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4.4

WP4 DELIVERABLE 4.4 PRESENTATION OF MINIMUM

LAB REQUIREMENTS

METVET

JOINT HIGHER VET

COURSE IN THE METAL SECTOR

WP4 – Creation of Curriculum and Syllabus, Qualification standard, evaluation & certification (Vol. B)

Co-funded by the Erasmus+ Programme of the European Union

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ABOUT METVET

Metal, machinery and related trades workers are engaged in a range of skilled activities. Those workers need to understand work organization, and the specialist materials and tools to be used in their jobs, as well as of the nature and purpose the final product they are engaged in making.

According to Cedefop's European skills and jobs survey (ESJS), the **5 key skills** for metal, machinery and related trades workers are job-specific skills, problem solving, teamwork, learning and communication. These skills will support employees in this occupation to also tackle anticipated future skill challenges.

METVET project aims at a competence-based professional generic profile served as a basis for designing competence-based training programs. The underlying idea is that vocational education should enable trainees to acquire the competences needed in their future professions. While working as professionals, they should continue to develop competences in order to be able to react to and anticipate future developments in their work.

The project specifically aims at one hand designing, for **Aluminium & Metal Constructions technicians** including:

- **a professional (qualification) profile & a core curriculum (EQF 5)**
- **a corresponding VET program, including innovative teaching methods**
- **a qualification standard (according to ISO/IEC17024) for evaluation & certification.**

All the above will be achieved through the strengthening of the exchange of knowledge and practice between education and training institutions and the labor market. The METVET consortium complementarity will ensure a strong collaboration between the labor market (sectoral organizations) and the education and training institutions. The role of the sectoral organizations will be of ensuring that the developed training is in total adequacy with the employer's needs, supporting the implementation of the training for workers. The role of VET providers will be to develop an adapted, attractive and innovative VET program The EU umbrella organization will promote the training in the other EU countries.

The objective of this volume is to present METVET's Deliverable D4.4 "Minimum Lab Requirements", therefore guidelines with the necessary minimum technical equipment, that will accompany the different modules of the training material (D4.3 - Syllabus), so as to maximize learning results.

The Project Partners

June 2020

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Principles & Environment

1 D4.4 | ABOUT THE LABORATORY

The primary objective in laboratory design is to provide a safe environment for laboratory personnel to conduct their work. Therefore, all health and safety hazards must be identified and carefully evaluated so that protective measures can be incorporated into the design.

The safety mistakes a student/technician/instructor/teacher makes today could have future ramifications both personally and environmentally. This guide is designed to help instructors/teachers instill safety awareness in their students. It is also intended to alert the school district staff to their areas of responsibility and, at the same time, to reduce accidents and exposure to litigation.

1.1 General Principals

For even one new laboratory there are a number of important points to consider:

- **How big can it be?** This will determine how many students can be sensibly taught in the room and what range of teaching and learning approaches might be possible. Future changes are more easily accommodated in a larger room than a smaller one. In general, larger spaces offer much more flexibility than smaller.
- **Fewer fixed structures also offer more future flexibility**
- **Who will draw up the plans?** Ask building professionals to draw up detailed plans and specifications; obtain several quotations for the work.

1.2 The laboratory environment

1.2.1 Acoustics

The maximum acceptable, background noise level in a laboratory is the same as in any other teaching room, i.e. about 40 dB. Should a laboratory be next to a road, measures may need to be taken to reduce noise levels but these could affect other important aspects such as ventilation. The recommended reverberation time for a laboratory is in the range 0.5 to 0.8 s.

If reverberation time is any longer than this, when the teacher and pupils speak, they tend to speak louder to make themselves heard which only makes the situation worse. Acoustic panels, window blinds and drapes and wooden furniture reduce reverberation time. It is unwise to fit acoustic panels on ceilings because this will not allow the teacher's voice to be reflected to all pupils. It is advisable that fume cupboards and other ventilation units run at less than 65 dB (at a distance of 300 mm) from the motor so that teachers can heard over the machine and not be tempted to switch it off if the fume cupboard motor is too loud.

1.2.2 Heating

Heating systems should maintain a temperature of 18 °C, 0.5 m above floor level when the outside temperature is -1 °C. Heating systems need to be planned with furniture layouts in mind to ensure they work effectively.

1.2.3 Lighting

Laboratories should be treated as any other room and should have an illuminance of not less than 300 lux on the work surface. Laboratories stresses a need for "adjustable bench lights where directional lighting is appropriate", i.e. portable lighting. Particular attention should be paid to glare from white boards, projection screens and computer monitors and from benches with pale colors. Lighting over a demonstration area or projection screen should be separately switchable.

Architectural LABORATORY Considerations

2 D4.4 | ARCHITECTURAL CONSIDERATIONS

2.1 Walls/Doors/Security

The laboratory must be completely separated from outside areas (i.e., must be bound by four walls). Contrary to popular opinion, there is no requirement for a second exit door to a laboratory, unless the room exit is in a dangerous position. Because of security problems, (i.e. the need to keep laboratories locked, and the hazards of substances used or stored) laboratories should not normally along a fire-escape route. It is sensible to insert glazed panels into doors to allow individuals to see who or what might be on the other side. Such panels should be long enough to allow for wheelchair users and short people. The laboratory shall have means of securing specifically regulated materials (i.e., lockable doors, lockable cabinets, etc.)

2.2 Windows

Windows can be treated as a source of light or ventilation and provide a view out of a room. It is recommended that a minimum of 20% of an exterior wall is glazed. However, if windows occupy too large an area or are south or west facing, the room may warm up to an unbearable temperature during a sunny day. Summer-time temperatures in excess of 28 °C are considered undesirable. Low-e insulating glass units should be installed and additional protection can be obtained by using outside shading (which will affect day lighting of the room) or blinds. Curtains are unsuitable. It may be necessary to darken the room (dim out) when visual aids are used and to reduce glare. Black material is unsuitable as it absorbs too much heat and warms up the room. Grey reflective blinds are suitable. Blinds should not be allowed to flap freely because any wind will cause noise, possibly break the blind or knock over equipment. Full blackout may be required for certain activities during lessons. Flexibility of use will be severely limited if this is available only in one laboratory. The means to open windows and/or to operate blinds should be considered when the furniture layout is planned. Too often it is impossible to reach the mechanism safely because tables or benches are in the way. Climbing on bench tops or stools is not acceptable.

2.3 Ventilation

Ventilation should be provided to limit the concentration of carbon dioxide in all teaching and learning spaces. When measured at seated head height, during the continuous period between the start and finish of teaching on any day, the average concentration of carbon dioxide should not exceed 1500 parts per million (PPM). To provide adequate ventilation, windows should be open at the top to let warm air out and at the bottom to let cooler air in. Restricting whether, how and how far windows open, for reasons of energy conservation, noise control or to prevent intrusion, may limit ventilation. The lab may, therefore, require forced ventilation. If this becomes necessary, choose an acid / steam resistant extractor. It is also necessary to have a sufficient in-flow of air so that the extraction fan(s) work efficiently. This could be accomplished by leaving a door open, but teachers often do not like doing this during lessons so suitable windows or vents are needed. Alternatively, one or more fans can be installed to blow fresh air in while other fans remove stale air.

2.4 Flooring

Getting the floor right within an industrial scope laboratory is critical to ensuring that the site can maintain a safe, hygienic and efficient operational environment. The floor must be a one piece non-pervious and with covings to the wall. This can be achieved by use of glue, heat welded vinyl flooring, epoxy coated concrete slab, etc. Floors should be coved up walls and cabinets to ensure spills cannot penetrate underneath floors/cabinets. Tiles and wooden planks are not appropriate. Floors in storage areas for corrosive liquids shall be of liquid tight construction.

2.5 Eyes and hands washing

Each laboratory must contain a sink for washing. Simple and effective wash facilities can be provided by a short length of clean rubber tubing attached to a laboratory tap at a sink dedicated to this purpose. Such a sink should be adjacent to a bench so that, if necessary, an injured person could lie on it whilst the eye was being rinsed. It's important, too, that the injured person's head can be placed over the sink.

Engineering LABORATORY Considerations

3 D4.4 | ENGINEERING CONSIDERATIONS

3.1 Fire prevention and control measures

Poor electrical wiring and arson are behind most school fires. **Automatic fire detection** is not generally required but recommended. Some schools have fitted automatic alarm systems in laboratories. These vary in how elaborate they are but those which are part of a whole school system are sometimes linked directly to the local fire station. Smoke sensors in such systems can cause serious interruptions to lessons for the whole school and considerable annoyance to the local fire brigade. Systems can be installed which are triggered by heat during the day and smoke at night when the school is not in session.

Firefighting equipment should be considered as a means of both prevention and protection. At minimum, portable equipment (eg fire extinguishers, fire blankets) is required. Dry powder extinguishers are not recommended as they cause permanent damage to computers and lead to such a mess that industrial cleaning will be required. A fire blanket (when using flammable metals) can be used to smother fires, often causing less damage than a carbon dioxide extinguisher, which may blast apparatus across the bench.

Portable extinguishers must be installed in all areas of the laboratory, selected and positioned based on the potential type and size of fire that can occur. To prevent fire extinguishers from being moved or damaged, they should be mounted on brackets or in wall cabinets with their carrying handles placed 1m to 1,5m above the floor, depending on the type of extinguisher. Place a sign that makes it easy for people to know where an extinguisher is. Consider placing it so it can be seen well from up close, at a distance, and from different angles, making sure there's nothing that obstructs a person's view of the extinguisher and/or the sign (such as a pile of boxes, machinery, or an open door).

3.2 Electrical Issues

The electrical installations must follow the respective essays, must be carried out by competent persons and before their use must be checked according to the recent CEN-CENELEC standards (e.g. BS 7671:2018 v.18th). However, the following provisions should be undertaken:

i. Electrical essay, mapping (as it build)

A copy of the approved electrical essay, with the complete mapping of the electrical installation, should be in the laboratory at a directly accessible area.

ii. Materials - Installation

The materials, the way of installation and their position should be in accordance with the specifications of the essay (Part 5: Selection & erection of equipment, CEN-CENELEC's standard) with emphasis on GFCI protection and the indicators IP, IK, about "Protection for safety" (Part 4) and especially in Areas with Special Installations or locations (Part 7).

Outside the laboratory and near its entrance there will be an Electrical Panel through which they will be able to interrupt immediately - in case of emergency - the main supply of the sub-panel in the laboratory, during which it may not be safe to enter the laboratory. Also the rail devices will be clearly marked, with regard to the equipment, lighting and electrical socket they serve.

An electrical socket per student, and an electrical tool or device is strongly recommended.

The students' ring main, normally supplying sockets on most benches, should be easy to be switched off in an emergency or when not in use. One or more additional ring mains should be used to supply other sockets. Separate RCDs (residual current devices) can be fitted to each ring main if required. RCDs type "A" or "F" 30 mA, 200 ms are satisfactory.

Fume cupboards or heavy machinery equipment (CNC, copy rooter, Grooving and Cutting Machine, etc.) should ideally be connected to a separate RCD circuit. They should not be powered from the students' ring main or from any circuit including sockets protected by an RCD. This ensures that, if the students' ring main is turned off

or an RCD trips, the fume cupboards (which may contain hazardous gases) will continue working.

Mains sockets should be positioned away from a water supply (Part 7, Chapter 701, Zones: 1 up to 3) and normally be below the height of any bench top.

It is important to ensure that mains sockets and their housings are sufficiently strong to withstand the use from students who may be excited, in a hurry, or both.

Budget materials that may be appropriate for domestic use will not last long in a laboratory. In addition, the socket housings must be securely mounted to avoid the possibility of fittings getting loose. Some types of raised sockets (where the area of the base is relatively small compared with the height of the housing) are liable to suffer damage by rocking and should be avoided.

iii. Installation Inspection and Testing.

Before the operation of the laboratory, the inspection of the electrical installation (Part 6) must have been successfully completed and a copy with the results of the measurements (Ch. 63) must be placed in the essay file. The date of the re-inspection must also be indicated on each Electrical Panel (Ch. 62).

Figure 1. Central supply panel

3.3 Laboratory layout

Facility layout is considered as one of the most important criteria which has a significant effect towards manufacturing productivity in terms of cost and time. The objectives of a layout are to minimize material handling cost, improve flexibility for arrangement and operation, utilize the available area and minimize overall production time.

A facility layout is an entity that provides the performance of any tasks that include a machine tool, a work center, a manufacturing cell, a machine shop, a department and a warehouse.

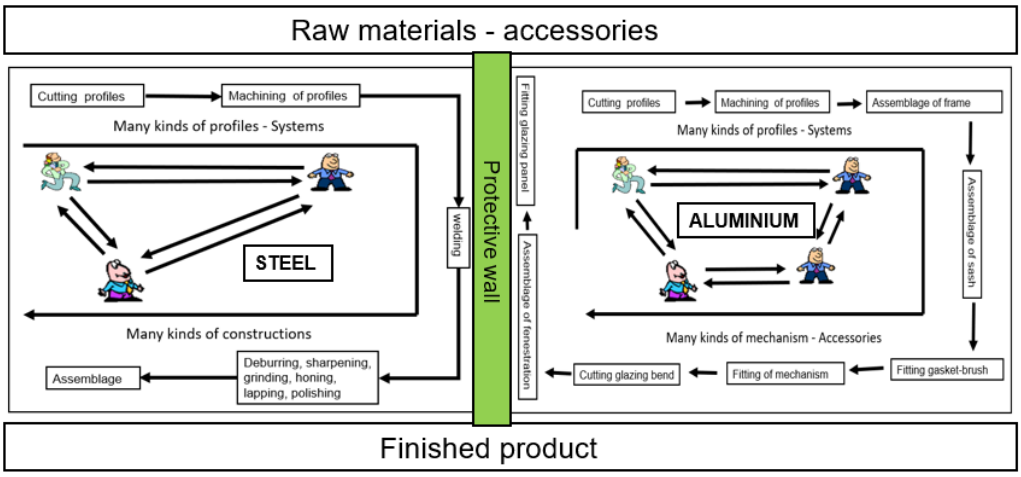

Figure 2. Laboratory layout

In cellular manufacturing, equipment and workstations are arranged in a sequence that supports a smooth flow of materials and components through the process, with minimal transport or delay.

One-piece flow is a condition that exists when products move through a manufacturing process one unit at a time, at a rate determined by the needs of the customer.

Applying one-piece flow allows to:

- Minimize stocks and thereby reduce transport and inventory wastes
- Deliver quicker
- Minimize damage, deterioration, and obsolescence.

How to operate in a U-shaped Cell?

Reduce travel distance by arranging equipment and workstations closer together. The beginning of the process must be close to the end of the process. The goal is to minimize the travel distance between each steps and cycles.

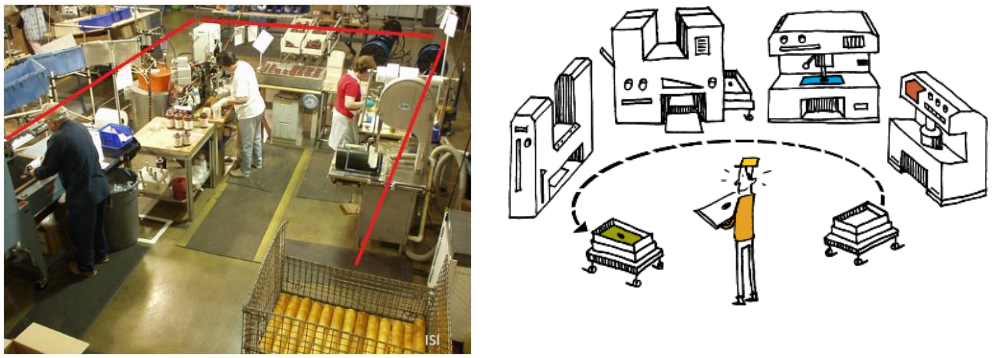

Figure 3. Figure: Cellular layout

The layout of the space with machines to produce metal and mixed constructions has the same principle as aluminium. The technical difference is that instead of assemblage with corners cleat, use different type of connection, like bolt or welding. The main parts in the laboratory for mounting are the welding and pre-processing section for drilling for connection to bolts. **The steel production area should be separated so that the aluminium profiles are not damaged.**

Figure 4. Divider wall

3.3.1 Compressed air networks

1 Compressed air production station (class 225 according to ISO 8573-1)

Figure 5. Screw air compressor with refrigeration dryer

The unit includes a lubricated screw air compressor (pressure 7 - 10 or 12 bar), 270lit air tank [4 - 7.5 KW] or 2 * 125lit [11 - 18.5 KW], refrigeration dryer (dew point + 5C class 5), and pre-filter (for particles <1μm class 2) - post-filter (oil residues 0,1 mg / m3, class 2), satisfying the basic needs in the quality of the compressed air produced for the industry.

Main Technical Parameters		
1.	Max Pressure	12 bar
2.	Voltage	400V AC
3.	Motor Power	8 kw
4.	Noise level	60 db
5.	Air tank	270 lt

Figure 6. Distribution of air INFINITY

Mechanical LABORATORY

Equipment

4 D4.4 | MINIMUM MECHANICAL EQUIPMENT FOR LABORATORY EXERCISES

The minimum mechanical equipment that must be present in the laboratory should meet the needs of aluminium processing and light metal structures training, as described in METVET's D4.3 Syllabus (training material).

The purpose of the training is to allow groups of 4-5 trainees to get familiar with the kind of machinery needed for each work (e.g. cutting, processing and assembling aluminium and metal structures) and safely use it in a specially designed workplace, so that no problems are occurred both in raw materials and the final product.

4.1 Minimum laboratory equipment

4.1.1 Single head saw for Aluminium Profile

1 piece

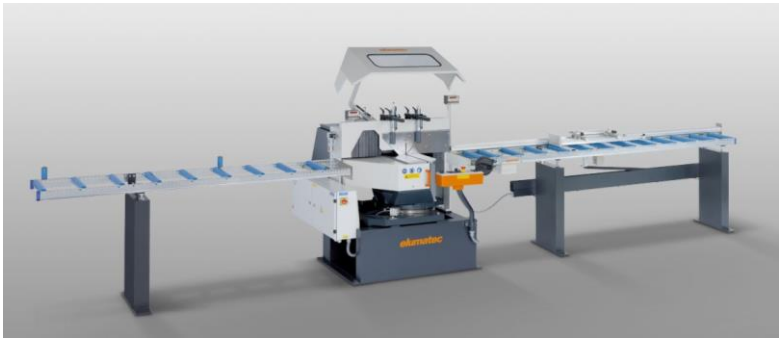

Figure 7. Single head saw for Aluminium Profile

Functions and Features:

Universal saw machine for special applications. Automatic operation and highly accurate cutting degrees left and right. Free access to the table surface for optimal loading and unloading of profiles. Safety hood opens automatically. Equipped with saw blade as standard.

Main Technical Parameters		
1.	Pivoting range	manually 22.5° to the left and right with digital display
2.	Tilting range	pneumatically from 90° - 45°
3.	Saw blade diameter	420 mm
4.	Saw blade speed	2,800 rpm
5.	Power supply	230/400 V, 3~, 50 Hz
6.	Motor power	4 kW
7.	Compressed air supply	7 bar

4.1.2 Single Axis Copy Router for Aluminium Profile

1 piece

Figure 8. Single Axis Copy Router for Aluminium Profile

Functions and Features:

The router machine suitable for copying process of various shapes on aluminium alloy profiles. Through the mold board, copy the shapes of hole to the workpiece in a proportion of This router machine can mill materials in 5 mm thickness.

Main Technical Parameters		
8.	Worktable size (LxW	660×300mm
9.	Max. distance of milling head from left to right	260mm
10.	Max. distance of milling head from front to rear	160(230)
11.	Max. space height of milling head	160mm
12.	Milling cutter diameter in common	Φ8 mm optional Φ3~Φ10 mm
13.	Milling cutter rotation speed	12000 r/min
14.	Motor power	N=2 kw
15.	Working air pressure	0.6~0.8Mpa

4.1.3 Aluminium Crimping Machine

1 piece

Figure 9. Crimping Machine

Functions and Features:

Put the frame of window into the 45° position, move the bump folks, squeeze the two-window profile tightly and make a 90° angle firmly.

Main Technical Parameters		
1.	Working air pressure	0.6~0.7 Mpa
2.	Max. working travel	60 mm
3.	Max. working push power	8000 kg

4.1.4 End milling machine

Figure 10.End Milling Machine

Functions and Features:

The slotting rotates in degrees and changes positions. Equipped with automatic spraying, two air slottings for the tight holding of the profiles and a transparent security bumper.

Main Technical Parameters		
1.	Working air pressure	5-7 Bar
2.	Motor Power	1.5 kW
3.	Max. Cutter Dia	150 mm

4.1.5 Column drilling machine

1 piece

Drilling machine

Main technical parameters:

- with belt drive,
- tilting table,
- 750 W single-phase motor and
- speed rotation from a minimum of 150 to a maximum of 2700 rpm

4.1.6 Mig-Mag

3 pieces

Figure 11.Mig-Mag

Main Technical Parameters		
1.	Material / Metal Processed	Metal / Aluminium Alloy
2.	Rated Input Voltage	220V
3.	Wire Melting Type	Short Circuit Transfer
4.	Max. Load Power Capacity	27V
5.	Rated Output Current (MIG)	20-220A
6.	Welding Current/Voltage Range	20-220A
7.	Rated Duty Cycle @40°C (MIG)	60%
8.	Output Voltage Adjusting Range	14-24V
9.	Open Circit Voltage	51V
10.	Current Range	40-250A
11.	Wire diameter	0.6/0.8/1.0mm
12.	Function	MIG MAG MMA ARC Welding
13.	Power (W)	13.5KVA

4.1.7 TIG

3 pieces

Figure 12.TIG

Main Technical Parameters		
1.	Material / Metal Processed	Metal / Aluminium Alloy
2.	Voltalge	220 V
3.	Frenquency	50/60 Hz
4.	Welding Thickness	0.3-6 mm
5.	Efficiency	85%
6.	Duty Cycle	60%
7.	Power Capacity	(kVA) 4.6

4.1.8 Electrode welding

6 pieces

Figure 13. Electrode Machine

Main Technical Parameters		
1.	Rated Input Voltage	110-220 V
2.	Current Range	60-250 AMP
3.	Rated Duty	10% at 250 AMP
4.	No Load Voltage	48 V
5.	Usable Electrodes	(0.078-0.22)"
6.	Input Capacity	14 KVA
7.	Ideal for Welding	Mild Steel, Stainless Steel
8.	Usable Electrodes	Rutile

4.1.9 Spot welding

1 piece

Figure 14.Spot welding

Main technical parameters:

- Foot-operated rocker arm resistance spot welder (manual)
- Arms adjust 15” to 29”
- Uses standard Morse #1 tapered tips
- Water-cooled transformer, arms and tip holders
- 220 or 440 volt 1PH electrics
- Dimensions: 40”L x 12”W x 50”H
- 25 KVA Capacity: 2 pcs 14 gauge
- Custom lower arm design allows welding tubes as small as 2” diameter and no hoses to interfere with parts

4.1.10 Bench of assemblage (work benches)

5 pieces

Figure 15.Bench of assemblage

4.1.11 Trolley for profiles

3 pieces each

Figure 16.Trolley for profiles

4.1.12 Power electrical tools

10 pieces each

Figure 17.Power electrical tools

4.1.13 Disk saw

1 piece

Figure 18.Disk saw

Main technical parameters:

- 1 Ph Electric motor kW 1.5
- Gearbox in oil bath Rapp 1:34
- Diameter of blade disc mm 315
- 3 Ph Blade revolution rpm 41 - 82
- 1 Ph Blade revolution rpm 41
- Vice opening mm 110
- Coolant tank capacity Lt 5
- Working height with pedestal mm 980
- Machines dimension with pedestal mm 500 x 850 x 1440
- Weight kg 125 Machine packing details mm 980 x 630 x 895
- Machine packing details kg 144

4.1.14 Band saw

1 piece

Figure 19. Band saw

Main Technical Parameters		
1.	Cutting speed	20, 29, 50 mpm (50hz) 80, 120, 220 fpm (60hz)
2.	Blade size	1/2" x 0.035" x 64 1/2" (12.7 x 0.9 x 1,640)
3.	Cutting capacity	90°: circular 4 1/2" (115) / square 4" x 6" (100 x 150) 45°: circular 3 1/2" (85) / square 3 1/2" x 2 3/4" (85 x 65)
4.	Head swivel	0° ~ 45° Motor: ½ hp, 50/60 hz, 1,420/1,720 rpm

4.2 Additional (optional) laboratory equipment

4.2.1 3-Axis Automatic Type CNC Double Mitre Saw Aluminium Cutting Machine

1 piece

Figure 20. CNC twin-head cutting-of machine for Aluminium profiles

Functions and Features:

This cnc machine is mainly used in the aluminium alloy

Main Technical Parameters		
1.	Saw cutting length	420-6000mm
2.	Saw cutting (W×H)	310×180mm (600) 310×150mm (550) 350×150mm (600)
3.	Main motor power	4Kw×2
4.	Main motor rotation speed	2840 rpm
5.	Saw blade dimension	Φ550(Φ600)×Φ30×120T
6.	Saw blade swing angle range	90°- 45°
7.	Worktable rotation angle	30°-90°-135°
8.	Saw blade feeding speed	0-3m/min
9.	Saw blade returning speed	2-3m/min
10.	Working air pressure	0.6-0.8Mpa

4.2.2 2-Axis CNC Single Head Saw Al Cutting Machine in Heavy-Duty

1 piece

Figure 21. 2-Axis CNC Single Head Saw Al Cutting Machine in Heavy-Duty

Functions and Features:

Primarily used for cutting industrial aluminium profiles and aluminium curtain wall profiles as well as combined angle cutting of aluminium curtain wall profiles. Worktable and cutting blades can be adjusted in random angles.

Main Technical Parameters		
1.	Saw cutting length	50-3000 mm
2.	Saw cutting	(Wa×H) 300 x 180 (600) mm (90°) 300 x 150 (550) mm (90°) 350 x 150 (600) mm (90°)
3.	Main motor power	4.0 kw
4.	Main motor rotation speed	2840 rpm
5.	Saw blade dimension	ø 550 x ø 38 x 140 T Ø 600 x ø 38 x 140 T
6.	Saw blade feeding speed	0~3 m/min
7.	Saw blade returning speed	2~3 m/min
8.	Worktable rotation angle	22.5°~90°~135°
9.	Saw blade swing angle range	90°~45°
10.	Operation air pressure	0.6~0.8 Mpa
11.	Operation voltage	380 V

4.2.3 3/5-axis CNC machining center for aluminium profile

1 piece

Figure 22. CNC machining center for aluminium profiles

Functions and Features:

Suitable for processing of installation holes, launder slots, lock holes on aluminium profiles. it can works on 3 sides of the profile with worktable pivoting between (-90)~0~(+90) degree after loading, ensure the high efficiency.

Main Technical Parameters		
1.	Collet Max. Diameter	Ø 16 mm
2.	Main spindle Power /rotary speed	6/18000 kw / rpm
3.	Servo motor (LNC)	X kw 0.75 Y kw 0.75 Z kw 0.75 A kw 0.75
4.	Total Voltage /Power supply	380 V 50 H Z/10 kw
5.	Air pressure	6～8 Kg/cm2

4.2.4 Aluminium Composite Panel Grooving and Cutting Machine

1 piece

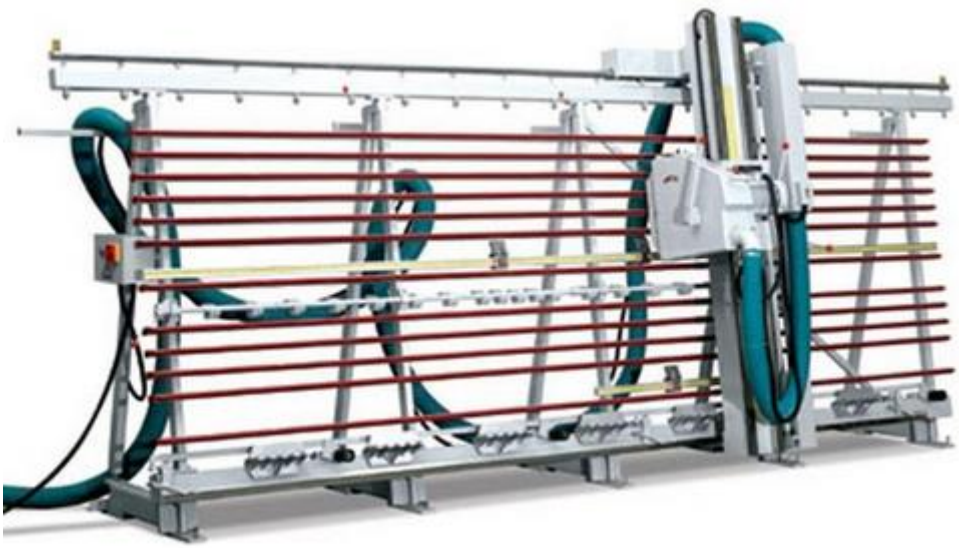

Figure 23.Aluminium Composite Panel Grooving and Cutting Machine

Functions and Features:

The grooving and cutting machine adopt special imported hard alloy blades and tools, featuring superb high-speed balance performance, high processing precision and durability, saving time and energy. Blade grooving depth can be adjusted steplessly from 0 to 8 mm. It is capable of grooving and cutting, capable of horizontal and vertical cutting, and with safety positioning. The overall machine is of superior rigidity, with stable cutting, without vibration traces.

Main Technical Parameters		
1.	Cutting dimension (LxH)	4100 x 1600 mm
2.	Blade dimension	250*30*15 mm (for grooving)
3.	Blade dimension	250*30*3 mm (for cutting)
4.	Motor power	2.2 kw
5.	Motor rotation speed	2840 r/min
6.	Diagonal deflection	2000 mm, deflection 1.5 mm, > 2000 mm, deflection: 2.5 mm

4.2.5 Hydraulic CNC Bending

1 piece

Figure 24.Hydraulic CNC Bending

Main Technical Parameters		
1.	Bending Material	Mild Steel
2.	Size	3200 mm
3.	Automation Grade	Automatic
4.	Max Force Or Load	160 ton
5.	Sheet Thickness	6-8 mm
6.	Length	3200 mm
7.	Motor Power	11 kw
8.	Capacity	160ton X 3200

4.2.6 Hydraulic scissors

1 piece

Figure 25.Hydraulic scissors

Main Technical Parameters		
1.	Thickness of a sheet of metal (max.)	0,6 - 6 mm
2.	Slave length	4.100 mm
3.	Back emphasis	1.000 mm
4.	Angle of cutting	1,45 °
5.	number of giving in a minute	8 courses/min
6.	Clip	18 pieces
7.	Desktop height	818 mm
8.	Quantity of basic arms	2 pieces
9.	Power engine capacity	15 kw

4.3 Consumables

Tools and consumables on electricals tools and large compatible tools are many and are stored in tool cabinets.

4.3.1 Abrasives

Cutting and grinding disks, grinding wheels and flap disks, drills, taps, dies, reamers, slot drills, end mills, carbide inserts etc.

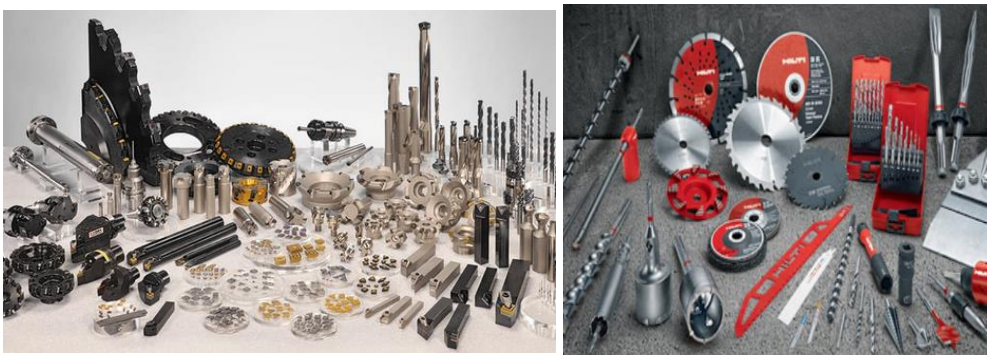

Figure 26.Tools and consumable

4.3.2 Tools cabinets

Figure 27.Tools cabinets

4.3.3 Gas cylinders

Acetylene 3 pieces
Oxygen 3 pieces
Argon 3 pieces

Trolley per bottle is strongly recommended

Figure 28. Gas

4.3.4 Safety Clothing

10 sets of quality workwear, safety footwear and a full range of PPE including eye, hearing, respiratory and hand protection.

Requirements for LABORATORY

References

5 References

- A G14, Designing and Planning Laboratories, CLEAPSS (2009) http://science.cleapss.org.uk/Resource/G014-Designing-and-Planning-Laboratories.pdf
- Laboratory design for teaching and learning, Association for Science Education, 2004. https://www.ase.org.uk/
- US Department of Labor, Laboratory Safety Guidance, OSHA 3404-11R. https://www.osha.gov/Publications/laboratory/OSHA3404laboratory-safety-guidance.pdf
- GUIDELINES for the design and planning of secondary school science facilities in Australian schools, Australian Science Teachers Association 2016. https://assist.asta.edu.au/sites/assist.asta.edu.au/files/Guidelines%20for%20Science%20facilities.pdf
- A guide to best practice in the specification and use of fire-resistant glazed systems, published by the Glass and Glazing Federation, 44– 48, Borough High Street, London. www.ggf.org.uk

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