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RÉPUBLIQUE FRANÇAISE

MINISTRY OF EDUCATION,
HIGHER EDUCATION AND RESEARCH

Higher technician certificate

Maintenance of construction and handling equipment

Implementation at the start of the 2017 school year

APPENDIX I – Diploma reference documents

Appendix I a – Professional activities reference system

1. The job of the senior technician

1.1 Description of the field of activity

The senior technician's certificate in maintenance of construction and handling equipment gives access to jobs in the maintenance and after-sales of materials and equipment for building and public works (BTP) and handling.

1.2 The economic context

1.2.1 Company typology

The holder of a senior technician certificate in the maintenance of construction and handling equipment fits into companies of variable size, very small companies (VSEs), small and medium-sized companies (SMEs), medium-sized companies (ETI), groups and group subsidiaries.
The profession is practiced in:

- equipment distribution and maintenance concessions and companies; • the entities of equipment manufacturers (head offices, subsidiaries, branches, agencies, points services…) ;
- equipment rental companies; • service companies (specialized operators, inspection companies, etc.); • the maintenance departments of companies and local authorities that use these materials.

1.2.2 The jobs concerned

Depending on the size of the company, the holder of the senior construction and handling equipment maintenance technician certificate carries out all or part of his or her activities in a maintenance workshop or on site. He or she can be: • itinerant/workshop technician; • diagnostic and maintenance technician; • technical adviser; • team leader; • technical/parts “hot line” adviser; • technical / parts inspector.

1.2.3 The field of professional activities

Within his company, his activities consist of: • carrying out a complete diagnosis; • conduct an intervention;
• ensure the relationship with a third party, including in English; • participate in the organization of the service's activities.

In a cross-cutting manner, the holder of the senior technician certificate in the maintenance of construction and handling equipment mobilizes:

- technical skills in different aspects of maintenance; • skills in organizing and managing one's activity; • computer skills for communication purposes and software operation specialized;
- skills in internal (teamwork) and external (customer relations, with the technical support of manufacturers and other interlocutors);
- oral and written skills in English (technical documentation, continuing education, e-mail…).

The holder of the senior technician certificate for the maintenance of construction and handling equipment contributes to compliance with regulations, both technical, safety and environmental and social, and to the quality of after-sales service.

2. Description of professional activities

2.1 Summary of the professional tasks associated with the activities

Professional activities		Professional tasks A1-T1	
A1	Carry out a diagnosis	Confirm the malfunction stated by the customer.	
		A1-T2	List the technical information needed for diagnosis.
		A1-T3	Carry out tests and measurements with regard to manufacturer / supplier / company procedures.
		A1-T4	Analyze the malfunctioning system and interpret the checks and measurements.
		A1-T5	If necessary, complete the diagnosis with the help of technical assistance or any competent contact person.
		A1-T6	Establish and send the estimate.
A2	Conduct an intervention	**A2-T1**	Organize the intervention.
		A2-T2	Perform preventive and corrective maintenance.
		A2-T3	Carry out specific operations (for example: regulatory or procedural checks, commissioning).
A3	Ensure the relationship with a third party, including in English	**A3-T1**	Communicate with the customer.
		A3-T2	Communicate with the hierarchy.
		A3-T3	Communicate with other interlocutors (for example: company services, technical support from manufacturers, insurance expert).
A4	Participate in the operation of the service	**A4-T1**	Contribute to the health, quality, safety and environment (HQSE) policy.
		A4-T2	Take into account the economic, legal and organizational aspects of the company in the course of activities.
		A4-T3	Develop specific technical expertise.

2.2 Levels of autonomy and responsibility in the activity

In the presentation sheets for the following professional activities, the level of autonomy can be defined as an indicator of the level of intervention and involvement in carrying them out by the senior maintenance technician for construction and handling equipment. . The level qualifies the average level of all the tasks related to the activity, certain tasks can be of a higher or lower level, the action verb describing them makes it possible to situate them in relation to this average level.

A four-level scale was adopted:

Level 1 ÿÿÿÿ Appreciate an achievement

Qualifies the mobilization of skills allowing to understand, through a presentation or reading a file, the nature of an activity that does not come under its direct field of intervention and to interpret the results.

This level does not in any way imply an ability to participate in the activity.

Level 2 ÿÿÿÿ Participate in the realization

Qualifies the mobilization of skills allowing to ensure a limited part of the activity within and with the help of a team, under the authority of a project manager.

It involves getting informed and communicating with other team members.

Level 3 ÿÿÿÿ Carrying out a simple activity

Qualifies the mobilization of skills to carry out, independently, all or part of an activity for the most common situations.

It implies: - a mastery, at least partial, of the technical aspects of the activity; - the faculties to obtain information, to communicate (report and argue) and to organize themselves.

Level 4 ÿÿÿÿ Carrying out a complex activity

Qualifies the mobilization of skills enabling mastery on the technical, procedural and decision-making levels of an activity involving multiple decision-making.

It involves:

- the ability to certify the adequacy between the goals and the results; - leading and supervising a team; taking full responsibility
- for any decisions; knowledge transfer.
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3. Description of activities

Activity 1: Make a diagnosis

Level of task autonomy in the activity: ÿÿÿÿ

A1-T6: ÿÿÿÿ

Description of tasks and expected results

Ref	Tasks	Description of the task
A1-T1	Confirm the malfunction stated by the customer.	Carry out the appropriate checks (reproduce the configuration described by the customer, carry out the necessary checks and tests, etc.).
RA1-T1 The malfunction is correctly observed or reformulated. The checks and tests carried out are consistent.		
A1-T2	List the technical information necessary for the diagnosis.	Identify the material and its equipment (serial number and/or specificity). Check and interpret the indications given on the intervention order. Make assumptions about the source of malfunction. Search for information (hardware history, technical notes, etc.). Analyze and prioritize the collected data.
RA1-T2 The material is correctly identified. The client's declarations mentioned on the intervention order are checked and interpreted correctly. Coherent hypotheses with regard to the observation are made. Technical data is properly collected, analyzed and prioritized.		
A1-T3	Carry out tests and measurements with regard to manufacturer / supplier / company procedures.	Choose the appropriate measuring tools. Conduct tests and measurements in accordance with manufacturer/supplier/company procedures. Develop a procedure in the absence of one or improve the existing one. Collect, organize and prioritize the findings and information found during the tests. Produce a summary of the test results by establishing a coherent relationship between the observed effect and the probable cause.
RA1-T3 The appropriate measurement tool is selected and correctly implemented. The recommended procedure is correctly applied. The results collected during the tests and measurements are usable.		
A1-T4	Analyze the malfunctioning system and interpret the checks and measurements.	Define an operating logic. Analyze the symptoms, all the data and measurements taken. Compare measured values to manufacturer values, identify discrepancies. Search the history of interventions for any similar malfunctions and their causes. Make assumptions about the cause of the malfunction.

		Use on-board or hardware-independent diagnostic aid tools to confirm assumptions. Identify faulty system(s) or component(s). Identify the probable cause of the failure. Identify the unsuitable setting(s) or setting(s). Identify the system(s) or peripheral component(s) that may have been damaged by the malfunction. Conclude and propose solutions.
RA1-T4 The diagnostic approach is relevant and logical. **Non-conforming measured values are flagged.** **The assumptions made are relevant and related to the malfunction observed.** **The identification of the system(s), of the component(s), of the setting(s), of the faulty setting(s) is correct.** **The diagnosis is established and formalized as part of the intervention order.**		
A1-T5	If necessary, complete the diagnosis with the help of technical assistance or any competent contact person.	Contact technical assistance at the appropriate time and respecting the possible procedure. Provide technical assistance with the history and pre-diagnosis. Complete the formulation of hypotheses and establish the diagnosis.
RA1-T5 Contact with technical assistance is relevant. **The history and the pre-diagnosis are correctly returned to technical assistance.** **The diagnosis is validated.**		
A1-T6	Establish and send the estimate.	Based on the diagnosis selected, choose the economically appropriate intervention process(es) (place, conditions and methods of intervention). Determine all the components of the estimate (spare parts, time, labor, external service). Communicate the estimate in accordance with the procedures.
RA1-T6 The choices made for the intervention are economically appropriate. **The spare parts and the necessary products have been well defined.** **The estimate is correctly established and the estimate transmitted.**		

Conditions of realization

• **The environment** ü

The work area in the workshop or on site and possibly in liaison with the client, the hierarchy, the set service and service providers, the spare parts department. • **The data**

ü The technical documentation of the manufacturer and the suppliers or software publishers, ...; ü Procedures and constraints related to safety, quality, hygiene and the environment; ü The regulatory context; ü Normative documents, supplier database; ü The order of intervention; ü The single occupational risk assessment document; ü Ergonomic rules, safety regulations (prevention plan), specific procedures to be followed; ü Economic constraints; ü Failure history of malfunctioning equipment; ü Maintenance contracts.

• **Means** ü The
usual computing environment of the profession; ü
Means of transport and lifting; ü The general principles
of prevention (labour code) and the mechanisms for applying the rules
ergonomics, hygiene, health, safety and environmental protection; ü Measuring
devices and diagnostic tools.

Activity 2: Conducting an Intervention

Level of autonomy in the activity: ÿÿÿÿ

Description of tasks and expected results

Ref	Tasks	Description of the task
A2-T1	Organize the intervention.	Prepare the intervention (intervention order, documentation and workstation). Provide human and material resources. Choose the appropriate procedure, define the different phases of the intervention and plan its progress. Implement the protection and safety measures prior to the intervention (consignment and de-energization). Take environmental rules into account (for example: selective sorting, effluent management). Manage co-activity with service providers and subcontractors. Ensure the administrative follow-up of the intervention (for example: transmission for invoicing, specific documents, replenishment of spare parts, machine history). Know and respect the contractual commitments and the general conditions of sale, repair, rental. Comply with the client's prevention plan and regulatory constraints. Develop an optimal choice of the means and methods used.
RA2-T1	**The context of the intervention, the parts supply times, the means to be mobilized, the workshop schedule and the scaled intervention times are taken into account. The appropriate procedure is selected and the course of the intervention is planned. The intervention order is implemented. The correct work location is defined and available. Consumables and spare parts are available. Company and manufacturer repair procedures are consulted and followed. The necessary tools are identified and available at the workstation. The measures related to the rules of ergonomics, hygiene, health, safety and environmental protection are applied in accordance with the regulations in force. The equipment is protected, possibly logged out and de-energized. The activity of the service provider or subcontractor is integrated into its own intervention. The administrative follow-up of the intervention is correctly carried out. The intervention respects the contractual commitments and the general conditions. The intervention is carried out in compliance with regulatory constraints and by optimizing resources.**	
A 2T2	Perform preventive and corrective maintenance.	Perform periodic maintenance. Deposit and handle an element or a sub-assembly. Ensure the repair of organs or sub-assemblies. Check and identify faulty elements. Determine the parts to order.

		Proceed with reassembly, adjustments (or settings) and recommissioning. Carry out the self-monitoring of the intervention. Configure an embedded system.
RA2-T2 The maintenance operations carried out meet the manufacturer's requirements and the customer expectations. **On-board systems are correctly tuned and/or configured.**		
A2-T3	Carry out specific operations (for example: regulatory or procedural checks, commissioning).	Perform equipment adaptation and preparation operations. Install equipment. Carry out the commissioning and/or "hand" of the equipment. Perform preventive and corrective maintenance operations. Carry out regulatory checks (for example: VGP periodic general checks, VRS and VCRS commissioning and re-commissioning checks). Perform procedural controls (eg ISO, internal).
RA2-T3 Regulatory or procedural checks have been carried out. Maintenance operations carried out meet the manufacturer's requirements and the customer's expectations. **Regulatory or procedural checks have been carried out.** **Equipment adaptation, preparation and installation operations are carried out correctly.** **The commissioning and/or "hand" operations of the equipment are correctly carried out.** **On-board systems are correctly tuned and/or configured.**		

Conditions of realization

• **The environment** ü The
work area in the workshop, on site or remotely and possibly in liaison with the customer, the hierarchy, the technical platform and the service providers, the spare parts department.

• **The data** ü The
technical documentation of the manufacturer and the suppliers or software publishers, ...; ü Procedures and constraints related to safety, quality, hygiene and the environment; ü The regulatory context; ü Normative documents, supplier database; ü The order of intervention; ü The single occupational risk assessment document; ü Economic constraints; ü The state of the store's stock, spare parts; ü Failure history of malfunctioning equipment; ü Maintenance contracts.

• **Means** ü The usual
computing environment of the profession; ü Human resources; ü The means of transport and lifting, general principles of prevention (labour code); ü Ergonomics, hygiene, health, safety and environmental protection rules; ü Measuring devices and diagnostic tools; ü Repair tools.

Activity 3: Ensure the relationship with a third party, including in English

Level of autonomy in the activity: ÿÿÿÿ

Description of tasks and expected results

Ref	Tasks	Description of tasks
A3-T1	Communicate with the customer.	Establish a relationship with the client (on the phone, face-to-face, by email, by SMS) in compliance with company procedures. Receive the customer. Listen and collect the information necessary for the activity related to the intervention. Inform the client, in interaction with the hierarchical link, on the contours of the intervention (for example: deadline, duration, cost) and its evolution. Inform, advise the customer on the additional technical and commercial services available.
RA3-T1	**Contact with the client is reactive, interactive and adapted to the situation (before, during and at the end of the intervention).** **The information needed to prepare and/or carry out the intervention is correctly collected.** **The client is informed and advised of the various services available as well as the duration and cost of the intervention.**	
A3-T2	Communicate with the hierarchy.	Report on the situation (context, technique). Explain and justify the estimate. Comply with any company validation procedures. Collect specific instructions.
RA3-T2	**The situation is presented in an exhaustive and structured manner.** **The estimate is explained and justified.** **Validation procedures and instructions are followed.**	
A3-T3	Communicate with other interlocutors (for example: company services, technical support from manufacturers, insurance expert).	Find out about the contours of the intervention. Obtain and read the appropriate technical documentation. Share / compare your field experience with the manufacturer's technical support. Participate in the appointment of expertise in insurance.
RA3-T3	**Service order is understood.** **Documentation is obtained and understood.** **Discussions with the manufacturer's technical support are fruitful.** **The answers to the questions during the appraisal meeting are adapted.**	

Conditions of realization

• **The environment** ü In the workshop or on site with the customer and his equipment;
ü On the phone, by e-mail.

• **Data** ü
Maintenance contracts; ü The
regulations relating to the conditions of use of the equipment; ü Procedures
and constraints related to HQSE rules; ü The regulatory context; ü Normative
documents, supplier database; ü The order of intervention; ü The single
occupational risk assessment document; ü Economic constraints.

• **Means** ü The
usual computing environment of the profession; ü
Appropriate means of communication.

Activity 4: Participate in the operation of the service

Level of autonomy in the activity: ÿÿÿÿ

Description of tasks and expected results

Ref	Tasks	Description of tasks
A4-T1	Contribute to the health, quality, safety and environment (HQSE) policy.	Comply with the various charters and regulations. Propose improvements in procedures with regard to charters and regulations.
RA4-T1 The texts are known and respected. Suggestions for improvements are relevant.		
A4-T2 Take into account the economic, legal and organizational aspects of the company in the conduct of activities.		Integrate the notions of cost calculation for customer invoicing. Integrate the management elements in relation to the organization of the activity of the senior technician. Integrate its activity in coherence with the services of the company. Integrate the legal dimension (for example: liability, contracts, guarantees, maintenance contracts, general conditions of repair, sale, rental).
RA4-T2 Economic, legal and organizational concepts are understood and used correctly wisely. The contractual dimension is assimilated.		
A4-T3 Develop specific technical expertise.		Obtain new knowledge and skills as needed. Transmit their skills and/or experience.
RA4-T3 New concepts are assimilated. Communication is structured and adapted to the interlocutor.		

Conditions of realization

• **The environment** ü
Within the company; ü In
the workshop, on the move or on site.

• **Data**
ü Procedures and constraints related to safety, quality, hygiene and the environment; ü The regulatory and contractual context; ü Databases (manufacturers, company, suppliers, etc.).

• **Means** ü The
usual computing environment of the profession; ü Training
courses; ü Appropriate means of communication.

Annex I b – Certification reference system

1 – List of skills

C1 **To communicate**	**C1.1** Getting informed	
	C1.2 Exchange internally and externally with a third party, including in English	
C2 **Analyze** **Diagnose**	**C2.1** Describe a technical system	
	C2.2 Characterizing physical quantities	
	C2.3 Characterize performance	
	C2.4 Identify the failure	
C3 **To propose**	**C3.1** Define solutions	
C4 **To organise**	**C4.1** Manage workstations	
	C4.2 Plan and manage operations	
C5 **Achieve**	**C5.1** Implement equipment, measurement or diagnostic tools, a procedure	
	C5.2 Restore compliance. Adjust, calibrate, adapt, configure	
	C5.3 Produce a professional document	

2 – Tables of correspondence between professional activities and skills

Activities	C1.1 Tasks		C1.2	C2.1	C2.2	C2.3	C2.4	C3.1	C4.1	C4.2	C5.1	C5.2	C5.3
A1-Perform a diagnosis	A1-T1	1									2		
	A1-T2	3		3	1								
	A1-T3					2					3		2
	A1-T4			1	3	3	3	3					
	A1-T5	1	2	1	2		2				1		
	A1-T6	1	2					2					2
A2-Conduct an intervention	A2-T1	2							3	2			
	A 2T2				2	2	3	2	2	3	3	3	
	A2-T3			1	2	2	2			2	2	3	2
A3-Ensuring the relationship with a third parties including in English	A3-T1	1	3					1		1	1		
	A3-T2		2						1	1			1
	A3-T3	1	2			1					1		1
A4-Participate in the operation of the service	A4-T1		1					1	3		2	1	3
	A4-T2	1	3						1	2			2
	A4-T3		2		1	1	2	2				2	2

*Legend for the type of skill-task relationship: skill **weakly (1)** or **moderately (2)** or **strongly (3)** mobilized in the accomplishment of the task concerned.*

3 – Description of skills

C1 Communicate C1.1
Get informed C1.2
Discuss internally and externally with a third party, including in English

C1.1 Getting informed			
Data	**Detailed Skills**	**Performance indicators**	**Knowledge associates**
The material, its documentation and its context of use. Customer information. The results of measurements or tests. A technical, commercial or other need. All technical or commercial documentation media. The customer and/or the company's technical or commercial team.	Collect the information necessary for its intervention on: - the client and his team lie; - the technical and economic data related to the intervention; - customer expectations; - data relating to health, quality, safety and the environment.	The information search procedures implemented are efficient. The information and sources used are relevant to the need. The information collected makes it possible to analyze the conditions of operation or malfunction of the equipment.	S5 S7.3.1 S8
	Structure, classify and prioritize the data collected.	The data collected is sorted and organized in a relevant way.	

C1.2 Exchange internally and externally with a third party, including in English

Data	Detailed Skills	Performance indicators	Associated knowledge
The internal database. The third party database. Professional documentation. The communication procedures specific to the third party. The interlocutor / the third party. Equipment.	Contact a third party.	Contact is prepared. The wording is clear and appropriate. The communication channel is well chosen.	S5.2 S5.3 S7 S8
	Chat with a third party.	The problem and the needs of the third party are identified. The answers given are correctly formulated and adapted to the context. The document is correctly filled in.	
	report on his intervention.	The choice of communication medium is relevant. A detailed and reliable report of the intervention is produced taking into account the company's internal policy. The quality of written and oral expression is taken into account.	
	Advise a third party.	The advice given is adapted to the problem (use, maintenance, safety, cost, legal, environment, etc.). Information on the additional technical and commercial services available and the technical characteristics of the possible solutions are presented and argued.	
	Share his experience.	The information is shared with the manufacturers' technical support and internal departments as part of a process to improve procedures.	

C2 Analyze - Diagnose C2.1
Describe a technical system C2.2
Characterize physical quantities C2.3
Characterize performance
C2.4 Identify the failure

C2.1 Describe a technical system			
Data	**Detailed Skills**	**Performance indicators**	**Knowledge associates**
The system or subsystem. The analysis situation (system or sub-system, work situation, dysfunction, adaptation, etc.). The documentary set associated with the situation (plans, diagrams, technical notes from the builders, etc.). The necessary analysis tools (computerized or not). A modeling proposal.	Identify the context and the use case.	The different elements of the context are identified. The use case is identified. Study boundaries are identified. Interactions with the external environment are correctly listed.	S5
	Describe the organization of the system from a functional and/or structural point of view.	The description tool is adapted. The functional organization is described. The structural organization is described. The function of each element is perfectly defined.	
	Identify the links between functions and/or structural elements.	The parameters which control, regulate or influence the activity of the system, of the element, are named and characterized.	
	Identify and name the elements making up the information chain.	The elements are identified and named. The relationships between the documentation and the real system are established.	
	Identify and name the elements that make up the energy chain.	The elements are identified and named. The relationships between the documentation and the real system are established.	
	Identify the interactions between the different elements of the system and the external environment.	The flows of energy, information and matter are identified.	

C2.2 Characterizing physical quantities			
Data	**Detailed Skills**	**Performance indicators**	**Knowledge associates**
The system or subsystem. The analysis situation (system or sub-system, work situation, dysfunction, adaptation, etc.). The documentary set associated with the situation (plans, diagrams, technical notes from the builders, etc.). The necessary analysis tools (computerized or not).	Identify the input and output quantities of the elements of the system.	Effort (force, torque, tension, pressure, temperature, etc.) and flux (linear and angular speeds, current, volume flow, heat flux, etc.) quantities are identified.	S5
	Define the nature of quantities.	The nature of the quantities is specified (analogue/digital, rotation/translation, DC/AC, etc.).	
	Qualify and estimate the input and output quantities of the system.	The time and frequency characteristics are defined. The order of magnitude is estimated correctly.	
	Characterize the evolution of quantities following tests, measurements, calculations and/or simulation.	The evolution of the quantities is described and explained.	
	Use the appropriate symbols and units of the quantities and check the homogeneity of the results.	Symbols and units are used correctly. A dimensional analysis is performed. The results are consistent.	

C2.3 Characterize performance			
Data	**Detailed Skills**	**Performance indicators**	**Knowledge associates**
The system or subsystem. The analysis situation (system or sub-system, work situation, dysfunction, adaptation, etc.). The documentary set associated with the situation (plans, diagrams, technical notes from the builders, etc.). The necessary analysis tools (computerized or not).	Identify the characteristic quantities representative of the performance of the system.	The quantities are identified and characterized.	S5
	Use and interpret the values obtained following a calculation, a test or a simulation.	The values obtained are in accordance with the manufacturer's data and/or the assumptions.	
	Quantify the differences between the expected values and the obtained values.	The deviations obtained allow the characterization of the performances.	
	Analyze the deviations obtained and characterize the performance of the system.	The evolution of the characteristic quantities is exploited and compared with the expected ones. The performances are characterized.	
	Highlight parameters that affect system performance.	Parameters that affect performance are identified.	
	Analyze and interpret the adequacy between the material (and/or) its equipment, and its use.	The performance related to suitability is analyzed with regard to the assessment criteria of the function studied. Suitability is characterized and assessed.	

C2.4 Identify the failure			
Data	**Detailed Skills**	**Performance indicators**	**Knowledge associates**
Equipment. The system or subsystem in its environment. The description of the context of use of the material. The results of structural and behavioral analysis. Input and output data, control. Normative documents, supplier database. The technical documentation of the manufacturer and the suppliers or software publishers, ... Hardware history.	Formulate and prioritize hypotheses.	Data is selected and interpreted. The assumptions made are consistent. The hypotheses are ranked.	S5.3 S5.4 S5.5 S5.6 S5.7 S5.8 S6.2
	Validate assumptions.	The hypothesis put forward is validated. The defective element(s) is (are) identified.	
	Locate the fault.	The fault is located according to the procedure.	
	Identify the probable cause and the consequences of the failure.	Probable cause and consequences are identified.	

C3 Propose
C3.1 Define solutions

C3.1 Define solutions			
Data	Detailed Skills	Performance indicators	Knowledge associates
All the data and documents collected beforehand. The functional specifications. The customer's material and/or equipment, its technical documentation and the conditions of use. Technical (components, materials, tools), commercial and regulatory databases. The company, its staff and its services. The customer. HQSE data.	Use documents and data collected.	Payload data is extracted.	S5 S6.1.2 S6.1.3 S6.3 S7.4 S8
	Describe solutions (maintenance, adaptation, procedure, etc.).	The solution is established (in schematic form, physical or digital model and/or editorial). The description is complete and appropriate. A set of solutions is proposed.	
	Characterize and quantify the proposed solutions.	The assessment criteria (technical, economic, HQSE, organizational and time) are listed and taken into account. The levels of appreciation are characterized and justified.	
	Classify solutions.	The solutions are ranked according to the assessment criteria.	
	Choose a solution.	The choice is argued with regard to the specifications.	

C4 Organize
C4.1 Manage workstations C4.2
Plan and manage operations

C4.1 Manage workstations			
Data	**Detailed Skills**	**Performance indicators**	**Knowledge associates**
The workshop, fixed equipment, maintenance and diagnostic equipment. The intervention order. Workshop personnel and their qualifications. The spare parts department or the manufacturer. Documentation of materials, equipment and tools. The documentary base in terms of hygiene, quality, safety and the environment. All the necessary procedures (manufacturer, internal, HQSE, customer).	Define the work area(s) and the appropriate means.	The defined area(s) is (are) suitable for the activities. The means are defined and adapted to the interventions. Hygiene, safety and environmental measures are taken into account.	S6.1.4 S6.1.5 S6.3 S7.1.2 S7.2 S8
	Organize the workstation(s).	The organization of the workstation is consistent with the intervention and complies with the procedures. Hygiene, safety and environmental rules are respected. The organization of the workstation and the equipment respects the company's quality approach.	
	Ensure the application and compliance with procedures (manufacturer, internal, HQSE, customer).	The workstations defined are kept in good condition with regard to regulatory or company requirements.	

C4.2 Plan and manage operations			
Data	**Detailed Skills**	**Performance indicators**	**Knowledge associates**
Intervention orders, contractual commitments. The hierarchy, the services of the company. The workshop and/or site load plan. Customers, their equipment and their needs. The human and material means of intervention. The availability of spare parts. Documentation of materials, equipment and tools. Technical assistance from manufacturers or the company (hotline, etc.). External service providers.	Organize and plan activities to meet deadlines.	The load plan is coherent and optimized. The planning takes into account all the constraints (human skills, material availability, deadlines, HQSE rules).	S6.1.1 S6.1.4 S6.1.5 S6.3 S7.4 S8
	Monitor and control the progress of activities Classes.	The progress of the work is recorded. Abnormalities are reported. The operations are carried out in compliance with the HQSE rules and the expected deadlines.	
	Remedy a hazard.	Deviations are taken into account. Corrective or additional actions are proposed.	
	Validate the activity.	A summary of operations and associated controls is carried out. The synthesis makes it possible to decide on the validation of the activity.	

C5 Perform	
C5.1 Implement equipment, measurement or diagnostic tools, a procedure C5.2 Restore compliance. Adjust, calibrate, adapt, configure C5.3 Produce a professional document	

C5.1 Implement equipment, measurement or diagnostic tools, a procedure

Data	Detailed Skills	Performance indicators	Knowledge associates
The necessary material and/or equipment and its accessories. The intervention order. The procedures. Measuring tools. diagnostic tools. Technical and user manuals. The purpose of the implementation. Rules, HQSE procedures. The places of evolution of the material.	Identify and list the conditions related to the implementation artwork.	Safety rules are identified. The implementation conditions are listed.	S6.2 S6.3 S8
	Choose, prepare materials, tools or procedures.	The choice of tools is appropriate to the expectation. The substrate is prepared for application in optimal conditions. The chosen procedure is appropriate.	
	Implement materials, tools or procedures.	The implementation of equipment, measurement and diagnostic tools, procedures is carried out under the conditions provided. Actions are logged.	

C5.2 Restore compliance. Adjust, calibrate, adapt, configure			
Data	**Detailed Skills**	**Performance indicators**	**Knowledge associates**
Intervention support. The procedure. The intervention order. Technical documentation. Workstations with their equipment. The technical regulations in force related to the equipment.	Remove, refit or replace sub-assemblies.	HQSE instructions and rules are taken into account. The manufacturer's instructions are complied with. The intervention time is respected.	S5 S6.1.5 S6.3 S7.1.2 S8
	Dismantle subsets. Control, assess the state of the constituent parts of the sub-assembly. Decide on the elements to be traced. Ride up.	The various stages of disassembly/reassembly are carried out in accordance with the procedures. The condition of the parts is properly checked and assessed. The judgment of the conformity of the elements selected for reassembly is correct (to be kept, repaired, replaced). Defective items are managed (listed, logged). The operations carried out are at the required level of quality.	
	Repair an element or make an adaptation element.	The quality of the work allows the reuse of the element or the prototype meets the specifications. Actions are carried out in compliance with regulations and procedures. HQSE rules are respected.	
	Make adjustments and fine-tuning of the various systems.	The settings comply with the manufacturer's recommendations and are carried out at each stage.	
	Parameterize / calibrate the systems.	The reset and settings procedures are applied and respected (examples: learning, calibration, zeroing, fault code erasing procedures). The settings respect the characteristics and configuration of the system. The software update is performed.	

	Validate the result of an intervention.	Findings are recorded. The performances or characteristics conform to the expected.	

C5.3 Produce a professional document			
Data	**Detailed Skills**	**Performance indicators**	**Knowledge associates**
Technical (components, materials, tools), commercial and regulatory databases. The company, its staff and its services. The chosen solution and the associated documentation. The specifications and/ or the problem.	Write the procedure (for example: diagnosis, intervention, use, adaptation).	The procedure makes it possible to tend towards the optimization of the means implemented to achieve the expected result (for example: time saving, quality gain). The technical vocabulary and/or the graphic representations are adapted. The support is adapted to the situation. HQSE and economic criteria are taken into account. Company requirements are met.	S5 S6 S7 S8
	Adapt, enrich technical or business documentation.	The support is adapted to the situation. The technical vocabulary and/or the graphic representations are adapted. HQSE and economic criteria are taken into account. Company requirements are met.	

4 – List of knowledge

S1	**General culture and expression**
S2	**Compulsory living language – English**
S3	**Mathematics**
S4	**Physics – Chemistry**
S5	**Study of the material, its equipment and its constituents**
S6	**Service**
S7	**Applied Economics-Management**
S8	**Professional environment**

S1. General culture and expression

The teaching of French in the sections of higher technicians refers to the provisions of the decree of November 16, 2006 (BOEN n ° 47 of December 21, 2006) fixing the objectives, the contents of the teaching and the reference of capacities of the field general culture and expression for the higher technician patent.

S2. Mandatory living language – English

The teaching of modern languages in the sections of higher technicians refers to the provisions of the decree of July 22, 2008 (BOESR n° 32 of August 28, 2008) setting the objectives, the contents of the teaching and the reference system for the capacities of the field of modern languages for the higher technician certificate.

1. The level required at the end of the training

The target level is that fixed in the programs for the final cycle (BO special edition n°7 28 August 2003) with reference to the *Common European Framework of Reference for Languages* (CECRL): level B2 for English; level B1 for the optional modern foreign language.

In the CEFR, level B2 is defined as follows: “Can understand
the essential content of concrete or abstract subjects in a complex text, including a technical discussion in his specialty; can communicate with such a degree of spontaneity and ease that a conversation with a native speaker does not involve tension for either of them; can express himself clearly and in detail on a wide range of subjects, express an opinion on a topical subject and explain the advantages and disadvantages of different possibilities”.

2. Content

For a detailed presentation of the objectives, content and language activities at levels B1 and B2 (" *Program and definition of modern foreign language test in higher technician certificates in the industrial sector* "), see the decree of July 22 2008 and its annexes.

2.1. Grammar

At level B2, a student has fairly good grammatical control and does not make mistakes leading to misunderstandings.

The operational mastery of the morphological, syntactic and phonological elements appearing in the program of the first and final classes constitutes a reasonable objective. It will be necessary to ensure its consolidation and deepening.

2.2. Lexicon

The lexical competence of a student at level B2 is characterized in the following way.

Range : has a good range of vocabulary for subjects related to his field and the most general subjects; can vary its wording to avoid frequent repetitions, but lexical gaps can still cause hesitation and the use of periphrases.

Fluency : Vocabulary accuracy is generally high although confusion and incorrect word choice do occur without impeding communication.

In this perspective, we will reactivate the elementary vocabulary of the language of communication in order to provide students with the essential means to approach general subjects.

It is from this consolidated base that we will be able to diversify knowledge according in particular to the specific needs of the profession, without these overshadowing the essential work concerning the acquisition of the more general lexicon linked to everyday communication. .

2.3. Cultural elements

In addition to the cultural particularities linked to the professional field (writing dates, monetary units, abbreviations, time, acronyms, dress code, preferred modes of communication, business life), the senior technician must show knowledge of the countries whose language he is studying. Knowledge of social practices and economic and political contexts is essential for effective communication, whether or not it is limited to the professional field.

2.4. Objectives of technological teaching in a modern foreign language (ETLV)

– as an extension of the English course, continue work on language activities by applying them to the professional field specific to the section and to technical gestures in context;

– ensure a documentary watch by visiting the press or scientific or general information sites in English and thus place the professional field of the section in a complementary perspective: that of professional culture and the scientific approach (parallel or concurrent) of English-speaking countries.

S3. Math

The teaching of mathematics in the sections of higher technicians refers to the provisions appearing in annexes I and II of the decree of June 4, 2013 setting the objectives, the contents of the teaching and the referential of the capacities of the field of mathematics for the higher technician certificates.

The provisions of this order are specified for this BTS as follows.

1. Guidelines

Objectives specific to the section
The study of continuous phenomena resulting from the physical sciences and technology constitutes one of the essential objectives of the training of senior technicians in equipment maintenance. They are described mathematically by functions obtained most often as solutions of differential equations.

A *geometric vision* of the problems must impregnate the whole of the teaching because the methods of geometry play a capital role in analysis and in their fields of intervention: contributions of geometric language and modes of representation.
Finally the *knowledge of some statistical methods* to control the quality of a production is essential in this training.

Organization of content It is
according to these objectives that the teaching of mathematics is designed; it can be organized around *five poles :* – a study of the *usual functions,* ie exponential, powers and logarithms, the mastery of which is necessary at this level; – the resolution *of differential equations* whose importance we wanted to highlight, in relation to the problems of evolution; – the resolution of *geometric problems* encountered in the various courses; – an introduction to the *calculation of probabilities,* followed by notions of *inferential statistics* leading to the construction of the simplest statistical tests used in quality control; – an appreciation of *the numerical and graphic aspects* for the whole program, an introduction to some elementary methods of *numerical analysis* and the use of the appropriate *IT resources* for this purpose : programmable calculator with graphic screen, computer equipped with a spreadsheet , computer algebra, geometry or application software (modeling, simulation, etc.).

Organization of studies In
the first and second year, the weekly timetable is 2 hours in the whole class (including half an hour in co-teaching) + 1 hour of tutorials.

2. Program The
mathematics program consists of the following modules:

Functions of a real variable, with the exception of the paragraphs " *Local approximation of a function* " and " *Parameterized curves* ".

Integral calculation, with the exception of the " *Formula for integration by parts* " paragraph.

Differential equations.

Descriptive statistics.

Probabilities 1.

Probabilities 2, with the exception of the paragraph " *Examples of random processes* ".

Inferential statistics.

Geometric configurations.

Vector calculation.

3. Complementary program The
complementary program is not subject to evaluation and can be taught during the hours of personalized support in the second year.
This contribution is a deepening which can be useful to the students wishing specific complements of geometrical modeling and matrix calculation.

Geometric modeling.

Matrix calculation.

S4. Chemical Physics

ü Preamble

The teaching of physics and chemistry in the **"maintenance of construction and handling equipment** " section for senior technicians is based on the scientific training acquired in the second cycle. It aims to reinforce the mastery of the scientific approach in order to give the student the autonomy necessary to carry out the professional tasks which will be proposed to him in his future profession and to act as a responsible citizen. It also aims to acquire or strengthen, in the future senior technician, knowledge, physical models and the ability to mobilize them in the context of his professional practice. It must enable him to cope with the technological developments that he will encounter in his career and be part of lifelong training.

The skills specific to the scientific approach must allow the student to make informed decisions and to act independently and appropriately. These skills require the mastery of abilities that go far beyond the framework of scientific activity: • confronting one's representations with reality; • observe with curiosity; • mobilize their knowledge, research, extract and organize the useful information provided by a situation, an experience or a document;

• reason, demonstrate, argue, exercise analytical and critical thinking.

Each theme of the physics-chemistry program is organized into two parts: • In the first part, the skills that the practice of the **experimental approach** makes it possible to develop are described. These skills and the associated abilities will be exercised and implemented in a variety of situations throughout the two years based on the areas studied described in the second part of the program. Their acquisition must therefore be subject to long-term planning and monitoring.

• In the second part are described the **knowledge and capacities** which are organized in two columns: to the first column "notions and contents" corresponds one or more "required capacities" of the second column. It thus highlights the key elements constituting the base of knowledge and abilities whose assimilation by all students is required. No more can be asked of them during the certification evaluations.

The program indicates the training objectives to be achieved for all students. It does not in any way represent an imposed progression. The teacher must organize his teaching by respecting four main guiding principles.

• Putting students into activity: the acquisition of knowledge and skills will be all the more effective if they have effectively implemented these skills. The experimental approach and the documentary approach allow this activity. The teacher can implement other activities along the same lines. • The contextualization of knowledge and capacities: scientific questioning, a prelude to the construction of notions and concepts, will be deployed from technological objects, simple or complex processes, relating to activities related to the maintenance of equipment. To deliver his teaching, the professor relies on professional practice. Consequently, lessons should be contextualized using examples taken from the non-exhaustive list of business applications offered in this repository. Links between each of them and the different parts of the program are proposed. The teacher will thus be able to build different organizations either around a theme of the physics-chemistry program, or around a business application. The teacher must take into account the needs and constraints of the professional sector of equipment maintenance.

• An adaptation to the needs of the students: a certain number of the required capacities of the program fall under the programs of high schools and are therefore already mastered by the students. The progression must therefore take into account the acquired knowledge of the students.
• A necessary coherence of the various scientific and technological teachings: the progress in physics-chemistry must be articulated with those implemented in the teachings of mathematics and sciences and industrial techniques.

The teacher may be required to present notions in relation to student projects or their internships, notions that do not appear explicitly in the physics-chemistry program. These situations are an opportunity for students to mobilize the skills targeted by the training in a new context and to reinforce their mastery. The additional knowledge thus acquired is not required for certification.

ü **The experimental approach**

The experimental activities implemented within the framework of a scientific approach mobilize the skills listed in the table below. Associated capacities are explained in order to specify the contours of each skill: they do not constitute an exhaustive list and can sometimes relate to several areas of skill.

The skills must be acquired at the end of the STS training, the level of requirement being naturally to be put into perspective with that of the other components of the program of the sector concerned. They need to be regularly mobilized by the students and are evaluated based, for example, on the use of evaluation grids. This therefore requires planning and monitoring over time.

The order of presentation of these does not prejudge an order of mobilization of these skills during a session, a sequence or an evaluation.

Skills	Abilities (non-exhaustive list)
Appropriate	• Understand the problem of the work to be carried out. • Adopt a critical attitude towards information. • Research, extract and organize information related to the problem. • Know the vocabulary, symbols and units used in artwork.
Analyze	• Choose an experimental protocol/device. • Represent or complete an experimental device diagram. • Formulate a hypothesis. • Propose a strategy to respond to the problem. • Mobilize knowledge in the disciplinary field.
Achieve	• Organize the workstation. • Pay for the equipment/device chosen or made available to him. • Implement an experimental protocol. • Carry out experimental surveys. • Handle with confidence in compliance with safety rules. • Know the equipment, its operation and its limits. • Criticize a result, a protocol or a measure. • Exploit and interpret observations,
To validate	measurements. • Validate or invalidate information, a hypothesis, a property, a law, … • Use the appropriate symbols and units. • Analyze results critically. • Report
To communicate	observations and work results made. • Present, formulate a conclusion. • Explain, represent, argue, comment. • Develop a
Be independent, demonstrate of initiative	process and make choices. • Organize your work. • Deal with any incidents encountered.

With regard to the " **Communicate** " skill , writing a written report is one of the training objectives. The experimental activities are also an opportunity to work on oral expression during a situation report or a final synthesis. The aim is to continue preparing STS students for the presentation of work and projects that they will have to conduct and exhibit during their training and, more generally, in the context of their profession. The use of a laboratory notebook, in the broad sense of the term including, for example, digital, can be an effective learning tool.

Concerning the competency " **To be autonomous, to show initiative** ", it is transversal in nature and contributes to the definition of the level of mastery of the other competencies. The use of activities based on open questions is particularly suitable for training students in autonomy and initiative.

Errors and uncertainties

To practice an autonomous and reasoned experimental approach, students must have knowledge and skills in the field of measurements and uncertainties: these intervene both upstream at the time of the analysis of the protocol, the choice of measuring instruments, etc., and downstream during the validation and critical analysis of the results obtained. The notions explained below are those addressed in the programs of the final cycle of the general and technological streams of the high school.

They must be reviewed in STS so that the required capacities are mastered by the senior technician in " **maintenance of construction and handling equipment** ".

Errors and uncertainties	
Concepts and contents	Required capacities
Errors and associated notions	• Identify the different sources of error (limits to precision) during a measurement: variability of the phenomenon and of the act of measurement (for example: factors linked to the operator, to the instruments).
Uncertainties and associated notions	• Evaluate the uncertainties associated with each source of error. • Compare the weight of the different sources of error. • Evaluate repeatability uncertainty using an evaluation formula provided. • Evaluate the uncertainty of a single measurement obtained using a measurement instrument. measure. • Evaluate, using a formula provided, the uncertainty of a measurement obtained when carrying out a protocol involving several sources of error.
Expression and acceptability of the result	• Master the use of significant figures and scientific writing. Associate uncertainty to this writing. • Express the result of a measurement operation by a value from possibly a mean, and a measurement uncertainty associated with a level of confidence. • Assess relative accuracy. • Determine the measures to keep according to a given criterion. • Comment on the result of a measurement operation by comparing it to a reference value. • Make suggestions to improve the process.

• Physics at the service of the maintenance of construction and handling equipment:

P1	The signal and its analysis
P2	The system and its performance
P3	The measurement of physical quantities and their environments
P4	Thermodynamics and thermal machines
P5	Conversion of electrical energy and control of actuators

• Chemical reaction for the maintenance of construction and handling equipment:

C1	Matter and its oxidation and reduction reactions

Technological fields concerned (non-exhaustive list)	Scientific fields covered					
	P1	P2	P3	P4	P5	C1
Spark-ignition and compression-ignition heat engine (production of thermal and mechanical energy, pollution and depollution techniques)					O	O
Energy management on thermal, mechanical, hydraulic and electrical systems						
- Acquisition of information (sensor, signals and conversion)	O	O	O			
- Data processing		O	O			
- Activation of actuators (on-off solenoid valves and proportional)		O	O			
Electric power transmissions (batteries and their recharging, generators, direct current and asynchronous motors)						O
Remote controls of machinery (nacelles, compactors, cranes, etc.)	O	O				
Driving assistance and diagnostic tools	O	O	O			
Cabin air conditioning (air conditioning)					O	O

Knowledge and skills

Required capacities favoring an experimental approach are written in italics.

• **Physics at the service of the maintenance of construction and handling equipment:**

P1: The signal and its analysis

Concepts and contents	Required capacities
Temporal properties	• *Propose an experimental protocol and implement it to determine the characteristics of a signal: average value, extreme values, rms value, rise time, settling time.* • Estimate, in simple cases, the mean value of a signal from its timing diagram. • State that a periodic signal can be considered as the sum of a DC component and an AC component. • *Practice an experimental approach to characterize a signal.*
Frequency properties	• State that an alternating periodic signal can be decomposed into the sum of a fundamental and harmonics. • Exploit an amplitude spectrum. • Characterize the amplitude spectrum of a signal, the frequencies and amplitudes of its fundamental and its harmonics being given. • Use spectral analysis software. • *Propose an experimental strategy and implement the associated protocol to plot the amplitude spectrum of a periodic signal.* • Use spectra obtained by simulation.

P2: The system and its performance

Concepts and contents	Required capacities
Transitional regime Steady state	• *Propose an experimental strategy and implement the associated protocol to visualize the time response of a linear system.* • Distinguish between transient and steady state on the time response of a linear system.
Response time, existence of overshoots and order of a system	• Identify the order of a system from its step response. • Use the step response of a first-order linear system to determine the response time of the associated system. • Use the step response of a second-order linear system to determine the response time of the associated system. • *Propose an experimental strategy and implement the associated protocol to highlight the influence of the damping coefficient on the shape of the step response of a second-order linear system.*
Block diagram of a controlled or regulated system	• Use the functional diagram of a control or servo loop to identify its components. • Explain the interest of a control or a regulation.

P3: The measurement of physical quantities and their environments

Concepts and contents	Required capacities
Measurement chains	• *Propose an experimental strategy and implement the associated protocol to carry out simple measurement chains in relation to business applications.*
Passive and active sensors	• Explain the role of a sensor. • Identify the sensor on a measurement chain. • Define the input and output quantities. • Define the nature of the output quantity of a sensor.
Static and dynamic characteristics	• Describe the choice of a sensor. • Exploit the static and dynamic characteristics of sensors. • *Propose an experimental strategy and implement the associated protocol to identify the static and dynamic characteristics of a sensor.*
Principle of operation of some sensors	• Establish the association of the laws of physics or chemistry to the transducers present in the main sensors used in the professional field by exploiting resources.
Conditioning a sensor	• Explain, in a particular application, the role of a sensor conditioner. • *Implement an experimental protocol to determine the static characteristic of a set {sensor, conditioner} (this set can be integrated).* • Dimension, by exploiting resources, a conditioning mode of a sensor for a given use.
Analog digital conversion	• Exploit the output/input characteristic of a DAC (digital converter analogue) and technical documentation to determine the characteristics of a DAC: resolution, non-linearity, conversion time.
Analog to digital conversion	• Use the output/input characteristic of an ADC (analog converter digital) and technical documentation to determine the characteristics of an ADC: resolution, non-linearity, conversion time. • Explain the role of a sample-and-hold.

P4: Thermodynamics and thermal machines

This chapter is intended to introduce as simply as possible the thermodynamic principles of operation of a heat engine. The notions introduced will be illustrated and applied to real machines (internal combustion engines, site compressor, air conditioning, heat exchanger). The Clapeyron diagram (P,V diagram) will be used to describe the transformations of a system, and the cycle of a heat engine.

1. Structure of matter

Concepts and contents	Required capacities
The three states of matter **The amount of matter** **Its unit: the mole** **Atomic and molecular molar masses: M (g.mol-1)**	• Describe the solid, liquid and gaseous states using a microscopic approach. • Define the changes of state of pure substances: fusion, solidification, vaporization, liquefaction, sublimation, condensation. • Dimension a molecular molar mass from the molar masses atomic. • Apply the different relationships to calculate a quantity of material.

2. Internal energy, first principle of thermodynamics

Concepts and contents	Required capacities
Vocabulary and definitions (system, equilibrium state, state variables, state function, various types of transformations, cycle, closed and open systems) **Internal energy U of a system.** **DU = W + Q** **Case of condensed phases: specific heat capacity of a solid or a liquid**	• Explain the measurement of a temperature as a measurement of the agitation of particles. • Explain the pressure of a gas as resulting from the elastic collisions of the particles on the wall. • Identify the intensive or extensive character of a quantity. • Interpret internal energy in microscopic form. • *Practice an experimental approach to determine the specific heat capacity of a solid or a liquid.* • Establish an energy balance during a heat transfer between two systems in condensed phases to determine the equilibrium temperature of the system.

3. The ideal gas model

Concepts and contents	Required capacities
Average kinetic energy **Heat capacities at constant volume and constant pressure** **Mixture of ideal gases, Dalton's law** **Work of pressure forces during compression or expansion of an ideal gas**	• State and apply the equation of state of an ideal gas. • State and apply Joule's first law relating to an ideal gas. • Evaluate the variation of internal energy during a transformation of an ideal gas, the initial and final temperatures being known. • Use the equation of state of an ideal gas in the case of a mixture of ideal gases. • Evaluate the work, the variation of internal energy and the heat transfer Q, in the case of simple transformations (adiabatic, isochoric, isothermal or isobaric) of an ideal gas.

4. Enthalpy

Concepts and contents	Required capacities
Definition and interest **Enthalpy of change of state (or latent heat of change of state)** **Reaction enthalpy**	• Evaluate the enthalpy variation for a transformation of an ideal gas, the initial and final temperatures being known • *Practice an experimental approach to determine a latent heat of change of state.* • Establish the enthalpy balance of a closed system during a transformation presenting a change of state.

5. Second law of thermodynamics

Concepts and contents	Required capacities
Statement of the second principle **Entropy** **Entropy exchanged and entropy created**	• State the second principle as a principle of evolution allowing to translate the irreversibility of thermodynamic transformations. • Evaluate the change in entropy exchanged during an isothermal transformation with thermostat to Text from expression: Se= Q/Text

6. Thermal machines

Concepts and contents	Required capacities
Application of the principles of thermodynamics to dithermal cyclic thermal machines (motor, air conditioner, refrigerator, heat pump) **Yield, efficiency, Carnot's theorem** **Example of thermodynamic treatments of thermal machines**	• Describe the operating principle of thermal machines and identify the energy transfers involved in carrying out an energy balance. • Define the enthalpy variation as the work done to the fluid during a adiabatic compression. • Define and express the output or efficiency of a dithermal heat engine. • Distinguish the efficiency of a heat engine from the efficiency of a cycle of Carnot equivalent. • • Using examples, identify the main causes of irreversibility. • Use information (simulation, text, graphics, etc.) to describe a real machine of your choice, emphasizing the modeling of transformations.

7. Thermal transfers

Concepts and contents	Required capacities
Heat transfers by conduction, convection and radiation **Thermal characteristics of materials**	• Characterize conduction and convection (forced, natural). • *Propose an experimental strategy and implement the associated protocol to compare the thermal conductivities of several materials.* • *Propose an experimental strategy and implement the associated protocol which makes it possible to classify materials according to their insulating properties, their thermal conductivity being given.*

P5: Conversion of electrical energy and control of actuators

1. Electromechanical converters

Concepts and contents	Required capacities
DC machines	• Represent the power conversion performed by a DC machine by specifying the relationships between the input and output quantities. • Define and exploit the equivalent electrical model of the armature in steady state. • Establish the power balance and evaluate performance. • Apply the fundamental principle of dynamics to study behavior dynamics of a motor-load assembly in a simple case. • *Propose an experimental strategy and implement the associated protocol to identify the mechanical characteristic Tu = f( ).* W • *Propose an experimental strategy and implement the associated protocol to determine the operating point of a motor-load assembly, the mechanical characteristics being given.*

AC machines	• Represent the power conversion performed by an alternating current machine by specifying the relationships between the input and output quantities. • Characterize the coupling of the armature on a network. • Establish the power balance and estimate the yield. • *Practice an experimental approach to characterize the operating point of a motor-load assembly, the mechanical characteristics being given. • Propose an experimental strategy and implement the associated protocol to record the characteristics Tu = f( ) for various values of the motor supply frequency for operation at constant U/f.* W

2. Static converters

Concepts and contents	Required capacities
Transformer	• Represent the power conversion carried out by a transformer by specifying the relationships between the input and output quantities. • *Propose an experimental strategy and implement the associated protocol to measure the turn ratio of a transformer.*
Switches in power electronics	• Describe the components used. • *Propose an experimental strategy and implement the associated protocol which characterizes the switching frequency.*
Rectifier not controlled	• Represent the power conversion performed by a rectifier by specifying the relationships between input and output quantities. • Identify the nature of the converter from the structural diagram or the output voltage timing diagram.
choppers	• Represent the power conversion performed by a chopper by specifying the relationships between the input and output quantities. • Identify the nature of the converter from the structural diagram or the output voltage timing diagram. • Characterize the voltage and the intensity of the current available at the output of a chopper with from the timelines. • Describe the influence of a coil on the current ripple and underline the interest of smooth. • *Propose an experimental strategy and implement the associated protocol to establish the relationship between the output quantity of the actuator (for example the speed of rotation of a motor) and the duty cycle of the command.*
inverters	• Represent the power conversion performed by an inverter by specifying the relationships between input and output quantities. • Identify the nature of the converter from the structural diagram or the output voltage timing diagram. • Establish the direction of energy transfer from the timing diagrams of the voltage and the intensity of the current available at the output. • *Propose an experimental strategy and implement the associated protocol to identify the voltage and current harmonics at the output of an inverter and highlight the relationship between the type of command and the frequency spectrum of the voltage or current in output from an inverter.*

• **Chemical reaction for the maintenance of construction and handling equipment**

C1: Matter and its oxidation and reduction reactions

1. The chemical reaction

Concepts and contents	Required capacities
Chemical reaction: symbolic writing, limiting reactant, stoichiometry, advancement, mass balance	• Describe the equation of the chemical reaction with stoichiometric numbers correct. • Evaluate a material balance. • Identify the limiting reactant. Define the concept of stoichiometric mixture. • *Practice an experimental approach to study the evolution of a system that is the site of a chemical reaction.*

2. Case of combustions

Concepts and contents	Required capacities
Combustion; fuels; fuels **Complete and incomplete combustion** **Composition of conventional and alternative fuels**	• Define the chemical equations of fuel combustion reactions (hydrocarbons). • Characterize alternative fuels (for example: composition, mode of operation). • Dimension CO2 emissions.
Energy aspects associated with combustion; orders of magnitude **Calorific value of a fuel** **Octane and cetane number**	• *Practice an experimental approach which shows that, during combustion, the system transfers energy to the external environment in thermal form and estimate the value of this energy released.* • Evaluate, using a formula provided, the energy released during combustion (enthalpy variation at constant pressure). • *Practice an experimental approach to define the powers calories of some fuels.* • Characterize the octane and cetane numbers.
pollutants **Protection against the risks of combustion**	• Explain the production of certain pollutants (eg products of incomplete combustion, nitrogen oxides). • Explain the physiological effects of pollutants. • Explain the dangers associated with combustion and the means of prevention and protection.

3. Redox

Concepts and contents	Required capacities
Oxidizer, reducer **Oxidizing/ reducing couple** **Redox reaction**	• Define a redox chemical reaction. • Identify the oxidant, the reducer, the oxidant/reducer couples involved. • Define the chemical equation of a redox reaction, the oxidant/reducer couples being given. • *Practicing an experimental approach that makes it possible to construct a electrochemical classification of metals.*

Electrochemical cell Accumulator	• *Practicing an experimental approach that makes it possible to create a battery electrochemistry and interpret its operation.* • Distinguish between batteries and accumulators. • Explain how a fuel cell works.

Specification of levels of acquisition and mastery of knowledge associated with knowledge S5 to S8

LEVEL 1: INFORMATION level

Knowledge is relative to **the apprehension of an overview of a subject :** the realities are shown under certain aspects in a partial or global way.

Comments: *This is a familiarization with the main (basic) elements of the subject allowing a simple description of the whole subject to be given, using common words, typical terms and examples.*

LEVEL 2: Level of EXPRESSION and COMMUNICATION

Knowledge is relative to **the acquisition of means of expression and communication:** defining, using the terms that make up the discipline. It is about mastering knowledge.

Comments: *this level encompasses the previous one.*
It is a question of having a general knowledge of the theoretical and practical aspects of the subject and of understanding the associated essential principles allowing:
- to give a general description of the subject, using, as appropriate, typical examples; - to use mathematical formulas in conjunction with physical laws describing the subject; - read and understand sketches, drawings, diagrams and detailed procedures; - apply knowledge in a practical way using detailed procedures.

LEVEL 3: Level of MASTERY OF STUDY OR ACTION TOOLS

Knowledge relates to the **mastery of study or action processes and tools :** using, manipulating rules or sets of rules (algorithm), principles, with a view to achieving a result. It is about mastering a skill.

Comments: *this level includes, in fact, the two previous levels.*
It is a question of having a detailed knowledge of the theoretical and practical aspects of the subject, as well as of the relations with the other subjects, allowing:
- combine and apply separate pieces of knowledge in a logical and comprehensive way sible;
- to give a detailed description of the subject using the essential theoretical principles and examples specific;
- to understand and use approaches, methods, laws, principles, expressions (example: mathematical formulas) related to the subject;
- to read, understand and prepare sketches, simple drawings and diagrams describing the subject; - apply their knowledge in a practical way using the manufacturer's instructions; - interpret results from different sources and measurements and apply corrective action as appropriate.

LEVEL 4: Level of

METHODOLOGY OF PROBLEM SETTING AND SOLVING

Knowledge relates to the **mastery of a methodology for posing and solving problems :** assembling, organizing the elements of a subject, identifying relationships, reasoning from these relationships, deciding with a view to a goal to be achieved. It is a question of mastering an approach: inducing, deducing, experimenting, documenting oneself.

Comments: *this level actually includes the three previous levels*

It is a question of having a conceptual knowledge of the theoretical and practical aspects of the subject, as well as of the relations with the other subjects, allowing: - to analyse, evaluate and compare technical and economic performances; - to model with a view to conducting theoretical or simulated behavioral studies; - to design or modify products, processes, approaches, organisations, etc.; - to experiment and qualify products, procedures, processes, approaches, organizations

you…

S5 Study of the material, its equipment and its constituents

The maintenance intervention on a piece of equipment requires, on the part of the technician, a preliminary approach to the functional and structural plans. This analysis, carried out from the technical file or the asset in its reality, allows it to carry out various maintenance activities: diagnosis, repair, adaptation and control.

The teaching of S5 knowledge is based on the intervention of the various teachers in charge of technical training, both theoretical and practical. It leads learners to be able to decode the types of technical representations from the industrial world by associating them with the observation of the material in its reality whether it is in a training establishment or in a company.

This teaching does not aim to train learners in the development of all types of models and representations of structures and technical solutions. It must allow them to identify and characterize a failure, malfunction or behavior, in order to determine the causes and consequences by proposing solutions for remediation or adaptation.

This teaching does not in any way aim to present all the constructive solutions. It must, based on maintenance issues, highlight the parameters influencing the performance and life of the system or mechanism.

This analysis approach mobilizes scientific and technological skills by providing knowledge of the functioning of the mechanisms and their constructive solutions, prior to diagnostic and maintenance activities.

Knowledge, knowledge (concepts, notions, methods)	Level	**Comments**
S5.1 Description of systems S5.1.1		
External approach • System or hardware environment. • Functional specifications for the equipment and/or its tool(s).	3	The diagrams of the systemic analysis are an input data. They make it possible to situate the frontier of the study in its multi-technological context. We limit ourselves to reading and understanding the diagrams. The function of the system or equipment is discussed and explained taking into account safety and environmental constraints. The study is limited to the definition of the environment of intervention of the system or equipment, to the interactions in order to justify the configuration of the system: nature of the terrain and production constraints.
S5.1.2 Internal approach • Service functions and links with technical functions. • Functional organization of the chain of energy: acting, feeding, converting, modulating, storing, transmitting. • Functional organization of the chain information: acquire, code, communicate, memorize, restore, process. Link between the information chain and the energy chain (open loop chain, closed loop). • Structural organization of the system or material.	3	The link must be made between the system(s) and/or subsystems (equipment and/or subassemblies) as well as between the associated representation diagrams. The internal description of the system or equipment must be carried out by integrating, if these elements exist, system engineering data by using system analysis diagrams but also functional description tools (usual, APTE method, SysML language). The goal is to show different system architectures as well as the flows (energy, information, matter) crossing the system or the material under study.

S5.2 Representation tools		
• Diagrams. • Freehand sketching. • Plan and nomenclature. • Digital model. • Flowchart. • Fault tree. • Block diagram. • Fluid diagram (pneumatic hydraulics). • Electrical diagram. • Kinematic diagram. • Graph of assembly, disassembly.	3	The use of representation tools is integrated into the functional and structural analysis of the system, technical communication. For digital models, we limit ourselves to the simulation of assembly and disassembly, to the extraction of a component or a subsystem. We do not neglect the 2D representations often used in companies. The different representation standards are provided.
S5.3 Materials and equipment •		
Operating functions of materials and team lies. • Production parameters: - production cycles; - factors influencing productivity; - the adaptation of the equipment to its use. • Notion of adequacy. • Safety and stability elements.	3	A set of materials and equipment representative of the various sectors of activity is thus approached the representative materials: - handling; - lifting (load and people); - public works (civil engineering, VRD roads and various networks, road infrastructure); - of the building ; - mines and quarries. The regulatory aspects are dealt with in connection with knowledge S6.3 and S8.
S5.4 Mechanical systems		
S5.4.1 Modeling of mechanisms • Modeling of mechanical assemblies. • Association of elementary mechanical connections: compound connections. • Descriptive tools for link chains.	4	The flat kinematic diagram is drawn up as a whole or supplemented and commented on. Spatial representation is approached from a reading point of view.
• Notions of hyperstatism.	2	This involves linking the notion of hyperstatism to the geometric or functional conditions to be respected within the assembly. Particular emphasis is placed on: - assembly conditions (adjustments, tolerances, compatibility); - the settings (play, tightening, pressure); - factors influencing service life (forces, relative speed, surrounding environment, etc.); - the problems posed by hyperstatic assemblies (misalignment, poorly adapted clearances, etc.).
S5.4.2 Modeling of mechanical actions • Contact and distance mechanical actions.	4	The representation of the mechanical actions is done in vectorial form and the writing in the form of torsor. Simulation is also used to visualize mechanical actions. Ground/machine contact will also be dealt with.

S5.4.3 Mechanical behavior of solids • Statics: - fundamental principle of statics; - problem solving methodology graphical and analytical statics problems.	3	The graphic and analytical resolutions are carried out in the cases of systems subjected to mechanical actions in the plane. The spatial loading case is processed by the computer tool.
• Kinematics: - nature and definition of movements; - trajectories of the points of the solid, velocity and acceleration vectors;	4	We limit ourselves to the study of plane movements and to movements of translation and rotation around a fixed axis in the case of uniform or uniformly varied movements. The analysis of speed and acceleration curves from experimental readings and/or simulations is preferred.
- instantaneous center of rotation; - properties and associated theorem; - study of the kinematic chains of the system, the input-output laws.	3	Simulation is favored in order to visualize the trajectories of points, the velocity and acceleration vectors. The graphical and analytical resolutions are used in the "simple" cases (3-bar system, 4-bar system, gear trains, pulley-belt, chain-sprockets, etc.), the more complex cases (cams, connecting rod-crank, etc.) are simulated.
• Dynamics: - inertia of the solid (center of gravity, moment of inertia around an axis); - fundamental principle of dynamics; - notions of static and dynamic balancing of a rotating solid.	3	The study is limited to the movements of rectilinear translation or rotation around a fixed axis (one exploits software for the other cases). The approach to balancing or unbalancing (vibrations), is done experimentally and using software (the approach is limited to imbalances materialized by an eccentric point mass).
• Resistance of materials: - different types of stress; - notions of stresses and deformations; - principle of superposition applied to bending - tensile loading; - matting (Hertz theory); - fatigue ; - buckling.	3	The objective is not the calculation for the dimensioning but the understanding and identification of the parameters which can be responsible for the failure of a part. The notions of resistance condition, safety factor are discussed. Simulation is favored in order to identify the influential parameters. As far as possible, tests are carried out implemented.
• Energy: - different forms of energy; - principle of conservation of energy; - yield ; energy balance of a system. -	3	The different forms of mechanical energy (potential, kinetic, hydraulic, pneumatic, electrical, thermal) are discussed. Applications are limited to translational and rotational movements around a fixed axis.

S5.4.4 Materials • Nature of materials and properties. • Relationship between strain and stress. • Notions of fatigue. • Designation of metals and alloys. • Characteristics of materials. • Special skills (heat treatment, mouldability, weldability, shaping, recycling, etc.).	2 2	We limit ourselves to the mechanical, thermal, electrical and magnetic characteristics and aptitudes. Particular attention is paid to the typology of materials and their fields of use as well as the main treatments of metals and alloys. The influence of external factors on the durability of the mechanical characteristics is addressed in particular during the overheating of parts and the behavior of heat treatments. The possibilities of treatment(s) of the materials are approached only from a theoretical point of view.
S5.4.5 Processes related to parts and their assemblies • Process properties. • Limits of use. • Cost.	3	We limit ourselves to case studies of constituents to highlight the part-material-process relationship in order to measure the limits of use of the different processes: - shaping (moulding, deformation, usi swimming); - surface treatment; - assembly processes (bolted, pinned, hooped). We favor the use of manufacturer's data in the form of charts or other while respecting the constraints related to their environment.
S5.4.6 Guides in rotation (including ball joint), in translation • Associated constructive solutions. • Concept of hyperstatism (misalignment). • Assembly conditions (adjustments, tolerance rancid, compatibility). • Adjustments (play, tightening, pressure). • Factors influencing service life (pres tion, relative speed, lubrication, protection linked to the surrounding environment, etc.).	4	We approach the various construction solutions (direct contact, pads and friction rings, bearings, bushings, oil films, etc.) in support of practical activities.
S5.4.7 Lubrication • Role of lubricants (lubrication, heat exchange and depollution of the circuit). • Designations of lubricants. • Physical and chemical characteristics • Lubrication techniques. • Limits of use. • Oil pollution and quality controls.	4	We discuss applications that use different lubricants: oil, grease and others. We limit ourselves to the main characteristics (quality, viscosity index, viscosity, smoothness, stability, etc.). We use analysis reports.

S5.4.8 Sealing • Standard designations. • Assembly conditions (adjustments, tolerance rancid, compatibility). • Adjustments (play, tightening, pressure). • Factors influencing service life (pressure, relative speed, surrounding environment, etc.).	4	All the constructive solutions are approached from the point of view of maintenance and in priority during practical activities. Sealing solutions are discussed: • direct by shape coincidence: - by linear contact (valves, hydraulic fittings, etc.), - by surface contact (windows, face seal), • by interposition of a deformable part (seal) : - without relative movement, - with relative movement (rotation or transla tion).
S5.4.9 Constituents of the transmission chain • Functional parameters (input/ output relations, characteristic curves, etc.). • Ranges and limits of use (speed, torque, temperature,…). • Performance criteria (yield, lifetime, etc.). • Assembly conditions, adjustments and maintenance. • Sizing of a component. • Advantages and disadvantages of the different constituents responding to the same function. • Common applications.	4	The following supports are discussed: - torque converters (single-phase, two-phase and three-phase); - multi-disc clutches and their controls; - Power shift gearboxes (parallel and planetary); - the continuously variable transmission naked; - transfer boxes; - bevel gears and differentials; - the brakes (dry, in oil bath); - speed bumps; - the final reduction (parallel gears and glide silencers); - the couplings (shafts, universal joints, elastic coupling, etc.); - the connection to the ground (tyres and undercarriages). We favor the use of manufacturer's data in the form of charts or other while respecting the constraints related to their environment.
S.5.4.10 Architecture of mechanical transmission systems • Machine architecture. • Expected production performance. • Expected lifetime. • Influence of design and manufacturing costs tion, of use. • Commercial strategy.	4	Different mechanical transmissions are compared to highlight the choice of constructive solutions according to: - building and public works machinery (returning, loading, excavation, transport machinery, etc.); - handling equipment (loads and people).
S5.5 Thermodynamic systems S.5.5.1		
Applications of thermodynamics • Operating cycles. • Functional parameters (input/output relations, characteristic curves, etc.). • Ranges and limits of use (speed, torque, temperature,…). • Factors influencing operation and performance.	4	This part covered in connection with the teaching of thermodynamics in the physics course aims to apply the knowledge acquired through an approach related to the maintenance of the following systems: - the 4-stroke spark-ignition engine; - the 4-stroke engine with compressor ignition if we ; - piston and screw compressors; - the heat transfer circuits and the associated heat exchanges for temperature stabilization (engine, hydraulics, passenger compartment, etc.); - hydropneumatic accumulators.

S.5.5.2 Associated construction solutions • Organization and operation. • Functional parameters (input/output relations, characteristic curves, etc.). • Factors influencing proper operation and performance. • Legislative and/or environmental constraints tales. • Methods and standards for measuring performance manses. • Assembly conditions, adjustments and maintenance. • Advantages and disadvantages of the different constituents or systems responding to the same function.	4	The following systems are discussed: - fuel conditioning and supply (natural supply and turbo compressor); - conditioning and fuel supply rant (petrol, LPG and diesel); - the oxidizer/fuel mixture, ignition of the mixture and combustion; - the mechanical architecture and energy transformation (controlled ignition and compression engine); - the lubrication circuit; - the cooling circuit; - depollution systems (pre and post combustion); - the site compressor; - the air conditioning circuit.
S5.5.3 Energy management in thermodynamic systems • Organization and operation. • Operating ranges and limits (characteristic curves, etc.). • Performance criteria (stability and precision in different work situations, etc.). • Settings and adjustments. • Advantages and disadvantages of the various constructive solutions. • Common applications.	4	In this context, energy management systems applied to: - internal combustion engines and their control systems are dealt with; annexes; - air conditioning circuits; - site compressors.
S.5.5.4 Architecture of thermodynamic systems • Organization of systems. • Selection criteria (performance, strategy commercial, design and manufacturing cost).	4	We deal with different architectures: - heat engines; - air conditioning; - site compressors.
S5.6 Hydraulic systems S5.6.1		
Fluid mechanics • Fluid statics: force-pressure law; - Pascal's theorem; - Archimedes' theorem; hydrostatic law. • Fluid kinematics: - volume flow, mass flow; - continuity equation. • Dynamics of incompressible fluids: - Bernoulli's equation, with or without energy transfer; work and power exchanged between - the fluid and the external environment during its evolution; - flow of a real fluid in a pipe; - kinematic and dynamic viscosities, Reynolds number; - laminar and turbulent flows; - singular and regular head losses.	4	We approach this knowledge through practical activities with the use of charts and manufacturer documents during the structural and behavioral analysis of a fluidic system (for example in the choice of pipe sizing, hydraulic components).
S5.6.2. Associated constructive solutions • General organization of circuits. • Schematic representation. • Constituents. • Functioning.	4	We discuss: - fluids and their packaging (filtration, etc.); - pipes and connections; - energy transformers (pumps, mo-

• Functional parameters (input/output relations, characteristic curves, etc.). • Ranges and limits of use (speed, pressure, flow rate, viscosity, temperature, response time, etc.). • Performance criteria (yield, lifetime, etc.). • Assembly conditions and adjustments, advantages and disadvantages of the various constructive solutions.		tors, cylinders); - the distribution elements; - flow control elements. (series regulator, bypass, divider, limiter); - the accumulator; - the pressure regulation elements (direct action limiter, pilot operated, pressure reducer, sequence valve, balancing valve); - the load control elements (check valve, pilot valve, drop arrester valve, etc.). We approach this knowledge through practical activities by dealing with current solutions with the use of manufacturer's data in the form of charts or others while respecting the constraints linked to their environment.
S5.6.3 Energy management in hydraulic circuits • Operation. • Operating ranges and limits (characteristic curves, etc.). • Performance criteria (stability and precision in different work situations, etc.). • Settings. • Construction solutions, advantages and disadvantages of the different construction solutions. • Common applications.	4	We deal with energy management systems using different technologies (hydraulic and/or electric) and applied in circuits taking into account one or more generators and/or one or more receivers. In this context, energy management systems are dealt with: • according to demand (conductor, load, etc.): - open center equipment circuits, - closed center equipment circuits, - closed circuits (hydrosta transmissions ticks), • depending on the energy available (engine): - the equipment circuits, - the closed circuits (hydrostatic transmissions ticks), • by accumulation; • pressure limitation by flow cancellation. We favor the use of manufacturer's data in the form of charts or other while respecting the constraints related to their environment.
S5.6.4 Hydraulic systems architectures • Machine architecture. • Expected production performance. • Expected lifetime. • Influence of design and manufacturing costs tion, of use. • Commercial strategy. • Typology of circuits.	4	We deal with the different circuits: - equipment with an open center distributor (with or without regulation); - closed center distributor equipment (with or without regulation); - open circuit hydrostatic transmission and closed circuit; - control (hydraulic, electro-hydraulic, manual control); - steering (steering boxes, steering valve, management priority); - braking; - suspension; - cooling.

S5.7 Electrical systems		
S5.7.1 Notions of electricity • Quantities used in electricity and their units (voltage, current, power, frequency, resistivity, etc.). • Law of knots. • Law of stitches.	4	These notions are approached jointly in physics.
S5.7.2 Associated constructive solutions • General organization of circuits. • Schematic representation. • Constituents. • Functioning. • Functional parameters (input/output relations, characteristic curves, etc.). • Ranges and limits of use (voltage, current, speed, acceleration, temperature, response time, etc.). • Performance criteria (yield, lifetime, etc.). • Sizing of a component. • Conditions for mounting adjustments and maintenance. • Constructive solutions, advantages and disadvantages deny. • Common applications.	4	The following components are discussed: - energy accumulators; - energy transformers (generator and receiver); - conductors and connectors; - distribution and regulation elements (diode, relay, resistor, transistor, etc.); - modulation and control elements (chopper, inverter, calculator, etc.); - safety elements (circuit breaker, circuit breaker, fuse, etc.); - the sensors (logic, analog, digital laugh. We favor the use of manufacturer's data in the form of charts or other while respecting the constraints related to their environment.
S5.7.3 Energy management in electrical circuits • Operation. • Operating ranges and limits (characteristic curves, etc.). • Performance criteria (stability and precision in different work situations, etc.). • Settings. • Advantages and disadvantages of the various constructive solutions. • Common applications.	4	The energy management systems applied in circuits taking into account one or more generators and/or one or more receivers are dealt with. In this context, energy management systems are dealt with: • according to demand (driver, load, etc.): - open loop circuits, - closed loop circuits, • according to available energy (motor): - open loop circuits, - closed loop circuits, • energy production and recovery; • hybrid solutions will be discussed. We favor the use of manufacturer's data in the form of charts or other while respecting the constraints related to their environment.
S5.7.4 Electrical systems architectures • Machine architecture. • Expected production performance. • Expected lifetime. • Influence of design and manufacturing costs tion, of use. • Commercial strategy. • Communication buses and networks.	4	The different circuits are treated: - load; - starting ; - signaling; - control ; - power.

S5.8 Embedded computing		
S5.8.1 Notions of embedded computing • Communication protocol. • Information transmission mode (wired, wireless, etc.). • Data processing.	3	These notions are approached jointly in physics.
S5.8.2 Associated constructive solutions • General organization of circuits. • Schematic representation. • Constituents. • Functioning. • Functional parameters (input/output relationships tie, …). • Ranges and limits of use (temperature, response time, electromagnetic compatibility, etc.). • Performance criteria (adaptability, etc.). • Mounting conditions, settings, configuration tion. • Advantages and disadvantages of the various constructive solutions. • Common applications.	3	Knowledge is approached through practical activities carried out on real or didactic systems. We discuss: - calculators and electronic card; - input and output interfaces; - organization of the CAN, LIN network; - the physical medium and class of bus (twisted pair, optical fibre, transmission speed, etc.); - the structure of a frame; - management of priorities and arbitration; - the measurable characteristics of a multiplexed network (resistance, voltage levels, presence of a frame). We limit ourselves to identifying the different media (for example: wires, optics, Bluetooth, wifi).
S5.8.3 Energy management in embedded computer circuits • Parameterization, calibration, initialization. • Program update. • Reading data for diagnostic purposes. • Advantages and disadvantages of the different solutions constructive actions. • Common applications. • Performance and adaptability criteria.	3	We discuss energy management systems according to demand (driver, load, etc.): - open loop circuits; - closed loop circuits; - multi-master, master-slave, etc. - priority management and arbitration.
S5.8.4 System Architectures in Embedded Computer Circuits • Engine architecture. • Expected production performance. • Expected lifetime. • Influence of design and manufacturing costs tion, of use. • Commercial strategy. • Communication buses and networks.	3	Circuits taking into account several computers, sensors and actuators are discussed: - telematics; - driving assistance; - GPS and laser guidance; - data remote transmissions; - remote maintenance / remote diagnosis. From the manufacturer's diagrams, it is a question of identifying the organization of the network: notion of topology, for the most common networks (CAN, LIN, etc.). The basic principles of the two fields mentioned are approached through topical examples.

S6 Service		
The objective is to make the future senior technician capable of: - carrying out preventive maintenance operations; - to check all or part of the performance of a system or subsystem; - to diagnose; - to restore compliance and/or adapt. This knowledge – in connection with S5 knowledge – must always be presented as elements of solutions to problems related to activities: - preventive maintenance; - repair or troubleshooting of systems; - diagnosis or configuration; - after-sales; - adaptation.		
Knowledge, knowledge (concepts, notions, methods)	Level	**Comments**
S6.1 Maintenance strategy S6.1.1		
Maintenance function • Maintenance policy and objectives.	2	We limit ourselves to a general knowledge of the vocabulary and concepts of maintenance. It is based on the general recommendations of the manufacturer or adapted to the particular conditions of use (for example: periodicity, particular clauses of the rental or maintenance contract) in relation to knowledge S5 & S7.1.2.
• Maintenance methods and criteria for choice: - corrective maintenance; - Preventive maintenance.	3	We refer to the standards in force (to date Standard NF FD X 60-000) by limiting ourselves to theoretical notions and dedicated vocabulary. Examples can be taken from company documents.
• Structuring of maintenance (study, preparation, scheduling, implementation, management).	3	This involves presenting the various documents associated with the maintenance plan through practical activities (for example: history file, maintenance data, maintenance plan).
S6.1.2 Costs induced by an act of maintenance • Costs related to maintenance.	2	Reference is made to the standards in force (currently Standard NF FD X 60-000). The cost of the intervention and the cost of the immobilization are studied. We also discuss the notions of the economic monitoring of equipment. We take into account the notions of variable and fixed charges in connection with S7 knowledge, notions discovered in the company and returned in class. Any theoretical approach is excluded.
S6.1.3 Maintenance Indicators • Reliability. • Maintainability. • Availablity. • Cost.	2	The average lambda, MTBF and MTTR failure rate as well as the maintenance, availability and performance ratios of the machine (logistics time) are studied in connection with knowledge S7.4.

• Indicator analysis methods and tools of maintenance.	2	We limit ourselves to the use of curves and data linked to the current standard X60-500 (bathtub curve, Pareto law for example).
S6.1.4 Piloting a maintenance action • Scheduling. - load and capacity of a mainte service nance; - needs and constraints; - planning. • Realization.	2	In connection with the legal and economic aspects of S7.1, planning tools (eg maintenance tracking software: GANTT chart, PERT network) are discussed. In compliance with the FD X 60-000 standard, the triggering and monitoring of an intervention as well as the choice of information to be collected are studied.
S6.1.5 Quality • Definitions, issues, organization of company quality (approaches, methods and tools), quality assurance. • Current certifications, quality tools.	2	We limit ourselves to dealing with the elements of the quality approach in connection with the profession with regard to standards and organizational methods (for example: ISO 9000, 5S) and in connection with knowledge S7.1. A focus is made on the various professional approvals.
S6.2 Diagnostics		
• Manufacturer/company diagnostic procedures. • Characteristics of diagnostic tools. • Technique for developing a diagnostic procedure. - observation and validation of the failure; - identification of the faulty function; - functional and structural analysis of the system concerned; - issuing hypotheses; - ranking of hypotheses; - definition of the tests; - test methods and procedures; - measurements, controls; - results analysis ; - location ; - search for causes (failure mechanism, causes of failure).	4	Care is taken to show the advantages and limits of these approaches based on a few significant examples. The finding may relate to: - a failure; - drift ; - failure. The appropriate measurement, test and control tools are implemented. Tests, measurements and controls to validate or not the hypotheses are carried out. The probabilities of the causes of failure are discussed. The development of the diagnostic procedure is made in connection with knowledge S5 and S8.
S6.3 Response		
S6.3.1 Types of actions linked to the intervention • Removal-refitting of a sub-assembly. • Replacement of a component. • Repair of a component. • Adaptation, improvement. • Settings, configuration. • Tests and controls. • Monitoring and inspection. • Put back into service. • Choice of intervention.	4	The intervention is made in connection with knowledge S5 and S8. The criteria (availability, interchangeability, durability, cost, deadline, etc.) linked to each type of action are listed. The quality approach is taken into account. The intervention choices are illustrated through case studies (repair, troubleshooting, adjustment, advice, etc.).
S6.3.2 Preparation of the workstation • Knowledge of the intervention, the steps to follow, the means to mobilize and the conditions to respect.	4	It is necessary to take into account the human, technical and material resources and the HQSE rules linked to the place of intervention.

S6.3.3 Implementing actions • Operating modes associated with commissioning and/or decommissioning. **S6.3.4 Maintenance actions** • Associated operating modes: - securing goods and people sounds; - when removing and refitting the sub-assembly; - disassembly-reassembly of the sub-assembly; - handling (principles and means related to lifting and handling); - the alignment and balancing of rotating components (for example: shaft lines, pulleys); - the development or adaptation of procedures; - the implementation of tools, control devices, measurements, adjustments; - cleaning and degreasing of parts; - replacement of fluids; - waste management, recycling; - mechanical manufacturing techniques and processes; - the usual repairs.	3 3	These operating methods are studied in connection with knowledge S5 & S8. We integrate the use of data from measurements or analyzes (for example: metrology, contamination and degradation of fluids). We limit ourselves to the techniques: - drilling; - tapping; - sawing; - threading; - grinding; - horizontal welding; - terminal crimping; - sharpening in the case of minor repair work.
S6.3.5 Monitoring and inspection actions • Operating methods associated with monitoring the evolution of the asset.	3	These operating modes are associated with the examination of the significant characteristics and/or taking measurements with regard to a standard, a regulation or a recommendation (for example VGP).

S7 Applied Economics-Management		
The teaching of economics-management applied in STS maintenance of construction and handling equipment meets a triple objective: - the construction of an economic, legal and organizational culture in the field of the maintenance of construction and handling by addressing current themes and by mobilizing knowledge and reasoning from these disciplinary fields; - the contribution to the construction of professional skills with a status of support teaching, in coherence and transversality with the other professional teachings; - the rational use of new information and communication technologies as aid tools for the transmission of information and the development of professional skills. Skills will be acquired by constantly referring to the reality of companies in the sector concerned and will have to be translated into professional situations through, for example, role plays and practical case studies.		
S7.1 Economic and legal framework of business activities		
Knowledge, knowledge (concepts, notions, methods)	Level	**Comments**
S 7.1.1 Economic framework • Market demand: - typology of customers (individual or professional customers, large accounts); - customer expectations and their evolution; - various decision-makers and prescribers. • Market supply: - typology of suppliers and distribution networks; - offers of goods and services and their development tion; - competitive positioning.	2	The issues and developments in the customer relationship are addressed, in particular the financial aspect that it generates for the company. We endeavor to present the importance and the economic evolution of the sector, the diversity of companies and structures, the professional bodies in a European and global context. We endeavor to present the different forms of distribution networks (integrated, franchised, mixed), rental and approved repairers with particular attention to local competition.
S7.1.2 Legal framework • Commercial law - contract law; - legal and contractual guarantees; - legal value of the offer; - general conditions of sale, rental, repair. • Types of civil and criminal liability, causal link - guarantees applied; - obligations and duties of the repairer; - regulatory controls (for example: VGP, VCRS, VRS). • Legal and regulatory environment HQSE.	2	Legislation on spare parts and non-manufacturer re-use is addressed. Through several court decisions, emblematic situations engaging the responsibility of the repairer will be highlighted. The articles (1101 and following) of the Civil Code relating to the characteristics of a contract will only be discussed in contextualized situations. The notions of each type of liability and the possible consequences in the event of a dispute are discussed. The notions of obligation of result, advice, diligence are treated, concrete cases will illustrate these notions. The knowledge and practice of the rules and obligations are defined, a practice in the workshop will extend this study.

• Contractual links between the construction supplier/equipment manufacturer/brand and the repairer. • Labor law (social dialogue, representation Staff,…).	1	The following concepts are covered: - environmental regulations (waste treatment, discharge standards, etc.); - the work safety management standard; - the regulations dedicated to compliance with goods and people; - regulations relating to equipment; - transport regulations specific to each sector. Knowledge of the regulations and obligations relating to the single document are covered. A characteristic example can be the support of the study. (Links with S8 Occupational Safety). The types of contract between the manufacturer and its network (concessions etc.) are presented. (Link to S6.1.1 types of maintenance contract). The typology of employment contracts, the thresholds and the prerogatives of employee representation bodies are discussed.
S7.2 Organizational context of the company •		
Typology and characteristics of the company - organization chart; - role of the various departments; - link between services; - circulation of information flows.	1	We limit ourselves to situating ourselves in the entity in which the senior technician operates and, possibly, to positioning the entity within a group (subsidiary, concession, etc.). This presentation must allow the senior technician to position his activity in relation to the various services and contribute to the supply of the company's information system (link with S7.3.1).

S7.3 Information and communication		
S 7.3.1 Information gathering and economic intelligence • Collection. • Treatment. • Storage. • Diffusion. • Protection.	1	We present the economic intelligence approach in a professional context related to the sectors of activity of senior technicians. Information is both a source and a result of individual and collective action. Information systems (IS) contribute to making it a strategic resource for any organization. The information system is fed by sharing experiences, developing the knowledge base internally or in conjunction with technical support, in compliance with security and confidentiality rules.
S 7.3.2 Communication techniques • Written communication - different types of documents; - compliance with rules specific to professional and commercial writings (form, cabular); - compliance with company-specific rules (graphic charter, standard letters, etc.); - traceability of exchanges; - digital communication tools and office ticks (sms, emails, texters, etc.). – • Oral communication - persuasive communication; - non-verbal communication ; - positive influence techniques; - stress management in a communication situation cation.	3 2	We discuss: - the estimate; - the order of intervention; - the bill ; - the documents for monitoring the procedures for quality ; - the memorandum; - the feedback. The implementation of the basic rules relating to professional writings will be approached on examples of the production of documents from the technician's professional environment, both in terms of form and vocabulary. Any theoretical approach is excluded. The concepts are based on real professional situations. We address: - socio-cultural and psychological factors; - decoding non-verbal communication in conflict prevention; - the practice of active listening, the notions of otherness and empathy, the importance of questioning and reformulation. Scenarios and role plays are implemented to develop relational skills in person or by telephone.

S7.4 Management tools applied -		
Management and performance indicators: - invoicing elements; - notions of cost, product, margin; - after-sales service dashboards and performance indicators (for example: ISC, productivity rate). - Costs: - cost/price distinction; - cost components; - highlighting cost differences (actual/scales); - cost of using a material and profitability tee; - stocks and their impact on the quality of the service offered.	2 2	The summary documents (balance sheet and income statement) are only used in the context of a margin calculation. The work is based on examples of dashboards and is mainly limited to their analysis. The productivity and performance ratios are defined and interpreted as a priority. Calculations and analyzes of individual or team ratios are carried out over different characteristic periods. On the basis of the study, areas for improvement are defined. We limit ourselves to the analysis of the costs within the framework of a classic intervention. The multiple components of a cost (hidden, variable and fixed) are discussed. The distinction is made on total hours, productive hours (theoretical and actual), unproductive hours, invoiced hours. On the basis of the study, areas for improvement are defined. Related to knowledge S6.1.3 maintenance costs.
- Stocks and impact on the quality of the service offered.	1	The management of flows between the workshop and the store is approached in such a way as to make the technician aware of the various possible sources of malfunction.

S8 Professional environment		
Safety is a major issue present in each of the activities of the senior technician in equipment maintenance. The health of personnel must be guaranteed while also ensuring the preservation of property and the environment. The procedures implemented are based on the recommendations of the National Health Insurance Fund for Salaried Workers (CNAMTS) and the National Institute for Research and Safety (INRS). The academic training modules in Occupational Health and Safety Education (HE&ST) are widely used to provide this S8 knowledge. S8 knowledge is defined with reference to the regulations in force on the date of writing of the reference system. It will evolve with these regulations.		
Knowledge, knowledge (concepts, notions, methods)	Level	**Comments**
S8.1 General principles of occupational risk prevention Laws, decrees,		
force, single evaluation document • Actors of prevention. (DUER), prevention plan, statistics specific to the	2	regulations are discussed. Regulations. in professional branch. A distinction is made between the actors and organisations: - external: CRAM, CARSAT, INRS, Inspection and Occupational Medicine; - internal: business manager, Committee Health, Safety and Working Conditions (CHSCT), Staff Representative Bodies (IRP).
S8.2 Risk control		
• Risks in the profession (linked to the work environment, the use of resources, work situations). • Professional risk analysis approach: - associated terminology; - diagram of the damage appearance process; - risk-based approach; - work-based approach (ergonomics). • Types of prevention and associated measures: - intrinsic prevention; - collective prevention; - individual prevention; - prevention by instruction.	2	We deal in particular with the risks associated with: - the use of means of lifting, wedging, handling; - movement of machinery; - maintenance interventions on the materials. Risk analysis and the types of prevention and associated measures are carried out through case studies during the intervention and with regard to the DUER.

• Targeted prevention in the mainte activity finance: - prevention linked to physical activity; - prevention related to electrical risks; - prevention related to the operation of machinery; - prevention linked to the handling of fluids; - what to do in the event of an accident.	3	In connection with S7 knowledge, the following training courses are mandatory artwork : - electrical certification training (B2VL-BCL); - training in the handling of fluids (for example: air conditioning, gas) (article R543-106 of the environmental code, category of activity V); - training in the safe operation of vehicles outside production, with reference to the recommendations of the CNAMTS (R372M category 10, R389 category 6, R386 category 3B). Awareness of the following training is implemented: - training in the prevention of risks linked to physical activity - industry, construction, commerce (PRAP IBC); - occupational first aid rescue training (SST).
S8.3 Safety in the company and on site • Identification,		
signage (symbols, colors, signals).	2	Any theoretical approach is excluded; this knowledge is based on real professional situations.
• Procedures and instructions related to traffic, in the event of fire, evacuation.	3	
• Mode of use of emergency means (extinguishers, fire network, eye wash).	3	
• Collective and individual protection (EPC, PPE, work clothes and protection against the dangers involved, isolated worker).	3	
• Choice of means, identification of points of lifting, slinging and wedging, safety zone in the case of lifting, wedging, handling of loads.	3	
• Safety related to the working environment.	3	Particular attention is paid to the storage and use of flammable and/or harmful products, storage and charging of batteries, capacities containing pressurized gases, interventions on moving mechanical systems (eg grinder, drill).
• Instructions specific to certain intervention sites.	2	These instructions can be illustrated by the general regulations of the extractive industry RGIE (part concerning external contractors) and by the constraints linked to SEVESO classified sites.

S8.4 Regulations and procedures applicable to equipment • Legislation in force		
concerning equipment new, second-hand equipment and adaptations of equipment.	2	We limit ourselves to the declaration of conformity and the user manual.
• Periodic General Checks (VGP).	3	This knowledge is approached through examples of equipment from the technical platform.
• Categories of machine transport.	2	This knowledge is worked on during the transfer of material and in the case of an intervention (in connection with knowledge S7.1.2 and S8.2).
S8.5 Sustainable development		
• Issues, regulations, standardization. • Life cycle. • Management of waste (nature, quantity, harmfulness, flammability, nuisances), collection, sorting, storage.	2	We limit ourselves to societal, economic and environmental issues in compliance with regulations (environmental code, ISO 14000 standards).

5 – Table of correspondence between professional knowledge and skills

		C1.1	C1.2	C2.1	C2.2	C2.3	C2.4	C3.1	C4.1	C4.2	C5.1	C5.2	C5.3		
S5.1	Description of systems	X		XXX					X					XX	
S5.2	Representation tools	XXXXX							X					XX	
S5.3	Materials and equipment	XXXXXXX												XX	
S5.4	Mechanical systems	X		XXXXX										XX	
S5.5	Thermodynamic systems X			XXXXX										XX	
S5.6	Hydraulic systems	X		XXXXX										XX	
S5.7	Electrical systems	X		XXXXX										XX	
S5.8	Embedded computing	X		XXXXX										XX	
S6.1	Maintenance strategy								XXX					XX	
S6.2	Diagnosis							X				X			X
S6.3 Response									XXXXXX						
S7.1	Economic and legal framework of the company's activities		X							X				XX	
S7.2	Organizational context of the company		X							X					X
S7.3	Information and communication XX														X
S7.4	Applied management tools		X						X		X				X
S8.1	General principles of occupational risk prevention	XX							XXXXXX						
S8.2	Risk management	XX							XXXXXX						
S8.3	Safety in the company and on site Regulations and	XX							XXXXXX						
S8.4	procedures applicable to equipment	XX							XXXXXX						
S8.5	Sustainable development	XX							XXXXXX						

6 – Glossary

Accessory

Part, instrument or system which, installed on a piece of equipment, provides it with additional but non-essential functions (GPS, motion control valve, winch, grapple, etc.).

Professional activities

Class of tasks that are part of a work process: it generates an identifiable result that takes a step forward in solving the technical problem posed.
Example: conduct an intervention, carry out a diagnosis.

APTE

The APTE method (Application to Business Techniques) is a method for conducting a project. Starting from the expression of a need, its validation and then its functional expression, it makes it possible to evaluate all the requirements (technical, economic, etc.) that affect the project. It constitutes the first design phase leading to the publication of the functional specifications.

Article (NF X 60-012)

Properly identified as such, thereby constituting a nomenclature or catalog item.

Assembly

Action, way of bringing together different parts previously adjusted so that they form a rigid whole; result of this action.

Database

In general, it is a structured resource of elements relating to a given domain (family of components, materials, suppliers, etc.). These data are available on computer media residing on the company's computer network or on the Internet.

Need (overall statement of need), (NF X 50-150)

Need or desire experienced by a user. The notion of need makes it possible to specify the real services to be rendered and to pose the problem at its highest useful level of study or questioning.

B2VL

Automobile electrical accreditation, operator level, for electricians and electrical work managers on motor vehicles and machinery with thermal, electric or hybrid engines with on-board electrical energy (according to UTE C-18 550 2012 standard).

CACES

Certificate of aptitude for safe driving (public works and handling machinery).

Functional specifications (NF X 50-151)

Document by which the applicant expresses his need (or the one he is responsible for translating) in terms of service functions and constraints. For each of them, assessment criteria and their levels are defined. Each of these levels must be accompanied by flexibility.

The functional specification (CdCF) is a document that evolves and is enriched as the product creation phase progresses.
The CdCF must therefore be drafted independently of the possible solutions and must allow the expression of the need in terms understandable by the users.

Calibration

Determination of whether a measurement belongs to an intensity class between two predetermined limit values.

Capacity

Set of abilities that the individual could use in different situations. An ability guards a

very general in nature and describes an available potential more than a mastered operational skill. It is neither observable nor assessable. It comes down to skills.

CARSAT
Retirement and Occupational Health Insurance Fund.

CCF
Control during training.

CHSCT
Health, safety and working conditions committee.

Customer (user, prescriber, buyer, decision-maker, etc.)

On the commercial level, it is an individual who has already purchased a good or service from the company concerned. The notion of customer is therefore opposed to that of prospect.
In common vocabulary, the customer is often confused with the buyer, the decision-maker or the user.
The buyer is the individual who buys the product. The term buyer can also designate the person in charge of purchases in a company or in a purchasing or referencing group. The buyer/user-prescriber distinction is important in the field of business-to-business (B to B) commerce.
The buyer is not necessarily confused with the user/consumer and is not necessarily the decision maker.

CNAM
National Health Insurance Fund.

CNAMTS

National sickness insurance fund for salaried workers.

Competence
Set of knowledge, know-how and knowing how to be organized in order to contribute in an appropriate way to the accomplishment of a task or activity. In a concrete situation or context, a skill translates into generally observable actions or behaviors. The behaviors or/and the results of the action are measurable or assessable. Examples: make adjustments and fine-tuning of the various systems.

Component
Basic element which, added to others, forms a system.

General Terms and Conditions (GTC)

According to the Law **(article L. 441-6 of the Commercial Code),** the **T&Cs** constitute “the basis of commercial negotiation”. They generally accompany prospectuses, catalogues, prospecting e-mails, etc. They form a **legal whole with the commercial offer,** constituting the sales contract to which the offeror intends to submit his future co-contractor. They are general in scope. The final contract will only be formed once the order has been formalized (return of the order form, e-mails, etc.). In the absence of negotiation, the **T&Cs** will apply to the sale as being **the one and only contract.**

Consumable (NF X 60-012)
Item of low cost and frequent consumption.

Manufacturer
Industrial firm manufacturing and marketing materials, equipment, accessories and components.

Assembly constraint Within the
framework of the use of a volume modeler, the assembly of two distinct parts is carried out by imposing one (or more) assembly constraint. This constraint is a geometric relationship (position and/or orientation), implicit or explicit, created between two geometric entities (point, curve, surface or volume) belonging to each of the parts.

CRAM
Regional Health Insurance Fund.

Failure (NF X 60-500)
Cessation of an entity's ability to perform a required function.
Note: a failure is a transition from one state to another, as opposed to a failure which is a state.
An entity can be a material, an equipment.

Quality approach
Process in which the company engages in order to improve or maintain customer satisfaction. ISO 9001 2000 standards for production and service and ISO 14001 for the environment.

Troubleshooting (NF EN 13306)
Physical actions performed to allow a failed item to perform its required function for a limited time until the repair is performed.

Drift In
this context: difference between the reference value and the measured value.

Sustainable development
Sustainable development is “development that meets the needs of the present without compromising the ability of future generations to meet theirs”, quote from Mrs. Gro Harlem Brundtland, Norwegian Prime Minister (1987). In 1992, the Earth Summit in Rio, held under the aegis of the United Nations, formalized the notion of sustainable development and that of the three pillars (economy/ecology/social): economically efficient, socially equitable and ecologically sustainable development.

Diagnosis
Study or analysis of a problem, a breakdown in order to know its origin. It is based on the search for causes and effects. The diagnosis also provides for the rational approach to compliance.

Technical documentation
Documentation made available by a manufacturer or equipment supplier to the brand's network.

Technical data
Technical data is information, part of a technical database.
It is selected for its relevance in technical operations that concern all stages of a product's life (design, industrialization, production, after-sales service, etc.).

Technical file
Generic term designating a set of technical data relating to one or more phases in the life of a product (design, industrialization, production, maintenance, etc.). This type of file includes data, reports, specific analyses, technical conclusions.

DUER
Single risk assessment document.
List of risks and measures taken and requests in the areas of health and safety. Its existence is mandatory in every company.

EPC
Environmental Power Concept
Clean energy concepts.

EPC-EPI
Collective protective equipment - Personal protective equipment.
Examples: gloves, helmet, shoes.

Equipment
Part, instrument or system that performs one of the main functions of equipment. The equipment includes the additional functions provided by the equipment manufacturers (buckets, etc.).

Equipment supplier
Industrial firm manufacturing equipment or complete equipment functions, as original equipment

(computer, dashboard) or as additional equipment (grab, etc.).

Workshop equipment

All the tools made available to workshop technicians enabling them to ensure quality maintenance as soon as possible.

Dynamic tests

Equipment testing under conditions of use.

Technical function

A technical function is a "characterized relationship" between different parts of a product (part or set of parts), it is expressed exclusively in terms of purpose.
The technical function is formulated by an action verb in the infinitive followed by one or more complements. This formulation must be independent of the solutions capable of carrying it out. A technical function must be characterized by criteria and values.

GANTT

Tool, commonly used in project management, to visually represent the progress of the various activities (tasks) that make up the project.

Quantity

We call quantity any property which can be measured or calculated, and whose different possible values are expressed using any real number or a complex number, often accompanied by a unit.

HQSE

Hygiene, quality, safety, environment.

Hybrid

Association of two different sources of energy for a common need.
Equipment equipped with two types of motorization, most often thermal and electric.

INRS

National Institute for Research and Security.

IRP

Employee representative bodies.

ISC

Customer Satisfaction Index.

ISO

International Organization for Standardization
International Organization for Standardization.

ISO 9000

Set of French standards concerning quality management.

ISO 14000

Set of French standards concerning environmental management.

Economic intelligence

Economic intelligence can be defined as the set of coordinated actions of research, processing and distribution, with a view to its exploitation, of information useful to economic actors. These various actions are carried out legally with all the protection guarantees necessary for the preservation of the company's assets, under the best conditions of time and cost.

Jurisprudence The
term “jurisprudence” is currently applied to all judgments and judgments rendered by Courts and Tribunals for the solution of a given legal situation.

LS

Load Sensing
Load signal.

Test equipment

Control and measurement benches and equipment.

Measure

Determine the value of a quantity in an appropriate unit.

Model

Simplified way of representing an already existing real thing (object, phenomenon, etc.), in order to understand it, to predict its behavior.

Means

Set of facilities, equipment, spare parts and consumables (material means) and manpower (human means) available to maintain and assist an element in its operational context.

MTBF

Mean time between failure
Mean time between consecutive failures; mean time between failures.

MTTR

Mean time to repair
Mean time to repair; Mean time to
recovery Mean time to startup.

NFC

Negative flow control.

Standards

A standard designates a set of specifications describing an object, a being or a way of operating. The result is a principle that serves as a rule and technical reference.
A standard is not mandatory, its adherence is a voluntary act. Some are made mandatory by a regulatory text or a decree of law.
Standards make it possible to define technical or procedural standards in order to promote compatibility and exchanges. That is to say a common frame of reference intended to harmonize the activity of a sector.

Technical Notes

Additional documents to the technical documentation, issued by the manufacturer or the equipment supplier, providing clarification or specifying an evolution or modification.

Instruction manual

Provided by the manufacturer or designer of equipment, document specifying the conditions of use and the limits of use. The manual provides the information necessary for installation, commissioning, use and all adjustment and maintenance operations.

Intervention order (OI)

Contractual document defining the nature and conditions of the work to be performed. This document implies the agreement of the customer by his signature (can be called repair order (OR) or work order (OT).

Failure (NF EN 13306)

State of an item unable to perform a required function under given conditions of use. Failure is a state and it can be partial or complete.

PERT

The PERT method is a technique for managing scheduling in a project. The PERT method

consists in representing in the form of a graph, a network of tasks whose sequence makes it possible to achieve the objectives of a project.

Part

Component of a product or tool.

Spare part (NF X 60-012)

Article intended to replace a faulty or degraded part on a good.

Workload plan

Comparative table between the resources available and the resources mobilized at a given time.

PRAP

Prevention of risks related to physical activity.

PRAP IBC

Prevention of risks related to physical activity; industry, construction, commerce.

Pre-diagnosis

Simple and quick orientation tests, checks and measurements, without removal, (sometimes visual and auditory) allowing the technician to choose a diagnostic method or the receptionist to provide some indications to the customer.

Prescriber A

prescriber is an individual whose activity is in a position to recommend the purchase of a product, brand or service.

Service

provider Company involved in subcontracting for interventions such as grinding, bodywork, pump adjustment, tires, hoses, welding, motorization.

Principle

Can be said of a theoretical element relating to a science or a technical solution. In the latter case, the expression of the principle applied in the realization of a constructive solution makes it possible to identify the fundamental operating mode adopted. For example, Pascal's principle.

Process (of production)

Way of going about it, practical method of doing something. Technique for producing a part (example: gravity casting, forging, machining, mechanical welding).

Intervention procedure

Methodological approach (written or oral) to be followed, including the precautions to be taken, to bring a defective component or sub-assembly back into conformity. Compliance with these instructions guarantees the result in the minimum time.

Process (NF FD X 60-000)

A set of interrelated or interactive activities that transforms input items into output items.

Product

Manufactured object: part or sub-assembly or assembly intended to be delivered to the customer or to be placed on the market.

Project

Process aiming at an objective conforming to specific requirements. This process is a sequence of coordinated activities with start and end dates as steps.

Prototype

A prototype (according to the OECD) is "an original model built to include all the technical characteristics and performances of the new product" but it is also sometimes an incomplete example (and

not final) of what a product (possibly of the software type) or a final material object may be.

QSE
Quality - Safety - Environment.

References and resources
Documentary collection composed in particular of technical documentation, technical notes, computer databases.

Regulations Set of
legal texts or measures/provisions.

Repairer
Employee/collaborator responsible for bringing a system back into conformity under the control of the workshop foreman.

Repair (NF EN 13306)

Physical actions performed to restore the required function of a failed asset.
Curative maintenance action. Repair consists above all of bringing equipment back into conformity by replacing defective systems. It may also involve the physical restoration of faulty system elements.

CAN Controller
Network Aera Network
Communication control network for intersystem exchanges.

LIN Network
Local Interconnect Network
Local interconnect network.

Corporate Social Responsibility (CSR)

It corresponds to the implementation of the principles of sustainable development at company level and essentially means that companies, on their own initiative, contribute to improving society and protecting the environment, in conjunction with stakeholders.

RGIE
General regulation of the extractive industry.

Know-how
Ability demonstrated in a defined professional situation. It is the set of gestures, methods best suited to the proposed task.
Know-how is **of a manipulative nature** when it is in the domain of action, of manipulation. Ex: act, connect, disassemble or reassemble, start, measure (take the measurement).
Know-how is **of an operational nature** when it is in the field of following an action protocol, carrying out an operation, implementing all or part of a process. Ex: adjust, implement, disassemble or reassemble a complex assembly, measure (implement the measurement).
The **know-how** is **of a methodological order** when it is in the field of the organization of the action, the design, the choice, the justification of a method with a view to carrying out a process or a service. Ex: organize, propose, design, choose, justify, compare, measure (design the measure).

Knowledge associated with skills

Conducting a professional activity requires one or more skills, each of them mobilizing know-how, interpersonal skills and knowledge. This knowledge is also referred to as knowledge associated with the skill in question.

After-sales service (SAV)

All services, material and human maintenance resources made available to customers after the purchase of equipment.

SEVESO
Industrial establishments classified according to the quantities and types of dangerous products they receive.

Constructive solution

Concrete and realistic proposal whose production is possible. It makes it possible to respond, in part, to one or more service functions in a mechanism.
Constructive solutions can be classified into large families meeting given objectives (transforming a movement, providing rotational guidance, ensuring watertightness, etc.). They can associate standardized, prefabricated and optimized elements, elements specific to the given problem, defined and produced for the circumstance or by adaptive elements, prefabricated but having the capacity to adapt to the specifications.

Subsystem A
subsystem is a part of a system.

OHS

Rescuers, first aiders at work.

STS

Higher Technician Section, structure in which the Higher Technician Certificate diploma is prepared.

SysML (Systems Modeling Language)

System modeling language allowing specification, analysis, design. Associated with other tools, it allows the verification and validation of these systems and their subsystems.

System A
set of dynamically interacting elements organized according to a purpose.

Information system (IS)

An information system (IS) is an organized set of resources (hardware, software, personnel, data and procedures) that allows grouping, classifying, processing and disseminating information on a given environment.

Systemic (Approach…)

The systemic approach, contrary to and in addition to the analytical approach, considers the whole of a system in all its complexity and its dynamics. While an analytical approach focuses on the behavior of elements, the systemic approach focuses on their interactions. These approaches are therefore eminently complementary. Finally, a systemic approach can be used both for the analysis of natural ecosystems and for that of human systems.

Dashboard Tool for
monitoring a service in order to highlight the evolution of its results according to different performance criteria.

Device for defining the hourly, daily or weekly occupation of technicians and positions in the company's workshops according to technical and economic criteria.

Professional tasks

Set of elementary operations implemented to carry out the prescribed work.
To be carried out successfully, a task requires skills. It is characterized by input data, the implementation of tools and methods, the production of expected and identifiable results.
Example: critical analysis of solutions.

Test

Quantitatively assess the characteristics of a system or organ.

Orientation tests

Set of visual, auditory, tactile and olfactory controls, carried out without a device, allowing the technician to direct his diagnosis.

Reference value

Measurable nature of a quantity, defined by the manufacturer, in the context of normal use of the system. When bringing a system back into conformity, the reference value must be respected.

VCRS
Compliance checks before commissioning or recommissioning.

VGP
Periodic general verification.

VRD
Roads and various networks.

VRS
Commissioning or recommissioning checks.

5S
Seiri, Seiton, Seiso, Seiketsu, Shitsuke
Japanese management technique aimed at the continuous improvement of tasks performed in companies.

APPENDIX II – Certification methods

Appendix II a – Conditions for obtaining exemptions from credits

U1 - GENERAL CULTURE AND EXPRESSION

Candidates for the examination of a higher technician certificate specialty, holders of a higher technician certificate of another specialty, a university diploma in technology or a national diploma of level III or higher are, at their request, exempted from taking the “General culture and expression” unit.

Beneficiaries of the “French”, “French Expression” or “General Culture and Expression” unit under another BTS specialty are, at their request, during the period of validity of the benefit, exempted from the corresponding tests. in unit U1 “General culture and expression”.

U2 - MODERN FOREIGN LANGUAGE 1: ENGLISH

Unit U2 “Language langue française 1” of the senior vehicle maintenance technician certificate and the unit “Language moderne 1” of the senior technician certificates covered by the decree of 22 July 2008 (BOESR n° 32 of 28 August 2008) are common.

Beneficiaries of the “Modern foreign language 1” unit under one of the aforementioned specialties are, at their request, exempted from the U2 unit “Modern foreign language 1” provided that the candidates have chosen English.

On the other hand, holders of a national diploma of level III or higher, having been assessed in modern language to obtain this diploma, are, at their request, exempted from undergoing unit U2 "Foreign living language 1" of the patent senior maintenance technician for construction and handling equipment, provided that the candidates have chosen English.

U31 - MATHEMATICS

Unit U31 "Mathematics" of the higher technician certificate "Maintenance of construction and handling equipment" is common to the Mathematics unit of other specialties of the higher technician certificate.

Beneficiaries of the Mathematics unit under one of these specialties who wish to apply for the specialty "Maintenance of construction and handling equipment" are, at their request, during the period of validity of the benefit, exempted from taking the Mathematics unit.

On the other hand, holders of a national scientific or technological diploma of level III or higher, having been assessed in Mathematics to obtain this diploma, are, at their request, exempted from undergoing unit U31 “Mathematics” of the higher technician certificate in the maintenance of construction and handling equipment

Annex II b – Definition of the professional units making up the diploma

The definition of the constituent units of the diploma aims to specify, for each of them, which tasks, skills and professional knowledge are concerned and in which context.

This involves

both: • enabling the matching of professional activities and units within the framework of the validation of acquired experience; • to establish the link between the units, corresponding to the tests, and the reference system of professional activities, in order to specify the framework of the assessment.

The table below shows these relationships.
The colored boxes correspond, for each of the four units, to the skills to be assessed during certification (examination or validation of learning). Only the skills designated by colored boxes will be assessed. If the other skills can be mobilized, they will not give rise to evaluation. In the event that they are not mastered, the corresponding tasks will be carried out with assistance.

Activities	Tasks	C1.1	C1.2	C2.1	C2.2	C2.3	C2.4	C3.1	C4.1	C4.2	C5.1	C5.2	C5.3
A1-Perform a diagnosis	A1-T1	1									2		
	A1-T2	3		3	1								
	A1-T3					2					3		2
	A1-T4			1	3	3	3	3					
	A1-T5	1	2	1	2		2				1		
	A1-T6	1	2					2					2
A2-Conduct an intervention	A2-T1	2							3	2			
	A 2T2				2	2	3	2	2	3	3	3	
	A2-T3			1	2	2	2			2	2	3	2
A3-Ensuring the relationship with a third party including in English	A3-T1	1	3					1		1	1		
	A3-T2		2						1	1			1
	A3-T3	1	2			1					1		1
A4-Participate in the operation of the service	A4-T1		1					1	3		2	1	3
	A4-T2	1	3						1	2			2
	A4-T3		2		1	1	2	2				2	2
Analysis of a malfunction	U4			C2-1	C2-2	C2-3		C3-1					
Making a diagnosis	U51	C1-1					C2-4				C5-1		
Organization and realization of an intervention	U52								C4-1	C4-2		C5-2	
Contribution to the operation of a service	U6		C1-2										C5-3

Annex II c – Examination regulations

EVENTS			Candidates				
			Schools (public or private establishments under contract), **Apprentices** (CFA or authorized apprenticeship sections), **Continuing vocational training** in authorized public establishments		**Continuing vocational training** (public establishments authorized to practice CCF for this BTS	**Schoolchildren** (private establishments without contract), **Apprentices** (CFA or non-accredited apprenticeship sections), **Continuing vocational training** (private establishment) **As part of their professional experience Distance education.**	
Nature of the tests	**Units**	**Coef.**	**Shape**	**Duration**	**Shape**	**Shape**	**Duration**
E1 – General culture and expression	**U1**	3	Punctual written	4 a.m.	CCF 2 situations	Punctual written	4 a.m.
E2 – Living foreign language English (1)	**U2**	2	CCF 2 situations		CCF 2 situations	Punctual oral	Understanding 30 mins + Expressing 15 mins
E3 – Mathematics and Physics – Chemistry							
Subtest: Mathematics	**U31**	2	CCF 2 situations		CCF 2 situations	Punctual written	2 hours
Subtest: Physics - Chemistry **U32**		2	CCF 2 situations		CCF 2 situations	punctual written	2 hours
E4 – Analysis of a malfunction	**U4**	5	Punctual written	4 a.m.	Punctual written	Punctual written	4 a.m.
E5 – Response							
Sub-test: Making a diagnosis	**U51**	3	CCF 2 situations		CCF 2 situations	Punctual practice	4 a.m.
Sub-test: Organizing and carrying out an intervention	**U52**	5	CCF 2 situations		CCF 2 situations	Punctual practice	6 a.m.
E6 – Contribution to the operation of a service	**U6**	3	Punctual oral	30 min presentation + 20 min discussion	CCF 1 situation	Punctual oral	30 min presentation + 20 min discussion
EF1 – Optional living language (2) (3)	**UF1**		Punctual oral	20 min preparation + 20 min	Punctual oral	Punctual oral	20 min preparation + 20 min

(1): The second CCF situation of oral expression and interaction in English is based, for the first working document, on the work of the learners carried out within the framework of unit U6.

(2): The living language chosen for the optional test must be different from English.

(3): Only points above the average are taken into account.

Appendix II d – Definition of tests

Paper E1 (Unit 1) – General culture and expression (Coefficient 3)

1. Objective of the test The

objective is to certify the ability of candidates to communicate effectively in everyday life and professional life.

The purpose of the assessment is therefore to verify the candidate's ability to:

- take advantage of the documents read during the year and the reflection carried out in progress; - report on a culture acquired during training; - appreciate a message or a situation; - communicate in writing or orally; - apprehend a message; - create a message.

(see appendix III of the decree of January 17, 2005 – BO n° 7 of February 17, 2005.)

2. Forms of assessment

2.1 - Occasional form

Written test, duration 4 hours

Three to four documents of a different nature are proposed (literary texts, non-literary texts, iconographic documents, statistical tables, etc.) chosen with reference to one of the two themes included in the program of the second year of STS. Each of them is dated and placed in its context.

First part: summary (marked out of 40)
The candidate writes an objective summary by comparing the documents provided.

Second part: personal writing (marked out of 20)
The candidate responds in a reasoned way to a question relating to the proposed documents. The question asked invites us to compare the documents proposed in summary and the document studies carried out during the current year of “General culture and expression”.

The overall score is reduced to a score out of 20 points. *(see appendix III of the decree of January 17, 2005 – BO n° 7 of February 17, 2005.)*

2.2 - Control during training

The “General culture and expression” unit consists of three assessment situations. The first two, of equal weight, relate to the assessment of the candidate's ability to understand and carry out a written message.

First evaluation situation (indicative duration: 2 hours):

a) General objective: Assessment of the candidate's ability to understand and produce a written message.

b) Skills to be assessed: Ø

Respect the constraints of the written language; Ø

Synthesize information: fidelity to the meaning of the documents, accuracy and precision in their understanding and their linking, relevance of the choices made according to the problem posed and the problem, consistency of production (classification and sequence of elements, balance of the parts, density of the subject, effectiveness of the message).

c) Example situation:

Realization of a synthesis of documents from 2 to 3 documents of different nature (literary texts, non-literary texts, iconographic documents, statistical tables, etc.) each of which is dated and located in its context. These documents refer to the second theme of the program of the second year of STS.

Second assessment situation (indicative duration: 2 hours):

a) General objective: Assessment of the candidate's ability to understand and produce a written message.

b) Skills to be assessed: Ø

Respect the constraints of the written language; Ø

Respond in a reasoned way to a question asked in relation to the documents proposed in reading.

c) Example situation:

From a file given to read in the days preceding the evaluation situation and composed of 2 to 3 documents of a different nature (literary texts, non-literary texts, iconographic documents, statistical tables, etc.), bound by a explicit problem with reference to one of the two themes included in the program of the second year of STS and in which each document is dated and placed in its context, writing of a reasoned answer to a question relating to the problem of the file.

Third evaluation situation

a) General objective: Assessment of the candidate's ability to communicate orally.

b) Skills to be assessed: Ø

Adapt to the situation (mastery of the constraints of time, place, objectives and adaptation to the recipient, choice of appropriate means of expression, taking into account the attitude and questions from the interlocutor(s);

Ø Organize an oral message: respect for the subject, internal structure of the message (intelligibility, precision and relevance of ideas, value of the argument, clarity of the conclusion, relevance of the answers, etc.).

c) Example situation

The candidate's ability to communicate orally is assessed at the time of the presentation of the internship report.

Each situation is scored out of 20 points. The overall score is reduced to a score out of 20.

Test E2 (Unit 2) – Living foreign language English (Coefficient 2)

1. Objectives of the event

The purpose of the test is to assess the following language activities **at level B2 :** - listening comprehension; - continuous and interactive oral expression.

2. Forms of assessment

2.1. Control during training, two evaluation situations

First assessment situation: assessment of listening comprehension, duration 30 minutes maximum without preparation, during the second or third trimester of the second year.

- **Organization of the event**

The teachers organize this evaluation situation when they judge that the students are ready and on the supports that they select. This evaluation situation is formally organized for each student or for a group of students according to the pace of acquisition, in any case before the end of the third semester. The grades obtained are not communicated to the students and no resiting is planned.

- **Taking the test** The title of

the recording is communicated to the candidate. We will ensure that it does not present any particular difficulty. Three listenings spaced 2 minutes apart of an audio or video document which the candidate will report in writing or orally **in French.**

- **Length of recordings** The duration

of the recording will not exceed three minutes. The use of authentic documents sometimes requires the selection of slightly longer extracts (hence the upper limit set at 3 minutes) so as not to proceed with the cutting of certain elements which facilitate understanding more than they complicate it. .

- **Nature of the supports**

The recorded documents, audio or video, will be likely to interest a student in STS without however presenting an excessive technicality. We can cite, by way of example, documents relating to employment (research and recruitment), safety and health at work, life in the company, diversity and gender balance in the professional world. , vocational training, consideration by industry of issues relating to the environment, sustainable development, etc. It may be monologues, dialogues, speeches, discussions, radio broadcasts, extracts from documentaries, films, television news.

It will not be in any way oral writing or recordings from textbooks. Press articles or any other document designed to be read should be avoided.

Second evaluation situation: evaluation of continuous oral expression and interaction in English that can be associated with the defense of the test "Contribution to the operation of a service" (Unit U6), during the second year (indicative duration 5 + 10 minutes).

- **Continuous oral expression (indicative duration 5 minutes)**

This test is based on three documents in English, one page each, which illustrate the theme of the internship or professional activity and are appended to the report: a technical document and two extracts from the written press or information sites scientist or generalist. The first is directly related to the technical or scientific content of the internship (or professional activity), the other two provide a complementary perspective on the subject. These may be articles of technological or scientific popularization, comments or testimonials on the field of activity, or any other text which induces reflection on the professional field concerned, from a source or a English-speaking context. The iconographic documents will only represent at most one third of the page.

The candidate will make a structured presentation of the three documents; it will highlight the theme and points

point of view that they illustrate, highlighting the important aspects and the relevant details of the file (cf. descriptors of level B2 of the CEFR for continuous oral production).

- **Oral expression in interaction (10 minutes minimum)**

During the interview, the examiner will rely on the documentary file presented by the candidate to invite him to develop certain aspects and possibly give him the opportunity to defend a point of view. He may ask him to clarify certain points and address others that he may have omitted.

The candidate will be given every opportunity to express his opinion, to react and to take the initiative in the exchanges (cf. descriptors of level B2 of the CEFR for oral interaction).

2.2. Oral point form

The procedures for taking the test, the definition of the length of the recordings and the nature of the aids for oral comprehension and continuous and interactive oral expression as well as the coefficient are identical to those of the control in training courses.

1. ***Listening comprehension :*** *30 minutes without preparation*
   Terms: See CCF's first evaluation situation above.
2. ***Continuous and interactive oral expression :*** *15 minutes.*
   Terms: See Second assessment situation of the CCF above.

Paper E3 – Mathematics and Physics-Chemistry
Unit U31 – Mathematics
(Coefficient 2)

1. Objectives of the test

The objectives of the mathematics sub-test are to assess: – the solidity of the students' knowledge and skills and their ability to mobilize them in situations varied killings;
– their investigative or initiative-taking skills, relying in particular on the use of the calculator or software;
– their ability to reason and their ability to correctly analyze a problem, to justify the results obtained and to assess their significance; – their qualities of written and/or oral expression.

2. Content of the assessment

The assessment is designed as a conclusive survey of the content and abilities of the mathematics program.

The subjects relate mainly to the mathematical fields most useful for solving a problem in connection with the technological disciplines or the applied physical sciences. When the situation relies on other disciplines, no knowledge relating to these disciplines is required of the candidates and all useful information must be provided.

3. Forms of assessment

3.1. In-training control

The control during training includes two evaluation situations. Each evaluation situation, lasting fifty-five minutes, is scored out of 10 points coefficient 1.
It takes place when the candidate is considered ready to be assessed on the basis of the program's capacities.
However, the first situation must be organized before the end of the first year and the second before the end of the second year.

Each evaluation situation includes one or two exercises with questions of progressive difficulty. This involves assessing the ability to mobilize knowledge and skills to solve problems, in particular: – obtaining information; - seek ; – model; – reason, argue; – calculate, illustrate, implement a strategy; - to communicate.

At least one of the exercises in each situation includes one or two questions whose resolution requires the use of software (installed on a computer or a calculator). The presentation of the resolution of the question(s) using the digital tools is done in the presence of the examiner. This type of question makes it possible to assess the ability to illustrate, calculate, experiment, simulate, program, make conjectures or check their plausibility. The candidate then writes on a form to be completed, the results obtained, observations or comments.

At the end of each evaluation situation, a file is compiled for each candidate. It includes: – the evaluation situation; – the copies written by the candidate on this occasion; – the situation assessment grid, the model of which is provided in the appendix below, with a proposal for

score out of 10 points.

The combination of the two evaluation situations allows the evaluation, by sampling, of the contents and capacities of the entire program.

At the end of the second evaluation situation, the head of the establishment, or by delegation the pedagogical team, sends the jury the proposed mark out of 20 points, accompanied by the two evaluation grids. The files described above, relating to the evaluation situations, are made available to the jury and the academic authorities until the following session. The jury may demand that it be communicated and, following an in-depth examination, may formulate any remarks and observations that it deems useful to decide on the score.

3.2. Punctual form

Written test lasting two hours.
The topics include two math exercises. These exercises relate to different parts of the program and must remain close to professional reality.
Any excessive theoretical difficulty and mathematical technicality should be avoided.
The use of the calculator is authorized according to the regulations in force.

Paper E3 – Mathematics and Physics-Chemistry
Unit U32 – Physics-Chemistry
(Coefficient 2)

1. Objectives of the event

The physics and chemistry sub-test assesses:

- the level of mastery of the targeted knowledge and skills; mastery
- of the different stages of the scientific process; mastery of
- computer tools;
- the ability to implement this approach independently.

2. Content of the assessment

The assessment is designed as a conclusive survey of the contents and abilities of the physics and chemistry program.

The subjects relate to the areas of knowledge most useful for solving a technical problem in connection with the professional field corresponding to this BTS, as well as with the technological and professional disciplines preparing for it. When the situation relies on other disciplines, no knowledge relating to these disciplines is required of the candidates and all useful information must be provided.

3. Forms of assessment

3.1. In-training control

It is carried out on the basis of two contextualized evaluation situations. These are complementary and assess different knowledge, abilities and skills. The evaluation of the capacities related to the experimental methods targeted by the training implies that they are both organized in the laboratory where the student is used to handling. Various documentations concerning the object of the study and the scientific material are provided in reasonable volume.

For each of the two evaluation situations, of identical weight, the test is made up of several parts that can be treated independently, or not, of each other but in connection with a single concrete situation in the professional field and must include the resolution of a complex task.

The evaluation situations are experimental, each has a maximum duration of two hours and is marked on twenty points. Above all, they must make it possible to evaluate experimental know-how. Theoretical knowledge or know-how related to the experimental situation can also be evaluated but their share must not exceed a quarter of the mark. The length and breadth of the topic should allow an average candidate to cover the topic and write it calmly in the time available. The use of the computer tool (acquisition, plotting of curves, modelling, simulation) is strongly recommended. It is quite possible that the candidate provides a computerized document as a copy.

The statement of the subject begins with a short description of a concrete situation and proposes or invites questions. Additional information (lists of several protocols, experimental results, etc.) can be provided in order to define the scope of the study or experiment.

Computer science must provide students with the tools needed to process data and assess uncertainties without them having to go into the details of the mathematical tools used.

Throughout the test, the student must act independently and show initiative. During the calls, the examiner can reinforce the student in his choices or provide him with appropriate assistance in order to assess the skills mobilized by the subject, even when the student has not managed to carry out certain tasks. These aids can be formalized during the design of the evaluation situation. The nature of the assistance provided influences the level of competency assessment.

The correction of the test will take the greatest account of the mastery of the conduct of the manipulations and the writing of the report, of the compatibility of the precision of the numerical results with that of the data of the statement and that of the devices of used, the care given to possible graphic representations and the quality of the French language in its scientific use.

The final mark out of twenty proposed to the evaluation committee is the average, rounded up to the upper half-point, of the marks resulting from the two evaluation situations.

The first evaluation situation takes place in the first semester of the second year of training, the second in the second semester of the second year of training.

The test is a complex task that a student of average level will have to carry out by mobilizing knowledge, capacities and attitudes vis-a-vis a situation which requires, to be treated, the use of material of laboratory or a computer .

The student is assessed on the following six skills:

- **appropriate:** the student appropriates the problem of the work to be done and the material environment to be using documentation;
- **analyze:** the student justifies or proposes a protocol, proposes a model or justifies its validity, chooses and specifies the methods for acquiring and processing the

measurements; • **carry out:** the student implements an experimental protocol while respecting the safety rules;

- **validate:** the student identifies sources of error, estimates the uncertainty on the measurements using the tools provided, critically analyzes the results and possibly proposes improvements to the approach or the model;

• **communicate:** the student explains his choices and reports on his results in written and oral form; • **be autonomous and show initiative:** the student exercises his autonomy and takes initiatives with discernment and responsibility.

A few essentials:

- the subject leaves an important place for initiative and autonomy; the subject should not give rise to experimental work mainly centered on laboratory techniques. Indeed, it is not only a question of validating technical capacities but of evaluating the skills of the students, within the framework of an experimental test where they are led to reason, to validate, to argue and to exercise their mind analysis to make choices and decisions in the field of laboratory practice;

• the documents proposed should not take too long to read and use; • the productions expected from the students must be clearly explained in the subject; • in order to allow the evaluator to determine the level of the candidate for each area of competence, the subject will leave room for initiative but will include additions and aids that the examiner can offer to candidates according to their needs.

Conditions for implementing the skills assessed

The subject must offer the possibility of evaluating the student on the six skills in an implementation explained below.

Skill	Conditions of implementation	Examples of capacities and attitudes (not exhaustive)
Appropriate	Contextualized subject, that is to say based on a system or on a problem. Miscellaneous documentation concerning the subject of the study and the scientific material must be provided in a reasonable volume.	State a problem of a scientific or technological nature. Define qualitative or quantitative objectives. Research, extract and organize information related to a situation.
Analyze	The subject must allow for a diversity of experimental approaches and the material available must be sufficiently varied to offer several possibilities to the student. Technical documentation is made available.	Formulate a hypothesis. Assess the order of magnitude of the physico-chemical magnitudes involved and their variations. Propose a strategy to respond to the problem. Propose a model. Choose, design or justify a protocol or an experimental device.

Achieve	The subject must allow the examiner to observe the overall mastery of certain technical operations and the appropriate attitude of the student in the laboratory environment.	Evolve with ease in the laboratory environment. Respect the safety rules. Organize your workstation. Use the equipment (including the computer tool) in an appropriate manner. Run a protocol. Perform measurements and assess the associated uncertainties.
To validate	The subject must make it possible to ensure that the student is able to critically analyze the results and respond to the problem.	Exploit and critically interpret observations, measurements. Validate or refute the hypotheses established in the analysis phase. Propose improvements to the approach or model.
To communicate	The student explains his choices and reports on his results in written or oral form, at times identified in the subject.	Present the measurements appropriately (curve, table, etc.). Use appropriate scientific concepts and vocabulary. Use the correct symbols and units. Present, formulate a proposal, an argument, a summary or a conclusion in a coherent, complete and understandable manner, in writing and orally.
Be autonomous, show initiative	This skill is mobilized throughout the event by participating in the definition of the level of mastery of the other skills.	Work independently. Complete a task without teacher assistance. Ask for help appropriately.

Evaluation grid

The grid must show items related to skills. All skills must be assessed on all CCF situations. The evaluation makes it possible to assess, according to four levels described here in a fairly general way, the degree of mastery by the student of each of the skills evaluated in the subject.

Level A: the student has completed all the work requested in a satisfactory manner according to the criteria specified in the subject. In the event of difficulty that he knows how to identify and formulate by himself, the student knows how to take advantage of the intervention of the examiner to provide a response by himself.

Level B: the student has carried out all the work requested satisfactorily according to the criteria specified in the subject but with some intervention by the examiner concerning difficulties or errors not identified by the student himself but resolved by him once underlined by the examiner: • after reflection following an open questioning led by the examiner; • or by providing a partial solution.

Level C: the student remains blocked in the progress of the tasks requested, despite the questions asked by the examiner. Elements of solutions are brought to him, which allows him to continue the tasks.

Level D: the student was not able to carry out the tasks requested despite the answers provided by the examiner. This situation leads the examiner to provide a complete solution to the task.

It is legitimate for a student to ask for details on the tasks to be performed, without being penalized.
The student must be reassured at this level, which should enable him to dialogue calmly with the examiner.

In any event, when an error or difficulty on the part of the student is noted: • the teacher must first ask him one or more open-ended questions in order to get him to resume only the wire of the test;

• if that was not enough, the teacher gives one or more solutions; • if this is still insufficient, the teacher gives, without explaining it, the solution that will allow the continuation of the test.

A necessary preparation

Students must be trained in this approach throughout the two years of training and the teacher must therefore offer them activities allowing the implementation of skills in the spirit described above.

3.2. Point form

Written test lasting 2 hours.

The subject of physics and chemistry includes exercises which relate to different parts of the program and which must remain close to professional reality. The test relates to the program of the entire course, but it is not forbidden, if necessary, to call on any knowledge acquired previously and supposedly known.

Each exercise includes a part of analysis of an experimental or practical situation allowing to evaluate the know-how of the candidates in the field of the measurement (knowledge of the scientific material, the methods of measurement) and the numerical applications intended to test their ability to carry out the previous study. Course knowledge questions can possibly be slipped into the graduated progression of each exercise for a part not to exceed a quarter of the overall mark. Any theoretical difficulty, any excessive technicality and any major recourse to mathematics should be avoided. The length and breadth of the topic should allow an average candidate to cover the entire topic and write their response in the time allowed.
At the top of the subject, it will be specified whether the calculator is authorized or prohibited during the test.

The correction of the test will take the greatest account of the clarity in the conduct of the resolution and in the drafting of the statement of the laws, of the compatibility of the precision of the numerical results with that of the data of the statement, of the care given to possible graphic representations and the quality of the French language in its scientific use.

Test E4 (Unit U4) – Analysis of a malfunction
(Weight 5)

1. Objectives of the event

The assessment covers all or part of the following skills:
- **C2.1:** Describe a technical system -
C2.2: Characterize physical quantities - **C2.3:**
Characterize performance - **C3.1:** Define solutions

The evaluation indicators corresponding to the skills assessed appear in the "Performance indicators" column of the tables describing the skills.

It should be noted that to perform the tasks requested, certain other skills may be mobilised. Under no circumstances will these give rise to an evaluation.

2. Content of the assessment

The support of the test consists of a file relating to a multi-technological material or system representative of the field of the specialty, presenting a malfunction.

For this E4 test, the candidate is placed in a position to carry out all or part of the tasks within the framework of activity A1-Perform a diagnosis:

A1-T2 List the technical information needed for diagnosis.	
A1-T4 Analyze the malfunctioning system and interpret the checks and measurements.	

3. Form of the assessment

One-off written test lasting 4 hours and with a coefficient of 5.

A national evaluation sheet, developed each year according to the subject by the General Inspectorate, is distributed to the rectoral services for examinations and competitions. Only the latter will be systematically used for proofreading.

Test E5 – Intervention
Unit U51 – Carrying out a diagnosis
(Coefficient 3)

1. Objectives of the event

This test must enable all or part of the following skills to be validated: - **C1.1 :** Obtaining information - **C2.4 :** Identifying the failure - **C5.1 :** Implementing equipment, measurement or diagnostic tools, a procedure

The evaluation indicators corresponding to the skills assessed appear in the "Performance indicators" column of the tables describing the skills.

It should be noted that to perform the tasks requested, certain other skills may be mobilised. Under no circumstances will these give rise to an evaluation. If these skills are not mastered at the time of this test, the corresponding tasks must be performed with assistance.

It is reminded that the evaluation is done on all the dimensions (knowledge, know-how, attitudes) of the skill and in no case on the associated knowledge alone.

2. Content of the test

The activities carried out within the framework of this sub-test are carried out in the training center and/or in the company for candidates who are subject to the control during training, on the technical platform of the examination center for other candidates. .

The supports of this sub-test are materials representative of the professional fields of construction and handling, of current generation, of which a system is malfunctioning.
The intervention order is provided.

A database of technical documents, tools, specific tools and other means necessary for diagnosis are available; the candidate chooses them and uses them according to his needs to carry out his diagnosis.

For this sub-test E51, the candidate is placed in a position to carry out all or part of the tasks within the framework of activity A1-Perform a diagnosis:

A1-T1	Confirm the malfunction stated by the customer.
A1-T3	Carry out tests and measurements with regard to manufacturer / supplier / company procedures.
A1-T5	If necessary, complete the diagnosis with the help of technical assistance or any competent contact person.
A1-T6 Establish and send the estimate.	

3. Forms of assessment

3.1 Control during training

The assessment during training is based on two professional situations relating to the tasks of activity A1 described in paragraph 2. At the end of each situation, an individual assessment will be established jointly by the tutor, the teaching team and the candidate. This report will indicate the inventory and evaluation of the tasks and activities entrusted and the performance achieved for each of the skills targeted.

The period chosen for these evaluations, located during the second half of the training, may be different for each of the candidates. The organization of these assessments is the responsibility of the teaching team.

For each candidate, the educational team of the training establishment compiles a file including:
- the documents describing the activities; -
all documents attesting to the level of skills reached by the candidate; - the
evaluation sheet with the indicators and criteria that allowed the score proposal. This evaluation sheet for the work carried out, drafted and updated by the General Inspectorate of National Education, will be distributed to the establishments by the rectoral services for examinations and competitions.

This file is made available to the deliberation jury and the academic authority in accordance with the regulations in force.

3.2 Point form

The assessment takes the form of a practical test lasting 4 hours.

It takes place on the technical platform of the examination center and allows the assessment of skills C1.1, C2.4 and C5.1. It complies with the elements defined in paragraph 2 (content of the test). The subject of the assessment is developed under the supervision of the inspector in charge of the sector.
The grading of the test is obtained from the national assessment grid by skill published in the national circular organizing the exam. The skill(s) mobilized in the assessment are identified.

The evaluation committee is made up of two members:
- a teacher (or trainer) of specialized technological or vocational education; - a professional or, failing
that, another teacher (or trainer) of technological education or
specialty professionals.

At the end of the assessment, a file consisting of:
- the subject relating to the
event; - all the documents produced or completed by the candidate; - the
evaluation sheet with the indicators and criteria that allowed the grade proposal. This evaluation sheet for the work carried out, drafted and updated by the General Inspectorate of National Education, will be distributed to the establishments by the rectoral services for examinations and competitions.

This file is made available to the deliberation jury and the academic authority in accordance with the regulations in force.

Test E5 – Intervention
Unit U52 – Organization and realization of an intervention
(Weight 5)

1. Objectives of the event

This test must validate all or part of the skills:
- **C4.1:** Manage workstations - **C4.2:**
Plan and manage operations - **C5.2: Restore**
compliance. Adjust, calibrate, adapt, configure

The evaluation indicators corresponding to the skills assessed appear in the "Performance indicators" column of the tables describing the skills.

It should be noted that to perform the tasks requested, certain other skills may be mobilised. Under no circumstances will these give rise to an evaluation. If these skills are not mastered at the time of this test, the corresponding tasks must be performed with assistance.

It is reminded that the evaluation is done on all the dimensions (knowledge, know-how, attitudes) of the skill and in no case on the associated knowledge alone.

2. Content of the test

The activities carried out within the framework of this sub-test are carried out in the training center and/or in the company for candidates who are subject to the control during training, on the technical platform of the examination center for other candidates. .

The support for this sub-test is current generation equipment or sub-assemblies to be brought back into conformity.

A database of technical documents, tools, specific tools and other means necessary for the intervention are available. The candidate chooses them and uses them according to his needs to carry out his intervention.

The intervention order is provided.

For this sub-test E52, the candidate is placed in a position to carry out all or part of the tasks within the framework of activity A2 - Conduct an intervention and activity A4 - Participate in the operation of the service:

A2-T1	Organize the intervention.
A2-T2 Perform preventive and corrective maintenance.	
A2-T3	Carry out specific operations (for example: regulatory or procedural checks, commissioning).

3. Forms of assessment

3.1 Control during training

The assessment during training is based on two professional situations relating to the tasks of activity A2 described in paragraph 2. At the end of each situation, an individual assessment will be established jointly by the supervisor, the teaching team and the candidate. This report will indicate the inventory and evaluation of the tasks and activities entrusted and the performance achieved for each of the skills targeted.

The period chosen for these evaluations, located during the second half of the training, may be different for each of the candidates. The organization of these assessments is the responsibility of the teaching team.

For each candidate, the educational team of the training establishment compiles a file including:
- the documents describing the activities;

- all documents attesting to the level of skills reached by the candidate; - the
evaluation sheet with the indicators and criteria that allowed the score proposal. This evaluation sheet for the work carried out, drafted and updated by the General Inspectorate of National Education, will be distributed to the establishments by the rectoral services for examinations and competitions.

This file is made available to the deliberation jury and the academic authority in accordance with the regulations in force.

3.2 Point form

The assessment takes the form of a practical test lasting 4 hours.

It takes place on the technical platform of the examination center and allows the evaluation of skills C4.1, C4.2 and C5.2. It complies with the elements defined in paragraph 2 (content of the sub-test). The subject of the assessment is developed under the supervision of the inspector in charge of the sector.
The grading of the test is obtained from the national assessment grid by skill published in the national circular organizing the exam. The skill(s) mobilized in the assessment are identified.

The evaluation committee is made up of two members:
- a teacher (or trainer) of specialized technological or vocational education; - a professional or, failing that, another teacher (or trainer) of technological education or specialty professionals.

At the end of the assessment, a file consisting of:
- the subject relating to the
event; - all the documents produced or completed by the candidate; - the
evaluation sheet containing the mark.

This file is made available to the deliberation jury and the academic authority in accordance with the regulations in force.

Paper E6 (Unit U6) – Contribution to the functioning of a service
(Coefficient 3)

1. Objective of the event

This test should validate all or part of the skills: • **C1.2 :** Exchange internally and externally with a third party, including in English. • **C5.3 :** Produce a professional document.

The evaluation indicators corresponding to the skills assessed appear in the "Performance indicators" column of the tables describing the skills.

It is recalled that the assessment is made on all the dimensions (knowledge, know-how, attitudes) of the two skills C1.2 and C5.3 and in no case on the associated knowledge alone.

2. Content of the test

For this E6 test, candidates will be placed in a position to carry out all or part of the tasks within the framework of activities A3-Ensuring the relationship with a third party, including in English and A4-Participate in the operation of the service:

A3-T1 Communicate with the customer.	
A3-T2 Communicate with the hierarchy.	
A3-T3	Communicate with other interlocutors (for example: company services, technical support from manufacturers, insurance expert).
A4-T1	Contribute to the quality, health, safety and environmental (HQSE) policy.
A4-T2	Take into account the economic, legal and organizational aspects of the activities.
A4-T3 Develop specific technical expertise.	

3. Forms of assessment

3.1 Point form

The assessment takes the form of an oral test lasting a maximum of 50 minutes.

It is based on a **digital file** called "activity report" of 30 pages maximum excluding annexes. The digital file communicated to the evaluation committee is saved in a non-modifiable communication format. It is deposited against signature with the person in charge of the training or evaluation center no later than 15 days before the start of the event.

The internship certificate or the employment contract must be attached to this file.

It is composed of three parts.

Part 1: Knowledge of the company This includes the **presentation of the company** (here we are talking about the place of reception) by limiting itself to a contextualization in connection with the activities carried out by the candidate (maximum 5 pages). This contextualization, written by the candidate with regard to the activities carried out, goes beyond the simple presentation of the company's identification sh
A particular focus is on the service provided to the customer through the organization of the company. This focus is written from the “customer” point of view. The information comes from the company; they are reliable, relevant, up-to-date.

Part 2: Presentation of one or more case studies The activities carried out by the candidate covering a wide variety of areas (customer relations, troubleshooting, repair, comparison of range of equipment, profitability study, etc.), all tasks related to the operation of a service may be presented.

In agreement with the referent in the company, the candidate chooses one or more case studies representative(s) of his activities, one of which will be the support of the problem for the third part (contribution to the operation of a service).

This part of 5 to 10 pages must include:

- the description of the process of taking charge of the intervention from the reception of the client and his equipment until the return of the latter (human relations, interpersonal communication); the flow of information
- within the company (administrative documents); the description of representative interventions carried out and/
- or observed; identified areas for improvement.
-

Note: the dimension of the health, quality, safety and environment policy (HQSE) as well as the economic, legal and organizational aspects are taken into account in the development of the above points.

The technical document in English supporting the second evaluation situation of the E2 test will be appended to this part.

Part 3: Contribution to the operation of a service The
problem chosen is presented by the teachers or trainers during a validation commission chaired by an inspector. It is presented using official documents. The validation sheet is attached to the digital file.

This part responds to a need identified within the company. The candidate is required to conduct investigations, in relation to the professional environment, aimed at providing answers to the problem posed. He uses his knowledge and skills acquired during his training in order to propose several solutions, compare them and argue the chosen solution.

One or more of the points for improvement identified previously serve as a basis for the development of a **professional document** (for example: procedure, adaptation, enrichment of company documentation, etc.).

This part of 10 to 15 pages must include: - the
stages of the analysis and resolution process:
o a presentation of the problem encountered in the company by the candidate, o the constraints related to the problem, o the analyses, conclusions and proposed solutions related to the problem posed, o the justification of his choices in substance and form leading to the held solution,

- the professional document.

The technical skills related to the resolution of the problem are not evaluated in the three parts of this test. They are part of the E52 sub-test.

The candidate makes a reasoned oral presentation, using the means of communication he deems most appropriate. During this presentation, lasting a maximum of 30 minutes, the evaluators do not intervene.

At the end of this service, the evaluators, who have examined the activity report made available to them before the test, conduct an interview with the candidate to deepen certain points covered in the report and in the presentation (duration: 20 minutes).
Under no circumstances will the questioning go beyond the scope of the project and the skills to be assessed.

The inquiry committee is made up of:
- a teacher (or trainer) of technological or professional teaching in the speciality; - an economics-management teacher; - a specialist in the field.

In the event of the professional's absence, the questioning commission may carry out its assessment task under the regulations.

If, on the day of the interrogation, the jury has a doubt about the conformity of the activity report, it nevertheless questions the candidate. The awarding of the mark is reserved pending a new verification implemented according to the procedures defined by the academic authorities. If, after verification, the report produced by the candidate is declared non-compliant, the mention "not valid" is entered in the test.

The non-compliance of the report produced by the candidate may be pronounced when one of the following situations is observed:

- absence of submission of the file produced by the candidate;
- submission of the file produced by the candidate beyond the date fixed by the circular organizing the examination or the organizing authority;
- duration of the internship less than that required by the examination regulations;
- internship certificate not covered or not signed by the persons authorized for this purpose or absence of a contract of work.

At the end of this test, the commission completes, for each student, the evaluation grid corresponding to a standard evaluation form, and its corresponding computer file, available from the rectoral services for examinations and competitions. No other type of plug should be used.

Candidate who failed a previous session of the exam

The candidate who failed a previous session of the examination has the choice between presenting the previous business internship activity report, modifying this report or drawing up another one after completing the corresponding professional internship period.

School candidate from a private establishment without a contract, apprentice from a CFA or an unqualified apprenticeship section, from continuing vocational training (private establishment) or presenting themselves on the basis of their professional experience or by the Through distance learning, the digital file is designed on the candidate's initiative.

The test takes place in the examination center within the same framework as defined above.

3.2 Control during training

The control during training assesses the skills defined in point 1 and is supported by an activity report which is drawn up by the candidate. The period chosen for these evaluations, located during the last semester of training, may be different for each of the candidates. The organization of this assessment is the responsibility of the teaching staff.

The conditions of realization, the design of the activity report by the candidate, its presentation and the commission of interrogation are defined in the same way as for the ad hoc form (point 3.1).

4. Conditions of realization of parts 2 and 3 of the digital file

Lasting a maximum of 60 hours during professional teaching sessions, the project will be supplemented by personal work. This work is carried out during the second year of training and will be accompanied by teachers in the professional field (STI and economics-management).

Under no circumstances will this activity give rise to manufacturing of any kind whatsoever, except for the communication medium.

EF1 test – Optional living language
Unit UF1

Oral test lasting 20 minutes preceded by 20 minutes of preparation.

The oral test consists of an interview based on appropriate documents.
The living foreign language chosen for the optional test must be different from the compulsory foreign language.

APPENDIX III – Internship in a professional environment

Two internships of a very different nature can punctuate the schooling of students according to their origin of training: - a discovery internship; - a professional internship.

1. Objectives of the discovery course

An internship is offered exclusively to students holding a general or technological baccalaureate or a professional baccalaureate from another field, chronologically located during the first semester of the first year (it may take place partly during school holidays) and lasting two weeks. It allows them to immerse themselves in the company and to better understand the professional environment specific to the BTS maintenance of construction and handling equipment (MMCM).

The discovery internship is not the subject of an internship report evaluated as part of the BTS MMCM certification tests.

The establishment, in the educational component of its establishment project, decides whether or not to organize this first internship to which the administrative regulations described in paragraph 3.1.1 apply. The pedagogical project must include the pedagogical organization established for students who do not do this internship.

2. Objectives of the business internship or training contract This

internship or period in a company allows the future senior technician to take stock of the technical and economic realities of the company and to build and develop skills in a professional context.
During this course, the learner must carry out maintenance activities for construction and handling equipment. In this context, he is led to understand the functioning of a company linked to these professional fields through its organization, its equipment, its various internal departments, its human resources, etc. It is also for him the opportunity to observe the company's social life (human relations, schedules, safety rules, etc.).

These functions correspond to the “senior technician” category.

The activities carried out during the internship are related to the maintenance and after-sales services of the company in accordance with the standard of professional activities. They contribute to the deepening of knowledge and the acquisition of new skills.

During this internship, one or more studies will be identified in order to serve as a problem for the E6 test.

3. Organization of internships

3.1 Educational path

3.1.1. Regulations relating to internships in a professional environment

The professional internship is compulsory for students taking face-to-face or distance preparation.

The internships, organized with the help of professional circles, are placed under the control of the academic authorities to which the student reports and, if necessary, the services of the cultural adviser at the French embassy of the host country for an internship at the stranger.

Each period of internship in a company is subject to an agreement between the establishment attended by the student and the host company(ies). The agreement is drawn up in accordance with the provisions and decrees in force.
However, this agreement may be adapted to take into account the constraints imposed by the legislation of the host country.

During work placements, the student must have the status of student trainee and not of employee.

Each internship agreement must, in its pedagogical appendix, specify in particular:
- training objectives and methods (duration, timetable); - the methods
of follow-up of the trainee by the teachers of the teaching team responsible for the training;
- the methods of follow-up of the trainee by the referent in the company.

3.1.2. Implementation and follow-up of internships

Each internship must take place within a company linked to the professional fields of maintenance of construction and handling equipment (concessions and equipment distribution and maintenance companies, equipment manufacturer entities (head offices, subsidiaries, branches, agencies, etc., equipment rental companies, service companies (specialized operators, etc.), maintenance services for companies and local authorities using this equipment). The search for host companies is carried out by the students under the responsibility of the head of the establishment. The choice of companies retained is validated by the educational team and approved by the head of the establishment.

In order to ensure their formative nature, the courses are placed under the educational responsibility of the teachers providing the professional lessons and of the referent in the company. The teaching team as a whole is responsible for explaining their objectives, their implementation, their follow-up and the use made of them. It must take care to inform the managers of the host companies or establishments of the objectives of each course and more particularly of the skills they aim to develop.

The tasks entrusted to the learner will be decided jointly by the referent in the company and the teaching team with regard to the acquisition of skills within his training course.

The period of the professional internship in a company, lasting six to ten weeks, the temporal positioning of which is left to the initiative of each establishment, must allow the trainee to apply the skills acquired during his training. At the end of the professional internship period, an internship certificate is given to the intern by the manager of the company or his

representative, attesting to the student's presence. A candidate who has not presented this document cannot be admitted to take the "Contribution to the operation of a service" test (Unit U6). A candidate who, for a duly established reason of force majeure, completes only part of the compulsory duration of the professional internship provided for in the agreement, may be authorized by the rector to take the examination, the jury being kept informed of his situation.

3.1.3 Adjustment of the duration of the professional internship

The normal duration of the professional internship is six to ten weeks. For a duly established reason of force majeure or in the context of adapted training or a positioning decision, the duration of the internship may be reduced, but may not be less than 4 weeks. However, candidates who produce an exemption (in particular for the validation of acquired experience) are not required to complete this internship.

The rector alone is authorized to validate adjustments to the duration of the internship or exemptions.

3.2 Path of learning

For apprentices, the internship certificates are replaced by a photocopy of the employment contract or by a certificate from the employer confirming the candidate's status as an apprentice in his company.

3.3 Continuing Education Path

For candidates who are preparing for the higher technician certificate through continuing education, the internship certificates are replaced by a photocopy of the employment contract.

3.3.1 Candidates in a situation of first training or in a situation of retraining

The internship duration is 8 weeks. It is added to the duration of training provided in the continuing education center pursuant to Article 11 of Decree No. 95-665 of May 9, 1995 as amended on the general regulations for the higher technician patent.

The training organization can help find the host company. The trainee may have the status of employee of another professional sector.

When this preparation is carried out within the framework of a particular type of employment contract, the compulsory internship is included in the training period provided in a professional environment if the activities carried out are consistent with the requirements of the reference system for the higher technician certificate. prepared and consistent with the objectives defined above.

3.3.2 Candidates undergoing further training

The training certificate may be replaced by one or more work certificates attesting that the person concerned has been employed full-time in the field of maintenance of construction and handling equipment for six months during the year preceding the exam or part-time for one year during the two years preceding the exam. The activities carried out must be consistent with the requirements of the BTS repository

considered.

3.4 Candidates in distance education

Candidates fall under one of the above cases, depending on their status (student, apprentice, continuing education).

3.5 Candidates presenting themselves on the basis of their professional experience

The internship certificate can be replaced by one or more work certificates justifying the nature and duration of the job held.

4. Internship report At the

end of the professional internship or training time in a company, the candidates write individually, a report whose content is defined in the test "Contribution to the operation of a service" (Unit U6 ; parts 1 & 2). ***Skills assessment*** At the end of the professional internship or training time in the company, the teachers concerned and the referent of the host company jointly assess the level of skills attained by the learner; skills that will be assessed as part of all the professional tests.

5. School candidates who failed a previous session of the exam Candidates who failed a previous

session of the exam have the choice between presenting the previous digital report of the professional internship, modifying this report or preparing another one after having carried out , in business, a new period of professional internship.

Apprentice candidates repeating a year may present at the session following the one during which they were not admitted: either their initial apprenticeship contract extended by one year; or a new contract concluded with another employer (in application of the

- provisions of article L6222-11 of the labor code).
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APPENDIX IV – Schedule

Timetable

	1st year schedule			2nd year schedule		
	Week a + b + c(2) Year (3)		Week a + b + c(2) Year (3)			
1. General culture and expression	3	3+0+0	90	3	2+1+0	108
2. Foreign living language	2	0+2+0	60	2	0+ 2 + 0	72
3. Mathematics	**2.5**	1.5 + 1 + 0	75	**2.5**	1.5+ 1 + 0	90
4. Physics - chemistry	2	1+0+1	60	3	1+0+2	108
5. Vocational Education (PE) and Associated Generals	**21**	7(4) + 3 + 11	630	**20**	6(4) + 3 + 11	720
Retail **STI vocational education**	4.5 + 2 + 11			3.5 + 2 + 11		
Vocational education Economics-management	1+1+0			1+1+0		
EP in modern foreign language in co-intervention	1(5) + 0 + 0			1(5) + 0 + 0		
Mathematics and EP in co-intervention	0.5(6) + 0 + 0			0.5(6) + 0 + 0		
6. Personalized support	1.5(9)	0 + 0 +1.5(7)	45	1.5(9)	0+0+1.5(8)	54
Total	**32h 12.5+6+13.5 960(1) h**			**32 p.m.**	**10.5+7+14.5 1152(1) hrs**	
Optional education Living language 2	2	0+2+0	60	2	0+ 2 + 0	72

(1): The schedules take into account 8 weeks of internship in a professional environment.
(2): a: course in whole division, b: tutorials or practical laboratory work, c: practical work in the workshop or project.
(3): The annual timetable is given as an indication.
(4): Including 1.5 hours of related STI and general professional teaching in co-intervention.
(5): Supported by two STI and English teachers (1 hour per week, which can be annualised).
(6): Supported by two teachers of mathematics and STI (0.5 hour per week, which can be annualized).
(7): In the first year, a significant part of the personalized support schedule is devoted to mastering the fundamentals of mathematics. The weekly schedule (1.5 hours) can be annualized.
(8): In the second year, a significant part of the personalized support schedule is devoted, for the students concerned, to a deepening of scientific disciplines with a view to continuing their studies.
The weekly schedule (1.5 hours) can be annualized.
(9): First and second year personalized support schedules can be combined over the cycle of 2 years and distributed differently, according to the educational project validated at the level of the establishment.

APPENDIX V – Correlation table between tests

Correspondences between the tests of the BTS Maintenance and after-sales of public works and handling machinery (MAVETPM) and the BTS Maintenance of construction and handling equipment (MMCM).

BTS MAVETPM Created by the decree of December 9, 1999 Last session 2018		**BTS MMCM** Created by this decree First session 2019	
Tests or sub-tests	**Units**	**Tests or sub-tests**	**Units**
E1 French	U1	E1 General culture and expression	U1
E2 Living foreign language	U2	E2 Living foreign language: English	U2
E3 Mathematics	U3	E31 Mathematics	U31
E3 Physical Sciences	U32	E32 Physics-chemistry	U32
E4 – Applied techniques E41 1st part: Search for site and equipment adequacy 2nd part: Modeling and predictive study of systems	U41	E4 Malfunction analysis	U4
E42 Diagnosis - Repair	U42	E51 Performing diagnostics	U51
E6 – Professional summary test Project realization	U61	E52 Organization and performance of an intervention	U52
E6 – Professional summary test Company internship	U62	E6 Contribution to the operation of a service	U6*
E5 – Economy and management E51 – Economic and legal management	U51		
E52 – Quantitative management techniques	U52		

NOTE : This table only has value in terms of test equivalence between the old diploma and the new one during the transitional phase when some candidates may retain the benefit of exemption from certain tests.
In no case does it mean a point-to-point correspondence between the contents of the tests.

Repeating candidates who have not chosen English in LV1 will be able to keep the language they have chosen for five years.

* A candidate benefiting from one or more of the units U51, U52 and U62 of the old diploma can keep the best of his marks and transfer it to the U6 unit of the new diploma.