A fire protection mechanic must have basic knowledge of the characteristics of low-voltage (less than 24 volts) electrical systems. He must know the different types, sizes and installation methods of electrical conduits and be able to make electrical connections by means of terminal boards.

Measuring instruments

The fire protection mechanic's work requires using various measuring instruments, such as a tachometer, pitometer, flow meter, ammeter, pressure gauge, temperature detector, laser level, etc.

Reading plans

Given that a fire protection mechanic must interpret plans to find out about the work he has to do, he must have a good knowledge of the various symbols, scales, measurement units, etc., appearing on the plans. In addition, he must, at the completion of work, produce freehand diagrams of the changes made to the various systems.

Materials and components

A fire protection mechanic must have a good knowledge of the properties of materials used, for example regarding pipes (plastic, steel, copper) and their different grades and categories. He must also know the types of glue, their properties and application methods, as well as the various types of anchors. In addition, he must know the different components used in fire-protection systems, and those components' characteristics and functions.

Mathematics

A fire protection mechanic must apply a basic knowledge of mathematics. The four basic operations are particularly important, for example in measuring (pipes, rods, etc.), as well as basic principles of geometry, for example in measuring areas (to determine the necessary number of sprinklers) or radiuses (pipe sizes). In addition, preparing the piping system requires calculation of angles. A fire protection mechanic must also apply predetermined formulas, for example in calculating the flow of fire pumps. It should be noted that metric or imperial units may be used.

Standards

A fire protection mechanic must know the standards of the National Fire Protection Association, particularly standard NFPA-13 (*Standard for the installation of sprinkler systems*) and standard NFPA-25 (*Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*).

He must also apply sprinkler manufacturers' standards, available only in English, which requires being able to interpret technical information in English.

Physics

A fire protection mechanic must have a basic knowledge of physics, particularly regarding the leverage principle (to understand the operating principle of lifting devices), pressures and flows.

Occupational health and safety

A fire protection mechanic must know the health and safety rules for the trade's tasks and the tools and equipment used. For example, he must be up-to-date regarding the use of various toxic products (gas, asbestos, etc.) and WHMIS principles[13], rules for working with lifting devices, etc.

4.2 SKILLS

Skills are types of know-how. They are divided into three categories: cognitive, motor and perceptual.

Cognitive skills

Cognitive skills pertain to intellectual strategies applied in working. The main cognitive skills that fire protection mechanics need are the following:

- quick reaction to unforeseen events;
- logic;
- making decisions and evaluating their consequences.

Motor skills

Motor skills involve gestures and movements. The main motor skills that fire protection mechanics need are the following:

- dexterity;
- agility, for working in tight spaces.

13. Workplace Hazardous Materials Information System.

The participants mentioned that a person subject to vertigo would have difficulty working from heights, so it would be difficult for him to become a fire protection mechanic. Indeed, he would expose himself and others to health and safety dangers.

Perceptual skills

Perceptual skills are sensory skills enabling a person to perceive by his senses what is happening in his environment. The main perceptual skills that fire protection mechanics need are the following:

- good hearing, to distinguish abnormal noises, particularly during air pressure tests;
- good spatial perception, to be able to implement data displayed on plans.

4.3 ATTITUDES

Attitudes are ways of acting, reacting and relating with others or with one's environment. They involve personal skills. The main attitudes fire protection mechanics need are the following:

- punctuality;
- work ethic;
- positive attitude;
- politeness and courtesy;
- alertness and vigilant;
- ability to concentrate on one's work;
- conscientiousness and patience;
- focus on protecting the public.

5. TRAINING SUGGESTIONS

Initial training

The participants made suggestions about various aspects of initial training. They suggest to:

- allocate more time to training in preparing pipes, particularly in adjusting, using and maintaining the threading machine;
- pay special attention to teaching the terminology used in the trade and on construction sites generally;
- focus training more on the tasks that the apprentice is likely to perform when entering the trade, rather than on specialized aspects that the apprentice will not be able to apply.

Continuous training and professional development

For professional development, the participants suggest activities related to:

- pre-action systems;
- electrical connections;
- detection;
- bending electrical tubes;
- backflow preventers.

Annexes

Annex 1

RAW MATERIALS, TOOLS AND EQUIPMENT

During the workshop, the participants were shown lists of raw materials, tools and equipment from the national occupational analysis of the fire protection mechanic trade (Red Seal). In the following pages is the list, for each task, of raw materials, tools and equipment that was validated by the participants.

Table A1 Raw Materials, Tools and Equipment

Grey boxes indicate items that **are not** used.

	Install systems	Connect accessories to systems	Rehabilitate or modify systems	Inspect and maintain systems	Repair systems
BASIC HAND TOOLS					
broom					
line-up bars					
wire brush					
brushes (various bristle brushes for caulking gun, chain vice, pipe vice, cleaning and scrubbing)					
oil can					
centre finder					
snips (heavy duty sheet metal cutting)					
scissors					
cold chisels					
wrenches (pipe, strap, adjustable, Allen, head, monkey)					
wire cutter					
gasket cutter					
rod cutters					
utility knives					
pipe pencil					
socket sets (metric and imperial)					

	Install systems	Connect accessories to systems	Rehabilitate or modify systems	Inspect and maintain systems	Repair systems
bench vice	■	■	■	■	
tripod vice				■	
flaring tool			■	■	
rod dies	■	■	■	■	
die and chasers				■	
drills (metal, concrete, etc.)	■	■	■		■
scrapers	■	■	■		
flashlight					
pry bar	■			■	
files (flat, half-round, rat-tail, bastard)				■	
nipple chuck		■		■	
hammers (ball-peen, claw, sledge)				■	
crimping tools			■	■	
pick	■	■	■	■	
brushes				■	
locking pliers				■	
pliers (needle nose, slip joint)	■				
grease gun	■		■		
plumb bob				■	
punch (e.g.: anchoring)				■	
centre punch				■	
polyethylene					
electric cord					
drywall saw	■		■	■	
strap saw				■	
high speed hole cutter				■	
hand saw		■	■	■	
hacksaw				■	
two-handed saw				■	

	Install systems	Connect accessories to systems	Rehabilitate or modify systems	Inspect and maintain systems	Repair systems
screwdrivers					
contour marker					
differential gauge test kit					
trowels (concrete and pointer)					
PORTABLE POWER TOOLS					
reamer (hand-held or mounted on power threader)					
hand-held and stationary radios					
vacuum cleaner (wet/dry)					
wire wheel (body grinder or angle grinder with wire brush)					
core driller					
torch (oxyacetylene brazing, oxyacetylene cutting, heating)					
impact wrenches (electric, pneumatic and wireless)					
compressor					
concrete cutting machine					
pipe cutter					
knife groover					
electronic measuring device					
air monitoring device					
threading machine					
mechanical pipe-joining equipment					
powervise					
threading machine					
flushing machine					
tapping machine and attachments					
hammer drill					
grinders (wire brush, angle grinders)					
roll groover					
computer					
drills (portable magnetic base, drill press, wireless)					

	Install systems	Connect accessories to systems	Rehabilitate or modify systems	Inspect and maintain systems	Repair systems
electric drills					
tamper					
water pump					
testing pump					
chop saw					
reciprocating saw					
MEASURING AND TESTING EQUIPMENT					
amp/volt meter					
battery load tester					
digital scale (to weigh cylinders)					
calculator					
calibrating gauge					
thread depth gauge					
stop watch					
torque wrench					
dial indicator					
compass					
liquid measuring containers					
flow meter					
square					
detection device testing equipment (heat detector, ionization detector, linear detector, spark detector)					
chemical system pressure gauge equipment					
hydrometer					
feeler gauge					
depth gauge					
heat lamp					
pressure gauge kit					
differential pressure gauge					

	Install systems	Connect accessories to systems	Rehabilitate or modify systems	Inspect and maintain systems	Repair systems
drafting equipment					
backflow test kit					
level (builder's, laser, magnetic, spirit)					
vernier calliper					
testing pump					
adapter fittings					
refractometer					
straightedge					
tape measure					
tachometer					
temperature gauge					
Pitot tubes					
play pipes					
hoses					
test hoses and securement					
HOISTING, LIFTING, AND ACCESS EQUIPMENT					
spreader bar					
chains					
fork-lift					
pipe dolly					
rope					
jack					
scaffolding (safety)					
ladder					
sling					
choker					
mobile crane					
man lift					
chain block hoist					

	Install systems	Connect accessories to systems	Rehabilitate or modify systems	Inspect and maintain systems	Repair systems
overhead hoist	■		■	■	
come-alongs (cable or chain)	■	■		■	
power-elevated work platform				■	
cable clamps	■	■	■	■	
support				■	
pipe stand				■	
PERSONAL PROTECTIVE EQUIPMENT AND SAFETY EQUIPMENT					
SCBA (self-contained breathing apparatus)	■			■	
boots					
air hood	■	■	■	■	
hard hat					
coveralls	■				
fire blanket	■	■	■	■	
air monitoring device	■	■	■	■	
tag- and lock-out devices	■	■			
welding partition	■	■		■	
confined space entry equipment	■			■	
fire extinguisher				■	
gloves					
knee pads	■				
safety glasses	■	■			
goggles					
mask (particle, vapour)		■			
face shield					
filtration mask					
earplugs and earmuffs					
respirator	■	■		■	
fall arrest system				■	

	Install systems	Connect accessories to systems	Rehabilitate or modify systems	Inspect and maintain systems	Repair systems
travel restraint system					
apron					
fire hoses					
reflector vest					
fire-retardant clothing					

Annex 2

GRID OF OCCUPATIONAL HEALTH AND SAFETY ELEMENTS

Produced by: **Isabelle Dugré**, Prevention Consultant
ASP Construction

Table A2 Description of Hazards in the Fire Protection Mechanic Trade

No.	Hazards	Effects on Health and Safety	Means of Prevention
1	**Same-level fall hazards** • Housekeeping (clutter, risk of tripping on obstacles such as waste, debris, electric cords, pipes, materials) • Slippery surfaces (rain, ice, snow, residues, dust, oil) • Holes, uneven ground	• Collisions • Contusions • Bruises • Fractures • Sprains	• Clean the work area (pick up debris). • Hang up any equipment that might constitute an obstacle 2.1 m high or protect the walking area. • Apply abrasives to make the surface less slippery. • Absorb oils, recover water. • Level the ground. • Plug holes (install plating).
2	**Fall-from-height hazards**		
2 a)	• Using a stepladder	• Collisions • Contusions • Bruises • Fractures • Sprains • Internal injuries • Psychological and physical after-effects • Paralysis • Death	• Use a class 1 stepladder with a nominal capacity of 113 kg (250 lb.) and: open the spreader bars fully; – install on a firm level surface; – choose a model according to the height to be attained; – keep the torso within the side rails.
2 b)	• Using a ladder	• Collisions • Contusions • Bruises • Fractures • Sprains • Internal injuries • Psychological and physical after-effects • Paralysis • Death	• Use a class 1 ladder. • Position while maintaining a slope of 1/4 to 1/3 from the height of the bearing point. • Climb up and down a ladder while: – always having three support points; – holding the bars and not the side rails; – remaining between the side rails; – not holding anything in the hands; – facing the ladder.

No.	Hazards	Effects on Health and Safety	Means of Prevention
2 c)	• Using small mobile scaffolding (Baker)	• Collisions • Contusions • Bruises • Fractures • Sprains • Internal injuries • Psychological and physical after-effects • Paralysis • Death	• Apply stability principles: – never exceed three times the smallest support base; – always use the wheel locking mechanism; – climb down the mobile scaffold to move it.
2 d)	• Using metal frame scaffolding or tubular, socket and rosette scaffolding	• Collisions • Contusions • Bruises • Fractures • Sprains • Internal injuries • Psychological and physical after-effects • Paralysis • Death	• Stabilize the scaffold by: – using stabilizers on the ground; – tying it to the building; – using guys; – placing the two side rails side by side and fastening them by wind bracing. • When there is a risk of falling more than 3 metres: – install a railing system of the type developed by the Association des entrepreneurs en maçonnerie du Québec (AEMQ); or – wear a shock-absorbing harness, with an anchor that has a breaking strength of 18 kN; or – be attached to a vertical lifeline complying with the specifications in the Safety Code for the construction industry. • Check the bearing capacity of the ground. • Install beds and jack screws if the ground is sloped or uneven. • For each scaffolding section, install vertical locks. • Use safe means of access. • Install anchors to the structure at intervals not exceeding three times the minimum scaffolding width. • Ensure that the planks are CSA certified, that the floor is wide enough (minimum 470 mm), that the distance between the structure and the floor is less than 350 mm, and that the load resistance is sufficient for the loads borne.

No.	Hazards	Effects on Health and Safety	Means of Prevention
2 e)	• Using an aerial automotive work platform	• Collisions • Contusions • Bruises • Fractures • Sprains • Electrical hazards • Internal injuries • Intoxication • Psychological and physical after-effects • Paralysis • Death	• Took training in safe use as required by standards and manufacturers. • Wear an energy-absorbing harness for the jib boom platform. • Delimit the work area to avoid collision hazards and prevent objects from falling on other workers. • Keep the feet on the platform floor. • Climb up and down facing the equipment, while maintaining three support points. • Keep the platform accesses and floor clean. • Use a carbon monoxide detector in the case of a combustion appliance used indoors. • Lock hazardous energy sources during use (electrical conduit, switched-on appliance, gantry, etc.).
3	**Chemical hazards** • Silica dust • Asbestos dust • Drilling anchoring holes • Using products such as silicone and sealants • Pipe glue • Cleaning solvent • Lubricant • Fuel for motorized devices • Fiberglass insulation • Carbon monoxide • Asphyxia (lack of oxygen)	• Silicosis • Asbestosis • Mesothelioma • Lung cancer • Skin disorders (dermatosis) • Carbon monoxide poisoning • Sensitization • Corrosive burns • Eye injuries, blindness • Fire, explosion	• Took WHMIS training. • Have on-site the specification sheets of products used. • Use less-toxic products or wear PPE prescribed by the product manufacturer. • Took asbestos training, as prescribed by the Safety Code, art. 3.23.7. • Be trained in the use of respiratory protection (masks and respirators) if required by the situation. • Wear respiratory protection and filters appropriate to contaminants. • Ensure mechanical or natural ventilation. • Wear safety goggles or a visor. • Use tools (e.g. drills) equipped with a vacuum system including a HEPA filter. • Have emergency equipment at hand (eye-wash station, fire extinguisher, etc.).

No.	Hazards	Effects on Health and Safety	Means of Prevention
4	**Ergonomic hazards** • Posture constraints / statis • Repetitive movements • Handling • Task difficulty • Weight and shape of tools • Vibrations (hand-arm system)	• Musculoskeletal lesions (back, neck, knees, shoulders, elbows, hand/thumb) • Sprains • Hernias • Fatigue, discomfort, pain • Tendinitis • Low back pain	• Rotate tasks if the situation allows it (reduce repetitive movements). • Use handling equipment. • Know handling techniques. • Favour the purchase of tools limiting vibrations to a minimum. • Provide necessary backup lighting.
5	**Electrical hazards** • Contact with an overhead electric line • Electric tools • Contact with electric wires or outlets • Contact with a turned-on electric appliance or with conduits in ceilings	• Electrification • Fibrillation • Burns • Amputation • Paralysis • Electrocution • Fall	• Maintain the minimum distances of approach prescribed by the Safety Code for the construction industry. • Use tools featuring double insulation or grounding. • Use electric cords in good condition and ground protections. • Apply a lockout procedure. • Train the workers in the lockout procedure in effect. • Took the compulsory training for working near electric lines. • Inspect electrical devices (wires) and tools according to manufacturer recommendations.
6	**Noise hazards** • Tools • Drilling for anchors • Handling scaffoldings	• Hearing loss • Occupational deafness • Increased stress	• Choose the most silent equipment possible. • Do required preventive maintenance. • Plan for work in the construction site's least noisy areas. • Wear hearing protection (plugs or earmuffs).

No.	Hazards	Effects on Health and Safety	Means of Prevention
7	**Mechanical hazards** • Moving parts • Breaking blade, bit or tool • Storage of materials • Superimposed work • Trench collapse • Falling object on an older installation	• Contusions • Fractures • Crushing • Amputation • Cuts • Falls • Concussion • Burial	• Comply with the regulatory grid regarding protection from machines. • Do required preventive maintenance. • Collect information and take training in the use of new tools. • Apply the lockout procedure in effect. • Keep a work environment clean, without obstruction. • Prevent the fall of objects. • Eliminate any possibility of superimposed work. • Use shoring or observe the disengagement slopes.
8	**Environmental hazards** • Extreme temperature (cold or hot) • Enclosed space	• Discomfort due to cold • Chilblains • Hypothermia • Thermal stresses (heat) • Heat stroke	• Comply with health and safety rules. • Measure gases before each entry in an enclosed space. • Train the workers to work in enclosed spaces. • Ensure adequate ventilation of work areas. • Do preventive maintenance of gas equipment. • Take training in the hazards of carbon monoxide and nitrogen dioxide. • Alternate periods of work and rest. • Drink water.
9	**Stress-related hazards** • Unrealistic deadlines • Unforeseen events related to existing installations • Client requirements	• Health disorders • Hypertension • Eczema	• Plan the work. • Limit work done under stress.

Annex 3

COMMENT OF THE FIRE PROTECTION MECHANIC PROFESSIONAL SUBCOMMITTEE

At the Professional Subcommittee meeting held on February 29, 2012 in Montreal, the members approved the present occupational analysis report, with the following clarification:

- Section 1.1 Definition of the Trade

  Activation systems are part of the trade and should be mentioned in the definition of the trade.