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Identification of materials used in Technology of Interior Drywall Systems 712[06].S1.01

Student's Handbook

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This Handbook provides methodological guidance for the modular unit program 712[06].S1.01 “Identification of materials used in Technology of Interior Drywall Systems”, being a part of the modular training program for the occupation of a Bricklayer 712[06].

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1. INTRODUCTION

You will find this handbook useful while acquiring knowledge about materials used in Technology of Interior Drywall Systems. The Handbook includes:

1. Prerequisite requirements, i.e. a list of indispensable skills and knowledge which you should possess before training within this modular unit.
2. Learning objectives of the modular unit.
3. Reference material (Chapter 4) which will enable you self-preparation for performing the tasks and successful test completion. In order to broaden your knowledge use the literature indicated and other sources of information. They cover also:
   - revision questions checking the knowledge indispensable for task completion,
   - tasks including instructions, the way of task completion and workplace resources,
   - progress checks checking the level of knowledge following a task completion.

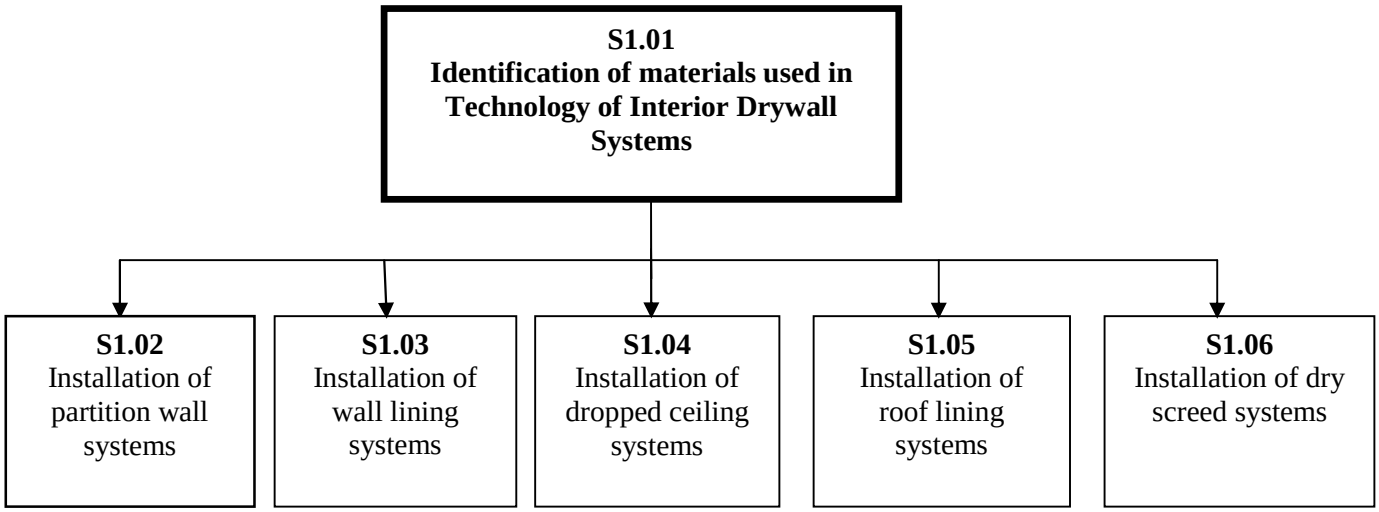
   While doing a progress check you should use "yes" or "no" to answer a question, which indicates that you have acquired the reference material or not. Successful task completion is a proof that you have acquired the skills specified in a given modular unit. If you find the subject or tasks difficult to understand, ask the teacher or instructor to explain or, alternatively, check if you perform a given activity properly.
4. A set of revision questions checking your acquisition of the knowledge and skills covered by the entire unit. After getting familiarized with the reference material try to take a test covering the whole unit.

The modular unit "Identification of materials used in the Technology of Interior Drywall Systems", the contents of which you will get familiarized with now is a part of a module "Technology of Interior Drywall Systems".

Safety and hygiene at work

During your stay in the workshop you must observe rules, regulations, safety and fire procedures related to the type of work performed. You will get familiarized with these regulations in the course of your training.

Diagram of modular units



2. PREREQUISITE SKILLS

Before starting the modular unit program “Identification of materials used in Technology of Interior Drywall Systems”, you should be able to:

- use technical building terminology,
- read and construe technical building drawings,
- use technical building documentation,
- identify construction elements of a building,
- organize the workplace in line with rules of ergonomics and safety,
- ensure the proper transportation of building materials,
- use different sources of information.

3. LEARNING OBJECTIVES

Upon completion of the modular unit program, you should be able to:

- identify paper-based plasterboards (drywalls) used in Technology of Interior Drywall Systems,
- identify gypsum fibre boards used in Technology of Interior Drywall Systems,
- identify steel profiles used in Technology of Interior Drywall Systems,
- identify construction components used in Technology of Interior Drywall Systems,
- identify sealants and insulation materials used in Technology of Interior Drywall Systems,
- identify physical, chemical and mechanical properties of plasterboards used in Technology of Interior Drywall Systems,
- specify parameters of plasterboards used in Technology of Interior Drywall Systems,
- specify parameters of steel profiles used in Technology of Interior Drywall Systems,
- prepare plastering “mud”/joint filler used in Technology of Interior Drywall Systems,
- identify symbols and properties of the materials used in Technology of Interior Drywall Systems and apply quality check methods,
- determine the appropriate application of the materials used in Technology of Interior Drywall Systems,
- observe occupational health and safety rules as well as environmental law requirements while using building materials, apply them economically.

4. REFERENCE MATERIAL

4.1. Types, properties and labelling of gypsum. Gypsum additives

4.1.1. Reference material

Gypsum obtained from natural deposits has been known for thousands of years. It is a well-tested, ecologically pure and man-friendly building material characterized by excellent material and biological properties.

More than 9,000 years ago inhabitants of Ain Ghazal (pronounce: aingazal) in Jordan (Middle East) used lime mixed with unburned limestone aggregate for the preparation of gypsum which was used on a large scale for coating walls, floors and furnaces in their homes. The structures for the erection of which the gypsum-lime mixture was used have survived until today. Babylonians used a mixture of gypsum, lime and slag for building purposes. Monumental Roman ruins testify to the ability of skillful use of gypsum and lime mortar.

In Poland the use of gypsum as a binder was first recorded in the 9^{th} century. In those days it was commonly used in early-Christian religious architecture. Probably the oldest monument of this type is the remains of the walls of the first brick-made cathedral in Gniezno. The first Romanesque church with a crypt of the Gothic collegiate in Wiślica (11th-12th century) contains fragments which were built of gypsum. They are an ornamental slab in the floor and mortar in the walls.

In St. Stanislaus church which was built around 1522 in Gniezno the mortar of gypsum mixed with water (but with no sand) was used for making foundations. Other examples include stuccowork in the Renaissance parish church in Kazimierz Dolny and in churches in Radzymin Podlaski, Zamość and Lublin.

The Polish gypsum industry developed in 1956. At present gypsum is produced in Lesser Poland (Stawiany, Leszcze) and Upper Silesia (Lubichów, Nowy Ląd). Due to the natural environment protection, using the so called synthetic gypsum in the building industry is becoming increasingly popular. It is produced in a wet process for desulfarization of exhaust gas (power stations in: Jaworzno, Opole and Bełchatów). Physical and chemical characteristics of synthetic gypsum (known also as “reagips”) are identical with natural gypsum. Annually, ca. 2.9 m tones of SO2 (some sources even mention much higher figures of 3.2 to 3.5 million tones) are emitted to the atmosphere. For this reason, setting up plants

for a wet process of flue-gas desulfarization within power stations is of great ecological, economic and technological importance.

Consumption of gypsum products in Poland is still much lower than in other European countries. This results mainly from the attachment of our domestic building industry to traditional wet technologies.

Gypsum as a mineral

Gypsum, or calcium sulfate, has been known for thousands of years as rocks appearing in nature, mainly as:

- gypsum rock (dihydrate - $CaSO_4 . H_2O$),
- its very pure, translucent variation - alabaster, anhydrite (hemihydrite $CaSO_4$)
- products of the gypsum rock roasting, i.e. gypsum binders, prevailingly in the form of hemihydrite gypsum ($CaSO_4 . 1/2 H_2O$) and so called soluble anhydrite ($CaSO_4$ III).

Synthetic gypsum – a by-product of industrial processes - also belongs to the gypsum group.

Gypsum binders are chemically active and after they have been mixed with water they harden giving a gypsum product whose composition is like that of the input dihydrate gypsum.

Possibilities of gypsum application are as varied as the forms in which it appears. Generally gypsum is used first and foremost in building industry and architecture but it is also irreplaceable in fine arts as a material for sculptures, models or decorations; in surgery and dentistry, for making moulds in the ceramic industry, even in the motor industry for making car models when a new shape of a car body is being designed. In the past, and sometimes even today, gypsum was used in the chemical, paper and food (e.g. in winemaking for reducing acid) industries, also for the production of paints and varnishes, in agriculture as a fertilizer. Gypsum offers particularly great possibilities in the building industry owing to the ease with which gypsum products and their surfaces can be formed . At the same time it is an ecological material, clean, healthy, ensuring hygienic conditions for humans. Gypsum materials together with lime and ceramics belong to the oldest building materials produced by man, having a long tradition of being used for building purposes. A many-century experience proved that gypsum is an ideal material for the building industry, especially for housing. The term “gypsum-based building materials” should be understood as gypsum binders and gypsum materials obtained from it – mainly from gypsum slurry (seldom from mortar and concrete) appropriately processed in the pre-fabrication processes or directly on the building site.

First of all, gypsum materials are used inside buildings – as finishing materials – but also for erecting walls, also external ones. They are used on a building site for wet technologies, mainly in the form of factory-prepared mixtures (special gypsum materials, e.g, for plastering, mudding, gypsum adhesives, floor bases for screeds) and mixtures prepared on a building site (mortar, gypsum-concrete), but in particular in the form of pre-fabricated products. Gypsum is an excellent material for production of different pre-fabricated products – slabs, hollow-bricks, blocks, profiles in the form of details and architectural decorations. It is also irreplaceable as a decorative material (stuccowork, stucco, sculptures).

At present, when the optimum solutions for the so-called "ecological building" are sought, i.e. buildings which would not destroy ecosystems or natural environment and at the same time would be healthy for man, gypsum is a material which can satisfy all these requirements. Gypsum building has all the features to be treated as ecological and economical.

Gypsum binder – raw-materials and binder types

A traditional raw-material for the gypsum binder production is the natural gypsum rock containing 80-95% of calcium sulfate dihydrate. As a result of roasting the crushed gypsum rock at the temperature of 160 - 180^{o}C a binder is obtained, which is a binding material including mainly hemihydrous gypsum and some amounts of other mineral phases (anhydrite, soluble CaSO4 III, insoluble anhydrite CaSO4 II) – depending on the roasting equipment and the thermal process. Recently synthetic calcium sulfate dihydrates, like gypsum dihydrate, from flue gas desulfarization (a wet lime method) have been used for the gypsum binder production. The resulting gypsum differs from natural gypsum in its form (very fine grain) and crystal structure. Transforming it into a building binder requires suitable preparations and specially adjusted equipment.

In the building industry, building gypsum is a commonly used gypsum binder. Its characteristics are conformable with the requirements of the Polish construction standard PN-B- 30041:1997 and is manufactured in 2 variations:

- GB-G, coarse-grained gypsum – intended for the production of pre-fabricated elements, plaster mortar and gypsum-concrete,
- GB-D, fine-grained – used mainly for decorations and stuccowork, special construction components and as a mortar binder.

Standardized gypsum binders include also special gypsum of targeted application. They include: products of gypsum dihydrate roasting and appropriate mineral additives

controlling the binding time and characteristics of the hardened material, whose properties as well as requirements are given in the PN-B-30042:1997 standard.

While applying gypsum materials in the building practice, one should have a very good knowledge of their characteristics and appropriate skills to apply them which would enable one to take full advantage of the product's favorable characteristics. Possibilities of the wide use of gypsum in the building industry result from many favorable characteristics that this material possesses.

Gypsum binders are ecologically clean materials, of short binding and setting times, so they are effective fairly rapidly, allow to perform building works quickly and easily, produce building elements of different sizes, create any shapes. Their advantages include white color, possibility of obtaining smooth surfaces and decorative patterns. Gypsum materials are light, characterized by good thermal insulation and sound absorption, good heat storage, low hygroscopicity (like that of a well-burnt ceramic brick), they are fireproof and when set reveal good frost resistance and sufficient mechanical strength. The unfavorable features are undoubtedly: high water absorbability and capillary action (e.g. where there is no moisture-proof insulation), reduced moisture resistance, poor impact resistance. These properties should be taken into consideration while using gypsum materials.

In today's world of natural environment and air pollution which result, among others, from the use of some building materials, a particular emphasis should be put on health impact of gypsum materials, which manifests itself through the creation of appropriate hygienic and humidity conditions for a human being, i.e. appropriate microclimate in buildings. It happens so because gypsum materials possess an ability to control humidity. Characterized by a relatively low hygroscopicity (absorption of air moisture), these materials "release" the moisture excess in a drier period and thus control humidity in the room. This property prevents also the occurrence of a phenomenon known as a "cold barrier" and water vapour condensation. Health impact of gypsum materials also reveals itself in lack of radioactive elements in them, so consequently they do not pose any radioactive threat to health.

Currently, when many new materials and technologies are introduced into the building industry, the use of gypsum materials is absolutely crucial for improvement of society's health.

The scope of gypsum material application in the building industry embraces their use directly on the building site as gypsum slurries and mortar for "wet" works such as plastering, mudding, making floor bases for screeds, joining and mounting components, decorative

works (e.g. stuccos, stuccowork), lining, e.g. fire-proof or screening from electro-magnetic fields, monolithic walls;

Gypsum slurries are mixtures of water and gypsum with binding retardants and other additives. Gypsum slurries are mainly used for the production of different gypsum components, e.g. paper based plasterboards. On the other hand, gypsum-based building mortar, also in the form of water and gypsum mixtures with retardants and filling additives (milled aggregate), is used for joining elements of building partitions, joint filling, protecting a building's elements against external influences by using plaster and providing these elements with specific properties, e.g. fire-resistance.

The scope of gypsum material applications in the building industry can embrace also the use of gypsum components for pre-fabrication (preliminary preparation) in industrial plants, mainly from slurries, seldom from mortar. Such an application refers to small-size products, such as slabs and hollow bricks for walls and ceilings, decorative products, sound-absorbing products, stuccowork components, etc., as well as products of bigger sizes as one-storey high plasterboards.

It is noteworthy that the use of gypsum in the building industry is systematically increasing thanks to the sale of ready-made gypsum mixes (plastering, fluid floors, etc.) together with appropriate mechanical equipment and development of the interior drywall system technologies using paper-based plasterboards.

Due to the physical and chemical characteristics of gypsum its use as a finishing material for building interiors is on the increase. Also its particular health properties and sensitivity to moisture contribute to this. Plasterboards of different types and for different interior drywall systems as well as wall plasterboards of the ProMonta type are particularly popular. As an interior material, gypsum is used for:

- wall, ceiling and slanted roof linings, paneling and finishing (drywalls, decorative and sound-proof boards, boards enhancing room acoustics, e.g. resonant plasterboards, plastering mortar, stuccos, Venetian plaster, architectural details, etc.)
- partition walls (drywall systems, Pro Monta boards),
- making floor bases for tiled floors (anhydrite and gypsum "wet" floor base for screeds and in the form of ready-made plasterboards),
- fire-proof linings, e.g. steel structures (gypsum profiles, spray).

Gypsum is less common in structural applications.

Mechanical strength of the material has a major effect on durability of structural solutions – it is assumed that the strength of gypsum materials and gypsum-concrete, even taking into

account their reduced moisture resistance, is sufficient to permit the use of these materials for erecting load-bearing walls in low-rise (one-storey) buildings. The requirements concerning mechanical strength are not a basic problem when gypsum components are used for filling the walls, e.g. in buildings of skeleton construction. Modern housing, while looking for economical (energy-saving) and ecological solutions in the field of materials and structures, is increasingly interested in gypsum products and technologies of drywall systems. In Poland gypsum building structures have quite a long tradition. Polish building industry knows several systems of erecting gypsum buildings of skeleton construction (reinforced concrete, steel, or wood) or frameless construction – taking advantage of small-sized hollow bricks of different shapes, also with thermo-insulation inserts or warmed up by foamed (expanded) gypsum poured on the construction site. The best-known but presently forgotten ones are the: R-system, KR-system, SOVA-system, Eko-Gips.

Gypsum binders are characterized by low thermal conductivity and high water vapour permeability. In this way they counteract reduction of thermoinsulation which can be caused by the influence of humidity. Gypsum is also a non-flammable building material used for fire-protection purposes. A 2 cm gypsum layer has a fire resistance of 20 minutes. The low surface conductivity of natural gypsum prevents accumulation of electrostatic charges on plastered or smoothly coated surfaces. For this reason the surfaces covered in natural gypsum do not attract dust.

Due to a considerable number (60%) of micropores and low level of diffusion resistance gypsum is able to absorb excess moisture from the humid air in the room and give it back very quickly when the humidity decreases. In this way gypsum can create an optimum microclimate and control it in our homes, offices and industrial space.

Ecologists draw attention to low energy-consumption of the gypsum binder production – only 160°C during the process of roasting the crushed gypsum rock in the production process of binding materials. What is even more important, in comparison to other building materials gypsum contains much lower levels of radioactive elements. For example, the ceramic brick contains 667 Bq/kg of K-40, cell concrete - 200 and industrial gypsum only 40 Bq/kg.

Depending on the type of a building's structure and technology of interior finishing, the heating method and ventilation efficiency, we create a specific microclimate in the rooms used by us. Gypsum materials made on the basis of gypsum binders (interior drywall systems, gypsum plaster and walls made of gypsum blocks) are very helpful and effective in creating a proper, man-friendly microclimate.

In the course of binding gypsum mortar (in prefabricated plasterboards or wet plaster) part of water gets bound with the gypsum particle structure and the rest evaporates during drying creating small empty spaces called macropores. These empty macropores are the components "working" for the creation of a proper microclimate. When humidity in the room is in excess, they absorb it; when it is becoming dry - they give it quickly back to the surroundings. Many building materials are characterized by susceptibility to moisture absorption, usually unfavorable, but absorbing moisture to give it quickly and easily back to the ambient air is the feature possessed only by gypsum materials.

Today, when man looks for optimum solutions to the problem of the "ecological building" – the building which would not destroy ecosystems and natural environment and at the same time would be healthy for man – gypsum is the material which can meet all these requirements. Gypsum building has all the characteristics which make it ecological, economical and man-friendly.

The market of building materials of gypsum origin includes: paper-based plasterboards, gypsum binders (plaster, mixtures, mortar, adhesives, gypsum), blocks, hollow bricks, fluid floors. In 2009 in Poland the estimated consumption of gypsum in the building industry was ca. 4.0 million tons, including 1.56 million tones of natural gypsum and 2.5 million tones of synthetic gypsum (data according to the Polish Association of Plaster of Paris)

In 2005 ca. 7 billion m2 of paper-based plasterboards were used in the world. More than a half of this quantity were sold in North America, which indicates that the US consumption is more than 10 m2 per head. In Europe and Japan the consumption is lower and amounts to 3 m2 per capita. In Poland this figure stands at a little above 2 m2 per head.

4.1.2. Revision questions

Answering the questions you can check if you are ready to the planned course of tasks and task completion.

1) In which region of the world was gypsum used first in the building industry?
2) Where is gypsum mined in Poland?
3) How is „reagips" produced?
4) What are basic applications of gypsum in economy?
5) Why is gypsum believed to be a good material for the use in the interior of a building?
6) What is gypsum hygroscopicity like?
7) What are the applications of gypsum in the building industry (give 5 examples)?

4.1.3. Tasks

Task 1

Identify prepared gypsum samples and match them with their names.

Tips for task performance:

The teacher will provide you with 4 gypsum samples. Your task is to match the names written on small cards with each sample and present the completed task to the teacher.

Workplace resources:

- reference material from Chapter 6 of Student's Handbook,
- cards with names of different gypsum types (dihydrate, alabaster, hemihydrate, anhydrite, soluble (CaSO4 III).
- gypsum samples.

Task 2

On the basis of given words-headings present subsequent stages of gypsum production.

The way to do the task:

To do this task, you should:

1) be familiar with gypsum properties (reference material, Chapter 4),
2) organize the workplace for task completion,
3) put in order the elements received from the teacher,
4) present the completed task,
5) assess correctness of the task completion.

Workplace resources:

– drawing paper pad, sizeA4,
– drawing instruments,
– reference material from Chapter 6 of Student's Handbook.

Task 3

You are provided with a cross-section drawing of a family house. Mark these elements which can be made with the use of gypsum-based building materials.

The way to do the task:

The teacher will provide you with a diagrammatic drawing of a family house. Your task is to mark with a cross (X) these components which can be made with the use of gypsum-based building materials.

Workplace resources:

– reference material from Chapter 6 of Student's Handbook,
– diagrammatic drawing of a house (a cross-section).

Task 4

Using the water provided in a container and a separate bag of gypsum mixture prepare gypsum plaster.

The way to do the task:

The teacher will provide you with a container filled with water and a sample of dry gypsum mixture. Using a trowel, mix both components until you get a uniform mix of thick cream texture.

Workplace resources:

– reference material from Chapter 6 of Student's Handbook,
– water and ready-made gypsum mix,
– a tub and a small metal trowel.

4.1.4. Progress check

	Yes	**No**
Are you able to:		
1) indicate locations in Poland where gypsum is mined ?	..	..
2) identify basic physical and chemical properties of gypsum?	..	..
3) list 5 applications of gypsum in the building industry?	..	..
4) explain what synthetic gypsum is?	..	..
5) describe the production method of gypsum from the gypsum rock?	..	..
6) give a chemical formula for gypsum?	..	..
7) prepare gypsum mortar?	..	..

4.2. Types of plasterboards used in Technology of Interior Drywall Systems. Paper-based plasterboards. Gypsum-fibre boards.

4.2.1. Reference material

History of paper-based plasterboard

The history of modern paper-based plasterboard development dates back to the 19th century and is inseparably connected with an American businessman and inventor whose name was Augustine Sackett (*read: Augustyn Saket*). He is generally considered the "father" of the modern gypsum board. However, the name of his partner, one Fred L. Kane (*read:. Fred El Kein*) should also be remembered. In 1890, Sackett and Kane improved the hitherto product, which until 1884 had been made from coal tar lined with straw paper. Originally, Sackett's plasterboard was used as transport packaging for big parcels – today we can talk about them as a sort of containers. However, Sackett wanted to develop his product further so as to be able to use his board for walls and ceilings. The anecdote is that Kane suggested replacing the straw paper by felt paper and using gypsum instead of tar. This was the beginning of today's plasterboards. In 1894 Sackett patented his invention and started production of "Sackett Board".

From the moment the plasterboard had been improved and Sackett's production process implemented, the gypsum industry was based on more than 40 manufacturers. Many of them also produced and sold lime traditionally used as a plasterboard component. Already in 1880, it was discovered that by adding appropriate chemical substances (retardants) chemical properties of gypsum can be controlled. In 1901, 17 out of 40 small gypsum producers combined to form the United States Gypsum Co. (USG). In the following year the group was joined by another 20 companies. In 1909 Sackett sold his company the "Sackett Plaster Board Co." to USG. Plasterboards entered European construction sites at the beginning of the 20th century. The first factory was built in England in 1917.

One of the most important events in the history of gypsum was preparation of a formula for an improved plasterboard, in which a core of milled newspaper paper was used. The innovation of this solution consisted in using aired starch in the core. Thanks to this solution the board was lighter and stronger. It was a breakthrough discovery which in the 1920s led to the production launch of modern gypsum boards under the auspices of Delaware Corporation (*read: delałer*).

In Poland the first plasterboards were manufactured at the end of the 1950s. In those days they were called "dry plaster". At that time the material served as a surrogate of interior

cement-lime plaster. There were no accessories available to help plasterboard installation. The product quality was low and that is why it was ill-reputed then. Changes occurred in the 1990s. It was during that decade that the consumption of plasterboard increased in Poland from 0.18 m2 in 1993 to almost 2 m2 per head in 2002.

Plasterboard manufacture

Paper-based plasterboard is a composite material made of a gypsum core sandwiched between several layers of cardboard. In plasterboards, gypsum effectively takes the compressive stress over, whereas its tensile strength is significantly reduced. The role of cardboard is to take over tensile stress. The thus created system works like reinforced concrete in which concrete (gypsum) takes over compression and reinforcing rods (cardboard) - tension.

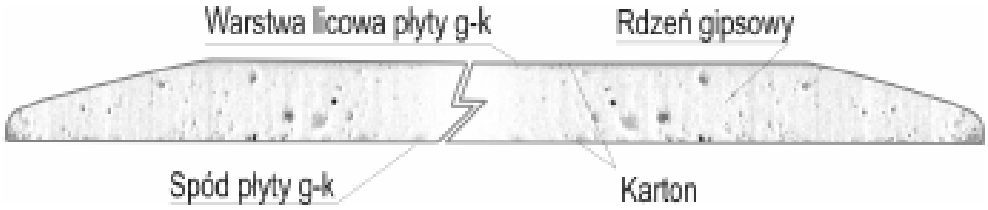


Fig. 1 Cross-section of a paper-based plasterboard

Gypsum is a porous material of high capillarity. Its ability to control relative air humidity in interiors has been known for long and highly appreciated. This ability results from the previously mentioned water absorption and a unique among building materials ability of rapid drying owing to water evaporation. This phenomenon is observed in gypsum when relative air humidity declines. It is due to this particular ability of gypsum that the interior in which it was used is characterized by good microclimate of a stable relative humidity of air.

Another feature of gypsum (or crystallized calcium sulfate with two water particles) is that when it is exposed to fire it is able to maintain the temperature of a wall or ceiling surface at ca. 120°C until the water bound in gypsum evaporates. This feature is used for constructing fire protection of gypsum plasterboards.

Cardboard is a lining layer on the plasterboard surface. Its task is to take over tensile stress occurring during plasterboard squeezing. Cardboard is produced in the form of a band drawn from the cellulose pulp. Due to the manufacturing method, the number of cellulose filaments

parallel to the band length is definitely higher than in other directions. Cardboard covers both sides of the board and two longitudinal edges whereas lateral edges are not covered by cardboard.

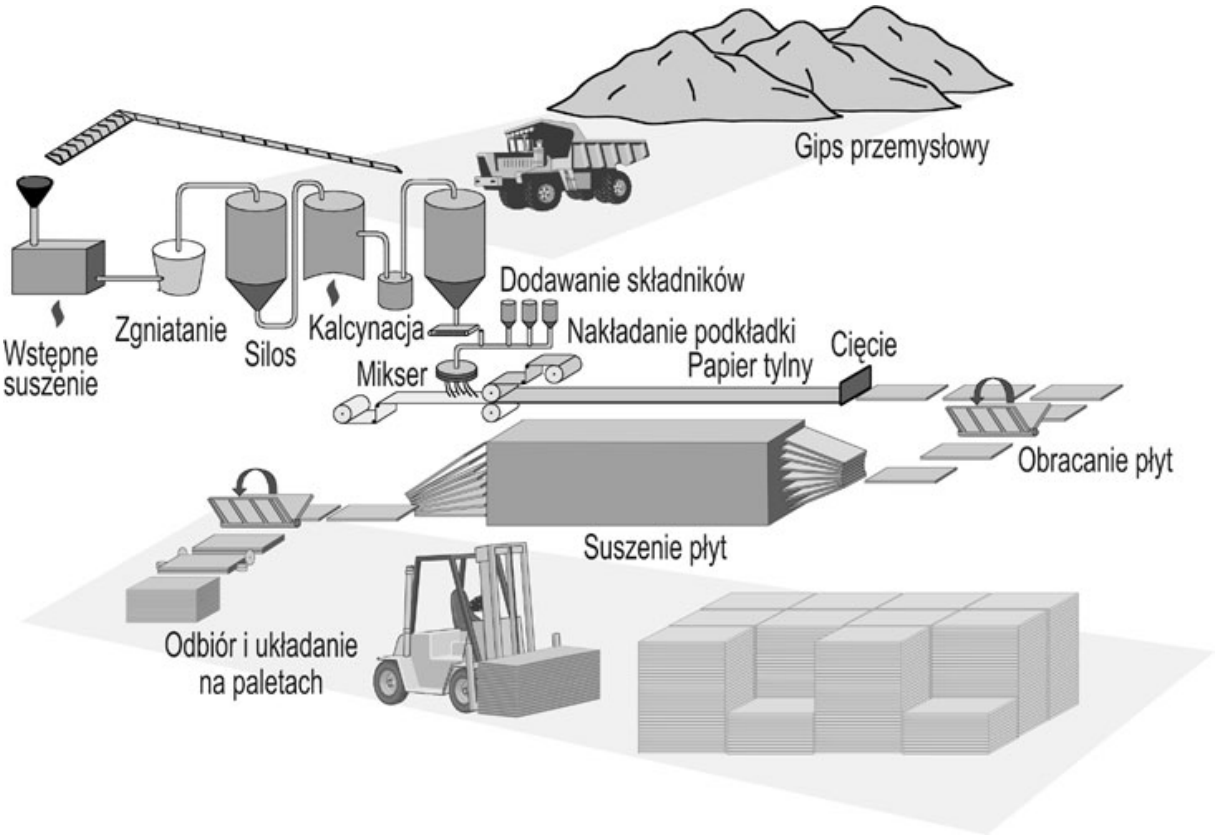


Fig. 2 Diagram of plasterboard production

1. Gypsum delivered to a factory contains ca. 10% of moisture.
2. In the process of calcination (i.e. water removal) calcium sulfate hemihydrate is produced.
3. In a mixer calcium sulfate hemihydrate is combined with water and other (modifying) ingredients.
4. On a moving belt, between two cardboard bands, a core of gypsum is formed which together with cardboard creates a plasterboard.
5. Special equipment cuts the band to specific lengths.
6. Boards are dried in a drying chamber and placed on palettes.

During the plasterboard production process, a number of additives are used which determine characteristics of the final product. To improve fire-resistance, cut fibreglass is added. To enable the use of plasterboards in interiors of temporarily higher humidity, hydrophobic substances are added to the gypsum core which reduce its absorbability. Using hydrophobic substances and fibreglass together, one receives plasterboards of improved fire-resistance and decreased water absorbability.

Plasterboards

The scope of the Polish Standard PN-EN 520:2006 (the previously binding standard was PN-B-79405:1997) covers, among others, plasterboards of the following dimensions:

- thickness 6.5; 9.5; 12.5; 15.0; 18.0 mm;
- width: 600; 625; 900; 1200 and 1250 mm.

Typical length: from 2000 to 4000 mm, but other lengths are available.

The following plasterboard types are distinguished:

Type "A" – standard plasterboard to be used in interiors of relative air humidity below 70%;

Type "H2" – impregnated plasterboard of enhanced moisture-resistance to be used in interiors of the relative air humidity below 70%. Also used in interiors of air humidity below 85%, however, the influence of such humidity should not exceed 10 hours per day. Absorbability of H2 board is limited (up to 10%), and is obtained by adding hydrophobic substances to a gypsum core. The cardboard surface is usually green in color.

Type "F" – fire-resistant plasterboard intended for fire-resistance rated walls. The glass fibre additive enhances the gypsum core integrity at high temperatures. Intended for the use in interiors of relative air humidity below 70%.

Type "DF" - fire-resistant plasterboard intended for building fire-resistance rated walls. The glass fibre additive improves the gypsum core integrity at high temperatures. Intended for the use in interiors of relative air humidity below 70%. Additionally, the DF type plasterboard is characterized by controlled density of the gypsum core - minimum 800 kg/m3 (minimum 10kg/m2) for plasterboard thickness of 12.5 mm. The surface cardboard can be pink in color.

Type "FH2" – fire-resistant and impregnated plasterboard. It combines characteristics of F and H2 types.

Type "DFH2" – fire-resistant and impregnated plasterboard which combines in itself properties of DF (GKF) and H2 (GKBI) types.

The standard mentions also other plasterboard types.

One of plasterboard variations is a gypsum fibre plasterboard. Disintegrated cellulose, fillers and binder (gypsum) are used for its manufacture. They are prevailingly, but not exclusively, used in skeleton building.

Gypsum-fibre plasterboards are produced from synthetic or natural gypsum and disintegrated recycled paper in the 80%:20% ratio. Ingredients are mixed together and then soaked with water and pressed under high pressure. Such a plasterboard is used for the interior drywall system. It is characterized by a uniform structure of the material in which cellulose fibre

plays the role of reinforcement. They differ from paper-based plasterboards in which the board bearing element is the external layer – cardboard. A uniform structure of a gypsum-fibre board facilitates the treatment of the material and assembly of structures made of it. The use of screws, nails or pneumatically shot clamps is not dangerous for board edges. The board is characterized by high mechanical strength.

Plasterboard edge variations

Longitudinal edges of boards with a cardboard layer can be shaped differently depending on their intended use, joint filling methods and preferences.

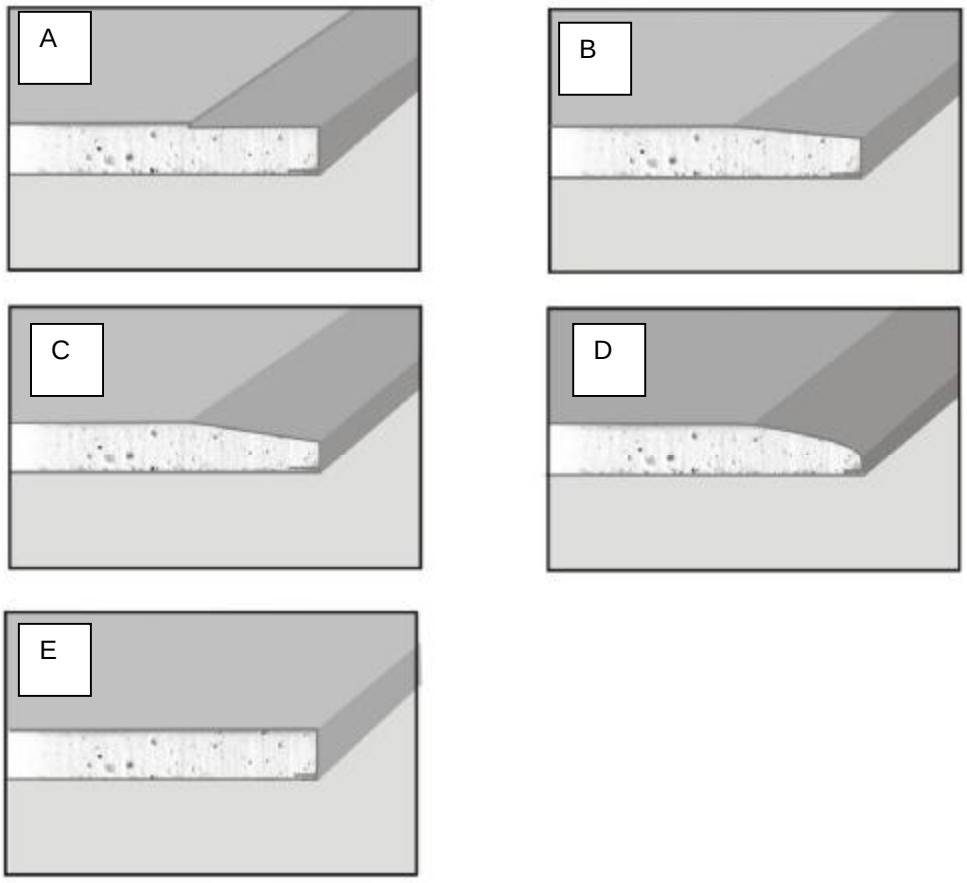


Fig.3. Edge types: (A) PRO, (B) NS, (C) KS, (D) KPOS, (E) KP

The Polish Standard PN-EN 520:2006 describes the following edge types:

KS – boards of tapered edges meant for concealing contact lines between boards, they require the use of joint compound (mud) and a joint tape.

NS – boards of tapered edges, a variation of the KS edge type of a lesser taper angle.

PRO – variation of the KS edge type of low and parallel taper angle.

KPOS – boards of half-round edge, tapered, for using joint compound between plasterboards; they can be used with both a joint tape and joint compound applied to them, or joint compound only, without a joint tape.

KP – boards of straight edge intended for the use without a joint compound.

The standard describes also other types of edges.

Cut edges

Cut edges in plasterboards are obtained by cutting commercial plasterboards. In the place of cutting, the gypsum core is exposed. Prior to the installation of cut elements, the edges must be beveled at an angle of ca. 45°.

Transportation and storage of plasterboards

High quality of interior finishing in the Technology of Interior Drywall Systems can be ensured by observing appropriate rules of handling plasterboards during their transportation to the construction site and during the assembly itself.

1. Paper-based plasterboards must be carried with their cut edge placed vertically or transported by special carts, palettes or other transporting vehicles.

2. Paper-based plasterboards should be stored on a flat substrate, preferably a palette or a wooden planks, maximum 35 cm apart from each other.

Attention: the total stress of 60 standard boards (a palette) on the substrate is ca. 600 kg/m2.

3. Plasterboards, adhesives, joint compounds and system-included gypsum should be protected against moisture. Wet or damp plasterboards must not be used.

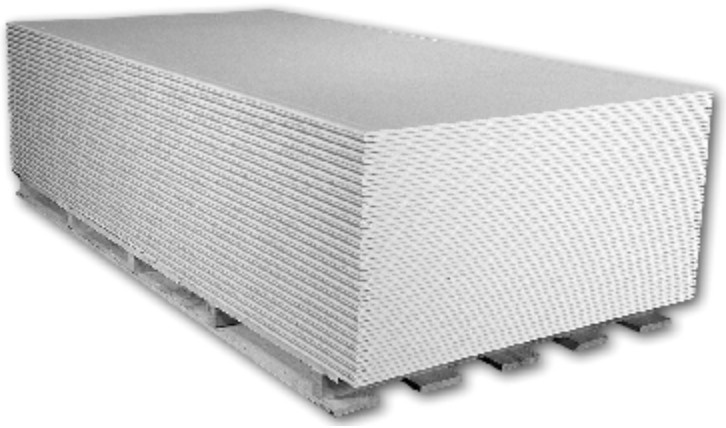


Fig. 4. Storing plasterboards.

4.2.2. Revision questions

Answering the questions you can check if you are ready for the planned course of tasks and task completion.

1) Who invented a plasterboard and when?
2) What is a plasterboard structure like?
3) What are the main operations in the plasterboard manufacture?
4) What are the basic types of plasterboards?
5) What basic characteristics determine the use of plasterboards in the building industry?
6) What basic edge types are there in plasterboards?
7) What basic regulations must be observed while storing plasterboards on a construction site?

4.2.3. Tasks

Task 1

On the basis of a drawing presented by the teacher describe the process of plasterboard production.

Tips for task performance:

Before starting the task, the teacher should discuss its scope and the way to perform it. Students must be familiar with safety rules at work.

The way to do the task:

The teacher will show you a diagrammatic drawing of plasterboard production. Your task is to describe the subsequent production stages and present them to the teacher.

Workplace resources:

– reference material from Chapter 6 of Student's Handbook,
– drawing instruments,
– diagram of the production process

Task 2

Using a drawing presented by the teacher, identify the types of plasterboard edges and write the correct name next to each edge.

The way to do the task:

To do this task you should:

1) get familiar with descriptions of plasterboard edge types (reference material from Chapter 4.2.1),
2) organize the workplace for task completion,
3) complete the drawing provided by the teacher,
4) present the completed task,
5) assess correctness of the task completion.

Workplace resources:

– drawing paper pad, size A-4,

– drawing instruments,
– reference material from Chapter 6 of Student's Handbook.

Task 3

In a Table provided by the teacher where advantages of different types of paper-based plasterboards are described, match each description with the name of the plasterboard type and its possible application in finishing works.

The way to do the task:

The teacher will provide you with a table including 7 descriptions of plasterboard types. Your task is to give the name of the type and match them with their applications.

Workplace resources:

– reference material from Chapter 6 of Student's Handbook,
– drawing of a table,
– descriptions of particular plasterboard types.

4.2.4. Progress check

	Yes	**No**
Are you able to:		
1) present a short history of plasterboard development ?	..	..
2) identify plasterboard types?	..	..
3) indicate differences between plasterboard type A and type F?	..	..
4) name a component making type H plasterboard distinctive?	..	..
5) give the rules of plasterboard edge cutting?	..	..
6) name applications of plasterboards depending on their edges?	..	..
7) list basic rules of plasterboard storage?	..	..

4.3. Steel profiles and assembly elements used in Technology of Interior Drywall Systems

4.3.1. Reference material

To make a wall, ceiling or other barrier/partition it is necessary to prepare an appropriate structure (in other words: a frame or a grid). To make it we need special steel profiles produced from a steel sheet with anti-corrosive protection (e.g. zinc galvanized), profiled in the cold process. Manufacturers who supply complete interior drywall systems offer different types of profiles. System-included profiles are produced in accordance with the requirements included in the Polish standard PN-EN 14195 or binding technical specifications.

Metal elements for the interior drywall systems, such as steel profiles or screws must be stored under the roof and protected against moisture.

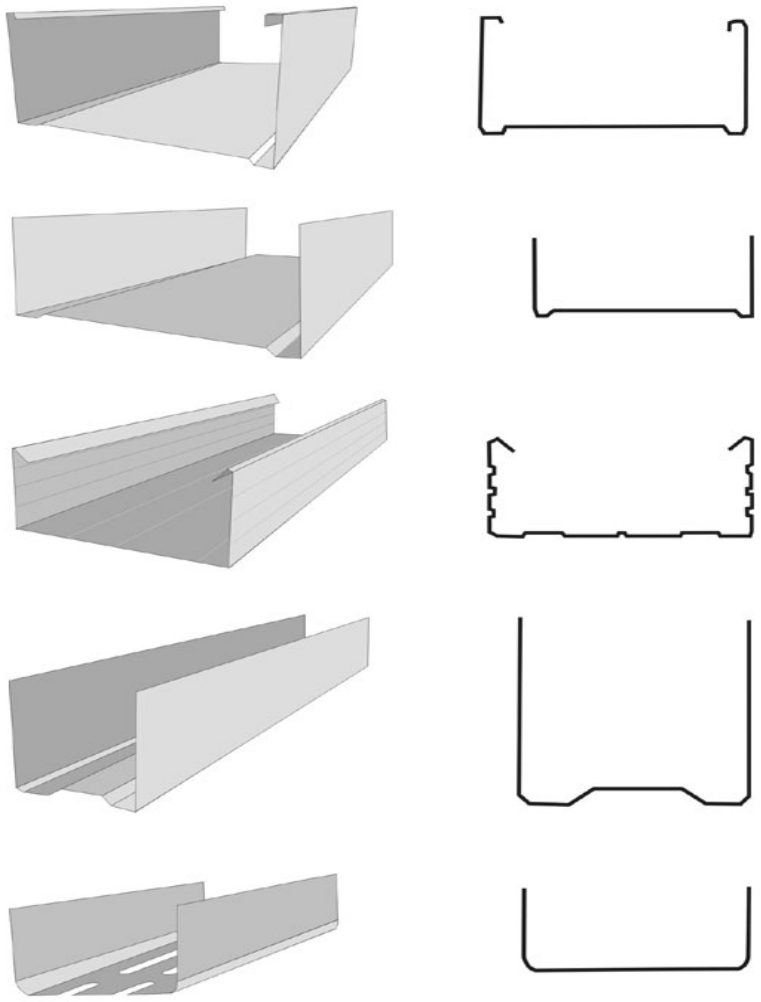


Fig. 5. Types of steel profiles and their cross-sections (*from the top*): UW, CW, CD, UD, UA

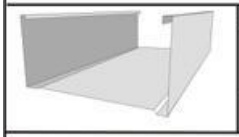
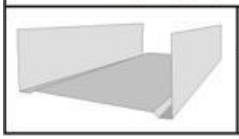
Wygląd, przekrój, nazwa i oznaczenie profila		Wymiary i odchyłki wymiarowe, mm			
		h	b		s
Profil ścienny słupkowy	CW 50 (C 50)	48,8±0,5	b_1= 50,0±0,5	b_2= 48,8±0,5	*wg dokumentacji producentów SSZ*
	CW 75 (C 75)	73,8±0,5			
	CW 100 (C 100)	98,8±0,5			
Profil ścienny poziomy	UW 50 (U 50)	50,0±0,5	40,0±0,5		
	UW 75 (U 75)	75,0±0,5			
	UW 100 (U 100)	100,0±0,5			

Table 1: Steel profiles for walls (h- profile height – width of channel center, b – width of channel flanges - in “CW” profiles flange widths are not identical, s- steel sheet thickness)

Wygląd, przekrój, nazwa i oznaczenie profila		Wymiary i odchyłki wymiarowe, mm		
		h	b	s
Profil ścienny ościeżnicowy	UA 50	48,8±0,5	40,0±0,5	*wg dokumentacji producentów SSZ*
	UA 75	73,8±0,5		
	UA 100	98,8±0,5		

Table 2. Steel profile for door frames - UA stud (h- profile height – width of channel center, b – width of channel flanges, s- steel sheet thickness)

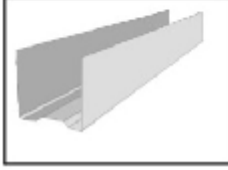
Wygląd, przekrój, nazwa i oznaczenie profila		Wymiary i odchyłki wymiarowe, mm		
		h	b	s
Profil sufitowy główny	CD 60	60,0±0,5	27,0±0,5	*wg dokumentacji producentów SSZ*
				
Profil sufitowy przyścienny	UD	28,0±0,5	27,0±0,5	
				

Table 3. Steel profiles for ceilings (h- ceiling height – width of channel center, b – width of channel flanges, s- steel sheet thickness)

System-included profiles are divided into 3 groups:

- wall profiles intended for light skeleton structures of partition walls, wall linings and pre-walls,
- ceiling profiles for suspended ceiling structures and wall linings as well as attic systems. In both above named types the nominal steel sheet thickness for wall and ceiling profiles is 0.6 mm or 0.55 mm, with tolerance specified by the system supplier,
- profiles intended for door mounting in partition walls and reinforcement of wall frames in non-standard solutions. Usually, they are made of steel sheet being at least 1.8 mm in thickness.

While buying profiles one must pay attention to the steel sheet thickness and the supplier of drywall systems. The use of non-standardized profiles of too thin a steel sheet may result in losing a warranty for the whole system (e.g. a wall or a ceiling) as well as a loss of defined technical and mechanical parameters (such as: fire resistance, sound resistance and mechanical strength).

Using profiles of nominal thickness of 0.5 mm requires development of a separate technical design taking into account a lower profile rigidity.

Accessories

The accessories used in interior drywall systems should originate from one of the four suppliers: Knauf, Lafarge, Norgips, Rigips. Accessories include: rotary hangers, nonius hangers, cross connectors, longitudinal connectors (connecting pcs to CD60) and ES elements (adjusting brackets).

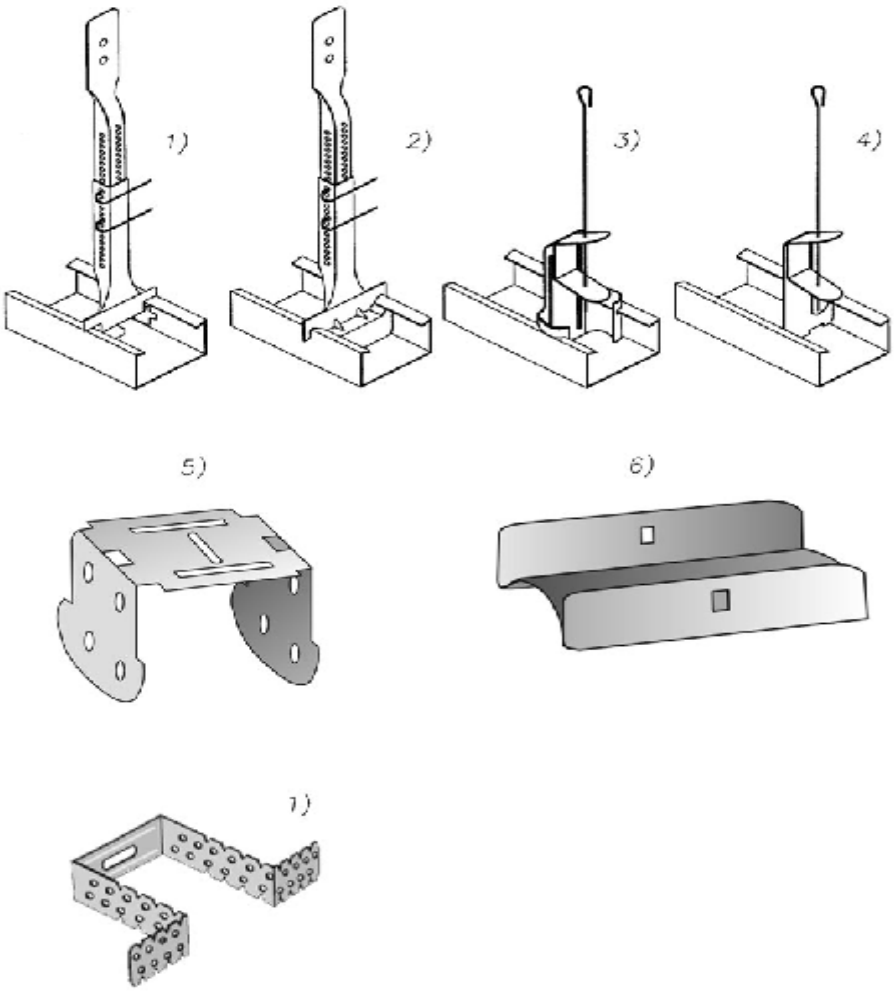


Fig.6. Accessories (*from left to right*): (1) nonius hanger, (2) nonius hanger (3) rotary hanger, (5) cross connector, (6) longitudinal connector connecting pcs to CD60, (7) ES adjusting bracket

Screws

They include: steel metal screws, self-drilling screws, wood screws. The screws used in interior drywall systems should originate from one of the four suppliers: Knauf, Lafarge, Norgips, Rigips.

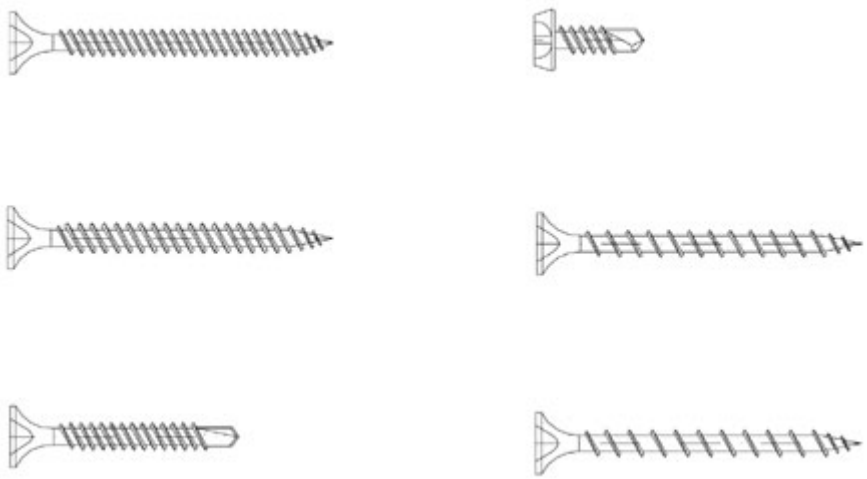


Fig. 7. Screws used in interior drywall systems (*from the left*): steel metal screw 3.5 mm, steel metal screw 3.5 mm, steel metal screw 4.2 mm, wood screw 3.5 mm, steel metal screw 3.5 mm, wood screw 4.2 mm,

Tools used in Technology of Interior Drywall Systems

Commonly used tools in Technology of Interior Drywall Systems:

a) for plasterboard cutting we use:

- a knife with a replaceable blade;
- key hole saw;
- crosscut saw;

b) for manual mixing of the system joint compound (mud) we use a trowel and a plastic bucket, whereas for mechanical mixing we use a slow-rotating mixer with a stirrer;

c) for the correct positioning of fixed plasterboards we use: a profile pole, spirit or laser level and rubber hammer;

d) the best tool for screwing plasterboards is an electric screwdriver with adjusted screwing depth;

e) for plasterboard mudding we need: a hawk, metal trowel, sandpaper or sanding mesh;

f) additionally, we can find the following useful:

- rebate plane (beveling plasterboard edges);
- painter's tape (for determination of level lines).

Fig. 8. Tools and materials used in interior drywall systems

4.3.2. Revision questions

While answering these questions check if you are ready for the planned course of tasks and task completion.

1) What are the types of and symbols for steel profiles used in the interior drywall systems?
2) What are the basic parameters of wall profiles?
3) What are the basic parameters of ceiling profiles?
4) What are the basic parameters of door frame profiles?
5) Which parameters of a system-included steel profile deserve special attention?
6) What accessories are used in interior drywall systems?
7) What types of screws are used in interior drywall systems?
8) What are the basic tools used in interior drywall systems?

4.3.3. Tasks

Task 1

Identify types of steel profiles used in Technology of Drywall Systems.

The way to do the task:

The teacher will provide you with samples of steel profiles. Your task is to give the name of a profile and its symbol.:

Workplace resources:

– reference material from Chapter 6 of Student's Handbook,
– samples of steel profiles,
– drawing instruments.

Task 2

Complete a table provided by the teacher with the missing data. The table presents 11 types of profiles. The missing descriptions should be completed with selected parameters or missing symbols.

The way to do the task:

To do the task you should:

1) get familiar with descriptions of types of steel profiles (reference material from Chapter 4.3.1),
2) organize the workplace for task performance,
3) complete the table provided by the teacher,
4) present the completed task,
5) assess correctness of the task completion.

Workplace resources:

– drawing paper pad, size A4,
– drawing instruments,
– reference material from Chapter 6 of Student's Handbook.

Task 3

Name accessories provided by the teacher which are used in Technology of Interior Drywall Systems and describe in what place they can be used (a wall, ceiling, attic).

The way to do the task:

The teacher will provide you with accessories. Your task is to name each of the accessories and match them with their applications.

Workplace resources:

– reference material from Chapter 6 of Student's Handbook,
– accessories used in Technology of Interior Drywall Systems,
– descriptions of applications of particular accessories

Task 4

From among the tools prepared choose the one which will let you cut a steel profile to a desired length.

The way to do the task:

The teacher will show you tools used in the assembly of drywall systems and a fragment of a UW profile. Your task is to cut a profile of 25 cm in length.

Workplace resources:

- reference material from Chapter 6 of Student's Handbook,
- tools (a pair of shears, measuring tape) and a UW profile.

4.3.4. Progress check

	Yes	**No**
Are you able to:		
1) identify basic types of steel profiles used in interior drywall systems ?	..	..
2) identify symbols used for steel profiles depending on their application?	..	..
3) identify profiles on the basis of their cross-sections?	..	..
4) identify crucial parameters of a profile from the point of view of safe use of drywall system elements?	..	..
5) name accessories used in interior drywall systems?	..	..
6) identify application of particular accessories	..	..
7) give the names of screws used in interior drywall systems?	..	..
8) identify applications of particular screws	..	..
9) name basic tools?	..	..
10) identify the application of particular tools	..	..
11) cut a steel profile to a desired length?	..	..

4.4. Materials for finishing works in Technology of Interior Drywall Systems. Sealants and insulation materials used in Technology of Interior Drywall Systems.

4.4.1. Reference material

Joint compounds

For structural and finishing joint filling as well as concealing the seams between plasterboards and filling the joints of the junctions within a wall, or between a ceiling and a building's structure we should use joint compounds.

System -included joint compounds are offered by suppliers of complete interior drywall systems. These compounds are produced following the requirements included in the Polish Standard PN-EN 13963.

We distinguish 4 types of joint compounds:

- structural joint compound to be used with a joint tape;
- finishing joint compound;
- two-functional joint compound (structural and finishing);
- structural joint compound to be used without a joint tape for the KPOS edge.

Tapes

According to the recommendations of drywall system suppliers, all types of joint tapes can be applied to the vertical joint of drywalls with tapered edges (NS, PRO, KS i KPOS). A self-adhering joint tape ("mesh") is applied directly to the cardboard edges of adjacent plasterboards in the case of NS and PRO-edge plasterboards and on a previously applied structural joint compound ("onto wet plaster") in the case of NS, PRO, KS and KPOS edge types. In the case when a "wool felt" or paper tape is used, one must check if they are applied to a joint on the so called "wet plaster".

On vertical joints (on edges tapered at the factory) between plasterboards of half-round tapered edges (KPOS), joint compound can be applied without the use of a joint tape provided that we use a special structural joint compound intended for this purpose.

Mudding horizontal joints between plasterboards, i.e. "cut" edges is carried out with the use of joint tapes of the "wool felt" or paper type applied on "wet plaster".

Gypsum plaster

The main components of gypsum plaster are, first of all, high quality gypsum, calibrated aggregate (diameter below 1.2 mm) and many modifying additives such as plasticizers and retardants. Such mixtures are delivered to a building yard or a construction site, or as ready made, commercial plaster mixtures, or ready for mixing with water in bags of different weights. It is noteworthy that gypsum plaster is produced in two technological versions:

- plaster for machine processing, which is made on the construction site with the use of special machinery,
- plaster for manual processing, preferred for repair and redecoration works with small areas to be plastered (e.g. up to 50 m2).

Gypsum plaster is commonly referred to as “warm” plaster. Popularity of gypsum plaster wet technologies is accounted for by plaster work productivity.

Gypsum adhesives

Gypsum adhesive is an indispensable element of technology of interior drywall systems. Gypsum adhesive is a ready-made dry gypsum binder of technical and practical parameters making it suitable for a quick, precise and durable bonding of plasterboards. The main application of gypsum adhesive is to fix interior plasterboards to a typical wall substrate (masonry background) of a ceramic or silicate brick, concrete or cell concrete.

Gypsum adhesive is produced on the basis of natural gypsum and mineral fillers and other special ingredients which cause that the mix created is flexible, easy to process when a longer binding time is required, and characterized by good adherence to both a substrate and plasterboards. Gypsum adhesive provides good stability and long-term durability of connection and at the same time it does not ruin cellulose fibres in plasterboards.

Installation of drywall systems should be carried out with the use of mortar consisting of gypsum adhesive following recommendations of drywall manufacturers. Consumption of gypsum adhesive depends on care with which the substrate was executed.

Floor bases for screeds

System-included fluid screeds are produced on the basis of high-quality dry gypsum mortar with an additive of anhydrite or high-silica sand (max. grain 1.8 mm). A fluid screed is a ready-made commercial dry mortar for industrial purposes which is mixed on a construction site with pure water only.

Most often floor bases for screeds are used in a fluid form on layers of acoustic or thermal insulation, as a screed on a separating layer or as an integrated screed and in the case of floor heating assembly.

Fluid jointless floors (screeds) are mixed mechanically and pumped out directly on a pre-treated substrate. They flow on their own, level off and thicken. They do not require a reinforcing mesh. No physical effort is needed to create them: no removing, rubbing or smoothing out. Gypsum-based screeds are jointless and smooth. They cover big surfaces well. Their strength is high and they are ready for further coating with natural or synthetic materials.

All supplementary materials which are needed for making screeds are supplied by the system suppliers. Apart from dry mortar, the system includes: a tape, insulation materials of all kinds, mudding compounds, primers, sand bed and joint profiles.

Manufacturers of self-levelling floor base systems which are gypsum-based supply also pumps for mixing jointless floors. Feeding equipment feeds the mix even at a distance of 150 m and the height of 50 m and their capacity is up to 170 kmw/her.

Mineral wool

Mineral wool is a natural insulation material. The general term referring to this class of products, i.e. “mineral wool” denotes both rock (stone) wool and glass wool.

The mineral wool’s advantages include: good thermal insulation (low thermal conductivity coefficient), non-flammability and fire-resistance, outstanding sound absorbability, stability of dimensions and shapes, mechanical strength combined with natural elasticity, biological and chemical resistance, stability, water resistance and vapour permeability.

Mineral wool is used for manufacture of products of shapes, finish, functional parameters and mechanical properties selected for their specific use and adjusted to user’s needs.

Due to its structure, mineral wool itself cannot be a barrier for undesired sounds, neither can it protect on its own against fire. In each case it is a part of the so called system, in other words it helps to fill a space inside a drywall structure. Insulation properties of mineral wool are a result of its low thermal conductivity of the air trapped among its fibres. The insulation material placed in a structural element of a building reduces heat exchange. The thermal conductivity coefficient (or heat transfer coefficient, in Poland denoted by the symbol λ) is a basic parameter qualifying mineral wool products to the group of thermoinsulation materials. The lower the value of this parameter is, the better heat insulation can be obtained. The thermal conductivity coefficient for mineral wool reaches even the value of 0.031 W/mK (a

full brick: 0.77 W/mK). Heat insulation is not only practical from the point of view of man's comfort of work and life, but first of all strictly economical. Properly performed insulation reduces costs borne on account of heating and cooling the room. Mineral wool used for insulation helps to maintain fire-resistance; at the same time it is an ecological and economical material.

Due to its natural properties, mineral wool is classified as inflammable material of class A1 and A2. The classification systems categorize building materials according to their reaction to fire and there are seven basic classes distinguished in this respect: A1, A2, B, C, D, E, F. The best (as far as non-flammability is concerned) products are in class A1, the subsequent ones encompass products revealing increasingly worse properties. Class F – does not specify any requirements. Numerous tests carried out with the use of standard test methods confirm the strictest criteria concerning surface requirements of fire resistance which enables the use of mineral wool in technical rooms and corridors. Wool is not impregnated with any chemical compounds enhancing its fire resistance. This property of wool is natural, unlike in the case of other insulation materials, e.g. foamed polystyrene – artificially impregnated with substances which artificially delay ignition. In conditions of high temperature they release very toxic and very durable chemical compounds to atmosphere.

A variety of uses for mineral wool products in the field of acoustic resistance results from its property of high sound absorbabilty (sound absorption coefficient), little dynamic rigidity and high internal suppression of acoustic energy.

In sound absorbing structures, such as suspended ceilings (flat and spacious) mineral wool boards (of both rock and glass wool) perform the role of sound absorbents and are placed in an empty space between the main ceiling and the dropped ceiling elements. In drywall systems which are used as sound proof barriers, the wool fills the space between the boards, also in sound proof systems executed on masonry walls mineral wool is used successfully. Damping layers made of mineral wool in fluid floors used for suspended ceilings increase ceiling insulation against impact and air sounds. Mineral wool products are also used for silencing noise coming from the water and central heating pipes –as insulation isolating and damping piping vibrations - as well as in silencers of ventilation installations. In industrial applications mineral wool is used for filling the walls of acoustic refuges, sound-proof and insulation screens, and machine housing. It must be mentioned that in the case of sound-proof systems mineral wool is a barrier element. Therefore acoustic parameters are given for specific sound-proof system structures.

Partitions inside a building can only separate individual rooms or are an indispensable element of a structure transferring loads from the ceiling and higher storeys. Depending on the required strength, sound absorbability and the use of adjacent rooms as well as a building structure they can be made of different materials. Fire, acoustic and thermal insulation is most often ensured by mineral wool.

4.4.2. Revision questions

Answering the questions you can check if you are ready for the planned course of action and the task completion.

1) What are the types of the system-included mud/joint compounds?
2) What types of gypsum plaster are used in building industry?
3) What is gypsum adhesive and what is its application?
4) What is the application of floor bases for screeds?
5) What is mineral wool used in drywall systems for?
6) What class of fire-resistance is mineral wool categorized in?

4.4.3. Tasks

Task 1

Match the descriptions of mud/joint compounds with the descriptions of their applications in drywall systems.

The way to do the task:

The teacher will provide you with descriptions of different types of mud/joint compounds and separately with descriptions of possible mud applications in finishing works. Your task is to match them and show the results to the teacher.

Workplace resources:

- reference material from Chapter 6 of Student's Handbook,
- drawing instruments,
- descriptions of mud types and separately descriptions of mud applications.

Ćwiczenie 2

Complete the table provided by the teacher with missing data. The table presents descriptions of floor bases for screeds and adhesives in such a way that you can match descriptions to possible applications of products.

The way to do the task

To do this task you should:

1) get familiar with descriptions of different floor bases for screed and types of adhesive (reference material from Chapter 4.4.1),
2) organize the workplace for task performance,

3) complete the table provided by the teacher,
4) present the completed task,
5) assess correctness of the task completion.

Workplace resources:
– drawing paper pad, size A4,
– drawing instruments,
– reference material from Chapter 6 of Student's Handbook.

Task 3

From the mineral (glass) wool provided cut off such a fragment as to fill a space between the frame profiles of two partition walls covered with plasterboards on one side only.

The way to do the task

The teacher will show you a technical documentation of performing insulation in a partition wall. Your task will be to cut mineral wool in such a way as to obtain tight insulation between profiles.

Workplace resources:
– reference material from Charter 6 of Student's Handbook,
– technical documentation for insulation,
– tools and materials indispensable for doing the task.

4.4.4. Progress check

	Yes	**No**
Are you able to:		
1) name basic types of mud?	..	..
2) distinguish between types of gypsum plaster?	..	..
3) name applications of gypsum adhesive?	..	..
4) name the ways of using insulation materials in interior drywall systems?	..	..
5) give applications of floor bases for screeds?	..	..
6) give the value of heat transfer coefficient for mineral wool?	..	..
7) fit mineral wool to the spacing of frame elements in a partition wall?	..	..

5. TEST OF ACHIEVEMENTS

STUDENT'S INSTRUCTIONS

1. Read the instructions carefully.
2. Sign the answer sheet with your name and surname.
3. Get acquainted with test tasks.
4. The test consists of 20 tasks of two difficulty levels. It includes tasks of the following types: open, gap-fill, multiple-choice and True/False.
5. Give your answers on the enclosed answer sheet only. Put a cross (X) in the right column or write the correct answer. If you make a mistake, put a circle around the incorrect answer and then put a cross (X) next to the correct answer.
6. The test consists of 2 parts containing tasks of different difficulty levels: tasks 2, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 20 – represent the basic level, whereas tasks: 1, 3, 4, 6, 19 – represent the above-basic level.
7. Work on your own because only then you will get satisfaction of completing the task.
8. When you find answering a question difficult, leave it for a later time and return to it when you have time.
9. You have 90 minutes to complete the test.

Good luck !

A SET of TEST TASKS

1. For the production of pre-fabricated elements as well as plaster mortar and gypsym-concrete we use gypsum:
   a) dihydrate, synthetic,
   b) GB-D, fine-grained,
   c) GB-G, coarse-grained,
   d) natural.

2. Identify basic construction components which are made of gypsum materials:
   a) …….
   b) …….
   c) …….....
   d) ……..
3. Are gypsum products classified as ecological?
   a) yes,
   b) no.
4. In your opinion which gypsum property determines its limited use?
   a) high brittleness,
   b) poor moisture resistance,
   c) fast setting of gypsum mixtures,

d) chemical resistance.

5. Draw a cross-section of a paper-based plasterboard and identify its elements.

6. In a paper-based plasterboard, the cardboard's role is to:
   a) protect against moisture,
   b) enhance plasterboard smoothness,
   c) increase tensile strength,
   d) enable further finishing works.

7. Identify particular paper-based plasterboard types:
   a) Type A - ……..……...,
   b) Type H2-……..……,
   c) Type F- ……..……..,
   d) Type FH2- …… .

8. Identify particular plasterboard variations from the point of view of their edges:
   a) PRO-……...,
   b) KS-…….…..,
   c) KPOS-……..,
   d) KP-…….…. .

9. Plasterboards are:
   a) transported horizontally, stored in a vertical position or stacked horizontally,
   b) transported vertically with the use of a special cart, stored horizontally,
   c) transported in such a way as not be damaged,
   d) transported on a special yoke and stored on the substrate.

10. What are the structures for the use in plasterboard partitions made of?
   a) brick or other small-size materials,
   b) fluid concrete,
   c) steel profiles,
   d) wood.

11. Identify basic types of steel profiles used in the technology of interior drywall systems:

a) ……..,

b) ……..,

c) ……..,

d) ……..,

e) ……

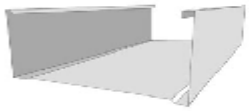
12. Identify basic dimensions of steel profiles:

a) h-……..,

b) b-……...,

c) s-…… .

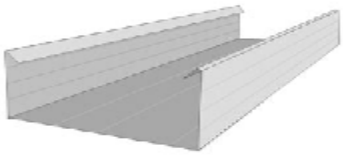
13. Identify the profiles depicted in these drawings and give their letter symbols:

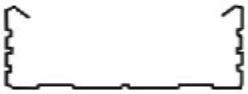


a) ……..,

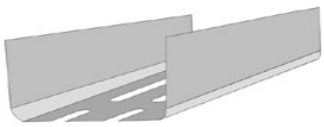
b) …….

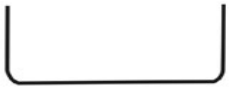
14. Identify the profiles depicted in the drawings below and give their letter symbols:





a) ……,

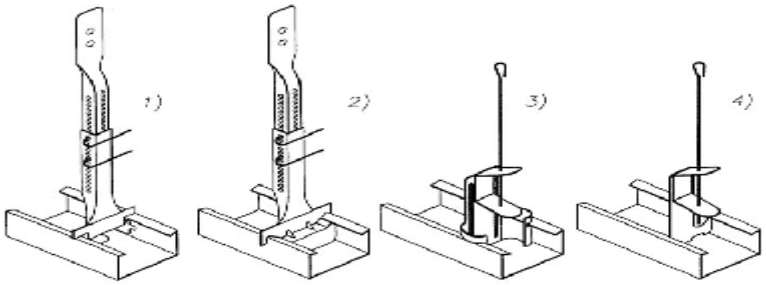




b) ……..,

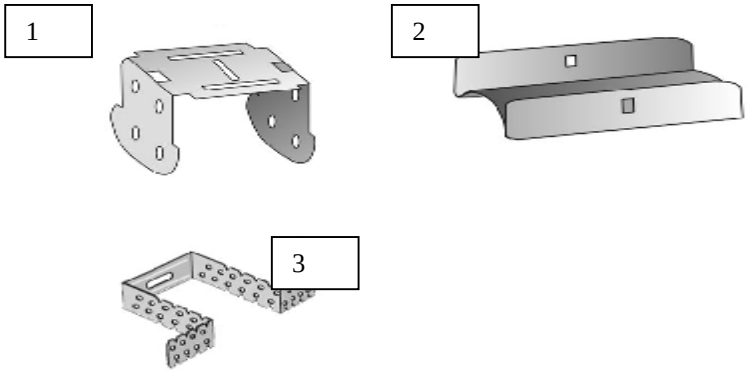
15. Draw a cross-section of the UA profile and give its symbol.

16. Identify accessories used for assembly in drywall systems:



a) 1), 2)…….,
b) 3), 4)……,

17. Identify accessories used in the assembly of drywall systems.



a) 1- ……..……..,
b) 2- ……..……..,
c) 3- ……..……..,

18. Identify basic types of mud:

a) …….,
b) …….……..,
c) …….……..,
d) ……..,
e) ……,

19. The most important parameters of mineral wool used in drywall systems are:
    a) high moisture-resistance, good acoustic insulation,
    b) good acoustic insulation, good thermal insulation, fire-resistance,
    c) poor acoustic insulation, good mechanical strength, stability of dimensions and shapes.

20. Identify basic tools needed to complete the assembly of drywall systems:
    a) ……,
    b) ……,
    c) ……..,
    d) ……..,
    e) …… .

ANSWER SHEET

Name and surname ……..

Identification of materials used in Technology of Interior Drywall Systems

Mark the correct answer, write in a missing phrase or an answer.

Question number	Answers					Points scored
1	a	b	c	d		
2						
3	a		b			
4	a	b	c	d		
5						
6	a	b	c	d		
7	a) b) c) d)					
8	a) b) c) d)					
9	a	b	c	d		
10	a	b	c	d		
11						
12	a	b	c			
13	a	b				
14	a	b				

15						
16	**a)**		**b)**			
17	**a)**		**b)**		**c)**	
18	**a)**	**b)**	**c)**	**d)**	**e)**	
19	**a**		**b**		**c**	
20	**a)**	**b)**	**c)**	**d)**	**e)**	
Total						

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