THE TOOL ANGLES MEASURING DEVICE

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Abstract: Measuring the constructive angles of the lathe tools' active part can be done directly, with the help of a mechanical table protractor or a tool geometry measuring device, indirectly with the help of a comparator clock and a rotary vice. Their knowledge is important in the determination of the effective cutting angles that influence the cutting regime, the cutting force and the roughness of the processed surface. Solid Edge software has been used to project and establish constructive – functional parameters of the device, and based on those the device has been carried out, being part of the Laboratory of Cutting Tools.

Key Words: Device, lathe tool, angle measurement

1. INTRODUCTION

Next to the new and modern procedures of materials machining, metal processing by cutting is still widely used and important, through the efforts of specialists in the field to permanently improve competitiveness. The great majority of the machine parts used in the manufacturing of machines and tools are processed by cutting, due to the fact that so far it is the only way by which high dimensional and geometrical precision and good surface roughness can rationally be achieved.

Due to multiple possibilities of processing by lathing , as well as to wide spread in machine construction of parts in the shape of revolution, lathes are the most largely used for cutting metals, representing more than 25% of their total.

The large diversity of machine-tools that use bits as cutting tools, the types of pieces processed, the operations executed, as well as their required quality, determined the existence of a large variety of cutter types and dimensions.

The design shape, the processing by cutting of the lathe cutters, as well as their denomination is shown in Figure 1.

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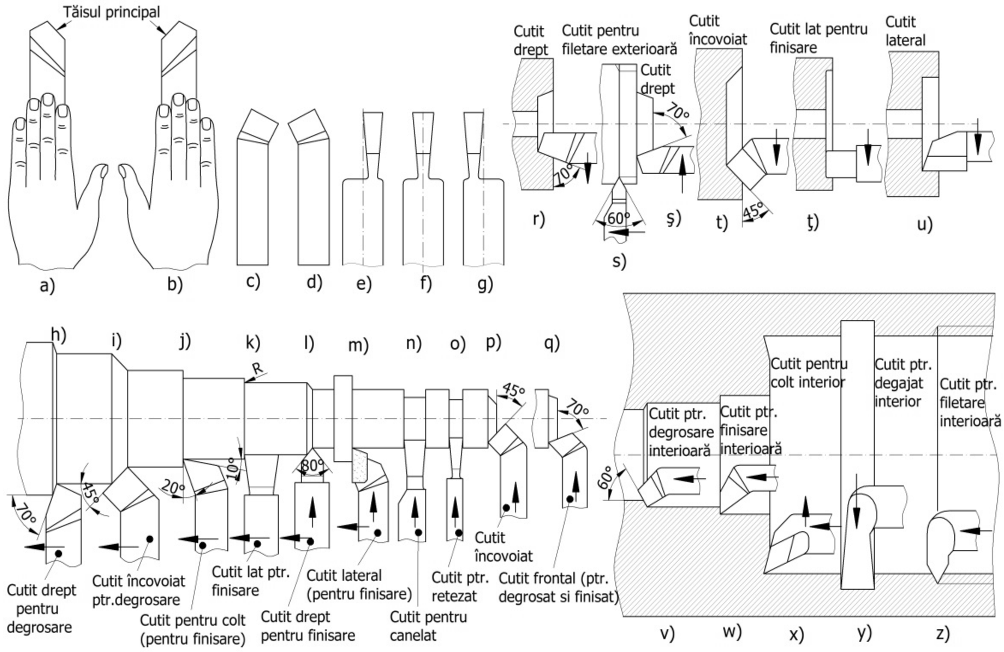

Figure 1. Constructive shape and processing by cutting of the lathe tools
"Taisul principal" = Main cutting edge
"Cutit drept" = Upright tool
"Cutit pentru filetare exterioara" = Exterior threading tool
"Cutit incovoiat" = Offset tool
"Cutit ptr. canelat" = Grooving tool
"Cutit ptr. retezat" = Parting tool
"Cutit frontal (ptr. degrosat si finisat)" = rough turn and finishing front tool
"Cutit lat ptr. finisare" = Shovel-nose tool for finishing
"Cutit lateral" = Side tool
"Cutit lateral ptr. finisare" = Finishing side tool
"Cutit ptr. degrosare interioara" = Inside rough turn tool
"Cutit ptr. finisare interioara" = Inside finishing tool
"Cutit ptr. filetare interioara" = Inside thread tool
"Cutit ptr. degajat interior" = Inside recess tool
"Cutit pentru colt interior" = Inside angle tool
"Cutit drept pentru degrosare" = Offset tool
"Cutit incovoiat ptr. degrosare" = Rough turn offset tool
"Cutit pentru colt (pentru finisare)" = Angle tool (for finishing)
"Cutit drept pentru finisare" = Finishing upright tool
"Cutit lateral (pentru finisare" = finishing side tool

Figure. 2 shows the constructive angle of the lathe tool, in section N-N, where: α is main relief angle, formed between the main relief angle *FAP* and the plane of the main cutting edge *T*; β – main sharpening angle formed between the recess face *FD* and the main relief face *FAP*; γ – main recess angle, formed between the recess face

FD and the base plane *B*; δ – main cutting angle, formed between the recess face *FD* and the plane of the cutting edge *T*. Analogously, the secondary angles of the secondary cutting edge *TS* are defined, shown in section N_1-N_1 , noted with α_1, β_1, γ_1 and δ_1. The following relations exist between these angles:

$$\alpha + \beta + \gamma = 90^\circ \qquad (1)$$

$$\alpha_1 + \beta_1 + \gamma_1 = 90^\circ \qquad (2)$$

$$\alpha + \beta = \delta \qquad (3)$$

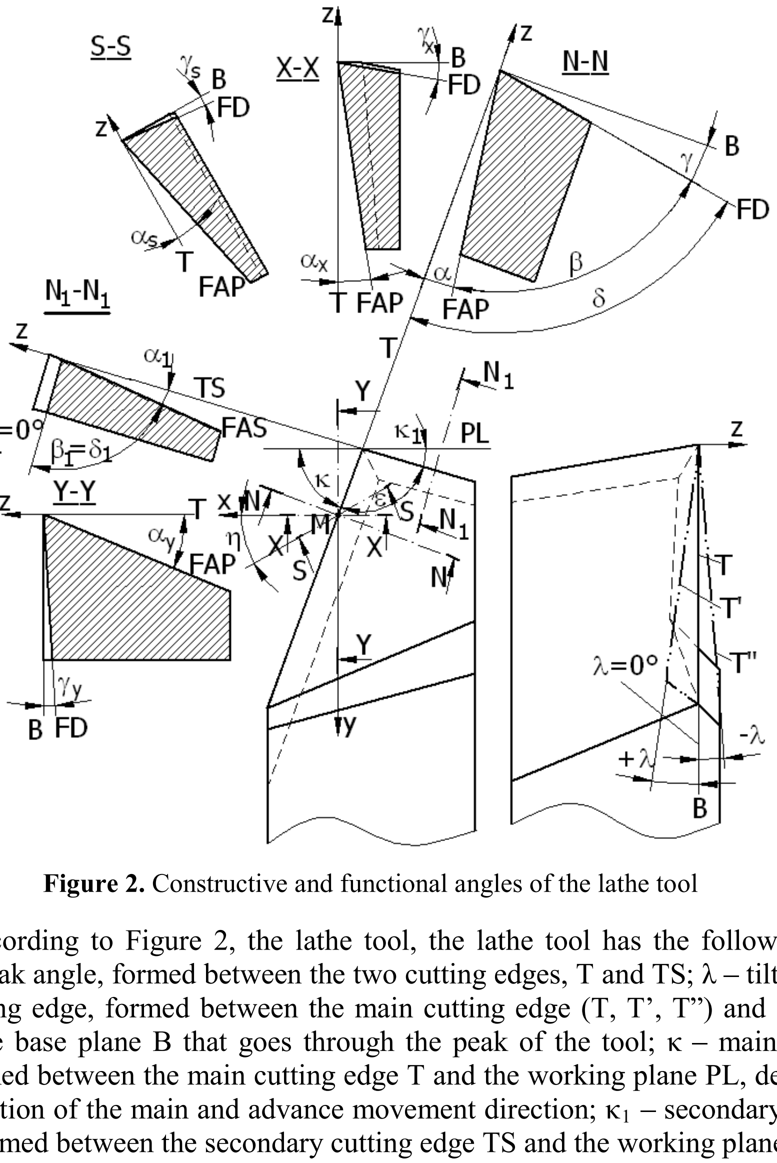

Figure 2. Constructive and functional angles of the lathe tool

According to Figure 2, the lathe tool, the lathe tool has the following more angles: ε peak angle, formed between the two cutting edges, T and TS; λ – tilting angle of the cutting edge, formed between the main cutting edge (T, T’, T”) and a parallel plane to the base plane B that goes through the peak of the tool; κ – main angle of attack, formed between the main cutting edge T and the working plane PL, determined by the direction of the main and advance movement direction; κ_1 – secondary angle of attack a, formed between the secondary cutting edge TS and the working plane PL.

Between the positioning angles of the cutter in relation with the part, the following relation exists:

$$\kappa + \varepsilon + \kappa_1 = 180^\circ \tag{4}$$

2. 3D MODELLING OF THE ANGLE MEASURING DEVICE OF THE LATHE TOOL

CAD (*Computer Aided Design*) methods have changed the traditional drawing methods (design) at drawing boards, when the drawing started with 2D views of the unit or subunit, and then the drawings of the component parts followed. In computer assisted drawing, in the first stage the 3D model of the parts and subunits is carried out, then the technical drawings follow. Thus, the technical documentation becomes a secondary activity, with less time involved.

Depending on the software used, the designer can choose between several 3D modelling of the part. Irrespective of the soft or method used for design, the software programs needs to be known, as well as the functional role of the part and the technological procedures of processing the surface of the part.

Solid Edge is a drawing (designing) computer assisted system for modelling the parts, the units and carrying out industrial technical drawings, being a complete solution for the digital development of the products. Combining the speed of the explicit modelling with the parametric control and flexibility of the model, the most rapid and flexible modelling system results, ***Synchronous Technology*** (ST). For the companies developing low and medium complexity products it is the most frequently used application in various fields: mechanical, aeronautical, automobile industry; goods of wide use; forestry etc.

Figure 3 shows the 3D model of the device of measuring constructive angles of the lathe tool, where: 1 – device support; 2 – cylindrical screw M6x18; 3 – support with rod; 4 – measuring unit; 5 – pick-up arm; 6 – stopper; 7 – cutter support; 8 – cylindrical screw M8x20; 9 – feigned screw M12; 10 – sliding table.

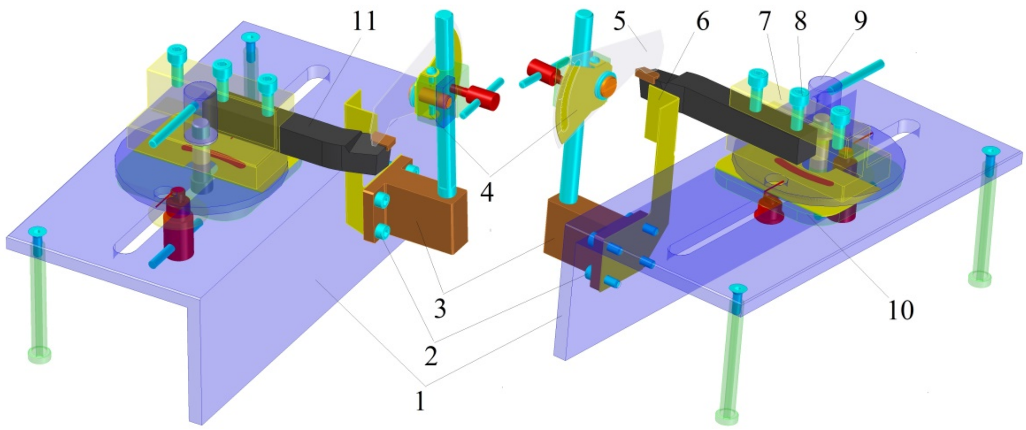

Figure 3. 3D model of the device for measuring lathe tool constructive angles

Fig. 4 shows the 3D model of the measuring device, made up of: 1 – protractor; 2 – support with crossed holes; 3 – screw M4x10; 4 – bolt for the pick-up arm; 5 –flat washer; 6 – plate-nut; 7 – blocking screw; 8 – rod-handle.

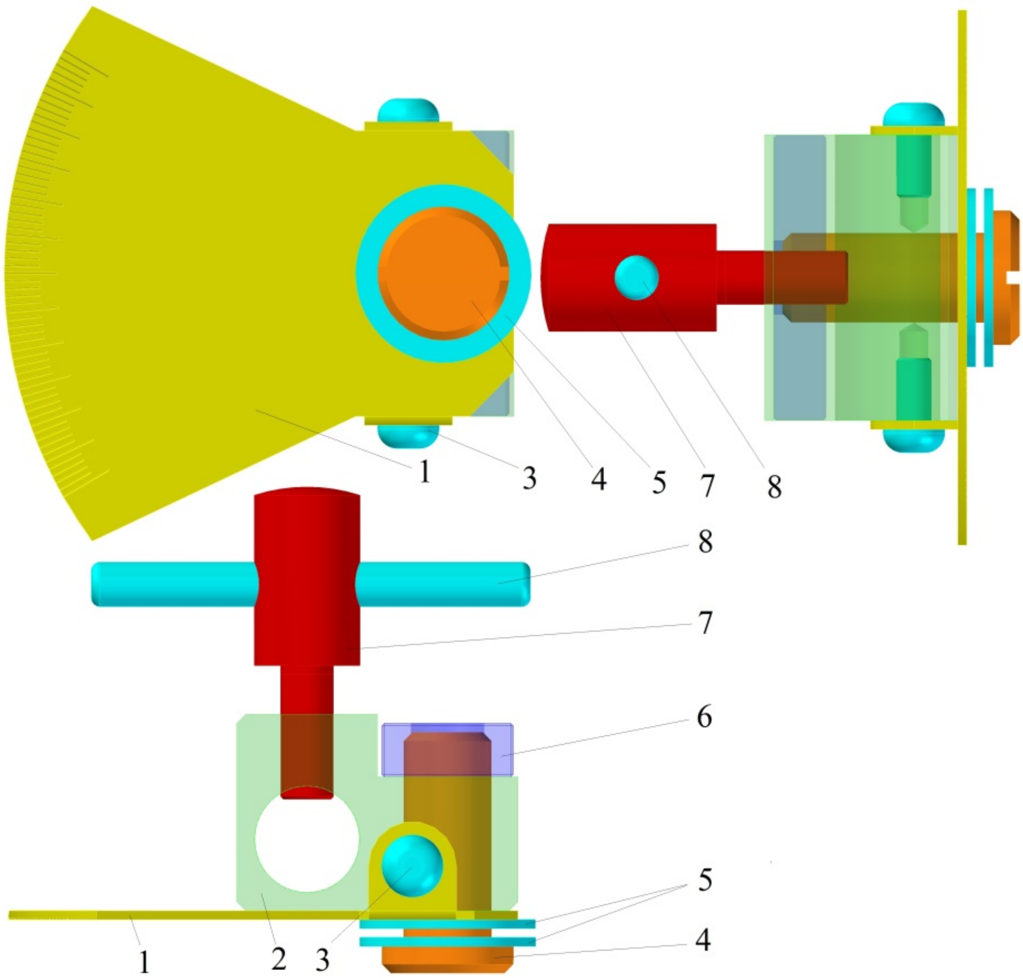

Figure 4. 3D model of the measuring unit

Figure 5 shows the 3D model of the sliding table 5, made up of: 1 – base plate; 2 – protractor; 3 – support plate; 4 – guide-block pin; 5 – rod-handle; 6 – special washer; 7 – central bolt; 8 – guide pin. Around the central bolt the cutter handle pivots to determine the attack angle of the lathe cutter. The guide pins keep the direction of the sliding table when it moves along the device support in the positioning of the cutter in order to measure the angle.

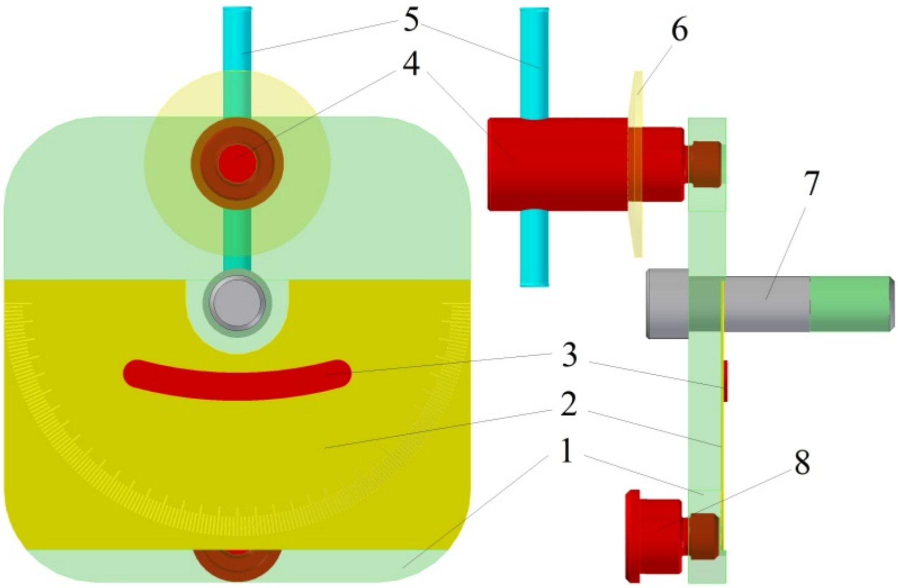

Figure 5. 3D model of the sliding table

3. MEASURING THE CONSTRUCTIVE ANGLE OF THE LATHE TOOL

In order to measure the main constructive angles of the lathe tool, the measuring device unit's front surface of the pick-up arm should be parallel with the sliding groove of the device support. This position is achieved by unscrewing the block screw of the measuring unit on the rod and rotating the measuring unit around the axis of the rod with the adequate angle.

In the first stage (Figure 6.a) the main cutting edge of the tool is brought to contact with the surface of the stopper, the cutter support is blocked on the sliding table with the help of a feigned nut and the main attack angle is read.

In the second stage (Figure 6.b) the fixing screws of the cutter are unscrewed and the cutter is translated to the support seat until the plate is traversed by the front plane of the pick-up arm, after which the fixing screws of the cutter are screwed back, thus fixing the cutter in the cutter support. The sliding table is then moved until the horizontal edge of the pick-up arm is over the cutter's recess face and the sliding table is blocked on the device support with the help of the guide-block pin. By unscrewing the measuring unit blocking screw o the rod, the measuring unit is moved along the rod and the pick-up arm rotates around the bolt, until the horizontal edge of the pick-up arm is seated on the plate recess face and the block screw is screwed to block the measuring unit on the rod, and the value of the γ recess angle is read on the scale of the protractor. The seating of the edge of the pick-up arm on the recess face is controlled by the light slot method.

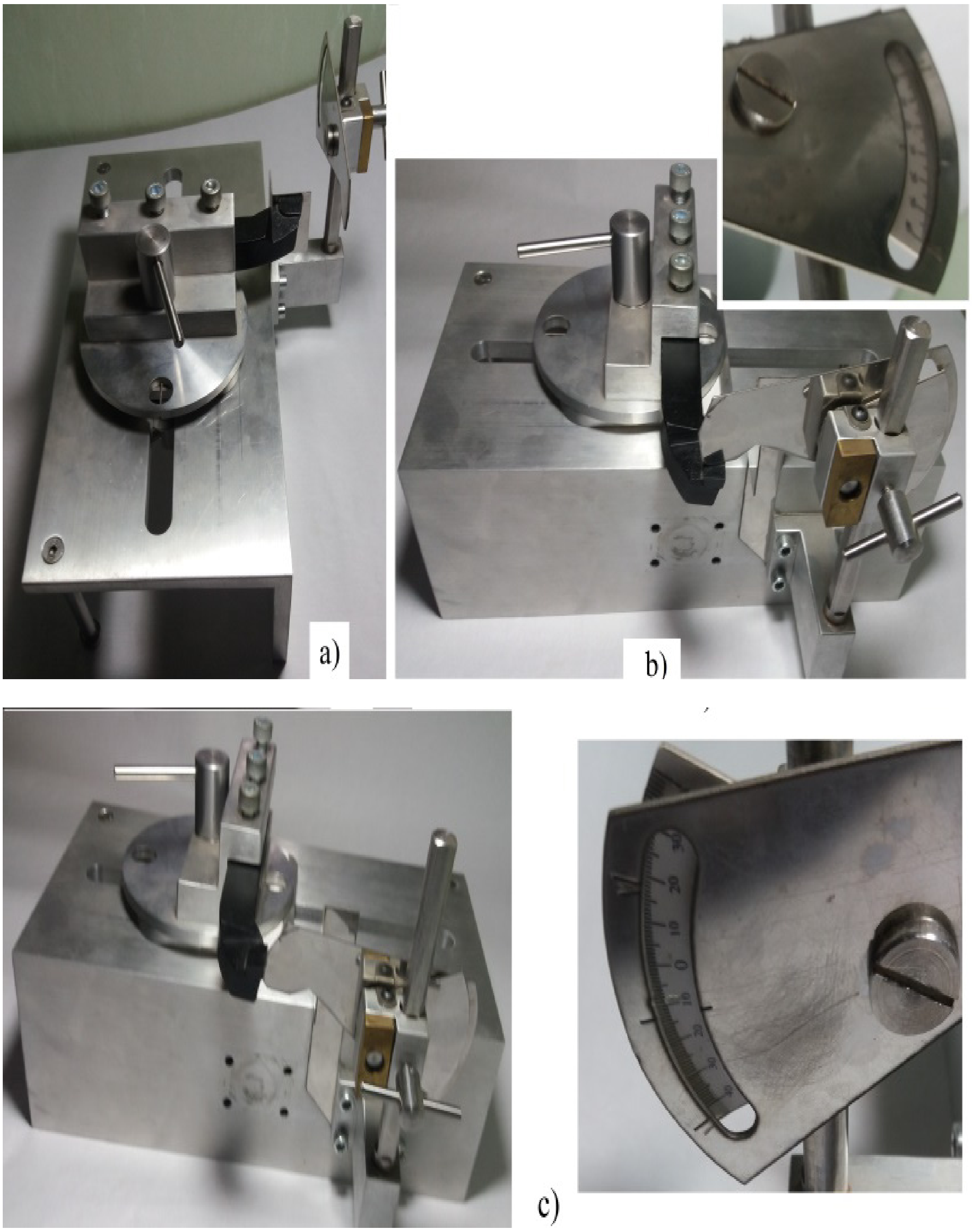

Figure 6. Measuring the main angles of the lathe tool

In stage 3 (Figure 6.c) the guide-block pin is unscrewed and the sliding table is moved until the recess face of the tool gets out from under the edge of the pick-up arm. The measuring unit on the rod is then unscrewed and the measuring unit is lowered until the vertical edge of the pick-up arm reaches next to the main relief face of the tool and the measuring unit on the rod is blocked with the help of the block screw. By the rotation of the pick-up arm and movement of the sliding table the vertical edge is seated on the main relief face, the sliding table is blocked with the help of the guide-block pin and the value of the principal relief angle α is read on the scale of the protractor.

In order to measure the secondary constructive angles of the lathe tool the measuring unit should have the front surface of the pick-up arm perpendicular to the sliding canal of the device support. This position is reached by unscrewing the block screw of the measuring unit on the rod and rotating the measuring unit around the rod axis with the corresponding angle.

In the first stage (Figure 7.a) the secondary cutting edge of the tool is brought to contact with the stopper surface, the tool support on the sliding table is blocked with the help of a feigned nut and the secondary attack angle is read.

In the second stage (Figure 7.b) the fixing screws for the tool are unscrewed and the tool is translated in the seat of the support until the plate is traversed by the front plane of the pick-up arm, after which the tool fixing screws are screwed back, fixing thus the tool in the tool support. The sliding table is then moved until the horizontal edge of the pick-up arm is over the recess face of the tool, and the sliding table is blocked on the device support with the help of the guide-block pin. Unscrewing the block-screw of the measuring unit on the rod, the measuring unit is moved along the rod and the pick-up arm rotates around the bolt, until the horizontal edge of the pick-up arm is on the plate recess face and the screw is screwed to block the measuring unit on the rod and the value of the secondary recess angle γ_1 is read on the protractor scale.

In the third stage (Figure 7.c) the fixing screws of the cutter are unscrewed and the cutter is translated in the support seat, until the tool recess face gets out from under the edge of the pick-up arm. The block screw of the measuring unit on the rod is then unscrewed and the measuring unit is lowered until the vertical edge of the pick-up arm reaches next to the secondary seating angle face of the tool, and the measuring unit on the rod is blocked with the help of the block screw. By rotating the pick-up arm and translating the tool in the support seat, the vertical edge is seated on the secondary seating face, the tool is blocked with the help of the fixing screws and the value of the principal relief angle α_1 is read on the scale of the protractor.

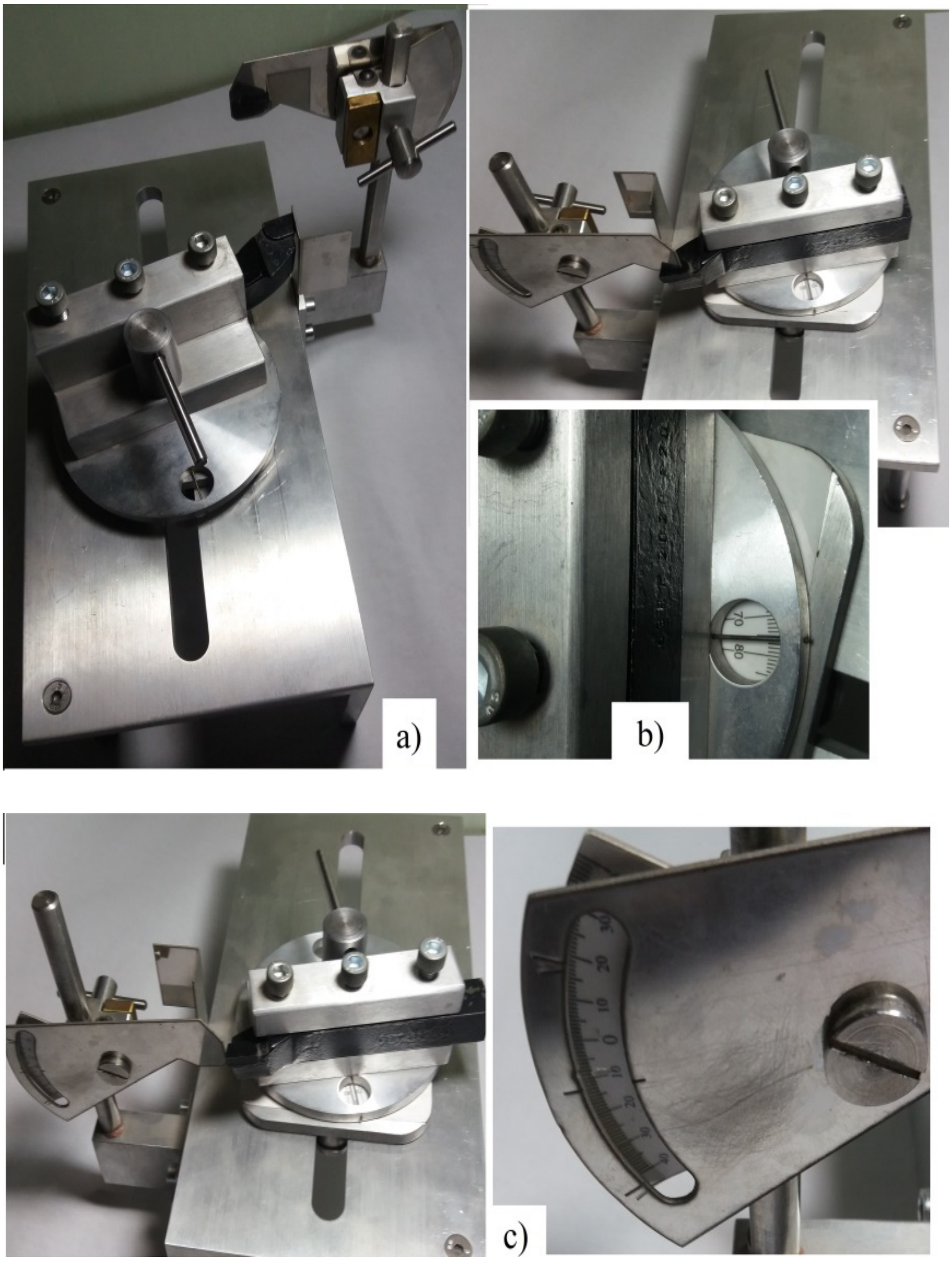

Figure 7. Measuring secondary angles of the lathe tool

4. CONCLUSIONS

The device of measuring lathe tool angles has been executed in the Laboratory of Cutting Tools and belongs to the laboratory.

The execution of the component elements of the device has been done of laminated profiles or stainless steel sheets. Special attention had to be given to the way of positioning of the component elements to allow the pick-up arm, the sectional plane, an as accurate as possible measuring of the constructive angles of the lathe tool.

With the help of the executed device, the measuring of the main and secondary constructive angles of angular tool with glued P20 metal carbide plates has been done, in three stages: measuring of the main and secondary angle of attack; measuring the main and secondary recess angles; measuring the main and secondary relief angles.

REFERENCES

[1]. Cozma, B.Z., Dumitrescu, I., Popescu, F.D., *Concepţia şi proiectarea asistată de calculator a utilajului minier*, Universitas publishing, Petroşani, 2019.

[2]. Dumitrescu, I., Florea,V.A., *Prelucrări prin aşchiere şi scule aşchietoare*, Universitas publishing, Petroşani, 2019.

[3]. Dumitrescu, I., *Proiectarea sculelor aşchietoare, Îndrumător de laborator*, Universitas publishing, Petroșani, 2016.

[4]. Dumitrescu, I., Florea, V.A., *Desen tehnic industrial, utilizând soft-uri CAD*, Universitas publishing, Petroșani, 2018.