

Boilermaker

Occupational Analysis Report

February 2010



Commission
de la construction
du Québec

The purpose of this report is to describe as accurately as possible the boilermaking 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 vocational 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.

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The Commission de la construction du Québec wishes to thank the production team for this occupational analysis.

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The masculine gender is used generically
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APPROVAL

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INTRODUCTION

In early 2009, the CCQ's Direction de la formation professionnelle launched a large-scale operation to review the occupational analyses¹ 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 analyses² 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 performing occupational analyses in order to obtain a current and complete profile of the various trades.

The occupational analysis for boilermakers belongs to this context³. Its purpose is to describe the 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 December 7 and 8, 2009.

This analysis aims to draw a portrait (tasks and operations) of the trade and its entry requirements, 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 experienced boilermakers. 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. Occupational analyses were then called "work situation analyses".

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, article 8) the term “boilermaker” means:

[...] anyone who performs the operations connected with the construction of steam generators, boilers and tanks including:

- a) all erection, dismantling, assembly and demolition work on boilers, as well as the steel erecting related thereto;
- b) setting equipment on foundations or supports;
- c) installing and rolling tubes;
- d) fitting all pressure or non-pressure parts, except the unloading, hoisting and placing of portable boilers, steam drums and assembled sections of tubular boilers;
- e) all work in connection with breechings, smoke boxes, stacks, uptakes, floats, air and water heaters, smoke consumers, all types of tanks, as well as all other plate work connected thereto;
- f) the erection and construction of purifying boxes, gas generators, brewery vats, standpipes, penstocks and gasometers, as well as the unloading, hoisting and placing of equipment or parts related to the abovementioned devices;
- g) all burning, chipping, caulking, riveting, welding and rigging work connected with the abovementioned operations.

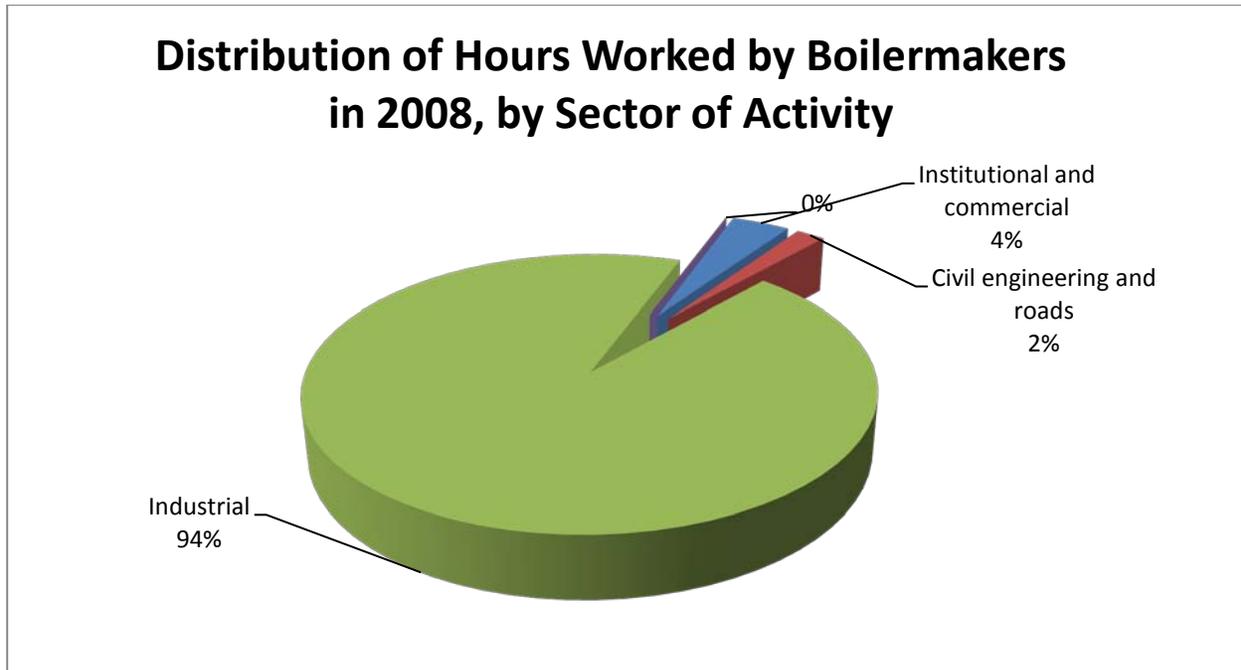
Performance of the work described in the first paragraph includes trade-related handling for the purposes of immediate and permanent installation.

1.2 JOB TITLES

The most widespread title for the trade is “boilermaker”, the English translation of “*chaudronnier*”. The participants consulted prefer the English term to “*chaudronnier*”, which is confusing in their view, particularly to the general public: most people think that “*chaudronniers*” make kitchen accessories.

1.3 SECTORS OF ACTIVITY

Boilermakers are active mainly in three sectors of the construction industry, but to different degrees, whereas their work in the residential sector is quite rare (less than .01% of hours worked). The following diagram illustrates the distribution of hours worked for all boilermakers in Quebec for the year 2008⁴, in the three other sectors.



The boilermakers who attended the workshop consider that this distribution of their hours worked corresponds to their reality. As can be noted, the industrial sector accounts for almost all the hours worked by boilermakers.

4. Commission de la construction du Québec, *Carrières construction*, Québec City, 2009-2010 edition.

1.4 FIELD OF PRACTICE

The trade's field of practice is the construction industry. The Act respecting labour relations, vocational training, and manpower 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

Boilermakers working 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* for the *construction industry*;
- the *National Building Code – Canada 2005* (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.
- American Society of Mechanical Engineers (ASME) standards for welding work and pressurized vessels;

- Canadian Standards Association (CSA) standards for welding work (W47-1, W47-2, W59, etc.);
- American Petroleum Institute standards (API 620, API 650, API 653);
- hoisting device standards.

1.6 WORKING CONDITIONS

The following information provides an overview of the conditions and context of the work of boilermakers, 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 for the construction industry sectors.

Salary⁵

The average annual salary of a journeyman boilermaker was \$65,021 in 2008. A journeyman's hourly wage varies slightly according to the sector. In May 2009, the daytime hourly wage was as follows:

- Industrial, institutional and commercial: \$32.54
- Civil engineering and roads: \$32.52
- Residential (heavy): \$32.50
- Residential (light): \$30.13

Vacations and time off⁶

Mandatory annual holidays of four weeks – two weeks in summer and two in winter at periods predetermined 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.

5. Salary data are excerpted from the following document, published by the Commission de la construction du Québec: *Carrières construction*, 2009-2010 edition and from the 2007-2010 collective agreements of the four construction industry sectors.

6. Data on vacations and time off, the pension plan and insurance are excerpted from the following document, published in 2009 by the Commission de la construction du Québec: *La construction au Québec : c'est bien plus payant!*

To these vacation periods are added eight not paid 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

Boilermakers have to be in good physical shape to do their work. They need a certain physical strength to hoist loads, although that strength need not be exceptional since safety regulations limit the loads while hoisting equipment makes the work easier. However, the work of boilermakers remains physically demanding. For example, they spend a large part of their work hours outdoors and are thus exposed to heat, cold and bad weather. In addition, indoor work can expose them to extreme heat in some cases. Finally, working in constrained positions (kneeling, bending over, crouched, etc.), whether in confined spaces or in other contexts, is widespread and requires suppleness and endurance.

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 per day, except in light residential construction, where it can reach a maximum of 10 hours within a 40-hour work week.

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

The schedules of boilermakers are quite variable and often depend on the type of construction site on which they are working. Work on new constructions or commissionings is generally done in daytime, Monday to Friday, for about 40 hours a week. The situation is different for maintenance and repair work; since the latter is usually done during a production stop, boilermakers have to act as quickly as possible in order to finish working when production resumes. In such cases, the work may be done in the daytime, evening and even nighttime, on both weekdays and weekends, and overtime is frequent.

Moreover, as opposed to trades that are seasonal, boilermakers have the possibility of working year-long.

Mobility

The trade requires a lot of mobility, particularly for boilermakers who live in areas where industrial sites are rare. Boilermakers often have to travel to various geographic areas, depending on the construction work in progress. In fact, the proportion of boilermakers who have to travel from one region to another is 69%⁷, whereas only 17% of workers in construction industry trades and occupations as a whole have to do so. Indeed, among the boilermakers who attended the workshop, most have worked in Northern Quebec, Ontario, Western Canada, etc. The length of these travels varies according to the type of work. When it involves maintenance or repairs, the work generally lasts from a few days to a month, but work on new constructions may last up to a year and a half or two.

7. See www.ccq.org/~media/PDF/Communications/Metiers/Chaudronnier.pdf.ashx?sc_lang=en-CA&profil=Medias.

1.7 JOB MARKET ENTRY CONDITIONS⁸

To obtain the competency certificate-apprentice in a construction industry trade, candidates must first:

- Supply proof that they are at least 16 years of age;
- Supply their social insurance number and their home address;
- Present their certificate for having passed the course Santé et sécurité générale sur les chantiers de construction;
- Pay the required fees;
- Designate the union association to which they wish to belong.

In addition, candidates who have obtained a diploma recognized by the CCQ (DEP in boilermaking) must:

- Present the original version of an academic transcript or apprenticeship transcript attesting that they have passed the course of study (the diploma is not an acceptable document);
- Present 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.

Candidates who meet these requirements obtain a competency certificate-apprentice (CCA) in the trade of boilermaking.

Although the construction industry favours graduates for access to the trade⁹, labour shortages may at times make it necessary for the CCQ to admit candidates without a diploma.

8. Other conditions than those listed below may apply, depending on candidates' particular situation, region, etc. For a complete list of the trade's entry conditions, see the Act respecting Labour relations, vocational training and workforce management in the construction industry (R.S.Q., c. R-20). We may also consult :

http://www.ccq.org/E_CertificatsCompetence.aspx?sc_lang=en&profil=DevenirTravailleur

9. In fact, in 2009, 80% of new boilermakers had obtained this DEP.

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

- Supply proof that they have the academic prerequisites for the program leading to a vocational studies diploma (DEP) in the trade referred to in the application or pledge, by signing a consent letter, to take the necessary training to obtain a DEP;
- Present a guarantee of employment registered 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 boilermaker must have completed 3 apprenticeship periods of 2,000 hours each (6,000 hours total) 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 boilermaker who has obtained his diploma. Of the boilermakers who attended the workshop, only one has taken the training leading to a DEP in boilermaking; the other participants entered the trade before the study program had been established.

Moreover, certain qualities are sought by employers hiring new boilermakers. The following list presents the main qualities¹⁰, in the participants' view:

- versatility in the trade;
- skill in manual work;
- knowledge of the job steps to be taken;
- resourcefulness;
- adaptability (work, schedules, persons);
- teamwork ability;
- relatively young age, for some of the work (from heights, for example);
- safe attitude and behaviour;
- drawing and building skills;
- welding skills.

10. The qualities are presented in the order in which they were mentioned, and not necessarily by order of importance.

The participants mentioned that some boilermakers “specialize” over the years in certain types of work, such as boilers, tanks, specialized welding (e.g.: (ex.: TIG / argon welding), etc. Such “specialization” is often acquired naturally, depending on the construction sites available in certain regions, the choice of boilermakers, their fields of interest and affinities. However, to start in the trade, employers prefer persons who demonstrate versatility and can adapt to all types of work.

The participants also mentioned that this year, they have noticed a decrease in the number of construction sites that have work for boilermakers. The work is becoming rarer, and a lot of boilermakers, even experienced ones, are having difficulty finding work.

1.8 PLACE OF WOMEN IN THE TRADE

Section 126.0.1 of the Act respecting labour relations, vocational training, and manpower 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 CCQ¹¹, the proportion of women active in the trade of boilermaker is 0.5% (4 women out of 787 boilermakers in 2008).

The boilermakers consulted do not really see any reasons why women would be prevented from practicing the trade, since the necessary physical strength is not excessive and teamwork makes it possible to share tasks that are more physically demanding. However, the participants mentioned that the necessity of travelling to various regions and for long periods is probably the main factor discouraging women from choosing this trade, which makes work-family balance practically impossible for them.

11. Commission de la construction du Québec, *Carrières construction*, Québec, 2009-2010 edition.

1.9 CAREER PROSPECTS

According to the participants, a boilermaker's prospects for promotion are interesting. After a number of years of experience, depending on the function and context, boilermakers can become:

- foremen;
- estimators;
- project managers;
- superintendents;
- consultants to engineering firms;
- specialized consultants for specific equipment;
- teachers;
- etc.

Boilermakers interested in entrepreneurship can also launch their own company.

1.10 DEVELOPMENT OF THE TRADE

The participants foresee changes in coming years, and they are already seeing some. For example:

- The development of metals and alloys: they are becoming lighter and stronger.
- The development of equipment: a growing use of welding robots, bundle extractors, tightening equipment, etc.

- Development of health and safety measures: the application of safety measures has greatly changed in recent years. Compliance with rules has become ubiquitous and is now an integral part of the trade, to the same extent as any other task. Boilermakers are therefore well aware of the new measures to be applied, and they expect this trend to continue. Among recent measures integrated to boilermaker tasks are: wearing masks and harnesses, using autonomous respiratory systems, safety rules for new equipment such as lifts, lift trucks, bundle extractors, welding robots, etc. Boilermakers receive training on the use of such equipment from the client or their supervisors, but the boilermakers consulted mentioned that this training should be more extensive.
- Increase in requirements for work in a nuclear environment: this type of work will require the application of stricter safety rules and procedures.

The participants mentioned that boilermakers absolutely must adapt to these changes, since the competitiveness of the companies hiring them depends on it.

1.11 IMPACT OF ENVIRONMENTAL STANDARDS ON THE PRACTICE OF THE TRADE

The application of environmental standards has had a major impact on the boilermaking trade. For example, several of the systems they install, repair or modify have environmental protection as their main purpose (dust removal system, gas treatment system, sulphur elimination system, protection against the spilling of hazardous products, new filtering system in boilers, etc.). In addition, some of the techniques applied by boilermakers have been modified by the application of environmental standards, such as welding standards. Those standards usually require new work methods, which in turn often require training offered by the client, the foreman, the suppliers, etc.

Accordingly, in some cases, the application of environmental standards increases the work demand for boilermakers, since certain new systems would doubtless not have been installed otherwise. Inversely, those standards can also lead to reduced labour needs: for example, many of the new systems perform better and last longer, so maintenance or repair work done by boilermakers will be less frequent.

2. WORK DESCRIPTION

2.1 TASKS AND OPERATIONS

List of tasks

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

- Task 1 Build parts
- Task 2 Assemble furnaces, ovens and incinerators
- Task 3 Erect fractionating towers
- Task 4 Erect tanks and silos
- Task 5 Install penstocks and spiral cases
- Task 6 Install gas, smoke and dust treatment systems¹²
- Task 7 Assemble boilers
- Task 8 Repair exchangers
- Task 9 Repair or modify elements¹³ and equipment¹⁴
- Task 10 Disassemble elements¹³ and equipment¹⁴
- Task 11 Demolish boilers, tanks, towers, etc.

Table of tasks and operations

During the workshop, a table of tasks and operations performed by boilermakers was proposed to the participants. Following discussions, modifications were made to the table. The final version is presented in the following pages.

12. Boilermakers are exclusively qualified for this type of work when the metal used is thicker than 10 gauges. If the metal used is less thick than 10 gauges, the responsibility for this work is shared between boilermakers and tinsmiths.

13. Elements such as a gas separator, smokeless incinerator, purifying box, dust extractor, material disposal and treatment system (precipitator), chimney flue, hopper, cyclone, economizer, air heater, reactor, evaporator, capacitor, kiln, filterer, bag filter, etc.

14. Equipment such as a furnace, oven, incinerator, fractionating tower, penstock, spiral casing, boiler, etc.

Table 2.1 Tasks and Operations

TASKS	OPERATIONS					
1. Build parts	1.1 Receive instructions from the client	1.2 Find out what work needs to be done	1.3 Become qualified for welding procedures, if applicable	1.4 Determine the required working methods, tools and equipment	1.5 Mobilize the site	1.6 Check and unload equipment
	1.7 Cut, shape, assemble and weld	1.8 Erect scaffolds, if applicable	1.9 Rig the parts	1.10 Demobilize the site		
2. Assemble furnaces, ovens and incinerators	2.1 Receive instructions from the client	2.2 Find out what work needs to be done	2.3 Become qualified for welding procedures, if applicable	2.4 Determine the required working methods, tools and equipment	2.5 Mobilize the site	2.6 Check the base, anchors and elevation
	2.7 Check and unload equipment	2.8 Preassemble the components	2.9 Erect supports and structures	2.10 Erect scaffolds, if applicable	2.11 Assemble the walls (welding, bolting)	2.12 Install anchors
	2.13 Install tube supports	2.14 Install tubes	2.15 Install conversion boxes	2.16 Fasten couplings and pipes	2.17 Weld the tubes	2.18 Roll and flare the tubes
	2.19 Assemble the chimney and branches	2.20 Install the burners	2.21 Bolt the header boxes	2.22 Install accessories and components	2.23 Check work quality	2.24 Demobilize the site

TASKS	OPERATIONS					
3. Erect fractionating towers	3.1 Receive instructions from the client	3.2 Find out what work needs to be done	3.3 Become qualified for welding procedures, if applicable	3.4 Determine the required working methods, tools and equipment	3.5 Mobilize the site	3.6 Erect scaffolds, if applicable
	3.7 Check the base, anchors and elevation	3.8 Install anchors	3.9 Check and unload equipment	3.10 Assemble the sections, if applicable	3.11 Rig and handle the parts	3.12 Erect the tower
	3.13 Recheck the levels, orientation and elevation	3.14 Make the tower plumb	3.15 Open the manholes	3.16 Install trays and components, if applicable	3.17 Close the manholes (bolting)	3.18 Check work quality
	3.19 Demobilize the site					
4. Erect tanks and silos	4.1 Receive instructions from the client	4.2 Find out what work needs to be done	4.3 Become qualified for welding procedures, if applicable	4.4 Determine the required working methods, tools and equipment	4.5 Mobilize the site	4.6 Check and unload equipment
	4.7 Locate the base area	4.8 Check the base, anchors and elevation	4.9 Install anchors	4.10 Place, assemble and weld floor plates	4.11 Erect scaffolds, if applicable	4.12 Rig the parts
	4.13 Place, assemble and weld wall plates	4.14 Install a door plate, if applicable	4.15 Install the roof angle	4.16 Install nozzles and reinforcing plates	4.17 Install centre column(s) and supports	4.18 Install rafters
	4.19 Install roof plates	4.20 Install stairs, catwalks and other components	4.21 Install the floating roof and heating components	4.22 Check work quality	4.23 Demobilize the site	

TASKS	OPERATIONS					
5. Install penstocks and spiral cases	5.1 Receive instructions from the client	5.2 Find out what work needs to be done	5.3 Become qualified for welding procedures, if applicable	5.4 Determine the required working methods, tools and equipment	5.5 Mobilize the site	5.6 Check and unload equipment
	5.7 Check the base, anchors and elevation	5.8 Install anchors	5.9 Rig and handle the parts and components	5.10 Install anti-float supports	5.11 Align and level the sections	5.12 Fasten components to supports
	5.13 Assemble and weld components and grind	5.14 Check work quality	5.15 Dismantle braces in penstocks	5.16 Demobilize the site		
6. Install gas, smoke and dust treatment systems	6.1 Receive instructions from the client	6.2 Find out what work needs to be done	6.3 Determine the required working methods, tools and equipment	6.4 Mobilize the site	6.5 Check the base, anchors and elevation	6.6 Install anchors
	6.7 Check and unload equipment	6.8 Erect the supports (structure)	6.9 Erect scaffolds, if applicable	6.10 Assemble and erect the modules	6.11 Install internal components	6.12 Install platforms and external components
	6.13 Assemble and install the ducts	6.14 Assemble and erect the chimney	6.15 Check work quality	6.16 Demobilize the site		

TASKS	OPERATIONS					
7. Assemble boilers	7.1 Receive instructions from the client	7.2 Find out what work needs to be done	7.3 Become qualified for welding procedures, if applicable	7.4 Determine the required working methods, tools and equipment	7.5 Mobilize the site	7.6 Erect scaffolds
	7.7 Check the base, anchors and elevation	7.8 Install anchors	7.9 Check and unload equipment	7.10 Put in place columns, steel beams and other structural elements of the boiler	7.11 Rig the balloons and put them in place	7.12 Install and fasten generator tubes
	7.13 Roll and flare the tubes	7.14 Preassemble water walls and other components	7.15 Put water walls and other components in place	7.16 Install superheaters	7.17 Install tubes	7.18 Assemble and weld the ashpit's screen pattern and tubes
	7.19 Install the economizer's modules	7.20 Install ducts and shutters	7.21 Mount, install and weld the hopper and economizer	7.22 Install the burners	7.23 Install boiler components	7.24 Check boiler and component tightness
	7.25 Install the dust extractor and its components	7.26 Install the chimney, ducts, ventilators, shutters and expansion joints	7.27 Check work quality	7.28 Demobilize the site		

TASKS	OPERATIONS					
8. Repair exchangers	8.1 Receive instructions from the client	8.2 Find out what work needs to be done	8.3 Determine the required working methods, tools and equipment	8.4 Mobilize the site	8.5 Plug the nozzles	8.6 Remove components
	8.7 Remove the tube nest	8.8 Clean the nest and repair, if applicable	8.9 Install the nest	8.10 Reinstall components	8.11 Test tube and shell tightness	8.12 Unplug the nozzles
	8.13 Demobilize the site					
9. Repair or modify elements¹⁵ and equipment¹⁶	9.1 Receive instructions from the client	9.2 Find out what work needs to be done	9.3 Become qualified for welding procedures, if applicable	9.4 Determine the required working methods, tools and equipment	9.5 Mobilize the site	9.6 Erect scaffolds, if applicable
	9.7 Plug ducts and nozzles, if applicable	9.8 Take measurements	9.9 Proceed to repair (cut, shape, assemble, weld)	9.10 Check work quality	9.11 Unplug the nozzles, if applicable	9.12 Demobilize the site

15. Elements such as a gas separator, smokeless incinerator, purifying box, dust extractor, material disposal and treatment system (precipitator), chimney flue, hopper, cyclone, economizer, air heater, reactor, evaporator, capacitor, kiln, filterer, bag filter, etc.

16. Equipment such as a furnace, oven, incinerator, fractionating tower, penstock, spiral casing, boiler, etc.

TASKS	OPERATIONS					
10. Disassemble elements¹⁷ and equipment¹⁸	10.1 Receive instructions from the client	10.2 Find out what work needs to be done	10.3 Determine the required working methods, tools and equipment	10.4 Mobilize the site	10.5 Erect scaffolds, if applicable	10.6 Confirm the weight of elements
	10.7 Rig the elements	10.8 Perform gas tests	10.9 Gouge, cut, unbolt	10.10 Handle disassembled elements	10.11 Demobilize the site	
11. Demolish boilers, tanks, towers, etc.	11.1 Receive instructions from the client	11.2 Find out what work needs to be done	11.3 Determine the required working methods, tools and equipment	11.4 Mobilize the site	11.5 Erect scaffolds, if applicable	11.6 Rig the elements
	11.7 Perform gas tests	11.8 Gouge, oxy-fuel cut, unbolt	11.9 Handle debris	11.10 Demobilize the site		

17. Elements such as a gas separator, smokeless incinerator, purifying box, dust extractor, material disposal and treatment system (precipitator), chimney flue, hopper, cyclone, economizer, air heater, reactor, evaporator, capacitor, kiln, filterer, bag filter, etc.

18. Equipment such as a furnace, oven, incinerator, fractionating tower, penstock, spiral casing, boiler, etc.

2.2 OPERATIONS AND SUB-OPERATIONS

In the following pages are presented the sub-operations related to each operation¹⁹.

Table 2.2 Sub-Operations

TASK 1 BUILD PARTS	
Operations	Sub-Operations
1.1 Receive instructions from the client	1.1.1 Attend the client's reception meeting 1.1.2 Receive general safety instructions 1.1.3 Pass a written comprehension examination 1.1.4 Learn about the prevention program
1.2 Find out what work needs to be done	1.2.1 Peruse the plan portions concerned 1.2.2 Peruse the specification portions concerned 1.2.3 Learn about specific safety measures 1.2.4 Read the WHMIS sheets
1.3 Become qualified for welding procedures, if applicable	1.3.1 Learn about the welding process 1.3.2 Prepare the parts 1.3.3 Perform welding examinations 1.3.4 Pass the test(s)
1.4 Determine the required working methods, tools and equipment	1.4.1 Perform a safe analysis of the task 1.4.2 Determine or examine the hoisting plan 1.4.3 Obtain required tools and equipment (welding, assembly, hoisting, handling, etc.)
1.5 Mobilize the site	1.5.1 Delimit and prepare work areas 1.5.2 Bring the tools and make sure they are in good condition 1.5.3 Plan the hoisting <ul style="list-style-type: none"> • Prepare hoisting devices 1.5.4 Prepare the equipment 1.5.5 Plan the lighting 1.5.6 Prepare accesses for doing the work 1.5.7 Establish safety perimeters 1.5.8 Prepare hoisting equipment, if applicable
1.6 Check and unload equipment	1.6.1 Receive the equipment <ul style="list-style-type: none"> • Check the condition and quantity of equipment • Compare the delivery order with plans and specifications data • Plan and install temporary courses (blocks) • Unload equipment • Protect unloaded equipment

¹⁹. The order of operations and sub-operations may vary.

TASK 1 BUILD PARTS

Operations	Sub-Operations
1.7 Cut, shape, assemble and weld	1.7.1 Take measurements 1.7.2 Calculate the angles 1.7.3 Mark, trace 1.7.4 Make templates 1.7.5 Cut (plasma, oxy-fuel cutting, grinder) 1.7.6 Shape: bend, roll 1.7.7 Assemble: clean, chamfer, weld or tack-weld or bolt
1.8 Erect scaffolds, if applicable	1.8.1 Take measurements of the structure 1.8.2 Find out about the plan, if applicable 1.8.3 Choose the scaffold types 1.8.4 Select the required equipment 1.8.5 Install accessories, if applicable
1.9 Rig the parts	1.9.1 Install a spreader beam 1.9.2 Check the condition of slings and shackles 1.9.3 Weld the lifting eyes, if applicable
1.10 Demobilize the site	1.10.1 Store the tools in toolboxes 1.10.2 Recover the equipment 1.10.3 Dismantle the scaffolds 1.10.4 Collect the rejects 1.10.5 Put the work area back in order

TASK 2 ASSEMBLE FURNACES, OVENS AND INCINERATORS

Operations	Sub-Operations
2.1 Receive instructions from the client	See the operation's sub-operations 1.1
2.2 Find out what work needs to be done	See the operation's sub-operations 1.2
2.3 Become qualified for welding procedures, if applicable	See the operation's sub-operations 1.3
2.4 Determine the required working methods, tools and equipment	See the operation's sub-operations 1.4
2.5 Mobilize the site	See the operation's sub-operations 1.5
2.6 Check the base, anchors and elevation	2.6.1 Take measurements 2.6.2 Take level readings 2.6.3 Check the base's condition and dimensions 2.6.4 Check the anchors 2.6.5 Repair if necessary 2.6.6 Locate the anchor point 2.6.7 Install a centreline 2.6.8 Drill the anchors 2.6.9 Apply quick-setting cement

TASK 2 ASSEMBLE FURNACES, OVENS AND INCINERATORS

Operations	Sub-Operations
2.7 Check and unload equipment	See the operation's sub-operations 1.6
2.8 Preassemble the components	2.8.1 Check the measurements according to the plans 2.8.2 Place two wall sections together 2.8.3 Adjust, fit, weld before erecting 2.8.4 Assemble chimney sections on the ground 2.8.5 Adjust, bolt before erecting 2.8.6 Install catwalks on components
2.9 Erect supports and structures	2.9.1 Check the dimensions according to the plans 2.9.2 Install shims 2.9.3 Go find the equipment at the storage site 2.9.4 Mobilize the cranes 2.9.5 Install the structure, beams, supports and floor 2.9.6 Install railings 2.9.7 Do a final tightening of the bolts 2.9.8 Retouch the paint
2.10 Erect scaffolds, if applicable	See the operation's sub-operations 1.8
2.11 Assemble the walls (welding, bolting)	2.11.1 Check the dimensions according to the drawings 2.11.2 Bring the sections to the site 2.11.3 Rig 2.11.4 Erect 2.11.5 Fit, weld and bolt the sections together
2.12 Install anchors	2.12.1 Locate the places for holes, if applicable 2.12.2 Drill holes, if applicable 2.12.3 Clean the threads 2.12.4 Bolt 2.12.5 Do a controlled tightening 2.12.6 Install grout under the plates
2.13 Install tube supports	2.13.1 Choose the supports 2.13.2 Bring the supports to their installation location 2.13.3 Bolt and weld
2.14 Install tubes	2.14.1 Choose the tubes 2.14.2 Prepare and clean the ends 2.14.3 Mobilize the crane 2.14.4 Put the tubes in place
2.15 Install conversion boxes	2.15.1 Prepare and clean the surfaces 2.15.2 Check the dimensions 2.15.3 Rig 2.15.4 Put the boxes in place and bolt
2.16 Fasten couplings and pipes	2.16.1 Bring sealing joints, pipes and bolts to the site 2.16.2 Bolt the pipes

TASK 2 ASSEMBLE FURNACES, OVENS AND INCINERATORS

Operations	Sub-Operations
2.17 Weld the tubes	2.17.1 Choose the filler equipment 2.17.2 Prepare weld seams
2.18 Roll and flare the tubes	2.18.1 Choose roll bending equipment according to the desired diameter
2.19 Assemble the chimney and branches	2.19.1 Check measurements 2.19.2 Prepare the rigging 2.19.3 Put the chimney in place 2.19.4 Bolt or weld the chimney 2.19.5 Put in place and bolt the branches
2.20 Install the burners	2.20.1 Obtain all burner components 2.20.2 Install rigging 2.20.3 Put the burners in place
2.21 Bolt the header boxes	2.21.1 Prepare surfaces (clean, apply sealing joints) 2.21.2 Install rigging 2.21.3 Place the crane 2.21.4 Put the header boxes in place and bolt them 2.21.5 Install the panels at each end
2.22 Install accessories and components	2.22.1 Put the soot blowers in place 2.22.2 Install check valves 2.22.3 Install pressure gauges 2.22.4 Install flexible joints
2.23 Check work quality	2.23.1 Perform a seal test 2.23.2 Check the P&ID 2.23.3 Install the blanks 2.23.4 Install the test pump 2.23.5 Fill with water and pressurize 2.23.6 Drain and remove the blanks
2.24 Demobilize the site	See the operation's sub-operations 1.10

TASK 3 ERECT FRACTIONATING TOWERS

Operations	Sub-Operations
3.1 Receive instructions from the client	See the operation's sub-operations 1.1
3.2 Find out what work needs to be done	See the operation's sub-operations 1.2
3.3 Become qualified for welding procedures	See the operation's sub-operations 1.3
3.4 Determine the required working methods, tools and equipment	See the operation's sub-operations 1.4

TASK 3 ERECT FRACTIONATING TOWERS

Operations	Sub-Operations
3.5 Mobilize the site	See the operation's sub-operations 1.5
3.6 Erect scaffolds, if applicable	See the operation's sub-operations 1.8
3.7 Check the base, anchors and elevation	See the operation's sub-operations 2.6
3.8 Install anchors	See the operation's sub-operations 2.12
3.9 Check and unload equipment	See the operation's sub-operations 1.6
3.10 Assemble the sections, if applicable	3.10.1 Install the crane and prepare slings and shackles 3.10.2 Install the bases to receive the sections 3.10.3 Install the sections on the bases 3.10.4 Position and fit section joints 3.10.5 Weld the sections
3.11 Rig and handle the parts	3.11.1 Install the cranes 3.11.2 Install rigging
3.12 Erect the tower	3.12.1 Proceed to a tandem hoist 3.12.2 Place the tower vertically
3.13 Recheck the levels, orientation and elevation	3.13.1 Review the elevation with a transit 3.13.2 Review the orientation, according to the plans
3.14 Make the tower plumb	3.14.1 Place the tower in the anchors 3.14.2 Use a theodolite or plumb line
3.15 Open the manholes	3.15.1 Unbolt the covers 3.15.2 Remove the covers
3.16 Install trays and components, if applicable	3.16.1 Perform a gas test 3.16.2 Install the cable 3.16.3 Prepare the work area at the bottom of the tower 3.16.4 Preassemble the trays 3.16.5 Rig the plates and components 3.16.6 Position the trays and components
3.17 Close the manholes (bolting)	3.17.1 Make a visual inspection of the tower 3.17.2 Clean the flanges 3.17.3 Install the seal joints 3.17.4 Put the covers back in place 3.17.5 Bolt the covers 3.17.6 Tighten according to the procedure

TASK 3 ERECT FRACTIONATING TOWERS

Operations	Sub-Operations
3.18 Check work quality	3.18.1 Check the tower's tightness <ul style="list-style-type: none">• Consult the testing procedure• Install the blanks• Prepare for the test• Fill the tower with liquid• Increase pressure according to the testing procedure• Depressurize and empty the tower• Remove the blanks• Close the flanges
3.19 Demobilize the site	See the operation's sub-operations 1.10

TASK 4 ERECT TANKS AND SILOS

Operations	Sub-Operations
4.1 Receive instructions from the client	See the operation's sub-operations 1.1
4.2 Find out what work needs to be done	See the operation's sub-operations 1.2
4.3 Become qualified for welding procedures, if applicable	See the operation's sub-operations 1.3
4.4 Determine the required working methods, tools and equipment	See the operation's sub-operations 1.4
4.5 Mobilize the site	See the operation's sub-operations 1.5
4.6 Check and unload equipment	See the operation's sub-operations 1.6
4.7 Locate the base area	
4.8 Check the base, anchors and elevation	See the operation's sub-operations 2.6
4.9 Install anchors	See the operation's sub-operations 2.12
4.10 Place, assemble and weld floor plates	4.10.1 Rig the plates 4.10.2 Position the plates 4.10.3 Fit and weld 4.10.4 Visually inspect the welding 4.10.5 Clean the welded plates

TASK 4 ERECT TANKS AND SILOS

Operations	Sub-Operations
4.11 Erect scaffolds, if applicable	See the operation's sub-operations 1.8
4.12 Rig the parts	See the operation's sub-operations 1.9
4.13 Place, assemble and weld wall plates	4.13.1 Weld temporary supports 4.13.2 Install the framework 4.13.3 Install catwalks (planks) 4.13.4 Install railing posts 4.13.5 Install railing cables 4.13.6 Put in place safety measures and access ladders
4.14 Install a door plate, if applicable	4.14.1 Oxy-fuel cut an opening in the wall <u>or</u> 4.14.2 Part of the plate should not be installed until the end of the work
4.15 Install the roof angle	4.15.1 Put the roof angle in place 4.15.2 Assemble the roof angle 4.15.3 Weld the roof angle and rafter supports 4.15.4 Take measurements (roundness) 4.15.5 Check the orientation
4.16 Install nozzles and reinforcing plates	4.16.1 Put nozzles and plates in place and assemble 4.16.2 Weld 4.16.3 Perform an inspection
4.17 Install centre column(s) and supports	4.17.1 Install rigging 4.17.2 Handle the column and install it 4.17.3 Check the plumb 4.17.4 Install temporary supports
4.18 Install rafters	4.18.1 Put the rafters in place 4.18.2 Bolt and weld
4.19 Install roof plates	4.19.1 Put in place using the spreader beam 4.19.2 Fit and weld
4.20 Install stairs, catwalks and other components	4.20.1 Preassemble the components, if applicable 4.20.2 Rig and handle the components
4.21 Install the floating roof and heating components	4.21.1 Rig the floating roof, if it is made of steel 4.21.2 Handle, put in place and assemble the floating roof 4.21.3 Check roof watertightness, if it is made of steel

TASK 4 ERECT TANKS AND SILOS

Operations	Sub-Operations
4.22 Check work quality	4.22.1 Perform tests (penetrating oil, vacuum, hydrostatic, elevation, etc.) 4.22.2 Perform a visual inspection 4.22.3 Perform a roof flotation test, if applicable
4.23 Demobilize the site	See the operation's sub-operations 1.10

TASK 5 INSTALL PENSTOCKS AND SPIRAL CASES

Operations	Sub-Operations
5.1 Receive instructions from the client	See the operation's sub-operations 1.1
5.2 Find out what work needs to be done	See the operation's sub-operations 1.2
5.3 Become qualified for welding procedures, if applicable	See the operation's sub-operations 1.3
5.4 Determine the required working methods, tools and equipment	See the operation's sub-operations 1.4
5.5 Mobilize the site	See the operation's sub-operations 1.5
5.6 Check and unload equipment	See the operation's sub-operations 1.6
5.7 Check the base, anchors and elevation	See the operation's sub-operations 2.6
5.8 Install anchors	See the operation's sub-operations 2.12
5.9 Rig and handle the parts and components	5.9.1 Install, level and anchor the tracks 5.9.2 Install slings to put parts and components on crawlers with a gantry 5.9.3 Use a winch to pull parts and components to their position
5.10 Install anti-float supports	5.10.1 Hoist the parts with hydraulic jacks to install anti-float supports 5.10.2 Build anti-float supports 5.10.3 Weld anti-float supports on the duct

TASK 5 INSTALL PENSTOCKS AND SPIRAL CASES

Operations	Sub-Operations
5.11 Align and level the sections	5.11.1 Install jacks to obtain the desired alignment and elevation 5.11.2 Install indoor and outdoor scaffolds facing seams to be welded
5.12 Fasten components to supports	5.12.1 Tighten anchors on supports 5.12.2 Level the supports
5.13 Assemble and weld components and grind	5.13.1 Install assembly and alignment parts (dogs) inside the room 5.13.2 Make a weld bead outside 5.13.3 Fill the seam with a weld bead inside 5.13.4 Cut assembly and alignment parts (dogs) 5.13.5 Grind the welds
5.14 Check work quality	5.14.1 Perform a visual inspection of welding work 5.14.2 Make corrections if applicable
5.15 Dismantle braces in penstocks	5.15.1 Gouge the braces 5.15.2 Disassemble the spacers 5.15.3 Grind the wall
5.16 Demobilize the site	See the operation's sub-operations 1.10

TASK 6 INSTALL GAS, SMOKE AND DUST TREATMENT SYSTEMS

Operations	Sub-Operations
6.1 Receive instructions from the client	See the operation's sub-operations 1.1
6.2 Find out what work needs to be done	See the operation's sub-operations 1.2
6.3 Determine the required working methods, tools and equipment	See the operation's sub-operations 1.4
6.4 Mobilize the site	See the operation's sub-operations 1.5
6.5 Check the base, anchors and elevation	See the operation's sub-operations 2.6
6.6 Install anchors	See the operation's sub-operations 2.12
6.7 Check and unload equipment	See the operation's sub-operations 1.6
6.8 Erect the supports (structure)	

TASK 6 INSTALL GAS, SMOKE AND DUST TREATMENT SYSTEMS

Operations	Sub-Operations
6.9 Erect scaffolds, if applicable	See the operation's sub-operations 1.8
6.10 Assemble and erect the modules	6.10.1 Preassemble the sections, if applicable 6.10.2 Bolt or weld
6.11 Install internal components	6.11.1 Prepare attachments 6.11.2 Bolt or weld
6.12 Install platforms and external components	6.12.1 Bolt or weld
6.13 Assemble and install the ducts	6.13.1 Rig the ducts 6.13.2 Bolt
6.14 Assemble and erect the chimney	6.14.1 Rig the chimney 6.14.2 Bolt
6.15 Check work quality	6.15.1 Check assemblies (welding, bolting) 6.15.2 Perform tightness tests (water, smoke) 6.15.3 Perform hydrostatic tests for pressurized vessels 6.15.4 Apply the inspection plan provided for in the specifications 6.15.5 Fill out inspection cards
6.16 Demobilize the site	See the operation's sub-operations 1.10

TASK 7 ASSEMBLE BOILERS

Operations	Sub-Operations
7.1 Receive instructions from the client	See the operation's sub-operations 1.1
7.2 Find out what work needs to be done	See the operation's sub-operations 1.2
7.3 Become qualified for welding procedures, if applicable	See the operation's sub-operations 1.3
7.4 Determine the required working methods, tools and equipment	See the operation's sub-operations 1.4
7.5 Mobilize the site	See the operation's sub-operations 1.5

TASK 7 ASSEMBLE BOILERS

Operations	Sub-Operations
7.6 Erect scaffolds	See the operation's sub-operations 1.8
7.7 Check the base, anchors and elevation	See the operation's sub-operations 2.6
7.8 Install anchors	See the operation's sub-operations 2.12
7.9 Check and unload equipment	See the operation's sub-operations 1.6
7.10 Put in place columns, steel beams and other structural elements of the boiler	7.10.1 Install shims at the desired elevation 7.10.2 Preassemble the beams, if applicable 7.10.3 Install structural elements 7.10.4 Secure the elements temporarily 7.10.5 Check the alignment and elevation 7.10.6 Bolt 7.10.7 Make the grout
7.11 Rig the balloons and put them in place	7.11.1 Install shims on supports at the desired elevation 7.11.2 Mount the balloons according to the hoisting plan 7.11.3 Check balloon elevation 7.11.4 Bolt
7.12 Install and fasten generator tubes	7.12.1 Open the manholes 7.12.2 Prepare (clean) the tubes 7.12.3 Prepare the balloons to receive the tubes 7.12.4 Prepare the parts to be welded 7.12.5 Weld
7.13 Roll and flare the tubes	7.13.1 Put the equipment inside the balloon 7.13.2 Install the tubes 7.13.3 Roll the tubes according to a determined sequence
7.14 Preassemble water walls and other components	7.14.1 Build supports to receive components 7.14.2 Build a shelter for welding 7.14.3 Weld the water walls 7.14.4 Weld components on the water walls
7.15 Put water walls and other components in place	7.15.1 Install the crane 7.15.2 Rig the walls according to the hoisting plan 7.15.3 Erect and install the water walls 7.15.4 Install indoor and outdoor scaffolds 7.15.5 Adjust and fit components 7.15.6 Check weld quality

TASK 7 ASSEMBLE BOILERS

Operations	Sub-Operations
7.16 Install superheaters	7.16.1 Rig the superheaters 7.16.2 Install scaffolds 7.16.3 Install temporary supports 7.16.4 Mount the superheaters 7.16.5 Secure the superheaters 7.16.6 Do the final welding
7.17 Install the tubes	7.17.1 Prepare the surfaces to be welded 7.17.2 Position the tubes 7.17.3 Weld the tubes
7.18 Assemble and weld the ashpit's screen pattern and tubes	
7.19 Install the economizer's modules	7.19.1 Rig the modules 7.19.2 Mount the modules according to the established procedure 7.19.3 Secure the modules temporarily 7.19.4 Install the scaffolds 7.19.5 Prepare the surfaces to be welded 7.19.6 Weld 7.19.7 Inspect the welds 7.19.8 Remove temporary supports 7.19.9 Dismantle the scaffolds
7.20 Install ducts and shutters	7.20.1 Install the scaffolds 7.20.2 Take measurements to install supports 7.20.3 Install the supports 7.20.4 Install rigging 7.20.5 Mount the ducts 7.20.6 Install seal joints and bolt
7.21 Mount, install and weld the hopper and economizer	7.21.1 Install the scaffolds 7.21.2 Position the hopper and economizer 7.21.3 Prepare the surfaces to be welded 7.21.4 Weld 7.21.5 Inspect the welds
7.22 Install the burners	7.22.1 Take the elevations 7.22.2 Install the rigging 7.22.3 Install seal joints and bolt 7.22.4 Connect pipes and equipment
7.23 Install boiler components	7.23.1 Rig and handle the components 7.23.2 Transfer the components on temporary supports 7.23.3 Hang or place the components 7.23.4 Bolt or weld the components

TASK 7 ASSEMBLE BOILERS

Operations	Sub-Operations
7.24 Check boiler and component tightness	7.24.1 Insulate the circuit with blanking plates 7.24.2 Install the hydrostatic testing equipment 7.24.3 Fill the boiler and components with liquid 7.24.4 Use a pump to adjust the pressure 7.24.5 Wait one hour 7.24.6 Check for leaks 7.24.7 Remove the blanking plates 7.24.8 Drain 7.24.9 Have test results approved by the person in charge of the inspection 7.24.10 Dismantle the testing equipment
7.25 Install the dust extractor and its components	
7.26 Install the chimney, ducts, ventilators, shutters and expansion joints	7.26.1 Assemble the chimney on the ground, on blocks 7.26.2 Use two cranes to erect the chimney 7.26.3 Align the chimney 7.26.4 Level and bolt the chimney 7.26.5 Mount the ducts with a crane 7.26.6 Install the seal joints, bolt and tighten 7.26.7 Adjust the ventilators' elevation 7.26.8 Place the ventilators on the anchors 7.26.9 Install the grout 7.26.10 Position the shutters and expansion joints and bolt them
7.27 Check work quality	7.27.1 Check boiler tightness 7.27.2 Perform a visual inspection at each step of the work
7.28 Demobilize the site	See the operation's sub-operations 1.10

TASK 8 REPAIR EXCHANGERS

Operations	Sub-Operations
8.1 Receive instructions from the client	See the operation's sub-operations 1.1
8.2 Find out what work needs to be done	See the operation's sub-operations 1.2
8.3 Determine the required working methods, tools and equipment	See the operation's sub-operations 1.4
8.4 Mobilize the site	See the operation's sub-operations 1.5

TASK 8 REPAIR EXCHANGERS

Operations	Sub-Operations
8.5 Plug the nozzles	8.5.1 Apply the lockout measures 8.5.2 Do the hot pre-unbolting 8.5.3 Open the flanges 8.5.4 Insert blanking plates 8.5.5 Bolt the flanges with controlled tightening tools
8.6 Remove components	8.6.1 Do the hot pre-unbolting 8.6.2 Unbolt 8.6.3 Rig and handle the components
8.7 Remove the tube nest	8.7.1 Modify the scaffolds 8.7.2 Extract the tube bundle (using the extractor) 8.7.3 Rig and handle the tube bundle
8.8 Clean the nest and repair, if applicable	8.8.1 Test the tube bundle 8.8.2 Locate the leak or breakage 8.8.3 Repair: <ul style="list-style-type: none">· install a plug· roll the tube(s)· change the tube(s) 8.8.4 Retest the tube bundle
8.9 Install the nest	8.9.1 Check and clean the expansion joints 8.9.2 Rig and handle the tube bundle 8.9.3 Position the tube bundle (using the extractor) 8.9.4 Adjust the level
8.10 Reinstall components	8.10.1 Clean and lubricate the bolts 8.10.2 Modify the scaffolds 8.10.3 Rig and handle the components 8.10.4 Bolt the components
8.11 Test tube and shell tightness	8.11.1 Install the hydrostatic testing equipment 8.11.2 Fill the exchanger with liquid 8.11.3 Obtain the required pressure 8.11.4 Locate leaks, if applicable 8.11.5 Caulk leaks, if applicable 8.11.6 Present test results to the person in charge of the inspection 8.11.7 Dismantle the testing equipment
8.12 Unplug the nozzles	8.12.1 Apply the lockout measures 8.12.2 Open the flanges 8.12.3 Check and clean expansion joints 8.12.4 Remove blanking plates 8.12.5 Insert new gaskets 8.12.6 Bolt the flanges with controlled tightening tools
8.13 Demobilize the site	See the operation's sub-operations 1.10

TASK 9 REPAIR OR MODIFY ELEMENTS²⁰ AND EQUIPMENT²¹

Operations	Sub-Operations
9.1 Receive instructions from the client	See the operation's sub-operations 1.1
9.2 Find out what work needs to be done	See the operation's sub-operations 1.2
9.3 Become qualified for welding procedures, if applicable	See the operation's sub-operations 1.3
9.4 Determine the required working methods, tools and equipment	See the operation's sub-operations 1.4
9.5 Mobilize the site	See the operation's sub-operations 1.5
9.6 Erect scaffolds, if applicable	See the operation's sub-operations 1.8
9.7 Plug ducts and nozzles, if applicable	9.7.1 Check the size of flanges 9.7.2 Unbolt the flanges 9.7.3 Install blanking plates and seal joints 9.7.4 Rebolt the flanges
9.8 Take measurements	9.8.1 Measure existing parts 9.8.2 Compare with drawings and procedures 9.8.3 Detect modifications
9.9 Proceed to repair (cut, shape, assemble, weld)	9.9.1 Mark the part to be modified 9.9.2 Cut with a grinder or by oxy-fuel cutting 9.9.3 Prepare for welding (clean, chamfer) 9.9.4 Adjust and fit the parts 9.9.5 Weld the parts
9.10 Check work quality	9.10.1 Check tightness (air, water, etc.) 9.10.2 Make a visual inspection (assembly, welds, etc.)
9.11 Unplug the nozzles, if applicable	9.11.1 Apply the lockout measures 9.11.2 Open the flanges 9.11.3 Remove blanking plates 9.11.4 Check and clean expansion joints 9.11.5 Insert new gaskets 9.11.6 Bolt the flanges
9.12 Demobilize the site	See the operation's sub-operations 1.10

20. Elements such as a gas separator, smokeless incinerator, purifying box, dust extractor, material disposal and treatment system (precipitator), chimney flue, hopper, cyclone, economizer, air heater, reactor, evaporator, capacitor, kiln, filterer, bag filter, etc.

21. Equipment such as a furnace, oven, incinerator, fractionating tower, penstock, spiral casing, boiler, etc.

TASK 10 DISASSEMBLE ELEMENTS²² AND EQUIPMENT²³

Operations	Sub-Operations
10.1 Receive instructions from the client	See the operation's sub-operations 1.1
10.2 Find out what work needs to be done	See the operation's sub-operations 1.2
10.3 Determine the required working methods, tools and equipment	See the operation's sub-operations 1.4
10.4 Mobilize the site	See the operation's sub-operations 1.5
10.5 Erect scaffolds, if applicable	See the operation's sub-operations 1.8
10.6 Confirm the weight of elements	
10.7 Rig the elements	10.7.1 Install the slings 10.7.2 Use a crane to weigh the part 10.7.3 Lower the part on a warehouse truck
10.8 Perform gas tests	10.8.1 Detect traces of fuel 10.8.2 Obtain necessary protective equipment
10.9 Gouge, cut, unbolt	10.9.1 Delimit the work area 10.9.2 Ventilate if applicable
10.10 Handle disassembled elements	10.10.1 Place unmounted equipment on a warehouse truck
10.11 Demobilize the site	See the operation's sub-operations 1.10

22. Elements such as a gas separator, smokeless incinerator, purifying box, dust extractor, material disposal and treatment system (precipitator), chimney flue, hopper, cyclone, economizer, air heater, reactor, evaporator, capacitor, kiln, filterer, bag filter, etc.

23. Equipment such as a furnace, oven, incinerator, fractionating tower, penstock, spiral casing, boiler, etc.

TASK 11 DEMOLISH BOILERS, TANKS, TOWERS, ETC.

Operations	Sub-Operations
11.1 Receive instructions from the client	See the operation's sub-operations 1.1
11.2 Find out what work needs to be done	See the operation's sub-operations 1.2
11.3 Determine the required working methods, tools and equipment	See the operation's sub-operations 1.4
11.4 Mobilize the site	See the operation's sub-operations 1.5
11.5 Erect scaffolds, if applicable	See the operation's sub-operations 1.8
11.6 Rig the elements	See the operation's sub-operations 1.9
11.7 Perform gas tests	11.7.1 Use a gas detector 11.7.2 Fill out the test report
11.8 Gouge, oxy-fuel cut, unbolt	11.8.1 Install a shelter 11.8.2 Establish a safety perimeter 11.8.3 Prepare the equipment 11.8.4 Install personal protective equipment
11.9 Handle debris	
11.10 Demobilize the site	See the operation's sub-operations 1.10

2.3 ACHIEVEMENT CONDITIONS

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

Table 2.3 Achievement Conditions

ACHIEVEMENT CONDITIONS
<p>Work areas²⁴</p> <p>Boilermakers can work in various work environments, such as: paper mills, petrochemical plants, refineries, steel mills, foundries, cement factories, sawmills, distilleries, lime plants, panel plants, etc.</p> <p>The great majority work outdoors, 80 to 90% of the time, year-round. They work indoors in some cases, for example to manufacture parts or in certain types of companies (e.g., paper mill), but this is exceptional. When they work indoors, boilermakers may have to work in confined spaces (e.g., tunnel).</p>
<p>Instructions</p> <p>Boilermakers receive instructions from their foreman. Occasionally, the client gives them special requirements. The instructions may be given through plans and specifications, sketches, job safety analyses (JSAs), work permits, lockout procedures, etc.</p>
<p>Degree of autonomy</p> <p>Boilermakers have to demonstrate a lot of independence. The participants estimate that they work without supervision about 80% of the time; their foreman comes to see them occasionally and they have to call him when necessary, for example to validate an instruction, verify the safety of an action, etc. Moreover, boilermakers always work in teams of at least two, which guarantees worker safety. The size of teams varies according to the construction site and the work to be done.</p>

24. Non-exhaustive list.

ACHIEVEMENT CONDITIONS

Interactions

Boilermakers are called upon to interact and collaborate with workers from various trades, of which the main ones are the following:

- crane operators;
- pipe fitters;
- insulators;
- electricians;
- millwrights;
- ironworkers.

They may also interact with:

- project managers;
- engineers;
- inspectors;
- security guards, prevention guards, etc.

References

To perform their tasks, boilermakers may use various reference documents, such as:

- plans and specifications;
- inspection and test plans;
- safety manuals;
- tables of metal weights and measures;
- schematic diagrams;
- material (steel) specifications;
- etc.

Tools and equipment

In Annex 1 of the present report is a list of material resources used by boilermakers in the practice of their trade. It should be noted that under collective agreements, certain tools are provided by the boilermaker, and others by his employer.

Health and safety hazards

In Annex 2 of the present report are a list of the main hazards involved in the tasks and operations of the boilermaking trade, and a list of applicable preventive measures.

ACHIEVEMENT CONDITIONS
<p>Stress factors</p> <p>Boilermakers face various stress factors, such as:</p> <ul style="list-style-type: none"> ▪ work environment (extreme temperatures, wind, toxic fumes, working from heights, confined spaces, fire or explosion hazards, nuclear standards, etc.); ▪ long working hours, tight schedules, safety requirements; ▪ complex hoisting operations, particularly for disassembling and demolishing equipment; ▪ welding qualification test; ▪ working with equipment that requires great attention.
<p>Decision-making</p> <p>Boilermakers must regularly make decisions that may affect the quality of work, their health and safety and that of their colleagues, the choice of tools and equipment, etc.</p>

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 compliance with a work procedure, the attitudes adopted, etc.

Table 2.4 Performance Criteria

TASK 1 BUILD PARTS
Performance Criteria
<ul style="list-style-type: none"> - Consulting the information appropriately - Compliance with plans and specifications - Compliance with manufacturing tolerances - Compliance with work methods - Correctly delimiting and protecting work areas - Compliance with welding processes - Cleanliness of work areas - Compliance with health and safety rules - Compliance with testing methods

TASK 2 ASSEMBLE FURNACES, OVENS AND INCINERATORS

Performance Criteria

- Consulting the information appropriately
- Compliance with plans and specifications
- Compliance with manufacturing tolerances
- Compliance with work methods
- Correctly delimiting and protecting work areas
- Compliance with welding processes
- Cleanliness of work areas
- Compliance with health and safety rules
- Efficient teamwork
- Double check of tolerances and measurements
- Vigilance during load hoisting and moving operations
- Attentive check of hoisting equipment and accessories
- Compliance with dimensions
- Appropriate interpretation of plans and specifications
- Appropriate choice of equipment and tools
- Following instructions
- Compliance with testing methods

TASK 3 ERECT FRACTIONATING TOWERS

Performance Criteria

- Consulting the information appropriately
- Compliance with plans and specifications
- Compliance with manufacturing tolerances
- Compliance with work methods
- Correctly delimiting and protecting work areas
- Compliance with welding processes
- Cleanliness of work areas
- Compliance with health and safety rules
- Efficient teamwork
- Double check of tolerances and measurements
- Vigilance during load hoisting and moving operations
- Attentive check of hoisting equipment and accessories
- Compliance with dimensions
- Appropriate interpretation of plans and specifications
- Appropriate choice of equipment and tools
- Following instructions
- Assembling trays appropriately
- Correct tightening
- Efficient coordination with other team members
- Choosing and handling hoisting equipment appropriately
- Compliance with the hoisting plan
- Accurate assessment of metal expansion aspects in welding sequences
- Vigilance when working from a height
- Compliance with weight hoisting charts
- Diligently checking work quality at the various stages
- Compliance with testing methods

TASK 4 ERECT TANKS AND SILOS

Performance Criteria

- Consulting the information appropriately
- Compliance with plans and specifications
- Compliance with manufacturing tolerances
- Compliance with work methods
- Correctly delimiting and protecting work areas
- Compliance with welding processes
- Cleanliness of work areas
- Compliance with health and safety rules
- Efficient teamwork
- Double check of tolerances and measurements
- Vigilance during load hoisting and moving operations
- Attentive check of hoisting equipment and accessories
- Compliance with dimensions
- Appropriate interpretation of plans and specifications
- Appropriate choice of equipment and tools
- Following instructions
- Efficient coordination with other team members
- Choosing and handling hoisting equipment appropriately
- Compliance with the hoisting plan
- Accurate assessment of metal expansion aspects in welding sequences
- Vigilance when working from a height
- Compliance with weight hoisting charts
- Diligently checking work quality at the various stages
- Compliance with testing methods

TASK 5 INSTALL PENSTOCKS AND SPIRAL CASES

Performance Criteria

- Consulting the information appropriately
- Compliance with plans and specifications
- Compliance with manufacturing tolerances
- Compliance with work methods
- Correctly delimiting and protecting work areas
- Compliance with welding processes
- Cleanliness of work areas
- Compliance with health and safety rules
- Efficient teamwork
- Double check of tolerances and measurements
- Vigilance during load hoisting and moving operations
- Attentive check of hoisting equipment and accessories
- Compliance with dimensions
- Appropriate interpretation of plans and specifications
- Appropriate choice of equipment and tools
- Following instructions
- Efficient coordination with other team members
- Choosing and handling hoisting equipment appropriately
- Compliance with the hoisting plan

TASK 5 INSTALL PENSTOCKS AND SPIRAL CASES (CONT'D)**Performance Criteria**

-
- Accurate assessment of metal expansion aspects in welding sequences
- Vigilance when working from a height
- Compliance with weight hoisting charts
- Diligently checking work quality at the various stages
- Compliance with testing methods

TASK 6 INSTALL GAS, SMOKE AND DUST TREATMENT SYSTEMS**Performance Criteria**

- Consulting the information appropriately
- Compliance with plans and specifications
- Compliance with manufacturing tolerances
- Compliance with work methods
- Correctly delimiting and protecting work areas
- Compliance with welding processes
- Cleanliness of work areas
- Compliance with health and safety rules
- Efficient teamwork
- Double check of tolerances and measurements
- Vigilance during load hoisting and moving operations
- Attentive check of hoisting equipment and accessories
- Compliance with dimensions
- Appropriate interpretation of plans and specifications
- Appropriate choice of equipment and tools
- Following instructions
- Efficient coordination with other team members
- Choosing and handling hoisting equipment appropriately
- Compliance with the hoisting plan
- Accurate assessment of metal expansion aspects in welding sequences
- Vigilance when working from a height
- Compliance with weight hoisting charts
- Diligently checking work quality at the various stages
- Compliance with testing methods

TASK 7 ASSEMBLE BOILERS**Performance Criteria**

- Consulting the information appropriately
- Compliance with plans and specifications
- Compliance with manufacturing tolerances
- Compliance with work methods
- Correctly delimiting and protecting work areas
- Compliance with welding processes

TASK 7 ASSEMBLE BOILERS (CONT'D)

Performance Criteria

- Cleanliness of work areas
- Compliance with health and safety rules
- Efficient teamwork
- Double check of tolerances and measurements
- Vigilance during load hoisting and moving operations
- Attentive check of hoisting equipment and accessories
- Compliance with dimensions
- Appropriate interpretation of plans and specifications
- Appropriate choice of equipment and tools
- Following instructions
- Efficient coordination with other team members
- Choosing and handling hoisting equipment appropriately
- Compliance with the hoisting plan
- Accurate assessment of metal expansion aspects in welding sequences
- Vigilance when working from a height
- Compliance with weight hoisting charts
- Diligently checking work quality at the various stages
- Compliance with testing methods

TASK 8 REPAIR EXCHANGERS

Performance Criteria

All the previous task's criteria and the following ones:

- Meticulously checking for defects and leaks, if applicable
- Finding the exact locations of defects and leaks, if applicable
- Compliance with testing methods
- Demonstrating resourcefulness and imagination in searching for solutions
- Quick and effective adaptation to unforeseen situations
- Compliance with health and safety rules

TASK 9 REPAIR OR MODIFY ELEMENTS AND EQUIPMENT

Performance Criteria

All Task 7 criteria and the following ones:

- Meticulously checking for defects and leaks, if applicable
- Finding the exact locations of defects and leaks, if applicable
- Compliance with testing methods
- Demonstrating resourcefulness and imagination in searching for solutions
- Quick and effective adaptation to unforeseen situations
- Compliance with health and safety rules

TASK 10 DISASSEMBLE ELEMENTS AND EQUIPMENT

Performance Criteria

All Task 7 criteria and the following ones:

- Structured working method
- Planning the procedure logically
- Determining the dismantling sequence appropriately
- Sound choice of hoisting points
- Quick and effective adaptation to unforeseen situations
- Compliance with health and safety rules

TASK 11 DEMOLISH BOILERS, TANKS, TOWERS, ETC.

Performance Criteria

All Task 7 criteria and the following ones:

- Structured working method
- Planning the procedure logically
- Determining the dismantling sequence appropriately
- Sound choice of hoisting points
- Quick and effective adaptation to unforeseen situations
- Compliance with health and safety rules

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 boilermaking trade, the participants agreed with the functions presented below. Thus, the boilermaker's work comprises three functions:

- a function regarding **installation**, and grouping the following tasks:
 - Assemble furnaces, ovens and incinerators;
 - Erect fractionating towers;
 - Erect tanks and silos;
 - Install penstocks and spiral cases;
 - Install gas, smoke and dust treatment systems;
 - Assemble boilers.

- a function regarding **repairs** and **modifications**, and grouping the following tasks:
 - Repair exchangers;
 - Repair or modify elements and equipment.

- a function regarding **disassembly** and **demolition**, and grouping the following tasks:
 - Disassemble elements and equipment;
 - Demolish boilers, tanks, towers, etc.

In addition, the “Build parts” task may be integrated with the three functions.

3. QUANTITATIVE DATA ON TASKS

3.1 OCCURRENCE

Occurrence data concern the percentage of workers who perform a task in the same workplace. Boilermakers do not work exclusively for one company: they change employers depending on the sites where they are called upon to work. It is therefore impossible for them to answer the questionnaire about occurrence, since they do not have the same employer from one construction site to another and thus do not have the same co-workers either.

3.2 WORK TIME

Work time, also expressed in percentages, represents the average time allocated to each task by the participants. They chose to answer the question for their entire career.

Table 3.1 Work Time Allocated to Each Task

Task	Work Time
1. Build parts	7.2%
2. Assemble furnaces, ovens and incinerators	8.6%
3. Erect fractionating towers	5.2%
4. Erect tanks and silos	14%
5. Install penstocks and spiral cases	3.5%
6. Install gas, smoke and dust treatment systems	9.4%
7. Assemble boilers	12.6%
8. Repair exchangers	24.1%
9. Repair or modify elements and equipment	6%
10. Disassemble elements and equipment	3.9%
11. Demolish boilers, tanks, towers, etc.	5.5%
	100%

We note that Task 8, “REPAIR EXCHANGERS”, obtains the highest percentage, i.e. one quarter of the participants’ work time. Then come Task 4, “Erect tanks and silos” at 14%, and Task 7, “Assemble boilers” at 12.6%. On average, half (50.7%) of the participants’ work time is allocated to those three tasks. The eight other tasks’ percentages vary between 3.5 (Task 5, “Install penstocks and spiral cases”) and 9.4 (Task 6, “Install gas, smoke and dust treatment systems”).

Moreover, in examining the individual results, we observe that:

- 5 participants never perform Task 4, “Erect tanks and silos”;
- 5 participants never perform Task 5, “Install penstocks and spiral cases”;
- 4 participants never perform Task 6, “Install gas, smoke and dust treatment systems”;
- 6 participants never perform Task 9, “Repair or modify elements and equipment”.

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 result in minimal costs, an unsatisfactory result, injury or minor accident hazards, etc.
3. Important: Poor execution of the task could result in substantial additional costs, injuries, accidents, etc.
4. Very important: Poor execution of the task could 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 for the boilermakers who participated in the workshop.

Table 3.2 Importance and Difficulty of Tasks

Task	Importance	Difficulty
1. Build parts	3.3	2.9
2. Assemble furnaces, ovens and incinerators	3.9	3.4
3. Erect fractionating towers	3.7	3
4. Erect tanks and silos	3.3	2.8
5. Install penstocks and spiral cases	3.6	3.3
6. Install gas, smoke and dust treatment systems	3.9	3.7
7. Assemble boilers	3.5	2.4
8. Repair exchangers	3.5	3.1
9. Repair or modify elements and equipment	3.3	2.8
10. Disassemble elements and equipment	3.3	3.5
11. Demolish boilers, tanks, towers, etc.	3.5	2.8

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 workshop participants, are considered essential for performing the tasks of the boilermaking trade.

4.1 KNOWLEDGE

Communication

The boilermaker has to know the basic principles of interpersonal communication and the necessary conditions for teamwork. He has to be able to establish harmonious interpersonal relations and work effectively within a team. Respect for others is mentioned as an essential factor in maintaining good relations.

Scaffolds

The boilermaker has to know the usage, inspection, installation and maintenance methods, as well as the safety measures, that apply to the scaffolds he is assigned to use, including more-novel equipment such as lifts and platforms.

Gases

Knowledge of the properties (volume, pressure, etc.) of the various gases that the boilermaker can encounter in his work is important. He must be aware of the risks and dangers involved, along with safety and protection measures. He must also know the methods for identifying those gases and, if applicable, the laws and regulations governing their use.

Reading plans and specifications

The boilermaker has to read excerpts from plans and specifications. Generally, the foreman hands him the plans and specifications section that applies to the work he is to do. The boilermaker must therefore be able to read drawings (of fitting, development, triangulations, etc.) and interpret their graphic conventions and scales. He must distinguish between the various views (isometric, cross-section, detail, etc.).

He must also be able to read specifications and find there the information he needs, for example when the time comes to check the equipment.

Mathematics

In the course of his work, the boilermaker must apply the four basic arithmetic operations (adding, subtracting, multiplying, subtracting), particularly in calculating weights and volumes. Calculations are done with fractions and decimals, in imperial and metric units. Converting from one system to the other is also necessary, as well as calculating square roots and applying the rule of three. With regard to geometry, the boilermaker must mainly calculate areas and angles. He must also know and apply tangent, sine and cosine formulas.

Metallurgy

The boilermaker must know the properties (physical properties, reactions) of the various metals and alloys that are most widely used in their trade, such as steel, stainless steel, copper, titanium, chrome, Inconel, etc. He particularly has to know their expansion and contraction rates, knowledge that will be useful during assembly. He must also be able to choose the tools and processes appropriate to each metal and alloy.

Tools and equipment

The boilermaker uses a great many tools, devices and types of equipment. He must be able to use them correctly, maintain them and repair them when necessary (minor repairs, since major repairs are entrusted to specialists).

In addition, the boilermaker uses a lot of hardware, such as bolts, seal joints, expansion joints, etc. He must be able to distinguish between those pieces and apply their respective installation methods.

Occupational health and safety

The boilermaker must have occupational health and safety knowledge. He must know the various individual protection components, their use, adjustments and aspects to be checked. He must also know the Workplace Hazardous Materials Information System (WHMIS) and be able to interpret its material safety data sheets (MSDSs). The boilermaker must be able to perform task safety analyses, and to participate actively in safety meetings on site. He must know all the safety rules that apply to the work he does, for example lockout procedures, safe behaviours, etc. Finally, he must know the preventive measures related to his equipment and tools, such as those involved in using a lift truck, a bundle extractor, etc.

Signage and rigging

The boilermaker must apply the rigging techniques necessary to the various loads to be hoisted and moved. He must choose hoisting equipment according to the load and the capacity of each device. He must also be able to assemble and disassemble, maintain and safely use hoisting accessories. Finally, he must be able to guide the hoisting equipment operator, generally a crane operator, by means of the signals in use.

Welding

The boilermaker must know the various welding processes that have to be used for doing the work. The most commonly used process is shielded metal arc welding (SMAW), but the boilermaker is also called upon to do semi-automatic flux-cored arc welding (FCAW), gas tungsten arc welding (GTAW) and semi-automatic gas metal arc welding (GMAW). He must have a good knowledge of the procedures related to those processes, the weld quality criteria and the standards of the Canadian Welding Bureau, ASME and ASTM. The boilermaker must also know oxy-fuel cutting and plasma cutting techniques.

Tests

The boilermaker must perform various tests on his work – for example, (hydrostatic) seam tests, non-destructive tests (liquid penetrant), etc. He must also know the usage and maintenance methods for various measuring instruments, such as micrometres, laser levels, tensiometers, 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 boilermakers need are the following:

- planning the work to be done;
- anticipating the work to be done;
- problem-solving.

Motor skills

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

- dexterity;
- balance (working from heights);
- coordination (notably when welding);
- absence of vertigo or claustrophobia.

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 boilermakers need are the following:

- spatial visualization of parts or components;
- good vision;
- good sense of hearing, to detect abnormal noises;
- good sense of smell, to detect certain gases or abnormal odours.

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 that boilermakers need are the following:

- adopting safe attitudes and behaviours;
- having a sense of observation;
- conscientiousness;
- having team spirit;
- being ingenious, inventive and resourceful;
- being versatile, hard-working and punctual;
- demonstrating patience and attention to detail;
- demonstrating discipline and professional rigour;
- being able to adapt to various environments, situations, persons, etc.

5. TRAINING SUGGESTIONS

Initial training

The participants made suggestions about various aspects of initial training.

- Persons who want to register for the study program should have good basic schooling (some participants mention Secondary 5) and aptitudes for manual work.
- The main targets for the training of future boilermakers should be the following:
 - parts manufacturing;
 - scaffolds (installation, load calculations, adaptation);
 - choice and use of hoisting appliances;
 - safety measures: equipment, methods, rules, lockout procedures, task safety analysis, etc.;
 - rigging and signage;
 - reading plans;
 - welding processes;
 - using scissor lifts and lifts;
 - using measuring instruments;
 - using lift trucks;
 - using the tube bundle extractor.
- The participants mentioned that it would be important to have French-language documentation, for students as well as practicing journeyman boilermakers.

Continuous training and professional development

In addition to the themes already present in the list of professional development activities offered by the CCQ, the participants mentioned that they would be interested in rigging activities. They add that such training absolutely should be well adapted to the specific needs of the trade.

Annexes

TOOLS AND EQUIPMENT

During the workshop, the participants were shown lists of raw materials, tools and equipment from the 1989 occupational training specifications²⁵. In the following pages is the list of raw materials, tools and equipment that was validated by the participants.

Table A.1 Tools and Equipment

PERSONAL PROTECTIVE EQUIPMENT AND SAFETY EQUIPMENT	WELDING EQUIPMENT
<ul style="list-style-type: none"> ▪ self-contained breathing apparatus (SCBA) ▪ tarpaulin ▪ ear plugs and ear muffs ▪ hard hat ▪ CSA protective footwear ▪ coveralls (fire retardant, acid-resistant, plastic oversuit) ▪ smock ▪ ground fault interrupter ▪ fall arrest equipment (lanyards, harnesses, retractable lanyards, tripods) ▪ smoke eaters and ventilation systems ▪ grinding shields ▪ welding shields ▪ welding masks ▪ face shield ▪ side shields ▪ atmospheric testing equipment ▪ warning tape, tags, signs, barricades ▪ protective gloves ▪ Kevlar gauntlets and gloves ▪ knee pads ▪ head lamp ▪ explosion-proof lights ▪ safety glasses and mono goggles ▪ cutting goggles ▪ dust masks ▪ welding masks ▪ respirators (half mask and full face) ▪ welding glass ▪ leather protective clothing and gloves 	<ul style="list-style-type: none"> ▪ anti-spatter spray ▪ hand wire brush ▪ welding cable ▪ TIG torch ▪ welding cable “Y” connectors ▪ remote amperage controls ▪ fire-retardant blankets ▪ temperature (“temp”) sticks ▪ leather welding shield ▪ welding electrodes ▪ pre-heating or heat treatment equipment ▪ electrode ovens (stationary/portable) ▪ gougers ▪ files ▪ chipping hammer ▪ stud welding equipment ▪ pre-heating torch and equipment ▪ light and batteries ▪ inspection mirror ▪ purge paper ▪ electrode holders (whips/stingers) ▪ ground clamps ▪ electrode pouch ▪ regulators ▪ welding robot ▪ power sources (welding machines) c/w ancillary equipment for welding processes such as ESW, FCAW, GMAW, GTAW and SAW ▪ purge hoses

25. Commission de la construction du Québec. *Chaudronnier: devis de formation professionnelle*, 1989.

CUTTING TOOLS AND EQUIPMENT

Hand Type

- scissors
- metal-cutting chisels
- erection wrench
- bolt cutters
- pipe/tube cutters
- utility knife
- rigging knives
- tap and die sets
- files
- metal-cutting snips
- handsaw
- hacksaw and blades

Powered Type

- tube milling machine
- nibblers
- water jet cutters
- grinders (air and electric)
- band saw
- abrasive cut-off saw
- reciprocating saw
- circular saw

Other Fuel Cutting Equipment

- oxygen lance

Oxy-Fuel Cutting Equipment

- adapters
- friction lighters (strikers)
- oxy-fuel cylinders
- oxy-fuel hoses and repair kits
- burning and heating tips
- manual cutting torches
- oxy-fuel cart c/w fire extinguishers
- flashback arrestors
- tip cleaners
- oxy-fuel couplings and wrenches
- regulators
- manifold systems

Plasma-Arc Cutting Equipment

- power supply c/w cables and torch
- compressed air source
- air line
- replacement ceramic cups and tips
- regulators

MEASURING TOOLS

- drill point gauge
- compound tube gauge
- compass
- callipers/dividers
- string line
- combination square
- framing squares
- sliding T-bevel
- angle and radius gauges
- telescoping gauge
- micrometers
- laser levels
- vernier calliper
- scale rule
- folding rule
- measuring tape
- steel tapes
- tensiometer
- transit (theodolite)
- vernier

HAND TOOLS

Holding Tools

- pipe vise
- sliding clamp (bessey clamp)
- bench vice
- needle-nose pliers
- slip-joint pliers
- side-cutter pliers
- end-cut pliers (nippers)
- slip-joint pliers
- locking (vise-grip™) wrench pliers
- bar clamp
- C-clamp
- hammer wrench holder

Holding/Turning Tools

- strap wrench
- open-end wrench
- spud wrench
- chuck wrench
- adjustable (crescent) wrench
- pipe wrench
- torque wrench
- combination wrench
- box wrench
- hammer (slug) wrench
- hex keys (Allen wrenches)
- ratchet and socket wrench sets
- screwdrivers

CUTTING TOOLS AND EQUIPMENT (Cont'd)

Plasma-Arc Cutting Equipment

- air and power supply
- air line
- carbon-cutting electrodes (round/flat)
- air-arc gouger
- replacement insulators
- replacement electrode holder

FITTING TOOLS

Hammering Tools

- wall-banger™
- pry bars
- hickey bars
- strongbacks
- hydraulic ram
- hose clamps
- bull pin
- shims and wedges
- drift pin
- metal-cutting chisel
- spud wrench
- steel, brass and wood wedges
- flange spreader
- clamping angles
- alignment pins
- lever
- claw hammer
- non-sparking hammer
- sledges
- soft-face hammer (lead-face)
- bucking tool
- come-alongs
- 4 lb. mini-sledge hammer
- key plates and blank nuts
- blacksmith's punch
- C-clamps
- drift pin
- hydraulic jack
- serial hydraulic jacks with control box

ELECTRIC-POWERED TOOLS AND EQUIPMENT (wired and wireless)

- string/trouble light
- nibblers/shears
- impact wrench (electric and battery)
- hammer drill
- die grinder
- electric supply panel
- drills/presses
- induction heat gun
- floodlights
- extension cords
- grinders
- miniature grinders
- cut-off saw
- reciprocating saw
- circular saw
- jigsaw
- electric screwdriver
- exhaust fans

RIGGING EQUIPMENT

- beam clamps
- wire rope
- beam trolleys
- caterpillar
- fibre rope
- jacks (hydraulic, screw, steamboat ratchet)
- hooks/latches
- slings (wire rope, fibre material, chain, synthetic web, wire/chain mesh)
- swivel hoist rings
- links, swivels, rings, thimbles, eye bolts, etc.
- shackles
- chain falls
- come-alongs
- spreader and equalizer beams
- plate clamps
- softeners
- headache ball
- blocks (tackle, wire rope, snatch)
- spreader beam
- terminal end connections for wire rope (clips, sockets)
- rigging belt
- bar clamp
- load binders
- Tirfor^{MC} jacks
- tuggers

PNEUMATIC TOOLS AND EQUIPMENT

- air supply hose
- hose safety cables and rods
- impact wrench/sockets
- air manifolds/receiver
- air compressor
- sand blasting equipment
- hydraulic and pneumatic tensioning equipment
- filters/oilers
- milling machine
- hydraulic and pneumatic machine for aligning wall plates
- air chippers
- air scalers
- air hammers
- rolling motor
- air utility hoist (air tugger)
- drills
- hydrostatic test pump
- air grinders
- regulator

TUBE REMOVAL/EXPANSION TOOLS AND EQUIPMENT

- expansion accessories (e.g., driving links, universals, gear drive)
- tube wall reducing tool
- tube plugs
- splitting chisels
- internal tube cutters (revolution tube cutter, fly cutter)
- flaring/belling tools
- hydraulic stub puller
- tube bundle extractor
- tube drift
- expanders for boilers and heat exchangers c/w mandrels
- torque controlled rolling motor
- air motor c/w adapter sleeves
- beading tool
- knockout tool
- collapsing tools
- induction heat gun
- tube end mill
- tube pulling spear

TOOLS AND EQUIPMENT FOR FIBERGLASS

- brooms
- kilo scale
- resin spray gun/hoses
- putty knife
- carborundum grinding discs (16-36 grit)
- catalyst dispenser
- rubber gloves
- heat lamps
- fiberglass cutting equipment
- grinder c/w flexible disc back
- shovels
- paint brushes
- barrel heater
- aluminum-serrated rollers
- rolls of cardboard
- mohair rollers
- masking tape
- plastic buckets
- wooden mixing spatulas

ACCESS AND SCAFFOLDING EQUIPMENT

- gas powered articulated boom lift
- electrical articulated boom lift
- end frames
- assembly cart
- telescopic lift truck
- sawhorses
- tank scaffold
- ladder jack scaffold
- tubular scaffold: rosette, clip, standard
- stationary scaffolds
- mechanical scaffolds
- rolling scaffolds
- flying scaffolds
- extension ladder
- ladders
- cable ladders
- stepladders
- boom lifts
- lifts
- aluminum planks
- scissor lifts
- aluminum platforms
- electrical vertical lift
- ramps
- handling supports
- scissor lift
- gas powered scissor lift
- electrical scissor lift
- tubes and clamps
- temporary access/freight elevator

TUBE PREPARATION/INSTALLATION TOOLS

- tube hold reamer
- hand/power brushes (twist)
- tube guide
- files
- serrating tool
- lead hammer
- die grinder c/w variety of stones
- peening tool (hydraulic expander)
- flapper wheels/emery cloth
- tube cut-off saw
- track saw

Annex 2

GRIDS OF OCCUPATIONAL HEALTH AND SAFETY ELEMENTS

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ASP Construction

Table A.2 Description of Hazards

No.	Hazards	Effects on Health and Safety	Means of Prevention
1	<p>Same-level fall hazards</p> <ul style="list-style-type: none"> • Housekeeping (clutter, risk of tripping due to obstacles such as rejects, debris, extension cords, pipes, materials) • Slippery surfaces (rain, ice, snow, residues, dust, oil) • Holes 	<ul style="list-style-type: none"> • Collisions • Contusions • Bruises • Fractures • Sprains 	<ul style="list-style-type: none"> • Clean the workplace (picking 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	<p>Fall-from-height hazards</p> <ul style="list-style-type: none"> • Using a stepladder • Using a ladder • Using a small mobile scaffold (Baker) 	<ul style="list-style-type: none"> • Collisions • Contusions • Bruises • Fractures • Sprains • Internal injuries • Psychological and physical after-effects • Paralysis • Death 	<ul style="list-style-type: none"> • Use a class 1 stepladder with a nominal capacity of 113 kg (250 lb.) and: <ul style="list-style-type: none"> - open the spreader bars fully; - install on a firm level surface; - choose a stepladder according to the height to be attained. • 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: <ul style="list-style-type: none"> - 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. • 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.

No.	Hazards	Effects on Health and Safety	Means of Prevention
3	<p>Ergonomic hazards</p> <ul style="list-style-type: none"> • Posture constraints / static • Repeated movements • Difficulty of the task • Handling • Vibrations (hand-arm system) 	<ul style="list-style-type: none"> • Musculoskeletal lesions • Sprains • Hernias • Fatigue • Discomfort • Pain • Tendinitis 	<ul style="list-style-type: none"> • Rotate tasks if the situation allows it. • Use handling equipment. • Know handling techniques. • Favour the purchase of tools limiting vibrations to a minimum.
4	<p>Chemical hazards – gases and fumes</p> <ul style="list-style-type: none"> • Using propane • Motor producing carbon monoxide • Fumes emanating from product mixes 	<ul style="list-style-type: none"> • Carbon monoxide intoxication • Corrosive burns • Respiratory illnesses 	<ul style="list-style-type: none"> • Took WHMIS training. • Have on-site the specification sheets of products used. • Carry respiratory protection and filters appropriate to contaminants. • Ensure mechanical or natural ventilation. • Wear personal protective equipment (gloves, coveralls, safety goggles, visor, etc.). • Use a water saw with a dust vacuum system. • Use tools equipped with a vacuum system including a HEPA filter. • Have emergency equipment at hand (eye-wash station, fire extinguisher, etc.).
5	<p>Chemical hazards – liquids and mist</p> <ul style="list-style-type: none"> • Corrosive effects of cement and mortar • Mix of liquids and grout • Acid-based products • Acid mist 	<ul style="list-style-type: none"> • Respiratory illnesses • Skin problems (dermatosis) • Irritation, redness, rashes • Burns due to chemicals • Suffocation due to respiratory illnesses 	<ul style="list-style-type: none"> • Took WHMIS training. • Keep the specification sheets of products used. • Carry respiratory protection and filters appropriate to contaminants. • Ensure mechanical or natural ventilation. • Wear appropriate personal protective equipment (gloves, coveralls, safety goggles, visor, etc.). • Use a water saw or a dust vacuum system. • Use tools 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
6	<p>Chemical hazards – dust and smoke</p> <ul style="list-style-type: none"> • Epoxy cement mix • Silica dust • Muller sanding • Drilling anchor holes 	<ul style="list-style-type: none"> • Corrosive burns • Respiratory illnesses • Skin problems (dermatosis) 	<ul style="list-style-type: none"> • Took WHMIS training. • Keep the specification sheets of products used. • Carry respiratory protection and filters appropriate to contaminants. • Ensure mechanical or natural ventilation. • Wear appropriate personal protective equipment (gloves, coveralls, safety goggles, visor, etc.). • Use a water saw or a dust vacuum system. • Use tools equipped with a vacuum system including a HEPA filter. • Have emergency equipment at hand (eye-wash station, fire extinguisher, etc.).
7	<p>Electrical hazards</p> <ul style="list-style-type: none"> • Contact with overhead electric lines • Electric tools • Contact with electric wires or outlets 	<ul style="list-style-type: none"> • Electrification • Fibrillation • Burns • Amputation • Paralysis • Electrocution • Death 	<ul style="list-style-type: none"> • Maintain the minimum distances of approach prescribed by the Safety Code for the construction industry. • Reach a working agreement with the operating company. • Use tools featuring double insulation or grounding. • Use extension cords in good condition and ground protections. • Cut the energy source, and then lock out and identify the components. • Took the compulsory training for working near electric lines.
8	<p>Noise hazards</p> <ul style="list-style-type: none"> • Tools • Anchoring in an angle iron • Cement mixer • Handling scaffolds 	<ul style="list-style-type: none"> • Hearing loss • Occupational deafness 	<ul style="list-style-type: none"> • Choose the most silent equipment possible. • Do required preventive maintenance. • Wear hearing protection (plugs or shells).
9	<p>Mechanical hazards</p> <ul style="list-style-type: none"> • Moving parts • Broken blade, drill bit or tool 	<ul style="list-style-type: none"> • Cuts • Contusions • Fractures • Crushing • Amputation 	<ul style="list-style-type: none"> • Comply with the regulatory grid regarding protection from machines. • Do required preventive maintenance. • Collect information and take training in the use of new tools.

No.	Hazards	Effects on Health and Safety	Means of Prevention
10	Environmental hazards <ul style="list-style-type: none"> • Extreme temperature (cold or hot) • Confined spaces 	<ul style="list-style-type: none"> • Discomfort due to cold • Chilblains • Hypothermia 	<ul style="list-style-type: none"> • Comply with health and safety rules. • Ensure adequate ventilation of work areas. • Do preventive maintenance of gas equipment. • Take training in the hazards of carbon monoxide and nitrogen dioxide.
11	Stress-related hazards <ul style="list-style-type: none"> • Quality of the finish • Application time • Application productivity • Reactions of mixes 	<ul style="list-style-type: none"> • Health problems • Hypertension • Eczema 	<ul style="list-style-type: none"> • Plan the work. • Limit work done under pressure. • Performing tasks outside of peak traffic periods.
12	Fire hazards <ul style="list-style-type: none"> • Smoke • Fire 	<ul style="list-style-type: none"> • Coughing • Irritation • Intoxication • Burns 	<ul style="list-style-type: none"> • Clean work areas appropriately. • Store flammable products appropriately. • Have a fire extinguisher at hand.

Table A.3 Hazards per Task and Operation

Legend

0	The risk is nil.
+	The risk is low.
++	The risk is average.
+++	The risk is high.

Risk levels are noted according to exposure to hazards, not according to the gravity of effects on personal health and safety.

	OPERATIONS AND SUB-OPERATIONS	Same-Level Fall Hazards	Fall-from-Height Hazards	Ergonomic Hazards	Chemical Hazards – Gases and Fumes	Chemical Hazards – Liquids and Mist	Chemical Hazards – Dust and Smoke	Electric Hazards	Noise Hazards	Mechanical Hazards	Environmental Hazards	Stress-Related Hazards	Fire Hazards
TASK 1	Build parts												
1.1	Receive instructions from the client												
1.1.1	Attend the client’s reception meeting	0	0	0	0	0	0	0	0	0	0	0	0
1.1.2	Receive general safety instructions	0	0	0	0	0	0	0	0	0	0	0	0
1.1.3	Pass a written comprehension examination	0	0	0	0	0	0	0	0	0	0	+	0
1.1.4	Learn about the prevention program	0	0	0	0	0	0	0	0	0	0	0	0
1.2	Find out what work needs to be done												
1.2.1	Peruse the plan portions concerned	0	0	0	0	0	0	0	0	0	0	0	0
1.2.2	Peruse the specification portions concerned	0	0	0	0	0	0	0	0	0	0	0	0
1.2.3	Learn about specific safety measures	0	0	0	0	0	0	0	0	0	0	0	0
1.2.4	Read the WHMIS sheets	0	0	0	0	0	0	0	0	0	0	0	0

	OPERATIONS AND SUB-OPERATIONS	Same-Level Fall Hazards	Fall-from-Height Hazards	Ergonomic Hazards	Chemical Hazards – Gases and Fumes	Chemical Hazards – Liquids and Mist	Chemical Hazards – Dust and Smoke	Electric Hazards	Noise Hazards	Mechanical Hazards	Environmental Hazards	Stress-Related Hazards	Fire Hazards
1.3	Become qualified for welding procedures, if applicable												
1.3.1	Learn about the welding process	0	0	0	0	0	0	0	0	0	0	0	0
1.3.2	Prepare the parts	+	+	+	+	+	+	+	+	+	+	+	+
1.3.3	Perform welding examinations	+	+	+	++	++	++	++	++	++	++	++	+
1.3.4	Pass the test(s)	+	+	+	++	++	++	++	++	++	++	++	+
1.4	Determine the required working methods, tools and equipment												
1.4.1	Perform a safe analysis of the task	+	+	+	0	0	0	+	+	+	+	+	+
1.4.2	Determine or examine the hoisting plan	+	+	+	0	0	0	0	0	+	+	+	0
1.4.3	Obtain required tools and equipment (welding, assembly, hoisting, handling, etc.)	+	+	+	0	0	0	0	0	+	+	+	0
1.5	Mobilize the site												
1.5.1	Delimit and prepare work areas	+	+	++	0	0	0	+	+	+	+	0	0
1.5.2	Bring the tools and make sure they are in good condition	+	+	++	+	+	+	+	+	+	+	0	0
1.5.3	Plan the hoisting · Prepare hoisting devices	+	+	++	0	0	0	0	+	+	+	0	0
1.5.4	Prepare the equipment	+	+	++	+	+	+	+	+	+	+	0	0
1.5.5	Plan the lighting	+	++	+	0	0	0	+	+	+	+	0	0
1.5.6	Prepare accesses for doing the work	+	++	+	0	0	0	+	+	+	+	0	0
1.5.7	Establish safety perimeters	+	+	+	0	0	0	0	0	+	+	0	0
1.5.8	Prepare hoisting equipment, if applicable	+	+	+	0	0	0	+	+	+	+	0	0

	OPERATIONS AND SUB-OPERATIONS	Same-Level Fall Hazards	Fall-from-Height Hazards	Ergonomic Hazards	Chemical Hazards – Gases and Fumes	Chemical Hazards – Liquids and Mist	Chemical Hazards – Dust and Smoke	Electric Hazards	Noise Hazards	Mechanical Hazards	Environmental Hazards	Stress-Related Hazards	Fire Hazards
1.6	Check and unload equipment												
1.6.1	Receive the equipment · Check the condition and quantity of equipment · Compare the delivery order with plans and specifications data · Plan and install temporary courses (blocks) · Unload equipment · Protect unloaded equipment	++	++	++	+	+	+	+	+	+	+	0	0
1.7	Cut, shape, assemble and weld												
1.7.1	Take measurements	+	+	+	0	0	0	0	0	0	+	+	0
1.7.2	Calculate the angles	+	+	+	0	0	+	+	+	+	+	0	0
1.7.3	Mark, trace	+	+	+	0	0	+	+	+	+	+	0	0
1.7.4	Make templates	+	+	+	0	0	+	+	+	+	+	0	0
1.7.5	Cut (plasma, oxy-fuel cutting, grinder)	+	+	++	+++	++	+++	++	++	++	+	0	+++
1.7.6	Shape: bend, roll	+	+	++	++	+	++	+	++	++	+	0	0
1.7.7	Assemble: clean, chamfer, weld or tack-weld or bolt	++	++	++	++	+	++	++	++	++	+	+	++
1.8	Erect scaffolds, if applicable												
1.8.1	Take measurements of the structure	+	+	+	0	0	0	0	+	+	+	+	0
1.8.2	Find out about the plan, if applicable	0	0	0	0	0	0	0	0	0	0	0	0
1.8.3	Choose the scaffold types	+	+	++	0	0	0	0	+	+	+	0	0
1.8.4	Select the required equipment												
1.8.5	Install accessories, if applicable	++	+++	+++	0	0	0	0	++	++	++	0	0
1.9	Rig the parts												
1.9.1	Install a spreader beam	+	++	+++	0	0	+	0	++	++	++	++	0

	OPERATIONS AND SUB-OPERATIONS	Same-Level Fall Hazards	Fall-from-Height Hazards	Ergonomic Hazards	Chemical Hazards – Gases and Fumes	Chemical Hazards – Liquids and Mist	Chemical Hazards – Dust and Smoke	Electric Hazards	Noise Hazards	Mechanical Hazards	Environmental Hazards	Stress-Related Hazards	Fire Hazards
1.9.2	Check the condition of slings and shackles	+	++	++	0	0	0	0	+	++	++	+	0
1.9.3	Weld the lifting eyes, if applicable	+	++	++	++	++	++	0	++	++	++	+	++
1.10	Demobilize the site												
1.10.1	Store the tools in toolboxes	++	++	++	+	+	++	0	++	++	+	0	0
1.10.2	Recover the equipment	++	++	++	+	+	+	0	++	++	+	0	0
1.10.3	Dismantle the scaffolds	++	+++	+++	0	+	+	0	++	++	+	0	0
1.10.4	Collect the rejects	++	++	+++	0	+	++	0	++	++	+	0	0
1.10.5	Put the work area back in order	++	++	++	0	+	++	0	++	++	+	0	0
TASK 2	Assemble furnaces, ovens and incinerators												
2.1	Receive instructions from the client												
	See the operation's sub-operations 1.1	0	0	0	0	0	0	0	0	0	0	0	0
2.2	Find out what work needs to be done												
	See the operation's sub-operations 1.2	0	0	0	0	0	0	0	0	0	0	0	0
2.3	Become qualified for welding procedures, if applicable												
	See the operation's sub-operations 1.3	+	+	+	++	++	++	++	++	++	++	++	+
2.4	Determine the required working methods, tools and equipment												
	See the operation's sub-operations 1.4	+	+	+	0	0	0	+	+	+	+	+	+
2.5	Mobilize the site												
	See the operation's sub-operations 1.5	+	++	++	+	+	+	+	+	+	+	0	0
2.6	Check the base, anchors and elevation												
2.6.1	Take measurements	+	++	+	0	0	+	+	+	+	+	+	0
2.6.2	Take level readings	++	++	++	0	0	+	+	+	+	+	0	0
2.6.3	Check the base's condition and dimensions	++	++	++	0	0	+	+	+	+	+	0	0

	OPERATIONS AND SUB-OPERATIONS	Same-Level Fall Hazards	Fall-from-Height Hazards	Ergonomic Hazards	Chemical Hazards – Gases and Fumes	Chemical Hazards – Liquids and Mist	Chemical Hazards – Dust and Smoke	Electric Hazards	Noise Hazards	Mechanical Hazards	Environmental Hazards	Stress-Related Hazards	Fire Hazards
2.6.4	Check the anchors	++	++	++	0	0	+	+	+	+	+	0	0
2.6.5	Repair if necessary	+	++	++	+	+	+	+	++	++	+	0	0
2.6.6	Locate the anchor point	+	++	++	0	0	+	+	+	+	+	0	0
2.6.7	Install a centreline	+	++	++	0	0	+	+	+	+	+	0	0
2.6.8	Drill the anchors	+	+++	+++	+	+	++	++	++	++	+	+	0
2.6.9	Apply quick-setting cement	+	++	++	+	+	++	++	++	++	+	+	0
2.7	Check and unload equipment												
	See the operation's sub-operations 1.6	++	++	++	+	+	+	+	+	+	+	0	0
2.8	Preassemble the components												
2.8.1	Check the measurements according to the plans	+	+	++	0	0	0	0	+	+	+	0	0
2.8.2	Place two wall sections together	++	+++	+++	+	0	+	+	++	++	+	0	0
2.8.3	Adjust, fit, weld before erecting	++	+++	+++	++	+	++	0	++	++	+	0	0
2.8.4	Assemble chimney sections on the ground	++	+++	+++	+	+	+	+	++	++	+	0	0
2.8.5	Adjust, bolt before erecting	++	+++	+++	+	+	+	+	++	++	+	0	0
2.8.6	Install catwalks on components	++	+++	+++	+	0	+	+	++	++	+	0	0
2.9	Erect supports and structures												
2.9.1	Check the dimensions according to the plans	+	++	++	0	0	+	+	+	+	+	0	0
2.9.2	Install shims	++	0	++	0	0	+	0	++	++	+	0	0
2.9.3	Go find the equipment at the storage site	++	+	++	0	0	+	0	++	++	+	0	0
2.9.4	Mobilize the cranes	+	+	0	0	0	+	0	+	++	+	0	0
2.9.5	Install the structure, beams, supports and floor	+	++	+++	0	0	+	0	++	++	+	0	0
2.9.6	Install railings	++	++	+++	0	0	+	0	++	++	+	0	0
2.9.7	Do a final tightening of the bolts	++	++	+++	0	0	+	0	++	++	+	0	0
2.9.8	Retouch the paint	++	++	++	++	+++	+	0	+	+	+	0	0

	OPERATIONS AND SUB-OPERATIONS	Same-Level Fall Hazards	Fall-from-Height Hazards	Ergonomic Hazards	Chemical Hazards – Gases and Fumes	Chemical Hazards – Liquids and Mist	Chemical Hazards – Dust and Smoke	Electric Hazards	Noise Hazards	Mechanical Hazards	Environmental Hazards	Stress-Related Hazards	Fire Hazards
2.10	Erect scaffolds, if applicable												
	See the sub-operations of operation 1.8	++	+++	+++	0	0	0	0	++	++	++	0	0
2.11	Assemble the walls (welding, bolting)												
2.11.1	Check the dimensions according to the drawings	+	+	+	0	0	+	0	0	+	+	0	0
2.11.2	Bring the sections to the site	+	++	++	0	0	+	0	+	++	+	0	0
2.11.3	Rig	+	++	++	0	0	+	0	++	++	+	0	0
2.11.4	Erect	+	++	++	0	0	+	0	++	++	+	0	0
2.11.5	Fit, weld and bolt the sections together	++	++	++	++	+	+	+	++	++	+	0	0
2.12	Install anchors												
2.12.1	Locate the places for holes, if applicable	+	+	++	0	+	+	+	++	++	+	0	0
2.12.2	Drill holes, if applicable	+	+	++	0	+	+	+	++	++	+	0	0
2.12.3	Clean the threads	+	+	+	0	+	+	+	++	++	+	0	0
2.12.4	Bolt	+	+	++	0	0	+	+	++	++	+	0	0
2.12.5	Do a controlled tightening	+	+	++	0	+	+	+	++	++	+	0	0
2.12.6	Install grout under the plates	+	+	++	0	+	+	+	+	++	+	0	0
2.13	Install tube supports												
2.13.1	Choose the supports	++	++	++	0	0	+	+	++	++	+	0	0
2.13.2	Bring the supports to their installation location	++	++	++	0	0	+	+	++	++	+	0	0
2.13.3	Bolt and weld	++	++	++	0	0	+	+	+++	+++	+	0	0
2.14	Install tubes												
2.14.1	Choose the tubes	++	++	++	0	0	+	+	++	++	+	0	0
2.14.2	Prepare and clean the ends	++	++	++	0	0	+	+	++	++	+	0	0
2.14.3	Mobilize the crane	+	+	+	0	0	+	+	++	++	+	0	0
2.14.4	Put the tubes in place	++	++	++	0	0	+	+	++	++	+	0	0

	OPERATIONS AND SUB-OPERATIONS	Same-Level Fall Hazards	Fall-from-Height Hazards	Ergonomic Hazards	Chemical Hazards – Gases and Fumes	Chemical Hazards – Liquids and Mist	Chemical Hazards – Dust and Smoke	Electric Hazards	Noise Hazards	Mechanical Hazards	Environmental Hazards	Stress-Related Hazards	Fire Hazards
2.15	Install conversion boxes												
2.15.1	Prepare and clean the surfaces	++	++	++	0	0	+	+	++	++	+	0	0
2.15.2	Check the dimensions	+	+	++	0	0	+	+	+	+	+	0	0
2.15.3	Rig	+	++	++	0	0	+	+	++	++	+	0	0
2.15.4	Put the boxes in place and bolt	++	++	++	0	0	+	++	++	++	+	0	0
2.16	Fasten couplings and pipes												
2.16.1	Bring sealing joints, pipes and bolts to the site	++	++	++	0	0	+	+	++	++	+	0	0
2.16.2	Bolt the pipes	++	++	++	0	0	+	++	+++	+++	+	0	0
2.17	Weld the tubes												
2.17.1	Choose the filler equipment	++	++	++	0	0	+	+	++	++	+	0	++
2.17.2	Prepare weld seams	++	++	++	0	0	+	+	++	++	+	0	++
2.18	Roll and flare the tubes												
2.18.1	Choose roll bending equipment according to the desired diameter	++	++	++	0	0	+	0	+	+	+	0	0
2.19	Assemble the chimney and branches												
2.19.1	Check measurements	++	++	++	0	0	+	0	+	+	+	0	0
2.19.2	Prepare the rigging	++	++	++	0	0	+	0	+	++	+	0	0
2.19.3	Put the chimney in place	++	++	++	0	0	+	0	++	++	+	0	0
2.19.4	Bolt or weld the chimney	++	++	++	0	0	+	+	++	++	+	0	0
2.19.5	Put in place and bolt the branches	++	++	++	0	0	+	+	++	++	+	0	0
2.20	Install the burners												
2.20.1	Obtain all burner components	++	++	++	0	0	+	+	++	++	+	0	0
2.20.2	Install rigging	++	++	++	0	0	+	+	++	++	+	0	0
2.20.3	Put the burners in place	++	++	++	0	0	+	+	++	++	+	0	0

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2.21	Bolt the header boxes												
2.21.1	Prepare surfaces (clean, apply sealing joints)	++	++	++	0	0	+	+	++	++	+	0	0
2.21.2	Install rigging	++	++	++	0	0	+	+	++	++	+	0	0
2.21.3	Place the crane	++	++	++	0	0	+	+	+	+	+	0	0
2.21.4	Put the header boxes in place and bolt them	++	++	++	0	0	+	+	+++	++	+	0	0
2.21.5	Install the panels at each end	++	++	++	0	0	+	+	++	++	+	0	0
2.22	Install accessories and components												
2.22.1	Put the soot blowers in place	+	++	++	+	+	++	+	++	++	+	0	0
2.22.2	Install check valves	+	+	++	+	+	++	+	++	++	+	0	0
2.22.3	Install pressure gauges	+	+	++	+	+	++	+	++	++	+	0	0
2.22.4	Install flexible joints	+	+	++	+	+	++	+	++	++	+	0	0
2.23	Check work quality												
2.23.1	Perform a seal test	+	+	++	+	+	+	+	++	++	+	0	0
2.23.2	Check the P&ID	+	+	++	+	+	+	+	++	++	+	0	0
2.23.3	Install the blanks	+	+	++	+	+	++	+	++	++	+	0	0
2.23.4	Install the test pump	+	+	++	+	+	+	+	++	++	+	0	0
2.23.5	Fill with water and pressurize	++	++	++	+	+	+	+	++	++	+	0	0
2.23.6	Drain and remove the blanks	++	++	++	++	++	+++	++	++	++	+	0	0
2.24	Demobilize the site												
	See the operation's sub-operations 1.10	++	++	++	0	+	++	0	++	++	+	0	0
TASK 3	Erect fractionating towers												
3.1	Receive instructions from the client												
	See the operation's sub-operations 1.1	0	0	0	0	0	0	0	0	0	0	0	0

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3.2	Find out what work needs to be done												
	See the operation's sub-operations 1.2	0	0	0	0	0	0	0	0	0	0	0	0
3.3	Become qualified for welding procedures												
	See the operation's sub-operations 1.3	+	+	+	++	++	++	++	++	++	++	++	+
3.4	Determine the required working methods, tools and equipment												
	See the operation's sub-operations 1.4	+	+	+	0	0	0	+	+	+	+	+	+
3.5	Mobilize the site												
	See the operation's sub-operations 1.5	+	+	++	+	+	+	+	+	+	+	0	0
3.6	Erect scaffolds, if applicable												
	See the operation's sub-operations 1.8	++	++	++	0	0	0	++	++	++	+	0	0
3.7	Check the base, anchors and elevation												
	See the operation's sub-operations 2.6	++	++	++	0	0	+	+	++	++	+	0	0
3.8	Install anchors												
	See sub-operations 2.12	+	+	++	0	+	+	+	++	++	+	0	0
3.9	Check and unload equipment												
	See the operation's sub-operations 1.6	++	++	++	+	+	+	+	+	+	+	0	0
3.10	Assemble the sections, if applicable												
3.10.1	Install the crane and prepare slings and shackles	+	+	+	0	0	+	+	+	+	+	+	0
3.10.2	Install the bases to receive the sections	++	++	++	0	0	+	+	++	++	+	+	0
3.10.3	Install the sections on the bases	++	++	++	0	0	+	+	++	++	+	+	0
3.10.4	Position and fit section joints	++	++	++	0	0	+	+	++	++	+	+	0
3.10.5	Weld the sections	++	++	++	++	+	++	+	++	++	+	+	0
3.11	Rig and handle the parts												
3.11.1	Install the cranes	+	++	++	0	0	+	0	++	++	+	+	0

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3.11.2	Install rigging	++	++	++	0	0	+	+	++	++	+	+	0
3.12	Erect the tower												
3.12.1	Proceed to a tandem hoist	+	++	++	0	0	+	+	++	++	++	++	0
3.12.2	Place the tower vertically	+	++	++	0	0	+	+	++	++	++	++	0
3.13	Recheck the levels, orientation and elevation												
3.13.1	Review the elevation with a transit	+	++	++	0	0	+	0	+	++	++	++	0
3.13.2	Review the orientation, according to the plans	+	++	++	0	0	+	0	+	++	++	++	0
3.14	Make the tower plumb												
3.14.1	Place the tower in the anchors	++	++	++	0	0	+	0	+	++	++	++	0
3.14.2	Use a theodolite or plumb line	++	++	++	0	0	+	0	+	++	++	++	0
3.15	Open the manholes												
3.15.1	Unbolt the covers	++	++	++	0	0	+	0	+	++	++	++	0
3.15.2	Remove the covers	++	++	++	0	0	+	0	+	++	++	++	0
3.16	Install trays and components, if applicable												
3.16.1	Perform a gas test	+	+	+	+	0	+	0	+	+	+	0	0
3.16.2	Install the cable	+	+	+	+	0	+	0	+	+	+	0	0
3.16.3	Prepare the work area at the bottom of the tower	+	+	+	+	0	+	+	++	++	+	0	0
3.16.4	Preassemble the trays	+	+	++	+	0	+	+	++	++	+	0	0
3.16.5	Rig the plates and components	+	+	++	+	0	+	+	++	++	+	0	0
3.16.6	Position the trays and components	+	+	++	+	0	+	+	++	++	+	0	0
3.17	Close the manholes (bolting)												
3.17.1	Make a visual inspection of the tower	+	+	++	+	0	+	+	+	+	+	0	0
3.17.2	Clean the flanges	+	+	++	+	0	+	+	++	++	+	0	0
3.17.3	Install the seal joints	+	+	++	+	0	+	+	++	+++	+	0	0
3.17.4	Put the covers back in place	+	+	++	+	0	+	+	++	++	+	0	0

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3.17.5	Bolt the covers	+	+	++	+	0	+	+	+++	+++	+	0	0
3.17.6	Tighten according to the procedure	+	+	++	+	0	+	+	+++	+++	+	0	0
3.18	Check work quality												
3.18.1	Check the tower's tightness · Consult the testing procedure · Install the blanks · Prepare for the test · Fill the tower with liquid · Increase pressure according to the testing procedure · Depressurize and empty the tower · Remove the blanks · Close the flanges	+	++	++	++	++	+	+	++	++	++	++	0
3.19	Demobilize the site												
	See the operation's sub-operations 1.10	++	++	++	0	+	++	0	++	++	+	0	0
TASK 4 Erect tanks and silos													
4.1	Receive instructions from the client												
	See the operation's sub-operations 1.1	0	0	0	0	0	0	0	0	0	0	0	0
4.2	Find out what work needs to be done												
	See the operation's sub-operations 1.2	0	0	0	0	0	0	0	0	0	0	0	0
4.3	Become qualified for welding procedures, if applicable												
	See the operation's sub-operations 1.3	+	+	+	++	++	++	++	++	++	++	++	+
4.4	Determine the required working methods, tools and equipment												
	See the operation's sub-operations 1.4	+	+	+	0	0	0	+	+	+	+	+	+
4.5	Mobilize the site												
	See the operation's sub-operations 1.5	+	+	++	+	+	+	+	+	+	+	0	0

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4.6	Check and unload equipment												
	See the operation's sub-operations 1.6	++	++	++	+	+	+	+	+	+	+	0	0
4.7	Locate the base area	0	0	0	0	0	0	0	0	0	0	0	0
4.8	Check the base, anchors and elevation												
	See the operation's sub-operations 2.6	++	++	++	+	+	+	+	+	+	+	0	0
4.8	Install anchors												
	See sub-operations 2.12	+	+	++	0	+	+	+	++	++	+	0	0
4.10	Place, assemble and weld floor plates												
4.10.1	Rig the plates	++	++	++	0	0	+	+	++	+++	++	++	0
4.10.2	Position the plates	++	++	++	0	0	+	+	++	+++	++	+++	0
4.10.3	Fit, weld	++	++	++	++	++	++	++	++	++	++	++	+++
4.10.4	Visually inspect the welding	++	++	++	+	0	+	+	+	++	++	++	0
4.10.5	Clean the welded plates	++	++	++	++	++	++	++	++	++	++	+	+
4.11	Erect scaffolds, if applicable												
4.11.1	See the operation's sub-operations 1.8	++	+++	+++	0	0	0	0	++	++	++	0	0
4.12	Rig the parts												
4.12.1	See the operation's sub-operations 1.9	+	++	++	++	++	++	+	++	++	++	+	++
4.13	Place, assemble and weld wall plates												
4.13.1	Weld temporary supports	++	++	+++	++	+	++	++	++	++	++	++	++
4.13.2	Install the framework	++	+++	+++	++	+	++	++	++	++	++	++	0
4.13.3	Install catwalks (planks)	++	+++	+++	0	0	+	+	++	++	++	+	0
4.13.4	Install railing posts	++	+++	+++	0	0	+	+	++	++	++	++	0

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4.13.5	Install railing cables	++	+++	+++	0	0	+	+	++	++	++	++	0
4.13.6	Put in place safety measures and access ladders	++	+++	+++	0	0	+	+	++	++	++	++	0
4.14	Install a door plate, if applicable												
4.14.1	Oxy-fuel cut an opening in the wall or	++	+++	+++	+++	+	+++	+	+++	+++	++	++	+++
4.14.2	Part of the plate should not be installed until the end of the work	++	++	0	0	0	0	0	0	0	0	++	0
4.15	Install the roof angle												
4.15.1	Put the roof angle in place	+++	+++	+++	+	+	++	+	+++	+++	+++	+++	+
4.15.2	Assemble the roof angle	+++	+++	+++	+	+	++	+	+++	+++	+++	+++	+
4.15.3	Weld the roof angle and rafter supports	+++	+++	+++	+++	+	+++	+	+++	+++	+++	+++	+++
4.15.4	Take measurements (roundness)	+++	+++	+++	0	0	+	+	+	+	+	++	0
4.15.5	Check the orientation	++	+++	++	0	0	+	+	+	+	+	++	0
4.16	Install nozzles and reinforcing plates												
4.16.1	Put nozzles and plates in place and assemble	+++	+++	+++	+	+	+	++	+++	+++	++	++	+
4.16.2	Weld	++	+++	+++	+++	++	+++	+++	+++	+++	++	++	+++
4.16.3	Perform an inspection	++	++	++	++	++	++	+	+	+	+	++	+
4.17	Install centre column(s) and supports												
4.17.1	Install rigging	++	+++	+++	0	0	+	++	+++	+++	+++	+++	0
4.17.2	Handle the column and install it	+++	+++	+++	0	0	+	+	+++	+++	+++	+++	0
4.17.3	Check the plumb	+++	+++	+++	0	0	+	+	++	++	+++	+++	0
4.17.4	Install temporary supports	+++	+++	+++	0	0	+	+	+++	+++	+++	+++	0
4.18	Install rafters												
4.18.1	Put the rafters in place	+++	+++	+++	0	0	+	+	++	++	++	+++	0
4.18.2	Bolt and weld	+++	+++	+++	+++	+	+++	++	++	++	++	+++	++

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4.19	Install roof plates												
4.19.1	Put in place using the spreader beam	+++	+++	+++	0	0	+	++	++	++	++	+++	0
4.19.2	Fit and weld	+++	+++	+++	+++	+	+++	++	++	++	++	+++	++
4.20	Install stairs, catwalks and other components												
4.20.1	Preassemble the components, if applicable	+++	+++	+++	+	0	+	+	++	+++	++	++	+
4.20.2	Rig and handle the components	+++	+++	+++	0	0	+	+	++	+++	++	+++	+
4.21	Install the floating roof and heating components												
4.21.1	Rig the floating roof, if it is made of steel	+++	+++	+++	0	0	+	+	++	+++	++	+++	+
4.21.2	Handle, put in place and assemble the floating roof	+++	+++	+++	0	0	+	+	+++	+++	+++	+++	+
4.21.3	Check roof watertightness, if it is made of steel	+++	+++	+++	0	0	+	+	+++	+++	+++	+++	0
4.22	Check work quality												
4.22.1	Perform tests (penetrating oil, vacuum, hydrostatic, elevation, etc.)	+++	+++	+++	++	+++	+++	++	+++	+++	++	+++	++
4.22.2	Perform a visual inspection	++	+++	+++	+	+	+	+	+	+	+	++	0
4.22.3	Perform a roof flotation test, if applicable	++	++	++	+	+	+	++	++	++	++	+++	0
4.23	Demobilize the site												
	See the operation's sub-operations 1.10	++	++	++	+	+	++	+	++	++	+	0	0
TASK 5 Install penstocks and spiral cases													
5.1	Receive instructions from the client												
	See the operation's sub-operations 1.1	0	0	0	0	0	0	0	0	0	0	0	0
5.2	Find out what work needs to be done												
	See the operation's sub-operations 1.2	0	0	0	0	0	0	0	0	0	0	0	0
5.3	Become qualified for welding procedures, if applicable												
	See the operation's sub-operations 1.3	+	+	+	++	++	++	++	++	++	++	++	+

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5.4	Determine the required working methods, tools and equipment												
	See the operation's sub-operations 1.4	+	+	+	0	0	0	+	+	+	+	+	+
5.5	Mobilize the site												
	See the operation's sub-operations 1.5	+	+	++	+	+	+	+	+	+	+	0	0
5.6	Check and unload equipment												
	See the operation's sub-operations 1.6	++	++	++	+	+	+	+	+	+	+	0	0
5.7	Check the base, anchors and elevation												
	See the operation's sub-operations 2.6	++	++	++	0	0	+	+	+	+	+	+	0
5.8	Install anchors												
	See sub-operations 2.12	+	+	++	0	+	+	+	++	++	+	0	0
5.9	Rig and handle the parts and components												
5.9.1	Install, level and anchor the tracks	+++	+++	+++	0	0	+	+	+++	+++	++	++	0
5.9.2	Install slings to put parts and components on crawlers with a gantry	+++	+++	+++	0	0	+	+	+++	+++	++	+++	0
5.9.3	Use a winch to pull parts and components to their position	+++	+++	+++	0	0	+	+	+++	+++	++	+++	0
5.10	Install anti-float supports												
5.10.1	Hoist the parts with hydraulic jacks to install anti-float supports	+++	+++	+++	0	0	+	+	+++	+++	++	++	0
5.10.2	Build anti-float supports	+++	+++	+++	0	0	+	+	+++	+++	++	++	0
5.10.3	Weld anti-float supports on the duct	+++	+++	+++	+++	0	+	+	++	+++	++	++	+++
5.11	Align and level the sections												
5.11.1	Install jacks to obtain the desired alignment and elevation	+++	+++	+++	0	0	+	+	++	++	++	++	0

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5.11.2	Install indoor and outdoor scaffolds facing seams to be welded	+++	+++	+++	0	0	+	+	++	++	++	++	0
5.12	Fasten components to supports												
5.12.1	Tighten anchors on supports	+++	+++	+++	0	0	+	+	++	++	++	++	0
5.12.2	Level the supports	+++	+++	+++	0	0	+	+	++	++	++	++	0
5.13	Assemble and weld components and grind												
5.13.1	Install assembly and alignment parts (dogs) inside the room	+++	+++	+++	0	0	+	+	+++	+++	+++	+++	0
5.13.2	Make a weld bead outside	+++	+++	+++	+++	++	+++	++	+++	+++	+++	+++	+++
5.13.3	Fill the seam with a weld bead inside	++	+++	+++	+++	+	+++	+++	+++	+++	+++	++	+++
5.13.4	Cut assembly and alignment parts (dogs)	++	+++	+++	+++	+	+++	+	+++	+++	+++	++	+++
5.13.5	Grind the welds	++	+++	+++	+	+	+++	++	+++	+++	+++	++	+++
5.14	Check work quality												
5.14.1	Perform a visual inspection of welding work	++	++	++	0	0	+	+	+	+	+	+	0
5.14.2	Make corrections if applicable	++	++	++	++	+	+	+	++	++	++	++	+++
5.15	Dismantle braces in penstocks												
5.15.1	Gouge the braces	++	+++	+++	+++	++	+++	+++	+++	+++	+++	++	+
5.15.2	Disassemble the spacers	++	+++	+++	0	0	+	++	+++	+++	++	+++	0
5.15.3	Grind the wall	++	+++	+++	0	0	+	+++	+++	+++	++	+	+
5.16	Demobilize the site												
	See the operation's sub-operations 1.10	++	++	++	+	+	++	0	++	++	+	0	0
TASK 6	Install gas, smoke and dust treatment systems												
6.1	Receive instructions from the client												
	See the operation's sub-operations 1.1	0	0	0	0	0	0	0	0	0	0	+	0

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6.2	Find out what work needs to be done												
	See the operation's sub-operations 1.2	0	0	0	0	0	0	0	0	0	0	0	0
6.3	Determine the required working methods, tools and equipment												
	See the operation's sub-operations 1.4	+	+	+	++	++	++	++	++	++	++	++	+
6.4	Mobilize the site												
	See the operation's sub-operations 1.5	+	+	++	+	+	+	+	++	++	+	0	0
6.5	Check the base, anchors and elevation												
	See the operation's sub-operations 2.6	++	++	++	+	+	+	+	+	+	+	0	0
6.6	Install anchors												
	See sub-operations 2.12	+	+	++	0	+	+	+	++	++	+	0	0
6.7	Check and unload equipment												
	See the operation's sub-operations 1.6	++	++	++	+	+	+	+	+	+	+	0	0
6.8	Erect the supports (structure)	++	++	++	+	+	+	+	++	++	++	++	+
6.9	Erect scaffolds, if applicable												
	See the operation's sub-operations 1.8	++	+++	+++	0	0	0	0	++	++	++	0	0
6.10	Assemble and erect the modules												
6.10.1	Preassemble the sections, if applicable	+++	+++	+++	++	+	+	++	++	++	++	+	+
6.10.2	Bolt or weld	++	+++	+++	++	0	++	++	++	++	++	++	++
6.11	Install internal components												
6.11.1	Prepare attachments	++	+++	+++	0	0	++	+	++	+++	++	++	0
6.11.2	Bolt or weld	++	+++	+++	++	0	++	++	++	++	++	++	++
6.12	Install platforms and external components												
6.12.1	Bolt or weld	++	+++	+++	++	0	++	++	++	++	++	++	++

	OPERATIONS AND SUB-OPERATIONS	Same-Level Fall Hazards	Fall-from-Height Hazards	Ergonomic Hazards	Chemical Hazards – Gases and Fumes	Chemical Hazards – Liquids and Mist	Chemical Hazards – Dust and Smoke	Electric Hazards	Noise Hazards	Mechanical Hazards	Environmental Hazards	Stress-Related Hazards	Fire Hazards
6.13	Assemble and install the ducts												
6.13.1	Rig the ducts	++	+++	+++	0	0	+	+	++	+++	++	++	0
6.13.2	Bolt	++	+++	+++	++	0	++	++	++	++	++	++	0
6.14	Assemble and erect the chimney												
6.14.1	Rig the chimney	++	+++	+++	0	0	+	+	++	+++	++	++	0
6.14.2	Bolt	++	+++	+++	++	0	++	++	++	++	+++	++	0
6.15	Check work quality												
6.15.1	Check assemblies (welding, bolting)	++	++	++	+++	0	+	+	++	++	+	++	0
6.15.2	Perform tightness tests (water, smoke)	++	++	++	+++	+++	+++	++	++	++	+	++	+
6.15.3	Perform hydrostatic tests for pressurized vessels	++	++	++	++	0	+	++	++	++	++	++	0
6.15.4	Apply the inspection plan provided for in the specifications	+	+	+	0	0	+	++	+	+	+	++	0
6.15.5	Fill out inspection cards	+	+	+	0	0	0	0	0	0	0	0	0
6.16	Demobilize the site												
	See the operation's sub-operations 1.10	++	++	+++	0	+	++	0	++	++	+	0	0
TASK 7	Assemble boilers												
7.1	Receive instructions from the client												
	See the operation's sub-operations 1.1	0	0	0	0	0	0	0	0	0	0	+	0
7.2	Find out what work needs to be done												
	See the operation's sub-operations 1.2	0	0	0	0	0	0	0	0	0	0	0	0
7.3	Become qualified for welding procedures, if applicable												
	See the operation's sub-operations 1.3	+	+	+	++	++	++	++	++	++	++	++	+

	OPERATIONS AND SUB-OPERATIONS	Same-Level Fall Hazards	Fall-from-Height Hazards	Ergonomic Hazards	Chemical Hazards – Gases and Fumes	Chemical Hazards – Liquids and Mist	Chemical Hazards – Dust and Smoke	Electric Hazards	Noise Hazards	Mechanical Hazards	Environmental Hazards	Stress-Related Hazards	Fire Hazards
7.4	Determine the required working methods, tools and equipment												
	See the operation's sub-operations 1.4	+	+	+	0	0	0	+	+	+	+	0	0
7.5	Mobilize the site												
	See the operation's sub-operations 1.5	+	+	++	+	+	+	+	+	+	+	0	0
7.6	Erect scaffolds												
	See the operation's sub-operations 1.8	++	+++	+++	0	0	0	0	++	++	++	0	0
7.7	Check the base, anchors and elevation												
	See the operation's sub-operations 2.6	++	++	++	+	+	+	+	++	++	+	0	0
7.8	Install anchors												
	See sub-operations 2.12	+	+	++	0	+	+	+	++	++	+	0	0
7.9	Check and unload equipment												
	See the operation's sub-operations 1.6	++	++	++	+	+	+	+	+	+	+	0	0
7.10	Put in place columns, steel beams and other structural elements of the boiler												
7.10.1	Install shims at the desired elevation	++	+	++	0	0	+	+	+	++	+	+	0
7.10.2	Preassemble the beams, if applicable	++	+	++	0	0	+	+	++	++	++	+	0
7.10.3	Install structural elements	++	+	++	0	0	+	+	++	++	++	+	0
7.10.4	Secure the elements temporarily	++	+	++	0	0	+	+	++	++	++	+	0
7.10.5	Check the alignment and elevation	++	+	++	0	0	+	+	+	+	+	++	0
7.10.6	Bolt	++	+	++	0	0	+	+	++	++	++	+	0
7.10.7	Make the grout	++	+	++	0	++	++	+	+	+	+	+	0
7.11	Rig the balloons and put them in place												
7.11.1	Install shims on supports at the desired elevation	++	+	+++	0	0	+	+	++	++	+	++	0
7.11.2	Mount the balloons according to the hoisting plan	++	+	+++	0	0	+	+	++	++	+	++	0

	OPERATIONS AND SUB-OPERATIONS	Same-Level Fall Hazards	Fall-from-Height Hazards	Ergonomic Hazards	Chemical Hazards – Gases and Fumes	Chemical Hazards – Liquids and Mist	Chemical Hazards – Dust and Smoke	Electric Hazards	Noise Hazards	Mechanical Hazards	Environmental Hazards	Stress-Related Hazards	Fire Hazards
7.11.3	Check balloon elevation	++	+	+++	0	0	+	+	+	+	+	++	0
7.11.4	Bolt	++	+	+++	0	0	+	+	++	++	+	+	0
7.12	Install and fasten generator tubes												
7.12.1	Open the manholes	++	+++	+++	+++	+	++	++	++	++	+++	+++	0
7.12.2	Prepare (clean) the tubes	+++	+++	+++	+++	+++	+++	++	++	++	+++	+++	0
7.12.3	Prepare the balloons to receive the tubes	+++	+++	+++	0	0	+	++	+	++	+++	+++	0
7.12.4	Prepare the parts to be welded	+++	+++	+++	++	+++	+++	++	++	++	+++	+++	++
7.12.5	Weld	+++	+++	+++	+++	+	+++	++	++	++	+++	++	+++
7.13	Roll and flare the tubes												
7.13.1	Put the equipment inside the balloon	++	+	+++	0	0	+	+	++	++	++	++	0
7.13.2	Install the tubes	++	++	+++	0	0	+	+	++	++	++	++	0
7.13.3	Roll the tubes according to a determined sequence	++	++	+++	0	0	+	+	++	++	++	++	0
7.14	Preassemble water walls and other components												
7.14.1	Build supports to receive components	++	++	+++	++	0	+	+	++	++	++	+	0
7.14.2	Build a shelter for welding	++	++	+++	+	0	+	+	++	++	++	+	0
7.14.3	Weld the water walls	++	+++	+++	+++	++	+++	++	++	++	++	++	++
7.14.4	Weld components on the water walls	++	+++	+++	+++	++	+++	++	++	++	++	++	++
7.15	Put water walls and other components in place												
7.15.1	Install the crane	+	+	++	0	0	+	+	++	++	+	++	0
7.15.2	Rig the walls according to the hoisting plan	++	+	++	0	0	+	+	++	++	++	++	0
7.15.3	Erect and install the water walls	++	++	+++	0	0	+	+	++	++	++	++	0
7.15.4	Install indoor and outdoor scaffolds	++	+++	+++	0	0	+	+	++	++	++	++	0
7.15.5	Adjust and fit components	+	+++	+++	++	+	++	++	++	++	++	+	++
7.15.6	Check weld quality	++	+++	+++	++	+	++	++	++	++	++	++	0

	OPERATIONS AND SUB-OPERATIONS	Same-Level Fall Hazards	Fall-from-Height Hazards	Ergonomic Hazards	Chemical Hazards – Gases and Fumes	Chemical Hazards – Liquids and Mist	Chemical Hazards – Dust and Smoke	Electric Hazards	Noise Hazards	Mechanical Hazards	Environmental Hazards	Stress-Related Hazards	Fire Hazards
7.16	Install superheaters												
7.16.1	Rig the superheaters	++	+	+++	0	0	+	+	++	++	++	+++	+
7.16.2	Install scaffolds	++	+++	+++	0	0	+	+	++	++	++	++	+
7.16.3	Install temporary supports	++	+++	+++	0	0	+	+	++	++	++	++	+
7.16.4	Mount the superheaters	++	+++	+++	0	0	+	+	++	++	++	+++	+
7.16.5	Secure the superheaters	++	+++	+++	++	0	+	+	++	++	++	+++	+++
7.16.6	Do the final welding	++	+++	+++	+++	+	+++	++	++	++	++	++	+++
7.17	Install the tubes												
7.17.1	Prepare the surfaces to be welded	++	+++	+++	++	++	++	++	++	++	++	++	+
7.17.2	Position the tubes	++	+++	+++	0	0	+	+	++	++	++	++	+
7.17.3	Weld the tubes	++	+++	+++	+++	0	+++	++	++	++	++	++	+++
7.18	Assemble and weld the ashpit’s screen pattern and tubes	++	+++	+++	+++	0	+++	++	++	++	++	++	+++
7.19	Install the economizer’s modules												
7.19.1	Rig the modules	++	++	+++	0	0	+	+	++	++	++	++	0
7.19.2	Mount the modules according to the established procedure	++	+++	+++	0	0	+	+	++	++	++	++	0
7.19.3	Secure the modules temporarily	++	+++	+++	0	0	+	+	++	++	++	+++	++
7.19.4	Install the scaffolds	++	+++	+++	0	0	+	+	++	++	++	++	0
7.19.5	Prepare the surfaces to be welded	++	+++	+++	0	++	+	+	++	++	++	++	+
7.19.6	Weld	++	+++	+++	+++	+	+++	++	++	++	++	+++	+++
7.19.7	Inspect the welds	++	+++	+++	++	+	++	+	+	+	++	+	0
7.19.8	Remove temporary supports	++	+++	+++	0	0	+	+	++	++	++	+	0
7.19.9	Dismantle the scaffolds	++	+++	+++	0	0	+	+	++	++	++	0	0

	OPERATIONS AND SUB-OPERATIONS	Same-Level Fall Hazards	Fall-from-Height Hazards	Ergonomic Hazards	Chemical Hazards – Gases and Fumes	Chemical Hazards – Liquids and Mist	Chemical Hazards – Dust and Smoke	Electric Hazards	Noise Hazards	Mechanical Hazards	Environmental Hazards	Stress-Related Hazards	Fire Hazards
7.20	Install ducts and shutters												
7.20.1	Install the scaffolds	++	+++	+++	0	0	+	+	++	++	++	++	0
7.20.2	Take measurements to install supports	++	+++	+++	0	0	+	+	++	++	++	++	0
7.20.3	Install the supports	++	+++	+++	0	0	+	+	++	++	++	++	0
7.20.4	Install rigging	++	++	+++	0	0	+	+	++	++	++	++	0
7.20.5	Mount the ducts	++	+++	+++	+	+	++	+	++	++	+++	+	0
7.20.6	Install seal joints and bolt	++	+++	+++	+	+	++	+	++	+++	++	+	0
7.21	Mount, install and weld the hopper and economizer												
7.21.1	Install the scaffolds	++	+++	+++	0	0	+	+	++	++	++	++	0
7.21.2	Position the hopper and economizer	++	+++	+++	0	0	+	+	++	++	++	++	0
7.21.3	Prepare the surfaces to be welded	++	+++	+++	+	++	+	+	++	++	++	++	+
7.21.4	Weld	++	+++	+++	+++	+	+++	+++	++	++	+++	+++	+++
7.21.5	Inspect the welds	++	+++	+++	+	+	+	+	+	+	+	++	0
7.22	Install the burners												
7.22.1	Take the elevations	++	+++	+++	0	0	+	+	+	+	+++	++	0
7.22.2	Install the rigging	++	+++	+++	0	0	+	+	++	+++	+++	+++	0
7.22.3	Install seal joints and bolt	++	+++	+++	+	+	++	+	++	+++	+++	++	0
7.22.4	Connect pipes and equipment	++	+++	+++	0	0	+	+	+++	+++	+++	++	0
7.23	Install boiler components												
7.23.1	Rig and handle the components	++	+++	+++	0	0	+	+	++	++	+++	++	0
7.23.2	Transfer the components on temporary supports	++	+++	+++	0	0	+	+	++	++	+++	++	0
7.23.3	Hang or place the components	++	+++	+++	0	0	+	+	++	++	+++	++	0
7.23.4	Bolt or weld the components	++	+++	+++	++	+	+++	+	++	++	+++	++	++
7.24	Check boiler and component tightness												
7.24.1	Insulate the circuit with blanking plates	++	+++	+++	0	+	++	+	++	++	++	++	0

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7.24.2	Install the hydrostatic testing equipment	++	+++	+++	0	0	+	++	++	++	++	++	0
7.24.3	Fill the boiler and components with liquid	++	+++	+++	0	++	+	+	++	++	++	+++	0
7.24.4	Use a pump to adjust the pressure	++	+++	+++	++	++	+	+	++	++	++	+++	0
7.24.5	Wait one hour	++	+++	+++	+	+	+	+	++	++	++	++	0
7.24.6	Check for leaks	++	+++	+++	0	0	0	+	+	+	+	+++	0
7.24.7	Remove the blanking plates	++	+++	+++	+	+	0	+	+	+	+	+++	0
7.24.8	Drain	++	+++	+++	0	+	0	+	++	++	++	++	0
7.24.9	Have test results approved by the person in charge of the inspection	++	+++	+++	0	0	0	+	+	+	++	+++	0
7.24.10	Dismantle the testing equipment	++	+++	+++	0	0	+	+	+	+	++	+	0
7.25	Install the dust extractor and its components	++	+++	+++	0	0	+	+	++	++	++	++	0
7.26	Install the chimney, ducts, ventilators, shutters and expansion joints												
7.26.1	Assemble the chimney on the ground, on blocks	++	+	+++	0	0	+	+	++	++	++	++	0
7.26.2	Use two cranes to erect the chimney	+	+	+++	0	0	+	+	++	++	++	+++	0
7.26.3	Align the chimney	++	++	+	0	0	+	0	++	++	++	+++	0
7.26.4	Level and bolt the chimney	++	+++	+	0	0	+	+	++	+++	++	+++	0
7.26.5	Mount the ducts with a crane	++	+++	++	0	0	+	+	++	++	++	+++	0
7.26.6	Install the seal joints, bolt and tighten	++	+++	+++	0	++	++	+	++	++	++	++	0
7.26.7	Adjust the ventilators' elevation	++	+++	+++	0	0	+	+	++	++	++	++	0
7.26.8	Place the ventilators on the anchors	++	+++	+++	0	0	+	+	++	++	++	+	0
7.26.9	Install the grout	++	+++	+++	0	++	++	+	+	+	++	+	0
7.26.10	Position the shutters and expansion joints and bolt them	++	+++	+++	0	+	++	+	++	++	++	+	0
7.27	Check work quality												
7.27.1	Check boiler tightness	++	++	++	+	+	+	+	+	+	+	+++	0

OPERATIONS AND SUB-OPERATIONS		Same-Level Fall Hazards	Fall-from-Height Hazards	Ergonomic Hazards	Chemical Hazards – Gases and Fumes	Chemical Hazards – Liquids and Mist	Chemical Hazards – Dust and Smoke	Electric Hazards	Noise Hazards	Mechanical Hazards	Environmental Hazards	Stress-Related Hazards	Fire Hazards
7.27.2	Perform a visual inspection at each step of the work	++	++	++	0	0	+	+	+	+	+	+++	0
7.28	Demobilize the site												
	See the operation's sub-operations 1.10	++	++	++	0	+	++	0	++	++	+	0	0
TASK 8 REPAIR EXCHANGERS													
8.1	Receive instructions from the client												
	See the operation's sub-operations 1.1	0	0	0	0	0	0	0	0	0	0	+	0
8.2	Find out what work needs to be done												
	See the operation's sub-operations 1.2	0	0	0	0	0	0	0	0	0	0	0	0
8.3	Determine the required working methods, tools and equipment												
	See the operation's sub-operations 1.4	+	+	+	++	++	++	++	++	++	++	++	+
8.4	Mobilize the site												
	See the operation's sub-operations 1.5	+	+	++	+	+	+	+	+	+	+	0	0
8.5	Plug the nozzles												
8.5.1	Apply the lockout measures	+	+	++	0	0	+	+	+	+	++	+++	0
8.5.2	Do the hot pre-unbolting	++	++	++	0	0	+	+	++	++	++	++	0
8.5.3	Open the flanges	++	++	++	0	0	+	+	++	++	++	++	0
8.5.4	Insert blanking plates	++	++	++	0	0	+	+	++	++	++	++	0
8.5.5	Bolt the flanges with controlled tightening tools	++	++	++	0	0	+	+	++	++	++	++	0
8.6	Remove components												
8.6.1	Do the hot pre-unbolting	++	+++	+++	0	0	+	+	++	++	++	+++	++
8.6.2	Unbolt	++	+++	+++	0	0	+	+	++	++	++	+	0
8.6.3	Rig and handle the components	++	+++	+++	0	0	+	+	++	++	++	+	0

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8.7	Remove the tube nest												
8.7.1	Modify the scaffolds	++	+++	+++	0	0	+	+	++	++	++	+	0
8.7.2	Extract the tube bundle (using the extractor)	++	+++	+++	++	++	+++	+	+++	+++	+++	++	0
8.7.3	Rig and handle the tube bundle	++	+++	+++	++	++	+++	+	++	+++	+++	+++	0
8.8	Clean the nest and repair, if applicable												
8.8.1	Test the tube bundle	++	+++	+++	++	++	+++	+	++	++	+++	++	0
8.8.2	Locate the leak or breakage	++	+++	+++	++	++	+++	+	++	++	++	++	0
8.8.3	Repair · Install a plug · Roll the tube(s) · Change the tube(s)	++	+++	+++	+++	+++	+++	+	++	++	++	++	0
8.8.4	Retest the tube bundle	++	+++	+++	++	+++	+++	+	++	++	++	++	0
8.9	Install the nest												
8.9.1	Check and clean expansion joints	++	+++	+++	+	++	+++	+	++	++	++	++	0
8.9.2	Rig and handle the tube bundle	++	+++	+++	+	++	+++	+	++	++	++	++	0
8.9.3	Position the tube bundle (using the extractor)	++	+++	+++	+	+	+++	+	++	++	++	++	0
8.9.4	Adjust the level	++	+++	+++	+	+	+++	+	++	++	++	++	0
8.10	Reinstall components												
8.10.1	Clean and lubricate the bolts	++	+++	+++	+	++	++	+	+	++	++	+	0
8.10.2	Modify the scaffolds	++	+++	+++	0	0	+	+	++	++	++	+	0
8.10.3	Rig and handle the components	++	+++	+++	0	0	+	+	++	++	++	+	0
8.10.4	Bolt the components	++	+++	+++	0	0	+	+	++	++	++	+	0
8.11	Test tube and shell tightness												
8.11.1	Install the hydrostatic testing equipment	++	+++	+++	+	+	+	+	++	++	++	+++	0
8.11.2	Fill the exchanger with liquid	++	+++	+++	0	++	++	+	++	++	++	++	0
8.11.3	Obtain the required pressure	++	+++	+++	++	+	+	+	++	++	++	+++	0

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8.11.4	Locate leaks, if applicable	++	+++	+++	+	+	+	+	+	++	++	+++	0
8.11.5	Caulk leaks, if applicable	++	+++	+++	+	++	+	+	+	++	++	+++	0
8.11.6	Present test results to the person in charge of the inspection	++	+++	+++	+	+	+	+	+	+	+	+++	0
8.11.7	Dismantle the testing equipment	++	+++	+++	0	+	+	+	++	++	++	+++	0
8.12	Unplug the nozzles												
8.12.1	Apply the lockout measures	+	+	+	0	0	+	+	+	+	+	++	0
8.12.2	Open the flanges	++	++	++	+	+	+	+	++	++	++	++	0
8.12.3	Check and clean expansion joints	+++	+++	+++	0	++	++	+	++	++	++	+++	0
8.12.4	Remove blanking plates	+++	+++	+++	++	++	++	+	++	++	++	+++	0
8.12.5	Insert new braces	+++	+++	+++	++	++	++	+	++	++	++	++	0
8.12.6	Bolt the flanges with controlled tightening tools	+++	+++	+++	0	0	+	+	++	++	++	++	0
8.13	Demobilize the site												
	See the operation's sub-operations 1.10	++	++	++	0	+	++	0	++	++	+	0	0
TASK 9 Repair or modify elements and equipment													
9.1	Receive instructions from the client												
	See the operation's sub-operations 1.1	0	0	0	0	0	0	0	0	0	0	+	0
9.2	Find out what work needs to be done												
	See the operation's sub-operations 1.2	0	0	0	0	0	0	0	0	0	0	0	0
9.3	Become qualified for welding procedures, if applicable												
	See the operation's sub-operations 1.3	+	+	+	++	++	++	++	++	++	++	++	+
9.4	Determine the required working methods, tools and equipment												
	See the operation's sub-operations 1.4	++	+	+	+	+	+	+	+	+	+	0	0

	OPERATIONS AND SUB-OPERATIONS	Same-Level Fall Hazards	Fall-from-Height Hazards	Ergonomic Hazards	Chemical Hazards – Gases and Fumes	Chemical Hazards – Liquids and Mist	Chemical Hazards – Dust and Smoke	Electric Hazards	Noise Hazards	Mechanical Hazards	Environmental Hazards	Stress-Related Hazards	Fire Hazards
9.5	Mobilize the site												
	See the operation's sub-operations 1.5	+	++	++	+	+	+	+	+	+	+	0	0
9.6	Erect scaffolds, if applicable												
	See the operation's sub-operations 1.8	++	+++	+++	0	0	0	0	++	++	++	0	0
9.7	Plug ducts and nozzles, if applicable												
9.7.1	Check the size of flanges	++	+++	+++	0	0	+	+	+	++	++	0	0
9.7.2	Unbolt the flanges	++	+++	+++	++	++	++	+	++	++	++	++	0
9.7.3	Install blanking plates and seal joints	++	+++	+++	++	++	+	+	+	++	++	+	0
9.7.4	Rebolt the flanges	++	+++	+++	+	+	+	+	++	++	++	+	0
9.8	Take measurements												
9.8.1	Measure existing parts	++	+++	+++	0	0	+	+	+	+	+	0	0
9.8.2	Compare with drawings and procedures	+	+++	+++	0	0	+	+	+	+	+	0	0
9.8.3	Detect modifications	++	+++	+++	0	0	+	+	+	+	+	0	0
9.9	Proceed to repair (cut, shape, assemble, weld)												
9.9.1	Mark the part to be modified	++	+++	+++	0	0	+	+	++	++	++	+	0
9.9.2	Cut with a grinder or by oxy-fuel cutting	++	+++	+++	+++	+	+++	++	++	++	++	+++	+++
9.9.3	Prepare for welding (clean, chamfer)	++	+++	+++	+++	++	+++	++	++	++	++	0	0
9.9.4	Adjust and fit the parts	++	+++	+++	+	+	+	++	++	++	++	++	0
9.9.5	Weld the parts	++	+++	+++	+++	+	+++	++	++	++	++	++	++
9.10	Check work quality												
9.10.1	Check tightness (air, water, etc.)	++	++	++	+	+	+	+	+	+	+	0	0
9.10.2	Make a visual inspection (assembly, welds, etc.)	++	++	++	+	+	+	+	+	+	+	0	0
9.11	Unplug the nozzles, if applicable												
9.11.1	Apply the lockout measures	++	++	++	0	0	+	+	+	+	+	+	0
9.11.2	Open the flanges	++	+++	+++	0	0	+	+	++	++	++	+	0

	OPERATIONS AND SUB-OPERATIONS	Same-Level Fall Hazards	Fall-from-Height Hazards	Ergonomic Hazards	Chemical Hazards – Gases and Fumes	Chemical Hazards – Liquids and Mist	Chemical Hazards – Dust and Smoke	Electric Hazards	Noise Hazards	Mechanical Hazards	Environmental Hazards	Stress-Related Hazards	Fire Hazards
9.11.3	Remove blanking plates	++	+++	+++	++	++	++	+	++	++	++	+	0
9.11.4	Check and clean expansion joints	++	+++	+++	++	++	++	+	++	++	++	+	0
9.11.5	Insert new gaskets	++	++	++	0	0	+	+	+	++	++	+	0
9.11.6	Bolt the flanges	++	++	++	0	0	+	+	++	++	++	+	0
9.12	Demobilize the site												
	See the operation's sub-operations 1.10	++	++	++	0	+	++	0	++	++	+	0	0
TASK 10 Disassemble elements and equipment													
10.1	Receive instructions from the client												
	See the operation's sub-operations 1.1	0	0	0	0	0	0	0	0	0	0	+	0
10.2	Find out what work needs to be done												
	See the operation's sub-operations 1.2	0	0	0	0	0	0	0	0	0	0	0	0
10.3	Determine the required working methods, tools and equipment												
	See the operation's sub-operations 1.4	++	++	++	+	+	+	+	+	+	+	+	0
10.4	Mobilize the site												
	See the operation's sub-operations 1.5	+	++	++	+	+	+	+	+	+	+	0	0
10.5	Erect scaffolds, if applicable												
	See the operation's sub-operations 1.8	++	+++	+++	0	0	0	0	++	++	++	0	0
10.6	Confirm the weight of elements	+	+	+	0	0	0	+	+	+	+	0	0
10.7	Rig the elements												
10.7.1	Install the slings	++	++	+++	0	0	+	+	++	++	++	++	0
10.7.2	Use a crane to weigh the part	++	++	+++	0	0	+	+	++	++	++	++	0
10.7.3	Lower the part on a warehouse truck	+	+	+	0	0	+	+	++	++	++	++	0

	OPERATIONS AND SUB-OPERATIONS	Same-Level Fall Hazards	Fall-from-Height Hazards	Ergonomic Hazards	Chemical Hazards – Gases and Fumes	Chemical Hazards – Liquids and Mist	Chemical Hazards – Dust and Smoke	Electric Hazards	Noise Hazards	Mechanical Hazards	Environmental Hazards	Stress-Related Hazards	Fire Hazards
10.8	Perform gas tests												
10.8.1	Detect traces of fuel	++	++	++	+++	++	+++	+	+	+	+	+++	+++
10.8.2	Obtain necessary protective equipment	++	++	++	++	++	+++	+	+	+	+	+++	++
10.9	Gouge, cut, unbolt												
10.9.1	Delimit the work area	+++	+++	+++	0	0	+	+	++	++	++	++	0
10.9.2	Ventilate if applicable	+++	+++	+++	0	0	+	+	++	++	++	++	0
10.10	Handle disassembled elements												
10.10.1	Place unmounted equipment on a warehouse truck	+++	+++	+++	0	0	+	0	++	++	++	++	0
10.11	Demobilize the site												
	See the operation's sub-operations 1.10	++	++	++	0	+	++	0	++	++	+	0	0
TASK 11 Demolish boilers, tanks, towers, etc.													
11.1	Receive instructions from the client												
	See the operation's sub-operations 1.1	0	0	0	0	0	0	0	0	0	0	+	0
11.2	Find out what work needs to be done												
	See the operation's sub-operations 1.2	0	0	0	0	0	0	0	0	0	0	0	0
11.3	Determine the required working methods, tools and equipment												
	See the operation's sub-operations 1.4	++	++	++	+	+	+	+	+	+	+	+	0
11.4	Mobilize the site												
	See the operation's sub-operations 1.5	+	++	++	+	+	+	+	+	+	+	0	0
11.5	Erect scaffolds, if applicable												
	See the operation's sub-operations 1.8	++	+++	+++	0	0	0	0	++	++	++	0	0
11.6	Rig the elements												
	See the operation's sub-operations 1.9	+	++	++	++	++	++	0	++	++	++	+	++

	OPERATIONS AND SUB-OPERATIONS	Same-Level Fall Hazards	Fall-from-Height Hazards	Ergonomic Hazards	Chemical Hazards – Gases and Fumes	Chemical Hazards – Liquids and Mist	Chemical Hazards – Dust and Smoke	Electric Hazards	Noise Hazards	Mechanical Hazards	Environmental Hazards	Stress-Related Hazards	Fire Hazards
11.7	Perform gas tests												
11.7.1	Use a gas detector	+	+	+	+++	+	++	0	+	+	+	++	0
11.7.2	Fill out the test report	+	+	+	+	+	++	0	+	0	0	0	0
11.8	Gouge, oxy-fuel cut, unbolt												
11.8.1	Install a shelter	++	++	+++	+	0	+	+	++	++	++	0	0
11.8.2	Establish a safety perimeter	++	++	++	0	0	0	0	+	+	+	0	0
11.8.3	Prepare the equipment	++	++	+++	0	0	0	+	++	++	++	+	++
11.8.4	Install personal protective equipment	++	++	+++	+	0	+	+	+	+	+	0	0
11.9	Handle debris	+++	+++	+++	+	++	+++	++	+++	+++	++	++	++
11.10	Demobilize the site												
	See the operation's sub-operations 1.10	++	++	++	+	+	++	0	++	+	+	0	0