



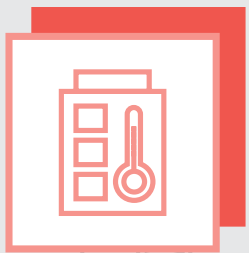
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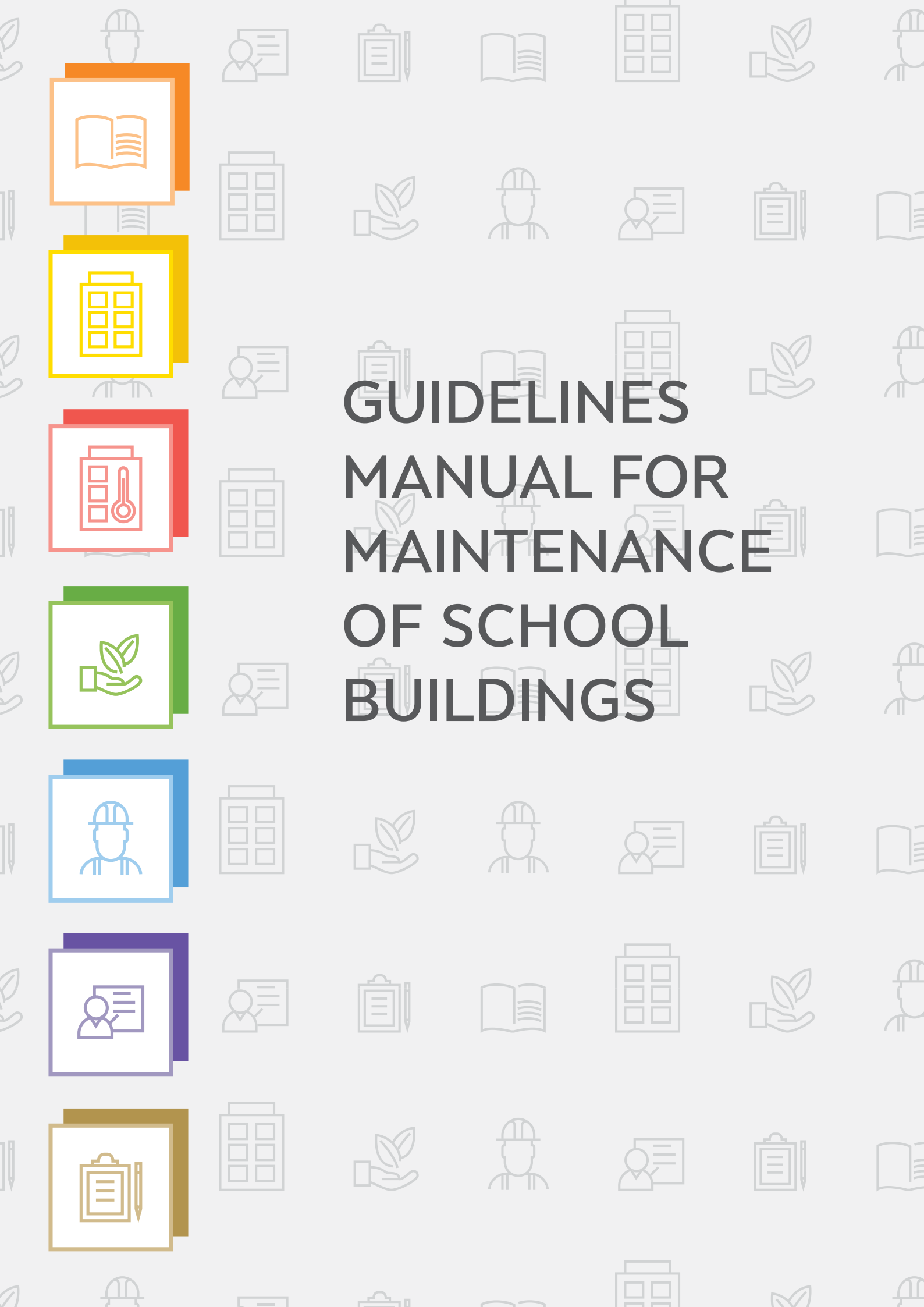


interethnic Integration in Education Project



# GUIDELINES MANUAL FOR MAINTENANCE OF SCHOOL BUILDINGS





**GUIDELINES  
MANUAL FOR  
MAINTENANCE  
OF SCHOOL  
BUILDINGS**



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# 1

# INTRODUCTION



Pursuant to Article 55 paragraph 1 of the Law on Organisation and Operation of the State Administrative Bodies ("Official Gazette of the Republic of Macedonia" No. 58/00, 44/02, 82/08, 167/10 and 51/11), the Minister of Education and Science adopted

## GUIDELINES MANUAL FOR MAINTENANCE OF SCHOOL BUILDINGS

This Guidelines Manual for maintenance of school buildings has been prepared within the USAID Interethnic Integration in Education Project (IIEP), implemented by the Macedonian Civic Education Center (MCEC), in cooperation with the Ministry of Education and Science, Department for Capital Investments in Education (MES). The funds for the reconstruction of the schools within the project are donated by the United States European Command (EUCOM).

The MCEC team has been working for many years on projects whose main objective is to improve the working conditions in the schools in the Republic of Macedonia. During the implementation of projects over the past 10 years, visits were made to almost all elementary and secondary schools in the Republic of Macedonia. As a result of the activities of the MCEC team within the many projects supported by the international community, over 300 projects have been implemented for full or partial renovation of the school buildings. This experience contributed greatly to the high-quality and comprehensive analysis of the situation in the schools, to the improvement of the conditions for the stay of the students, as well as the conditions in which the pedagogical and educational process takes place. In these analyzes, we arrived to the following findings:

- ▶ A large number of schools in the Republic of Macedonia still do not fully meet the basic requirements which one educational building where students study should meet;
- ▶ The quality of the maintenance of the school buildings in the entire country differs greatly from school to school;
- ▶ Many school buildings, in a short period after the renovation, again fall into disrepair.

The purpose of this Guidelines Manual for maintenance of school buildings is to share knowledge, experiences and best practices for maintenance of school buildings which the MCEC team, in cooperation with the MES, acquired over the years of working with the schools, on their renovation and strengthening the capacity of schools staff.



The Guidelines Manual is designed for the needs of the elementary and secondary schools in the Republic of Macedonia, directors, professional service staff, school secretaries and school technical staff. The findings, advices and recommendations comprised in the Guidelines Manual will also be of great importance for the municipalities, which as founders of the schools are responsible for their management and maintenance. Providing good learning conditions, cost-effective management of the buildings and achieving savings as a result of the good maintenance should be a common goal of all stakeholders in the pedagogical and educational process.

## 1.1. THE IMPORTANCE OF SCHOOL MAINTENANCE

Children hold a central place in the community. After the home and the family, the school is the most important place where children spend time and study. The school building, the classrooms and other premises in the schools should be accessible and enjoyable for students to stay in and learn and for other teaching related activities.

For the newly built, renovated and well maintained school buildings to retain their look and functionality in the long run, they need to be properly managed and timely and professionally maintained.

The maintenance of the school buildings is important from economic aspect as well. With proper maintenance of the school building, rational use of energy resources and installation of energy efficient materials, the school will save energy, which means that it will spend much less funds during operation. The maintenance funds saved can be invested by the school for the improvement of the conditions in the school, and modernization and improvement of the educational process.

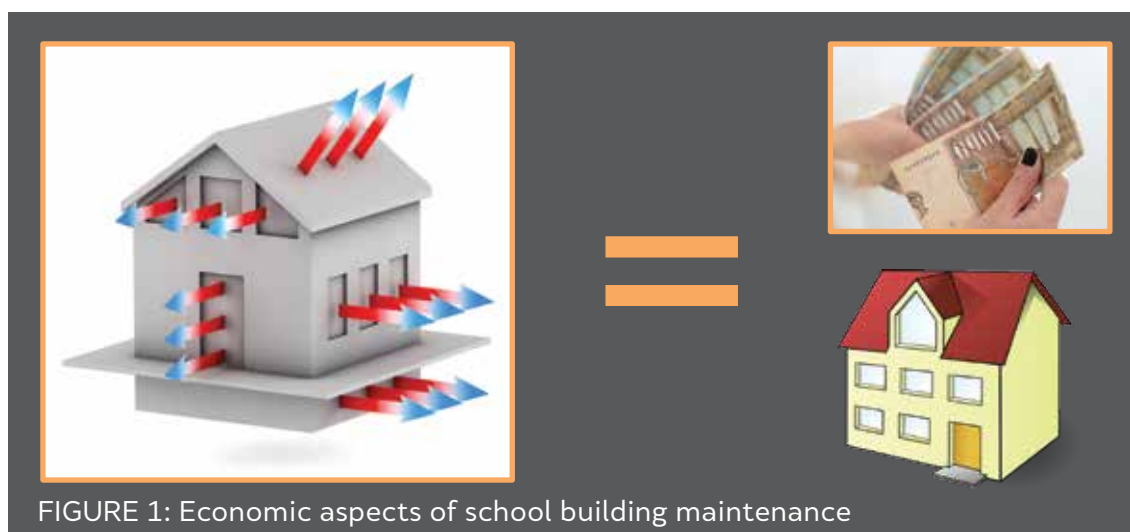


FIGURE 1: Economic aspects of school building maintenance



The effective maintenance of school buildings provides for:

- ▶ Safe and healthy physical environment in the school;
- ▶ Normal functioning of the teaching process;
- ▶ Extended lifespan of the school buildings and the school equipment;
- ▶ Increased energy efficiency;
- ▶ More rational maintenance from financial aspect and
- ▶ Lower operating costs.

It must be noted that the maintenance of the schools is not a responsibility of the school technical staff only, but all users of the school building - the school management, teachers, parents and students should participate in the maintenance.

## 1.2. WHY DO WE NEED A GUIDELINES MANUAL FOR MAINTENANCE OF SCHOOL BUILDINGS?

In order to provide specific guidance and advices to the municipalities and the schools for overcoming the everyday challenges in the maintenance of school buildings, the USAID Interethnic Integration in Education Project, in its program, introduced trainings for the school management team and the school technical staff so as to clarify the basic procedures and activities that are necessary for the maintenance of school buildings. As a result of the analysis of the maintenance needs of the schools, the research conducted during the preparation of the trainings and the experience of the team in this area, we came up with an idea to prepare a Guidelines Manual for maintenance of school buildings.

The Guidelines Manual covers the maintenance of school buildings from two aspects –technical and planning. The technical aspect of the maintenance of schools comprises the total package of infrastructure, capacities and sanitary conditions in and around the school building, while the planning aspect covers the activities and practices that are to be implemented by the school staff and the students so as to maintain high-quality, hygienic and technical conditions in the school.



### DID YOU KNOW??

The physical health of the students is affected by the location, orientation, lighting, ventilation, heating and maintenance of hygiene in the school building, as well as the furniture, teaching aids and the study load<sup>1</sup>.

<sup>1</sup> Regulation on space, equipment and teaching aids for the nine-year elementary education adopted by the Minister of Education and Science of the Republic of Macedonia on 28.02.2008.



## 1.3. WHAT IS THE PURPOSE OF THE GUIDELINES MANUAL?

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The school, as a building where the students and school staff study and work, needs to meet the standards for school buildings in many aspects. The objectives of the Guidelines Manual are to present the best practices, lessons learned and recommendations resulting from long years of working with and in the schools in the Republic of Macedonia.

The Guidelines Manual presents:

- ▶ The school building from construction and infrastructure aspects;
- ▶ The manner and the activities for maintenance of construction positions and heating systems in the school building;
- ▶ The maintenance of hygiene in the schools, activities and dynamics;
- ▶ The procedures for preventive maintenance of the school building;
- ▶ The most common maintenance problems and how to solve them on daily, monthly and annual basis;
- ▶ The measures for environmental protection; and
- ▶ The required maintenance tools and protective equipment for safety at work.

## 1.4. WHO PREPARED THE GUIDELINES MANUAL?

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This Guidelines Manual has been prepared by the Macedonian Civic Education Center (MCEC) within the USAID Interethnic Integration in Education Project (IIEP), by representatives from the Ministry of Education and Science (MES) - Department for Capital Investments in Education, in cooperation with experts in the field of construction, architecture, mechanical engineering and safety at work.



## 1.5. WHO IS THE GUIDELINES MANUAL INTENDED FOR?

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The Guidelines Manual is intended for different groups of users. It will help in the daily work of the employees in:

- ▶ the elementary and secondary schools in the Republic of Macedonia, i.e. the persons responsible for the schools: directors, professional service staff, school secretaries and school technical staff;
- ▶ The education departments/units in the local self-government and the municipal educational inspectors which are directly controlling the conditions in the schools and may impact the application of regulations and standards for their maintenance;
- ▶ Ministry of Education and Science/Sector for Capital Investments which may influence the national development of programs and legislation for school maintenance.

## 1.6. WHAT DOES THE GUIDELINES MANUAL CONTAIN?

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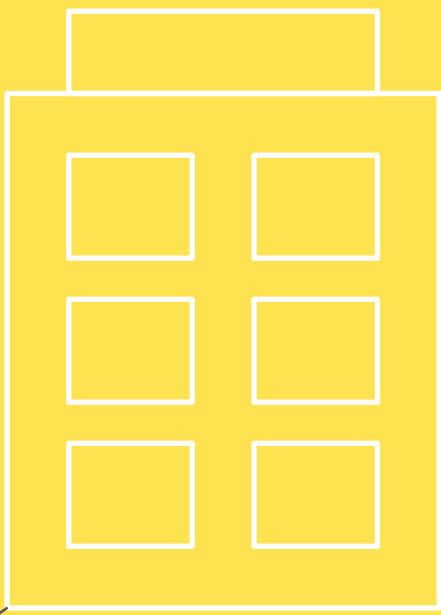
The Guidelines Manual covers:

- ▶ The most common problems that the schools and school technical staff usually face during maintenance;
- ▶ Practical ways to solve them;
- ▶ Recommendations for preventive maintenance, measures for safety at work;
- ▶ The tools required for maintenance of the schools.

The Guidelines Manual also contains materials - tables that can be used in daily, monthly and annual maintenance of the schools, wherein the persons responsible for maintenance per items and the applicable procedures are stated so as to ensure high-quality maintenance process.

The results/effects from the implementation of these plans, standards and recommendations in the maintenance of school buildings refer to:

- ▶ Increasing the level of hygiene in the school;
- ▶ Improving the learning conditions in the building;
- ▶ Increasing the lifespan of the systems and materials (windows, doors, floors, etc.) installed in the building;
- ▶ Reducing the heating costs;
- ▶ Increasing the energy efficiency of the building.



# 2

## MAINTENANCE OF SCHOOL BUILDINGS



Maintenance of school buildings is a set of activities, terms and responsible persons that should be organized and act in a coordinated and purposeful manner. For successful maintenance, a maintenance plan should be prepared which will provide an answer to the four questions - WHAT? WHEN? WHO? HOW?

If the answers to these four questions are precisely defined, clearly recorded and practically applied, then the maintenance of the school building will be much more successful, efficient and effective.

**Maintenance is an ongoing, daily activity of the school and the school staff, which should be organized in a systematic and proactive manner.**

Effective maintenance of school buildings protects the capital investments, ensures for the health and safety of children and employees and provides conditions for development of the educational process.

Different stakeholders in the educational process have different roles, obligations and responsibilities in the process of maintenance of the school buildings.

The education officials in the municipalities / the City of Skopje and the school directors should know that:

- ▶ The maintenance of school buildings contributes to physical and financial well-being of the school;
- ▶ The maintenance of school buildings affects the look of the building, the operation of the equipment, the health of the students and the school staff and the teaching process itself;
- ▶ The maintenance of school buildings requires funding;
- ▶ The strategic planning of the maintenance of school buildings is a teamwork, which requires contribution and expertise of various stakeholders;



- ▶ The maintenance should be coordinated within the school;
- ▶ They need to work on proper implementation and evaluation of plans for maintenance of the school facilities;
- ▶ They need to continuously inform the community about the state of the school and how the community can help with the maintenance.

#### **The school staff responsible for maintenance should:**

- ▶ Understand that the observing of numerous procedures related to the maintenance of school buildings and their proper application leads to successful maintenance;
- ▶ Be prepared for continuous training so as to improve their knowledge and skills related to the maintenance of school buildings;
- ▶ Communicate their knowledge and experiences to the other employees so that they can help in the maintenance of school buildings;
- ▶ Cooperate with the management staff who make budget decisions;
- ▶ Know that the needs for successful teaching process directly affect the decisions on maintenance of school buildings.

#### **The teachers should:**

- ▶ Raise the level of importance of the direct impact of the maintenance of school buildings on the teaching process;
- ▶ Educate students how to behave in and out of the school buildings;
- ▶ Communicate their expectations about what the internal conditions in school buildings should be like, as they affect the improvement of student learning;
- ▶ Observe the maintenance procedures.

#### **The students should:**

- ▶ Recognize the school buildings as their environment for learning and development;
- ▶ Treat the school property with respect;
- ▶ Gain positive habits that will enrich their life experiences.

#### **The parents and the community, through their representatives in the School Board, should:**

- ▶ Recognize that the school buildings are a place where the future citizens and leaders are cultivated;





- ▶ Respect the decisions regarding the use and maintenance of school buildings;
- ▶ Contribute to the decision making process related to the maintenance of school buildings, when requested.

In the chapters that follow we will focus in more detail on the maintenance of the building, both in terms of maintenance of hygiene, and in terms of the construction positions and the heating systems of the buildings. For each position we will describe the most common problems that occur, as well as the possible solutions for their removal.

## 2.1. MAINTENANCE OF SCHOOL BUILDINGS: CONSTRUCTION POSITIONS

---

Building maintenance is an ongoing, daily activity of the school and the school staff, which should be organized in a systematic and proactive manner so as to prevent the need for larger repairs. Generally speaking, maintenance can be divided into planned and unplanned.

### UNPLANNED

Maintenance intervention (reactive - corrective), where measures are taken upon a malfunction or when more severe damage is detected. This is the most common way of maintenance, i.e. approximately 50% of the maintenance programs for the schools in Macedonia are focused on this kind of maintenance. Unplanned maintenance is basically corrective maintenance, i.e. reaction to unexpected, accidental or unintentional damages. The annual plans and budgets for school maintenance allocate approximately 2% for covering damages resulting from unintentional damages.

### PLANNED

Preventative (proactive) maintenance aimed at preventing damages to the building or equipment malfunction. This maintenance is performed in planned regular time intervals during the school year, and not just as a reaction to the occurred damage. As its name suggests, planned maintenance means that an action plan for the school maintenance is prepared which should be implemented in organized, coordinated and controlled manner. Approximately 30% of the maintenance in the schools in Macedonia is preventive maintenance.

The schools are expected to adopt a pre-defined plan, rather than reactive approach to maintenance. Developing maintenance mentality and conscientious approach to performing maintenance and small repairs ensure the optimal utilization of school buildings.



The maintenance of the construction positions includes planned and regular check of all construction positions of the building including: windows, doors, roof, walls, facades, floors, ceilings, and yard areas, pathways and access ramps for students with special needs (physical disabilities).



FIGURE 2: Components of the maintenance of construction positions

In the Guidelines Manual, the most common problems that occur during the maintenance of the construction positions, the methods for their removal and the best practices for regular preventive maintenance are stated for each construction position. In the Tables - Annual action plan for maintenance of the construction positions (Appendix 1) and Monthly action plan for maintenance of hygiene in school buildings (Appendix 2) the activities, the time period for their execution and the person responsible for maintenance of the construction positions / hygiene are listed.



### DID YOU KNOW??

Students achieve 13-26% higher results on standard tests when working in rooms with daylight. The provision of daylight by design and installation of larger area with windows in the classroom is the best construction investment to create a stimulating learning environment.



## 2.1.1. WINDOWS

### 2.1.1.1. THERMAL EXPANSION (DILATATION) IN WINDOWS AND DOORS

Dilatation is expansion or stretching of profiles of which windows and doors are made, due to changes in temperature.



#### **DID YOU KNOW??**

The windows and doors, under the influence of high temperatures and depending on the material of which they are made, stretch during the summer as follows:

Aluminum	➡	1,2 mm
PVC	➡	3–4 mm
Wood	➡	depending on the wood quality

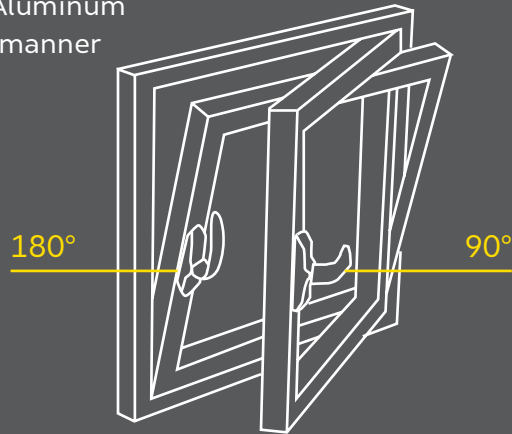
From our extensive experience of working on renovation of schools, i.e. replacing windows and doors in schools, we came to a conclusion that the use of aluminum profiles for manufacturing windows and doors for public buildings is very pragmatic. Aluminum profiles (three chamber, with thermal bridge) have solid features when it comes to energy efficiency, react well to changes in temperature, have a long lifespan (50 years), and are not deformed and destroyed at high temperatures (fires).

The various dimensions of windows profiles are affected by huge forces which result in deformation of the windows. These deformations can cause:

- ▶ Breaking of the glass (due to excessive tension);
- ▶ Window condensation (due to cracks in the putty);
- ▶ Drafting (due to distortion);
- ▶ Difficult functioning of the mechanisms (due to deformations).



FIGURE 3: Aluminum profile and manner of opening



#### NOTE:

For the avoidance or mitigation of anomalies in aluminum windows it is necessary to do the following:

- ▶ to provide enough room for expansion between the glass and the frame;
- ▶ to provide enough space between the window and the wall that will be filled with polyurethane foam that will be able to neutralize all thermal dilatations.

#### 2.1.1.2. TIMELY REMOVAL OF THE PROTECTIVE FOIL

After the installation of the windows and doors, it is necessary to remove the protective foil within a period of one month. If the foil is not removed over a longer period (depending on the manufacturer's recommendations, but on average the foil should be removed no later than 3 months after the setting), it may result in difficulties during its removal, and possibly damages.

#### 2.1.1.3. VENTILATION OF PREMISES

During the long heating periods, ventilation of the premises by opening the windows in the tilt position should be avoided. Fresh air can best be provided by opening all windows and doors to make draft which for a very short time (3-4 minutes) can replace all the air in the room, and thus avoid cooling the walls.

**NOTE:**

Regular ventilation is needed for:

- ▶ Regulating the humidity in the room;
- ▶ Replacing the old air with new;
- ▶ Preventing condensation and mold growth;
- ▶ Creating conditions for healthy environment and pleasant stay of students and school staff.

**NOTE:**

In optimal conditions, the premises should be ventilated every class hour.

**DID YOU KNOW?**

Uncontrolled drafts and poor sealing of windows and doors increase the energy consumption by 15%!

TABLE 1: Solving problems related to the use of aluminum windows and doors

SOLVING PROBLEMS RELATED TO THE USE OF ALUMINUM WINDOWS AND DOORS		
PROBLEMS	MEASURES	NECESSARY TOOLS
Difficult functioning of the mechanisms.	▶ Adjustment.	▶ Tee key.
Window condensation.	▶ Applying silicon.	▶ Screwdriver; ▶ Tee key; ▶ Wooden mallet.
Damaged handles.	▶ Replacement.	▶ Screwdriver; ▶ Tee key; ▶ Drill.
Damaged rubber sealants.	▶ Replacement.	



## 2.1.2. ROOF

The roof is part of school building that protects the building against:

- ▶ UV radiation;
- ▶ Snow, rain, frost, dew, hail, etc.

In school building in the Republic of Macedonia there are two types of roofs:

- ▶ Flat roof;
- ▶ Pitched roof.

### 2.1.2.1. CHECKING THE CONDITION OF THE ROOF SURFACE

There are three types of roof coverings in the school buildings:

- ▶ Roof tiles;
- ▶ Galvanized sheets;
- ▶ Asbestos tiles (banned for use, and should be replaced where present). The replacement should be performed in accordance with the Regulation on handling of asbestos waste and asbestos-containing waste materials, Official Gazette of the RM No. 68/04 and 71/04 ([http://www.moep.gov.mk/wp-content/uploads/2014/09/Pravilnik\\_za\\_naciot\\_za\\_postapuvanje\\_so\\_otpad\\_od\\_azbest\\_i\\_otpad\\_od\\_proizvodi\\_koi\\_sodrzat\\_azbest.pdf](http://www.moep.gov.mk/wp-content/uploads/2014/09/Pravilnik_za_naciot_za_postapuvanje_so_otpad_od_azbest_i_otpad_od_proizvodi_koi_sodrzat_azbest.pdf)).

The roof surface should be checked every three to six months.



#### NOTE:

When checking the roof coverings it is necessary to:

- ▶ Inspect the roof tiles, sheets, brackets and screws;
- ▶ Check the ventilation tiles, roof flashings, snow guards and cavities.



FIGURE 4: Roof construction



## 2.1.2.2. CLEANING THE ROOF AND THE GUTTERS

Roof cleaning includes washing the roof covering and cleaning the gutters. Gutter cleaning is one of the most important and one of the most significant steps. Unfortunately, the cleaning is often performed only after the gutters get clogged. The gutters should be thoroughly cleaned every spring and every fall.

TABLE 2: Solving problems related to poorly functioning gutters

SOLVING PROBLEMS RELATED TO POORLY FUNCTIONING GUTTERS		
PROBLEMS	MEASURES	NECESSARY TOOLS
Clogging of the horizontal gutters as a result of accumulated leaves, branches and other debris.	<ul style="list-style-type: none"><li>▶ Cleaning of the gutters and removal of the accumulated waste;</li><li>▶ Washing the gutter with a pressure washer hose.</li></ul>	<ul style="list-style-type: none"><li>▶ Ladder;</li><li>▶ Gloves;</li><li>▶ Waste container (bag, basket, bags);</li><li>▶ Hose.</li></ul>
Clogging of the vertical gutters as a result of accumulated leaves, branches and other debris.	<ul style="list-style-type: none"><li>▶ Cleaning of the gutters and removal of the accumulated waste;</li><li>▶ Washing the gutter with a pressure washer hose.</li></ul>	<ul style="list-style-type: none"><li>▶ Ladder;</li><li>▶ Gloves;</li><li>▶ Waste container (bag, basket, bags);</li><li>▶ Hose.</li></ul>
Damaged gutters, disconnected gutter (when a module-piece is missing) and irregular drainage of stormwater.	<p>The damaged parts and broken brackets should be replaced by:</p> <ul style="list-style-type: none"><li>▶ Determining the length of the damaged part;</li><li>▶ Unscrewing the gutter brackets and removing the damaged part;</li><li>▶ Installation of a new part of the gutter and fixing new brackets.</li></ul>	<ul style="list-style-type: none"><li>▶ Drill;</li><li>▶ Silicone;</li><li>▶ Screws.</li></ul>
Cracked gutters in winter as a result of retention of stormwater and freezing.	<p>If the gutters are leaking, it is necessary to:</p> <ul style="list-style-type: none"><li>▶ Identify the location of the leaks,</li><li>▶ Apply silicone on the joints;</li><li>▶ Level the horizontal gutters, as when the drop is not proper, the gutters tend to collect, i.e. retain water.</li></ul>	<ul style="list-style-type: none"><li>▶ Drill;</li><li>▶ Silicone;</li><li>▶ Screws.</li></ul>
Damaging of the wall surfaces and ceilings due to retaining of stormwater in the gutters.	<ul style="list-style-type: none"><li>▶ Repair or cleaning of the gutters;</li><li>▶ Cleaning of the damp patches on the walls and ceilings;</li><li>▶ Coating the patches with base primers;</li><li>▶ Painting the wall and the ceiling.</li></ul>	<ul style="list-style-type: none"><li>▶ Drill;</li><li>▶ Silicone;</li><li>▶ Screws.</li></ul>



### 2.1.2.3. LIGHTNING INSTALLATION

A part of the electrical installation of the building is designed to minimize the possibility of lightning strike in the object that it is protecting.

The protection of the buildings from atmospheric pressure discharges is performed with external lightning installation or lightning rod.

The lightning rod is intended to intercept a good portion of the lightning strikes in the protection zone and to safely pass the extremely high currents of the lightning to the ground without harmful consequences.

It consists of air terminals, which supersede the protected building, ground terminals and bonding conductors, which connect the air to the grounding terminals of the lightning rod. These three parts of the external lightning installation in the literature can also be found under the names:

- 1) Lightning rods or strike termination devices;
- 2) Ground conductors or downloads and
- 3) Grounding system.

The air terminals should be placed on those areas of the building that are most likely to be hit by lightning, whereas the roof lines or outlets, form a closed cage with as many outlets as possible.

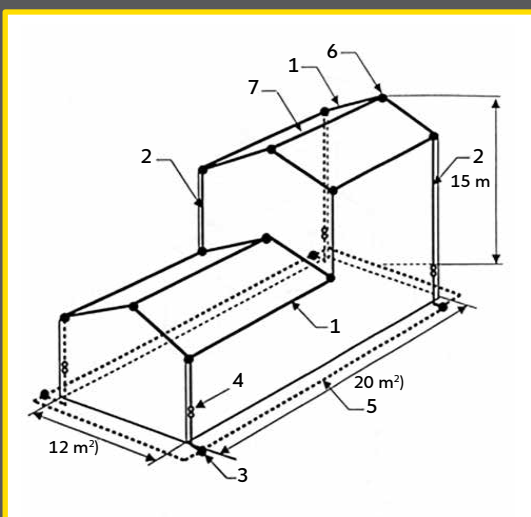


FIGURE 5: Fitting the external lightning installation on a building made of insulation material, in case of different roof levels:

- 1 – horizontal conductor of the air terminal
- 2 – downleads
- 3 – T piece connector, resistant to corrosion
- 4 – joint/ test point
- 5 – ring grounds
- 6 – T piece connector on the top of the roof
- 7 – Mesh network





FIGURE 6: Lightning installation

The lightning installation must be checked when:

- ▶ certain modifications or repairs are made on the roof or the facade;
- ▶ after lightning strike in the installations or the building.



**NOTE:**

Regarding the lightning installation it is necessary to:

- ▶ check and inspection of the lightning installation every two years, where the inspection is performed by a licensed company authorized for testing of lightning installations;

Schools that do not have lightning installation are not protected against lightning and damage to the electrical systems in the building. \*In accordance with the Law on Safety and Health at Work, Official Gazette of the RM No. 53/2013. ([http://mtsp.gov.mk/WBStorage/Files/brz\\_precisten.pdf](http://mtsp.gov.mk/WBStorage/Files/brz_precisten.pdf))



## 2.1.3. WALLS

### 2.1.3.1. EXTERIOR WALLS AND FACADE

Exterior walls and facade protect the building from rain, snow, penetration of wind, dust and polluted air. The method and materials applied in the making of the walls and facade impact the heat and cold protection, fire protection, water vaporization without condensation on their surfaces and inside, energy saving and protection from external noise. Exterior walls and facade can be made with insulation and without insulation. The type of insulation that will be used (thickness of the polystyrene and treatment) depends on the location of the building, the structure, the dimensions, the type of building materials used and the method of heating.

The most common problems that occur in the exterior - facade walls are cracks on the walls and removing graffiti from the facade.

### 2.1.3.2. WALL CRACKING AND REMOVING GRAFFITI FROM THE FACADE

The wall cracking can occur in case of high temperature range, i.e. large dilatation strains.

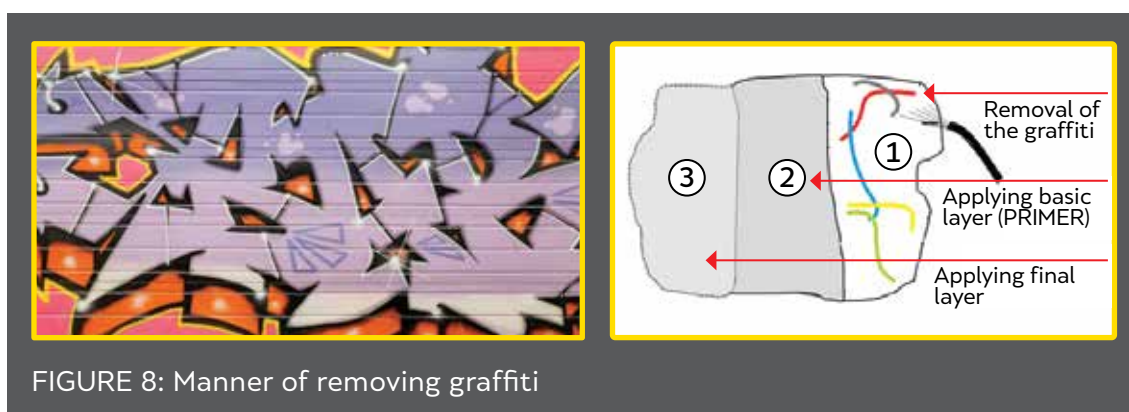
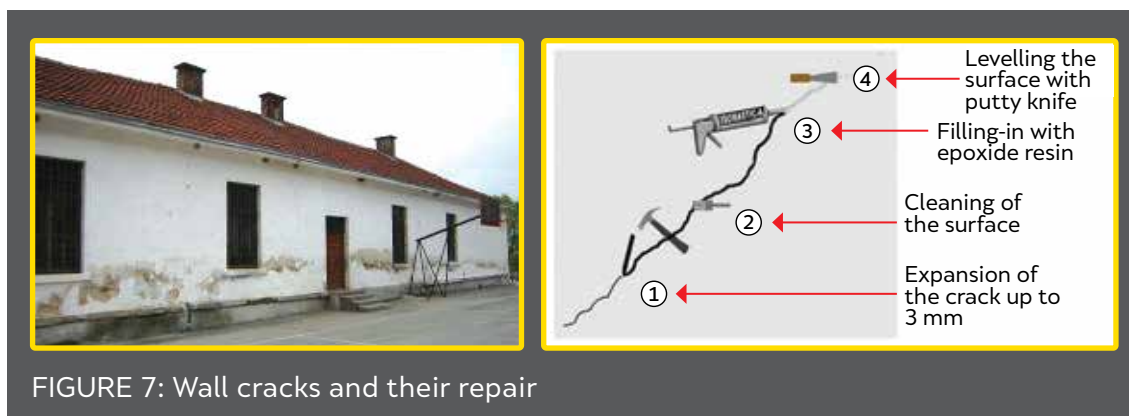




TABLE 3: Solving problems with wall cracks and removing graffiti from the facade

SOLVING PROBLEMS WITH WALL CRACKS AND REMOVING GRAFFITI FROM THE FACADE		
PROBLEMS	MEASURES	NECESSARY TOOLS
Wall cracking.	<ul style="list-style-type: none"><li>▶ Cleaning of the surface;</li><li>▶ Assessment of the depth of the crack;</li><li>▶ Filling-in the cracked part with epoxide resin, skimming coat or mortar;</li><li>▶ Leveling the surface with putty knife for smoothing uneven parts;</li><li>▶ Painting.</li></ul>	<ul style="list-style-type: none"><li>▶ Skimming trowel;</li><li>▶ Brush;</li><li>▶ Sponge roller.</li></ul>
Graffiti on facades.	<ul style="list-style-type: none"><li>▶ Cleaning of the surface;</li><li>▶ Placing a primer as a base. The prime is a basic coating, i.e. binding layer of the base. It binds the pieces of dust that cannot be removed with cleaning, it improves the adhesion of the coating and it strengthens the base. It is applied in one layer with a brush;</li><li>▶ After the basic coating is applied, the final layer of paint should be applied. The paint should cover well and it should be with high water resistance and consistency in all climate conditions.</li></ul>	<ul style="list-style-type: none"><li>▶ Brush;</li><li>▶ Sponge roller.</li></ul>



### 2.1.3.3. INTERNAL WALLS AND CEILINGS

The painting represents a regular maintenance of the internal walls. The wall painting consists of the following:

- ▶ Basic color in one layer (basic coating for all types of bases before painting the facade and interior colors);
- ▶ Two layers of water colors (for internal use).

Problems that occur with the internal walls are wall cracking and damp on the walls and ceilings.

The internal wall cracking can be repaired in the same manner as shown on the external walls.

The wet spots on the ceiling usually occur as a result of leaking of the roof, damp and condensation. Before removing these spots, first of all it is necessary to detect the cause of the damp, to take measures for removal of the leakage, and then to leave the wet spots to dry. After the area with the wet spots has dried, it is necessary to paint it with a new layer of paint.



#### DID YOU KNOW??

The damp and mold can cause allergies, asthma attacks, cough, throat irritation and runny nose!



FIGURE 9: Wet spots on ceilings and walls and their removal



FIGURE 10: Painting internal walls with final layer of paint

TABLE 4: Solving problems with damp and painting walls and ceilings that have damp spots

SOLVING PROBLEMS WITH DAMP AND PAINTING WALLS AND CEILINGS THAT HAVE DAMP SPOTS		
PROBLEMS	MEASURES	NECESSARY TOOLS
Damp on ceilings and internal walls. Damps on floors.	<ul style="list-style-type: none"> <li>▶ Detecting the cause of the damp;</li> <li>▶ Removing the cause: repair of the roof, gutters, hydro insulation, removal of capillary damp.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Ladder;</li> <li>▶ Drill;</li> <li>▶ Silicone;</li> <li>▶ Screws;</li> <li>▶ Gloves.</li> </ul>
Painting internal walls that have damp spots.	<ul style="list-style-type: none"> <li>▶ The surfaces are cleaned in order to remove the dust from the walls;</li> <li>▶ An adequate basic coating is applied;</li> <li>▶ The wall is painted by evenly applying the paint. During the final painting of the surface, the roller has to be moved from top to bottom and vice versa so that the wall surface would be even;</li> <li>▶ The time interval between the first and the second layer should be 4-6 hours.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Semi-wet towel;</li> <li>▶ Skimming trowel;</li> <li>▶ Brush;</li> <li>▶ Sponge roller.</li> </ul>



### NOTE:

The internal walls should be painted in a time interval of three to five years.

The walls should be painted with lighter colors and the ceilings should be white.

The protective paint on the walls is applied at the height of up to 1.2 meters.

**BE CAREFUL WHAT KIND OF PAINTS YOU BUY!**

- ▶ They should be water-based;
- ▶ They should not contain acetone, ammonia or formaldehyde;
- ▶ They should not contain heavy metals and volatile organic compounds.



### DID YOU KNOW??

The light reflects white color the best.

The pastel colors decrease the daily light by 50%.

The computers should be placed at the angle of 45° from the windows in order to prevent the reflection.

## 2.1.4. FLOORS

The floors in the schools are covered with floor layer depending on the type and size of the premises. The classrooms, cabinets, offices and other premises which accommodate the students and employees are covered with warm floors, whereas the halls, toilets and auxiliary premises are covered with cold floors.

There are several types of warm floor layers that are used in the schools and they are made of the following:

- ▶ PVC floor covering, heterogeneous, roll shaped 2 mm thick with finishing layer with extreme protection;
- ▶ Wood based materials (parquet, laminate, matched board);
- ▶ Vinas tiles;
- ▶ Epoxide resins.



FIGURE 11: Examples of warm floors

The cold floors are made of the following:

- ▶ Terrazzo;
- ▶ Ceramic tiles.



FIGURE 12: Examples of cold floors

The maintenance of the floors is very important for the persons that are staying in the school. The manner of maintenance depends on the type of the floor cover. Most of the premises in the schools where the students are staying are with floor covers made of PVC materials.



**NOTE:**

The floors should be maintained in accordance with the manufacturer's recommendations.

The maintenance requires everyday sweeping and cleaning with wet mop and removing chewing gums; monthly check (loosening, cracking); annual machine cleaning.



TABLE 5: Solving problems with maintenance of PVC floors

SOLVING PROBLEMS WITH MAINTENANCE OF PVC FLOORS		
PROBLEMS	MEASURES	NECESSARY TOOLS
Cleaning spots made of color pens, ketchup, mustard, grease etc.	<ul style="list-style-type: none"> <li>▶ The spots are soaked in water with dissolved cleaning agent;</li> <li>▶ The floor is swept with towel and polished in accordance with the instructions of the floor manufacturer.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Towel;</li> <li>▶ Detergent;</li> <li>▶ Mop;</li> <li>▶ Towel and detergent.</li> </ul>
Cleaning rust spots.	<ul style="list-style-type: none"> <li>▶ The rust spots are soaked in water with dissolved cleaning agent;</li> <li>▶ The floor is swept with towel and polished in accordance with the instructions of the floor manufacturer.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Rust remover;</li> <li>▶ Towel;</li> <li>▶ Mop.</li> </ul>
Loosened parts of the PVC floor.	<p>It is necessary to check the PVC floor.</p> <p>If there are any loosen parts, it is necessary to put bonding agent between the PVC floor and the existing floor lining (this usually happens at the joining parts and at the joints with the computer installations).</p>	<ul style="list-style-type: none"> <li>▶ Skimming trowel;</li> <li>▶ Roller.</li> </ul>
Damaged surfaces as a result of irregular replacement of the furniture pads (desks and chairs).	<ul style="list-style-type: none"> <li>▶ A bonding agent is put between the PVC floor and the existing floor lining;</li> <li>▶ Go over the floor with a roller in order to remove the excess material and to make a pressure for better adhesion;</li> <li>▶ A heavy object is placed which should be left for 12 hours in order to improve the binding;</li> <li>▶ A final coating is placed to join the edges of both parts and to prevent ungluing of the damaged part.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Skimming trowel;</li> <li>▶ Roller;</li> <li>▶ Drill.</li> </ul>





### 2.1.4.1. REPLACEMENT OF THE RUBBER PADS OF THE FURNITURE WITH PLASTIC PADS

The pads protect the legs of the furniture in order to prevent damage to the PVC floor. The rubber pads need to be replaced with plastic pads because the rubber pads leave marks on the PVC floor. The furniture should be checked on regular basis (desks and chairs) and the damaged pads should be replaced.

### 2.1.4.2. REPLACEMENT OF DAMAGED BASEBOARDS

The baseboards should be checked on regular basis. In the event of damage, they should be replaced with new baseboards.



#### **NOTE:**

When placing new baseboards please make sure that:

- ▶ The fastening screws are not bent and sticking out;
- ▶ When placing the screws make sure that the baseboard does not crack or that you don't damage it;
- ▶ In the areas where two angled baseboards are joined, they should be filled with putty in case their angles are not even (this usually happens with old uneven walls).



FIGURE 13: Damage of the PVC floors and baseboards



#### **DID YOU KNOW??**

Japanese schools do not have technical staff. The students and teachers jointly clean the floors after lunch and at the end of the day, they also empty the rubbish bins and clean the toilets!



## 2.1.5. SANITARY BLOCKS

The sanitary blocks are parts of the school building, the maintenance and hygiene of which are very important. The maintenance and hygiene of the sanitary premises have a direct impact on the health of the users of these premises. The good organization for cleaning and maintaining the toilets and sanitary blocks of the school is of utmost importance. The poor maintenance of the sanitary premises imposes a great risk and has a direct impact on the health of the children and employees.

For the purposes of quality maintenance of the sanitary blocks and maintenance of their hygiene, the school has to provide spare parts, cleaning agents, manpower and equipment, as well as clear division of the tasks and responsibilities among the engaged employees.

### 2.1.5.1. HYGIENE IN THE SANITARY BLOCKS

The technical staff, i.e. the cleaning staff is responsible for the hygiene in the schools. Their tasks and responsibilities include cleaning of the classrooms, offices, halls, toilets and other premises in the school.

The cleaning and maintaining of the sanitary premises is performed as follows:

- ▶ Every day during the recess and after the classes, the toilet bowls, urinals and sinks are cleaned, the liquid soap is refilled and the rubbish bins are emptied.
- ▶ Each month the toilet cisterns, drain, taps, faucets and valves are checked;
- ▶ Every year the water and sewage installation (pipes and shafts) is checked.

The maintenance of the hygiene in the school and the dynamics of the activities are given in the table (Appendix 2) which includes all elements in the school that need to be cleaned, as well as the dynamics or frequency of the activity – daily, monthly, annual.



#### **NOTE:**

When cleaning the toilets in the school you should use disinfectants that:

- ▶ Do not contain toxic substances;
- ▶ Do not erode the construction materials and equipment integrated in the toilets and
- ▶ Are ecologically acceptable.

The toilets should be cleaned **ONLY** with a mop and the hose should be used only for cleaning out of the facility.



## 2.1.5.2. MAINTENANCE OF THE SANITARY BLOCKS

The maintenance of the sanitary blocks is a responsibility of the technical personnel, i.e. the handyman. It is the handyman's task to continuously control the water and sewage installations, as well as the sanitary equipment installed in these installations. Upon the detecting of the defect, it should be removed as soon as possible.



### DID YOU KNOW??

A leaky faucet, which leaks 30 drops in a minute, consumes 10 liters of water per day.

TABLE 6: Solving problems with maintenance of sanitary blocks

SOLVING PROBLEMS WITH MAINTENANCE OF SANITARY BLOCKS		
PROBLEMS	MEASURES	NECESSARY TOOLS
Repair of the toilet cistern from which a small quantity of water is constantly leaking in the toilet bowl.	<p>There are two ways to repair the toilet cistern:</p> <ul style="list-style-type: none"> <li>▶ Remove the cistern lid; if the water is overflowing through the overflow tube, it means that the defect is located in the fill valve. Pull up the float lever and if the water stops overflowing, you should only adjust the water level without replacing any part;</li> <li>▶ If the water continues to flow, after you pull up the lever with your hand, you should repair or replace the valve. First of all you should turn off the water supply to the toilet cistern (close the stop valve at the bottom of the flexible hose) and dismantle the valve assembly which also comprises the float together with the lever and then replace it with a new one.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Pliers;</li> <li>▶ Screwdriver;</li> <li>▶ Drill.</li> </ul>
Repair of the drain.	<p>There are three ways to unblock the sink drain:</p> <ul style="list-style-type: none"> <li>▶ Unblocking agent should not be used if the pipes are completely blocked. The manufacturer's instructions should always be followed;</li> <li>▶ Using a plunger – when a plunger is used, the sink should be filled with water. Place the plunger over the sink drain and plunge the handle up and down. The rubber part of the plunger should be placed in the middle of the drain in a static position;</li> <li>▶ Cleaning the siphon – firstly unscrew the siphon with an adequate wrench and remove it. Place a container to catch the water that will spill from the siphon and then place the new siphon. When replacing the siphon, check if the washers are tight and firm because if they are soft and loose they will not hold the siphon and it will leak.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Pliers;</li> <li>▶ Screwdriver;</li> <li>▶ Plunger;</li> <li>▶ Drill.</li> </ul>
Repair of faucets, taps and valves.	<ul style="list-style-type: none"> <li>▶ Replacing washers;</li> <li>▶ Replacing valves;</li> <li>▶ Replacing faucets.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Pliers;</li> <li>▶ Screwdriver;</li> <li>▶ Drill.</li> </ul>



## 2.1.6. SCHOOLYARD

The area around the school building, i.e. the schoolyard is organized and arranged in accordance with the needs of the students. The schoolyard comprises of a fence, green area, pathways and sport fields. The maintenance of the elements of the schoolyard is a responsibility of the technical staff. The quality maintenance of the schoolyard requires adequate tools and equipment, as well as plan and dynamics of activities that should be implemented. The records of all activities, the performance dynamics and the data on the responsible persons are shown in the table (Appendix 1). These records should be kept by the person who is responsible for maintenance of the schoolyard.

Activities for maintenance of the schoolyard are as follows:

- ▶ Checking the access paths, sidewalks, parking;
- ▶ Disinfestation, disinsection and disinfection;
- ▶ Lawn mowing and cutting branches.

### 2.1.6.1. COLLECTING LEAVES

In the school yards with deciduous trees, the fallen leaves should be collected on regular basis due to the following reasons:

- ▶ The wet leaves create slippery ground on the school pathways on which the students can slip;
- ▶ The grass can be damaged due to the decay of wet leaves;
- ▶ Spots can occur on the grass as a result of the piled up leaves on the grass;
- ▶ The collected leaves and branches can be used as ecological fertilizer.



#### **NOTE:**

When maintaining the schoolyards and collecting the leaves, the students and employees should be organized to carry out these activities together.



TABLE 7: Solving problems with maintenance of the schoolyards

SOLVING PROBLEMS WITH MAINTENANCE OF THE SCHOOLYARDS		
PROBLEMS	MEASURES	NECESSARY TOOLS
Fallen leaves.	<ul style="list-style-type: none"><li>▶ Collecting and removing the leaves from the schoolyard.</li></ul>	<ul style="list-style-type: none"><li>▶ Rake;</li><li>▶ Bags;</li><li>▶ Gloves.</li></ul>
Maintenance of the grass.	<ul style="list-style-type: none"><li>▶ Grass mowing;</li><li>▶ Watering the grass;</li><li>▶ Cleaning the fallen leaves and branches;</li><li>▶ Raking the grass in order to remove the dry grass, leaves, etc.</li></ul>	<ul style="list-style-type: none"><li>▶ Rake;</li><li>▶ Bags;</li><li>▶ Gloves;</li><li>▶ Lawn mower;</li><li>▶ Grass shears.</li></ul>
Maintenance of the trees, shrubs and hedge.	<ul style="list-style-type: none"><li>▶ Regular removal of old dead branches;</li><li>▶ Regular cutting and trimming the hedge;</li><li>▶ Regular pruning of the trees.</li></ul>	<ul style="list-style-type: none"><li>▶ Hedge trimming electric machine;</li><li>▶ Trimming and pruning shears;</li><li>▶ Shovel;</li><li>▶ Rake;</li><li>▶ Gloves.</li></ul>
Maintenance of the school fence.	<ul style="list-style-type: none"><li>▶ The fence should be painted in a time interval of 3 to 5 years;</li><li>▶ Regular greasing of the hinges and locks of the entrance doors etc.</li></ul>	<ul style="list-style-type: none"><li>▶ Brush;</li><li>▶ Gloves.</li></ul>



### 2.1.6.2. MAINTENANCE OF THE SCHOOL PATHWAYS

The maintenance of the school pathways primarily depends on their material and they can be as follows:

- ▶ School pathways made of concrete – before their maintenance, the concrete should be first of all examined for any damage, i.e. holes and grooves. The damaged areas should be first of all coated with U-bond and then mesh reinforcement should be placed (in order to prevent the crumble of the concrete areas) and at the end they should be concreted over.
- ▶ The school pathways made of behaton elements – the school pathways should be first of all checked, i.e. all behaton elements should be examined, including the curves that form the school pathways. After the damaged areas are identified, they should be repaired, i.e. the damaged behaton elements and curves should be replaced with new ones. The procedure for their replacement is simple: the damaged elements are removed and new ones are placed and then sand is poured between them in order to connect them.

TABLE 8: Solving problems with maintenance of school pathways and sports fields

SOLVING PROBLEMS WITH MAINTENANCE OF SCHOOL PATHWAYS AND SPORTS FIELDS		
PROBLEMS	MEASURES	NECESSARY TOOLS
Damaged pathways.	<ul style="list-style-type: none"> <li>▶ Check of the concrete surfaces;</li> <li>▶ Identifying the damaged areas, holes and grooves;</li> <li>▶ Coating of the damaged areas with U-bond;</li> <li>▶ Placing mesh reinforcement (in order to prevent the crumble of the concrete areas);</li> <li>▶ Concreting.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Brush;</li> <li>▶ Gloves;</li> <li>▶ Shovel.</li> </ul>
Sport fields – renewal of the damaged parts, i.e. asphaltting).	<ul style="list-style-type: none"> <li>▶ Cleaning the entire area;</li> <li>▶ Coating with bitumen as a bonding agent;</li> <li>▶ Placing cold asphalt;</li> <li>▶ Compacting and spraying with water;</li> <li>▶ Re-demarcation of the borders of the sport fields with a paint;</li> <li>▶ Painting the sport field equipment (basket, goals and the like) with oil color.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Brush;</li> <li>▶ Gloves;</li> <li>▶ Shovel.</li> </ul>



### 2.1.6.3. ACCESS RAMPS

Every school building should have an access ramp in order to provide unhindered access, movement, stay and work of the people with disabilities. The access ramp or other solutions that provide access to a public facility should be planned and constructed in accordance with the valid Rulebook on the manner of providing unhindered access, movement, stay and work of the people with disability to and within the facilities, adopted by the Ministry of Transport and Communications of the Republic of Macedonia. ([http://www.mtc.gov.mk/new\\_site/images/storija\\_doc/115/pravilnici/25-2010.pdf](http://www.mtc.gov.mk/new_site/images/storija_doc/115/pravilnici/25-2010.pdf)).



FIGURE 14: Access ramp

TABLE 9: Solving problems with maintenance of access ramps

SOLVING PROBLEMS WITH MAINTENANCE OF ACCESS RAMPS		
PROBLEMS	MEASURES	NECESSARY TOOLS
Coating of the ramp with material that prevents slipping.	<ul style="list-style-type: none"> <li>▶ The concrete works are performed with a final layer of concrete by compacting on each 10 cm thus forming a fishbone pattern.</li> <li>▶ A steel coat can also be used as a final layer shaped as a ribbed structure which prevents slipping.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Brush;</li> <li>▶ Gloves;</li> <li>▶ Shovel.</li> </ul>
Painting the fence with a protective layer.	<ul style="list-style-type: none"> <li>▶ Cleaning the entire surface of the fence from the dirt and treating the uneven surface with a sandpaper in order to get even surface;</li> <li>▶ Painting the fence with a two-component (final) color for external use with a high level of consistency in external weather conditions.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Brush;</li> <li>▶ Roller;</li> <li>▶ Broom;</li> <li>▶ Bucket.</li> </ul>





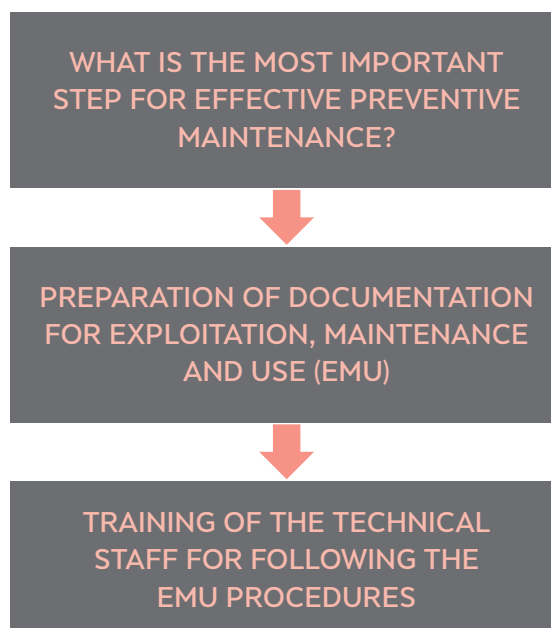
## 2.2.

## MAINTENANCE OF SCHOOL BUILDINGS: HEATING SYSTEM AND BOILER ROOMS



### 2.2.1. PROCEDURES FOR PREVENTIVE MAINTENANCE AND CORRECT EXPLOITATION AND USE

The most important step in the preventive maintenance of the hot water heating systems is to prepare the documentation for exploitation, maintenance and use (EMU) of these systems. The next step is to train the technical staff for following the EMU procedures.



There is usually only one person in the schools, member of the technical personal, who is responsible for the operation and maintenance of the hot water heating system (Criteria for defining the required number of employees in the activity of the primary education, Ministry of Education and Science, 2003). Furthermore, the heating system is usually managed by the technical staff, based on the experience acquired during the performance of this job in the past years. In most of the larger central hot water heating

systems, when the operator is absent from work, there is a risk that the heating system will operate with difficulties or it will not operate at all because there is no other trained personnel for that purpose.

Pursuant to Article 157 of the Energy Law (Official Gazette of the Republic of Macedonia No. 16/11, 136/11, 79/13, 164/13, 41/14, 151/14 and 33/15) the operators of energy operated devices and plants (in this case boiler rooms and central heating systems) must pass a **vocational proficiency exam**. For that purpose, Rulebook on the conditions that should be met by the operators, the program, the manner and procedure for taking the vocational proficiency exam by the operators of energy operated devices and plants was adopted (Official Gazette of RM No. 101/09).

[http://www.economy.gov.mk/regulativa/podzakonski\\_akti/3978.html](http://www.economy.gov.mk/regulativa/podzakonski_akti/3978.html)



The Rulebook does not stipulate taking a vocational proficiency exam for operating with boilers for central heating with installed power of up to 200 kW, whereas the operator should pass vocational proficiency exam, in accordance with the Rulebook, for plants with installed power of 200 kW and more, working pressure of 0.5 bar and temperature of 110 °C.

The ideal solution would be to have a minimum of two employees as a technical staff, who will be responsible for operation and maintenance of the hot water heating systems.

In accordance with the technical regulation in this sphere, every boiler room should obligatorily have a detailed working instruction for the entire heating installation and inventory list of the entire equipment, as well as as-built project on the entire heating installation. In addition to the detailed working instruction, a short work instruction should be prepared that will contain the most basic functions and it will be put on a visible spot in the boiler room.

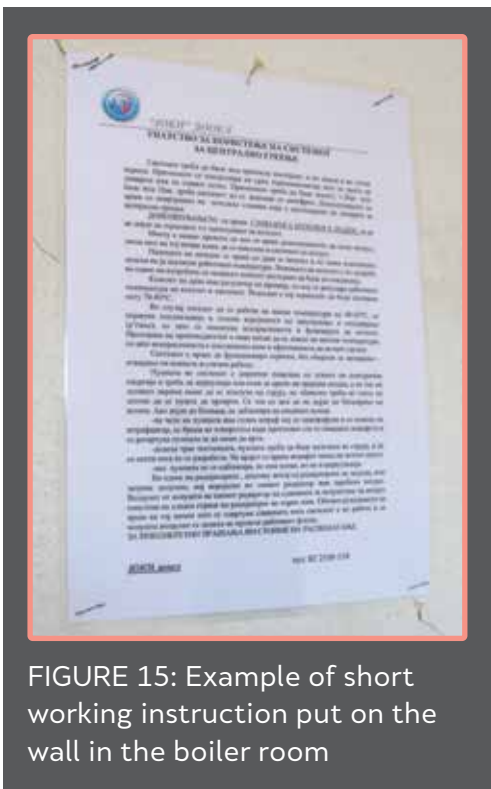


FIGURE 15: Example of short working instruction put on the wall in the boiler room

The benefits of having documentation for exploitation, maintenance and use of the hot water heating systems in combination with an adequate training are the following:

- ▶ Protection and safety at work;
- ▶ Prompt intervention in the event of defect and failure of the system;
- ▶ Possibility for the system to be operated by other persons in the absence of the technical staff responsible for the heating system;
- ▶ Knowledge of the type and features of the entire equipment for the purposes of making an adequate and timely replacement of the defected equipment;
- ▶ Planned absence by the procedures for preventive maintenance of the equipment;
- ▶ Precise knowledge of all underground and hidden parts of the installation.

The right and adequate documentation for exploitation, maintenance and use (EMU) is important for safe, secure and efficient operation of the facilities and systems therein.



The documentation should be prepared in accordance with the following:

- ▶ MKC EH 12170 – Heating systems in facilities – Procedure for preparation of documentation for exploitation, maintenance and use – Heating systems which require trained operator (this standard can be obtained at the following address: [http://www.isrm.gov.mk/mk/standard/?natstandard\\_document\\_id=33710](http://www.isrm.gov.mk/mk/standard/?natstandard_document_id=33710)).
- ▶ MKC EH 12171 – Heating systems in facilities – Procedure for preparation of documentation for exploitation, maintenance and use – Heating systems which do not require trained operator (this standard can be obtained at the following address: [http://www.isrm.gov.mk/mk/standard/?natstandard\\_document\\_id=33711](http://www.isrm.gov.mk/mk/standard/?natstandard_document_id=33711)).

The documentation should contain instructions prepared in a certain form and with a certain order. The instructions should contain the project requirements for exploitation and use of the system. These instructions can be provided as part of the instructions for the entire facility.

- ▶ The documentation for EMU should contain instructions on the manufacturers' equipment and components. If the system designer uses certain components that are not specified in the manufacturers' instructions, then that should be explained and indicated in the documentation;
- ▶ The documentation should be clear and prepared in unalterable form. It should be printed on indelible material that is adequate for everyday use;
- ▶ The format, style and number of copies of the documentation of EMU should be in accordance with the contract between the owner and the designer of the systems; There should be a list of locations to which the documentation has been delivered;
- ▶ One copy of the documentation for EMU should be adjusted for use by the persons responsible for the exploitation, maintenance and use of the systems;
- ▶ The International System of Units - SI should be obligatorily applied in the documentation for EMU.



## **NOTE:**

A complete documentation for EMU should contain the following documents:

- ▶ Instruction for documentation for EMU;
- ▶ Instruction for maintenance;
- ▶ Instruction for exploitation;
- ▶ Testing reports;
- ▶ Troubleshooting;
- ▶ Information on working in extraordinary conditions;
- ▶ Documentation on as-built status;
- ▶ Instructions on safety at work.

Every thermo technical system should have its own documentation in accordance with the system complexity. A more comprehensive documentation is needed for large systems with big boiler rooms. Small systems require only basic instructions.

The annual action plan for maintenance of the systems (see Appendix 3) is part of the Instruction for maintenance, whereas the Schedule for daily maintenance and operation of the heating system (see Appendix 4 and 5) is part of the Instruction for exploitation.

### **2.2.2. ANNUAL ACTION PLAN FOR MAINTENANCE OF THE HEATING SYSTEMS**

Each part of the system has to be examined in accordance with a prior prepared Action plan. The period of the heating off-season is the most convenient period for performing preventive maintenance of the heating systems. The annual checks and equipment testing and any repairs, if necessary, have to be performed in this period.

An action plan has to be prepared for each boiler room and these activities have to be implemented before the beginning of the heating season. The action plan will be an integral part of the working instruction and it will be a document that will enable systematic checks of the entire system.

The machinery equipment should be checked and repaired in accordance with the instructions of the equipment manufacturer. All repairs and settings of the equipment shall be performed during the checks. If certain equipment has to be replaced, the person responsible for preventive maintenance will be obliged to order the adequate equipment and other elements that are necessary for recuperation of the system.

Any delays of the maintenance should be avoided, of course if the budget, time and use thereof permit that. In any case, all remaining responsibilities pertaining to the



preventive maintenance should be completed before the beginning of the heating season.

An analysis of the equipment purchase orders or the needs of system repairs and settings will have to be made on a six month basis in order to be able to foresee the trends of maintenance and repairs for the forthcoming period.

The equipment that will be identified as equipment which has been more time consuming in terms of repairs and settings than the time projected by the manufacturer will have to be replaced as soon as possible. The external technical support from the manufacturers or equipment repairers will have to be envisaged for all foregoing activities.

The table Annual action plan (Appendix 5) contains a model of activities that need to be undertaken by the technical staff before the beginning of the heating season. A separate action plan has to be prepared for each heating system.

In addition to the Annual plan, the documentation should also contain an action plan for maintenance of each part of the equipment separately.

### 2.2.3. ACTION PLAN FOR EXPLOITATION AND MAINTENANCE

With good preparation and correct preventive maintenance, the activities in the heating season will consist of putting the hot water heating system into operation, monitoring its operation, optimization of the operation and occasional repairs. The tables: Action plan for exploitation and maintenance of central heating boilers and Monthly action plan for exploitation and maintenance of heating system (see Appendix 4 and 5) contain the activities for use and maintenance of a typical central hot water heating system without automatic operation. The activities are divided as follows:

- ▶ Daily routines starting with: Starting of the system, monitoring and daily checks and ending with shutting down of the system;
- ▶ Weekly mandatory checks;
- ▶ Monthly mandatory checks.

#### 2.2.3.1. PUTTING INTO OPERATION

**Measurement of the external and internal temperature.** The automatically operated systems have a continuous and automatic reading of the temperature. However, since most of the systems are not automatically operated, the technical person responsible for system operation (boiler operator) should read the temperature manually.



## IMPORTANT!!!

**READING INTERVAL.** It is advisable for the data on the temperature to be read on more frequent intervals, however it will be sufficient to be read at least once in the morning before putting the system into operation and once in the afternoon before the repeated putting of the system into operation and during the operation.

**APPLICATION AND BENEFITS.** The information on the temperature is important because it will help the boiler operator to determine the intensity of the heating which is necessary during the day whereby boiler operator will adjust the system operation, i.e. he will optimize it for the purpose of fuel saving.

**EQUIPMENT:** Thermometers.

**Check of the daily amount and supply of fuel.** Every morning the boiler operator must check and make sure that there is a sufficient amount of fuel for uninterrupted operation of the system for one day. In case of solid fuel, it must be brought in the boiler room at the location intended for daily storage of solid fuel.

In case of liquid fuel, it is advisable that there is a daily fuel tank in the boiler room or in the immediate vicinity, which contains an indicator or a gauge of the quantity of fuel. If there is not enough fuel, the liquid fuel from the seasonal tank is to be transferred. The oil pump is activated and it starts to fill the daily tank. During the entire operation, the presence of the boiler operator is obligatory in order to prevent overflowing and leakage from the daily tank.

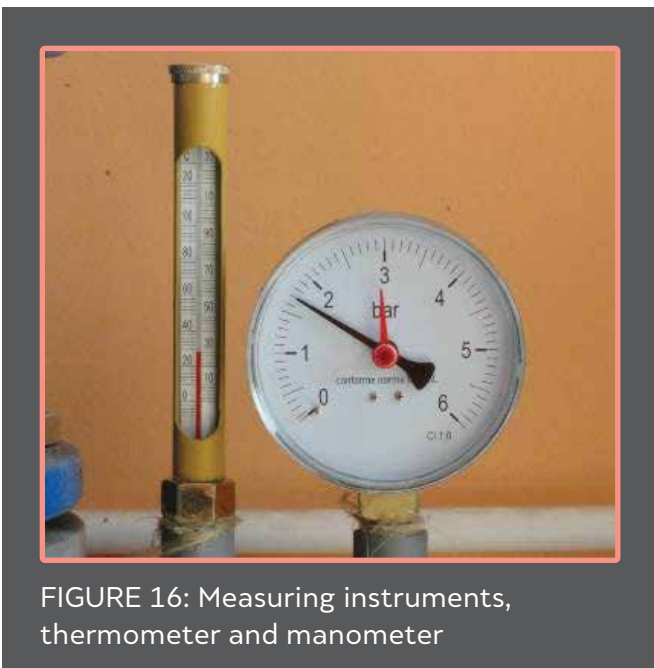


FIGURE 16: Measuring instruments, thermometer and manometer

**Check of the pressure in the installation.** Before commissioning, the pressure in the installation must be checked, which, in hot water heating, is mostly set to 2 bar. The work pressure is read from a manometer that can be installed on a pipe, distributor or a boiler. If the pressure falls under 1.5 bar, it means that there is a leakage somewhere in the system. The fault must be detected and cleared.



### IMPORTANT!!!

After the fault clearance, the installation must be filled with the working liquid (softened water or antifreeze) that was previously drained. The installation must be connected to the supply system by a valve. The liquid supply should be performed only when the system is cold. During the supply, do not let air into the installation.

**Commissioning of the circulation pumps.** Before starting the boilers and before the system starts heating, firstly, turn on the circulation pumps that distribute the hot water to the heating elements. In the morning, start the circulation pumps before starting the boilers. The start is manual and is mostly done via the main switchboard. Check the functioning of the pumps and if everything is in order, start the procedure for ignition of the burners.



### NOTE:

Continuous operation of the circulation pumps during the entire heating season is mostly present in small systems.

- ▶ Advantage: Continuous circulation does not allow freezing of the water.
- ▶ Disadvantage: Increased consumption of electricity and decreasing of the lifespan of the pump.

Discontinuous operation or turning them off during night periods when heating is not necessary.

- ▶ Advantage: Decreased consumption and increased lifespan of the pump.
- ▶ Disadvantage: Increased investment due to use of antifreeze.

**Commissioning of the short circulation pumps.** If the boiler of the pressure pipe delivers water with temperatures above 70°C, and water with temperature from 40 to 45°C, or lower, returns through the return pipe, then occurrence of condensation is possible. In order to prevent this occurrence, short circulation pumps are used whose function is to equalize the temperature at the entry with the one at the exit of the boiler.



## IMPORTANT!!!

**INTERVAL.** Every morning, before starting the boilers, the short circulation pumps are put into operation manually. The short circulation pump pushes the water from the pressure pipe to the return pipe in the immediate vicinity of the boiler. The function of this equipment is to prevent condensation and corrosion in the boilers. When during the operation, the temperature at the entry of the boiler (return pipe) is higher than 55°C, the short circulation pump should be turned off. The temperatures are mostly measured at the distributor and the collector or pressure and return pipe of the boiler.

**MANNER OF OPERATION.** Manually, by visual reading of the temperature and starting of the pump. Automatically, by reading the temperature via sensors that control the operation of the pump.

**BENEFITS:** The function of this equipment is to prevent condensation and corrosion in the boilers, and thus increasing the lifespan of the boilers.

**EQUIPMENT:** Thermometers.

### STARTING OF THE BOILER.

The boilers can use:

- ▶ **Solid fuels:**
  - ▶ Wood;
  - ▶ Coal (hard coal, lignite, anthracite, coke...);
  - ▶ Briquettes;
  - ▶ Pellets.
- ▶ **Liquid fuels:**
  - ▶ Mineral oils – oil or crude oil.
- ▶ **Gaseous fuels:**
  - ▶ Natural gas (methane);
  - ▶ Liquid petroleum gas (LPG - propane butane).

The solid fuel boilers are fired up manually. The ignition is also manual. After the ignition and the start, the fireplace is fired up and supplied with fuel, until the boiler reaches the operational temperature. The temperature regulation is manual and is done by adding fuel to the fireplace, or by regulating the draft that is present in every boiler of this type. The optimal temperature at which these boilers are to work is within the 70–90°C interval.



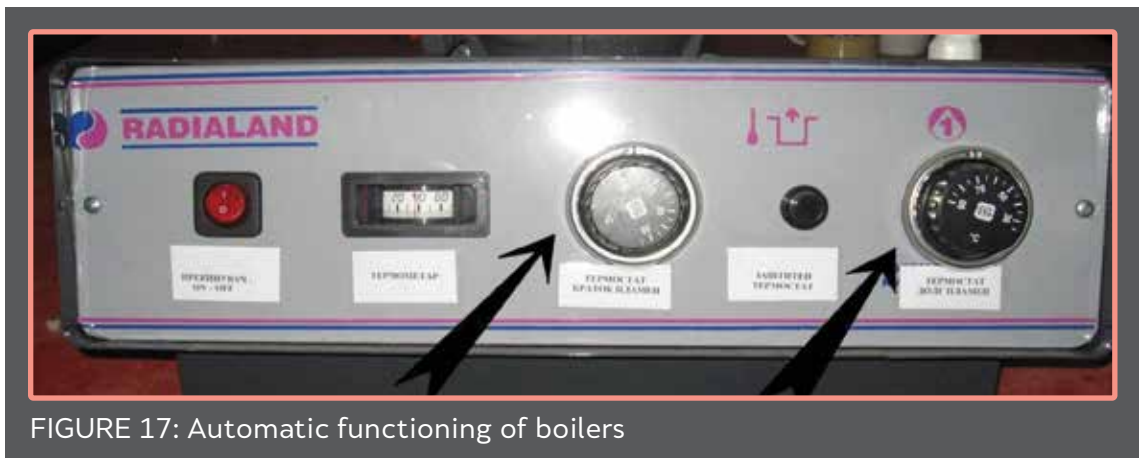


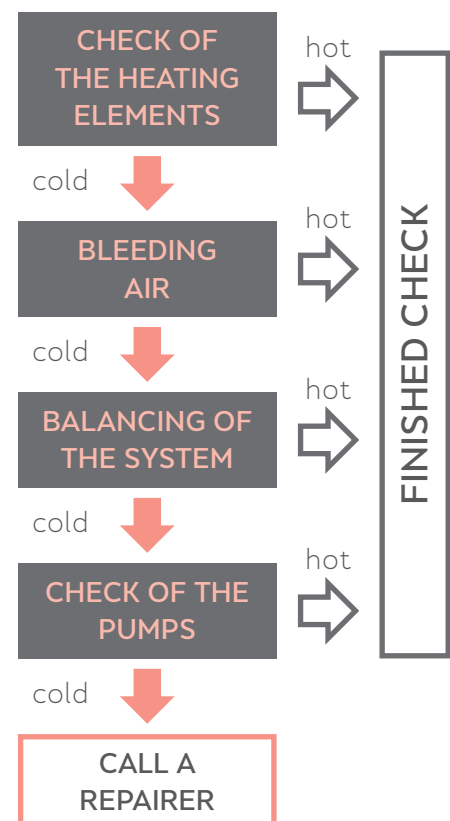
FIGURE 17: Automatic functioning of boilers

The solid and gaseous fuel hot water boilers are equipped with **burners** that burn the fuel and emit heat which heats the boiler. The operation of the burners can be fully automatic, but mostly it is semi-automatic, provided that the boiler has its own automatic functioning. The commissioning is manual, i.e. the starting of the burner is activated by the boiler operator. The boiler operator sets the wanted temperature of the water that the boiler must reach via a thermostat on the automatics. The burner will work until the wanted temperature is reached..

The hot water boilers are set to operate at temperatures equal or higher than 70°C with which higher efficiency in the operation is achieved. If the operational temperature of the boiler is below 70°C, its efficiency decreases significantly.

When the burner reaches the operational temperature, it will automatically shut off and it will be on standby until the temperature of the water in the boiler falls below the lower limit of 55–60°C. If the control is automatic, the burner will be activated by itself, and if the control is manual, presence of the boiler operator is needed for turning it on and off.

**Check of the heating elements.** The radiators are being checked. If some of the radiators do not reach sufficient heat, or heats with lower temperature compared to the others, they probably have trapped air. The trapped air in the radiator is bled via the bleeder valve that is located at the top zone of every radiator. If there are no bleeder valves on the radiator, then, there must be some at the highest part of the pipe network. There are various bleeder valves and they are all easy to use, mostly by unscrewing the tap. The tap should be open until the entire air is pushed out and until water starts flowing. At that moment, the tap should be closed and the bleeding is finished.





**Balancing of the air.** If this measure does not function and all radiators are not heated equally, you should check whether the distribution network is balanced. Balancing of the network is a long process in which, by opening and closing of the radiator valves, the installation flow is regulated and the effect of equal heating of the radiators is achieved.

If, after the balancing of the network, there is still not sufficient heat in the last radiator, then you should check the functioning of the pumps. If there is no good circulation, then there will be no good heat distribution to the most remote parts of the installation.

### **2.2.3.2. MONITORING AND ADJUSTMENT**

During the operation of the heating system, the operation must be constantly monitored and adjusted. The level of monitoring directly depends on the level of automation of the system. The more automated the system, the less the presence and the interventions of the boiler operator are necessary, and vice versa.

In manually operated systems, the pressure and the temperature in the system must be monitored while the system works. According to the temperature readings, the boiler operator makes adjustments in the system in order to optimize the operation and save fuel.

#### **OPERATION MODES OF THE BOILERS:**

During periods when the external temperatures are above 0°C, the boiler room may not work with full capacity. If there is only one boiler, then the temperature of the boiler must be around the lower limits or around 70°C.

When there are systems with two or more boilers, and smaller amount of heat in the system is needed, then it would be more efficient if one boiler works with full capacity than two boilers with 50% of the capacity.

In case of two or more boilers, then only one boiler is put into operation. If one boiler cannot meet the needs with full capacity, then the next boiler is put into operation.

The following day, the second boiler should work, the third day, the first boiler should work again, etc. The purpose of rotating the work of the equipment is to create equal exploitation and to extend its lifespan.

Benefits: Optimization of the system by exploiting the boilers at the best efficiency point and extending the lifespan of the equipment by equal loading and using of all system elements.



If there are parts of the facility where there is no presence of people over a longer period, the heating should be decreased or completely turned off. You should be careful, because by shutting down of some parts, the need for delivered heat is also decreased, therefore the operation of the boilers should be decreased

### 2.2.3.3. SYSTEM SHUT DOWN

The system should be shut down before the end of the working day in the following order:

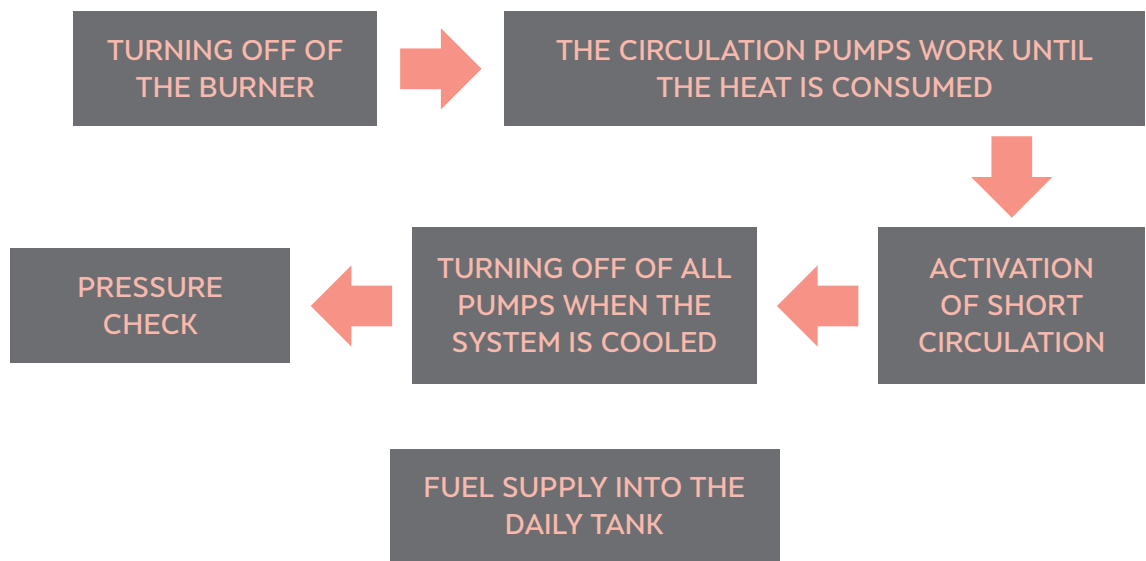


FIGURE 18: System shut down procedure



## 2.2.4. SYSTEM OPERATION UNDER CONDITIONS OF MALFUNCTION OR BREAKDOWN AND TROUBLESHOOTING

The EMU documentation should contain instructions for system management under conditions of malfunction or breakdown of the equipment and troubleshooting. This part of the documentation should describe all possible scenarios of malfunction of the equipment and procedures of replacement in case of breakdown.



### **FAULT:**

The circulation pump No.1 is not functioning.

Steps for fault clearance:

- ▶ Turn off pump No. 1 from the main switchboard;
- ▶ If there is a hot spare pump No. 2, turn it on and put it into operation;
- ▶ Close the valves before and after pump No. 1;
- ▶ Dismantle pump No. 1;
- ▶ If possible, repair the pump, if not, provide a new one;
- ▶ Install the functional pump back in the system;
- ▶ Turn off pump No. 2 from the main switchboard;
- ▶ Open the valves before and after pump No. 1;
- ▶ Turn on pump No. 1 from the main switchboard.

The instructions should contain a part in which the possible faults during the operation of the heating system, the reasons for the occurrence of the faults and the possible manners for their clearance will be resolved. This is a very useful document that will enable the boiler operators to make fast interventions and improve the work of the system. The following tables contain examples for fault clearance in various heating systems.



TABLE 10: Fault clearance in solid fuel heating systems

FAULT CLEARANCE IN SOLID FUEL HEATING SYSTEMS		
SYMPTOMS	POSSIBLE REASON	MEASURE
Insufficient heat.	<ul style="list-style-type: none"><li>▶ Insufficient supply of solid fuel;</li><li>▶ Excessive amount of solid fuel;</li><li>▶ Insufficient draft in the fireplace.</li></ul>	<ul style="list-style-type: none"><li>▶ Increase the supply of solid fuel and adjust the air supply;</li><li>▶ Increase the air supply and decrease the supply of solid fuel;</li><li>▶ Check the work of the chimney.</li></ul>
Excessive heat.	<ul style="list-style-type: none"><li>▶ Excessive amount of solid fuel;</li><li>▶ Excessive draft.</li></ul>	<ul style="list-style-type: none"><li>▶ Decrease the supply of solid fuel and adjust the air supply;</li><li>▶ Adjust the air supply.</li></ul>
Backdraft from the chimney.	<ul style="list-style-type: none"><li>▶ Insufficient air quantity for combustion;</li><li>▶ Insufficient size of the fireplace.</li></ul>	<ul style="list-style-type: none"><li>▶ Increase the air supply. Check the air supply system and the chimney. Cleaning, if necessary;</li><li>▶ Consult with the manufacturer.</li></ul>
Increase of the heat in the boiler and increase of the pressure in the installation.	<ul style="list-style-type: none"><li>▶ Termination of the operation of the circulation pump due to power failure or other reason.</li></ul>	<ul style="list-style-type: none"><li>▶ Stop the supply of solid fuel and air;</li><li>▶ Connect the circulation pump to a generator;</li><li>▶ Manually reduce the pressure;</li><li>▶ Regularly calibrate and service the safety valves;</li><li>▶ Installation of a tank (buffer) that will neutralize the excessive amount of heat.</li></ul>



TABLE 11: Fault clearance in liquid fuel heating systems

FAULT CLEARANCE IN LIQUID FUEL HEATING SYSTEMS		
SYMPTOMS	POSSIBLE REASON	MEASURE
Variable operating conditions in the fireplace at the start, stop and continued operation of the burner.	<ul style="list-style-type: none"> <li>▶ Improper work of the nozzles;</li> <li>▶ Insufficient draft.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Adjustment of the work or change of the nozzles;</li> <li>▶ Adjustment of the draft and check of the chimney.</li> </ul>
Occurrence of noise during the operation of the pump.	<ul style="list-style-type: none"> <li>▶ Trapped air in the pipe;</li> <li>▶ Possible occurrence of leaks in the pipeline;</li> <li>▶ Clogging of the filter (dirt trap).</li> </ul>	<ul style="list-style-type: none"> <li>▶ Pipeline bleeding;</li> <li>▶ Check the leaking and repair the defect;</li> <li>▶ Clean the filter.</li> </ul>

TABLE 12: Fault clearance in hot air heating systems

FAULT CLEARANCE IN HOT AIR HEATING SYSTEMS		
SYMPTOMS	POSSIBLE REASON	MEASURE
Insufficient heat.	<ul style="list-style-type: none"> <li>▶ Clogged air filter;</li> <li>▶ Fan works with lower capacity;</li> <li>▶ Closed regulation grid.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Cleaning or change of the air filter;</li> <li>▶ Check of the fan drive;</li> <li>▶ Check and adjustment of the regulation grids.</li> </ul>
High variation of the ambient temperature.	<ul style="list-style-type: none"> <li>▶ The activation is set to high value;</li> <li>▶ Improper work of the room thermostat.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Setting the activation to a lower value or according to the manufacturer instructions;</li> <li>▶ Check the suitability and adjust the thermostat.</li> </ul>



## 2.2.5. INCREASING THE EFFICIENCY AND RECOMMENDATIONS FOR OPTIMIZATION OF THE SYSTEMS

The increase of the efficiency of the heating systems by optimizing their operation will directly generate savings via the decreased oil consumption. The general recommendations that can be used in any heating system are given below.

### 2.2.5.1. HYGIENE

This may not look like a measure for increasing the efficiency, however, it must always come first.

TABLE 13: Hygiene maintenance in the boiler rooms

HYGIENE MAINTENANCE IN THE BOILER ROOMS		
MEASURE	MANNER OF IMPLEMENTATION	BENEFITS
Hygiene.	Keeping the environment of the hot water heating system, especially in the boiler room, clean.  Once a month cleaning during the heating season and at least once out of the heating season.	Providing a healthy and safe working environment.  Extending the lifespan of the equipment.



a) Poor hygiene



b) Good hygiene

FIGURE 19: Examples for hygiene in the boiler rooms



### 2.2.5.2. SELECTION OF HIGH QUALITY EQUIPMENT

Here, we will focus on the selection of the boiler for central heating as the most important energy plant in the central heating system. Today, on the market you can find hot water boilers in which liquid and gaseous fuels are combusted with different degree of usefulness (expressed in %), which is a ratio between the heat transferred to the water in the boiler and the product of the lower heating value of the fuel at constant pressure and fuel consumption in a unit of time. The higher the degree of usefulness, the more efficient is the boiler.

When selecting and installing new hot water boilers, you need to meet the criteria from the Rulebook on the requirements for efficiency of the new hot water boilers in which liquid and gaseous fuels are combusted (Official Gazette of RM 13/2007). <http://www.slvesnik.com.mk/Issues/B969DC39CD2FA34F932ECF1EF2ED68A9.pdf>

The following table contains the limits of the degree of usefulness required for selection and installation of the new hot water boilers.

TABLE 14: Limits of the degree of usefulness of the new hot water boilers

TYPE OF BOILER	CAPACITY	DEGREE OF USEFULNESS AT NOMINAL POWER		DEGREE OF USEFULNESS AT PARTIAL LOAD	
	kW	MEDIUM TEMPERATURE OF WATER IN THE BOILER (in °C)	REQUIRED DEGREE OF USEFULNESS (in %)	MEDIUM TEMPERATURE OF WATER IN THE BOILER (in °C)	REQUIRED DEGREE OF USEFULNESS (in %)
Standard boiler	4 to 400	70	$\geq 84 + 2 \log P_n$	$\geq 50$	$\geq 80 + 3 \log P_n$
Low temperature boilers	4 to 400	70	$\geq 87,5 + 1,5 \log P_n$	40	$\geq 87,5 + 1,5 \log P_n$
Condensation boilers	4 to 400	70	$\geq 91 + 1 \log P_n$	30 (**)	$\geq 97 + 1 \log P_n$

(\*) Including liquid fuel boilers with condensation of water vapor in gases - condensation boilers

(\*\*) Temperature of the water for supply in the boiler

### 2.2.5.3. SELECTION OF HIGH QUALITY FUEL

A special attention should be paid on the selection of the solid fuel. The selection of solid fuel is large and the solid fuel combustion systems are universal. Economic analysis is needed when selecting solid fuel, however, as a general rule, it is always best choice so select fuel with higher calorific value and of course, dry fuel, i.e. fuel with small amount of humidity.

The liquid fuel boilers can be easily adapted to solid fuel. For that, you need to change the burner and the storage tank. The gaseous fuel is more cost effective than the liquid fuel, however, here it is still distributed in cisterns, there is no gas line, and as a result, the adaptation from liquid to solid fuel is not cheap. However, this is a measure



that needs to be reviewed in future, because construction of gas distribution network is planned. There are already such examples in our country where gas distribution network exist.

TABLE 15: Calorific value of solid fuels

TYPE OF FUEL	CALORIFIC VALUE (kJ/kg)
Oil	40.000 – 43.000
Hard coal	29.000 – 36.000
Black coal	17.000 – 29.000
Pellets (beech)	17.500 – 19.500
Lignite	7.500 – 12.600
Briquettes	7.700 – 18.700
Beech	7.000 – 14.700
Oak	7.000 – 14.700

#### 2.2.5.4. PROPER STORAGE OF THE FUELS AND DRYING OF THE SOLID FUELS BEFORE THEIR USE

The solid fuels must be stored at open locations where humidity will not occur but there will be airing. They are best stored under ledges or specially prepared storages. The decrease of the humidity percentage in fuel increases its calorific value. Drier fuel, such as briquettes, with small percentage of humidity, burns quickly and releases larger amount of heat, wetter fuel, such as coal, burns more slowly, i.e. smolders and maintains heat for a longer period, but with smaller efficiency. In wood, the optimal value of humidity must be between 15–25%.



a) bad



b) good

FIGURE 20: Manners of storing wood

The ideal combination for selection of solid fuels is to have small amount of briquettes and wood and larger amount of coal. Dry wood have smaller percentage of humidity, and the briquettes almost do not contain any humidity. As a result, they combust quickly and release relatively large amount of heat for a short time. Therefore, it is



advisable the ignition of the boiler to be done with this type of fuel which will quickly reach the operational temperature. Then, you can continue with adding coal, because coal has higher percentage of humidity and burns more slowly. Heat is released more slowly, and for a longer period, and it is easier to control.

### 2.2.5.5. OTHER MEASURES

TABLE 16: Other measures for increasing energy efficiency of the heating systems

OTHER MEASURES FOR INCREASING ENERGY EFFICIENCY OF THE HEATING SYSTEMS		
MEASURE	MANNER OF IMPLEMENTATION	BENEFITS
Equipment operation around the point of maximum efficiency.	It is better for one boiler to work at maximum load, then two boilers at 50%; It is advisable for the pumps to work around the point of maximum efficiency.	Optimal exploitation of the equipment and decreased consumption of fuel or energy.
Periodic control of the temperature.	Periodic control of the temperature and timely adjustment of the operation of the system.	Heat is delivered as much as it is needed; Saving fuel.
Complete shutdown.	In premises where people are not present, heating is turned off or temperature is decreased after the working hours too.	Saving fuel.
Balancing of the distribution network.	Opening or closing of the valves for certain sections of the facility.	Equal distribution of the quantity of delivered heat.
Use of automatic system control.	Automatic heating system control.	Optimization of the working mode and saving of energy up to 20%.
Use of renewable energy sources.	Use of geothermal pumps or solar collectors	Saving energy (only in energy efficient facilities). *Application in any facility needs prior analysis.



## 2.2.6. USUAL PROBLEMS AND POSSIBLE SOLUTIONS

The most frequent problems that occur during the maintenance of the heating system are as follows:

### 2.2.6.1. WATER LEAKAGE

Water leakage is possible at the joints of the pipes in the network, the radiators, the joints of the burner or the boiler joints. After the detection of the leakage, if the system is functioning, the defect should be isolated by closing the valves. If the problem cannot be isolated, then the entire system must be shut down. The system needs to cool down. If necessary, the water should be discharged from the system. If the system is filled with antifreeze, you need to collect it during the discharging of the liquid and store it, in order to use it again.

If the leakage is from a pipe, replace a certain part or the entire pipe. The decision should be brought on the spot, depending on the damage of the remaining part of the pipe. In case of a steel pipe, the joints are made by thread or welding. In case of a copper pipe, the joint is made by brazing or gluing. In case of an aluplast hose, then the whole hose needs to be replaced. Upon the performed repair, the pipe needs to be checked when cold, i.e. at hydrostatic pressure 50% higher than the operational one. If the test is satisfactory, anticorrosive protection is applied and that part of the installation is put into operation again.



FIGURE 21: Leakage in joints and radiators

If leakage occurs in the radiator, first, you should analyze the type of the radiator and whether it is possible to repair it. In cast iron and steel radiators composed of separate elements, the repair is possible by removal of the part where the problem has occurred and by installing new elements. Close the radiator valves and dismantle the entire radiator. Dismantle the defective elements and replace them with new ones. You need special tool for dismantling and installing the radiator elements, adequate spare radiator elements and gaskets. After the installation, wash the radiator with water and check the pressure. Compressed pressure is most easily checked, 50% larger than the operational pressure, while dismantled from the system. Then, install it back in the system and bleed the air via the bleeding valve.



TABLE 17: Troubleshooting in case of water leakage

TROUBLESHOOTING IN CASE OF WATER LEAKAGE		
FAULT	MEASURES	NECESSARY TOOLS
Water leakage from the pipe joints in the network, valves and fittings.	<ul style="list-style-type: none"> <li>▶ Isolate the defect by closing the valves;</li> <li>▶ System cooling;</li> <li>▶ Discharge the water from the system (if necessary). If the system is filled with antifreeze, you need to collect the liquid during the discharge and store it;</li> <li>▶ Replacement of joints, valves and fittings.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Screwdrivers set, wrenches, hex keys, pliers;</li> <li>▶ Hacksaw;</li> <li>▶ Binding material; Glue, twine, thread seal tape; duct tape;</li> <li>▶ Measuring instruments; Measuring tape, vernier scale;</li> <li>▶ Protective clothes, shoes, gloves and goggles.</li> </ul>
Leakage from a pipe.	<ul style="list-style-type: none"> <li>▶ Replacement of a certain part or the entire pipe (the decision should be brought on the spot);</li> <li>▶ Install the new pipe;</li> <li>▶ Connecting the new pipe to the existing installation (in case of a steel pipe, the joints are made by thread or welding, in case of a copper pipe, the joint is made by brazing or gluing, in case of a aluplast hose, then the whole hose needs to be replaced.</li> <li>▶ Upon the performed repair, the pipe needs to be checked when cold, at hydrostatic pressure 50% higher than the operational one;</li> <li>▶ After the test, apply anticorrosive protection and put that part of the installation into operation again.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Screwdrivers set, wrenches, hex keys, pliers;</li> <li>▶ Small grinder and grinder brush;</li> <li>▶ Hacksaw;</li> <li>▶ Binding material; Glue, twine, thread seal tape; duct tape;</li> <li>▶ Paint brushes and rollers;</li> <li>▶ Protective clothes, shoes, gloves and goggles.</li> </ul>



Leakage in the radiator.	<ul style="list-style-type: none"><li>▶ Close the radiator valves and dismantle the entire radiator.</li><li>▶ If the radiator is made of cast iron or steel, the parts where the problem had occurred are replaced with new ones, and in case of other types of radiators, the entire radiator is replaced.</li><li>▶ Wash it with water and check it under hydrostatic pressure 50% higher than the operational one before the installation;</li><li>▶ Installation;</li><li>▶ Bleed the air via the bleeding valve.</li></ul>	<ul style="list-style-type: none"><li>▶ Screwdriver set, wrenches, hex keys, pliers;</li><li>▶ Binding material;</li><li>▶ Protective clothes, shoes, gloves and goggles.</li></ul>
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### **2.2.6.2. CLOGGING THE BLEEDING VALVES**

The automatic valves are mostly clogged due to dirt in the installation. They can be cleaned without dismantling them. If necessary, dismantle the automatic valve and replace it with a new one. To diminish such problems, it is necessary to install dirt traps (filters) in the network that will trap and remove the inner dirt.

### **2.2.6.3. SERVICING, REPAIR AND REPLACEMENT OF EQUIPMENT**

Servicing, repair and replacement is performed to the following equipment: boilers, stoves, burners, fuel tanks, pumps, valves, radiator valves, radiators, manometers and thermometers.

### **2.2.6.4. CORRECTIONS IN THE ANTICORROSIVE PROTECTION OF THE PIPE INSTALLATION**

Periodical visual checks are needed of the anticorrosive protection of the installation. Repairs of the anticorrosive protection are made when the system is cooled down, and the best period for that is out of the heating season.

Proper anticorrosive protection of the steel pipes is made by applying 1-2 layers of the basic paint (minium) and another layer of the finishing paint. For control purposes, both paints need to be different. Minium is mostly red, and the finishing paint is upon the choice of the user, but mostly white.



When performing checks of the existing anticorrosive protection of the pipes, the following is necessary: Firstly, remove the existing layer of paint with a grinder brush or a grinder stone on a bigger surface until metal shine of the surface is obtained. Then, apply degreaser and surface cleaner on the surface. The agent is liquid and it is applied on a cloth or a towel and the metal surface is cleaned. Leave the surface to dry for a short period and then quickly apply one layer of minium. The first layer needs to dry for 24 hours. Then, apply the second layer of minium that also needs to dry for one day. In the end, apply the finishing layer. The application of the paint is most frequently performed by brushes and rollers.

TABLE 18: Troubleshooting in case of damaging the anticorrosive protection

TROUBLESHOOTING IN CASE OF DAMAGING THE ANTICORROSIVE PROTECTION		
FAULT	MEASURES	NECESSARY TOOLS
Damaged anticorrosive protection of a pipe.	<ul style="list-style-type: none"> <li>▶ Remove the existing paint with a grinder brush or a grinder stone on a bigger surface until metal shine of the surface is obtained;</li> <li>▶ Apply degreaser and surface cleaner on the surface (the agent is applied on a cloth or a towel);</li> <li>▶ The surface dries for a short period of time;</li> <li>▶ Apply the first layer of minium and let it dry for 24 hours;</li> <li>▶ Apply the second layer of minium and let it dry for 24 hours;</li> <li>▶ Apply the finishing layer of paint (always different color than the one of the minium, for control purpose).</li> </ul>	<ul style="list-style-type: none"> <li>▶ Grinder brush or grinder stone;</li> <li>▶ Towel or cloth;</li> <li>▶ Degreaser and surface cleaner;</li> <li>▶ Minium;</li> <li>▶ Finishing paint;</li> <li>▶ Brushes and rollers.</li> </ul>



### 2.2.6.5. CORRECTIONS IN THE THERMAL INSULATION OF THE PIPES IN THE BOILER ROOM

If there is no good thermal insulation on the pipes in the boiler room, unnecessary losses of heat may occur. If there is no thermal insulation or the thermal insulation has been damaged, preventive intervention is needed. Aluminum tin 0.5 mm and thermal insulation for pipes is needed for preparation of thermal insulation. Hard-pressed thermal insulation with 50 mm thickness is most commonly used. The thermal insulation is applied around the pipe and fixed to it most frequently with a soft wire. Then, the aluminum tin is applied around the thermal insulation. The aluminum tin is closed with studs, but if there is no adequate tools, an alternative solution, wire, or duct tape can be used as a temporary measure. Mind that the dimensions of the insulation are the same along the entire pipe, for aesthetic purposes.

TABLE 19:  
Troubleshooting in case of defect or lack of thermal insulation on the pipes in the boiler room

TROUBLESHOOTING IN CASE OF DEFECT OR LACK OF THERMAL INSULATION ON THE PIPES IN THE BOILER ROOM		
PROBLEMS	MEASURES	TOOLS
No thermal insulation on the pipes in the boiler room or damaged existing thermal insulation.	<ul style="list-style-type: none"><li>▶ Applying thermal insulation around the pipe and fixing it with soft wire;</li><li>▶ Application of the aluminum tin around the thermal insulation;</li><li>▶ Closing of the aluminum tin with studs (if there are no studs, wire or duct tape can be used as a temporary solution)</li><li>▶ The dimensions of the insulation must be the same along the entire pipe, for aesthetic purposes.</li></ul>	<ul style="list-style-type: none"><li>▶ Aluminum tin with 0.5 mm thickness;</li><li>▶ Thermal insulation for pipes (most commonly hard-pressed with 0.5 mm thickness);</li><li>▶ Soft wire for fixing;</li><li>▶ Studs for fixing.</li></ul>

### 2.2.7. MINIMUM REQUIRED TOOLS

The following set of tools is needed for proper maintenance of the heating system:

- ▶ Screwdriver set, wrenches, hex keys, pliers;
- ▶ Small grinder and grinder brush;
- ▶ Hacksaw and tin snips;
- ▶ Grease;
- ▶ Binding material; Glue, twine, thread seal tape; duct tape;
- ▶ Measuring instruments; Measuring tape, vernier scale; mains tester; multimeter;
- ▶ Paint brushes and rollers;
- ▶ Flashlight;
- ▶ Protective clothes, shoes, gloves and goggles.





# 3

## ENVIRONMENTAL PROTECTION



A very important aspect of the activities for renovation and maintenance of the school buildings is the protection of the environment and the health and safety of the students and the employees. When it comes to the protection of the environment, the first and the best approach is to prevent the occurrence of any negative effects on the environment as a consequence of the renovation and maintenance activities. In order to prevent the occurrence of these negative consequences, it is necessary to train and inform the technical personnel of the school that is in charge of the maintenance about the potential negative impact of each activity and materials on the environment.

### 3.1. PAINT

The concentration of the harmful particles inside the school is several times higher than the concentration outside. Without proper ventilation, these harmful particles can harm humans and cause dizziness, headache, asthma, fatigue, and even cancer and heart diseases. Significant contribution to the occurrence of these harmful particles in the air is made by the chemicals that are an integral part of the paint used for coloring floors, carpentry, walls etc. These harmful particles are called volatile organic compounds (VOCs or VOC) and they are released during the painting process and during the drying of the paint and wherein harmful substances can also be released for a long time after that. The harmful elements in the VOC may include formaldehyde, pesticides and the like. To prevent such negative impacts, environmentally friendly paints are increasingly used, which paints do not have any or have very little VOC. These environmentally friendly paints are made on water, instead of oil base. Environmentally friendly paints are those paints that have a maximum of 200 grams of harmful substances per liter. When purchasing paint, make sure it does not contain formaldehyde, ammonia, or acetone. In the paints, biocides and fungicides are often added which prevent the occurrence of mold, but at the same time have harmful effects on humans and the environment. Environmentally friendly paints do not contain heavy metals and VOCs, they contain oils, extracts and simple minerals and enable the walls and the furniture to breathe and to be transparent. However, these environmentally friendly paints are not very resistant when used outdoors.



The paints used outdoors can be said to be environmentally friendly if they do not contain heavy metals or toxins. The other harmful particles that can cause a problem indoors are not dangerous when used outdoors because the exposure to wind and external influences neutralizes their effect.



### USEFUL TIPS:

- ▶ When purchasing environmentally friendly paints, the label should comprise the following information: good performances when used indoors, limited harmful substances and low content of solvents;
- ▶ The water-based environmentally friendly paints can deteriorate due to low temperatures so keep them indoors;
- ▶ Keep the cans with paint upside down to prevent entry of air which can dry the paint;
- ▶ If you use a combination of oil paints and water-based paints, then use two types of brushes as well. It is a known fact that oil and water do not mix, so using the same brush can result in a poorly painted product.
- ▶ Never apply paint in the presence of students, regardless of the compositions of the paint.

Benefits of using environmentally friendly paints:

- ▶ They are long-lasting;
- ▶ They are antistatic (they lower the amount of dust and allergens);
- ▶ They are highly porous.

## 3.2. ASBESTOS

Asbestos is a material that was often used in the past. However, nowadays it is proven that it can be the cause of many diseases (meziotelioma, lung cancer, asbestosis) and it is harmful for both the humans and the environment. It is said to be a silent killer, because people exposed to asbestos do not feel any sudden change in health, but it can occur after a longer exposure to asbestos fibers. Asbestos can be friable (insulation of pipes, water heaters, powder materials etc.) and non-friable (asbestos-cement sheets and pipes, waterproof materials based on bitumen, vinyl floor tiles) when it is mixed with cement and similar materials and it is not easily crumbled. The asbestos has the most negative effect when it is broken and the asbestos particles are released into the air and inhaled by people. It is particularly important, when removing asbestos, to be attentive to certain steps that will enable the asbestos to be removed easily and without any negative consequences.



FIGURE 23: Use of asbestos: roof coverings (picture left) and water pipes (picture right)



FIGURE 24: Necessary and mandatory equipment for work with asbestos

**Asbestos removal\*.** Before starting with the removal of asbestos, you must first mark the place and prevent the access of unqualified persons for the duration of the works. At the beginning, it is necessary to spray the asbestos with a mixture of water and soap in the ratio 200:1. In this manner, in case of a possible breaking of the asbestos boards no asbestos particles will be released and move freely in the air. When removing asbestos boards from the roof, it is necessary to build a bridge and to safely descend the boards in one piece, tied with ropes, and not thrown from above. The asbestos should be carefully removed and packed in sealed impermeable bags. The bags should be well closed and transported to the official landfill in a covered truck. In the landfill, the asbestos, packed in bags, is buried in the ground at a depth of one meter and totally isolated from the other municipal waste.

After the removal of asbestos, thoroughly clean the surfaces in order to ensure that there are no traces of asbestos. The workers who will work on the removal and cleaning must wear protective equipment (masks, gloves, clothing) and after the completion of the activities to be decontaminated in order to be sure that there are no traces of asbestos on their body.

\*Rulebook on the manner of handling asbestos waste and waste from asbestos-containing products, Official Gazette of the RM, No. 68/04 and 71/04 (<http://www.moepp.gov.mk/wp-content/uploads/2014/09/Pravilnik%20za%20nacinot%20za%20postapuvanje%20so%20otpad%20od%20azbest%20i%20otpad%20od%20proizvodi%20koi%20sodrzat%20azbest.pdf>).



### 3.3. CONSTRUCTION WASTE

During the renovation or building activities there is always construction waste for the handling of which there are special rules. The construction waste consists of materials such as: insulation, nails, cables, wood, metal, and may also contain hazardous materials such as asbestos and the like.



FIGURE 25: Construction waste

In accordance with the Law on Public Hygiene, Official Gazette of the RM No. 111/08 ([http://www.mtc.gov.mk/new\\_site/images/storija\\_doc/115/normativno%20pravni/Zakon\\_za\\_Javna\\_chistota\\_111\\_03092008.pdf](http://www.mtc.gov.mk/new_site/images/storija_doc/115/normativno%20pravni/Zakon_za_Javna_chistota_111_03092008.pdf)), it is prohibited to shed and leave or to burn or bury construction debris in public areas. This means that the construction waste must be transported to a legal landfill. Transportation must be carried out in a closed truck in order to prevent spilling on the road from the school to the legal landfill.

Under this law, the fines for throwing construction waste for entities are ranging from 3,000 to 4,000 Euros, and for the person in charge of the legal entity the fine is from 500 to 1,000 Euros. After disposing the debris at the legal landfill, a confirmation shall be obtained which is to be kept in the documentation of the school.

### 3.4. CHIMNEY

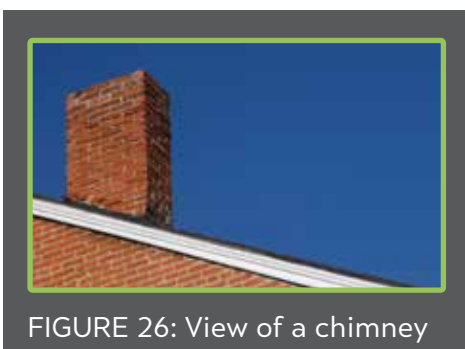


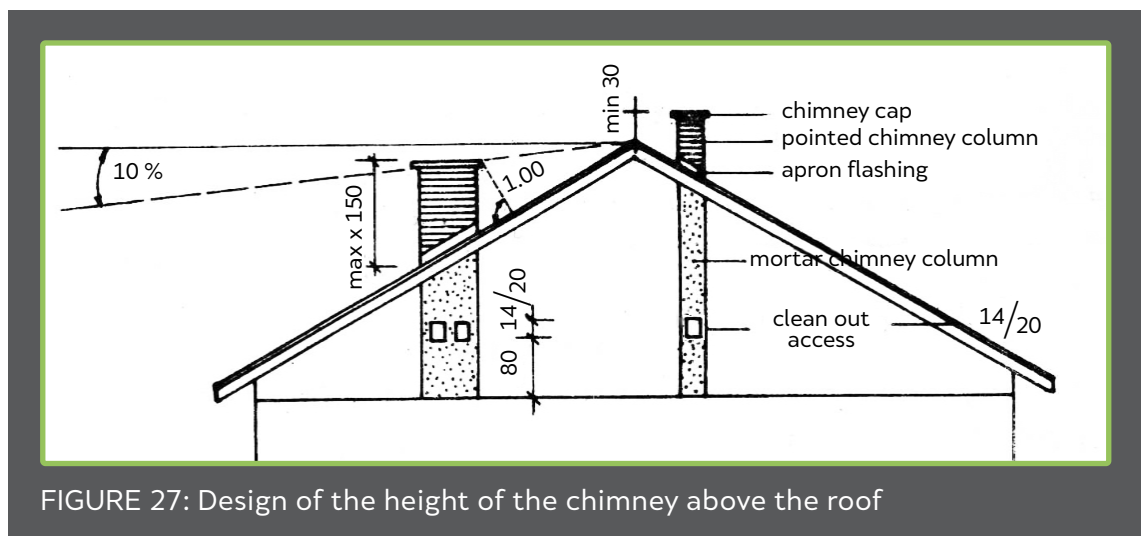
FIGURE 26: View of a chimney

Chimneys are vertical channels constructed of different incombustible material and are part of each firebox or power plant. The hot gases from the fireplaces go into the channels, and, being lighter than the outside air, climb up until they go out above the rooftops.

Each chimney has its base or bottom for collection of soot and for cleaning the channel



through special doors. Also, each chimney has its own end which is finished with a cap that protects it against external environmental factors. The height of the chimney above the roof depends on its distance from the top of the roof (ridge). If the distance is up to 1 m, the height should be at least 50 cm above the ridge. If the distance is from 1 to 3 m from the ridge, the height may be 10 degrees lower than the ridge. If the distance is bigger than 3 m, the height may be 15 degrees lower than the ridge. The chimneys on flat roofs - terraces are made with a height of 150 to 200 cm.



It is known that the smoke that comes out of the chimneys contains carbon dioxide, as well as many other harmful substances. In order to reduce air pollution, it is necessary to set filters on the chimneys. To reduce the possibility of occurrence of fires, the chimneys and their filters should be regularly cleaned.

Maintenance of chimneys is done through:

- ▶ Examination of the chimneys (Protection and Rescue Directorate);
- ▶ Chimney cleaning;
- ▶ Combustion of soot in the chimneys;
- ▶ Taking preventive measures to protect the chimneys against fire and their preparation for normal functioning. Before commissioning, the chimneys should have a certificate (attestation) for proper functioning.

In public buildings, chimney cleaning is done once a month during the heating season and once out of the heating season by professionals and licensed companies\*.

\*"Rules for maintenance of chimneys in good condition, flue elements, air systems, air and water heating systems, fireplaces - boilers for central heating in buildings, as well as in industrial and artisan facilities," Official Gazette of the RM No. 146/2010 (<http://www.slvesnik.com.mk/Issues/889E49F83974BF429078D17C806F1331.pdf> page 30.



The benefits of the timely, high-quality and permanent cleaning of chimneys and other flue elements are:

- ▶ Prevention of fires and other unwanted consequences;
- ▶ Energy source savings of more than 20%;
- ▶ Increased delivery of thermal energy;
- ▶ Preserving the flue elements for a longer period of time;
- ▶ Protecting the environment by reducing harmful emissions into the air.



### **IMPORTANT!!!**

Internal partial cleaning by unskilled persons are harmful, dangerous and prohibited.

## 3.5. RECYCLING



FIGURE 28: Benefits of recycling of waste

Recycling is increasingly present in the schools in Macedonia and the schools become more and more aware of the usefulness of recycling. In that manner, the school is maintained clean (there are no scattered plastic bottles, papers, etc.), and recycling is a good way to collect additional funds. You can recycle old paper, plastic bottles, cans, glass and metal. Paper and plastic bottles are collected in special containers at certain time intervals.

## 3.6. LEAVES AND BRANCHES

Just like the construction waste, it is prohibited to leave or burn at public areas the leaves and the branches that are collected in large quantities when mowing the lawn and cleaning the yard. Instead, they can be practically used for making fertilizer, which can then be used for fertilizing the green areas in the school.



Fertilizer from leaves, branches and other organic material is made by firstly cutting it in as much as possible smaller pieces in order to speed up the process of decomposing. The collected leaves and branches should be collected in a pile, which will be set so as to be protected from excessive influence of sun and wind. The nitrogen in the fresh grass can speed up the process of decomposition. It is necessary to have enough air for the leaves and the branches to decompose, because otherwise an unpleasant odor can be released. Also, there needs to be enough water, not too much or too little, in order to avoid the unpleasant smell and not to lose the nutrients. The pile of leaves and branches should be placed in an enclosed space. In order to accelerate the decomposition, from time to time, the leaves and the branches should be mixed so as to provide enough oxygen.

The decomposing leaves and branches are dark brown and crumbly. This process can last from 2 weeks to 4 months.

If the leaves and branches need to be removed from the school, it must be done in a closed truck and they should be transported to a legal landfill where a confirmation is to be obtained that is kept in the documentation of the school.

### 3.7. ASH

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Ash which is a result from the burning of wood in the school in the winter period can be used as fertilizer for the plants in the school yard. Ash is rich in potassium and phosphorus, which are especially useful for plants. However, ash should be avoided and it should not be used as fertilizer in more alkaline or neutral soils and on plants that prefer acidic soils such as the blueberry. Care should be taken not to put too much ash, but to distribute it in smaller quantities.

The waste from the heating systems that run on wood, i.e. the ashes should be removed from the school building and from the school yard in accordance with the applicable legal regulations\*.

\*Rulebook on the common rules for dealing with municipal and other sorts of non-hazardous waste (<http://www.moepp.gov.mk/wp-content/uploads/2014/09/Pravilnik%20za%20opstite%20pravila%20za%20postapuvanje%20so%20komunalniot%20i%20drugite%20vidovi%20neopasen%20otpad.pdf>).





## 4 SAFETY AT WORK



One of the most important measures for work safety is the use of means of personal protection at work and safety equipment in accordance with the Rulebook on the personal protective equipment used by the employees at work (<http://dit.gov.mk/dokumenti/propisi/pravilnik-za-licna-zastitna-oprema-koi-vrabotenite-ja-upotrebuvaat-pri-rabota.pdf>; <http://dit.gov.mk/dokumenti/propisi/pravilnik-za-bezbednost-i-zdravje-pri-rabota-pri-upotreba-na-oprema-za-rabota.pdf>).

### 4.1. HEAD PROTECTION

It is one of the most important types of protection, and it consists of:

- ▶ Wearing a helmet (which protects against mechanical impacts);
- ▶ Wearing a protective cap (which replaces the helmet, i.e. is used during work in places where blows to the head are ruled out, but it protects against UV radiation and dirt).



#### 4.1.1. FACE SHIELD

- ▶ It is made of polycarbonate and it protects the face against all kinds of particles, dust, powder materials, paints, etc.



#### 4.1.2. GLASSES

- ▶ They are made of polycarbonate and they are used for protection against hits, dust, particles, sprays, paints, etc.





### 4.1.3. FACE MASK

- ▶ It serves to protect against inhalation of various chemicals (paints, varnishes, etc.).



## 4.2. PROTECTIVE CLOTHING

- ▶ It serves to protect the body from cold, grease, solar radiation, dust, etc. It is made of a material that does not absorb dirt from different origins, and at the same time it provides ventilation of the body.



### 4.2.1. PROTECTIVE FOOTWEAR

- ▶ They serve for protection against rain and penetration of sharp objects, and they are characterized by resistance to sliding and high temperatures.



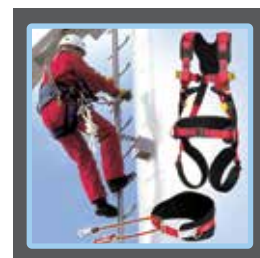
### 4.2.2. GLOVES

- ▶ They serve for protection of the hands when working with rough materials, for protection against greasing with oil, for dust protection, for protection when working in the garden, etc.



### 4.2.3. PROTECTION BELT

The protection belt is used for work at height, i.e. for protection when working on roof surfaces. It is recommended for all works on the roof of the school building to be performed by a licensed company that needs to take all necessary measures for safety at work.



#### **IMPORTANT NOTICE:**

Each school building needs to respect the Law on Safety and Health at Work, and to also possess the necessary protective equipment.



## 4.3. SAFETY AT WORK IN A BOILER ROOM

Each boiler room should strictly observe the conditions for safety at work of the employees and the visitors to the boiler room. In a typical boiler room which runs on liquid fuel, it is necessary to have at least the following equipment for work safety of the employees:

- ▶ Protective clothing (shoes, clothes, glasses);
- ▶ Maintenance of clean floors;
- ▶ At least one fire extinguisher which is placed at a visible and easily accessible place;
- ▶ A box with sand and a shovel.



FIGURE 29: Fire protection equipment

Also, the technical conditions for installation of equipment, such as fuel tanks, fuel pumps, main distribution boards for electricity, should be respected.

- ▶ The seasonal tank for liquid or gaseous fuel should be placed out of the boiler room. It is possible to construct it outdoors, underground or in a neighboring room, and all works should be in accordance with the regulations for such installations;
- ▶ The pumps and the other equipment that are in contact with the fuel should be in an anti-explosive (EH) mode, i.e. not to produce sparks;
- ▶ Automatic valves should be installed on the main fuel intake, which will disrupt the fuel intake in case of a major accident;
- ▶ Main distribution boards for electricity should be installed with appropriate degree of protection, mechanical protection and protection against water;
- ▶ Proper ventilation of the boiler rooms due to the possible leakage of fuel. More attention to be paid to the systems with LPG (liquefied petroleum gas), because it is heavier than air and leakage remains at the bottom of the room. If the fuel is LPG, the construction of underground boiler room is strictly prohibited;
- ▶ The use of protective clothing when working with liquid fuels. More attention to be paid in the case of gas fuels. In case of a leakage and contact with a human body, freezing of body parts appears.



## 5 OPERATING PROCEDURES



The operating procedures provide a description of the objectives, the activities or the steps in case of their implementation, the results of the taken activities, the manner of controlling the quality of the results, the legal requirements, the necessary documents and the duties of the persons involved in such procedures.

From the perspective of the schools, the most important thing is to have procedures for the routine tasks that are regularly performed. At the beginning it is better to adopt simple operating procedures, and over time they can be updated so as to become more detailed and more precise. The implementation of the procedures increases the quality of the work and improves the efficiency of school employees in performing their duties. The procedures should be clear, precise and simple.

The benefits of the operating procedures are as follows:

**EFFICIENCY** – The operating procedures allow better management of the available resources – the personnel and the time. Every employee in the school team is given clear and precisely defined scope of responsibilities. Their application prevents duplication of duties. Using the operating procedures, professional decisions are adopted which are in accordance with the law.

**STANDARDIZATION** – Precisely defined tasks and responsibilities of each employee in the process, are necessary in order to complete the activity in the shortest period of time. This enables continuous performance of tasks.

**SELF-PROTECTION** - The introduction of the operating procedures reduces the likelihood of the employees to make a mistake. Whenever the employees are unsure about how to proceed, the operating procedure can direct them how to take appropriate measures.

**MEASURABILITY** - Each activity is defined and it can be measured how much work is required for its completion. At the same time, the application of the operating procedures allows to assess the work of each member of the team responsible for acting in accordance with the procedure.

**SIMPLE REPLACEMENT** - The introduction of the operating procedures enables easy and fast training and knowledge transfer to the new employees who will be able to begin to work effectively in a very short period of time.



However, even those who have been part of the school staff for a long time can easily learn to use them in their daily work, or if necessary, to perform a task of their colleague, in case of his/her absence.

**MONITORING AND EVALUATION** – The introduction of procedures allows the monitoring of the effectiveness of the execution of the tasks by the employees. Also, the continuous monitoring enables to make changes in the procedures if they are too complicated, if there is duplication of the duties of the employees or if they are ineffective, i.e. if the activities are not completed within the prescribed time period.

**INCREASED TRANSPARENCY** – It increases the responsibility of each of the employees who are in charge of the execution of parts of the operating procedure, it streamlines the financial operations and it improves the decision-making process.

**DISADVANTAGES OF THE OPERATING PROCEDURES** - In the schools there is no tradition for writing procedures (although most often there are such procedures in oral form) and it is possible to provoke the resistance of the employees and to decrease the creativity in terms of the solving of some issues or problems.

## EXAMPLES

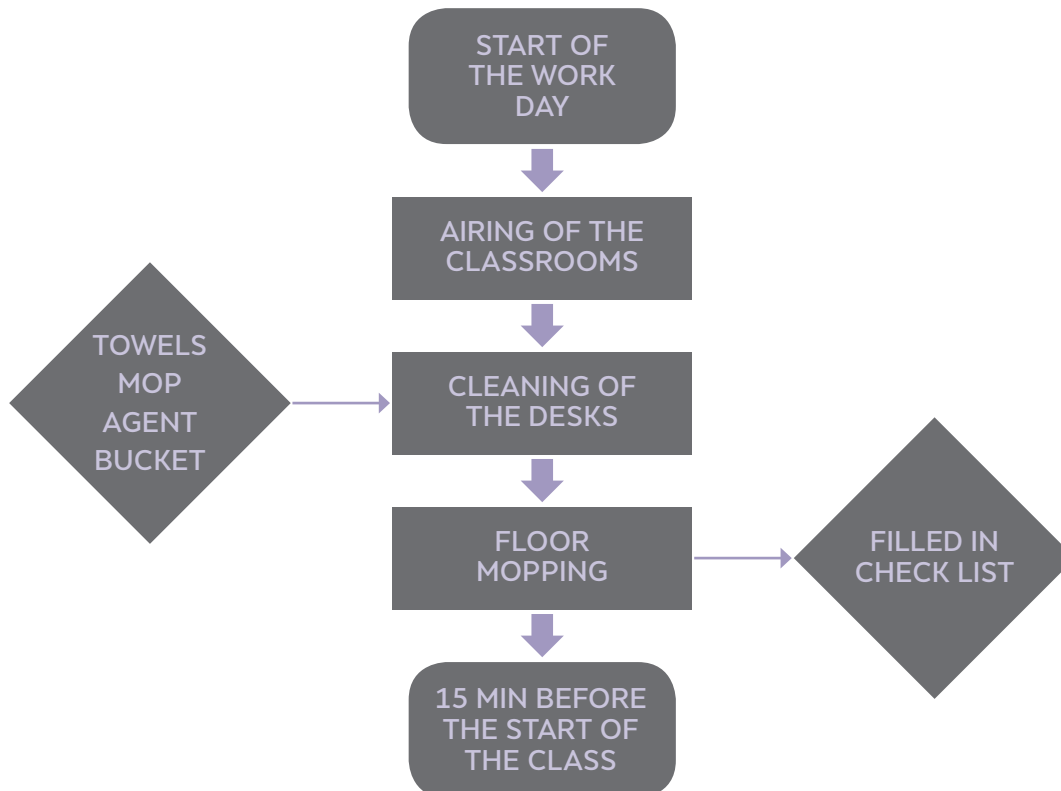


FIGURE 30: Hygiene Procedure

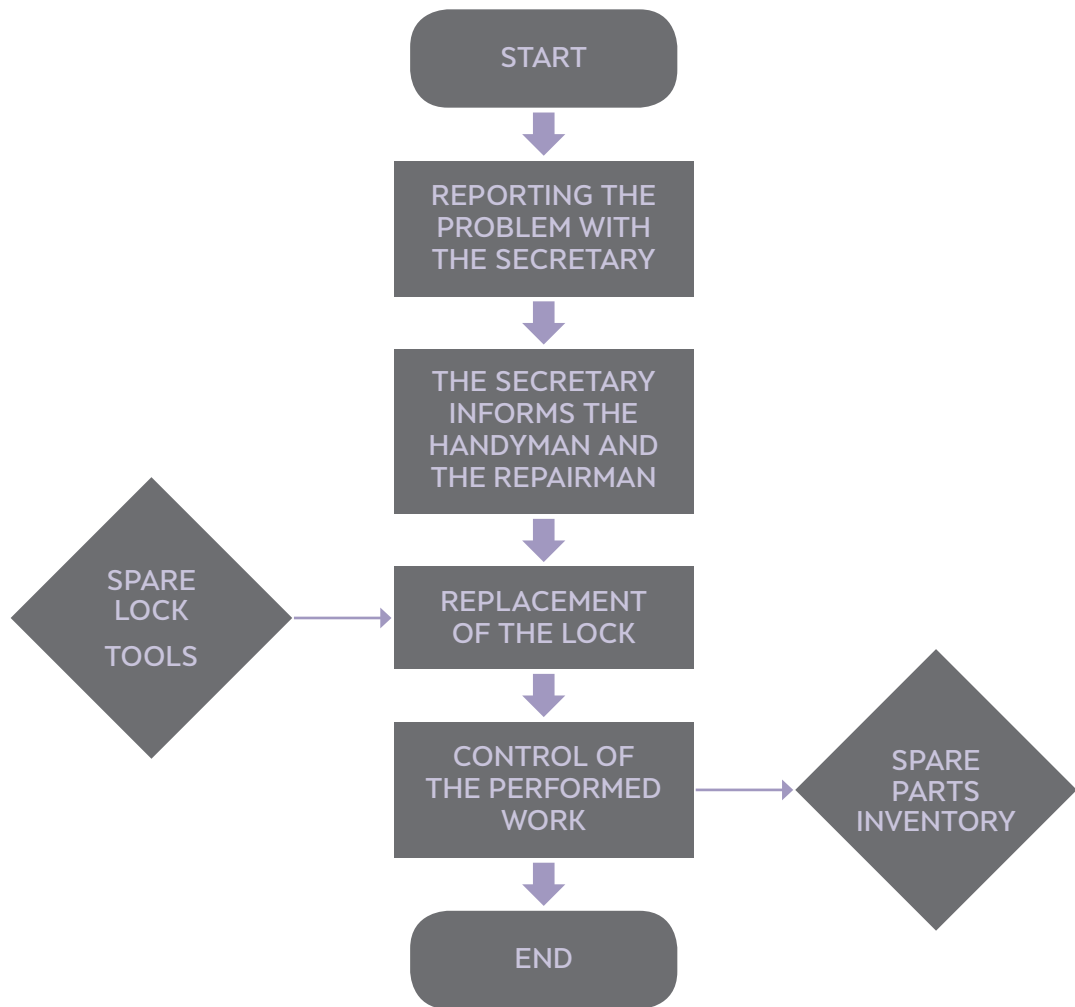


FIGURE 31: Procedure for defect reporting and procurement of parts







The plan for maintenance of the school building is designed for the school teams that are in charge of these activities, which usually consist of the secretary and the technical staff (handyman, boiler operator, cleaners) of the school.

The plan is prepared in the form of tables and lists that will allow easier use and completing.

The plan is divided into two parts which are further divided into annual, monthly and daily activities:

#### ► MAINTENANCE OF THE SCHOOL BUILDING (CONSTRUCTION PART)

**APPENDIX 1:** Annual Action Plan for the maintenance of the construction positions in the school buildings. The annual plan for maintenance of the building contains all the necessary activities that need to be carried out prior to the start and in the course of the school year;

**APPENDIX 2:** Monthly action plan for maintenance of hygiene in the school buildings. The monthly plans refer to the execution of the daily activities while maintaining hygiene in the building.

#### ► OPERATION AND MAINTENANCE OF THE HEATING SYSTEM

**APPENDIX 3:** Annual action plan for maintenance prior to the start of the heating season. The annual plan for maintenance of the heating system contains all the necessary activities that need to be carried out prior to the start and in the course of the heating season;

**APPENDIX 4:** Action plan for maintenance of the central heating boiler. The plan for maintenance of the central heating boiler contains all the necessary activities that are to be performed daily, monthly and annually.

**APPENDIX 5:** Monthly action plan for exploitation and maintenance of the heating system. The monthly plans refer to the daily activities in managing the heating system.



The implementation of the activities and the registration of the performed activities (filling in the maintenance tables) should be controlled and archived by the responsible persons in the school. It is recommended to keep records and to archive them in an electronic form.

These data will enable the school to compare and analyze the performance of certain activities at different times of the year or in the same periods of different years.

Also, the municipality will need to have insight in the maintenance plans in order to be able to monitor the maintenance of the schools, but also to analyze and compare the maintenance activities and their implementation in the schools that belong to the municipality.

THESE GUIDELINES SHALL ENTER INTO FORCE THE FOLLOWING DAY  
AS OF THE DAY OF ITS ADOPTION.

10-17187/1 No.

9-11-2015 2015

Minister of education  
and science, Skopje  
**Abdilaqim Ademi**





## APPENDIX 1: Annual Action Plan for the maintenance of the construction positions in the school buildings

ANNUAL ACTION PLAN FOR MAINTENANCE OF SCHOOL BUILDINGS							
INSTITUTION:		SECRETARY:		RESPONSIBLE PERSON:		PERIOD:	
						20____	
No.	Activity	Performed by:	Time interval	Measures and interventions	Date	Signature	
1	Leveling and repairs of windows and doors	Technical staff	Monthly / when needed				
2	Checking and cleaning gutters	Technical staff	Every 6 months				
3	Checking the roof (broken/damaged roof tiles, boards), the area under the roof, the roof flashings and the eaves	Technical staff	Every 6 months				
4	Check and interventions on floors, walls and ceilings	Technical staff	Every 6 months				
5	Graffiti removal	Technical staff	When needed				
6	Facade painting	Technical staff	Every 3-5 years				
7	Interior wall painting	Technical staff	Every 3-5 years				
8	Machine floor cleaning	External service provider	Once a year				

## ANNUAL ACTION PLAN FOR MAINTENANCE OF SCHOOL BUILDINGS

INSTITUTION:		SECRETARY:			RESPONSIBLE PERSON:		PERIOD:	
							20__	
No.	Activity	Performed by:	Time interval	Measures and interventions	Date	Signature		
9	Replacement of rubber pads with plastic pads	Technical staff	Once a year					
10	Replacement of damaged base boards	Technical staff	Once a year					
11	School yard maintenance (tree trimming, new grass sowing, tree planting)	Technical staff	Every 6 months					
12	Flower and vegetation watering, grass mowing, leaf collection	Technical staff	months / When needed					
13	Fence checking (corrections and painting)	Technical staff	Once a year					
14	Check and interventions of sport fields, school pathways, access ramps	Technical staff	Every 2 years					
15	Checking the lightning rod installation	Technical staff	Every 2 years					
16	Disinfection, fumigation and pest control	External service	Every 6 months					

## APPENDIX 2: Monthly action plan for hygiene in the school buildings

MONTHLY PLAN OF ACTIVITIES FOR HYGIENE OF SCHOOL BUILDINGS																																							
SCHOOL:		SECRETARY:												RESPONSIBLE PERSON:												MONTH:			YEAR:										
1	Daily activities	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Comments:						
1.1	Everyday cleaning and wet mopping of floors																																						
1.2	Ventilate classrooms																																						
1.3	Clean school furniture (desks, chairs)																																						
1.4	Clean boards																																						
1.5	Clean WC bowls, pissoirs, washbasins and floors in the toilets																																						
1.6	Check and refill liquid soap																																						
1.7	Empty waste bins																																						
1.8	Check water tanks, drainage																																						
1.9	Check taps, faucets, valves																																						
1.10	Clean access ramp																																						
1.11	Clean doors and windows																																						
1.12	Clean cabinets, shelves and showcase																																						

### NOTES

- Operator/technical person responsible for maintenance should fill out the form every day
- The filled form should be submitted to the responsible person (secretary)
- In case of malfunction of the equipment immediately inform the responsible person (secretary)
- All activities to be conducted in accordance with the technical guidelines

### APPENDIX 3: Annual action plan for maintenance prior to the start of the heating season

ANNUAL ACTION PLAN FOR TESTS AND CHECKS PRIOR TO THE START OF THE HEATING SEASON						
SCHOOL:		SECRETARY:		RESPONSIBLE PERSON:		PERIOD:
						20__
No.	Activity	Performed by	Time interval	Measures and interventions	Date	Signature
1	Check of chimneys and their annual cleaning	Technical staff	Once a year			
2	Check of boilers and their annual cleaning	Technical staff / service provider	Once a year			
3	Check of burners and adjustment, cleaning or replacement of nozzles, if necessary	External service provider	Once a year			
4	Check of the measuring instruments and calibration when necessary	External service provider	Every 2 years			
5	Visual check of the pipelines, valves and fittings and detection of leakages in the heating system	Technical staff	Every 6 months			
6	Visual check of the heating elements	Technical staff	Every 6 months			

## ANNUAL ACTION PLAN FOR TESTS AND CHECKS PRIOR TO THE START OF THE HEATING SEASON

SCHOOL:		SECRETARY:			RESPONSIBLE PERSON:		PERIOD:	
							20__	
No.	Activity	Performed by	Time interval	Measures and interventions	Date	Signature		
7	Complete or partial emptying of the system for the purposes of making corrections in the network of pipes, heating elements or the system in whole	Technical staff	When needed					
8	Dirt traps cleaning	Technical staff	When needed					
9	Refill of the heating system and the pipe network Checking the installation when cold	Technical staff	When needed					
10	Checking the work of the pumps	Technical staff	Once a year					
11	Checking the operation of the automatic control (if applicable)	Technical staff + External service provider	Once a year					
12	Visual inspection and corrections of the thermal insulation in the boiler room	Technical staff	Once a year					
13	Visual inspection of the anti-corrosion protection of the pipelines	Technical staff	Once a year					



## ANNUAL ACTION PLAN FOR TESTS AND CHECKS PRIOR TO THE START OF THE HEATING SEASON

SCHOOL:		SECRETARY:			RESPONSIBLE PERSON:		PERIOD:	
							20__	
No.	Activity	Performed by	Time interval	Measures and interventions	Date	Signature		
14	Inspection of the expansion vessels	Authorized service provider	Once in 5 years					
15	Inspection of the fuel tank	Authorized service provider	Once in 5 years					
16	Check of the boiler safety valves	Authorized service provider	Once a year					
17	Check of the water softening system	Technical staff	Once a year					
18	Cleaning the equipment and the boiler room	Technical staff	Twice a year					
19	Checking the heating system in operation prior to the heating season	Technical staff	Once a year					

## APPENDIX 4: Action plan for maintenance of the central heating boiler

ACTION PLAN FOR MAINTAINANCE OF THE CENTRAL HEATING BOILER						
INSTITUTION:		SECRETARY:		RESPONSIBLE PERSON:		PERIOD:
						20__
No.	Activity	Performed by	Time interval	Measures and interventions	Date	Signature
1	<ul style="list-style-type: none"> <li>▶ To check whether the boiler is ready for operation</li> <li>▶ To check the inflow and outflow water temperature</li> </ul>	Technical staff	Daily			
2	<ul style="list-style-type: none"> <li>▶ To check the operation of the burner and the regulation</li> <li>▶ To make sure that the air intake in the burner is clean and unobstructed</li> <li>▶ Cleaning the boiler and checking whether there are damages or corrosion</li> <li>▶ Checking the operation of the safety valve of the boiler</li> <li>▶ To change the combustion sequences</li> </ul>	Technical staff	Weekly			

## ACTION PLAN FOR MAINTAINANCE OF THE CENTRAL HEATING BOILER

INSTITUTION:		SECRETARY:		RESPONSIBLE PERSON:		PERIOD:	
						20__	
No.	Activity	Performed by	Time interval	Measures and interventions	Date	Signature	
3	<ul style="list-style-type: none"> <li>▶ To check whether the burner is securely connected</li> <li>▶ To check the gas pipelines to the burner and to check whether there are signs of damages and/or leakages</li> </ul>	Technical staff	Monthly				
4	<ul style="list-style-type: none"> <li>▶ To check the combustion efficiency</li> </ul>	External service provider	Quarterly				
5	<ul style="list-style-type: none"> <li>▶ Inspection of all cables leading to the boiler and the burner and making sure that they are secure</li> <li>▶ Checking for any signs of overheating</li> <li>▶ Inspection and testing of the safety valve on the boiler</li> </ul>	External service provider	Every six months				
6	<ul style="list-style-type: none"> <li>▶ Inspection, cleaning and servicing of the boiler and the burner in line with the instructions of the manufacturer</li> </ul>	External service provider	Annually				





**The Guidelines Manual for Maintenance of School Buildings** can be downloaded from the following web sites:

[www.pmio.mk](http://www.pmio.mk)

[www.mcgo.org.mk](http://www.mcgo.org.mk)

[www.mon.gov.mk](http://www.mon.gov.mk)



